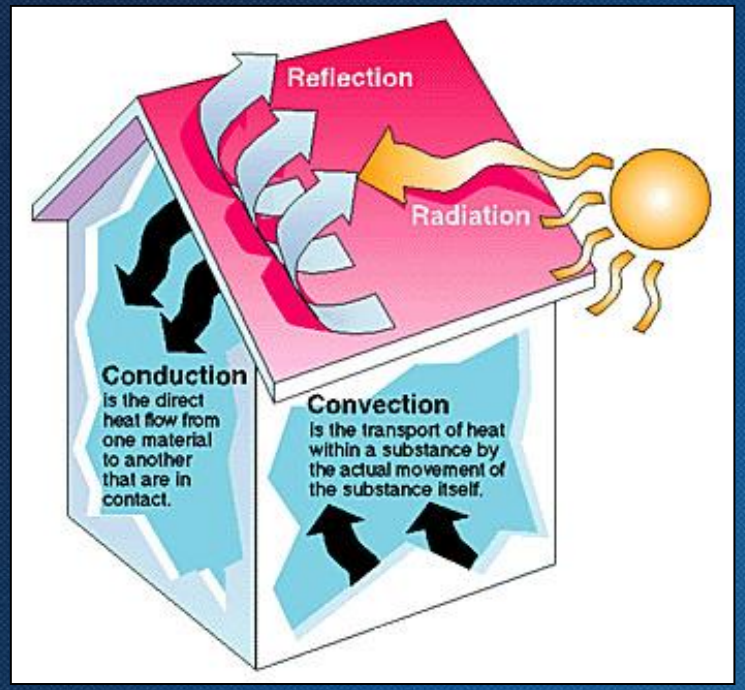
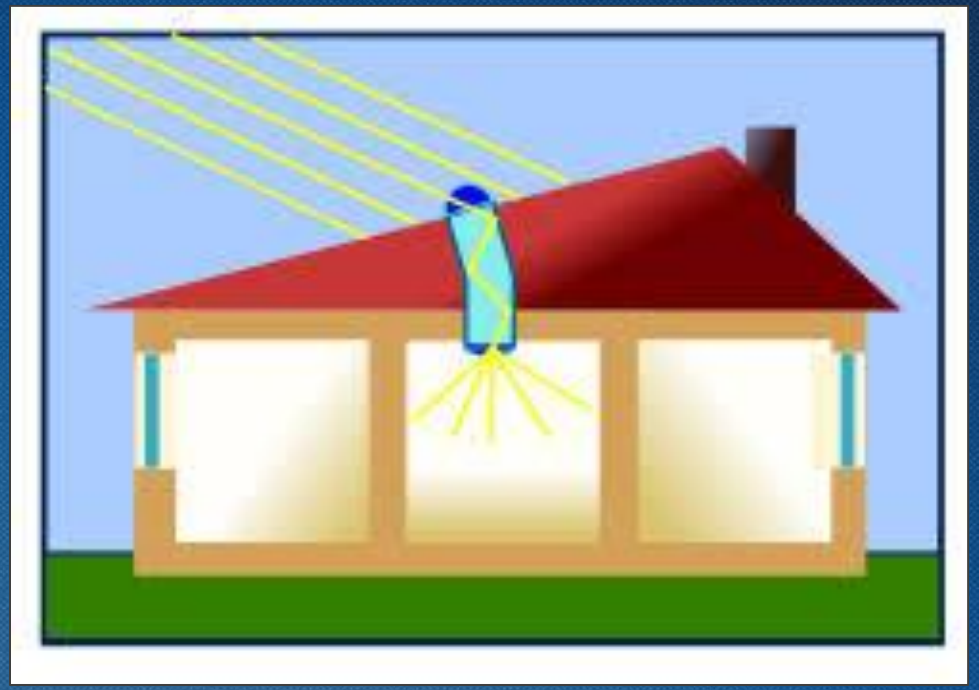
MGTC WEBINAR

"Improving Energy Efficiency of Shopping Malls"

8 October 2020

How do we describe an energy efficient shopping mall?





Passive:

- Effective passive design - façade and opening that are able to find a trade-off between external heat gain (OTTV) & daylighting.

How do we describe an energy efficient shopping mall?

<u>Active:</u>

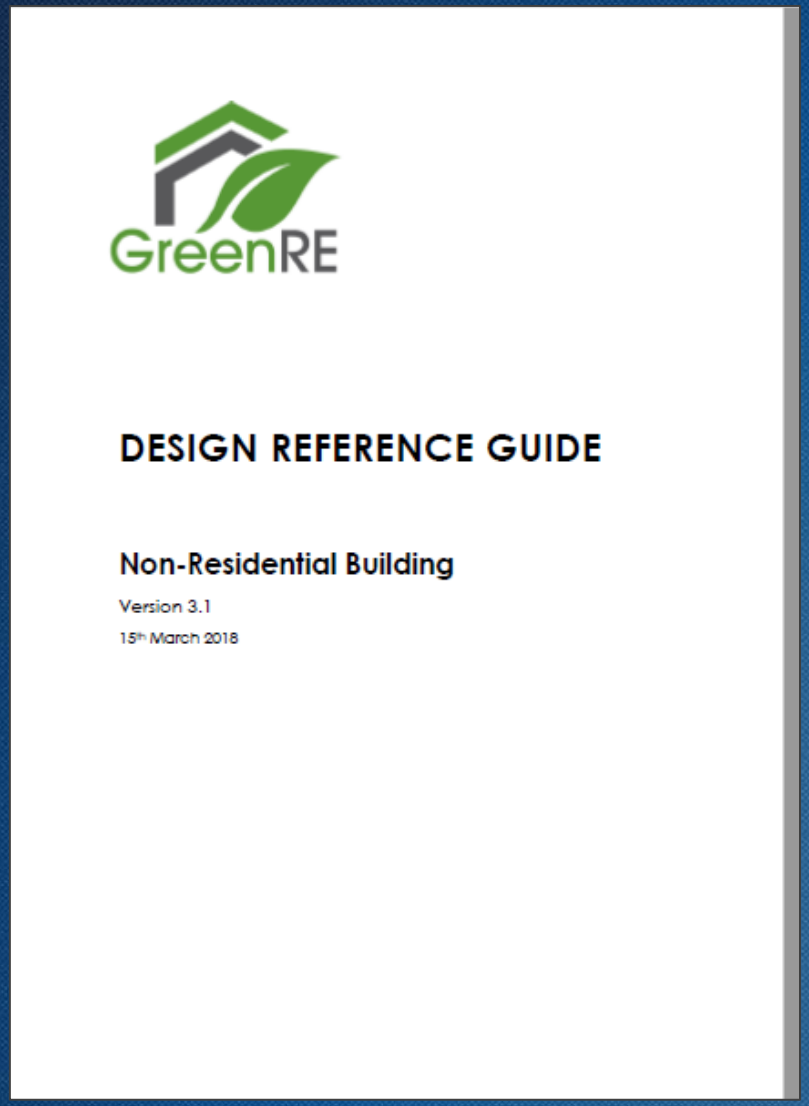
- Efficient Lighting System (LPD, Photo / Motion Sensor & Control);
- Efficient Chiller Plant System (Eff, Automation & Control);
- Efficient Air Distribution System (Eff, Automation & Control);
- Efficient Mechanical Ventilation System (Eff, CO / CO2 Sensor & Control);

