

Technologies and Innovations for an Energy Efficient Cold Chain

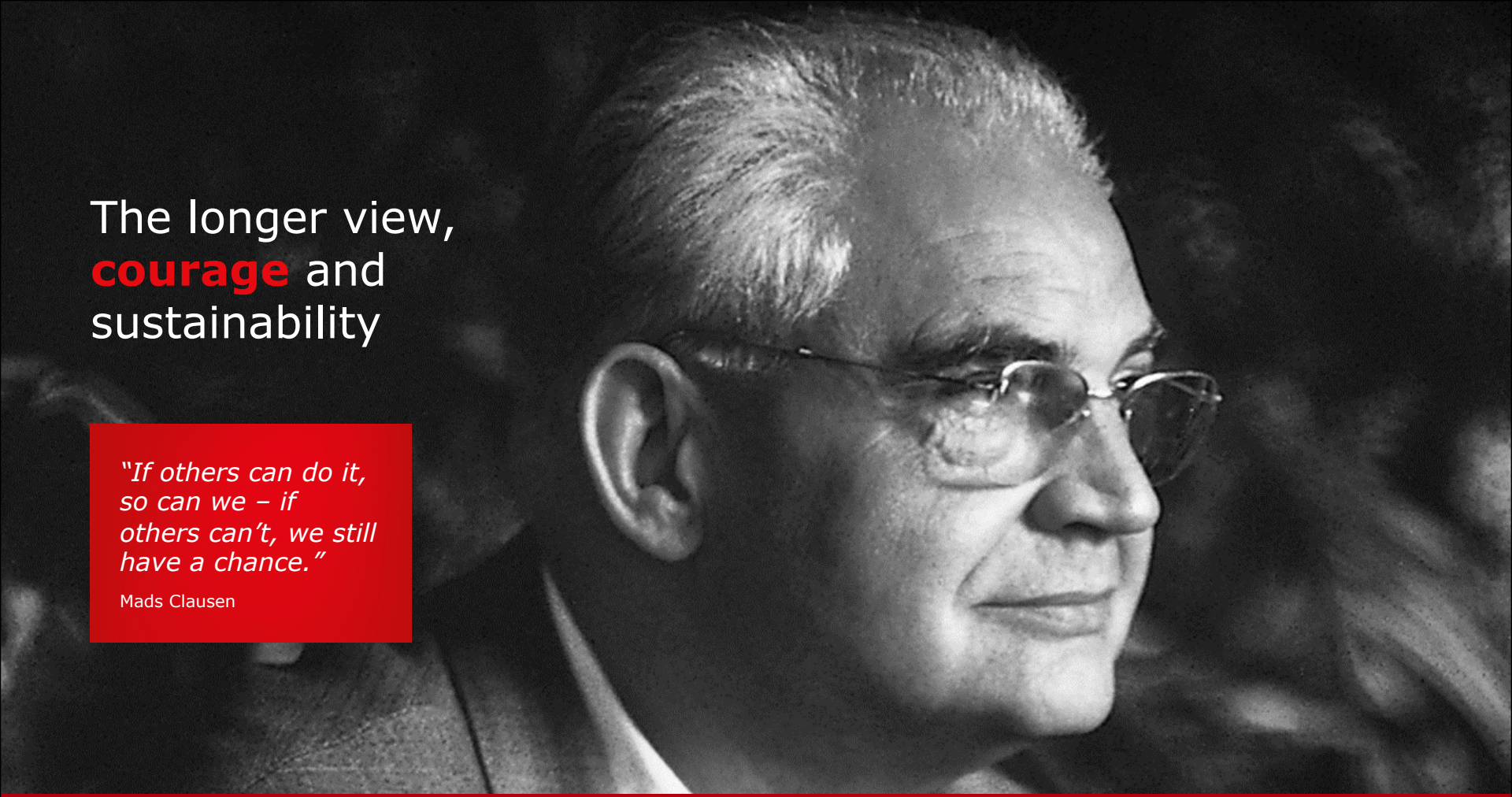
ENGINEERING TOMORROW

Danfoss

International workshop on Energy Efficient cooling, India

12. December 2019

The longer view, **courage** and sustainability

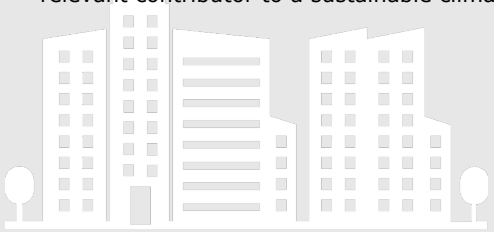


"If others can do it, so can we – if others can't, we still have a chance."

