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refrigerants delivered by mother nature

eurammon Symposium 2017

Small Applications with Ammonia

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Star Refrigeration Ltd.

Schaffhausen, 22nd/23rd June, 2017

Traditional Ammonia Refrigeration Technology

Compressor Plantroom

Surge Drum Vessel and Liquid Pumps

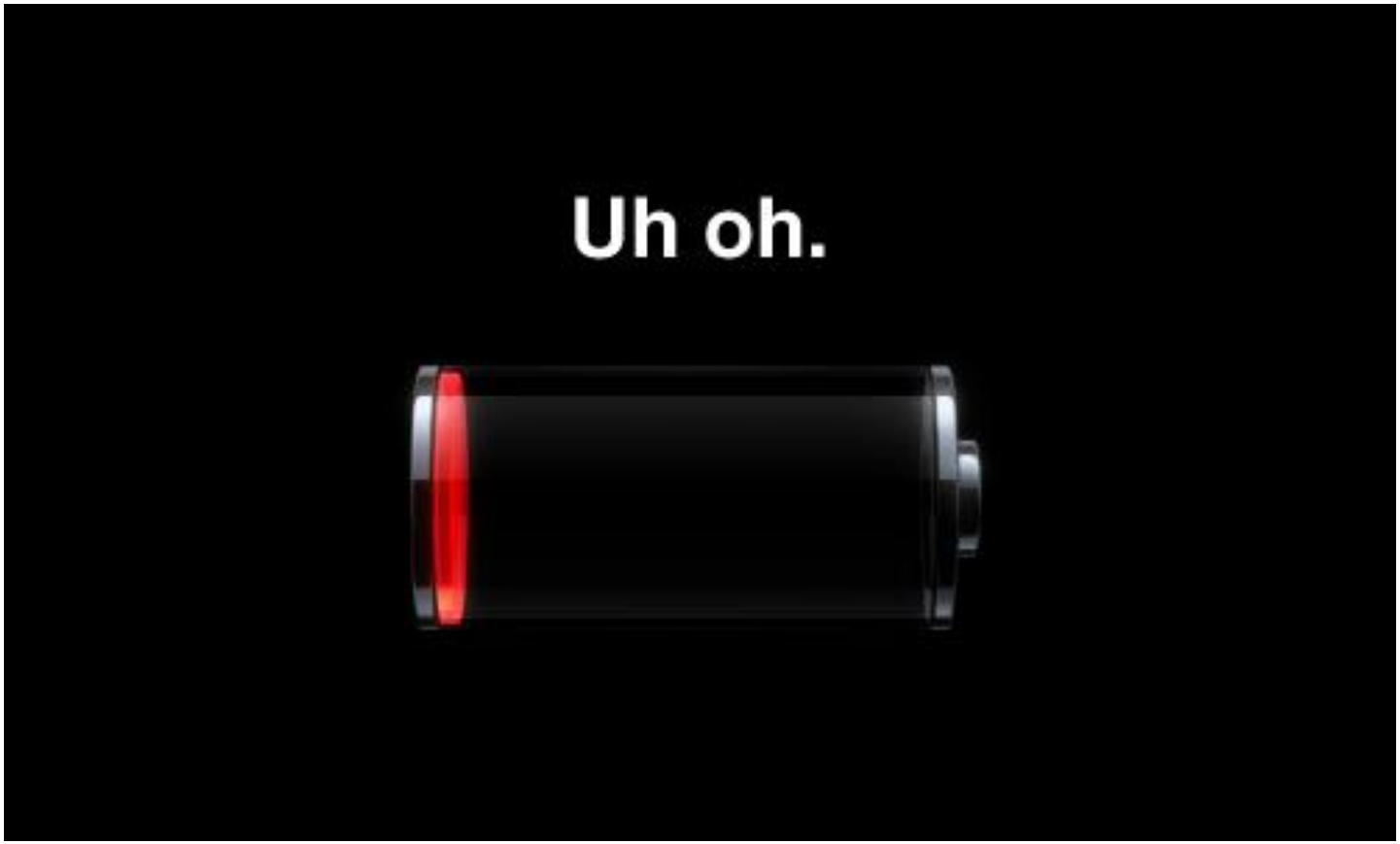
HPR Liquid Storage Vessel

Ammonia Refrigerant Charge

The refrigerant for a well designed pumped recirculation *ammonia system is* ** **2.6 kg/kW**

**GCCA White Paper on Low Charge Systems

So what Is Low Charge?



Low Charge: A Definition

*Any ammonia system which requires a specific system charge of less than ****1.3kg/kW** *(10 lb/TR) of refrigerant.*

*GCCA White Paper on Low Charge Systems

Case Study 1 - System Refrigerant Charge – Small R22 DX Plant

- *Single **DX R22** Refrigeration Plant installed 1991*
- *Single stage plant with 3x Compound Reciprocating Compressors*
- *2x Evaporative condensers*
- *5x DX Evaporators*
- *Main Freezer Chamber -22degC*

- ***175kW** installed room cooler capacity*
- ***540kg** refrigerant charge*

3.1kg/kW specific system charge

Case Study 2 - System Refrigerant Charge – Small R407F DX Plant

- *4x Modular **DX R407F** Split Systems installed 2014*
- *Each modular system comprised*
  - *1x Air-cooled condensing unit*
  - *1x Evaporator*
  - *55kg gas charge*
- *Main Freezer Chamber -22degC*

