November 21, 2025

ELECTRONIC SUBMISSION

ATTN: EPA-HQ-OAR-2025-0005

U.S. Environmental Protection Agency
1200 Pennsylvania Ave NW
Washington, DC 20460

Re: Phasedown of Hydrofluorocarbons: Reconsideration of Certain Regulatory Requirements Promulgated Under the Technology Transitions Provisions of the American Innovation and Manufacturing Act of 2020; Docket No. EPA-HQ-OAR-2025-0005

To Whom It May Concern:

On Friday, October 3, 2025, the U.S. Environmental Protection Agency (EPA) published the proposed rule (NPRM), "Phasedown of Hydrofluorocarbons: Reconsideration of Certain Regulatory Requirements Promulgated Under the Technology Transitions Provisions of the American Innovation and Manufacturing Act of 2020."[1] On November 14, 2025, EPA published an extension for the comment period to this NPRM.[2] This NPRM would, perhaps most importantly, extend the compliance date for many of the hydrofluorocarbon (HFC) phasedowns that EPA previously promulgated in the Technology Transitions Rule of 2023 (the Technology Transitions Rule).[3] In addition, the NPRM would expand the compliance exemption for certain intermodal containers and adjust Global Warming Potential (GWP) thresholds in various instances.

EPA's proposed regulatory relief is a welcome development, as a matter of both economics and public safety. However, many of the potential future actions for which EPA seeks feedback as part of the Advanced Notice of Proposed Rulemaking (ANPRM)[4] to address the R-454B supply chain issues, would likely be illegal and counterproductive, and so I appreciate the opportunity to provide these constructive comments for EPA's consideration.

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[1] U.S. Environmental Protection Agency, "Phasedown of Hydrofluorocarbons: Reconsideration of Certain Regulatory Requirements Promulgated Under the Technology Transitions Provisions of the American Innovation and Manufacturing Act of 2020," *Federal Register*, Vol. 90, No. 190 (October 3, 2025), p. 47,999.
[2] U.S. Environmental Protection Agency, "Phasedown of Hydrofluorocarbons: Reconsideration of Certain Regulatory Requirements Promulgated Under the Technology Transitions Provisions of the American Innovation and Manufacturing Act of 2020; Extension of Comment Period," *Federal Register*, Vol. 90., No. 190 (November 14, 2025), p. 51,042.
[3] U.S. Environmental Protection Agency, "Phasedown of Hydrofluorocarbons: Restrictions on the Use of Certain Hydrofluorocarbons Under the American Innovation and Manufacturing Act of 2020," *Federal Register*, Vol. 88, No. 204 (October 23, 2023), p. 73,098.
[4] 90 Fed. Reg. at 48017.

Discussion

I. EPA's Technology Transitions Rule Went Beyond the Requirements of the AIM Act and Undermined the Interests of the American Public.

The American Innovation and Manufacturing (AIM) Act of 2020[5] aims to reduce the production and consumption of certain regulated HFCs,[6] by limiting their production and consumption levels to 60 percent of their 2011-13 baseline levels currently, set to escalate to a 70 percent reduction in 2029, an 80 percent reduction in 2034, and an 85 percent reduction in 2036 and thereafter.[7] Such a dramatic reduction in the availability of market-favored refrigerants will raise costs for American businesses and households, but are required by the AIM Act, purportedly to combat climate change.[8]

However, EPA has exacerbated these adverse effects by using its discretionary authority under the Technology Transitions provisions of the AIM Act[9] to set additional restrictions on the use of refrigerants containing the regulated HFCs, even to prohibit certain refrigerants years ahead of the statutorily required schedule. EPA's discretion under the Technology Transitions provisions is not limitless, however; Congress requires EPA to consider certain factors in making these additional restrictions, including "technological achievability, commercial demands, affordability for residential and small business consumers, safety, consumer costs,"[10] "overall economic costs,"[11] and "the remaining phase-down period for regulated substances."[12]

Disappointingly, EPA dismissed these Congressionally mandated affordability concerns in its 2023 rulemaking, stating that "the vast majority of affected small businesses will experience zero or positive net impacts due to the reduced cost of substitute chemicals as compared to HFCs,"[13] which of course begs the question as to why regulators would need to require such cost-saving moves if that were the case. Nevertheless, EPA also looked at some corporations' "sustainability goals" as an excuse to assume that this regulation would have either minimal or positive economic affects across entire sectors.[14] In addition, EPA rather optimistically factored in projected energy efficiency changes to further support their assumption that the rule would have minimal or positive economic effects.[15] EPA concluded "that overall,

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[5] 42 U.S.C. 7675.
[6] 42 U.S.C. 7675(c)(1).
[7] 42 U.S.C. 7675(e).
[8] *See* U.S. Senate Committee on Environment & Public Works. *Phasing Down HFCs: The AIM Act* ("HFCs have a global warming potential that is tens of thousands of times worse than carbon dioxide. With the passage of the AIM Act, the United States joins a majority of other countries in phasing down HFCs"). https://www.epw.senate.gov/public/index.cfm/phasing-down-hfcs-the-aim-act
[9] 42 U.S.C. 7675(i).
[10] 42 U.S.C. 7675(i)(4)(B).
[11] 42 U.S.C. 7675(i)(4)(C).
[12] 42 U.S.C. 7675(i)(4)(D).
[13] U.S. Environmental Protection Agency, "Phasedown of Hydrofluorocarbons: Restrictions on the Use of Certain Hydrofluorocarbons Under Subsection (i) the American Innovation Act of 2020," *Federal Register*, Vol. 87, No. 240 (December 15, 2022), p. 76,748 at 76,764.
[14] *Id.*
[15] 87 Fed. Reg. at 76,765.

the proposed rule is expected to provide net savings to the economy, which may in turn be passed on to small businesses and residential consumers."[16] EPA thus assumed away the very economic effects that Congress had charged the agency with considering when using its authority under the Technology Transitions provisions.

As businesses have continued to petition EPA to extend compliance deadlines and otherwise alter provisions of the Technology Transitions Rule, these petitioners have demonstrated the negative consequences of these provisions both on their businesses and on consumers. Hence, it is encouraging that EPA has published this NPRM, and is more open to acknowledging the harmful effects of the published Technology Transitions rule, particularly in mandating a premature move away from commercially favored to regulatorily favored refrigerants.

As EPA considers making restrictions beyond those that Congress mandated in the AIM Act, it is critical for EPA to recognize that the HFC phasedown comes at a major cost to the American public, both economically and in terms of safety. Bearing these costs in mind, it is appropriate that EPA should proceed with pronounced caution before imposing transitional requirements that go beyond the Congressional mandates laid out in the AIM Act, even where Congress has granted EPA such discretion. What's more, Congress clearly intended for EPA to take these costs into account before going beyond the Congressional mandates, as is clear in the limitations that Congress wrote into EPA's Technology Transitions authority.[17]

II. EPA Should Extend the Compliance Deadlines from its Technology Transitions Rule, to the Fullest Extent Possible, to Help Alleviate the Cost-of-Living Crisis Recognized in the time Since that Rule was Promulgated.

As noted above, the AIM Act requires EPA to consider "affordability for residential and small business consumers,"[18] "consumer costs,"[19] and "overall economic costs"[20] when making discretionary rulemakings pursuant to EPA's AIM Act Technology Transitions authority. The AIM Act also requires EPA to factor in "the best available data"[21] when making these determinations. Although EPA largely assumed away the economic costs of the Technology Transitions Rule at the time, it is not just normatively prudent, but statutorily appropriate, for EPA to better account for the economic costs of the Technology Transitions Rule, especially now that information on the actual economic effects of that rulemaking are available, rather than merely hypothetical.

To begin with, the Technology Transitions is not the only Federal regulation that is potentially increasing the cost of appliances that use refrigerants. In 2023, around the same time as EPA promulgated its Technology Transitions Rule, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) implemented stringent energy requirements

[16] *Id.*
[17] *Supra*, n. 10-12.
[18] *Supra*, n. 10.
[19] *Id.*
[20] *Supra*, n. 11.
[21] 42 U.S.C. 7675(i)(4)(A).

for air conditioners.[22] Thus, at a time when America is going through a "cost-of-living crisis,"[23] the effects of these separate regulatory mandates governing energy usage and hydrofluorocarbons reinforce and exacerbate each other, to the extent that "[a] homeowner replacing a 15-year-old system that likely cost around $5,000 at the time of installation now faces a price take in the $13,000 to $14,000 range."[24]

It is true that EPA and EERE administer separate statutes, with their own requirements, but given Congress's directive that EPA take costs, particularly for consumers, into account in the context of any Technology Transition rulemakings, EPA should take into account the reinforcing economic effects on consumers by other regulatory requirements, before adding to the burden. This lack of regulatory coordination helped create the very cost-of-living crisis that has caused the President to require executive agencies "to deliver emergency price relief, consistent with applicable law, to the American people."[25]

Unfortunately, EERE will find it challenging to mitigate the costs to consumers of its aggressive appliance standards, given underlying statutory provisions that require energy efficiency standards for air conditioners[26] and that generally prevent those standards from being loosened once finalized.[27] Attempts to loosen these energy standards on air conditioners have been specifically rejected by courts in the past.[28] However, the AIM Act lacks such an anti-backsliding clause, and EPA's phasedowns as set forth in the Technology Transitions Rule are entirely discretionary. In light of both the economic considerations with which Congress has charged EPA to consider before promulgating these rules, and in light of the affordability crisis as the cost of everyday essentials continues to grow faster than household incomes, it is critical that EPA minimize the burden of its discretionary regulatory requirements, by extending these discretionary compliance dates to the fullest extent possible.

