Environmental Transformation of the Built Environment

Thomas Auer, Transsolar/TUM

WORLD SBE HONG KONG 2017
WORLD Sustainable Built Environment Conference
Organisers:
CONSTRUCTION INDUSTRY COUNCIL 建造業議會
HKGBC 香港綠色建築議會
SBE SERIES
International Co-owners:
iiSBE
Sustainable Buildings and Climate Initiative
FIDIC
Global Alliance for Buildings and Construction

credit: BDir Dipl.-Ing. Hans-Dieter Hegner
Bundesministerium für Verkehr, Bau und Stadtentwicklung

CO_2 TO ZERO

WE NEED TO REDUCE OUR EMISSIONS

Desired CO_2 Emissions in Stuttgart --- and Reality ---

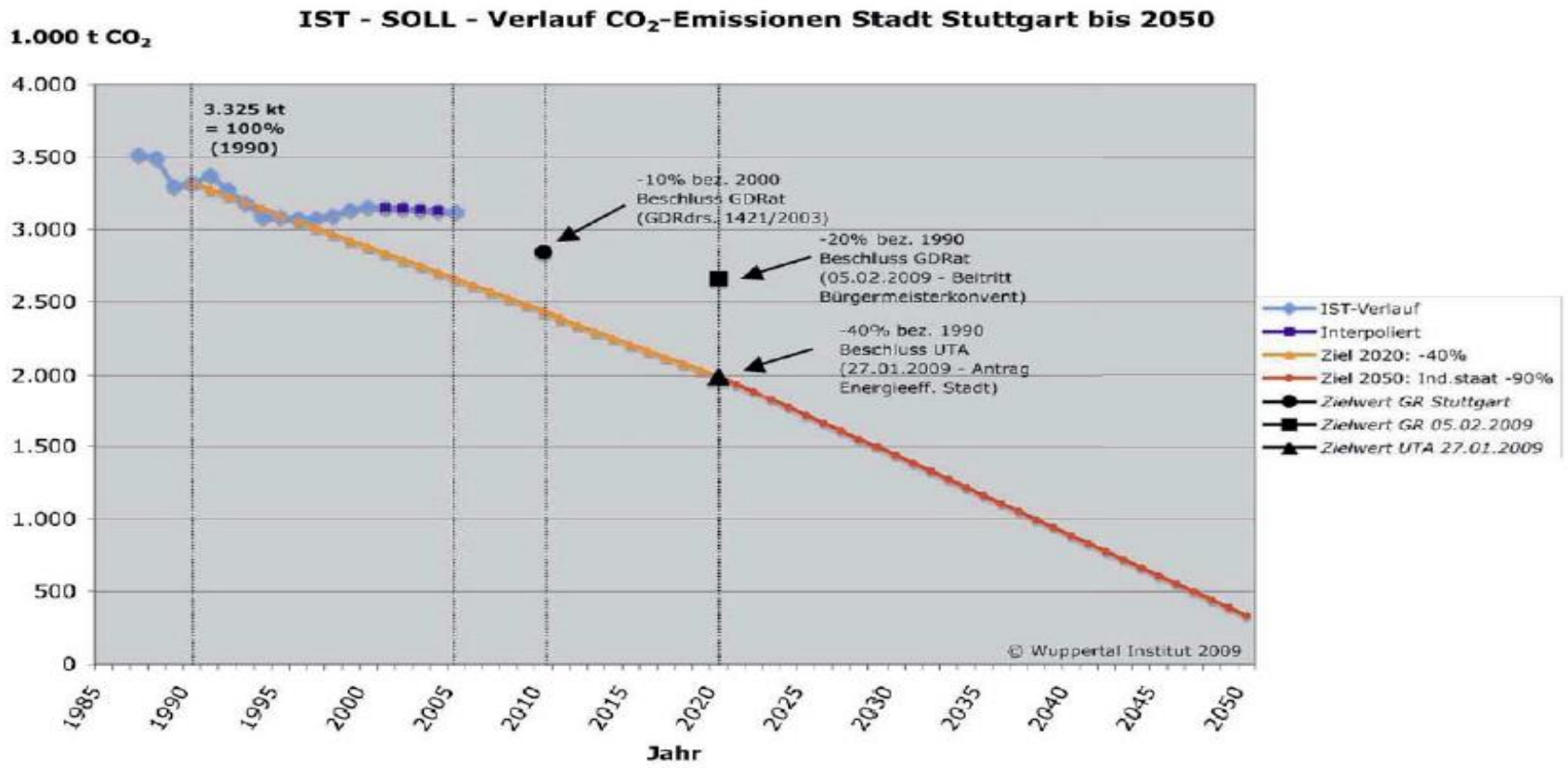


Abbildung 2: Verlauf der CO_2-Emissionen der Stadt Stuttgart bis 2005 (ab 2001 geschätzt) und Ziele bis 2020 (minus 40%) bzw. bis 2050 (minus 90%)

Wuppertal Institut für Klima, Umwelt , Energie Gmbh

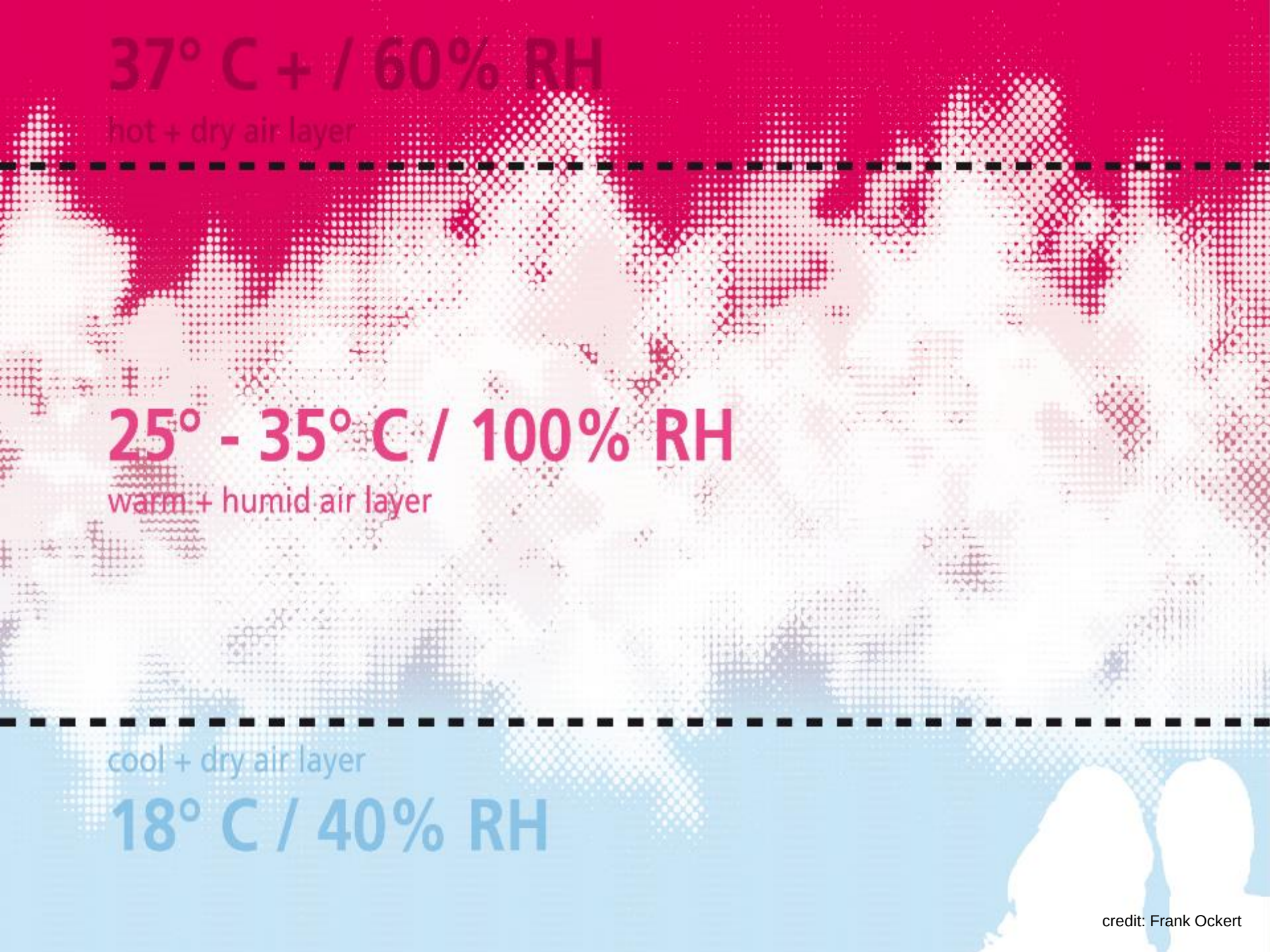
Lost in Transformation?

