



RMK-13 ENERGY AUDIT CONDITIONAL GRANT (EACG)

GUIDES ON EACG ENERGY AUDIT REPORT

Energy Audit Conditional Grant (EACG) is a programme under Ministry of Energy Transition and Water Transformation (PETRA) which SEDA Malaysia is the implementing agency for this programme.

PURPOSE

1. As a guide/example for the Receiver of the Grant and Energy Auditor.
2. To establish a structured and uniform energy audit report.
3. To ensure a good quality energy audit report.
4. To provide an example of the report's content.

DISCLAIMER

1. SEDA Malaysia is not responsible for the findings of the energy audit conducted, however SEDA Malaysia is responsible to check and review the report.
2. The energy audit report shall be prepared by Registered Energy Auditor (REA) and shall be agreed upon and verified by the energy consumer or person in charge of building.
3. REA shall be responsible on the energy audit report made as per stated in the Act 861 : Energy Efficiency and Conservation Act (EECA) 2024.
4. This template only serves as a guide whereby any contents, analysis, or modification made/provided by REA shall follow the Guidelines published by the Commission.
5. Name the draft report included with the submission date as such **(EACG Draft Report for [Building Name] dd/mm/yyyy).**

REFERENCES

This guide is our interpretation of the Guidelines published by the Energy Commission which are;

1. [GUIDELINES ON ASCERTAINING ENERGY CONSUMER](#) (GP/ST/No.44/2024)
2. [GUIDELINES ON ENERGY EFFICIENCY AND CONSERVATION REPORT](#) (GP/ST/No.45/2024)
3. [GUIDELINES ON ASCERTAINING A BUILDING AND THE ENERGY INTENSITY PERFORMANCE OF A BUILDING](#) [GP/ST/No.48/2024]
4. [GUIDELINES ON ENERGY AUDIT REPORT](#) (GP/ST/No.49/2024)

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1 ENERGY AUDIT

Energy audit is an important tool in establishing the energy supply and consumption pattern and the measures that need to be taken to optimize energy usage in buildings. Energy audit is an important effort to facilitate the building owners / ESCO to identify the energy saving potentials and to promote efficient use of energy.

The reference in this document stipulate the objectives, scope of work, deliverables, and other requirements of energy audit to be conducted at selected commercial buildings that consume high electrical energy.

Thus, the building owners and ESCOs shall comply with the terms of reference provided in order to conduct and produce a good, systematic and quality audit exercise, as well as uniform and comprehensive reports.

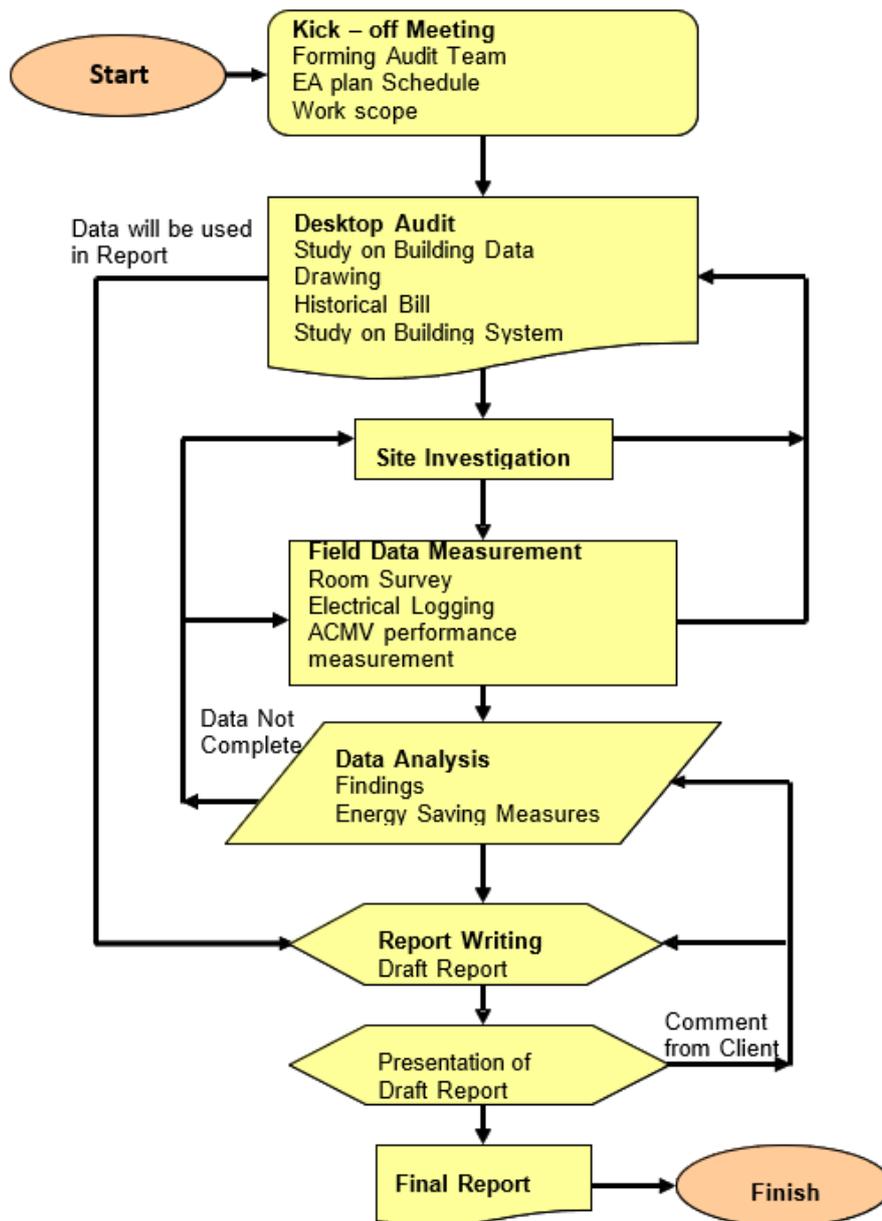
The objectives of the Energy Audits are;

- **To identify the energy supply information and status;**
- **To identify the current energy management program, setup, policy, implementation, and effectiveness.**
- **To identify present and historical energy usage pattern;**
- **To identify where the wastage occurs and measures to be taken to optimize consumption and reduce wastage; and**
- **The findings of this audit will be used to assist the building owner to formulate energy management plan and implement the relevant energy saving measures (ESMs) recommended in the energy audit report.**
- **Providing detail technical solutions and estimated cost in the energy audit report.**

2 METHODOLOGY OF ENERGY AUDIT

The energy audit consists of several main activities such as the following:

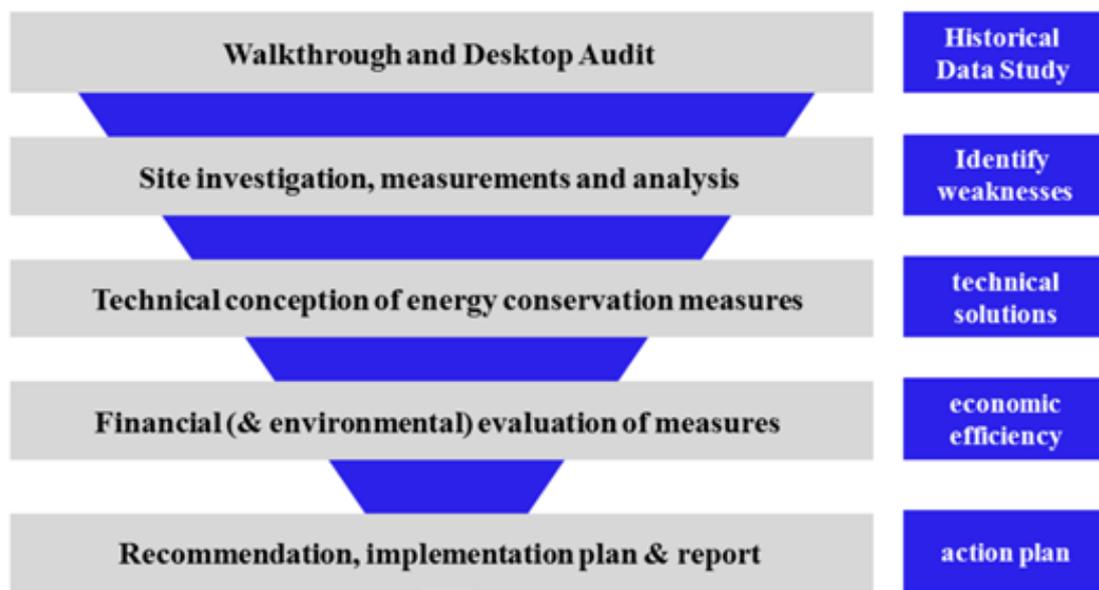
- ✓ Kick-off meeting
- ✓ Walk through
- ✓ Site investigation and measurement
- ✓ Data analysis
- ✓ Data verification
- ✓ Report Writing
- ✓ Presentation of result
- ✓ Feedback from all parties
- ✓ Submission of final report



The energy audit approach and process normally involve;

- i. Obtain and study the historical data of the building in order to establish baseline;
- ii. Identify the current weakness or energy wastages;
- iii. Propose the technical solutions to minimise the wastages;
- iv. Evaluate and perform economic efficiency or life cycle costing analysis; and
- v. Develop recommendation and action plan

Approach of energy audits



MALAYSIA

3 SCOPE OF WORK ENERGY AUDIT

The main component of the audit shall cover the following:

3.1 Energy Management Of The Building;

- To review Operation and Maintenance Contract including budget required;
- To review existing Energy Efficiency Policy/Energy Management System;
- To review documents and data pertaining to energy usage;
- To review Organizational Structure and Resource Allocation for Energy Management; and
- To obtain building information on total occupied and air- conditioned areas.

3.2 Energy Supply Information;

- Tariff structure;
- Maximum demand value and charges;
- Voltage level;
- Historical supply information (preferably 5 years-subject to age of building); and
- Power factor.

3.3 Energy Usage Information;

- To conduct power distribution profile monitoring and analysis for overall electrical supply (compulsory) and main electrical powered equipment (if available) **at least for a period of 7 days;**
- To conduct electrical energy load loss survey and site evaluation for the transformers and UPS system after the meter (if necessary and have potential energy savings);
- To study on the energy usage for all equipment and systems.
- To establish electricity consumption distribution based on equipment/systems e.g. air-conditioning, lighting, office equipment etc. in kWh, GJ and percentage;
- To establish **Energy Indices** for each building;
 - **Building Energy Index (BEI)** kWh/m²/year & GJ/m²/year (*Please refer to document, GUIDELINES ON ASCERTAINING A BUILDING AND THE ENERGY INTENSITY PERFORMANCE OF A BUILDING by ST*);

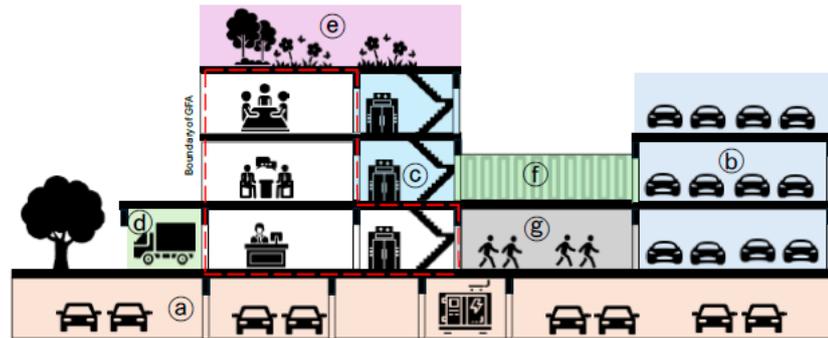


Figure 3-1: The usual boundary of the GFA for an office building

- **Net Building Energy Index (BEI)** kWh/m²/year & GJ/m²/year (if renewable energy system available);
- **Building Energy Intensity Index (BEII)**, kWh/m²/year/person & GJ/m²/year/person;
- **Lighting Energy Intensity Index (LEII)**, kWh/m²/year/person & GJ/m²/year/person;
- **Air-conditioning Energy Intensity Index (ACEII)** kWh/m²/year/person & GJ/m²/year/person; and
- **Building power baseload** (extract from the building profile), kW.
- To establish **Power Indices** for the building;
 - **Lighting Power Density [W/m²]**
 - **Air-conditioning Power Density [W/m²]**
 - **Equipment Power Density [W/m²]**
 - **Baseload power index (Baseload / GFA) [W/m²]**
- **Passive System;**
 - **Window**
 - shading / glazing level
 - design and opening
 - **Wall / Roof**
 - types of insulation
 - material and colour
 - **Day lighting opportunities**
 - To determine OTTV, RTTV
 - Building orientation and footprint
 - Availability of natural ventilation and opportunities
 - Roof structure
 - pitch
 - material and colour
 - Ceiling
 - height

- material, colour
- Floor material and colour
- Landscaping
- Active System;
 - Air Conditioning System
 - To identify technical information for key air-conditioning equipment such as chiller, AHU and split units;
 - To identify and study operating schedule;
 - To identify control system being used (automatic/manual);
 - To conduct power measurement and analysis for air conditioning system;
 - To carry out air flow, chilled water temperature, air temperature, and analysis for all AHU;
 - To conduct pump system efficiency (depend to site condition);
 - To conduct chilled and condenser water supply and return temperature and flow rate measurement;
 - To calculate overall System Coefficient of Performance;
 - To calculate Coefficient of Performance for chillers;
 - To conduct temperature, CO₂ and Relative Humidity (RH) level survey; and
 - To conduct Variable Air Volume (VAV) zoning and air change analysis (if any).
 - Lighting
 - To prepare a list of types of lamps used and its rated power at internal and external areas (fluorescent, CFL, LED etc);
 - To study lighting operating schedule;
 - To conduct measurement and analysis of lighting fitting layout and lux level;
 - To conduct power measurement and analysis; and
 - To conduct lighting control systems and zoning analysis
 - Ventilation System / Indoor Air Quality & Infiltration
 - To identify control system being used (automatic/manual);
 - To study ventilation system operating schedule;
 - To conduct air flow measurement and analysis;
 - To conduct energy and power measurement for selected fan;
 - To conduct CO and CO₂ level measurement and analysis; and
 - Analysis on zoning and air change measurement.

- Building Automation System (BAS)
 - To confirm the function of the BAS facilities and parameters being controlled;
 - To perform measurement variation study between actual and the reading in the system; and
 - To study the characteristic of BAS in term of monitoring, control and reporting.
- Office Equipment
 - To survey identify the types of office equipment (printers, computers, photocopy machine, etc) in each room and area with its power consumption (rated capacity, performance rating etc).

