CampusEnergy2021

BRIDGE TO THE FUTURE

Feb. 16-18 | CONNECTING VIRTUALLY

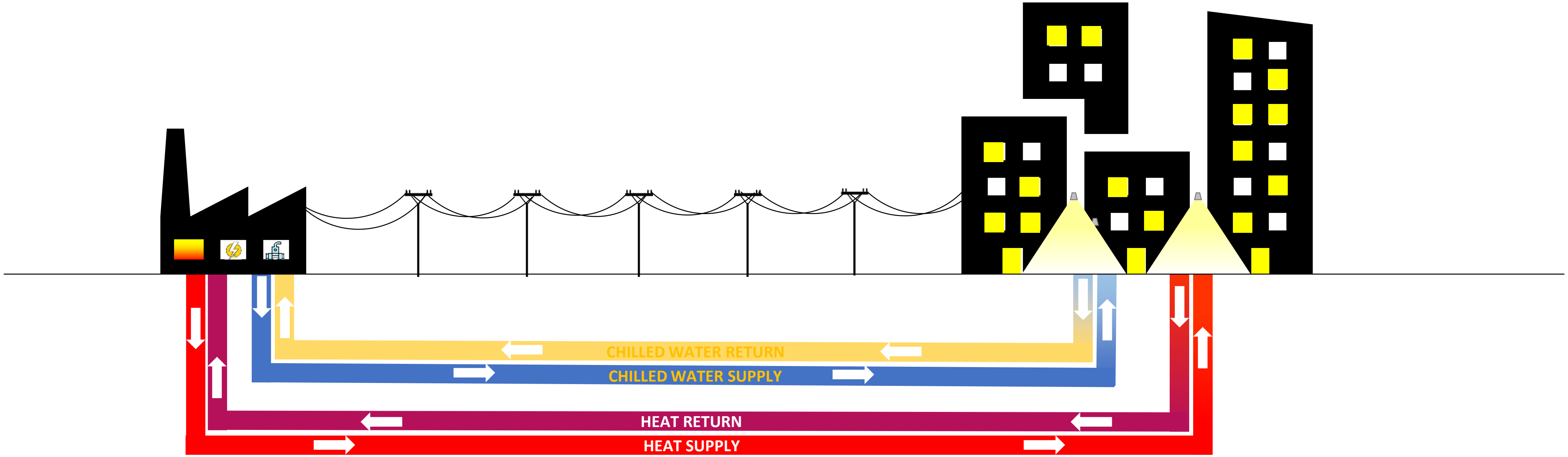
WORKSHOPS | Thermal Distribution: March 2 | Microgrid: March 16

The Evolution of District Energy

Michael Roppelt

GSS Integrated Energy Ltd.

Evolution of District Energy Systems



1st Generation 1880 – 1930 Steam Boilers fueled by Coal

2nd Generation 1930 – 1970 CHP Hot Water <100°C fueled by Coal and Oil

3rd Generation 1970 – 2000 Boiler Hot Water <70°C fueled by Coal, Oil, natural gas and biomass

4th Generation 2000 – Now Boiler, CHP Hot Water <70°C fueled by natural gas, biomass, and waste

5th Generation heating and cooling supplied by 100% renewables

Benefits of District Energy Systems

Environmental Benefits

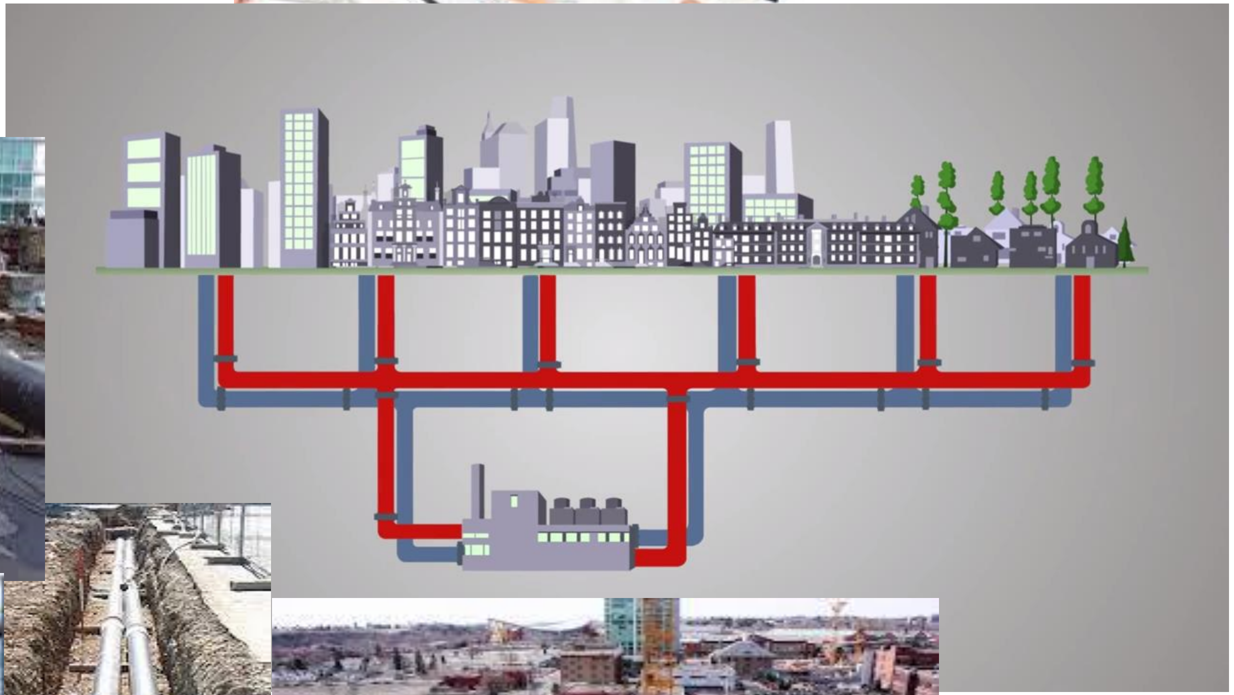
- Cleaner combustion
- Higher efficiencies
- Ability to utilize renewable energy
- Reduced risk of fuel spills
- Reduced pollution from trucking fuel.
- Improved health and safety

Economic Benefits

- Lower first cost to building owner
- Lower maintenance costs
- Lower cost of heat to the building owner
- Value of space used by equipment in buildings
- Increased reliability

Benefits of District Energy Systems – (Wilson, 2007)









