HEARING OFFICER'S REPORT

TO: The Honorable Shawn M. Garvin
Cabinet Secretary, Department of Natural Resources and Environmental Control

FROM: Lisa A. Vest
Regulatory Specialist, Office of the Secretary
Department of Natural Resources and Environmental Control

RE: ***Revised* Proposed New Regulation: 7 DE Admin. Code 1151: *Prohibitions on Use of Certain Hydrofluorocarbons in Specific End-Uses* ("HFC Regulation")**

DATE: February 8, 2021

I. BACKGROUND AND PROCEDURAL HISTORY:

A virtual public hearing was held on Thursday, April 23, 2020, at 6:00 p.m. via the State of Delaware Cisco WebEx Meeting Platform by the Department of Natural Resources and Environmental Control ("DNREC" or "Department") to receive comment on a proposed new regulation to be codified in the Delaware Administrative Code as follows: 7 DE Admin. Code 1151: *Prohibitions on Use of Certain Hydrofluorocarbons in Specific End-Uses* ("HFC Regulation"). The Department's objective of this proposed action is to regulate the use and manufacturing of hydrofluorocarbons ("HFCs") through this promulgation. This regulatory development process was initiated pursuant to the *Governor's Directive on Delaware to Eliminate HFCs to Confront Climate Change* (June 30, 2019), and House Concurrent Resolution 60 (Passed June 30, 2019), requiring the Department to regulate the manufacturing and use of HFCs in Delaware.

The proposed HFC Regulation establishes the prohibitions and requirements for the use and manufacture of HFCs in the State of Delaware, according to their specific end usage, which includes air conditioning and refrigeration equipment, aerosol propellants, and foam-end uses, and adopts specific United States Environmental Protection Agency ("EPA") Significant New Alternatives Policy Program ("SNAP") prohibitions.

The proposed new HFC Regulation is also designed to support Greenhouse Gas ("GHG") emission reductions in the State of Delaware, and to offer Delawareans an increasing quality of life through the reduction of air pollution, increased economic opportunities, and mitigation of the detrimental effects of climate change. Currently, through Governor Carney's commitment to participate in achieving the goals of the United States Climate Alliance, Delaware has committed to reduce its GHG emissions by 26 to 28% by 2025, compared to 2005 levels.

As HFC emissions are growing at a rapid rate in Delaware, the proposed new HFC Regulation is an important part of achieving Delaware's GHG reduction goals, as well as mitigating the environmental, social, and health risks related to climate change. Climate change poses significant threat especially to Delaware as a coastal state, which has the lowest average elevation in the country. Many of Delaware's industries and infrastructure are vulnerable to the effects of climate change, including, but certainly not limited to, tourism, real estate, agriculture, wastewater, and transportation. Further, human health, air and water quality, and ecosystems are all at increasing risk with the strengthening consequences of climate change.

To serve as background, HFCs are gaseous compounds used across various economic sectors in applications for air conditioning, refrigeration, foam-blowing, solvents, and aerosols. HFCs were identified in the 2009 GHG Endangerment Finding by EPA as one of six GHGs in the atmosphere that "threaten the public health and welfare of current and future generations." As noted above, HFC emissions are GHGs that can have a warming effect that is hundreds to thousands times that of carbon dioxide ("CO_2").

HFCs were originally introduced as substitution ozone-depleting substances ("ODS"), within the same applications, as part of the phase-out established in accordance with the Montreal Protocol, a landmark multilateral environmental agreement adopted by the United Nations on September 15, 1987 that regulates the production and consumption of nearly 100 man-made chemicals (referred to therein as ODS). When released to the atmosphere, the ODS damage the stratospheric ozone layer, Earth's protective shield that protects humans and the environment from harmful levels of ultraviolet radiation from the sun.

The Montreal Protocol phases down the consumption and production of the different ODS in a stepwise manner, with different timetables for developed and developing countries. Under this treaty, all parties have specific responsibilities related to the phase out of the different groups of ODS, control of ODS trade, annual reporting of data, national licensing systems to control ODS imports and exports, and other related matters. The treaty evolves over time, in light of new scientific, technical and economic developments, and it continues to be amended and adjusted. Under the Montreal Protocol, chlorofluorocarbons ("CFCs") were recognized as ODS, and the EPA defined a phase-out schedule for the different classes of ODS (Class I and Class II). The phase-out targets the ODS that are produced or imported in the country, and the original schedule was amended over time.

HFCs were developed to address the phase-out of the HCFCs[1] (same applications), however, they were recognized as GHGs with high Global Warming Potentials ("GWPs). Because of the increasing urgency of climate action, the Kigali Amendment to the Montreal Protocol requires the participating countries to cut their production and consumption of HFCs by more than 80% by 2050. While the United States did not ratify the Kigali Amendment, references to the same contained within both the Department's Technical Support Document and its Regulatory Impact Statement were included to emphasize the international interest in the phase-down of high GWP HFCs, and to express the need for industry in the United States to adopt similar restrictions to remain competitive while assuring emissions reductions in a critical segment of GHGs.

The EPA sought to phase-down the use and manufacturing of these high GWP pollutants through its SNAP program. On August 8, 2017, the United States Court of Appeals for the District of Columbia Circuit limited EPA's ability to require replacement of HFCs (*Mexichem v. EPA*, No.15-1328, Aug. 8, 2017).

[1] Hydrofluorocarbons ("HFCs") is defined in Section 3.0 as "a class of greenhouse gases that are saturated organic compounds containing hydrogen, fluorine, and carbon." Hydrochlorofluorocarbons ("HCFCs") are not covered under this regulation, and thus were not formally defined within the HFC Regulation. For clarification, however, the EPA defines HCFCs as "a compound consisting of hydrogen, chlorine, fluorine, and carbon. HCFCs contain chlorine, and thus deplete stratospheric ozone, with ozone depletion potentials ranging from 0.01 to 0.1. HCFCs were used in a wide variety of applications, including refrigeration, air conditioning, foam blowing, solvents, and more, and are subject to a phase-out schedule.

The Court subsequently clarified its previous ruling with regard to EPA's authority to require a second substitution in place of HFCs (*Nat.Res.Def. Council v. Wheeler, et al.*, No. 18-1172, April 7, 2020). Although legal actions remain ongoing at the federal level to defend the SNAP rules, state action is required at this time to maintain HFCs' prohibitions schedule, in line with the vacated SNAP rules.

With regard to applicability, the proposed HFC Regulations will establish prohibitions for any person who sells, offers for sale, leases, rents, installs, uses or manufactures in the State of Delaware, any product or equipment that uses a substance in any of the end-uses listed under the list of prohibited substances covered by the proposed regulation. As a flexibility mechanism, the Department has proposed language to allow the use of product or equipment containing a prohibited substance if the product or equipment was acquired prior to the applicable effective date of prohibition, unless an existing system is retrofit.

Additionally, the Department has proposed regulatory language to clarify that, unless an operation constitutes a retrofit or reclassifies a system as "new," the proposed HFC Regulations do not prevent the use of a prohibited substance in the servicing, maintenance and repair operations of existing equipment, in any end-use covered by the proposed new regulation. The Department has also proposed language to allow the importation, exportation, installation, and use of product or equipment containing a prohibited substance after the specified date of prohibition, only if the product or equipment was manufactured prior to the applicable date of prohibition.

The Department has listed each prohibited substance and the effective date of its prohibition, according to its specific end-use, in its Technical Support Document dated April 2020 (see p.9, Part III, Section B, Table 2), that was entered into the hearing record ("Record") as one of the Department's Exhibits at the time of the public hearing held on April 23, 2020. The prohibitions and effective dates detailed in the proposed new regulation were informed by the EPA SNAP Rules 20 and 21 (intended phase-down schedule for the different substances), which took into consideration many economic constraints for the industry, along with the availability of viable and cost-effective low GWP alternatives.

It should be noted that the prohibition dates were subsequently revised under the proposed new regulation, to accommodate for the time necessitated for the Department's regulatory development process.

Additionally, the Department has allowed a one-year extension (revised to January 1, 2022) for the new vending machine end-use category, before the effective date of prohibition for all substances covered under this end-use. This extension resulted from industry stakeholders informing the Department that the current preferred low GWP refrigerant alternative (R-290) for the vending machine industry is currently designated as a flammable chemical (A-3) by the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. ("ASHRAE"), Guideline 34. UL[2] 541 and ASHRAE 15 have authority over products containing this chemical and their placement within buildings, and pursuant to these requirements, in the United States, vending machines with any refrigerant other than A1 (non-flammable) classification may not be placed in locations of ingress, egress, hallways, or lobby areas of any buildings, at the risk of severe liabilities in case of incident[3]. During the course of the Department's regulatory development process for this promulgation, the industry informed the Department of the current work with UL and ASHRAE that may allow R-290 to work within the safety standards, by modifying UL541 and ASHRAE 15. For these reasons, the Department is proposing to allow the industry a one-year extension to establish their compliance pathway.

The proposed HFC Regulations also establish disclosure requirements for manufacturers of the products and equipment covered under the new regulation. By requiring a disclosure statement or label to be available to the buyer of products and/or equipment covered under this proposed new regulation, the Department aims to ensure that the buyer can verify that their purchase follows State regulations. Furthermore, in setting the disclosure statement requirements, the Department is proposing language to allow flexibility for managers to comply, while offering customers transparent and easily accessible information regarding their purchase.

[2] UL (Underwriters Laboratories) is a standards-setting organization that develops and publishes consensus standards that guide the safety, performance and sustainability for industries from household appliances to batteries to environment, to cybersecurity to building materials.
[3] UL 541 and ASHRAE 15 refer to specific standards set by external standard-setting organizations (i.e., UL, ASHRAE) that some manufacturers, covered in this regulation, already comply with and that include considerations that informed the rulemaking development (i.e., safety, flammability, and labeling standards).

The Department has the statutory basis and legal authority to promulgate new regulations, specifically, to regulate the use of HFCs in Delaware with the proposed 7 DE Admin. Code 1151: *Prohibitions on Use of Certain Hydrofluorocarbons in Specific End-Uses*, pursuant to 7 *Del.C.* §§6001(c) and 6010, which authorize the Department to adopt rules to control air pollution as necessary to protect the public health, safety, and welfare. As previously noted, this new regulation was developed by the Department, pursuant to the *Governor's Directive on Delaware to Eliminate HFCs to Confront Climate* (June 30, 2019), and House Concurrent Resolution 60 (Passed June 30, 2019), which requires the Department to regulate the manufacturing and use of HFCs in Delaware.

The Department published the initial proposed new HFC Regulations in the April 1, 2020 *Delaware Register of Regulations*. Thereafter, the virtual public hearing regarding this matter was held on April 23, 2020. Members of the public attended the April 23, 2020 virtual public hearing. Due to the level of public interest in this matter, the Record remained open for receipt of public comment subsequent to the hearing through May 31, 2020.

Subsequent to the close of the Record, the Department's Division of Air Quality ("DAQ") prepared a Technical Response Memorandum ("TRM"), at the request of this Hearing Officer, which responded to the written comments received from the public concerning the Department's proposed new HFC Regulations. It should be noted that a Supplemental TRM was also provided by the Department's DAQ for the benefit of the Record in this matter, in order to formally acknowledge the receipt of additional information provided to the Department regarding EPA SNAP Proposed Rule 23, as described below. It should be noted that all notification and noticing requirements concerning this matter were met by the Department. Proper notice of the hearing was provided as required by law.

II. SUMMARY OF THE PUBLIC HEARING RECORD:

The Record consists of the following documents: (1) a verbatim transcript; (2) nineteen (19) documents introduced by Department staff at the public hearing held on April 23, 2020 and marked by this Hearing Officer at the time of the hearing accordingly as Department Exhibits 1-19; (3) TRM provided by Ajo Rabemiarisoa, Engineer I, DAQ, dated June 25, 2020, offering the Department's formal responses to the written comments received from the public in this matter; and (4) Supplemental TRM, also provided by Ms. Rabemiarisoa, dated August 5, 2020. The Department's person primarily responsible for the drafting and overall promulgation of this proposed new regulation, Ms. Rabemiarisoa, developed the Record with the relevant documents in the Department's files.

As noted previously, written comment was received by the Department concerning this proposed new regulation, during both the pre- and post-hearing phases of this promulgation. The Department's initial TRM, dated June 25, 2020, provides a summary of the comments received, and the DAQ's detailed response to the same. Subsequent to the close of the public comment period, the Polyisocyanurate Insulation Manufacturers Association ("PIMA") provided the Department's DAQ with its comments that were submitted to the EPA regarding the EPA SNAP Proposed Rule 23 (for which a Notice of Proposed Rulemaking was released by EPA on June 12, 2020). These supplemental comments were provided to DAQ by PIMA as a courtesy, so that the Department would be aware of this submission, and to provide DAQ with additional information on not only the proposed EPA SNAP Rule 23, but also PIMA's concerns as to the availability of commercialized products with low GWP formulations for covered end-uses in the global markets.

The Department's proposed new HFC Regulation, the Department's Technical Support Memorandum dated April 2020, DAQ's initial TRM dated June 25, 2020, and the supplemental TRM dated August 5, 2020 (thanking PIMA for its additional contribution as noted above), are all expressly incorporated into the Record generated in this matter and are attached hereto as Appendices "A" through "D," respectively.

III. RECOMMENDED FINDINGS AND CONCLUSIONS:

The new HFC Regulation proposed by the Department is to establish the prohibitions and requirements for the use and manufacture of HFCs in the State of Delaware, according to their specific end usage, which includes air conditioning and refrigeration equipment, aerosol propellants, and foam-end uses, and to adopt specific EPA SNAP prohibitions. The proposed HFC Regulation is also designed to support GHG emission reductions in the State of Delaware, and to offer Delawareans an increasing quality of life through the reduction of air pollution, increased economic opportunities, and mitigation of the detrimental effects of climate change.

With regard to the comments received by the Department that suggest the proposed new regulation will only add financial burden to Delawareans, DAQ notes in its TRM of June 25, 2020 that many flexible mechanisms have been included in the language of the proposed new regulation to minimize the burden on Delaware's residents and small businesses. First, this regulation does not include recordkeeping requirements, nor does it cover motor vehicle air conditioning end-uses or household equipment. Most of the compliance burdens are expected to rest on manufacturers of the regulated products and equipment, which are, in majority, large enterprises.

Additionally, the proposed new regulation does not require users to cease the use of their equipment or product(s) acquired prior to its effective date of prohibition, unless said equipment is retrofit or classified (or reclassified) as new. The proposed regulation also allows for any covered equipment or product manufactured prior to the applicable effective date of prohibition to be sold, imported, exported, distributed, installed and used after its effective date of prohibition.

Additionally, DAQ's aforementioned TRM notes that the variable difference in capital expenses, when replacing conventional equipment with equipment that is in compliance with the proposed new regulation, is projected to decrease as the economies of scale set in (as the demand for low GWP alternatives grows at the global scale). Thus, most small businesses that will change their equipment as part of the regular life cycle of their operations are likely to pay lower or smaller incremental costs over time. To encourage and accelerate the transition to low GWP, the Department has also designed an incentives program, the *Cool Switch Low Impact Refrigerant Program*, that will help pay the upfront cost of the new or retrofitted equipment using low GWP refrigerants.

Moreover, the aforementioned TRM notes that, according to the EPA SNAP Rules 20 and 21 screening analyses, the probability of having one small business in Delaware incurring costs in excess of 1% or 3% of their revenues, on a population basis, is less than 0.0003%. Based on this estimate, and DAQ's strong stakeholder engagement process which prompted the inclusion of the flexibility mechanisms detailed above, the Department believes that the proposed new HFC Regulation is unlikely to add substantive financial burden to Delawareans.

The written comments received from the regulated community concerning this proposed promulgation are fully responded to in detail within the DAQ TRM referenced above. It should be noted that the Department will be developing a guidance document to assist the regulated community with regard to compliance issues associated with this new regulation. This guidance document will include, but will certainly not be limited to, the acceptable formats for disclosure statements for the covered end-uses; considerations for the easily recognizable date code formats; and considerations for how to treat the exemptions listed under Section 7.0 (in terms of disclosure statement requirements).

In comments submitted to the Department by the American Chemistry Council ("ACC") Center for the Polyurethanes Industry ("CPI"), suggestions were made for modifications of eleven stated definitions, as contained within the initially proposed HFC Regulations, plus the addition of one new definition. Honeywell Fluorine Products, another commenter that congratulated Delaware's initiative to regulate HFCs in a consistent manner with other States and agreed with the necessity to transition away from high GWP HFCs (and further commented that technologies using environmentally preferable HFC alternatives are often also more energy efficient than traditional systems, thus offering lower customer costs and increased competitiveness), also supported changes to the polyurethane and foam end-uses definitions as suggested by ACC CPI.

Subsequent to the close of the public comment period in this matter, the Department received input from Paul Ashford, an expert from the United Nations Environment Programme's ("UNEP") Foams Technical Options Committee ("FTOC"). Mr. Ashford is also listed as one of the co-authors of the latest 2018 FTOC reports from UNEP. Mr. Ashford has provided DAQ with suggestions that clarify the proposed definitions as set forth in the HFC Regulations. The DAQ's TRM notes that the Department believes other states are in the process of adopting similar regulations that will include these definition clarifications. The TRM further notes that the USCA model rule has also been amended to include these definitions.

In light of the above, the DAQ is recommending revisions be made to the Department's initial proposed HFC Regulation, specifically, to incorporate technical clarifications to the following terms, as requested by the Center for the Polyurethanes Industry, and as verified by the above referenced industry expert: Polyurethane; Flexible Polyurethane; Foam Blowing Agent; Integral Skin Polyurethane; Rigid Polyurethane Appliance Foam; Rigid Polyurethane Commercial Refrigeration and Sandwich Panels; Rigid Polyurethane High-Pressure Two-Component Spray Foam; Rigid Polyurethane Low-Pressure Two-Component Spray Foam; Rigid Polyurethane Marine Flotation Foam; Rigid Polyurethane One-Component Foam Sealants; and Rigid Polyurethane Slabstock and Other.

In addition to requesting the aforementioned definition modifications, ACC CPI further noted that, although they support the "sell-through" provision proposed in subsection 4.1.4 of the proposed regulation, the term "on site" may be too limiting and may not include factory uses of polyurethane systems. The Department agrees with the removal of this term from the above referenced subsection.

For the Secretary's ease of review, a Summary Sheet of all revisions being proposed by DAQ during the post-hearing phase of this promulgation (the revisions to eleven definitions in Section 3.0, the revision of "on site" considerations as set forth in Subsection 4.1.4, and the revisions to the effective dates of prohibition in Section 6.0) is attached hereto as Attachment "E," as previously noted.

Based on the Record developed in this matter, I find and conclude that the Department has provided appropriate reasoning regarding the need for the ***revised*** proposed new regulation to be codified in the Delaware Administrative Code as follows: 7 DE Admin. Code 1151: *Prohibitions on Use of Certain Hydrofluorocarbons in Specific End-Uses.* I further find that the ***revised*** proposed HFC Regulation establishes the prohibitions and requirements for the use and manufacture of HFCs in the State of Delaware, according to their specific end usage, which includes air conditioning and refrigeration equipment, aerosol propellants, and foam-end uses, and adopts specific EPA SNAP prohibitions. The ***revised*** proposed new HFC Regulation is also designed to support GHG emission reductions in the State of Delaware and offers Delawareans an increasing quality of life through the reduction of air pollution, increased economic opportunities, and mitigation of the detrimental effects of climate change, as noted above.

Accordingly, I recommend promulgation of the ***revised*** proposed new HFC Regulation, in the customary manner provided by law.

Further, I recommend the Secretary adopt the following findings and conclusions:

1. The Department has the statutory basis and legal authority to act with regard to the ***revised*** proposed 7 DE Admin. Code 1151: *Prohibitions on Use of Certain Hydrofluorocarbons in Specific End-Uses*, pursuant to 7 *Del.C.* §§6001(c) and 6010, which authorize the Department to adopt rules to control air pollution as necessary to protect the public health, safety, and welfare;

2. The Department has jurisdiction under its statutory authority, pursuant to 7 *Del.C.* Chapter 60, to issue an Order adopting the ***revised*** proposed new HFC Regulation as final;

3. The Department provided adequate public notice of the proposed new HFC Regulation and all proceedings in a manner required by the law and regulations. The Department also provided the public with an adequate opportunity to comment on the proposed new HFC Regulation subsequent to the time of the public hearing (through May 31, 2020), in order to consider all public comment on the same before making any final decision;

4. Promulgation of the ***revised*** proposed new HFC Regulation, as set forth herein, will enable the Department to establish the prohibitions and requirements for the use and manufacture of HFCs in the State of Delaware, according to their specific end usage. Furthermore, the ***revised*** proposed new HFC Regulation supports GHG emission reductions in the State of Delaware and offers Delawareans an increasing quality of life through the reduction of air pollution, increased economic opportunities, and mitigation of the detrimental effects of climate change;

5. The Department has reviewed the ***revised*** proposed new HFC Regulation in the light of the Regulatory Flexibility Act, consistent with 29 *Del.C.* Ch. 104, and believes the same to be lawful, feasible, and desirable, that it will not establish reporting requirements or substantive additional costs for individuals or small businesses, and that the recommendations as proposed should be applicable to all Delaware individuals or small businesses equally;

6. The Department's proposed new HFC Regulation, as initially published in the April 1, 2020 *Delaware Register of Regulations*, and then subsequently ***revised*** as set forth in Appendix "A" hereto, is adequately supported, is not arbitrary or capricious, and is consistent with the applicable laws and regulations. Consequently, the same should be approved as a final new regulation, which shall go into effect ten days after publication in the next available issue of the *Delaware Register of Regulations*;

7. The Department has an adequate Record for its decision, and no further public hearing is appropriate or necessary; and

8. The Department shall submit the ***revised*** proposed new regulation as a final new regulation to the *Delaware Register of Regulations* for publication in its next available issue and shall provide such other notice as the law and regulation require, as the Department determines is appropriate.

/s/Lisa A. Vest
LISA A. VEST
Regulatory Specialist

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Attachments:

Appendix A: ***Revised*** proposed HFC Regulation
Appendix B: Technical Support Document (April 2020)
Appendix C: TRM (06/25/2020)
Appendix D: Supplemental TRM (08/05/2020)
Appendix E: Summary Sheet of all Post-Hearing Regulatory Revisions

TITLE 7 NATURAL RESOURCES AND ENVIRONMENTAL CONTROL

DIVISION OF AIR QUALITY

PROPOSED REGULATION

1151 Prohibitions on Use of Certain Hydrofluorocarbons in Specific End-Uses

1.0 Purpose

This regulation establishes the prohibitions and requirements for the use and manufacture of hydrofluorocarbons in the State of Delaware according to their specific end usage (including air conditioning and refrigeration equipment, aerosol propellants, and foam end-uses) and adopts specific United States Environmental Protection Agency Significant New Alternatives Policy Program prohibitions. This regulation is designed to support greenhouse gas emission reductions in the State of Delaware.

2.0 Applicability

2.1 This regulation applies to any person who sells, offers for sale, leases, rents, installs, uses, or manufactures in the State of Delaware, any product or equipment that uses a substance in any of the end-uses listed in Section 6.0.

2.2 Any person who manufactures product or equipment covered in the specific end-uses listed in Section 6.0 is subject to disclosure statement requirements, as detailed in subsection 4.2.

2.3 Substances used in end-uses listed in Section 7.0 are exempt from the prohibitions covered in this regulation.

2.4 Severability. Each section of this regulation shall be deemed severable, and in the event that any provision of this regulation is held to be invalid, the remainder of this regulation shall continue in full force and effect.

3.0 Definitions

The following terms, when used in this regulation, shall have the following meanings unless the context clearly indicates otherwise. Terms used but not defined herein shall have the meanings given to them in 7 Del. C. Ch. 60, 7 DE Admin. Code 1101 or the Clean Air Act as amended in 1990, in that order of:

"**Aerosol Propellant**" means a compressed gas that serves to dispense the contents of an aerosol container when the pressure is released.

"**Air Conditioning Equipment**" means chillers, both centrifugal chillers and positive displacement chillers, intended for comfort cooling of occupied spaces.

"Bunstock" means a large solid box-like structure formed during the production of polyurethane, polyisocyanurate, phenolic, or polystyrene insulation.

"**Capital Cost**" means an expense incurred in the production of goods or in rendering services, including but not limited to the cost of engineering, purchase, and installation of components or systems, and instrumentation, and contractor and construction fees.

"**Centrifugal Chiller**" means air conditioning equipment that utilizes a centrifugal compressor in a vapor-compression refrigeration cycle typically used for commercial comfort air conditioning. Centrifugal chiller in this definition is a chiller intended for comfort cooling and does not include cooling for industrial process cooling and refrigeration.

"**Cold Storage Warehouse**" means a cooled facility designed to store meat, produce, dairy products, and other products that are delivered to other locations for sale to the ultimate consumer.

"**Component**" means a part of a refrigeration system, including but not limited to condensing units, compressors, condensers, evaporators, and receivers; and all of its connections and subassemblies, without which the refrigeration system will not properly function or will be subject to failures.

"**Cumulative Replacement**" means the addition of or change in multiple components within a three-year period.

"**Department**" means the State of Delaware Department of Natural Resources and Environmental Control.

"**Effective Date**" or "**Effective Date of Prohibition**" means date after which the prohibitions provided in Section 6.0 go into effect.

''**End-use**'' means processes or classes of specific applications within industry sectors, including but not limited to those listed in Section 6.0.

"**Flexible Polyurethane**" means a non-rigid **[~~synthetic~~] [polyurethane]** foam **[~~containing polymers created by the reaction of isocyanate and polyol~~],** including but not limited to that used in furniture, bedding, and chair cushions.

"**Foam**" means a product with a cellular structure formed via a foaming process in a variety of materials that undergo hardening via a chemical reaction or phase transition.

"**Foam Blowing Agent**" means a substance **[~~used to produce the product with a cellular structure formed via a foaming process in a variety of materials that undergo hardening via chemical reaction or phase transition~~] [that functions as a source of gas to generate bubbles in the mixture during the formation of foam]**.

"**Global Warming Potential" or "GWP**" means a measure of the radiative efficiency (heat-absorbing ability) of a particular gas relative to that of carbon dioxide (CO_2) after taking into account the decay rate of each gas (the amount removed from the atmosphere over a given number of years) relative to that of CO_2. Global warming potentials used in this regulation are consistent with the values used in the Intergovernmental Panel on Climate Change, Fourth Assessment Report.

"**Household Refrigerators and Freezers**" means refrigerators, refrigerator-freezers, freezers, and miscellaneous household refrigeration appliances intended for residential use. For the purposes of this regulation, "household refrigerators and freezers" does not include "household refrigerators and freezers - compact", or "household refrigerators and freezers - built-in".

"**Household Refrigerators and Freezers - Compact**" means any refrigerator, refrigerator-freezer or freezer intended for residential use with a total refrigerated volume of less than 7.75 cubic feet (220 liters).

"**Household Refrigerators and Freezers - Built-in**" means any refrigerator, refrigerator-freezer or freezer intended for residential use with 7.75 cubic feet or greater total volume and 24 inches or less depth not including doors, handles, and custom front panels; with sides which are not finished and not designed to be visible after installation; and that is designed, intended, and marketed exclusively to be: installed totally encased by cabinetry or panels that are attached during installation; securely fastened to adjacent cabinetry, walls or floor; and equipped with an integral factory-finished face or accept a custom front panel.

"**Hydrofluorocarbons**" means a class of greenhouse gases that are saturated organic compounds containing hydrogen, fluorine, and carbon.

"**Integral Skin Polyurethane**" means a **[~~synthetic~~]** self-skinning **[polyurethane]** foam **[~~containing polyurethane polymers formed by the reaction of an isocyanate and a polyol~~]**, **[including but not limited to that used in car steering wheels and dashboards]**.

"**MDI**" means a metered dose inhaler or medical dose inhaler or a device that delivers a measured amount of medication as a mist that a patient can inhale, typically used for bronchodilation to treat symptoms of asthma, chronic obstructive pulmonary disease (COPD), chronic bronchitis, emphysema, and other respiratory illnesses. An MDI consists of a pressurized canister of medication in a case with a mouthpiece.

"**Miscellaneous Residential Refrigeration Appliance**" means a residential refrigeration appliance smaller than a refrigerator, refrigerator-freezer, or freezer; and which includes coolers, cooler compartments, and combination cooler refrigeration or cooler freezer products.

"**Motor-bearing**" means refrigeration equipment containing motorized parts, including compressors, condensers, and evaporators.

"**New**" means products or equipment:

(1)That are manufactured after the effective date of this regulation; or

(2)First installed for an intended purpose with new or used components after the effective date of this regulation; or

(3)Expanded after the effective date of this regulation, to handle an expanded cooling load by the addition of components in which the capacity of the system is increased, including refrigerant lines, evaporators, compressors, and condensers; or

(4)Replaced or cumulatively replaced after the effective date of this regulation, such that the capital cost of replacing or cumulatively replacing components exceeds 50% of the capital cost of replacing the whole system.

"**Phenolic Insulation Board"** means phenolic insulation including but not limited to that used for roofing and wall insulation.

"**Polyolefin**" means foam sheets and tubes made of polyolefin.

"**Polystyrene Extruded Boardstock and Billet (XPS)**" means a foam formed from predominantly styrene monomer and produced on extruding machines in the form of continuous foam slabs which can be cut and shaped into panels used for roofing, walls, and flooring.

"**Polystyrene Extruded Sheet**" means polystyrene foam including that used for packaging. It is also made into food-service items, including hinged polystyrene containers (for "take-out" from restaurants); food trays (meat and poultry) plates, bowls, and retail egg containers.

[“Polyurethane” means a polymer formed principally by the reaction of an isocyanate and a polyol.]

“**Positive Displacement Chiller**” means vapor compression cycle chillers that use positive displacement compressors, typically used for commercial comfort air conditioning. Positive displacement chiller in this regulation is a chiller intended for comfort cooling and does not include cooling for industrial process cooling and refrigeration.

“**Refrigerant**” or “**Refrigerant Gas**” means any substance, including blends and mixtures, which is used for heat transfer purposes.

“**Refrigerated Food Processing and Dispensing Equipment**” means retail food refrigeration equipment that is designed to process food and beverages dispensed via a nozzle that are intended for immediate or near-immediate consumption, including but not limited to chilled and frozen beverages, ice cream, and whipped cream. This end-use excludes water coolers, or units designed solely to cool and dispense water.

“**Refrigeration Equipment**” means any stationary device that is designed to contain and use refrigerant gas, including but not limited to retail or commercial refrigeration equipment, household refrigeration equipment, and cold storage warehouses.

“**Remote Condensing Units**” means retail refrigeration equipment or units that have a central condensing portion and may consist of compressor or compressors, condenser or condensers, and receiver or receivers assembled into a single unit, which may be located external to the sales area. The condensing portion (and often other parts of the system) is located outside the space or area cooled by the evaporator. Remote condensing units are commonly installed in convenience stores, specialty shops (e.g., bakeries, butcher shops), supermarkets, restaurants, and other locations where food is stored, served, or sold.

“**Residential use**” means use by a private individual of a substance, or a product or equipment containing the substance, in or around a permanent or temporary household, during recreation, or for any personal use or enjoyment. Use within a household for commercial or medical applications is not included in this definition, nor is use in automobiles, watercraft, or aircraft.

“**Retail Food Refrigeration**” or “**Commercial Refrigeration**” means equipment designed to store and display chilled or frozen goods for commercial sale including but not limited to stand-alone units, refrigerated food processing and dispensing equipment, remote condensing units, supermarket systems, and vending machines.

"**Retrofit**" means to convert a system from one refrigerant to another refrigerant. Retrofitting includes the conversion of the system to achieve system compatibility with the new refrigerant and may include, but is not limited to, changes in lubricants, gaskets, filters, driers, valves, O-rings, or system components.

"**Rigid Polyurethane and Polyisocyanurate Laminated Boardstock**" means laminated board insulation made with polyurethane or polyisocyanurate foam, including that used for roofing and wall insulation.

"**Rigid Polyurethane Appliance Foam**" means polyurethane **[~~insulation~~]** foam in household appliances **[used for insulation]**.

"**Rigid Polyurethane Commercial Refrigeration and Sandwich Panels**" means polyurethane **[foam, used to provide]** insulation **[~~for use~~]** in walls and doors, including that used for commercial refrigeration equipment, and used in doors, including garage doors.

"**Rigid Polyurethane High-pressure Two-component Spray Foam**" means a **[liquid polyurethane]** foam **[system sold as two parts (i.e., A-side and B-side) in non-pressurized containers;]** **[~~product that is pressurized 800-1600 pounds per square inch (psi) during installation manufacture; sold in pressurized containers as two parts (i.e., A-side and B-side)]**; and is **[field or factory]** **[~~blown~~]** applied in situ using high-pressure **[proportioning]** pumps **[at 800-1600 pounds per square inch (psi) and an application gun to mix and dispense the chemical components.]** **[~~may use liquid blowing agents without an additional propellant~~]**.

"**Rigid Polyurethane Low-pressure Two-component Spray Foam**" means a **[liquid polyurethane]** foam **[system]** **[~~product~~]** **[sold as two parts (i.e., A-side and B-side) in containers]** that is pressurized to less than 250 psi during manufacture **[of the system for application without pumps]**; **[~~sold in pressurized containers as two parts (i.e., A-side and B-side);~~]** and is typically applied in situ relying upon a **[liquid blowing agent and/or]** gaseous foam blowing agent that also serves as a propellant **[~~so pumps typically are not needed~~]**.

"**Rigid Polyurethane Marine Flotation Foam**" means buoyancy or flotation **[polyurethane]** foam used in boat and ship manufacturing for both structural and flotation purposes.

"**Rigid Polyurethane One-component Foam Sealants**" means a **[polyurethane]** foam **[generally]** packaged in aerosol cans that is applied in situ using a gaseous foam blowing agent that is also the propellant for the aerosol formulation.

"**Rigid Polyurethane Slabstock and Other**" means a rigid closed-cell **[polyurethane]** foam **[~~containing urethane polymers produced by the reaction of an isocyanate and a polyol and~~]** formed into slabstock insulation for panels and fabricated shapes for pipes and vessels.

"**Stand-alone Unit**" means retail refrigerators, freezers, and reach-in coolers (either open or with doors) where all refrigeration components are integrated and, for the smallest types, the refrigeration circuit is entirely brazed or welded. These systems are fully charged with refrigerant at the factory and typically require only an electricity supply to begin operation.

"**Stand-alone Low-Temperature Unit**" means a stand-alone unit that maintains food or beverages at temperatures at or below 32°F (0 °C).

"**Stand-alone Medium-Temperature Unit**" means a stand-alone unit that maintains food or beverages at temperatures above 32°F (0 °C).

"**Substance**" means any chemical intended for use in the end-uses listed in Section 6.0.

"**Supermarket Systems**" means multiplex or centralized retail food refrigeration equipment systems designed to cool or refrigerate, which typically operate with racks of compressors installed in a machinery room and which includes both direct and indirect systems.

"**Use**" means any utilization of any substance, including but not limited to utilization in a manufacturing process or product in Delaware, consumption by the end-user in the State of Delaware, or in intermediate applications in the State of Delaware, such as formulation or packaging for other subsequent applications. For the purposes of this regulation, use excludes residential use, but it does not exclude manufacturing for the purpose of residential use.

"**Vending Machines**" means self-contained commercial food refrigeration equipment that dispense goods that must be kept hot, cold or frozen.

4.0 Standards (Requirements)

4.1 Prohibitions

4.1.1 No person may sell, lease, rent, install, use or manufacture in the State of Delaware, any product or equipment using a listed substance for any air conditioning, refrigeration, foam, or aerosol propellant end-use listed as prohibited in Section 6.0, and not exempt by Section 7.0.

4.1.2 Except where an existing system is retrofit, nothing in this regulation requires a person that acquired a product or equipment containing a prohibited substance prior to an effective date of the prohibition in Section 6.0 to cease use of that product or equipment.

4.1.3 This regulation does not prevent the use of a prohibited substance in the servicing, maintenance and repair operations of an existing product or equipment in an end-use listed in Section 6.0, which contains or was designed to contain a prohibited substance, except if the operations constitute a retrofit or reclassifies the system as new.

4.1.4 Products or equipment manufactured prior to the applicable effective date of the restrictions specified in Table 1 of subsection 6.1.1 (including foam systems not yet applied **[~~on site~~]**) may be sold, imported, exported, distributed, installed, and used after the specified date of prohibition.

4.2 Disclosure Statement

4.2.1 As of the effective date of prohibition, any person who manufactures for sale in the State of Delaware, products or equipment in the air conditioning, refrigeration, foam, or aerosol propellant end-uses listed as prohibited in Section 6.0, must provide a written disclosure to the buyer, as follows,

4.2.1.1 For motor-bearing refrigeration and air-conditioning equipment that is neither factory-charged nor pre-charged with refrigerant, the required disclosure or label must state:

"This equipment is prohibited from using any substance on the "List of Prohibited Substances" for that specific end-use, in accordance with State regulations for hydrofluorocarbons."

4.2.1.2 Except for products and equipment with existing labeling required by state building codes and safety standards which contain the information required in subsections 4.2.1.2.1 and 4.2.1.2.2, the disclosure or label for refrigeration and air-conditioning equipment that are factory-charged or pre-charged with a hydrofluorocarbon or hydrofluorocarbon blend should include:

4.2.1.2.1 The date of manufacture; and

4.2.1.2.2 The refrigerant and foam blowing agent the product or equipment contains.

4.2.1.3 For foam products, the disclosure or label should include one of the two alternatives (Alternative 1 or Alternative 2) detailed below:

4.2.1.3.1 Alternative 1

4.2.1.3.1.1 The date of manufacture; and

4.2.1.3.1.2 The foam blowing agent the product contains, or a reference to a Safety Data Sheet (complying with 29 CFR 1910.1200 requirements), if the latter identifies the foam blowing agent the product contains.

4.2.1.3.2 Alternative 2

4.2.1.3.2.1 *"Where sold, compliant with State HFC regulations."*

4.2.1.4 For aerosol propellants, the disclosure or label should include one of the two alternatives (Alternative 1 or Alternative 2) detailed below:

4.2.1.4.1 Alternative 1

4.2.1.4.1.1 The date of manufacture or a date code representing the date, shall be indicated on the label, lid, or bottom of the container. If the manufacturer uses a date code for any product, the manufacturer shall file an explanation of each code to the Department; and

4.2.1.4.1.2 The aerosol propellant the product contains, or a reference to a Safety Data Sheet (complying with 29 CFR 1910.1200 requirements), if the latter identifies the propellant the product contains.

4.2.1.4.2 Alternative 2

4.2.1.4.2.1 *"Where sold, compliant with State HFC regulations."*

5.0 [RESERVED]

6.0 List of Prohibited Substances

6.1 End-use and prohibited substances

6.1.1 The following table lists prohibited substance in specific end-uses and the effective date of prohibition, unless and exemption is provided for in Section 7.0.

