

ENERGY SAVINGS WEBINAR

On-site Power Generation & Cooling Systems



ENGAGEBC

AGENDA

- Introduction
- Gas Powered Heat Pump (Heating and Cooling)
- Combined Heat & Power (CHP) System
- Electric Heat Pump (Cooling and Heating)
- Question & Answer Session

INTRODUCTION

Presenters

- Jeff Hoogveld from Guillevin International Inc.
- Kenneth McNamee from Impact Engineering
- Paul Binotto from Guillevin International Inc.

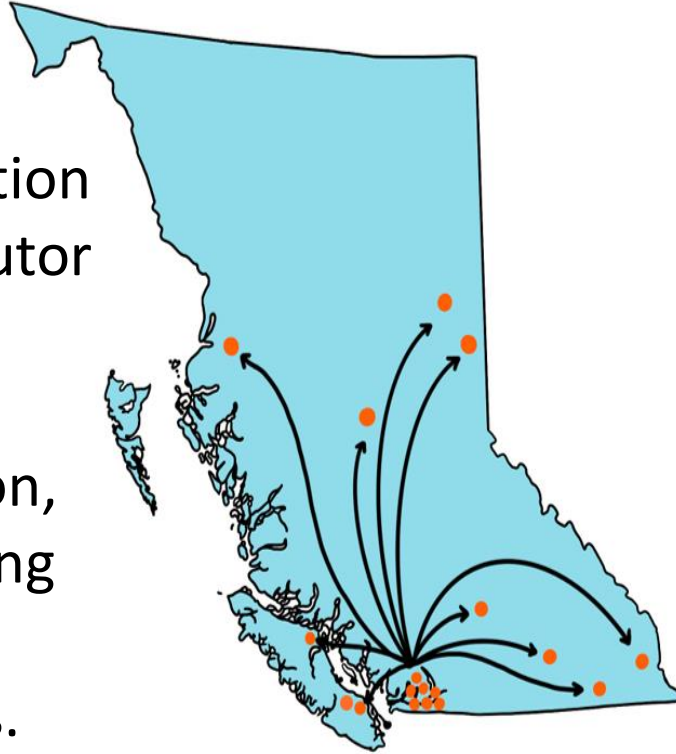


Energy Solutions



Guillevin

- Full-service solution provider/distributor
- 17 locations throughout BC
- Onsite installation, service & on-going support via LSM Energy Solutions.



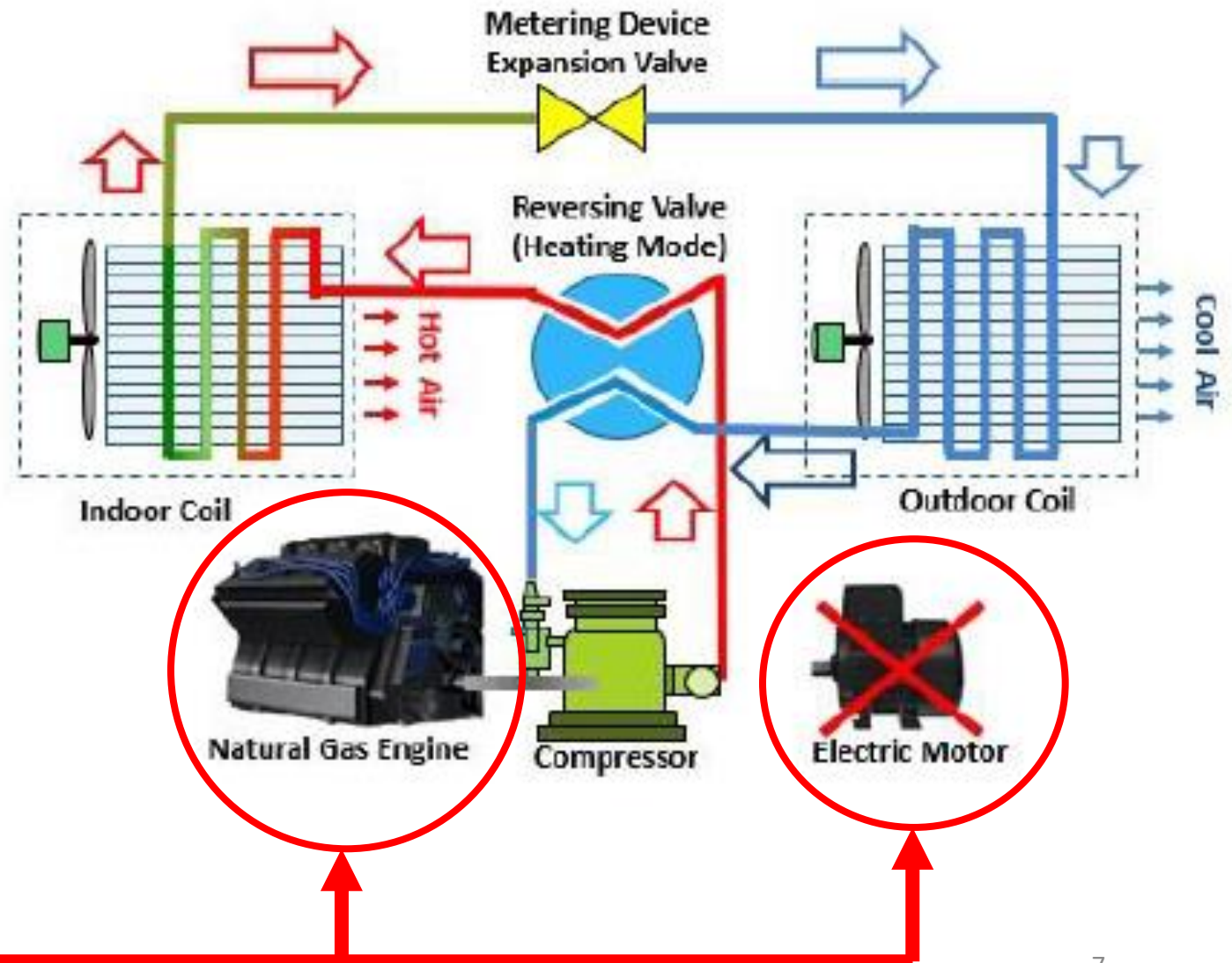


GAS-POWERED HEAT PUMPS

- Gas Powered Heat Pumps & Electric Heat Pumps
 - Introduction & Difference
- Questions & Answers

Electric Motor vs. Gas-Powered Motor

- Engine-drive gas heat pumps (GHP) use a reciprocating engine fueled by renewable or natural gas to drive the compressor versus electricity to drive the electric motor.
- Both use the compressions cycles and functionality for all heat pumps
- Only difference is how the unit is powered



GHP & EHP – Industry Standard Components

GHP & EHP– Uses Same Industry Standard Components

- Modular design - completely scalable for any building.
- For any nurse homes, senior care centre or extended health facility
- Uses same distribution system / piping / controls as all heat pumps.
 - Contractors – familiar with technology, installation, etc.