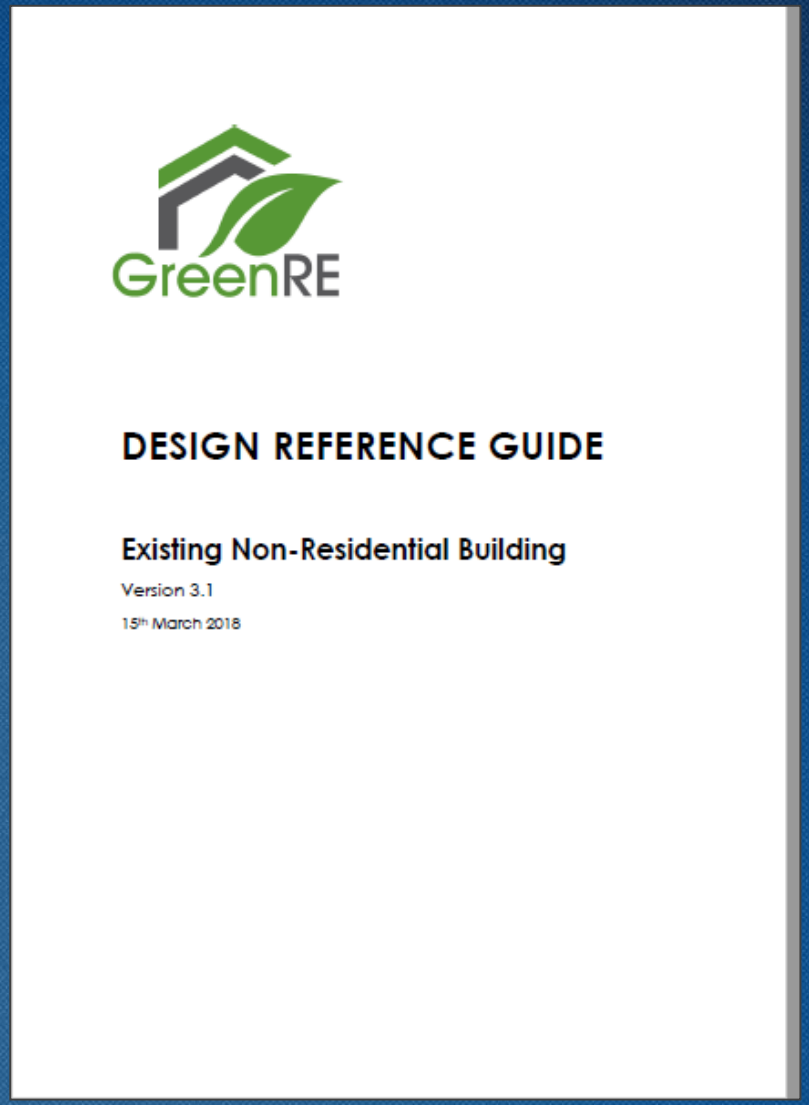
How do we describe an energy efficient shopping mall?

Active (Cont'd):

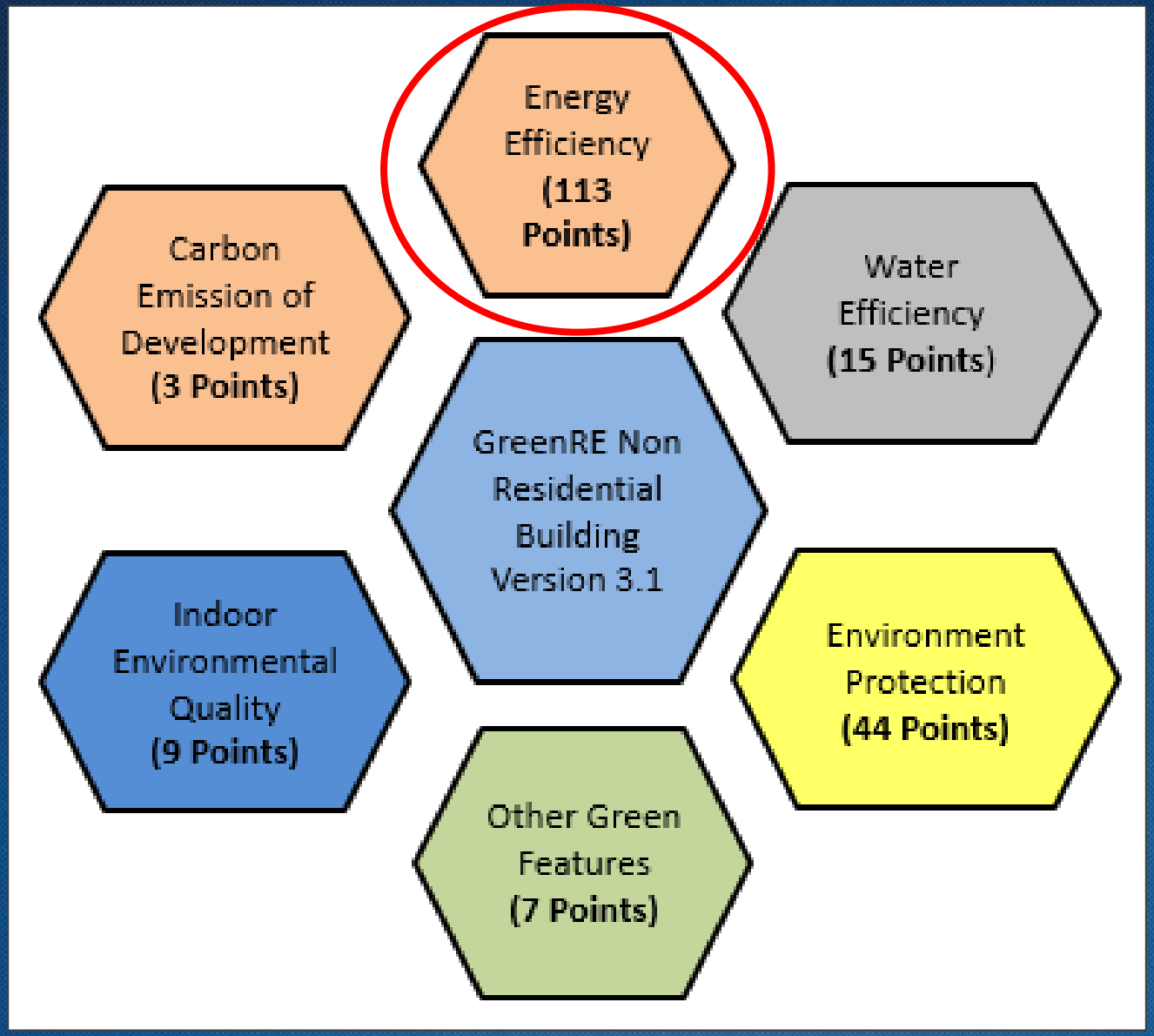
- Efficient transportation system i.e. lift, escalator (Eff, Motion Sensor, Control);
- Renewable Energy;
- Overall Energy Management System & Control (M&V, Heat Balance, Automation, Etc).

