

# Status of Energy Regulations for Commercial Refrigeration Equipment

January 2008



# Overview

## Purpose

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The purpose of this paper is to provide updated information about state and federal energy regulations, as well as ENERGY STAR policies related to commercial refrigeration. The product classes covered include reach-ins, ice machines, walk-ins, supermarket display cases and any other stationary commercial refrigeration equipment that has pending or applied federal or state energy legislation.

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## Summary

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### Introduction

The consumption of energy to power commercial refrigeration systems has increased exponentially in the United States, prompting state and national governments to require commercial refrigeration product manufacturers to produce more efficient products.

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### Commercial energy use increasing

Energy use overall has increased dramatically; from 1970 to 2000, commercial electricity consumption grew by 229 percent, compared to a population increase of only 38 percent. The commercial sector already consumes more electricity than the industrial sector and will consume more than the residential sector within 10 years.

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### Environmental concerns

As the demand for energy increases, so do concerns about how it is generated. The move toward stricter energy legislation stems from the desire to curb pollution, slow global warming, reverse the depletion of the ozone layer and improve population health.

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### Energy regulations target refrigeration

Within the commercial sector, foodservice has the highest energy use per square foot, due largely to the need for commercial refrigerators and freezers. Because so much energy is used for commercial refrigeration, these products are a logical target of regulators.

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### Energy guidelines lead to state regulations

Energy regulations are generally introduced as voluntary guidelines, which later become established law. In 2001, the Environmental Protection Agency's (EPA) ENERGY STAR program enacted voluntary energy-consumption guidelines for commercial refrigerators and freezers. The California Energy Commission (CEC) subsequently used those guidelines as the basis for a state law mandating new standards, while outlawing the sale of nonconforming products. Three additional states have enacted similar legislation, and at least five more are considering doing the same.

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### National standards become law

In 2005, the Air-Conditioning and Refrigeration Institute (ARI) took a proactive step toward the industry's involvement in energy-consumption standards, recommending standards to Congress that were equal to the most stringent in California. The Energy Policy Act of 2005, which included ARI recommendations, became national law and will become effective in 2010.

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### More regulation on horizon

More regulation is on the horizon. Additional standards for ice machines are expected in 2010, and the Department of Energy (DOE) will make a ruling on display cases by 2009 that will become effective in 2012.

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## Summary (continued)

### Effective dates of energy-consumption standards

Table 1 shows the effective dates of voluntary and regulated energy-consumption standards for commercial refrigeration equipment.

**Table 1**

<b>Effective Dates of Energy-Consumption Standards</b>					
<b>Program</b>	<b>Solid-door reach-in</b>	<b>Glass-door reach-in</b>	<b>Walk-in</b>	<b>Ice machine</b>	<b>Display cases</b>
Test procedure	ARI 1200	ARI 1200	Component selection	ARI 810	ARI 1200
Energy Policy Act of 2005	2010	2010	N/A	2010	2012
California Energy Commission (CEC) (April 2005)	2006–2007	2006–2007	2006	2008	N/A
California Energy Commission (CEC) (August 2003)	2003–2004	2003–2004	N/A	N/A	N/A
EPA ENERGY STAR	2001 (voluntary)	N/A	N/A	2008 (voluntary)	N/A

### Energy-efficient technologies = OEM compliance

Original equipment manufacturers (OEMs) can comply with existing and pending energy-use regulations by selecting the most efficient component products. For example, the compressor can be responsible for up to 60 percent of a system's total energy use. Evaporator- and condenser-fan motors are the second largest energy-consuming components.

Scroll compressors and electronic-commutated motors are the most efficient compressor and motor options. Additional technologies, including system controllers, component diagnostics and monitoring software, can also help reduce overall product energy use.

### Federal vs. state preemptions

One goal of the Energy Policy Act of 2005 was to establish one national energy-efficiency standard for most products. Different energy standards in various states had led to confusion among consumers and businesses. While it is possible for states to challenge the EPA in order to establish stricter energy guidelines, for now manufacturers must work toward these energy-efficiency levels. Various local and regional incentives will gradually encourage the adoption of even more efficient refrigeration equipment.

