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van Raaij, W.F.; Verhallen, T.M.M.

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DETERMINANTS OF HOME INSULATION INTENTION¹

W. Fred van Raaij, Erasmus University Rotterdam
Theo M.M. Verhallen, Tilburg University, The Netherlands

Abstract

Home insulation intention of home owners and renters is explained by a set of determinants: home characteristics, energy-related household behavior, attitudes, expectations, and sociodemographics. In a survey among 845 owners and 1101 renters, differences between owners and renters with and without insulation, are shown. Some home characteristics, attitude components, and expectations are significant determinants, although the level of explained variance is low. Home insulation intention of renters is mainly a matter of expected savings and expected high energy prices. For owners, comfort and an expected favorable household financial situation are the main determinants.

Introduction

One of the objectives of the energy policy of the Dutch government is to reduce the amount of energy, mainly natural gas, for home heating. This objective can be realized through a number of policies, one of them being a better thermic insulation of homes. The typical approach of a policy of better home insulation is to start with a survey of the technical state of homes and their possibilities for insulation, e.g. filling cavity walls and installing double glazing. Secondly, the economic aspects of home insulation are studied, and economic tradeoffs are made of the costs of installing home insulation of different types of homes and the energy conservation that can be attained. Thirdly, the behavioral aspects of home insulation come into focus. Why do some homeowners not insulate their homes, if this is technically and economically feasible? Why do other homeowners insulate their home, while they do not get enough return on this investment? Why do homeowners start their home insulation with double glazing, which is economically less effective than wall cavity filling? How do renters relate to the owners of their homes, and how does this influence home insulation decisions?

Determinants of Home Insulation

A number of factors influence the home insulation intention. Verhallen and Van Raaij (1981), in their study of factors determining household energy use, distinguish situational characteristics (climate, weather, technical home characteristics), behavioral factors (energy-related household behavior), and special circumstances, e.g. the presence of babies or elderly persons with a need for a higher temperature. Attitudinal and life-style factors may affect household energy behavior and thus energy use.

In a similar manner, the home insulation intention may be influenced by home characteristics, energy-related household behavior, home insulation attitudes, expectations with regard to the future energy price and prices in general, and sociodemographic characteristics of the homeowners and renters. A number of these determinants are discussed below.

Home Characteristics

Verhallen and Van Raaij (1981) use the following home characteristics in their study on household energy use: degree of home insulation, type of home (free standing,

semi-detached, row house, apartment), energy use of neighbors in attached homes, and wind orientation of the home. These home characteristics have both a direct and an indirect effect on energy use. The direct effect is the energy required to bring the home to an acceptable temperature. The amounts of energy required differ between home with different technical characteristics. The indirect effect is the effect of home characteristics on energy-related household behavior, and thus on energy use.

While the degree of home insulation is a significant determinant of energy use, we expect the reverse for this study. Energy use may be an important determinant of the home insulation intention. High energy bills might elicit an intention to install better home insulation, improving the "shell" (Van Raaij and Verhallen 1983b) of the home.

Related to the home's energy use is the type of heating system. We expect that people living in a home with an individual central-heating system (and their individual energy bill) will be more likely to consider home insulation than people living in a home without individual heating and billing.

Houses with a cavity wall are easier and less expensive to insulate than houses with a single wall. Most houses built after 1945 possess a cavity wall. Only a part of the houses built between 1925 and 1945 have a cavity wall, and almost no houses built before 1925 are built with a cavity wall.

Other relevant home characteristics are the maintenance level of the home. Owners of well-maintained homes are more likely to install home insulation than owners of poorly maintained homes. Homes with a low level of maintenance might be insulation in a process of home improvement and renovation.

Type of home, free-standing bungalow, row house, apartment, is a fifth relevant home characteristic. Larger, free-standing homes with a higher energy use have a higher potential for energy saving than, for instance, apartments. These homes are thus more likely to be insulated. Related to type of home is home ownership. Owners, living in their own home, make their own home insulation decisions. Renters, often renting apartments, have to make an arrangement with the home owner (private person, private organisation or municipality in the case of public housing). In the study of home insulation intention, the distinction between owners (living in their own home) and renters will prove to be essential.