Gas Outdoor Unit

+



Indoor Fan Coils
& *Hydronic Baseboards,
Infloor, Fan Coils, etc.*

+



Standard Piping
*Refrigerant or
Hydronic Piping*

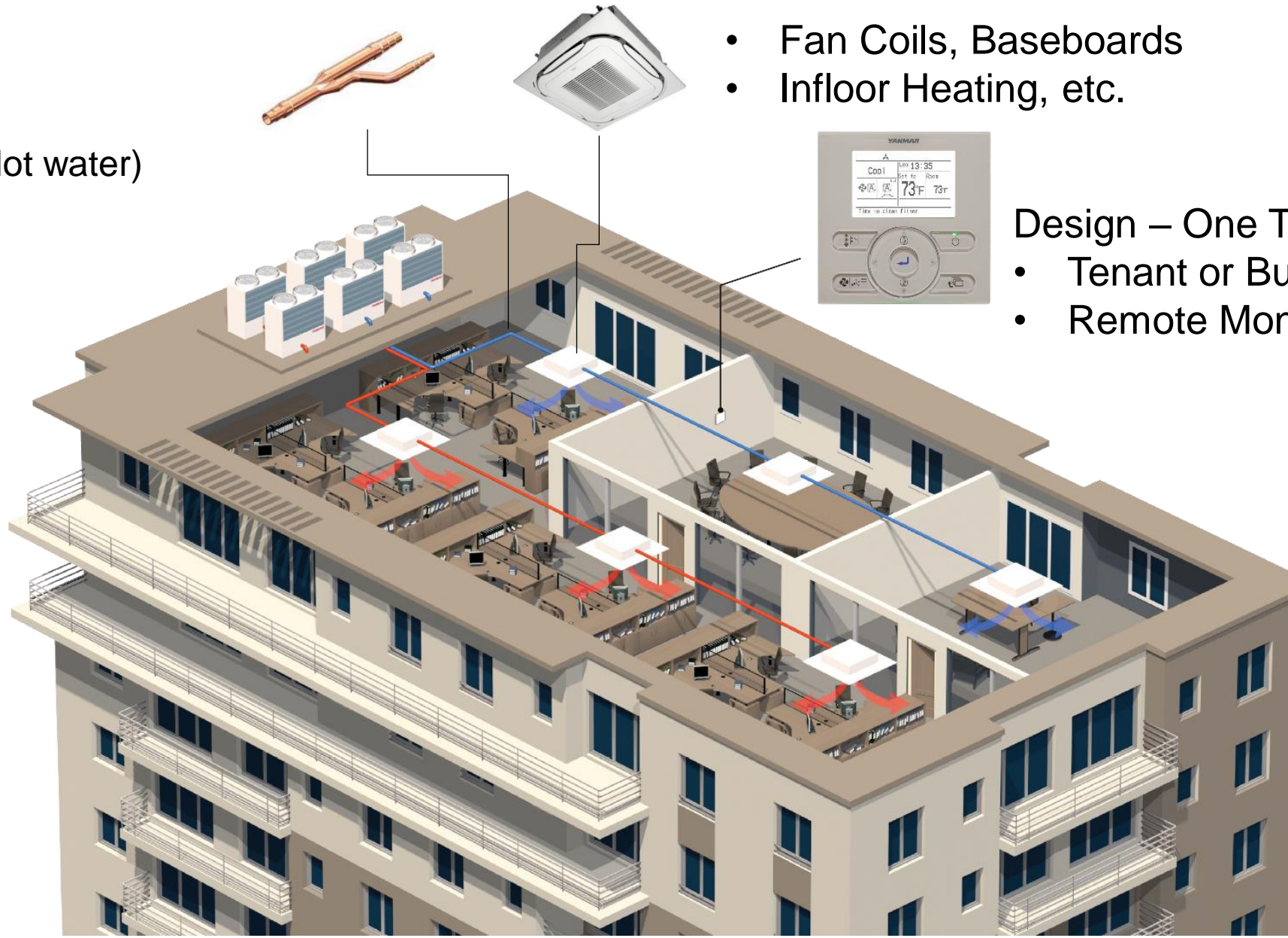
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Standard Building or Suite Controls

GHP & EHP – Standard Components – Same Install & Support

- Piping
 - Refrigerant
 - Hydronic (Hot water)



- Fan Coils, Baseboards
- Infloor Heating, etc.



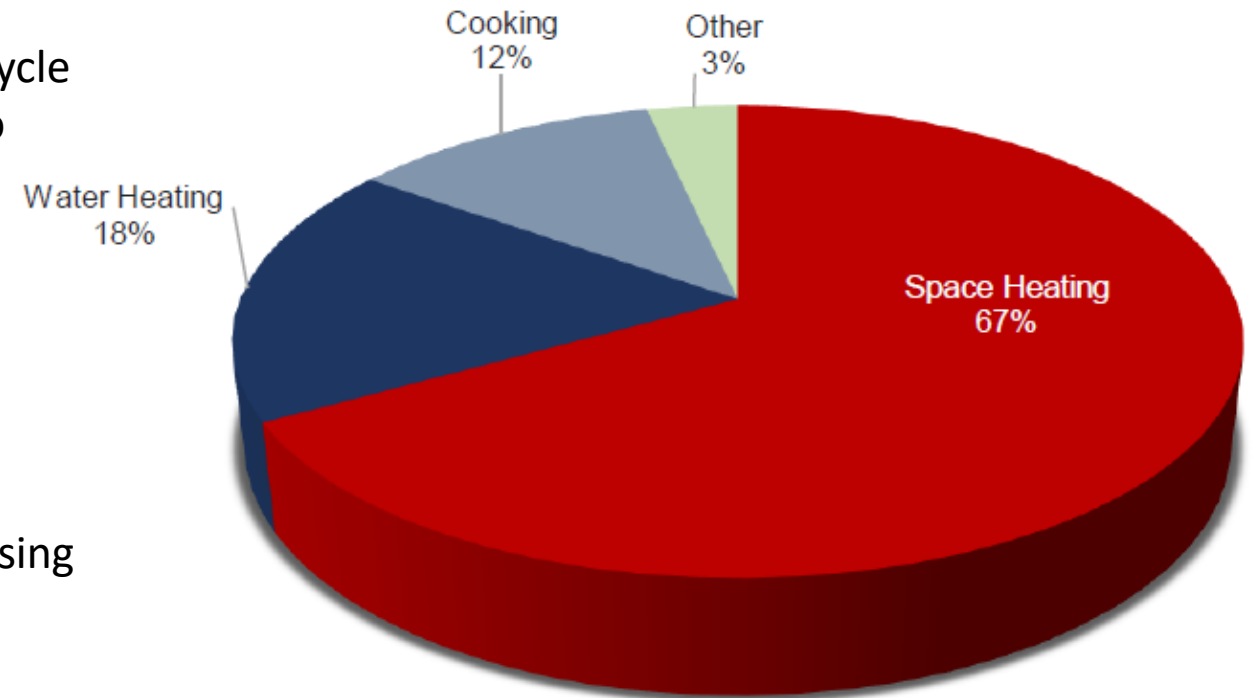
- Design – One Touch Solutions
- Tenant or Building Controls
 - Remote Monitoring

GHP – SIGNIFICANT BENEFITS OVER EHP

GHP Benefits vs EHP

- **Net-Zero Emissions** - When powered by renewable fuels such as renewable gas or hydrogen, carbon neutral targets can easily be achieved
- **Waste Heat Recovery Technology** - eliminates defrost cycle as heat from engine is used to supply continuous heat to the heat exchanger while maintaining space heating
 - Ideal in cold climates (-5C/-35C)
- **Energy Resiliency** – Over 80% of natural disasters cause power outages, renewable or natural gas solution help avoid this by continuous energy (low-cost storage)
 - **Occupancy stability**, security, health and safety
- **Reduce Operational Cost** – costs savings realized when using renewable or natural gas versus electrification
 - **Single Phase** – 90% less electricity than EHP
- **Avoid Peak Demand** - GHP's help avoid peak demand, peak demand billing or any penalties for high electric uses, etc.

