



# Micro Combined Heat and Power Systems (microCHP)

Micro-CHP Product Introduction

**Guillevin International – Victoria Renewable Energy Div.**

# MICRO Combined Heat & Power Solutions



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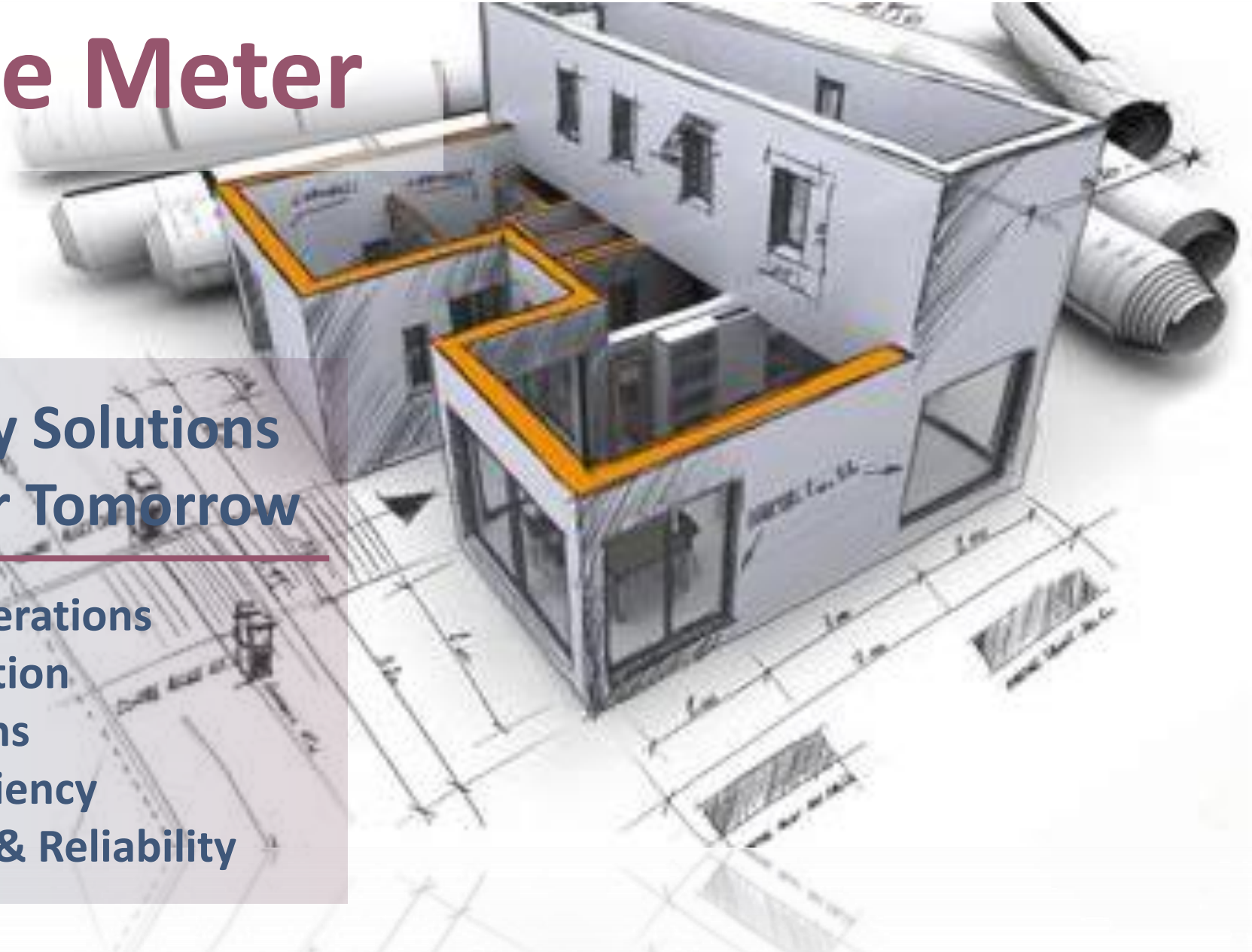
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- Waste Heat Recovery Technology  
Integration
- Building Automation & System Controls

# Energy Generation Behind The Meter

## Renewable Energy Solutions Today, For A Better Tomorrow

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- Net Zero Building Operations
- Lower Fuel Consumption
- Reduce GHG Emissions
- Increase Energy Resiliency
- Proven Performance & Reliability



# Building Energy & The Move To Decarbonization

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- Electrification Solutions
- Heat Pump Solutions
- Renewable Gas Solutions
- Mixed Renewables



# UNDERSTAND THE BUILDINGS ENERGY EQUATION

Climate Control  
**HEATING**  
**COOLING**

**MIXED**  
**RENEWABLES**

Electricity Demand  
**GRID or ONSITE**  
**POWER**

- Lower your energy consumption while optimizing efficiency
- Reduce GHG emissions
- Reduce operational costs
- Increase energy resiliency while avoiding peak demand – climate change
- Allocate more power for EV charging, electric heat pumps, etc.

