GREEN COUNCIL
環保促進會

Webinar:
Climate Change Mitigation: Decarbonisation Technology and Innovation - What To Know and Do About it

HVAC Technology Update

Ir. Dr. Dennis Tung
Founder & CEO
Sustainable Energy Ltd

Remarks: This material/event is funded by the Professional Services Advancement Support Scheme of the Government of the Hong Kong Special Administrative Region. Any opinions, findings, conclusions or recommendations expressed in this material/any event organised under this project do not reflect the views of the Government of the Hong Kong Special Administrative Region or the Vetting Committee of the Professional Services Advancement Support Scheme.

SustainE

HVAC Technology Update

Heat Pump for Sustainable Heating & Cooling

22th September 2022

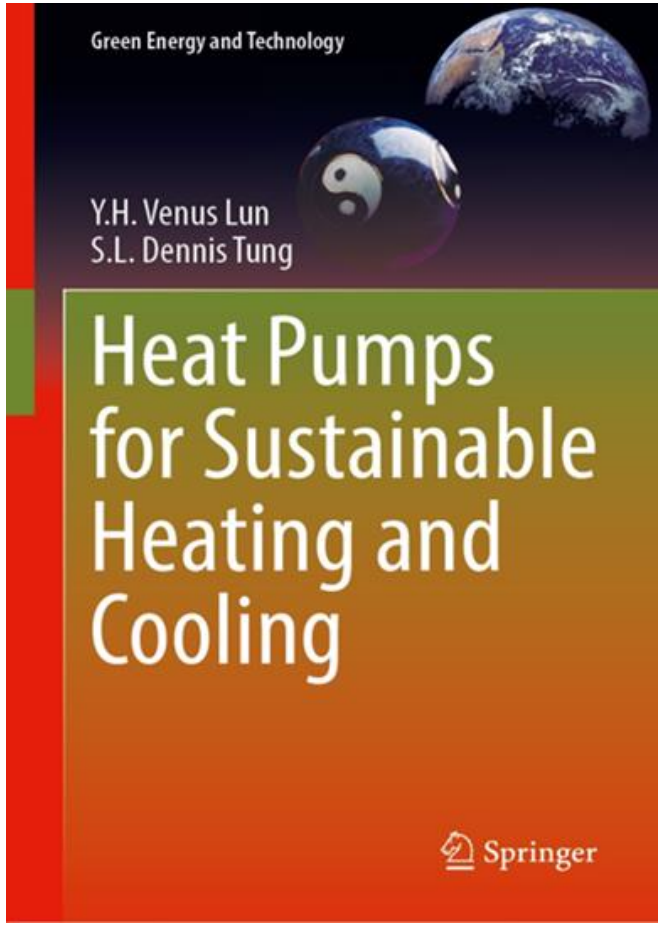
Ir Dr. Dennis Tung

Email: info@sustaine.com.hk | Whatsapp: +852 90270632 | Phone: +852 23708300

About SustainE

- Sustainable Energy Ltd is a **Heat Pump Manufacturer** and solution provider for green technology.
- Solutions on energy-intensive sectors such as air-conditioning, dehumidification, and hot water systems.
- Innovative heat pump technology, desiccant dehumidification, integrated functions.
- Design integrating heat pumps systems to optimize energy use.

Publications



Book title: Heat Pumps for Sustainable Heating and Cooling

Authors: Y.H. Venus Lun and S.L. Dennis Tung

eBook ISBN: 978-3-030-31387-6
Hardcover ISBN: 978-3-030-31386-9

Publisher: Springer

This book:

- Demonstrates how heat pumps provide an energy-efficient solution for heating and cooling
- Describes innovative heat pump system designs
- Explains the practical applications of heat pump technology in buildings

Designated Local Research Institution (DLRI)

Annex

Inland Revenue Ordinance (Cap. 112)

Designated Local Research Institution (DLRI)

Details of Designation

DLRI No.: D034

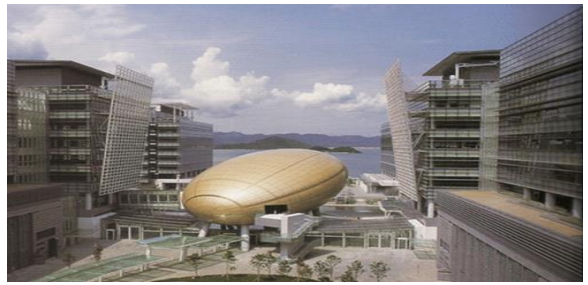
Name of DLRI: **Sustainable Energy Limited**

