Advancing Net Zero Carbon
Architecture + Community

Existing Building Category
Oxford House

Approach to Sustainable Development Goals

By understanding the meaning behind each UNSDG, different groups of the goals were being approached and achieved in various ways.

Theme 1
Zero Carbon and
Ultra-Energy Efficient

- Air Improvement PV
- Thermal Crete on mullion
- Dynamic External Shading
- Operable Windows
- Free Cooling
- Stormwater AirCon

Theme 2
Embodied Carbon
Reduction

- Ultra-lightweight Green roof
- Bio-diesel tri-generation system
- Under-floor air supply
- Solar Thermal Hot Water System

Theme 3
Healthy and
Sustainable

- Air Improvement PV
- Solar IAQ
- Daylight Autonomy
- Operable Windows
- High-volume low speed fan
- under-floor air supply
- Displacement ventilation
- Biophilic Design

Advancing Net Zero | Sustainable Design Approach

The Existing measured energy performance 131.9 and 72.3 kWh/m²/yr for whole building and landlord respectively

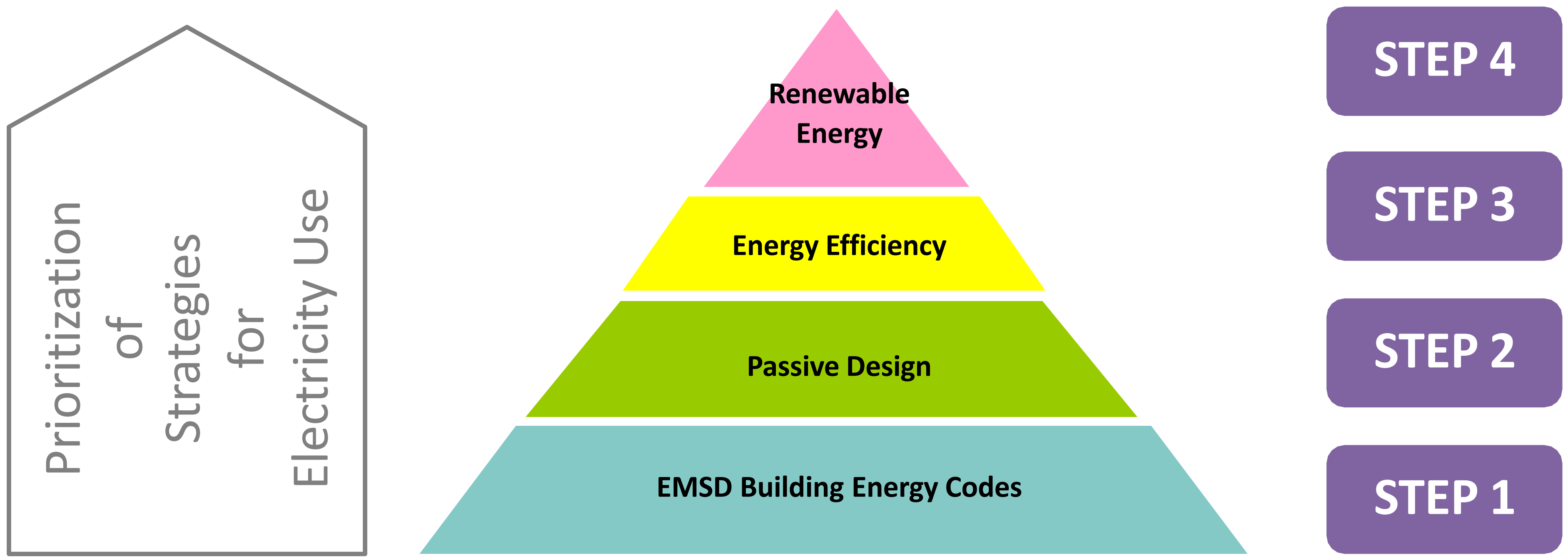
a **targeted EUI (kWh/m²/yr) beyond 127 and 66** for whole building and landlord respectively
and to strive for super low energy building performance

Theme 1
Zero Carbon and
Ultra-Energy Efficient

Theme 2
Embodied Carbon
Reduction

Theme 3
Healthy and
Sustainable

Carbon Neutral : Renewables + Carbon Capture **-** Electricity use x HK EF 0.7 kgCO2e/kWh **-** Embodied CO2 transport + materials + processes **= 0**



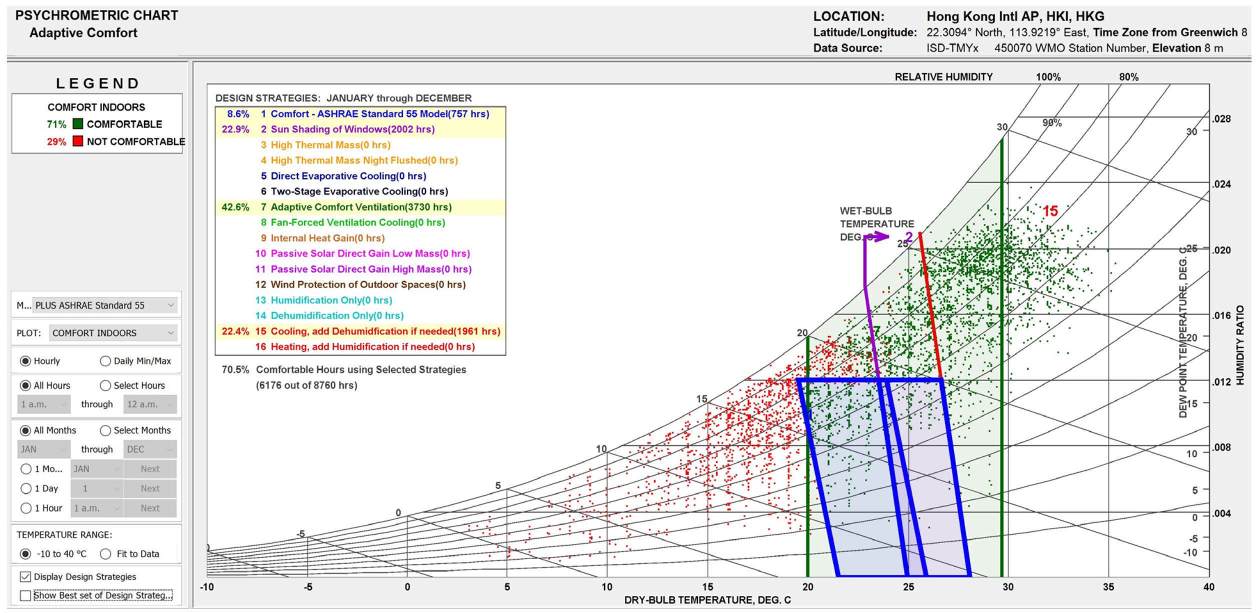
Advancing Net Zero | Target EUI

The Existing measured energy performance 131.9 and 72.3 kWh/m²/yr for whole building and landlord respectively

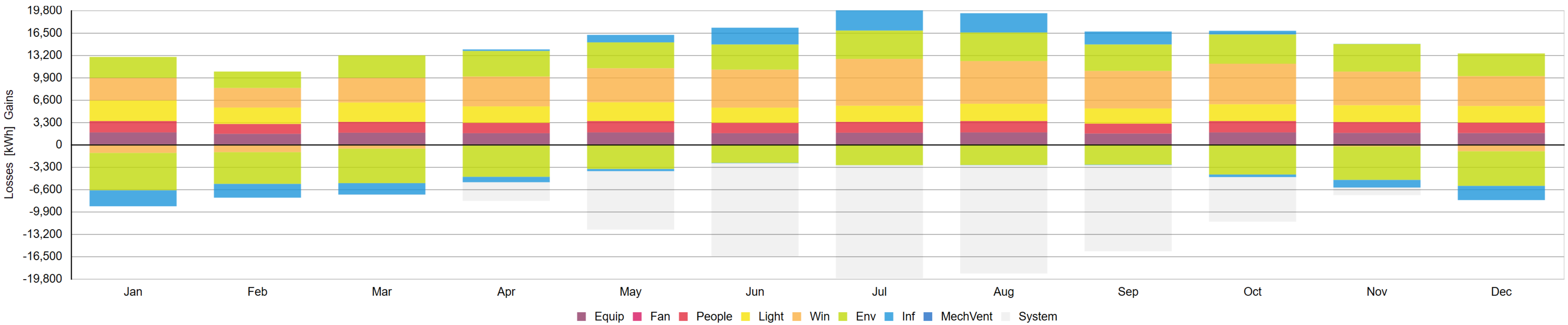
a **targeted EUI (kWh/m²/yr) beyond 127 and 66** for whole building and landlord respectively
and to strive for super low energy building performance

Theme 1	Theme 2	Theme 3
Zero Carbon and Ultra-Energy Efficient	Embodied Carbon Reduction	Healthy and Sustainable

66	46.2	74
Site EUI [kWh/m2/yr]	Op. Carbon [kgCO2/m2/yr]	Energy Cost [$/m2/yr]



Energy Flows Breakdown



Master Plan

PASSIVE DESIGN STRATEGIES

Weather Monitoring
Monitor the instant weather for instant response of façade on indoor thermal comfort

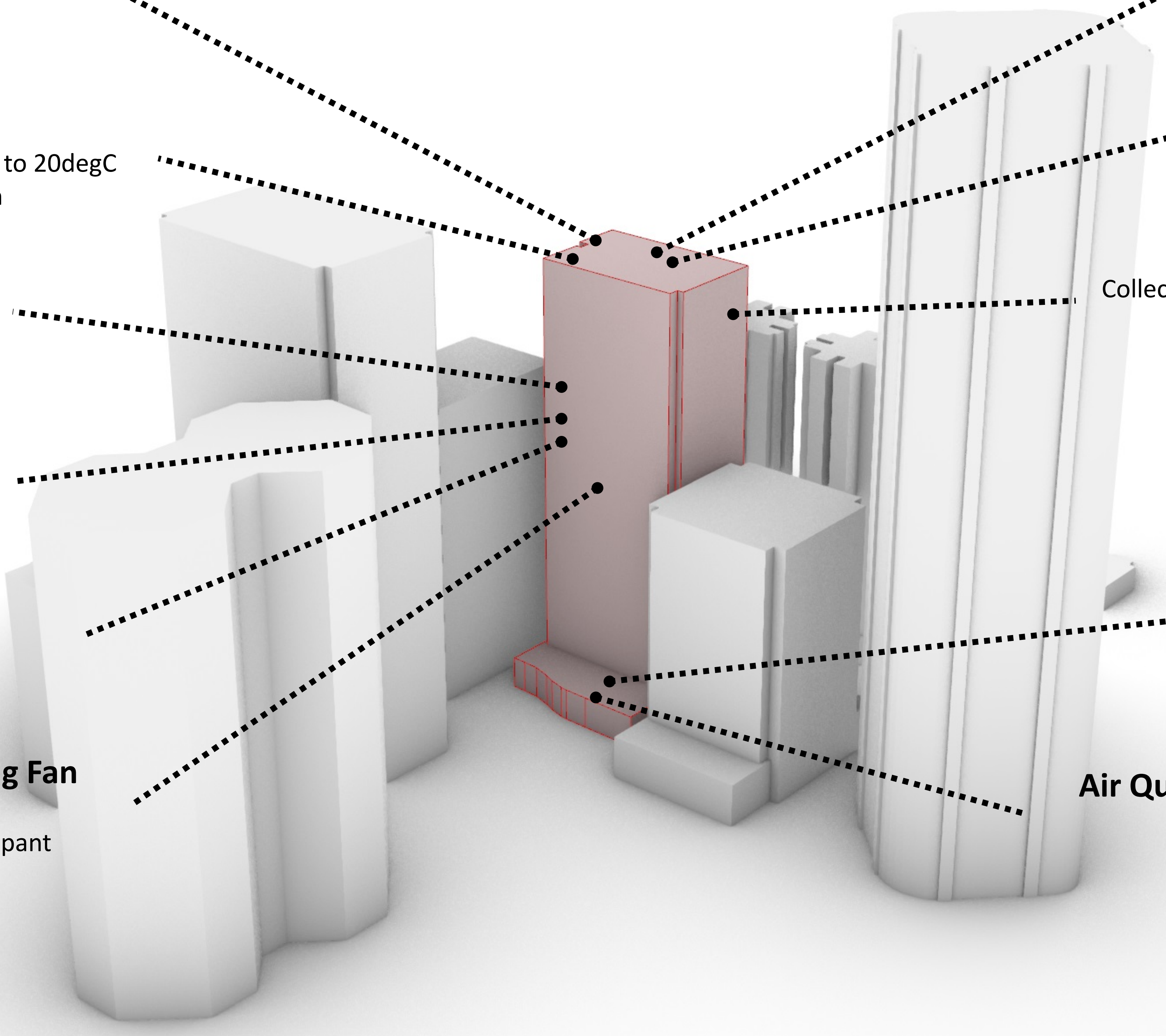
Ultra-lightweight Green Roof
Achieve a temperature reduction of up to 20degC
Higher water absorbency and retention

