**Slide 1**

**Rob Weeder**
Service Business Development Manager
GEA Heating & Refrigeration Division

- Name: Rob Weeder
- Company: GEA Heating & Refrigeration Division
- Role: Service Business Development Manager
- Located: 's-Hertogenbosch, The Netherlands
- Working for GEA for more than 20 years,
  - 4 years in (global) Service Business Development
- General goal: Supporting our local offices to improve customer satisfaction.

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**Slide 2**

**Agenda**

| 01 | Energy Efficiency installations |
| 02 | Energy Efficiency compressors |
| 03 | Digital Solutions & Remote Monitoring |

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**Slide 3**

**Power consumption**
Average power consumption food industry

Installation & compressor efficiency is key in reducing energy costs

| Cold storage | Up to 70 – 80% of total electrical power consumption |
| Ice business | Approx. 75 – 85% of total electrical power consumption |
| Dairy / Brewery | Approx. 30 – 40% of total electrical power consumption |

| Refrigeration plant power consumption | Compressors 60 – 80%<br>Condensers 15 – 30%<br>Pumps, aircoolers etc. 5 – 20% |

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**Slide 4**

**Industrial Refrigeration Energy efficiency**
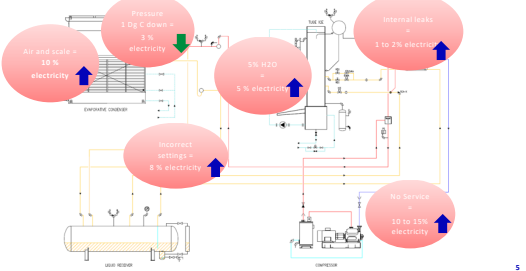Main influencing factors

- **Efficient system design**
- **Usage of energy efficient components**
  - Condenser
  - Evaporator
  - Pumps, Valves and Fans
  - Compressors
- **Using advanced control logic**
- **Proper installation and commissioning**
  - 2 out of 3 industrial refrigeration plants are not commissioned in an optimal way (no heat load at the time of commissioning)
  - There is no focus on energy saving during commissioning
- **Solid maintenance plan (…and execution of it)**
  - Maintain compressors
  - Maintain heat exchangers
  - Maintain pumps and fans
  - Maintain electrical components
  - Maintain chemical purity of working fluids
- **If available, benchmark performance to best in class.**
  - For Cold Stores application, as example, use SEC (Specific Energy Consumption)
  - Rule of Thumb a 100.000m3 coldstore should aim for 10kWh/m3/yr

Compressor Total Cost of Ownership

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**Slide 5**

**Power Consumption and losses**
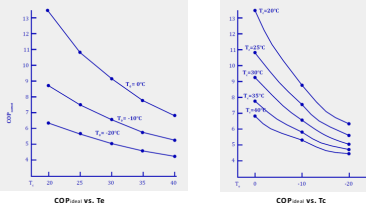


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**Slide 6**

**Settings (or finetuning)**

$COP_{ideal}$ vs. Te

$COP_{ideal}$ vs. Tc

Rules of thumb

1K Discharge Pressure ~ 3-3.5 % Energy Saving

Saving energy, saving costs, reducing $CO_2$ footprint

1K Suction Pressure ~ 3% Energy Saving
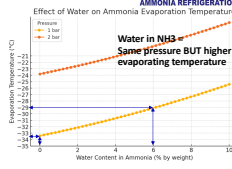
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## Water (H2O) in ammonia

**1% water ~ 1% increased Powerconsumption**

5% water of 500kW motor = 25 kW
16 h/day = 400 kWh
365 days = 146,000 kWh

**8 INR/kWh = 1.168.000 INR/year (Euro 11.097)**

This is excluding effects like:

- Additional electricity from fans and pump on,
- evaporative condenser) plus water and chemical.
- Sludge / moisture in system, increased wear and tear on internal parts
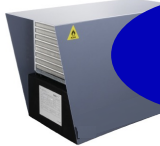- Lubrication issues