Certificate of Incorporation No.: 1338440

Scope of Designation:
Field 2.3 Mechanical Engineering
Areas – (1) Heat pump and (2) Heating, ventilation, and air conditioning

Date of First Designation:
14 February 2020

Validity Period of Designation:
24 months from 14 February 2022



創新科技署
Innovation and Technology Commission
香港特別行政區政府
The Government of the Hong Kong Special Administrative Region

Our Ref. : DLRI/102/006

9 February 2022

Sustainable Energy Limited
Unit 301, 3/F, Building 16W
16 Science Park West Avenue
Hong Kong Science Park
New Territories,
Hong Kong
(Attn.: Ir Dr Tung Siu Lok, Dennis, Director)

Dear Ir Dr Tung,

Instrument of Designation

Thank you for applying for the renewal designation as a Designated Local Research Institution ("DLRI"). I am pleased to inform you that, pursuant to section 19(1) of Schedule 45 to the Inland Revenue Ordinance (Cap. 112), the Commissioner for Innovation and Technology has designated –

Sustainable Energy Limited

as a DLRI with effect from **14 February 2022** for 24 months. Details of the renewal designation are set out in **Annex** to this letter.

The designation is subject to the condition that your organisation agrees to be bound by the provisions specified in the *Application Guidelines For Designation As Designated Local Research Institution* (as may be amended by the Innovation and Technology Commission from time to time). If a DLRI fails to comply with any of the provisions, the Commissioner for Innovation and Technology may revoke the designation at any time pursuant to section 19(3)(b) of Schedule 45 to the Inland Revenue Ordinance (Cap. 112).

Yours sincerely,

(Jenny Lee)
for Commissioner for Innovation and Technology

Encl.

21/F, West Wing, Central Government Offices, 2 Tim Mei Avenue, Tamar, Hong Kong
香港添馬添美道二號政府總部西翼二十一樓

Energy consumption in non-residential buildings

- More than 60% of building energy consumption is accounted for HVAC system.
- 1 unit of Cooling requires 1.3 unit of Heat rejection to outdoor.
- Demand for heating in building includes dehumidification and hot water.
- Locally recycle of heat energy is feasible for energy saving.
- Other than regulation on machine efficiency (BEC), innovative design is required for further reduction on energy consumption.
- Heat pump is an effective way to recycle heat energy locally.

Coefficient of Performance (COP)

Cooling capacity (2 units) + Input power (1 units)
= Heat output (3 units)(kW)

