Cooling Your Home but Warming the Planet: How We Can Stop Air Conditioning from Worsening Climate Change

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The Trouble with Air Conditioning

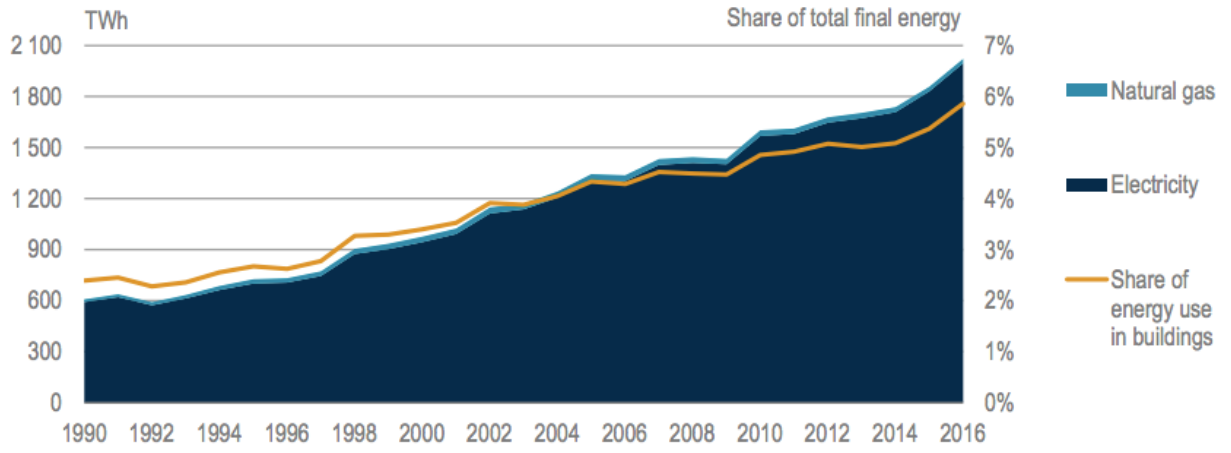
Summer is in full swing and air conditioning units are working hard to keep people cool. As our planet warms, the demand for space cooling (air conditioning and refrigeration) will rise. With increasing incomes and standards of living, more nations are starting to increase investments in air conditioning to keep their citizens comfortable. Dangerous heat waves may become more prevalent, and people will need to find ways to stay cool and safe as climate change continues.

Here's the rub: while our planet is warming, using and producing air conditioning equipment exacerbates climate change. The organic compound Hydrofluorocarbon (HFC) is the primary refrigerant used in air conditioning and refrigeration units. HFCs are a much more potent greenhouse gas than carbon dioxide and are leaked anywhere from manufacturing air conditioning equipment, to installation, to the disposal of old units. Additionally, air conditioning and refrigeration units run on electricity that relies primarily on fossil fuels to generate power. As the need for cooling rises, so too will the need for electricity. The air conditioning market is facing major growth in the years to come, introducing many challenges for the future. Fortunately, there are many solutions to keep people cool and comfortable while also reducing climate pressures.

The State of Cooling

Today, approximately 20% of the total electricity used in buildings around the world goes towards air conditioners and electric fans.[1] Energy use for space cooling has been on the rise for years. The International Energy Agency expects space cooling energy needs to triple by 2050. The graph below shows that the rise in global energy consumption for space cooling has over tripled in the last three decades from approximately 600 terawatt hours in 1990 to 2,000 terawatt hours in 2016.

World energy consumption for space cooling in buildings (IEA)



Source: IEA Report, the Future of Cooling

Rising air conditioning needs will come with a range of challenges. Cooling makes up more than 70% of peak residential energy demand in parts of the United States and Middle East on the hottest days.[2] Increasing electric power demands will place a greater strain on electric systems, potentially requiring costly repairs and maintenance efforts in the years to come. On top of that, much of the energy used for cooling will be generated by burning more carbon emitting coal and oil.

