Ecoline

Solar Thermal Air Conditioning

Recycle | Reuse I Reduce

HEAT FOR A
Cooler WORLD
Since 2003

Ecoline Solar Pte Ltd
www.ecolinesolar.com.sg

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Solar Thermal Air Conditioning

About Ecoline Solar

- **Pioneer in Heat Recovery Since 2003**
- **Installed World's First DX Solar Thermal Aircon System in 2008**
- **Only DX Aircon System Certified Green Product by SGBC**
- **Maximum BCA Green Mark For Energy Efficiency**
  - **Achieved COP > 6 @ NTU Hall Of Residence 4 Green Mark Platinum**
- **ASEAN Outstanding Engineering Achievement Award 2019**
- **IES Prestigious Engineering Achievement Award 2019**
- **Green Cooling Provider with focus on Urban Heat Island Reduction**

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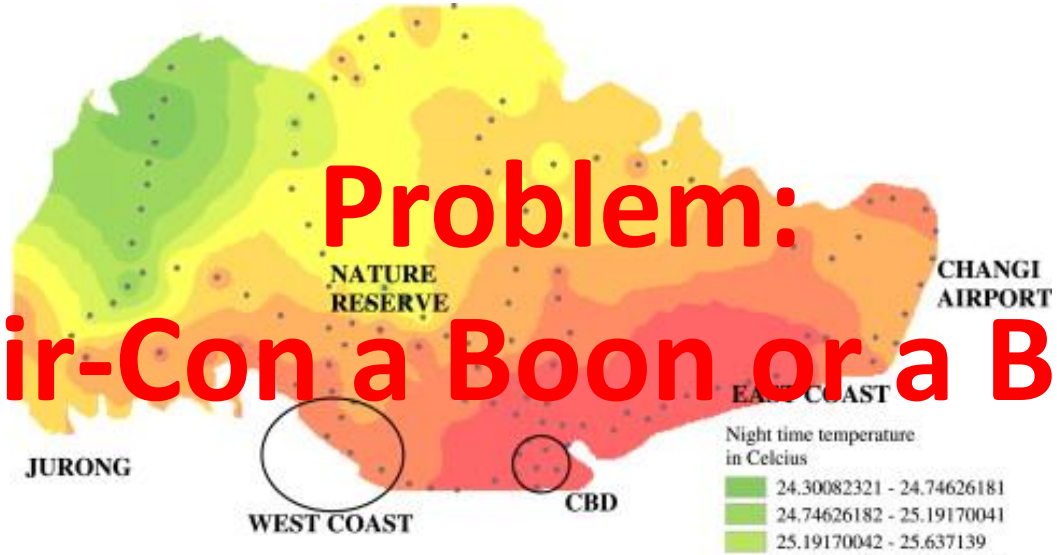
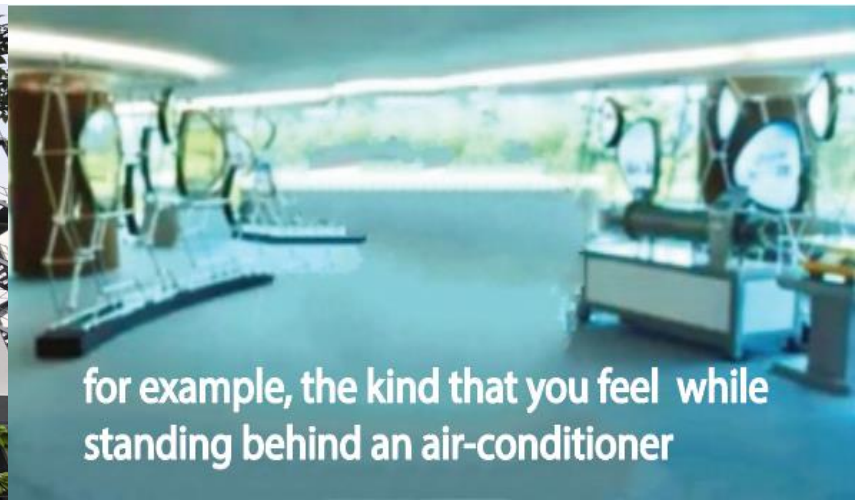
Problem:

Is Air-Con a Boon or a Bane?



Cooler Indoor = Hotter Outdoor!



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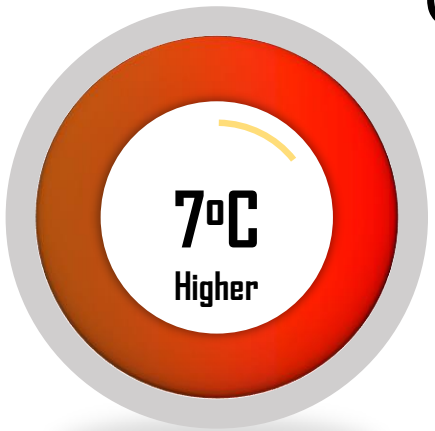
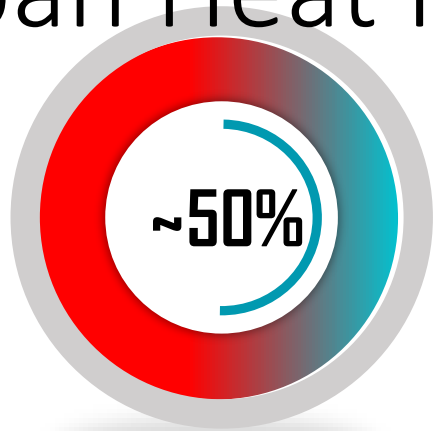
Urban Heat Island



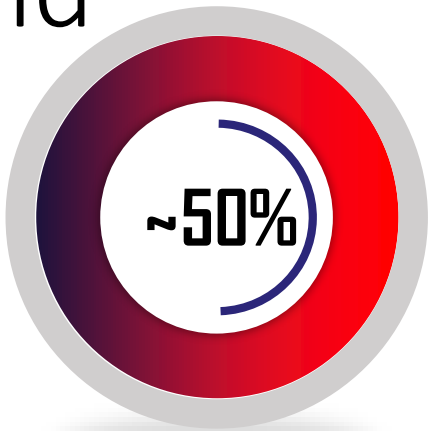
UHI Effect

An **urban heat island** (**UHI**) is an urban area or metropolitan area that is significantly warmer than its surrounding rural areas due to human activities.



