Building picture/s

ENERGY AUDIT CONDITIONAL GRANT REPORT FOR

Building Name

Prepared By

Company logo

Auditor Name and Address

Client logo

Client Name and Address

Under

SUSTAINABLE ENERGY DEVELOPMENT AUTHORITY MALAYSIA

CONFIDENTIALITY

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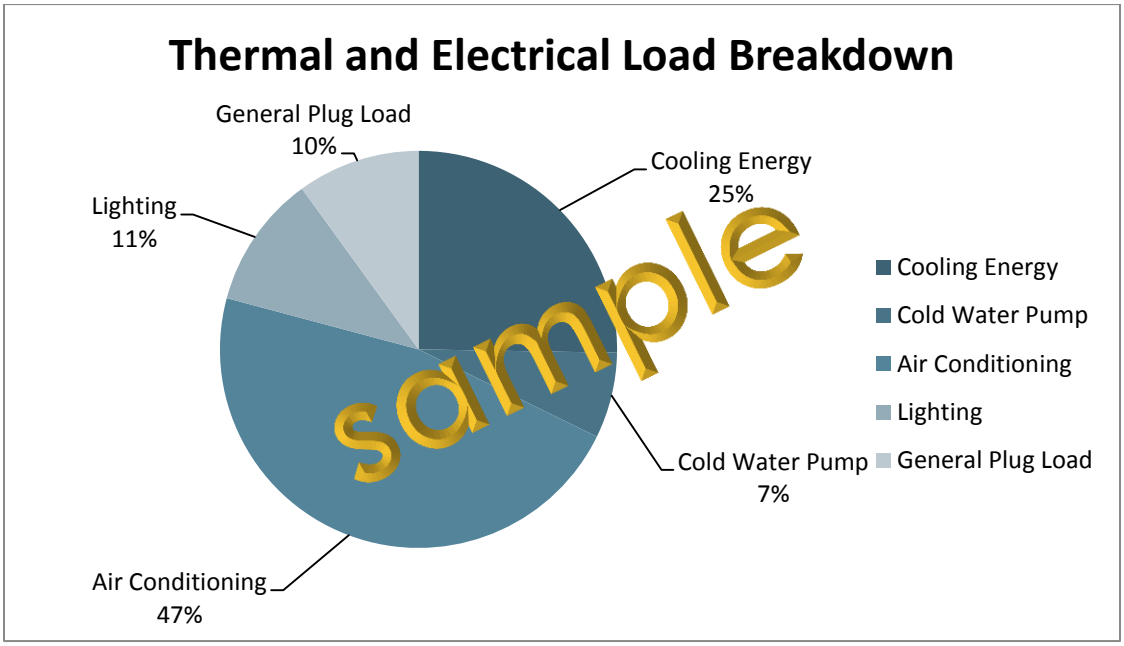
Table of Contents

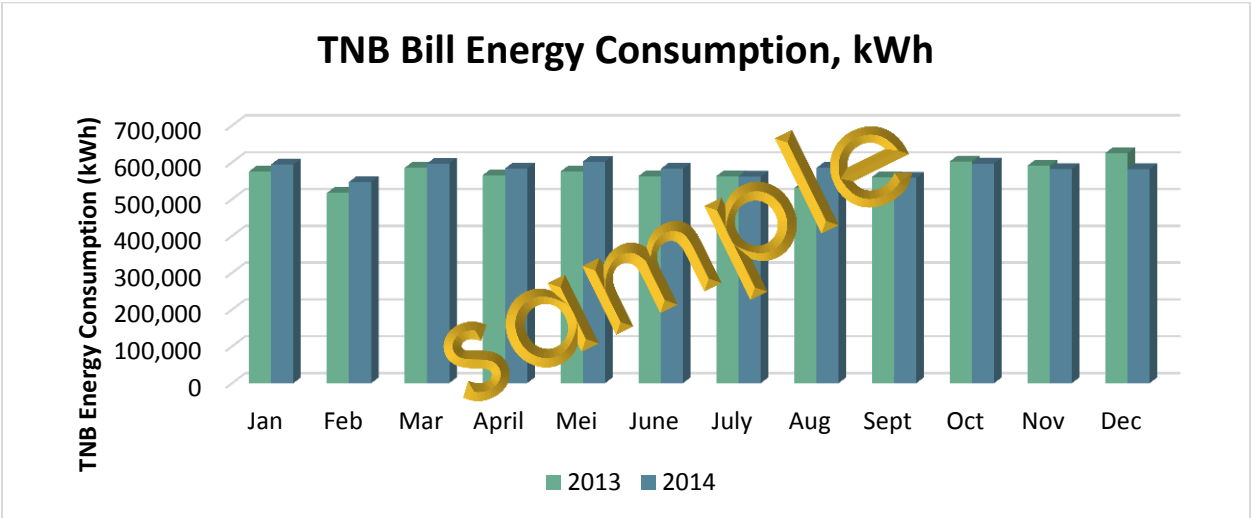
1 EXECUTIVE SUMMARY

Objectives, scope and type of audit.

Key systems and equipment audited.



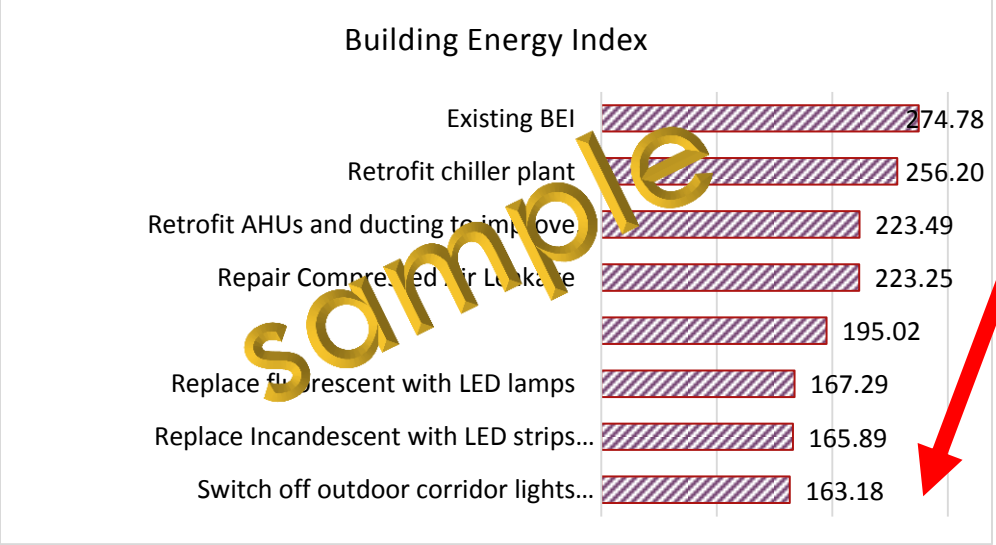
Describe chart



Describe graph

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

No.	ESM	Estimated Saving			Estimated Investment	Simple Payback Period / ROI	Estimated Carbon Reduction
		Energy (%)	Energy (KWh)	Cost (RM)	RM	Years	Tonne/yr
	No Cost						
1.	Decommissioning all non-critical ACSU units when chiller plant has been retrofitted	Calculate from baseline	577,587.64	306,121.45	-	0.1	-
2.	Delamping		63,825.41	26,577.99	-	0.1	44.29
..							
	Low/Medium Cost						
1.	Transform Electricity Tariff (TNB) from C1 to C1-OPTR		-	[illegible]	12,000	0.36	-
2	Retrofit FL 36W to LED 20W		[illegible]	07,288.30	116,820	4.76	51.37
..							
	High Cost						
1.	Retrofit High Efficiency AHU with Valve Actuator		305,746.18	111,567.31	965,000	8.68	233.41
2.							
..							
TOTAL		**XX**	**XXX,XXX**	**XXX,XXX**	**XXX,XXX**	**X**	**XXX**