Implementation Strategy 1:
Green Building Assessment & Certification





Green Building Core Principles



Green Building Requirements (NRB)

(I)	Energy Related Requirements		
Minimum 30 credits	**Part 1: Energy Efficiency**		
	NRB 1-1 Thermal Performance of Building Envelope – OTTV NRB 1-2 Air – Conditioning System	Section (A) Applicable to air-cond. areas	15 33
	Sub -Total (A) – NRB 1-1 to 1-2		**48**
	NRB 1-3 Building Envelope – Design/ Thermal Parameters NRB 1-4 Natural Ventilation/Mechanical Ventilation	Section (B) Applicable to non air- cond. areas	30 20
	Sub – Total (B) – NRB 1-3 to 1-4		**50**
	NRB 1-5 Daylighting NRB 1-6 Artificial Lighting NRB 1-7 Ventilation in Carparks NRB 1-8 Ventilation in Common Areas NRB 1-9 Lifts and Escalators NRB 1-10 Energy Efficient Practices & Features NRB 1-11 Renewable Energy	Section(C) Applicable to all areas	6 12 4 5 3 13 20
	Sub – Total (C) – NRB 1-5 to 1-11		**63**
	Category Score for Part 1 – Energy Efficiency **[Prorate Subtotal (A) + Prorate Subtotal (B)] + Subtotal (C)**		**114 (MAX)**

Green Building Prerequisites (NRB)

General

- Building envelope design with Overall Thermal Transfer Value (OTTV) computed based on the methodology and guidelines stipulated in the MS1525:2014.
  GreenRE Gold – OTTV of 42 W/m² or lower
  GreenRE Platinum – OTTV of 40 W/m² or lower

- To demonstrate the stipulated energy savings over its reference model using an energy modelling framework set out. Details and submission requirements on energy modelling can be found in Appendix A of this Guideline.
  GreenRE Gold - At least 25% energy savings
  GreenRE Platinum - At least 30% energy savings

Minimum System Efficiency

- Minimum Design System Efficiency/Operating System Efficiency (DSE/OSE)

  (i) For buildings using Water-Cooled Chilled Water Plant

GreenRE Rating	Building Cooling Load (RT)	
	< 500	≥ 500
	Efficiency (kW/RT)	
Bronze	0.85	0.75
Silver	0.80	0.70
Gold	0.75	0.68
Platinum	0.70	0.65

Chiller Plant M&V Instrumentation

- Provision of permanent measuring instruments for monitoring of water-cooled chilled-water system and air-cooled chilled water system operating system efficiency. The installed instrumentation shall have the capability to calculate resultant plant operating system efficiency (i.e. kW/RT) within 5% of its true value and in accordance with ASHRAE Guide 22 and AHRI 550/590. Heat balance test for water-cooled chilled water system is required for verification of the accuracy of the Measurement and Verification (M&V) instrumentation.

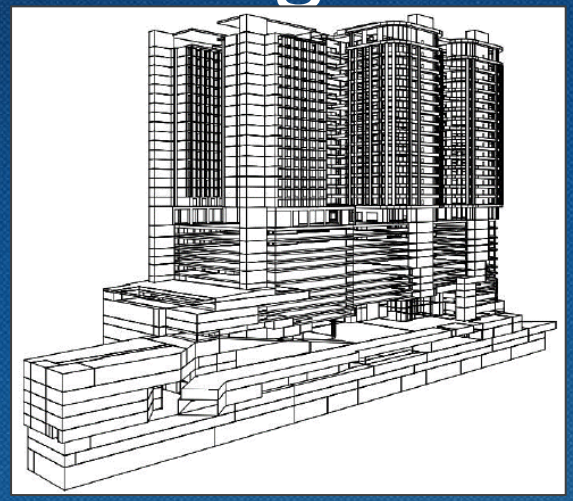
Green Building Baseline Standard

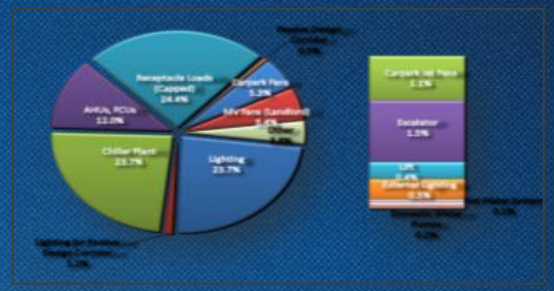
No	Component	Baseline Standard	Minimum Requirement
1.	Building Envelope Design	MS 1525:2014	OTTV = 50 W/sqm RTTV = 50 W/sqm Roof U-Value = 0.6 W/sqm.K
2.	Chiller Efficiency	MS1525:2014	0.588 kW/RT
3.	CHWP Efficiency	CP 13:1999	0.113 kW/RT
4.	CWP Efficiency	CP 13:1999	0.086 kW/RT
5.	CT Efficiency	SS530:2006	0.039 kW/RT
6.	Mechanical Fans	CP 13:1999	CAV = 0.47 W/cmh VAV = 0.74 W/cmh