Environment Design

Vegetation
Urban Geometry
Water Features & Body
Materials & Surfaces
Shading



Energy Usage

Air Conditioning
Electrical Appliances
Transportation

"Some solutions that could work at existing estates could include, for example, having larger park spaces, green roofs and green walls, or having better technology, such as **solar thermal hybrid air-conditioners, to reduce waste heat inputs into the urban climate," said Assoc Prof Chow.**

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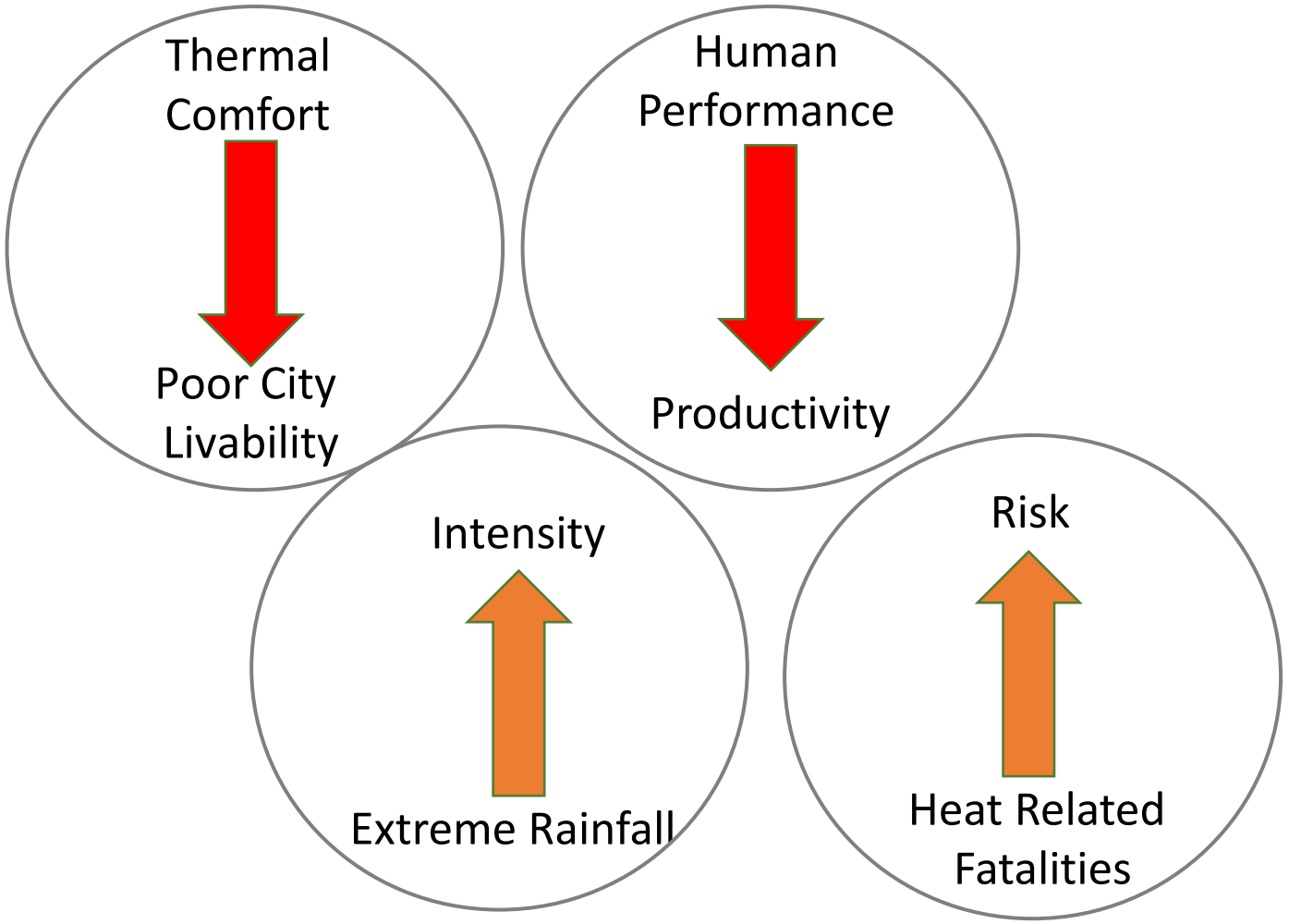
UHI Effect



Singapore Mean surface air temperature has risen by an average of **0.25°C** per decade between 1948 and today. The upward trend is approximately **double** the trend in global temperatures, which occurred at a rate of **0.12°C** per decade from 1951-2012.

- Meteorological Services Singapore

Latest UN research indicates that we may not achieve the goal of limiting global warming to well below 2°C compared to pre-industrial levels. They predict that we will be heading for a **3°C** increase in average global temperature.

