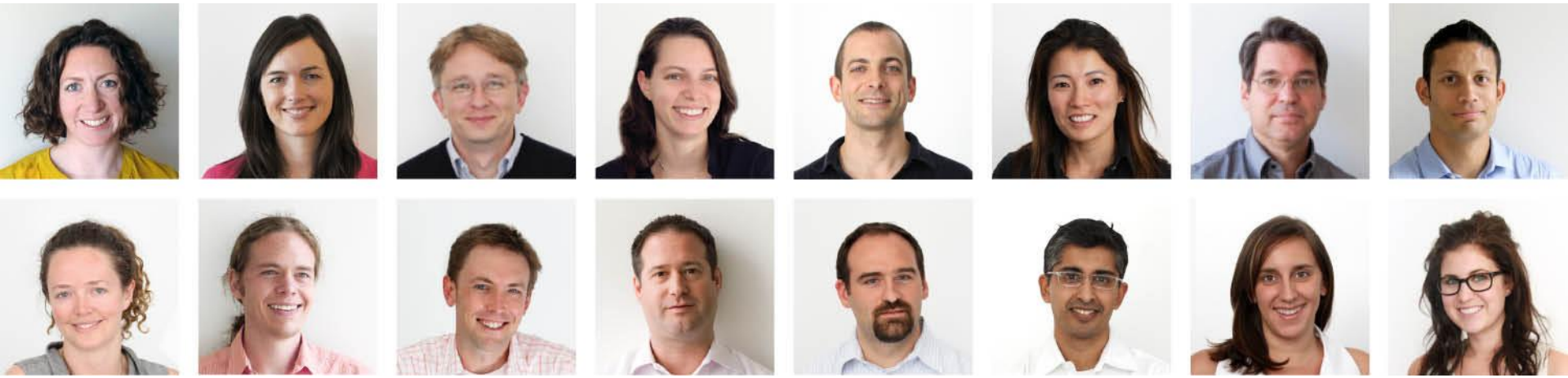
Atelier Ten – Daylight Case Studies

Radiance Workshop 2013

Golden, CO

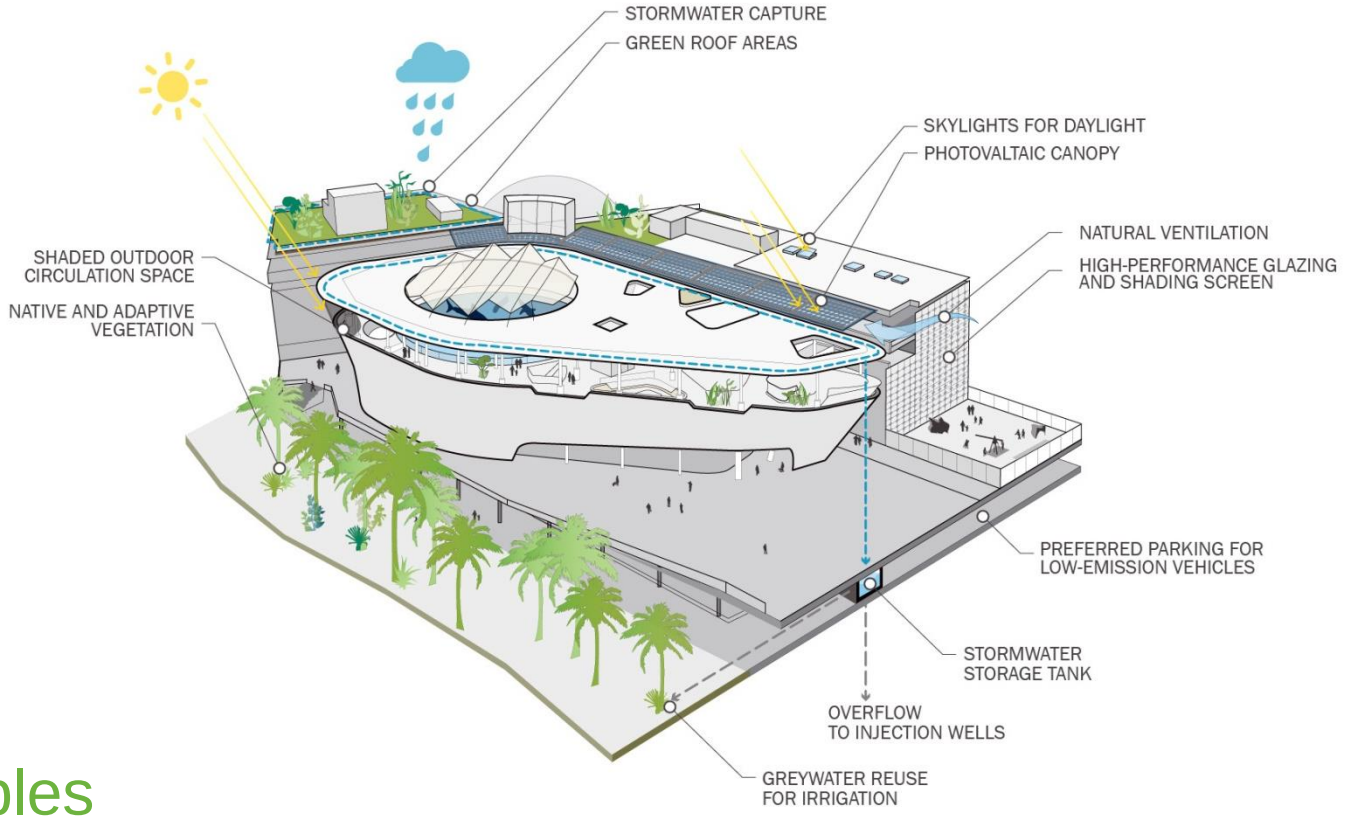
Jessica Zofchak

Senior Environmental Designer



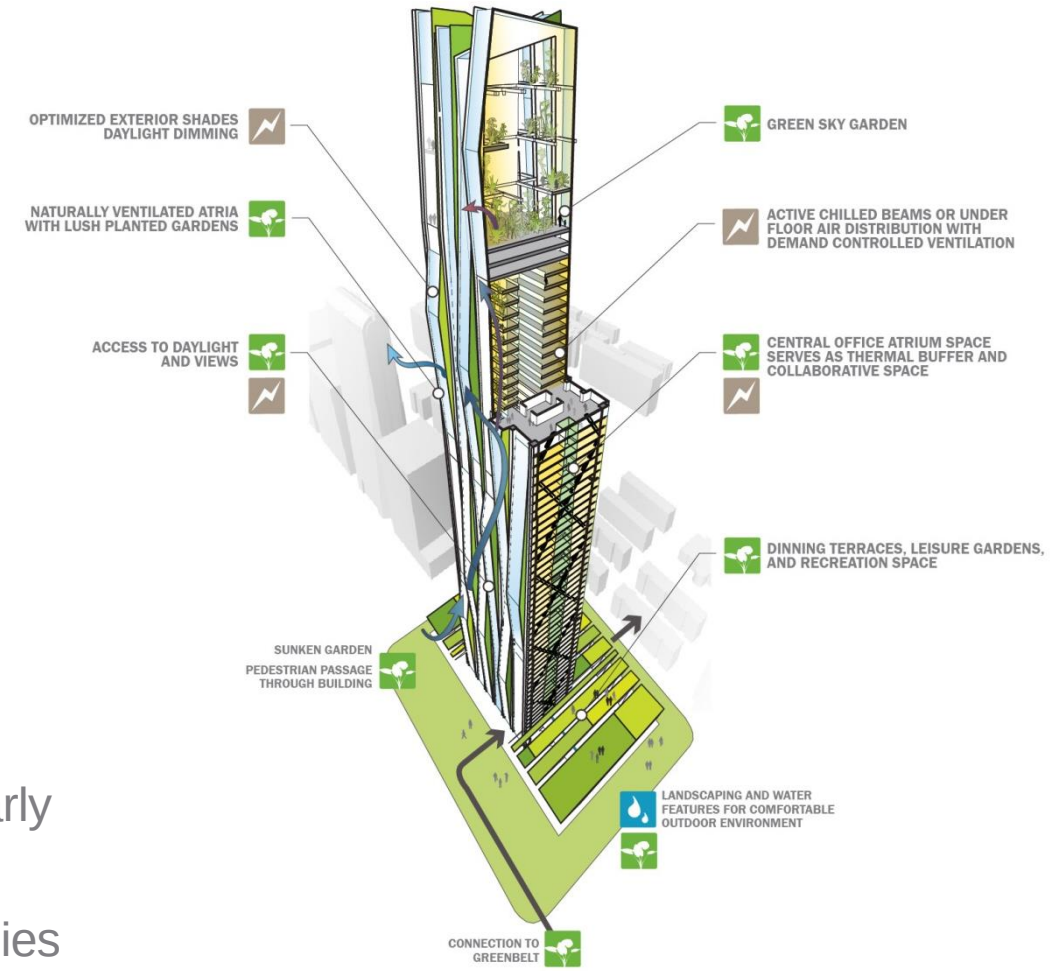
A legacy of positive change

We are an international team of environmental design consultants and lighting designers focused on delivering sustainability to the planned and built environment.



Practice Principles

- Buildings and landscapes do more, systems do less
- Design from first principles
- Integrated design process and solutions
- Pragmatic strategies

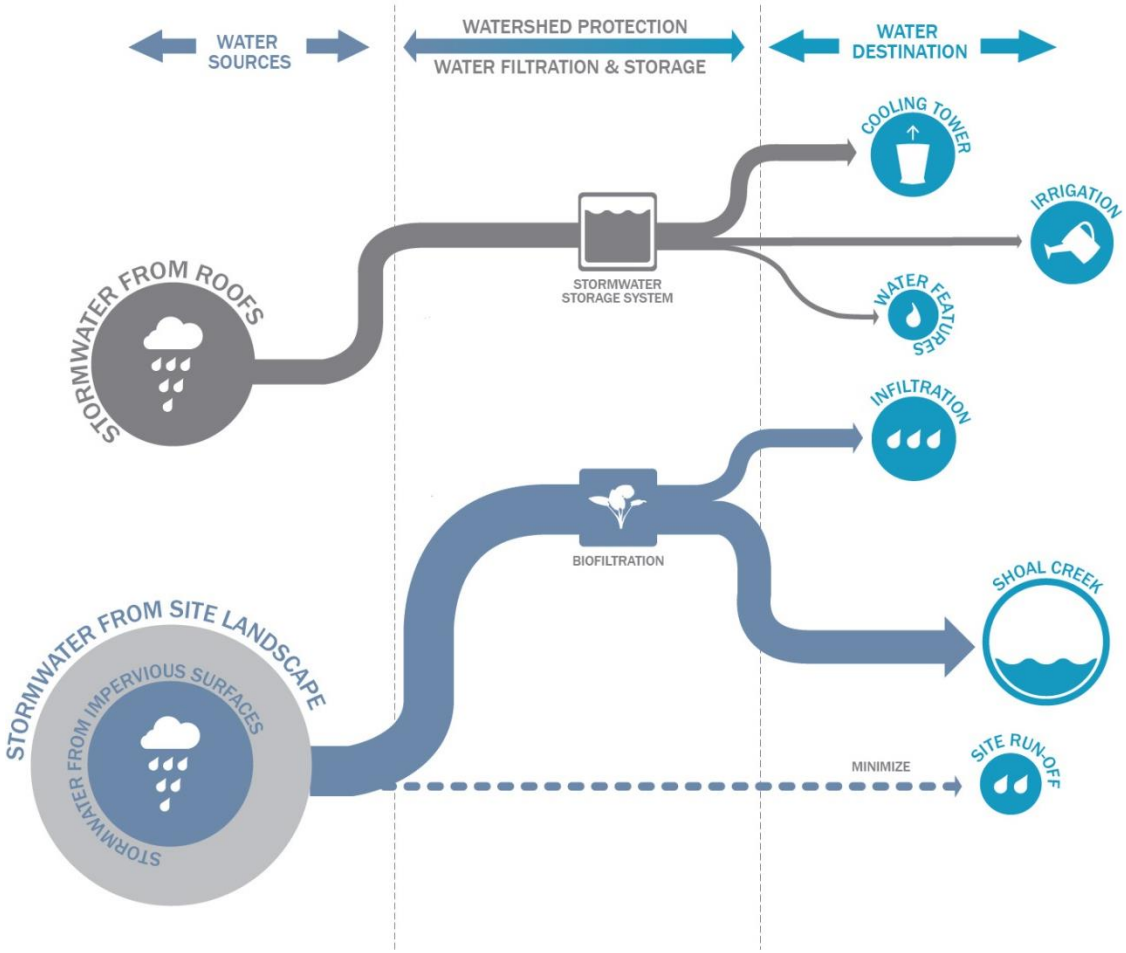


Strategy

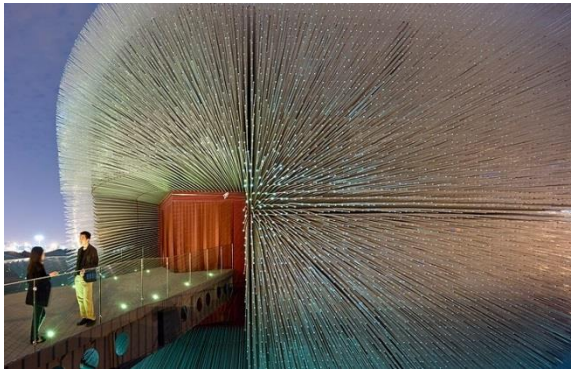
- Establish sustainability goals early
- Set performance targets
- Develop and test design strategies
- Select technologies to support strategies
- Monitor progress against benchmarks

Services

- Environmental Design
- Energy Analysis
- Lighting Design
- Masterplanning
- Benchmarking
- Carbon Management
- Façade Optimization



High Performance Facades



Case Studies

- Façade optimization using DIVA for Rhino and Grasshopper

- Daylight design for vegetation

Façade Optimization – MSKCC/CUNY

Urban Context Façade Optimization

Project Team:

Architect: Ennead Architects

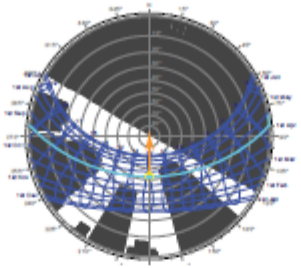
Envelope Consultant: Heintges

Environmental Consultant: Atelier Ten

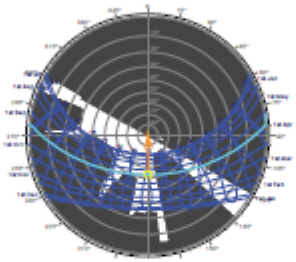
Mechanical Engineer: JB&B

Overshadowing

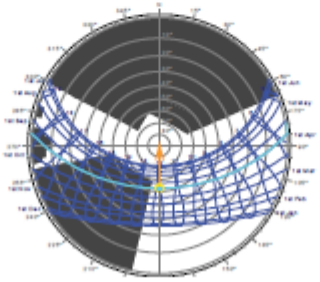
South Facade



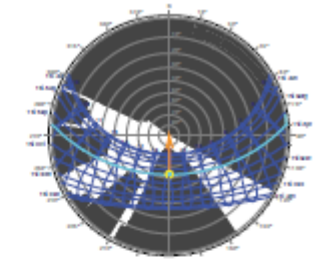
1. CUNY UPPER SOUTH FACADE (LABS)
SUMMER: SUN AFTER 10AM
SPRING/FALL: SUN FROM 9-10AM, 11AM-3PM
WINTER: SUN FROM 7-9AM, 11AM-1PM, 2-4PM



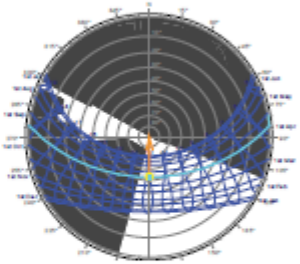
2. CUNY LOWER SOUTH FACADE (OFFICES)
SUMMER: SUN FROM 10-11AM, 11:30AM-2PM
WINTER: SUN FROM 7-9AM, 11:30AM-1PM



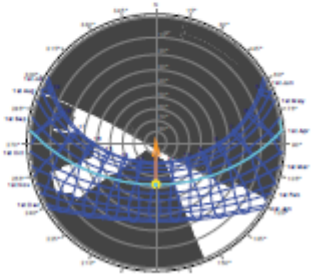
3. MSK UPPER SOUTH FACADE
SUMMER: SUN ALL DAY
SPRING/FALL/WINTER: SUN UNTIL 12:30PM



4. MSK MID-WEST SOUTH FACADE
SUMMER: SHADE FOR 1 HR AROUND NOON
SPRING/FALL: SUN FROM 8-10AM, 1-4PM
WINTER: SUN BEFORE 11AM AND AFTER 3PM



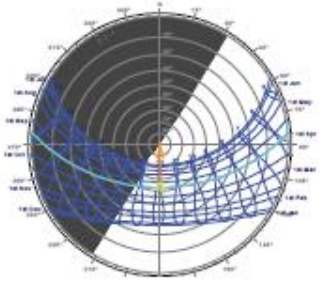
5. MSK MID-EAST SOUTH FACADE
SUMMER: SUN FROM 9AM-12PM
SPRING/FALL: SUN FROM 8AM-12:30PM
WINTER: SUN UNTIL 1PM



6. MSK LOWER SOUTH FACADE
SUMMER: SUN FROM 10:30-11:30AM, 2-4PM
SPRING/FALL: SUN FROM 9-11AM, 3-5PM
WINTER: SUN UNTIL 11AM