III. EPA is Prudent to Extend the HFC Phasedown Dates as a Matter of Promoting the Safety and Security of the American Public

The AIM Act specifically requires EPA to consider safety when conducting discretionary rulemaking processes under the AIM Act's Technology Transitions authority.[29] Given this consideration, it is extraordinary that the Technology Transitions Rule requires the use of so many refrigerants that are more toxic, explosive, and/or flammable than the refrigerants being prohibited. As an example, the Technology Transitions Rule restricts retail food refrigeration of

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[22] U.S. Office of Energy Efficiency and Renewable Energy, "Energy Conservation Program: Energy Conservation Standards for Room Air Conditioners," *Federal Register*, Vol. 88, No. 102 (May 26, 2023), p. 34,298.
[23] "Memorandum on Delivering Emergency Price Relief for American Families and Defeating the Cost-of-Living Crisis," *Federal Register*, Vol. 90, No. 17 (January 20, 2025), p. 8,245.
[24] Ben Lieberman, *How to Beat the High Cost of Cooling*, WALL STREET JOURNAL, August 24, 2025. https://www.wsj.com/opinion/how-to-beat-the-high-cost-of-cooling-6604bebd?gaa_at=eafs&gaa_n=AWEtsqflfvGZZGx79WQt5-oBceAe53lEAZVAMLxpCzf6phMv93H51DPeO4p3&gaa_ts=6917d7fb&gaa_sig=736cXLJ50A8UJO5oQwgdsu_KceBfDG5ryBgBPRjHpjxVc-36BAw818n4qpdqGoPie0JgBCnnLM6V3ofvVGbmAw%3D%3D
[25] *Id.*
[26] 42 U.S.C. 6292(a)(2) and 6295(d).
[27] 42 U.S.C. 6295(o).
[28] *NRDC v. Abraham*, 355 F.3d 179 (2d Cir. 2004).
[29] 42 U.S.C. 7675(i)(4)(B).

the type used in supermarkets to alternatives that include ammonia, which is well-known for both its toxicity and potentially flammable properties.[30] Other flammable refrigerants that the 2023 rule pushed supermarkets toward using include A2L and A3L.[31]

Similar concerns were raised regarding the way that the Technology Transitions Rule incentivized cold storage warehouses to rely on ammonia-based refrigerants,[32] and in how that rule restricted Industrial Process Refrigeration in laboratory equipment to refrigerants that "are either flammable, higher toxicity, or high pressure."[33] It is an unfortunate truth that the HFCs with lower global warming potential (GWP), as a group, tend to have significantly higher flammability and extreme pressure risks. In addition, although they were not specifically noted in the NPRM preamble, similar concerns apply to the refrigerants used to replace the restricted refrigerants in the case of consumer and light commercial air conditioners.

Given that the AIM Act requires EPA to bear public safety in mind, it is unfortunate that the Technology Transitions Rule pushed ammonia-based refrigerants at the expense of safer alternatives. Even since the publication of the NPRM, there have been multiple instances of ammonia leaks and accidents throughout the United States, often in the very facilities that EPA has pushed to adopt ammonia-based refrigerants. For example, on October 31st, an ammonia leak at a cold storage facility in Kern County, California required a shelter-in-place order for residents who lived within half a mile of the leak.[34] Less than two weeks later, on November 13th, an ammonia leak in a tanker truck prompted evacuations in Weatherford, Oklahoma, with at least 36 people transported to the hospital for treatment.[35] As serious as are these recent incidents, they pale in comparison to more tragic ammonia accidents, like the 1992 accident in Dakar that led to 129 deaths and 1,150 injuries over a 5-kilometer radius.[36]

Moreover, the U.S. Government has been consistent in warning the American public about the dangers of anhydrous ammonia. Under the now-lapsed Chemical Facility Anti-Terrorism Standards[37] administered by the U.S. Department of Homeland Security's[38] Cybersecurity and Infrastructure Security Agency,[39] ammonia was designated as a "chemical of

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[30] *See* Food Industry Association's letter to EPA, dated February 11, 2025, in the docket for this action.
[31] 90 Fed. Reg. at 48,005-06.
[32] 90 Fed. Reg. at 48,009.
[33] 90 Fed. Reg. at 48,012.
[34] Kern County issues shelter-in-place order after ammonia leak south of Delano. (2025, October 31). *23 ABC Bakersfield*. https://www.turnto23.com/news/in-your-nieghborhood/delano-mcfarland/kern-county-issues-shelter-in-place-order-after-ammonia-leak-south-of-delano#:~:text=Kern%20County%20issues%20shelter%2Din,platforms%20for%20fairness%20and%20accuracy
[35] Deliso, M. & Maglunog, T. (2025, November 13). Dozens hospitalized after ammonia leaks from tanker truck in Oklahoma hotel parking lot. *ABC News*. https://abcnews.go.com/US/dozens-hospitalized-after-ammonia-leaks-tanker-truck-oklahoma/story?id=127501094
[36] Dhamavaram, S. & Pattabathula, V. (2023, July). Learning from the Worst Ammonia Accident. *American Institute of Chemical Engineers*. https://www.aiche.org/resources/publications/cep/2023/july/learning-worst-ammonia-accident
[37] 6 CFR Part 27.
[38] U.S. Department of Homeland Security. *Chemical Facility Anti-Terrorism Standards: Ammonia (Anhydrous)*. https://www.cisa.gov/sites/default/files/publications/201808-fl-ammonia-508.pdf
[39] U.S. Cybersecurity and Infrastructure Security Agency. *Chemical Facility Anti-Terrorism Standards: Ammonia (Anhydrous)*. https://www.cisa.gov/sites/default/files/publications/201808-fl-ammonia-508.pdf

interest,"[40] which raised significant security concerns if weaponized by bad actors, due to the toxic properties of ammonia, which can create a toxic plume that harms populations well beyond the initial point of release. Similarly, the Occupational Safety and Health Administration, within the U.S. Department of Labor, has recognized the potential hazard posed to workers in ammonia refrigeration facilities, and has compiled multiple resources to address ammonia refrigeration as a workplace hazard.[41]

Yet we do not even have to look to other agencies to see how dangerous ammonia can be; EPA itself has issued an alert warning stakeholders about the potential dangers of ammonia.[42] In its alert, EPA recognized that the risks from ammonia are not restricted to its toxic properties, but that the chemical also constitutes a flammability and explosion hazard.[43] It is true that these hazards can be mitigated, and the EPA alert does an admirable job listing potential safety measures. Yet these measures constitute a 30-bullet list, which represents significant time and expense for installing and running such systems. Moreover, as helpful as such lists can be, they also represent significant vulnerability, inasmuch as any safety measure that is overlooked becomes a potential risk to the broader community.

Given the significant and widely recognized safety and security risks inherent in ammonia refrigeration and other low-GWP HFCs, the Technology Transitions Rule raised significant Federalism concerns, insofar as EPA's promotion of potentially toxic, flammable, and explosive refrigerants potentially contradicts the building codes of the States and municipalities in which the refrigerants are being used. Indeed, Congress recognized these concerns when it mandated that EPA factor in building codes when making any Technology Transition rules.[44]

Yet even without looking at such federalism concerns, it is sufficient to note that Congress required EPA to take safety into account in the AIM Act.[45] EPA is right to meet this statutory goal by extending the HFC compliance deadlines, and should not encourage the use of less safe refrigerants ahead of the schedule mandated by Congress.

IV. The AIM Act's Technology Transition Provisions Containing the One-Year Effective Date Requirement are Best Read as Not Applying to Rules that Relax or Remove Existing Restrictions

a. EPA is Correct to Understand the Statutory Lead Time Requirement as Applying to New Restrictions, Rather than to Regulatory Relief

The AIM Act's Technology Transition provisions state that "[n]o rule under this subsection may take effect before the date that is 1 year after the date on which the Administrator

[40] 6 CFR Part 27, Appendix A (listing ammonia as a Chemical of Interest).
[41] U.S. Occupational Safety and Health Administration. *Ammonia Refrigeration*. https://www.osha.gov/ammonia-refrigeration/evaluation-control
[42] U.S. Environmental Protection Agency. *Hazards of Ammonia Releases at Ammonia Refrigeration Facilities (Update)*. (August 2001). https://www.epa.gov/sites/default/files/2013-11/documents/ammonia.pdf
[43] *Id.* at p. 2.
[44] 42 U.S.C. 7675(i)(4)(B).
[45] *Id.*

promulgates the applicable rule under this subsection."[46] EPA is correct to interpret this provision as applying only to rules creating new restrictions, not to rules that relax or remove existing restrictions.[47]

Due process of law, as enshrined in the Fifth and Fourteenth Amendments of the U.S. Constitution, has generally been understood as requiring that regulated parties be given time to comply with new legal requirements. There is no single, universally accepted timeframe that constitutes sufficient notice to comply, but these requirements are often set in specific statutes. For example, the Administrative Procedure Act (APA) sets a general requirement of 30 days before which published Final Rules can take effect.[48] However, the APA contains an exception for "a substantive rule which grants or recognizes an exemption or relieves a restriction."[49] This is logical, given that regulatory relief by its nature helps the regulated stakeholders, unlike regulatory restrictions, which can harm their commercial and property interests without sufficient time to comply. Thus, to apply this same time lapse requirement would effectively transform the shield that due process creates to help protect regulated stakeholders, into a sword that would effectively harm obligated parties by denying regulatory relief, particularly in cases where that relief may be time-sensitive or urgent.

Section 7675(i)(6) of the AIM Act should be understood within the context of regulatory due process, as grounded in the decades of practice and evidence provided by the APA. Given that the technology transitions required to facilitate any HFC phasedowns would, by their nature, be very difficult if not impossible for the relevant industries to comply with under the APA's 30-day timeframe, the AIM Act's yearlong notice requirement provides the regulated industries with enhanced due process rights, compared to what regulated stakeholders would generally be entitled to under the APA. It would be extraordinary to treat this clear demonstration of Congressional relief, in comparison to notice requirements under the APA, as a rationale to then deny stakeholders the rights to regulatory relief that the APA would otherwise provide them.

This is particularly true when, as here, the relief is precipitated in part by concerns as to whether the regulated industry even has the capacity to meet regulatory targets within the required timeframe. Indeed, EPA itself demonstrated its recognition of this principle during the previous administration, when administering these same provisions of the AIM Act. On December 26, 2023, EPA published an Interim Final Rule (IFR) to allow an additional year of compliance for the installation of new residential and light commercial air conditioning and heat pump systems.[50] In that case, EPA used the "Good Cause exception" (which exists in the APA[51] and not in the AIM Act) to publish the IFR, which created regulatory relief without any notice-and-comment period, to extend the compliance deadline to January 1, 2026.

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[46] 42 U.S.C. 7675(i)(6).
[47] *See* 90 Fed. Reg. at 48015.
[48] 5 U.S.C. 553(d).
[49] 5 U.S.C. 553(d)(1).
[50] U.S. Environmental Protection Agency, "Phasedown of Hydrofluorocarbons: Technology Transitions Program Residential and Light Commercial Air Conditioning and Heat Pump Subsector," *Federal Register*, Vol. 88, No. 246 (December 26, 2023), p. 88,825.
[51] 5 U.S.C. 553(d)(3).

