TRANE LET'S GO BEYOND™

New Innovation for Green & Digital Solutions

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CenTraVac™ Chillers with R-514A

R-514A

- Non-ODS (Ozone Depletion Substance)
- Ultra-low GWP (Global Warming Potential): < 2
- Short atmospheric life: 22 Days
- Low operation pressure (Low leakage rates)
- High operating efficiency

Technologies

- Low Compressor Speed (<4,000 rpm, Low noise)
- Semi-Hermetic Motor Layout
- Permanent Magnet Motor
- Variable Speed Drive (VSD)
- AdaptiSpeed™ Technology
- Falling Film Condenser

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Refrigerant Comparison

Table. Environmental attributes comparison of various refrigerants

Type	Refrigerant	ODP	$GWP_{100\text{-}year}$	Atmospheric Lifetime *
CFC	R-11	1.0	4,750	16,425 Days
	R-12	1.0	10,900	36,500 Days
HCFC	R-22	0.055	1,810	4,380 Days
	R-123	0.02	77	475 Days
HFC	R-134a	0.000, Non-ODS*	1,300	4,891Days
	R-410A	0.000, Non-ODS	1920	6,205 Days
HFO	R-1233zd(E)	0.000, Non-ODS	1	26 Days
	R-513A	0.000, Non-ODS	573	2,154 Days
	R-514A	0.000, Non-ODS	1.75	22 Days

* The Atmospheric lifetime is the time of a greenhouse gas remain in the atmosphere. it is defined as the burden divided by the mean global sink for a gas in steady state. A short atmospheric life assures the refrigerants will not stay long in the atmosphere and move to stratospheric.
*Non-ODS means not listed as Ozone Depletion Substance[9].

Source: Ho. P.L., Ultra-low GWP Alternatives to HFC Refrigerants: Safety Analysis, The 8th Tropical and Subtropical Green Building Council Alliance Conference & The 9th Cross-Strait Green Building Technology Development Forum, 16 to 18 Nov. 2018. Hong Kong, China.

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Refrigerant Comparison

Table. The comparison between old and new refrigerants

Refrigerant Name	R-134a (HFC)	R-123 (HCFC)	R-514A (HFO)	R-1233zd(E) (HFO)	Remarks
Ozone Depleting (ODS)	No	Yes	No	No	US-EPA
Global Warming (GWP)	1300	77	1.75	1	Published
Atmospheric Lifetime	4900 Days	475 Days	22 Days	26 Days	Published
Flammability	Class 1 (Non-flammable)	Class 1 (Non-flammable)	Class 1 (Non-flammable)	Class 1 (Non-flammable)	ASHRAE 34
Toxicity	Neither	Neither	Neither	Neither	ASHRAE 34
Pressure systems	Medium pressure	Low pressure	Low pressure	Low pressure	Actual
Refrigerant Efficiency	8.47	8.95	8.93	8.85	Published
Operating pressure (Leakage Potential)	124 psig (High) 33 psig (Low)	6 psig (High) -9 psig (Low)	5 psig (High) -8 psig (Low)	13 psig (High) -5 psig (Low)	Actual
Phase out / down schedule	Yes	Yes	No	No	-Kigali Amendment -California EPA -Environment and Climate Change Canada

Source: Ho. P.L., Ultra-low GWP Alternatives to HFC Refrigerants: Safety Analysis, The 8th Tropical and Subtropical Green Building Council Alliance Conference & The 9th Cross-Strait Green Building Technology Development Forum, 16 to 18 Nov. 2018. Hong Kong, China.

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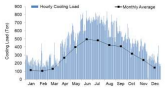
Trace 700 Simulation — Approach 1



Existing Cooling load Profile

+

Chiller data

TRANE Trace 700
LEED Approved Energy Simulation Software

Simulation Results

TRANE Trace 3D Plus

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Trace 700 Simulation — Approach 2

Building Information

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Chiller data

TRANE Trace 700
LEED Approved Energy Simulation Software

Simulation Results

TRANE Trace 3D Plus

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Application — Club House

Building A

- **Location:** Causeway Bay, Hong Kong
- **Type:** Club House

Water-cooled Centrifugal Chiller

CVHF410-080L-080L

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Building A — Chiller Plant Layout

