

# KLEA<sup>®</sup> 407A

## Case Study: Power Supermarkets Dundalk, Ireland

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**INEOS Fluor**

## Background

The INEOS Fluor case study "Designing and Operating the First European Supermarket to use KLEA® 407A for Low and High Temperature Refrigeration" tells the story surrounding Europe's first R-407A supermarket. After a trouble free 10 months of operation the KLEA® 407A system performance and running costs were compared to a store with an R-22 pack of similar duty and layout at a different location.

HCFC refrigerants, such as R-22 are now subject to regulation and eventual phase-out. Longer-term HFC refrigerants, with zero ODP, such as KLEA® 407A have been developed to HCFCs.

Power Supermarkets has taken a leading role in Europe by specifying KLEA® 407A as the only refrigerant in its "Crazy Prices" superstore built in Dundalk, Ireland. Commissioned during March 1994 this supermarket was the first European installation to rely totally on KLEA® 407A for the store's entire refrigeration requirements. Michael Stewart from Power Supermarkets, Joe Brennan from Linde and Gerry McDonagh of RSL formed the project team for this all new, KLEA® 407A supermarket. The joint project involved cabinet layout and design by Linde with the Bitzer compressor packs and INEOS' KLEA® 407A supplied by RSL, Dublin. The plant was successfully designed and commissioned using commercially available hardware.

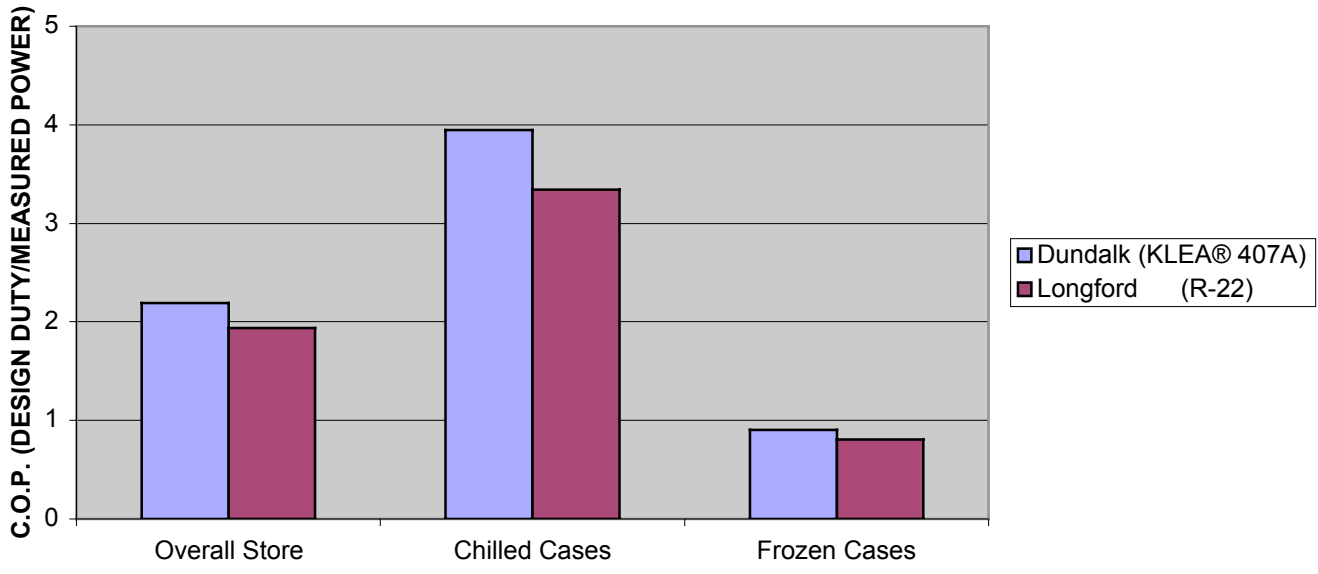
A key feature of this installation is the fitment of a comprehensive ELM data-logging system, which allows continuous monitoring of the store performance. Cabinet, cold-room temperatures and pack power requirements have been recorded since commissioning. This case study examines the data obtained from the Dundalk site and compares it with data from a Power Supermarket of similar duty using R-22.

| Store    | Refrigerant | High Temp, duty (kW) | Low Temp. duty(kW) |
|----------|-------------|----------------------|--------------------|
| Dundalk  | KLEA® 407A  | 137                  | 43                 |
| Longford | R-22        | 109                  | 33                 |

### Performance data

Data was logged during normal supermarket operation, to make fair comparison the plant design duty for both plants was compared to the average measured power over a two-week period. The C.O.P for each system was then calculated using the measured power and the design refrigeration duty.

