Copeland-RAC Magazine - Store of the Future Seminar

Technology Choices:

Convenience Food Retail

Presented by:

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REFRIGERATION AND AIR CONDITIONING MAGAZINE rac

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Biography

Nabil Cook

- 13 years in the commercial retail sector.
- Chartered Engineer, Master of Engineering graduate and Member of the IOR.
- Experience working in contracting, manufacturing, component OEM, and consulting.

James Bailey

- 21 years in the commercial retail sector.
- Chartered Engineer, Master of Management graduate and Fellow of the IOR.
- Experience working in contracting and consulting.

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Topics

- The Need for Change
- Highlighting Industry Success
- Three Viable Options
- Datasets
- Integral Solution
- CO2 Solution
- A2L Solution (R454C)
- CAPEX
- OPEX – Annual Maintenance & Energy Costs
- Life Cycle Costs (LCC)
- Global Warming Potential (GWP)
- Life Cycle Emissions (LCE)
- Other Considerations
- Comparing the Three Viable Options vs. HFC Technology

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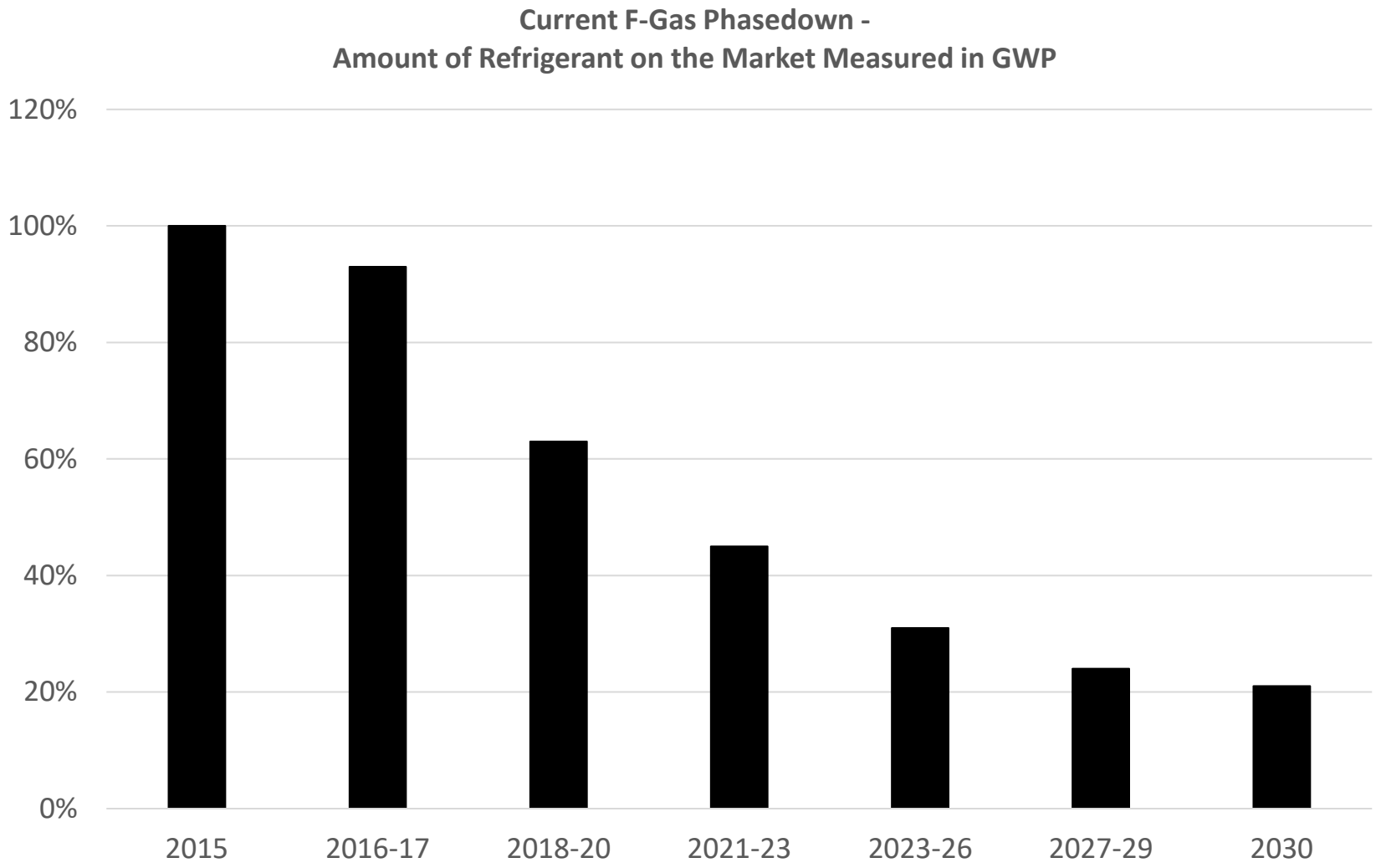
The Need for Change



Notes:

- Regulation is driving change to reduce direct carbon equivalent emissions.
- We also need to consider indirect emissions.
- The average refrigerant GWP values based on the current F-Gas Regulations are:

  2015 – 2000
  2022 – 900
  2030 – 400

- We must move away from high GWP refrigerants.

