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THE EFFECTS OF LOANS ON RESIDENTIAL RETROFIT: EXTENT, PACE, AND LONGEVITY *

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ABSTRACT

Many gas and electric utilities throughout the U. S. offer financial incentives to their residential customers in an effort to encourage installation of energy-efficient measures. These low-interest loan and cash rebate programs represent major energy conservation investments on the part of these utilities and therefore warrant careful assessment of their effects and effectiveness.

This article reviews empirical evidence on the effects of no- and low-interest loan programs that help finance retrofit measures in single-family homes. The evidence shows that these financial incentives have several effects. Households that participate in these programs install *more* retrofit measures, install measures more *quickly*, and install measures with *longer lifetimes* than do households not participating in these programs.

Almost all major gas and electric utilities in the U. S. offer their residential customers on-site home energy audits [1]. The major purposes of these audits are to identify cost-effective energy conservation actions for individual homes and to encourage adoption of these actions.

Many utilities supplement their audit programs with offers of financial incentives [2]. These incentives (usually low-interest loans) are intended to increase the number and effectiveness of retrofit measures installed.

Households that take low-interest loans generally install more conservation measures than do those taking only a home energy audit. In addition,

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households who accept such loans may install measures more quickly and install measures with longer lifetimes. The purpose of this article is to discuss these three effects of loan programs on residential retrofit – extent, pace, longevity – using data from a recent evaluation of utility home energy audit and loan programs in Minnesota.

EXTENT

Several studies show the effect of low-interest loans on the extent of residential retrofit. For example, homes receiving an audit in Connecticut installed (during the following twelve to eighteen months) measures that captured only 32 percent of the conservation potential identified during the audit (see Figure 1). Households in the Pacific Northwest offered a zero-interest loan to finance audit-recommended measures, on the other hand, installed measures that captured 82 percent of the potential identified during the audit (see Figure 2).

The preceding comparison is of limited value because Connecticut and the Pacific Northwest are such different areas. Northern States Power (NSP), the largest utility in Minnesota, operated both audit only and audit plus loan programs in the St. Paul area. Here again, households that took a loan installed much larger fractions of the recommended measures than did households who were not offered a loan or households who declined the loan offer (Table 1).[1]

PACE

The above examples demonstrate the effectiveness of loans in stimulating additional residential retrofit and energy savings. Another important effect of these loans, which has not been discussed before, concerns the *pace* at which households adopt audit recommendations. Intuition suggests that households receiving a list of recommended measures (subsequent to their audit) will adopt the measures slowly over time. The speed with which measures are adopted will depend on the free time household members have to install simple measures such as caulking and weatherstripping and their financial resources to pay for more expensive measures such as storm windows and wall insulation.

If, however, a low-interest loan is available, the household is more likely to install a "package" of measures at one time. That is, the availability and use of a loan should encourage households to accelerate the rate at which they adopt measures. The NSP program provides evidence to support this hypothesis (see Figure 3).

[1] See [3] for additional details on the NSP programs, evaluation design, data collection, and findings.

