DRAFT
Commercial Refrigeration Equipment Survey

[EERE-2017-BT-STD-0007] Commercial Refrigeration Equipment
Supplemental Data Survey Results and Summary Findings

Thank you for taking the time to review these slides. We know you and your subcontractors have had your hands full trying to respond to a significant number of regulations in our industry and others. Our members share the same time pressure that you face. We needed a way to summarize their concerns and share them with you.

To accomplish this and fill in the data gaps, our associations – AHRI, NAMA, and NAFEM – have been working together over the past few months to survey our members about the commercial refrigeration equipment technologies they use to meet requirements and how those technologies address energy efficiency. Last month, we previewed the survey results with the Small Business Administration Office of Advocacy.

We’re excited to share this information with you while you’re conducting interviews with various industry stakeholders. We believe these survey results will help you with these interviews and interpret data across a broad spectrum of industry participants, including small businesses. Hopefully, you’ll find the results helpful in determining how to address CRE energy efficiency standards, as presented in DOE’s Semi-Annual Regulatory Agenda, with a decision slated for October of this year.

The three associations preparing these materials, AHRI, NAFEM, and NAMA represent various aspects of the Commercial Refrigeration Equipment industry. AHRI represents more than 300 manufacturers of heating, cooling, water heating, and refrigeration equipment.

The North American Association of Food Equipment Manufacturers (NAFEM)

- Represents more than 550 commercial foodservice equipment and supplies manufacturers
- These businesses, their employees and the products they manufacture, support the food away from home market, which includes more than one million locations in the U.S. and countless more around the world
- Approximately 54% of NAFEM members are small businesses, with less than $10 million in annual sales; 31% sell $10-$20 million; and 15% sell more than $50 million
- $14.3 billion industry (according to NAFEM's 2022 Size & Shape of the Industry Study)
- Sales in 2021 for the refrigeration and ice machines market were $4.12 billion, an increase of approximately 6% from 2019 (according to NAFEM's 2022 Size & Shape of the Industry Study)
- NAFEM estimates more than 150 member companies make some type of commercial refrigeration equipment
- Contact: Charlie Souhrada, csouhrada@nafem.org; +1.312.821.0212

NAFEM
North American Association of Food Equipment Manufacturers

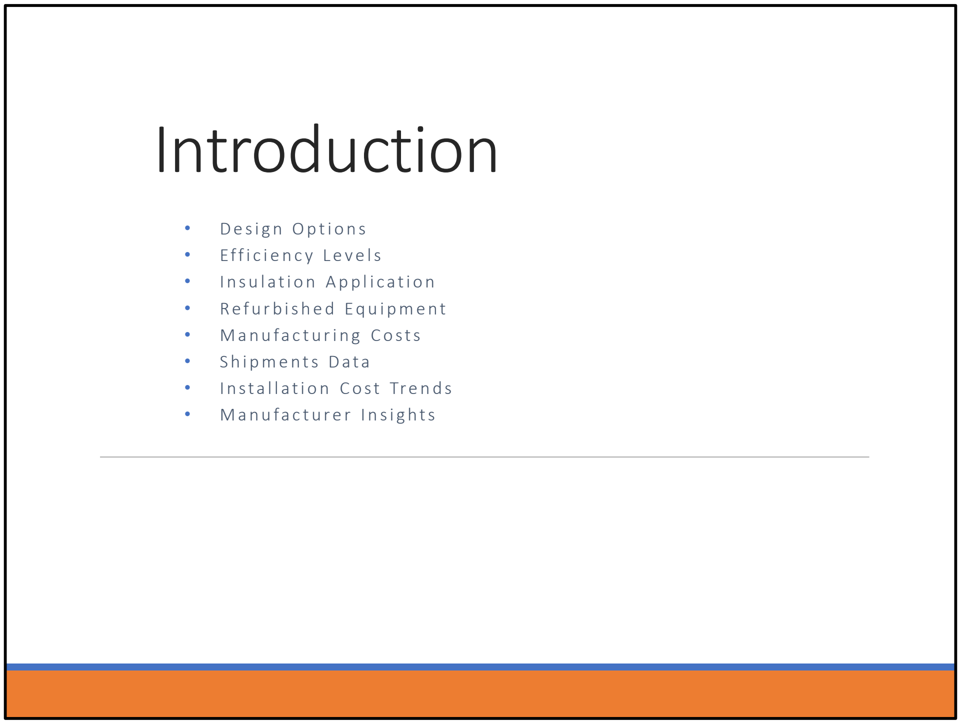
NAFEM represents more than 500 commercial foodservice equipment and supplies manufacturers.

National Automatic Merchandising Association (NAMA)

- Founded in 1936, NAMA is the association represent the $31 billion U.S. convenience services industry.
- Nearly 1,000 member companies
- Promotes and protects the advancement of the convenience services industry through advocacy, education and research
- Contact: Wayne Morris, wcps@ptd.net; +1.202.256.4200

NAMA
Bringing convenience to life.®

NAMA represents nearly 1,000 companies in the $31 billion U.S. convenience services industry.



In July 2022, the Department of Energy published a preliminary Technical Support document (pTSD) regarding potential energy conservation standards (ECS) for commercial refrigeration equipment (CRE) equipment. When AHRI, NAFEM, and NAMA members worked to respond to questions in the pTSD, they found that much of the data needed to be updated from the previous, 2014 report. Data used for the ECS analysis was outdated and did not align with current market conditions. Many of the suggested design options were currently in use to meet current efficiency requirements, some were impractical, while others had very high costs.

In their comments, the three associations committed to collect data to update the analysis to assist in the development of a reasonable outcome. In October 2022, AHRI, NAFEM, and NAMA conducted a survey of members that manufacture Commercial Refrigeration Equipment to share up-to-date information from manufacturers to DOE. The survey results shed additional light on the following:

- pTSD Design Options include many options that are currently in use to meet existing ECS, other proposed design options that raise concerns regarding applicability, and some design options that manufacturers could support
- the efficiency levels proposed by DOE raise questions and concerns
- whether implementing utilizing anticipated design options would result in EE

improvements

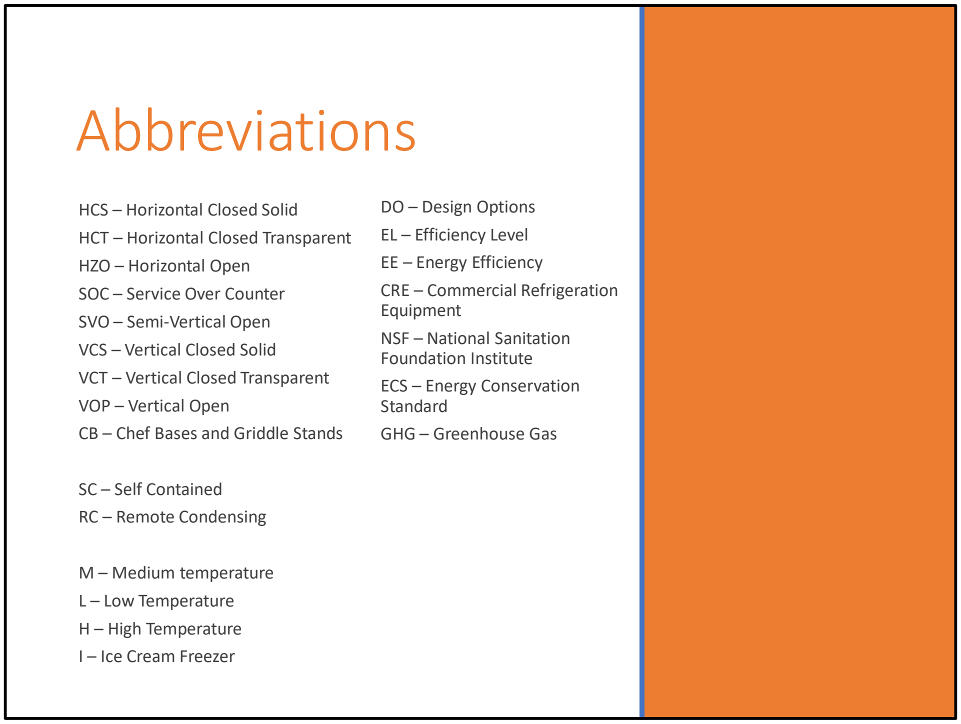
- insight into insulation application options being considered
- Information about trade-offs between new equipment cost and energy efficiency gains that are lost when customers resort to refurbished equipment
- Insight into manufacturing costs related to incorporating the various proposed design options into CRE equipment design
- Considerations about shipment channels data
- New equipment installation cost trends/considerations
- Additional thoughts shared by CRE manufacturers