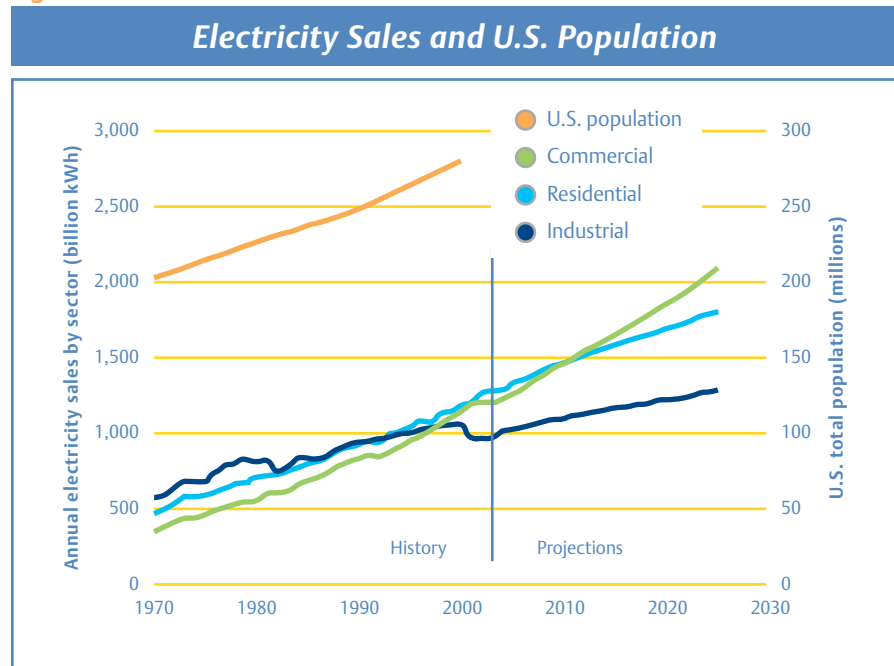
# Current energy standards for commercial refrigeration equipment

## Issue: High commercial electricity consumption

### Vs. population growth

From 1970 to 2000, annual electricity consumption by the commercial sector in the United States grew by 229 percent,<sup>1</sup> while the total U.S. population grew by 38 percent.<sup>2</sup> Figure 1 charts this historic growth and projects future growth of electricity sales and the U.S. population.

Figure 1



### Substantial refrigeration usage

A substantial amount of energy is used each year to keep food cold or frozen in commercial establishments, including restaurants, grocery stores, convenience stores and fast-food restaurants. The foodservice industry has the highest rate of energy consumption per square foot, due to the need for specialized, high-energy-consuming equipment,<sup>3</sup> including commercial refrigerators and freezers.

Inside restaurants refrigeration accounts for 10 to 16 percent of energy consumption,<sup>4</sup> and inside supermarkets refrigeration accounts for 44 to 62 percent.<sup>5</sup>

### Need for refrigeration regulations

It has been reported that 43 trillion British thermal units (Btu) – or 12.6 billion kilowatt-hours (kWh) – of total energy are consumed annually by refrigeration inside foodservice buildings.<sup>6</sup> This high rate of electricity use in the previously unregulated commercial refrigeration equipment industry has prompted industry groups, state governments and the federal government to enact energy legislation.

