



# SK Refrigeration Heating and Cooling Ltd

Nationwide Produce Plc.  
Largest Opteon™ XL40 Project in UK  
for Cold Chain Applications.

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## Introduction

“Nationwide Produce PLC is one of the largest, longest established and most diverse produce companies in UK. What do we do? Well, just about everything in fresh produce. We grow it, we grade it, we pack it, we trade it, we import and we export... but above all we are importers.

Group turnover for financial year 2021-22 was £144 m – 61% of this was produce we bought from outside the UK. Our customers are in every sector of the market – food service, catering, processing, wholesale, export and retail – and want to be able to buy a full range of veg, fruit and exotics from around the World every day...whatever the circumstances. We provide this service to over 1,000 customers throughout Europe, every day of the year. Whether you’re a caterer or a processor; whether you require potatoes or pomegranates – we’re here to serve you!”

## Project Overview

SK Refrigeration Heating and Cooling were **asked to provide cooling to 5 storage chambers (17,000 m<sup>3</sup>) area using a modern, energy efficient and reliable refrigerant.**

**In this case, the solution is a truly ground breaking installation utilising c. 600 kg of Opteon™ XL40 over 11 separate systems. The project was Commissioned in December 2022.**

The next phase of the project in Q2 2023 includes expansion to the marshalling area (8400 m<sup>2</sup>) with an additional charge size of 290 kg Opteon™ XL40. It will incorporate 3 circuits, with c. 100 kg per system including a separate banana room. The total charge size on site will be c. 900 kg Opteon™ XL40.

This case study demonstrates the practical application and solution of applying large charge sizes of A2L refrigerants to large commercial cold storage installations, whilst maintaining compliance with EN378 and PED / PES(R).

The focus in this instance being on the “5 Chambers” Project.

## Project Background

Today it is well known that the pressure on refrigerants from F-Gas regulations and the drive to reduce carbon dioxide equivalents (CO<sub>2</sub>eq) will require systems to be designed with Low Global Warming Potential (LGWP) refrigerants in mind. Failure to do so will result in quota levels severely limiting the amount of refrigerant available for new installs and maintenance, as high-GWP refrigerants will use a disproportionate amount of quota and will consequently be very expensive. Currently the plan is to further reduce quota by 69% from the 2015 baseline in 2024.

### **Add to this the possibility of:**

1. Additional cuts to quota in 2024 as proposed by the F-Gas review.
2. The expected exponential increase in heat pump installations in the UK/EU.
3. The inclusion of metered dose inhaler requirements into the quota.

From this, it is clear that our industry has to rapidly adapt and adopt low-GWP solutions. Global events in 2022 added further pressure on the choice of available refrigerants through the cost and supply of energy and the Actual Global Warming (GWA) impact of the energy consumed, including the percentage of fossil fuels used to generate this power.

**Consideration of direct emissions (refrigerant leakage), indirect emissions (from power supply) and increasing energy costs are now more important than ever when deciding on equipment specification.**

Lower GWP refrigerants are a recognized and important alternative to HFC's and "Industrial Natural" refrigerants when considered as a holistic solution to the pressures on our industry and society.

Opteon™ refrigerants are a low-GWP and energy efficient HFO/HFC blend and provide sufficient performance to replace legacy and interim replacements but with a GWP significantly lower.

With a GWP of just 238, Opteon™ XL40 is expected to be sustainable with respect to the CO<sub>2</sub>eq phasedown and, therefore, a good choice to replace these interim refrigerants. Furthermore, the refrigerant characteristics allow for large installations, such as industrial cold storage, whilst continuing to meet the requirements of EN-378 Safety Standard.

## **Project Risk Assessment**

In order to find the right solution for the customer a risk assessment was carried out, looking at criteria such as produce security and system maintenance.

The review also examined sustainability, CapEx, OpEx, system architecture and ease of maintenance and aligned everything with end user aspirations for carbon emission savings and green energy strategies.

