RMK-12 ENERGY AUDIT CONDITIONAL GRANT (EACG)

ENERGY AUDIT GUIDE

(FOR COMMERCIAL BUILDINGS)

BY

SUSTAINABLE ENERGY DEVELOPMENT AUTHORITY

(SEDA MALAYSIA)

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1.0 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 must 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.

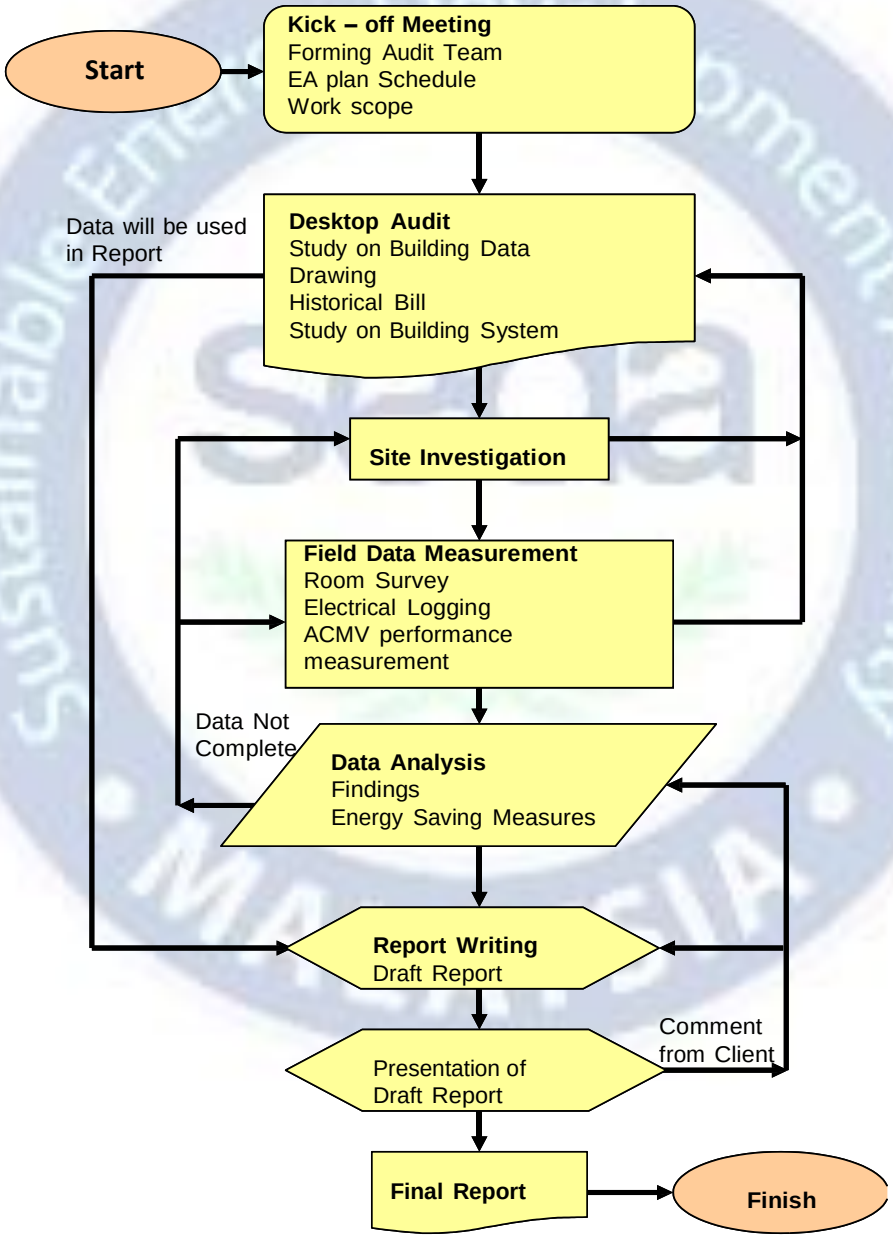
The objectives of the Energy Audits are;

- **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.**

2.0 METHODOLOGY OF ENERGY AUDIT

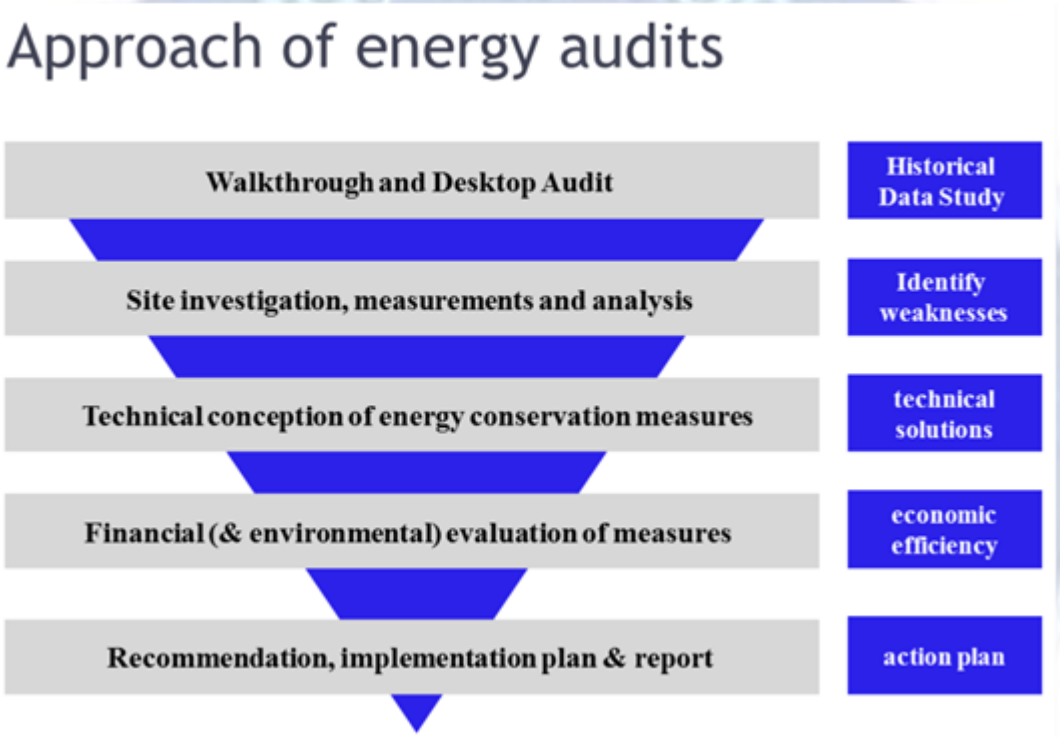
The energy audit consists of several main activities such as the following:

- √ 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.



3.0 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 14 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 and percentage;
- To establish Energy Indices for each building;
    - Building Energy Index (BEI) kWh/m2/year (*Please refer to document, Method to Identifying BEI by SEDA Malaysia and GreenTech Malaysia)*;
    - Net Building Energy Index (BEI) kWh/m2/year (if renewable energy system available);
    - Building Energy Intensity Index (BEII), kWh/m2/year/person;

- Lighting Energy Intensity Index (LEII), kWh/m2/year/person;
- Air-conditioning Energy Intensity Index (ACEII) kWh/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 / NFA) [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 (estimate)
  - 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, CO_2 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 CO_2 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;
- 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.

4.0 MANDATORY REQUIREMENT

Energy audit report must be according to the Energy Audit Report Template as in **Appendix A**.