East Facade

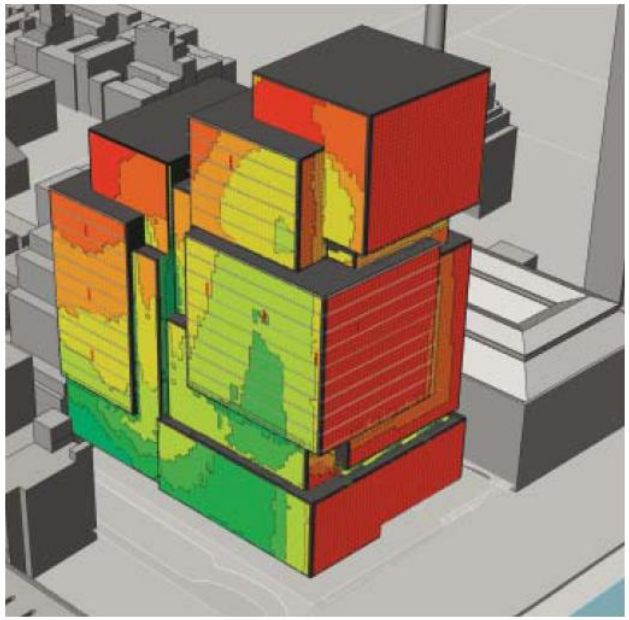
EAST ELEVATION



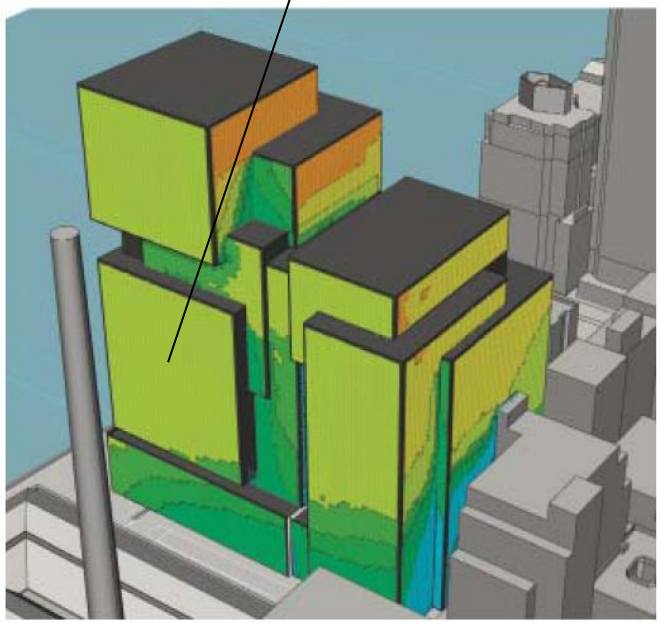
EAST FACADE OVERSHADOWING
SUMMER: SUN UNTIL 1PM
WINTER: SUN UNTIL 2PM

Solar Insolation Bands (100 kWh/m2 increments)

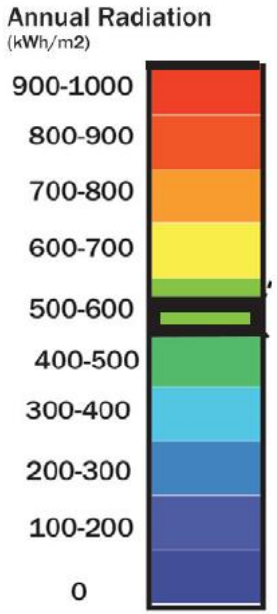
North façade used as target solar radiation level



SOUTH AND EAST FACADE SOLAR RADIATION ZONES

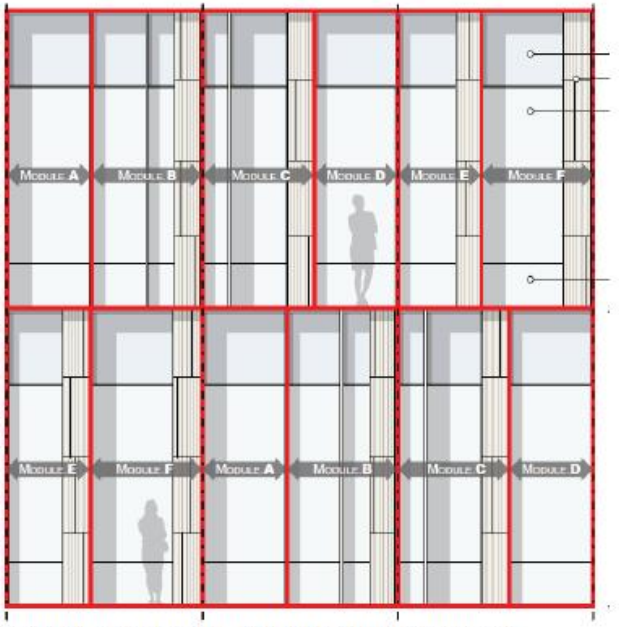


NORTH AND WEST FACADE SOLAR RADIATION ZONES



Curtain Wall System

RENDERING OF MODULES - SYSTEM 1A-V55



DEPLOYMENT OF VARIOUS PANEL WIDTHS ACROSS A MODULE - SYSTEM 1A-V55

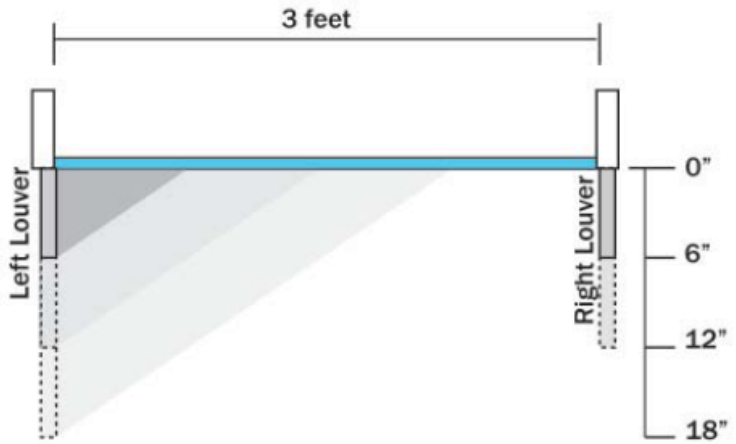
Glass lite widths:

1’-6”

3’-0”

4’-6”

External Shading Studies



GLAZING PANEL ANALYZED (PLAN VIEW)

800-900 kWh/m2 **1**		Left Fin Depth			
		0 Inch	6 Inch	12 Inch	18 Inch
Right Fin Depth	0 Inch	823	783	746	706
	6 Inch	812	771	724	689
	12 Inch	812	757	714	679

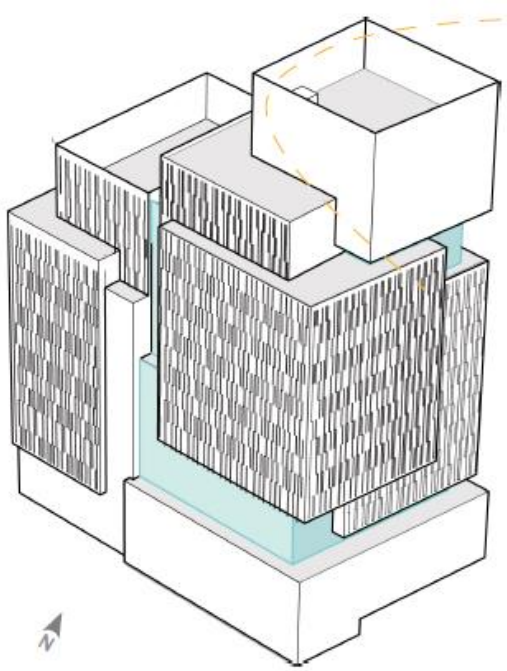
600-700 kWh/m2 **3**		Left Fin Depth			
		0 Inch	6 Inch	12 Inch	18 Inch
Right Fin Depth	0 Inch	636	607	592	574
	6 Inch	612	600	574	552
	12 Inch	621	588	571	549

700-800 kWh/m2 **4**		Left Fin Depth			
		0 Inch	6 Inch	12 Inch	18 Inch
Right Fin Depth	0 Inch	726	651	606	554
	6 Inch	705	619	567	524
	12 Inch	665	595	552	503

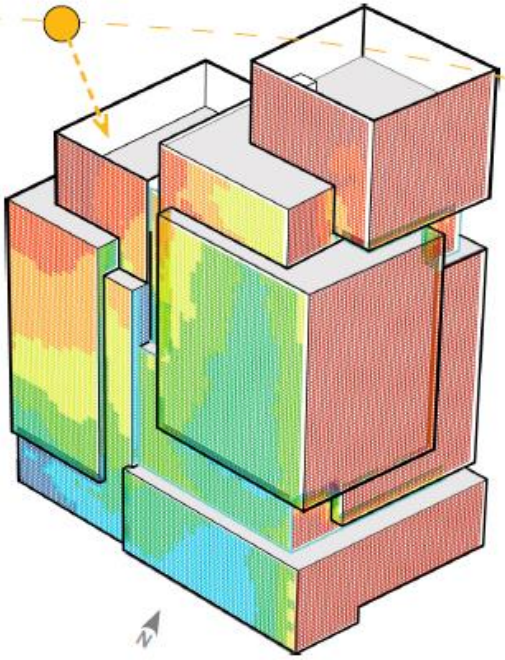
600-700 kWh/m2 **5**		Left Fin Depth			
		0 Inch	6 Inch	12 Inch	18 Inch
Right Fin Depth	0 Inch	601	555	492	450
	6 Inch	570	525	459	417
	12 Inch	547	507	443	400

RECOMMENDED VERTICAL FIN DEPTH COMBINATIONS FOR LEFT AND RIGHT FINS

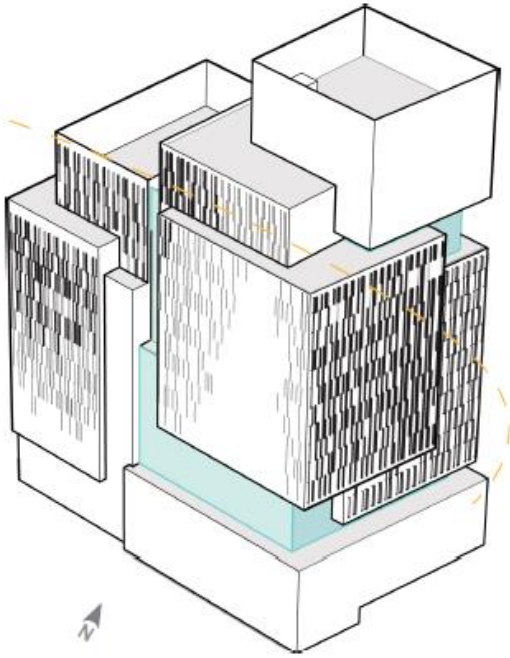
Vertical Fin Application Diagram



Current Fin Design (12", 6" Fin Depth)

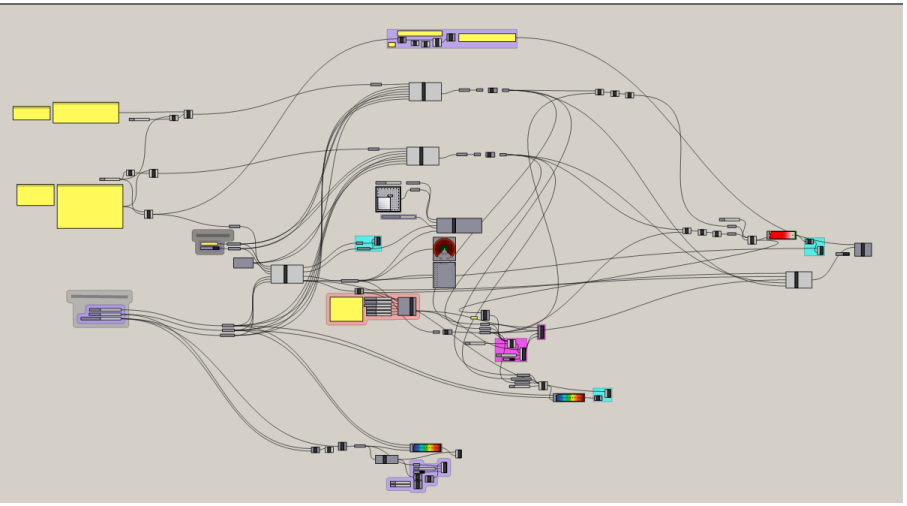


Annual Incident Solar Radiation Analysis



Proposed Fin Design (13.5", 10", 6", 4" Fin Depth)

Grasshopper Process – Radiation Analysis



Location	Area	No Fin	Org Fin	A10 Fin	Change 1	Change 2	% Change 1A	% Change 1B
-149.2244	3.22	639	636	637	-1	3	-0.47%	-0.31%
-149.2244	12.72	645	637	644	-7	8	-1.24%	-0.16%
9, -77.448	24.08	677	550	562	-12	127	-18.76%	-16.99%
-77.44837	6.10	700	578	575	3	122	-17.43%	-17.86%
-148.3898	3.74	548	543	631	-88	5	-0.91%	15.15%
-148.7534	0.07	596	575	604	-29	21	-3.52%	1.34%
-147.2125	7.74	622	440	585	-145	182	-29.26%	-5.95%
-145.2102	3.74	618	458	481	-23	160	-25.89%	-22.17%
1, -148.385	14.78	624	542	582	-40	82	-13.14%	-6.73%
5, -148.753	0.30	588	578	589	-11	10	-1.70%	0.17%
7, -147.212	30.54	628	443	552	-109	185	-29.46%	-12.10%
5, -145.21(	14.78	626	469	470	-1	157	-25.08%	-24.92%
-109.5101	3.74	410	382	417	-35	28	-6.83%	1.71%
-106.3305	3.74	432	399	427	-28	33	-7.64%	-1.16%
-108.3329	7.74	529	438	523	-85	91	-17.20%	-1.13%
-103.5534	7.74	495	451	481	-30	44	-8.89%	-2.83%
-100.7763	3.74	493	389	494	-105	104	-21.10%	0.20%
-98.40171	3.74	480	398	482	-84	82	-17.08%	0.42%
-97.22445	7.74	559	482	553	-71	77	-13.77%	-1.07%
3, -14.173	27.78	787	761	722	39	26	-3.30%	-8.26%
-14.17325	7.04	762	767	714	53	-5	0.66%	-6.30%
6, -15.994	13.60	766	724	686	38	42	-5.48%	-10.44%
-15.99447	3.44	737	709	687	22	28	-3.80%	-6.78%
2, -18.530	27.78	759	688	688	0	71	-9.35%	-9.35%
-18.5301(	7.04	726	697	698	-1	29	-3.99%	-3.86%
5, -20.7035	7.04	761	683	677	6	78	-10.25%	-11.04%
93, -20.70	27.78	755	687	673	14	68	-9.01%	-10.86%
6, -24.315	27.78	806	729	720	9	77	-9.55%	-10.67%
-24.3157(	7.04	774	724	706	18	50	-6.46%	-8.79%
2, -26.1365	13.60	795	728	706	22	67	-8.43%	-11.19%
-26.13698	3.44	798	712	694	18	86	-10.78%	-13.03%
31, -9.1015	27.78	777	753	734	19	24	-3.09%	-5.53%
-9.10199	7.04	768	743	717	26	25	-3.26%	-6.64%
34, -10.921	13.60	795	699	676	23	96	-12.08%	-14.97%
, -10.9232	3.44	804	695	666	29	109	-13.56%	-17.16%
7, -53.688	15.57	186	154	185	-31	32	-17.20%	-0.54%
-53.6886(	3.94	199	164	190	-26	35	-17.59%	-4.52%
9, -52.956	13.60	704	501	457	44	203	-28.84%	-35.09%
-52.95612	3.44	694	530	470	60	164	-23.63%	-32.28%

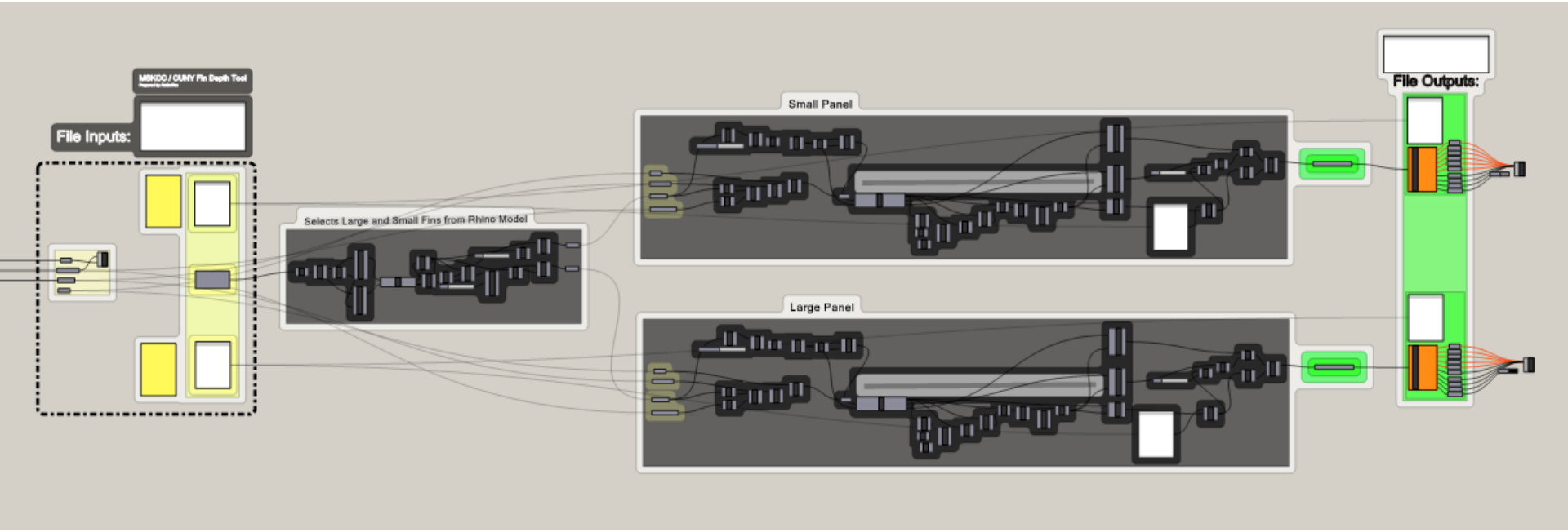
A10 Radiation Component

- Standard component introduced before
- Different visual output options
- Excel output options

Excel Post processing

- Takes input from Grasshopper
- Allows additional post processing abilities
- Formats data in our standard layout