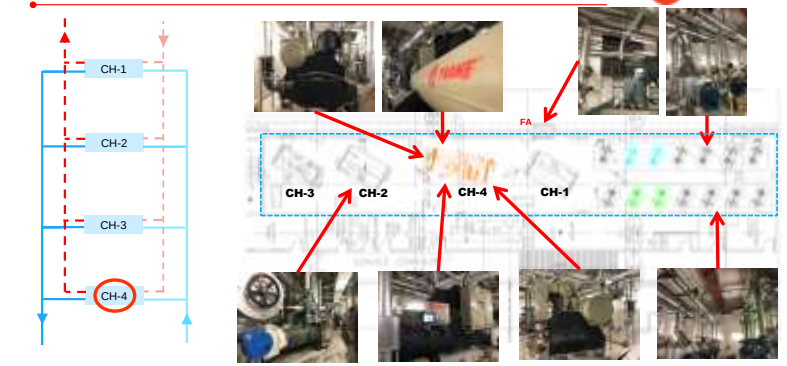

Figure. Simply chiller schematic diagram

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Building A — Chiller Description

Chiller Description

Chiller No. & Model	Refrigerant	Capacity (RTon)	Type
CH-1-2	R-134a	350	Constant Speed Drive (CSD) water-cooled screw
CH-3	R-134a	400	CSD water-cooled centrifugal
NEW CH-4 (CVHF410-080L-080L)	R-514A	400	CSD water-cooled centrifugal

COP[1]

Model	COP	BEC 2015	Efficiency
CH-4 (CVHF410-080L-080L)	6.15	5.70	Better **7.90%**

1) Design COP compared with Min. COP at 100% load requirement in BEC.

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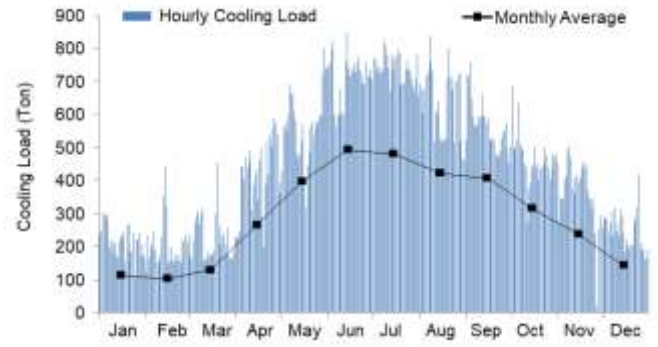
Building A — Cooling Load Profile



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Building A — Results

Energy

Economic

Annual Energy Saving (%)	Annual Cost Saving (HK$)	Simply Payback (year)
31.27%	731,351	5.9

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Application — University

Building B

- **Location:** New Territory, Hong Kong
- **Type:** University

Water-cooled Centrifugal Chiller

CVHG1100-142E-210L

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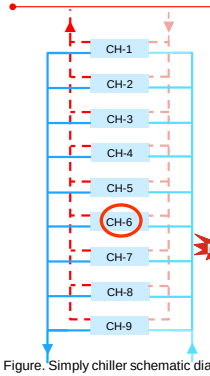
Building B — Chiller Replacement



Before Replacement

Chiller No.	Capacity (RTon)	Type of Drive
CH-1	1200	CSD
CH-2-4	1000	
CH-5-7	1200	
CH-8-9	1000	

After Replacement

Chiller No. & Model	Capacity (RTon)	Type of Drive
CH-1	1200	CSD
CH-2-4	1000	
CH-5	1200	
CH-6 (CVHG1100-142E-210L)	1200	
CH-7	1200	
CH-8-9	1000	

COP[1]

