Ecoline

Solar Thermal Air Conditioning

Recycle | Reuse I Reduce

HEAT FOR A
Cooler WORLD
Since 2003

Ecoline Solar Pte Ltd
www.ecolinesolar.com.sg

About Ecoline Solar

- Pioneer in Heat Recovery Since 2003
- Installed World's First DX Solar Thermal Aircon System in 2008
- Incorporated in Singapore in 2014
- Only DX Aircon System Certified Green Product by SGBC
- Certified Green Mark Product
  - Achieved COP > 6 @ NTU Hall Of Residence 4 Green Mark Platinum
- Accolades:
  - ASEAN Outstanding Engineering Achievement Award 2019
  - IES Prestigious Engineering Achievement Award 2019
- Green Cooling Provider with focus on Urban Heat Island Reduction

UN, Workers Container Dormitory @ Sudan 2008

CERTIFIED ISO 9001:2015 COMPANY

CERTIFIED ISO 14001:2015 COMPANY

bizSAFE 4

SINGAPORE GREEN BUILDING PRODUCT SGBC VERY GOOD

Our Facilities

- Ecoline Solar China
  - Lian Yun Gang, Jiansu Province, China
  - Manufacturing & Engineering

- Ecoline Solar Singapore HQ
  - 2 Fan Yoong Road
- R&D and Engineering
- Sales & Marketing
- Operations
- Roadmap towards Made in “SG Label”

Technological Innovations Thermal Collector

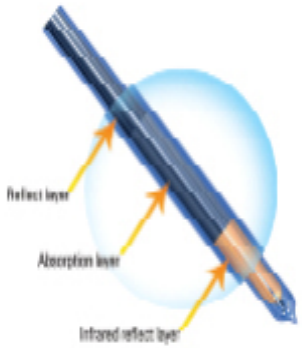
- Two Key Components
  - Solar Absorption Medium
    - Operates with just 20°C Outdoor Ambient Temperature
  - Heat Storage Tank Up to 2 Days

- Applications
  - Heat Recovery for Cooling/Heating

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

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

Dr. Amy Khor, Senior Minister of State for the Environment & Water Resources
World Engineers Summit 2019



Vacuum Tubes

- ✓ The Vacuum tubes are composed of an inner and outer glass pipe, Reflective layer, vacuum space, Absorption layer, and Infrared reflective membrane.
- ✓ The surface of the inner tube is coated by the Absorption layer; this layer absorbs the solar energy and converts it into heat energy.

Storage Tank

- ✓ The medium tank is a storage tank which contains a medium mixture which absorbs the solar energy and converts it into heat energy and stores this energy for **up to 96 hours**

Press Coverage

cna SINGAPORE
NUS engineers invent hybrid air-conditioner that reduces electricity consumption

14 May 2020 01:24PM
(Updated: 14 May 2020 01:30PM)

Bookmark

Singapore

NUS engineers invent hybrid air-conditioner that reduces electricity consumption

From left: Associate Professor Ernest Chua Kian Jon, Mr Colin Chia (Ecoline Solar), and Mr Liam Kok Aeng (Ecoline Solar) demonstrate their hybrid solar technology. (Photo: National University of Singapore)

SINGAPORE: A team of researchers from the National University of Singapore (NUS) has invented hybrid air-conditioners that reduce electricity consumption.

The technology uses solar heat as an energy source, increasing the efficiency of the hybrid air-con as the weather gets hotter, NUS said.

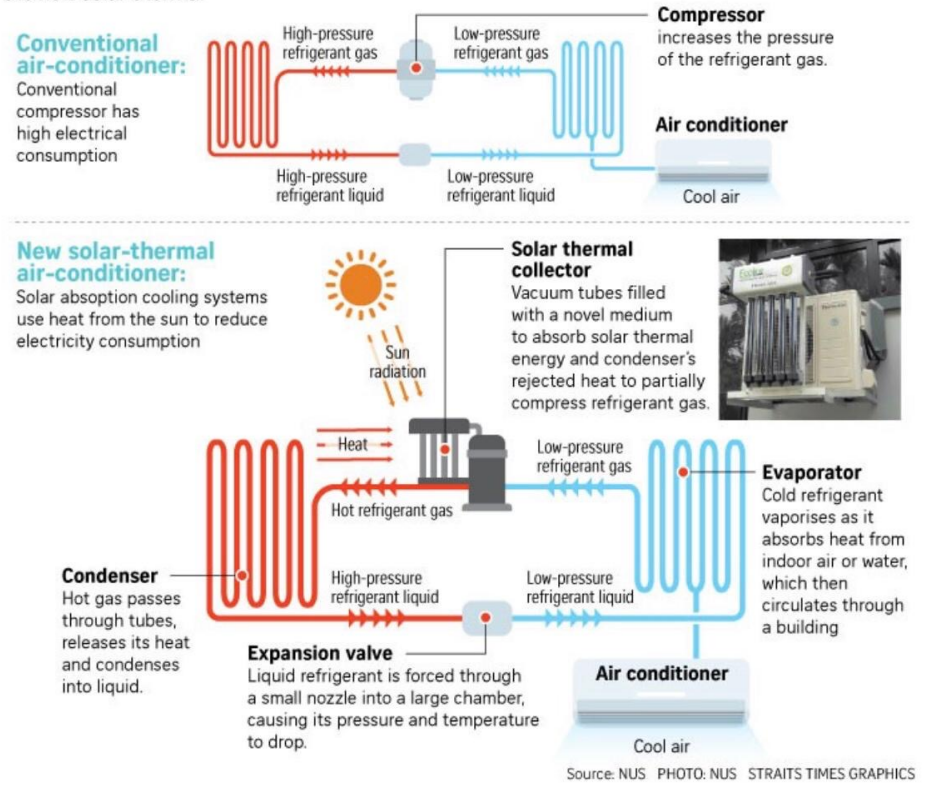
The team, from the Department of Mechanical Engineering at the NUS Faculty of Engineering, worked with industry collaborator Ecoline Solar to develop the "next generation of hybrid solar-thermal air-conditioners" to reduce energy consumption and carbon footprint.