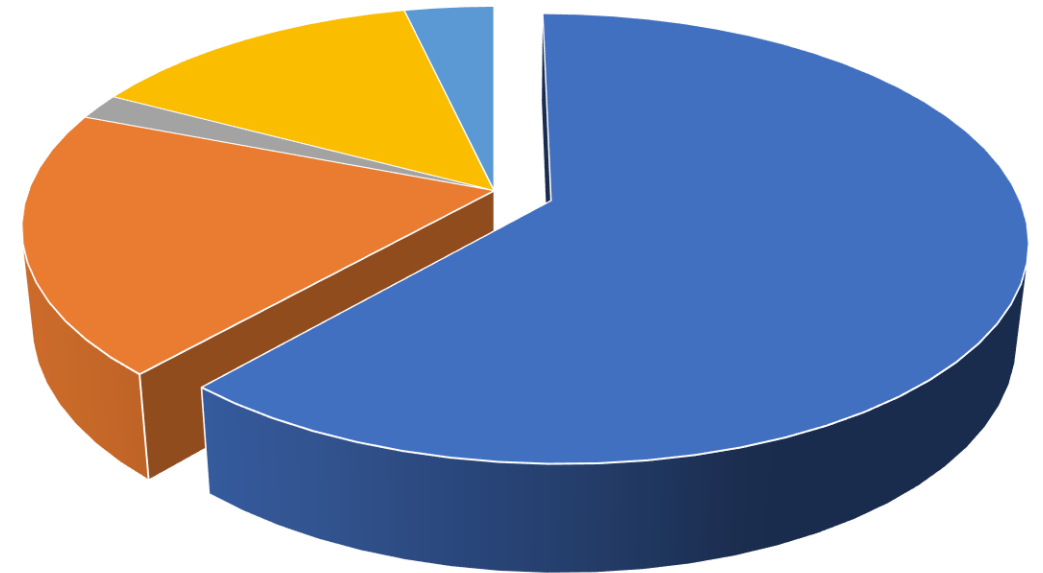


# Natural Resources Canada

Canada's cold climate demonstrates that **space heating & DHW** accounts for a remarkable **60% to 70% of the energy used** in the average **Canadian home**. To help meet Canada's GHG emissions goals, we should look to heating and now, power generation solutions!

- In our **colder northern climates** – this **number is greater** as the winters are colder, longer, etc.
- When we look at **energy resiliency / occupancy sustainability** for climate control or power what is the best solution or combination of mixed renewables?
- When we talk about climate change - **energy availability** is as important as **energy readiness** and **energy flexibility**
- Which could mean switching from electrification to gasification solutions

## ENERGY CONSUMPTION



■ SPACE HEATING ■ WATER HEATING ■ SPACE COOLING  
■ APPLIANCES ■ LIGHTING

# micro-CHP Solutions

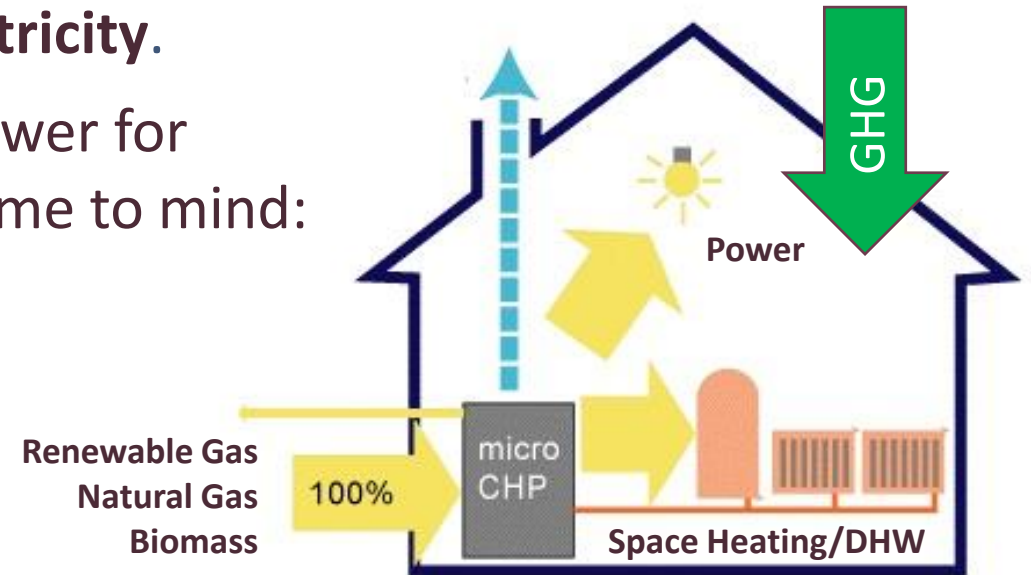
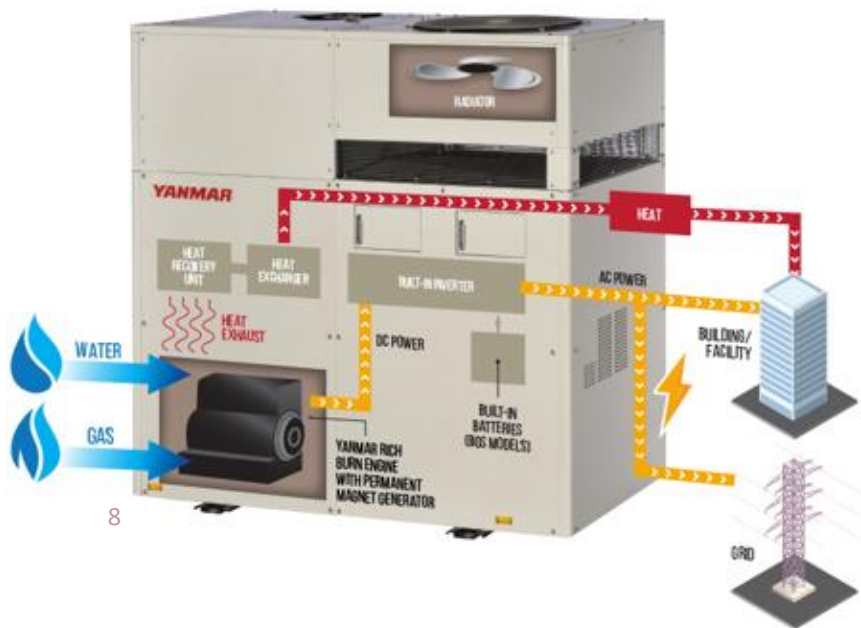
**Different Types**  
**Different Applications**