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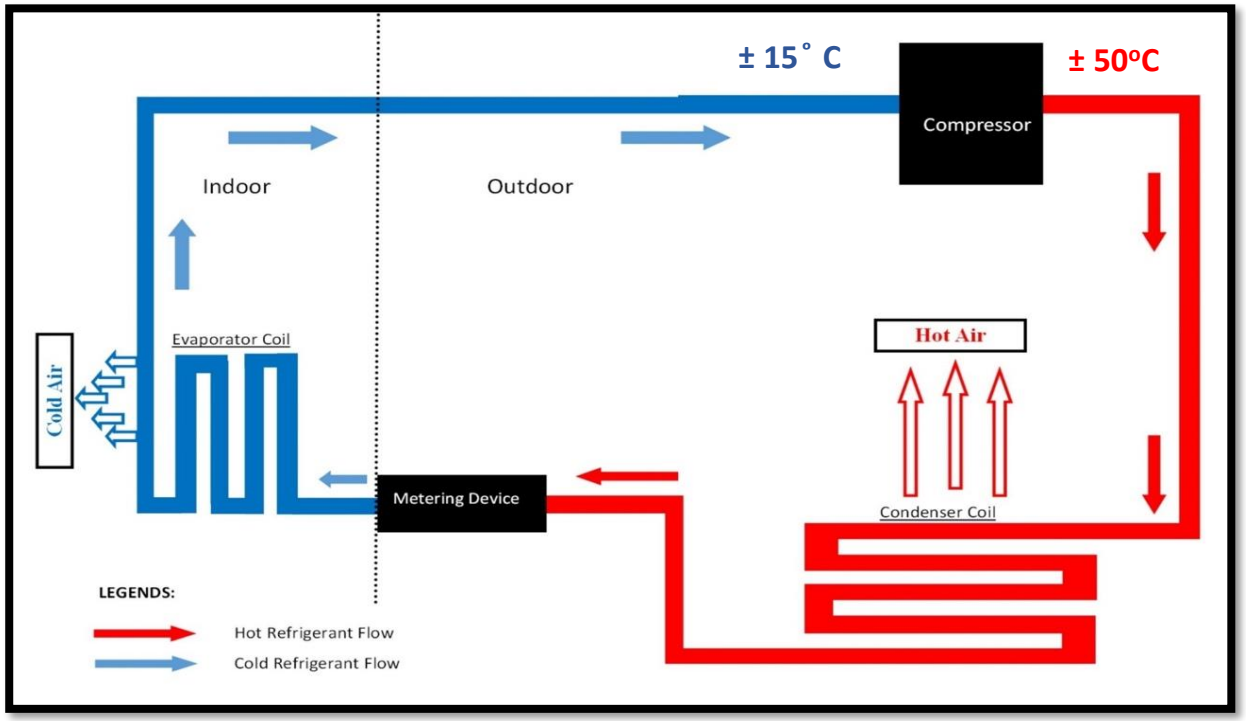
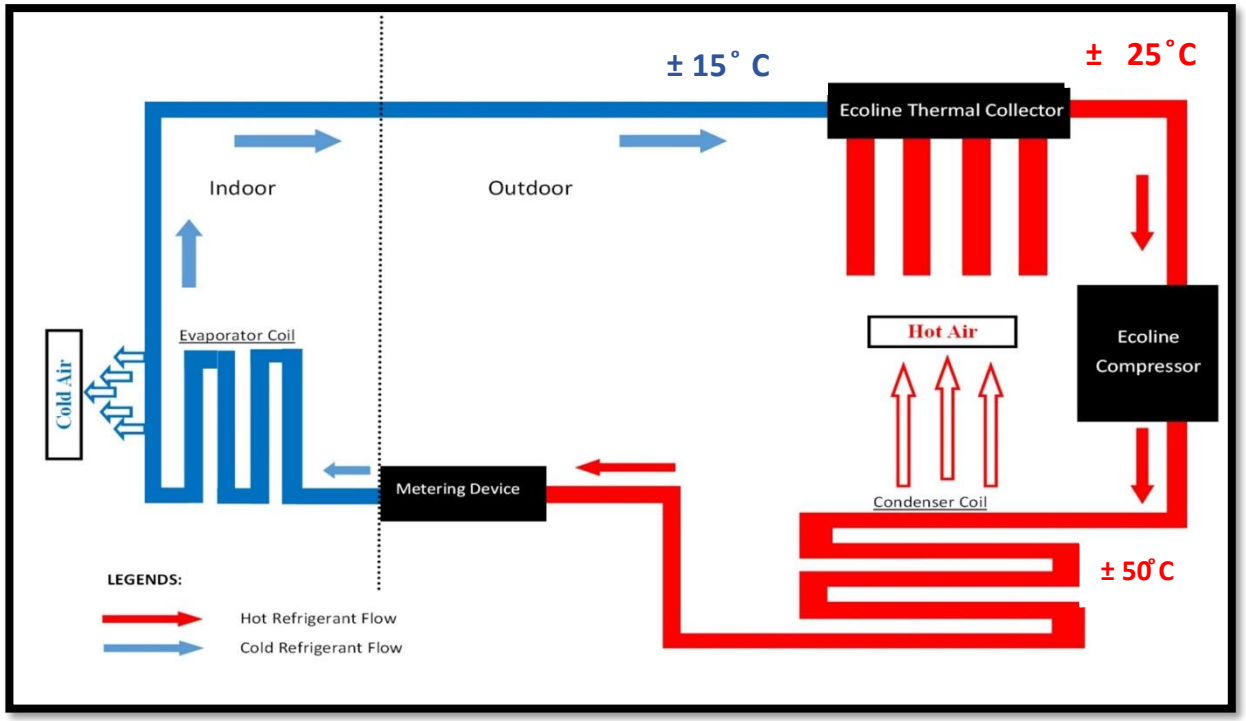
How it Works

Conventional Air Conditioner



- **Compressor is used to superheat and raise the refrigerant pressure - using more than 90% of aircon electricity**
- **Waste Condenser heat is constantly rejected to the environment – contributing to the Urban Heat Island (UHI) effect.**

Ecoline Solar-Thermal Air Conditioner



- **Ecoline's proprietary solar thermal collector harnesses solar heat as well as ambient and rejected heat to pre-heat the refrigerant before going to compressor.**
- **Reduction of electrical load on the compressor, and also the Urban Heat Island (UHI) effect.**

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Therm-Aire Range of Products

