ZERO ENERGY BUILDING
Conversion Retrofitting of Existing Building in Malaysia

ASTAKA SPORT COMPLEX
Majlis Perbandaran Petaling Jaya
National & ASEAN Energy Award

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INTRODUCTION

Case of Retrofitting of Existing Building
THE ASTAKA BUILDING

• Simple and straightforward retrofitting.
• According to ZEB Ready target performance.
• Step-by Step approach & affordable.
• Reduced energy up to 64.8% on Energy Efficiency
  • Sustainable Energy GreenPASS (ZEB Ready) 2019.
  • National Energy Award (ZEB Ready) 2022
  • ASEAN Energy Award (ZEB Ready) 2022
ZERO CARBON & ZERO ENERGY CONCEPT
Looks the same but it is different and will have different impact

PERFORMANCE (Degree of Reduction, %)

Zero Carbon Concept

Zero Energy Concept (ISO/TC 23764)
SUMMARY / MAPPING OF GREEN BUILDING / SUSTAINABLE LOW CARBON BUILDING / ZEB IN MALAYSIA

GOV. POLICY

GOV. POLICY TARGET = REDUCE CARBON / GHG INTENSITY 45% (2030) & CARBON NEUTRAL (2050)

GREEN BUILDING (GB)

° SUSTAINABLE ENERGY LOW CARBON BUILDING (LCB)

METRIC:
Based on Number of Points Collected

METRIC:
Based on % of Energy reduction

Conventional Green Building
o Penarafan Hijau (PH-JKR).
° Green Building Index (GBI)
° GreenRE
° Melaka Green Seal
° GreenMARK
° LEED

Low Carbon Green Building
- MyCREST (CIDB)
- CASBEE - ISKANDAR

Energy Efficient Low Carbon Building (BASIC)

Zero Energy Building (ZEB)
° Ready for ZEB / nZEB / NZEB
° BY SEDA

Owner ready with budget

Owner ready but NO / Less budget

GB Project

Upgrade to GB

GB Project

Upgrade to GB

Owner ready with budget

EE Building Project

Step-by-step

Pilot / facilitation / certification by SEDA

Passing points (45% - 50%)

OPTIONS?
Affordable Way to Achieve Zero Energy Building (ZEB) For Existing Building

Performance (Degree of Energy Reduction, %)

- ZEB Ready
- Near ZEB
- Net ZEB

Motivation through Facilitation & GreenPASS Certification

For Existing Buildings

STEP-BY-STEP APPROACH
The objective of retrofitting the ASTAKA

To Building Operation

- To reduce operation cost / overhead by reducing electricity bill

For The Community

- To enjoy more conducive, comfortable, safety and good facilities services at affordable rates.
- Indirectly, the use of better technology (efficient products) will promote and enhance the awareness of energy savings.

To MBPJ

- To reduce the overhead burden, the building must operate at minimum cost.
- Capacity building / new experience to MBPJ on energy savings and reduce carbon emission.
- Pilot demonstration of the 1st high performance energy efficiency retrofitting at MBPJ’s assets. This creates example and motivation to MBPJ's staffs. After the success, MBPJ had embarked the Energy Management Program in 2021 and several MBPJ’s building has undergo energy auditing and, in the progress, to implement phase by phase retrofitting.
- To demonstrate as pioneer among the PBTs, government to lead by-example in managing and reducing energy and carbon.

To Government & Industry

- Shows that simple, straight forward / practical but affordable zero energy building (ZEB) for existing building is achievable. No need to construct new ZEB buildings.
- Same concept can be applied to private and government buildings.
- Direct support the national 45% carbon intensity reduction target by 2030 and carbon neutral target by 2050.
# The ASTAKA BUILDING

