
LEADING THE WAY
CampusEnergy2022
Feb. 15-18 | Westin Boston Seaport District Hotel | Boston, Mass.
INTERNATIONAL DISTRICT ENERGY ASSOCIATION

Efficient High Temperature Heat Pumps for District Heating

Kenneth Hoffmann

GEA Heating and Refrigeration Technologies

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Urgent need for decarbonization!

GLOBAL CO_2 CONCENTRATION LEVELS

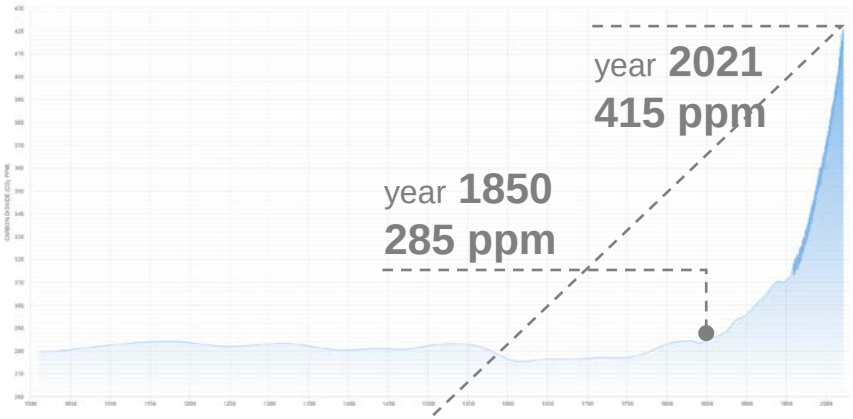
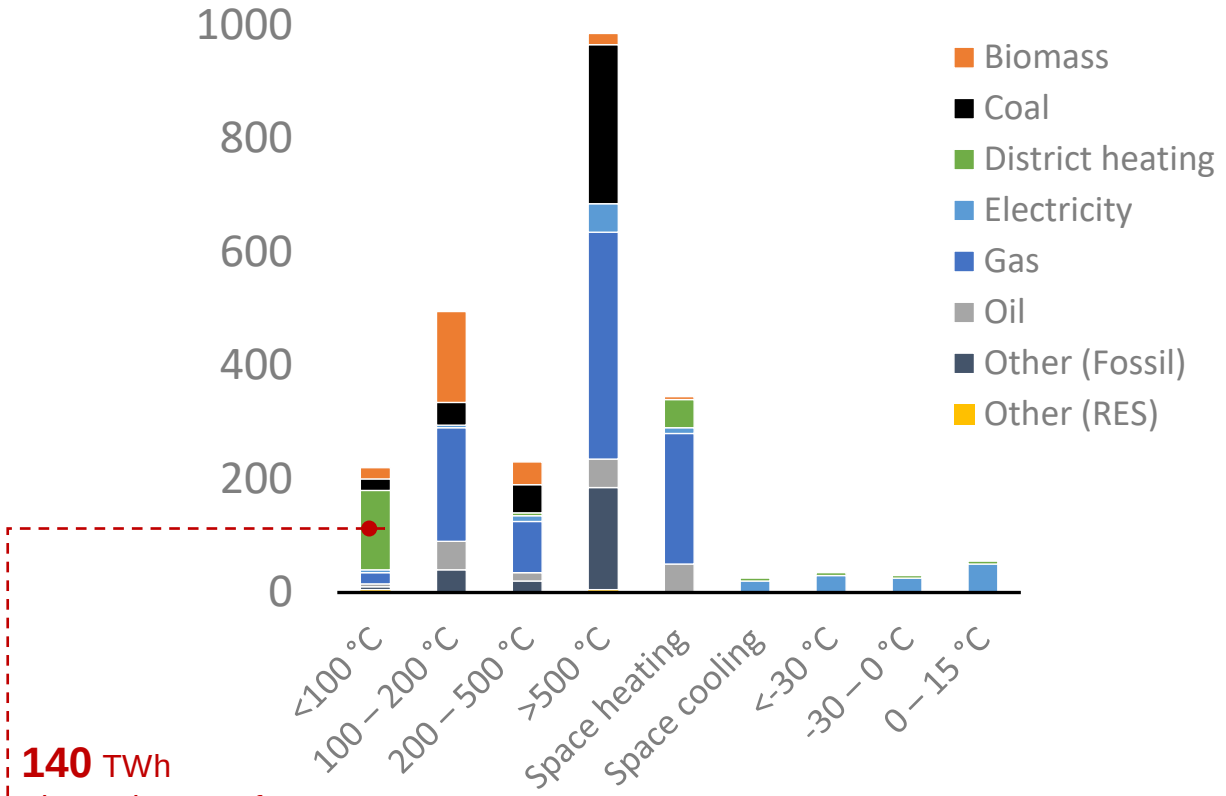


