



STATE OF THE INDUSTRY REPORT

MARCH 2024 | 7TH EDITION



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ABSTRACT

The 7th edition of the State of the Industry Report has evolved to include more information from IIAR Survey questions and observations of industry leaders. Emerging information on regulatory and training developments and IIAR's influence on the industry continues to grow.

IIAR's efforts in the government relations sector are more important than ever. IIAR has expanded on the challenges for end users in the industry, the state of government relations with IIAR, and the educational resources of IIAR. Continuing in tradition is a preface from the Chair of the Board of Directors, Dave Malinauskas.



PREFACE

In recent years, our industry has seen a focus on change, away from synthetic refrigerants and towards natural solutions, casting the broad range of natural refrigerants into the limelight. Along with this change, demand for new technologies, and the education, training and advocacy for those new technologies and uses of natural refrigerants has grown. Keeping pace with that rapid growth has been the relentless dedication and work of our membership.

This cannot be truer today, as you will see from reading this comprehensive report – and IAR’s vision and mission are more important than ever.

With the final signing of the American Innovation and Manufacturing (AIM) Act in October of 2023, a new, mandated set of priorities has been put in place for the phaseout of harmful, high-GWP refrigerants.

It’s no accident that IAR’s membership has grown twenty-five percent over the last two years. Our industry is poised to usher in a new era of dominance for natural refrigerants as new end users, manufacturers, and customers enter our market.

The acceleration of CO₂ as a refrigerant, especially in North America, and a new focus on hydrocarbons, including the development of a new IAR standard to address them, is a testament to the rapid, exciting change we are all witnessing.

Fourth-generation synthetics will soon be a thing of the past, while natural refrigerants, a 100-year-old technology, have not only stood the test of time but are evolving with it.

IAR is evolving as well, going through a comprehensive rebranding process in 2024 to include two name changes (IAR now stands for The International Institute of All-Natural Refrigeration, while NRF stands for the Natural Refrigeration Foundation).

As always, it is the time, enthusiasm and dedication of our many committees and all our volunteer members that makes the work of our organization possible.

Whether it’s the hard work of standards development, training development, or the task of advocating on behalf of our industry, I would like to thank you all for your interest in this important work and for your effort in expanding and making our industry as safe as it can be.

Sincerely,

Dave Malinauskas
2023-2024 IAR Chairman

INTRODUCTION

The American Innovation and Manufacturing (AIM) Act continues to change our industry, and the anticipated elimination of certain refrigerants is reshaping the way natural refrigerants are considered – for everything from environmentally sustainable policies to new technologies. Meanwhile, the conflicting dynamic between natural refrigerants and synthetic refrigerants will continue to be an important topic of discussion in 2024.

As the industry looks toward more uses for natural refrigerants, it is becoming apparent that more educational resources and training opportunities are needed, especially in carbon dioxide applications, which are already widely used.

Alongside a broader base of training, the emphasis on energy efficiency will continue to expand as the industry tries to apply new ways to make systems more efficient – to new and legacy systems alike.

Throughout all of these challenges and opportunities, IAR remains diligent in its efforts to support its existing members. By providing educational offerings and benefits while also reaching out to new members, IAR, its committees, and its membership will draw more expertise to our industry and tap new markets for natural refrigerants in 2024.

MEMBERSHIP UPDATE

IIAR has over 3,700 members from more than 50 countries around the world and members of IIAR include design engineers, end users, manufacturers, contractors, students, scientists, and trainers. Alliance organizations in Asia Pacific, Europe, Latin America, North America, and Australia continue to make international outreach a hallmark mission of the organization.

The new membership structure, introduced in 2022, continues to provide access to the e-Library, member directory, an eKIT of all IIAR standards (current and past revisions) via an eREADER service, and online webinars. IIAR is encouraging members to take advantage of the free IIAR Academy of Natural Refrigerants certificate course per member per year and the free IIAR Training Video Series per member per year.

Additional benefits, such as eligibility for listing in the Natural Refrigeration Directory, are exclusive to Group Membership vs. Individual Membership. Members receive a discount for purchasing published electronic and hard copies through the website, and new for 2024, the Condenser magazine has moved to a new online platform with additional search features on all published articles. For more information, please see the Member Benefits page.