## Standards for reach-ins

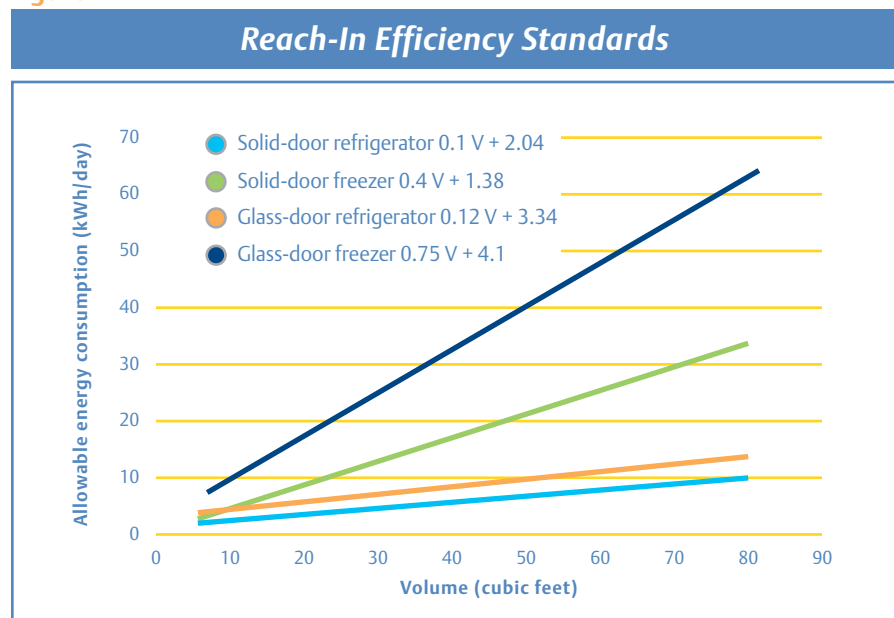
### Introduction

Multiple energy standards define allowable energy consumption for reach-in refrigerators and freezers. Most of today's standards are based on the voluntary standards set by ENERGY STAR in 2001.

### 2008–2009 Tier 1 standards

The efficiency standards shown in Figure 2 are the current 2008–2009 Consortium of Energy Efficiency (CEE) Tier 1 levels for reach-in refrigerators. These are also the current allowable CEC levels and the original ENERGY STAR voluntary standards.

Figure 2



### 2008–2009 Tier 2 standards

The CEE has also established Tier 2 levels, which are used for utility incentive rebates. Tier 2 efficiency levels are 30 to 40 percent higher than Tier 1 levels.

### 2010–2015 DOE standards

In 2010, a national minimum level of reach-in energy performance preempting any standards set by the states will be instituted. This 2010 minimum level of energy performance will be at the same level as 2001 Tier 1 ENERGY STAR recommendations and the energy minimums established in California (see Figure 2). This minimum level of energy performance, set by the DOE, will be static until 2015, subject to changes every five years thereafter.

### 2010 ENERGY STAR standards

Also in 2010, new voluntary ENERGY STAR standards for reach-ins are expected to be set; this will be baselined to capture the top 25 percent of energy performers after 2010.

## Prescriptive standards for walk-ins

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### No standards set

Walk-in refrigerators and freezers were also addressed for the first time in the April 2005 release of the updated CEC standards. For walk-ins, explicit energy-consumption standards were not given.

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### Consensus standard submitted

In 2007, the Renewable Energy and Energy Conservation Tax Act of 2007 (HR 3221) was passed, which allows states to go beyond the national energy-efficiency minimum for refrigeration equipment; however, ARI and the American Council for an Energy Efficient Economy (ACEEE) reached a consensus agreement on energy standards. The legislation contains a provision to establish standards for walk-in refrigerators and freezers.

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### Types of walk-ins addressed

These **prescriptive** standards, or design guidelines, contain recommendations for the construction of walk-in refrigerator and freezer rooms that utilize:

- Automatic door openers
- High-efficiency wall insulation
- High-efficiency evaporator- and condenser-fan motors

Additionally walk-ins with glass doors must use triple-pane glass and must control or limit the total power used by antisweat heaters. These prescriptive standards are based on standards already in place in California.

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### Timeline for designs, tests, performance standards

It is expected that these prescriptive standards for commercial walk-in freezers and coolers will begin affecting the design of new equipment nationally in 2009. The DOE will develop test procedures by 2010 and **performance** standards by 2012. The DOE will revise these standards by 2020.