## Alternative refrigerant solutions were considered as part of this review.

### CO<sub>2</sub>, which was rejected due to:

1. Capital cost of equipment and installation.
2. High energy costs (high cost of ownership).
3. The high value of product stored, and the loss of product or quality proved to be too high a risk in the event of CO<sub>2</sub> charge loss due to high ambient temperatures.
4. Risk if there are repeated CO<sub>2</sub> supply shortages.

### NH<sub>3</sub>, which was rejected due to:

1. High capital cost.
2. System complexity in this market.
3. Higher operating costs.
4. B2L refrigerant, toxicity.
5. High maintenance cost.

## Solution Adopted:

### A2L Opteon™ XL40:

1. Acceptable capital cost.
2. Lower operating costs using energy efficient refrigerants.
3. Lower environmental impact due to low energy consumption in a fossil fuel rich energy supply chain.
4. Familiar system architecture and easily maintained.
5. Confidence in maintaining stored product quality.

### New Installation Specifications “Five Chambers”

Conditions:

Chambers: 1 to 5

Evaporator Temp : -6 °C

Condensing Temp: 50 °C

Subcooling: 2 K

Total Superheat: 20 K

**11 circuits** with total charge of 600 kg R-454A Opteon™ XL40.

**11 condensing units** HZ9-4MH1-25X-AWM-D-N fitted with Emerson Semi Hermetic Compressors.

Each condensing unit having been designed, qualified and certified for use with A2L refrigerants by Peter Woods F.InstR Technical Director at Wolseley Custom Build. The units are UKCA labelled.

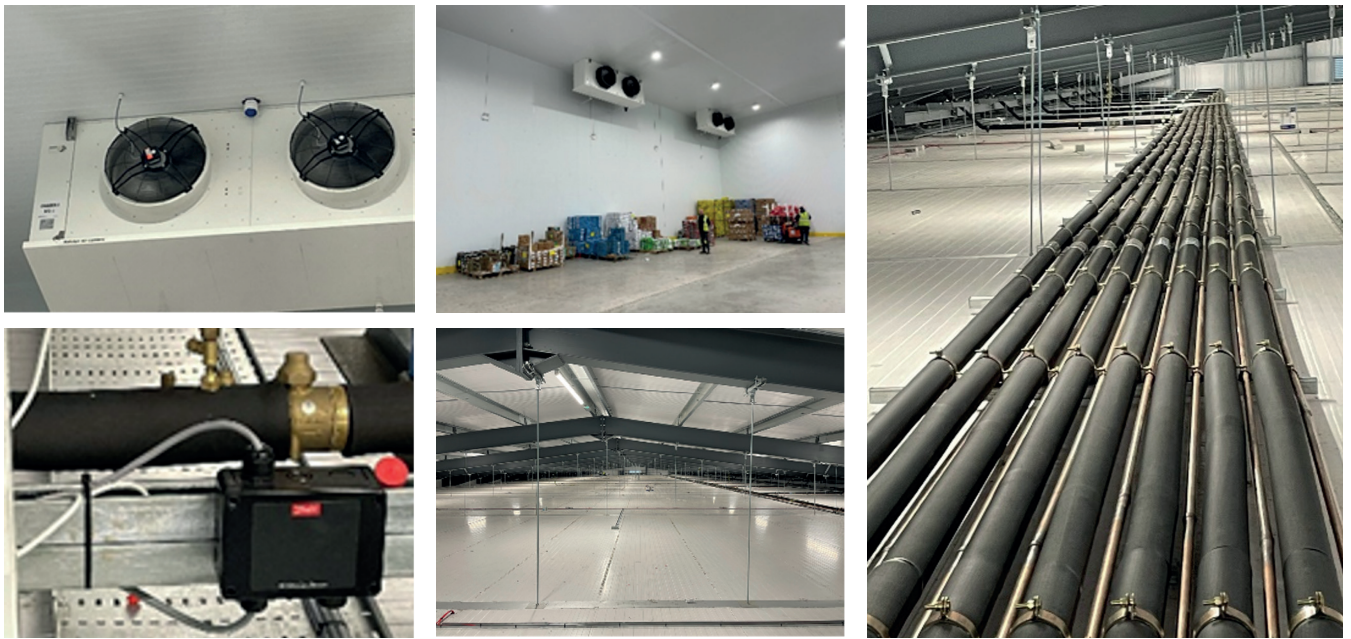
**11 Kelvion A2L Certified Evaporators GSK8026VE-FX28.**

**Total Pipe Length:** 653 m

**Controls:** Carel EVD0000E00

**Expansion Valves:** Danfoss ETS12.5

**Additional Measures:** Leak detection Danfoss DGS Group 1 gas at valve stations on roof, repeater panel on main panel. Alarm indication within the space for each evaporator.