REFRIGERANT CONSIDERATIONS

IIAR has taken a strong stance in defending natural refrigerants in its Green Paper, republished in 2019. The paper focuses on the advantages of natural refrigerants and increased use in new and traditional markets – because much of their benefit revolves around their environmental compatibility. For more information on natural refrigerants and considerations for using them, please see the published Green Paper.

EDUCATION NEEDS

Training at ammonia refrigeration facilities is critical to ensure safety and comply with regulatory requirements. From onsite training provided by manufacturers and end-users to formal training provided by industry groups, the natural refrigeration industry has led the effort to train generations of new technicians, operators, and managers on ammonia systems.

Now, that same dedication to training may also extend beyond ammonia as more and more natural refrigerants are adopted and industry leaders move to expand the foundation of natural refrigerant training – to CO₂ and hydrocarbon systems.

Expanded training can be seen as a way to remove one more roadblock or excuse for not using natural refrigerants – by increasing technician familiarity with a specific kind of system. And by laying the groundwork for institutional knowledge that may not yet exist. One example of this is low-charge hydrocarbon equipment, where US codes have not traditionally allowed for volume use in commercial or larger residential applications.

The benefits of making broader training available on these less used, but growing systems are often the same as traditional ammonia systems.

Employees who operate or maintain a refrigeration system need more advanced training on system operating and maintenance procedures. Employees need to know how to do their jobs safely, and the amount of training they require can vary depending on their tasks.

Effective industry training programs allow anyone to fully participate in the training process and practice their skills or knowledge at a broader level.

At most facilities, management decides who receives more advanced training, but broader training and general education is useful for any worker in proximity to a refrigeration system, including roundsmen, operators, mechanics, technicians, electricians, contractors, engineers, and various management roles.

The availability of on-the-job and general training certifications for ammonia has long been a driving force behind the high safety standards upheld by the industry where ammonia is concerned. However, those same pressures may not yet apply to the growth of any future hydrocarbon and CO₂ resources.

Currently, CO₂ and hydrocarbon use are not covered by PSM, unlike ammonia, where regulatory mandates ensure broad training resources. However, as CO₂ and hydrocarbon use continue, training needs for these systems will also grow as demand increases for greater institutional knowledge and more trained workers.

Industry organizations are already recognizing the opportunity to fill the education and training void for refrigerants beyond ammonia.

