Advancing Net Zero

Ideas Competition

Presentation | May 2021

SUBTROPICAL

Innovative ideas must contribute to revenue generation, and based on practical sciences using current or near future technologies

Meeting Chinese national emissions targets

GLOBAL & NATIONAL GOALS

1. Local Climate

ON-SITE
OFF-SITE

To encourage better services & cheaper tariffs, the current monopolistic situation must be removed

6. Net Zero Challenges

2. Local Energy Source

5. Social Norms & Human Behaviour

3. Building Typology

TECHNOLOGY
IMPROVE USER WELLBEING

Raising thermal comfort threshold and providing human-centric adjustability

4. Local Building Codes

OFFICE
HIGH-RISE

Financial or corporate benefits so that both owner and tenants make concerted effort to save.

REGULATIONS
OPPORTUNITIES

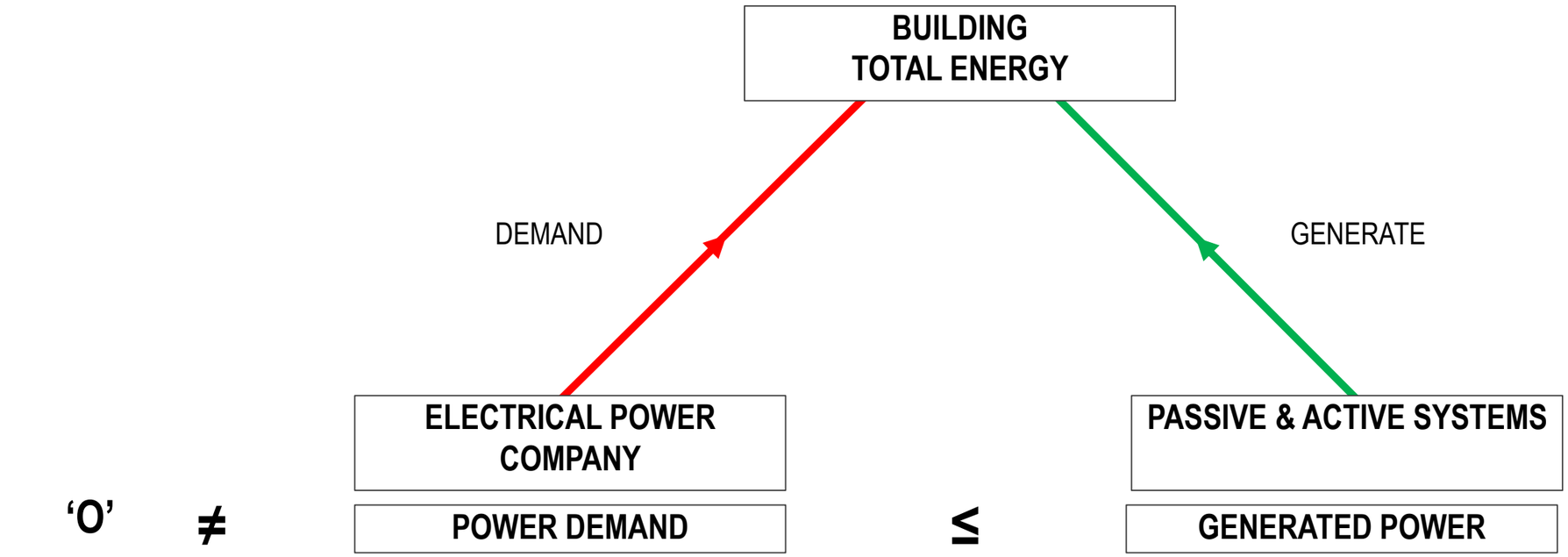
Statutory control mechanisms require overhauling when dealing with ANZ initiatives because their contributions are social economic benefits at a macro level

Objectives

Principles of Advancing Net Zero

Principle of advancing net zero to have a greater or equal amount of power generated by building than the amount of power demanded by the city grid.

In Hong Kong, it will be extremely difficult to meet this criteria for high-rise buildings.



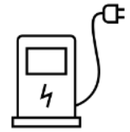
In Hong Kong power demand will not = 'O'

Energy Principle in Hong Kong High-rise Buildings

4 PRINCIPLE OBJECTIVES

1. **MINIMISE ENERGY DEMAND FROM POWER GRID**
2. **MINIMISE EMBODIED ENERGY THROUGH INNOVATIVE CONSTRUCTION METHODS AND MATERIAL SELECTION**
3. **MINIMIZE OPERATIONAL ENERGY OVER 30+ YEARS DESIGN LIFE CYCLE**
4. **MAXIMIZE BUILDING SELF-GENERATED ENERGY**

BUILDING WHOLE-LIFE CARBON



EMBODIED ENERGY
UPFRONT

ENERGY DEMAND
MINIMISED

REDUCE ENERGY CONSUMPTION

GENERATED ENERGY
MAXIMISED

POWER GENERATION
OPTIMISED

- P.V. SOLAR
- WIND

END OF LIFE CARBON

ACTIVE SYSTEM

- HVAC
- HOT WATER
- COOLING
- LIGHTING
- PLUG LOAD
- MOVEMENT SYSTEM

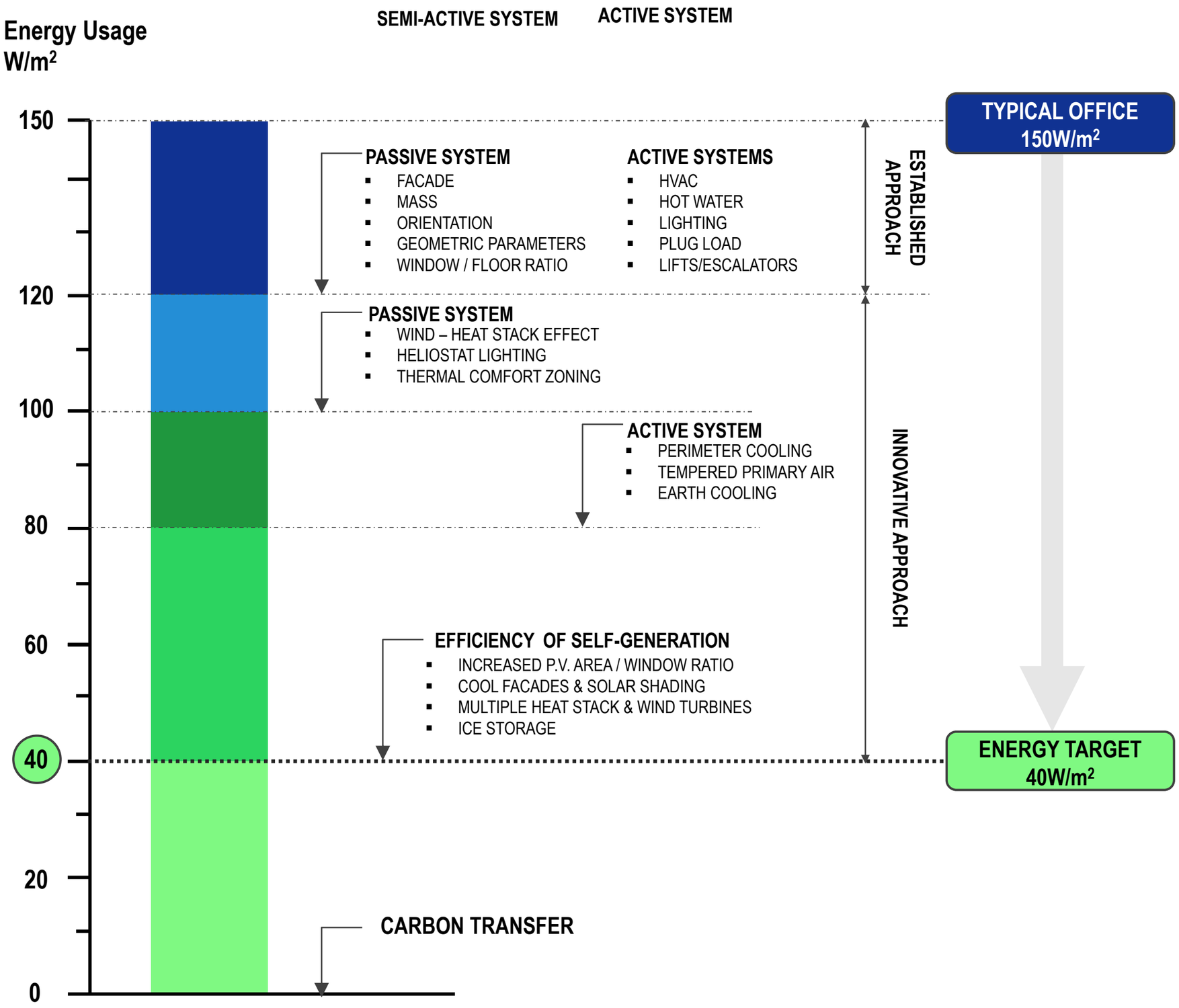
PASSIVE SYSTEM

- ENVELOPE / FAÇADE / ROOF
- ORIENTATION
- GEOMETRIC PARAMETERS SHAPE FACTOR (Ae/Aac)
- HYBRID SOLUTION

INNOVATIVE TECHNOLOGIES

- MULTIPLE HEAT STACK & WIND TURBINES
- HELIOSTAT LIGHTING
- STRATIFIED PLAN ZONES BASED ON COOLING GRADIENT
- EARTH COOLING
- ICE STORAGE
- TEMPERED PRIMARY AIR

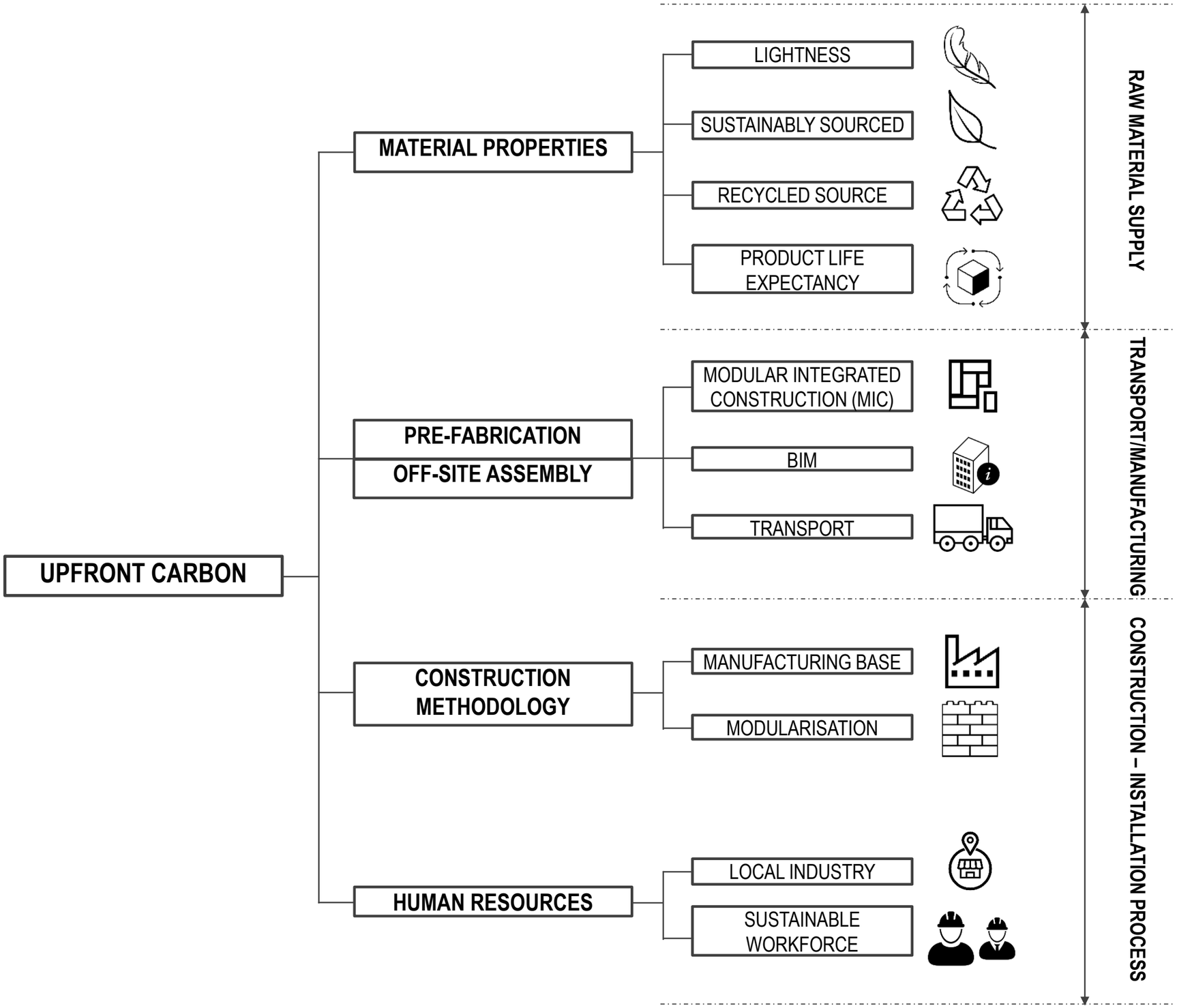
Objectives
Energy Target



Our objective is integrate both design strategies and innovative technologies to increase the energy efficiency of the future building from a typical 150W/m^2 to our energy target of 40W/m^2.

To achieve this target we incrementally reduce the energy consumption during operational energy use, by utilizing introducing tiers of passive & active design strategies, as well as semi-active, active systems, efficiency of power generation within innovative technologies.

Embodied Carbon Optimization
Overall Strategy



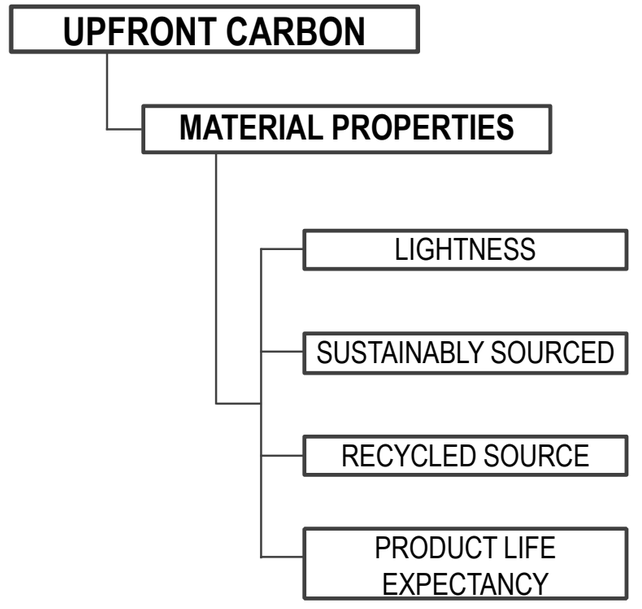
Upfront carbon as being categorized into the sections of material properties, pre-fabrication & off-site assembly, and construction methodology / human resources, which correspond to raw material supply, manufacturing & transport, and the construction-installation process respectively.