<table>
<thead>
<tr>
<th>Name of Building</th>
<th>Astaka Sport Complex (Kompleks Sukan Astaka)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner</td>
<td>Majlis Bandaraya Petaling Jaya (MBPJ)</td>
</tr>
<tr>
<td>Address</td>
<td>Jalan Utara, Seksyen 52, 46200 Petaling Jaya, Selangor</td>
</tr>
<tr>
<td>Type of Building</td>
<td>Multipurpose Building (Sport Complex) (Single Storey)</td>
</tr>
<tr>
<td>Age of Building</td>
<td>Operated since 1982 (40 Years)</td>
</tr>
<tr>
<td>Gross Floor Area (GFA)</td>
<td>4,625.08 sq.m</td>
</tr>
<tr>
<td>Net Floor Area (NFA)</td>
<td>2,060.69 sq.m</td>
</tr>
<tr>
<td>Building Energy Consumption of Baseline Year (2015)</td>
<td>106,218 kWh/yr</td>
</tr>
<tr>
<td>Building Energy Consumption of Reporting Year (2019)</td>
<td>37,366.00 kWh/yr</td>
</tr>
<tr>
<td>Nature of Business</td>
<td>A building complex of sport facilities, meeting rooms, surau and common activities.</td>
</tr>
<tr>
<td>ZEB Category</td>
<td>ZEB Ready</td>
</tr>
<tr>
<td></td>
<td>(64.82% Energy Saving excluding Renewable Energy)</td>
</tr>
</tbody>
</table>
Energy Savings Approach & Method

Identify the main energy consumer / activities or process

1

- Quick energy audit with energy consumption data.
- Analyse and obviously found that lighting and air-conditioning system uses about 81% from the total energy. That is mean the focus is on lighting and air-conditioning system.

Identify the potential Energy Saving Measures (ESMs)

2

- Propose to change the inefficient lighting system. The efficient power rated is lower about 50% compared to the current one.
- Propose to change the old and inefficient air-conditioning to high efficiency one.
- Choose possibly the most viable cost.

Implement Retrofitting

3

- Appoint contractor or Energy Service Company (ESCO) to implement the retrofitting.
- Testing and Commissioning

Implement energy management and finetuning during operation

4

- Operate the building according to the function.
- Keep finetuning in order to get the best configuration.
- Monitor and collecting monthly energy consumption and recording it using cloud-based system (Building Energy Online Data Monitoring -BEDOS) www.seda.gov.my/bedos
- Analyse and compare the performance with the baseline data.
# Summary of retrofitting work in Astaka

## 1.0 Improvement of Passive Design

Installation of metal cladding at some part of the building to provides shades and reduce direct heat from the sun

## 2.0 Improvement of Active Design

- Replacement of conventional Metal Halide spot light (400W/lamp) & florescent light (40W/lamp) to high-efficient light especially (20 Watt/ lamp) & (18 Watt/lamp).
- Replacement of old air-conditioning system (ACSU) with 5-Star Rating air condition.
- Replacement of old air-conditioning system (ACPU Type) to high-efficient system.

## 3.0 Other sustainable feature

Installation of Rainwater Harvesting System
Building Energy Performance/Savings
## Building Energy Performance/Savings

<table>
<thead>
<tr>
<th>Item</th>
<th>Energy Saving Measures</th>
<th>Retrofitting / Improvement Taken</th>
<th>Estimated Savings</th>
<th>Overall Savings Based on Total Energy.</th>
</tr>
</thead>
</table>
| 1    | Retrofitting the internal lighting system. | Replacement of conventional florescent light (40W) to high-efficient light LED (20W and 18W).  
- Saving is based on **power reduction**. | 60% | **106,218 kWh/year**  
Baseline (2015) |
| 2    | Retrofitting of the air-conditioning system. | Replacement of electrical appliances to high-efficient unit only (ACPU). Equipment obsolete (1 Unit)  
- Saving is based on **COP improvement**. | 30% | **37,366 kWh/year**  
Reporting Year (2019) |
| 3    | Retrofitting of the air-conditioning system. | Replacement of electrical appliances to high-efficient unit only (ACSU). 5-Star Rating ACSU (6 Unit)  
- Saving is based on **COP improvement**. | | **68,852 kWh/year**  
The Total Reduction  
= Baseline – Reporting Yr  
= 106,218 - 37,366.00 |
| 4    | Improvement of the passive system | Building painting, building shading (new cladding), improve building wall and floor.  
- Saving is based on **lower heat penetration** into the building and **reduced cooling load**, light colour painting **promotes good daylight and use less artificial lighting** during the day. | Unable to calculate the savings. | **40 Ton CO₂ Carbon Reduction**  
*Note: Based on emission factor of 0.585 tCO2/MWh (Peninsular Malaysia) - 2017 CDM Electricity Baseline for Malaysia. |
| 5    | Energy management (Since 2016) | Energy management practice, awareness and finetuning in operation.  
- Saving is based on integrated action by **awareness, energy monitoring and action, finetuning**.  
- This also help to reduce further energy from **lighting and air-conditioning system**. | Unable to calculate the savings due to lack of collected data. | **Percentage savings 64.8% reduction**  
(qualify for ZEB READY) |
### Yearly Energy Consumptions

