Principles and Applications

Green Buildings & Passive Designs

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TIME
ARE WE MAKING HURRICANES WORSE?
COMMERCIAL REAL
GOING GREEN
Environmental efficiency is actually the hottest trend in
ment. The challenge is creating demand among te
Special Reprint Edition
USA TODAY
As seen in USA TODAY Money
July 26, 2006
Building 'green' reaches a new level
NATIONAL GEOGRAPHIC
GLOBAL WARNING
REAL ESTATE FINANCE
WIRED
CLIMATE CRISIS!
green by DESIGN
Estate's Latest Movement
SPECIAL REPORT GLOBAL WARMING
TIME
BE WORRIED. BE VERY WORRIED.
BusinessWeek
GLOBAL WARMING
Why Business Is Taking It So Seriously
The New York Times
Editorial
The Gre
in A
Adobe has turned its headquarter
and is saving millions of d
Build Green, Make Green
BUSINESS 2.0
GO GREEN. GET RICH.
ew York Times
ucation Life
The Greening of America's Campus
cling anymore. The sustainability movemen
w campuses are built, and
dents live
The Economist
The greening of America
CONDOLiving
It's Easy Being Green
The Economist
The oiloholics
NATIONAL GEOGRAPHIC
After Oil
The Washington Post
REAL ES
an inconvenient truth

figure 2: the greenhouse effect

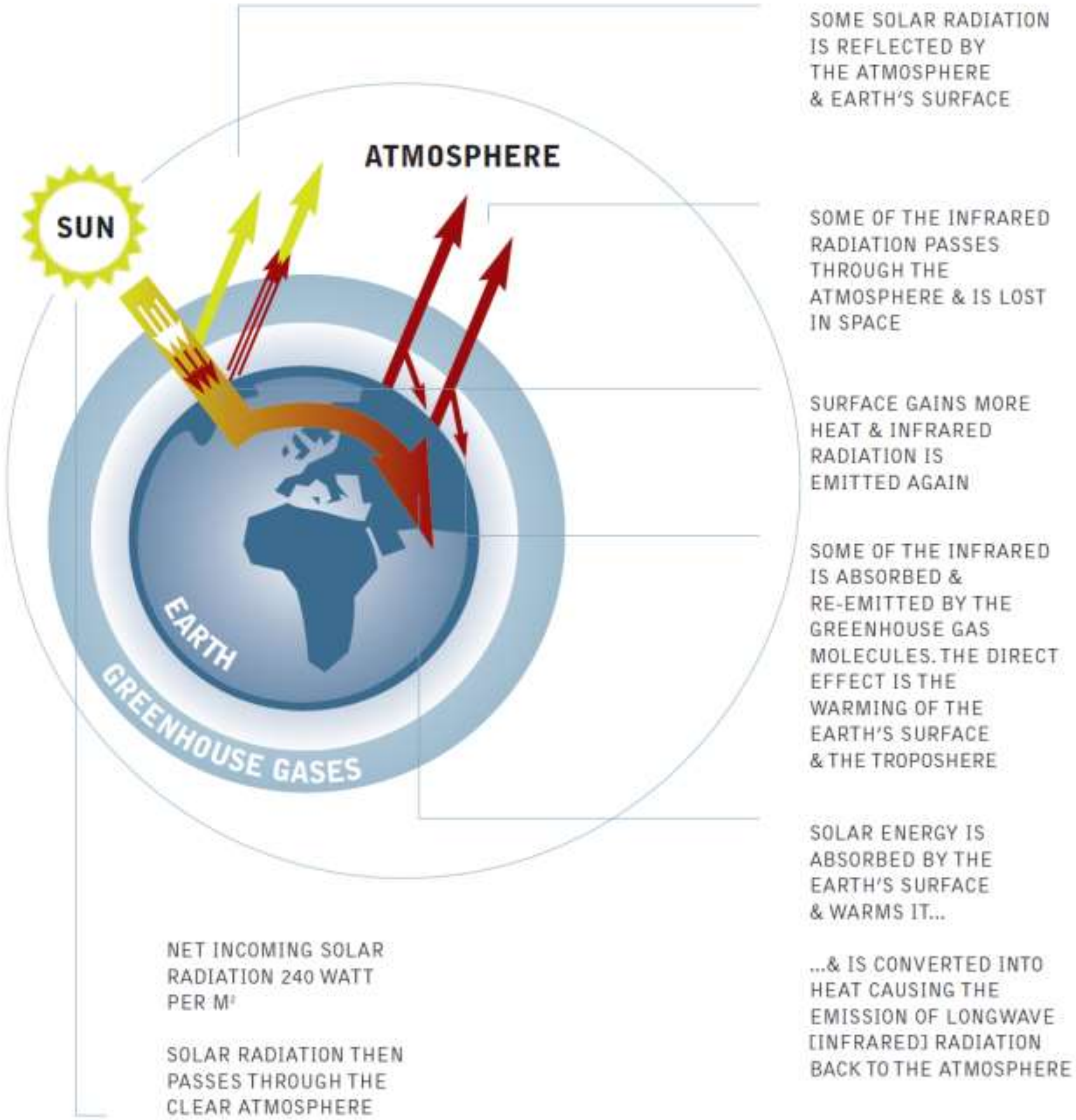


table 1: top 10 warmest years between 1850 and 2005

COMPARED TO MEAN GLOBAL TEMPERATURE 1880-2003

YEAR	GLOBAL TEMPERATURE ANOMALY	RANK
1998, 2005	+0.63°C	1
2003	+0.56°C	2 (tie)
2002	+0.56°C	2 (tie)
2004	+0.54°C	4
2001	+0.51°C	5
1997	+0.47°C	6
1995	+0.40°C	7 (tie)
1990	+0.40°C	7 (tie)
1999	+0.38°C	9
2000	+0.37°C	10

source NATIONAL CLIMATIC DATA CENTER

2016 was the hottest year on record -- again

By Brandon Miller, CNN Meteorologist





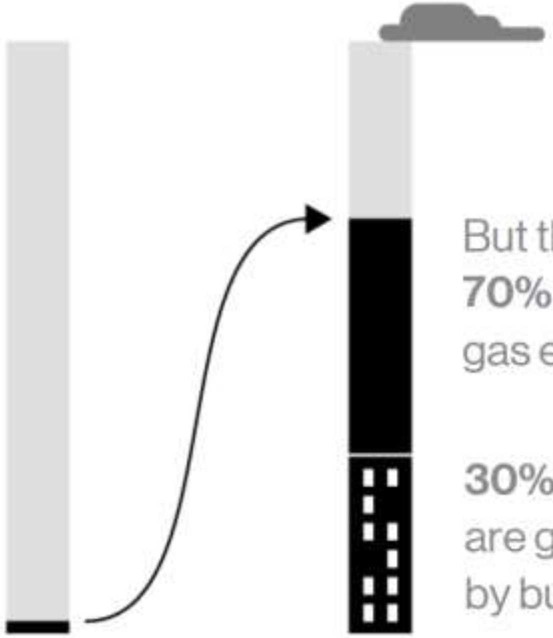
THE BUILDING BLOCKS OF CITIES

AN URBAN FUTURE

Nearly **70 percent** of the world's population will live in cities by 2050, up from **55 percent** today.

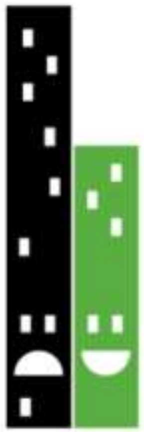
THE ROLE OF BUILDINGS

Cities cover **2%** of the world's land area.



But they account for **70%** of greenhouse-gas emissions.

30% of those are generated by buildings.

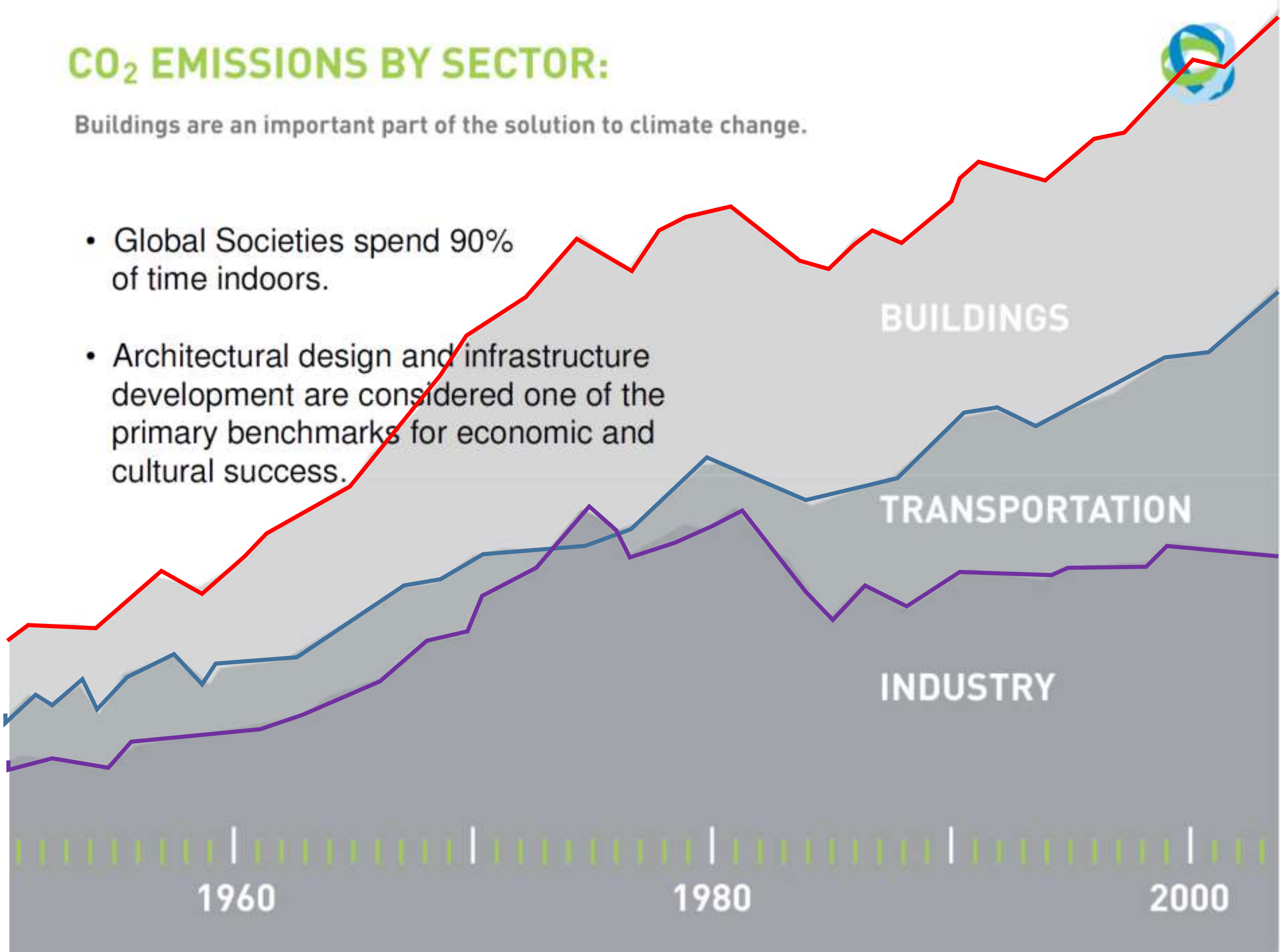


But that could change. Compared to traditional construction, green buildings in the U.S. have reduced CO_2 emissions by **34%**.

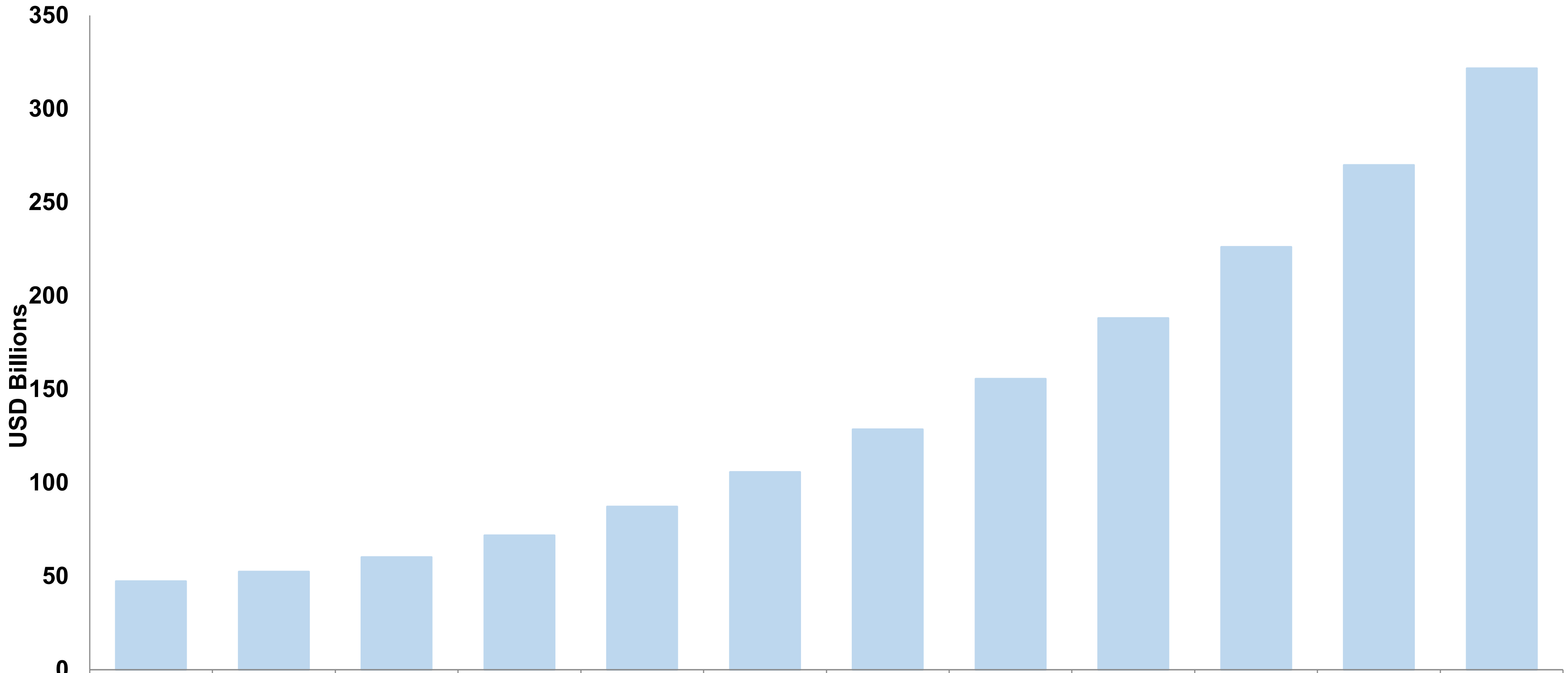
CO_2 EMISSIONS BY SECTOR:

Buildings are an important part of the solution to climate change.

- Global Societies spend 90% of time indoors.
- Architectural design and infrastructure development are considered one of the primary benchmarks for economic and cultural success.



Resource Crunch in the Indonesia



	2011	2012 (e)	2013 (f)	2014 (f)	2015 (f)	2016 (f)	2017 (f)	2018 (f)	2019 (f)	2020 (f)	2021 (f)	2022 (f)
Buildings	47,4	52,5	60,3	71,9	87,3	105,7	128,6	155,7	188,1	226,2	270,1	321,8

- **Indonesian Construction Growth is among the fastest in the world- above 10% annual**
- **By 2030, 71% of the Indonesian population will be in the cities**
- **Building sector emissions are expected to grow annually at 4.5%**

SHADES OF GREEN: INVESTMENT POTENTIAL BY REGION AND SECTOR ($ BILLION)

	Wind	Solar	Biomass	Small Hydro	Geothermal	All Renewables	Electric Transmission & Distribution	Industrial Energy Efficiency	Buildings	Transport	Waste	Subtotal
East Asia Pacific	231	537	48	34	16	866	392	143	13,235	1,357	53	16,046
Latin America and Caribbean	118	44	45	11	14	232	0	21	901	1,460	26	2,640
South Asia	111	211	16	0	0	338	0	85	1,543	255	13	2,234
Europe and Central Asia	51	39	6	7	6	109	0	57	410	78	11	665
Sub-Saharan Africa	27	63	3	3	27	123	0	0	153	499	8	783
Middle East and North Africa	50	46	0	1	0	97	21	1	92	50	4	265
Total Climate-Smart Investment Potential by Sector ($ billion)	588	940	118	56	63	1,765	413	307	16,334	3,699	115	22,633

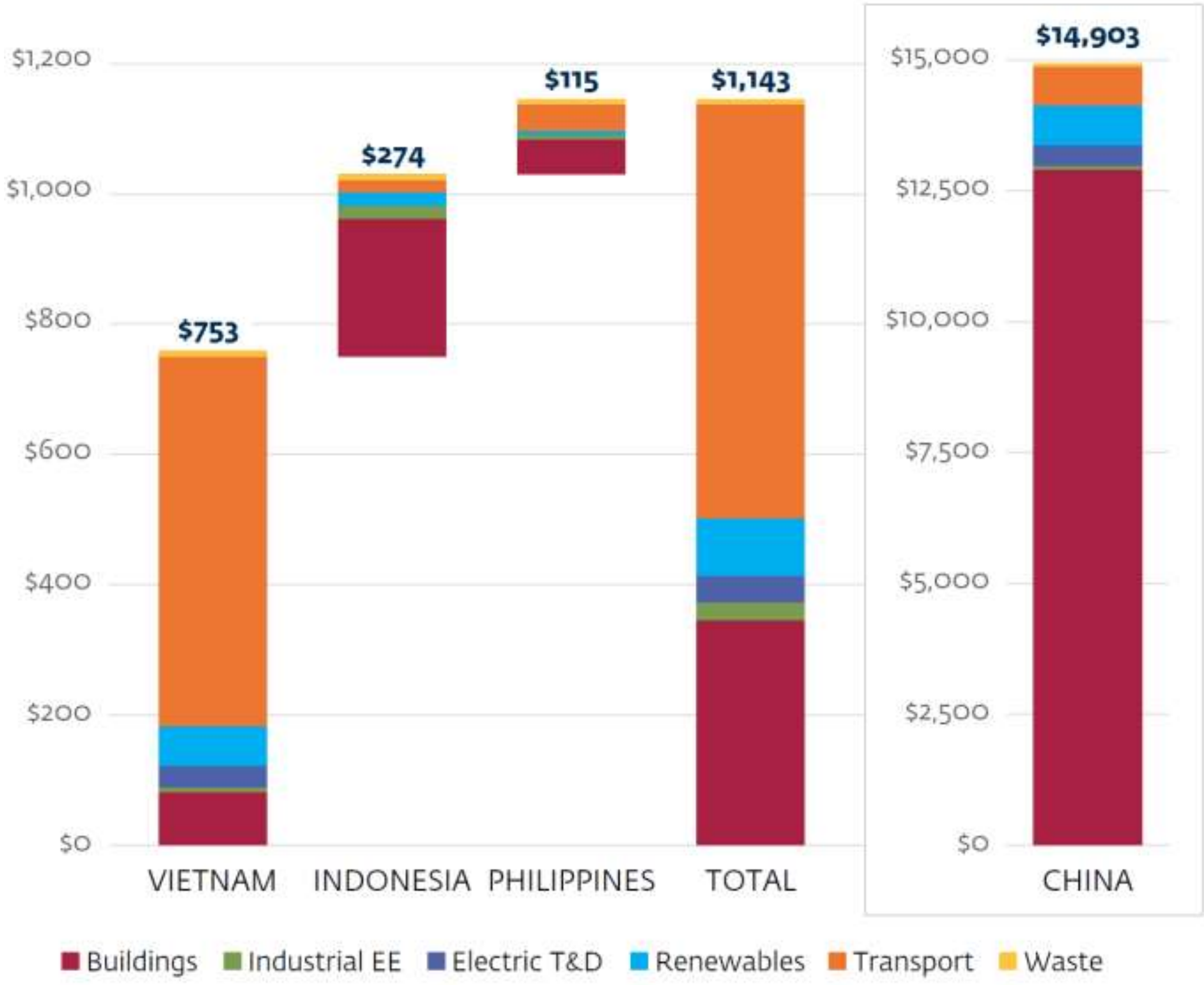
>1000
>500<1000
>250<500
>100<250
>50<100
>25<50
<25

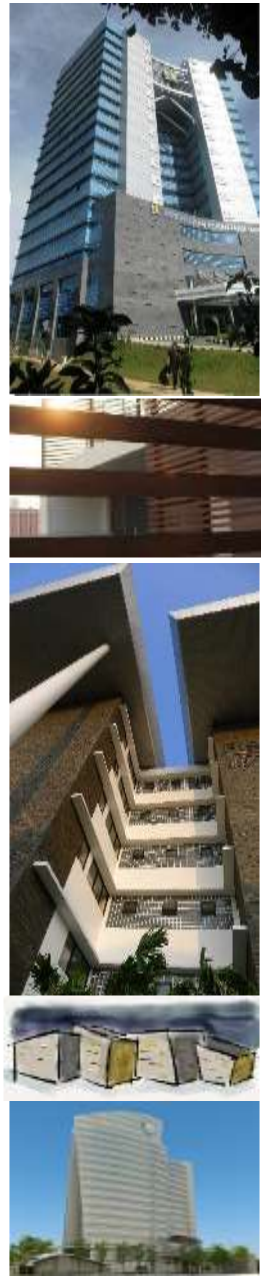
IFC estimates that there is a $23 trillion private climate investment opportunity in the 21 countries studied for this report.





