



solutions for europe  
natural refrigerants

19 & 20 April, 2016 – Barcelona

# Sustainable refrigeration – Ammonia at its best

Industrial Ref. session – ATMOsphere Barcelona

WOLFGANG DIETRICH - GEA BERLIN



GEA is a global leader in equipment and process technology providing innovative solutions for smart food processing and for a more efficient use of energy resources.



Dairy Farming



Dairy Processing



Food



Beverages



**Revenue**  
EUR 4.5bn (FY14)



**Operating EBIT Margin**  
11.4% (FY14)

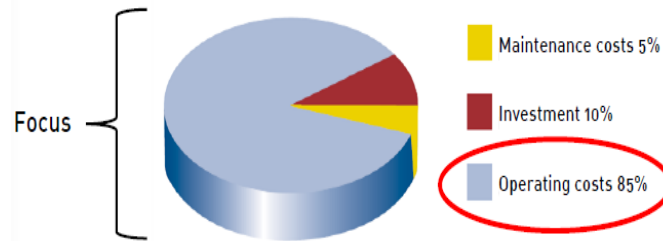


**Employees**  
>18,000 (Dec14)



**Market Cap**  
>EUR 9.0bn (Apr15)

- Investment - Equipment; constructional expenses: safety installations
  - Compact components thanks to Ammonia (refrigerant with highest volumetric cooling capacity)
  - Following the EN 378-3; equipment of machinery room determined by ammonia content; heat to reject from electrical components
  - Additional safety equipment for Ammonia negligible; high warning potential (5ppm you will already smell; TLV 50ppm)
- Lifetime (25 years) - maintenance; spare parts; possibly re-investment
- Operational costs - electrical consumption; part load efficiency of the equipment
- Defined as **Total Costs of Ownership**



# Cooling of a cold store – reliability meets efficiency

- The challenge

- Supply of 3MW cooling capacity for a food cold store at -10°C sec refrigerant outlet
- Compact solution on base of NATURAL REFRIGERANT required; remote execution since air cooled condenser
- 1% maintenance related to investment in max., long lifetime (min. 20years), minimized content of refrigerant
- Highest efficiency in full load and partload; stepless capacity adjustment

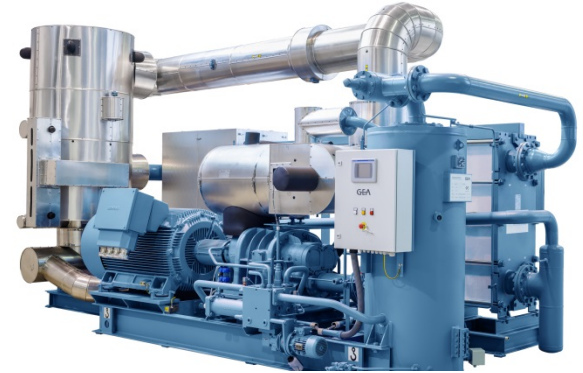
- The solution

- **Provide high efficient industrial chiller based on Ammonia as refrigerant; ESEER 8,8 – The BluAstrum series**
- **40% less service costs compared to standard solution; extended maintenance on site only at 50.000 operating hours**
- **ammonia content appr. 80g NH<sub>3</sub>/kW capacity (including air cooled condenser)**
- **By default equipped with VSD; enables stepless capacity adjustment between 15-100%; no capacity slide**



# The Blu-Chiller – Ammonia technology at its best

- Available for years and still existing – the modular Ammonia chiller
  - Industrial chiller using Ammonia; modular design; wide capacity range (300 - >6000 kW); evaporation temperatures down to -35°C
  - highest capacities and flexibility in foreground; relatively high ammonia content
  - Normally fixed speed operation; capacity adjustment by capacity slide;
  - Disadvantage: Efficiency in part load limited; full load operation preferred
- **The new approach – High efficient Compact-Chiller**
  - Industrial Ammonia chiller in an outstanding design; available within a limited capacity range ( 550-1750 kW)
  - Simple, very efficient, optimized dimensions – 5m<sup>2</sup>/1000 kW; low ammonia content (60-80g/kW)
  - Fully welded heat exchanger; combined evaporator/liquid separator; lowest sec.refrigerant out -15°C
  - State of the art control equipment; developed sequence control if more than one chiller