- ***140kW** installed refrigeration capacity*
- ***220kg** refrigerant charge*

<u>1.75kg/kW specific system charge</u>

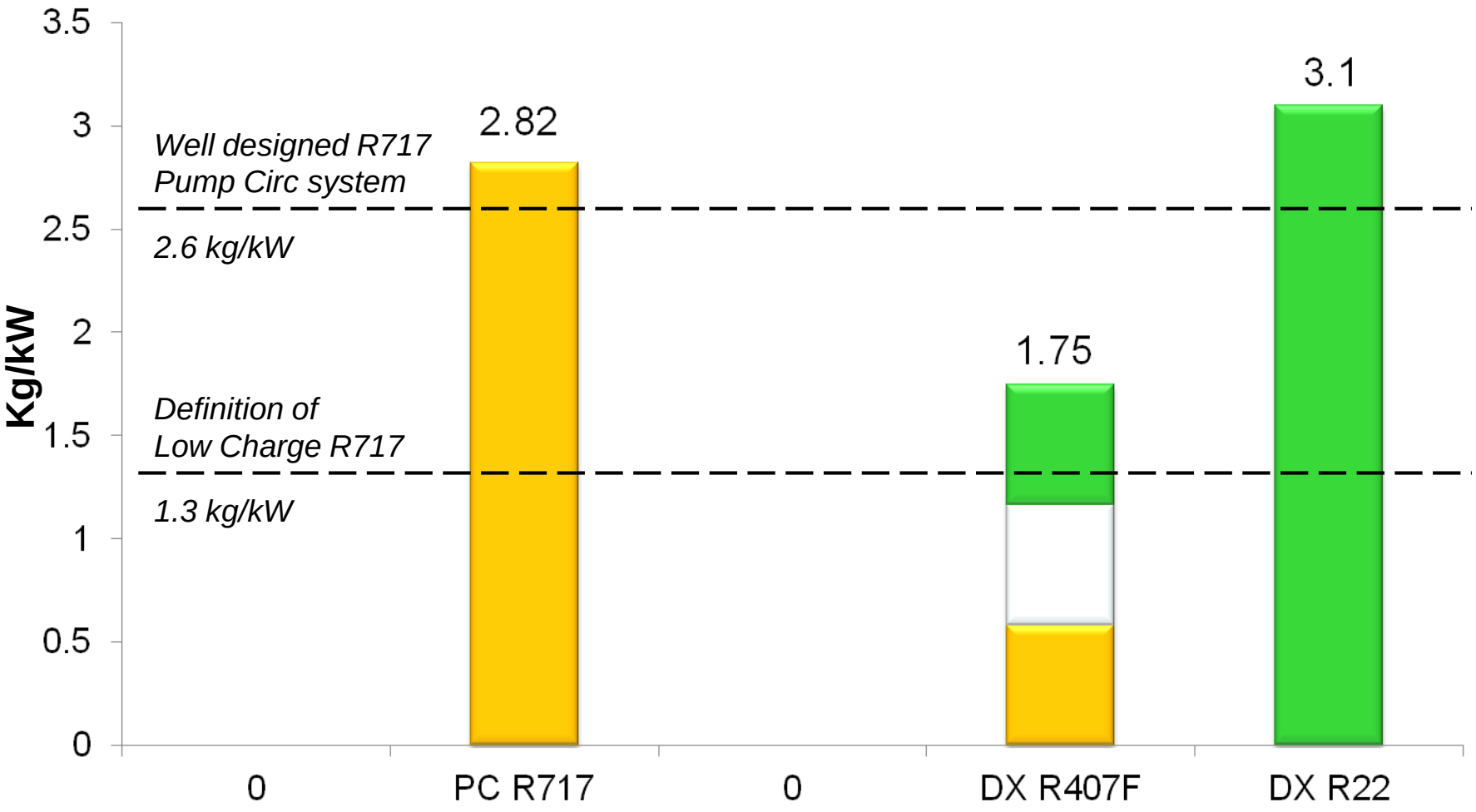
Case Study 3 - System Refrigerant Charge – Large R717 PC Plant

- *Single **R717 Pump Circulation** Refrigeration Plant installed 2013*
- *Two stage plant with 2 LT + 3 HT Screw Comps + 2 Evap Condensers*
- *LT Freezer Chamber -22degC @810kW 5 Evaporators*
- *MT Chamber +2degC @ 1,656kW 12 Evaporators*
- *HT Chamber +12degC @ 492kW 4 Evaporators*
- *Approximately 1,000 meters of PL and WR refrigerant pipework*

- ***3,085kW** installed refrigeration capacity*
- ***8,700kg** refrigerant charge*

