SUSTAINABLE + PASSIVE DESIGN

Covering on….
~Why the Green Wave?
~Step to Step Passive Strategy
~ST Diamond Building / Green Energy Office / Cooltek House
~5 Myths about Green Building Design
~Designing with Building Science
~Regenerative Design

UCSI UNIVERSITY
The University. The Experience

2015 0626 IEN Knowledge Sharing
Sustainable & Passive Design

I|E|N CONSULTANTS

I | E | N CONSULTANTS

BUILD GREEN.

MALAYSIA, SINGAPORE, CHINA

UCSI UNIVERSITY
The University. The Experience

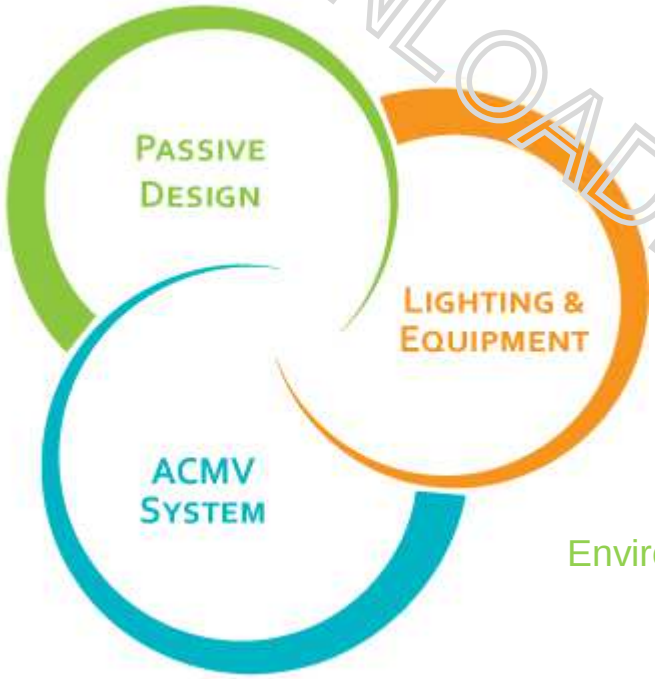
2015 0626 IEN Knowledge Sharing
Sustainable & Passive Design

I | E | N CONSULTANTS

Green Building Consultant? What do we do?

Courtesy of Gregers Reimann/IEN Consultants Sdn Bhd / Illustration by Rachel Chen Rui

Green Building Consultant? What do we do?



Optimizing buildings in an integrated design process with the rest of the design team.

Energy Simulation Modelling

Integrated Energy Design Strategy. Passive & Active

Involvement from Schematic Design phase… towards Post Occupancy

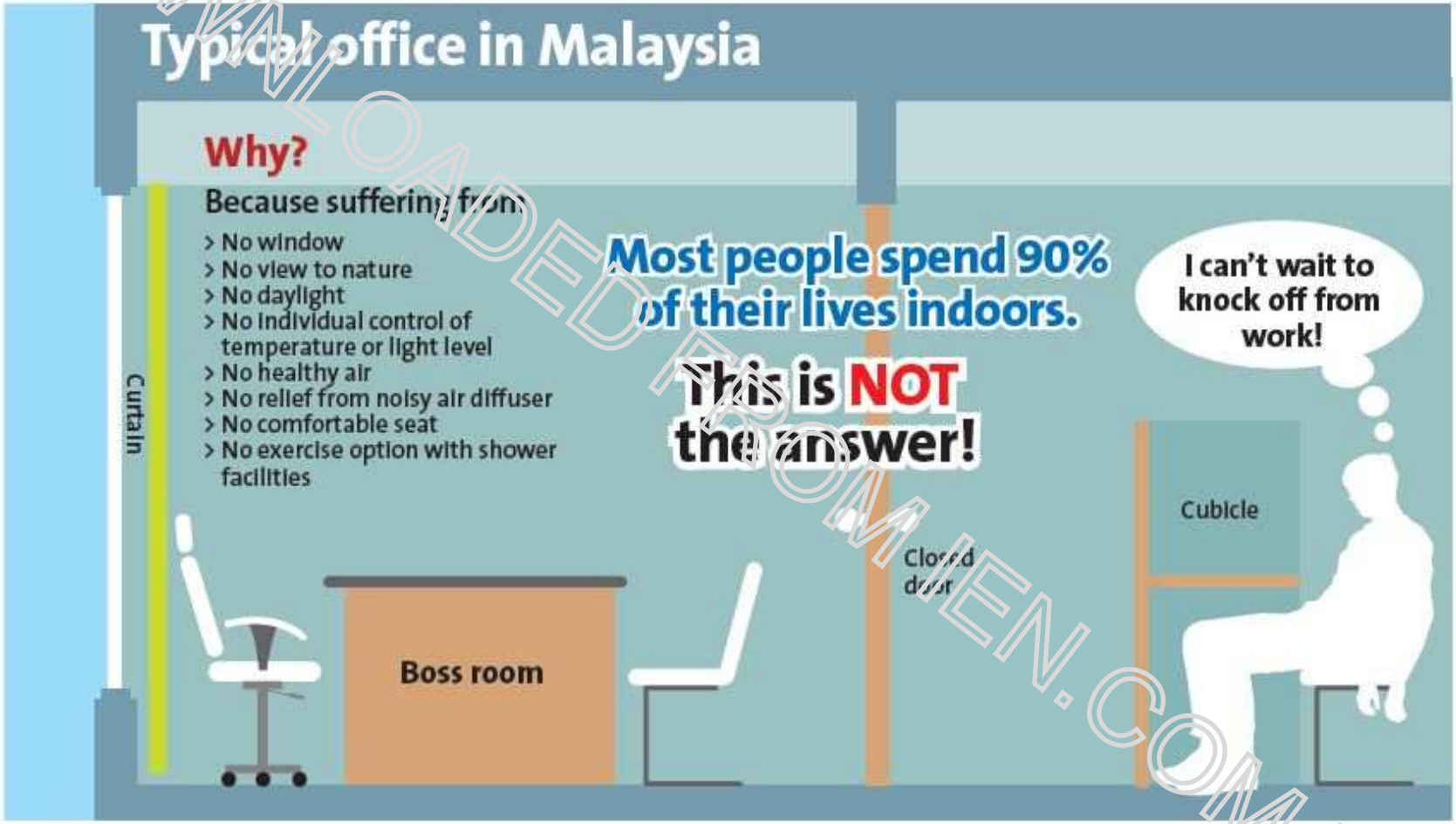
Environmental Friendly Construction Best Practices

Integrated Water Strategy..

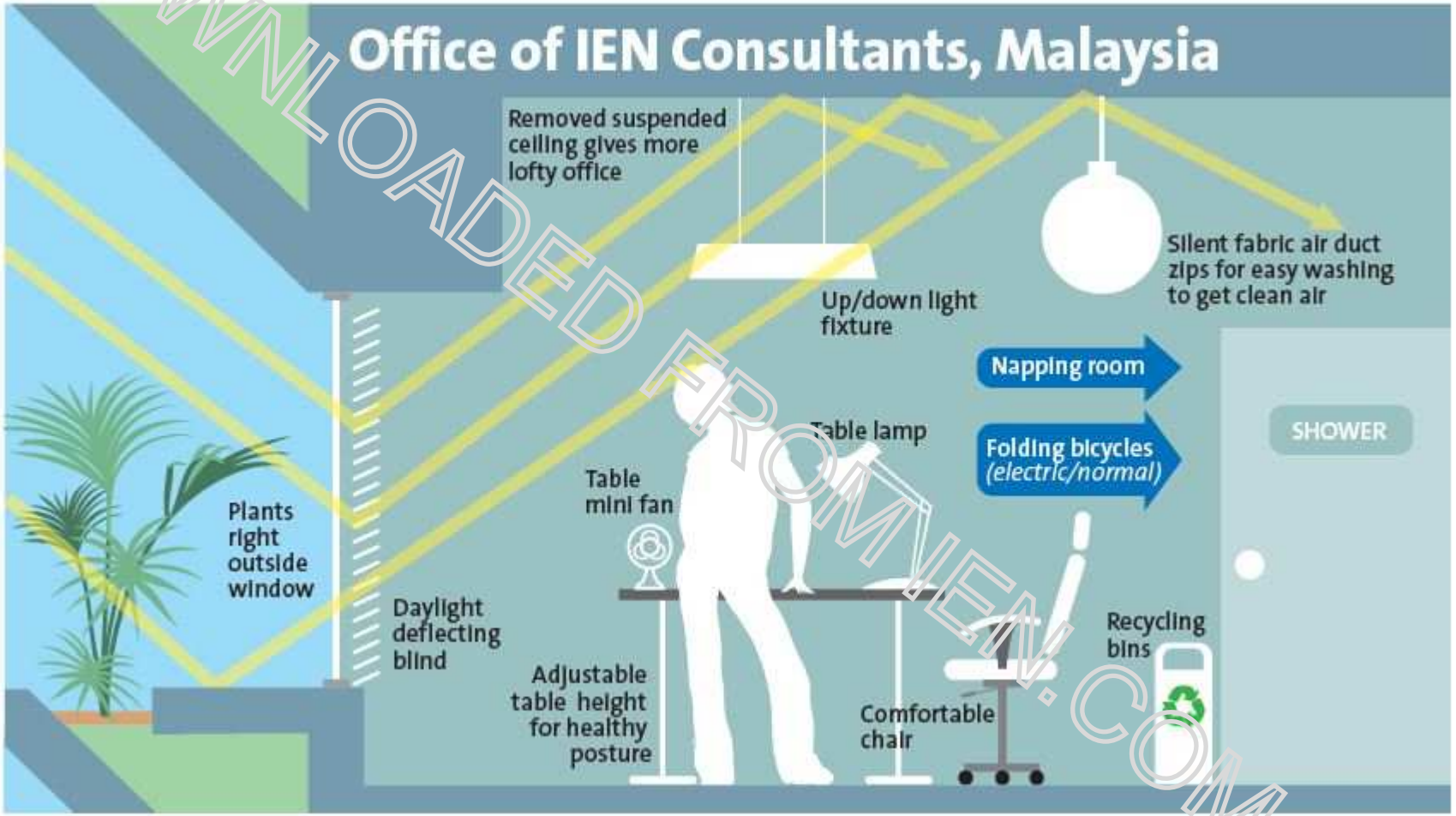
Well, some say we are the scientist behind Buildings?

Walking the Talk. Office space as the test lab for green design.

A QUICK SUMMARY OF OUR OFFICE STRATEGIES..
ON FUTURAC THIS COMING ISSUE!



A quick summary of our office strategies..
On futurac this coming issue!



What is Green?

Passive Design

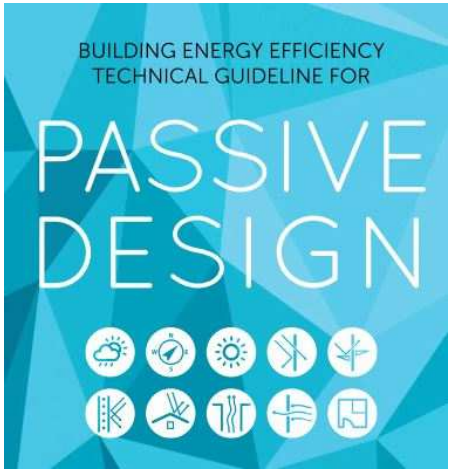
Objective:

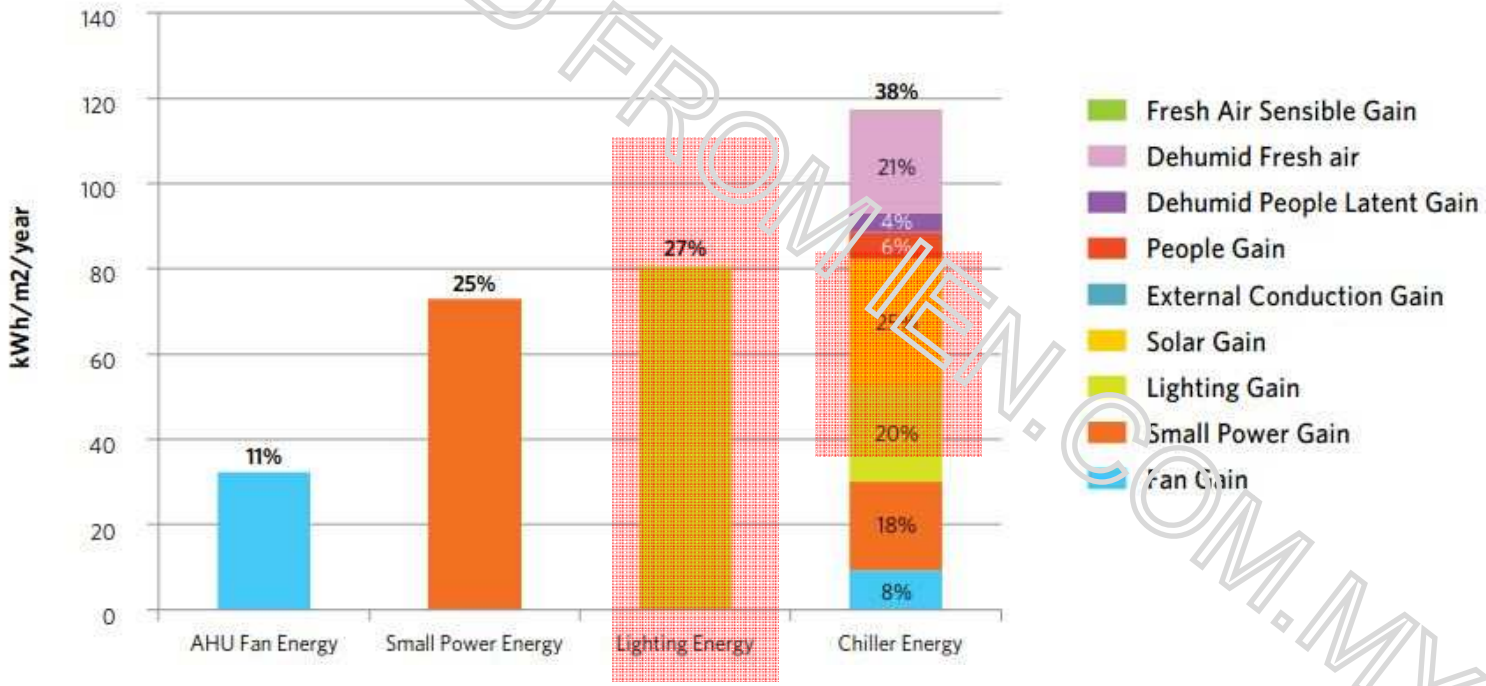
Minimizing Heat Gain into the Air Conditioned Space

Strategy:

1. Orientation
2. Building AC & Non AC Layout Plan
3. Building Window to Wall Ratio
4. Building Fabric Insulation
5. External / Internal Shading Device
6. Maximizing Comfortable Diffuse Daylighting

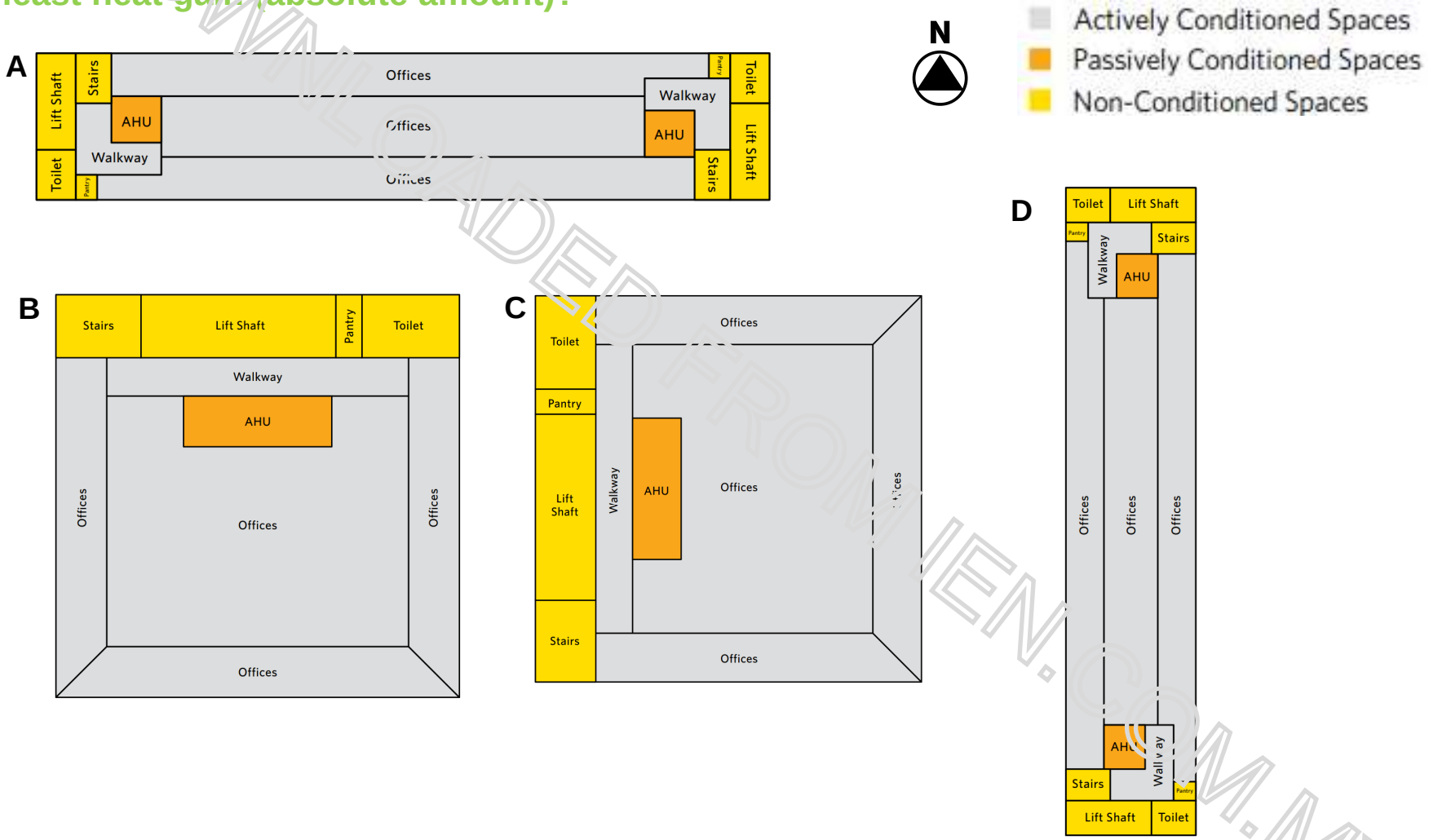
(Lesser Artificial Lighting Heat Gain)





Passive Design

Which arrangement of Orientation & Floor AC/Non AC Zone layout will have the least heat gain (absolute amount)?



