

Status of energy regulations for commercial refrigeration equipment

January 2015

Overview

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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Introduction

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

From 1980 to 2010, commercial electricity consumption grew by 250 percent, compared to a population increase of only 39 percent. The commercial sector already consumes more electricity than the industrial sector and will soon consume more than the residential sector. 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.

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. Federal minimum energy levels are now set at those original levels and even higher ENERGY STAR levels have been established.

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 went into effect in 2010.

Energy efficiency standards and effective dates

Equipment Type	Effective Date of DOE Minimum Federal Efficiency Standard	ENERGY STAR Efficiency Standards	CEE Efficiency Specifications	LEED Prescriptive Standards
Reach-ins	2010 Requires certification in 2014 March 2017	Approx. 25% higher than federal minimum New in 2014 (v3.0)	Yes (Jan 2010)	Yes
Ice machines	2010 Requires certification in 2013 New in 2018	20-25% higher than federal minimum (new in 2013)	Yes (July 2011)	Yes
Display cases	2012 (new in 2017)	In development	n/a	n/a
Walk-ins	June 2017	After 2017	n/a	Yes

Table 1

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

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 (ECM) 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.

Electricity sales and U.S. population

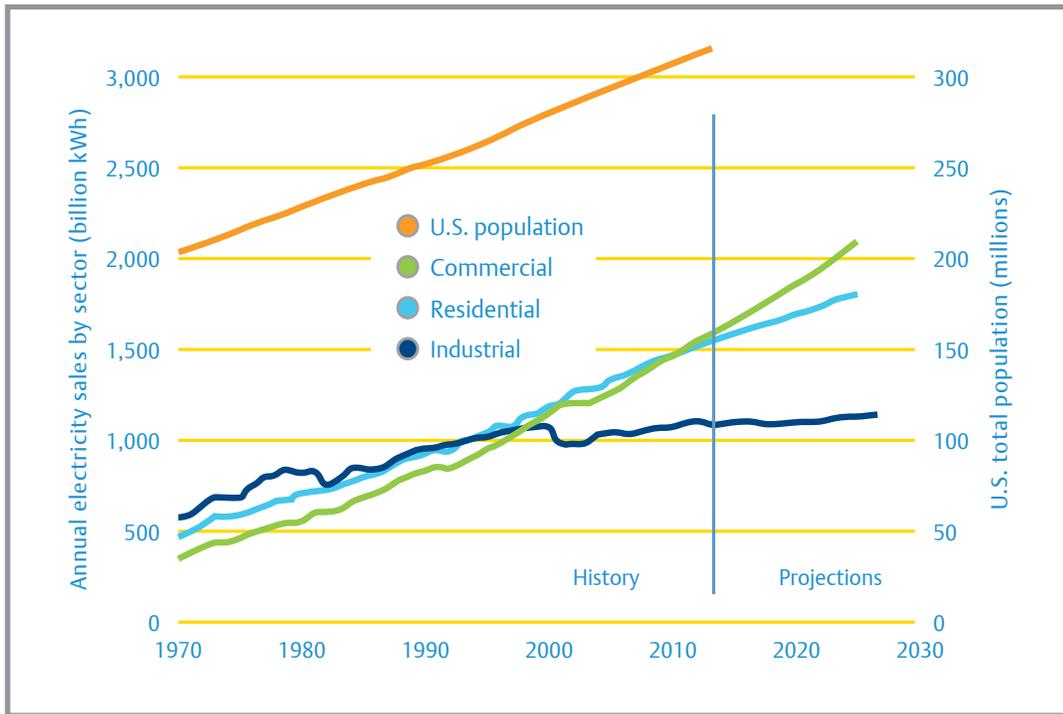


Figure 1

Reach-in efficiency standards

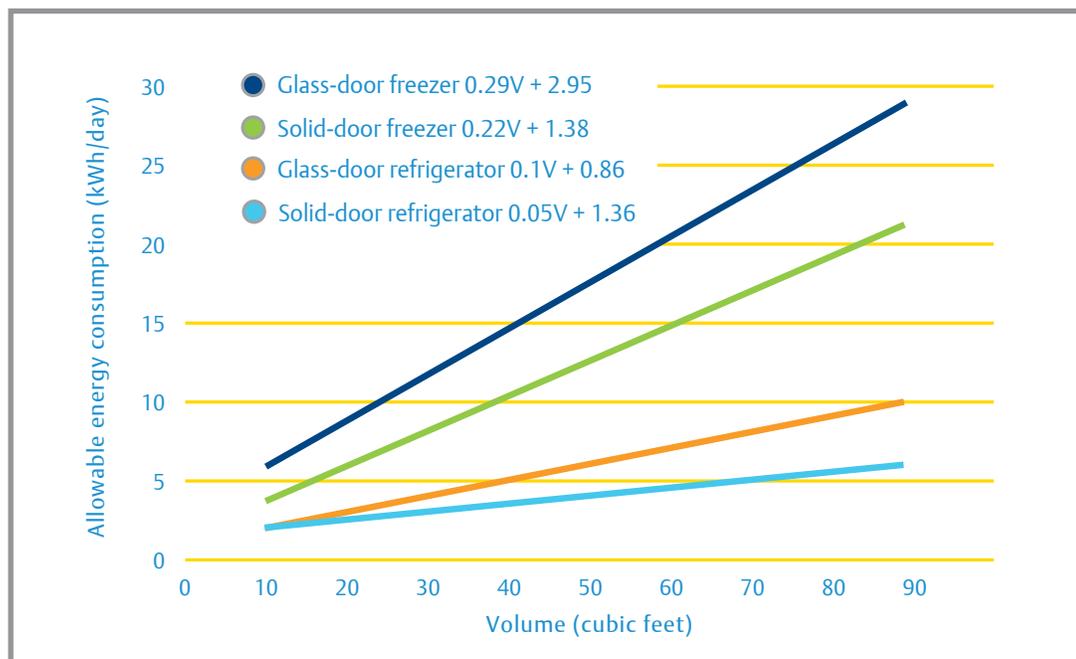


Figure 2

Current energy standards for commercial refrigeration equipment

From 1980 to 2010, annual electricity consumption by the commercial sector in the United States grew by nearly 250 percent¹, while the total U.S. population grew by 39 percent². **Figure 1** charts this historic growth and projects future growth of electricity sales and the U.S. population.

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 equipment³, including commercial refrigerators and freezers. Inside restaurants refrigeration accounts for 10 to 16 percent of energy consumption⁴, and inside supermarkets refrigeration accounts for 44 to 62 percent⁵.

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 buildings⁶. 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. The new regulations and incentives are intended to push consumers to more energy-efficient equipment choices.

Standards for reach-ins

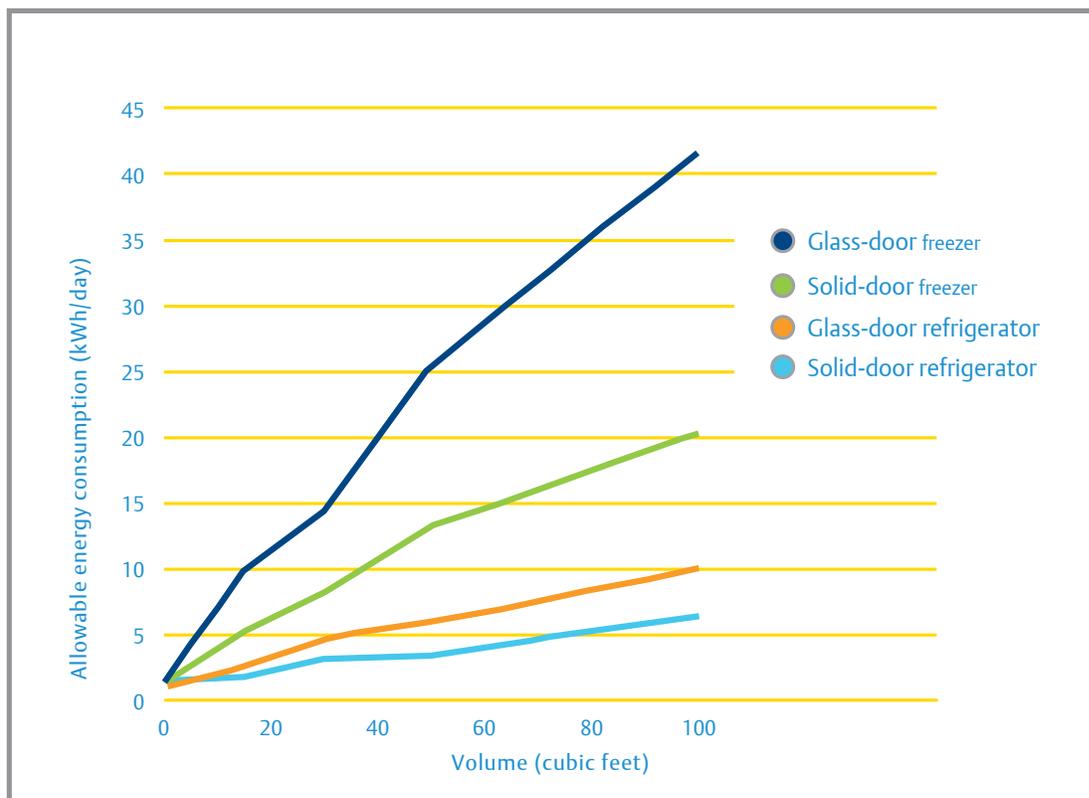
Multiple energy standards define allowable energy consumption for reach-in refrigerators and freezers. Most of today's standards are based on the voluntary standards set by ENERGY STAR in 2001.