**ROOM 1**

**Dimensions:** 27 x 27 x 8.5 m  
**Room Volume:** 6196.5 m<sup>3</sup>  
**Refrigerant:** R454A  
**Room Temperature:** 1-4 °C  
**Circuits:** 3  
**Charge / Circuit:** 41 kg

**ROOM 2**

**Dimensions:** 27 x 12 x 8.5 m  
**Room Volume:** 2754 m<sup>3</sup>  
**Refrigerant:** R454A  
**Room Temperature:** 1-4 °C  
**Circuits:** 2  
**Charge / Circuit:** 44 kg and 47 kg

**ROOM 3**

**Dimensions:** 27 x 11.4 x 8.5 m  
**Room Volume:** 2639 m<sup>3</sup>  
**Refrigerant:** R454A  
**Room Temperature:** 1-4 °C  
**Circuits:** 2  
**Charge / Circuit:** 50 kg and 53 kg

**ROOM 4**

**Dimensions:** 27 x 11.4 x 8.5 mm  
**Room Volume:** 2639 m<sup>3</sup>  
**Refrigerant:** R454A  
**Room Temperature:** 1-4 °C  
**Circuits:** 2  
**Charge / Circuit:** 56 kg and 59 kg

**ROOM 5**

**Dimensions:** 27x14x8.5 m  
**Refrigerant:** R454A  
**Circuits:** 2

**Room Volume:** 2639 m<sup>3</sup>  
**Room Temperature:** 1-4 °C  
**Charge / Circuit:** 61 kg and 67 kg

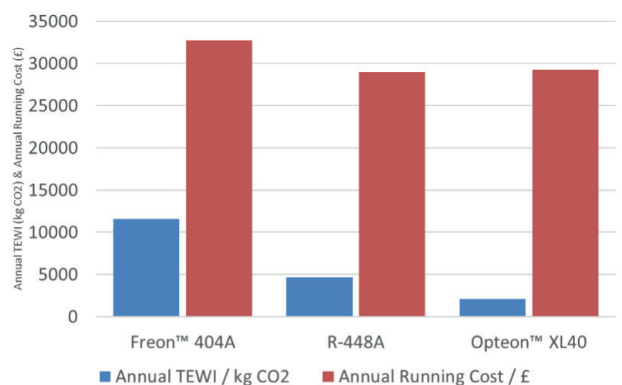
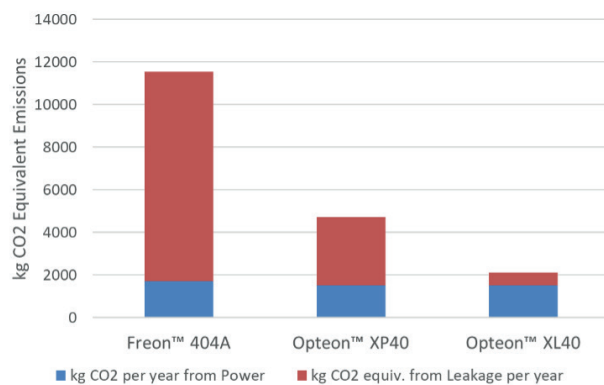
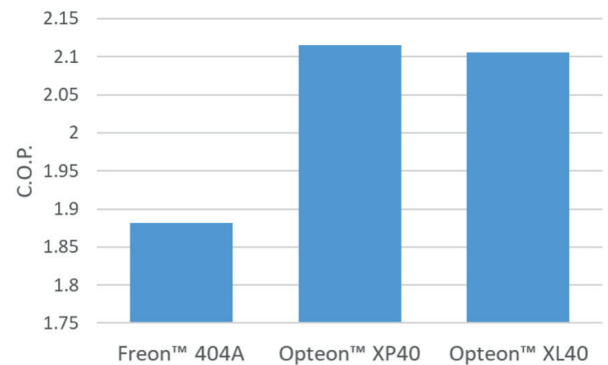
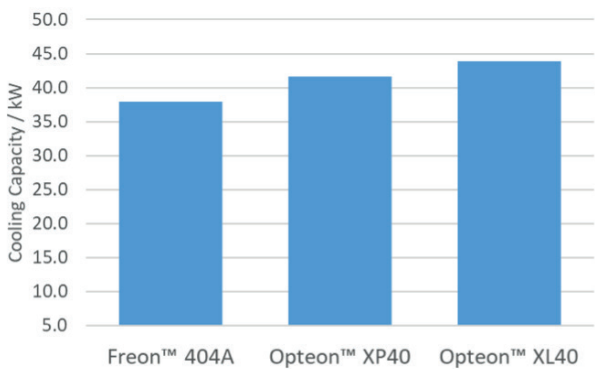
# Performance and Major Findings

