IDEA's 27th Annual Campus Energy Conference
"Clean, Efficient & Resilient Energy"
February 18 - 21, 2014 • Atlanta Marriott Marquis • Atlanta, GA
Including Pre-Conference Workshops on Monday Feb 17 and Tuesday Feb 18

Optimizing Efficiency of CHP Plant with Add-On Heat Pump

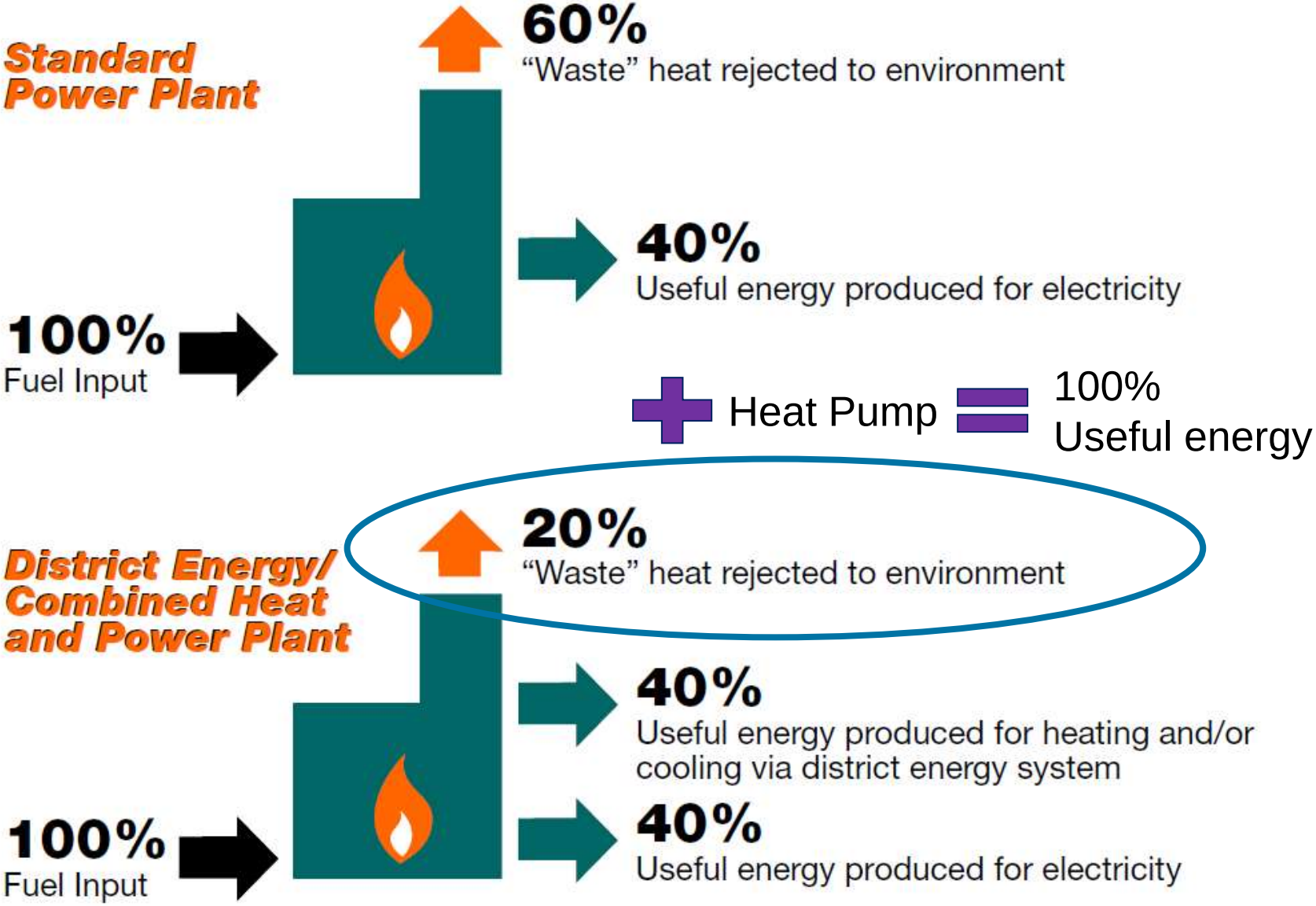
by

Kenneth Hoffmann

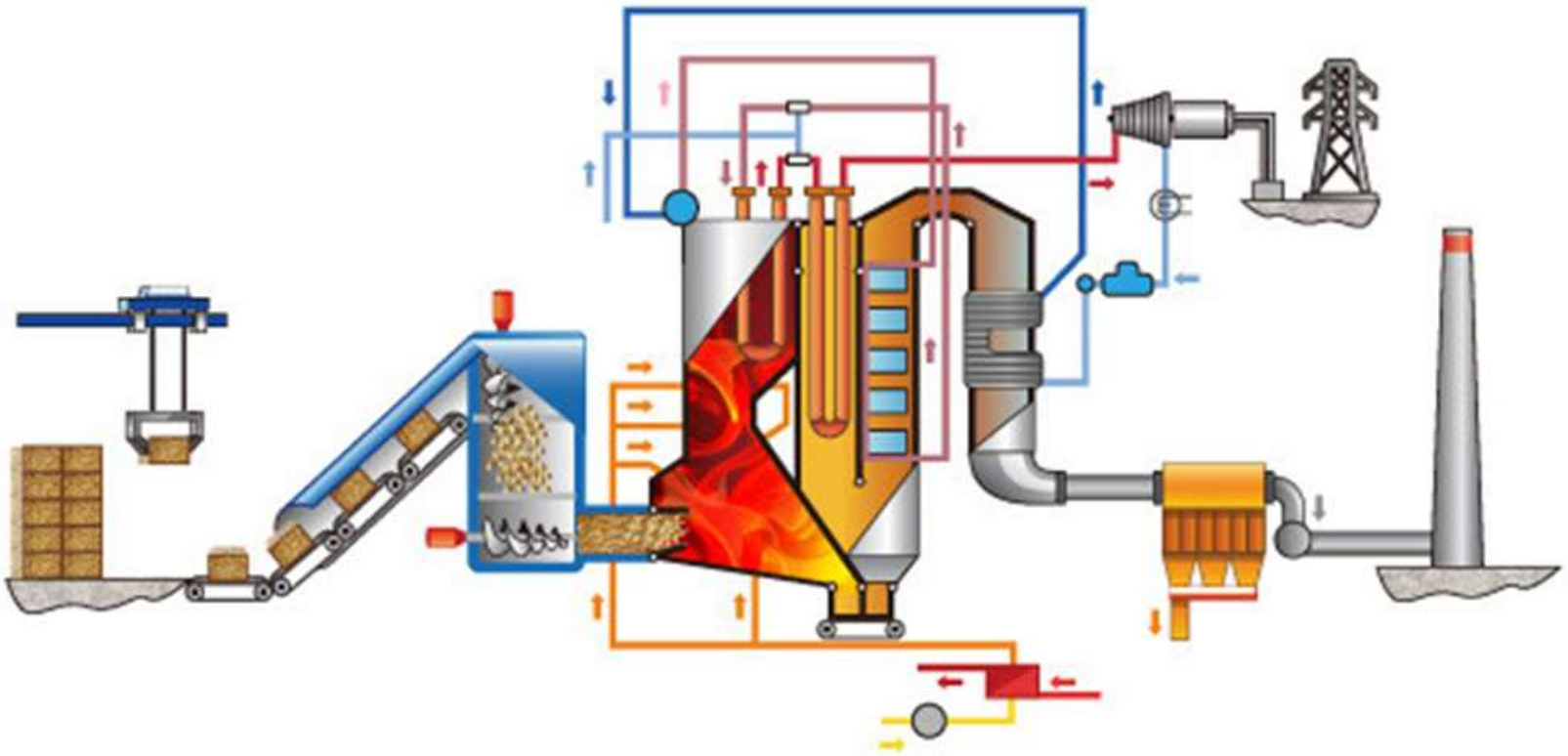
GEA Refrigeration Technologies

INTERNATIONAL DISTRICT ENERGY ASSOCIATION

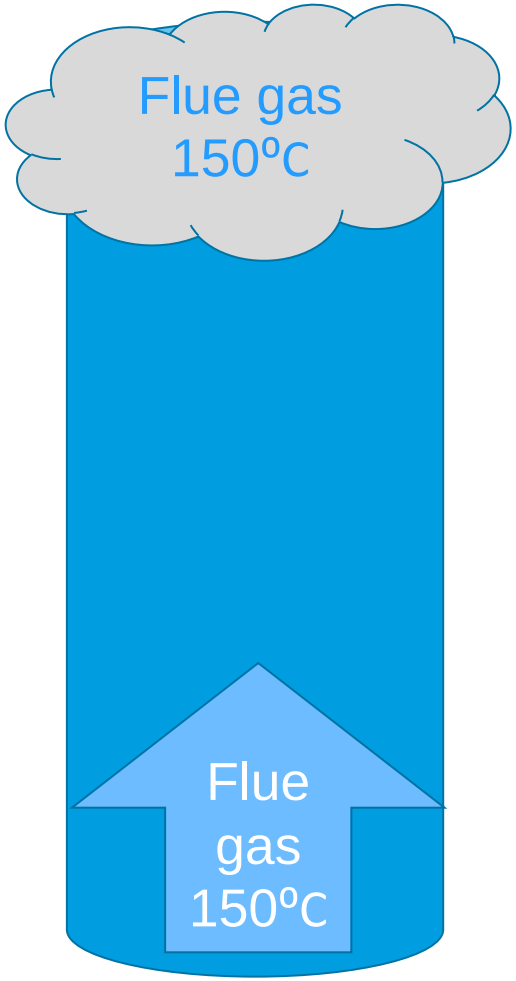
Energy-Efficiency Comparisons



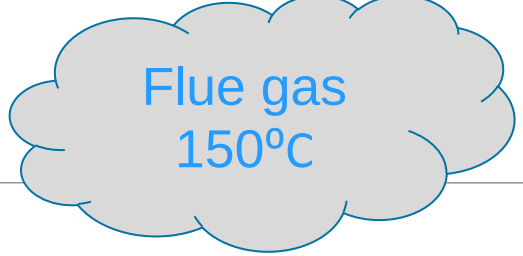
How does it work?