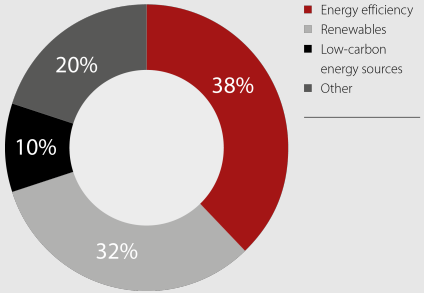
Mads Clausen

We have a **passion for energy efficiency**

- The Paris Agreement has set out a global action plan to keep global warming below 2°C by 2050
- If we are to achieve this low-carbon future, we must leverage **energy efficiency** being a relevant contributor to a sustainable climate



Main contributors to achieve the 2050 target of the Paris Agreement



Source: International Energy Agency: Energy Technology Perspective 2016

Danfoss in brief

We engineer tomorrow
and build a better future

27,795
employees dedicated to engineering **smart energy technology** making a difference to people and businesses worldwide

72
factories in 20 countries and products sold in more than 100 countries

Group highlights 2018

Net sales, EURbn	Growth in local currency	EBIT margin	Energy reduction since 2007	CO_2 reduction since 2007
6.1	7%	10.6%	43%	25%

More than 20 years in India

- 729 Employees
- HQ in Chennai
- EUR 160M Turnover

11% YTD Sales Growth (May 2019)



Total HC – 930
(Including Off Rolls)





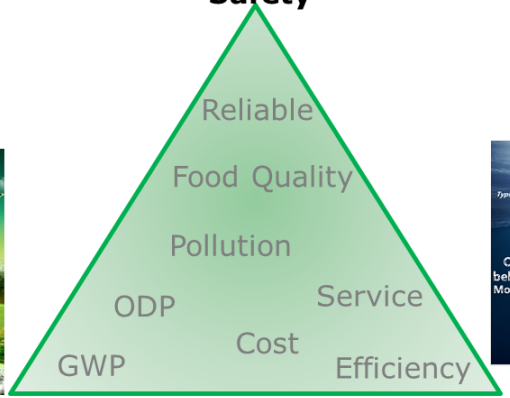


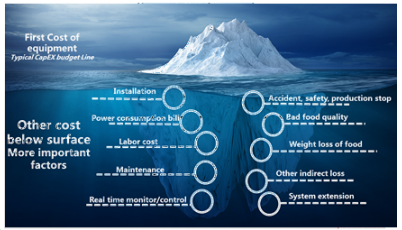
Driving forces of Large Refrigeration System within Cold Chain



Safety



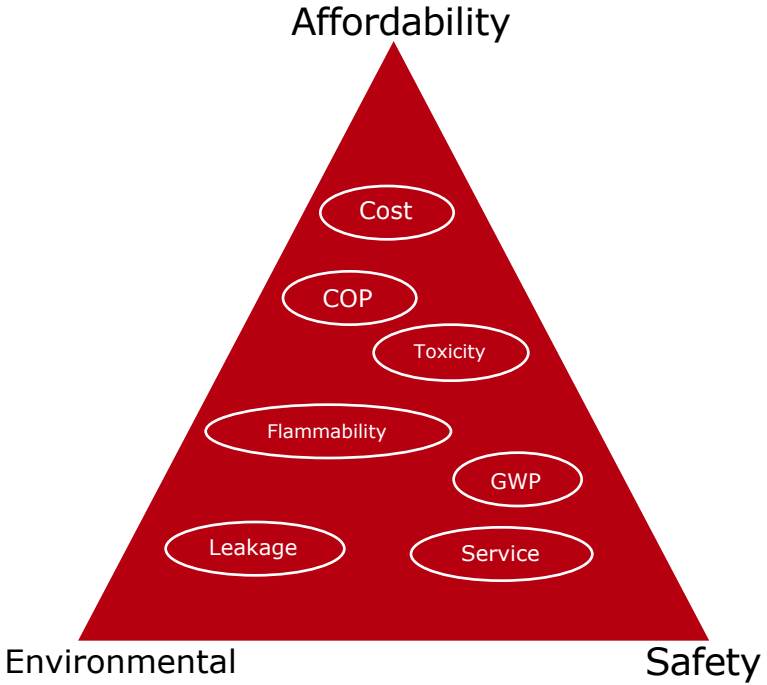




Environment Friendly

Total Cost Of Ownership

Refrigerant Sustainability Triangle



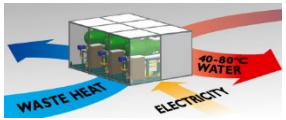
Safety to be addressed through education and certifiation (licence)

