

## **H8 RESIDENTIAL GAS ABSORPTION CHILLER HEAT PUMPS**

### **Description of Technology**

Residential absorption heat pumps use an ammonia-water absorption cycle to provide heating and cooling. The heat pumps circulate ammonia and water through the system. Ammonia (the refrigerant) is sequentially absorbed, boiled out, condensed, and reabsorbed in water (the absorbent) to produce the heat pump action (Sauer and Howell 1983).

**Current Status of Measure**  
Although cooling-only absorption units have existed for several decades, absorption heat pumps are still in the research stage. DOE has been funding Rocky Research and Ambian Climate Technologies to produce an absorption heat pump using the Generator Absorber heat exchanger (GAX) technology. This technology uses the heat that is released when the ammonia is reabsorbed into the water. By using this heat, the efficiency of the unit is increased significantly. Ambian Climate Technologies is a consortium of utility investors, including Mississippi Energies, Inc., Southern California Gas, Southwest Gas, Texas Gas Pipeline, and others including the Gas Technology Institute.

### **Energy Savings and Costs**

The new chiller/ heat pump technology developed by Rocky Research and Ambian uses GAX technology but also has a number of other innovations. These include a method for achieving high-efficiency vapor separation, ability to control variable refrigerant flow rates, the utilization of a low-emission, variable-capacity combustion process, and a new novel solution pump. The technology is currently in the development stage, soon to have prototypes in field tests (Anderson 2003).

These recent developments have resulted in a very efficient unit with a cooling COP of 0.7 at 95° F and a heating COP of 1.4 at a 47° F. However, since the technology allows for variable capacity, the efficiency seen during normal use should typically be higher, while cycling losses are significantly reduced. The 5-ton unit is expected to have a production cost target of \$3,000 with a goal of entering the market in 2005 (Anderson 2003). It is anticipated that other capacities will become available as the product is commercialized.

### **Key Assumptions Used in Analysis**

The most favorable applications for an absorption heat pump are in displacing conventional air conditioning systems in new construction applications. Retrofitting, although possible, is more difficult and costly, since it would be necessary to replace the refrigerant lines and the coil with a hydronic loop. Although the GAX technology is at a source energy performance disadvantage when compared to new 12 SEER cooling systems, the lower relative cost for gas (vs. electricity) results in homeowner cost savings, which will be amplified if time-of-day or demand rates are applied for residential tariffs. Maintenance requirements for the system are not yet clearly known, but the goal is to have requirements comparable to conventional HVAC equipment.

### **Recommended Next Steps**

The GAX technology faces significant barriers since maintenance and field performance of the unit has not been well quantified. Once the technology is proven in the field, the gas industry can effectively market the technology. Additional ongoing research areas include incorporating a water heating option to reclaim cooling mode waste heat. Added cooling mode energy benefits will help in offsetting the fairly low cooling efficiency.

## H8 Residential Gas Absorption Chiller Heat Pumps

<i>Description</i>	Absorption chillers/Hybrid absorp+mechanical chiller		
<i>Market Information:</i>			
Market sector	RES		
End-use(s)	HC		
Energy types	GAS, ELEC		
Market segment	NEW, ROB		
<i>Basecase Information:</i>			
Description	5 ton central AC/furnace		
Efficiency	80 AFUE / 12 SEER		
Electric use	3,538 kWh/year	Energy Databook avg national cooling x 5/3	
Summer peak demand	5.4 kW	5 ton, .9 coincidence	
Winter peak demand	0.8 kW	furnace fan	
Gas/fuel use	108.3	Energy Databook avg national gas heating x 5/3	
<i>New Measure Information:</i>			
Description	5 ton Absorption HP		
Efficiency	COP cooling, 1.40 COP heating		
Electric use	1,990 kWh/year		
Summer peak demand	1 kW	includes fan and system parasitics	
Winter peak demand	1 kW	includes fan and system parasitics	
Gas/Fuel use	110.8		
Current status	RES		
Date of commercialization	2005		
Life	20 years		
<i>Savings Information:</i>			
Electricity	1,548 kWh/year		
Summer peak demand	4.4 kW		
Winter peak demand	-0.2 kW		
Gas/Fuel	-2.5 MMBTU/year		
Percent savings	9%		
Feasible applications	14%	90% of large houses (30%) with gas (53%)	
2020 Savings potential	6,260 GWh		
2020 Savings potential	41 TBtu (source)		
Industrial savings > 25%	NO		
<i>Cost Information:</i>			
Projected Incr. Retail Cost	\$900 2003 \$	per 1998 study	
Other cost/(savings)	\$19 \$/year	added gas use reflected in cost	
Cost of saved energy	\$0.07 \$/kWh		
Cost of saved energy	\$6.63 \$/MMBtu		
Data quality assessment	C (A-D)		
<i>Likelihood of Success:</i>			
Major market barriers	Establishing distribution and service		
Effect on utility	None		
Current promotion activity	gas utility consortium		
Rating	2	(1-5)	
Rationale	Improved efficiencies needed		
<i>Priority / Next Steps</i>			
Priority	Special		
Recommended next steps	Field tests to document performance, utility incentives to follow		
<i>Sources:</i>			
Savings	Anderson 2003		
Peak demand	DEG estimate		
Cost	Anderson 2003 for production cost, DEG estimate for retail cost		
Feasible applications	DEG estimate		
Measure life	Anderson 2003		
Other key sources	Ryan 2002, Babyak 2003		
Principal contacts	Joel Anderson, Ambien Climate Technologies (205-822-8740)		
Notes			