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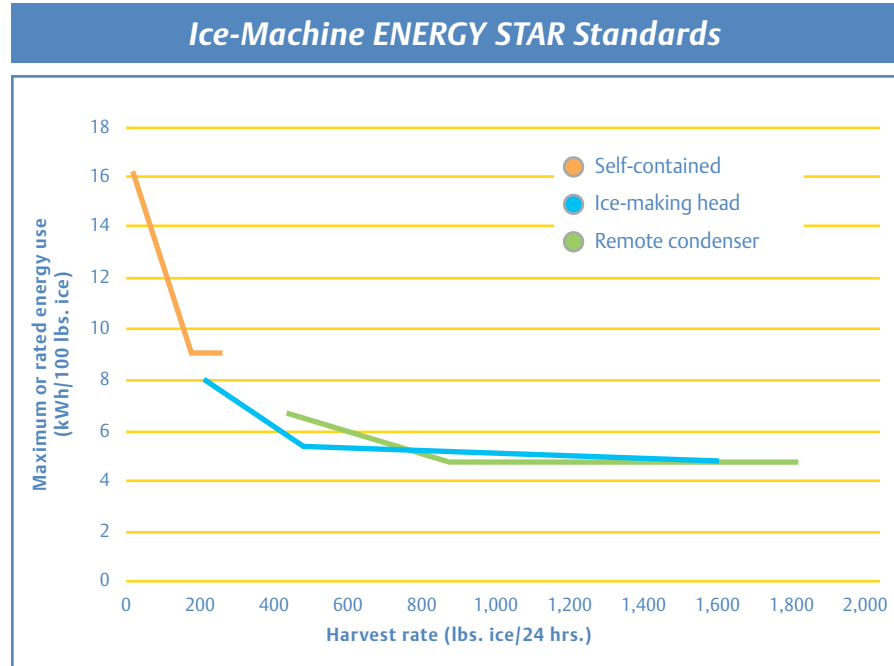
## Standards for ice machines

### 2008 ENERGY STAR standards

The EPA enacted a new standard for ENERGY STAR ice-machine specifications, effective January 1, 2008. These new specifications address not only energy, but also the efficient use of water, to promote water conservation.

Figure 3 shows efficiency requirements for air-cooled self-contained units, as well as ice-making heads and remote condenser models.

Figure 3



### CEE standards

Multitier efficiency guidelines have also been developed by the CEE. These tiers are reviewed annually for additional changes.

### 2010 national standards

Just like for reach-ins, in 2010, a national minimum level of ice-machine energy performance preempting any standards set by the states will be instituted. This 2010 minimum level of energy performance will be at the same level as ENERGY STAR recommendations.

### 2010 ENERGY STAR standards

Also in 2010, a new voluntary ENERGY STAR level for ice machines is expected to be set; this will be baselined to capture the top 25 percent of energy performers.

## *Standards for display cases and other units*

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### **Self-contained and remote display cases**

A DOE ruling is in process that covers remote and self-contained display cases. The Analyses for Advanced Notice of Proposed Rulemaking (ANOPR) will occur by April 2008. Testing will be performed, using the ARI 1200 procedure. The ruling is expected in 2009, after a Department of Justice review, and will be effective January 1, 2012. The ongoing analysis reviews design options, efficiency and cost tradeoffs, life-cycle cost and payback, and the impact on manufacturers.

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### **Ice-cream freezers**

New standards specifically for ice-cream freezers with either solid or glass doors were introduced in the April 2005 release of the updated CEC standards, as well, with an effective date of January 2007.

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### **Vending machines**

Specific vending-machine energy-consumption standards were also introduced in the April 2005 release of the updated CEC standards, with an effective date of January 2006. The formulas to calculate the allowable energy consumption for vending machines are based on a unit's rated capacity to store 12-ounce cans.

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## Potential refrigeration energy savings

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### Introduction

In 2005, the federal government passed the Energy Savings Act, which nationalized energy-consumption standards. The implementation of these standards has resulted in increased efficiency in commercial refrigerators and freezers.

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### Overall national savings

According to ACEEE, the Energy Policy Act of 2005 will reduce U.S. electricity use by about 2.3 billion kWh annually by 2020, and save consumers and businesses more than \$1 billion from products purchased through 2030.