Affordability and up front cost must be balanced through design and incentives for investment

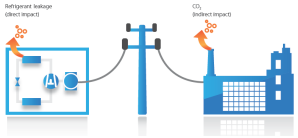
Environmental impact is a mix of refrigerants GWP, **real** energy efficiency and lately the acknowlegdement of sector coupling with decarbonised electricity

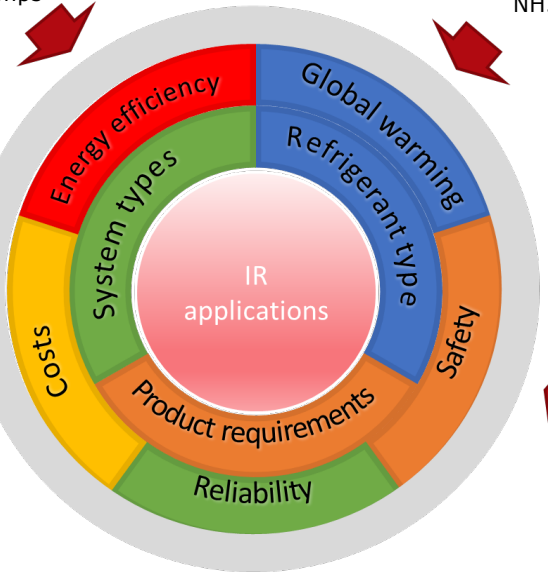
Drivers and reactions for Industrial Refrigeration

Energy efficiency
- new and retrofit systems
- Industriel heat pumps



Global warming
- refrigerants focus, plays along with NH3 and CO2





Costs
- primary growth in emerging markets with higher price pressure, TCO awareness