With this information, we will explain the data collection process the survey results and the implications for related CRE rulemakings. We encourage your questions and discussion on these issues as we walk through the survey results.

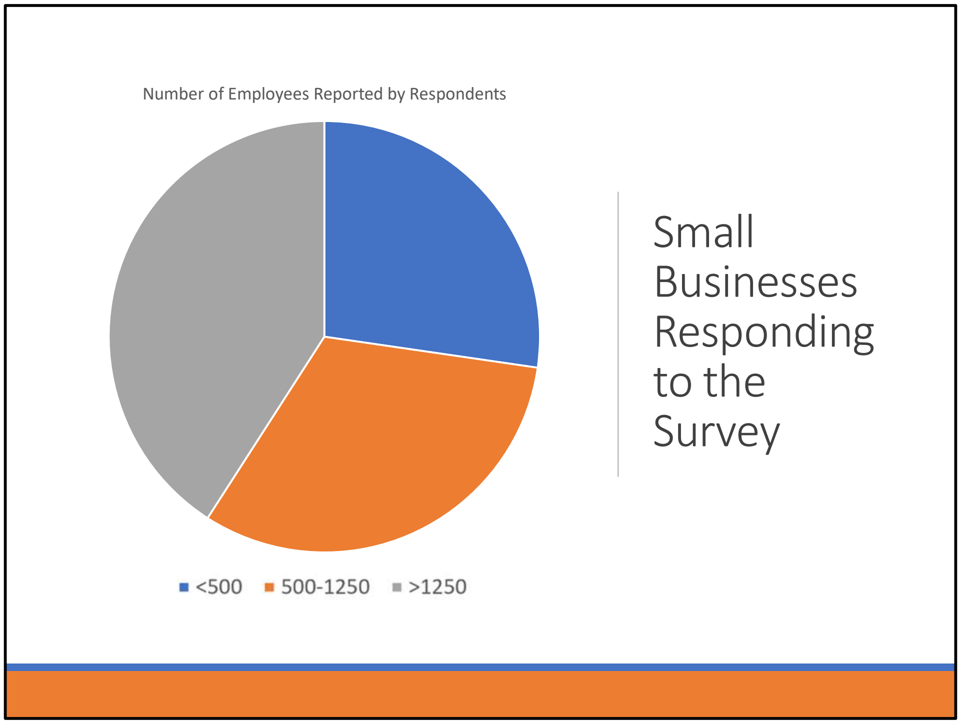
We wanted to take a minute to focus on the market for CRE. The consumers of CRE products are not residential homes; they are restaurants, educational institutions, military institutions, healthcare facilities, prisons, grocery/convenience stores, supermarkets, and supercenters. Their primary concern is to obtain appropriate CRE to comply with strict and sufficient temperature control mandates to keep food safe in a wide range of ambient temperatures. Any deficiency in holding food at a safe temperature has significant economic and regulatory consequences for these entities. By way of comparison, residential applications will generally only need to bring to temperature several pounds of meat, while commercial applications must decrease the temperature for several hundred pounds of meat within tight timelines to prevent food spoilage.

Hence, food safety and energy efficiency can be competing interests, yet both have environmental and climate change ramifications. According to the US Department of Agriculture, food loss and waste exacerbates the climate crisis with its significant greenhouse gas (GHG) footprint. Production, transportation, and handling of food generate significant Carbon Dioxide (CO_2) emissions and when food ends up in landfills, it generates methane, an even more potent greenhouse gas.

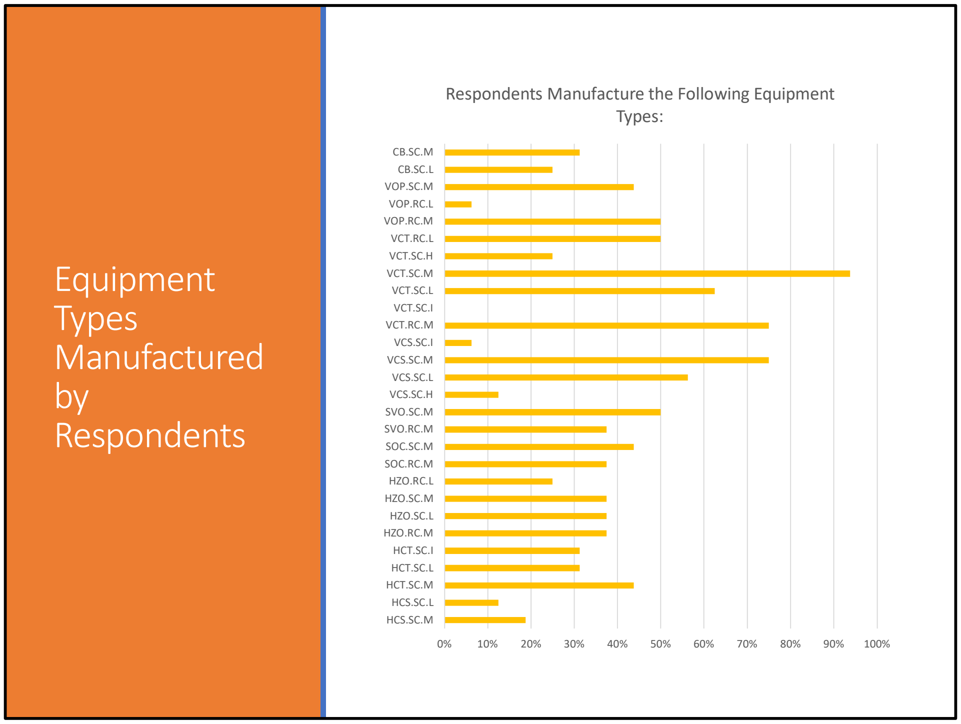
The U.S. Environmental Protection Agency (EPA) published a report in 2021 on the environmental impacts of food waste, and estimated that each year, U.S. food loss and waste embodies 170 million metric tons of carbon dioxide equivalent (million MTCO2e) GHG emissions (excluding landfill emissions) – equal to the annual CO2 emissions of 42 coal-fired power plants. This estimate does not include the significant methane emissions from food waste rotting in landfills.