Describe chart

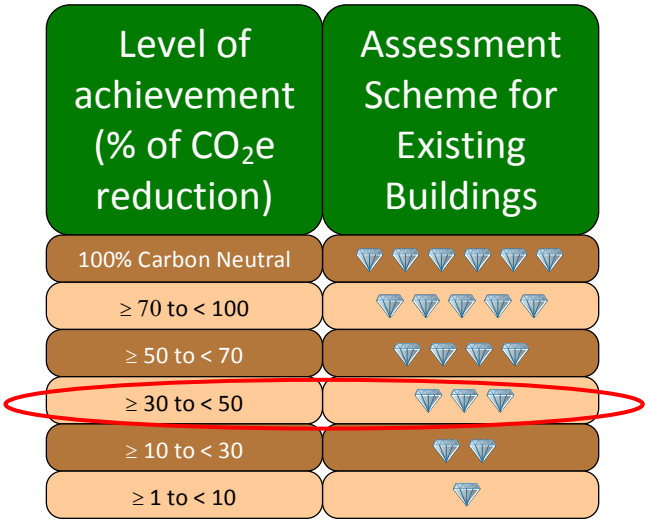
Table xx: Overall potential saving

Net Floor Area	Baseline (year)		After ESM Implementation		Reduction
	Energy	BEI	Energy	BEI	
m^2	kWh/yr	$kWh/m^2/yr$	kWh/yr	$kWh/m^2/yr$	
27,470.86	5,655,205	205.86	3,968,302.45	144.45	30%

Table xx: Carbon Emission Intensity (CEI) ($kg/m^2/yr$)

Net Floor Area	CO_2 Baseline (year)		After ESM Implementation		Reduction
	CO_2 e	CEI	CO_2 e	CEI	
m^2	kg/yr	$kg/m^2/yr$	kg/yr	$kg/m^2/yr$	
27,470.86	3,371,633.22	122.73	2,083,851.81	75.86	38%

Table xx: **CO_2 Emission Reduction Assessment Scheme for GreenPASS**



Based on the CIDB 2012 GreenPASS assessment scheme above, the level of achievement in 38% carbon reduction is eligible for 3 diamonds 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**

