



United Technologies

Building & Industrial Systems

ATMOsphere OEWG 36 Networking Side Event

CO₂ in Supermarket and Transport Refrigeration
Systems for Cold and Warm Climates

July 22nd, 2015

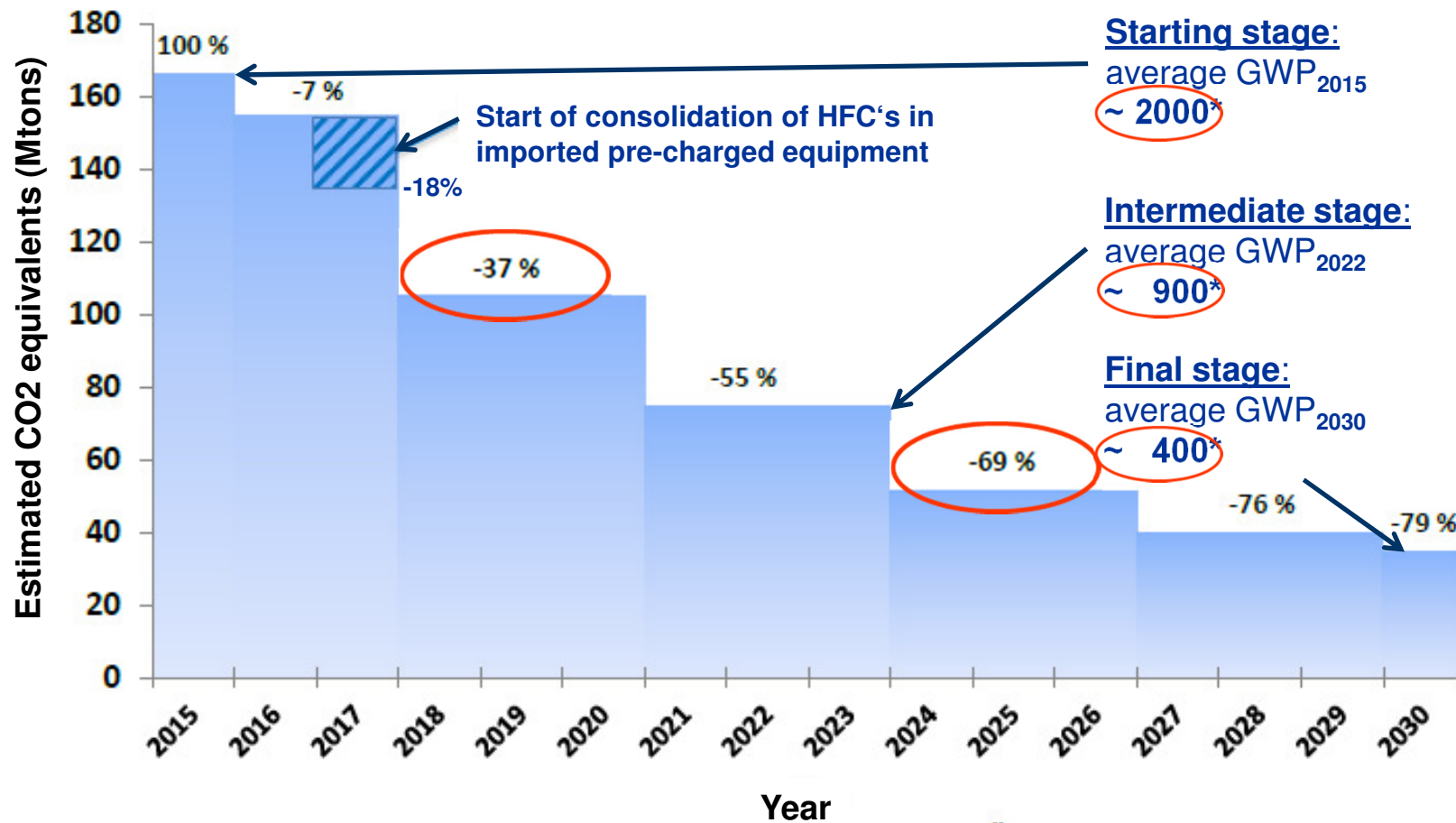
Juergen Goeller, Director Sustainability, Refrigeration