According to ARI, “The efficiency levels contained in the [Energy Policy Act of 2005] will reduce peak power needs by an estimated 8,000 megawatts [MW] by 2020, which is equivalent to the output of 27 new power plants of 300 MW each.”<sup>7</sup>

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### For solid-door and reach-in units

In 1996, the average energy use of a solid-door reach-in freezer was 7,500 kWh per year, with a potential increase in efficiency of 30 percent (less than a two-year payback). The average energy use of a solid-door reach-in refrigerator was 3,800 kWh per year, with a potential increase in efficiency of 35 percent (also less than a two-year payback).

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### For glass-door units

Substantial efficiency gains are also possible for glass-door models. A 1996 Arthur D. Little study identified opportunities for per-unit savings on reach-in glass-door refrigerators at 45 percent, with a potential payback of 2.2 years or less.

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### For ice machines

According to the CEC, the estimated annual per-unit reduction of energy use ranges from 142 kWh to 1,714 kWh, depending on the equipment type. The total statewide first-year energy savings resulting from the proposed standards is 6.6 million kWh.

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## Incentives

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### Types offered

Many utility companies offer consumer rebates for the purchase of high-efficiency commercial refrigerators and freezers, as well as ice machines and other types of refrigerated equipment.

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### Qualified models

Applicability usually depends on the unit's rating per the standards described in this paper, either ENERGY STAR or CEC. Qualified models are often listed on the utilities' websites.

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### Where available

Designers, contractors and end-users are advised to check with their local utility companies for available energy incentives and rebates. In addition, the ENERGY STAR website includes a rebate-finder tool that provides commercial foodservice equipment manufacturers, dealers, distributors and purchasers with information about rebates for ENERGY STAR-qualified equipment available from utilities and other energy-efficiency program sponsors.

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## Making commercial refrigeration more energy efficient

### Sources of energy consumption

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#### Compressors

Compressors are the single largest energy consumer in reach-in refrigerators and freezers. Depending on the unit's design, the compressor may be responsible for 35 to 60 percent of the unit's total energy consumption.

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#### Fan motors

Evaporator- and condenser-fan motors are the second largest consumer of energy in reach-in refrigerators and freezers.

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#### Other parts

The remainder of energy consumption in commercial refrigerators and freezers is by antisweat heaters, condensate evaporators, lighting, antifog heaters on glass-door models and evaporator defrost systems in freezers.

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## Emerson Climate Technologies' energy-efficient solutions

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### Mission statement

Emerson Climate Technologies is committed to working with OEMs to provide global solutions to improve human comfort, safeguard food and protect the environment.

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### Helping industry meet standards

Emerson helps the industry meet the increasingly stringent energy-consumption guidelines by participating in the development of these standards, communicating standards and trends, providing the most energy-efficient components and offering energy-reducing design and consultation services.

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### Refrigeration compressors

For decades Emerson Climate Technologies, Inc., whose products play a substantial role in the energy consumption of commercial refrigerators and freezers, has been developing new energy-efficient compressor technologies. The next generation of fractional-horsepower hermetic compressors released recently includes design improvements that make it the most energy-efficient offering in its class. For both low-temperature freezer and medium-temperature refrigeration applications, Emerson Climate Technologies, Inc. offers the highly reliable and energy-efficient semi-hermetic compressor, in addition to its full offering of hermetic compressors.

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### Condensing units

Emerson's Integrated Products offers a wide variety of engineered condensing units using Copeland® brand hermetic or semi-hermetic compressors. These condensing units are custom engineered with the perfectly matched condenser and professionally manufactured to minimize thermal inefficiencies, resulting in highly energy-efficient systems.

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### Thermal expansion valves

Emerson Climate Technologies Flow Controls Division offers a full range of thermal expansion valves. These intelligent devices sense the amount of cooling required at each moment throughout the refrigeration cycle and supply exactly that amount. In this way the thermal expansion valve minimizes energy wasted by oversupplying capacity, while limiting the duration of the energy-consuming on cycle.