The efficiency standards shown in **Figure 2** are the 2017 allowable federal minimum levels. As of today, if refrigeration equipment does not meet the minimum federal energy efficiency levels, this equipment cannot be sold in the United States.

The 2014 ENERGY STAR 3.0 standards were baselined to capture the top 25 percent of energy performers. **Figure 3** show the maximum daily energy consumption requirements for ENERGY STAR qualified glass door and solid door commercial refrigerators and freezers (kWh/day). Beginning January 1, 2011, EPA requires third party lab testing for the ENERGY STAR program. Products must be tested in a laboratory that is accredited to ISO/ IEC 17025 standards for the relevant test procedures.

The new LEED for Retail rating system includes equations to calculate levels for prescriptive path LEED efficiency. The prescriptive criteria are based on the previous CEE Tier 2 and California Investor Owned Utilities incentive program (CAIOU).

ENERGY STAR® 3.0 reach-in standards



Note: See ENERGYSTAR.GOV for detailed energy equations

Figure 3

Here is an example for a typical 24 cubic foot solid-door reach-in commercial refrigerator (maximum daily energy consumption):

Pre-EEM efficiency: $0.1V + 2.04 \text{ kWh/day} = 4.44 \text{ kWh/day}$
(same as 2010 federal minimum standard & Natural Resources Canada NRCan)

ENERGY STAR 2.0: $0.037V + 2.200 = 3.09 \text{ kWh/day}$
(same as 2010 CEE specification)

ENERGY STAR 3.0: $0.09V + 0.55 = 2.71 \text{ kWh/day}$

LEED efficiency: $0.06V + 1.22 \text{ kWh/day} = 2.66 \text{ kWh/day}$

DOE 2017: $0.05V + 1.36 = 2.56 \text{ kWh/day}$

Commercial refrigerators and freezers must meet Canada's Energy Efficiency Regulations before they can qualify for the ENERGY STAR symbol in Canada. Natural Resources Canada (NRCan) lists minimum performance requirements which are tied to the energy efficiency levels set by ENERGY STAR.

Standards for walk-ins

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 have been finalized. Refer to Table 2 and AHRI 1250 for details.

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.

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 BPM evaporator- and PSC condenser-fan motors

There are two options for cooler doors. Doors may be triple-pane with either heat-reflective treated glass or gas fill. Alternately, double-pane glass may be used and have both the heat-reflective treated glass and the gas fill. These prescriptive standards are based on standards already in place in California. The total power used by anti-sweat heater must be limited.

Prescriptive standards for commercial walk-in freezers and coolers went into effect January 1, 2009, affecting units less than 3,000 square feet. Performance standards were developed in 2014. In December 2009 AHRI published Standard 1250-2009, Performance Rating of Walk-In Coolers and Freezers. The standard establishes definitions, test requirements, rating requirements, minimum data requirements for published ratings, operating requirements, marking and nameplate data, and conformance conditions for walk-in coolers and freezers. This standard applies to both packaged refrigeration systems and separate unit cooler with condensing unit. The standard applied to both indoor and outdoor units. Along with this test procedure, performance standards will become effective in June 2017.

The new LEED for Retail rating system includes prescriptive measures for walk-ins.