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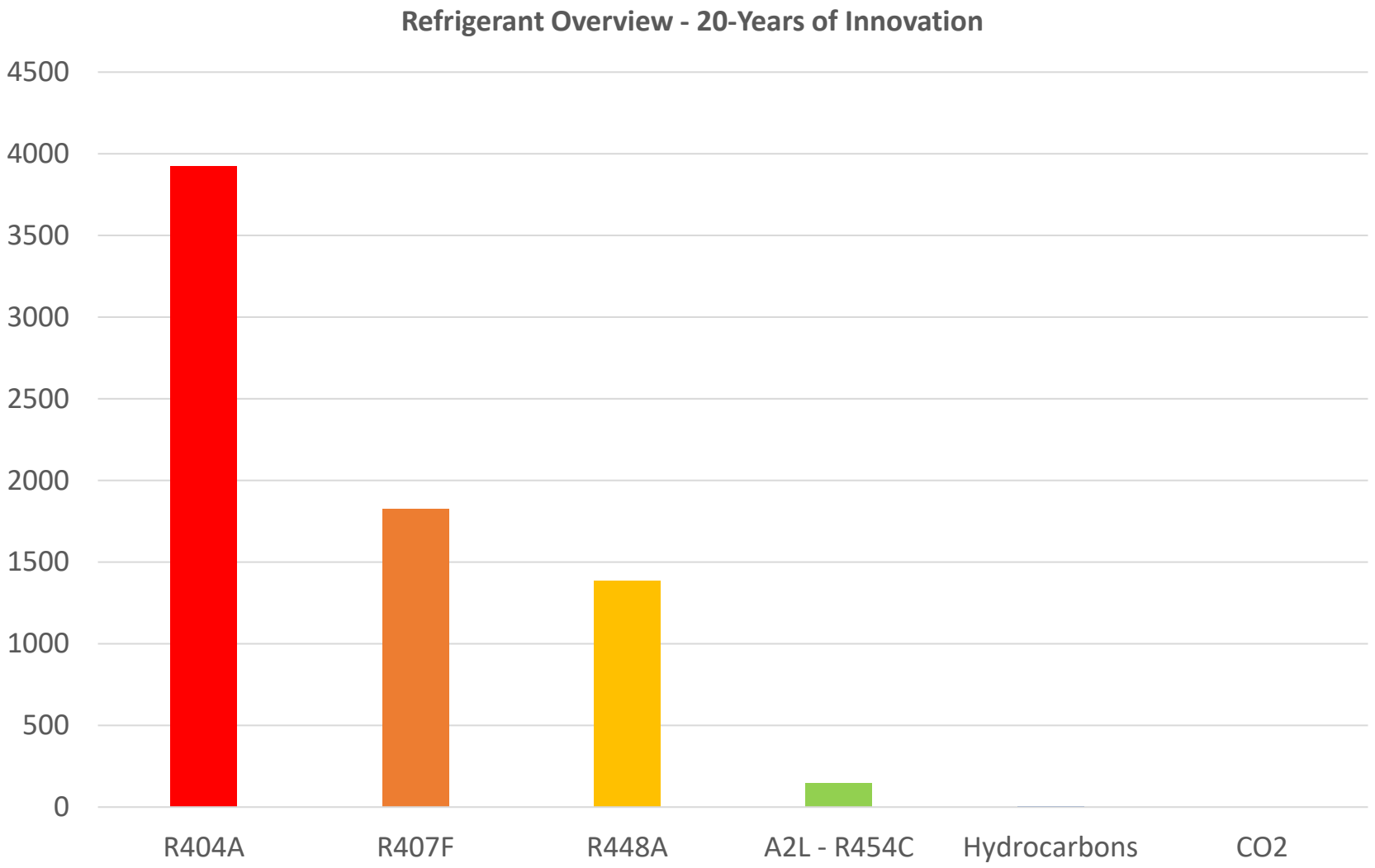
Highlighting Industry Success



Notes:

- 20 years ago, the most common refrigerant in the retail sector was HFC R404A.
- Due to its high GWP, new HFCs focussing on GWP came to market (R407A, R407F, R448A, R449A, etc.) over the past two decades.
- Natural refrigerants with negligible GWP reemerged in the mid-2000s, with HFO (A2L) refrigerants following in the past decade, representing up to 96% reduction in GWP v R404A.

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Three Viable Options

Further options exist for the refrigeration industry holistically, though we are focussing on three technology choices that will suit the constraints of the convenience sector:

- Hydrocarbon Integral/Plug-in Refrigerated Display Cabinets (Next Generation Air-Cooled Technology).
- Transcritical CO2 Systems.
- HFO Systems.