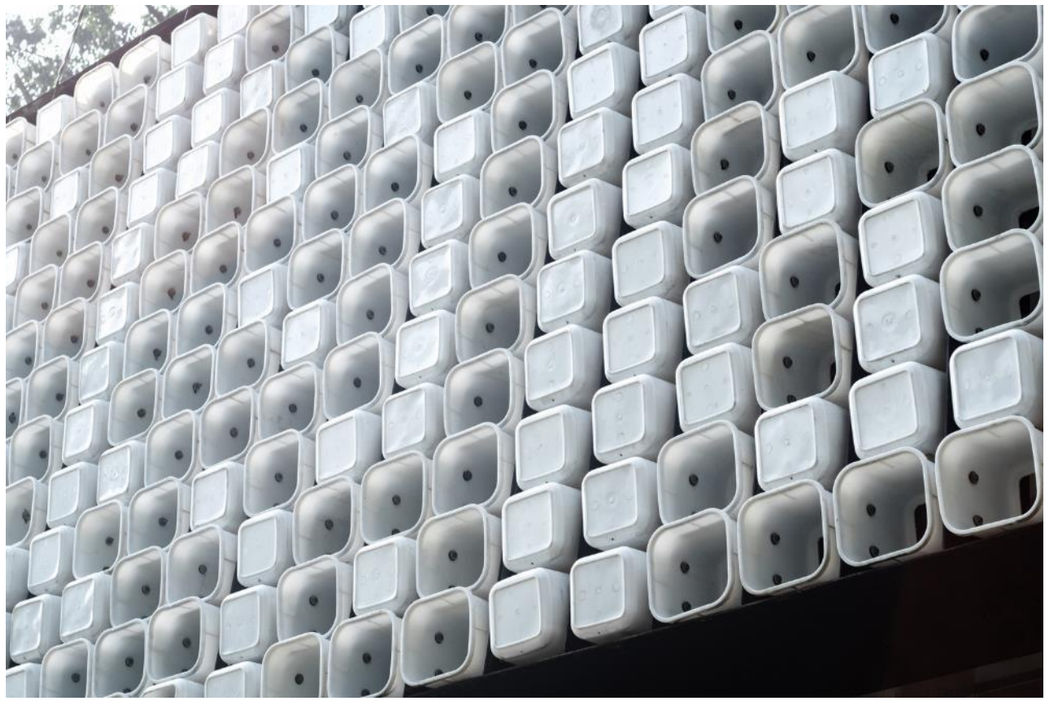
Each of the categories sections can be further subcategorized into specific aspects (e.g. sustainable sources, MIC construction, modularization & local industries) as a means of identifying how to optimize lower the amount of embodied carbon

Embodied Carbon Optimization
Materials

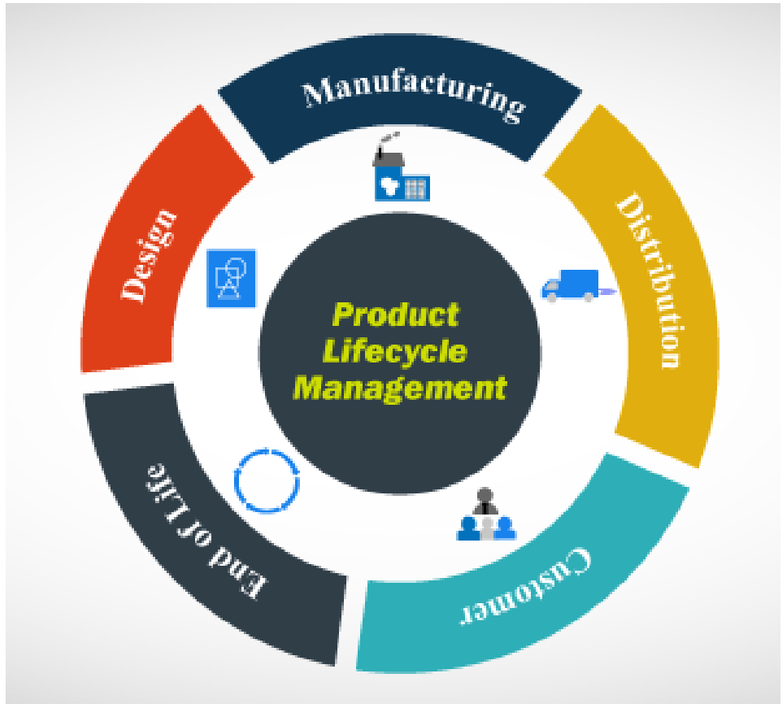
Lightness

Sustainably Sourced





Recycled Source



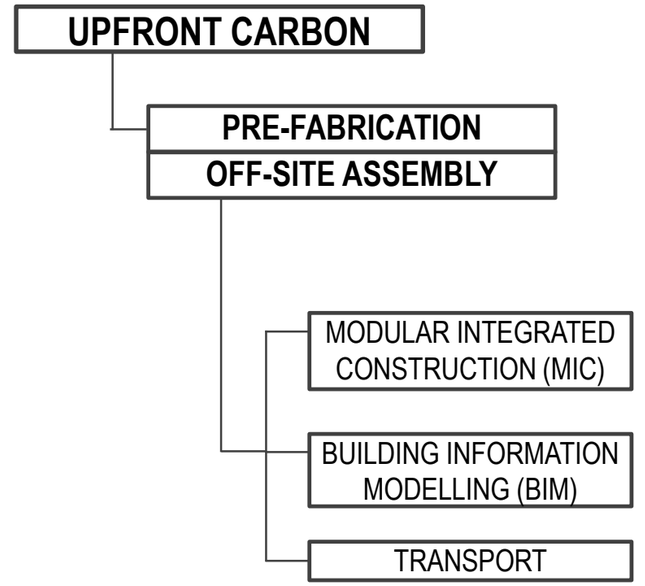
Product Lifecycle

Embodied Carbon Optimization

Pre-Fabrication & Off-Site Assembly

Modular Integrated Construction (MIC)

BIM Enabled design & manufacturing

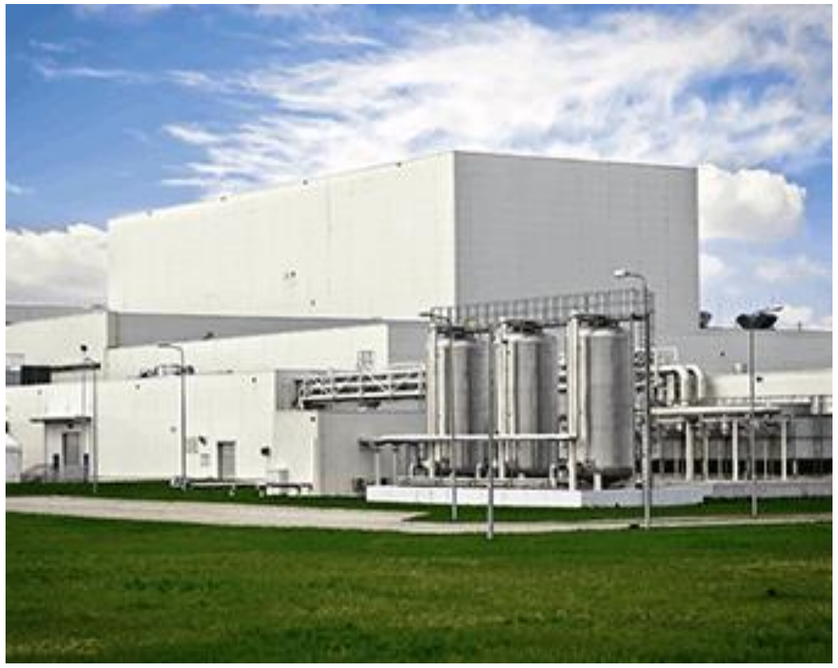


Transportation

Material selection of products sourced within a 800km radius around Hong Kong.

Embodied Carbon Optimization

Construction Methodology & Human Resources



Manufacturing base

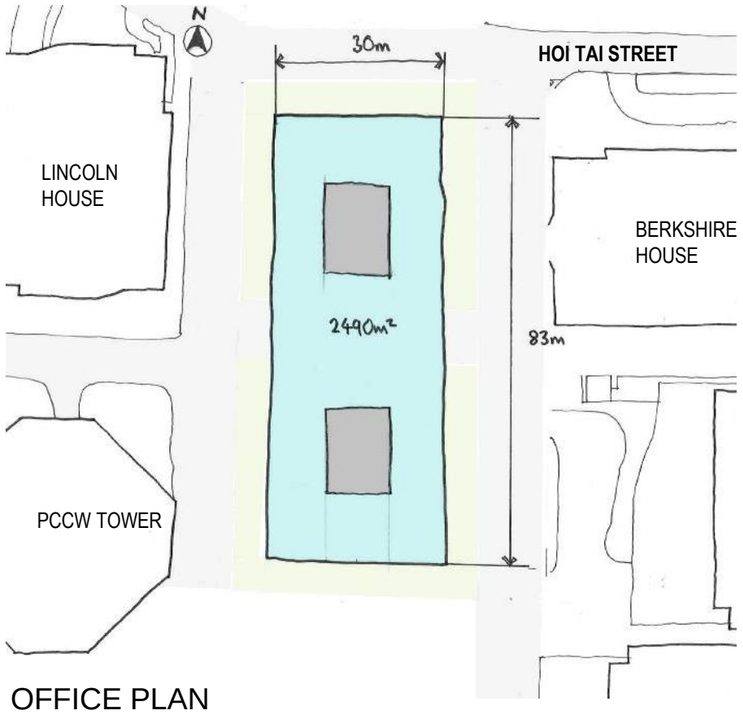
Modularisation

Local Industry

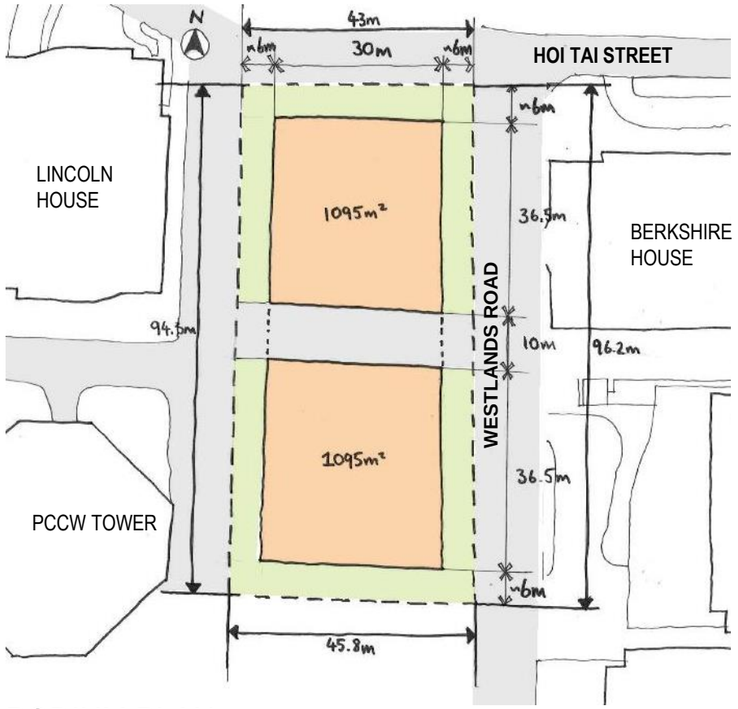
Sustainable Workforce

- UPFRONT CARBON
  - CONSTRUCTION METHODOLOGY
    - MANUFACTURING BASE
    - MODULARISATION
  - HUMAN RESOURCES
    - LOCAL INDUSTRY
    - SUSTAINABLE WORKFORCE
    - TRANSPORT

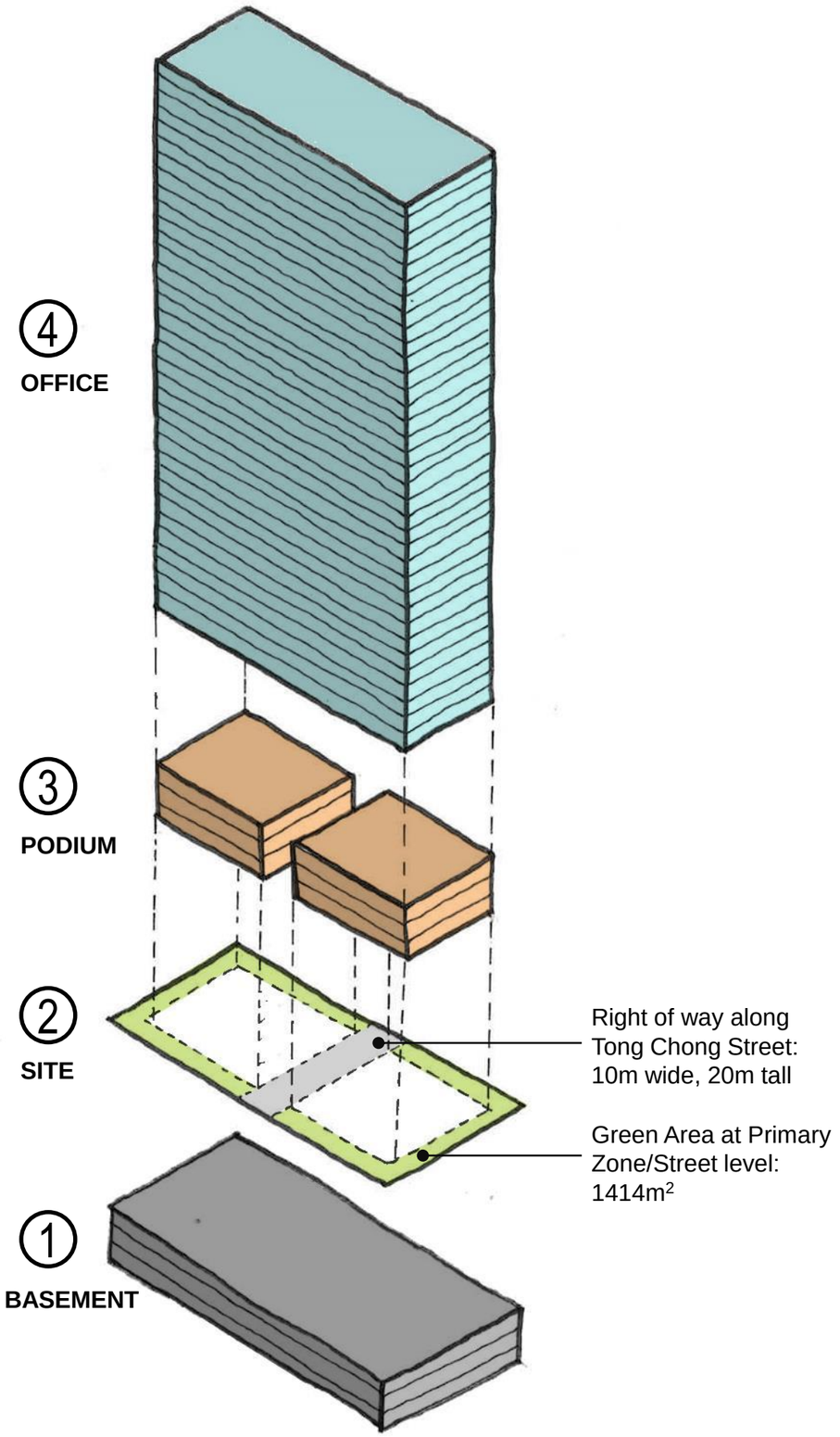
Design Strategy
Building Mass



OFFICE PLAN



PODIUM PLAN



GFA Summary
Permissable GFA: 94,144m²
Total Building GFA: 87,150m² + 6570m²
= 93,720m²

