



BP/M&S St Ives

Integrated CO₂ Convenience Refrigeration Installation



Project Overview

The purpose of this project was to bring CO₂ refrigeration to the BP estate and ensure the maximum value and benefit in terms of environmental impact was achieved

As key supplier Carter Synergy designed and provided an option for a fully integrated refrigeration solution the key aspects of which were:

- To provide all refrigeration capacity
- To provide a second temperature band for air conditioning
- To provide all building heat through heat recovery

The design was presented and approved in late 2013 with the St Ives store nominated for a trial and the installation complete and running by July 2014.

Following the installation, a period of monitoring in direct comparison with a store of the same format in Cockfosters was initiated and continues to date.

This document gives an overview of the scheme and details the findings of this monitoring so far.

General Installation & Componentry

Pack:

Central to this scheme is a Green & Cool dual temperature CO₂ refrigeration pack, this is complete with PLC and plate heat exchanger/3 way valve arrangement for heat recovery. The two temperature bands in this instance are -7°C (SST) for MT refrigeration and 7°C (SST) for air conditioning. All Green & Cool systems are designed to contain refrigerant (system resilience) and as a result PRV setpoints are 80 Bar liquid & 60 Bar suction to ensure refrigerant charge is held under power failure.

The pack is an external unit with an integrated gas cooler to offer a compact footprint suitable for this small format application.



Pack in situ

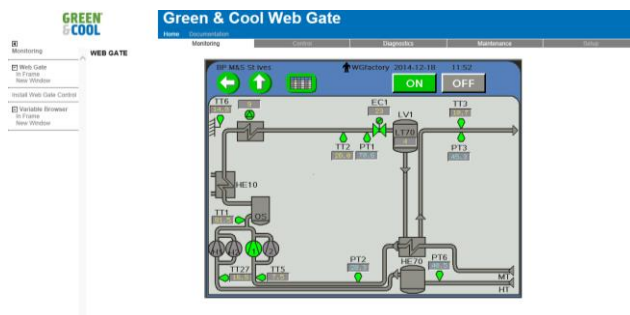
Pack Controller, Remote Access & Interface:

The pack controller is a purpose built PLC, the software is designed and written by Green & Cool directly and as a result we have great flexibility in adapting it to many different applications such as heat recovery. The touchscreen user interface allows easy understanding for technicians with logical navigation around the system.

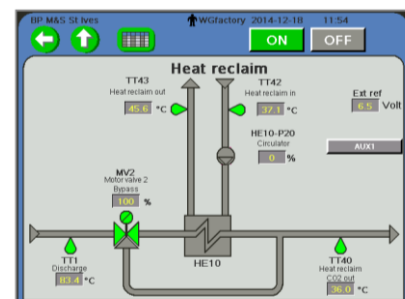
The PLC also allows remote access to the unit. This is an internet based tool which can be provided through an on-site connection and accessed from any computer connected to the internet. There is also a phone/tablet application for access.

The controller links directly with the store HVAC controller through a 0-10V signal, in this instance the interface it with a purpose built RDM solution due to the clients preference of monitoring system however any system able to provide this signal would be compatible.

The plant controller also sends an alarm signal to the store monitoring system.



Remote Access



Heat Recovery Control

Remote Cabinets:

The remote cabinets for this scheme were provided by Carter Retail Equipment, these were the standard Brooklands range adapted for transcritical CO₂ operation namely higher operating and standstill pressures.



Island Cabinets



Wall Cabinets

Coldstore:

The coldstore was supplied and built by Carter Coldstore Services and is standard 80mm PIR panelling with glazed doors along one wall facing the salesfloor. Internal shelving is back-filled and stock is traded from the coldstore. This layout significantly increases shelving space without compromising refrigerated storage.



Doors facing sales floor

HVAC Distribution:

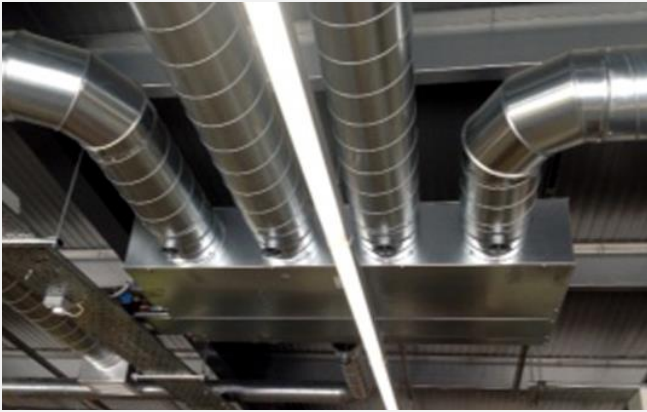
The distribution of salesfloor and office heating & cooling is through 3 No. ducted fan coil units, these are Marstair units designed in conjunction with Carter Synergy and contain 2 coils for LPHW and DX CO₂ respectively.

An LPHW overdoor has also been installed due to the high throughput of customers to these sites.

All LPHW and CO₂ equipment is supplied by the refrigeration plant only.

