

National Grocery Chain Makes Transition to Transcritical Refrigeration

Phoenix-based grocery chain deploys its first CO₂ transcritical booster system in Atlanta store



In “Hotlanta” ambient temperatures routinely rise above 87.8 °F. That’s the critical point temperature for the emerging natural refrigerant CO₂ (R-744). When the temperature outside approaches this point, CO₂-based commercial refrigeration systems begin to experience declining efficiencies. That’s why CO₂-based refrigeration architectures are more common in cooler climates. And why CO₂ transcritical booster systems — which rely entirely on CO₂ — are not considered an obvious solution in places like Atlanta.

However, with increasing regulations prompting a shift toward sustainable alternative refrigerants, retailers are looking more closely at CO₂ transcritical booster systems to anchor their refrigeration operations, even in warmer climates.

With more than 200 U.S. locations, Sprouts Farmers Market, a healthy grocery chain that offers fresh, natural and organic foods, is among the first retailers in North America to do just that. They opened their first store in suburban Atlanta in July 2014, and when they did, they set out to prove CO₂ transcritical booster systems aren’t only for cool climates.

But Sprouts had clear business objectives for their CO₂ pilot program, as well. Their senior leadership wanted to reduce the company’s carbon footprint and mitigate regulatory compliance concerns. The forward-thinking grocery chain wanted to push the envelope and establish a sustainable refrigeration alternative in their new fleet of southern stores.

Going Green and Keeping It Fresh

When you’re a grocery chain focusing on selling fresh foods, fresh is the fundamental ingredient. That means your refrigeration system design has to be—above all else—reliable.

Like many food retailers, Sprouts has historically employed more traditional refrigeration systems based on common hydrofluorocarbon (HFC) refrigerants. These HFC systems operate with what’s traditionally seen as acceptable temperatures and pressures.

CO₂’s low critical point temperature and high operating pressure (around 1,500 psig) are characteristically not found in traditional HFC-based refrigeration. These are the primary reasons for the reluctance to move toward CO₂. But, with advances in system technology and architecture, CO₂ can be a game changer for retailers seeking to improve energy efficiencies, achieve sustainability targets and cross the finish line on regulatory compliance.

Changing their refrigeration philosophy and moving to a CO₂ transcritical system architecture was a giant step for Sprouts, especially for this store in the hot, humid climate of Atlanta.

To pull this off, they turned to OEM partner Hillphoenix, whom the company partnered with to earn an EPA GreenChill platinum certification in 2011. And Hillphoenix, seeing the challenge presented by installing a CO₂ transcritical booster system in a warm climate, turned to Emerson Climate Technologies.

Transcritical Technology in Action

Emerson Climate Technologies, Hillphoenix and Sprouts all shared the same goal: show the industry it’s possible to operate an efficient refrigeration system in higher ambient temperatures using CO₂ exclusively.

A key enabling feature of the CO₂ transcritical booster system is an adiabatic condenser, which was designed to operate in high ambient temperatures. Adiabatic condenser cooling is the process of spraying water



Hillphoenix warm climate CO₂-based transcritical booster system installation utilizing Emerson Climate Technologies components



into the air supply of an air-cooled condenser to pre-cool the air and improve refrigeration efficiency. The goal of this condenser technology is to keep the CO₂ below its critical point, thus maximizing system efficiencies.

Hillphoenix's rack refrigeration system featured four Copeland™ semi-hermetic transcritical CO₂ compressors and three Copeland Scroll™ ZO compressors. Both models were designed for CO₂'s high-pressure requirements and benefit from its thermal properties.

Emerson's E2 Facility Management System was installed to oversee the CO₂ transcritical booster system, manage nearly 50 electronic case control units and optimize the facility's overall energy management profile. The E2 system helps improve performance in multiple ways:

- 1) Controls the variable speed of the fans on the adiabatic condenser in response to operating conditions
- 2) Optimizes compressor coefficient of performance by regulating system discharge pressures via Emerson's high-pressure CO₂ controller
- 3) Provides complete oil management control of all CO₂ refrigeration compressors
- 4) Communicates with and captures information from individual case control units
- 5) Provides complete control of building HVAC and refrigeration systems, and supports the retailer's energy and maintenance reduction strategies

The E2 system also allows Sprouts operators to run diagnostics, monitor the system remotely through Emerson's ProAct™ Service Center and, if necessary, shut down the system components before failure.

The condenser manages both low- and medium-temperature refrigeration requirements on the same system using only CO₂ as the refrigerant, another unique aspect to the transcritical booster system. Running both requirements from the same condenser enhances the efficiency of the system across the store.

Easing Concerns

CO₂ transcritical booster systems have been used in Europe for nearly a decade. Adoption by the U.S. refrigeration industry has been slower due to a general apprehension about new (and, to many, unknown) technology.

It's understandable why stateside end users are hesitant to switch to CO₂ transcritical booster systems. Concerns over operating pressures, maintenance levels and energy have prompted careful and steady evaluations to understand the true cost of ownership for their enterprises.

Emerson technology helped ease those concerns for Sprouts. Their Atlanta-area store is operating efficiently and effectively on the transcritical system.