Table 1. End-use and Prohibited substances
End-use Category: Aerosol Propellants

End-use	Prohibited Substances	Effective Date
Aerosol Propellants	HFC-125, HFC-134a, HFC-227ea and blends of HFC-227ea and HFC 134a.	~~[January 1, 2021]~~ **[September 1, 2021]**
End-use Category: Air Conditioning		
End-use	Prohibited Substances	Effective Date
Centrifugal chillers (new)	FOR12A, FOR12B, HFC-134a, HFC-227ea, HFC-236fa, HFC245fa, R-125/ 134a/ 600a (28.1/70/1.9), R-125/ 290/ 134a/ 600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-410A, R-410B, R-417A, R-421A, R-422B, R-422C, R-422D, R-423A, R-424A, R-434A, R438A, R-507A, RS-44 (2003 composition), THR-03.	January 1, 2024
Positive displacement chillers (new)	FOR12A, FOR12B, HFC-134a, HFC-227ea, KDD6, R125/ 134a/ 600a (28.1/70/1.9), R-125/ 290/ 134a/ 600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-410A, R-410B, R-417A, R-421A, R-422B, R-422C, R-422D, R-424A, R-434A, R-437A, R438A, R-507A, RS-44 (2003 composition), SP34E, THR-03.	January 1, 2024
End-use Category: Refrigeration		
End-use	Prohibited Substances	Effective Date
Cold storage warehouses (new)	HFC-227ea, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R404A, R-407A, R-407B, R-410A, R-410B, R-417A, R-421A, R421B, R-422A, R-422B, R-422C, R-422D, R-423A, R-424A, R428A, R-434A, R-438A, R-507A, RS-44 (2003 composition).	January 1, 2023
Household refrigerators and freezers (new)	FOR12A, FOR12B, HFC-134a, KDD6, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-407F, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R424A, R-426A, R-428A, R-434A, R-437A, R-438A, R-507A, RS24 (2002 formulation), RS-44 (2003 formulation), SP34E, THR-03.	January 1, 2022
Household refrigerators and freezers—compact (new)	FOR12A, FOR12B, HFC-134a, KDD6, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-407F, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D,	~~[January 1, 2021]~~ **[September 1, 2021]**

	R424A, R-426A, R-428A, R-434A, R-437A, R-438A, R-507A, RS24 (2002 formulation), RS-44 (2003 formulation), SP34E, THR-03.	
Household refrigerators and freezers—built in appliances (new)	FOR12A, FOR12B, HFC-134a, KDD6, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-407F, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R424A, R-426A, R-428A, R-434A, R-437A, R-438A, R-507A, RS24 (2002 formulation), RS-44 (2003 formulation), SP34E, THR-03.	January 1, 2023
Supermarket Systems (Retrofit)	R-404A, R-407B, R-421B, R-422A, R-422C, R-422D, R428A, R-434A, R-507A	**~~[January 1, 2021]~~ [September 1, 2021]**
Supermarket Systems (New)	HFC-227ea, R-404A, R-407B, R-421B, R-422A, R-422C, R-422D, R-428A, R-434A, R-507A.	**~~[January 1, 2021]~~ [September 1, 2021]**
Remote Condensing Units (Retrofit)	R-404A, R-407B, R-421B, R-422A, R-422C, R-422D, R428A, R-434A, R-507A.	**~~[January 1, 2021]~~ [September 1, 2021]**
Remote Condensing Units (New)	HFC-227ea, R-404A, R-407B, R-421B, R-422A, R-422C, R-422D, R-428A, R-434A, R-507A.	**~~[January 1, 2021]~~ [September 1, 2021]**
Stand-Alone Units (Retrofit)	R-404A, R-507A.	**~~[January 1, 2021]~~ [September 1, 2021]**
Stand-Alone Medium-Temperature Units (New)	FOR12A, FOR12B, HFC-134a, HFC-227ea, KDD6, R125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R407A, R-407B, R-407C, R-407F, R-410A, R-410B, R417A, R-421A, R-421B, R-422A, R-422B, R-422C, R422D, R-424A, R-426A, R-428A, R-434A, R-437A, R438A, R-507A, RS-24 (2002 formulation), RS-44 (2003 formulation), SP34E, THR-03.	**~~[January 1, 2021]~~ [September 1, 2021]**
Stand-Alone Low-Temperature Units (New)	HFC-227ea, KDD6, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407A, R-407B, R-407C, R-407F, R-410A,	**~~[January 1, 2021]~~**

	R-410B, R-417A, R-421A, R-421B, R422A, R-422B, R-422C, R-422D, R-424A, R-428A, R434A, R-437A, R-438A, R-507A, RS-44 (2003 formulation).	**[September 1, 2021]**
Refrigerated food processing and dispensing equipment (New)	HFC-227ea, KDD6, R-125/ 290/ 134a/ 600a (55.0/1.0/42.5/1.5), R-404A, R-407A, R-407B, R-407C, R-407F, R-410A, R-410B, R417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R424A, R-428A, R-434A, R-437A, R-438A, R-507A, RS-44 (2003 formulation).	~~**[January 1, 2021]**~~ **[September 1, 2021]**
Vending Machines (Retrofit)	R-404A, R-507A.	~~**[January 1, 2021]**~~ **[September 1, 2021]**
Vending Machines (New)	FOR12A, FOR12B, HFC-134a, KDD6, R125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R407C, R-410A, R-410B, R-417A, R-421A, R-422B, R422C, R-422D, R-426A, R-437A, R-438A, R-507A, RS-24 (2002 formulation), SP34E.	January 1, 2022
End-use Category: Foams		
End-use	Prohibited Substances	Effective Date
Rigid Polyurethane and Polyisocyanurate Laminated Boardstock	HFC 134a, HFC 245fa, HFC 365mfc, and blends thereof.	~~**[January 1, 2021]**~~ **[September 1, 2021]**
Flexible Polyurethane	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof.	~~**[January 1, 2021]**~~ **[September 1, 2021]**
Integral Skin Polyurethane	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, Formacel Z-6.	~~**[January 1, 2021]**~~ **[September 1, 2021]**
Polystyrene Extruded Sheet	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, Formacel Z-6.	~~**[January 1, 2021]**~~ **[September 1, 2021]**
Phenolic Insulation Board and Bunstock	HFC-143a, HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof.	~~**[January 1, 2021]**~~

		[September 1, 2021]
Rigid Polyurethane Slabstock and Other	HFC-134a, HFC-245fa, HFC-365mfc and blends thereof; Formacel TI, Formacel Z-6.	**~~[January 1, 2021]~~ [September 1, 2021]**
Rigid Polyurethane Appliance Foam	HFC-134a, HFC-245fa, HFC-365mfc and blends thereof; Formacel TI, Formacel Z-6.	**~~[January 1, 2021]~~ [September 1, 2021]**
Rigid Polyurethane Commercial Refrigeration and Sandwich Panels	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, Formacel Z-6.	**~~[January 1, 2021]~~ [September 1, 2021]**
Polyolefin	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, Formacel Z-6.	**~~[January 1, 2021]~~ [September 1, 2021]**
Rigid Polyurethane Marine Flotation Foam	HFC-134a, HFC-245fa, HFC-365mfc and blends thereof; Formacel TI, Formacel Z-6.	**~~[January 1, 2021]~~ [September 1, 2021]**
Polystyrene Extruded Boardstock and Billet (XPS)	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, Formacel B, Formacel Z-6.	**~~[January 1, 2021]~~ [September 1, 2021]**
Rigid polyurethane (PU) high-pressure two-component spray foam	HFC-134a, HFC-245fa, and blends thereof; blends of HFC365mfc with at least 4 percent HFC-245fa, and commercial blends of HFC-365mfc with 7 to 13 percent HFC-227ea and the remainder HFC-365mfc; Formacel TI.	**~~[January 1, 2021]~~ [September 1, 2021]**
Rigid PU low-pressure two-component spray foam	HFC-134a, HFC-245fa, and blends thereof; blends of HFC365mfc with at least 4 percent HFC-245fa, and commercial blends of HFC-365mfc with 7 to 13 percent HFC-227ea and the remainder HFC-365mfc; Formacel TI.	**~~[January 1, 2021]~~ [September 1, 2021]**
Rigid PU one-component foam sealants	HFC-134a, HFC-245fa, and blends thereof; blends of HFC365mfc with at least 4 percent HFC-245fa, and commercial blends of HFC-365mfc with 7 to 13 percent HFC-227ea and the remainder HFC-365mfc; Formacel TI.	**~~[January 1, 2021]~~ [September 1, 2021]**

6.1.2 Proposed Modifications to List of Prohibited Substances

6.1.2.1 A person subject to the list of prohibited substances in Section 6.0 may request that the Department modify the regulation to exempt hydrofluorocarbon blends with a global-warming-potential of 750 or less in rigid polyurethane low-pressure two-component spray foam and polystyrene extruded boardstock and billet (XPS) from the list of prohibited substances in Section 6.0. The request shall contain the following information:

6.1.2.1.1 A detailed description of the end-use category for which the modification is requested; and

6.1.2.1.2 A demonstration that the U.S. EPA has approved the hydrofluorocarbon blend under the Significant New Alternatives Policy under section 7671(k) of the Clean Air Act.

7.0 End-use and prohibited substances exemptions

The following table lists exemptions to the prohibitions in Section 6.0

Table 2. End-use and Prohibited Substances exemptions

End-use category	Prohibited Substances	Acceptable Uses
Aerosol Propellants	HFC-134a.	Cleaning products for removal of grease, flux and other soils from electrical equipment; refrigerant flushes; products for sensitivity testing of smoke detectors; lubricants and freeze sprays for electrical equipment or electronics; sprays for aircraft maintenance; sprays containing corrosion preventive compounds used in the maintenance of aircraft, electrical equipment or electronics, or military equipment; pesticides for use near electrical wires, in aircraft, in total release insecticide foggers, or in certified organic use pesticides for which EPA has specifically disallowed all other lower-GWP propellants; mold release agents and mold cleaners; lubricants and cleaners for spinnerettes for synthetic fabrics; duster sprays specifically for removal of dust from photographic negatives, semiconductor chips, specimens under electron microscopes, and energized electrical equipment; adhesives and sealants in large canisters; document preservation sprays; FDA-approved MDIs for medical purposes; wound care sprays; topical coolant sprays for pain

		relief; and products for removing bandage adhesives from skin.
Aerosol Propellants	HFC-227ea and blends of HFC-227ea and HFC 134a.	FDA-approved MDIs for medical purposes.
Air Conditioning	HFC–134a.	Military marine vessels where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements.
Air Conditioning	HFC-134a and R-404A.	Human-rated spacecraft and related support equipment where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements.
Foams – Except Rigid polyurethane (PU) spray foam	All substances.	Military applications where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements until January 1, 2022.
Foams – Except Rigid polyurethane (PU) spray foam	All substances.	Space- and aeronautics-related applications where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements until January 1, 2025.
Rigid polyurethane (PU) two-component spray foam	All substances.	Military or space- and aeronautics-related applications where reasonable efforts have been made to ascertain that other alternatives are not technically feasible due to performance or safety requirements until January 1, 2025.

Department of Natural Resources and Environmental Control

Division of Air Quality

Regulation Proposal
7 DE Admin Code 1151 –
Prohibitions on Use of Certain Hydrofluorocarbons in Specific End-Uses

Technical Support Document

April 2020

TABLE OF CONTENTS

I. Executive Summary

As a coastal state with over 381 miles of shoreline, Delaware is already experiencing the detrimental effects of climate change, and its associated increased temperatures, sea level rise and intense rainfall events. Delaware is vulnerable to coastal erosion, storm surge, saltwater intrusion, and tidal wetland losses. Intense rainfall and rising sea levels increase the risk of permanent and temporary flooding across the state, which threatens public safety and incurs costly damage to homes and businesses. Rising temperatures, and extreme heat events increase the risk of serious illnesses, especially for vulnerable citizens—the elderly, young children, outdoor workers, and people with pre-existing health conditions. Temperature and rainfall extremes pose serious challenges for our agriculture and tourism economies, as well as imposing increasing costs for maintaining and repairing critical infrastructure. Inundation from sea level rise will occur in all three of Delaware's counties, affecting a wide variety of resources. For all these reasons, Delaware needs to prioritize addressing the effects of climate change and mitigating greenhouse gas emissions. Hydrofluorocarbons (HFCs) are potent greenhouse gases with global warming potential that are hundreds to thousands of times that of carbon dioxide (CO_2), and their use is projected to increase through 2050. Currently, HFCs are the fastest growing source of greenhouse gases globally, in sectors where energy-efficient alternatives are readily available for a growing number of applications.

This regulatory development process was initiated as a result of the 2019 Delaware House Concurrent Resolution 60[1] and the Governor's directive[2] to the Department of Natural Resources and Environmental Control to propose regulations for the use and manufacturing of HFCs in the State, by March 30, 2020. The proposed new regulation 7 DE Admin Code 1151 will establish prohibitions and phase down requirements for the manufacture and use of HFCs in Delaware, following an end-use specific schedule beginning as early as January 1, 2021. The proposed new regulation is based on the previously promulgated EPA Significant New Alternatives Policy (SNAP) rules 20 and 21[3], for which the federal agency had built an extensive technical support for the overall costs and the benefits for transitioning to lower global warming potential refrigerants that minimize risks to human health and the environment. According to estimates based on tools developed by the California Air Resources Board, on behalf of the United State Climate Alliance (USCA)[4], the proposed regulation is expected to reduce HFC emissions by 25% by 2030 compared to a Business as Usual scenario. In 10 years, (between 2020 and 2030), the Delaware proposal would avoid a total of 0.832 million metric tons of CO2 equivalent emissions.

This proposal is necessary to continue Delaware's effort to reduce its Greenhouse Gas (GHG) emissions, and to offer Delawareans an increasing quality of life through reduced air pollution, increased economic opportunities, and mitigating the effects of climate change.

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[1] Delaware General Assembly. Passed on June 30, 2019. House Concurrent Resolution 60. Accessible via: http://legis.delaware.gov/BillDetail/47864

[2] Delaware News, June 30, 2019. Governor's Directive on Delaware to Eliminate HFCs to Confront Climate. Accessible via: https://news.delaware.gov/2019/06/30/delaware-to-eliminate-hfcs-to-confront-climate-change/

[3] United States Environmental Protection Agency, Significant New Alternatives Policy, Regulatory website. Accessible via: https://www.epa.gov/snap/snap-regulations,

[4] United States Climate Alliance is a bipartisan coalition of governors committed to reducing greenhouse gas emissions consistent with the goals of the Paris Agreement. Accessible via: https://www.usclimatealliance.org/

II. Introduction and Background

A. What are Hydrofluorocarbons

Hydrofluorocarbons (HFCs) are gaseous compounds used across various economic sectors in applications for air conditioning, refrigeration, foam-blowing, solvents, and aerosols. HFCs were identified in the 2009 GHG Endangerment Finding[5] by the U.S. Environmental Protection Agency (EPA) as one of six GHGs in the atmosphere that "threaten the public health and welfare of current and future generations." As stated above, HFC emissions are GHG that can have a warming effect that is hundreds to thousands times that of carbon dioxide (CO_2), as illustrated in Table 1[6]. In the latter, two values are listed for the GWPs of each HFC; they refer to the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4)[7] and Fifth Assessment Report (AR5)[8]. While more recent data were used for the AR5, official emission estimates are currently being reported by the U.S. using AR4 GWP values[9]. Blends of HFCs are also commonly used as refrigerant; for example, R-410A is common refrigerant used in air conditioning that is a mixture of difluoromethane (HFC-32) and pentafluoroethane (HFC-125), resulting in a GWP of 2,088 (AR4; 1,924 for AR5).

Table 1. Examples of global warming potentials of commonly used HFCs

	100-year GWP Values	
Gas	**AR4***	**AR5****
HFC-23	14,800	12,400
HFC-32	675	677
HFC-125	3,500	3,170
HFC-134a	1,430	1,300
HFC-143a	4,470	4,800
HFC-152a	124	138
HFC-227ea	3,220	3,350
HFC-236fa	9,810	8,060
HFC-4310mee	1,640	1,650

* Intergovernmental Panel on Climate Change, Fourth Assessment Report (AR4); official emission estimates are reported by the U.S. using AR4 GWP values
** Intergovernmental Panel on Climate Change, Fifth Assessment Report (AR5)

[5] United States Environmental Protection Agency, December 2009. Endangerment and Cause or Contribute Findings for Greenhouse Gases under the Clean Air Act. Regulatory website. Accessible via: https://www.epa.gov/ghgemissions/endangerment-and-cause-or-contribute-findings-greenhouse-gases-under-clean-air-act.
[6] United States Environmental Protection Agency. April 2019. Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2017. Accessible via: https://www.epa.gov/sites/production/files/2019-04/documents/us-ghg-inventory-2019-main-text.pdf
[7] The Intergovernmental Panel on Climate Change. September 2017. Fourth Assessment Report on climate Change. Accessible via: https://www.ipcc.ch/assessment-report/ar4/.
[8] The Intergovernmental Panel on Climate Change. September 2014. Fifth Assessment Report on Climate Change. Accessible via: https://www.ipcc.ch/assessment-report/ar5/.
[9] The Intergovernmental Panel on Climate Change. September 2014. Fourth Assessment Report on Climate Change. Accessible via: https://www.ipcc.ch/assessment-report/ar5/.

As discussed in the following section, HFCs were originally introduced as a substitution ozone-depleting substances (ODS), within the same applications, as part of the phase-out established in accordance to the Montreal Protocol[10].

B. Background to this Initiative

Under the Montreal Protocol[11], chlorofluorocarbons (CFCs) were recognized as ozone depletion substances (ODS), and the EPA defined a phase-out schedule for the different classes of ODS (Class I and Class II). The phase-out targets the ODS that are produced or imported in the country, and the original schedule was amended over time.

The EPA rule for Class I substances (CFCs, halons, carbon tetrachloride, and methyl chloroform) required the producers to gradually reduce production of these chemicals and completely phase them out by January 1, 2000 (was later accelerated). Class II ODS (HCFCs – that were developed as transitional substitutes for class I) are used in a variety of applications, including refrigeration, air conditioning, foam blowing, solvents, aerosols, and fire suppression. Currently, there are 34 HCFCs subject to the EPA phase-out, but only a few are still commonly used (the most common being HCFC-22, HCFC-141b, HCFC-142-b). As a Party of the Montreal Protocol, the U.S.A. must incrementally decrease HCFCs consumption and production, to completion in 2030. HCFCs usage must be reduced to at least 99.5% below the baseline levels, in 2020. Section 605 of the CAA establishes the U.S. strategy and framework.

HFCs were developed to address the phase-out of the HCFCs (same applications), however they were recognized as greenhouse gases (GHGs) with high Global Warming Potentials (GWPs), and because of the increasing urgency of climate action, the Kigali Amendment[12] to the Montreal Protocol requires the participating countries to cut their production and consumption of HFCs by more than 80% by 2050.

The U.S. EPA sought to phase-down the use and manufacturing of these high-GWP pollutants through its Significant New Alternatives Policy (SNAP) program[13]. However, on August 8, 2017, the D.C. Court of Appeals limited the agency's ability to require replacement of HFCs due to a decision resulting from the Mexichem Fluor, Inc. (petitioner) v. EPA (respondent) case[14]. Although legal actions have been initiated to defend the SNAP rules in court, state action is required to maintain HFCs prohibitions schedule, in line with the vacated SNAP rules.

Delaware's Department of Natural Resources and Environmental Control has authority to regulate the use of HFCs upon Del. Code Title 7, Chapter 60 §§ 6001(c) & 6010 which authorize the

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[10] United Nations. About Montreal Protocol Website. Accessible via: https://www.unenvironment.org/ozonaction/who-we-are/about-montreal-protocol

[11] United Nations. About Montreal Protocol Website. Accessible via: https://www.unenvironment.org/ozonaction/who-we-are/about-montreal-protocol

[12] United Nations Environment Programme. The Kigali Amendment to the Montreal protocol: another global commitment to stop climate change. Accessible via: https://www.unenvironment.org/news-and-stories/news/kigali-amendment-montreal-protocol-another-global-commitment-stop-climate

[13] United States Environmental Protection Agency, Significant New Alternatives Policy, Regulatory website. Accessible via: https://www.epa.gov/snap/snap-regulations,

[14] United States Court of Appeals for the District of Columbia Circuit. August 8, 2017. Mexichem Fluor, Inc. v. EPA. Accessible via: https://www.cadc.uscourts.gov/internet/opinions.nsf/3EDC3D4817D618CF8525817600508EF4/$file/15-1328-1687707.pdf

Department to adopt rules to control air pollution, as necessary to protect the public health, safety, and welfare.

The Division of Air Quality is developing regulation 7 DE Admin. Code 1151 "Prohibitions on Use of Certain Hydrofluorocarbons in Specific End-Uses", pursuant to the Governor's directive[15] and House Concurrent Resolution 60[16]. This proposed new regulation addresses the critical need to phase down the use of high-GWP gases, to confront climate change.

C. Meeting Delaware's Greenhouse Gas Reduction Goals

Nationally, the use of HFCs in air conditioning, refrigeration, and other applications has been rapidly increasing, while emissions of HFCs have been increasing by as much 8% annually[17].

According to the 2016 Delaware GHG Inventory report, HFC emissions are projected to increase in multiple economic sectors18. HFCs are the fastest growing type of GHG emissions in Delaware, increasing by 36% from 2016 to 2025, as seen in Figure 1. Other GHG emissions, including N2O, methane and SF6, are projected to remain constant or decrease in that same time period.

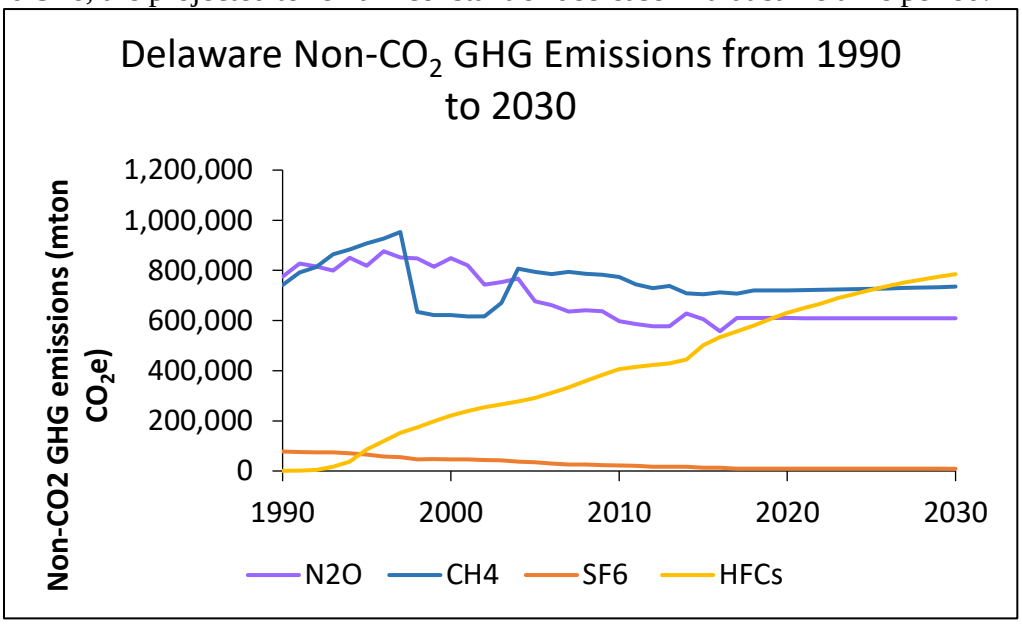

Figure 1. Emission estimates and projections of N_2O, CH_4, and SF_6, and HFCs in Delaware from 1990 to 2030

[15] Delaware News, June 30, 2019. Governor's Directive on Delaware to Eliminate HFCs to Confront Climate. Accessible via: https://news.delaware.gov/2019/06/30/delaware-to-eliminate-hfcs-to-confront-climate-change/

[16] Delaware General Assembly. Passed on June 30, 2019. House Concurrent Resolution 60. Accessible via: http://legis.delaware.gov/BillDetail/47864

[17] Delaware General Assembly. Passed on June 30, 2019. House Concurrent Resolution 60. Accessible via: http://legis.delaware.gov/BillDetail/47864

[18] Delaware Department of Natural Resources and Environmental Control. Division of Air Quality. July 2019. Delaware's 2016 Greenhouse Gas Emissions Inventory. Accessible via: http://www.dnrec.delaware.gov/Air/Documents/2016-de-ghg-inventory.pdf

Further, HFC emissions are anticipated to contribute to 4.5% of the total gross GHG emissions (in $MmtCO_2e$) in Delaware in 2025 (Figure 2). The proposed regulation will establish prohibitions for specific end-uses of certain HFC refrigerants in order to reduce associated GHG emissions. The reduction of these high-GWP emissions will help to reduce the negative impacts of climate change in Delaware and help the State to achieve its GHG emissions reduction commitment. According Delaware's 2016 Greenhouse Gas Emissions Inventory[19], the State is not on track to meet its GHG emission reduction target commitment of 26%-28% below 2005 levels, by 2025[20]. Currently, the State is projected to achieve a 16% reduction in GHG emissions from 2005 levels by 2025.

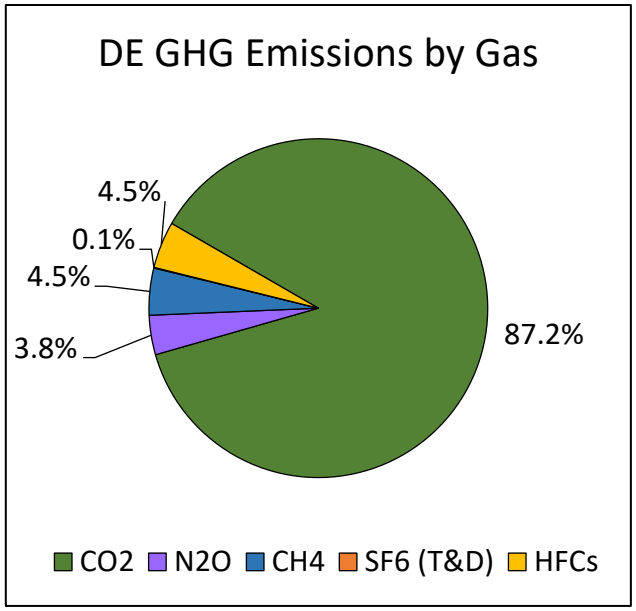

Figure 2. Breakdown of projected GHG emissions ($MmtCO_2e$) in DE in 2025

As HFC emissions are growing at a rapid rate in Delaware, the proposed new regulation on the manufacture and use of HFCs in the State is an important aspect to achieve the state's GHG reduction goals, as well as mitigate the environmental, social and, health risks related to climate change. Climate change poses significant threat especially to Delaware as a coastal state, which has the lowest average elevation in the country[21]. Among Delaware's industries and infrastructure that are vulnerable to the effects of climate change are the tourism, real estate, agriculture, transportation, wastewater, and more. Further, human health, air and water quality, and ecosystems are at increasing risk with the strengthening consequences of climate change[22].

Delaware is already experiencing climate change, which is causing increased temperatures, sea levels rise and heavy precipitation events.[23] Since 1900 the average annual temperature rose by 2°Fahrenheit, and average temperatures are expected to increase another 2.5 to 4.5 degrees Fahrenheit by mid-century (2050) and by as much as 8 degrees by 2100 (late century). By 2100, average precipitation is expected to increase by about 10 percent. Heavy rainstorms and the potential for flooding are expected to become more frequent and more intense. Increasing temperatures may

[19] Delaware Department of Natural Resources and Environmental Control. Division of Air Quality. July 2019. Delaware's 2016 Greenhouse Gas Emissions Inventory. Accessible via: http://www.dnrec.delaware.gov/Air/Documents/2016-de-ghg-inventory.pdf
[20] United States Climate Alliance. Alliance Member State Commitments. Accessible via: http://www.usclimatealliance.org/alliance-principles.
[21] University of Delaware. 2018. Research on Sea Level Rise. Accessible via: https://www1.udel.edu/researchmagazine/issue/vol4_no1/slr_intro.html
[22] Delaware Department of Natural Resources and Environmental Control. Division of Energy and Climate. February 2014. Delaware Climate Change Impact Assessment. Accessible via: http://www.dnrec.delaware.gov/energy/Documents/Climate%20Change%202013-2014/DCCIA%20interior_full_dated.pdf
[23] Delaware Department of Natural Resources and Environmental Control. Division of Energy and Climate. February 2014. Delaware Climate Change Impact Assessment. Accessible via: http://www.dnrec.delaware.gov/energy/Documents/Climate%20Change%202013-2014/DCCIA%20interior_full_dated.pdf

increase the risk of serious illness such as heat stroke, especially for our state's vulnerable citizens. Increased temperatures may also increase the number of days when ground-level ozone concentrations exceed health-based standards, which will impact children, the elderly, and healthy individuals. Changes in precipitation patterns and temperature may also impact how disease spreads, including mosquito and tick-borne diseases.

Because of its location, low average elevation, and dependence on the coast, Delaware is particularly vulnerable to the effects of rising sea levels including loss of low-lying land and structures, saltwater intrusion into ground and surface waters, and increased coastal flooding from storm events. Statewide, between 8% and 11% of the state's land area could be inundated by sea level rise by the year 2100.[24] Sea level rise is likely to affect the condition of roads and bridges and other infrastructure throughout the state, including access routes and evacuation routes to many beach communities and other low-lying areas. Although the direct impacts from sea level rise will be felt primarily in areas near tidal waters, every Delawarean is likely to be affected whether through increased costs of maintaining public infrastructure, decreased tax base, loss of recreational opportunities or loss of community character."

Because climate change is impacting Delaware's residents, natural resources, infrastructure and industries, Delaware believes that strong actions to mitigate greenhouse gases are necessary to ensure a high quality of life and economic vitality for generations to come. Following the 2017 decision by the Federal administration to withdraw the U.S. from the Paris climate agreement[25], the U.S. Climate Alliance[26] was formed by a bi-partisan coalition of 17 states committed to reducing greenhouse gas emissions consistent with the goals of the Paris Agreement. Delaware is a founding member of the U.S. Climate Alliance, and in joining the coalition, committed to reduce its economy-wide GHG emissions by 26-28% by 2025 from a 2005 baseline.

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[24] Department of Natural Resources and Environmental Control. July 2012. Preparing for Tomorrow's High Tide – Sea Level Rise Vulnerability Assessment for the State of Delaware. Accessible via: http://www.dnrec.delaware.gov/coastal/Pages/SLR/DelawareSLRVulnerabilityAssessment.aspx

[25] United Nations Climate Change. The Paris Agreement aims to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. Accessible via: https://unfccc.int/process-and- meetings/the-paris-agreement/the-paris-agreement

[26] United States Climate Alliance is a bipartisan coalition of governors committed to reducing greenhouse gas emissions consistent with the goals of the Paris Agreement. Accessible via: https://www.usclimatealliance.org/

III. Overview of the Proposed Regulation 7 DE Admin Code 1151

In accordance with the Governor's directive, the proposed new regulation 7 DE Amin. Code 1151 *Prohibitions on Use of Certain Hydrofluorocarbons in Specific End-Uses* establishes the prohibitions and the requirements for the use and manufacture of hydrofluorocarbons in the State of Delaware, according to their specific end usage, which include air conditioning and refrigeration equipment, aerosol propellants, and foam end-uses.

A. Applicability

The proposed regulation will establish prohibitions for any person who sells, offers for sale, leases, rents, installs, uses or manufactures in the State of Delaware, any product or equipment that uses a substance in any of the end-uses listed under the list of prohibited substances covered by the regulation.

As a flexibility mechanism, the Department proposed language to allow the use of product or equipment containing a prohibited substance if this product or equipment was acquired prior to the applicable effective date of prohibition, unless an existing system is retrofit. Additionally, the Department has proposed language to clarify that, unless an operation constitute a retrofit or reclassifies a system as "new", this proposed new regulation does not prevent the use of a prohibited substance in the servicing, maintenance and repair operations of an existing equipment, in any end-use covered by the proposed new regulation.

The Department has also proposed language to allow the sale, importation, exportation, installation, and use of product or equipment containing a prohibited substance after the specified date of prohibition, only if the product or equipment was manufactured prior to the applicable date of prohibition.

B. Prohibitions

Table 2 below lists each prohibited substance and the effective date of its prohibition, according to its specific end-use. The prohibitions and effective dates detailed in the proposed new regulation were informed by the EPA SNAP rules 20 and 21 intended phase down schedule for the different substances, which took into consideration many economic constraints for the industry, along with the availability of viable and cost-effective low-GWP alternatives.

Table 2: Proposed Regulation's List of Prohibited Substances and their Effective Date of Prohibition, by End-Use.

End-use and Prohibited substances		
End-use Category: Aerosol Propellants		
End-use	Prohibited Substances	Effective Date
Aerosol Propellants	HFC-125, HFC-134a, HFC-227ea and blends of HFC-227ea and HFC 134a.	January 1, 2021
End-use Category: Air Conditioning		
End-use	Prohibited Substances	Effective Date

Centrifugal chillers (new)	FOR12A, FOR12B, HFC-134a, HFC-227ea, HFC-236fa, HFC245fa, R-125/ 134a/ 600a (28.1/70/1.9), R-125/ 290/ 134a/ 600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-410A, R-410B, R-417A, R-421A, R-422B, R-422C, R-422D, R-423A, R-424A, R-434A, R438A, R-507A, RS-44 (2003 composition), THR-03.	January 1, 2024
Positive displacement chillers (new)	FOR12A, FOR12B, HFC-134a, HFC-227ea, KDD6, R125/ 134a/ 600a (28.1/70/1.9), R-125/ 290/ 134a/ 600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-410A, R-410B, R-417A, R-421A, R-422B, R-422C, R-422D, R-424A, R-434A, R-437A, R438A, R-507A, RS-44 (2003 composition), SP34E, THR-03.	January 1, 2024
End-use Category: Refrigeration		
End-use	Prohibited Substances	Effective Date
Cold storage warehouses (new)	HFC-227ea, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R404A, R-407A, R-407B, R-410A, R-410B, R-417A, R-421A, R421B, R-422A, R-422B, R-422C, R-422D, R-423A, R-424A, R428A, R-434A, R-438A, R-507A, RS-44 (2003 composition).	January 1, 2023
Household refrigerators and freezers (new)	FOR12A, FOR12B, HFC-134a, KDD6, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-407F, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R424A, R-426A, R-428A, R-434A, R-437A, R-438A, R-507A, RS24 (2002 formulation), RS-44 (2003 formulation), SP34E, THR-03.	January 1, 2022
Household refrigerators and freezers—compact (new)	FOR12A, FOR12B, HFC-134a, KDD6, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-407F, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R424A, R-426A, R-428A, R-434A, R-437A, R-438A, R-507A, RS24 (2002 formulation), RS-44 (2003 formulation), SP34E, THR-03.	January 1, 2021
Household refrigerators and freezers—built in appliances (new)	FOR12A, FOR12B, HFC-134a, KDD6, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-407F, R-410A, R-410B, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R424A, R-426A, R-428A, R-434A, R-437A, R-438A, R-507A, RS24 (2002 formulation), RS-44 (2003 formulation), SP34E, THR-03.	January 1, 2023

Supermarket Systems (Retrofit)	R-404A, R-407B, R-421B, R-422A, R-422C, R-422D, R428A, R-434A, R-507A	January 1, 2021
Supermarket Systems (New)	HFC-227ea, R-404A, R-407B, R-421B, R-422A, R-422C, R-422D, R-428A, R-434A, R-507A.	January 1, 2021
Remote Condensing Units (Retrofit)	R-404A, R-407B, R-421B, R-422A, R-422C, R-422D, R428A, R-434A, R-507A.	January 1, 2021
Remote Condensing Units (New)	HFC-227ea, R-404A, R-407B, R-421B, R-422A, R-422C, R-422D, R-428A, R-434A, R-507A.	January 1, 2021
Stand-Alone Units (Retrofit)	R-404A, R-507A.	January 1, 2021
Stand-Alone Medium-Temperature Units (New)	FOR12A, FOR12B, HFC-134a, HFC-227ea, KDD6, R125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R407A, R-407B, R-407C, R-407F, R-410A, R-410B, R417A, R-421A, R-421B, R-422A, R-422B, R-422C, R422D, R-424A, R-426A, R-428A, R-434A, R-437A, R438A, R-507A, RS-24 (2002 formulation), RS-44 (2003 formulation), SP34E, THR-03.	January 1, 2021
Stand-Alone Low-Temperature Units (New)	HFC-227ea, KDD6, R-125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R-407A, R-407B, R-407C, R-407F, R-410A, R-410B, R-417A, R-421A, R-421B, R422A, R-422B, R-422C, R-422D, R-424A, R-428A, R434A, R-437A, R-438A, R-507A, RS-44 (2003 formulation).	January 1, 2021
Refrigerated food processing and dispensing equipment (New)	HFC-227ea, KDD6, R-125/ 290/ 134a/ 600a (55.0/1.0/42.5/1.5), R-404A, R-407A, R-407B, R-407C, R-407F, R-410A, R-410B, R417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-422D, R424A, R-428A, R-434A, R-437A, R-438A, R-507A, RS-44 (2003 formulation).	January 1, 2021
Vending Machines (Retrofit)	R-404A, R-507A.	January 1, 2021
Vending Machines (New)	FOR12A, FOR12B, HFC-134a, KDD6, R125/290/134a/600a (55.0/1.0/42.5/1.5), R-404A, R407C, R-410A, R-410B, R-417A, R-421A, R-422B, R422C, R-422D, R-426A, R-437A, R-438A, R-507A, RS-24 (2002 formulation), SP34E.	January 1, 2022
End-use Category: Foams		
End-use	Prohibited Substances	Effective Date
Rigid Polyurethane and Polyisocyanurate	HFC 134a, HFC 245fa, HFC 365mfc, and blends thereof.	January 1, 2021

Laminated Boardstock		
Flexible Polyurethane	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof.	January 1, 2021
Integral Skin Polyurethane	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, Formacel Z-6.	January 1, 2021
Polystyrene Extruded Sheet	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, Formacel Z-6.	January 1, 2021
Phenolic Insulation Board and Bunstock	HFC-143a, HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof.	January 1, 2021
Rigid Polyurethane Slabstock and Other	HFC-134a, HFC-245fa, HFC-365mfc and blends thereof; Formacel TI, Formacel Z-6.	January 1, 2021
Rigid Polyurethane Appliance Foam	HFC-134a, HFC-245fa, HFC-365mfc and blends thereof; Formacel TI, Formacel Z-6.	January 1, 2021
Rigid Polyurethane Commercial Refrigeration and Sandwich Panels	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, Formacel Z-6.	January 1, 2021
Polyolefin	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, Formacel Z-6.	January 1, 2021
Rigid Polyurethane Marine Flotation Foam	HFC-134a, HFC-245fa, HFC-365mfc and blends thereof; Formacel TI, Formacel Z-6.	January 1, 2021
Polystyrene Extruded Boardstock and Billet (XPS)	HFC-134a, HFC-245fa, HFC-365mfc, and blends thereof; Formacel TI, Formacel B, Formacel Z-6.	January 1, 2021
Rigid polyurethane (PU) high-pressure two-component spray foam	HFC-134a, HFC-245fa, and blends thereof; blends of HFC365mfc with at least 4 percent HFC-245fa, and commercial blends of HFC-365mfc with 7 to 13 percent HFC-227ea and the remainder HFC-365mfc; Formacel TI.	January 1, 2021
Rigid PU low-pressure two-component spray foam	HFC-134a, HFC-245fa, and blends thereof; blends of HFC365mfc with at least 4 percent HFC-245fa, and commercial blends of HFC-365mfc with 7 to 13 percent HFC-227ea and the remainder HFC-365mfc; Formacel TI.	January 1, 2021
Rigid PU one-component foam sealants	HFC-134a, HFC-245fa, and blends thereof; blends of HFC365mfc with at least 4 percent HFC-245fa, and commercial blends of HFC-365mfc with 7 to 13 percent HFC-227ea and the remainder HFC-365mfc; Formacel TI.	January 1, 2021

The EPA SNAP rules prohibition dates that pre-dated December 31st, 2020 were revised to be January 1, 2021 under this proposed new regulation, to accommodate for the Department's regulatory process development.

