Nearly Zero Energy Building (nZEB) in Malaysia

STEVE ANTHONY LOJUNTIN
SUSTAINABLE ENERGY DEVELOPMENT AUTHORITY (SEDA MALAYSIA)
steve@seda.gov.my / asetip@damansara.net

INTRODUCTION

- Nearly Zero Energy Building (nZEB) is an advance Low Carbon Building initiatives.
- It is a one step ahead to facilitate towards achieving Net Zero Building (NZEB) or Carbon Neutral Building (operational carbon).
- Focus mainly to building element that have direct impact on carbon reduction which is sustainable energy (EE & RE).
- Focus on basic, practical & viable elements in sustainable building (quantitative – measurable, recordable and reportable).
- Global race on nZEB in Europe and Japan (by 2020 – 2030).
- Attempt for nZEB / ZEB has been started in Malaysia since 2002.

GLOBAL PROBLEM - CLIMATE CHANGE, GHG

PROBLEM!

CLIMATE CHANGE IS THE PROBLEM [MAINLY CAUSED BY GREEN HOUSE GASES (GHG)]

GHG : Carbon dioxide, Methane, NOx, SOx, CFC, etc

SOLUTION!

GREEN TECHNOLOGY AND GREEN LIVING IS THE SOLUTION

"CO2 is the most important anthropogenic of GHG and the main sources of atmospheric CO2 is from burning of fossil fuels – 75% of increase in atmospheric CO2 since industrial times *(Source: Cities and Climate Change – Global Report on Human Settlements 2011, UN-Habitat).*

LOW CARBON DEVELOPMENT IN MALAYSIA

2009 : COP 15 in Copenhagen

Speech by Datuk Seri Najib Tun Razak, Prime Minister

"...Malaysia is adopting an indicator of a voluntary reduction of up to 40% in terms of emissions intensity of GDP by the year 2020 compared to 2005 levels."

17 December 2009

2016 : COP 21 in Paris

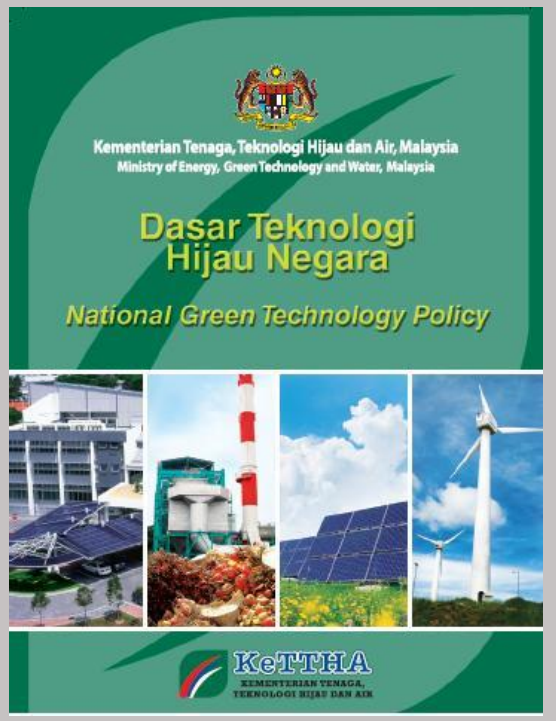
"... Malaysia intends to reduce its greenhouse gas (GHG) emissions intensity of GDP by 45% by 2030 relative to the emissions intensity of GDP in 2005."

- Malaysia ratified the Paris Agreement on 16 November 2016

2010 : Green Technology Policy (to support green and low carbon development)

Green technology is the development and application of products, equipment, and systems used to conserve the natural environment and resources, which minimises and reduces the negative impact of human activities

- Minimises the degradation of the environment.
- It has zero or low green house (GHG) emission.
- It safe for use and promotes healthy and improved environment for all forms of life
- It conserves the uses of energy and natural resources; and
- It promotes the use of renewable resources.



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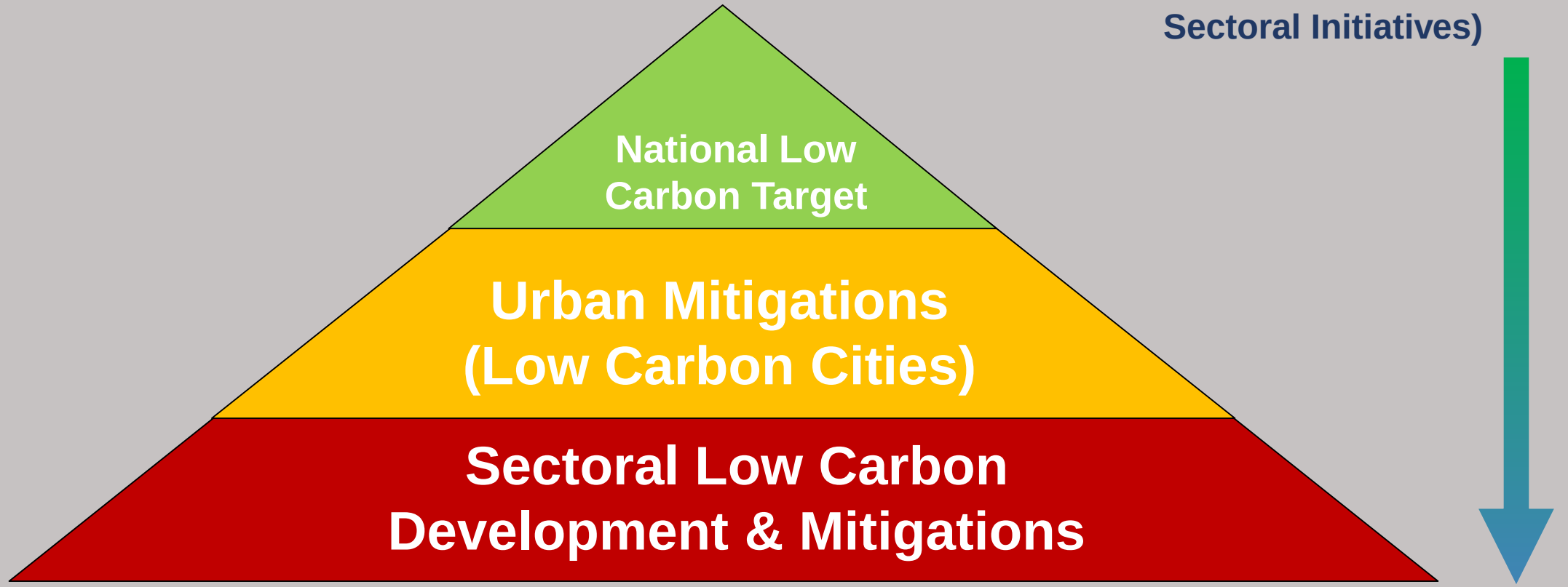
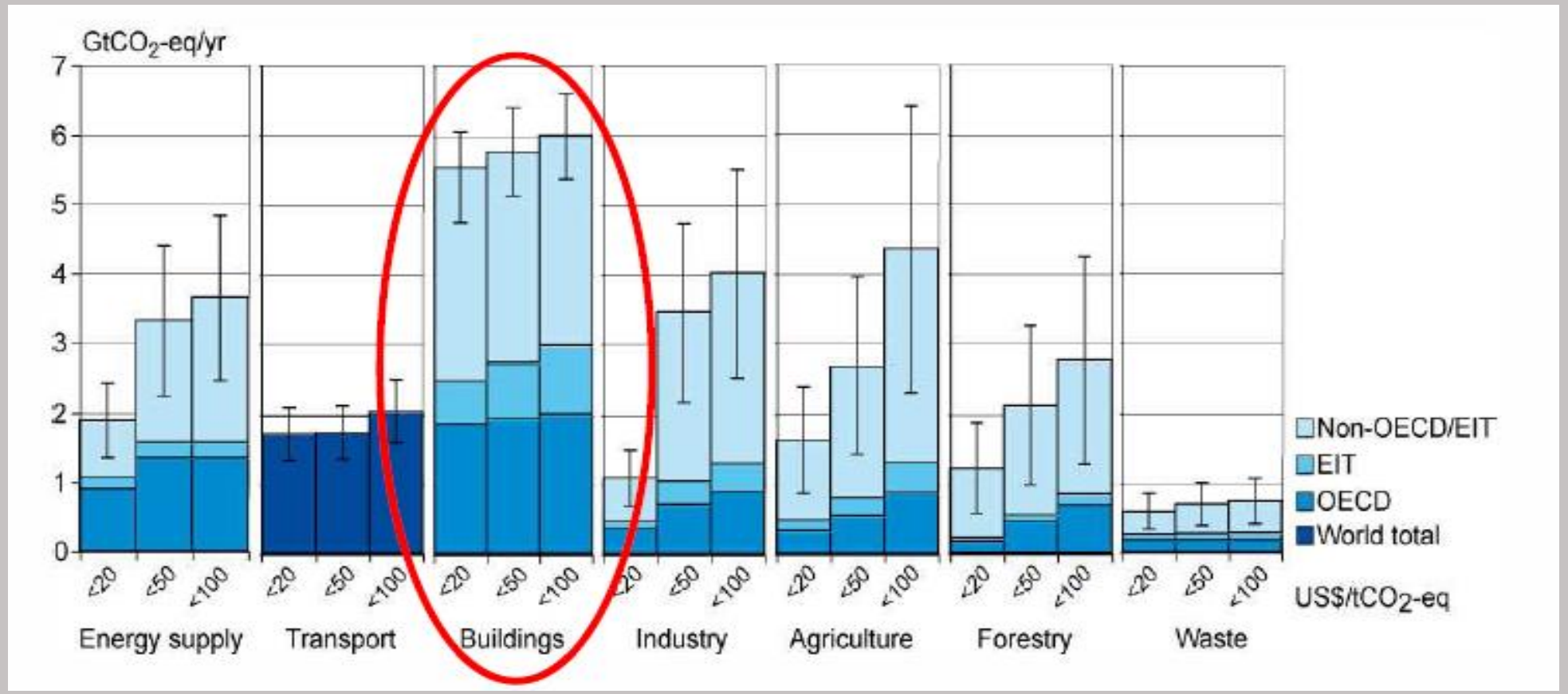
CLIMATE CHANGE MITIGATIONS – LOW CARBON PROGRAM