Companies such as NCS, Starhub and Singtel have recently installed the cooling systems in their buildings.

Energy-saving hybrid air conditioner

Engineers from National University of Singapore (NUS) have co-developed an eco-friendly hybrid air conditioner system that uses heat as an energy source, reducing electricity consumption by 30 to 55 per cent.

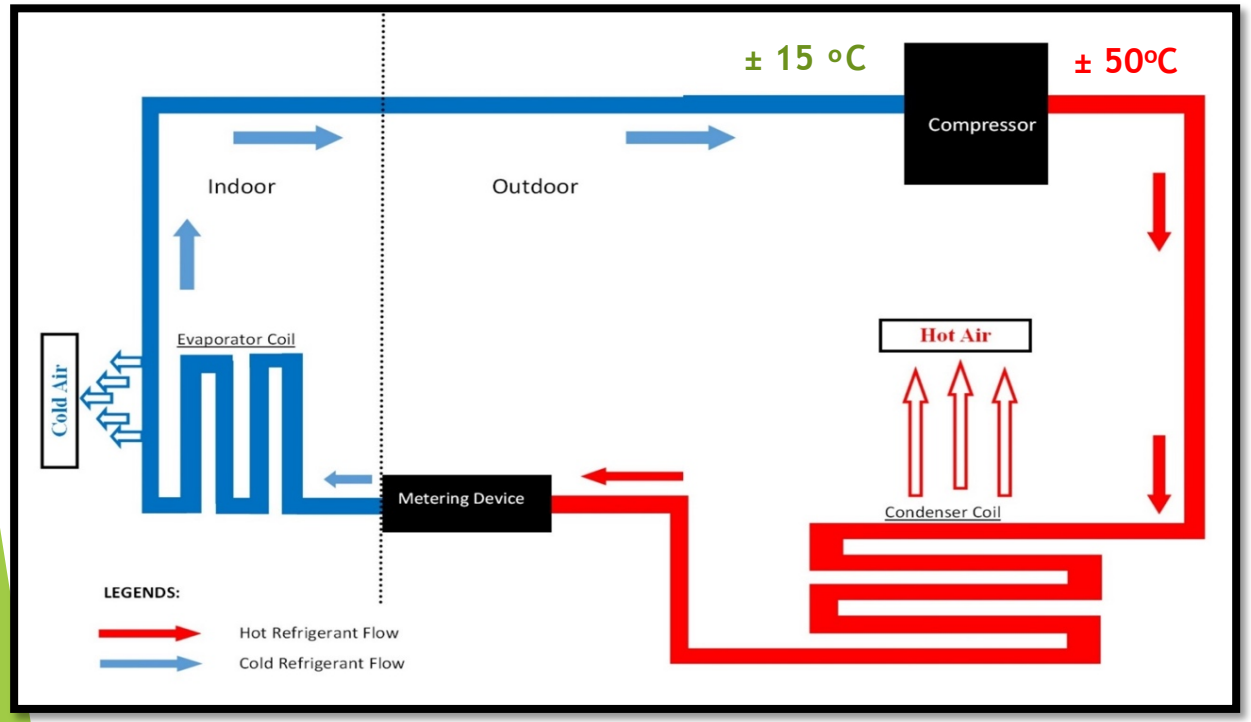
This system is developed by the Department of Mechanical Engineering in NUS and industry collaborator, Ecoline Solar. The team believes that the new solar thermal technology has a smaller carbon footprint and will ease the electrical load of existing air conditioner compressors by up to 55 per cent.



