



ATMO sphere

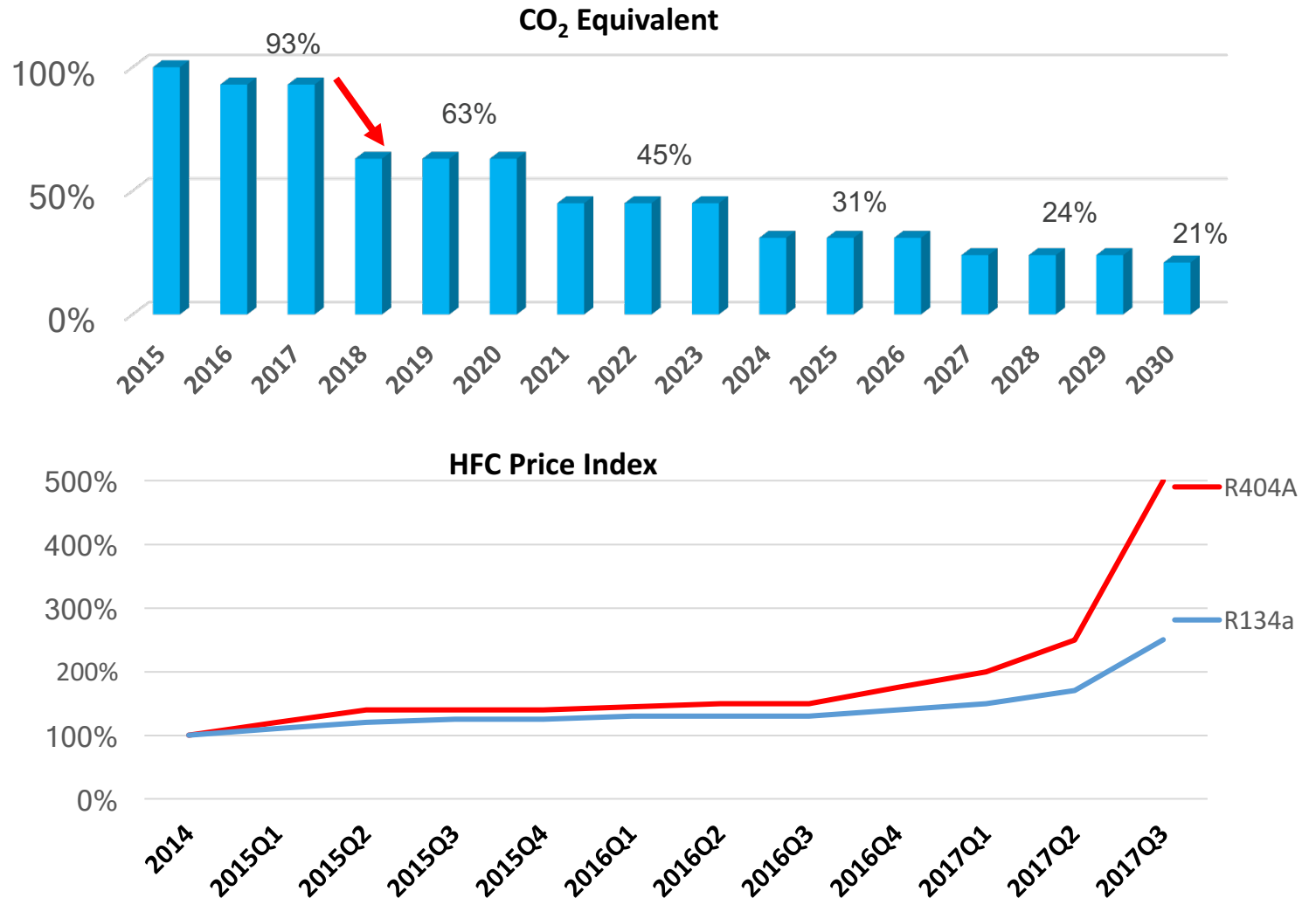




Compact CO₂ Refrigeration Unit in Commercial Applications

Markus Lenz

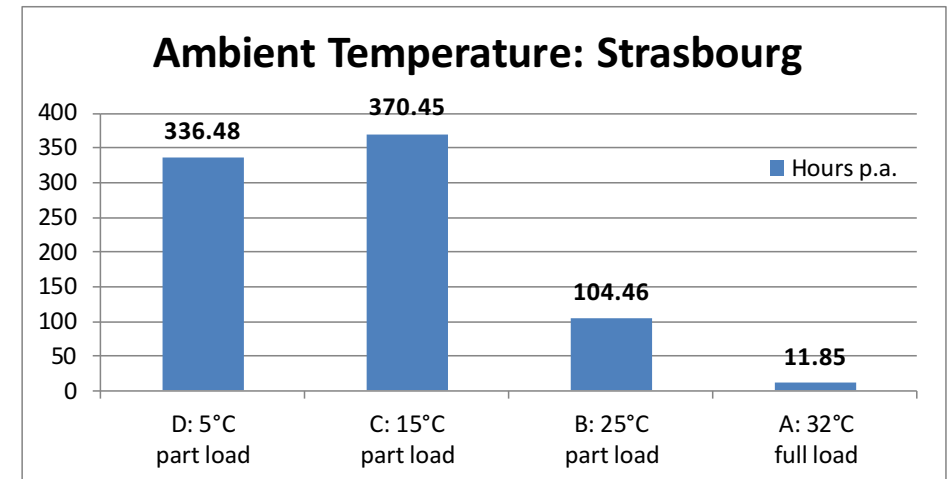
- F-Gas Regulation EU 517/2014
 - HFC reduction of 79% by 2030
 - Base: CO₂ equivalent in the market 2015
- Consequence
 - HFC prices increase drastically
 - Proliferation of refrigerants in the market
 - Unavailability of high GWP refrigerants
 - Increasing demand for natural solutions
- National Legislation
 - Penalties with HFC tax (ES/NO/FR)
 - Subsidy schemes (DE/NL)



- Ecodesign Directive 2009/125/EC:
 - Energy-Efficiency for Energy Related Products
