CARTER GROUP

GREEN REFRIGERATION SOLUTIONS

Integrated Transcritical CO_2 Refrigeration Systems

Agenda

- Why Transcritical CO_2?
- What do we mean by the term “integrated solution”?
- The Carter Group integrated system
- Case studies and energy benefits being realised
- Summary
- Q&A

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Why Transcritical CO_2?

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- **Legislation**
- Corporate **responsibility**
- Price **competitive**
- **Future** proof

- **Simple** DX solution as with conventional systems
- Tried and **tested**
- Change in "drivers" with more focus on **energy saving**

What do changes in legislation mean to me?

Proposal to decrease CO_2 emissions. How? What does it mean to me?

How long and certain a future do low GWP HFC's have?

What will the EPA proposal for 2016 on high GWP HFC's mean to me?

How do my customers view the environment?

Am I maximising the output of my refrigeration system?

F-Gas Regulations – Montreal Protocol?

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What do we mean by the term “Integrated Solution”?

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"Integration allows us to maximise the potential of the refrigeration plant"

1. CO_2 high discharge temperature give massive heat recovery potential
2. Adding air conditioning to the refrigeration plant removes need for heat pump type solutions
3. Depending on heating requirement could remove the need for all other sources of heat
4. Reduced capital investment on HVAC systems
5. Reduced life-cycle Investment for energy

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The Carter Group Integrated Solution

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Carter Group transcritical system at the heart of the solution

Massive energy savings being realised in systems today

Single, dual or triple temperature

Heat available for use in multiple applications

High resilience design

Controller HVAC interface

Integrated heat pump stage available

Green CO_2ntrol PLC

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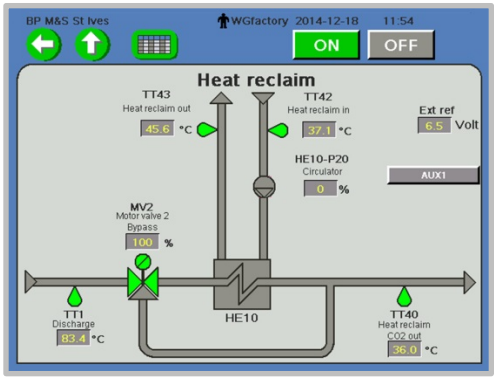
Case Studies