Height Summary
Permissable Height: +225mPD
Building Height: +181.5mPD

2 Buildable Site Area: 4238m²
Non-Building Area: 10m wide, 20m Tall

3 Podium Floor GFA: 2,190m²
No. of Storeys: 3
100% Site Coverage excl. non-building area
Total Podium GFA 6,570m²

4 Office Floor GFA: 2490m²
No. of Storeys: 35
Total Office GFA: 87,150m²

CFA Summary
Total Building CFA: 12,714m² + 6570m² + 12,714m²
= 106,434m²

1 Basement CFA : 4238m²
No. of Storeys: 3
Total Basement CFA: 12,714m²

3 Podium CFA : 2190m²
No. of Storeys: 3
Total Podium CFA: 6,570m²

4 Office CFA : 2490m²
No. of Storeys: 35
Total Office CFA: 87,150m²

IFA Summary
Total Building IFA: 12,714m² + 6570m² + 12,714m²
= 104,956m²

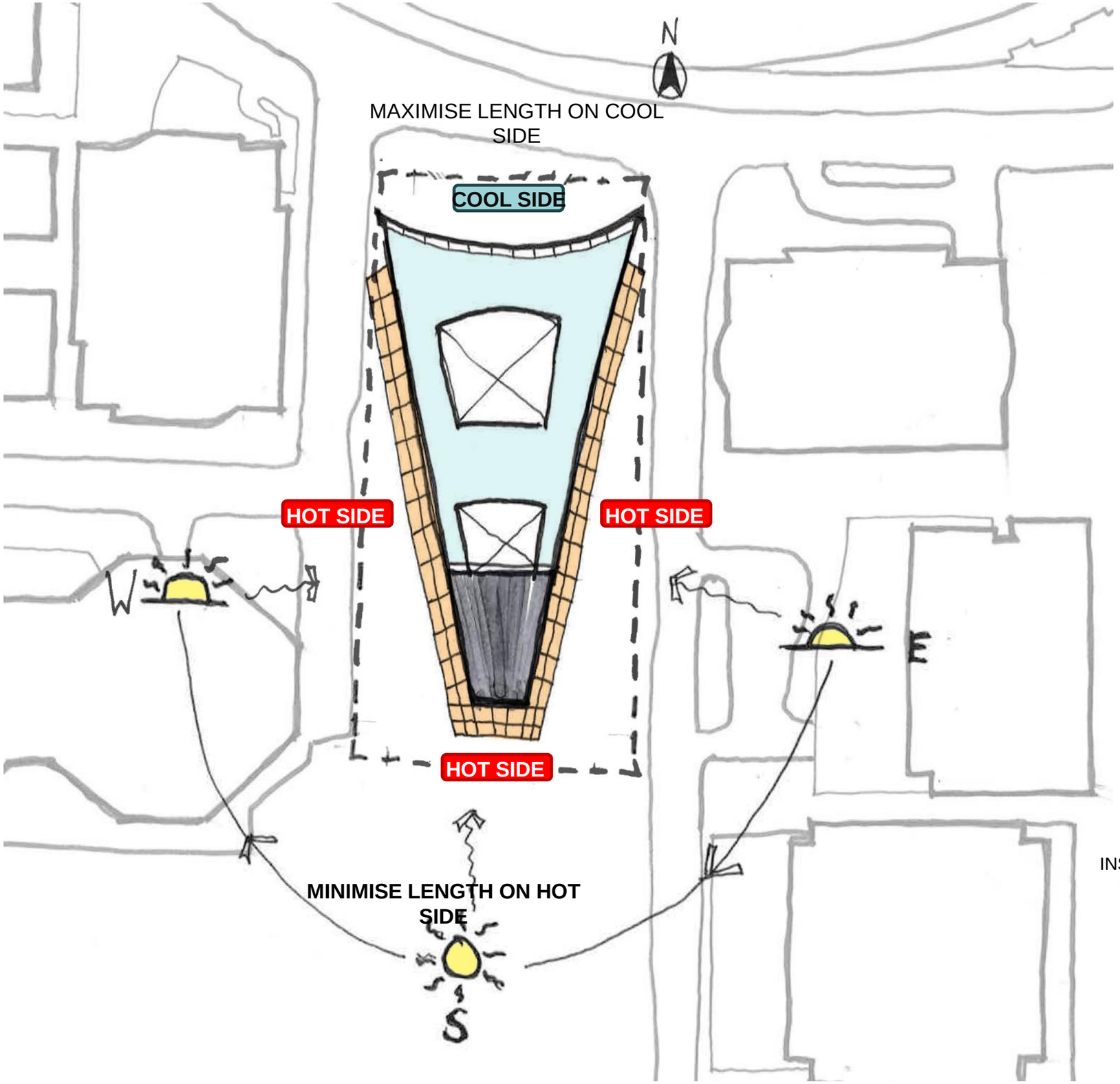
1 Basement IFA : 3990m²
No. of Storeys: 3
Total Basement IFA: 11,970m²

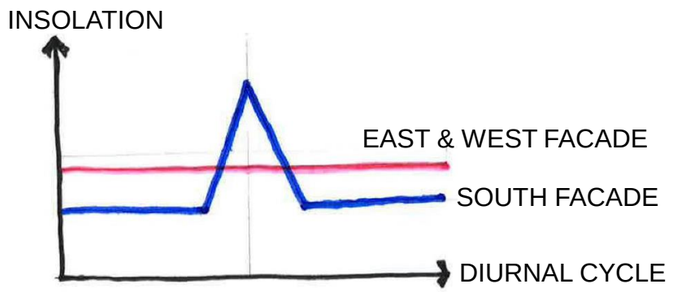
3 Podium IFA : 2137m²
No. of Storeys: 3
Total Podium IFA: 6,411m²

4 Office IFA : 2445m²
No. of Storeys: 35
Total Office IFA: 85,575m²

Design Strategy
Building Orientation

Building's geometric proportion designed to provide greater frontage on the North façade (cool side of the building), whilst minimizing length on East, South & West facades (hot sides of the building).



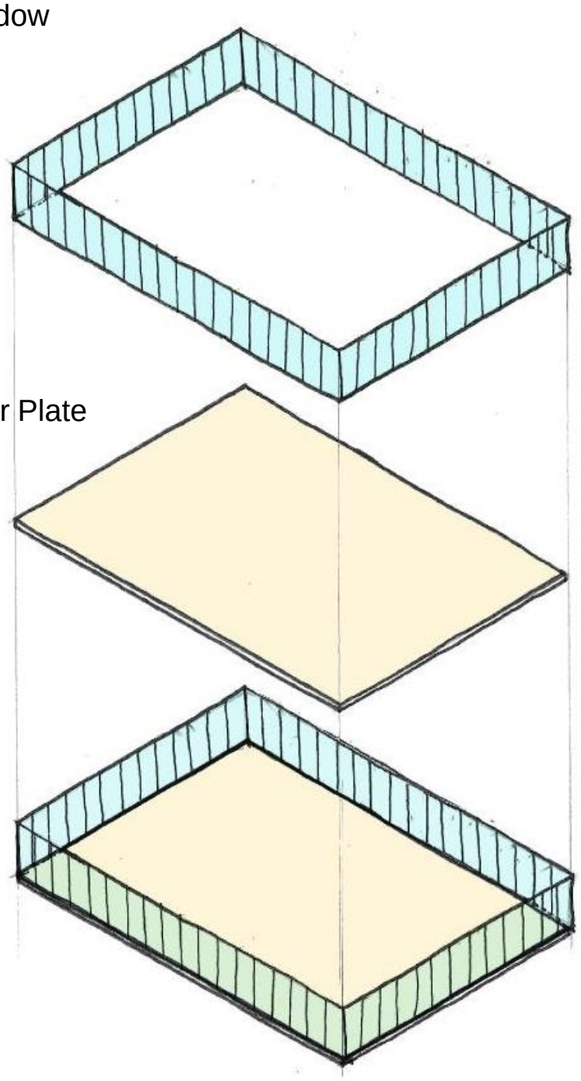


Design Strategy
Window / Floor Ratio

Design strategy to decrease window / floor ratio to achieve better Overall Thermal Transfer Value (OTTV).

SCENARIO A

Typical Window
X m^2



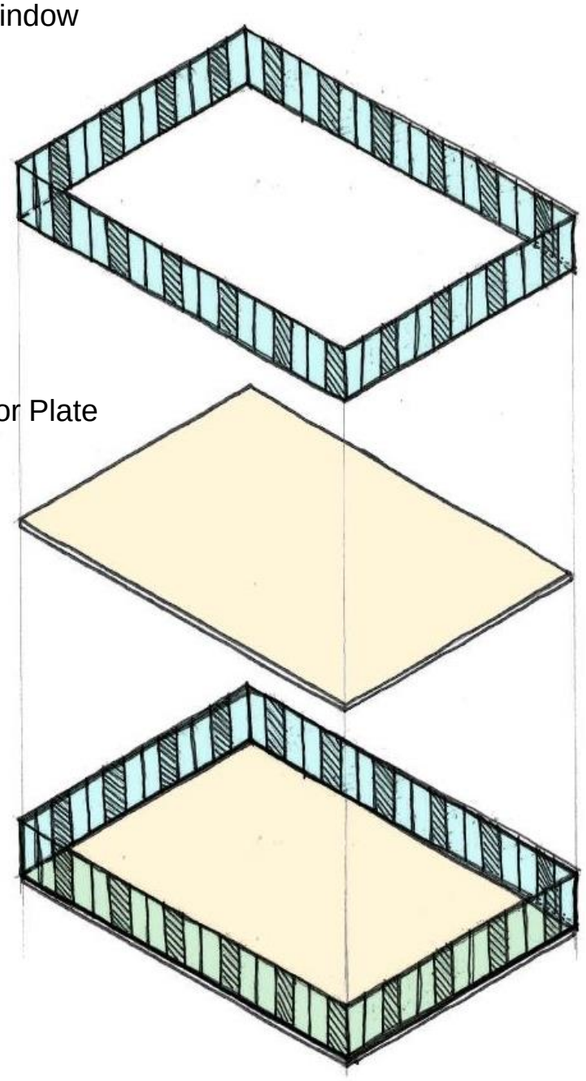
Typical Floor Plate
2500m^2

Typical Window/Floor Ratio
X ÷2500 m^2

X ÷2500 m^2

SCENARIO B

Typical Window
Y m^2



Typical Floor Plate
2500m^2

Typical Window/Floor Ratio
Y ÷2500 m^2

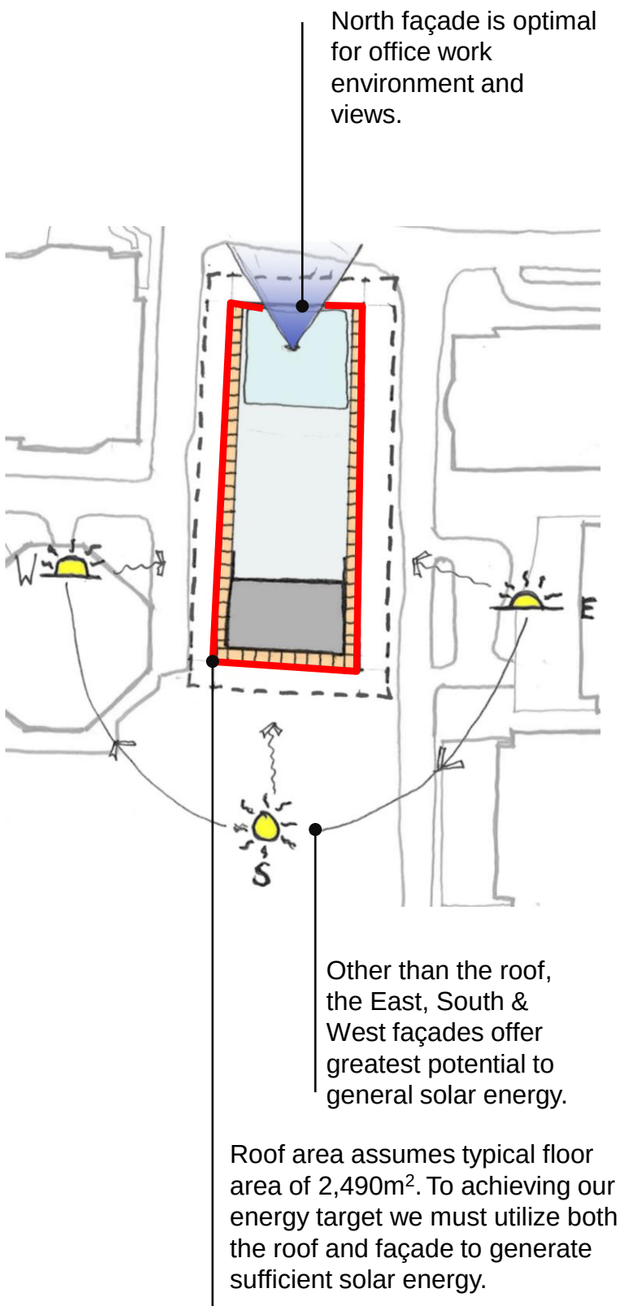
Y ÷2500 m^2

>

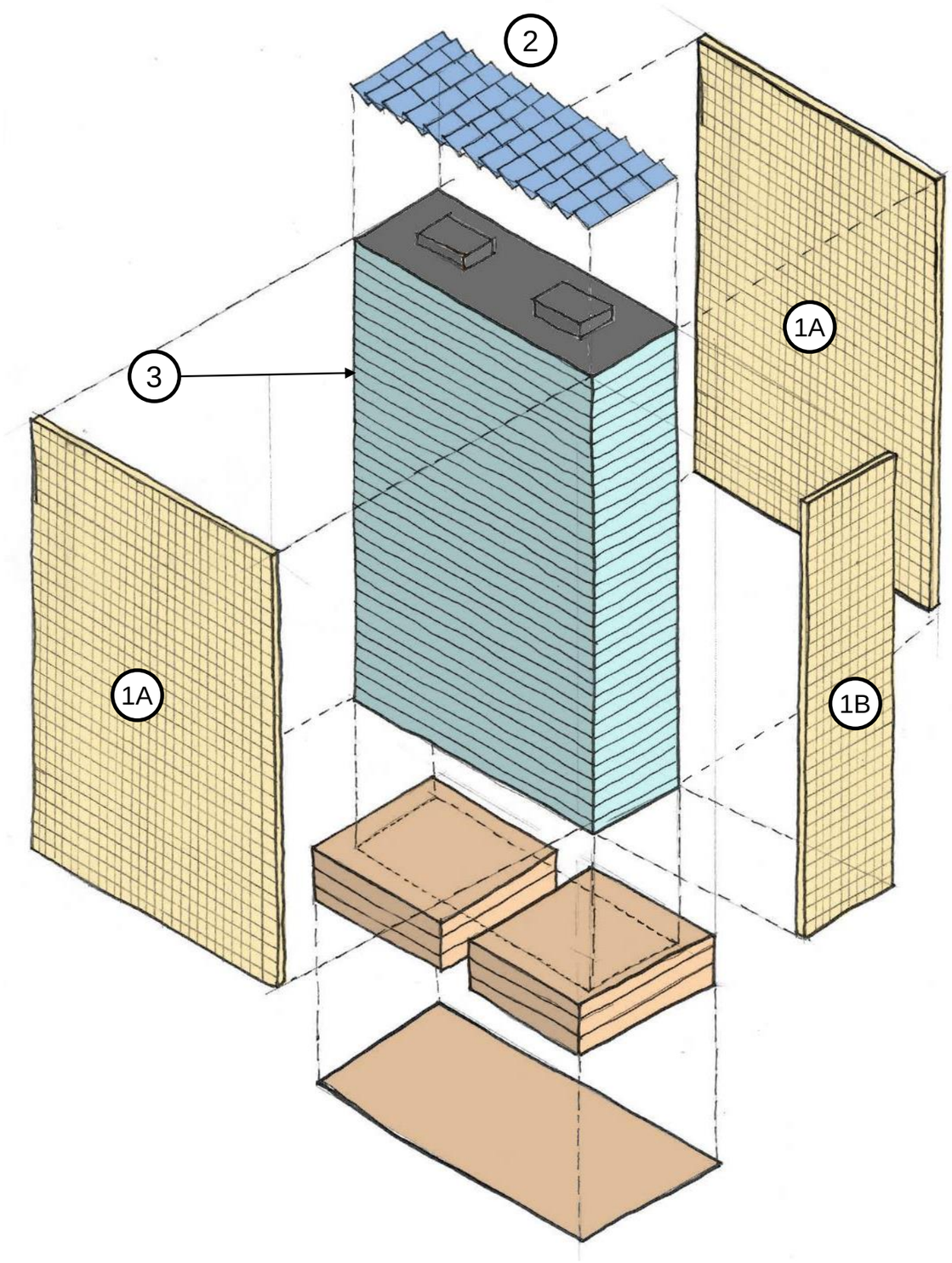
OBJECTIVE: ACHIEVE LOWER WINDOW-FLOOR RATIO

Design Strategy
Building Facade

East, South & Western building façade provides greatest opportunity for solar power generation.