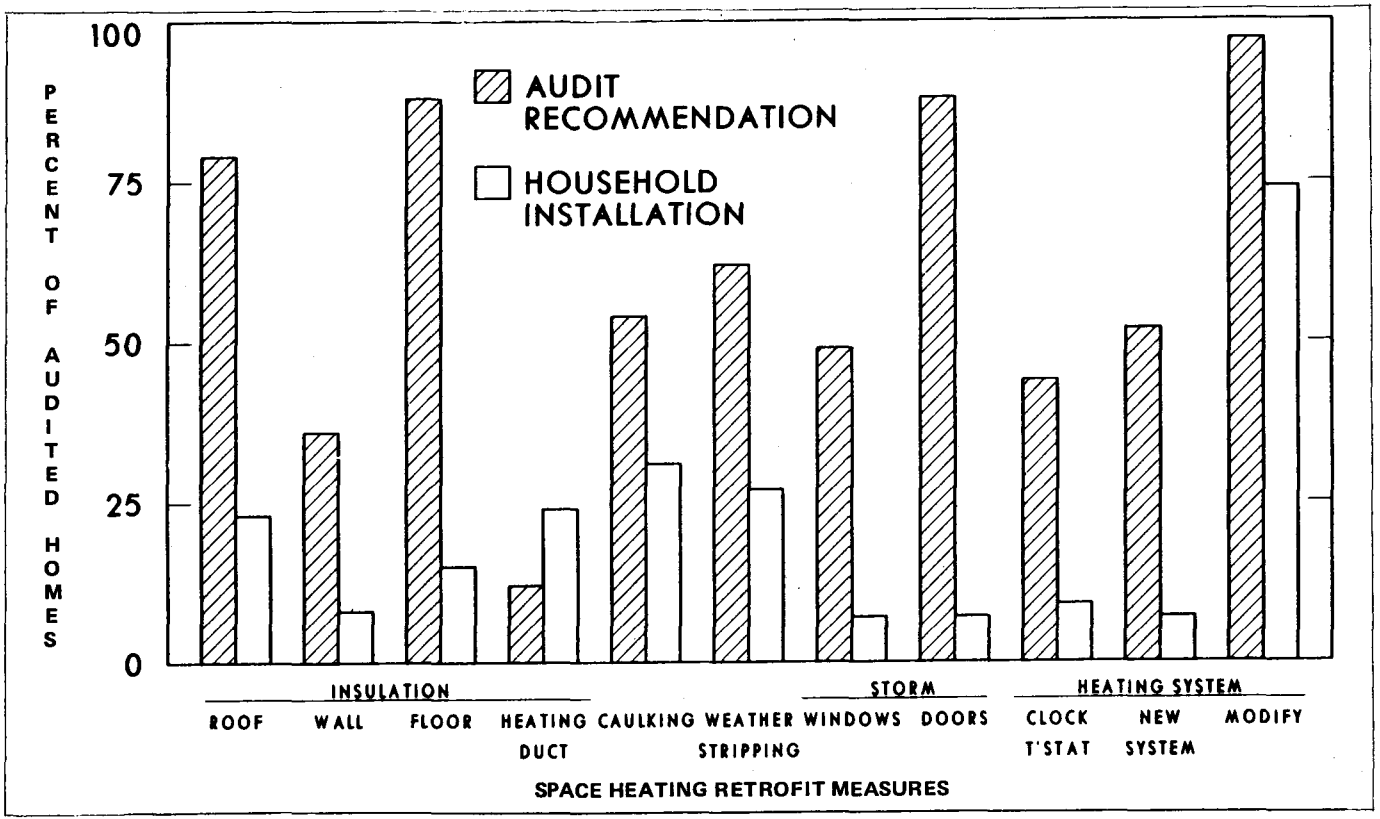

Figure 1. Relative frequency with which space heating retrofit measures were recommended and installed in 298 Connecticut homes audited in Spring 1981 [4].