Passive Design

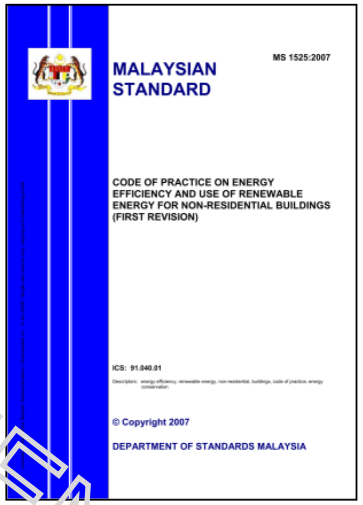
Quantifying your Envelope Thermal Performance > OTTV RTTV

Also a mandatory requirement under UBBL to comply OTTV <50W/m2

REQUIREMENTS

MS 1525, a Code of Practice intended to be incorporated in UBBL

1. Non-residential, air conditioned buildings with an area ≥4,000 m2
2. Architects and Engineers must submit OTTV and RTTV calculations



Passive Design

Quantifying your Envelope Thermal Performance > OTTV RTTV

Also a mandatory requirement under UBBL to comply OTTV <50W/m2

CONCEPT OF OTTV

MS1525:2007 Clause 5.2.2

The formula for the OTTV of any given wall orientation is as follows:

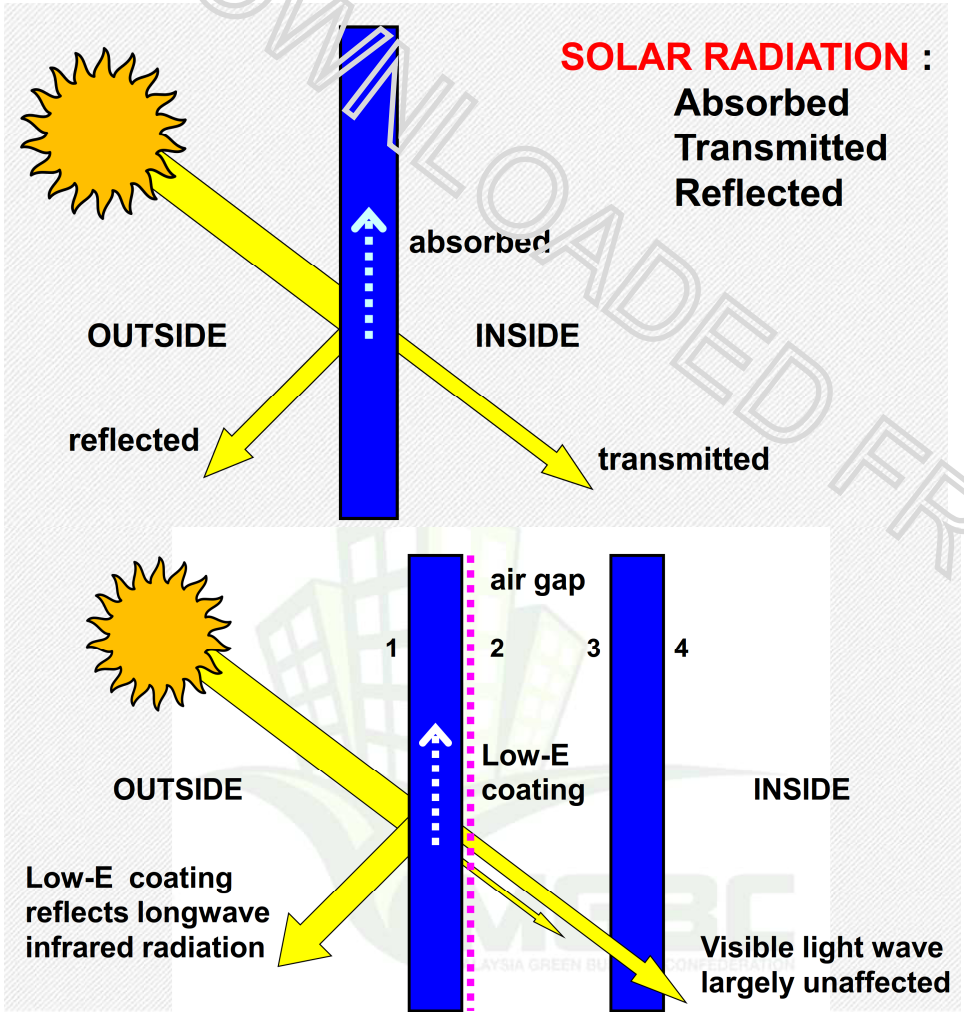
$$OTTVi = 15\alpha(1 - WWR)\,U_w + 6(WWR)\,U_f + (194 \times CF \times WWR \times SC)$$

OTTV = Heat Conduction through Walls + Heat Conduction through Windows + Solar Heat Gain through Windows

0.2% to 5% | **10% to 20%** | **70% to 85%**

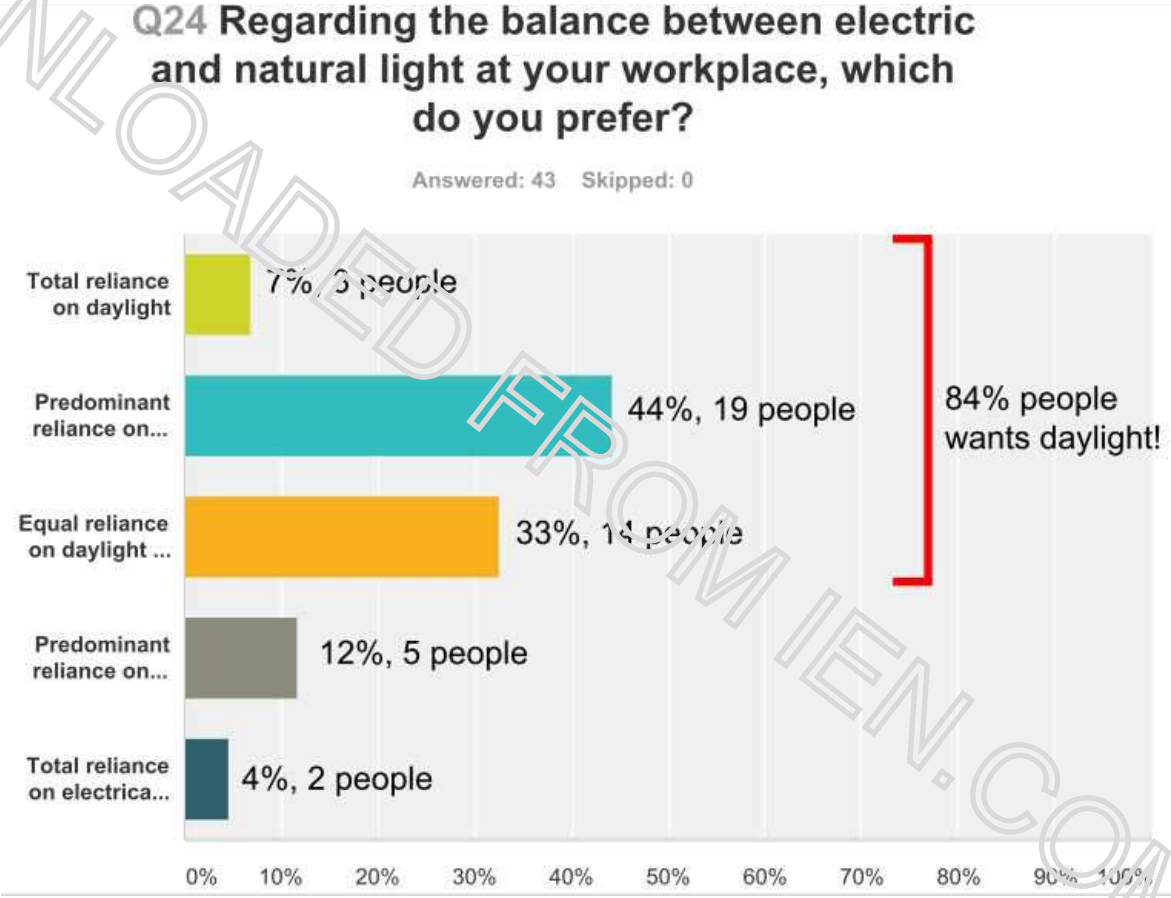
Passive Design

Solar Radiation Heat Gain can be reduced with better thermal performance glazing.



Passive Design

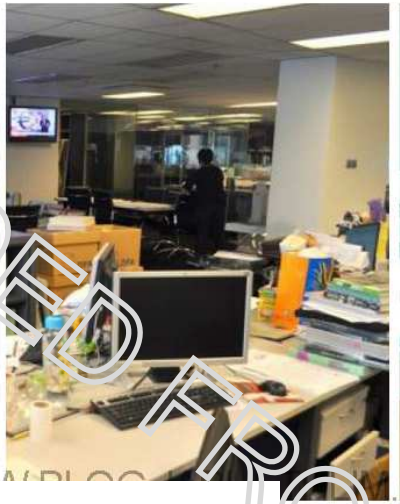
Harvesting Diffuse Daylight

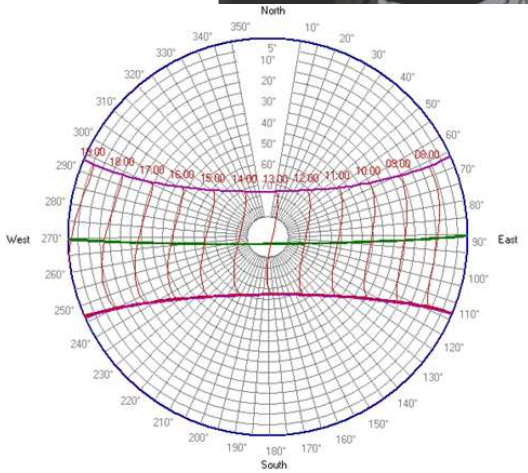


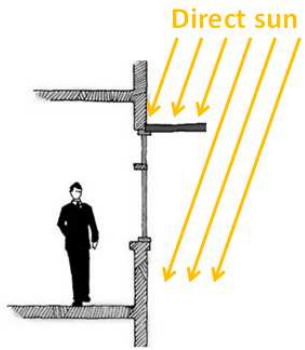
Passive Design

Harvesting Diffuse Daylight

Lighting Matters. How do you want your working space to look like?





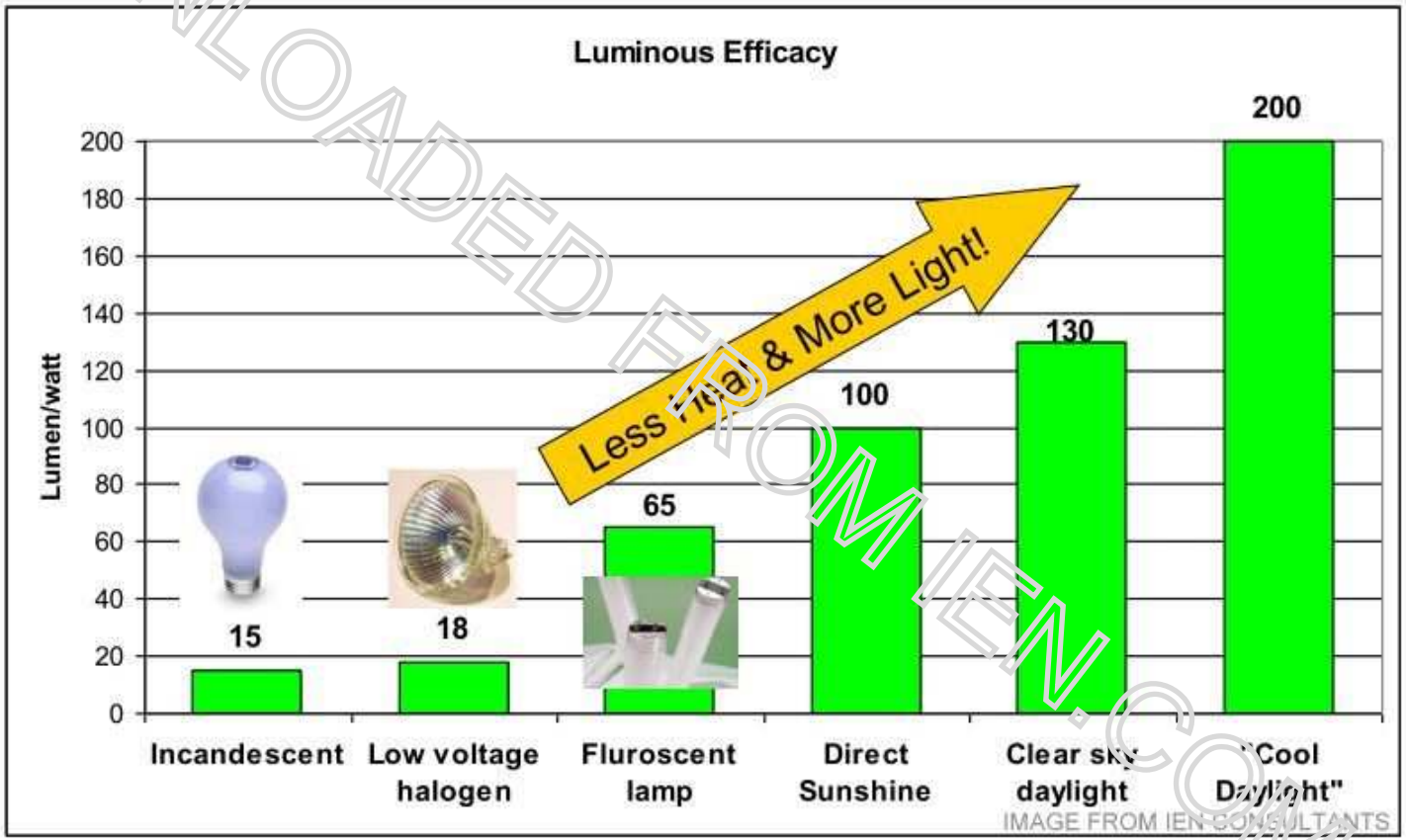


North & South windows can easily be shaded by horizontal overhang.

Passive Design

Diffuse Daylight has higher Luminous Efficacy than Artificial Light!

Luminous Efficacy: The ability of the light source to convert consumed electrical power into visible luminous flux (light).



Source:

1. Estimation of luminous efficacy of daylight and illuminance for composite climate, (M. Jamil Ahmad, G.N. Tiwari) 2010. Journal of Energy and Environment
2. A simple evaluation of global and diffuse Luminous Efficacy for all sky conditions in tropical and humid climate (A.H Fakra et al) 2008, University of La Reunion

Passive Design

20th Century design with extensive overhang shading.

Asia Insurance Building, Raffles Place (1954)

Jalan Duta Government Complex (1970s)

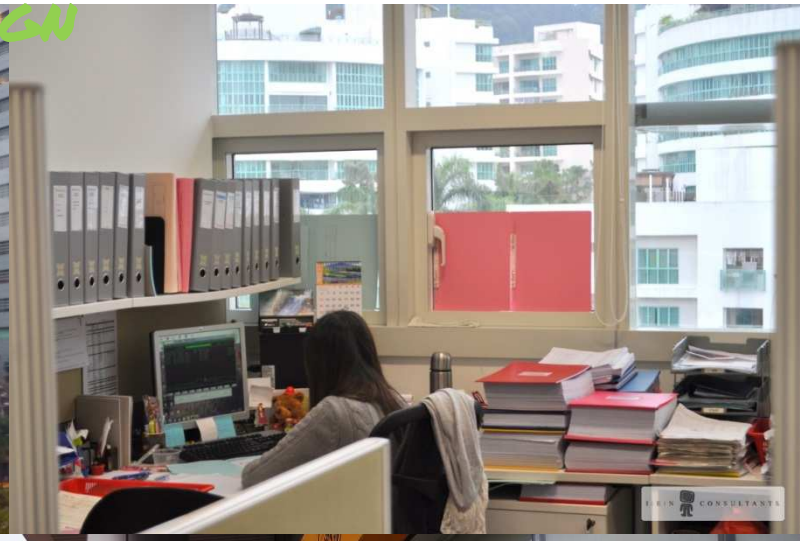
Passive Design

21st century design modernism celebrating overloaded glazing?

Passive Design

Really abundance of daylight? Or Glare?

Passive Design

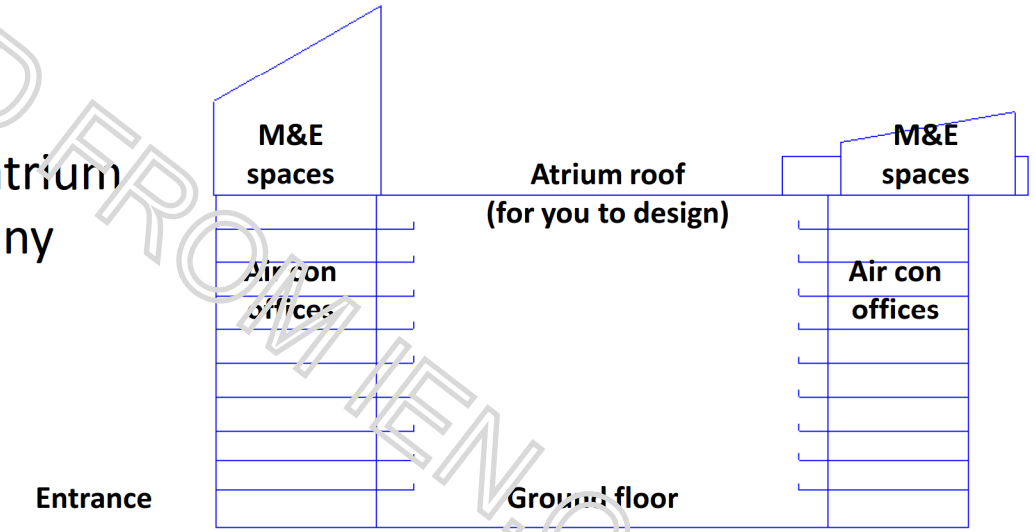


Daylight Harvesting Fail!