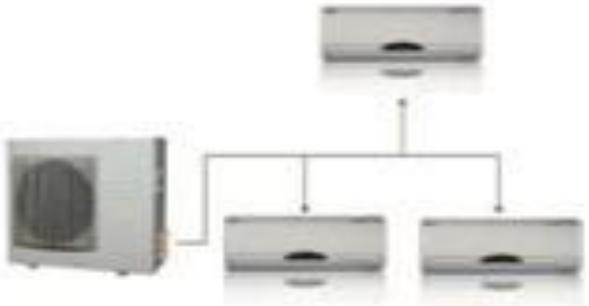
Wall-Mounted

Celling Cassette

Ceiling Floor

Ducted

Multi-Split



Floor Standing

VRF

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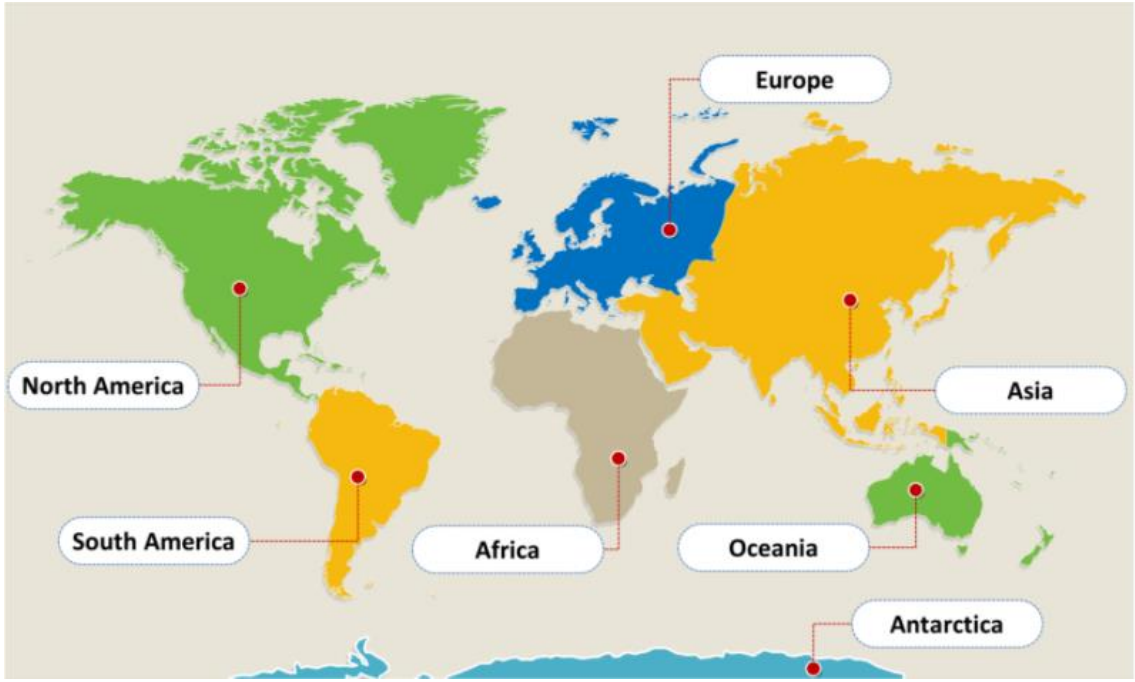
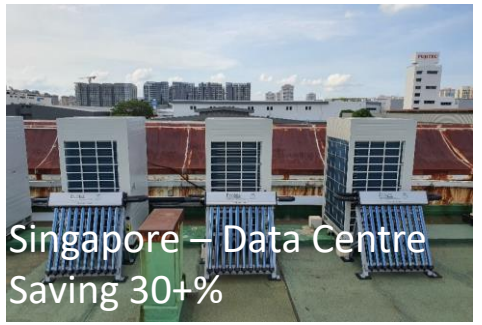
Installations

- More than 1500 systems in Asia Pacific through local partners
- System is capable of performing both Cooling & Heating





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Industry Partners

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Communities

- Research

- Industry

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Technological Innovation: Awards & Recognitions

ASEAN Outstanding Engineering Achievement Award 2019

IES Prestigious Engineering Achievement Award 2019

"... Another example is the ***Next-Generation Hybrid Air-Conditioners*** developed by **Ecoline Solar Pte Ltd.** These **significantly reduce energy consumption** of compressors while harvesting **solar heat.**

This has enabled buildings, such as hostels at the Nanyang Technological University, to achieve the BCA Platinum Green Mark Award..."

Dr Amy Khor, Senior Minister of State for the Environment and Water Resources

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Summary

- Hybrid solar-thermal air-conditioners Harnesses Surrounding Ambient Heat to reduce energy consumption and carbon footprint.
- Lower waste heat from compressor unit reducing Urban Heat Island (UHI) effect.
  - Reduce outdoor temperature
  - Increase outdoor thermal comfort
  - Only Aircon Manufacturer that focus on reducing HEAT WASTE with the 3Rs of Sustainability
- Saves 30% ~ 55% of Electricity Bill
  - Ease the electrical load of equipment by up to 55%
  - Resulting in lower cost of maintenance
  - Longer equipment lifespan.
  - ROI ~ 2 Years

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Solar Thermal Air Conditioning

Case Studies

Energy Savings

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Nanyang Technological University Hall of Residence 4

BCA AWARDS 2017
Recognising Excellence in the Built Environment

GREEN MARK AWARD FOR BUILDINGS

PLATINUM

Building Owner:	**Nanyang Technological University**
Facility Management:	**Nanyang Technological University**
ESD/Green Consultant:	**GreenA Consultants Pte Ltd**

Estimate energy savings : 105,801.91kWh/year

Use of solar thermal air–con with COP higher than 6

LED lighting for common area with motion and photo sensor controls

Common area such as corridors, staircases and lobbies are naturally ventilated

Use of non-potable water for irrigation

Use of sustainable products for renovation works

Key card control of air-con units in student rooms

30 ~ 35% Aircon Energy Savings

SOURCE: https://www.bca.gov.sg/greenMark/others/gm2017.pdf

BCA Academy Test

Less Heat Dissipation

35° C

31° C

Test conducted and monitored by BCA Academy showing the comparison of energy saving between "Therm-Aire" Solar Air Conditioning and a Conventional Inverter System.