The abbreviations listed here are utilized throughout this presentation.

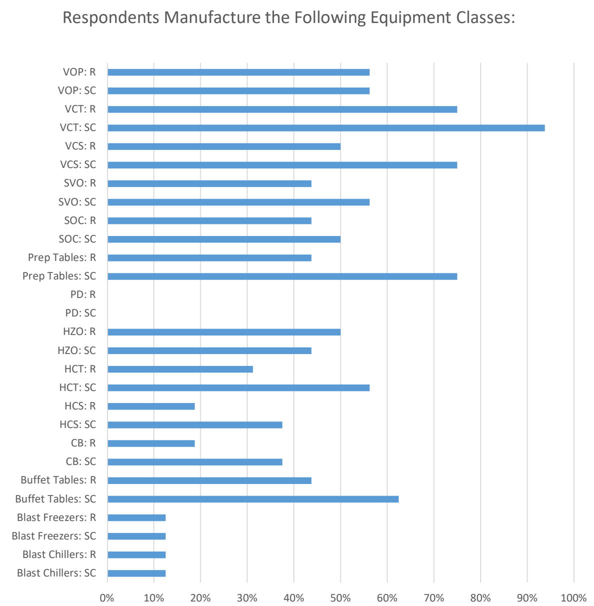


More than 50% of the data in the survey was shared by small businesses. As we are aware that all stakeholders including DOE, are concerned about smaller companies and the impact that rulemakings can have on small businesses. We are well represented in the CRE space by small businesses and want to provide the most up-to-date information to support this rulemaking process.

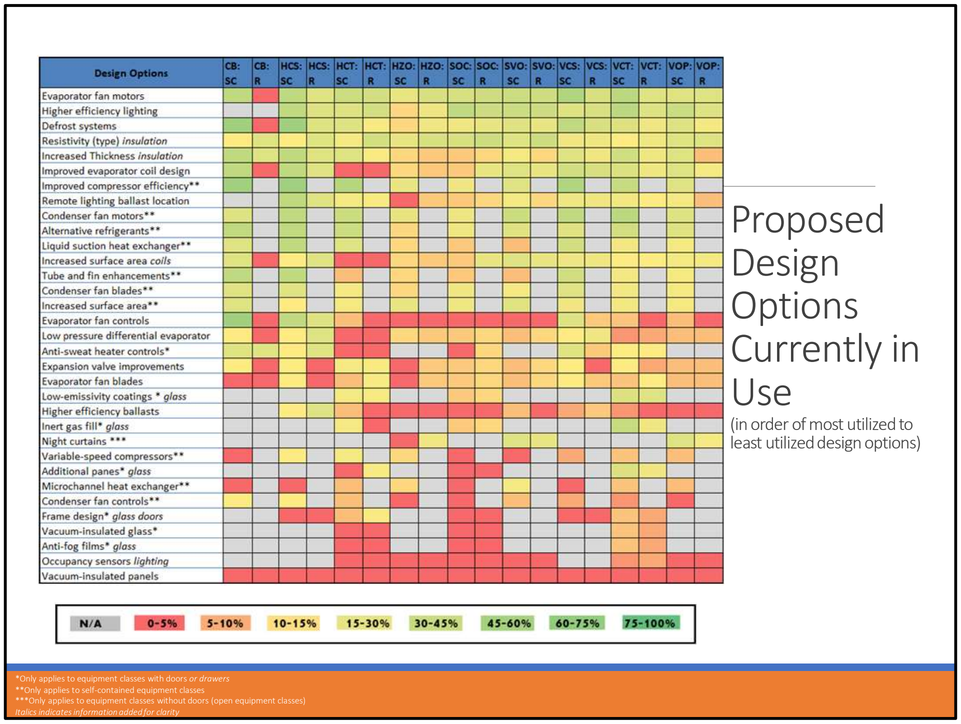


In addition to being well represented by small businesses, we had manufacturers of the following equipment types share data via the survey. The only equipment type not represented was Vertical Close Transparent Self-contained, Ice Cream Temperature.

Equipment Classes Manufactured by Respondents

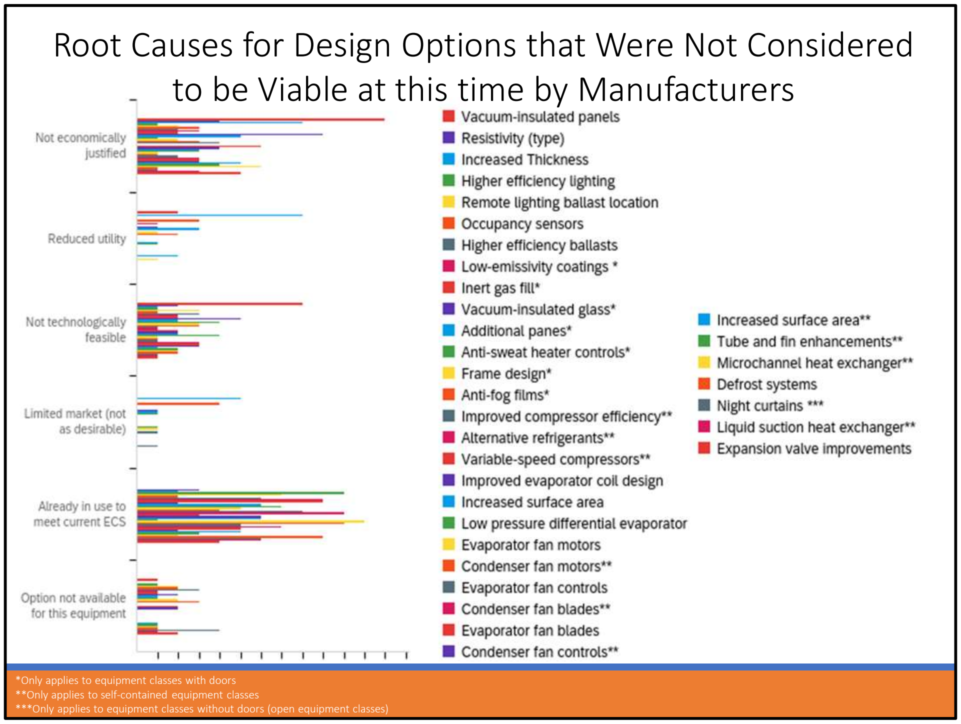


Likewise for equipment classes, we had the following manufacturers share data via the survey. The only equipment classes not represented were pull-down remote and pull down self-contained.



We surveyed respondents on the various design options used in each equipment type to better understand which design options manufacturers are currently using to meet current energy conservation standards. This heat map offers a visual representation of which design options are not in use. Gray cells are used to indicate the design options that are not applicable in certain equipment classes. Later in this presentation we will discuss the reasoning for why many of the design options that are not already in use such as vacuum insulated panels (highlighted here as the only design option not already being used in a single type of equipment), would not be economically or otherwise viable to incorporate into equipment design to meet updated ECS. The design options on this slide are organized in order of most to least employed to help illustrate the design options that are most frequently used today.

