

## ATP-Funded Research Promises Improved Food Safety and Quality

**Highlights from “Case Study of an ATP-Funded Project: Close Cycle Air Refrigeration (CCAR): Cross Cutting Applications in Food Processing, Volatile Organic Compound Recovery, and Liquefied Natural Gas Industries” by Pelsoci**

- **New closed-cycle air refrigeration (CCAR) technology is a higher performing, more cost effective industrial refrigeration technology for the ultra cold (–70° F to –150° F) range.**
  - Replaces applications where ammonia based mechanical refrigeration has been the dominant industrial technology but with a temperature limitation of above –70° F, and some applications that previously depended on cryogenic cooling to achieve temperatures approaching –150° F.
- **New CCAR technology promises improved food safety and quality, with reduced costs for cooling and less reliance on highly emissive diesel-powered transportation.**
  - The target and primary market for CCAR is currently expected to be the \$131 billion “further-processed” and “ready-to-eat” segment of the U.S. food industry.
  - In this rapidly growing market segment, CCAR is poised to become an enabling technology for:
    - *Improved food safety from rapid freezing of precooked processed foods;*
    - *Increased food quality and food processing yields; and*
    - *Reduced environmental emissions from diesel powered road transportation of liquid nitrogen and other cryogens.*
- **Estimated economic benefits<sup>1</sup> over the 2002 to 2016 time period from use of CCAR in food processing are high.**

---

<sup>1</sup> To estimate economic benefits, the author reviewed available market studies and industry publications and conducted in-depth interviews with ATP’s joint venture partners, food processors, food industry associations, and refrigeration manufacturers.

- Benefit to Cost Ratio estimated between 220:1 and 280:1 (from improved food quality and yield).
- Net Present Value of ATP's investment (\$2.1M) estimated between \$459M and \$585M.
- Additional annual exports estimated between \$5M and \$6M.
- Diesel emissions estimated to be lower as 12,000 to 14,000 truck shipments of cryogenics are avoided each year.
- **Additional environmental and energy benefits are promised in secondary applications, beyond food processing, including volatile organic compound recovery systems and liquid natural gas distribution.**
  - Significant potential for use in the U.S. liquefied natural gas (LNG), volatile organic compound (VOC) recovery, pharmaceutical and petrochemical industries.
    - *Use of CCAR as refrigeration for LNG terminals would enable the shift from diesel fuel to natural gas for ocean going vessels, with up to 98 percent reduction in carbon monoxide, 55 percent reduction in nitrogen oxide, and 95 percent reduction in particulate emissions.*

### Description of Study

*This study examines the national economic benefit of an ATP joint venture project, involving Air Products and Chemicals, Inc., and Toromont Process Systems, Inc., that received funding in 1995 to design, fabricate and pilot test closed-cycle air refrigeration (CCAR). CCAR is a new form of industrial refrigeration that uses environmentally benign dry air as the working fluid. With ATP's \$2.1 million investment, matched by \$2.2 million corporate investment, this joint venture developed CCAR as a cost effective industrial refrigeration technology for the ultra cold (−70° F to −150° F) range. Technology development and successful pilot testing were completed in 1999. Business development and marketing are underway. The non-proprietary abstract of the project can be found on ATP's home page: <http://jazz.nist.gov/atpcf/prjbriefs/prjbrief.cfm?ProjectNumber=95-01-0150>.*

Factsheet 1.B5 (September 2001)