Given that the compliance dates have not yet taken effect, and given the well-recognized principle that agencies can postpone or suspend effective compliance dates that have not yet taken effect, even after the relevant rule has been published, EPA is on strong ground to interpret Section 7675(i)(6) as applying to new rules for obligated parties to follow, rather than to regulatory relief. In the same way that EPA issued such regulatory relief in December 2023, when they understood that the requirements of the original Technology Transitions Rule were too aggressive for industry to follow along the initially proposed timeline, EPA is justified in providing that relief again.

b. There are No Legitimate Reliance Interests to Prevent EPA's Proposed Regulatory Relief

For the following reasons, there are no justifiable reliance interests on the part of any relevant parties that prevent EPA from acting on its proposed regulatory relief measures.

First, while the language of the AIM Act mandates certain HFC quotas, the AIM Act specifically leaves any promulgations under the Technology Transitions provisions to EPA's discretion.[52] As part of this discretion, Congress has required EPA to hear petitions from affected parties.[53] The challenges in meeting the HFC phasedowns required by the Technology Transitions Rule are well-established, and multiple stakeholders across the breadth of affected industries had requested compliance extensions through petitions, which EPA made publicly available as statutorily required.[54] Thus, all the regulated stakeholders had fair warning that: (1) the Technology Transition Rule, to the extent that it exceeded the AIM Act's requirements, fell within EPA's discretion; (2) that EPA's discretion included the responsibility to respond to petitions; and (3) that multiple petitioners had requested an extension to the compliance requirements of the Technology Transitions Rule and had demonstrated their need.

Second, and relatedly, administrative agencies possess inherent authority to reconsider their decisions.[55] Thus, the language of the AIM Act, combined with the public availability of the petitions for reconsideration and the well-established traditions of administrative discretion, made clear to any regulated stakeholder that the requirements were subject to extension before their effective dates came due.

Third, EPA had previously used its discretion under the AIM Act to extend certain compliance requirements under the Technology Transitions Rule,[56] which gave fair notice that the industry was struggling to comply with the requirements of the Technology Transitions Rule, and which provided precedent that demonstrated EPA's power and willingness to extend the compliance dates when necessary to mitigate the negative effects of the 2023 rule.

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[52] 42 U.S.C. 7675(i).
[53] 42 U.S.C. 7675(i)(3).
[54] 42 U.S.C. 7675(i)(3)(C)(iii).
[55] *See, e.g., Spanish Int'l Broadcasting Co. v. FCC*, 385 F.2d 615, 621 (1967); *Sierra Club v. Antwerp*, 560 F. Supp. 2d 21, 23 (2008); *ConocoPhillips Co. v. EPA*, 612 F.3d 822, 832 (5th Cir. 2010).
[56] 88 Fed. Reg. 88825.

Fourth, the costs of the HFC phasedown have been tremendous, as reflected in the Presidential Memorandum calling on EPA and other agencies to address the cost-of-living crisis, and as have been reflected in the skyrocketing costs for many refrigerants, and supply shortages, resulting from the Technology Transitions Rule. This is particularly true given that the factual predicates upon which EPA relied when adopting the Technology Transitions Rule, in which EPA largely assumed away economic effects that instead proved massive, were in fact wrong. It would be complacent for any industry member to expect that EPA would not consider extending compliance deadlines for regulations that proved to be more costly than EPA had predicted.

Fifth, this NPRM is a liberalizing measure, permissive rather than prescriptive in nature. Nobody will be legally required to change their behavior in response to this rulemaking action. This NPRM would not prohibit any refrigerants with lower GWP values from being sold or manufactured, but would simply allow manufacturers, importers, and contractors to offer a broader variety of options, including safer and more cost-effective options, to commercial buyers and consumers.

In this context, it is worth bearing in mind that some industry members benefit from the regulatory creation of captive markets, which increase the cost burden of smaller competitors and force consumers to pay for more expensive, less competitive products from the regulatorily created market. This is not a legitimate reliance interest, particularly in the context of requirements that have not yet taken effect, and that have been shown so conclusively to damage both consumers and many industry participants who absent the regulation are able to offer more cost-effective and competitive products. This is particularly true given that this proposal would not remove any choices or participants from the market, but will instead benefit the consumer by fostering greater choice through competition.

Sixth, and finally, even if the agency "ultimately concludes that the reliance interests rank as serious, they are but one factor to consider."[57] Balancing the totality of considerations weighed in the NPRM and in these comments, along with the factors that weigh against reliance as listed above, EPA should find that there are no reliance interests sufficient to bar the extension of the compliance dates and any other regulatory relief proposed in this rulemaking.

c. The Comments on the Rulemaking Docket Substantiate the Lack of any Reliance Interests to Counter EPA's Proposal

As of the morning of the original comment deadline for this rulemaking proposal, namely November 17th, 2025,[58] there was only a single comment on the docket that claimed reliance interests against EPA's proposal to delay the compliance dates. Yet this comment, from Hill Phoenix, Inc.,[59] unintentionally demonstrates the profound weakness of the claimed reliance interests.

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[57] *DHS v. Regents of the University of California*, 591 U.S. 1, 32 (2020).
[58] 90 Fed. Reg. at 47999.
[59] Hill Phoenix, Inc., Comments on Proposed Rule "Phasedown of Hydrofluorocarbons: Reconsideration of Certain Regulatory Requirements Promulgated Under the Technology Transitions Provisions of the American Innovation and Manufacturing Act of 2020," EPA-HA-OAR-2025-0005-0015 (October 24, 2025) (on file with Environmental Protection Agency).

To begin with, Hill Phoenix claims that they, "in good faith, invested heavily in low-GWP refrigerant technologies." Although Hill Phoenix does not provide any additional details on these investments, they write as support, "Since 2006, Hill Phoenix has installed more than 20,000 CO_2 systems globally." Yet this timeline starts well before the publication of the Technology Transitions Rule in 2023, or even the passage of the AIM Act of 2020. The one comment currently on the docket cites activities starting 17 years before the Technology Transitions Rule was even finalized. This demonstrates how incumbents have not been acting in reliance on any EPA actions, so much as using the Technology Transitions Rule to enforce a captive market against competitors.

In the second section of their comment, Hill Phoenix claims that "[a]ltering the transition dates now would undermine years of planning," an extraordinary claim given that the Technology Transitions Rule was less than two years old when the current NPRM was published. There is simply no way that "years of planning" and investment could have been performed in response to the promulgation of the Technology Transitions Rule in 2023. To the extent that such years of investment have occurred, they would clearly be in response to profit-maximizing considerations, factors that predated the Technology Transitions Rule, which, at most (and at worst), would have created a regulatorily captive market to reward their preexisting investments. This is not a valid reliance interest, as traditionally understood.

Less revealing and more odd is Hill Phoenix's claim that "[t]he AIM Act has provided the regulatory certainty necessary for continued investment and job creation." First, the AIM Act provided statutory rather than regulatory certainty, and that the AIM Act's statutory provisions remain in place. Second, the statutory certainty from the AIM Act arises from separate provisions that mandate HFC drawdowns on a schedule stretching out to 2036.[60] For better or worse, these scheduled drawdown quotas remain unchanged, and allow industry certainty around which to plan their operations, absent a statutory change.

Yet the 2023 Technology Transitions Rule was never certain in the same way; under the very terms of the enabling statute, any regulation under those provisions of the AIM Act go beyond the statutorily required mandates provided Congress, and remain open to adjustment by EPA. It is thus strange for them to argue that the statute provided the certainty for them to proceed, when the Technology Transitions Rule by its very name and reasoning traced EPA's authority to the part of the statute where the HFC standards were variable by EPA, and not fixed by Congress.

In the third section of their comment, Hill Phoenix dismisses the incremental costs to grocery stores of these regulations as "modest," before describing them as "approximately $68,000 to $100,000—on an overall investment exceeding $1 million." Yet this is an extraordinary admission; such a figure represents 6.8 to 10 percent of the overall costs they cite, which in terms of business profitability is not at all a trivial figure, especially to a small business. Nor are seven-digit investments in a single store. This is particularly the case for businesses with

[60] 42 U.S.C. 7675(e).

tight profit margins, such as grocery stores that have famously thin profit margins of 1 to 3 percent.[61]

Perhaps more comments may be posted nearer to the new deadline, with additional arguments. However, it is noteworthy how the lone comment currently arguing in *favor* of the existence of reliance interests allegedly hurt by the proposal has in fact demonstrated the extent to which such arguments can be used to justify a captive market, based on investments that long predated the regulation and even statute in question, in the absence of true reliance interests.

V. EPA's Proposal to Remove the Installation Cutoff for Legacy Split-System AC/HP Equipment Manufactured or Imported Before January 1, 2025 is a Commendable and Important Measure

It is commendable for EPA to recognize that the deadlines in the Technology Transitions Rule would result in stranded inventory, given the that the January 1, 2026 restriction on installation would have had on inventory that had already been manufactured and imported into the United States before January 1, 2025.[62] Requiring obligated stakeholders to write off this inventory would raise the cost of new residential construction, particularly given that over $1 billion of inventory must be abandoned before the original January 1, 2025 compliance date.[63] Even if 90 percent of that inventory (optimistically) had been used up in time for the new deadline extension, $100 million in stranded inventory would remain. To comply with EPA's prohibition, all of this remaining stranded inventory would represent an economic loss.

Moreover, the environmental consequences of for EPA to require the disposal (and waste) of such unused, yet safe and functional R-410A refrigerant systems would be highly negative, which is all the more ironic given the environmental motivations that underlay the economically costly Technology Transitions Rule in the first place. Simply requiring the redundant manufacture of these systems would by itself have negative environmental effects, yet that does not even consider the question of how the functional inventory would be disposed of. To the extent that such inventory was illegally vented, EPA's ban on this inventory would be exacerbating the environmental harm, in the context of an economically costly regulation meant to advance environmental interests. It is far better, both economically and environmentally, for EPA to allow the proper deployment of these systems rather than effectively mandate their waste and destruction.

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[61] Griffith, J. (2024, August 29). *Food Profit Margins Shrink, But Harris Blames Them for Rising Grocery Bills*. American Institute for Economic Research (detailing how grocery store profit margins shrank in 2023 for the 3rd consecutive year, to 1.6 percent).
https://thedailyeconomy.org/article/food-profit-margins-shrink-but-harris-blames-them-for-rising-grocery-bills/

[62] *See* 88 Fed. Reg. at 88825.