Prepared and updated by,
SEDA Malaysia

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

Building picture/s

ENERGY AUDIT CONDITIONAL GRANT REPORT FOR Building Name

Prepared By

Company logo

Client logo

Auditor Name and Address

Client Name and Address

Under

SUSTAINABLE ENERGY DEVELOPMENT AUTHORITY MALAYSIA

CONFIDENTIALITY

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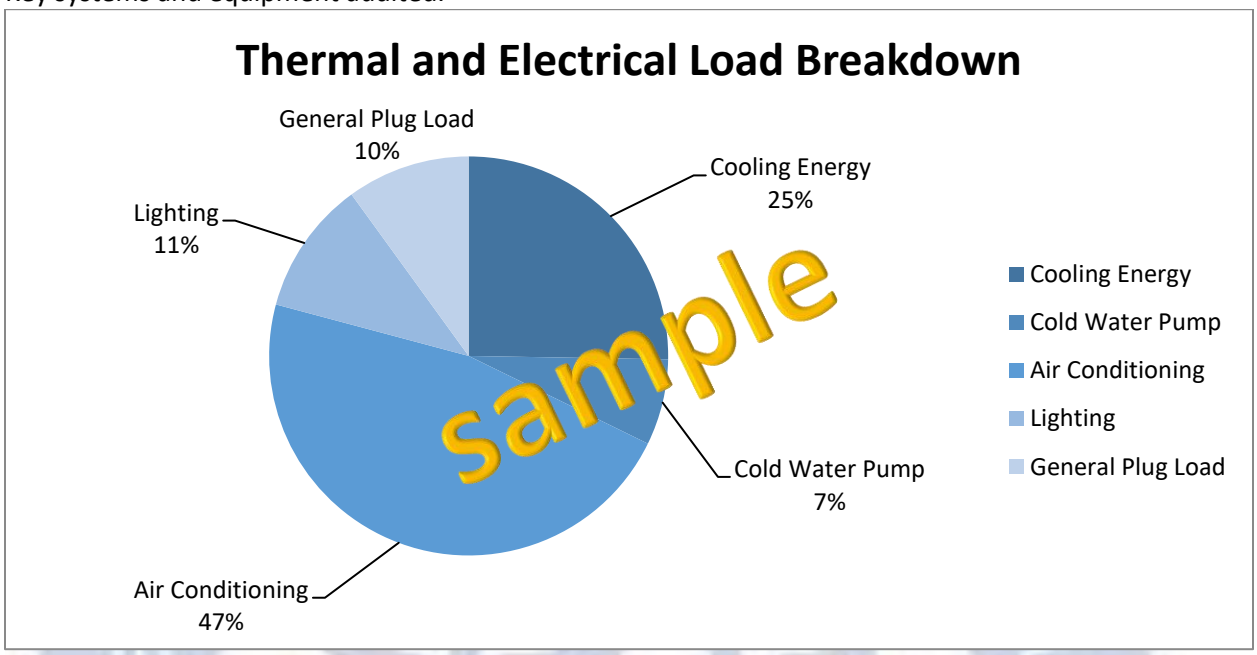
Table of Contents

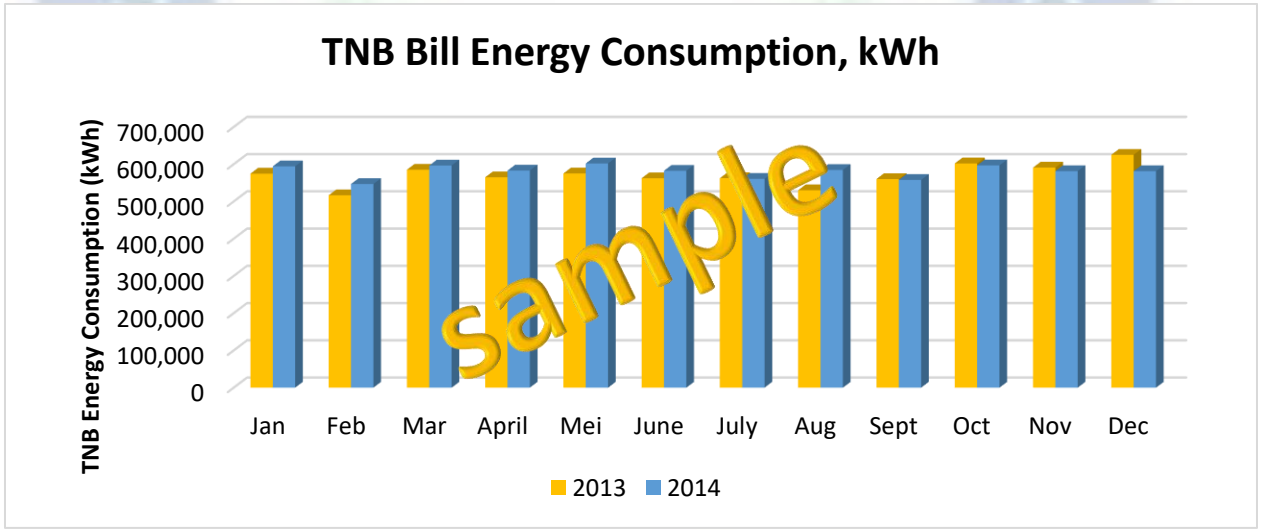
1 EXECUTIVE SUMMARY

Objectives, scope and type of audit.

Key systems and equipment audited.



Describe chart

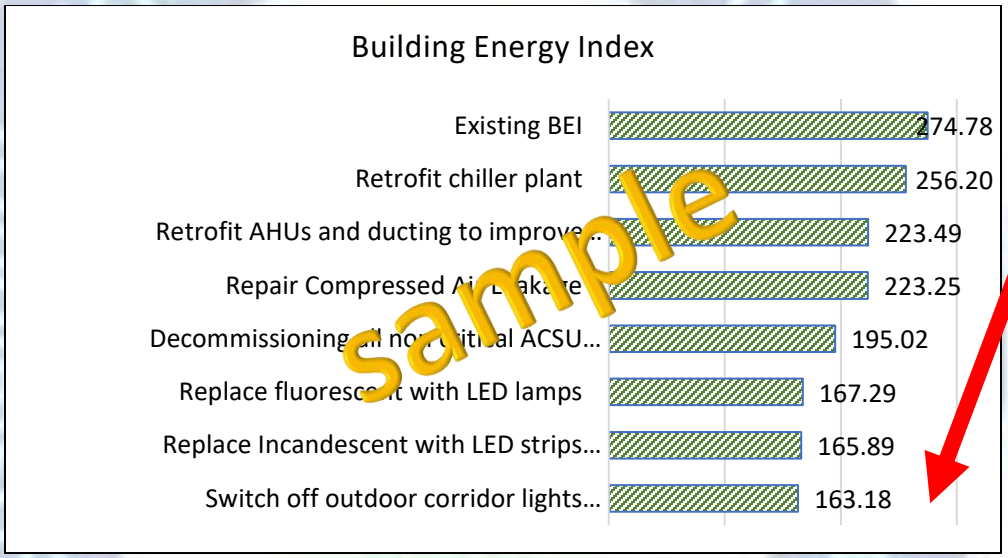


Describe graph

Brief summarized description of energy saving recommendations and their cost-effectiveness

Appendix A

No.	ESM	Estimated Savings		Estimated Investment(RM)	Simple Payback Period (yrs)	Estimated Carbon Reduction
		Energy (kWh)	Cost (RM)			kgCO2/kWh
No Cost						
1	Decommissioning all non critical ACSU units when chiller plant has been retrofitted	577587.64	306121.45	0	Immediate	
Low/Medium Cost						
2	Replace all Incandescent decorative lamps with LED strips/LED lamps	28539.22	15,[illegible]5.7[illegible]	1,000.00	0.07	21,147.56
3	Switch off outdoor corridor lights during the daytime	55[illegible].85	[illegible],384.71	80000	2.7	41,083.15
4	Repairing compressed air leakage	[illegible]90[illegible]0	2597.00	15000	5.8	3,630.9
High Cost						
5	Retrofit chillers, chilled water pumps, condenser water pumps, cooling tower and upgrade pipeworks	380112.00	201459.36	1190000	5.9	281,662.9
6	Retrofit AHUs and ducting to improve efficacy	669384.00	354773.52	359000	1.0	496,013.54
7	Replace all existing fluorescent and CFL lamps with LED lamps	567599.96	300,827.98	482,640.00	1.60	420,591.57



Describe chart

Level of achievement (% of CO_2e 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 CIDB 2012 GreenPASS assessment scheme above, the level of achievement in % carbon reduction is eligible for x diamond certification.

2 INTRODUCTION

Brief explanation on functions, operation hours, occupancy rate, etc.

Building Description

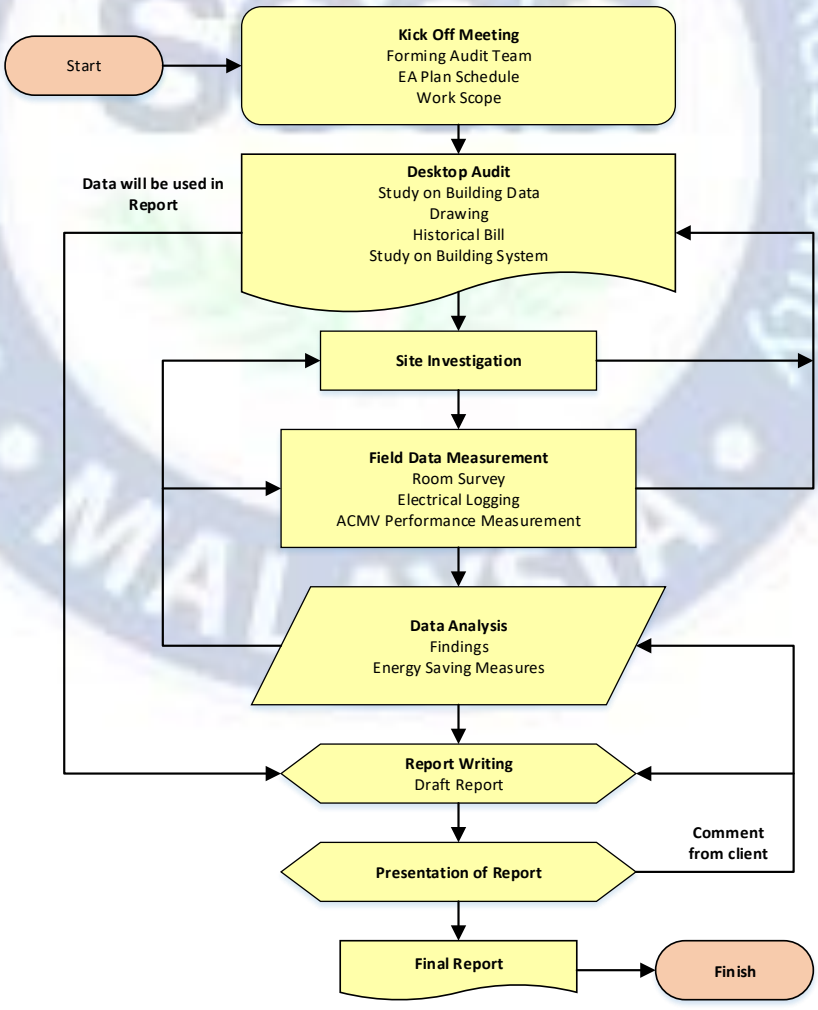
Building Name:	**Client name**
Address:	**Client address**
Building Use:	**Commercial and Office**
In operation since:	**2001**