Roof area assumes typical floor area of 2,490m^2. To achieving our energy target we must utilize both the roof and façade to generate sufficient solar energy.



1A
Tower - East Façade
No. of Storeys: 35 , 4.5m height
Façade Length 83m
Area = 35storeys x (83m x 4.5m)
Total Tower - East Façade Area = 13,075m^2

1A
Tower - West Façade
No. of Storeys: 35 , 4.5m height
Façade Length 83m
Area = 35storeys x (83m x 4.5m)
Total Tower - West Façade Area = 13,075m^2

1B
Tower - South Façade
No. of Storeys: 35 , 4.5m height
Façade Length 83m
Area = 35storeys x (30m x 4.5m)
Total Tower - South Façade Area = 4,725m^2

Tower – East, West & South Area Summary
East + West + South Façade Area:
13,075m^2 + 13,075m^2 + 4725m^2
= 30,870m

2
Roof
No. of Storeys: 1 level
Roof Area: 2**,490**m^2

Tower – E, W, South & Roof Area Summary
E,W & S Façade Area + Roof Area:
30,870m^2 + 2490m^2
= 33,360m

Design Strategy
Active Systems

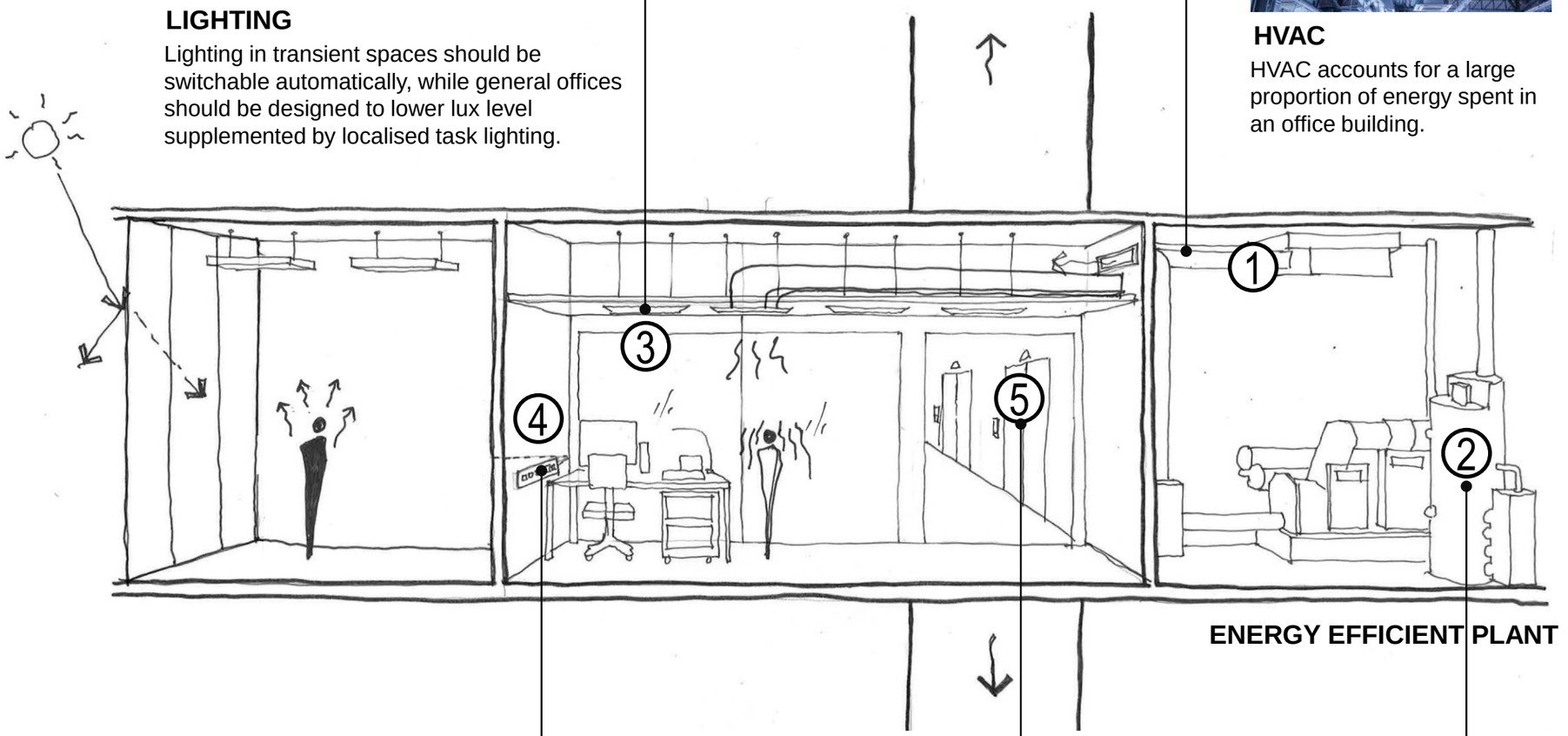
HVAC, Lighting, hot water, movement systems, and plug load are key active systems where energy-saving measure should be implemented.

LIGHTING

Lighting in transient spaces should be switchable automatically, while general offices should be designed to lower lux level supplemented by localised task lighting.

HVAC

HVAC accounts for a large proportion of energy spent in an office building.



ENERGY EFFICIENT PLANT

PLUG LOAD

Plug Load should be reduced by using energy efficient appliances.

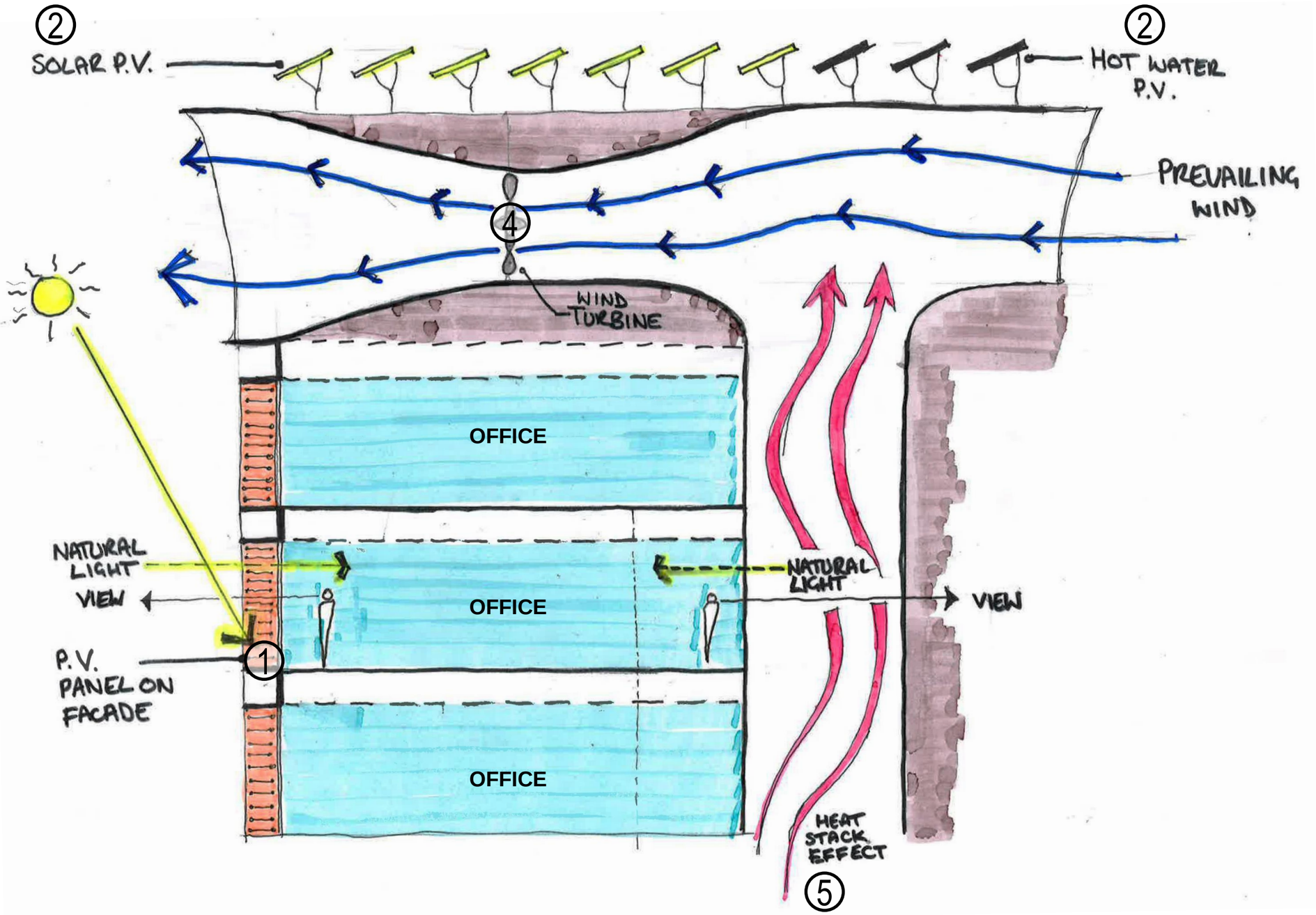
MOVEMENT SYSTEMS

Energy Recuperation Lifts can be installed in addition to lift optimization programme based on peak flow demand.

HOT WATER

Hot water can be provided by solar panels on roofs since hot water usage is not a high demand in offices.

Design Strategy
Passive Systems



Passive systems utilised in the design strategy:

1. Energy Efficient Façade where solar heat within the system can be removed, e.g. ventilated double facade, supplemented by external shading or horizontal / vertical projections.

2. PV Panels on roofs as well as spandrel panels of the façades.

3. Light Reflectors, Solar Light Tubes provide natural light deep into spaces typically illuminated by artificial lights.

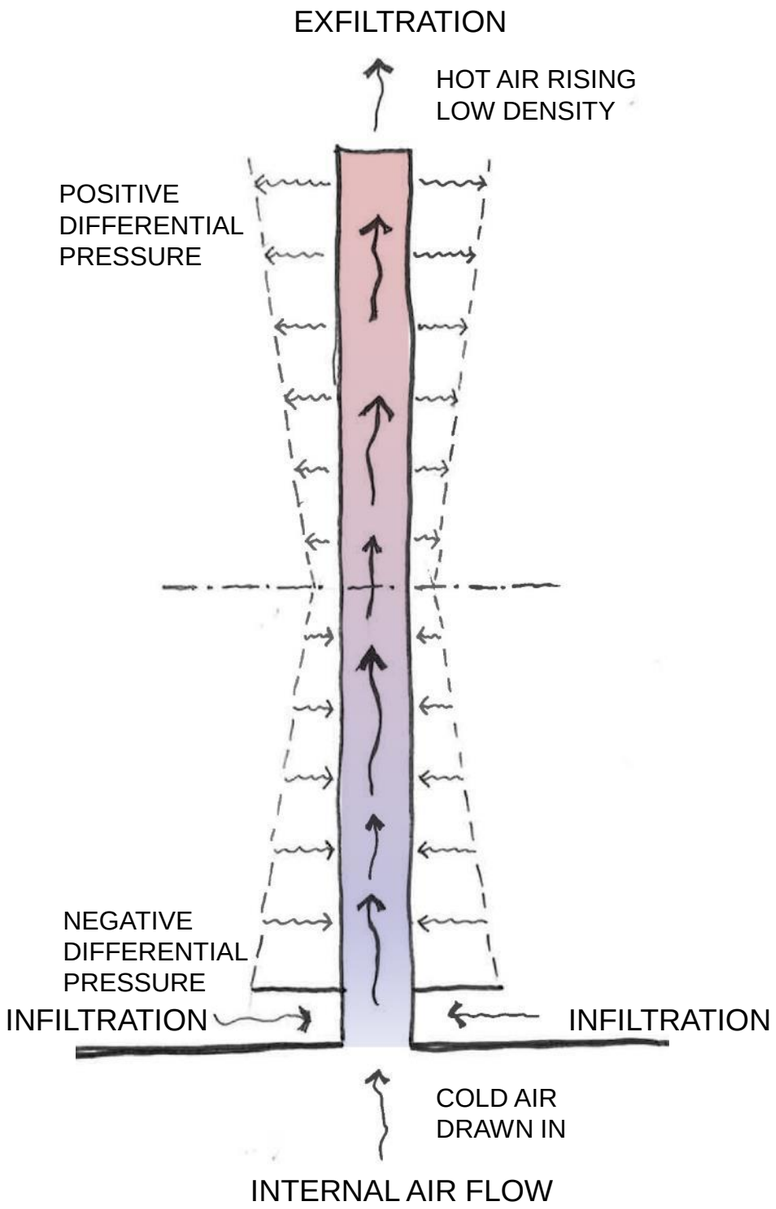
4. Wind Turbines provide a much higher energy generation efficiency than solar panels because they work throughout 24 hours.

