

SOBEYS' NEW EFFICIENCY-MEASURING TOOL

In a comparison of two transcritical CO₂ booster systems, the Canadian retailer is using System Efficiency Index (SEI) rather than COP or EER.

— By Michael Garry



Ian Crookston, Sobeys

Over the past several years, Sobeys Inc., Canada's second largest grocery chain with nearly 1,500 stores (some franchised), has become the North American leader in the number of installed transcritical CO₂ booster refrigeration systems.

There are currently 78 Sobeys stores in eight provinces (63 in Quebec that operate under the IGA banner) using CO₂ transcritical booster systems with heat reclaim, the company's standard

refrigeration technology; forty-four of these received EPA GreenChill Platinum certification. Each year, another 15 to 20 stores (both new and renovated) are being equipped with transcritical systems. Sobeys also has nine stores with cascade CO₂ systems.

Based on its experience, Sobeys believes the first cost of a transcritical system, including all components (racks, cases, controls, etc.) is comparable to that of traditional DX systems using synthetic

refrigerants and the same level of controls. It also believes transcritical is more efficient than traditional DX with synthetics.

This year, Sobeys began a two-year study comparing two transcritical systems, each from a different manufacturer, one running in a store in Milton, Ontario (opened in December 2014) and the other in a store in Stratford, Ontario (opened in March 2015). The study aims at determining which system has the highest efficiency and the lowest total cost of ownership (TCO).

Each store has two similarly sized racks and each rack contains both low- and medium-temperature cooling, along with reverse-cycle defrost. The difference is that the Stratford store's system employs mechanical sub-cooling and has three separate low-temp suction groups per rack; the Milton store's system does not use mechanical sub-cooling and has one low-temp suction group per rack.

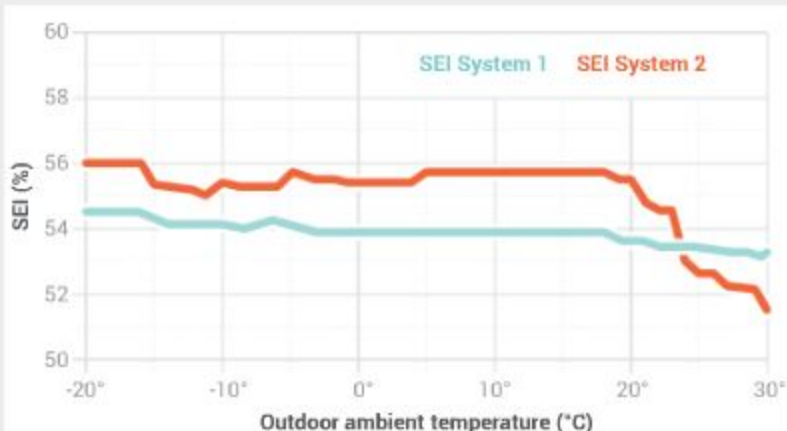
One of the interesting aspects of this study is that energy efficiency is being measured with a recently developed benchmarking tool – System Efficiency Index (SEI) – rather than Coefficient of Performance (COP) or Energy Efficiency Ratio (EER). Sobeys is utilizing a ClimaCheck Performance Analyzing System that applies SEI along with consulting services from Renteknik Group for this project.

SEI BENCHMARKING

SEI is independent of outdoor temperature and:

Figure 1.

- » should be consistent across wide range of temperatures
- » changes vs temperature represent issues with sub-system performance
- » difference between systems represents overall efficiency difference.



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ACCELERATE AMERICA ASKED IAN CROOKSTON, MANAGER, ENERGY MANAGEMENT, FOR SOBEYS TO EXPLAIN WHY THE RETAILER CHOSE THIS APPROACH.

Accelerate America: Why do you consider System Efficiency Index (SEI) a better measure of a system's energy consumption than other measures like COP or EER? When did SEI come to your attention?

Ian Crookston: System Efficiency Index (SEI) has the advantage of being a normalized unit of absolute efficiency. 100% SEI occurs when a system is operating at the ideal theoretical efficiency (i.e. the Carnot Cycle). It was introduced by VDMA (Verband Deutscher Maschinen- und Anlagenbau, or the German Engineering Association) and IOR (The Institute of Refrigeration) in the U.K.

Coefficient of Performance (COP), Energy Efficiency Ratio (EER), etc. are based on design/standard conditions (i.e. saturated suction temperature, condensing temperature, etc.). As an example, ANSI/AHRI Standard 1201 (Performance Rating of Commercial Refrigerated Display Merchandisers and Storage Cabinets) uses "standard conditions" of 75°F (24°C) and 55% RH. It is great for relative comparison of refrigerated display cases

at steady state, but does not account for the geographical location (i.e. local weather) of the refrigeration system and the wide range of load and control behavior a real system is exposed to. It will generate the same "values" for a store located in Phoenix, AZ as Nome, AK. Your actual system, in your actual location, will have a very different performance. A bin temperature analysis is needed to predict actual energy consumption.

A decrease in COP/EER is not necessarily a change in performance, as it would require an expert's analyses of both ambient and load conditions. SEI will, without any adjustments for ambient or load conditions, show the actual magnitude of any performance change (See Figure 1).

SEI can also be used on sub-systems (i.e. compressor, evaporator, condenser, etc.) to measure their performance. If there is an issue, this will expose the right part of the system for corrective measures.

We learned about SEI through a paper published by the SP Technical Research Institute of Sweden.

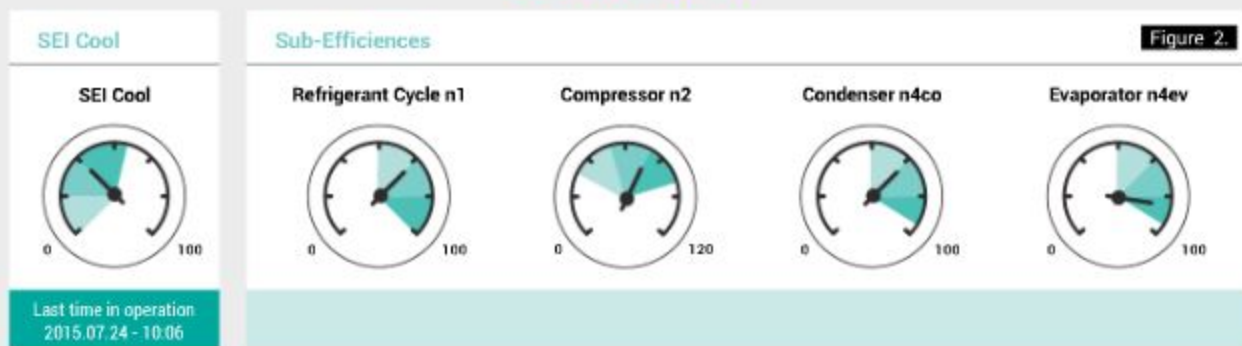
AA: How have you employed SEI?

IC: We are currently using SEI to benchmark two CO₂ transcritical booster systems installed in Ontario (Milton and Stratford). SEI also enables us to get an early warning of when the performance of any part of the system is deviating from its optimized state. SEI, together with comparing the predicted energy use to actual energy use, allows us to understand, in detail, how each system operates (see Figure 2).

AA: Is SEI incorporated into TCO?

IC: Optimizing SEI reduces the amount of energy a system consumes, which impacts total cost of ownership (TCO). In food retail, efficiency is important, but having an effective refrigeration system is paramount. The refrigeration system must always provide the appropriate level of "cold." **MG**

SEI DASHBOARD



Compressor energy consumed relative to statistical profile

