

# HVAC & R NEWSLETTER

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## Real-Time Pricing and Thermal Energy Storage - *Challenges and Opportunities*

*By Jim Elleson*

The new electricity marketplace presents new challenges and uncertainties to utilities and their customers. Thermal storage is a proven technology that helps both utilities and their customers meet these challenges while minimizing their risks and maximizing their benefits.

### Challenges for Utilities

Deregulation in the electric utility industry is forcing utilities that identify strategies to maintain revenues and maximize profits. In the regulated environment, the following model largely determined utility rates:

$$\text{Price} = \text{Cost to produce and distribute} + \text{Profit as guaranteed by regulators}$$

In the new marketplace, the model is becoming:

$$\text{Profit} = \text{Price} - \text{Cost to produce and distribute}$$

A utility that offers a flat-rate energy charge must determine an appropriate price that will cover the average cost of supplying power. The utility runs the risk that during times when the power cost is high, its customers' total demand will be greater than was estimated when the rate was established; thereby, lowering profits. Time-of-use rates represent a step toward matching the price of electricity to the cost of providing it. However, the utility still bears some risk that its cost of production and distribution will not be covered.

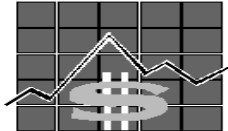
This risk was vividly illustrated in the Midwest during the summers of 1998 and 1999, when wholesale electricity prices experienced peaks as high as \$10,000 per MWh. Most utility customers were insulated from these price spikes, because they buy power at a guaranteed price from a utility that has an "obligation to serve". However, some utilities were forced to buy power at a price 100 times higher than their selling price.

### Real-time Pricing

Real-time pricing is an extension of the time-of-use pricing concept, whereby the rate for electric service varies hourly depending on the actual cost of production. Under real-time pricing, rates are communicated to the customer a short time ahead of delivery, typically one day.



Real-time pricing reduces a utility's risks in two ways. First, by linking the price of power to the utility's actual cost, it helps the utility avoid selling power at a loss. Second, it provides a price signal to customers, giving them a monetary incentive to reduce their demand when the supply of power is limited and prices are high. This helps reduce the amount of power that the utility must purchase at high spot-market prices.



Real-time pricing also offers significant benefits to those customers who can flatten their load profiles and reduce their usage during peak demand periods. Thermal storage is an ideal technology to help customers better manage the use of electricity during both high and low price periods. However, the design and application of thermal storage systems is different in the new electricity marketplace than under past rate structures.

### Challenges for Thermal Storage

Most thermal storage systems to date have been designed and operated under traditional, well-defined time-of-use rate structures. Under real-time pricing, electricity prices vary in new ways, and facility owners and designers must change how they apply thermal storage technology.

Real-time pricing adds new steps to the thermal storage design process. A designer must now determine the design day electric rate profile and select a time "window" during which demand is to be reduced. Only then can the designer establish the operating strategy and determine the appropriate combination of storage capacity and chiller capacity.

Real-time pricing also complicates the analysis of thermal storage operating costs. Such an analysis is essential for selecting the optimum storage capacity and operating strategy among many possible options. It is also critical for evaluating the economic feasibility of

thermal storage for a given application. Because variations in electricity prices do not follow a set pattern, new methods are needed to evaluate probable operating costs.

Improved operating strategies will also be needed to determine when to charge storage, and how much of the current load should be met from storage. With real-time pricing, these decisions must be made based on the upcoming rates for the current day, and on the cost expended to generate the cooling capacity currently in storage.

### Addressing the Challenges

EPRI and the HVAC&R Center are currently pursuing research to address these challenges, and to provide guidelines for designing and operating thermal storage systems under real-time price structures. Preliminary results suggest that real-time prices can be categorized into a few fairly predictable patterns. This work promises to identify some relatively simple guidelines that will help thermal storage practitioners minimize the challenges and maximize the benefits of real-time pricing.

Organizations who wish to participate in this research should contact Dr. Mukesh Khattar, EPRI, (650) 855-2699, mkhattar@epri.com, or Jim Elleson at the HVAC&R Center, (608) 262-6940, jselleson@facstaff.wisc.edu.