Household Behavior

Energy-related household behavior may be described by the components "temperature" and "ventilation" (Van Raaij and Verhallen 1983b). After a principal components analysis, Van Raaij and Verhallen (1983b) obtained two central temperature variables (home temperature while at home and during absence from home) and two ventilation variables (airing rooms and the use of the hall door). Temperature variables apply to the "kernel" (heating of the home), whereas ventilation variables pertain to the "shell". Based on these variables, respondents are grouped in five behavioral clusters: "Conservers" are characterized by low temperature and low levels of ventilation. The "spenders" have the opposite pattern: high temperature and high ventilation. The "cool" are low on temperature, but high on ventilation. The "warm" are high on temperature, but low on ventilation. The other respondents are "average" on both temperature and

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ventilation.

It is expected that respondents of these five behavioral clusters also differ with regard to their home insulation intention. We expect that the "conservers" and "warm" have higher home insulation than the "cool" and the "spenders", unless they have already insulated their homes.

Attitudes

Verhallen en Van Raaij (1981) obtained three principal components in their attitude statements: (1) Energy consciousness, beliefs that one should reduce energy consumption, (2) Home comfort and susceptibility to draughts; and (3) Price consciousness, energy saving for financial reasons.

One may distinguish costs and benefits of home insulation (Verhallen and Pieters 1984; Verhallen and Van Raaij 1985). Costs are short-term, related to the trouble and disorder, when the home insulation is installed. Long-term costs are also perceived as negative effects of home insulation, e.g., a damp and humid atmosphere in the home, and lack of fresh air. Benefits are the energy saving and increase of comfort of the home. Note that these costs and benefits are not only financial, but also behavioral.

Expectations

Consumer expectations with regard to economic developments, especially energy prices, prices in general, and the financial situation of the household. Consumers expecting higher prices in the future, may be more intended to insulate their homes than consumers not expecting higher prices. The expectation about unemployment is taken as an indicator of optimism/pessimism about future economic condition in the Netherlands. The expectation questions are similar to questions used to measure the "index of consumer sentiment" (Katona 1975; Van Raaij and Gianotten 1982).

Study Design

In order to investigate the relative importance of the home insulation determinants, a survey has been done among home owners and renters, commissioned by the (Dutch) National Insulation Program (NIP). The NIP is a government organization to stimulate and promote home insulation, and to perform research on the factors determining home insulation.

The survey was done by NIPO/Gallup Amsterdam on a national sample of addresses in The Netherlands. During a five-week period in February-March 1985, each week a sample of persons living at 400 addresses was interviewed. The random sampling procedure was to select 80 addresses from a universe of all available private addresses in The Netherlands. Starting with these 80 addresses, five interviews are held. This result is a clustered sample of five interviews per cluster. During the five-week period, 2000 interviews have been held, of which 1946 questionnaires are complete and available for analysis.

The sample consisted of 1101 renters and 845 owners of homes. No systematic differences are found between male and female heads of households.

Home Insulation Intention

In this paper, we will analyse the determinants of home insulation intention. Home insulation intention is measured with two questions on how likely/unlikely it is that the home will be insulated. The results are shown in Table 1.

For most respondents, home insulation intentions are low or very low. For 54.3 percent of the renters it is very unlikely that they will insulate their homes; for owners this is 44.6 percent. For 18.1 percent of the renters and 32.4 percent of the owners home insulation is likely or very likely.

TABLE 1
HOME INSULATION INTENTIONS OF RENTERS AND OWNERS

	renters		owners	
very likely	73	8.6%	118	17.0%
likely	81	9.5%	107	15.4%
unlikely	234	27.6%	160	23.0%
very unlikely	461	54.3%	310	44.6%
	849		695	

The category "very likely" pertains to home insulation intentions within the next 12 months. The other categories pertain to home insulation after 12 months.