Light Shelves
Reflect daylight into deeper space

Dynamic External Shading
Block excess solar heat
Specific to different orientations
Track the solar positions

Operable Windows
Allows natural ventilation manually
Shift in occupant behavior / dress code

High Volume Low Speed Ceiling Fan
Enhance ventilation
Manually and locally controlled by occupant



ENERGY-EFFICIENCY / CARBON REDUCTION

Free Cooling
Make use of air temperature to assist in chilling water

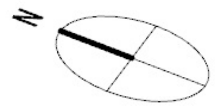
Bio-diesel
Deploy tri-generation system making use of waste to generate energy

Solar Thermal Hot Water
Collect Solar Energy to heat up water for building use
Installed on south side of the east façade
And top part of the south facade

HUMAN HEALTH

Air Improvement Photovoltaic
Generate renewable energy
Purifies and improves air quality

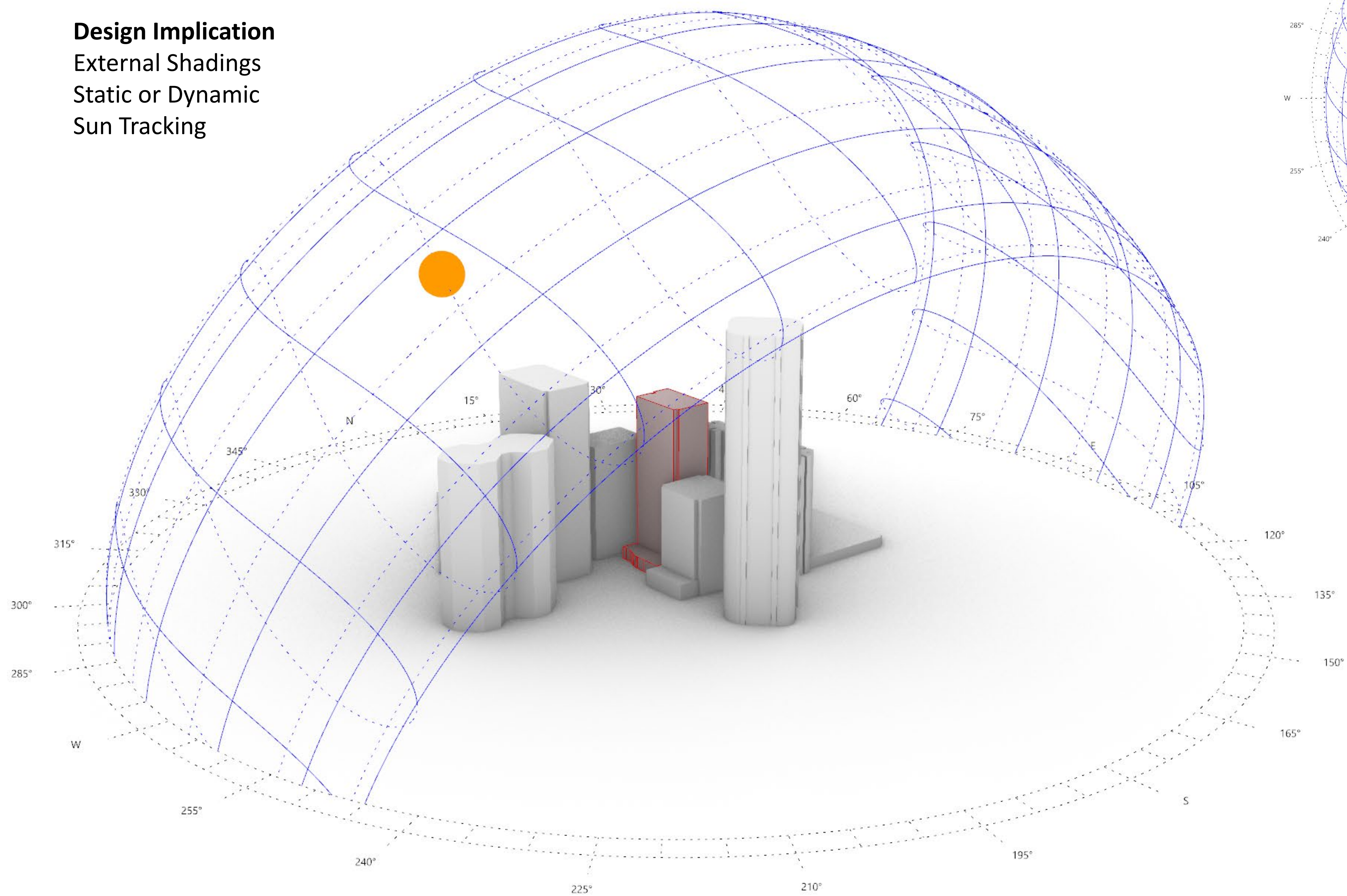
Solar IAQ Coating AQHI
Air Quality & Health Improvement System
kills viruses, bacteria, fungi, and spores
Eliminate hazardous particles
Decompose and eliminate VOCs



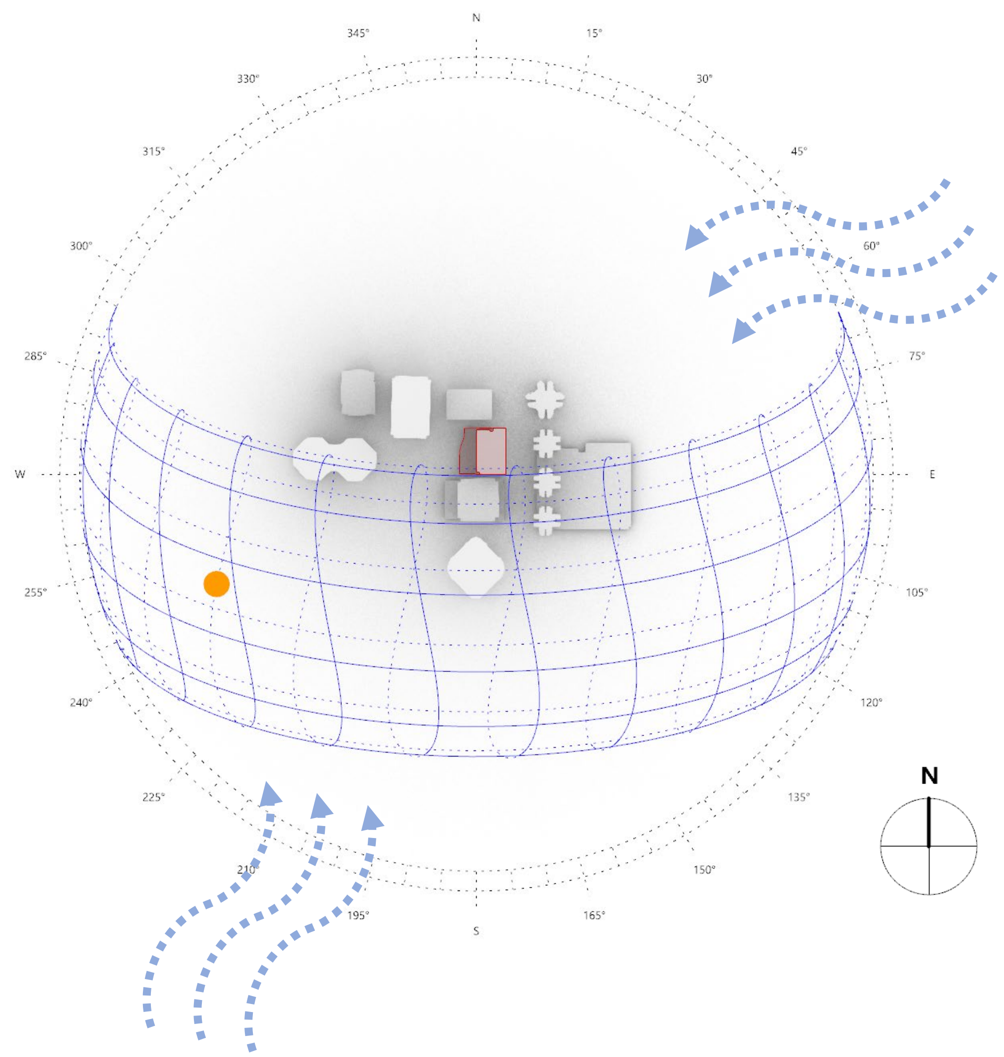
Site Analysis | Sun Path Diagram + Prevailing Wind

Solar Position
Fall Equinox | 21 Sept
0300 pm

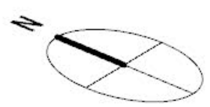
Design Implication
External Shadings
Static or Dynamic
Sun Tracking



Prevailing Wind
Easterly Wind
(Annual / Winter / Summer)



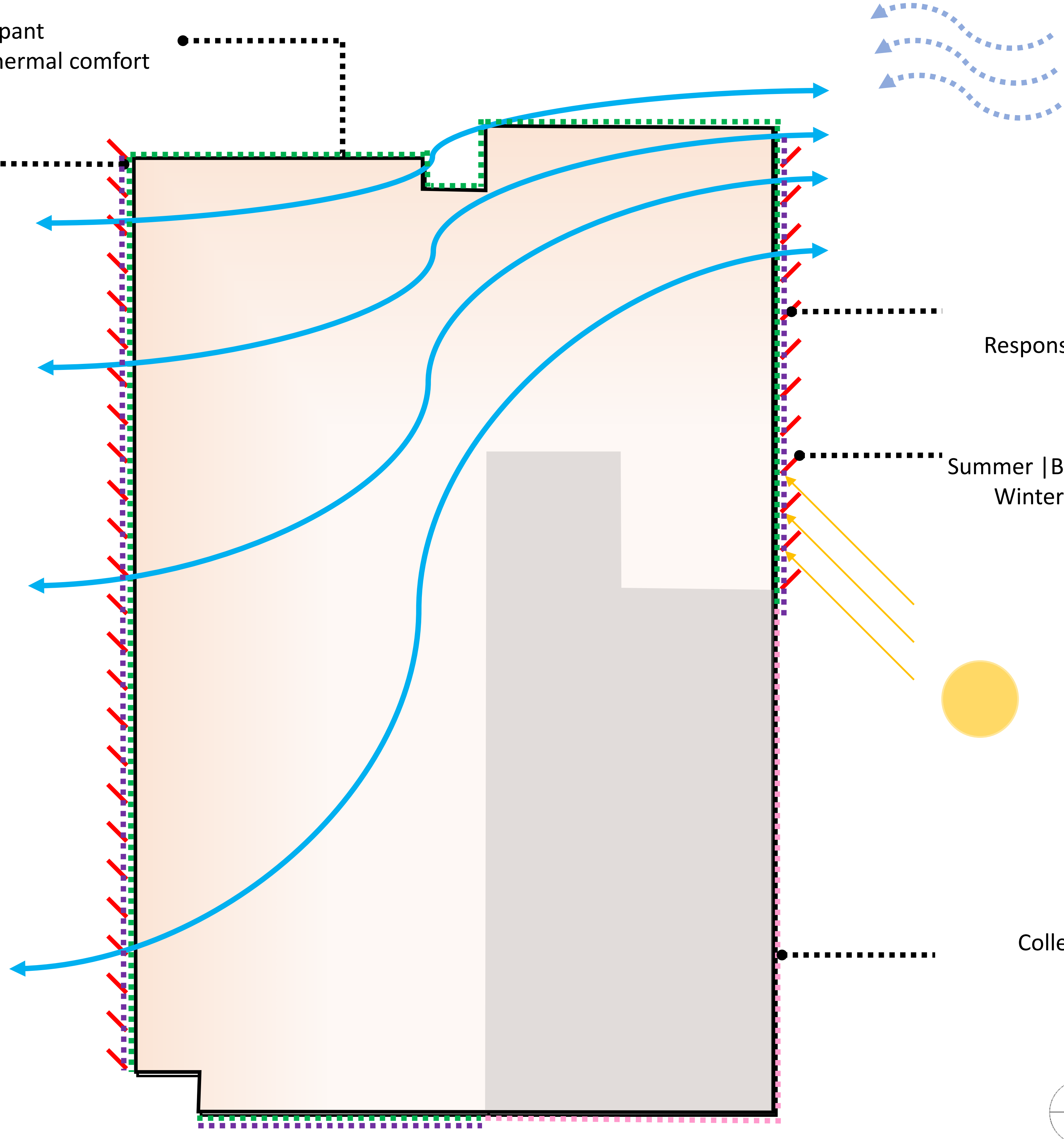
Prevailing Wind
Southeasterly Wind (Summer)



