



# Largest Opteon™ Low-GWP A2L Refrigeration Installation in the UK for Cold Chain Applications

Nationwide Produce in Partnership with SK Refrigeration Heating and Cooling, Wolseley and Chemours



# Benefits of Moving to Low-GWP A2L Opteon™ XL40

72% increase in Capacity

76% reduction in TEWI

## Introduction to End User

Nationwide Produce PLC is one of the largest, longest established, and most diverse produce companies in the UK. Group turnover for the financial year 2021-22 was £144m – 61% of this was produce they bought from outside the UK. They grow it, grade it, pack it, trade it, import and their 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. They provide this service to over 1,000 customers throughout Europe every day of the year.

“Whether you’re a caterer or a processor, or require potatoes or pomegranates, we’re here to serve you!”

## Project Overview

SK Refrigeration Heating and Cooling recently commissioned cooling circuits to five storage chambers (17,000 m<sup>3</sup>) area using a modern, energy efficient and reliable refrigerant.

**The solution was a formidable win for installations with large charge sizes, utilising c.600 kg of Opteon™ XL40 over 11 separate systems.**

To complete the refurbishment, the next phase of the project is the subject of this case study which covers an expansion to the marshalling area (8400 m<sup>2</sup>) with an additional charge size of 225 kg Opteon™ XL40. It incorporates three circuits, designed with c.90 kg per system, including a separate perishable fruits storage room.

**The total charge size on site is c. 825 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).

## 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 the quota and will consequently be very expensive.



[Download our Case Study here.](#)

**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.

All these factors make it clear that our industry has to rapidly adapt and adopt low-GWP solutions.

Global events in 2022 added further pressure on the choice of refrigerants available both 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** is now more important than ever when deciding on equipment specification.

Lower GWP HFO based refrigerants are a recognized and important alternative to HFCs and “Industrial Gas” refrigerants when considered as a holistic solution to the pressures on our industry and society.

Opteon™ refrigerants are low-GWP energy-efficient HFO (HydroFluoroOlefin) blends that provide the needed performance to replace legacy and interim solutions while reducing direct and indirect carbon emissions. With a GWP of just 238, Opteon™ XL40 represents a sustainable solution while following the latest climate regulations and contributing to lowering system emissions in the long run. Furthermore, the refrigerant characteristics allow for large installations, such as industrial cold storage, while continuing to meet the requirements of EN-378 Safety Standard.

In order to find the right solution for the customer, a project 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> 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> 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



Reduced capital cost.



Lower operating costs using energy-efficient refrigerants.



Similar to existing architecture and easily maintained.



Confidence in maintaining stored product quality.

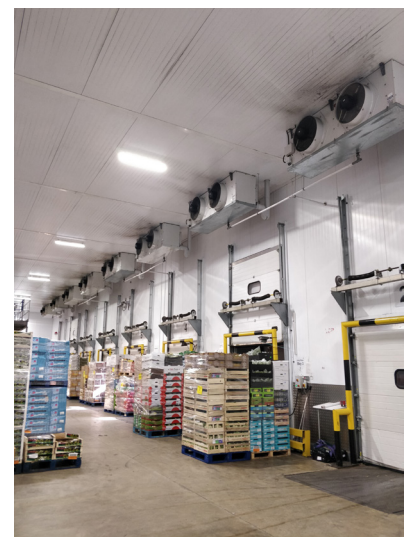


Lower environmental impact due to low energy consumption in a fossil fuel-rich energy supply chain.

## Legacy System

GEA - Grasso RC69 reciprocating compressor (2 in total)  
4x Evaporators GEA - SGBE 122 (8 in total)  
1x remote condenser unit for system 1 & 2  
Refrigerant R134a 150 kgs per system (300 kgs in total)

Room size  
56m x 23m x 6.5m H  
58m x 23m x 6.5m H  
Volume 8671 m<sup>3</sup>



Legacy Grass RC69 Compressor and Evaporator arrangement over loading bays.

# Conditions

Evaporator Temp:  
**-2 °C**

Condensing Temp:  
**50 °C**

Subcooling:  
**2K**

Total Superheat:  
**20K**

Room Temperature:  
**+6 °C**

Age >20 Years

## New System

The newly installed system comprised new equipment and circuits, a marshalling area, pipe runs and charge sizes per circuit.

There are now three systems each consisting of one condensing unit and two evaporators c. 50 kW per circuit:

- System 1 - 90 meters pipe run - 80 kg refrigerant
- System 2 - 80 meters pipe run - 75 kg refrigerant
- System 3 - 70 meters pipe run - 70 kg refrigerant

The total charge size for **marshalling area is 225 kg (saving 75 kg versus legacy R-134a).**

## Other Equipment Comprised

- **Six evaporators** off KELVION CDK-633-3BE.
- **Three condensing units** off H29-4MI2-30X A2L EXTND HOUSING + ACCESSORIES.
- **Controls and Accessories**
  - One off main control panel + leak detection panel.
  - Danfoss DGS group 1 sensor, Carel EEV driver d, Carel EVD0000E00 superheat controller.
  - Alarm and beacon fitted to each evaporator.