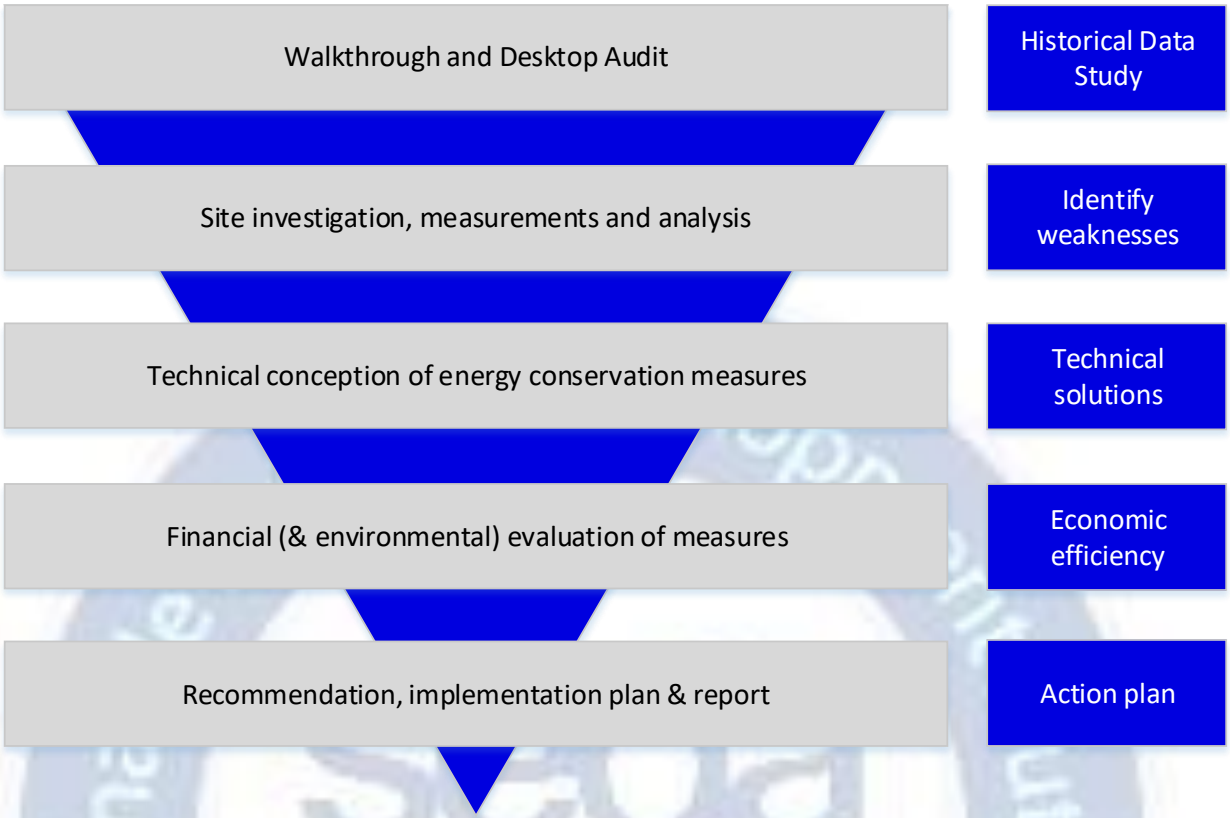
2.1 Objective

Brief explanation

2.2 Methodology

Brief explanation





2.3 Type of Energy Audit and Process

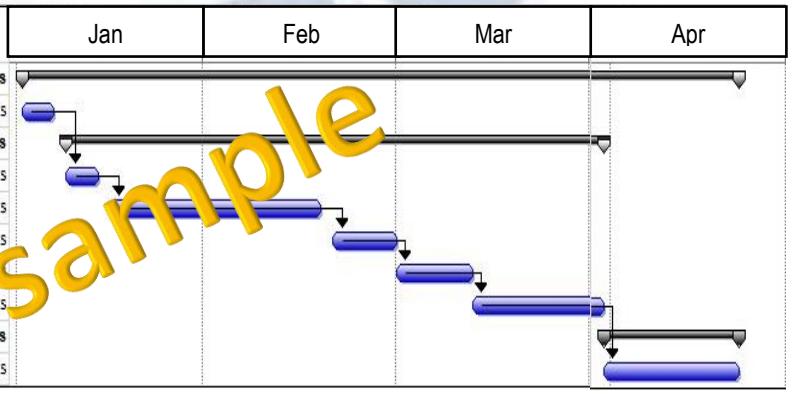
Brief explanation

2.4 Scope of work

Brief explanation

2.5 Time Schedule and Audit Framework

	Indicators	Task Name	Duration	Work
1		**Energy Audit Proposal for 3G3**	**81 days**	**0 hrs**
2		Preliminary Walkthrough	5 days	0 hrs
3		**Detailed Energy Audit**	**61 days**	**0 hrs**
4		Desktop Data	5 days	0 hrs
5		Field Measurement & Observation	25 days	0 hrs
6		Data Analysis	8 days	0 hrs
7		Load Demand	8 days	0 hrs
8		Energy Saving Measures	15 days	0 hrs
9		**Report**	**15 days**	**0 hrs**
10		1st Draftc& Presentation	15 days	0 hrs



2.6 Energy Audit Equipment

List of equipment

3 ENERGY MANAGEMENT SYSTEM REVIEW

3.1 Policy and targets

Policy declaration and brief description of action plans, targets, timeframe, roles and responsibilities

3.2 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

3.3 Compliance towards regulations

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

3.4 Energy management team

List names, position and role

3.5 Energy audit team

List names, position and role

3.6 Energy Management Matrix

Energy Management Matrix may be used to determine level of energy management practiced and can be used as a guide for improvement

	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 tracking	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

	Policy and Systems	Organization	Motivation	Information System.	Training and awareness	Investment
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 ad-hoc committee but line management and 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 or energy efficiency in premises

3.7 Operation and Maintenance System Review

List scope of works involved for energy management

4 BUILDING DESCRIPTION

4.1 General Description and Operation Hours

Describe building function, occupancy, general services provided

4.2 Building Orientation and footprint

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)

4.3 Building Envelope

Overall Thermal Transfer Value (OTTV) and Roof Thermal Transfer Value (RTTV)

WALL CONSTRUCTION

Types of insulation

Material colour

No.	Description	Thickness (mm)	U-Value (W/m^2K)
1	*Wall* Cement Plaster Granite (Solar Absorption Factor, α = 0.45, Light Grey)	 20 20	 2.19 2.927
2	*Fenestration* Laminated toughened tinted glass	 12	 4.8
3	*Roof* Roof Tile Reflective Foil & Fibreglass Asbestos Board	 20 50 3	 0.6 0.035 1.298

WINDOW TO WALL RATIO

Shading/glazing level

Design and operation

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	[illegible]	0.09
South East Wall	[illegible]	8933.72	0.11
South West Wall	355.60	4108.48	0.09

OTTV OF EACH FAÇADE

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

ROOF CONSTRUCTION

Types of insulation

Material colour

Material	Thickness (m)	Density kg/m3	k-value W/m K	Resistance (m2K/W)
Outside air film	-			0.06
Roof Tile	0.02	[illegible]	0.836	0.02
Reflective Foil & Fibreglass	[illegible]	[illegible]	0.035	1.43
Asbestos Board	[illegible]	720	0.108	0.03
Inside air film				0.15
Total Resistance				1.68
U-Value				**0.59**

RTTV of each roof direction

	Gross Roof Area (m2)	RTTV
Flat Roof	759[illegible]	10[illegible].1
North East	1490	2[illegible]33
North West	[illegible]285	[illegible].0734.93
South East	[illegible]421	41647.44
South [illegible]es	1522	21700.58
T[illegible]tal R[illegible]TV	**16389**	**14.26**