Test result summary

Results obtained over a 4.5-day period

Total consumption of electricity

Inverter System (kW)
62.0

Therm-Aire (kW)
38.9

Savings of 23.1 KW

37% savings

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Solar Thermal Air Conditioning

Power Consumption Result and NCS Testimonial

Logging Readings of Power Consumption at NCS (Bedok South) Equipment Room over 5-day period

THERM-AIRE Power Consumption					DAIKIN Power Consumption			
DAY	Date	Time	Power (kw)		Day	Date	Time	Power (kw)
1	5 to 6 Dec 2017	8:30 to 8:29	53.04		1	9 to 10 Nov 2017	8:30 to 8:29	99.56
2	6 to 7 Dec 2017	8:30 to 8:29	70.23		2	10 to11 Nov 2017	8:30 to 8:29	109.48
3	7 to 8 Dec 2017	8:30 to 8:29	65.10		3	11 to 12 Nov 2017	8:30 to 8:29	91.40
4	8 to 9 Dec 2017	8:30 to 8:29	63.61		4	12 to 13 Nov 2017	8:30 to 8:29	84.62
5	9 to 10 Dec 2017	8:30 to 8:29	60.11		5	13 to 14 Nov 2017	8:30 to 8:29	90.35
Total Consumption (THERM-AIRE)			**312.09**		**Total Consumption (DAIKIN)**			**475.41**

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Illustration of Returns on Investment (ROI)

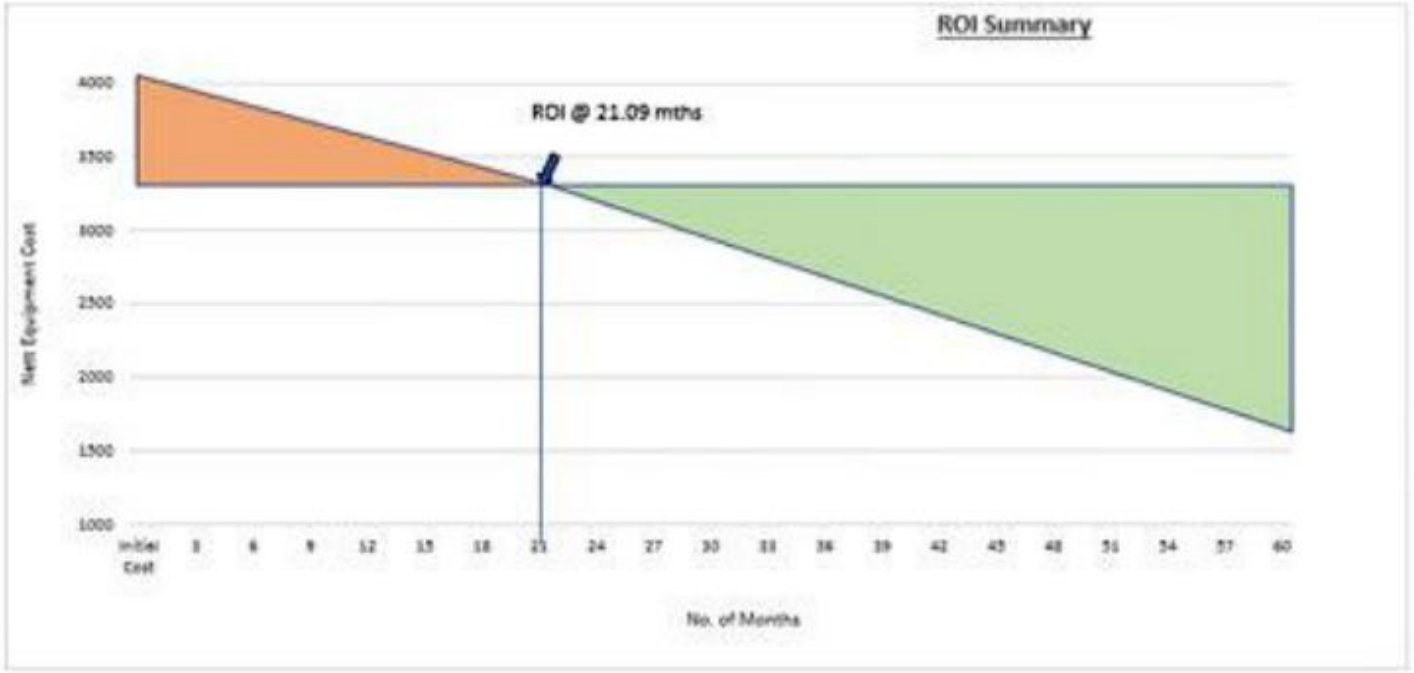
ROI CALCULATION _ Single Split 24K BTU Wall Mount System (2 units)

Description	Therm-Aire	Other Inverter Brands	Difference
Power Consumption (kWh)	2.300	3.280	0.980
*Price (S$)	4,160	3,300	860

*based on equipment price only

Savings with Therm-Aire		
$ Savings per mth	$ Savings p.a.	ROI (mths)
40.77	489.22	21.09

*Based on 10 hrs, 26 days, $0.16



Ecoline Impressive Returns on Investment (ROI)

Solar Thermal Air Conditioning

Typical ROI Table

	PX			KWh			Savings with Therm-Aire			
	Therm Aire	Inverter	Diff	Therm Aire	Inverter	Diff	Sav/mth	ROI -Mths	(1yr)	(5yrs)
12K WM Single Split	$1,150.00	$850.00	$300.00	0.48	0.80	0.32	$12.4	24.04	$ 49.76	$748.80
24K WM Single Split	$2,100.00	$1,600.00	$500.00	1.23	2.05	0.82	$31.9	15.63	$ 83.76	$1,918.80
18K WM Multi Split (2 X 9)	$2,080.00	$1,750.00	$330.00	0.77	1.28	0.51	$19.8	16.59	$ 38.68	$1,193.40

Example of Therm-Aire $Saving - 18K WM M-S (2 X 9)

No. of units	Annual Savings	5-year savings
200	$47,800.00	$239,000.00
300	$71,700.00	$358,500.00
500	$119,500.00	$597,500.00