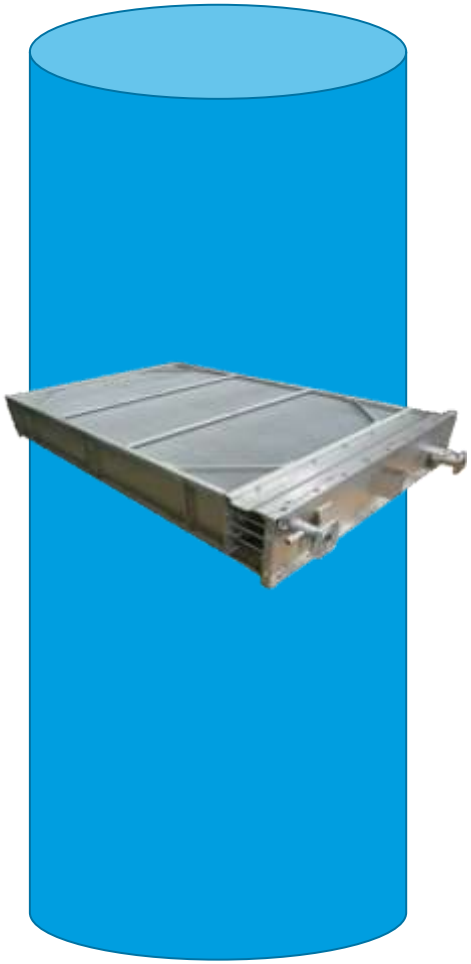


Schematic

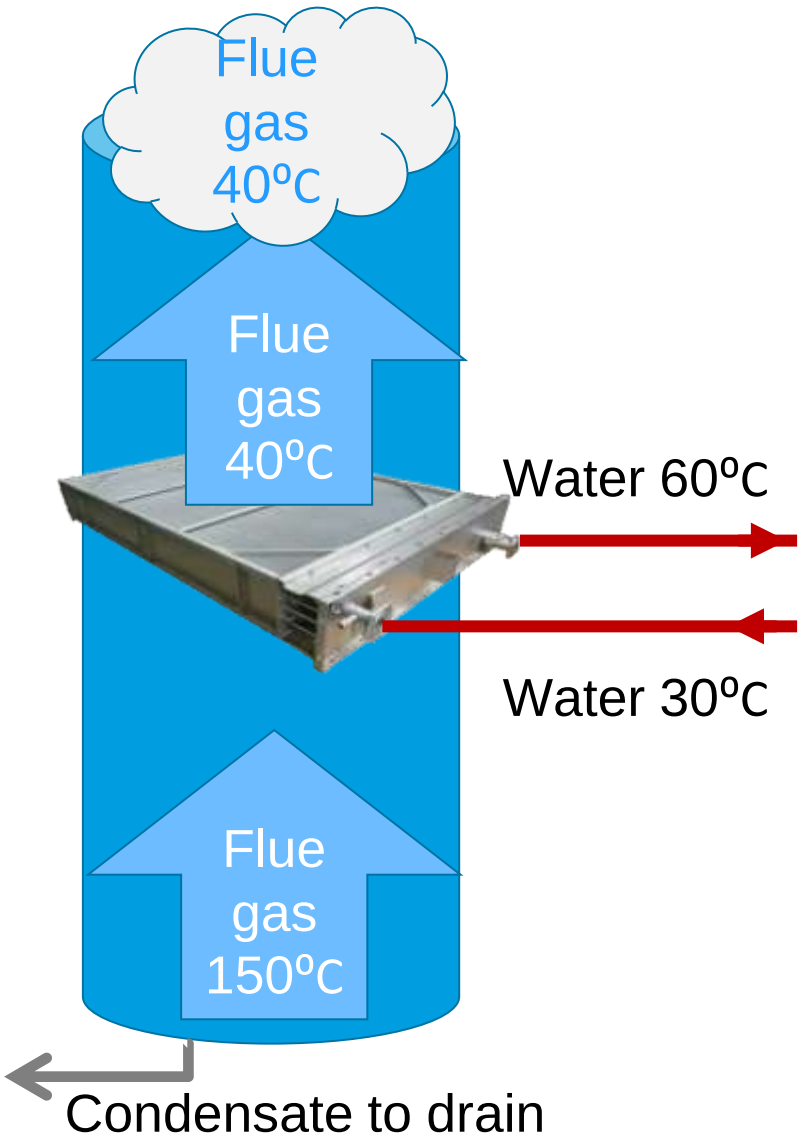


Schematic





Schematic



Applications:

1. Natural gas
2. Oil
3. Coal
4. Biogas
5. Biomass
6. Waste

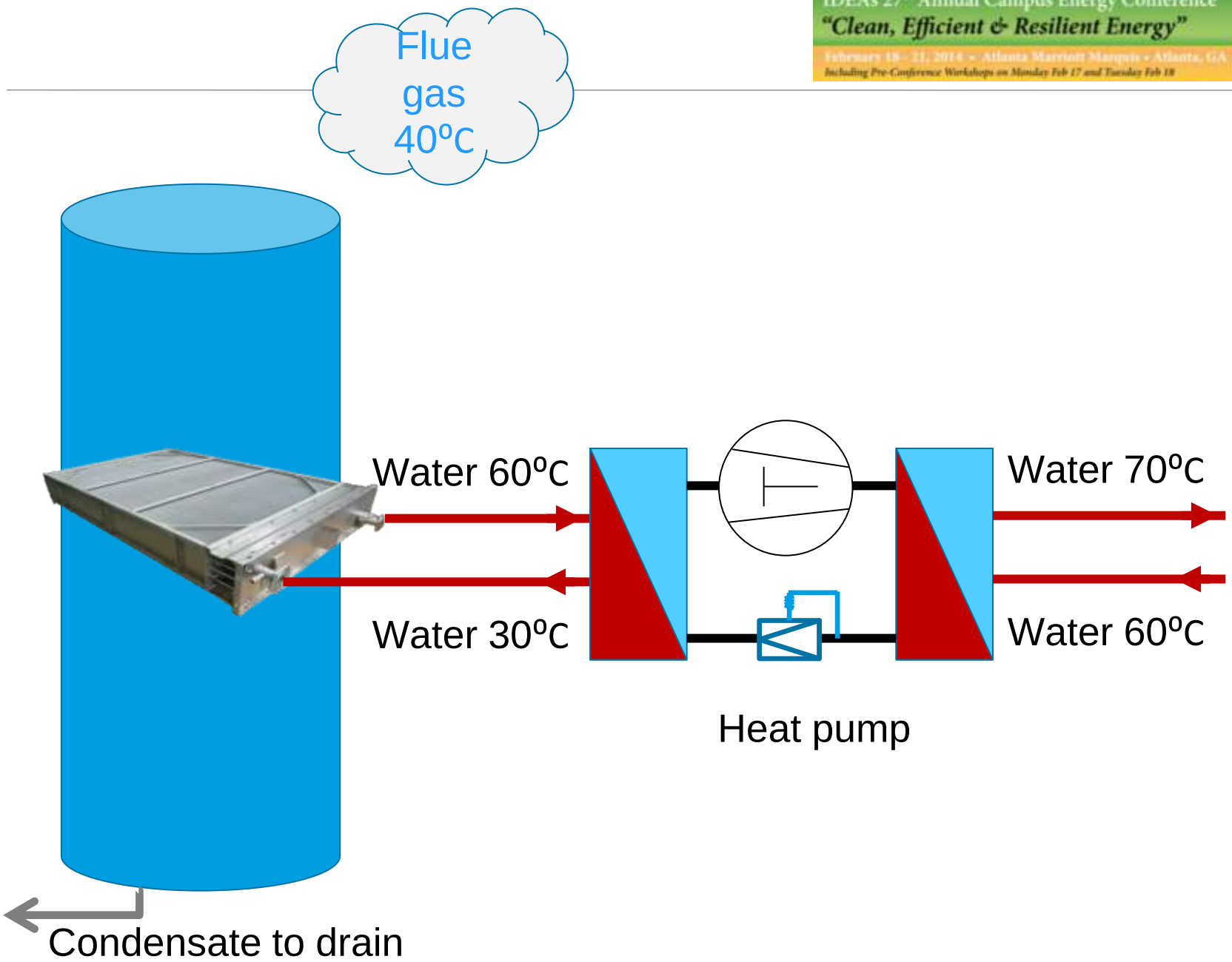
Low moisture content

High moisture content

Flue gas heat recovery

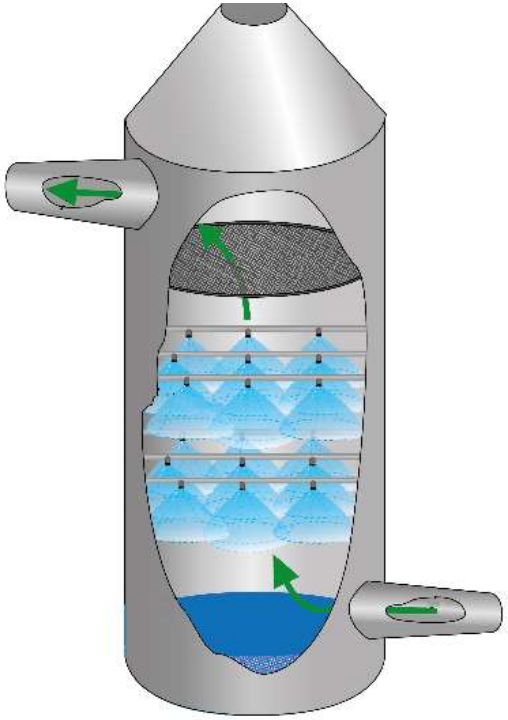
Flue Gas Temperature Leaving Condensing Economizer	75°F	100°F	125°F	150°F
Sensible Heat	6.46	5.75	5.03	4.31
Latent Heat	9.51	7.00	2.01	0.0
Total Available	15.97	12.75	7.04	4.31

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy


Flue gas 40ºC
Water 60ºC
Water 70ºC
Water 30ºC
Water 60ºC
Heat pump
Condensate to drain