2.82kg/kW specific system charge

Specific System Refrigerant Charge kg/kW

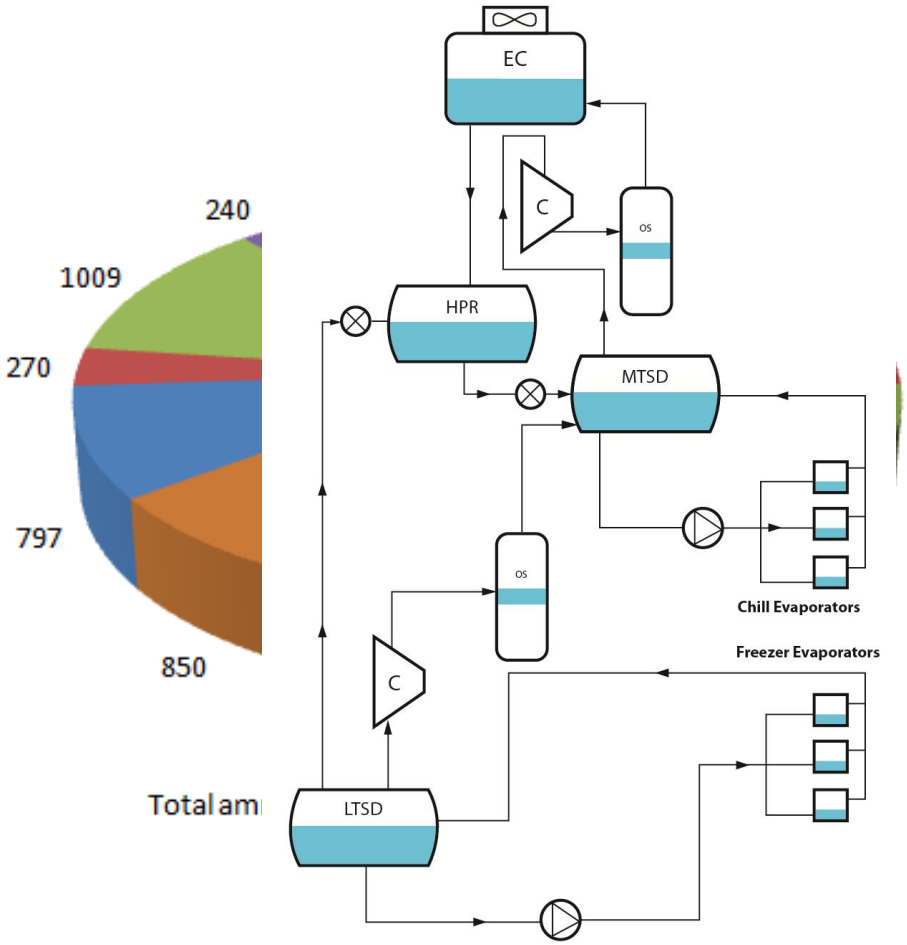


Low Charge : Alternative Definition

The lowest possible charge required for stable operation of the unit over the
full range of possible operating conditions
while maintaining the system's rated capacity

Refrigerant Charge Reduction in Refrigerating Systems – IIR Informatory Note

Where's The Charge?



- Evaporative condensers 6%
- HT drum 20%
- HT liquid lines 10%
- Chill coolers 16%
- Product coolers 3%
- HT wet return 10%
- LT drum 9%
- LT liquid lines 3%
- Freezer coolers 12%
- LT wet return 3%
- Other liquid lines 6%
- Vapour allowance 3%