Grasshopper Process – Fin deployment



Input

- Radiation data
- Fins
- Fin chart

Output location

Grouping of existing fins

Output processing

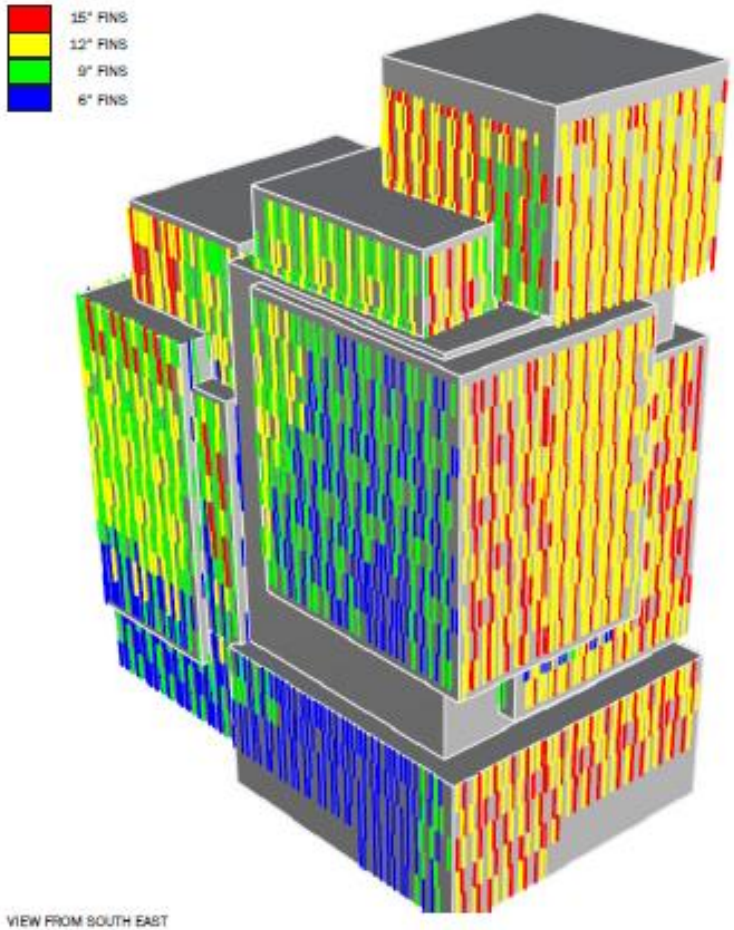
Grouping of fins based on solar radiation analysis

Output

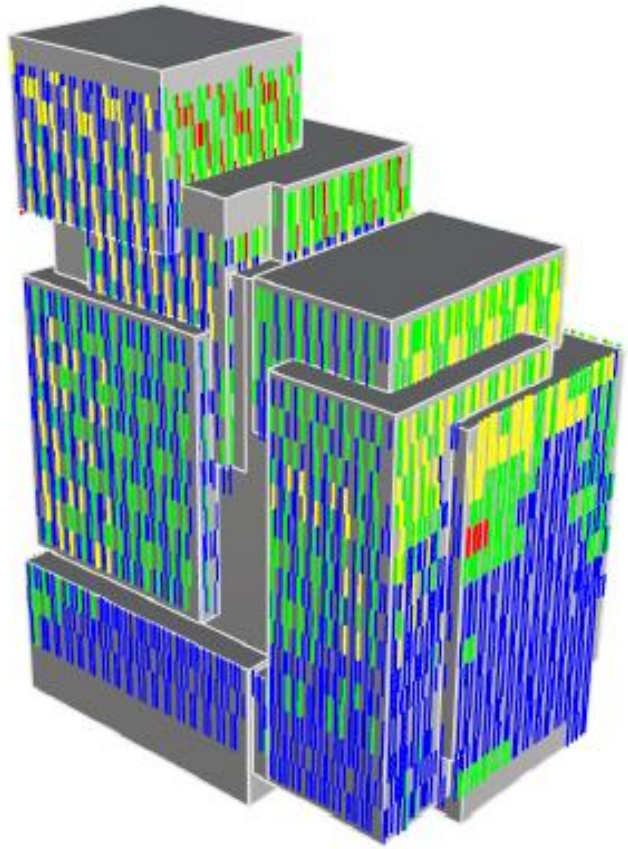
Fins in different layers according to radiation bands

Baseline – Recommendation Comparison

Analysis with recommended fin depth



VIEW FROM SOUTH EAST

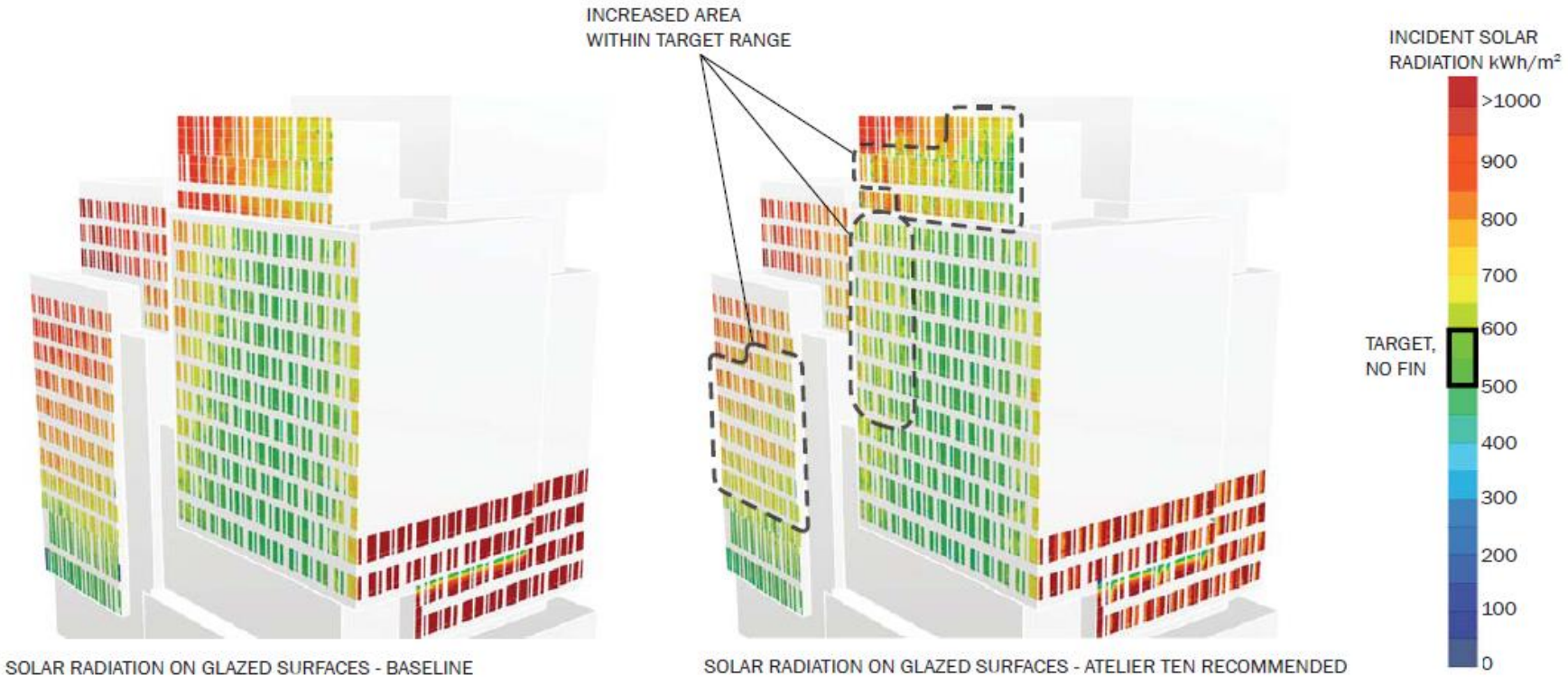


VIEW FROM NORT

Incident Solar Radiation received by panel	Adjacent Glass Width		
	< 2'-0"	2'-0" - 4'-0"	> 4'-0"
> 900	12"	15"	15"
750 - 899	9"	12"	15"
600 - 749	9"	12"	15"
450 - 599	6"	9"	12"
< 450	6"	6"	9"

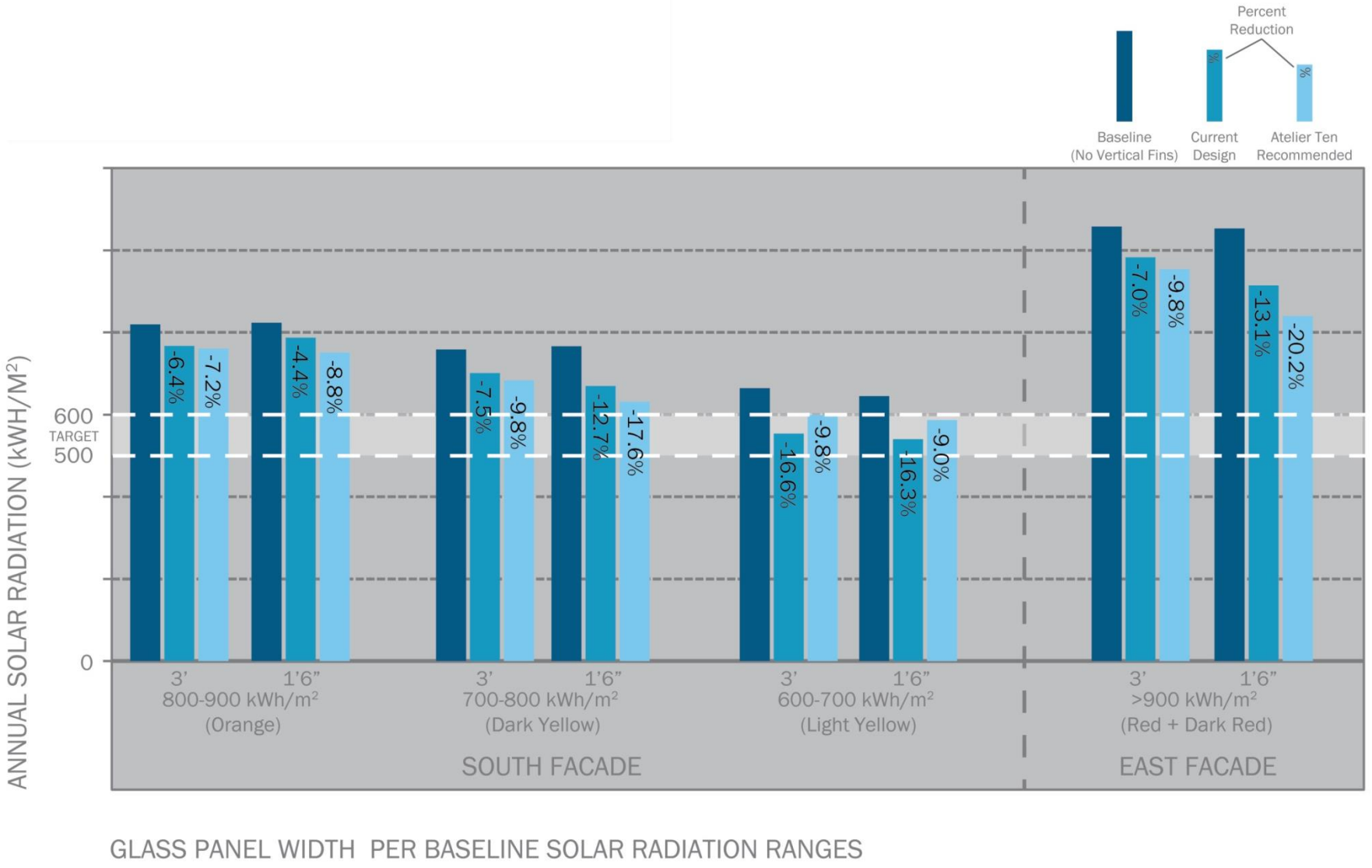
Baseline – Recommendation Comparison

Analysis with recommended fin depth

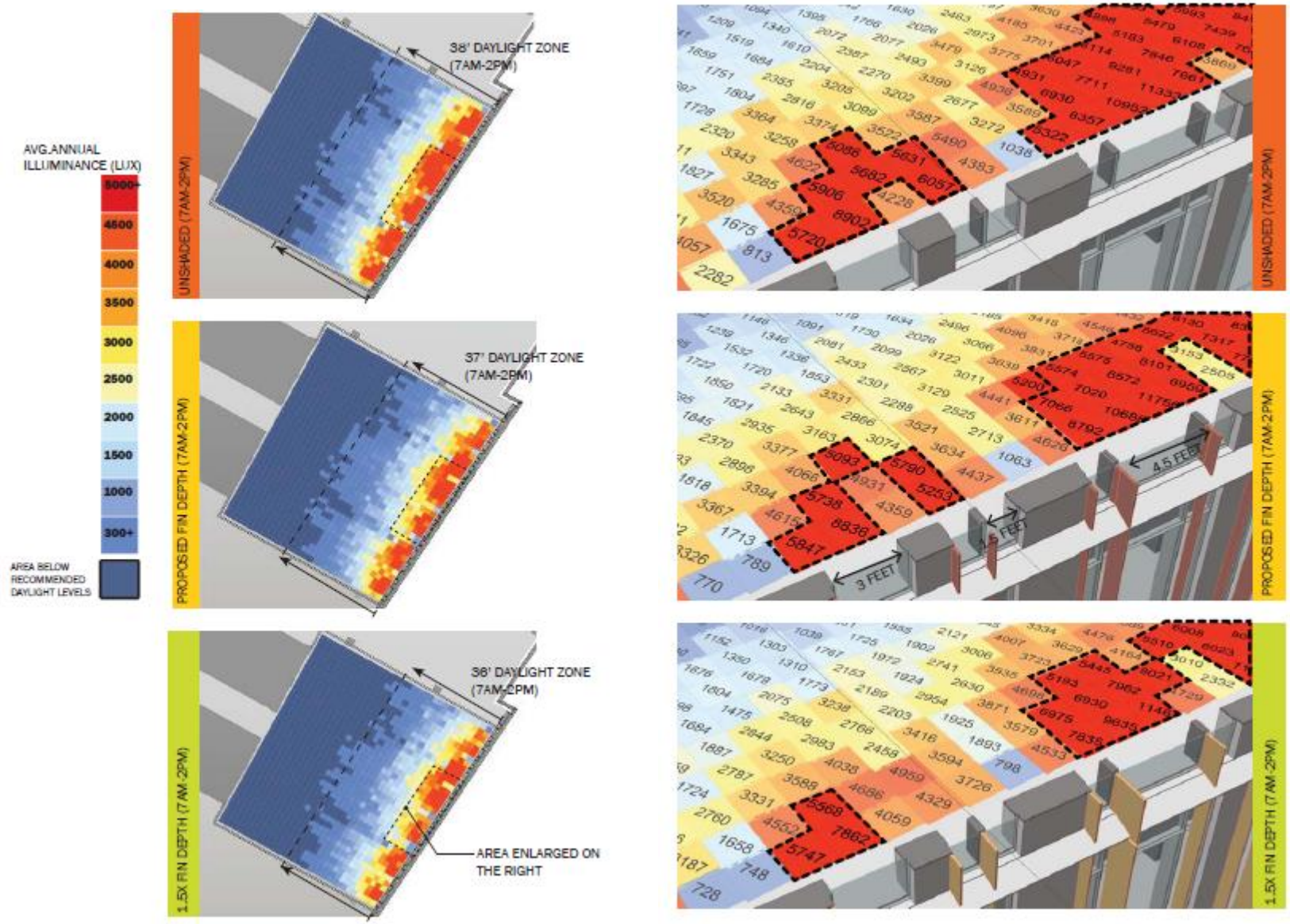


Fin Optimization Summary

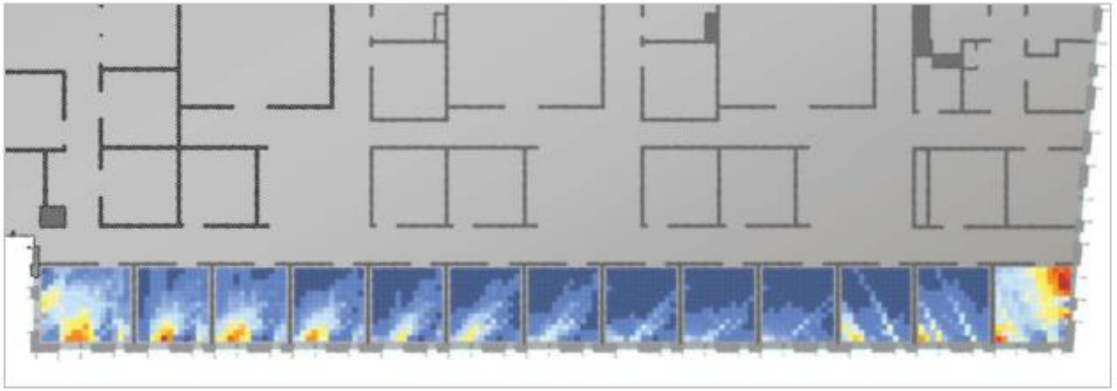
Vertical Fin Options Tested

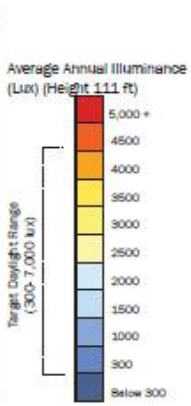


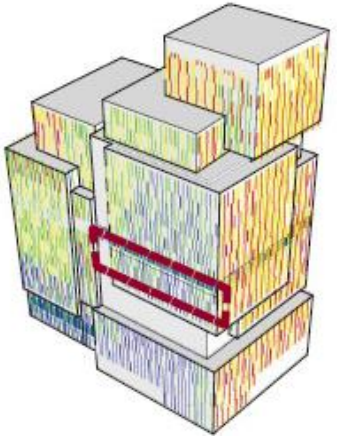
Daylight Analysis & Fin Depth East Facade