Passive Design – Atrium Cooling QUIZ

Draw on piece paper

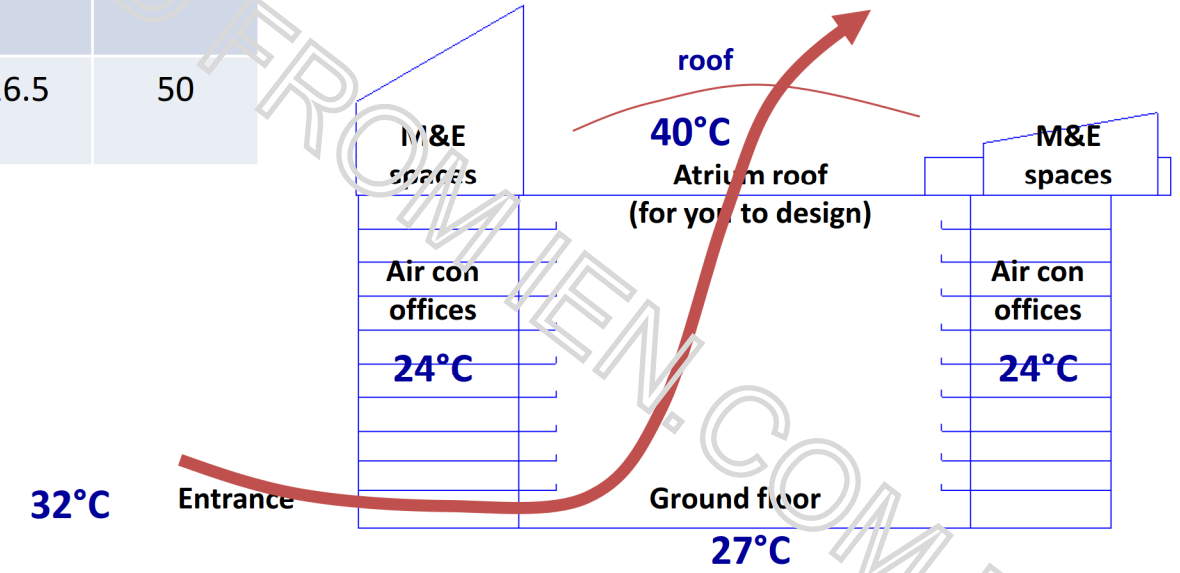
- Atrium ventilation strategy
- Arrows to indicate airflows
- Temperature & Humidity at atrium top & bottom at 2 pm on sunny day



Passive Design – Atrium Cooling QUIZ

Strategy	Count	Temp. (°C)	RH (%)
Naturally ventilated	8 votes	27-29	
Air-conditioned	0 votes		
Evaporative cooling)	1 vote	28	30-100
Closed and passive atrium	IEN solution (simulated)	26.5	50

Comment: All student groups proposed a naturally ventilated atrium where cool air would enter at the bottom and be expelled at the top

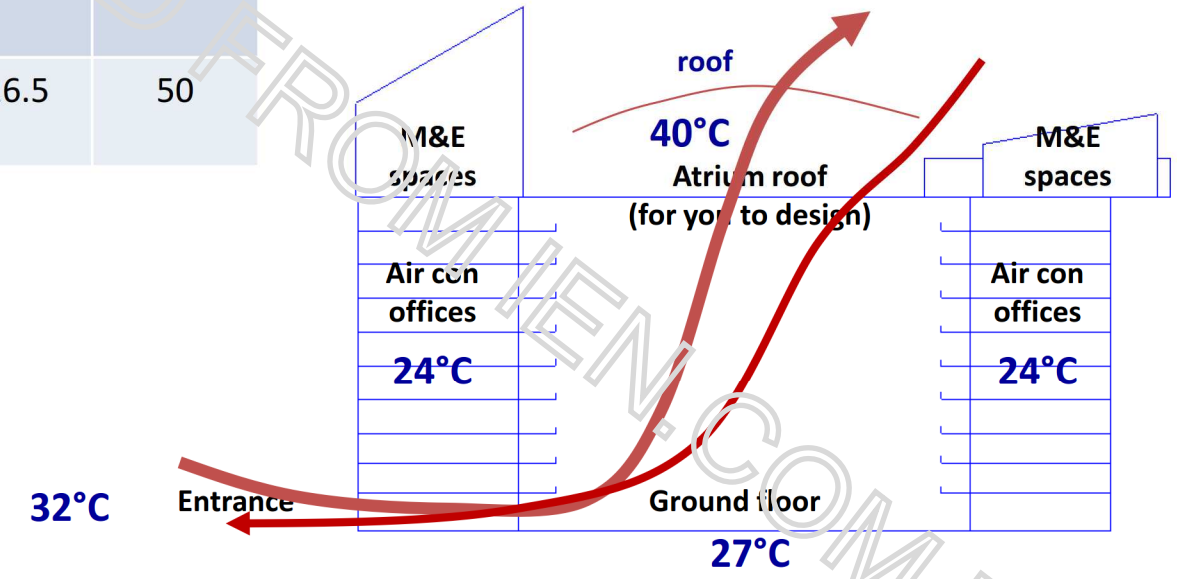


Passive Design – Atrium Cooling QUIZ

Strategy	Count	Temp. (°C)	RH (%)
Naturally ventilated	8 votes	27-29	
Air-conditioned	0 votes		
Evaporative cooling)	1 vote	28	80-100
Closed and passive atrium	IEN solution (simulated)	26.5	50

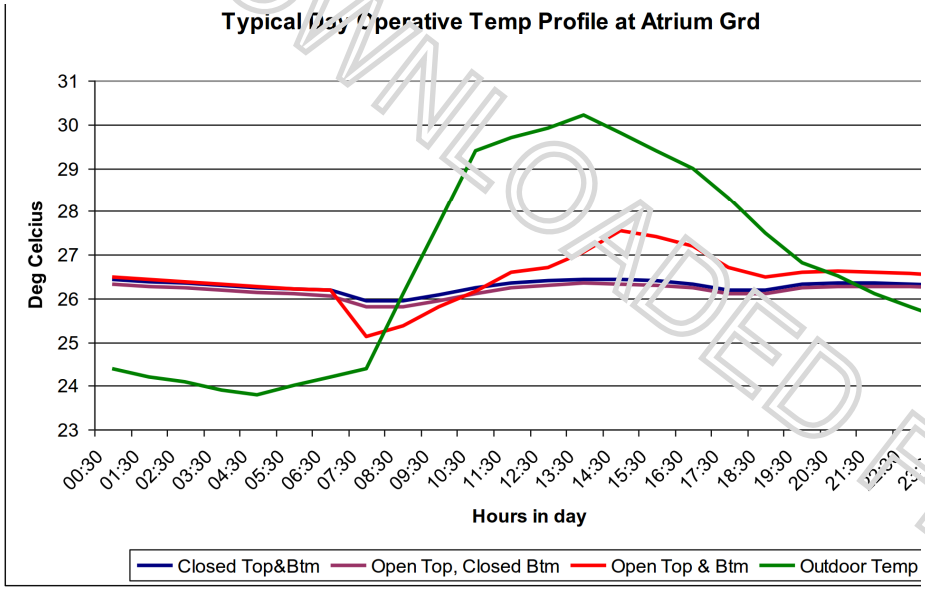
Comment: In actual fact, the air in the atrium will be cooled down by the surrounding air-con offices. The atrium air will be hence be cooler and heavier than the outside air and wil drop out of the ground floor entrance door, similar to the 'shopping mall effect', i.e. a rush of cool air gushing out on the street outside.

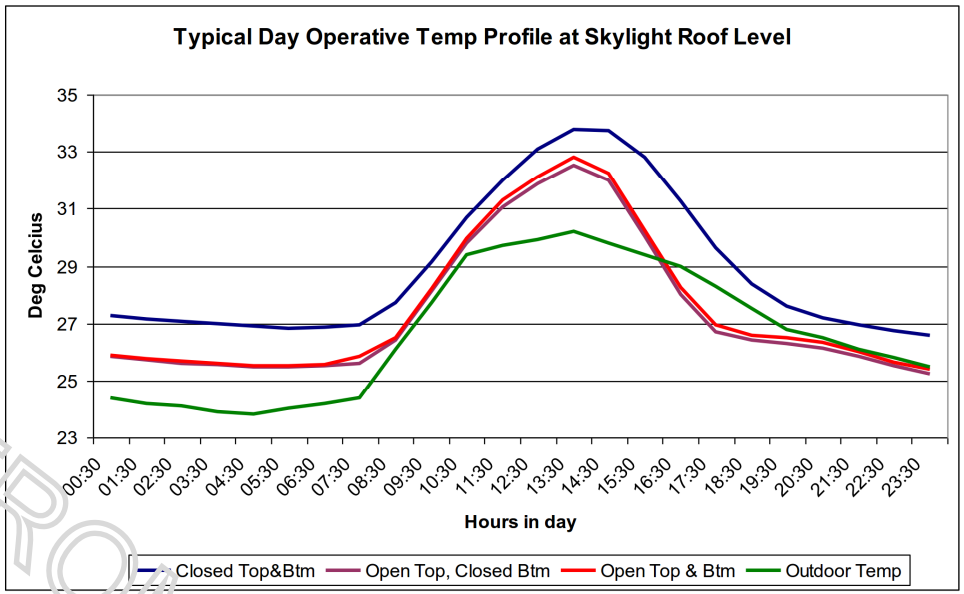
The hot pocket of air under the atrium roof will just stay up there



Passive Design – Atrium Cooling QUIZ

Using IES Software to simulate.





NB. Temperatures below the atrium glazing are higher than the outside temperature during the hottest part of the day and most of the night. Hence, it is advised to use single glazing not to restrict the heat from escaping through the atrium roof.

- Top of atrium:
  Open or closed (does not really matter)
- Bottom of atrium:
  Closed (use air-lock, e.g. double door)

Finding:

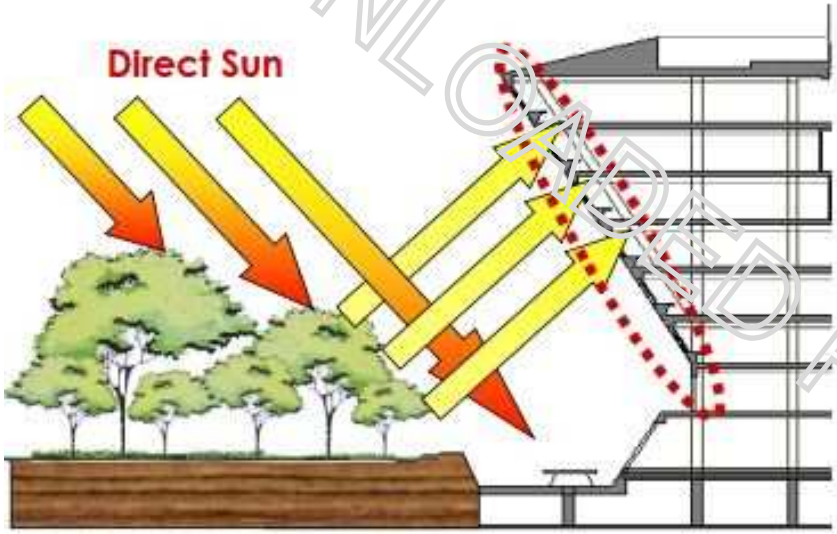
Comfortable (relatively cool & dry) atrium free of charge

Comment: This workshop showed that computer simulation is a good design aid, as the actual atrium design and air-flow dynamics in the atrium was opposite to the best atrium design perceived by the 8 student groups.

ST DIAMOND BUILDING, ENERGY COMMISSION HQ @ PUTRAJAYA

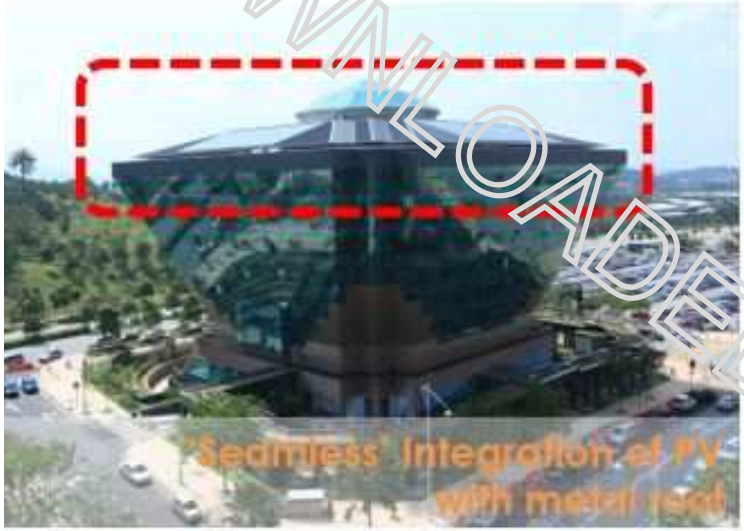
ST DIAMOND BUILDING, ENERGY COMMISSION HQ @ PUTRAJAYA

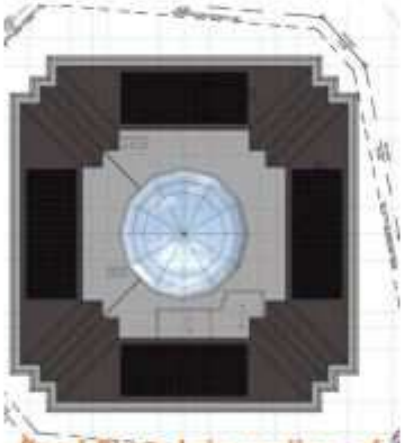
ARCHITECTURAL PASSIVE DESIGN



- The diamond form with the Tilting Façade avoid direct sun rays into building
- Tilting Façade results in smaller building footprint which allows for more area for landscape.
- Surrounding landscape reduces heat gain into the building.

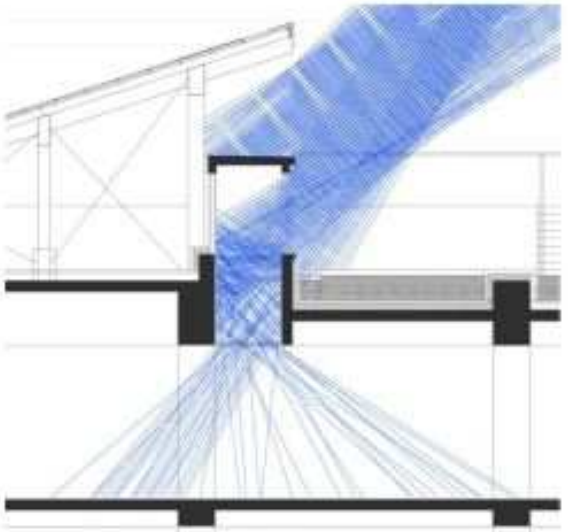
GREEN ROOF: SOLAR PHOTOVOLTAIC (PV)





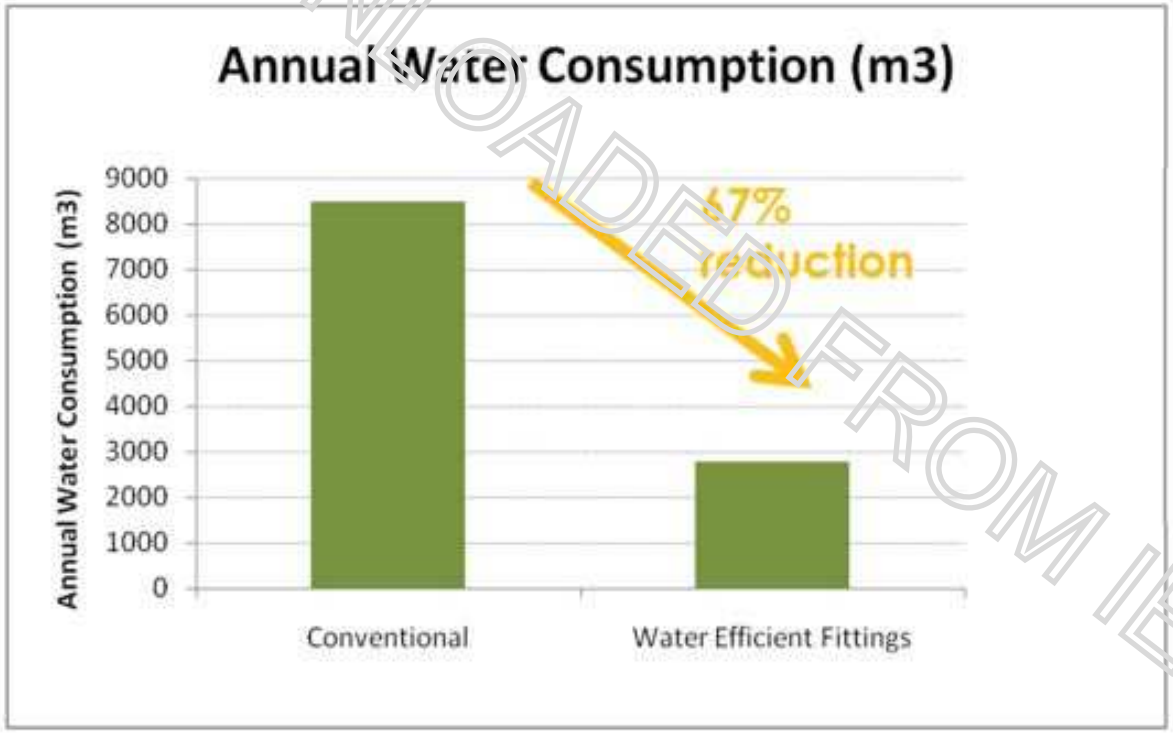
GREEN ROOF: RAINWATER HARVESTING

GREEN ROOF: LIGHT TROUGH



Indirect daylight drawn into the Roof Light Trough to the space below

WATER EFFICIENCY: WE FITTINGS

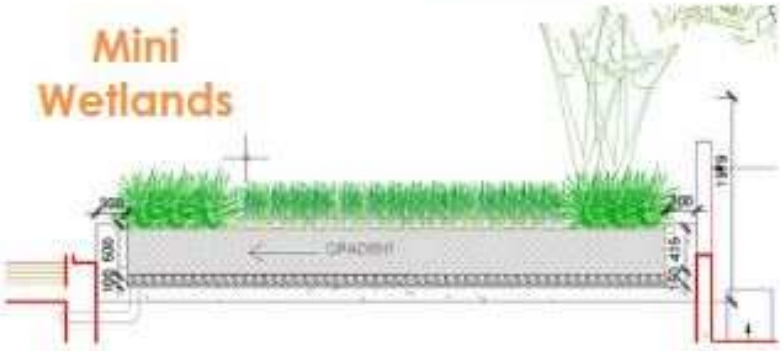


Dual flush toilets

Waterless urinals
(with water tap for Muslim users)

Taps with aerators

WATER EFFICIENCY: GREYWATER RECYCLING



ST Diamond Building, Energy Commission HQ @ Putrajaya

ENVIRONMENTAL FRIENDLY MATERIALS

BORAL

Recycled Plaster Board
(Green Label)

Low VOC Paint
(Green Label)

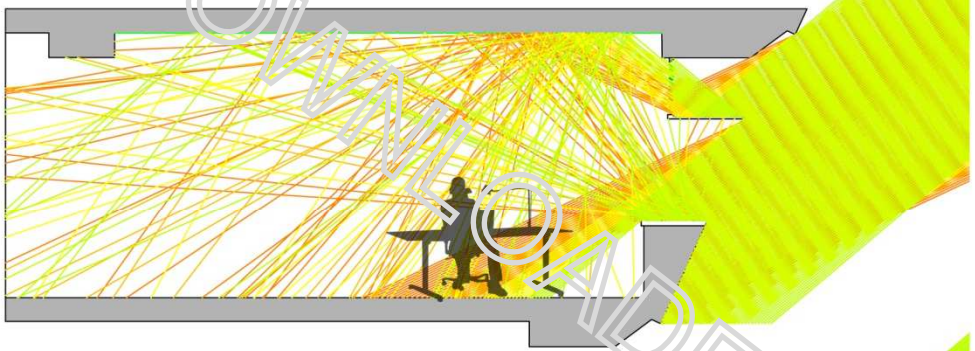
Shaw

Recycled Content Carpet
(Green Label)