3.4 Energy Saving Potential And Measures (ESMs)

ESMs (action plan and estimated time required to implement the measure recommended, amount of saving and cost of implementation). The ESMs shall address the energy management and energy efficiency. Renewable energy can be included but it is not part of the energy audit scope.

- Energy Saving Measures and Recommendations
 - Text
 - Describe the proposed energy savings measures
 - A list of equipment potential credible suppliers
 - Chart
 - Graphical illustration
 - Existing and proposed system (*if applicable*)
 - Photo
 - Existing situation
 - Proposed equipment sketches or sample photo from manufacturer catalogue
- To list opportunities for electrical energy saving measures identified (saving to systems / equipment / control / monitoring / management) in tables
 - Each measure should have tables consisting:
 - The assumptions used in estimating the energy savings
 - The methods used in estimating the savings
 - Technical calculation
 - The conditions to achieve the savings
- To identify detailed methods to achieve savings/electrical energy reduction according to;

- No cost/ min cost – changes of time and operation methods, minor repair / improvements
 - Low and high cost or Medium cost - based on percentage
 - High cost measure
- To estimate total potential electrical energy saving in kWh & GJ;
 - To propose an action plan and the estimated time required to implement each saving measure if the management decides to implement it; and
 - To propose methods of measurement and calculation to quantify energy savings based on identified saving potentials.

3.5 Financial analysis

Normally involved basic life cost cycle analysis for the proposed energy saving measures (SPP, ROI)

- Measures and costs
- Each measure and potential saving
- Expected return of investments from financial evaluation tools (e.g. SPP, ROI etc.) in years or months.

3.6 Financial and Energy Saving Measures Implementation Planning for the Owner to Implement (3 Years)

Brief budget and implementation planning for building owner to implement within the 3 years.

- 1st Year, estimated implementation cost and savings.
- 2nd Year, estimated implementation cost and savings.
- 3rd Year, estimated implementation cost and savings.

** The ESMs implementation planning shall address the energy management and energy efficiency. Renewable energy can be included but it is not part of the Energy Audit Conditional Grant scope. The total cost and savings from renewable energy are not counted as implementation and savings achieved under this EACG scheme.*

4 MANDATORY REQUIREMENT

Energy audit report shall be according to the Energy Audit Report Template as in **Appendix A; EACG Energy Audit Report Template**

Prepared and updated by,
SEDA Malaysia

Mobile : +603 8870 5849 / +603 8870 5814 / 019-2829102 for any enquiry



ENERGY AUDIT CONDITIONAL GRANT REPORT

FOR

BUILDING NAME

Prepared by

<p>ESCO logo</p> 	<p>Client logo</p> 
<p>ESCO Name Office Address</p>	<p>Client Name Building Address</p>

Under



CONFIDENTIALITY

Example:

This document contains information for the sole perusal of *Client name* located in *Client address*. All information contained here is prohibited from being copied out. The information here shall not be copied, printed or disclosed to any 3rd party sources without prior written permission from *Client name*.

DISCLAIMER

Example:

ESCO has no personal or financial interest in supplying or installing equipment for this document.



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GLOSSARY

In this report, the following words and abbreviations shall be defined as follows:

Words/Abbreviations	Definition
Audit	means the Energy Audit
BEI	means Building Energy Intensity which refers to the energy intensity performance of a building; $BEI \text{ office building} = \frac{\text{Energy Consumption (GJ)}}{\text{GFA (m2)}}$
EECA	means the Energy Efficiency and Conservation Act 2024 [Act 861]
EIP	means Energy Intensity Performance
ESM	means Energy Saving Measure which refers to range of actions, strategies, and practices implemented to reduce energy consumption and improve energy efficiency in various systems, processes, and operations
GFA	means the Gross Floor Area which refers to the total area of floor space within a building, as measured between the external sides of wall or, in the case of party walls, between the centres of such walls but it excludes the following areas: <ol style="list-style-type: none"> parking spaces and circulation areas, including any mechanical or electrical spaces within the parking area of the building; open or covered parking area outside the building; staircases and lift shafts on floors other than the ground floor or lobby; waiting area for commercial vehicles unloading goods; gardens or recreational facilities for residents provided on the rooftop or podium in open or semi-open spaces; pedestrian pathway connected to the building or transit station, including any supporting activities; and pedestrian pathways within building functioning as public walkways.
SEU	means Significant Energy Use which refers to any system, proses, or equipment within an organization that consumes a substantial amount of energy.
TR	Tonne of Refrigerant is a unit measuring cooling power, defined as the heat removal rate to freeze 1 short ton (907 kg) of pure ice at 0°C in 24 hours, equivalent to 12,000 BTU/hr (British Thermal Units per hour) or roughly 3.517 kilowatts (kW),
TNB	means Tenaga Nasional Berhad who is the supplier of energy

DECLARATION BY REGISTERED ENERGY AUDITOR

I, **[Name of REA]**, hereby declare that –

- (a) I have conducted the energy audit;
- (b) I have ensured the accuracy and completeness of the energy audit report to the best of my knowledge and expertise;
- (c) I have prepared the energy audit report in accordance with the Guidelines on Energy Audit Report issued by the Commission; and
- (d) I shall be responsible for the preservation of confidentiality, integrity and availability of the information obtained when conducting the energy audit and when preparing the energy audit report.

Signature: _____

Date: _____

[Name of REA]

[REA Certificate of Registration number]

ACKNOWLEDGEMENT BY FACILITY REPRESENTATIVE

I, **[*Name of Facility Representative]**, hereby acknowledges receipt of the energy audit report prepared by the REA, **[Name of REA]**, confirms that I have reviewed the contents of the energy audit report and accepts responsibility to take appropriate actions and measures based on the energy audit findings and recommendations in the energy audit report.

Signature: _____

Date: _____

[Name of Facility Representative]

[Position/Title]

Note:

**Facility Representative refers to the energy consumer or the person in charge of a building who is responsible for overseeing the implementation of energy-saving initiatives of the facility.*

1 EXECUTIVE SUMMARY

SHALL include but not limited to objectives of the audit, scope of the audit, summary on the systems / equipment audited, summary information on baseline, load apportioning and brief description of energy saving measures.

Example:

Energy Audit Conditional Grant (EACG) is an energy efficiency programme under the 12th Malaysia plan (RMK-12) for the implementation year of 2021-2025. This programme is supported by grants which were allocated for the year 2021 until 2025 to commercial and industrial sectors to collaborate with local energy service companies (ESCOs) registered with the energy commission (ST) to conduct energy audit in their buildings. As a continuum, this programme is continued for year 2026 under RMK13.

The grant will serve as a financial facility (assistance) to building/installation owner to do energy audit to implement energy saving at their premises. This programme also to promote energy audit exercise to establish the current energy consumption baseline and identify potential energy saving in their premises which will foster awareness on the importance of energy management among commercial and industrial premises owner in Malaysia to reduce energy consumption (save energy and save operational cost).

With the current act, Energy Efficiency and Conservation Act (EECA) 2024, an energy consumer to whom this Act applies shall from time-to-time cause to be conducted an energy audit in respect of his activity, business or trade so as to comply with the requirements relating to the submission of energy audit report under Subsection 9(2).

Building name has an estimated total gross building area of **[XX m²]**, with an air-conditioned area of **[XX m²]**. The annual electricity consumption obtained from the historical TNB billing data for the baseline year **[2019]** is **[232,050kWh]** with a cost of **[RM66,831.00]**. Meanwhile, the thermal consumption for the same period of time was recorded at **[XX GJ]** with a cost of **[RM XX.XX]**. This totals up the energy consumption at this building to be **[XX GJ]** with a total cost of **[RM XXXX.XX]** which will be referred as the baseline value. **Building name** is **[describe the building composition, e.g. one unit of single-story building]** which is used solely as an **office purposes** which also emplaced **200 staffs** at the moment.

Energy Audit had been conducted by **[Auditor name]** for **[Client name and Building Name]**, between **[date]**. An energy audit is defined as a systematic and objective assessment of energy needs, consumption and efficiency. This report represents the findings of the Energy Audit for the audited equipment which includes **[e.g. chiller plant, centralised air conditioning system and lighting system]**. The audit for the general equipment was done using a general survey.

1.1 OBJECTIVE

Example:

The objective of this detailed energy audit study is to determine the energy performance of the building through detailed measurement and analysis, and identify potential savings that can optimize energy consumption, reduce wastage and reduce the operating costs of the building.

The compiled data and findings from this audit are to be used to assist **Client name** to monitor and operate the plant more efficiently and at the same time identify potential energy saving measures for improved performance and optimization of equipment operation.

1.2 SCOPE OF ENERGY AUDIT

REA shall briefly explain what/how audit is being done towards the selected system/equipment.

Example:

The scope of works covered in the energy audit are as per SEDA's guideline listed below.

Energy Management of the building:

- Review of operation and maintenance contract including budget required
- Review of existing energy efficiency policies or if an energy management system was in place
- Review all documents pertaining to energy usage
- Review organizational structure and resource allocation for energy management
- Obtain all building information on total occupied and air-conditioned areas and it's purpose

Energy supply information:

- Tariff structure, energy consumption and costs
- Maximum demand and costs
- Voltage supply level from TNB and Consumer
- Historical supply information for the past 3 years
- Power factor information

Energy usage information:

- Power distribution profile monitoring and analysis for overall electrical supply and main electrical powered equipment for a period of 7 days;
 - To conduct electrical energy load loss survey and site evaluation for the transformers and UPS system after the meter (if necessary and have potential energy savings);
 - Study on the energy usage for all equipment and systems.
 - Establish electricity consumption distribution based on equipment/systems e.g. air-conditioning, lighting, office equipment etc. in kWh and percentage;
- Establish Energy Indices for the building:
 - Building Energy Index (BEI) kWh/m²/year & GJ/m²/year
 - Net Building Energy Index (BEI) kWh/m²/year & GJ/m²/year
 - Building Energy Intensity Index (BEII), kWh/m²/year/person & GJ/m²/person
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 - Baseload power index (Baseload / NFA) [W/m²]
- **Passive System**
 - Window
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 - Design and opening
 - Wall / Roof
 - Insulation

- Material and colour
 - Day lighting opportunities
 - To determine OTTV, RTTV (estimate)
 - Building orientation and footprint
 - Availability of natural ventilation and opportunities
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 - Floor material and colour
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- Active system
 - Air Conditioning Mechanical Ventilation System (ACMV)
 - Identify technical information for key air-conditioning equipment such as chiller, AHU and split units
 - Identify and study operating schedule
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 - Conduct power measurement and analysis for air conditioning systems
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- Study the characteristic of BAS in term of monitoring, control and reporting
- Office Equipment
 - Survey/identify the types of office equipment (printers, computers, photocopy machine, etc) in each room and area with its power consumption (rated capacity, performance rating etc)
- Production Equipment
 - Survey/identify the types of production equipment in each room and area with its power consumption (rated capacity, performance rating etc)

Energy saving potential and measures (ESM)

ESMs (action plan and estimated time required to implement the measure recommended, amount of saving and cost of implementation). The ESMs addresses energy management and energy efficiency. Renewable energy can be included but is not part of the Energy Audit Conditional Grant scope.

- Energy Saving Measures and Recommendations
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- List opportunities for electrical energy saving measures identified (saving to systems/equipment/control/monitoring/management) in tables
 - Each measure should have tables consisting:
 - The assumptions used in estimating the energy savings
 - The methods used in estimating the savings
 - Technical calculation
 - The conditions to achieve the savings
- Identify detailed methods to achieve savings/electrical energy reduction according to:
 - No cost/ min cost – changes of time and operation methods, minor repair / improvements
 - Low and high cost or Medium cost - based on percentage
 - High cost measure
- Estimate total potential electrical energy saving in kWh
- Propose an action plan and the estimated time required to implement each saving measure if the management decides to implement it.
- Propose methods of measurement and calculation to quantify energy savings based on identified saving potentials.

Financial analysis

The basic life cost cycle analysis for the proposed energy saving measures (SPP, ROI)

- Measures and costs
- Each measure and potential saving
- Expected return of investments from financial evaluation tools (e.g. SPP, ROI etc.) in years or months.

Financial and Energy Saving Measures Implementation Plan for Owner to Implement (3 years)

- 1st Year, estimated implementation cost and savings.
- 2nd Year, estimated implementation cost and savings.
- 3rd Year, estimated implementation cost and savings.

The ESMs implementation planning addresses energy management and energy efficiency. Renewable energy can be included but is not part of the Energy Audit Conditional Grant scope. The total cost and savings from renewable energy are not counted as implementation and savings achieved under this EACG scheme.

1.3 INFORMATION ON THE AUDITED SYSTEMS / EQUIPMENT

Auditor to provide the information on the systems or equipment audited.

Example:

At the building, there are several systems available and functional. One of the biggest systems is the Air Conditioning and Mechanical Ventilation (ACMV) where a total capacity of 900 RT was installed at the facility. A number of the systems are audited to find out the relevant information on their performance. The audited systems are as follows;

System	Unit	Total Rated Capacity	Rated Performance	Measured Performance
Water Cooled Chiller	3	900 RT	0.6 W/RT	
Water Cooled Chiller	1	450 RT	0.6 kW/RT	
Cooling Tower	4	2,000 RT	8 % effectiveness	
Air Cooled Chiller	1	1 RT	1.1 kW/RT	
Air Handling Unit	45	** Btu/h @ kW		
Fan Coil Unit	15	** Btu/h @ kW		
Air-Conditioning Split Unit	20	** Btu/h @ kW	** kW/RT	
Vertical Transport	10	kW		
Lighting	500	94 kW		
Pumps	3	45 kW		

Table 1-1: Information on Audited Systems

1.4 INFORMATION ON BASELINE PERIOD

Example:

For [building name], the baseline was set up for the period of [baseline period]. A sum of ***** kWh @ *** GJ had been consumed for that period which is equivalent to Rm ***. At the moment, only one type of energy being used which is electrical energy, supplied by Tenaga Nasional Berhad (TNB). With a net floor area of *** m², the energy intensity performance is *** GJ/m². The summary information for the baseline consumption is as follows;

Information			* Baseline period (Annual) (mm/yyyy – mm/yyyy)
Energy or Energy Resources	(Energy or Energy Resources name)	(Unit of measurement)	
	Electricity	kWh	
		GJ	
	Natural Gas	MMBtu	
Total Energy GJ			
***List of variables	(Variable name)	(Unit of measurement)	
	Occupancy	pax	
	Operating hour	hour	
	Gross Floor Area	m ²	
Energy intensity performance		(Unit of measurement)	
		GJ/m ²	

Table 1-2: Summary information for [baseline period] at [building name]

Note:

Table 1.2: Summary information is mandatory. Please do not remove.

* baseline period shall be in month and year as specified in the tables above.