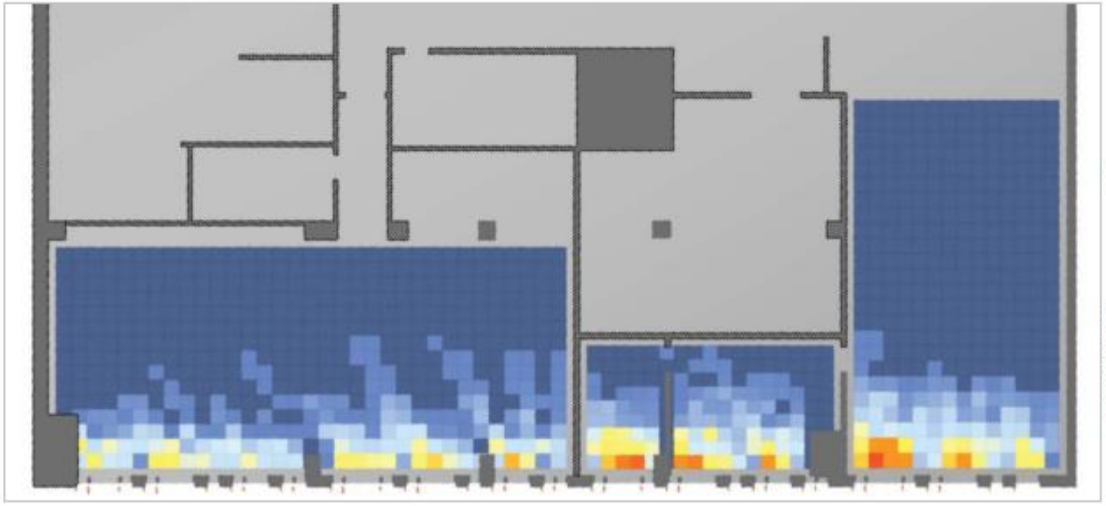
Daylight Analysis & Fin Depth South Facade

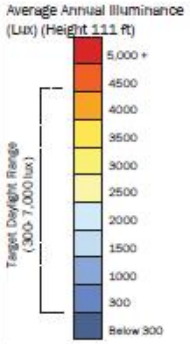


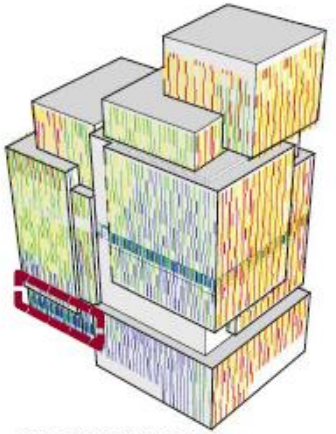




MSKCC- 12TH FLOOR SOUTH, WITH FINS







CUNY- 3RD FLOOR SOUTH, WITH FINS

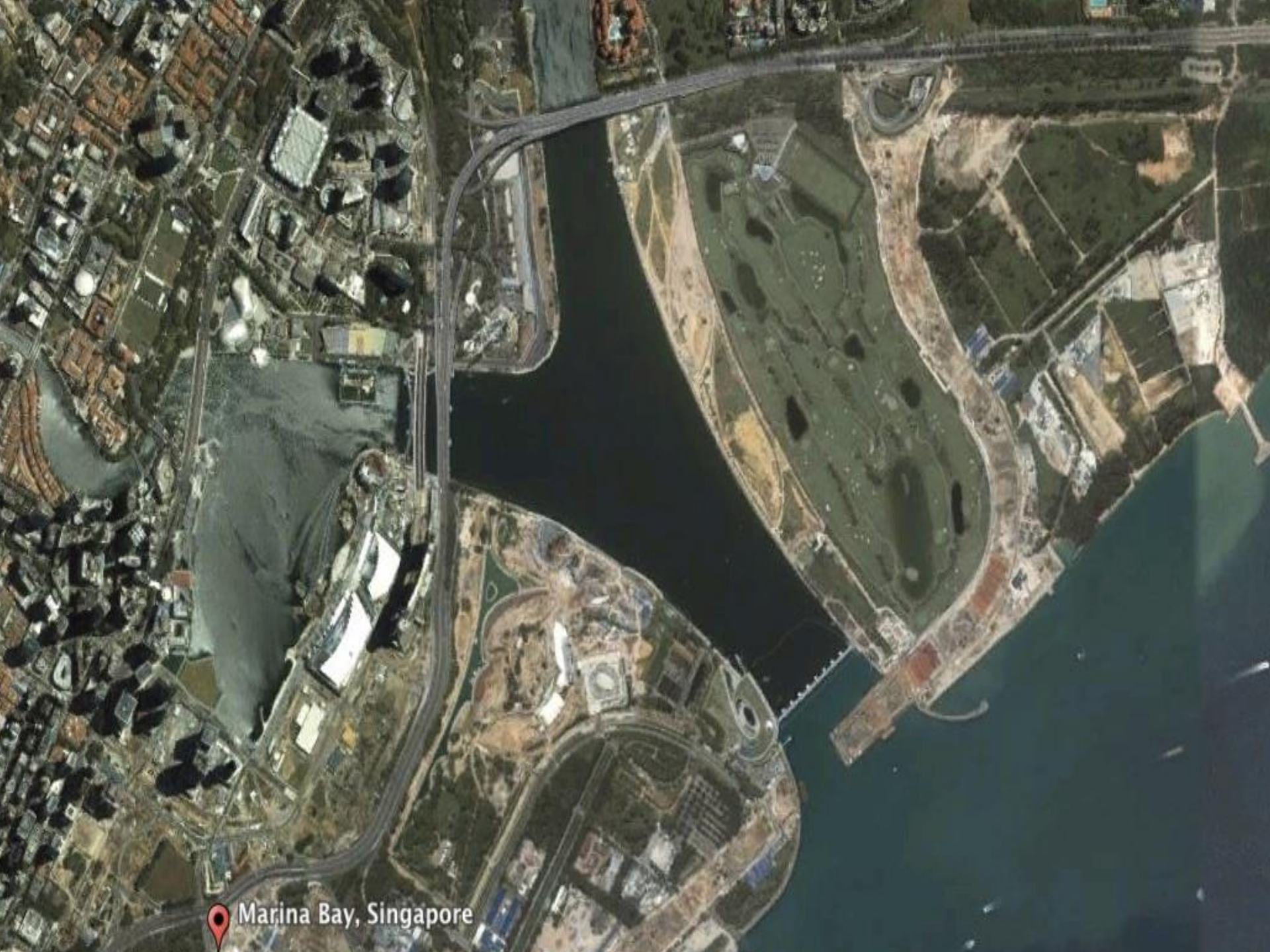
CUNY, FLOOR 3, SOUTH FACADE

Façade Optimization - Designing for Vegetation

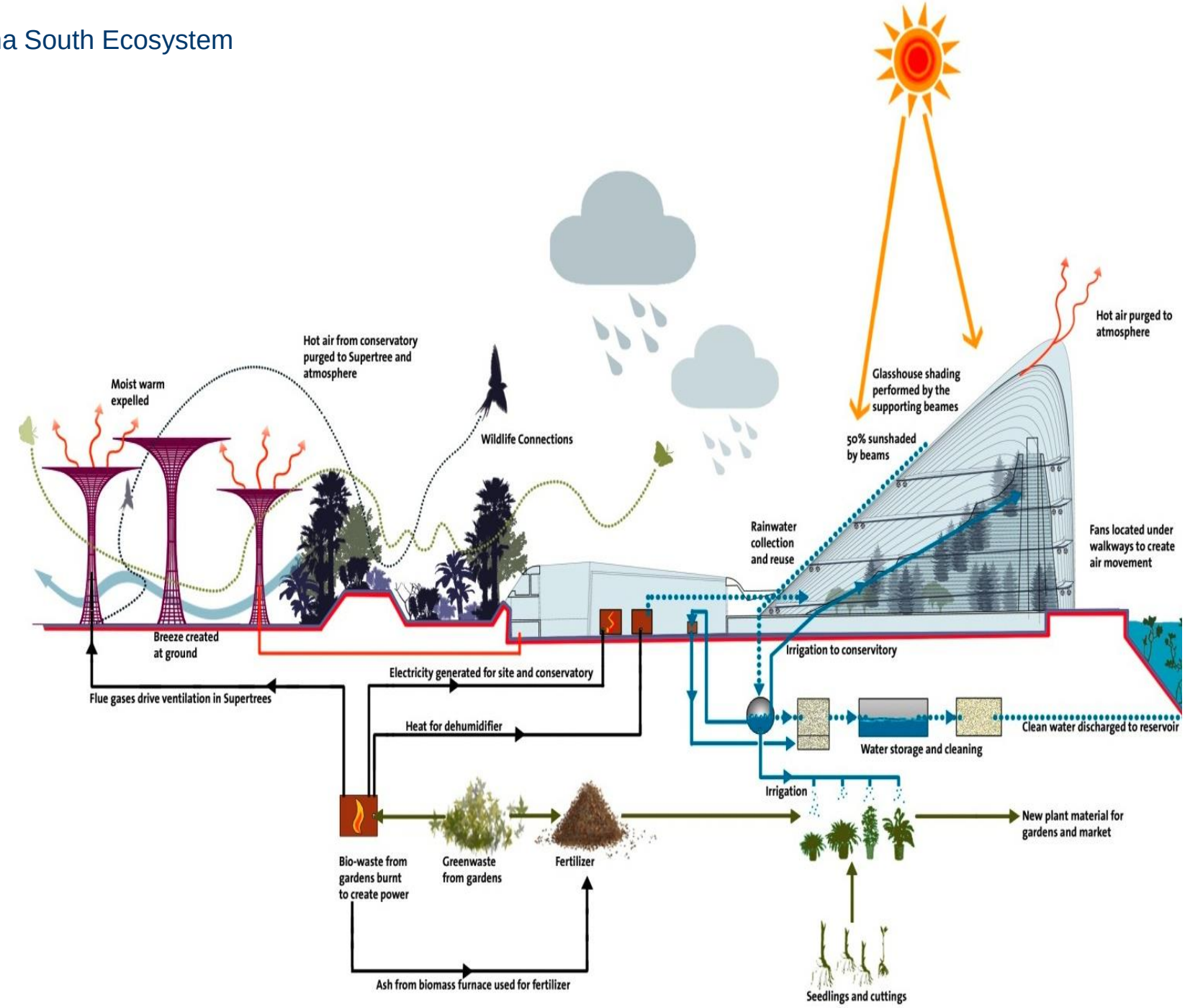
Marina Bay - 2006

The Esplanade Theatres on the Bay

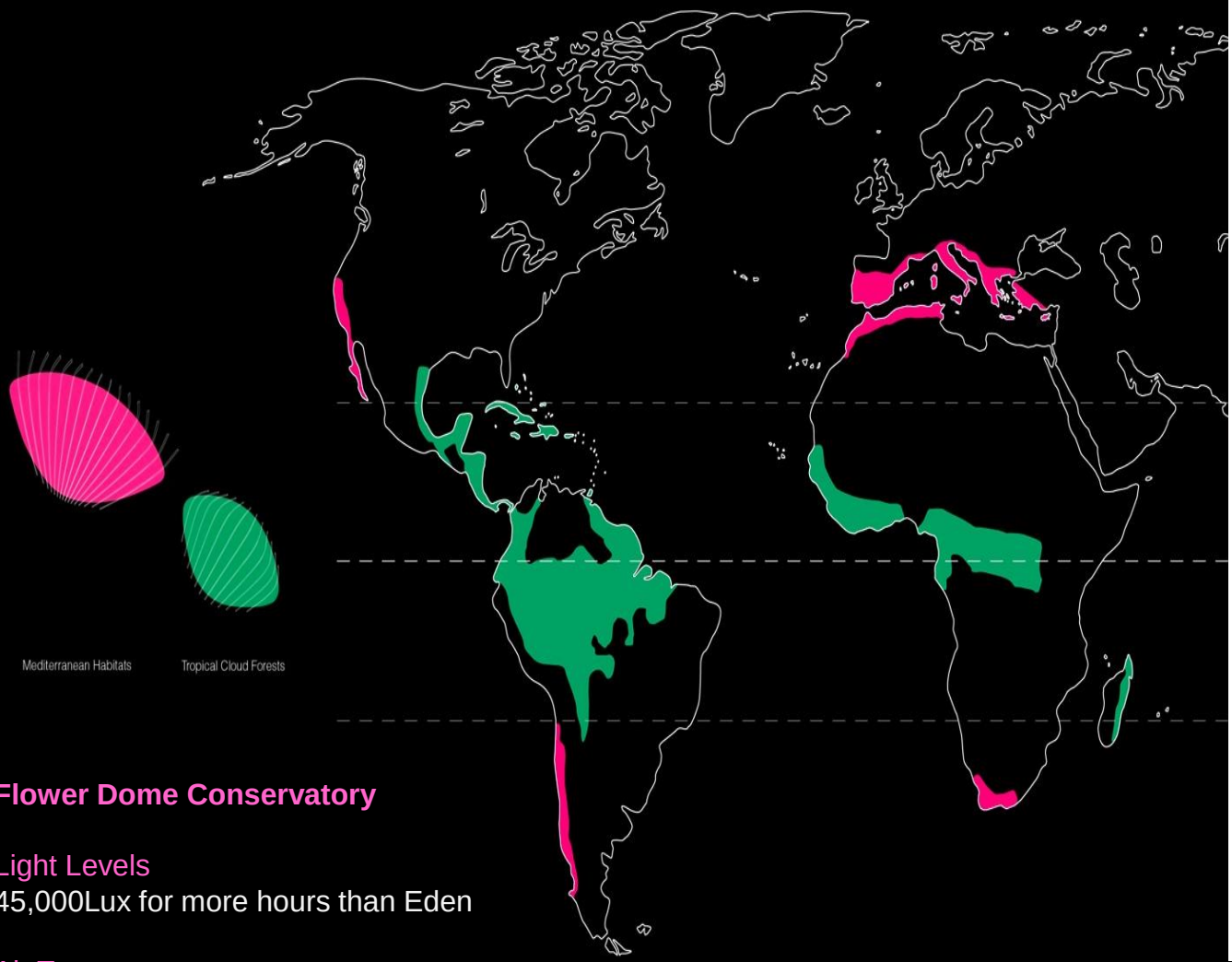
Michael Wilford + DP Architects

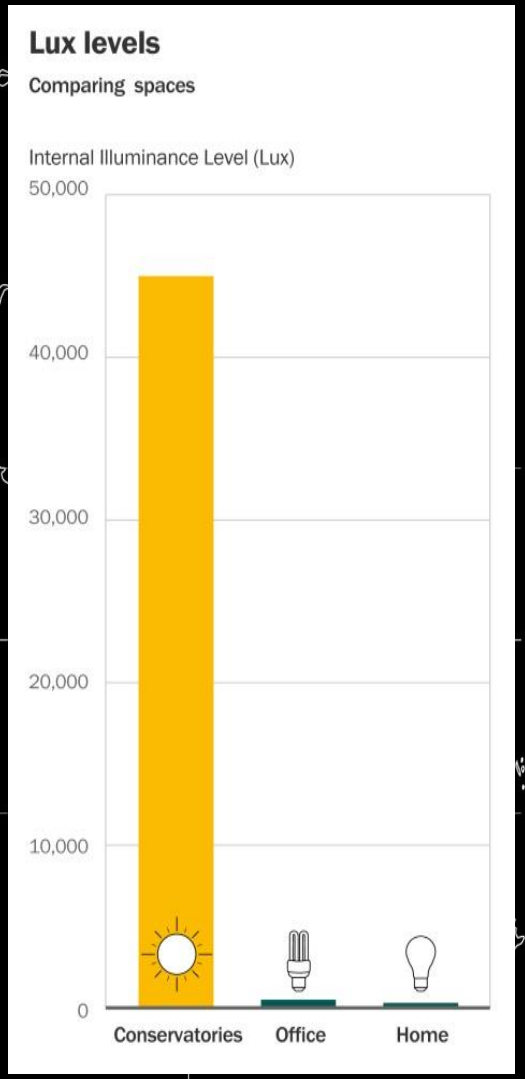

Marina Bay, Singapore

Marina South Ecosystem



Design Criteria – Temperature, Humidity + Light





Flower Dome Conservatory

Light Levels
45,000Lux for more hours than Eden

Air Temperature

Daytime condition:	25°C @ 65% RH max
Night-time condition:	17°C @ 65% RH or more
Ignition condition :	13°C @ 70% RH or more

Singapore
1° 22' N, 103° 45' E

Cool Dry Biome
Design Criteria

Daylight Levels
45,000Lux for more hours per annum than Eden

Air Temperatures
Daytime Condition – 25oC** @ 60% RH
Night-time Condition – 17oC @ 80% RH
Ignition Condition – 13oC @ 80% RH