**POWER SUPERMARKETS C.O.P. COMPARISONS**  
**Design refrigeration duty/measured power**  
**KLEA® 407A at Dundalk versus R-22 at Longford**



| Store                | Load       | Design Capacity kW | Measured Power kW | C.O.P |
|----------------------|------------|--------------------|-------------------|-------|
| Dundalk (KLEA® 407A) | High temp. | 137                | 34.73             | 3.945 |
|                      | Low temp.  | 43                 | 47.47             | 0.906 |
|                      | Total      | 180                | 82.2              | 2.19  |
| Longford (R-22)      | High temp. | 109                | 32.59             | 3.341 |
|                      | Low temp.  | 33                 | 40.77             | 0.809 |
|                      | Total      | 142                | 73.76             | 1.94  |

Theoretical energy consumption of Dundalk if it was using R-22, using typical C.O.P. figures from the Longford R-22 site.

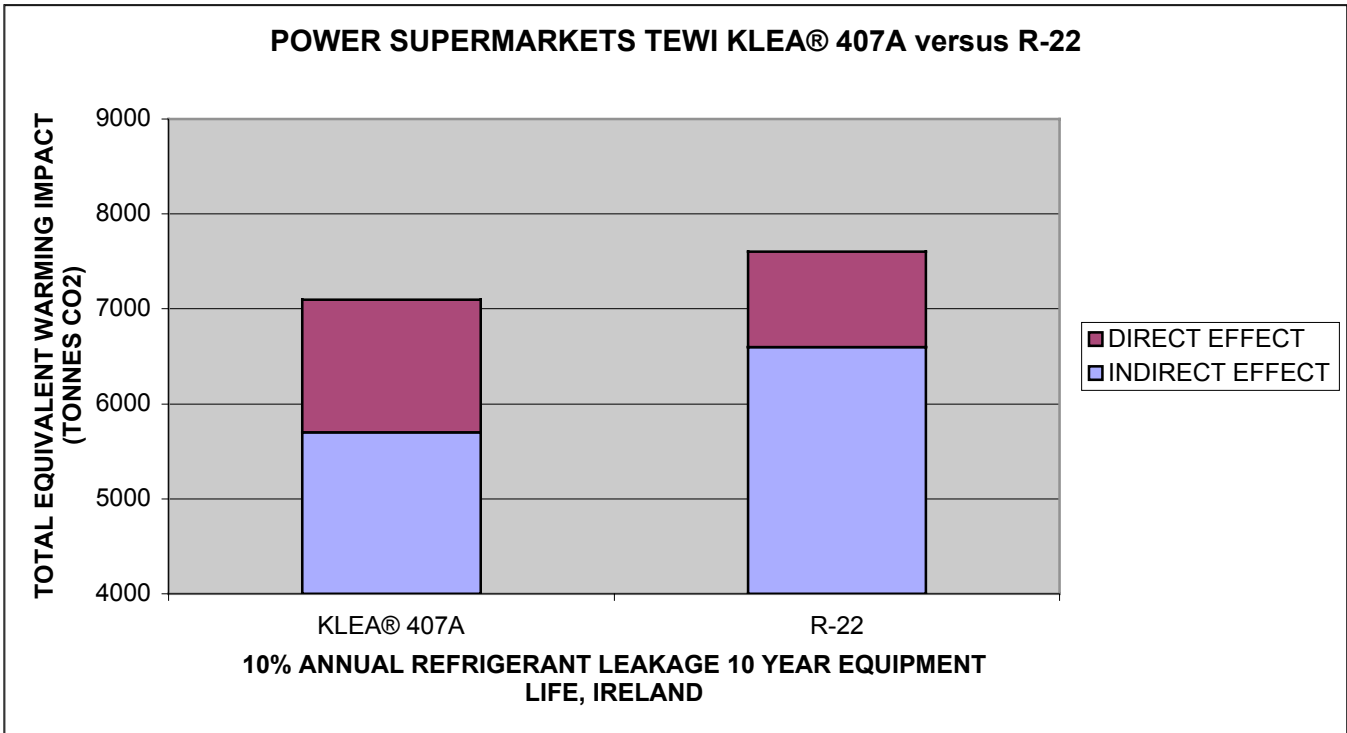
| Store                    | Load       | Capacity kW | R-22 C.O.P | Calculated power kW |
|--------------------------|------------|-------------|------------|---------------------|
| Crazy Price (KLEA® 407A) | High temp. | 137         | 3.341      | 41.01               |
|                          | Low temp.  | 43          | 0.809      | 53.16               |

The power consumption at the Dundalk store is 12.8 % less with KLEA® 407A when compared to the power that would be required for equivalent duty with R-22.