Consistent Energy Savings of 30 to 40% compared to Japanese -Brand Inverted AC

Average ROI of less than 2 years

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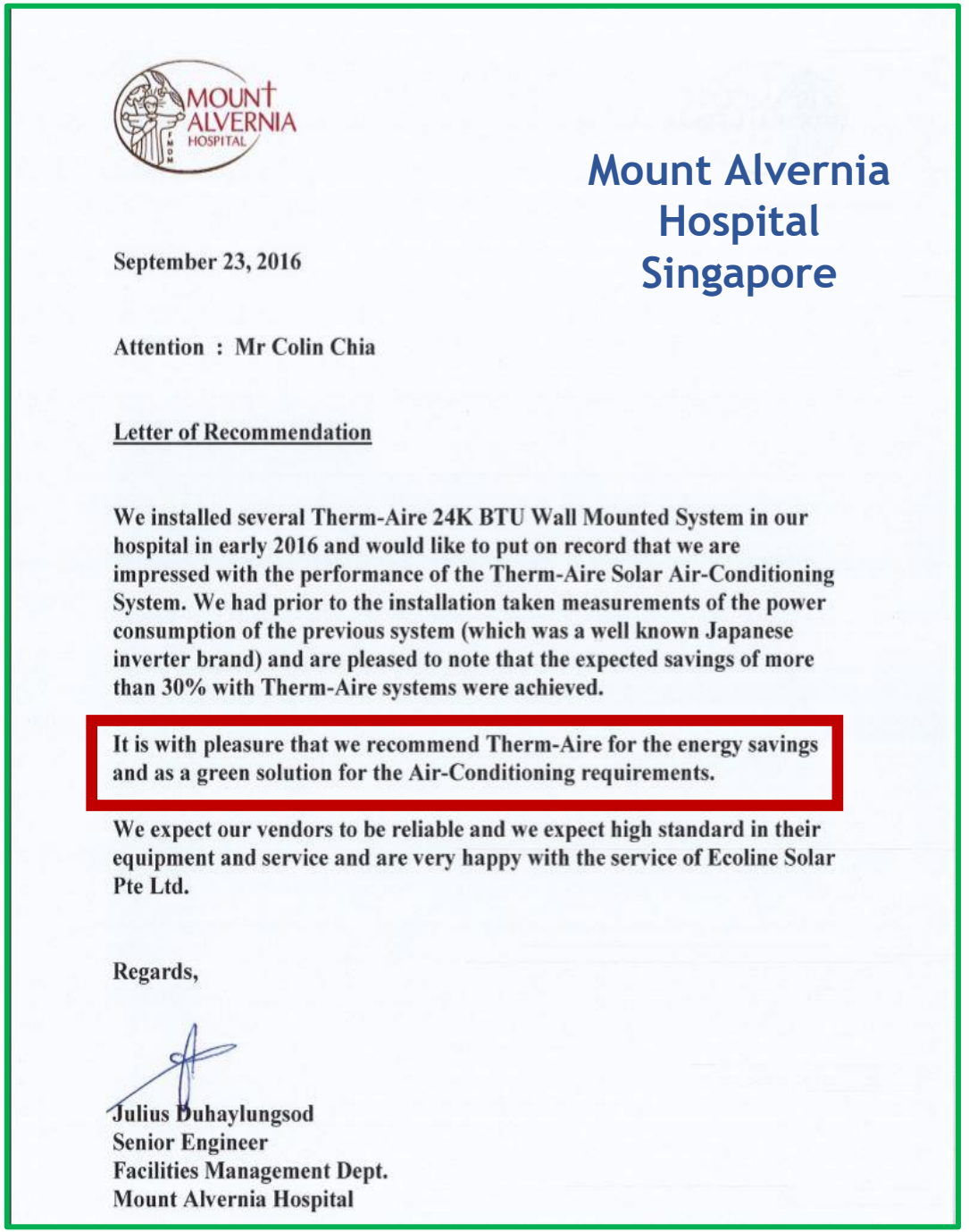
Mount Alvernia Hospital Singapore

More than 30% Energy Saving compared to previous Japanese -Brand Inverted AC



MOUNT ALVERNIA HOSPITAL

Mount Alvernia Hospital Singapore

September 23, 2016

Attention : Mr Colin Chia

Letter of Recommendation

We installed several Therm-Aire 24K BTU Wall Mounted System in our hospital in early 2016 and would like to put on record that we are impressed with the performance of the Therm-Aire Solar Air-Conditioning System. We had prior to the installation taken measurements of the power consumption of the previous system (which was a well known Japanese inverter brand) and are pleased to note that the expected savings of more than 30% with Therm-Aire systems were achieved.

It is with pleasure that we recommend Therm-Aire for the energy savings and as a green solution for the Air-Conditioning requirements.

We expect our vendors to be reliable and we expect high standard in their equipment and service and are very happy with the service of Ecoline Solar Pte Ltd.

Regards,

Julius Buhaylungsod
Senior Engineer
Facilities Management Dept.
Mount Alvernia Hospital