Safety
- products and system design

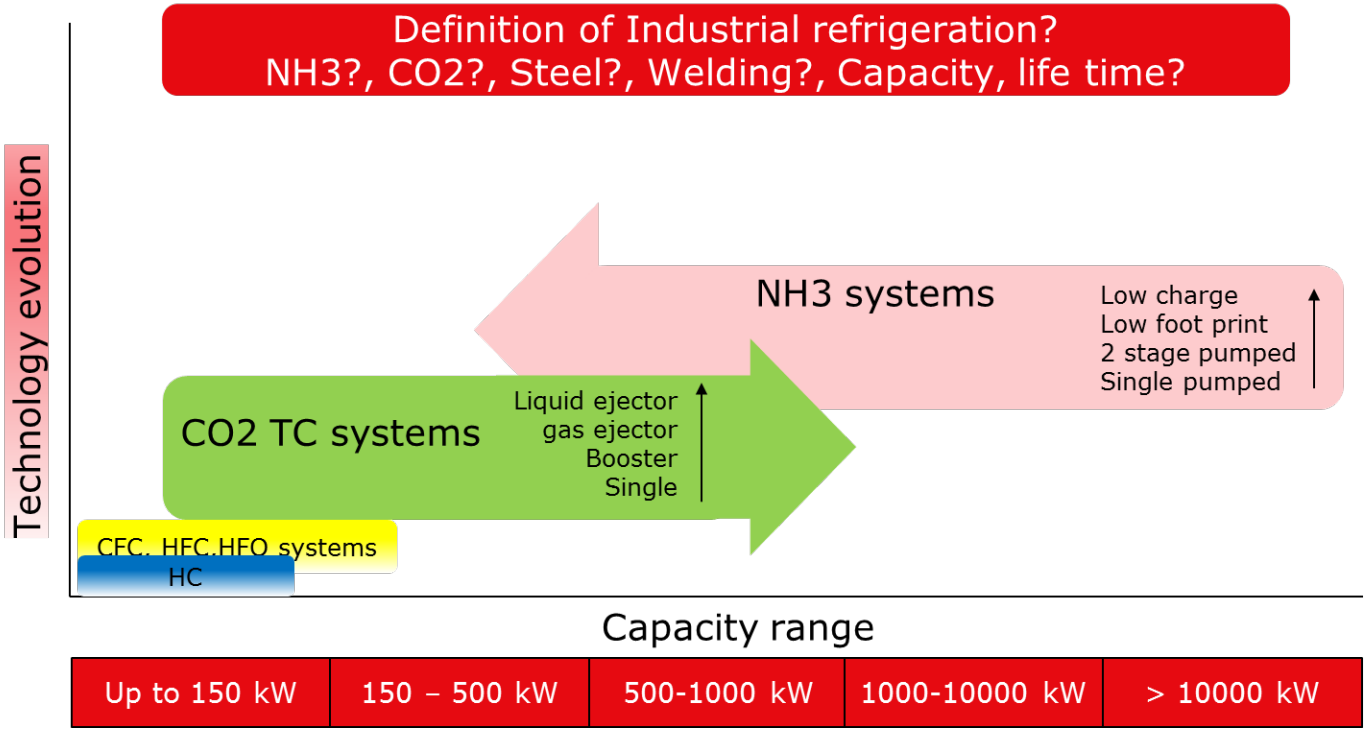


Reliability
- Automatic running
- Data
- Controls



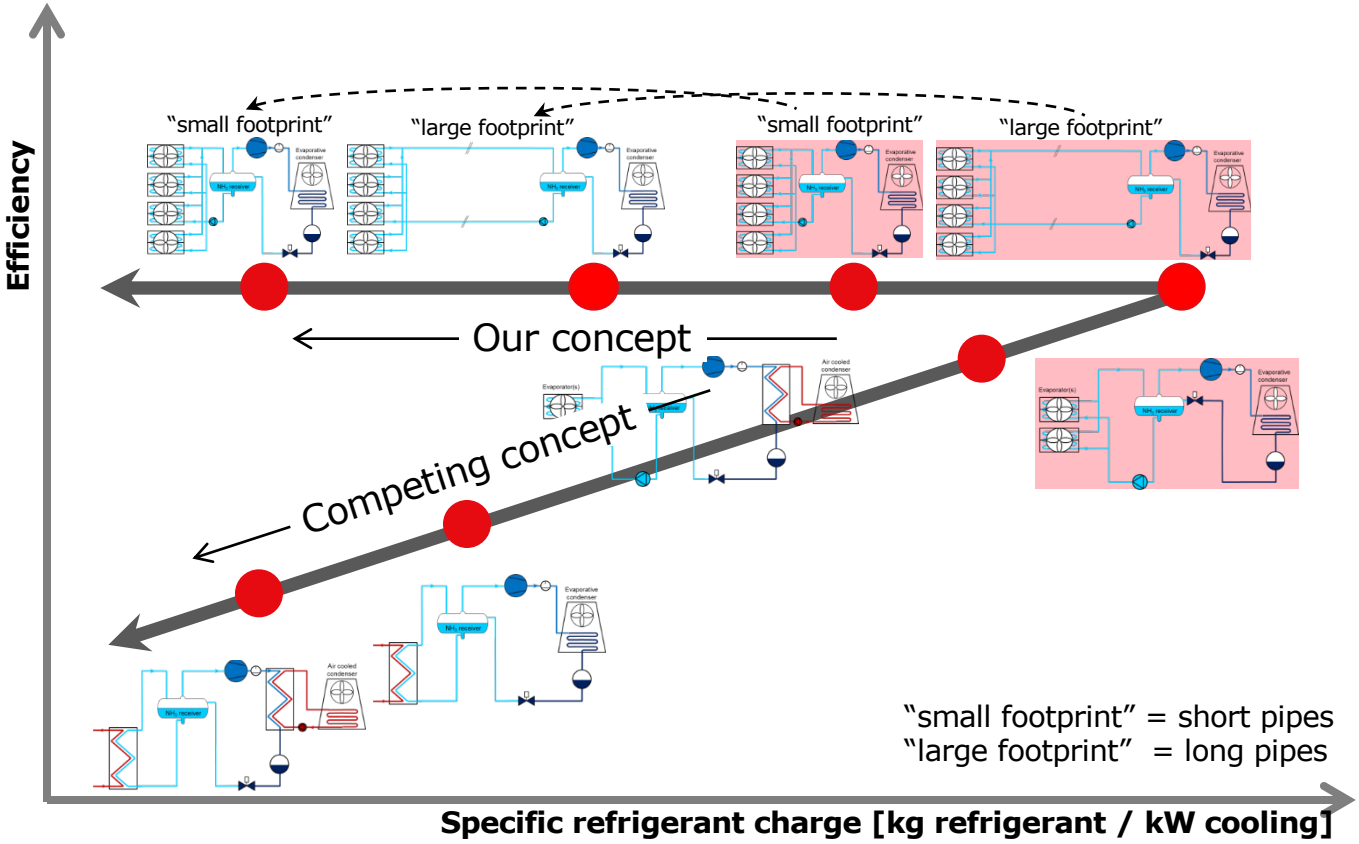
Refrigeration System Developments – Industry reaction