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### Retail Solutions

Emerson offers a range of refrigerator, freezer and case controls that intelligently monitor a refrigeration system, including critical defrost periods. Emerson Climate Technologies' Retail Solutions products ensure that sufficient heat is sent to the evaporator to defrost it, but no excess energy-consuming heat is sent after the defrost is complete.

Emerson is constantly refining and releasing new devices that minimize the heat and energy required by glass doors to keep them clear of fog after the doors are opened and closed, as well as devices that minimize the heat required to prevent sweat around door gaskets.

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## Emerson Climate Technologies' energy-efficient solutions (continued)

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### End-user monitor systems

Emerson Climate Technologies' Retail Solutions offers end-users the ability to monitor all refrigeration and air conditioning systems in a facility, to ensure that they are operating at peak efficiency, reducing total energy consumption for the end-user.

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### Lab for CEC testing

Emerson's Design Services Network is an approved laboratory for CEC testing of commercial refrigerators and freezers; it has a full staff of engineers available to help manufacturers reduce energy consumption and get products approved for sale.

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### More information

More detailed descriptions of all Emerson Climate Technologies™ products and services can be found at **EmersonClimate.com**.

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## About the authors

### Robert Lehman, PE

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Robert is the project leader for Emerson Climate Technologies' Intelligent Store™ architecture. He held several positions with Emerson Climate Technologies' Design Services Network from 2001 through 2006, providing consulting engineering services to commercial refrigeration and air conditioning manufacturers. Prior to joining Emerson, he spent 12 years in engineering, marketing and management for three commercial refrigeration manufacturers. He has a bachelor of mechanical engineering degree from The Georgia Institute of Technology and a master of business administration degree from Western Carolina University.

### Brian Buynacek

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Brian is a graduate of Cornell University and the University of Dayton, with a master of business administration degree and degrees in mechanical engineering. He has 15 years of industrial marketing experience, including positions in marketing product management, key account management, and application and manufacturing engineering. He is a registered professional engineer in the state of Ohio. As a senior consultant with Emerson's Design Services Network, he has driven more than 50 key marketing and engineering projects in the past five years.

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## Endnotes

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<sup>1</sup> Energy Information Administration, [eia.doe.gov](http://eia.doe.gov)

<sup>2</sup> U.S. Census Bureau, [www.census.gov](http://www.census.gov)

<sup>3</sup> Energy Information Administration, 1995 Commercial Building Energy Consumption Survey

<sup>4</sup> Platts Research & Consulting, Managing Energy Costs in Restaurants, 2002

<sup>5</sup> Platts Research & Consulting, Managing Energy Costs in Grocery Stores, 2002

<sup>6</sup> Waste Reduction Resource Center, [wrrc.p2pays.org](http://wrrc.p2pays.org)

<sup>7</sup> Air-Conditioning and Refrigeration Institute, [ari.org](http://ari.org)

<sup>8</sup> Consensus Agreement on Commercial Refrigeration Efficiency Standards Reached, April 5, 2005

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## Appendices

### How standards were developed for refrigeration equipment

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#### 2001 ENERGY STAR guidelines

The first group in the United States to issue energy regulations for commercial refrigeration equipment was the EPA, with its release of ENERGY STAR standards for commercial refrigerators and freezers in 2001. These energy-consumption guidelines were only recommendations for commercial OEMs to follow. They were intended to separate the 25 percent of the marketplace that is the most energy efficient; however, no legislation was put in place to prohibit the sale of non-ENERGY STAR-rated commercial refrigerators and freezers.

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#### 2003 CEC legislated standards

California released its first commercial refrigerator and freezer standards in 2003. Energy-consumption standards were established for each type of unit, with the maximum allowable energy consumption being reduced over time. Any units not specifically listed by the CEC as having been proven through testing to consume less than the allowable energy could not be sold legally in the state of California. This was the first legislative attempt to limit the sale of non-energy-efficient commercial refrigerators and freezers.

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#### 2005 CEC revised standards

In April 2005, the CEC released a revised version of its standards, covering more product categories and more discrete products per category. Two new tiers of energy consumption for commercial refrigerators and freezers were introduced with this release, each with decreasing allowances for energy consumption.

