

# CO<sub>2</sub>: The Inconvenient Truth

There are now better technologies than CO<sub>2</sub> for retail refrigeration systems



LOW GWP  
**Opteon™ XL**  
Energy Efficient



# Introduction

Articles have been published over the last 12-18 months **raising doubts about the green credentials of CO<sub>2</sub> (R-744)** as a refrigerant due to its inherent poor energy efficiency.

This raises the questions of why did the industry choose a relatively high total emissions technology to comply with the European F-Gas Regulation and **should other technologies be considered before deciding on which low GWP option provides the lowest environmental impact and best value for money.**

From a climate change emissions perspective, it's obvious that any significant leakage of the high GWP R-404A (3922) easily outweighs any energy efficiency benefits seen over using CO<sub>2</sub> (R-744). Of course, the issue when choosing CO<sub>2</sub> (R-744) technology is that the equipment is more complex, more expensive and less energy efficient.

**This contributes to a higher 10-year Life Cycle Cost, but the EU F-Gas Regulations primary focus is low GWP not cost, so CO<sub>2</sub> (R-744) appeared to be a good choice...**

**BUT IS IT REALLY?**



# Is there a better option than CO<sub>2</sub> (R-744)?

Although CO<sub>2</sub> (R-744) achieves the primary objective of lowering the total emissions below R-404A levels, apart from matching cooling performance, CO<sub>2</sub> (R-744) does not necessarily meet any of the other desired criteria.

**Clearly there is room for improvement in the technology choice.**

Very low GWP A2L refrigerants such as Opteon™ XL20 (148) and Opteon™ XL40 (239) have been commercially available since 2016, with the first commercial application installed in October 2017 at Park Cake Bakeries in Oldham (UK). This raised the profile of this alternative technology and led to interest from retailers for use in supermarket refrigeration. The use of Opteon™ XL refrigerants is now a reality with installations made during 2019 by the large retailer ASDA (part of the Walmart Group) and Central England Co op in the UK, **meaning the use of the very low GWP Opteon™ XL range is now a valid choice for retailers to consider.**