Source: NUS PHOTO: NUS STRAITS TIMES GRAPHICS

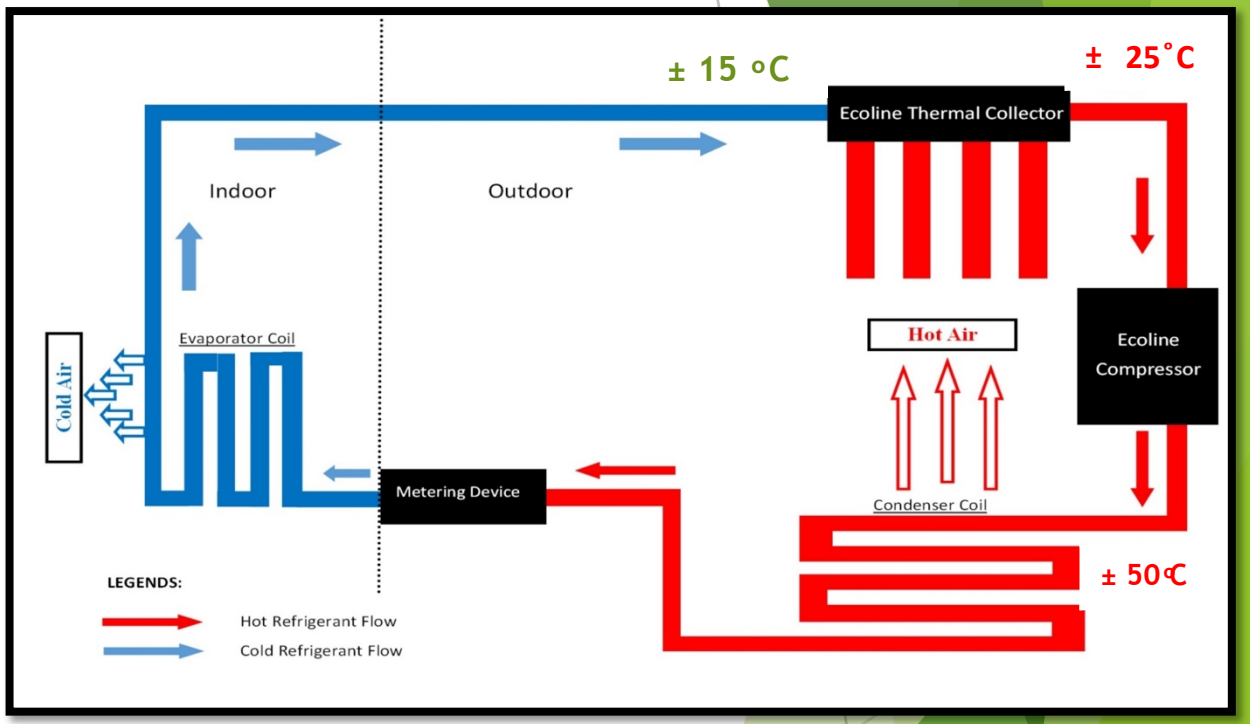
How it Works

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.

Ecoline “Therm-Aire” Range of DX Aircon

Thermal Collector

5 Years Warranty for Compressor & Thermal Collector
Service & Maintenance in-house/contractors
Local stock for spare parts support

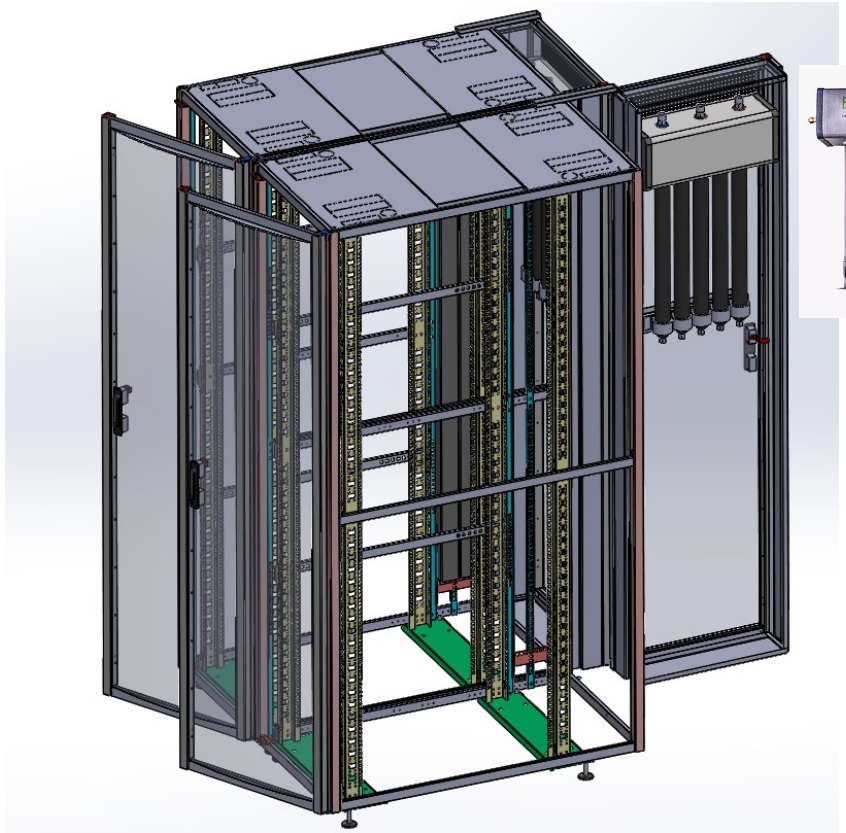
No Retrofitting

+

=

Thermal Collector

Solar Thermal Cooling Solution Provider



New Applications
Data Centre Rack Cooling

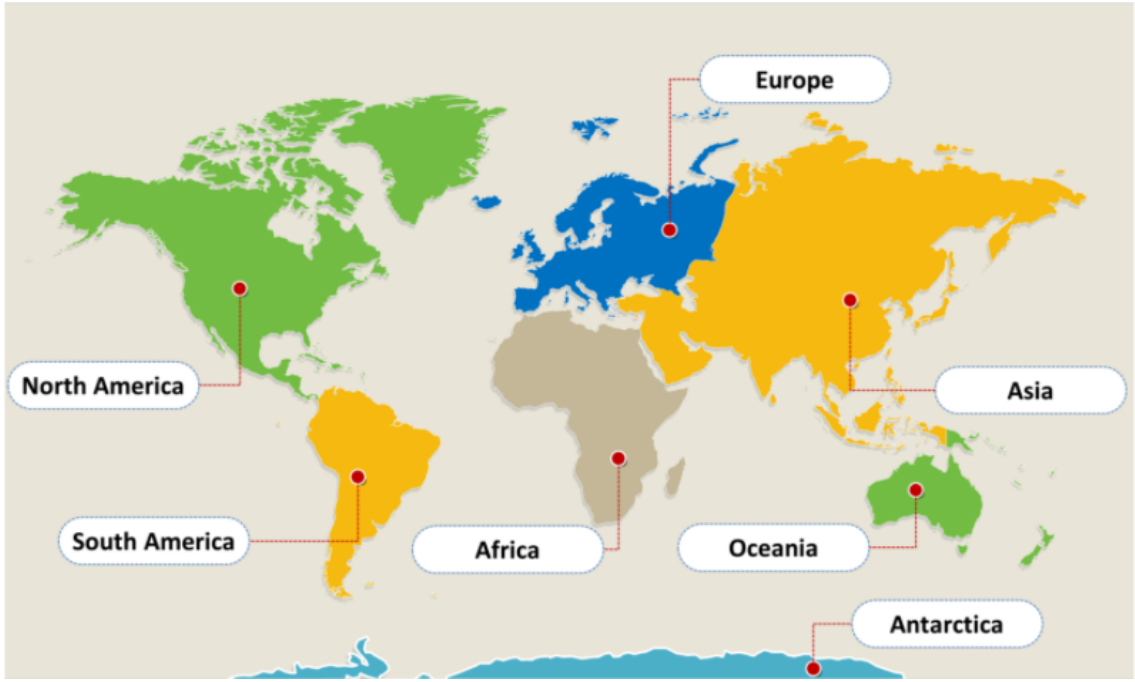
Indoor Farming:
Recover Heat from LED Lights for Cooling
1. Roots@Tuas Pte Ltd
2. Aedro Culture Pte Ltd