The legacy compressors have a combined displacement of 844 m<sup>3</sup>/hr compared to a total of 234.6 m<sup>3</sup>/hr when using Emerson Stream compressors.

## Evaporators

6 off KELVION CDK-633-3BE

## Condensing Units

3 off H29-4MI2-30X A2L EXTND HOUSING + ACCESSORIES

## Controls and Accessories

1 X main control panel leak detection panel.  
Danfoss DGS GROUP 1 SENSOR, CAREL EEV DRIVER, CAREL EVD0000E00 SUPERHEAT CONTROLLER.  
Alarm and beacon fitted to each evaporator.



## Total Operational Charge Size Including “5 Chambers” 834 kg



New Condensing Unit Bay and Dual Discharge Kelvinon Evaporators

## Additional Perishable Fruits Storage Room

An additional volume with specific temperature setting which has been dedicated to banana storage, due to the relevance of accurate temperature control required of this fruit.

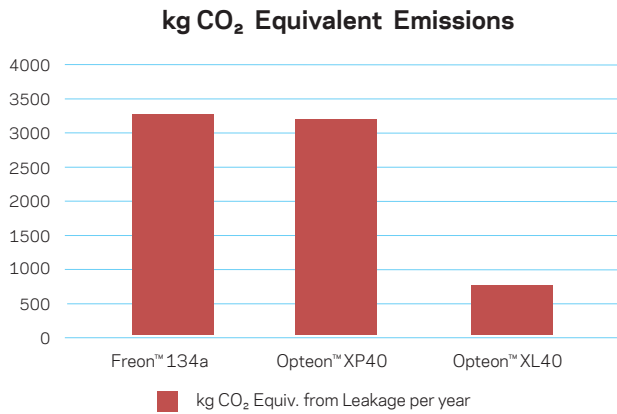
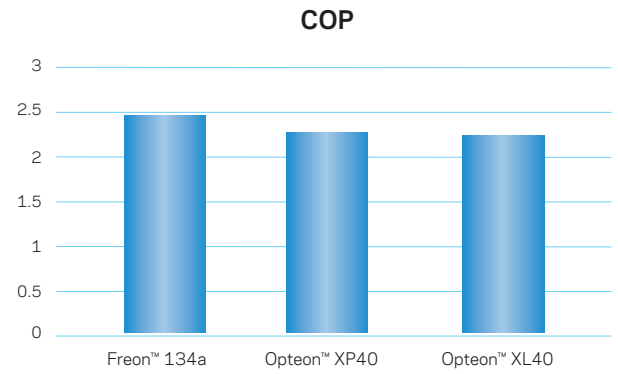
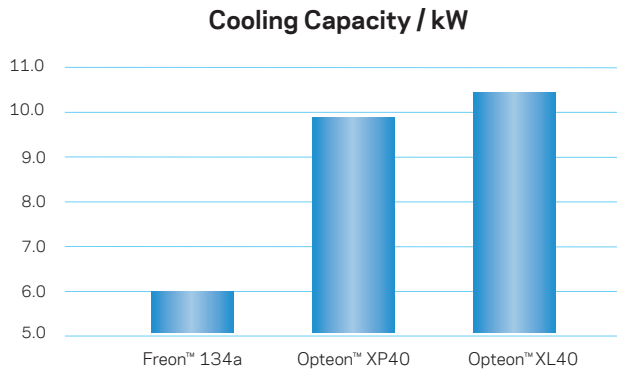
Room size	12 meters x 5 meters x 6.5 meters
Product load	1000 kg daily
Turnaround	25%
Temp range	Product Entering +5 °C Product Leaving +2 °C
Cooling time	24 Hours
<b>Total Load</b>	<b>11.013 kW</b>
<b>Charge</b>	<b>9 kg Opteon™ XL40</b>



Perishable fruits room Copland system from the ZX family A2L compatible Condensing Unit.

## Performance and Major Findings

A like-for-like assessment was not realistic as this is a cutting-edge installation with Copeland compressor technology. A comparison has been made using the characteristics of the new condensing units against common legacy refrigerants to show performance on a comparable basis.



**Opteon™ XL40 compared to R134a \***

**72%** increase in **Capacity**  
**76%** reduction in **TEWI**  
**7%** reduction in comparable **COP**

\* Intermediate refrigerant Opteon™ XP40 (R-449A) included to show additional overall benefits of moving to LGWP A2L options.

## Conclusions

When looking for a practical and efficient solution for large commercial cold storage installations, whilst maintaining compliance with current standards and regulations, **Opteon™ XL40 (R-454A)** can play a decisive role.

This unique application utilizing very large charge sizes of A2L refrigerants has demonstrated that it is possible to attain significantly better results than legacy HFC systems. Switching to low GWP refrigerant Opteon™ XL40, not only improved greatly the cooling capacity by 72% but also resulted in a reduction of 76% in the TEWI (Total Environment Warming Impact).