Effect of Water on Ammonia Evaporation Temperature

**Water in NH3 = Same pressure BUT higher evaporating temperature**

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## None condensable gasses

Most often causes of failures are missing or incorrect maintenance:
- One time no vacuum of compressor = degrees of increased condensing temperature
- 1 Dg C increase = 3.5% increased electricidal consumption of compressor

No vacuum after service
=
~1 compressor volume of air
=
~1 volume of condenser =
=
~10 % Increased electricity

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## Other variables

**Recommissioning**
- Up to 8% due to incorrect settings or adjustment of valves

**Parallel operation**
- if units stand alone (not talking together): up to 10% increased power consumption due to load/onload

**Condenser control**
- Saving in 10 to 15% range due to better control (Floating control)

**Oil filters and coalescent filters**
- Oil carry over increases due to coalescer issues.
- Clogged result in approx. 0,5 bar additional pressure drop resulting in 2.5 % additional motor power consumption
- More oil in the system resulting in oil layer on evaporators resulting in 10 to 20 % reduced heat transfer resulting in 3 % increased motor power
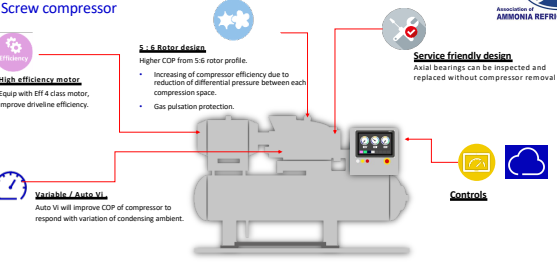
**Regularly drain oil from your system**

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## Agenda

**01**     Energy efficiency installations

**02**     **Energy efficiency compressors**

**03**     Digital Solutions & Remote Monitoring

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## Industrial Refrigeration Energy efficiency
### Screw compressor

**Efficiency**

**High efficiency motor**
Equip with Eff 4 class motor, improve driveline efficiency.

**5 : 6 Rotor design**
Higher COP from 5:6 rotor profile.
- Increasing of compressor efficiency due to reduction of differential pressure between each compression space.
- Gas pulsation protection.

**Service friendly design**
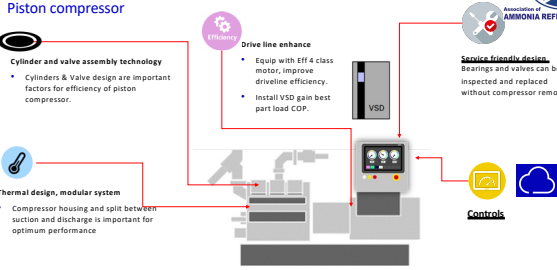Axial bearings can be inspected and replaced without compressor removal

**Variable / Auto VI**
Auto Vi will improve COP of compressor to respond with variation of condensing ambient.

**Controls**

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## Industrial Refrigeration Energy efficiency
### Piston compressor

**Efficiency**

**Cylinder and valve assembly technology**
- Cylinders & Valve design are important factors for efficiency of piston compressor.

**Drive line enhance**
- Equip with Eff 4 class motor, improve driveline efficiency.
- Install VSD gain best part load COP.

**Service friendly design**
Bearings and valves can be inspected and replaced without compressor removal

**Thermal design, modular system**
- Compressor housing and split between suction and discharge is important for optimum performance

VSD

**Controls**

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## Slide 13

### Industrial Refrigeration Energy efficiency
#### Screw compressor

**Maintenance**

If the manufacturer is chosen, of course it is important to keep the compressor in excellent shape.

Follow manufacturers prescription:
- Regular check oil levels
- Register oil carry-over, increased oil carry-over generally means loss of efficiency
- Regularly check oil quality (test sample)
- Clean gas suction filter
- Clean or replace oil filter(s)
- Check shaft seal and leakage rate, replace when necessary
- Measure bearing wear by face gap measurement, replace bearing when required
- Use original spare parts, these are tested and specially selected for the application.