HVAC/ACMV
1. DX Aircon System
2. Absorption Chiller

Other Applications
1. Solar Panel
    1. Recover Heat for Cooling
2. Manufacturing
    1. Recover Boiler Heat for Heating
3. ***Off-Grid***

Installations

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



Customers


Nestlé
Good food, Good life

Kenny Rogers
ROASTERS
Deliciously Healthy


Hotel Dawei


Far East Organization
INSPIRING BETTER LIVES


PSA
The World's Port of Call


SUBWAY


ncs
making IT happen


StarHub


Jollibee


MOUNT
ALVERNIA
HOSPITAL
Serve all with Love


HIGHWAY INTERNATIONAL PRIVATE LIMITED


IRON MOUNTAIN


UNITED NATIONS


NANYANG
TECHNOLOGICAL
UNIVERSITY
SINGAPORE


NUS
National University
of Singapore


UNIVERSITI
TEKNOLOGI
PETRONAS


3M


Micron

Installation Teams

- Ecoline Solar In House Workers

Ecoline
Solar Thermal Air Conditioning

- Certified HVAC/ACMV Contractors

BCD
ENGINEERING PTE LTD

维达
VEEDA

Infinity Air
Feel the Difference

光辉工程与建筑有限公司
KWONG HUI ENGINEERING & CONSTRUCTION PTE LTD

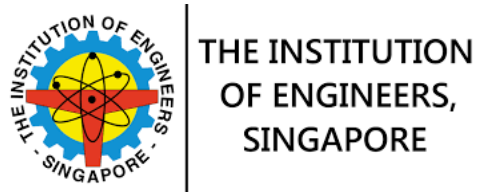
- Main Contractors

HAMPTONFORD SINGAPORE PTE LTD

Communities

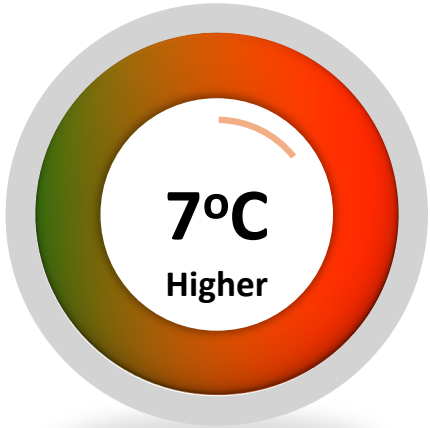
- Research

- Industry




Urban Heat Island
Is Air-Con a Boon or a Bane?
Cooler Indoor = Hotter Outdoor!

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.**

A Virtual First Step in Tackling Heat in Singapore

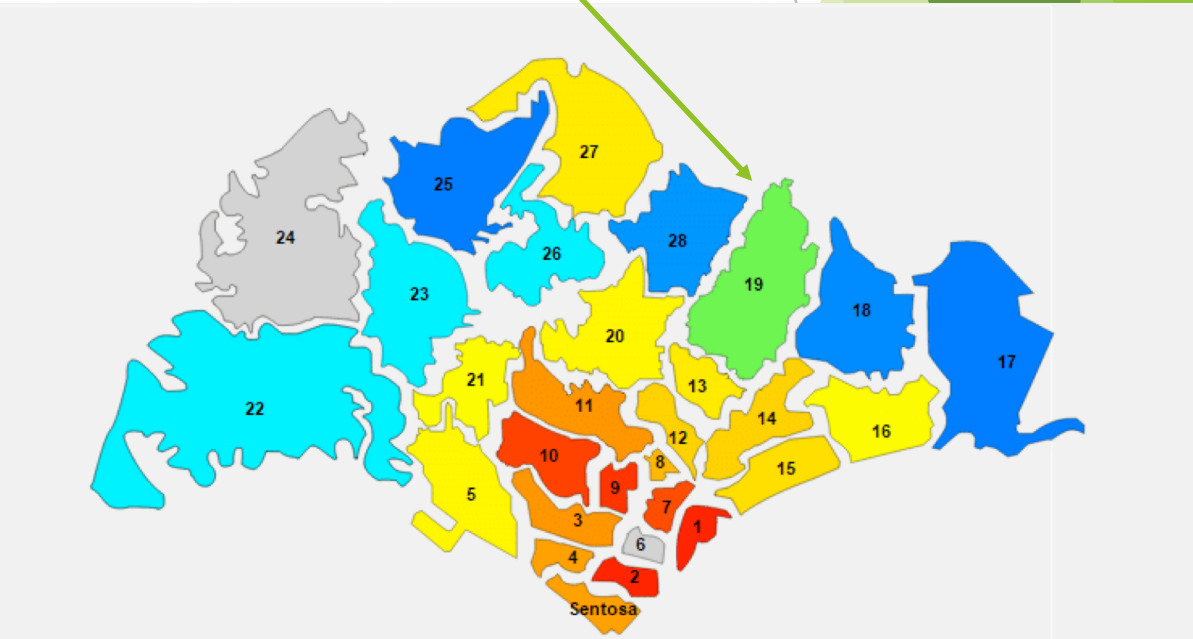
Source:
The Straits Times
Link:
https://www.straitstimes.com/singapore/environment/a-virtual-first-step-to-tackl...

