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EXPERTS.

# CHILLVENTA eSPECIAL

Refrigeration | AC & Ventilation | Heat Pumps

13.–15.10.2020

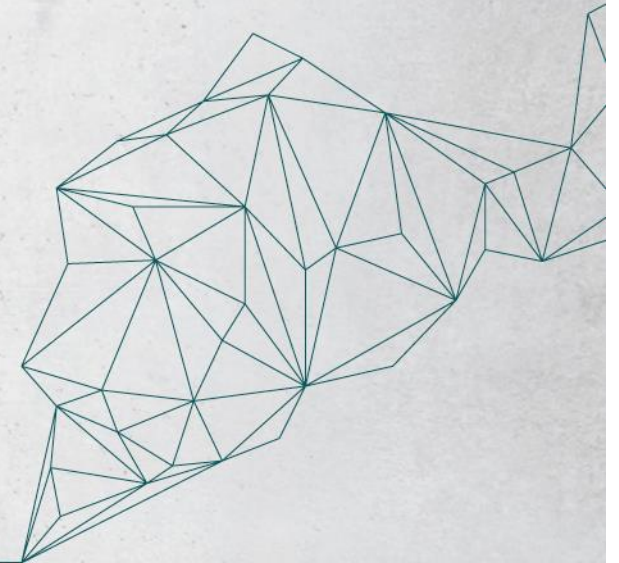
NÜRNBERG MESSE

# Ultra-low charge ammonia refrigeration

14th October 2020