- Regulation (EU) 2015/1095:
 - Energy-Efficiency of Condensing Units
- Seasonal Energy Performance Ratio
- Specified operation points for unit efficiency calculation
 - Te: -10 °C or LT -35 °C at Ta 5 / 15 / 25 / 35 °C
- COPs related to temperature profile of Strasbourg
- Majority of operating hours in low ambient favours CO₂

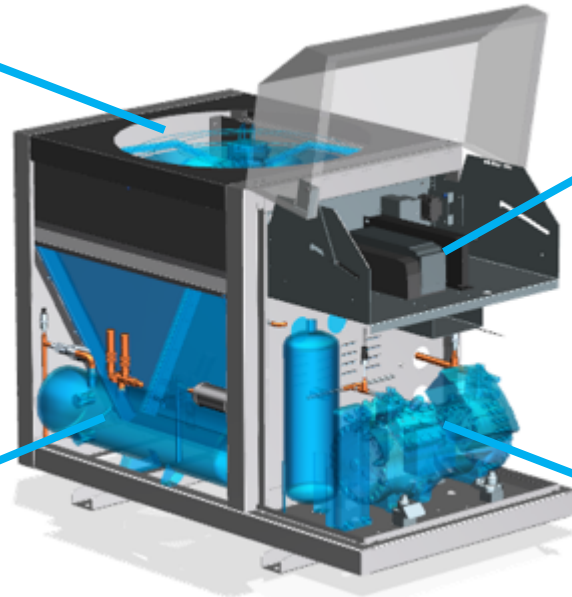
Application	Capacity (kW)	Performance Evaluation	MEPS	
			From July 1st 2016	From July 1st 2018
Medium Temperature	< 1,0	COP	1,20	1,40
	1,0-5,0		1,40	1,60
	5,0-20	SEPR	2,25	2,55
	> 20		2,35	2,65
Low Temperature	< 0,4	COP	0,75	0,80
	0,5-2,0		0,85	0,95
	2,0-8,0	SEPR	1,50	1,60
	> 8,0		1,60	1,70

