

Greenhouse Gas Regulations Might Aggravate Climate Change

March 16 2010, By Pete Brown



Associate Professor Paul Blowers

(PhysOrg.com) -- University of Arizona engineers find swapping one chemical for another may actually result in greater energy use, compounding the problems the new chemical was supposed to fix.

The U.S. government wants to regulate the use of [hydrofluorocarbons](#), which could lead to an increased use of hydrofluoroethers as a replacement. Both are greenhouse gases, and research at the University of Arizona indicates that HFEs might be worse for the environment than HFCs.

Paul Blowers, an associate professor of chemical and environmental engineering, and James Lownsbury, a UA senior majoring in chemical engineering, recently cast doubt on the credentials of a new group of chemicals called hydrofluoroethers, or HFEs.

Their research suggests that these new chemicals, originally thought to have low greenhouse gas potential when used as refrigerants, might actually lead to increased emissions. Their conclusions were published recently in a paper in [Environmental Science and Technology](#), the leading journal for the environmental science and engineering field.

Blowers and Lownsburry agree that HFEs have low emissions potential in terms of their chemical properties when studied in isolation. They contend, however, that the true potential of an HFE can only be determined by a complete analysis of its entire life cycle, from manufacture through use to disposal.

For instance, an HFE could have a low footprint, but the refrigeration or air-conditioning system in which it is used might have poor energy efficiency. The source of the electricity to run the system is also a factor in determining [environmental impact](#).

In their paper, Blowers and Lownsburry noted that refrigeration system compressors use about 70 percent of the total electricity requirement. Quoted in the journal's comment section, Blowers said: "What's often hidden is the indirect emissions due to the efficiency of the equipment and the chemical, and the need for electricity to run compressors or pumps or to deliver water."

Blowers added that geographic location affects greenhouse gas emissions, and said that current refrigerants such as hydrofluorocarbons, or HFCs, are better for the environment than the HFE he and Lownsburry tested wherever electricity is produced mostly from coal.

However, if renewable or nuclear power is used, the HFE causes lower [greenhouse gas](#) emissions than HFCs. Blowers said the "one-size-fits-all approach" to regulating chemicals and achieving sustainability will not work. He also said that the paucity of data available for these new

chemicals means it is impossible to measure their environmental impact.

This lack of data forced Blowers and Lownsbury to use computational chemistry to obtain some of the physical data, such as heat capacity, needed to perform the analyses because no experiments had been done to provide it.

Their current research is evaluating dry cleaning systems, window air conditioners and automobile cooling systems to see if results are similar for those cases. This involves designing the process, understanding how the technologies work, and determining the physical properties of the chemicals in order to do the evaluation.

Blowers also noted that the amount of energy required to manufacture a chemical needs to be considered when trying to establish its effect on climate. "What if making the HFE used up 100 times more energy than making up the HFC? Or what if it's the opposite?"

Meet the New Gas, Same as the Old Gas

In the 1970s scientists linked chlorofluorocarbons, or CFCs, to a hole in the ozone layer. Thanks to the CFCs contained in coolants, aerosols, solvents and pesticides, we were being exposed to harmful ultraviolet radiation from the sun.

These findings led to the adoption of the Montreal Protocol in 1989 to phase out the use of ozone-damaging chemicals such as CFCs. Among the chemicals that replaced CFCs were hydrochlorofluorocarbons, or HCFCs.

Then scientists became concerned about the part that HCFCs, which are greenhouse gases, were playing in climate change. So the parties to the Montreal Protocol agreed to phase out HCFCs.

In many cases, HCFCs have been replaced by hydrofluorocarbons, or HFCs, which also are greenhouse gases. In 2009, the EPA ruled that HFCs are health hazards and contribute to climate change.

Currently, HFCs are not regulated, and a big increase in HFC emissions is expected. If HFCs do become regulated, the main contenders for their replacement are hydrofluoroethers, or HFEs.

The environmental effects of HFEs are unknown.

Provided by University of Arizona

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