In addition, EPRI has set up a temporary web site to discuss this topic, exchange ideas, and share data. Please visit <http://209.24.93.147/khattar/TESRTPdiscussion> to participate in the discussion. Ψ

### Changes at the Center

Research Intern Dagmar Jaehnig has returned to Germany.

Wayne Krill has assumed responsibilities as the EPRI Project Manager for the Center. Bruce Lindsay has departed EPRI in pursuit of new opportunities. Ψ



## Update on ASHRAE Standard 90.1

By Robert Gansler

This year was a momentous one for ASHRAE Standard 90.1 "Energy Standard for Buildings Except Low-Rise Residential Buildings." After years of work by the Standing Standards Project Committee (SSPC), ASHRAE finally approved a document for publication.

A number of appeals were filed with ASHRAE by interest groups such as the gas industry regarding the Standard, but all of the appeals were rejected. ASHRAE has published the document as ASHRAE Standard 90.1-1999. The Society will be submitting the Standard to the American National Standards Institute (ANSI) to gain its approval as well.

ASHRAE has also established a new committee to develop a Guideline for Standard 90.1. The Guideline will incorporate higher levels of energy efficiency for buildings covered by Standard 90.1. The Guideline is not intended to be an alternative to Standard 90.1, but rather it is to be a guide for those designers who wish to design buildings that will be cost-effective while exceeding the minimum requirements of Standard 90.1

With Standard 90.1 being put into continuous maintenance, previously contentious issues are certain to resurface. It is inevitable that previously rejected changes sought by other parties will be submitted in the future as potential changes to the new Standard under continuous maintenance. We must be prepared to carefully evaluate all proposed changes.

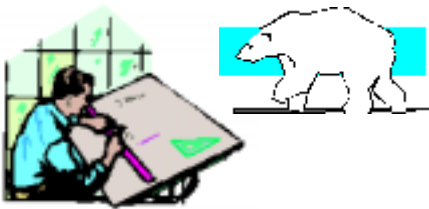


In addition, the battleground is not limited to ASHRAE but extends to other arenas. Home Efficiency Rating Systems and the International Code Committee are two other venues in which other parties are trying to win the battles that they lost at ASHRAE. If they are successful in promulgating their viewpoints and having other alternative codes be adopted instead of ASHRAE 90.1, the common sense victories at ASHRAE could be rendered meaningless.

The aspects of previous drafts of the Standard that were discriminatory towards electrotechnologies, such as dual-envelope criteria or envelope mapping, are not a part of the published document. However, such topics will undoubtedly be proposed as changes to 90.1-1999 in its continuous maintenance life. Ψ

## Identifying Opportunities at a Midwestern Cold Storage Warehouse

By Daniel Dettmers



Refrigeration is a major consumer of electricity in the industrial sector. In most food processing and distribution facilities, refrigeration is responsible for the bulk of energy-related costs. Typically, industrial refrigeration systems are large vapor compression systems that utilize ammonia as a refrigerant. These systems are prime candidates for targeted programs to improve their performance and efficiency.

The HVAC&R Center was recently asked to provide technical assistance to

a Midwestern supermarket chain's primary cold storage warehouse. The Center identified methods for improving the reliability and operation of two refrigeration systems in operation at the warehouse while simultaneously striving to reduce their annual energy costs. Daniel Dettmers and consultant James Denkmann performed an initial two-day on-site investigation followed by two separate trips to gather more data from the warehouse's refrigeration system.

- The client's primary goals during the investigation were:
- Reduce refrigeration system operating cost
- Decrease annual system energy use
- Shift electrical load from on-peak to off-peak periods where possible
- Improve refrigeration system operation
- Reduce refrigeration system maintenance costs

The warehouse was experiencing many operational problems. They were unable to maintain the desired temperature inside their cold warehouse or on the loading docks. Additionally, the liquid ammonia had a habit of hanging up in unknown parts of the system during the wintertime. An opportunity for significant energy efficiency improvements was evident from the lack of demand decrease during the cold Midwestern winters.