COP = Heat output / input power =3

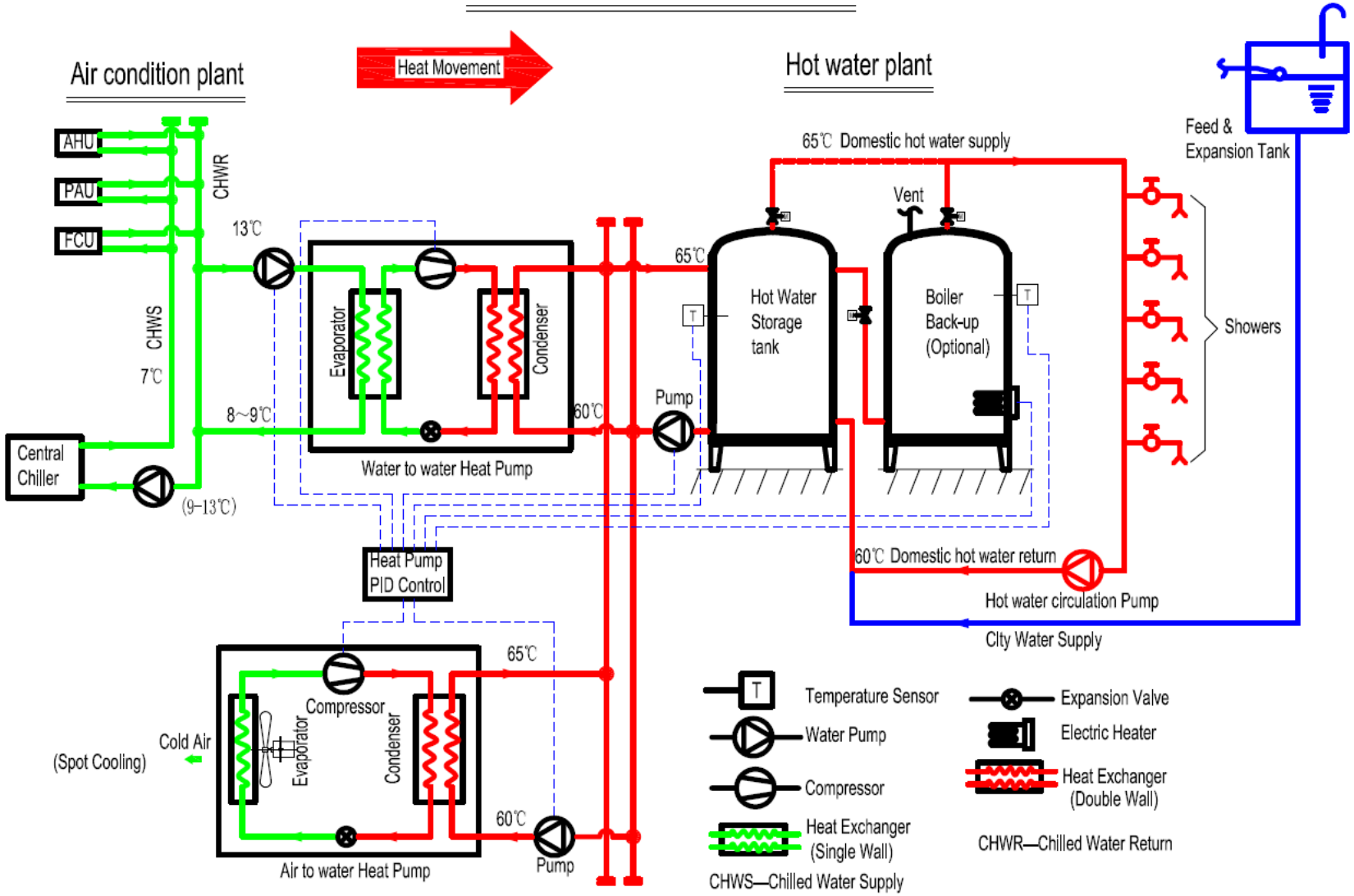
Air to water heat pump COP = 2.8~3.8

Water to water heat pump COP = 4.4~4.5

Benefit of using heat pump

- Cooling and heating simultaneously.
- Recycle waste heat into usable heat within same location.
- Reduce energy consumption in electrical or gas.
- Reduce waste heat emission to ambient.
- Heat pumps are largely adopted in non-residential buildings of both public sector and commercial sector