Most air conditioning takes place in China, the Unites States, and Japan, but the demand for air conditioning is rising all around the globe, particularly in warm regions like India, Indonesia, and the Middle East.[3] In India, for example, about 8% of the country's 249 million households were air conditioned as of March 2018.[4] Coverage is expected to rise to 50% by 2050, which would mean a significant increase in energy needs, as well as in HFC leakage with the introduction of new units.[5]

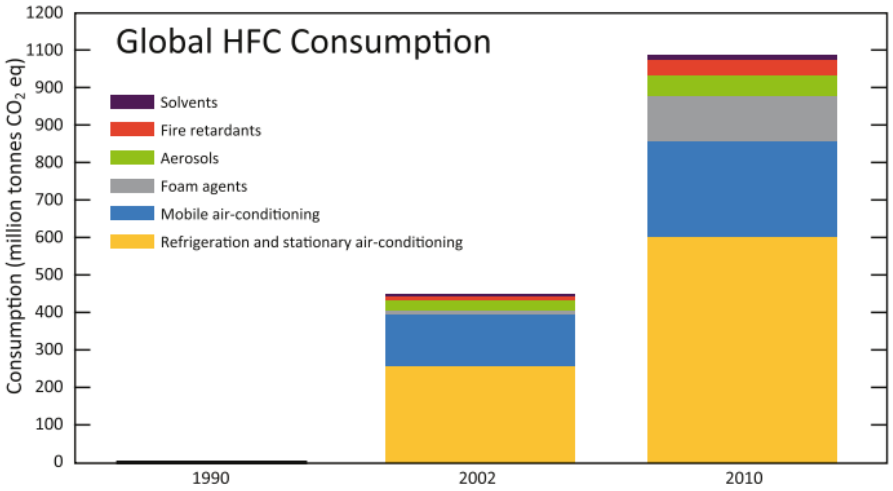
HCF Phase Out

In addition to increased power needs, HFC leakage may be an increasing concern with space cooling and refrigeration. Fortunately, recent global efforts, such as through the pending implementation of the Kigali Amendment, could help change this.

Prior to the widespread use of hydrofluorocarbons (HFCs), chlorofluorocarbons (CFCs) were used extensively in refrigeration and other applications. It was later linked to ozone depletion. When decomposed by UV radiation in the stratosphere, CFCs release inorganic chlorine, which then destroys O3 (ozone) compounds.[6] In 1987, the Montreal Protocol on Substances that Deplete the Ozone Layer was introduced, the first international policy effort to protect the ozone. This treaty called for the phaseout of ozone depleting compounds like chlorofluorocarbons and hydrochlorofluorocarbons (HCFCs).[7]

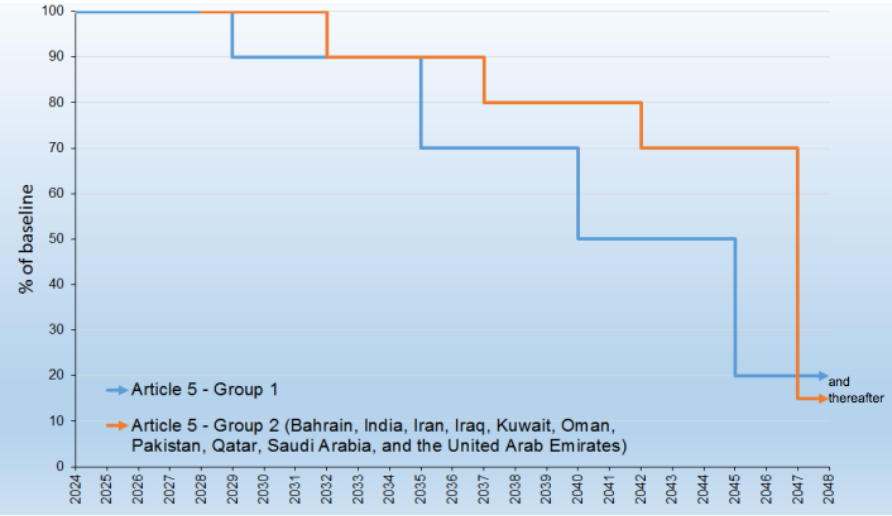
This proved to be a major success for the restoration for the ozone layer, which is expected to return to 1980 coverage around 2050. The use of hydrofluorocarbons in place of chlorine-containing compounds, however, also has negative global consequences. The HFC compounds most commonly used in air conditioning systems, such as R-410A and R-407C, are over a thousand times more potent than carbon dioxide, establishing them as a significant climate concern.

The graph below shows the substantial rise in HFC consumption since the introduction of the Montreal Protocol. Reducing our dependency on HFCs could be a great opportunity to combat climate change, and indeed a later change to the Montreal Protocol would make this a priority.