Additionally, the Department has allowed a one-year extension (revised to January 1st, 2022) for the new vending machine end-use category, before the effective date of prohibition for all substances covered under this end-use. This extension resulted from industry stakeholders informing the Department that the current preferred low GWP refrigerant alternative (R-290) for the vending machine industry is currently designated as a flammable chemical A-3 by the American Society of Heating, refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) guideline 34[27]. UL 541 and ASHRAE 15 have authority over products containing this chemical and their placement within buildings, and pursuant to these requirements, in the US, vending machines with any refrigerant other than A1 (non-flammable) classification may not be placed in locations of ingress, egress, hallways, or lobby areas of any buildings, at the risk of severe liabilities in case of incident. The industry informed the Department of the current work with UL and ASHRAE that may allow R-290 to work within the safety standards, by modifying UL 541 and ASHRAE 15. For these reasons, the Department is proposing to allow the industry a one-year extension to establish their compliance pathway.

C. Disclosure Statement

This proposed regulation establishes disclosure requirements for manufacturers of the products and equipment covered under the proposed new regulation. By requiring a disclosure statement or label to be available to the buyer of products and/or equipment covered under this proposed new regulation, the Department aims to ensure that said buyer can verify that their purchase follows State regulation.

In setting the disclosure statement requirements, the Department is proposing language to allow flexibility for manufacturers to comply, while offering the customers transparent and easily accessible information on their purchase.

The Department has proposed the following disclosure statement requirements, to be made available to the buyer accompanying the product or equipment covered under this proposed regulation. These requirements were crafted in collaboration with many industry-specific stakeholders that informed the process by highlighting the practical challenges, and existing practices in their respective field.

I) For motor-bearing refrigeration and air-conditioning equipment that is neither factory-charged nor pre-charged with refrigerant. The disclosure or label will include the following statement:

"This equipment is prohibited from using any substance on the "List of Prohibited Substances" for that specific end-use, in accordance with State regulations for hydrofluorocarbons."

II) For motor-bearing refrigeration and air-conditioning equipment that is factory-charged or pre-charged with refrigerant. The disclosure or label will include the following information:

[27] ANSI/ASHRAE Standard 34 -2019, Designation and Safety Classification of Refrigerants. Accessible via https://www.ashrae.org/technical-resources/standards-and-guidelines/standards-addenda/addenda-to-standard-34-2019

a. The date of manufacture
b. The refrigerant and foam blowing agent that the product/equipment contains

For this category, the Department has proposed language to allow existing labels to be used as an alternative compliance path, if they contain the required information mentioned above.

III) For foam products, the disclosure or label will comply with either one of the following options:
   a. **Option 1** should include de following information:
      i. The date of manufacture
      ii. The foam blowing agent that the product contains.
         1. For this criterion, the Department has proposed language to allow Safety Data Sheet[28] as an alternative compliance path.
   b. **Option 2** should include the following statement:
      "Where sold, compliant with State HFC regulations."

IV) For aerosol propellants, the disclosure or label will comply with either one of the following options:
   a. **Option 1** should include de following information:
      i. The date of manufacture
         1. For this criterion, the Department has proposed language to allow a date code[29] as an alternative compliance path.
      ii. The aerosol propellant the product contains.
         1. For this criterion, the Department has proposed language to allow Safety Data Sheet[30] as an alternative compliance path.
   b. **Option 2** should include the following statement:
      "Where sold, compliant with State HFC regulations."

[28] A reference to a Safety Data Sheet that is in compliance with 29 CFR 1910.1200 requirements, and identifies the foam blowing agent the product contains.
[29] Where a date code representing the date, shall be indicated on the label, lid, or bottom of the container. If the manufacturer uses a date code for any product, the manufacturer shall file an explanation of each code to the Department.
[30] A reference to a Safety Data Sheet that is in compliance with 29 CFR 1910.1200 requirements, and identifies the propellant the product contains.

IV. Economic Impacts

A. EPA's SNAP Economic Impact Analysis

I) Aerosols, foams, commercial refrigeration and motor vehicle air conditioning end-uses

EPA's analysis estimates the nationwide potential annualized compliance costs associated with the requirements to change certain high-GWP alternatives used in aerosols, foams, commercial refrigeration, and motor vehicle air conditioning (SNAP 20)[31], to range from $28.0 million to $50.6 million, in 2013 dollars using a 3% discount rate. When combined with the estimated savings, the total annualized costs are estimated to range from $0.2 million to $31.9 million. The estimated annualized compliance costs for these specific end-uses are shown in Table 3, below.

For example, as illustrated in Table 3, no annual costs or savings are assumed for Supermarket Systems and Remote Condensing Units, since supermarkets the incremental cost of using R-407A in new systems in lieu of R-404A or R-507A is negligible for end-users (e.g. supermarkets), given that the composition of the chemicals are similar the cost of the refrigerant is assumed to be the same.

Scaling down these national estimates of annualized compliance costs associated with SNAP 20, the highest potential annualized costs (including savings) for the entire State of Delaware are estimated to total $93,460 in 2013 U.S. dollars[32]

[31] ICF International. July 2015. Revised Cost Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives. Accessible via: https://www.regulations.gov/document?D=EPA-HQ-OAR-2014-0198-0242

[32] Using the United States Census Bureau population data of 967,171 people and 330,119,397 for Delaware population and National population respectively, on December 10, 2019. Accessible via: https://www.census.gov/popclock/

Table 3. U.S. EPA's National Estimate of Annualized Compliance Cost of the Regulatory Changes Associated with SNAP 20, using a 3% Discount Rate[33]

Sector	Higher			Lower		
	Annualized Upfront Costs[a]	Annual Savings[b]	Annualized Upfront Cost and Annual Savings[c]	Annualized Upfront Costs[a]	Annual Savings[b]	Annualized Upfront Cost and Annual Savings[b]
Motor Vehicle Air Conditioning – Exports[d]	$8,760,000	$0	$8,760,000	$0	$0	$0
Aerosols	$860,000	($5,250,000)	$0[c]	$210,000	($5,250,000)	($5,040,000)
Foams	$26,940,000	($14,090,000)	$21,860,000	$18,910,000	($14,090,000)	$4,820,000
Polystyrene foam product manufacturing	$18,400,000	$0	$18,400,000	$11,810,000	$0	$11,810,000
Household refrigerator and freezer manufacturing	$2,280,000	($6,600,000)	$0[c]	$1,900,000	($6,600,000)	($4,700,000)
Commercial and industrial refrigeration equipment manufacturing	$2,790,000	($7,480,000)	$0[c]	$2,320,000	($7,480,000)	($5,160,000)
Urethane and other foam product (except polystyrene) manufacturing	$3,480,000	($10,000)	$3,470,000	$2,890,000	($10,000)	$2,880,000
Commercial Refrigeration	$1,280,000	$0	$1,280,000	$400,000	$0	$400,000
New Equipment	$1,280,000	$0	$1,280,000	$400,000	$0	$400,000
Supermarket systems	$0	$0	$0	$0	$0	$0
Remote condensing units	$0	$0	$0	$0	$0	$0
Stand-alone equipment	$1,080,000	$0	$1,080,000	$320,000	$0	$320,000
Vending machines	$200,000	$0	$200,000	$80,000	$0	$80,000
Retrofits	$0	$0	$0	$0	$0	$0
Supermarket systems	$0	$0	$0	$0	$0	$0
Remote condensing units	$0	$0	$0	$0	$0	$0
Stand-alone equipment	$0	$0	$0	$0	$0	$0
Vending machines	$0	$0	$0	$0	$0	$0
ALL SECTORS	$37,840,000	($19,340,000)	$31,910,000[c]	$19,530,000	($19,340,000)	$180,000

Totals may not sum due to independent rounding.

[a] Includes annualized upfront capital costs as well as recurring annual costs.

[b] Savings are shown as negative values; costs are shown as positive values.

[c] Annualized upfront costs and annual savings have been rounded to zero rather than a negative combined annualized upfront costs and annual savings for the higher estimate. The rounding assumes that at least some portion of the industry would have made the change even in the absence of the regulation.

[d] Costs are estimated on a per vehicle basis and are assumed for a subset of the export market only.

[33] Id at 31.

II) Refrigeration, air conditioning, foams and fire suppression end-uses

EPA's analysis estimates the nationwide potential annualized compliance costs associated with the requirements to change certain high-GWP alternatives used in refrigeration and air conditioning, foams, and fire suppression (SNAP 21)[34], to range from $59.3 million to $71.2 million, in 2015 dollars using a 3% discount rate, as shown in Table 4. For these end-uses, however, the potential costs savings associated with the changes in energy efficiency were not estimated because energy efficiency was related to a large number of factors, including equipment design, and equipment characteristics. Energy efficiency does not just depend on the refrigerant or foam blowing agent used.

For example, in EPA's estimate illustrated in Table 4, manufacturers of refrigerated food processing and dispensing equipment incur an incremental cost of $4-5 for each for each piece of equipment they produce using R-450A in place of R-404A (regulated substance). With units estimated to sell for $10,000 a piece on average, manufacturers are estimated to incur, on average, an annual incremental cost of ~$200-$200,000 (2015 dollars), depending on the size of the firm.

Table 4. U.S. EPA's National Estimate of Annualized Compliance Cost of the Regulatory Changes Associated with SNAP 21, using a 3% Discount Rate[35]

Sector	Estimated Number of Businesses Impacted by the Rule[a]	Higher Annualized Costs[a]	Lower Annualized Costs[a]
Refrigeration and Air Conditioning	50	$69,659,000	$58,213,000
Centrifugal Chillers	<10	$29,352,000	$25,879,000
Positive Displacement Chillers		$33,799,000	$27,039,000
Food Processing and Dispensing Equipment	20	$419,000	$335,000
Household Refrigerators and Freezers	20	$5,604,000	$4,616,000
Cold Storage Warehouses	<10	$142,000	$69,000
Foams	50	$1,560,000	$1,118,000
High-Pressure Two-Component Spray Foam	40	$1,089,000	$726,000
Low-Pressure Two-Component Spray Foam	<10	$467,000	$359,000
One-Component Foam	<10	$5,000	$3,000
Flexible Polyurethane	0	$0	$0
Fire Suppression	0	$0	$0
Total Flooding	0	$0	$0
ALL SECTORS	100	$71,219,000	$59,331,000

Totals may not sum due to independent rounding.

[a] Includes annualized upfront capital costs as well as recurring annual costs.

[34] ICF International. September 2016. Cost Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives used in Refrigeration and Air Conditioning, Foams, and Fire Suppression.

[35] ICF International. September 2016. Cost Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives used in Refrigeration and Air Conditioning, Foams, and Fire Suppression.

Scaling down these annualized compliance costs associated with SNAP 21, the highest potential annualized costs for the entire State of Delaware are estimated to total $208,599 in 2015 U.S. dollars[36].

III) SNAP 20 and 21 entities in the State of Delaware

EPA's Economic Impact Screening Analyses[37] uses the North American Industry Classification System (NAICS) codes for all sectors, potentially affected by the SNAP rules to clarify the industry sectors covered under each end-use.

For illustration purposes, Table 5 below lists all sector of activities targeted by the vacated SNAP rules, and their corresponding NAICS codes (used for EPA's Economic Impact Analyses), along with the number of corresponding entities in Delaware falling in these NAICS codes and potentially impacted by the proposal.

It should be noted that EPA's economic impact analyses are likely to overestimate the compliance costs as they would be implemented in Delaware with prohibitions dates starting not earlier than January 2021. The reasons include:

1) EPA's estimates of costs are primarily applied to manufacturers that are not located in Delaware state,

2) The current proposal does not cover Motor Vehicle Air Conditioning end-uses, which was included in the EPA rules,

3) EPA rules had their first effective date of prohibitions starting in 2016, thus some of the covered entities have already made the transition to alternative substances and already incurred the costs that would be associated with this proposal, and

4) The current proposal does not contain record-keeping requirements where the EPA SNAP rules did.

[36] Using the United States Census Bureau population data of 967,171 people and 330,119,397 for Delaware population and National population respectively, on December 10, 2019. Accessible via: https://www.census.gov/popclock/

[37] ICF International for U.S. Environmental Protection Agency. July 2015. Economic Impact Screening Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives – Revised. Accessible via https://www.regulations.gov/document?D=EPA-HQ-OAR-2014-0198-0240

And

ICF International for U.S. Environmental Protection Agency. September 2016. Economic Impact Screening Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives used in Refrigeration and Air Conditioning, Foams, and Fire Suppression.

Table 5. Identified Delaware Entities by NAICS Codes, based on EPA's Screening Analysis for SNAP rules 20 and 21 Impacted Entities

Category	NAICS Code	Number of Entities in Delaware
Motor Vehicle Air Conditioning	NAICS 336111 Automobile Manufacturing	0
	NAICS 336112 Light Truck and Utility Vehicle Manufacturing	0
Aerosols *The broader industries represented by these NAICS codes may also manufacture a majority of products which are not aerosols, and aerosol products that are already using non-HFC technologies.*	NAICS 325620 Perfumes, makeups and other toiletries	1
	NAICS 325612 Polishes and other sanitation goods	1
	NAICS 325520 Adhesive manufacturing	1
	NAICS 324191 Petroleum lubricating oil and grease manufacturing	1
	NAICS 325998 All other miscellaneous chemical product and preparation manufacturing	8
	NAICS 325412 Pharmaceutical preparation manufacturing	16
	NAICS 325199 All other basic organic chemical manufacturing	6
	NAICS 339113 Surgical appliance and supplies manufacturing	8
Foam Sector	NAICS 326140 Polystyrene foam product manufacturing	1
	NAICS 335222 Household refrigerator and home freezer manufacturing	0
	NAICS 333415 Air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing	4

Category	NAICS Code	Number of Entities in Delaware
	NAICS 326150 Urethane and other foam product (except polystyrene) manufacturing	5
Remote Retail Food Equipment	NAICS 44511 Supermarkets and other grocery (except convenience) stores	157
	NAICS 44512 Convenience stores	103
	NAICS 44521 Specialty food stores – meat markets	20
	NAICS 44522 Specialty food stores – fish and seafood markets	20
	NAICS 44523 Specialty food stores – fruit and vegetable markets	15
	NAICS 445291 Specialty food stores – baked goods stores	4
	NAICS 445292 Specialty food stores – confectionary and nut stores	12
	NAICS 445299 All other specialty food stores	12
	NAICS 4453 Beer, wine, and liquor stores	258
	NAICS 453110 Florist	35
	NAICS 44711 Gasoline stations with convenience stores	165
	NAICS 44719 Other gasoline stations	15
	NAICS 446110 Pharmacies and drug stores	265
	NAICS 452311 Warehouse clubs and superstores	24
	NAICS 452319 All other general merchandise stores	129

Category	NAICS Code	Number of Entities in Delaware
	NAICS 72111 Hotels (except casino hotels) and motels	171
	NAICS 72112 Casino hotels	1
	NAICS 722511 Full-service Restaurants	817
	NAICS 722513 Limited-service restaurants	722
	NAICS 722514 Cafeterias, buffets, and grill buffets	18
	NAICS 722515 Snack and nonalcoholic beverage bars	232
	NAICS 72241 Drinking places	52
Stand-Alone Retail Food Equipment	NAICS 333415 Air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing	4
Vending Machines	NAICS 333311 Automatic vending machine manufacturing	0
Centrifugal and positive displacement chiller manufacturers	NAICS code 333415, air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing	4 - *already counted under "Stand-Alone Retail Food Equipment"*
Household Refrigerators and Freezers	NAICS 335222 Household refrigerator and home freezer manufacturing	0

B. Low-GWP Alternative Costs

Most HFCs are used as refrigerants in refrigeration and air conditioning equipment, but also as blowing agents, aerosol propellants and solvents. The lower-GWP alternatives to commonly used HFCs include natural refrigerants, HFCs with lower GWP (such as R32), hydrofluoroolefins (HFOs), and HFC-HFO blends. Each substance varies in terms of flammability and toxicity potential, and although many industries already have adopted preferred low-GWP alternatives for specific end-uses, for most end-use categories, there is ongoing research and development for optimal climate-friendly, energy-efficient, safe and proven alternatives.

Table 3, presented in section IV(A) of this Technical Support Document details nationwide estimated savings expected for the transition to lower-GWP substances in some end-uses[38]. For example, EPA's Screening Analysis[39] estimated that if 50% of the nation's large supermarkets choose to replace an old R404A or R507A system with a new transcritical CO_2 system, those supermarkets were estimated to incur an additional total annualized upfront cost of ~$979,000 and total annual cost savings of ~$72,000 (in 2013 dollars).

Unfortunately, there are no simple formula to quantify the potential savings associated with the transition to a lower-GWP system/equipment, simply because these savings are dependent on a very large number of factors, including equipment design, energy efficiency and equipment characteristics, not just on the refrigerant or foam blowing agent used.

From a European Parliament commission study[40], we know that for natural refrigerants (e.g. CO_2, water), the upfront cost of equipment is often higher when natural refrigerants are not yet the standard technology. However, the overall lifecycle cost is lower than conventional technology that relies on HFCs, thanks to improved energy performance, lower maintenance costs and other factors. In sectors where natural refrigerants are a standard technology (domestic refrigeration and some industrial refrigeration in Europe), the upfront cost of equipment is comparable to systems using HFCs and can be even more cost competitive than HFCs when looking at a lifecycle point of view.

With growing production (demand) the capital cost of equipment is expected to decrease due to economies of scale, and as more suppliers enter the market and the availability of components increases, making the new technology competitive with the conventional HFC systems. For these reasons, along with the urgency of climate action, HFC regulations are an essential component of driving the industry towards adopting long-term solutions.

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[38] ICF International. July 2015. Revised Cost Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives. Accessible via https://www.regulations.gov/document?D=EPA-HQ-OAR-2014-0198-0242

[39] ICF International. July 2015. Revised Cost Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives. Accessible via: https://www.regulations.gov/document?D=EPA-HQ-OAR-2014-0198-0242

[40] Shecco. October 2016. F-Gas Regulation shaking up the HVAC&R industry. Report commissioned in the European Parliament. Accessible via: https://issuu.com/shecco/docs/f-gas_impact_shecco_october2016

As a way to alleviate the financial burden to the industry and the end-users, the Division of Climate, Coastal & Energy has designed an incentive program[41] to help accelerate the transition away from high-GWP refrigerants. The latter approach is a less intrusive method to reduce the use of HFCs in Delaware, since it implies a voluntary program that will incentivize Delaware residents and businesses to use or switch to low-GWP refrigerants. The Department believes that combining the regulatory approach to the incentive program, and deploying them in close timeline, offers the best way to accelerate the transition and achieve the most efficient transition schedule.

C. Small Business Impact Statement

According to EPA's Screening Analysis for the SNAP rules 20[42] and 21[43] implementation in the nation, the estimated highest aggregated Total Annualized Economic Impact on Small Businesses (for all industries affected by the SNAP rules) is $18,700,000 when a 3% discount rate is applied. National impact values across each of the sectors, by NAICS code, can be seen in Table 6 below.

According to the EPA, the implementation of the SNAP rules 20 and 21 can be presumed to have no Significant Economic Impact on a Substantial Number of Small Entities (SISNOSE), because of the following reasons:

- About 500,000 small businesses could be subject to the rulemaking nationally, and more than 99% of these small businesses would be expected to experience zero compliance costs.
    - For about 120 small businesses that are expected to incur compliance costs as a result of SNAP, their costs are estimated to be less than 1% of annual sales.
    - This analysis indicates that fewer than 80 of the nearly 500,000 affected small businesses—or <0.1%—could incur costs in excess of 1% of annual sales, and that fewer than 60 small businesses could incur costs in excess of 3% of annual sales.
- For the refrigeration, and air conditioning, foams, and fire suppression sectors particularly:
    - Roughly 89 small businesses could be subject to the rulemaking, although roughly 76% of small businesses subject to this rulemaking would be expected to incur compliance costs that are estimated to be less than 1% of annual sales.
    - This analysis indicates that up to 21 of the 89 affected small businesses—or roughly 24%—could incur costs in excess of 1% of annual sales, and that up to 12 small businesses could incur costs in excess of 3% of annual sales.

[41] Department of Natural Resources and Environmental Control. March 2020. Cool Switch Low Impact Refrigerant Program. Accessible via: https://dnrec.alpha.delaware.gov/climate-coastal-energy/efficiency/cool-switch/

[42] ICF International for U.S. Environmental Protection Agency. July 2015. Economic Impact Screening Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives – Revised. Accessible via https://www.regulations.gov/document?D=EPA-HQ-OAR-2014-0198-0240

[43] ICF International for U.S. Environmental Protection Agency. September 2016. Economic Impact Screening Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives used in Refrigeration and Air Conditioning, Foams, and Fire Suppression.

Table 6. U.S. EPA' Estimate off SNAP 20 and 21 Rules' National Impact to Small Businesses, using a 3% Discount Rate[44, 45]

Sector	NAICS	Industry	Estimated Number of Small Businesses Affected by the Rule	Total Annualized Economic Impact on Small Businesses	
				Lower	Higher
MVACs	336111	Automobile Manufacturing	0	$0	$0
	336112	Light truck and utility vehicle manufacturing	0	$0	$0
Aerosols	325620	Perfumes, Makeups and Other Toiletries	-	$0	$0
	325612	Polishes and Other Sanitation Goods	-	$0	$0
	325520	Adhesive manufacturing	-	$0	$0
	324191	Petroleum lubricating oil and grease manufacturing	-	$0	$0
	325510	Paint and Coating Manufacturing	-	$0	$0
	325998	All Other Miscellaneous Chemical Product and Preparation Manufacturing	5	($390,000)	($20,000)
	325412	Pharmaceutical Preparation Manufacturing	-	$0	$0
	325199	All Other Basic Organic Chemical Manufacturing	-	$0	$0
	339113	Surgical Appliance & Supplies Manufacturing	-	$0	$0
Foams	326140	Polystyrene foam product manufacturing	-	$0	$0
	335222	Household refrigerator and home freezer manufacturing	5	$240,000	$490,000
	333415	Air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing	47	($800,000)	($370,000)
	326150	Urethane and other foam product (except polystyrene) manufacturing	61	$2,870,000	$3,460,000
Retail Food	44511	Supermarkets and Other Grocery (Except Convenience) Stores	31,665	$0	$0
	44512	Convenience Stores	16,072	$0	$0

[44] ICF International for U.S. Environmental Protection Agency. July 2015. Economic Impact Screening Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives – Revised. Accessible via: https://www.regulations.gov/document?D=EPA-HQ-OAR-2014-0198-0240

[45] ICF International for U.S. Environmental Protection Agency. September 2016. Economic Impact Screening Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives used in Refrigeration and Air Conditioning, Foams, and Fire Suppression.

Sector	NAICS	Industry	Estimated Number of Small Businesses Affected by the Rule	Total Annualized Economic Impact on Small Businesses	
				Lower	Higher
	44521	Specialty Food Stores – Meat Markets	4,305	$0	$0
	44522	Specialty Food Stores – Fish & Seafood Markets	1,470	$0	$0
	44523	Specialty Food Stores – Fruit & Vegetable Markets	1,884	$0	$0
	445291	Specialty Food Stores – Baked Goods Stores	2,109	$0	$0
	445292	Specialty Food Stores – Confectionary & Nut Stores	1,520	$0	$0
	445299	All Other Specialty Food Stores	3,004	$0	$0
	4453	Beer, Wine, & Liquor Stores	21,562	$0	$0
	453110	Florist	15,201	$0	$0
	44711	Gasoline Stations with Convenience Stores	41,538	$0	$0
	44719	Other Gasoline Stations	11,553	$0	$0
	446110	Pharmacies and Drug Stores	16,216	$0	$0
	452910	Warehouse Clubs and Superstores	-	$0	$0
	452990	All Other General Merchandise Stores	6,536	$0	$0
	72111	Hotels (Except Casino Hotels) & Motels	29,170	$0	$0
	72112	Casino Hotels	19	$0	$0
	72211	Full-Service Restaurants	134,992	$0	$0
	722211	Limited-Service restaurants	98,304	$0	$0
	722212	Cafeterias, Buffets, & Grill Buffets	3,900	$0	$0
	722213	Snack & Nonalcoholic Beverage Bars	23,226	$0	$0
	72241	Drinking Places	35,185	$0	$0
	333415	Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing	30	$300,000	$1,010,000
	333311	Automatic Vending Machine Manufacturing	7	$50,000	$120,000
Chillers	333415	Air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing	1[a]	$2,880,000	$3,260,000

Sector	NAICS	Industry	Estimated Number of Small Businesses Affected by the Rule	Total Annualized Economic Impact on Small Businesses	
				Lower	Higher
	333415	Air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing		$3,030,000	$3,790,000
Retail Food	333415	Air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing	19	$70,000	$90,000
Household Refrigeration	335222	Household refrigerator and home freezer manufacturing	20	$4,590,000	$5,500,000
Cold Storage	333415	Air-Conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing	4	$70,000	$140,000
Foam	326150	Urethane and other foam product (except polystyrene) manufacturing	36[b]	$600,000	$600,000
			8[c]	$300,000	$400,000
			1[d]	$2,000	$4,000
			0[e]	$0	$0
Fire Suppression	3399991	Fire extinguishing equipment, handportable and fixed-system (excluding water sprinkler systems), including parts and attachments, manufacturing	0	$0	$0
TOTAL				$13,812,000	$18,474,000

[a] The same small business is affected by both regulatory decisions (per EPA)
[b] Rigid polyurethane: high-pressure two-component spray foam
[c] Rigid polyurethane: low-pressure two-component spray foam
[d] Rigid polyurethane: one-component foam sealants
[e] Flexible polyurethane

Scaled to the state of Delaware, on a population basis (0.30% of U.S.A. population), this corresponds to a negligible probability (<0.0003%) of having one small businesses in Delaware incurring costs in excess of 1% or 3%.

Additionally, the proposed regulation is not expected to add substantive burden on Delaware's individuals and small businesses for the following reasons:

1) The proposed regulation does not warrant end-users to cease the use product or equipment acquired before the prohibition date. Thus, individuals and small businesses are likely to follow their existing replacement/repair & maintenance schedules for their products and equipment covered under the proposed new regulation.
2) Only when a system needs to be retrofitted or replaced will businesses need to purchase compliant product/equipment – and alternatives are readily available for end-uses covered under this proposed new regulation.
3) The proposed new regulation includes a sell through provision, allowing manufacturers to sell all products and equipment manufactured prior the effective date of the prohibition for that specific end-use.
4) The impacts of the regulation will be borne primarily by foam manufacturers and refrigeration equipment manufacturers who have developed or will develop compliant materials and equipment. Contractors, installers of equipment, and service technicians would be impacted by the requirement to sell, offer for sale, lease, rent, install, or use only compliant equipment.
5) The proposed regulation does not include recordkeeping requirements.
6) Increased energy efficiency of the systems using low-GWP refrigerants are expected to result in savings for many businesses over the lifecycle of their equipment, which alleviates the higher capital costs associated with new compliant equipment covered under this proposed new regulation.

D. Economic Benefits

Adopting HFCs regulations regionally or nationwide is expected to lead to many benefits for the industry and U.S. residents, beyond Delaware.

Manufacturers of products and equipment covered by this proposed regulation would prefer the development of a unified (nationwide) rule, since they would have to comply with only one national standard. However, apart from this consideration, the industry has expressed support for adopting the prohibitions for the end-uses covered under this proposed regulation, as they recognize the urgency of climate action, but also the economic opportunity of being an early supplier of the new technology (increased competitiveness), as more and more countries and regions are looking at reducing emissions from HFCs.

For example, some companies, such as The Chemours Company, headquartered in Delaware, that already manufactures acceptable alternatives to the prohibited substances covered

by this proposal, will benefit from their proactive research and development, and will have short term benefits from the implementation of the regulation.

The end users of the new technology will also benefit from the proposed regulation, through cost savings in the form of increased energy efficiency, and lower maintenance costs, of their new or retrofitted equipment using lower-GWP refrigerants.

Additionally, HFCs regulations are anticipated to have an impact on the training requirements of technicians and contractors offering equipment in the end-uses covered by this proposed new regulation. This implies both costs and opportunities for the industry, and stakeholders have informed the Department that the industry is already preparing for the new demand in training and continuous improvement. These new opportunities are associated with increased employment in more sustainable technologies. In the long haul, the U.S. Climate Alliance has estimated that phasing down the use of HFCs has the potential to create tens of thousands of jobs, and tens of billions of annual economic value nationwide[46].

[46] United States Climate Alliance. September 2018. From SLCP Challenge to Action: A roadmap for reducing short-lived climate pollutants to meet the goals of the Paris Agreement. Accessible via: https://static1.squarespace.com/static/5a4cfbfe18b27d4da21c9361/t/5b9a9cc1758d466394325454/1536859334343/USCA+SLCP+Roadmap_final+Sept2018.pdf

V. Health, Environmental, and Public Welfare Benefits

A. Projected Emissions Reductions

To quantify potential HFC emissions reduction achievable by the proposed new regulation, the Department used an HFC emissions inventory tool developed by the California Air Resources Board (CARB) and the USCA. The tool, called the Short-Lived Climate Pollutants (SLCP) Emissions Tool, uses state population and other economic data to apportion HFC emissions to specific end-uses. The following data sources and methodologies are referenced within the tool:

- Population Projections, United States, 2004 - 2030, by state, age and sex, on CDC WONDER Online Database, September 2005. Accessed at http://wonder.cdc.gov/population-projections.html on May 30, 2018
- Annual Estimates of Housing Units for the United States, Regions, Divisions, States, and Counties: April 1, 2010 to July 1, 2017 on US Census Bureau American FactFinder Online Database, May 2018. Accessed at https://www.census.gov/data/tables/2017/demo/popest/total-housing-units.html on May 30, 2018
- 2005 Residential Energy Consumption Survey (RECs) Survey Data on U.S. Energy Information Administration (EIA) Webpage. Accessed at https://www.eia.gov/consumption/residential/data/2005/ on September 9, 2018
- 2009 Residential Energy Consumption Survey (RECs) Survey Data on U.S. Energy Information Administration (EIA) Webpage, 19 August 2011. Accessed at https://www.eia.gov/consumption/residential/data/2009/ on June 1, 2018
- 2015 Residential Energy Consumption Survey (RECs) Survey Data on U.S. Energy Information Administration (EIA) Webpage. Accessed at https://www.eia.gov/consumption/residential/data/2015/#ac on September 9, 2018
- United States Environmental Protection Agency (US EPA). MOVES 2014a: Latest Version of MOtor Vehicle Emissions Simulator (MOVES). https://www.epa.gov/moves/moves2014a-latest-version-motor-vehicle-emission-simulator-moves (accessed 10 August 2018) (US EPA, 2015)
- California's High Global Warming Potential Gases Emission Inventory: Emission Inventory Methodology and Technical Support Document, California Air Resources Board (2016), https://ww3.arb.ca.gov/cc/inventory/slcp/doc/hfc_inventory_tsd_20160411.pdf

The SLCP Emissions Tool quantifies HFC emissions under a business as usual (BAU) case, as well as various policy scenarios including the incorporation of EPA SNAP Rules 20 and 21. Using the tool, HFC emissions can be estimated from 2005 through 2030. The tool categorizes HFCs in the end-uses shown in Table 7.

Using the tool, it is estimated that in the course of 10 years, the total cumulative reduction in HFC emissions is roughly 0.832 $MMTCO_2e$, or roughly the equivalent of the annual greenhouse gas emissions of 176,000 passenger cars in Delaware.

Table 7. HFC use categories as provided in the USCA/CARB SLCP Emissions Tool

Commercial Refrigeration
Industrial Refrigeration
Domestic Refrigeration
Commercial Stationary A/C > 50 lbs. refrigerant
Commercial Stationary A/C < 50 lbs. refrigerant
Stationary A/C Residential Heat Pumps
Stationary Central A/C Residential
Stationary Room Unit AC/ Residential
Light-duty MVAC
Heavy-duty MVAC
Transport Refrigeration
Foam
Aerosol Propellants
Solvents and Fire Suppressant

Per the proposed regulation, not all end-uses categorized in the SLCP Emissions Tool are applicable. To reflect the affected end-uses as listed in the proposed regulation, the Department focused only on the appropriate categories. Table 8 shows the identified categories as applicable to the purpose of the proposed regulation.

Table 8. End-use categories of HFCs that are anticipated to show emission reductions per the proposed regulation

Commercial Refrigeration
Industrial Refrigeration
Domestic Refrigeration
Commercial Stationary A/C > 50 lbs. refrigerant
Commercial Stationary A/C < 50 lbs. refrigerant
Foam
Aerosol Propellants

It should be noted that the proposed regulation does not include the following end-uses categorized by the SLCP Emissions Tool: Stationary A/C Residential Heat Pumps, Stationary Central A/C Residential, Stationary Room Unit A/C Residential, Light-duty MVAC, Heavy-duty MVAC, Transport Refrigeration, Solvents and Fire Suppressant. As such, there are no emissions reductions in these end-uses that would be associated directly with the prohibitions in the proposed regulation.

The emissions and associated potential reductions anticipated by the proposed regulation are provided in Table 99 for years 2020-2030 for Delaware. It can be seen that, compared to a BAU case, HFC emissions are anticipated to have been reduced by 25% in 2030 with implantation of the proposed regulation. Once reductions begin in the year 2021, the average annual reduction rate is 20%. It should be noted that there are no emissions reductions for the industrial refrigeration end-use until 2023 and for commercial stationary A/C (> 50 lbs refrigerant) until 2024, as is consistent with the proposed new regulation.

Table 9. HFC emission estimates in a BAU case and the case with implementation of the proposed regulation (emissions in $MmtCO_2e$) in Delaware

Year	BAU*	SNAP**	Savings	Savings (%)
2020	0.347	0.347	0	0%
2021	0.362	0.314	0.048	13%
2022	0.376	0.320	0.056	15%
2023	0.391	0.327	0.064	16%
2024	0.403	0.331	0.072	18%
2025	0.415	0.335	0.080	19%
2026	0.426	0.338	0.088	21%
2027	0.435	0.340	0.095	22%
2028	0.444	0.342	0.103	23%
2029	0.452	0.342	0.110	24%
2030	0.460	0.343	0.117	25%
TOTAL	4.511	3.679	0.832	-

* The BAU case emissions shown are only those from the end-use categories displayed in Table 8

** The SNAP column is representative for the emission reductions from the proposed regulation (effectively, SNAP 20 and 21 implementation) for the end-use categories specified in Table 8

The emissions reductions by end-use category can be seen in Figure 3. The "Regulation BAU" line refers to the BAU emissions in the affected end-use categories only (as listed in Table 8). The greatest potential HFC emissions reductions are projected to be achieved in the commercial refrigeration end-use followed by aerosol propellants on a mass basis. On a percentage basis, potential HFC emissions reductions are greatest for the aerosol propellant and foam end-uses. From 2021 through 2030, the aerosol propellant end-use is projected to have a cumulative reduction of 62%, while the foam end-use category is projected a cumulative emission reduction of 54%. It should also be noted that relative to BAU emissions, no reduction is projected for the commercial stationary A/C (< 50 lbs refrigerant) end-use category. This likely because the proposed regulation lists centrifugal and positive displacement chillers as the prohibited end-uses in commercial A/C. Centrifugal chillers are typically used for larger commercial systems, such as those in office buildings, hotels, convention halls, and others[47]. Positive displacement chillers are typically used for relatively smaller commercial systems, such as those in mid- and low-rise buildings[48].

[47] U.S. EPA. December 2016. Proposed Final rule for SNAP 21. Accessible via: https://www.govinfo.gov/content/pkg/FR-2016-12-01/pdf/2016-25167.pdf

[48] While relatively smaller than centrifugal chillers, commercial applications of positive displacement chillers are most likely above 50 lbs of refrigerant.