Climate-Smart Investment Potential 2016 - 2030 ($ billion)

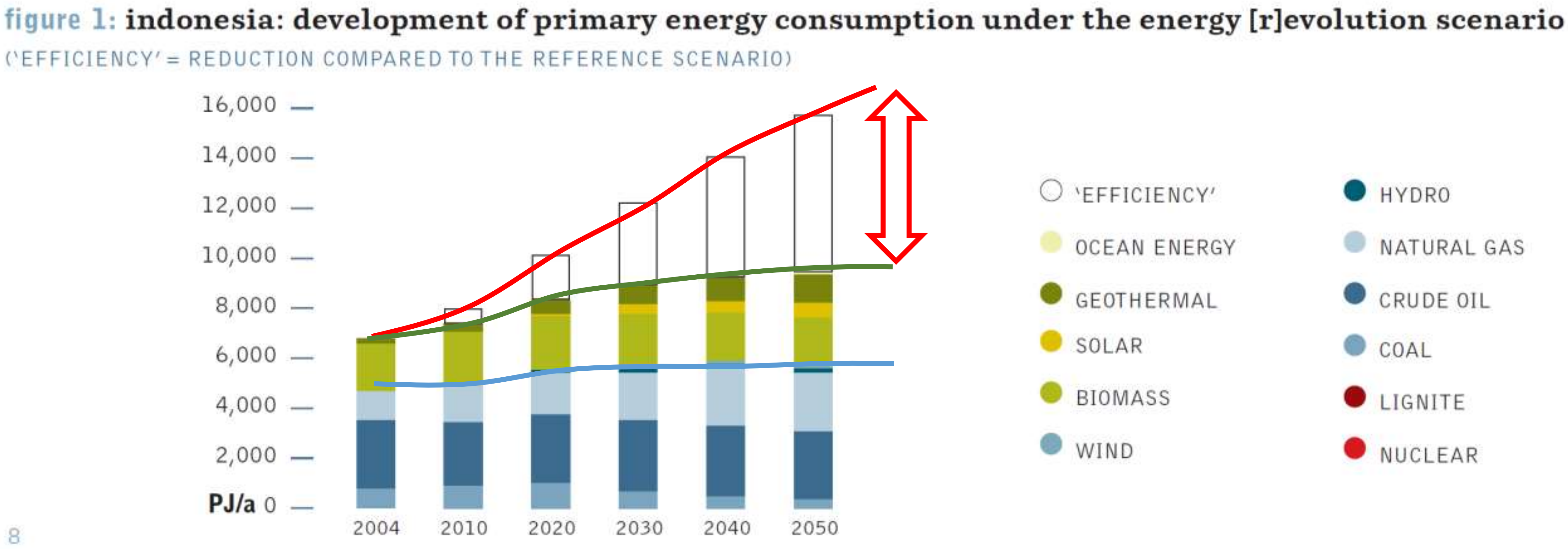




Buildings are part of a big problem,

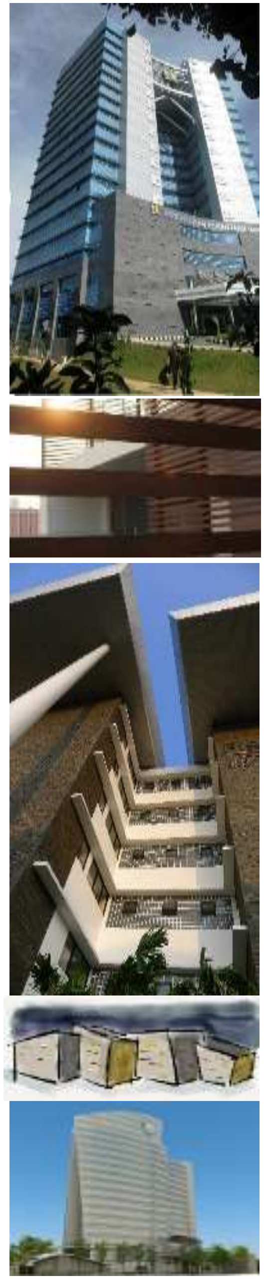
...but they can be a big part of the solution!

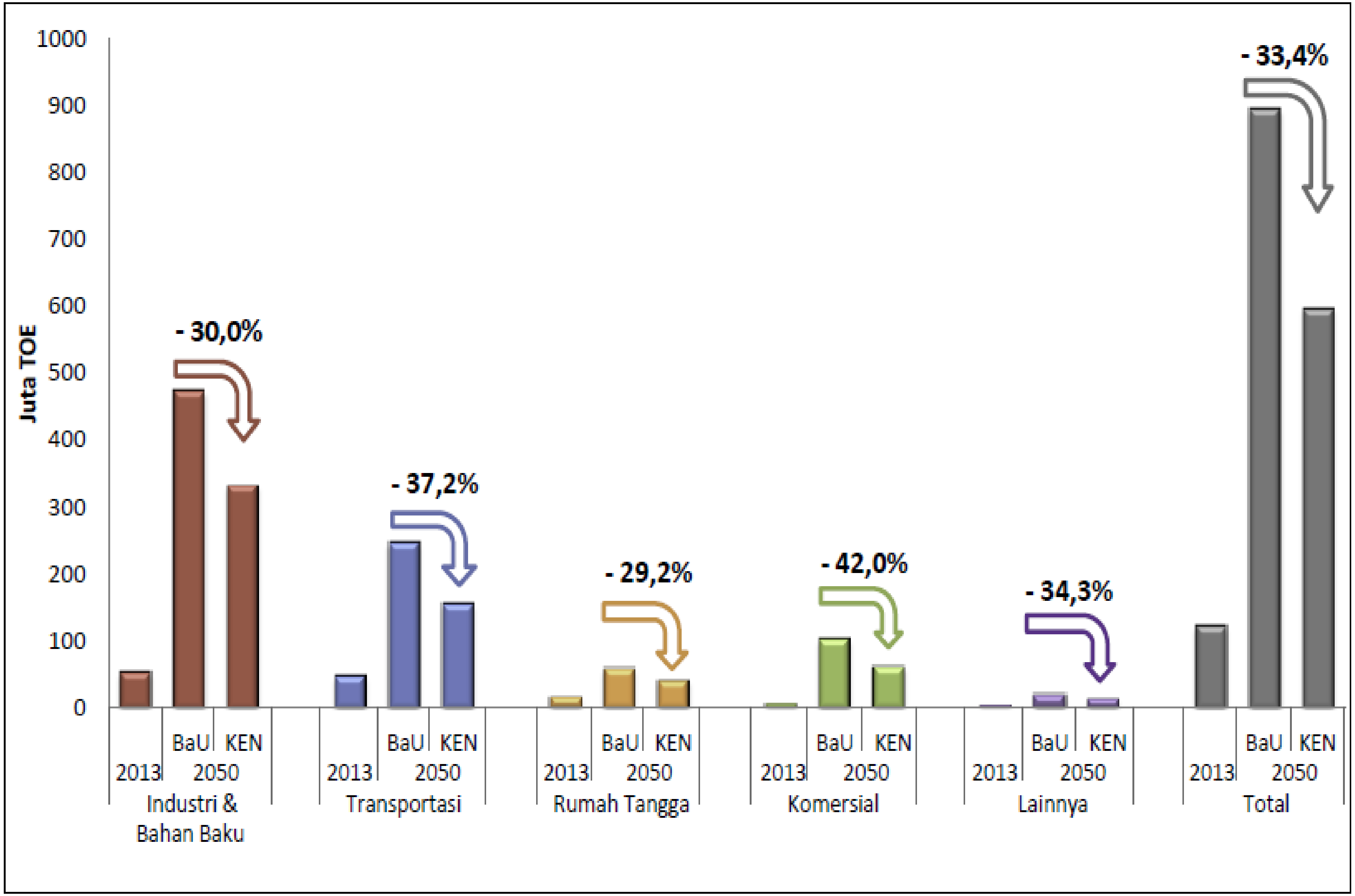
Indonesia Primary Energy consumption scenario



Source: Energy [r]evolution. A sustainable Indonesia energy outlook

POTENSI PENGHEMATAN ENERGI FINAL





Jakarta GB Grand Design : Target

By 2030, Green Building implementation shall achieve

Energy Saving	Water Saving	CO2 Saving
30%	**30%**	**30%**

vs

Business as Usual

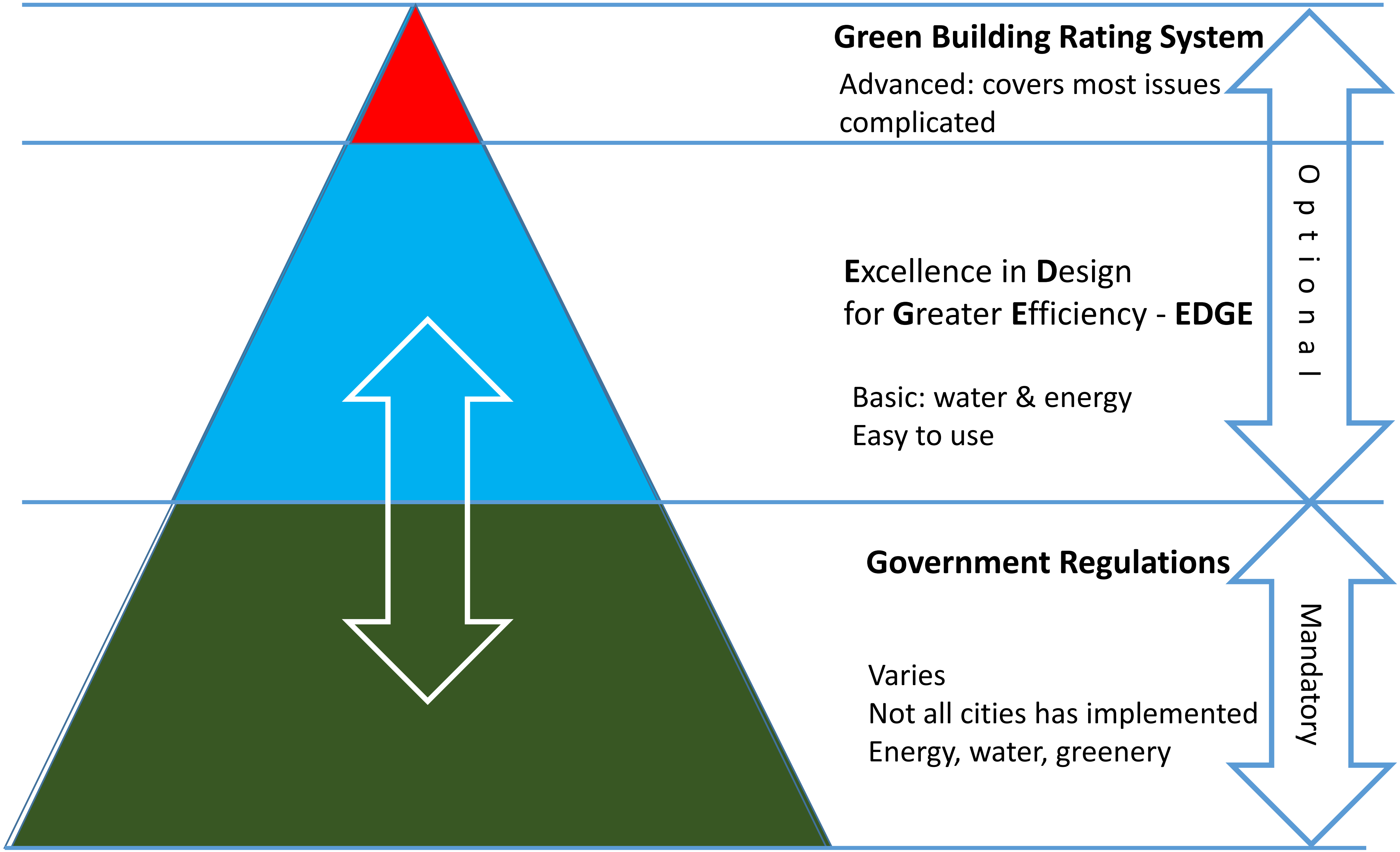






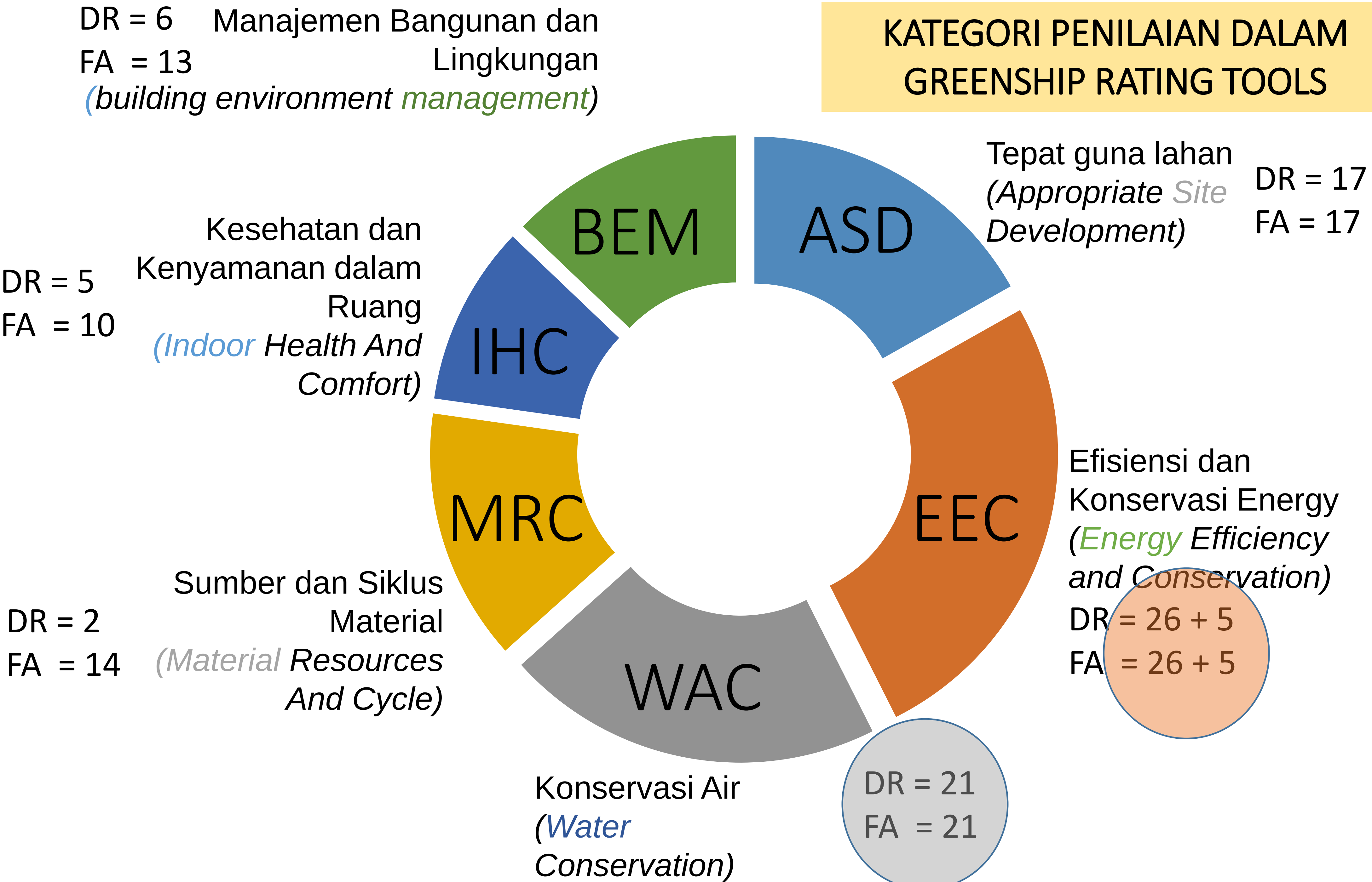
Bench marking

Are these “green properties” really green?
What is the criteria? … parameters?



Green Building Rating System
Advanced: covers most issues
complicated
Excellence in Design
for Greater Efficiency - EDGE
Basic: water & energy
Easy to use
Government Regulations
Varies
Not all cities has implemented
Energy, water, greenery
Optional
Mandatory

KATEGORI PENILAIAN DALAM GREENSHIP RATING TOOLS



Edge
Excellence In Design For Greater Efficiencies

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International Finance Corporation
WORLD BANK GROUP

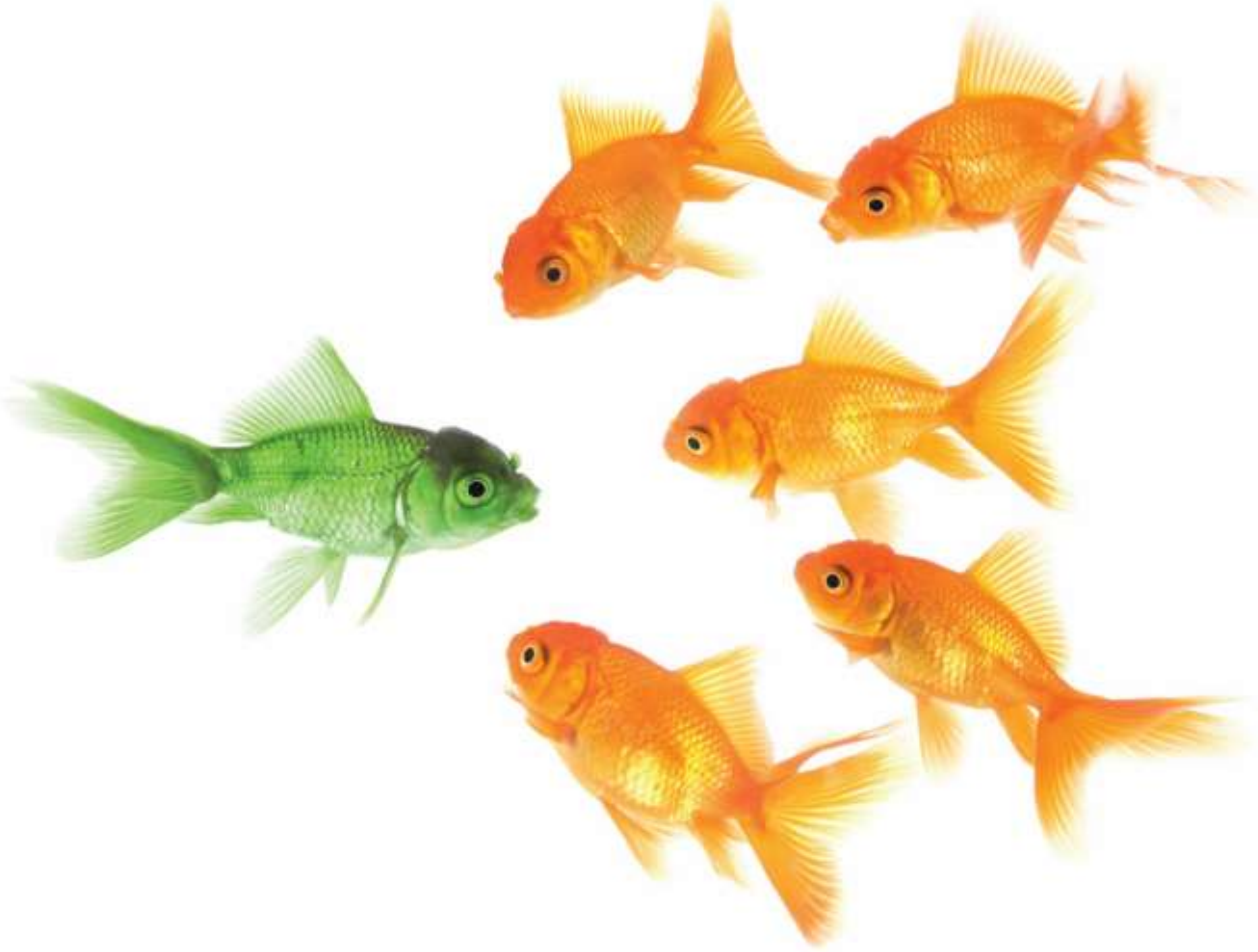
GREEN BUILDINGS

FOR A SMARTER WORLD

www.edgebuildings.com

HOW CAN YOU SHOW THAT YOUR DESIGN IS GREEN IN EMERGING MARKETS?

____



HOW CAN YOU DESIGN WITH DATA?

THE SOLUTION IS EDGE: A SOFTWARE, A STANDARD, AND A GREEN BUILDING CERTIFICATION SYSTEM.

20%

Edge

A SOFTWARE

A STANDARD

A LABEL

THE EDGE STANDARD FOCUSES SHARPLY ON RESOURCE EFFICIENCY,
KEEPING CERTIFICATION ACHIEVABLE.

English
Super Admin

Homes | Hotels | Retail | Offices | Hospitals

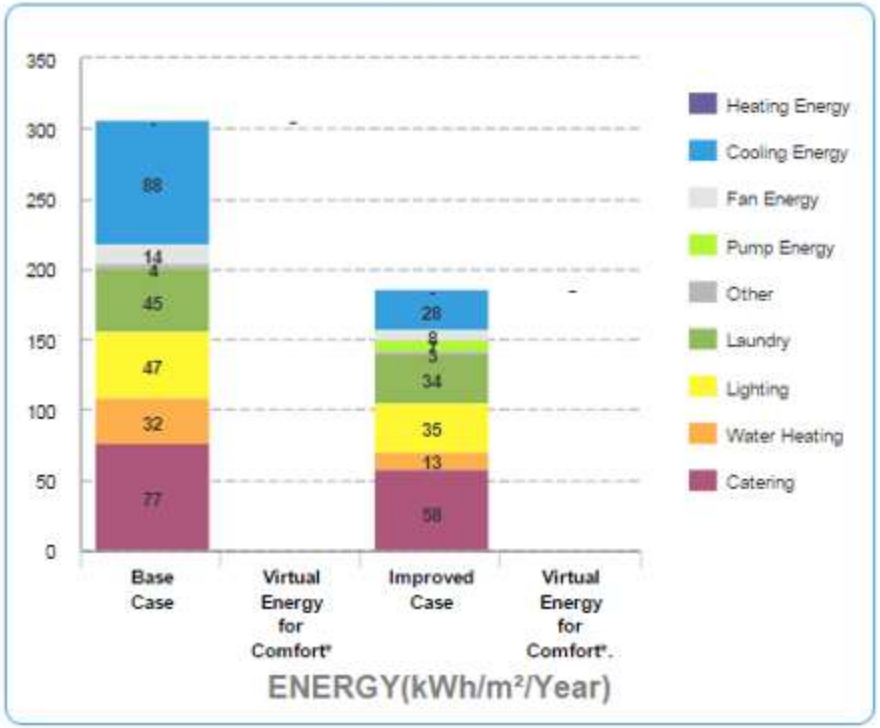
Base Case Utility Cost	102,432	$/Month	Incremental Cost	915,675	$
Utility Costs Reduction	40,040	$/Month	Payback in Years	1.9	Yrs.