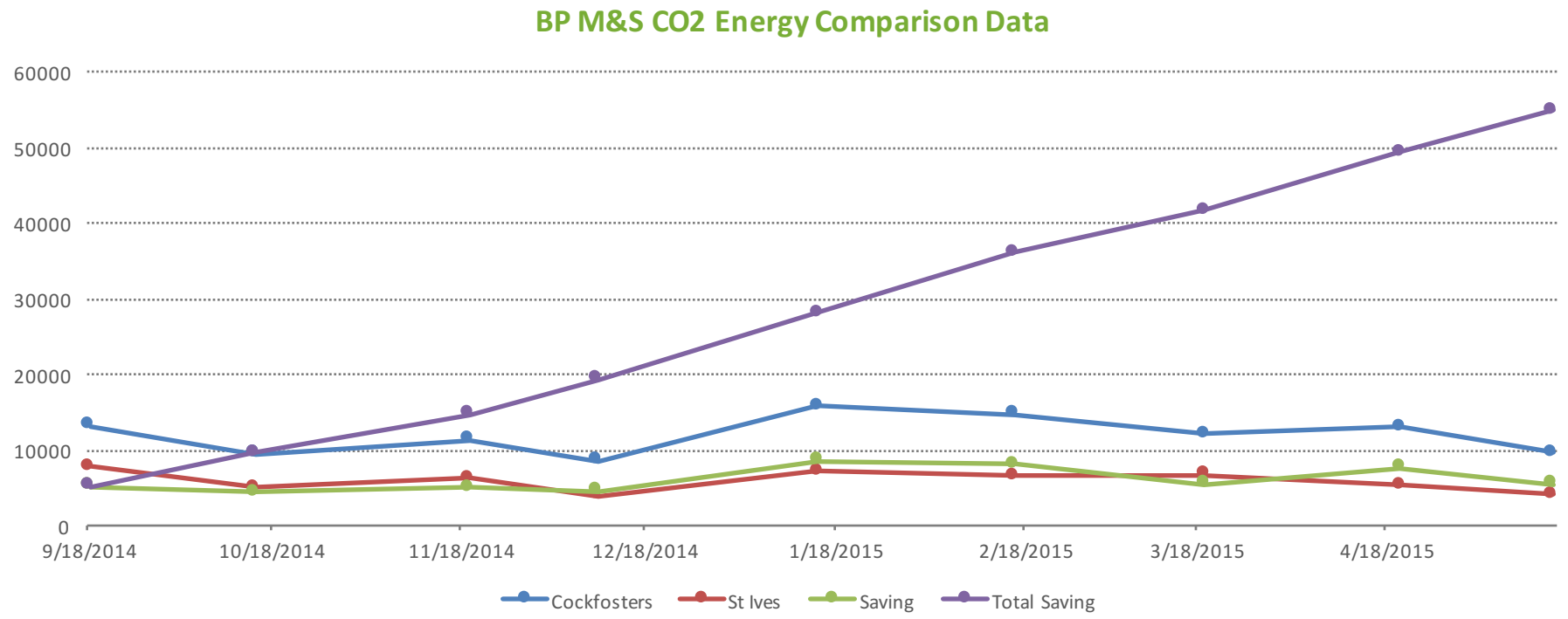
European Case Study - BP/M&S

- Carter Group designed, installed, commissioned and maintain the store
- **Fully integrated** CO_2 solution for Heating, AC and Refrigeration
- **50%+** Energy Reductions
- Remote access & support
- System is **evolving** to incorporate further benefits such as hot water generation, underfloor heating etc.