Cool Dry Biome

Cool Moist Biome

Design Criteria

Daylight Levels

45,000Lux For More Hours Than Eden

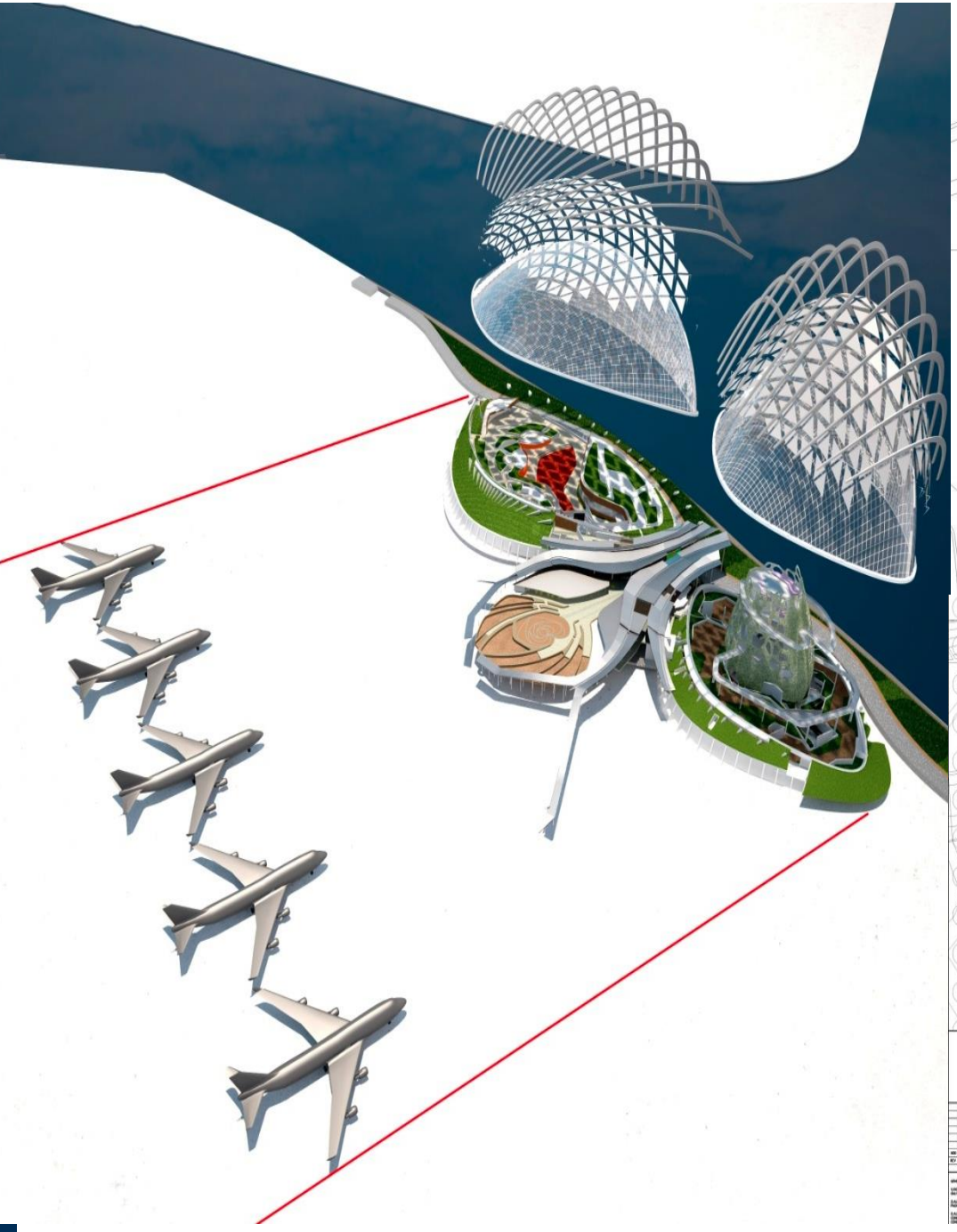
Air Temperatures

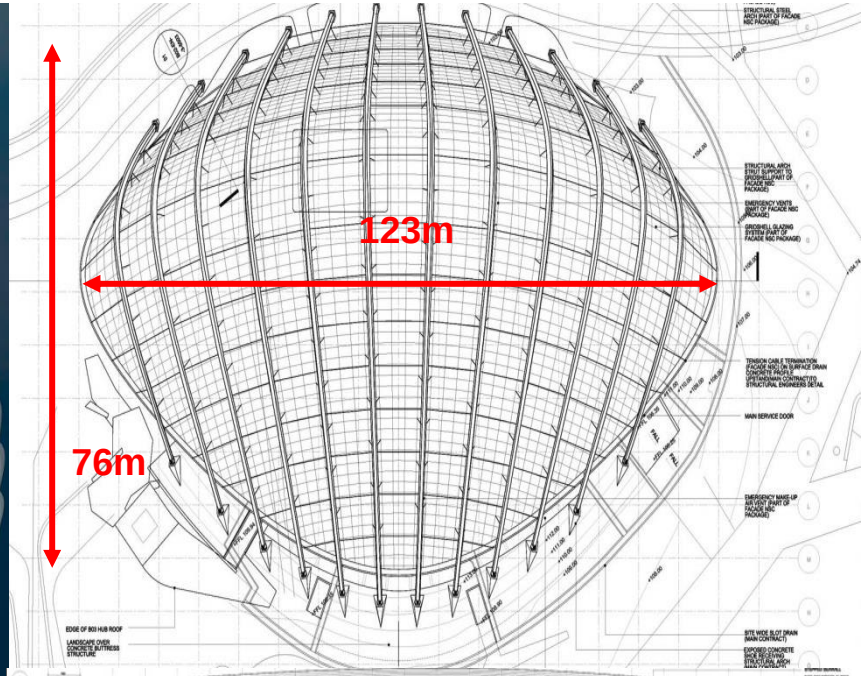
Daytime Condition – 25oC @ 80% RH +

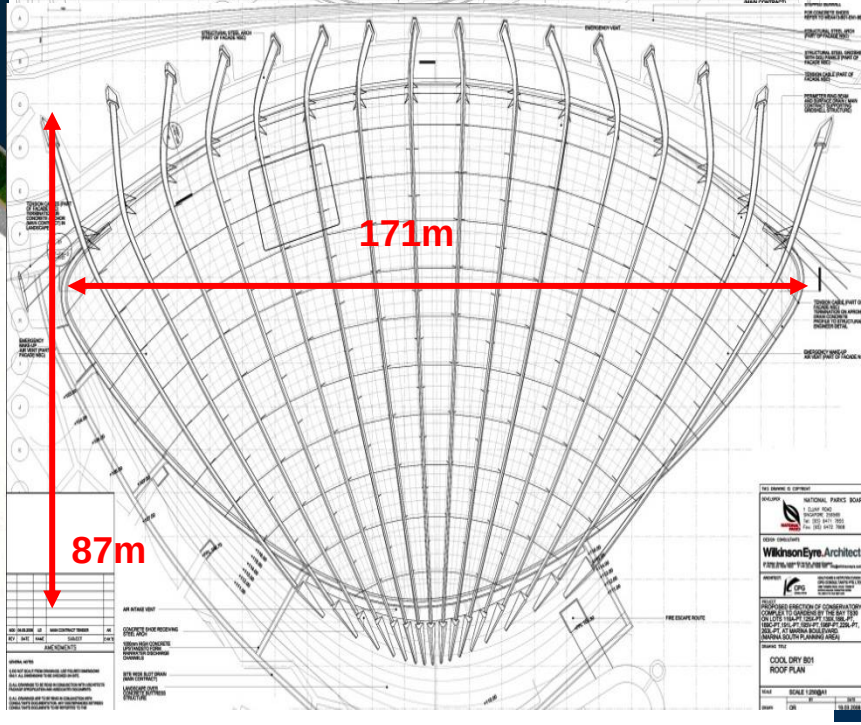
Night-time Condition – 17oC @ 80% RH +

Ignition Condition – 16oC @ 80% RH +

Cool Moist Biome



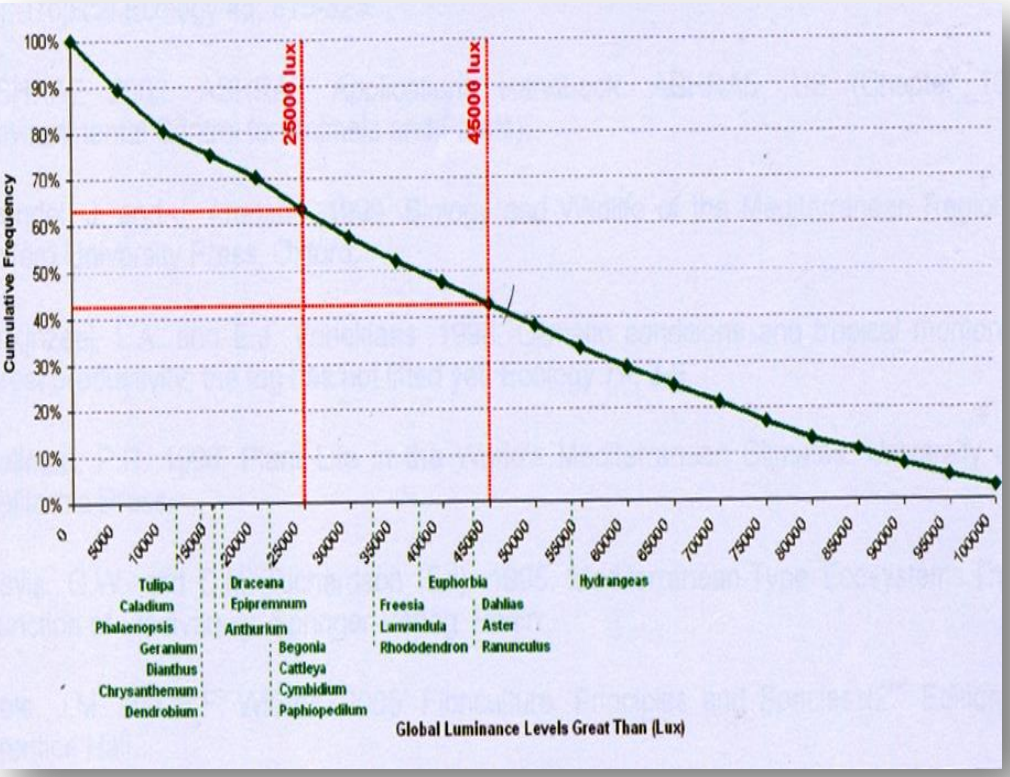

123m
76m


171m
87m
Wilkinson Eyre Architects
COOL DRY 801
ROOF PLAN

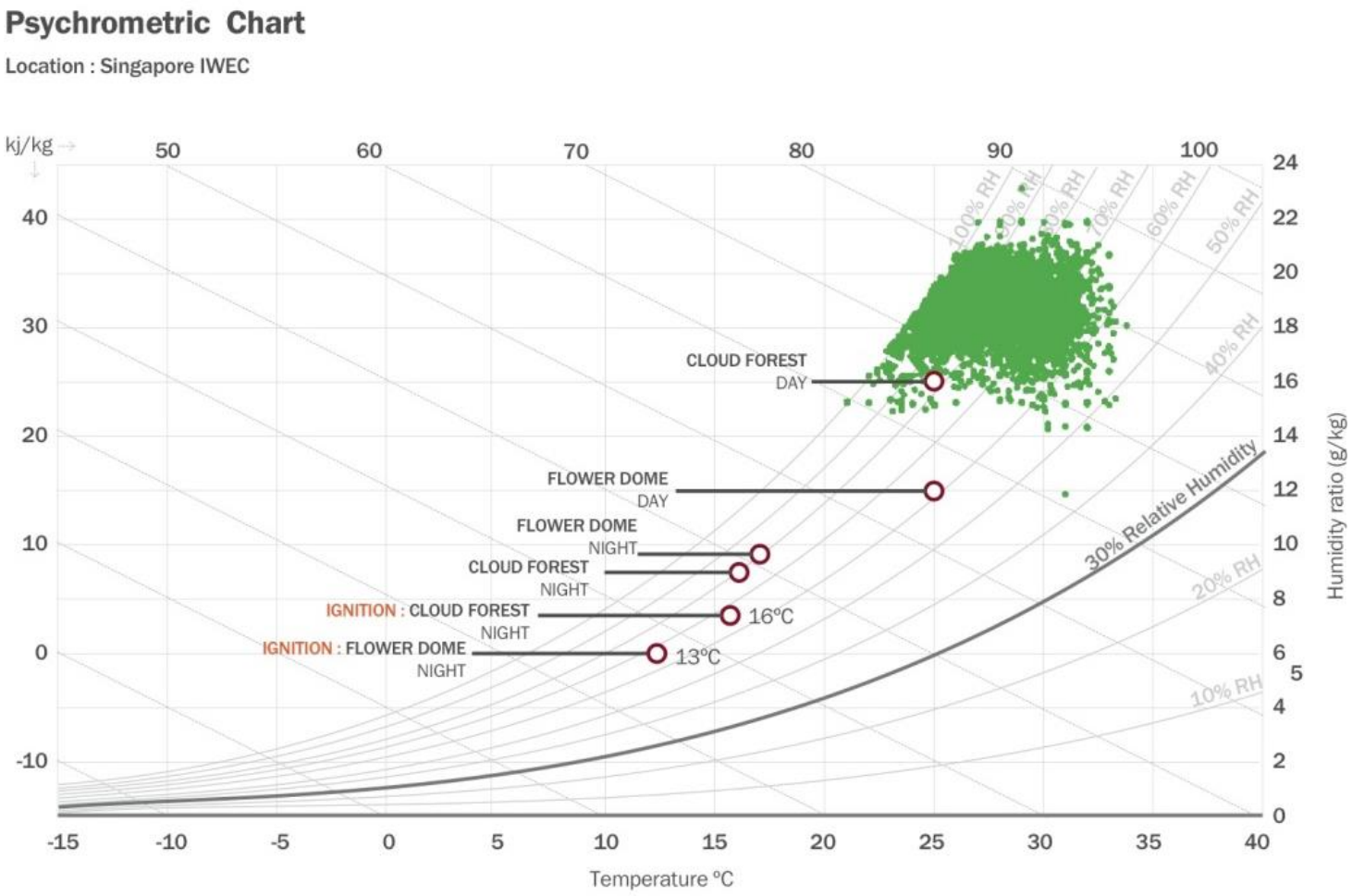
The Biomes at Eden

Grimshaw 2000

Annual Global Luminance Levels for Plants



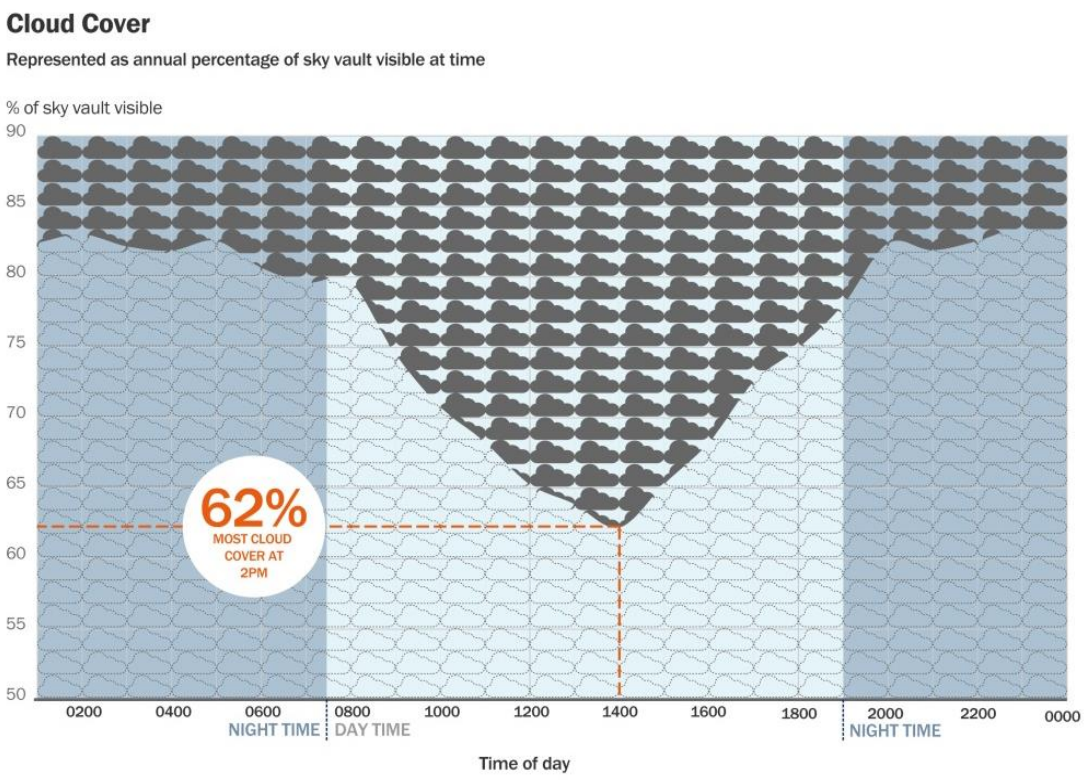
Greenhouse Conditions

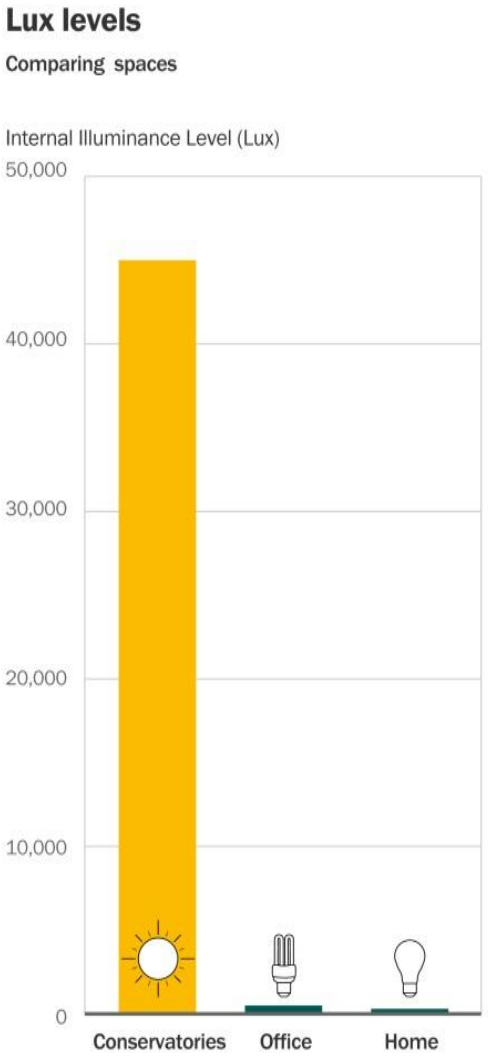


Daylight Levels

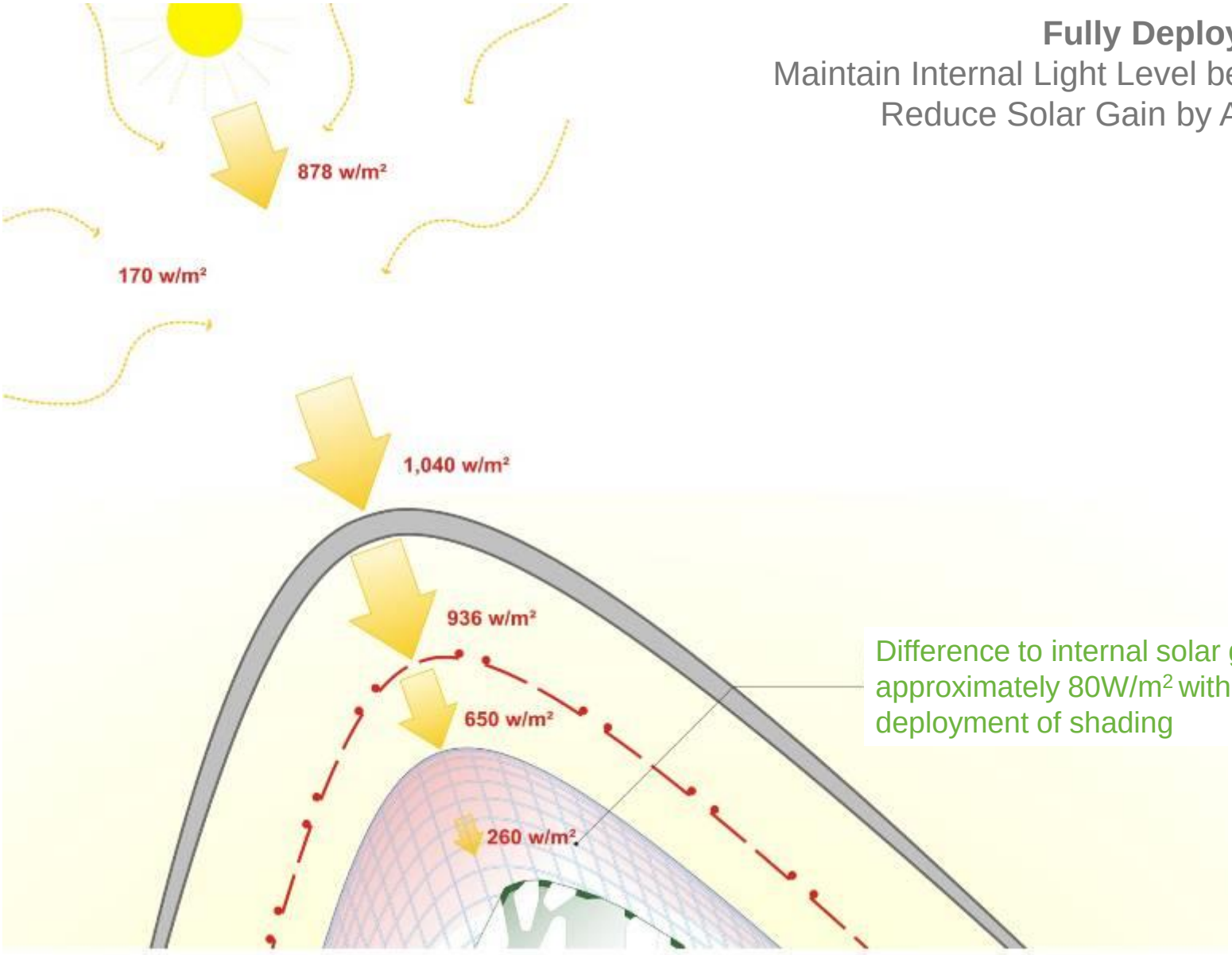
45,000Lux for more hours per annum than Eden Project

Climate Analysis





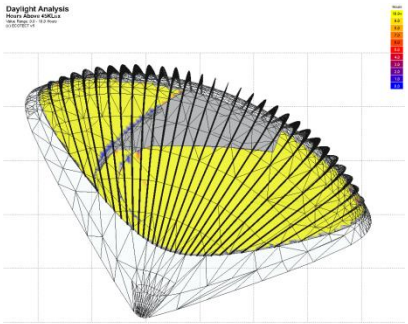
Solar Control

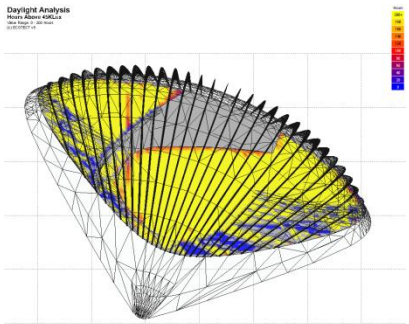


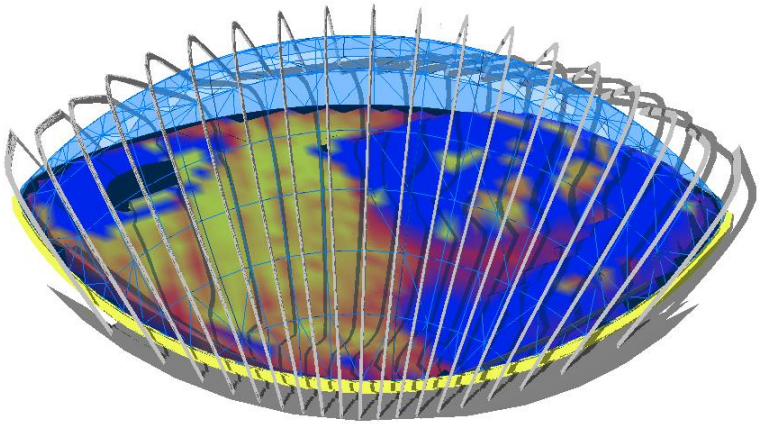
Fully Deployed Shades
Maintain Internal Light Level below 45kLux
Reduce Solar Gain by Approx 90%.

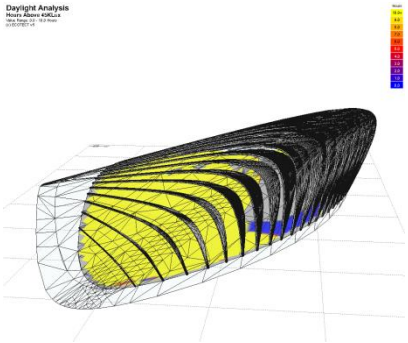
Difference to internal solar gain approximately 80W/m² with full deployment of shading