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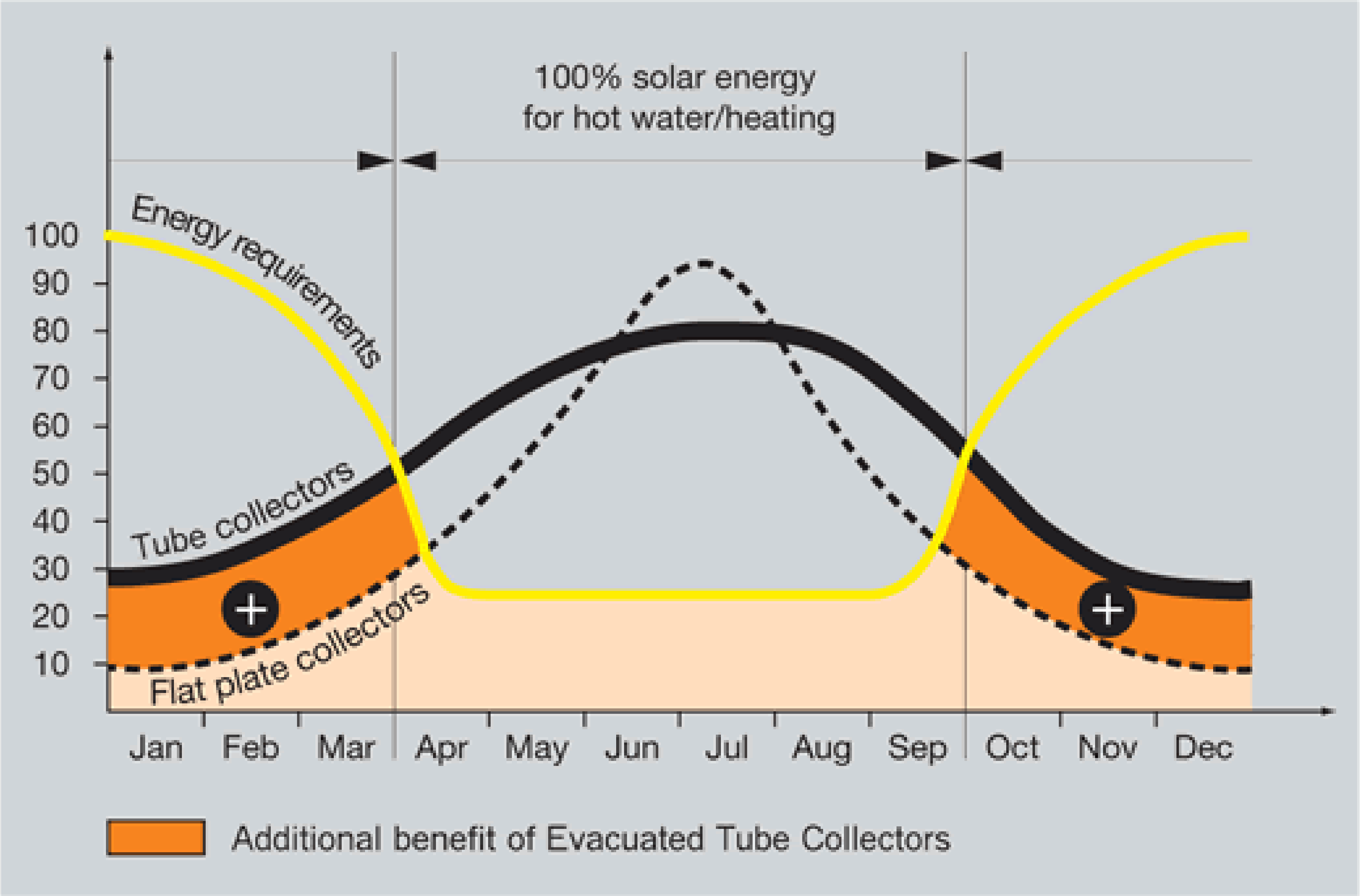
INTERNATIONAL DISTRICT ENERGY ASSOCIATION

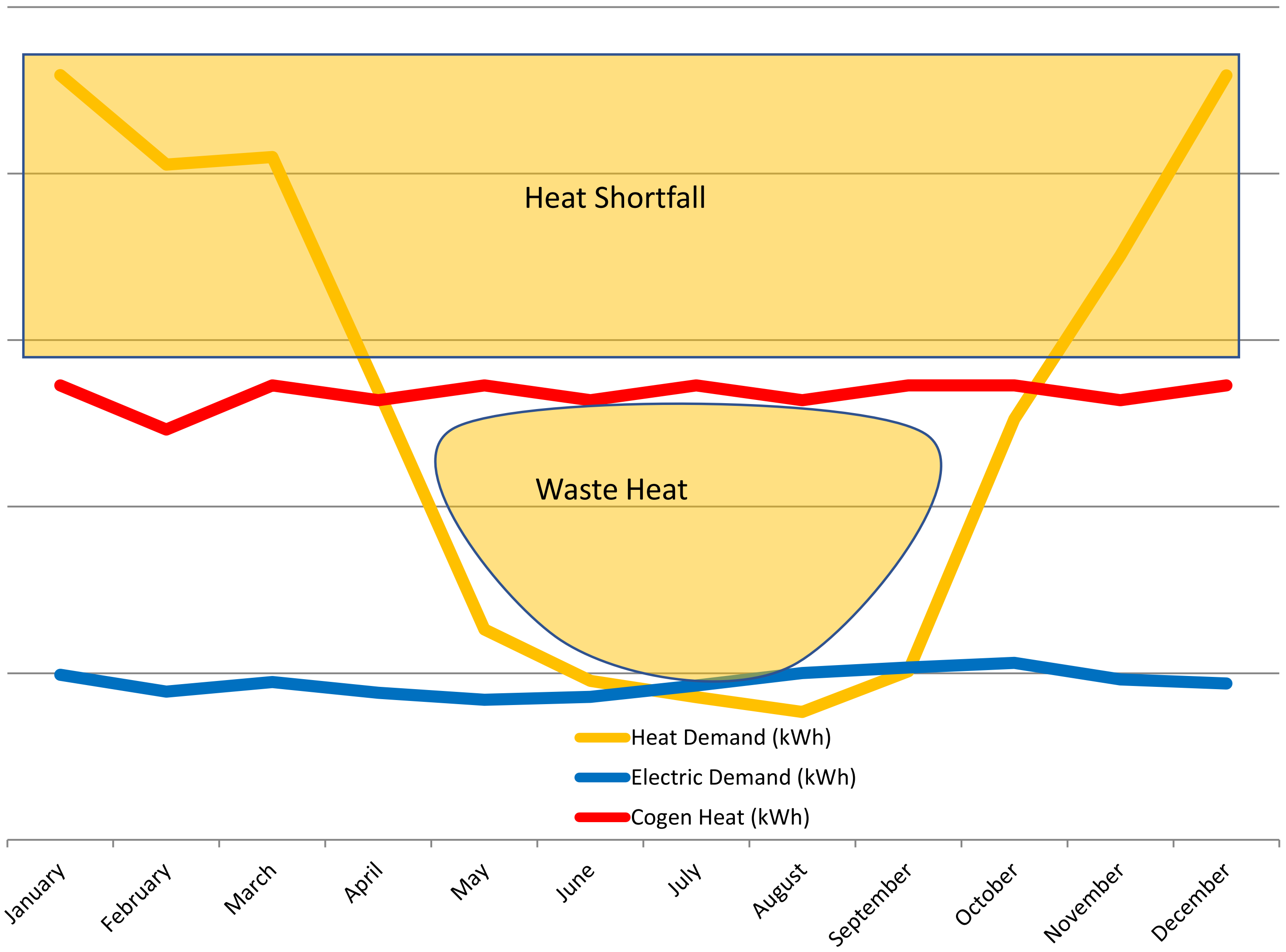
The Challenges of Integrating Technologies