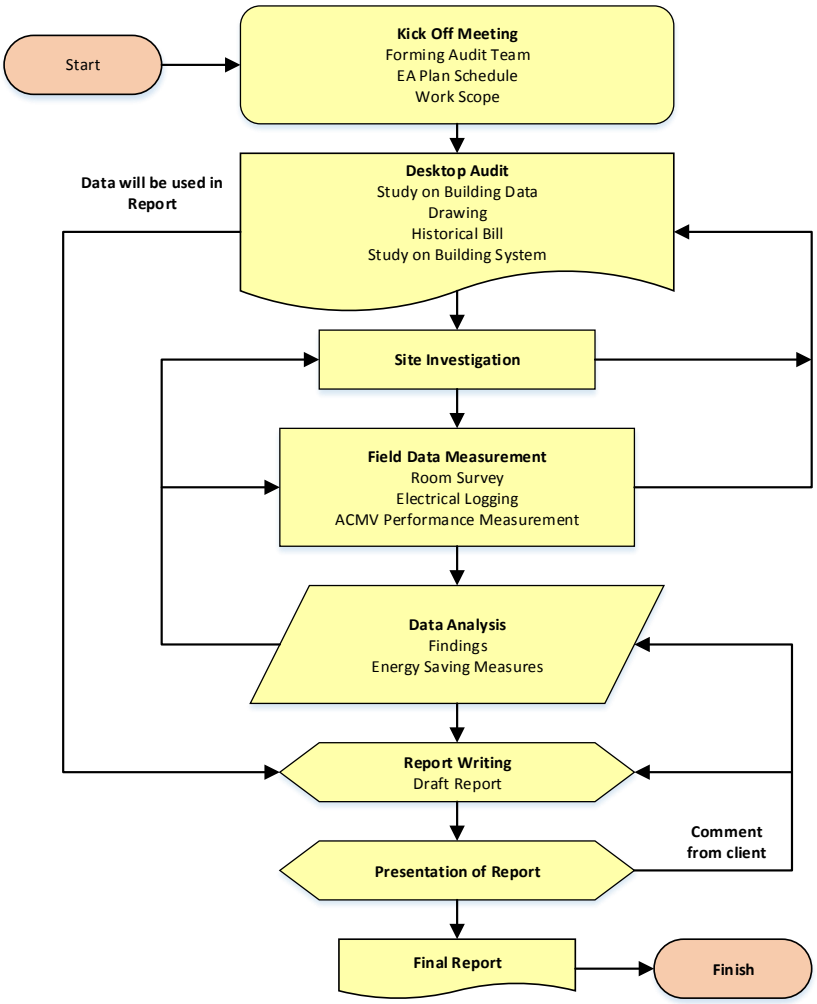
In operation since: **2001**

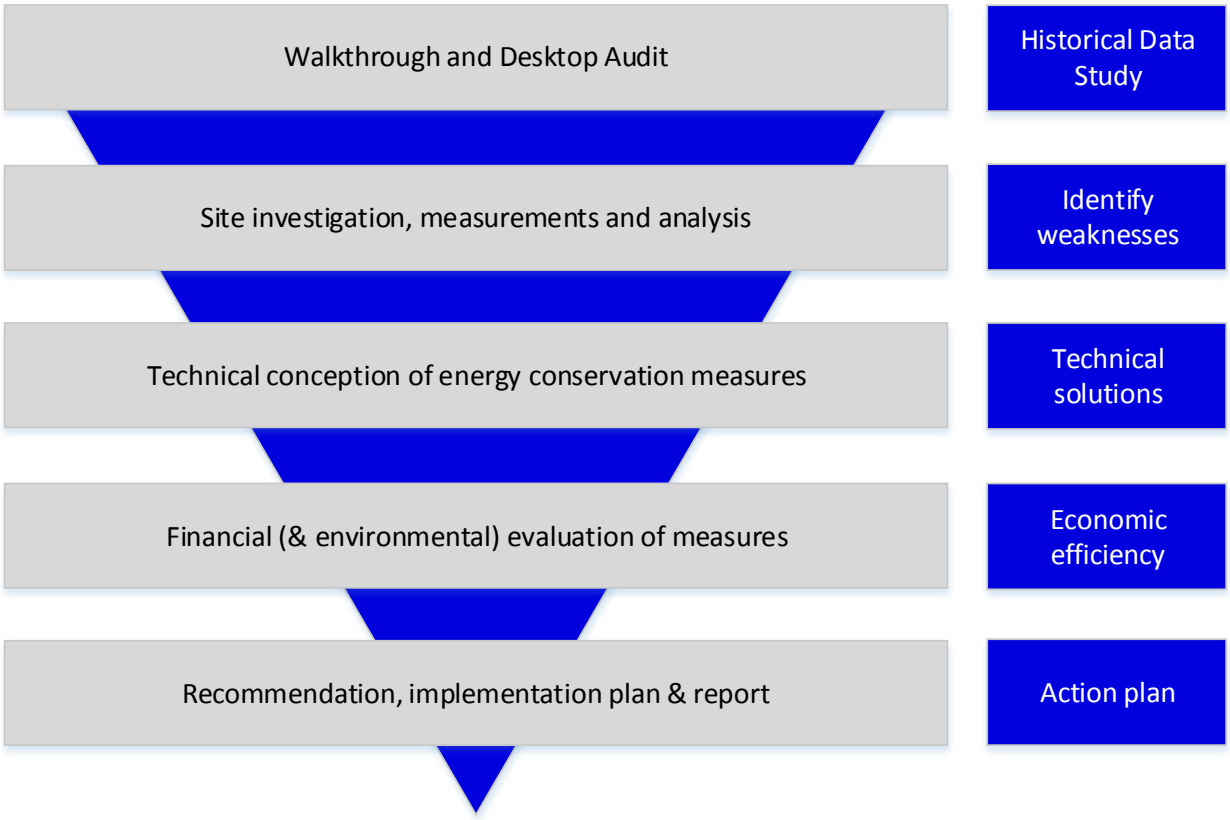
2.1 Objective

Brief explanation

2.2 Methodology

Brief explanation





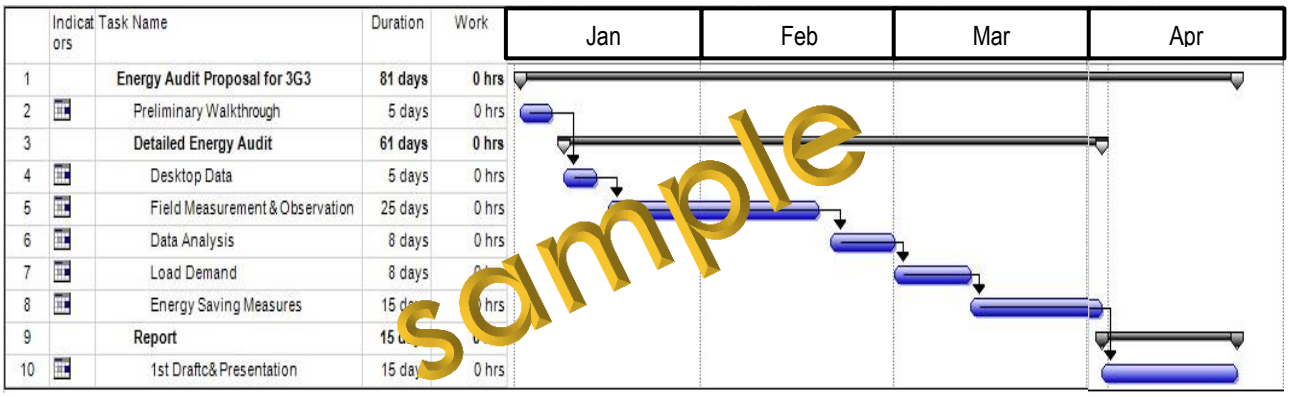
2.3 Type of Energy Audit and Process

Brief explanation

2.4 Scope of work

Brief explanation

2.5 Time Schedule and Audit Framework



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

EM 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
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	Informal contacts between engineer and a few users	Cost reporting based on invoice data. Engineer compiles	Informal contacts used to promote energy efficiency and	Only low cost measures taken

	Policy and Systems	Organization	Motivation	Information System.	Training and awareness	Investment
		someone with only limited influence or authority		reports for internal use within technical department	resource conservation	
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)	 20 200	 2.19 2.927
2	*Fenestration* Laminated toughened tinted gl	 12	 4.8
3	*Roof* Roof Tile Reflective Foi & Fi egl s 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	4108.48	0.09
South East Wall	1027.24	8938.72	[illegible]11
South West Wall	355.60	[illegible]	0.09

OTTV OF EACH F AÇADE

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	1890	0.836	0.02
Reflective Foil & Fibreglass	0.05	[illegible]	0.035	1.43
Asbestos Board	[illegible]00	720	0.108	0.03
Inside air film				0.15
Total Resist[illegible]nce				1.68
U-Value				**0.59**

RTTV of each roof direction

	Gross Roof Area (m2)	**RTTV**
Flat Roof	7599	10[illegible]6.1
North East	1490	2[illegible]33
North West	285	[illegible]0734.93
South East	[illegible]21	41647.44
South West	1522	21700.58
Total RTTV	**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

