January 17, 2017

Clerk of the Board
Air Resources Board
1001 I Street
Sacramento, CA 95814

Re: Comments on November 2016 proposed Short-Lived Climate Pollutant (SLCP) Reduction Strategy

Dear Clerk of the Board:

Bluon Energy, which is based in California, is uniquely positioned to comment because it is an energy-efficiency focused refrigerant company that has developed an effective replacement product for HCFC-22 (also known as R-22), a widely-used refrigerant which has significant ozone depleting potential (ODP) and global warming potential (GWP). Our product, TdX 20, also serves to replace R-404A and R-507A within the commercial refrigeration marketplace. Having received EPA authorization as well as the designation of R-458A from ASHRAE, Bluon looks forward to the opportunity to work with ARB to ensure that any final strategy for SLCP truly reduces greenhouse gas (GHG) emissions associated with hydrofluorocarbons (HFCs) and achieves ARB's overarching goal of reducing global warming. Bluon Energy is a proponent of including energy efficiency, as a result of using a specific refrigerant, as a key factor for consideration when replacing refrigerants. With regard to climate change the energy consumed is far more impactful than a refrigerant's GWP on the overall GHG's associated with a system in use.

The Air Resources Board (ARB) released the Revised Draft Short-Live Climate Pollutant Reduction Strategy (Revised Draft Strategy) for public review on November 28, 2016, which will be quoted from and commented on below in italics.

Page 127 | Hydrofluorcarbon (HFC) Emission Reductions
"HFC's currently account for four percent of California's GHG emissions, but are expected to double in emissions in the next few decades without additional reduction actions."

> *It is important to note that this figure only reflects potential leakage of HFCs into the atmosphere and not any GHG's associated with their inherent use in a system.*

Page 83 | Emission Trends of ODS and ODS substitutes (hydrofluorocarbons) – as ODS are phased out, HFCs increase).*
"The majority of HFC emissions come from fugitive emissions of refrigerants used in refrigeration and air-conditioning (AC) systems. The largest uses of HFCs are in commercial and industrial refrigeration and air-conditioning, which comprise 48 percent of HFC emissions."

> *The largest contributor of HFC emissions come from HVAC-R energy use at roughly 50% of the impact, also indicating that the HVAC-R applications themselves are a standalone group accounting for 2% of all GHG emissions. It's critically important to consider that the **energy consumed** by HVAC-R equipment using the HFCs accounts for 25% of California's GHG emissions by virtue of the electricity generated for operation. By this statement on a pure comparative of GHGs to GHGs, energy efficiency is 12.5X more impactful than the actual GHG emissions from HFC refrigerant leakage. An incentive to improve the energy efficiency of current HVAC-R equipment by just 10% would have the same impact as removing ALL HFC's entirely from the HVAC-R industry.*

Page 128 | Hydrofluorocarbon (HFC) Emission Reductions
"The cost of strategies to reduce HFCs is highly dependent upon assumptions of the added initial cost of low-GWP equipment, which is estimated to be approximately 10 percent higher than baseline high-GWP equipment, as detailed in

Appendix F. The additional initial cost ranges from $500,000 for a large cold storage facility, and $200,000 for a supermarket; to $400 for a residential AC system, and $140 for a residential refrigerator-freezer."

> *Buying new equipment is not in general a feasible activity for consumers in most sectors as it is extremely expensive and can interrupt business activity for too long to be financially sustainable. Also at this time for HVAC the low-GWP equipment referenced does not exist and the ones that do are not viable to use in areas with people for various reasons (Flammability, Toxicity, and Operating Pressures). To comply with this proposed regulation would put manufacturers of HVAC-R equipment in a position to price gauge the market and consumers for fear of being out of compliance.*

Page 128 | Hydrofluorocarbon (HFC) Emission Reductions
"In many cases, the added initial cost is offset or reversed through energy savings of low-GWP refrigeration and AC. Additionally, low-GWP refrigerants such as carbon dioxide refrigerant, ammonia, and hydrocarbons are less expensive than HFCs. The main barrier to adoption of low-GWP refrigeration equipment is the added initial cost. For low-GWP AC, the barriers include added initial cost and current building codes that do not allow very slightly flammable low-GWP refrigerants."