5. Natural Ventilation by heat stack effect provides thermal comfort by convection and excess heat removal.

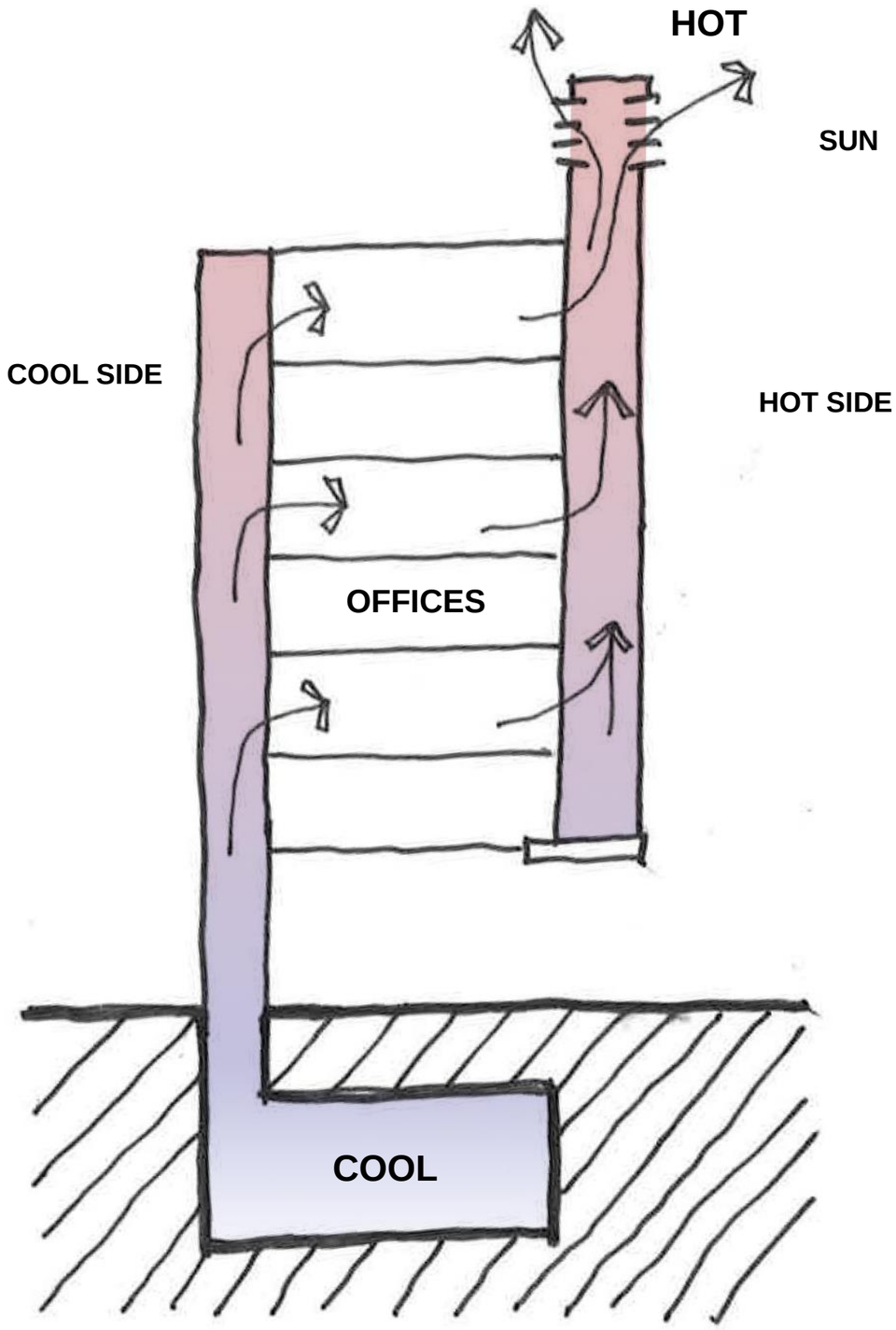
Design Strategy

Passive Systems - Heat Stack Effect

PRINCIPLE STACK EFFECT



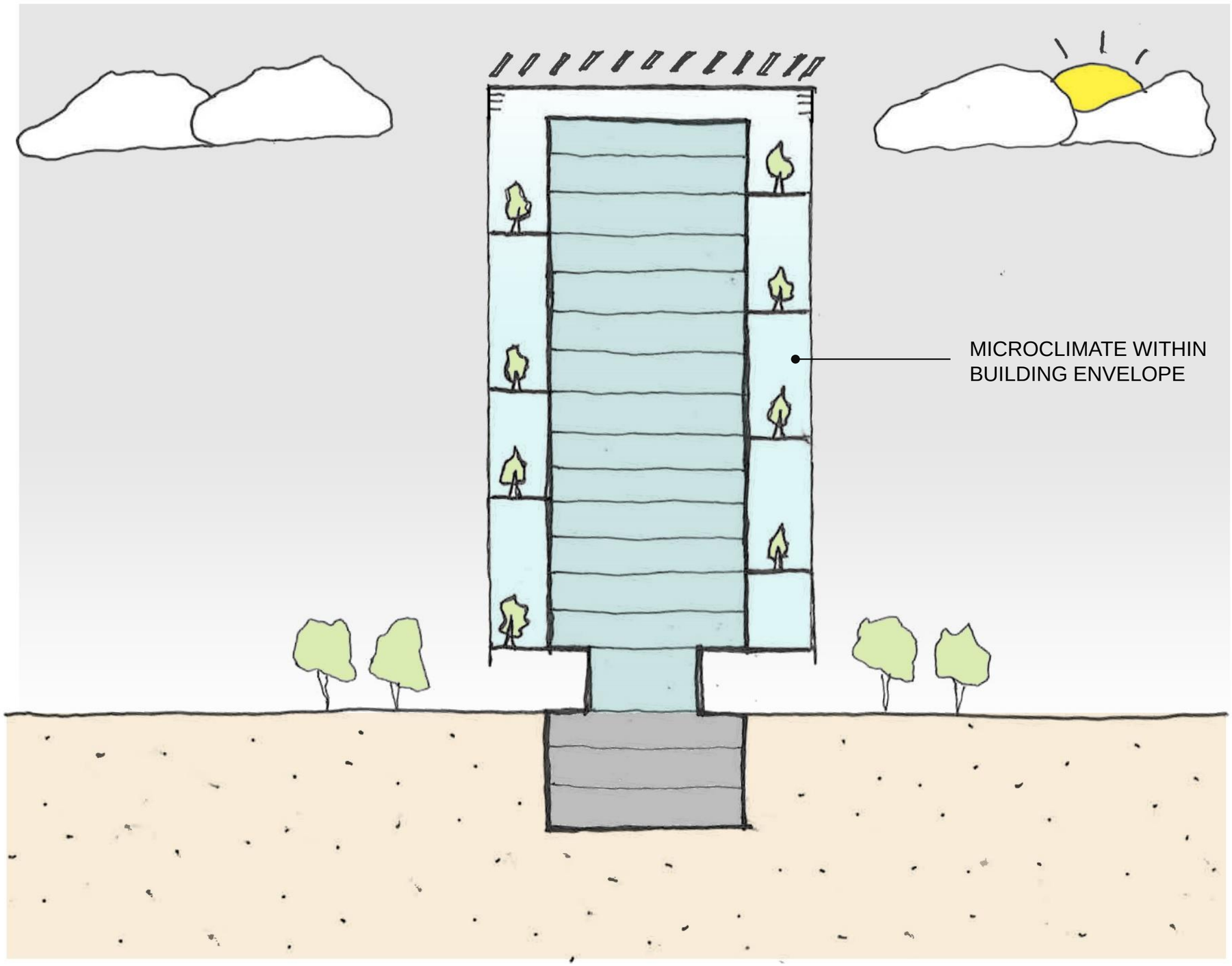
OPTIMISED VENTILATION HEAT STACK



As air warms it becomes less dense, more buoyant, and therefore has a tendency to rise through the building, which can be used to naturally ventilate the building.

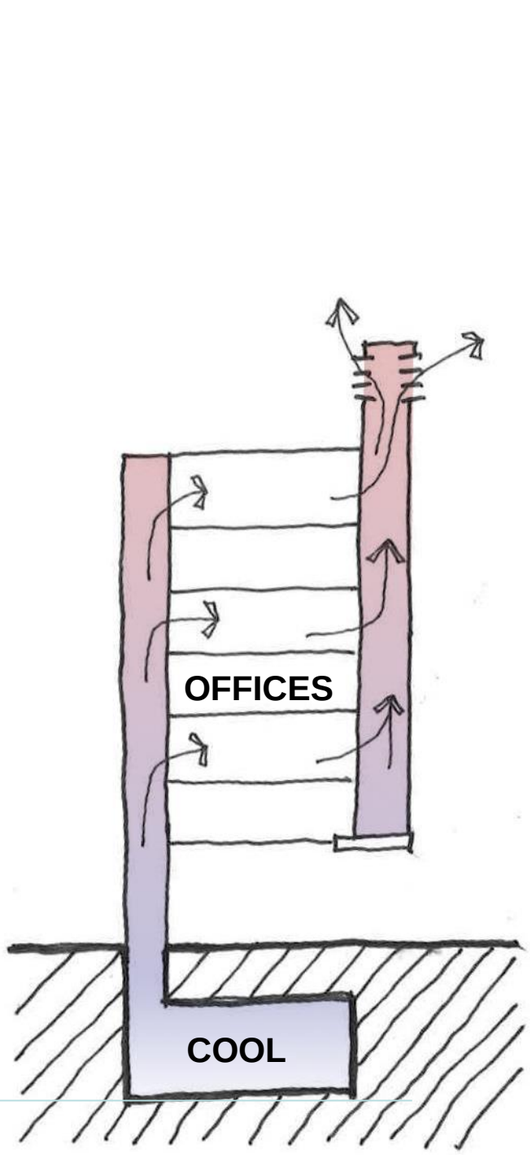
Innovative Technologies
Microclimate Envelope

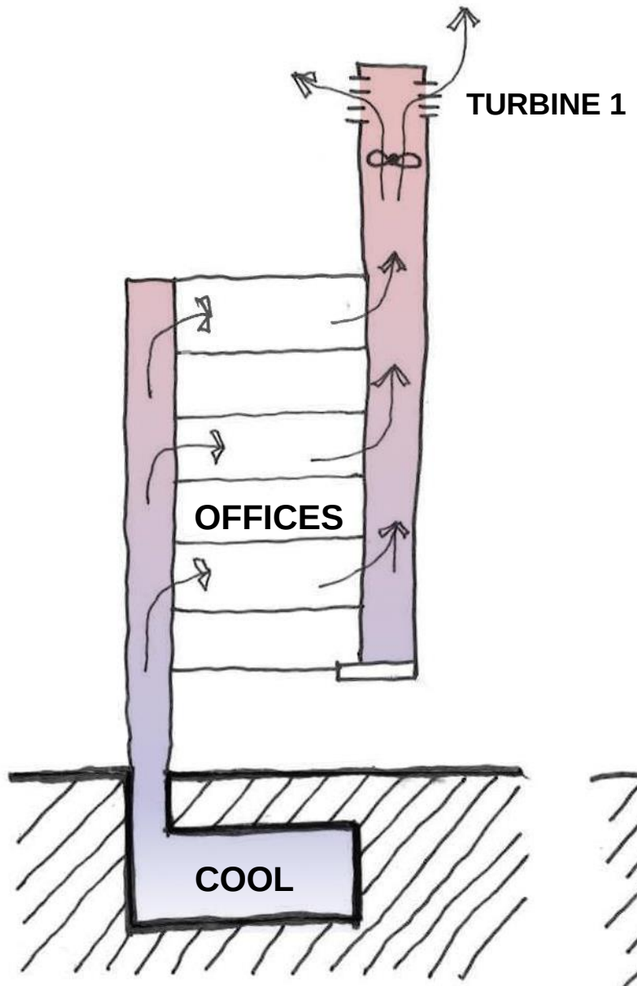
Create a microclimate within the building envelope that can assist in managing the building overall energy equation, tempering thermal comfort, and providing accessible amenities for tenants' well-being.

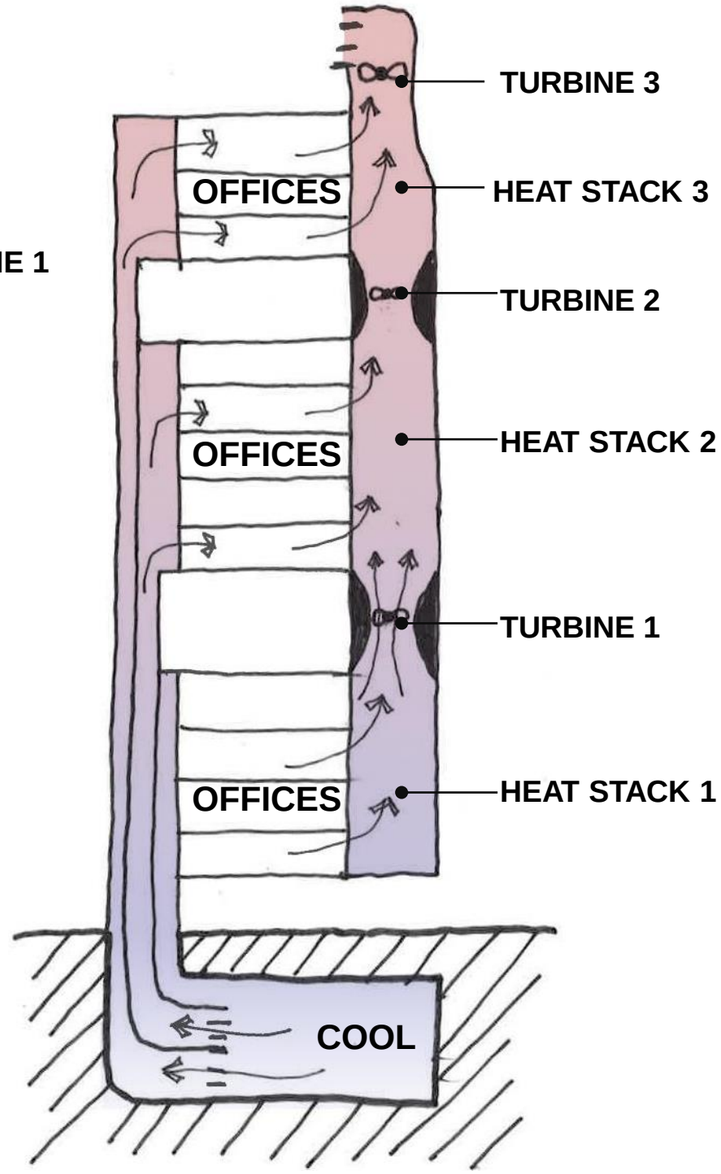


Innovative Technologies
Multiple Heat Stack

Wind generated power typically relies on prevailing wind. Turbines can be placed in heat stacks to harvest the updraft of hot air rising through the stack. Once air has passed the turbine it can still be harvested by another stack above.