When compared to HFC refrigerants, all three pose an increased level of risk:

- Hydrocarbons – A3 Classified | Highly Flammable (our assessment ensures compliance with charge risk mitigation).
- Transcritical CO2 – Like HFCs, CO2 is an A1 (non-toxic | non-flammable), but it operates at high pressure (>100 bar).
- HFOs – A2L Classified | Lower Flammability (our assessment ensures compliance through following charge volume limitations as per BS EN-378 and DSEAR).

All three technologies require a higher level of skill and competency across the board (design through to in-life servicing) compared to HFCs.

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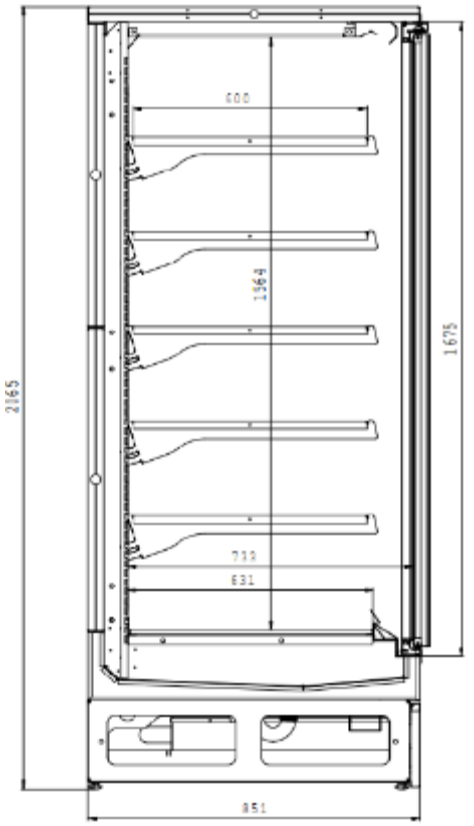
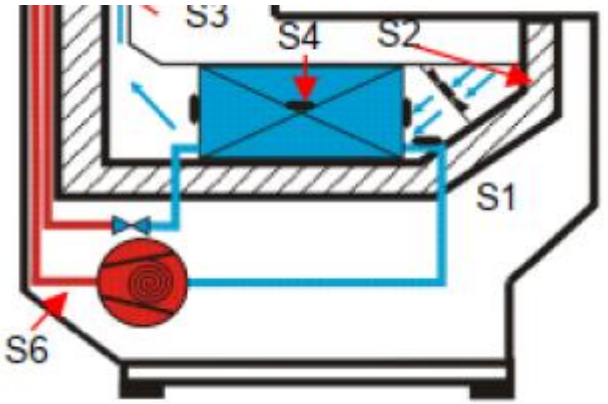
Datasets

The analysis is based on:

- Standard “UK24hrs” hours spent at each ambient bracket associated with the Total Equivalent Warming Impact (TEWI).
- 10-year operational lifecycle.
- Average CO2 emissions factor 0.1559kgCO2e/kWh (indirect emissions) – GOV.UK projections over the next 10 years.
- 10% annual refrigerant leak rate (direct emissions) – same for all technologies considered.
- £0.27/kWh electricity cost – the current rate assumed to remain constant over the next 10 years.
- Analysis is based on with and without heat recovery and associated in-store heating and comfort cooling requirements.
- Comfort loads and associated energy consumption and CAPEX are based on the following:
  - Building fabric heat loss/gain profile – assumed to be linear across the relevant range.
  - Refrigerated display case net cooling effect if remote solution/net heating effect if integral solution.
  - Requirements served by reversible air-to-water R290 heat pumps, considering the reduction in heating due to heat recovery (if applicable).
- Higher heating load, lower comfort cooling load for remote solutions (CO2, A2L).
- Lower heating load, higher comfort cooling load for the integral solution.
- Doors on both chilled cabinets and frozen cabinet for all solutions.

Integral Solution





Costs & Emissions	Integral Refrigeration Solution
CAPEX	£ 147,992
Annual Maintenance Cost	£ 5,025
Annaul Energy Consumption kWh	105,016
Life Cycle Costs (LCC)	£ 481,785.53
Life Cycle Emissions (LCE)	163.74

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CO2 Solution

Based on one Copeland CO2 Scroll Pack

Costs & Emissions	CO2 - No Heat Recovery	CO2 - Inc. Heat Recovery
CAPEX	£ 181,812	£ 184,312
Annual Maintenance Cost	£ 5,138	£ 5,738
Annaul Energy Consumption kWh	102,703	92,859
Life Cycle Costs (LCC)	£ 510,485	£ 492,406
Life Cycle Emissions (LCE)	160.14	144.80

