

Supported by:



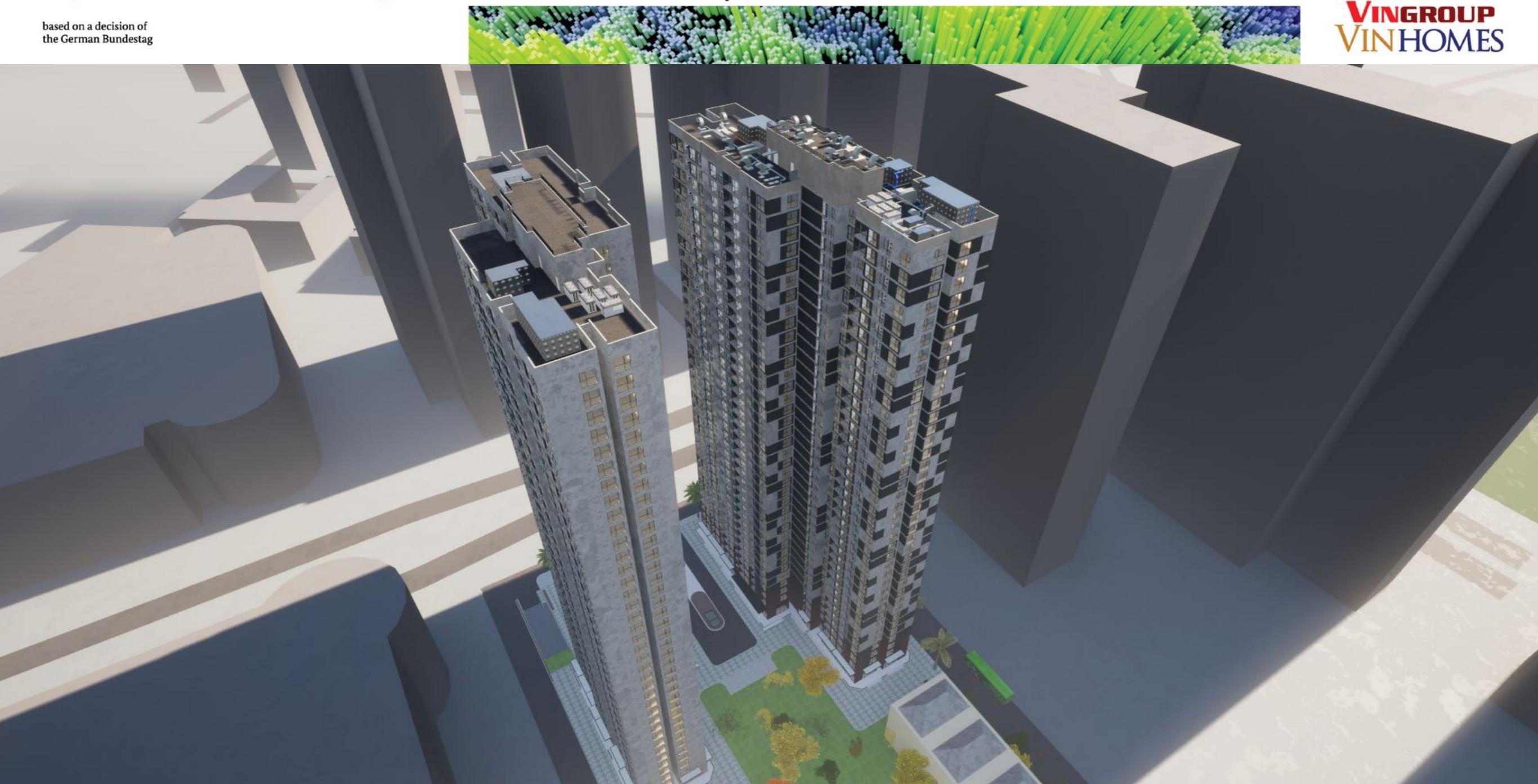
Federal Ministry
for the Environment, Nature Conservation,
Nuclear Safety and Consumer Protection



based on a decision of
the German Bundestag



research group
of spatial information
management and modeling



SMART URBAN AREAS - SUA

BUILDING ENVELOPE AND ENERGY OPTIMISATION EVALUATIONS FOR URBAN AREAS IN VIETNAM: LEARNING FROM GLOBAL STANDARDS



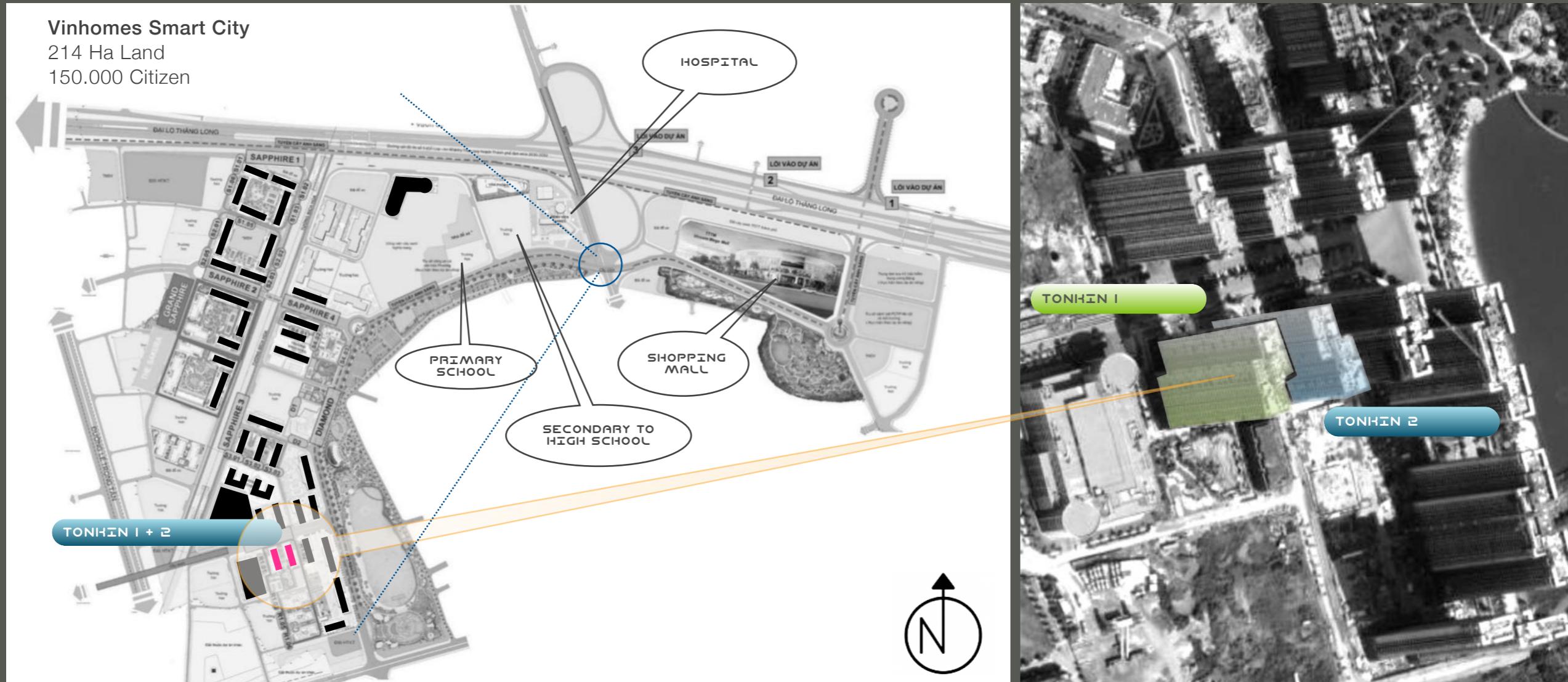
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SMART CITY HANOI

Site plan & Bird view



Source: Vinhomes

Source: Google Earth



TONKIN 2

Building Information Board:

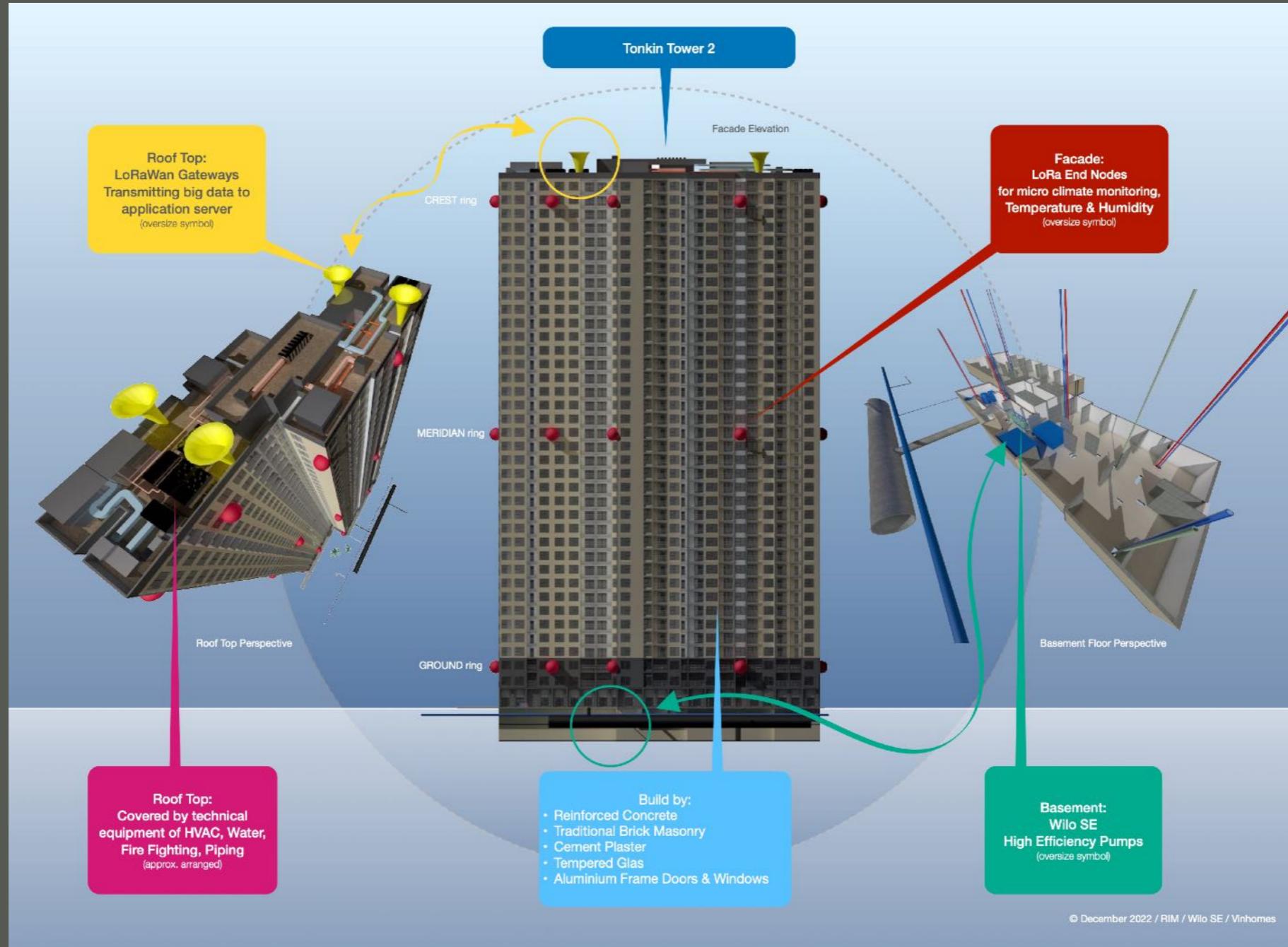
- Length: 70,80 m
- Width: 37,35 m
- Height: 139,00 m
- Floor area: 1.217,90 m²
- Gross floor area: 46.279,80 m²
- Umbauter Raum: 160.870,99 m³
- Floors: **39** (incl. rooftop)
- Residential floors: 38
- Retail floors: 1
- Apartments: **602**
 - Studios: 114
 - 1 Bed Apt: 112
 - 2 Bed Apt: 301
 - 3 Bed Apt: 75
- Residents (fix): **~1.917**
- Residents (flex): ~100 (Maid / Family / Service staff)
- Construction Material: Concrete, Bricks, Cement plaster, Ceramic, Stone, Metals, Glass, Paint, div. Plastics