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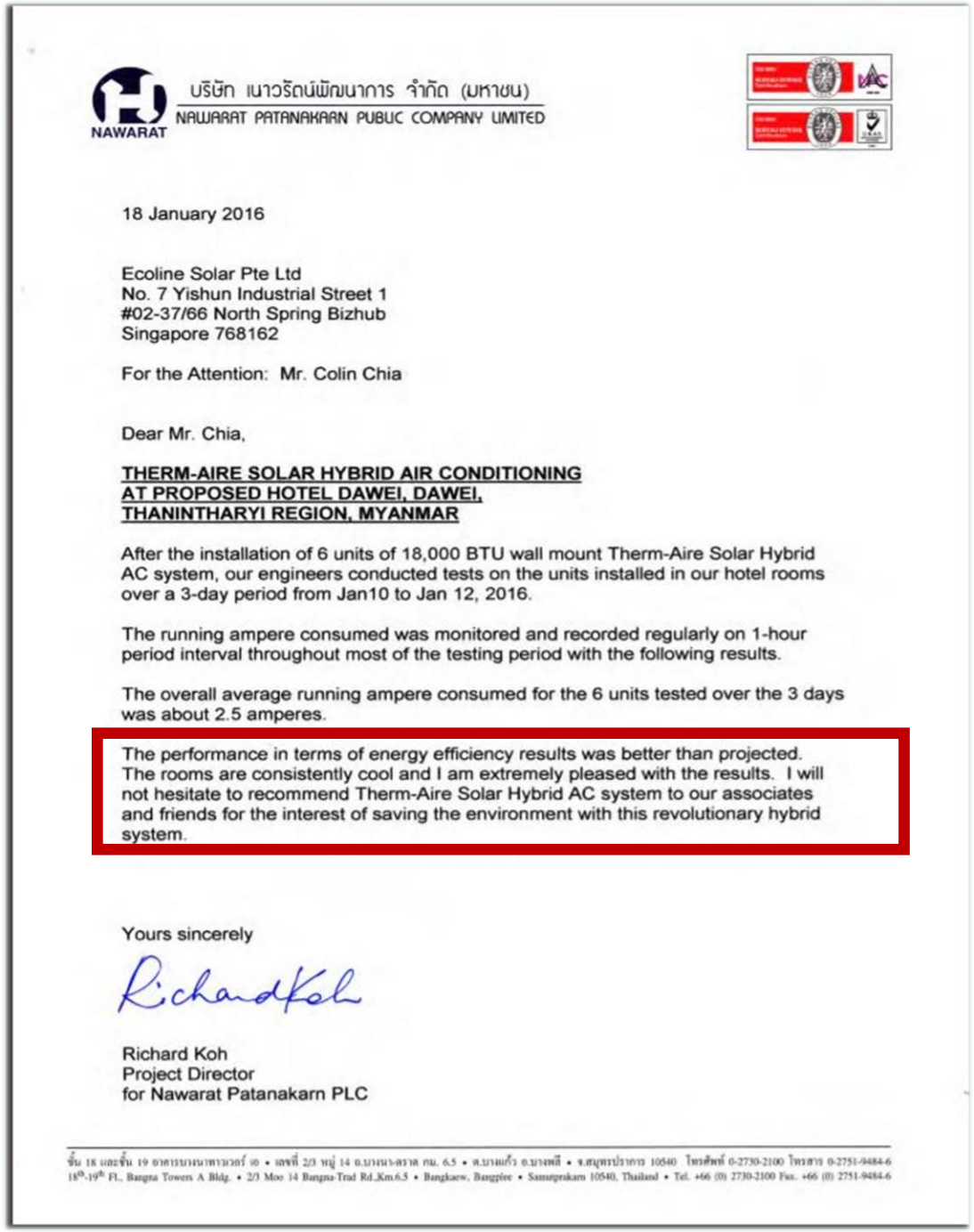
Solar Thermal Air Conditioning

Hotel Dawei, Dawei Thanintharyi Region, Myanmar

Hotel was fully equipped by Therm-Aire Solar Thermal Hybrid AC Systems after successful P O V of energy savings of more than 40%. This has been consistently achieved since installation in 2016.



บริษัท เนาวรัตน์พัฒนาการ จำกัด (มหาชน)
NAWARAT PATANAKARN PUBLIC COMPANY LIMITED

NAWARAT

18 January 2016

Ecoline Solar Pte Ltd
No. 7 Yishun Industrial Street 1
#02-37/66 North Spring Bizhub
Singapore 768162

For the Attention: Mr. Colin Chia

Dear Mr. Chia,

THERM-AIRE SOLAR HYBRID AIR CONDITIONING AT PROPOSED HOTEL DAWEI, DAWEI, THANINTHARYI REGION, MYANMAR

After the installation of 6 units of 18,000 BTU wall mount Therm-Aire Solar Hybrid AC system, our engineers conducted tests on the units installed in our hotel rooms over a 3-day period from Jan10 to Jan 12, 2016.

The running ampere consumed was monitored and recorded regularly on 1-hour period interval throughout most of the testing period with the following results.

The overall average running ampere consumed for the 6 units tested over the 3 days was about 2.5 amperes.

The performance in terms of energy efficiency results was better than projected. The rooms are consistently cool and I am extremely pleased with the results. I will not hesitate to recommend Therm-Aire Solar Hybrid AC system to our associates and friends for the interest of saving the environment with this revolutionary hybrid system.

Yours sincerely

Richard Koh

Richard Koh
Project Director
for Nawarat Patanakarn PLC

ชั้น 18 และชั้น 19 อาคารบางนาทาวเวอร์ เอ • เลขที่ 2/3 หมู่ 14 ถ.บางนา-ตราด กม. 6.5 • ต.บางแก้ว อ.บางพลี • จ.สมุทรปราการ 10540 โทรศัพท์ 0-2730-2100 โทรสาร 0-2751-9484-6
18th-19th Fl., Bangna Towers A Bldg. • 2/3 Moo 14 Bangna-Trad Rd.,Km.6.5 • Bangkaew, Bangplee • Samutprakarn 10540, Thailand • Tel. +66 (0) 2730-2100 Fax. +66 (0) 2751-9484-6

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BEYONDGREEN Energy Innovations Inc.
A subsidiary of Beyond Innovations, Inc.

Proof of Concept

Data Monitoring

Client Project	Feliz Hotel
Competitor	General Electric Model: AA1AC12EKQ Split Wall Mounted 1.0TR
Unit Location	MBC Building (HR room)
Equipment Used	Therm-Aire Brand Model: STA-012WM Split Wall Mounted 1.0TR
Unit Location	MBC Building (HR room)
POC Findings	50.20% reduction of electrical consumption compared to existing General Electric Brand Basic Type unit.
Inclusive Data	Data Monitoring Log Sheet - Electrical Readings - Room, Ambient & Off-coil Temperature Results Fluke Energy Analyzer - Power - Current - Voltage - Electricity Consumption
Validation Method	Temperature readings were gathered 3-6 times daily: • Room Temperature was measured in 2 points to derive Room Average; • Off-Coil Temperature was measured with probes 5' from Evaporator. Fluke® Energy logger was used to monitor electrical consumption.
Project Manager	***Mary Jane Bascos*** Beyond Green Energy Innovations
Signature Date	
Client Name	***Felipe M. Bayno, Jr.*** Elizalde Holdings Corporation
Signature Date	

"Feliz Hotel… 50.2% reduction of electrical consumption…"

BEYONDGREEN Energy Innovations Inc.
A subsidiary of Beyond Innovations, Inc.