4.4 Daylighting opportunities

4.5 Natural ventilation

4.6 Ceiling – height, material and colour

4.7 Floor material and colour

4.8 Landscaping

5 ELECTRICAL SUPPLY INFORMATION

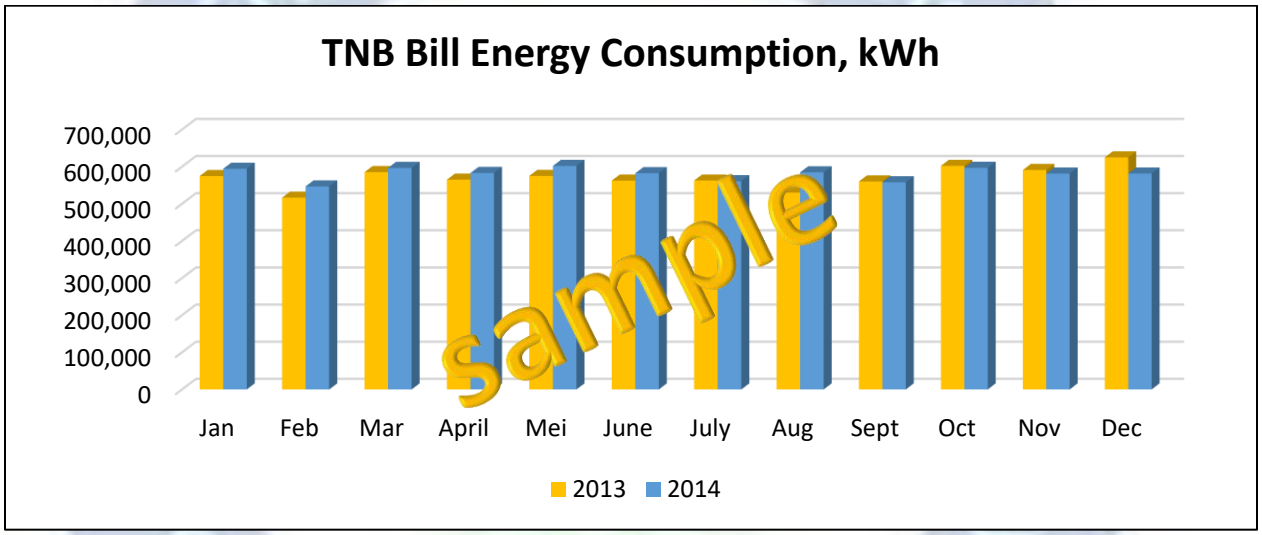
5.1 Tariff

Describe tariff system used

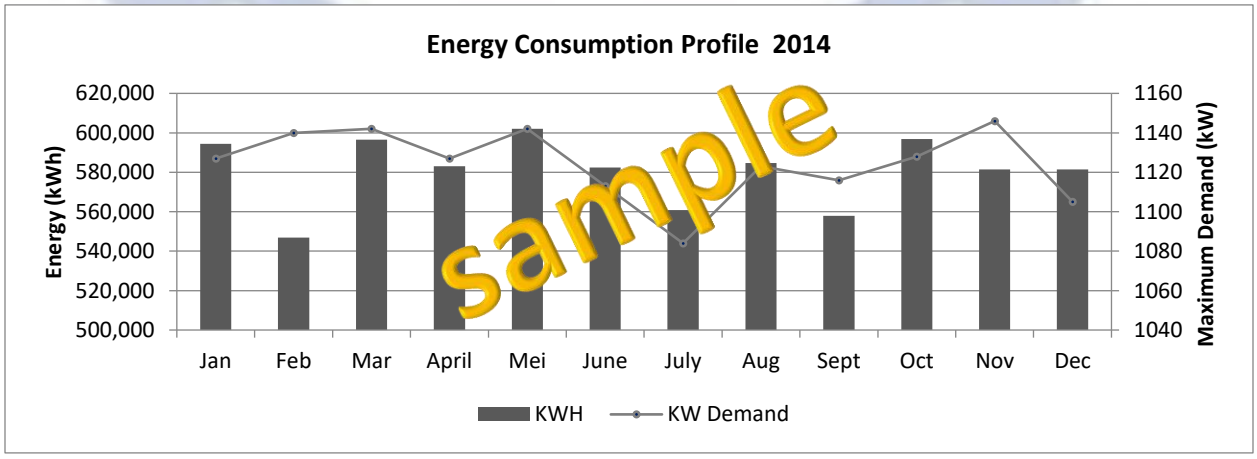
Year	Energy Rate (RM/kWh)	Maximum Demand Rate (RM/kW)
June 2011 – Dec 2013	RM0.312	RM25.90
Jan 2014- present	RM0.365	RM30.30

5.2 Historical Energy Consumption

Describe energy consumption and cost



Describe energy consumption, maximum demand and costs



Describe load factor and evaluation

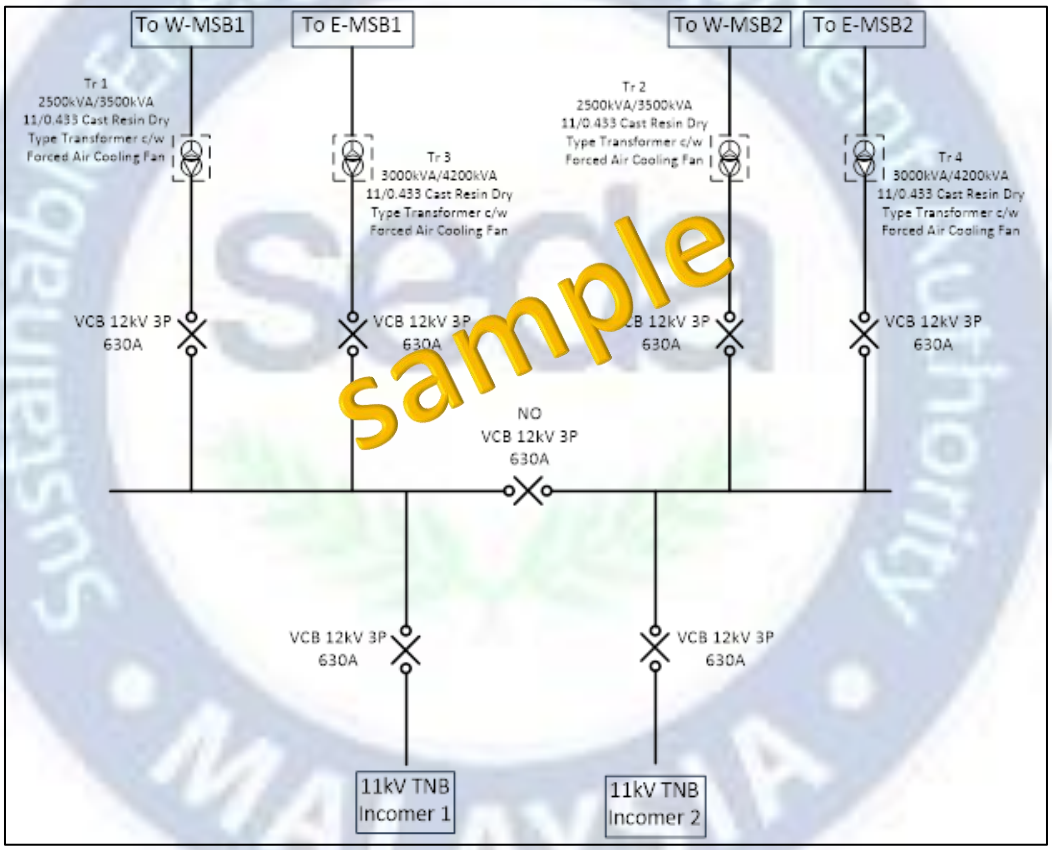
6 ENERGY CONSUMPTION INFORMATION AND ANALYSIS – ELECTRICAL

6.1 System Description

Please include the photos/diagram/schematic of the overall view of the electrical distribution and reflecting the energy balance in the premise. This is to make people who read the report can understand the power / load capacity and energy flows, how and where it been used (incoming and outgoing/consumed)

