

Transport refrigeration system using CO₂



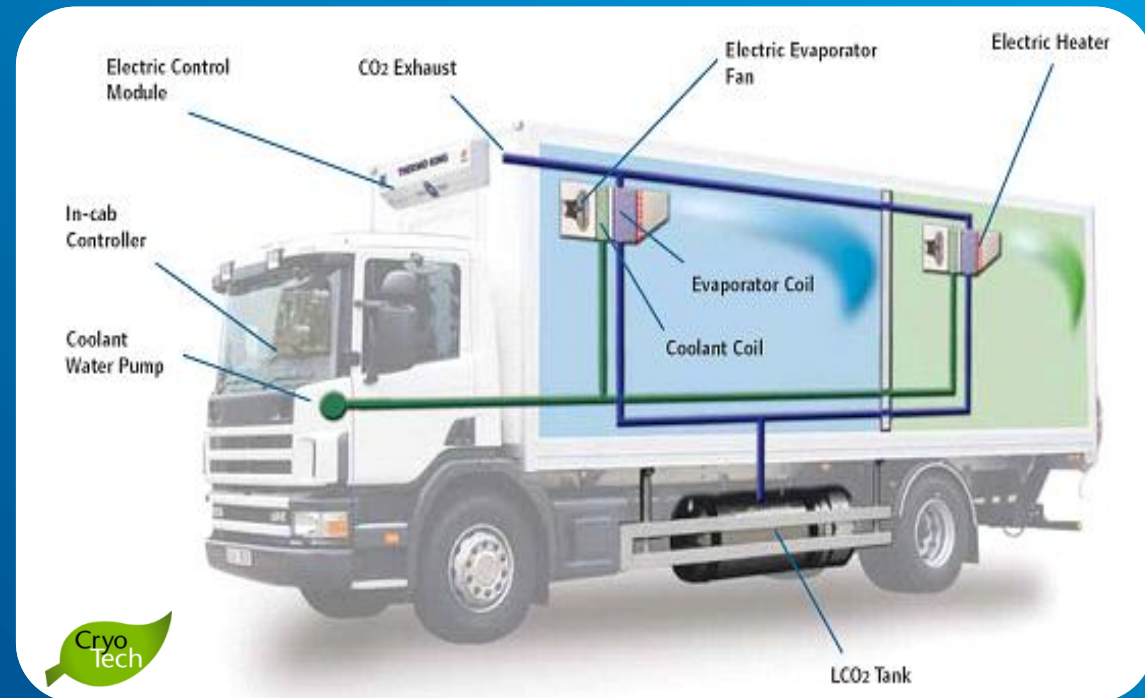
Cryo
Tech

Agenda

- System description & operation
- Environmental benefits
- Other benefits
- Infrastructure
- Challenges
- Spar business case

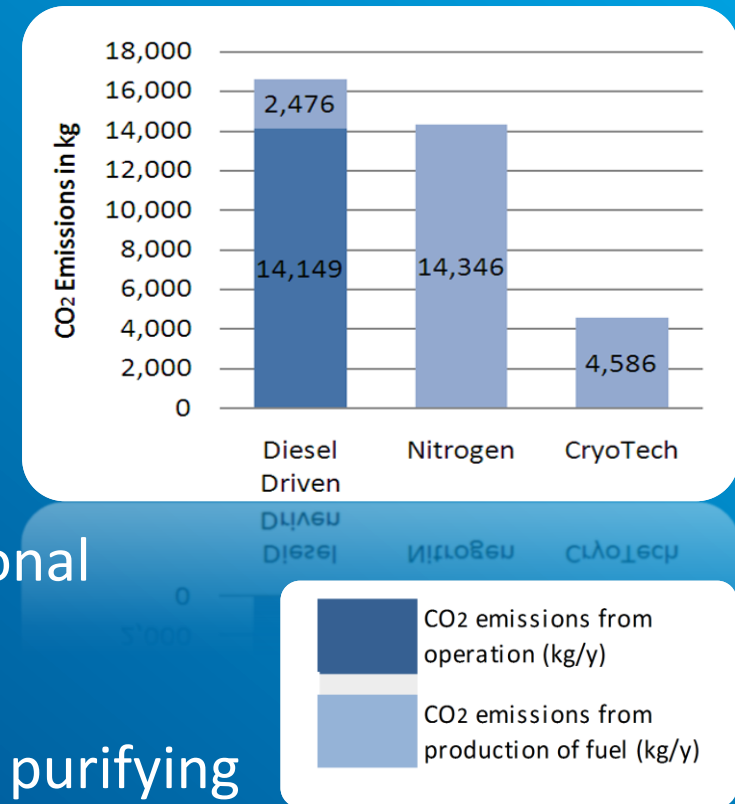
System Description & Operation

- Recycled liquid CO₂ through evaporator coil located inside load space
- Air around evaporator coil cooled and blown through box by electric evaporator fans
- Used CO₂ gas vented to atmosphere via exhaust muffler