Energy Standards for Walk-In Refrigeration Systems

Refrigeration system		Minimum AWEF (Btu/W-h) *
Dedicated Condensing, Medium Temperature, Indoor System, <9,000 Btu/h Capacity	DC.M.I, <9,000	5.61
Dedicated Condensing, Medium Temperature, Indoor System, ≥9,000 Btu/h Capacity	DC.M.I, ≥9,000	5.61
Dedicated Condensing, Medium Temperature, Outdoor System, <9,000 Btu/h Capacity	DC.M.O, <9,000	7.60
Dedicated Condensing, Medium Temperature, Outdoor System, ≥9,000 Btu/h Capacity	DC.M.O, ≥9,000	7.60
Dedicated Condensing, Low Temperature, Indoor System, <9,000 Btu/h Capacity	DC.L.I, <9,000	$5.93 \times 10^{-5} \times Q + 2.23$
Dedicated Condensing, Low Temperature, Indoor System, ≥9,000 Btu/h Capacity	DC.L.I, ≥9,000	3.10
Dedicated Condensing, Low Temperature, Outdoor System, <9,000 Btu/h Capacity	DC.L.O, <9,000	$2.30 \times 10^{-4} \times Q + 2.73$
Dedicated Condensing, Low Temperature, Outdoor System, ≥9,000 Btu/h Capacity	DC.L.O, ≥9,000	4.79
Multiplex Condensing, Medium Temperature	MC.M	10.89
Multiplex Condensing, Low Temperature	MC.L	6.57

Table 2

Standards for ice machines

In May 2012, the EPA finalized and released ENERGY STAR Version 2.0 specifications for automatic commercial ice makers. These specifications address not only energy, but also the efficient use of water, to promote water conservation. This new ruling went into effect February 1, 2013. As of that date, any product manufactured and labeled as ENERGY STAR must meet Version 2.0 requirements. The new ENERGY STAR levels were baselined to capture the top 25 percent of energy performers and require about a 7-10% energy improvement over previous specifications.

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

Multitier efficiency guidelines have also been developed by the CEE. These tiers are reviewed annually for additional changes. The July 1, 2011 revisions expand the scope of the specification to include continuous type (flake and nugget) machines and increase the stringency of the performance levels. The previous CEE Tier 2 became CEE Tier 1, and a new CEE Tier 2 was defined. The revised specification no longer includes a Tier 3.

In 2010, a national minimum level of ice machine energy performance was instituted, preempting any minimum standards set by the states. In February 2012 the U.S. Department of Energy (DOE) issued a final rule that amended the test procedure for automatic commercial ice makers.

The changes expanded coverage of the test procedure to all batch type and continuous type ice makers with capacities between 50 and 4,000 pounds of ice per 24 hours, standardized test results based on ice hardness for continuous type ice makers, and clarified the test methods and reporting requirements for ice makers connected to a remote compressor rack. The final rule changes are mandatory for equipment testing as of January 7, 2013. The new LEED for Retail rating system includes equations to calculate levels for prescriptive path LEED efficiency.

The DOE will issue a final ruling by January 2015 with new minimum energy levels that be take effect three years after the final ruling is published.

Here is an example calculation of the maximum allowable energy use for a typical 1,000 pound cuber ice machine:

Pre-EEM efficiency: $6.89 - 0.0011H = 5.79$ kWh/100 lb ice (same as 2010 federal minimum standard)

ENERGY STAR 1.0: $6.20 - 0.0010H = 5.20$ kWh/100 lb ice (same as LEED efficiency and CEE Tier 1 and approximate 2016 federal minimum standard)

ENERGY STAR 2.0: $37.72 * H^{-0.298} = 4.81$ kWh/100 lb ice

CEE Tier 2: $5.9 - 0.0016H = 4.30$ kWh/100 lb ice

Natural Resources Canada (NRCan) lists minimum performance requirements for cubers and flakers under Canada's Energy Efficiency Regulations. These levels are tied to the energy efficiency levels set by ENERGY STAR.

