Electrification of Heating

Powered by Trane
Sustained by Nature

Heat pumps are classified by heat source and heat distribution system

- Air to Air

- Air to Water

- Water to Air

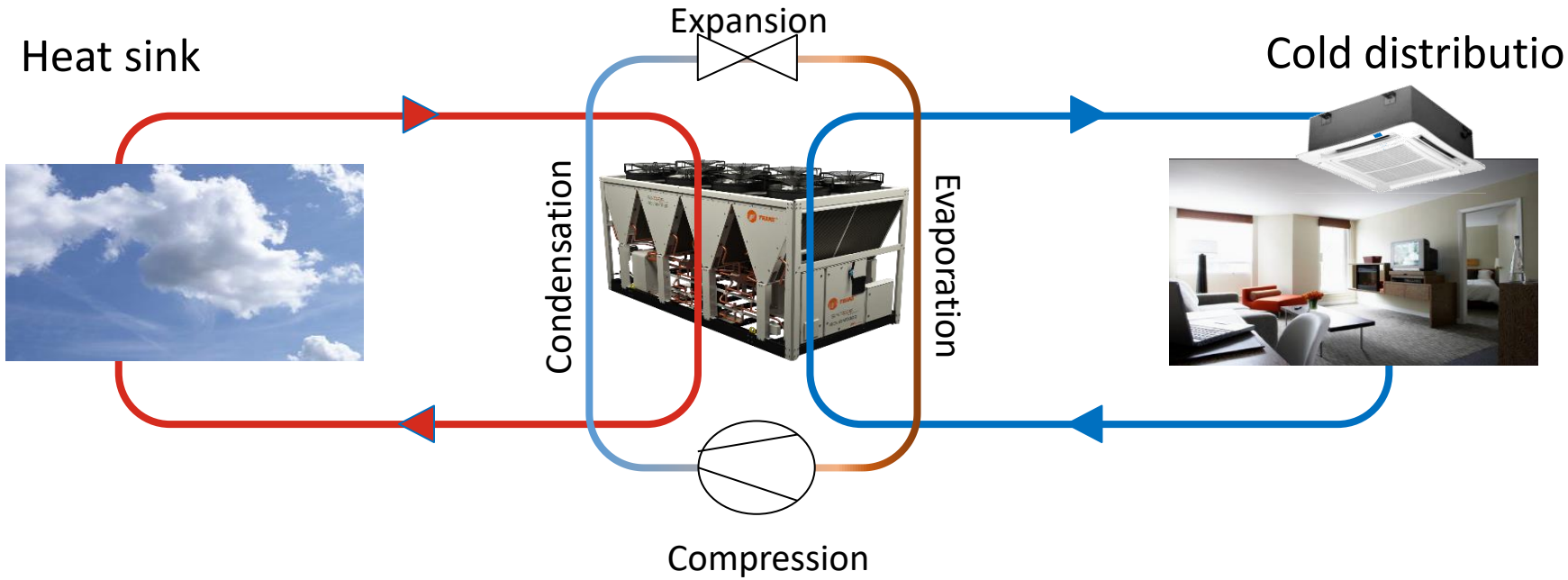
- Water to Water

Heat pumps transfer (move) energy very effectively

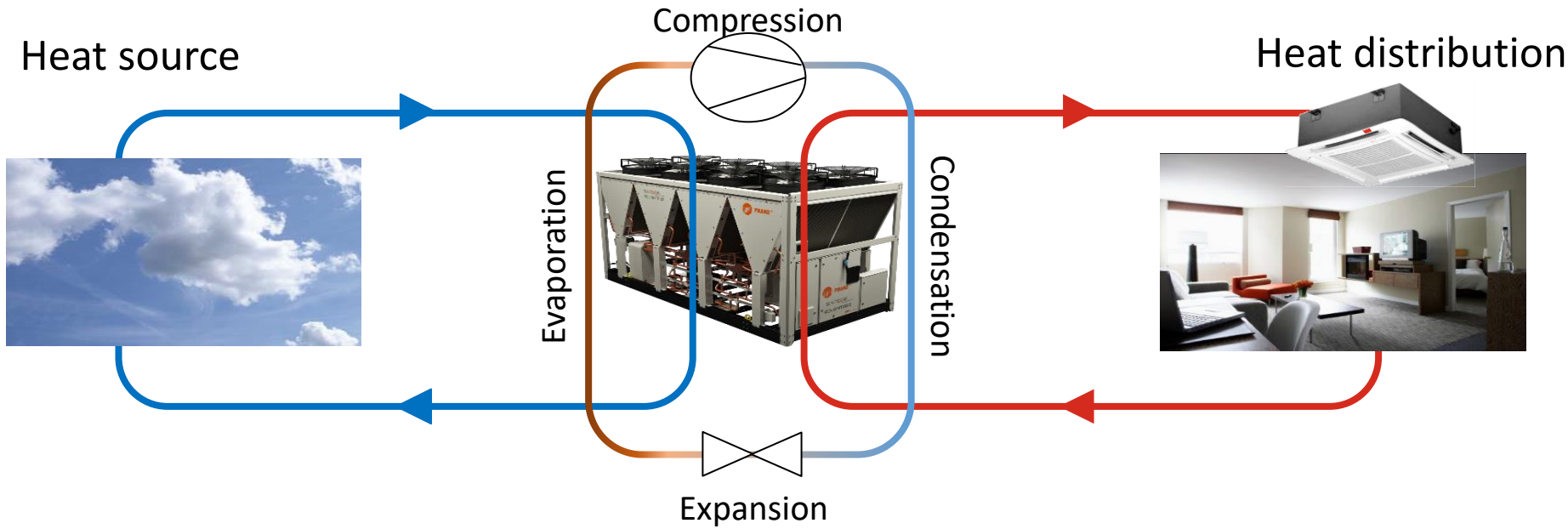
They typically have an average coefficient of performance (COP) In the order of 2-5 depending on operating conditions.

In other words they move multiple units of heat energy per one unit of electrical input

Working Principle – reversible heat pump