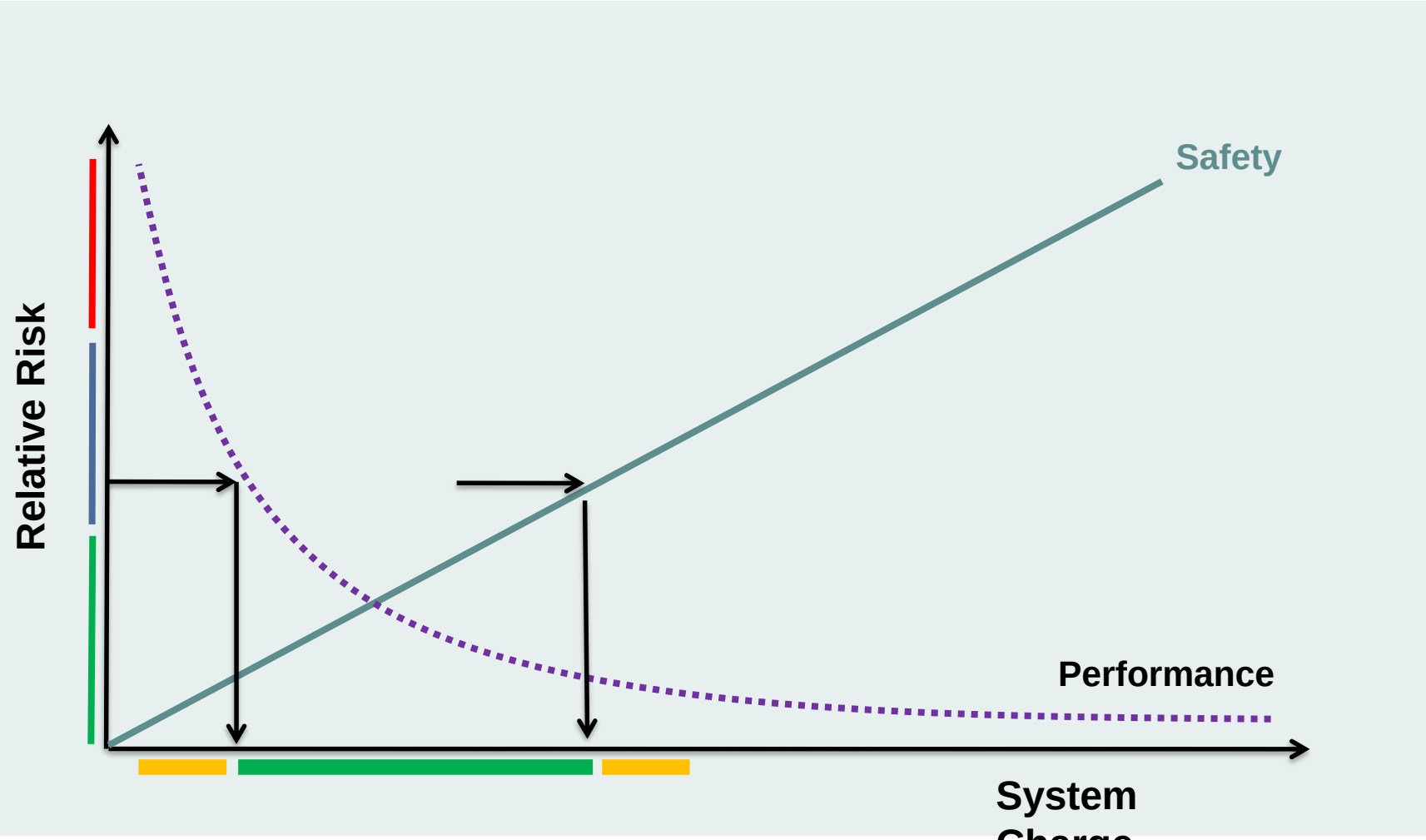
Target Areas For Reducing Charge

Design Criteria For Low Charge

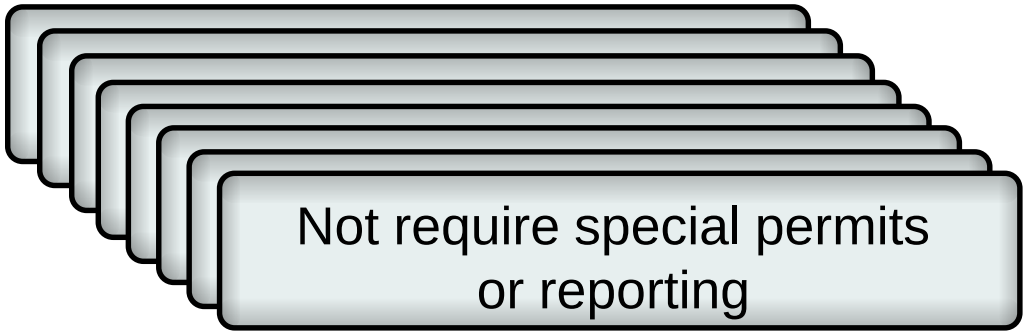
Lowest possible charge for
safe and reliable operation

Charge – How Low Can You Go?

Charge – How Low Can You Go?