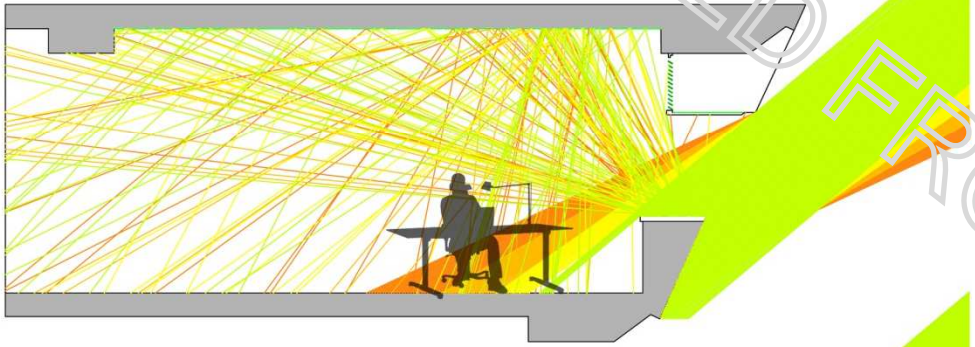
ST Diamond Building, Energy Commission HQ @ Putrajaya

Light Reflections from:

Lightshelf + Window Sill



Lightshelf Only



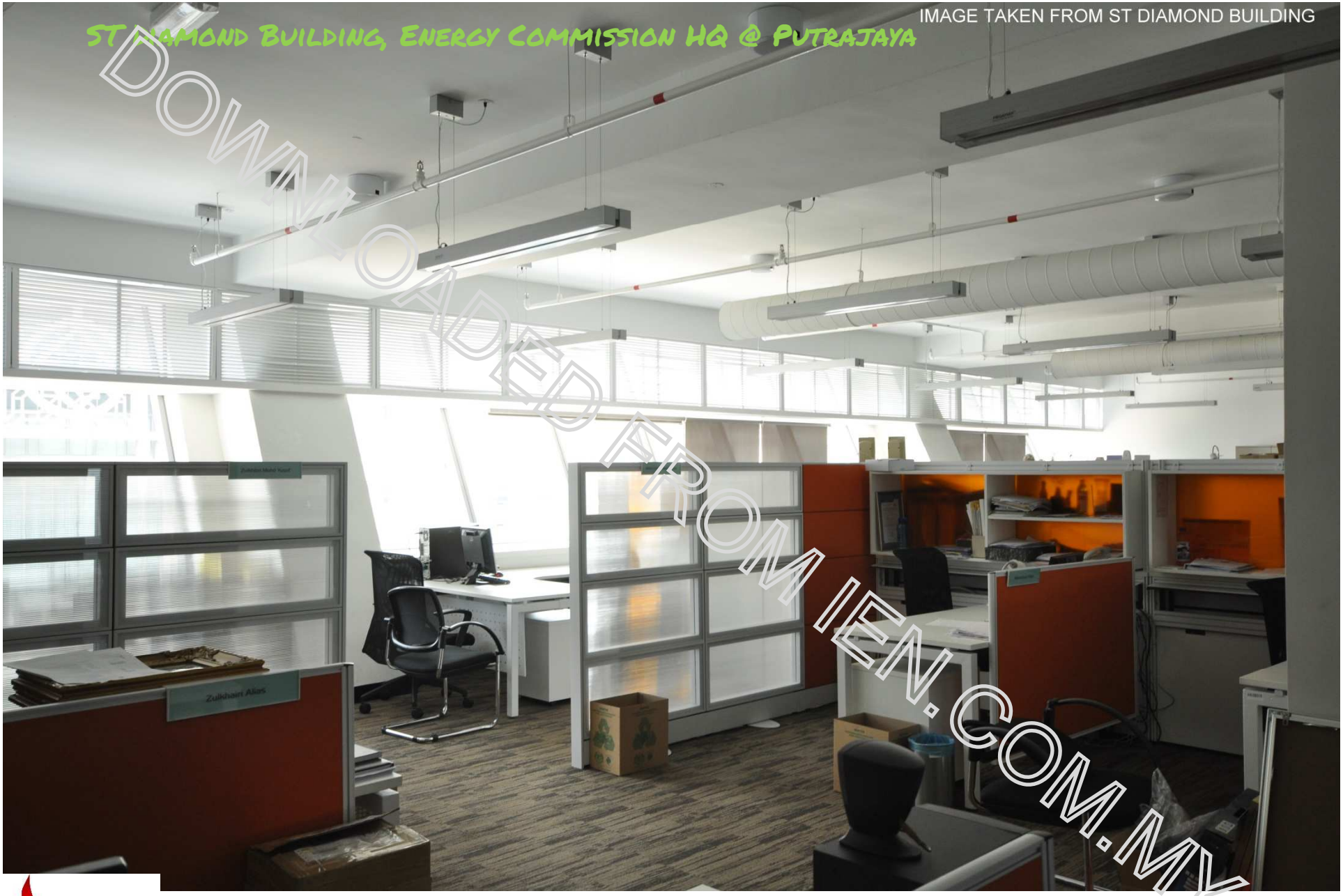
Window Sill Only

ST DIAMOND BUILDING, ENERGY COMMISSION HQ @ PUTRAJAYA

IMAGE TAKEN FROM ST DIAMOND BUILDING

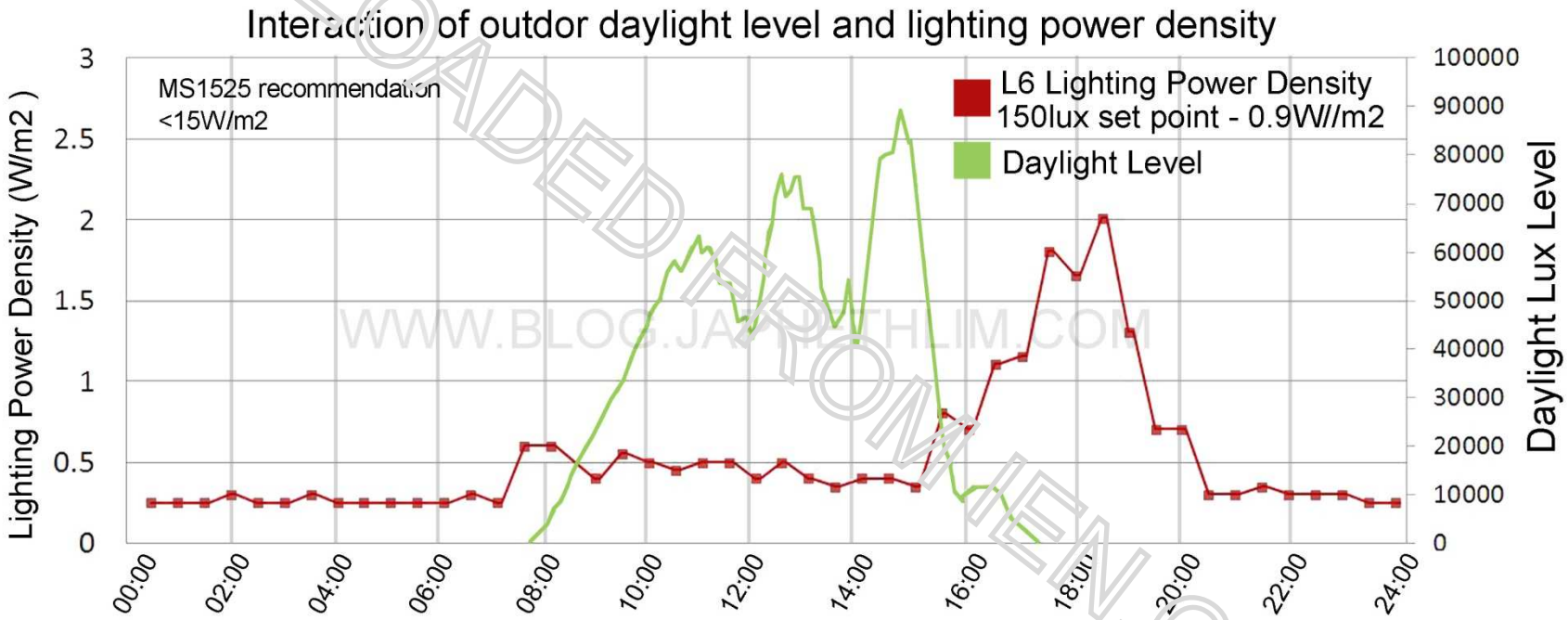
ST DIAMOND BUILDING, ENERGY COMMISSION HQ @ PUTRAJAYA

IMAGE TAKEN FROM ST DIAMOND BUILDING

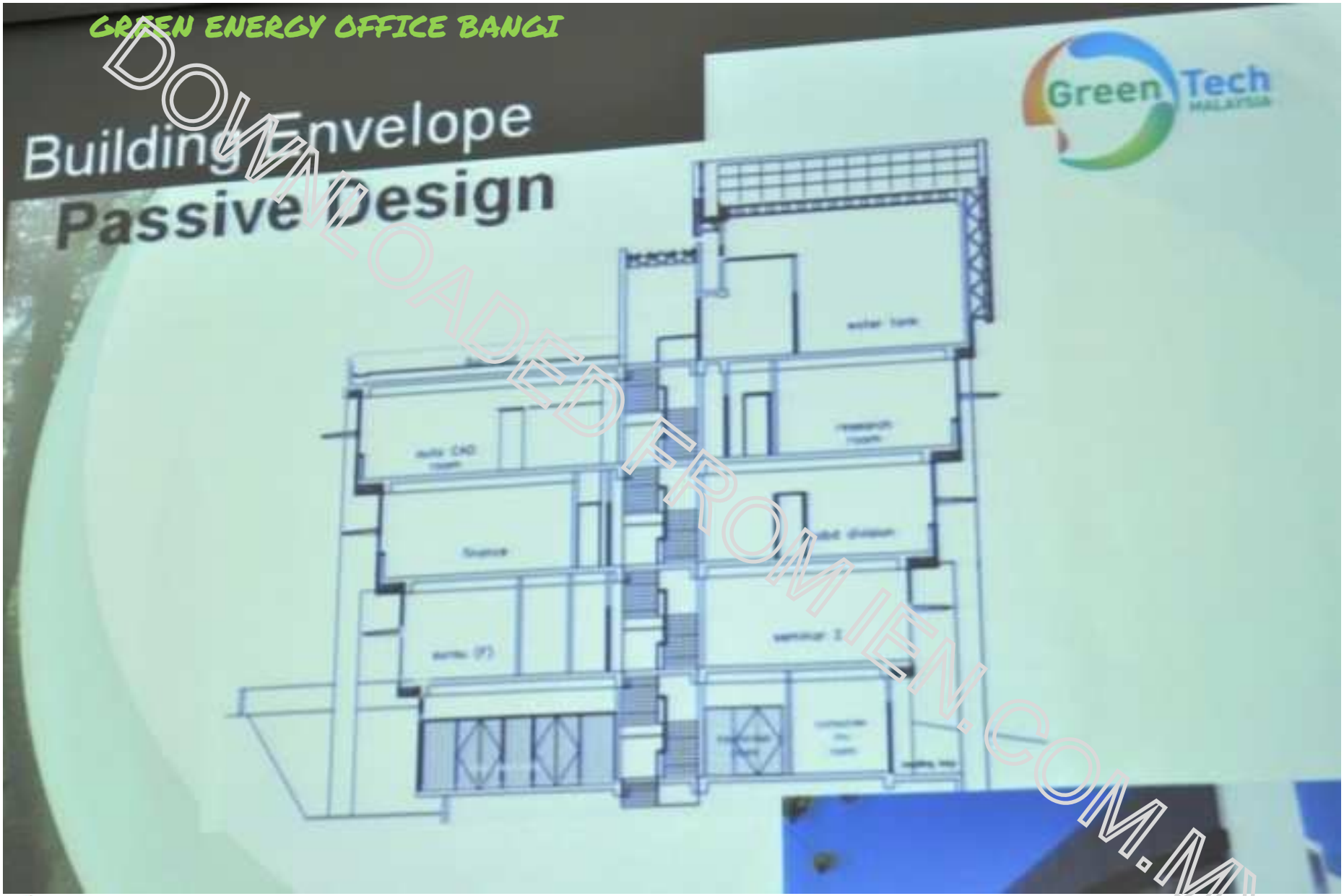


ST DIAMOND BUILDING, ENERGY COMMISSION HQ @ PUTRAJAYA

ST Diamond Building, Energy Commission HQ @ Putrajaya



GREEN ENERGY OFFICE BANGI

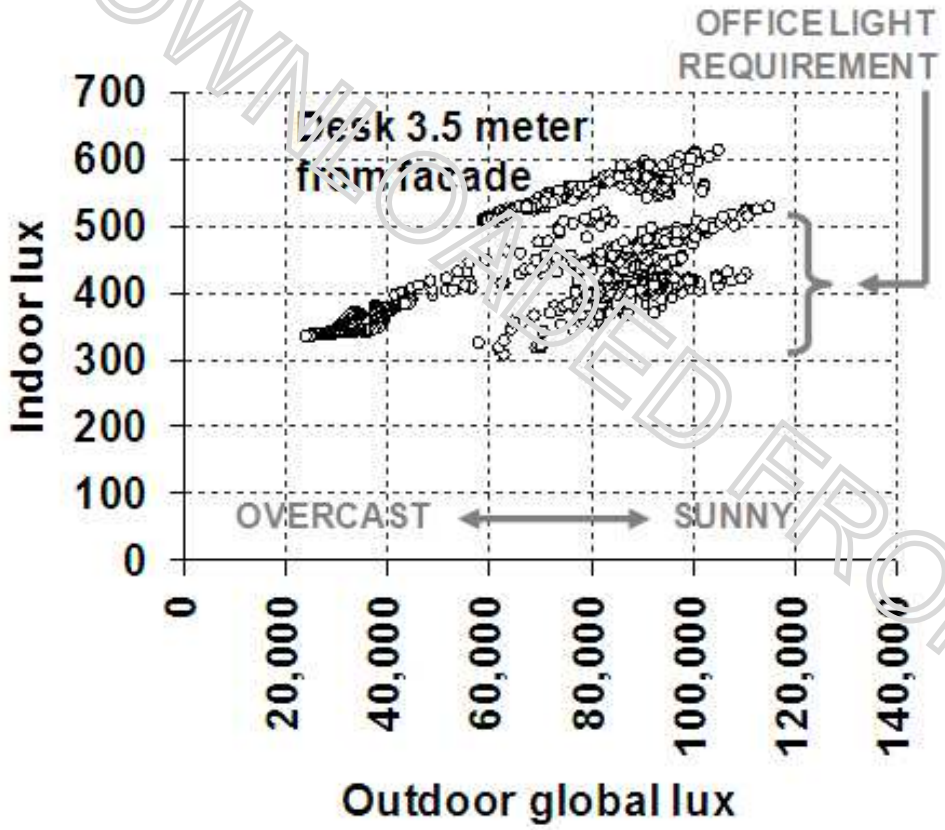


GREEN ENERGY OFFICE BANGI

GREEN ENERGY OFFICE BANGI

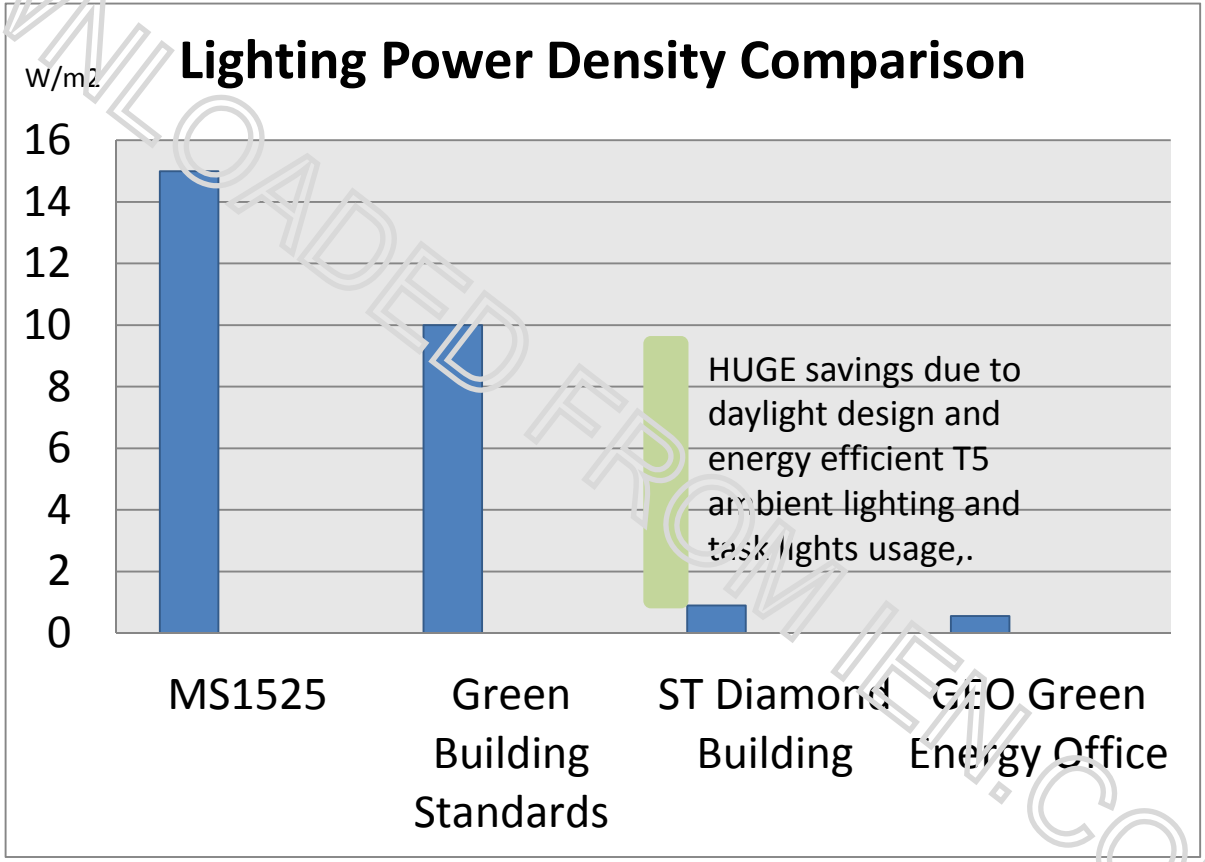
GREEN ENERGY OFFICE BANGI

GREEN ENERGY OFFICE BANGI



- Lighting consumption: 0.56 W/m^2
- Code requirement: 15 W/m^2

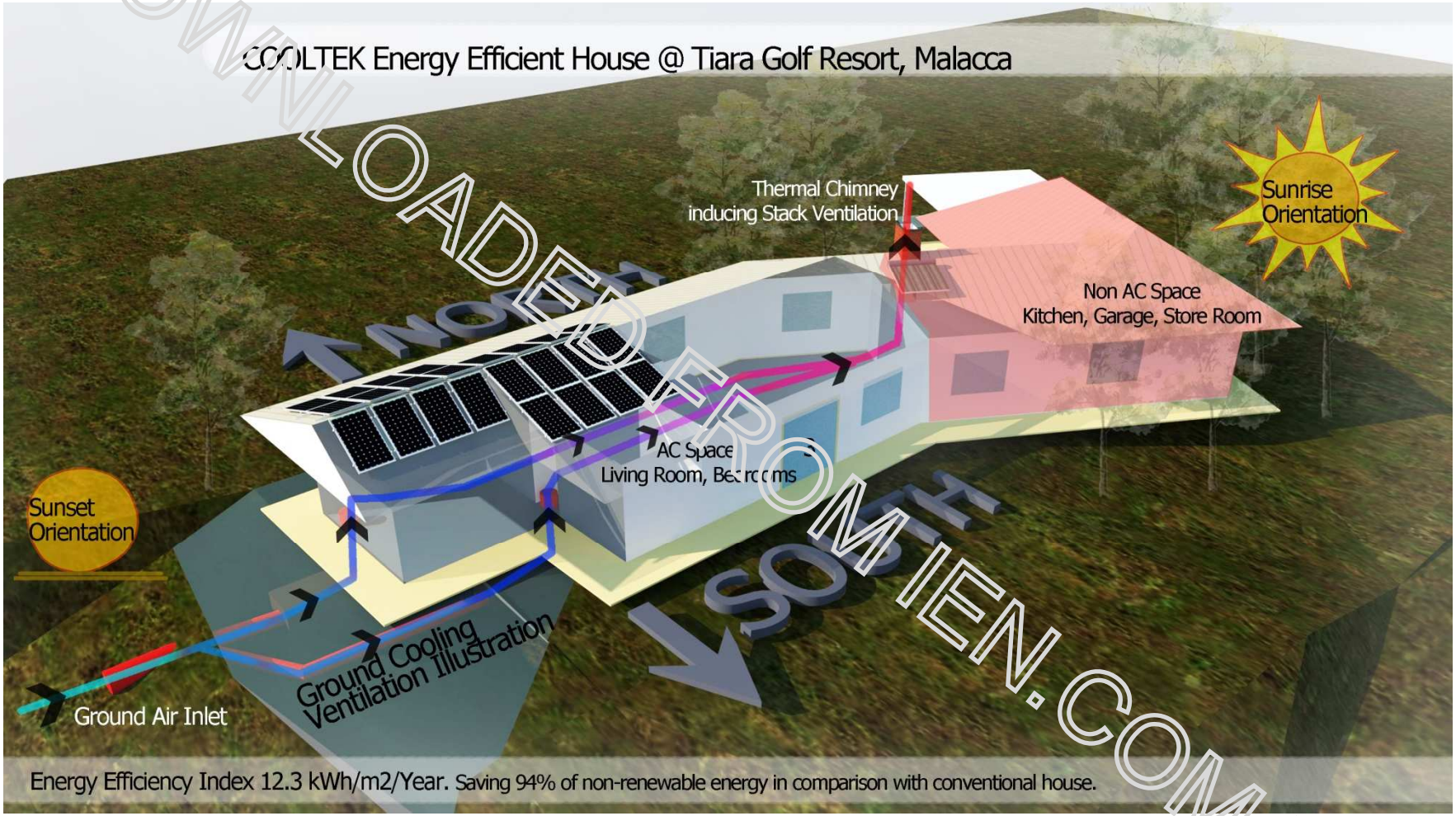
} 25 times more efficient



COOLTEK HOME AS AN EXAMPLE...