**Astaka Building**

<table>
<thead>
<tr>
<th>Year</th>
<th>Energy consumptions, kWh</th>
<th>Reduction compared to baseline</th>
<th>Activities / Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>106,218.00</td>
<td>Baseline</td>
<td>No retrofitting</td>
</tr>
<tr>
<td>2016</td>
<td>92,450.00</td>
<td>-12.96%</td>
<td>Basic energy management.</td>
</tr>
<tr>
<td>2017</td>
<td>44,966.00</td>
<td>-57.67%</td>
<td>Retrofit lighting and air-conditioning system.</td>
</tr>
<tr>
<td>2018</td>
<td>15,064.00</td>
<td>-85.82%</td>
<td>Improve passive design – provide cladding as shades, painting, etc. Operation interruption due to some interior design repair / renovation.</td>
</tr>
<tr>
<td>2019</td>
<td>37,366.00</td>
<td>-64.82%</td>
<td>As Reporting Year. Normal operation. Retrofitting and Renovation completed.</td>
</tr>
<tr>
<td>2020</td>
<td>27,247.00</td>
<td>-74.35%</td>
<td>MCO and affect the operation.</td>
</tr>
<tr>
<td>2021</td>
<td>32,377.00</td>
<td>-69.52%</td>
<td>MCO and affect the operation.</td>
</tr>
</tbody>
</table>

- **2015** as baseline since the energy management program to reduce energy has started.
- **2009** as the reporting year, which is 64.82% energy reduction compared to 2015 (Baseline Year).
- The reason why not using energy consumption in 2020 and 2021 is due to factor of Movement Control Order (MCO). The Covid-19 cases has forced the government to close down all major activities in all sectors for several month in 2020 and 2021.
Further improvement for future target is planned by harvesting Renewable Energy implementation as follows:

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline [kWh/yr]</td>
<td>106,218</td>
</tr>
<tr>
<td>Reporting [kWh/yr]</td>
<td>37,366</td>
</tr>
<tr>
<td>Reduction by EE</td>
<td>68,852 kWh/yr</td>
</tr>
<tr>
<td>EE rate</td>
<td>64.8%</td>
</tr>
<tr>
<td>Potential RE</td>
<td>20 kWp</td>
</tr>
<tr>
<td>RE rate</td>
<td>23.5%</td>
</tr>
<tr>
<td>Net reduction (EE+RE)</td>
<td>93,852</td>
</tr>
<tr>
<td>Future Target</td>
<td>88.4%</td>
</tr>
</tbody>
</table>
Photos
Improvement of Passive Design

Figure 7: Photo was captured on Year 2016
Figure 8: Photo was captured on Year 2022

Figure 9: The Passive Design Improvement by installing metal cladding
The installation covered the South-East of the building area.