Summer



Winter

Air-to-water application overview

Trane's portfolio

CGAF
RTAF
GVAF

CGAF or RTAF
-PHR
-THR

Chiller + Heat Recovery

CXAF

Heat Pump

RTXC
CXAF
-PHR

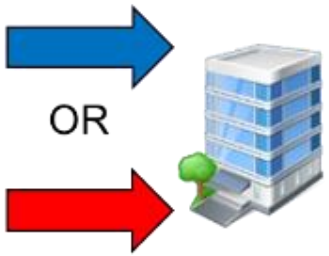
Heat Recovery
Heat Pump

CMAF

Multi-pipe

Cooling only

Heating while Cooling



Heating or Cooling

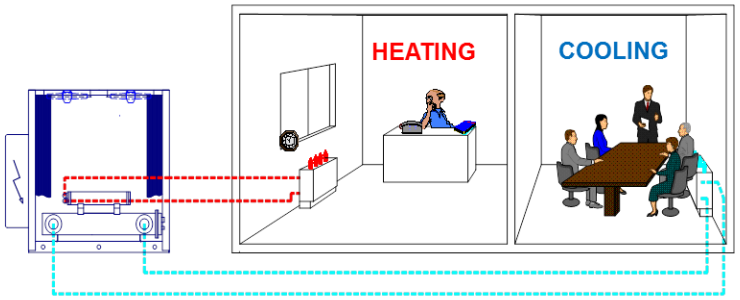
Heating while Cooling
Or
Heating/Cooling

Any combination

The most versatile and flexible portfolio of Air-to-Water Heat Pumps

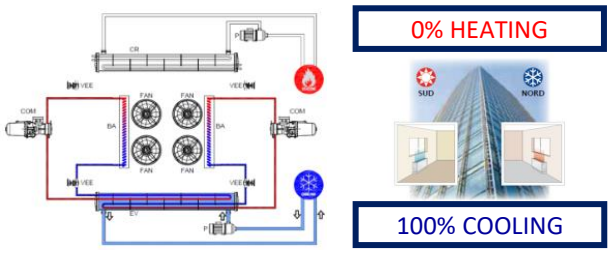
What is a Multi-pipe unit ?

Heating & Cooling demand at same time



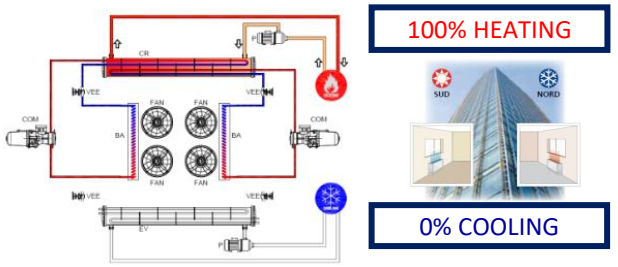
Operating modes:

Chiller



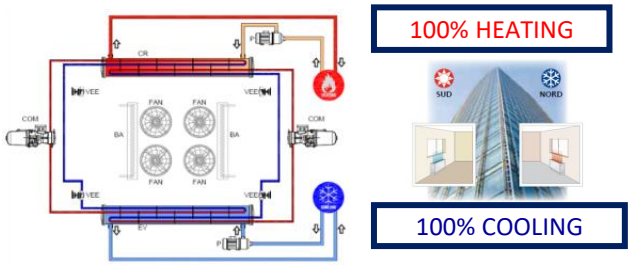
Condenser only disposes of heat

Heat Pump



Evaporator not utilized
Separate HX for hot water

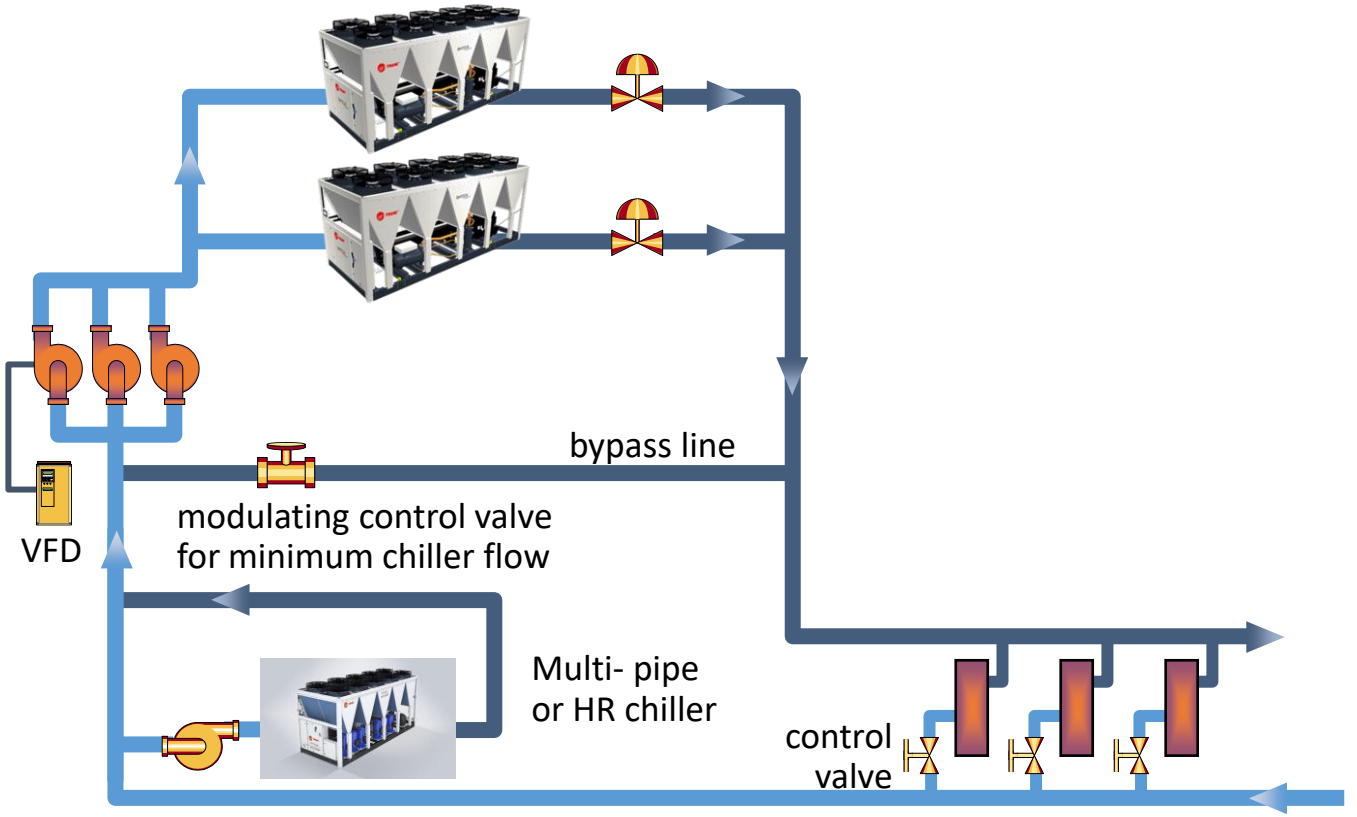
Chiller + Heat Recovery



Condenser & evaporator fully utilized for cooling/heating needs

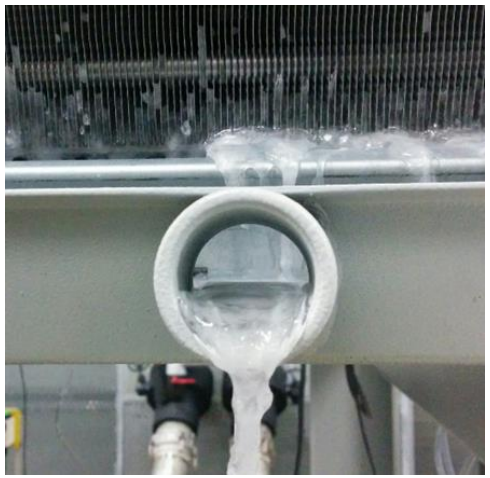
- Heating , Cooling , plus **simultaneous** heating and cooling
- Different to traditional heat pumps as there are separate heat exchangers for CHW and HW production
- **Combines an A-W H/P with a W-W H/P within the same unit**

Preferential loading is desirable when applying heat recovery where heat energy can be recovered from the cooling demand. Side-stream location also permits application in a VPF system.



Boilers vs heat pumps / defrosting

- When ambient air temperature is low (below 6ºC) and the relative humidity is high, the heat pump coils will condense moisture and freeze up



- **Defrost cycle is:**
  - Reversing the refrigerant cycle of the circuit (with 4-way reversing valve)
  - Once back in cooling mode the hot gas will flow through the condenser coils and ensure the coil defrosting

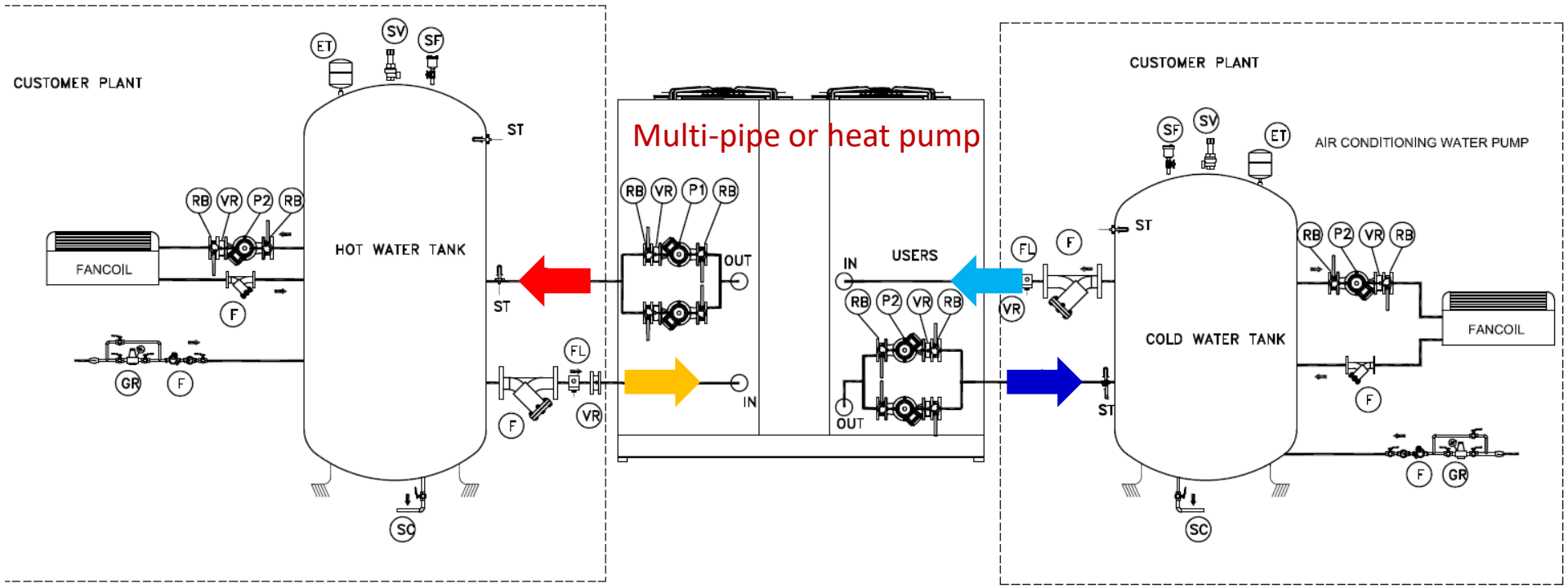
- **Defrost time and defrost cycles depending:**
  - Ambient air temperature and relative humidity
  - Heat pump load
  - Air flow over the coils.
  - Maintenance condition of unit

- **Heat pump refrigerant circuit in defrosting cycle is <u>NOT</u> providing heat to the hot water loop**
  - *.... there is no magic. Valid for all manufacturers*

Hydraulic System

Hot water circuit

Chilled water circuit

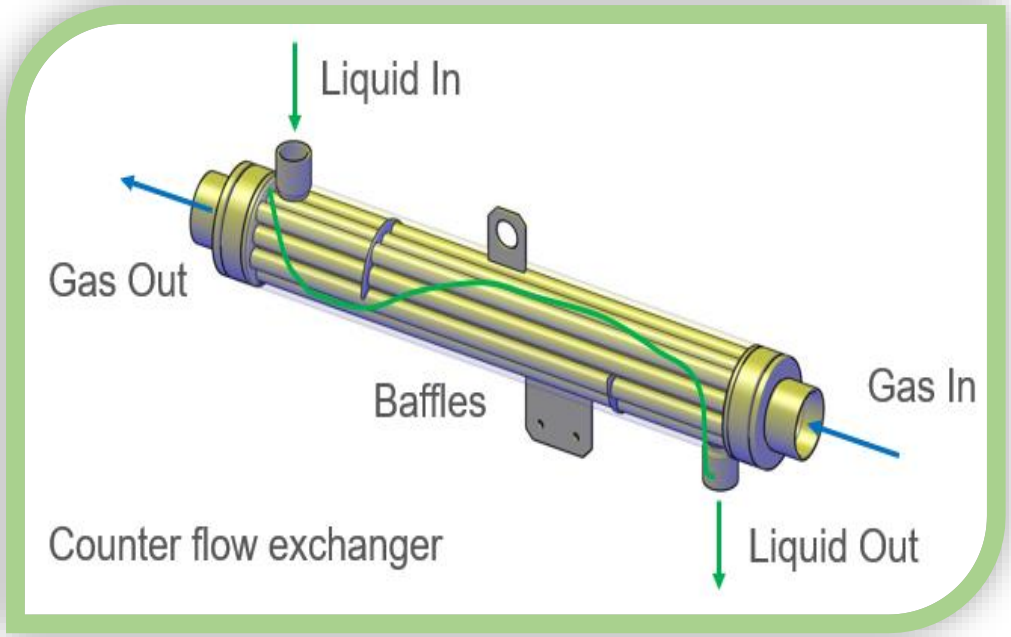


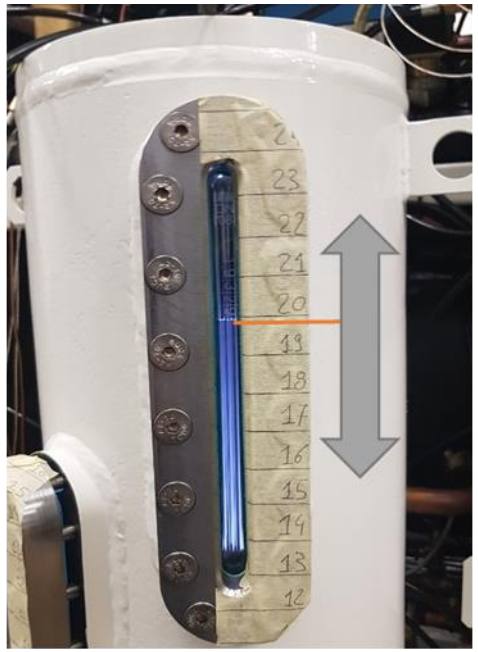
Rule of thumb: Minimum water content in hot water circuit = **3x** chilled water circuit