[63] 88 Fed. Reg. at 88827.

VI. In Response to the ANPRM, the Recent Supply Chain Challenges Facing R-454B are Caused by EPA's Interference in the Market Through the 2023 Technology Transitions Rule, and can Only be Resolved by Lessening the Regulatory Burden on the Industry

Although it is encouraging that EPA recognizes the recent challenges relating to the R-454B supply,[64] some of the solutions for which EPA seeks comment in the ANPRM are alarming. In particular, EPA's discussion of "potential future actions that include but are not limited to" a price cap or similar mechanisms to prevent what EPA characterizes as "price gouging," "a requirement that equipment manufacturers provide the necessary amount of R-454B or other refrigerants experiencing shortages for installation of equipment, particularly when contractors and technicians are unable to acquire the refrigerants readily," and "compulsory licensing agreements"[65] are deeply concerning, in that they seem to indicate EPA's refusal to acknowledge how its previous actions have directly caused this shortage, and also because EPA's suggested policy responses are both illegal and counterproductive.

a. EPA's Proposed Actions in the ANPRM are Not Statutorily Authorized

As a preliminary matter, it should be sufficient to note that EPA's suggested price caps, compulsory licensing agreements, and requirements that manufacturers provide R-454B are flagrantly illegal under the AIM Act. Under its statutory structure, the AIM Act merely provides for mandatory phasedowns[66] of the "regulated substances"[67] listed[68] in the statute, and allows discretion for EPA to make additional rulemakings, under its Technology Transitions authority, to further restrict "the use of a regulated substance."[69] Nothing in this statute authorizes EPA to promulgate regulations governing substances that are not regulated under the statute.

Although the statute does provide EPA with limited discretion to add to the statutory list of regulated substances,[70] this discretion is limited to saturated HFCs[71] with an exchange value greater than 53;[72] in other words, this power is limited to HFCs with elevated GWP. Moreover, even in these cases, as with the statutorily listed HFCs, EPA's power is limited to mandating the statutorily required phasedowns, and imposing further restrictions if warranted under the Technology Transitions authority.

In *West Virginia v. EPA*,[73] the Supreme Court recently prevented EPA from granting itself regulatory authority over questions of "vast economic and political significance, unless such authority is clearly granted by Congress." Because such extraordinary regulatory authority is rarely granted through modest, vague, or subtle wording, the agency must point to "clear

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[64] *See* 88 Fed. Reg. at 48014.
[65] 88 Fed. Reg at 48017.
[66] 42 U.S.C. 7675(e).
[67] 42 U.S.C. 7675(b)(11).
[68] 42 U.S.C. 7675(c)(1).
[69] 42 U.S.C. 7675(i)(1).
[70] 42 U.S.C. 7675(c)(3).
[71] 42 U.S.C. 7675(c)(3)(i)(I).
[72] 42 U.S.C. 7675(c)(3)(i)(II).
[73] 597 U.S. 697 (2022).

congressional authorization." In *Loper Bright Enterprises v. Raimondo*, the Court further confirmed that agencies are required to adhere to the "single, best"[74] meaning of the authorizing statute. In light of this recent Supreme Court caselaw, it is extraordinary that EPA would publish an ANPRM seeking ideas to inform the future actions mentioned in the Advance Notice.

The AIM Act only allows EPA to regulate items on the list of regulated substances, and the permissible regulations are only to guide phasedowns and further restrictions of such substances. The Act contains no language authorizing or even contemplating that EPA would mandate the availability of or in any way proactively encourage the use of HFCs that remain unregulated under the AIM Act. Indeed, it can be seen that EPA is not empowered to regulate HFCs excluded from the list because the list itself is referred to the "list of regulated substances."[75] It is essentially a tautology to point out that the AIM Act only authorizes EPA to regulate substances on the list of regulated substances. Thus, EPA's suggested price caps and compulsory measures to require the availability of R-454B, or any other refrigerant that remains outside the list of regulated substances, is clearly unauthorized, and such suggested measures should be immediately abandoned.

b. As an Economic Matter, Price Caps and Mandates Would Exacerbate Rather than Ameliorate Supply Chain Challenges

Price controls, including price caps, have long been established as famously counterproductive, particularly in the context of relatively new products such as R-454B. It has been repeatedly shown in the economic literature that capping prices causes shortages[76] and diverts commerce to the black market.[77] Fixing prices below their market price causes two negative effects; price caps stimulate demand by lowering the price, even while disincentivizing production, given how profitability is limited by the price cap. The result quite readily leads to shortages and/or black market commerce, particularly when large volumes of the product are needed.

R-454B is a relatively new refrigerant, having first been developed in 2018. Moreover, the refrigerant became far more sought after as a result of the Technology Transitions Rule in 2023. The product is made by both the Chemours Company and Honeywell, which continue to build the infrastructure to produce R-454B. Yet in April of 2025, Honeywell announced a surcharge of 42 percent, citing "unprecedented demand for R-454B, which cannot be met with domestic production alone." EPA is clearly aware of this, given that EPA included Honeywell's announcement in the rulemaking docket, but seems to have taken the wrong lesson from this.

The problem here is the "unprecedented demand," which EPA has effectively created through the Technology Transitions Rule. Fixing prices, as EPA proposes, will do nothing to improve supplies, but will only increase demand further to the extent that any prices fall. As anybody who remembers the shortages and hoarding that took place during the COVID-19 pandemic, this threatens to create a doom loop that only further exacerbates the shortage, as fears

[74] *Loper Bright Enterprises v. Raimondo*, 603 U.S. 369 (2024).
[75] 42 U.S.C. 7675(c)(1).
[76] *E.g.*, Mankiw, N.G. (2011). *Principles of Microeconomics* (6th ed.), pp. 112-13.
[77] *E.g.*, Krugman, P. & Wells, R. (2008). (2nd ed.), p. 125.

of the consequences of the shortage induce people to buy excessive amounts when the product becomes available, so as to protect themselves from any shortage in future. This is particularly true for a product as vital as the refrigerants necessary for cooling.

Thus, EPA should avoid any price caps or compulsory licensing requirements, which would only worsen the R-454B supply challenges rather than ameliorate them.

c. The Best way for EPA to Combine These Economic and Statutory Considerations is to Rescind the 2023 Technology Transitions Rule

The shortages, price spikes, and stockpiling of R-454B refrigerants that have characterized the spring and summer of 2025 occurred as a direct result of the EPA regulations that are effectively requiring the industry to move on from the commercially favored refrigerant, R-410, to EPA's regulatorily favored R-454, ahead of the statutory schedule required by the AIM Act. By forcing the market to make this transition ahead of the statutory timeline, EPA has prematurely removed R-410 from the U.S. market. The forced removal of R-410 has simultaneously lowered the overall supply capacity for these refrigerants, thereby putting more pressure on R-454 (and, to a lesser extent, R-32) to meet all of the demand that R-410 had previously satisfied. This is further exacerbated by EPA's effective creation of a captive market through regulatory means, which has given duopoly power over the U.S. market to the two main producers of R-454, namely the Chemours Corporation and Honeywell.

At the same time as Honeywell has announced the need to hike R-454 prices by more than 40 percent, explaining that U.S. demand has outstripped domestic manufacturing capacity to the extent that Honeywell now needs to import R-454 to meet demand, the other company in the duopoly, Chemours, has petitioned EPA to enforce the provisions of the Technology Transitions Rule more rigidly. This clearly illustrates how EPA's overeager promulgation of the Technology Transitions Rule has created a regulatorily favored, captive market that has benefited two companies at the expense of the rest of the U.S. economy.

Given that the R-454 supply crisis has effectively been created by the regulations that EPA promulgated in the Technology Transitions Rule, the simplest solution is not to add more regulations, rules, or restrictions into the mix, but rather simply to rescind that rule, to the fullest extent possible. The R-454 supply crunch is a classic example of the unintended consequences that occur through intrusive regulations. Rather than try to correct these effects through additional layers of rules that would create further economic distortions, which in any event are not even authorized by the enabling statute in this case, the far simpler, and far more effective strategy, would be for EPA to rescind the 2023 Technology Transitions Rule, and provide the industry as much time to transition as possible until the AIM Act's statutory phasedown quotas take effect.

Attachments

For your consideration, please find included five attachments, which provide strong support for EPA's proposed regulatory relief, and indeed provide support for the fullest possible rescission of the 2023 Technology Transitions Rule.

Three of the attachments, specifically an EPA Alert, and fact sheets from DHS and CISA, speak to the long-recognized safety and security risks inherent in ammonia refrigeration, and should hopefully persuade EPA to refrain from providing regulatory incentives to use ammonia, and any other toxic or flammable refrigerants, at the expense of safer alternatives.

Another attachment, a column in the *Wall Street Journal* by Ben Lieberman entitled, "How to Beat the High Cost of Cooling," published on August 24, 2025, provides succinct and detailed analysis into how EPA's Technology Transitions Rule and EERE's energy efficiency requirements have reinforced each other to dramatically increase the costs of residential air conditioning systems to consumers.

Finally, please find attached a November 2025 report from the CO_2 Coalition, which shows how miniscule any global warming effect would be from the Technology Transitions Rule. This report reinforces the point that, even taking EPA's previously stated climate change concerns into consideration, any environmental effects are far too minor to justify the significant economic damage caused by the Technology Transitions Rule, including the upcoming deadlines that EPA is now proposing to extend.

Conclusion

For the reasons stated above, EPA's proposed action to extend the compliance deadlines, expand the exemption for certain intermodal containers, and adjust GWP thresholds in various instances, all represent welcome relief for U.S. industry and for consumers. Yet even these moves do not go far enough, as EPA itself has recognized by including the ANPRM that constitutes Part VII of the published NPRM.[78] To the very real extent that damaging economic distortions remain, notwithstanding the regulatory relief within this NPRM, the most effective response would be simply to rescind the 2023 Technology Transitions Rule entirely, or at least to the fullest extent that EPA is willing to contemplate, rather than to attempt to add further regulations or restrictions to address the distortions that remain from the Technology Transitions Rule.

Thank you for your consideration of these comments.

Respectfully yours,

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[78] 90 Fed. Reg. at 48017.

[79] These comments are submitted in my personal capacity and do not necessarily represent the views of The Heritage Foundation.

Chill Out: AC Refrigerants Cause Negligible Warming

Frits Byron Soepyan, Ph.D.