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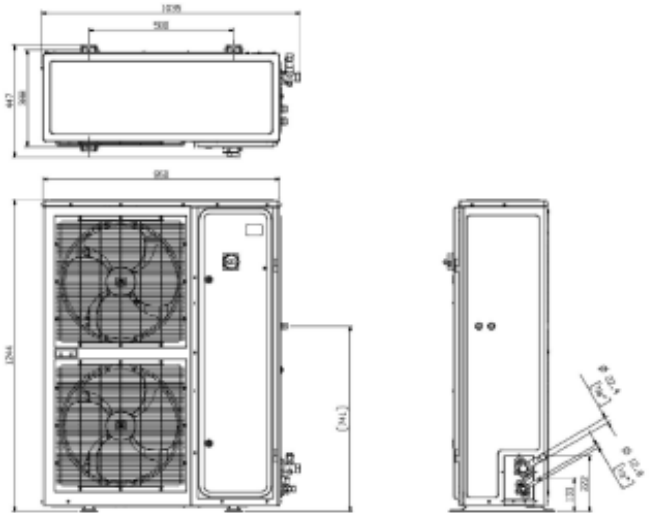
A2L Solution (R454C)



Based on four Copeland A2L Condensing Units

Costs & Emissions	A2L - No Heat Recovery	A2L - Inc. Heat Recovery
CAPEX	£ 162,682	£ 163,642
Annual Maintenance Cost	£ 4,088	£ 4,388
Annaul Energy Consumption kWh	101,134	96,642
Life Cycle Costs (LCC)	£ 476,619	£ 468,451
Life Cycle Emissions (LCE)	163.40	156.40

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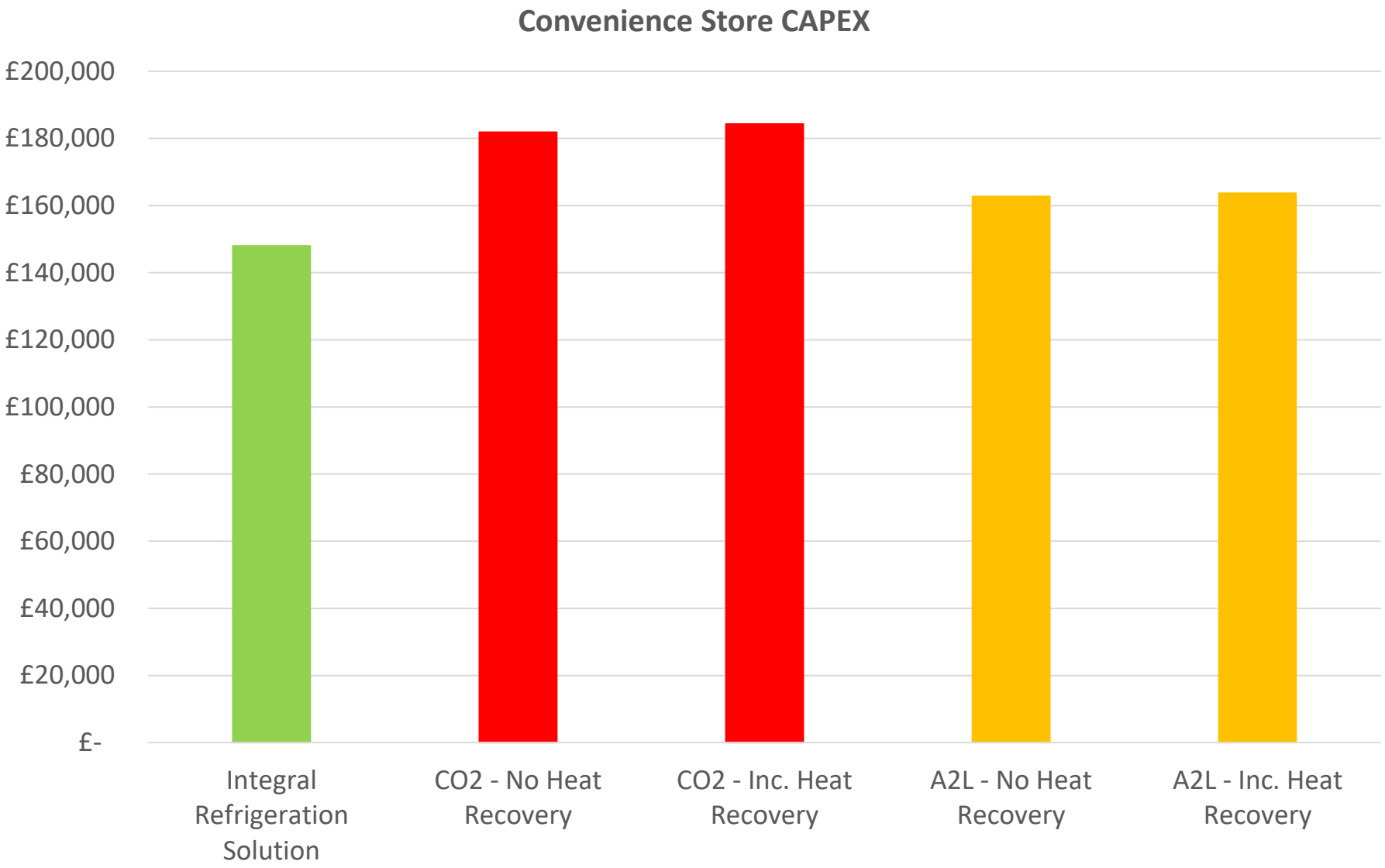
CAPEX