Quelle: BIM Planung, RIM



TONKIN 2 - RESEARCH BUILDING

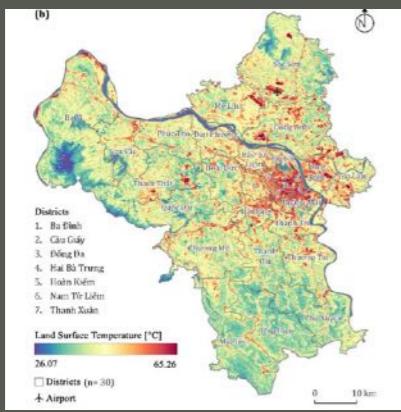
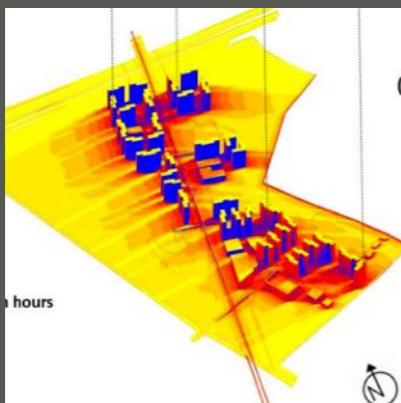
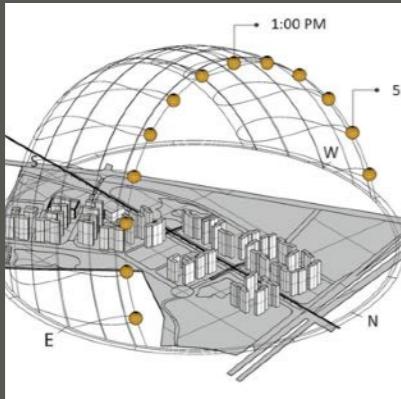


Source: RIM

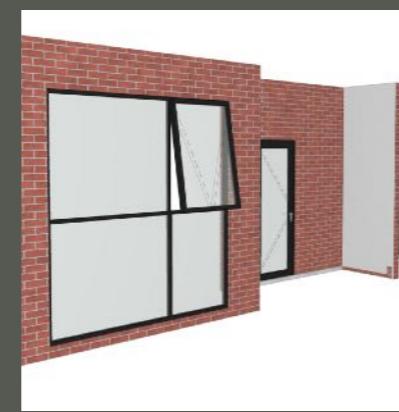


TONKIN 2 - FOCUS

Micro-Climate Dynamic:



Building Materials:



Energy - Water - Performance:



LIVING
COMFORT

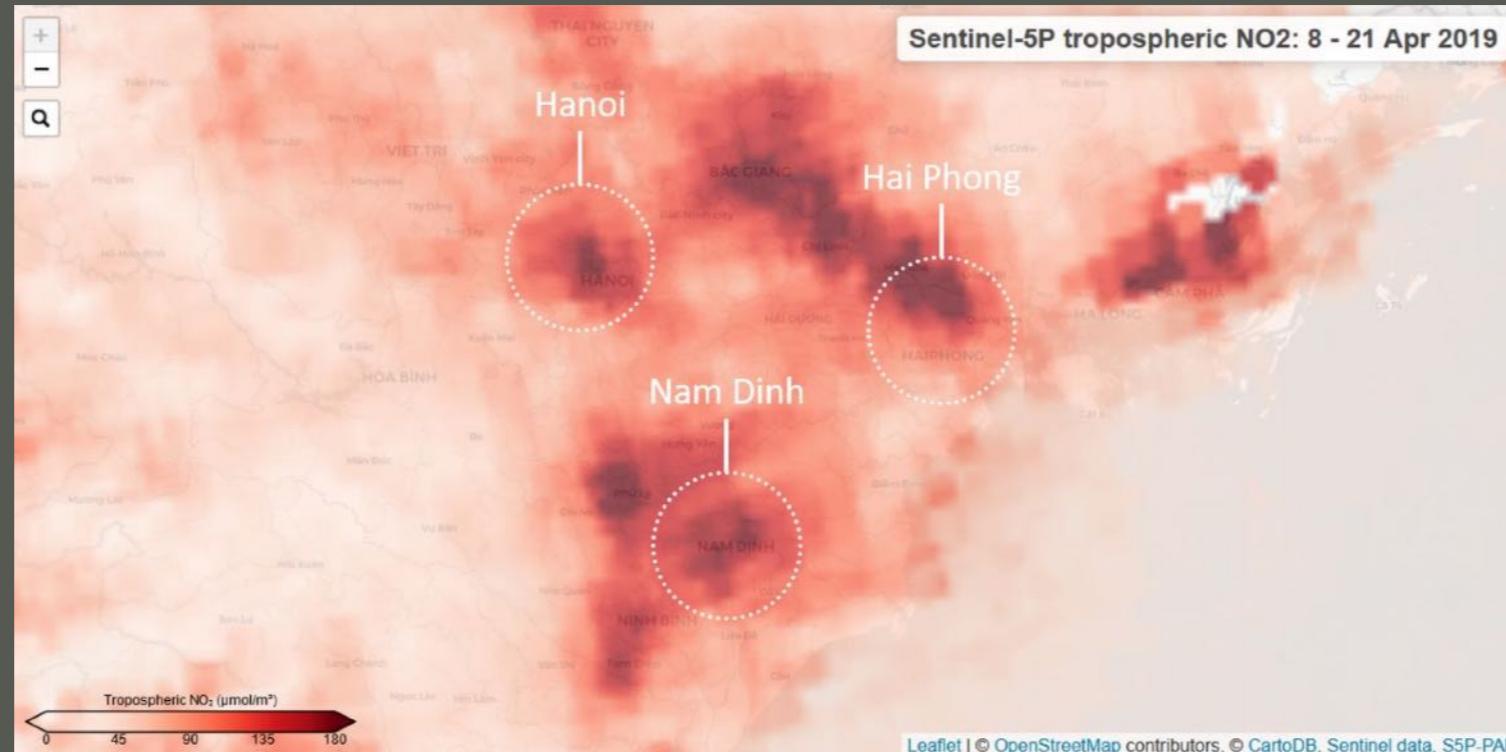
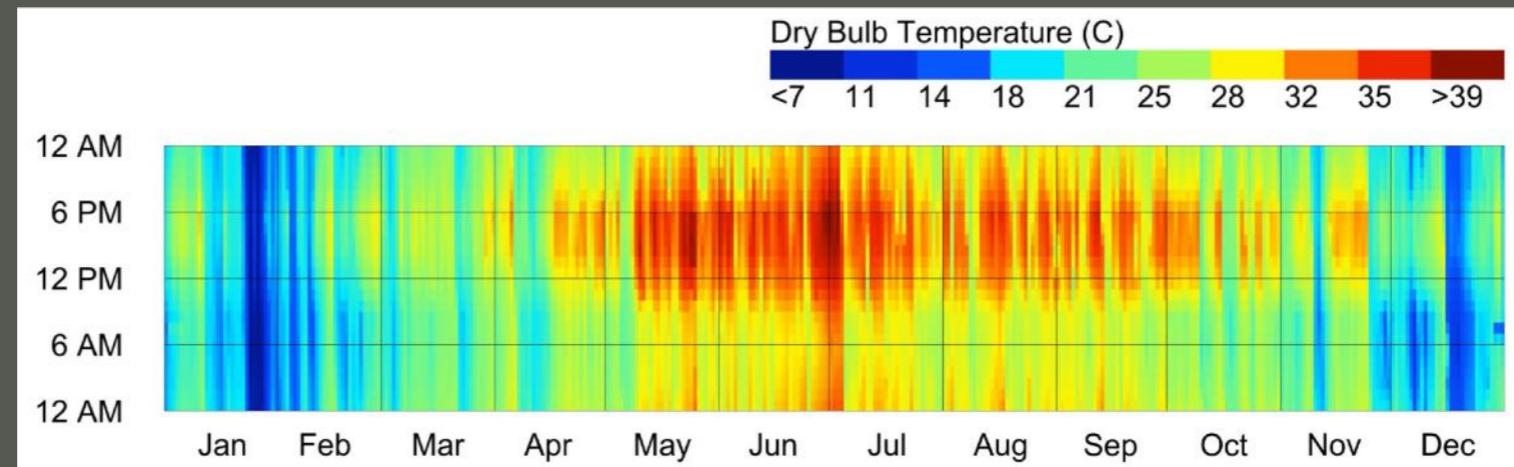
BUILDING
PERFORMANCE