November 2025

CO2COALITION

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ABSTRACT

The refrigerant R-410A, which has been used in heating, ventilation, and air conditioning (HVAC) systems since 2010, is in the process of being phased out due to the American Innovation and Manufacturing (AIM) Act of 2020 and the regulation passed by the Biden Administration's United States Environmental Protection Agency (U.S. EPA). The purported warming caused by the hydrofluorocarbons (HFCs) that comprise the refrigerant R-410A was cited as the reason behind this move. As a result, the refrigerant R-410A was to be replaced with more "environmentally friendly," but at the same time, more flammable and more expensive, alternatives.

To determine if such a move is necessary, the concentration and radiative forcing of the above-mentioned HFCs were used to predict the temperature rise caused by the continued emission of the current refrigerant. Based on our estimates, the continued emission of R-410A into the atmosphere would cause a temperature increase of about 0.044 °C in 100 years. Such a rise in temperature is negligible and cannot be measured or felt.

Moreover, the proposed replacements for the refrigerant R-410A also contain greenhouse gases with lower, but still very high global warming potential. These replacement refrigerants are expected to cause a warming of about 0.013 °C in 100 years. This means that the net warming averted by the switch is an incredibly small 0.03 °C in 100 years.

Therefore, curbing the emissions of refrigerants into the atmosphere is unnecessary and would have minimal effect on the climate, while at the same time, would increase the cost and fire risk for consumers. Given this conclusion, the selection of refrigerants for air conditioning systems should be based on the safety and the needs of the consumers, rather than on a purported environmental benefit.

INTRODUCTION

The refrigerant R-410A has been "one of the most used refrigerants"[1] and has been used in heating, ventilation, and air conditioning (HVAC) systems since 2010.[2,3,4] The refrigerant R-410A proved to be advantageous compared to its predecessor, R-22, as not only is R-410A cheaper and not flammable, but using R-410A, instead of R-22, allows the HVAC system to work more efficiently, and R-410A does not damage Earth's ozone layer, as was alleged for R-22.

But despite these advantages, the refrigerant R-410A may also be phased out due to the American Innovation and Manufacturing (AIM) Act of 2020[5] and the regulation passed by the Biden Administration's United States Environmental Protection Agency (U.S. EPA), which claimed that hydrofluorocarbons (HFCs) that comprise refrigerants have significant warming effects on the climate:

> *"Hydrofluorocarbons (HFCs) are potent greenhouse gases developed and manufactured as replacements for ozone-depleting substances … They can have impacts on the climate hundreds to thousands of times greater than the same amount of carbon dioxide (CO_2). The impact is measured by the global warming potential (GWP) of a substance; one kilogram of a greenhouse gas with a GWP of 700 has an impact on the climate that is 700 times stronger than one kilogram of CO_2, which has a GWP of 1."*[6]

In response, the U.S. EPA under the Biden Administration mandated an 85% "phasedown" of HFCs by 2036.[7] Such a "phasedown" involved specifying allowances for the production and use of HFCs. Starting on January 1, 2025, restrictions were to take effect on the use of HFCs with high global warming potential for aerosols, foams and refrigeration, air conditioning, and heat pump equipment.[6]

Because the current refrigerant (R-410A) used by HVAC systems consists of 50% HFC-32 (CH_2F_2) and 50% HFC-125 (C_2HF_5),[8,9] and has a global warming potential of 2,088, which is considered extremely high, this refrigerant is being phased out.[2,10] Instead, more "environmentally friendly" and "sustainable" refrigerants were to be used, including R-454B and R-32, both of which also have high global warming potentials of 466 and 675, respectively.

The replacement refrigerant R-32 consists of the chemical CH_2F_2 (HFC-32).[11] The other replacement refrigerant, R-454B, is a mixture of about 69% R-32 (HFC-32) and 31% R-1234yf (which consists of the hydrofluoroolefin, i.e., HFO, HFO-1234yf, or CF_3CFCH_2).[12,13,14]

The transition from the current refrigerant (R-410A) to its replacements (R-454B and R-32) comes with major drawbacks in terms of safety and cost. For starters, while the current refrigerant has "no flame propagation," the proposed replacements are "mildly flammable".[10] This transition would mean that homes and businesses with HVAC systems that use the new refrigerants have greater fire risks, and the necessary additional precautions taken during the installation would result in higher bills.[15] Furthermore, a shortage in the replacement refrigerant R-454B due to high demand has resulted in soaring prices, further punishing homeowners and businesses.[5,15]

Given this situation, the question now becomes: Does the current refrigerant R-410A really cause dangerous warming to the point that we must sacrifice safety and pay more to install new HVAC systems?

To answer this question, we crunched the numbers.

METHODS

Given that the global warming potential has been used as a metric to justify the phasing down of the refrigerant R-410A, it is worth mentioning that the global warming potential is not an

appropriate quantity to use for estimating the warming caused by greenhouse gases.[16,17] For instance, the global warming potential quantifies the warming caused by the release of 1 kilogram (kg) (about 2.2 pounds) of a greenhouse gas over a specified time period relative to carbon dioxide (CO_2). However, given that greenhouse gases exist in the atmosphere in different amounts, using the global warming potential to compare the warming caused by these greenhouse gases makes for a misleading comparison. In addition, the global warming potential does not consider the atmospheric lifetimes of the greenhouse gases. Nor does the global warming potential account for feedback (i.e., warming amplification or diminishment) from the most abundant and dominant greenhouse gas in Earth's atmosphere by far: water.[18]

Given the shortcomings of the global warming potential, the combination of the radiative forcing (which quantifies the solar heat being retained by a greenhouse gas)[19] and concentration of each greenhouse gas have been recommended as the more reliable quantities for estimating the warming caused by each greenhouse gas.[16,17] Therefore, these metrics will be used to estimate and compare the feedback-free warming caused by the emissions of the chemicals that comprise the refrigerants R-410A (HFC-32 and HFC-125), R-454B (HFC-32 and HFO-1234yf), and R-32 (HFC-32). In addition, the water feedback will be considered, and it will be shown to be almost certainly negative, i.e., almost certainly *diminishes* the warming caused by the chemicals comprising the above-mentioned refrigerants.

The feedback-free warming caused by the emissions of the chemicals that comprise the refrigerants can be estimated by using the following equation:[20]

$$\Delta T = \lambda \Delta F. \quad (1)$$

In this equation, ΔF denotes the change in radiative forcing of each greenhouse gas over time, ΔT is the temperature increase associated with the change in radiative forcing over time, and λ represents the climate sensitivity parameter, which quantifies the response of the worldwide mean surface temperature to the radiative forcing.

Unfortunately, no agreement has been reached regarding the value of the climate sensitivity parameter λ in equation (1). For instance, de Lange et al.[19] estimated a value of 0.18 °C m^2 W^{-1} for the climate sensitivity parameter through the incorporation of the change in the radiative forcing of greenhouse gases due to the change in altitude (where the atmosphere becomes thinner at increasing altitude), the annual change in the concentrations of the greenhouse gases, and the estimated temperature increase due to greenhouse gases. But if the temperature increase due to greenhouse gases is assumed to be uniform, regardless of altitude, the estimated value of the climate sensitivity parameter becomes 0.26 °C m^2 W^{-1}.[19,21,22] On the other hand, Soepyan et al.[23] estimated a value of 0.23 °C m^2 W^{-1} for the climate sensitivity parameter, based on the Stefan-Boltzmann law, the thermal emissivity of Earth (from satellite observations), and the effects of increasing greenhouse gases on Earth's emissivity and temperature. Meanwhile, the Intergovernmental Panel on Climate Change (IPCC) described the

climate sensitivity parameter as "a nearly invariant parameter … for a variety of radiative forcings," with a typical value of about 0.5 °C m^2 W^{-1}.[20]

Given these variations in the value of the climate sensitivity parameter λ, we have opted to use the value of 0.5 °C m^2 W^{-1} suggested by the IPCC to provide a conservative estimate.

RESULTS AND DISCUSSIONS

The calculations for the estimates of the feedback-free warming caused by the emissions of the chemicals that comprise the refrigerants R-410A (HFC-32 and HFC-125), R-32 (HFC-32), and R-454B (HFC-32 and HFO-1234yf) are summarized in Table 1. We first begin with the concentrations of HFC-32 and HFC-125 in 2012 and 2019,[9] and the concentrations of HFO-1234yf in 2014 and 2019.[24] The concentrations of these chemicals during these years were used to compute the rate of increase of the concentrations of these chemicals, assuming a linear rate of increase.

Afterwards, we continued with the radiative forcing of these chemicals, with the values for HFC-32 and HFC-125 provided by Zhang et al.,[9] and the value for HFO-1234yf provided by Hodnebrog et al.[13] Then, the values of the radiative forcing were multiplied with the rates of increase in concentration to obtain the rates of increase in the radiative forcing of these chemicals. Finally, Equation (1) was used to estimate the warming caused by the emissions of these chemicals, where the rates of increase in the radiative forcing of these chemicals were multiplied with the climate sensitivity parameter of 0.5 °C m^2 W^{-1}.

Table 1: *Estimated warming caused by HFC-32, HFC-125, and HFO-1234yf.*[9,13,24]

Chemical	Concentration (ppt)		Concentration Increase (ppt $year^{-1}$)	Radiative Forcing (mW m^{-2} ppt^{-1})	Increase in Radiative Forcing (mW m^{-2} $year^{-1}$)	Temperature Increase (°C $year^{-1}$)	Temperature Increase (°C in 100 years)
	2012	**2019**					
HFC-125	12.1	30.0	2.6	0.239	0.61	0.00031	0.031
HFC-32	6.28	21.5	2.2	0.12	0.26	0.00013	0.013
	2014	**2019**					
HFO-1234yf	0.03	0.81	0.16	0.03	0.0047	0.0000023	0.00023
					Total:	**0.00044**	**0.044**

°C = degree Celsius
m = meter
mW = milliwatt, 1 mW = 10^{-3} W
ppt = parts per trillion, 10^{12} ppt = 100%
W = Watt

Because the current refrigerant R-410A is comprised of HFC-125 and HFC-32, the warming caused by the continued emission of this refrigerant amounts to 0.044 °C in 100 years, which is already absurdly small. Meanwhile, the continued emissions of either R-32 (comprised of HFC-

32) and R-454B (comprised of HFC-32 and HFO-1234yf) would cause a warming of 0.013 °C in 100 years, i.e., a value more than three times smaller than that for R-410A.