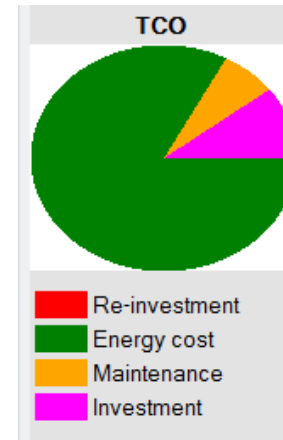
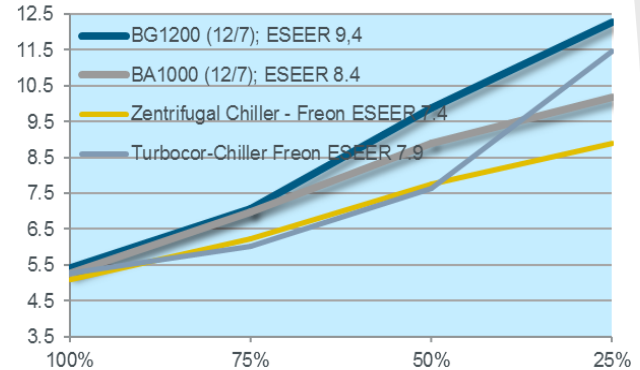
# The project – efficiency requirements

## • Project requirements

- Customer (Bio-company) asks for best and defined efficiency in full load and part load
- Required profile based on ESEER – part load steps but at from ESEER definition different part-/full load shares (more full load shares) and conditions
- Secondary refrigerant outlet evaporator at -10°C / constant volume flow / air cooled condenser
- Relatively high condensing temperature due to ambient conditions (45°C)

## • .....and the results

- BluAstrum 1000 remote – screw compressor based ammonia chiller
- M(odified) - ESEER of 3,5 (air-cooled cond.)
- Compact dimensions fits perfect to the room dimensions of the customer
- Chiller fedded by well dimensioned buffer tank of sec. Refrigerant (Hycool-20)
- 6,5% lower TCO then former HFC solution, mainly based on safed Pe
- Stable and trouble-free operation since 2013; >8000 operating hours/year