Source: RIM, WILO



BIG PICTURE

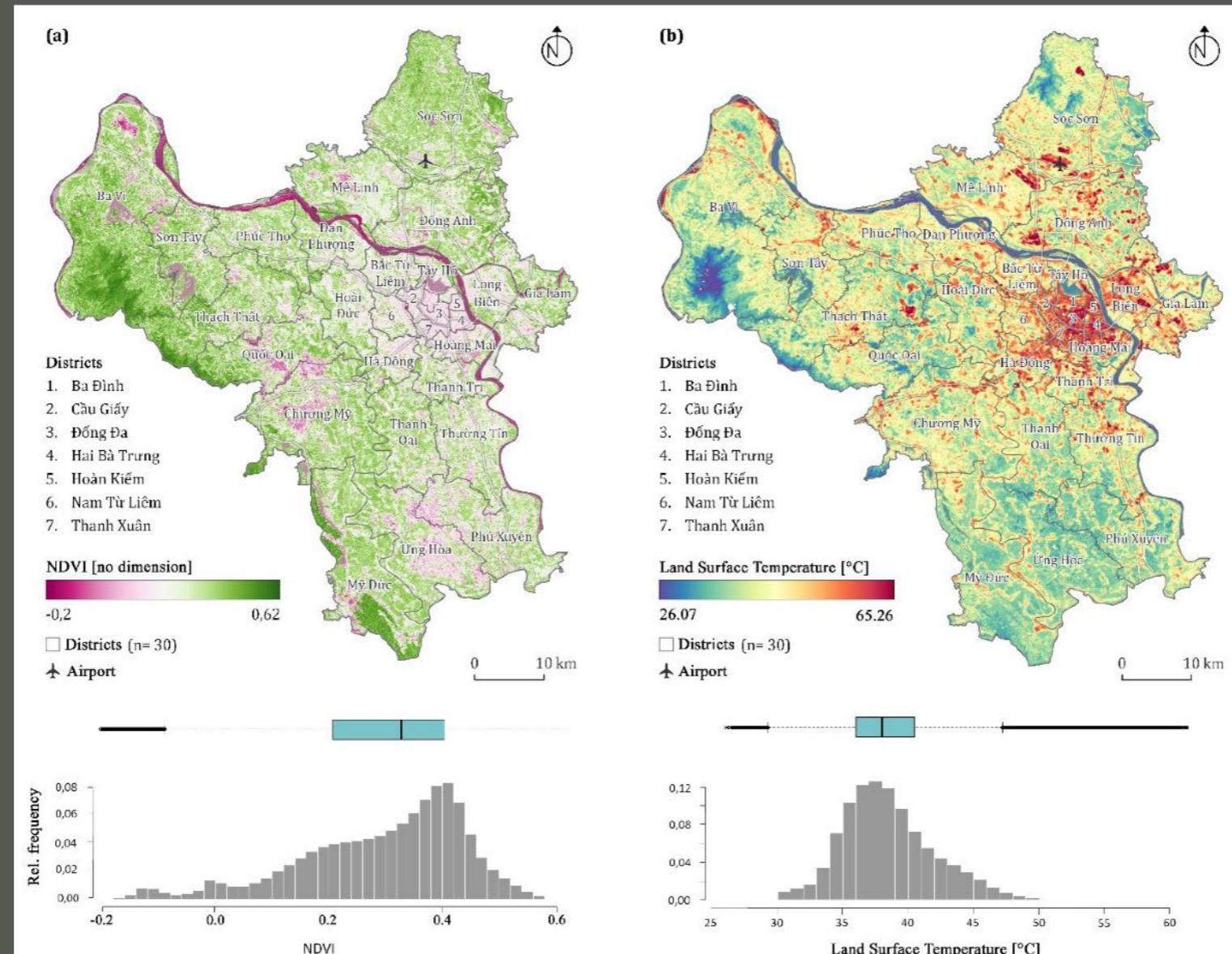
NO₂ - Nitrogen Dioxide concentration in northern Vietnam



Source: RIM

CITY ENVIRONMENT

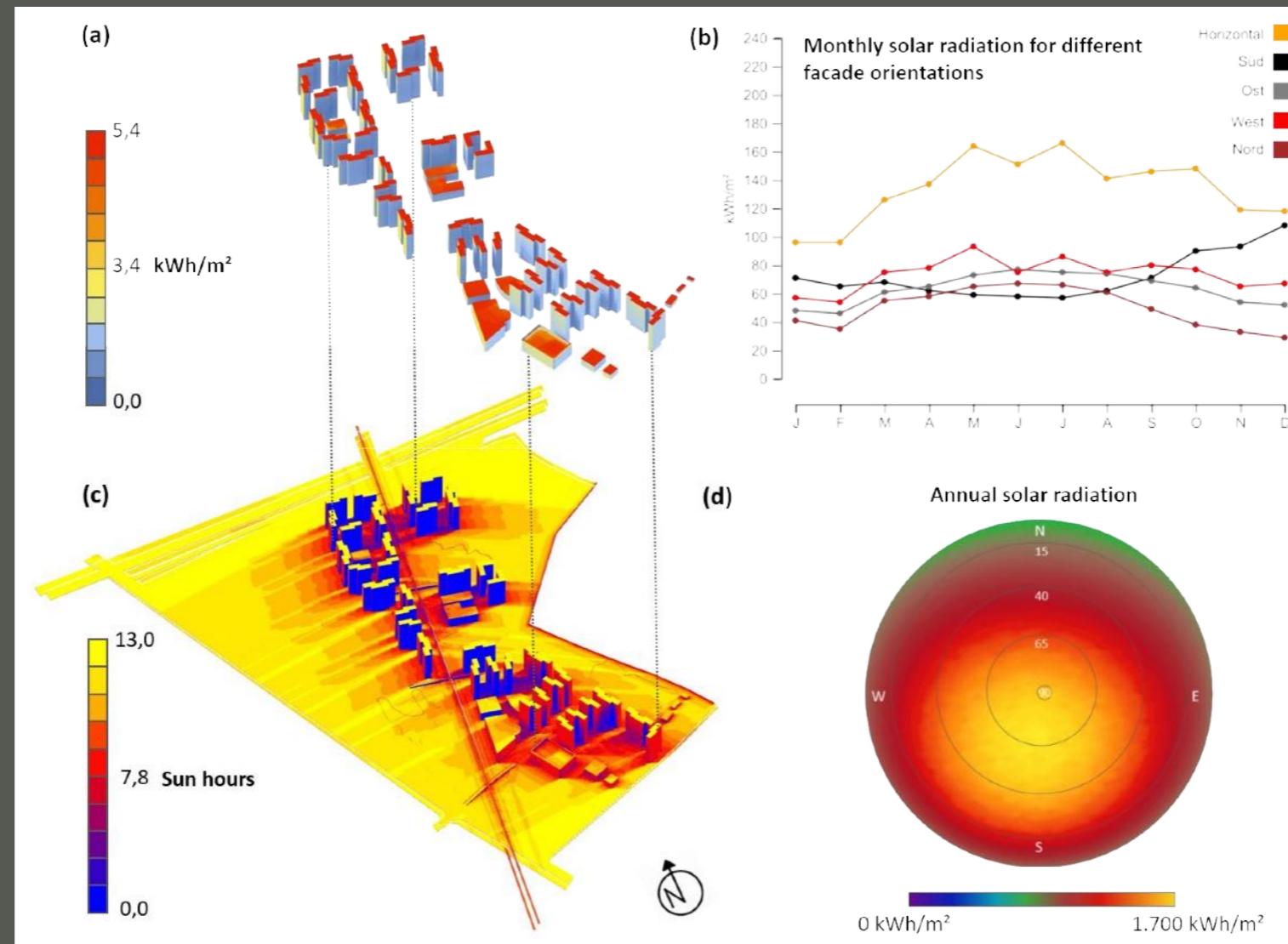
Normalised Difference Vegetation Index (NDVI) vs. Land Surface Temperature



Source: RIM

SOLAR RADIATION ANALYSE

Solar potential, Monthly solar radiation, 24hrs absolut Sunshine in June and annual solar radiation Hanoi



Source: RIM



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ENVELOPE SURFACE

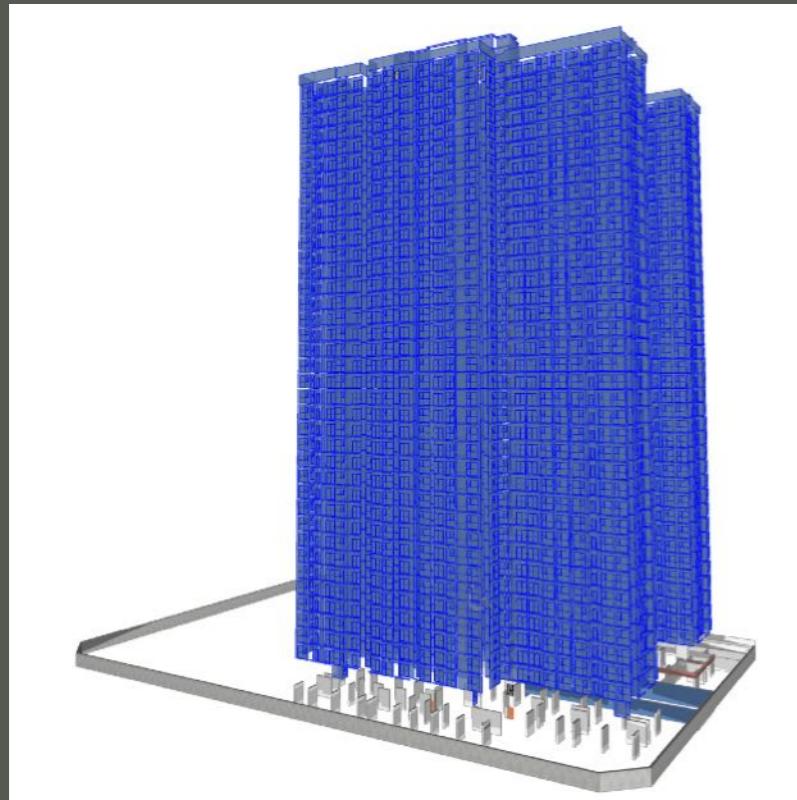
Brick Masonry w/ cement plaster - 150mm

● Bricks:

$$\begin{aligned} 1,0 \text{ m}^3 &= 1.000 \text{ pcs.} \\ 5.000 \text{ m}^3 &= 5.000.000 \text{ pcs.} \\ 5.000 \text{ m}^3 &= 7.500 \text{ mt} \\ 1,0 \text{ Stk.} &= 0,000514 \text{ metric ton CO}_{2\text{eq}} \end{aligned}$$