** for conversion to GJ, please refer to the Appendix F: Conversion Coefficients and Equivalence

*** examples of variable data such as operating hours, production volume, weather, occupancy, etc which affects the energy consumption of facility or SEU, as referred to the Guidelines on Energy Management System issued by the Commission.

1.5 LOAD APPORTIONING

The findings shall provide the distribution of the total electrical energy consumption among the electrical SEU, based on the load data collected

Example:

At the building, the biggest consumption was Air Conditioning and Mechanical Ventilation (ACMV) which is 74% followed by Lighting system and Plug load. Chiller consumed 49% of the total energy while lighting system and plug load are 11% and 9% respectively.

System	Measured Energy, GJ	Percentage
Chiller		
Cooling Tower		
Lighting		
Plug load		
AHU		
ACSU		
Others		
Total	XX	100%

Table 1-3: End Load Apportioning

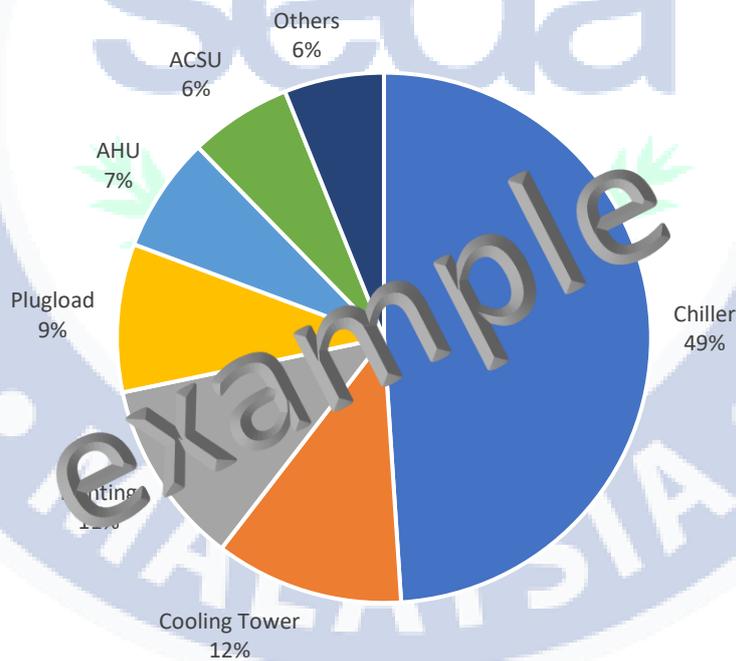


Figure 1-1: End Load Apportioning

1.6 ENERGY SAVING MEASURES

Brief summary of energy savings recommendations.

Example:

Six (6) Energy Saving Measures (ESMs) have been identified in the Energy Audit conducted. The baseline energy consumption was found to be ******* GJ/year**. By implementing all recommended Energy Saving Measures, the energy consumption for **Building name** can be reduced by about **23%**, or **52,416kWh @ 188.69 GJ** per year representing **RM15,096.00** in monetary value. The estimated budget cost of implementing the Energy Saving Measures is **RM27,042.00** with a payback period of about **1.79 years**. The estimated savings, investment costs and Simple Payback Period of all recommended Energy Saving Measures, are listed in the table below.

No	Category <i>Operation/ System/Equipment</i>	Type <i>Air conditioner/Chiller/AHU, compressor, fan, lighting, motor, pump, boiler, thermal oil heater, furnace, etc..</i>	Description	Energy Baseline by System (GJ/year)	Estimated Yearly Saving		Estimated Investment (RM)	Estimated Simple Payback Period (Years)	Estimated Carbon Reduction (Ton/year)	Overall Percentage Saving (%)
					Energy (GJ)	Cost (RM)				
No-Cost										
1										
2										
				Total						
Low/Medium-Cost										
3										
4										
				Total						
High-Cost										
5										
6										
				Total						
				Overall						

Note:

**for "Category" and "Type", reference shall be made to the Guidelines on Energy Efficiency and Conservation Report issued by the Commission.*

***Overall percentage saving" shall be based on Energy baseline (["estimated yearly saving"/Energy baseline] GJ/year * 100%)*

Table 1-4: ESM Summary Table

Using the estimated current annual energy consumption **232,050kWh @ *** GJ** and [Gross floor area], the current Building Energy Intensity (BEI) is **274 kWh/m²/year @ **** GJ/ m²/year** costing **RM67.68 /m²/year** and after implementing all recommended Energy Saving Measures to **163 kWh/m²/year @ **** GJ/ m²/year** costing **RM52.13/m²/year**. The percentage reduction is **41%**.

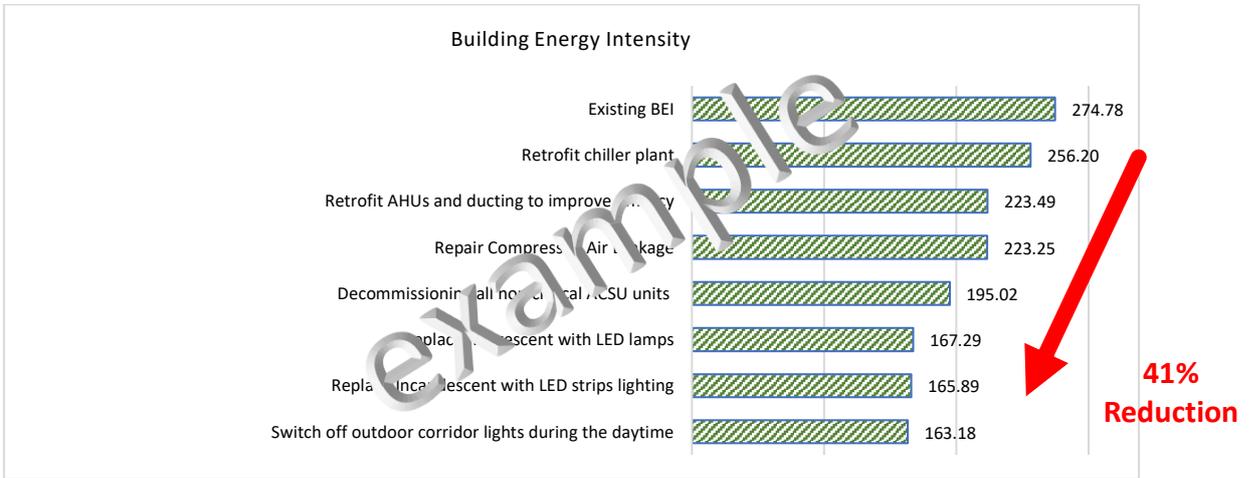


Figure 1-2: BEI Reduction Chart

(Refer diagram below on the number of diamonds achieved based on the percentage reduction in energy consumption- GreenPASS certification for Commercial Sector only)

Level of achievement (% of CO ₂ e reduction)	Assessment Scheme for Existing Buildings
100% Carbon Neutral	◆◆◆◆◆
≥ 70 to < 100	◆◆◆◆◆
≥ 50 to < 70	◆◆◆◆◆
≥ 30 to < 50	◆◆◆◆◆
≥ 10 to < 30	◆◆◆◆◆
≥ 1 to < 10	◆◆◆◆◆

Based on the SEDA Sustainable Energy Low Carbon Building Assessment GreenPASS by Construction Industry Standard 2012 CIS20, the level of achievement in **xx** % carbon reduction is eligible for **xx** diamond certification. All the information can be obtained from the SEDA website.

<https://www.seda.gov.my/greenpass>

2 INTRODUCTION

The introduction **SHALL** include the details on audited facility, brief description of all energy resources consumed at the facility, constraints faced while conducting energy audit, and justification on scope of energy audit.

Example:

Building name was built in 2004 and has been in full operation for the last 22 years. It comprises of two (2) floors consisting of a Ground Floor and 1st Floor. The General Office, Cubicle Office Rooms, Meeting Rooms, Laboratories, Pantry and Café occupy the Ground Floor. The 1st Floor consists of a small area for the Air-conditioning Plant Room, which is next to the Library and another general office area.

With a capacity of 200 occupants, the building serves as the head office for Client name. The building operates from 8.30 am to 5.30 pm daily. Saturday and Sunday are non-working days. In general, the main function of the building is to serve as an office and also as a research centre.

Building Name	:
Address	:
Business Activities	:
Number of employees	:
Sector	:
Sub-sector <i>(Refer to Appendix B, EE & C report)</i>	:
In operation since:	:
Gross Floor Area, m ² (GFA)	:
Air-Conditioned Area, m ² (relative to GFA)	:
Data Centre Area, m ²	:
Enclosed Parking Area, m ²	:
External corridor area, m ²	:
Historical variables for baseline period	:

Table 2-1: Building Description

The selection of "Sector" and "Subsector" can be referred to Appendix B of the Guidelines on Energy Efficiency and Conservation Report issued by the Commission

2.1 BUILDING ORIENTATION AND FOOTPRINT

Brief description of the building orientation

Example:

The building has an East and West orientation with the longest parts of the building facing East and West. This will allow sunlight to enter the building throughout the day causing an increase in heat gain.



Picture's of building – side, front, top views

Description	Gross Floor Area	Air-Conditioned Area	Height (m)
Client name	83,000	45,900	35 (6 floors)

2.2 BUILDING ENVELOPE

REA to provide information on the building envelope, if there is sufficient data.

Example:

The OTTV and RTTV criteria, as recommended in MS1525:2019, is used to determine the heat transfer into the building by evaluating the material performance. The thermal performance of the materials is calculated by considering three major conditions of the building which are heat conduction through walls, heat conduction through windows and solar heat gain through windows by radiation. As recommended in the standard, the OTTV of an air conditioned building should not exceed 50 W/m² and the RTTV not more than 25 W/m².

2.2.1 Window (if any)

Shading/glazing level

Example

Each façade has similar features of shading geometry. Generally, all fenestrations have arches on the 5th level and long pillars at the base of the arches extending all the way down to the 2nd floor.

No.	Description	Thickness (mm)	U-Value (W/m ² K)
1	Fenestration Laminated toughened tinted glass	12	4.8

2.2.2 Wall Structure (if any)

Type of material, insulation, colour

The building envelope material for **building name** is shown in the Table. The data for the building material was obtained from the building architectural drawings. The wall material is Granite and there is a layer of asbestos. The colour of the building is mainly light grey with an α value of 0.45.

Material	Thickness (m)	Density kg/m ³	k-value W/m K	Resistance (m ² K/W)
Outside air film	-	-	-	0.06
Cement Plaster	0.02	1890	0.836	0.02
Granite Slab	0.40	2640	2.927	1.17
Asbestos	0.003	720	0.108	0.03
Cement Plaster	0.02	1890	0.836	0.02
Inside air film	-	-	-	0.15
Total Resistance				1.45
U-Value				0.67

2.2.3 Roof Structure (if any)

Type of material, insulation, colour

The material is roof tile with a layer of reflective foil and fibreglass and a layer of asbestos above the ceiling. The colour of the roof is medium grey.

Material	Thickness (m)	Density kg/m ³	k-value W/m K	Resistance (m ² K/W)
Outside air film	-	-	-	0.06
Roof Tile	0.07	1890	0.836	0.02
Reflective Foil & Fibreglass	0.03	32	0.035	1.43
Asbestos Board	0.003	720	0.108	0.03
Inside air film	-	-	-	0.15
Total Resistance				1.68
U-Value				0.59

2.2.4 OTTV/RTTV (if any)

The OTTV of the building was calculated using the Window Wall Ratio and U values of the Window and Wall respectively.

Window to Wall Ratio Table

Wall	Total Glass Area (m ²)	Total Façade Area (m ²)	WWR
North West Wall	1037.18	8938.715	0.12
North East Wall	355.6	4108.48	0.09
South East Wall	1027.24	8938.72	0.11
South West Wall	355.60	4108.48	0.09

The overall window area amounts to only 10% of the total building façade area.

OTTV Table for each façade and total OTTV

OTTV (North West)	OTTV (North East)	OTTV (South East)	OTTV (South West)	Total OTTV
20.34	21.28	21.39	20.34	21.02

The building **Total Building OTTV** is calculated to be **21.02 W/m²**. The detailed calculation is shown in Appendix 1.1. The building can be said to be well insulated from outside heat gain due to the small window area and thick wall construction.

RTTV Table for each roof orientation and total RTTV are provided below;

	Gross Roof Area (m ²)	RTTV
Flat Roof	108346.1	108346.1
North East	21244.33	21244.33
North West	40734.93	40734.93
South East	41647.44	41647.44
South West	21700.58	21700.58
Total RTTV	16389	14.26

There is no skylight for this roof structure. The **RTTV** was calculated to be **14.26 W/m²**.

2.3 DAYLIGHTING

Example:

Due to the small window area, there is not much opportunity for daylighting into the building.

2.4 NATURAL VENTILATION

Example:

The building is air conditioned and there are no openings within the building structure for natural ventilation.

2.5 CEILING (HEIGHT) AND FLOOR – MATERIAL AND COLOUR

Example:

The ceiling height for is 7.1m for both the 1st and 2nd floors and 5m for the remaining floors. The inner wall colour is mainly white with the library walls being light yellow.

2.6 LANDSCAPING

Example:

The green area surrounds the outer perimeter of the building. There is no greenery or vegetation at the roof levels of within the building. There is a water fountain in the garden just outside the building.

2.7 ENERGY MANAGEMENT MATRIX REVIEW

To assess the current performance and indicate the achievable target

Example:

An assessment was carried out to determine whether an Energy management system (EnMS) is in place in the building. An energy management matrix was used to determine the scope of energy practices being implemented in the building.