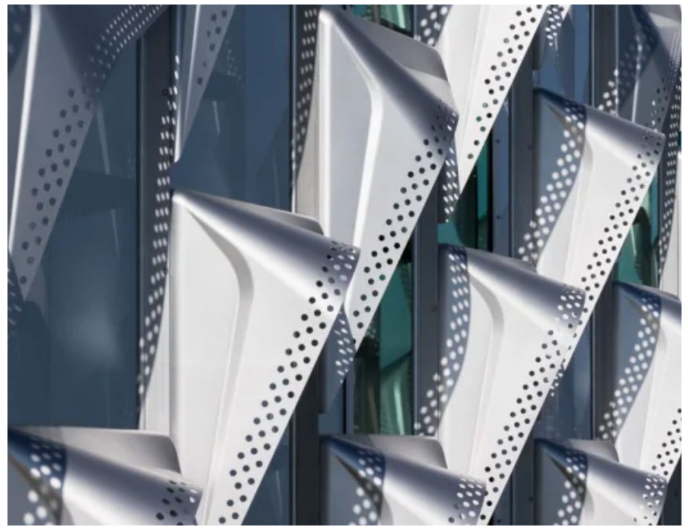
Schematic Plan | Typical Floor

Operable Window
Operable locally and manually by occupant
Optimize airflow for indoor adaptive thermal comfort

Light Shelves
Reflect daylight into deeper space

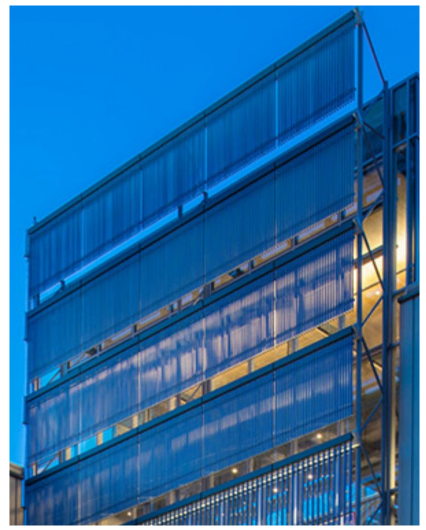


Prevailing Wind
Easterly Wind
(Annual / Winter / Summer)

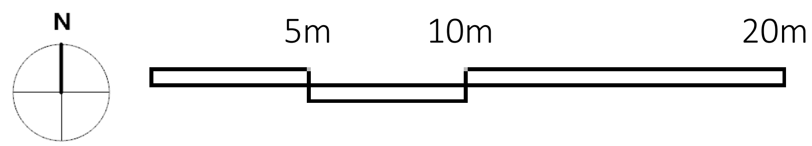


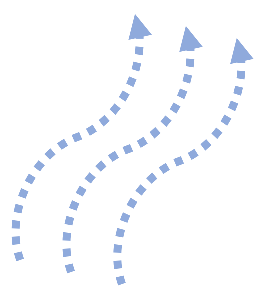
Wind Wall (also Shading)
Operable locally and manually by occupant
Optimize airflow for indoor thermal comfort
Response to weather monitoring, occupant sensor and smartphone

Dynamic External Shading
Summer |Block the Direct Solar Heat Gain if Cooling mode
Winter | wide open to the Solar Heat if Heating mode



Solar Thermal Hot Water System
Collect Solar Energy to heat up water for building use
Installed on south side of the east façade
And top part of the south facade



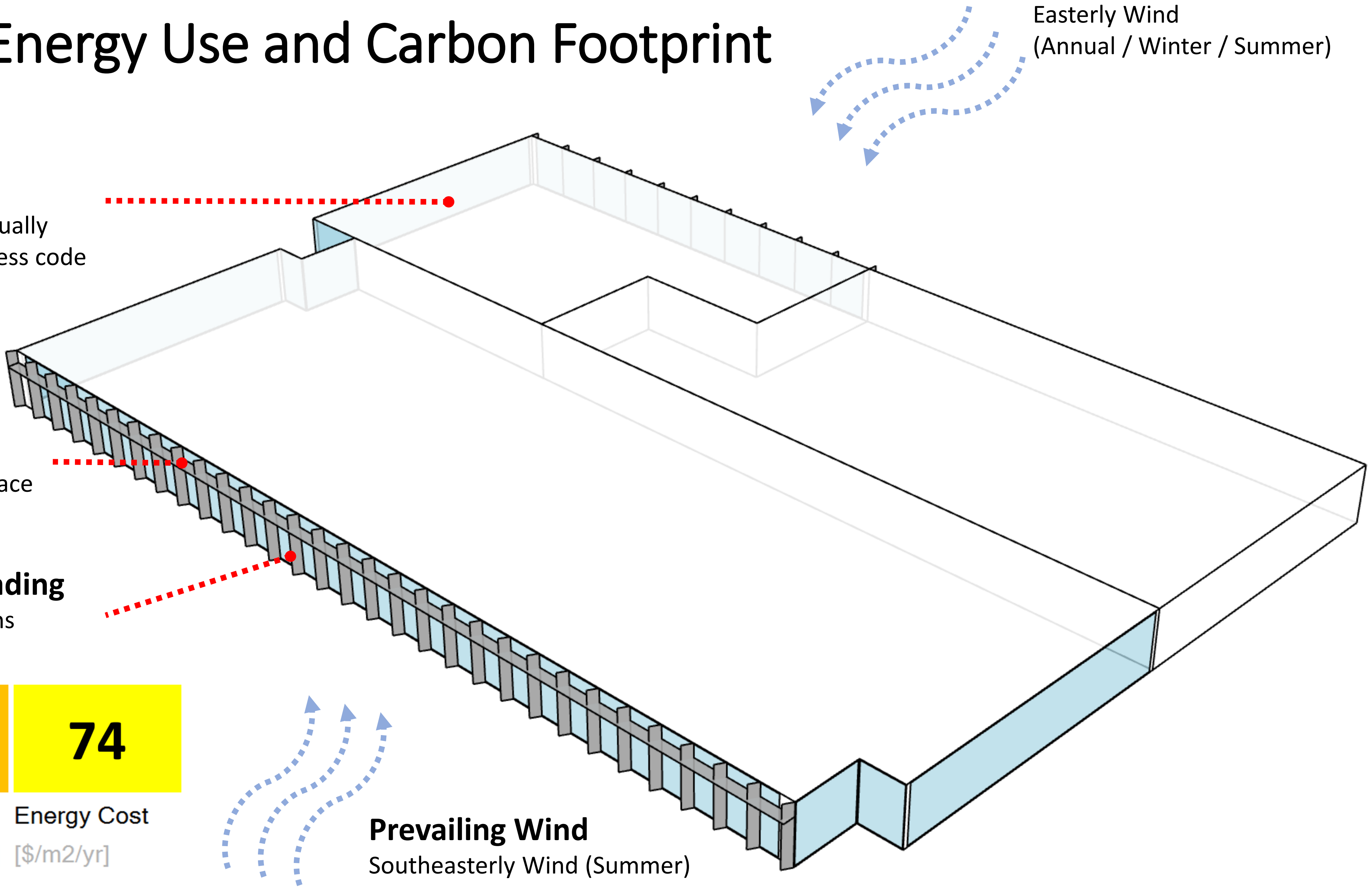


Prevailing Wind
Southeasterly Wind (Summer)

Monitoring Energy Use and Carbon Footprint

Prevailing Wind
Easterly Wind
(Annual / Winter / Summer)

Operable Windows for Natural Ventilation
Allows natural ventilation manually
Shift in occupant behavior / dress code

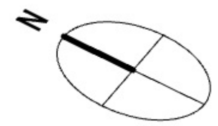


Light Shelves
Reflect daylight into deeper space

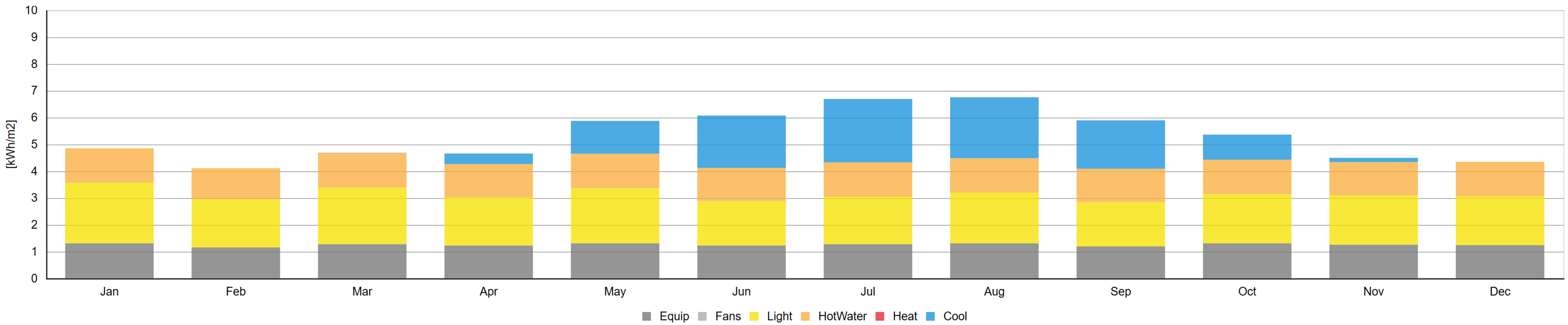
External / Operable Shading
Specific to different orientations
Track the solar positions

66	46.2	74
Site EUI [kWh/m2/yr]	Op. Carbon [kgCO2/m2/yr]	Energy Cost [$/m2/yr]

Prevailing Wind
Southeasterly Wind (Summer)

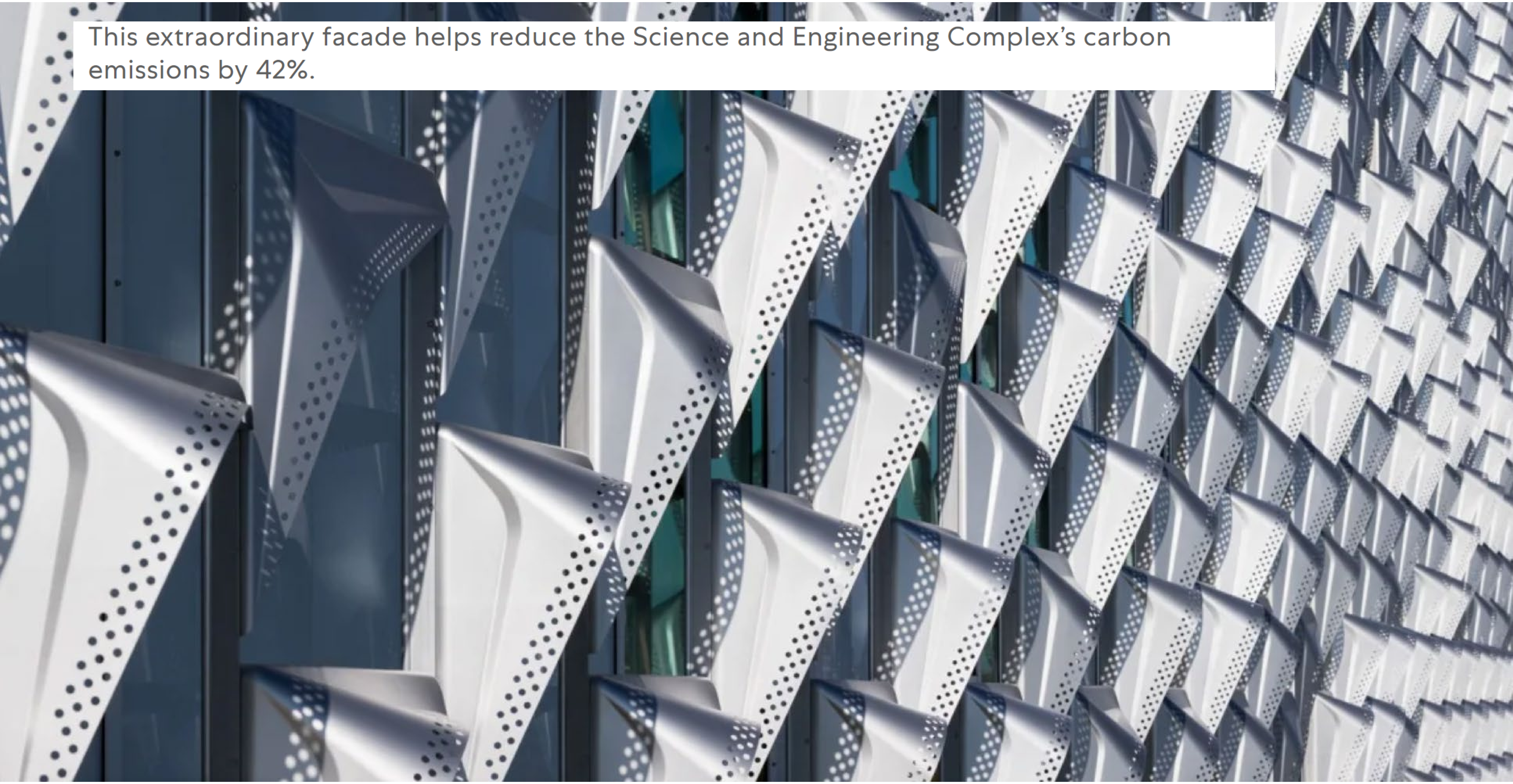


Energy Use Intensity



External Shading

Block the heat from summer sun and allow it in winter



This extraordinary facade helps reduce the Science and Engineering Complex's carbon emissions by 42%.

new Science and Engineering Complex at Harvard University

Photo | courtesy Behnisch Architekten

https://www.fastcompany.com/90639278/it-looks-like-a-cheese-grater-but-this-new-harvard-building-has-environmental-superpowers.