5.000.000 pcs. = 2.570 metric tons CO_{2eq} / year



Wall surfaces

Source: RIM

Source: <https://www.ccacoalition.org/en/resources/emissions-brick-manufacturing-industry-book-chapter>



ENVELOPE SURFACE

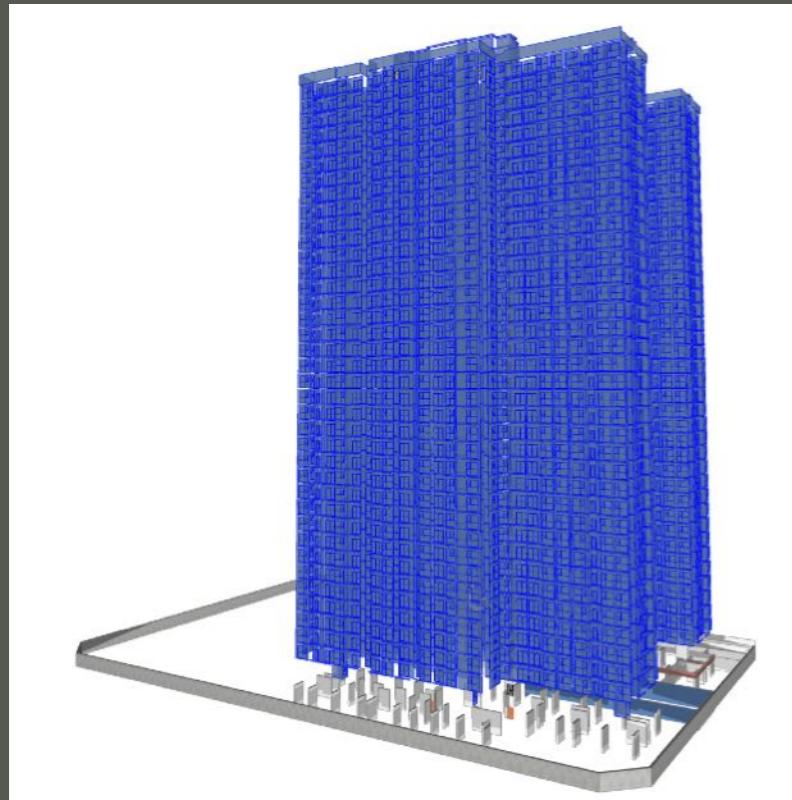
Brick Masonry w/ cement plaster - 150mm

● Bricks:

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5.000.000 pcs. = 2.570 metric tons CO_{2eq} / year



Wall surface material



Source: RIM, Wienerberger, Viglacera

Source: <https://www.ccacoalition.org/en/resources/emissions-brick-manufacturing-industry-book-chapter>



CONSTRUCTION MATERIAL

Building framework

- Evaluation



16.932m³

33.864t

= 42.330 mt concrete (one tower)

= cement share

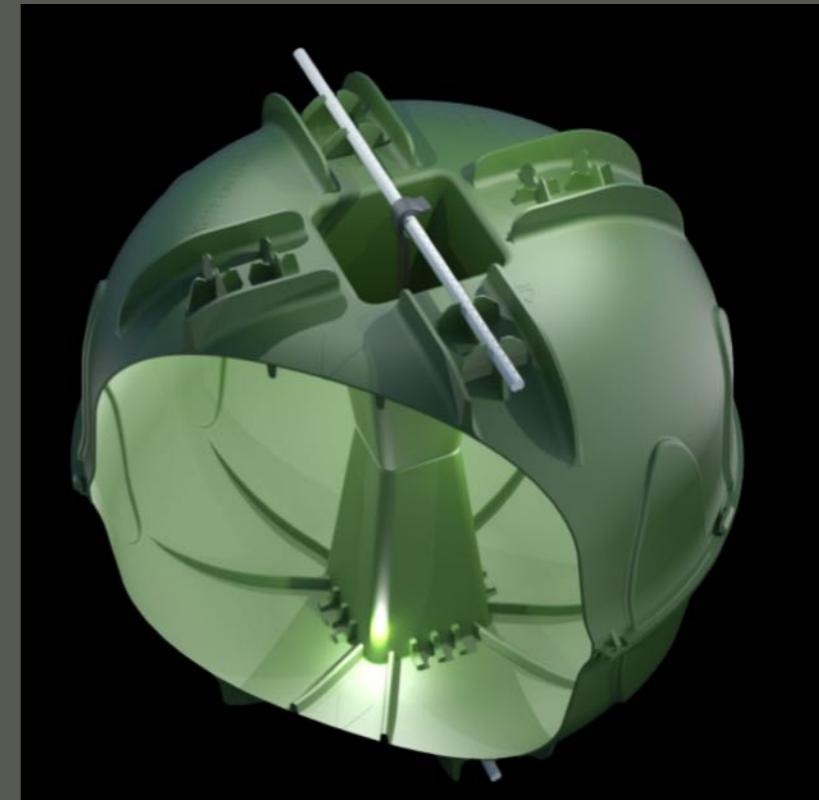
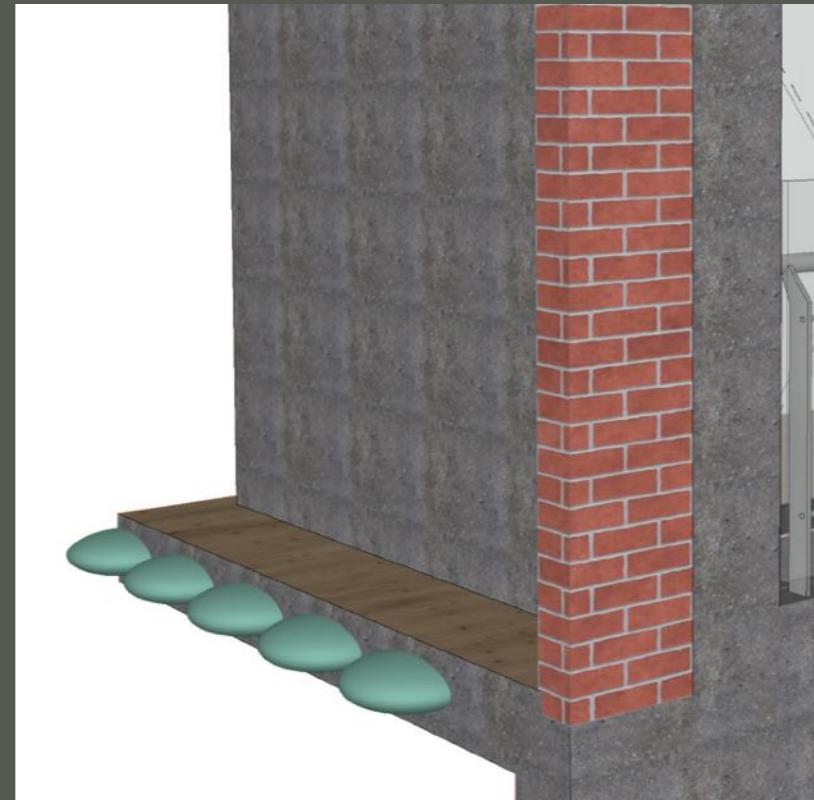
= 20.318.400 kg CO_{2eq}/year

= Bubble Deck, UBoot, Unidome

- up to 30% - 40% cement reduction in slabs, floors, foundations and basement walls.
- Higher stability and durability
- Less Building load (earth pressure)
- Faster construction



Concrete Frame Work



Source: RIM, Unidome

Source: <https://baustoffbeton.at/faq/wie-viel-co2-entsteht-durch-beton/>

Source: <https://gccassociation.org/sustainability-innovation/gnr-gcca-in-numbers/>