GADGETS


PERFORMANCE
by DESIGN
BMW ORACLE Racing
BMW ORACLE Racing

Welcome to the breathtaking

Tokyo Water Park



credit: Frank Ockert

Venice Biennale 2010 cloudscapes

photo: Tetsuo Kondo

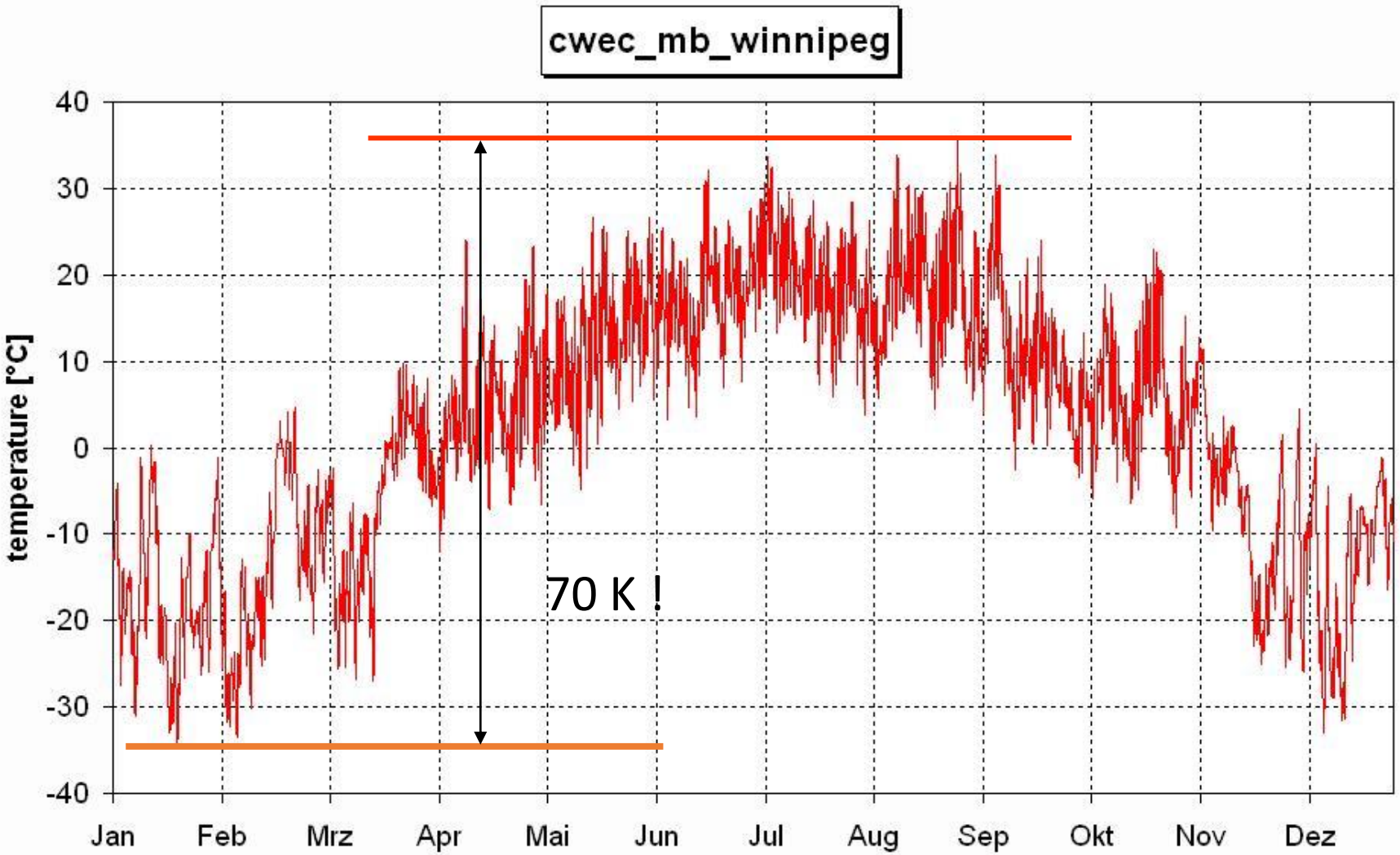
Venice Biennale 2010 cloudscapes

photo: Tetsuo Kondo

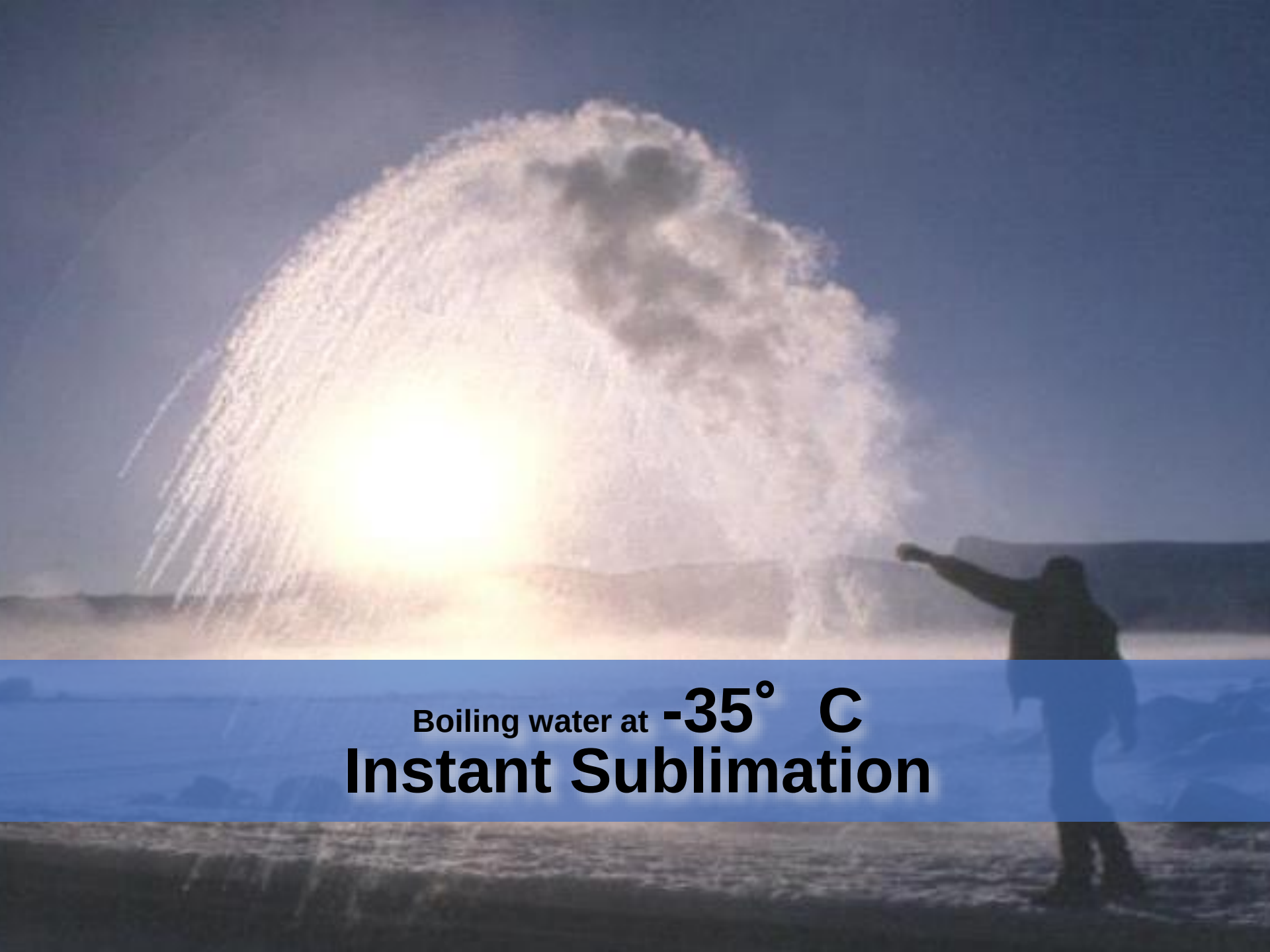
Manitoba Hydro - Winnipeg

architect: KPMB

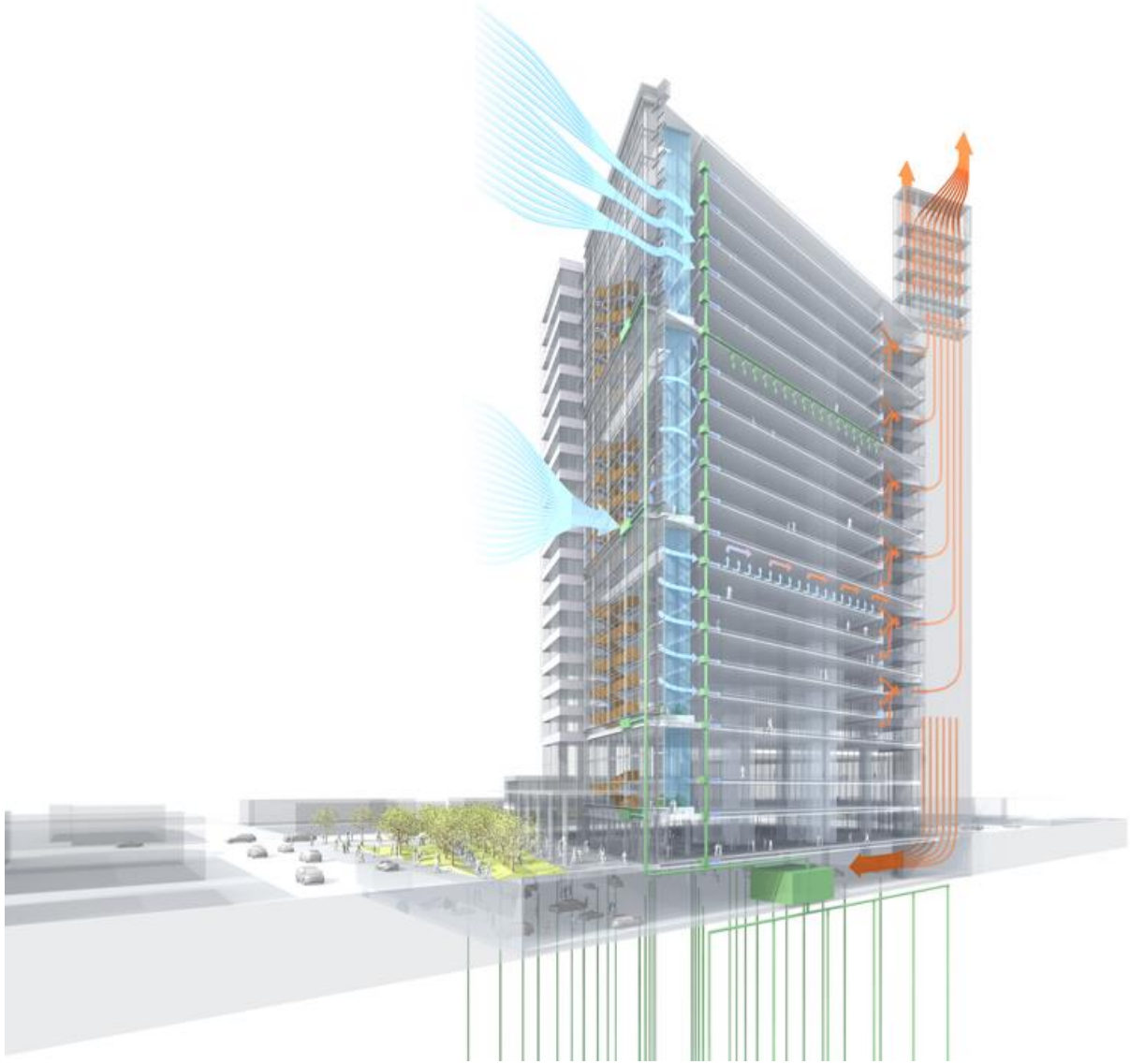
photo: Gerry Kopelow

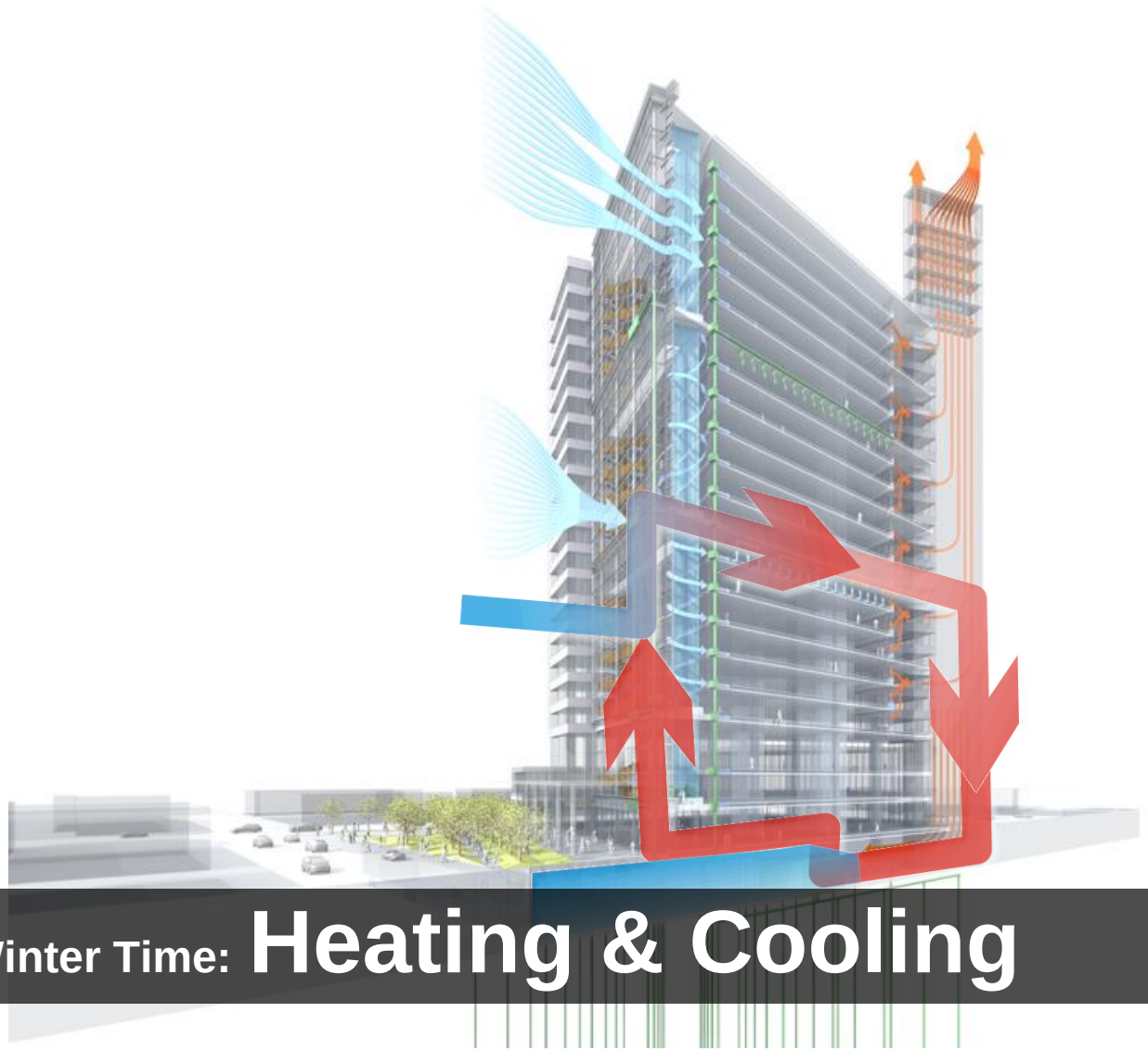


Climate - Winnipeg

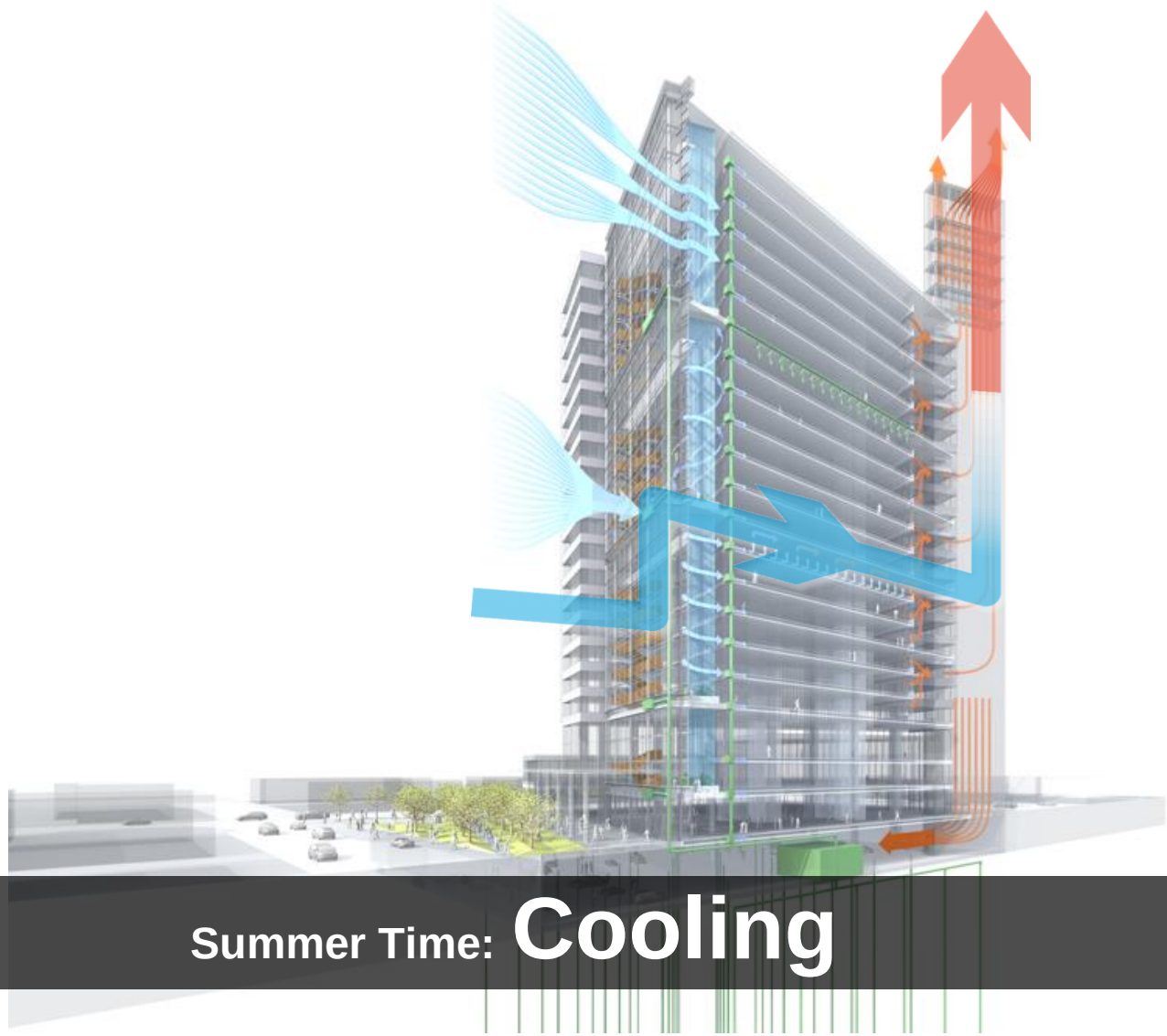

Boiling water at -35° C
Instant Sublimation

Typical Floor Plan





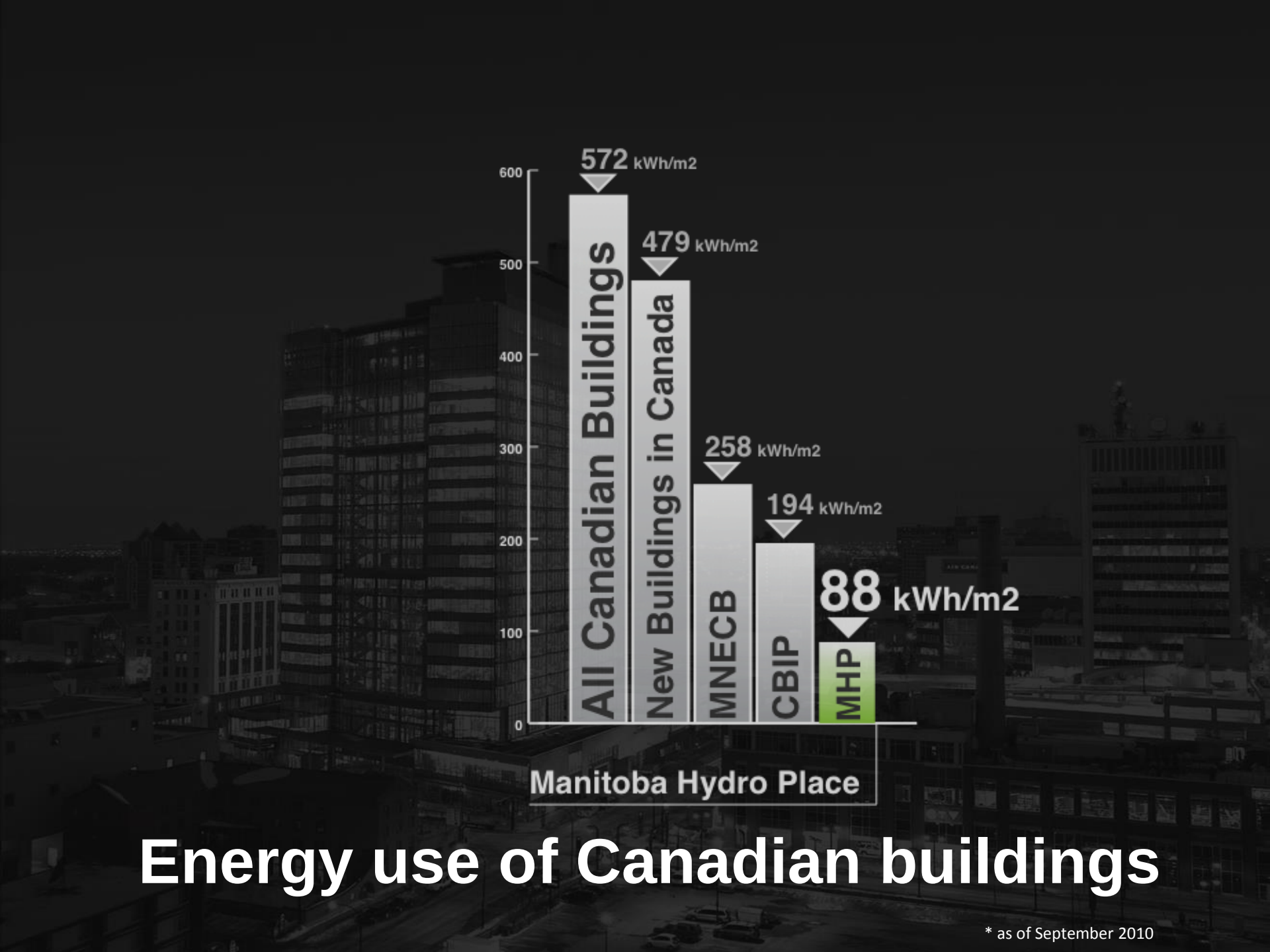
Winter Time: Heating & Cooling



Summer Time: Cooling

photo: Eduard Hueber

photo: Gerry Kopelow



Energy use of Canadian buildings

* as of September 2010