SPF Thermal Insulation on Mullion | Low Global Warming Potential

- **Low GWP SPF** | Low Global Warming Potential Formulation
  | Spray Polyurethane Foam

- **Higher Thermal Insulation** | to fill and insulate large voids and surfaces
  | Application to metal buildings
  | Application to mullion filling

- **Continuous air barrier** | complete air tight | stopped unwanted air infiltration

Application to metal buildings

Application to mullion filling

LOW GWP

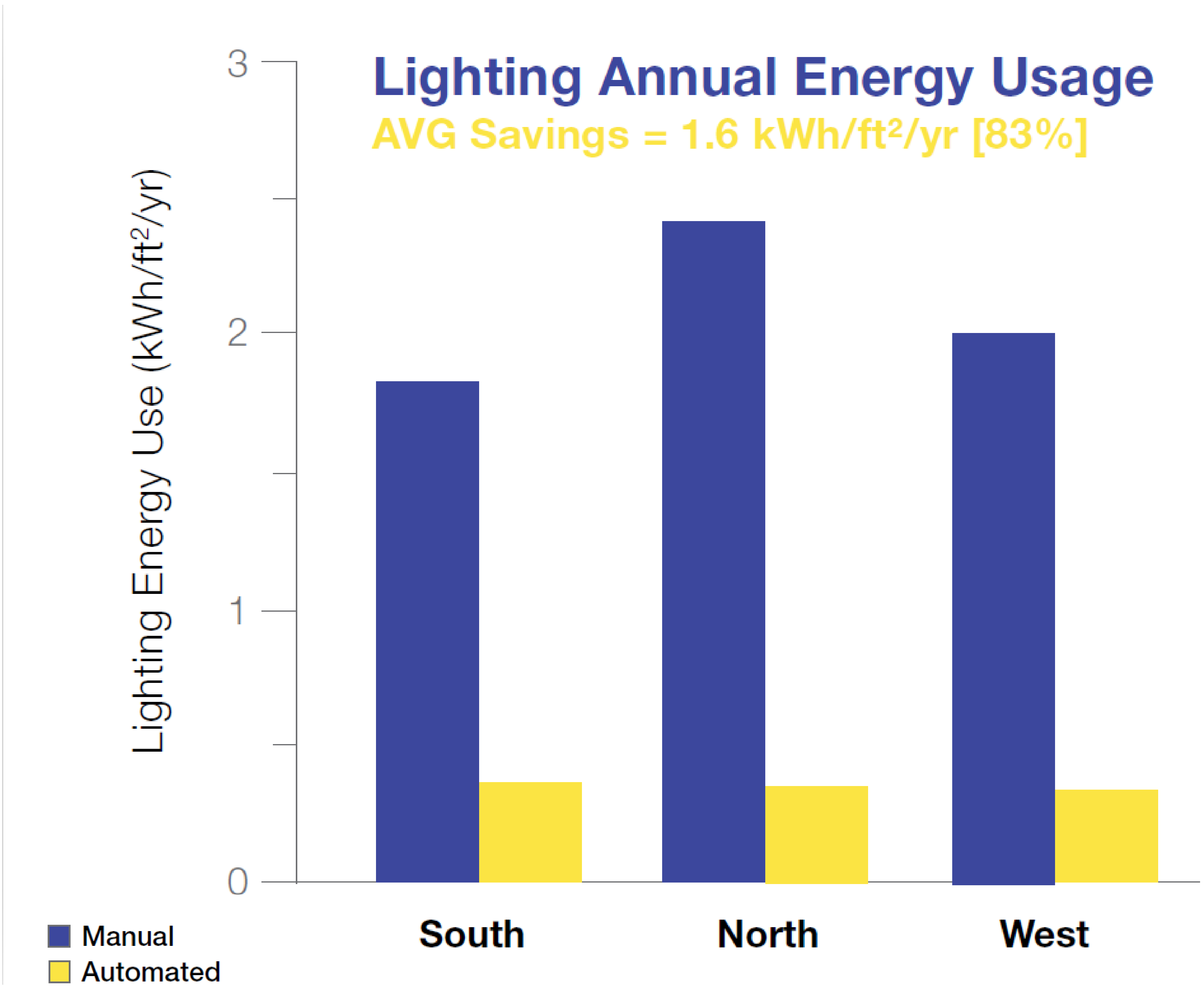
DEVELOPED WITH A
LOW GWP BLOWING AGENT

https://www.handifoam.com/product/handifoam-e84-hfo/

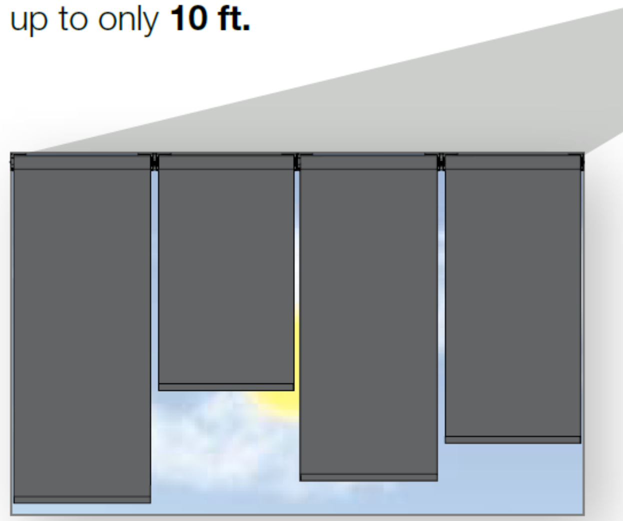
https://www.handifoam.com/markets-solutions/commercial-industrial/

Low / Zero Carbon Tech | Automated Shade

Reduce daytime lighting energy use by through the use of automated shades **65%**

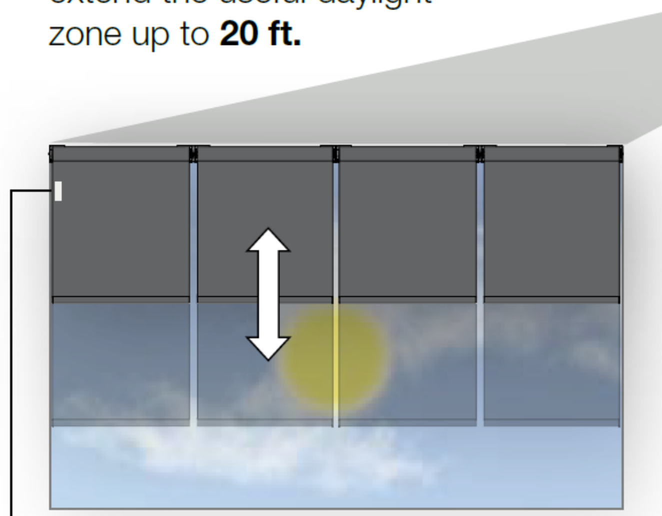


Manual shades provide a useful daylight zone up to only **10 ft.**



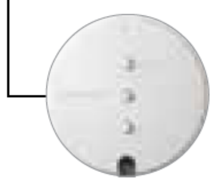
Manual shades are rarely adjusted and are usually misaligned, diminishing their effectiveness.

extend the useful daylight zone up to **20 ft.**



Sensor adjusts automated shades according to daylight conditions.

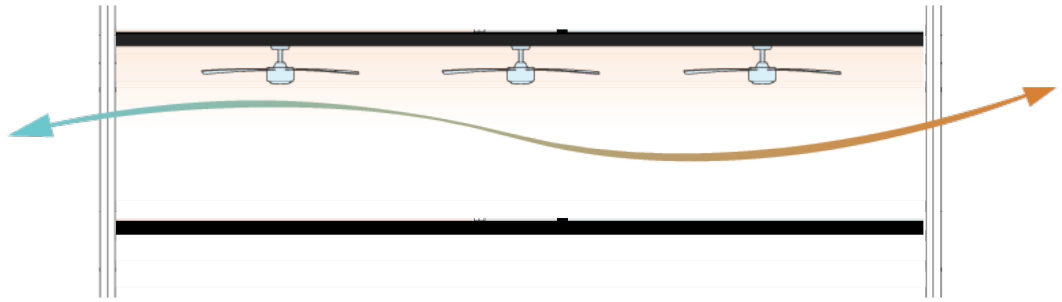
Maximizes useful daylight entering a space, reducing electric light usage.



Wireless window sensor (discreet mullion mount)

https://www.lutron.com/TechnicalDocumentLibrary/Daylight_Ana_Bklt.pdf

High Volume Low Speed Ceiling Fan | Enhance Natural Ventilation

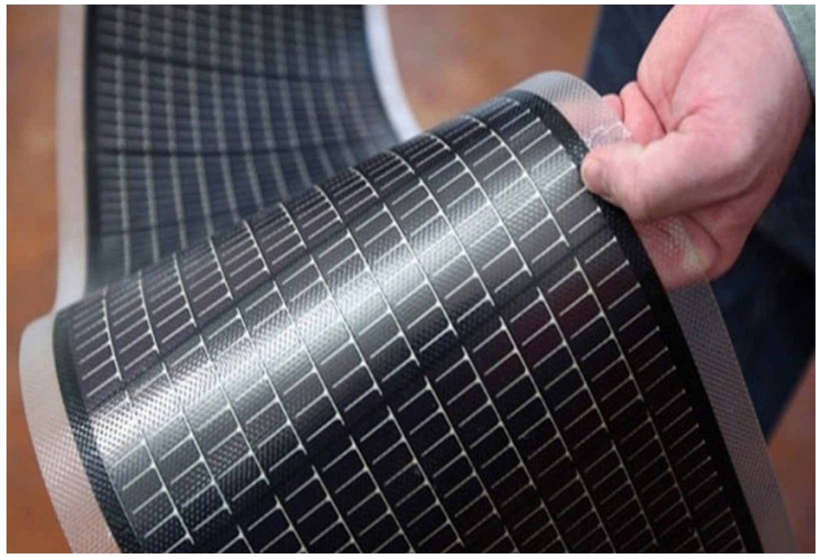


High Volume Low Speed Ceiling Fan
Enhance ventilation
Manually and locally controlled by occupant

https://ergonomicshealth.com/office-ceiling-fans/

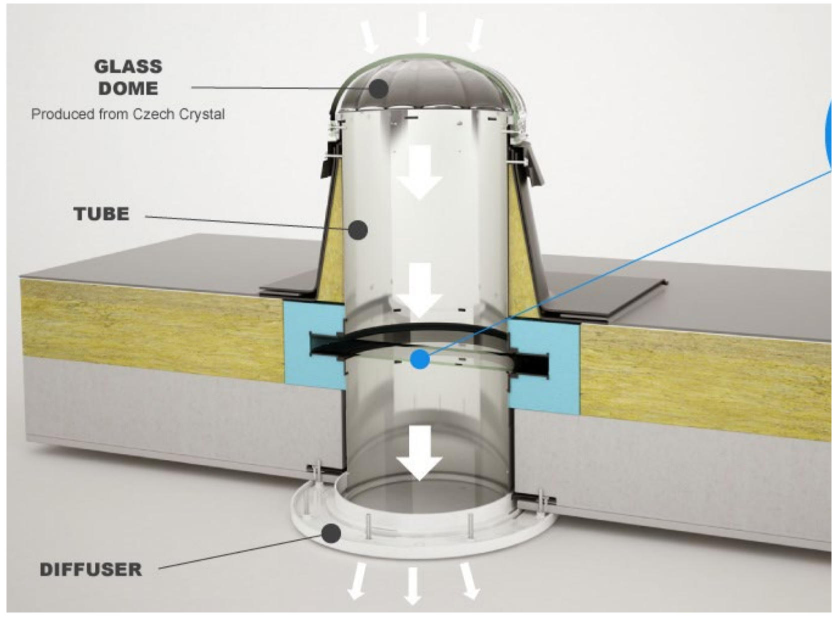
Low / Zero Carbon Tech | Passive Strategies