From National Initiatives down to Sectoral Initiatives)



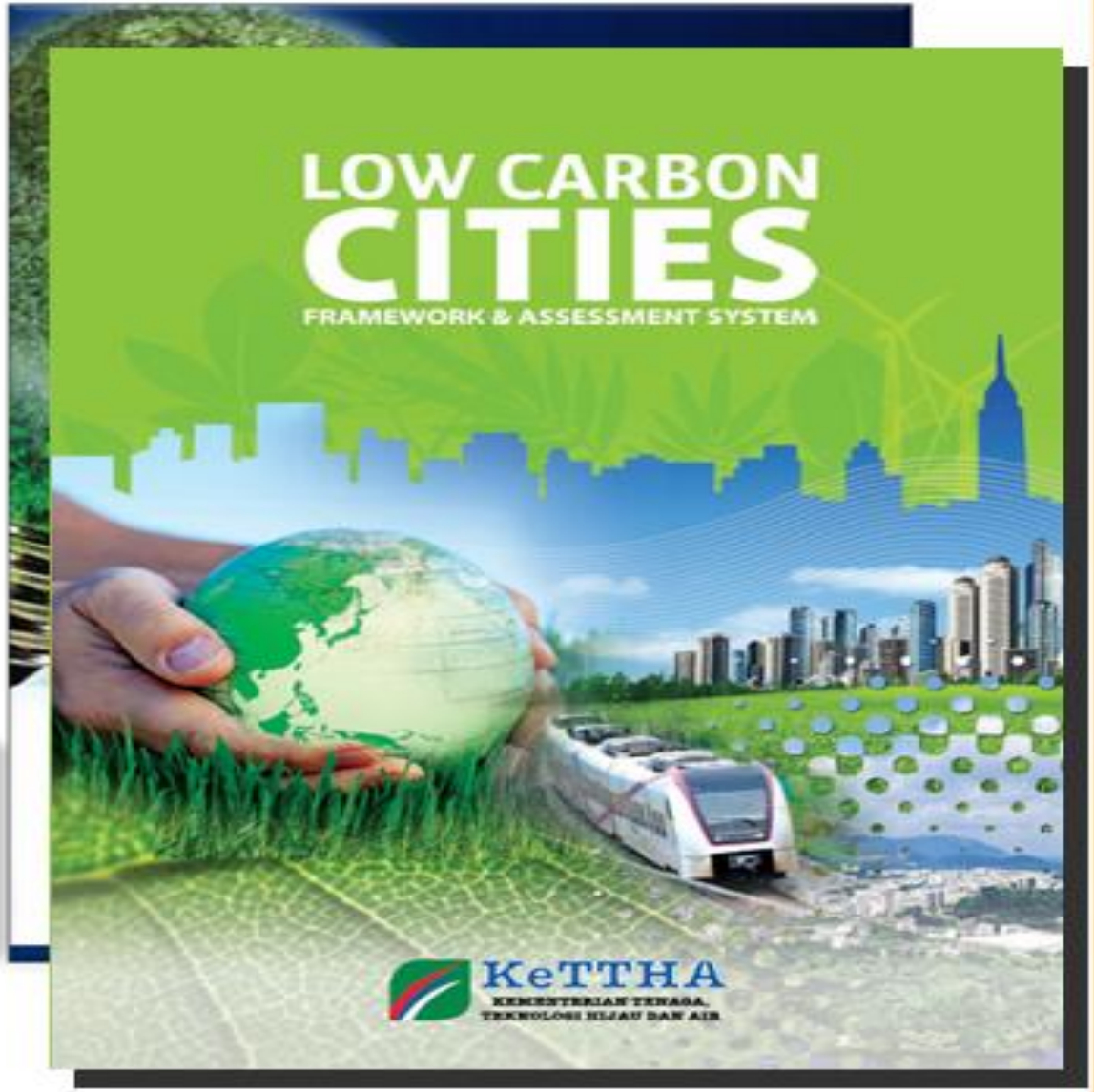
FACT : CHANCES TO REDUCE CARBON EMSISSIONS (report by IPCC)



Building sector has the higher chances to reduce carbon emission in a township *** Quick wins to reduce carbon emissions !!**

Low Carbon Cities Framework & Assessment System
- Use of Document

This document is to *assist local authorities, township developers, designers and individuals* in assessing whether developments carried out within the city contributes towards the reduction or decrease in GHG.