Taking the differences between the warming caused by the continued emission of R-410A to those from R-454B and R-32, replacing the refrigerant R-410A with either R-454B or R-32 would reduce the warming caused by the refrigerant's emission by 0.030 and 0.031 °C in 100 years, respectively. This temperature difference is so small that it cannot be measured or felt.

Turning now to the question of feedbacks from atmospheric water, Le Chatelier's principle states:

> *"If a system at equilibrium is disturbed by a change in temperature, pressure, or the concentration of one of the components, the system will shift its equilibrium position so as to counteract the effect of the disturbance."*[25]

In other words, feedbacks from atmospheric water to HFC and HFO warming are almost certainly negative. Since water is vastly more abundant in the atmosphere than HFCs and HFOs, and can be about 100 times more abundant in the atmosphere than CO_2, depending on the region,[26] this negative feedback to HFC and HFO warming is likely to be overwhelming. In other words, it is almost certain that the calculated tiny warming effects of the HFCs and HFO in Table 1 are *overestimates* of the true warming effects of HFCs and HFOs in Earth's atmosphere.

CONCLUSION

Based on the tiny amount of feedback-free warming from the hydrofluorocarbons (HFCs) that constitute the refrigerant R-410A, and the diminishing effects of atmospheric water to that warming, any measures for curbing the emissions of these HFCs into the atmosphere are unnecessary and serve no useful environmental purpose. Therefore, the selection of the refrigerants for air conditioning systems should be based on both the safety and the needs of the consumers, rather than on a purported environmental benefit.

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IT Security | Supply Chain | OT Security | Insider Threat | Physical Security | Interoperable Communications

Chemical Facility Anti-Terrorism Standards: Ammonia (Anhydrous)

Under the Chemical Facility Anti-Terrorism Standards (CFATS) regulation, if you possess 10,000 lb or more of ammonia (anhydrous)—expected to be less than 10 percent water—you may be required to report it to the Cybersecurity and Infrastructure Security Agency (CISA).

To reduce the risk of more than 300 chemicals of interest (COI) being weaponized, the Cybersecurity and Infrastructure Security Agency's (CISA) Chemical Facility Anti-Terrorism Standards (CFATS) program identifies and regulates high-risk chemical facilities to ensure appropriate security measures are in place.

Under CFATS, a chemical facility is "any establishment that possesses or plans to possess certain chemicals, at any relevant point in time …" and can be a large company or a single individual. If in possession of a COI at or above the screening threshold quantity (STQ) and minimum concentration listed in Appendix A of the CFATS regulation, facilities must report those chemicals to CISA within 60 days, regardless of how long the facility possesses COI.

Facilities that may possess ammonia (anhydrous) include, but are not limited to, agricultural suppliers, electric generation facilities, chemical manufacturers, and cold storage facilities, among others.

Ammonia (anhydrous) is a COI under CFATS. Ammonia (anhydrous) is a Release-Toxic chemical—meaning, if intentionally released, it has the potential to create a toxic cloud that could affect populations within and beyond the facility.

The STQ for ammonia (anhydrous) is 10,000 lb. Failure to report possession of a COI at or above the STQ can be subject to civil penalties. For more information, visit cisa.gov/appendix-chemicals-interest.

Resources for Facilities with Ammonia (Anhydrous)

CFATS First Steps: If the quantity and concentration of ammonia (anhydrous) at a facility meet or exceed those listed in Appendix A, the facility has 60 days from the time of possession to report those chemicals via an online survey called a Top-Screen. **Get started** by visiting cisa.gov/cfats-process to learn more about how to comply with CFATS.

Learn more about Chemical-terrorism Vulnerability Information (CVI) and complete CVI Authorized User training to access CISA's Chemical Security Assessment Tool (CSAT) (cisa.gov/chemical-terrorism-vulnerability-information).

Go to the Chemical Security Assessment Tool (CSAT) at csat-registration.dhs.gov to register the facility/facilities. Once registered, you can use CSAT to report COI to CISA at csat.dhs.gov/industry.

How should a facility report **ammonia (anhydrous) that undergoes various changes in temperature, pressure, and physical state** within a refrigeration system? The total mass quantity within the system and the physical state, temperature, and pressure of the ammonia as it exists in the vessel(s) downstream of the condenser(s) should be reported. To learn more, visit the **CFATS Knowledge Center** at csat-help.dhs.gov.

Agricultural Production Facilities: The agricultural production facility extension **does not** apply to agricultural production facilities that use ammonia (anhydrous) for refrigeration, or if the facility is a retailer, distributor, or warehouse. Agricultural facilities possessing ammonia (anhydrous) at or above STQ for such purposes should still report their inventory to CFATS. The extension may apply if the facility uses the COI in direct treatment to their crops. Visit cisa.gov/publication/cfats-agricultural-production-facilities to learn more.

Contact the CSAT Help Desk for technical assistance at 1-866-323-2957 or at CSAT@hq.dhs.gov.

Learn more about the CFATS program at cisa.gov/cfats, including the CFATS regulation, list of COI, frequently asked questions, how facilities' information is protected, and more.

Please note that **ammonia with a concentration of 20 percent or greater** is also listed as a COI in Appendix A. It has an STQ of 20,000 lb. Learn more by visiting cisa.gov/appendix-chemicals-interest.

Chemical Facility Anti-Terrorism Standards: Ammonia (Anhydrous)

If you possess 10,000 lb. or more of ammonia (anhydrous)--expected to be less than 10% water--you may be required to report it to the Department of Homeland Security (DHS).

DHS regulates security at high-risk chemical facilities under the *Chemical Facility Anti-Terrorism Standards* (CFATS) program (6 CFR Part 27). CFATS ensures high-risk facilities have security measures in place to reduce the security risks of certain chemicals that DHS has designated as "chemicals of interest" (COI).

Under CFATS, a chemical facility is "any establishment that possesses or plans to possess certain chemicals, at any relevant point in time…" and can be a large company or a single individual. CFATS requires a facility to report to DHS if it possesses a COI, such as ammonia (anhydrous), at or above a specified screening threshold quantity (STQ).

A facility must report to DHS all COI holdings that meet or exceed the STQ, regardless of how long the facility is in possession of the COI. Facilities that may possess ammonia (anhydrous) include, but are not limited to, farm suppliers, electric generation utilities, chemical manufacturers, and cold storage facilities, among others.

Ammonia (anhydrous) is a COI under CFATS. Ammonia (anhydrous) is a Release-Toxic chemical—meaning, if intentionally released, it has the potential to create a toxic cloud that would affect populations within and beyond the facility.

The STQ for ammonia (anhydrous) is 10,000 lb. Failure to report possession of a COI at or above the STQ can be subject to civil penalties. For more information on ammonia (anhydrous) as a COI, visit www.dhs.gov/publication/cfats-coi-list.

Resources for Facilities with Ammonia (Anhydrous)

- **Contact the CFATS Help Desk** with questions or to help begin the process. The Help Desk can be reached at 1-866-323-2957 or at csat@hq.dhs.gov.
- **CFATS First Steps**: If your facility possesses ammonia (anhydrous) in quantities that meet or exceed the STQ, you have 60 days from the time you come into possession to report your holdings via an online survey called a Top-Screen. **Get started** by visiting www.dhs.gov/publication/cfats-first-steps-fact-sheet to see what steps to follow to determine if you need to comply with CFATS.
- **How should a facility report ammonia (anhydrous)** that undergoes various changes in temperature, pressure, and physical state within a refrigeration system? The total mass quantity within the system and the physical state, temperature, and pressure of the ammonia as it exists in the vessel(s) downstream of the condenser(s) should be reported. Learn more by visiting the **CFATS Knowledge Center**: csat-help.dhs.gov.
- **Agricultural Production Facilities:** The agricultural facility extension **does not** apply to agricultural production facilities that use ammonia (anhydrous) for refrigeration, or if the facility is a retailer, distributor, or warehouse. Agricultural facilities possessing ammonia (anhydrous) at or above STQ for such purposes should still report their inventory to CFATS. The extension may apply if the facility uses the COI in direct treatment to their crops. Visit www.dhs.gov/publication/cfats-agricultural-production-facilities to learn more.
- **Learn more about the program** at www.dhs.gov/chemicalsecurity. Resources include the regulation, list of COI, FAQs, and more on how facilities' information is protected.
- Please note that ammonia with a concentration of 20% or greater is also listed as a COI in Appendix A. It has an STQ of 20,000 lb. Learn more by visiting www.dhs.gov/appendix-a-chemicals-interest-list.

United States
Environmental Protection
Agency

Office of Solid Waste
and Emergency Response
(5104A)

EPA 550-F-01-009
August 2001
www.epa.gov/ceppo

Hazards of Ammonia Releases at Ammonia Refrigeration Facilities (Update)

The Environmental Protection Agency (EPA) is issuing this *Alert* as part of its ongoing effort to protect human health and the environment by preventing chemical accidents. We are striving to learn the causes and contributing factors associated with chemical accidents and to prevent their recurrence. Major chemical accidents cannot be prevented solely through regulatory requirements. Rather, understanding the fundamental root causes, widely disseminating the lessons learned, and integrating these lessons learned into safe operations are also required. EPA publishes *Alerts* to increase awareness of possible hazards. It is important that facilities, State Emergency Response Commissions (SERCs), Local Emergency Planning Committees (LEPCs), emergency responders, and others review this information and take appropriate steps to minimize risk. This document does not substitute for EPA's regulations, nor is it a regulation itself. It cannot and does not impose legally binding requirements on EPA, states, or the regulated community, and the measures it describes may not apply to a particular situation based upon the circumstances. This guidance does not represent final agency action and may change in the future, as appropriate.

Chemical Safety ALERT

Problem

Anhydrous ammonia is used as a refrigerant in mechanical compression systems at a large number of industrial facilities. Ammonia is a toxic gas under ambient conditions. Many parts of a refrigeration system contain ammonia liquefied under pressure. Releases of ammonia have the potential for harmful effects on workers and the public. If the ammonia is under pressure, risk of exposure increases since larger quantities of the refrigerant have the potential for rapid release into the air. Also, some explosions have been attributed to releases of ammonia contaminated with lubricating oil. This Alert further discusses these potential hazards and the steps that can be taken to minimize risks. This Alert should be reviewed by personnel who operate and maintain refrigeration systems, managers of facilities, and emergency responders (e.g., haz mat teams).