European Case Study - BP/M&S - Energy Profile/ Comparison

System Item	Energy Saving kWh	Energy Saving %
Combined Refrigeration & HVAC	54,990.49kWh	50.75%
Refrigeration Plant Only	3,516.6kWh	6.84%
HVAC Equipment Only	51,473.59kWh	90.44%



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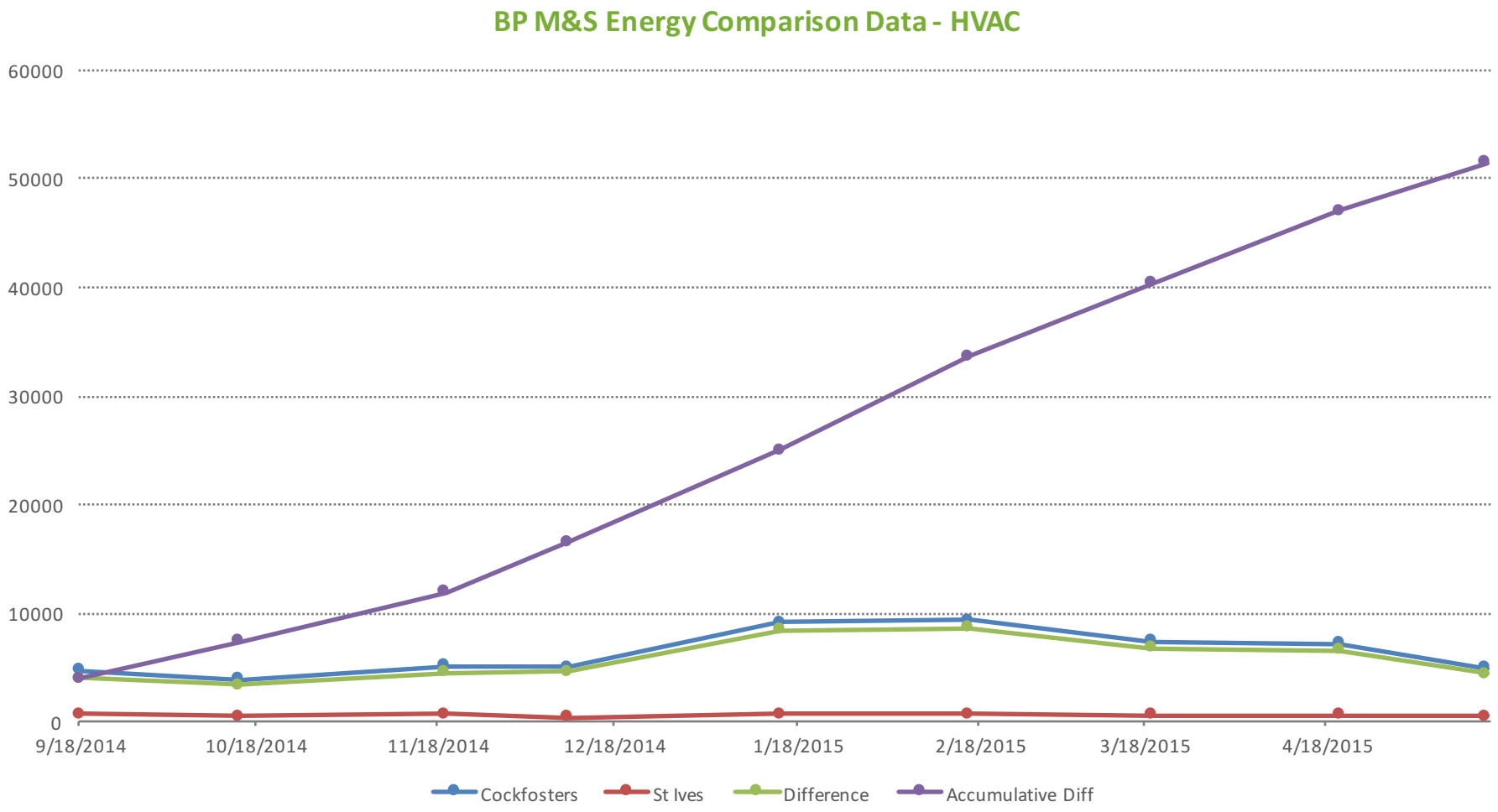