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# WHAT IS A COMBINED HEAT & POWER (CHP) SYSTEM & WHY?

- CHP is also known as “**Cogeneration or Cogen,**” which is the **production of both hot-water** (for space heating, DHW, etc.) **and electricity.**
- **Traditionally,** when thinking about heating and power for buildings, two important, but separate systems come to mind:
  - **one for hot water, via a boiler**
  - **one for electricity, from the grid**

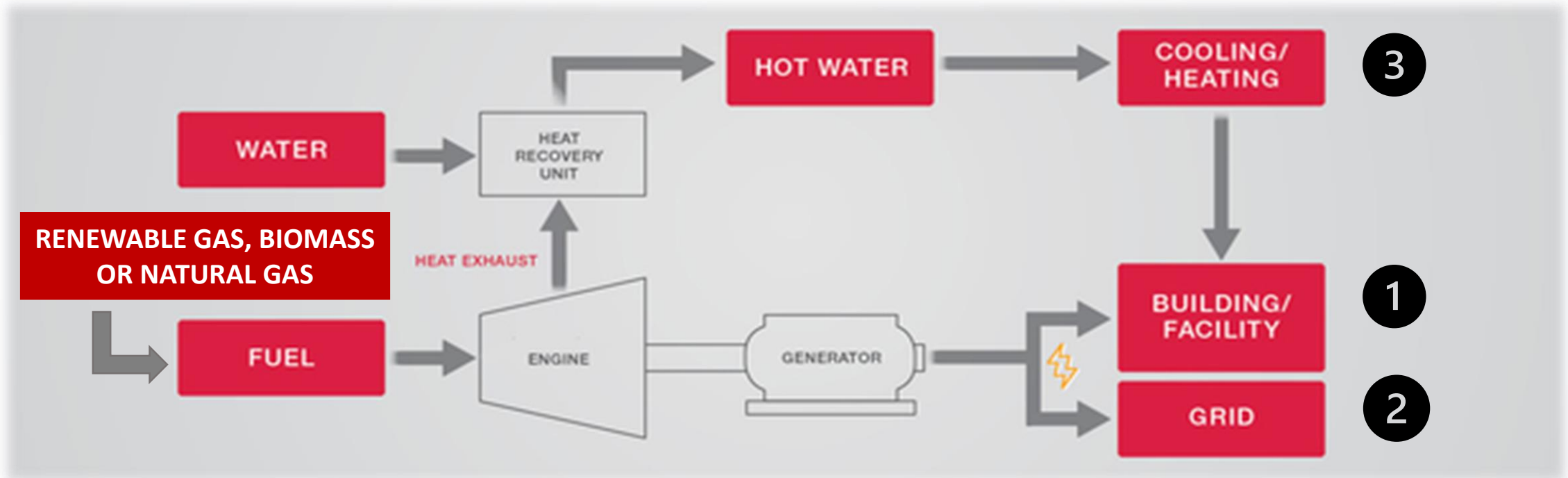


- CHP Systems **combine these two independent functions into one complete system**
- **Whisper quiet** operation, inside or out
- **On-site power, heating and DHW generation, at your facility, reduce energy consumption and emissions**