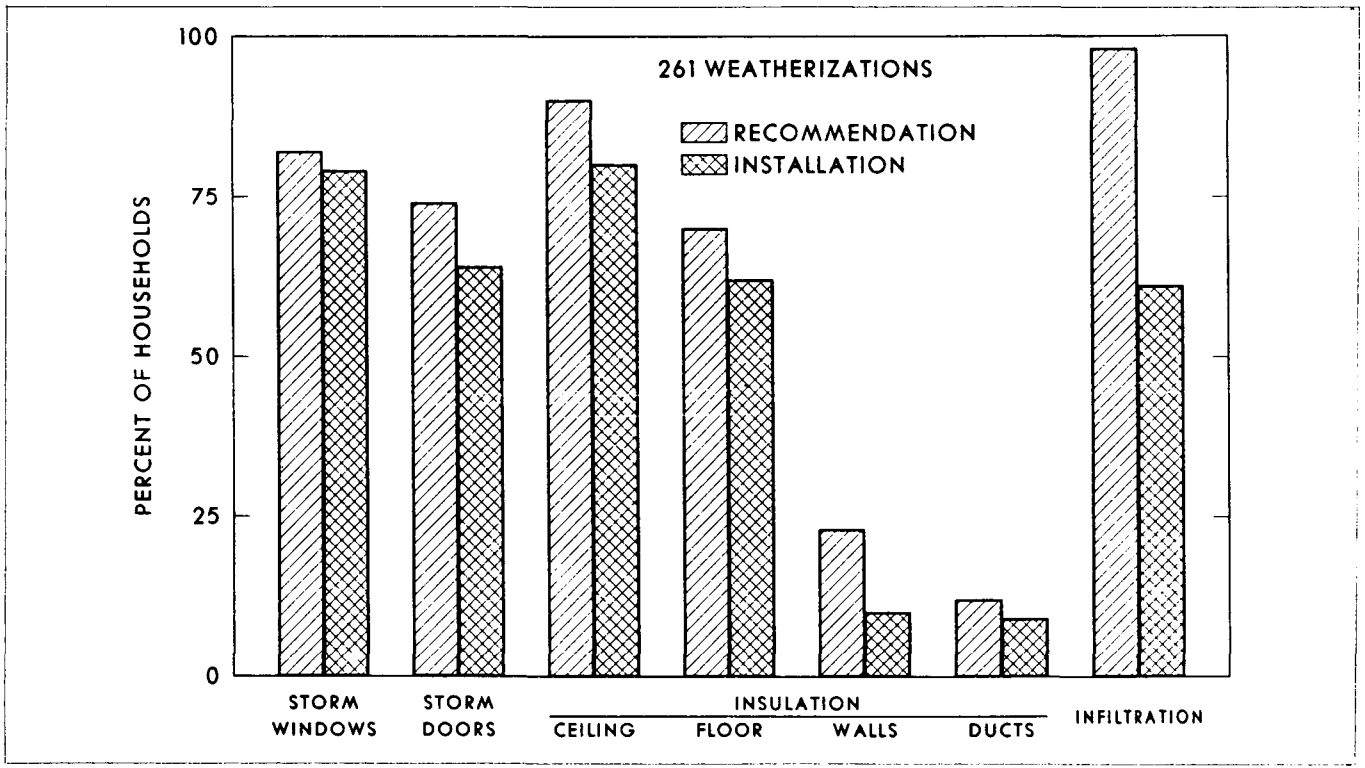

Figure 2. Relative frequency with which space heating retrofit measures were recommended and installed in 261 Pacific Northwest homes that received zero-interest retrofit loans in mid-1981 [5].

Table 1. Audit Recommendations and Adoptions for Minnesota Homes

	Percentage of Audited Homes In Which Measure was Recommended/Percentage of Recommendations Adopted[a]		
		Audit + Loan Program	
	Audit Program	*Loan + Audit*	*Audit Only*
Insulation			
Ceiling	61/21	82/44	82/8
Basement Wall	53/18	66/22	67/13
Other Wall	12/10	37/48	24/11
Crawl Space	15/10	15/14	14/0
Storm Windows	8/39	14/31	13/20
Storm Doors	8/30	10/90	5/25
Caulking/Weatherstripping	57/60	94/61	72/54
Clock Thermostat	76/7	80/43	71/2
New Heating System	68/4	90/58	73/9
Heating System Improvement	94/6	99/12	92/3
Number of Households	339	96	78

[a] The first number is the percentage of homes in which the measure was recommended; the second number is the percentage of homes that adopted the recommended measure after the audit.

Source: Hirst, et al. [3].

Households offered only an audit began to install measures only gradually after their audit. Based on household responses to a detailed telephone survey, households increased their energy savings in a roughly linear fashion during the first twelve months after the audit (Figure 3).

Households who received an audit and were offered a loan, but declined to take the loan showed an energy-saving pattern almost identical to that shown for the households offered an audit only. Their energy saving also increased slowly from month-to-month, reaching an estimated 8 MBtu twelve months after their audit.

On the other hand, households offered a loan who accepted one installed measures more promptly. The average energy saving for these audit + loan households grew by about 7 MBtu/month during the first six months after audit. This large saving is spread over six months because the elapsed time between the audit and retrofit/loan varies from household to household. However, the difference between the adoption rate of the audit only households and the audit + loan households clearly shows the much faster pace, as well as greater extent, of retrofit for those who used the utility's low-interest loan. Note that the rate of savings increase slows sharply during the second six month period for the audit + loan households (Figure 3). This is probably because most households obtain their loans within a few months and perhaps install one or two measures on their own later on.

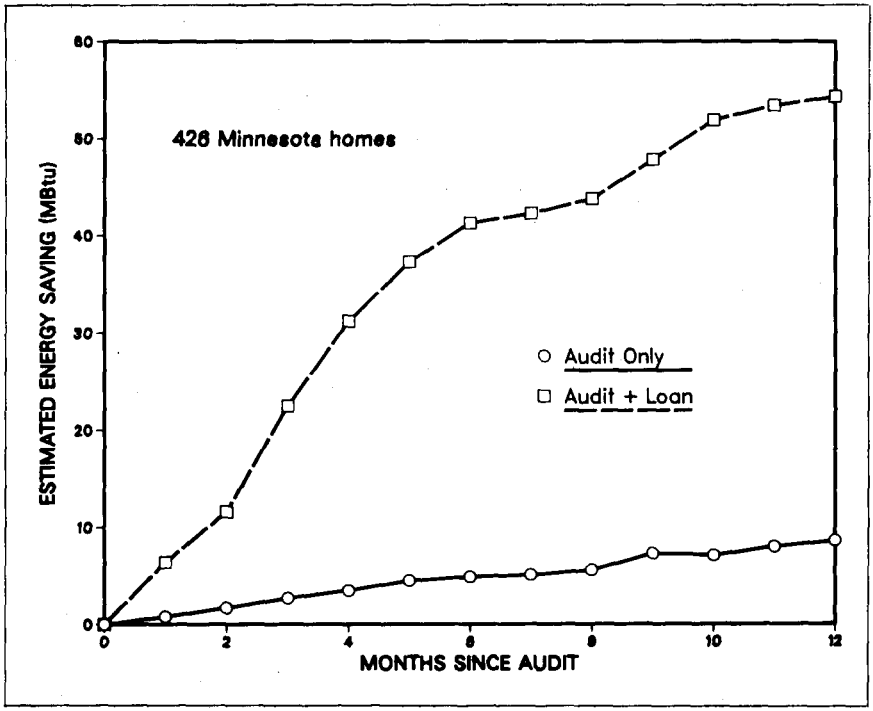

Figure 3. Estimated energy savings due to retrofit measures installed after home energy audits, for Minnesota households that received an audit only and for households that received both an audit and a low-interest retrofit loan. These figures are averages, based on telephone survey responses and home energy audit data from 331 audit only households and 95 audit + loan households [3].