Describe system

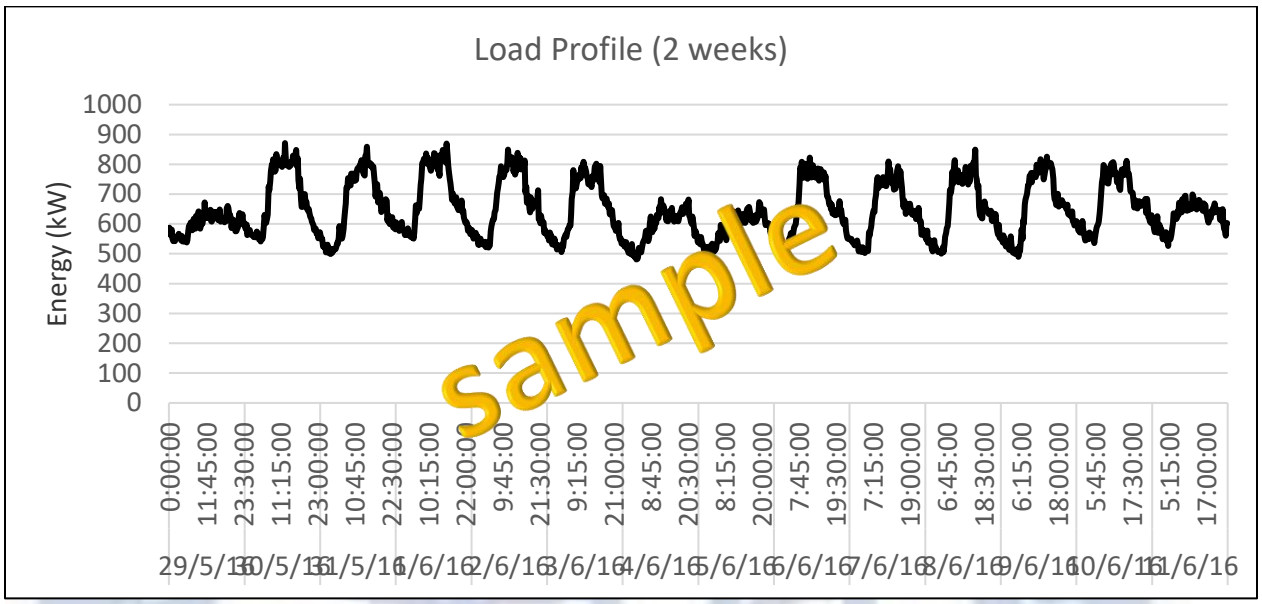
Electrical Schematic Diagram



6.2 Load Profile – Electrical

Describe load profile and observations

Highlight baseload readings



6.3 Energy load survey and site evaluation for transformers and UPS system

Describe load loss evaluation for transformers and UPS (if any)

Description	Tx 1	Tx 2	Tx 3	Tx 4
Average Efficiency (%)	94.37%	94.63%	94.52%	94.85%
Current Capacity (kVA)	321.65	156.86	1.30	551.88
	12.87%	6 %	7.65%	13.14%
Available Capacity (%)	87.13	93.73%	92.35%	86.86%
Problems Detected		Dip, swell, interruption and impulse	Interruption	Interruption and impulse