Heat Pump Hot Water System



Air to Water Heat Pump
- COP by hot water inlet/outlet

40C/45C	• Scroll COP 2.8-3.0 • Screw COP 3.2-3.8
60C/65C	• Scroll COP 2.8 • Screw COP 2.3
75C/80C	• Only available in Scroll COP 2.1
85C/90C	• Only available in Screw COP 2.2

BEC-2021 requirements:

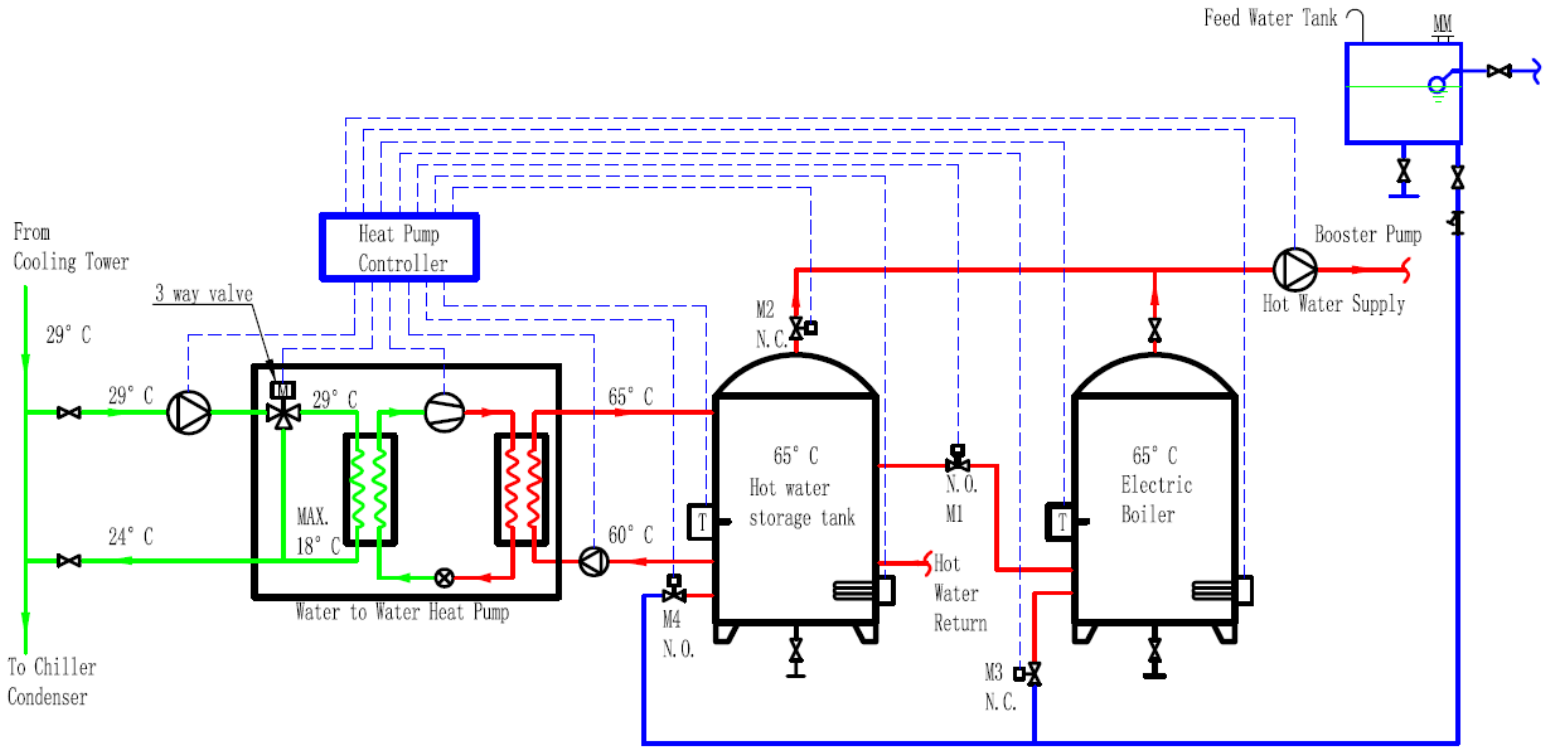
- Below or 500kW, not less than 2.8
- Above 500kW, not less than 3.1
- Rated at hot water inlet/outlet @ 40°C/45 °C
- Ambient 7 °C ; 90%RH