Light shelves



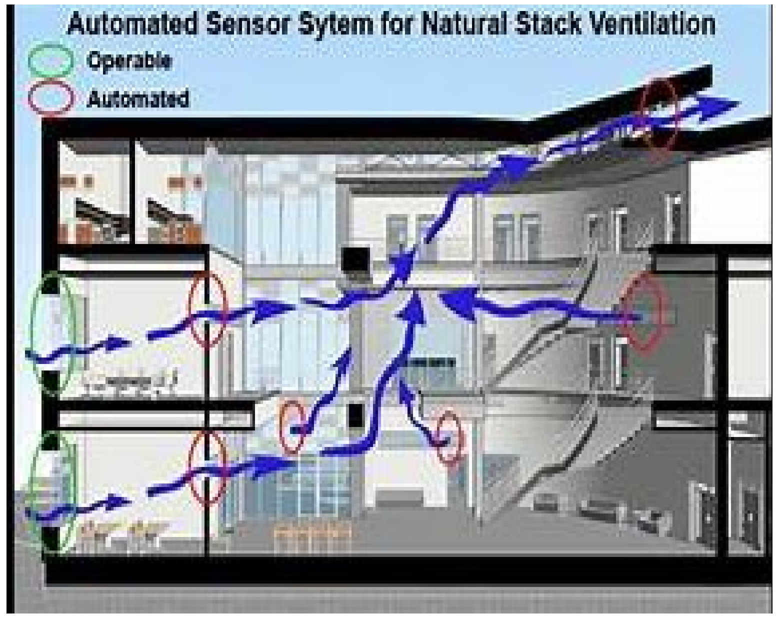
Thin film

Smart glazing



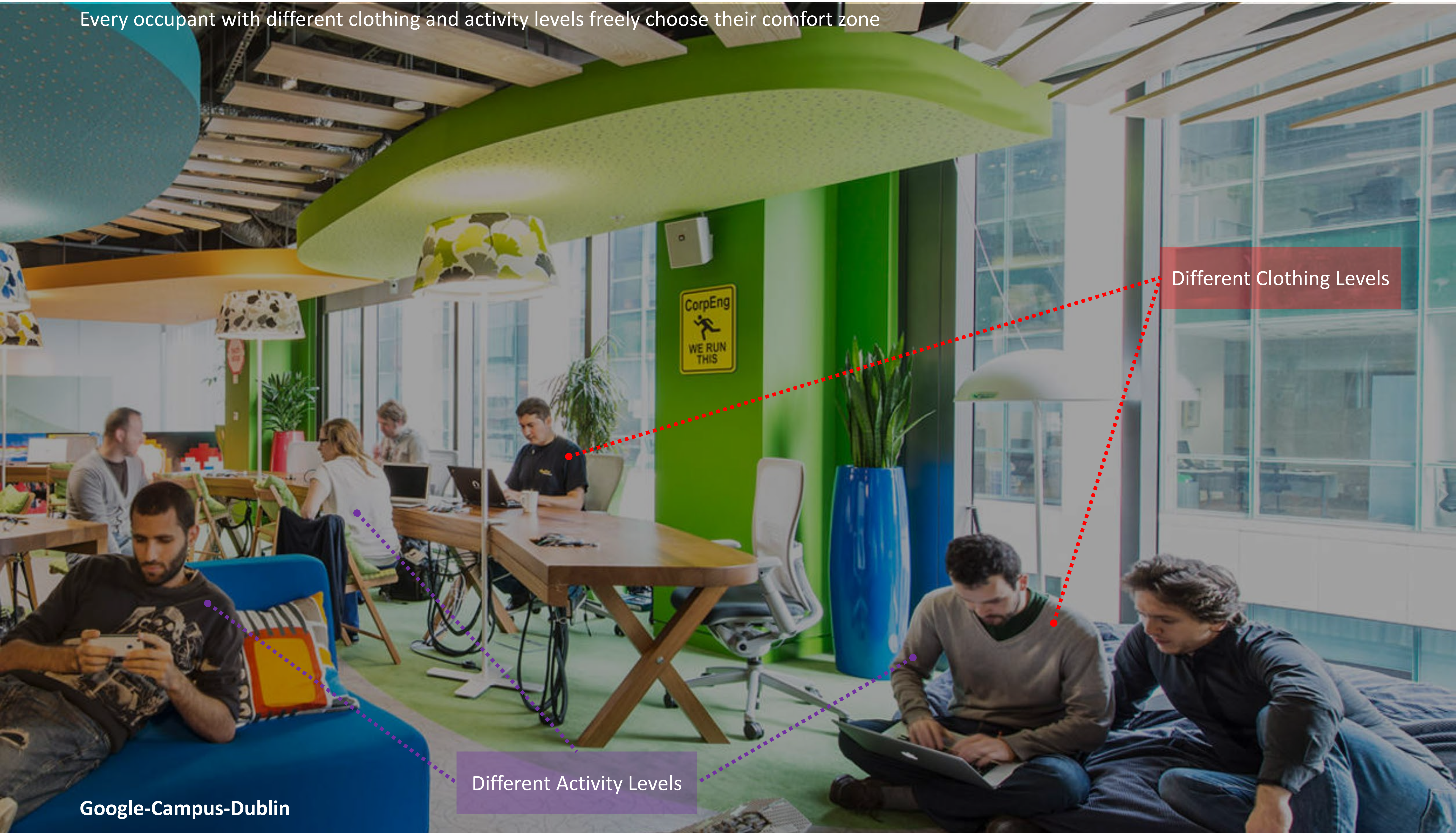
Light pipe

Self-cleansing glass



Mixed mode ventilation

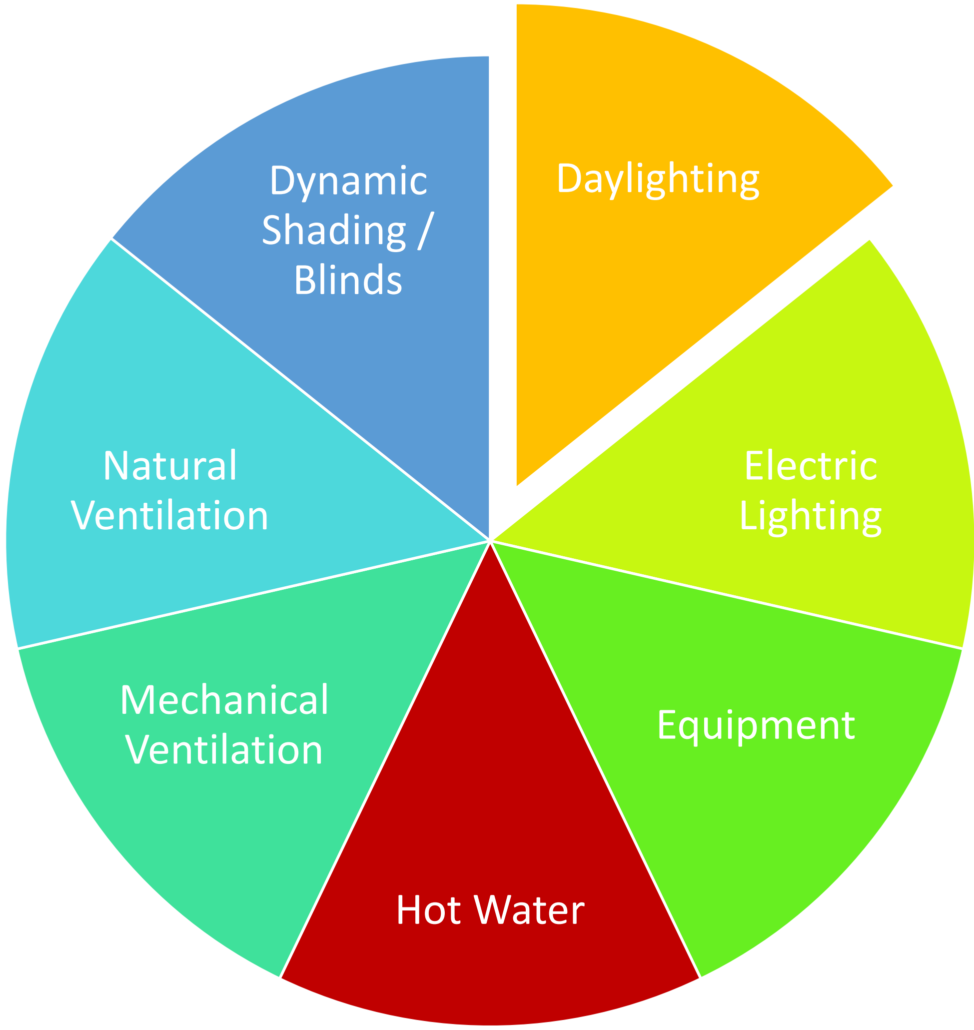
Create different Thermal Zones | Allow Occupants free to choose their own spots



https://www.camenzindevolution.com/Office/Google/Google-Campus-Dublin

Personal Carbon Footprint Tracking| IoT to Tenant Energy Use Record

Every occupant contribute the energy consumption and carbon footprint



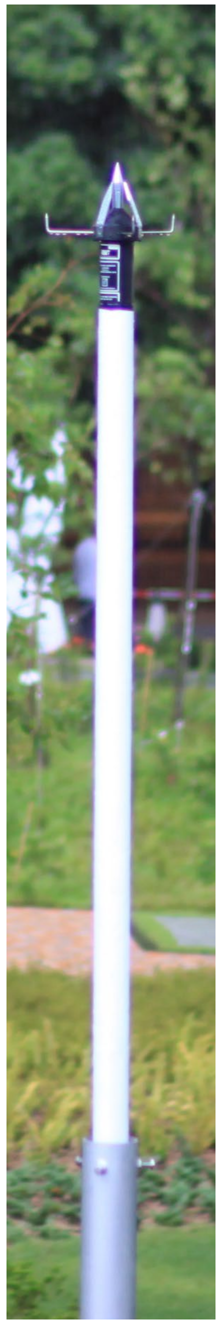
https://www.sciencedirect.com/science/article/pii/S0959652620304431#fig2a

Andersson, D. (2020). A novel approach to calculate individuals' carbon footprints using financial transaction data – App development and design. Journal of Clearner Product. Volume 256, 20 May 2020. https://doi.org/10.1016/j.jclepro.2020.120396

Real-Time Weather Monitoring | instant measurement

Inform instant decisions of building fabric on indoor environment

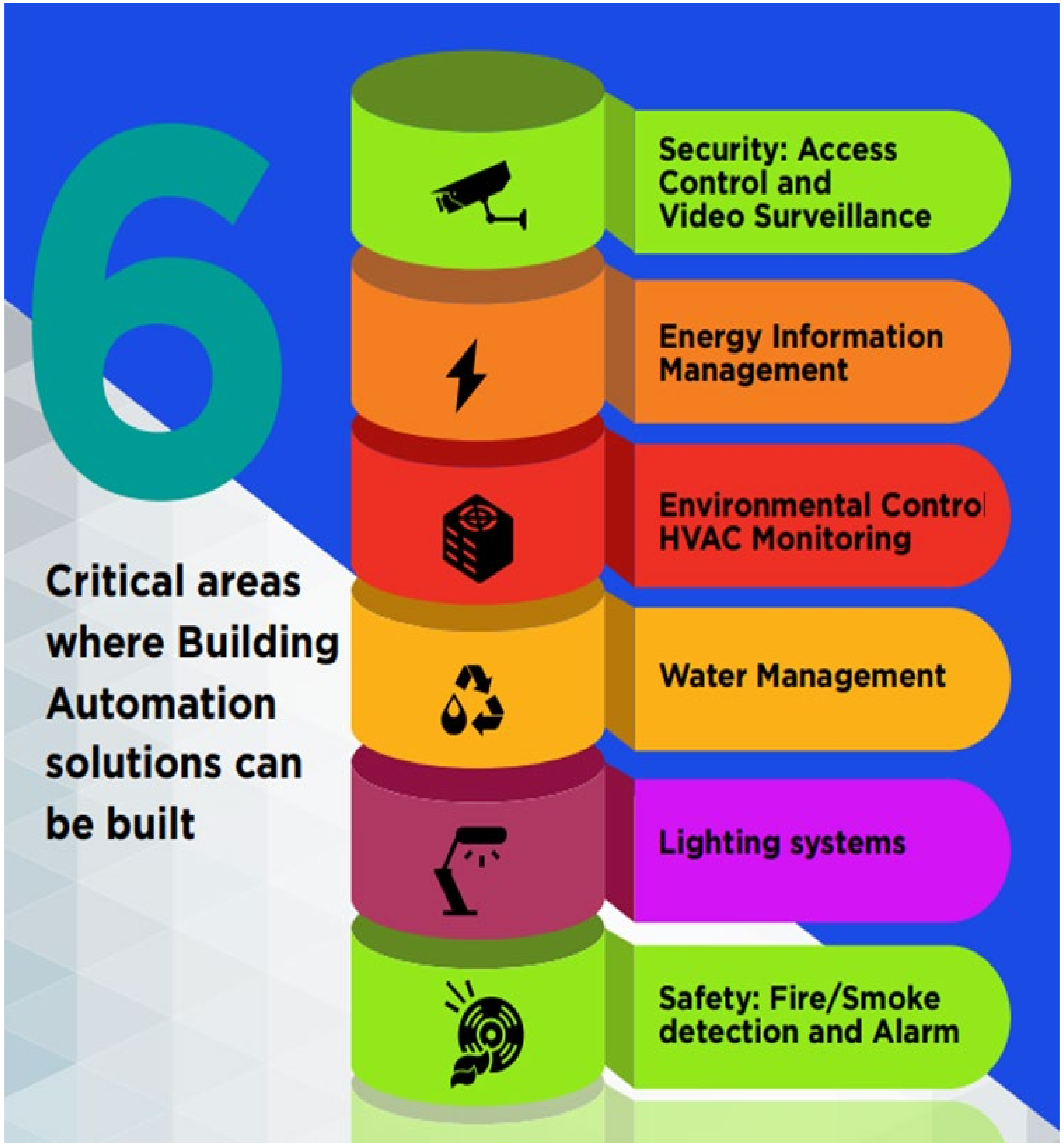
- Solar Radiation
- Ambient Temperature
- Relative Humidity
- Wind Speed and Direction
- Precipitation



Grondzik, W.T. and Kwok, A.G., 2014. Mechanical and electrical equipment for buildings. 12th Ed. John Wiley & Sons.