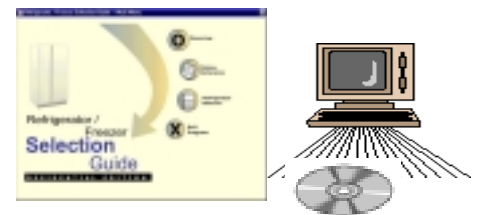
Many of the opportunities identified emphasized implementation of "best practice engineering" in the design, construction and operation of refrigeration equipment installed (or proposed for installation) at the cold storage warehouse. The operation problems of the warehouse were narrowed down to an improper control sequence in the defrosting of the coils, while installing additional evaporator capacity and tightening up the dock to prevent infiltration loads are expected to solve the dock temperature control problems. A modification to the evaporative condenser will help alleviate their liquid ammonia hang-up problems.

The investigation also identified methods for reducing the facility's electrical demand. A modification to the evaporators in their medium temperature warehouse will allow them to reduce the number of compressors run when the winter outdoor temperatures dip. The Center's report also recommends the installation of an Energy Management System (EMS) which is capable of monitoring all electrical loads. This would allow the facility to maintain a low electrical demand by shutting the refrigeration system down when other loads increased.

The resulting report outlined several key changes to their systems that would result in significant savings for very little capital investment. To ensure the customer could make the beneficial modifications, their electric utility offered a very attractive shared savings program to finance the improvements. The final report from the HVAC&R Center also provided guidance on other areas of the plant that required further maintenance and investigation. Ψ

## EPRI Publishes "Residential Space Conditioning Selection Guide"

By Daniel Dettmers



Over 50% of the energy consumed in the average residential home is used for space conditioning. As the quality of the indoor environment improves in commercial buildings, retail stores, and public buildings, people are beginning to demand the same level of air quality and comfort in their own homes. At the same time, environmental pressures and

the rising costs of energy are forcing us to reduce the amount of energy used to heat and cool our homes. To aid the average residential consumer, the HVAC&R Center, with Energy International and EPRI, have developed the *Residential Space Conditioning Selection Guide* (RSCS Guide).

The RSCS Guide is a computer-based tool aimed at providing specific guidance on selecting residential space conditioning systems that can deliver a quality indoor environment at an affordable price. The Guide features an online reference section covering topics essential for a homeowner to understand. It describes the different types of systems, safety and maintenance guidelines, and insight into important selection criteria when choosing a system.

The RSCS Guide is a flexible tool that has been designed to provide knowledgeable information on space conditioning topics to many audiences. The Guide can function as:

- A self-directed guide to space conditioning systems for the average homeowner.
- A self-directed guide to space conditioning systems to train residential utility representatives.
- An on-line reference tool for utility phone center marketing and technical support staff.
- A demonstration tool for utility personnel to educate attendees of garden and home shows.

A System Selector tool has also been incorporated into the RSCS Guide. The system selector allows the user to provide a list of important considerations (i.e. first cost, operating cost, air quality, etc.) to them in ranked order. The user also inputs their utility rates and basic information about the house. The Selector uses the data to create a list of space conditioning systems that meet their needs along with an estimate of installation cost and operating costs for each option. This allows users to “weed” through various systems on the market and narrow choices before calling on a contractor.

Based upon the success of this Guide, EPRI has also asked the HVAC&R Center to create a *Refrigerator and Freezer Selection Guide*. This Guide provides the same level of detailed information to allow the average homeowner to a savvy shopper. The guide also features a Selection Tool that has incorporated a database of over 1,000 units that are currently available on the market. Currently passing through EPRI’s Software Acceptance Testing division, the Guide will soon be available for distribution. Look for more information on this product in future newsletters.

To obtain a copy of the Residential Space Conditioning Selection Guide, please contact EPRI Distribution at (925) 934-4212 or (800) 313-3774 and ask for PS-112995. The entire RSCS Guide fits on a single CD. If you have any questions about the RSCS Guide, or you would like it customized to your territory, please contact the HVAC&R Center at (800) 858-3774. Ψ

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