Was Launched in Sept 2011 by YAB Prime Minister

LCCF
PERFORMANCE CRITERIA
Base on Carbon Footprint

4 Elements for GHG Reductions in Cities and Townships

Urban Environment

- Site Selection
- Urban Form
- Urban Greenery & Air Quality

Urban Transportation

- Shift of Transport Mode
- Green Transport Infrastructure
- Green Vehicles
- Traffic Management

Urban Infrastructure

- Infrastructure Provision
- Waste
- Energy
- Water

Buildings

- Low Carbon Building
- Community Service

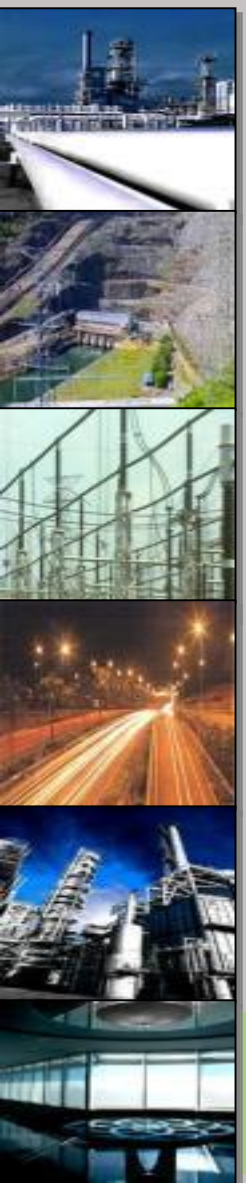
** nZEB = High performance Low Carbon Building

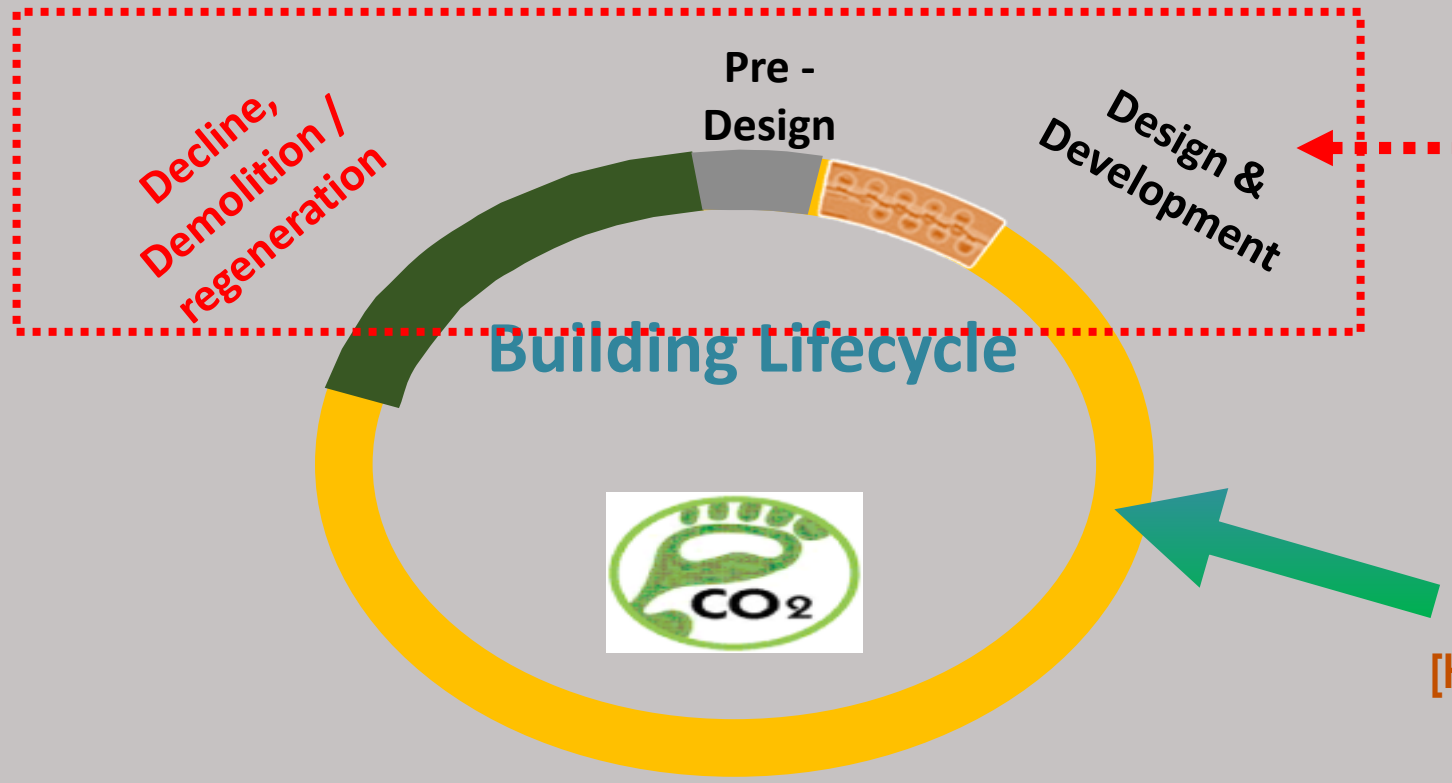
Elements Contribute to GHG emission

13 Performance Criteria*

35 Sub Criteria

IMPORTANT FACT (by UNEP SCBI)
Carbon Emission in a life cycle of a building





During development phase
[Embodied CO2 footprint]
~ 20%

Operation Phase : Use, Management & Maintenance
[Higher Operational CO2 footprint]
From Energy Usage !!
80%

Next Step: After Energy Efficiency then Use Renewable Energy to off-set further the CO2 emission in building

FACT! Most of the CO2e emission is during the operation phase !!
ENERGY MANAGEMENT to tackle the source of the CO2 emission

RELATION BETWEEN USE OF ENERGY AND THE ENVIRONMENT

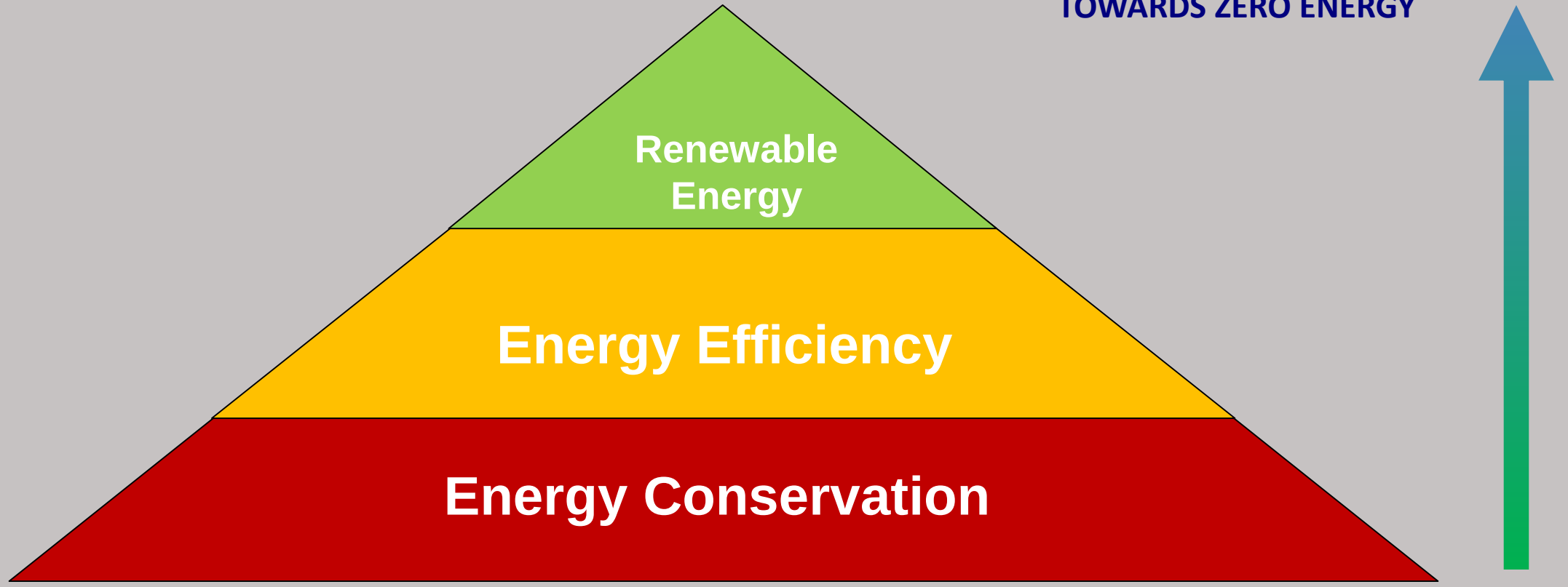
0.741 kg of CO2 emitted to the atmosphere for each 1 kWh electricity generated by power plant (Peninsula Malaysia)

Kawasan	2011
Semenanjung Malaysia	0.747 kg CO2 / kwj
Sarawak	0.841 kg CO2 / kwj
Sabah	0.531 kg CO2 / kwj

Sumber: Laporan Penanda Aras Clean Development Mechanism (CDM) Malaysia 2011 oleh Malaysian Green Technology Corporation

PRACTICAL APPROACH
to achieve Nearly Zero Energy Building (nZEB)

TOWARDS CARBON NEUTRAL
TOWARDS ZERO ENERGY



SUSTAINABLE ENERGY PYRAMID !!