EU F-GAS REGULATION EU/517/2014

HFC cap and phase-down scheme is central pillar

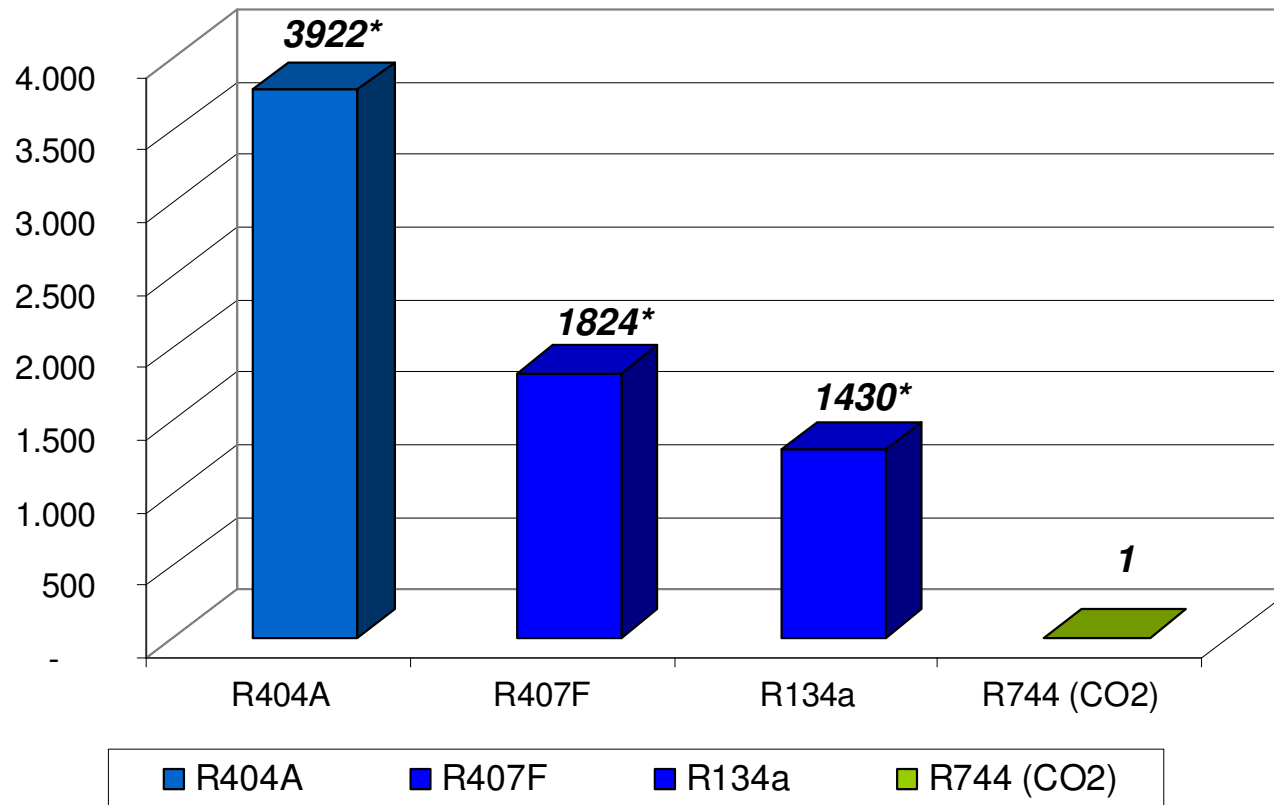
Reduction of HFC supply (Annex V)



