#2020

Residential Energy Conservation:

The Case for House Doctors

Testimony Before
the Subcommittee on Energy and Power
of
the Committee on Interstate and Foreign Commerce
The United States House of Representatives

by

Gautam S. Dutt
Center for Energy and Environmental Studies
Princeton University
Princeton, N. J. 08544

October 30, 1979

Mr. Chairman and Members of the Committee, thank you for the opportunity to testify at this hearing.

The potential for energy savings through more efficient energy use in U.S. residences is enormous. Cost effective measures to reduce space heating energy use in existing oil and gas heated houses could lead by 1990 to saving the equivalent of 1.6 million barrels of oil per day. That is almost half of what is currently imported from Arab and Iranian sources.

In order to tap the enormous energy saving potential in home heating, we need to fullfil three requirements: First, we need to know what's wrong with houses and how to fix them up. Second, we need trained people to evaluate and fix up houses. Third, we need a high level of resident participation.

Many ways to reduce space heating energy use are already familiar: you add insulation where there isn't enough, install storm windows if there aren't any, and maybe caulk and weatherstrip around doors and windows. But most people are not aware of many, less obvious heat losses that are equally important, and can easily be eliminated. For instance, in a series of experiments in occupied houses, we found that heat losses through insulated attics are three to five times as much as predicted by most calculations. The main reason is that these houses have paths by which warm air can escape from the living space through the attic, bypassing any attic insulation.

The most easily spotted of these heat leakage paths are holes and openings in the attic floor. For instance, in many houses, plumbing vents

and electrical wiring pass through the attic floor and usually have openings around them (slide 1). The larger the opening, the greater the heat loss. For instance, the heat lost through a one square foot opening around a furnace flue was found to be about 700 times the heat lost by conduction through a square foot of attic floor with three and a half inches of insulation. Heat leaks like these are easy to block: all you need to do is plug up the openings with some fireproof bulky material such a fiberglass.

However, not all of the heat loss paths are easy to find. Hidden under the insulation in one attic we studied was a dropped ceiling: warm air from the inside of a wall cavity was mixing with cooler attic air, and adding considerably to the heat loss. It took us a while to find this heat loss path, but once found it was quite easy to block.

In a survey of 40 wood frame houses in the Northeast, we found that on the average 20% of space heating energy is lost from these houses through attic bypasses alone, not counting the heat that is conducted through the insulation. In these experiments, we found that heat losses through insulated attics are three to five times as much as predicted by most calculations. Handbooks or computer programs will usually fail to give people advice that will minimize the cost of improving the energy performance of their houses. While savings based on theoretical calculations may be cost-effective, the homeowner could often be saving much more for the same level of investment if the bypasses were blocked first. Moreover, because of attic bypasses a homeowner who follows advice to add more ceiling insulation is likely to get only

1/3 to 2/3 of the fuel savings claimed for the insulation job. And the insulation job will usually make it much more difficult in the future to find and plug up the bypass heat flows.

Attic bypasses illustrate a type of heat loss that is difficult to find, but once found, relatively easy to eliminate. Fortunately, we have been able to develop a package of diagnostic equipment which makes it possible to identify these obscure heat losses much more quickly than was possible previously. In one test procedure, we use a high power blower to pull air out of a house. The blower is mounted in a wooden panel of adjustable width and height to fit into the front door frame of the house (slide 2). While the blower is sucking air out of the house, we scan the interior surfaces of the house with an infrared viewer. The infrared scan helps us to distinguish surfaces at different temperatures and to identify obscure heat loss paths. Infrared views also show up other defects of construction such as missing insulation. Following an infrared scan, specific leaks can be identified using a smoke pencil.