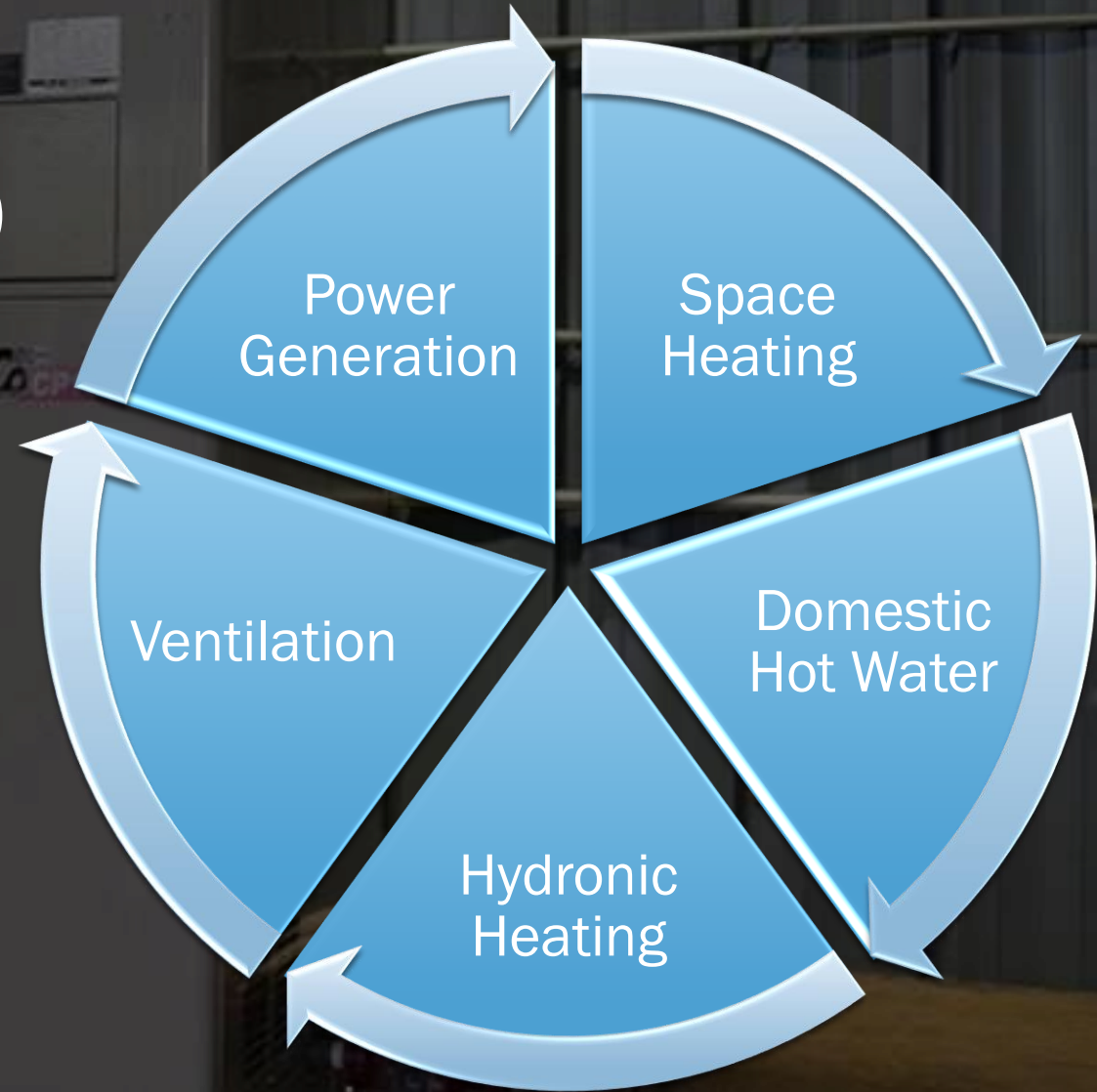
# HOW DOES IT WORK?

1. Powered by Natural Gas, Renewable Gas, Hydrogen & 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)



# Why

## Combined Heat & Power (CHP)



# Decarbonizing Building Operations



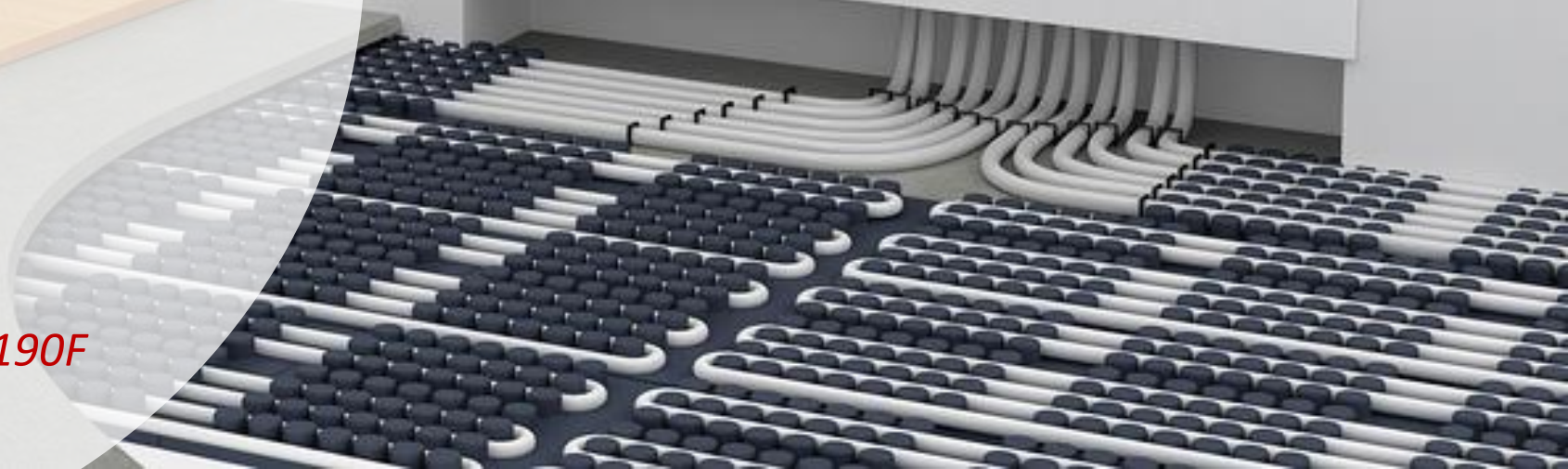
# EASY INSTALLATIONS

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- Installs like any boiler for heating
  - Indoor or outdoor
- Standard hydronic & piping installation
- Multiple zoning & heating applications
- Distribution & emitter flexibility
- Limited-service intervals
- Modular & scalable