Natural Gas Consumption for Total Commercial Market





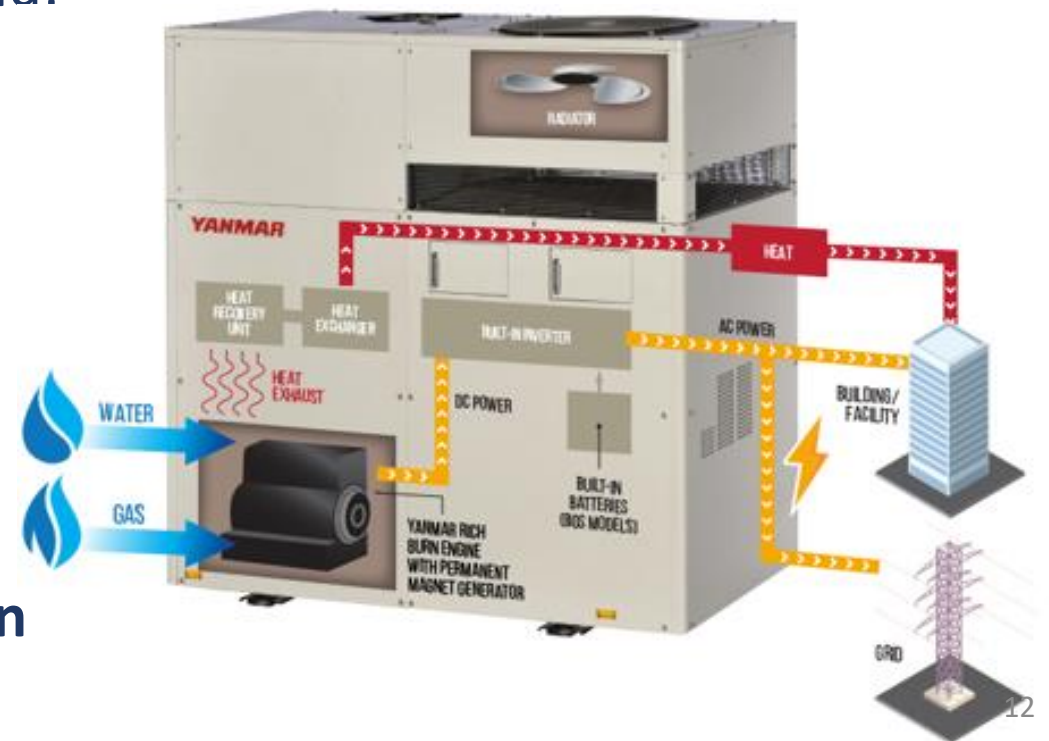
COMBINED HEAT & POWER

- CHP Introduction
- CHP Main Features
- CHP Installation/Case File
- Questions & Answers

YANMAR CHP - WHAT IS A CHP SYSTEM & WHY?

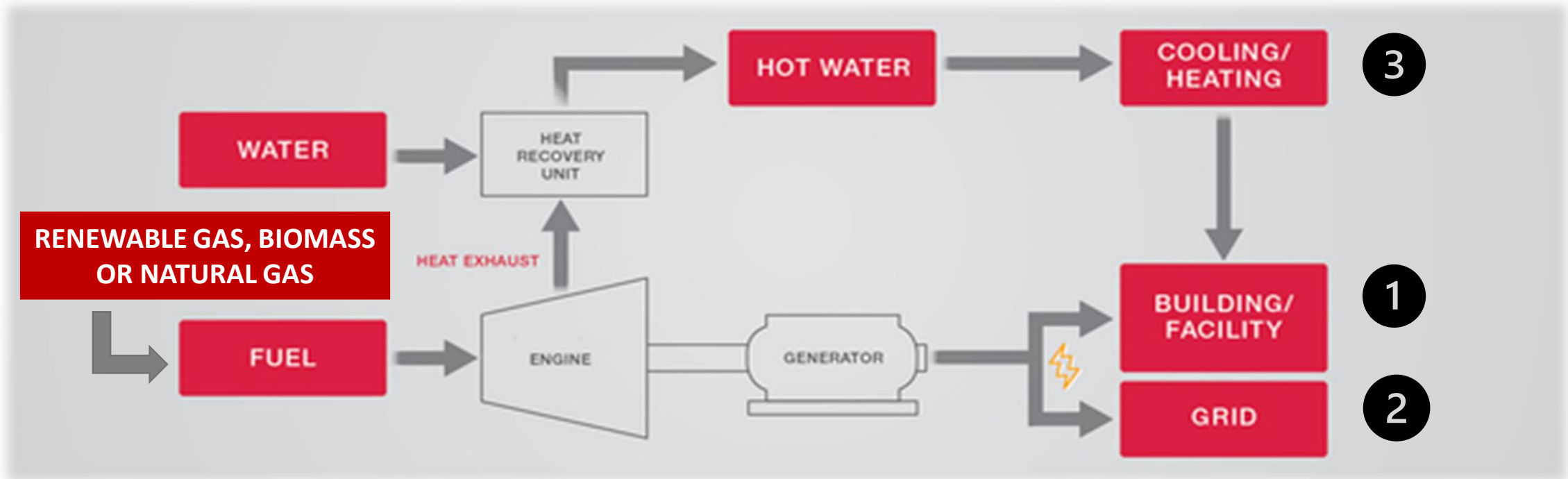
- CHP is an abbreviation for **Combined Heat and Power**.
- CHP is also known as “**Cogeneration or Cogen,**” which is the **production of both hot-water** (for space heating, DHW, etc.) **and electricity**.
- When thinking about heating and power for a variety of buildings/facilities, two important, but separate systems come to mind:
 - **one for hot water via boiler**
 - **one for electricity, from the grid**
- Yanmar’s Combined Heat and Power systems **combines these two independent functions into one complete system**

**On-site power and thermal energy generation
– next to the building**



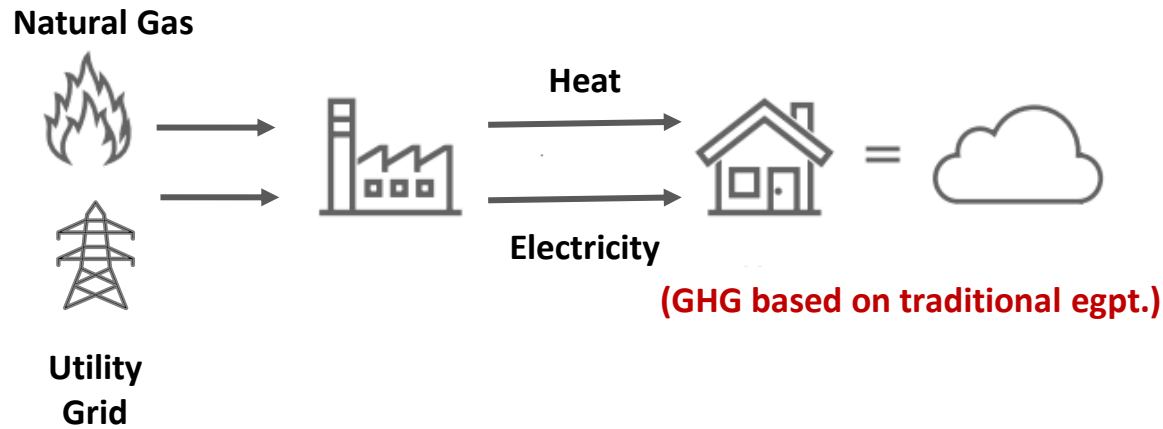
YANMAR CHP – HOW DOES IT WORK?

1. Powered by Natural Gas, Renewable Gas or Biomass
2. The CHP powers the motor which drives the generator producing electricity
3. Water is used to scrub the waste heat off the engine jacket and exhaust, producing hot water for heating
4. Hot water temperature output:
 - 80c/175f to 88c/190f.
5. Cooling can be done via the addition of an absorption chiller (CCHP) (hot water-fired chiller)
6. Designed to maximize efficiency, reduce emissions while lower operating costs

