



BP MARKS & SPENCER ST. IVES, UNITED KINGDOM

CASE STUDY #2, MAY 2016

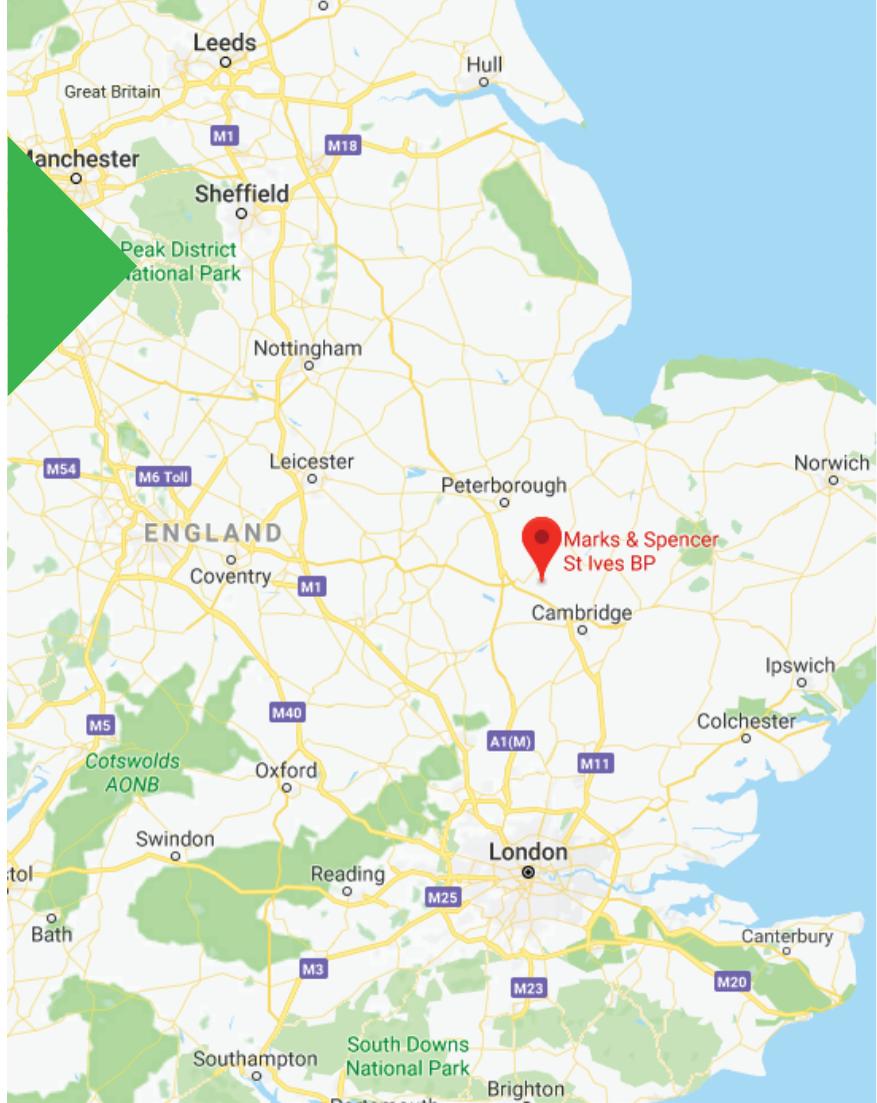
System Type:	Refrigerant:	GWP:
Transcritical CO2	R-744 (carbon dioxide)	1

Store Size: Small format (<3,000 sq ft) convenience store

ASHRAE Climate Zone: 4

Average Electricity Cost: \$0.14/kWh

System & Charge: Transcritical CO2 / 165-lb R-744



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Key Characteristics:

Fully integrated transcritical CO2 system, with a second temperature band specifically for air-conditioning. Heat recovery supplies all building heat demand.

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SYSTEM BASICS

System: Transcritical CO2 (TC), with 165-lb charge of R-744 (carbon dioxide).

System location: External unit and an integrated gas cooler. Compact footprint (13 x 3 ft).

System capacity: Low temp capacity is 68,200 Btu/hr and medium temp capacity is 170,600 BTU/hr .