Installation of floor tiles (anti slip ceramic) for 300mmx600mm area

Figure 10: Every Interior Wall of the Building is Painted in White
Three (3) layered of painting - one basis layer and two layer of weather shield paint with white colour

Figure 11 Replacement of Floor Material at Foyer (left) and Ventilation Window (Right)
Improvement of Active Design

- **Replacement of Conventional Lighting to LED Lights**
  - Figure 12: The common area is equipped with 72 units of LED Downlights
  - Figure 13: The main corridor of the building is equipped with LED Downlights
  - Figure 14: Lighting layout at Squash Courts
  - Figure 15: The lighting is installed according to Squash Court Lux Level Standard
  - Figure 16: The stair corridor is equipped with LED Lights
  - Figure 17: The building's toilet is equipped with LED Lights

- **Replacement of AC System to Energy Efficient Unit**
  - Figure 18: Ducted Split System with Energy-Efficient Feature located at main Squash Court for 2-units
  - Figure 19: PFC Heat Exchanger (Energy Efficient Feature) Yield Better Efficiency Compared to Conventional One
  - Figure 20: 5-Star Labelling Air-Conditioning Split Units
  - Figure 21: The ACSU Ceiling Expose with R410A refrigerant located at each Squash Court

The ACSU has been replaced from 3-star to 5-star energy rating Energy Efficiency Label by Suruhanjaya Tenaga
ZEB Certification (voluntary)

Tool: Sustainable Energy Low Carbon Building Assessment
GreenPASS by SEDA Malaysia
(www.seda.gov.my/greempass)
ASSESSMENT TOOL SUITABLE FOR ZERO ENERGY BUILDING (ZEB) IN MALAYSIA

www.seda.gov.my/greenpass
**SUSTAINABLE ENERGY LOW CARBON BUILDING ASSESSMENT**

**GREENPASS BY SEDA**

**Adopted the CIDB’s Construction Industry Standard (CIS-20:2012) – GreenPASS Operation**

**TOWARDS ZERO ENERGY**

<table>
<thead>
<tr>
<th>Level of Achievement</th>
<th>Assessment Scheme for buildings (diamond)</th>
<th>ZEB Certification Scheme *</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% or more</td>
<td>💎💎💎💎💎 (diamond)</td>
<td>Net ZEB (NZEB)</td>
</tr>
<tr>
<td>≥ 70 to &lt; 100</td>
<td>💎💎💎💎 (diamond)</td>
<td>Near ZEB (nZEB)</td>
</tr>
<tr>
<td>≥ 50 to &lt; 70</td>
<td>💎💎💎 (diamond)</td>
<td>ZEB Ready</td>
</tr>
<tr>
<td>≥ 30 to &lt; 50</td>
<td>💎💎 (diamond)</td>
<td></td>
</tr>
<tr>
<td>≥ 10 to &lt; 30</td>
<td>💎 (diamond)</td>
<td></td>
</tr>
<tr>
<td>≥ 1 to &lt; 10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: Aligning to ISOTC 23764 & Japan ZEB Scheme Concept*
PILOT ASSESSMENT & CERTIFICATION (VOLUNTARY) USING GREENPASS FOR ASTAKA BUILDING

<table>
<thead>
<tr>
<th>Level of Achievement (% of CO₂e Reduction)</th>
<th>Assessment Scheme for buildings (diamond)</th>
<th>ZEB Certification Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% Carbon Neutral</td>
<td></td>
<td>Net ZEB (NZEB)</td>
</tr>
<tr>
<td>≥ 70 to &lt; 100</td>
<td></td>
<td>Near ZEB (nZEB)</td>
</tr>
<tr>
<td>≥ 50 to &lt; 70</td>
<td></td>
<td>Ready Towards ZEB</td>
</tr>
<tr>
<td>≥ 30 to &lt; 50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 10 to &lt; 30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 1 to &lt; 10</td>
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<td></td>
</tr>
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ZEB voluntary certification by SEDA to existing building.
Thank you for your attention

FACILITATION ON ZERO ENERGY BUILDING (ZEB) PROGRAM?
Call / text +6019 2829102 / +603 88705800
www.seda.gov.my

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Jalan P4W, Persiaran Perdana,
Presint 4, 62100 Putrajaya, Malaysia.