Manitoba Hydro Place - Annual Rolling Energy Totals

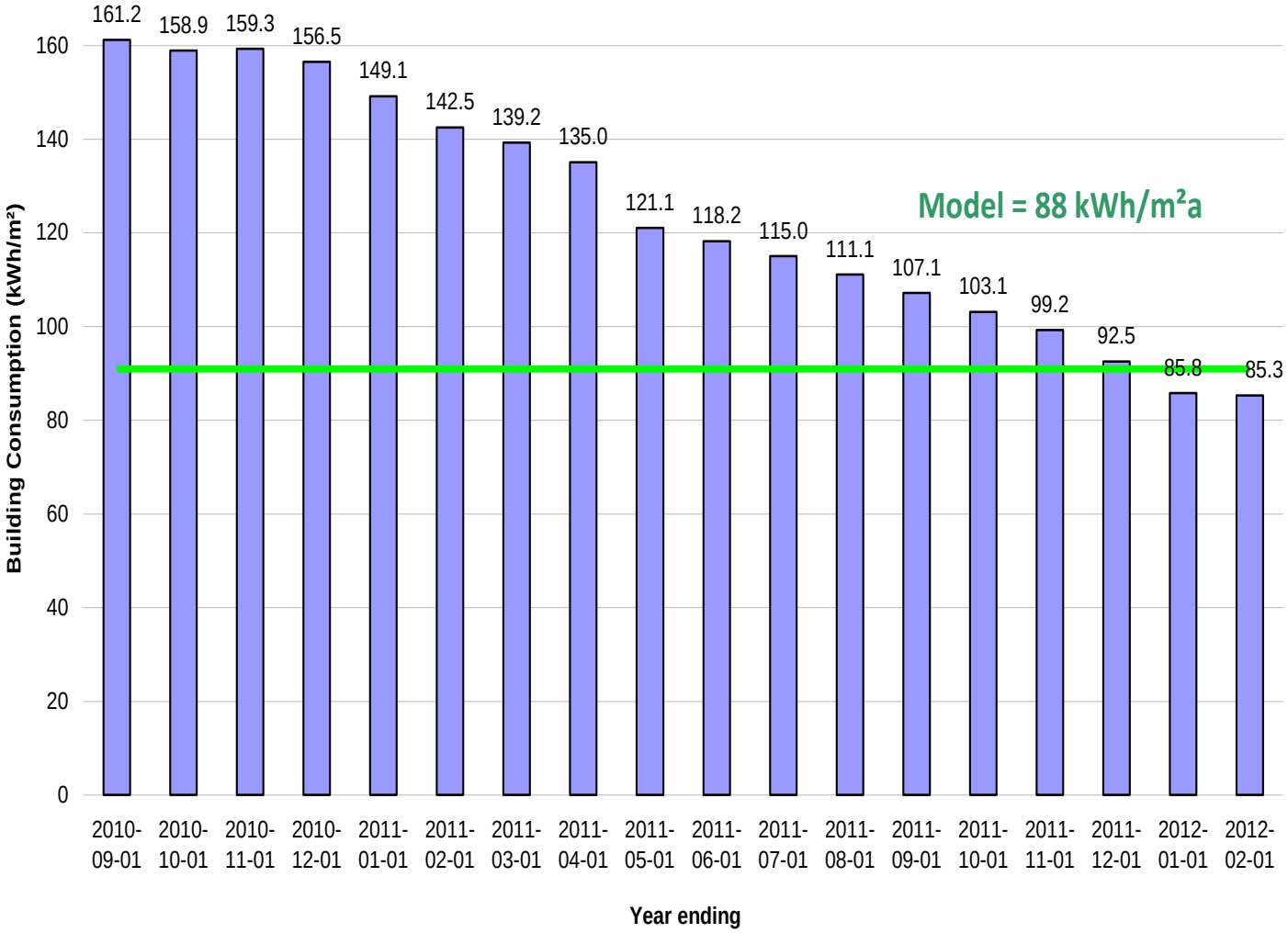


photo: Gerry Kopelow

French School - Damascus

architect: **Atelier Lion, Paris**

photo: Adria Goula

Historic city of Damascus
Fixed shading + vegetation

Climate concept summer day

Shaded Patio between the buildings

photo: Adria Goula

Net Zero by Design

Comfortable and Energy Efficient, Building Performance by Design

School of Design at NUS

Client
National University Singapore

Architect
Series Multiply, London and Singapore

MEP and Architects of record
Surbana, Singapore

VISION

high-comfort
net-zero
energy building

conventional approach

operative Temperature 24°C

adaptive comfort approach

operative Temperature 29°C
tempered air + elevated air speed

Photovoltaic
renewable energy

Hybrid Tempered, 26%
library, design studios