6.4 Observations and Findings

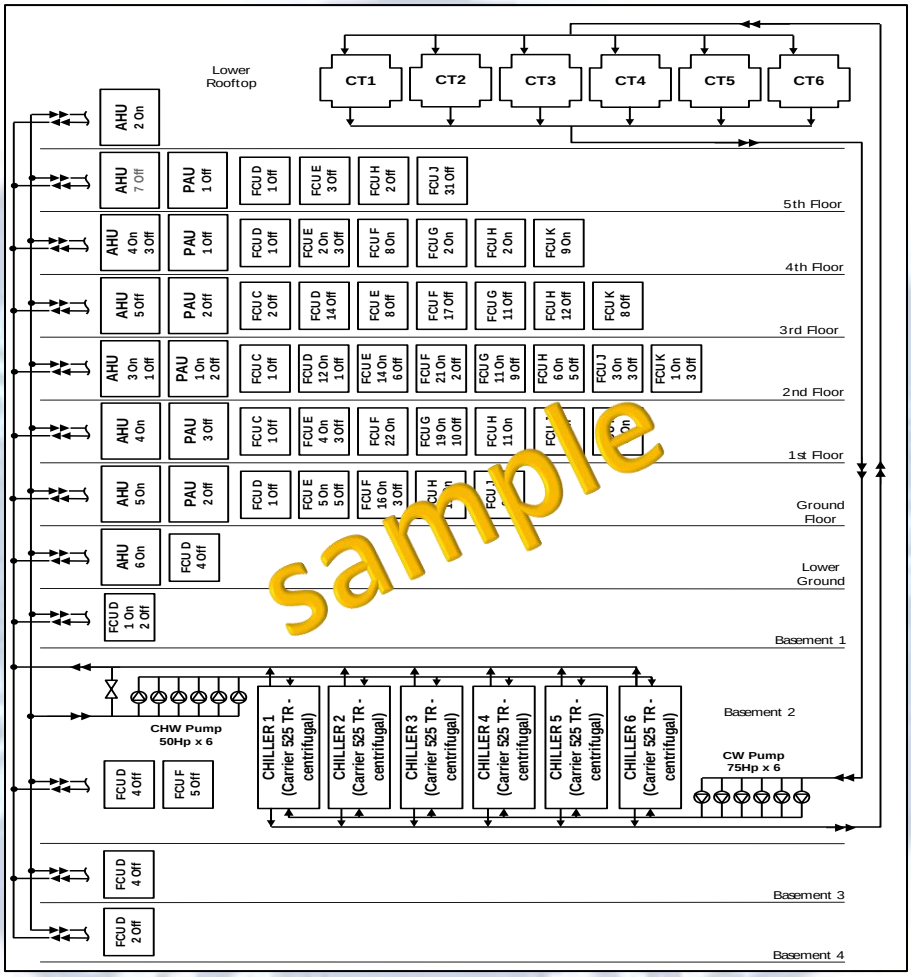
Describe observations and findings

7 ENERGY CONSUMPTION INFORMATION AND ANALYSIS – CHILLED WATER SYSTEM

7.1 System description

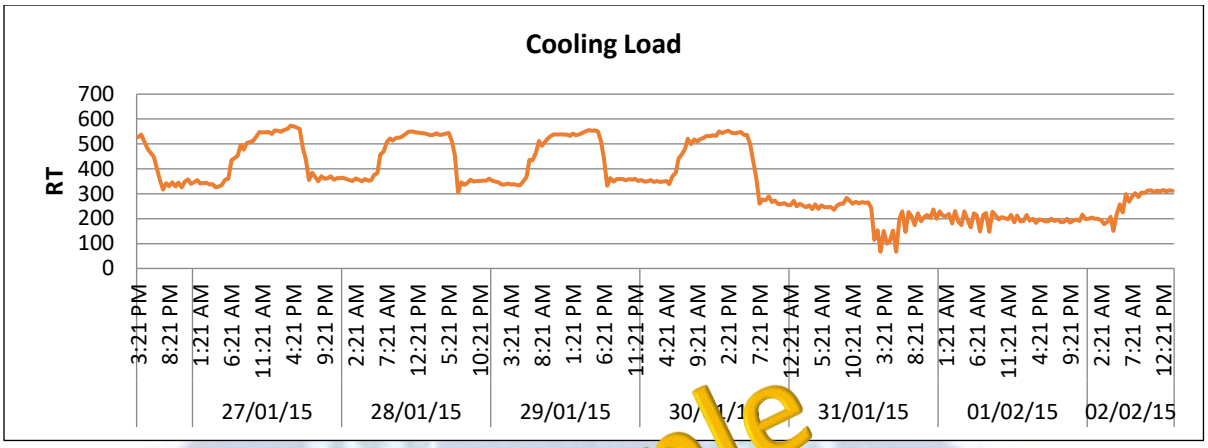
Describe system

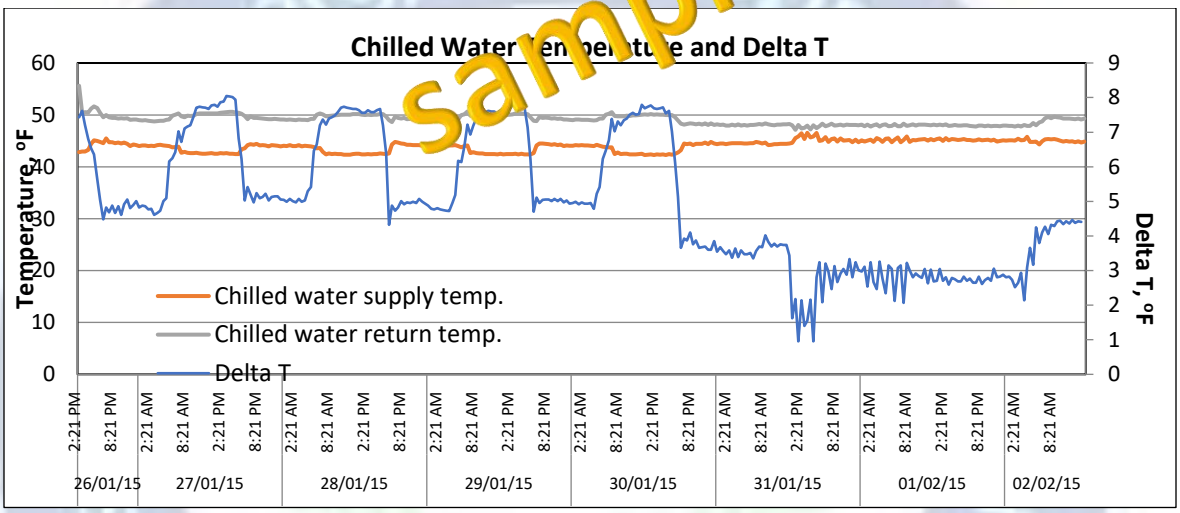
Air conditioning schematic diagram



7.2 Load Profile – Thermal/Chilled Water

Describe load profile and observations

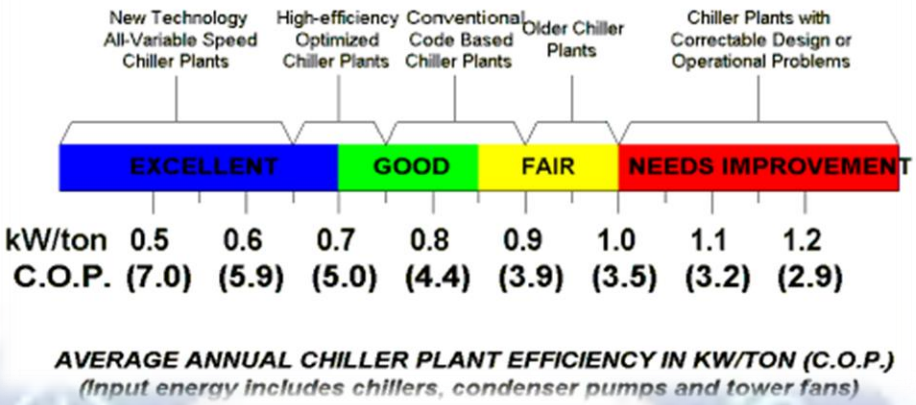




Describe chilled water system and operation

Day	Average Load factor	Average COP
01	77%	3.7
02	82%	[illegible]
03	88%	4.5
04	[illegible]	4.3
05	[illegible]4%	4.8
06	95%	4.9
07	94%	5.1
Overall	**88%**	**4.5**

Evaluate Chiller COP and System COP



AVERAGE ANNUAL CHILLER PLANT EFFICIENCY IN KW/TON (C.O.P.)
(Input energy includes chillers, condenser pumps and tower fans)

7.3 Observations and Findings

Describe observations and findings

8 ENERGY CONSUMPTION INFORMATION AND ANALYSIS - AIR CONDITIONING AND MECHANICAL VENTILATION SYSTEM

8.1 System Description

Describe system/s

No	Description	Qty	Total Installed Power (kW)
Main Building			
1	Chilled Water Pumps	4	220kW
2	Air Handling Units	4	632.2kW
3	Fan Coil Unit	30	188kW
4	Variable Refrigerant Volume (VRV) Unit	29	100.37kW
5	Ventilation Fan	90	337.6kW
6	Cooling Tower Fan	4	200kW
7	Condenser Water Pumps	4	130kW

Time schedule of operations

No	Description	Quantity	Operation Hours	
			Start	Stop
Main Building				
1	Chilled Water Pumps (Duty)	2	6:00am	6:00pm
	Chilled Water Pumps (Standby)	2	6:00pm	6:00am
2	Rooftop Chiller (Duty)	1	6:00pm	6:00am
	Rooftop Chiller (Standby)	1	6:00am	6:00pm
3	Air Handling Units (24hrs)	25	6:00am	6:00am
4	Air Handling Units	21	6:30am	6:00pm
5	Fan Coil Unit (24hrs)	16	6:00am	6:00am
6	Fan Coil Unit	14	7:00am	6:00pm
7	Variable Refrigerant Volume (VRV) Unit	28	6:00am	6:00am
8	Ventilation Fans (toilets)	86	Manual	
9	Ventilation Fans (Fresh air)	4	6.00 a.m	6.00 p.m

Fan Specific Power

Describe findings

No	AHU	Air Flow Rate, m³/hr		Fan Power, W	Fan Efficiency, W/m³hr
		Design	Running		
1	AHU-L1-MO1.4	28,237	17,193	8,668	0.50
2	AHU-L1-MO1.8	34,503	33,3[illegible]	[illegible],833	0.29
3	AHU-L1-MO1.9	24,45[illegible]	[illegible]89	7,439	0.78
4	AHU-L2-MO1.1	3[illegible],392	25,554	9,768	0.38
5	AHU-L2-MO1.2	36,621	10,602	8,345	0.79
6	AHU-L2-MO1.5	36,358	30,991	15,202	0.49

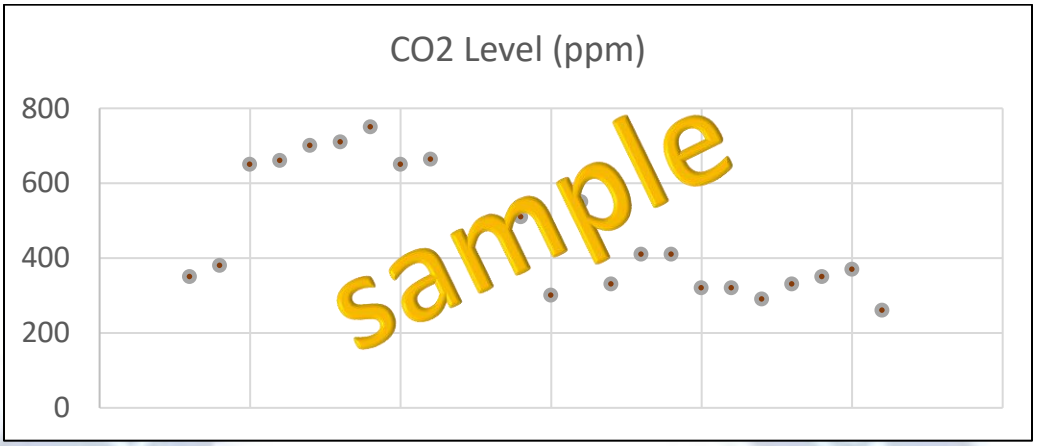
Air Change Rate (ACR) and AHU Capacity Analysis

Describe findings

No	AHU	Capacity, Btu/hr	Air Flow Rate, m³/hr		Served Area, m²	Air Change Per Hour (ACH)		Capacity Intensity, Btu/hr ft²
			Design	Running		Design	Running	
1	AHU-L1-M01.9	593,688	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,[illegible]9[illegible]	1,[illegible]77.[illegible]	8.6	5.2	57.4
4	AHU-ANX-L1A.3	535,684	22,[illegible]24	5,853	925.2	8.1	2.1	53.8
5	AHU-L2-M01.1	880,296	37,392	25,554	1,720.3	12.8	4.9	47.5
6	AHU-L2-M01.2	863,236	36,621	10,603	1,448.8	8.3	2.4	55.4

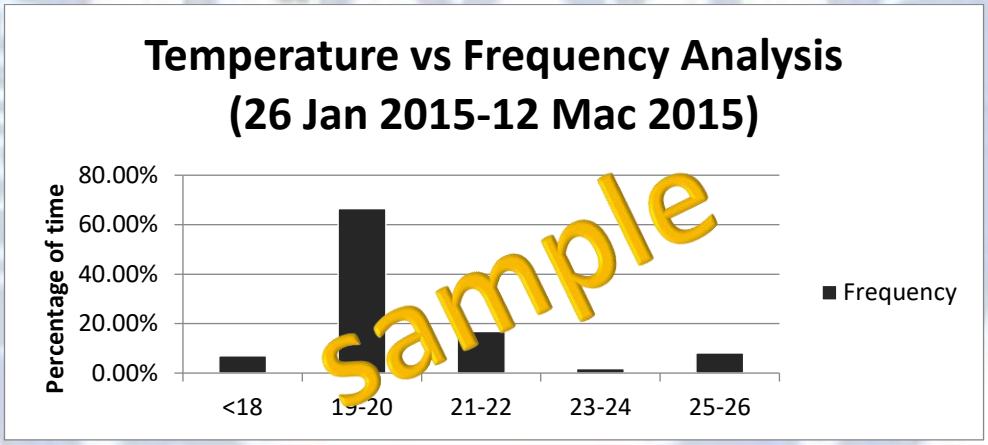
Indoor Air Quality

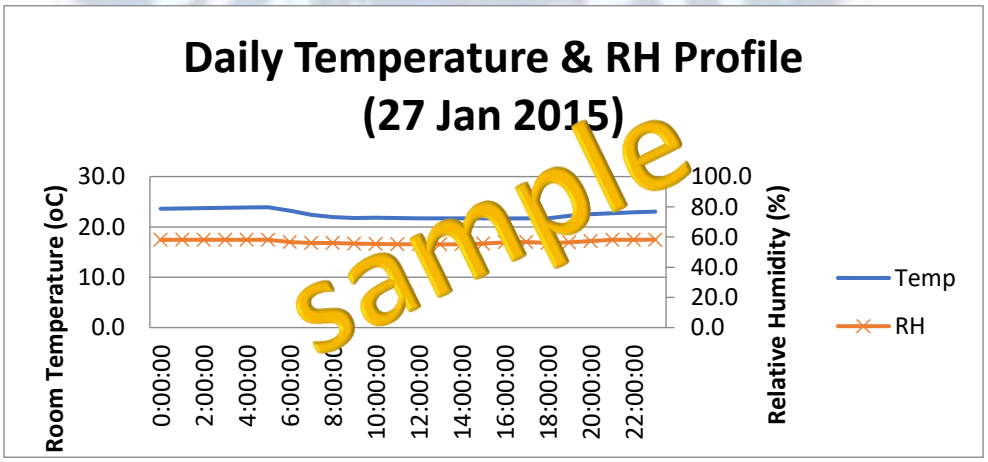
Describe findings



Air Conditioning Room Conditions

Describe findings





8.2 Observations and Findings

Describe observations and findings.