# Standard Hydronic Distribution Heating Emitters

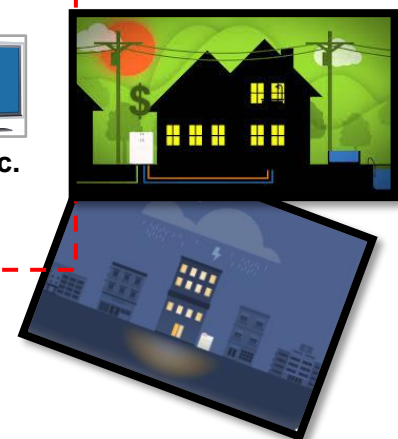
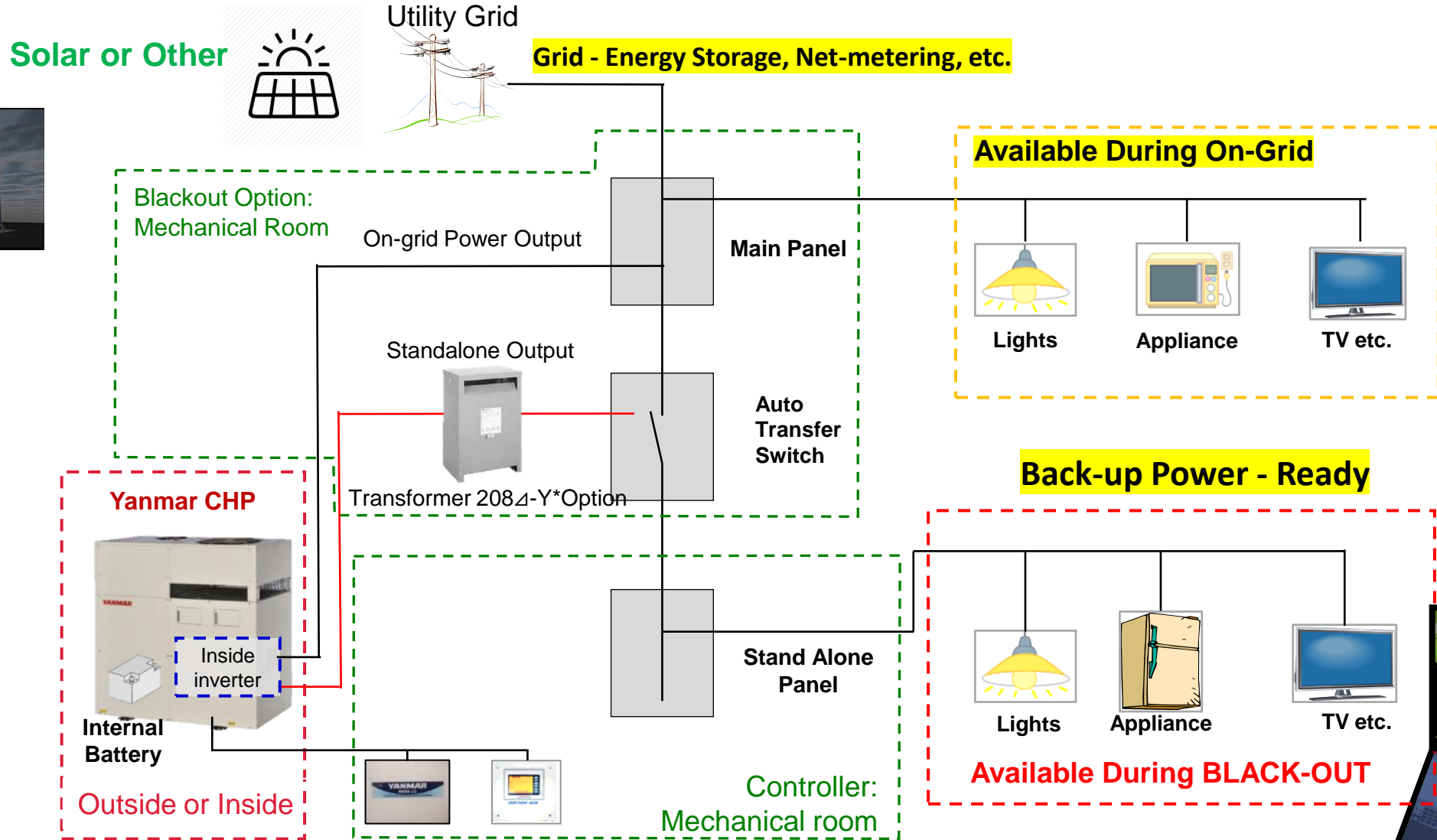
- Hydronic Baseboards
- Fan Coils
- Air Handlers
- High Velocity Systems
- Ceiling Cassettes
- High Wall Units
- Radiant Floors & Panels
- *Maximum Temp. Output 190F*  
(equal to or lower)