	Policy and Systems	Organization	Motivation	Information System.	Training and awareness	Investment
4	Formal energy /environmental policy and management system, action plan and regular review with commitment of senior management or part of corporate strategy 	Energy / environmental management fully integrated into management structure. Clear delegation of responsibility for energy use 	Formal and informal channels of communication regularly exploited by energy / environmental manager and staff at all levels 	Comprehensive system sets targets, monitors materials and energy consumption and wastes and emissions, identifies faults, quantifies costs and savings and provides budget training 	Marketing the value of material and energy efficiency and the performance of energy / environmental management both within the organization and outside it 	Positive discrimination in favour of energy / environmental saving schemes with detailed investment appraisal of all new build and plant improvement opportunities 
3	Formal energy / environmental policy but no formal management system and with no active commitment from top management	Energy / environmental manager accountable to energy committee, chaired by a member of the management board	Energy / environmental committee used as main channel together with direct contact with major users	Monitoring and targeting reports for individual premises based on sub-metering / monitoring but savings not reported effectively to users	Programme of staff training, awareness and regular publicity campaigns	Same pay back criteria as for all other investments. cursory appraisal of new build and plant improvement opportunities
2	Unadopted / informal energy / environmental policy set by energy / environmental manager or senior departmental manager	Energy / environmental manager in post, reporting to a hoc committee but line manager not a authority unclear	Contact with major users through ad-hoc committee chaired by senior departmental manager	Monitoring and targeting reports based on supply meter / measurement data and invoice. Env / energy staff have ad-hoc involvement in budget setting	Some ad-hoc staff awareness and training	Investment using short term pay back criteria mostly
1	An unwritten set of guidelines 	Energy or environmental management the part-time responsibility of someone with only limited influence or authority 	Informal contacts between engineer and a few users 	Cost reporting based on invoice data. Engineer compiles reports for internal use within technical department 	Informal contacts used to promote energy efficiency and resource conservation	Only low cost measures taken
0	No explicit policy	No energy environmental manager or any formal delegation of responsibility for env/energy use	No contact with users	No information system. No accounting for materials and energy consumption and waste	No awareness raising of energy efficiency and resource conservation 	No investments in increasing environmental performance of energy efficiency in premises 

Table 2-2: Energy Management Matrix



Current



Target

2.8 THE SUMMARY FROM PREVIOUS ENERGY AUDIT REPORT

Example:

As of now, there was no Energy Audit had been done before and this will be the first audit to be done. Thus, it is important for the building owner to find out the performance of the building in order to find opportunity for energy savings. At the same time, there was no Energy Saving Measures had been done and this is reflected in the Energy Management Matrix.

2.9 THE STATUS OF IMPLEMENTATION OF ESM FROM PREVIOUS ENERGY AUDIT REPORT

Example:

As there is no energy audit done before, no ESM had been proposed ever.

2.10 ENERGY RESOURCES CONSUMED AT THE FACILITY

To provide brief description of all energy or energy resources consumed at the facility

Example:

As an office building, this facility consumed only one type of energy resource which is electrical energy, supplied by Tenaga Nasional Berhad (TNB). The account number is 7681304 with a tariff of C2.

2.11 THE CONSTRAINTS FACED WHILE CONDUCTING THE ENERGY AUDIT

such as difficulty in getting information, limitation and disclaimer, if applicable. State and justify any possible constraints involved in conducting the audit, such as availability of sub-metering, assumptions used in analysis, basis of estimation approach used and the limit of the responsibility or legal liability.

Example:

During the audit activities, a few constraints were faced by the auditor where the MSB itself is hard to be accessed due to small space. The auditor also had to face with the difficulties to set up the data logger due to restriction from the building owner's side. However, the issues were handled as professional as we can with the help from the on-site chageman.

2.12 THE JUSTIFICATION ON THE SCOPE OF THE ENERGY AUDIT CONDUCTED BY THE REA

Example:

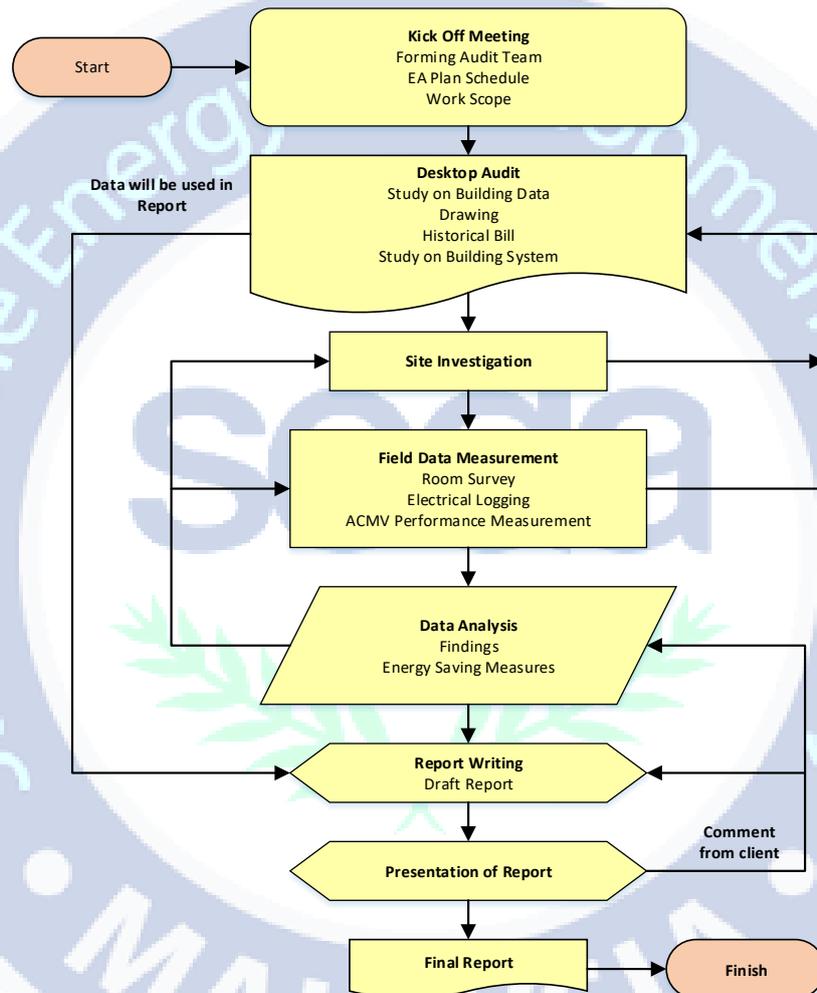
As an office building, the scope conducted is relative to the daily operation of the building usage. The ACMV which is expected to be the highest energy consumer needs to be audited where it has the biggest potential for energy reduction. Reducing a portion of energy consumption from the ACMV will result in bigger overall saving percentage. For the lighting system, the current usage is the second largest among other system in the building where a sum of 5,907 units of lightings had been detected. As such, it is necessary to find out any possible saving measures to be taken to further reduce the consumption.

3 ENERGY AUDIT METHODOLOGY

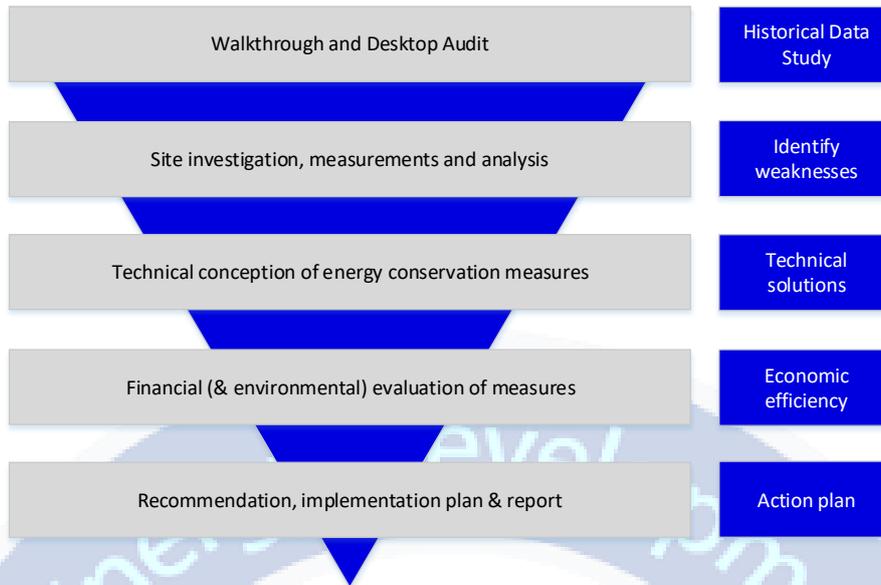
SHALL include but not limited to chronology and description of the methods, timeframe, list of tools

Example:

The methodology used for the energy audit is based on SEDA's guideline shown below. The kick off meeting was held on **date/time**. All desktop data was made available to the energy audit team prior to the on-site audit works. The on-site audit works was held between **date** and **date**. There were some delays due to unforeseen circumstances, but the energy auditor managed to complete all works within the stipulated timeframe.



The data collection and analysis of all data was completed within the timeframe given. The energy baseline was determined from the past year TNB bills analysis and was cross referenced with the 2 week data logging that took place at the beginning of the audit. During the on-site survey and investigation, several weaknesses on energy wastage were identified. These are listed in the energy supply and consumption analysis sections. Recommendations for energy saving opportunities, financial evaluation and projected implementation was completed in the last week before submission of the draft report and are highlighted in the energy saving and financial evaluation, and implementation sections of the report. Refer figure below.



3.1 TYPE OF ENERGY AUDIT AND PROCESS

Example:

The energy audit conducted was a Detailed Energy Audit or also known as **ASHRAE Level II** which included a detailed survey of the premises. Detailed data collection was obtained through on-site measurements such as power data logging and on-the-spot measurements. The energy audit focussed on significant energy use including the chilled water plant, air handling units and lighting.

The detailed analysis was done based on the data collected with estimated energy use values and costs to develop a proposal for implementation of energy saving projects.

3.2 ENERGY AUDIT TIMEFRAME

Example:

The time schedule for carrying out the audit is a per table below. The audit started on 2 Mar 2022 and was completed on 20 May 2022. There was a 2 week delay due to shutdown of some of the processes in the plant for maintenance works.

Indicators	Task Name	Duration	Work	Jan	Feb	Mar	Apr
1	Energy Audit Proposal for 3G3	81 days	0 hrs	[Gantt bar spanning from Jan to Apr]			
2	Preliminary Walkthrough	5 days	0 hrs	[Gantt bar in Jan]			
3	Detailed Energy Audit	61 days	0 hrs	[Gantt bar spanning from Jan to Apr]			
4	Desktop Data	5 days	0 hrs	[Gantt bar in Jan]			
5	Field Measurement & Observation	25 days	0 hrs	[Gantt bar spanning from Jan to Feb]			
6	Data Analysis	8 days	0 hrs	[Gantt bar in Feb]			
7	Load Demand	8 days	0 hrs	[Gantt bar in Feb]			
8	Energy Saving Measures	15 days	0 hrs	[Gantt bar spanning from Feb to Mar]			
9	Report	15 days	0 hrs	[Gantt bar spanning from Mar to Apr]			
10	1st Draft & Presentation	15 days	0 hrs	[Gantt bar spanning from Apr to May]			

Table 3-1: Energy Audit Timeline

3.3 ENERGY AUDIT EQUIPMENT

A list of the measurement tools used by the REA to conduct the energy audit. The measuring tools used for the purpose to conduct the energy audit shall be calibrated once every two years and the calibration record shall be included in the energy audit report as part of its appendices.

Example:

The type of audit equipment used are as per table below:

Equipment	Function
	<p>Data Loggers / Power Monitoring Meter (Single/3phase) Measures electrical power parameters such as kWh, kVAh, kVAh and power factor (pf) Other parameters measured include Frequency, Maximum Demand, Voltage, Current and Power Quality It is normally used to check for electrical faults and if the phases are balanced.</p>
	<p>Thermo hygrometer (Temperature/ Relative Humidity Meter) Measures the temperature as well as the relative humidity of an area. It is normally used for air conditioning design or investigations. Usually measured in °Celsius/°Fahrenheit and %Relative Humidity</p>
	<p>Anemometer Measure the air velocity flowing through a channel. It is normally used for measuring air flow in an air handling unit, at duct intakes and openings such as doorways. Usually measured in m/s.</p>
	<p>Tachometer Measures motor speed on shafts. It is also used to calculate motor efficiency.</p>
	<p>Ultrasonic Flowmeter Measures the velocity of fluid over a known area. It is normally used for measuring chilled water flow in pipes. Usually measured in l/s.</p>

Table 3-2: List of Audit Equipment

3.4 POLICY AND TARGETS

Policy declaration and brief description of targets and timeframe

Example:

Client name has an Energy Management Policy in place. The Client is committed to ensuring that all activities in the company are carried out sustainably. Some of the commitments are listed below:

1. Provide adequate training for employees
2. Employ energy conservation and saving practices to all levels of the company
3. Committed to make information on energy conservation and resource available to all levels of the company
4. Committed to comply with local legal requirements where necessary
5. Continuously monitor and control energy consumption
6. Identify energy wastages and take corrective measures to eliminate them
7. Procure energy efficient products
8. Periodically review and improve goals for a successful sustainability program

Targets for the energy management program for **Client name** are:

1. Real live tracking of energy consumption and maximum demand control
2. Reduce energy cost by 20% within the next 3 years
 - Through implementing energy saving measures
 - Procuring energy efficient equipment
 - Upgrading lighting system and control
 - Training to continuously optimize energy consumption

3.5 ENERGY DATA, DOCUMENTATION AND MONITORING

Describe the level of documentation available in the organization, policies, records, regulations, guides, training in relation to energy management

Describe monitoring of energy use procedures, energy performance indicators, effectiveness of action plans in achieving objectives and targets, evaluation of actual vs expected energy consumption – results from monitoring and measurement should be recorded

Example:

The energy consumption documents as well as information pertaining to energy consumption such as policy, regulations, procurement documents, design and installation drawings, testing and commissioning reports and financial evaluation reports are kept in the administration office under the purview of the Registered Energy Manager (REM), **name** and is accessible to the top management and energy management team. For every quarter, a monthly assembly will be done and the performance of the energy consumption will be presented to the staffs.

The REM sees to monitoring the energy consumption of the company. Two (2) energy audits have been conducted in the past 8 years and some minor energy saving implementation projects have been carried out, i.e. replacing LED in certain areas and purchasing 5-star appliances for the office.

The REM also reports the energy consumption to Suruhanjaya Tenaga, Malaysia yearly as per requirement.

3.6 COMPLIANCE TOWARDS REGULATIONS

Describe evaluation procedures in complying with legal requirements in relation to energy use and consumption, records

Example:

The company is subject to **Energy Efficiency and Conservation Act (EECA) 2024**:

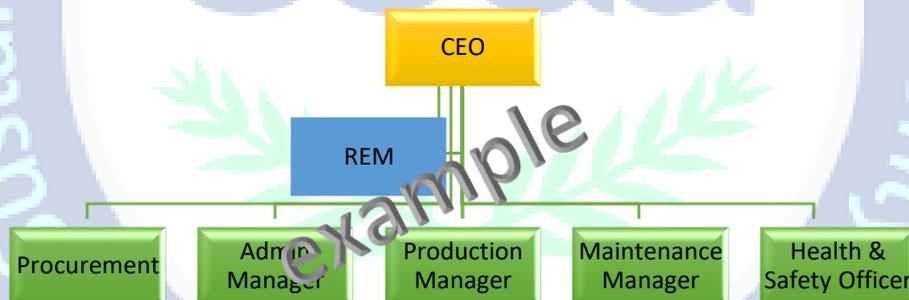
1. Is applicable to large energy users, i.e. 21,600 GJ consumption for one year
2. Appointment of Registered Energy Manager
3. Energy Management System (EnMS)
4. Energy Efficiency and Conservation report
5. Energy Audit
6. Energy Audit Report

3.7 ENERGY MANAGEMENT TEAM

List names, position and role

Example:

The energy management team is headed by **Manager name** and assisted by his team members as shown in the Chart. The CEO overlooks the whole energy management activities carried out by the company. The team meets once a week to discuss issues pertaining to energy consumption and production output. The activities are mainly carried out by the Maintenance Team and reported back to the energy management team.