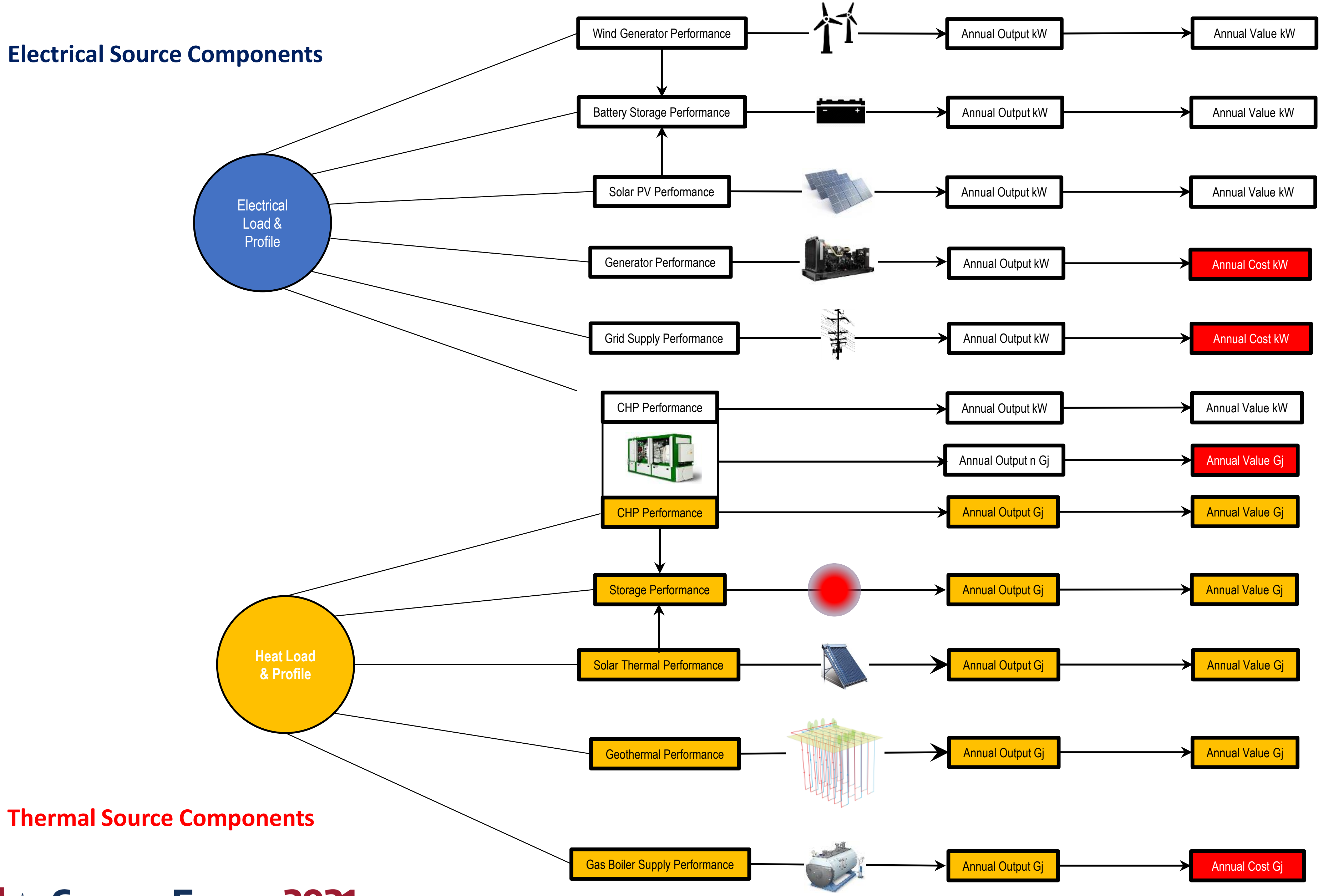
Finding a Balance

Renewable
Solar thermal – Generation vs Demand



Low Carbon
CHP Cogeneration – Demand vs Generation





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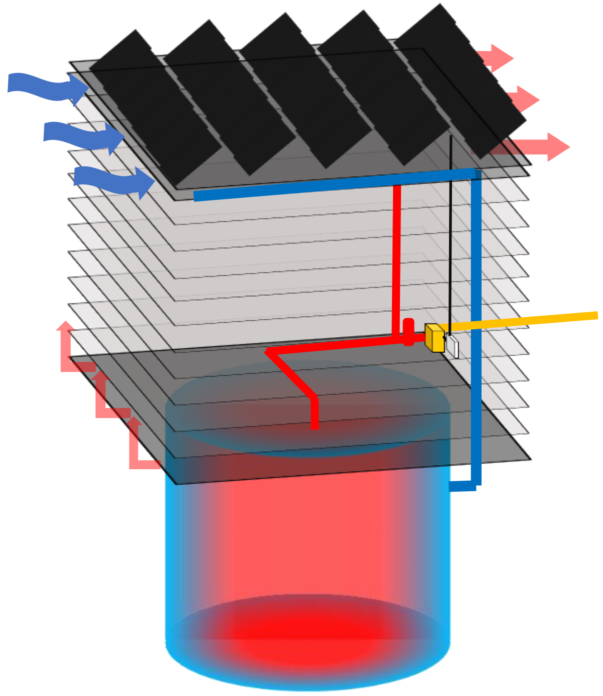
INTERNATIONAL DISTRICT ENERGY ASSOCIATION

Design, Modelling and Simulation



Development Size
Development Loads
Development Mix
Location
Site Size

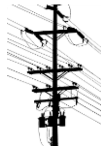
Building Size
Building Loads
Building Purpose
Location
Site Size

CHP Cogeneration Size?

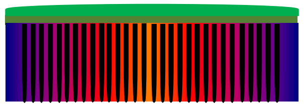
Solar Thermal Size?

Solar PV Size?

Grid Supply Size?

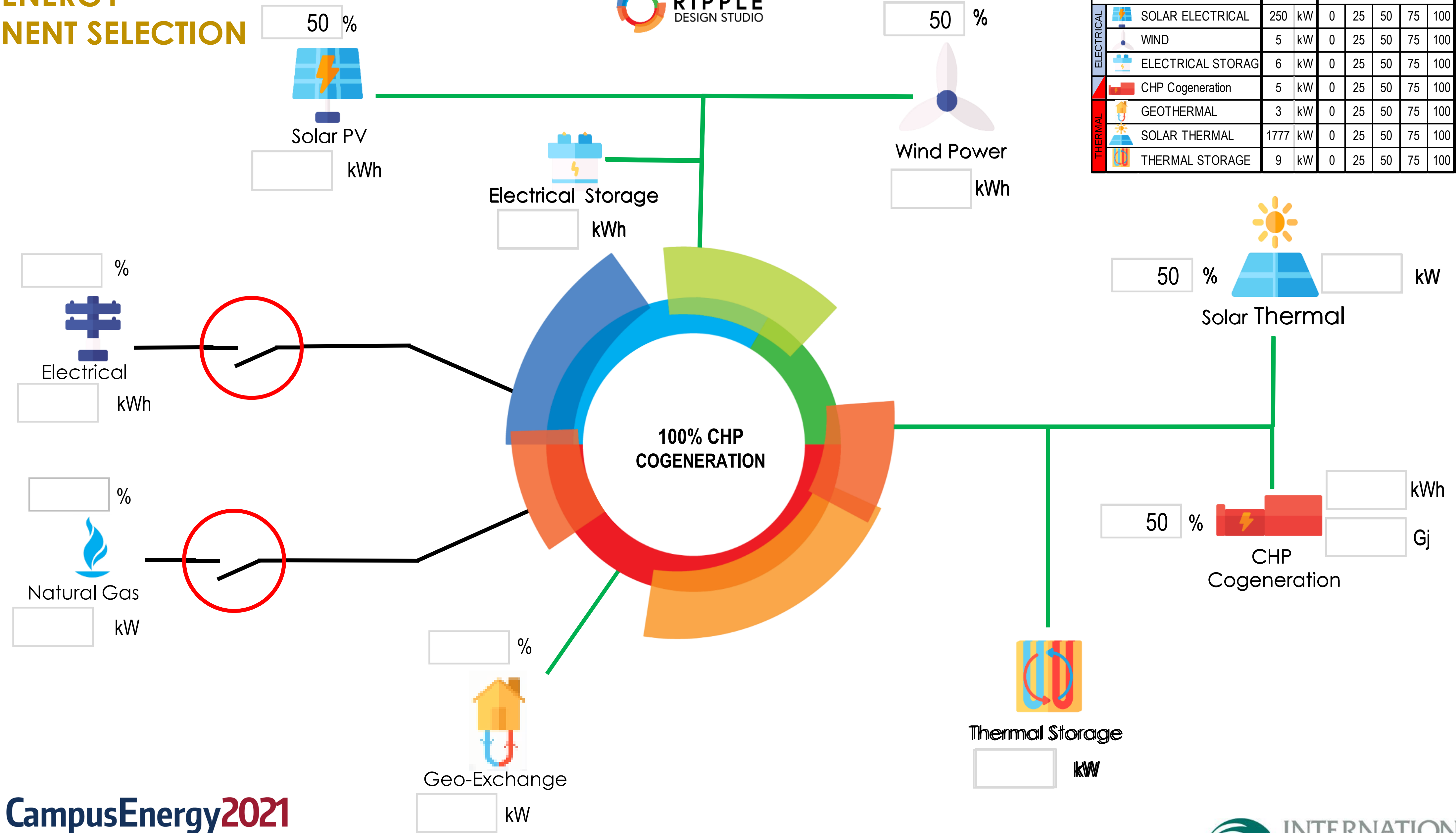


Thermal Storage Size?