# CHP – POWER (24/7), EMERGENCY POWER READY & ENERGY STORAGE

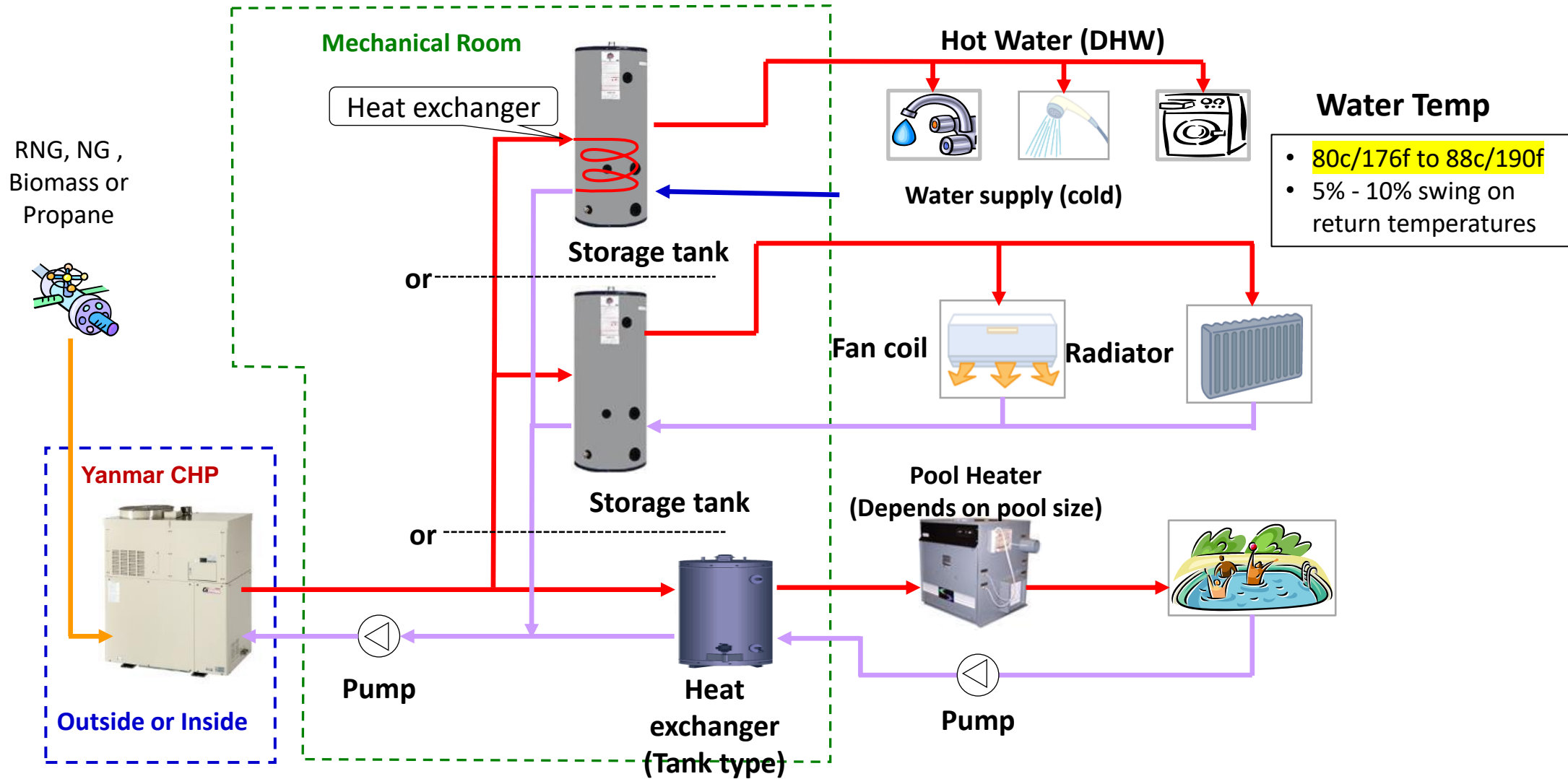


## Emergency Power Readiness



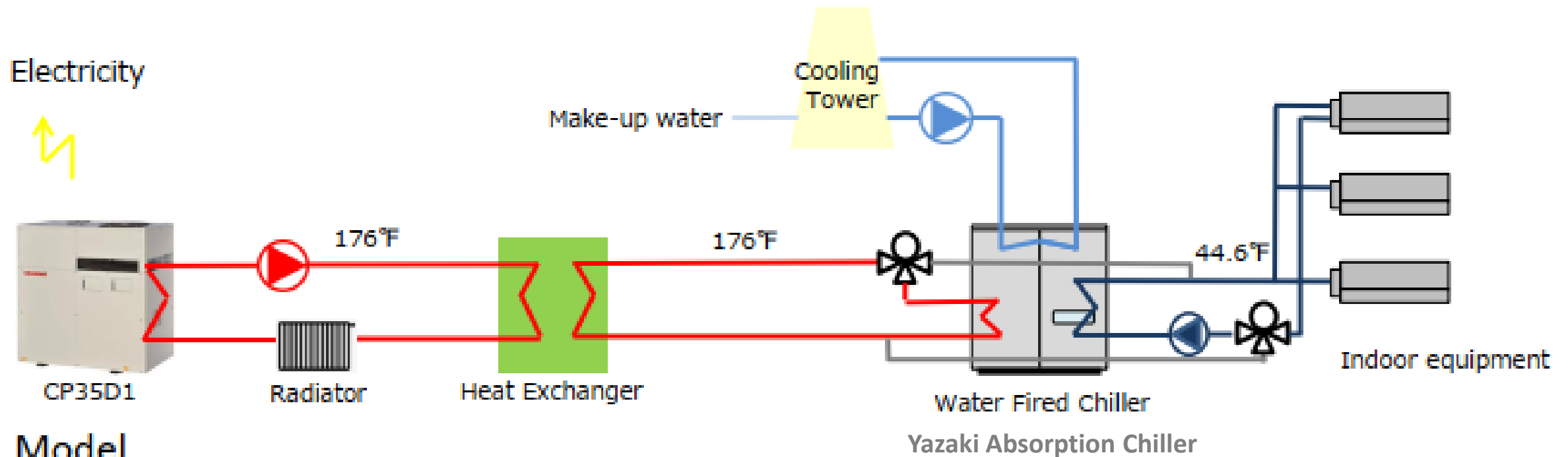
# SPACE HEATING/COOLING, DHW, POOLS, ETC.