BASIC PRINCIPAL FOR SUSTAINABLE ENERGY & LOW CARBON PROGRAM

COST OF IMPLEMENTATION (Research by SEDA Malaysia)
(For Low Carbon Building / nZEB / NZEB)

ENERGY MANAGEMENT / ENERGY EFFICIENCY

- **RM0.60 to RM2.00 per kWh reduction**
- **RM 0.80 to RM 2.70 per KgCO2 reduction**

(payback within 3 – 8 years)

** Based on several energy auditing, retrofitting and low carbon buildings at commercial, industries and residential buildings in Malaysia by SEDA Malaysia.*

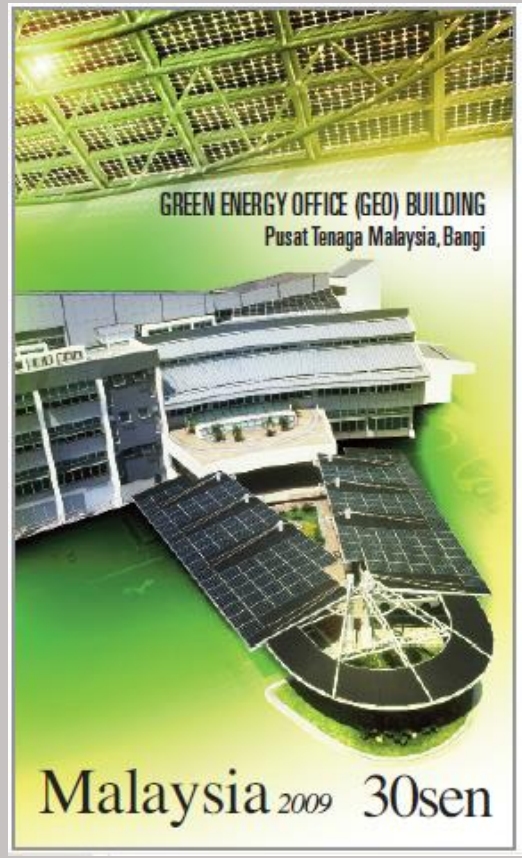
RENERWABLE ENERGY – RE (Solar PV)

- **(RM 6.70 to RM 8.40) per kWh reduction**
- **RM 7.30 to RM 11.20 per KgCO2 reduction**

** Based on installation of solar PV on roof pricing (RM6.5k – 10k/kWp)*

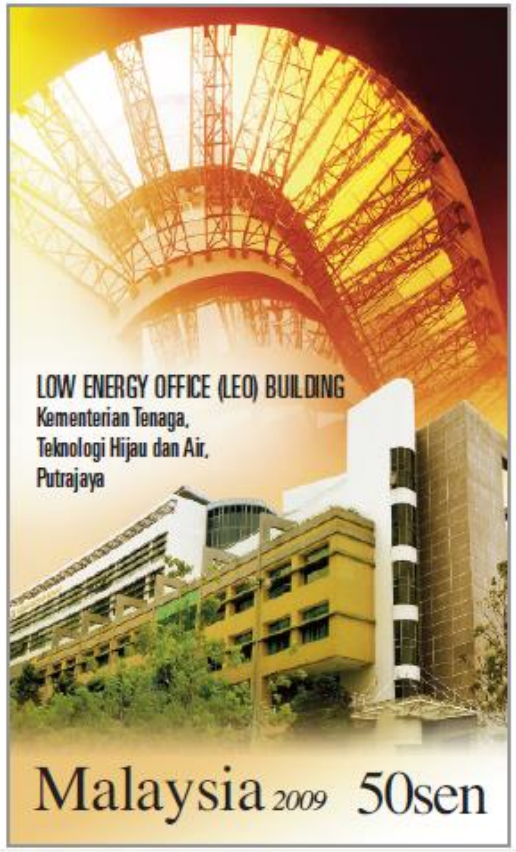
EXAMPLE OF NEARLY ZERO ENERGY BUILDING (nZEB) IN MALAYSIA

2007



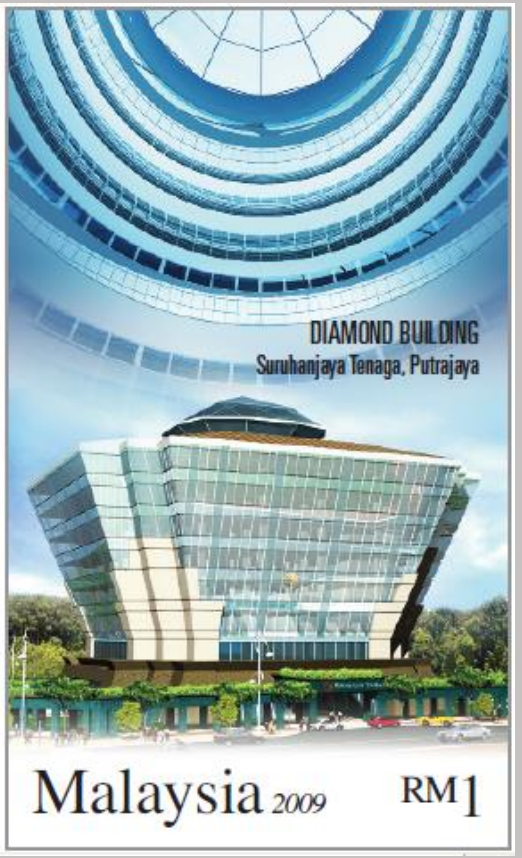
Net BEI = 30 (86% reduce)
65 TonCO2/year
GBI : Certified (2009)
ASEAN EA : 2009/2010/2011

2004



Net BEI = 114 (59% reduce)
1,490 TonCO2/year
GBI : Silver (2011)
ASEAN Energy Award : 2006

2010



Net BEI = 63 (70% reduce)
637 TonCO2/year (**To verify)
GBI & GreenMark : Platinum (2011)
ASEAN EA : 2012

PRACTICAL APPROACH
to achieve Nearly Zero Energy Building (nZEB)