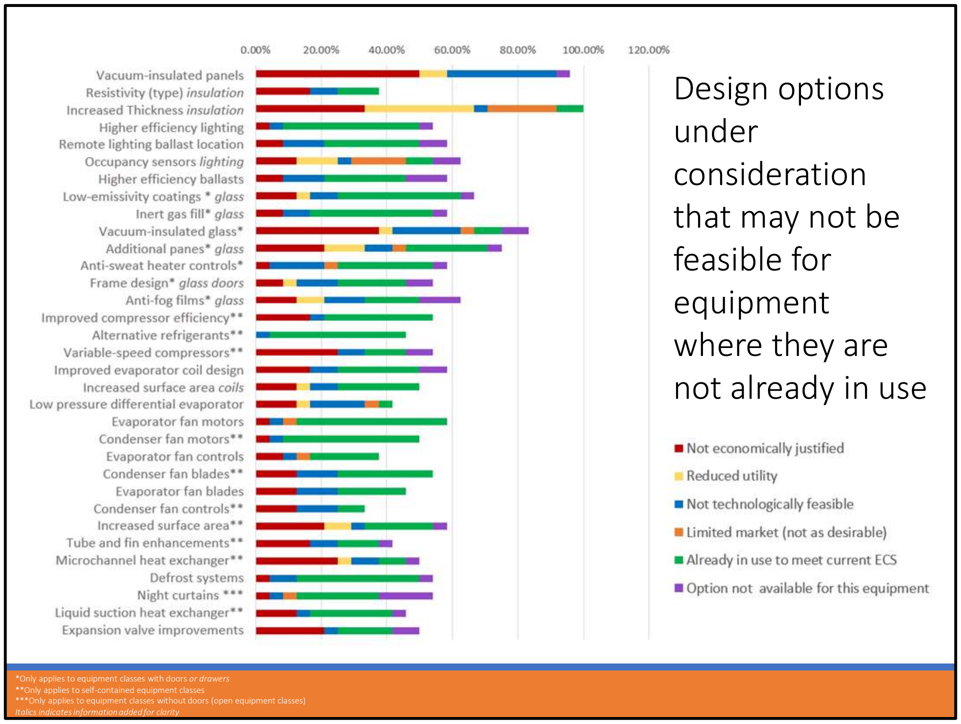
Please note that all members have reported using LED lighting and that they are unaware of any higher efficiency lighting that could be incorporated into their equipment. Some respondents answered with respect to use of LED lighting, while others responded with respect to "higher efficiency lighting". Manufacturers are using the highest efficiency lighting available on the market at this time. Manufacturers are always searching for better, more efficient alternatives.



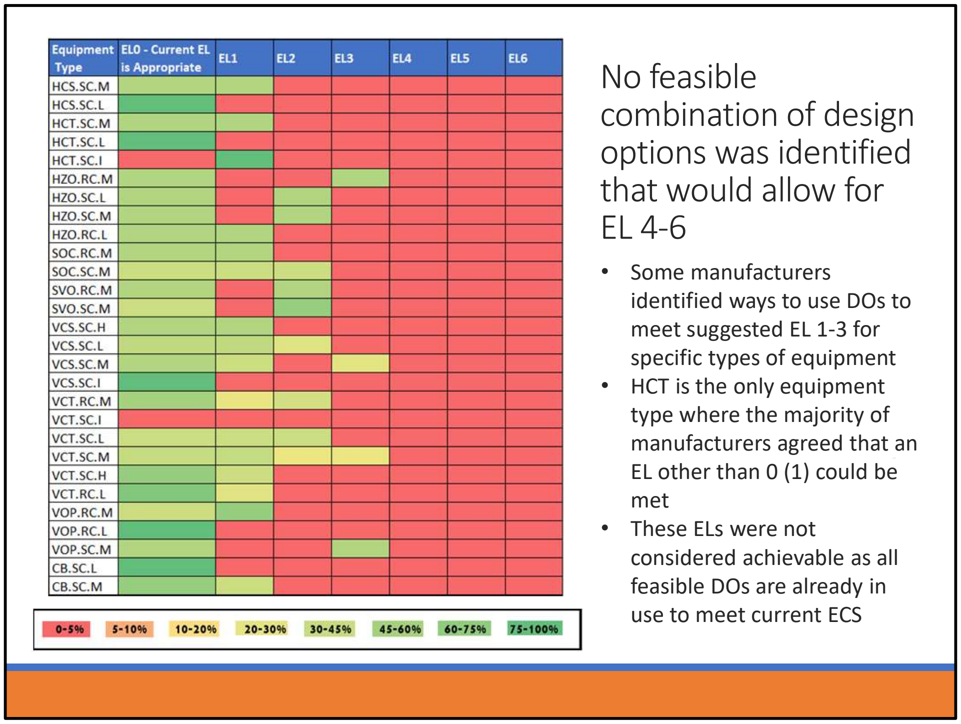
We asked survey respondents to explain which of the listed design options they would not consider to be feasible to incorporate into their equipment design. As you can see in this graph which gives just a high-level visual representation of the response trends, the most robust response by far was that the design options were already in use by manufacturers to meet the current ECS. The second most robust response, was that those design options not already in use, were not economically justified. Please note again with our example of vacuum insulated panels that no one is currently using this option in their equipment design, and that this first red line here on 'not economically justified' has by far the most responses of any reply. Other concerns included that design options had reduced utility, were not technologically feasible, had a limited market, or that certain options were not available for specific equipment types. This can help you to understand some of the limitations that manufacturers have regarding design options.

Current technology on producing insulated vacuum panels requires the panels to be produced in flat sections and joined together at the edges and corners of the five pieces it takes to make a refrigerated cabinet (left, right, back sidewalls, and top and bottom panels). Historically this is where insulation value declines dramatically and is not acceptable. Foam in place has the advantage to foam all five wall sections in one pour application, making the cabinet free of edges and corners requiring sealing. Obviously, the door will still require perimeter sealing visa via gasketing and thermal breaker improvements, which are constantly being reevaluated.

You may be aware that commercial refrigeration equipment makes up a fairly small niche market for manufacturers of compressors, evaporators and other components. There are a number of instances where more efficient components are unavailable commercially for these equipment types. In other cases, end users do not want equipment with certain design options. For example, occupancy sensors that are not activated may cause consumers to perceive that it is malfunctioning, causing concern for food spoilage. Certain design options may also not be economically or technologically viable.



This allows you to look at a more detailed example of the high-level spread of data in the previous slide. The graph illustrates manufacturer concerns or reasoning for why the various design options may be problematic to incorporate into their equipment design. Note that the green section of bars indicate that the respective design option is already in use.



We asked manufacturers to share with us, out of the various efficiency levels proposed in the CRE pTSD, which Energy Levels (Els) could be considered appropriate and reasonable for the various types of equipment made. Zero respondents shared that they thought efficiency level 4, 5, or 6 was acceptable, and you can see the trend with EL 0 (no improvement possible) having the most robust responses, followed in order by EL 1, EL2, and EL3.