Integrated Self-learning and Monitoring | Smart Building Management

Inform instant decisions of building fabric on indoor environment



Future Technology of Smart Building
Integrated Self-learning and Monitoring Building Management

AIPV | Air Improvement Photovoltaic | Purify air and Generate Energy

Apply AIPV to Glazing System

An example of AIPV

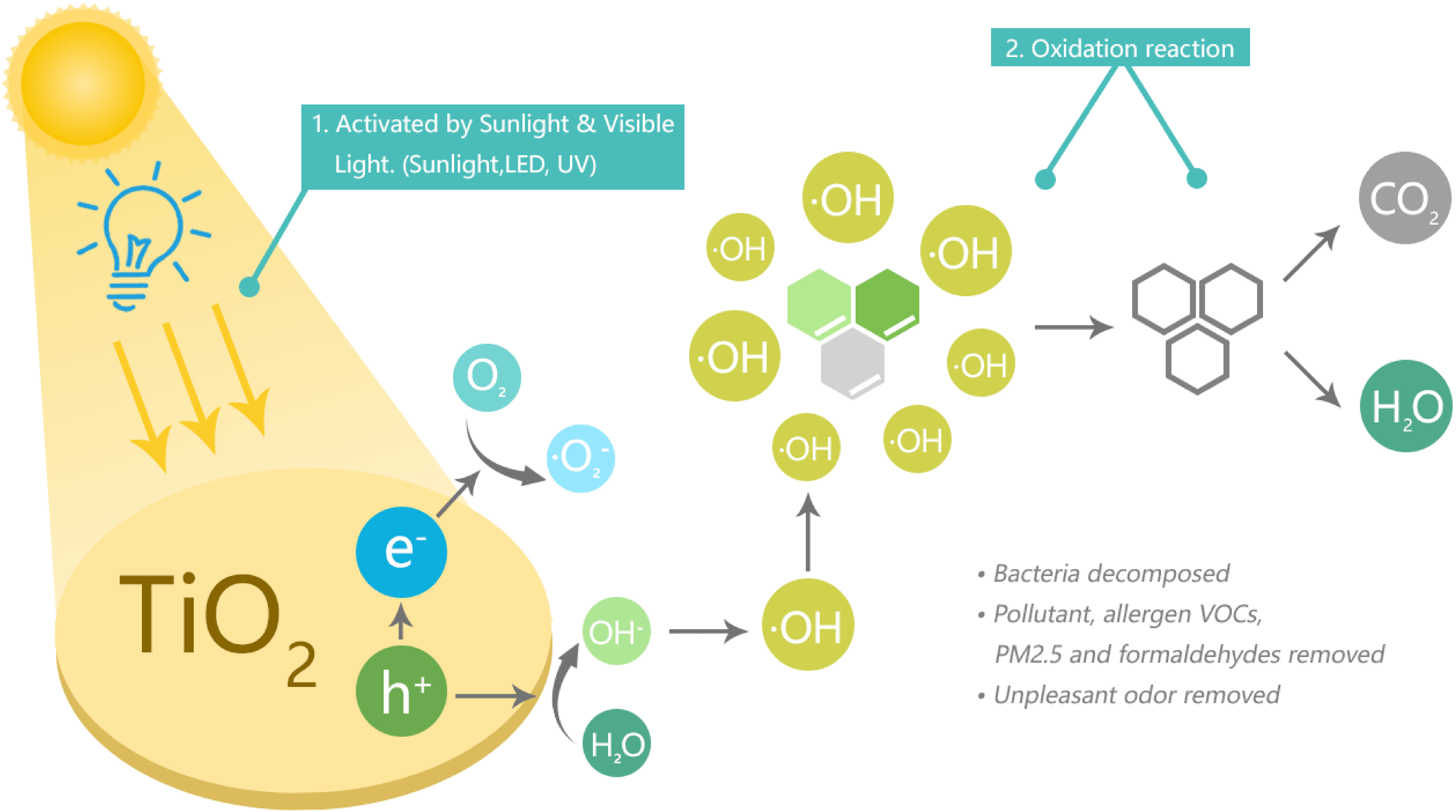
Oxford House footbridge with One Taikoo Place

https://www.greenwalls.com.hk/solartech

https://www.pv-magazine.com/2020/09/25/cdte-facade-solar-panel-with-18-2-efficiency/

https://re.emsd.gov.hk/english/solar/solar_ph/Solar_Cells.html

Air Quality & Health Improvement System | eliminate hazardous particles



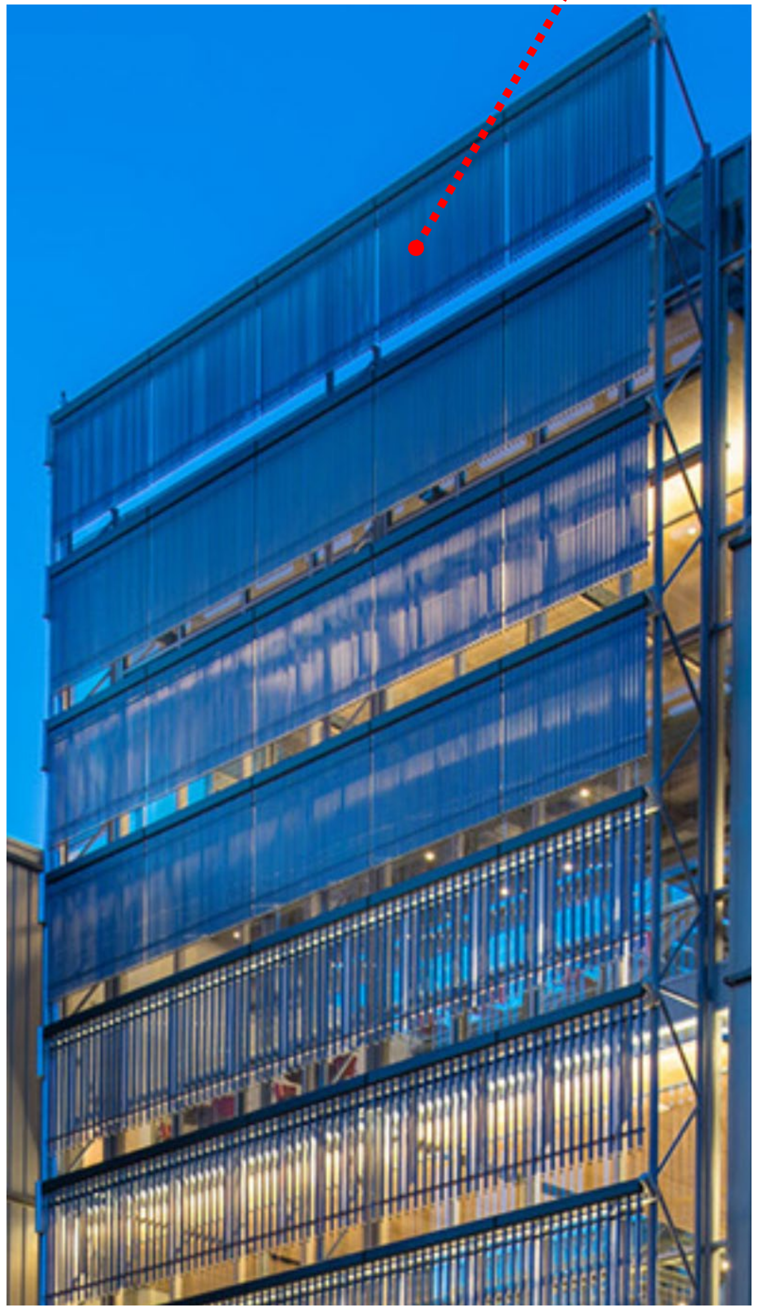
- *Bacteria decomposed*
- *Pollutant, allergen VOCs, PM2.5 and formaldehydes removed*
- *Unpleasant odor removed*

Solar Thermal Hot Water System

Block the heat from summer sun and Collect the Solar Energy

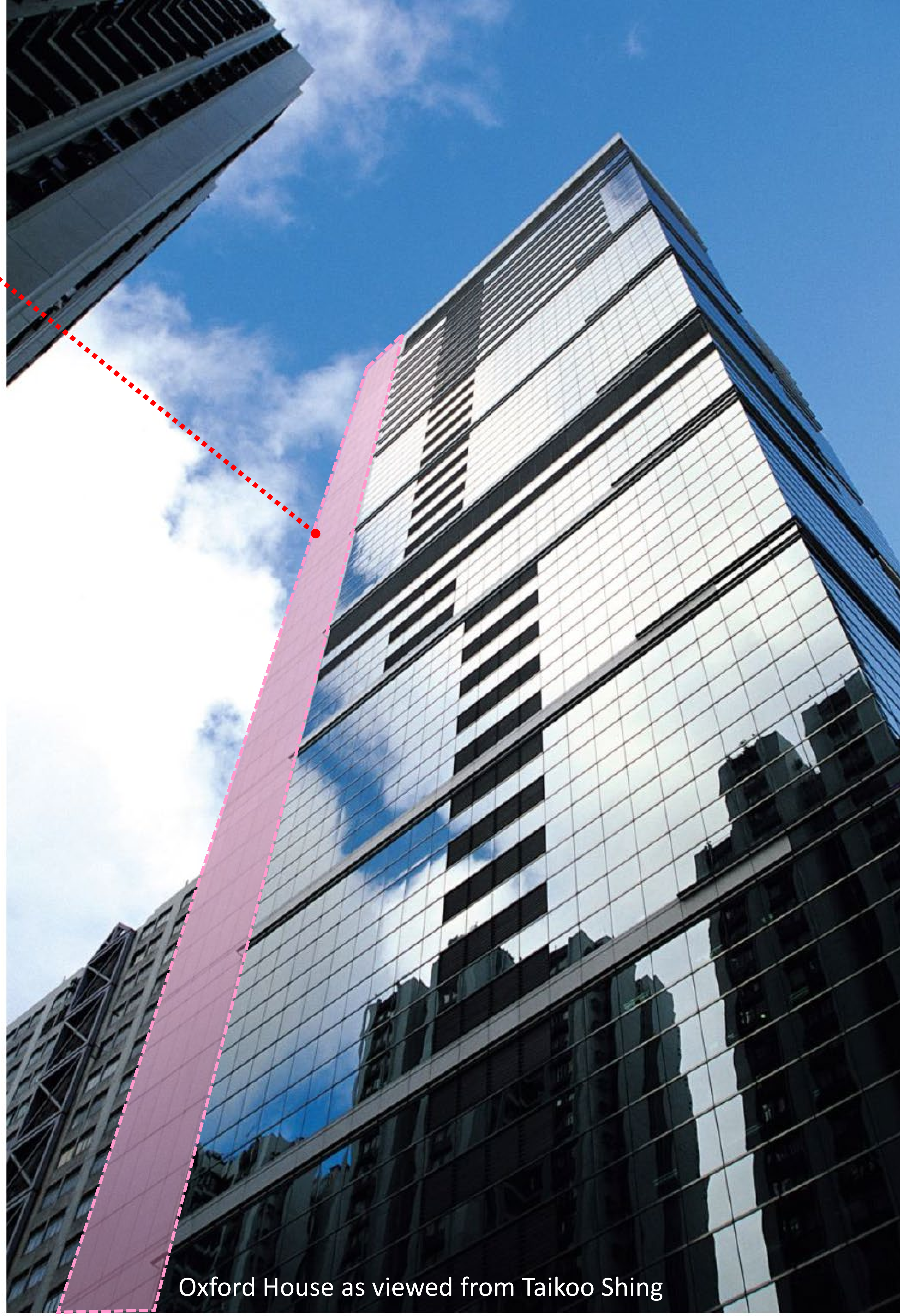
Solar Thermal Hot Water System

Collect Solar Energy to heat up water for building use
Installed on south side of the east façade
And top part of the south facade