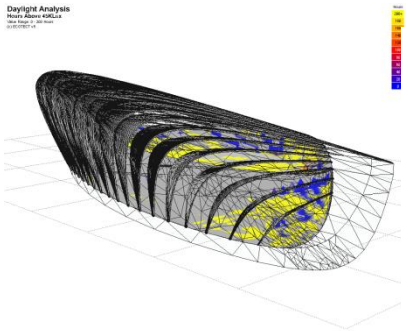
Solar Control

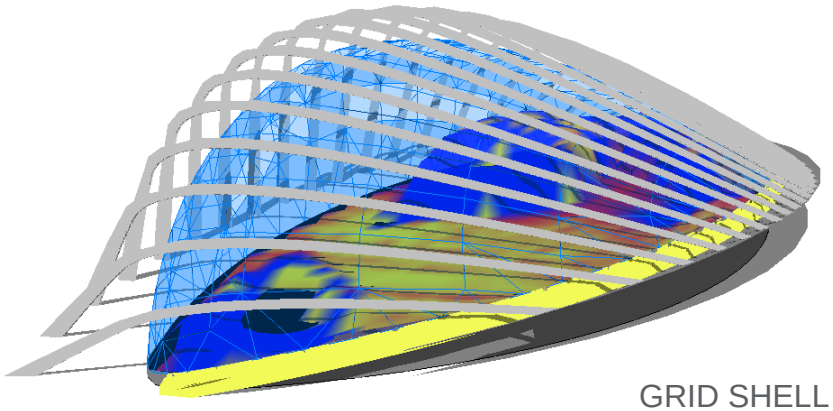










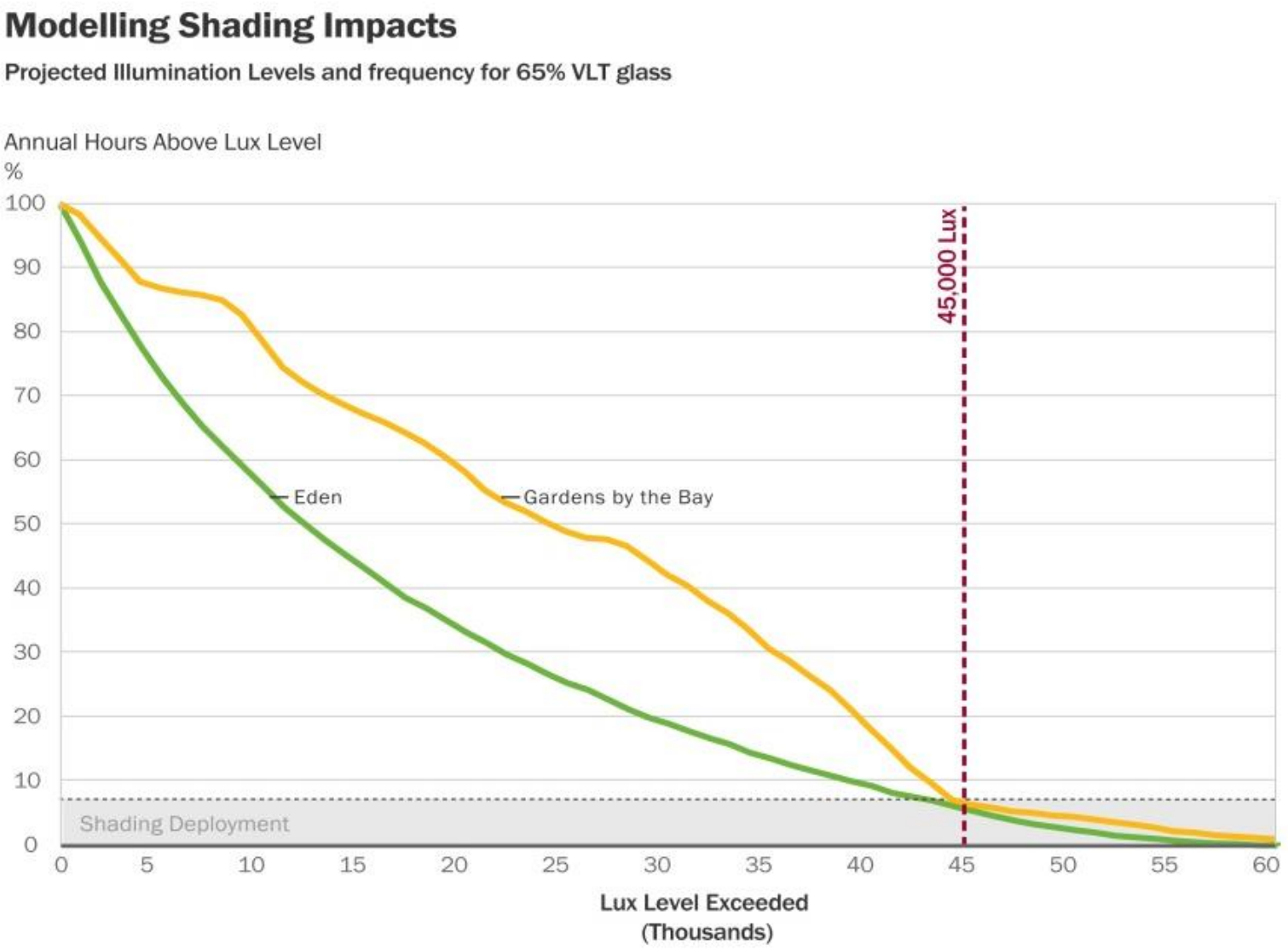


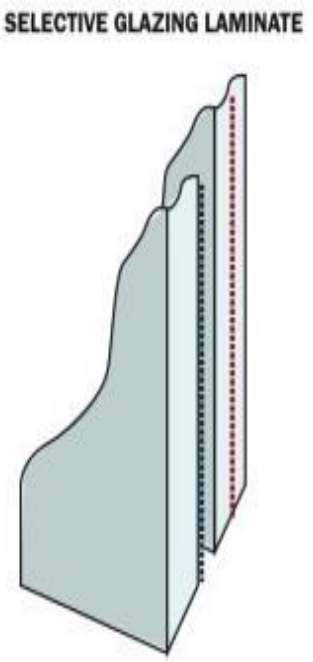
FIN

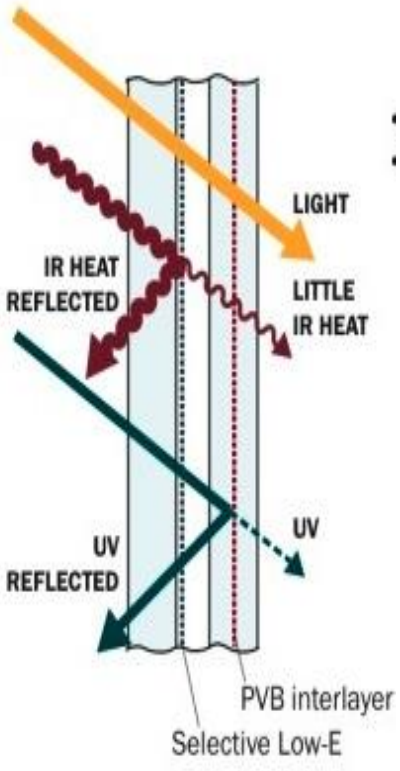
TRUSS

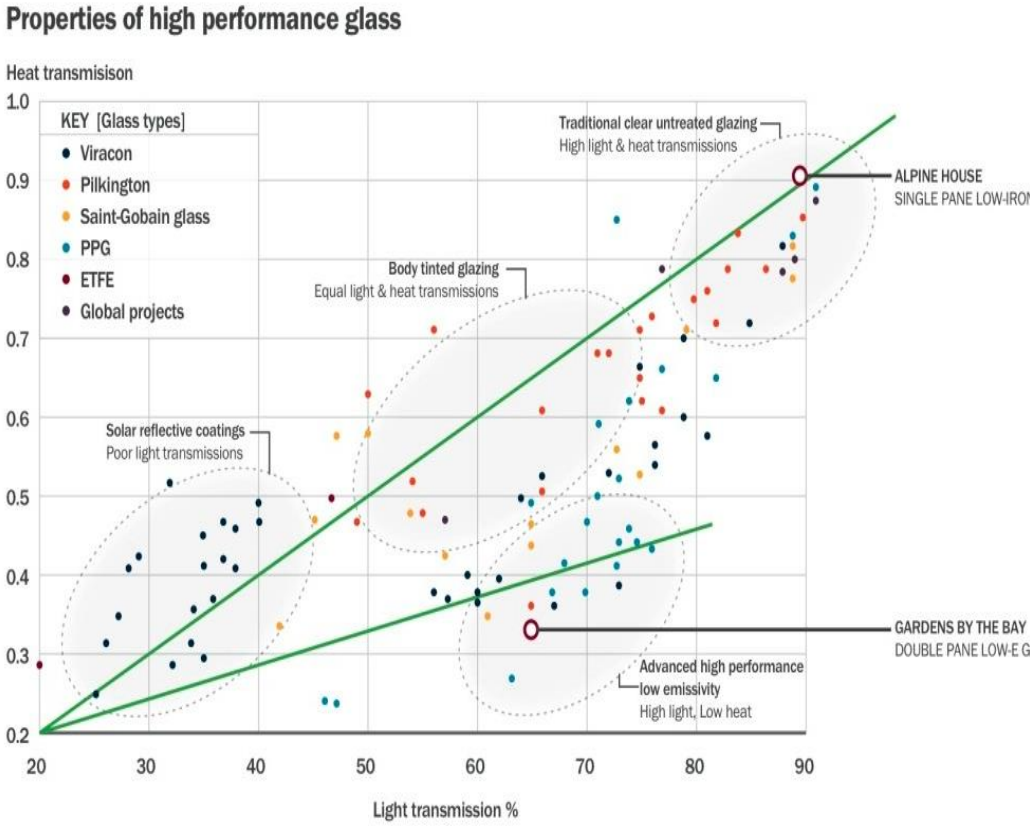
GRID SHELL

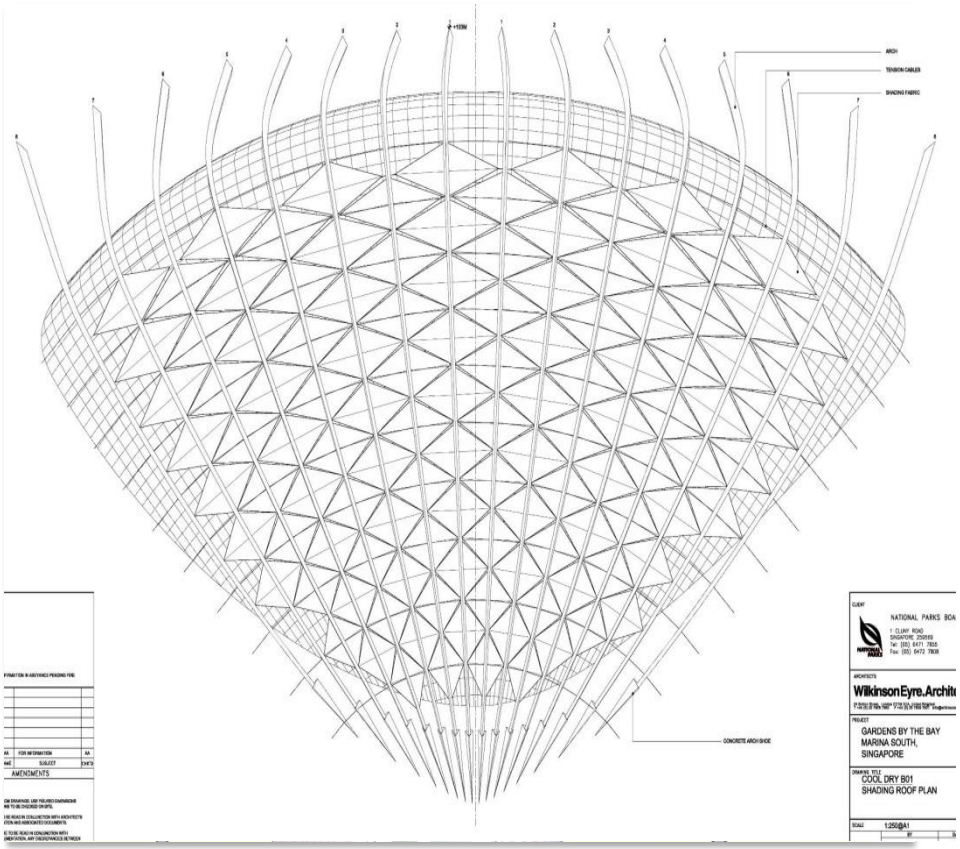
Modeling Shading

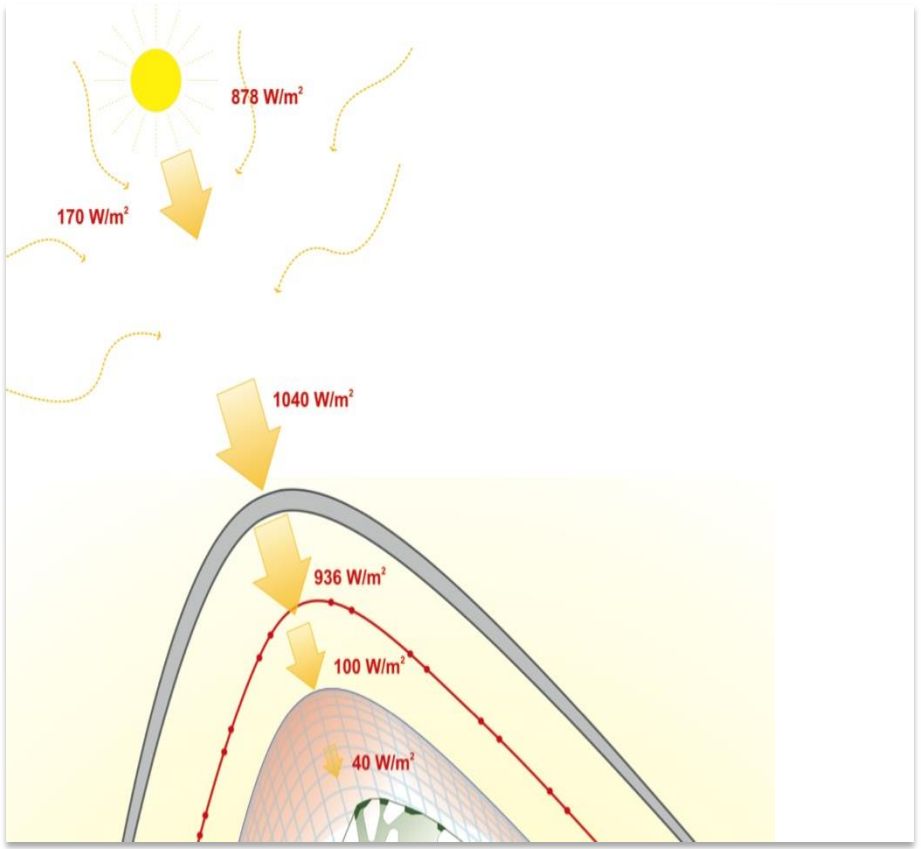



SELECTIVE GLAZING LAMINATE


LIGHT
IR HEAT
REFLECTED
LITTLE
IR HEAT
UV
UV
REFLECTED
PVB interlayer
Selective Low-E


Properties of high performance glass
Heat transmisison
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
KEY [Glass types]
Viracon
Pilkington
Saint-Gobain glass
PPG
ETFE
Global projects
Traditional clear untreated glazing
High light & heat transmissions
ALPINE HOUSE
SINGLE PANE LOW-IRON
Body tinted glazing
Equal light & heat transmissions
Solar reflective coatings
Poor light transmissions
GARDENS BY THE BAY
DOUBLE PANE LOW-E G
Advanced high performance
low emissivity
High light, Low heat
20
30
40
50
60
70
80
90
Light transmission %

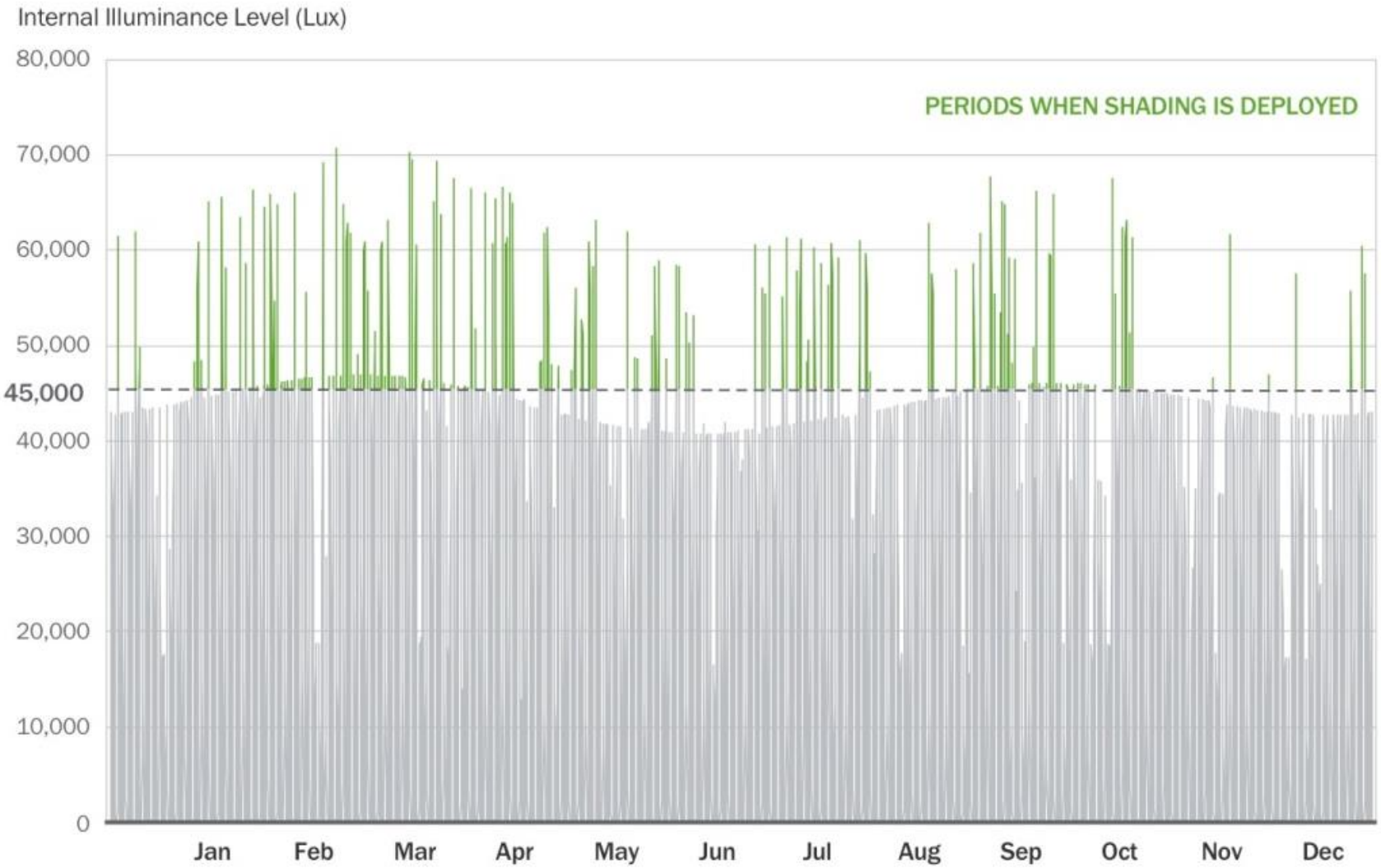

+103M
ARCH
TENSION CABLES
SHADING FABRIC
CONCRETE ARCH SHOE
AMENDMENTS
NATIONAL PARKS BOA
Wilkinson Eyre.Archite
GARDENS BY THE BAY
MARINA SOUTH,
SINGAPORE
COOL DRY B01
SHADING ROOF PLAN
1:250@A1