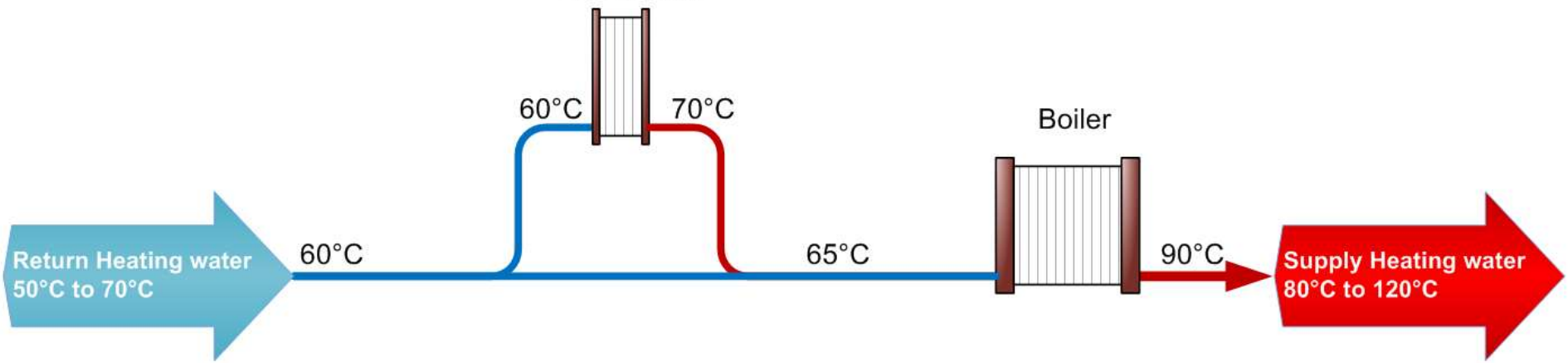
Flue gas condensate options

- Economiser option should be with:
  Coated aluminium fins with high temperature resistance
  (up to **400°C**)



- Wet scrubber system with corrosion proof material:
  SMO254 or titanium