9 ENERGY CONSUMPTION INFORMATION AND ANALYSIS - LIGHTING SYSTEM

9.1 System Description

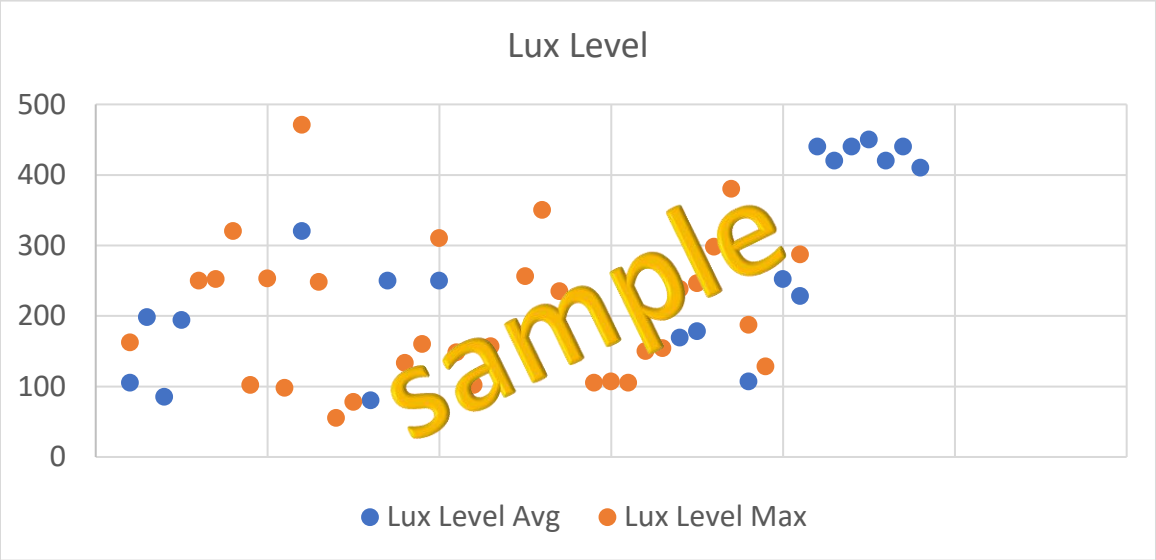
Show list of lighting types and quantity

Describe lighting system and operation

No	Description	Operation Hours	
		Start	Stop
Main Building			
2	Lobby, Walkways	6:00am	6:00am
3	Offices	6:30am	6:00pm
4	Outdoor Lighting	7:00pm	7:00am
5	Decorative Lighting	6:00am	6:00am
6	Car Park (24hrs)	6:00am	6:00am

Lighting Conditions

Describe findings



9.2 Observations and Findings

Describe observations and findings

10 ENERGY CONSUMPTION INFORMATION AND ANALYSIS - VERTICAL TRANSPORT (LIFTS AND ESCALATORS)

10.1 System Description

Describe system and operation

Room No./ Description	Equipment Description	Rated Power [kW]	Quantity
North Lift	Lift No. 2	22	1
North Lift	Lift No. 3	22	1
South Lift	Lift No. 4	22	1
South Lift	Lift No. 5	22	1
Main Lobby	Lift No. 6	22	1
Main Lobby	Lift No. 7	22	1
OKT Lift	Lift No. 8	11	1
OKT Lift	Lift No. 9	11	1
Service Lift	Lift No. 12	22	1

10.2 Observations and Findings

Describe observations and findings

11 ENERGY CONSUMPTION INFORMATION AND ANALYSIS - GENERAL EQUIPMENT AND PLUG LOADS

Describe typical list of equipment used, operation hours and rated power

Summary of total energy consumption measured from instantaneous power readings

11.1 Observations and Findings

Describe observations and findings

12 ENERGY CONSUMPTION INFORMATION AND ANALYSIS - BUILDING CONTROL SYSTEM

12.1 System Description

Describe system/s

No.	Description	Qty	Monitor/control
1	CHWP	4	Control
2	AHU	99	Control
3	VAV	NA	Control
4	FCU	46	Control
5	VRV	56	Control
6	Lighting – General Areas Only	NA	Control
7	External Lighting	296	Control
8	Car Park Lighting	NA	Monitor
9	Ventilation Fans (Main Bldg only)	138	Control

Describe system operations

System	Equipment	Control strategy
ACMV	AHU	• Fan speed is controlled by variable speed drive. Controlled variable is supply duct static pressure which is set at certain value. • Control valve position is controlled by valve actuator. Controlled variable is supply air temperature. • AHU operation is controlled by schedule program from BCS.
	VAV	• VAV damper position is controlled by VAV actuator. Controlled variable is zone temperature. • VAV position and zone temperature are monitored by BCS.
	VRV	• VRV damper position is controlled by VAV actuator. Controlled variable is zone temperature. • VRV position and zone temperature are monitored by BCS.
	Ventilation/Fresh Air Fan	• Fresh air fan operation hours are controlled by schedule program from BCS. • Speed regulation of fresh air fan is controlled by Variable speed drive. Controlled variable is static pressure which varies according to fresh air damper position to each AHU.
	Chilled water pump	Chilled water pump is controlled by variable speed drive. Controlled variable is chilled water pressure differential between supply and return main.
Lighting	Indoor General Areas	Lighting operation is controlled by schedule program from BCS

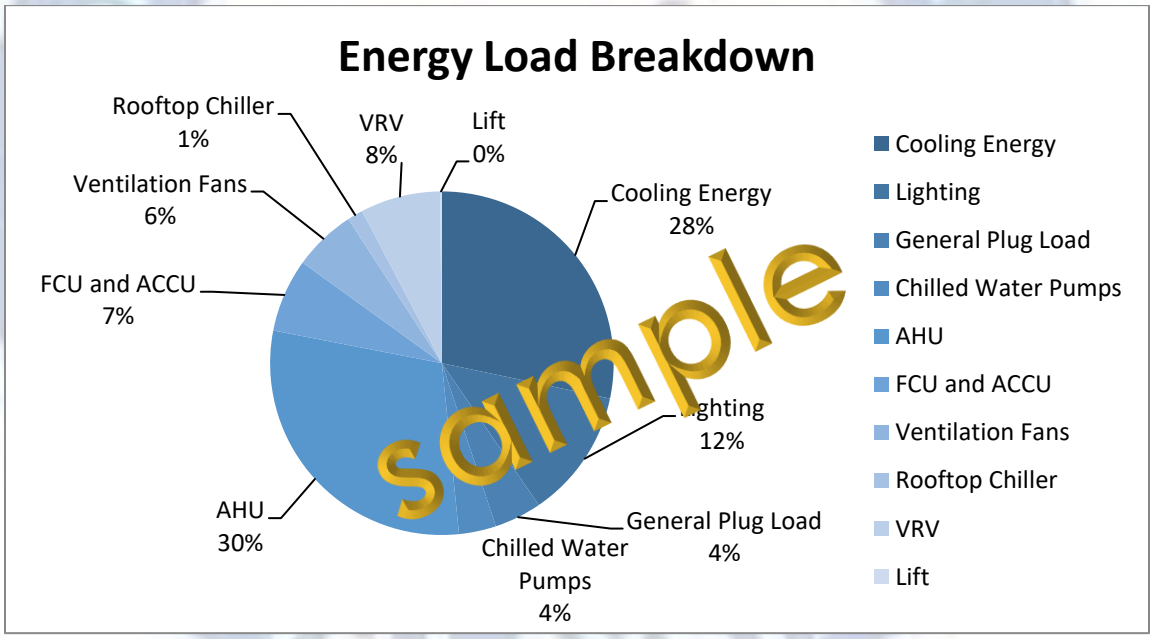
12.2 Observations and Findings

Describe observations and findings

13 LOAD APPORTIONING AND ENERGY INDEX

Describe chart.