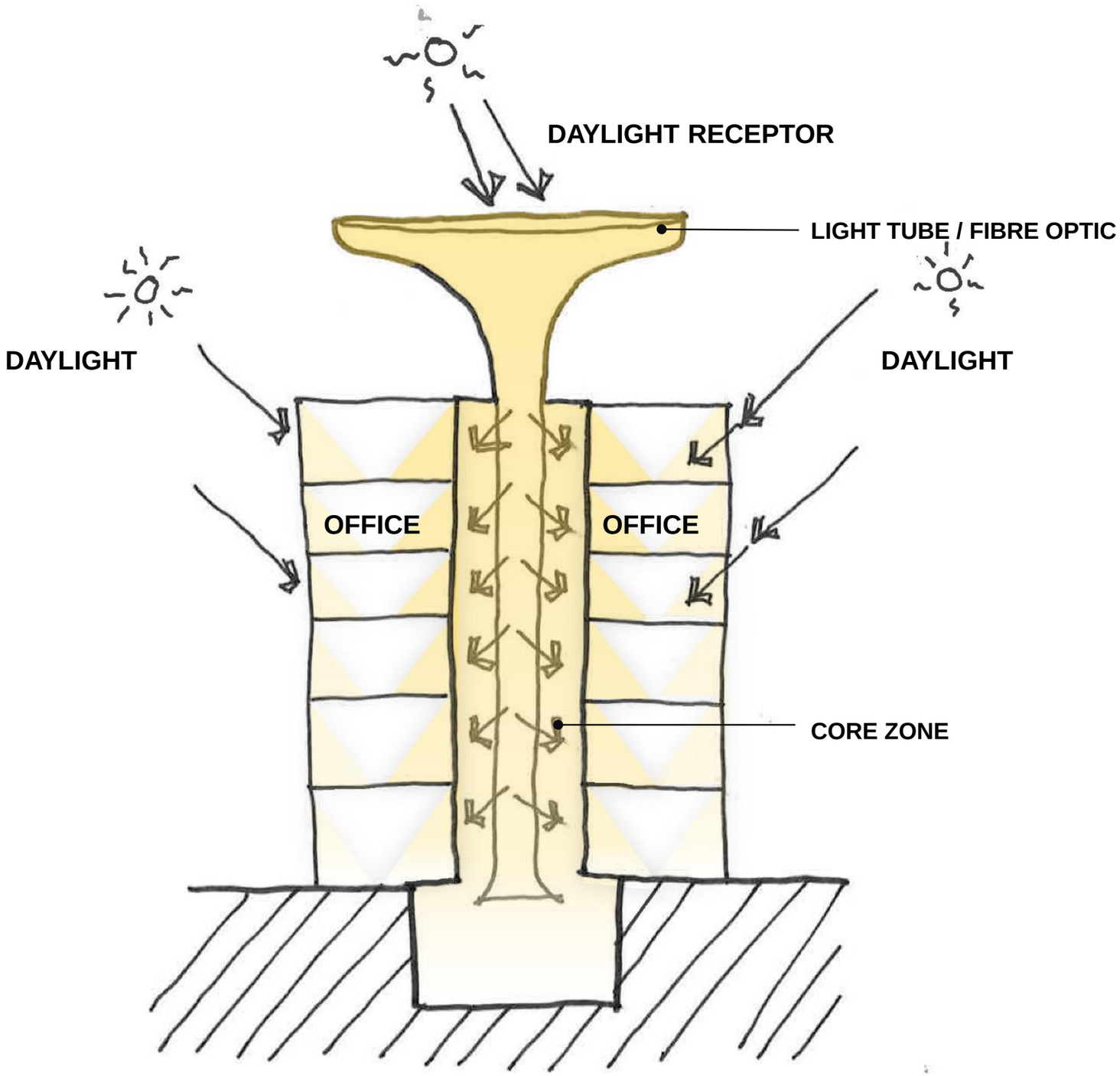




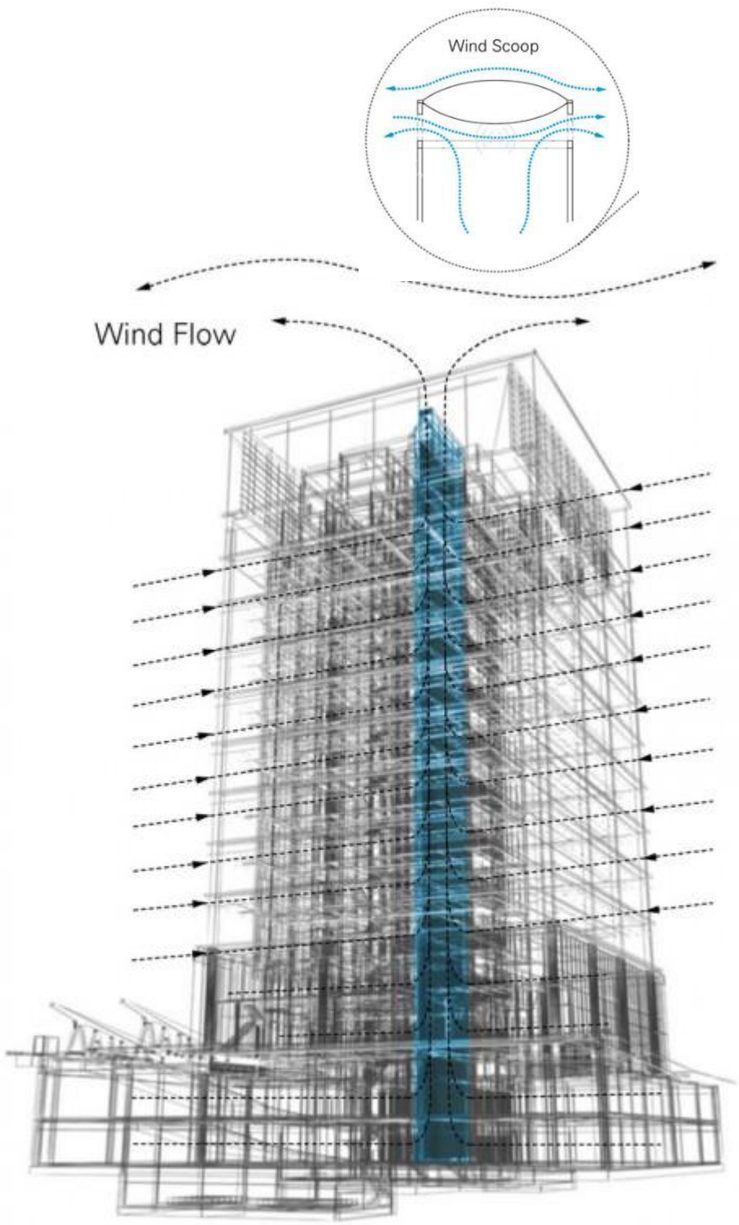


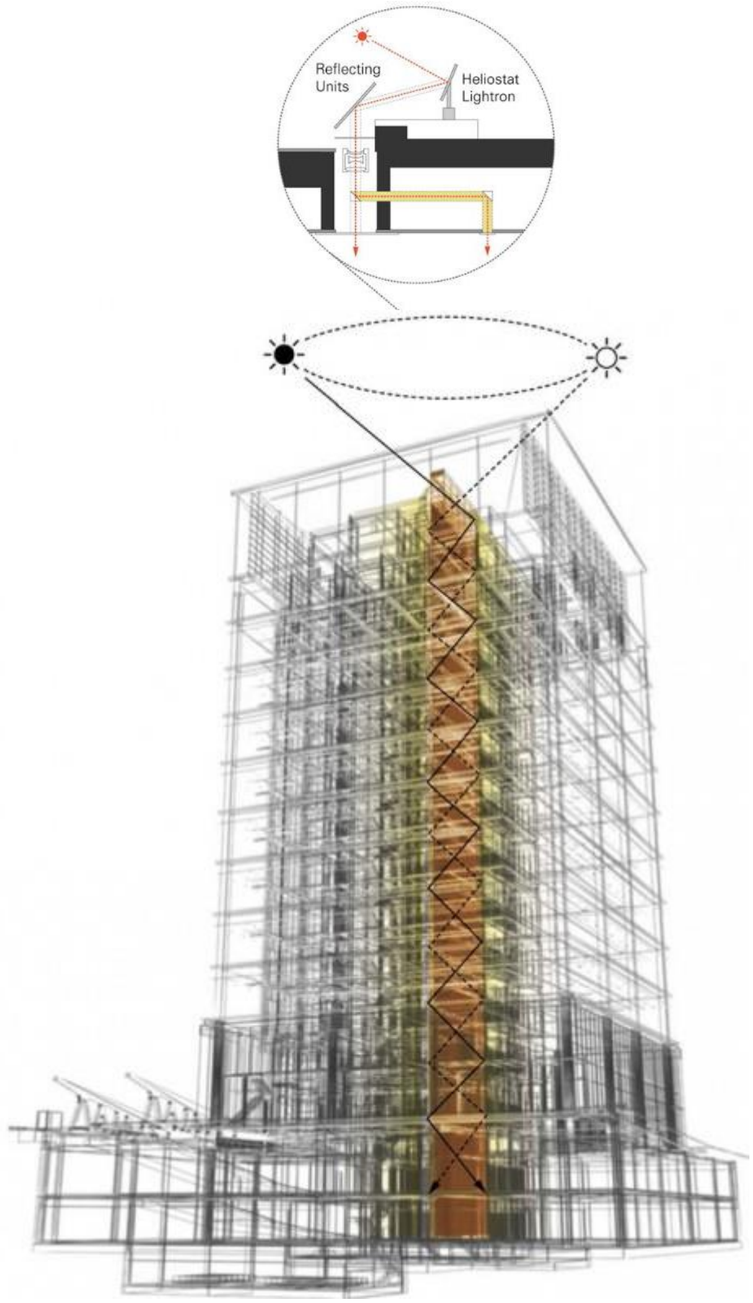
Innovative Technologies
Heliostat Lighting

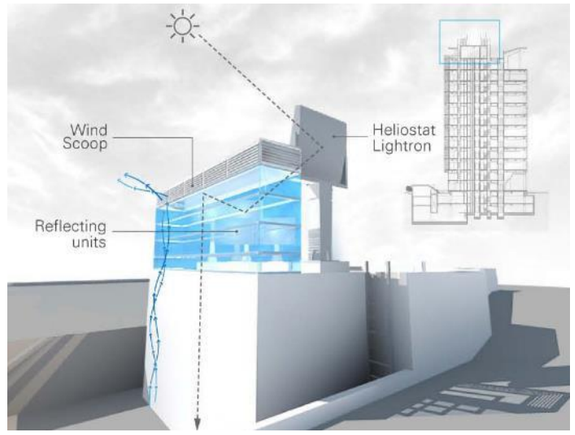
Heliostat to refract light through the core to bring natural light to spaces where light can only be provided by artificial lighting e.g. common areas, lobbies & basement.

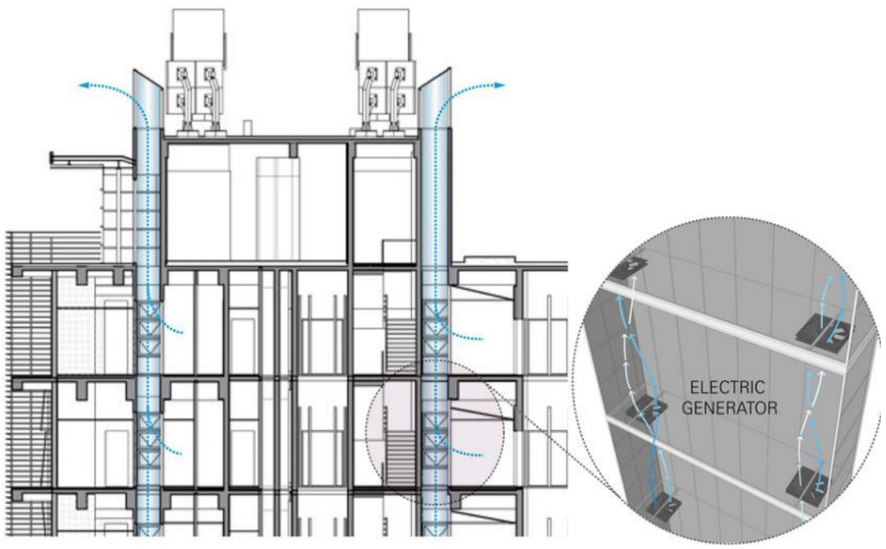


Innovative Technologies
Multi-purpose Ventilation and Light Shaft









Atrium, light and ventilation shaft, with wind scoop and heliostat to enhance

Natural ventilation by stack effect and wind effect
Natural daylight by heliostat, reflecting units and light pipe

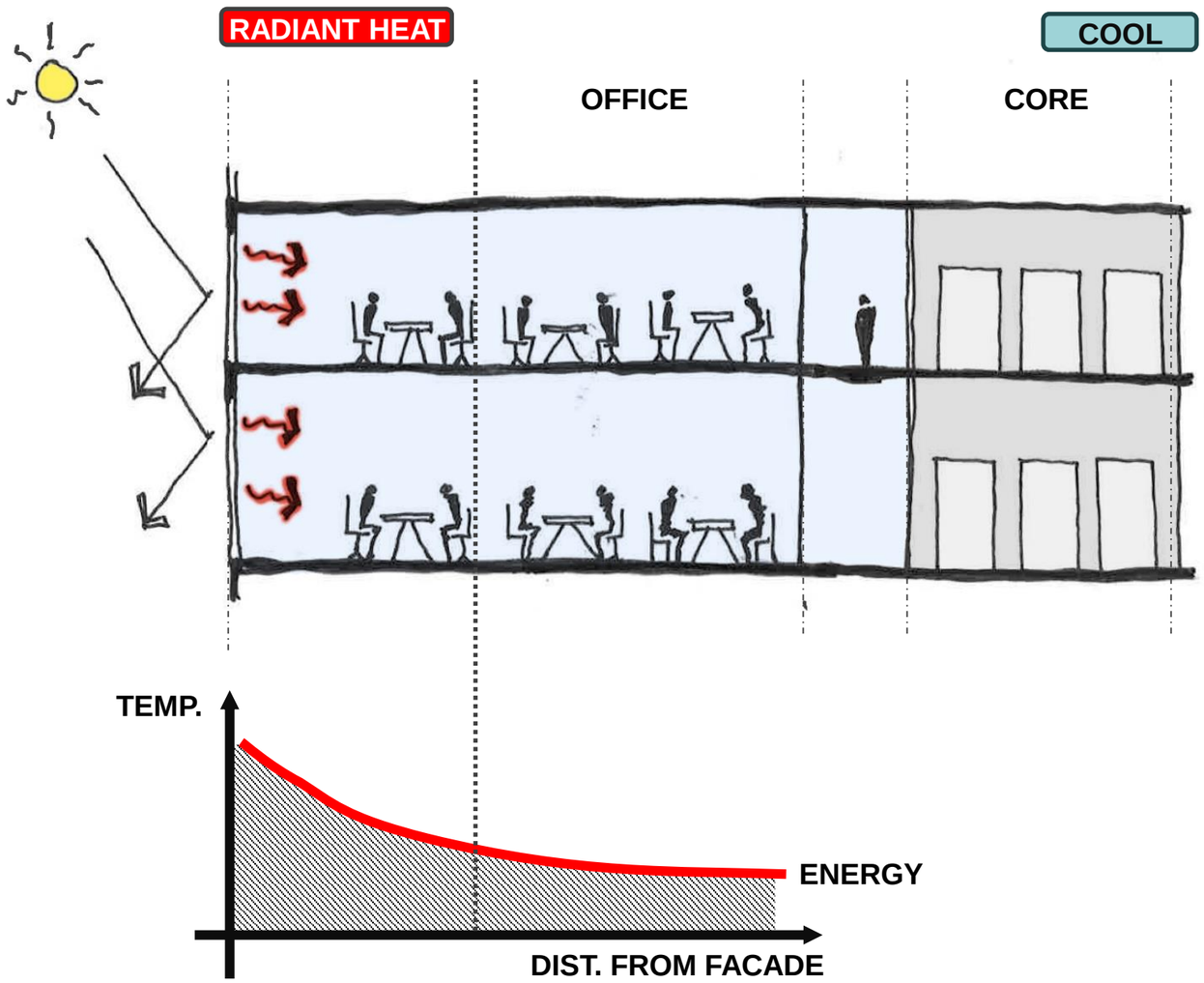
Micro wind turbines arranged at various height of the shaft

Innovative Technologies

Stratified Plan Zones based on Cooling Load Gradient

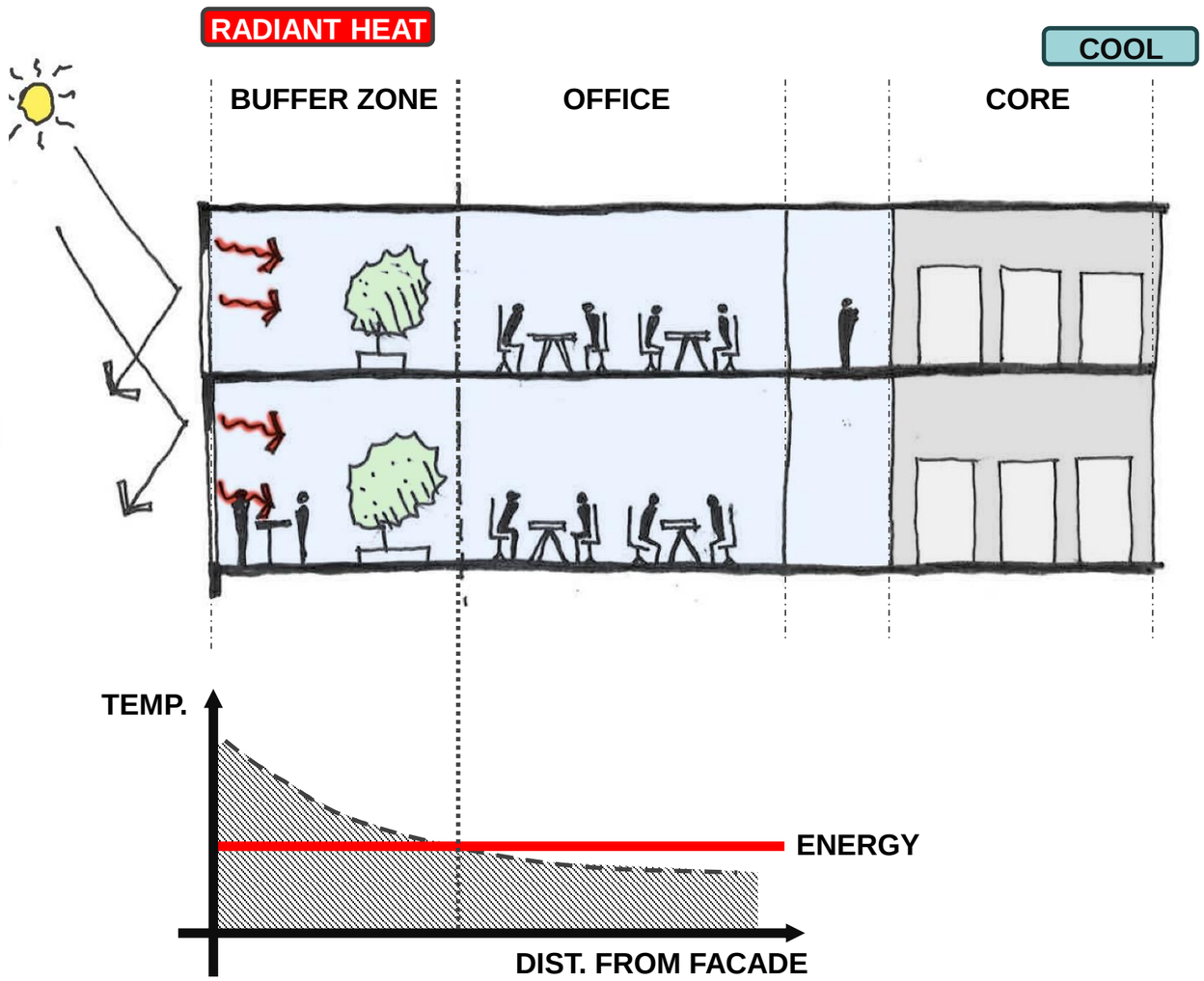
By creating a buffer zone for transient activities, which require less cooling than a static activity, along the facades mean the energy curve can be flattened to save energy.