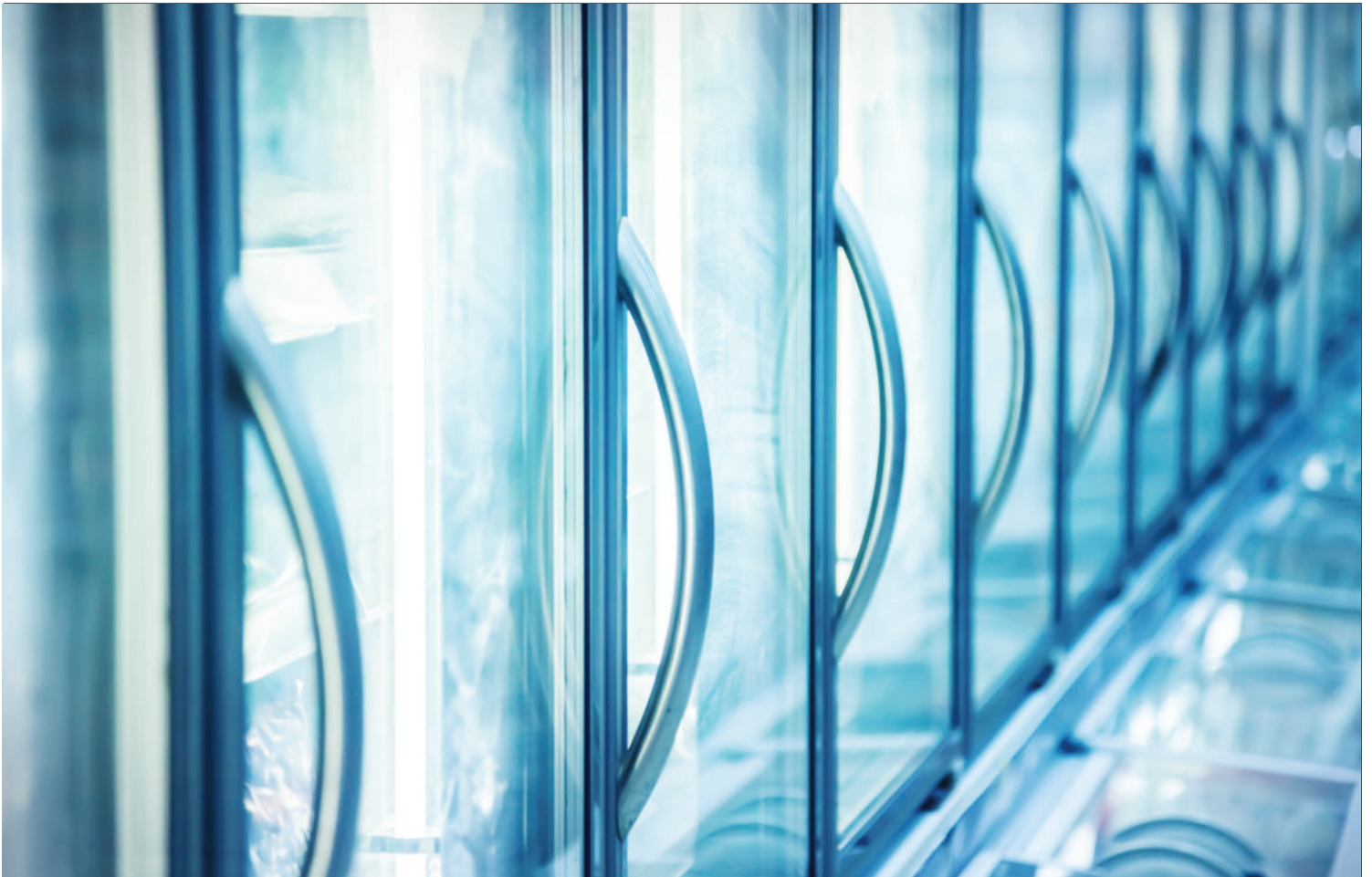
While current training resources for CO₂ and hydrocarbons are typically offered by manufacturers and tailored to manufacturer-specific equipment, a number of new training resources that offer education across systems may soon be available.

The recent merger of the Refrigerating Engineers & Technician's Association (RETA) and the Refrigeration Service Engineers Society (RSES) will give RETA the ability to expand an existing RSES hydrocarbon training course, according to leaders of the two organizations.

Meanwhile, the North American Sustainable Refrigeration Council (NASRC) has been making advancements in CO₂ training, conducting quarterly summits around the United States. The NASRC training focuses on commercial and residential use for propane and CO₂ and is delivered by manufacturers in the form of workshops.

The IIR has also recognized the need for broader training, announcing in 2024 that it is developing training on the organization's CO₂ standard, which will likely be released in 2025. IIR said it is currently in the process of making a broad assessment of training gaps where CO₂ and hydrocarbons are concerned – across the industry – so that those gaps can be filled.

As CO₂ and hydrocarbon systems begin to represent a new area of growth for natural refrigerants, it is vital that the industry responds with robust training and educational resources –beyond those offered by manufacturers alone. These new training and educational resources will play a vital role in the growth of natural refrigerants in the coming years.



CURRENT EVENTS

The American Innovation and Manufacturing Act is the most influential recent development in the domestic industrial, commercial, and residential refrigeration industries. Internationally, IAR, working with other industry groups, continues to solidify a presence for natural refrigerants around the world. Meanwhile, new technologies like full building thermal systems are taking center stage, drawing the focus of environmentally minded end users, while industry consolidation is a growing trend rounding out a list of the most important current events in 2024.

AIM Act Advocacy

Building awareness of the American Innovation and Manufacturing (AIM) Act of 2020 continues to be a top priority for IAR, which has created several resources to help promote it.