## Thermal Energy Generation



# TriGeneration – Combined Cooling, Heating & Power

## TriGeneration - CCHP



### Model

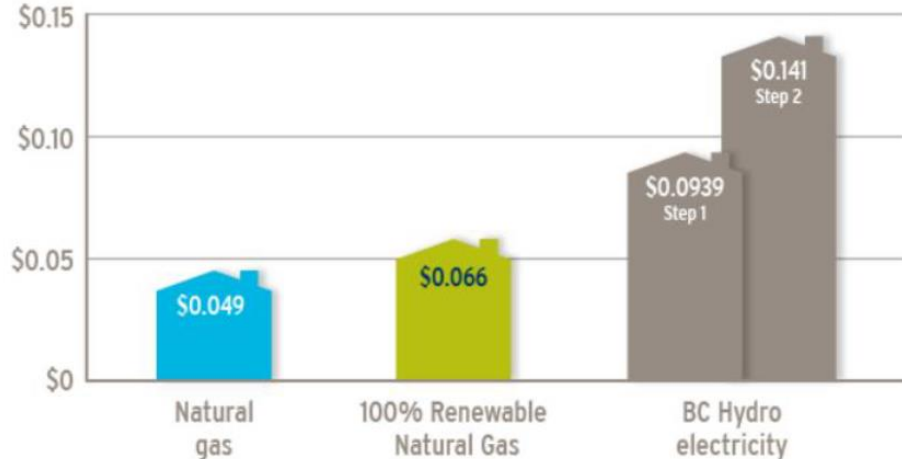
CHP	Fuel	Heat output	Heat medium Inlet/Outlet	Hot Water Flow rate
		MBtu	°F	GPM
CP35D1	Natural gas	204	176⇒167	45

# KEY BENEFITS – EMISSIONS & COSTS

## ENVIRONMENTALLY FRIENDLY – Net Zero

- **Net-Zero** – Carbon neutral when powered by renewable gas, biomass, or hydrogen
  - **BC Gov't Published Report**

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 <sub>2e</sub> /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 & heating**
- **Renewable gas is still much less than electricity**
- Designed to run 24/7, the more operating hours, the more you save
  - Equal to boiler operation



# ELECTRICITY & GAS BENEFICIAL REALIZATION



## AVOID PEAK DEMAND & OCCUPANCY STABILITY

- **Maintaining occupancy health, safety & security**
  - New climate changing environment
- **A/C loads growing rapidly** – avoid shortage and peak usage as well as regulations that penalize high-energy use

## ELECTRIC VEHICLE CHARGING, EHP & MORE

- Continues energy supply - **The electrification of everything is placing a huge demand on our current infrastructure**
- CHP – independent, onsite power generation (24/7)
  - **Immediate, without the wait times or additional infrastructure costs**



# ONSITE ENERGY & EMERGENCY READINESS

## ENERGY RESILIENCY & INDEPENDENCE

- **Emergency readiness with backup storage (power & heating)**
  - **Eliminates the costs associated for stand-by generators, fuel costs, fuel storage risks and on-going maintenance as well as necessary routine testing, including related emissions**



## RENEWABLE ENERGY INTERGATION

- **Seamless integrates** with other renewables, such as solar and wind
  - **Backbone to power & heat generation**

# ENVIROMENTALLY FRIENDLY



## WHISPER QUIET OPERATION - INSTALLTIONS

- **Whisper quiet operation** / at 3 feet, CHP maximum noise levels
  - 54dB(A) to 60dB(A)

## 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 repairs



# micro co-GENERATION Installation



**Outside Building**  
Energy Independent



**Inside Building**  
Whisper Quiet



**Hybrid**  
Maximum Efficiency / Net Zero

# CHP's High Efficiency Saves CO2 Emissions Today

Combined Heat & Power Systems (CHP)	Category	Natural Gas CHP	Utility Solar PV	Utility Wind	Biogas CHP
<ul style="list-style-type: none"> <li>• CHP and Renewables displace marginal grid generation (including T&amp;D losses)</li> <li>• Marginal generation is currently a mix of coal and natural gas in most regions of the US</li> <li>• CHP's high efficiency and high annual capacity factor currently results in significant annual energy and emissions savings</li> <li>• CHP's efficiency advantages will continue as the gas infrastructure decarbonizes</li> </ul> <p>“Because emissions are cumulative and because we have a limited amount of time to reduce them, carbon reductions now have more value than carbon reductions in the future”</p> <p>Source: “Time Value of Money”, Larry Stein, Carbon Leadership Form, April 2020</p>	<b>Capacity, MW</b>	20.0	20.0	20.0	20.0
	Annual Capacity Factor	<b>90%</b>	24.3%	34.3%	<b>90%</b>
	Annual Electricity, MWh	<b>157,680</b>	42,574	60,094	<b>157,680</b>
	Annual Thermal Provide, MWh <sub>th</sub>	<b>169,466</b>	None	None	<b>169,466</b>
	Annual Energy Savings, MMBtu	<b>689,110</b>	399,382	563,737	<b>689,110</b>
	Annual CO <sub>2</sub> Savings, Tons	<b>71,375</b>	32,995	46,573	<b>164,448</b>
	Annual NO <sub>x</sub> Savings, Tons	<b>59.8</b>	18.1	25.5	<b>59.8</b>
	<ul style="list-style-type: none"> <li>• Savings based on EPA AVERT Uniform EE Emissions Factors as a first level estimate of displaced marginal generation (<a href="https://www.epa.gov/avert">https://www.epa.gov/avert</a>)</li> <li>• Prepared by: Entropy Research, LLC, 9/26/21</li> <li>• Redrafted by: LSM Energy Solutions (<a href="http://www.lsmenergysolutions.com">www.lsmenergysolutions.com</a>)</li> </ul>				