Design Criteria For Low Charge



Design Criteria For Low Charge

Lowest possible charge for safe and reliable operation

Maximum possible efficiency

Require the lowest possible level of maintenance

Pose zero (or close to zero) risk to employees

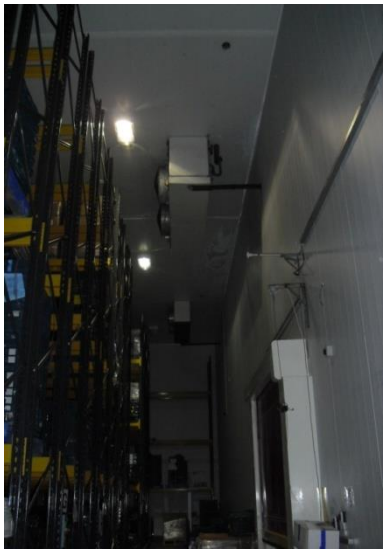
Be leak-free

Be reliable across a range of operating conditions

Be low cost

Not require special permits or reporting

Case Study 4 – 140kW Low Charge R717 Condensing Unit



Photos taken from Pinneys
DX R22 Freezer Plant with Air Cooled Condenser

Freezer Storage facility -22degC

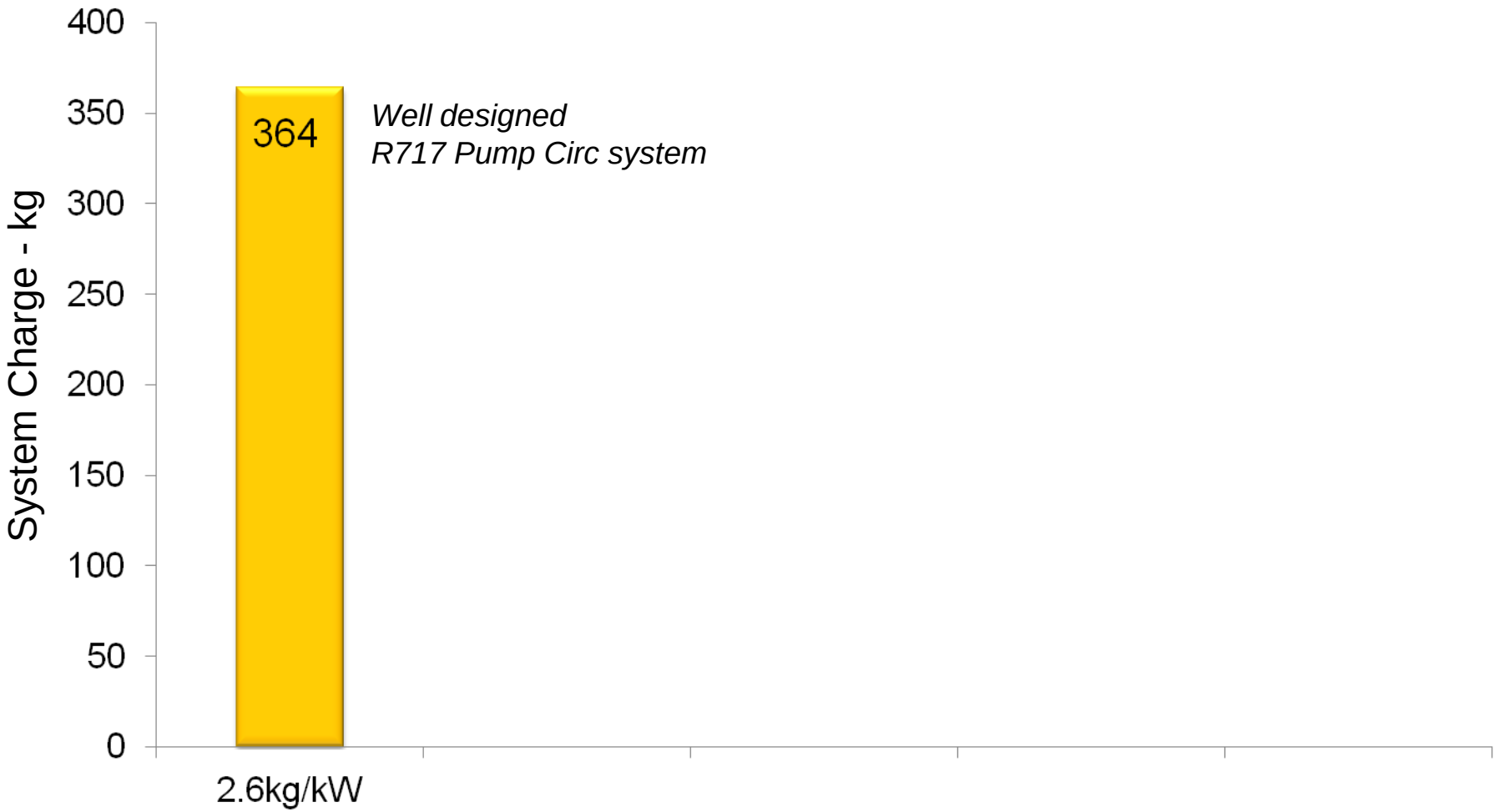
Country: Scotland, UK

Capacity: circa 140kW

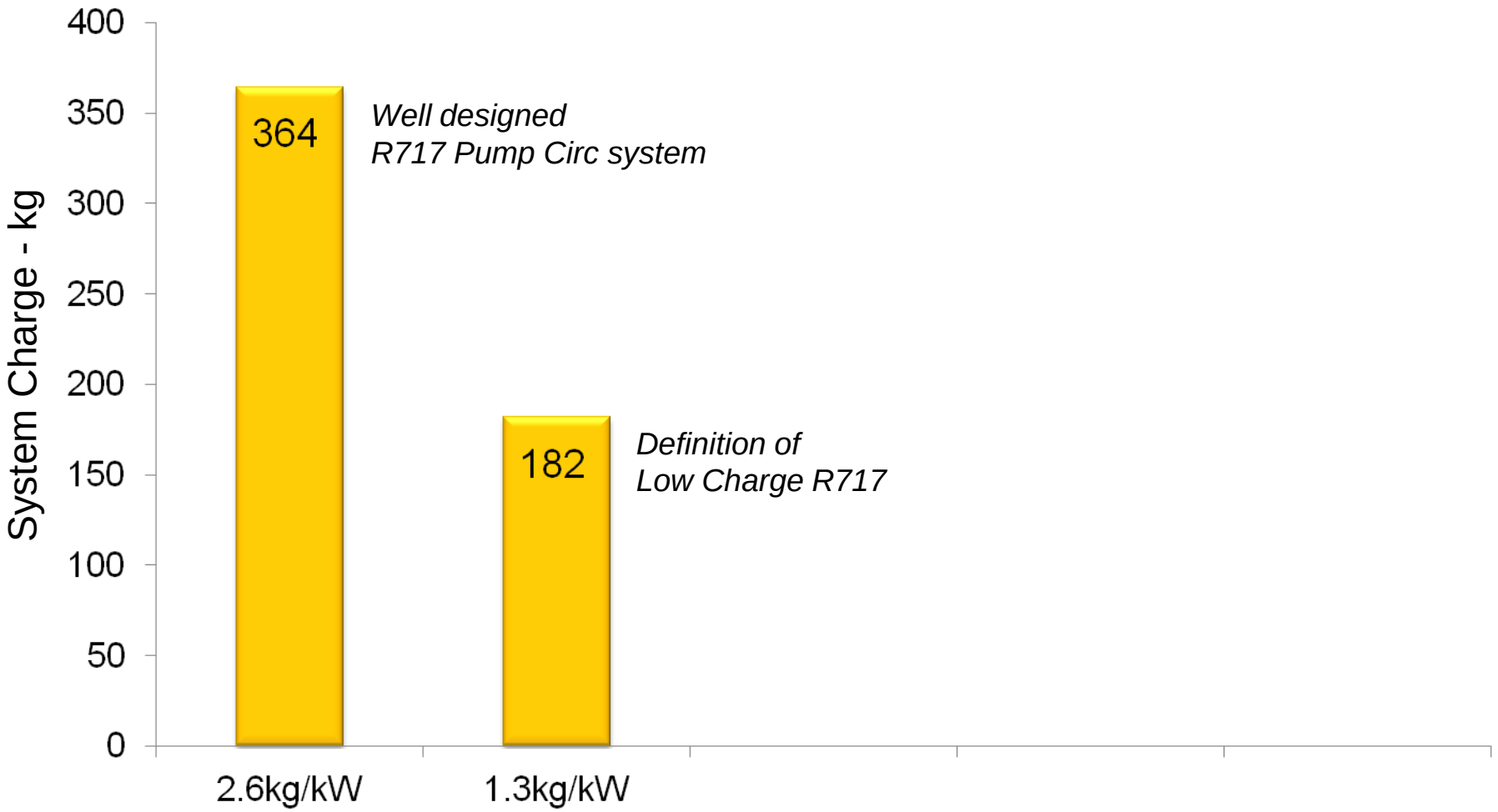
Refrigerant: R22 - kg unknown?