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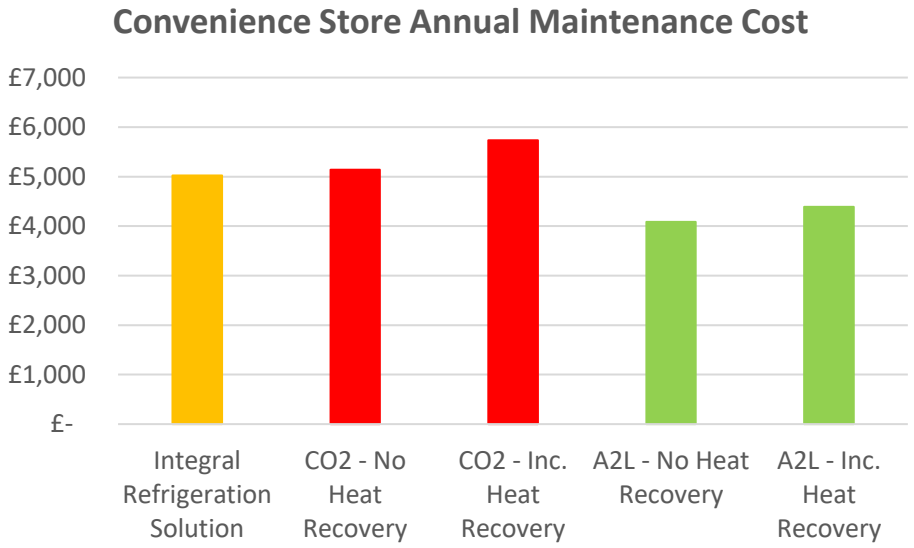
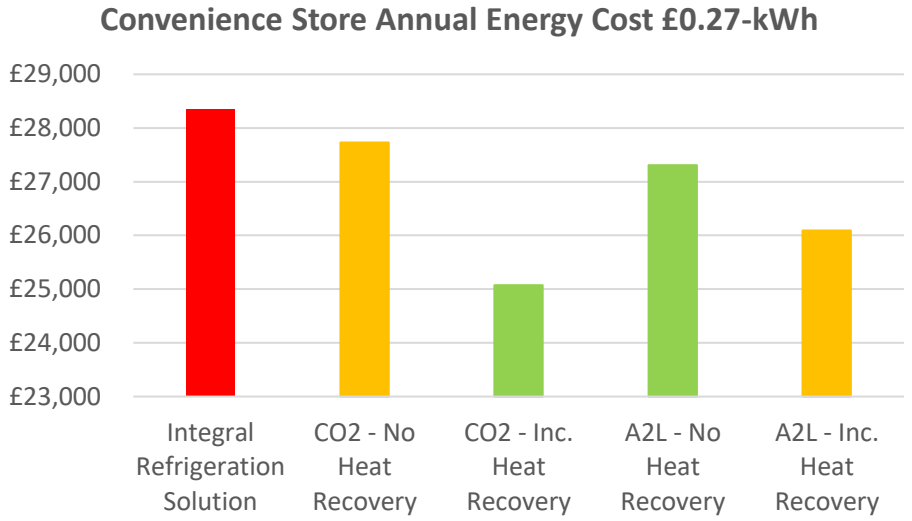
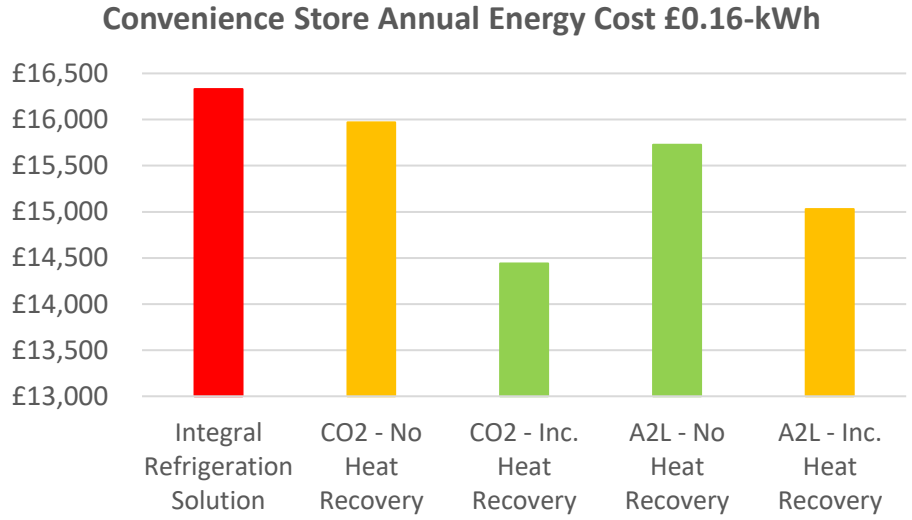
OPEX – Annual Maintenance & Energy Costs





Maintenance Cost Notes:

- Integral costs are based on increased in-store maintenance vs. remote display cabinets.
- CO2 costs factor in higher levels of call-out in high ambient temperatures and a higher PRV replacement cost (Vs. HFC).
- A2L costs are based on a higher per kg cost of refrigerant.
- Where heat recovery is applied, costs reflect additional maintenance requirements.