Accidents

A number of accidental releases of ammonia have occurred from refrigeration facilities in the past. Releases result from a number of situations that include plant upsets leading to over pressure conditions and lifting of pressure relief valves; seal leaks from rotating shafts and valve stems; refrigerant piping failures due to loss of mechanical integrity from corrosion; physical damage of system components from equipment collisions; hydraulic shock; and hose failures that occur during ammonia deliveries. Some of these incidents have led to injury and fatalities on-site as well as causing adverse off-site consequences. In addition to risks of personal injury, ammonia releases have the potential of causing significant collateral damage including: product loss due to ammonia contamination, interruption of refrigeration capacity, product loss due to refrigeration interruption, and potential for equipment and property damage resulting from the incident. In many cases, ammonia releases have resulted in multi-million dollar financial losses. The Factory Mutual Loss Prevention Data Bulletin 12-61 describes several incidents with property damage ranging from $100,000 to $1,000,000 per incident. The following describes several recent incidents in more detail.

One type of accident that is easily preventable is equipment failure due to physical impact. In a 1992 incident at a meat packing plant, a forklift struck and ruptured a pipe carrying ammonia for

refrigeration. Workers were evacuated when the leak was detected. A short time later, an explosion occurred that caused extensive damage, including large holes in two sides of the building. The forklift was believed to be the source of ignition. In this incident, physical barriers would have provided mechanical protection to the refrigeration system and prevented a release.

Another incident highlights the need for an adequate preventive maintenance program and scheduling. In a 1996 incident involving a cold storage warehouse facility, compressor oil pressure progressively dropped during a long weekend. The low oil pressure cutout switch failed to shutdown the compressor leading to a catastrophic failure as the compressor tore itself apart. A significant release of ammonia ensued. Periodically testing all refrigeration-related safety cutout switches is absolutely necessary to minimize the likelihood of such incidents.

Two other incidents illustrate the potential for serious effects from accidental releases from ammonia refrigeration systems, although the causes of these releases were not reported. In a 1986 incident in a packing plant slaughterhouse, a refrigeration line ruptured, releasing ammonia. Eight workers were critically injured, suffering respiratory burns from ammonia inhalation, and 17 others were less severely hurt. A 1989 ammonia release in a frozen pizza plant led to the evacuation of nearly all of the 6,500 residents of the town where the plant was located. The release started when an end cap of a 16-inch suction line of the ammonia refrigeration system was knocked off. Up to 45,000 pounds of ammonia was released, forming a cloud 24 city blocks long. About 50 area residents were taken to hospitals, where they were treated with oxygen and released, while dozens of others were treated with oxygen at evacuation centers.

Hazard Awareness

Ammonia is used widely and in large quantities for a variety of purposes. More than 80% of ammonia produced is used for agricultural purposes; less than two percent is used for refrigeration. Ammonia can safely be used as a refrigerant provided the system is properly designed, constructed, operated, and maintained. It is important to recognize, however, that ammonia is toxic and can be a hazard to human health. It may be harmful if inhaled at high concentrations. The Occupational Safety and Health Administration (OSHA) Permissible Exposure Level (PEL) is 50 parts per million (ppm), 8-hour time-weighted average. Effects of inhalation of ammonia range from irritation to severe respiratory injuries, with possible fatality at higher concentrations. The National Institute of Occupational Safety and Health (NIOSH) has established an Immediately Dangerous to Life and Health (IDLH) level of 300 ppm for the purposes of respirator selection. Ammonia is corrosive and exposure will result in a chemical-type burn. Since ammonia is extremely hygroscopic, it readily migrates to moist areas of the body such as eyes, nose, throat, and moist skin areas. Exposure to liquid ammonia will also result in frostbite since its temperature at atmospheric pressure is –28ºF.

The American Industrial Hygiene Association (AIHA) has developed Emergency Response Planning Guidelines (ERPGs) for a number of substances to assist in planning for catastrophic releases to the community. The ERPG-2 represents the concentration below which it is believed nearly all individuals could be exposed for up to one hour without irreversible or serious health effects. The ERPG-2 for ammonia is 200 ppm. EPA has adopted the ERPG-2 as the toxic endpoint for ammonia for the offsite consequence analysis required by the Risk Management Program (RMP) Rule under section 112(r) of the Clean Air Act.

In refrigeration systems, ammonia is liquefied under pressure. Any liquid ammonia released to the atmosphere will aerosolize producing a mixture of liquid and vapor at a temperature of –28ºF. The released ammonia rapidly absorbs moisture in the air and forms a dense, visible white cloud of ammonium hydroxide. The dense mixture tends to travel along the ground rather than rapidly rising. This behavior may increase the potential for exposure of workers and the public.

Although pure ammonia vapors are not flammable at concentrations of less than 16%, they may be a fire and explosion hazard at concentrations between 16 and 25%. Mixtures involving ammonia contaminated with lubricating oil from the system, however, may have a much broader explosive range. A study conducted to determine the influence of oil on the flammability limits of ammonia found that oil reduced the lower flammability limit as low as 8%, depending on the type and concentration of oil (Fenton, et al., 1995).

An important property of ammonia is its pungent odor. The threshold concentration at which ammonia is detectable varies from person to person; however, ammonia can be usually detected at concentrations in the range of 5 ppm to 50 ppm. Concentrations above about 100 ppm are uncomfortable to most people; concentrations in the range of 300 to 500 ppm will cause people to leave the area immediately.

Hazard Reduction

The Chemical Accident Prevention Group of EPA's Region III (Pennsylvania, Maryland, Virginia, West Virginia, Delaware, and the District of Columbia) has been evaluating facilities in Region III with ammonia refrigeration systems to gather information on safety practices and technologies and to share its knowledge with these facilities. Region III has conducted more than 135 chemical safety audits from 1995 to the present of both large and small facilities using ammonia for refrigeration. In addition, over the past 2 years, Region III has conducted 32 Risk Management Program (RMP) audits of ammonia refrigeration systems to ensure compliance with the RMP rule and 17 General Duty Clause inspections of systems that are not covered by the RMP regulation but had a near miss incident. (A brief explanation of the General Duty Clause and the RMP Rule is found in the Statutes and Regulations Section of this *Alert*). To share their findings from the audits, including both the deficiencies observed and the actions that facilities are taking to increase safety, Region III has made presentations to the Refrigerating Engineers and Technicians Association (RETA). This Alert is intended to communicate these findings to a wider audience.

Ammonia refrigeration facilities should be aware of the potential hazards of ammonia releases and of the steps that can be taken to prevent such releases. They should be prepared to respond appropriately if releases do occur. Here are steps that ammonia refrigeration facilities could take to prevent releases and reduce the severity of releases that do occur:

- Establish training programs to ensure that the ammonia refrigeration system is operated and maintained by knowledgeable personnel. Some organizations that provide ammonia refrigeration education and training are listed in the Training Resources Section of this *Alert*.

- Consider using a spring-loaded ball valve (dead-man valve) in conjunction with the oil drain valve on all oil out pots (used to collect oil that migrates into system components) as an emergency stop valve.

- Develop and require refrigeration maintenance personnel to follow written, standard procedures for maintaining the system including such routine procedures as oil draining. Consider developing in-house checklists to guide maintenance personnel while they execute these procedures.

- Remove refrigeration oil from the refrigeration system on a regular basis. Never remove oil directly from the refrigeration system without pumping down and properly isolating that component.

- Provide barriers to protect refrigeration equipment, i.e., lines, valves, and refrigeration coils, from impact in areas where forklifts are used. Consider integrating ammonia refrigeration awareness and discussion of the risks of forklift accidents that can lead to ammonia releases as part of a formal forklift driver training program.

- Develop and maintain a written preventive maintenance program and schedule based on the manufacturers recommendations for all of the refrigeration equipment. The preventive maintenance program should include, but not be limited to:
    a) compressors
    b) pumps
    c) evaporators
    d) condensers
    e) control valves
    f) all electrical safety(s), including
        1) high pressure cutouts
        2) high temperature cutouts
        3) low pressure cutouts
        4) low temperature cutouts
        5) low oil pressure cutouts
        6) automatic purge systems
    g) ammonia detectors
    h) emergency response equipment, including,
        1) air monitoring equipment

2) self-contained breathing apparatus (SCBA)
3) level A suit
4) air- purifying respirators.

- Perform regular vibration testing on compressors. Document and analyze results for trends.

- Maintain a leak-free ammonia refrigeration system. Investigate all reports of an ammonia odor and repair all leaks immediately. Leak test all piping, valves, seals, flanges, etc., at least four times a year. Some methods which can be used for leak testing are sulfur sticks, litmus paper, or a portable monitor equipped with a flexible probe.

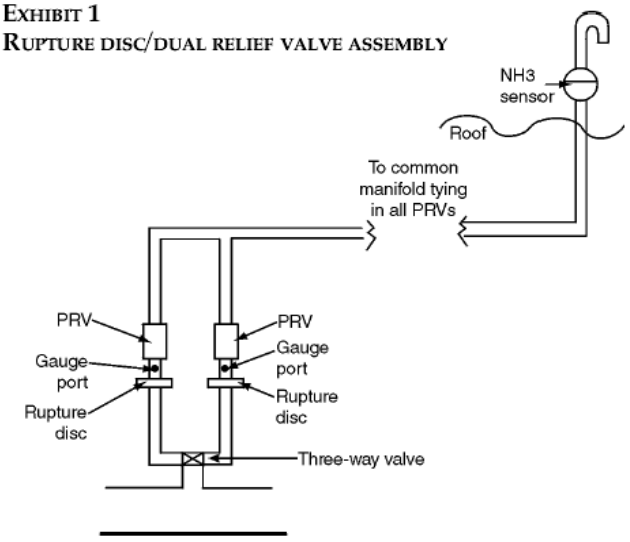
- Consider installing ammonia detectors in areas where a substantial leak could occur or if the facility is not manned 24 hours/day. The ammonia detectors should be monitored by a local alarm company or tied into a call-down system. Ensure that the ammonia detectors are calibrated regularly against a known standard. Check the operation of ammonia sensors and alarms regularly.

- Replace pressure relief valves (PRVs) on a regular schedule (consult ANSI/IIAR Standard 2– Equipment, Design, and Installation of Ammonia Mechanical Refrigerating Systems); document replacement dates by stamping the replacement date onto each unit's tag.

- Replace single PRVs with dual relief valve installations. A dual relief valve installation consists of one three-way shut-off valve with two pressure safety relief valves. The required use of dual relief valves (based on the size of the vessel to be protected) is outlined in ASHRAE Standard 15 – Safety Code for Mechanical Refrigeration. Consider how the use of dual relief valve installations may facilitate the replacement, servicing, or testing of PRVs on a regular schedule – a three-way valve allows one PRV to be isolated while the other remains on-line to protect the vessel. This setup allows each PRV to be serviced, tested or replaced on a regular basis without the need to pump down the system.

