

Affordable Housing and Energy Efficiency
A Study of Incentives, Consumer Habits, and Building Design

By

Jennifer Shepherd

Thesis

**Submitted in partial fulfillment of the requirements for the Degree of Bachelor
of Arts in Environmental Studies at Brown University**

May 1993

ABSTRACT

In order for a home to be affordable it must have low initial and operating costs (lifecycle costs). Energy efficiency in the home's design lowers both the operating cost and the lifecycle cost. An affordable home should provide a safe, healthy environment for its occupants. Indoor air pollution can impose costs in terms of increased health care expenditures and decreased personal efficiency. These costs should be incorporated into the definition of affordability.

The Providence Housing Authority (PHA) has made significant strides in incorporating energy efficiency into the specifications for their newest low income housing development, the Scattered Site project. The Scattered Site development calls for 240 units of single family and duplex houses to be built throughout the city. Completed Phase I units of this development have thermal efficiencies above minimum building code requirements. Phase II specifications set even stronger energy efficiency standards.

The heat use in a house is determined by two factors: the habits of the residents and the heat containing and generating abilities of the house. This paper provides a case study analysis of these two factors in the Scattered Site homes.

26 Scattered Site residents were interviewed in their homes to determine their energy use habits, knowledge of energy issues, opinions on their home's energy use, and exposure to health risks related to indoor air pollution. Many tenants had little knowledge of ways to save energy or actions that put them at risk from indoor toxics. Eleven of the respondents indicated that they sometimes kept their thermostat at or above 80 degrees Fahrenheit. The mean reported thermostat setting for the houses surveyed was 72 degrees Fahrenheit. Half of the residents keep their windows open periodically in the winter.

The second part of this study calculated the heating load of six different unit types in the Scattered Site development. The heating load was modeled using home energy rating software. Information on the specific building attributes were entered from architectural drawings and site visits. Infiltration rates were determined by blower door tests of six units, two from each of three unit types. Combined with information from the survey, the heating load models accurately predicted the gas consumption in specific units.

A simple upgrade of insulation in a home will not significantly decrease the energy consumption if infiltration rates are high. Infiltration in the Scattered Site units is responsible for as much as 40% of the heating load. Performance testing for air tightness should be conducted to measure a building's tightness and identify leaks before a unit is bought by PHA. Infiltration rates in the units were high enough to cause small noticeable drafts, and increase heating bills, but low enough to cause accumulation of indoor air pollutants. Low levels of natural ventilation causes interior condensation, growth of dangerous microbes, and possible accumulation of air toxics. Ventilation systems should be installed in the Scattered Site units to make the units safer and reduce future maintenance costs. Tenants should be educated as to the added risks of indoor air pollution in a tight home.

Energy for many low-income households is subsidized through federal energy assistance programs or housing assistance allowances. When subsidies are structured so that all incentives for conservation are removed, many residents consume at higher rates. High consumption rates limit the amount of assistance available for other low-income households. Subsidized rates can be restructured to retain incentives for energy conservation.