The home insulation intentions of owners are significantly higher than of renters. Owners have more freedom to insulate their homes. Renters have to negotiate with the home owner or have to accept the home owner's proposals. Renters face a rent increase after home insulation that may be higher than their energy savings.

Home insulation intentions may be lower for people who have already insulated their home. Prior partial insulation, however, may lead to higher intentions to continue on the way to a better home insulation. In the remainder of the analysis, we distinguish between renters and owners of insulated and non-insulated homes.

Home Characteristics

Four groups are formed of renters and owners with insulated and non-insulated homes: (I) Renters with home insulation; (II) renters without insulation; (III) owners with insulation; and (IV) owners without insulation. Group sizes are 313, 348, 408, and 155, respectively, due to missing data on intentions or on home characteristics. Multiple regressions are run for each of these four groups.

Year of building is a relevant home characteristic. Renters and owners of a more recently built home with insulation have lower insulation intentions, because their homes are already insulated (groups I and III). Renters of a non-insulated home also have lower intentions, probably due to institutional problems with the home owner. Another explanation is that group II constitutes a group of renters without intentions, left over after all renters with the positive intention did have their homes insulated. Insulation intentions of group II are positively related to the presence of cavity walls and an individual heating system.

For home owners with insulation (group III), the presence of cavity walls is related to a lower intention. Homes with a cavity wall are generally already insulated. For home owners without insulation (group IV), an individual central-heating system is correlated with more insulation.

Household Behavior

Based on reported behavior with regard to temperature and ventilation, five behavioral groups are formed: "conservers", "spenders", "cool", "warm", and "average" (Van Raaij and Verhallen 1983b). Respondents with a room temperature lower than or equal to 19° Celsius, and with lower thermostat settings during absence, are classified as "conservers" or "cool". They are classified as "conservers" if they do not air their rooms very often and rarely leave the hall door open. Otherwise, they are classified as "cool".

Respondents with a room temperature higher than 19° Celsius, who do not always have lower thermostat settings during absence, are classified as "warm" and "spenders". They are classified as "warm", if they do not air their rooms very often and rarely leave the hall door open. Otherwise, they are classified as "spenders". Respondents remaining unclassified by the above procedure, are named "average".

TABLE 2

A. Multiple Regressions of Home Characteristics Explaining Home Insulation Intention

Home Characteristics	Renter with insulation	Renter without insulation	Owner with insulation	Owner without insulation
	I	II	III	IV
cavity walls	.00	-.12 *	.16 *	.00
(semi) detached	.03	.03	-.03	.23
row house	.00	-.06	-.08	.15
maintenance level	.00	.02	-.07	-.11
own heating system	.02	-.15 *	-.05	-.19 *
collective heating	.08	-.10	-.07	.08
energy costs	-.02	-.02	.02	.02
year of building	.23 *	.14 *	.21 *	.11
R ² (explained variance)	.06	.04	.10	.07
	n=313	n=348	n=408	n=155

B. Multiple Regressions of Consumer Typology Explaining Home Insulation Intention

Consumer Typology	I	II	III	IV
conservator	-.05	.03	.00	.00
spender	-.04	.00	.04	.05
cool	-.04	-.06	-.03	-.14
warm	.02	.03	.05	.02
R ²	.01	.01	.01	.03
	n=357	n=403	n=459	n=191

C. Multiple Regressions of Attitude Components Explaining Home Insulation Intention

Attitude Components	I	II	III	IV
I. saving	-.18 *	-.12 *	.02	.12
II. benefits	.08	.09	.14 *	.35 *
III. long-term costs	.05	-.03	.10 *	-.07
IV. short-term costs	-.04	-.09	.01	-.03
R ²	.05	.04	.03	.16
	n=357	n=403	n=459	n=191