This issue is not to be dismissed, as they are not realistic for the following reasons:

1. *CO_2 runs at near 1000psi on exorbitantly expensive equipment making it not viable*
2. *Ammonia is toxic, cannot be used in large amounts around people*
3. *Hydrocarbons are quite flammable, not "very slightly flammable" and would not pass building/insurance code in the current environment*

Page 128 | Hydrofluorocarbon (HFC) Emission Reductions
"An HFC phasedown could incentivize new equipment to use low-GWP refrigeration and AC, and a prohibition on high-GWP refrigeration and AC would largely overlap with HFC phasedown requirements."

> *An HFC phasedown would do exactly as it's done on the HCFC phasedown, confuse consumers, create a black market for product, and force Californians down a path that is overall more harmful than helpful when looking at total reduction in GHGs. This direction would be a doubling down on the prior mistake of solely pushing HFC's as the solution to HCFC's. The solution must be the energy efficiency of the refrigerant and applicable HVAC-R equipment in combination with its GWP as well as being non-ozone depleting.*

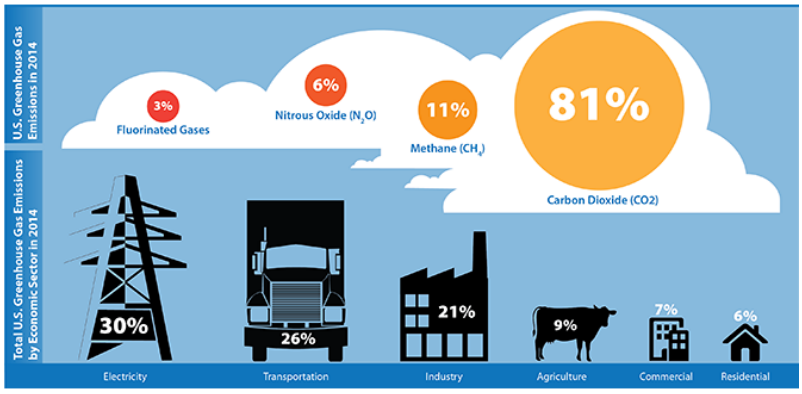
Page 129 | Hydrofluorocarbon (HFC) Emission Reductions
"Note that the indirect emission reductions account for less than four percent of GHG reductions from refrigeration and AC (the carbon intensity of electricity generation used to power cooling equipment is overwhelmed by the very-high GWPs of HFC refrigerants).

HFCs are also potent GHGs, with a warming effect hundreds to thousands of times more powerful than CO2. The average 100-year GWP of the current mix of HFCs being used is about 1700, and the average 20-year GWP is about 3800. The major concern with respect to HFCs is that their contribution to climate forcing is expected to increase rapidly in the future as they continue to replace ozone-depleting substances (ODS), such that they will become very significant contributors. Studies indicate that a lack of action to prevent the growth of HFCs would greatly undermine efforts to address climate change. A recent study concluded that replacing high-GWP HFCs with low-GWP alternatives could avoid 0.1°C of warming by 2050 and warming of up to 0.5°C by 2100,81 offering one of the most cost-effective climate mitigation strategies available."

If the California Air Resource Board is to stay true to the mission of the Short-Lived Climate Pollutant Reduction Strategy, they must utilize a comprehensive metric such as "F-GWP" or Functional Global Warming Potential, which would consider both the energy efficiency attributes as well as the much less impactful environmental attributes of refrigerants into consideration. The EPA within the Significant New Alternatives Policy (SNAP) states it beautifully:

> *The total environmental effects impacts [sic] of these refrigerants also depend upon the energy use of appliances, since the "indirect" GHG emissions associated with electricity consumption typically exceed those from refrigerants over the full lifecycle of refrigerant-containing products. If appliances designed to use refrigerants listed as acceptable in this final rule are less energy efficient than the appliances they replace, then it is possible that these appliances would result in higher lifecycle GHG emissions than appliances using a higher GWP refrigerant or refrigerant substitute. Conversely, higher energy efficiency of these appliances would lead to even lower lifecycle GHG emissions.*

Within the EPA's own website, they share a graph that demonstrates carbon dioxide's impact on GHG with the generation of electricity being by far the highest contributor.