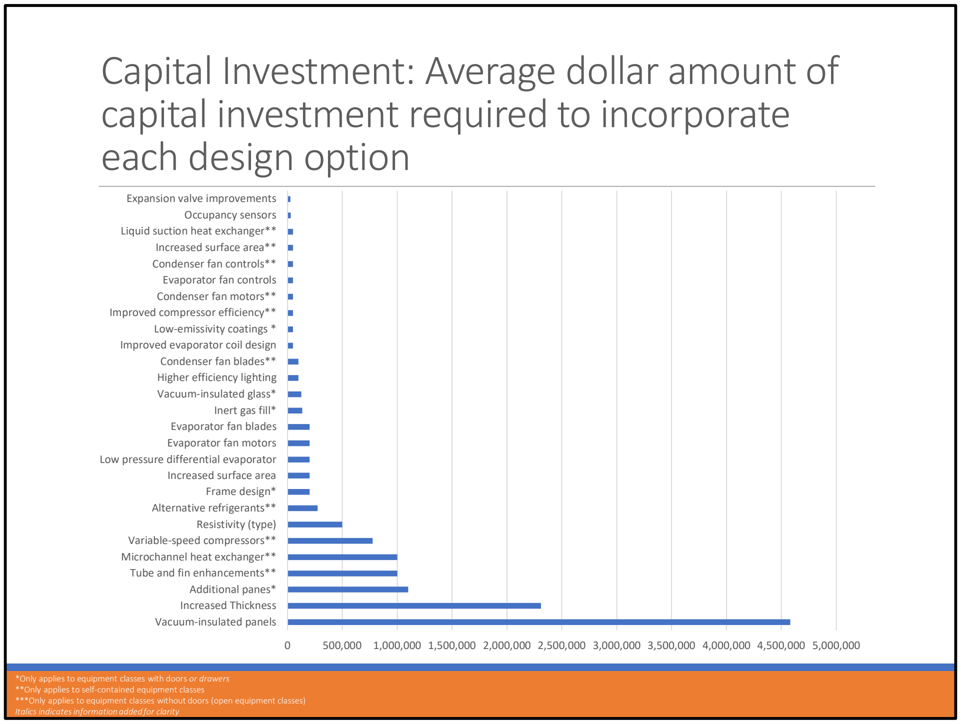
This is one more way to look at the data in the question we are discussing. Please note that there was no feasible combination of design options that was identified by manufacturers that would make Efficiency Levels 4-6 feasible. Some manufacturers identified ways to use design options to meet suggested EL 1, 2 and 3 for specific types of equipment, but HCT.SC.I was the only equipment type where the majority manufacturers agreed that an efficiency level other than 0 (efficiency level 1) could be met. These efficiency levels were generally not found to be achievable, largely because all feasible design options are already in use to meet current energy conservation standards.

Feedback from manufacturers that stated none of the proposed minimum ECLs was appropriate

- Most high efficiency components are already in use
- Max tech is currently being applied to equipment design
- We are proactively working with our component manufacturers/suppliers to address the challenges related to availability and cost of components
- 1% over today's EE levels would be acceptable
- We request that DOE clarify which ELs it favors and how they are justified in the analysis

As a follow up to our question about which efficiency levels were appropriate, we asked respondents who shared that none of the proposed ELs were appropriate, to share which levels they might choose. We received the following feedback from manufacturers, including and particularly that a 1% increase in EE over today's levels would be acceptable, and numerous responses stating that max tech has already been achieved limiting the ability to further improve equipment design EE. Manufacturers also expressed that there is a lack of clarity around which ELs DOE is favoring, and how the various ELs are justified in DOE's analysis.

Manufacturers also expressed concerns about the availability and cost of components. Many of the proposed DO require redesign of components for these niche equipment types. During transitions, highest priority is set for suppliers for the largest markets. Eventually, suppliers generally do develop components and we are working with components manufacturers to help them to improve components that we use in our products.



Continuing in the vein of cost, the average dollar amount of capital required to incorporate the various design options into equipment design, is represented here. VIPs at the very bottom have by far the highest associated dollar amount increase if incorporated into equipment design, at over 4.5 million dollars. This continues to help us understand the costs associated with significant energy efficiency improvements.

Capital and Product Conversion Costs for Design Options Anticipated to Improve Energy Efficiency

- Manufacturers were asked to provide capital and product conversion costs related to various design options
- Manufacturers reported that some design options would have no associated anticipated energy efficiency improvement
- There were also a few design options for which insufficient capital or product conversion costs were reported to meet the antitrust threshold of 5 manufacturers reporting
- Note that capital and product costs are reflected in the market at higher values than those listed here
- The remaining design options are included in the next graph

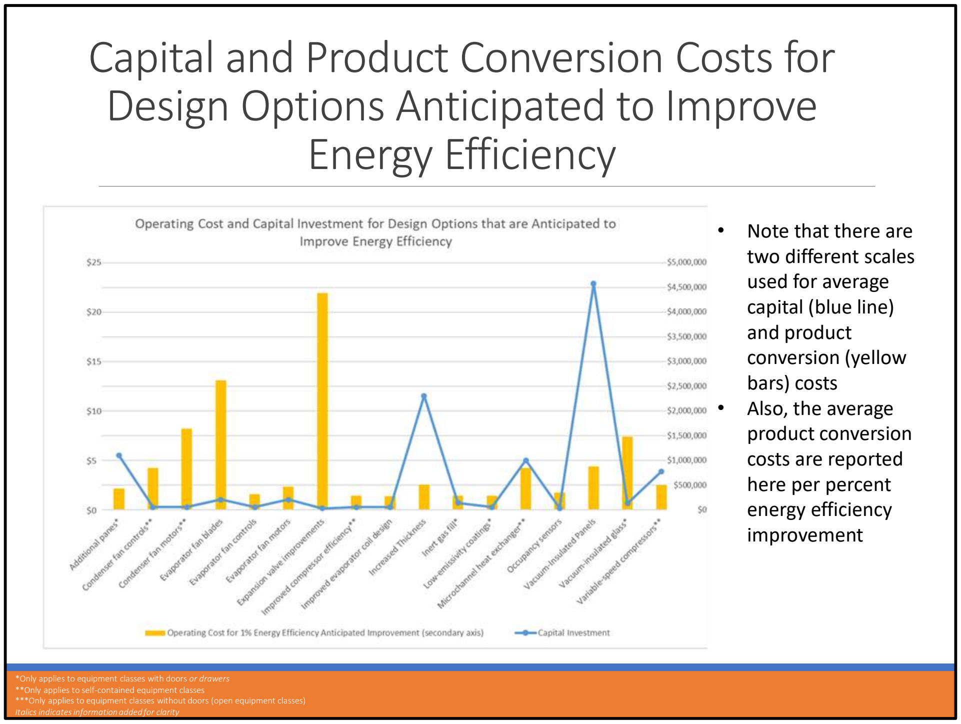
No Energy Efficiency Improvement Anticipated:
Condenser fan blades**
Defrost systems
Frame design* *glass doors*
Higher E Lighting
Increased surface area *coils*
Increased surface area**
Liquid suction heat exchanger**
Low pressure differential evaporator
Resistivity (type) *insulation*
Tube and fin enhancements**

No Product Conversion Cost Data
Alternative refrigerants**
Higher E ballasts
Remote Lighting ballast location

No Capital Conversion Cost Data
Remote lighting ballast location
Higher efficiency ballasts
Anti-sweat heater controls*
Anti-fog films* *glass*
Defrost systems
Night curtains***