The AIM Task Force continues to support IAR in its objectives to provide advocacy and education for natural refrigerants in all industries. An informational page, [What is the AIM Act?](#), on the IAR website was established to provide updated AIM Act news and developments.

International Influence

IIAR has created strong alliances with many international associations and has been able to extend its reach worldwide through these partnerships. IIAR's active international alliances include those listed on the Alliances webpage.

IIAR's Chile Chapter held its biannual IIAR Seminar in Santiago, Chile, in August 2023, and an official IIAR Seminar was held in San Paolo, Brazil, in November 2023. IIAR's Ecuador Chapter will be holding its biannual IIAR Seminar in April 2024 in Guayaquil, Ecuador, and planning is underway for an IIAR Seminar to be held in Guadalajara, Mexico, in 2024.

Technology Trends

Industry leaders are looking to the next technology evolutions on the horizon, which will increasingly include the transformation of cooling and refrigeration systems to full-building thermal systems that provide heating and cooling within a facility or district of buildings. Beyond refrigerant emissions, eliminating natural gas is paramount in reducing GHG emissions. It will be a crucial focus of the "net zero" goals and targets of organizations taking a leadership role on the environment.

This will apply to large food manufacturers, cold storage facilities, and ice rink operators, as they have a large cooling load that generates a lot of waste heat.

In the past, capturing waste heat from the refrigeration system was not always economically feasible from a pure payback perspective. However, the business case can be quite attractive as organizations shift to incorporate GHG into their project analysis.

Beyond the payback, another challenge has been the usefulness and availability of the waste heat from refrigeration systems. The industry is addressing this by developing natural refrigeration heat pumps that can be used as either boosters to existing or standalone systems.

The combination of refrigeration phaseouts/downs, proven case studies, and the drive towards reducing or eliminating natural gas within buildings will lead to the further development of solutions that maximize the waste heat from refrigeration systems.

Industry Consolidation

The industrial refrigeration industry is becoming increasingly concentrated. Most notably, in 2023, several private equity companies acquired regional contracting companies, equipment manufacturers acquired other refrigeration component manufacturers, and end users developed dominance within their industries. This trend mirrors that of the overall economy – with increased market concentration and fewer individual companies. Regarding the forces driving this trend, speculation on why it is happening ranges from a perceived willingness of banks to fund green initiatives to investor visions of larger margins with the establishment of larger companies. While this trend is likely to continue in 2024, the factors driving it may remain unclear.



REGULATORY AND IAR STANDARDS UPDATE

The American Innovation and Manufacturing (AIM) Act influenced everything from IAR standards creation to regulatory advocacy in 2023 and into the beginning of 2024. IAR staff met with the Significant New Alternatives Policy (SNAP) Team, which reviews and determines which refrigerants can be used to satisfy EPA requirements.

IAR also began development of a hydrocarbon standard – targeted for final release in 2024 – in part as a response to the phasing down of refrigerants that are harmful to the ozone and are harmful for global warming.

The hydrocarbon standard broadens the knowledge base of available natural refrigerants, while the AIM Act accelerates the use and consideration of natural refrigerants with zero ozone-depleting potential and zero or very low global warming potential.

The IAR hydrocarbon standard has been written to address larger closed-circuit refrigeration systems that use natural hydrocarbons as the refrigerant. The systems being considered are beyond the size of the presently approved SNAP-listed equipment and systems. IAR hopes that the EPA will consider the standard as a basis for expanding the SNAP approval listings for natural hydrocarbon refrigerants.

The IAR hydrocarbon standard includes specific design, installation, and startup, as well as inspection, testing, maintenance, decommissioning, and general safety equipment.

The current draft of the standard covers the use of propane, butane, and iso-butane in refrigeration applications, with the potential to add a few other hydrocarbons at a later date. The standard has exceptions for listed systems and those systems for use in chemical and petrochemical applications. Listed systems are those built to UL standards, currently utilizing less than 150 grams of refrigerant per circuit. This amount will be increased over time as the UL standards for hydrocarbon systems are revised.