Commenting on a "digital twin" of Singapore being built under the Cooling Singapore project to help researchers study factors affecting outdoor temperatures, SMU Associate Professor of Science, Technology and Society Winston Chow, a Cooling Singapore project principal investigator, said cooling strategies that can be implemented at new sites will differ from those in existing estates, which may need more retrofitting. "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.**

https://socsc.smu.edu.sg/news/2020/sep/07/virtual-first-step-tackling-heat-singapore

Potential Impact of Solar Thermal Aircon (STC)

- If the whole of Singapore/a district (**Example District 19**) is installed with STC, surface temperature could be reduced by at least **1~2°C**.
- Likewise, if STC is used in a housing estate or condominium, the surrounding temperature in these areas will be cooler than their neighboring estate/condominium
  - Residents there can enjoy cooler outdoor temperature.
  - **Green Branding for Condominium Projects & Housing Estate**



Summary

- Consume Environment waste heat from the surrounding, reducing the Urban Heat Island (UHI) effect.
  - Reduce outdoor temperature
  - Increase outdoor thermal comfort
- 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.
- Hybrid solar-thermal air-conditioners to reduce energy consumption and carbon footprint.

Case Studies

Energy Savings

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

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.

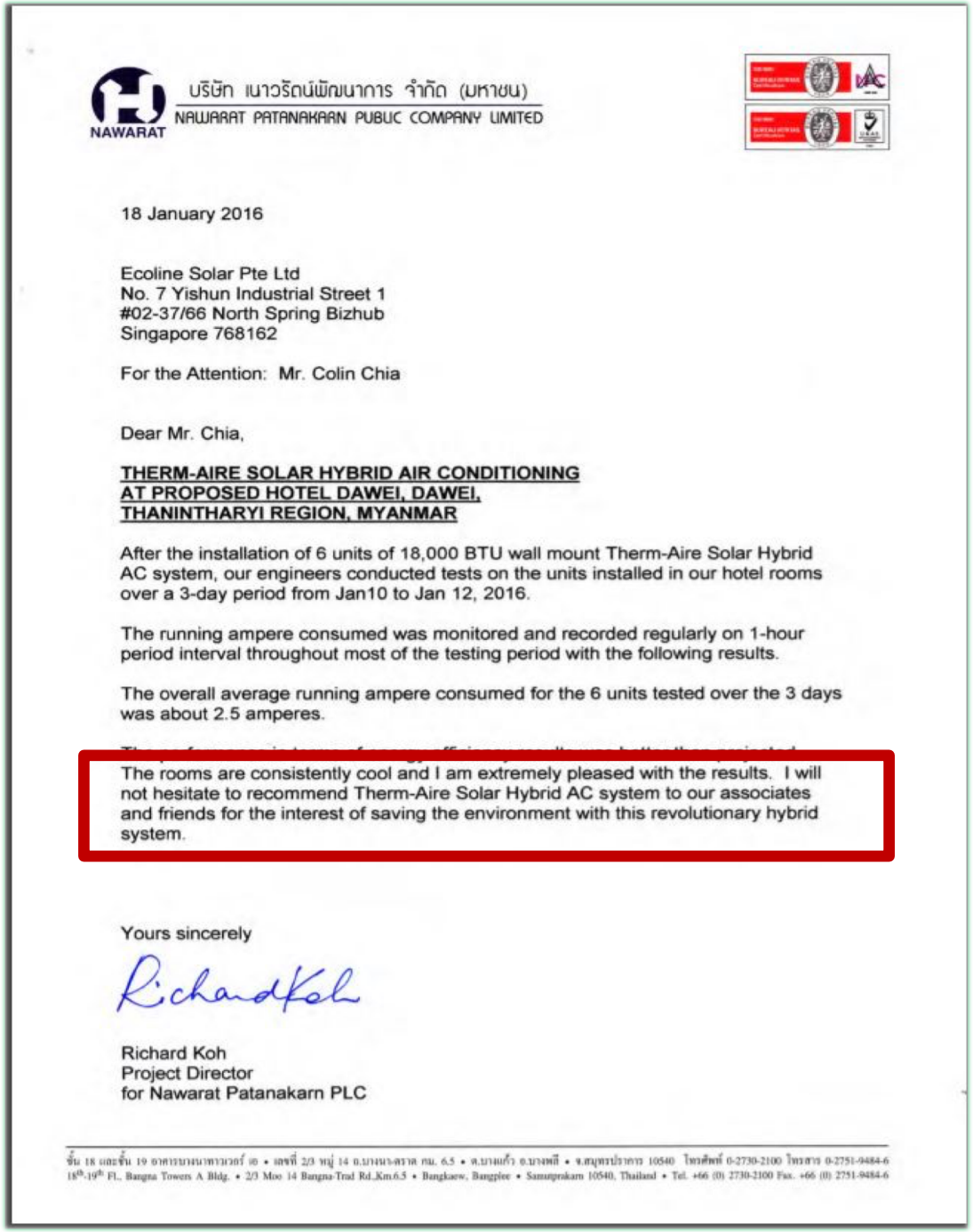
We expect our vendors to be reliable and we expect high standard in their equipment and service and are very happy with the service of Ecoline Solar Pte Ltd.

Regards,

Julius Duhaylungsod
Senior Engineer
Facilities Management Dept.
Mount Alvernia Hospital

Mount Alvernia Hospital Singapore

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



บริษัท เนาวรัตน์พัฒนาการ จำกัด (มหาชน)
NAWARAT PATANAKARN PUBLIC COMPANY LIMITED

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 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

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.