End Use Loads	Annual Consumption (kWh)	Percentage
Cooling Energy	2,281,310.00	28%
Lighting	979987.17	12%
General Plug Load	35[illegible]3	4%
Chilled Water Pumps	28[illegible]64	3%
AHU	2[illegible]722.14	30%
FCU and ACCU	556365.12	7%
Ventilation Fans	474451.85	6%
Rooftop Chiller	118081.65	1%
VRV	607505.74	8%
Lift	12776.99	0.2%

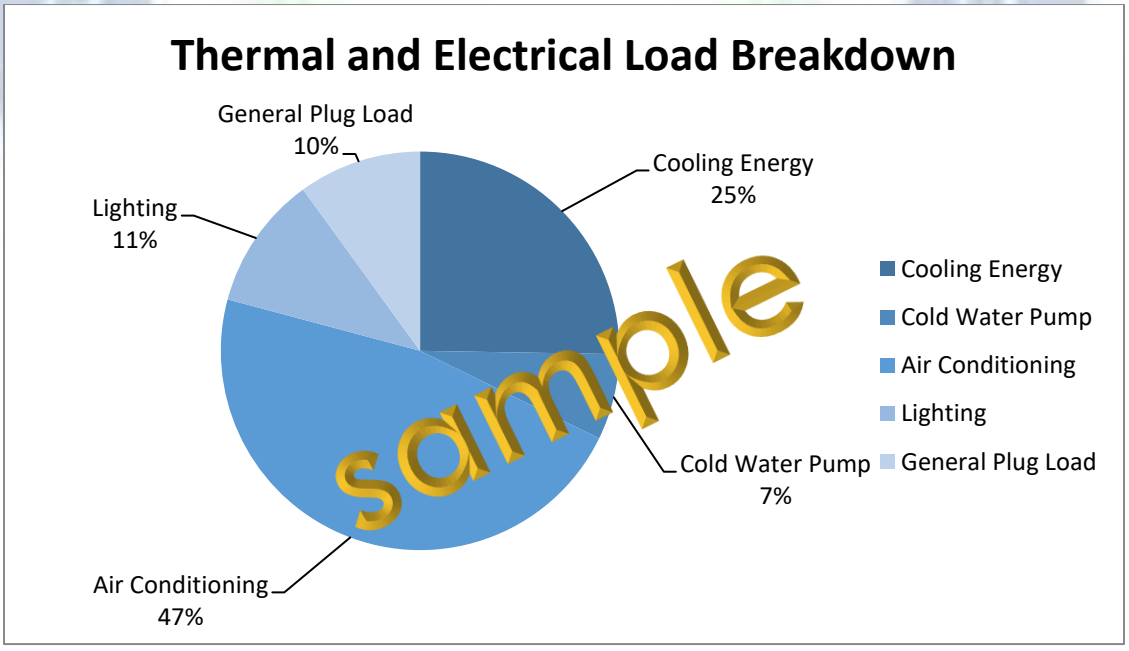


Energy Indices

Describe table and charts

Building Energy Intensity Index (BEII)		kWh/m2
Lighting Energy Intensity Index (LEII)		kWh/m2
Air Conditioning Energy Intensity Index (ACEII)		kWh/m2
Building Power Baseload		kW

Lighting Power Density		W/m2
Air Conditioning Power Density		W/m2
Equipment Power Density		W/m2
Baseload Power Index		W/m2



14 ENERGY SAVING MEASURES

Explain each esm in detail showing basis of calculations and assumptions made.

No low cost measure

Findings

Energy Saving Recommendation/Measure

Potential Annual Cost and Savings

Estimated Investment Cost

ROI/SPP

Medium cost measure

Findings

Energy Saving Recommendation/Measure

Potential Annual Cost and Savings

Estimated Investment Cost

ROI/SPP

High cost measure

Findings

Energy Saving Recommendation/Measure

Potential Annual Cost and Savings

Estimated Investment Cost

ROI/SPP

* The ESMs 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.

Summary ESM table

No.	ESM	Estimated Savings		Estimated Investment(RM)	Simple Payback Period (yrs)	Estimated Carbon Reduction
		Energy (kWh)	Cost (RM)			kgCO2/kWh
No Cost						
1	Decommissioning all non critical ACSU units when chiller plant has been retrofitted	577587.64	306121.45	0	Immediate	
Low/Medium Cost						
2	Replace all Incandescent decorative lamps with LED strips/LED lamps	28539.22	[illegible]	1,000.00	0.07	21,147.56
3	Switch off outdoor corridor lights during the daytime	[illegible]	[illegible]	80000	2.7	41,083.15
4	Repairing compressed air leakage	[illegible]	2597.00	15000	5.8	3,630.9
High Cost						
5	Retrofit chillers, chilled water pumps, condenser [illegible] pumps, cooling tower and upgrade pipeworks	380112.00	201459.36	1190000	5.9	281,662.9
6	Retrofit AHUs and ducting to improve efficacy	669384.00	354773.52	359000	1.0	496,013.54
7	Replace all existing fluorescent and CFL lamps with LED lamps	567599.96	300,827.98	482,640.00	1.60	420,591.57

'TO BE COMPLETED BY BUILDING OWNER'

- Financing options/Government Incentives available
- Guides on how to implement proposed energy saving measures
- Proposed action plan and estimated time required to implement each measure

15 ENERGY SAVING MEASUREMENT AND VERIFICATION

'TO BE COMPLETED BY ENERGY AUDITORS AND OWNER'

Types of baseline data:

- Past year bills
- Measurements

Measurement and Calculation methods

Measurement & Verification methods

16 FINANCIAL AND ENERGY SAVINGS MEASURES IMPLEMENTATION PLANNING FOR OWNER TO IMPLEMENT (3 YEARS)

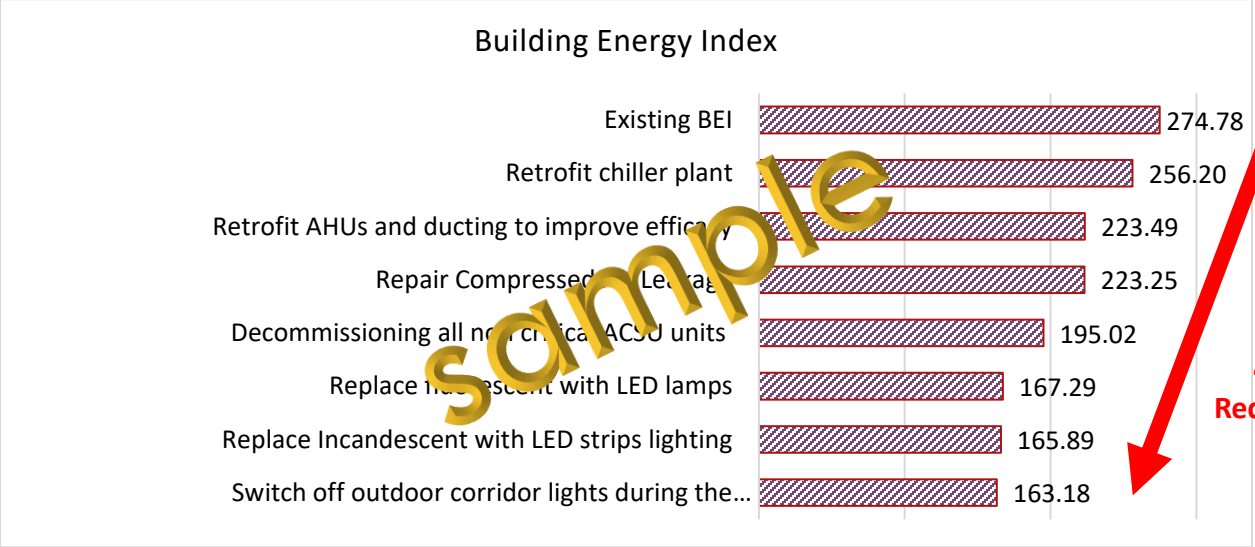
'TO BE COMPLETED BY ENERGY AUDITORS AND BUILDING OWNER'

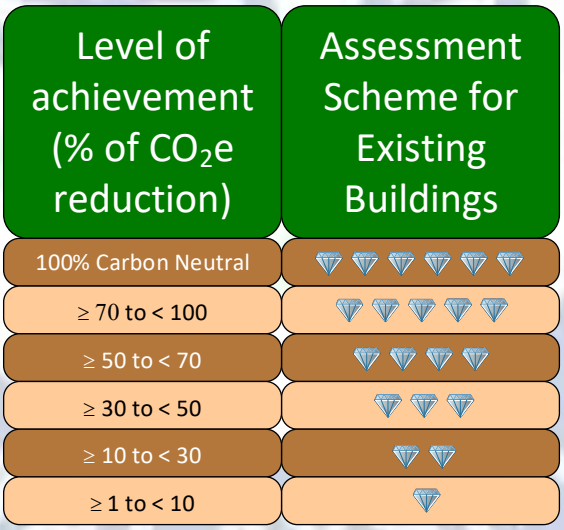
- 1ST Year, estimated implementation cost and savings.
- 2ND Year, estimated implementation cost and savings.
- 3rd Year, estimated implementation cost and savings.

* 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.

17 CONCLUSION

Conclusion





Construction Industry Standard 2012 CIS20:2012 GreenPASS assessment scheme

18 VERIFICATION

This Energy Audit Report is		
prepared by:	checked by:	received by SEDA Malaysia
Name: **Position:** **Date:**	Name: Position: Date:	Name: Position: Date: