



TRANE®

**Evolution for a better
World**





A quick introduction...

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Product Portfolio Leader Europe – Applied Products

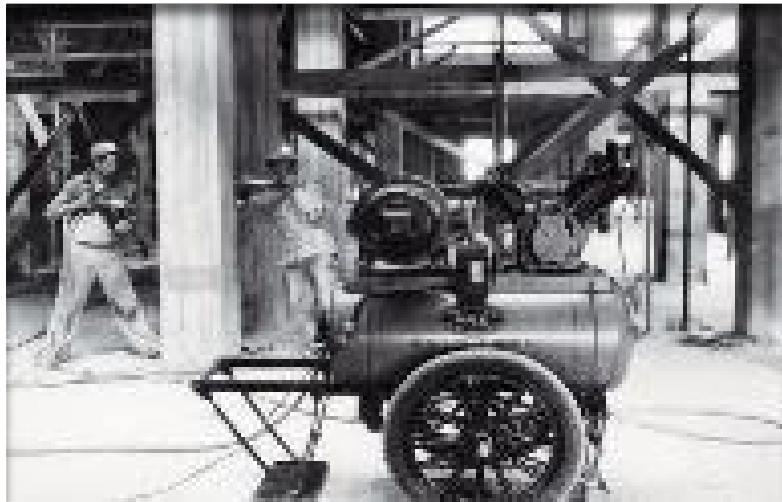
Field Background

1990 – 2014 Sales / Country Leader Netherlands & Scandinavia



INGERSOLL RAND: OUR COMPANY

A rich legacy serves as the foundation for the next 100 years.



Innovating for 147 years

- Founded when Simon Ingersoll patented the steam-powered rock drill in **1871**.
- The **Ingersoll Rand** Company was first incorporated on June 1, 1905.
- Acquired **Trane** (established 1885) in June 2008.



Company headquarters

- Incorporated in Swords, Ireland.
- North American Headquarters and Corporate Center in Davidson, North Carolina.



A global company

- More than 44,000 employees globally.
- A total of 894 facilities around the world, including 53 manufacturing facilities worldwide.
- Trane Owned Sales Offices: including Israel: as stable as Trane chiller lifetime



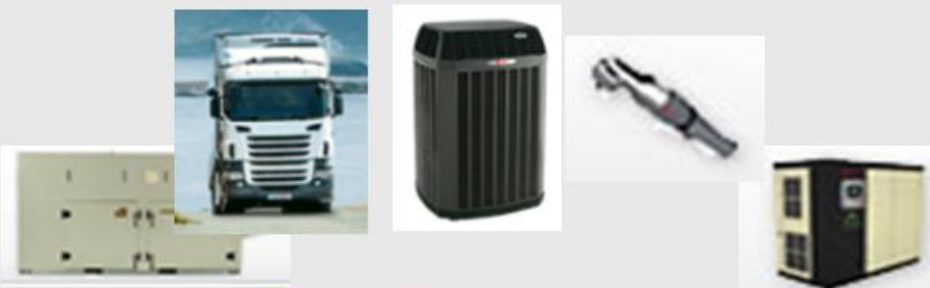
Traded on NYSE

- Listed (NYSE: IR) since **1906**.

Ingersoll Rand Climate Commitment (2015)

Reducing Greenhouse Gas Emissions

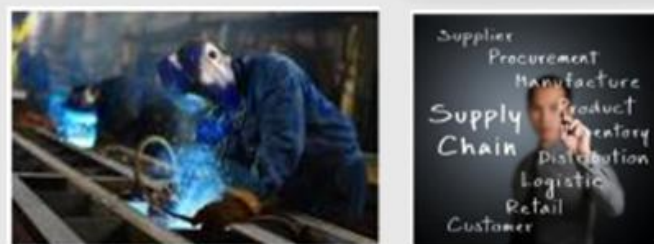
Our company is helping to solve some of the world's most pressing challenges – including the unsustainable demand for energy resources and impact on greenhouse gas emissions.



Our Products

50% reduction in GHG via:
1) increased energy-efficient products; 2) use of next generation refrigerants with lower GWP in refrigerant-based products by 2020

50%



Our Operations

35% GHG reductions in our office buildings, manufacturing facilities and fleet by 2020

35%



Market Leadership and Convening

\$500M in research to promote energy efficiency & solve refrigerant gaps via innovation, research, testing, policy over the next 5 years

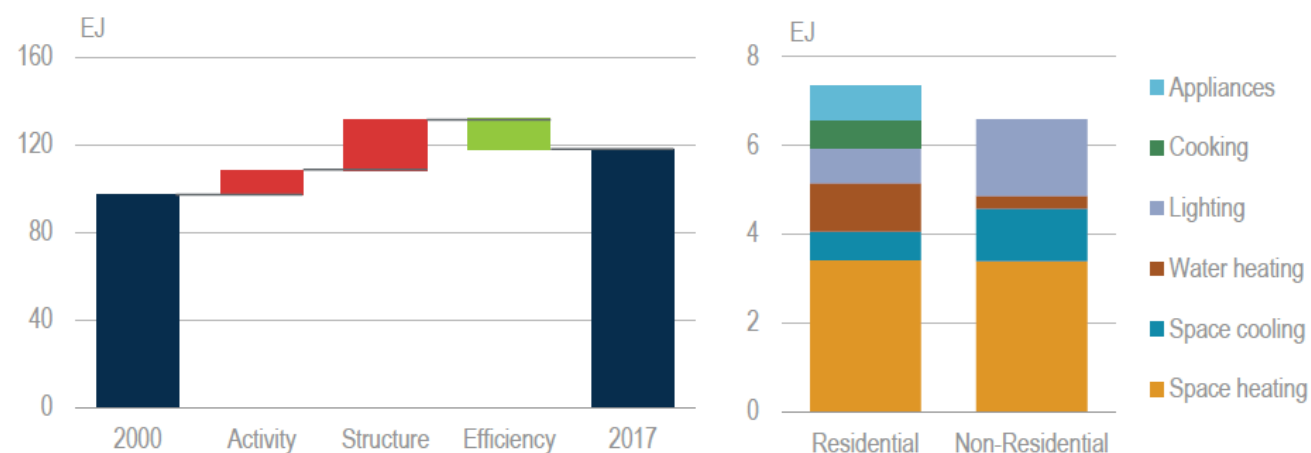
\$500M



Building energy use covers 30% of all Global Energy usage

Good news: Significant energy efficiency savings (-12%) counter the impact of building intensity....

Figure 3.1 Decomposition of buildings global final energy use, 2000-17 (left) and end-use contribution to efficiency savings in residential and non-residential buildings, 2000-17 (right)

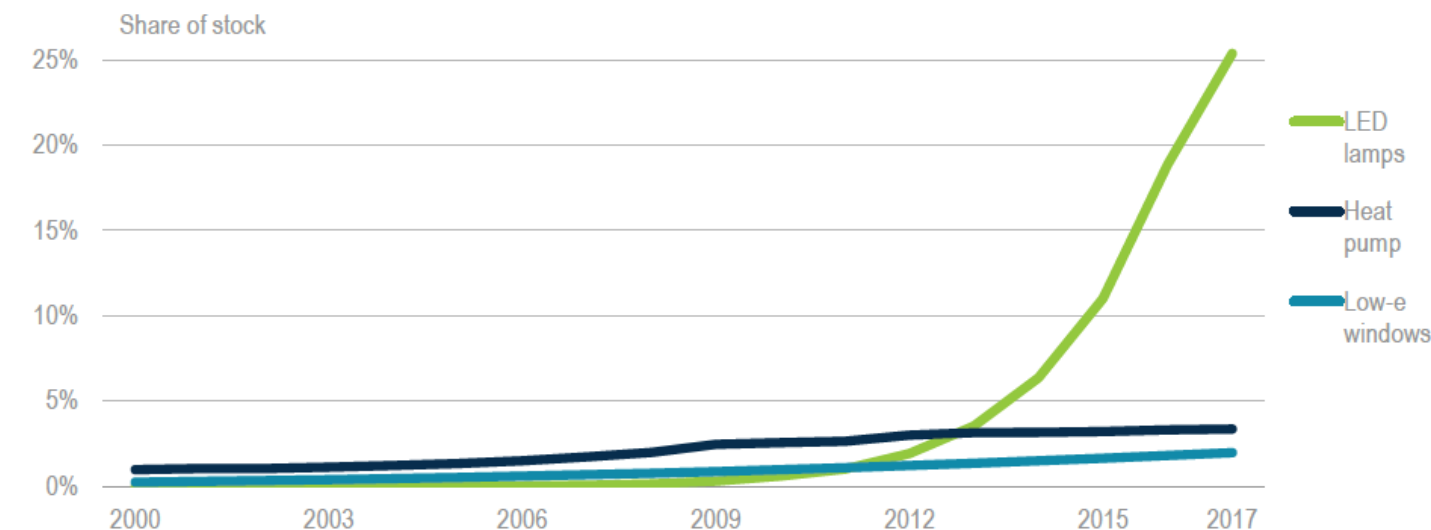


Note: Non-residential buildings in this analysis exclude other non-core buildings services (e.g. business services, computers, data centres), which are included in the industry and services decomposition analysis in Chapter 4.

Sources: Adapted from IEA (2018a), *Energy Efficiency Indicators 2018* (database) and IEA *Energy Technology Perspectives Buildings model* (www.iea.org/etp/etpmodel/buildings/).

... mainly lead by.... LED...

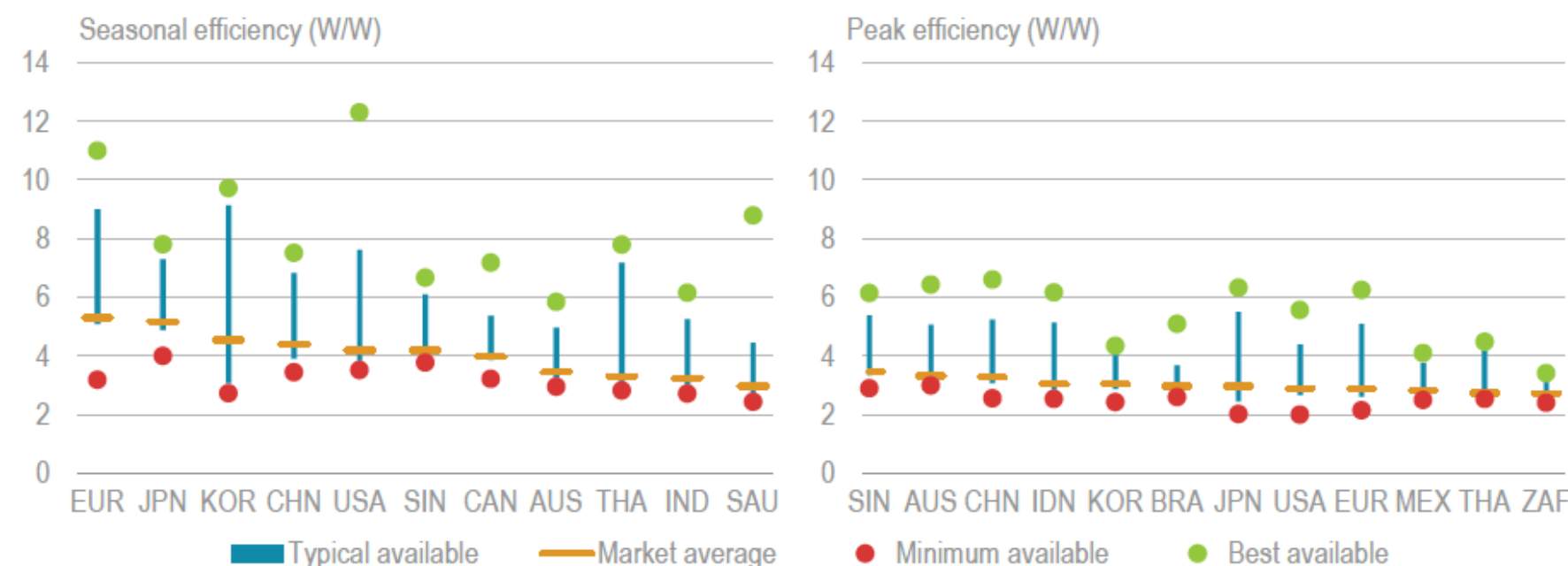
Figure 3.9 Share of stock in buildings for key energy efficient technologies



Sources: Adapted from IEA *Energy Technology Perspectives Buildings model* (www.iea.org/etp/etpmodel/buildings/) and Selkowitz (2014).

... leading to a nice opportunity for the HVAC industry!

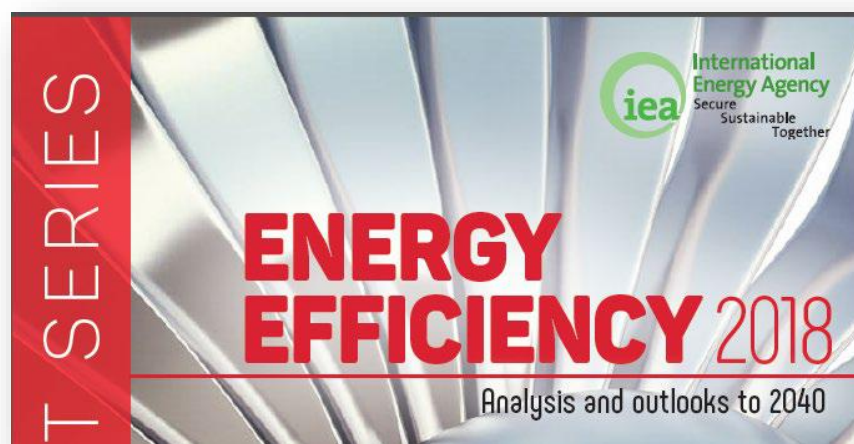
Figure 3.11 Energy efficiency performance for small cooling equipment by country, 2018



Note: Seasonal efficiency is typically reported as SEER and peak efficiency is typically reported as EER. EER and SEER values for each country are not always comparable due to different testing procedures to determine the efficiency ratios.

Source: IEA (2018b), *Global Exchange on Efficiency: Cooling*.

Source: IEA





Legislative Levers moving the industry:

❖ Energy Efficiency: EcoDesign

❖ F Gas conversion: F Gas Regulation / Kigali



Ecodesign for Chillers

Ecodesign Framework Directive 2009/125/EC

The four main objectives :

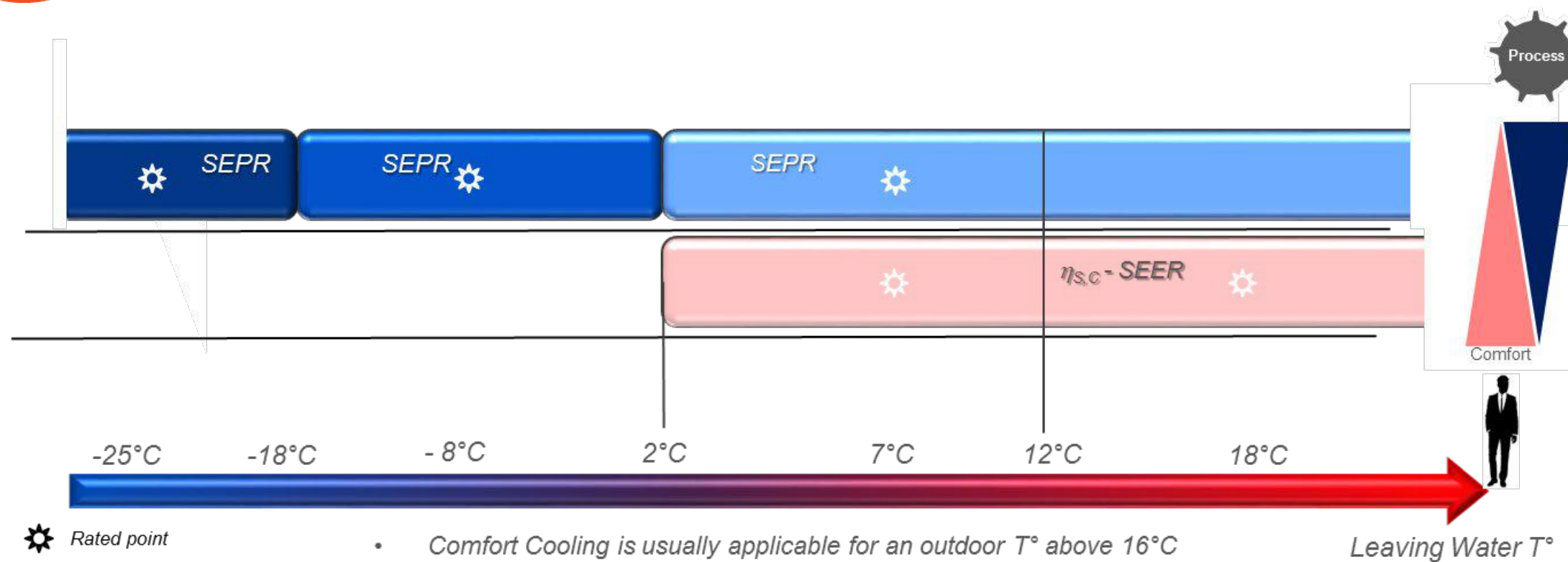
- Ensure the free movement of energy related products within the EU
- **Improve the overall environmental performance of these products and thereby protect the environment**
- Contribute to the security of energy supply and enhance the competitiveness of the EU economy
- Preserve the interests of industry, consumers, and other stakeholders





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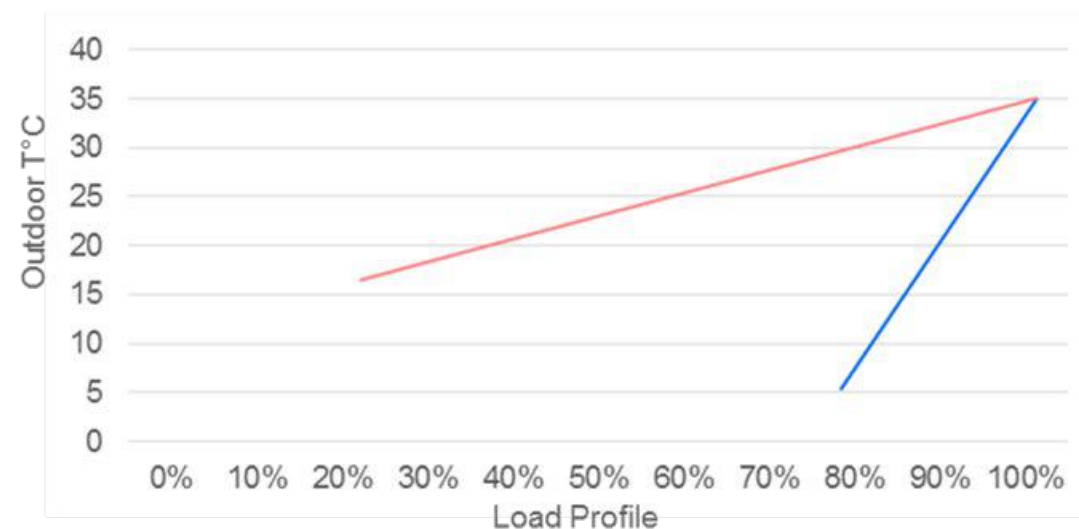
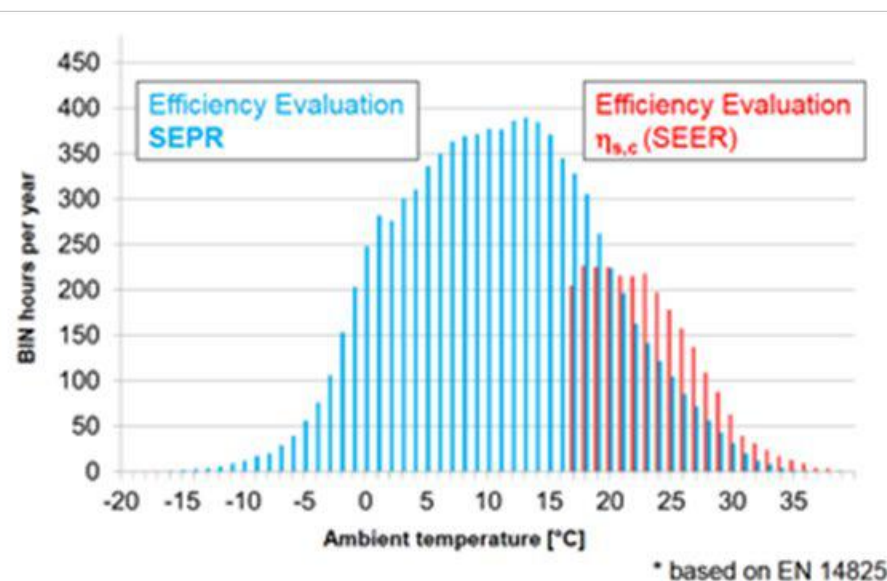
Ecodesign: New Seasonal Efficiency definitions



Comfort: SEER, rating point 7C
Process: SEPR, Med Temp: RP -8C
Process: SEPR, High Temp: RP 7C

SEER: Seasonal Energy Efficiency Ratio
SEPR: Seasonal Energy Performance Ratio

➤ Ecodesign is pushing for Seasonal Efficiency



Kigali Amendment

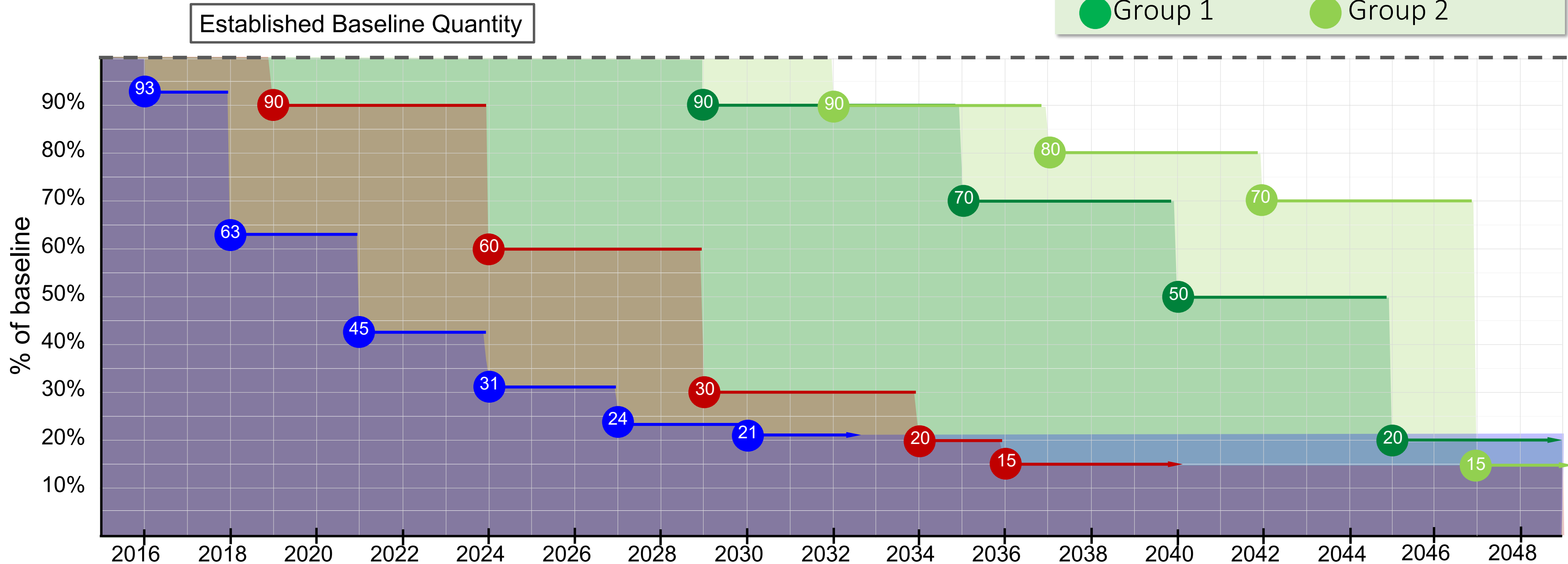
Pathway for a global phase down of HFCs

October 15, 2016

- Developed (non-Article 5) Countries:
- European Union (EU)

Developed Nations (incl Israel)
- Developing (Article 5) Countries:
- Group 1

Group 2



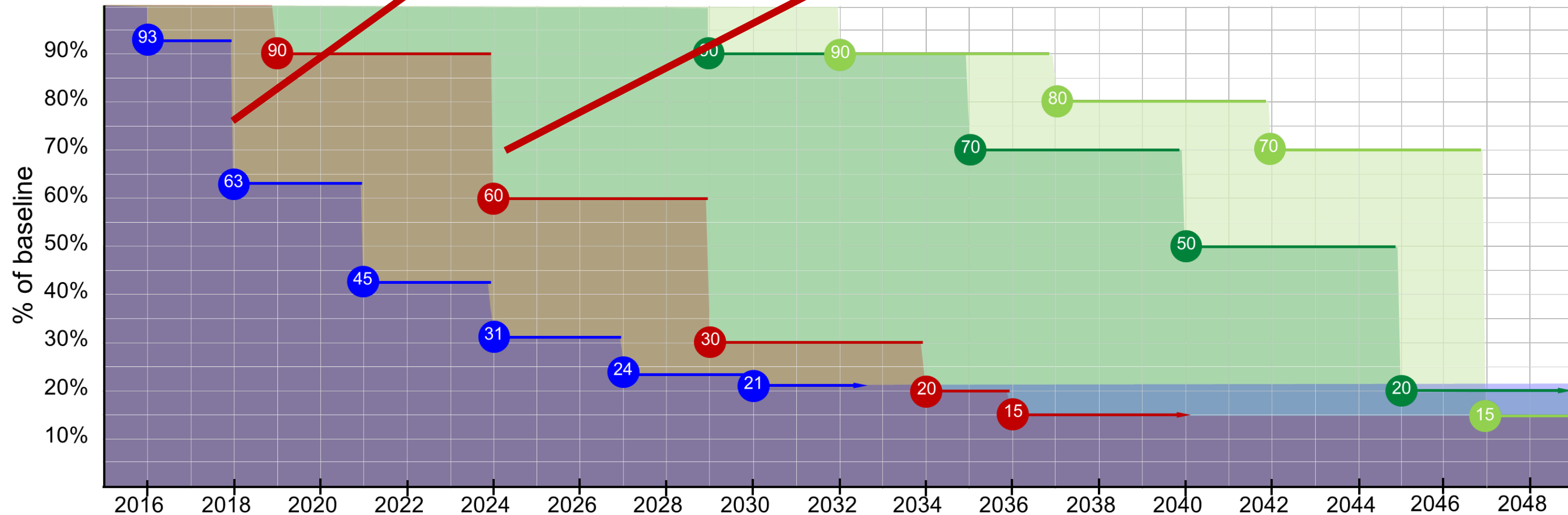
Cap-and-phase-down of HFCs starting in 2019 for developed nations



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Lessons learnt: Chemical Industry
uses Price / costs based on GWP /
refrigerant

Israel: it is coming: be prepared..





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Three pillars for Sustainable solutions:

- Energy efficiency / energy avoidance
- Electrification of Heating
- GWP reduction of refrigerants

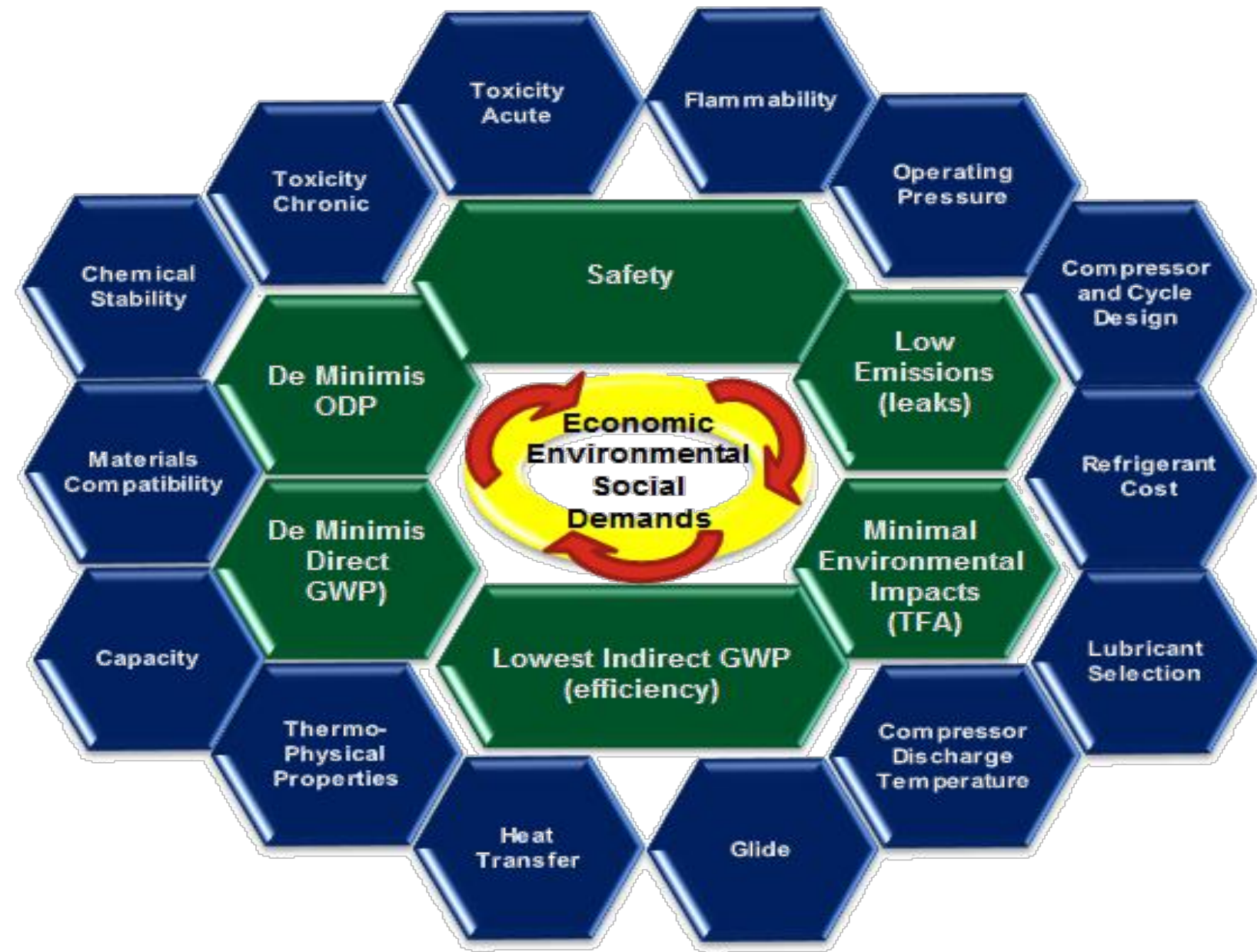




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NEXT-GENERATION REFRIGERANTS

More variables; balancing offers challenges



New refrigerant selections are a balancing act

- safety
- efficiency
- system requirements
- any possible impact to environment

There is no “ideal” solution, but some solutions come close to it



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NEXT GENERATION REFRIGERANT COMPARATIVE

Past

Transitional

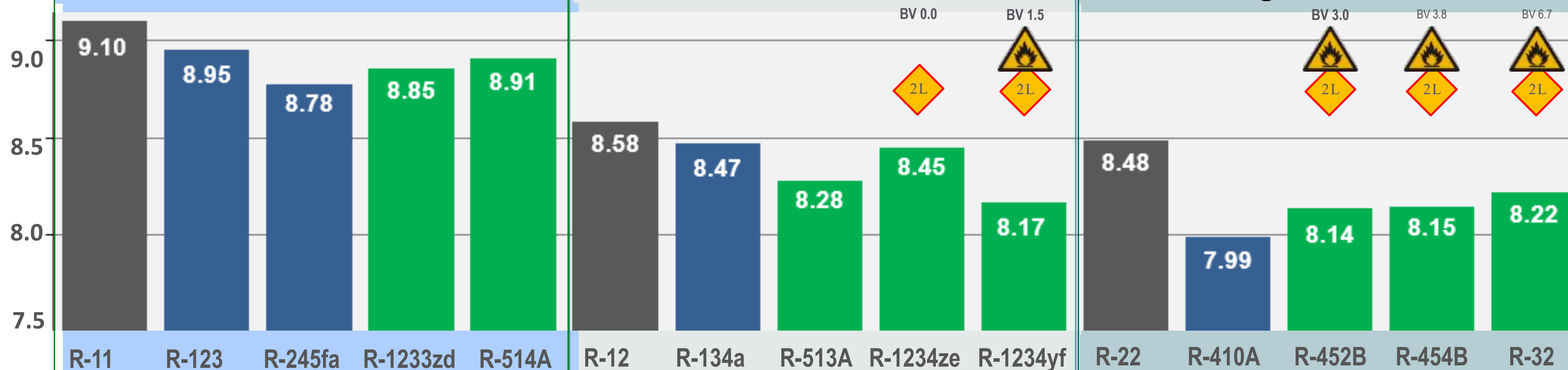
Future

Refrigerant Efficiency
(COP)
All variables held constant for comparison

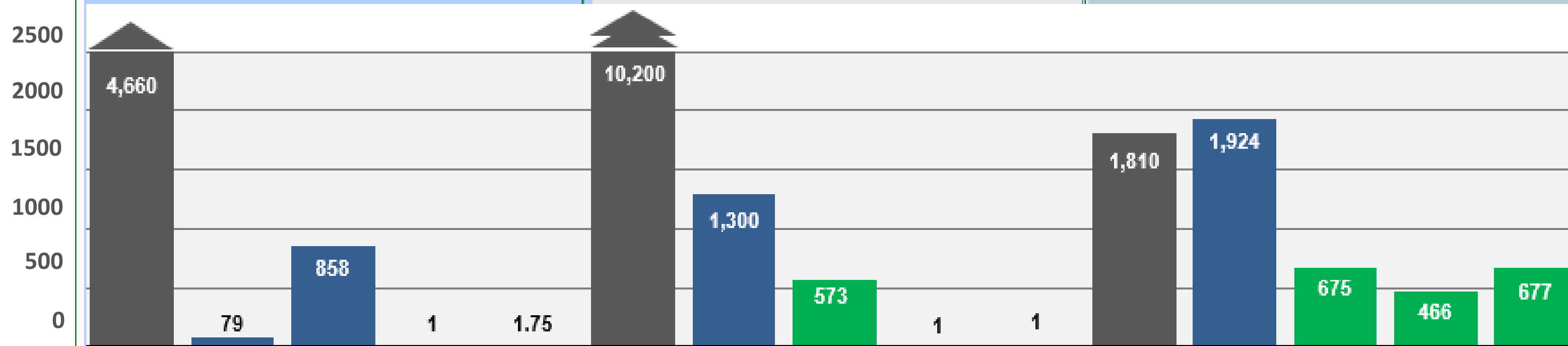
Low Pressure

Medium Pressure

High Pressure



Global Warming Potential
(GWP: CO₂ = 1.0)



BV represents "Burning Velocity" of 2L refrigerants; range from 0-10 cm/sec.

Industry choices offer options & trade-offs; New options being investigated



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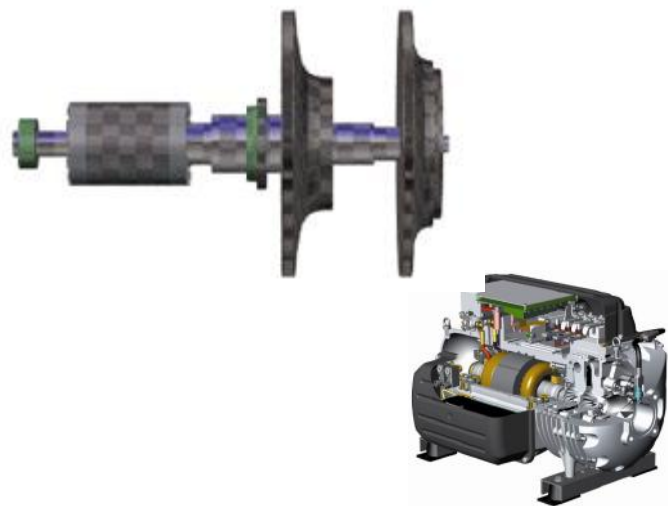
Technology / Applications / Refrigerants



Scroll: Compact / high pressure / limited capacity per compressor / mainly on off
(Smaller) Office buildings / retail



Screw: Robust, up to 1800kW/ compressor, capacity control per compressor, variable Vi
requires slide valve
Larger Office buildings / Healthcare / Process



Centrifugal: Robust, up to 7MW/compressor, speed converts to pressure: limitations
mainly at part load, but variable Vi by nature
Largest Office Buildings / Healthcare / Datacenters / “low lift” process



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Technology / Applications / Refrigerants



R410 / R407c => ??? (R32 / R452B / ??) : Medium GPW of 600 – 700, mildly flammable



R1234ze: **GWP<1**, -25% capacity, PED: Not flammable (room temp) / ASHRAE: Mildly flammable (60C)

R513A: **GWP 573**, no capacity drop, not flammable



R1234ze (High Speed Centrifugal compressor)

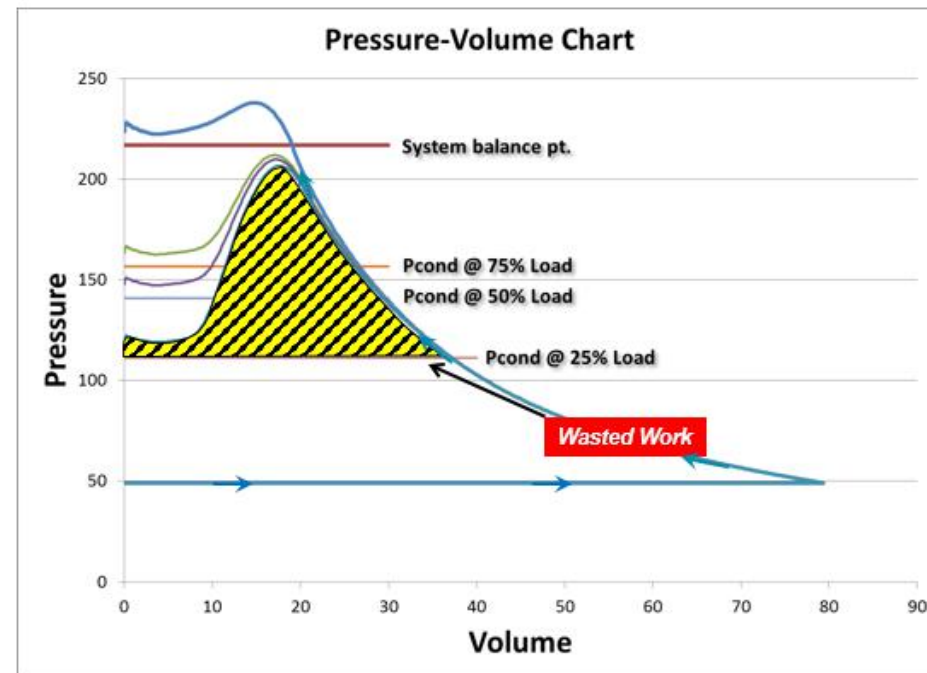
R1233zd (Low Speed Centrifugal compressor: **GWP =1**)

R514A (Low Speed Centrifugal compressor: **GWP <2**)

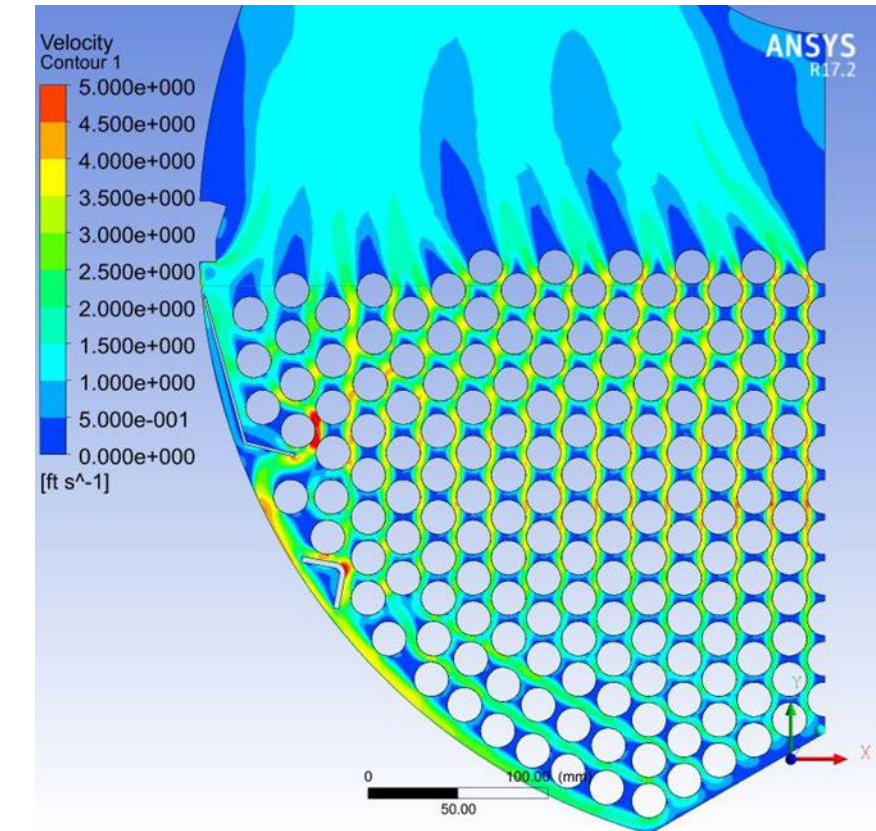
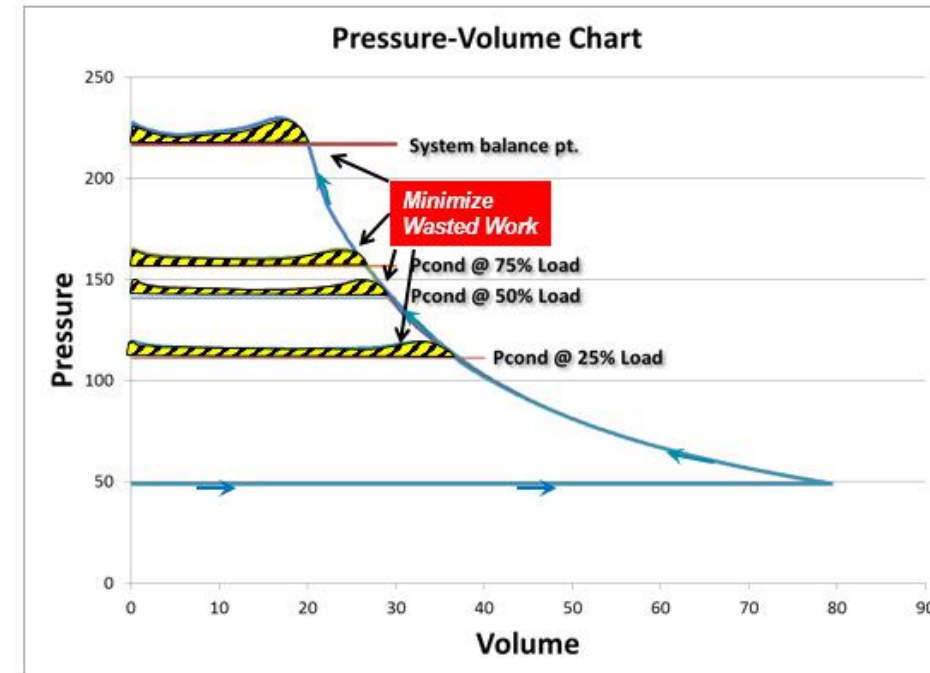




New Technologies answering new requirements



Variable Vi at Screw compressors
Avoiding waste of compression work (+10 – 15% SEER)



Highly Compact evaporators (CHILL)
-30% refrigerant charge



TRANE®

SINTECIS™ FAMILY

SINTECIS™ ADVANTAGE

R410A



CGAF/CXAF

Scroll compressors

Lowest first costs

SINTECIS™ PRIME

R1234ze

R134a

R513a



RTAF

Durable – legendary screw compressors
Runs at any condition

SINTECIS™ EXCELLENT

R134a

R1234ze

R513a



GVAF

High speed centrifugal compressors

Best efficiency

Maximum performance at
moderate temperatures



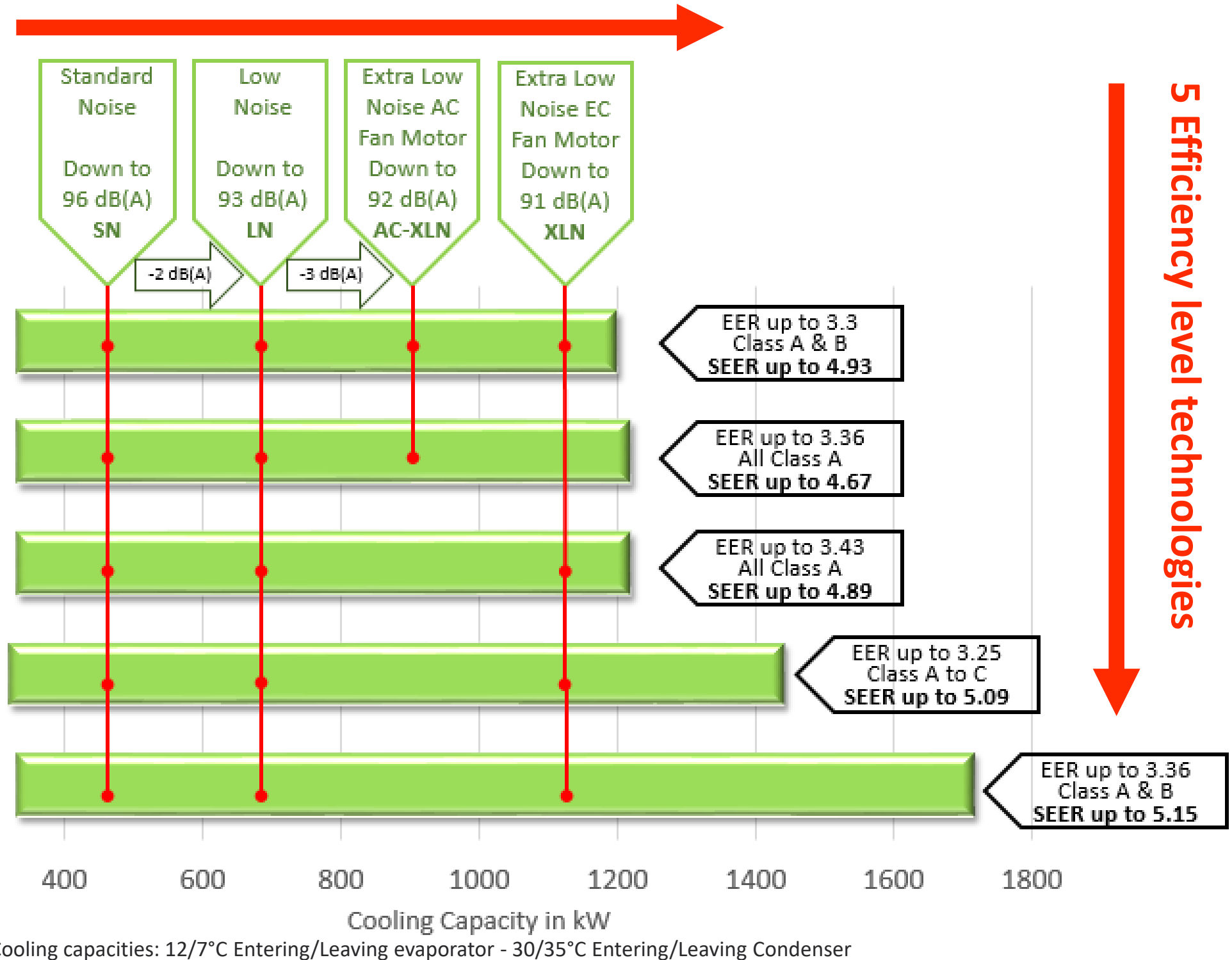
TRANE®

SINTECIS™
PRIME



- Standard Efficiency SE
- High Efficiency HE
- Extra Efficiency XE
- High Seasonal Short HSS
- High Seasonal Efficiency HSE

4 noise level technologies



Maximum Flexibility



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Sintesis™ platform options

Energy avoidance / re-use

Partial Heat Recovery (PHR)

- ✓ Generate heating up to 25% of cooling capacity

Total Heat Recovery (THR)

- ✓ Generate heating up to 130% of cooling capacity

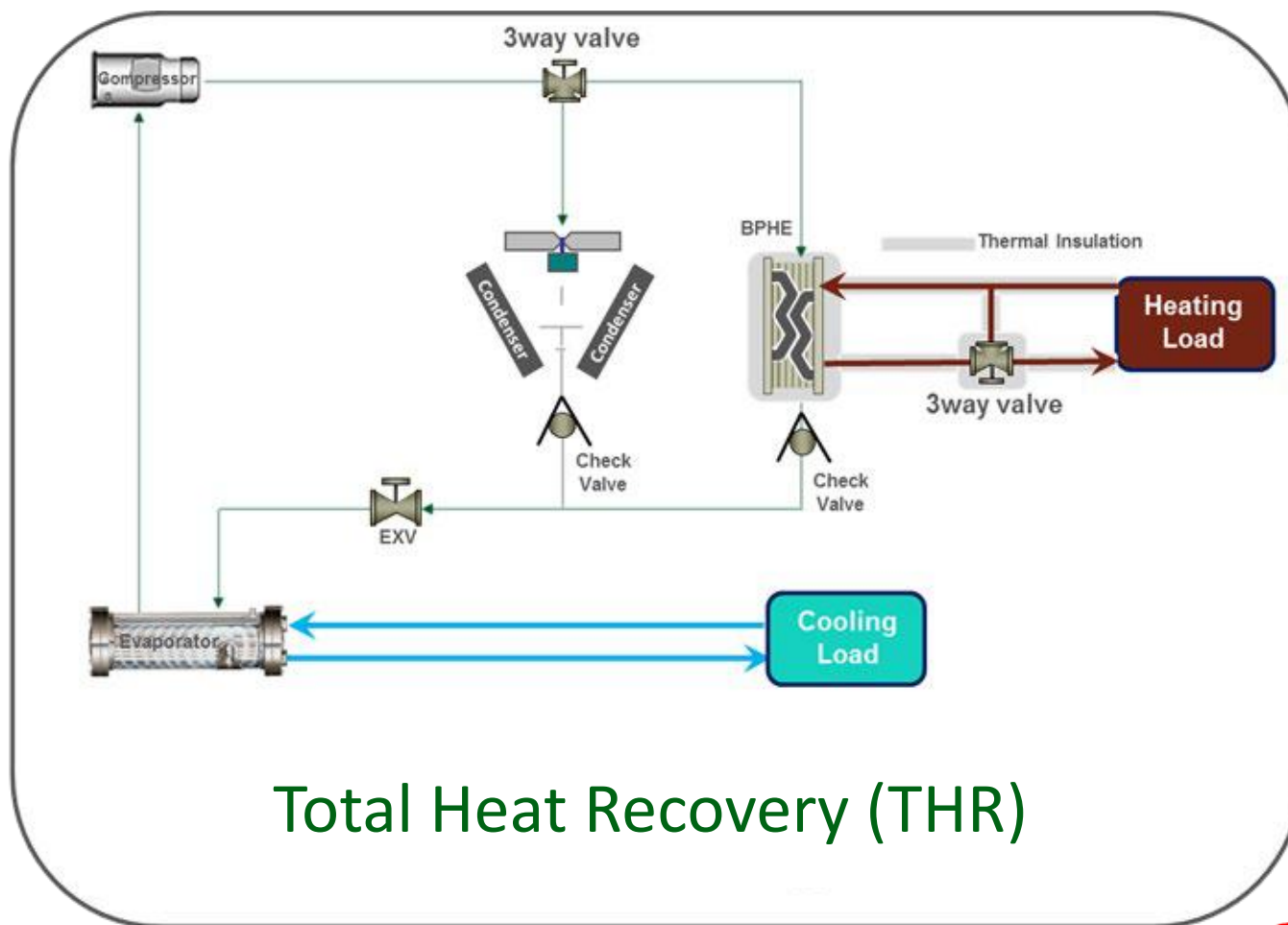


Partial Free cooling

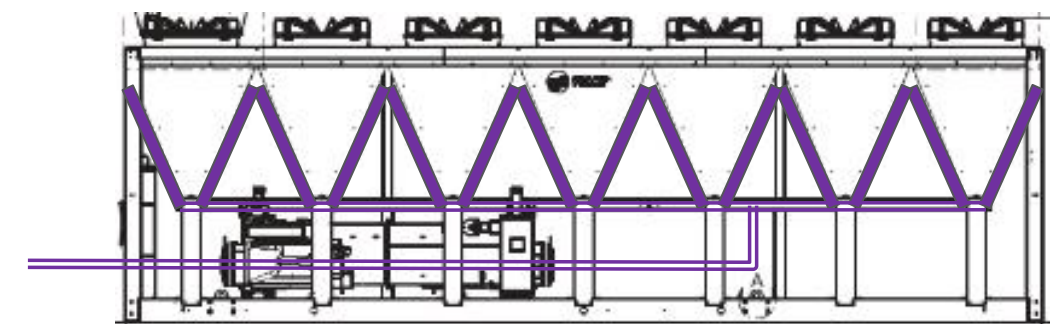
- ✓ Direct or indirect / glycol free

Total Free Cooling

- ✓ Direct or indirect / glycol free



Direct Free Cooling Version





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Utilizing the new opportunities of R1234ze: High temp heating,
Efficient cooling, Safe freezing with <1 GWP

150 – 400kW



CITY Comfort

7/35°C

- HFO solution vs scroll
- Compact: Fits tight building
- Modular

CITY Process

-12/35°C

- Cools to -12°C
- Safe refrigerant <1 GWP
- Easy installation and maintenance

R1234ze

CITY Booster

25/80°C

- Lifts 30°C (heat pump) to 80°C
- Waste water for heating
- Geothermal heating and cooling
- Mini District heating / cooling



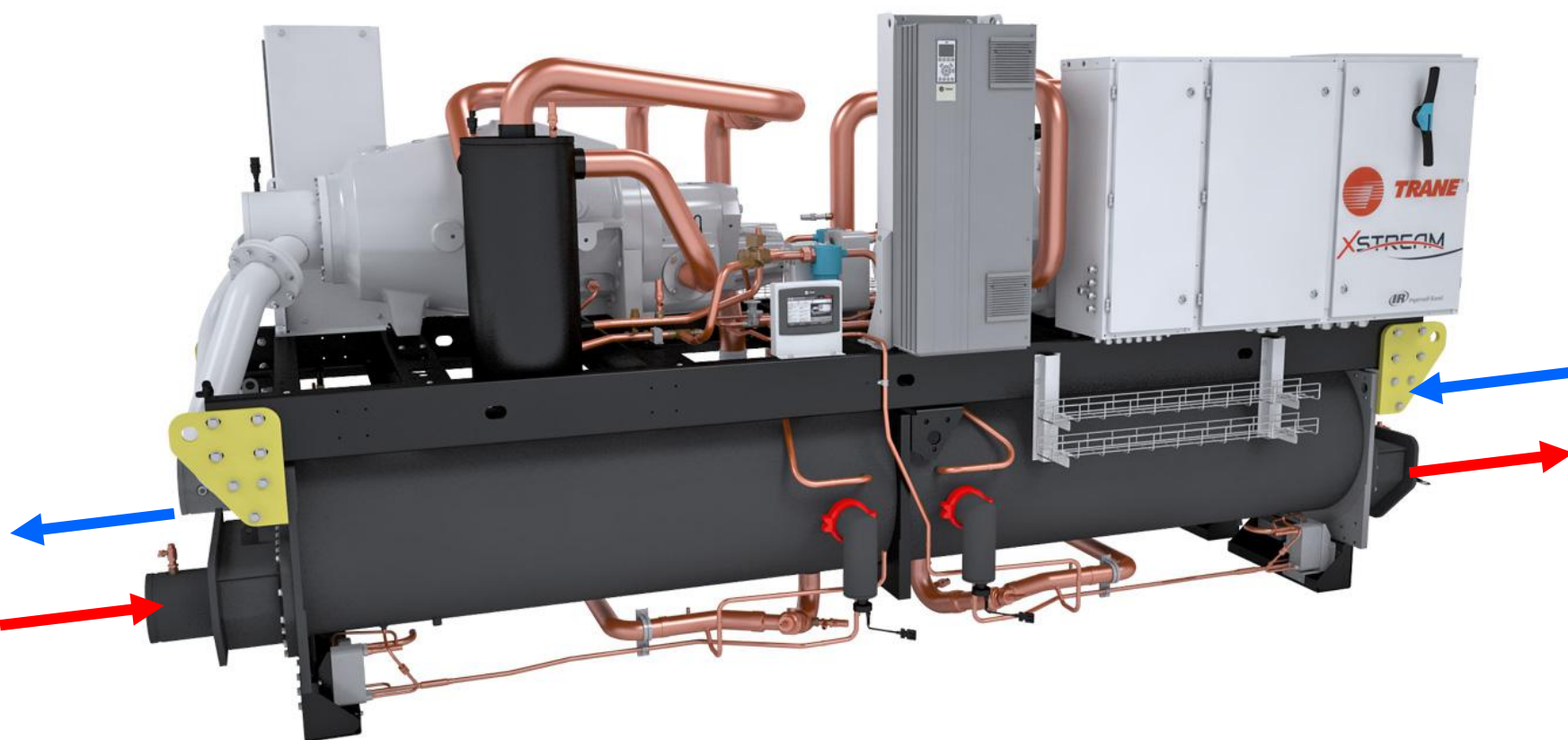
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XSTREAM