Water to Water Heat Pump
- COP by hot water inlet/outlet

40C/45C	• Scroll COP Heating 4.4, Total 7.8 • Screw COP Heating 4.5, Total 8.0
60C/65C	• Scroll COP Heating 2.6, Total 4.2 • Screw COP Heating 2.7, Total 4.4
75C/80C	• Only available in Scroll COP • Heating 2.3, Total
85C/90C	• Only available in Screw COP • Heating 2.5, Total

BEC-2021 requirements:

- Below or 500kW, not less than 4.4
- Above 500kW, not less than 4.5
- Rated at hot water inlet/outlet @ 40°C/45 °C
- Rated at chilled water inlet/outlet @ 12.5°C/7 °C



Condenser Water as Heat Source

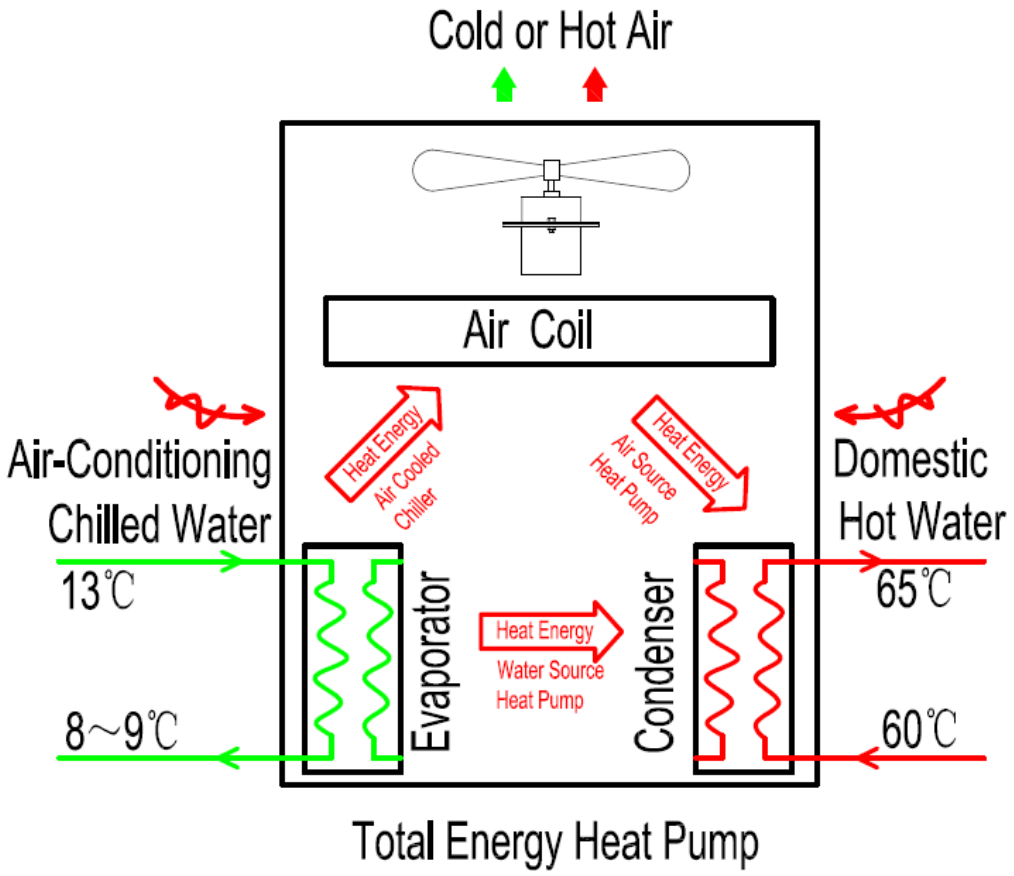
Total Energy Heat Pump

No need to worry about load balance between cooling & heating

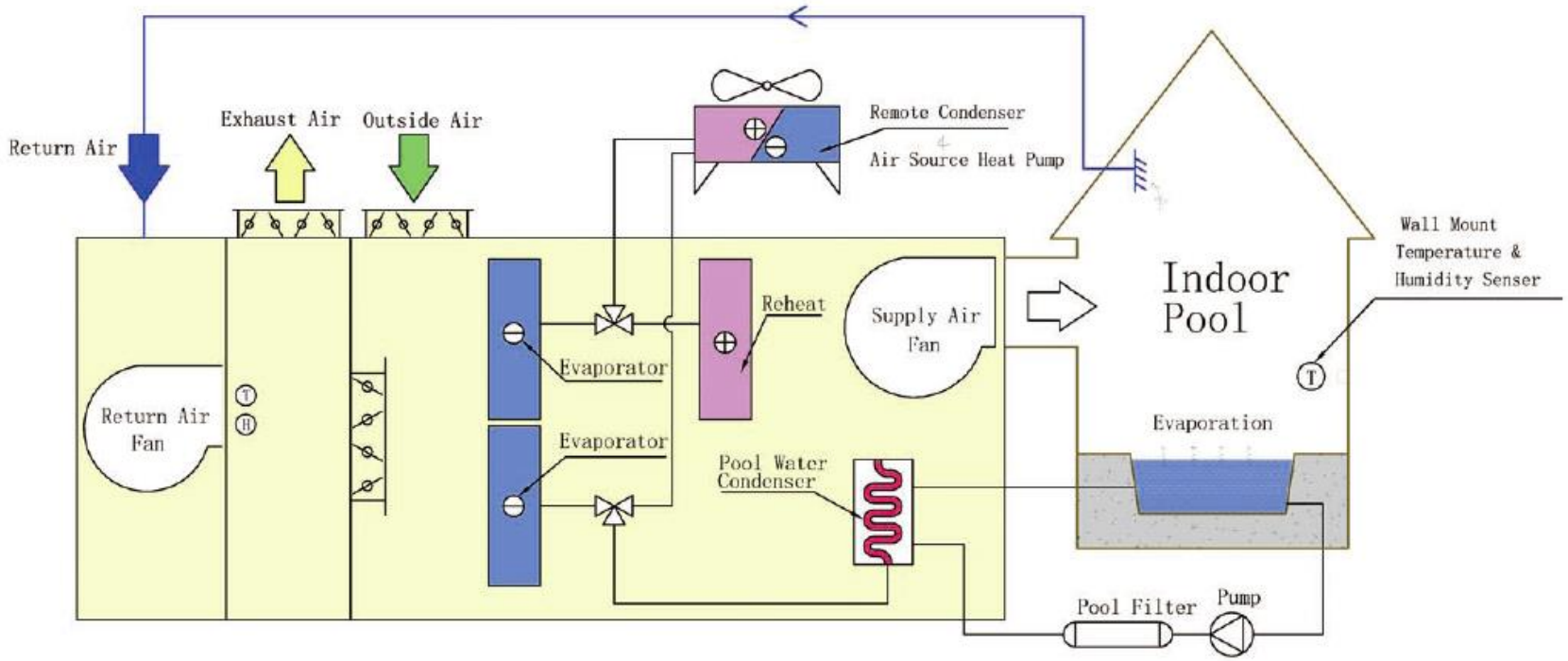
- Heating mode – Air source heat pump.
- Heat recovery mode – Water to water heat pump.
- Cooling mode – Air cooled package chiller.
- High cooling small heating mode
- Small cooling and high heating mode

Total Energy Heat Pump

Schematic Diagram



Indoor Swimming Pool Heat Pump



Indoor swimming pool heat pump schematic diagram

Energy optimization

- Recover heat energy from dehumidification process
- Use recovered heat to keep indoor pool water at warm temperature.
- Less energy consumption for providing warm air to pool hall.
- An example of locally recycle of heat energy to maximize energy saving.