Ice machine ENERGY STAR® standards

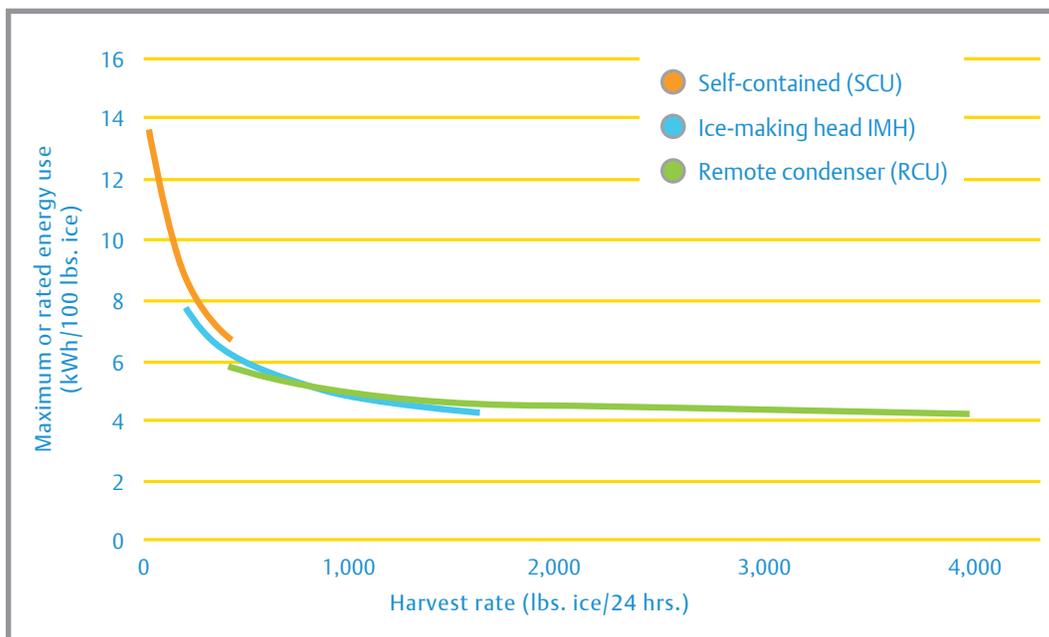


Figure 4

Beginning January 1, 2011, the EPA required third party lab testing for the ENERGY STAR program. Products must be tested in a laboratory that is accredited to ISO/ IEC 17025 standards for the relevant test procedures.

Standards for display cases and other units

The majority of display cases are open. Energy conservation requirements for display cases per Part C of Title III of the Energy Policy and Conservation Act have now been defined. 431.66 Energy Conservation Standards became rule in January 2009 and went into effect January 2012 for display cases. This covers self contained and remote open display cases and requires testing per ARI 1200.

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. These standards are covered by the DOE ruling mentioned above.

On December 18, 2012 H.R. 6582 (American Energy Manufacturing Technical Corrections Act) became law. This energy package included parts of H.R. 5710 (Better Use of Refrigeration Regulations BURR Act). This law lessens the regulatory burden on deli-style display cases by making Service-Over-the-Counter (SOTC) refrigerator units into a separate product classification. These SOTC units have more glass and lighting than conventional reach-ins. Each SOC–SC–M manufactured on or after January 1, 2012, shall have a total daily energy consumption (in kilowatt hours per day) of not more than $0.6 \times TDA + 1.0$.

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. These standards are covered by the DOE ruling mentioned above.

Energy standards have not yet been developed for frozen carbonated beverage machines, but equipment manufacturers are incorporating power saving features into these types of refrigerated equipment.

Some categories of undercounter refrigerators are covered under CFR 431.66. In general, manufacturers are working to improve the energy efficiency of food prep and refrigerated buffet tables even though energy standards have not been developed yet. Food preparation tables, refrigerated buffet and preparation tables, and work top tables can be tested per ASTM F2143-04 Standard Test Method for Performance of Refrigerated Buffet and Preparation Tables.

The EPA is currently developing a new ENERGY STAR product specification for laboratory grade refrigerators and freezers. Several scientific product categories will be covered, including:

- General Purpose Laboratory Refrigerators
- Blood Bank Refrigerators
- Pharmacy and Chromatography Refrigerators
- General Purpose Laboratory Freezers
- Plasma Freezers
- Enzyme Freezers

Alternative Efficiency Determination Method (AEDM)

AEDMs are computer modeling or mathematical tools that predict the energy performance of refrigerated equipment. AEDMs enable manufacturers to rate and certify their basic models by using the projected energy use or energy efficiency results derived from these simulation models. DOE has authorized the use of AEDMs for certain products that are difficult or expensive to test in an effort to reduce the testing burden faced by the manufacturers of expensive or highly customized basic models. AEDMs do not require prior DOE approval.

DOE's regulations currently permit manufacturers of HVAC equipment to use alternative methods. DOE is proposing to extend the use of AEDMs to manufacturers of commercial refrigeration equipment, automatic commercial ice makers, beverage vending machines, walk-in cooler and freezer refrigeration systems and small electric motors. At least one basic model from each product class must be tested to substantiate the AEDM. It is expected that AEDMs will be permitted for these new classes of equipment by 2014.

DOE Enforcement

On March 7, 2011, DOE published a final rule that imposed new reporting requirements for equipment, including a requirement that manufacturers submit annual reports to the DOE certifying compliance of their basic models with applicable standards. Individual models can be grouped as a 'basic model' such that the certified rating for the basic model matched the represented rating for all the included models.