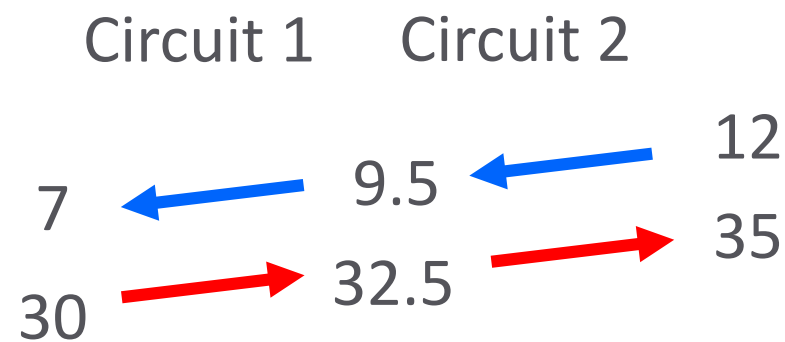
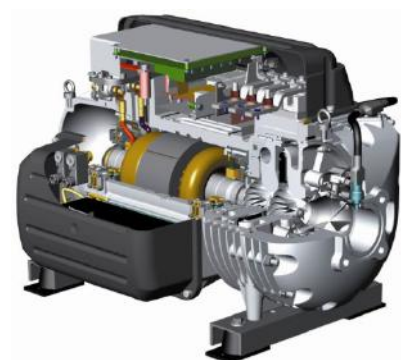
R1234ze

R513A

R134a



- ✓ 900 – 3700kW
- ✓ ESEER up to 9.5
- ✓ R134a and R1234ze
- ✓ Double Circuit: Refrigerant Containment
- ✓ Serial Counter flow Design



Efficiency “for free”!

Saving 2.5C “lift” by smart design



TRANE®

Process solutions with HFO



Industrial



Cold Room



Food & Beverages



Milk Factory



Ice Rink



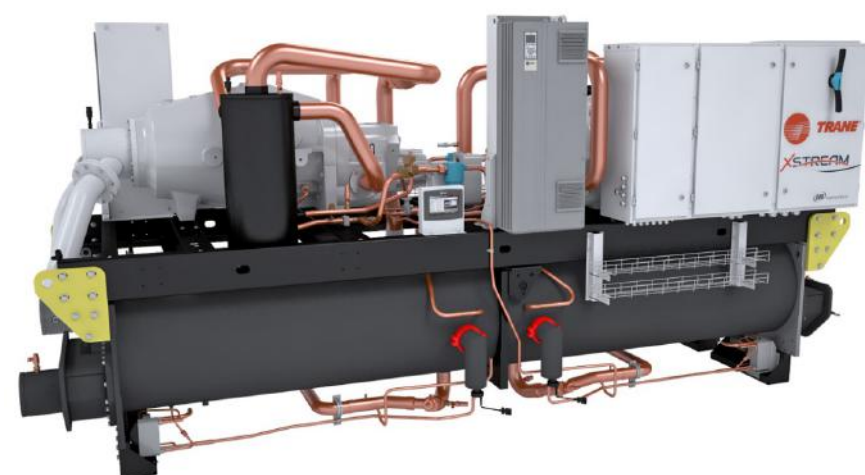
R1234ze

- ✓ <1 GWP Solutions
- ✓ SAFE: non toxic
- ✓ Designed for Process applications
- ✓ Standard: easy maintenance / optimal costs
- ✓ Proven Design

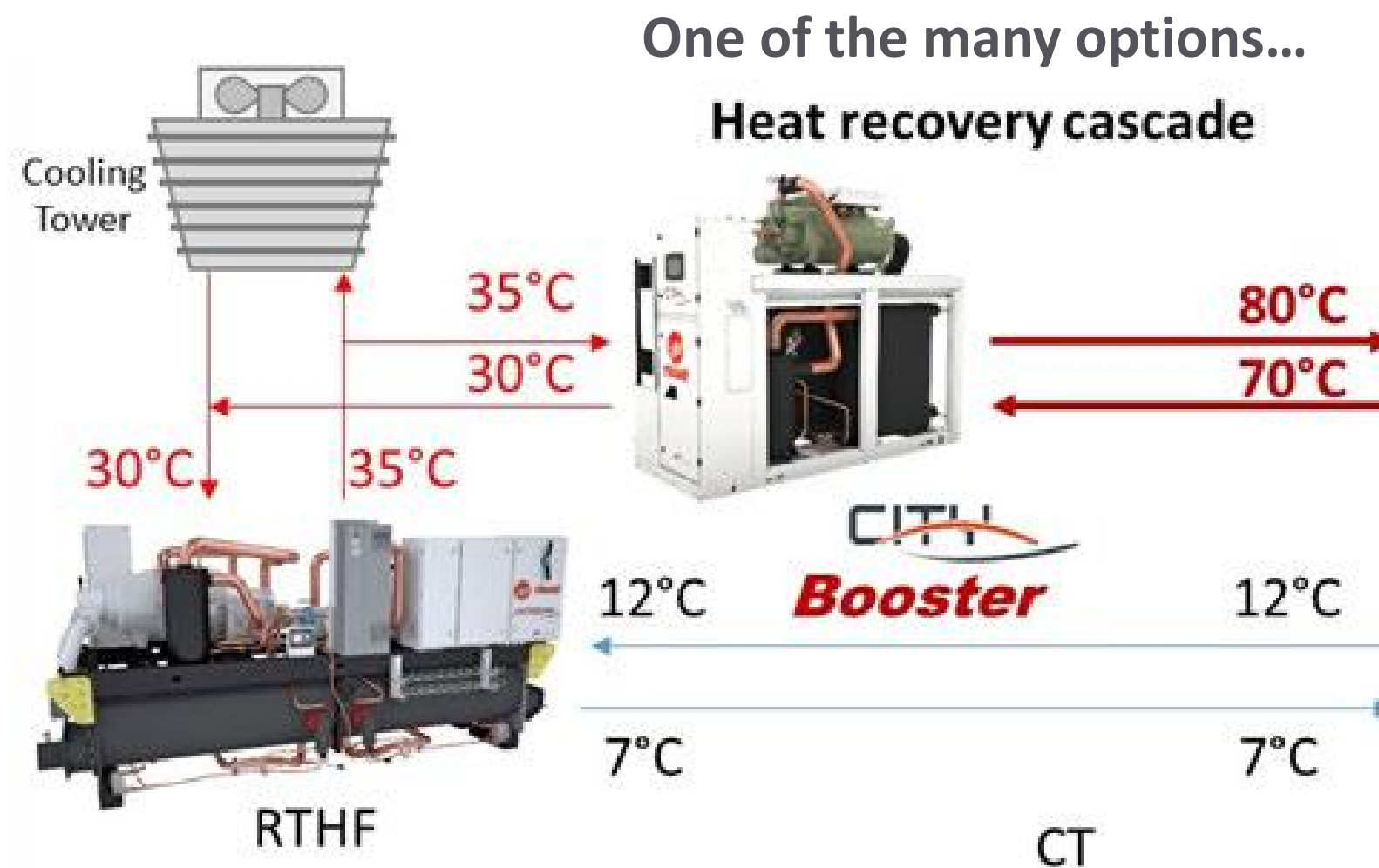


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Heating solutions with HFO



R1234ze



- ✓ <1 GWP Solutions
- ✓ Reach up to 85C
- ✓ Cascading possibilities
- ✓ Sourcing from -12C to 30C temperature levels
- ✓ System Controls by Trane



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Thank you!

Questions?

More Questions? - come and see us at the booth!