System integration



Heat pump options

200 – 15,000 kW heating capacity

More than 200 reference projects

Ammonia

Up to 90°C water

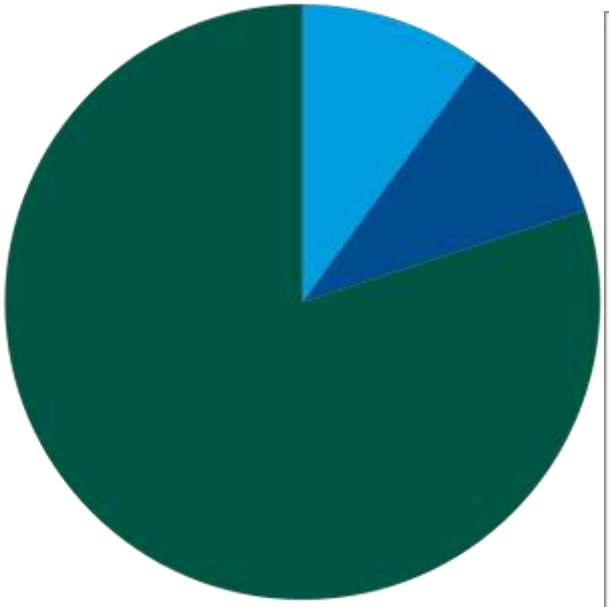
Highest efficiency
Best return of investment

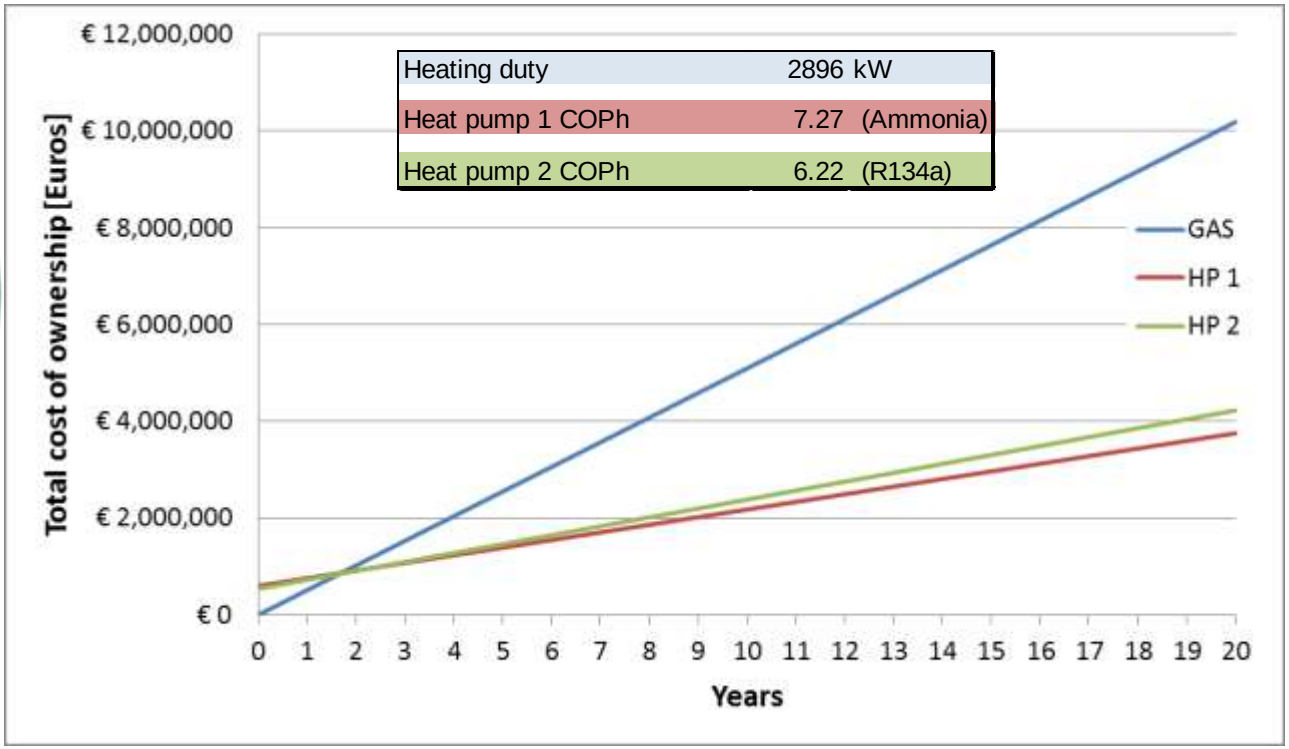
Why ammonia?