The DOE may monitor compliance by requesting data and testing products at any time, and to initiate enforcement investigations and actions based on belief that covered equipment may not be compliant with an applicable standard. The DOE may at anytime, test a basic model to assess whether the basic model is in compliance with the applicable energy conservation standards.

It does not have to receive a written complaint alleging a violation of the standard before it can perform enforcement testing to determine a model's compliance. The DOE can select models from distribution or manufacturer sources to ensure enforcement test results that are as unbiased, accurate and representative as possible. The testing is to take place at a third party's ISO 17025 approved facility or if this is impractical for low volume, custom built cases testing may be done at the manufacturers ISO 17025 approved facility with the DOE witnessing the testing.

If the DOE determines that a basic model is noncompliant with an applicable energy standard, it may issue a notice of noncompliance determination to the manufacturer. This notice of noncompliance determination will notify the manufacturer of its obligation to immediately cease distribution of the basic model, give written notice of noncompliance to all persons to whom the manufacturer has distributed units of the basic model manufactured since the date of the last determination of compliance and provide the DOE within 30 days of the request documentation pertaining to the sale of a basic model determined to be in noncompliance. Noncompliant equipment can be modified to pass the energy standard and must be certified as a new basic model and re-submitted. If a manufacturer fails to comply with the required actions in the notice of noncompliance, the General Counsel for the DOE may seek, injunctive action and civil penalties, where appropriate.

California Title 24 for supermarkets

Energy Efficiency Standards for Residential and Nonresidential Buildings (Title 24) were established in 1978 in response to a legislative mandate to reduce California's energy consumption. The standards are updated periodically to allow consideration and possible incorporation of new energy-efficiency technologies and methods. These standards apply to residential, nonresidential, high-rise residential, and hotel and motel buildings.

New energy-efficiency standards are outlined in Section 6 of California's Title 24 building code to include supermarket refrigeration systems. 2013 Building Energy Efficiency Standards (or 2013 Standards) go into effect on July 1, 2014. Section 120.6 includes the following mandatory requirements for supermarket refrigeration systems:

- Floating head pressure (down to 70°F)
- Remote condenser specific efficiency
- Floating suction pressure
- Mechanical subcooling (liquid subcooling requirements for low temp parallel racks)
- Display case lighting control
- Refrigeration heat recovery (without increasing HFC charge)

Display case energy levels – 2017 Energy Conservation Standards 10 CFR Part 431

Equipment Class*	Standard Level	Equipment Class	Standard Level
VOP.RC.M	0.64 • TDA + 4.07	VCT.RC.I	0.58 • TDA + 3.05
VOP.RC.I	2.79 • TDA + 8.7	SOC.RC.M	0.44 • TDA + 0.11
VOP.RC.L	2.2 • TDA + 6.85	HCT.RC.M	0.16 • TDA + 0.13
SVO.RC.L	2.2 • TDA + 6.85	SOC.SC.M	0.52 • TDA + 1
VOP.SC.M	1.69 • TDA + 4.71	HCT.RC.L	0.34 • TDA + 0.26
SVO.RC.I	2.79 • TDA + 8.7	HZO.RC.M	0.35 • TDA + 2.88
VCT.RC.M	0.15 • TDA + 1.95	HCT.RC.I	0.4 • TDA + 0.31
HZO.RC.I	0.7 • TDA + 8.74	HZO.RC.L	0.55 • TDA + 6.88
VCT.RC.L	0.49 • TDA + 2.61	VCS.RC.M	0.1 • V + 0.26
VOP.SC.L	4.25 • TDA + 11.82	HZO.SC.M	0.72 • TDA + 5.55
VCT.SC.M	0.1 • V + 0.86	VCS.RC.L	0.21 • V + 0.54
VOP.SC.I	5.4 • TDA + 15.02	HZO.SC.L	1.9 • TDA + 7.08
VCT.SC.L	0.29 • V + 2.95	VCS.RC.I	0.25 • V + 0.63
SVO.SC.L	4.26 • TDA + 11.51	HCT.SC.M	0.06 • V + 0.37
VCT.SC.I	0.62 • TDA + 3.29	HCS.SC.I	0.34 • V + 0.88
SVO.SC.I	5.41 • TDA + 14.63	HCT.SC.L	0.08 • V + 1.23
VCS.SC.M	0.05 • V + 1.36	HCS.RC.M	0.1 • V + 0.26
HZO.SC.I	2.42 • TDA + 9	HCT.SC.I	0.56 • TDA + 0.43
VCS.SC.L	0.22 • V + 1.38	HCS.RC.L	0.21 • V + 0.54
SOC.RC.L	0.93 • TDA + 0.22	HCS.SC.M	0.05 • V + 0.91
VCS.SC.I	0.34 • V + 0.88	HCS.RC.I	0.25 • V + 0.63
SOC.RC.I	1.09 • TDA + 0.26	HCS.SC.L	0.06 • V + 1.12
SVO.RC.M	0.66 • TDA + 3.18	SOC.SC.L	1.1 • TDA + 2.1
SOC.SC.I	1.53 • TDA + 0.36	PD.SC.M	0.11 • V + 0.81
SVO.SC.M	1.7 • TDA + 4.59		