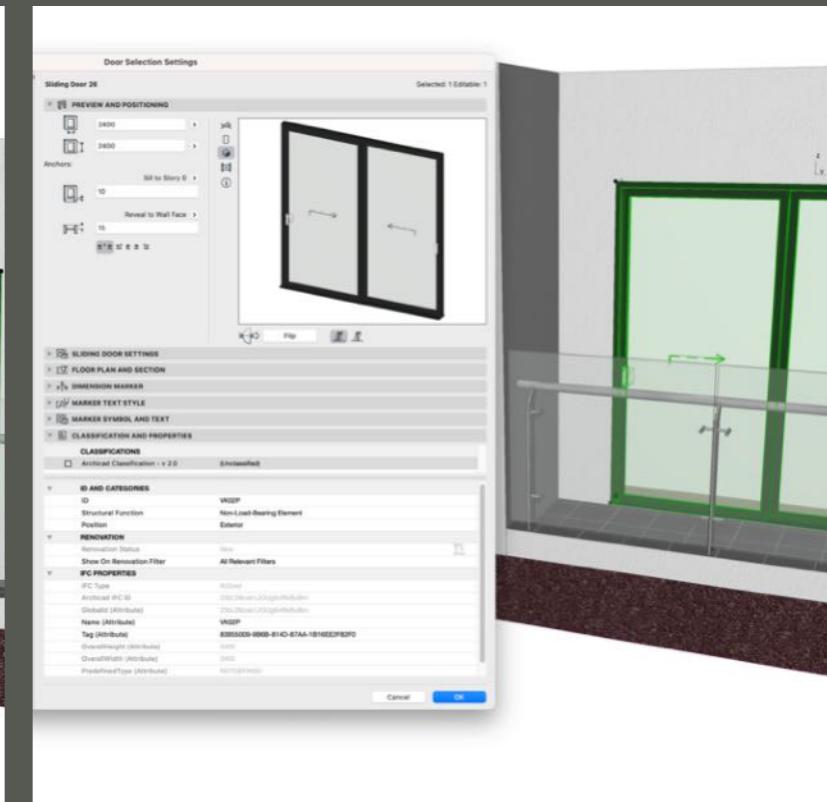
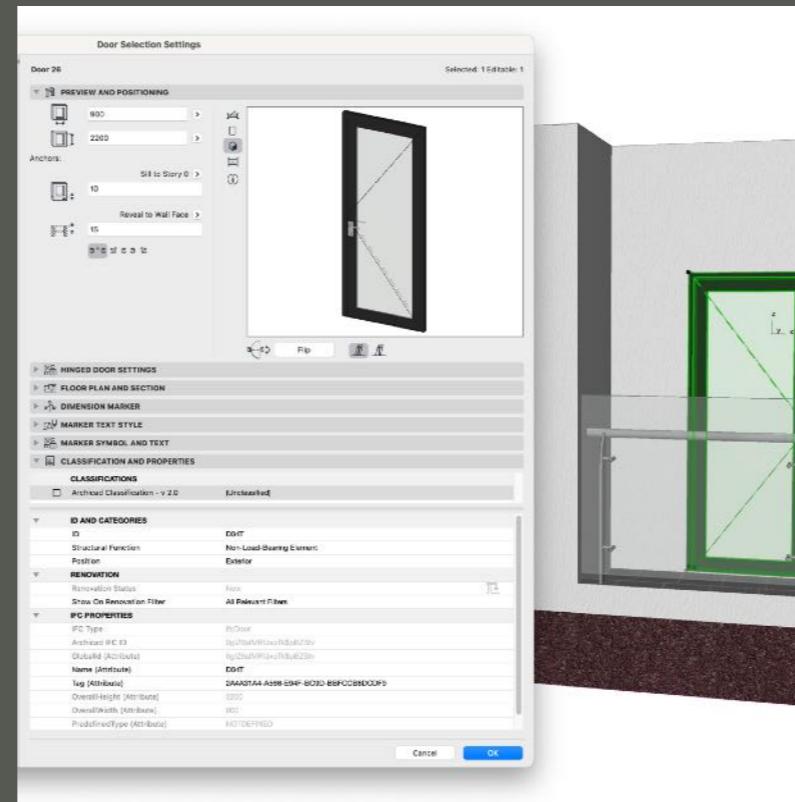
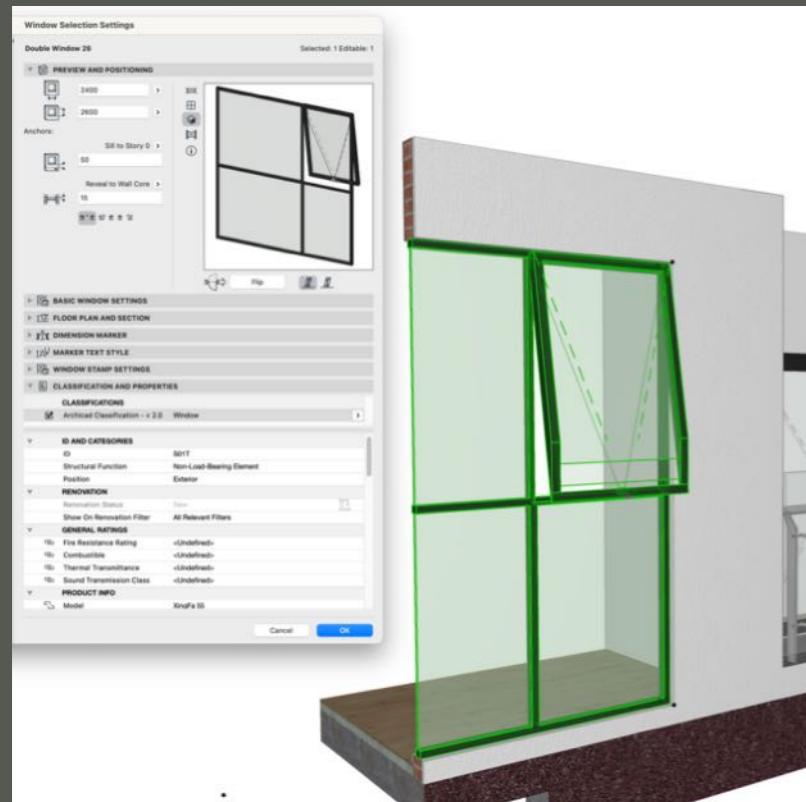
Source: <https://www.baunetzwissen.de/beton/fachwissen/herstellung/betonherstellung-und-klimaschutz-7229519>

Source: https://www.researchgate.net/publication/350823893_CO2_EMISSION_ASSESSMENT_FOR_RICE_HUSK_ASH_IN_CONCRETE_ON_ENVIRONMENTAL_APPROACH



WINDOWS & FRAMES

- Quantity: 1175 pcs.
- Window frame: Aluminium, dark grey, powder coated (Jotun Grey 1301), NOT insulated
- Glass: 2-layer 4mm Tempered Glass with film (Safety glass), total thickness 8,38 mm, NOT insulation glass
- Manufacturer Xing Fa (China)



Windows, Doors and Sliding Doors

Source: BIM Planung, RIM



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COOLING HVAC



**100T
LOAD**



**1540 UNITS
18.MIO KW/YEAR**



3,5KW Geräte / 18.000 - 24.000 BTU

Source: daikin.com



60KW outdoor unit

Source: midea.com



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WATER & HEATING



355T
LOAD

COOL WATER
WARM WATER
FIRE FIGHTING
DRINKING WATER

NO
RAIN WATER USAGE
GREY WATER USAGE



~ 500KW Heat Pump Water Heater

Source: RIM



Water tanks on roof

Source: RIM



SUA - HOLISTIC APPROACH - WHY?