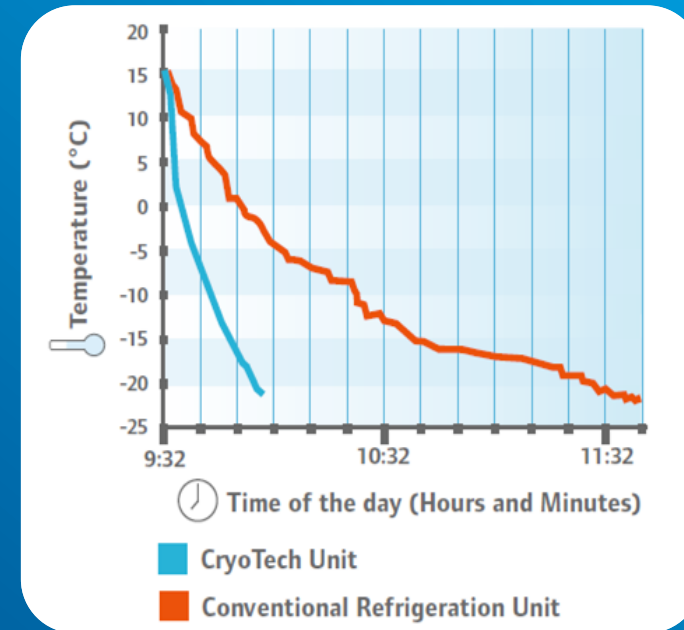
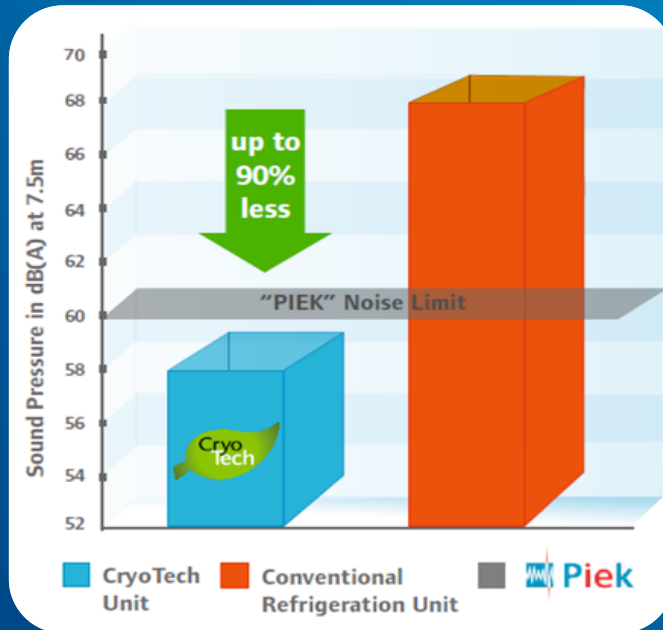


Environmental Benefits

- 100% of liquid CO₂ obtained as by-product from industrial fertilizer, bio-ethanol or chemical production
- In Europe, commercial CO₂ represents only ~0.1% of total man-made emissions
- Majority of carbon footprint for conventional systems due to fuel combustion
- Lower carbon footprint for liquefying and purifying CO₂ versus nitrogen or diesel driven equipment



Other Benefits



- Significant noise reduction
 - Exceeds requirements of Dutch PIEK noise standard
- Superior cooling capacity and temperature pull down
 - Four times faster pull down than equivalent conventional unit – less spoilage



CryoTech Infrastructure

- Developed in conjunction with Yara International
- Filling stations consist of:
 - Storage tank
 - High speed CO₂ dispenser
 - Breakaway couplings
 - RFID based unit identification, billing system & fleet management system
- In operation: 26 stations in 7 countries supplying over 600 CryoTech installations
 - 7 stations in The Netherlands



Challenges



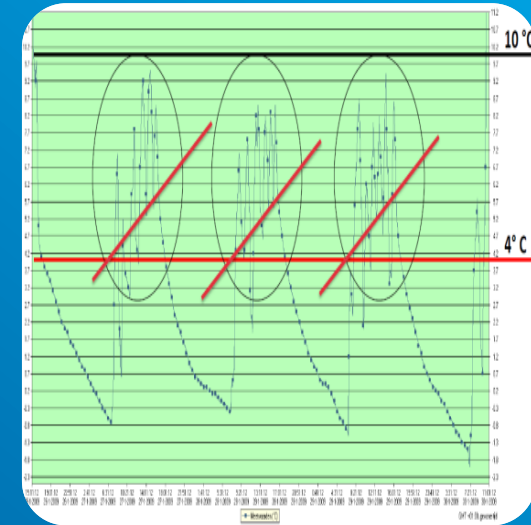
- Infrastructure for refilling CO₂
 - Long distance transports requires a closed filling station network
 - warmer climate regions require a more dense filling station network with subsequent higher initial investments
- Cooling capacity is unlimited
 - Due to higher ambient temperatures the CO₂-consumption increases
- Each region & application requires a thorough cost-benefit calculation



There is no perfect refrigerant!

Spar business case

- In 2009 a test with 1 trailer worst case scenario
→ 40 kg of CO₂ per operational hour
- Goal: Secure Cold Chain (0-4°C)
- In 2011 go ahead for 51 CryoTech units on new fleet
- 2 DC's in the Netherlands: 1 new and 1 refurbished
- Small scale distribution: 677 stores to fulfil
- Approx. 4% market share in NL



Thank you for your attention!