# 10-Year Total Emissions

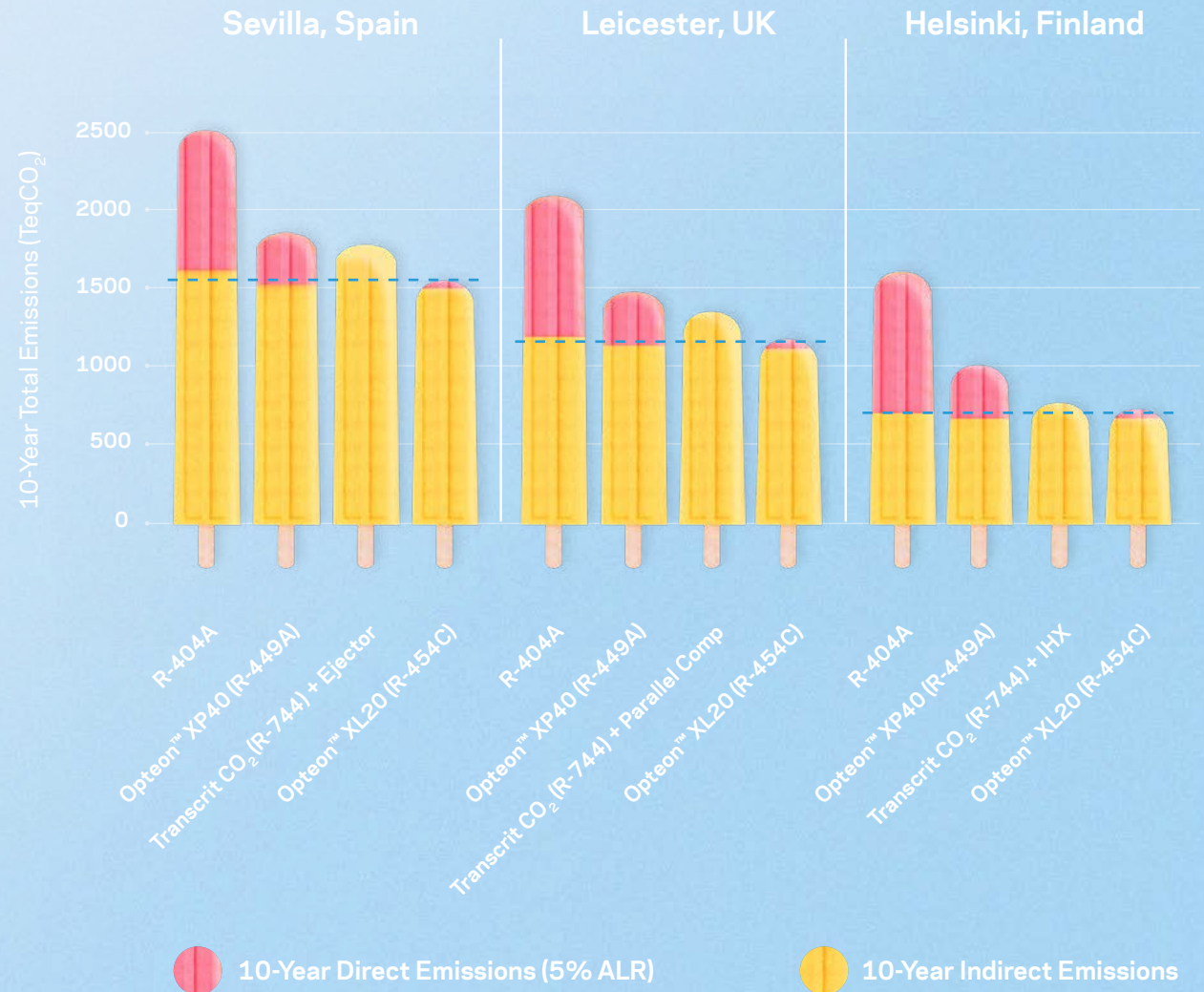
A study performed by Wave Refrigeration, based on their own practical experience working with ASDA and other international retailers, looked at the use of the very low GWP Opteon™ XL products compared to the various available CO<sub>2</sub> (R-744) technologies, namely FGB/Booster, internal heat exchanger (IHX), parallel compression and Ejector. Wave considered standard and small sized supermarkets (~2000m<sup>2</sup> and 300-500m<sup>2</sup> retail area) in 3 locations representing the range of climatic conditions found across Europe (Helsinki, Finland, Leicester, UK & Sevilla, Spain).

Using an annual leak rate (ALR) of 5%, a level achieved by responsible retailers across Europe, **the very low GWP of Opteon™ XL20 and Opteon™ XL40 greatly reduces the contribution of direct refrigerant emissions.**

This combined with improved energy performance delivered by **Opteon™ XL refrigerants** result in the **total emissions being 12-13% lower in Sevilla and Leicester**, and even in the cooler low carbon power generation location of **Helsinki, 6-8% lower** than those produced from the use of the equivalent optimal CO<sub>2</sub> (R-744) technology.

**Figure 1**

10-Year Total Emissions (TegCO<sub>2</sub>) comparison for a standard supermarket format (~2000m<sup>2</sup> sales area with design loads of 160 kW medium temperature/30 kW low temperature)



# 10-Year Life Cycle Cost

As there is now an alternative low emissions technology to match or reduce total emissions from CO<sub>2</sub> (R-744) technologies, the cost element now becomes a relevant and important consideration.

The study deduced that the use of the Opteon™ XL technology provides the lowest CAPEX (up to 11% lower) and maintenance costs (up to 15% lower), but the most significant cost saving over a 10-year period is from the lower energy consumption (up to 15% lower).

Combining these elements give significantly lower 10-year Life Cycle Costs i.e. 11-13% lower in Sevilla and Leicester, and even in the low-cost power generation location of Helsinki, 5-7% lower than using the equivalent optimal CO<sub>2</sub> (R-744) technology.