Javier Cano, INTARCON

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Refrigerant charge systems

Low charge technologies

Safety issues

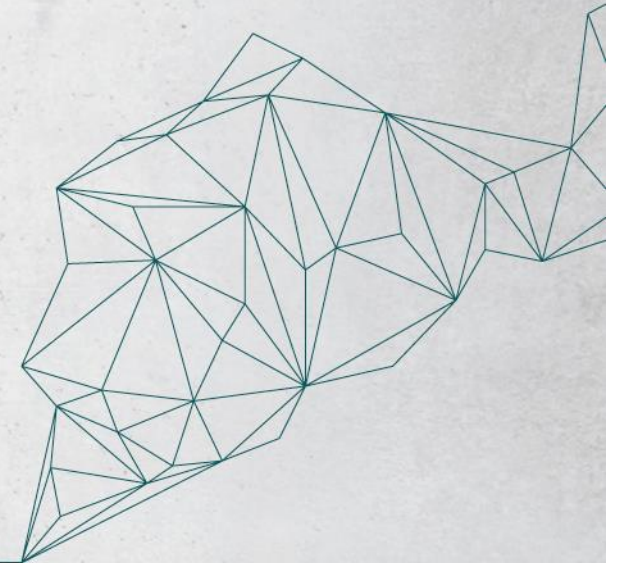
Performance

Life cycle cost comparison