878 W/m²
170 W/m²
1040 W/m²
936 W/m²
100 W/m²
40 W/m²

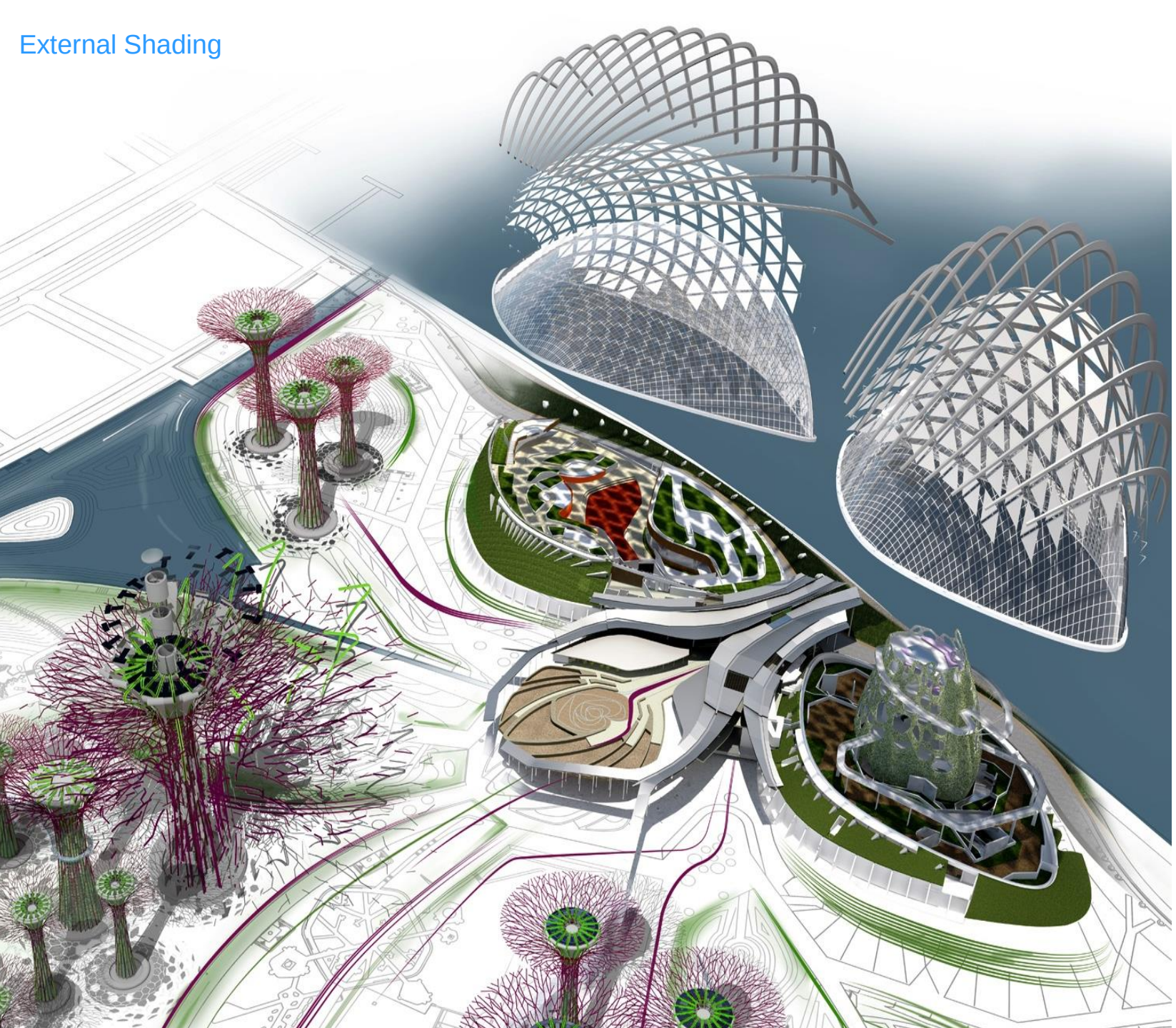
External Shading

External Shading

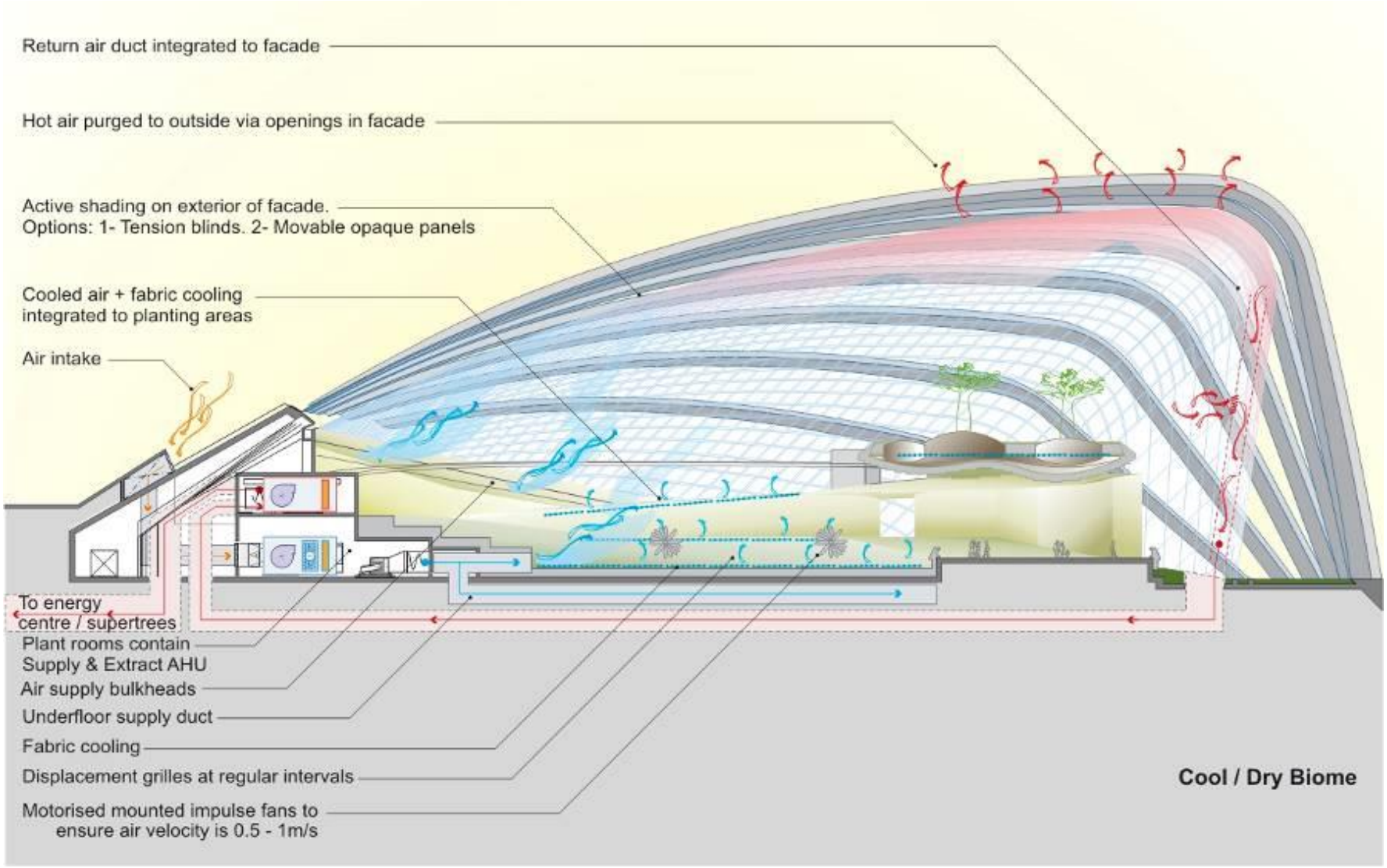
Solar Control



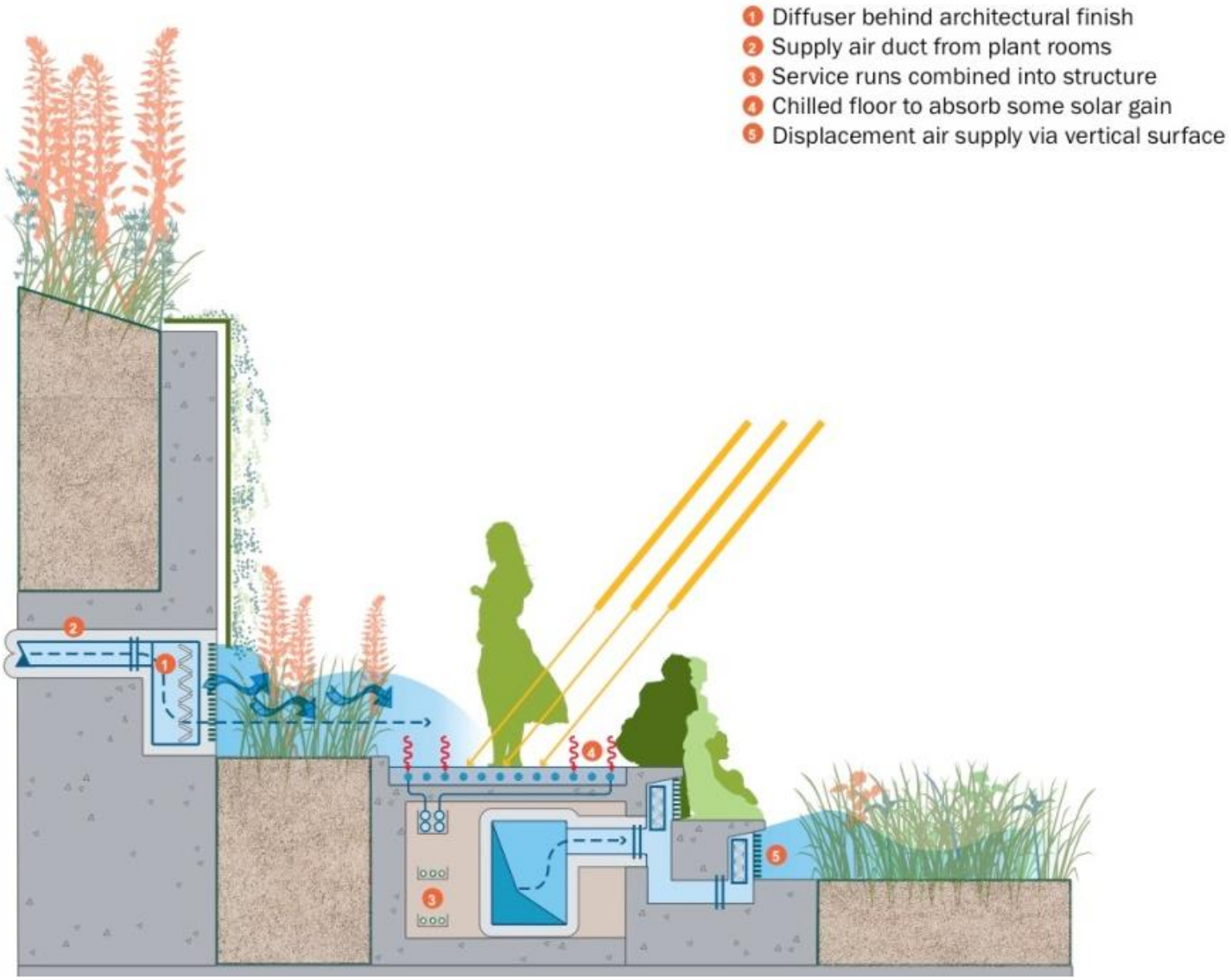
External Shading



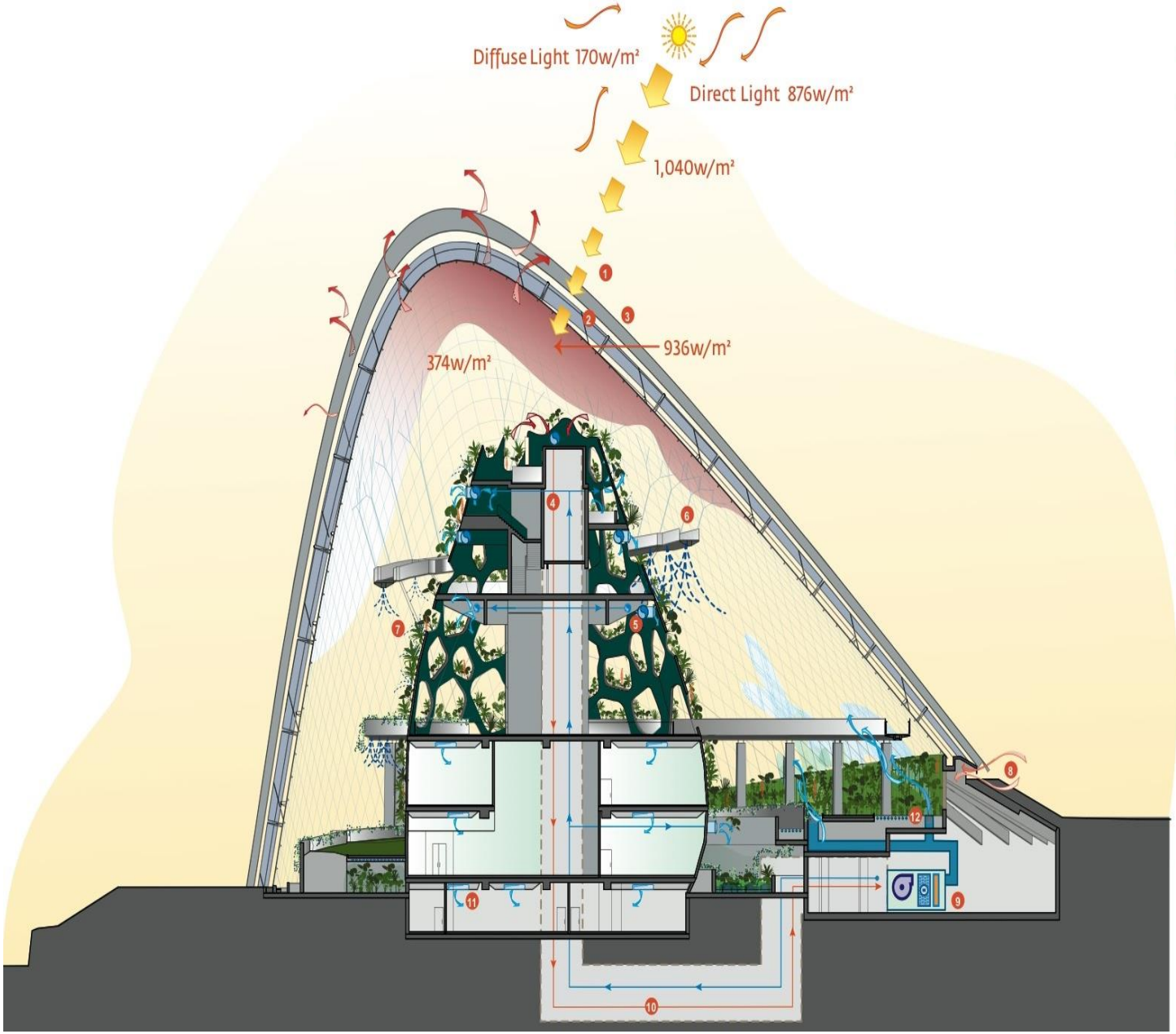
Environmental Concept



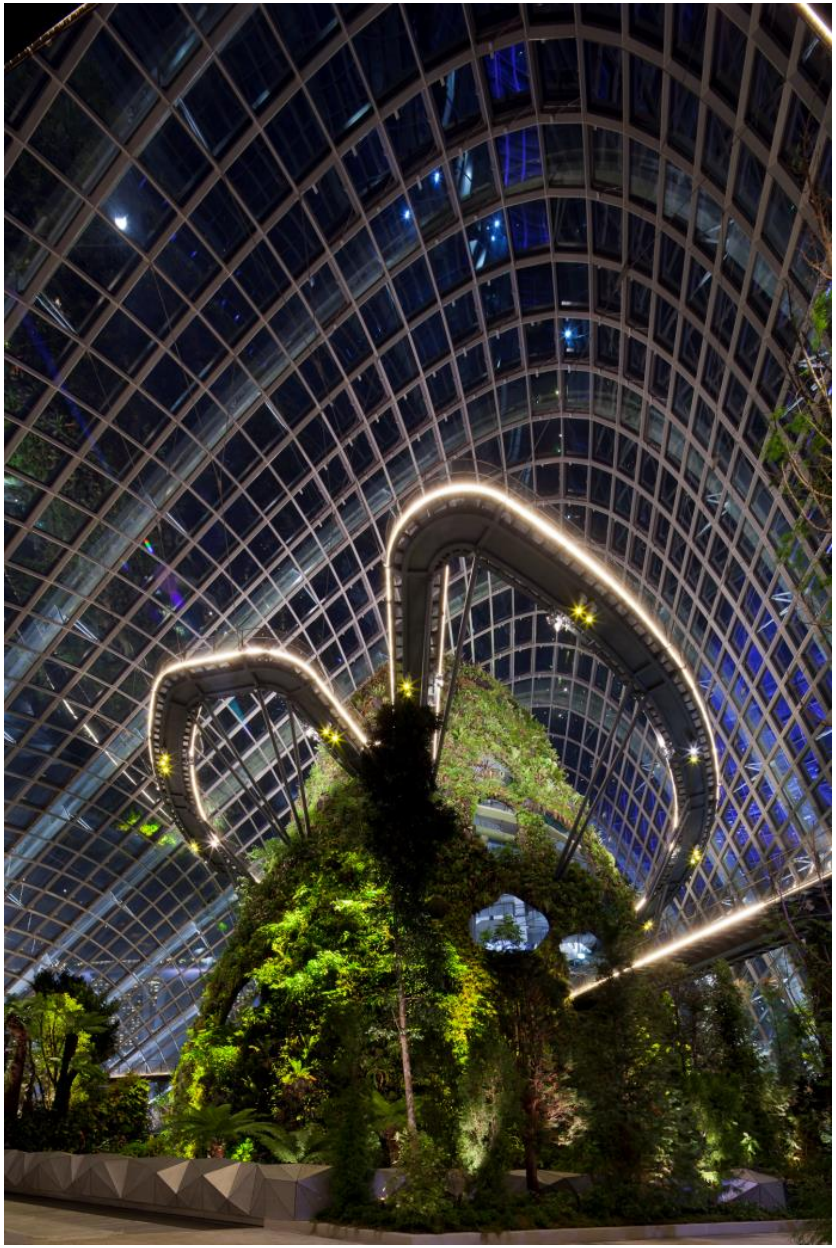
Conditioning Strategy



The Cloud Forest



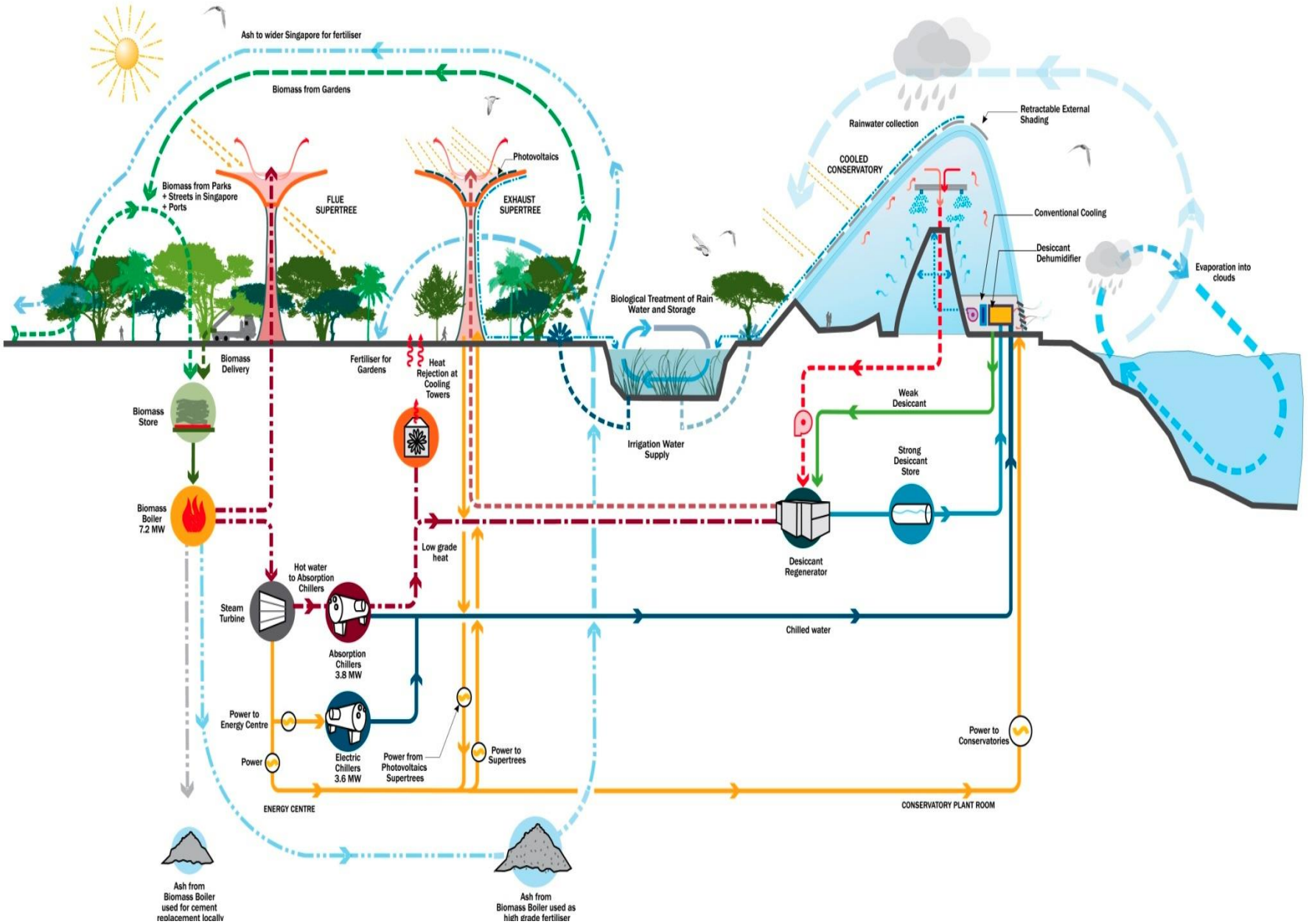
1. Hot air Purged to outside via openings in facade. Space is always positively pressurised
2. Active shading on exterior of facade. Self-furling shades
3. Air volume equivalent to fresh air rate purged through facade at high level
4. Return air duct integrated to mountain
5. Air distribution via ring ducts at each level to set diffusers pointing inwards and pointing outwards