Year of Installation: 1990

Case Study 4 – 140kW Low Charge R717 Condensing Unit



Case Study 4 – 140kW Low Charge R717 Condensing Unit



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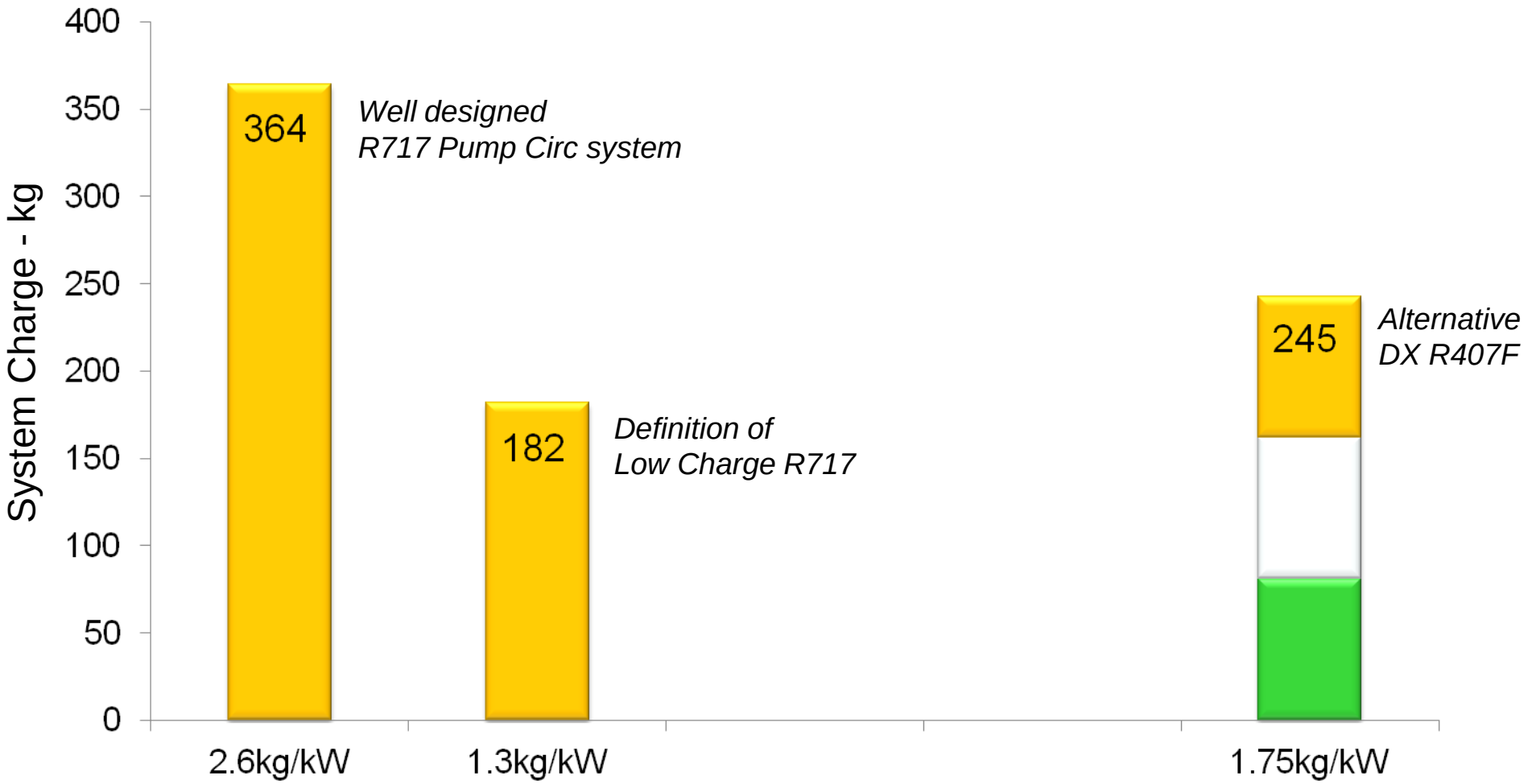
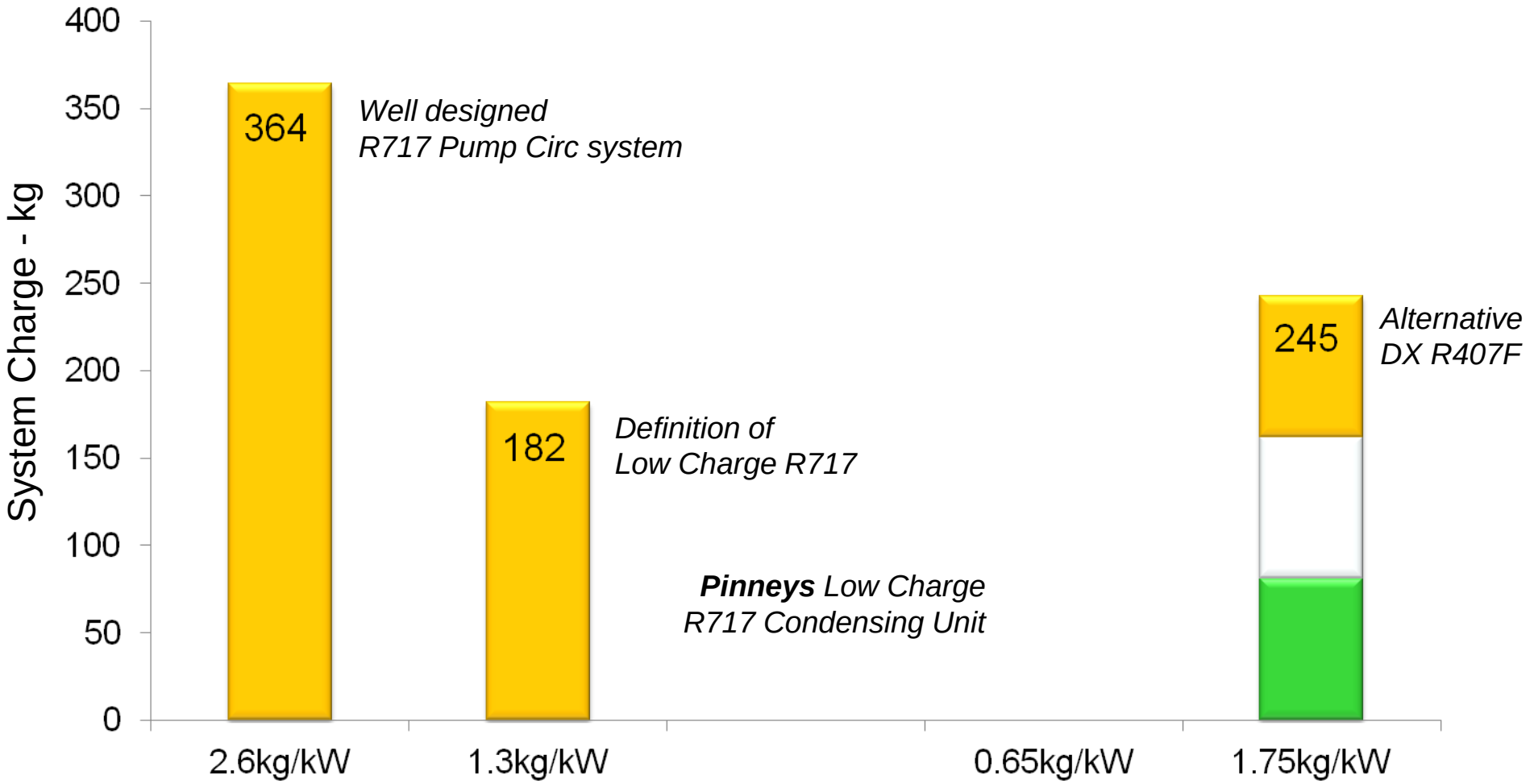
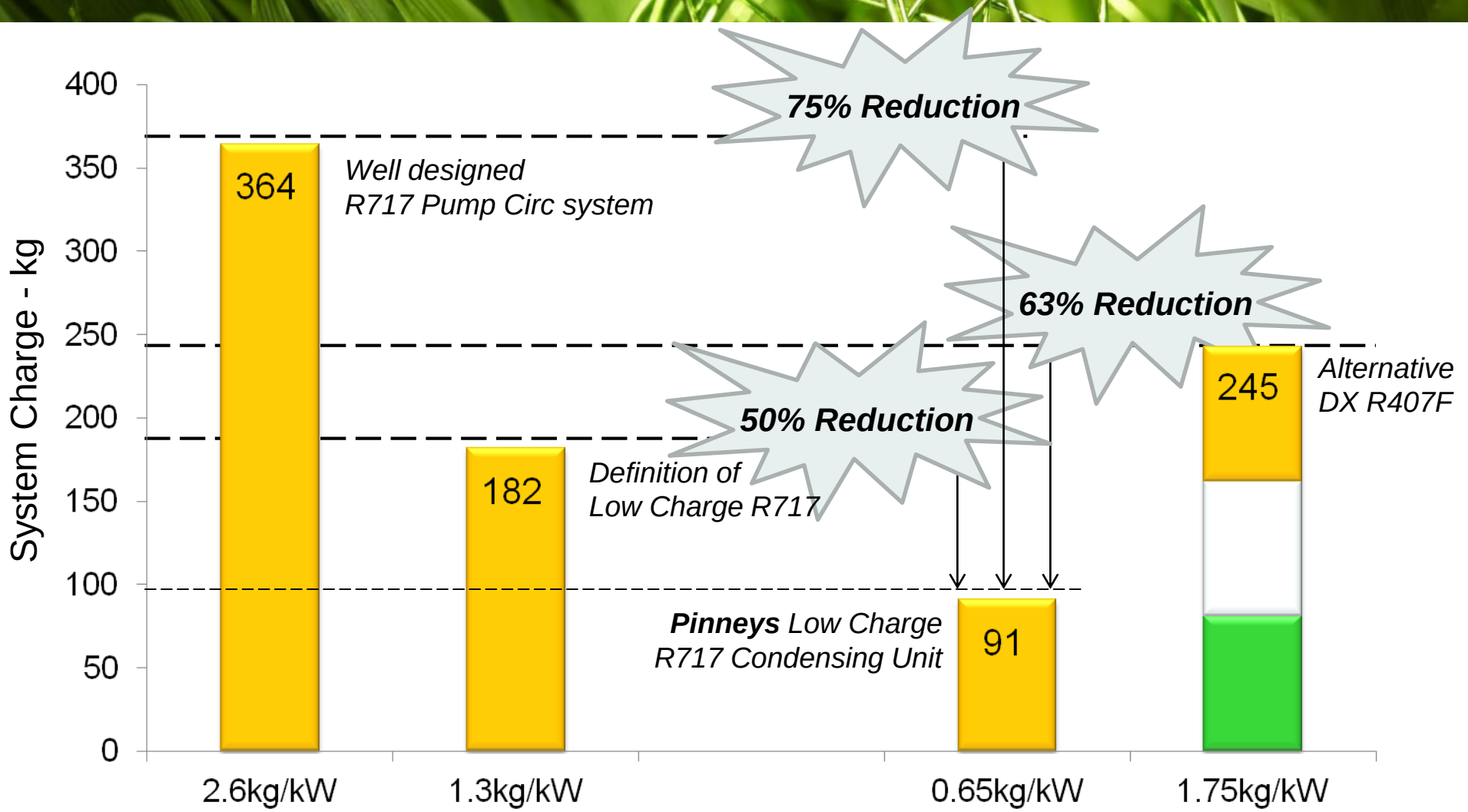