See: https://www3.epa.gov/climatechange/ghgemissions/inventoryexplorer/

Page 83 | Reducing HFC Emissions

"Hydrofluorocarbons (HFCs) are the fastest-growing source of GHG emissions both globally and in California. HFCs are fluorinated gases (F-gases), which also include the ozone-depleting substances (ODS) that are being phased out under the Montreal Protocol. HFCs currently comprise four percent of all GHG emissions in California, and without a phasedown and additional emission reduction measures, annual HFC emissions would increase 60 percent under business-as-usual by 2030 as HFCs continue to replace ODS (Figure 6).

The majority of HFC emissions come from fugitive emissions of refrigerants used in refrigeration and air-conditioning (AC) systems. The largest uses of HFCs are in commercial and industrial refrigeration and air-conditioning, which comprise 48 percent of HFC emissions. More than half of refrigeration and air-conditioning equipment currently uses HCFC-22, a high-GWP ODS which is scheduled for a complete phase- out of new production and import in the U.S. by 2020. The HCFC-22 refrigerant is being replaced with HFCs that have higher GWPs, thus increasing the GHG impact of refrigerants. We expect that in anticipation of the HCFC-22 phase-out by 2020, most owners of equipment using HCFC-22 will either replace the equipment by 2020, or at a minimum replace the HCFC-22 refrigerant in the same equipment (retrofit) with a high- GWP HFC refrigerant. A window of opportunity exists in the next five years to accelerate the transition of refrigeration and air-conditioning equipment to lower-GWP refrigerants, before another generation of equipment is locked into using higher-GWP refrigerants over their average lifetimes of 15 to 20 years."

Stated above is the fact that "more than half" of current HVAC-R equipment still use R-22, which is often ignored in plans and calculations of GHG emissions. What the ARB policy has failed to address is that of the HVAC systems still in operation more than 65+/-% of these systems still use HCFC (R-22) refrigerants. These existing systems are in the infancy of their lifecycle, the refrigerant has not been replaced with a non-ozone depleting HCFC, and will not be replaced with new equipment contrary to the expectations of regulation. An incentive needs to be created to replace the ozone depleting and inefficient refrigerant in existing systems with a low-GWP, energy efficient refrigerant for the next 10-20 years while owners maximize the life cycle of their existing HVAC-R systems.

Page 84 | Reducing HFC Emissions
"(ODS emissions are not shown because they are being completely phased out under the Montreal Protocol and are not included in the AB 32 GHG emission reduction targets.)"

This statement speaks for itself in that ozone-depleting substances such as R-22 are still in use in more than 50% of all HVAC-R equipment. It is impossible to neglect the emissions related to this large sector of equipment in operation currently and for the next 20-30 years. A mandated phase-out does not necessitate the discontinuation on the use of a product, so consumers will continue to use R-22 well past 2020 instead of buying expensive new HVAC-R systems. Also, the rise of HFCs can be attributed to many R-22 conversions to date. Currently half of the equipment is still running on R-22 with the only option at this time being to update with an HFC replacement refrigerant or to purchase new HFC equipment. By definition HFC emissions are going to increase over the next 10+ years while innovation is underway for equipment that is energy efficient and environmental.

Page 89 | Reducing HFC Emissions
"In addition to the natural refrigerants, a new generation of fluorinated refrigerants known as hydrofluoro-olefins (HFOs) have been developed that are non-ODS and have GWP values less than six. HFOs can be used in pure form for some cooling applications, such as motor vehicle AC, and are also used in blends with HFCs for other cooling applications, such as commercial and industrial refrigeration. Initial results indicate that the newest generation of fluorinated refrigerants performs as well as the high-GWP HFCs they replace."