Electrical Storage Size?

ENERGY COMPONENT SELECTION



	SYSTEM COMPONENTS	STD. UNIT		% OF PROJECT LOAD					Total	
ELECTRICAL	SOLAR ELECTRICAL	250	kW	0	25	50	75	100		kW
ELECTRICAL	WIND	5	kW	0	25	50	75	100		kW
ELECTRICAL	ELECTRICAL STORAG	6	kW	0	25	50	75	100		kW
	CHP Cogeneration	5	kW	0	25	50	75	100		kW
THERMAL	GEOTHERMAL	3	kW	0	25	50	75	100		kW
THERMAL	SOLAR THERMAL	1777	kW	0	25	50	75	100		kW
THERMAL	THERMAL STORAGE	9	kW	0	25	50	75	100		kW

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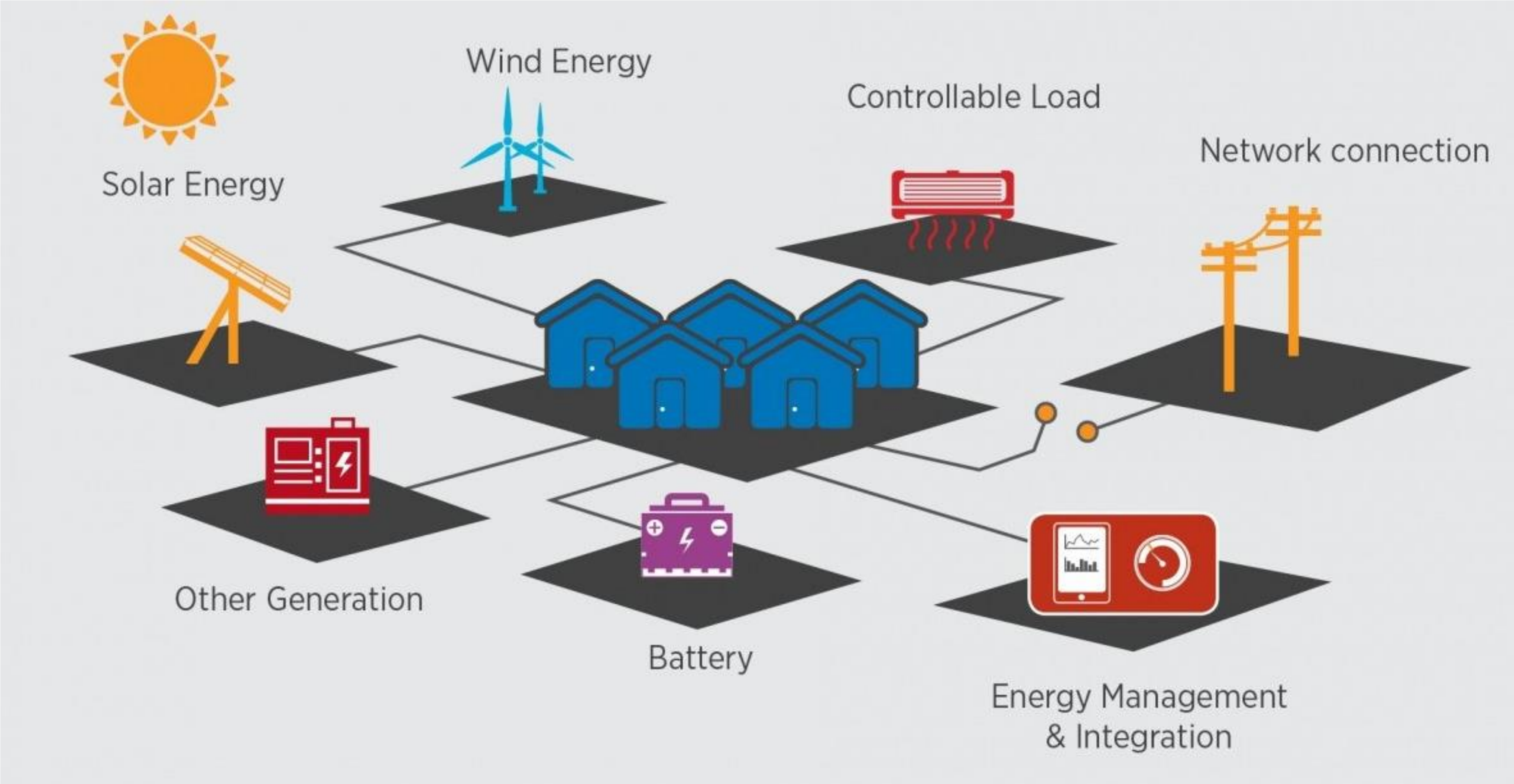
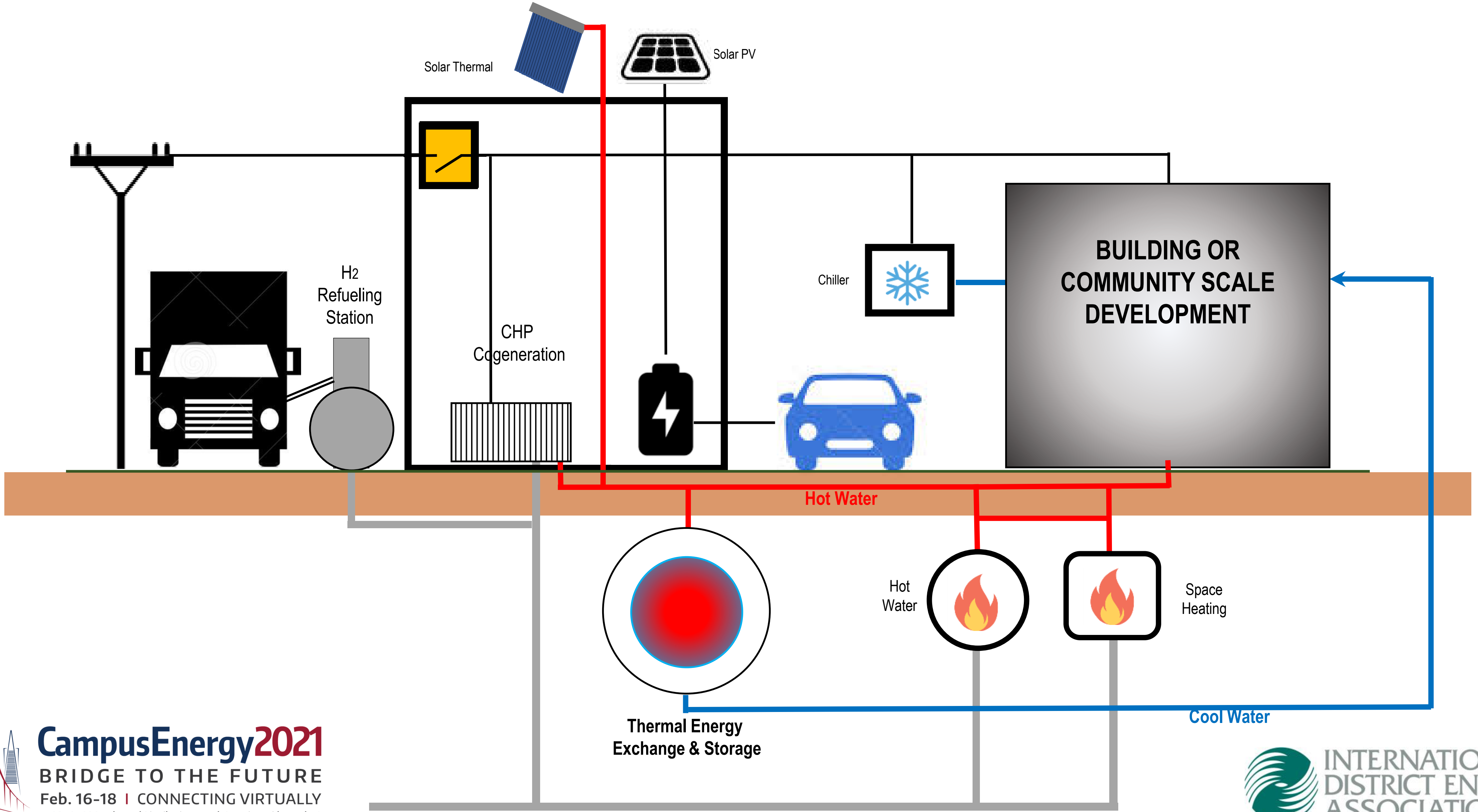
The Shift to Microgrids