Theatrette, offices

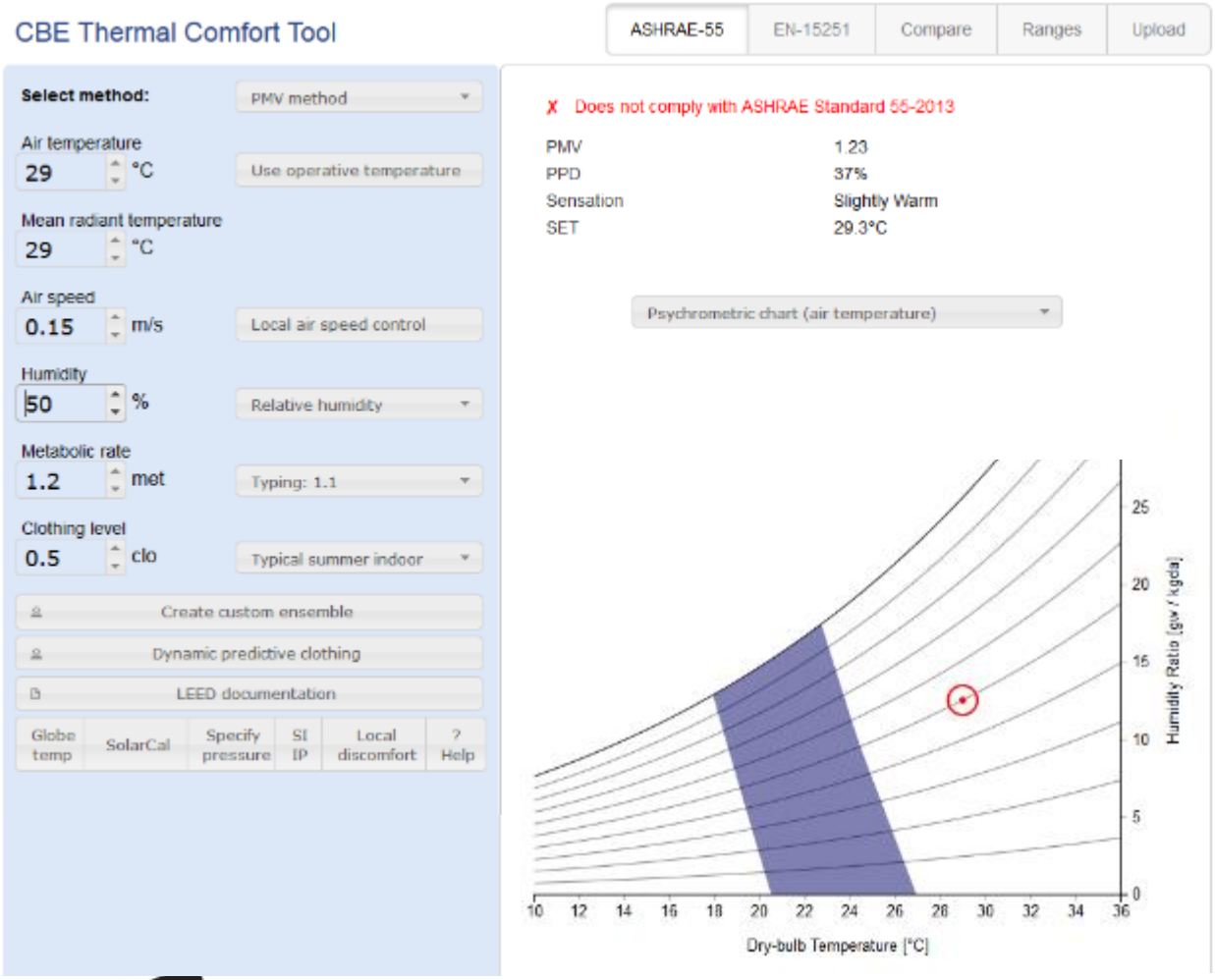
Full AC,17%
green building technology lab
energy lab, computer lab

Natural Cross Ventilated, 46%
with elevated air speed
social Plaza and social
interaction spaces
modeling areas, work shops
smart green home

Circulation
micro climate, wind
vegetation, green and blue

mech and aux rooms 10%

Thermal Comfort without elevated air speed



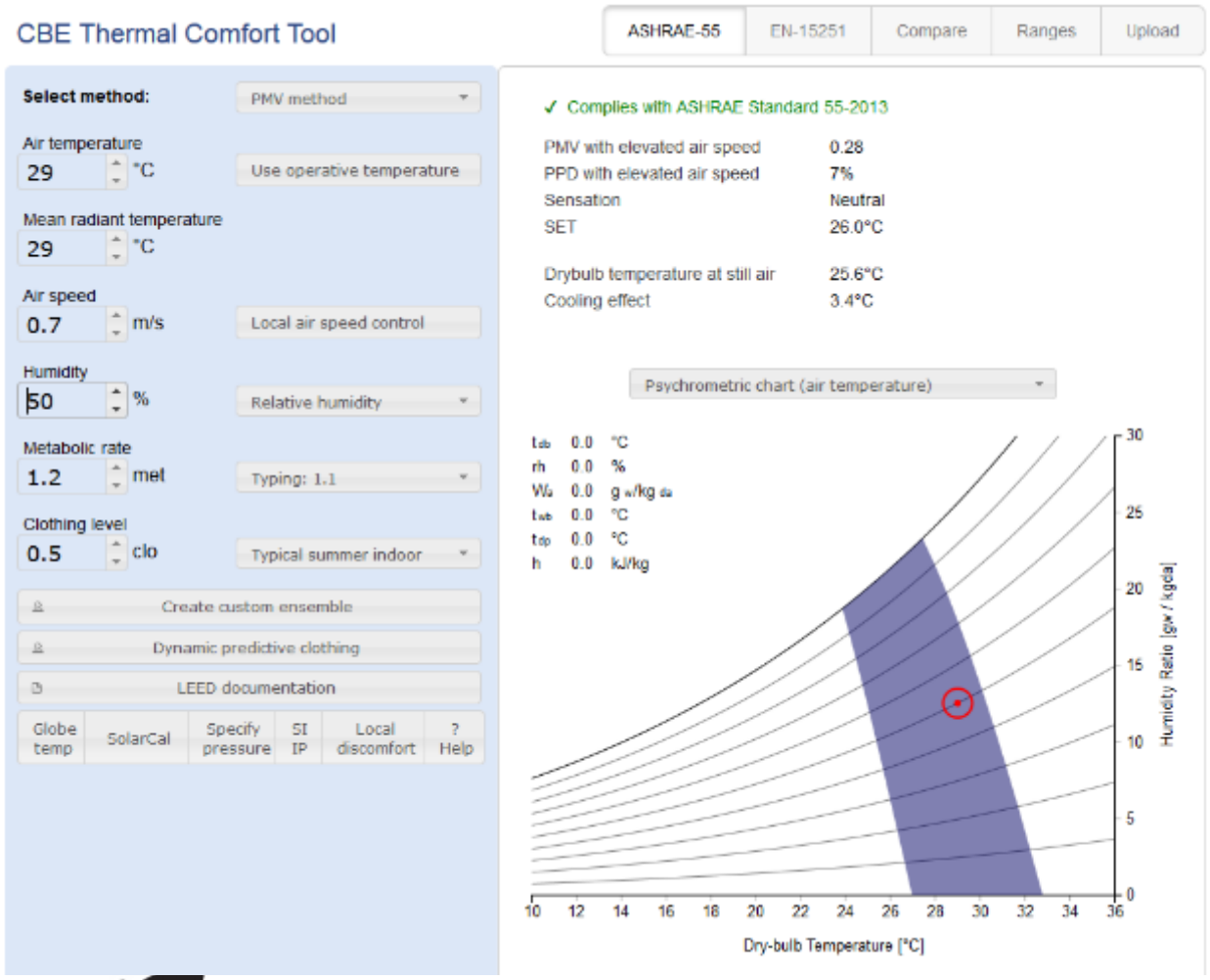
Operative Temperature 29°C
Air speed 0.15 m/s

PMV 1.2

☹

Comfort tool of Center for the Built Environment, University of California Berkeley

Thermal Comfort with elevated air speed

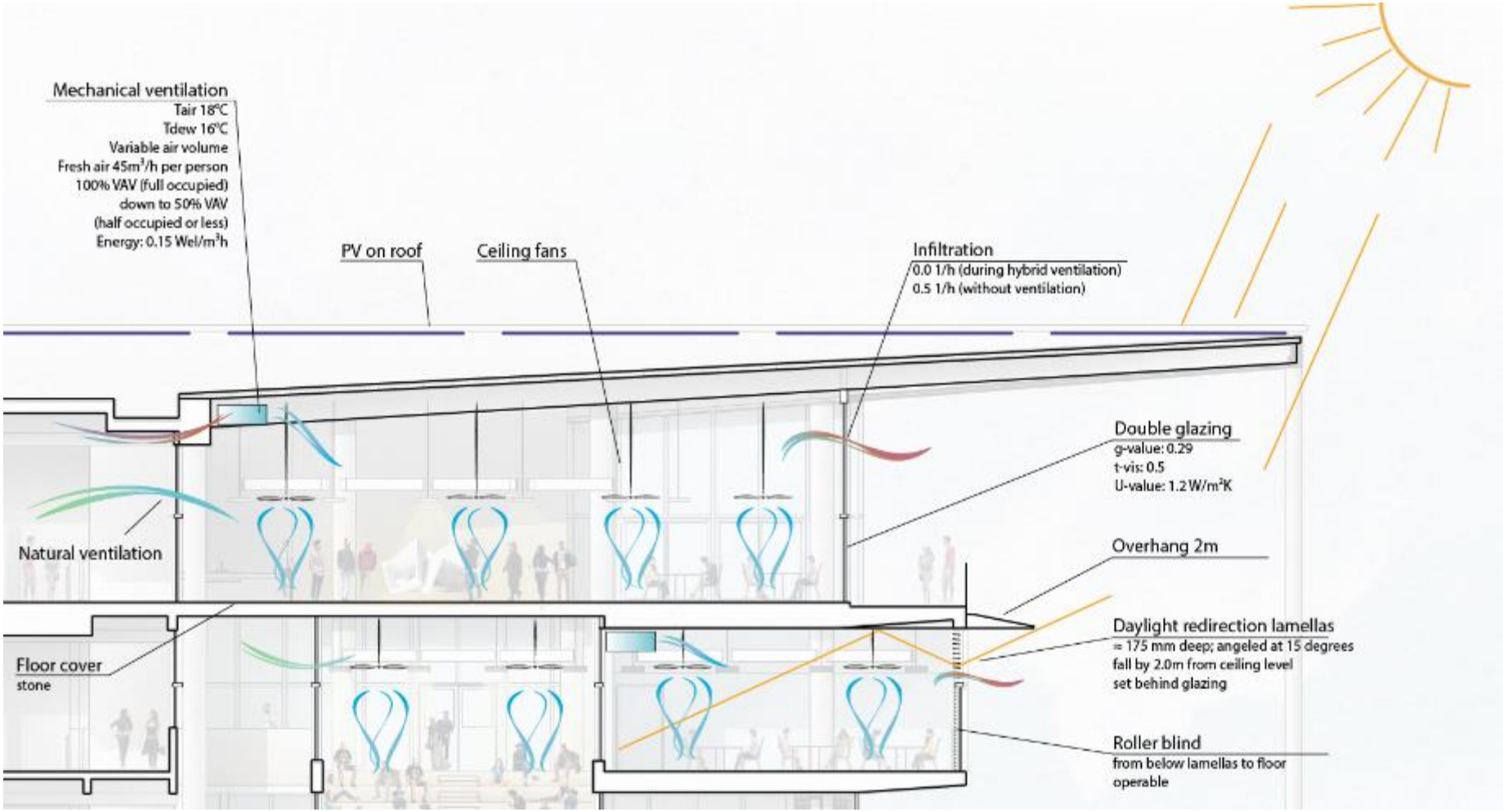


Operative Temperature 29°C

Air speed **0.7 m/s**

PMV_{eas} 0.3

Comfort tool of Center for the Built Environment, University of California Berkeley