Energy Efficiency Measures

Select options from the list below

- [x] Reduced Window to Wall Ratio
- [x] External Shading Devices
- [ ] Insulation of Roof Surface
- [ ] Insulation of External Walls
- [x] Low-E Coated Glass
- [x] Higher Thermal Performance Glass
- [ ] Natural Ventilation - Corridors
- [ ] Natural Ventilation - Guest Rooms with Auto Controls
- [ ] Variable Refrigerant Volume (VRV) Cooling System
- [ ] Air Conditioning with Air Cooled Screw Chiller
- [ ] Air Conditioning with Water Cooled Chiller

39.3% MEETS EDGE ENERGY STANDARD



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Super Admin

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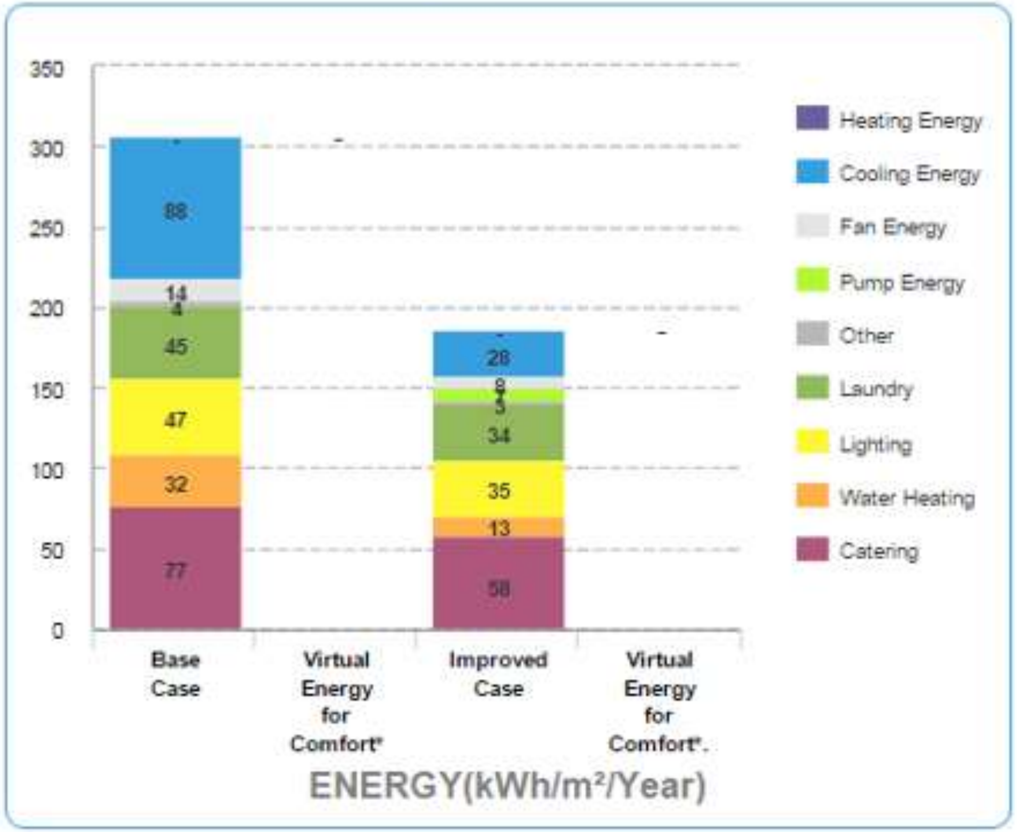


EDGE IS DIFFERENT FROM OTHER CERTIFICATIONS

FINANCIAL CALCULATOR No other certification system has free software to calculate the cost of going green.

QUANTITATIVE APPROACH EDGE uses projected performance for a uniquely measurable approach to certification.

ONE-STOP SHOP Efficiency simulations are executed in EDGE – software or special consulting is no longer needed.

PROJECT INTEGRATION Certification compliance can be achieved with invoices, onsite inspection photos and simple architectural drawings.

LOCATION-SPECIFIC EDGE is adapted to specific climates and lifestyles for the most accurate results.

GREEN BUILDINGS FOR ALL Fast and low-cost, EDGE makes certification easy for everybody.





Government Regulations

RANCANGAN PERATURAN GUBERNUR
PROVINSI DAERAH KHUSUS IBUKOTA JAKARTA
Nomor Tahun 2010

TENTANG
BANGUNAN GEDUNG RAMAH LINGKUNGAN

DENGAN RAHMAT TUHAN YANG MAHA ESA
GUBERNUR PROVINSI DAERAH KHUSUS IBUKOTA JAKARTA,

Menimbang : a. bahwa setiap penyelenggaraan bangunan gedung mempunyai tanggung jawab untuk menerapkan kaidah pembangunan berkelanjutan guna mengatasi gejala perubahan iklim dan memperbaiki kerusakan lingkungan dengan memperhatikan aspek-aspek penyelenggaraan bangunan gedung yang ramah lingkungan.

b. bahwa sehubungan dengan huruf a di atas, perlu menetapkan pengaturan bangunan gedung ramah lingkungan dengan Peraturan Gubernur.

KEMENTERIAN PEKERJAAN UMUM

PERATURAN MENTERI PEKERJAAN UMUM
NOMOR .../PRT/M/20XX
TANGGAL 20XX

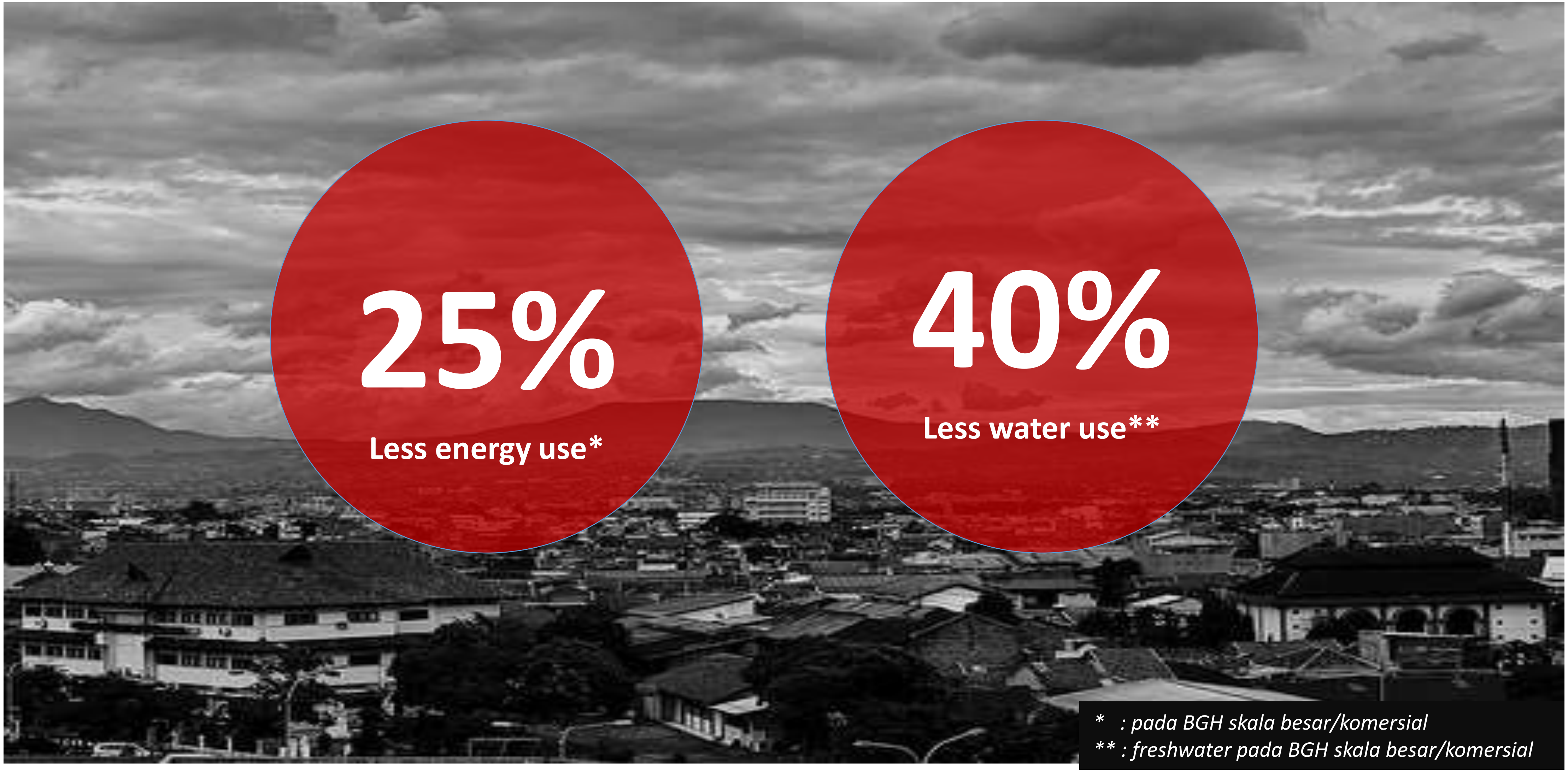
TENTANG

PEDOMAN TEKNIS RAMAH LINGKUNGAN
(*GREEN BUILDING*)

DIREKTORAT PENATAAN BANGUNAN DAN LINGKUNGAN
DIREKTORAT JENDERAL CIPTA KARYA

Potensi Konservasi

Potensi Konservasi Energi dan Air Kota Bandung dengan seluruh Rekomendasi



** : pada BGH skala besar/komersial*
*** : freshwater pada BGH skala besar/komersial*

4. Muatan Substansi Raperwal – *Komponen Disain Pasif / Arsitektur*

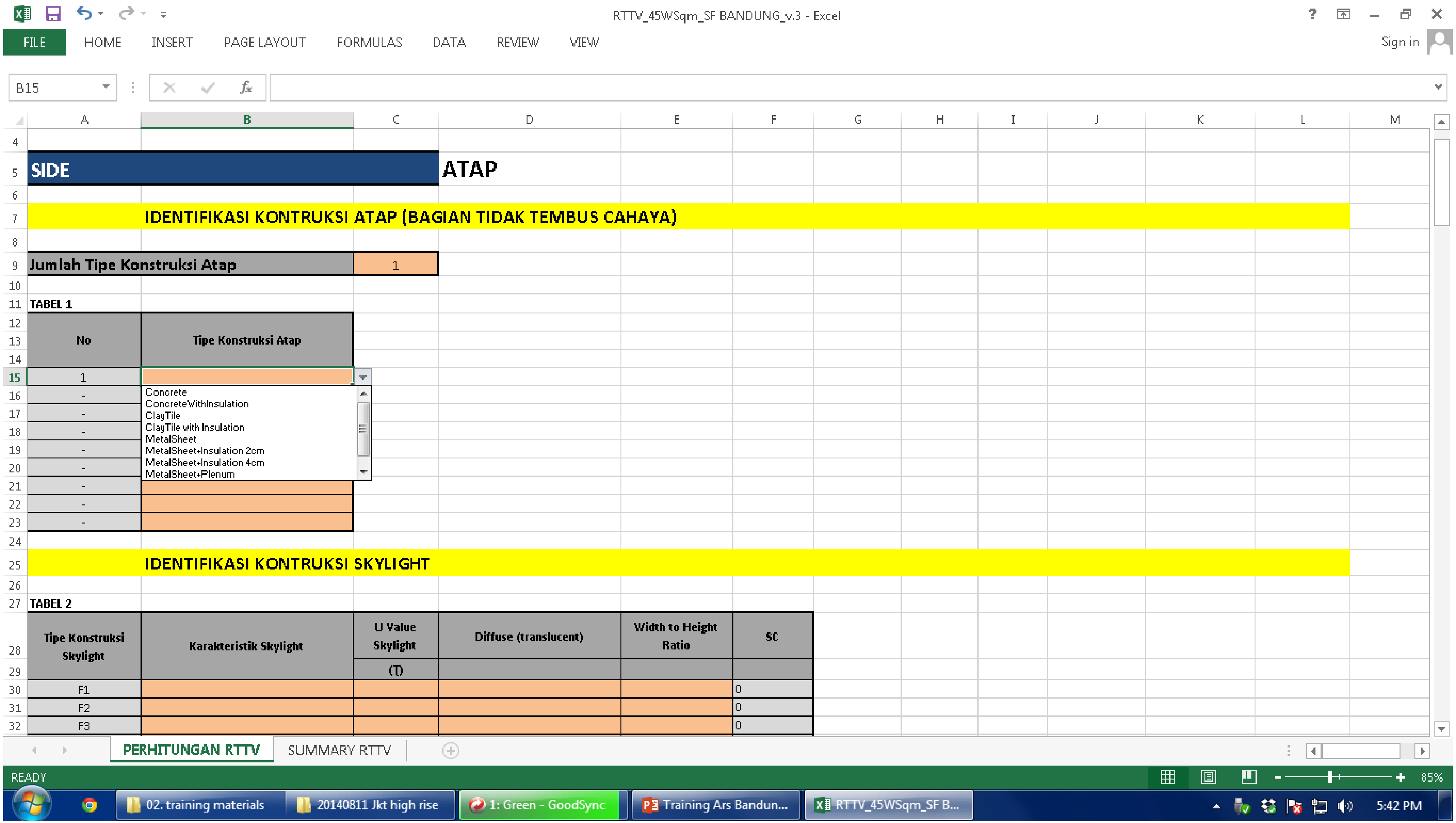
No.	Materi	Standar	Keterangan
1	OTTV	45 W/m^2≤	Denah, tampak, pot, detail pot typical dg spec kaca. Gunakan spreadsheet Distarcip
2	RTTV	45 W/m^2≤	Denah atap, detail atap dg spec atap. Gunakan Spreadsheet Distarcip
3	Operable windows pada ruang ber AC 5% dari luas lantai	luas lantai < 5%	Denah tiap lantai, detail typical jendela
4	Penampungan Air hujan	(0.025 x GF area) ≥	Lokasi GWT dan ukuran, bisa digabungkan dg Raw water tank. Hrs sesuai dg one line diagram water system.
5	Sumur resapan, kolam resapan	(0.025 x GF area) ≥	Layout SR, KL dan detailnya
6	RTH	Sesuai RTBL, RDTR	Site plan
7	DHB	30% ≥ GF Area	Site plan, tampak utk (vertical greenery, roof garden) informasi luasan.
8	Parkir sepeda	4% parkir mobil	Denah lokasi
9	Shower room	10% parkir sepeda	Denah lokasi

4. Muatan Substansi Raperwal – *Komponen Disain Aktif/ MEP*

No	Materi	Standar	Keterangan
1	Ventilasi mekanis (non AC)	See attachment	Laporan perhitungan fresh air utk ventilasi mekanis, check gbr system diagram, spec
2	Temperature setting 25 C		Laporan perhitungan cooling load dan HVAC system
3	Fresh air utk AC room	See attachment	Laporan perhitungan cooling load dan HVAC system
4	Zonasi thermal dan VAV		Laporan perhitungan cooling load dan HVAC system Gbr system diagram
5	VSD Pompa air		Laporan perhitungan cooling load dan HVAC system Gbr system diagram Spec equipment
6	VSD chiller		Spec equipment
7	COP	See attachment	Spec Equipment
8	Zonasi pencahayaan dan sensor		Gbr Lighting wiring system
9	Perletakkan sensor	1.5 x tinggi floor to floor	Denah layout tata lampu dan sensor

No	Materi	Standar	Keterangan
10	LPD < persyaratan sesuai fungsi	See attachment	Gunakan LPD calculator dari distarchip Gbr layout tata lampu Spec lampu
11	Eskalator	Automatic stop & go	Check spec equipment
12	Lift	Lift dg kec < 60 m/s dg VVVF	Check spec equipment
13	Sub metering system	See attachment	Elect. System diagram
14	System air bersih, rain water harvesting, recycle	See attached diagram	Gbr system diagram
15	Sanitair hemat air	See attachment	check specs, tertulis dlm gbr
16	Limbah cair		Check spec STP
17	Building Management system (BMS)	(?)	KLB > 10,000 m2 & central AC. Check system diagram Check specs
18	Sensor CO2	Rg dg kepadatan > 3 m2/org → CO2 < 1000 ppm	Denah fungsi ruang AC system diagram
19	Sensor CO	Parkir basement < 200 mobil	Denah basement Fresh air system diagram & layout
20	Non CFC refrigerant		Specs equipment
21	Limbah padat	Pemilahan	Pernyataan owner dan

B. Alat Bantu : Perhitungan OTTV dan RTTV menggunakan *Spreadsheet* standar



B. Alat Bantu : Perhitungan OTTV dan RTTV menggunakan *Spreadsheet* standar

BUILDING ENVELOPE COMPLIANCE FORM

PERSYARATAN

Nilai Overall Thermal Transfer Value (OTTV) untuk bangunan tidak boleh melebihi 45 Watts/m^2

No	Side	Konduksi melalui Dinding	Konduksi melalui Bukaan	Radiasi melalui Bukaan	Total	Total Area Fasad	OTTV
		Watt	Watt	Watt	Watt	m2	Watt/m2
		A	B	C	D = A + B + C	E	D / E
1	North	1539.44	5992.70	37918.48	45450.63	672.00	67.63
2	South	1539.44	5992.70	28005.21	35537.35	672.00	52.88
3	East	962.15	3745.44	26822.85	31530.44	420.00	75.07
4	West	962.15	3745.44	27662.29	32369.88	420.00	77.07
5	North East	0.00	0.00	0.00	0.00	0.00	0.00
6	North West	0.00	0.00	0.00	0.00	0.00	0.00
7	South East	0.00	0.00	0.00	0.00	0.00	0.00
8	South West	0.00	0.00	0.00	0.00	0.00	0.00
		5003.18	19476.29	120408.83	144888.30	2184.00	66.34
		TOTAL	TOTAL	TOTAL	TOTAL	TOTAL	TOTAL

COMPLY? **NO**

SUMMARY - RTTV

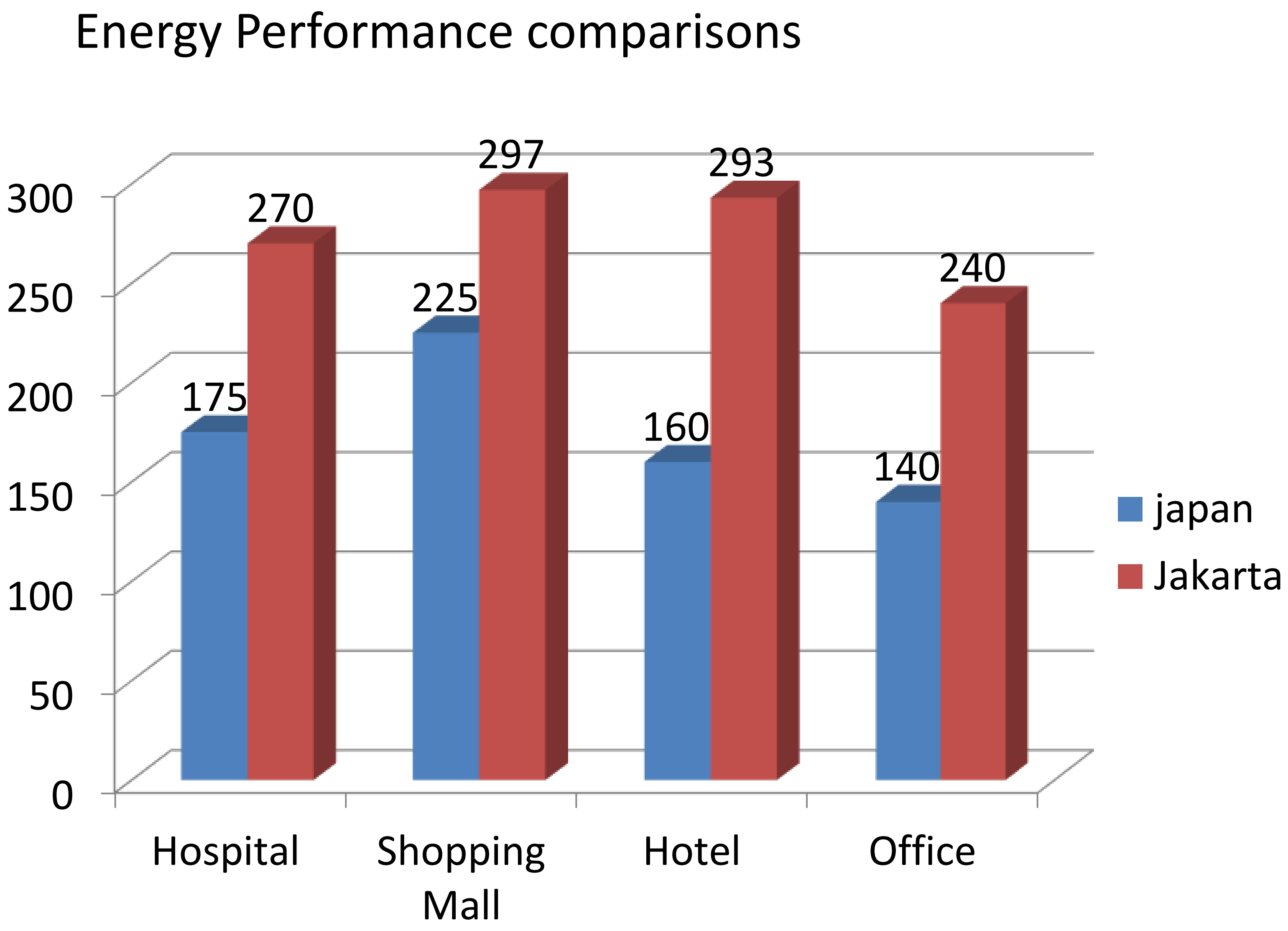
REQUIREMENT

Nilai Roof Thermal Transfer Value (RTTV) untuk bangunan tidak boleh melebihi 45 Watts/m2

No	Side	Konduksi melalui atap	Konduksi melalui Skylight	Radiasi melalui Skylight	Total	Total Area Atap	RTTV
		Watt	Watt	Watt	Watt	m2	Watt/m2
		A	B	C	D = A + B + C	E	D / E
1	Atap	18361.37	0.00	0.00	18361.37	1000.00	18.36
		TOTAL	TOTAL	TOTAL	TOTAL	TOTAL	TOTAL

COMPLY? **YES**

Passive Design / Energy efficient Design



IFC Study 2011
JICA Study 2009

GAMBAR. 01

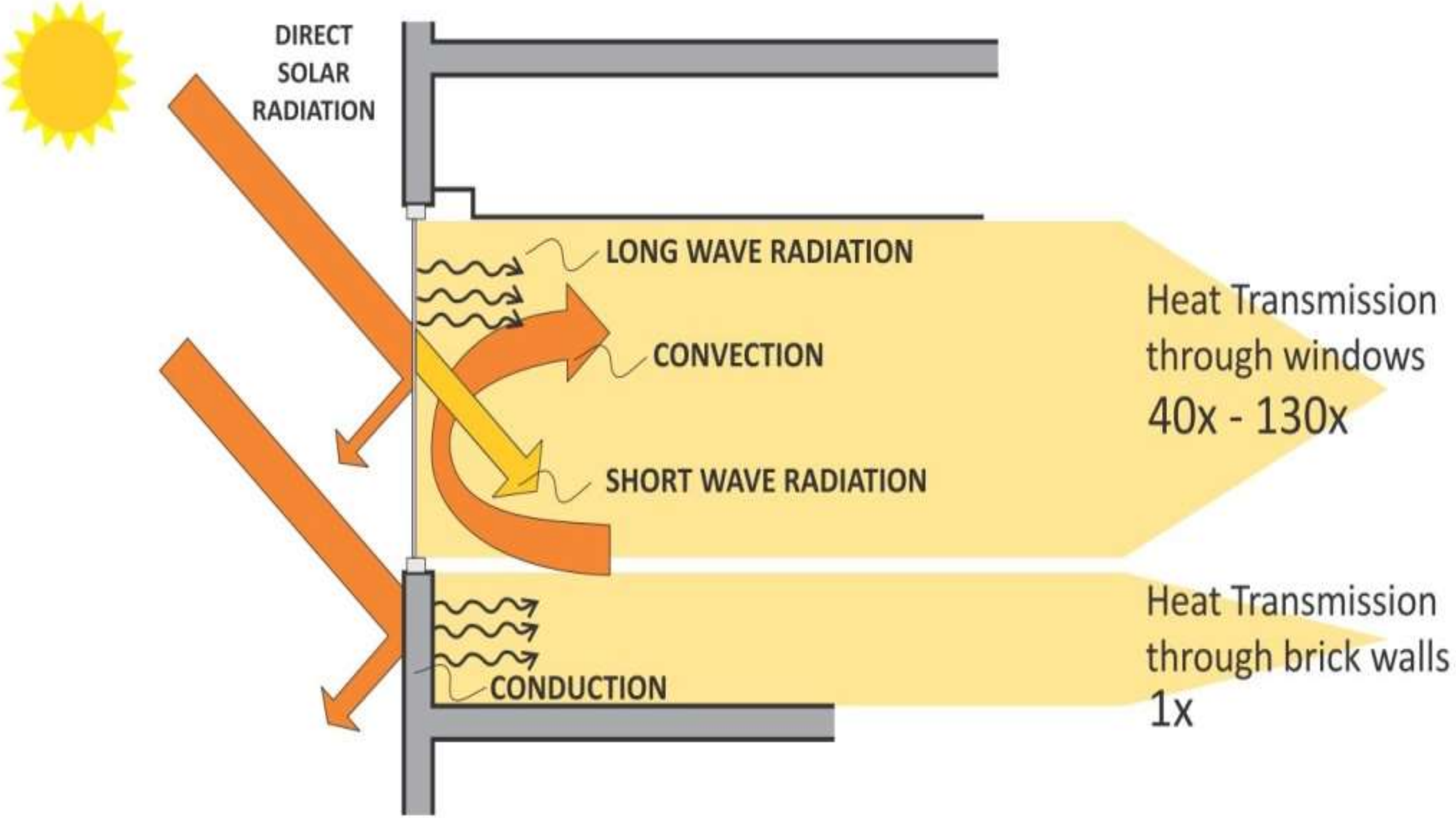
Rincian Konsumsi Energi untuk Berbagai Tipe Bangunan[1]