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#### CEC refrigerator/freezer tests

In order to sell commercial refrigerators or freezers in California, a production sample of the model must be tested by a CEC-certified test laboratory, with resulting data submitted to and approved by the CEC. The CEC maintains records on its website of all submitted data.

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## Appendices (continued)

### Energy Policy Act of 2005 national standards

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#### Introduction

In 2005, ARI released a proposal to the federal government to nationalize energy-consumption standards for commercial refrigerators and freezers.

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#### What is ARI

According to its website, ARI is “the national trade association representing manufacturers of more than 90 percent of North American-produced central air conditioning and commercial refrigeration equipment.”

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#### Rationale for proposal

The manufacturers of these products feared that each state would have its own standard and own test-data submittal and approval process. This would result in mountains of paperwork and increased costs for the OEMs. A national standard, however, would only require a single submittal and would be much more manageable, limiting the increase in costs that OEMs would ultimately be passing on to consumers.

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#### Guidelines recommended to Congress

On April 5, 2005, ARI formally recommended to Congress energy-consumption guidelines equivalent to the most stringent CEC standards (and also the original ENERGY STAR guidelines), with a proposed effective date of January 1, 2010.<sup>8</sup>

Refer to the “Potential refrigeration energy savings” section, page 8, to see ACEEE’s estimation of energy savings based on standards identified in the Energy Policy Act.

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## Consortium for Energy Efficiency

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### What it is

CEE is a nonprofit organization that brings together energy-efficiency program administrators in the U.S. and Canada.

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### What it does

CEE provides a forum in which energy-efficiency organizations can pool ideas and resources, as well as partner with industry members and stakeholders, such as ARI. CEE members administer about 91 percent of the country's total ratepayer support for energy efficiency.

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### Supports ENERGY STAR

The EPA/DOE ENERGY STAR program has become a prominent marketing platform for energy-efficiency programs in North America. CEE and its members strongly support ENERGY STAR, providing input on product categories and minimum performance levels.

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### Its initiatives

CEE launched an initiative for commercial solid-door reach-in refrigerators and freezers in December 2002. The initiative for high-efficiency commercial glass-door reach-in refrigerators was launched in December of the following year. The specifications for these initiatives are in line with ENERGY STAR specifications, as well as CEC standards.

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### Specifications

The CEC specifications are contained in the California Appliance Efficiency Regulations, which became effective January 1, 2006. The CEC's higher-efficiency levels for commercial glass-door refrigerators became effective January 1, 2007.

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### *About Emerson*

Emerson (NYSE: EMR), based in St. Louis, is a global leader in bringing technology and engineering together to provide innovative solutions to customers through its network power, process management, industrial automation, climate technologies, and appliance and tools businesses. For more information, visit **emerson.com**.

### *About Emerson Climate Technologies*

Emerson Climate Technologies, a business of Emerson, is the world's leading provider of heating, ventilation, air conditioning and refrigeration solutions for residential, industrial and commercial applications. The group combines best-in-class technology with proven engineering, design, distribution, educational and monitoring services to provide customized, integrated climate-control solutions for customers worldwide. The innovative solutions of Emerson Climate Technologies, which include industry-leading brands such as Copeland Scroll and White-Rodgers, improve human comfort, safeguard food and protect the environment. For more information, visit **EmersonClimate.com**.

### *About Emerson Climate Technologies, Inc.*

Emerson Climate Technologies, Inc., part of Emerson Climate Technologies, is the world's leading compressor manufacturer, offering more than 10,000 compressor models in a full range of technologies, including scroll, reciprocating and screw compressor designs. A pioneer in the HVACR industry, the company led the introduction of scroll technology to the marketplace. Today more than 56 million Copeland Scroll® compressors are installed in residential and commercial air conditioning and commercial refrigeration systems around the world. Emerson Climate Technologies, Inc. is headquartered in Sidney, Ohio. For more information, visit **EmersonClimate.com**.