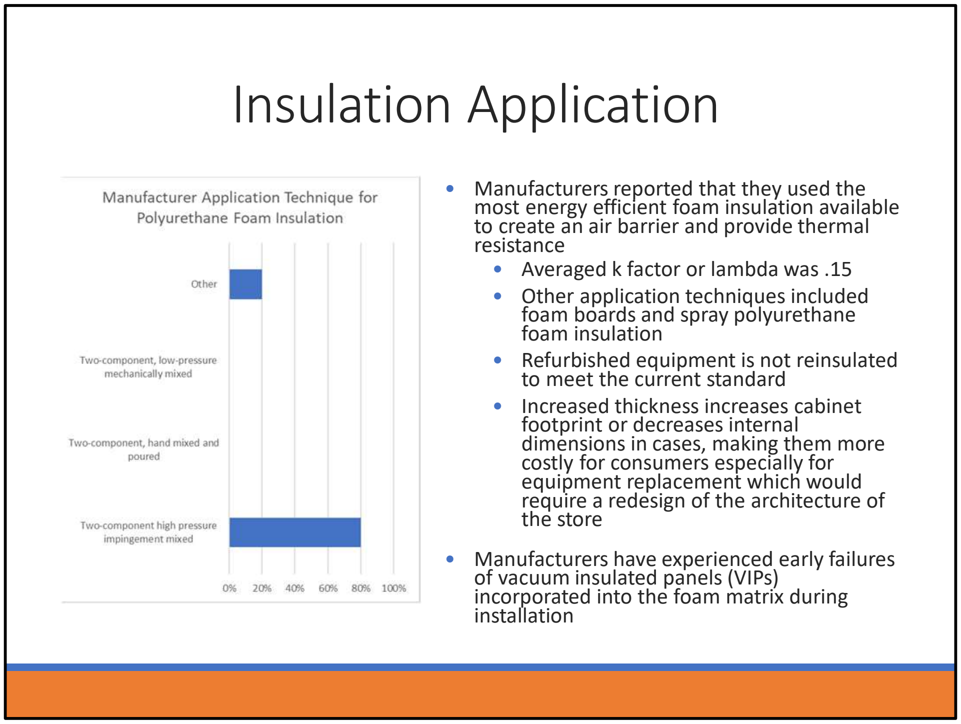
*Only applies to equipment classes with doors *or drawers*
**Only applies to self-contained equipment classes
***Only applies to equipment classes without doors (open equipment classes)
Italics indicates information added for clarity

Note that no energy efficiency improvement is anticipated for a number of different design options. No product conversion cost data was provided for three design optons, and no capital conversion data was provided for three different design options.



This graph shows the product conversion cost for a 1% anticipated energy efficiency improvement as well as the capital conversion costs to implement various design options. Note that no energy efficiency improvement is anticipated for a number of different design options. No product conversion cost data was provided for three design optons, and no capital conversion data was provided for three different design options.

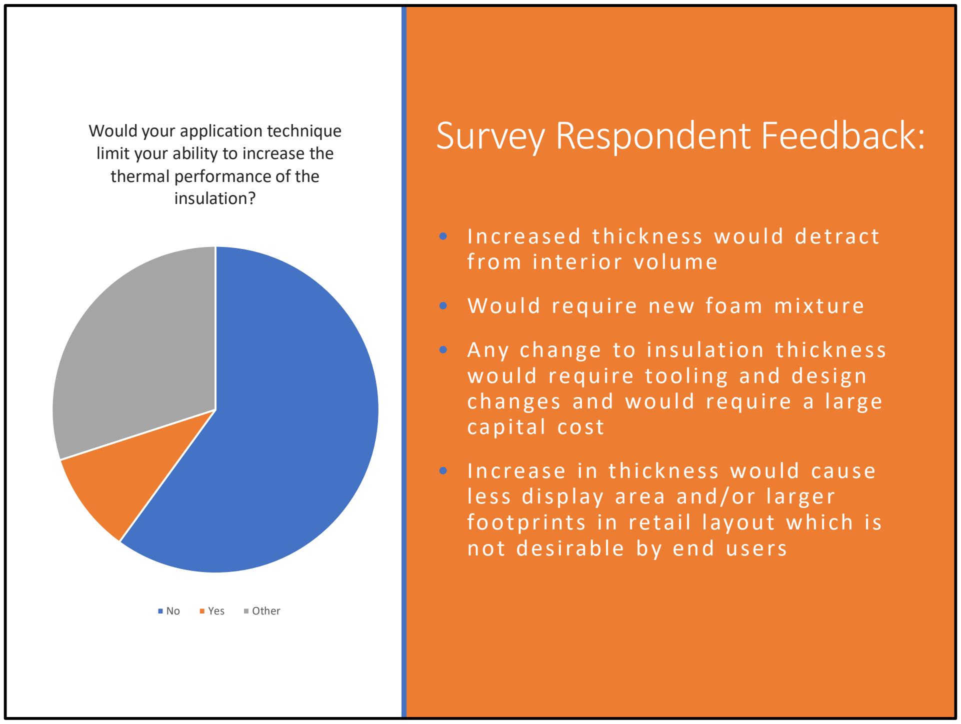
Althought the capital conversion costs for expansion valves are relatively low, they have a very high product conversion cost by comparison, per anticipated energy efficiency improvement. Note that vacuum insulated panels and increased thickness of insulation both require a large capital conversion cost and have moderate associated product conversion costs. Consumers may not be willing or able to bear the additional cost burden imposed.



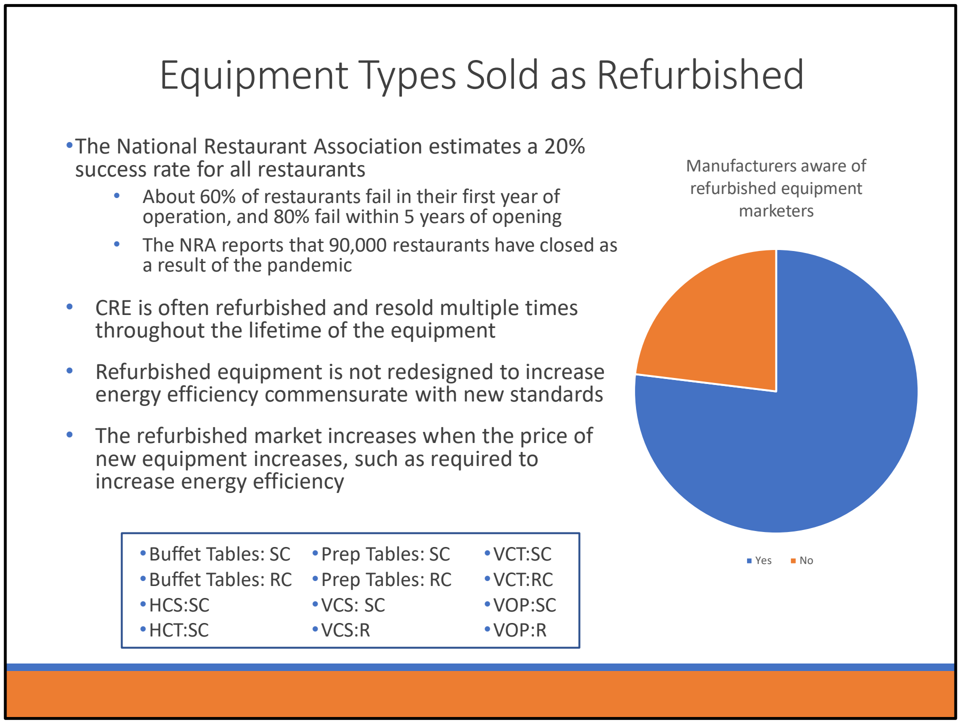
Survey respondents were asked to share data about their insulation application techniques. The majority of respondents shared that they used a high pressure, two-components foam system, with the rest using an application technique not listed, such as foam boards and spray polyurethane foam insulation. The average K factor or lambda was indicated to be .15.