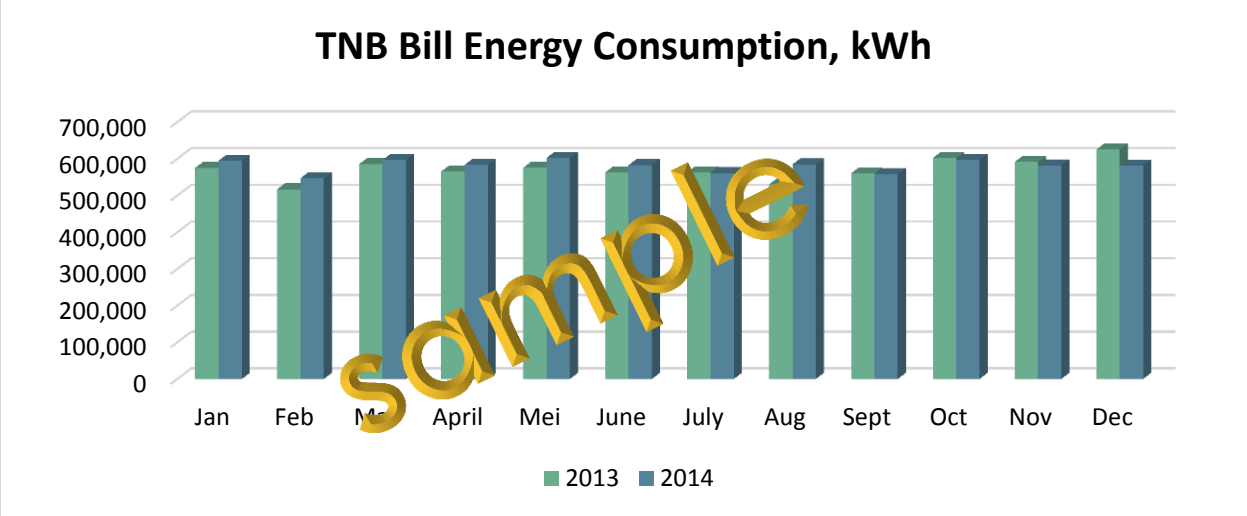
5.1 Tariff

Describe tariff system used

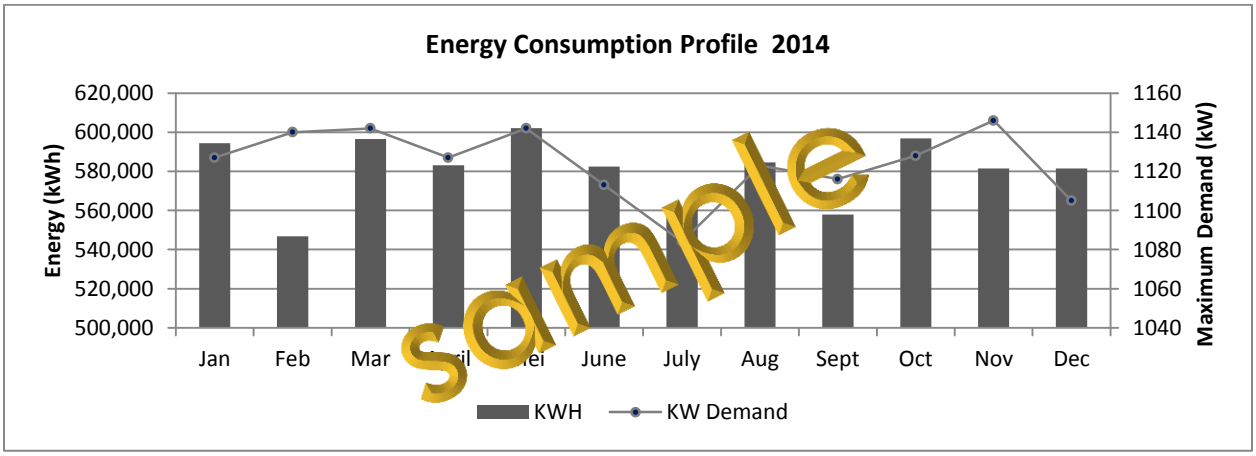
Year	Energy Rate (RM/kWh)	Maximum Demand Rate (RM/kW)
June 2011 – Dec 2013	RM0.312	RM25.90
Jan 2014- present	RM0.365	RM30.30

5.2 Historical Energy Consumption

Describe energy consumption and cost



Describe energy consumption, maximum demand and costs



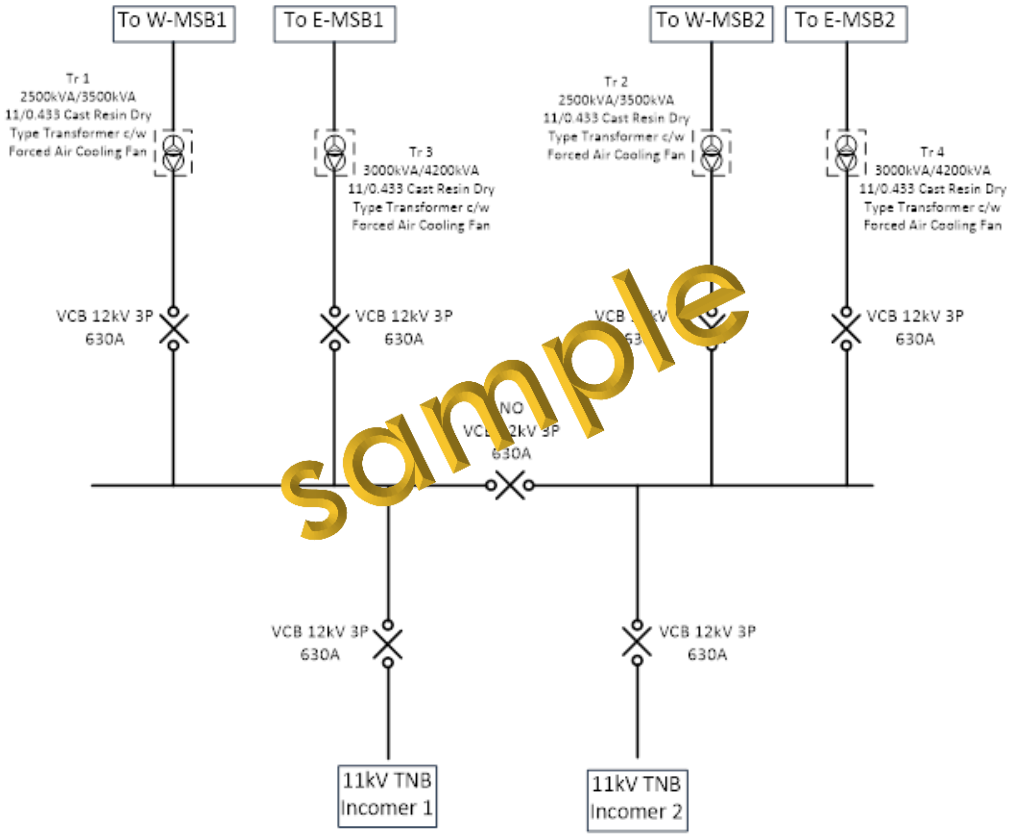
Describe load factor and evaluation

6 ENERGY CONSUMPTION INFORMATION AND ANALYSIS – ELECTRICAL

6.1 System Description

Describe system

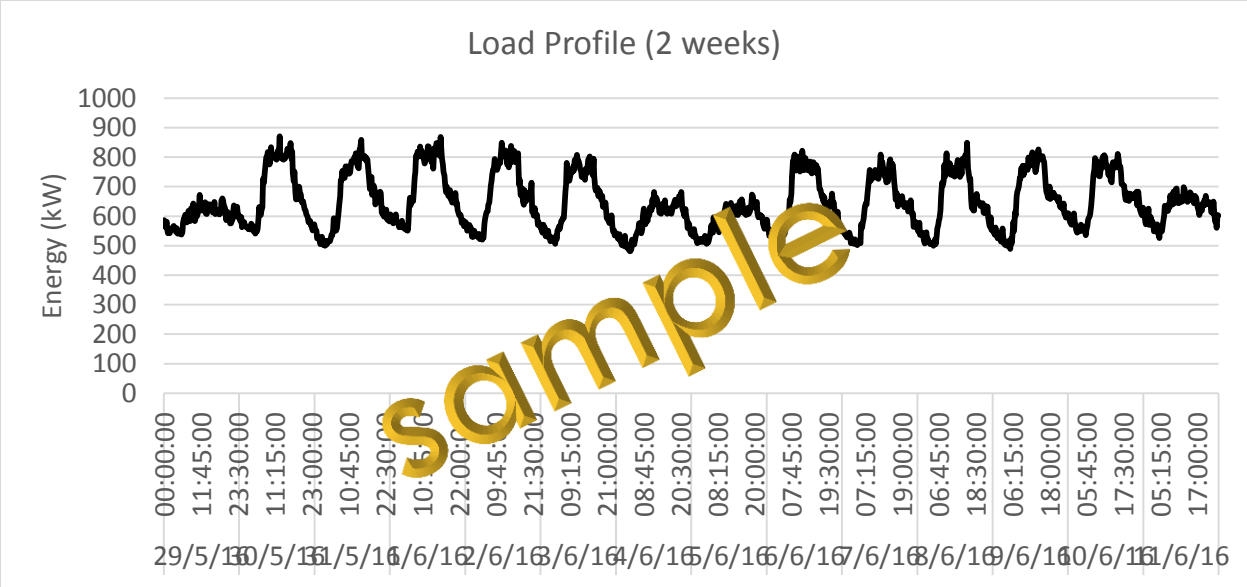
electrical schematic diagram



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	321.30	551.88
	12.87%	6.27%	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