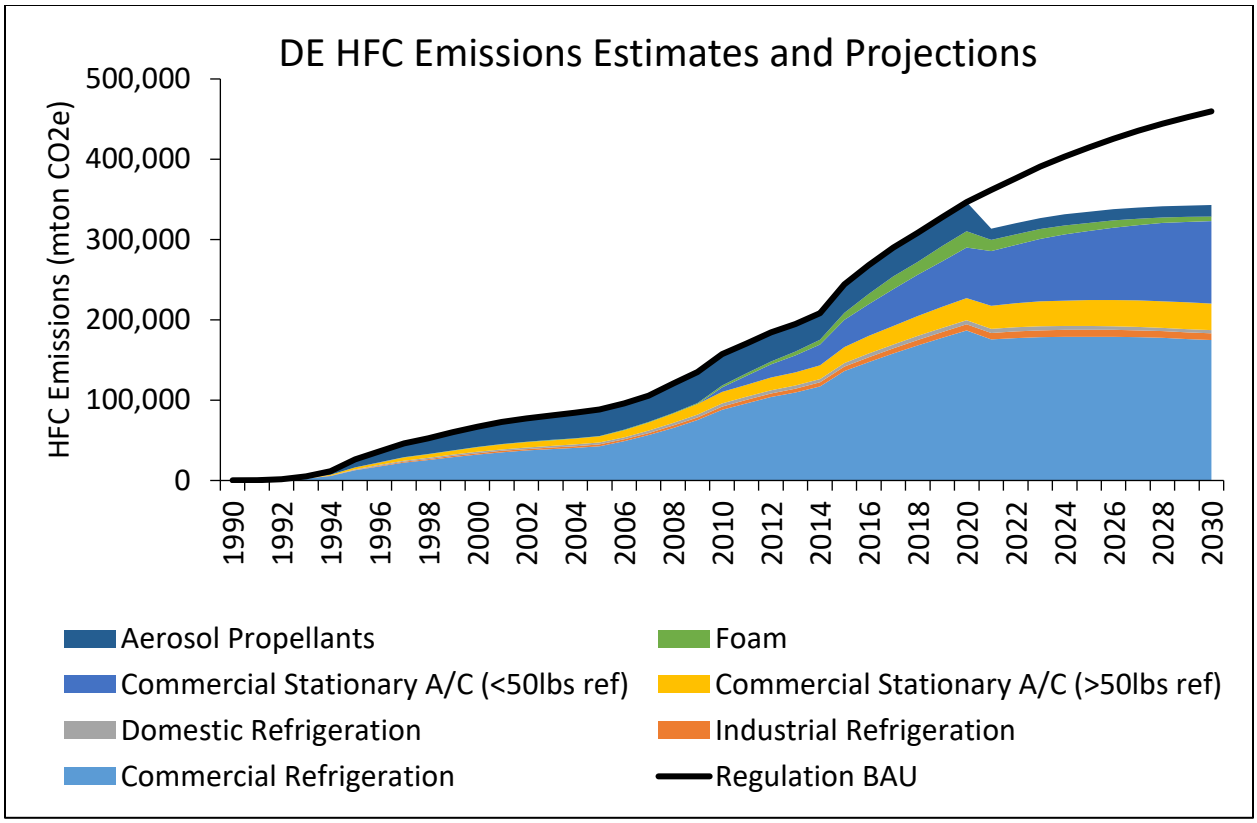

Figure 3. Potential HFC emissions reductions by end-use category in Delaware from the proposed regulation

B. Quantifying Benefits

The science of quantifying environmental and social impacts of a given emissions reduction is still in its infancy, given the complexity of economic, social and environmental systems and their underlying assumptions. For this technical support document, the Department has chosen to use the Theory of the Social Cost of Carbon (SCC) [49] to help quantify the impacts of the proposed regulation. SCC is a concept used in policy evaluation to offer a monetized value of the net impact from the global climate change that results from a small (1 metric ton) increase in carbon dioxide emissions. These monetized impacts include, but are not limited to, changes in net agricultural productivity, energy use, property damage from increased flood risk, human health and services that the natural ecosystems provide to society.

SCC's estimates require several steps using specialized computer models to be relevant, since it factors several detailed economic, social, and environmental assumptions. Following Resources for the Future latest published article on the topic, the Department chose to use the Global SCC

[49] The National Academies Press. 2017. Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide. Accessible via: https://www.nap.edu/catalog/24651/valuing-climate-damages-updating-estimation-of-the-social-cost-of

estimate of 50 USD per metric ton of CO_2 equivalent[50] (in 2019 dollars, using a discount rate of 3%) to support this technical support documentation.

Using the previously estimated 0.832 $MmtCO_2e$ reduction for Delaware from 2020 to 2030, the SCC theory estimates that this proposed new regulation could help achieve global benefits equivalent to $41.4 million within this ten-year timeframe.

If the regulation was similarly adopted nationwide (including Washington, D.C.), a cumulative reduction of 295.3 $MmtCO_2e$ is estimated from 2020 to 2030. Using the Social Cost of Carbon, these emissions reduction would result in approximately $14.8 billion in global benefits, from 2020 to 2030.

VI. Stakeholder Participation

Two review committee meetings were held (September 24, 2019, and October 8, 2019) to closely interact with key stakeholders in the early development stages of the proposed regulation. Discussions with key stakeholders helped shape the proposed regulation to ensure the viewpoints of a diverse group of representatives from industry, trade groups, environmental groups, and Delaware-specific organizations were understood. The initial meeting on September 24th included a presentation and other materials to inform participants of the development of the proposed regulation. After the presentation, the review committee consisted of open discussion and suggestions to the draft language. Comments were received and informed technical and non-technical edits to the draft language of the proposed regulation. Participants in the first review committee meeting largely supported the effort of the proposed regulation.

A second review committee meeting took place on October 8, 2019 and included a draft regulatory language presentation informed by the comments received from stakeholders at the first review committee meeting and those received by staff after the meeting. Attendees of this review committee meeting included representatives from industry, trade and environmental groups, and Delaware-specific organizations, similar to the first review committee meeting. Stakeholders were walked through the revised draft language, and offered comments and feedback to assist in crafting the final proposed new regulation language. This review committee meeting also included a brief presentation from staff from the Division of Climate, Coastal, and Energy to introduce their voluntary incentive program to switch to low-GWP refrigerants, the Cool Switch Low Impact Refrigerant Program[51].

In between, and after the review committee meetings, the Department continuously engaged with key stakeholders to develop the proposed new regulation, through documented written exchanges, phone call conversations, and face-to-face meetings with the goal of tailoring the final language to best address the key social, environmental and economic concerns raised by the stakeholders.

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[50] Resources for the Future. August 2019. Social Cost of Carbon 101. A review of the social cost of carbon, from a basic definition to the history of its use in policy analysis. Accessible via: https://www.rff.org/publications/explainers/social-cost-carbon-101/

[51] Department of Natural Resources and Environmental Control. March 2020. Cool Switch Low Impact Refrigerant Program. Accessible via: https://dnrec.alpha.delaware.gov/climate-coastal-energy/efficiency/cool-switch/

VII. Public Participation

The Department held three public workshops to provide the public with outreach and education opportunities on the proposed new regulation 7 DE Admin Code 1151. The meetings were held in each of the New Castle, Sussex, and Kent Counties on December 9, 10, and 18, 2019, respectively, with the latest meeting offering a remote participation option via the Skype application or web access.

The public workshops consisted in a short presentation about the background leading to the regulatory initiative, followed by a presentation of the draft regulatory language (as informed by the review committee meetings), and concluded with an open question and answer format. The presentation slides, along with the supporting documents, and comments received following the workshops are posted on the Department's regulatory development website: https://dnrec.alpha.delaware.gov/air/permitting/under-development/.

Overall, the Department has received support for the regulatory initiative throughout the rulemaking process. Many of the comments offered by stakeholders consisted in additional technical or logistical consideration to edit the regulatory language to reduce the burden on the industry or to aim for consistency with other states working to develop HFCs regulations. Please find, in Table 10 below, the summary of the public comments received from October 31, 2019 to January 17, 2020 which was the deadline indicated to receive public comments for consideration for the proposed new regulation.

Table 10: **Summary of public comments received from October 31, 2019 and January 17, 2020, and the actions taken following these comments.**

Interested Party	Date	Section in Draft Regulatory Language	Summary of Comment	Changes made
Section 1.0				
AHRI and Daikin US	1/17/2020	1.0	Suggestion to remove "and manufacture" from section 1.0, as this may ban warehousing and the transport of non-Delaware products through the state, and products from being imported or transported through the state of Delaware or prevent research in the state where companies make small amounts of refrigerants. It can also prevent research in Universities or in companies located in the state that manufacture small amounts of refrigerant.	Following these comments, the Department has removed the definition of "manufacturer" from Section 3.0, as the definition previously included might have caused the confusion on the importation and transportation of products and equipment in the State. The intent of the regulation is to prohibit the manufacturing of the covered foams and aerosol propellants products, and refrigeration and air-conditioning equipment using an end-use-specific substance covered under this regulation, after their respective prohibition dates.
Section 2.0				
Honeywell	12/7/2019	2.1	Recommendation to edit the language to not only prohibit the sale or installation of a listed substance, but also the sale or installation of a product or equipment using a listed substance, within the state after the relevant end-use transition date. Suggested edits: *2.1. This regulation applies to any person who sells, offers for sale, installs, uses, or manufactures in the State of Delaware, any substance used in end-uses listed in Section 6.0 or any product or equipment using any such substance.*	**The Department staff made no changes based on the received comments.** Honeywell has provided additional comments on January 17, 2020 on this topic.
Honeywell	1/17/2020	2.1	Request to prohibit not the sale or installation of a listed substance, but the sale or installation of *a product or equipment using* a listed substance, within the state after the relevant end-use transition date. For consistency with CA, VT, WA, NJ (intent). If the DE regulation fails to incorporate such language, it will potentially be	The Department has edited the regulatory language to clarify the intent of this regulation, which is to regulate any person who sells, offers for sale, leases, rents, installs, uses, or manufactures in the State of Delaware, any product or equipment that uses a substance in any of the end-uses covered under the proposed new regulation.

Table 10: **Summary of public comments received from October 31, 2019 and January 17, 2020, and the actions taken following these comments.**

			applying its prohibition on HFCs to a smaller subset of activities and excluding instances in which products or equipment are delivered to, or installed in, the state containing prohibited substances.	
NRDC	1/17/2020	2.1	Recommendation to modify the scope of prohibitions to the products and equipment containing prohibited substances, not to the substances themselves	The Department has edited the regulatory language to clarify the intent of this regulation, which is to regulate any person who sells, offers for sale, leases, rents, installs, uses, or manufactures in the State of Delaware, any product or equipment that uses a substance in any of the end-uses covered under the proposed new regulation.
Chemours	1/17/2020	2.0	As written, language in draft regulation 1151 may be interpreted to prohibit the sale or installation of a listed substance rather than sale or installation of a product or equipment using a listed substance within the state, according to Section 6 of the proposed regulation. Such an interpretation could prevent research and development activities within the State of Delaware. It is imperative that the regulation be clear that research and development activities are exempt from any prohibitions established by this regulation.	The Department has edited the regulatory language to clarify the intent of this regulation, which is to regulate any person who sells, offers for sale, leases, rents, installs, uses, or manufactures in the State of Delaware, any product or equipment that uses a substance in any of the end-uses covered under the proposed new regulation. The Department believes that this language does not prevent research and development activities.
PIMA	1/17/2020	2.0	Recommendation for the Dept. to scope its regulations narrowly to exclude polyisocyanurate insulation products, which as a category do not use the prohibitive HFC substances, from the draft regulation's disclosure statement requirements.	The Department has acknowledged this comment and has clarified the intent of the Disclosure Statement requirement, in Section 2.2, where any person who manufactures product or equipment covered in the specific end-uses covered under this regulation is subject to disclosure statement requirements. The Department wants to clarify that the end goal of including Disclosure requirements is to inform potential buyers as to whether the product/equipment they purchased is in compliance with State Regulations. Additionally, the Department believes the proposed disclosure requirements offer flexibility for manufacturers to comply, without substantive financial or operational burden.
Section 3.0				
AHRI and Daikin US	1/17/2020	3.0	Recommendation to modify the definition of the term "use", since banning the formulation or packaging of controlled substances inequitably impacts small and medium distributors, packagers, and companies who	**The Department staff made no changes based on the received comments.** The Department has edited the regulatory language to clarify the intent of this regulation, which is to regulate any person

Table 10: **Summary of public comments received from October 31, 2019 and January 17, 2020, and the actions taken following these comments.**

			may not have sufficient capital to move distribution in another state. AHRI is concerned that the definition of "Use" in the draft regulation may prohibit the proper collection of refrigerant during maintenance and at the end of life for the equipment Additional recommendation to modify the definition of "new" based on stakeholders' feedback	who sells, offers for sale, leases, rents, installs, uses, or manufactures in the State of Delaware, any product or equipment that uses a substance in any of the end-uses covered under the proposed new regulation. Thus, the Department does not believe that the current definition of "use" overburdens the small and medium distributors, packagers, and companies in Delaware, or prohibit the proper collection of refrigerant during maintenance and at the end of life of the equipment. The Department believes that the current definition of "new" captures the technical considerations for the implementation of this regulation. This definition is consistent with U.S. EPA, which reclassifies systems as new if a modification is made, which increases the capacity of the system. This formulation is also preferred to prevent existing refrigeration systems from undergoing extensive repairs to the extent that they become a new piece of equipment with a few older parts remaining, which could be a strategy to avoid the regulations covering new equipment. This definition does not prevent end-users or customers to repair, update and improve their systems.
ACC CPI	1/17/2020	3.0	Offered technical considerations to promote clarity to the regulated entities CPI suggests developing a definition for "polyurethane," and then referencing the term polyurethane in the definition of the end uses. This builds a consistent approach to the end use definitions. CPI has suggested a definition for "polyurethane", and edits to 9 polyurethane end-uses' definitions.	**The Department staff made no changes based on the received comments.** The Department has acknowledged the comments received, however it does not believe that making these amendments is warranted at this time. The current definitions of the different foam end-uses have been reviewed by a review committee during the first phase of the stakeholders engagement, and they are consistent with U.S. EPA SNAP rules. The proposed edits by the stakeholder may be considered as part of a future amendment to the proposed regulatory language, following an additional technical review from other industry stakeholders.
Honeywell	1/17/2020	3.0	Support CPI's suggested edits to definitions regarding foam end-uses	**The Department staff made no changes based on the received comments.** The Department has acknowledged the comments received, however it does not believe that making these amendments is warranted at this time. The current definitions of the different

Table 10: **Summary of public comments received from October 31, 2019 and January 17, 2020, and the actions taken following these comments.**

				foam end-uses have been reviewed by a review committee during the first phase of the stakeholders engagement process, and they are consistent with U.S. EPA SNAP rules. The proposed edits by the stakeholder may be considered as part of a future amendment to the proposed regulatory language, following an additional technical review from other industry stakeholders.
HCPA	1/17/2020	3.0	Recommendation to modify the definition of "aerosol propellant", for consistency with Delaware's "limiting emissions of volatile organic compounds from consumer and commercial products" regulation	**The Department staff made no changes based on the received comments.** The Department will keep the current definition of "Aerosol Propellant", since it believes that it captures all the technical considerations for the current regulation.
InterMetro Industries Corporation	12/19/2019	3.0	Request to have a definition of "stationary" added to the regulation, to identify whether or not mobile refrigerators intended for use with central kitchens inside heavy-duty vehicles serving remote locations are covered under this regulation.	**The Department staff made no changes based on the received comments.** The description of the refrigeration equipment detailed by the stakeholder clearly falls under commercial refrigeration end-uses, even if it is designed with rollers and is used inside of a heavy-duty vehicle. The Department does not believe that a definition of the term "stationary" is warranted at this time.
Illinois Tool Works Inc.	12/18/2019	3.0	Offer their interpretation of the issue raised during the 12/18/2019 public workshop, where InterMetro asked for clarification on the definition of "stationary" in Refrigeration Equipment. According to ITW, being designed to roll into a vehicle, where that vehicle will transport food to another physical location, does not qualify as mobile refrigeration in the industry. Thus, this commercial refrigeration equipment is covered under EPA SNAP rules and should be covered under DE's proposed regulation.	**The Department staff made no changes based on the received comments.** The Department agrees that refrigeration equipment designed to roll into a vehicle, to be utilized to deliver food in remote location, is a commercial refrigeration equipment, and is consequently covered under this regulation.
Cold Technology	12/20/2019 And 12/09/2019	3.0	Suggested edits to the definition of "new" using "nominal compressor capacity". The reasoning for the use of the term "nominal compressor capacity" is that various efficiency upgrades to a system could actually result in an increase to system heat removal capacity. Obviously, we would not want to dissuade owner's from performing upgrades on their systems to more energy	**The Department staff made no changes based on the received comments.** The Department believes that the current definition of "new" captures the technical considerations for the implementation of this regulation. This definition is consistent with U.S. EPA, which reclassifies systems as new if a modification is made, which increases the capacity of the system. This formulation

Table 10: **Summary of public comments received from October 31, 2019 and January 17, 2020, and the actions taken following these comments.**

			efficient equipment by forcing them to perform a retrofit on top of the component upgrade.	is also preferred to prevent existing refrigeration systems from undergoing extensive repairs to the extent that they become a new piece of equipment with a few older parts remaining, which could be a strategy to avoid the regulations covering new equipment. This definition does not prevent end-users or customers to repair, update and improve their systems.
Section 4.0				
HCPA	11/8/2019 And 11/15/2019	4.2.1.4	Suggestion to add the date coding which aerosol manufacturers comply with for Delaware's *Limiting Emissions of Volatile Organic Compounds from Consumer and Commercial Products* regulation, section 2.5.1 under Administrative Requirements, as a compliance path for the date of manufacture disclosure requirement. Suggestion to allow for the Material Safety Data Sheet to be an acceptable compliance path for the disclosure statement requirements.	Following this comment, the Department is proposing language to include date codes and Safety Data Sheet to be acceptable compliance options to meet the Disclosure Statement requirements for foam and aerosol propellant products.
PIMA	12/9/2019	4.2 and subsections	Commented that the Polyisocyanurate industry is opposed to the proposed disclosure statement requirements, since the industry does not manufacture with HFCs. Recommendation to edit the draft regulatory language to regulate the current uses of HFCs only. Suggested addition: *4.2.1.1 As of the effective date of this regulation, any person who does not manufacture and/or sell products or equipment containing any substance listed as prohibited in Section 6.0 shall not be required to provide a written disclosure to the buyer.* Suggestion, as an alternative to a full exemption, for any future regulation to include an opportunity for polyiso insulation manufacturers to submit a one-time certification to DE that their respective products do not contain the prohibited HFC substances.	Although the Department recognizes that some industries may have shifted from manufacturing products and equipment with HFCs, the Department believes that the intent of the disclosure statement is to inform the buyer as to whether the product/equipment purchased is in compliance with State regulation. To clarify the intent of the Department, we have added language in Section 2.0 of the proposed regulation, stating that manufacturers of products and equipment of the specific end-uses covered in this regulation, are subject to disclosure statement requirements. By subjecting all manufacturers to disclosure statement requirements, the Department ensures that any industry that previously moved away from the use of HFCs, are required to disclose it if they go back to using these substances.

Table 10: **Summary of public comments received from October 31, 2019 and January 17, 2020, and the actions taken following these comments.**

				The suggestion of a one-time certification process to identify that a manufacturer does not use HFCs may be studied under a future regulation/amendment.
PIMA	12/9/2019	4.2.1.3	If the Department does decide to proceed with disclosure requirements, any labeling requirements should allow a label to be placed on the product itself or factory packaging. And another potential alternative would be for product manufacturers to provide or make available Safety Data Sheets to the buyers, disclosing the blowing agent.	The Department believes that the regulation, as it is drafted, allows for labels and disclosure statements to be placed on the product itself or factory packaging. Following this comment, the Department has included language to allow Safety Data Sheets to be used as a compliance path to disclose the blowing agent information to the buyers, for foam manufacturers.
Cold Technology	12/20/2019 And 12/09/2019	4.1.2	Suggested amendments to 4.1.2 to clarify the intent not to affect the operators' ability to maintain/preserve the operability of existing systems.	The Department has recognized the value of specifying that operations to maintain and preserve the operability of an existing system are not prohibited by the proposed regulation. Thus, the Department is proposing language to address this consideration, in 4.1.3.: "This regulation does not prevent the use of a prohibited substance in the servicing, maintenance and repair operations of an existing product or equipment in an end-use listed in Section 6.0, which contains or was designed to contain a prohibited substance, except if the operations constitute a retrofit or reclassifies the system as new."
Cold Technology	12/20/2019 And 12/09/2019	4.2.1	Comment that in 4.2.1. the language should clarify that the burden of disclosure is solely that of the manufacturer, not the re-seller. The wording "any person who manufactures and/or sells" can lead to believe than any contractor/distributor that re-sells and installs the equipment would have disclosure responsibility.	The Department agrees that disclosure requirements are targeting manufacturers of the covered products and equipment, thus the Department proposing language to clarify this intent, by modifying the language to read "who manufactures for sale in the State of Delaware"
HCPA	1/17/2020	4.2.1.4	Recommendations for modifying the Disclosure requirements of aerosol products Proposed language: *4.2.1.4:* *For aerosol propellant products, the aerosol propellant must be listed in a Safety Data Sheet (SDS) that complies with the requirements of the 29 CFR 1910.1200. The person who manufactures and sells or introduces into commerce in the State must also ensure that each aerosol propellant product complies*	**The Department staff made no changes based on the received comments.** The Department has acknowledged the comment, and considers that the current approach offering two alternatives for disclosure compliance offers flexibility and answers the considerations raised. The Department is allowing for Safety Data Sheet and Date Code to be acceptable compliance paths to meet the disclosure requirements.

Table 10: **Summary of public comments received from October 31, 2019 and January 17, 2020, and the actions taken following these comments.**

			with the product-dating requirements in 7 DE Admin. Code 1141 § 2.5.1.	
Honeywell	1/17/2020	4.0	Suggestion to clarify that the sale of prohibited substitutes for servicing (i.e., for recharging existing equipment that was installed prior to the effective date of the prohibited use of that substitute) is allowable.	The Department has recognized the value of specifying that operations to maintain and preserve the operability of an existing system are not prohibited by the proposed regulation. Thus, the Department is proposing language to address this consideration, in 4.1.3.: "This regulation does not prevent the use of a prohibited substance in the servicing, maintenance and repair operations of an existing product or equipment in an end-use listed in Section 6.0, which contains or was designed to contain a prohibited substance, except if the operations constitute a retrofit or reclassifies the system as new."
ACC CPI	1/17/2020	4.2.1.3.1	Commented that while CPI does not have significant opposition to proposed disclosure alternative 1 in section 4.2.1.3.1, CPI is concerned that it is not entirely clear that regulated entities can choose either option. Additionally, alterative 1 focuses on disclosure of specific chemistries, not compliance status. Disclosure of a specific chemistry likely does not provide the clarity needed for users and enforcement officials to know the product they would like to use is compliant – especially if an exemption is granted for certain foam end uses to continue to use HFC blowing agents. In this example, users and enforcement officials will likely assume the product is not compliant if it discloses use of an HFC. Alternative 2 covers all scenarios because it focuses on compliance status. Additionally, CPI urges DNREC to clarify that the disclosure can be on the product or on the product packaging. CPI anticipates that manufacturers of polyurethane systems will include the disclosure on the drum or on the box for low pressure SPF systems.	The Department has acknowledged the comment and is proposing language to clarify that regulated entities can choose one of the two alternatives presented in the Disclosure Statement requirements. Other foam end-uses stakeholders have requested for Safety Data sheets to be considered as a compliance path for disclosing the foam blowing agents, thus the Department still believes that offering the two alternatives offers flexibility to the manufacturers, along as the proper information for consumers/buyers that want to access the information. The Department believes that the current language does not prevent the disclosure or label to be either on the product or on the product packaging, thus including the disclosure on the drum or on the box for low pressure SPF systems is allowed.
ACC CPI	1/17/2020	4.1.2	Commented that spray polyurethane foam systems manufactured or blended prior to the date of restriction can be used or applied in Delaware after the effective date of the restriction. Multiple types of polyurethane	The Department has understood and agrees with the technical consideration provided by the stakeholder and has incorporated the suggested edit to the proposed regulatory language.

Table 10: **Summary of public comments received from October 31, 2019 and January 17, 2020, and the actions taken following these comments.**

			foams – not just spray foam – that are used as "systems." For context, the polyurethane industry refers to the liquid components of the "A-side" and "B-side" together as a system. Recommendation: […] Products or equipment manufactured prior to the applicable effective date of the restrictions specified in Table 1 of subsection 6.1.1 of this regulation (including ~~spray~~ polyurethane foam systems not yet applied) may be sold […].	
National Refrigerants, Inc.	1/17/2020	4.1.2	Commented that, as it is currently drafted, 4.1.2 appears to prohibit the use of a substance for service of equipment installed prior to the dates specified in section 6.0. Section 4.1.2 clearly includes equipment manufactured prior to the applicable effective date of the restrictions in Table 1 of subsection 6.1.1 of the regulation but it does not include the word 'substance' which is defined as "any chemical intended for use in the end-uses listed in Section 6.0." Since substance, by definition, is the refrigerant, its exclusion from the exception in 4.1.2 could be interpreted as not allowing any refrigerant listed in section 6.0 to be used to service the installed equipment.	The Department has recognized the value of specifying that operations to maintain and preserve the operability of an existing system are not prohibited by the proposed regulation. Thus, the Department is proposing language to address this consideration, in 4.1.3.: "This regulation does not prevent the use of a prohibited substance in the servicing, maintenance and repair operations of an existing product or equipment in an end-use listed in Section 6.0, which contains or was designed to contain a prohibited substance, except if the operations constitute a retrofit or reclassifies the system as new."
Chemours	1/17/2020	4.1.1 & 4.1.2	Suggested edits to section 4.0 that will clarify this regulation does not prohibit the continued use of listed substances for servicing of existing equipment. In Section 4.0, Standards (Requirements)	The Department has recognized the value of specifying that operations to maintain and preserve the operability of an existing system are not prohibited by the proposed regulation. Thus, the Department is proposing language to address this consideration, in 4.1.3.: "This regulation does not prevent the use of a prohibited substance in the servicing, maintenance and repair operations of an existing product or equipment in an end-use listed in Section 6.0, which contains or was designed to contain a prohibited substance, except if the operations constitute a retrofit or reclassifies the system as new."
Daikin US	1/17/2020	4.2	Recommendation that the state accepts UL label as sufficient for disclosure requirements.	**Department staff made no changes based on the received comments.**

Table 10: **Summary of public comments received from October 31, 2019 and January 17, 2020, and the actions taken following these comments.**

				The Department believes that the proposed regulation allows for UL labels to be used as a disclosure compliances path, as long as they contain the required information, as stated in 4.2.1.2 : " Except for products and equipment with existing labeling required by state building codes and safety standards which contain the information required in subsections […]".
AHRI and Daikin US	1/17/2020	4.0	In Section 4.0, clarify that products intended for the servicing, maintenance, or repair of existing equipment may still be manufactured and used after the effective date of the regulation, so long as they do not fall under the definition of "new equipment".	The Department has recognized the value of specifying that operations to maintain and preserve the operability of an existing system are not prohibited by the proposed regulation. Thus, the Department is proposing language to address this consideration, in 4.1.3.: "This regulation does not prevent the use of a prohibited substance in the servicing, maintenance and repair operations of an existing product or equipment in an end-use listed in Section 6.0, which contains or was designed to contain a prohibited substance, except if the operations constitute a retrofit or reclassifies the system as new."
AHRI and Daikin US	1/17/2020	4.2	Recommendation to allow internet disclosures as a compliance path for disclosure requirements. Internet disclosures ease the burden on manufacturers and to allow for a more effective means of communicating compliance with consumers and regulators.	**Department staff made no changes based on the received comments.** The Department believes that the proposed disclosure requirements currently offer a flexible, low-cost and convenient way for manufacturers to comply. Although the Department acknowledges the advantages of having a centralized online database for disclosures, this system would need to be comprehensively detailed and developed before being integrated into regulatory language. This option can be studied as part of a future amendment/regulation.
Section 5.0				
HCPA	1/17/2020	5.0	Recommendation to modify record keeping requirement: 3 years instead of 5 years	**Department staff made no changes based on the received comments.** The Department has acknowledged the comment; however no edits were made to the proposed regulatory language since the proposed language at the public workshops did not include recordkeeping requirements. The recordkeeping requirements were removed from the proposed new regulation following

Table 10: **Summary of public comments received from October 31, 2019 and January 17, 2020, and the actions taken following these comments.**

				the first phase of the stakeholder engagement process, the review committee meetings.
Section 6.0				
Honeywell, Chemours	11/18/2019	6.1.2	Commented that they were not in support of the suggested language recognizing potential future EPA approvals of foam-blowing agents if the language allows for any EPA approvals to be automatically recognized by Delaware. The state should have a process to determine whether it is appropriate to allow subsequently approved blowing agents that have a higher climate impact than other currently allowed, approved and available substitutes	After receiving these comments, the Department is proposing language in 6.1.2.1 that establishes a process where the Department will consider approving (or rejecting) HFC blends with lower global warming potential for two identified foam end-uses, provided the requested blends have been approved by the EPA, and offer sufficient technical support in favor of the request. The Department reserves the right to base their decision on the supporting technical documentation, and additional stakeholders' review.
Honeywell, NRDC	12/4/2019	6.1.2	Suggestion to edit the 6.1.2. proposed language to conform the scope of the language to the two foam types identified by the industry.	Following these comments, the Department has modified the language in subsection 6.1.2. to only apply to rigid polyurethane low-pressure two-component spray foam and polystyrene extruded boardstock and billet (XPS).
Dupont	12/12/2019	6.1.2.1	Request clarification on the use of the word "exclude" in section 6.1.2.1. There is confusion as to whether the current language could be interpreted to mean either " 750 blends would be excluded from the prohibited list" or if It should read that "the blends would be included in the regulation as being allowed".	To clarify the intent of this section, the department is proposing the following modification to subsection 6.1.2.1: "[…] *modify the regulation to exempt hydrofluorocarbon blends with a global-warming-potential of 750 or less in rigid polyurethane low-pressure two-component spray foam and polystyrene extruded boardstock and billet (XPS) from the list of prohibited substances in Section 6.0.* "
Arkema	1/13/2020	6.0	Request that the end-use date for the following four foam applications be extended to 1/1/2022, to allow for enough time for product reformulation, customer trials, production changes, equipment and plant design, capital appropriation, equipment order and implementation (12-18 months process after selecting the new formulation): • Extruded Polystyrene (XPS) Board Stock and Billet • Rigid Polyurethane (PU) Spray – High Pressure 2-Component Foam • Rigid Polyurethane (PU) Spray – Low Pressure 2-Component Foam • Rigid Polyurethane (PU) Spray –One Component Foam	**Department staff made no changes based on the received comments.** The Department has acknowledged Arkema's request, however it believes that the proposed timeline is still appropriate as it offers enough lead-time from the intended schedule of the vacated EPA SNAP rules (effective dates prior to January 2019 for all 4 foam end-uses). EPA's analyses to justify an earlier prohibition date included technical and economic considerations for the availability of lower GWP alternatives for these end-uses.

Table 10: **Summary of public comments received from October 31, 2019 and January 17, 2020, and the actions taken following these comments.**

			This would enable local businesses the opportunity to compete across the state lines where restrictions are not being considered. Mentioned the costs of switching to new refrigerants, and the implications for businesses that operate on thin margins. Recommends that the Department reach out to smaller businesses, such as groceries to understand the impact.	The Department has invited grocery stores associations to the initial rounds of review committee meetings – for them to be part of the initial discussions on the regulatory language. The impact to small businesses was compiled in Department's Regulatory Flexibility Analysis and Impact Statement Form – based on EPA's screening analyses of SNAP rules 20 and 21, the impact of the proposed regulation can be presumed to have no Significant Economic Impact on a Substantial Number of Small Entities, and more details are offered in Section IV C of the Technical Support Document.
NRDC	1/17/2020	6.1.2.1	Commented that NRDC conditionally supports the amendment to section 6.1.2.1 which allows a person to submit a request to exclude from the prohibition an HFC-blend with a GWP of 750 or less for use in rigid polyurethane low-pressure two-component spray foam and polystyrene extruded boardstock and billet (XPS). NRDC's support is contingent on the GWP and end-use criteria being met. To ensure a transparent and equitable process, stakeholders should have an opportunity to provide input and feedback on the request prior to a determination by DNREC.	The Department understands the concerned raise by the stakeholder and wants to emphasize the intent to receive/build strong technical support documentation, along with general agreement from industry stakeholders, for any future request for exemption of the two identified foam products. The Department is proposing language in 6.1.2.1 that establishes a process where the Department will consider approving (or rejecting) HFC blends with lower global warming potential for two identified foam end-uses, provided the requested blends have been approved by the EPA, and offer sufficient technical support in favor of the request. The Department reserves the right to base their decision on the supporting technical documentation, and additional stakeholders' review.
Overall Regulation				
Citizen: Jeanette Robinson	11/19/2019	Overall Regulation	Comment on the urgency of Climate Action, and general support for stringent regulations and policies phasing down Hydrofluorocarbons and the use and production of fossil fuels.	**The Department staff made no changes based on the received comments.** The Department agrees with the general sentiment, and the need for policies supporting GHG reductions.
Citizen: Nancy Hannigan	12/9/2019	Overall Regulation	Expressing support for the HFCs regulation proposed by DNREC.	**The Department staff made no changes based on the received comments.** The Department appreciates the support.
Out of Scope of this Regulation				

Table 10: **Summary of public comments received from October 31, 2019 and January 17, 2020, and the actions taken following these comments.**

Arkema	1/13/2020	Out of Scope	Comment that the Department should start discussing regulated organizations' timing needs to address their workforce training considerations. Arkema offered to facilitate these discussions.	**The Department staff made no changes based on the received comments.** The Department has acknowledged this comment and thanks Arkema for the proposition to facilitate further discussion on workforce training considerations, following the potential adoption of this regulation. These suggestions will be further reviewed out of the scope of this proposed new regulation.
NRDC	1/17/2020	Out of Scope	Comments on the following items, out of the scope included in this proposed new regulation. o NRDC opposes essential purpose permits o NRDC supports refrigerant reclamation in general, but warns that there is no need to exempt reclaimed refrigerant from the proposed rule o NRDC encourages coordination with the relevant department to update the state's building codes	**The Department staff made no changes based on the received comments.** The Departments thanks NRDC for offering these comments, however, will not be integrating them as part of this proposed regulatory development process. These suggestions will be further reviewed out of the scope of this proposed new regulation.
AHRI and Daikin US	1/17/2020	Out of Scope	Comments on the following items, out of the scope included in this proposed new regulation. o Recommends that DNREC take affirmative steps to promote reclamation by requiring the use of reclaimed refrigerant in state procurement processes. o Recommendation for Delaware to work with county offices to adopt building codes that allow for low GWP refrigerants (ASHRAE 15-2019 & UL 60335-2-40 3rd edition – or equivalent). o Offers to help working with stakeholders on guidance for training materials and curriculum o Recommendation to allow for an "essential purpose permit option"	**The Department staff made no changes based on the received comments.** The Departments thanks AHRI and Daikin for offering these comments, however, will not be integrating them as part of this proposed regulatory development process. These suggestions will be further reviewed out of the scope of this proposed new regulation.

The Department has provided a register notice and published the proposed new regulation on April 1st, 2020, via the Delaware Registrar of Regulations[52] which is at least 20 days prior to holding the public hearing. The public hearing notice, proposed regulation, and background document will be made available on DNREC's website at:
https://dnrec.alpha.delaware.gov/air/permitting/under-development/

Questions about this document may be addressed to:
Ajo Rabemiarisoa at (302) 323-4542 or via email at ajo.rabemiarisoa@delaware.gov

[52] Delaware General Assembly. Registrar of Regulations. Accessible via:
https://legis.delaware.gov/Offices/DivisionOfResearch/RegistrarOfRegulations

TECHNICAL RESPONSE MEMORANDUM

To: Lisa Vest, Hearing Officer

Through: Valerie Gray 6/25/2020

From: Ajo Rabemiarisoa 6/25/2020

Re: Department's response to public comments received on the proposed amendments to 7 DE Admin. Code 1151 – *Prohibitions on Use of Certain Hydrofluorocarbons in Specific End-Uses*

You presided over a public hearing on Thursday, April 23, 2020, beginning at 6:00 PM held virtually via the WebEx platform. The subject of the public hearing was the proposed new regulation 7 DE Admin. Code 1151 – *Prohibitions on Use of Certain Hydrofluorocarbons in Specific End-Uses*. The Department received comments from the following:

Date Received	*Name*	*Organization*
April 14, 2020	David T. Stevenson	Caesar Rodney Institute
April 16, 2020	Joint Comments from Allen Karpman Ming Xie Lisa Massaro Peter M. Geosits	Joint Comments from Arkema Inc. Kingspan Insulation LLC DuPont Specialty Products USA, LLC Koura Business Group
April 20, 2020	Kevin Messner	Association of Home Appliance Manufacturers
April 20, 2020	Mike Goscinski	National Automatic Merchandising Association
April 22, 2020	David T. Stevenson	Caesar Rodney Institute
April 23, 2020	Ronald Shebik	Hussman Corporation
Comments Received after the Public Hearing		
May 5, 2020	Jennifer Kane	Air-Conditioning, Heating, and Refrigeration Institute
May 6, 2020	Durwood Zaelke	Institute for Governance and Sustainable Development
May 7, 2020	Nicholas Georges	Household & Commercial Products Association
May 8, 2020	Jordan A. Smith	Global Forum on Advanced Climate Technologies
May 8, 2020	Sanjeev Rastogi	Honeywell
May 8, 2020	Kevin Washington	Illinois Tools Works Inc.
May 28, 2020	Christina Theodoridi	Natural Resources Defense Council
May 29, 2020	Stephen Wieroniey	American Chemistry Council; Center for the Polyurethane Industry

May 29, 2020	Justin Koscher	Polyisocyanurate Insulation Manufacturers Association
June 1, 2020	Kim Willson	Ruggerio Willson & Associates LLC
June 9, 2020	Joint Comments from Allen Karpman Ming Xie Lisa Massaro Peter M. Geosits	Joint Comments from Arkema Inc. Kingspan Insulation LLC DuPont Specialty Products USA, LLC Koura Business Group

This memorandum provides a summary of the comments received and the Division of Air Quality (DAQ) response. Each comment is included verbatim as an attachment. The comments and the public hearing transcript containing comments are available on the Department's Regulations and Plans Under Development webpage. Available: https://dnrec.alpha.delaware.gov/air/permitting/under-development/

I. Comments Received from The Caesar Rodney Institute [1]

Comment 1

The comments provided by The Caesar Rodney Institute suggest that Delaware should withdraw the proposed new regulation, because the technical support for the proposed regulation is based on the Environmental Protection Agency (EPA) Significant New Alternatives Policy (SNAP) 2015 rules that were overturned by the U.S. Court of Appeals for the District of Columbia.

Department Response

The Department thanks The Caesar Rodney Institute for providing their comments. The Department wants to clarify that the proposed new regulation was initiated as a result of the Governor's directive[2] and the House Concurrent Resolution 60[3], which required the Department to propose to regulate the manufacturing and use of hydrofluorocarbons (HFCs) in Delaware. The EPA SNAP rules 20 and 21, and their structural approach to high global warming potential (GWP) substances prohibition by end-use, offered extensive technical support documentation for the overall costs and the benefits for transitioning to lower global warming potential substances that minimize risks to human health and the environment. For this reason, the Department staff

[1] The Caesar Rodney Institute submitted comments on April 14, 2020 and April 22, 2020, and they can be accessed through the following link: http://www.dnrec.delaware.gov/Admin/Documents/dnrec-hearings/2020-R-A-0004/Exhibit-19-Copies-of-all-public-comments-received.pdf
[2] Delaware News, June 30, 2019. Governor's Directive on Delaware to Eliminate HFCs to Confront Climate. Accessible via: https://news.delaware.gov/2019/06/30/delaware-to-eliminate-hfcs-to-confront-climate-change/
[3] Delaware General Assembly. Passed on June 30, 2019. House Concurrent Resolution 60. Accessible via: http://legis.delaware.gov/BillDetail/47864

working with the U.S. Climate Alliance (USCA) HFCs working group focused their approach on maintaining the partially vacated high-GWP HFCs prohibitions as laid out in the EPA SNAP rules. The Department used the federal agency's technical review and economic analyses to inform and help construct the technical support document for Delaware's proposed regulation 7 DE Admin. Code 1151.