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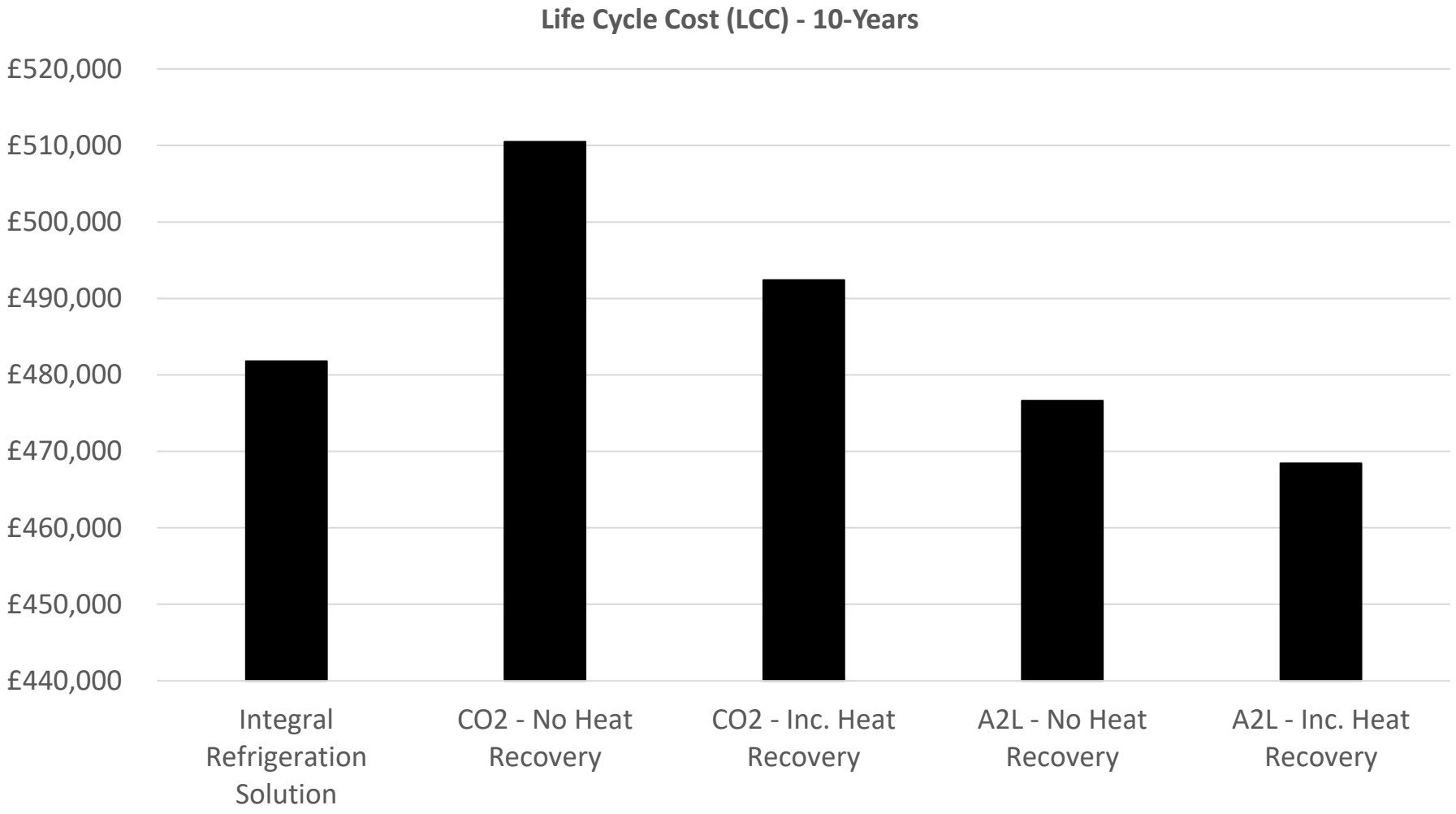
Life Cycle Costs (LCC)



Integral Refrigeration Solution	£	481,786
CO2 - No Heat Recovery	£	510,485
CO2 - Inc. Heat Recovery	£	492,406
A2L - No Heat Recovery	£	476,619
A2L - Inc. Heat Recovery	£	468,451
Average LCC	**£**	**485,949**
Range (highest - lowest LCC)	£	42,035
Range (over 10-years)	£	4,203
Percentage Difference		9%