Source: HFCs: A Critical Link in Protecting Climate and the Ozone Layer[8]

Introduced in October 2016, The Kigali Amendment was the first modification to the Montreal Protocol (now ratified by 197 countries) to monitor substances that did not contribute to ozone depletion. Under this amendment, the involved parties agree to cut the production and consumption of hydrofluorocarbons by approximately 80% over the next three decades.[9] The phase down is split into two major groups and has the potential to avoid up to 0.5° C of global warming by the end of the century.[10] A graph of the phasedown schedule can be seen below.



Source: The Kigali Amendment to the Montreal Protocol: HFC Phase-down[11]

The Kigali Amendment is set to go into force on January 1, 2019. With over 20 countries that have ratified the agreement and some efforts already taking effect, much support is still needed in order to have a lasting impact. Efforts like the Kigali Cooling Efficiency Program (K-CEP), a philanthropic program that supports the implementation of the Kigali Amendment, can help provide tools and research to help countries shift away from HFCs and find new cooling solutions. Countries with a larger HFC footprint, like the United States, China, and India have yet to ratify the amendment.

Challenges and Opportunities

Some of the warmest countries, especially those with burgeoning economies, are expected to become much heavier air conditioning users over the next few decades. Countries with high air conditioning use, like China and the Unites States, already have a huge footprint in space cooling energy use and HFC leakage. Head of the Climate and Clean Air Coalition Secretariat at the UN

Environment office in Paris, Helena Molin Valdés, has reported that HFCs "the fastest-growing [source of greenhouse gas] emissions in every country on Earth."[12]

Efficient air conditioning units can certainly help lighten the burden of increased electric power needs, but there is a great range in equipment energy use available on the market. Coordinated global efforts, both in policy and technology, would be required in order to make energy efficient units a reliable solution. Supporting global efforts such as the Kigali Amendment will be essential to this goal. Smaller scale policy changes can be profoundly impactful as well. In the United States, for example, federal-level policy might be difficult to implement, but states such as California can help lead the country. Already, the California Air Resources Board has adopted a regulation that limits the use of HFCs, and is expected to lead to the reduction of 3.4 million metric tonnes of CO2 equivalent annually by 2030.[13]

Technological improvements will be another important step to reducing the impact of space cooling. In fact, testing and development for HFC replacements are already in place. Honeywell International has been developing HFC alternatives since the early 2000s, and has pledged to commit $900 million in total to the effort to research and development and new capacity for next generation refrigerants with a vastly lower global warming potential.[14] Other companies like Chemours and Johnson Controls, Inc are also putting forth efforts to developing HFC replacements.[15] This may not yet be a perfect solution, as some alternatives have been found to be flammable, but these efforts are an important step towards finding viable solutions to air conditioning climate challenges.[16]

Local infrastructural and behavioral changes will be an important complement to policy and technological developments. As the planet warms, not everyone will have access to air conditioning technology. The urban heat island effect, usually linked to industrial processes, roads, and traffic, can be particularly dangerous for vulnerable populations. Aside from the global warming potential of space cooling, the waste heat produced from air conditioning and refrigeration adds to the severity of urban heat islands.[17] Green urban spaces can help keep people safe and cool during heat waves and hot summers. Simple solutions can involve introducing more trees and parks and lightening the color of roads and building materials.[18] For those that do have access to air conditioning, it would be helpful to better educate users on the importance of programmable thermostats and on how to

properly operate them. Programmable thermostats can help lower in-home electricity use, but they are not always used properly or even at all. According to the Energy Information Administration, nearly two-thirds of all homes with central air conditioning and have a programmable thermostat do not actually program the thermostat.[19]

In office buildings, which also tend to be high air conditioning users, business could reduce their reliance on very cold temperatures by changing office practices. For example, the Cool Biz campaign in Japan encourages changes such as allowing workers to take longer summer holidays, adding greenery in the office, allowing men to wear short sleeves and to forgo ties and jackets in summer months, and relying on blinds and curtains more often. Such changes could be extended to help reduce air conditioning needs in buildings around the world.

Additionally, we must also consider our fuel mix. As air conditioning is powered by electricity, shifting to a greater percentage of renewable resources could help reduce carbon emissions related to space cooling. Many countries are already making such shifts, but citizens and businesses should continue to encourage and support renewable energies to maintain this momentum.

Staying cool in hot weather does not have to exacerbate climate change. Strategies for reducing the global warming impact of space cooling are numerous and can be tailored to meet the needs of different countries and regions.

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Notes

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