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	

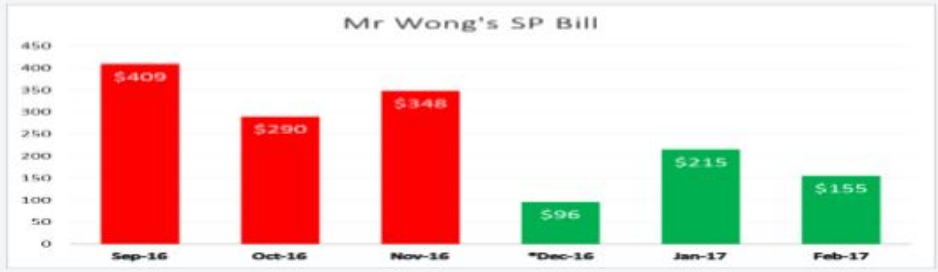
"Feliz Hotel… 50.2% reduction of electrical consumption…"

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 • Average Room Temp: 25.56°C Savings/Efficient Increment: **51.56%** 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%"



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

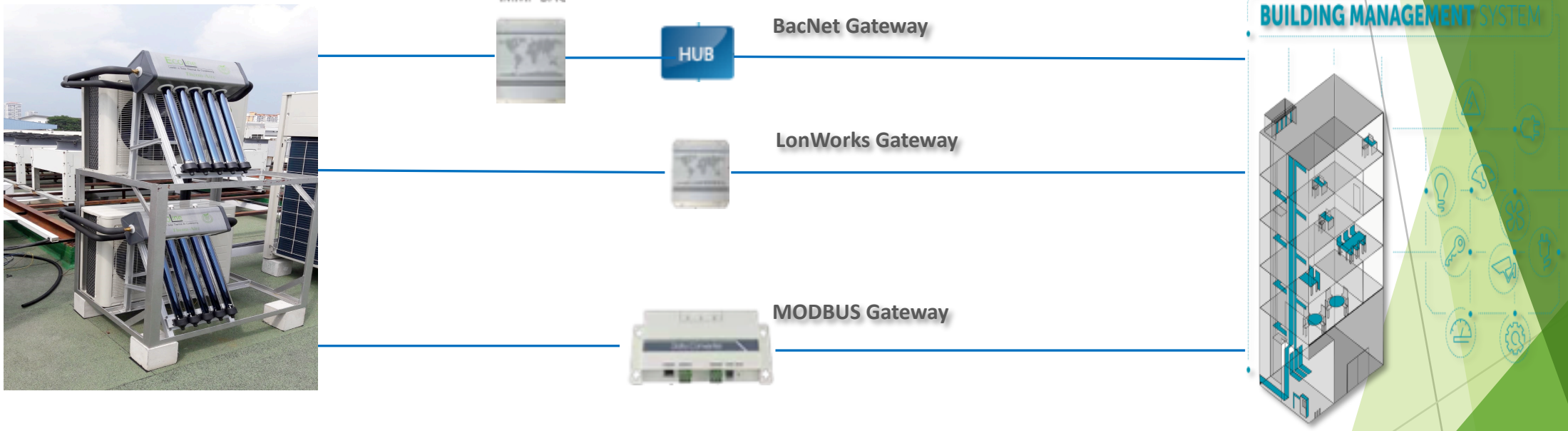
Certified Green Product of SGBC (Singapore Green Building Council)

Loyang View Residence, Singapore

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

BMS Connectivity

BMS Gateway Schematic



IoT Connectivity

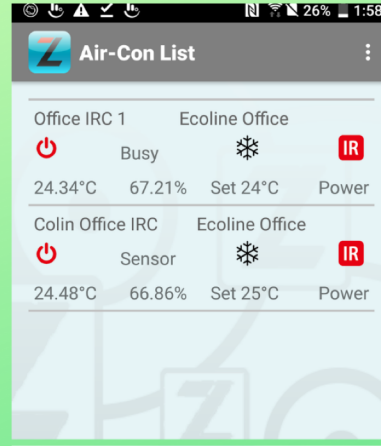
Ecoline
Solar Thermal Air Conditioning

Lumani

Autonomous
Ambient
Management

GREEN ENERGY

SOLAR THERMAL



Benefits
A seamless experience integrating the green technology of air-conditioning and light.