A like-for-like assessment isn't possible as this is a new installation. Instead, a comparison has been made using the characteristics of the new condensing units against common legacy alternatives to show results on a comparable basis.

**Figures are per unit per circuit.**

Condenser = 500 °C, Evaporator = -6 °C, Subcool amount=2 K, Tatal Superheat = 201<, Compressor Efficiency = 0.72

		Freon™ 404A R404Amix	Opteon™ XP40 R449a.mix	Opteon™ XL40 R454a.mix
GWP (AR5)		3940	1282	238
Flammability		A1	A1	A2L
PED Gas Classification		2	2	1
Mean Evaporating Temperature	°C	-6.0	-6.0	-6.0
Evaporating Pressure	bar.g	3.952	3.424	3.771
Suction Line Superheat	K	20.0	20.0	20.0
Mean Condensing Temperature	°C	50.0	50.0	50.0
Condensing Pressure	bar.g	22.02	21.35	22.32
Compressor Capacity	kW	46.03	47.79	50.28
Evaporator Cooling Capacity	kW	38.0	41.6	43.8
Cooling C.O.P.		1.88	2.12	2.11
Evaporator Glide	K	0.4	3.4	4.1



	Per Year Per Circuit	Per Year 11 Circuits	15 Years Per Circuit	15 Years 11 Circuits
<b>Compared to R-404A Saving Energy Cost</b>	3488	38368	52320	575520
Direct Emissions (5% Leakage)	-9.3TCO2e	-102TCO2e	-140TCO2e	-1540TCO2e
Indirect Emissions (Power)	-0.18TCO2e	-1.98TCO2e	-2.7TCO2e	-40.5TCO2e

19.3g/kWhr 0.37£/kWhr

## Conclusions

A number of conclusions were made as a result of this project and final system installation.

Large charge sizes are possible due to access category and room size.

A full risk assessment is critical as with any other installation and was carried out prior to commencing with the project.

Choice of refrigerant and partners resulted in both CapEx and TCO being very satisfactory.

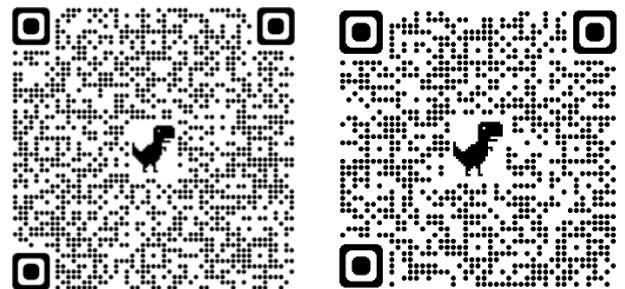
Projects of this type are not only possible, but also proven to be scalable and repeatable within the confines of standards and regulations and provide an excellent, safe and environmental solution to this part of the cold chain.



### QR code to Opteon™ product



### QR Code to other A2L case studies



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