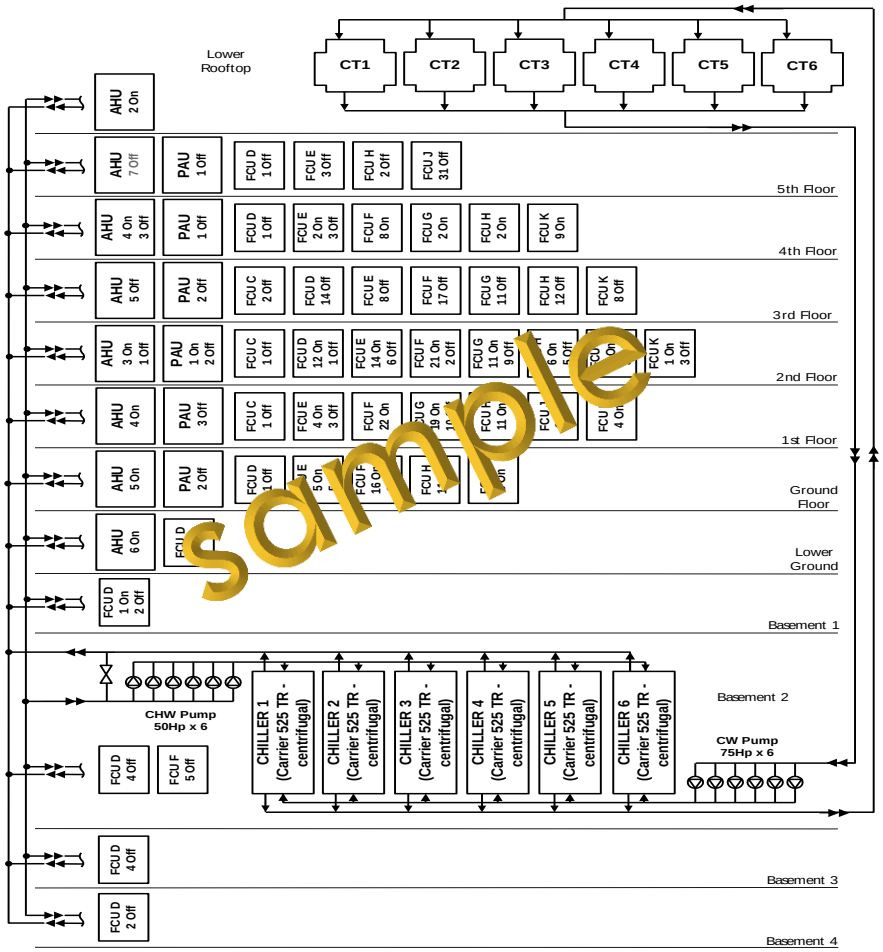
Describe observations and findings

7 ENERGY CONSUMPTION INFORMATION AND ANALYSIS – CHILLED WATER SYSTEM

7.1 System description

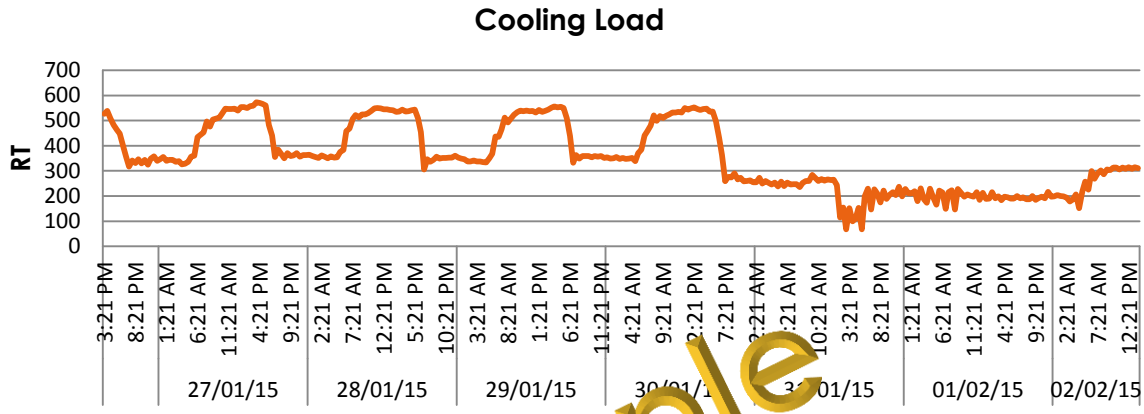
Describe system

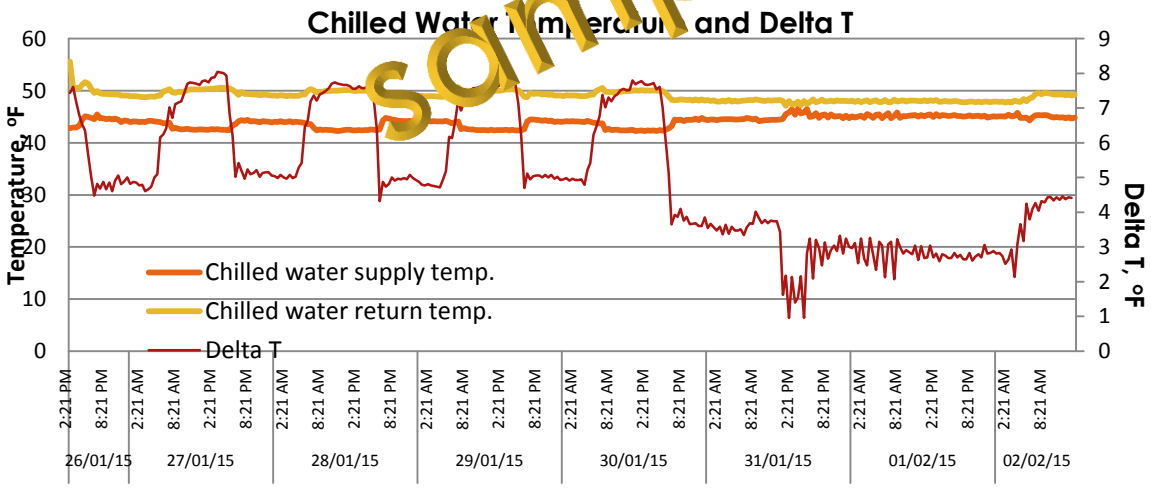
Air conditioning schematic diagram



7.2 Load Profile – Thermal/Chilled Water

Describe load profile and observations

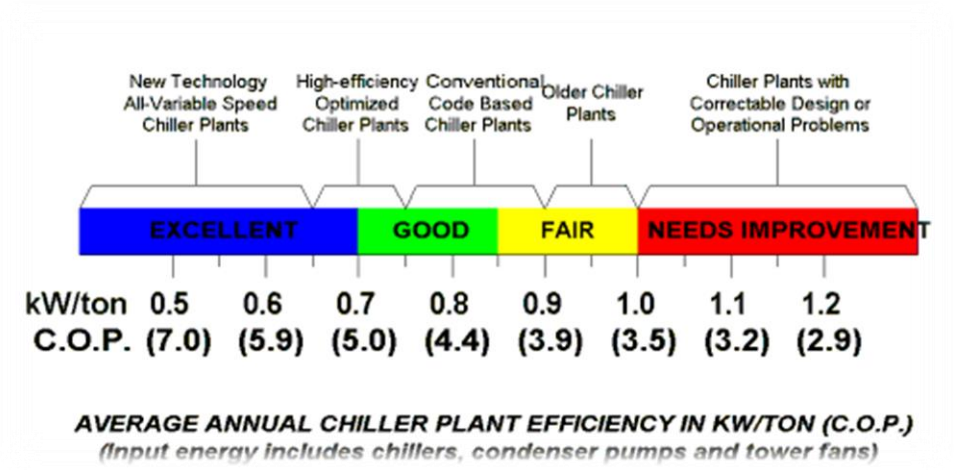




Describe chilled water system and operation

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

Evaluate Chiller COP and System COP



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 (24 hrs)	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, m^3/hr		Fan Power, W	Fan Efficiency, W/m^3hr
		Design	Running		
1	AHU-L1-MO1.4	28,237	17,193	8,668	0.50
2	AHU-L1-MO1.8	34,503	33,361	9,833	0.29