For systems utilizing larger refrigerant quantities than those covered by the UL standards (i.e., listed: equipment that has been tested and is identified as acceptable by an approved, nationally recognized testing laboratory), the standard recommends that the refrigerant containing equipment should be installed in a machinery room or outdoors. A secondary refrigerant would be used to transfer heat from the source to the hydrocarbon equipment.

The natural hydrocarbon refrigerant, which remains in the machinery room, can be used as the primary refrigerant in a cascade system and, or, for secondary systems that can chill and circulate a secondary fluid, such as a natural refrigerant like CO₂, brine, or glycol.

In addition to the hydrocarbon standard, IIAR standards 5, 6, and 7 will be released in 2024 after a review and update. While IIAR 5 and 7 will undergo less significant updates, IIAR-6 will be the biggest update of 2024. The IIAR-6 update will address the subject of internal relief valves. The industry is currently receiving regulatory pressure from OSHA to set a 5-year interval for the replacement of those valves. In response, the IIAR research committee will complete a research project to determine how long internal relief valves last and when they need to be replaced. This research will then inform an update of IIAR-6 to include a specific replacement interval.

Beyond influencing standards, the regulatory environment will impact the industry in several ways in 2024. The EPA's technology transitions rule, which was published under the AIM Act, set forth global warming potential limits for refrigerants with various applications – with deadlines starting as early as 2025. IIAR has taken a leadership role in the implementation of this timeline, working with the agency and developing a web portal around the AIM Act to communicate phase-down deadlines.

Meanwhile, the new EPA Risk Management Program Safer Communities by Chemical Accident Prevention Rule, published March 1, will be a big focus for IIAR in 2024. The rule includes additional RMP requirements regarding third-party audits, root cause analysis, emergency response, and information availability.

The EPA's RMP Reconsideration Final Rule Fact Sheet has been in effect since 2019, and it's important to note that the annual notification drills in coordination with emergency responders and field exercises must be done, and compliance is required by December 19, 2024. Tabletop exercises are due by December 21, 2026. The scope and frequencies of these notifications and exercises are written in the regulations.

IIAR continues to monitor government programs that impact the use of all refrigerants. IIAR also continues to make government agencies aware of the benefits of ammonia and other natural refrigerants for their viability and potential for future use. For more information on government programs, please go to the Government Services Support Portal.

INDUSTRY DYNAMICS

Beyond the many factors influencing growth in the industry, several new trends may indicate a broader industry shift for natural refrigerants.

First among these trends is a practical focus on improving energy efficiency through heat recovery and customized refrigeration solutions. The growing integration of heat recovery systems – to capture and reuse waste heat generated during the refrigeration process – is helping facilities improve overall energy efficiency. Customized refrigeration solutions tailored to specific food manufacturing processes are also increasingly in demand as end users look to optimize the temperature and humidity conditions for different products. Higher demand for customization may be emerging as end users focus more on designing refrigeration systems with materials and features that meet high hygiene standards, which is particularly important in food manufacturing.

Another indication that natural refrigerants are seeing broader adoption is the growth of the industry in the warehousing and logistics space.

According to the GCAA Global Top 25 list of largest temperature-controlled warehousing and logistics members published in June of 2023, a total capacity of over 750 million cubic feet was added to the Global Top 25 since the publication of the 2022 lists due to mergers and acquisitions activity as well as new facility assets coming online. The Global Top 25 currently operates 6.26 billion cubic feet (177 million cubic meters). The North American Top 25 operates 4.37 billion cubic feet (124 million cubic meters). The European Top 10 operates 1.18 billion cubic feet (33 million cubic meters). The Latin American Top 10 operates 441 million cubic feet (12.5 million cubic meters).

Meanwhile, several less-defined trends may be pointing to the broader adoption of natural refrigerants: the transition from HFC chillers to CO₂-based systems is becoming common in industrial applications; HVAC&R contractors are installing and servicing natural refrigerant systems; various global entities are aiming to phase out synthetic refrigerants and reduce environmental impact; and corporate commitments to reducing greenhouse gas emissions by incorporating natural refrigerants are growing.