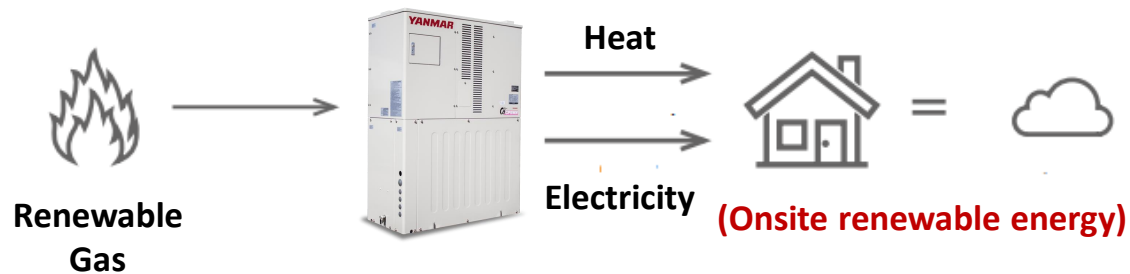


NET ZERO EMISSIONS – RENEWABLE ENERGY

TRADITIONAL UTILITIES - BOILER & GRID TIED

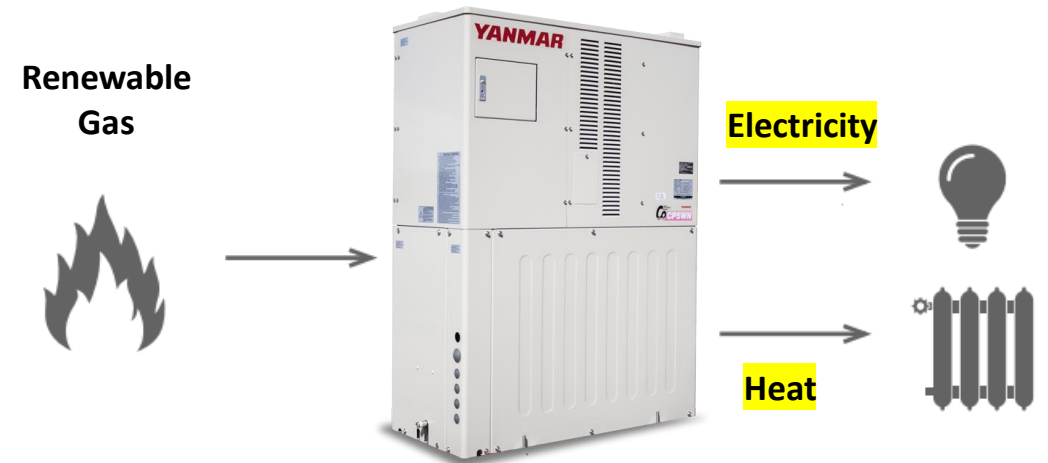


ONSITE POWER & HEATING GENERATION



GRID & BOILER – HYBRID BACKUP SUPPLY OPTION

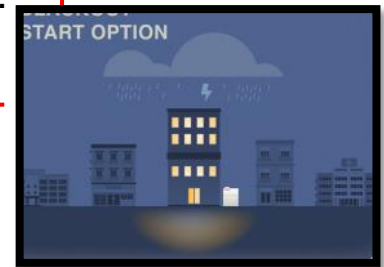
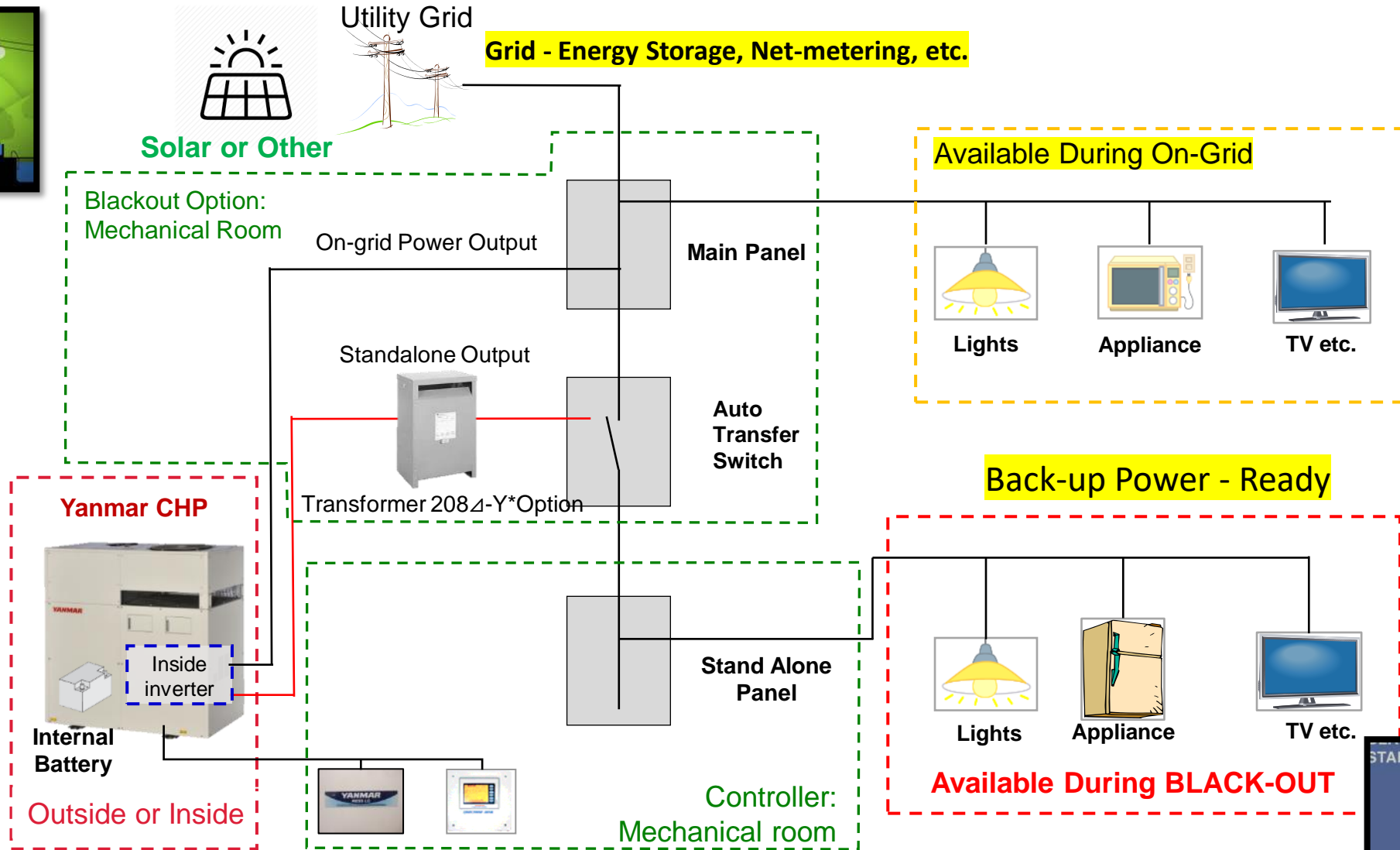
COMBINED HEAT & POWER



- Zero Emissions
- Energy Resiliency (Power & Heat)
 - Occupancy Stability
 - Emergency Readiness (Power & Heat)
- Low Operating Cost & Max. Efficiency
- Energy Storage