CONVENTIONAL OFFICE



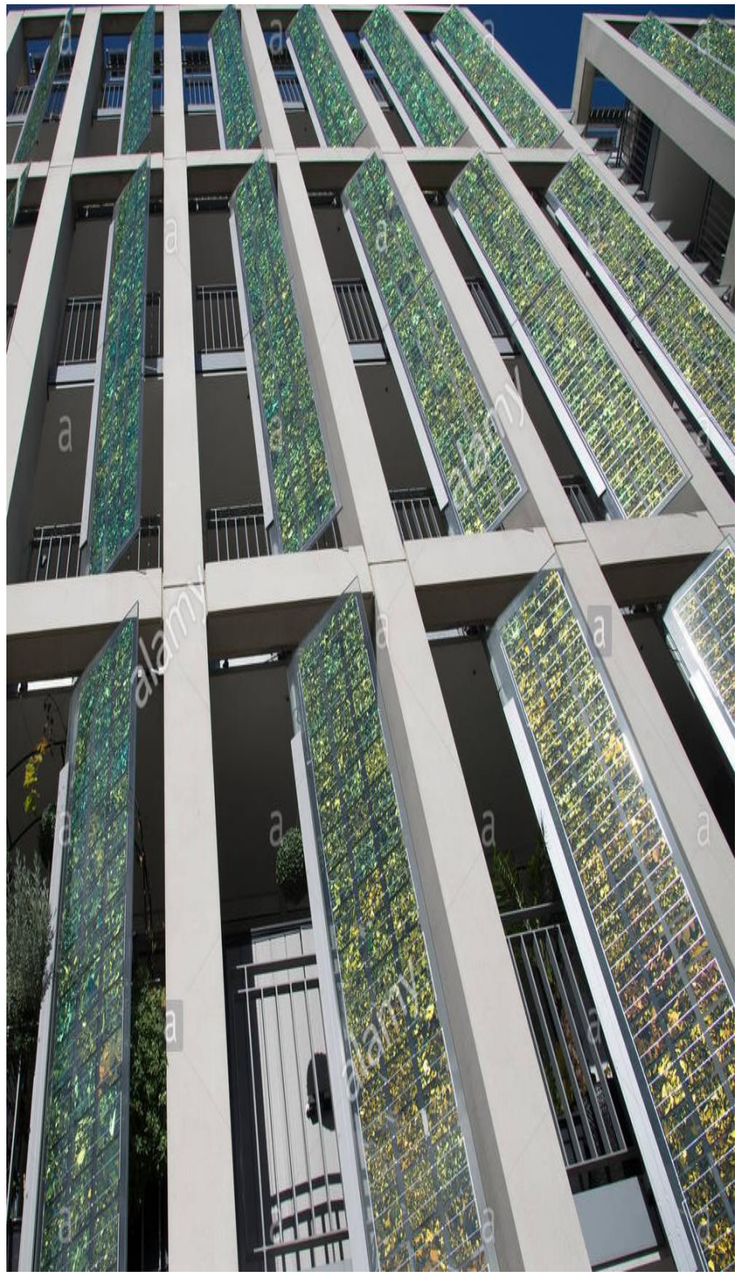
COOLING GRADIENT FOR
CONVENTIONAL PLAN

BUFFER ZONE



COOLING GRADIENT WITH
INTRODUCTION OF BUFFER ZONE

Office plan with spacious break out area around perimeter for causal meeting and amenity, which also serves as thermal buffer zone

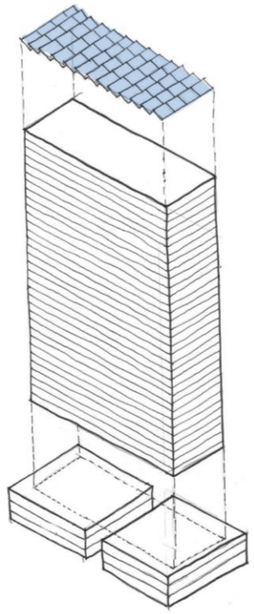
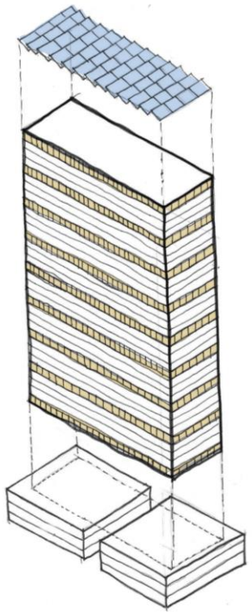
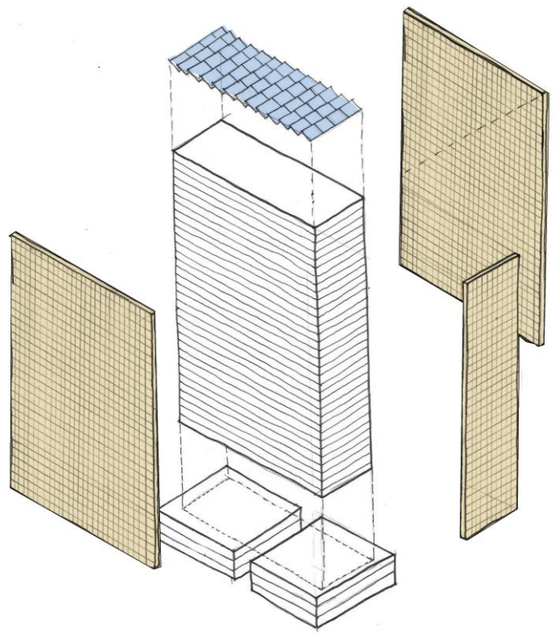
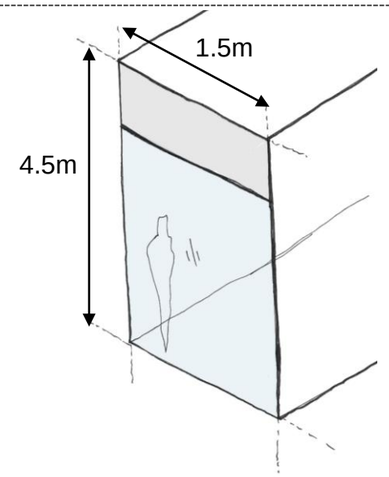
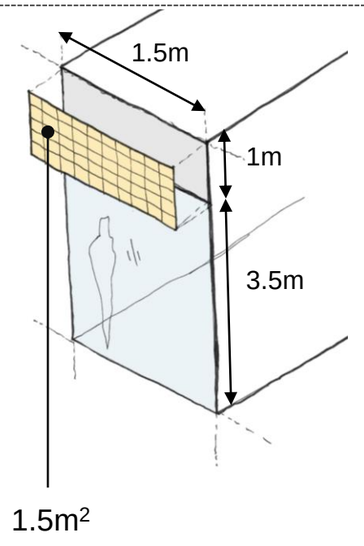
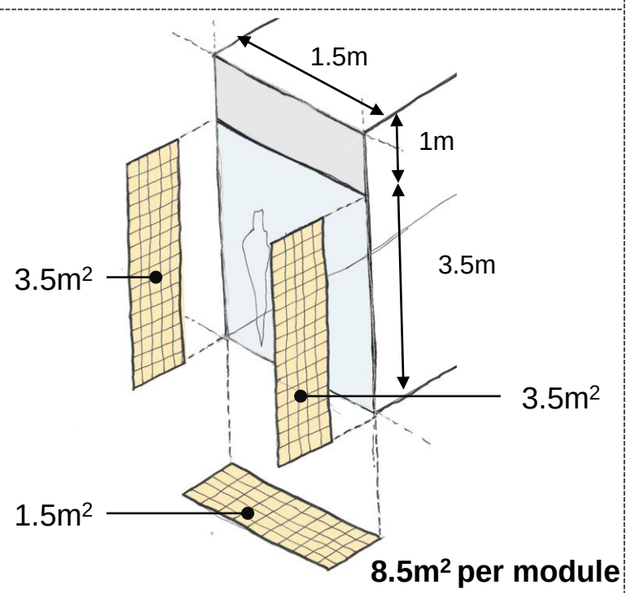


Solar shading device with horizontal overhang and vertical fins covered by non-reflective PV panel

Design Strategy

Increased P.V. Area & Window Ratio

Introduce PV on both sides of vertical fins and a horizontal shelf greatly increases the ratio of PV to window. The solar shelf façade meets our target PV area equal to 1/3 of the floor area of the building (31,300m^2).

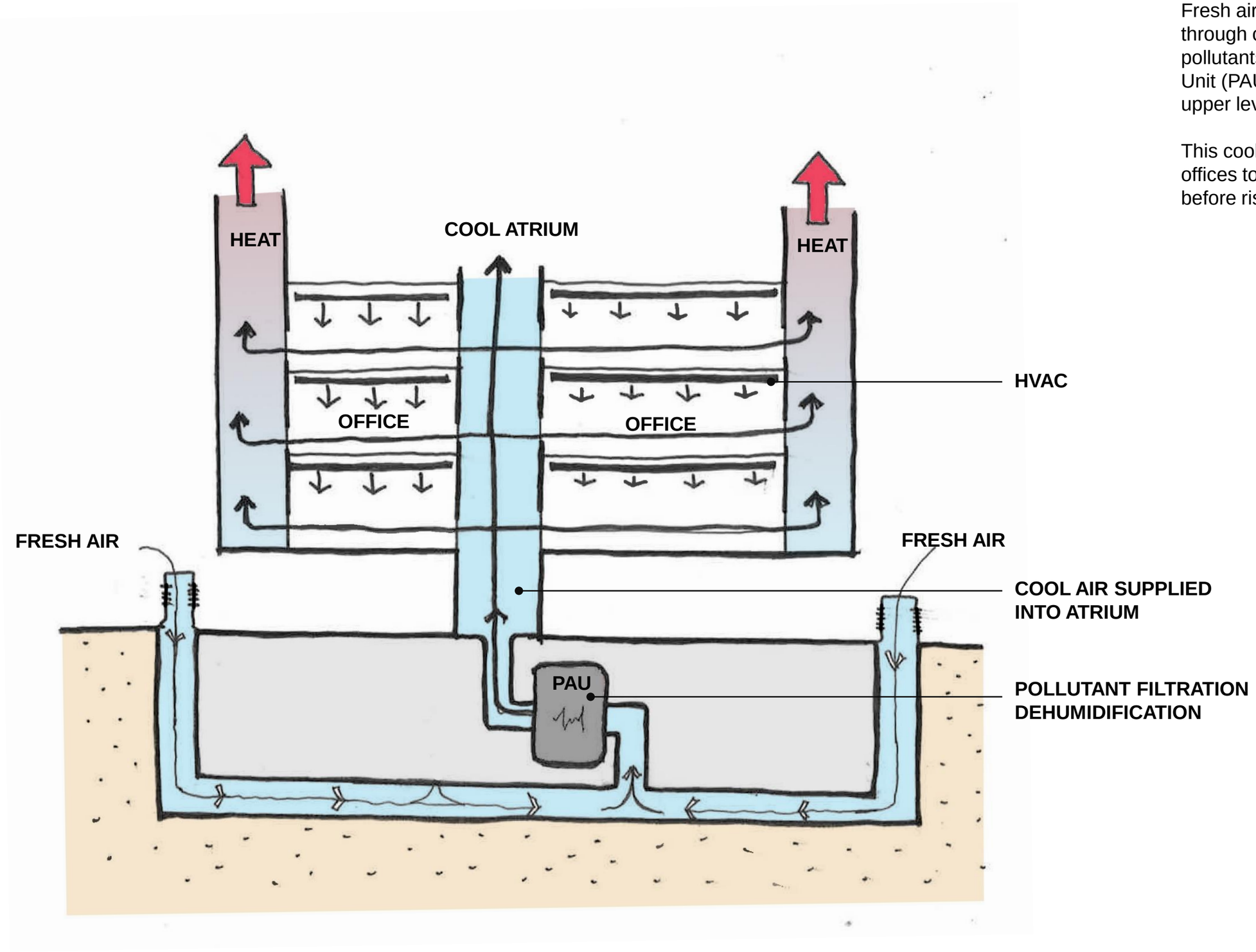
BUILDING FAÇADE			
FAÇADE MODULE		 **1.5m² per module**	 **8.5m² per module**
ROOF P.V.	2400m^2	2400m^2	2400m^2
SPANDREL P.V.		6650m^2	
SOLAR SHELF			35,700m^2
TOTAL P.V.	**2400m^2**	**9050m^2**	**38,100m^2**

Innovative Technologies

Earth Cooling to Temper Primary Air

Fresh air intake at ground level and passes through cooling tubes. Air is filtered for pollutants and dehumidified at Primary Air Unit (PAU) before supplying atriums at upper level with cool air.

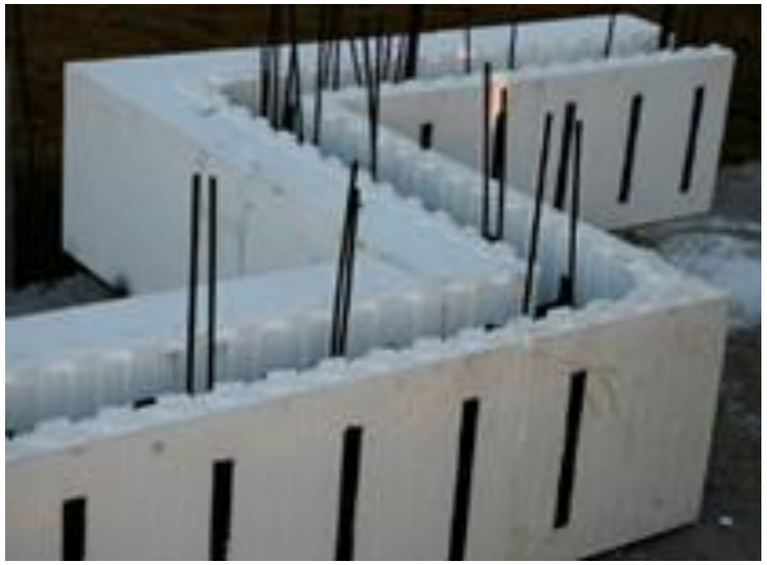
This cool air is cross-ventilated across offices to supplement HVAC systems before rising into heat stack.



Innovative Technologies

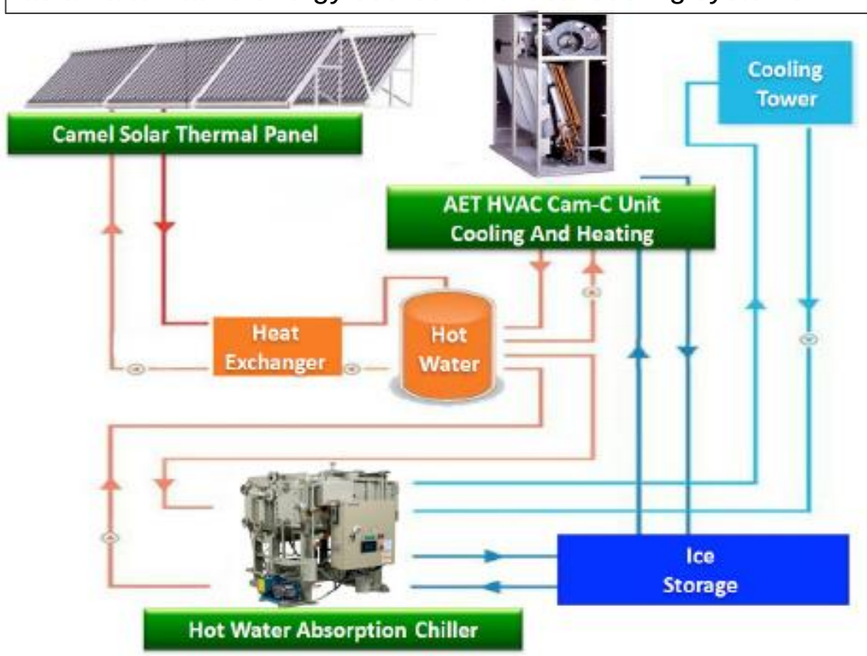
Active System – Fresh Air Pre-Cooling
Phase Changing Material and Ice Storage Chiller

Underground fresh air pre-cooling throught sunken entrance, courtyard and sub-structure and basement wall cavity.