GAMBAR. 02

Rincian Beban Pendinginan untuk Tipikal Bangunan Kantor di Bandung[2]

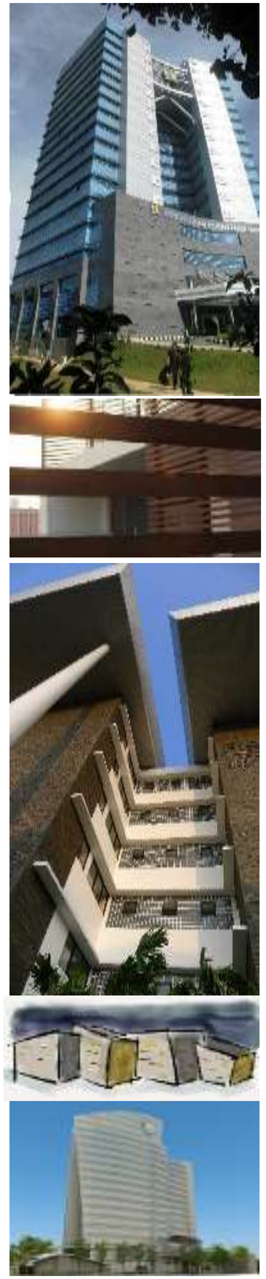


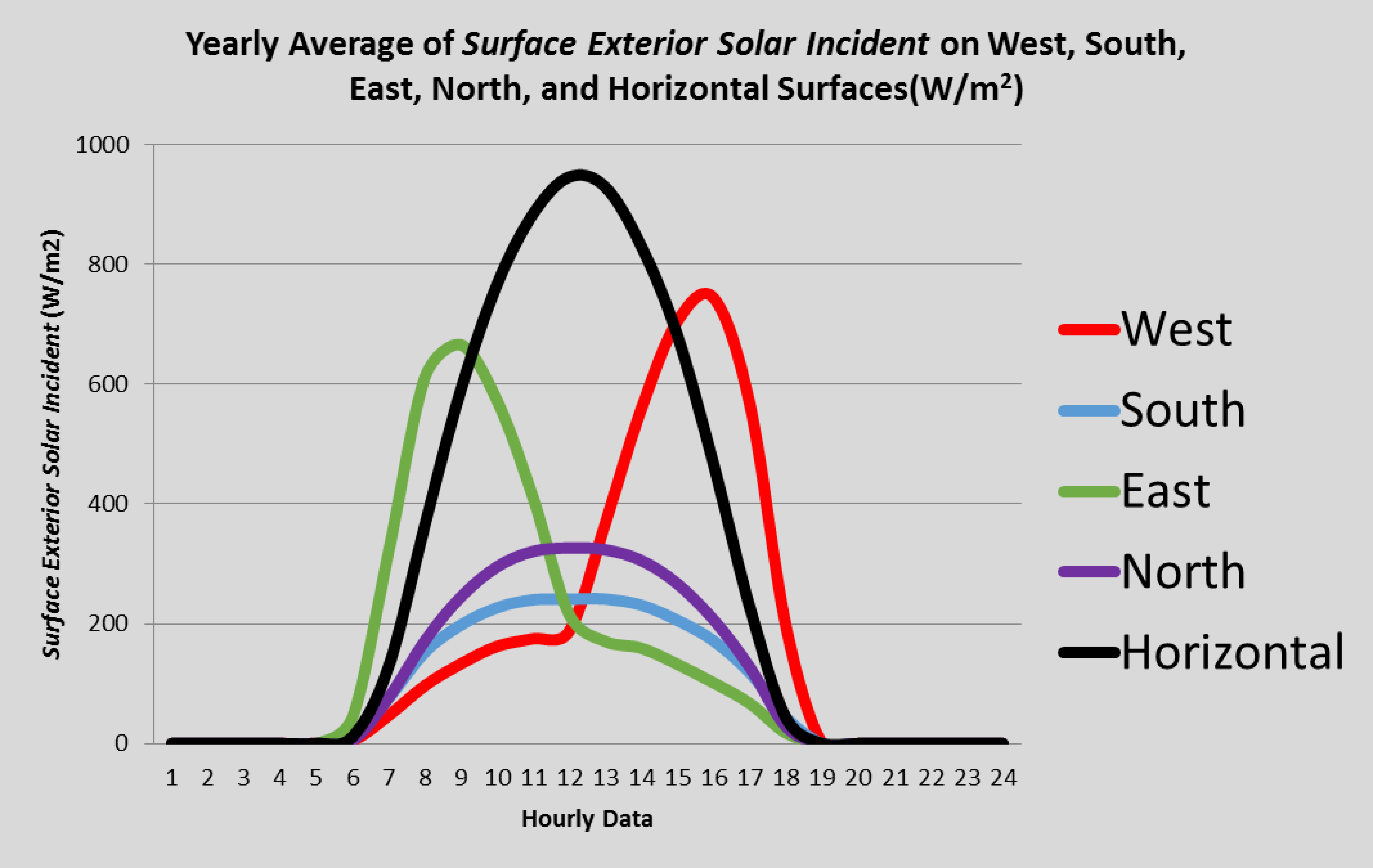


DIRECT
SOLAR
RADIATION
LONG WAVE RADIATION
CONVECTION
SHORT WAVE RADIATION
CONDUCTION
Heat Transmission
through windows
40x - 130x
Heat Transmission
through brick walls
1x

The Impact of Building Orientation





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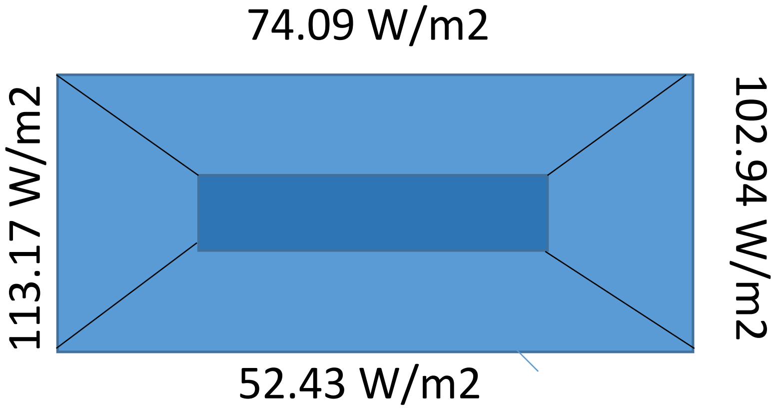


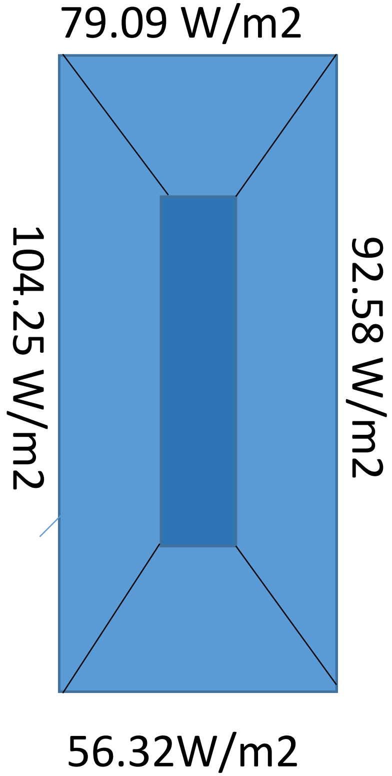
WWR = 70%

SHGC = 0.6 (panasap)

HVAC COP = 3 (package system, VRF/VRV)

OTTV = 74.47 W/m2

IKE = 171.99 kWh/m2/year



WWR = 70%

SHGC = 0.6 (panasap)

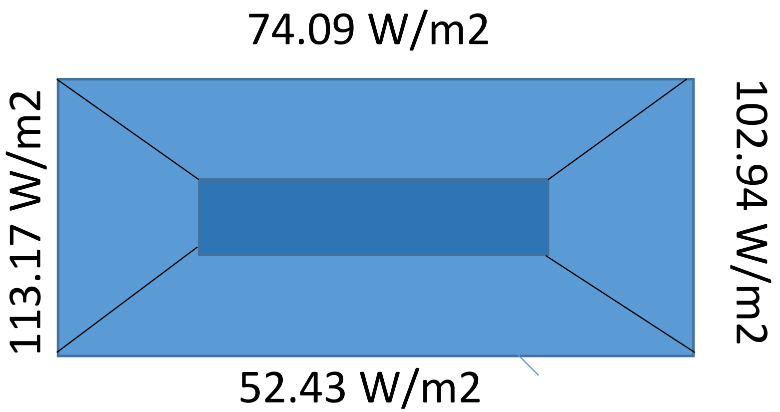
HVAC COP = 3 (package system, VRF/VRV)

OTTV = 98.82 W/m2

IKE =201.40 kWh/m2/year


FedEx

The Impact of WWR 70% → 30%



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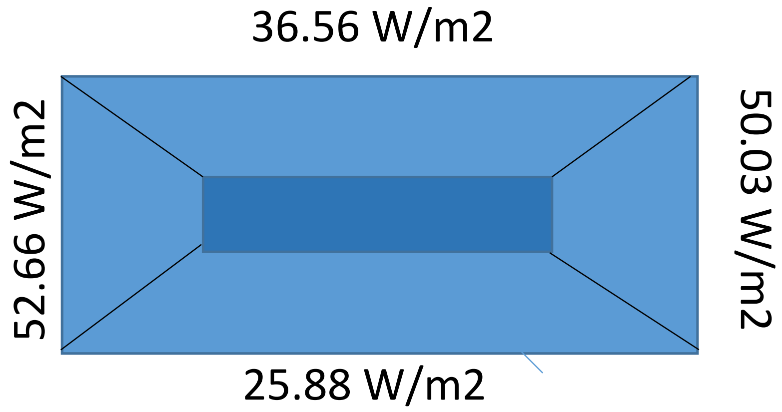


WWR = 30%

SHGC = 0.6 (panasap)

HVAC COP = 3 (package system, VRF/VRV)

OTTV = 36.26 W/m2

IKE = 143.36 kWh/m2/year





WWR: Window to Wall Ratio (%), yaitu persentase luasan jendela kaca terhadap dinding masif.

Semakin besar luasan jendela, semakin banyak beban panas untuk AC dan semakin tinggi konsumsi energy.

WWR 20%

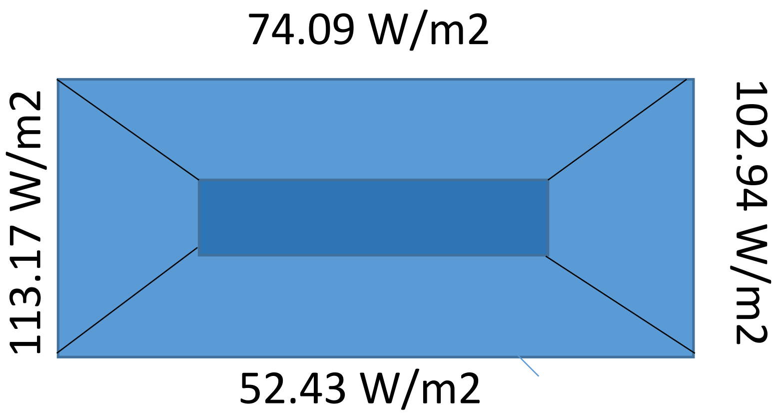
WWR 33% - 50%

WWR 70 %





The Impact of SHGC 0.6 → 0.4 (stopsol)



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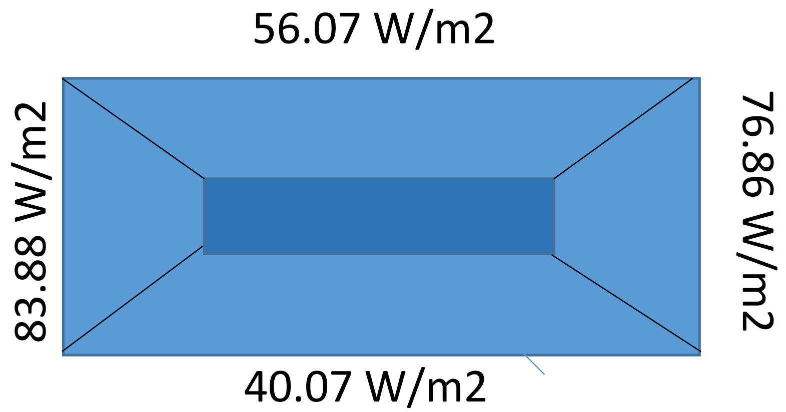


WWR = 70%

SHGC = 0.4 (stopsol)

HVAC COP = 3 (package system, VRF/VRV)

OTTV = 56.14 W/m2

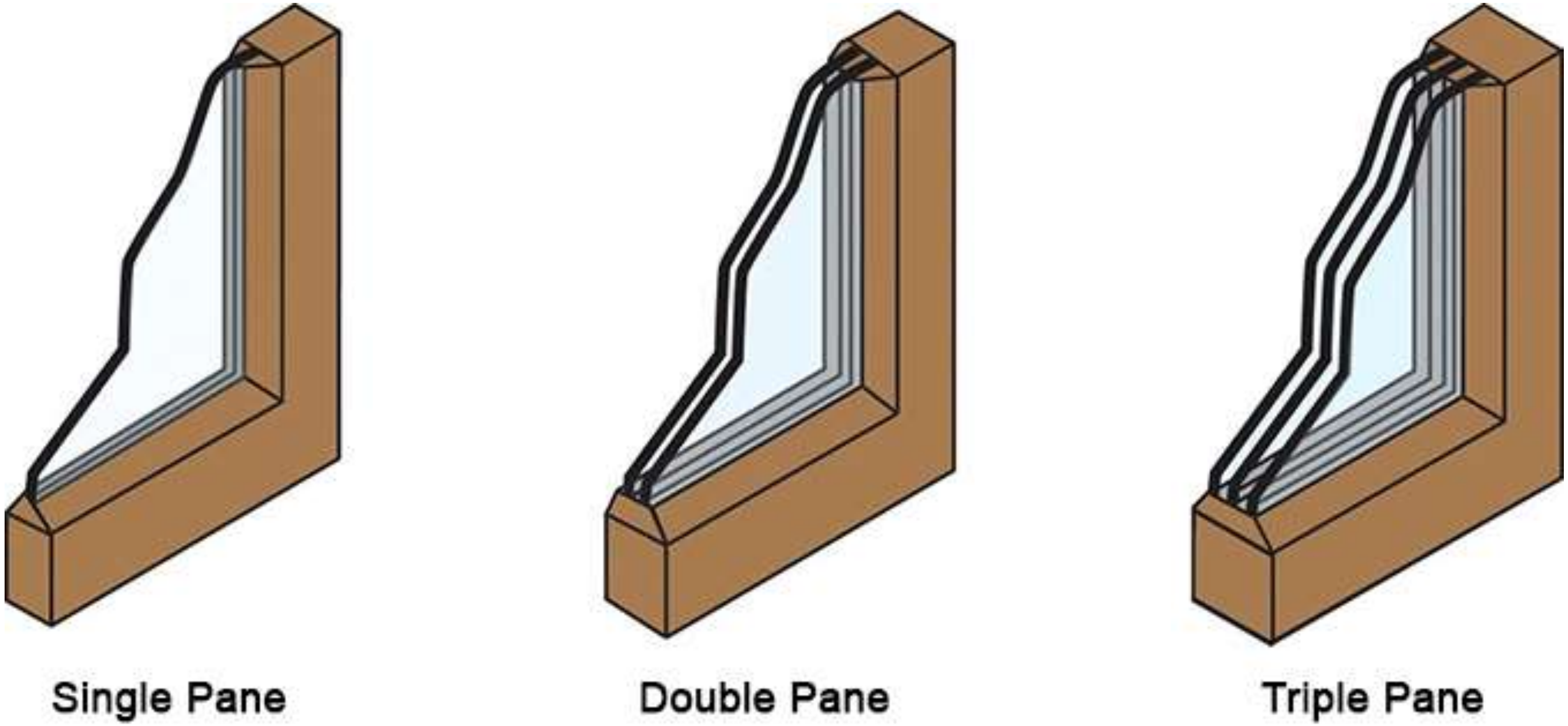
IKE = 154.02 kWh/m2/year



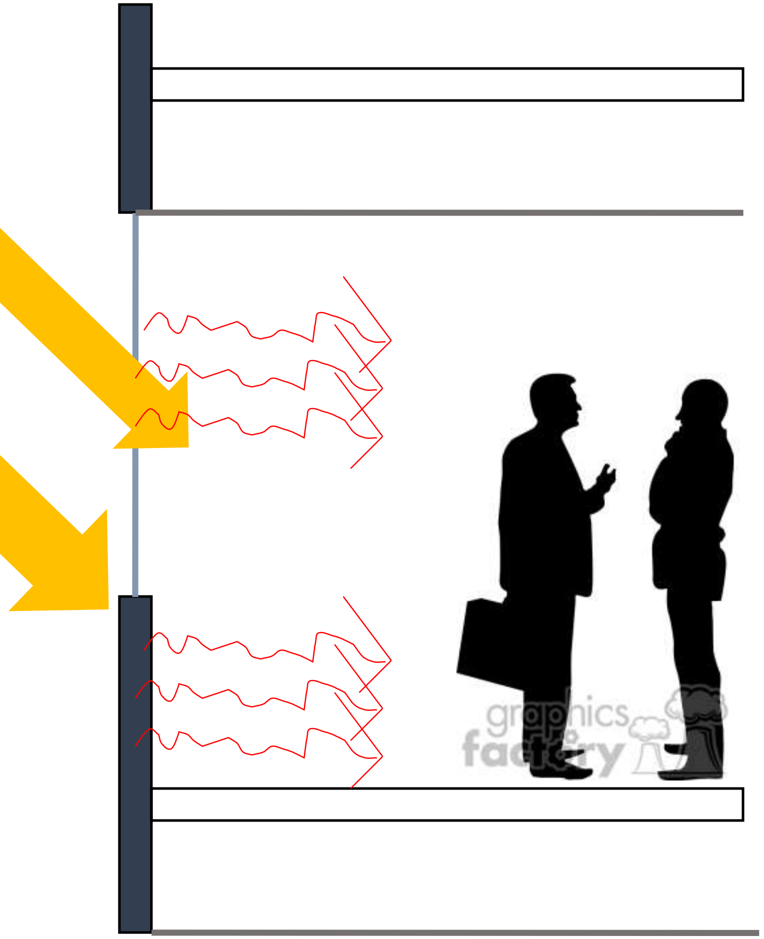


The Impact of Building Double Glazing

- Does not improve SHGC/SC (with second layer of clear glass)
- Improve U-value from around 5.2 W/m^{o}K to around 2.5 W/m^{o}K
- Reduce sound transmission by 5 dB (about one third)

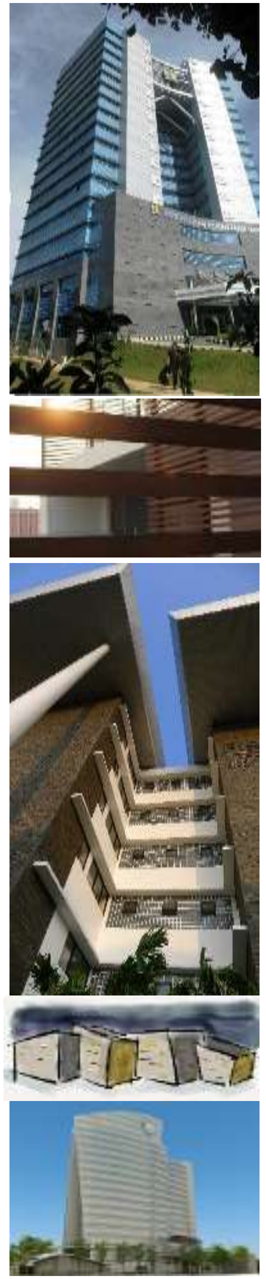


External heat gain / Overall Thermal Transfer Value
(Externally Dominated Load Buildings)

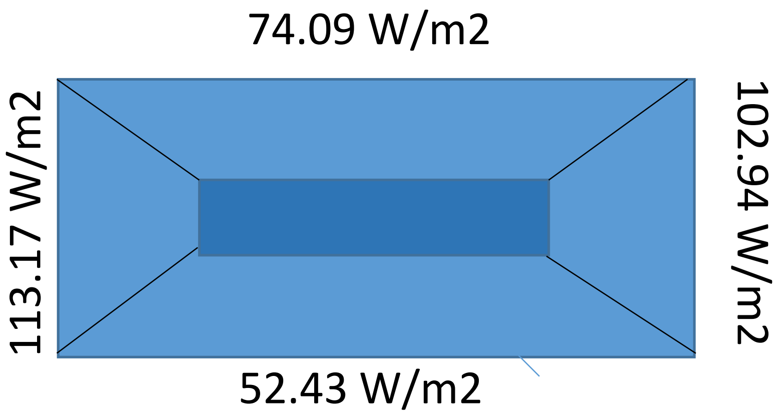


Radiation heat gain through windows	70% to 80% **Affected by SC/SHGC)**
Heat conduction through windows	10% to 20% **Affected by U-value**
Heat conduction through walls	0.2% to 5%