* EU Commission DG CLIMA

CO₂ TECHNOLOGY EVOLUTION

Direct GWP of CO₂ substantially lower

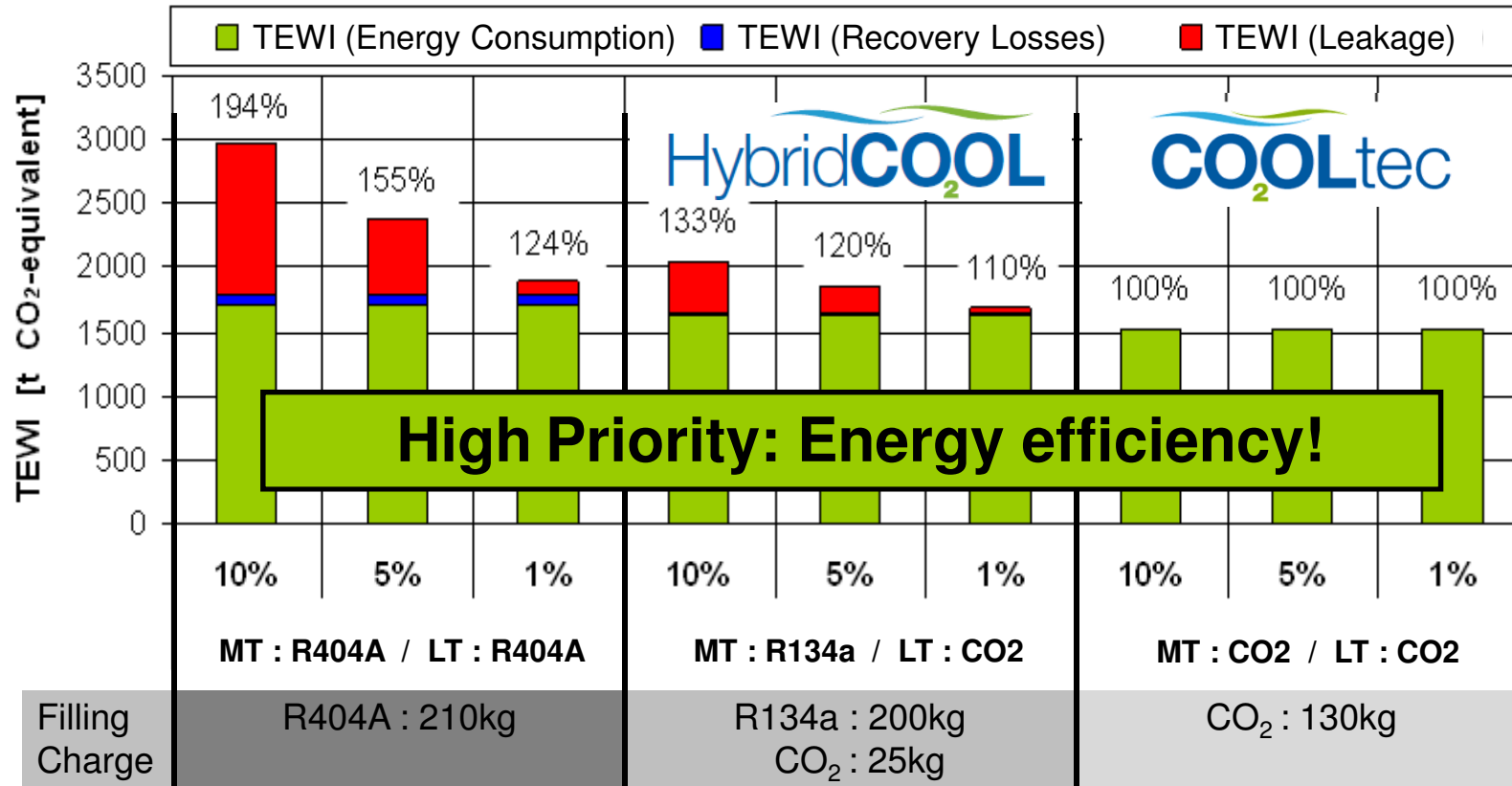


* IPCC AR 4 GWP values

CO₂ TECHNOLOGY EVOLUTION

TEWI of CO₂ Systems (Central Europe)

Q_{oMT}=60kW, Q_{oTK}=20kW, 15 years, 10%, 5%, 1% leakage rate
 Data according mild to cold climates, emission factor (**Europe** weighted): 0,48 kg CO₂/kWh