Green Building Baseline Standard

No	Component	Baseline Standard	Minimum Requirement
7.	Lighting	MS 1525:2014	Dining Area = 25 W/m2 Kiosk (F&B) = 25 W/m2 Retail = 25 W/m2 Concourse = 5 W/m2 Cinema = 10W/m2 Office = 14W/m2 Corridor = 5 W/m2 Lift Lobby = 6 W/m2 Warehouse = 5 W/m2 Loading Dock = 8 W/m2 Toilet = 5 W/m2 M&E Room = 8 W/m2 Kitchen = 11 W/m2 Stairs = 5 W/m2 Carpark = 5 W/m2

Implementation Strategy 2:
Energy Modelling & Simulation

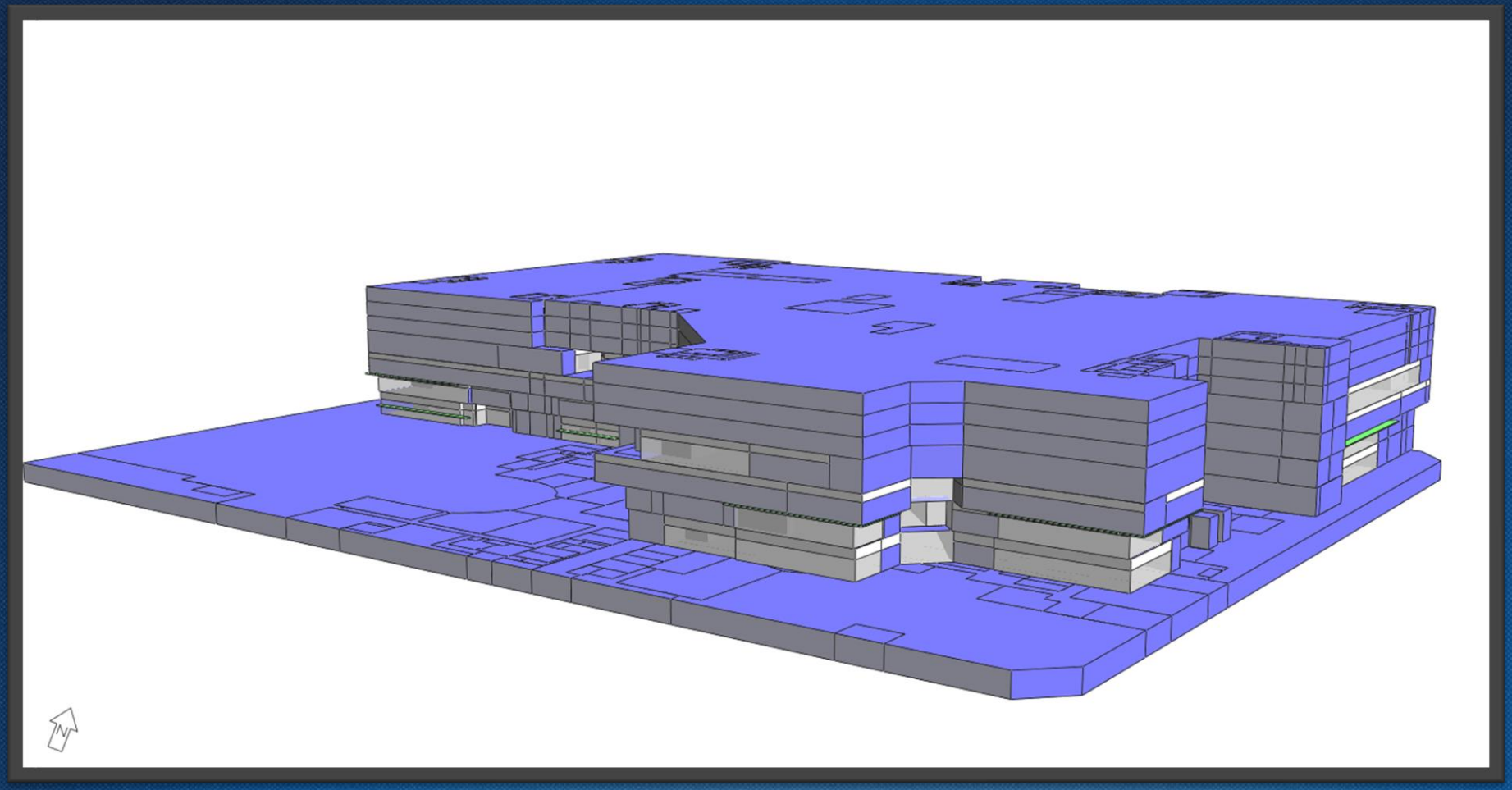




Benefits:

- Able to simulate & predict actual building energy consumption, patterns, etc;
- Avoid excessive oversizing of systems i.e. ACMV system;
- Able to help in chiller selection, sequencing, optimization and operation.