Figure: co2levels.org

EU THERMAL ENERGY DEMAND [TWH]



140 TWh
Thermal energy for district heating

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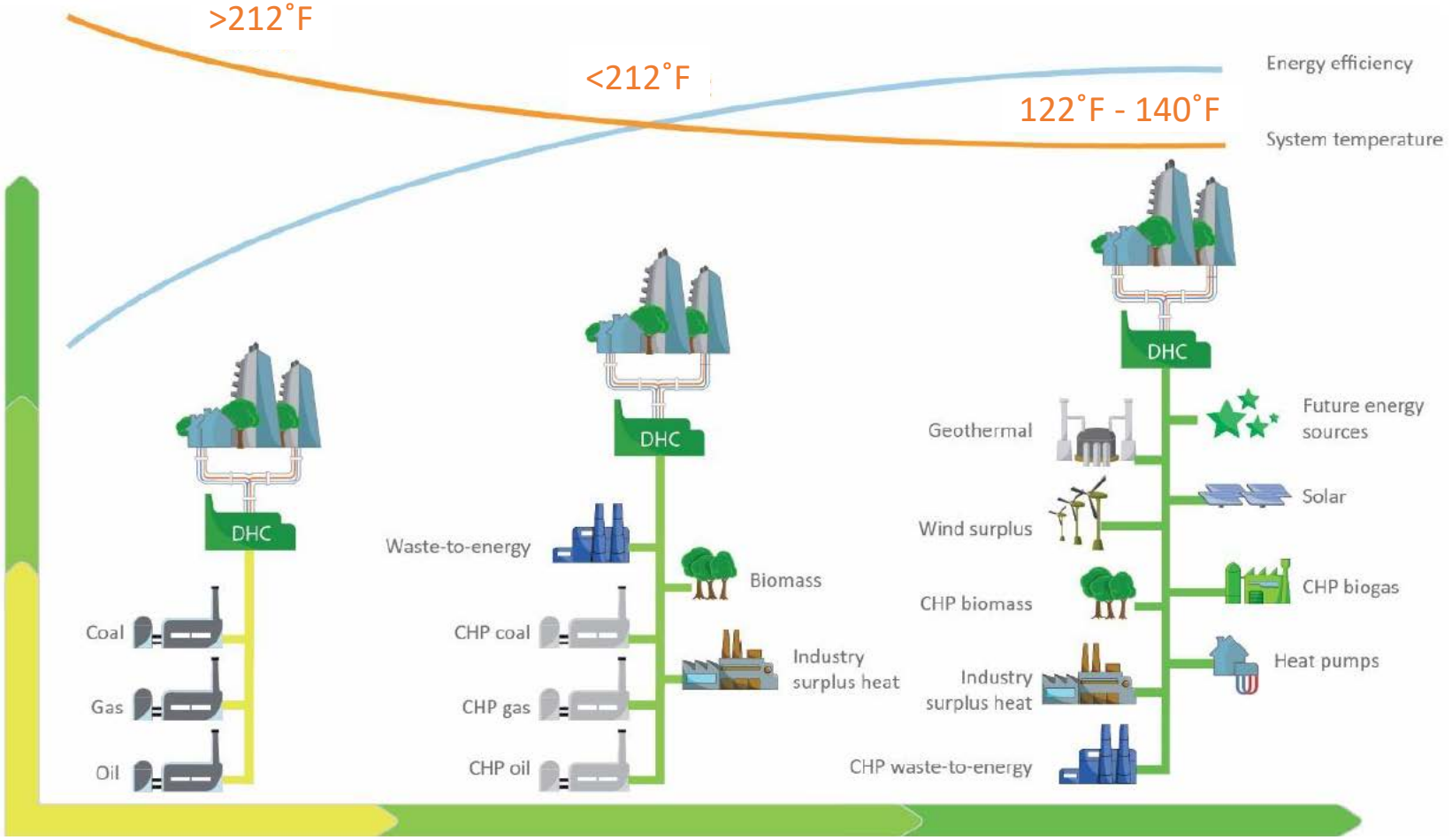
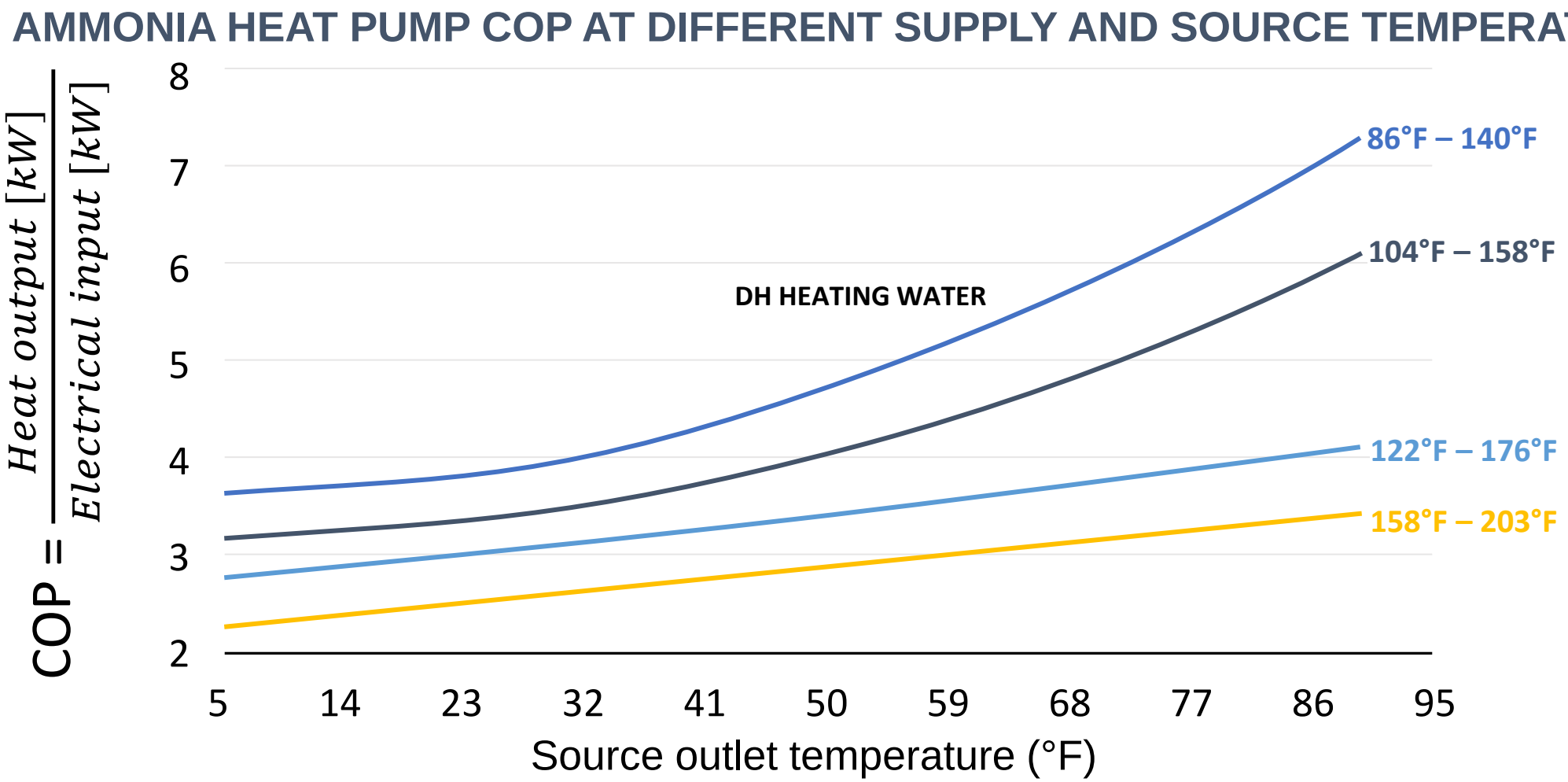
The way we do district heating is changing