MOVING TO MICROGRIDS



Thermal Microgrid District Energy

Moving Energy
not
Wasting Energy

Electrical Microgrid

SOURCE
Solar
Boiler
CHP Cogen
Water
Air

CONSUMPTION
Air Handlers
Heat Pumps
Hydronics

DISTRIBUTION NETWORK
Pumps
Pipes

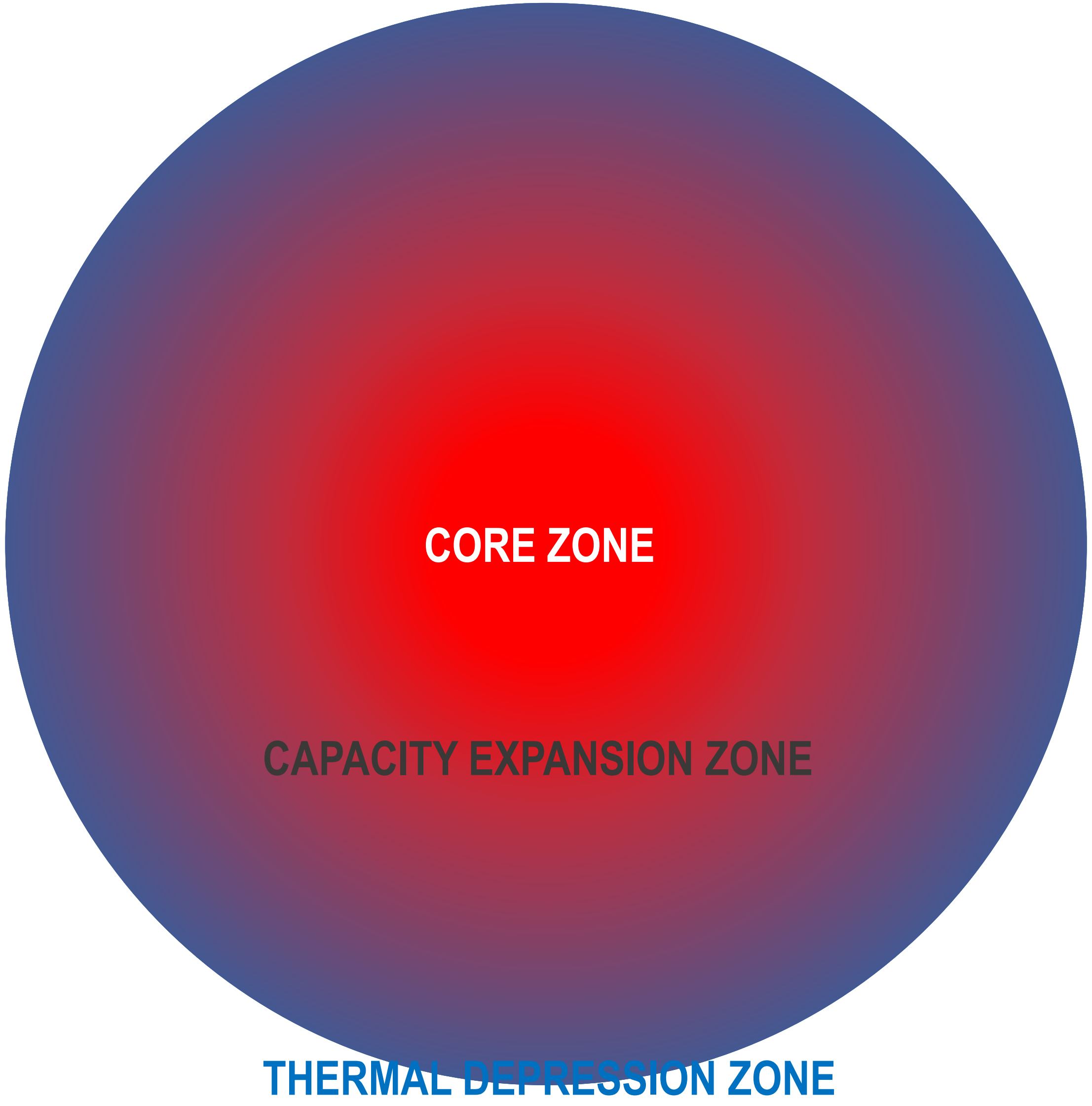
CONTROLS (PLC)

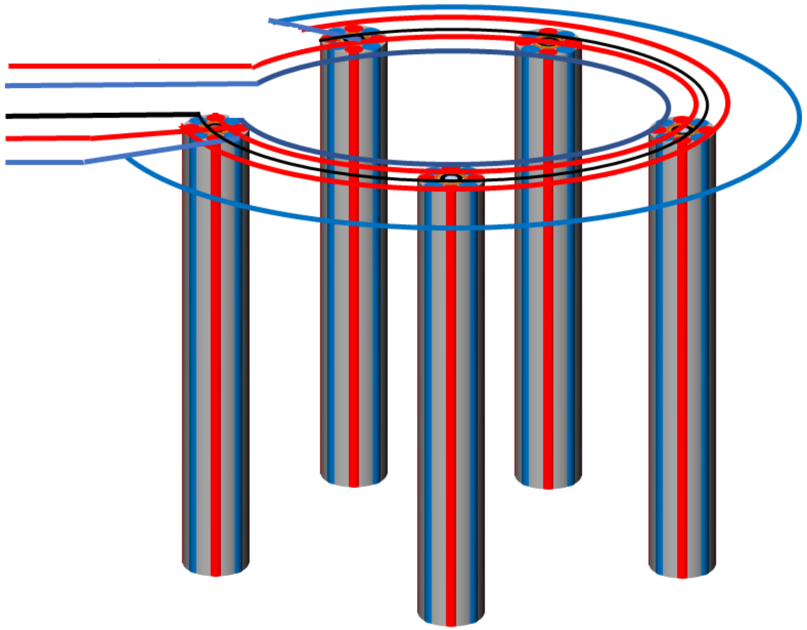
LOAD BALANCE
Grid Connection
Storage ?