No	AHU	Air Flow Rate, m^3/hr		Fan Power, W	Fan Efficiency, W/m^3hr
		Design	Running		
3	AHU-L1-MO1.9	24,401	9,539	7,439	0.78
4	AHU-L2-MO1.1	37,392	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

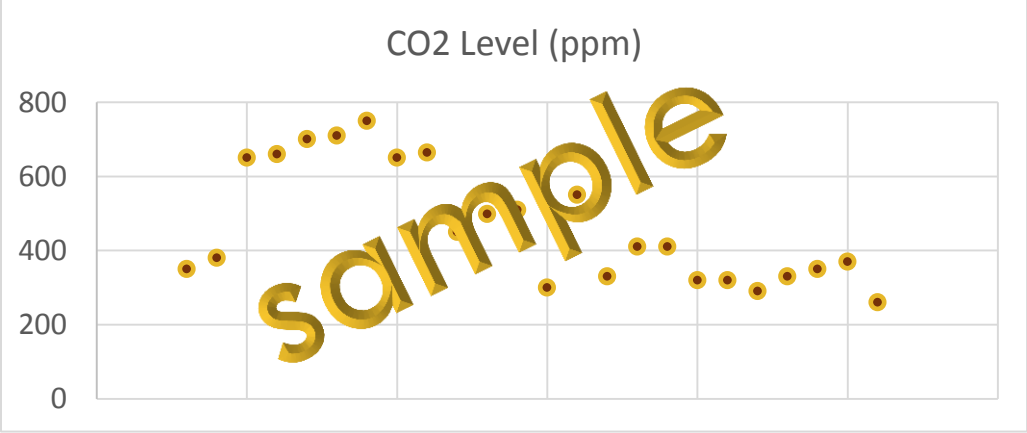
Air Change Rate (ACR) and AHU Capacity Analysis

Describe findings

No	AHU	Capacity, Btu/hr	Air Flow Rate, 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	593,688	25,269	9,539	9[illegible].2	8.5	3.2	56.9
2	AHU-L1-M01.8	812,056	34,502	13,36[illegible]	1,600.9	7.0	6.8	47.1
3	AHU-L1-M01.4	665,340	18,2[illegible]2	1[illegible]192	1,077.5	8.6	5.2	57.4
4	AHU-ANX-L1A.3	535,6[illegible]4	[illegible],824	5,853	925.2	8.1	2.1	53.8
5	AHU-L2-M01.1	[illegible]880.2[illegible]	37,392	25,554	1,720.3	12.8	4.9	47.5
6	AHU-L2-M01.2	8[illegible],236	36,621	10,603	1,448.8	8.3	2.4	55.4