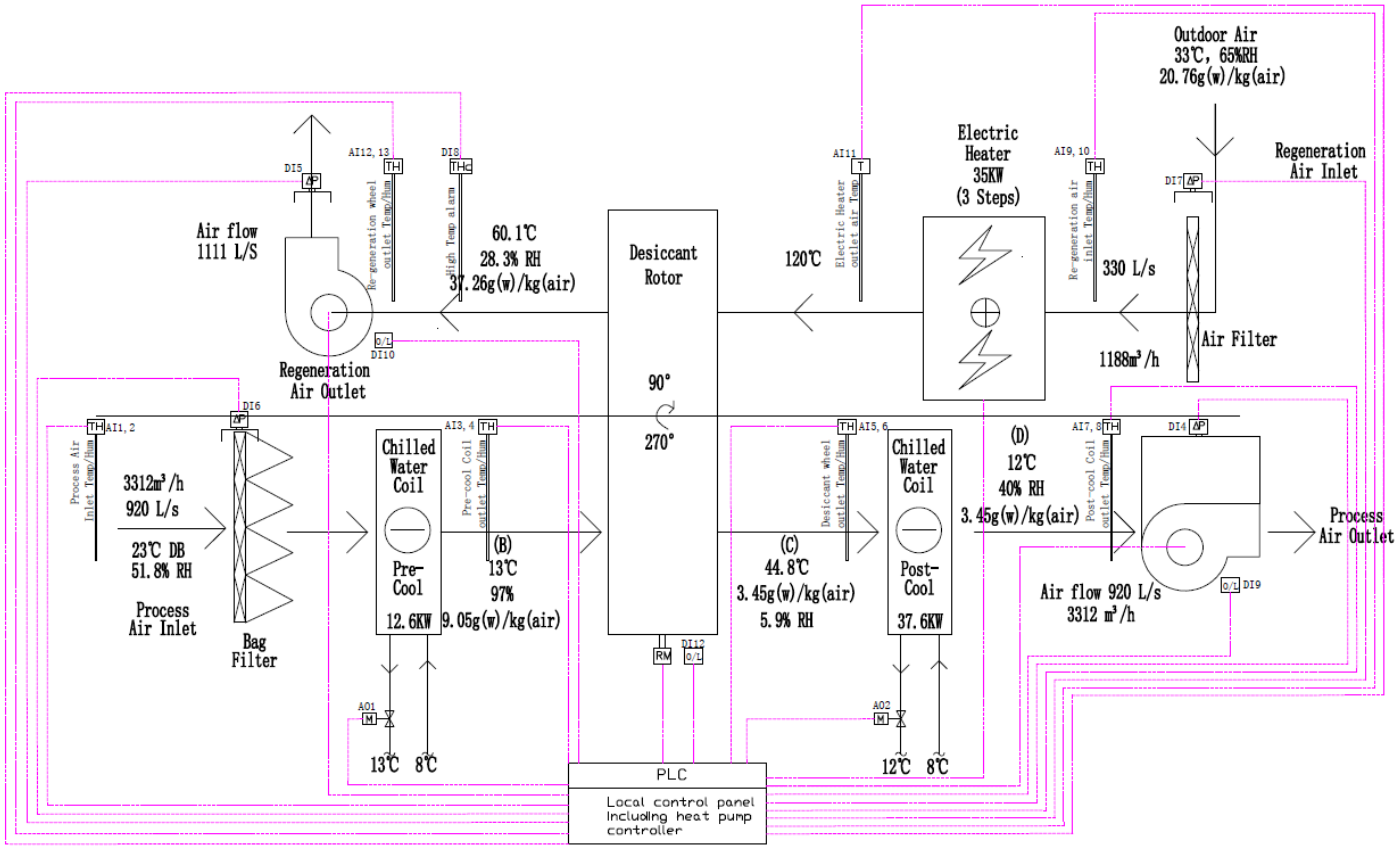
Desiccant Dehumidification technology

- High humidity weather condition
- Air conditioning too cold

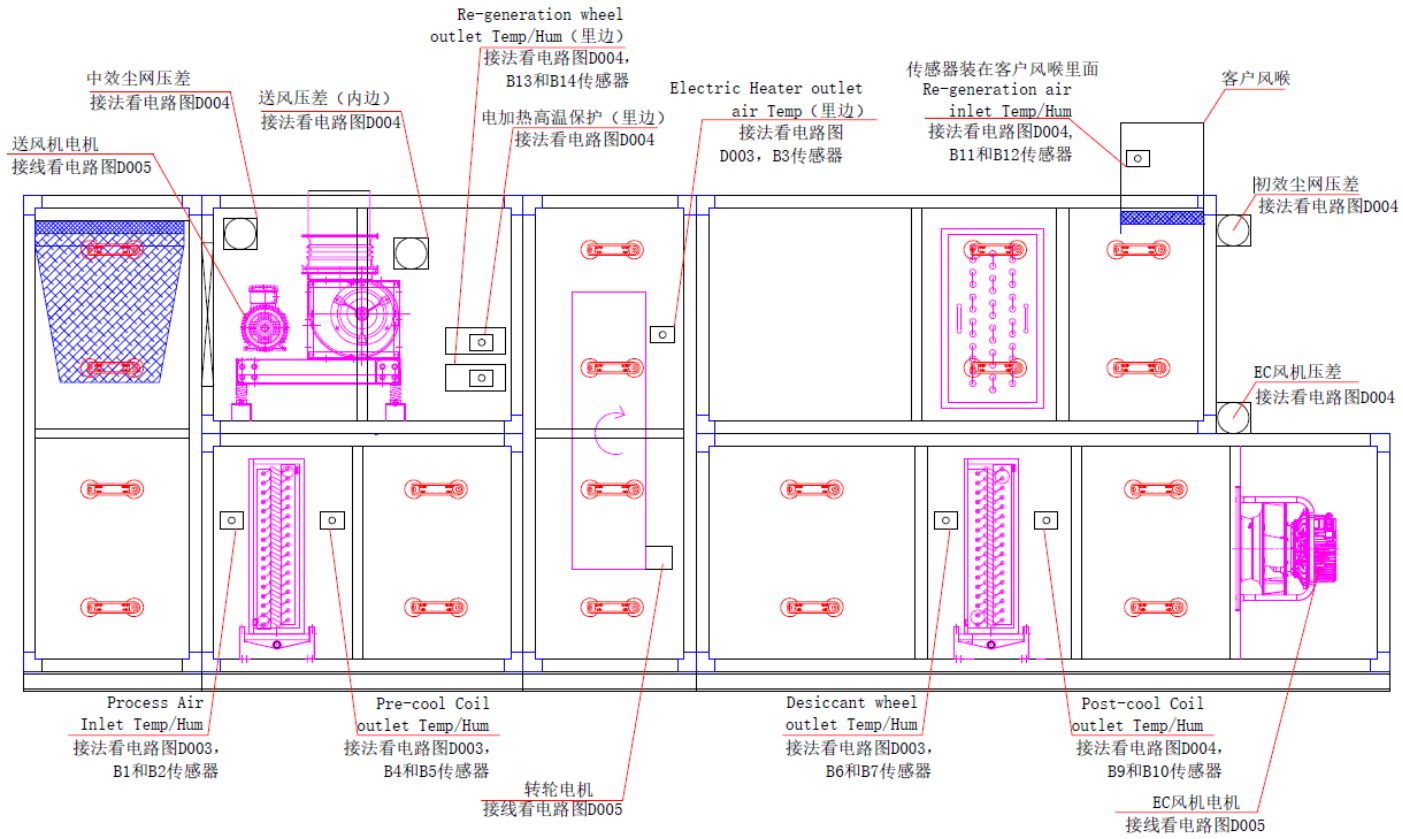
Desiccant Application

- Designated Fresh Air System
- Fresh air is treated by Desiccant to achieve very low dew point.
- Building latent load is removed by low dew point fresh air.
- Whereas sensible load is handled by chilled ceiling / panel.
- Huge energy saving for chiller plant operating at higher chilled water leaving temperature.
- Integrated with heat pump at regeneration air path for extend energy saving.
- Other application including laboratory, food processing, etc.