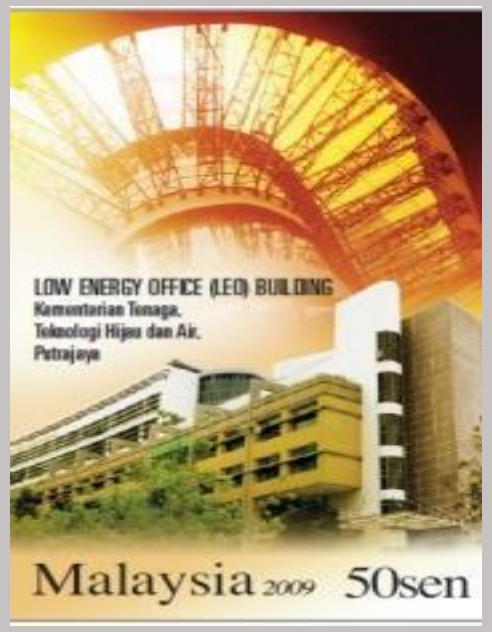
NEW BUILDING DESIGN

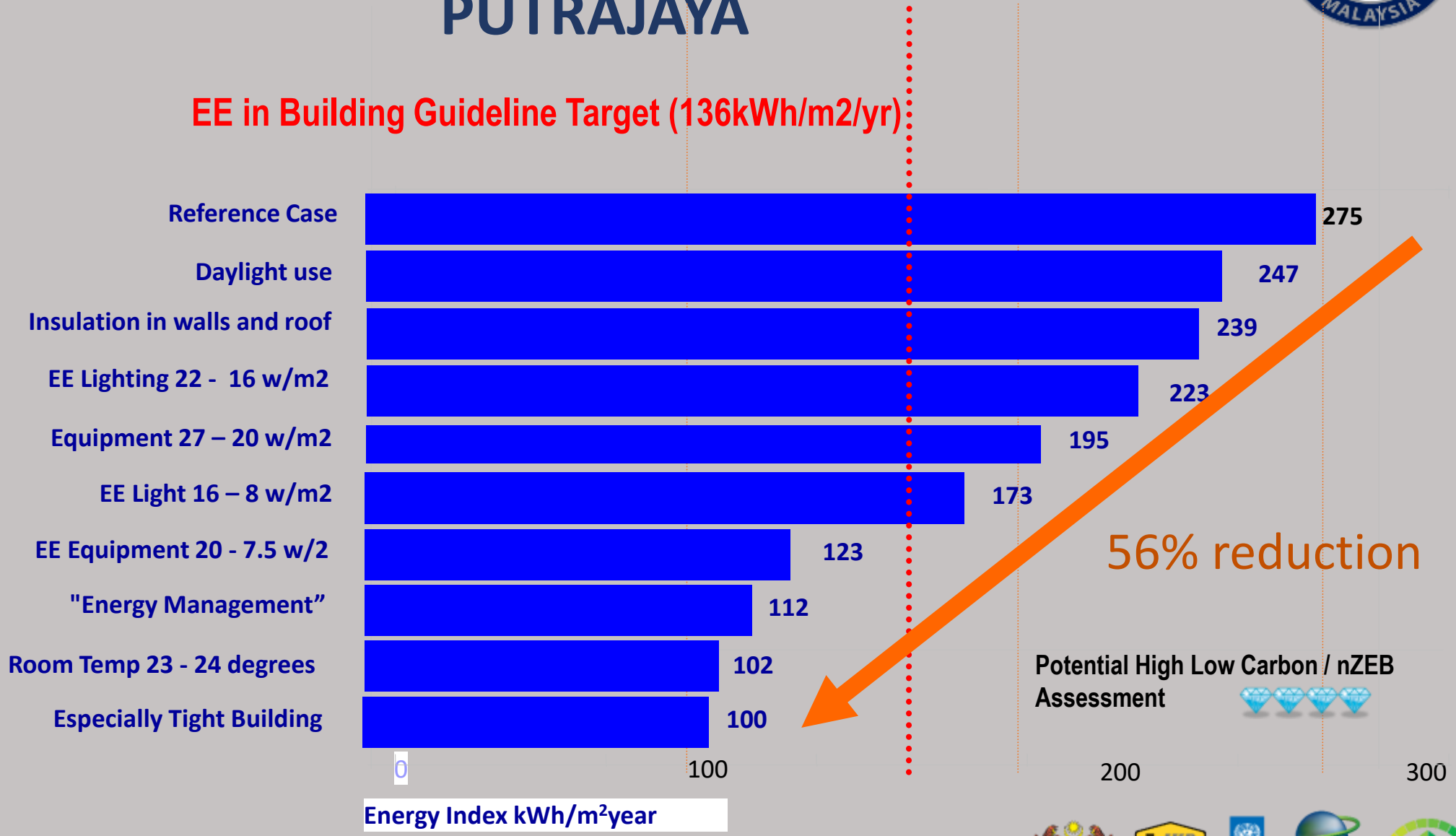
Energy Management Features & The Building Performance

In 2002: KeTTHA's LEO BUILDING IN PUTRAJAYA

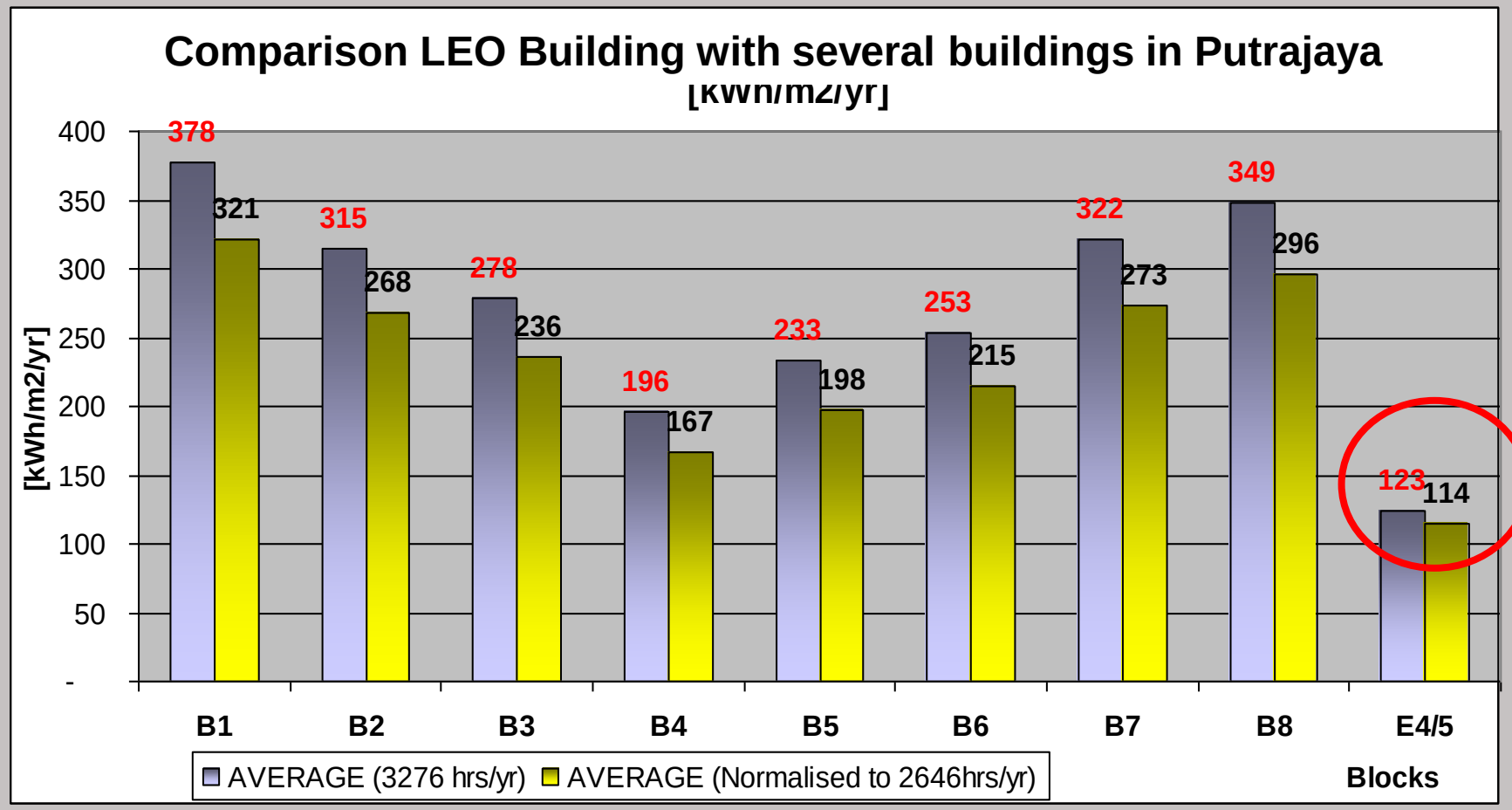
In-house Energy Manager + Operation monitoring team by SEDA