- For large systems with many PRVs, consider using the arrangement shown in Exhibit 1 for detecting leakage. This arrangement includes installation of a rupture disc upstream of each PRV with a gauge port or transducer in between the disc and PRV and installation of an ammonia sensor in the PRV common manifold. In case of leakage from a PRV, the sensor would set off an alarm. A check of either the pressure gauge or transducer signal would permit easy identification of which PRV has popped.
- Ensure that the ammonia refrigeration system is routinely monitored. Consider using a daily engine room log, recording process parameters (e.g., temperature and pressure levels) and reviewing the log on a regular basis. Consider having the chief engineer and the refrigeration technician sign the daily engine room log. In designing new systems or retrofitting existing systems, consider the use of computer controls to monitor the process parameters.

EXHIBIT 1
RUPTURE DISC/DUAL RELIEF VALVE ASSEMBLY



- Keep an accurate record of the amount of ammonia that is purchased for the initial charge to the refrigeration system(s) and the amount that is replaced. Consider keeping a record of the amount of lubricating oil added to the system and removed from the system.

- Ensure that good housekeeping procedures are followed in the compressor/recycle rooms.

- Ensure that refrigeration system lines and valves are adequately identified (e.g., by color coding or labeling) by using an in-house system.

- Properly post ammonia placards (i.e. NFPA 704 NH_3 diamond) and warning signs in areas where ammonia is being used as a refrigerant or being stored (for example, compressor room doors). Properly identify the chemicals within the piping system(s); label all process piping, i.e. piping containing ammonia, as "AMMONIA." Label must use black letters with yellow background. (This requirement is not the same as the in-house color coding system.)

- Periodically inspect all ammonia refrigeration piping for failed insulation/ vapor barrier, rust, and corrosion. Inspect any ammonia refrigeration piping underneath any failed insulation systems for rust and corrosion. Replace all deteriorated refrigeration piping as needed. Protect all un-insulated refrigeration piping from rust and/or corrosion by cleaning, priming, and painting with an appropriate coating.

- Carry out regular inspections of emergency equipment and keep respirators, including air-purifying and self-contained breathing apparatus (SCBA), and other equipment in good shape; ensure that personnel are trained in proper use of this equipment. For SCBA, it is important to ensure that air is bone dry. For air-purifying respirators, replace cartridges as needed and check expiration dates.

- Consider using the compressor room ammonia detector to control the ventilation fans.

- Identify the king valve and other emergency isolation valves with a large placard so that they can easily be identified by emergency responders, in case of an emergency. These valves should be clearly indicated on the piping and instrumentation diagrams (P&IDs) and/or process flow diagrams.

- Establish emergency shutdown procedures and instructions on what to do during and after a power failure.

- Consider installing a solenoid valve in the king valve line operated by a switch located outside of the compressor/recycle room.

- Establish written emergency procedures and instructions on what to do in the event of an ammonia release.

- Regularly conduct emergency response drills. Emergency response personnel should "suit-up" as part of the drill process. As needed, members of the hazmat team should regularly suit-up to sharpen their emergency response skills.

- Stage a realistic emergency response spill exercise with the local fire company.

- Mount a compressor room ventilation fan manual switch outside of the compressor room and identify it with a placard for use in an emergency. Good practice would be to have ventilation switches located outside and inside of each door to the compressor room.

- Mount windsocks in appropriate places and incorporate their use into the facility emergency response plan. In addition to the emergency response plan, consider developing additional materials (posters, signs, etc.) to provide useful information to employees and emergency responders in case of an emergency. In developing emergency information, consider whether materials should be developed in languages other than English.

- Keep piping and instrumentation diagrams (P&IDs), process flow diagrams, ladder diagrams, or single lines up-to-date and incorporate them into training programs for operators. A good suggestion is to laminate the P&ID and ladder diagrams and post nearby to the equipment.

- Frost accumulates on evaporator coils. The evaporator can be "soft gassed" during the defrost cycle by placing a smaller hot gas solenoid valve in parallel with the main hot

gas solenoid valve. The smaller valve is sequenced to open first; thereby, allowing the evaporator pressure to rise slowly. An alternative approach is to use a motorized full port ball valve in the hot gas supply line and open it slowly initially to accomplish the soft gassing. Once the pressure in the evaporator is brought up, then fully open the valve. For additional information, consult IIAR's *Ammonia Refrigeration Piping Handbook*.

References

Factory Mutual. 1993. Loss Prevention Data Bulletin 12-61 (April 1993).

Fenton, D.L., K.S. Chapman, R.D. Kelley, and A.S. Khan. 1995. "Operating Characteristics of a flare/oxidizer for the disposal of ammonia from and industrial refrigeration facility." *ASHRAE Transactions*, 101 (2), pp. 463-475. Atlanta, GA: American Society of Heating, Refrigeration, and Air-Conditioning Engineers.

IIAR. 2000. *Ammonia Refrigeration Piping Handbook*

Education and Training Resources

Garden City Community College: offers hands-on training oriented toward operators of industrial ammonia refrigeration systems and PSM/RMP implementation classes.
801 Campus Drive
Garden City, Kansas 67846
Tel: (620) 276-9520
www.nh3gccc.com

Industrial Refrigeration Consortium (IRC) at the University of Wisconsin-Madison: this university-industry partnership offers educational opportunities and refrigeration-related resources.
949 E. Washington Avenue, Suite 2
Madison, WI 53703
Tel: (608) 262-8220
(866) 635 - 4721 Toll-free
www.irc.wisc.edu

International Institute of Ammonia Refrigeration (IIAR): offers ammonia refrigeration-related educational videos, short course, and an annual conference.
110 North Glebe Road, Suite 250
Arlington, VA 22201
Tel: (703) 312-4200
www.iiar.org

Refrigeration Engineers Technicians Association: offers self-study materials and a tiered certification/evaluation program for refrigeration technicians/mechanics.
700 W. Lake Avenue
Glenview, IL 60025-1485
Tel: (847) 375-4738
www.reta.com

Information Resources

General References

OSHA has a web site with information on ammonia refrigeration and process safety: www.slc.osha-slc.gov/SLTC/ammoniarefrigeration/index.html

CEPPO has prepared a general advisory on ammonia (OSWER 91-008.2 Series 8 No. 2), available at: www.epa.gov/ceppo/acc-his.html.

Industrial Refrigeration Consortium (IRC) Headquartered at the University of Wisconsin-Madison, the IRC is a university-industry partnership aimed at improving safety, efficiency, and productivity of industrial refrigeration systems and technologies. The IRC conducts applied research, offers refrigeration training, and provides technical assistance to refrigeration end-users. The IRC maintains a website with additional information and resources related to ammonia refrigeration at: www.irc.wisc.edu.

Statutes and Regulations

The following are a list of federal statutes and regulations related to process safety, accident prevention, emergency planning, and release reporting.

EPA

Clean Air Act (CAA)

- General Duty Clause [Section 112(r) of the Act]- Facilities have a general duty to prevent

and mitigate accidental releases of extremely hazardous substances, including ammonia.

- Risk Management Program (RMP) Rule [40 CFR 68]- Facilities that have anhydrous ammonia in quantities greater than 10,000 pounds are required to develop a hazard assessment, a prevention program, and an emergency response program. EPA has developed a model guidance to assist ammonia refrigeration facilities comply with the RMP rule.

Emergency Planning and Community Right-to-Know Act (EPCRA)

- Emergency Planning [40 CFR Part 355] - Facilities that have ammonia at or above 500 pounds must report to their LEPC and SERC and comply with certain requirements for emergency planning.

- Emergency Release Notification [40 CFR Part 355]- Facilities that release 100 pounds or more of ammonia must immediately report the release to the LEPC and the SERC.

- Hazardous Chemical Reporting [40 CFR Part 370]- Facilities that have ammonia at or above 500 pounds must submit a MSDS to their LEPC, SERC, and local fire department and comply with the Tier I/ Tier II inventory reporting requirements.

- Toxic Chemicals Release Inventory [40 CFR Part 372] - Manufacturing businesses with ten or more employees that manufacture, process, or otherwise use ammonia above an applicable threshold must file annually a Toxic Chemical Release form with EPA and the state.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

- Hazardous Substance Release Reporting [40 CFR Part 302]- Facilities must report to the National Response Center (NRC) any environmental release of ammonia which exceeds 100 pounds. A release may trigger a response by EPA, or by one or more Federal or State emergency response authorities.

OSHA

- ***Process Safety Management (PSM)*** Standard [29 CFR 1910] Ammonia (anhydrous) is listed as a highly hazardous substance. Facilities that have ammonia in quantities at or above the threshold quantity of 10,000 pounds are subject to a number of requirements for management of hazards, including performing a process hazards analysis and maintaining mechanical integrity of equipment.

- ***Hazard Communication*** [29 CFR 1910.1200] -Requires that the potential hazards of toxic and hazardous chemicals be evaluated and that employers transmit this information to their employees.

For additional information, contact OSHA Public Information at (202) 219- 8151.
Web site: http://www.osha.gov

Codes and Standards
There are a number of American National Standards Institute (ANSI) Standards available for refrigeration systems. Some examples are given below.

ANSI/ASHRAE Standard 15-1994 - Safety Code for Mechanical Refrigeration

Available for purchase from the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) International Headquarters, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. Customer service: 1-800-527- 4723

ANSI/IIAR 2-1992 - Equipment, Design, and Installation of Ammonia Mechanical Refrigeration Systems

Available from the International Institute of Ammonia Refrigeration (IIAR)
1200 19th Street, NW
Suite 300
Washington, DC 22036-2422
(202) 857-1110

Web site: http://www.iiar.org

ISO 5149-1993 - Mechanical Refrigerating Systems Used for Cooling and Heating -- Safety Requirements

Available from the American National Standards Institute (ANSI)
11 West 42nd Street
New York, NY 10036
(212) 642-4900

Web site: http://www.ansi.org

For More Information...

Contact the RCRA, Superfund, and EPCRA Call Center

(800) 424-9346 or (703) 412-9810
TDD (800) 553-7672

Monday-Friday, 9 AM to 6 PM, Eastern Time

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Visit The CEPPO Home Page:

http://www.epa.gov/ceppo/