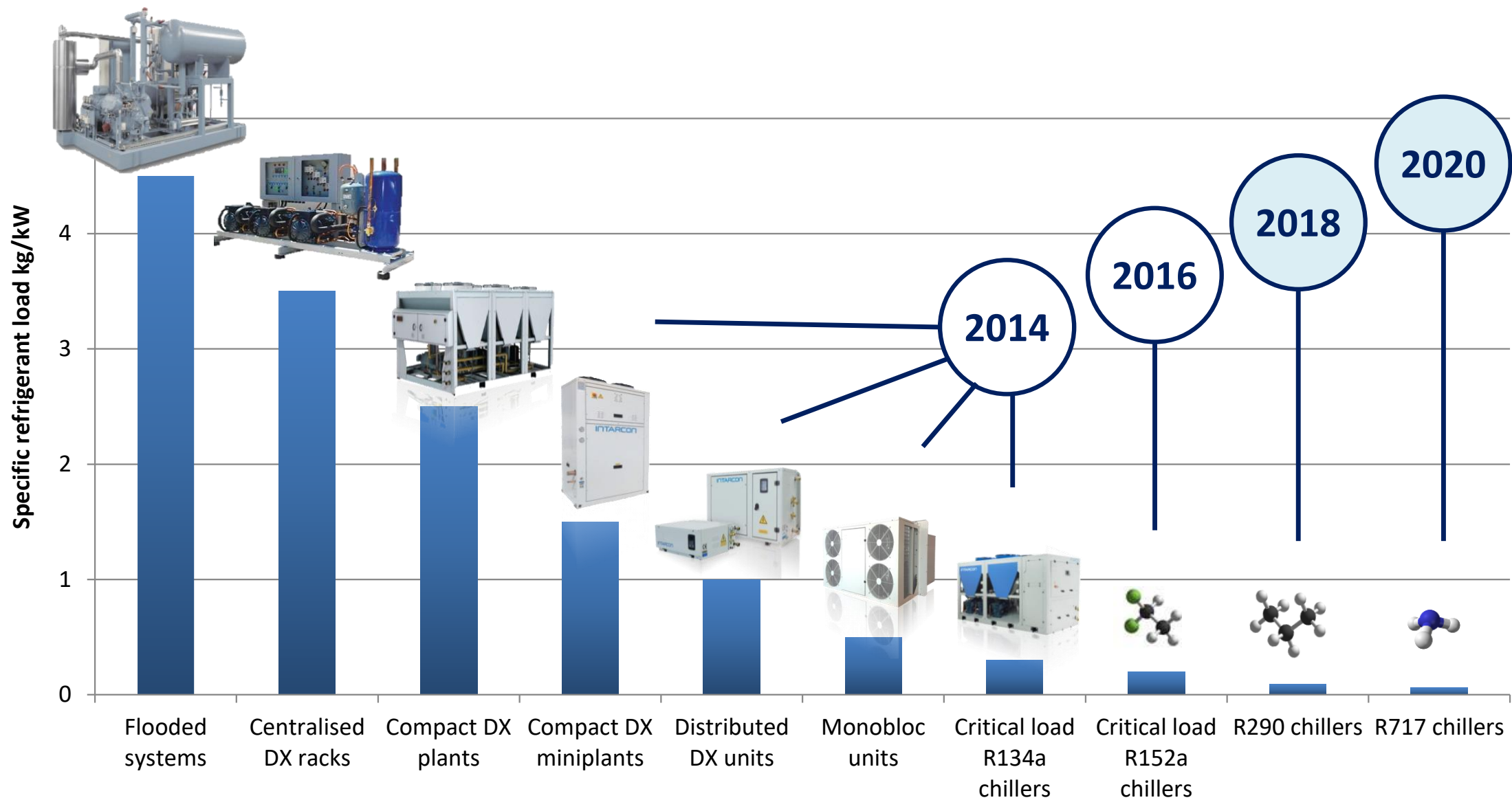
New Ammolite range

Virtual visit

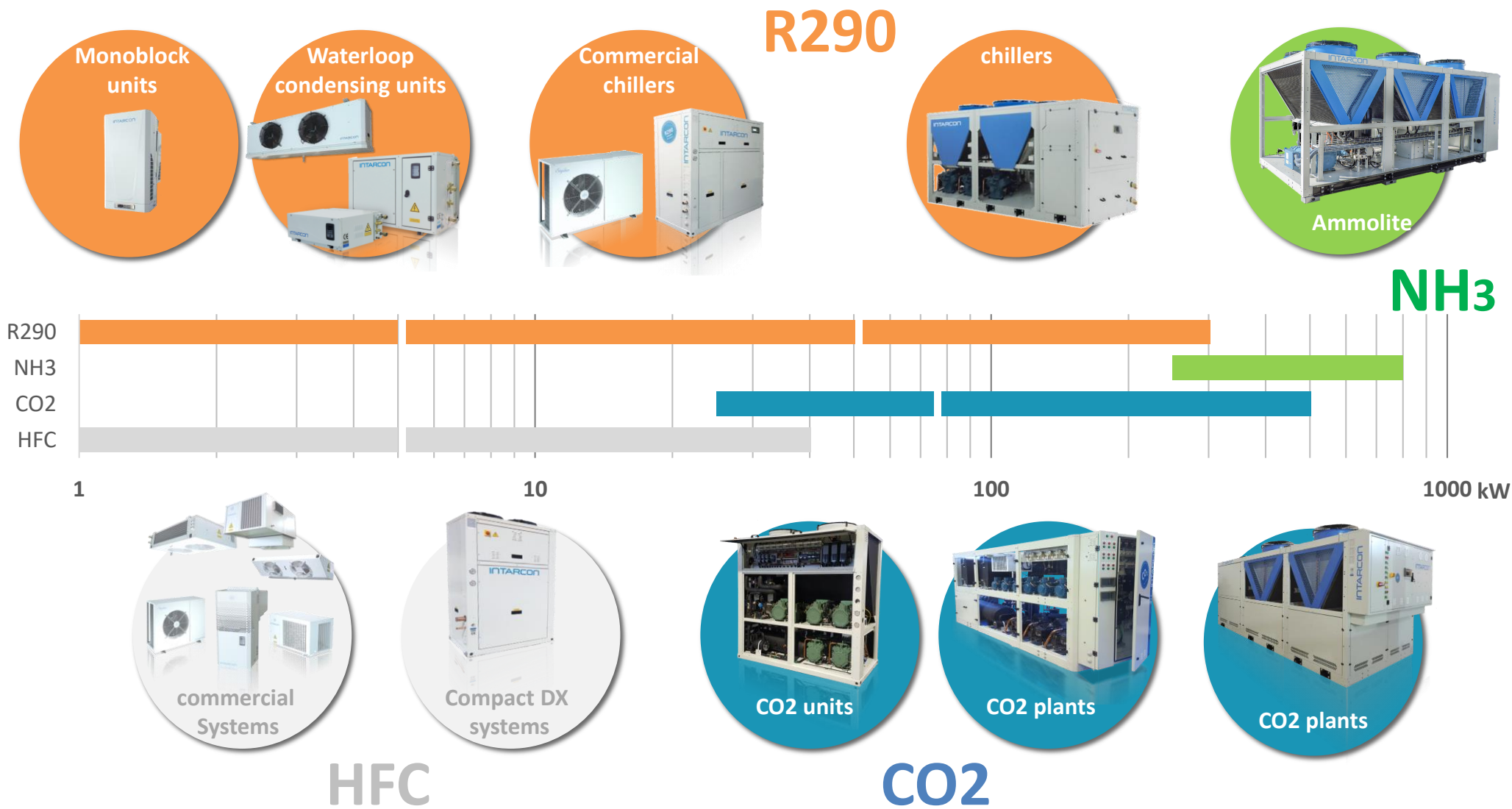
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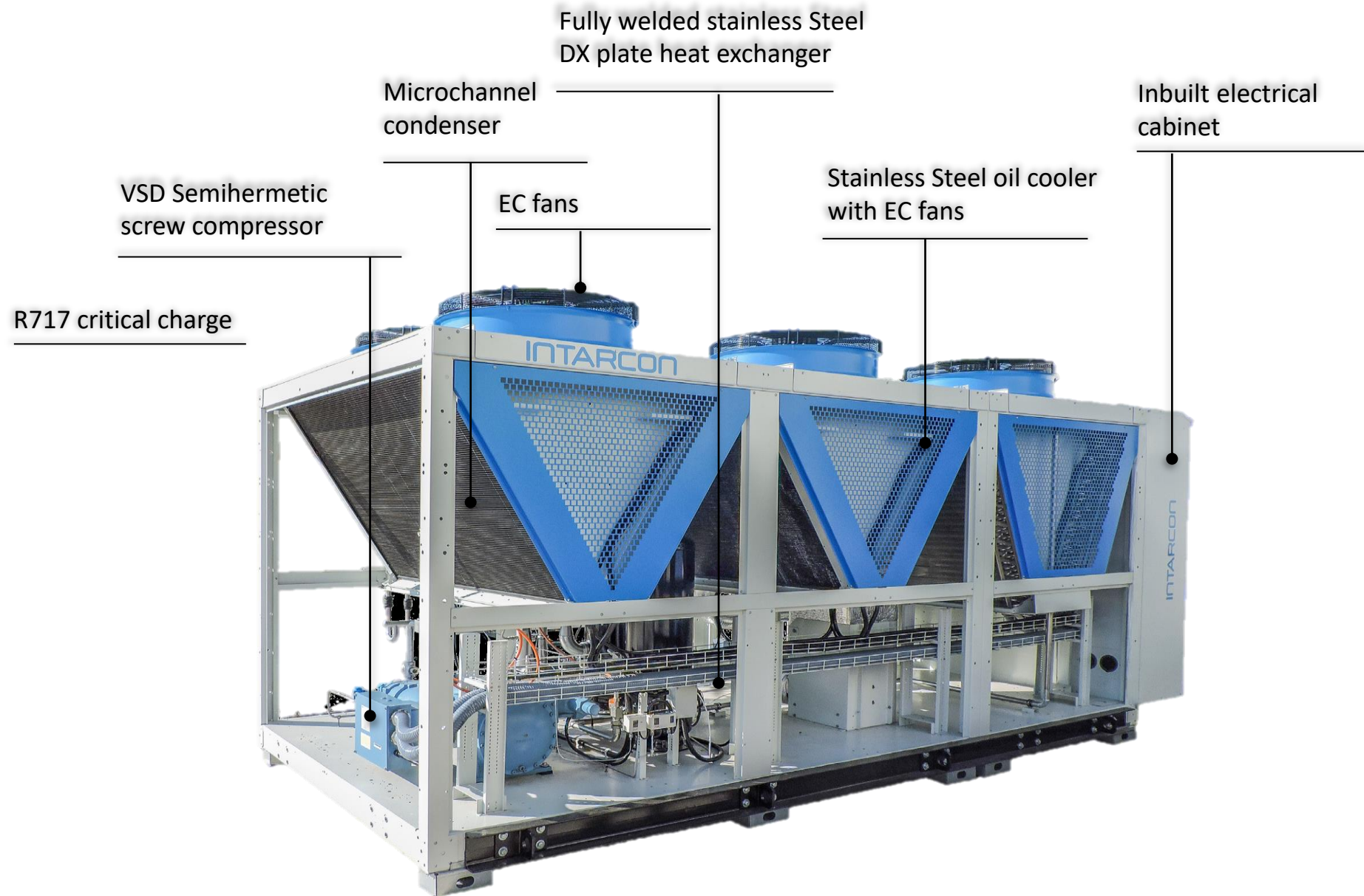
# Refrigerant charge evolution