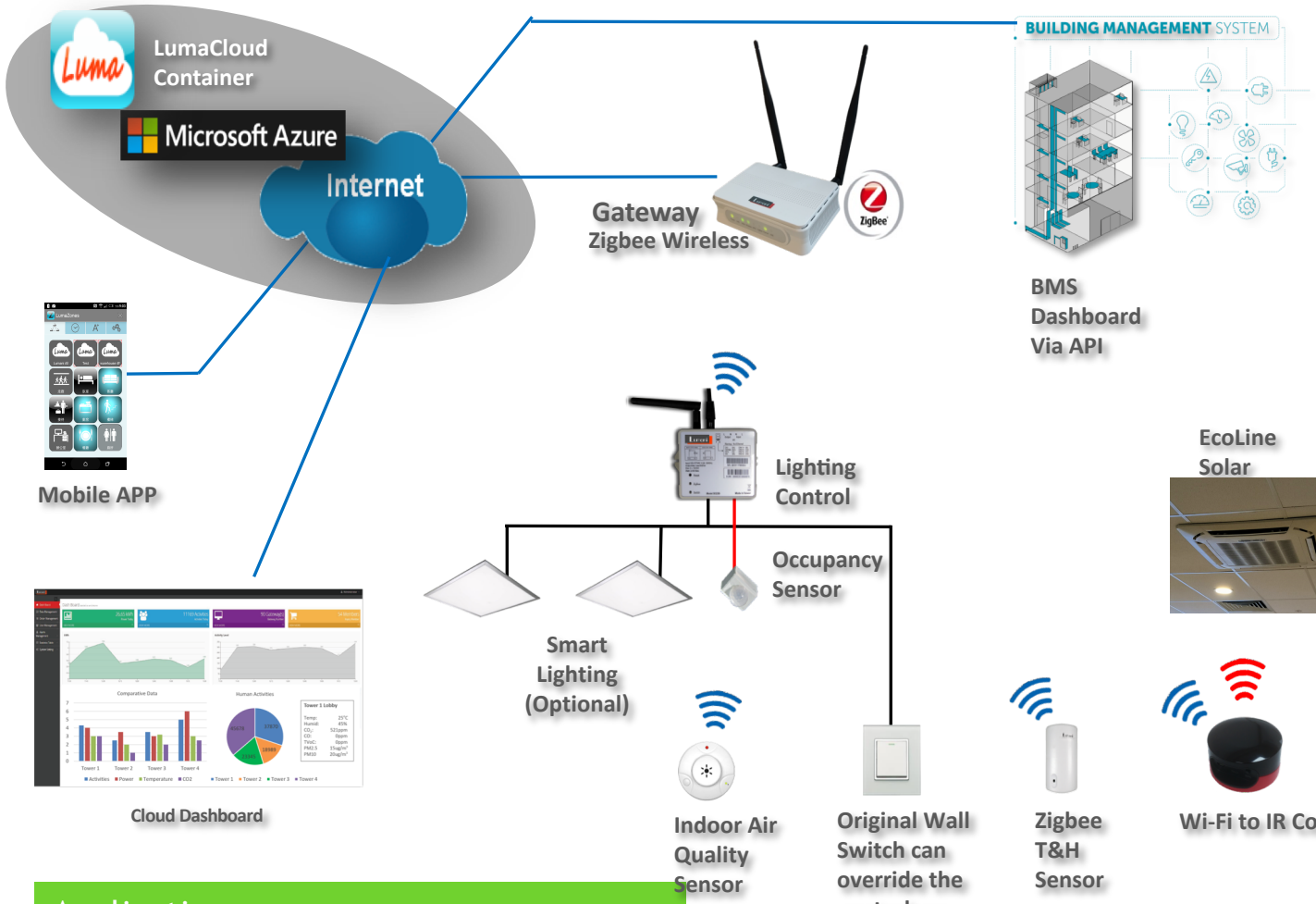
Lower Urban Heat Island Effect
- By harnessing the heat from sun & surrounding

Energy Savings:
- Aircon: 30 ~ 55% with EcoLine Solar
- Light & Aircon: Additional 30 ~ 40% with Autonomous Ambient Management

Smart:
- Lumani Patented Automatic Switch Mode

Health:
- Thermal; Humidity & Lighting Comfort

Autonomous Ambient Management



Applications:
1. Chains Stores
2. Bank Branches
3. Unmanned Stores
4. Commercial & Industrial Properties

Find out more: vinsonchua@ecolinesolar.com.sg

Indoor Air Quality (IAQ)

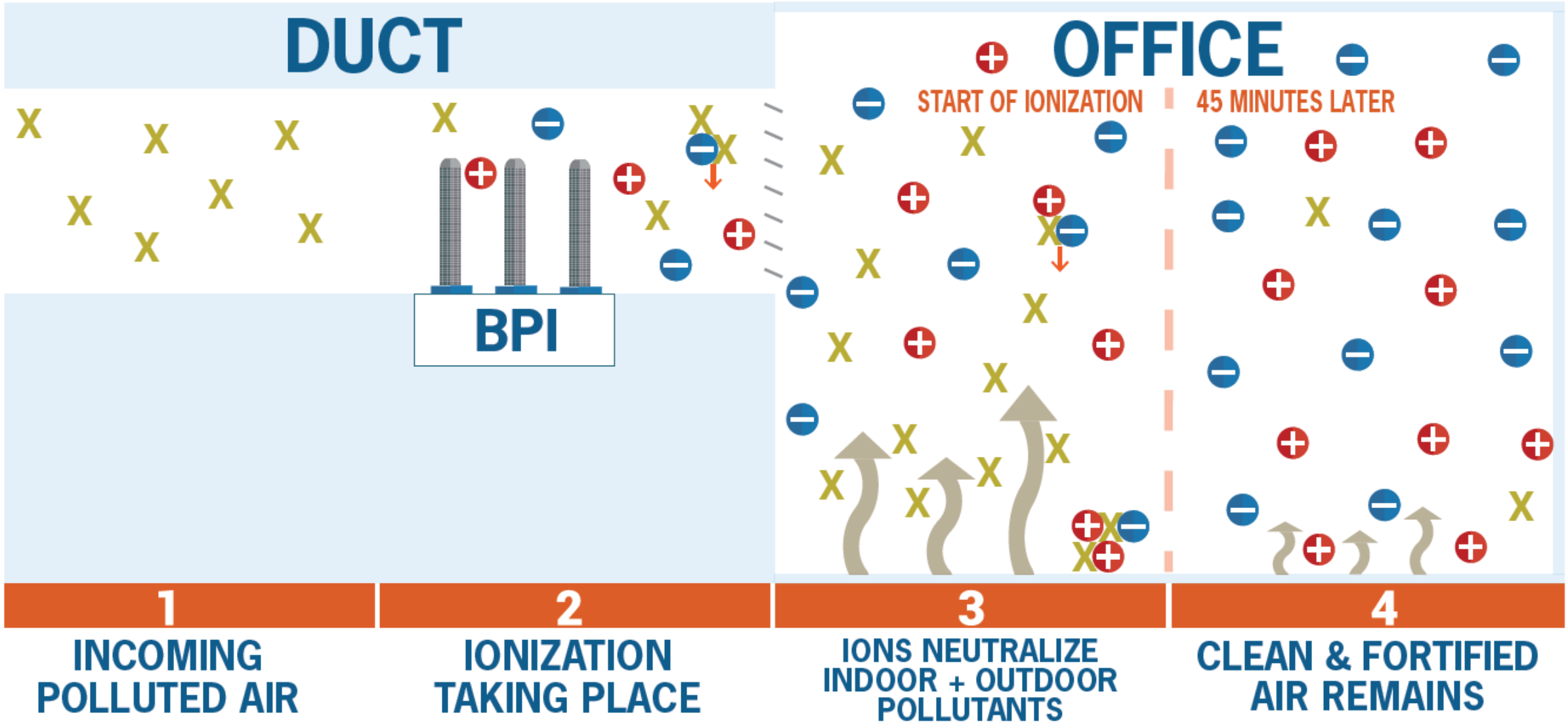
Management & Monitoring

Range of IAQ Solutions

- Plasma Technology
- Bipolar Ion Technology
- Smart IoT
  - Demand Oriented Cleaning & Disinfection
  - Heat map & Dash Board for monitoring
  - People Counting
  - Add-on:
    - Ambient noise monitoring
    - Human Centric Circadian Light