**Wear of screw compressors**
- Above 10 to 15 years efficiency drop with 1% per year. E.g., a 20 years old screw will have an average of 20% efficiency loss
- Energy loss can be irreversible if housing / rotors are wearing.
- Maintain, monitor and if necessary, even replace / exchange compressor

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## Slide 14

### Industrial Refrigeration Energy efficiency
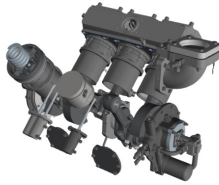#### Piston compressor

**Maintenance**

If design / manufacturer is chosen, of course it is important to keep the compressor in excellent shape.

Follow manufacturers prescription:
- Regular check oil levels
- Register oil carry-over, increased oil carry-over generally means loss of efficiency
- Regularly check oil quality (test sample)
- Clean gas suction filter
- Clean or replace oil filter(s)
- Check shaft seal and leakage rate, replace when necessary
- As prescribed, replace valves, piston rings, bearings etc. depending on running hours / running conditions
- Use original spare parts, these are tested and specially selected for the application.

**Wear of piston compressors**
- Wear of piston compressor suction or discharge valves gives approx. 1 to 2 % efficient loss
- Replacement of wear parts can restore this efficiency loss.

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## Slide 15

### Agenda

**01**     Energy efficiency installations

**02**     Energy efficiency compressors

**03**     **Digital Solutions & Remote Monitoring**

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## Slide 16

### Digital Solutions & Remote Monitoring
#### IIoT Solutions for Industrial Refrigeration & Heating Equipment

**Monitoring Equipment Status**
Tracking the status of the refrigeration equipment, ensure efficient and reliable operation.

**Energy Efficiency**
Deliver measurable energy efficiency savings up to 20%, while reducing Carbon Footprint as well.

**Customer Satisfaction**
Providing reliable service and quickly addressing issues increases customer satisfaction

**Predicting Failures**
The software can infer potential equipment failures, allowing end-users & contractors to take preventive actions and avoid downtime.
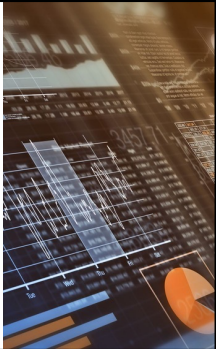
**Reduced Operational Costs**
Improved monitoring and maintenance lead to more reliable service, quick issue resolution, and better workload management, enhancing overall efficiency.

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## Slide 17

### Digital Solutions & Remote Monitoring
#### More data → more intelligence → more value

**When equipment is connected:**
- Centralized analytics across compressors and installations worldwide
- Performance benchmarking across sites and regions

**Value for manufacturers;**
- Continuous product improvement (efficiency, controls, reliability)
- Early detection of failures and preventive maintenance insights

**Value for contractors:**
- Full visibility of all maintained assets
- Proactive resource planning based on real priorities
- Clear identification of urgent vs. non-urgent jobs
- Dispatch of FSEs with the right skills, tools and spare parts

**Operational impact:**
- ✓ Real-time health check machine updates
- ✓ Prevent / Eliminate re-occurring warning messages
- ✓ Guided recommendations to resolve specific errors and warnings
- ✓ 24/7 remote helpdesk with access to analyzed data and expertise

## Slide 18

### Digital Solutions & Remote Monitoring
#### More data → more intelligence → more value

**But also:**
- Remote optimization of operating parameters
- Active start/stop control aligned with electricity price fluctuations
- Digital Twin comparison to calculate actual savings
- Energy savings of up to 20% achievable
- Foundation for performance- and outcome-based service contracts

**In a nutshell - main takeaways:**
- ✓ Global performance transparency
- ✓ Proactive maintenance instead of reactive service
- ✓ Smarter planning of people, parts and priorities
- ✓ Faster issue resolution with expert remote support

**The more data is gathered, the more value and functionality is unlocked**

Thank you for your attention

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