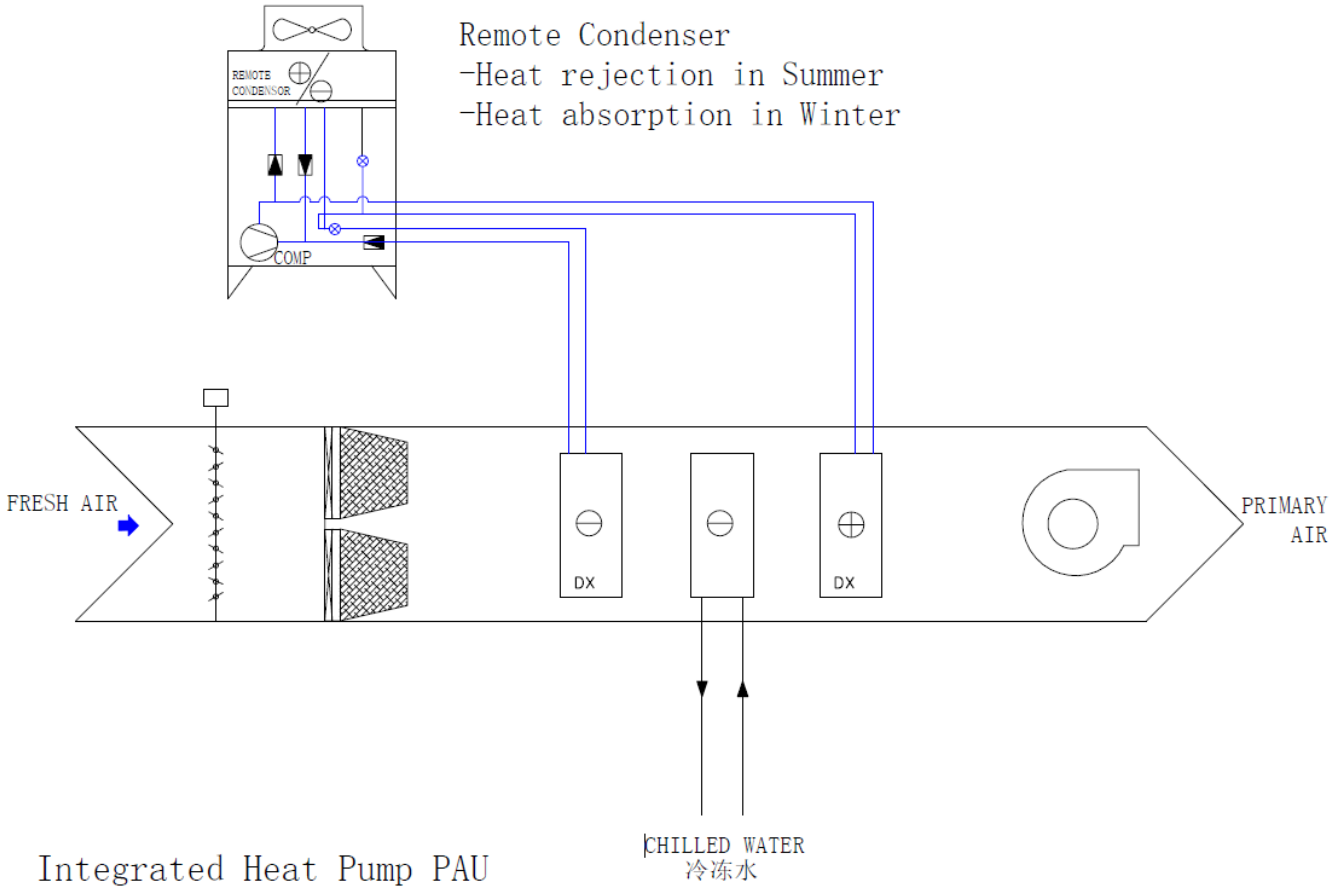
Desiccant Dehumidifier Principle



Desiccant Dehumidifier Unit



Integrated Heat Pump PAU/AHU



Integrated Heat Pump PAU

Advantages & Application

- Prevent high relative humidity at low supply air temperature.
- Useful for unoccupied period of space with unwanted high relative humidity in summer.
- Reduce energy consumption of HVAC system.
- Can provide fresh air heating by heat pump for energy saving.
- Sport hall, classroom.

Future Developments

- High Temperature 120C Air to Air Heat Pump (2023)
- Integrated with Desiccant Dehumidification – energy saving
- Designated fresh air system – (Room temperature set-point 27C)
- Dryer in food processing – Chinese medicine, dry sea food.

DLRI No.: D034

Name of DLRI: **Sustainable Energy Limited**

Certificate of Incorporation No.: 1338440

Scope of Designation:

Field 2.3 Mechanical Engineering
Areas – (1) Heat pump and (2) Heating, ventilation, and air conditioning

Innovation and Technology Commission
The Government of the Hong Kong Special Administrative Region of the People's Republic of China

Email: info@sustaine.com.hk | Whatsapp: +852 90270632 | Phone: +852 23708300

Q&A

Thank you for your time

Please visit our:

WhatsApp

Website

Email: info@sustaine.com.hk | Whatsapp: +852 90270632 | Phone: +852 23708300

Care for our globe,
Use sustainable energy.

SustainE