COOLTEK @ Tiara Golf Resort

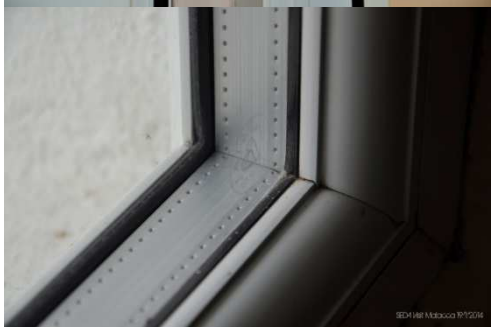
COOLTEK HOME AS AN EXAMPLE...

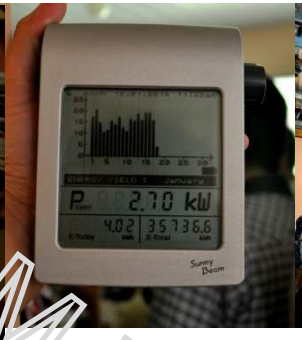


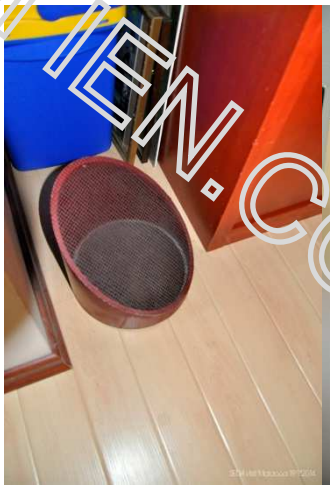
COOLTEK was designed to use AC continuously and is therefore a sealed building, preventing loss of the cooled air-conditioned air to the outside. It is a small, simple minimalist building, thus ensuring Energy Efficient in design.

COOLTEK HOME!

MORE INFO AT
WWW.COOLTEK.COM.MY







COOLTEK HOME!

MORE INFO AT WWW.COOLTEK.ORG

COOLTEK

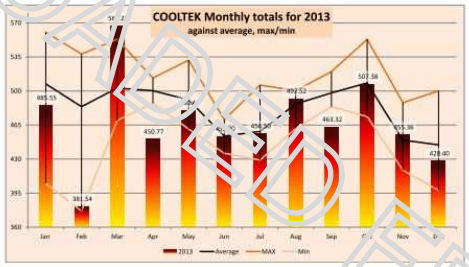
350 Jalan Woodland, Tiara Melaka Golf & Country Club, Ayer Keroh, 75450 Melaka

4.8 kWp BIPV SYSTEM FOR DECEMBER 2013

UNDERSTANDING YOUR HOME AS YOUR HABITABLE SPACE INSTEAD OF AN INVESTMENT!

During the month of December, 426kWh were generated, 4% below the December average generation of 445kWh.

This December was cooler than December 2012 with an average temperature of 26.5°C. The highest temperature recorded during the month was 36.2°C on 13th December. The temperature reached 32°C on 24 days in December.

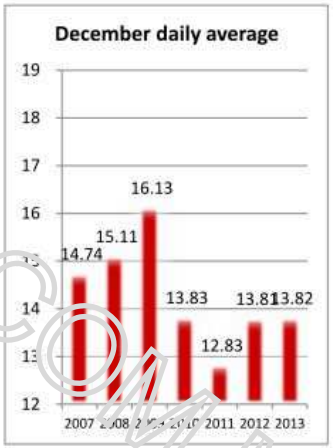


With 31 days in December, the installation was generating for a total of 343 hours.

Average daily solar electricity generated for the month was 13.82kWh, practically the same as last year and 2010.

The system generated 108% of the electricity of that was consumed by COOLTEK, helped by the fact that it was unoccupied for four days while I was in Kuala Lumpur.

The average daily generation for the year 2013 is 15.40kWh and the average since the system was installed in December 2007 is now 15.78kWh.



5 Misconceptions / Myths about green building designs

Misconception 1 - Going Green is not Cheap?

Misconception 2 - Green Building is just another “fashion” in the built environment design trend?

Misconception 3 - Green Building is just about the “Saving the Environment”?

Misconception 4 - Green Building is just about the Green Design of the building/project?

Misconception 5 - Going Green “dictates” the design of the project?

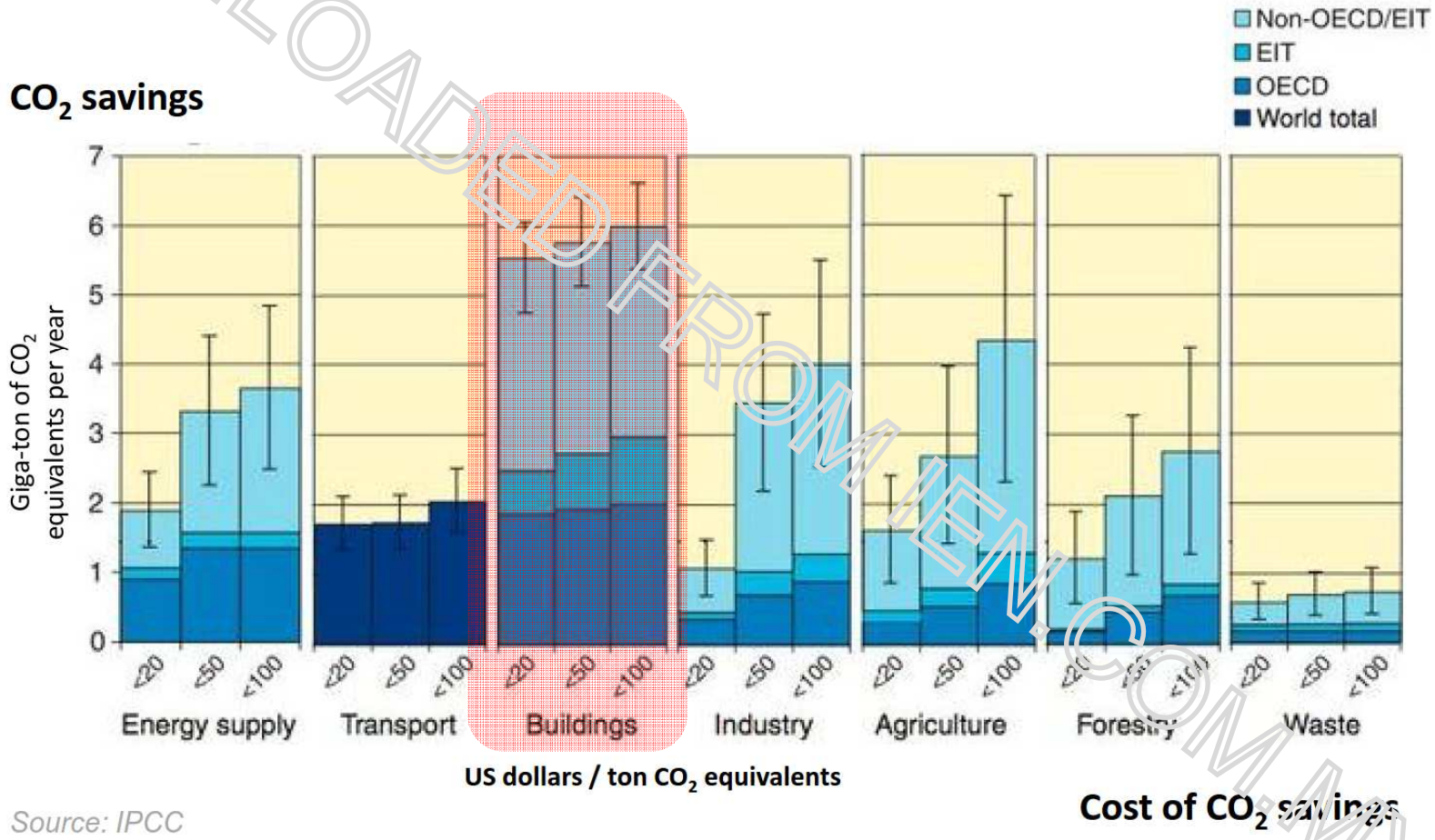
Misconception 1

Going Green is not Cheap?

Misconception 1 - Going Green is not Cheap

BUILDINGS SECTOR AS THE LARGEST POTENTIAL FOR CARBON OFFSET

Environmentally sound to improve energy efficiency of buildings:
Cheapest and largest CO_2 savings in building sector

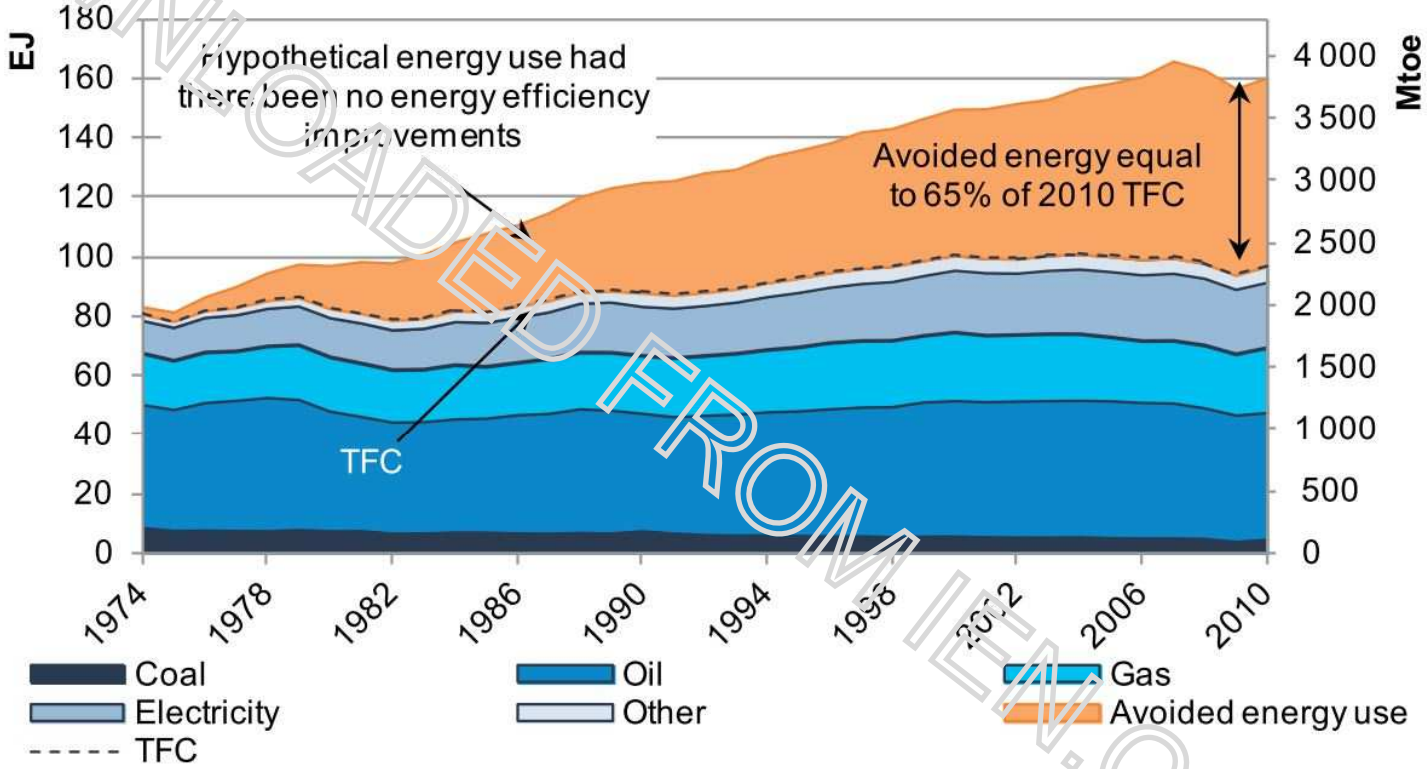


Source: IPCC

Misconception 1 - Going Green is not Cheap

BUILDINGS SECTOR AS THE LARGEST POTENTIAL FOR CARBON OFFSET

Figure ES.2 The "first fuel": avoided energy use from energy efficiency in 11 IEA member countries

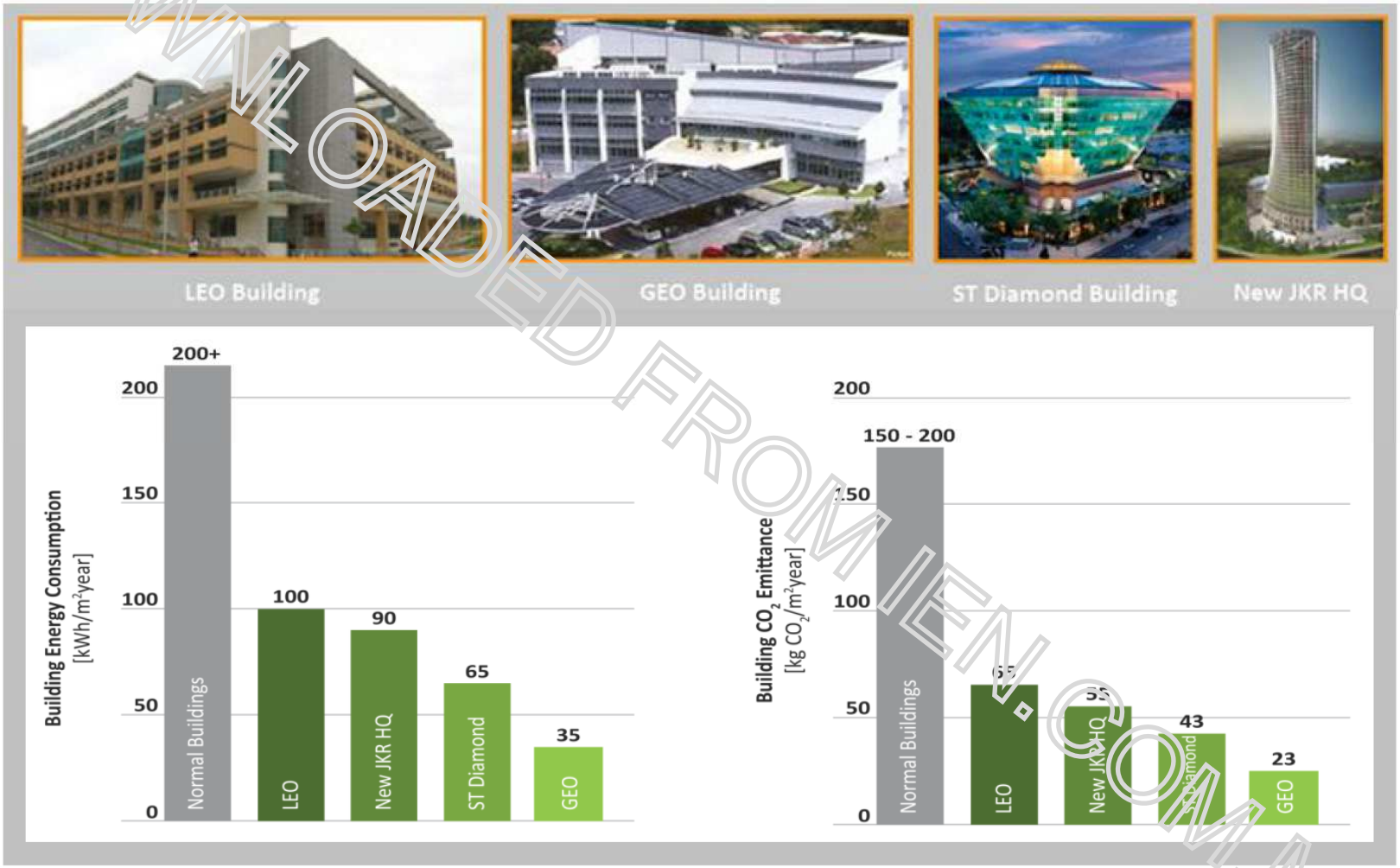


Notes: TFC = total final consumption. The 11 countries are Australia, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Sweden, the United Kingdom and the United States, those for which sufficient data is available to undertake analysis. "Other" includes biofuels plus heat from geothermal, solar, co-generation and district heating. Co-generation refers to the combined production of heat and power.

Source: IEA indicators database.