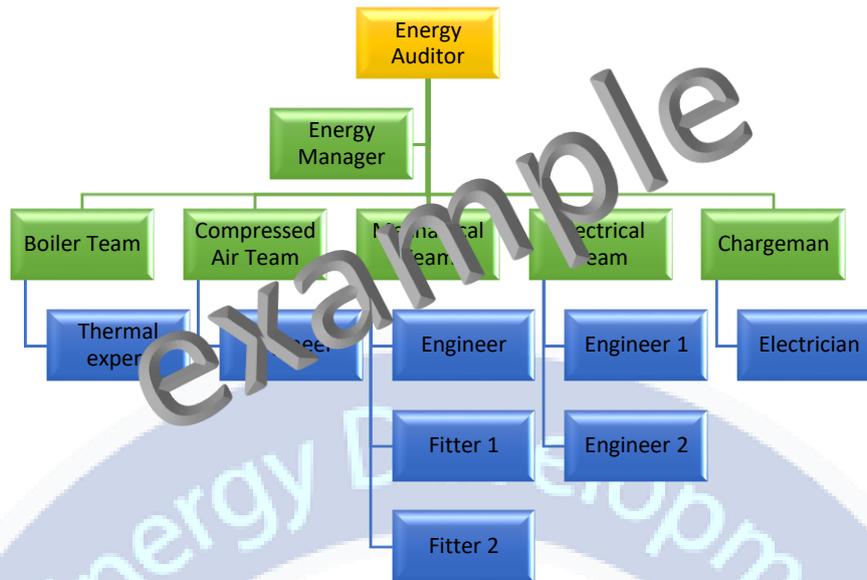


3.8 ENERGY AUDIT TEAM

List names, position and role

Example:

The energy audit team is headed by **auditor lead** and assisted by his team members as shown in the Chart. The Energy Auditor is assisted by a team of experts from various fields of expertise to carry out the various types of energy audit measurements. The data is compiled by the Energy Manager who analysed the data and prepared the energy audit report.



3.9 OPERATIONS AND MAINTENANCE SYSTEM REVIEW

List scope of works involved for energy management

Example:

The Operation & Maintenance Contract for the building covers the following:

- Monitoring and managing energy usage and conservation
- Steps taken and opportunities identified to reduce energy consumption
- Operate a continuous improvement process on energy usage
- Review annually the building performance against current best practice and institute an energy conservation program for the following year
- Demonstrate innovation in the efficient use of energy and materials to provide a sustainable environment
- Conduct energy audits
- Implement energy saving opportunities in stages
- All relevant building energy parameters shall be monitored before and after the energy saving measures are implemented
- An energy saving baseline shall be established for comparison
- Conduct training for awareness to staff
- Integrate best energy practice in the daily operation and servicing of the building

4 DETAILS OF OPERATION OF THE FACILITY

*This section shall provide **detailed description** of the function and operation of the facility that may include the detail of production process, operation hours, type of machinery used, and significant energy consumption machinery or equipment.*



5 DESCRIPTION OF THE EQUIPMENT OR SYSTEM AUDITED

5.1 ELECTRICITY SUPPLY

5.1.1 SYSTEM DESCRIPTION

The report shall provide information about the electrical distribution system of the facility and a single line diagram which includes but not limited to voltage level, rating and number of transformers installed and tariff used. Include Solar generation as well if any.

Example:

The building has two 11kV/415V TNB Incomers supplying power to the building. The building electrical supply and distribution system then feeds into two transformers Tx1 and Tx2. Both transformers are rated at 2500kVA/3500kVA. The transformers feed 2 MSBs labelled MSB1 and MSB2 respectively. The Annex building also obtains its power supply from the main building MSBs.

Two (2) 1250kVA Gensets are used for back-up supply in case of power failure. The two gensets are on standby during power failure. The tariff used for this facility currently is Tariff C1, Medium Voltage with the energy consumption charge at 36.5 cent per kWh and maximum demand charge at RM30.30 per kW. The average cost is RM0.43/kWh.

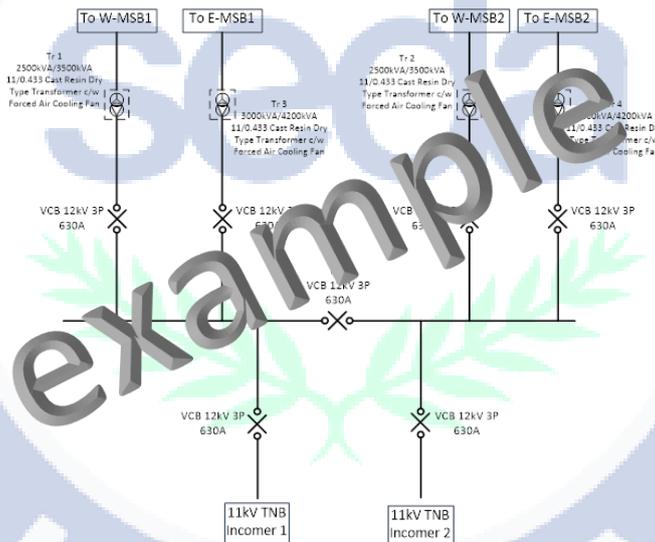


Figure 5-1: Simple Single Line Diagram

	Tariff Usage	C1: Medium Voltage
	Incoming Voltage	11 kV / 415 V
Year	Energy Rate (RM/kWh)	Maximum Demand Rate (RM/kW)
Jan 2014- present	RM0.365	RM30.30

Table 5-1: Electrical Supply Information

5.1.2 BUILDING LOAD PROFILE ANALYSIS

For systems with more than 1 MSB, please provide **the total MSB loads** for the total building load profile and **the individual MSB**. The period shall be a minimum of 7 days as stated in EECA 2024. Include Solar generation as well (if any) and REA to provide baseload power (kW).

Example:

Data Loggers to measure power in a half-hourly profile were installed in both MSBs. The loggers recorded the voltages, average frequency and power factor for the 3 phases. The electrical load profiles were recorded on a daily and weekly basis. Both weekday and weekend profiles were captured and monitored. The total load profile is shown in the following graph.

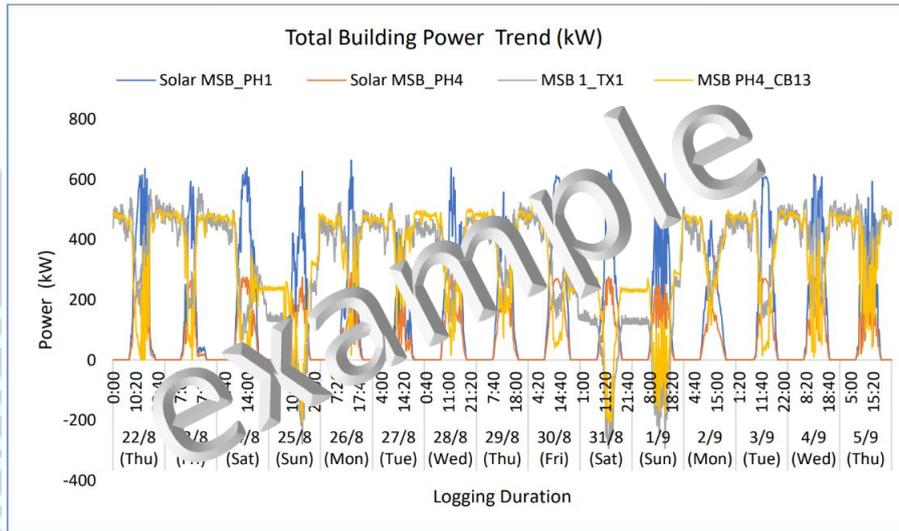


Figure 5-2: Total Building Load (Including Solar)

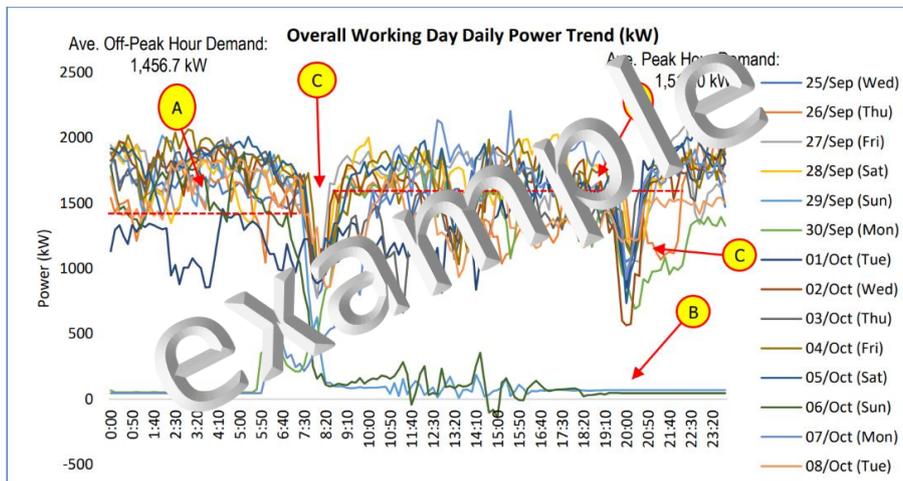


Figure 5-3: Daily Load Profile

	TX 1	TX 3	TX 4	TX 5	TX 7	TX 8	Total
	MEC 1	CM 1	CHILLER 1A	MEC 2	CM 2	CHILLER 1B	
Max, kW	726.30	650.27	2145.00	59.72	537.50	591.00	4497.33
Average, kW	401.45	250.15	735.85	31.92	400.51	274.33	2065.73
Min, kW	41.13	127.51	0.00	6.25	234.77	0.00	421.08
Load Percentage	14%	13%	48%	1%	11%	13%	

Table 5-2: Summary for MSB

5.1.3 IDENTIFICATION OF SIGNIFICANT ENERGY USAGE (SEU)

To provide the active system chart, the methodology used to identify the SEU, and analysis on the building load. Refer to Section G, 4.1.9 (c) of Guidelines on Energy Audit Report.

Example:

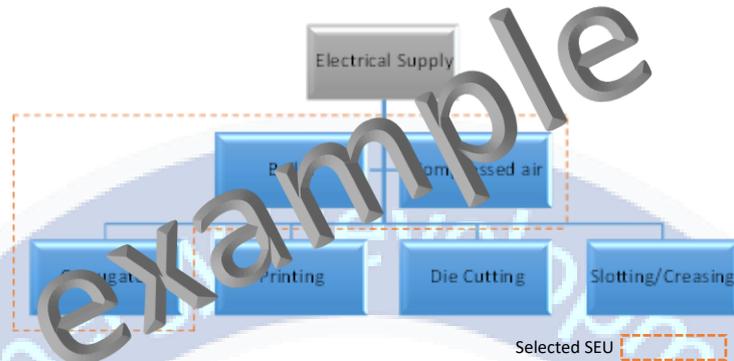


Figure 5-4: Active System

5.1.3.1 METHODOLOGY USED TO IDENTIFY SEU

REA to explain the methodology used to identify the SEU at the building

5.1.3.2 TECHNICAL DESCRIPTION OF THE IDENTIFIED SEU

Discuss the technical description and plot of the electrical load profile of the identified SEU which includes but not limited to –

- a) lighting system;
- b) air conditioning system including –
 - i.chiller;
 - ii.cooling tower;
 - iii.Air Handling Unit; or
 - iv.split unit air conditioning system;
- c) motor system;
- d) pump system;
- e) air compressor system;
- f) industrial furnace system;
- g) oven system;
- h) lift system; or
- i) escalator.

5.2 THERMAL ENERGY

5.2.1 SYSTEM DESCRIPTION

The report shall provide information about the thermal energy supply collection, distribution or storages systems and a thermal energy flow diagram.

Example:

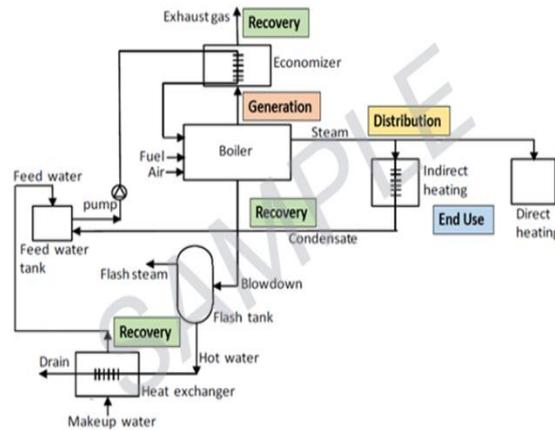


Figure 5-5: Sample of thermal energy flow diagram

5.2.2 TECHNICAL DESCRIPTION

Briefly describe the technical description on the thermal energy of the facility which includes but not limited to –

- (i) heat generation and distribution;
- (ii) heat-use processes;
- (iii) waste heat utilization; or
- (iv) co-generation.

5.2.3 IDENTIFICATION OF SIGNIFICANT ENERGY USAGE (SEU)

Description and identification of SEU for thermal energy which shall include the following

- (i) the methodology used to identify the SEU;
- (ii) the technical description and plot of the thermal load profile of the identified SEU which includes but not limited to –
 - A. reactor;
 - B. boiler system;
 - C. dryer system;
 - D. industrial furnace system such as kiln or oven;
 - E. heat exchanger;
 - F. preheater;
 - G. chiller;
 - H. absorption chiller system;
 - I. co-generation system;
 - J. steam system;
 - K. thermal oil heater system; or
 - L. heat pump system.

6 DESCRIPTION OF BASELINE

6.1 MAXIMUM DEMAND REVIEW

Describe maximum demand status and means to control monthly maximum demand levels

Example:

For the baseline period, it was found the maximum demand is ranging from 1,450 kW to 2,588 kW with the highest recorded is 3,150 kW. However, there is currently no maximum demand control in place.

6.2 HISTORICAL ENERGY CONSUMPTION

Describe total energy consumption for the establishment of energy baseline and cost for all energy type with at least 12 months period. Preferably 24 months.

Example:

The Energy Consumption and Energy Costs for the building from 2023 to 2025 are provided below.