Emerson Climate Technologies equipment portfolio

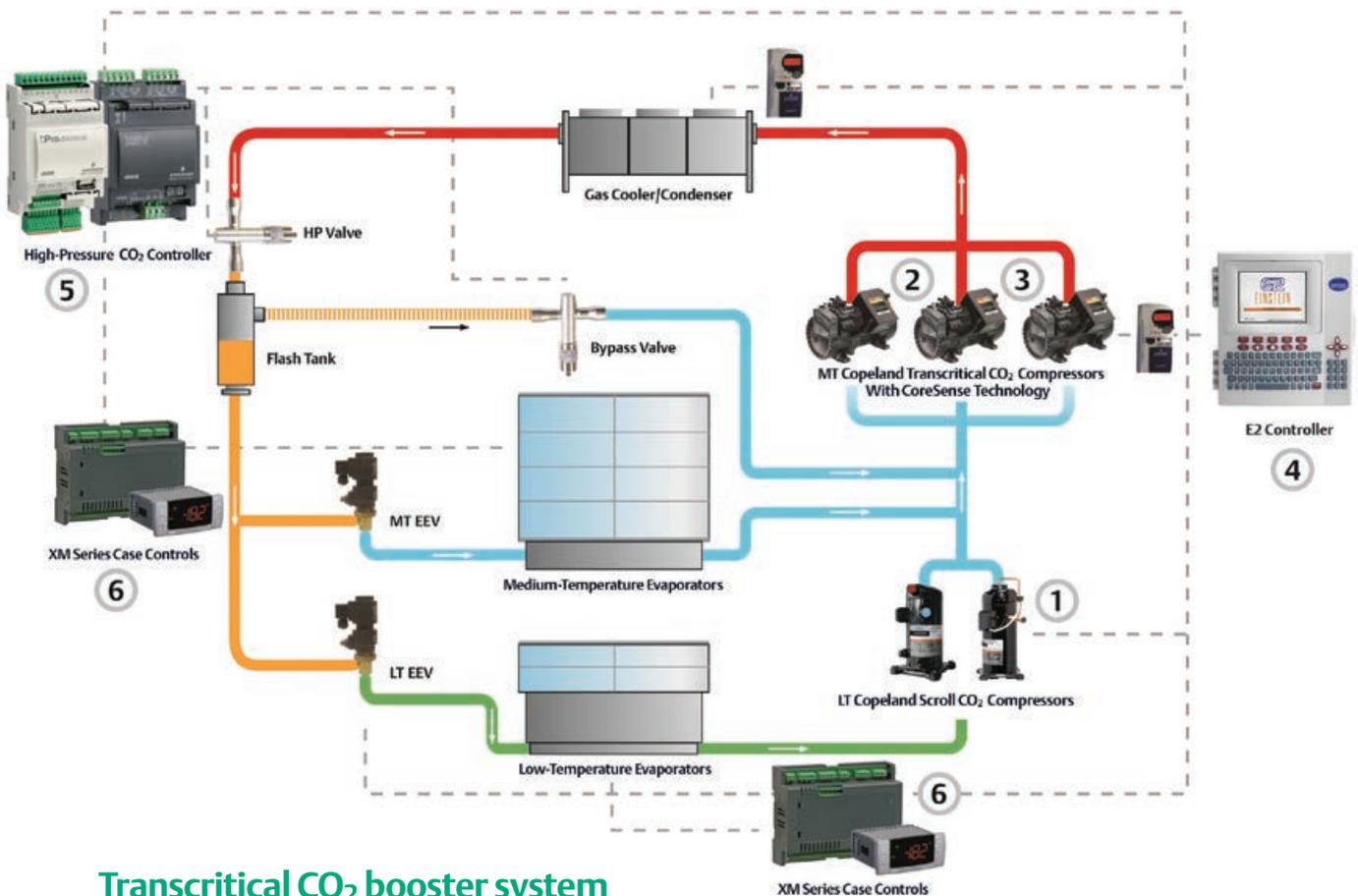
The pilot CO₂ transcritical booster system designed for Sprouts' Atlanta store utilizes multiple Emerson Climate Technologies components, including:

- 1. Copeland Scroll ZO compressors** — for low-temperature refrigeration requirements (freezers)
- 2. Copeland semi-hermetic transcritical CO₂ compressors** — for medium-temperature refrigeration requirements (dairy, produce and meat cases); includes variable frequency drives to prevent the compressors from cycling on and off too frequently
- 3. CoreSense™ technology for Copeland compressors** — advanced compressor diagnostics, protection and communications technology that allows technicians to make faster, more accurate decisions, resulting in improved compressor

performance and reliability; present on all store compressors

- 4. E2 Facility Management System** — provides complete CO₂ transcritical booster system optimization and facility-wide energy management
- 5. High-pressure CO₂ controller** — optimizes high side pressures and liquid quality to the cases
- 6. XM Series case controls (pulse-width modulated)** — integrates with the E2 system to maximize operating efficiencies through tighter temperature controls; present on nearly 50 cases

Discharge air controller (not shown) — operates in unison with the E2 system and is capable of controlling heat and cool stages, fans, dehumidification devices and economizers using on-board I/O



Transcritical CO₂ booster system