CONVENTIONAL GEOTHERMAL

BOREHOLE THERMAL ENERGY STORAGE

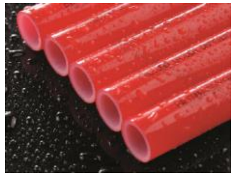
THERMAL ENERGY EXCHANGE AND STORAGE systems

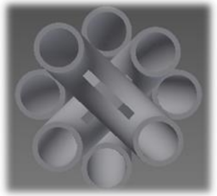

CORE ZONE
CAPACITY EXPANSION ZONE
THERMAL DEPRESSION ZONE



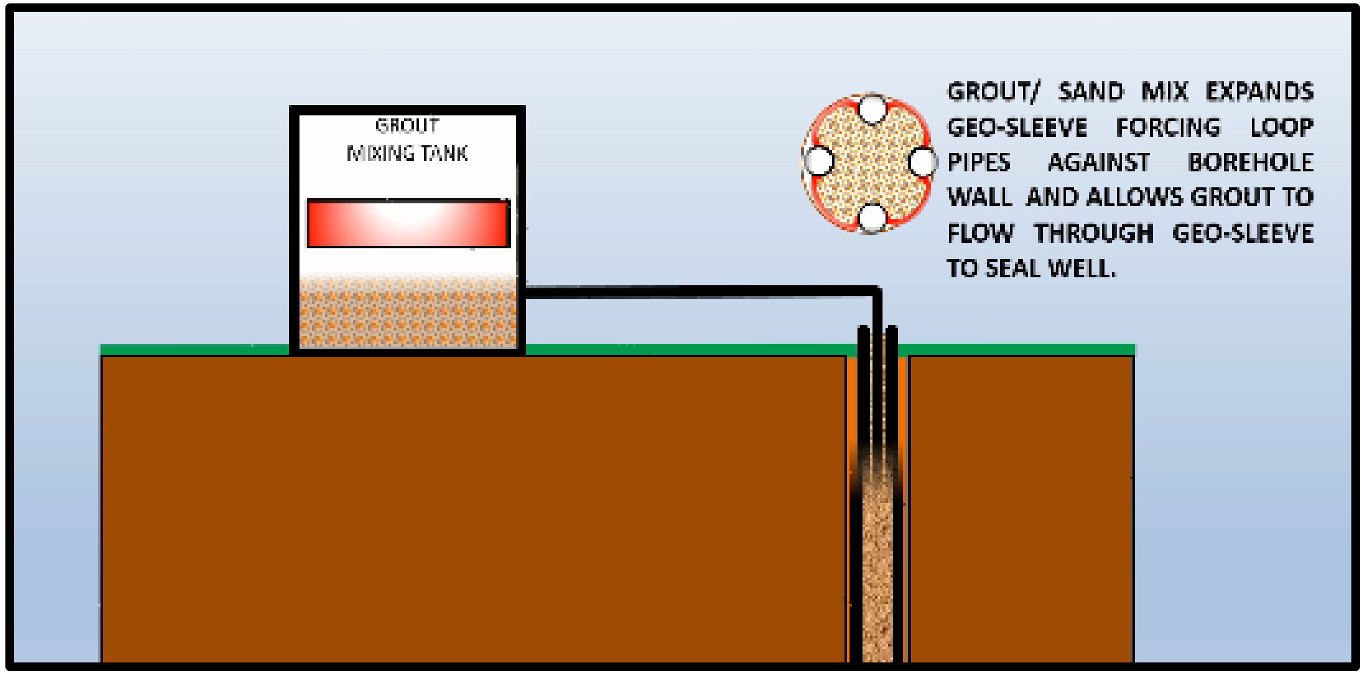
Active Zone Geothermal

PE-RT & Geo-Sleeve





AMBIENT							GROUND TEMPERATURE				AMBIENT				PROCESS								
-40	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
-40	-22	-13	-4	5	14	23	32	41	50	59	68	77	86	95	104	113	122	131	140	149	158	167	180
	AIR HANDLER				HEAT PUMP OPERATING RANGE										AIR HANDLER								
PEX Pipe - Connections: Mechanical																							
PE-RT Pipe - Connections: Fusion																							
HDPE - Connections: Fusion																							



Redevelopment Project

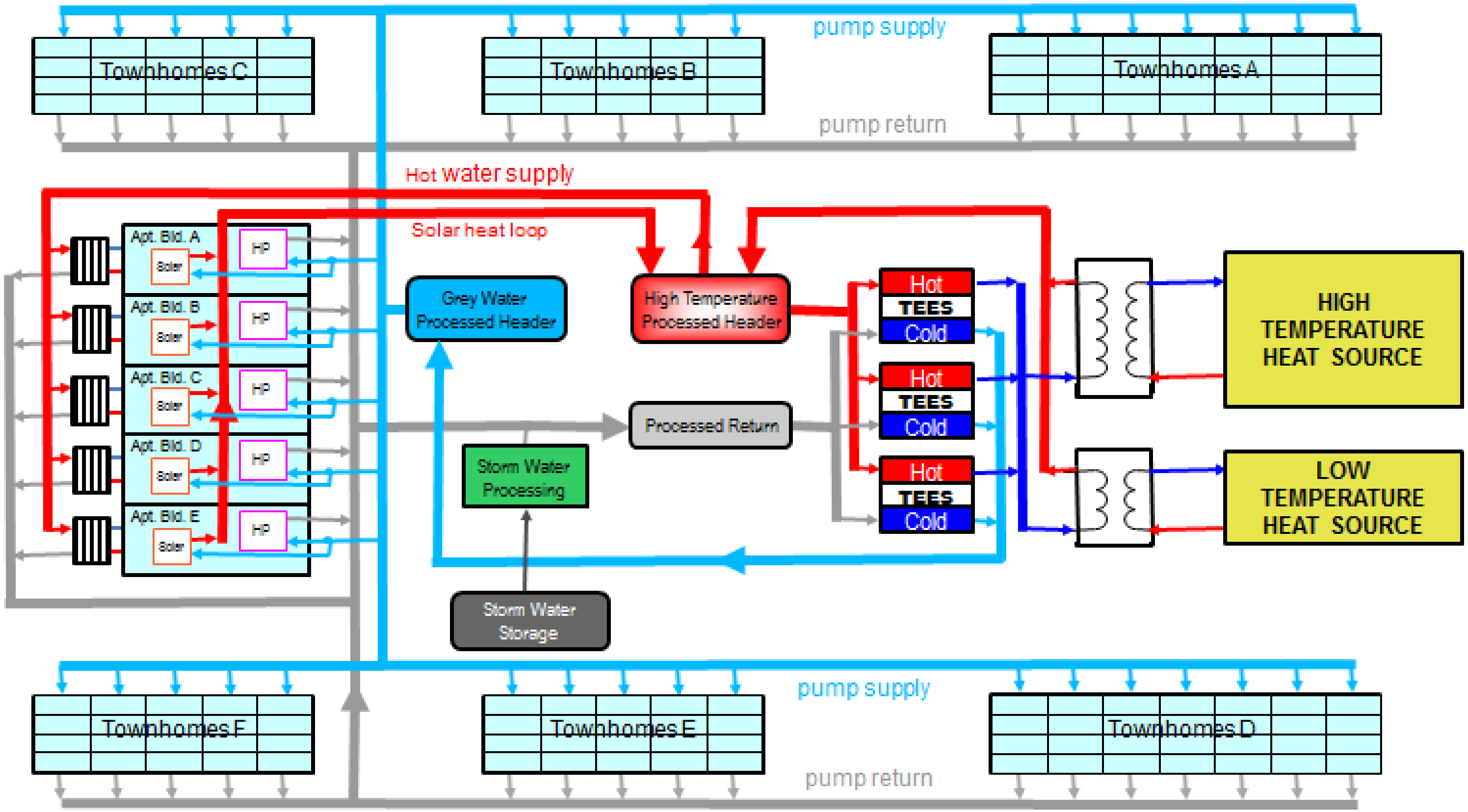
SouthWoods AT HAZELDEAN VILLAGE

CHRISTENSON COMMUNITIES LTD.