CO₂ Units allowed for 10 % lower COP/SEPR



Low Noise

- Latest Generation EC Fans



Efficiency & Flexibility

- Intelligent Controls
- Capacity Modulation
- Monitoring

Long Stand Still:

- High Capacity 90 bar Receiver

Efficiency & Reliability

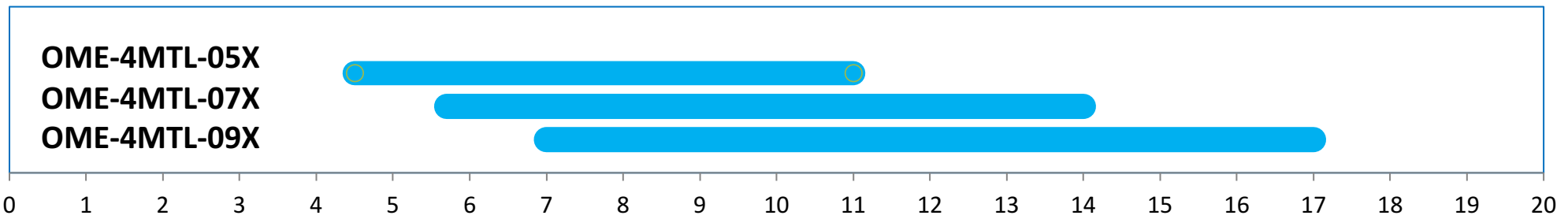
- Low Vibration Stream Compressor

EazyCool CO₂



OME-4MTL-05X
OME-4MTL-07X
OME-4MTL-09X

Max. Capacity (kW)
-10/35 °C

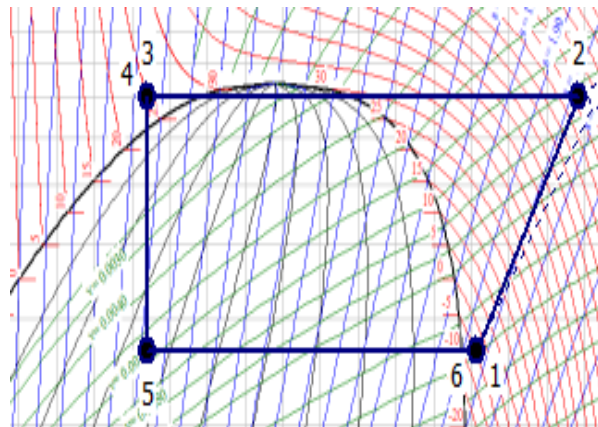
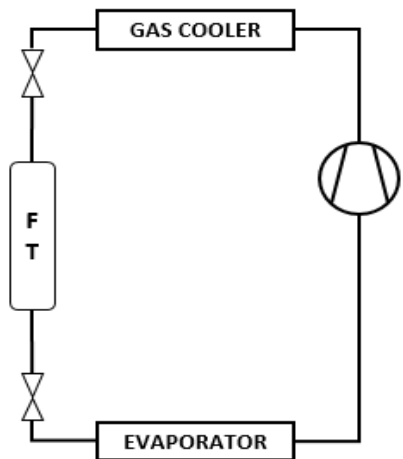


Case 1

120/90/90 bar System



- Longer stand still time
- Slightly higher Efficiency
- Slightly higher capacity in high ambient
- Special pipework (K65/stainless steel)
- Less Cycling

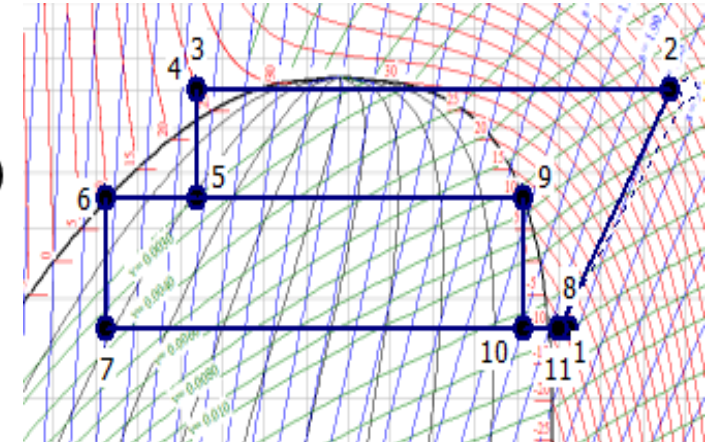
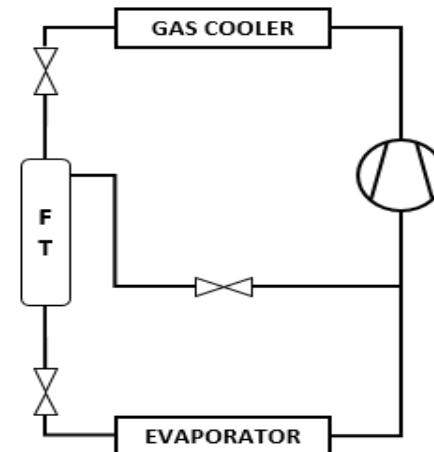