Sample Shopping Mall A



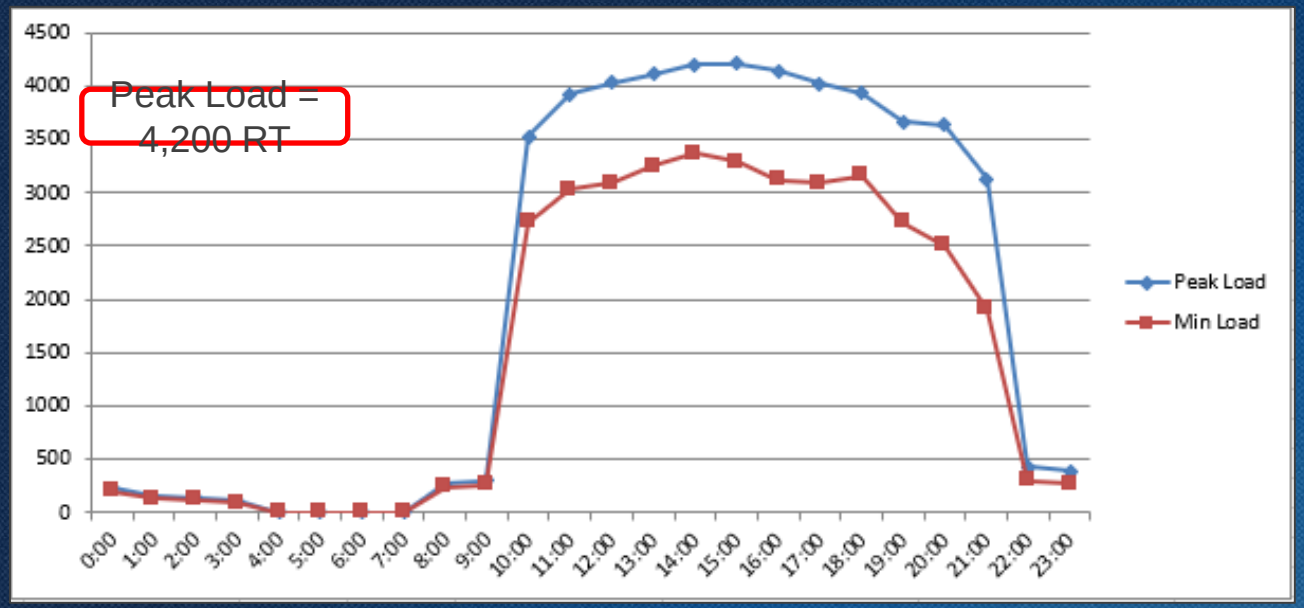
Sample Shopping Mall A

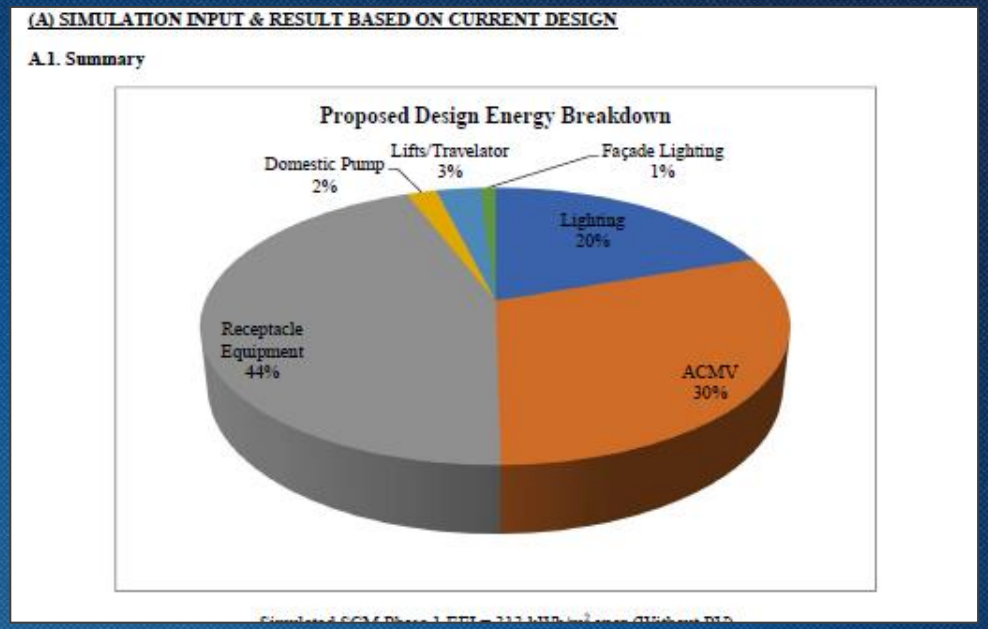
No	Component	GreenRE Baseline Parameter	Design Parameter
1.	Building Envelope Design	OTTV = 50 W/sqm RTTV = 50 W/sqm Roof U-Value = 0.6 W/sqm.K	OTTV = 39 W/sqm RTTV = N/A Roof U-Value = 0.4 W/sqm.K
2.	Chiller Efficiency	0.588 kW/RT	0.483 kW/RT (CHWS = 9C, CHWR = 15C, CWS = 34.45, CWR = 29.45)
3.	CHWP Efficiency	0.113 kW/RT	0.039 kW/RT (Head = 100 ft, Eff = 85% VSD Min = 50%)
4.	CWP Efficiency	0.086 kW/RT	0.031 kW/RT ((Head = 65 ft, Eff = 80% VSD Min = 80%)
5.	CT Efficiency	0.039 kW/RT	0.025 kW/RT (Eff = 85%, VSD Min = 50%)
6.	Mechanical Fans	CAV = 0.47 W/cmh VAV = 0.74 W/cmh	CAV = N/A VAV = 0.561 W/cmh (AHU), 0.3 W/cmh (FCU)

Sample Shopping Mall A

No	Component	GreenRE Baseline Parameter	Design Parameter
7.	Lighting	Dining Area = 25 W/m2 Kiosk (F&B) = 25 W/m2 Retail = 25 W/m2 Concourse = 5 W/m2 Cinema = 10W/m2 Office = 14W/m2 Corridor = 5 W/m2 Lift Lobby = 6 W/m2 Warehouse = 5 W/m2 Loading Dock = 8 W/m2 Toilet = 5 W/m2 M&E Room = 8 W/m2 Kitchen = 11 W/m2 Stairs = 5 W/m2 Carpark = 5 W/m2	Dining Area = 15 W/m2 Kiosk (F&B) = 15 W/m2 Retail = 25 W/m2 Concourse = 4.15 W/m2 Cinema = 10 W/m2 Office = 12 W/m2 Corridor = 4.15 W/m2 Lift Lobby = 4.98 W/m2 Warehouse = 4.15 W/m2 Loading Dock = 6.64 W/m2 Toilet = 4.15 W/m2 M&E Room = 6.64 W/m2 Kitchen = 11 W/m2 Stairs = 4.15 W/m2 Carpark = 1.3 W/m2