*Equipment class designations consist of a combination (in sequential order separated by periods) of:

(1) An equipment family code (VOP = vertical open, SVO = semivertical open, HZO = horizontal open, VCT = vertical closed with transparent doors, VCS = vertical closed with solid doors, HCT = horizontal closed with transparent doors, HCS = horizontal closed with solid doors, SOC = service over counter, or PD = pulldown);

(2) an operating mode code (RC = remote condensing or SC = self-contained); and (3) a rating temperature code (M = medium temperature (38 +/- 2°F), L = low temperature (0 +/- 2°F), or I = ice-cream temperature (-15 +/- 2°F)).

TDA: The total display area of the case, as measured in the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1200–2010, appendix D.

V: The volume of the case, as measured in American National Standards Institute (ANSI)/Association of Home Appliance Manufacturers (AHAM) Standard HRF–1–2004.

Table 3

Supermarkets affected by these changes include 8,000 square foot small neighborhood markets, all the way up to 150,000 square foot big box stores. Parallel rack refrigeration systems and distributed refrigeration systems must meet these new requirements.

Floating head pressure requires controls to float refrigeration system saturated condensing temperature (SCT) to 70°F during low-ambient temperature conditions. Condenser specific efficiency sets condenser fan motor efficiency requirements. Floating suction pressure requires controls to set target suction temperatures based on space temperature rather than a fixed setpoint. Mechanical subcooling requires liquid refrigerant to be subcooled to 50°F or less on low-temperature systems. Automated display case lighting must turn off display case lights during non-business hours. Finally, heat recovery must use rejected heat from refrigeration systems for space heating, with a limited increase in refrigerant charge.

Potential refrigeration energy savings

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.

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.”⁷

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).

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.

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.

Incentives and LEED

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.

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

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.

DSIRE (www.dsireusa.org) is a comprehensive source of information on state, local, utility and federal incentives and policies that promote renewable energy and energy efficiency. Established in 1995 and funded by the U.S. Department of Energy, DSIRE is an ongoing project of the N.C. Solar Center and the Interstate Renewable Energy Council.

The LEED® Green Building Rating System is a voluntary, consensus-based, market-driven building rating system based on existing proven technology. It defines and promotes green designs, and rewards organizations that adopt some or all of its principles towards green or integrated building design. LEED credits are awarded based on criteria in six categories of performance. A building project must meet a set of prerequisites to be registered, and it must achieve the minimum number of points to earn a basic ‘Certified’ level determines the level of LEED certification (from a Certified level through Silver and Gold to the Platinum level).

The retail and foodservice industries are investing in environmentally-friendly construction, in accordance with LEED guidelines, to enhance occupant comfort and reduce environmental impact. LEED building design requires some added initial cost; however, research shows the investment becomes offset over time by a reduction in energy usage and other related expenses.

In 2013, a new version of the rating system called LEED v4 was approved. USGBC will keep LEED 2009 available for three more years, but project teams can move to the new version of LEED during that period. LEED v4 focuses on increasing technical stringency from past versions and developing new requirements for project types such as data centers, warehouses & distribution centers, hotels/motels, existing schools, existing retail, and mid-rise residential.

The credit requirement changes in the proposed LEED v4 rating system are the most extensive in LEED's twelve-year history. Retail-specific requirements were added, including the energy and refrigerant credits.