In 2002: KeTTHA's LEO BUILDING IN PUTRAJAYA





In 2002: KeTTHA's LEO BUILDING IN PUTRAJAYA



LEO Building

LEO BEI = 100

(Conventional) BEI = 275

175 kWh/m2year

= 3,366,475 kWh/yr
or more than **RM 800,000 per year**

Tariff C1
28.8 sen/kWh

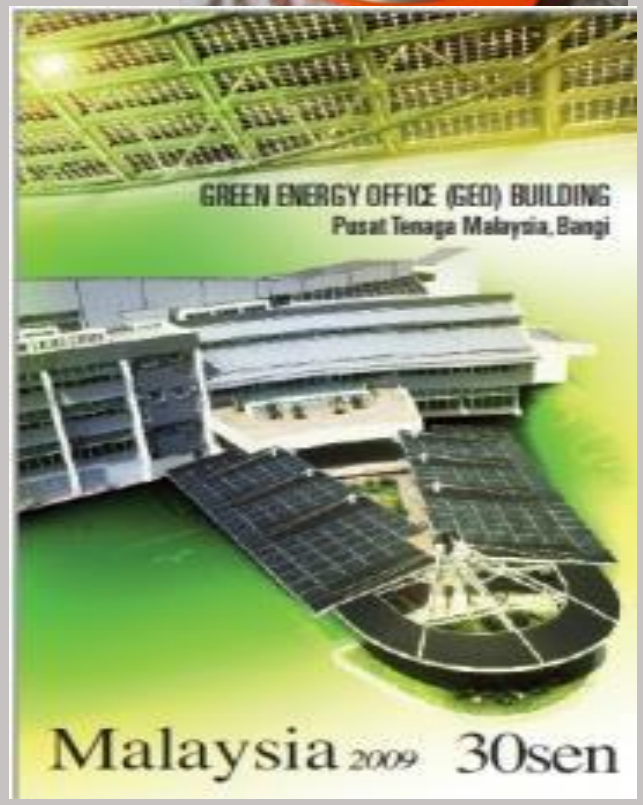
Savings = 56%

= 3,366,475 kWh/yr x 0.614 kg CO2/kwh
= 2,514,757 kg/year CO2
= 2,515 tones CO2/year

Extra cost = 6 % (RM 1.60 / kWh reduction). Payback = 7 years

In 2007: THE GEO BUILDING IN BANGI

- **Daylighting (almost 100%)**
- **EE lighting + task lights**
- **EE office equipment** (laptops, LCD monitors, networked printers)
- **Green IT Network & server room** (75% wireless network)
- **EE air conditioning & ventilation**
- **Floor slab cooling** (For radiant cooling and thermal storage)
- **PCM storage cooling system** (minimised air-cond chillers capacity)
- **Controls & Sensors** (VSDs, VAVs, CO_2, BMS / Energy monitoring)
- **Double glazing** (heat and sound insulation)
- **Roof and wall Insulation** (reduce outside heat gain)
- **Grid connected BIPV system** (Sell energy to TNB / no batteries)
- **Rain water harvest system** (landscape, aircond and cleaning)



In 2007: THE GEO BUILDING IN BANGI

GreenTech GEO Building
(~100% Daylight)

In 2007: THE GEO BUILDING IN BANGI
Energy & CO@ Savings)

GEO BEI = 65

(Conventional) BEI = 220

a/c area 3,175 sq.m

155 kWh/m2year

Savings (EE) = 70%

Net saving with Renewable Energy (EE+RE) = 85%

Potential Low Carbon / nZEB Assessment

Energy saved = 492,125 kWh/yr

or **RM 195,374 per year**

Tariff B *(Low Voltage Commercial Tariff) for all kWh 39.7sen.kWh*

CO_2 saved = 492,125 x 0.614

= 302,165 kg/year CO2

= 302 tones CO2/year

NEAR TO CARBON NEUTRAL BUILDING

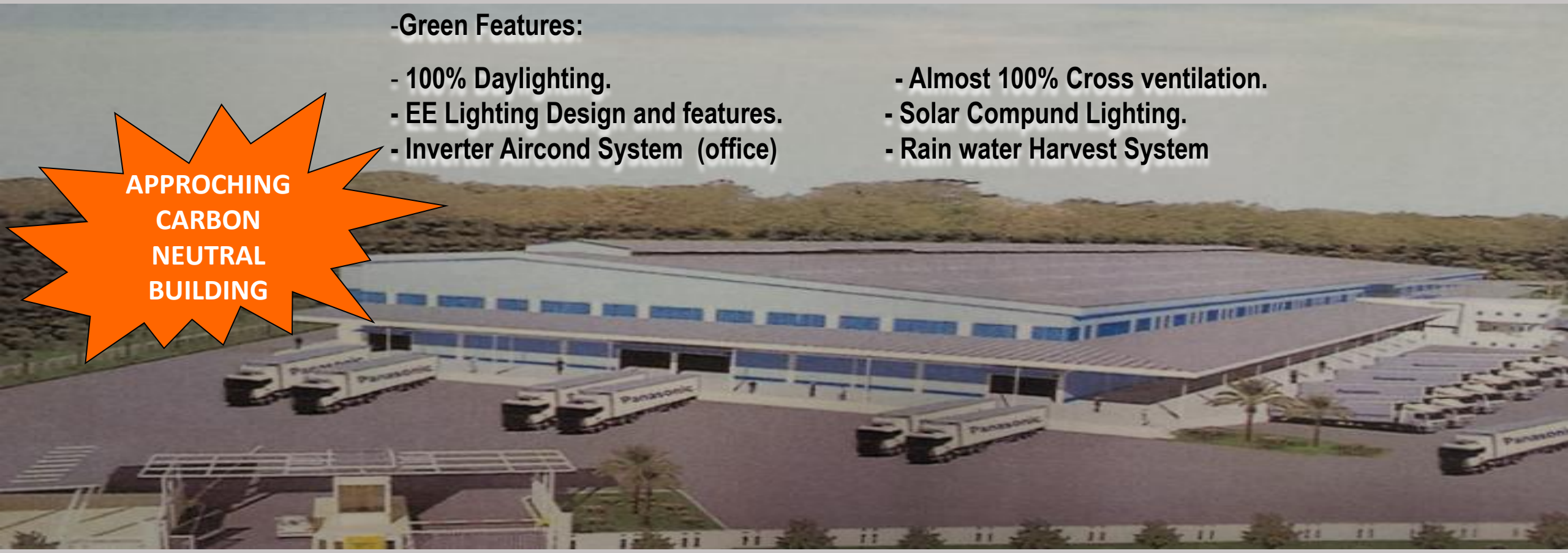
0.614 kg of CO2 emitted to the atmosphere for each 1 kWh electricity generated by power plant (Peninsula Malaysia)

2011 ESB – PANASONIC GREEN WAREHOUSE in SHAH ALAM

-Green Features:

- 100% Daylighting.
- EE Lighting Design and features.
- Inverter Aircond System (office)
- Almost 100% Cross ventilation.
- Solar Compund Lighting.
- Rain water Harvest System