We recommend the following prescription for saving energy in the home. A pair of "house doctors," trained technicians, enter a house carrying diagnostic equipment and some inexpensive building materials, such as caulking compund, adhesive tape, polyethylene film, and some glass fiber insulation. As they walk through the house looking for obvious defects, they identify and eliminate obscure heat loss paths. For example, when checking insulation levels in the attic, they seal openings around flues and pipes by stuffing them with glass fiber, and close small cracks with caulking compound, or adhesive tape. They close larger air leakage paths, such as those above

dropped ceilings and stairwells, by taping or stapling a sheet of polyethylene over the opening (below any insulation on the attic floor). They install foam gaskets to reduce air leakage through electrical switches and outlets on outside walls. They also tune up the furnace. According to our experiments, about 20% of the space heat may be saved in a typical house by just these on-the-spot improvements. In addition, the house doctors provide the residents with a list of other energy conservation measures requiring more extensive work. While many of these measures are relatively obvious (e.g. adding insulation, storm windows, shutters, clock thermostats), the house doctor should indicate which are cost justified and rank investment priorities. The total energy savings that can be achieved by all these improvements depends on the condition of the house. In the case of one townhouse, "well insulated" to begin with, a further two-thirds savings in space heating fuel was obtained.

In order to have a successful housing energy conservation program, we need highly trained house doctors to diagnose houses and assess which conservation measures are economically justifiable. We don't have any house doctors today. Therefore, recruiting and training them should be the highest priority item in the national residential energy conservation program. Otherwise, we could spend a great deal of money and have much less to show for it than we should.

A major component of the house doctor program should be the field evaluation of house doctor visits and subsequent house improvements. This evaluation is essential not only for marking the progress of the effort, but also for upgrading the house doctor training program and retrofit installation

practices. New information, based in part on the evaluation of past performance, will help to reduce the time and cost of house calls and retrofits. The entire program is shown schematically in the viewgraph. Based on our present knowledge, a house doctor training, certification, and licensing program could be set up. These house doctors, along with one or two assistants, "house para-medics", will visit houses to rectify obscure heat leaks, adjust furnaces, and list major retrofits that could reduce energy use cost-effectively. Subsequently, home improvement contractors would come in and fix up the houses. The cost of house calls, the subsequent retrofits, and the energy savings would be documented for evaluating the success of the program. This evaluation, along with information about new products and techniques, would be used to improve the training of house doctors. I want to stress the importance of this evaluation component. Without it, the program will not be able to learn from its mistakes.

In August, we proposed to the Administration that about a thousand houses be selected for detailed analysis, retrofit, and as a training ground for house doctors. These houses would also be used to identify and catalog many of the obscure heat losses that may be typical of houses in a given region. These houses could be designated as "showcase" houses for publicizing the energy savings potential. With a thousand showcase houses in the country, most people will be near one. This will bring home the enormous potential for energy conservation to everyone.