The HVAC system is controlled by a purpose built RDM controller with a programme developed with Carter Synergy to meet the needs of the specific system. The system reacts to changes in the store environment in a more measured manner than typical LPHW systems to ensure we maximise the free heat output from the plant.

Ducted fan coil units



St Ives and Cockfosters Comparison Exercise

The site at Cockfosters was selected as a typical refrigeration/HVAC installation for direct comparison with the St Ives integrated scheme. Sub-metering was fitted to all refrigeration and AC plant and associated equipment to allow detailed analysis of the two system performances. The findings for the period 8/8/14 – 10/12/14 are detailed in the following report.

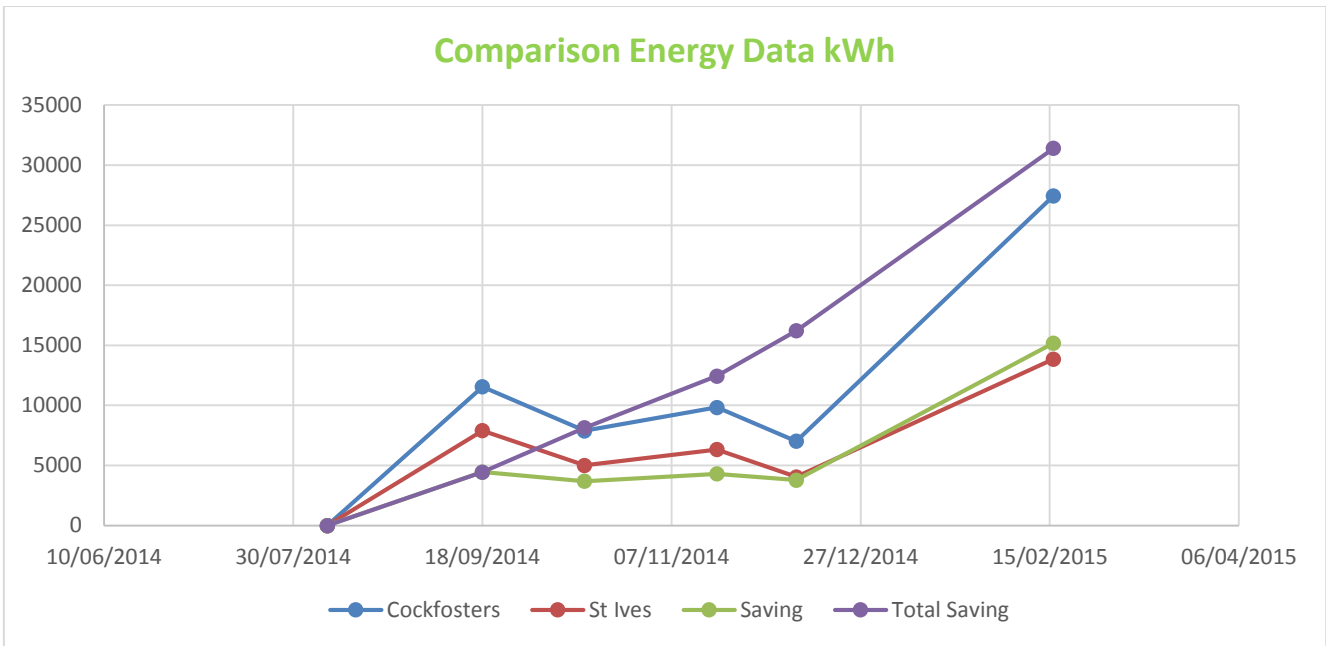
Energy Savings

Energy readings have been taken at regular intervals across the period and a more detailed breakdown of the findings is contained in the graph & table below however the headline figures are as follows:

System Item	Energy Saving kWh	Energy Saving %
Combined Refrigeration & HVAC	31,404.11kWh	45.81%
Refrigeration Plant Only	2,584.8kWh	7.18%
HVAC Equipment Only	28,819.31kWh	88.45%

The table and graph below detail how the energy was saved on a month by month basis.

Total Use kWh				
Date	Cockfosters	St Ives	Diff	Total Saving
08/08/2014	0	0	0	0
18/09/2014	12353.41	7900.72	4452.69	4452.69
15/10/2014	8689.57	5002.12	3687.45	8140.14
19/11/2014	10632.37	6332.18	4300.19	12440.33
10/12/2014	7822.52	4041.88	3780.64	16220.97
16/02/2015	27442.04	13858.9	15183.14	31404.11



Summary

For the 6 months the study has been carried out so far the store is demonstrating a 45% reduction in energy use for refrigeration and HVAC services. This is being received as a huge success and ensures that the payback on investment will allow significant benefits to BP across the life cycle of the equipment.

The period monitored to date is an excellent snapshot of a year as it contains months with high ambient temperatures and those with low, the expectation is that we will continue to see a continuation of these savings at the very least. The study is to continue for a full 12 month period.

For the Carter Group the intention is to continue developing our offer to ensure value and efficiency are maximised. It is also key that we continue to work with our supply base to ensure componentry and equipment is available, suitable and offers good value which we will endeavour to do.

On the back of this success a second scheme has been allocated as an integrated solution and we are looking to alter the proposal slightly from lessons already learnt at St Ives.