Sustainable Community

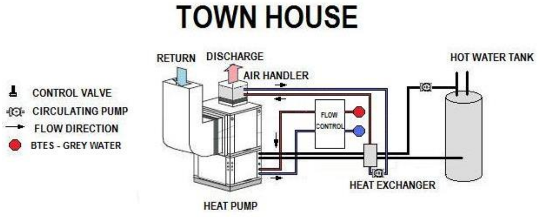
Microgrid Utility

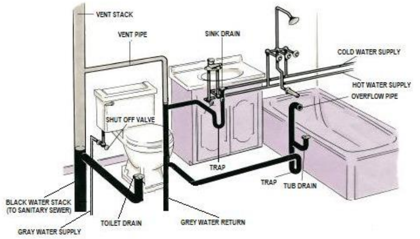
TEES Low Temperature Energy Distribution

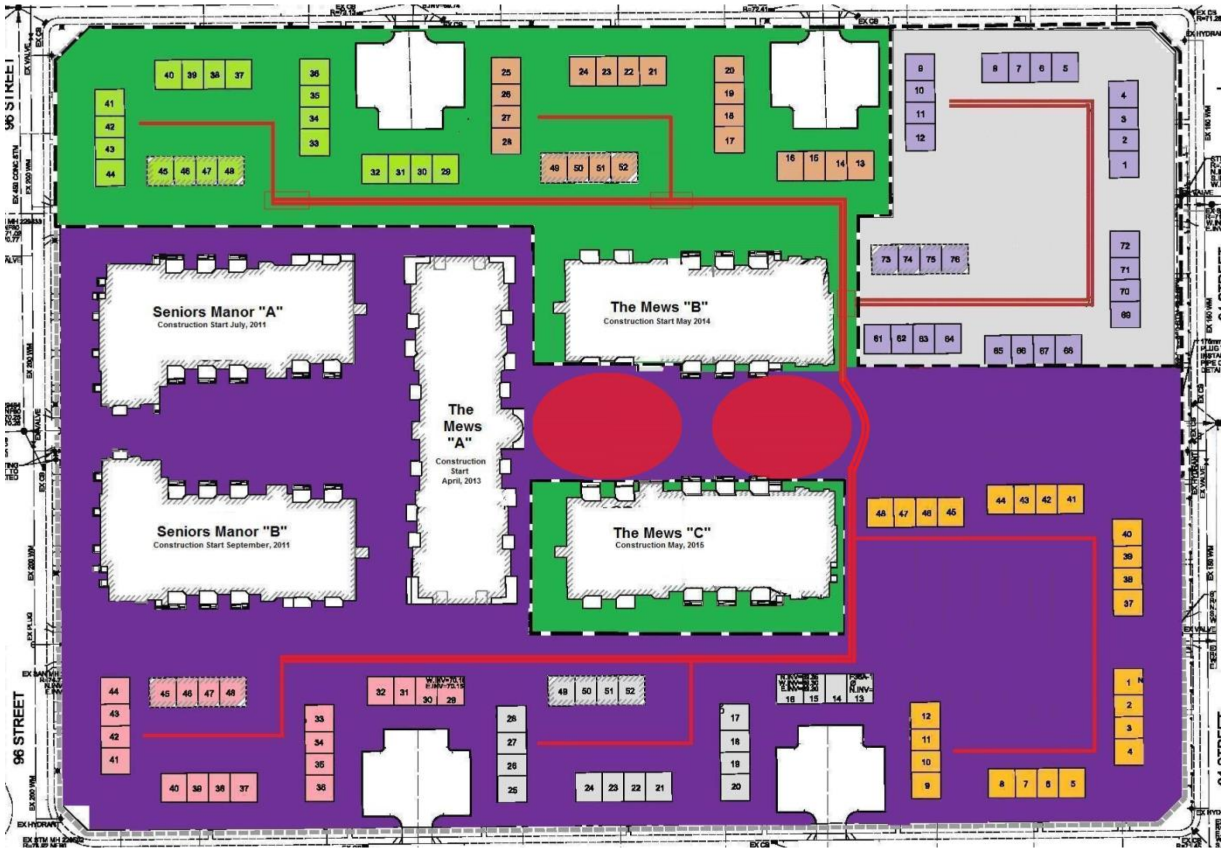


Thermal Microgrid Heating and Cooling -10°C - 70°C supplied by alternative and renewable energy

Storm and Rain Water Treatment Site Reuse







Southwoods GHG Credit Energy Assessment

Greening Energy Production

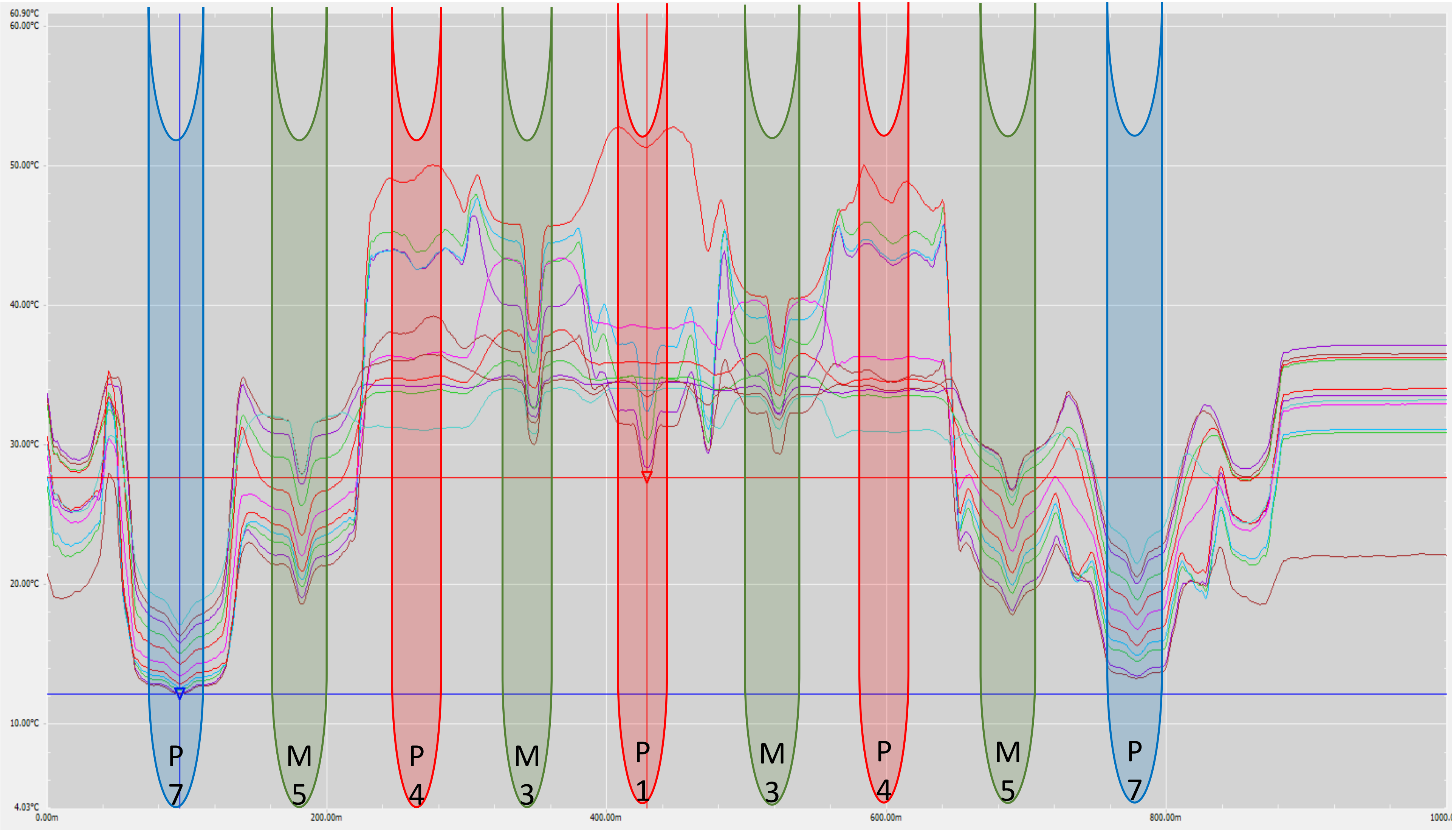
Real Time Monitoring
Distributed Temperature Sensing (DTS)

DTS equipment offer unparalleled level of flexibility and accuracy of the temperature measurements.