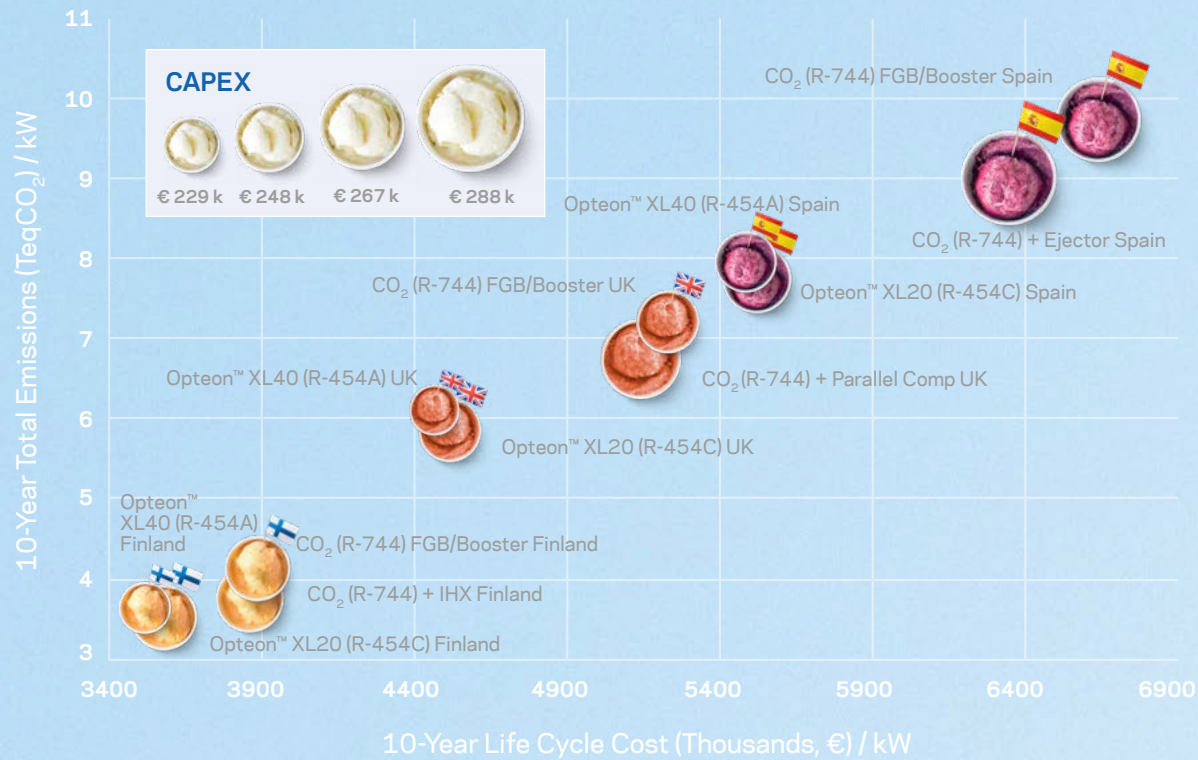
**Figure 2**

10-Year Life Cycle Cost (Thousands, €) comparison for a standard supermarket format (~2000m<sup>2</sup> sales area with design loads of 160 kW medium temperature/30 kW low temperature)



**Figure 3**

10-Year total emissions vs 10-year LCC and CAPEX comparison between Opteon™ XL and R-744 Technologies for a standard supermarket located in Sevilla, Leicester & Helsinki



# Inconvenient or not, the truth is...

The inherent lower energy efficiency and complexity of CO<sub>2</sub> (R-744) systems has left many question marks as to whether this technology is indeed the best choice.

**The introduction of very low GWP Opteon™ XL refrigerants has been proven to be a viable alternative to R-404A and CO<sub>2</sub> (R-744) in both standard and small supermarket refrigeration applications.**

**The practical experience from installations have shown improved energy performance, whilst maintaining similar equipment costs, maintaining system simplicity and reliability** compared with R-404A, with the lowest 10-year life cycle cost, lowest 10-year total emissions and lowest cost per TCO<sub>2e</sub> reduction when compared to the optimum CO<sub>2</sub> (R-744) technology choice over a wide range of climatic conditions.

**Looking for a compliant Low GWP solution? Opteon™ XL refrigerants, why would you choose anything else?**