The Administration expressed an interest in our proposal but has not

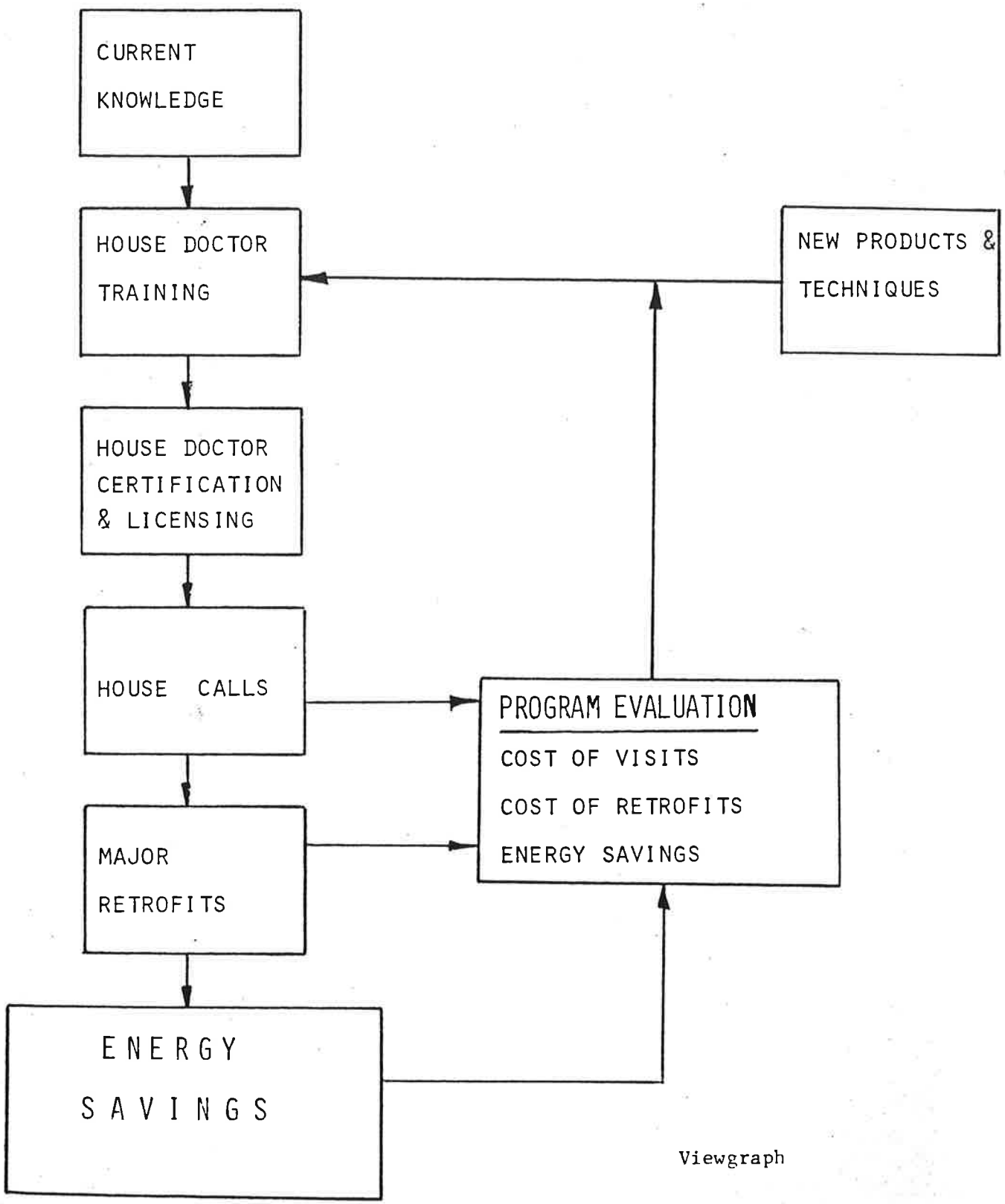
made any new financial commitments to carry it through. Since we were already engaged in a research contract for the Department of Energy, however, they agreed to let us redirect some of the effort towards a demonstration program along the lines of our proposal. A number of public and investor-owned utilities and conservation programs have agreed to participate in this program. By the spring of 1980 we hope to have evaluated over 100 houses in places as far apart as upstate New York and San Francisco.

Thus in a few months since our identification of the house doctor approach, a demonstration program is well under way without any additional federal financial assistance. If this demonstration proves to be successful, full scale commercialization can begin in a few months. In contrast to other energy technologies residential energy conservation holds the promise of a large payoff and a rapid transition from laboratory to commercialization.

The federal government can play a vital role in initiating a successful energy conservation program. For instance, although the instrumented audit and partial retrofit approach characterizing the house doctor program is now included as an option in DOE's model audit program, states may not have the resources readily available to set up the necessary training and evaluation programs. In such cases, the federal government could speed up the process by providing the funds for establishing the necessary infrastructure.

Conservation through improved energy efficiency has many advantages. People will not have to sacrifice comfort or convenience in order to save energy. Indeed, comfort may be improved. Increased energy efficiency will also reduce both pollution and inflation, create jobs, and perhaps most importantly, reduce the dependence on foreign oil. Thank you.

HOUSE DOCTORS AND ENERGY CONSERVATION



Viewgraph