OTTV = α((1-WWR)*Uw)*TDeq) + (WWR*Uf*ΔT) + (WWR*SC*SF)



The Impact of HVAC system (COP)



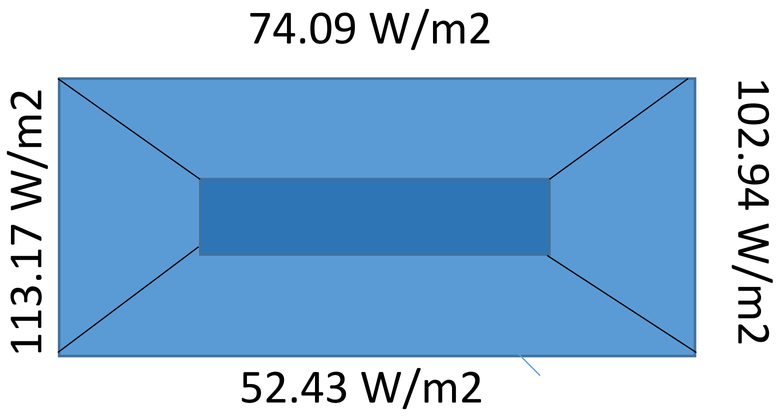
WWR = 70%

SHGC = 0.6 (panasap)

HVAC COP = 3 (package system, VRF/VRV)

OTTV = 74.47 W/m2

IKE = 171.99 kWh/m2/year



WWR = 70%

SHGC = 0.6 (panasap)

HVAC COP = 5.8 (water cooled chiller)

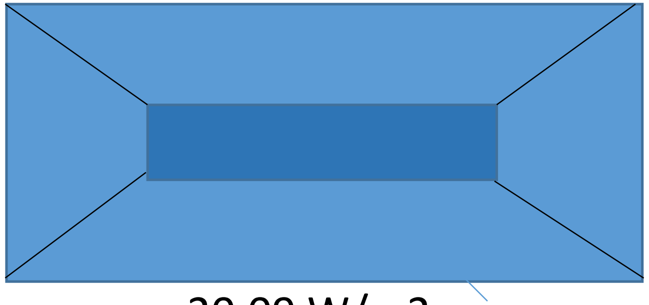
OTTV = 74.47 W/m2

IKE = 147.12 kWh/m2/year

Best Practices → passive & active







WWR = 70%

SHGC = 0.6 (panasap)

HVAC COP = 3

OTTV = 74.47 W/m2

IKE = 171.99 kWh/m2/year

WWR = 30%

SHGC = 0.4 (stopsol)

HVAC COP = 3

OTTV = 27.86 W/m2

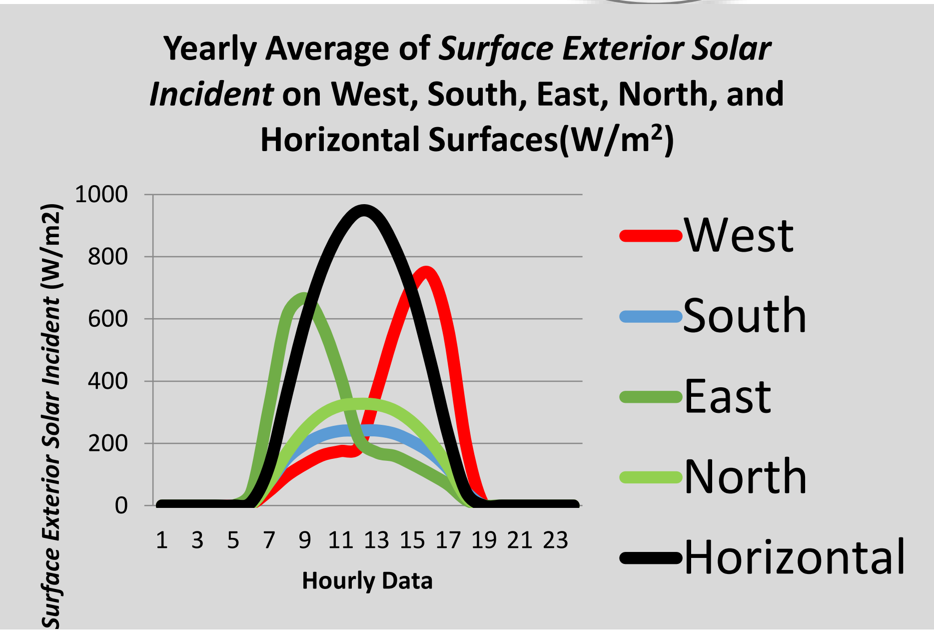
IKE = 151.10 kWh/m2/year

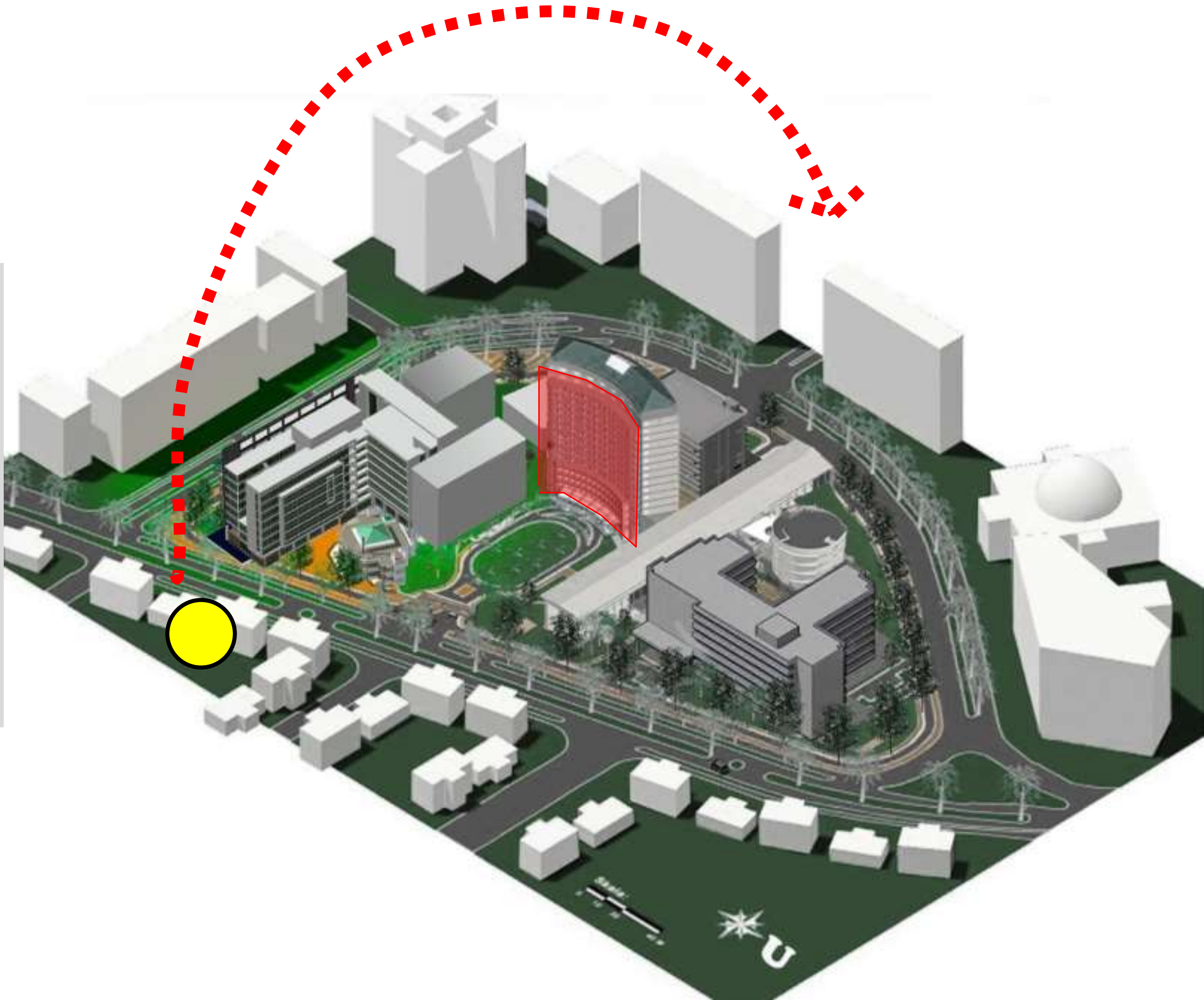
HVAC COP = 5.8

IKE = 129.33 kWh/m2/year

Gedung Utama Kementerian PU

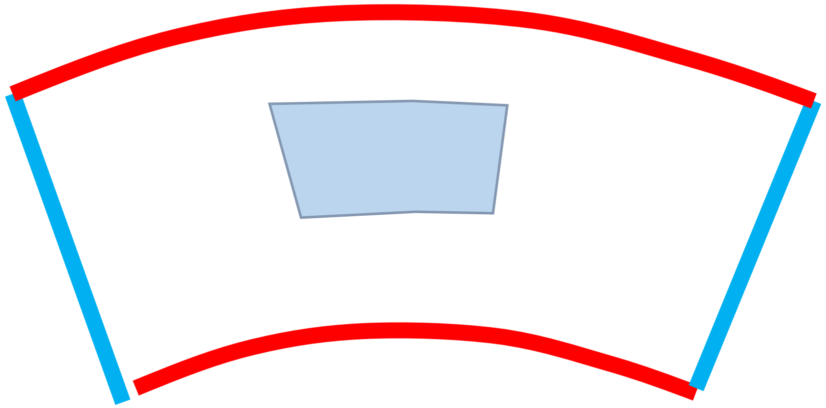
Building form & orientation



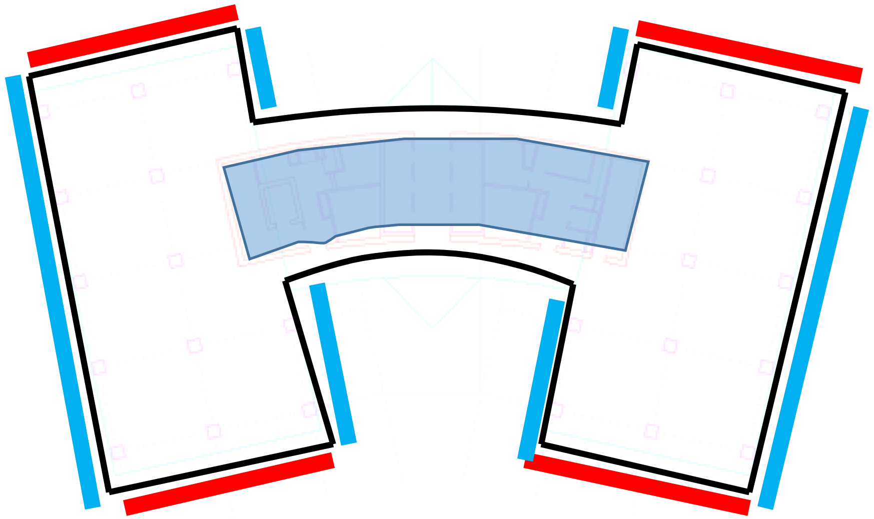


Original block plan:
Larger area of the building is oriented to east and west

Building form & orientation → minimize exposure to east and west solar radiation



Original building form



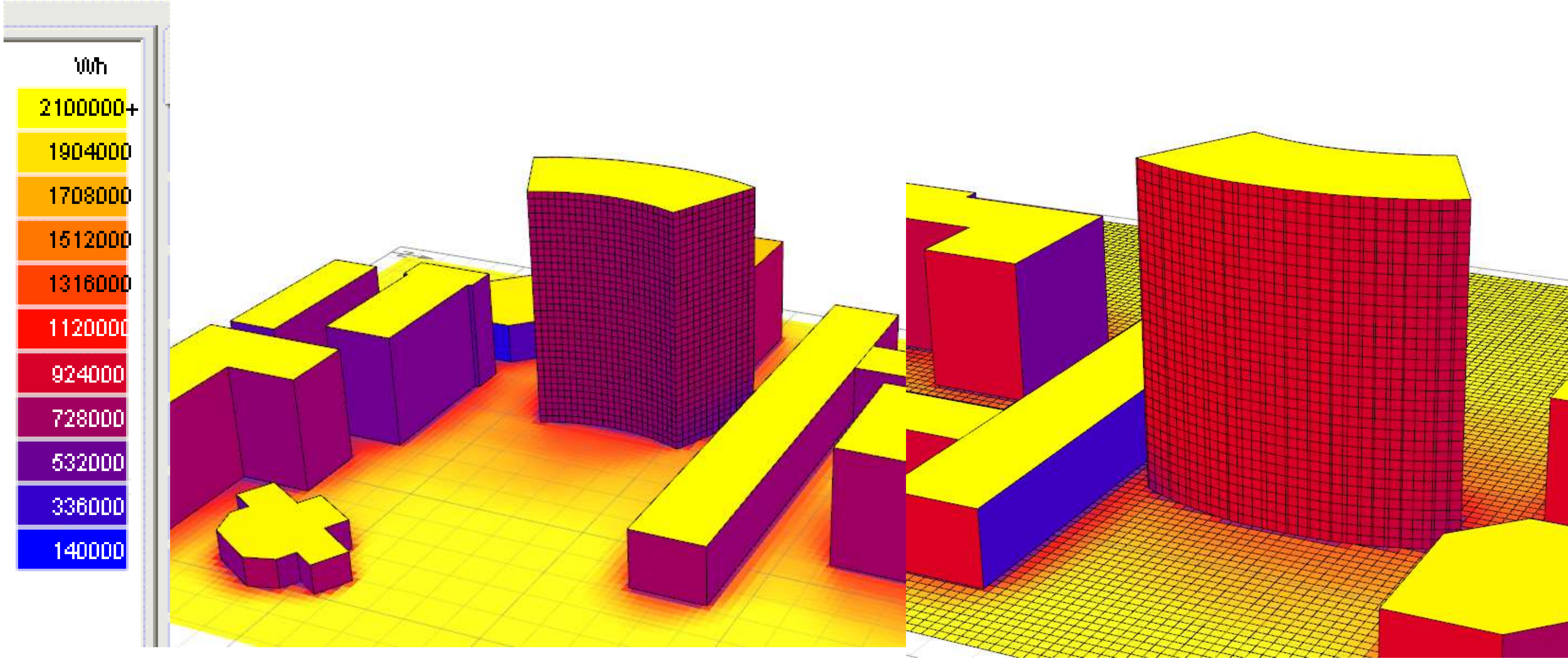
Modified building form

Modified Building form:

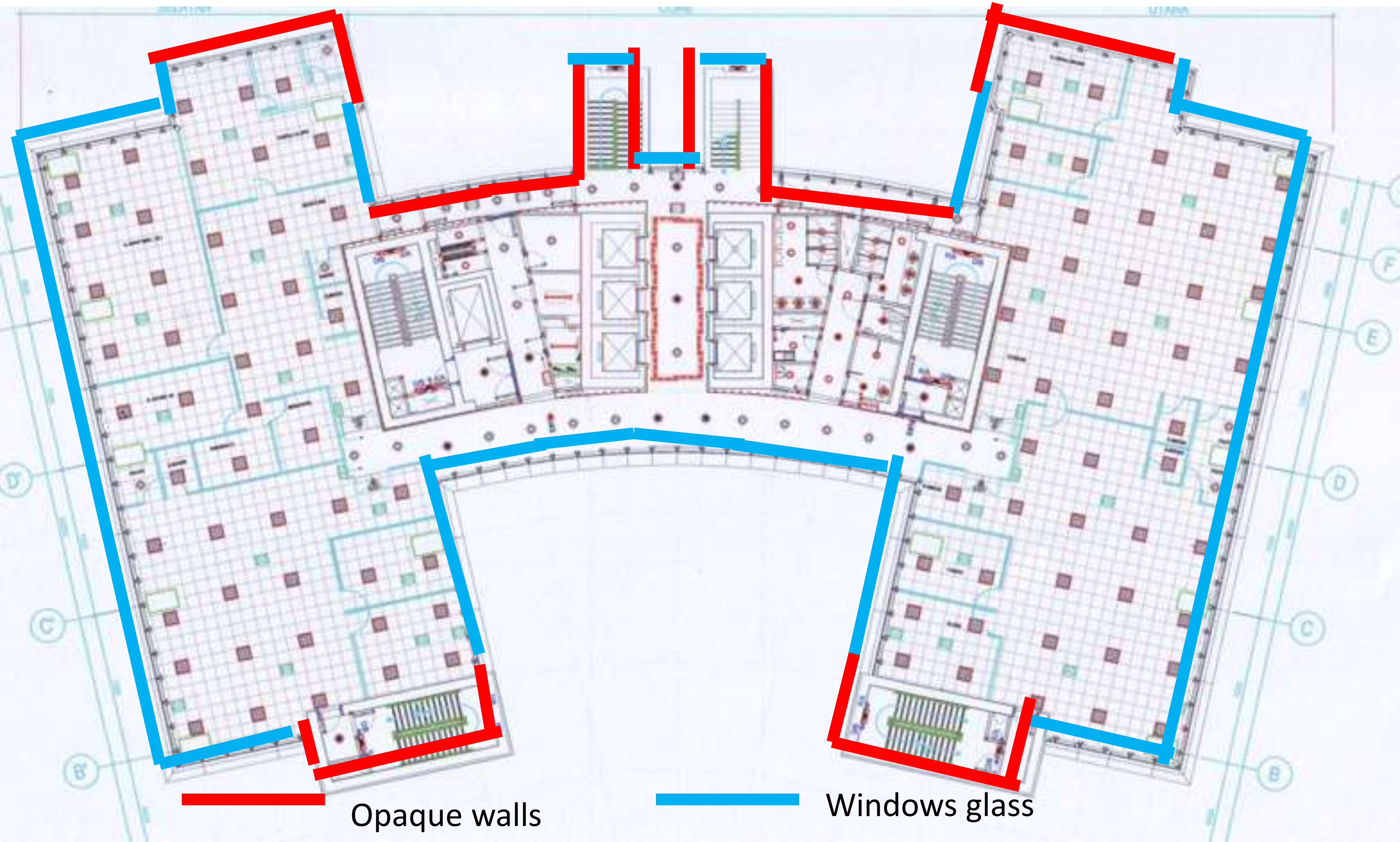
1. Reduced surface exposure of the working spaces to east and west sun
2. Narrow building form → improve daylight performance

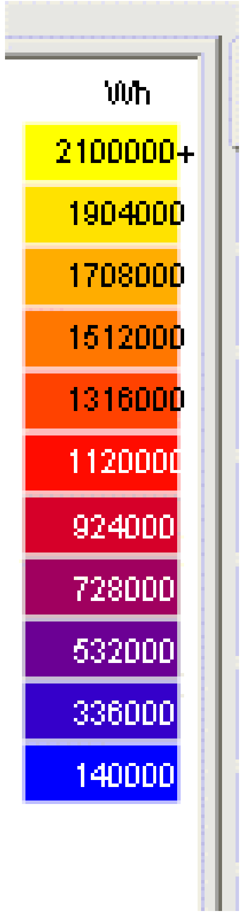


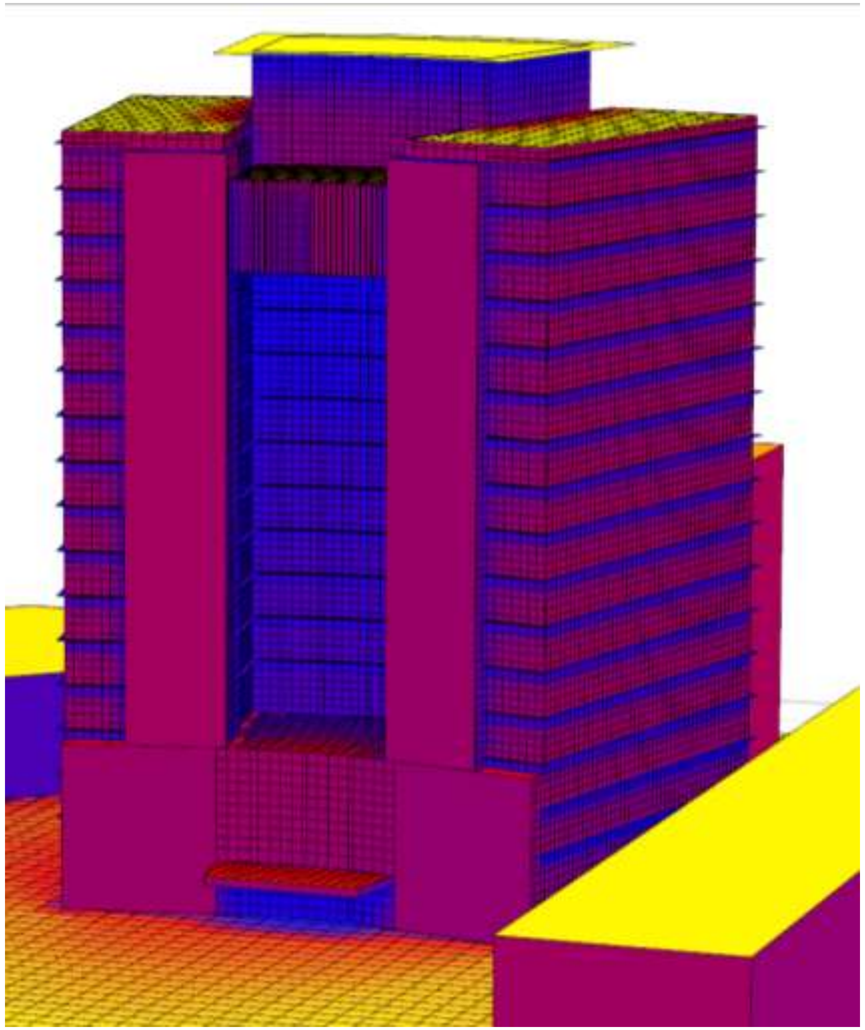


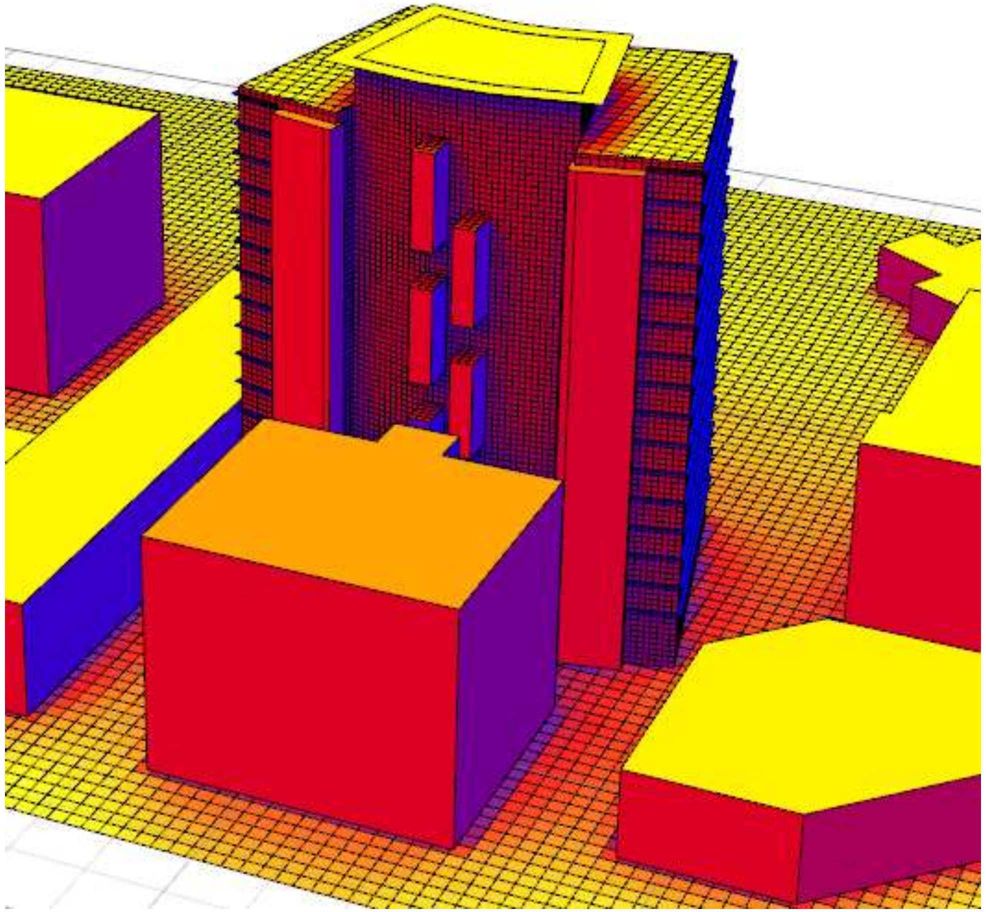


Wh
2100000+
1904000
1708000
1512000
1316000
1120000
924000
728000
532000
336000
140000