The continued challenge for end users adopting natural refrigerants is the public perception of widely used refrigerants, which may be variable due to a lack of widespread knowledge of the pros and cons of all refrigerants. In addition, the cost of regulatory compliance is a driver for decision-making for companies and the refrigerants they select to use. As regulations become more complex and expand to new chemicals, the pressure grows to find refrigerants that meet those regulations and do not present significant costs.

IIAR has created and maintained a Government Support Portal to help the industry understand these pressures. The portal allows access to IIAR's most current standards as well as the basic Ammonia Refrigeration and Safety Series to Regulatory agents and officers. Additional partnership will be achieved in 2024 with the merger of the Refrigerating Engineers and Technicians Association (RETA) and the Refrigeration Service Engineers Society (RSES).

The IIAR Marketing Committee is currently completing work on a refrigeration informational portal, which should be ready to launch by the end of June 2024. This portal will give members access to regulatory information, an avenue for sharing ideas and solutions to common issues, and general information about changes within the industry.

IIAR EDUCATIONAL RESOURCES

In a year of greater emphasis on climate change, new regulations, and energy efficiency, IIAR harnessed the focus on environmentally sustainable technologies to draw attention to natural refrigerants. IIAR delivered over 40 presentations webinars and facilitated discussions with industry groups and regulators, including:

- Five virtual presentations were completed for the Refrigerating Engineers & Technicians Association (RETA).
- Eight live presentations at the RETA Conference.
- One virtual presentation was produced for Gordon Foods Services.
- One live presentation was produced for Trident Seafoods.
- Eight new IIAR webinars, including five revised webinars and three new topics.
- International presentations delivered in Brazil and Costa Rica.
- An IIAR presentation was delivered at the Process Heating & Cooling Show in Chicago.
- An IIAR presentation was delivered at the Ammonia Safety Day.
- Multiple presentations and facilitated discussions of enforcement awareness and General Duty Clause requirements to ensure that facility owners identify hazards using appropriate hazard assessment techniques no matter the size of the ammonia refrigeration system.
- Multiple presentations and facilitated discussions pertaining to progress in natural refrigeration codes and standards, including ammonia, carbon dioxide, and hydrocarbons.
- A webinar covering heat stress protection and cold stress protection – by membership request – due to the excessive (hot) temperatures in 2023. (IIAR added cold stress protection as a topic to cover freezers, low-temperature palletizing areas, and other areas where cold stress is a consideration.)
- Participation in the EPA's Green Chill group activities, including delivering a presentation and answering questions on the progress made in natural refrigerants, including ammonia, carbon dioxide, and hydrocarbons.

IIAR has also expanded its educational content and offerings to include online and on-demand education resources through the IIAR Learning Management System (LMS). This online resource has been critical in helping IIAR achieve its mission of education and training via a virtual medium. The Piping, CO₂, and Basic Ammonia Refrigeration courses will also be updated soon. And IIAR plans to release a “refrigerant evaluation tool” in 2024 to help managers compare refrigerants to better assess the needs of a facility. IIAR continues to work with chapters and alliance partners to establish events and education offerings throughout the world via its international events.

WHERE IS THE INDUSTRY HEADED?

In a warming world, the natural refrigeration industry stands poised to make an impact through technological developments, training, and safety education. Several factors will contribute to growth in the coming year:

Energy Efficiency

An increasing focus on energy-efficient technologies – adopted to reduce operational costs and environmental impact – will draw new groups of end users to the industry.

Thermal Systems

Interest in holistic thermal designed systems that maximize the movement of thermal energy within a building will continue to grow.

Community Benefits

Accessing the thermal energy produced by a single building and offering the thermal energy to district heating and cooling loops will yield new efficiencies.

Merging of Sectors

Traditional HVAC and industrial refrigeration contractors are manufacturing and installing solutions to broader markets and, increasingly, broadening their training and in-use understanding of new technologies.

Smart Technology Integration

The use of the IoT (Internet of Things) and smart sensors - for monitoring and controlling refrigeration systems remotely - will evolve.