Refurbished equipment is not reinsulated to meet the current standard. Increased case thickness increases cabinet footprint, or will decrease internal dimensions in cases, making them more costly for consumers. This is especially true for equipment replacement which would require a redesign of the architecture of the store. Please also note that decreased volume in cases impacts the planogram of a store as well.

Respondents overwhelmingly indicated that vacuum insulated panels or VIPs could not be incorporated into the foam matrix without early failures, raising concerns that VIPs are not a viable design option (DO) that would yield some EE improvement, and why certain options might not be feasible for use simply based on anticipated energy efficiency improvements.



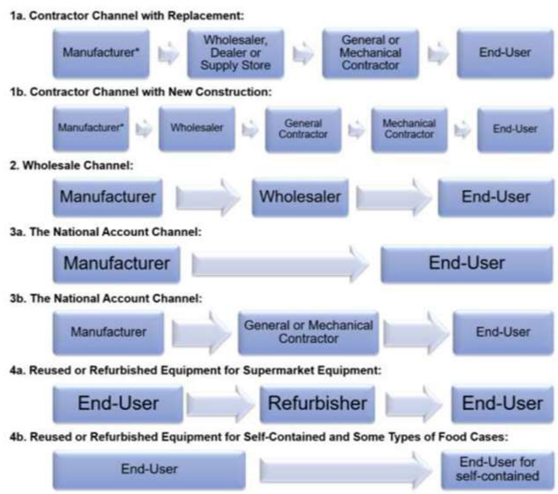
Continuing the section on insulation, we requested manufacturers share information on whether their application technique would limit the ability to increase thermal performance of the insulation. The majority of respondents said no, while a few other said yes, and other respondents shared the bulleted feedback. Respondents stated that increased thickness would detract from interior volume, that a new foam mixture would be required, and that changes to insulation thickness would require tooling and design changes, would decrease the display/storage area or increase the footprint of equipment.



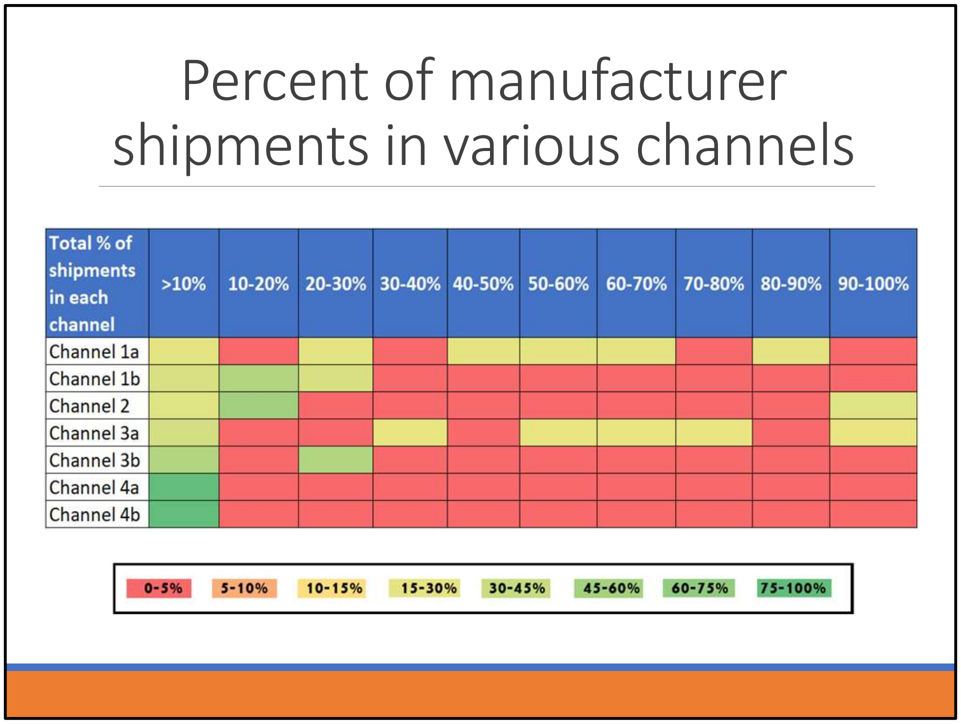
We posed a few questions to respondents about refurbished equipment with the purpose of illustrating the impact that strict ECS inevitably has on market. As ECS become more stringent, it is more difficult and costly for manufacturers to make compliant equipment. Ultimately this cost is passed on to consumers, who may be more inclined to choose a less expensive, less efficient, used model over a brand new, more efficient and more expensive model. This often causes the owners, brand owners, and companies who lease the equipment to refurbish the equipment. This refurbishing usually does not involve the refrigeration equipment. The process of refurbishing equipment usually involves updating for example door hinges, delivery motors, and seals, but not the most energy intensive parts of the equipment.

If reasonable changes are not considered carefully in the process of updating the ECS, the market will continue to shift toward refurbished equipment marketers. This slide illustrates that refurbished equipment may comprise a notable portion of the market which could increase if improvements to energy efficiency are not achievable.