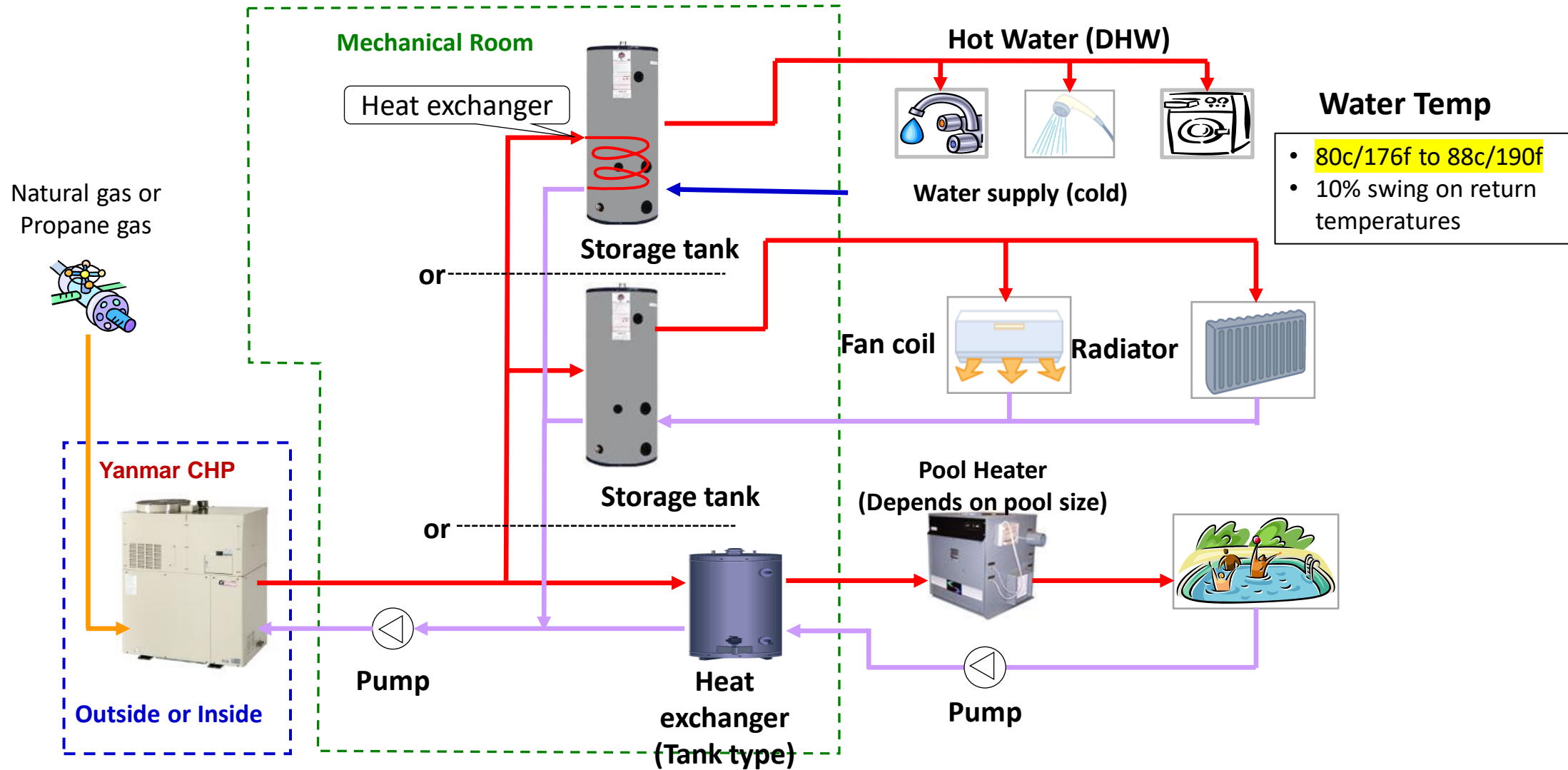
YANMAR CHP – EMERGENCY POWER READY - CONNECTION

Emergency Power
Readiness



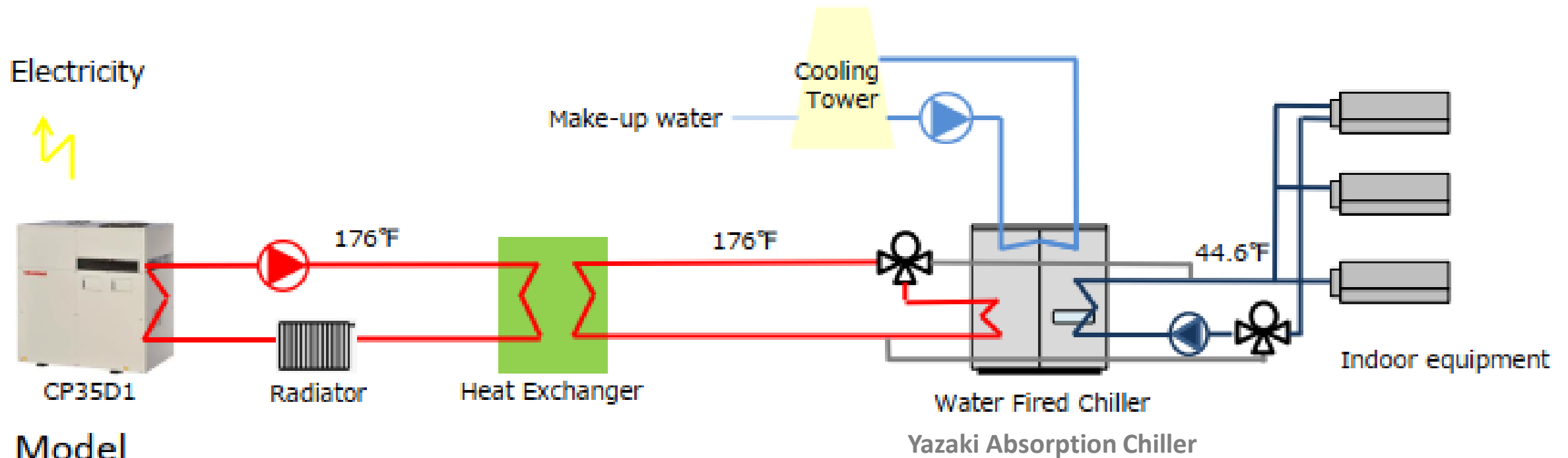
YANMAR CHP – SPACE HEATING/COOLING, DHW, POOLS, ETC.

Thermal Energy Generation



YANMAR CCHP – Combined Cooling, Heating & Power

Trigeneration - CCHP



Model

CHP	Fuel	Heat output	Heat medium Inlet/Outlet	Hot Water Flow rate
		MBtu	°F	GPM
CP35D1	Natural gas	204	176⇒167	45



CCHP - WATER-FIRED ABSORPTION CHILLERS

CCHP – COMBINED COOLING, HEATING & POWER GENERATION



5 kW CHP



10 kW CHP



35 kW CHP



25 kW BIOMAS CHP

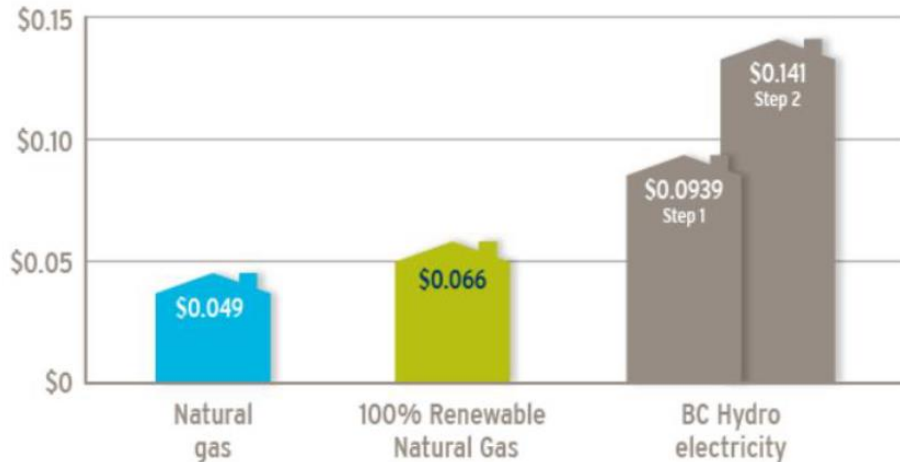
Yanmar Cogeneration Solutions micro-CHP / CCHP Descriptions	Fuel Source			Multi-Unit Connect
	Renewable or Natural Gas	Propane	Biomass	
5 kW micro - Cogeneration System	●	●		Yes
10 kW micro - Cogeneration System	●	●		Yes
35 kW micro - Cogeneration System	●			Yes
25 kW micro - Cogeneration System			●	Yes

YANMAR CHP – KEY BENEFITS

ENVIRONMENTALLY FRIENDLY – Net Zero

- Net-Zero – when powered by renewable fuel sources such as renewable gas or hydrogen, net-zero targets can easily be achieved

Residential gas \$/kWh price comparison



Based on rates as of January, 2022. Electricity rates exclude basic charges.

Emission Factors – Renewable Gas has a very low emission factor

Energy Source	Source of Values	Emission Factor Values
		kgCO _{2e} /GJ
Conventional Natural Gas	2020 BC Best Practices Methodology for Quantifying Greenhouse Gas Emissions	49.87
Renewable Gas	2020 BC Best Practices Methodology for Quantifying Greenhouse Gas Emissions	0.2932
BC Hydro Electricity	2020 BC Best Practices Methodology for Quantifying Greenhouse Gas Emissions	3.0*

REDUCED OPERATIONAL COSTS

- Save money - simultaneous production of both electricity and heat/cooling
- Designed to run 24/7, the more operating hours per year, the more you save

YANMAR CHP – EXTENDED BENEFITS



REDUCED PEAK DEMAND

- Avoid peak demand - Yanmar CHP energy system help avoid peak demand charges, by creating its own power on-site, and ample thermal energy for both heating and cooling – year-round, 24/7
- Significantly reducing operational costs and peak demand billing or rate spikes

ELECTRIC VEHICLE CHARGING & MORE

- Continues energy supply - The electrification of everything is placing a huge demand on our current infrastructure, CHP supplies both power and heating at the source.
- Allows for the accommodation of other electric appliances without the wait times or additional infrastructure costs