GWP = 0

Natural refrigerant = No risk of phase out (EU to phase out all HFC)

Highest efficiency = Lowest cost





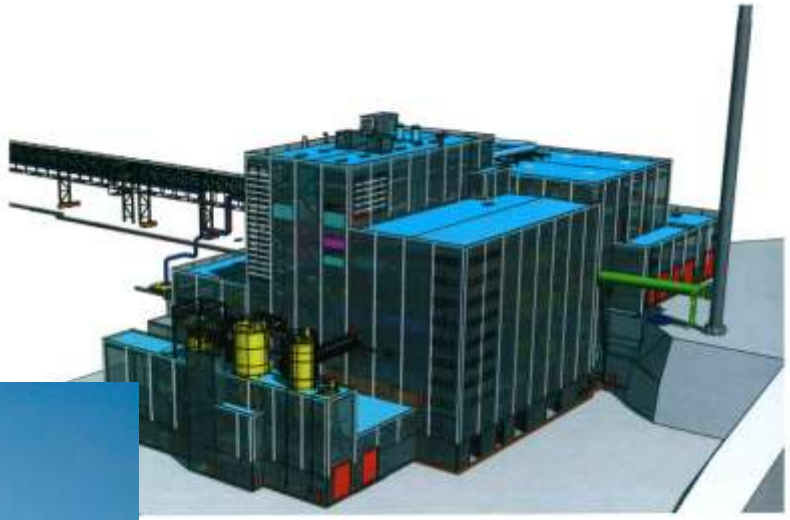
References for large installations

Heating duty	Run date	City	Country	Application	Heat source outlet temperature	Heating inlet	Heating outlet
kW		–	–	–	°C	°C	°C
7200	2013	Stockholm	Sweden	Waste incinerator	34	50	60
3080	2012	Sarpsborg	Norway	Biomass	23	60	75
2000	2010	Sarpsborg	Norway	Biomass	30	60	75
2800	2008	Odense	Denmark	Biomass (straw)	30	50	55

References

References

7,200 kW system installed in Sweden at a Waste incinerator plant in 2013. – COP 6.5



2,800 kW Heat pump installed in Denmark at a straw fired CHP plant in 2008 – COP 7.2

Stockholm 2013

Startup – November 2013

6,350 kW flue gas cooling + 750 kW oil cooling

High reliability 98% up time

Constant chilled water temperature – independent of heating temperature

Part of flue gas cleaning process to meet local emission regulation

3 years warranty

2 x 3,175 kW Heat pumps + 2 x 375 kW Heat pumps

Chilled water inlet temperature up to 60ºC

Hot water outlet temperature up to 72ºC

Heating COP above 6.5

Added benefit of flue gas condensation

- 20% more heat recovery
- COP heating above 6
- Payback of installation of 2 – 3 years
- Less particles in fumes
- Less plume
- Lower CO_2 emission per Kw output
- **Improved return of investment!**

engineering for a better world

www.gea.com