Building form & orientation → orienting windows to north and south



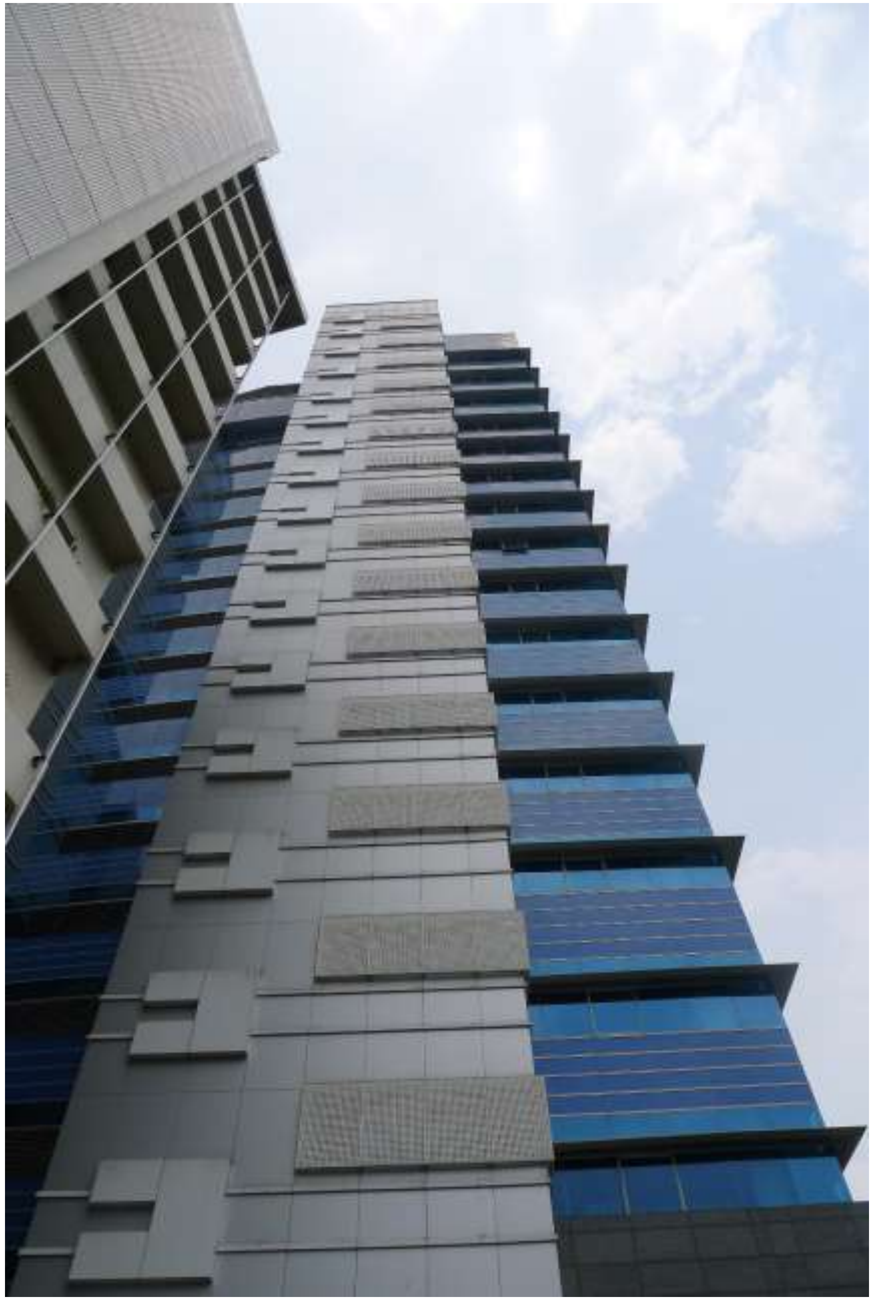

Wh
2100000+
1904000
1708000
1512000
1316000
1120000
924000
728000
532000
336000
140000





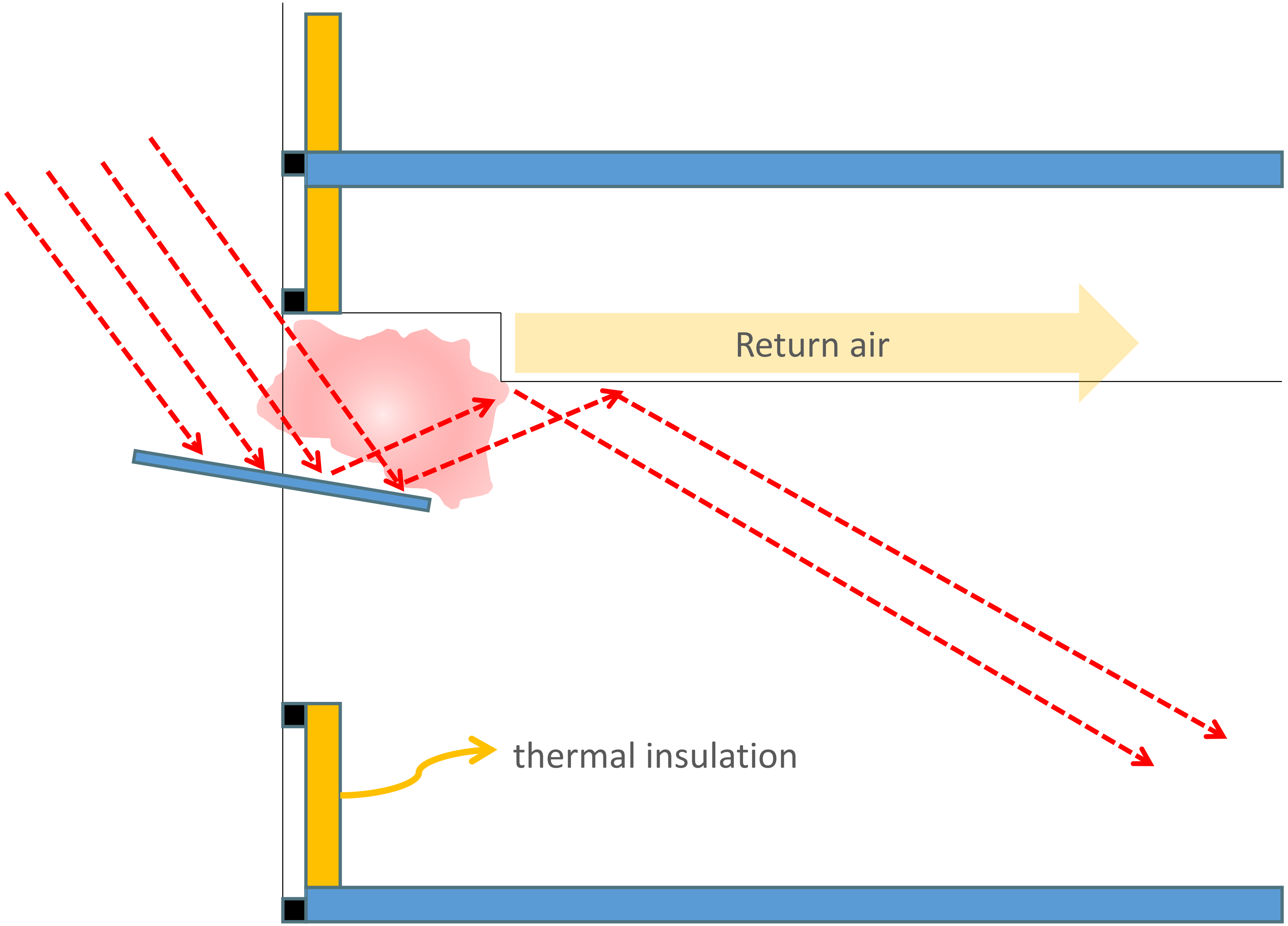




Windows with perforated metal shading on west side

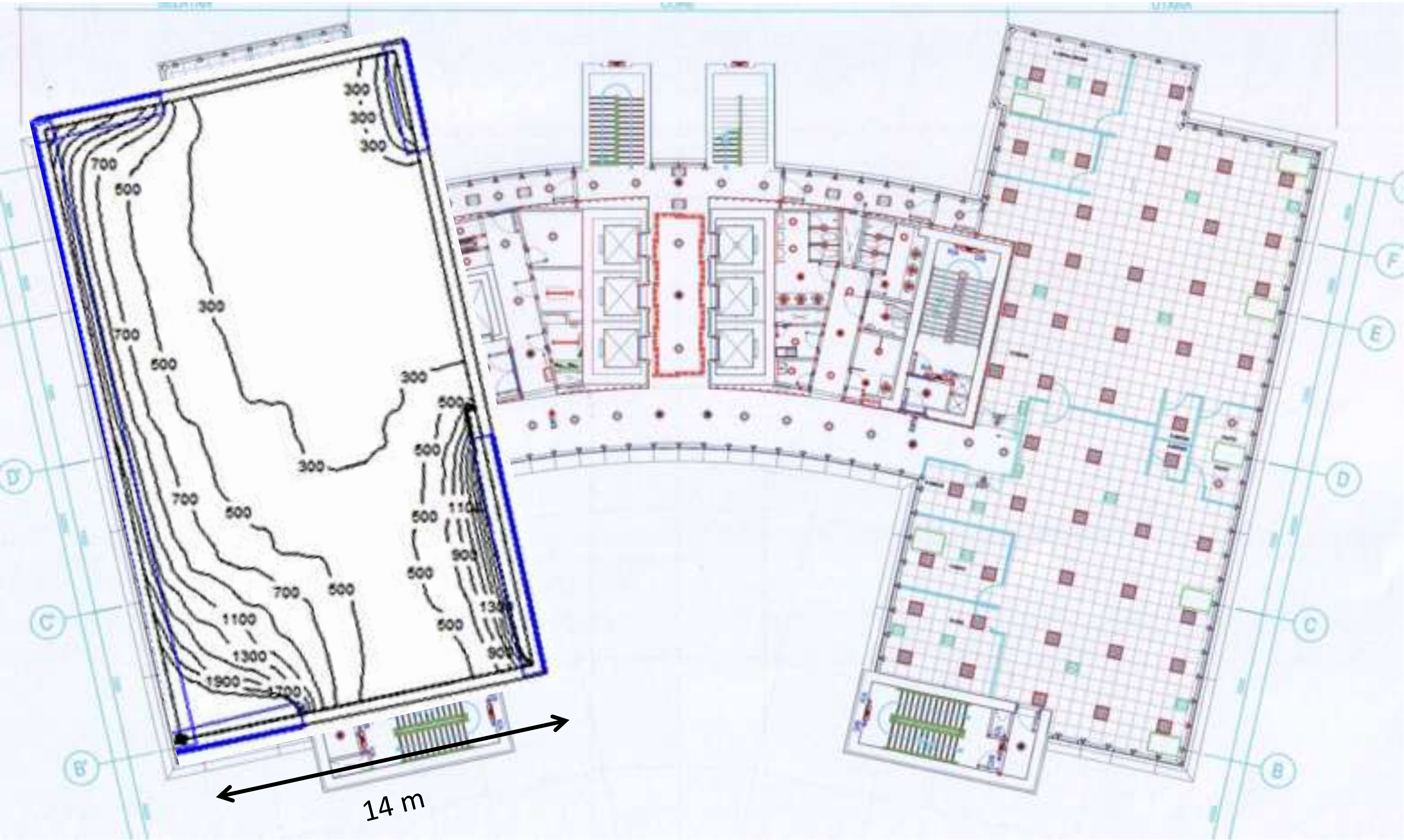
Daylighting → light shelves for better daylight distribution





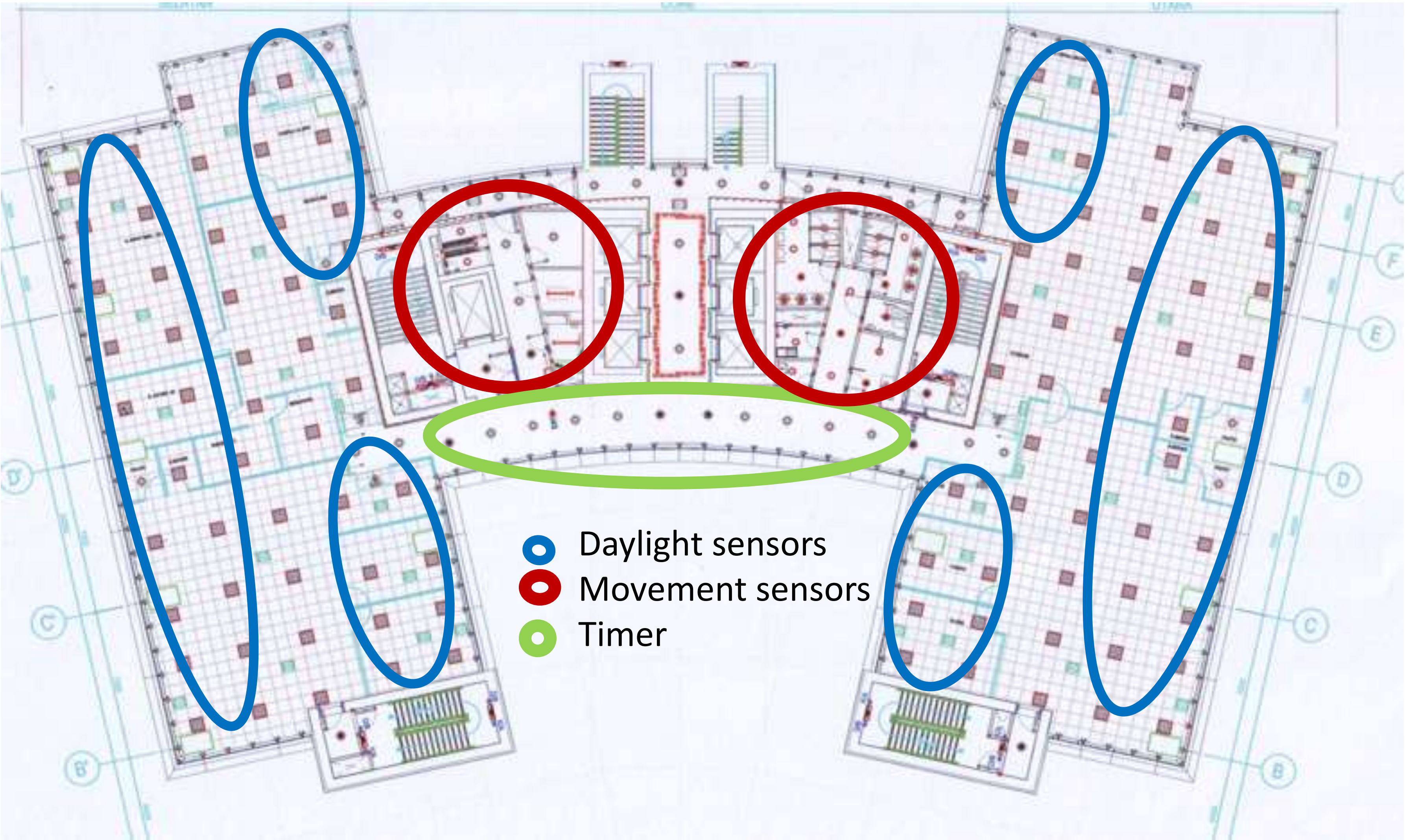


Daylight Performance → narrow building span & light shelves



Daylighting with lightshelf

Automatic Lighting Control Zone → saving electric lighting energy consumption > 30%







Energy cost Savings
+ IDR 230 mil/mo

Platinum certification by GBCI

Winner 2014 ASEAN Energy Awards for new Building

Winner 2016 ASEAN Energy Awards for Green Building

Kementerian Kelautan dan Perikanan

OTTV 35 W/m2
IKE **165.28 kWh/m2/yr**

BIG IDEA

KAPAL PINISI

GMB IV KKP

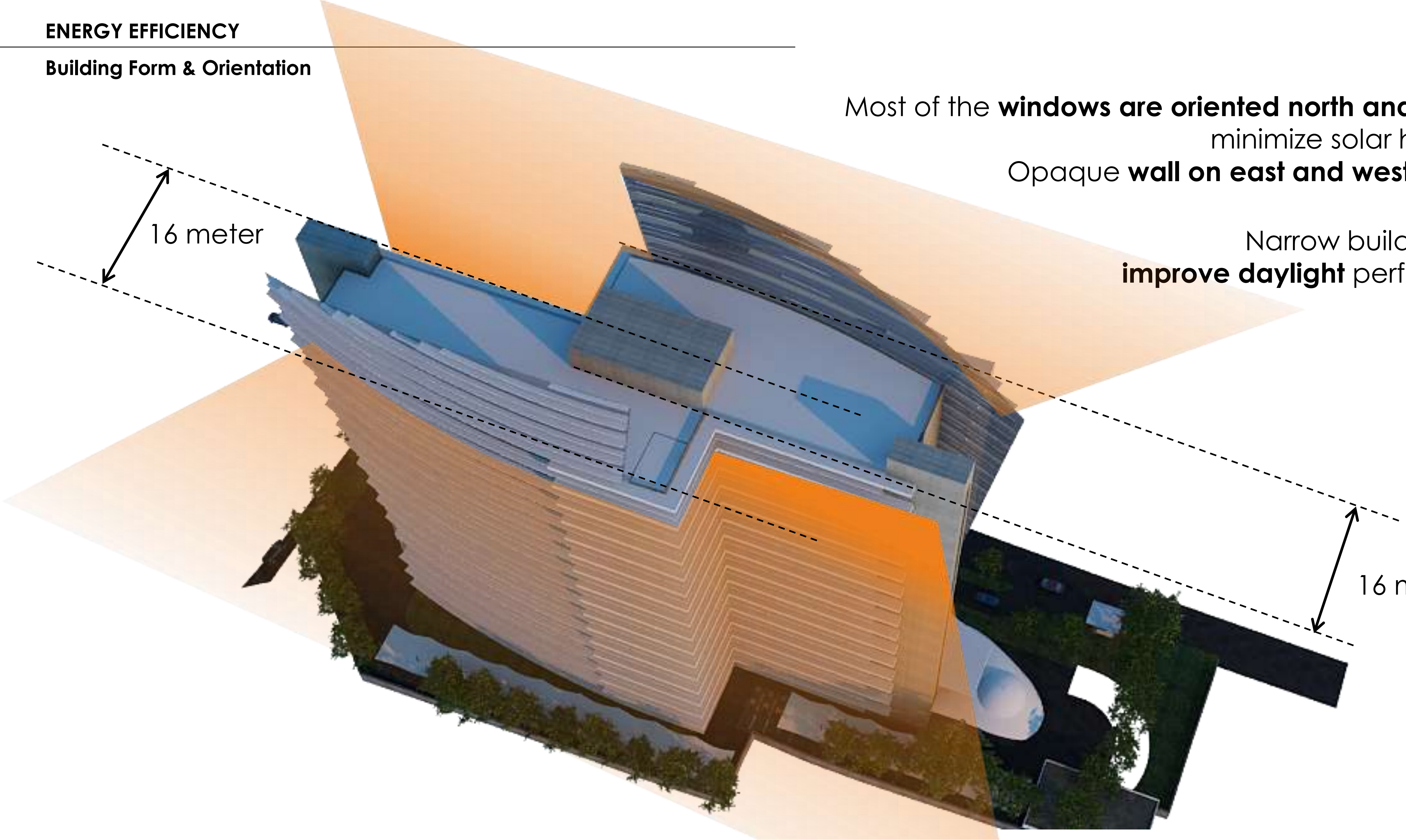
Design Strategies to reduce building energy consumption

- **Building Form and Orientation**
- **Shading & Building Skin**
- **Day Lighting**
- **Highly Energy Efficient Lighting System**
- **Highly Energy Efficient HVAC System**

Building Form & Orientation

Most of the **windows are oriented north and south** to minimize solar heat gain
Opaque **wall on east and west facades**