LONGEVITY

A final effect of utility financial incentives (one that is also generally overlooked) concerns the longevity of the measures installed. Once again, intuition suggests that households who retrofit on their own (i.e., do no accept the utility's financial incentive offer) are more likely to install low-cost measures. Households who take out a loan, on the other hand, will install more expensive measures. Generally, measures that cost more also last longer (e.g., attic and wall insulation vs. caulking and weatherstripping). Data from the NSP programs support this hypothesis. The average lifetime[2] of the measures installed by the

[2] The average lifetime is computed using estimated energy saving for each measure as a weighting factor: $L = \Sigma L_i Q_i / \Sigma Q_i$, where L_i is the lifetime (in years) of measure i and Q_i is the estimated energy saving for that measure.

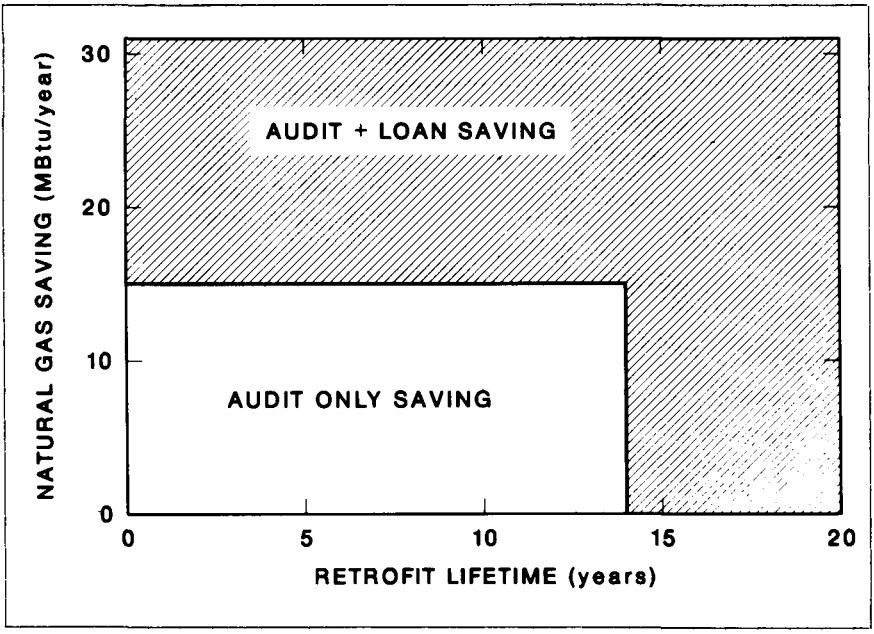

Figure 4. Average energy savings and retrofit lifetimes for households that received an audit only and for households that received both an audit and a low-interest loan in Minnesota [3].

audit + loan households was twenty years, compared with fourteen years for the audit only households (Figure 4).

CONCLUSIONS

The results presented here show that utility financial incentives (low- or zero-interest loans in this case) have several effects on residential retrofit decisions. Compared with households that receive an energy audit and no financial assistance, households that obtain both an audit and a loan install *more* energy conservation measures, install measures more *quickly,* and install measures with *longer lifetimes.* It is important to note that these findings are based on *data* – rather than assumptions – collected from households that participated in utility residential conservation programs in Connecticut, Minnesota, and the Pacific Northwest.

These findings suggest that the effects of utility energy conservation programs (information and/or financial incentives) are likely to be both manifold and subtle. In assessing the worth (benefits and costs) of conservation programs, it is important to consider multiple measures of program benefits. In

this case, analysis of first-year energy savings alone would underestimate the benefits of a retrofit loan program; such a limited analysis would ignore benefits of the loan program in accelerating retrofit investments and in stimulating installation of measures with long lifetimes.

Loan programs offer utilities a mechanism for achieving large and durable energy savings in a short time period (relative to audit only programs). Loan programs also reduce uncertainty for utilities about customer conservation actions and energy savings; by offering loans (with their associated quality assurance functions), utilities ensure that retrofit measures are installed fully and properly. These attributes of the loan also influence household decisions to install measures, by reducing their uncertainties and transaction costs.

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