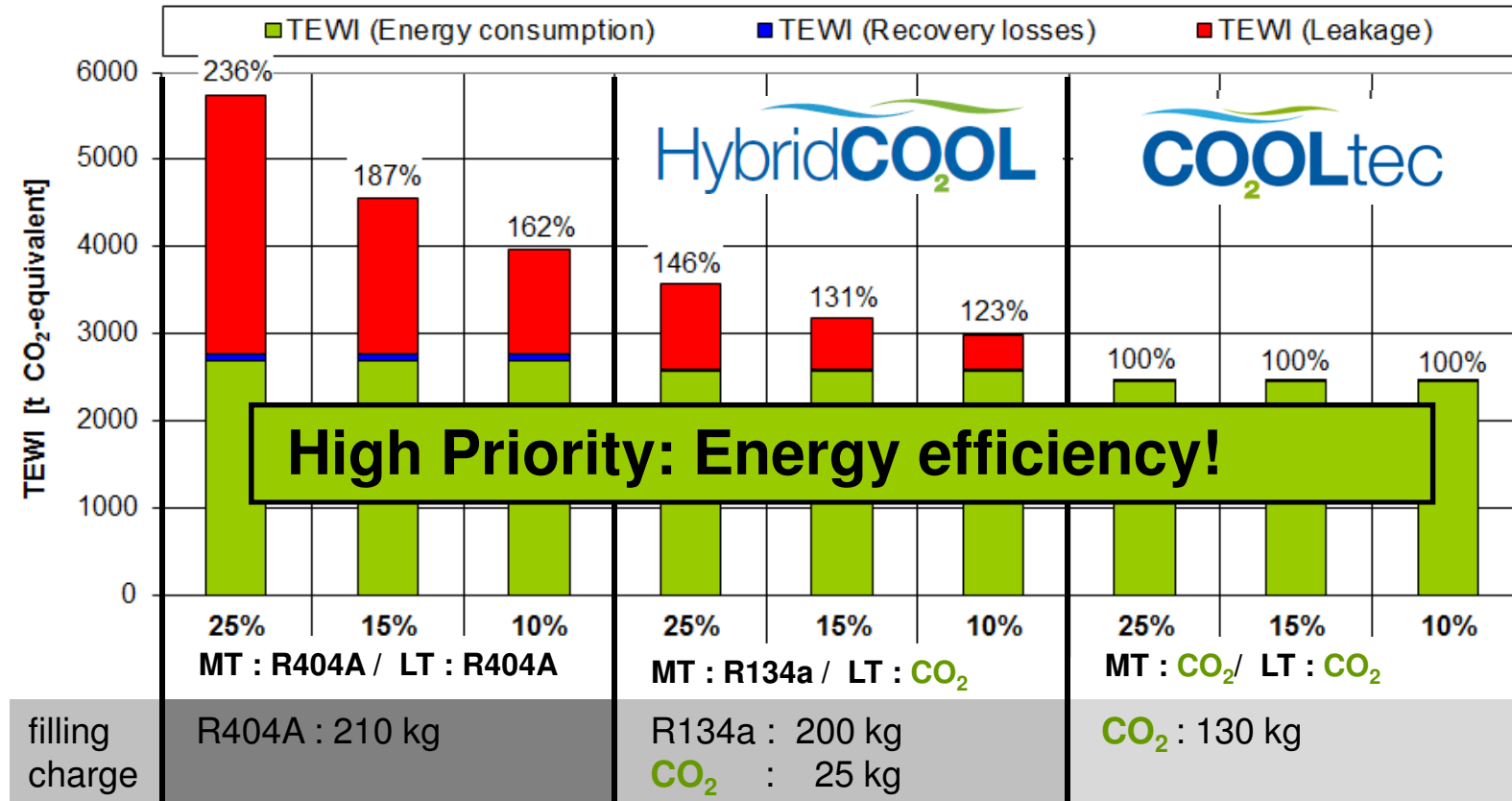


Even one breakdown with a total loss of the refrigerant results in an average leakage rate of approx. 7% based on a life cycle of 15 years

CO₂ TECHNOLOGY EVOLUTION

TEWI of CO₂ Systems (Central China)