Month	TNB (GJ)	Solar (GJ)	Natural Gas (GJ)	Total Energy (GJ)
2025				
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				
Total				

Table 6-1: Historical Consumption for Energy Resources (2025)

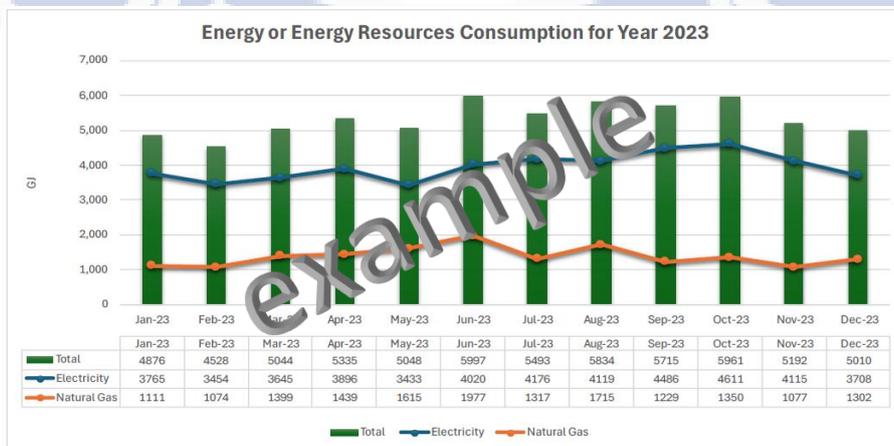


Figure 6-1: Energy Consumption based on Energy Type

Month	TNB (RM)	Solar (RM)	Natural Gas (RM)	Total Cost (RM)
2025				
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				
Total				

Table 6-2: Historical Cost Incurred for Energy Resources (2025)

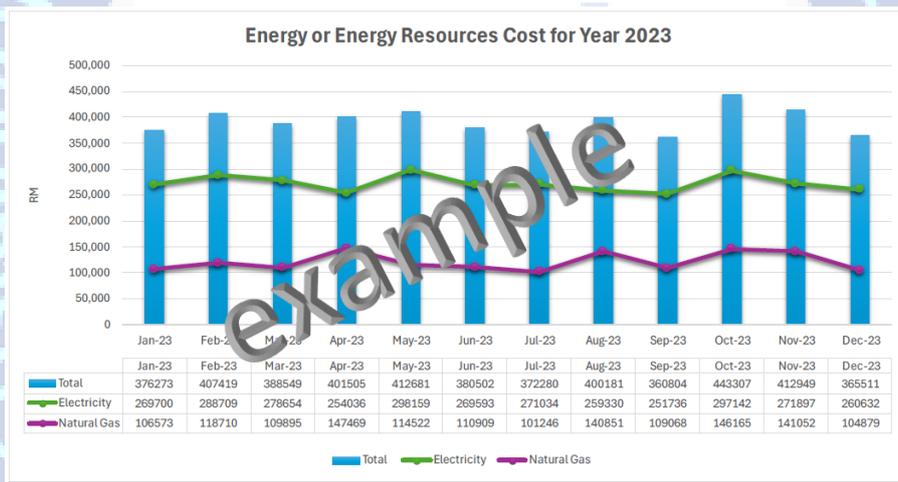


Figure 6-2: Energy Cost based on Energy Type

From the historical, we can see that Solar generation covers 15% of the total energy at this plant while.....(to analyse the consumption for each energy resource)

TNB Bill Analysis-

Month	Off-Peak	Peak	Maximum Demand	Energy Cost (RM)
2025				
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				
Total				

Table 6-3: Historical Electrical Consumption for 2025

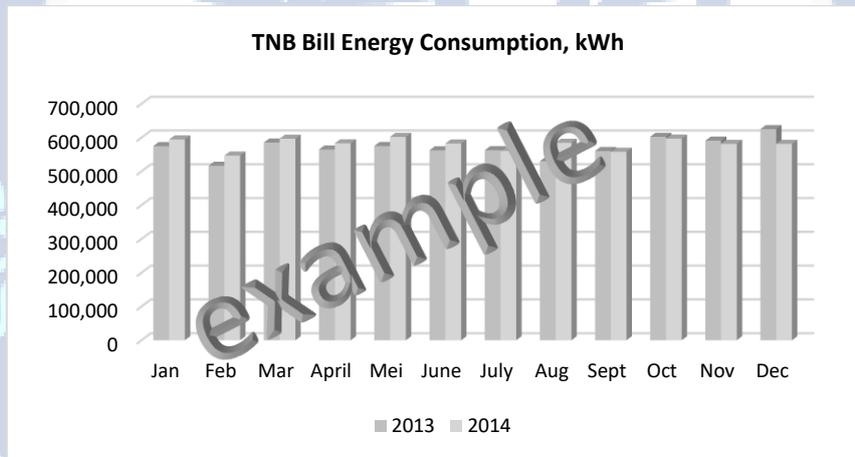


Figure 6-3: Electrical Energy Consumption, kWh

The energy consumption is seen at the lowest in the month of July as there were many holidays during that month. The trend is showing a higher consumption in year 2014 compared to 2013, but the consumption had been decreasing at the end of the year starting on September 2014.

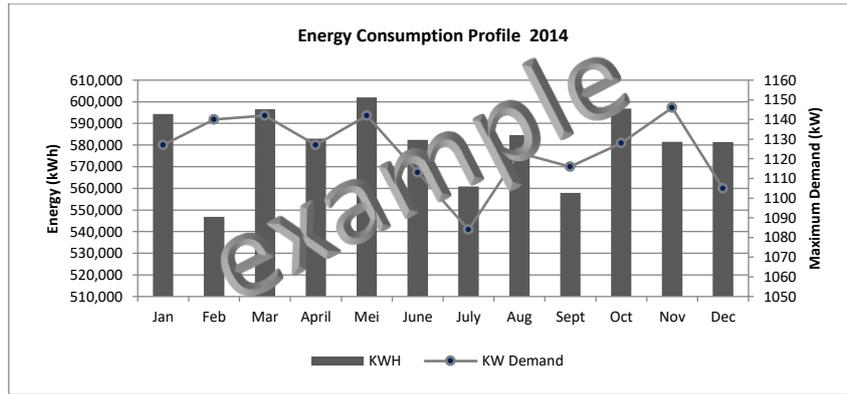


Figure 6-4: Energy Consumption, kWh versus Maximum Demand, kW

The maximum demand reading is fluctuating which shows it does not directly proportionate with the monthly energy consumption. The data on February show maximum demand value is high however the monthly energy consumption is showing the lowest reading for 2014. This mean the energy consumption is not directly affected by the maximum demand.



6.3 HISTORICAL VARIABLES DATA

Provide the historical production data.

Example:

Table below shows the data for the independent variable and the dependent variable is operating throughout 2021 to 2023.

	Month	Independent variable	Independent variable	Independent variable	Energy Consumptions (kWh)
2021	Jan				
	Feb				
	Mar				
	Apr				
	May				
	Jun				
	Jul				
	Aug				
	Sep				
	Oct				
	Nov				
	Dec				
2022	Jan				
	Feb				
	Mar				
	Apr				
	May				
	Jun				
	Jul				
	Aug				
	Sep				
	Oct				
	Nov				

	Dec				
2023	Jan				
	Feb				
	Mar				
	Apr				
	May				
	Jun				
	Jul				
	Aug				
	Sep				
	Oct				
	Nov				
	Dec				

Table 6-4: Variables used for Regression Analysis

6.4 REGRESSION ANALYSIS

To do regression analysis for the relationship between energy or energy resources consumption and relevant variables such as the operating hours, production output, etc. Consist of Single Regression Analysis and Multiple Regression Analysis.

Example:

There are three (3) major factors related to Energy Consumptions determined for **building name** which are as follows:

1. No of working days;
2. No of events;
3. Occupancy

Multiple Analysis using Three (3) Variable Factors

Multiple Regression Analysis was performed using Microsoft Excel for number of patients, number of working days as the multiple independent variables. Table below shows the summary of output of the Regression Analysis. From Table, the y-intercept, the coefficient of each independent variable as in Equation 1, R-square (coefficient of determination) and standard error of the mathematical modelling can be obtained.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.913109046
R Square	0.83376813
Adjusted R Square	0.771431179
Standard Error	17490.6745
Observations	12

ANOVA					
	df	SS	MS	F	Significance F
Regression	3	12275356217	4091785404	13.37518003	0.001749518
Residual	8	244719535	3059244.3		
Total	11	12520075576			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	4938.496614	200563.202	0.024623144	0.980958673	-457561.0765	467438.0697	-457561.0765	467438.0697
No of Patients	47.56917116	15.15889545	3.13803676	0.013846208	12.61269557	82.52564675	12.61269557	82.52564675
No of Working Days	18439.21638	7182.802472	2.567133992	0.033275587	1875.64418	35002.78858	1875.64418	35002.78858
CDD- Accuweather	209.8566564	379.5745498	0.552873359	0.595456861	-665.443825	1085.157138	-665.443825	1085.157138

Table 6-5: Regression with Three Independent Variables

$$Y = 47.57x_1 + 18439.21x_2 + 209.85x_3 + 4938.49$$

Where,

Y = Electricity consumption (kWh)

X1 = independent Variable

X2 = independent Variable

X3 = independent Variable

4938.49 = Base load

The $R^2 = 0.833$ is more than 0.75. All these 3 factors will be considered in monitoring energy consumption.

6.5 ENERGY INTENSITY PERFORMANCE

6.5.1 DETERMINATION OF GROSS FLOOR AREA (GFA)

REA to provide the total area of floor space within a building, as measured between the external sides of wall or, in the case of party walls, between the centres of such walls but it **excludes the following areas:**

- (a) parking spaces and circulation areas, including any mechanical or electrical spaces within the parking area of the building;
- (b) open or covered parking area outside the building;
- (c) staircases and lift shafts on floors other than the ground floor or lobby;
- (d) waiting area for commercial vehicles unloading goods;
- (e) gardens or recreational facilities for residents provided on the rooftop or podium in open or semi-open spaces;
- (f) pedestrian pathway connected to the building or transit station, including any supporting activities; and
- (g) pedestrian pathways within building functioning as public walkways.

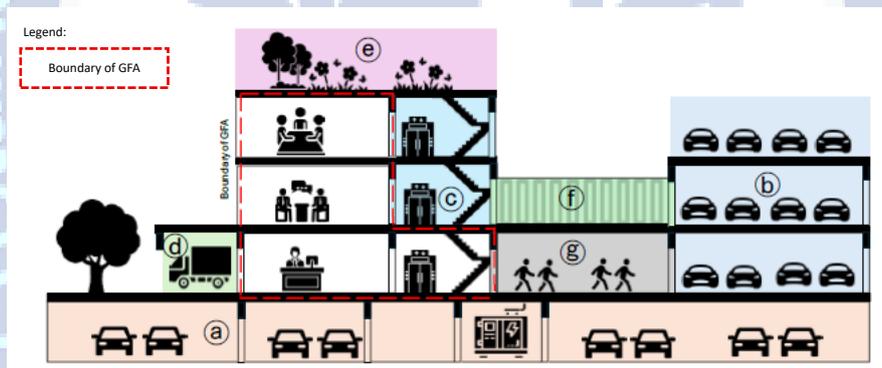


Figure 6-5: The usual boundary of the GFA for an office building

6.5.2 CALCULATION OF ENERGY INTENSITY PERFORMANCE (EIP) OF THE BUILDING

REA shall provide the calculations for the EIP of the Building and shall be expressed in energy units in gigajoule per square meter (GJ/m²) and calculated as per equation in the Guideline.

Example:

Based on the baseline performance, the energy intensity performance used for this building is **Building Energy Intensity (BEI) or EIP** where the value of EIP is the products of annual consumption divided by Gross Floor Area (GFA) of **XXX** m².

$$\text{BEI/EIP of the Building} = \frac{\text{Energy Consumption (GJ)}}{\text{GFA (m}^2\text{)}}$$

Month	Consumption, kWh	Energy Intensity (kWh/m ²)
January		
February		
March		
April		
May		
June		
July		
August		
September		
October		
November		
December		
Total	1,776,000 kWh	222.0 kWh/m²/year
	**** GJ	***** GJ/m²/year

Table 6-6: Building Energy Intensity Performance

6.5.3 ENERGY EFFICIENCY RATING (EER)

REA shall indicate the level of the EER for the building. The star rating as stated in the Regulations shall be based on Table 1 and Table 2.

7 OBSERVATION AND FINDINGS

7.1 ELECTRICAL SYSTEM / EQUIPMENT

7.1.1 LOAD APPORTIONING

The findings shall provide the distribution of the total electrical energy consumption among the electrical SEU, based on the load data collected

Example:

At the building, the biggest consumption was Air Conditioning and Mechanical Ventilation (ACMV) which is 74% followed by Lighting system and Plug load. Chiller consumed 49% of the total energy while lighting system and plug load are 11% and 9% respectively.

System	Measured Energy, GJ	Percentage
Chiller		
Cooling Tower		
Lighting		
Plug load		
AHU		
ACSU		
Others		
Total	XX	100%

Table 7-1: End Load Apportioning

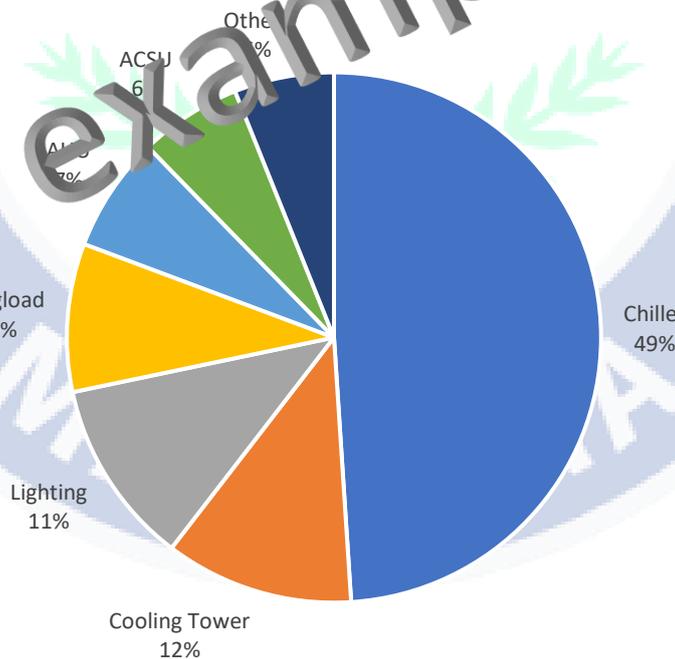


Figure 7-1: End Load Apportioning

7.1.2 ENERGY INDICES

To provide the indices for the building

Example:

The following are the energy and power indices obtained from the energy audit.