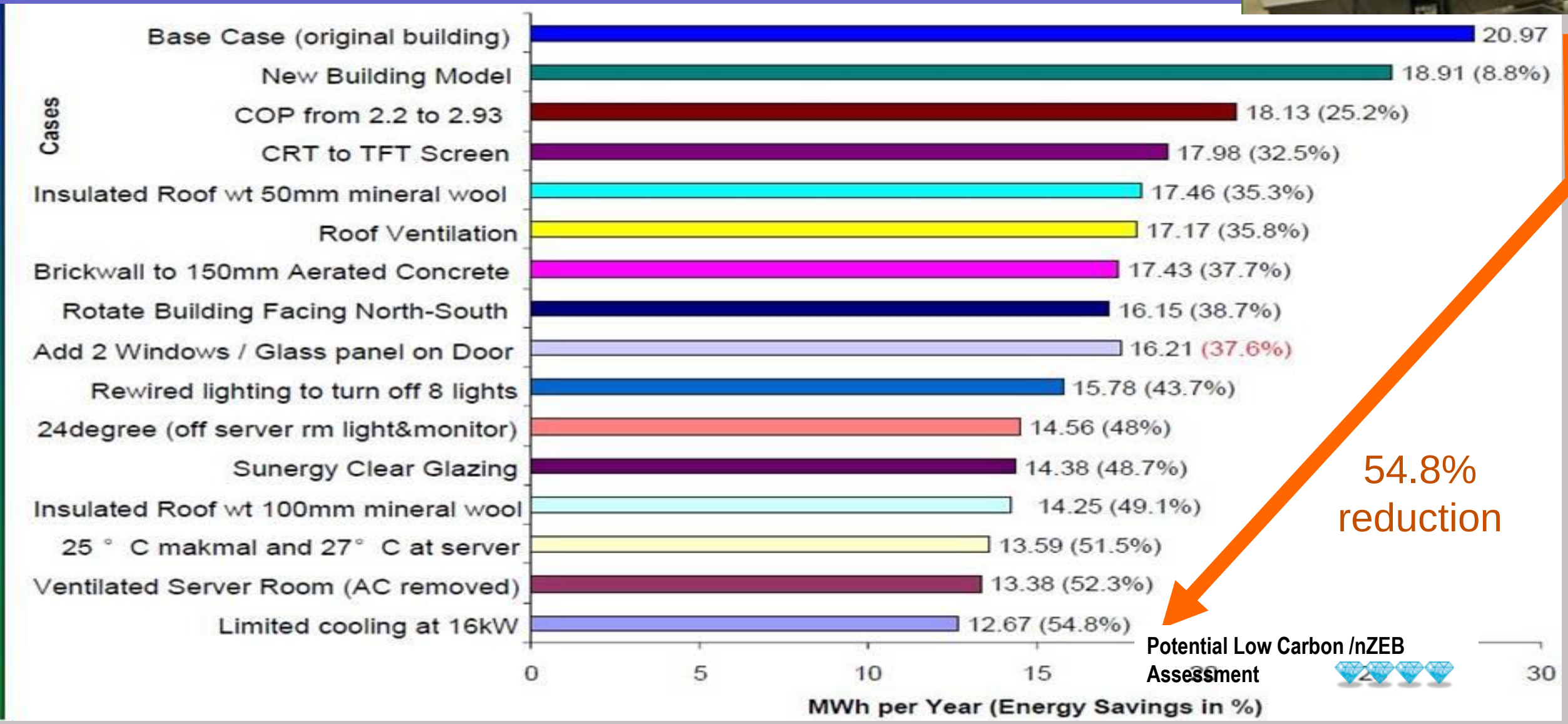
APPROCHING CARBON NEUTRAL BUILDING



- Net BEI = 15.6kWh/m2/year (more than 70% energy reduced)
- 384.2 TonCO2/year
- SME Green Award 2012
- ASEAN Energy Award : 2012 : 1st Runner-up Tropical Buildings

Potential Low Carbon / nZEB Assessment

A Government School Computer Lab : ENERGY DESIGN ELEMENTS



54.8% reduction

Potential Low Carbon /nZEB Assessment

PRACTICAL APPROACH
to achieve Nearly Zero Energy Building (nZEB)

EXISTING / RETROFITTED BUILDING / PARTIALLY BUILDING

Through energy auditing and energy saving implementation

ENERGY AUDITING

A systematic energy management process

To identify the potential energy saving measures in quantitative method and life cost cycle analysis

2007 – RETROFFITED OLD WAREHOUSE IN SHAH ALAM with enhance energy management program

Measures	Annual Saving	
	Electrical	
	kWh/yr	RM/yr
No Cost Measures		
De-lamping office lighting	13,476	3,153.38
Low Cost Measures		
Use timer controller for temperature and operate silo ventilation	687,760	160,935.84
Use of daylight in warehouse	19,943	4,666.66
Replace normal EXIT signage to LED	2,208	516.67
Awareness campaigns	703,931	164,719.85
High Cost Measures		
Replace the Metal Halide lamps to T5HO lamps	957,012	223,940.81
Lighting zoning	498,584	116,668.66
TOTAL	**2,882,914**	**674,602**

Actual Energy & CO2 Reduction 50%

Potential High Low Carbon / nZEB Assessment

2010 – LOW CARBON HOUSE P14 @ PUTRAJAYA

Since 2010 – Nearly Zero Energy Home (nZEB)
In 2017 – Net Zero Energy Home (NZEB)

- The Green Features:
  - East-West building orientation.
  - Landscape to absorb heat (IR and UV).
  - Natural cross ventilation & Daylighting.
  - Energy efficient light & appliances.
  - Energy efficient Interior Design.
  - Waste management.
  - Awareness and Green Practice.

Cekap Tenaga, Amalan Kita

BEI = 8.27 kWh/m2/year
CO2 = 1.7 ton / year
= 61.4% reduction

Potential Low Carbon / nZEB Assessment

2010 – LOW CARBON HOUSE P14 @ PUTRAJAYA

In 2017 – Net Zero Energy Home (NZEB)

- Upgrade become *Zero Energy House / Zero Carbon Emission / Carbon Neutral House* with cost below than RM50,000.

  - To off-set the balance of the energy used, a minimum of 2-3 kWp Solar PV grid needed.
  - *Testing & Commissioning* with TNB & PV service provider on 7 Oktober 2016.
  - Latest Net BEI = 0 kWh/m2/year
  - Latest Net Carbon Index = 0 KgCO2/m2/year
  - **Operational Energy / Carbon reduction = 100%**

Potential Low Carbon / nZEB Assessment

2014 – PARTIALLY BUILDING CASE

SEDA Low Energy Office @ Kota Kinabalu

APPROCHING CARBON NEUTRAL OFFICE

BEI = 27 kWh/m2/year
CO2 = 16 KgCO2 / m2 / year
= 86.4% reduction

Only need 2.5kWp Solar PV to make zero energy office

- The Energy Efficient Features:
  - Maximise use of Daylighting.
  - Energy efficient light & appliances.
  - Energy efficient Interior Design.
  - Low Carbon ICT system
  - Awareness and Practice.