Proof of Concept Acceptance

Client Project	Astoria Hotels and Resorts - Astoria Plaza: Security Room
Solution Delivered	STA-012SPWM-FC STA-012SPWM-C 1TR Wall Mounted
POC Settings	Thermostat Settings: 20°C Fan/Blower Speed: Medium Mode: Cool
Acceptance Criteria	20%++ Savings vs Inverter ACUs Average Off-coil Temp ≤ 5°C of Thermostat Setting
POC Findings	Therm-Aire 1TR WM: • Ambient Temperature: 35.00°C • Averge KwH: 0.93 • Average Off-coil: 13.27°C • Average Room Temp: 25.24°C Mitsubishi 1.5HP WM: • Ambient Temperature: 34.89°C • Averge KwH: 1.92 • Average Off-coil: 13.10°C • [illegible] Please refer to Annex A for POC data and graphs below.
Validation Method	Each unit cooled the room independently. Temperature readings were gathered 3-4 times daily: • Room Temperature was measured in 5 points to derive Room Average; • Off-Coil Temperature was measured with probes 1" from Evaporator. Fluke® Energy logger was used to monitor electrical consumption.
Project Manager	Leo Veroy Beyond Green Energy Innovations
Signature Date	23 May 2016
Client Name	Engr. Dante Atendido Head of Engineering Astoria Hotels and Resorts - Astoria Plaza
Signature Date	23 May 2016

"Astoria Hotels & Resorts…Savings Efficient Increment 51.56%"

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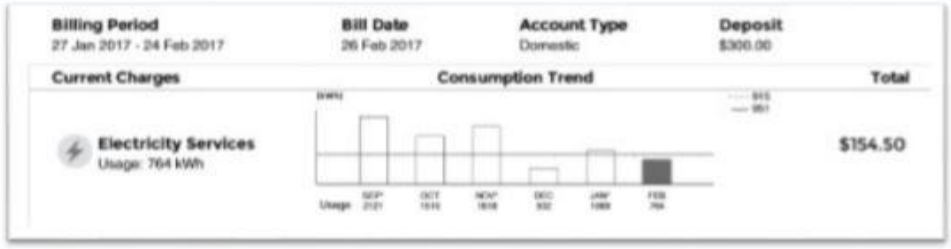
Solar Thermal Air Conditioning

Loyang View Residence, Singapore

"Saving more than 40% on my monthly SP bill"

Therm-Aire Air Conditioning Systems installed end of Nov 2016



**Above from SP Bill*

"With Therm-Aire Solar Hybrid Air Conditioning Systems…

I'm saving more than 40% on my monthly SP bill"

-Mr T.K.Wong, Loyang View-

Loyang View Residence, Singapore

BCA Green Marks for Energy Efficiency

Certified Green Product of SGBC (Singapore Green Building Council)

Ecoline

Solar Thermal Air Conditioning

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Avenue 5
#04-01 West Lobby
Singapore 569877
T +65 6653 8682
W www.ormgt.com.sg

ORM/Testimonial/2018/0056

5th March 2018

Ecoline Solar Pte Ltd
7 Yishun Industrial Street
#02-37 North Spring Bizhub
SINGAPORE 768162
(Attention: Mr Liam Kok Aeng)

Dear Mr Liam,

TESTIMONIALS

We were introduced to Ecoline Solar Pte Ltd during a business networking session in 2017.

Being a Data Centre Professional and Consultant in the data centre industry for almost 30 years where we provide data centre infrastructure & operations management, data centre design & build and data centre risk management, we saw it as an innovative solution which could help to improve the energy and cooling efficiencies in the data centre.

With conclusive empirical tests, we have since recommended various clients including Data Centre Providers, such as NCS Pte Ltd and 1-Net Singapore Pte Ltd and other commercial facilities.

Meanwhile, we are also currently working with Ecoline Solar Pte Ltd on a business partnership for a major Data Centre project in Cambodia.

Best Regards,

Wong Tew Kiat, CBCP, Associate Fellow BCI, CITBCM(S), COMIT(S), CITIPM(S), Fellow SCS
Member Managing Director

Organisation Resilience Management Pte Ltd Registration No. 201114619H

"With conclusive empirical evidence, we have recommended various clients including Data Centre providers…"

T K Wong / Managing Director of ORM Pte Ltd
(Data Centre Consultants)

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11 July 2018

To whom it may concern,

As a Singapore Certified Energy Manager (SCEM), part of my job requires that I look for energy efficient equipment for my company.

I came across Ecoline Solar Pte Ltd in my search. I was very interested in their thermal hybrid air conditioning technology for its potential in energy saving. As Highway International has over 50 ACs in our building, the potential saving is significant.

We have installed Therm-Aire ACs to compare to our existing ACs and found Therm-Aire to be more energy efficient.

I highly recommend companies and organizations to consider Ecoline Solar's thermal hybrid AC technology.

Regards
Steven Tan
Energy and Facilities Manager
SCEM 0634
Highway International Private Limited

"As a Singapore Certified Energy Manager (SCEM) part of my job requires that I look for energy efficient equipment for my company….I highly recommend companies and organisations to consider Ecoline's Solar Thermal Hybrid AC technology."

Steven Tan (SCEM 0634) / Energy and Facilities Manager of Highway International

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3rd Joint Challenge Call by the Building and Construction Authority (BCA) and Enterprise Singapore (ESG)

Alkaf Kampung Melayu Mosque	St James Power Station	JTC Summit
		

Initiated by:

Building and Construction Authority
We shape a safe, high quality, sustainable and friendly built environment.

Enterprise Singapore

National Research Foundation
Prime Minister's Office
Singapore

VRF **Aircon Efficiency** by
EcoLine 2.0
Up to 65% Savings
New Coating

VRF **Aircon Operational Efficiency** by
Lumani Ambient Management
20% Reduction in Energy Wasstage

IAQ Management by
Atmos Air Bipolar Ioniser
Active Cleaning
And Disinfection

Ecoline

Solar Thermal Air Conditioning

Reduce | Reuse | Recycle
Cooling with sustainable energy – Thermal Heat - for a Greener World

Thank You

Liam : 9777 0654

Eddy : 8201 6946

Vinson : 9678 9439

Amanda : 9232 7213

www.ecolinesolar.com.sg