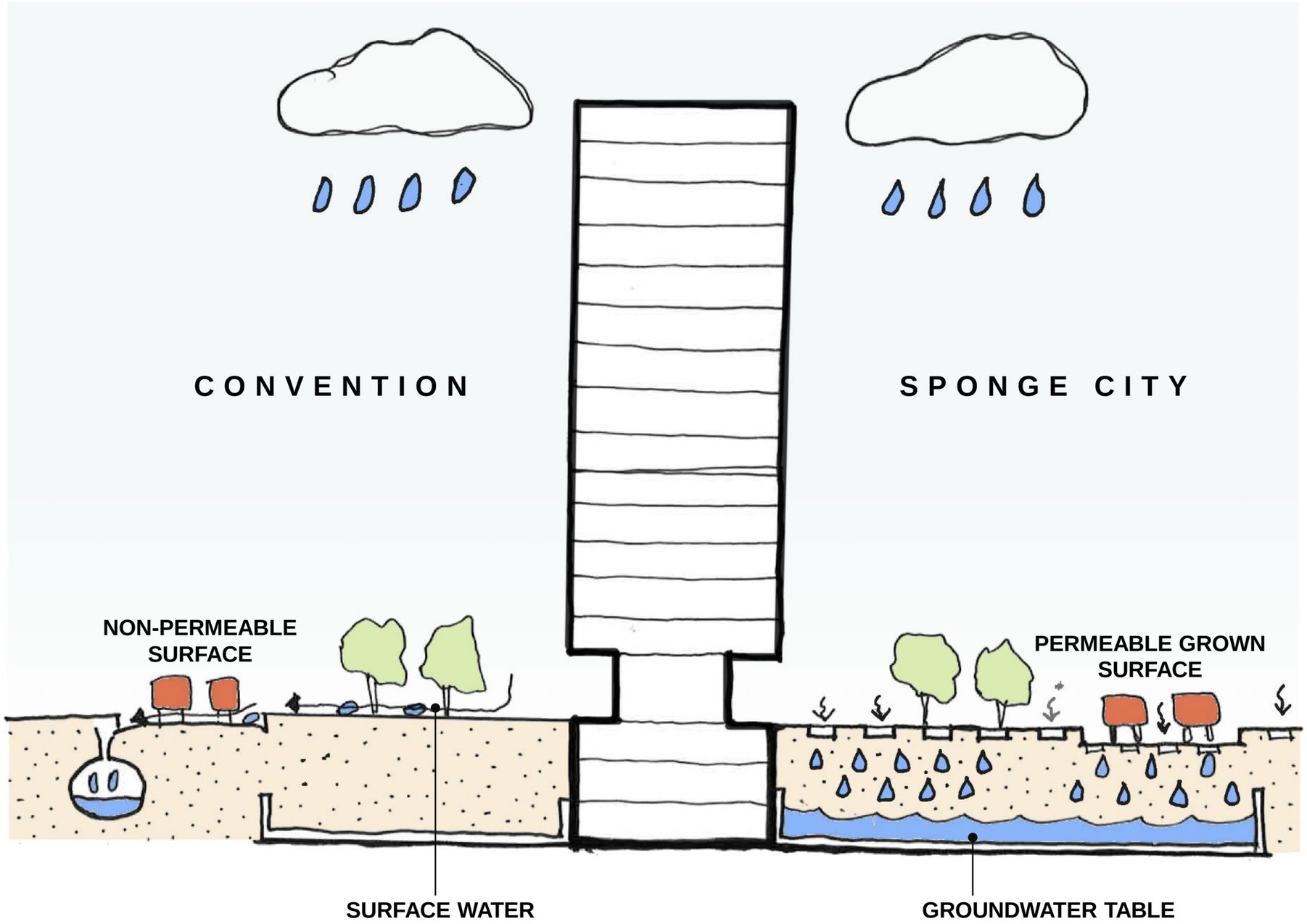
Phase Changing Material at strategic locations to store and release latent heat as designed to even out energy demand

Solar energy powered small capacity ice storage chiller to provide as an alternative energy source for critical cooling systems

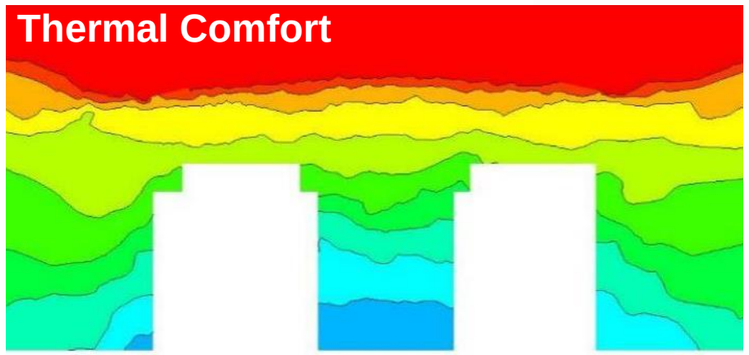


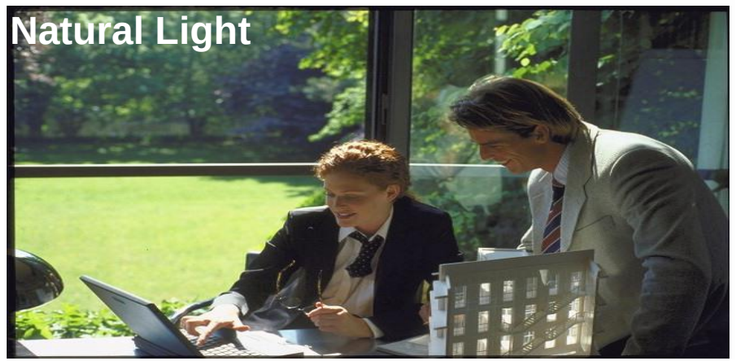
Innovative Technologies
Sponge City Concept

Create permeable ground surfaces to retain ground water instead of letting rain-water runoff and discharged into sewerage system.

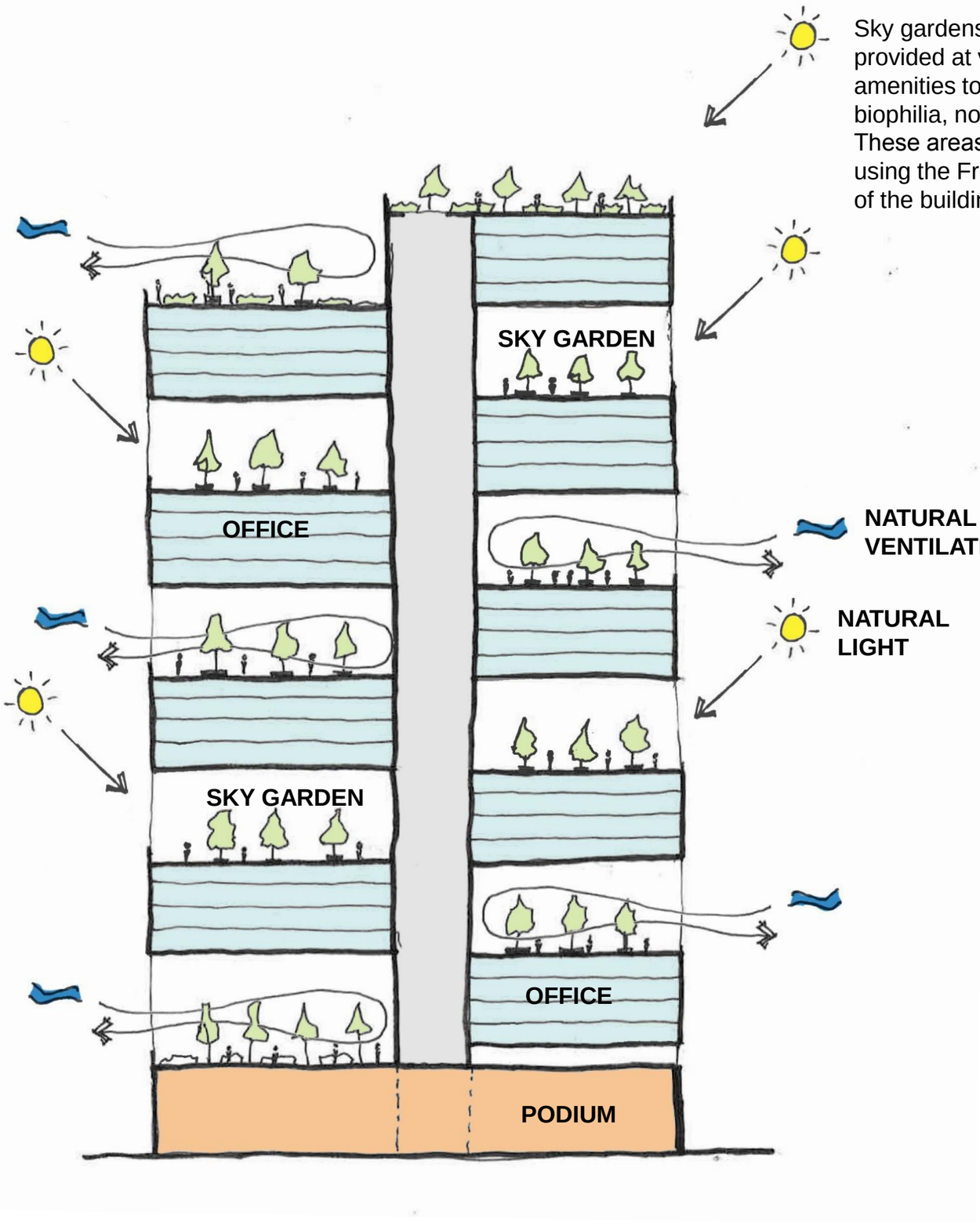


Occupant Wellbeing
Amenity to Light & Air





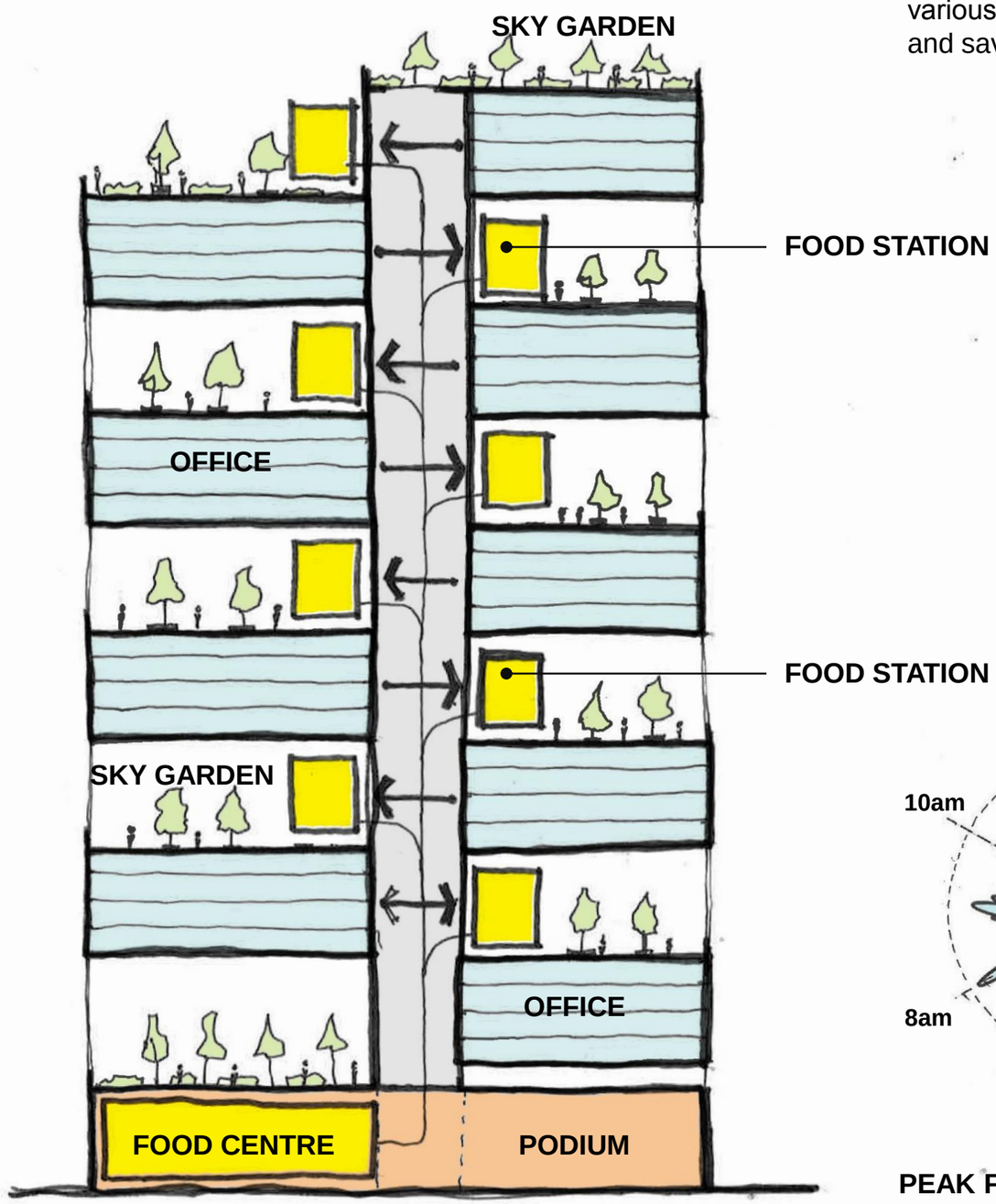
Sky gardens, rest areas, food stations are provided at various levels of the building as amenities to satisfy human needs for biophilia, nourishment, natural light and air. These areas are “naturally ventilated” using the Fresh Air within the microclimate of the building.

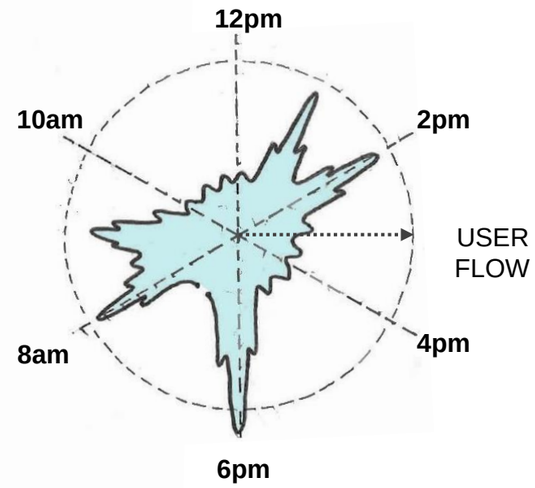


Occupant Wellbeing

Nourishment provisions & Accessibility

The building can operate a Hub and Spoke concept for F&B. Pre-ordered foods are prepared by Restaurants or Food Court and served through Food Stations at various levels for customers' convenience and saving journey time.





PEAK FLOW & DEMAND

Occupant Wellbeing
Health & Exercise

Sports centre, exercise areas in sky gardens should be planned around the building and in sky gardens to facilitate and to encourage a healthier lifestyle.