The system was designed as a low noise solution (30dB(A) @ 32 ft) due to the surrounding residential property.

The dual temperature CO2 transcritical (TC) rack was completed with a purpose-built Programmable Logic Controller (PLC) and plate heat exchanger/ 3-way valve arrangement for heat recovery. Pressure Relief Valve (PRV) set points are 1,160 psi liquid and 870 psi suction, which ensures that the charge is not lost in the event of a power failure. The PLC user-interface allows for remote access to the unit via a phone/ tablet app.

The remote cases for this installation were typical BP cases adapted for the higher operating and standstill pressures of TC CO2.

A nearby store with same square footage uses an HFC DX system, which can be used for a baseline comparison.

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QUANTIFYING CHANGES IN ENERGY USE

For comparison, energy data was collected over the same period at the BP store in Cockfosters, UK with the exact same store footprint. Cockfosters is just outside of London, and experiences similar seasonal temperatures as St. Ives.

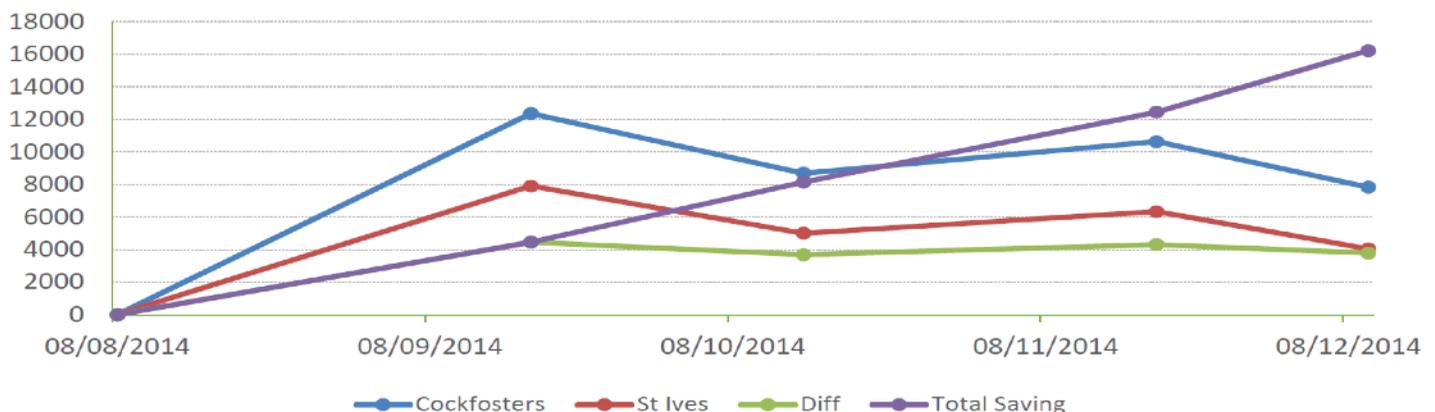
The following graph shows electricity usage in the St. Ives TC store as compared to the HFC store in Cockfosters. Submetered data were collected on a monthly basis from September 2014 through December 2014 showing the energy use for refrigeration and AC, respectively.

After four months of data, total energy savings from the TC installation were 41% as compared to the HFC system in Cockfosters. As shown in the chart, a majority of the energy savings is due to heat recovery and reuse in the HVAC system; however the TC refrigeration system was 12% more efficient than the HFC system.

WHAT BP SAYS

“On the back of this successful pilot project further stores were trialed, and going into 2016 this integrated TC solution has now become the standard engineering solution for BP Marks & Spencer Simply Food franchises moving forward.” with expectations.”

Combined Refrig & HVAC kWh



The North American Sustainable Refrigeration Council is a 501(c)(3) nonprofit dedicated to advancing natural refrigerants and creating a more sustainable future for retail food refrigeration. Learn more at <http://nasrc.org>

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System Item	Energy Savings (kWh)	Energy Savings (%)
Combined Refrigeration & HVAC	16,221	41.07%
Refrigeration Plant Only	2,981	12.15%
HVAC Equipment Only	13,330	84.88%

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