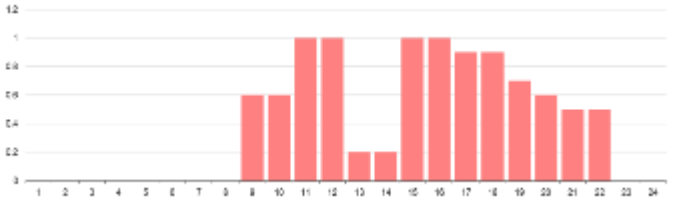


4 m² per person
MET 1.2
Summer CLO 0.6

max: 0.7 m/s
14 m² per fan

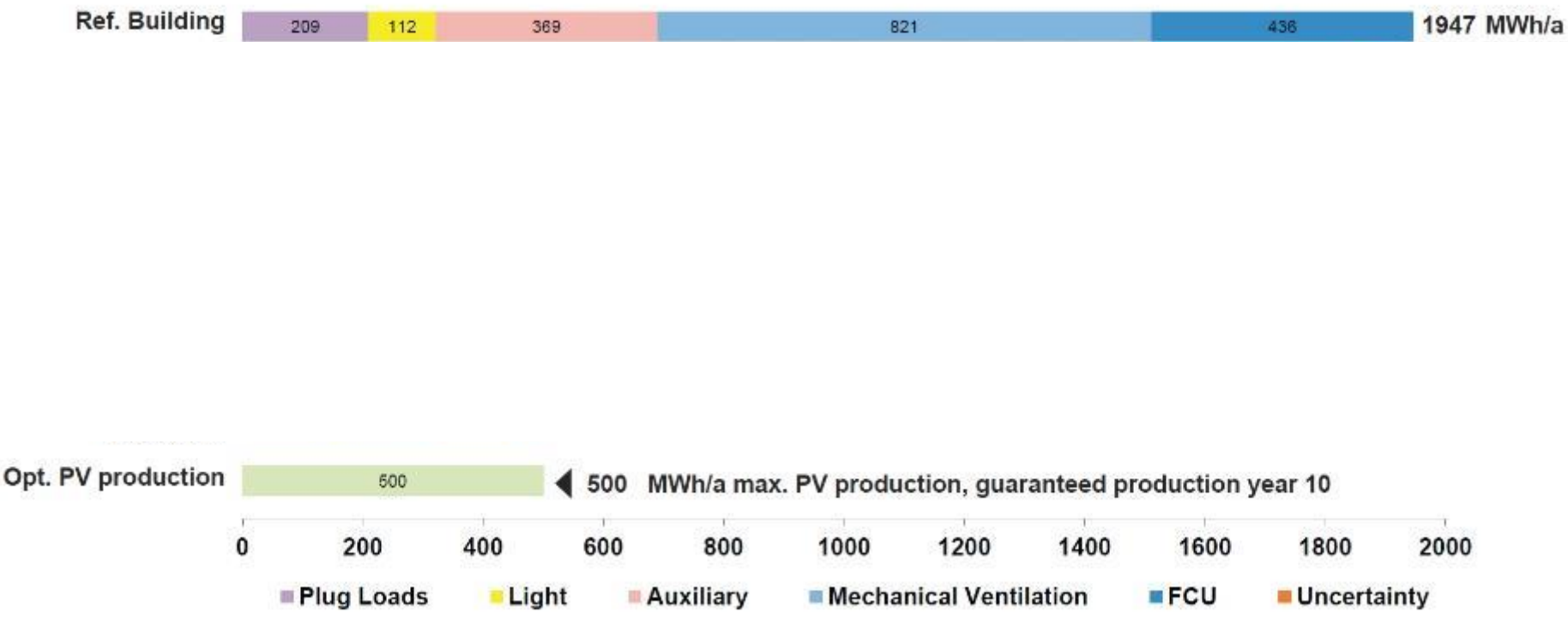
60 W per person
15 W/m²

min 300 Lux
6 W/m²

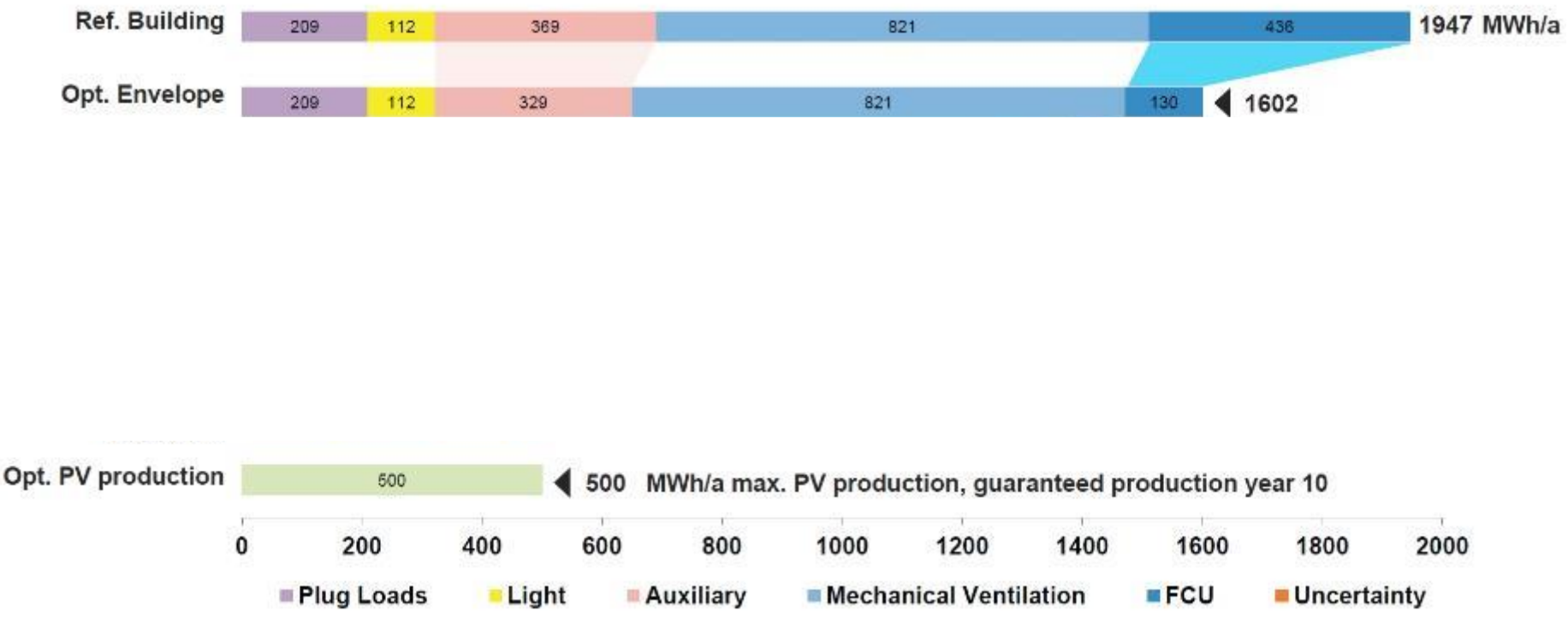


schedule occupancy and internal gains
operation time: 5 working days

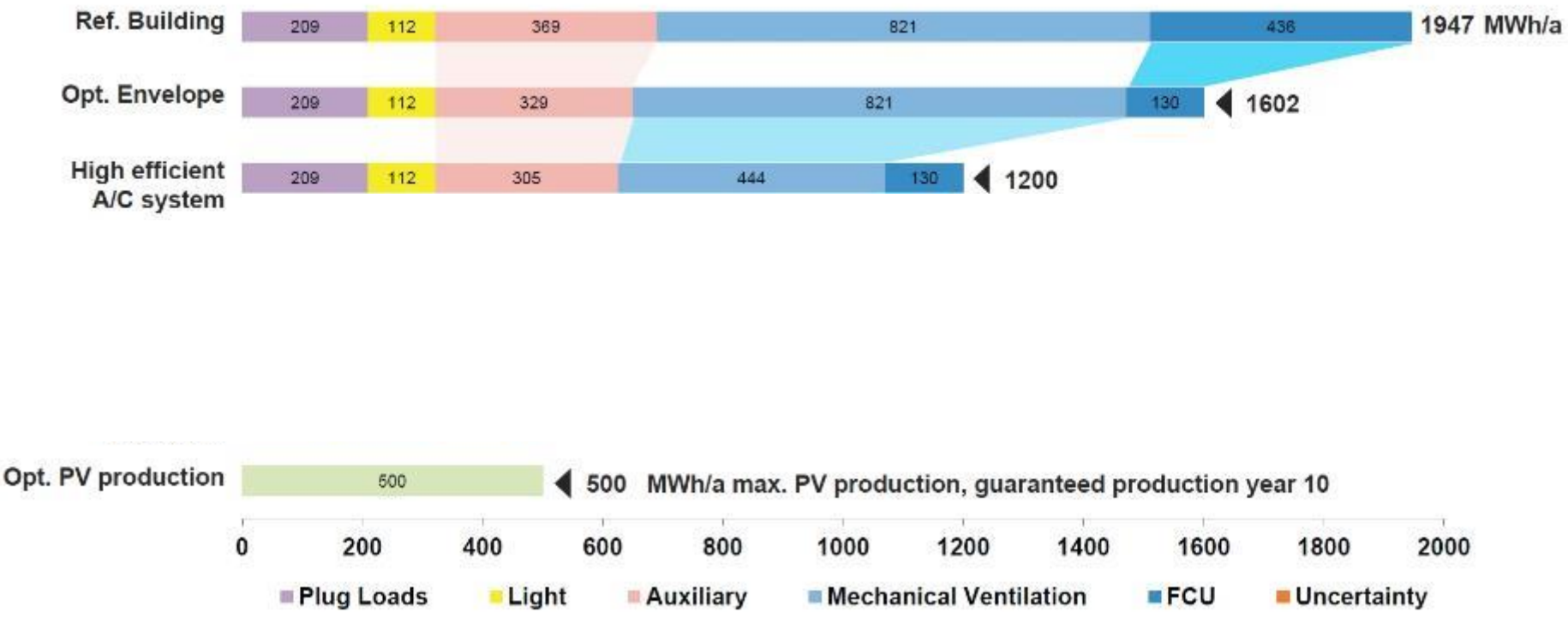
⇨ Maximal renewable energy production with PV system defines the available electrical energy to operate the building on net zero.



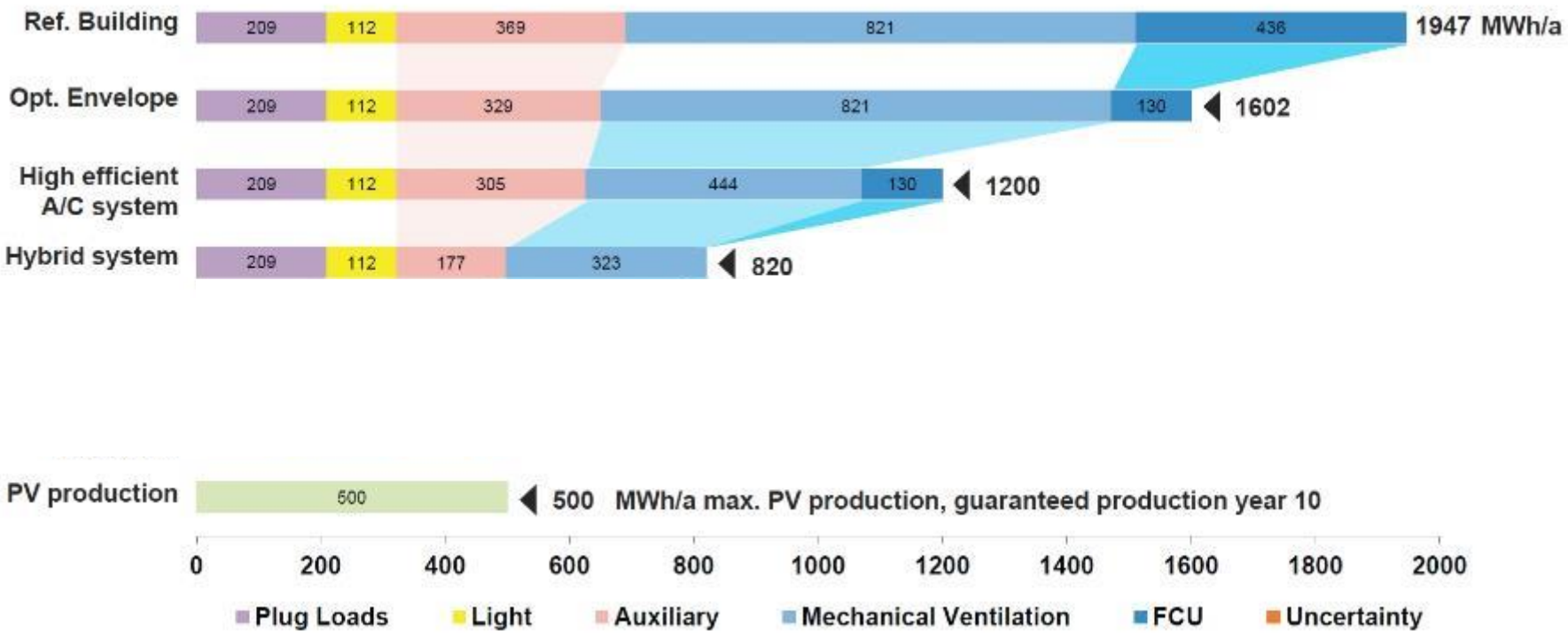
⇨ Challenge the client design brief



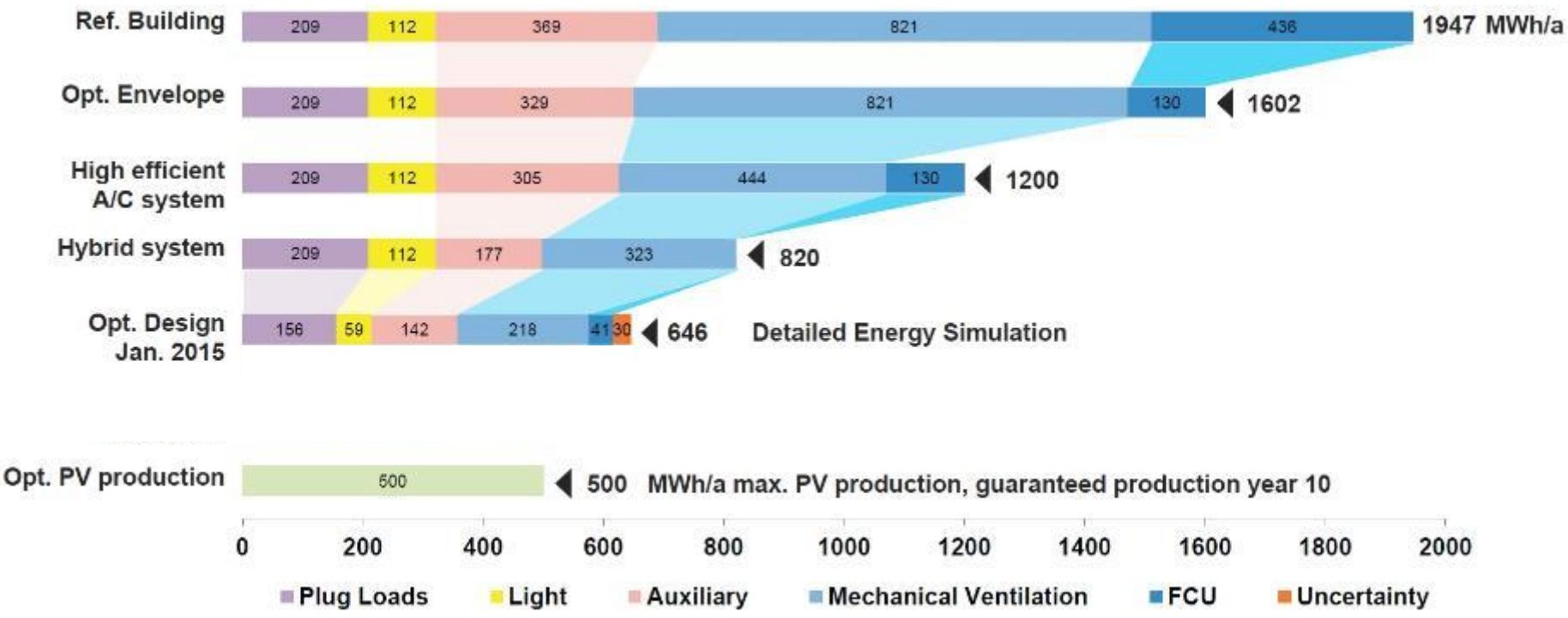
⇨ Optimize the envelope for thermal comfort and energy and glare and daylight



