
Green, Healthy, and Affordable Homes on Their Way to Zero Energy—A Case Study

Robb A. Aldrich

Douglas K. Owens

ABSTRACT

In 2003 in South Chicago, Ill., Claretian Associates, a nonprofit community development organization, and South Chicago Workforce, a local nonprofit contractor, began construction of the “New Homes for South Chicago III” development. This development, with significant support from the city of Chicago and the state of Illinois Department of Commerce and Economic Opportunity, takes great steps toward making city-sponsored housing healthy, efficient, and affordable to own and operate.

The homes are constructed of structural insulated panels (SIPs) yielding R-25 walls and R-42 roofs. The homes are heated with condensing furnaces and lit predominantly with compact fluorescent lamps. The homes are very airtight (blower door tests show near 400 CFM₅₀ for all homes) and achieve HERS scores above 90. The first twelve homes include 1.2-kW photovoltaic systems.

As part of the Department of Energy’s Zero Energy Homes and Building America programs, Steven Winter Associates, Inc. (SWA) has been working with the builder, developer, and other partners to assess the performance of the homes and their energy systems. Of particular interest to the builder was the effectiveness of various ventilation systems. The first three homes each have a different ventilation system:

- *House 1: Energy recovery ventilator (ERV)*
- *House 2: Supply ventilation (outside air ducted to return plenum)*
- *House 3: Exhaust ventilation (controlled bath exhaust fans)*

To assess the energy implications of these systems, SWA is monitoring electric energy consumed as well as the flow rate, temperature, and humidity of exhausted, supplied, and tempered air in each home. To evaluate the effectiveness of the ventilation systems in delivering fresh air, SWA is monitoring temperature, humidity, and carbon dioxide concentrations at three points within each home and outside.

Of particular interest to SWA in the overall evaluation was how these efficient homes approached the “zero energy” target. SWA is monitoring total electricity consumed in the homes, energy produced by the PV systems, and operation of the gas furnace and water heater.

Regarding ventilation as well as energy consumption, preliminary results show that

- *actively distributing air is important for ensuring IEQ and*
- *distributing air using typical residential air-handling equipment consumes tremendous amounts of energy.*

While these results are not groundbreaking, the implications for homes targeting zero energy are significant. Figure 1 shows average daily energy consumption and PV generation for the three homes. In the first home (ERV system with distribution by central air handler), the ventilation system consumes an average of 11 kWh/day. In the second home (supply ventilation distributed

R.A. Aldrich is Engineer and Associate and **D.K. Owens** is Residential Energy Analyst, Steven Winter Associates, Inc., Norwalk, CT.

by air handler), the ventilation system consumes an average of 6.5 kWh/day. The solar electric systems, by contrast, produce an average of 3.5 kWh/day.

In working in similar climates with other builders targeting “zero energy,” SWA has recorded average electricity use of 8-12 kWh/day. Most of these homes share one notable feature: hydronic heating without a central air handler.

The results of the monitoring further demonstrate that, when targeting “zero energy,” energy efficiency is the first and most critical step. This session will review these findings in more detail specifically focusing on how ventilation, heating and cooling distribution, lighting specification, and lighting design should be optimized before more expensive renewable energy systems are considered.

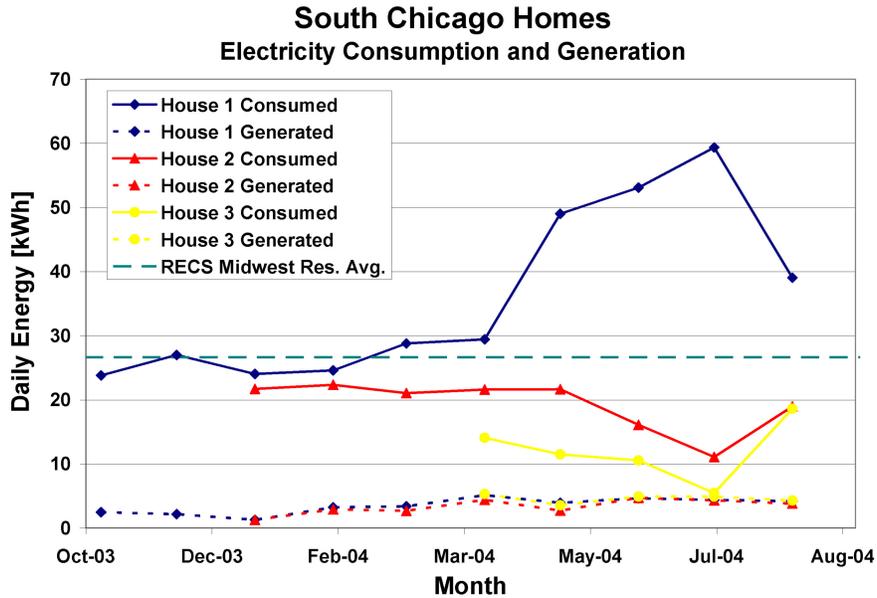


Figure 1 Chart showing average energy consumption and PV generation each month at each of the first three South Chicago homes. The dashed green line is the average electricity consumption of all homes in the Midwest (RECS).