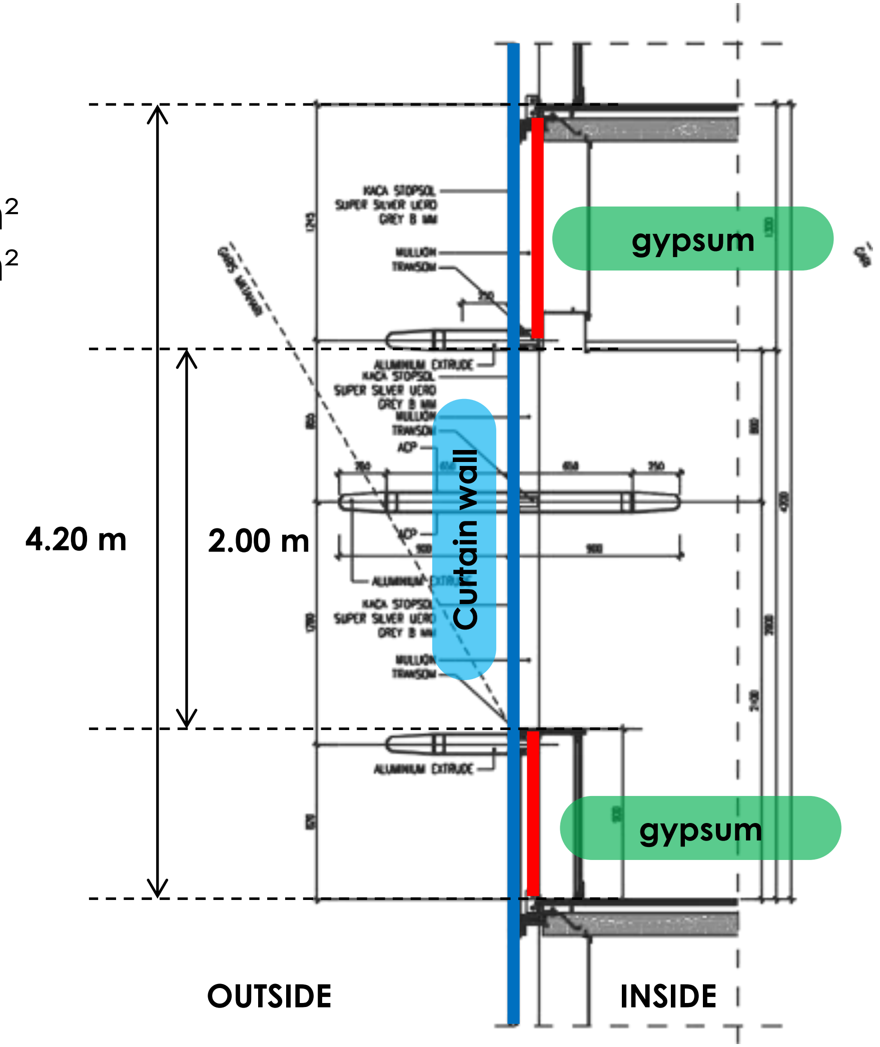
Narrow building form, **improve daylight** performance



ENERGY EFFICIENCY

Shading & Building Skin

Glass Material	: Asahimas 8mm Stopsol Supersilver Grey
SHGC	: 0.423
U-value	: 5.731
Visible Trans.	: 0.226
WWR	: 45.20%
OTTV manual	: 44.25 w/m²
OTTV simulasi	: 37.62 w/m²
Outside view	: 94.00%



ENERGY EFFICIENCY

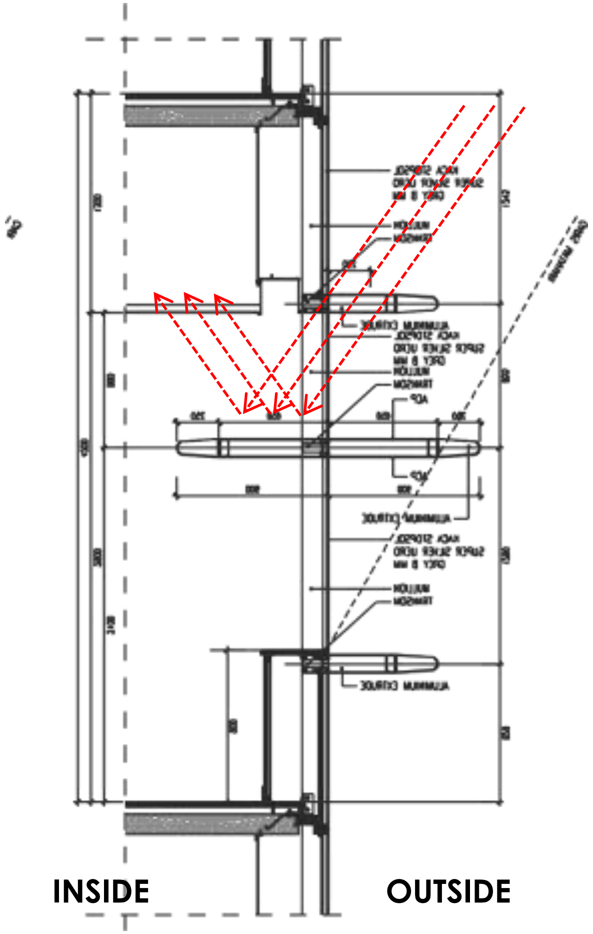
Daylighting

Light shelves

Reduce heat gain

Better daylight distribution

(more uniform and deeper penetration)



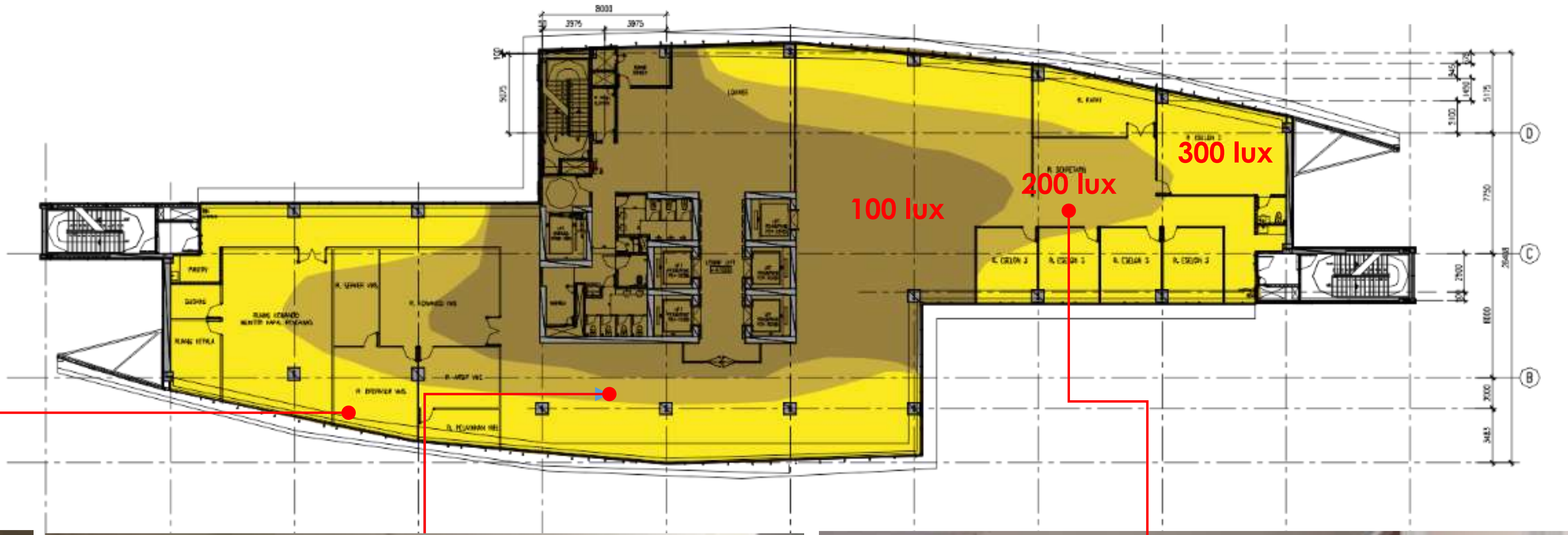
ENERGY EFFICIENCY

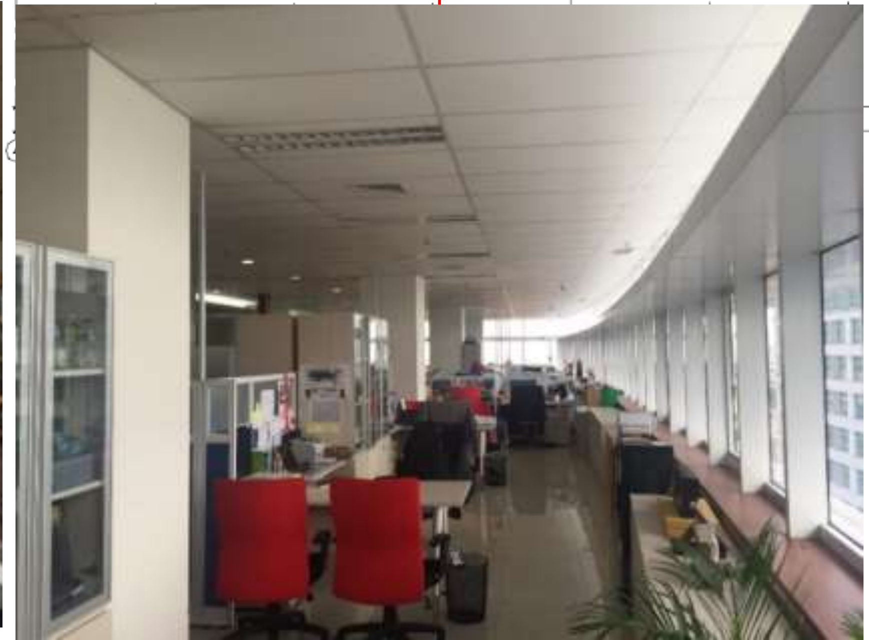
Shading & Building Skin

ENERGY EFFICIENCY

Daylighting

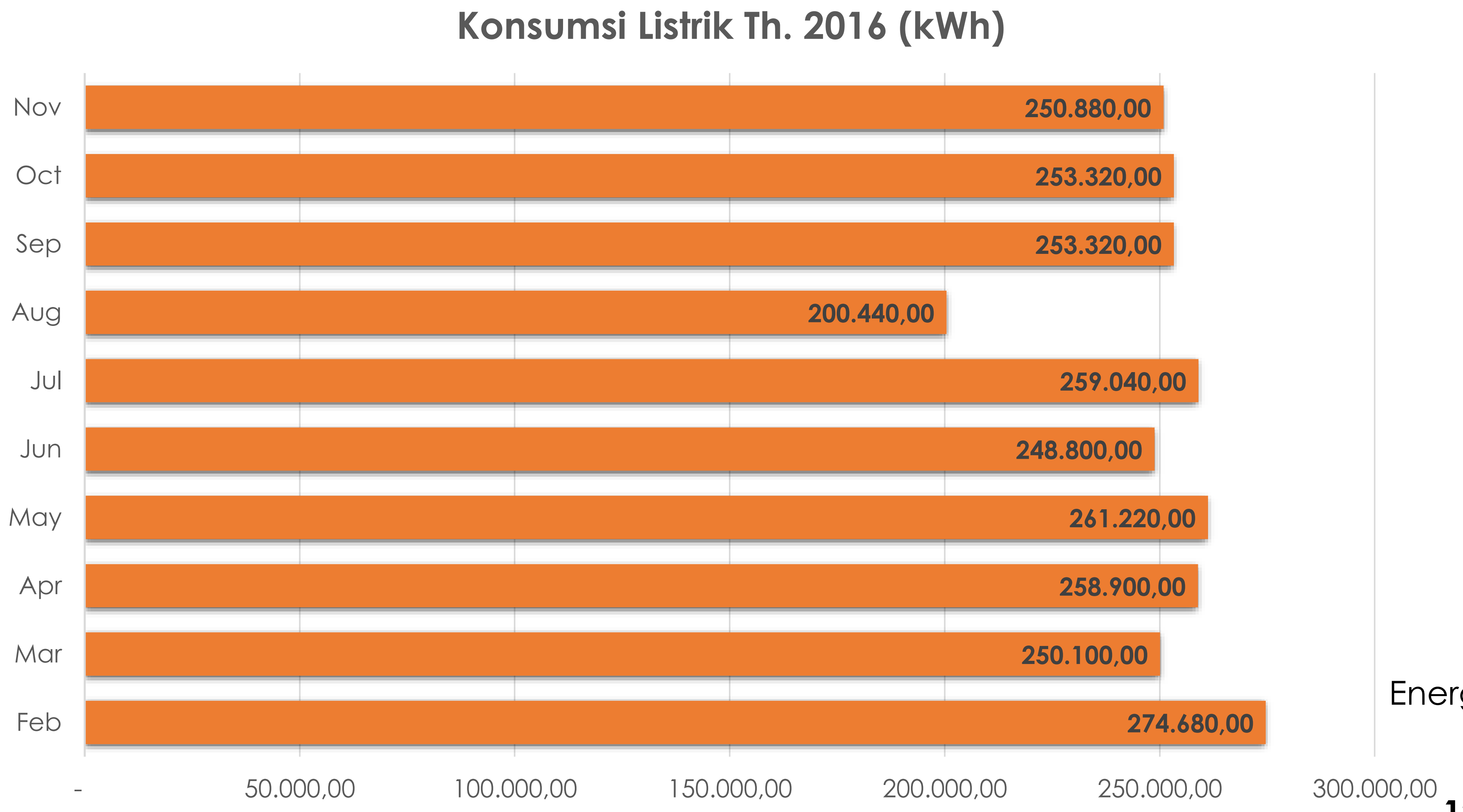
Standar illum. : 300 lux
Area daylight : 33.00%





ENERGY EFFICIENCY

Category	Value	Unit	Baseline	Saving
Cooling	47.60	kWh/m²/year	83.50	43%
Lighting	24.76	kWh/m²/year	81.15	69%
Equipment		kWh/m²/year	40.22	
Others	66.47	kWh/m²/year	71.37	7%
Energy Performance Index	179.04	kWh/m²/year	276.23	35%
Emisi CO2	1,681	ton/year		



Conditioned Area
18,695.35 m³
Energy performance Index
155.13 kWh/m²/year
or
124.93 kWh/m2/th (w/o servers & basements





Conditioned Area

18,695.35 m^3

Energy performance Index

134.30 $kWh/m^2/year$

or 124.93 kWh/m2/th (w/o servers & basements

Greenship Gold Certified

No additional Cost

Penghematan:

Listrik:

(225 – 124) x 1450 x 18695 =

Rp. 2.737.882.750,-

Air:

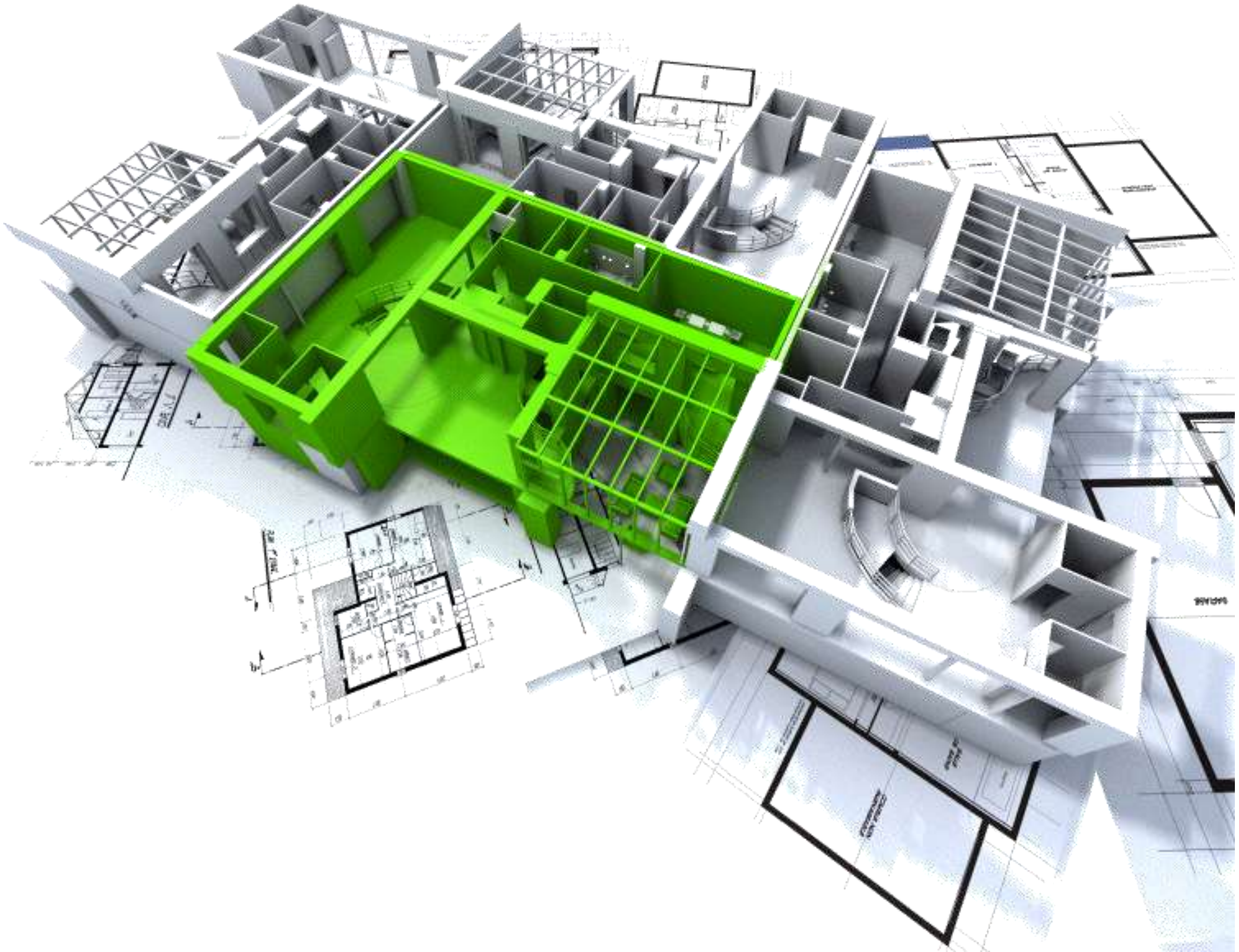
(50 – 22,69) x 1.408 x (12,500 – 5000) =

Rp 269,167,360 (PAM)

(50 – 22,69) x 1.408 x (23,333 – 5000) =

Rp. 704,949,315 (Deep well).

Green design / passive design / bioclimatic design



Is not a style ….