Misconception 1 - Going Green is not Cheap

Green + Energy Efficient Buildings by IEN



Misconception 1 - Going Green is not Cheap

Strategies to optimize building energy consumption

"If you're involved in a new project and you are not making it as green and low energy as possible, it will be functionally obsolete the day it opens and economically disadvantaged for its entire lifetime"

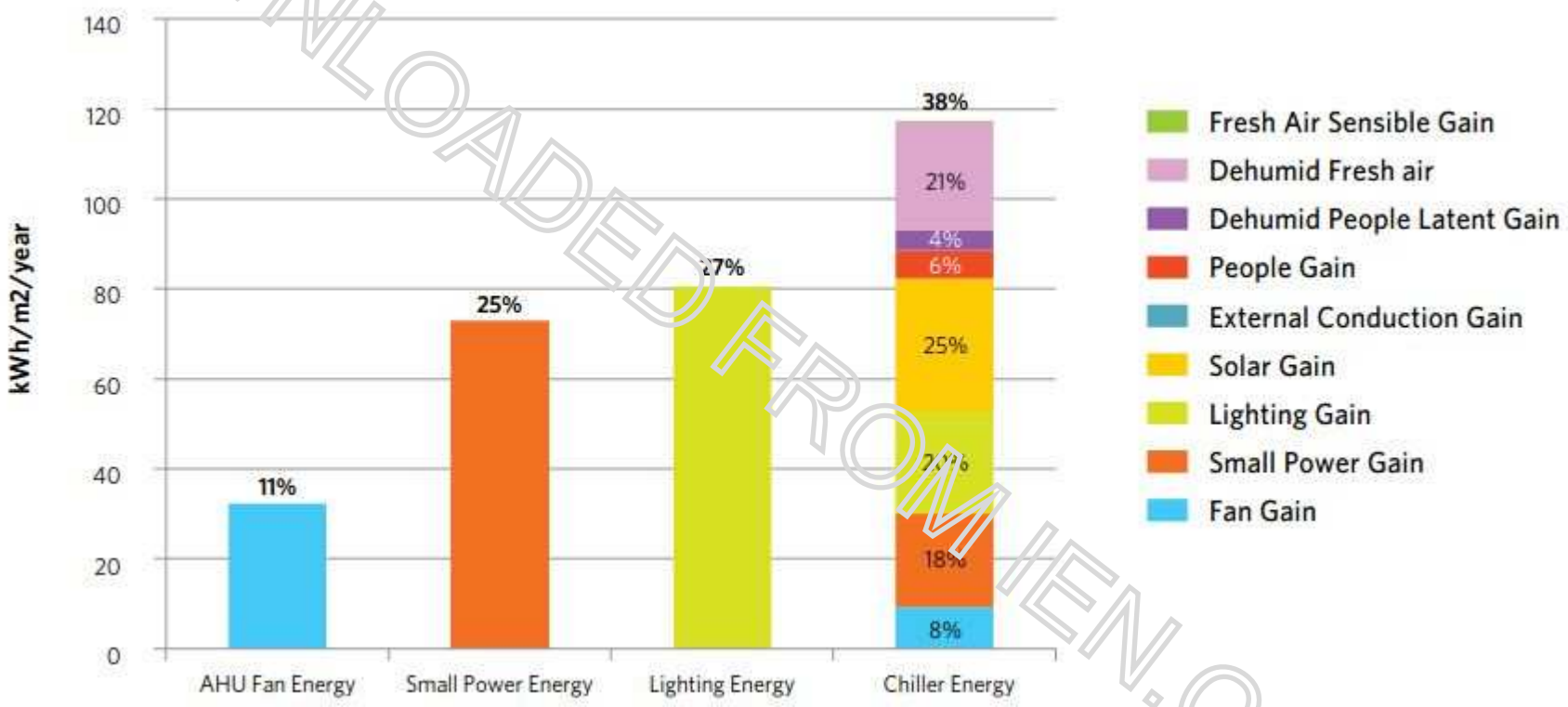
Mr. Jerry Yudelson (2008)
national board member
US Green Building Council

Building Owner

Cartoon by IEN Consultants / The Star newspaper (2014)

Misconception 1 - Going Green is not Cheap

Typical breakdown of office energy consumption



Misconception 1 - Going Green is not Cheap

Strategies to optimize building energy consumption

Misconception 1 - Going Green is not Cheap

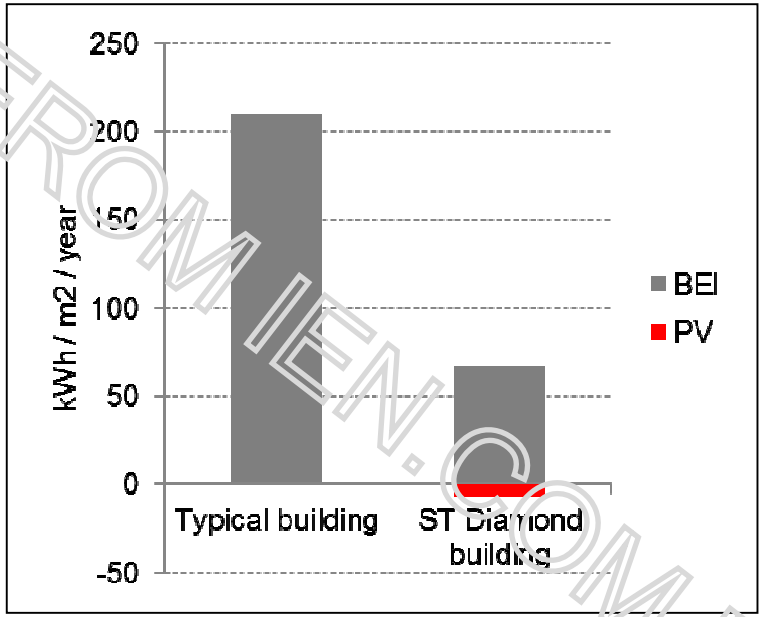
Proven! ST Diamond Building – 3 years payback.

Key Data

Gross Floor Are: 14,000sqm
Year of Completion: 2011
Building Energy Intensity: 69kWh/m2*year
Total Construction Cost: RM60mil
Additional EE Cost: 3.2%
Payback Period: < 3years
IRR: 34% (based on 7year Lease Term)

GBI **Platinum**

Green Mark **Platinum**



1/3 of usual energy consumption!

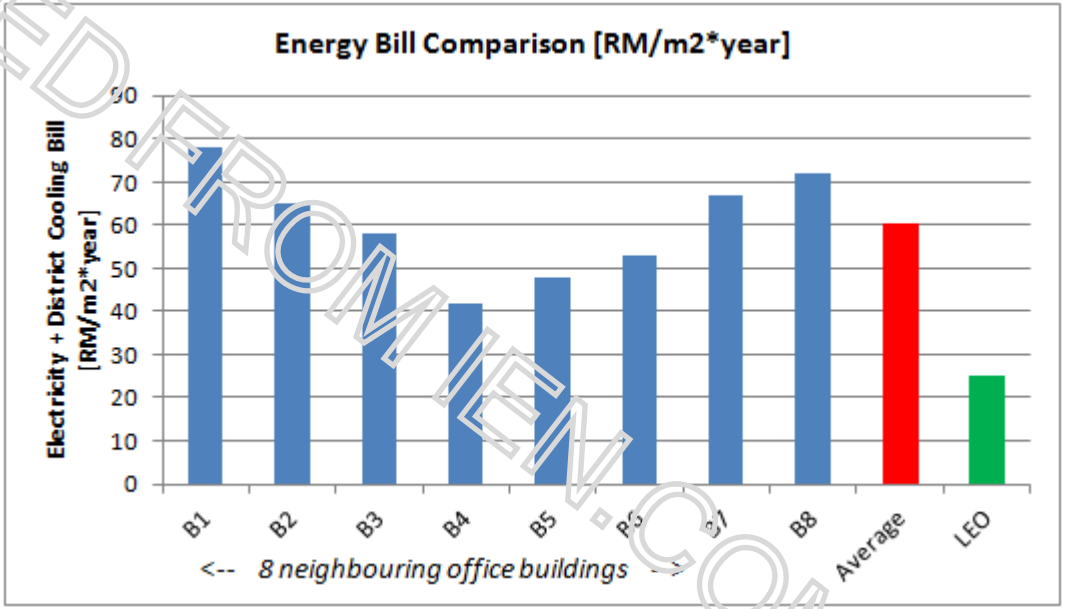
Misconception 1 - Going Green is not Cheap

Proven! Low Energy Office- 5 years payback.

Key Data

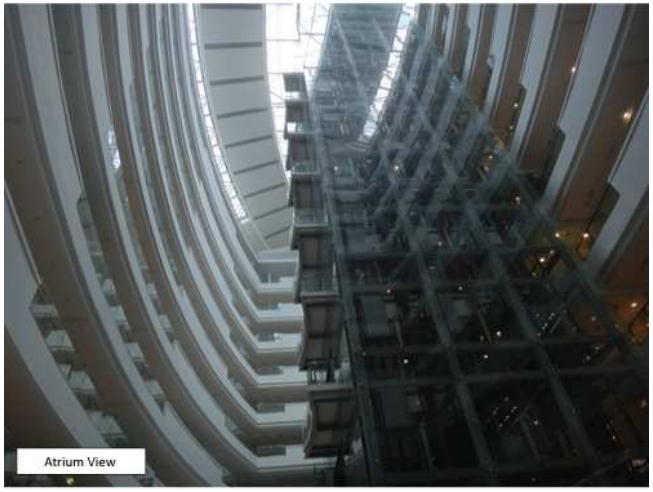
Gross Floor Are: 20,000sqm
Year of Completion: 2004
Building Energy Intensity: 114kWh/m2*year
Additional EE Cost: 5%
Payback Period: 5years
IRR: 23% (based on 10year Lease Term)

GBI Silver



Misconception 1 - Going Green is not Cheap

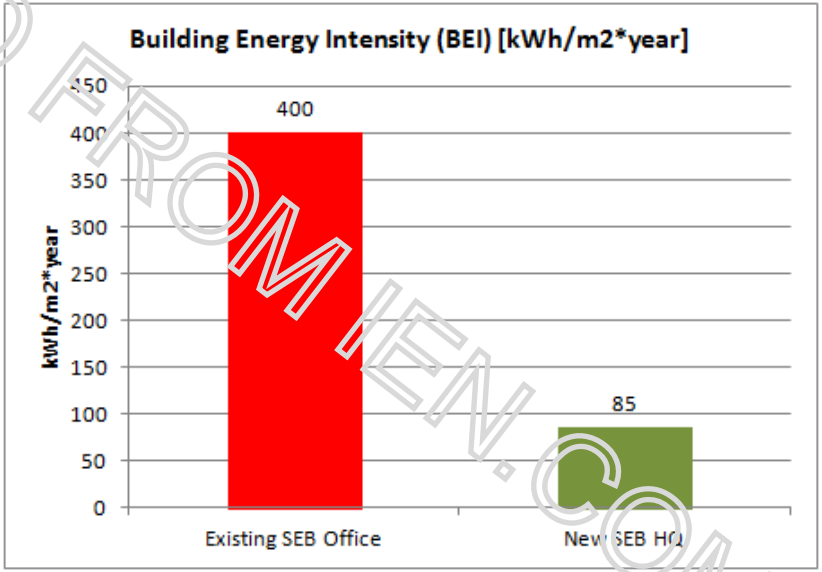
Proven! Sarawak Energy Building– 5 years payback.



Key Data

Gross Floor Are: 40,000sqm
Year of Completion: 2012
Building Energy Intensity: 85kWh/m2*year
Additional EE Cost: 5%
Payback Period: <5 years
IRR: 22% (based on 10year Lease Term)

GBI Certified



Misconception 1 - Going Green is not Cheap

Strategies to optimize building energy consumption

Buildings are Like a Leaky Bucket

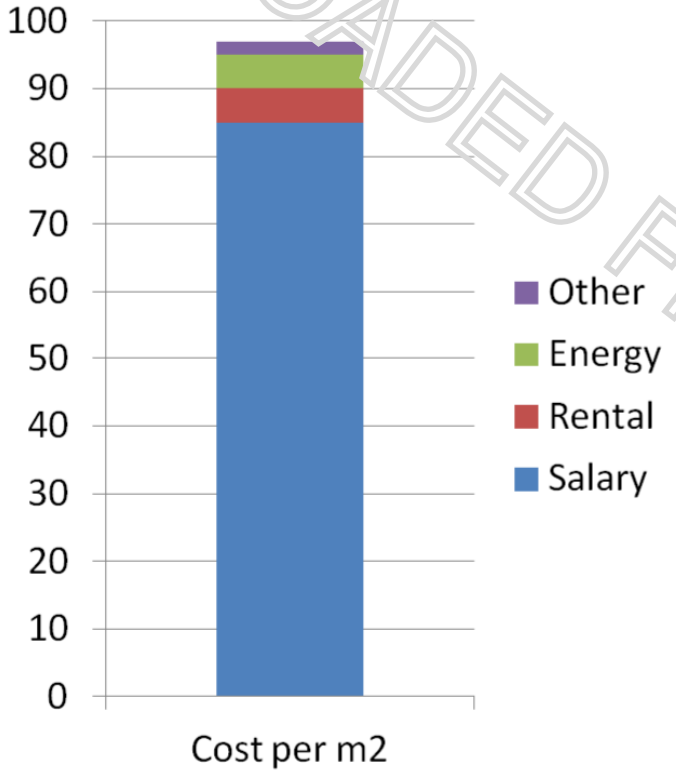
with lots of unnecessary wastages

Plug the holes, and you are well on the way to a green inexpensive buildings that people appreciate to use

Misconception 1 - Going Green is not Cheap

Intangible cost is often overlooked...

Operational Costs of a Building



Studies have proven that a **good indoor environment** leads to:

- Less sick leave
- Higher well-being
- More productive employees
- Students score higher on exams
- Shops have higher sales
- Hospitals can discharge patients faster

Misconception 1 - Going Green is not Cheap

Malaysia

- 5% extra construction cost
- 50% reduction in energy use
- 60% reduction in water use
- 5 year payback

Source:
IEN Consultants, 2010

United States

- 2-7% extra construction cost
- 64% higher sales price
- 36% higher rental rates
- 5% higher occupancy rates

Source:
US National Study, EnergyStar and LEED buildings, 2008

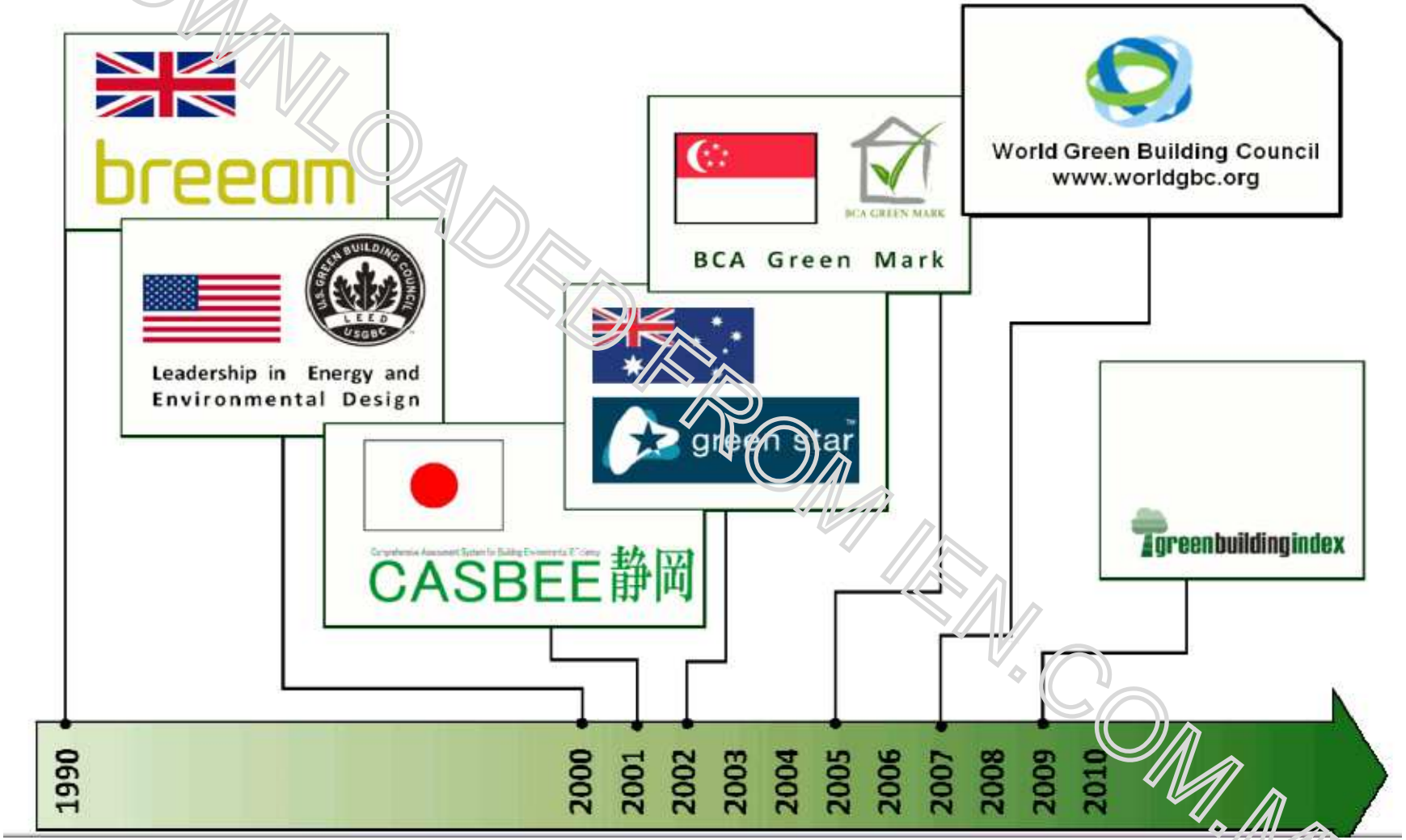
CONCLUSION – EXPENSIVE TO NOT GO GREEN

Misconception 2

Green Building is just another “fashion” in the built environment design trend?