HFO refrigerants are actually unsaturated HFC refrigerants and are widely recognized as the next generation of refrigerants. HFOs are distinguished from HFCs by being derivatives of olefins rather than alkanes (paraffins). Olefins have carbon atoms linked by a double bond where alkanes have single bonds between carbon atoms. Hydrofluorocarbon (HFC) refrigerants like R-134a, -125, -143a, and -152a, and HFC-based refrigerant blends like R-507, -407A, -407B, -407C, and -410A are all composed of hydrogen, fluorine, and carbon connected by single bonds between the atoms. Hydrofluoroolefin (HFO) refrigerants are also composed of hydrogen, fluorine, and carbon atoms, but contain at least one double bond between the carbon atoms.[1] These HFO's are talked about in a singular fashion with having low GWP's but then in practice are combined with HFC's to make HFO blends that are still largely HFC by composition (Most are > 50% HFC). If HFOs, or any other new refrigerant class, are not developed to be equally or more energy efficient as their HFC predecessor, the HFC phase-out will result in significant detriment to climate change by actually increasing the overall GHG impact of the HVAC-R equipment. Also important to note is that HFO's as a stand-alone are flammable and in practice must be blended with other constituents that are flame mitigating.

The most important aspect of this current reality is the fact than an effective, non-HFC refrigerant, which is neither flammable nor non-toxic has yet to be developed for HVAC. Translation: If you own or are planning to upgrade your HVAC equipment in the near future, you will be using HFCs. What matters most, in terms of your impact to climate change is the energy efficiency of the refrigerant and the system it is running in and to a lesser degree, but still meaningful, the GWP of your refrigerant.

*The current crop of HFCs comes in a wide variety of constituents, blends, and uses. It would be more than fair to say that **not all HFCs are created equal** in terms of their energy efficiency or their impact when leaking into the atmosphere (their GWP).*

[1] ACHR News, December 1, 2014, "The Professor's Lesson on HFO, HC Refrigerants" by John Tomczyk, HVACR Professor Emeritus, Ferris State University.

Page 94 | Prohibition on the Sale of New Refrigerant with Very-High GWPs
"Energy efficiency of low-GWP refrigeration and AC is one of the most important factors in the transition from high-GWP to low-GWP technology. If energy consumption increases, the additional GHG emissions from electricity generation will defeat the purpose of the low-GWP requirements. Therefore, energy efficiencies and "energy penalties" of low-GWP technologies are taken under consideration in the development of HFC emission reduction measures."

This is precisely the error made in the transition from R-22 equipment to the new R-410A HVAC-R equipment. As policymakers, we urge the California Air Resource Board to re-direct mandates toward energy efficiency. The widely used Total Equivalent Warming Impact (TEWI) is an appropriate direction to be considered and adopted. TEWI is the sum of the direct (chemical) and indirect (energy) emissions of greenhouse gases from certain equipment during its useful life. With emphasis on the full equation, the recommendation simply toward low-GWP or HFO refrigerants would not be approved.

Page 94 | Prohibition on the Sale of New Refrigerant with Very-High GWPs
"According to refrigerant manufacturers, the new low-GWP synthetic refrigerant hydrofluoro-olefin (HFO) blends are as energy efficient as the HFC refrigerants they replace**.** In some cases, the HFO blends exhibit better energy efficiency than baseline HFC refrigerants. Among the "natural" refrigerants, hydrocarbon and ammonia refrigerants exhibit well-known energy efficiencies compared to HFC refrigerants. Carbon dioxide refrigerant is generally the same efficiency or more energy-efficient in cooler climates, and less efficient in warmer climates compared to HFCs."

This statement is simply non-validated by third parties and in most cases false. Counter to the "importance" of energy efficiency that is suggested above as a factor for new refrigerants, no independent group or approval body is testing for the overall energy efficiency. The manufacturers, who are incented only to sell product, are setting the bar for what is believed to be the efficiency of the product they are trying to sell. Also to be noted, the manufacturers are not comparing data to R-22, which is currently still being used in over 70% of HVAC equipment. The manufacturers mentioned only compare their products to the high-GWP products that were developed to replace R-22 with a non-ozone depleting objective not energy efficiency. Any baseline from the manufacturers is an artificially inflated baseline not representative of the transition from R-22 to the current replacement refrigerants on the market.

Respectfully submitted,

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