Based on ΔT of 5°C on the heat exchanger . IOM provides very good info on this

Heat pump system designs need to consider defrost cycles

Innovative technologies exist to improve defrost performance





Dynamic Receiver

Varying refrigerant level in TARS

4-6 row

Traditional building cool/heat system

Chiller for cooling

Gas Boiler for heating

1 row

6 C

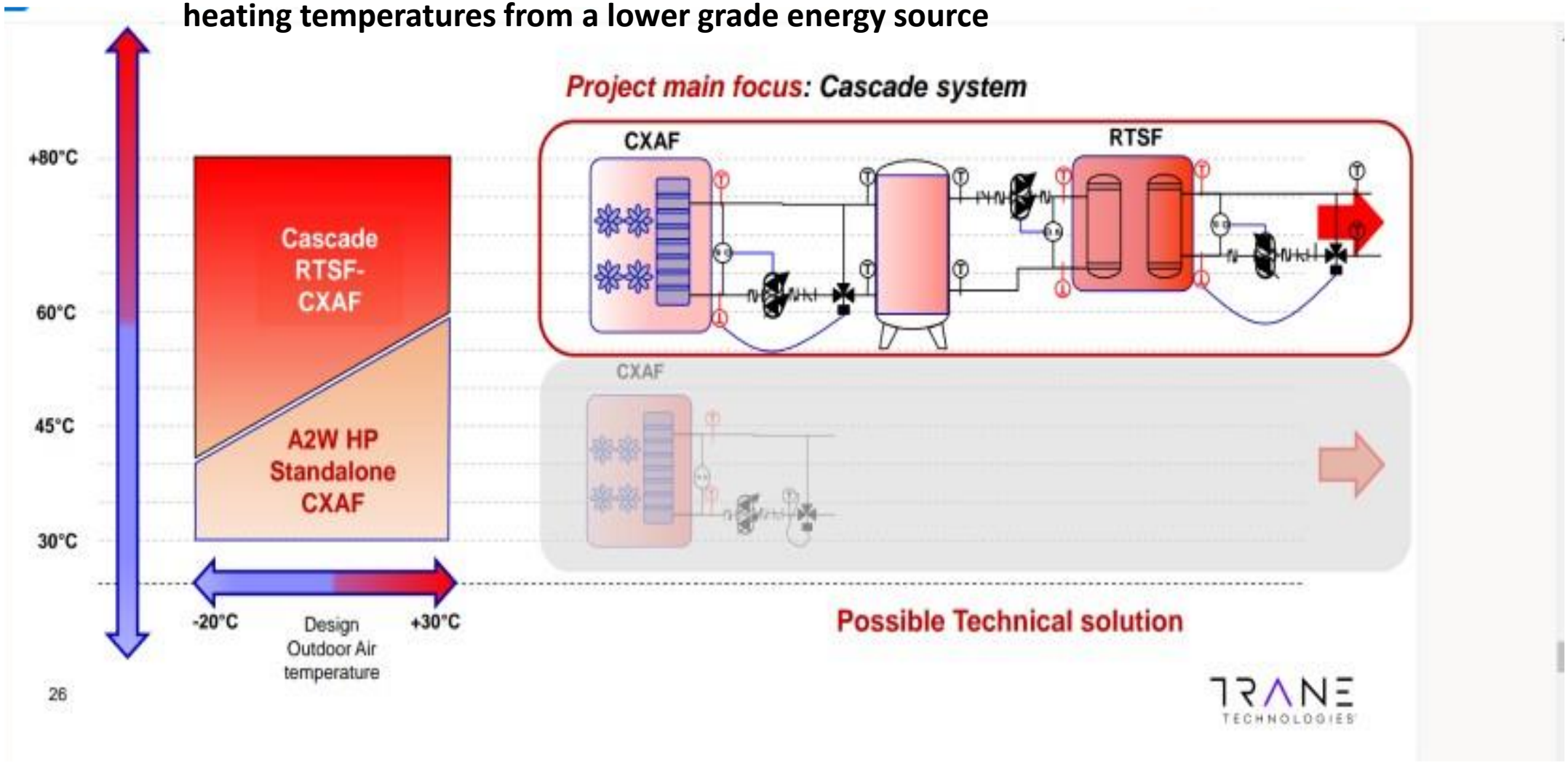
14 C

80 C

60 C

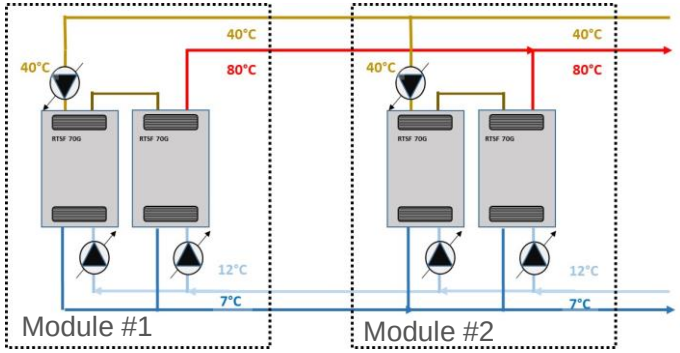
What is boosting ?

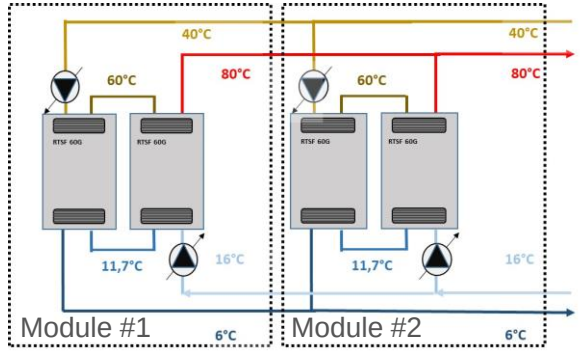
Boosting installs a high temperature water to water heat pump
In cascade with an air to water heat pump to produce “boiler grade” 70-80 C heating temperatures from a lower grade energy source