# The natural way

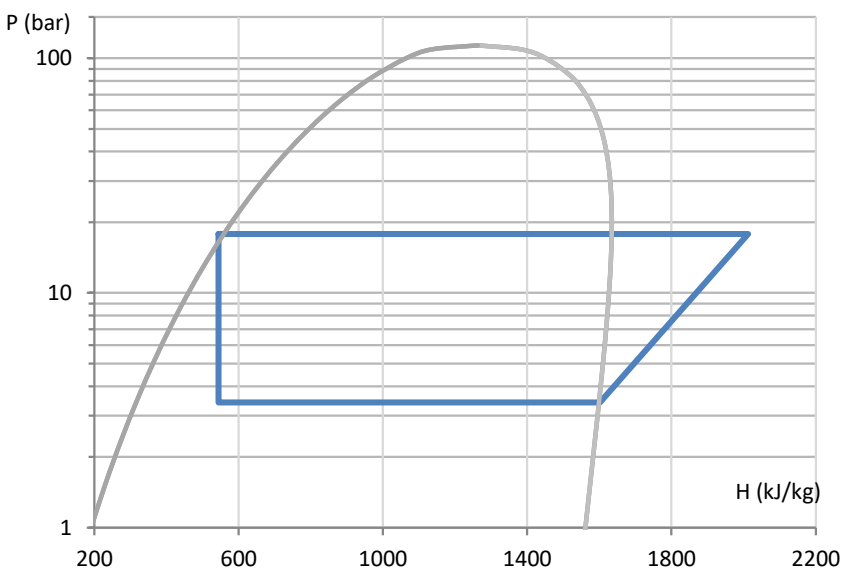
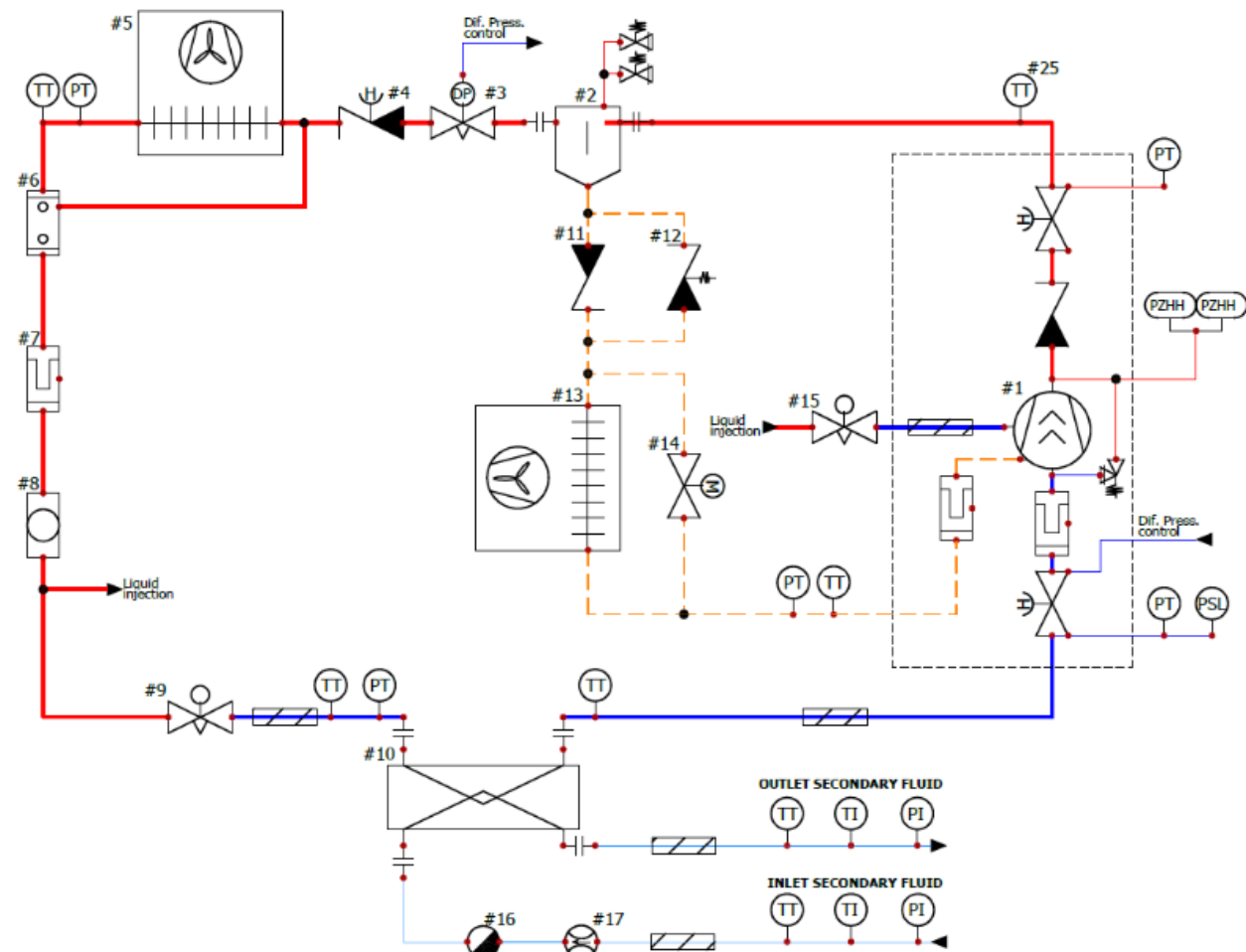