Energy Intensity Index		
Building Energy Intensity Index (BEII)		GJ/m ²
Lighting Energy Intensity Index (LEII)		GJ/m ²
Air Conditioning Energy Intensity Index (ACEII)		GJ/m ²
Building Power Baseload		kW

Power Density Index		
Lighting Power Density		W/m ²
Air Conditioning Power Density		W/m ²
Equipment Power Density		W/m ²
Baseload Power Index		W/m ²

Table 7-2: Energy Indices

7.1.3 ENERGY SUPPLY

Describe the energy supply and consumption analysis which includes but not limited to load factor, maximum demand, type of tariff and power factor value from the logging activities

Example:

The logging data shows an average voltage of 405 V during the logging period. This value is still in the good range where TNB supply is 400 V with a variation of -6% and +10%. The measured voltage shows the incoming supply is not over-voltage where over-voltage issues shall not be a problem for this facility.

At the same time, the power factor also can be measured. From the logging activities, it was found that the building had recorded a **power factor of 0.90** which is in the recommended range by TNB, thus there is no power factor penalty subjected to the installation. This also shows the capacitor bank installed are still functioning well.

Using the measured maximum demand (230.8 kW) during the logging period, we then compared with the current month TNB bill which record a maximum demand of 243 kW. As such, a percentage of difference is calculated to measure the discrepancy of the logged data with the TNB bills. A 5% discrepancy is detected between the logged data with the TNB bill which is used as the main method for data monitoring and record. With the 5% difference, this logged data is deemed reliable and can be used as a reference for the building energy consumption.

** (Discrepancy can be compared with kWh and kW of the same month as audit period)

	Measured (Logging)	TNB Bill
Maximum Demand, kW	230.8	243
Percentage of difference		-5.02%
Energy Consumption, kWh	1,224,271	1,326,712
Percentage of difference		-7.72%

Table 7-3: Percentage of discrepancy

7.1.4 DATA AND FINDINGS

REA shall discuss/analyse the data and specific findings on identified system, focusing on details that includes but not limited to as follows:

- I. for lighting system –
 - the lux level;
 - the operation hours;
 - the lighting control system;
 - the maintenance and lighting application; or
 - the human behavior.

- II. for air conditioning system, the related measurements such as the temperature setting, operation hours, control system, schedule arrangement, maintenance, indoor air quality, human behavior, etc.
 for air conditioning equipped with chiller system, the data includes the heat balance, thermistor accuracy and flow accuracy.
 for air conditioning equipped with air handling unit (AHU), the measurements includes –
 - the air handling pressure drop;
 - the airflow and duct pressure loss;
 - the AHU supply and return air parameters such as the flow rate, dry bulb, wet bulb and dew point;
 - the fresh air intake parameters such as the flow, temperature, dew point or the relative humidity;
 - the room conditions such as its relative humidity and temperature for selected areas;
 - the AHU efficiency;
 - the state of operation of the AHU, which refers to whether the AHU operation is at overcapacity or under capacity;
 - the control valve operations; and
 - the thermal comfort.

- III. for motor system, the related measurements such as the corresponding load characteristics;

- IV. for pump system, the measurements such as –
 - the pump head;
 - the flow and differential head;
 - any issues related to over-pumping; and
 - cavitation.;

- V. for air compressor system, the related measurements such as –
 - the output capacity at the main header;
 - the operating and idling time of compressors;
 - the pressure drop profile;
 - the result of any leakage test and controls;
 - the user side demand check; and
 - the pipe sizing and design.;

- VI. for industrial furnace system, the related measurements such as –
- the electricity consumption;
 - the fuel and air use;
 - the air-fuel ratio;
 - the temperature of heating zone;
 - the furnace walls and outlet;
 - the heat loss through infiltration and walls;
 - the potential heat recovery; and
 - the basis or method used in any calculative analysis.
- VII. any related output parameter data for other electrical equipment or system.



7.2 THERMAL SYSTEM / EQUIPMENT

7.2.1 DESCRIPTION OF THE THERMAL FLOW

The energy audit report shall provide the findings on the thermal equipment or system in a stream list. A stream list is an organized representation of different streams of thermal energy inputs and outputs in a system.

The stream list description includes the types of stream, its temperature, flow rate, energy content and other related input and output of the description of the thermal energy. The stream list shall be presented in table form as shown in table below.

Stream Description	Temperature (°C)	Flow Rate (kg/h)
Hot Water Inlet	80	500
Hot Water Outlet	40	500
Steam Inlet		200
Condensate Outlet	90	200
Cooling Water Inlet	25	800
Cooling Water Outlet	35	800

Table 7-4: Stream List Details

7.2.2 ENERGY BALANCE DIAGRAM

REA shall provide an energy balance diagram which shall be presented in the form of a Sankey diagram.

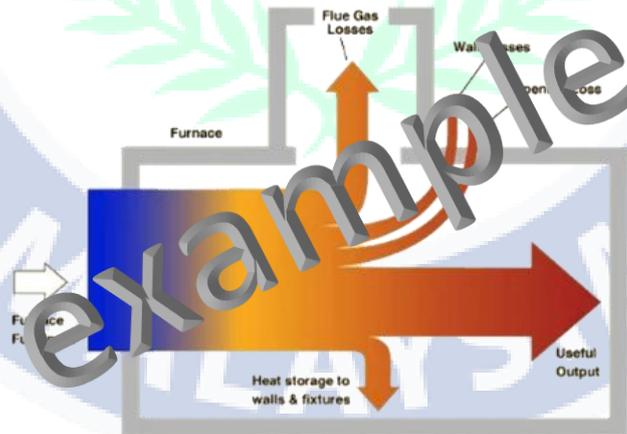


Figure 7-2: Sankey Diagram for [Building Name]

7.2.3 DATA AND FINDINGS

Where applicable, the data and specific findings on identified system, emphasizing on details that includes but not limited to as follows:

for boiler –

- A. the pressure;
- B. the temperature;
- C. the steam capacity;
- D. the flow rate;
- E. the blowdown;
- F. flue gas analysis; and
- G. efficiency of the boiler.

for thermal oil heater –

- A. the pressure;
- B. the inlet and outline temperatures;
- C. the production capacity;
- D. the ambient air condition;
- E. the flue gas analysis; and
- F. efficiency of the thermal oil heater.

for furnace –

- A. operating temperature;
- B. production capacity;
- C. flue gas analysis; and
- D. efficiency of the furnace

Any related output parameter data for other thermal equipment or system -

The related information or basic measurable data that is related to energy consumption and conservation as well as the efficiency of the equipment or system

8 ANALYSIS AND IDENTIFICATION OF ENERGY SAVING MEASURES

8.1 EXPLANATION OF THE EACH ESM

The explanation of the calculation for each ESM shall include but not limited to the following:

- a) Explanation of the findings and suggestions for ESM
- b) The methods used in estimating the savings (detailed calculation, reference, experience, rule of thumb);
- c) assumptions made;
- d) energy saving potentials;
- e) the estimated budget or investment cost for implementing the recommended ESM;
- f) cost savings and potential returns from the costs to implement ESM for example simple payback period (reasonable), return on investment or internal rate of return; and
- g) equivalent carbon emission reduction. For carbon emission conversion, reference may be made to the IPCC Guidelines for National Greenhouse Gas Inventories.

DESCRIPTION	UNIT	VALUE
Overall Consumption Baseline		
System Consumption Baseline		
[A] Electricity Rate		
[B] Estimated Annual Saving		
[C] Estimated Annual Cost Saving = [B] X [A]		
[D] Estimated Annual Carbon Reduction = [B] X 0.758 tCO₂e/MWh (GEF 2021)		
[E] Estimated Investment Cost		
[H] Simple Payback Period = [E] / [C]		
[I] Estimated System Saving = [B] / System Baseline		
[J] Estimated Overall Saving = [B] / Overall Baseline		
Financing Option		
Measurement & Verification	Option	

- h) Implementation method and Measurement & Verification

8.2 SUMMARY OF ENERGY SAVING MEASURES

Brief summary of energy savings recommendations. The summary of the findings and the ESM shall be provided in table format as shown below.

Example:

Six (6) Energy Saving Measures (ESMs) have been identified in the Energy Audit conducted. The baseline energy consumption was found to be ***** GJ/year. By implementing all recommended Energy Saving Measures, the energy consumption for Building name can be reduced by about 23%, or 52,416kWh @ 188.69 GJ per year representing RM15,096.00 in monetary value. The estimated budget cost of implementing the Energy Saving Measures is RM27,042.00 with a payback period of about 1.79 years. The estimated savings, investment costs and Simple Payback Period of all recommended Energy Saving Measures, are listed in the table below.

ESM	Category <i>Operation/ System/Equipment</i>	Type <i>Air conditioner/Chiller/AHU, compressor, fan, lighting, motor, pump, boiler, thermal oil heater, furnace, etc..</i>	Description	Energy Baseline by System (GJ/year)	Estimated Yearly Saving		Estimated Investment (RM)	Estimated Simple Payback Period (Years)	Estimated Carbon Reduction (Ton/year)	Overall Percentage Saving (%)
					Energy (GJ)	Cost (RM)				
No-Cost										
1										
2										
				Total						
Low/Medium-Cost										
3										
4										
				Total						
High-Cost										
5										
6										
				Total						
				Overall						

Note:

*for "Category" and "Type", reference shall be made to the Guidelines on Energy Efficiency and Conservation Report issued by the Commission.

**Overall percentage saving" shall be based on Energy baseline (["estimated yearly saving"/Energy baseline] GJ/year * 100%)

Table 8-1: ESM Summary Table

9 ENERGY SAVING MEASURES (ESM) IMPROVEMENT PLAN (3 YEARS)

REA to provide some recommendations of priorities and strategies on the improvement plan for the ESM which may include:

- the recommendation for immediate implementation of the improvement plan for a facility under the “no cost or low-cost measures” category”
- the strategies to implement the proposed ESM improvement plan, for example ESM prioritization based on the return on investment;
- the proposed action plan and estimated time required to implement each ESM improvement plan;
- the proposed timeline of each ESM improvement plan within appropriate implementation period; and
- the financing options or government incentives available for the purpose of implementing the ESM improvement plan.

Example:

The table below lists the implementation measures to be carried out over the course of 3 years.

Year	Measures	Percentage Reduced	Cost in RM	Time to Implement
Base year				
Year 1	No Cost	5%		
ESM 1				1 month
ESM 2				3 months
Year 2	Low/Medium Cost	7%		
ESM 3				5 months
Year 3	High Cost	8%		
ESM 4				2 months

Table 9-1: ESM Improvement Plan

10 CONCLUSION

Describe EIP Chart and conclude the findings, what shall be done to the issues found from the audit

Example:

Based on the findings, several issues had been found and had been covered in the Energy Saving Measures chapter. The Chilled Water system is in a very urgent need to be replaced where the current COP measured show 1.83 kW/RT. The building owner shall do replacement as soon as possible to avoid wastage which can incur high cost to the monthly operational cost. The AHU units need to be periodically maintained and ensure the setpoints are set at 24°C.

Using the estimated current annual energy consumption **232,050 kWh @ **** GJ** and [Net floor area], the current Building Energy Index (BEI) is **274 kWh/m²/year @ **** GJ/m²/year** costing **RM67.68 /m²/year** and after implementing all recommended Energy Saving Measures, the energy consumption for **Building name** can be reduced by about **23%**, or **52,416kWh @ 188.69 GJ** per year representing **RM15,096.00** in monetary value. The estimated budget cost of implementing the Energy Saving Measures is **RM27,042.00** with a payback period of about **1.79 years**

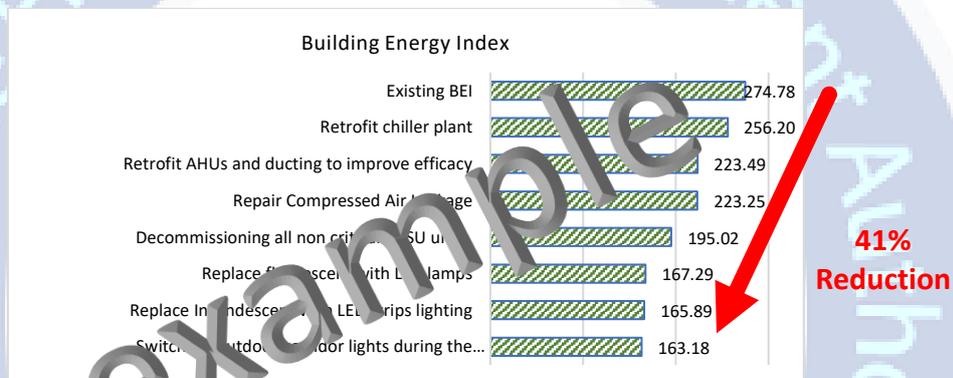


Figure 10-1: BEI Reduction Chart

Describe number of diamonds that can be achieved based on percentage reduction of BEI

Level of achievement (% of CO ₂ e reduction)	Assessment Scheme for Existing Buildings
100% Carbon Neutral	◆◆◆◆◆
≥ 70 to < 100	◆◆◆◆◆
≥ 50 to < 70	◆◆◆◆◆
≥ 30 to < 50	◆◆◆◆
≥ 10 to < 30	◆◆◆
≥ 1 to < 10	◆◆

Based on the SEDA Sustainable Energy Low Carbon Building Assessment GreenPASS by Construction Industry Standard 2012 CIS20, the level of achievement in **xx %** carbon reduction is eligible for **xx diamond** certification. All the information can get from the SEDA website.

<https://www.seda.gov.my/greenpass>

11 VERIFICATION

The energy audit report shall be prepared by REA, and shall be checked and agreed by the person in charge of building.