- One source to multiple sources
- High temperature to low temperature
- Increase District heating



Heat pump performance at variable conditions



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Choosing the right heat source

High efficiency → Lower efficiency

COMBINED HEATING COOLING
(Data centres, dairies, food process etc.)
+ Temperature: 5˚F – 77˚F
+ High COP
+ Constant source
+ 40 years life

SEWAGE WATER
+ Temperature: 50˚F – 77˚F
+ Small risk of freezing
- Variable source
(sewage buffer needed)
+ 40 years life

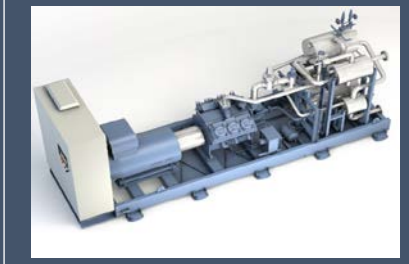
AIR SOURCE
+ Temperature: 5˚F – 95˚F
+ Constant source
- Large seasonal variations
- Low COP
- 10 – 15 years life

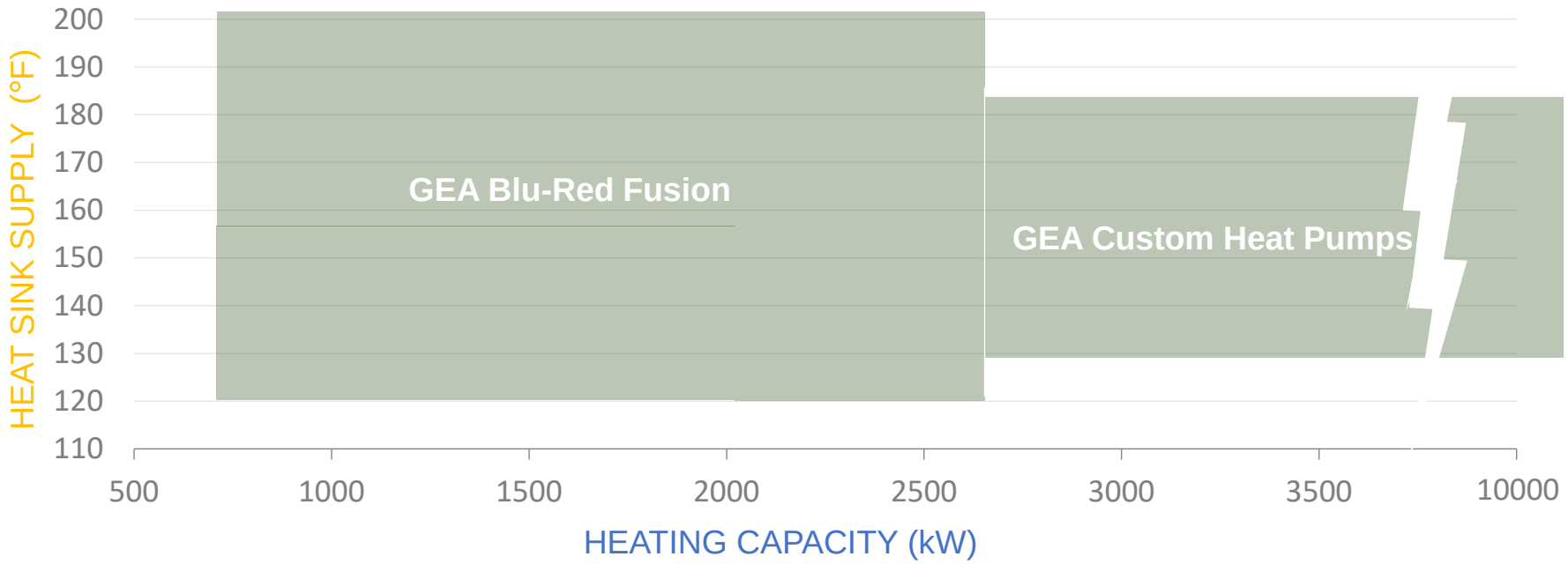
WASTE WATER/GEOTHERMAL WATER/ FLUE GAS CONDENSATION
+ Temperature: 77˚F – 140˚F
+ High COP
+ Constant source
+ 40 years life