The partial[4] vacatur of EPA's authority to regulate HFCs builds upon the urgency of why State action became critical. The need to address these sources of high-GWP greenhouse gas (GHG) emissions grows larger. The purpose of this regulation is to reduce GHG emissions from the critical segment that is high-GWP HFCs, and we believe that our proposed new regulation achieves a step in this direction.

Comment 2

The comments provided by The Caesar Rodney Institute suggest that Delaware should withdraw the proposed new regulation, because the United States did not ratify the Kigali Amendment to the Montreal Protocol.

Department Response

The purpose of this proposed new regulation is to support the GHG emissions reduction, and it was initiated by the Governor's directive[5] and the House Concurrent Resolution 60[6], requiring the Department to propose to regulate the manufacturing and use of hydrofluorocarbons - in Delaware. Currently, through Governor Carney's commitment to participate in achieving the goals of the USCA[7], Delaware has committed to reduce its GHG emissions by 26 to 28% by 2025, compared to 2005 levels. The State has already experienced the threats of climate change, thus addressing the rise of high-GWP HFCs is necessary to further mitigate the impacts of climate change.

While it is true that the U.S. did not ratify the Kigali amendment, references to the latter in our technical support document, or as part of our regulatory impact statement, were included to emphasize the international interest in the phase-down of high-GWP HFCs and to express the need for the US industry to adopt similar restrictions to remain competitive, while assuring emissions reduction in a critical segment of GHGs. The

[4] On May 3, 2020, the United States Court of Appeals for the District of Columbia clarified the previous (2015) court's ruling intent that EPA lacks the authority to require a second substitution in place of HFCs. No. 18-1172 details available here: https://www.cadc.uscourts.gov/internet/opinions.nsf/60819211428AA9358525854300528C43/$file/18-1172-1837000.pdf

[5] Delaware News, June 30, 2019. Governor's Directive on Delaware to Eliminate HFCs to Confront Climate. Accessible via: https://news.delaware.gov/2019/06/30/delaware-to-eliminate-hfcs-to-confront-climate-change/

[6] Delaware General Assembly. Passed on June 30, 2019. House Concurrent Resolution 60. Accessible via: http://legis.delaware.gov/BillDetail/47864

[7] United States Climate Alliance is a bipartisan coalition of governors committed to reducing greenhouse gas emissions consistent with the goals of the Paris Agreement. Accessible via: https://www.usclimatealliance.org/

purpose of this regulation is to reduce GHG emissions from the critical segment that is high-GWP HFCs, and we believe that our proposed new regulation achieves a step in this direction.

Comment 3

The comments provided by The Caesar Rodney Institute suggest that Delaware should withdraw the proposed new regulation, because Delaware's greenhouse gas reduction goals have already been met

Department Response

Per the Department's 2016 GHG Emissions Inventory[8], presenting historical GHG emissions up to 2016, and projecting GHG emissions up to 2030, the projected GHG emissions in 2025 are 16.2 $MmtCO_2e$, which is a reduction of 16% from 2005. An emissions gap of about 1.9 $MmtCO_2e$ exists that must be reduced to achieve the minimum USCA target for Delaware of 26% by 2025.

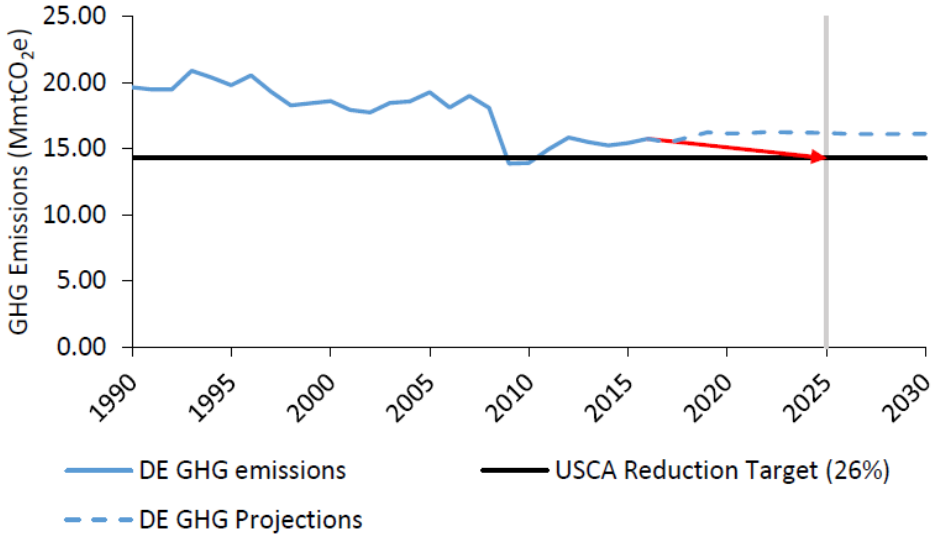

Figure 1: Delaware gross GHG emissions and projections from 1990 to 2030[9]

[8] Delaware Open Data. Delaware Greenhouse Gas (GHG) Emissions Inventory 1990-2030. Updated July 26, 2019. Accessible at: https://data.delaware.gov/Energy-and-Environment/Delaware-Greenhouse-Gas-GHG-Emissions-Inventory-19/w7vd-h5a8

[9] Delaware Department of Natural Resources and Environmental Control. July 2019. Delaware's 2016 Greenhouse Gas Emissions Inventory. Accessible at: http://www.dnrec.delaware.gov/Air/Documents/2016-de-ghg-inventory.pdf

Comment 4

The comments provided by The Caesar Rodney Institute suggest that Delaware should withdraw the proposed new regulation, because the proposed regulation will only add financial burden to Delawareans.

Department Response

Many flexibility mechanisms have been included in the language of the proposed new regulation to minimize the burden on Delaware's residents and small businesses. First, this regulation does not include recordkeeping requirements, nor does it cover motor vehicle air conditioning end-uses or household equipment. Most of the compliance burden are expected to be on manufacturers of the regulated products and equipment, which are, in majority, large enterprises. This regulation does not require users to cease the use of their equipment or product acquired prior to their effective date of prohibition, unless the equipment is retrofit or classified (or re-classified) as new. The proposed regulation also allows for any equipment or product, manufactured prior to the applicable effective date of prohibition, to be sold/imported/exported/distributed/installed and used after their effective date of prohibition. Additionally, the variable difference in capital expenses, when replacing a conventional equipment with an equipment in compliance with the proposed new regulation, is projected to decrease as the economies of scale set in (as the demand for low-GWP alternatives grows at the global scale), thus most small businesses that will change their equipment as part of the regular life-cycle of their operations are likely to pay less substantive differences within a few years. To encourage and accelerate the transition to low GWP the Department has also designed an incentives program[10], that will help pay the upfront cost of the new or retrofitted equipment using low-GWP refrigerants.

According to US EPA SNAP rules 20 and 21 screening analyses[11], the probability of having one small business in Delaware incurring costs in excess of 1% or 3% of their revenues, on a population basis, is less than 0.0003%. Based on this estimate, and our strong stakeholder engagement process which prompted us to include the flexibility mechanisms detailed above, the Department believes that the proposed new regulation is unlikely to add substantive burden to Delawareans.

[10] Delaware Department of Natural Resources and Environmental Control. Cool Switch Low Impact Refrigerant Program. Details available here: https://dnrec.alpha.delaware.gov/climate-coastal-energy/efficiency/cool-switch/

[11] ICF International for U.S. Environmental Protection Agency. July 2015. Economic Impact Screening Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives – Revised. Accessible via https://www.regulations.gov/document?D=EPA-HQ-OAR-2014-0198-0240
And
ICF International for U.S. Environmental Protection Agency. September 2016. Economic Impact Screening Analysis for Regulatory Changes to the Listing Status of High-GWP Alternatives used in Refrigeration and Air Conditioning, Foams, and Fire Suppression.

Comment 5

The comments provided by The Caesar Rodney Institute suggest that Delaware should withdraw the proposed new regulation, because the proposed new regulation is favoring two companies that share the patents on hydrofluoroolefins (HFO).

Department Response

Additionally, the proposed new regulation does not prescribe or advocate for HFOs, over the available low-GWP alternatives to the prohibited substances. The purpose of the regulation is to transition away from high-GWP in the specified end-uses, and many alternatives are available and have shown to be effective for different applications, such as ammonia, and carbon dioxide for industrial process refrigeration and cold storage systems[12].

Comment 6

The comments provided by The Caesar Rodney Institute suggest that Delaware should withdraw proposed new regulation, because the United States Senate Bill S. 2754, *the American Manufacturing and Innovation Act*, has been met with opposing businesses' testimony, and will overwhelm any benefits from the proposed regulation with many negative impacts.

Department Response

The Department appreciates the comments regarding the proposed federal action and will continue to follow it as it moves through Congress.

[12] Environmental Protection Agency. September 2019. Global Non-CO2 Greenhouse Gas Emission Projections & Marginal Abatement Cost Analysis: Methodology Documentation Report. Available at: https://www.epa.gov/sites/production/files/2019-09/documents/nonco2_methodology_report.pdf

II. Joint Comments from Arkema Inc, Kingspan Insulation LLC, Dupont Specialty Products USA, LLC, and Koura Business Group[13]

Comment 1

The joint letter received from the four businesses requests that 3 construction foam products (XPS Boardstock and Billet, Low Pressure two Component Polyurethane Spray Foam, and High Pressure two Component Polyurethane Spray Foam) covered under the regulation be granted an extension for the effective prohibition date (1/1/22 instead of the proposed 1/1/21), due to technical considerations, safety and commercial reasons, and closures related to COVID-19. For these reasons, a large portion of the suppliers and producers of this small subset of 3 foam products will not be able to meet the proposed prohibition dates. The joint letter states that unlike in the majority of HFC end-uses, foams technology adoption, includes testing and formulation that must be carried out facility by facility. Such processes usually require 12-18 months of implementation time; thus, not allowing the requested extension may result in the number of construction foam products available in Delaware to be severely restricted. As a result, there may be increased costs to consumers and businesses at a time when the economy is projected to be slower. The joint letter claims that the request will have no effect on Delaware's ability to meet its GHG emissions reduction goals.

Department Response

The Department thanks the four companies who collaborated on this letter for providing their written comments. The Department has read through the considerations provided in the joint letter and the attached documentation, for XPS Boardstock and Billet, Low Pressure two Component Polyurethane Spray Foam, and High Pressure two Component Polyurethane Spray Foam end-uses. We understand that the location-specific requirements to adapt the formulation (where significant changes to formulation require building code certification approvals) combined with the delays and economic uncertainty (impacting availability of new ingredients, lab/code accreditation testing facilities, compliant storage and transportation options, and supply agreements) brought up by the ongoing pandemic crisis constitute barriers to implementing an effective date of prohibition in less than six months. We also understand that, based on the estimate provided by the stakeholders, the current requested extension would result in approximately 0.034% of the total annual GHG emissions in the State of Delaware in 2021.

That being said, the Department has addressed a similar comment in the Technical Support Document to the proposed new regulation, answering Arkema Inc's January 13, 2020 request to extend the effective date of prohibition for the same three foam products and the Rigid Polyurethane (PU) Spray – One Component Foam. The

[13] Arkema Inc., Kingspan Insulation LLC, DuPont Specialty Products USA, LLC, and Koura Business Group submitted a joint letter on April 16, 2020, which can be accessed through the following link: http://www.dnrec.delaware.gov/Admin/Documents/dnrec-hearings/2020-R-A-0004/Exhibit-19-Copies-of-all-public-comments-received.pdf

Department did not amend the proposal following this request, since it believed that 1) the SNAP Rules 20 and 21 prohibition timeline should have prompted the industry to plan for the transition away from the high-GWP HFCs, and 2) that the proposed effective dates of prohibition are aligned with other USCA States legislation or regulatory adoptions or proposals.

The January 2020 request from Arkema Inc. pointed to similar logistical and accreditation considerations. It has been more than six months since the original request, and the industry is standing at a similar place for these end-uses. The three foam product end uses constitute a very small portion (approximately 0.034%) of the 2021 GHG emissions in Delaware. The Department believes that the risk in delaying the potential adoption of this proposed new regulation is greater than recommending the adoption of the proposed effective date of prohibition.

The ongoing crisis, and its resulting economic and logistical impacts certainly have the potential to impact the State and its residents for years to come. Quantifying and qualifying these impacts go beyond the Department's ability to project, due to the nature of this unprecedented crisis. Thus, even if delays and disturbances may be experienced in the supply chain and accreditation processes of these foam products, the Department Staff have no data to support the materiality of these delays and economic impacts at this point. We believe the emissions reduction needed from this critical segment (high-GWP HFCs) should be prioritized.

For these reasons, the Department does not recommend the modification of the proposed new regulation to allow a one-year extension for the three identified foam end-uses. This decision aligns with the USCA States that are committed to adopt and/or formalize their rulemaking by 2020.

Comment 2

The joint letter received from the four businesses requests to correct the answer provided to Arkema, in Section VII. of the Technical Support Document, since the four foam end-uses mentioned did not have prohibition dates prior to January 2019 under the EPA SNAP rules.

Department Response

The Department has reviewed the EPA final rule for SNAP 20 and recognizes that indeed the effective date of prohibition for each of the four foam end-uses was either January 1, 2020 or January 1, 2021. The Department appreciates the commenters' clarifications.

Comment 3

The joint letter received from the four businesses requests to modify section 6.1.2.2. of the proposed new regulation, by adding a clause stating that the Department "*shall expeditiously modify the regulation to add the blend if the two above conditions are accurately established in the federal register*".

Department Response

The Department appreciates the industry comment on subsection 6.1.2.2. However, the Department Staff believe that the proposed language currently achieves its intent, which is to allow the Department to control the process of amending the regulation, including the request and evaluation of additional industry stakeholders on the amendment. For these reasons, the Department Staff do not recommend any modification to subsection 6.1.2.2. of the proposed new regulation.

III. Comments Received from the Association of Home Appliance Manufacturers[14]

Comment 1

The comments provided by the Association of Home Appliance Manufacturers (AHAM) recommend edits to section 4.2.1.3, to allow for existing labeling containing the information required to be used as a compliance path for the disclosure statement requirements. The specific labeling standards referenced in the comments are CAN/CSA-C22.2 No. 60335-2-24:17 and UL 60335-2-24, both of which cover household and similar electrical appliances.

Department Response

The Department thanks AHAM for providing their written comments. The intent of the proposed disclosure requirements is to allow existing labeling required by state building codes and safety standards (that satisfies the identified requirements), including for the foam blowing agents, to be an acceptable compliance path. That being said, multiple stakeholders' comments emphasized the need to clarify the disclosure statement's acceptable format and content. The Department Staff do not recommend edits to the proposed new regulation, however the Department Staff will develop a guidance document to detail the acceptable formats for disclosure statements, for the covered end-uses in the proposed new regulation.

[14] The Association of Home Appliance Manufacturers submitted comments on April 20, 2020, which can be accessed through the following link: http://www.dnrec.delaware.gov/Admin/Documents/dnrec-hearings/2020-R-A-0004/Exhibit-19-Copies-of-all-public-comments-received.pdf

IV. Comments Received from the National Automatic Merchandising Association[15]

Comment 1

The comments provided by the National Automatic Merchandising Association (NAMA) request clarification as to which types of labels are acceptable, pointing out that the State of Washington's HFC proposal that points to the Underwriters Laboratories (UL) label already required on commercial equipment, is a good model for this purpose.

Department Response

The Department thanks NAMA for their support, and their cooperation throughout the rulemaking process. The Department believes that the language for the disclosure statement requirements for vending machines, which are covered under subsection 4.2.1.2., allows compliance through any existing labeling required by state building codes and safety standards, which includes Underwriters Laboratories labels. That being said, multiple stakeholders' comments emphasized the need to clarify the disclosure statement's acceptable format and content. The Department Staff do not recommend edits to the proposed new regulation, however the Department Staff will develop a guidance document to detail the acceptable formats and content for disclosure statements, for the covered end-uses in the proposed new regulation.

V. Comments Received from Hussman Corporation[16]

Comment 1

The comments provided by Hussman Corporation requests clarification on how the Department defines "new equipment" and "retrofit", especially what differentiates new equipment from "replacement" and "servicing" operations.

Department Response

The Department has a definition for both the terms "new" and "retrofit", listed under Section 3.0 of the proposed new regulation. These definitions clarify what activity constitutes or classifies a product or equipment as "new" or "retrofitting", which is beyond the realm of normal lifecycle operation of an existing equipment's maintenance, servicing, and repair activities, which are not covered under this proposed regulation.

[15] The National Automatic Merchandising Association submitted comments on April 20, 2020, which can be accessed through the following link: http://www.dnrec.delaware.gov/Admin/Documents/dnrec-hearings/2020-R-A-0004/Exhibit-19-Copies-of-all-public-comments-received.pdf

[16] The Hussman Corporation submitted comments on April 23, 2020, which can be accessed through the following link: http://www.dnrec.delaware.gov/Admin/Documents/dnrec-hearings/2020-R-A-0004/Exhibit-19-Copies-of-all-public-comments-received.pdf

VI. Comments Received from the Air-Conditioning, Heating, and Refrigeration Institute[17]

Comment 1

The comments provided by the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) requests clarification on how to interpret part (2) of the definition of "New", regarding how it translates to subsection 4.1.4 of the proposed new regulation. In other words, is equipment manufactured prior to the effective date of prohibition allowed to be installed in the State of Delaware after that effective date?

Department Response

The Department thanks AHRI for providing these written comments, and for their continuous participation to the rulemaking process. The Department interprets that any product or equipment manufactured prior to their effective prohibition date (as detailed in Table 1 of Section 6.0 of the proposed new regulation) is allowed to be sold and installed after its respective prohibition date, according to the sell-through provision detailed in subsection 4.1.4 of the proposed new regulation.

VII. Comments Received from the Institute for Governance and Sustainable Development[18]

Comment 1

The comments provided by the Institute for Governance and Sustainable Development (IGSD) congratulated Delaware on the proposed new regulation, stating that the initiative reinforces the State's reputation as a leader on cost-effective, common-sense strategies to preserve our climate. The commenter presented information about the environmental and economic advantages of leading the transition from high global warming HFCs.

Department Response

The Department appreciates the support and thanks IGSD for providing these written comments. The purpose of this regulation is to reduce GHG emissions from the critical segment that is high-GWP HFCs, and we believe that our proposed new regulation achieves a step in this direction.

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[17] The Air-Conditioning, Heating, and Refrigeration Institute submitted comments on May 5, 2020, which can be accessed through the following link: http://www.dnrec.delaware.gov/Admin/Documents/dnrec-hearings/2020-R-A-0004/Jennifer-Kane-AHRI-20200505.pdf

[18] The Institute for Governance and Sustainable Development submitted comments on May 6, 2020, which can be accessed through the following link: http://www.dnrec.delaware.gov/Admin/Documents/dnrec-hearings/2020-R-A-0004/IGSD-Comments-Delaware-HFCs-clean.pdf

VIII. Comments Received from the Household & Commercial Products Association[19]

Comment 1

The comments provided by the Household & Commercial Products Association (HCPA) supports the Department's approach to regulate HFCs, as it is consistent with other state actions, which is critical for industry to obtain certainty and plan for future investment, sales, research and development decisions.

Department Response

The Department appreciates the support of HCPA and thanks them for providing these written comments. The purpose of this regulation is to reduce GHG emissions from the critical segment that is high-GWP HFCs, and the Department agrees on the importance of doing so while helping industry gain some certainty on future investment and R&D planning.

Comment 2

The comments provided by HCPA recommends that the Department aligns the definition of "aerosol propellant" with current Delaware regulation 7 DE Admin. Code 1141 "Limiting Emissions of Volatile Organic Compounds from Consumer and Commercial Products.", in order to maintain consistency in the definition of an aerosol propellant.

Department Response

The Department understands the concerns brought up by the stakeholder, however, does not believe that the edits to the definition of "Aerosol Propellant" is warranted, as the current definition is satisfactory and technically sound for the purpose of this proposed new regulation.

[19] The Household & Commercial Products Association submitted comments on May 7, 2020, which can be accessed through the following link: http://www.dnrec.delaware.gov/Admin/Documents/dnrec-hearings/2020-R-A-0004/HCPA-Comments-DE-Reg-1151-Docket-2020-R-A-0004.pdf

Comment 3

The comments provided by HCPA recommends modifying the disclosure requirement for aerosol products to include section 2.5.1.1 from Delaware regulation 7 DE Admin Code 1141, so that manufacturers already using the complying date code are not required to submit an explanation of the same code. The comments express that manufacturers that previously submitted their date code should not be required to resubmit their documentation as the Department already has this information.

Department Response

The Department has acknowledged the content of section 2.5.1.1 from 7 DE Admin Code 1141 and agrees that manufacturers should not be mandated to file an explanation of the date code, if it is represented separately from other codes on the product container such that it is easily recognizable.

Multiple stakeholders' comments emphasized the need to clarify the disclosure statement's acceptable format and content. The Department Staff do not recommend edits to the proposed new regulation following this comment, however the Department Staff will be developing a guidance document to detail the acceptable formats for disclosure statements, for the covered end-uses in the proposed new regulation. This guidance document will include considerations for the easily recognizable date code formats.

Comment 4

The comments provided by HCPA recommends modification to the section 2.2 of the proposed new regulation, stating that the applicability described for the disclosure requirements is overreaching as the scope of the regulation is to the prohibited substances listed in Section 6.0. HCPA also recommends modifying section 2.2, so that the disclosure statement for aerosol products take into account the exempted uses described in Section 7.0, which are allowed to use the prohibited substances.

Department Response

The Department believes that the proposed disclosure requirements allow enough flexibility for compliance as to not become a burden to the manufacturers of the products or equipment covered under the proposed new regulation. The Department further believes that the proposed disclosure requirements achieve the intended functions, which is to offer transparent information to the buyer, while serving as a verification point for the Department since no recordkeeping requirements are proposed in this regulation. Thus, the Department does not believe a modification to section 2.2. is warranted.

Multiple stakeholders' comments emphasized the need to clarify the disclosure statement's acceptable format and content. The Department Staff do not recommend

edits to the proposed new regulation following this comment, however the Department Staff will be developing a guidance document to detail the acceptable formats for disclosure statements, for the covered end-uses in the proposed new regulation. This guidance document will include considerations for how to treat the exemptions listed under Section 7.0, in terms of disclosure statement requirements.

Comment 5

The comments provided by HCPA emphasize that the labeling of aerosol products can fall under the jurisdiction of multiple federal government agencies, which makes it difficult, if not impossible, for all products to comply with one format. Thus, HCPA recognizes that providing two compliance options, including one that allows aerosol manufacturers to comply using the Safety Data Sheet, ensures that all aerosol products covered can comply.

Department Response

The Department appreciates the comment and agrees with the importance of allowing enough flexibility for the manufacturers to comply to the disclosure requirements without substantive burden, while ensuring the buyers are provided with the proper information.

IX. Comments Received from the Global Forum on Advanced Climate Technologies[20]

Comment 1

The comments provided by the Global Forum on Advanced Climate Technology (GlobalFACT) request to clarify information included as part of the Department's Technical Support Document, including technical information from the cited Shecco report[21], which GlobalFACT believes lacks relevance and credibility to inform any industry-wide insights or conclusions. The comments argues that the availability and overall lower lifecycle costs statements made about the low-GWP alternatives are overstated, and that in addition to higher system costs, many of the new low-GWP systems will require knowledgeable engineers and trained personnel for design, start-up, and maintenance, and that this pool of individuals is currently limited. GlobalFACT also references one presentation[22] sponsored by the EPA GrennChill program has concluded that hydrocarbon systems can have higher energy and maintenance costs, which effectively cancel out any lower cost of refrigerants.

[20] The Global Forum on Advanced Climate Technologies submitted comments on May 8, 2020, which can be accessed through the following link: http://www.dnrec.delaware.gov/Admin/Documents/dnrec-hearings/2020-R-A-0004/globalFACT-Comments-Proposed-Prohibitions-on-Use-of-Certain-Hydrofluorocarbons-in-Specific-End-Uses-08MAY2020.pdf

[21] Shecco. October 2016. F-Gas Regulation shaking up the HVAC&R industry. Report commissioned in the European Parliament. Accessible via: https://issuu.com/shecco/docs/f-gas_impact_shecco_october2016

[22] The GreenChill Partnership. February 2019. Webinar on Microdistributed Systems – Supermarket Experiences and Future Direction. Available at: https://epawebconferencing.acms.com/p59jn0jc1jt2/?launcher=false&fcsContent=true&pbMode=normal

GlobalFACT conclude their comments stating that they believe that, due to the vastness and complexity of available refrigerant options, and systems, there will never be one solution for all situations, but rather preferred solutions for specific applications — all with the aim of lowering the climate impact and providing safe and efficient operation and ease of use.

Department Response

The Department thanks GlobalFACT for providing these written comments, and the thorough technical considerations and additional references. The Department agrees that there is no single solution for the transition from high-GWP HFC refrigerants. The proposed regulation does not advocate for any given technology or any specific refrigerant replacement. The Department doesn't believe modification to the proposed new regulation is warranted following this comment.

X. Comments Received from Honeywell[23]

Comment 1

The comments provided by Honeywell congratulates Delaware's initiative to regulate HFCs, in a consistent manner with other States. Honeywell supports the approach, agrees with the necessity to transition away from high Global Warming Potential HFCs, and states that technologies using environmentally preferable HFC alternatives are often also more energy efficient than traditional systems, and thus offer lower customer costs and increase competitiveness.

Department Response

The Department appreciates the support and thanks Honeywell for providing these written comments, and for their continuous participation throughout the rulemaking process. The purpose of this regulation is to reduce GHG emissions from the critical segment that is high-GWP HFCs, and we believe that our proposed new regulation achieves a step in this direction.

Comment 2

The comments provided by Honeywell requests for the following technical amendment to the definition "Polystyrene Extruded Boardstock and Billet (XPS)", clarifying that styrene monomers are converted to polystyrene under very controlled conditions by plastic producers, not foam producers.

[23] Honeywell submitted comments on May 8, 2020, which can be accessed through the following link: http://www.dnrec.delaware.gov/Admin/Documents/dnrec-hearings/2020-R-A-0004/Honeywell-Comments-on-DE-Proposed-HFC-Regulation.pdf

"Polystyrene Extruded Boardstock and Billet (XPS)" means a foam formed from predominantly polystyrene pellets ~~monomer~~ and produced on extruding machines in the form of continuous foam slabs which can be cut and shaped into panels used for roofing, walls, ~~and~~ flooring, pipe and vessel insulation and other miscellaneous uses.

Additionally, Honeywell states that they support the changes to the polyurethane and foam end-uses definitions, as suggested from the American Chemistry Council (ACC) Center for the Polyurethanes Industry (CPI).

Department Response

Please refer to Section XIII of this Technical Response Memo for the Department's recommendation for the Secretary to consider modifying nine definitions, following ACC CPI suggestions.

XI. Comments Received from Illinois Tool Works, Inc.[24]

Comment 1

The comments provided by Illinois Tool Works, Inc. (ITW) are supportive of the Department's initiative, definitions for their specific end-uses, and the timelines laid-out in the proposal. ITW requests for the Department to consider an amendment to Section 4.2.1.3 to allow manufacturers to comply with disclosure through a printed statement in a product's owner's manual in addition to the defined options, stating that it is unclear that the proposed regulation allows for this option. This option will allow manufacturers' products made and sold for use in any state to be more freely sold while remaining uniformly compliant with all states' disclosure requirements.

Department Response

The Department thanks ITW for providing their written comments. The intent of the broad language crafted for the disclosure statement requirements was to allow manufacturers to have flexibility in the form/format that the disclosure takes, as long as they accompany the regulated products and equipment and include the category-specific requirements. We agree with the importance of allowing flexibility in the disclosure formats, and our language allows for disclosure and labels to be on-product/equipment, or accompanying the product/equipment, such as on the packaging or in the owner's manual.

[24] Illinois Tools Works Inc. submitted comments on May 8, 2020, which can be accessed through the following link: http://www.dnrec.delaware.gov/Admin/Documents/dnrec-hearings/2020-R-A-0004/ITW-comment-DE-HFC-prop-rule-050820.pdf

Multiple stakeholders' comments emphasized the need to clarify the disclosure statement's acceptable format and content. The Department Staff do not recommend edits to the proposed new regulation following this comment, however the Department Staff will be developing a guidance document to detail the acceptable formats for disclosure statements, for the covered end-uses in the proposed new regulation.

XII. Comments Received from the Natural Resources Defense Council[25]

Comment 1

The comments provided by the Natural Resources Defense Council (NRDC) state that NRDC's more than 7,800 members and online activists in Delaware are supportive of the proposed regulation and encourage its prompt adoption. NRDC commends Delaware for prompt action to reduce greenhouse gas emissions from HFCs, and thanks the Department for pursuing an extensive and thorough stakeholder engagement process.

Department Response

The Department appreciates the support and thanks NRDC for providing these written comments. The purpose of this regulation is to reduce GHG emissions from the critical segment that is high GWP HFCs, and we believe that our proposed new regulation achieves a step in this direction.

XIII. Comments Received from the American Chemistry Council Center for the Polyurethanes Industry[26]

Comment 1

The comments provided by ACC CPI suggests developing a definition for "polyurethane" and referencing this definition in the different polyurethane end-uses. CPI also offered technical changes to the definitions of nine polyurethane end-uses, and the definition of "Foam Blowing Agent".

[25] The Natural Resources Defense Council submitted comments on May 28, 2020, which can be accessed through the following link: http://www.dnrec.delaware.gov/Admin/Documents/dnrec-hearings/2020-R-A-0004/NRDC-Comments-7-DE-Admin-Code-1151.pdf

[26] The American Chemistry Council; Center for the Polyurethane Industry submitted comments on May 29, 2020, which can be accessed through the following link: http://www.dnrec.delaware.gov/Admin/Documents/dnrec-hearings/2020-R-A-0004/ACC-CPI-Comments-DE-Draft-HFC-Regulations.pdf

Department Response

The Department thanks ACC CPI for providing their written comments. Since the public hearing, the Department has heard from an expert from the, United Nations Environment Programme's Foams Technical Options Committee, Paul Ashford, who is also listed as one of the co-authors of the latest 2018 Foams Technical Options Committee (FTOC) reports from UNEP[27]. Mr. Ashford has provided suggestions that clarify the proposed definitions. It is the belief of the Department Staff that other states in the process of adopting a similar regulation will include these clarifications to the following definitions. The USCA model rule has been amended to include these definitions.

The Department Staff recommend the Secretary consider the following technical clarifications, as requested by the Center for the Polyurethanes Industry, and as verified by the aforementioned industry expert.

"Polyurethane" means a polymer formed principally by the reaction of an isocyanate and a polyol.

"Flexible Polyurethane" means a non-rigid ~~synthetic~~ polyurethane foam ~~containing polymers created by the reaction of isocyanate and polyol~~, including but not limited to that used in furniture, bedding, and chair cushions.

"Foam Blowing Agent" means a substance ~~used to produce the product with a cellular structure formed via a foaming process in a variety of materials that undergo hardening via chemical reaction or phase transition~~ that functions as a source of gas to generate bubbles in the mixture during the formation of foam.

"Integral Skin Polyurethane" means a ~~synthetic~~ self-skinning polyurethane foam ~~containing polyurethane polymers formed by the reaction of an isocyanate and a polyol~~, including but not limited to that used in car steering wheels and dashboards.

"Rigid Polyurethane Appliance Foam" means polyurethane ~~insulation~~ foam in household appliances used for insulation.

"Rigid Polyurethane Commercial Refrigeration and Sandwich Panels" means polyurethane foam, used to provide insulation ~~for use~~ in walls and doors, including that used for commercial refrigeration equipment, and used in doors, including garage doors.

"Rigid Polyurethane High-pressure Two-component Spray Foam" means a liquid polyurethane foam system sold as two parts (i.e., A-side and B-side) in non-pressurized containers; ~~product that is pressurized 800-1600 pounds per square inch (psi) during installation manufacture; sold in pressurized containers as two parts (i.e., A-side and B-side)~~; and is field or factory ~~blown~~ applied in situ using high-pressure proportioning pumps at 800-1600 pounds per square inch (psi) and an

[27] UN Environment. Rigid and Flexible Foams Technical Options Committee, 2018 Assessment Report. Accessible via: https://ozone.unep.org/sites/default/files/2019-04/FTOC-assessment-report-2018.pdf

application gun to mix and dispense the chemical components. ~~may use liquid blowing agents without an additional propellant~~.

"Rigid Polyurethane Low-pressure Two-component Spray Foam" means a liquid polyurethane foam system ~~product~~ sold as two parts (i.e., A-side and B-side) in containers that is pressurized to less than 250 psi during manufacture of the system for application without pumps; ~~sold in pressurized containers as two parts (i.e., A-side and B-side);~~ and is typically applied in situ relying upon a liquid blowing agent and/or gaseous foam blowing agent that also serves as a propellant ~~so pumps typically are not needed~~.

"Rigid Polyurethane Marine Flotation Foam" means buoyancy or flotation polyurethane foam used in boat and ship manufacturing for both structural and flotation purposes.

"Rigid Polyurethane One-component Foam Sealants" means a polyurethane foam generally packaged in aerosol cans that is applied in situ using a gaseous foam blowing agent that is also the propellant for the aerosol formulation.

"Rigid Polyurethane Slabstock and Other" means a rigid closed-cell polyurethane foam ~~containing urethane polymers produced by the reaction of an isocyanate and a polyol and~~ formed into slabstock insulation for panels and fabricated shapes for pipes and vessels.

Comment 2

The comments provided by ACC CPI support the Department's decision to not require recordkeeping, and the proposed disclosure Statement requirements that the Departments has laid-out for foam products, specifically the language under subsections 4.2.1.3.2. ACC CPI believes that disclosures focused on a product's compliance status provides users and regulators the necessary information to ensure that low global warming potential products are used and installed in Delaware.

Department Response

The Department thanks ACC CPI for providing their written comments and appreciates the support for the proposed recordkeeping and disclosure requirements.

Comment 3

The comments provided by ACC CPI support the sell-through provision proposed in sub-section 4.1.4 of the proposed regulation, however state that the term "on site" may be too limiting and may not include factory uses of polyurethane systems.

Department Response

The Department understands the clarification provided by ACC CPI, as it excludes some foam end-uses that are not meant for site-specific applications, including factory uses of polyurethane systems. The intent of the sell-through provision is to allow

all the products and equipment covered under the proposed regulation, to be able to be sold, imported, exported, distributed, installed, and used, if they were manufactured prior to their applicable effective date of prohibition. Thus, the Department Staff agree with the removal of the term "on site", and recommends the Secretary consider the following clarification to the proposed new regulation:

4.1.4 Products or equipment manufactured prior to the applicable effective date of the restrictions specified in Table 1 of subsection 6.1.1 (including foam systems not yet applied ~~on site~~) may be sold, imported, exported, distributed, installed, and used after the specified date of prohibition.

XIV. Comments Received from the Polyisocyanurate Insulation Manufacturers Association[28]

Comment 1

The comments provided by the Polyisocyanurate Insulation Manufacturers Association (PIMA) opposes the provision requiring all manufacturers of end-uses referenced in the proposed regulation to provide disclosure statements to buyers. The comments support their position with two main arguments. First, that the polyiso industry have already transitioned away from using HFC substances in their product formulations, and that the Department does not have the statutory authority to impose disclosure statement requirements on end-uses that do not use the targeted high-GWP HFC substances. Second, that buyers do not require or expect every product they buy to be labeled with a statement about its compliance status, and that the disclosure statement will be confusing to the buyers, as some HFCs with GWP value of nearly 750 will continue to be used and is allowed to be labeled the same manner as a product that uses a low-GWP substitute. Thus, PIMA argues that no real benefits are provided to the buyers through the proposed disclosure statements.

Department Response

The Department believes that the proposed disclosure requirements allow enough flexibility for compliance as to not become a burden to the manufacturers of the products or equipment covered under the proposed new regulation. The Department further believes that the proposed disclosure requirements achieve the intended functions, which is to offer transparent information to the buyer, while serving as a verification point for the Department since no recordkeeping requirements are proposed in this regulation.

The Department does not believe that the disclosure requirements go beyond its statutory authority and understanding that some industry did already transition away from

[28] The Polyisocyanurate Insulation Manufacturers Association submitted comments on May 29, 2020, which can be accessed through the following link: http://www.dnrec.delaware.gov/Admin/Documents/dnrec-hearings/2020-R-A-0004/PIMA-Comments-Delaware-HFC-Proposed-Regulation-1151-20200529.pdf

the use of high-GWP HFCs in their product formulation, disclosure requirements will ensure continued and accountable compliance. The Department Staff do not recommend edits to the proposed new regulation following this comment.

XV. Comments Received from Ruggerio Willson & Associates LLC[29]

Comment 1

The comments provided by Ruggerio Willson request a clarification on whether the proposed regulation intends to regulate Research and Development activities in Delaware, per the inclusion of the language "in a manufacturing process" as a part of the definition of the term "use".

Department Response

The Department thanks Ruggerio Willson for providing their written comments. The intent of the regulation is to solely establish prohibitions on the products and equipment that use an end-use specific substance as defined in Section 6.0 of the regulation. It is not the intent of this regulation to regulate Research and Development activities in the State.

XVI. Joint Comments from Arkema Inc, Kingspan Insulation LLC, Dupont Specialty Products USA, LLC, and Koura Business Group[30]

Comment 1

The joint letter received from the four businesses are requesting that the recently (May 29, 2020) published pre-publication of EPA SNAP Rule 23[31] are included as a part of the hearing record submitted to Secretary Garvin. The proposed EPA SNAP Rule 23 explains that only one of the substitutes that the Agency believed at the time of the 2015 Rule would be available for use in XPS foam as of January 1, 2021 is in fact available and likely could only be used to meet the needs for some portion of the XPS foams market. EPA also considers important that the SNAP program not limit the choice of acceptable substitutes to only one option, and for these reasons the agency is proposing to list additional blowing agent options for XPS that have been proven to work for this end-use. The three HFC blends EPA is proposing to add as acceptable in

[29] The Ruggerio Willson & Associates LLC submitted comments on June 1, 2020, which can be accessed through the following link: http://www.dnrec.delaware.gov/Admin/Documents/dnrec-hearings/2020-R-A-0004/Ruggerio-Willson-Comment.pdf

[30] Arkema Inc., Kingspan Insulation LLC, DuPont Specialty Products USA, LLC, and Koura Business Group submitted a joint letter on June 9, 2020, which can be accessed through the following link: http://www.dnrec.delaware.gov/Admin/Documents/dnrec-hearings/2020-R-A-0004/james-nutter-comments.pdf

[31] The Proposed Snap Amendments have been submitted for publication in the Federal Register as part of Docket No. EPA-HQ-OAR-2019-0698 and an unofficial copy can be accessed through the following URL: https://www.epa.gov/sites/production/files/2020-06/documents/pre_publication_snap_listing_rule_23_nprm_05292020.pdf.