### The Importance of Total Equivalent Warming Impact (TEWI)

TEWI (Total Equivalent Warming Impact) is a concept pioneered by leading scientists and adopted by the US Department of Energy as an accurate and environmentally sound basis for the measurement of total contribution to global warming (expressed as CO<sub>2</sub> equivalent). It measures both the direct global warming effect of the refrigerant, if emitted, and the indirect contribution of the energy required to power the unit over its normal operational life.

If we apply the TEWI concept to the Dundalk Site then we can see the higher energy consumption that would be required if using HCFC-22 as the working fluid would greatly increase the TEWI for the system.



The plot above compares the TEWI of the Dundalk store when using KLEA® 407A with the calculated TEWI for equivalent refrigeration duty using R-22. The calculations assume leakage at 10 % of the total charge per year and a system lifetime of 10 years.

## Summary

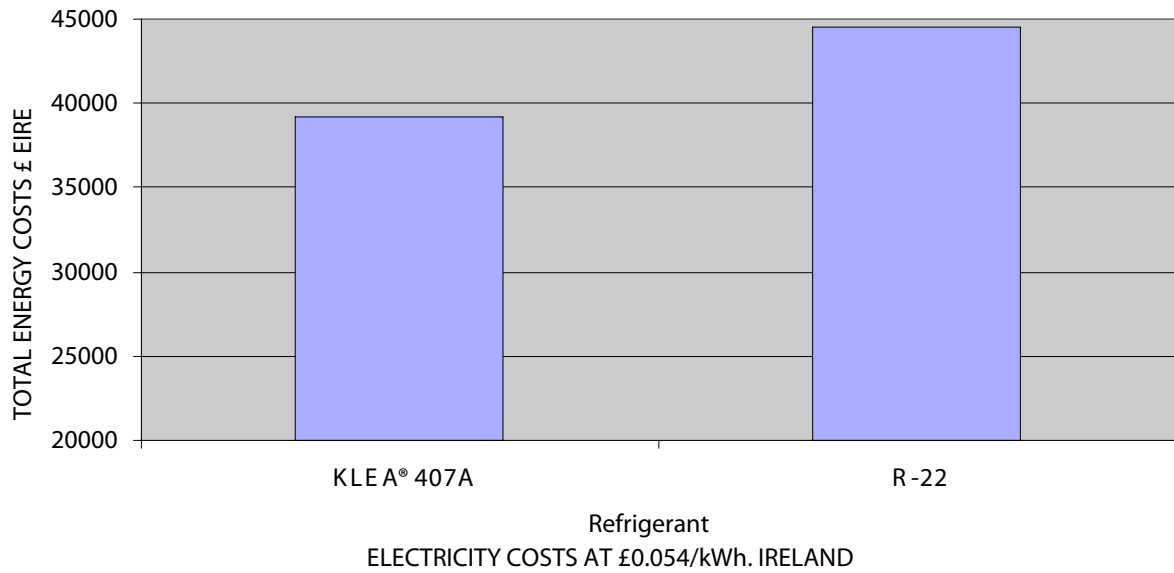
Europe's first supermarket totally dependent on KLEA® 407A was designed and commissioned using existing commercially available equipment. The KLEA® 407A power requirements showed a substantial saving of 12.7% against the same duty from an equivalent R-22 store. If the TEWI of the store is calculated using the power consumed over a 10-year period, and assuming a leakage rate of 10% refrigerant per annum, KLEA® 407A offers significant environmental benefits.

With supermarket total refrigeration power requirements at around 40% of total store power usage the decision to use KLEA® 407A makes

good financial sense. Our measurements have shown that Power Supermarkets saved a massive 87381 kWh of electricity over the first 10 months of operation in comparison to Longford, a figure that could rise to 1049-megawatt hours over 10 years of operation. Put another way the lower TEWI offered by KLEA® 407A results in a reduction in CO<sub>2</sub> emissions of 541 tonnes and that's not just good for the customer but represents a real saving on the environment!

HCFC phase out is a massive challenge for our industry however; it has resulted in an opportunity to re-engineer to more efficient systems and refrigerants.

POWER Supermarkets  
Dundalk KLEA® 407A annual power costs compared to  
calculated cost for equivalent R-22 duty



# KLEA<sup>®</sup> 407A

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