Downtown Academic Building,
Lane Community College, Oregon, USA
LEED PLATINUM

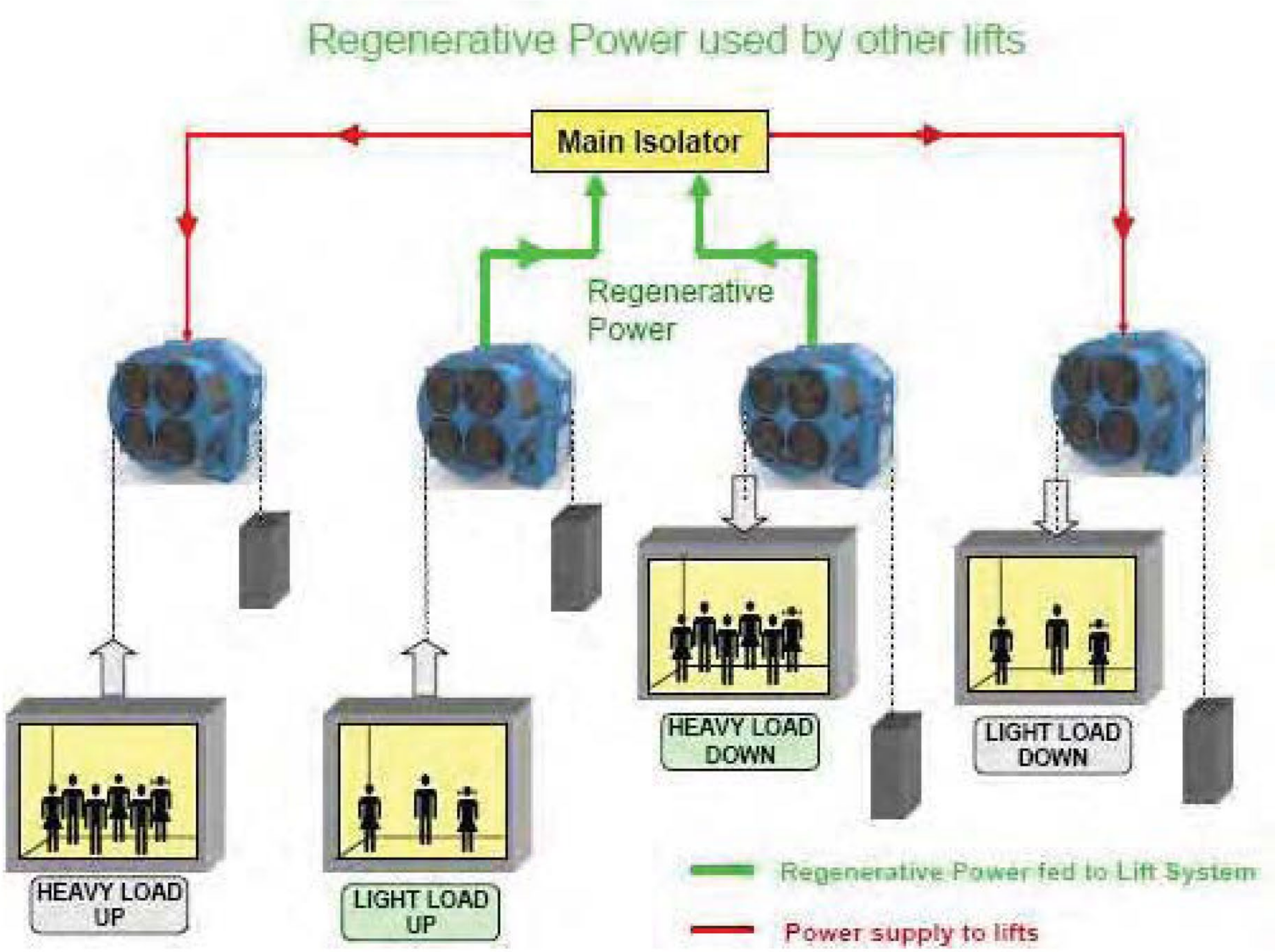
https://www.pae-engineers.com/projects/downtown-campus-academic-building-lane-community-college



Oxford House as viewed from Taikoo Shing

Low / Zero Carbon Tech | Regenerative Lift | up to 30% Energy Reduction

Energy regenerated is up to 20% to 30% of energy typically consumed by lifts



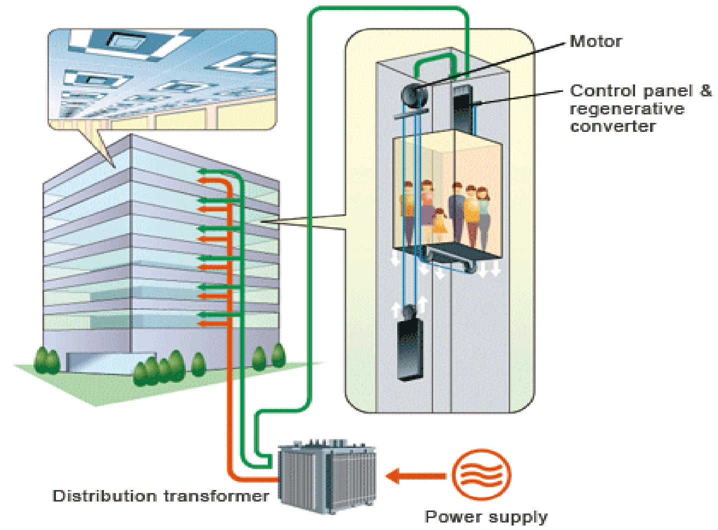
https://www.emsd.gov.hk/filemanager/en/content_764/applctn_lift_rgnrt_pwr.pdf

Low / Zero Carbon Tech | Renewable Energy

Wind Turbines

BIPV

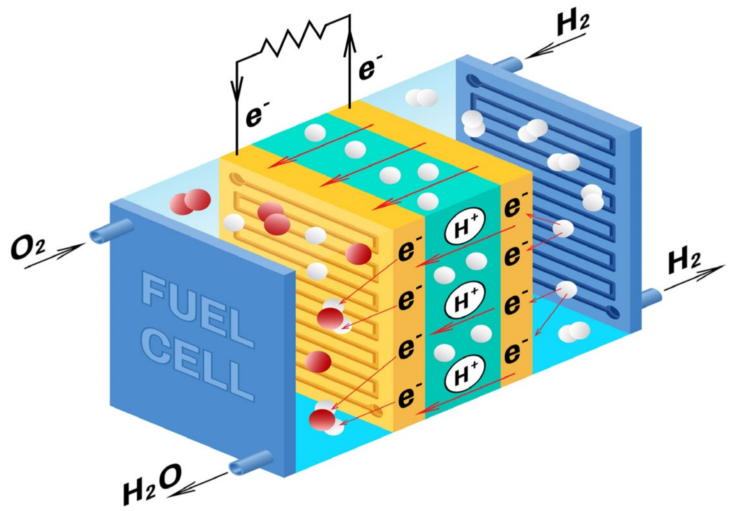
Biodiesel Generator



Lift Regenerative System

Photovoltaic Panels

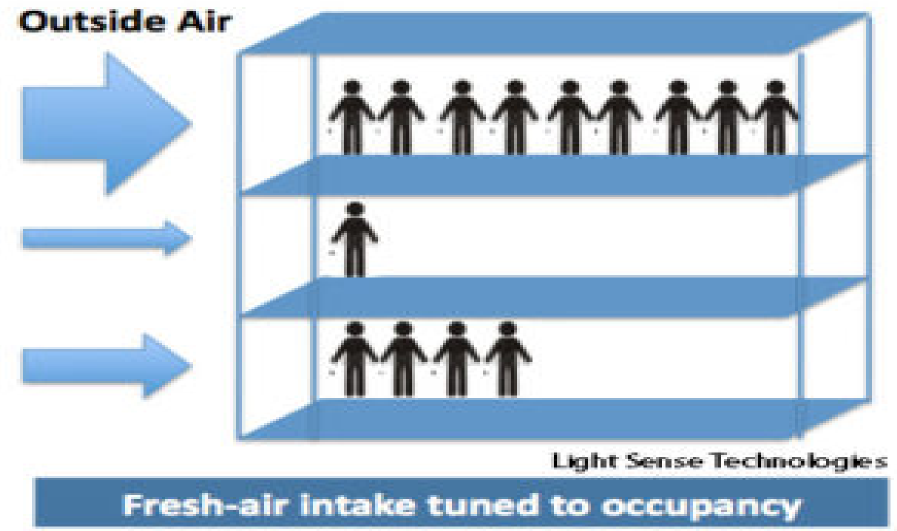
Solar Hot Water Panel



Fuel Cell

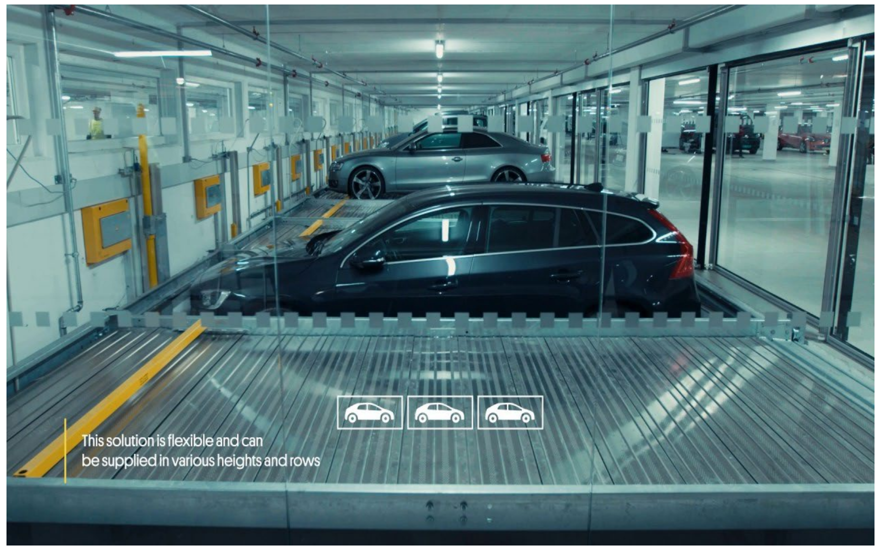
Low / Zero Carbon Tech | Active Strategies

Daylight autonomy system (integration of daylight sensor, automatic blind, lighting dimmer control)

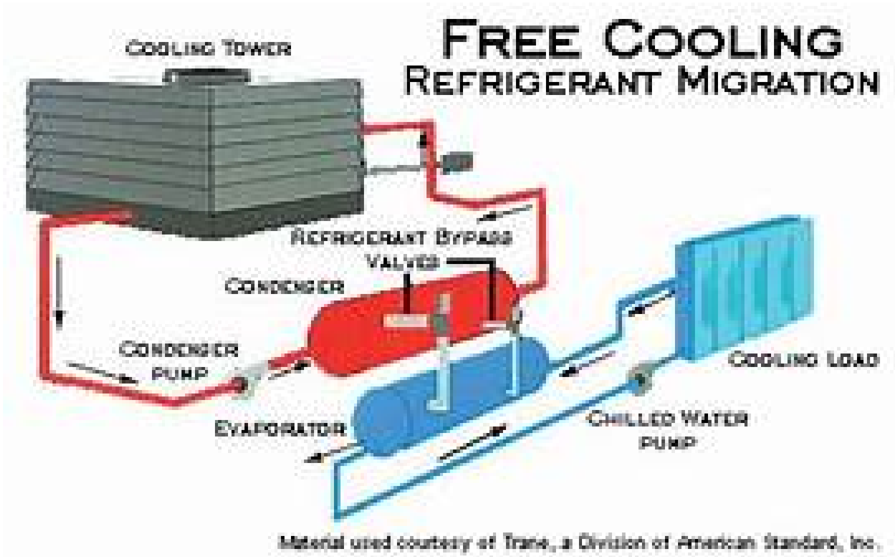


Demand Control Ventilation System

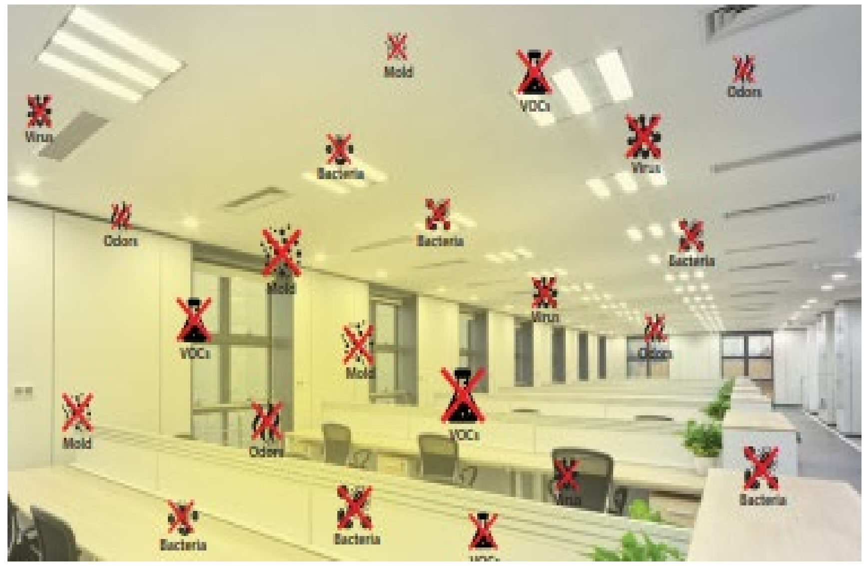
Integrated air purification control system