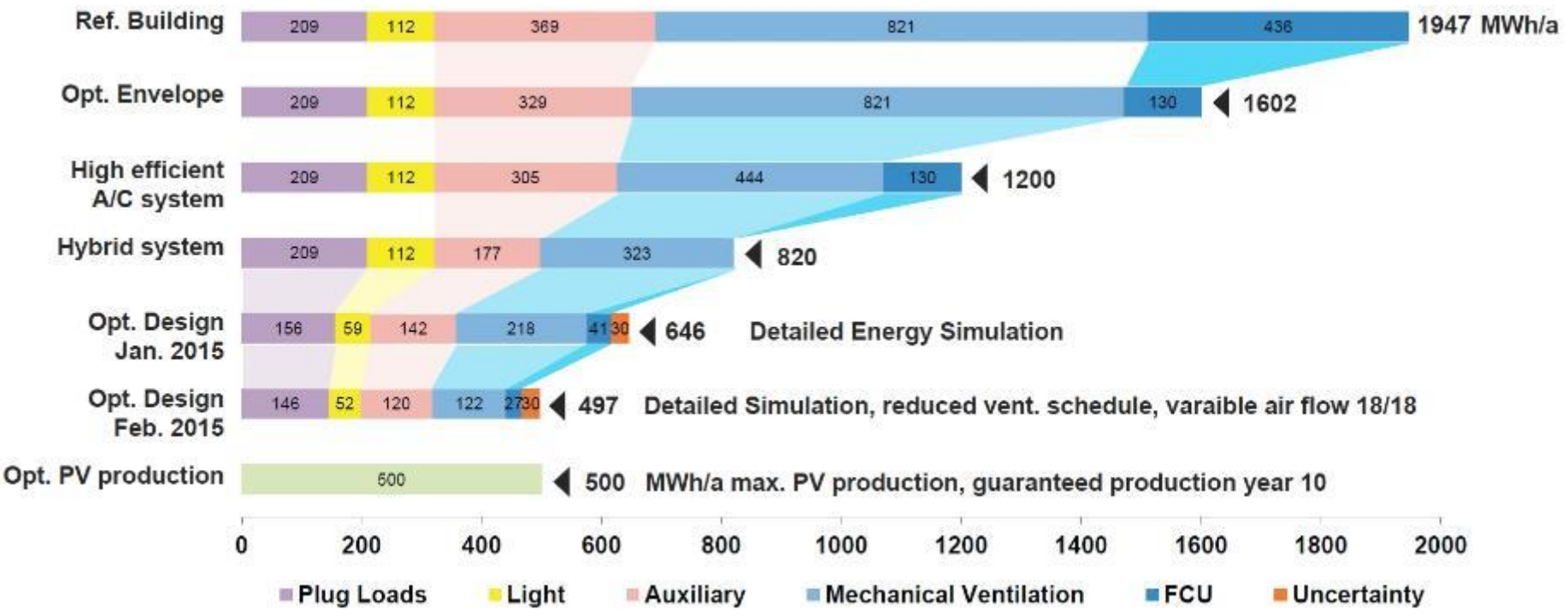
⇨ Maximal energy efficiency of a/c systems



⇨ Design for adaptive comfort with hybrid system
great fresh air, tempered and elevated air speed



Get the details right



Inform and improve the building design step by step with design charrettes

Comfort with elevated air speed

Sustainable Cooling Concepts for the Tropics

BRAC University, Bangladesh

Client
BRAC, Bangladesh

Architect
WOHA, Singapore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Centenary City Abuja, Nigeria

Masterplan for a Sustainable City Development

Client:

Centenary City Ltd, Abuja

Design Team:

