

Natural Connection Heat Pump Cycle, Technical Report

Foreword

The Natural Connection Heat Pump Cycle (NCHP) integrates solar energy, evaporative cooling, and traditional heat pump technology to create an efficient, biomimetic approach to heating and cooling. It is offered freely in the hope that it accelerates sustainable HVAC innovation.

Why Natural Connection?

The Natural Connection concept bridges existing HVAC technology with natural processes. Inspired by Janine Benyus' book 'Biomimicry', it mirrors nature's ability to capture, store, and reuse energy efficiently. It is a system that 'echoes nature' using solar warmth, evaporative cooling, and natural energy storage.

The Solar Story

Solar energy remains underused primarily due to cost, reliability, and misunderstanding. Today, technology convergence, manufacturing efficiency, and rising energy costs make solar-assisted systems economically viable. The NCHP Cycle captures these opportunities by integrating solar thermal collection with heat pump efficiency.

The Model

A modeled 1,800 ft² home (R-11 walls, R-19 ceiling) using EQuest demonstrated that 84% of energy demand was space heating. By capturing solar and evaporative efficiencies, the NCHP system can reduce annual consumption by approximately 60%, translating to savings of about \$564 per year and a simple payback between 10 and 15 years.

Cycle-by-Cycle Operation

Cycle 1: A fan in series with the outdoor heat pump fan maintains equivalent air volume. No freeze protection is needed.

Cycle 2: An enclosure directs airflow and supports components such as fan, coil, valve, evaporator pad, and controls.

Cycle 3: A heating coil uses stored warm water to heat air, drawing from upper tank layers and returning cooler water to the bottom.

Cycle 4: An evaporative cooling pad lowers incoming air temperature towards wet-bulb for summer operation.

Cycle 5: Air preconditioned by the coil and pad enters the heat pump coil, improving efficiency in both heating and cooling modes.

Cycle 6: Solar thermal panels deliver ~25,000 BTU/day each; approximately 900 ft² of collectors serve an 1,800 ft² home.

Cycle 7: A below-grade, insulated 600-gallon-per-ton tank stores and stratifies water, supporting both heating and cooling cycles.

System Cost & Payback

System costs are driven by collector pricing. With 2009 collector costs around \$1.94/ft², achieving \$150 per panel remains key to hitting a 15-year simple payback. At current utility rates, owners benefit from sustained energy cost reduction beyond the payback period.

Collector and Storage Considerations

Solar collectors and piping are designed for drain-back protection during freezing conditions. A 600-gallon-per-ton insulated underground tank provides thermal storage with minimal heat loss and no freezing risk.

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Nature shows us what works, what lasts, and what is appropriate. The Natural Connection Heat Pump Cycle is an attempt to learn from that wisdom.

Notice

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