This Energy Audit Report is:			
Prepared by:	Checked by:	Received by SEDA Malaysia	Received by SEDA Malaysia
Name:	Name:	Name:	Name:
Position:	Position:	Position:	Position:
Date:	Date:	Date:	Date:

APPENDIX A: LIST OF EQUIPMENT

MODEL	WCDX60
CAPACITY	44 TON
VOLTS	415
PH	3
CONTROL VALVE	115V/1PH/50HZ
BRAND	DUNHAM-BUSH
SERIAL NO	1A32100001
HZ	50
REFRIGERANT	R22

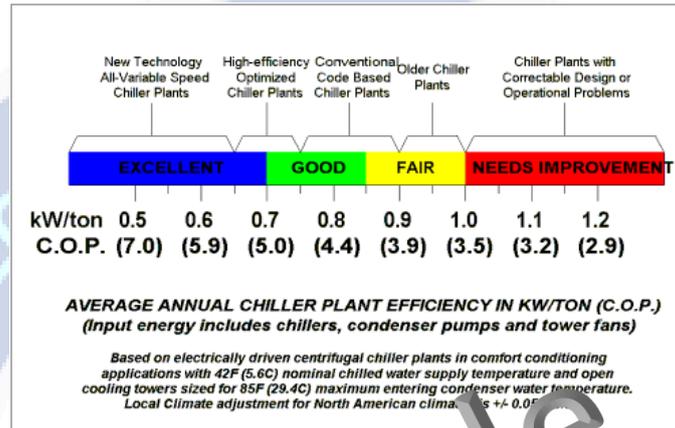
Attachment I: Chiller Specification

No.	AHU Tag	Air Flow Rate, m3/hr	Fan Power, W	Fan Efficiency, W/m3 hr	Capacity, Btu/hr
1	AHU ROOM 8-40	361.62	5,414.92	14.97	853,035,500.00
2	AHU ROOM 8-40	1,431.72	5,696.71	3.98	853,035,500.00
3	AHU 1	12,667.54	4,046.67	0.32	853,035,500.00
4	AHU 2	19,139.33	5,435.26	0.28	853,035,500.00
5	AHU 1	8,880.04	4,183.20	0.47	682,428,400.00
6	AHU ROOM 5-01	6,708.88	3,669.92	0.55	682,428,400.00
7	AHU 1	16,887.17	10,336.55	1.09	853,035,500.00
8	AHU 2A	20,461.82	6,122.41	0.30	1,023,642,600.00
9	AHU 2B	16,222.30	6,948.76	0.42	1,023,642,600.00
10	AHU 1B	14,099.47	4,822.30	0.34	1,023,642,600.00
11	AHU 1A	19,229.18	4,679.96	0.24	1,023,642,600.00
12	AHU 3A	18,058.18	5,168.00	0.29	1,023,642,600.00
13	AHU 1	10,464.99	2,992.15	0.29	682,428,400.00

Attachment II: List of AHU

APPENDIX B: EQUIPMENT ANALYSIS

Total Chiller Plant Energy Consumption (kWh/week)	2,377.87
Average Daily Energy	475.574
Average Power (kW)	52.49
Average Cooling Load (RT)	39.30
Chiller Plant Efficiency (kW/ton) (COP)	1.33



Attachment III: Chiller COP

No	AHU	Capacity Btu/hr	Air Flow Rate, m ³ /hr		Served Area, m ²	Air Change Per Hour (ACH)		Capacity Intensity, Btu/hr ft ²
			Design	Running		Design	Running	
1	AHU-L1-M01.9	53,688	25,269	9,539	969.2	8.5	3.2	56.9
2	AHU-L1-M01.8	812,056	34,503	33,361	1,600.9	7.0	6.8	47.1
3	AHU-L1-M01.4	665,340	28,252	17,192	1,077.5	8.6	5.2	57.4
4	AHU-ANX-L1A.3	535,684	22,824	5,853	925.2	8.1	2.1	53.8

Attachment IV: AHU Capacity Analysis

APPENDIX C: ESM CALCULATION

REA must justify how they estimate the saving (By calculation/based on reference/based on their experience). Show how the calculations are done

DESCRIPTION	UNIT	VALUE
Overall Consumption Baseline	kWh	
System Consumption Baseline	kWh	
[A] Electricity Rate	RM/kWh	
[B] Estimated Annual Saving	kWh	
[C] Estimated Annual Cost Saving = [B] X [A]	RM/year	
[D] Estimated Annual Carbon Reduction = [B] X 0.758 tCO ₂ e/MWh (GEF 2021)	tCO ₂ e	
[E] Estimated Investment Cost	RM	
[H] Simple Payback Period = [E] / [C]	Year	
[I] Estimated System Saving = [B] / System Baseline	%	
[J] Estimated Overall Saving = [B] / Overall Baseline	%	
Financing Option		
Measurement & Verification	Option	

APPENDIX D: SAMPLE DATA COLLECTION FORM FOR LIGHTING SYSTEM

Lighting Data Form

Desktop Data Collection

Type of light: _____						
Level	Operation hours (hr/day)	Rated power (lamp + ballast) (kW)	Total unit installed (nos)	Place of use	Control system (manual/auto)	Remark
						Please expand the table for other type of lighting

Field Data Collection (if any changes/absence of information during desktop data collection)

Type of light: _____						
Level	Operation hours (hr/day)	Rated power (lamp + ballast) (kW)	Loading factor (%)	Place of use	Control system (manual/auto)	Average lux level
						Please expand the table for other type of lighting

* T8/T5 fluorescent light, CFL, incandescent light, LED, etc

FOR AIR CONDITIONING SYSTEM

Air Conditioning Data Form

Desktop Data Collection

Centralized Air Conditioning System

A/C Components	Rated power (kW)	Operating hours (hr/day)	Loading factor (%)	Time usage factor (%)	Control (manual/auto)	Year installed	Refrigerant type (R134 / R22 / HFC / etc)	Chiller type (centrifugal / screw / etc)	COP chiller design (kW/r/kWe)	Setting temperature	
										Supply temp (°C)	Return temp (°C)
Chiller 1											
Chiller 2											
Chiller 3											
AHU 1											
AHU 2											
AHU 3											
Cooling tower 1											
Cooling tower 2											
Cooling tower 3											
Total chilled water pumps											
Total condenser water pumps											

Air Conditioning Data Form

Split Unit Air Conditioning System

Split Unit No.	Level	Room No / Description	Rated Power (kW)	Operating hours (hr/day)	Control (manual/ auto)	Remarks
Split Unit 1						
Split Unit 2						

Field Data Collection (if any changes/absence of information during desktop data collection)

Chiller No.	Loading factor (%)	Time usage factor (%)	Flow rate (l/s)	Operating hours (hr/day)	Chilled water temperature measured		Total power measured				
					Supply temp (°C)	Return temp (°C)	Chiller (kW)	Chilled water pump (kW)	Condenser water pumps (kW)	Cooling tower (kW)	
Chiller 1											
Chiller 2											
Chiller 3											

Air Handling Unit (AHU)

AHU No.	Level	Outside air intake			Return air			AHU air intake			Control (manual/auto)	Measured Power (kW)	Loading factor (%)	Operating hours (hr/day)	Remarks
		Temp (°C)	RH (%)	Vel (m/s)	Area (m ²)	Temp (°C)	RH (%)	Vel (m/s)	Area (m ²)	Temp (°C)					
AHU 1															
AHU 2															
AHU 3															

Split Unit No.	Level	Room No/Description	Measured Power (kW)	Loading factor (%)	Operating hours (hr/day)	Control (manual/auto)	Remarks
Split Unit 1							
Split Unit 2							

Field Data Collection Indoor Air Quality

Indoor Air Quality						
Level	Place of use	Temperature (°C)	Humidity (%)	CO ₂ (ppm)	CO (ppm)	Remarks

Note:

RH - Relative Humidity (%)

Vel - Velocity (m/s)

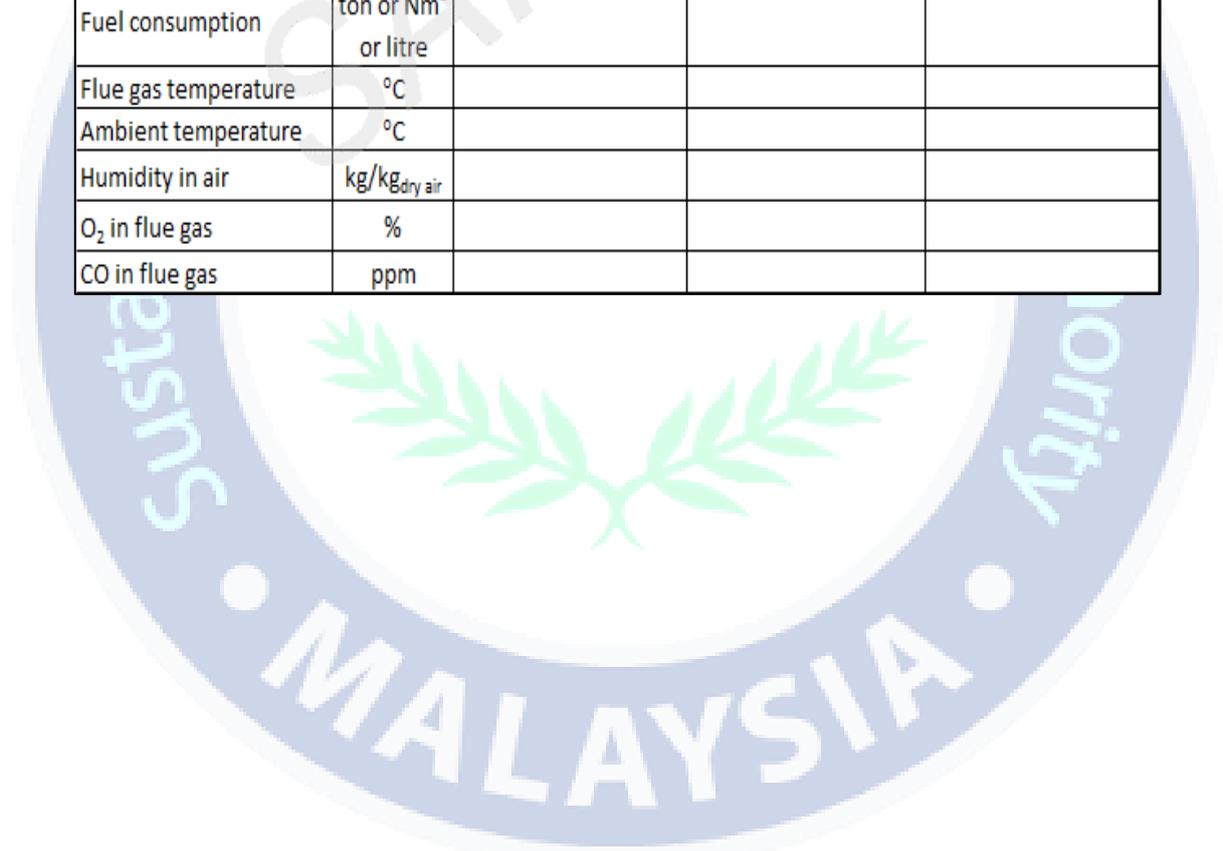
Temp - Temperature (°C)

FOR BOILER

	Unit	Boiler #1	Boiler # 2	Boiler #3
Design Parameters				
Type of boiler	-			
Pressure	barg			
Temperature	°C			
Steaming Capacity	ton/hr			
Operating Parameters				
Feedwater pressure	barg			
Feedwater inlet temperature	°C			
% blowdown	%			
Steam pressure	barg			
Steam temperature	°C			
Steam production	ton/hr			
Type of fuel	-			
GCV of fuel	MJ/ton or MJ/Nm ³			
Fuel consumption	ton or Nm ³			
Flue gas temperature	°C			
Ambient temperature	°C			
O ₂ in flue gas	%			
CO in flue gas	ppm			

FOR THERMAL OIL HEATER

	Unit	Thermal Oil Heater #1	Thermal Oil Heater # 2	Thermal Oil Heater #3
Design Parameters				
Production Capacity	ton/hr			
Operating Parameters				
Thermal oil pressure	barg			
Thermal oil inlet temp	°C			
Thermal oil outlet temp	°C			
Thermal oil production	ton/hr			
Type of fuel	-			
GCV of fuel	MJ/ton or MJ/Nm ³ or MJ/lit			
Fuel consumption	ton or Nm ³ or litre			
Flue gas temperature	°C			
Ambient temperature	°C			
Humidity in air	kg/kg _{dry air}			
O ₂ in flue gas	%			
CO in flue gas	ppm			



FOR INDUSTRIAL FURNACE

Operation Status					
Amount of steel heated					
Temperature of discharged steel (surface)					
Amount of burning loss					
Temperature of charging steel					
Amount of crude oil used; caloric value					
Temperature of crude oil used					
Temperature of combustion air					
Temperature of flue gas at furnace outlet					
Temperature for each zone (°C)					
Measurement Results					
Flue gas temperature (°C) and composition (%)	Temp.	CO ₂	O ₂	CO	N ₂
*Flue gas at furnace outlet					
*Flue gas before recuperator					
*Flue gas after recuperator					
Internal pressure					
Temp. and amount of skid rail cooling water					
Temperature of furnace walls					

APPENDIX E: CONVERSION COEFFICIENTS AND EQUIVALENCE

Energy Resources

Energy Resources	Conversion Coefficients/Equivalence
Hard coal	29.3076 GJ/tonne
Coke/oven coke	26.3768 GJ/tonne
Gas coke	26.3768 GJ/tonne
Brown coal coke	19.6361 GJ/tonne
Pattern fuel briquettes	29.3076 GJ/tonne
Lignite/brown coal	11.2834 GJ/tonne
Peat	9.5250 GJ/tonne
Lignite briquettes	19.6361 GJ/tonne
Liquefied Natural Gas (LNG)	45.1923 GJ/tonne
Butane	50.393 GJ/tonne
Propane	49.473 GJ/tonne
Liquefied Petroleum Gas (LPG) (Mixture of Butane and Propane)	0.045544 GJ/kg
	0.13640 GJ/m ³
Natural Gas	1000 GJ/mscf
	1.055 GJ/mmbtu
	0.02898 GJ/m ³
Ethane	1,067.82 GJ/mscf
Methane	1,131.31 GJ/mscf
Solar Photovoltaic	0.0036 GJ/kWh
Solar Thermal	0.0036 GJ/kWh
Biogas	50.4 GJ/tonne
Biodiesel	27.0 GJ/tonne
Charcoal	29.5 GJ/tonne
Empty Fruit Bunch (EFB)	18.8 GJ/tonne
Fuelwood	15.6 GJ/tonne
Mesocarp Fibre	18.8 GJ/tonne
Palm Kernel Shell (PKS)	20.1 GJ/tonne

Note: The listed values are based on the net calorific value of each energy resources and the average calorific values for EFB, Fibre and PKS at 0% moisture content. The values may vary due to the characteristics of the fuel, such as moisture content, hydrogen, and oxygen contents. Therefore, any calorific value used for energy calculation needs to be declared in the online system.

Energy

Energy	Conversion Coefficients/Equivalence
Electricity	0.0036 GJ/kWh
Chilled water	0.01266 GJ/RTH
Steam (saturated condition)	
(a) at 10 bar steam pressure	2.78 GJ/tonne
(b) at 8 bar steam pressure	2.77 GJ/tonne
(c) at 6 bar steam pressure	2.76 GJ/tonne
Hot water (saturated condition)	
(a) at 80°C hot water temperature	0.335 GJ/tonne
(b) at 90°C hot water temperature	0.377 GJ/tonne

Note: The operating conditions listed above are based on industry standard practices. Please refer to the enthalpy values for other operating pressure and temperature conditions of hot water and steam. 1 kJ/kg is equivalent to 0.001 GJ/tonne.



APPENDIX F: ENERGY BILLS

APPENDIX G: CALIBRATION CERTIFICATE