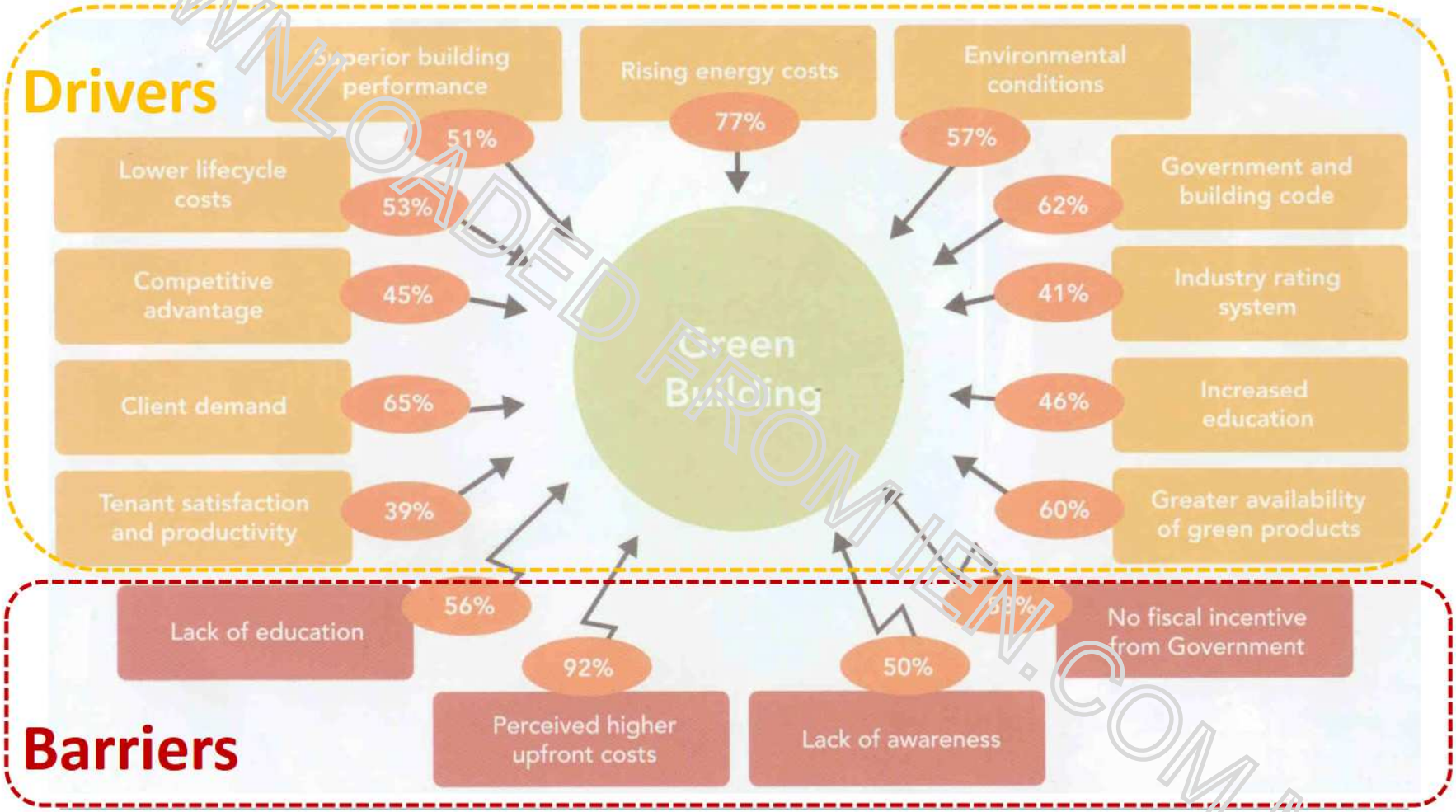
Misconception 2 -Green Building is just another "fashion" in the built environment design trend?

Green building movement started since 1990..



Misconception 2 -Green Building is just another "fashion" in the built environment design trend?

Green building – Drivers & Barrier



Misconception 2 -Green Building is just another "fashion" in the built environment design trend?

Increasing competition of green building certifications locally

5 current existing green building rating tools in Malaysia

GBI
By Industry Professionals

LEED
By USGBC

GreenMark
By BCA (Singapore Government)

GREENRE
By REHDA

MyCREST
By CIDB (Government)

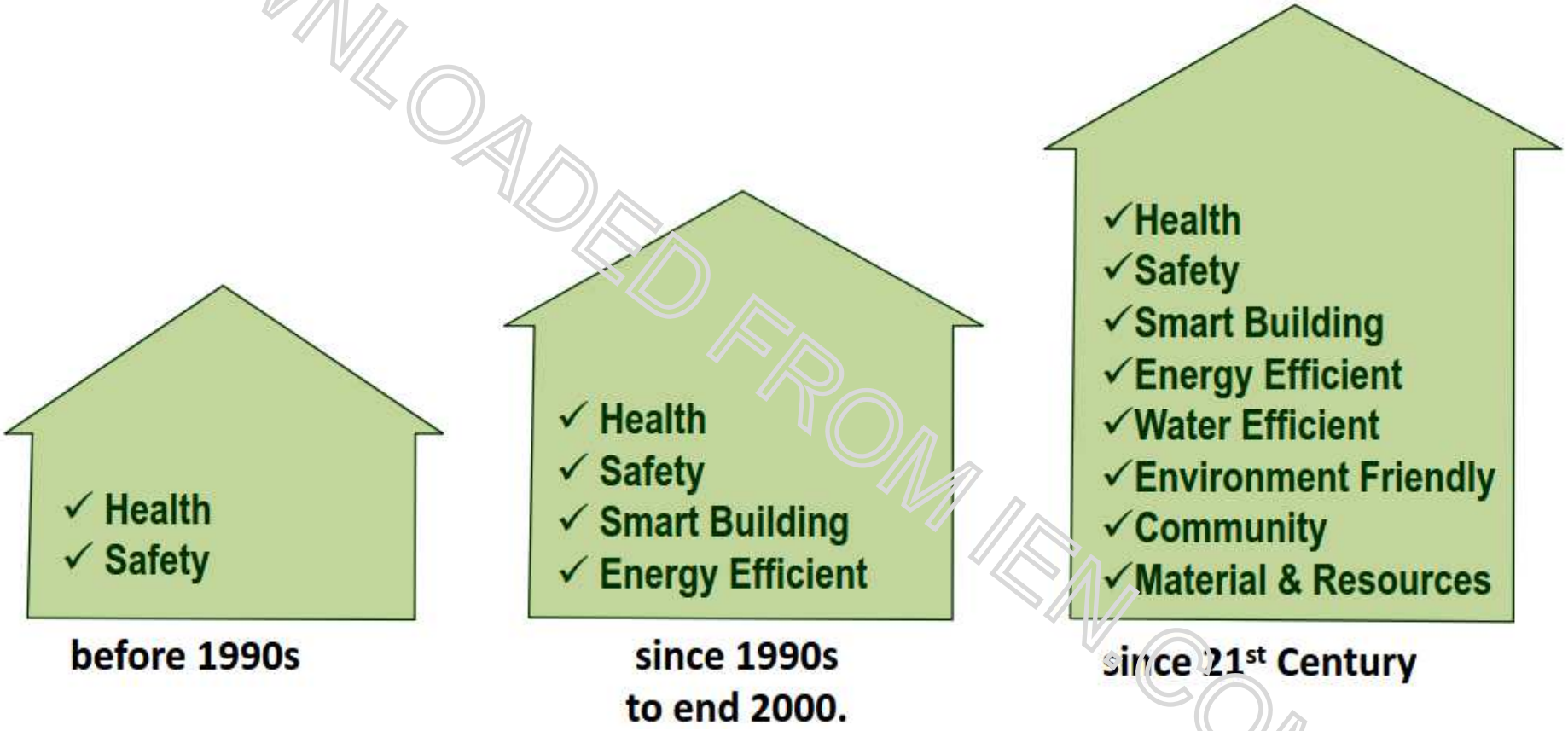
Conclusion – The Green Building wave is here to stay, in the pursuit to mandate energy efficient guidelines such as MS1525.

Misconception 3

Green Building is just about the "Saving the Environment"?

Misconception 3 -Green Building is just about the "Saving the Environment"?

How are buildings rated for 'sustainability'?

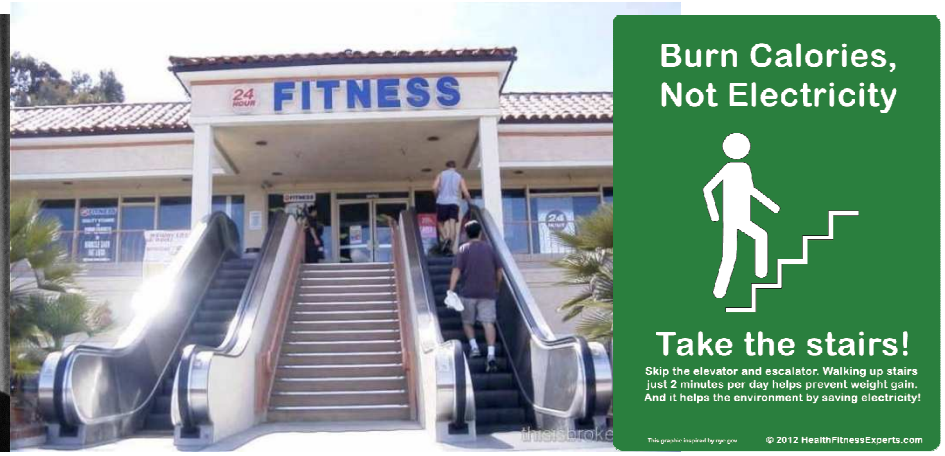


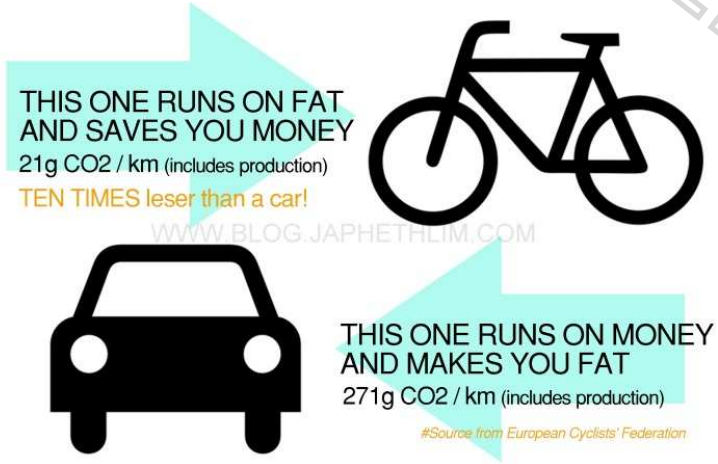
Misconception 3 -Green Building is just about the "Saving the Environment"?

Green building tools reward holistically

LEED (USA) 1996		GREEN MARK (SINGAPORE) 2005		GREEN BUILDING INDEX (MALAYSIA) Launch May 2009	
1) Sustainable Site 2) Water Efficiency 3) Energy & Atmosphere 4) Material & Resources 5) Indoor Environmental Quality 6) Innovation & Design / Construction Process		1) Energy Efficiency 2) Water Efficiency 3) Indoor Environmental Quality 4) Environmental Protection 5) Other Green Features		1) Energy Efficiency 2) Water Efficiency 3) Indoor Environmental Quality 4) Sustainable Site & Management 5) Materials & Resources 6) Innovation	
Platinum	45 - 61	Platinum	90 - 100	Platinum	86 +
Gold	34 - 44	Gold Plus	85 - 89	Gold	76 - 85
Silver	28 - 33	Gold	75 - 84	Silver	66 - 75
Certified	23 - 27	Certified	50 - 74	Certified	50 - 65

Misconception 3 -Green Building is just about the "Saving the Environment"?





CONCLUSION – GREEN BUILDING DESIGN ALSO FOCUSES ON PRODUCTIVITY AND WELL BEING OF THE OCCUPANTS.

Misconception 4

Green Building is just about the
Green Design of the building/project?

Misconception 4 - Green Building is just about the Green Design of the building/project?

The determining factors of a successful green building project:

1. Design technicalities (least barrier)
2. Green Cost
3. Opportunity Cost (Space commercial value)
4. Co-operation of design team and client
5. Communication strategy to ensure all design team and contractors participate the aspiration
6. Consideration of end user's work culture
7. Commissioning ensure all components in placed
8. Post occupancy survey

Conclusion – Green Building success lies within communication from various stakeholders on the green strategy

Misconception 5

Going Green "dictates" the design of the project?

CONCLUSION – GOING GREEN HOLISTICALLY IMPROVISE THE DESIGN OF THE PROJECT IN RESPECT TO THE PROBLEM SOLVING SKILL OF THE DESIGN TEAM

5 Misconceptions / Myths about green building designs

Misconception 1 - Going Green is not Cheap?
CONCLUSION – Expensive to Not Go Green.

Misconception 2 - Green Building is just another "fashion" in the built environment design trend?
CONCLUSION – The Green Building wave is here to stay, in the pursuit to mandate energy efficient guidelines such as MS1525.

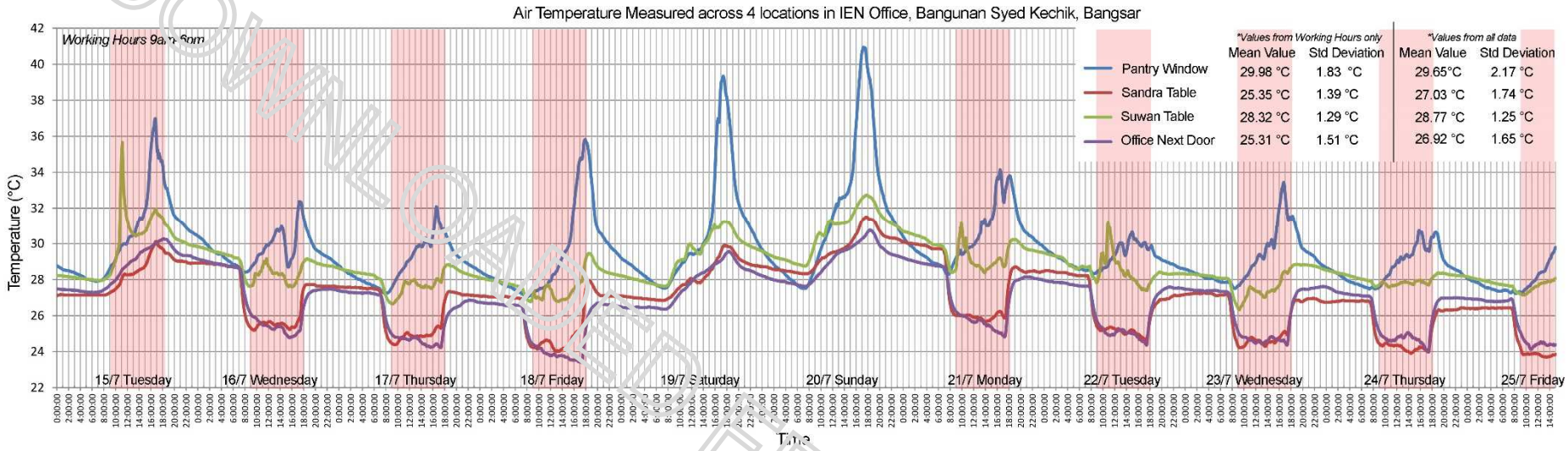
Misconception 3 - Green Building is just about the "Saving the Environment"?
CONCLUSION – Green Building design also focuses on productivity and well being of the occupants.

Misconception 4 - Green Building is just about the Green Design of the building/project?
CONCLUSION – Green Building success lies within communication from various stakeholders on the green strategy

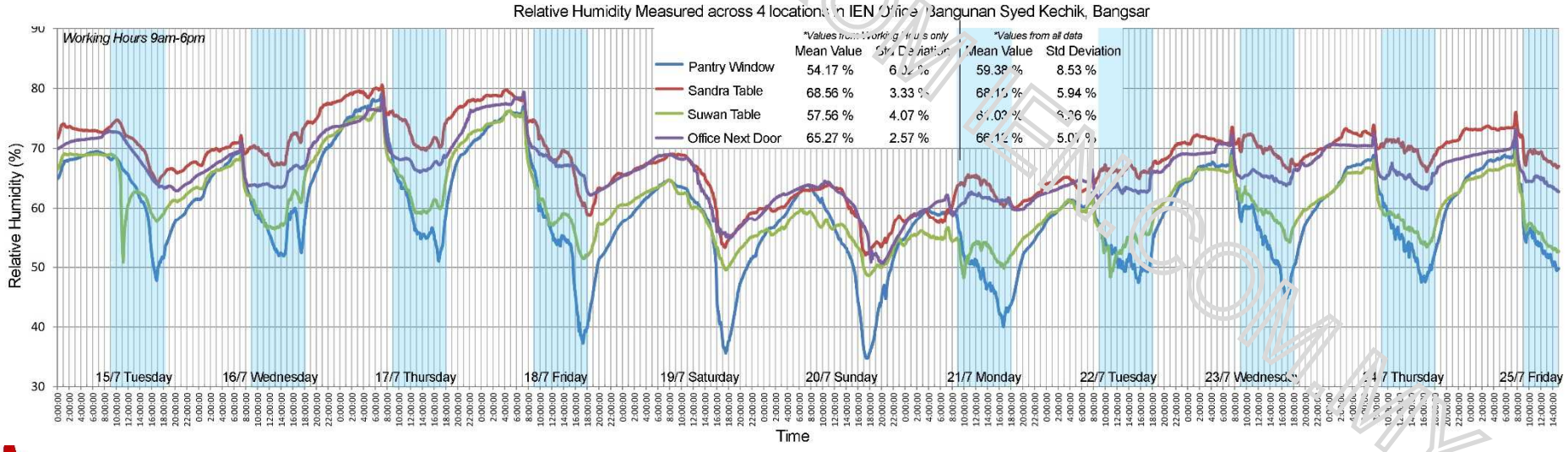
Misconception 5 - Going Green "dictates" the design of the project?
CONCLUSION – Going Green holistically improvise the design of the project in respect to the problem solving skill of the design team.

Designing with Building Science

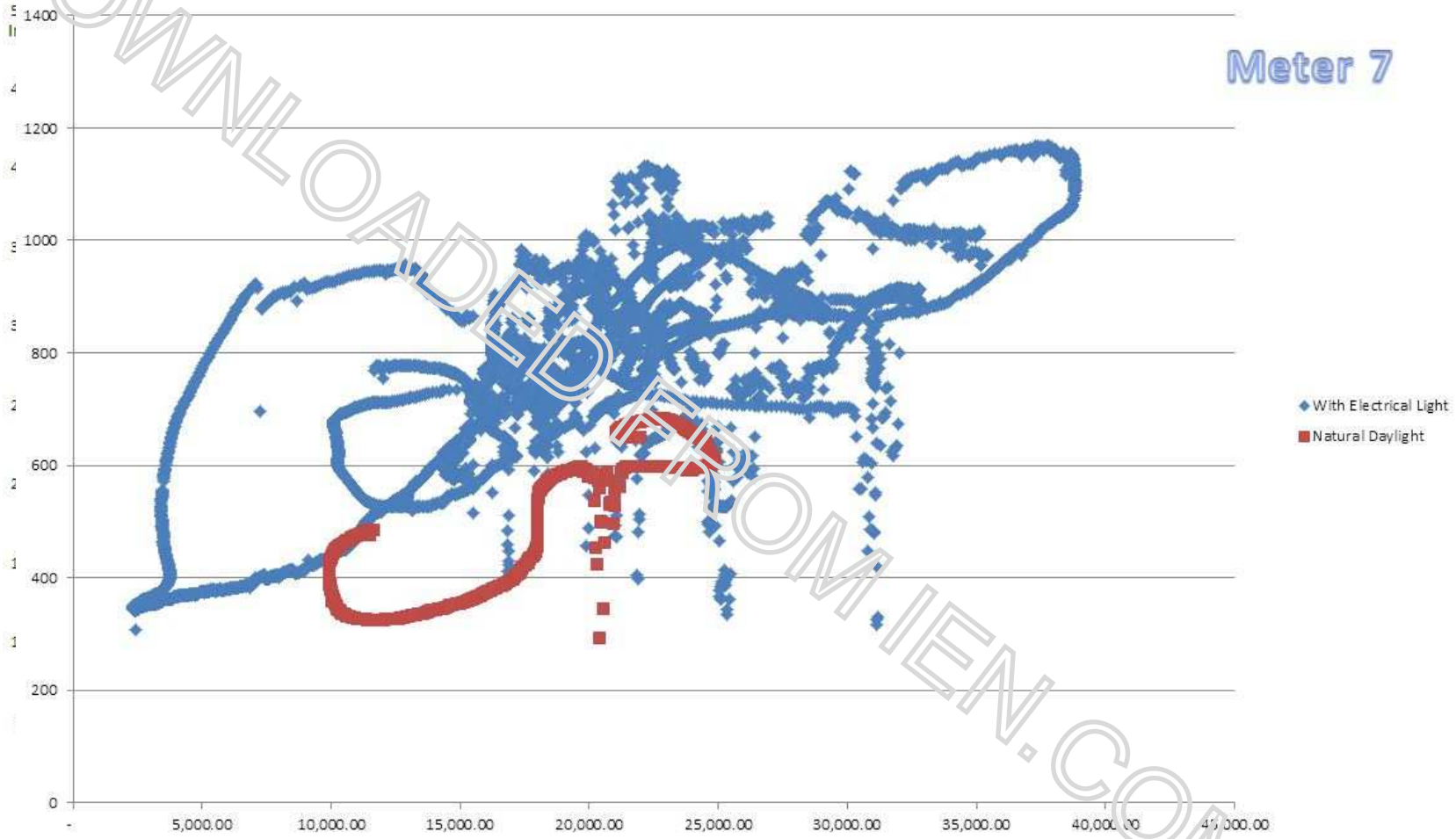
Don't just design qualititatively but argue quantitatively!