Sample Shopping Mall A





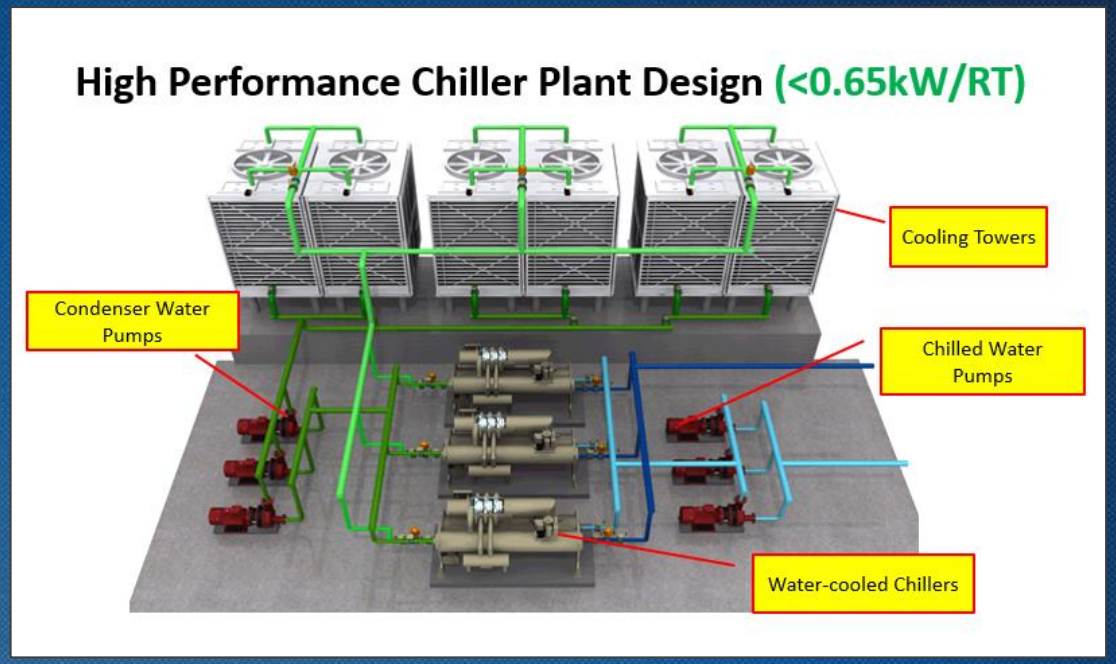
Parameter	GreenMark v4.1 Savings	GreenRE v3.0 Savings
Centralized Chiller Plant	28%	38%
AC Fan System	8%	10%
Mechanical Ventilation	-10%	28%
AC Space Lighting	7%	20%
Non-AC Space Lighting	34%	21%
Car Park Lighting	74%	74%
Receptacle Equipment	0%	0%
Domestic Pump	0%	0%
Façade Lighting	0%	0%
Lifts/Travellators	20%	20%
Renewable Energy (PV)	2.1% energy savings	2.0% energy savings
TOTAL SAVINGS	**25.6%**	**25.7%**