Case Study – 140kW Low Charge R717 Condensing Unit



Case Study – 140kW Low Charge R717 Condensing Unit



Case Study 4 – 140kW Low Charge R717 Condensing Unit

Freezer facility -22degC

140kW Refrigeration Capacity

Low Charge R717 Cond Unit

91kg Charge = 0.65kg/kW

Low Charge R717 Condensing Units

- 70kW to 350kW capacities
- Cold storage applications
- No plant room
- Factory assembled and wired
- Local or remote location
- Air, evaporative or water cooled
- Efficient operation
- Fast installation
- <0.65kg/kW charge

Key Component – Aluminium Coil

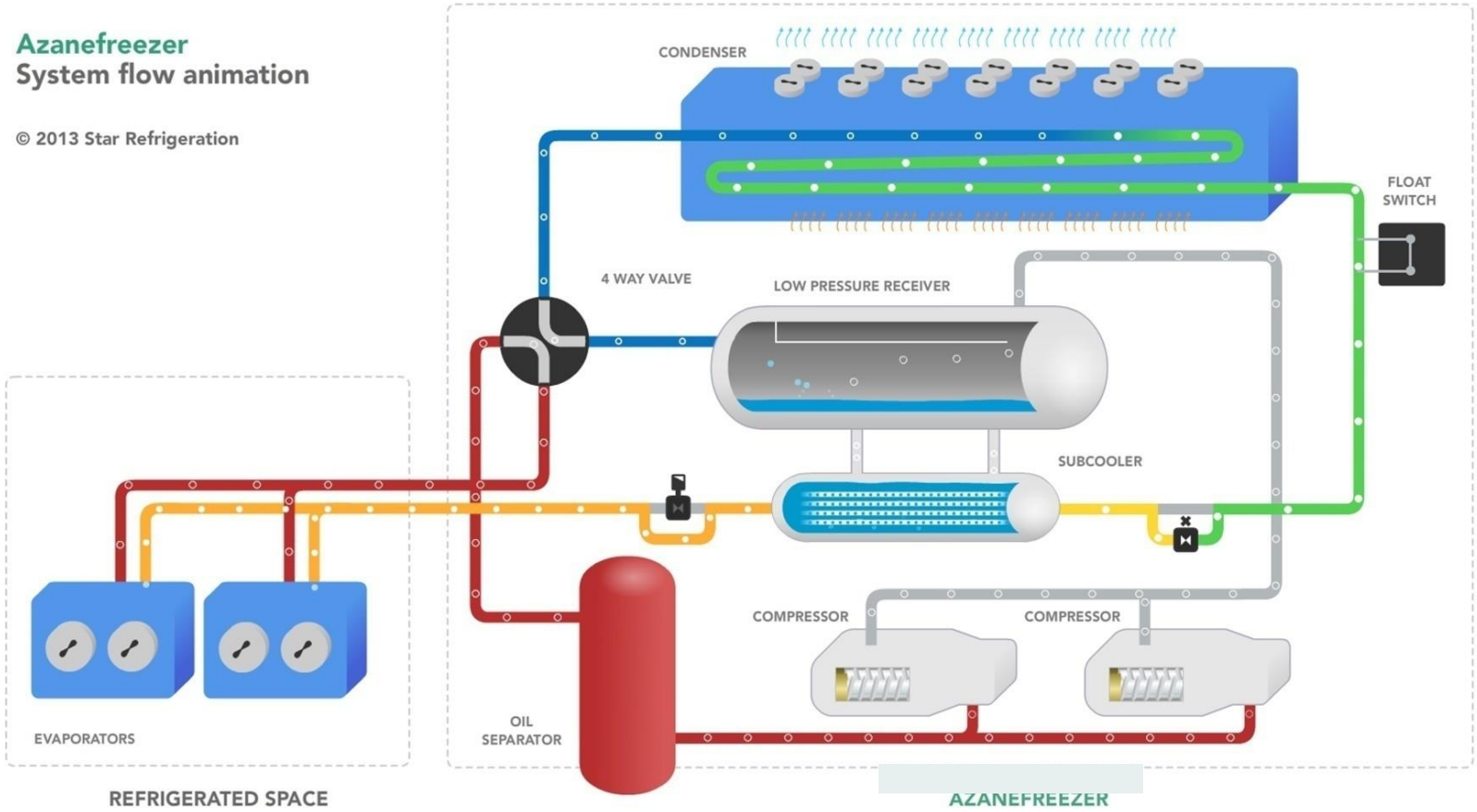
- Excellent heat transfer
- Very low charge
- High efficiency

Metal	Density kg/m^3	Thermal Conductivity kW/ m^2 °C
Aluminium	2643	202
Stainless Steel	8030	16
Galvanised Steel	7048	112

Key Component – 4 Way Valve

- Single 4 way ball valve
- Reverse plant operation
- Electrical actuator
- Rapid defrost

Low Charge R717 Condensing Unit



Packaged Low Charge Ammonia Units

Case Study 5 – Low Charge Packaged Systems

- Low pressure receiver system
- Reverse cycle defrosting
- Pump free design
- High efficiency, low charge
- Secondary glycol to loading dock

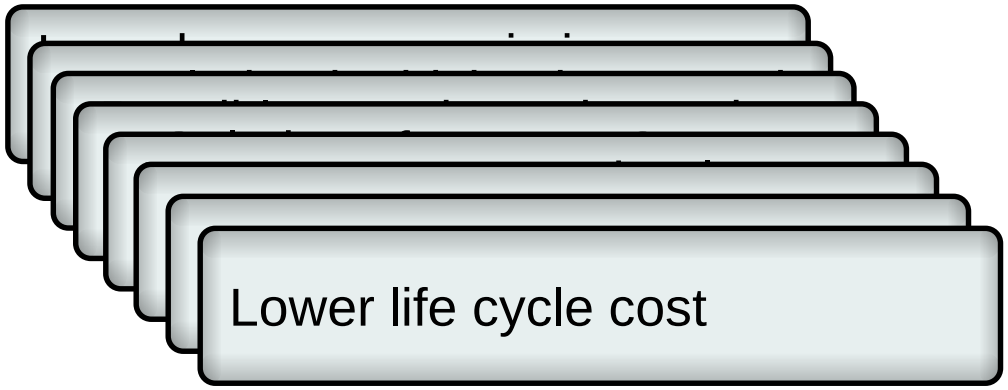
Future Development

components

control systems

package design

Summary



Summary

Low charge ammonia is already available

Regulation is driving increased interest

Solutions from HVAC to Freezers

Possible to reduce charge by 75%+

New component technology development

New system development

Improved efficiency

Lower life cycle cost

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