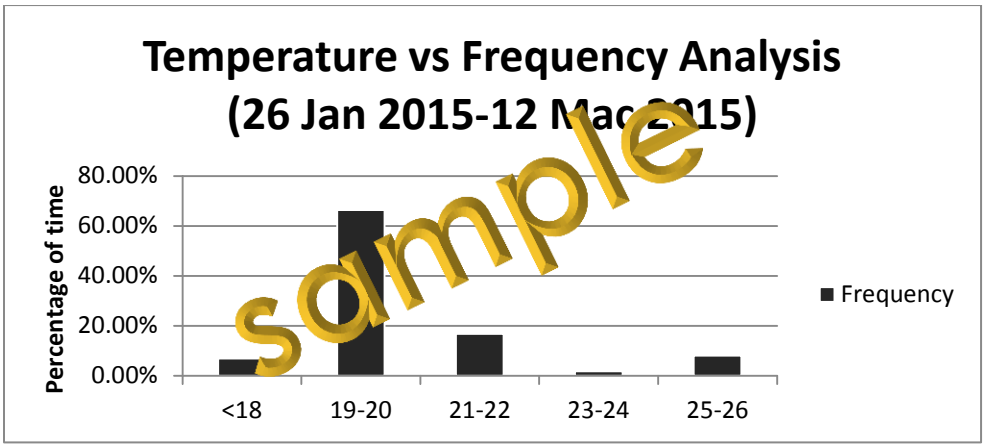
Indoor Air Quality

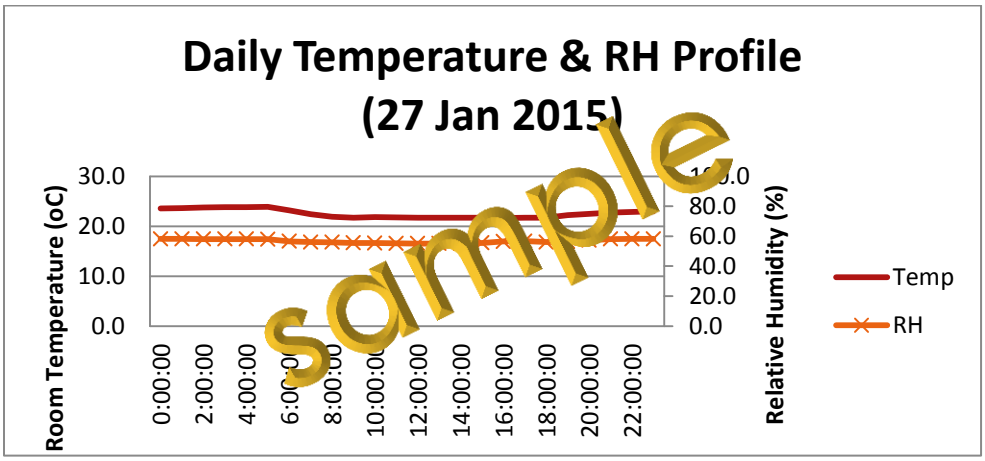
Describe findings



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

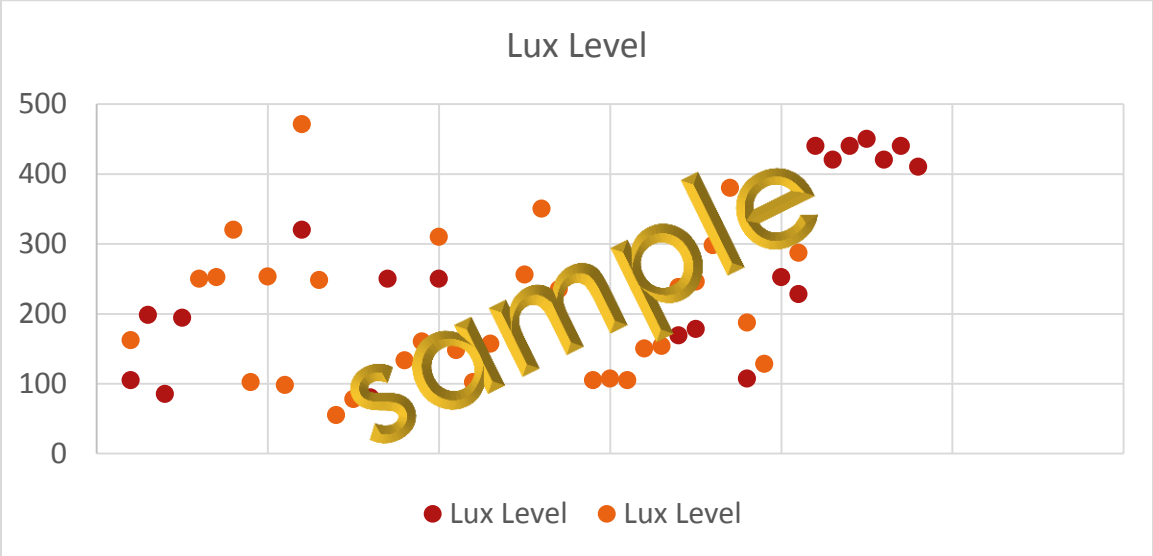
Show list of lighting types and quantity

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**	**59**	**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

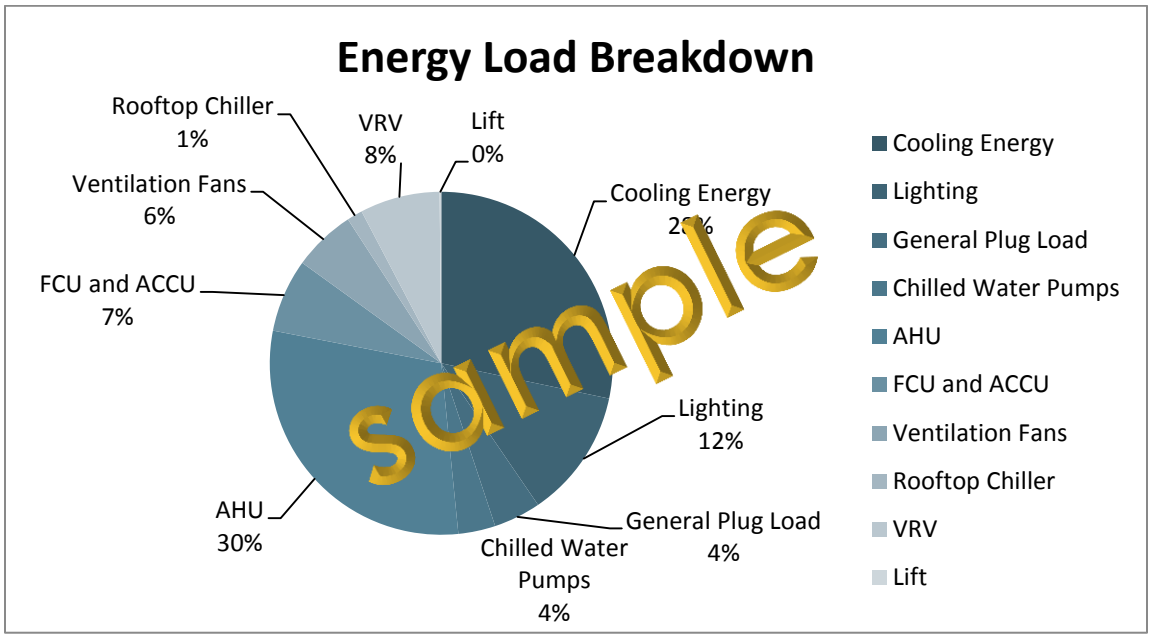
12.2 Observations and Findings

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	359[illegible]3.	4%
Chilled Water Pumps	28[illegible]64	3%
AHU	2[illegible]22.14	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%

