© OECD 2011

Chapter 3

Residential Energy Use

Growing world energy demand, including from the residential sector, is putting increasing pressure on the environment and is key to addressing climate change. This chapter looks at the effect of measures available to policy makers to promote energy efficiency and the use of renewable energy. These range from economic incentives, such as energy taxation or grants for investment in solar panels, to energy efficiency labelling and communication campaigns. The main factors influencing energy-saving behaviour at home and affecting investments in energy-efficiency equipments are analysed, with particular attention paid to the role of energy pricing. The role of respondents' level of environmental concern is considered. The chapter also examines the determinants of demand for renewable energy and how much more households are willing to pay to use renewable energy.

1. Introduction

Growing world energy demand, including from the residential sector, is putting increasing pressure on the environment and is a key challenge to address climate change. Globally, household energy consumption grew by 20% between 1990 and 2006 (IEA, 2009), accounting for almost 30% of total final consumption and 20% of end-use sectors' CO_2 emissions. Residential energy use in OECD countries is expected to increase by an average of 1.4% per year through to 2030, and this increase will be even more rapid in non-OECD countries (OECD, 2008a).

While energy demand from large appliances and space heating has been constrained by the implementation of energy efficiency policies in IEA countries, these efficiency gains have been more than offset by the rapid diffusion of new small appliances (*e.g.* personal computers, mobile phones and other home electronics) and the use of air conditioning. During that same period, energy consumption for space heating increased by only 5%, compared to 52% for appliances energy consumption. A number of other factors affect this trend, including income growth, changing lifestyles with smaller households, and demographic pressure.

Improving energy efficiency at home and increasing household renewable energy use is a policy goal of governments in a number of countries. The European Union objectives to reduce energy consumption by 20% by 2020 and to source 20% of its energy from renewable sources by 2020 (CEC, 2009) are an example. The OECD work on *Household Behaviour and Environmental Policy* and the 2008 Survey results provide new insight to inform the design of environmental policies targeting residential energy use on the demand side.[1]

Policies available to policy makers to promote more efficient use of energy in the residential sector, as well as the use of renewable energy, range from economic incentives (*e.g.* energy/carbon taxation, energy conservation grants), to information provision (*e.g.* energy efficiency labelling, communication campaigns) and direct regulation (*e.g.* energy standards for appliances).

Economic instruments are widely used to influence household energy consumption, and include energy taxes, grants and preferential loans to invest in energy efficient equipments, as well as financial incentives to promote the installation of solar panels and residential wind turbines. Funding for energy saving measures in Norway, solar incentives in France,

building retrofit subsidies in the Czech Republic under the Panel Programme and a Canadian programme (*ecoENERGY Retrofit – Homes*) to provide grants to homeowners to improve the energy performance of dwellings are some examples of current measures being applied in the countries surveyed.

Energy efficiency labelling and information campaigns are another key policy measure aimed at enabling consumers to compare products and to make more informed choices. The *EU Energy Label* has been in place for over fifteen years and has proved to be successful. To promote greater public awareness on energy savings in buildings, the Energy Performance of Buildings Directive introduced an energy performance certificate which has to be produced when a house is sold or rented out.

Direct regulations targeting residential energy use are also commonly applied by governments. At the European level, minimum energy efficiency standards for new residential buildings were tightened in 2009 and the progressive phase-out of traditional light bulbs started the same year. Recent initiatives in Australia include the enforcement of new lighting standards and the phasing-out of incandescent bulbs in 2009; Korea implemented the *e-Standby Programme* with the goal of reducing the stand-by power of each electrical device below one watt by 2010, and Canada is planning as well to ban the sale of inefficient light bulbs by 2012.

In addition, governments can encourage end-use energy efficiency and promote the take up of green energy demand through well-designed energy-related public services, such as the installation of smarter metering in homes or the provision of differentiated "green" energy to residential customers. In recent years, programmes to develop smart electricity meters, allowing households to see how much energy they are using and to adjust consumption accordingly, have multiplied. Initiatives in Australia, Italy and by the Government of Ontario, in Canada, are examples, as well as the recent plan to equip every home with smart meters by the end of 2020 in the United Kingdom.

Improved understanding of the main drivers of consumers' behaviour towards residential energy use is necessary for the design of public policies promoting energy efficiency and renewable energy use. This is one objective of the OECD survey. Drawing upon observations from over 10 000 households in ten OECD countries, analysis of the survey results provides insights into key issues including:

- *Main factors influencing energy-saving behaviour at home*. Results confirm the impact of economic incentives on household behaviour. Respondents who are charged for the energy they use are more likely to undertake energy saving activities such as turning off lights. Being concerned with environmental issues also appears to have a positive effect, highlighting the significant role of information tools.

- *Main factors affecting investments in energy-efficiency equipments.* Energy metering is also found to induce more frequent investment in energy-saving equipment. Stated concern for the environment also increases the likelihood of making such investment. In addition, results show that homeowners are more likely than tenants to invest in thermal insulation and energy-efficient appliances as well as low-energy lighting.
- *Main factors motivating demand for renewable energy.* The survey results indicate that general attitude towards the environment (environmental awareness, membership of environmental organisations, etc.) strongly influences demand for renewable energy. However, the results confirm the finding from previous studies that households are not willing to pay much to use renewable energy. While there is significant variation across countries, in general respondents display a price premium of less than 5% of their bill.