The LCC range across all solutions is less than 10%

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Global Warming Potential (GWP)

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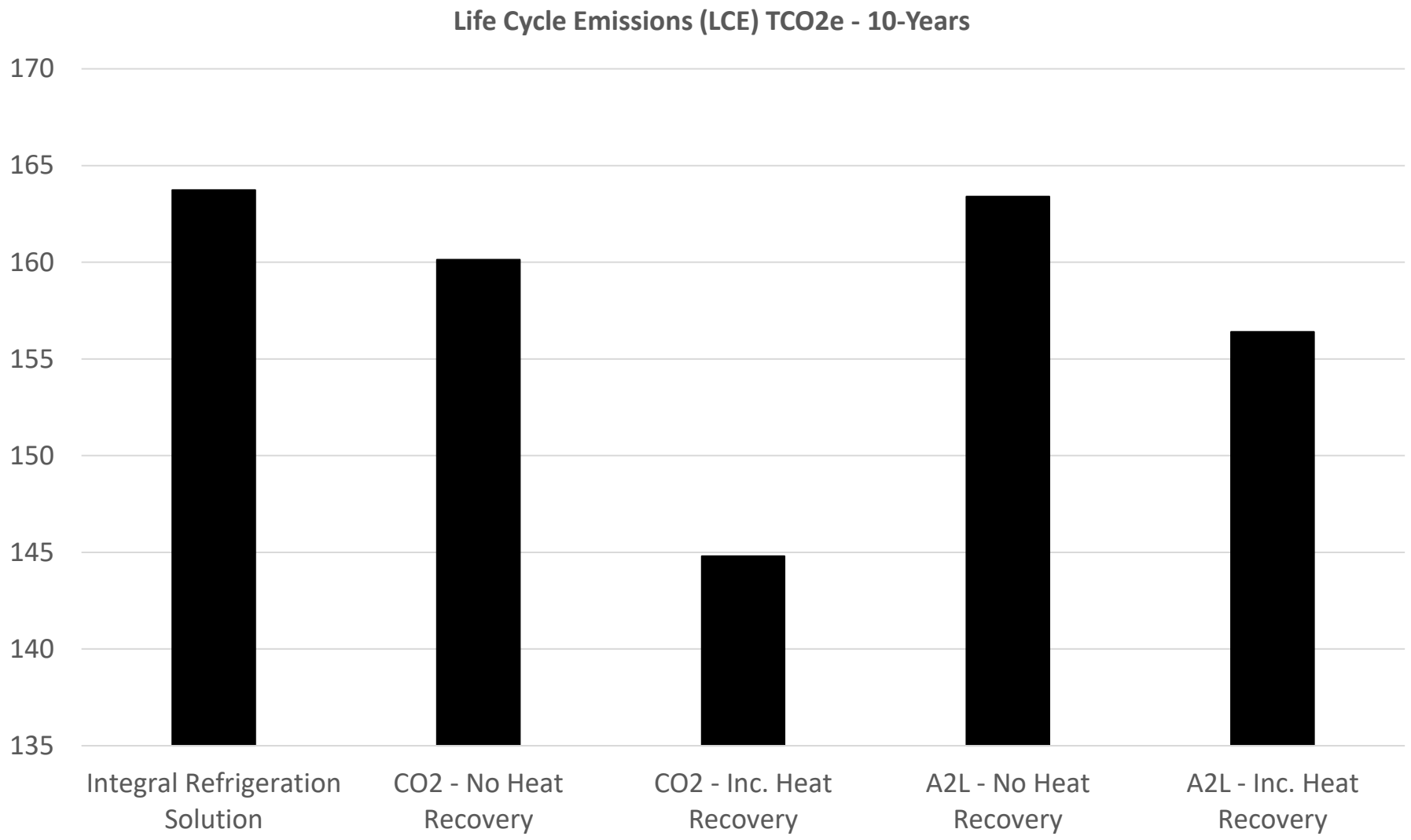
Life Cycle Emissions (LCE)



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Other Considerations

Other Considerations	CO2	Hydrocarbons	A2L	Comment
Footprint				No external refrigeration plant is required for Hydrocarbon Integrals
Design & Maintenance Skill Base				Integrals are "plug and play" technology. Design complexity is reduced
Control Complexity				Integrals are "plug and play" technology. Control complexity is reduced
Noise (External)				External noise where Integrals are installed will only be emitted from the heating/cooling system
Noise (Internal)				Internal noise where Integrals are installed will be higher than the CO2 and A2L options
Trading Surety & Resilience				In high ambient temperatures, Integrals are not as resilient as remote refrigeration. A2Ls provide the highest trading surety and resilience in warmer ambient temperatures
Environmental Perception & Legislative Risk				Due to the upcoming revision to the F-Gas Regulations and PFAS (forever chemicals), there are long term concerns regarding the viability of A2Ls
Global Warming Potential (GWP)	GWP 1	GWP 3	GWP 148	Through representing an up to 96% reduction in GWP compared to R404A, A2Ls exhibit a significant higher GWP than Natural Refrigerants
Refrigerant Cost	£	£	£ £ £	The cost of F-gas refrigerants are significantly higher than natural refrigerants (£40 per kg, opposed to £3 per kg). The cost of HFCs will rise significantly due to the quota reduction