# Gensets & micro-CHP Systems

**There's a difference! – Size the CHP To The Energy 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

## 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





# mCHP Possible Applications

## Project Examples

- Residential
- Commercial
- Industrial
- Recreational Facilities & Swimming Pools
- Multi-Family, Highrise & Apartment Bldg.'s
- Senior Care Facilities & Hospitals
- Hospitality & Service Sector
- College campuses and schools
- Airports, Shopping & Office Bldg.'s
- Public & Private Commercial Bldg.'s
- District Heating & Central Power Stations
- Industrial Independent Applications
- Rural & Remote Locations





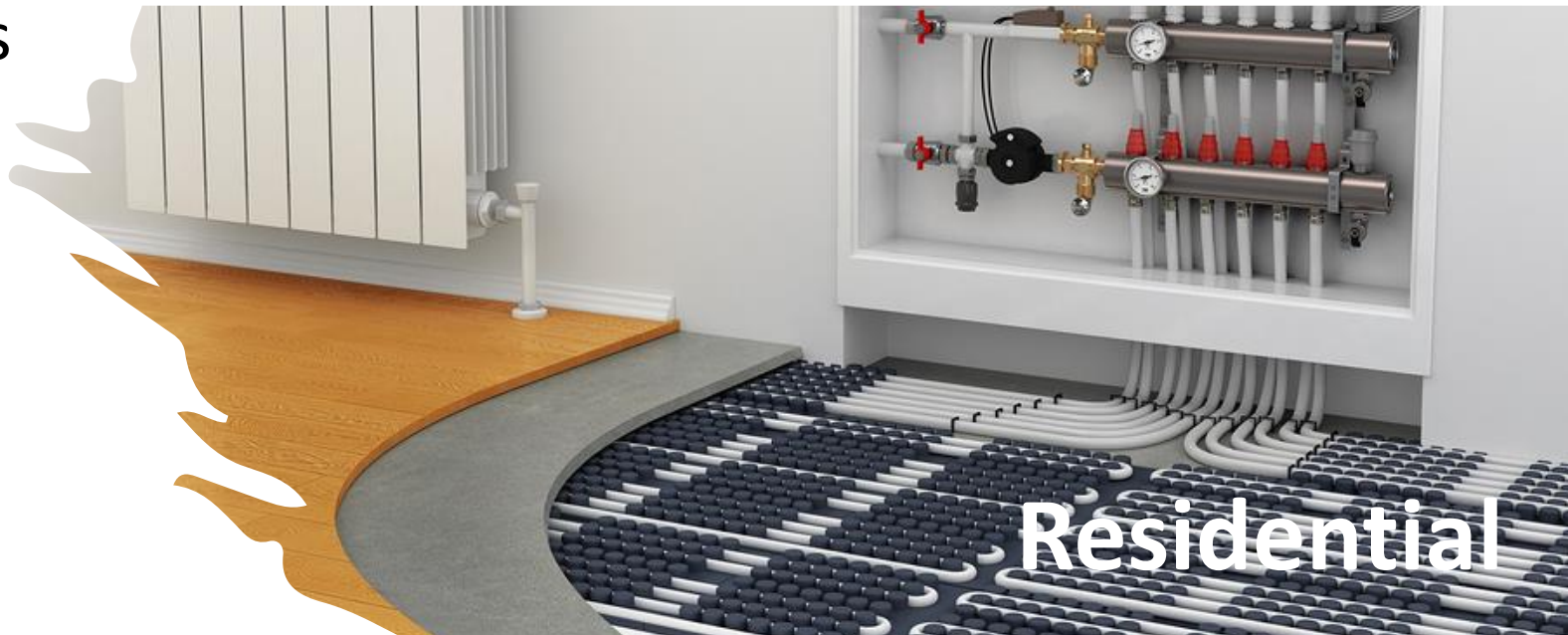
# Why - ROI

## CHP - Environmental & Financial

- Reduces GHG Emissions
- Lowers Fuel Consumption
- Matched with reduced operating & associated costs
- ROI within 4 to 6 years
- Unlimited expandability & scalability



Commercial



Residential



**COMBINED HEAT & POWER**

**INSTALLATIONS**

**EXAMPLES AVAILABLE**

A 3D architectural rendering of a building's interior layout. The walls and structural elements are shown in a light gray color. A specific section of the building, including a staircase and several rooms, is highlighted in a vibrant green color. The perspective is from an elevated angle, looking down into the space.

**Thank you!**

Guillevin International – Victoria Renewable Energy Div.

Jeff Hoogveld