AS+P – Albert Speer + Partner, Frankfurt

Transsolar Energietechnik, Munich

Atelier Dreiseitl, Überlingen

Primetech Design + Engineering, Abuja

Land Area:	10 km²
Total GFA:	6 Mio m²
Inhabitants:	135 000

Masterplan: 2013 – 2014

Construction 2015 - 2025

Centenary City Abuja

Framework for sustainability concept

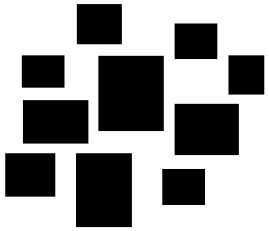
VISION

A self-sustaining
energy efficient city
of the future

Centenary City Abuja

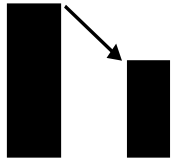
Framework for sustainability concept

STRATEGY



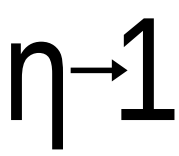
1

Optimize city layout for solar & daylight potential



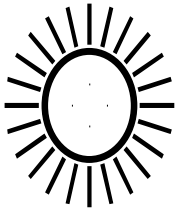
2

Minimize building energy demand



3

Maximize efficiency of energy production



4

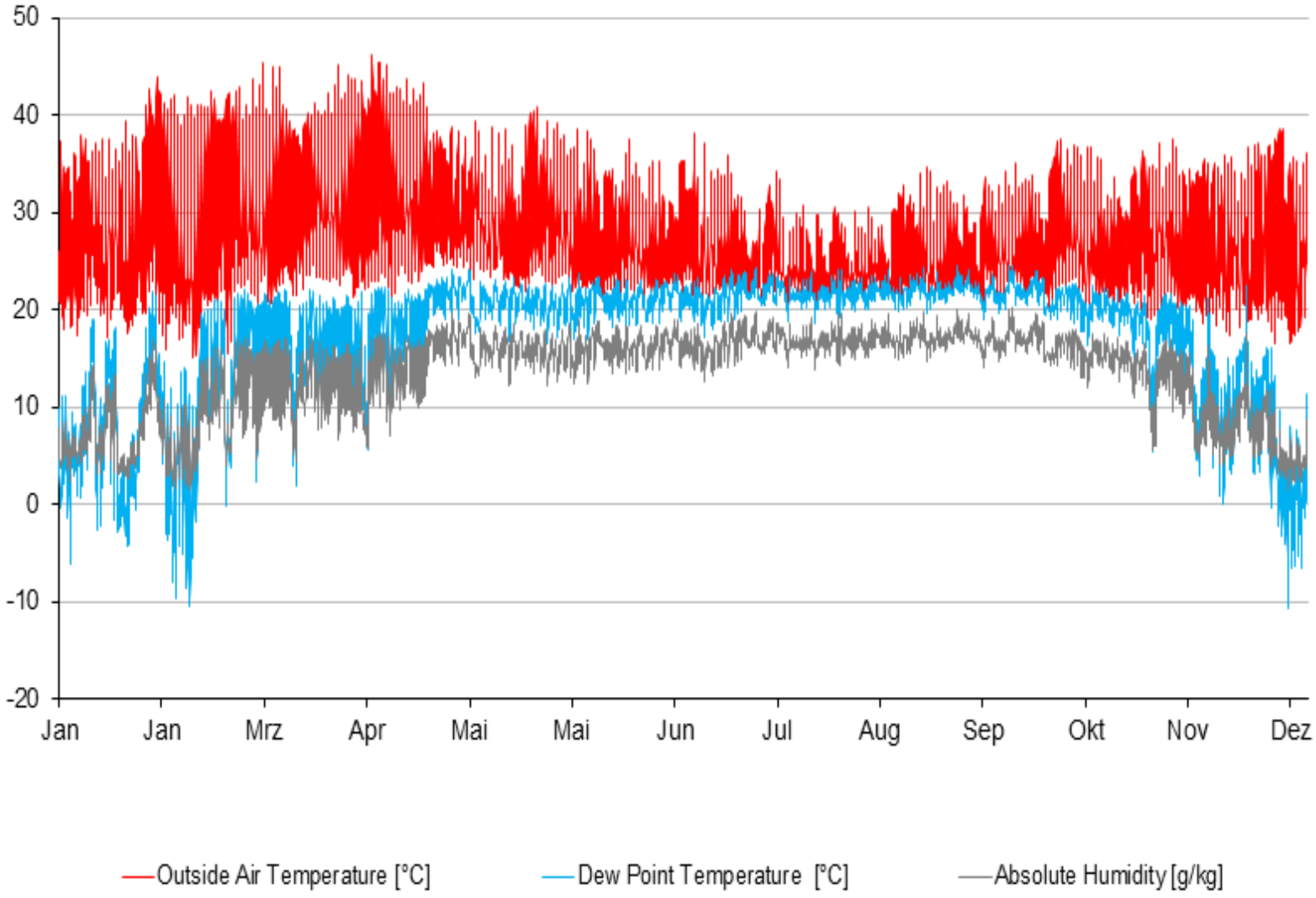
Maximize renewable energy production

The site

View from the mountain

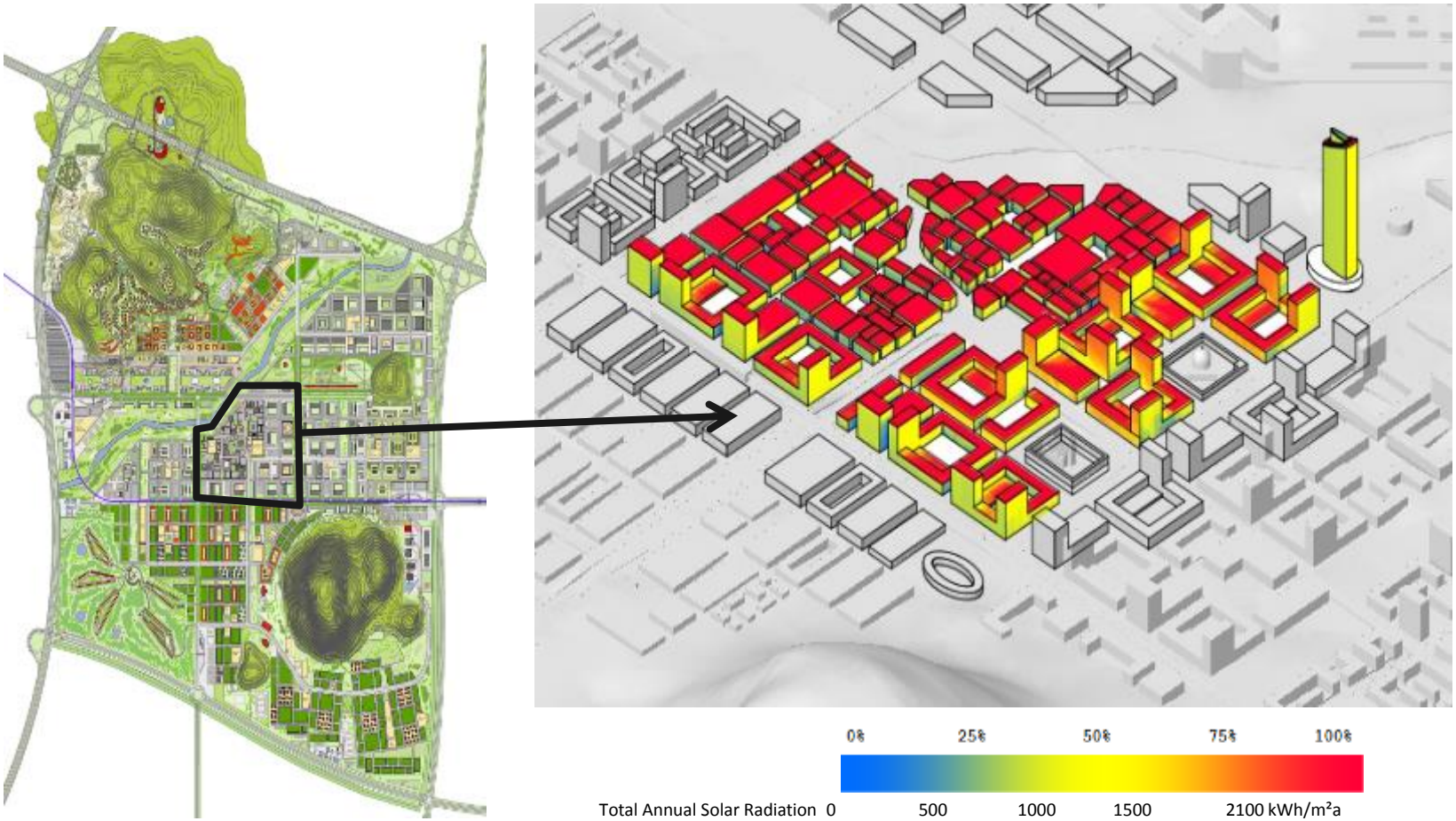
Local Weather Conditions

Air temperature and humidity over the course of a year



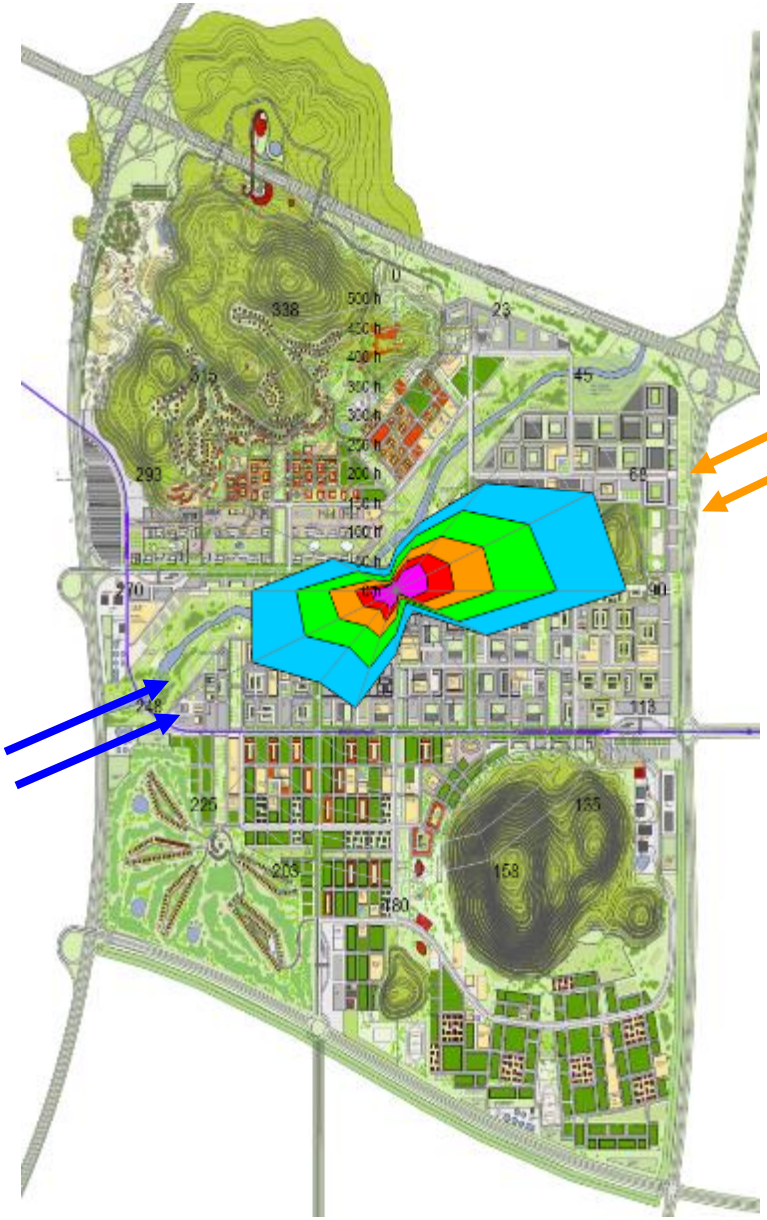
Step 1: Optimize city layout

Solar Access



Step 1: Optimize city layout

Optimized city ventilation



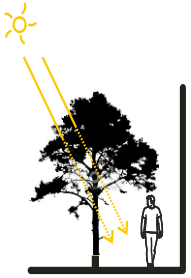
dry season wind direction
(Oct – Apr)

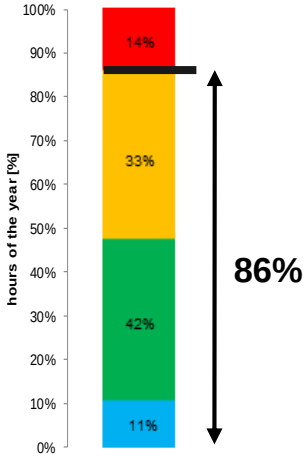
wet season wind direction
(May – Sept)

Step 1: Optimize city layout

Outdoor Comfort

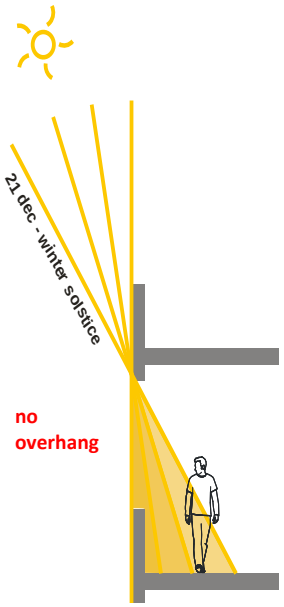
overhead shading
trees + water

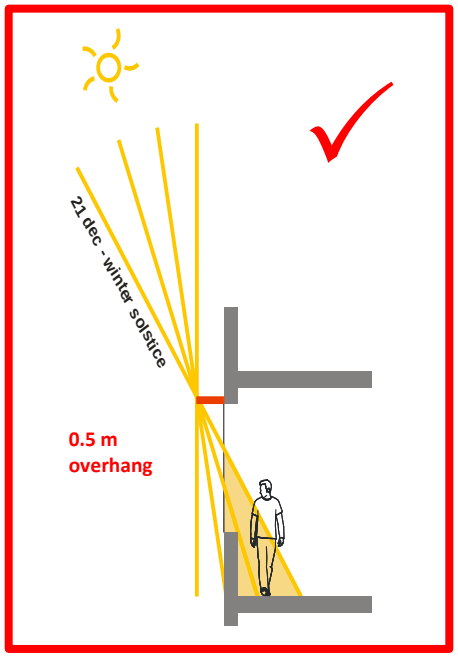


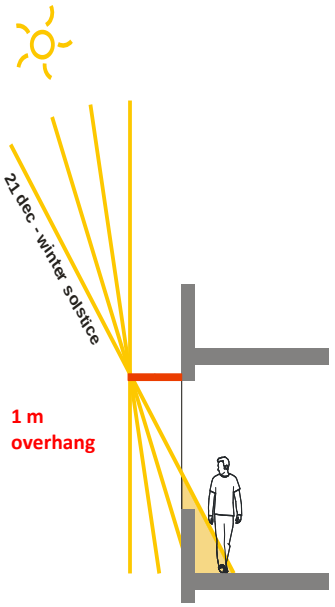


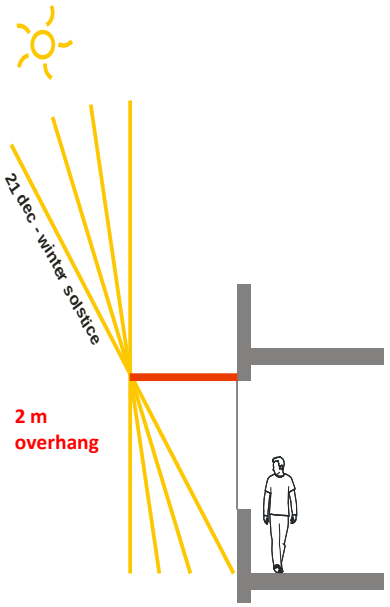
Step 2: Minimize Building Energy Consumption

Optimize Shading vs. Daylighting





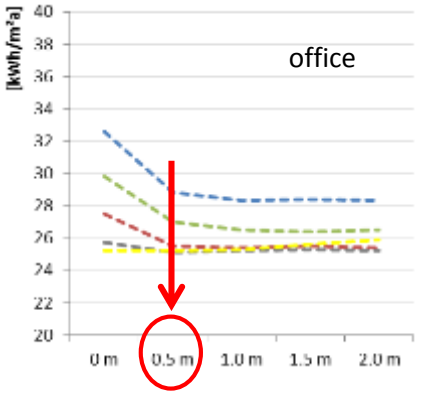


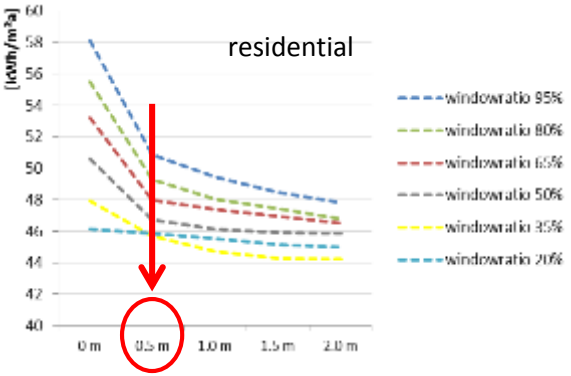


optimized overhang shading

-10% savings

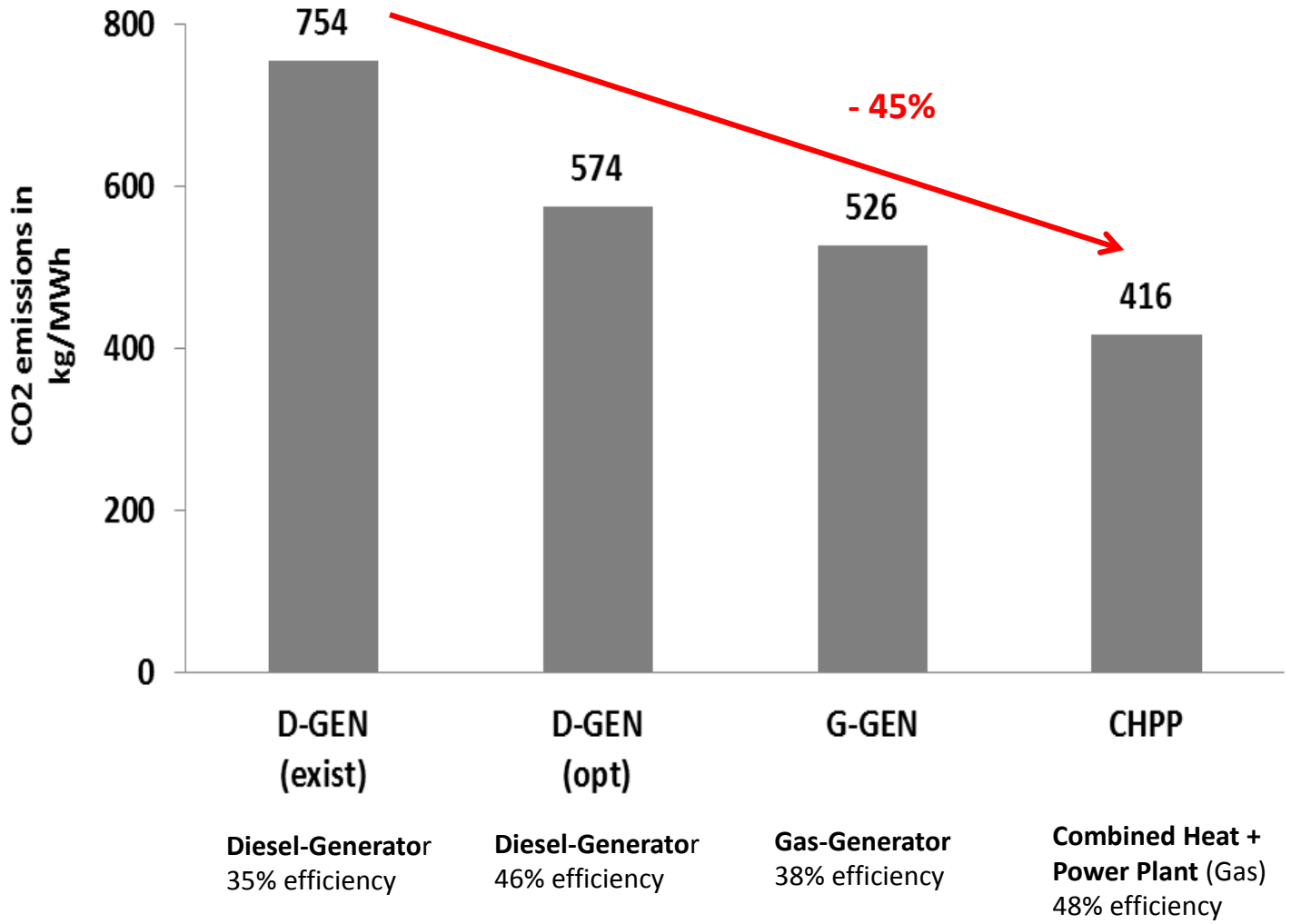
assessment of
total electricity for
cooling + lighting