XPS foam will be prohibited as of January 1, 2021, if Regulation 1151 is adopted without modification. Delaware consumers and construction industry participants are likely to experience either or both higher costs or procurement delays resulting from a restricted supply of legal XPS foam products. For the reasons set forth in the Proposed SNAP Amendments and outlined herein, the undersigned parties respectfully reiterate their request that the end-use date for XPS Boardstock and Billet, Low Pressure two Component Polyurethane Spray Foam, and High Pressure two Component Polyurethane Spray Foam be extended an additional year to January 1, 2022.

Department Response

The Department thanks the four signatory businesses for providing their written comments and reaction to the proposed EPA SNAP Rule 23 amendment. Although the federal proposal does offer technical arguments for HFC blends for XPS foam end-uses, the Department cannot consider the proposed EPA amendment (SNAP Rule 23), because it is a proposal on which EPA is scheduled to receive public comments. Thus, neither the timeline nor the content of the final SNAP Rule 23 can be assumed in this point in time.

That being said, once the EPA SNAP Rule 23 is finalized, the Department invites the signatory stakeholders to submit a request to amend 7 DE Admin. Code 1151, following subsection 6.1.2. of the proposed new regulation, based on the final blends approved by the EPA. The Department Staff do not recommend edits to the proposed new regulation following this comment.

SUPPLEMENTAL TECHNICAL RESPONSE MEMORANDUM

To: Lisa Vest, Hearing Officer

Through: Valerie Gray 8/5/2020 vag

From: Ajo Rabemiarisoa 8/5/2020 ar

Re: Department's response to public comments received on the proposed amendments to 7 DE Admin. Code 1151 – *Prohibitions on Use of Certain Hydrofluorocarbons in Specific End-Uses*

You presided over a public hearing on Thursday, April 23, 2020, beginning at 6:00 PM held virtually via the WebEx platform. The subject of the public hearing was the proposed new regulation 7 DE Admin. Code 1151 – *Prohibitions on Use of Certain Hydrofluorocarbons in Specific End-Uses.*

The Department previously submitted a Technical Response Memorandum (dated 6/25/2020) addressing the comments received for the public and stakeholders. This supplemental Memorandum addresses information received after the public comments deadline (May 31, 2020), regarding the proposed Environmental Protection Agency (EPA) Significant New Alternatives Policy (SNAP) Proposed Rule 23, for which a Notice of Proposed Rulemaking[1] was released by the federal agency on June 12, 2020.

Date Received	*Name*	*Organization*
July 28, 2020	Justin Koscher	Polyisocyanurate Insulation Manufacturers Association

The supplemental information is included verbatim as an attachment to this Technical Response Memorandum.

I. Information Received from the Polyisocyanurate Insulation Manufacturers Association

The information provided by the Polyisocyanurate Insulation Manufacturers Association (PIMA) states that PIMA is concerned that EPA has been misled with respect to the suitability of low-Global Warming Potential (GWP) alternatives for XPS insulation. PIMA states that the latter is demonstrated by the low-GWP XPS products available globally, and objects to the conclusions of the EPA Proposed Rule 23 aiming to list three blends of HFC-134a as acceptable for the "extruded polysterene: boardstock and billet" end-use. PIMA also provided additional

[1] Environmental Protection Agency. 40 CFR Part 82. [EPA-HQ-OAR-2019-0698; FRL-10009-66-OAR]. Available at: https://www.govinfo.gov/content/pkg/FR-2020-06-12/pdf/2020-11990.pdf

information on the availability of commercialized products with low-GWP formulations in the global markets.

Department Response

The Department thanks PIMA for their continued collaboration throughout our regulatory process, and for providing additional information regarding the proposed EPA SNAP Rule 23, along with the availability of low-GWP products for the covered end-uses, in the global market.

Background Information on US EPA SNAP Proposed Rule 23 - XPS Insulation

Justin Koscher <jkoscher@pima.org>

Tue 7/28/2020 5:21 PM

To: Rabemiarisoa, Ajo (DNREC) <Ajo.Rabemiarisoa@delaware.gov>

1 attachments (3 MB)

PIMA Public Comments SNAP Rule 23 EPA-HQ-OAR-2019-0698 FINAL 07.27.2020.pdf;

Ajo,

I hope this email finds you doing well.

I understand the comment period on the proposed HFC reduction rule is closed. That said, I know the Department keeps a watchful eye on US EPA SNAP activities. While the Department's proposed HFC reduction rule would limit the use of HFCs and blends thereof in foam end uses (which we support), SNAP Proposed Rule 23 would list as acceptable certain blends of HFC-134a for use with XPS insulation only. PIMA is concerned that EPA has been misled with respect to the suitability of low-GWP alternatives for XPS insulation. This fact is simply demonstrated by the low-GWP XPS products available globally. In order to correct the record, PIMA submitted the attached comments.

Again, while it's my understanding that the Department plans to finalize a rule that will limit the use of HFCs and blends thereof in foam end uses effective January 1, 2021, I wanted to share the attached comments with your team so you have a full picture of the landscape for commercially available low-GWP XPS products.

Please contact me with any questions. PIMA looks forward to seeing the HFC reduction rule in its final version later this fall.

Thank you,
Justin

Justin Koscher
President

PIMA
POLYISOCYANURATE INSULATION MANUFACTURERS ASSOCIATION

Polyisocyanurate Insulation Manufacturers Association
3330 Washington Blvd.
Suite 200
Arlington, VA 22201

O: 703-224-2289 (direct)
C: 630-251-4761
E: jkoscher@pima.org
www.polyiso.org


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3330 Washington Blvd. / Suite 200 / Arlington, VA 22201 / p: 703.258.0093 / www.polyiso.org

July 27, 2020

Submitted via www.regulations.gov

U.S. Environmental Protection Agency
Stratospheric Protection Division
Office of Atmospheric Program
Attn: Christina Thompson
1200 Pennsylvania Ave. NW
Washington, DC 20460

Re: Docket No. EPA-HQ-OAR-2019-0698; Protection of Stratospheric Ozone: Listing of Substitutes Under the Significant New Alternatives Policy Program (Proposed Rule 23)

Dear Ms. Christina Thompson,

The Polyisocyanurate Insulation Manufacturers Association[1] (PIMA) is pleased to submit the following public comments in response to the Environmental Protection Agency's (EPA) Significant New Alternatives Policy (SNAP) Program Proposed Rule 23. The PIMA comments respond to the proposed listing of three blends of HFC-134a as acceptable for the "extruded polystyrene: boardstock and billet" end use category (XPS products).

Specifically, PIMA objects to the conclusions regarding the suitability of substitutes with low global warming potential (GWP) for XPS products. **The commercial successes of XPS products with low-GWP formulations globally contradict the conclusions in Proposed Rule 23 and we urge the Agency to reconsider the proposed acceptable status for the HFC-134a blends.**

As the Agency considers the arguments presented below, it is important to recognize that the domestic market for foam insulation products is highly competitive with multiple products being suitable alternatives for many applications. This is especially true for the building products sector. In this sector, other closed-cell foam insulation products have converted, or are in the process of converting, to low-GWP blowing agent substitutes. We encourage EPA to consider this landscape as it proposes to list HFC blends as acceptable for one foam insulation end-use when the use of the same blends in other competing end-uses is prohibited.

[1] More information available at: www.polyiso.org.

I. The availability of commercialized XPS products with low-GWP formulations in global markets undermines Proposed Rule 23's conclusion that low-GWP substitutes are not suitable for use within the United States market.

With respect to Proposed Rule 23, EPA concludes that certain low-GWP substitutes do not satisfy the technical needs and performance requirements for the XPS market. A review of XPS products available globally tells a different story. For example, Owens Corning – a domestic manufacturer of XPS products – has announced that its low-GWP XPS product (Foamular® NGX) will be available in Canada beginning January 1, 2021 in order to satisfy the country's restrictions on high-GWP substitutes.[2] Canada prohibits the use of blowing agent substitutes with a GWP greater than 150 effective January 1, 2021 for XPS products.

Soprema, a global manufacturer of building products, also announced in June 2020 that it will produce a low-GWP XPS product for the Canadian market beginning January 1, 2021.[3] Importantly, in its announcement, Soprema highlights that its low-GWP formulation will maintain the same physical properties exhibited by the product formulation based on HFC-134a.

DuPont, a domestic producer of XPS products, operates an XPS manufacturing plant in Québec Canada. A press release published by DuPont in December 2019 states that the company plans to manufacture compliant XPS products for the Canadian marketplace effective January 1, 2021.[4] This fact further undermines the claim that low-GWP substitutes are not suitable for XPS products manufactured in the United States market.

In Europe, the European Union's F-gas Regulation prohibits the use of blowing agent substitutes with a GWP greater than 150 effective January 1, 2020 for XPS products.[5] Producers across Europe continue to manufacture compliant XPS products under the regulation. An

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[2] A copy of Owens Corning Canada's July 6, 2020 announcement is attached to these comments. The announcement indicates that a low-GWP alternative will be available January 1, 2021. The information in the announcement also demonstrates that the new formulation will be launched across the company's XPS product portfolio and that the new products will meet the needs of the marketplace in terms of performance.

[3] A copy of Soprema's June 18, 2020 announcement regarding its SOPRA-XPS product line is attached to these comments.

[4] DuPont Press Release, "Rooted in sustainable technology and innovation, DuPont reaffirms commitment to leading with environmentally compliant products and building solutions that support global sustainability" (December 6, 2019). Available at: https://www.dupont.com/news/dupont-on-track-for-styrofoam-hfc-compliance.html. The press statement indicates that XPS products manufactured by DuPont will be "fully compliant with the . . . Canadian Environmental Protection Act in Canada, as regulations come into effect in 2021."

[5] Information on the European Union regulation to control emissions from fluorinated greenhouse gases is available at: https://ec.europa.eu/clima/policies/f-gas/legislation_en.

example of these success stories includes Kingspan Insulation's launch of its low-GWP XPS product, Kingspan GreenGuard GG300.[6]

The global presence of commercialized low-GWP formulations for XPS products is evidence of the fact that domestic manufacturers have the technology and capability to produce similar products for the United States market.

II. The XPS manufacturer's claim that a minimum R-value of R-5.0 is unachievable with low-GWP substitutes is contradicted by the published data for commercialized low-GWP XPS products.

First, as described in Section I of these comments, manufacturers globally have successfully adopted low-GWP substitutes for use with XPS product formulations. A review of the associated product marketing literature demonstrates that manufacturers have been successful in producing products with a minimum R-value of 5.0 per inch. This fact contradicts the statement included in Proposed Rule 23 that low-GWP substitutes "have not been proven to meet density and testing requirements of building codes and standards, such as for thermal efficiency, compressive strength, and flame and smoke generation, necessary for XPS products" (emphasis added).

Second, polystyrene insulation manufacturers have commercialized graphite-infused technology to increase the R-value of products. As a result, technologies are available to manufacturers who desire to maintain, or even increase, the R-value of products in combination with a transition to low-GWP blowing agents.

Third, a minimum R-value of 5.0 per inch is not a requirement for insulation products to be competitive in the United States market. Several insulation products like expanded polystyrene and mineral wool are manufactured with lower R-values per inch as compared to the marketed R-value of XPS products. These products compete regularly with XPS products and are used in many of the same construction applications. Furthermore, the building codes adopted and enforced in the United States do not require insulation products to maintain a minimum R-value of 5.0 per inch. Therefore, EPA should not regard the potential for a change in a product's R-value as a determinative factor when evaluating the effectiveness of low-GWP substitutes.

III. The XPS manufacturer's claim that low-GWP substitutes limit its ability to maintain other desired physical characteristics for its products is contradicted by the published data for other commercialized low-GWP XPS products.

The building codes adopted by jurisdictions in the United States establish minimum performance requirements for building products like insulation. While the applicable test standards and pass/fail criteria can be unique to the domestic market, global manufacturers of

[6] "Kingspan reimagines XPS with Kingspan GreenGuard" (January 28, 2019). Available at: https://www.kingspan.com/gb/en-gb/products/insulation/kingspan-insight/articles-and-advice/kingspan-reimagines-xps-with-kingspan-greenguard. Examples of the published marketing brochures for the company's low-GWP XPS products are attached.

insulation products also must comply with minimum performance requirements. In many instances, these requirements are comparable if not identical to those in the United States. Therefore, the global presence of XPS products with low-GWP formulations, as described above, undermines the assertions of manufacturing impossibility within the United States as outlined in Proposed Rule 23.

Proposed Rule 23 asserts that low-GWP substitutes do not permit the XPS product manufacturer in the United States to maintain desired physical characteristics for properties like density and fire performance. However, the Canadian and European markets also impose minimum density and fire performance requirements. With respect to Canada specifically, attempts are made to harmonize requirements with the United States so products manufactured in one country can be sold and used in the other country. Therefore, it stands to reason that low-GWP XPS products that are acceptable to the Canadian market would also be accepted in the United States. However, Proposed Rule 23 and the supporting docket fail to explain how the requirements applicable to XPS products manufactured in the United States present unique challenges to formulating with low-GWP substitutes. Furthermore, as it relates to fire, it is unclear how the introduction of low-GWP blowing agents like CO_2 can negatively impact a product's performance given these substances are non-flammable.

Unfortunately, the documentation provided to support the XPS manufacturer's claims regarding the non-functionality of low-GWP substitutes includes broad conclusions and ignores important details. For example, the claim that low-GWP formulations do not meet fire performance requirements lacks sufficient detail for a thorough understanding of the issue and leaves important questions unanswered. Specifically, which fire performance test is the low-GWP formulation unable to satisfy? How is this performance test related to the XPS manufacturer's ability to bring a product to market? How many applications or what percentage of the manufacturer's market is negatively impacted by this limitation? These questions are critical for assessing the manufacturer's assertions regarding low-GWP substitutes. This assessment is important because the cited fire performance test could be required for only niche applications of XPS products. Therefore, the majority of XPS products manufactured and sold for the domestic market could be unaffected by this single technical challenge, yet EPA's proposal would grant a pass for all products. Similar detail is required for the other physical characteristics (i.e., density) referenced in Proposed Rule 23 because not all test requirements or performance criteria are required minimums for each (or the majority of) intended applications of XPS products.

IV. The polyisocyanurate industry was subjected to a much higher bar for converting to more environmentally-friendly blowing agent substitutes as compared to the threshold for the XPS manufacturer as outlined in Proposed Rule 23.

For more than twenty years, the polyisocyanurate industry has been a leader in the manufacture of insulation with low-GWP, non-ozone depleting blowing agent substitutes. However, the regulatory world did not wait for a drop-in substitute to be developed before

requiring our industry to adopt next generation technology. In order to facilitate the transition to the substances used today, the polyisocyanurate industry made significant investments in research and development (including partnerships with industry stakeholders and Oak Ridge National Laboratory) as well as capital investments to retrofit existing manufacturing facilities to facilitate the safe-use of new substitutes. Polyisocyanurate manufacturers were also forced to overcome and formulate around challenges that negatively impacted product performance.

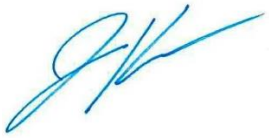
While the circumstances around the phase-out of ozone depleting substances were different than those surrounding current efforts to reduce the use of high-GWP substances like HFC-134a, Proposed Rule 23 applies a much lower threshold for evaluating the suitability of low-GWP alternatives for XPS products compared to the high bar set for the polyisocyanurate industry. Furthermore, other industries will be impacted by EPA's decision to finalize Rule 23 as proposed because XPS products compete in the marketplace with a wide-variety of insulation alternatives. Some of these alternatives are currently undergoing the transition to low-GWP alternatives as well (e.g., spray polyurethane foam). EPA's decision to grant authority to the XPS manufacturer for the continued use of HFC-134a blends could create unfair advantages; an outcome that should be avoided given the proven viability of low-GWP alternatives for XPS products.

V. Conclusion

In light of the SNAP Program's history of protecting the environment together with the examples highlighted above that demonstrate the viability of low-GWP substances at commercial scale for XPS products, PIMA strongly urges EPA to reconsider its proposed listing of the three blends of HFC-134a as acceptable for XPS products.

PIMA appreciates the opportunity to submit these public comments regarding Proposed Rule 23. Please contact me (jkoscher@pima.org; (703) 224-2289) should additional information be helpful to the regulatory process.

Sincerely,



Justin Koscher
President

Enclosures (4)

OWENS CORNING WORLD HEADQUARTERS
ONE OWENS CORNING PARKWAY
TOLEDO, OHIO 43659
419.248.8000

July 6, 2020

Dear Owens Corning® FOAMULAR® Customer,

We are excited to **introduce Foamular® NGX** (Next Generation Extruded), our new extruded polystyrene (XPS) product line produced with a foam blowing agent solution specifically designed to meet and exceed the requirements of upcoming regulatory changes in Canada.

Foamular® NGX will be available January 1, 2021 to ensure our customers' ability to comply with the regulated timing requirements that take effect on that date.

The new product line will retain the signature Owens Corning® Pink® color, while including visible differentiation from our current line to help customers easily distinguish between the two. These products deliver **the same great quality, performance and variety** you expect from the Foamular® brand. Foamular® NGX will deliver best-in-class performance, including:

- Excellent energy efficiency in the form of a high R-5 per inch
- Extremely low water absorption potential, delivering superior R-value retention in the presence of water
- A wide range of compressive strengths – up to 100 psi – to handle heavy loads
- The only XPS with a limited lifetime warranty that guarantees a minimum 90% of R-value for the life of the product
- Zero ozone depletion potential
- Updated CCMC listings to ensure all necessary compliance

In addition, Foamular® NGX will be produced with a **formulation specifically designed to meet and exceed the stricter regulatory standards** going into effect January 1, 2021, throughout Canada. This is yet another step forward in Owens Corning's market-leading commitment to sustainability.

Customers will receive the same best-in-class service and support with Foamular® NGX. All Owens Corning Foamular® plants serving the Canadian market will be equipped to produce the new product well ahead of the regulatory enactment dates, ensuring **the product you need will be available when you need it**.

Thank you for continuing to be a valued Owens Corning customer. We look forward to our ongoing partnership and mutual growth with Foamular® NGX.

Please reach out to your local Area Sales Manager with any questions. We will send further details on the product launch – with a preview of the new look – soon.

Sincerely,

Jose Manuel Canovas
General Manager North America
XPS Foam (Foamular®)

NOTE: These enhancements and new name will affect the following products:

OLD Name	NEW Name
FOAMULAR® Half Inch	FOAMULAR® NGX Half Inch
FOAMULAR® C-200	FOAMULAR® NGX C-200
FOAMULAR® CodeBord 200®	FOAMULAR® NGX CodeBord® 200
FOAMULAR® C-300	FOAMULAR® NGX C-300
FOAMULAR® 350	FOAMULAR® NGX 350
FOAMULAR® 400	FOAMULAR® NGX 400
FOAMULAR® 600	FOAMULAR® NGX 600
FOAMULAR® 1000	FOAMULAR® NGX 1000
FOAMULAR® Cel-Lok®200	FOAMULAR® NGX Cel-Lok® 200

June 18, 2020

Subject: Changes to SOPRA-XPS

Dear Partner,

In January 2021, a new Environment Canada regulation governing the use of halocarbons with a global warming potential of more than 150 will be implemented in Canada. Therefore, all insulation materials made of extruded polystyrene (XPS) made in Canada will no longer contain the HFC-134a blowing agent.

SOPREMA will abide by this new regulation for its SOPRA-XPS panels and will offer a product that complies with the new standard by the end of 2020.

In order to prepare for the new regulation, we have already started to optimize the product recipe. **The only visible change will be its colour, which will go from orange to grey** at the end of **June 2020**. You may therefore receive grey panels rather than orange ones in your next order, but be assured that it is the same quality product.

Indeed, although SOPRA-XPS will be grey at the end of June 2020, and manufactured without HFC-134a at the end of the year 2020, all of its properties—including its R-value of 5 per inch, low water absorption, and high compression resistance—will remain the same. Product names and codes, our broad product line, and our current certifications and approvals will also remain unaffected.

Further communications regarding SOPRA-XPS will be sent to you in the fall. If you have any questions or concerns, please contact customer service.

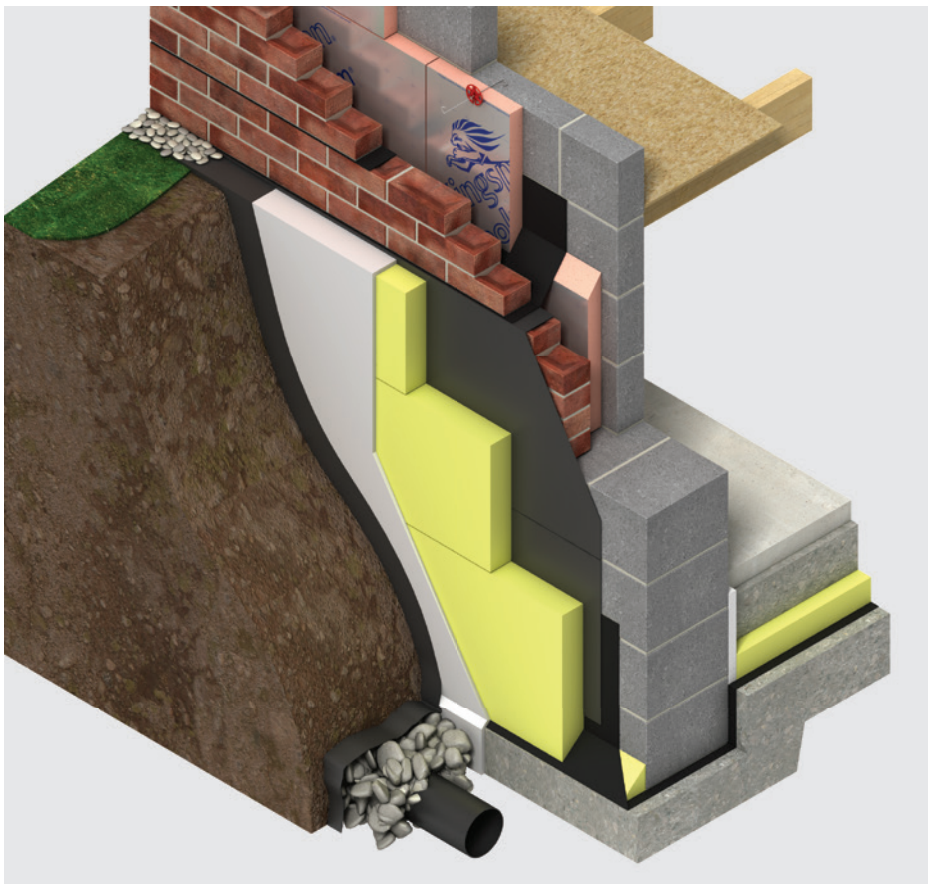
Regards,

Daniel Nadeau, National Vice-President of Sales
SOPREMA Canada

Insulation

Kingspan GreenGuard® Basements

Insulation for Basements



- High performance rigid extruded polystyrene insulation - thermal conductivities as low as 0.034 W/mK
- High compressive stress
- Resistant to ground moisture penetration
- Unaffected by air infiltration
- Easy to handle and install
- Ideal for new build and refurbishment
- Non-deleterious material
- Manufactured with a blowing agent that has zero ODP and low GWP

Fibre-free Core

Kingspan®

Typical Constructions and U-values

Assumptions

The U-values in the tables that follow have been calculated, under a management system certified to the BBA Scheme for Assessing the Competency of Persons to Undertake U-value and Condensation Risk Calculations, using the method detailed in BS EN ISO 13370: 2017 / I.S. EN ISO 13370: 2007 (Thermal performance of buildings. Heat transfer via the ground. Calculation methods), and using the conventions set out in BR 443 (Conventions for U-value calculations). They are valid for the constructions shown in the details immediately above each table. These examples assume that the basement walls are 300 mm thick and the height of the basement walls are 2.5 m.

BBA CERTIFICATE CS/1004-4 U Value Competency Scheme

Unlike roofs, walls and intermediate floors, U-value calculations for basement floors cannot be calculated with reference to the construction detail alone. Heat loss from basement floors depends upon the ratio of exposed floor perimeter to the total floor area, the thickness of the basement wall and depth of the basement.

Floor dimensions should be measured between the finished internal surfaces of the external walls. Non-usable heated space such as ducts and stairwells should be included when determining the area of the floor. Unheated spaces outside of the insulated fabric, such as attached garages or porches, should be excluded when determining the area of the floor, but the length of the wall between the heated building and the unheated space should be included when determining the perimeter. The floor dimensions of semi-detached, terraced or other joined premises / dwellings can be taken either as those of the premises / dwelling itself or those of the whole building. Where extensions to existing buildings are under consideration, the floor dimensions should be taken as those of the extension.

If the P/A ratio lies between two of the numbers shown in the tables to follow, for a safe estimate, please use the P/A ratio shown that is the next highest i.e. for 0.57 use 0.6.

NB The figures quoted are for guidance only. A detailed U-value calculation should be completed for each project.

NB For the purposes of these calculations, using the method as detailed in BS EN ISO 13370: 2017 / I.S. EN ISO 13370: 2007, the soil has been assumed to be sand or gravel, the wall insulation is assumed to overlap the floor insulation by minimum 150 / 225* mm, and the standard of workmanship has been assumed good, and therefore the correction factor for air gaps has been ignored.

NB If your construction is different from those specified, and / or to gain a comprehensive U-value calculation for your project, please consult the Kingspan Insulation Technical Service Department for assistance (see rear cover).

* 150 mm applies to the UK and 225 mm to the Republic of Ireland.

U-value Table Key

Where an ✗ is shown, the U-value is higher than the worst of the maximum new build area weighted average U-values allowed by the:

- 2013 editions of Approved Documents L to the Building Regulations for England;
- 2014 editions of Approved Documents L to the Building Regulations for Wales;
- 2015 editions of Technical Handbooks Section 6 to the Building Standards for Scotland;
- 2012 editions of Technical Booklets F1 & F2 to the Building Regulations for Northern Ireland; and
- 2011 edition of Technical Guidance Document L (Dwellings) and 2008 edition of Technical Guidance Document L (Buildings other than Dwellings) to the Building Regulations for the Republic of Ireland.

Typical Constructions and U-values

Basement Floors

Basement Insulated with Kingspan GreenGuard® GG300

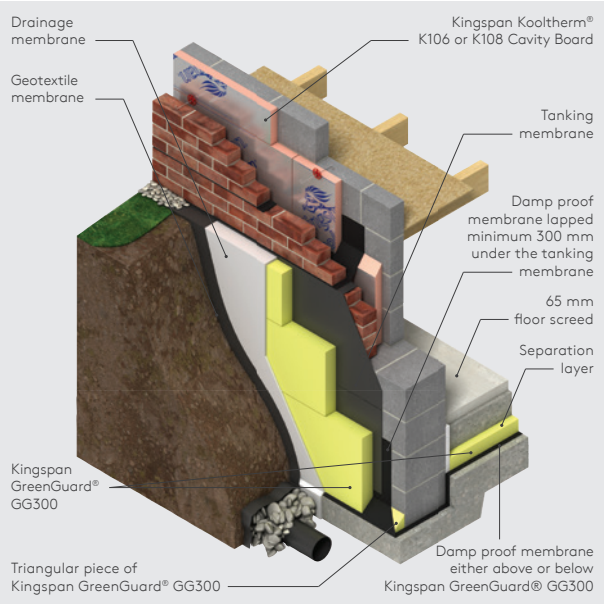


Figure 1

U-values (W/m²K) for Various Thicknesses of Kingspan GreenGuard® GG300* and Floor Perimeter / Area Ratios						
Insulant Thickness (mm)	Perimeter / Area (m^{-1})					
	0.3	0.4	0.5	0.6	0.7	0.8
40	✗	✗	✗	✗	✗	✗
50	0.25	✗	✗	✗	✗	✗
60	0.23	0.25	✗	✗	✗	✗
70	0.21	0.23	0.24	0.25	✗	✗
80	0.20	0.22	0.23	0.24	0.24	0.25
90 (40 + 50)	0.19	0.20	0.21	0.22	0.23	0.23
100	0.18	0.19	0.20	0.21	0.21	0.21
110 (50+60)	0.17	0.18	0.19	0.19	0.20	0.20
120	0.16	0.17	0.18	0.18	0.19	0.19
130 (80 + 50)	0.15	0.16	0.17	0.17	0.18	0.18
140	0.15	0.16	0.16	0.17	0.17	0.17
150	0.15	0.15	0.15	0.16	0.16	0.16
160 (80 + 80)	0.14	0.14	0.15	0.15	0.15	0.16
170 (120 + 50)	0.13	0.14	0.14	0.14	0.15	0.15
180 (100 + 80)	0.13	0.13	0.14	0.14	0.14	0.14
190 (150 + 40)	0.12	0.13	0.13	0.13	0.14	0.14
200 (100 + 100)	0.12	0.12	0.13	0.13	0.13	0.13
210 (150 + 60)	0.11	0.12	0.12	0.12	0.13	0.13
220 (120 + 100)	0.11	0.12	0.12	0.12	0.12	0.12
230 (150 + 80)	0.11	0.11	0.11	0.12	0.12	0.12
240 (120 + 120)	0.10	0.11	0.11	0.11	0.11	0.11
250 (150 + 100)	0.10	0.10	0.11	0.11	0.11	0.11
260 (140 + 120)	0.10	0.10	0.10	0.10	0.11	0.11
270 (150 + 120)	0.09	0.10	0.10	0.10	0.10	0.11
280 (140 + 140)	0.09	0.10	0.10	0.10	0.10	0.10
290 (150 + 140)	0.09	0.09	0.09	0.10	0.10	0.10
300 (150 + 150)	0.09	0.09	0.09	0.09	0.09	0.09
320 (100 + 100 + 120)	0.08	0.09	0.09	0.09	0.09	0.09
340 (100 + 120 + 120)	0.08	0.08	0.08	0.08	0.08	0.09
360 (120 + 120 + 120)	0.08	0.08	0.08	0.08	0.08	0.08

* The above table contains figures for Kingspan GreenGuard® GG300 only. Please consult the Kingspan Insulation Technical Service Department (see rear cover) for calculations for other products in the range.

NB Where multiple layers of insulation of different thicknesses are used, the thickest layer should be installed as the outermost layer in the construction.

NB Refer to local distributor or Kingspan Insulation price list for current stock and non-stock sizes.

Basement Walls

Calculations for basement walls are based on the height of the basement, the P/A ratio of the basement floor and the thermal performance of the basement floor. Once all three variables have been obtained, please contact the Kingspan Insulation Technical Service Department (see rear cover) for the U-values to be calculated.

Design Considerations

Heat Loss and Linear Thermal Bridging

Basic Principles

Linear thermal bridging describes the heat loss or gain that occurs at junctions between elements e.g. where a basement wall meets the floor, or at junctions around openings in the building fabric where the thermal insulation layer is discontinuous e.g. sills, jambs and lintels.

Interruptions within the insulation layer by materials with poorer insulating properties can result in a thermal bridge, which in turn can lead to problems of condensation and mould growth, especially if there is a drop in surface temperature.

The heat flow at these junctions and opening locations, over and above that through the adjoining plane elements, is the linear thermal transmittance of the thermal bridge: measured in W/mK; referred to as a 'psi-value'; and expressed as a 'ψ-value'.

The lower the ψ-value, the better the performance. ψ-values are taken into account in the calculation methodologies e.g. the Standard Assessment Procedure (SAP) that are used to assess the operational CO_2 emissions and, where applicable, the fabric energy efficiency of buildings.

ψ-values can comprise either, or a combination of, approved, calculated or assumed values.

Approved details, such as the Accredited Construction Details (England & Wales / Scotland / Northern Ireland) and Acceptable Construction Details (Republic of Ireland), collectively referred to here as ACDs, can uplift performance to provide a clear starting point towards achieving compliance, but they are limited in scope and applicability. The greatest opportunity for mitigating the impact of linear thermal bridges can come from following accurately 'modelled' details that take into account the following design considerations.

Reducing Linear Thermal Bridging

Detailing at junctions to minimise the effects of thermal bridging and the associated risk of condensation or mould growth is important and there are some simple design considerations that can be adopted to help mitigate the risks and to reduce heat losses.

- Care is required to ensure continuation of insulation wherever possible between the basement wall and floor and also at the junction between the external wall, ground floor and basement wall for best thermal performance. Where this is not possible, the insulation should be overlapped and ideally, insulation material introduced between.
- The best approach to minimise cold bridging is to take insulation externally of the construction and junction and to overlap this such that the wall insulation extends past the level of the floor insulation.
- In order to minimise cold bridging at the edge of the floor, the distance between the top surface of the floor insulation or perimeter insulation upstand, and the bottom of the wall insulation must be a minimum of 150 / 225* mm. The further down the wall insulation extends past the floor insulation, the better the thermal performance of the junction between the wall and the floor.

* 150 mm applies to the UK and 225 mm to the Republic of Ireland.

- Perimeter upstand insulation can also help to reduce heat losses from the junction between the floor and walls. The upstand insulation further increases the distance that the heat has to travel in order to escape through the junction, which therefore helps to reduce heat loss. Omitting this, or using a poorer performing insulation, can increase these losses.
- Using better thermally performing blockwork for the basement and above ground wall constructions, particularly in adjacency to the junction with the floor, can assist with reducing heat losses from the junctions.
- An internal lining of insulation on the warm side of the construction can also help to reduce heat losses through the junction. The internal lining, such as Kingspan Kooltherm® K118, could be used over the whole wall area, or a thin insulation layer could be used behind the wall lining adjacent to the junction to help reduce losses. A combination of external and internal insulation layers can be particularly effective to reduce cold bridging.

For further advice on details to reduce linear thermal bridging please contact the Kingspan Insulation Technical Service Department (see rear cover for details).

Design Considerations

Responsible Sourcing

Kingspan GreenGuard® GG300 produced at Kingspan Insulation's Selby, North Yorkshire manufacturing facility is manufactured under a management system certified to BS EN ISO 14001: 2015.

NB The above information is correct at the time of writing. Please confirm at the point of need by contacting Kingspan Insulation's Technical Service Department (see rear cover), from which copies of Kingspan Insulation's certificates can be obtained.

Sustainability & Responsibility

Kingspan Insulation has a long-term commitment to sustainability and responsibility: as a manufacturer and supplier of insulation products; as an employer; as a substantial landholder; and as a key member of its neighbouring communities.

A report covering the sustainability and responsibility of Kingspan Insulation Ltd's British operations at its Pembridge, Herefordshire and Selby, North Yorkshire manufacturing facilities is available at **www.kingspaninsulation.co.uk/sustainabilityandresponsibility**.

Specification Clause

Kingspan GreenGuard® should be described in specification as:–

The basement wall / floor insulation shall be Kingspan GreenGuard® GG300 / GG500 / GG700 (delete as appropriate) _____ mm thick: comprising high performance rigid extruded polystyrene insulation. The product shall be manufactured, with a blowing agent that has zero Ozone Depletion Potential (ODP) and low Global Warming Potential (GWP); under a management system certified to ISO 9001: 2015; and installed in accordance with the instructions issued by Kingspan Insulation Limited.

NBS Specifications

Details also available in NBS Plus.
NBS users should refer to clause(s):
J30 330 (Standard and Intermediate)
J40 380 (Minor Works)

Product Selection

The high compressive stress of Kingspan GreenGuard® makes it particularly suitable for use where floor loads are to be severe.

Consideration must be given to which Kingspan GreenGuard® product is most appropriate for the required application. A table of the key distinguishing features is shown below.

Product	Thermal Conductivity (W/mK)	Density (kg/m^3)	Compressive Stress (kPa)
Kingspan GreenGuard® GG300	0.034 W/mK (30 - 150 mm) 0.036 W/mK (> 150 mm)	30	300
Kingspan GreenGuard® GG500	0.034 W/mK (40 - 60 mm) 0.036 W/mK (> 60 mm)	35	500
Kingspan GreenGuard® GG700	0.034 W/mK (40 - 60 mm) 0.036 W/mK (> 60 mm)	45	700

Design Standards

Consideration should be given to the recommendations of BS 8102: 2009 (Code of practice for protection of structures against water from the ground), BS 8215: 1991 (Code of practice for design and installation of damp proof courses in masonry construction) and the information given in Building Research Establishment Digest 104 (Floor Screeds).

Waterproofing

BS 8102: 2009 (Code of practice for protection of structures against water from the ground) provides guidance on protection of basements against ground water. The level of protection needed by a new basement in housing, offices, restaurants, leisure centres etc. is Grade 3 (refer to BS 8102 for a full list). Grade 3 protection consists of one of the following waterproofing options.

Tanking System - A continuous waterproofing membrane surrounding the exterior of the basement structure, preventing ground water from penetrating the basement construction. Available in mastic asphalt tanking, cementitious renders, self-adhesive membranes and liquid applied membranes (see Figure 1).

Waterproofed Concrete - A continuous waterproofed concrete, mixed in accordance with BS EN 1992-3: 2006 (Eurocode 2. Design of concrete structures. Liquid retaining and containing structures). The waterproofed concrete is used as the exterior of the construction to prevent water penetration.

Drained Cavity & DPM - An effective drainage system where moisture that seeps through a monolithic wall, into the cavity is collected and channelled away under the floor. Using a DPM in conjunction with the drained cavity prevents any water penetrating the structure.

Sitework

General

- Kingspan Insulation recommends that suitable professional advice is sought when designing basements.

Drainage

- Water collecting at the base of Kingspan GreenGuard® must be drained away by filter drains located around the perimeter of the basement.
- To construct a filter drain, a perforated / porous drainage pipe should be positioned 200 mm below the floor level of the basement and should be surrounded by a free draining aggregate e.g. course gravel.
- A geotextile membrane must be placed around the gravel to prevent fines blocking the drain.
- Depending upon ground conditions, drains may be connected to surface drainage systems or soakaways.

Basement Floors

Installation Below a Floor Slab

- The site should be prepared and foundations, where appropriate, built to damp proof course (DPC) level.
- A thin sand blinding may be used to achieve a continuous level surface free from projections over rolled hardcore.
- The damp proof membrane (minimum 300 micron / 1200 gauge polythene) can be laid with joints well lapped and folded, to prevent the passage of ground water, either directly over the well compacted hardcore prior to laying the insulation boards, or over the insulation boards.
- The membrane should be laid under the basement wall, and under the triangular shaped piece of insulation placed between the concrete slab and the exterior of the basement wall, and lapped by 300 mm under the basement wall tanking membrane.
- Insulation boards should always be loose-laid break-bonded, with the joints lightly butted.
- If two layers of insulation are required, they should be horizontally offset relative to each other so that, as far as possible, the board joints in the two adjacent layers do not coincide with each other (see Figure 2).