The time to move away from HFC refrigerants in the convenience sector is now

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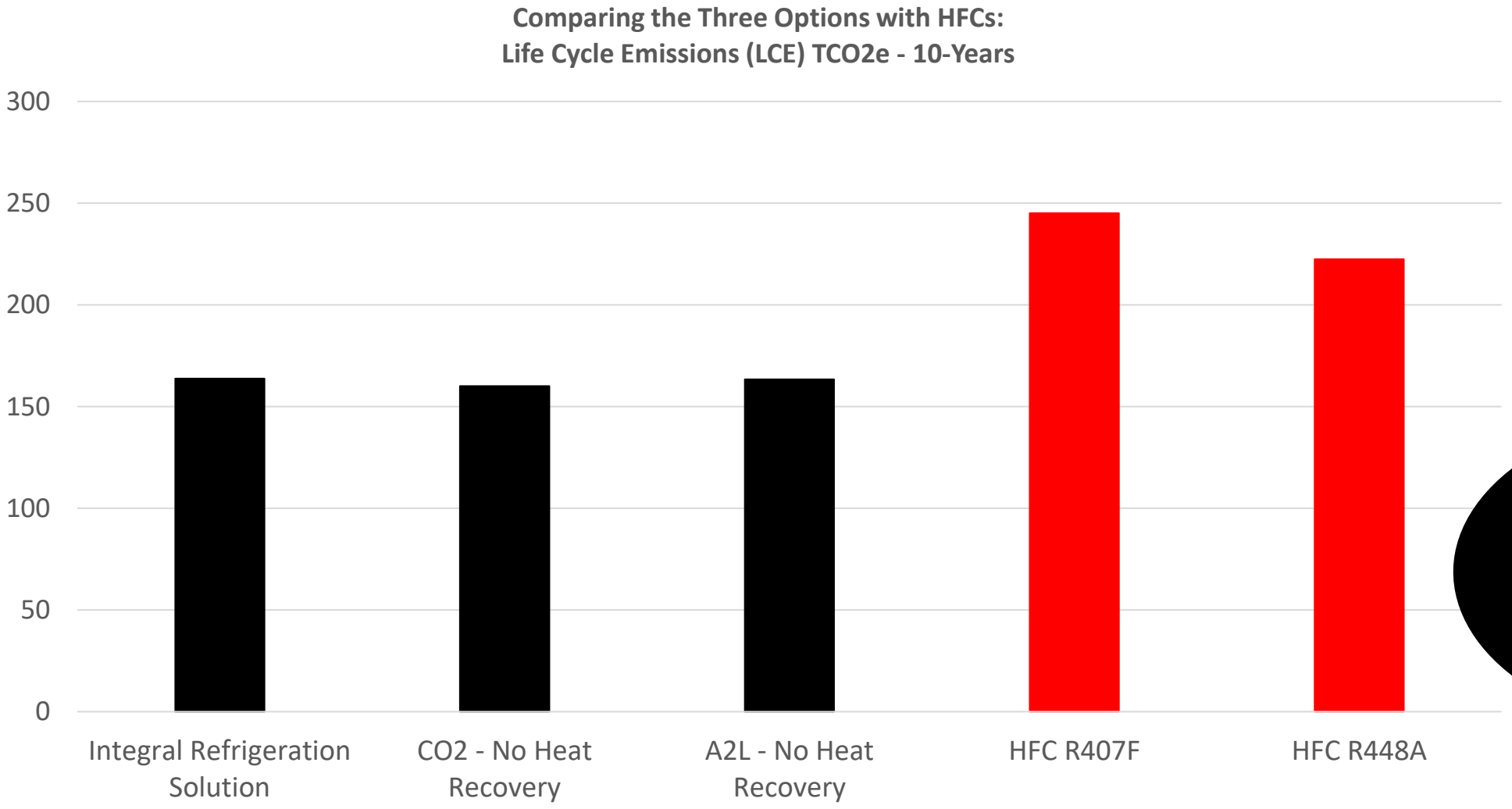
Comparing the Three Viable Options vs. HFC Technology



Notes:

- HC R290 GWP = 3
- CO2 GWP = 1
- A2L R454C GWP = 148
- HFC R407F GWP = 1825
- HFC R448A GWP = 1387

Direct Emissions from high GWP refrigerants are potent and significantly increase overall system emissions

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OMEGA Solutions can identify your current emissions and help you transition to low-carbon refrigeration and heating technologies.

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Thank you for listening!
Any questions?

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