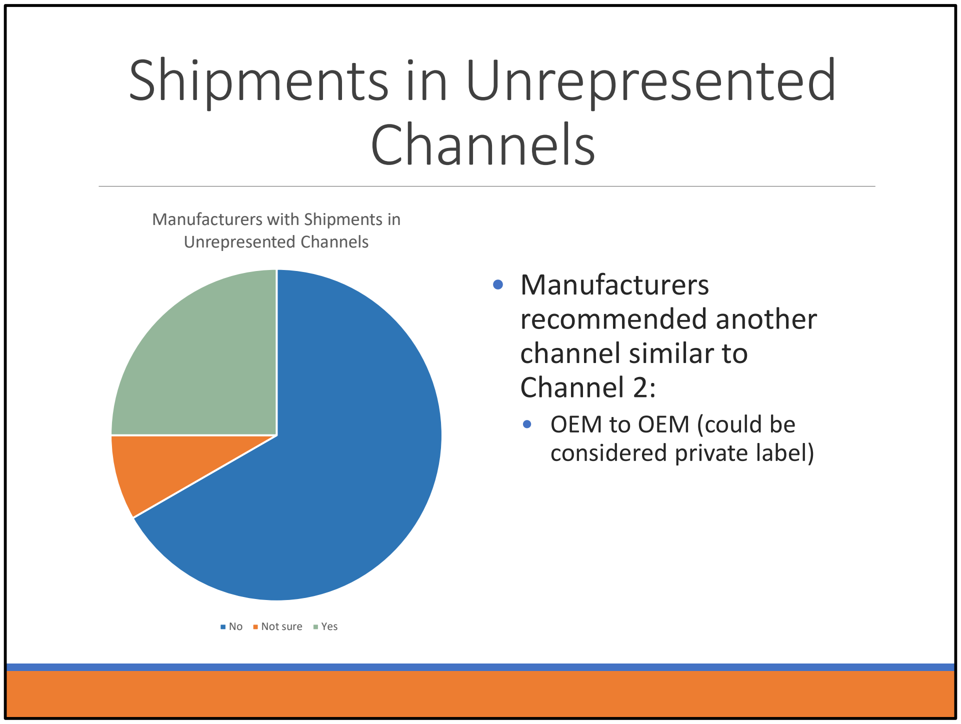
Shipment Channels



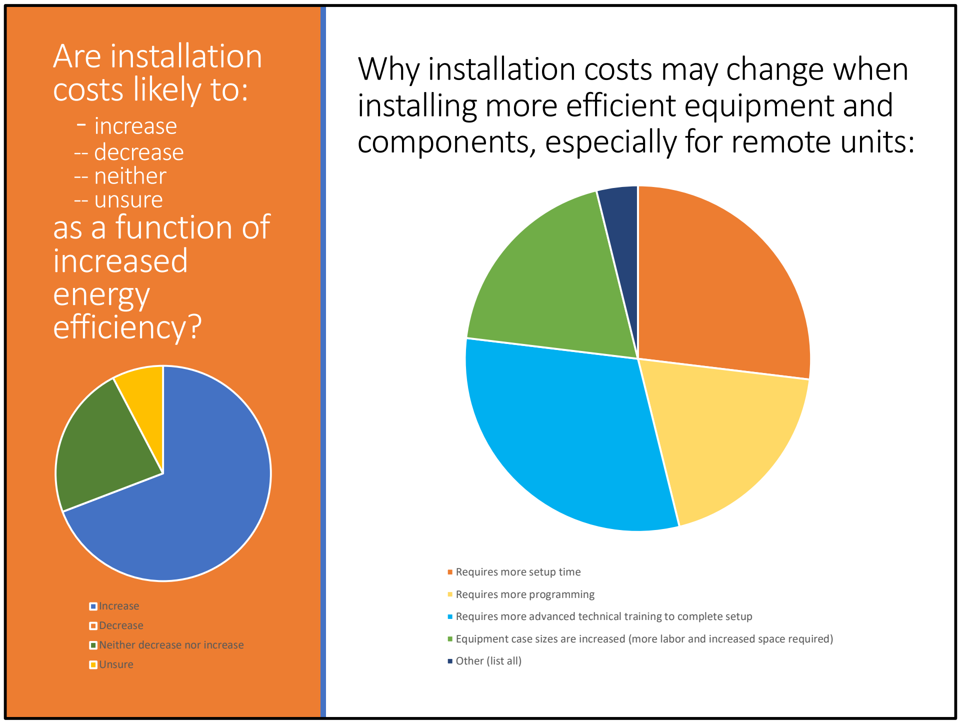
We requested that manufacturers share data about shipments in various channels. The channels discussed throughout this section are depicted here for your reference. This is the same representation of channels that we included in our comments to DOE on the pTSD.



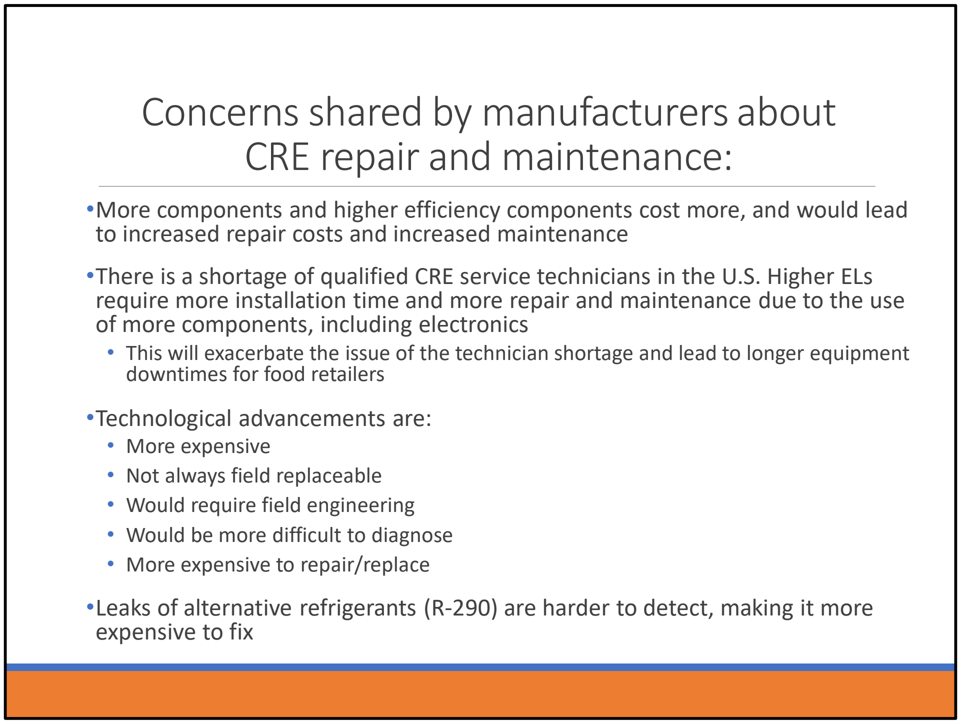
Here we have a heat map showing the percent of manufacturer shipments in various channels. For example, as you can see, 100%, or all manufacturers that had shipments in Channel 4b or Channel 4a, had cumulatively less than 10% of their shipments in these channels. 50% of manufacturers that had shipments in Channel 3b had less than 10% of shipments in Channel 3b, and the other 50% had 20-30% of their shipments in Channel 3b.



The majority of manufacturers stated that the channels referenced in slide 21 accurately encompassed each of the channels that they had shipments in. A few respondents shared that they had shipments not represented, and recommended including an additional channel under channel 2, for OEM to OEM. OEM to OEM moves through supply chain similarly to a wholesaler.



Respondents who answered that installation costs would increase as a function of improved energy efficiency shared here the primary reasons that costs would increase. Due to more advanced technical training to install and commission equipment and that more setup time would be required, more programming would be required, and that equipment case sizes would be increased, requiring more labor and increased space.



Additional information was shared by manufacturers about CRE repair and maintenance:

•More components and higher efficiency components cost more, and would lead to increased repair costs and increased maintenance

•There is a shortage of qualified service technicians for CRE in the U.S. Higher ELs require more installation time and more repair and maintenance due to the use of more components, including electronics

 •This will exacerbate the issue of the technician shortage and lead to longer equipment downtimes for food retailers

•Technological advancements are more expensive, harder to diagnose and more expensive to repair/replace

•Alternative refrigerants (R-290) are harder to detect leaks, making it more expensive to fix

Other Factors Compounding Challenges Facing CRE

- Sanitation testing and certification
  - National Sanitation Foundation Institute (NSF)
  - American National Standards Institute (ANSI)
  - ServSafe®
- Refrigerant transition
  - American Innovation and Manufacturing (AIM) Act supply phase down and technology transitions
  - State adoption of refrigerant bans and global warming potential (GWP) limits
- Potential chemical bans in components and parts
  - Phenol, isopropylated phosphate (PIP) (3:1)
  - Per- and poly- fluoroalkyl (PFAS) substances

Conclusion

The purpose for commercial refrigeration equipment is to protect and ensure food safety. We recognize that such equipment should be as energy efficient as reasonably practicable. Our products actually affect more people in restaurants, educational institutions, military institutions, and prisons than single households. Any deficiency in holding food at a safe temperature has environmental and climate change impacts. We welcome engagement with DOE to maximize energy savings that are reasonable and practicable, and look forward to working with DOE to achieve the best possible results.

Equipment manufacturers need the certainty of a reasonably balanced outcome from DOE's future CRE rulemaking to ensure that equipment can be designed in a way that it can be manufactured and installed to meet the critical need of food preservation and meet the expectations of our customers. We look forward to working with DOE to accomplish this shared goal. We also value the insight and perspective that SBA Advocacy can provide to this process.

Discussion & Questions