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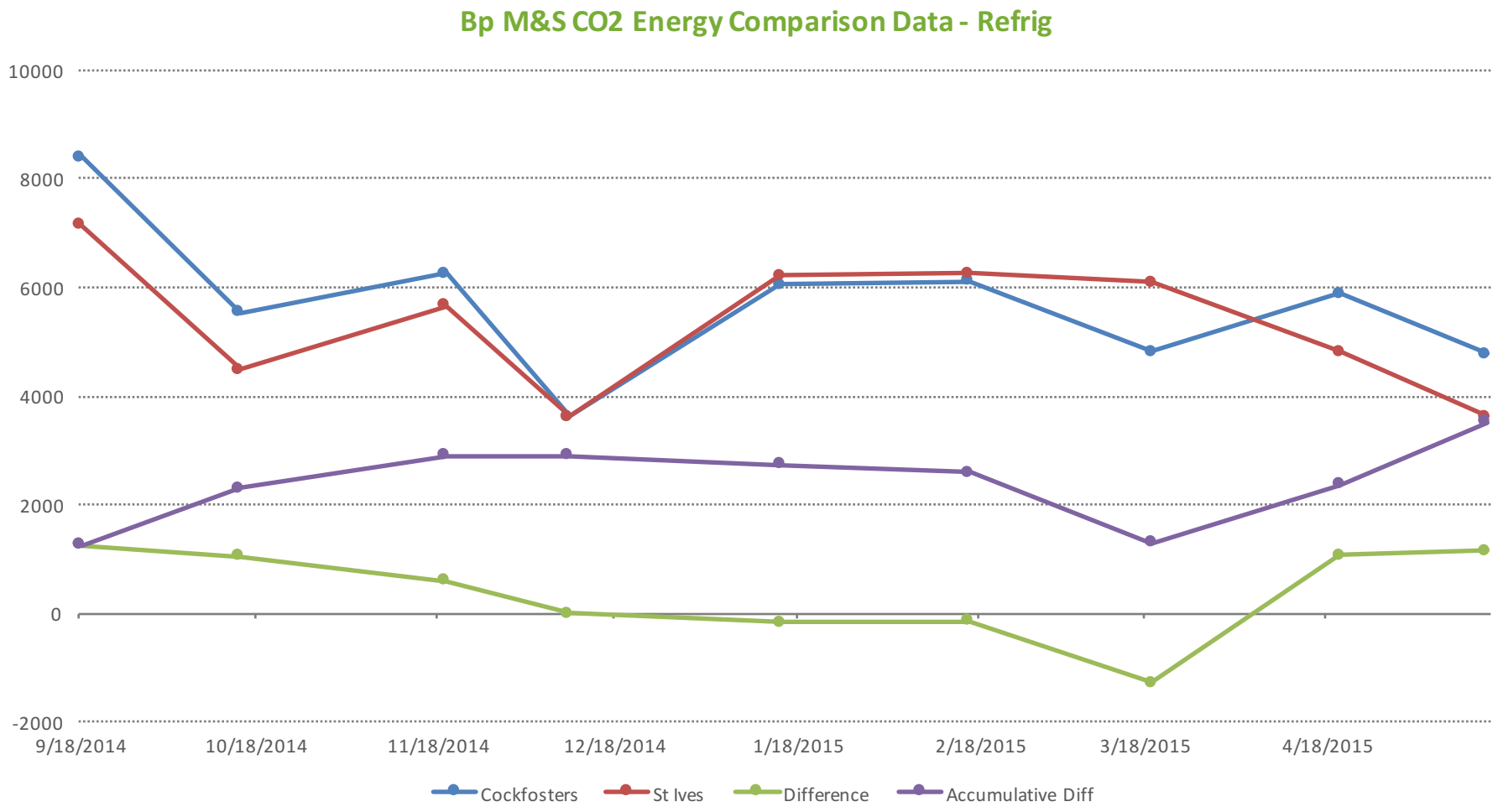
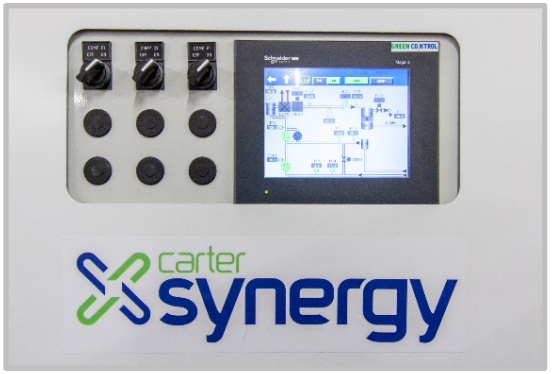
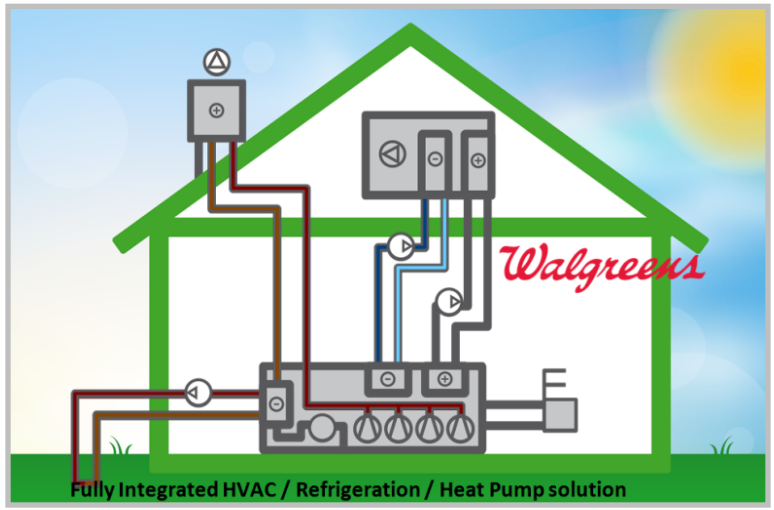


European Case Study – Sainsbury's Wembley

- **Fully integrated** CO_2 solution for Heating, AC and Refrigeration
- Small AC requirement so compressor stage removed and **valve arrangement** used for office cooling
- **60%+** Energy Reductions
- Internal plant solution located against wall
- Internal gas cooler utilised to minimise noise breakout



North American Case Study - Walgreens Net Zero Store, Chicago



- Engaged by client due to CO_2 experience
- Involved throughout design phase
- **Integrated** Ground Source Heat Pump (GSHP) solution
- **Partnered** with local contractor providing training, critical spares stocks & continued remote **support**
- Project running 12 months and **achieving** net zero ambition
- **60%** energy saving on traditional heating & refrigeration solutions

"We expect the store to consume 200,000 kilowatt hours a year of electricity and generate 256,000 kWh a year."

- Walgreens

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Summary

Summary

- CO_2 refrigeration systems now accepted as a solution
- Systems now up front cost effective
- By integrating the systems we can reduce capital investment elsewhere
- CO_2 plant proving more efficient that HFC in moderate climates
- Through heat recovery massive energy benefits available
- CO_2 offers a viable, economic and efficient solution for all store formats
- We need to ensure we are unlocking the **potential** of our systems

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Questions & Answers