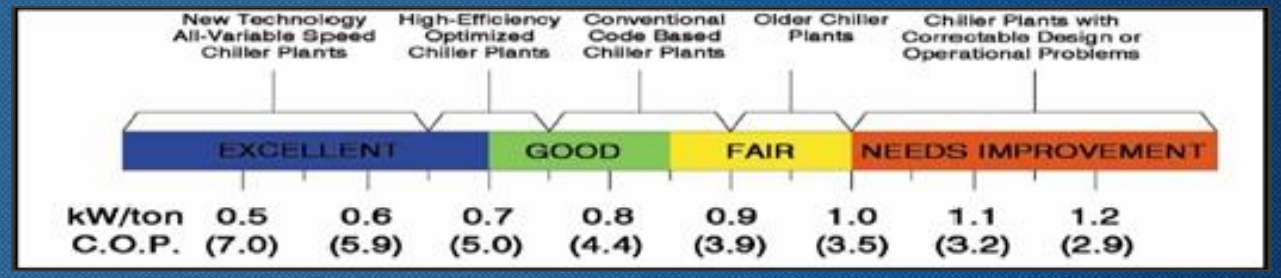
Energy Efficiency Index

= **<u>310 kWh/sqm/year</u>**

Implementation Strategy 3: Energy Audit & Optimization

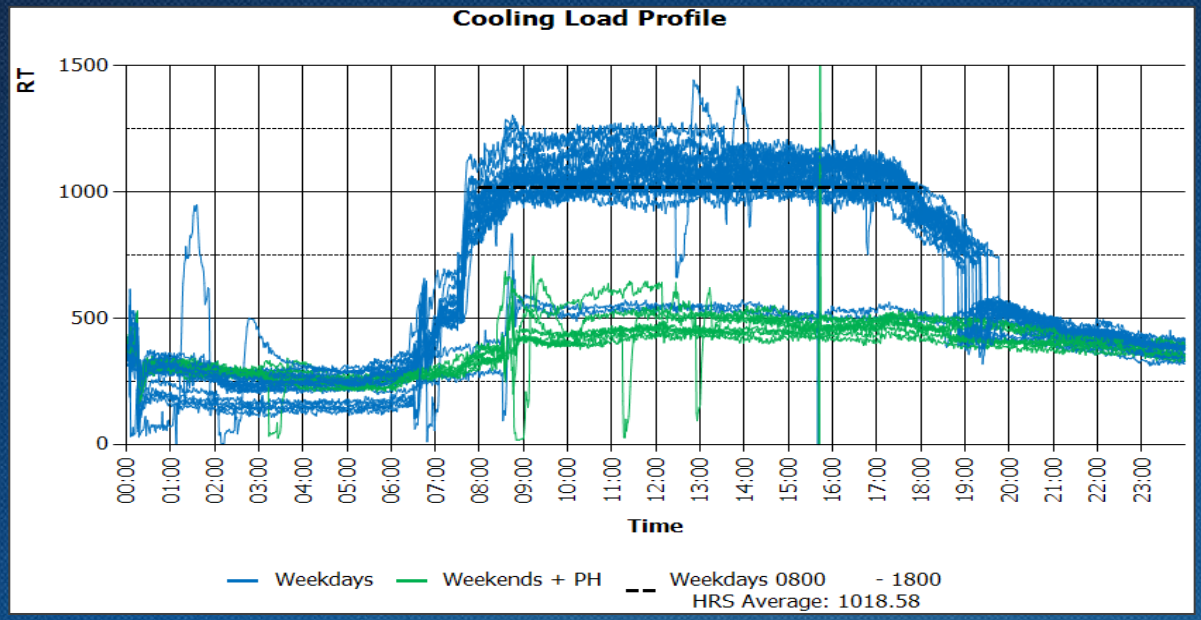
Energy Audit

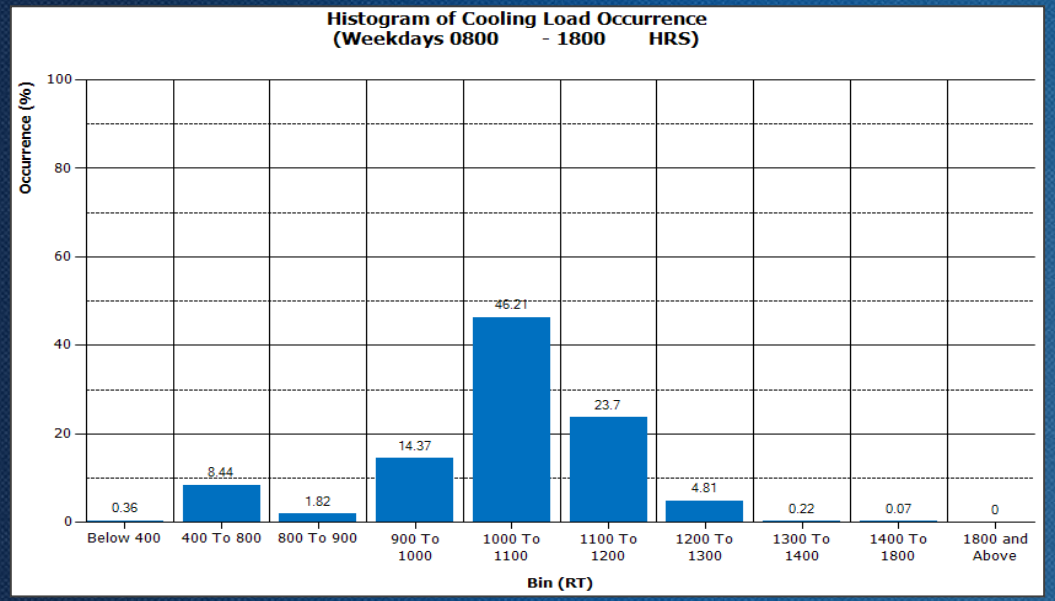




Energy Optimization

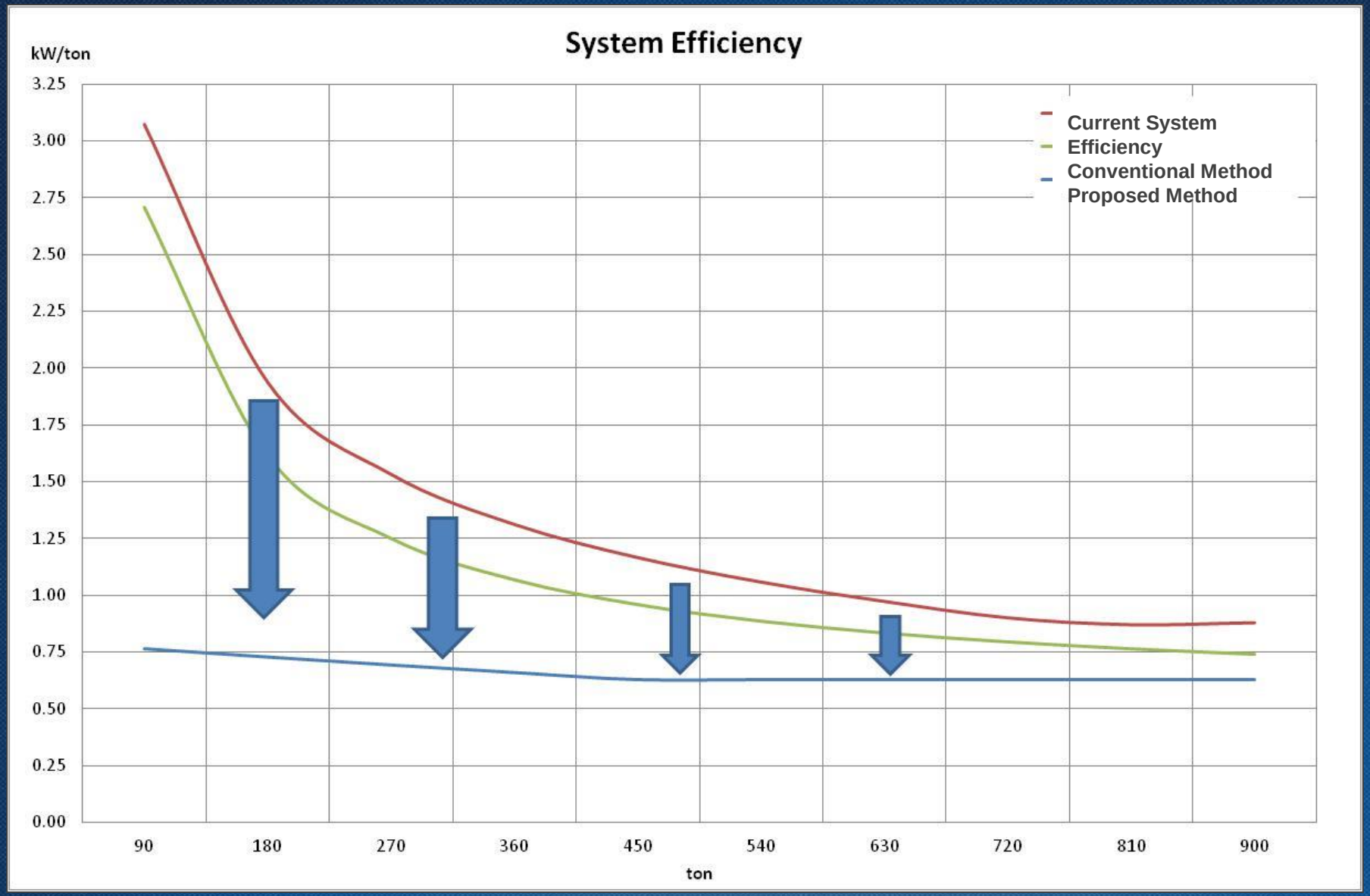
Energy Audit & Optimization





Percentage Bin	Occurrence	Percentage
Below 400	50	0.00
400 To 800	1,166	0.08
800 To 900	252	0.02
900 To 1000	1,986	0.14
1000 To 1100	6,388	0.46
1100 To 1200	3,276	0.24
1200 To 1300	665	0.05
1300 To 1400	31	0.00
1400 To 1800	9	0.00
1800 and Above	0	0
	13,823	**0.99**