ENERGY RESILIENCY & INDEPENDENCE

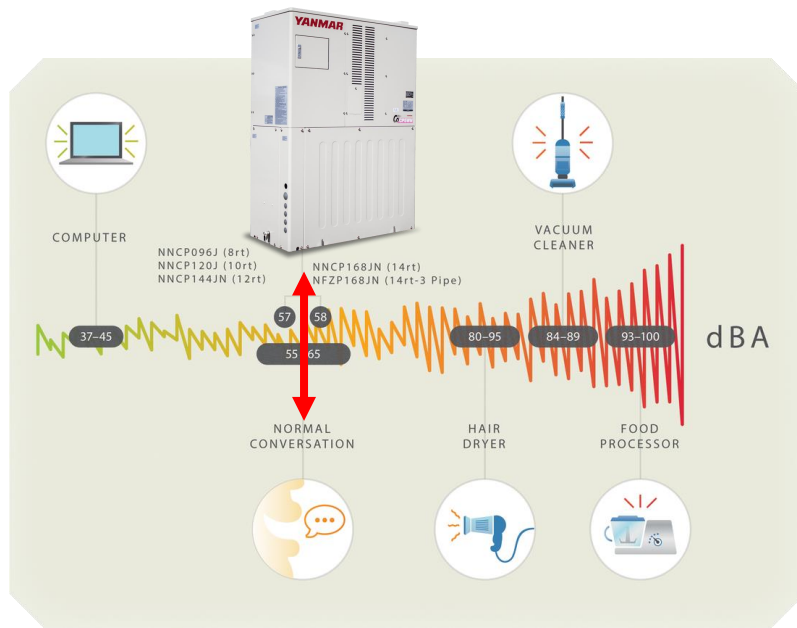
- Onsite energy generation at the point of service, next to the building – new construction or retrofits (hybrid)
- Occupancy stability, reliability, health & safety
- Emergency readiness with backup storage (power and hot water)
- Elimination of cost reduction of any stand-by generators, fuel storage or any going maintenance and necessary monthly test-runs



OPTIONAL - RENEWABLE ENERGY INTERGATION

- Seamless integrates with other renewables, such as solar and wind – providing a constant supply of both power and climate control (heating/cooling)

YANMAR CHP – ENVIROMENTIALLY FRIENDLY



WHISPER QUIET OPERATION - INSTALLTIONS

- Whisper quiet operation / At 3 feet, CHP maximum noise levels
 - 54dB(A) CP5WN
 - 56dB(A) CP10WN
 - 62dB(A) CP35D1
- Small footprint deign, easy of installation
 - Indoor installation
 - Outdoor installation

MULTI-UNIT CONNECTIVITY – SAVE MONEY & TIME

- No job too big or small
- Unlimited scalability, flexibility and installation options
- No down-time, during maintenance cycles or any system repairs
- One controller can control up to 16 units



YANMAR CHP – REMOTE MONITORING & WARRANTY

Best in Class Warranty & Options

- CP5WN/CP10WN: 2 Years/17,600 hours*
 - CP35D1(Z): 2 Years/15,000 hours*
- *Whichever comes first*



- 10 Years / 30k Hours*
- 10 Years / 60k Hours*
- 15 Years / 90k Hours*(**)

**Whichever comes first*

***Excludes CP35D1(Z) models*



Remote Monitoring

- Trouble free support, low-cost monitoring
- Know/solve the problem before it's an expensive problem
- Provides energy data reporting
- Alarm notification

Gensets & Yanmar micro-CHP Systems

There's a difference! – Size the CHP to Zero The Load - Not As Stand By Power



Traditional Generator

- Back-up power only
- Emergency ready only
- No Inverter
- Single Application
- Typically, loud, not neighbourhood friendly
- Not environmentally responsible (Diesel, oil, etc.)
- Mandatory scheduled maintenance required – run system, exhaust fuel, more GHG emissions, etc.
- Typical outside installation
- Short service cycles
- Short life span

Yanmar micro-CHP

- Designed to provide energy 24/7/365
- Greater ROI running at capacity
- Dual service, heating and power generation
- Waste heat recovery
- Excess power can be stored or shared with grid
- Ideal in all climates
- Emergency readiness (BOS)
- Inside or outside installation
- Environmentally friendly
- Low emissions & operating costs
- Solar & renewables connectivity



YANMAR CHP – ELECTICITY & HEATING SOLUTON



- Hospitals & Extended Care Facilities
- Nursing Homes & Senior Care Centre's



Application Solutions

- Power/Electricity Resiliency
- Climate Control
 - Heating
 - Cooling
- Domestic Hot water
- Other



Energy Assessments Assistances

Thank You

COMBINED HEAT & POWER

Life Care Center

Email: Jeff Hoogveld

Email: Paul Binotto

**CASE FILES
EXAMPLE**

Video - Yanmar Combined Heat & Power

The image shows three large, white, rectangular Yanmar Combined Heat & Power (CHP) units. They are arranged in a row outdoors, with the ground covered in light-colored gravel. The units have 'YANMAR' printed in red on their upper sections. The unit on the right has '6 CPSWH' printed on its side. The units are connected to various pipes and conduits. The background shows a building with blue vertical pipes and some greenery.

COMBINED HEAT & POWER

APPENDIX

YANMAR micro COGENERATION



SOCIAL FAMILY HOUSING
GRAND PRAIRIE, ALBERTA, CANADA



"Installing two Yanmar 35kW Cogeneration Systems has substantially reduced our operational costs year-round for all of us to enjoy, while giving our tenants energy security. Onsite power and thermal energy generation not only helps us avoid peak billing demand charges during extreme weather conditions, it also eliminates blackouts due to weather or utility malfunctions, including emergencies. Adding increased residential comfort and safety, that is also shared with our commercial tenants."



PROJECT OVERVIEW

The CARIN apartment building has 82 rental apartments ranging from 300 to 1300 sq. ft. The building is 6 floors with 66,000 sq. ft., with the bottom floor as commercial retail space. LSM Energy Solutions installed (2x) 35 kW

Yanmar (cogeneration) CHP units in May of 2020 and the units have run for 7500 hrs. without any trouble. The first oil and filter change was completed in March of 2021.

REASON FOR CHOOSING YANMAR

The Yanmar CHPs have been able to eliminate electrical usage for the building, with an additional 24,000 KWh being sold to the grid for a credit of approximately \$1,350 per month. In previous years, the electricity bill was approximately \$5,500 per month.

The two 35kW CHP units consume 720,000 BTUs. The CHPs inject into the existing boiler loop and run constantly. A bar and plate heat exchanger in the boiler loop feeds two domestic hot water storage tanks combined with a building thermostatic mixing valve for

anti-scald safety. Approximately 50% of the heat from the CHPs are used for domestic hot water production. In addition to the electrical savings, the lifespan of the existing boilers will be lengthened.

The building's heat is hydronic-based, with two 750,000 boilers. Constant heat output of the CHP allows it to satisfy the heat demand of the space heating for the 66,000 sq. ft. building, as well as 5500 cfm of outdoor air from the hallway pressurization unit and all the domestic hot water production.

ABOUT YANMAR AMERICA ENERGY SYSTEMS

Yanmar America Energy Systems is the North, Central and South American headquarters for the company's Variable Refrigerant Flow and Combined Heat and Power systems. Yanmar Energy Systems Canada is located in

Hamilton, Ontario, and supports variable refrigerant flow and combined heat and power systems sales and service for Canadian customers. Our team and products are focused on sustainability, reliability, and efficiency.



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SOCIAL FAMILY HOUSING
GRAND PRAIRIE, ALBERTA, CANADA



QUICK FACTS

APPLICATION: Social Housing
Residential & Commercial

LOCATION: Grand Prairie, AB

COMMISSIONING DATE: May 2020

PRODUCT INSTALLED: 35kW CHP Systems x 2

OVERVIEW

Annual savings of more than \$65,000.00
Electrical loads eliminated with a surplus
Utility net-metering credit of \$16,200
Increased comfort, lower costs, and reduced building emissions
Average monthly use of 25,500kWh
Average monthly operation of 720 hours during the first year

RESULTS

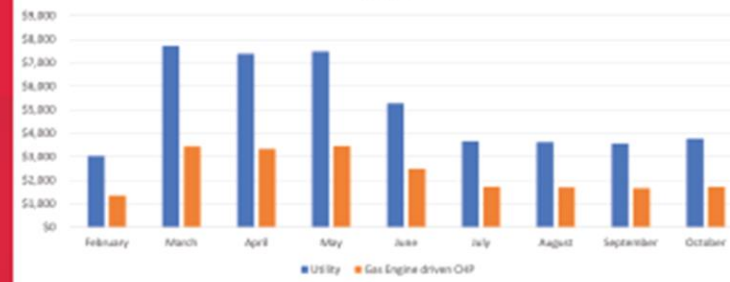
The two, whisper-quiet units provided can provide 100% of the 66,000 square foot Carin Building's total electricity while being credited for any excess by the local utility, as well as supplies most of the domestic hot water and heating for the hydronic heating system.