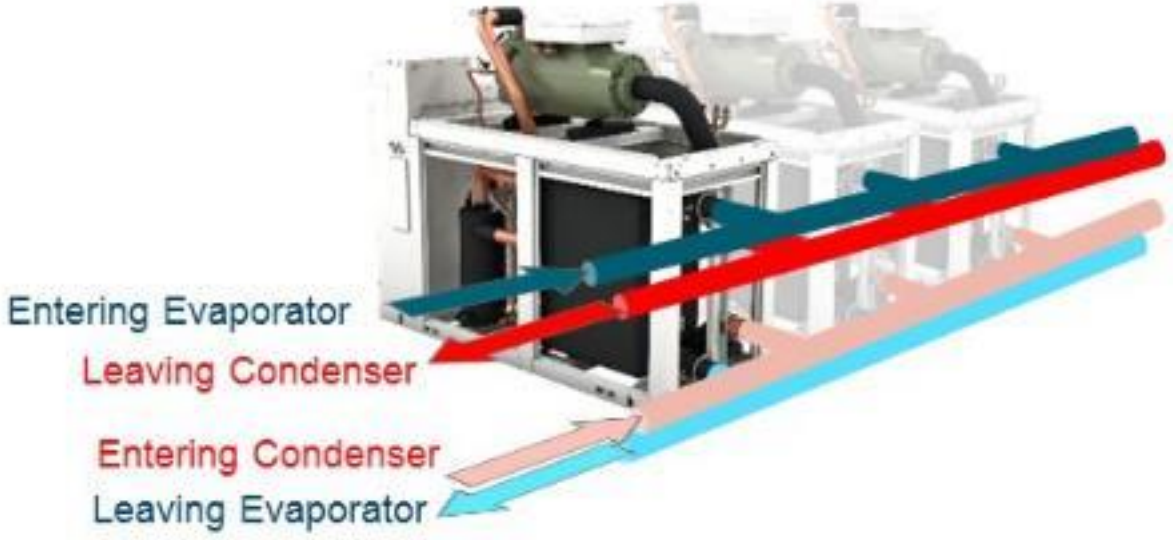


Water to Water heat pumps (R1234ze) provide up to 70-80 deg C

Flexibility for a wide range of flow rates and delta T’s







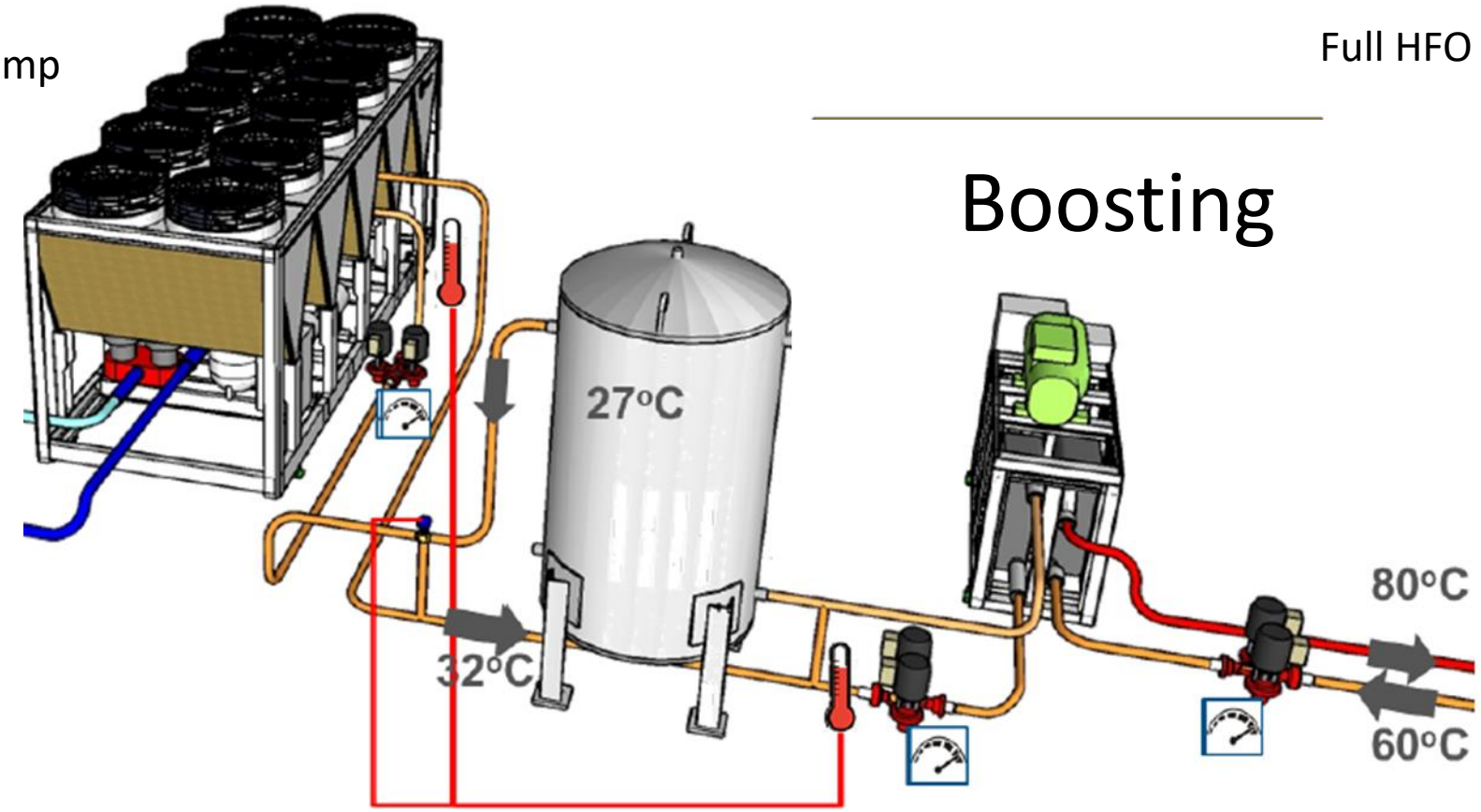
Easy for retrofit application

Buffer tank provides loop volume for defrost and/or mode changes

A-W Heat Pump
OR
Multi-pipe

Full HFO solution

Boosting



Boosting to equivalent boiler temperatures

Design ambient 7 deg C

35C

30C

35C

30C

80C

60C

Air to water heat pump
4.28 COP

Water to water heat pump
3.71 COP

System COP = 2.22

Air to Water heat pump efficiency depends on ambient temperature and heating water temperatures.

Water to Water heat pump efficiency depends on cooling water and heating water temperatures.

Boosting with heating water reset
(match supply temperature to part load /off design demand)

Off- Design ambient 16 deg C

35C

30C

35C

30C

45C

25C

Air to water heat pump
5.32 COP

Water to water heat pump
7.3 COP

System COP = 3.35

What impacts CO2 reduction when moving away from Gas Heating ?

- Carbon intensity of the source energy
- Water temperatures used for heating
- Equipment / System efficiencies