6. No conditioning to walkways. Misters are on underside of walkway Internal misters can be used to assist shade on very bright days
7. Misting nozzles distributed throughout surface of space
8. Air intake
9. Ground air handling plant room Supply and extract AHU's dehumidification unit
10. Tunnel beneath building connecting air handling plant room plant room to core of mountain
11. Block box internal spaces conditined with fancoil
12. Air distribution and fabric cooling integrated to planter and walkway areas



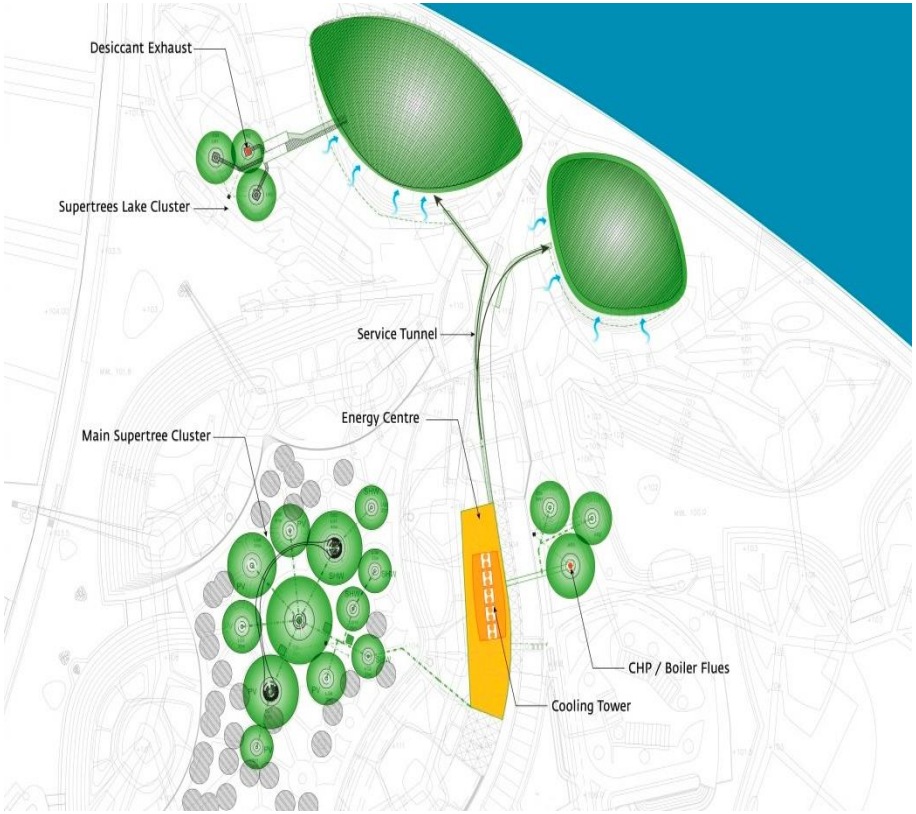
Gardens by the Bay, Singapore

Grant Associates and Wilkinson Eyre Architects

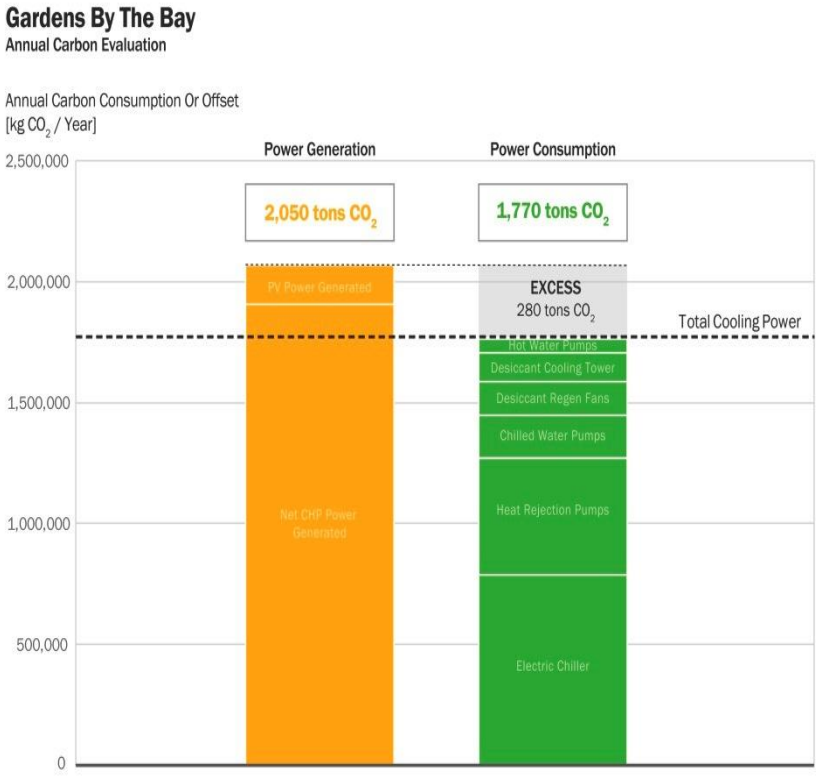
Marina South Eco-System



Biomass


Desiccant Exhaust
Supertrees Lake Cluster
Service Tunnel
Energy Centre
Main Supertree Cluster
CHP / Boiler Flues
Cooling Tower

The Energy Centre



New York

45 East 20th Street, 4th Floor
New York NY 10003
T +1 (212) 254 4500