# Low-charge technologies





# Low charge ammonia circuit



## Safe systems

Indirect refrigeration systems are safer

| Refrigerant                                        | System                                             | Load limit   |
|----------------------------------------------------|----------------------------------------------------|--------------|
| <b>A2L: R454C (GWP=148)</b><br><b>A2L: R1234yf</b> | commercial refrigeration DX plant                  | ≤ 56kg       |
|                                                    | Industrial refrigeration DX plant < 1pers per 10m2 | No limit     |
|                                                    | Process chiller                                    | No limit     |
| <b>A3: R290</b>                                    | Compact units                                      | ≤ 500gr      |
|                                                    | DX Split systems                                   | ≤ 1.5 kg     |
|                                                    | Commercial chillers (public access, category A)    | < 5 kg       |
|                                                    | Process chillers (restricted access, category C)   | No limit     |
|                                                    | AC chillers                                        | ≤ 70kg total |
| <b>B2L: R717 (ammonia)</b>                         | Process rooms in industry                          | ≤ 25 kg      |
|                                                    | Process chillers (commercial or industrial)        | No limit     |
|                                                    | AC chillers                                        | ≤ 70kg total |



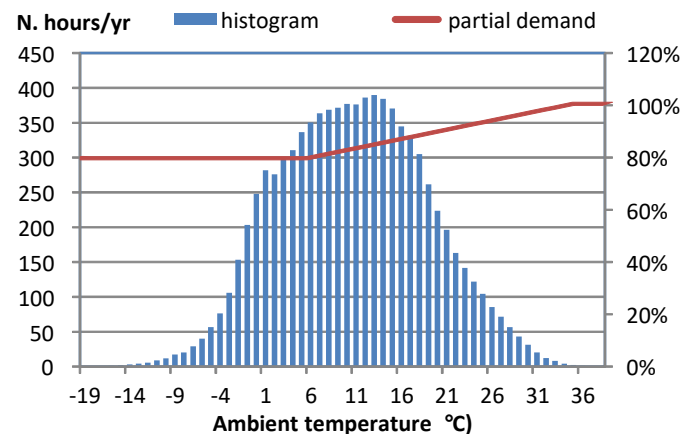
# Higher performance

## Comparison of thermophysical properties of refrigerants

|                                  | R404A         | R134a                                        | R1234yf                                      | R152a                                        | R290                                    | R717            |
|----------------------------------|---------------|----------------------------------------------|----------------------------------------------|----------------------------------------------|-----------------------------------------|-----------------|
| Chemical formula                 | HFCs          | H <sub>2</sub> F <sub>4</sub> C <sub>2</sub> | H <sub>2</sub> F <sub>4</sub> C <sub>3</sub> | H <sub>4</sub> F <sub>2</sub> C <sub>2</sub> | H <sub>8</sub> C <sub>3</sub> (natural) | NH <sub>3</sub> |
| Molar mass                       | 97.6 gr/mol   | 102 gr/mol                                   | 114 gr/mol                                   | 66 gr/mol                                    | 44 gr/mol                               | 17 gr/mol       |
| Boiling temperature              | -46.2/-45.5°C | -26.1 °C                                     | -29,5°C                                      | -24.0 °C                                     | -42°C                                   | -33.3 °C        |
| Critical temperature             | 72 °C         | 101.1 °C                                     | 94.7°C                                       | 113.3 °C                                     | 96.7°C                                  | 132.4 °C        |
| Latent heat (-10°C)              | 166 kJ/kg     | 199 kJ/kg                                    | 163 kJ/kg                                    | 307 kJ/kg                                    | 375 kJ/kg                               |                 |
| Saturated liquid density (-10°C) | 1187 kg/m3    | 1327 kg/m3                                   | 1207 kg/m3                                   | 860 kg/m3                                    | 542 kg/m3                               | 652 kg/m3       |
| Vol. cooling capacity (-10°C)    | 2022 kJ/m3    | 1293 kJ/m3                                   | 1186 kJ/m3                                   | 1283 kJ/m3                                   | 1846 kJ/m3                              | 2475 kJ/m3      |
| Ideal COP (-10/+45°C)            | 3.0           | 3.5                                          | 3.2                                          | 3.7                                          | 3.6 *                                   | 3.8             |
| GWP                              | 3922          | 1430                                         | 4                                            | 124                                          | 3                                       | 0               |
| Safety class                     | A1            | A1                                           | A2L                                          | A2                                           | A3                                      | B2L             |
| Flamability. LFL / UFL           |               |                                              | 6% / 12%                                     | 4% / 17%                                     | 2% / 10%                                | 15% / 28%       |
| Combustion heat                  |               | 428 kJ/mol                                   | 1220 kJ/mol                                  | 1090 kJ/mol                                  | 2200 kJ/mol                             | 382 kJ/mol      |
| Autoignition temperature         |               | 770°C                                        | 405°C                                        | 454°C                                        | 470°C                                   | 651 °C          |
| Practical limit                  | 480 gr/m3     | 250 gr/m3                                    | 61 gr/m3                                     | 27 gr/m3                                     | 8 gr/m3                                 | 0.035 gr/m3     |

# Higher performance

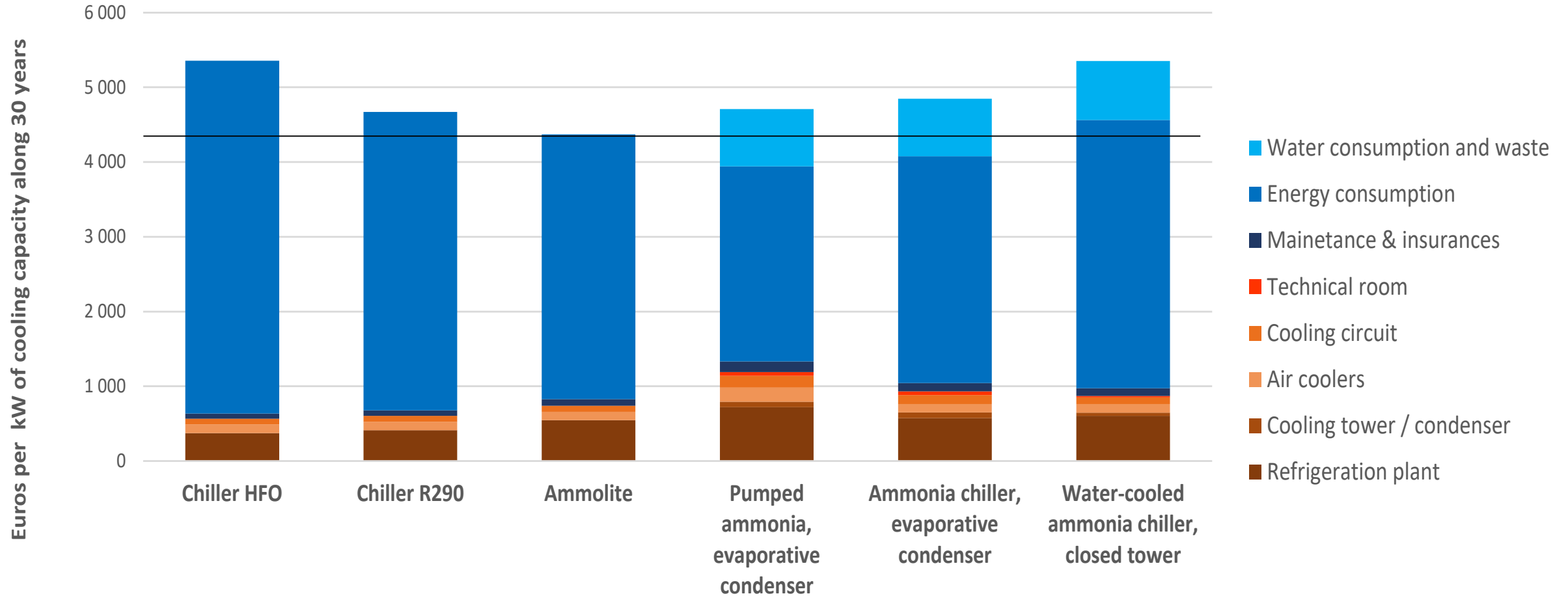
*comparison of SEPR of medium temperature process chillers according to Ecodesign regulation*



|                          | R134a | R1234yf | R152a | R290 | R717 |
|--------------------------|-------|---------|-------|------|------|
| Typical SEPR coefficient | 3.8   | 3.2     | 4.2   | 4.2  | 4.5  |

# Life cycle cost

Comparison between different refrigeration systems.