In shoulder seasons, the waste heat from the CHP's only having to cycle 1 - boiler 20% when the temperature

drops below -20C and 50% at -40C. This will lengthen the lifespan of the existing boilers in addition to the electrical savings.

Environmentally, green house gas emissions dropped substantially, an estimated 30%. Simply by upgrading a very common mechanical room with the Yanmar CHP systems.

YANMAR CHP Operating Costs from February to October
2021



Operating costs data is a calculated estimate based only on remote monitoring data and local average utility costs or bills.

Net metering based on \$0.0575/kWh Alberta regulated rate | Electrical savings based on \$0.12.5 kWh including transmission and electricity costs.

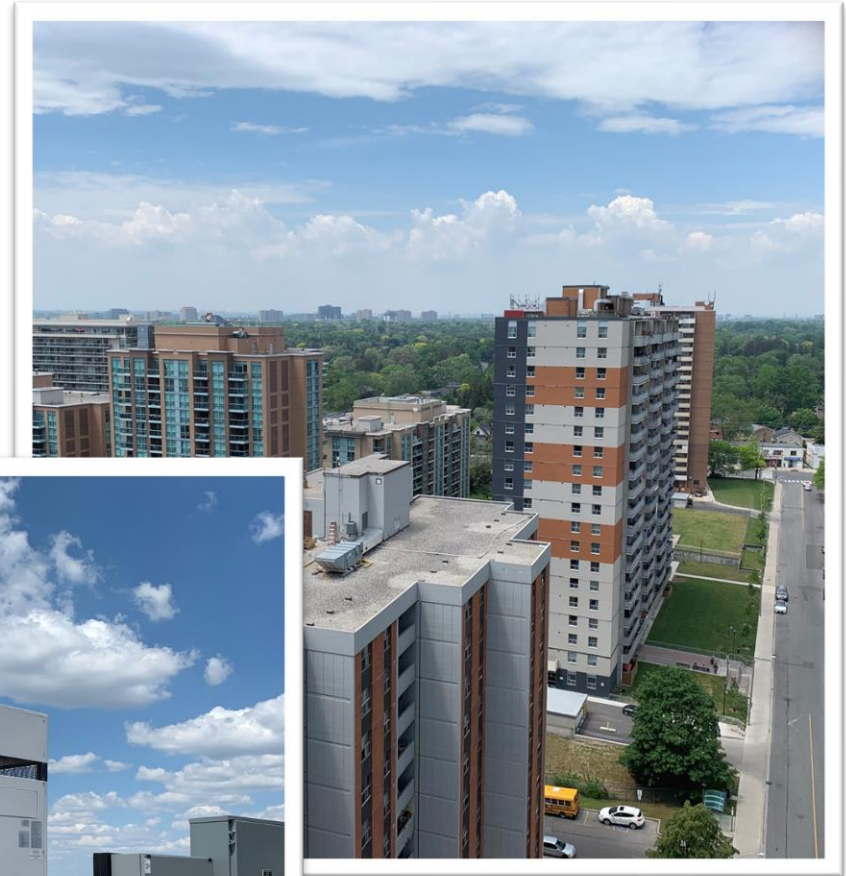


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YANMAR

TORONTO HOUSING AUTHORITY



54 CHP Units
Occupancy Sustainability

YANMAR
35kW CHP



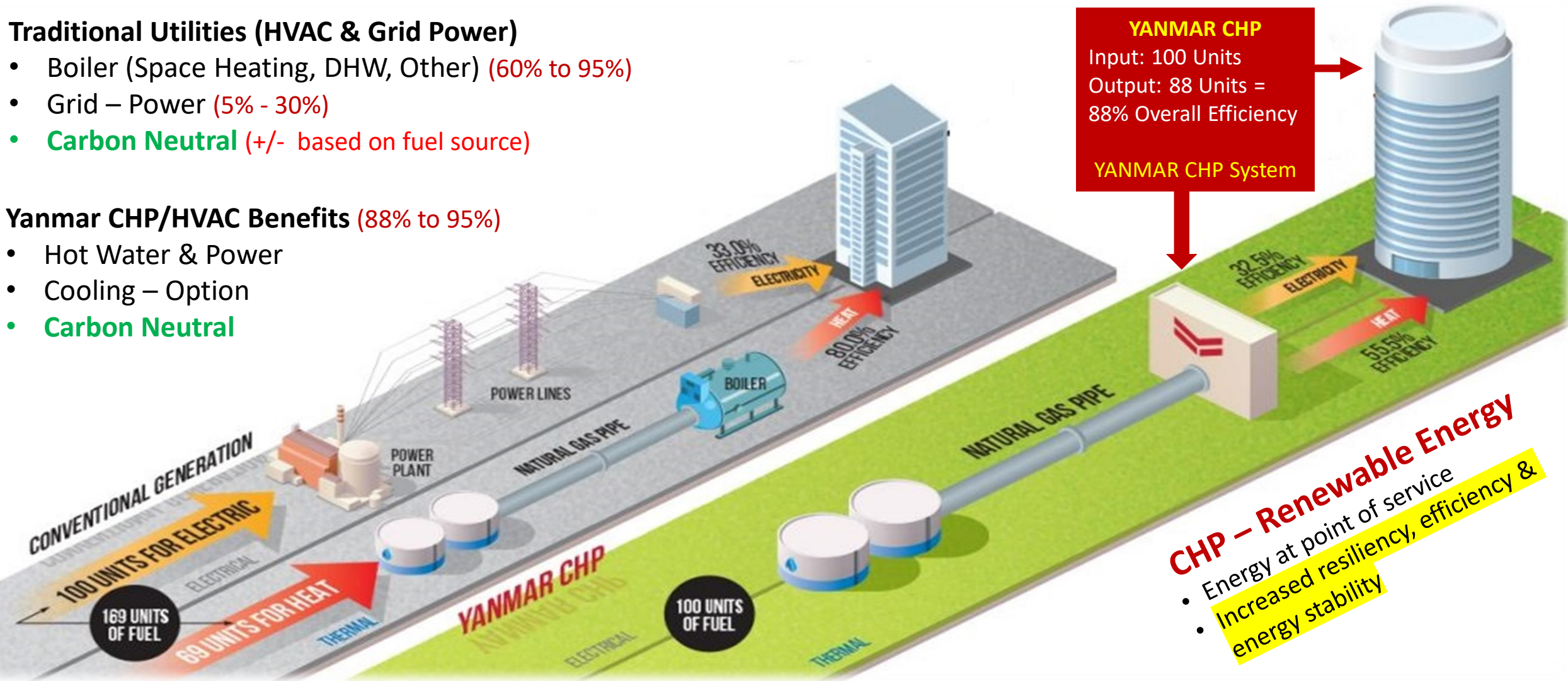
REDUCED EMISSIONS - REDUCING ENERGY COSTS

Traditional Utilities (HVAC & Grid Power)

- Boiler (Space Heating, DHW, Other) (60% to 95%)
- Grid – Power (5% - 30%)
- **Carbon Neutral** (+/- based on fuel source)

Yanmar CHP/HVAC Benefits (88% to 95%)

- Hot Water & Power
- Cooling – Option
- **Carbon Neutral**



As compared to conventional heating and electricity from the grid, a CHP solution is more energy efficient simply because it's producing energy, right at the point of service, reducing emissions and increasing resiliency.