The Minimum Energy Performance prerequisite was updated to reference to ASHRAE 90.1-2010. Retail-specific process load requirements were added including refrigeration equipment, cooking and food preparation, clothes washing, and other major support appliances. Many industry standard baseline conditions for commercial kitchen equipment and refrigeration were defined, meaning that no additional documentation is necessary to substantiate these predefined baseline systems as industry standard. For appliances and equipment not covered in the baseline measures, LEED project teams must indicate hourly energy use for proposed and budget equipment, along with estimated daily use hours. ENERGY STAR ratings and evaluations are a valid basis for performing this calculation. For hard-wired refrigeration loads, teams must model the effect of energy performance improvements with a simulation program designed to account for refrigeration equipment.

LEED v4 will also make changes to the Enhanced Refrigerant Management credit. Stores with commercial refrigeration systems must select equipment with an average HFC refrigerant charge of no more than 1.75 pounds of refrigerant per 1,000 Btu/h total evaporator cooling load. Each store must also demonstrate a predicted store-wide annual refrigerant emissions rate of no more than 15% and conduct leak testing using the procedures in GreenChill's best practices guideline for leak tightness at installation.

The DOE and CBEA have published Commercial Building Energy Specifications. The concept is similar to ENERGY STAR – the equipment buyer has a guide to the most energy efficient equipment. Besides listing products that meet the specification, it also lists available incentives for the end user.

Many retail operators are installing submeters to manage energy. Submeters are metering devices with monitoring capabilities, installed after the master meter in a building or facility. Submeters can be used to monitor the electricity use of a specific circuit. A better understanding of individual facility loads highlight energy-saving opportunities. Low-cost submetering solutions are now available, and many utility companies will subsidize their installation and use. These meters do not require major changes in the equipment installation and can be mounted almost anywhere.

Choice of refrigerants

Today there is more attention on climate change and reducing greenhouse gases. Carbon dioxide is by far the most significant greenhouse gas, produced mainly by burning fossil fuels for electrical generation and transportation.

Since refrigeration equipment consumes energy, energy-efficient designs are important to reducing carbon dioxide production.

Hydrofluorocarbons (HFCs) are non-ozone-depleting, nonflammable, recyclable and energy-efficient refrigerants of low toxicity that are used safely worldwide. Although HFCs are the best environmental and economic choice today, the global sustainability of HFCs requires a focus by the industry on refrigerant containment and energy efficiency.

Manufacturers are investigating alternate refrigerants, including hydrocarbons such as propane (R-290) for low charge system (less than 5.3 ounces). New slightly flammable (A2L Class) chemical blends (i.e., HFO1234yf) are being considered as future low GWP options. China is also evaluating an A2L alternative known as R-32 (a component of R-410A). Several new candidate refrigerants have been identified through the AHRI Low Global Warming Potential Alternative Refrigerants Evaluation Program (Low-GWP AREP).

System designers should not sacrifice energy efficiency just to use lower GWP refrigerants. Properly designed and maintained systems using HFC refrigerants provide the lowest global warming potential and zero ozone depletion. They are also a safe and cost-effective solution that will serve us well into the future. For a detailed discussion on refrigerant choices, see Emerson Climate Technologies white paper 2005ECT-162.

Energy-efficient solutions from Emerson Climate Technologies

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

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.

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.

Compressors are the single largest energy consumer in most 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. Copeland™ compressors are engineered for higher efficiency, lower sound levels, superior durability and unsurpassed reliability. They allow the integration of new and environmentally-friendly refrigerants into your systems, while seamlessly improving efficiency and performance levels.

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

Emerson Climate Technologies Flow Controls business unit 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.

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.

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.

Emerson's Design Services Network is an approved laboratory for CEC testing of commercial refrigerators and freezers and is formally recognized by the EPA as a third-party test lab for the ENERGY STAR program for the following categories:

- Commercial Ice Machines
- Commercial Refrigerators and Freezers
- Central ACs and Air-Source Heat Pumps
- Light Commercial HVAC
- New Refrigerated Beverage Vending Machines

Design Services Network has a full staff of engineers available to help manufacturers reduce energy consumption and get products approved for sale.

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

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About Emerson

Emerson (NYSE: EMR), based in St. Louis, Missouri (USA), is a global leader in bringing technology and engineering together to provide innovative solutions for customers in industrial, commercial, and consumer markets around the world. The company is comprised of five business segments: Process Management, Industrial Automation, Network Power, Climate Technologies, and Commercial & Residential Solutions. Sales in fiscal 2014 were \$24.5 billion. For more information, visit Emerson.com.

About Emerson Climate Technologies

Emerson Climate Technologies, a business segment of Emerson, is the world's leading provider of heating, 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., a company of the Emerson Climate Technologies business segment, 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 100 million Copeland Scroll™ compressors have been produced for 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.

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