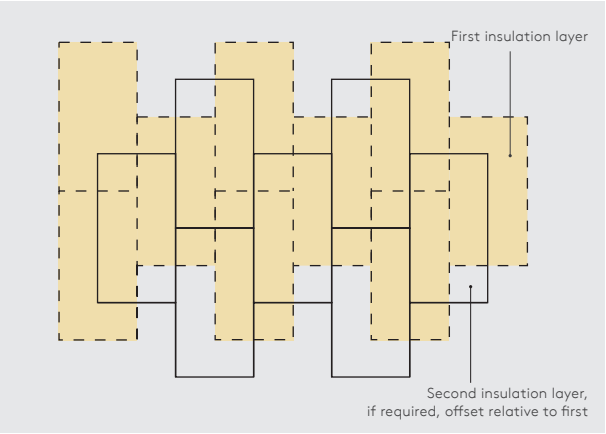


Figure 2 - Offsetting of Multiple Insulation Layers

- A strip of rigid insulation board (minimum 20 mm thick) should be placed vertically around the perimeter of the floor slab in order to prevent cold bridging. The top of the strip of insulation board should be level with the top of the floor screed and the bottom should be level with the bottom of the horizontal floor insulation, and closely butted up to it.
- If the damp proof membrane is laid directly onto the hardcore below the insulation boards, the boards should be overlaid with a polythene sheet (not less than 125 micron / 500 gauge), to prevent the wet concrete penetrating the joints between the boards, and to act as a vapour control layer. Ensure the polythene sheet has 150 mm overlaps and is taped at the joints.
- The subsequent installation of the concrete slab and screed or other flooring material is carried out in a manner similar to that for an un-insulated floor.
- The concrete slab and screed should be allowed to dry out prior to the installation of the floor finish.

Installation Below a Floor Screed

- Concrete slabs should be allowed to dry out fully prior to the installation of the insulation boards (average 1 day per mm of slab thickness).
- The surface of the slab should be smooth, flat and free from projections. Rough cast slabs should be levelled using a thin sand blinding to ensure boards are continuously supported.
- The damp proof membrane (minimum 300 micron / 1200 gauge polythene) should be laid with joints well lapped and folded, to prevent the passage of ground water, either directly over the floor slab prior to laying the insulation boards, or over the insulation boards.
- The membrane should be laid under the basement wall, and over the triangular shaped piece of insulation placed between the concrete slab and the exterior of the basement wall, and lapped by 300 mm under the basement wall tanking membrane.

Sitework

- Insulation boards should always be loose-laid break-bonded, with the joints lightly butted.
- If two layers of insulation are required, they should be horizontally offset relative to each other so that, as far as possible, the board joints in the two adjacent layers do not coincide with each other (see Figure 2).
- A strip of rigid insulation board (minimum 20 mm thick) should be placed vertically around the perimeter of the floor slab in order to prevent cold bridging. The top of the strip of insulation board should be level with the top of the floor screed and the bottom should be level with the bottom of the horizontal floor insulation, and closely butted up to it.
- Insulation boards should be overlaid with a polythene sheet (not less than 125 micron / 500 gauge), to prevent the wet screed penetrating the joints between the boards, and to act as a vapour control layer. Ensure the polythene sheet has 150 mm overlaps and is taped at the joints.
- Use sand and cement screed laid to a minimum thickness of 65 mm for domestic construction and 75 mm elsewhere.

Basement Walls

- A triangular shaped piece of Kingspan GreenGuard® should be placed between the concrete slab and the exterior of the basement wall to create a slope (see Figure 1) and a platform for the basement wall insulation.
- The damp proof membrane should be laid under the basement wall and the triangular shaped piece of insulation, and connect with the basement wall tanking membrane in accordance with the tanking membrane manufacturer's recommendations.
- A tanking membrane is applied to the external face of the basement wall, to prevent water entering the basement structure.
- The insulation board should be installed outside of the tanking membrane.
- A cavity drainage membrane or layer of washed no fines gravel should be installed outside of the insulation boards.
- This relieves hydrostatic pressure and channels water to the foundation drain.
- The membrane or gravel should be covered with a geotextile layer to prevent fines from blocking the drainage material.
- The ground around the structure must slope away from the basement wall to ensure rainwater drains away from the building.

Waterstops

- When using reinforced concrete as the main structure of the basement, waterstops must be installed at the junctions where day joints have been made in the structure to prevent water leakage.

Refer to:

Movement Joints (UK) Ltd **www.mjuk.co.uk**	+44 (0) 1354 60 79 60
Fosroc Ltd **www.fosroc.com**	+44 (0) 1827 262 222
Beton Construction Materials Ltd **www.betonconmat.co.uk**	+44 (0) 1256 353 146

Wheeled / Foot Traffic

- Ensure boards are protected during installation from wheeled / foot traffic by using scaffold planks or other protective measures.

General

Cutting

- Cutting should be carried out either by using a fine toothed saw, a hot wire system or by scoring with a sharp knife and snapping the board over a straight edge.
- Ensure accurate trimming to achieve close-butting joints and continuity of insulation.

Availability

- Kingspan GreenGuard® is available through specialist insulation distributors and selected builders' merchants throughout the UK, and Ireland.

Packaging and Storage

- Kingspan GreenGuard® may be delivered in packaging bearing alternative product branding.
- The polyethylene packaging of Kingspan Insulation products, which is recyclable, should not be considered adequate for outside protection.
- Ideally, boards should be stored inside a well ventilated building. If, however, outside storage cannot be avoided, then the boards should be stacked clear of the ground and covered with a pale pigmented polythene sheet or weatherproof tarpaulin.
- Kingspan GreenGuard® should not be left in the sun covered by either a transparent or a dark plastic sheet, since in both cases, board temperatures can build up to a level hot enough to appreciably alter board dimensions or cause warping.

Health and Safety

- Kingspan Insulation products are chemically inert and safe to use.
- A Safety Information Data Sheet for this product is available from the Kingspan Insulation website **www.kingspaninsulation.co.uk/safety** or **www.kingspaninsulation.ie/safety**.

Warning - do not stand on or otherwise support your weight on this product unless it is fully supported by a load-bearing surface.

Product Details

Composition

Kingspan GreenGuard® GG300, GG500 and GG700 are high performance rigid extruded polystyrene insulants with a fibre-free core. They are manufactured with a blowing agent that has zero Ozone Depletion Potential (ODP) and low Global Warming Potential (GWP) and has a smooth, dense skin on both faces.

Standards and Approvals

Kingspan GreenGuard® GG300 produced at Kingspan Insulation's Selby, North Yorkshire manufacturing facility is manufactured to the highest standards under a management system certified to ISO 9001: 2015 (Quality management systems. Requirements), ISO 14001: 2015 (Environmental Management Systems. Requirements), BS / I.S OHSAS 18001: 2007 (Health and Safety Management Systems. Requirements) and ISO 50001: 2011 (Energy management systems. Requirements).

NB The above information is correct at the time of writing. Please confirm at the point of need by contacting Kingspan Insulation's Technical Service Department (see rear cover), from which copies of Kingspan Insulation's certificates can be obtained.

Standard Dimensions

All products in the Kingspan GreenGuard® range are available in the following standard size:

Nominal Dimension		Availability
Length	(m)	2.50
Width	(m)	0.6
Insulant Thickness	(mm)	Refer to local distributor or Kingspan Insulation price list for current stock and non-stock sizes.
Edge Profile		Straight

Compressive Stress

The compressive stress of Kingspan GreenGuard® is as follows:

Kingspan GreenGuard® GG300 – 300 kPa;

Kingspan GreenGuard® GG500 – 500 kPa; and

Kingspan GreenGuard® GG700 – 700 kPa,

when tested to EN 826: 2013 (Thermal insulating products for building applications. Determination of compression behaviour).

Water Vapour Resistivity

The products typically achieve a resistivity greater than 400 MNs/gm, when tested in accordance with BS EN 12086: 2013 (Thermal insulating products for building applications. Determination of water vapour transmission properties).

Absorption of Moisture

Kingspan GreenGuard® is highly resistant to water absorption and the effects of freeze-thaw cycling.

Durability

If correctly installed, Kingspan GreenGuard® can have an indefinite life. Its durability depends on the supporting structure and the conditions of its use.

Resistance to Solvents, Fungi & Rodents

Kingspan GreenGuard® is resistant to most commonly occurring construction materials such as lime, cement, plaster, anhydrous gypsum, solvent-free bituminous compounds, water-based wood preservatives, as well as alcohols, acids and alkalis. Certain organic materials such as solvent-based wood preservatives, coal tar and derivatives (creosote), paint thinners and common solvents (e.g. acetone, ethyl acetate, petrol, toluene and white spirit), will attack Kingspan GreenGuard®, resulting in softening, shrinkage and possible dissolution, with a consequent loss of performance.

Kingspan GreenGuard® does not provide any food value to vermin and is not normally attractive to them.

Fire Performance

Kingspan GreenGuard® achieves European Classification (Euroclass) E when classified to EN 13501-1:2018 (Fire classification of construction products and building elements. Classification using data from reaction to fire tests).

Further details on the fire performance of Kingspan Insulation products may be obtained from the Kingspan Insulation Technical Service Department (see rear cover).

Maximum Service Temperature

Kingspan GreenGuard® should not be brought into direct contact with high temperature heat sources. The maximum service temperature of Kingspan GreenGuard® is 75°C.

Product Details

Thermal Properties

The λu-values and R-values detailed below are quoted in accordance with BS / I.S. EN 13164: 2012: + A1: 2015 (Thermal insulation products for buildings. Factory made extruded polystyrene foam (XPS) products. Specification).

Thermal Conductivity

The boards achieve a thermal conductivity (λu-value) of Kingspan GreenGuard® GG300 is:

0.034 W/mK (insulant thickness 30 - 150 mm); and

0.036 W/mK (insulant thickness > 150 mm).

Kingspan GreenGuard® GG500 is:

0.034 W/mK (insulant thickness 40 - 60 mm); and

0.036 W/mK (insulant thickness > 60 mm).

Kingspan GreenGuard® GG700 is:

0.034 W/mK (Insulant thickness 40 - 60 mm); and

0.036 W/mK (insulant thickness > 60 mm).

Thermal Resistance

Thermal resistance (R-value) varies with thickness and is calculated by dividing the thickness of the board (expressed in metres) by its thermal conductivity. The resulting number is rounded down to the nearest 0.05 (m^2K/W).

Insulant Thickness (mm)	Thermal Resistance (m^2K/W)		
	GG300	GG500	GG700
30	0.85	-	-
40	1.15	1.15	1.15
50	1.45	1.45	1.45
60	1.75	1.75	1.75
70	2.05	1.90	1.90
80	2.35	2.20	2.20
100	2.90	2.75	2.75
120	3.50	3.30	3.30
140	4.10	3.85	3.85
150	4.40	-	-

NB Multiple layers of insulation are required for higher thermal resistances.

NB Refer to local distributor or Kingspan Insulation price list for current stock and non-stock sizes.

NB Where a hyphen is shown the thickness is not available.

Kingspan Insulation

Company Details

Kingspan Insulation Ltd is part of the Kingspan Group plc., one of Europe's leading construction product manufacturers. The Kingspan Group was formed in the late 1960s and is a publicly quoted group of companies headquartered in Kingscourt, County Cavan, Ireland.

Kingspan Insulation Ltd is a market leading manufacturer of premium and high performance rigid insulation products and insulated systems for building fabric and building services applications.

Products & Applications

Kingspan Insulation Ltd has a vast product range. Kingspan Insulation Ltd products are suitable for both new build and refurbishment in a variety of applications within both domestic and non-domestic buildings. The available insulation solutions are listed below.

- Pitched Roofs
- Flat Roofs
- Green Roofs
- Cavity Walls
- Solid Walls
- Timber and Steel Framing
- Insulated Cladding Systems
- Insulated Render Systems
- Floors
- Soffits
- Ductwork

Further Solutions:

- Insulated Dry-Lining
- Tapered Roofing Systems
- Cavity Closers
- The Kingspan KoolDuct® System
- Kingspan nilvent®
- Kingspan TEK® Building System

Insulation Product Benefits

Kingspan OPTIM-R® Vacuum Insulation Panel (VIP) Products

- With a declared value thermal conductivity of 0.007 W/mK, these products provide an insulating performance that is up to five times better than commonly used insulation materials.
- Provides high levels of thermal efficiency with minimal thickness.
- Over 90% (by weight) recyclable.

Kingspan Kooltherm® and Kooltherm® 100 Products

- With a thermal conductivity of 0.018–0.023 W/mK these are the most thermally efficient insulation products commonly used.
- The thinnest commonly used insulation products for any specific U-value.
- Manufactured with a blowing agent that has zero Ozone Depletion Potential (ODP) and low Global Warming Potential (GWP).

Kingspan QuadCore®

- With a thermal conductivity of 0.021 W/mK this is amongst one of the more thermally efficient insulation products commonly used.
- Offering excellent thermal and fire performance, enhanced environmental credentials and backed by an extended warranty.
- Manufactured with a blowing agent that has zero Ozone Depletion Potential (ODP) and low Global Warming Potential (GWP).

Kingspan Therma™ Products

- With a thermal conductivity of 0.022-0.028 W/mK these are amongst the more thermally efficient insulation products commonly used.
- Manufactured with a blowing agent that has zero Ozone Depletion Potential (ODP) and low Global Warming Potential (GWP).

Kingspan GreenGuard® Products

- Rigid extruded polystyrene insulation (XPS) has the necessary compressive stress to make it the product of choice for specialist applications such as heavy duty flooring, car park decks and inverted roofing.
- Manufactured with a blowing agent that has zero Ozone Depletion Potential (ODP) and low Global Warming Potential (GWP).

All Products

- Unaffected by air infiltration - a problem that can be experienced with mineral fibre and which can reduce thermal performance.
- Safe and easy to install.
- If installed correctly, can provide reliable long term thermal performance over the lifetime of the building.
- Each product achieves the required fire performance for its intended application.

Contact Details

UK

Kingspan Insulation Ltd
Pembridge | Leominster
Herefordshire | HR6 9LA

T: +44 (0) 1544 388 601
E: info@kingspaninsulation.co.uk
www.kingspaninsulation.co.uk

For individual department contact details please visit
www.kingspaninsulation.co.uk/contact

Ireland

Kingspan Insulation Ltd
Castleblayney | County Monaghan

T: +353 (0) 42 979 5000
E: info@kingspaninsulation.ie
www.kingspaninsulation.ie

For individual department contact details please visit
www.kingspaninsulation.ie/contact

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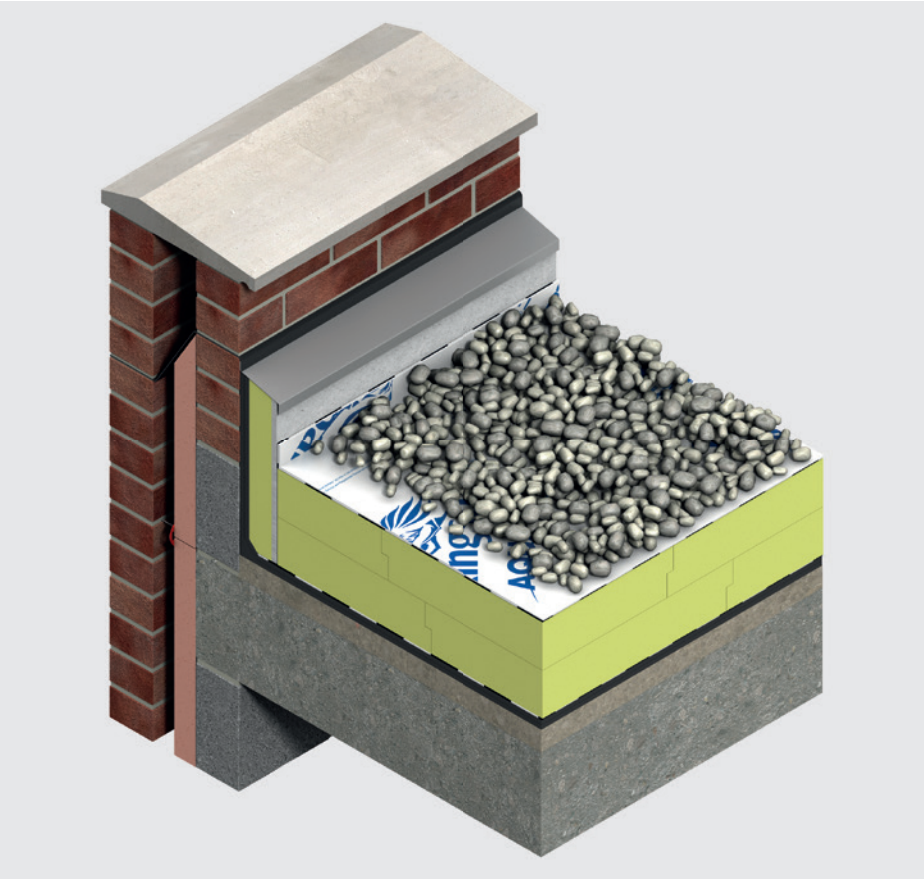
Insulation

Kingspan GreenGuard® Inverted Roofs

Insulation for Protected Membrane Flat Roofs and Green Roofs



- High performance rigid extruded polystyrene insulation - thermal conductivities as low as 0.034 W/mK
- Protects waterproofing membrane
- Minimal water absorption
- High compressive stress
- Withstands freeze / thaw cycling
- Compatible with green roof systems
- Resistant to the passage of water vapour
- Easy to handle and install
- Ideal for new build and refurbishment
- Non-deleterious material
- Manufactured with a blowing agent that has zero ODP and low GWP

Fibre-free Core

Kingspan®

Typical Constructions and U-values

Assumptions

The U-values in the tables that follow have been calculated, under a management system certified to the BBA Scheme for Assessing the Competency of Persons to Undertake U-value and Condensation Risk Calculations, using the method detailed in BS EN ISO 6946: 2017 / I.S. EN ISO 6946: 2007 (Building components and building elements. Thermal resistance and thermal transmittance. Calculation methods), and using the conventions set out in BR 443 (Conventions for U-value calculations). The method detailed in part F.4.2 of BS EN ISO 6946: 2017 and D.4.2 of I.S. EN ISO 6946: 2007 has been used to take account of the effect of the Kingspan AQUAZONE® (high performance, non-woven polyethylene membrane) over the insulation, and an (fx) factor of 0.0012 for a paving slab ballast application or 0.0010 for a green roof or gravel ballast application, has been assumed. They are valid for the constructions shown in the details immediately above each table.

BBA CERTIFICATE CS/1004-4 U Value Competency Scheme

They assume a nominal selection of post-codes, selected to represent the influence of geographical variations in rainfall on thermal performance.

The ceiling, where applicable, is taken to be a 3 mm skim coated 12.5 mm plasterboard with a cavity between it and the underside of the deck.

NB For the purposes of these calculations the standard of workmanship has been assumed good, and therefore the correction factor for air gaps has been ignored.

NB The figures quoted are for guidance only. A detailed U-value calculation together with condensation risk analysis should be completed for each project.

NB If your construction is different from those specified, and / or to gain a comprehensive U-value calculation along with a condensation risk analysis for your project, please consult the Kingspan Insulation Technical Service Department for assistance (see rear cover).

U-value Table Key

Where an ✗ is shown, the U-value is higher than the worst of the maximum new build area weighted average U-values allowed by the:

- 2013 editions of Approved Documents L to the Building Regulations for England;
- 2014 editions of Approved Documents L to the Building Regulations for Wales;
- 2015 editions of Technical Handbooks Section 6 to the Building Standards for Scotland;
- 2012 editions of Technical Booklets F1 & F2 to the Building Regulations for Northern Ireland; and
- 2011 edition of Technical Guidance Document L (Dwellings) and 2008 edition of Technical Guidance Document L (Buildings other than Dwellings) to the Building Regulations for the Republic of Ireland.

Concrete Deck with Paving Slab Ballast

Dense Concrete Deck with Suspended Ceiling

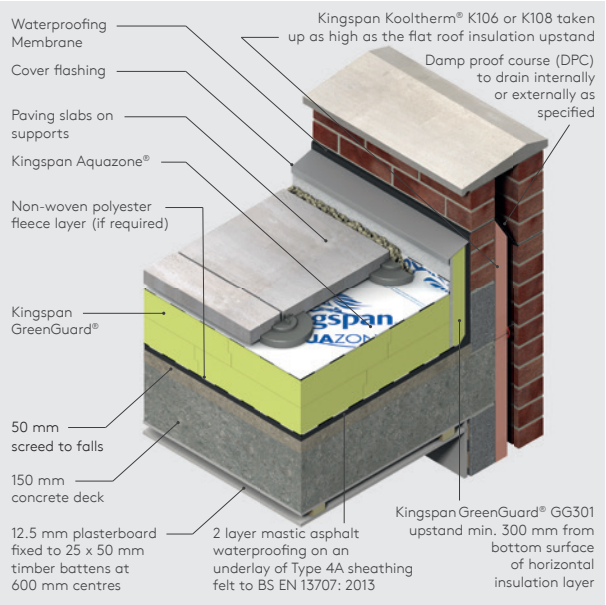


Figure 1

U-values (W/m²K) for a Nominal Selection of Post-Codes					
Insulant Thickness (mm)	Post-Code				
	London NW1	Birm'ham B1	Glasgow G1	Cardiff CF10	Ireland
Kingspan GreenGuard® GG300*					
120	✗	✗	✗	✗	✗
130 (80 + 50)	0.24	0.24	0.24	0.25	0.24
140	0.22	0.22	0.22	0.23	0.22
150	0.21	0.21	0.21	0.22	0.21
160 (80 + 80)	0.20	0.20	0.20	0.21	0.20
170 (120 + 50)	0.19	0.19	0.19	0.20	0.19
180 (100 + 80)	0.18	0.18	0.18	0.19	0.18
190 (150 + 40)	0.17	0.17	0.17	0.18	0.17
200 (100 + 100)	0.16	0.16	0.17	0.17	0.16
210 (150 + 60)	0.16	0.16	0.16	0.16	0.16
220 (120 + 100)	0.15	0.15	0.16	0.16	0.15
230 (150 + 80)	0.14	0.14	0.15	0.15	0.14
240 (120 + 120)	0.14	0.14	0.14	0.15	0.14
250 (150 + 100)	0.13	0.13	0.14	0.14	0.13
260 (140 + 120)	0.13	0.13	0.13	0.14	0.13
270 (150 + 120)	0.12	0.12	0.13	0.13	0.12
280 (140 + 140)	0.12	0.12	0.13	0.13	0.12
290 (150 + 140)	0.12	0.12	0.12	0.12	0.12
300 (150 + 150)	0.11	0.11	0.12	0.12	0.11
320 (100 + 100 + 120)	0.11	0.11	0.11	0.11	0.11
340 (100 + 120 + 120)	0.10	0.10	0.11	0.11	0.10
360 (120 + 120 + 120)	0.09	0.09	0.10	0.10	0.10

* The above table contains figures for Kingspan GreenGuard® GG300 only. Please consult the Kingspan Insulation Technical Service Department (see rear cover) for calculations for other products in the range.

NB Where there are multiple layers of insulation of different thicknesses the thickest insulation board is installed first.

NB Refer to local distributor or Kingspan Insulation price list for current stock and non-stock sizes.

Typical Constructions and U-values

Concrete Deck with Gravel Ballast

Dense Concrete Deck with Suspended Ceiling

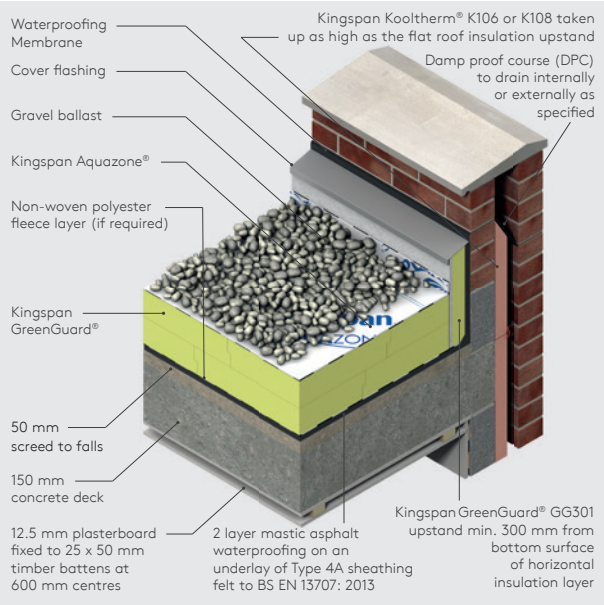


Figure 2

Dense Concrete Deck with no Ceiling

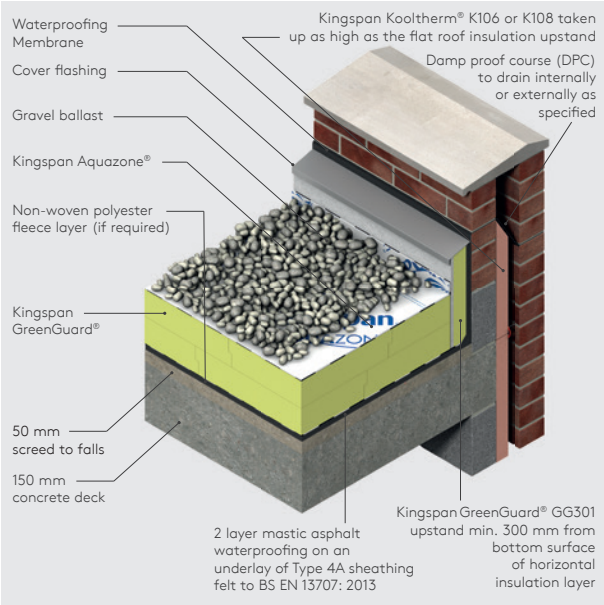


Figure 3

U-values (W/m²K) for a Nominal Selection of Post-Codes					
Insulant Thickness (mm)	Post-Code				
	London NW1	Birm'ham B1	Glasgow G1	Cardiff CF10	Ireland
Kingspan GreenGuard® GG300*					
120	✗	✗	✗	✗	✗
130 (80 + 50)	0.24	0.24	0.24	0.24	0.24
140	0.22	0.22	0.22	0.22	0.22
150	0.21	0.21	0.21	0.22	0.21
160 (80 + 80)	0.20	0.20	0.20	0.21	0.20
170 (120 + 50)	0.19	0.19	0.19	0.20	0.19
180 (100 + 80)	0.18	0.18	0.18	0.19	0.18
190 (150 + 40)	0.17	0.17	0.17	0.18	0.17
200 (100 + 100)	0.16	0.16	0.16	0.17	0.16
210 (150 + 60)	0.16	0.16	0.16	0.16	0.16
220 (120 + 100)	0.15	0.15	0.15	0.16	0.15
230 (150 + 80)	0.14	0.14	0.15	0.15	0.14
240 (120 + 120)	0.14	0.14	0.14	0.15	0.14
250 (150 + 100)	0.13	0.13	0.14	0.14	0.13
260 (140 + 120)	0.13	0.13	0.13	0.14	0.13
270 (150 + 120)	0.12	0.12	0.13	0.13	0.12
280 (140 + 140)	0.12	0.13	0.12	0.13	0.12
290 (150 + 140)	0.12	0.12	0.12	0.12	0.12
300 (150 + 150)	0.11	0.11	0.12	0.12	0.11
320 (100 + 100 + 120)	0.11	0.11	0.11	0.11	0.11
340 (100 + 120 + 120)	0.10	0.10	0.10	0.11	0.10
360 (120 + 120 + 120)	0.09	0.09	0.10	0.10	0.09

* The above table contains figures for Kingspan GreenGuard® GG300 only. Please consult the Kingspan Insulation Technical Service Department (see rear cover) for calculations for other products in the range.

NB Where there are multiple layers of insulation of different thicknesses the thickest insulation board is installed first.

NB Refer to local distributor or Kingspan Insulation price list for current stock and non-stock sizes.

U-values (W/m²K) for a Nominal Selection of Post-Codes					
Insulant Thickness (mm)	Post-Code				
	London NW1	Birm'ham B1	Glasgow G1	Cardiff CF10	Ireland
Kingspan GreenGuard® GG300*					
120	✗	✗	✗	✗	✗
130 (80 + 50)	0.25	0.25	0.25	0.25	0.25
140	0.24	0.24	0.24	0.23	0.24
150	0.22	0.22	0.22	0.23	0.22
160 (80 + 80)	0.21	0.21	0.21	0.22	0.21
170 (120 + 50)	0.20	0.20	0.20	0.21	0.20
180 (100 + 80)	0.19	0.19	0.19	0.20	0.19
190 (150 + 40)	0.18	0.18	0.18	0.19	0.18
200 (100 + 100)	0.17	0.17	0.17	0.18	0.17
210 (150 + 60)	0.16	0.16	0.16	0.17	0.16
220 (120 + 100)	0.16	0.16	0.16	0.16	0.16
230 (150 + 80)	0.15	0.15	0.15	0.16	0.15
240 (120 + 120)	0.14	0.14	0.15	0.15	0.14
250 (150 + 100)	0.14	0.14	0.14	0.15	0.14
260 (140 + 120)	0.13	0.14	0.14	0.14	0.13
270 (150 + 120)	0.13	0.13	0.13	0.14	0.13
280 (140 + 140)	0.12	0.12	0.13	0.13	0.12
290 (150 + 140)	0.12	0.12	0.12	0.13	0.12
300 (150 + 150)	0.12	0.12	0.12	0.12	0.12
320 (100 + 100 + 120)	0.11	0.11	0.11	0.12	0.11
340 (100 + 120 + 120)	0.11	0.10	0.11	0.11	0.10
360 (120 + 120 + 120)	0.10	0.10	0.10	0.10	0.10

* The above table contains figures for Kingspan GreenGuard® GG300 only. Please consult the Kingspan Insulation Technical Service Department (see rear cover) for calculations for other products in the range.

NB Where there are multiple layers of insulation of different thicknesses the thickest insulation board is installed first.

NB Refer to local distributor or Kingspan Insulation price list for current stock and non-stock sizes.

Typical Constructions and U-values

Green Roofs

Semi-intensive Green Roof Covering with no Ceiling

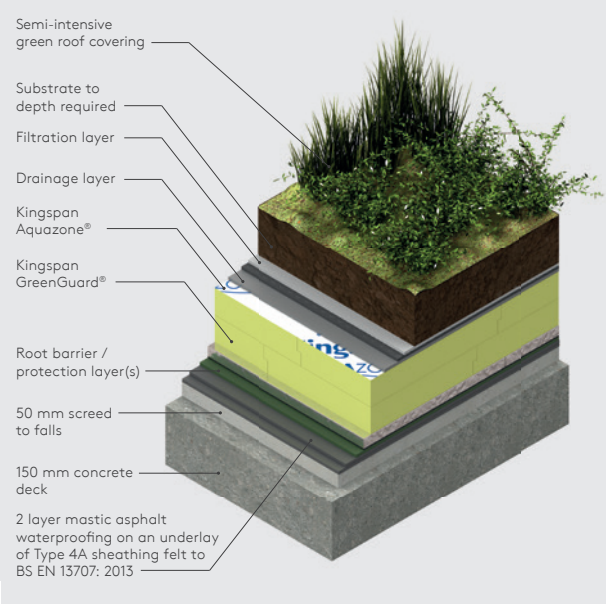


Figure 4

U-values (W/m²K) for a Nominal Selection of Post-Codes					
Insulant Thickness (mm)	Post-Code				
	London NW1	Birm'ham B1	Glasgow G1	Cardiff CF10	Ireland
Kingspan GreenGuard® GG300*					
120	✗	✗	✗	✗	✗
130 (80 + 50)	0.25	0.25	0.25	0.25	0.25
140	0.24	0.24	0.24	0.24	0.24
150	0.22	0.22	0.22	0.23	0.22
160 (80 + 80)	0.21	0.21	0.21	0.22	0.21
170 (120 + 50)	0.20	0.20	0.20	0.21	0.20
180 (100 + 80)	0.19	0.19	0.19	0.20	0.19
190 (150 + 40)	0.18	0.18	0.18	0.19	0.18
200 (100 + 100)	0.17	0.17	0.17	0.18	0.17
210 (150 + 60)	0.16	0.16	0.16	0.17	0.16
220 (120 + 100)	0.16	0.16	0.16	0.16	0.16
230 (150 + 80)	0.15	0.15	0.15	0.16	0.15
240 (120 + 120)	0.14	0.14	0.15	0.15	0.14
250 (150 + 100)	0.14	0.14	0.14	0.15	0.14
260 (140 + 120)	0.13	0.13	0.14	0.15	0.13
270 (150 + 120)	0.13	0.13	0.13	0.14	0.13
280 (140 + 140)	0.12	0.12	0.13	0.13	0.12
290 (150 + 140)	0.12	0.12	0.12	0.13	0.12
300 (150 + 150)	0.12	0.12	0.12	0.12	0.12
320 (100 + 100 + 120)	0.11	0.11	0.11	0.12	0.11
340 (100 + 120 + 120)	0.10	0.10	0.11	0.11	0.10
360 (120 + 120 + 120)	0.10	0.10	0.10	0.10	0.10

* The above table contains figures for Kingspan GreenGuard® GG300 only. Please consult the Kingspan Insulation Technical Service Department (see rear cover) for calculations for other products in the range.

NB Where there are multiple layers of insulation of different thicknesses the thickest insulation board is installed first.

NB Refer to local distributor or Kingspan Insulation price list for current stock and non-stock sizes.

Intensive Green Roof Covering with no Ceiling

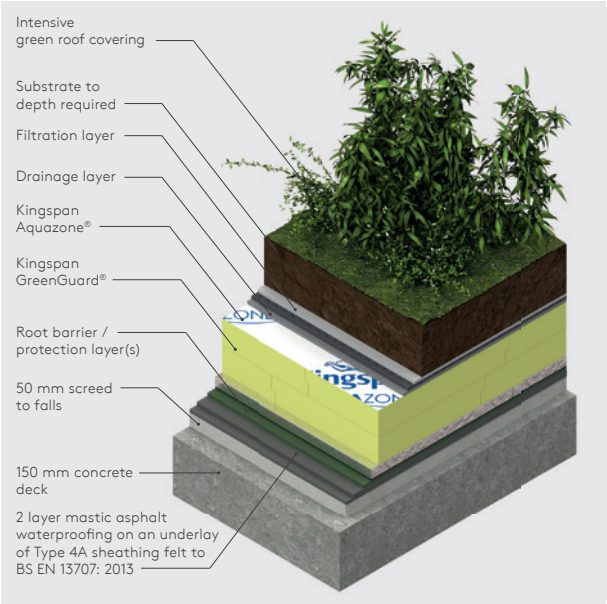


Figure 5

U-values (W/m²K) for a Nominal Selection of Post-Codes					
Insulant Thickness (mm)	Post-Code				
	London NW1	Birm'ham B1	Glasgow G1	Cardiff CF10	Ireland
Kingspan GreenGuard® GG300*					
120	✗	✗	✗	✗	✗
130 (80 + 50)	0.25	0.25	0.25	0.25	0.25
140	0.24	0.24	0.24	0.24	0.24
150	0.22	0.22	0.22	0.23	0.22
160 (80 + 80)	0.21	0.21	0.21	0.22	0.21
170 (120 + 50)	0.20	0.20	0.20	0.21	0.20
180 (100 + 80)	0.19	0.19	0.19	0.20	0.19
190 (150 + 40)	0.18	0.18	0.18	0.19	0.18
200 (100 + 100)	0.17	0.17	0.17	0.18	0.17
210 (150 + 60)	0.16	0.16	0.16	0.17	0.16
220 (120 + 100)	0.16	0.16	0.16	0.16	0.16
230 (150 + 80)	0.15	0.15	0.15	0.16	0.15
240 (120 + 120)	0.14	0.14	0.15	0.15	0.14
250 (150 + 100)	0.14	0.14	0.14	0.15	0.14
260 (140 + 120)	0.13	0.13	0.14	0.15	0.13
270 (150 + 120)	0.13	0.13	0.13	0.14	0.13
280 (140 + 140)	0.12	0.12	0.13	0.13	0.12
290 (150 + 140)	0.12	0.12	0.12	0.13	0.12
300 (150 + 150)	0.12	0.12	0.12	0.12	0.12
320 (100 + 100 + 120)	0.11	0.11	0.11	0.12	0.11
340 (100 + 120 + 120)	0.10	0.10	0.11	0.11	0.10
360 (120 + 120 + 120)	0.10	0.10	0.10	0.10	0.10

* The above table contains figures for Kingspan GreenGuard® GG300 only. Please consult the Kingspan Insulation Technical Service Department (see rear cover) for calculations for other products in the range.

NB Where there are multiple layers of insulation of different thicknesses the thickest insulation board is installed first.

NB Refer to local distributor or Kingspan Insulation price list for current stock and non-stock sizes.

Design Considerations

Linear Thermal Bridging

Basic Principles

Linear thermal bridging describes the heat loss / gain that occurs at junctions between elements e.g. where an external wall meets the roof, or at junctions around openings in the building fabric where the thermal insulation layer is discontinuous e.g. sills, jambs and lintels.

Interruptions within the insulation layer by materials with poorer insulating properties can result in a thermal bridge, which in turn can lead to problems of condensation and mould growth, especially if there is a drop in surface temperature.

The heat flow at these junctions and opening locations, over and above that through the adjoining plane elements, is the linear thermal transmittance of the thermal bridge: measured in W/mK; referred to as a 'psi-value'; and expressed as a 'ψ-value'.

The lower the ψ-value, the better the performance. ψ-values are taken into account in the calculation methodologies e.g. the Standard Assessment Procedure (SAP), that are used to assess the operational CO_2 emissions and, where applicable, the fabric energy efficiency of buildings.

ψ-values can comprise either, or a combination of, approved, calculated or assumed values.

Reducing Linear Thermal Bridging

Detailing at junctions to minimise the effects of thermal bridging and the associated risk of condensation or mould growth is important and there are some simple design considerations that can be adopted to help mitigate the risks and to reduce heat losses.