Building Cooling Strategies Incentive Funding Opportunities

August 10th, 2022

Kenneth McNamee

P. Eng., MSc., CEM, CMVP Principal

E: kmcnamee@impacteng.ca

Aspirational Ideas,
Practical Implementation



1. Building Cooling Requirements & Overheating
2. Options Analysis + Funding Opportunities



Ben Mills
P. Eng., CEM, CPHD
Founding Principal



Kenneth McNamee
P. Eng., MSc., CEM, CMVP
Principal



Jason Le
P. Eng., CEM
Senior Mechanical Engineer



Steve Fetterly
P. Eng., CPHD
Lead Energy Engineer



Ruffy Ruan
P. Eng., CPHD
Passive House Design Lead



Patrick Fyfe
P. Eng., CPHD
Mechanical Engineer



Natasha Samson
P. Eng., LEED AP
Sustainability Specialist



Nathan Trang
Dipl. Mech Eng., CPHD
Mechanical Technologist



Healthcare
CSA Z317.2



Multi-Unit Residential Buildings
No Cooling Requirement by Code



All Time Records Again!

	New	Old
Lytton (Canadian Record)	47.9°	46.6° 2021
Kamloops	45.8°	44.0° 2021
Abbotsford	42.9°	41.5° 2021
Kelowna	42.9°	41.5° 2021
Victoria A.	39.4°	37.7° 2021

Design Temperature (July 2.5%) - BC Building Code
35 °C (Lytton)
34 °C (Kamloops)
29 °C (Abbotsford)
33 °C (Kelowna)
24 °C (Victoria)

The current CoV guidelines for Passive Cooling state that the interior dry bulb temperature of occupied spaces **cannot exceed specified acceptability limits (80%) for more than 200 hours per year, and 20 hours for vulnerable populations**. The acceptability limits for Vancouver are outlined below and are based on a methodology defined in ASHRAE Standard 55.

Table 4 Acceptability Limits for Naturally Conditioned Spaces in Vancouver ¹	
Month	80% Acceptability Limit
April	N/A (Mean temperature too low)
May	25.2 °C
June	26.1 °C
July	26.9 °C
August	26.9 °C
September	25.2 °C
October	N/A (Mean temperature too low)

Notes:
¹ Acceptability limits for other locations must be derived from the weather file for that location.



- *Require cooling for new multi-family buildings beginning in 2025*

Options Analysis + Funding

**Perform Study +
Evaluate Options**

**Overheating
Analysis (Optional)**

**Select Heat Pump +
Incentives**

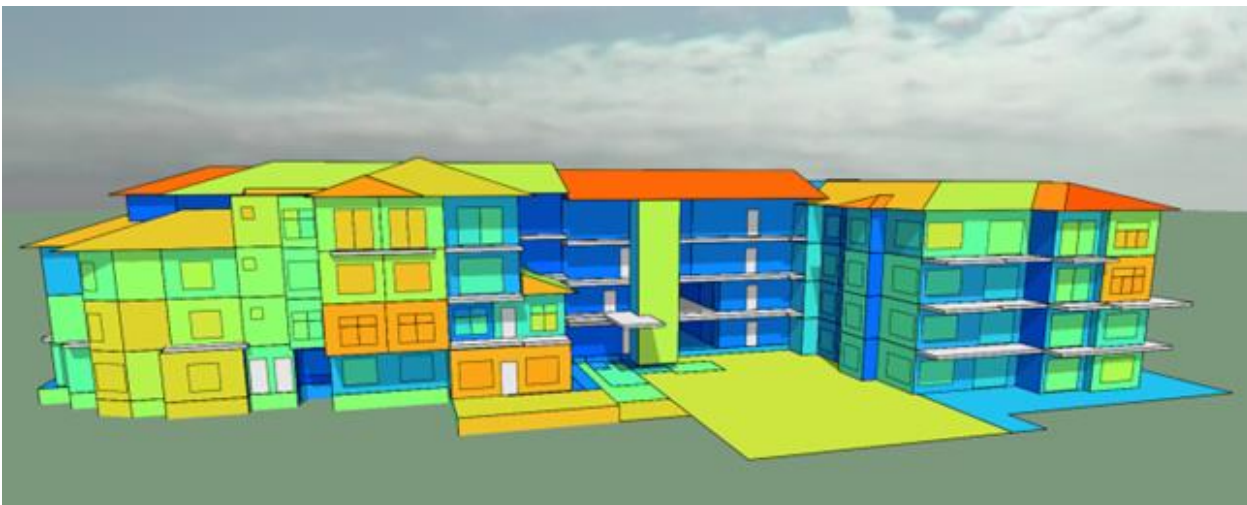


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Notes:
¹ Acceptability limits for other locations must be derived from the weather file for that location.

- Assess Passive Cooling Strategies
- Right-size cooling system



- Energy Study
 - Up to 75% of Energy Study Costs
 - 25% (implementation bonus)
- Capital incentives (\$3/GJ saved / measure life)
- Focus on natural gas efficiency measures



- Energy Study Incentives
 - 50% up to maximum \$20,000
- Capital incentives
 - \$40/tCO₂e of lifetime GHG savings
 - \$60/tCO₂e of lifetime GHG saving for heat pump rooftop units
- Focus on electrification projects



In-suite Heat Pump



Split DX System



PTACs

Benefits

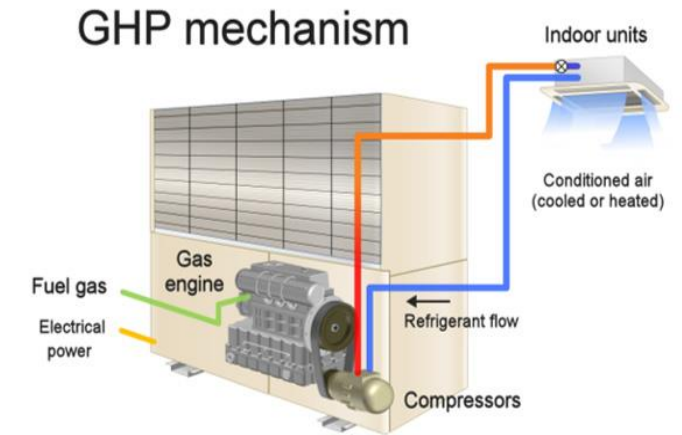
- Minimal disruption to building tenants during installation
- Individual suite temperature control
- Heat pumps provide high efficiency heating and cooling (reduced GHG emissions)
- Costs from \$10,000 - \$15,000 per suite



Heat Pump RTU



Heat recovery Chiller
(larger facilities)



VRF (Gas / Electric)

Benefits

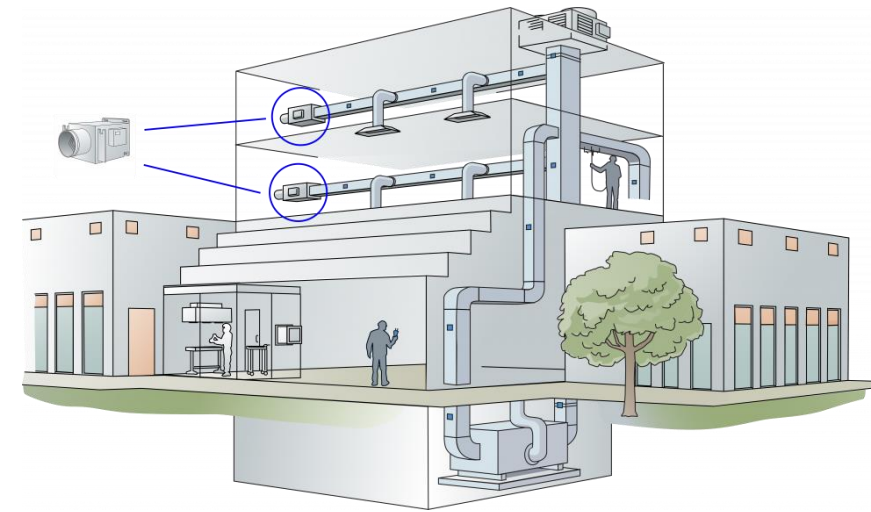
- Heat Pump Rooftop Unit is one of the most effective cooling retrofits
 - Typically no allowance for individual suite temperature control
- Heat recovery chillers are an option for larger more complex facilities
- Central VRF solutions allow for individual suite control
 - Refrigerant piping to be run through building to terminal units
- Energy study can provide more accurate assessment of costs



Structural Capacity



Electrical Capacity



Existing Systems

Questions

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