Energy Audit & Optimization



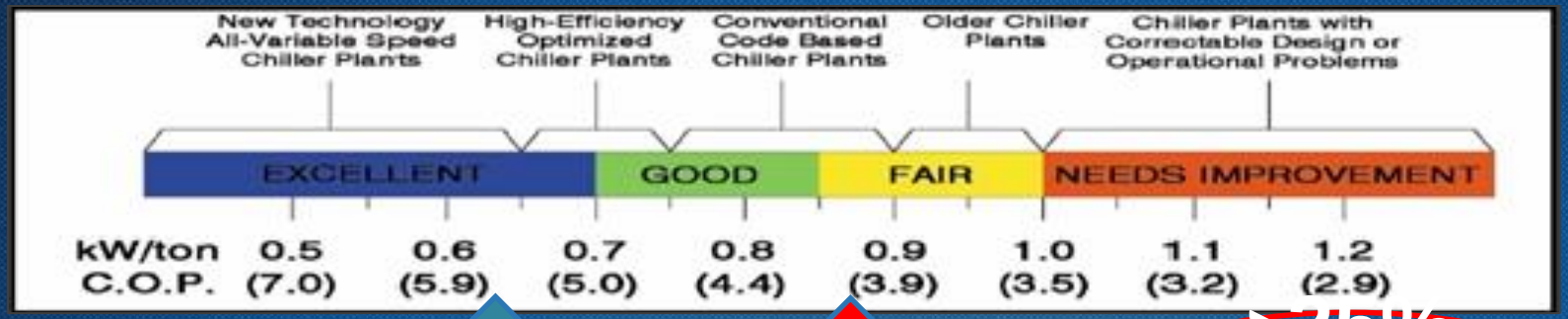
CAPEX & OPEX SAVING

- **CAPEX** - Saving of capital expenditure by reducing chiller installed capacity through detail cooling load analysis of the building – both internal and external heat sources.
- Sample Shopping Mall B:

Item	***Before Optimization***	***After Optimization***
Installed Capacity **Saving on CAPEX*	Existing Mall: 4,000 RT New Mall: 4,200 RT	Combine: 5,400 RT
Chiller Plant Efficiency	Existing Mall: 0.98 kW/RT New Mall: 0.75 kW/RT	Combine: 0.65 kW/RT
Annual Energy Usage	Existing Mall: 7,431,191 kWh New Mall: 6,067,425 kWh	Combine: 10,187,286 kWh
Annual Energy Saving	3,311,329 kWh	
Estimated Annual Electricity Bill Saving	RM 1,069,559	

CAPEX & OPEX SAVING – CONT'D

- **OPEX** - Saving of operating expenditure by designing an efficient chiller plant system.



Target: < 0.65 kW/RT

Malaysian Standard 0.86 kW/RT

>25% potential improvement

CAPEX & OPEX SAVING – CONT'D

"Study on Improvement of Chiller Plant Efficiency for Sample Shopping Mall C from 0.864 kW/RT to 0.65 kW/RT"

Gross Floor Area (sqft)	**307,459.000**
Air Conditioned Area (sqft)	**245,967.200**
Installed Capacity (RT)	**922.377**
Design Improvement (kW/RT)	**0.214**
Investment	**RM2,121,467.10**
First Year Saving	**RM520,682.71**
Electricity Rate Increase (Every 3 Years)	**10%**
Total 25 Year Saving	**RM18,979,537.30**
Inflation	**3%**
Present Value	**RM12,593,703.54**
Net Present Value	**RM10,472,236.44**
IRR	**27%**
Simple Payback (Years)	**4**

Implementation Strategy 4: Green Leasing

- Set environmental objectives for both landlord and tenants;

  A Sustainable Building = Sustainable Operations + Sustainable Retailers

- Binding leases with **green component** and obligations for **both landlord and tenants;**
- Contributing towards achievement of **Green Building Certifications.**

Green Leasing

- **Landlord Sustainable Manager** to educate prospective tenants, demonstration of design, drive sustainability effort;
- **ESD Consultant** to facilitate overall green initiatives;
- **Retail Services Guide** - focus on lighting improvement / recommendation;
- **Provide Incentive** - discount to tenant electricity rate - 313 experience: 2%.

Reduction in Tenants Heat Load = Reduction in Landlord ACMV System Power Consumption

Rental Rate is inclusive of Chilled Water Supply

Green Leasing

❖ Reduction in Landlord ACMV System Power Consumption [SAMPLE]

Item	Unit	Values
Total Cooling Load	RT	7,000
Reduction in Lighting Heat Load (30% Lighting Heat Load x 80% Tenant Area x 50% Reduction)	RT	840
Chiller Plant System Efficiency	kW/RT	0.75
Saving in Chiller Plant System due to Reduction of Lighting Heat Load	kW	630
Monthly Operation (12 hours / day * 30 days)	Hours	360
Saving in kWh due to Reduction of Lighting Heat Load	kWh	226,800
Electricity Tariff	RM/kWh	0.303
Saving in RM due to Reduction of Lighting Heat Load (RM)	**RM**	**68,720**

❖ Tenants' Electricity Bill [SAMPLE]

Type of Area	Area (sqm)	Lighting Load (W/sqm)	Plug Load (W/sqm)	Monthly Operating Hour	Energy Consumption Per Month (kWh)	Electricity Bill Per Month (RM)
Retail	29,731	9	16	360	267,579	136,198
F&B	12,471	7.5	22	360	132,442	67,413
Anchor	40,575	9	16	360	365,175	185,874
Entertainment	14,044	9	22	480	208,975	106,368
Kiosk	2,444	9	11	360	17,597	8,957
Total	**99,265**				**991,768**	**504,810**