- Care is required to ensure continuation of insulation wherever possible between the wall and roof for best thermal performance. Where this is not possible, the roof and wall insulation should be overlapped and ideally, insulation material introduced between.
- Parapet detailing can represent a good, low heat loss approach, with insulation continuity maintained using an insulated upstand to reduce cold bridging. A Kingspan GreenGuard® GG301 upstand should be used around the perimeter of the roof on the internal façade of parapets. The upstand should extend a minimum of 150 mm above the roof insulation and achieve a minimum distance of 300 mm between the top of the insulation upstand and the bottom of the horizontal roof insulation. Wall insulation should be carried up into parapets at least as high as the flat roof insulation upstand.
- For best thermal performance, roof-lights and ventilator kerbs should be insulated with the same thickness of Kingspan GreenGuard® GG301, with a separate backing layer of Kingspan GreenGuard®, as the general roof area (see Figure 6).
- Where a parapet construction is not used, to achieve best performance, the roof insulation should overlap the wall to extend the thermal bridge path, if necessary by adding thermal insulation to edge beams to achieve continuity with external insulation (see Figure 7).
- Insulate internal rainwater downpipes and other pipes that penetrate the roof if they pass through spaces with a high humidity and if any condensate will damage the structure or internal finishes. Use Kingspan GreenGuard® around the pipe outlet and wrap joints with vapour resistant tape to restrict water vapour from reaching the pipe (see Figure 8).
- Where guttering is incorporated within a flat roof construction, this should be accounted for within the overall thermal design of the roof via an area-weighted calculation for the whole roof. The risk of localised interstitial condensation from reduced insulation provision at the gutter should be considered.
- Where an Internal gutter is formed, vertical insulation should be used to reduce thermal bridging, using Kingspan GreenGuard® GG301 with a separate backing layer of Kingspan GreenGuard® (see Figure 9). A similar approach can also reduce losses where a change in levels is required (see Figure 11).
- Lightweight aggregate blockwork to the inner leaf of wall constructions can help to improve thermal performance at junctions generally and where used for the inner leaf of parapet walls it can help to reduce losses (see Figure 10).

Responsible Sourcing

Kingspan GreenGuard® GG300 produced at Kingspan Insulation's Selby, North Yorkshire manufacturing facility is manufactured under a management system certified to ISO 14001: 2015.

NB The above information is correct at the time of writing. Please confirm at the point of need by contacting Kingspan Insulation's Technical Service Department (see rear cover), from which copies of Kingspan Insulation's certificates can be obtained.

Design Considerations

Sustainability & Responsibility

Kingspan Insulation has a long-term commitment to sustainability and responsibility: as a manufacturer and supplier of insulation products; as an employer; as a substantial landholder; and as a key member of its neighbouring communities.

A report covering the sustainability and responsibility of Kingspan Insulation Ltd's British operations at its Pembridge, Herefordshire and Selby, North Yorkshire manufacturing facilities is available at **www.kingspaninsulation.co.uk/sustainabilityandresponsibility.**

Specification Clause

Kingspan GreenGuard® should be described in specifications as:–

The roof insulation shall be Kingspan GreenGuard® GG300 / GG500 / GG700 (delete as appropriate) (insert grade) _____ mm thick: comprising high performance rigid extruded polystyrene insulation. The product shall be manufactured, with a blowing agent that has zero Ozone Depletion Potential (ODP) and low Global Warming Potential (GWP); under a management system certified to ISO 9001: 2015; and installed in accordance with the instructions issued by Kingspan Insulation Limited.

NBS Specifications

Details also available in NBS PLUS.
NBS users should refer to clause(s):
J21 440, J31 340, J41 440
(Standard and Intermediate)

Protected Membrane Roofs

This literature describes the use of Kingspan GreenGuard® as a component of protected membrane roofing systems using either a gravel or paving slab finish, and as a component of green roof systems.

Protected membrane roofing systems place the insulation above the waterproofing, and offer several advantages over traditional warm flat roofs.

- The waterproofing system can be expected to have a life in excess of that obtained in an exposed situation, as it is protected from mechanical damage, UV degradation from solar radiation and temperature extremes (both daily and seasonal).
- The roof is safe from condensation risk.
- The roof achieves the national requirements for external fire exposure when covered with an inorganic material i.e. 50mm gravel or 40mm paving slabs.
- Insulation can be lifted to allow inspection of the waterproofing system.
- Additional insulation can be added at a later date.
- The installation of the insulation is not weather dependant.

Rigid extruded polystyrene insulation has minimal water absorption, due to its closed cell structure, and is one of only a few materials suitable and approved for this application, where it will be subject to wetting / drying and freeze / thaw cycles.

Product Selection

Consideration must be given to which Kingspan GreenGuard® product is most appropriate for the required application. A table of the key distinguishing features is shown below.

Product	Thermal Conductivity (W/mK)	Density (kg/m³)	Compressive Stress (kPa)
Kingspan GreenGuard® GG300	0.034 W/mK (30 - 150 mm) 0.036 W/mK (> 150 mm)	30	300
Kingspan GreenGuard® GG500	0.034 W/mK (40 - 60 mm) 0.036 W/mK (> 60 mm)	35	500
Kingspan GreenGuard® GG700	0.034 W/mK (40 - 60 mm) 0.036 W/mK (> 60 mm)	45	700

Design Loads & Roof Structure

The suitability of the structure under consideration to accept design loads, including the increased dead load from ballast, snow and roof traffic, should be verified in accordance with BS EN 1991-1-3: 2003 + A1: 2015 (Eurocode 1. Actions on structures. General actions. Snow loads).

The additional load from ballast can be considerable.

Ballast Layer	Dead Load
50 mm thick paving slabs	125 kg/m²
Gravel (16-32 mm diameter)	16 kg/m² per 10 mm depth
Soil (intensive green roof)	180 - 500 kg/m²
Soil (semi-intensive green roof)	120 - 200 kg/m²
Soil (extensive green roof)	60 - 150 kg/m²

The ballast layer resists wind uplift, prevents floatation of the boards after heavy rain and prevents UV degradation of the boards.

Design Considerations

Wind Loads

The resistance of the waterproofing system, insulation and ballast to wind uplift should be assessed in accordance with BS EN 1991-1-4: 2005 + A1: 2010 (Eurocode 1. Actions on structures. General actions. Wind actions). BRE Digest 295 gives specific design guidelines for loose-laid insulation systems.

For constructions located in sheltered exposure zones, or on buildings of up to 10 storeys, the self weight of a minimum 50 mm gravel ballast layer (minimum 80 kg/m^2), installed over a non-woven polyethylene membrane, is generally sufficient to ensure that both the insulation boards and waterproofing system remain stable under the full design load.

For constructions located in moderate exposure zones, or on buildings of up to 10 to 15 storeys, this gravel ballast specification is generally sufficient, but the perimeter should be loaded with 50 mm thick paving slabs.

For severe exposure zones or tall buildings over 15 storeys, specialist advice should be sought. BRE Digest 311 (Wind scour of gravel ballast on roofs) should be used when a calculation is required for a specific building project.

Flotation

The ballast specifications detailed in the 'Wind Loads' section (above) will be sufficient to prevent flotation of the insulation boards after heavy rain.

Falls

The fall on a flat roof, constructed using Kingspan GreenGuard®, is normally provided by the supporting structure being directed towards the rainwater outlets. The fall should be smooth and steep enough to prevent the formation of rainwater ponds. In order to ensure adequate drainage, BS 6229: 2003 (Flat roofs with continuously supported coverings. Code of practice) recommends uniform gradients of not less than 1 in 80. However, because of building settlement, it is advisable to design in even greater falls.

Protected membrane roofing systems incorporating Kingspan GreenGuard® can be laid on roofs with a finished fall of less than 1:80, but the waterproofing system must be of a tanking specification.

Design Details

Paving Slab Ballasted Protected Membrane Roof Details

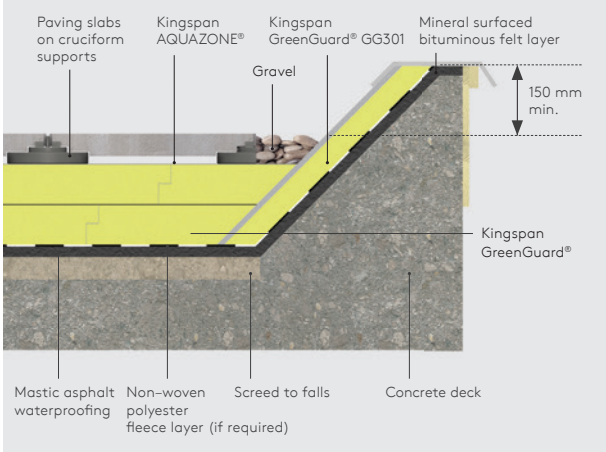


Figure 6 - Eave / Kerb Detail

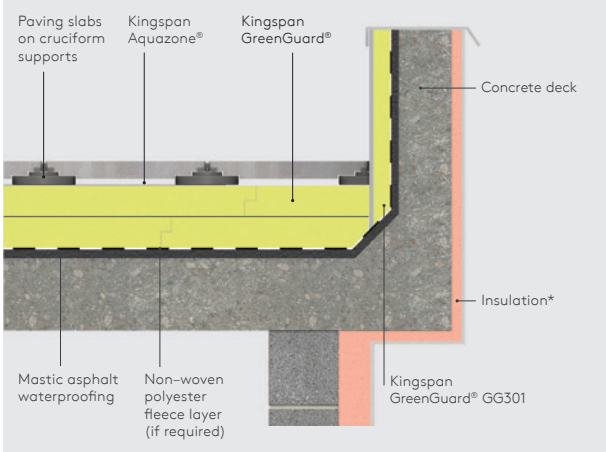


Figure 7 - Eave / Gutter Detail

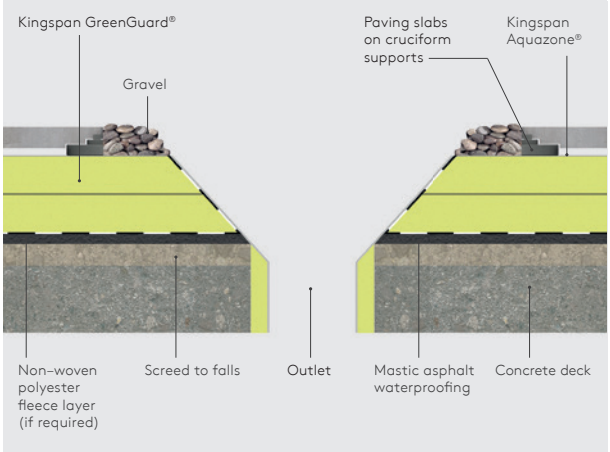


Figure 8 - Two Level Drainage

* The insulation specification will depend on the full build up and facade finish.

Design Considerations

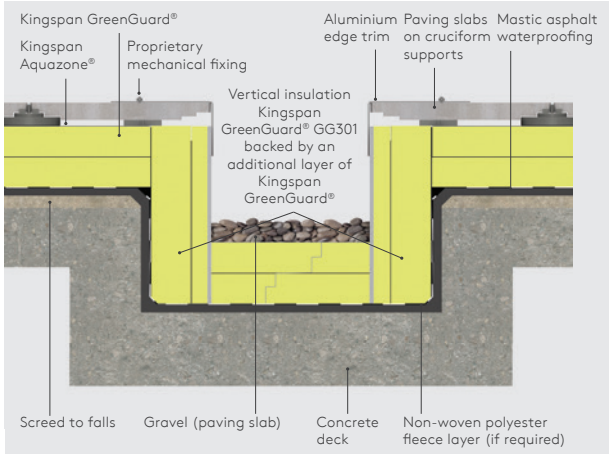


Figure 9 - Internal Gutter

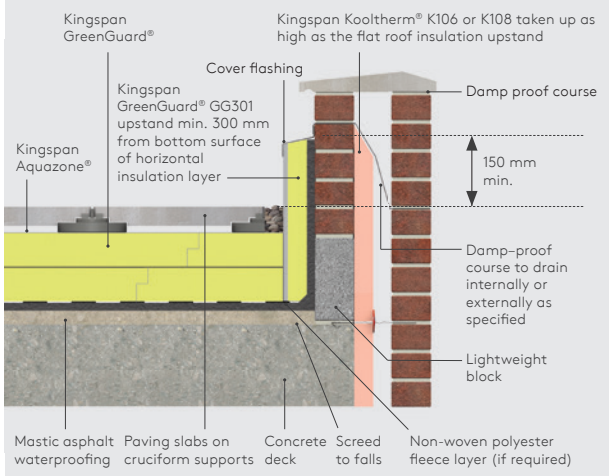


Figure 10 - Parapet Abutment

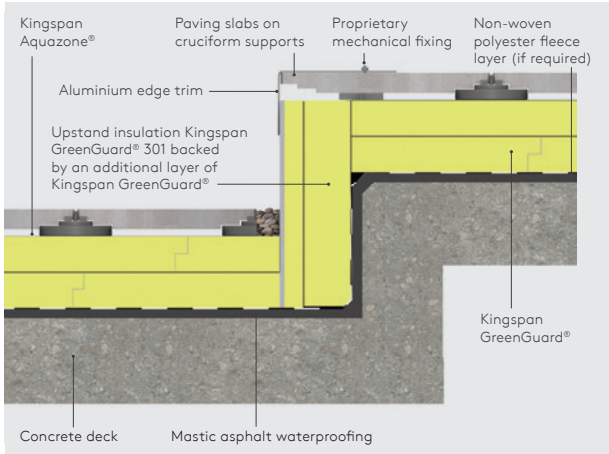


Figure 11 - Change in Level

Rainfall Factors

The requirements of part F.4.2 of BS EN ISO 6946: 2017 and D.4.2 of I.S. EN ISO 6946: 2007 dictate that inverted roof constructions are subject to a geographical rainfall analysis. The cooling effect of rainwater flowing between and beneath the insulation boards, can mean that greater thicknesses of insulation are required to meet desired U-values, particularly in locations that receive high levels of rainfall.

The use of Kingspan Aquazone® over the insulation (see Figures 6-11), can dramatically minimise heat loss by reducing the amount of rainwater that flows between and beneath the insulation boards.

This reduction in rainwater flow is represented by the infiltration (fx) factor of the membrane. The fx factor of a membrane is fall (gradient) specific, and an fx factor measured on a fall can not be used to represent the performance of a membrane if installed horizontally.

Drainage

The number and type of rainwater outlets should be assessed in accordance with BS EN 12056-3: 2000 (Gravity drainage systems inside buildings. Roof drainage, layout and calculation). The rainwater outlets should be double entry type, to allow rainwater to be drained from the roof surface at both the membrane level and the upper surface level. When using paving slabs as ballast, on a roof with a finished fall of less than 1:80, they must be laid on supports, in order to aid drainage.

The drainage of green roofs should be carefully considered, especially in the case of intensive systems, which may require a moisture retention layer to ensure adequate moisture levels for the system but still allow the rapid drainage of excess rainwater. Dam type rainwater outlets that hold water in the system are not recommended, as the depth of water may create a moisture vapour impermeable layer above the insulation.

Design Considerations

Roof Waterproofing

Kingspan GreenGuard® is suitable for use over some fully adhered single-ply waterproofing membranes.

Kingspan GreenGuard® is also suitable for use over mastic asphalt waterproofing systems. Mastic asphalt waterproofing should be laid, where applicable, in accordance with BS 8218: 1998 (Code of practice for mastic asphalt roofing). Mastic asphalt should always be laid over an isolating layer of loose-laid Type 4A sheathing felt to BS EN 13707: 2013 (Flexible sheets for waterproofing. Reinforced bitumen sheets for roof waterproofing. Definitions and characteristics).

Kingspan GreenGuard® is also suitable for use over some hot and cold liquid applied waterproofing systems.

Mastic asphalt, some single-ply and some hot liquid applied waterproofing systems require a separation layer (non-woven polyester fleece layer, 130 - 140 g/m^2, with an overlap of 250 - 300 mm) positioned between the membrane and the insulation.

Waterproofing systems containing solvents should be allowed to fully cure before installing Kingspan GreenGuard® insulation.

Water Vapour Control

Protected membrane roofs are inherently safe in respect of condensation risk. The roof design can be assessed for the risk of interstitial condensation using BS 5250: 2011 + A1: 2016 (Code of practice for control of condensation in buildings) or BS 6229: 2003 (Flat roofs with continuously supported coverings. Code of practice).

Green Roofs

Benefits

Green roofs, are an alternative to the standard protected membrane roof that offer many advantages but require precise design and detailing.

Specifically they can:

- reduce dust levels;
- provide a habitat for wildlife;
- create usable areas for recreational activities;
- retain rainfall thus prevent water surges into the drainage system;
- improve sound insulation; and
- provide a visually more attractive finish than protected membrane roofs with gravel or paving slab ballast.

Types of Green Roof

Green roof systems can be divided into three main categories.

Extensive green roofs comprise a relatively shallow growing medium and low maintenance vegetation such as grass. They are lightweight, simple to design, construct and maintain, but should not be considered suitable for regular traffic or recreational activities. Extensive systems are especially useful in creating green areas for both ecological and aesthetic reasons.

Semi-intensive green roofs comprise a deeper growing medium and vegetation such as grass, perennials and shrubs. They are designed to be more garden-like and to accommodate limited access for maintenance and recreation.

Intensive green roofs have a much deeper growing medium and a wider variety of flora, including grass, shrubs and smaller trees. They are comparable with normal gardens in respect of maintenance, and can be used for recreation activities. The self weight of the system can be very high, due to the increased soil depth.

Careful design and detailing of all roof types is important and includes the following elements.

Growing Medium

In its simplest form this is normal soil. Specialist mixtures are available, incorporating expanded clay and lava rock, which form the growing medium and have filtration, drainage and moisture retention functions.

Drainage Layer

The drainage layer normally consists of either: a layer of washed gravel 8/16; expanded clay; or a specialist 'egg carton' or castellated plastic (HDPE) sheeting; all overlaid with a filtration membrane. The drainage layer allows the rapid removal of excess rainwater from the roof, thus avoiding saturation of the soil and the associated increase in weight.

Moisture Retention Layer

The limited depth of soil, especially in the extensive type of roof, may require the use of a moisture retention layer to ensure sufficient water is available for the vegetation.

Root Barrier

The roots of growing plants can seriously damage waterproof membranes, by growing into any small cracks, lap joints or other discontinuities. A root barrier may be formed by a separate cap sheet of polythene, or bitumen felt incorporating a thin copper film. The cap sheet is either adhered or loose-laid onto the waterproof membrane, with all joints sealed by bonding or welding, and must be continued up vertical faces of upstands.

Sitework

Waterproofing

- Prior to installing the insulation, it is essential to ensure that the waterproofing system has been installed correctly and that the roof is watertight and clean.
- Single-ply membranes, in particular, need careful attention to ensure that there has been no damage from following trades, and that puncturing from below the membrane (from nail heads or debris) cannot occur.
- If a single-ply membrane or mastic asphalt waterproofing system has been installed, a non-woven polyester fleece separation layer, with 250 - 300 mm overlaps, should be laid on top of the membrane prior to the installation of the insulation.

Insulation Boards

- Start laying the Kingspan GreenGuard® insulation boards from the point of access to the roof.
- Insulation boards should always be loose-laid break-bonded, either with their long edges at right angles to the edge of, or diagonally across the roof, and with joints lightly butted. There should be no gaps at abutments.
- If two or more layers of insulation are required, they should be horizontally offset relative to each other so that, as far as possible, the board joints in any two adjacent layers do not coincide with each other (see Figure 12).

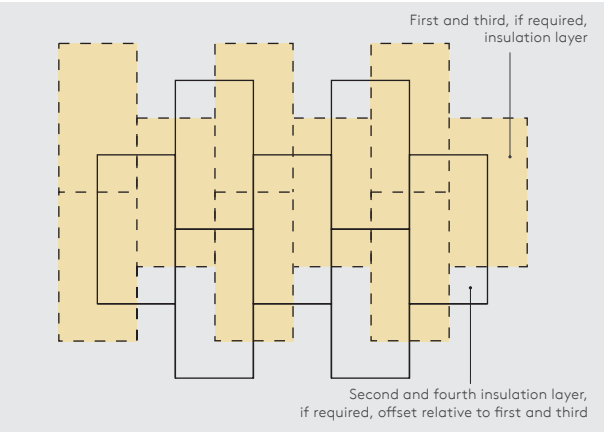


Figure 12 - Offsetting of Multiple Insulation Layers

- Roof-light or ventilator kerbs, gutter etc. should always be insulated (Kingspan GreenGuard® GG301 with a separate backing layer of Kingspan GreenGuard®) to meet the same U-value as the general roof area.
- A Kingspan GreenGuard® GG301 upstand should be used around the perimeter of the roof on the internal façade of parapets.
- A minimum distance of 300 mm should be maintained between the top of the insulation upstand and the bottom of the horizontal roof insulation.
- Boards can be laid in any weather but, due to the boards being lightweight, care must be taken in windy conditions.

Kingspan Aquazone®

- Kingspan Aquazone®, a high performance, non-woven polyethylene membrane, should be laid over the insulation boards.
- Where one run of the membrane laps another, there should be a minimum 300 mm side and end overlaps.
- The membrane should be turned up at the edge of the roof insulation and sealed under the flashing.

Gravel Ballast

- Install the ballast layer as soon as possible, to ensure that Kingspan Aquazone® is always protected and excessive heat build up or high winds do not damage the insulation boards.
- Gravel ballast should be washed, rounded, nominal 20 - 40 mm diameter, and of minimum depth 50 mm.
- The diameter of the gravel is important as this size has been found to be the most resistant to wind scour, BRE Digest 311 gives advice.

Paving Slab Ballast

- Min. 50 mm thick paving slabs should be laid, over Kingspan Aquazone®, on proprietary paving slab supports of minimum diameter 175 mm (or equivalent base area), in order to maintain drainage below the slabs, and to ensure that moisture vapour can escape.
- Install paving slabs and supports as soon as possible, to ensure that Kingspan Aquazone® is always protected and excessive heat build up or high winds do not damage the insulation boards.
- Gaps between the paving slabs and upstands should be filled with washed, rounded gravel, nominal 20 – 40 mm diameter.

Sitework

Roof Gardens

- Having chosen the type of planting system and correctly detailed the various filter layers, moisture retention layers and growing medium, the installation, especially of extensive systems, is quick and simple.
- A root barrier (unless provided by the waterproofing layer) should be loose-laid on or bonded to the waterproofing membrane with all the laps sealed.
- The root barrier should be turned up at the edge of the roof insulation and sealed under the flashing.
- Kingspan GreenGuard® should be installed as described previously.
- Boards should be overlaid with Kingspan Aquazone®, which should be installed as described previously.
- A filtration layer or combined filtration layer / drainage mat is then installed, per its manufacturer's instructions.
- The growing medium, generally 50 - 200 mm deep is then installed. Specialist spray systems are available, which allow the application of growing medium and grass / plant seed to be applied in one operation.
- The depth of growing medium should be assessed for wind loads in accordance with BS EN 1991-1-4: 2005 + A1: 2010 (Eurocode 1. Actions on structures. General actions. Wind actions). BRE Digest 295 gives specific design guidelines for loose–laid insulation systems.

Mechanical Fixings (Kingspan GreenGuard® GG301 only)

- Cutting Kingspan GreenGuard® GG301 should be carried out by using a TCT saw. Ensure correct FFP2 or 3 grade PPE is used to protect against inhalation of dust during cutting.
- A minimum of 3 fixings, with a minimum head diameter of 25 mm, are required to secure 1200 mm long boards of Kingspan GreenGuard® GG301 Upstand Board to the parapet.
- The requirement for additional fixings should be assessed in accordance with BS / I.S. EN 1991-1-4: 2005 + A1: 2010 (National Annex to Eurocode 1. Actions on structures. General Actions. Wind Actions).
- Mechanical fixings must be arranged in an even pattern.
- Fixings for Kingspan GreenGuard® GG301 should be positioned across the top edge of the board and at a maximum of 600 mm centres.
- Fixings at insulation board edges must be located > 50 mm and < 200 mm from edges and corners of the board and not overlap board joints.
- Each fixing should incorporate a square or circular plate washer (minimum 25 x 25 mm or 25 mm diameter).
- Fixings should be driven straight.
- Care should be taken not to overdrive fixings.
- The bottom of the board should be supported and held in place by the Kingspan GreenGuard® and ballast / paving slabs on supports.
- Additional fixings should be used if the Kingspan GreenGuard® GG301 is not supported, following the same specification as detailed in the previous bullet point.
- For details on fixings refer to:

Ejot UK Limited **www.mejot.co.uk**	+44 (0) 1977 687 040
Fixfast **www.fixfast.com**	+44 (0) 1732 882 387
MAK Fasteners **www.makfasteners.com**	+353 (0) 1 451 9004
SFS Intec **www.sfsintec.biz/uk**	+44 (0) 1132 085 500

General

Cutting

- Cutting should be carried out either by using a fine toothed saw, a hot wire system or by scoring with a sharp knife and snapping the board over a straight edge.
- Ensure accurate trimming to achieve close-butting joints and continuity of insulation.

Availability

- Kingspan GreenGuard® is available through specialist insulation distributors and selected roofing merchants throughout the UK and Ireland.

Packaging and Storage

- Kingspan GreenGuard® may be delivered in packaging bearing alternative product branding.
- The polyethylene packaging of Kingspan Insulation products, which is recyclable, should not be considered adequate for outside protection.
- Ideally, boards should be stored inside a well ventilated building. If, however, outside storage cannot be avoided, then the boards should be stacked clear of the ground and covered with a pale pigmented polythene sheet or weatherproof tarpaulin.
- Kingspan GreenGuard® should not be left in the sun covered by either a transparent or a dark plastic sheet, since in both cases, board temperatures can build up to a level hot enough to appreciably alter their dimensions or warp them.

Health and Safety

- Kingspan Insulation products are chemically inert and safe to use.
- A Safety Information Data Sheet for this product is available from the Kingspan Insulation website **www.kingspaninsulation.co.uk/safety or www.kingspaninsulation.ie/safety**.

Warning - do not stand on or otherwise support your weight on this product unless it is fully supported by a load–bearing surface.

Product Details

Composition

Kingspan GreenGuard® GG300, GG500 and GG700 are high performance rigid extruded polystyrene insulants with a fibre-free core. They are manufactured with a blowing agent that has zero Ozone Depletion Potential (ODP) and low Global Warming Potential (GWP) and has a smooth, dense skin on both faces.

Standards and Approvals

Kingspan GreenGuard® GG300 produced at Kingspan Insulation's Selby, North Yorkshire manufacturing facility is manufactured to the highest standards under a management system certified to ISO 9001: 2015 (Quality management systems. Requirements), ISO 14001: 2015 (Environmental Management Systems. Requirements), BS / I.S OHSAS 18001: 2007 (Health and Safety Management Systems. Requirements) and ISO 50001: 2011 (Energy management systems. Requirements).

NB The above information is correct at the time of writing. Please confi rm at the point of need by contacting Kingspan Insulation's Technical Service Department (see rear cover), from which copies of Kingspan Insulation's certificates can be obtained.

Standard Dimensions

All products in the Kingspan GreenGuard® range are available in the following standard size:

Nominal Dimension		Availability
Length	(m)	1.25
Width	(m)	0.6
Insulant Thickness	(mm)	Refer to local distributor or Kingspan Insulation price list for current stock and non-stock sizes.
Edge Profile		Rebated

Compressive Stress

The compressive stress of Kingspan GreenGuard® products typically exceeds the following values:

Kingspan GreenGuard® GG300 – 300 kPa;

Kingspan GreenGuard® GG500 – 500 kPa; and

Kingspan GreenGuard® GG700 – 700 kPa;

when tested to EN 826: 2013 (Thermal insulating products for building applications. Determination of compression behaviour).

Water Vapour Resistivity

The products typically achieve a resistivity greater than 400 MNs/gm, when tested in accordance with BS EN 12086: 2013 (Thermal insulating products for building applications. Determination of water vapour transmission properties).

Absorption of Moisture

Kingspan GreenGuard® is highly resistant to water absorption and the effects of freeze-thaw cycling.

Durability

If correctly installed, Kingspan GreenGuard® can have an indefinite life. Its durability depends on the supporting structure and the conditions of its use.

Resistance to Solvents, Fungi & Rodents

Kingspan GreenGuard® is resistant to most commonly occurring construction materials such as lime, cement, plaster, anhydrous gypsum, solvent-free bituminous compounds, water-based wood preservatives, as well as alcohols, acids and alkalis. Certain organic materials such as solvent-based wood preservatives, coal tar and derivatives (creosote), paint thinners and common solvents (e.g. acetone, ethyl acetate, petrol, toluene and white spirit) will attack Kingspan GreenGuard®, resulting in softening, shrinkage and possible dissolution, with a consequent loss of performance.

Kingspan GreenGuard® does not provide any food value to vermin and is not normally attractive to them.

Fire Performance

Kingspan GreenGuard® GG300, GG500 and GG700 achieve European Classification (Euroclass) E when classified to EN 13501-1:2018 (Fire classification of construction products and building elements. Classification using data from reaction to fire tests).

Kingspan GreenGuard®, when used within an inverted roof system meets the National requirements for external fire exposure when covered with an inorganic material i.e. 50 mm gravel or 40 mm paving slabs. For specifications without the gravel ballast or paving slabs please consult the manufacturer of the specific external weatherproofing / ballast for their fire classification details.

Further details on the fire performance of Kingspan Insulation products may be obtained from the Kingspan Insulation Technical Service Department (see rear cover).

Maximum Service Temperature

Kingspan GreenGuard® should not be brought into direct contact with high temperature heat sources. The maximum service temperature of Kingspan GreenGuard® is 75°C.

Product Details

Thermal Properties

The λu-values and R-values detailed below are quoted in accordance with BS / I.S. EN 13164: 2012: + A1: 2015 (Thermal insulation products for buildings. Factory made extruded polystyrene foam (XPS) products. Specification).

Declared Thermal Conductivity

The boards achieve a declared thermal conductivity (λu-value) of Kingspan GreenGuard® GG300 is:

0.034 W/mK (insulant thickness 30 - 150 mm); and

0.036 W/mK (insulant thickness > 150 mm).

Kingspan GreenGuard® GG500 is:

0.034 W/mK (insulant thickness 40 - 60 mm); and

0.036 W/mK (insulant thickness > 60 mm).

Kingspan GreenGuard® GG700 is:

0.034 W/mK (Insulant thickness 40 - 60 mm); and

0.036 W/mK (insulant thickness > 60 mm).

Thermal Resistance

Thermal resistance (R-value) varies with thickness and is calculated by dividing the thickness of the board (expressed in metres) by its thermal conductivity. The resulting number is rounded down to the nearest 0.05 (m^2K/W).

Insulant Thickness (mm)	Thermal Resistance (m^2K/W)		
	GG300	GG500	GG700
30	0.85	-	-
40	1.15	1.15	1.15
50	1.45	1.45	1.45
60	1.75	1.75	1.75
70	2.05	1.90	1.90
80	2.35	2.20	2.20
100	2.90	2.75	2.75
120	3.50	3.30	3.30
140	4.10	3.85	3.85
150	4.40	-	-

NB Multiple layers of insulation are required for higher thermal resistances.

NB Refer to local distributor or Kingspan Insulation price list for current stock and non-stock sizes.

NB Where a hyphen is shown the thickness is not available.

Design Thermal Conductivity

In applications where Kingspan GreenGuard® could come into contact with moisture, a design thermal conductivity is taken into account within U-value calculations. The boards achieve a design thermal conductivity (λu-value) of Kingspan GreenGuard® GG300 is:

0.036 W/mK (insulant thickness 30 - 150 mm); and

0.038 W/mK (insulant thickness > 150 mm).

Kingspan GreenGuard® GG500 is:

0.036 W/mK (insulant thickness 40 - 60 mm); and

0.038 W/mK (insulant thickness > 60 mm).

Kingspan GreenGuard® GG700 is:

0.038 W/mK (insulant thickness 40 - 60 mm); and

0.040 W/mK (insulant thickness > 60 mm).

Kingspan Insulation

Company Details

Kingspan Insulation Ltd is part of the Kingspan Group plc., one of Europe's leading construction product manufacturers. The Kingspan Group was formed in the late 1960s and is a publicly quoted group of companies headquartered in Kingscourt, County Cavan, Ireland.

Kingspan Insulation Ltd is a market leading manufacturer of premium and high performance rigid insulation products and insulated systems for building fabric and building services applications.

Products & Applications

Kingspan Insulation Ltd has a vast product range. Kingspan Insulation Ltd products are suitable for both new build and refurbishment in a variety of applications within both domestic and non-domestic buildings. The available insulation solutions are listed below.

- Pitched Roofs
- Flat Roofs
- Green Roofs
- Cavity Walls
- Solid Walls
- Timber and Steel Framing
- Insulated Cladding Systems
- Insulated Render Systems
- Floors
- Soffits
- Ductwork

Further Solutions:

- Insulated Dry-Lining
- Tapered Roofing Systems
- Cavity Closers
- The Kingspan KoolDuct® System
- Kingspan nilvent®
- Kingspan TEK® Building System

Insulation Product Benefits

Kingspan OPTIM-R® Vacuum Insulation Panel (VIP) Products

- With a declared value thermal conductivity of 0.007 W/mK, these products provide an insulating performance that is up to five times better than commonly used insulation materials.
- Provides high levels of thermal efficiency with minimal thickness.
- Over 90% (by weight) recyclable.

Kingspan Kooltherm® and Kooltherm® 100 Products

- With a thermal conductivity of 0.018–0.023 W/mK these are the most thermally efficient insulation products commonly used.
- The thinnest commonly used insulation products for any specific U-value.
- Manufactured with a blowing agent that has zero Ozone Depletion Potential (ODP) and low Global Warming Potential (GWP).

Kingspan QuadCore®

- With a thermal conductivity of 0.021 W/mK this is amongst one of the more thermally efficient insulation products commonly used.
- Offering excellent thermal and fire performance, enhanced environmental credentials and backed by an extended warranty.
- Manufactured with a blowing agent that has zero Ozone Depletion Potential (ODP) and low Global Warming Potential (GWP).

Kingspan Therma™ Products

- With a thermal conductivity of 0.022-0.028 W/mK these are amongst the more thermally efficient insulation products commonly used.
- Manufactured with a blowing agent that has zero Ozone Depletion Potential (ODP) and low Global Warming Potential (GWP).

Kingspan GreenGuard® Products

- Rigid extruded polystyrene insulation (XPS) has the necessary compressive stress to make it the product of choice for specialist applications such as heavy duty flooring, car park decks and inverted roofing.
- Manufactured with a blowing agent that has zero Ozone Depletion Potential (ODP) and low Global Warming Potential (GWP).

All Products

- Unaffected by air infiltration - a problem that can be experienced with mineral fibre and which can reduce thermal performance.
- Safe and easy to install.
- If installed correctly, can provide reliable long term thermal performance over the lifetime of the building.
- Each product achieves the required fire performance for its intended application.

Contact Details

UK

Kingspan Insulation Ltd
Pembridge | Leominster
Herefordshire | HR6 9LA

T: +44 (0) 1544 388 601
E: info@kingspaninsulation.co.uk
www.kingspaninsulation.co.uk

For individual department contact details please visit
www.kingspaninsulation.co.uk/contact

Ireland

Kingspan Insulation Ltd
Castleblayney | County Monaghan

T: +353 (0) 42 979 5000
E: info@kingspaninsulation.ie
www.kingspaninsulation.ie

For individual department contact details please visit
www.kingspaninsulation.ie/contact

Registered in England & Wales, No. 01882722. Registered Office: Pembridge, Leominster, Herefordshire HR6 9LA UK. VAT GB428602456.

Registered in Ireland, No. 54621. Registered Office: Bree Industrial Estate, Castleblayney, Co. Monaghan, Ireland. VAT IE4575069I.

Attachment E

This document provides a summary of the revisions being proposed post-hearing to the proposed new regulation language.

I. Revisions to 11 Definitions in Section 3.0

Following comments provided by the American Chemistry Council – Center for the Polyurethanes Industry and input by additional foam sector experts, Staff revised the following 11 definitions to polyurethane applications, for technical accuracy.

"Polyurethane" means a polymer formed principally by the reaction of an isocyanate and a polyol.

"Flexible Polyurethane" means a non-rigid ~~synthetic~~ polyurethane foam ~~containing polymers created by the reaction of isocyanate and polyol~~, including but not limited to that used in furniture, bedding, and chair cushions.

"Foam Blowing Agent" means a substance ~~used to produce the product with a cellular structure formed via a foaming process in a variety of materials that undergo hardening via chemical reaction or phase transition~~ that functions as a source of gas to generate bubbles in the mixture during the formation of foam.

"Integral Skin Polyurethane" means a ~~synthetic~~ self-skinning polyurethane foam ~~containing polyurethane polymers formed by the reaction of an isocyanate and a polyol~~, including but not limited to that used in car steering wheels and dashboards.

"Rigid Polyurethane Appliance Foam" means polyurethane ~~insulation~~ foam in household appliances used for insulation.

"Rigid Polyurethane Commercial Refrigeration and Sandwich Panels" means polyurethane foam, used to provide insulation ~~for use~~ in walls and doors, including that used for commercial refrigeration equipment, and used in doors, including garage doors.

"Rigid Polyurethane High-pressure Two-component Spray Foam" means a liquid polyurethane foam system sold as two parts (i.e., A-side and B-side) in non-pressurized containers; ~~product that is pressurized 800-1600 pounds per square inch (psi) during installation manufacture; sold in pressurized containers as two parts (i.e., A-side and B-side)~~; and is field or factory ~~blown~~ applied in situ using high-pressure proportioning

pumps at 800-1600 pounds per square inch (psi) and an application gun to mix and dispense the chemical components. ~~may use liquid blowing agents without an additional propellant.~~

"Rigid Polyurethane Low-pressure Two-component Spray Foam" means a liquid polyurethane foam system ~~product~~ sold as two parts (i.e., A-side and B-side) in containers that is pressurized to less than 250 psi during manufacture of the system for application without pumps; ~~sold in pressurized containers as two parts (i.e., A-side and B-side);~~ and is typically applied in situ relying upon a liquid blowing agent and/or gaseous foam blowing agent that also serves as a propellant ~~so pumps typically are not needed~~.

"Rigid Polyurethane Marine Flotation Foam" means buoyancy or flotation polyurethane foam used in boat and ship manufacturing for both structural and flotation purposes.

"Rigid Polyurethane One-component Foam Sealants" means a polyurethane foam generally packaged in aerosol cans that is applied in situ using a gaseous foam blowing agent that is also the propellant for the aerosol formulation.

"Rigid Polyurethane Slabstock and Other" means a rigid closed-cell polyurethane foam ~~containing urethane polymers produced by the reaction of an isocyanate and a polyol and~~ formed into slabstock insulation for panels and fabricated shapes for pipes and vessels.

II. Revision of "on site" Considerations in Article 4.1.4

Following comments provided by the American Chemistry Council – Center for the Polyurethanes Industry, Staff revised the following article to avoid limiting terminology, and ensure all uses of polyurethane systems were captured by the regulatory language.

4.1.4 Products or equipment manufactured prior to the applicable effective date of the restrictions specified in Table 1 of subsection 6.1.1 (including foam systems not yet applied ~~on site~~) may be sold, imported, exported, distributed, installed, and used after the specified date of prohibition.

III. Revision to Effective Dates of Prohibition in Section 6.0

Following directions from the Office of the Secretary, Staff revised all the proposed effective dates of prohibition that were initially on January 1, 2021, to September 1, 2021 thus 6 months after the publication of the Final regulation.

Example illustrated below with Effective Date for the Aerosol Propellants end-use:

End-use	Prohibited Substances	Effective Date
Aerosol Propellants	HFC-125, HFC-134a, HFC-227ea and blends of HFC-227ea and HFC 134a.	~~January 1, 2021~~ September 1, 2021