MS1525 recommended Indoor Air Temp 24-26, RH <65%



DON'T JUST DESIGN QUALITITATIVELY BUT ARGUE QUANTITATIVELY!



MS1525 recommended work plane lux level 400

Be innovative in simple passive design strategy!

1st office in the tropics with daylight trough – Menara Mustapha Kamal

Be innovative in simple passive design strategy!

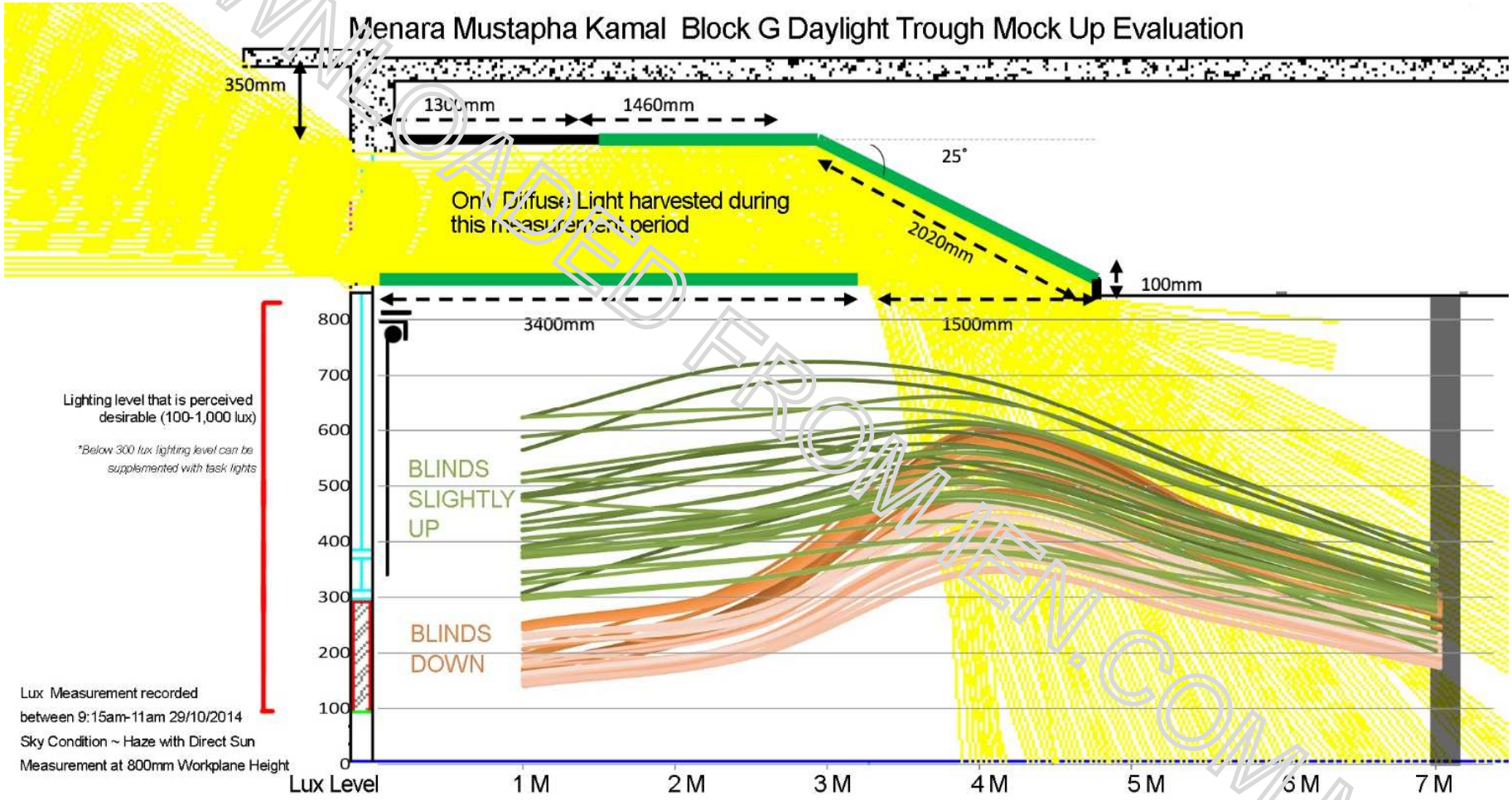
1st office in the tropics with daylight trough – Menara Mustapha Kamal

Be innovative in simple passive design strategy!

1st office in the tropics with daylight trough – Menara Mustapha Kamal

Be innovative in simple passive design strategy!

1st office in the tropics with daylight trough – Menara Mustapha Kamal



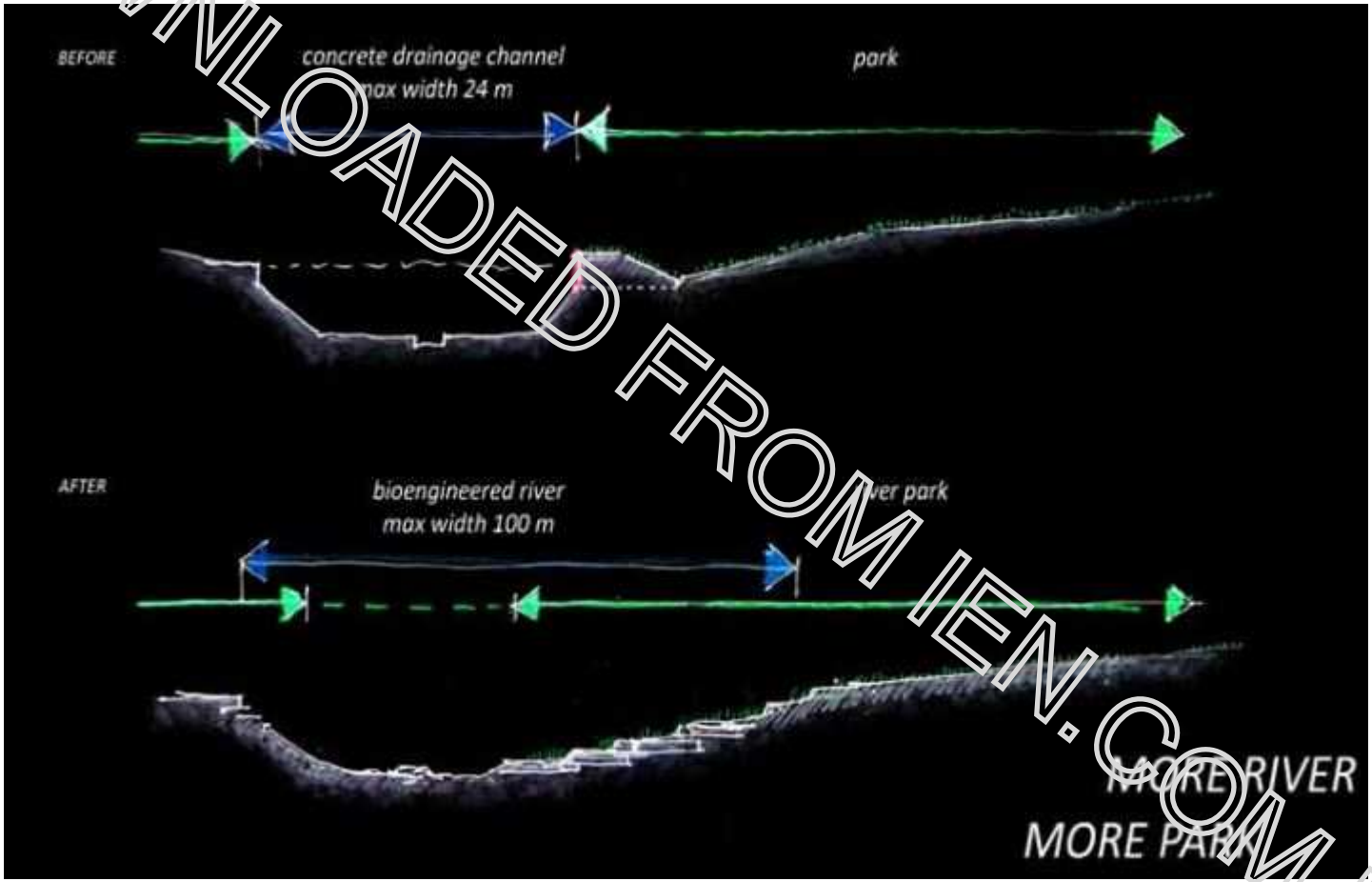
Regenerative Design – as crucial as green strategy

How do you restore local social and environmental infrastructure / support system?

Bishan – Ang Mo Kio Park (Singapore)

Regenerative Design – as crucial as green strategy

Bishan – Ang Mo Kio Park (Singapore) – Redefining stormwater channel



Regenerative Design – as crucial as green strategy

Bishan – Ang Mo Kio Park (Singapore) – Redefining stormwater channel

Regenerative Design – as crucial as green strategy

Bishan – Ang Mo Kio Park (Singapore) – Redefining stormwater channel

Regenerative Design – as crucial as green strategy

Bishan – Ang Mo Kio Park (Singapore) – Redefining stormwater channel

Regenerative Design – as crucial as green strategy

Promoting Biophilic Design - Agritecture Design - Urban Farm at Pasona Tokyo Headquarters

Regenerative Design – as crucial as green strategy

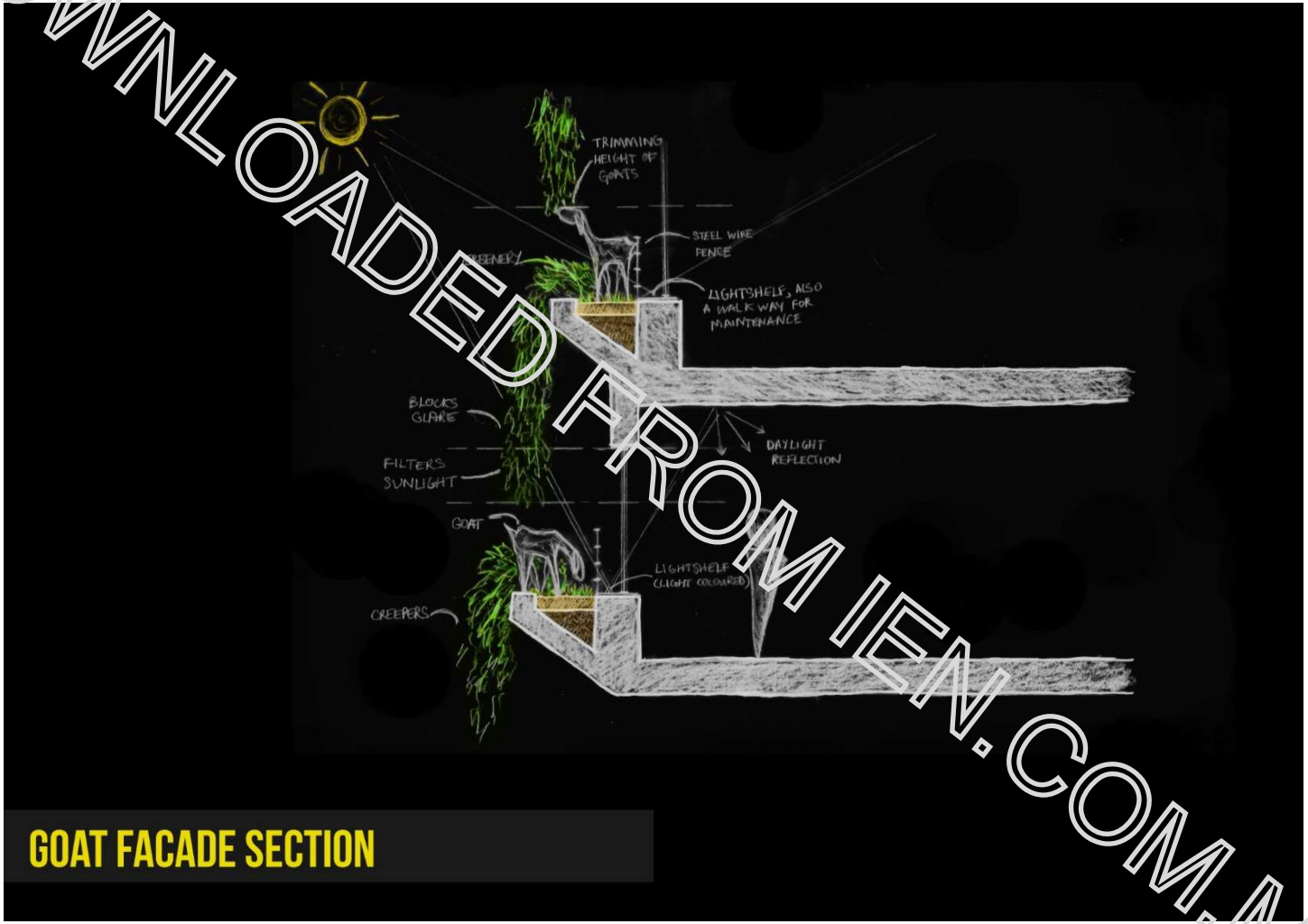
Promoting Biophilic Design - Agritecture Design - Urban Farm at Pasona Tokyo Headquarters

Regenerative Design – as crucial as green strategy

Goat Project – Introducing other species into the common space

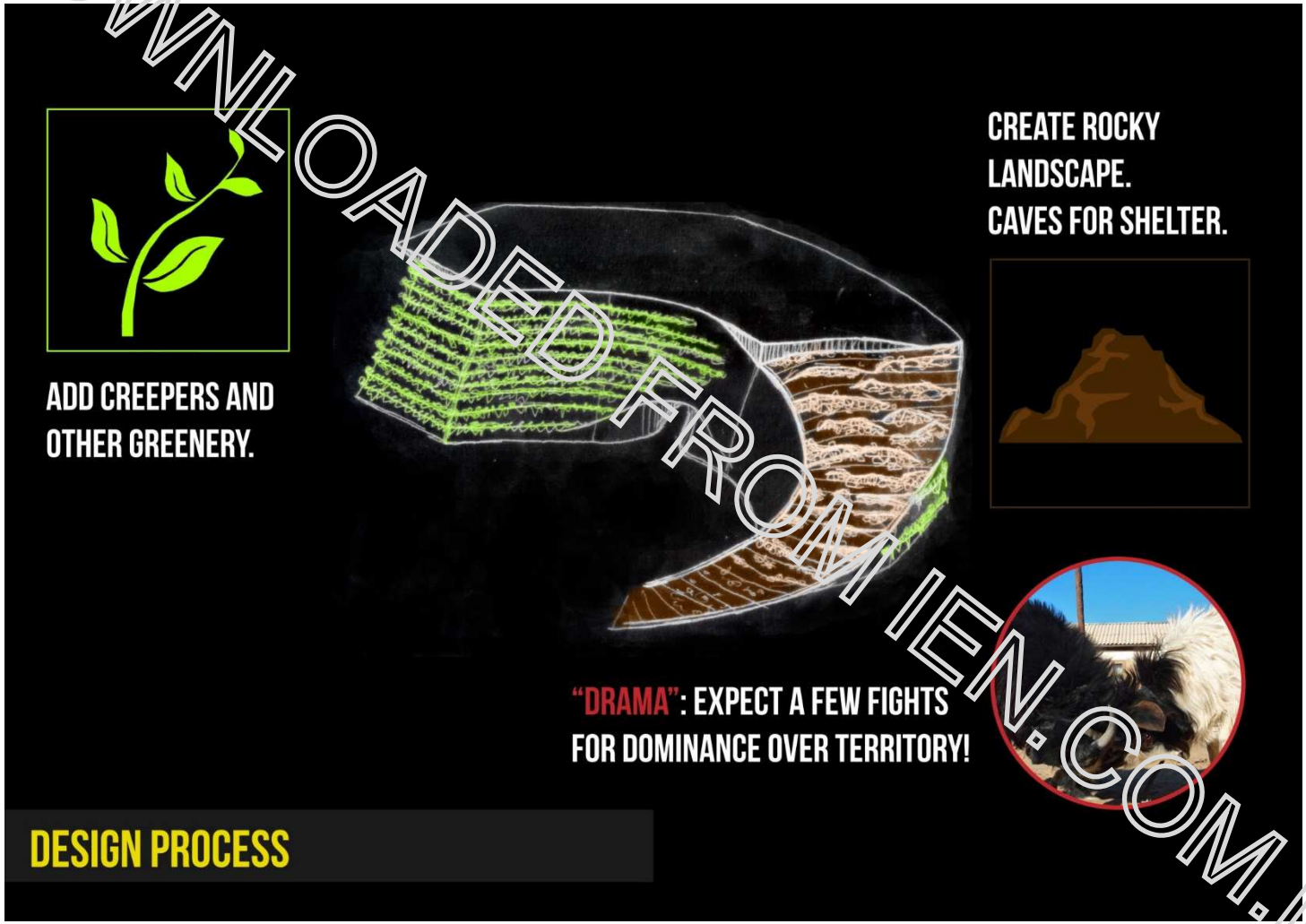
Regenerative Design – as crucial as green strategy

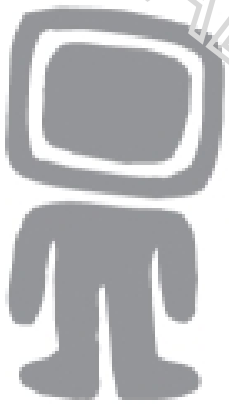
Goat Project – Introducing other species into the common space



Regenerative Design – as crucial as green strategy

Goat Project – Introducing other species into the common space





THANK YOU!

Contact me @ geneharn@ien.com.my
Presentation Slide can be downloaded at....
http://ien.com.my/news.html