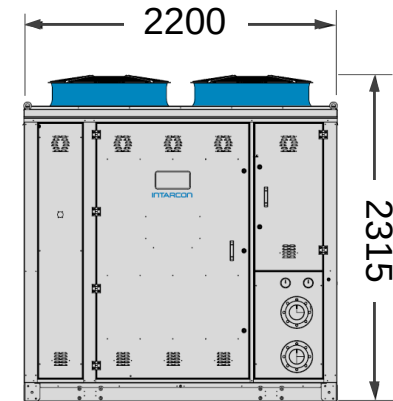
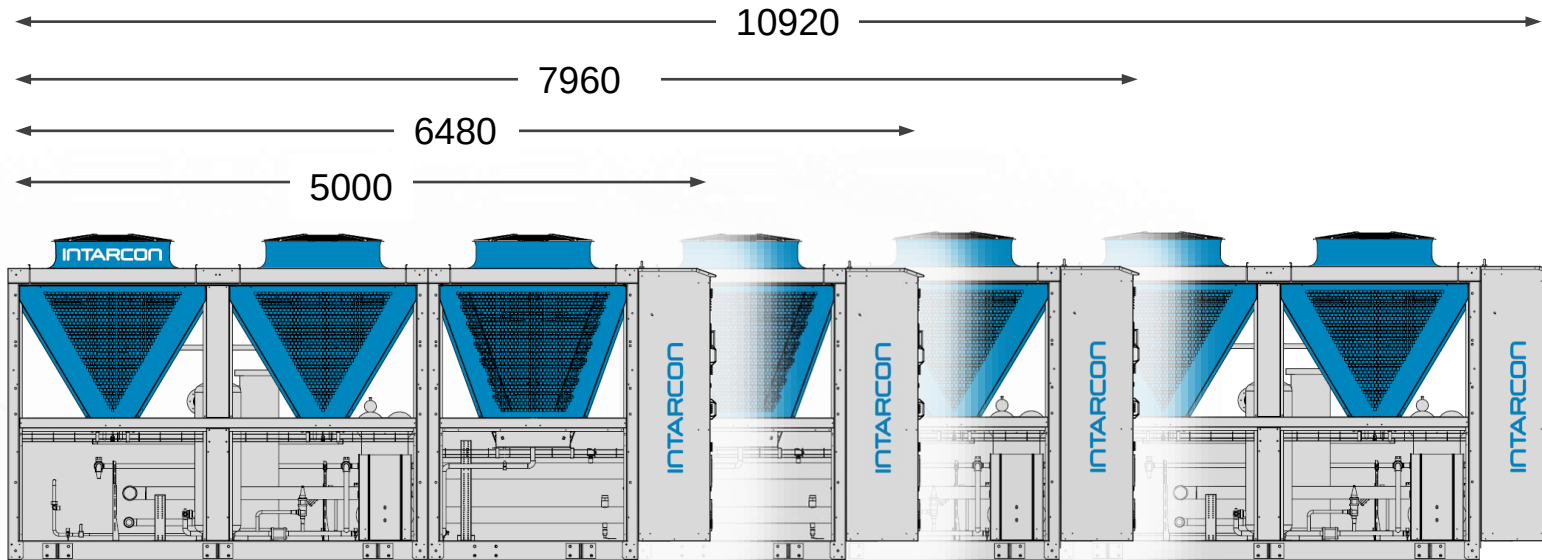




# Ammolite chillers

Capacity range

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1x 

250 kW MT  
150 kW BT



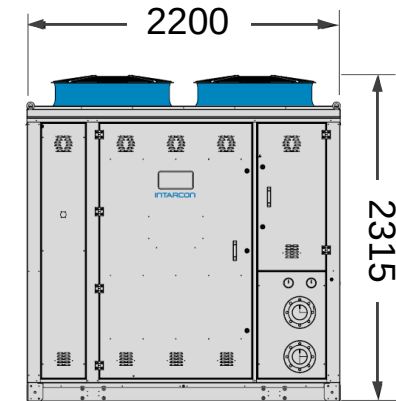
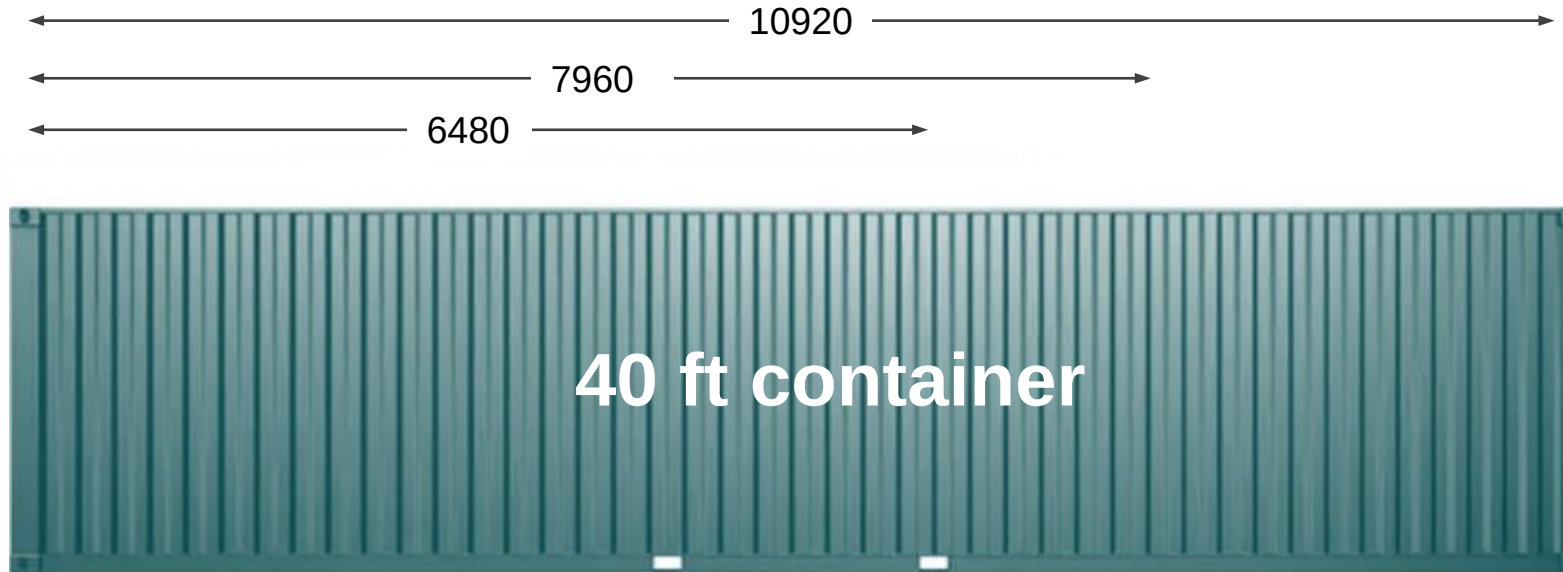
2x 

