Bilaga 1

IEA Annex 26:
Advanced Supermarket Refrigeration/Heat Recovery Systems

Introduction

Supermarkets are one of the most energy-intensive types of commercial buildings. Significant energy is used to maintain chilled and frozen food in both product display cases and storage refrigerators. The refrigeration systems also produce a large amount of rejected heat that can be recovered and used by heat pumps or other equipment to provide space and water heating for store requirements.

In order to help promote the development of advanced systems and expand the knowledge base for energy-efficient supermarket technology, this Annex was established in April 1999 under the *IEA Implementing Agreement on Heat Pumping Technologies*. Annex 26 focuses on demonstrating and documenting the benefits of advanced systems design for food refrigeration and space heating and cooling for supermarkets. Advanced in this context means systems that use less energy, require less refrigerant and produce lower refrigerant emissions. Stated another way, the goal is to identify supermarket refrigeration and HVAC technology options that reduce the total equivalent warming impact (TEWI) of supermarkets.

The Annex currently has four participating countries: Canada, Sweden, the United Kingdom, and the United Satiates. In addition, Denmark will likely soon join the Annex. The United States is the designated Operating Agent. All countries involved have established national teams including industry representatives to help direct their respective research programs.

Technical Approach

The Annex participants are investigating several candidate system design approaches to determine their potential to reduce refrigerant usage and energy consumption. System types include the following:

secondary loop systems – a central chiller is used to refrigerate a secondary coolant (e.g. brine, ice slurry, or CO_2) which is pumped to the food display cases on the sales floor;
distributed compressor systems – small compressor racks are located in close proximity to the food display cases they serve thus significantly shortening the connecting refrigerant line lengths;
self-contained display cases – each food display case has its own refrigeration unit.

Means to integrate store HVAC systems for space heating/cooling with the refrigeration system are being investigated as well. One approach is to use heat pumps to recover refrigeration waste heat and raise it to a sufficient level to provide for store heating needs. Another is to use refrigeration condenser heat directly for store heating or to regenerate a desiccant system for humidity control.

Each participant is conducting field tests or case studies of one or more advanced systems. Information is being collected on refrigeration load and energy use, HVAC loads and

energy use, indoor and outdoor ambient conditions, total store energy usage, and refrigerant usage. For comparison purposes, stores with baseline direct expansion refrigeration systems are being monitored as well.

Summary of country projects

Canada. There are two organizations contribution to Canada's Annex 26 work. They are the CANMET Energy Diversification Research Laboratory (CEDRL) of Natural Resources Canada and Hydro Quebec's Laboratoire des Technologies Électrochimiques et des Électrotechnologies (LTEE).

CEDRL aims at evaluating a number of technology options including secondary loop systems with brines or CO_2 as well as heat rejection to a water loop, cooling tower or geothermal loop. Store HVAC options of interest include radiant floor heating and desiccant dehumidification. System modeling, laboratory-scale evaluations, and field-testing will follow in collaboration with an Industry Advisory Panel.

LTEE is conducting field tests of two advanced systems. One features integral heat reclaim for store heating, a rapid defrost scheme, and use of groundwater for heat rejection. The other is using heat pumps to recover refrigeration waste heat and features a refrigerant pumping scheme for liquid pressure control. A baseline store is being monitored as well.

Sweden. Sweden's work for the Annex is part of their national program Klimat 21 under a project "Energy Efficient Solutions for Supermarkets in Theory and Practice". At least six field tests of advanced systems are planned. Several use different secondary loop system designs and at least one will use distributed compressors. They are also working to develop a refrigeration system computer model to deal with technology solution options, life cycle costs, and environmental impact of supermarket energy systems.

United Kingdom. Several case studies are planned under the UK program. One of the stores involved features maximum use of outdoor air for ventilation, natural lighting, and other building energy saving measures as well as the refrigeration system. Optimal design and integration of the case refrigeration and store heating distribution systems is being investigated to minimize spillage of cold air from the cases into store aisles and thus maximize customer comfort.

United States. The US effort is a part of a national program on improved commercial refrigeration technologies. A spreadsheet-based model of supermarket refrigeration systems is being developed. The goal for this model is to provide supermarket planners and equipment designers and other users with an easy-to-use tool for making relatively quick comparisons of energy use and environmental impact of different system design options. In addition, field tests of two systems (one distributed compressor system and a low-charge, multiplex direct expansion system) are underway.

Denmark. Denmark is just joining the Annex after this workshop. Their contribution will be field testing of a new supermarket system using propane and CO_2 refrigerants. In addition they are including some information on the "Energy Goodness" rating system being developed for supermarkets.

Annex reporting plans

A final report will be prepared that will include an executive summary section to compare results from all the field tests and case studies prepared by the participants.
The main body of the Annex report will consist of country reports that will provide full details of each country's work. The Executive summary for the Annex report will be made available to all interested parties as soon as possible after the Annex closes. Detailed country results will be held within the Annex for a period of one year before being made generally available.

Annex web site

A web page has been created for the Annex at the address www.ornl.gov/annex26/. The site includes links to the IEA Heat Pump Centre (HPC) site. The site will include downloadable copies of the papers presented at this workshop as well as the executive summary section of the final report.