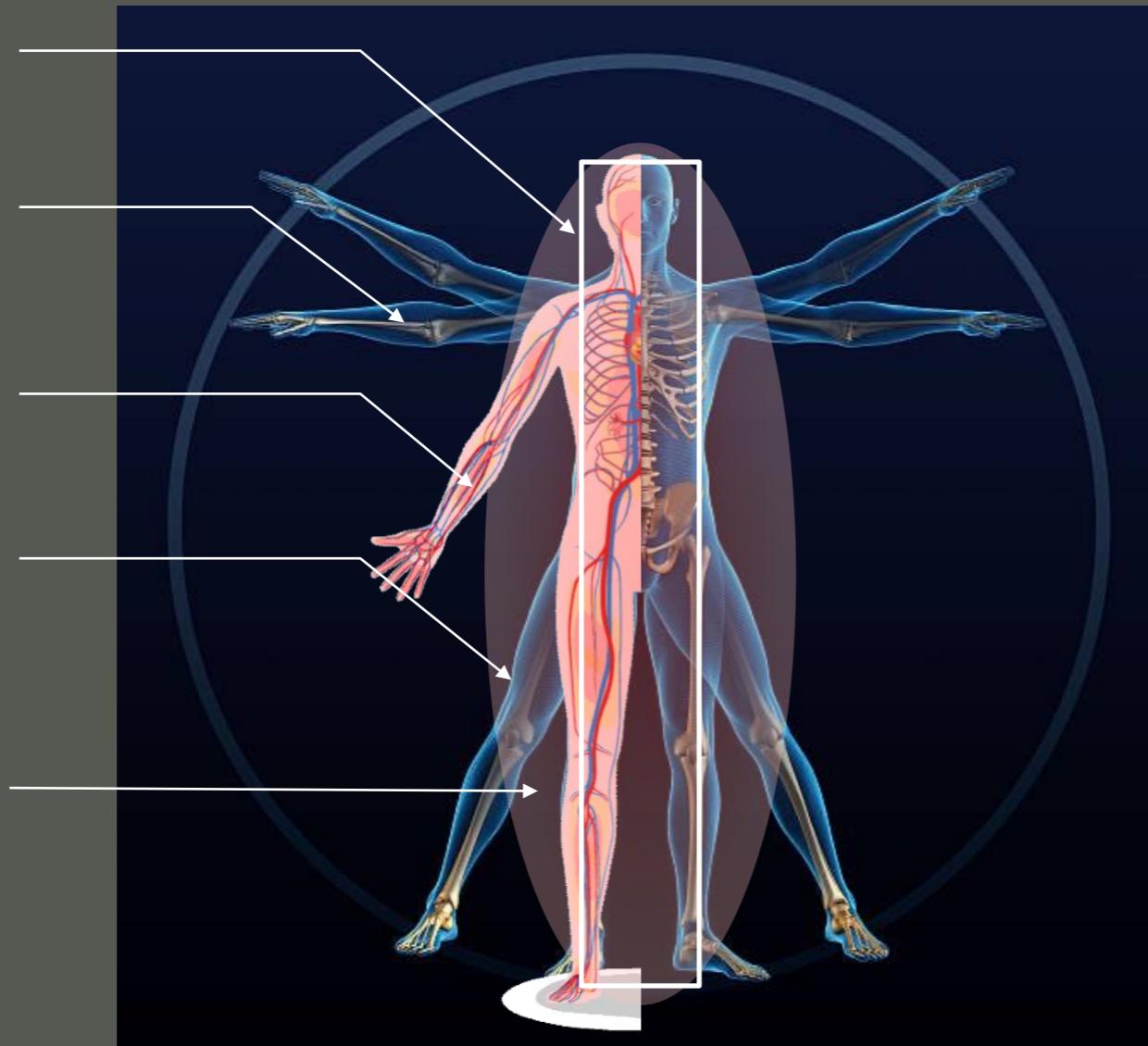
TONKIN 2

Skeleton System =
Reinforced Concrete

Vascular System =
WILO SE

Skin =
Building Envelope

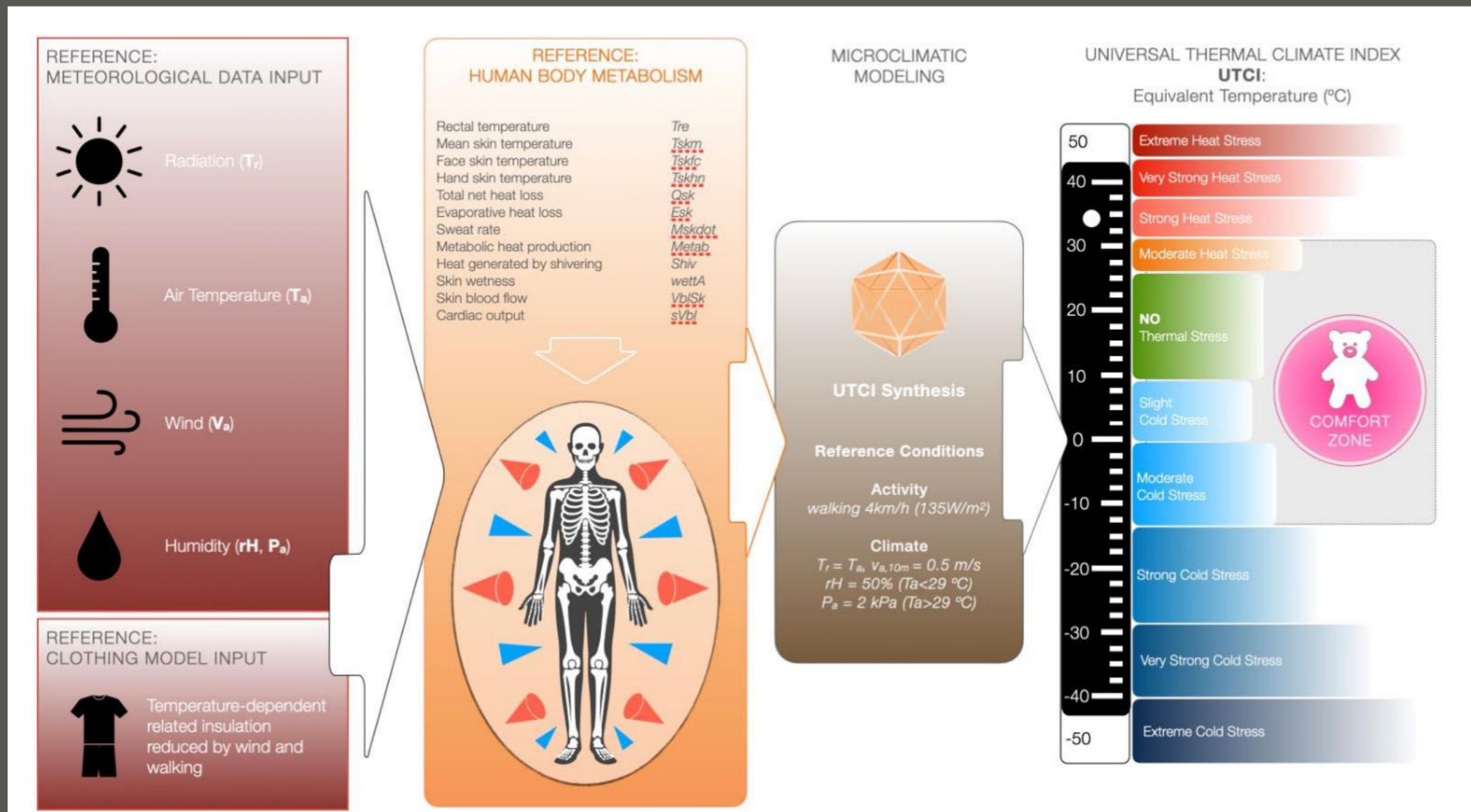
Micro Climate =
Comfort Zone



Source: Getty Images, St. Joseph Hospital

UNIVERSAL THERMAL CLIMATE INDEX

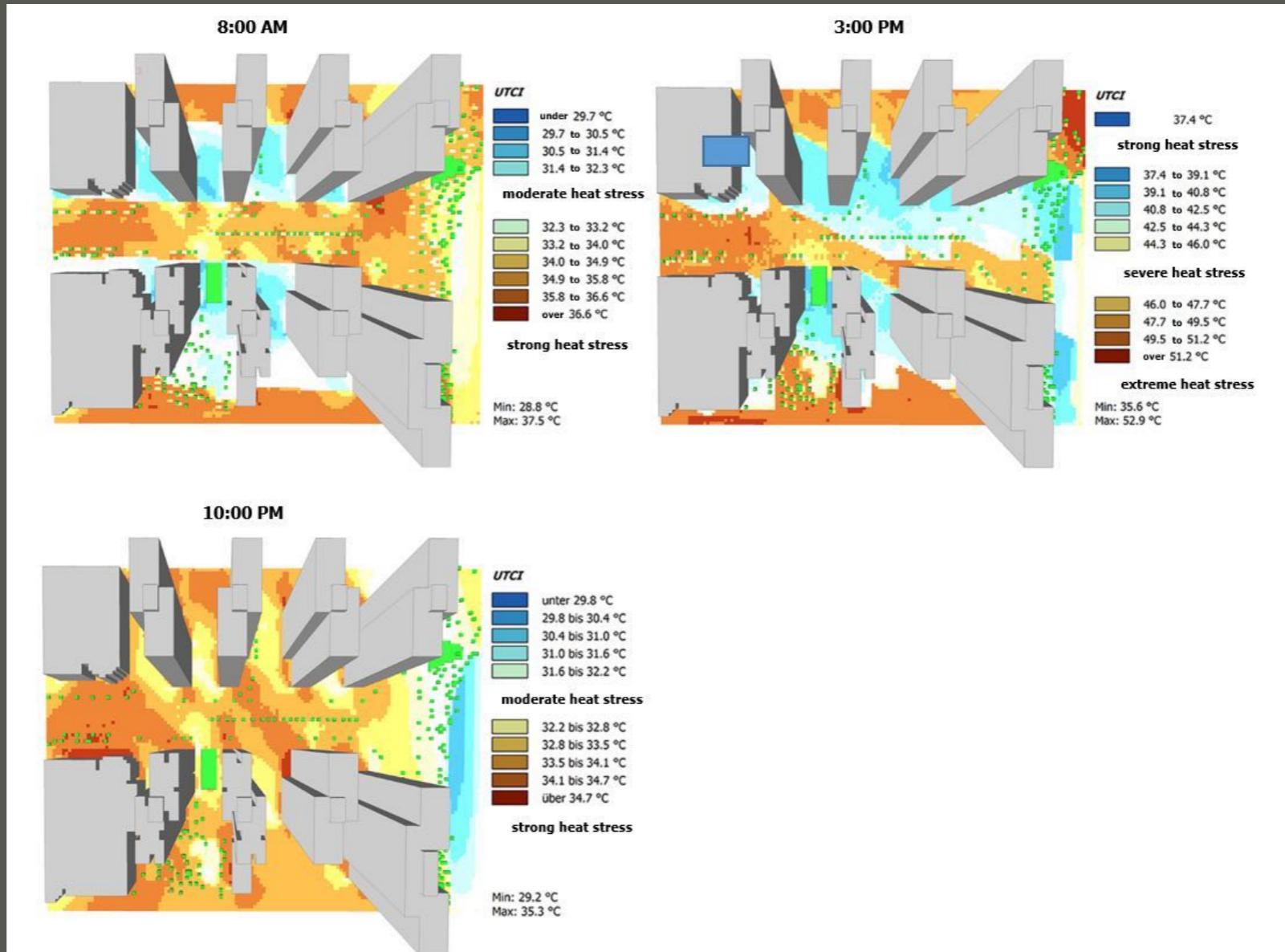
our thermal comfort, what is within the acceptable