Active Clean, Continuously Disinfected Air

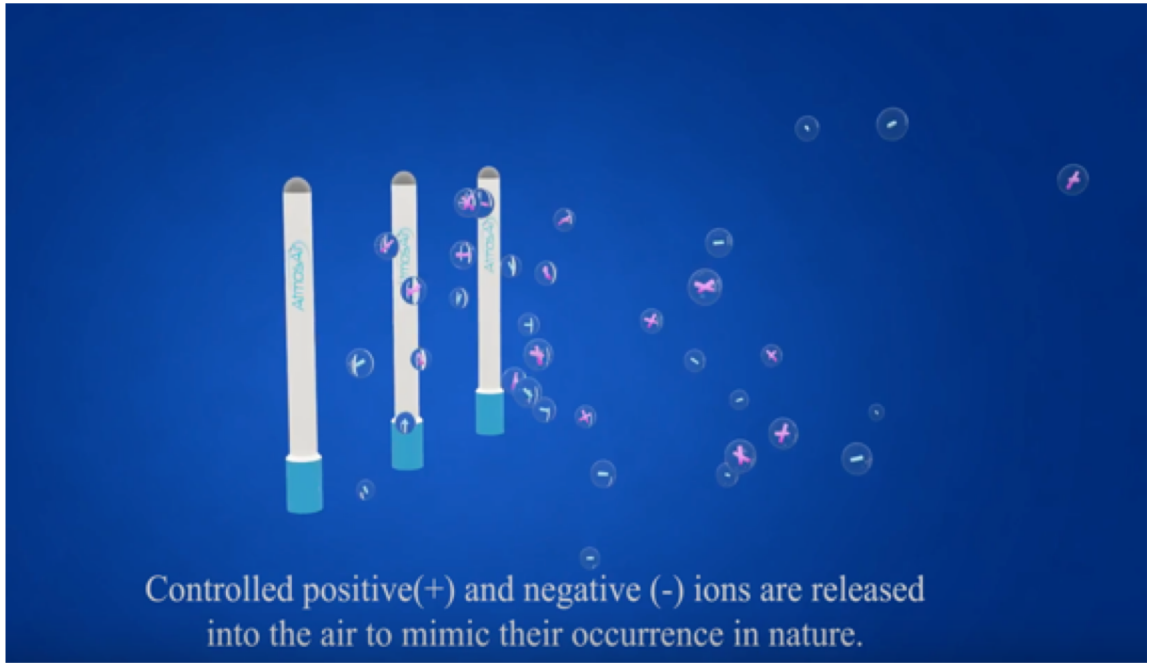
Applicable also to Ceiling Cassette & Ceiling Floor.



Deactivates Corona Virus at 99.2% in 30mins

For Both Air & Surfaces

Bipolar Ion Technology



Here is a closer look

Dash Board & Heatmap

- Real-time heatmap data captures activity level changes throughout the day
- Improve space and tenancy management
- Better management of occupant health
- Integrates with third party space management applications via API
- **Demand oriented Air Cleaning & Disinfection**

Ecoline

Solar Thermal Air Conditioning

Thank You

Recycle | Reuse | Reduce

Heat for a Cooler World

info@ecolinesolar.com

www.ecolinesolar.com.sg

FAQ

- Are these product more expensive than the convention type products?

  This product is more than a conventional DX systems as it has solar thermal collector included.

  It is typically cost 20% more than conventional type product. The value proposition we offer outweigh this additional Cost.
  For example the effectiveness and efficiency is something that we have proven through working with research institutes such as NUS that it saves 30 - 55% energy usage.

  ROI is typically 2 years.

- What is the system reliability and service support level

  Compressor load is reduce with this technology and life span will be extended. Like any DX System regular servicing will extend comfort and reliability

  We provide 5 years warranty for CU & Thermal Collector. 1 Year for other parts.

  We keep enough spare parts stock to support all our clients

FAQ

- Am I able to buy other brands aircon and link to your system? Or Is the Solar Collector compatible with 3rd party Outdoor Units?

  We supply both the FCU & CU from Single Split, Multi Split to VRF systems.

  We do not link to other brands due to the compatibility require for the thermal collector with the CU.

  It is like a “heart transplant” scenario.

- What types of copper pipes is needed?

  We use same type of piping as required by inverter systems

- Are you using inverter type compressor?

  We use similar inverter type compressor with enhancement with the solar collector

FAQ

- Is collection of dust a factor in reducing the efficiency of the system on the thermal collectors?
  - The thermal collector is not affected by dust. One of our early system was installed in UAE in 2007 and is still in good working condition with maintenance done locally.
- Once install your system, is the spare parts readily available?

  We are the manufacturer and we keep stock for the spares that is readily available to our customers.
- What Refrigerant is use?

  R407C

FAQ

- Does your AC system comes with and integrate with energy management system?

  We have a tie up with Lumani Autonomous Ambient Management Platform for commercial applications.
  We can integrate with other system via API.
  We also work with BMS Protocols