It is a design principles





Norman Foster









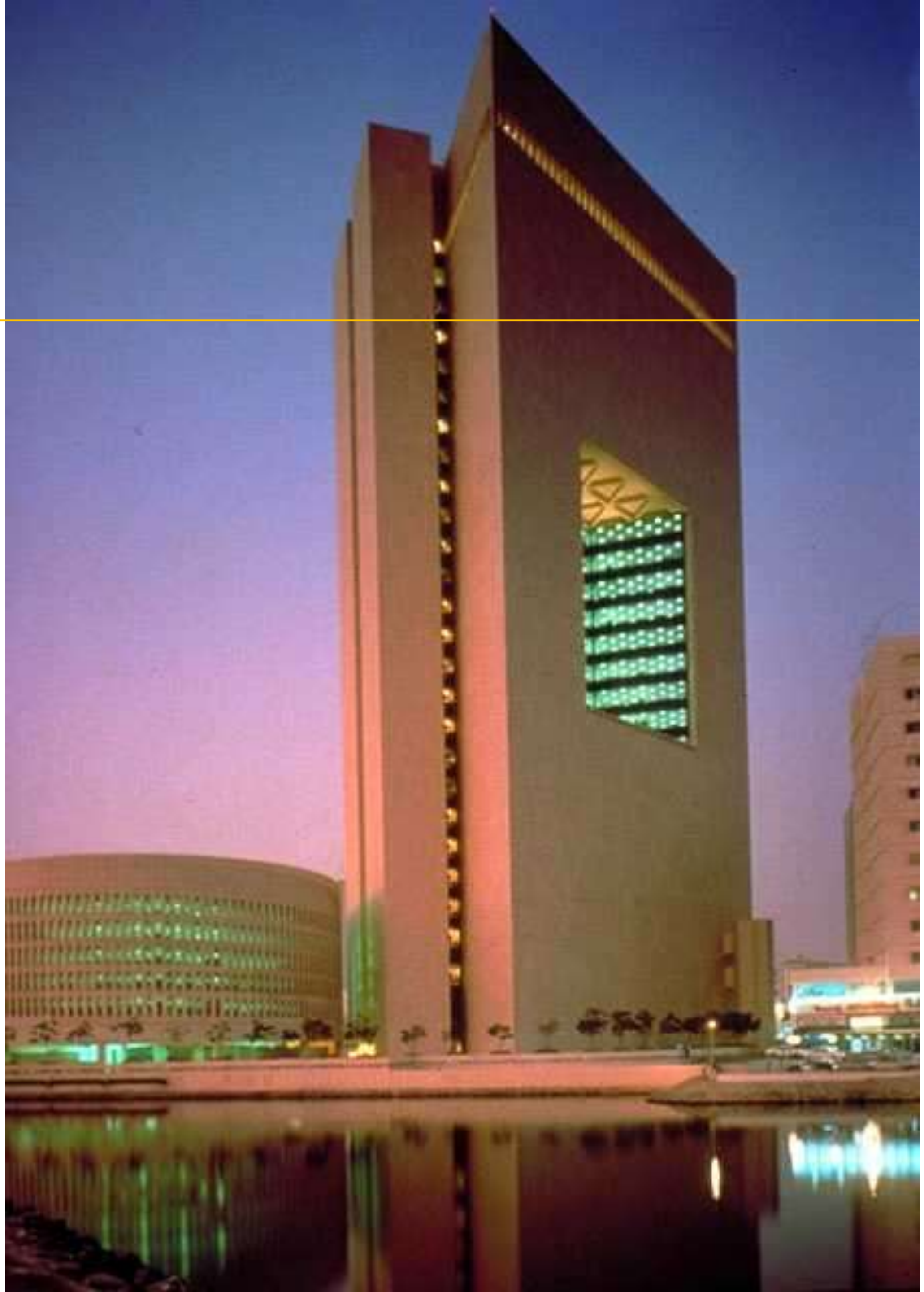




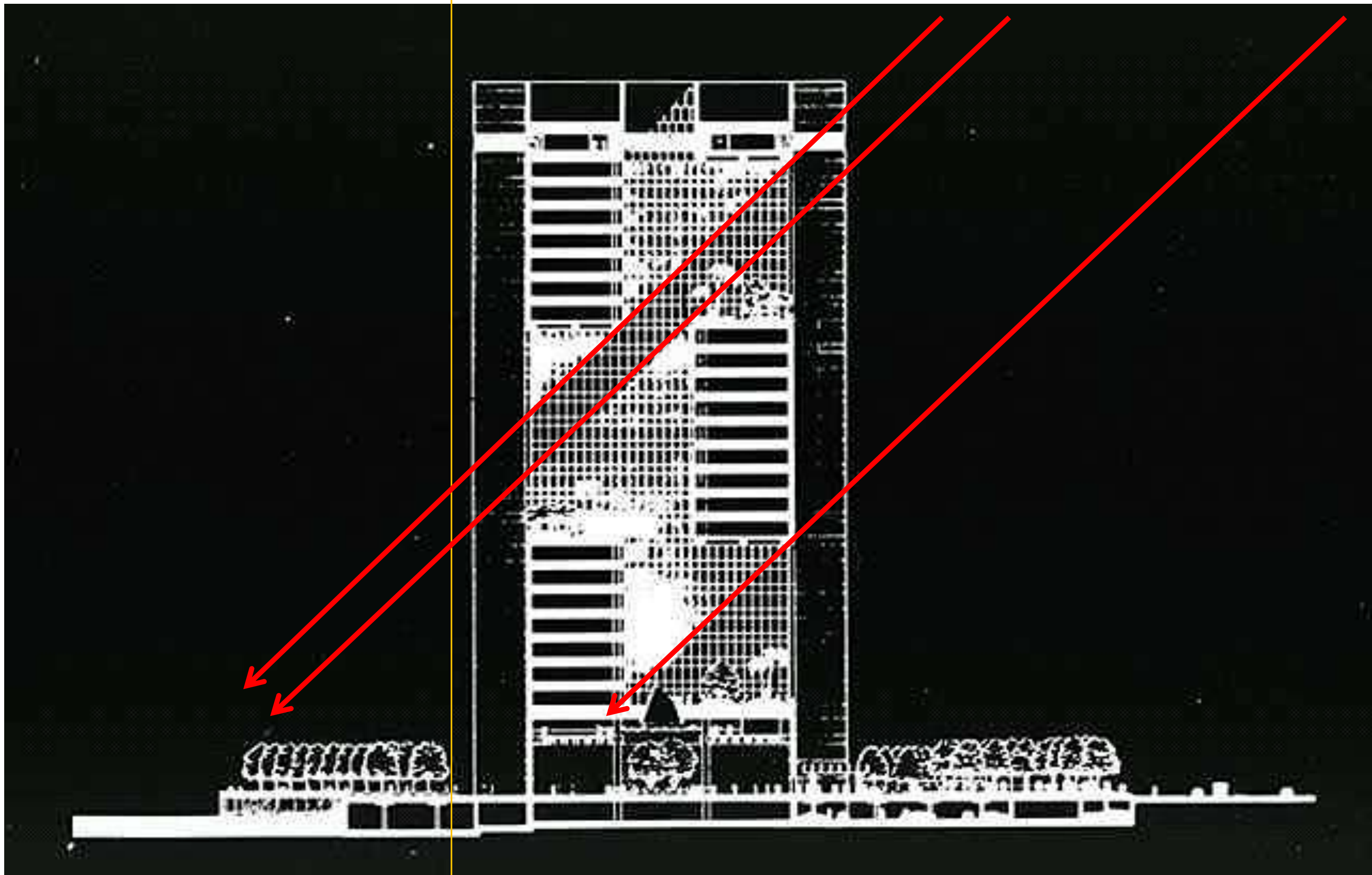




SOM



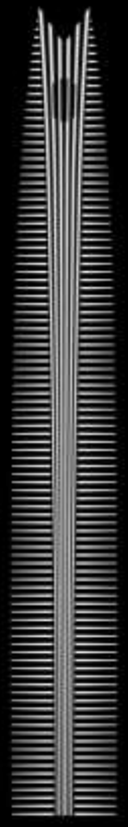
SOM







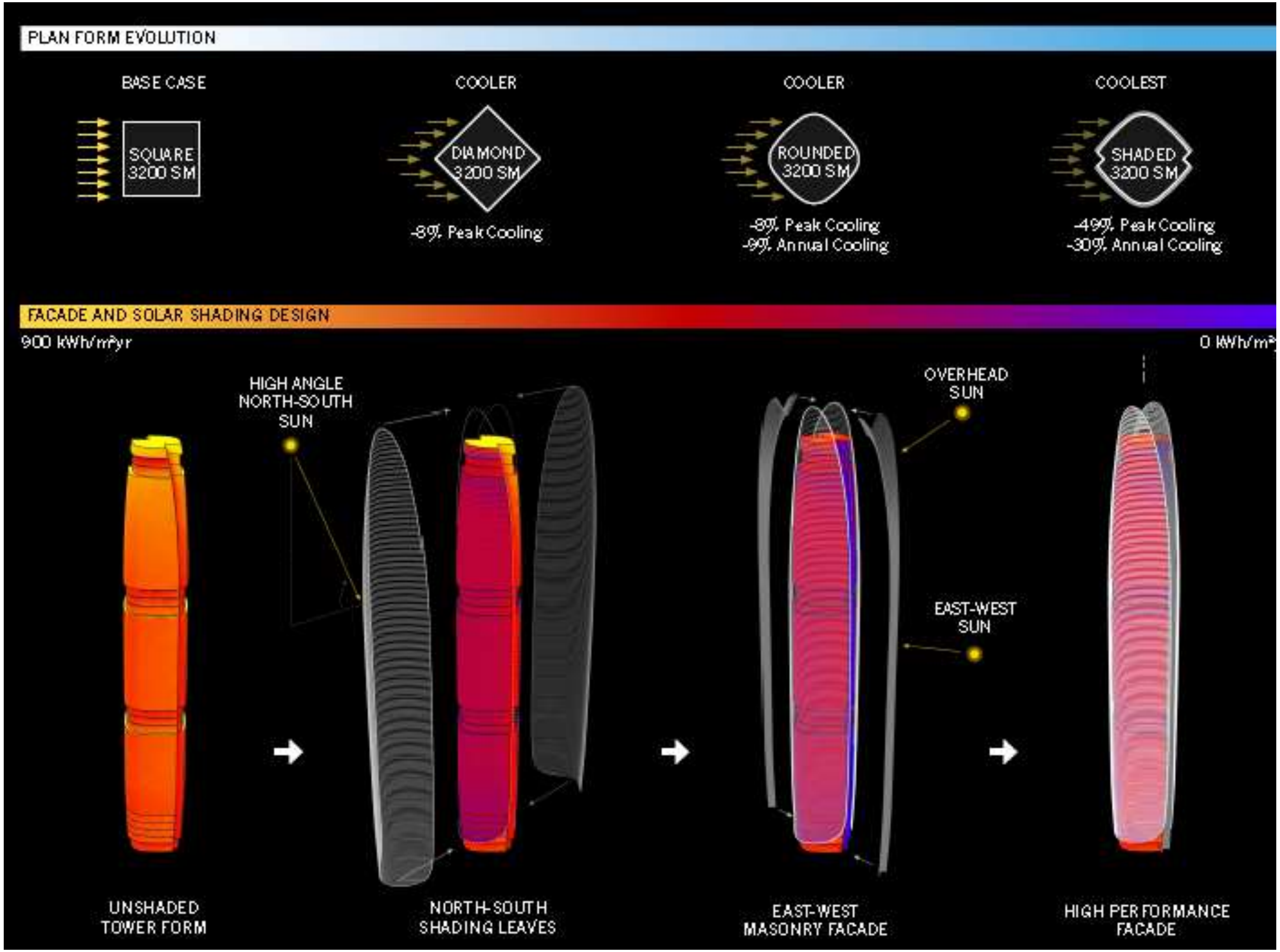
SOM



Pertamina Energy Tower

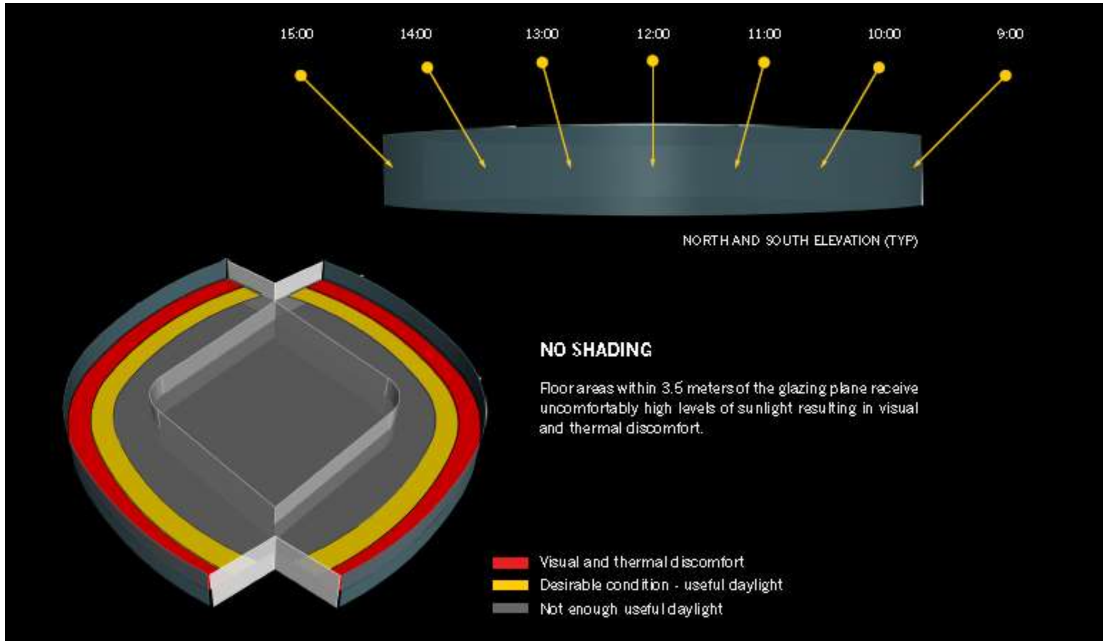
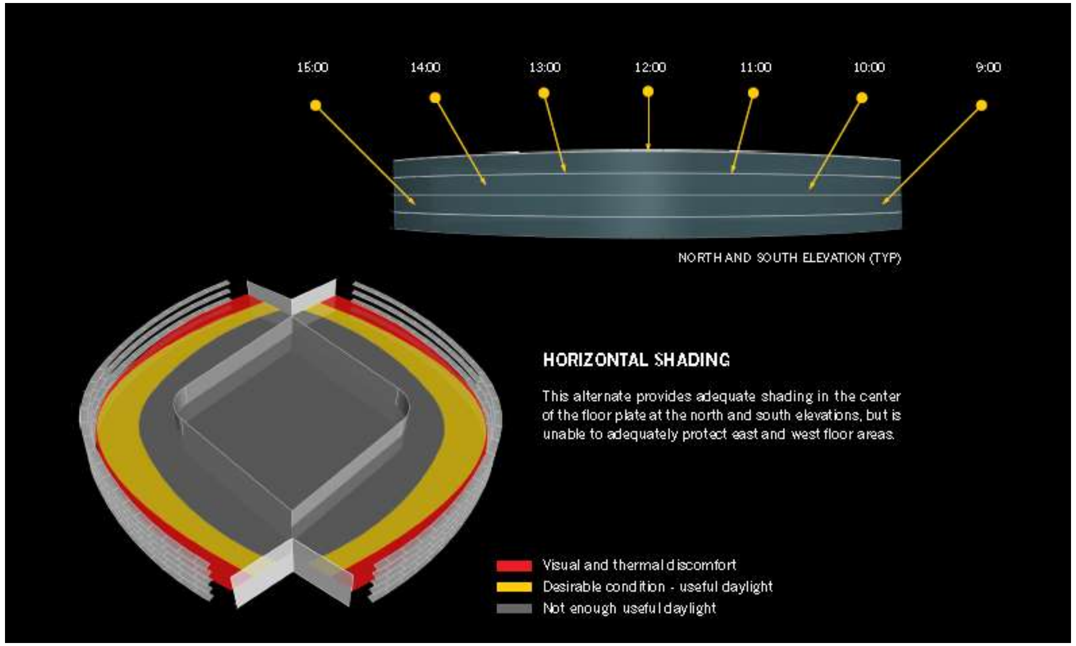
INTERIM SCHEMATIC DESIGN PRESENTATION
NOVEMBER 12, 2013

PERTAMINA SOM


PLAN FORM EVOLUTION
BASE CASE
COOLER
COOLER
COOLEST
SQUARE 3200 SM
DIAMOND 3200 SM
ROUNDED 3200 SM
SHADED 3200 SM
-8% Peak Cooling
-8% Peak Cooling
-9% Annual Cooling
-49% Peak Cooling
-30% Annual Cooling
FACADE AND SOLAR SHADING DESIGN
900 kWh/m²yr
0 kWh/m²
HIGH ANGLE NORTH-SOUTH SUN
OVERHEAD SUN
EAST-WEST SUN
UNSHADED TOWER FORM
NORTH-SOUTH SHADING LEAVES
EAST-WEST MASONRY FACADE
HIGH PERFORMANCE FACADE







15:00
14:00
13:00
12:00
11:00
10:00
9:00
NORTH AND SOUTH ELEVATION (TYP)
NO SHADING
Floor areas within 3.5 meters of the glazing plane receive uncomfortably high levels of sunlight resulting in visual and thermal discomfort.
Visual and thermal discomfort
Desirable condition - useful daylight
Not enough useful daylight

15:00
14:00
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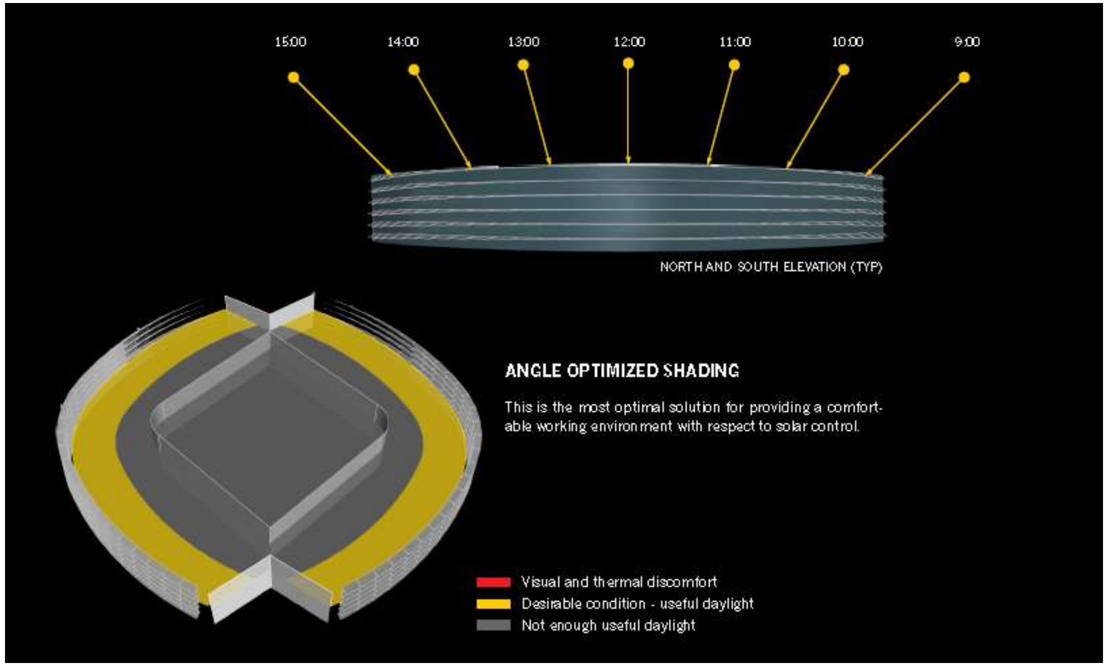
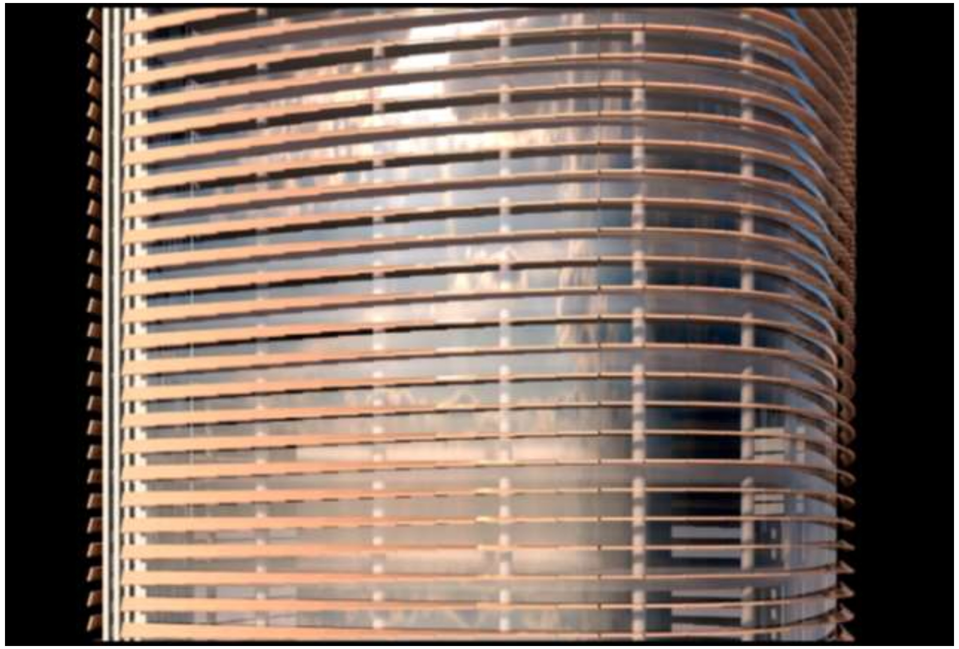
12:00
11:00
10:00
9:00
NORTH AND SOUTH ELEVATION (TYP)
HORIZONTAL SHADING
This alternate provides adequate shading in the center of the floor plate at the north and south elevations, but is unable to adequately protect east and west floor areas.
Visual and thermal discomfort
Desirable condition - useful daylight
Not enough useful daylight

15:00
14:00
13:00
12:00
11:00
10:00
9:00
NORTH AND SOUTH ELEVATION (TYP)
ANGLE OPTIMIZED SHADING
This is the most optimal solution for providing a comfortable working environment with respect to solar control.
Visual and thermal discomfort
Desirable condition - useful daylight
Not enough useful daylight


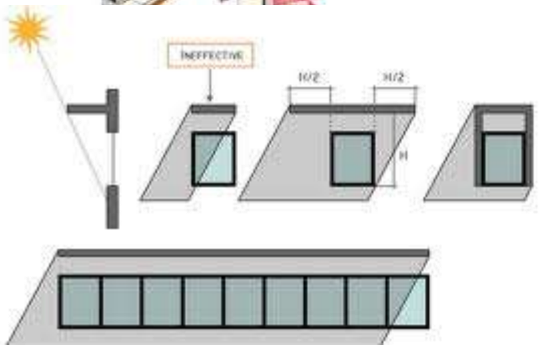

555 M (TOWER HEIGHT)
569 M (ELEVATION)

Passive Design Strategies:

Building orientation

Window to wall ratio

Glazing Performance (Solar Heat Gain Coefficient)

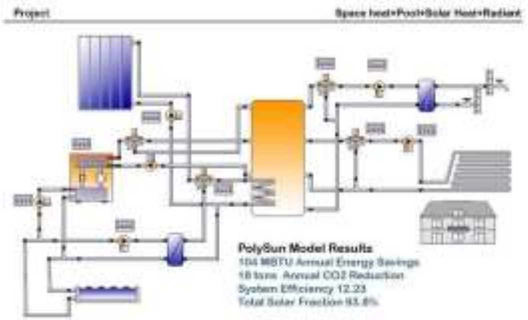


Shading devices & double facades system

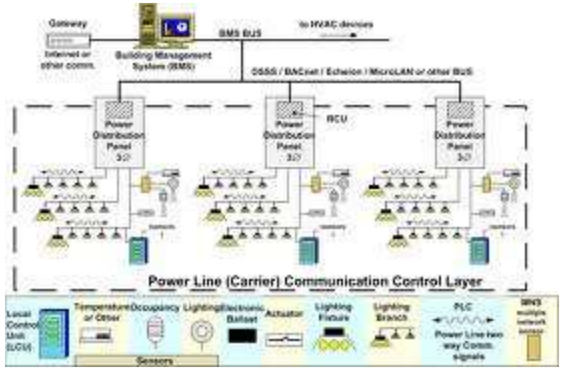
Active Design Strategies:







Highly efficient AC System
Right & not oversized AC system
Heat Recovery/Heat exchanger



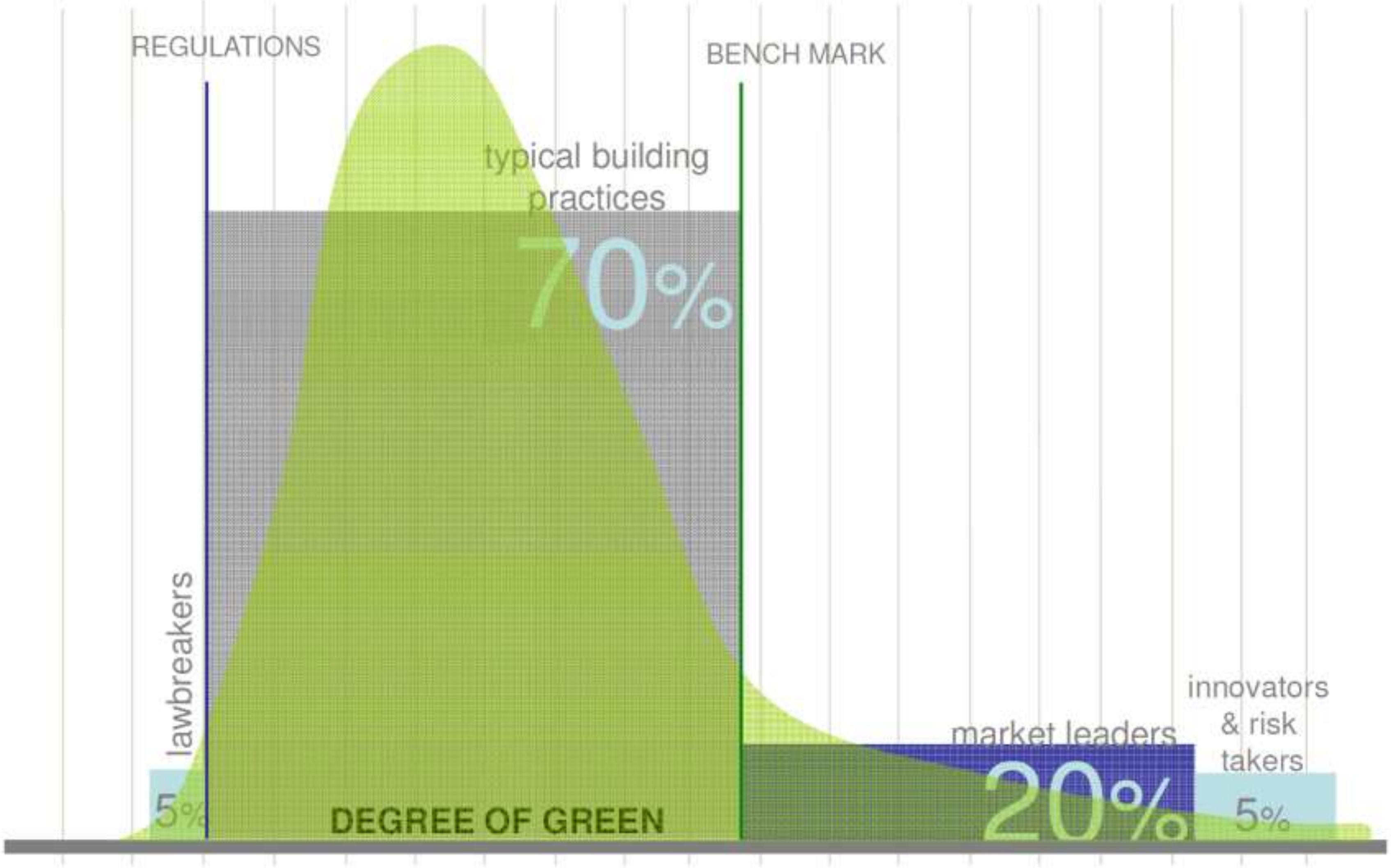
Automatic Control via BAS/BMS

High Performance lighting system & design

market transformation.







Thank you

Jatmika Adi Suryabrata

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