Potential Low Carbon / nZEB Assessment

2014 – PARTIALLY BUILDING CASE

SEDA Low Energy Office @ Kota Kinabalu

Maximum use of daylight

SEDA Energy Efficient Office @ Likas Square

ECO SYSTEM TO SUPPORT NEARLY ZERO ENERGY BUILDING (nZEB)

EXISTING & PLANNED PROGRAM & INITIATIVES

ECO SYSTEM TO SUPPORT NEARLY ZERO ENERGY BUILDING (nZEB)

Existing professional & experts in Malaysia (government & private)

Low Carbon Cities Framework (LCCF) : Low Carbon Building

STANDARDS on Sustainable Energy: MS1525, ISO15001

Guidelines & References Cases

Energy Efficient products ready in Malaysia

INCENTIVES: Current incentives on sustainable energy & financial facilities (soon)

Supporting nZEB = High Performance Low Carbon Building in Malaysia

Trainings & Capacity Building Program

R & D Experts for local universities on Sustainable Energy

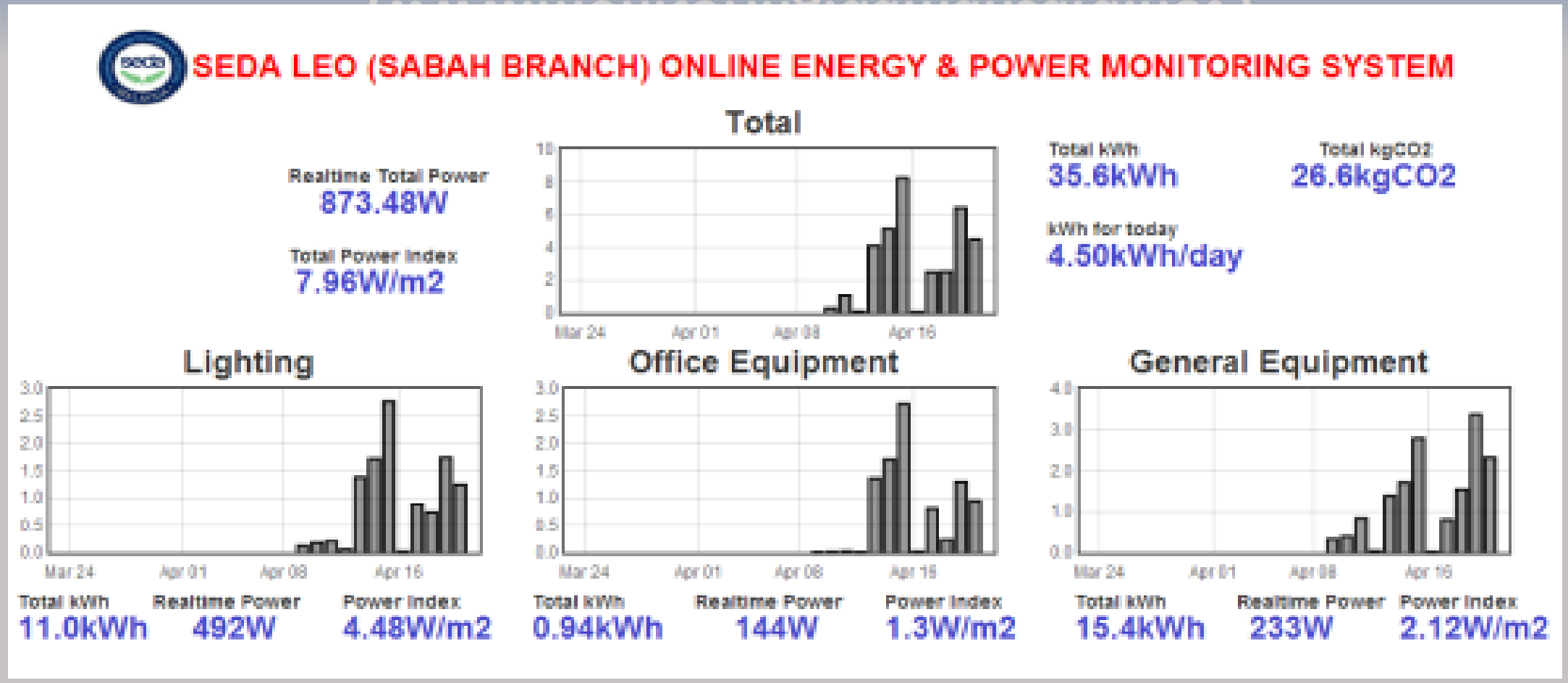
Net Energy Metering (NEM) Program by SEDA : To off-set further balance of energy needed.

SEDA's Low Carbon Building Facilitation Program: PBTs, Gov Agencies & Private

Existing Sustainable Energy Service Provider (ESCOs & Solar PV Service Provider)

Affordable Online Energy Monitoring System by SEDA

ONLINE ENERGY & CARBON MONITORING SYSTEM – SEDA (www.monitoring.damansara.net)



STANDARDS THAT ALREADY AVAILABLE IN MALAYSIA

- **DESIGN & RETROFITTING PHASE:**
  - ✓ **BUILDING ENERGY STANDARD - MS1525 – Code of Practice in Energy Efficiency & Use of Renewable Energy for Non-residential Buildings.**
  - ✓ **MS for RE (Grid Connected Solar PV Systam)**

- **OPERATION AND USE PHASE:**
  - ✓ **ISO 15001 – Energy Management System.**

LOCAL AND PROFESSIONAL EXPERTS

Available local experts in sustainable energy ;

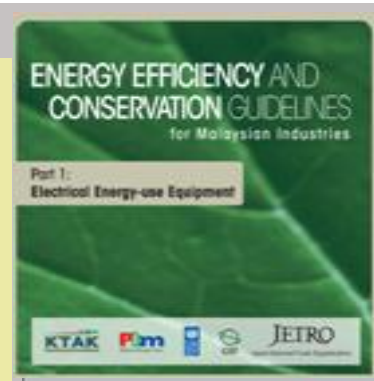
- Energy efficiency.
- Renewable Energy.
- Energy management.
- Integrated design.

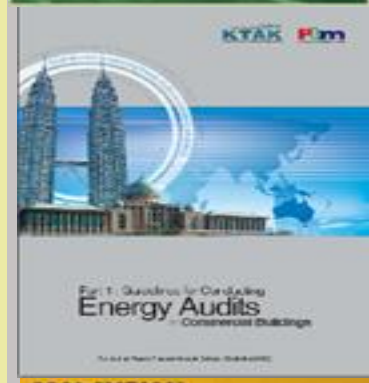
- Government : Building experts from JKR, SEDA Malaysia, Universities, etc.

- Private & Businesses :
  - ✓ Building experts such as Engineers, architects, QS, ID, Energy, ICT, FM, etc.
  - ✓ Energy Service Companies (ESCOs)- retrofitting.
  - ✓ Solar Photovoltaic PV Service Providers.

GUIDELINES AND REFERENCES RELATED TO SUSTAINABLE ENERGY
(Energy Efficiency & Renewable Energy)

- Development and Publication of ***EE in Buildings Guidelines*** *by Ministry of Energy, Telecommunications & Post*, 1989.
- ***Malaysia Industrial Energy Audit Guidelines****, a handbook for energy auditors* by KTAK, PTM and UNDP-GEF, 2003.
- ***Guidelines for Conducting Energy Audits in Commercial Buildings*** by KTAK & PTM, 2004.
- ***Guide for Conducting Energy Audits in Commercial Buildings*** by SEDA Malaysia, 2016.
- ***Design Strategies for Energy Efficiency in New Buildings (Non-Domestic)*** by KTAK, DANIDA & JKR, 2004.
- ***Energy Efficiency & Conservation Guidelines for Malaysian Industries*** by KTAK, PTM and UNDP-GEF;
  - *Part 1 : Electrical Energy-use Equipment*, 2007.
  - *Part 2 : Thermal Energy-use Equipment* (2010)
- ***Sustainable Low Carbon Building Performance Guide (documentation in progress)*** by SEDA Malaysia.





Thank you for your attention

NEED HELP ON LOW CARBON BUILDING / nZEB PROGRAM?

- Tel / SMS : +6019-2829102

steve@seda.gov.my / asetip@damansara.net

http://www.slideshare.net/asetip

SEDA Malaysia,
Galeria PjH, Level 9
Jalan P4W, Persiaran Perdana,
Presint 4, 62100 Putrajaya, Malaysia.

\+ **Steve Anthony Lojuntin**

Phone : +603-8870 5800 / 5841
Email: fit@seda.gov.my / steve@seda.gov.my
Web: www.seda.gov.my