D. Multiple Regressions of "All" Determinants Explaining Home Insulation Intention

	I	II	III	IV
<u>Home characteristics:</u>				
cavity walls	.00	-.09	.16 *	.00
maintenance level	.00	.04	-.06	-.15 *
own heating system	.02	-.13 *	-.05	-.09
year of building	.23 *	.11	.24 *	.21 *
<u>Attitude components:</u>				
I. saving	-.20 *	-.10 *	.03	.09
II. benefits	.05	.06	.14 *	.33 *
<u>Expectations:</u>				
energy price	-.08	-.16 *	-.03	.05
household finances	-.10	.00	-.09	-.19 *
R ²	.13	.10	.14	.28
	n=313	n=348	n=408	n=155

* p < .05

The size of the five groups are as follows: 298 "conservers", 368 "cool", 410 "warm", 456 "spenders", and 406 "average".

Group membership, as dummy variables, is used in multiple regressions to explain home insulation intention (Table 2B). Explained variances are extremely low and regression weights are insignificant. One may conclude that energy-related house hold behavior, as measured with these five groups, is not related to home insulation intention. Daily energy conservation or spending behavior is apparently not generalizable to home insulation intentions. There might be no generalizable "energy conservation ethic" (Painter, Semenik, and Belk 1983). Or, insulation intention and behavior belong to a behavioral category (Verhallen and Pieters 1984) different from daily energy-related behavior. It might be clear that these behavioral groups, although successful in explaining differences in energy use (Van Raaij and Verhallen 1983b), are no useful basis for segmentation on home insulation intention.

Insulation Attitudes

The questionnaire contained 15 questions on the attitudes toward home insulation (agree-disagree scale). A principal components analysis of these questions provided a four-component solution, explaining nearly 50 percent of the total variance. Only component loadings over .40 are reproduced in Table 3.

The four questions loading on the first component relate to savings and costs. Saving money and energy have positive weights; while statements that home insulation is after all more expensive or that home insulation has no benefits have negative loadings. The second component unites a number of insulation benefits (comfort, cosiness), insulation interest, and the statement that insulation is a necessity for all homes. The third component brings together a number of non-financial costs, e.g., damp home, humidity, mould, lack of fresh air, and ventilation problems. The fourth component is related to the behavioral costs of insulation installment.

We interpret this principal components solution as follows. Home insulation has two types of benefits: Financial/energy savings (I) and improved comfort (II). Respondents perceive two types of costs: Long-term costs of humidity (III) and short-term installment costs (IV).

Component scores of each of these four components are computed for all respondents and used in a multiple regression analysis to explain home insulation intentions.

Explained variance is generally low, between 3 and 16 percent. For renters, home insulation is related to financial/energy saving, in the sense that they believe that the costs are higher than the savings. For home owners, the benefits (comfort, cosiness, necessity, interest) are related to home insulation intention. For owners with insulation, long-term costs (damp home, humidity) are related to insulation. Other regression weights are insignificant, notably the short-term (behavioral) costs. We may conclude that a major obstacle for renters to have their homes insulated, is the belief that the costs exceed the benefits. Owners perceive more benefits related to home insulation, but tend to become aware of long-term disadvantages after home insulation (Table 2C).

Total Set of Determinants

In order to integrate the findings of the multiple regressions shown above, the total set of determinant variables is used in multiple regressions to explain home insulation intentions. Even when using 22 variables, the proportions of explained variance remain low, between 10 and 28 percent. These proportions are much lower than in studies explaining energy use. Verhallen and Van Raaij

(1981) explain almost 60 percent of the variance of energy use employing home characteristics household behavior, special circumstances, and attitudes. Home insulation intentions are obviously difficult to predict with the variables employed in this study. Discriminant analyses to distinguish between intenders and non-intenders were unsuccessful.