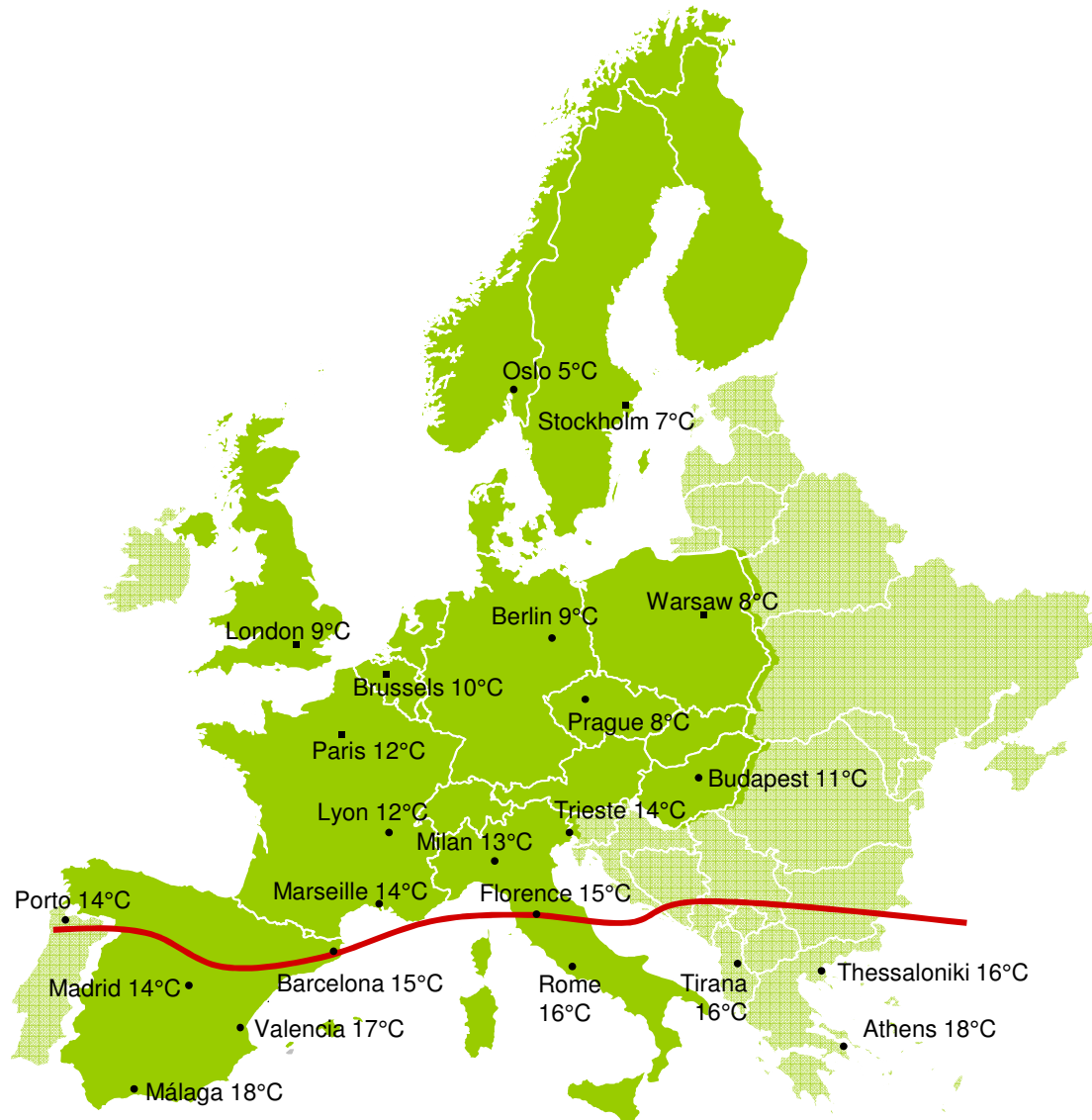
Q_{o,MT}=60kW, Q_{o,TK}=20kW, 15 years, 25%, 15%, 10% leakage rate
 data according mild to cold climates, emission factor (**China** 2010: 0,77 kg CO₂/kWh)



Even one breakdown with a total loss of the refrigerant results in an average leakage rate of approx. 7% based on a life cycle of 15 years

CO₂ SYSTEMS FOR SOUTHERN EUROPE

CO₂ trans-critical solutions for warm climates



Standard Efficiency

Proven energy efficiency of trans-critical CO₂ DX systems in cold and moderate climates

High Efficiency Innovation

Next generation of trans-critical CO₂ DX systems developed and field tested for warm climates

Targeting attractive energy performance across all of Europe, eliminating current *“CO₂ equator”*

Source: www.eurometeo.com- yearly climate averages

CO₂ SYSTEMS INNOVATION

CO₂ trans-critical solutions for warm climates

Installations:

Economizer

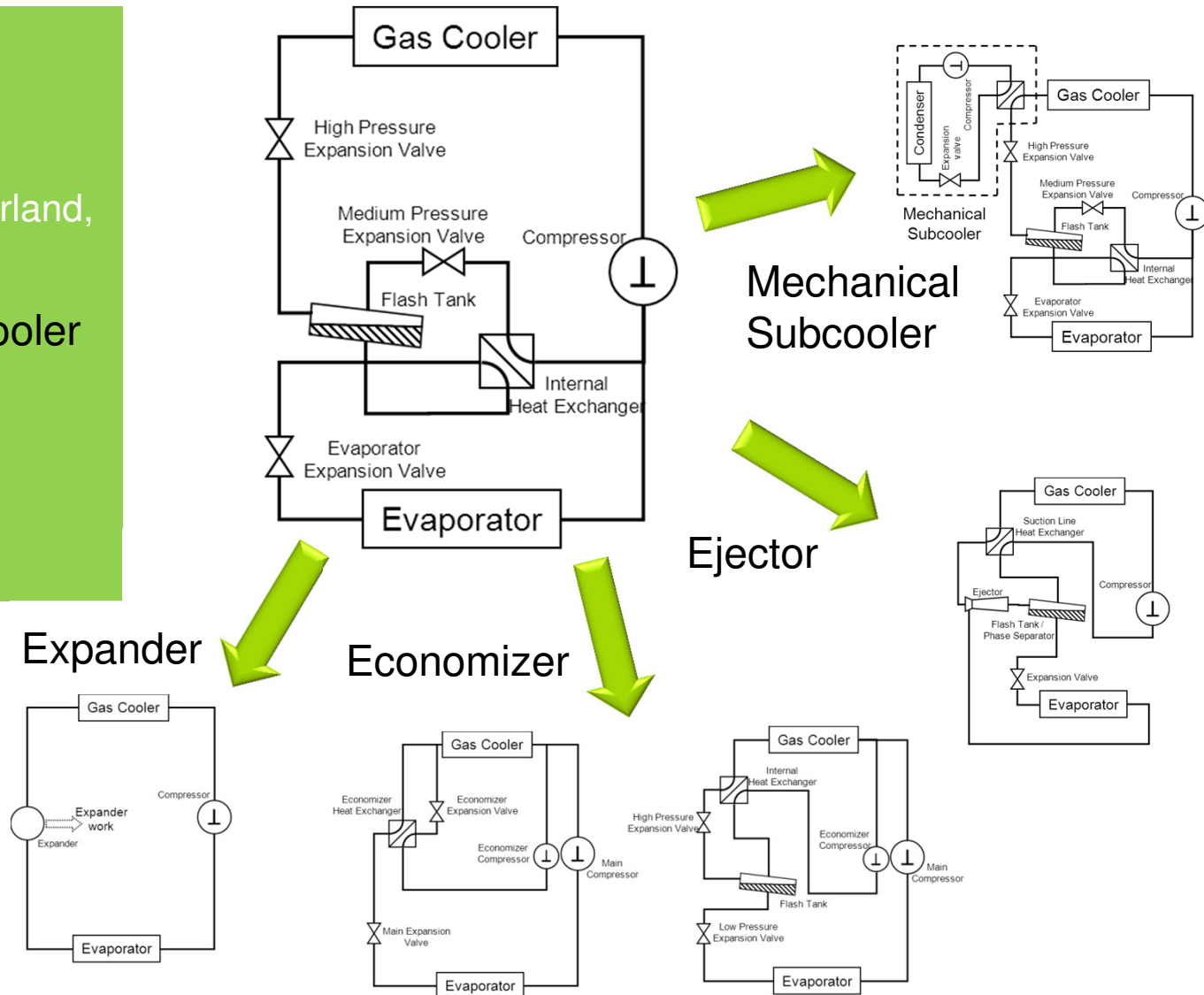
Denmark, Germany,
Netherlands, Switzerland,
Italy and Spain

Mechanical Subcooler

Spain
Portugal (2015)

Ejector

Spain



CO₂ SYSTEMS INNOVATION

CO₂ trans-critical system with economizer & ejector

Application : Food Retail Hypermarket,
Location : South-Eastern Spain
Total MT capacity : 222 kW
Total LT capacity : 57 kW
Commissioned : October 2014

