UNIVERSITY OF NOTRE DAME
CARBON DIOXIDE AND IONIC LIQUID REFRIGERANTS

PROJECT TITLE: Compact, Efficient Air Conditioning with Ionic Liquid-Based Refrigerants

ORGANIZATION: University of Notre Dame (Notre Dame) LOCATION: Notre Dame, IN

PROGRAM: BEETIT ARPA-E AWARD: $2,817,926

TECH TOPIC: Building Efficiency PROJECT TERM: 10/1/10-9/30/13

WEBSITE: www.arpa-e.energy.gov/ProgramsProjects/BEETIT.aspx

CRITICAL NEED
New and more efficient cooling methods are needed to reduce building energy consumption and environmental impact. Residential and commercial buildings currently account for 72% of the nation’s electricity use and 40% of its CO\(_2\) emissions each year, 5% of which comes directly from air conditioning. In addition, the refrigerants used in air conditioners are potent greenhouse gases (GHGs) that may contribute to global climate change. Because the majority of cooling systems run on electricity, and most U.S. electricity comes from coal-fired power plants which produce CO\(_2\), there is a pressing need to support improvements that increase the efficiency of these technologies and reduce the use of GHG refrigerants.

PROJECT INNOVATION + ADVANTAGES
Notre Dame is developing an air-conditioning system with a new ionic liquid and CO\(_2\) as the working fluid. Synthetic refrigerants used in air conditioning and refrigeration systems are potent GHGs and can trap 1,000 times more heat in the atmosphere than CO\(_2\) alone—making CO\(_2\) an attractive alternative for synthetic refrigerants in cooling systems. However, operating cooling systems with pure CO\(_2\) requires prohibitively high pressures and expensive hardware. Notre Dame is creating a new fluid made of CO\(_2\) and ionic liquid that enables the use of CO\(_2\) at low pressures and requires minimal changes to existing hardware and production lines. This new fluid also produces no harmful emissions and can improve the efficiency of air conditioning systems—enabling new use of CO\(_2\) as a refrigerant in cooling systems.

IMPACT
If successful, Notre Dame would decrease the use of conventional, polluting refrigerants and increase the energy efficiency of air conditioners.

- SECURITY: Increased energy efficiency would decrease U.S. energy demand and reduce reliance on fossil fuels—strengthening U.S. energy security.
- ENVIRONMENT: Refrigerants with polluting emissions could account for up to 10%-20% of global warming by year 2050. Notre Dame’s technology could eliminate the use of these refrigerants.
- ECONOMY: Widespread adoption of this technology could reduce energy consumption for air conditioning of buildings—providing consumers with cost savings on energy bills.
- JOBS: As new technologies develop, there will be new job opportunities in the design, installation, testing, and maintenance of efficient heating and cooling systems.

CONTACTS
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