Blending in of technologies and systems



Charge reduction without compromising efficiency

Impact on efficiency by concepts

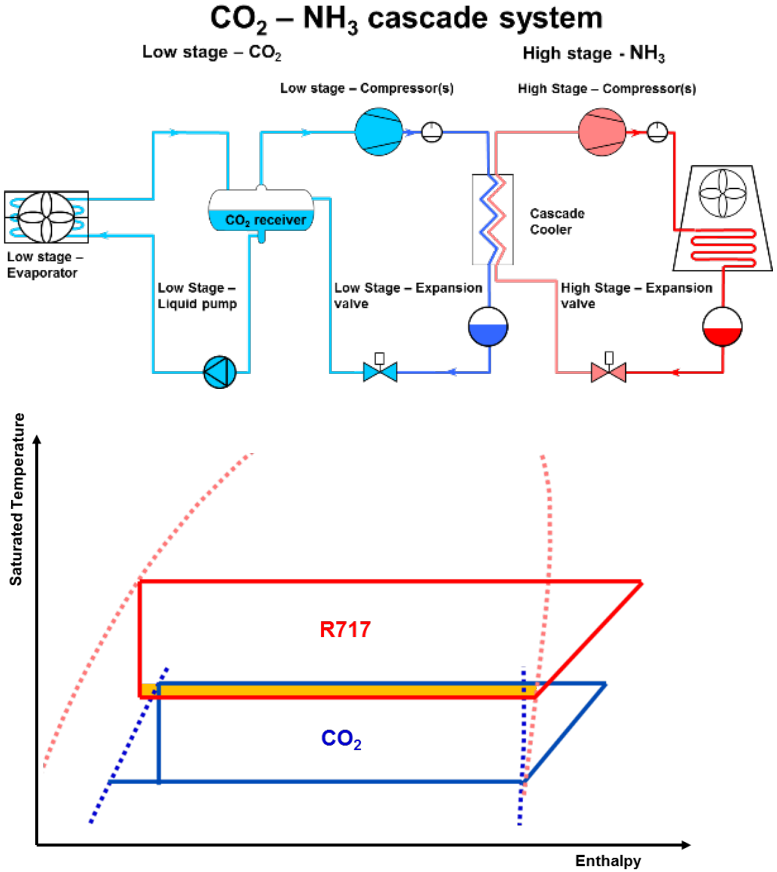


CO_2 in industrial refrigeration systems

Ammonia/CO_2 cascade system are dominant application within large industrial systems

Main driver:

- Ammonia **charge reduction** due to safety requirements.
  - Reduce charge by **70-90%**
  - Limited ammonia to engine room
- CO_2 is energy **efficient** at low temperature
- CO_2 is an attractive refrigerants for industrial applications
  - CO_2 is non-toxic
  - CO_2 is non-flammable



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Ammonia/ CO_2 cascade system



- Large scallop & sea cucumber processing center
- Dalian Zhangzi Island Fishery Group
- The first Ammonia/ CO_2 cascade syste in China
- Lowered NH_3 charge by 90%
- 30000 Ton



Recommendation

- **The ammonia and CO2 industry has a long history with more than +100 years of experience, where ammonia's properties has shown that it has been, and still is, one of the most effective refrigerants during all the years.**

Today's challenges:

- Ammonia is still the preferred refrigerant for industrial applications, **however safety is a topic**, that has to be treated professional.
- Low charge ammonia systems is a solution for mitigating the risk, and "low charge" is the name of the game for new ammonia systems, in paticular in US and Europe are starting to look in to Low charge ammonia to find the best solution for the customer needs.
- **In India**
  - Recognize Ammonia with Co2 is an option where safety is a concern
  - Safety Standards – Up Skill, Voluntary Vs Mandatory



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