The DTS performs measurements down to 1-meter spatial resolution with less than 0.1 °C temperature resolution providing hundreds of measurement points in a single trace capture up to 2 km.

Advanced data processing and visualization offer great tools for analysis of thermal processes and/or hazarded situations alerts.

Active Zone Geothermal Temperature Monitoring



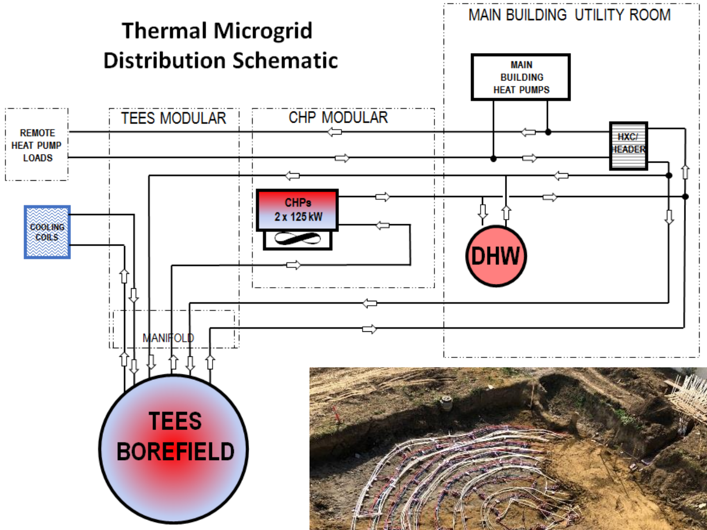
139 kW CHP Microgrid Active Zone Geothermal borefield from December 2018 – March 2019
P = Production Wells M = Monitoring Wells Total Data Collection Length = 1000 m (3280 ft.)

SouthWoods
AT HAZELDEAN VILLAGE

CD CHRISTENSON
COMMUNITIES LTD.

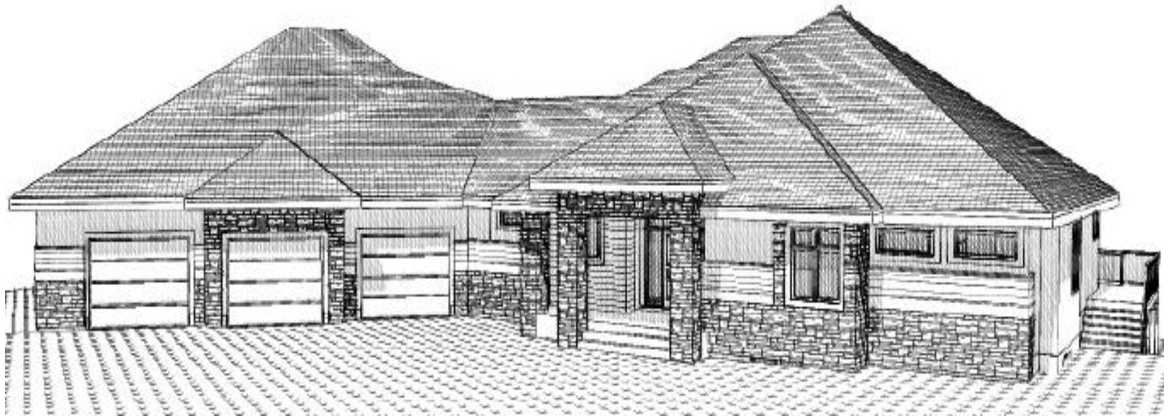
140,000 sq. ft. residential townhomes (144 Units)
250,000 sq. ft. seniors' apartments (264 Units)
750 kW Natural gas CHP cogeneration
Consumes 67,500 Gj gas ($300,000.) gas annually
produce and uses 6.5Mw/ yr., ($900,000.) electricity.
produces 33,750 Gj heat ($150,000.)/ yr.
Net Positive Value: approx. $750,000/ year
and provides :
Domestic hot water, (Apartments)
TEES District Energy - ambient temperature distribution w/ grey water pipes for toilet flushing.
Low temperature tempered heat pump water circuits
48,000 total drilled feet Active Zone Geothermal borefields.
Energy System Cost $5,200,000 will produce gross positive value of $750,000./ yr.

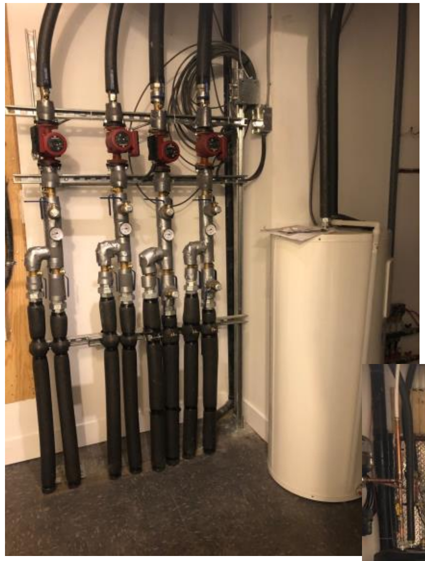
Normal geothermal would require this development to have 146000 drilled feet.
Estimated cost: $5M + consume $900,000./ year in grid electricity.



Maple Ridge Self Storage
(currently under construction)
150,000 sq. ft. commercial development.
Natural gas CHP cogeneration
Consumes 8800 Gj gas ($40,000) gas annually
produces 875,000 kw/ yr., electricity.
uses 650,000 kW/ yr. ($97,500.) electricity.
exports 225,000 kW ($33,750) to grid/ yr.
produces 4400 Gj heat ($20,000.)/ yr.
Net Positive Value: approx. $111,250/ yr.
and provides :
Domestic hot water, (Main building, car wash) -
TEES District Energy - ambient temperature distribution
Low temperature tempered heat pump water circuit
6500 total drilled feet Active Zone Geothermal borefield.
System Cost $1,200,000 will produce gross positive value of $95,500/ yr.

Normal geothermal would require this development to have 30000 drilled feet.
Estimated cost: $950,000 + consume $97,500, year in grid electricity.





4.4 kW Axiom Eco-power natural gas CHP cogeneration that:
Consumes 360 Gj gas ($1,550) gas annually
produces 38,500 kw/ yr.,
uses 23,000 ($3,450.) electricity/ yr.,
exports 17,500 kW ($1400) to grid/ yr.
produces 180 Gj heat ($775.)/ yr.
Positive: approx. $4,000/ year
and provides :
Domestic hot water,
Hydronic heating of basement and garage using waste heat
Single 6 Ton water to air Waterfurnace heat pump.
1200 total drilled feet Active Zone Geothermal borefield.
System Cost $85,000 and produces net positive value of $4100/ yr.

Normal geothermal would require this home to have
Qty. 2 – 6-ton heat pumps and 3000 drilled feet for pipe.
Estimated cost: $75,000 + consume $3,450/ year in grid electricity.

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Questions?