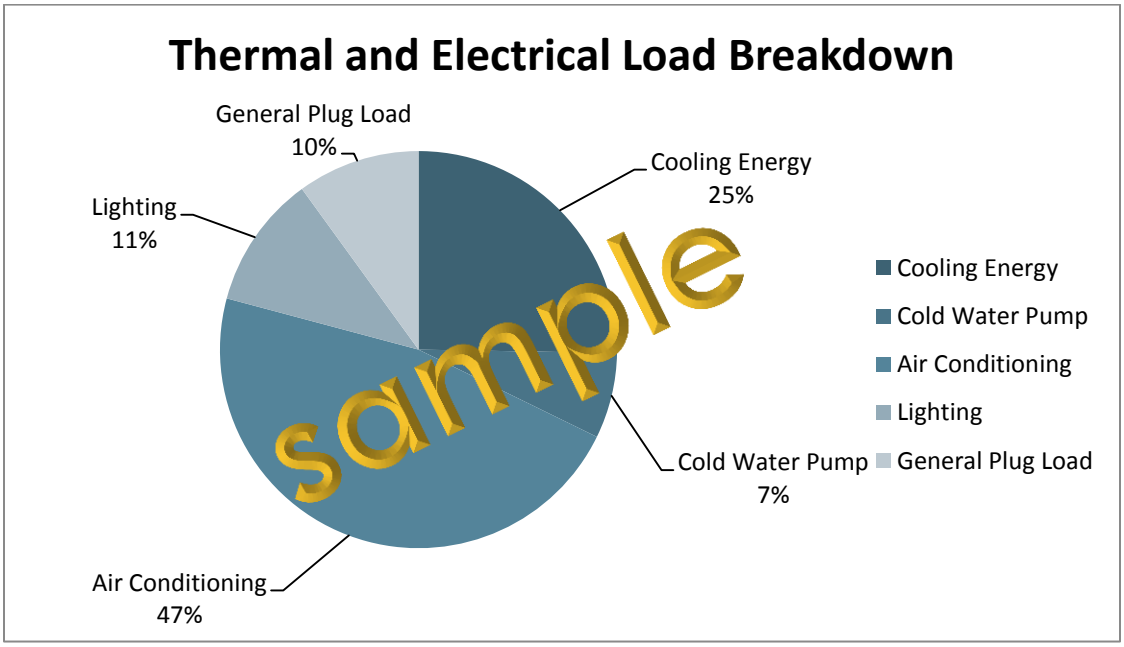


Energy Indices

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

Summary ESM table

No.	ESM	Estimated Saving			Estimated Investment	Simple Payback Period / ROI	Estimated Carbon Reduction
		Energy (%)	Energy (KWh)	Cost (RM)	RM	Years	Tonne/yr
	No Cost						
1.	Decommissioning all non-critical ACSU units when chiller plant has been retrofitted	*Calculate from baseline*	577,587.64	306,121.45	-	0.1	-
2.	De-lamping		63,825.41	6,57[illegible]	-	0.1	44.29
..							
	Low/Medium Cost						
1.	Transform Electricity Tariff (TNB) from C1 to C1-OPTR		-	33,196.31	12,000	0.36	-
2	Retrofit FL 36W to LED 20W		57,288.32	67,288.30	116,820	4.76	51.37
..							
	High Cost						
1.	Retrofit High Efficiency AHU with Valve Actuator		305,746.18	111,567.31	965,000	8.68	233.41
2.							
..							
TOTAL		**XX**	**XXX,XXX**	**XXX,XXX**	**XXX,XXX**	**X**	**XXX**

- 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 :

Year		Energy Consumption (kWh/yr)	% reduction of Energy Consumption	BEI (kWh/m^2 /year)	Initiatives -ESM	Investment Cost (RM)	Gross Saving / Net Saving (RM)
Oct-Sep 2017 (Baseline)		5,655,207.00					
			Target				
Year 1 Implementation	**Q1** (Oct-Dec 2017)	5,275.700.35	6.71		Low Cost Measures 1. Transform Electricity Tariff (TNB) from C1 to C1-OPTR	12,000	33,196.31
	Q2-Q3 (Jan-Jun 2018)				No Cost Measures 1. Decommissioning of non-critical AHU unit when chiller plant has been retrofitted	-	306,121.45
	Q4 (Jul-Sep 2018)				No Cost Measures 1. De-lamping 2. ….xxx		26,577.99
Year 2 Implementation	**Q1** (Oct-Dec 2018)	4,748,130.15	10		Low Cost Measures 1. EE Awareness campaign – *eco mode PC / switch-off when not using appliances/lunch time*	XX,XXX	XXX,XXX
	Q2-Q3 (Jan-Jun 2019)				Medium Cost Measures 1. Retrofit FL 36W to LED 20W	XX,XXX	67,288.30
	Q4 (Jul-Sep 2019)				Medium Cost Measures 1. XXXXXXXXX	XX,XXX	XX,XXX
Year 3 Implementation	**Q1-Q4** (Oct 2019 – Sep 2020)	4,083,391.90	14		High Cost Measures 1. Retrofit High Efficiency AHU with Valve Actuator	XXX,XXX	XXX,XXX

15 ENERGY SAVING MEASUREMENT AND VERIFICATION

Types of baseline data:

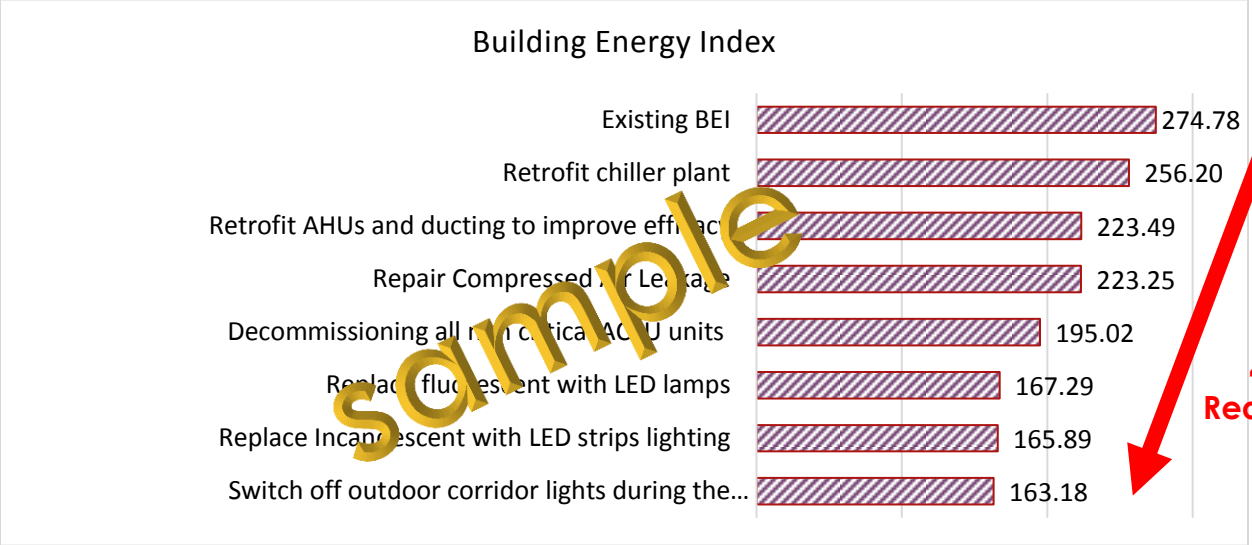
- Past year bills
- Measurements

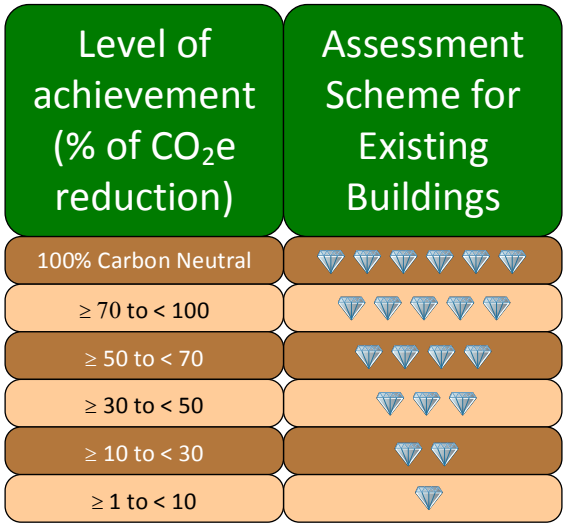
Measurement and Calculation methods

Measurement & Verification methods

16 CONCLUSION

conclusion





Construction Industry Standard 2012 CIS20:2012 GreenPASS assessment scheme

17 VERIFICATION

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