Source: RIM

AMBIENT TEMPERATURE SIMULATIONS

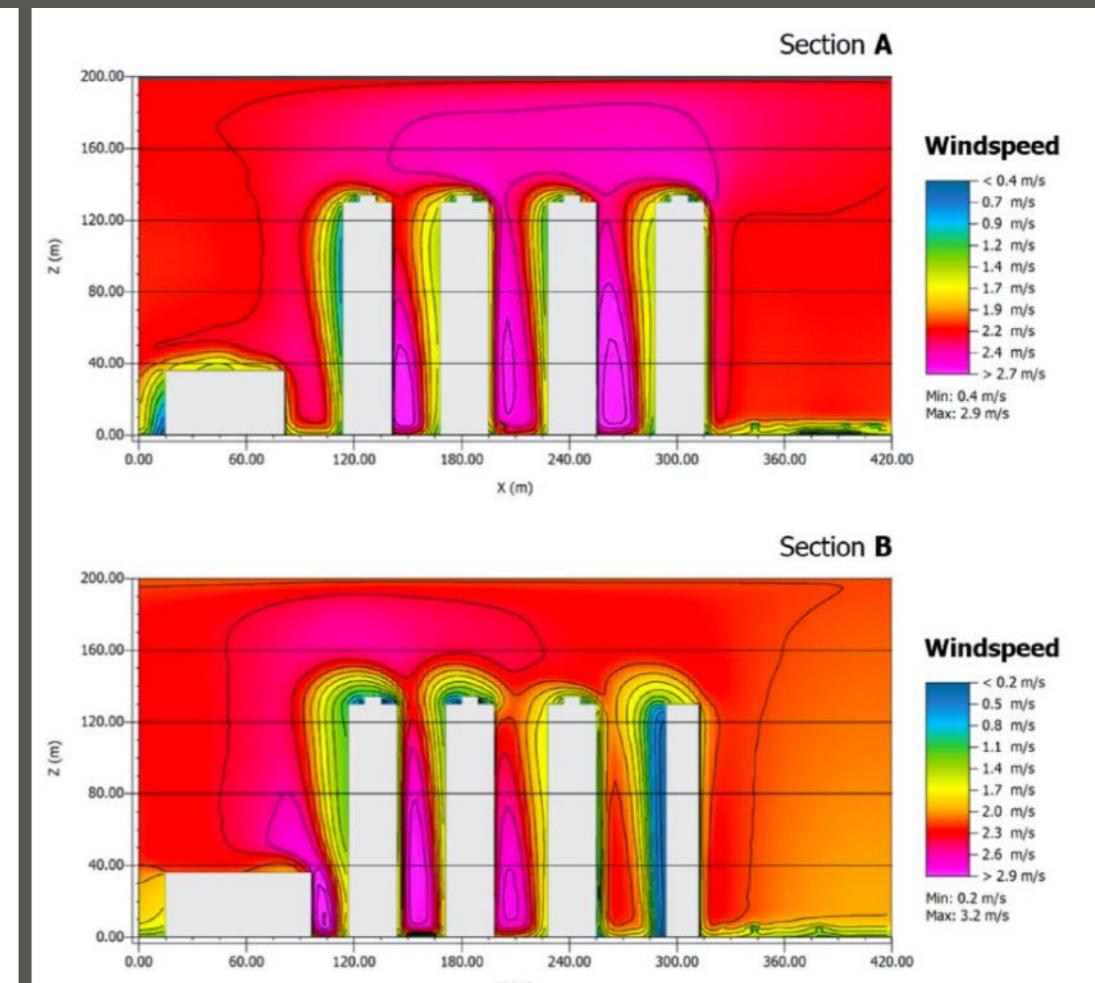
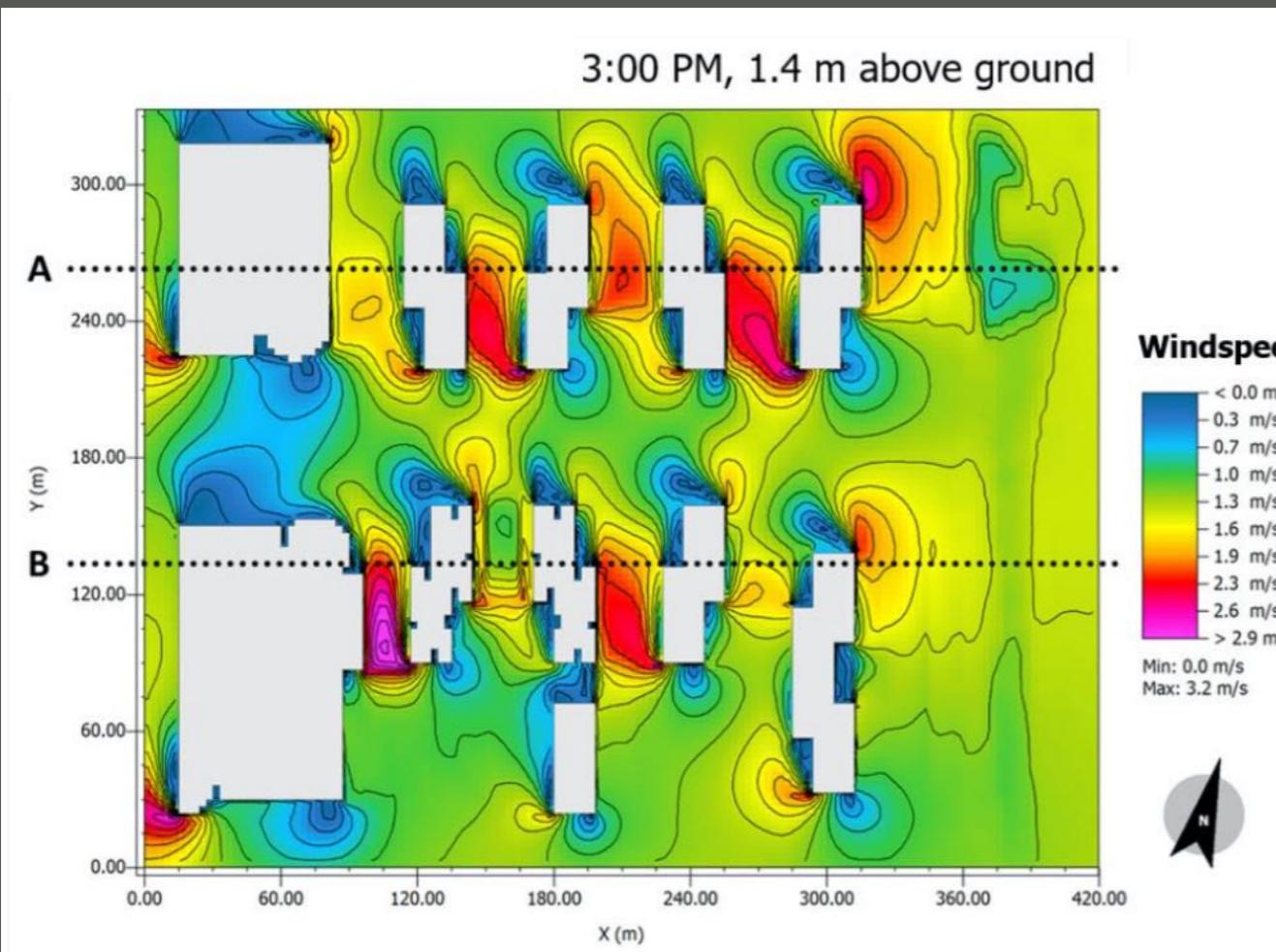
UTCI on 1,4 m above ground



Source: RIM

WIND SIMULATION

ENVI-met simulations 1.4 m and around research buildings



Source: RIM



SCENARIOS - WHAT IF...

Three scenarios designed on feasibility

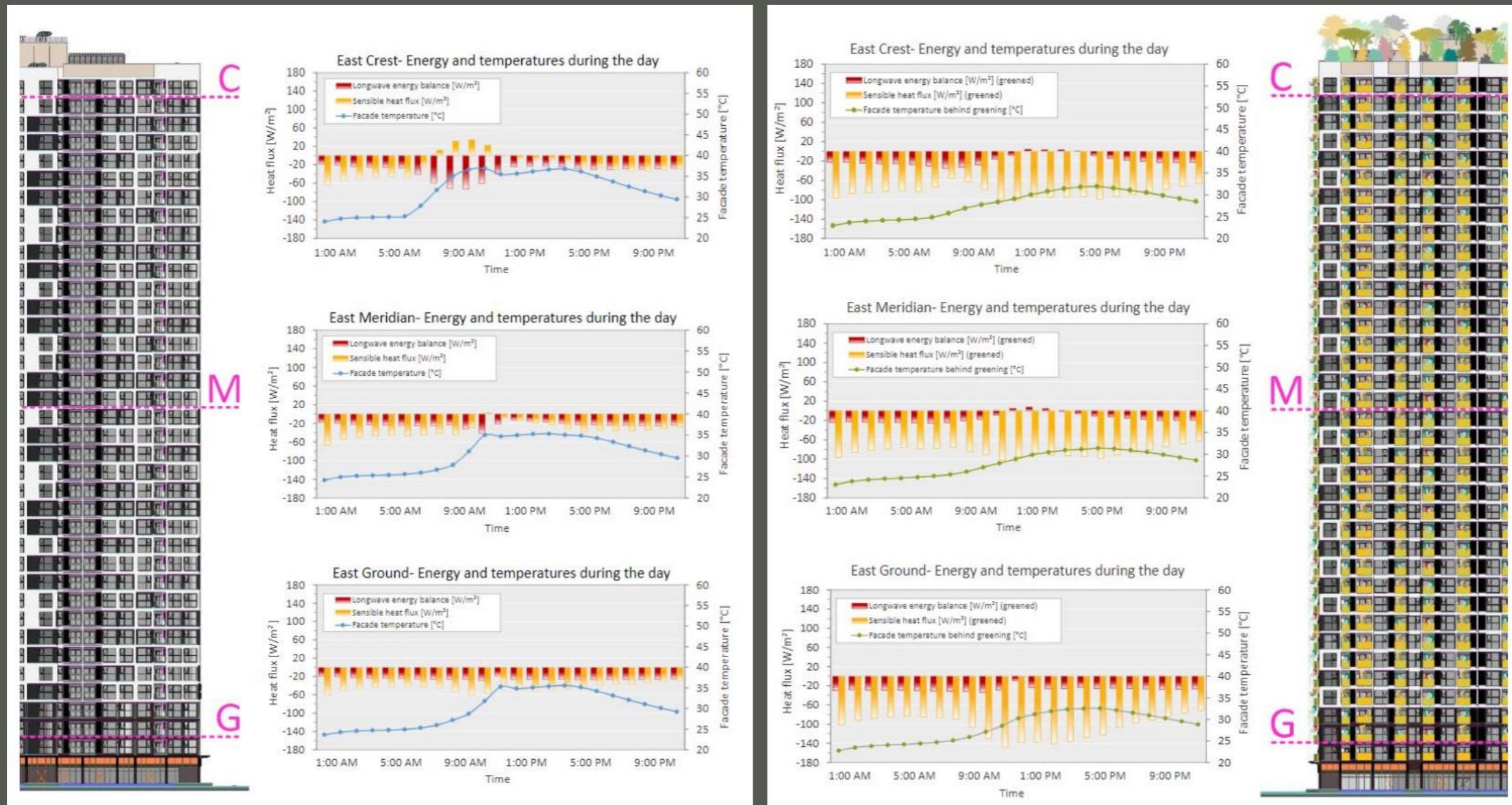


Source: RIM



ENERGY AND TEMPERATURE

climate simulations on three level at the facade (Ground, Meridian, Crest)