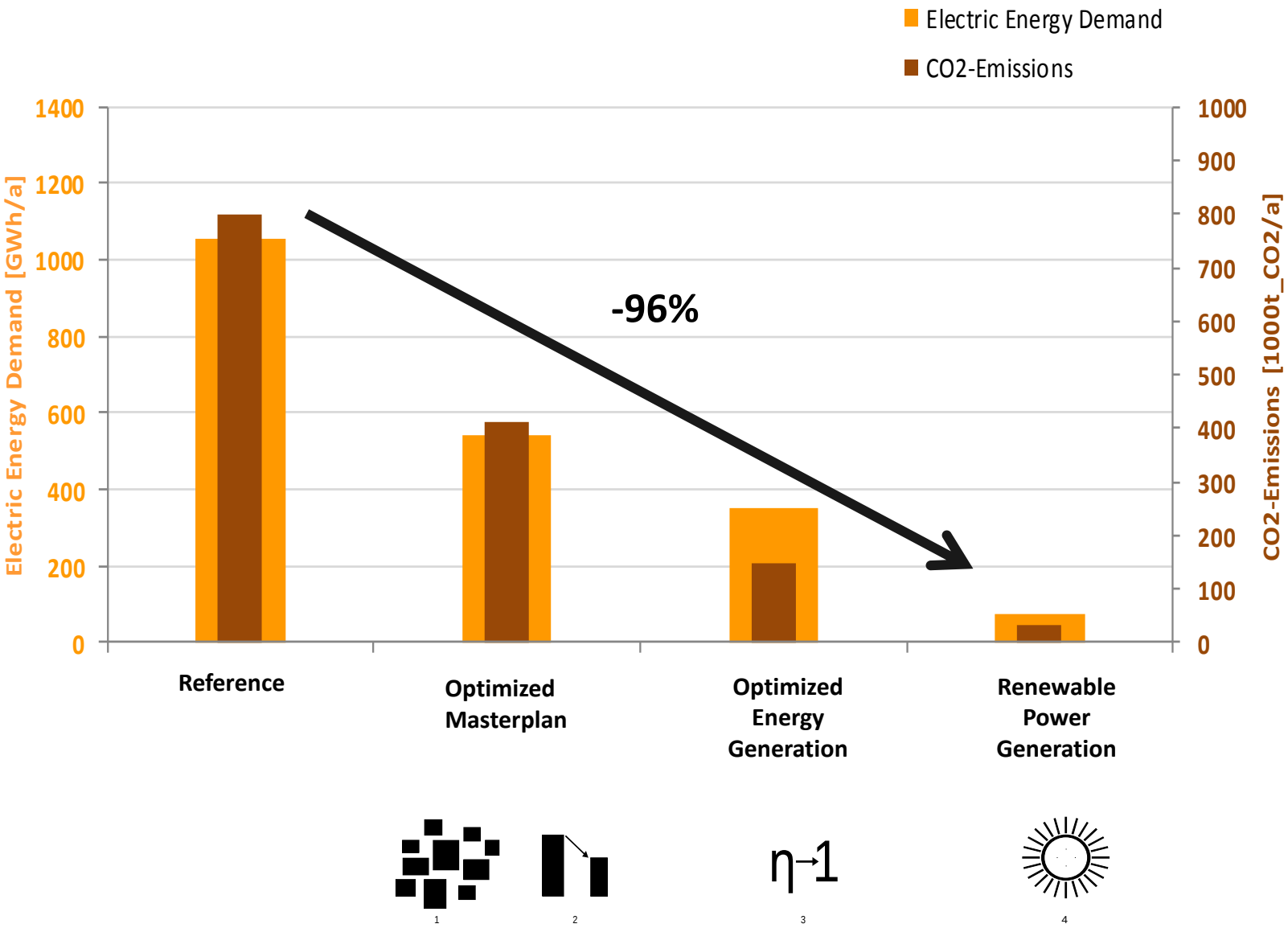


Step 3: Maximize Efficiency of Energy Generation

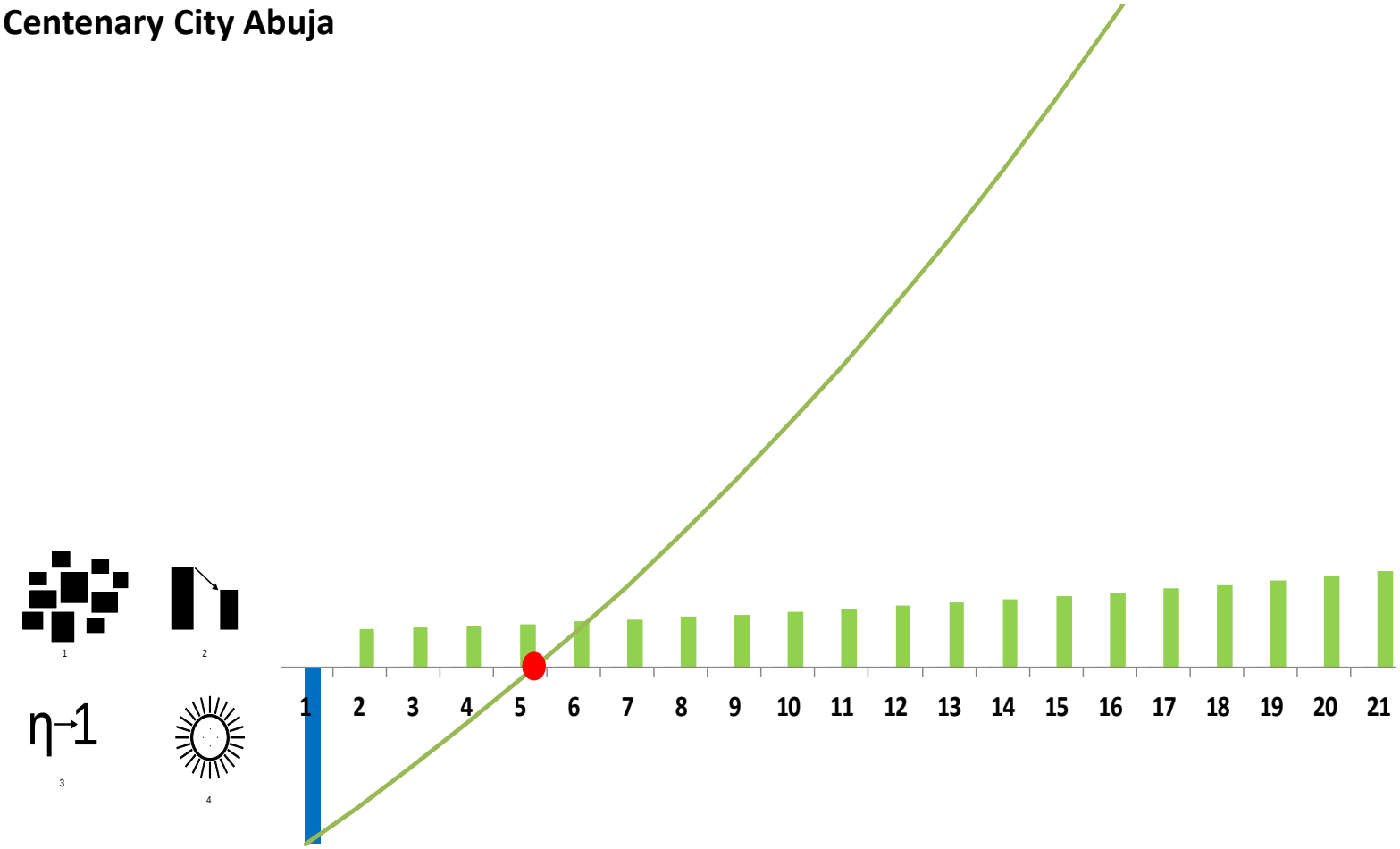
Efficient power generation



Centenary City Abuja



Centenary City Abuja



premium for sustainable city: **+8.5%** of total invest for city

cashflow

savings on running costs over **> 20%** of premium per year

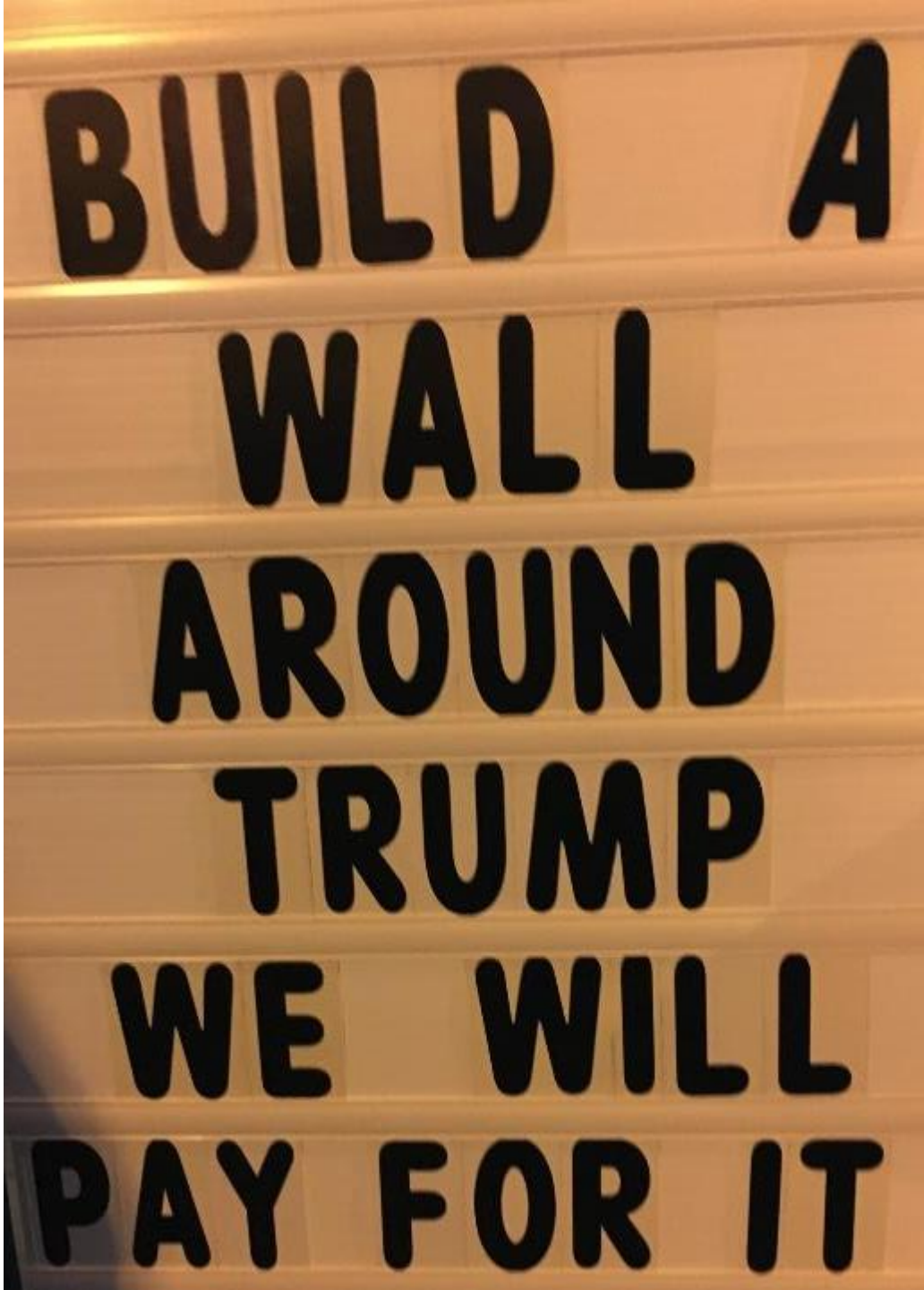
return of invest after **5.5 years**

"Transforming Our Built Environment through Innovation and Integration: Putting Ideas into Action"

- Successful at all scales
- Holistic and Synergetic
- Environmental Quality – Creating Delight

- Aspirational and Inspirational

At a Bar in Hong Kong…



Thank you