Automatic carparking system



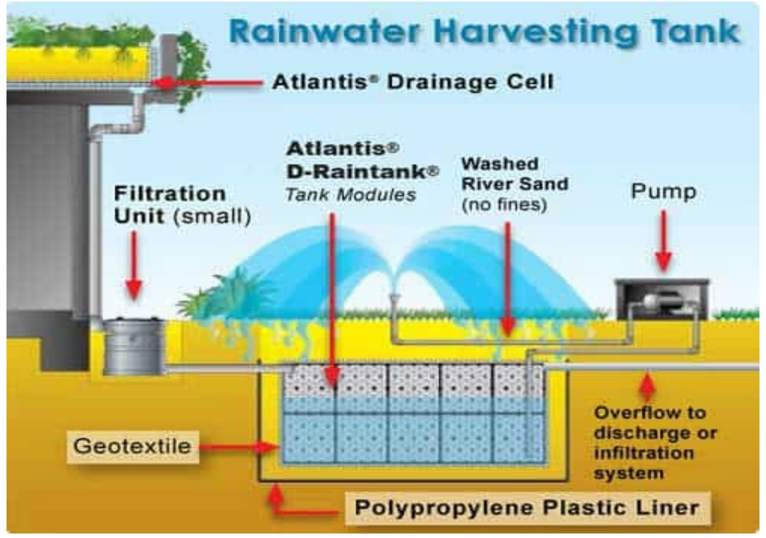
Waterside free cooling system



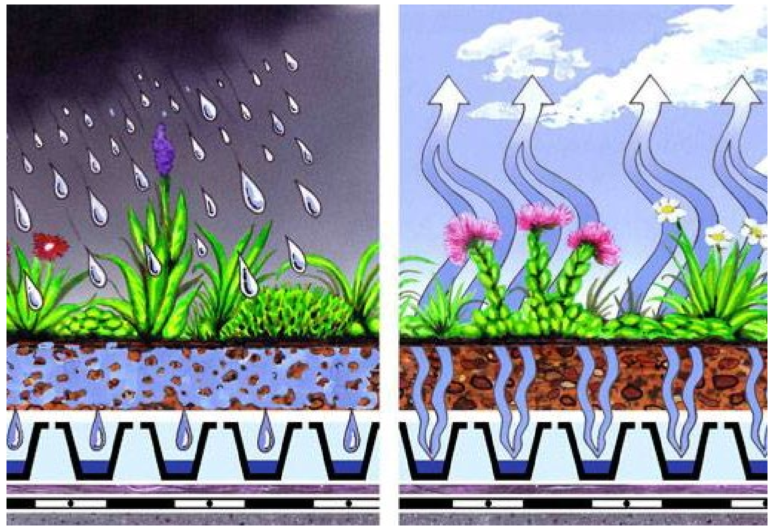
Nano-photocatalytic lighting

https://solariaq.com/en/solariaq/
https://solariaq.com/en/lab-test/

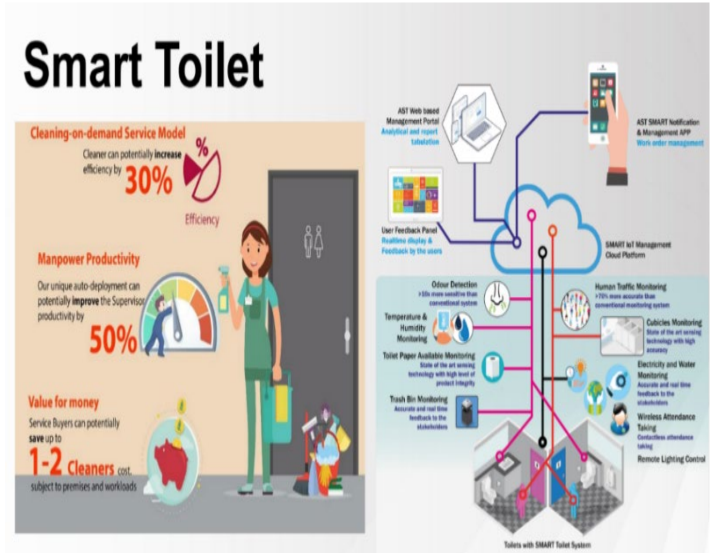
Low / Zero Carbon Tech | Energy / Carbon Management



Rainwater recycling system

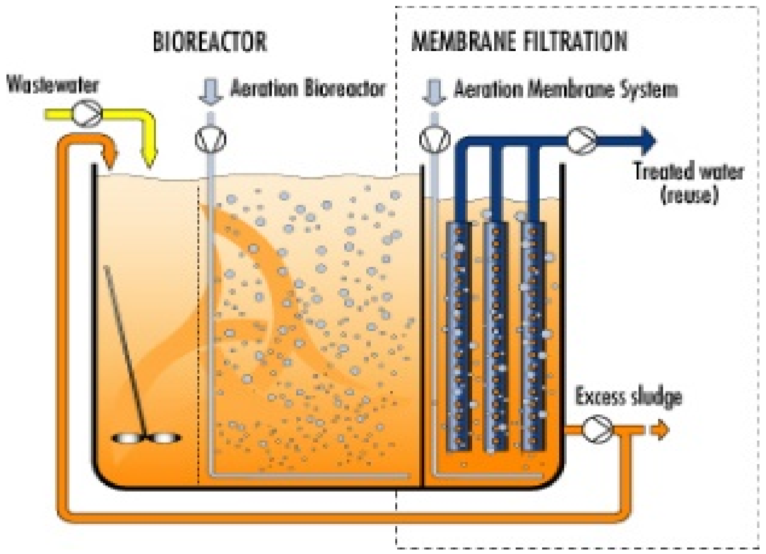


Self-storage roofing system



Smart toilet system

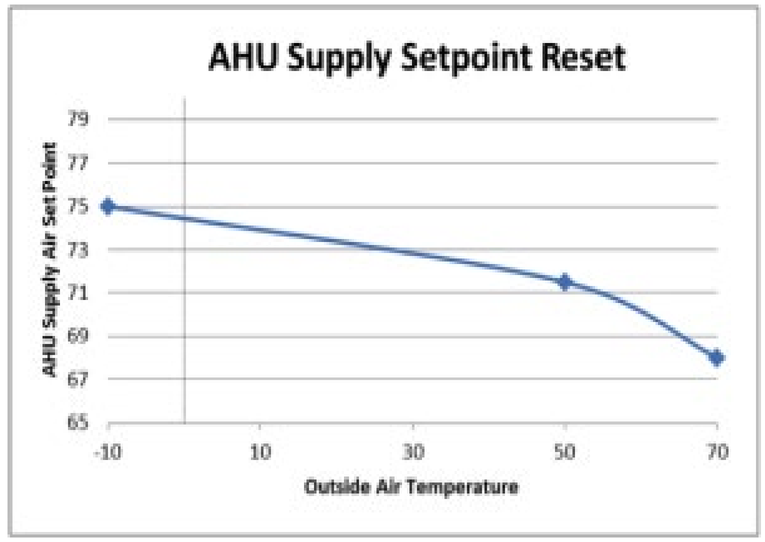
Smart water and electricity metering



Membrane bio-reactor

Internet Operation Centre

Water efficient equipment



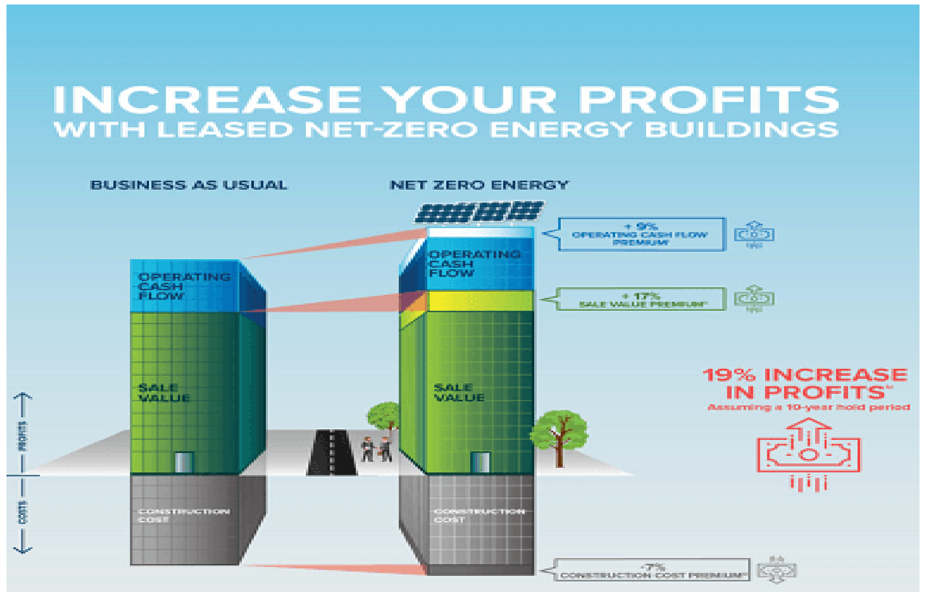
Temperature Reset

Low / Zero Carbon Tech | Fit out / User Strategies

Green operation training programme

Green educational tour

Promote Sustainability Through Gamification

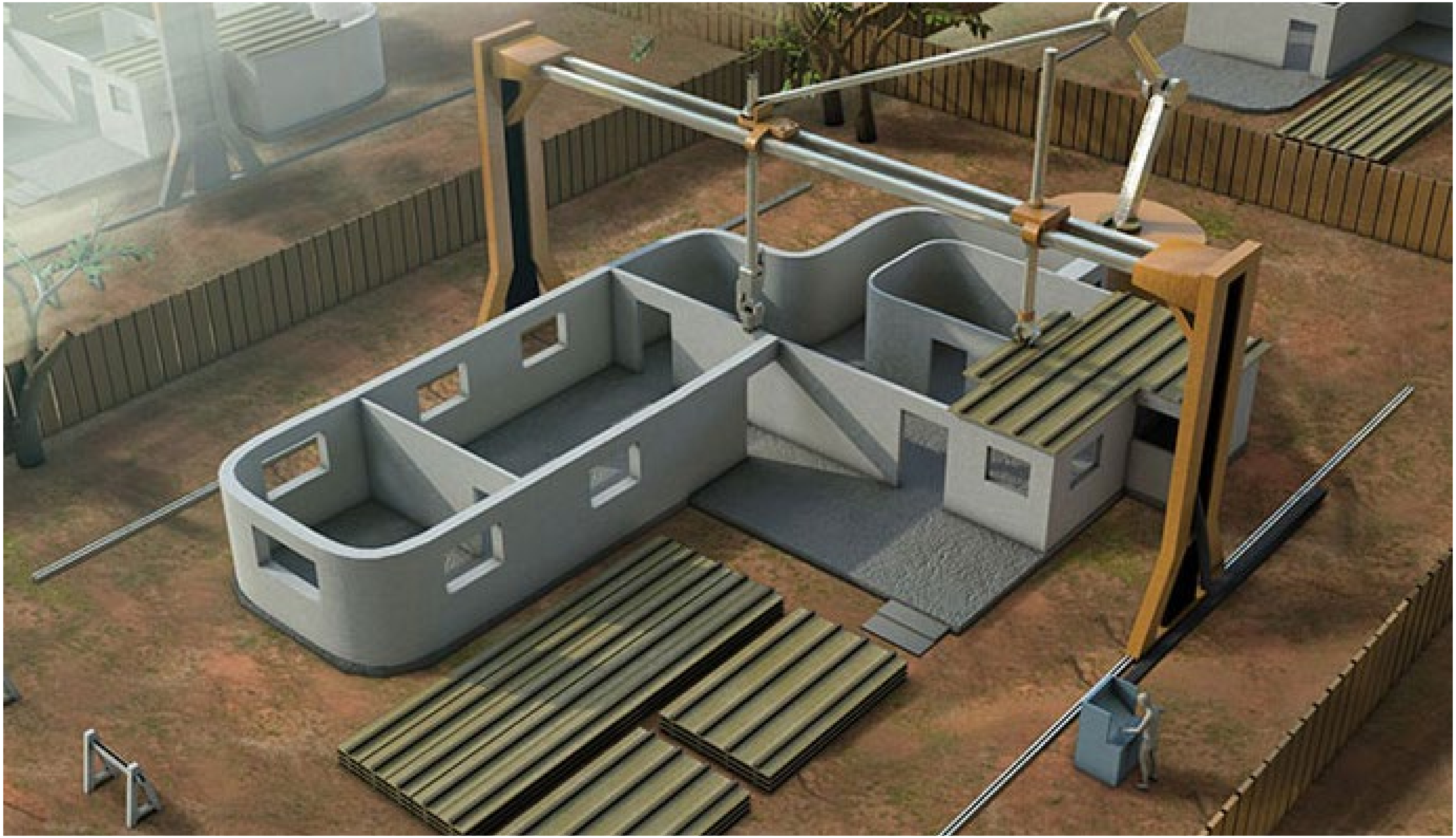


User Guidance and Green Leasing Guidelines

Incentive scheme for tenant in achieving preset tenant target

Smart Bin

Low / Zero Carbon Tech | Design for Buildability | 3D Printing



Advancing Net Zero Carbon
Architecture + Community

SUMMARY

In order to further reduce the energy consumption and carbon footprint of existing Oxford House, occupant behavioral change is essential on top of the highly efficient building equipment.

Therefore, this proposal encourages occupants to participate into the operation of the building to seek for their own adaptive thermal comfort at a right spot. The design features are meant to be manually and locally controlled by the occupants.