700 kW MT  
500 kW BT  
< 50 kg NH3

# Ammolite chillers

Capacity range

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150 kW BT

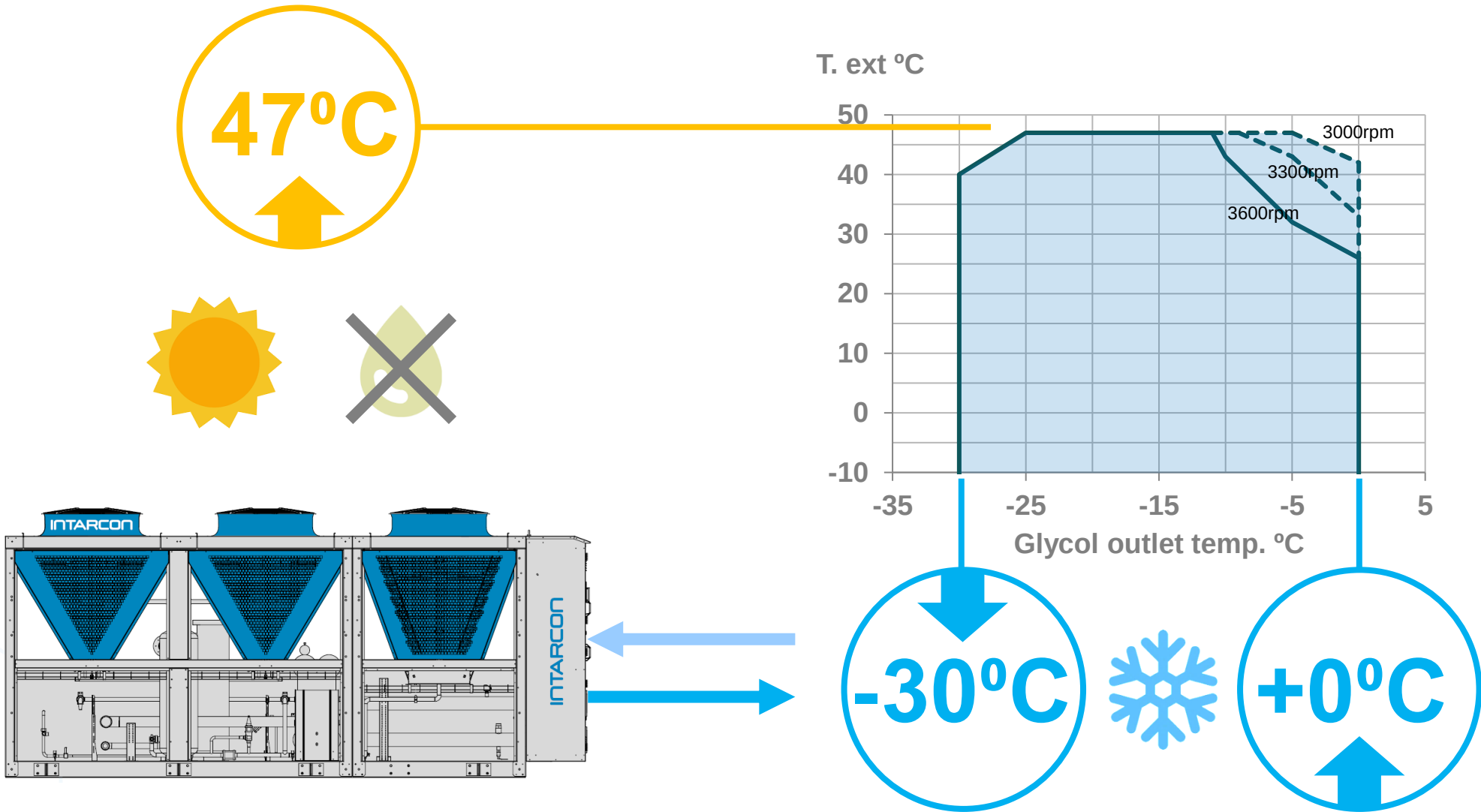


2x 

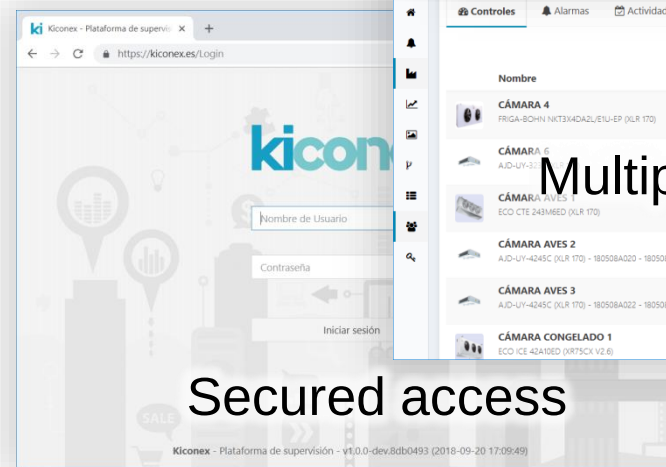
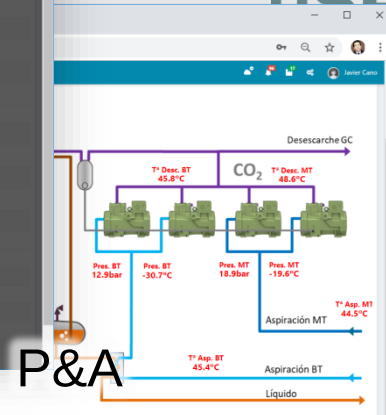
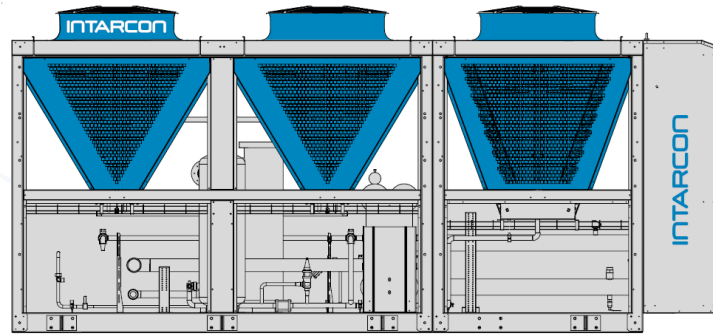
700 kW MT  
500 kW BT  
< 50 kg NH3

# Ammolite chillers

Temperature range



# CHILLVENTA SPECIAL



## Multiple devices

## Secured access



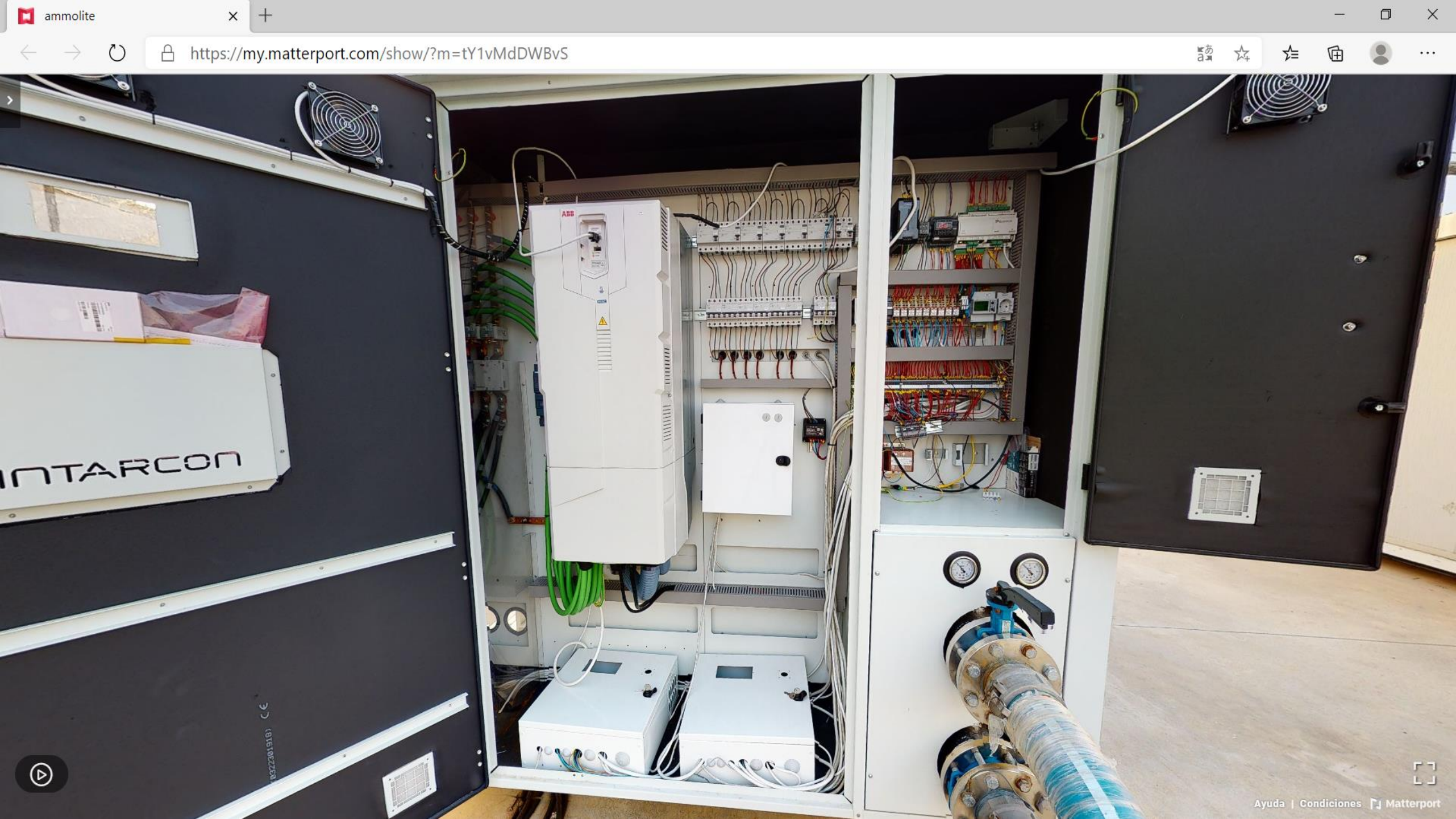
# Ammolite Virtual Visit











## Conclusions

*Ammolite – Low charge ammonia chillers*



R717

Environmental friendly  
Zero carbon footprint



Safety and reliability  
No risk for humans or environment



Quick and easy installation  
Plug & Play



Real time control  
Cloud based monitoring



Rapid return of investment  
Optimal life cycle cost



**Thank you for your  
attention.**

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