GROUNDSOURE OR MINE WATER
+ Temperature: 46˚F – 59˚F
+ Constant source
+ No risk of freezing
+ 40 years life

SEAWATER/RIVER/LAKE WATER
+ Temperature: 32˚F – 77˚F
+ Constant source
- Risk of freezing
+ 40 years life

Ammonia Heat Pumps

GEA Blu-Red Fusion	GEA RedGenium / RedAstrum	GEA Custom Heat Pumps
		
Standard chiller – heat pump combination	Standard Reciprocating or screw compressor heat pump	Customized screw and reciprocating heat pumps



1000 kW = 3.4 MBTU/hr

Compact heating solution

F-GAS 2015

NH_3

Efficiency

Safety

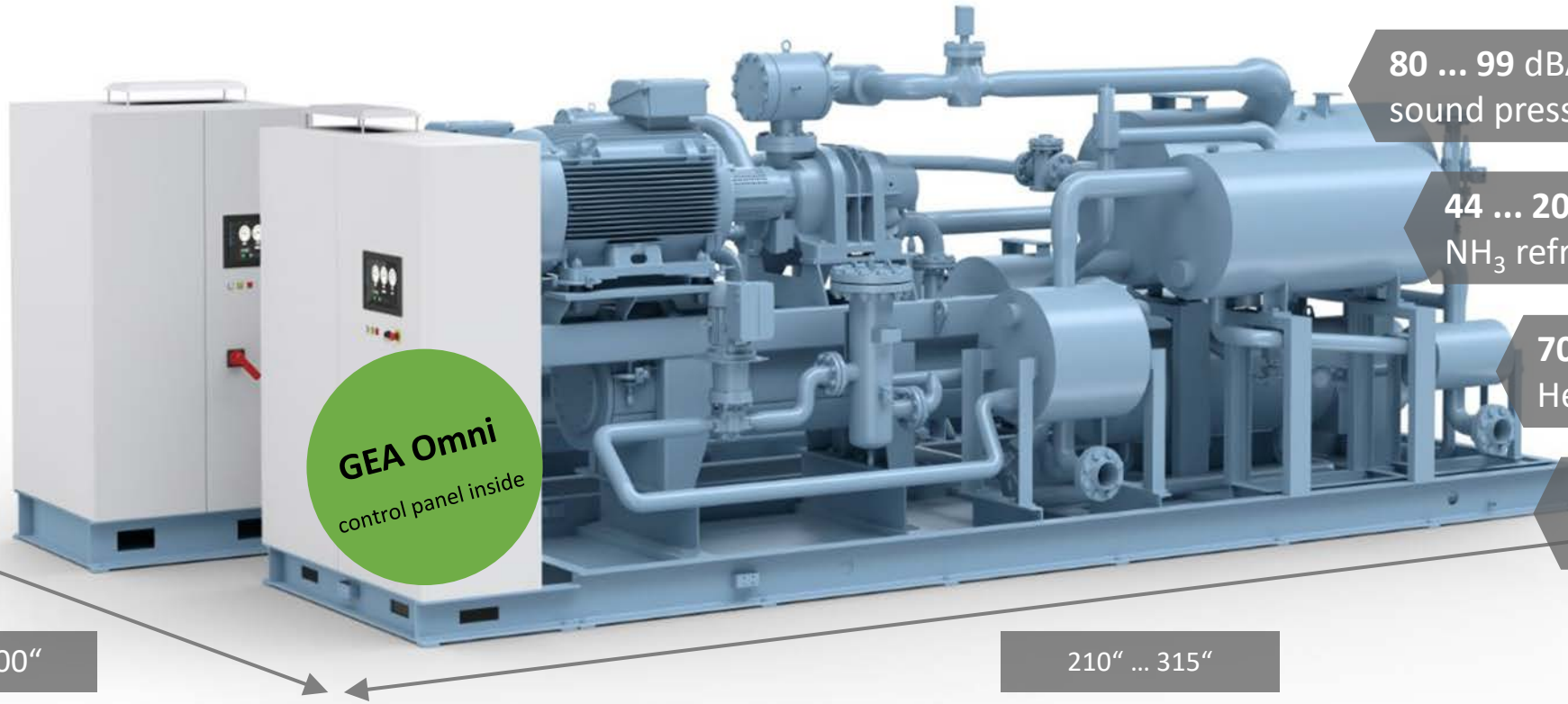
17,000 ... 50,000 lbs
total weight

80 ... 99 dBA
sound pressure level

44 ... 200 lbs
NH_3 refrigerant charge

700 – 2600 kW
Heating duty

Upto 203˚C
Heating water



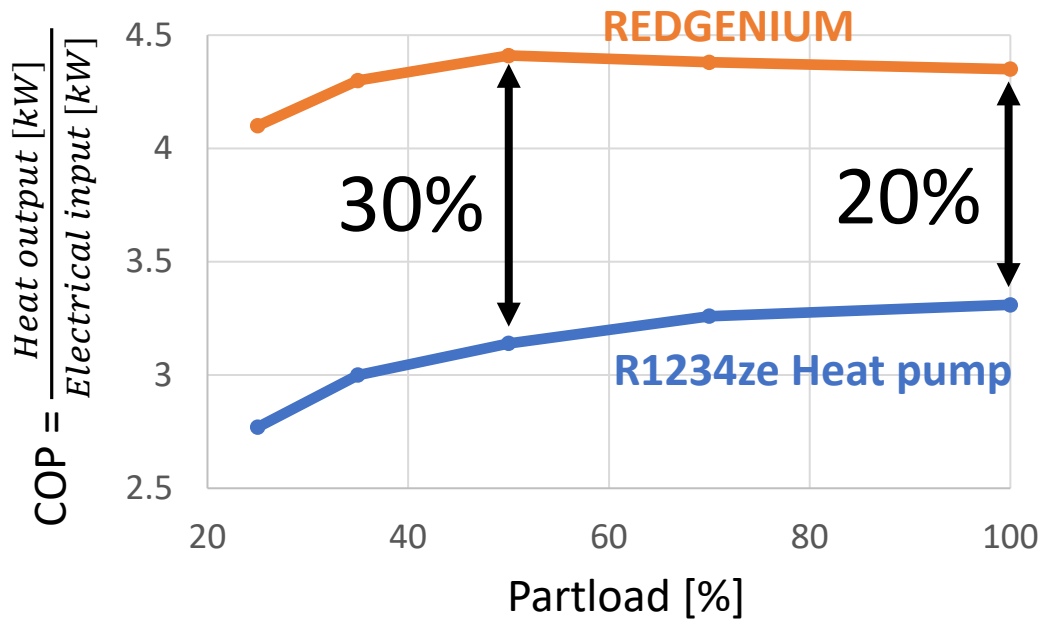
82“ ... 115“

155“ ... 200“

210“ ... 315“

How does an ammonia heat pump compare

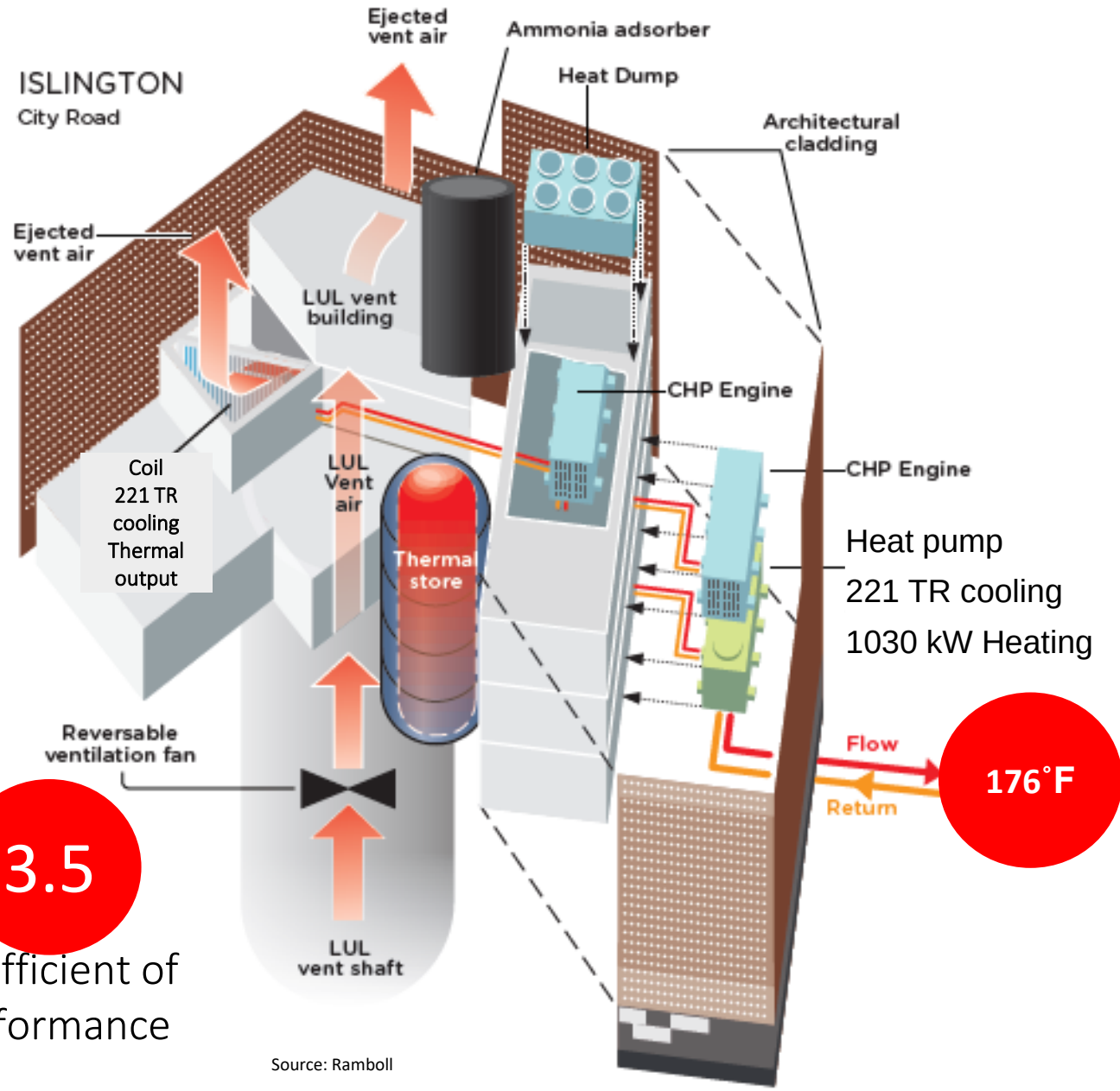
	REDGENIUM 1100 HP	R1234ze HEAT PUMP
Chilled water inlet	59˚F	59˚F
Chilled water outlet	50˚F	50˚F
Cooling duty	553 kW	494 kW
Heating water in	110˚F	110˚F
Heating water out	150˚F	150˚F
Heating duty	700 kW	701 kW
Heating COP	**4.06**	**3.31**
Refrigerant charge	88 lbs	308 lbs



CASE 1 – Heat Source:

London Underground Ventilation

Description	Design conditions
Cooling Duty (TR)	221
Chilled Water Return Temperature (°F)	52
Chilled Water Supply Temperature (°F)	43
Heating Duty (kW)	1030
Hot Water Return temperature (°F)	131
Hot Water Supply temperature (°F)	176
Electrical Consumption (kW)	286
Heating COP	3.5