Automation and Artificial Intelligence

The integration of automation and AI for predictive maintenance, optimizing system performance, and minimizing downtime will grow. More automation systems are being provided in new and existing cold storage buildings to increase efficiency and profitability. And new Automated Storage and Retrieval Systems (ASRS) are now more commonly included as the basis of design for new, larger, cold storage facilities.

Digitalization and Data Analytics

Organizations will place greater emphasis on data analytics to improve efficiency, troubleshoot issues, and enhance overall system performance.

Regulatory Compliance

The industry will see a continued adaptation to evolving regulations and standards related to refrigerants, energy efficiency, and environmental impact.

Integration with Renewable Energy

As companies move towards a greater awareness of environmental responsibility, they will continue to explore ways to integrate industrial refrigeration with renewable energy sources to reduce their carbon footprint.

Modular and Flexible Designs

The industry will continue to move towards modular and flexible system designs for easier installation, scalability, and adaptability to changing needs.

Health and Safety Measures

Infrastructure security will continue to be a focus, with heightened emphasis on health and safety features, including advancements in leak detection systems, refrigerant reduction, and advanced refrigerant recovery units.

There is an increased focus on hygiene with the COVID-19 pandemic, food recalls, and food safety regulations. Equipment provided in the food processing space is increasingly being built with a focus on hygiene. Noncorrosive materials are more commonly used on the equipment and washdown components (fan motors, control panels, etc.). Other examples of increased focus on hygiene include food-grade welds that eliminate areas for harboring bacteria and drain pans on evaporators that are designed not to splash or drip.

Construction Changes

New food storage and processing facilities have been increasingly installed with larger air units (evaporators). Many facilities are now built with the evaporator units outside of the cooled space with insulated penthouse units. These insulated penthouse air units are installed outside of the cooled space on the roof of the building, on the dock roof, or at the base of the building. Meanwhile, cold storage facilities are increasingly being built larger, higher in height, and longer in length.

SURVEY QUESTIONS

Each year we ask our members to participate in a survey created to serve as a year over year benchmark for our industry. We appreciate the response we received from past surveys. Your input has helped create the discussions in this report year-over-year. We would appreciate everyone's feedback and look forward to hearing from more members each year.

Question 1: How do you see the consolidation of major companies impacting the industry in the next three (3) to five (5) years?

Question 2: How is your company reaching out and advertising to the next generation of workers/personnel?

Question 3: As a result of the AIM act, do you see end users moving more towards:

- A. Lower GWP Synthetics
 - B. Ammonia
 - C. CO2
 - D. Hydrocarbons/Propane.
-

Question 4: How has the AIM Act impacted your business?

- A. It's a major focus for us, and we are making major changes as a result.
 - B. We are aware of the AIM Act, but it doesn't fit our business plan.
 - C. What is the AIM Act?
-

Question 5: Which of the following refrigerants do you think the general public believes is the safest for use in refrigeration? (This information is going to be used for general research/knowledge / understanding purposes.)

- A. Propane
 - B. CO2
 - C. Ammonia
-

Question 6: What information would you like to see in future reports?

To participate in the survey, go to www.iiar.org/iiar/stateoftheindustry.
Email publications@iiar.org for more information.

PARTICIPATE IN IIAR COMMITTEES

IIAR is the world's leading advocate for the safe, reliable, and efficient use of ammonia and other natural refrigerants. IIAR members share their collective knowledge and experience to produce consensus documents that address various aspects of the natural and industrial refrigeration industry. IIAR has a broad industry representation that includes manufacturers, design engineers, contractors, end users, academics, scientists, and trainers. IIAR sets the standard for providing advocacy, education, and the most up-to-date technical information to the ammonia and natural refrigeration community. We help professionals develop their skills and further their careers by promoting the common interests of members.

A list of our committees and how to be involved is on the Committee's webpage.

ABOUT IIAR

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OUR VISION AND MISSION

OUR VISION

Our vision is to create a better world through the safe and sustainable use of natural refrigerants

OUR MISSION

Our mission is to provide advocacy, education, and standards for the benefit of the global community in the safe and sustainable design, installation and operation of ammonia and other natural refrigerant systems.