The home characteristics in Table 2D show a similar pattern as in Table 2A. Building year, cavity walls, maintenance, and own heating system, show significant relationships with insulation intentions. Household behavior, again, is insignificant in explaining insulation intention (Compare Tables 2B and 2D). The attitude components show a similar pattern (Compare Tables 2C and 2D). Renters relate home insulation to financial/energy saving; owners benefits, such as comfort, are related to insulation intention.

Sociodemographic variables, such as respondent's sex or social class, have no effect on home insulation intentions.

Consumer expectations, in combination with other variables, have only a minor effect on insulation intentions. For renters without insulation, pessimistic expectations about the energy price are related to higher insulation intentions. For owners without insulation, more optimistic expectations about the financial situation of the household are related to higher insulation intentions.

Note that for renters and owners with home insulation expectations are not relevant for their insulation intention. A rising energy price might increase the insulation intentions of renters. For owners, however, a better financial situation might be a stimulus for home insulation. If economic conditions improve, one may expect an increase of insulation intention for home owners.

Conclusions

Home insulation intentions, and probably behavior, do not belong to the same behavioral category as energy related household behavior. Explaining home insulation with the same set of variables as explaining energy use (Verhallen and Van Raaij 1981) is not successful, explaining a maximum of 28 percent of the variance (of owners without insulation). Energy use and behavior are daily activities, to be characterized by the dimensions "temperature" and "ventilation". Home insulation intentions are probably seen as investments in conservation done only once or a limited number of times. For renters, home insulation is probably the owner's business and they may feel that their intentions do not matter.

The behavioral model, proposed by Van Raaij and Verhallen (1983), for the explanation of energy use, is less applicable to the explanation of home insulation intention. The behavioral cost-benefit approach, however, may be useful. Owners and renters perceive different benefits (financial, comfort) and costs (short-term disorder and long-term humidity) related to home insulation. The task of advertising and promotion is to provide a realistic picture of benefits and costs, and to overcome the perceived short-term costs.

Home characteristics provide the opportunities and feasibility of home insulation, but they do not offer a sufficient explanation, why people decide to insulate their homes. For home owners, the building year of the home, the maintenance level, and the presence of cavity walls are the important home characteristics. For renters, the building year of the home and the presence of an individual heating system, are important.

Home owners, intending to insulate their homes, are inspired by the perceived benefits of insulation (comfort, cosiness) and optimistic expectations about their household financial situation. Energy or money saving are apparently not the first objectives. Home

insulation, as an expenditure category, is probably competing with other outlays on home improvement.

Furthermore, it was found that the intention of home owners with a non-insulated house (group IV) could be better predicted than the intentions of the other groups. This is probably so because they think more often about home insulation, and it is their own decision. Moreover, an economic upturn, resulting in better household financial situations, may result in an increase of home insulation intentions and consequent behavior.

Renters, on the other hand, considering home insulation, keep a sharp eye on savings. They face higher rents. Savings should thus be higher than the rent increase. Renters with pessimistic expectations about the future energy price, are more likely to consider home insulation. A major obstacle, however, is their lack of discretion or freedom. The owner of the house should cooperate or take the initiative. Renters' intentions may be less predictive of home insulation, because of institutional factors of home ownership and renting contracts.

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TABLE 3
PRINCIPAL COMPONENTS ANALYSIS OF ATTITUDE STATEMENTS
(Varimax rotation)

<u>Attitude Statements</u>	<u>I</u>	<u>II</u>	<u>III</u>	<u>IV</u>	<u>h²</u>
saving money	.80				.66
saving energy	.76				.58
more expensive	-.70				.60
no benefits	-.64				.43
interest		.72			.54
more comfort		.68			.54
necessity for homes		.66			.48
cosiness		.52			.42
damp home			.78		.64
humidity			.71		.55
more ventilation			.62		.47
lack of fresh air			.55		.44
disorder with install.				.57	.42
costs > benefits				.57	.49
installation trouble				.50	.34
eigenvalue	3.95	2.00	1.32	1.08	8.35
% explained variance	23.2	11.7	7.8	6.4	49.1