Model	COP	BEC 2015	Efficiency
CH-6 (CVHG1100-142E-210L)	6.20	5.80	Better 6.9%

Figure. Simply chiller schematic diagram

1) *Design COP compared with Min. COP at 100% load requirement in BEC.*

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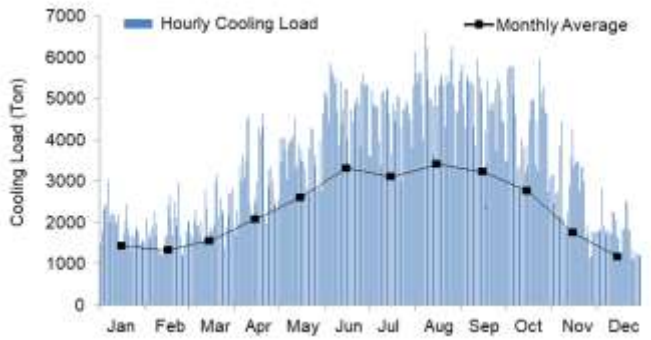
Building B — Cooling Load Profile



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Building B — Results

Energy

8.87%

Economic

Annual Energy Saving (%)	Annual Cost Saving (HK$)	Simply Payback (year)
8.87%	1,241,359	4.4

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Application — Shopping Mall

Building C

- **Location:** New Territory, Hong Kong
- **Type:** Shopping Mall

Water-cooled Centrifugal Chiller

CVHG1100-142L-142L
CVHF485-050L-080L

(Re-Engineering for Chiller Plant)

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Building C — Chiller Replacement

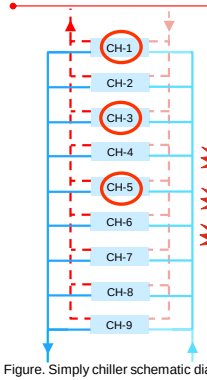

Figure. Simply chiller schematic diagram

Before Replacement

Chiller No.	Capacity (RTon)	Type of Drive
CH-1-3	900	CSD
CH-4-6	500	
CH-7-9	250	

After Replacement

Chiller No. & Model	Capacity (RTon)	Type of Drive
NEW CH-1 (CVHG1100-142L-142L)	1200	CSD
CH-2	900	CSD
NEW CH-3 (CVHG1100-142L-142L)	1200	CSD
CH-4	500	CSD
NEW CH-5 (CVHF485-050L-080L)	500	Variable Speed (VSD)
CH-6	500	CSD
CH-7-9	250	CSD

COP[1]

Model	COP	BEC 2015	Efficiency
CH-1 (CVHG1100-142L-142L)	6.39	5.80	Better 10.17%
CH-3,5 (CVHF485-050L-080L)	6.32	5.50	Better 14.90%

1) *Design COP compared with Min. COP at 100% load requirement in BEC.*

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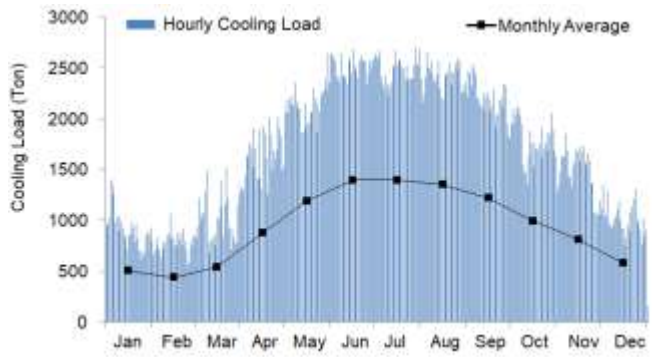
Building C — Cooling Load Profile



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Building C — Results

Energy

18.68%

Economic

Annual Energy Saving (%)	Annual Cost Saving (HK$)
18.68%	1,090,252

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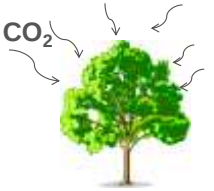
Results Summary

Results	Building A	Building B	Building C
Annual Energy Saving	31.27%	8.87%	18.68%
Electricity Consumption (kWh)	664,865	1,128,508	1,044,450
Reducing CO_2 (kg/year)	465,400	790,000	731, 100
Equivalent of Trees	20,235 = 1 Victoria Park	34,348 = 1.7 Victoria Park	31,788 = 1.6 Victoria Park



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Green Payback

$$\text{Payback} = \frac{\text{Total Project Cost}}{\text{Annual Saving}_{BEC}} \qquad \text{Green Payback} = \frac{\text{Additional Cost for "Go Greener"}}{\text{Annual Saving}_{Green}}$$

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Digitization of MEP

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