Source: Ramboll

CASE 1 – Heat Source

London Underground Ventilation

First **Blu-Red Fusion** concepts
Manufactured 2016

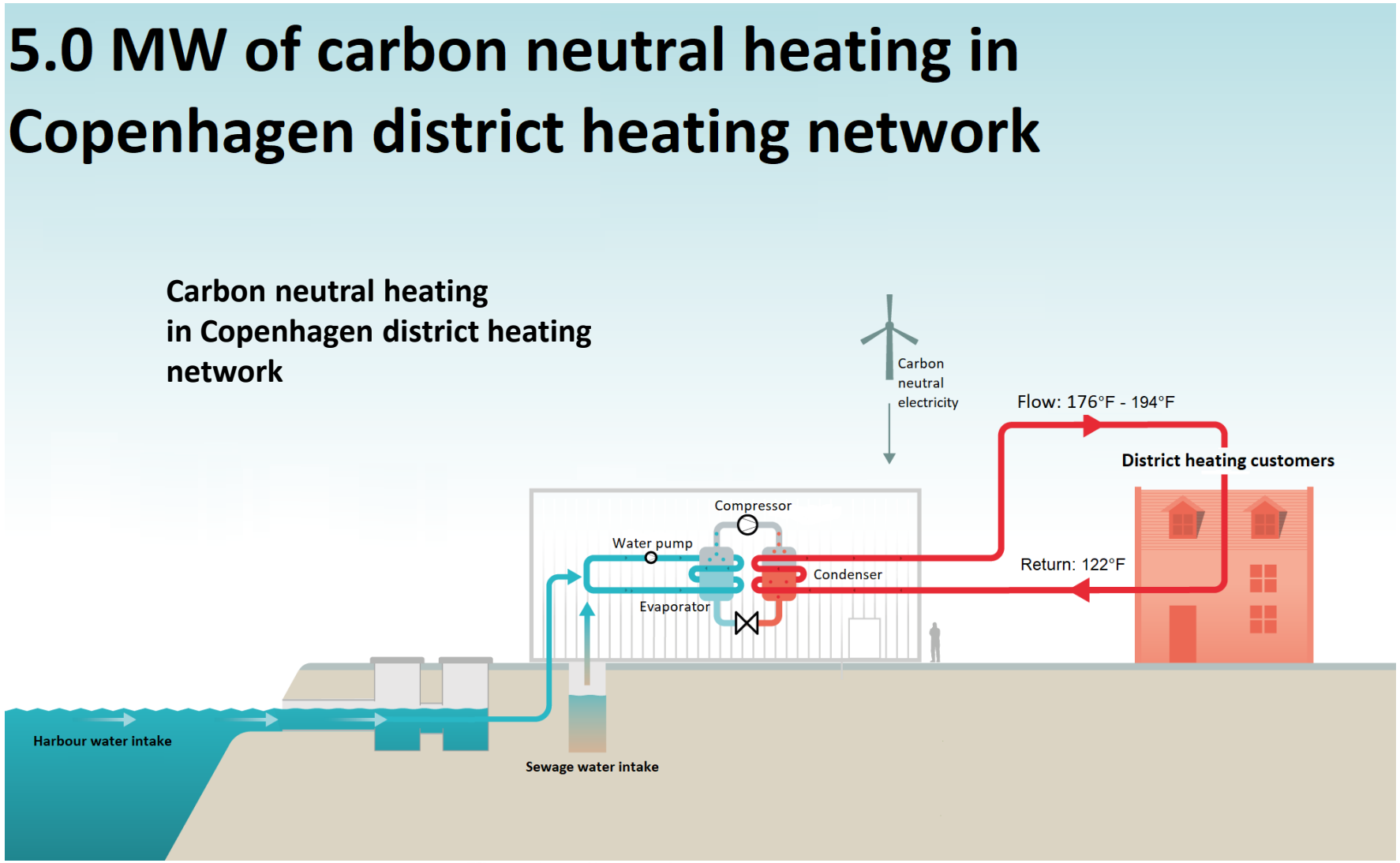
HEAT SOURCE
UNDERGROUND VENTILATION AIR
64°F – 86°F

HEAT SINK
DISTRICT HEATING WATER
131°F – 176°F

HEATING
COP >3.50

CASE 2 – Heat Source: Seawater

Copenhagen harbour



CASE 2 Heat Source: Seawater

194˚F 5MW GEA Heat Pump in Copenhagen

2 x 2.5MW Heat pump Serial heating Installed 2018		
SEAWATER @ 41˚F chilled to 34˚F	**HEATING WATER** 122˚F – 176˚F	**COP** 3.20
SEAWATER @ 41˚F chilled to 34˚F	**HEATING WATER** 122˚F – 194˚F	**COP** 2.95

CASE 3 – Heat Source: Sewage Water

Malmo, Sweden

District heating supply water: 158˚F - 203˚F

Flue gas economiser

Waste incinerator CHP

142˚F - 160˚F

40 MW heat pump

District heating return water: 113˚F

131˚F - 144˚F

46˚F

Waste water treatment plant

City's sewage water

57˚F

Clean sewage water

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CASE 3 – Heat Source: Sewage Water

Malmo, Sweden

INSTALLATION
4 x 10 MW heat pumps
Installed 2017

CARBON SAVINGS
50,000 tons of CO_2 saved per year

HEAT PRODUCTION
170 GWH of heat energy produced

COST SAVINGS
$12,000 saved per day

Thank you!

Kenneth Hoffmann

Product manager

Heat pumps