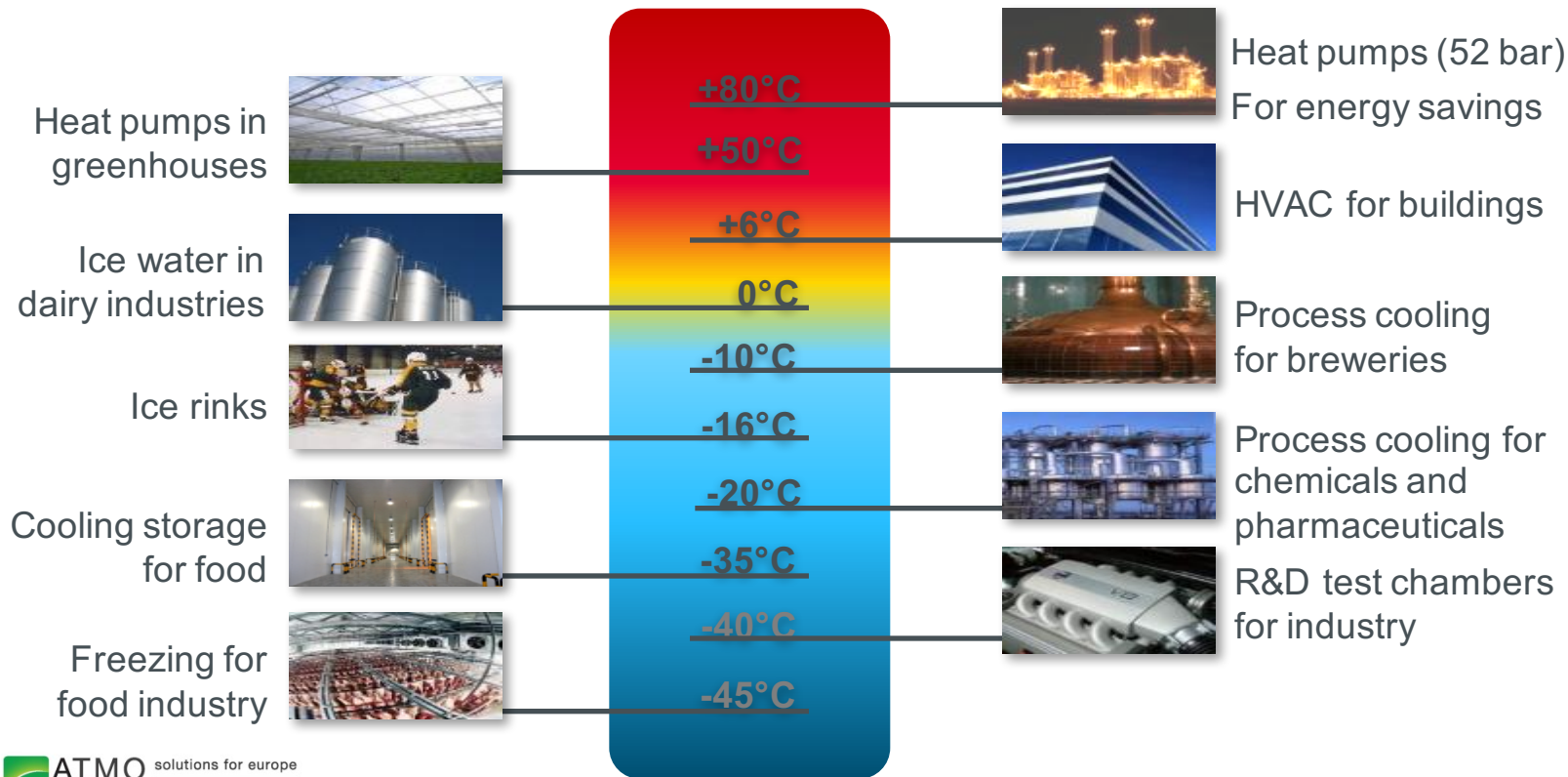


# Local Installation / look into the machinery room



- Air cooled condenser requires HP-receiver to cover external ammonia content
- Ammonia detection system installed
- Buffer system needs to be sized well!
- Air changes determined by motor heat to reject

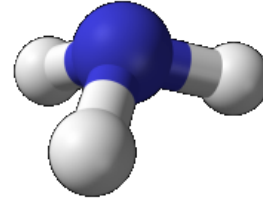
# What are Ammonia chiller able to cover - temperature scale & applications





# Industrial refrigeration by Ammonia – long experiences - future proof refrigerant

- A simple molecule – made in huge quantities
- Ammonia combines several advantages
  - ⚡ no GWP; future proof; always available; relatively cheap
  - ⚡ High volumetric capacity leads to lower mass flow compared to HFC's and HFO'S – smaller pipes and valves
  - ⚡ Up to 100% better heat transfer coefficient (U-value) reduces heat exchanger sizes and boosts efficiency
  - ⚡ High warning potential (5 ppm) if leaking; not more dangerous than other gases they displacing air



Planning guide

Chillers with screw and reciprocating compressors  
(Translation of the original text)

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## 3.4 Installation in buildings



Fig. 24 Installation on 1st basement floor

**Installation on 1st basement floor**  
By separate access to the machinery room in this hotel (installation on 1st basement floor) the installation is permitted in a class C area with unlimited charge. There are also no restrictions for basement floors, if all remaining requirements on machinery rooms are observed.  
See also EN 378-1:2012-06, 3.2 and Appendix C as well as EN 378-1:2012-06, 4.2.



Fig. 25 Installation on 2nd basement floor

**Installation on 2nd basement floor**  
The machinery room has no separate access in the figure "Installation on 2nd basement floor". Hence, the room with access to the machinery room may be occupied solely by authorized instructed personnel in accordance with installation area class C EN 378.



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