Laboratory Performance Evaluation of Residential Scale Gas Engine Driven Heat Pump

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Outline

- Why GHPs?
- Project overview.
- Laboratory testing results.
- Technical and market barriers.
- Future plans.
Benefits of GHP

- Electric demand reduction by 80%.
- Elimination of electricity transmission losses.
- Heat recovery from engine block.

BTO report in 2012 estimated energy saving potential of GHP technology in residential sector to be 44 Terawatt-hour (0.15 Quads) annually.
Project Overview

Southwest Gas
+
Oak Ridge National Laboratory

CRADA
Project Overview

NextAire 11-ton Packaged Rooftop Heat Pump

- Demonstrated for 12 months at six DoD bases.
- Electric and Gas utility savings reported for all locations.
- Utility combined savings ranged from $680 to $2,134.
Project Overview

Main Specifications
- Single family residence.
- 4-ton cooling capacity at 105°F (40.5°C)
- Water heating capability.
- Condensing unit power consumption < 1 kW.
- Multi-stage operation.

Other design targets
- Noise requirements.
- Low vibration levels.
- Footprint.
CRADA Outcomes

- Final design built.
- Laboratory tested.
- ETL certified.
Laboratory Testing Results

Sensible heat ratio

Condensing unit power consumption

Outdoor Temperature, C

Outdoor Temperature, F

SHR

Watt

1800 rpm
2400 rpm
3400 rpm
Technical and Market Barrier

Low Frequency Noise

- Sound-generating vibrations from engine.
- Noise insulation is costly and not always effective for low frequency band.

Engine Performance

- Limited power.
- Low thermal efficiency.
- Efficiency needs to increase to 28-30% for economic viability.
Technical and Market Barrier

High Initial Cost

- Currently $14,000.
- Mass production will reduce cost.
- Engine subassembly, compressor, and exhaust to coolant heat exchanger need to be redesigned.

Market Acceptance

- Low awareness.
- Poor perception.
- Greater exposure of the technology to end-users, installers, designers and contractor is needed.
Technical and Market Barrier

Incomplete Valuation

- Better tools needed to evaluate full benefits and better model GHP technology.

Regulatory Issues

- Investment credits.
- Incentives to tie to renewables.
- Continuous engagement with regulators, policy makers, market operators, utilities, and manufacturers is needed.