Measurement of daily energy consumption (24h) during summer operation

Operation with/without ejector for comparison

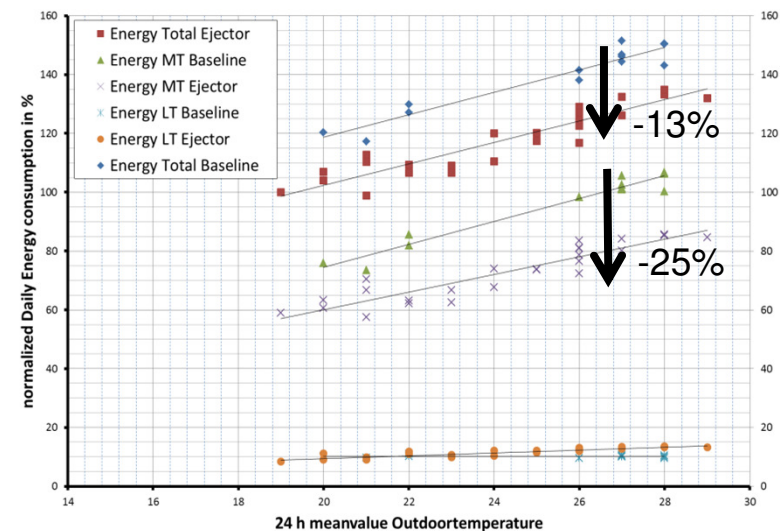
Reduced energy consumption in ejector operation mode @ 28°C :

-25% MT compressor rack

-13% total refrigeration system

(MT rack + LT rack + cabinets lighting/defrost)

Further optimization ongoing



CARRIER CO₂ TECHNOLOGY EVOLUTION

NaturaLINE[®] global field trials



CARRIER CO₂ TECHNOLOGY EVOLUTION

CO₂ in Commercial and Transport Refrigeration

COOLtec



Commercial Refrigeration segment uptake :
1.525 trans-critical and 832 sub-critical CO₂
refrigeration system installations in Europe
with significant efficiency improvements

NaturaLINE



Container Refrigeration commercially
available after 2 years of intensive field trials
(training, reliability, performance, efficiency)

AdvanTEC³

United Technologies

Transport



IAA 2014 : New
Prototype
presented

Road Transport Refrigeration system
field trials started in September 2013;
new prototype presented at IAA 2014

CARRIER CO₂ TECHNOLOGY EVOLUTION

Summary

- CO₂ Supermarket Refrigeration systems and hydrocarbon integral stand-alone products are becoming mainstream in Europe
- Subcritical CO₂ systems already available in Asia-Pacific, first transcritical CO₂ supermarket systems soon to come in China
- CO₂ refrigeration technology in reefer containers is already available in all main markets around the globe
- CO₂ refrigeration systems for road transport applications is under development and will be applied in Europe first



CARRIER CO₂ TECHNOLOGY TRAINING

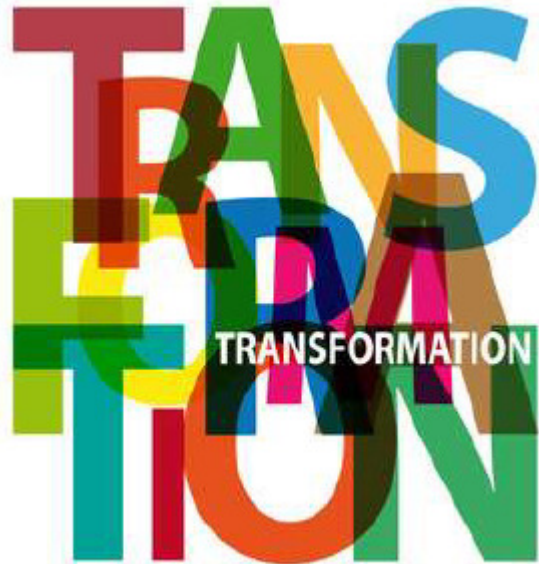


Official Opening 25 March 2015



GLOBAL MARKET TRANSFORMATION

Key industry activities



- National F-Gas Regulations adopted in Japan and the U.S., pending in Canada
- Appropriate education and training of installers and service staff is key priority
- Standards and building codes need to be adapted to (mildly) flammable refrigerants
- New lower GWP refrigerants and blends will be on offer short-term and mid-term
- Equipment manufacturers develop new technologies, in particular in Europe and in North America



Thank you for your attention!
For further information please visit our website
www.carrier.com

Carrier has the right refrigerant for every application, but every application will not have the same refrigerant solution

Innovative solutions,
naturally...