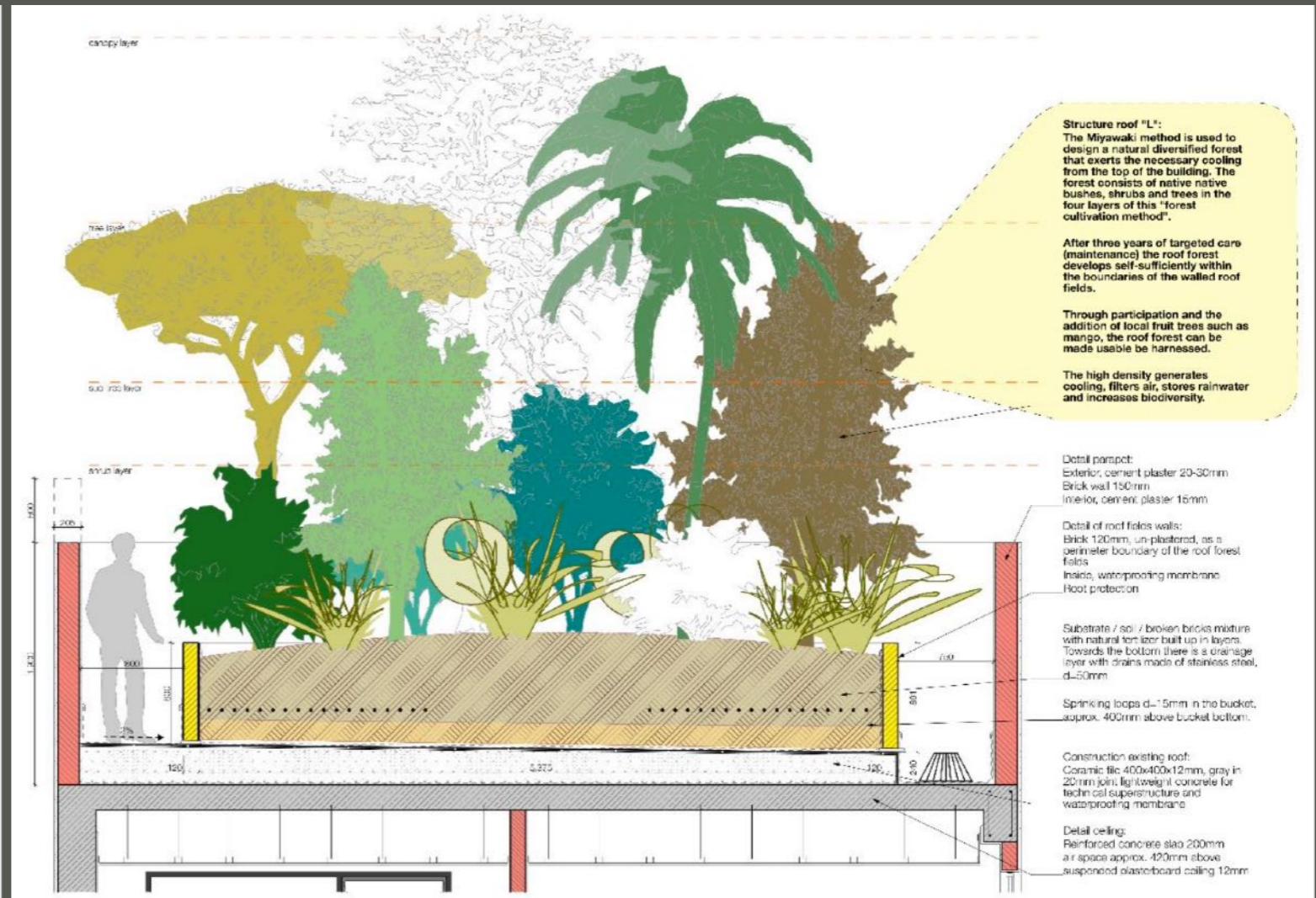
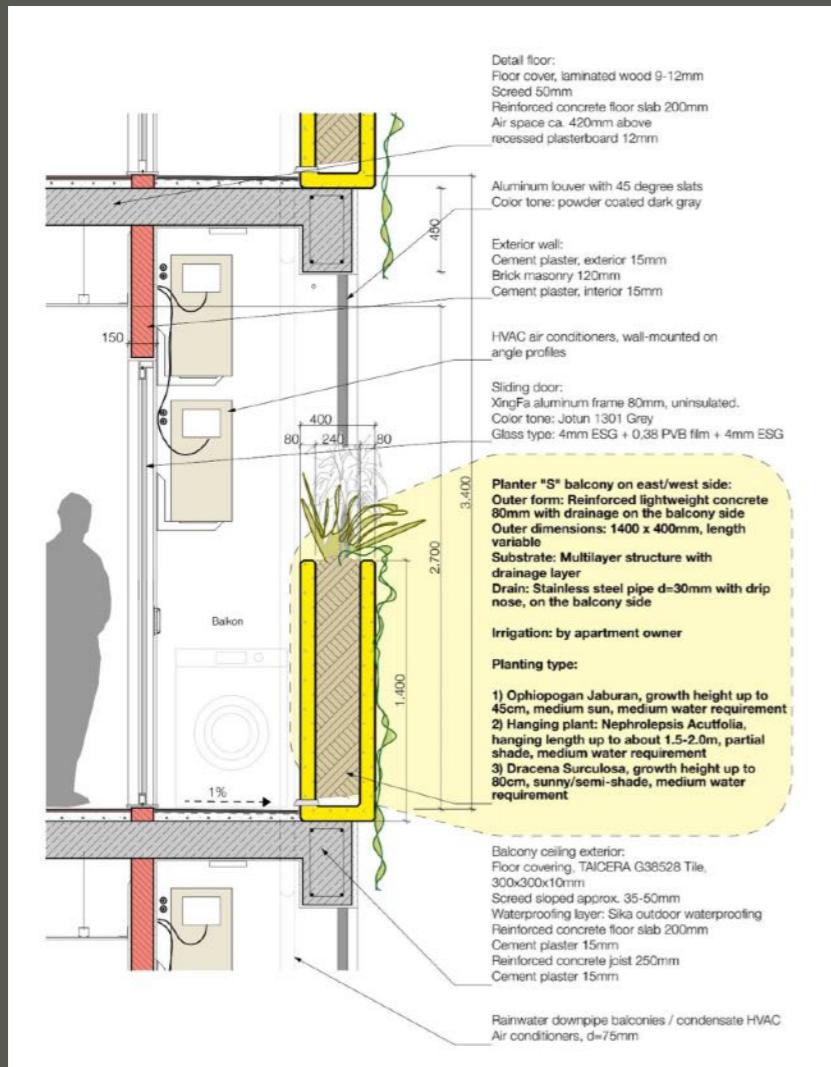


Source: RIM



SHADING SOLUTIONS FOR COOLING

What can be replaced? Where shading does make sense?



Source: RIM



2024 YEAR OF MAKING

TestBed 01 - Planning & Engineering

The collage consists of several panels of technical documentation:

- Top Left:** Aerial views of a building with extensive green roofs and walls, labeled "Greening CEMM Building Scenario".
- Top Middle:** Floor plans for the 1st Floor, 2nd Floor Reference Balconies, 3rd Floor CEMM Test Floor 1, 4th Floor CEMM Test Floor 2, and a "Roof Top CEMM Test Floor 3 (optional)".
- Top Right:** A detailed "S-01 Facade Section" diagram showing a multi-story building's exterior with various components labeled.
- Middle Left:** An "Irrigation System - schematic / Hệ thống tưới - sơ đồ" diagram showing a network of planter rings (A, B, C) connected to a central pump and valves.
- Middle Center:** A "Plant System - minimum requirement - schematic / Hệ thống nhà máy - yêu cầu tối thiểu sơ đồ" table listing plant types and their requirements.
- Middle Right:** A "Sensor System - schematic / Hệ thống cảm biến - sơ đồ" diagram showing a weather station on the roof and sensors on a balcony.
- Bottom Left:** A detailed "Irrigation System - schematic / Hệ thống tưới - sơ đồ" diagram with specific component labels like T1, T2, and C1.
- Bottom Center:** A "Plant pots A, B, C / Chậu cây A, B, C" table with images of Bushy Bamboo (B), Bush & Shrub (A), and Hanging & Creepers (C).
- Bottom Right:** A "Sensor System - schematic / Hệ thống cảm biến - sơ đồ" diagram with specific component labels like LS, Q5, WoS, and WoB.

Source: RIM



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TestBed 01 - Pilot Green Roof and Facade



Source: RIM



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TestBed 01 - Automated Irrigation System + DAVIS Weather station

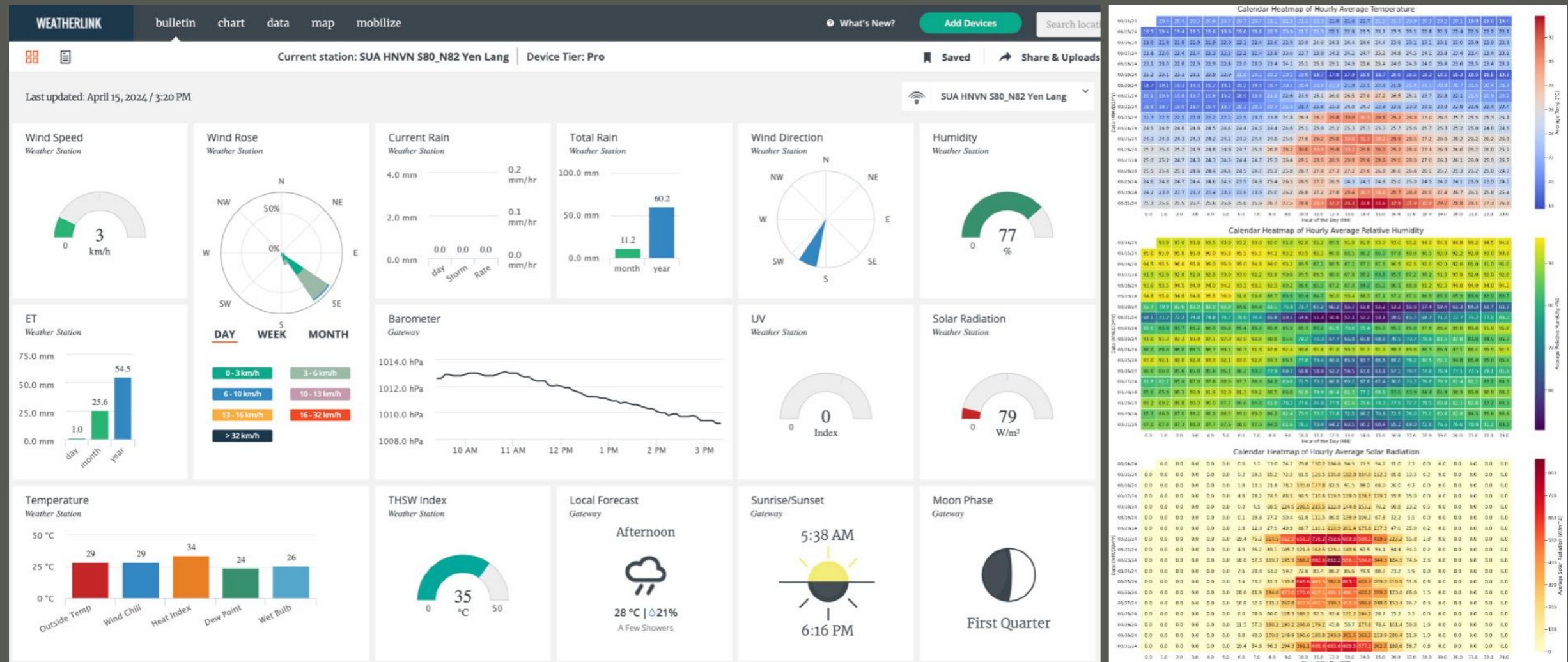


Source: RIM



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TestBed 01 - DAVIS Weather station - data mining



Source: RIM



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TONKIN 2 - LoRaWAN System of 26 sensors for relative air humidity & temperature



Source: RIM

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THANK YOU!