Case 2

120/45/45 bar System



- Reduced stand still time
- Higher Cycling rate
- Standard CO2 cabinets
- Standard pipework
- Reduced applied costs



- Application: Cold room – ca. 200 m³
 - Location: Norway, near Oslo
 - Customer: Cabbage Farmer
 - Temperature: 2 - 5 °C, Te = -10 °C
 - Capacity: 16 kW, 12 kg CO₂ charge
 - System HP/IP/LP: 120/90/90 bar
 - Remote Monitoring: XWEB
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- Standard SEPR: 3,60
 - Standard Energy consumption per year: 28758 kWh
 - Local SEPR Oslo: 4,07
 - Expected Energy consumption per year: 25007 kWh

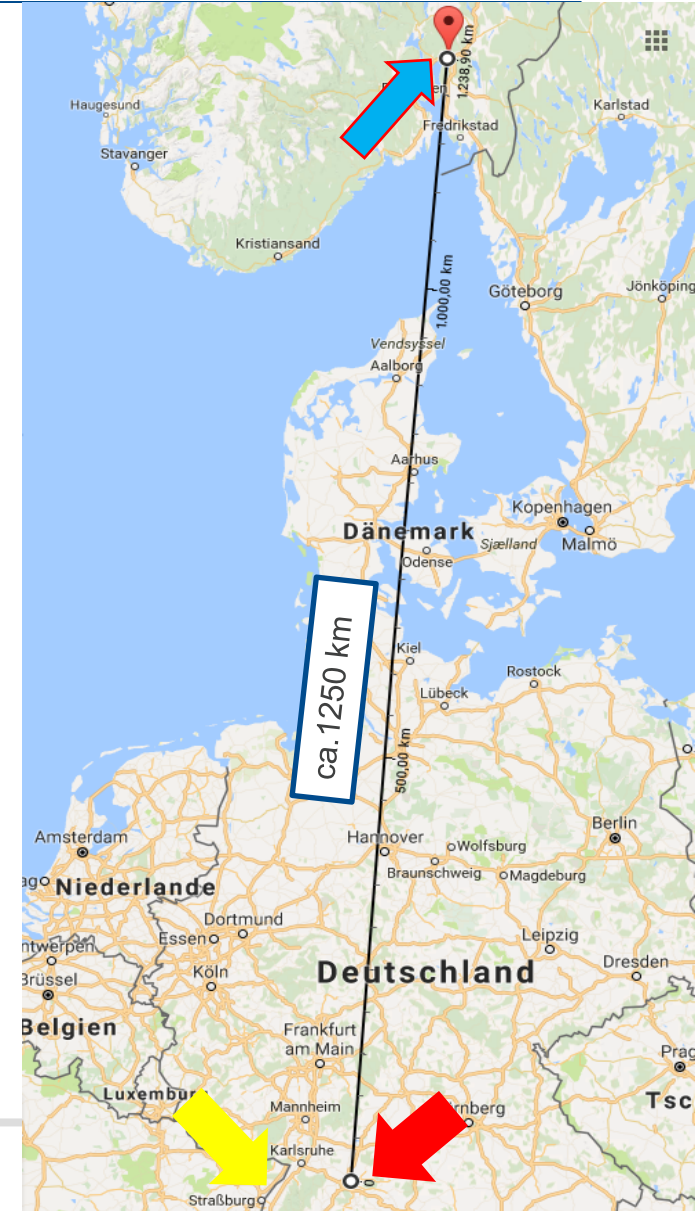
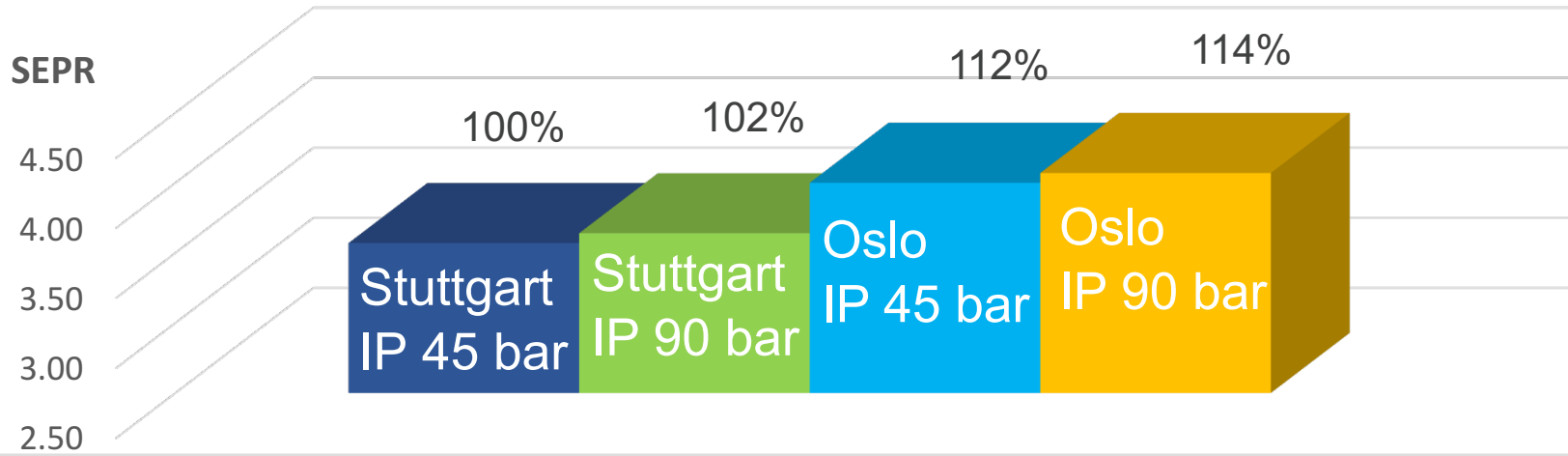


- Application: Food retail capacity extension by 10 m display cabinets
 - Customer/Operator: Supermarket chain
 - Location: Germany, near Stuttgart – Jul 17
 - Temperature: 2 - 5 °C, Te = -10 °C
 - Capacity: 15 kW, 20 kg CO₂ charge
 - System HP/IP/LP: 120/45/45 bar
 - Remote Monitoring: XWEB
 - System Monitoring: Wurm Frigolink
-
- Standard SEPR: 3,53
 - Standard Energy consumption per year: 29328 kWh



	Case 1: Oslo CO ₂ Unit	Case 2: Stuttgart CO ₂ Unit	Oslo HFC Unit (R449A)	Stuttgart HFC Unit (R449A)
SEPR adjusted	4,07	3,53	3,73	3,39
kWh/year	25007	29328	26759	30772
€/kW	0,11	0,17	0,11	0,17
Energy Costs/Year	2851 €	4986 €	2943 €	5231 €
GWP	1	1	1397	1397

SEPR Comparison



- The tested CO₂ Refrigeration unit **exceeds 2018 Ecodesign** efficiency requirements
- The unit can operate on same or **higher efficiency levels** than comparable HFC/HFO units
- One year **monitoring** needs to confirm calculated data
- System efficiency is strongly related to site location, system design and **control intelligence**
- The F-Gas Regulation will further **drive natural refrigerant solutions**
- **CO₂ refrigeration units will gain market share**, success depends on relative price premium vs HFC/HFO solutions



Thank you very much!