This chapter presents a summary of the main survey findings concerning residential energy use. Two reports prepared for the Secretariat and presented at the OECD Conference on Household Behaviour and Environmental Policy, held in Paris 3-4 June 2009, were used as main inputs in the preparation of this chapter. The first contribution addresses residential energy efficiency and has been prepared by Milan Ščasný and Jan Urban from Charles University in Prague, the Czech Republic. The second report analyses demand for renewable energy and has been prepared by Bengt Kriström from SLU University, Sweden. The full technical reports are available at: *http://dx.doi.org/10.1787/9789264096875-en* and *www.oecd.org/environment/households/greeningbehaviour*.

The chapter is structured as follows: Section 2 examines the main determinants of energy saving behaviour at home, Section 3 looks specifically at factors influencing household investments in energy-saving equipment and the role of energy efficiency labelling, Section 4 analyses household demand for renewable energy. The last section concludes with a discussion of the main policy implications.

2. Main factors influencing energy consumption and energy-saving behaviour at home

Residential energy use typically includes space and water heating, cooking, lighting and the use of appliances and equipment. This section examines household stock of appliances and main motivations to reduce energy consumption, as well as energy saving behaviours and factors affecting them.

Differences in electric appliances ownership

As noted by Kriström (OECD, 2008b), residential energy demand is a derived demand. Energy is combined with other goods, typically a capital good (*e.g.* refrigerator, boiler), to provide a service. Total household energy demand is

clearly affected by the number of appliances at home. The questionnaire collected information about whether households are equipped with certain appliances, and if so, how many appliances of a particular type they have in their primary residence. On average, the households surveyed have almost 10 electric appliances of those for which information is requested. The highest number of these appliances is found in Australia, Norway and Canada (more than 11), while Korean, Mexican and Czech households are equipped with the lowest number of the appliances (about 8). Australians come first for refrigerators and air conditioners. Norwegians have the highest number of personal computers and freezers and Swedes have the highest number of set-top boxes.

The results of empirical analysis of the data indicate that income is the most important factor influencing the number of appliances households are equipped with, in line with the literature. This is particularly the case for appliances such as washing machines, microwaves, and set-top boxes.[2] The number of appliances is also found to increase with the size of the household, but in a non-linear fashion. The average number of electric appliances owned by the household increases with age but, generally, not the number of appliances of a particular type. Home ownership also appears to have a clear positive impact on appliance ownership, while the effect of education seems to be mixed and often insignificant. Households with higher education seem to own fewer television sets and set-top boxes but more personal computers.

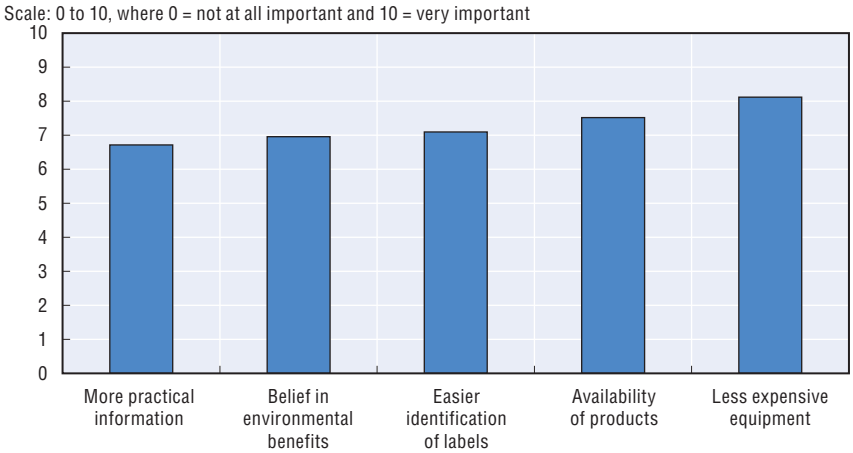
As to the effect of other variables, analysis of the survey responses indicates that semi-detached and detached houses are generally equipped with more appliances, and the probability of the households having an appliance increases with the size of residence. It is also worth noting that environmental concerns and pro-environmental attitudes decrease the probability of owning selected appliances such as freezers and microwaves; and have a negative influence on the total number of appliances that a household possesses.

Factors motivating a reduction in energy use

Respondents were asked how important a range of factors were in encouraging them to reduce their energy consumption. The results presented in Figure 3.1 indicate that making it less expensive to invest in energy-efficient equipment is ranked first by respondents followed by the greater availability of energy-efficient products, the easier identification of labels and the belief that environmental benefits are significant. The provision of more practical information on energy conservation measures does not appear to be as important.

A closer look at the results highlights significant country variations as indicated in Figure 3.2. Countries where respondents indicated that greater affordability of energy-saving equipment would encourage them to reduce energy consumption the most are Canada, France and Mexico. It is interesting

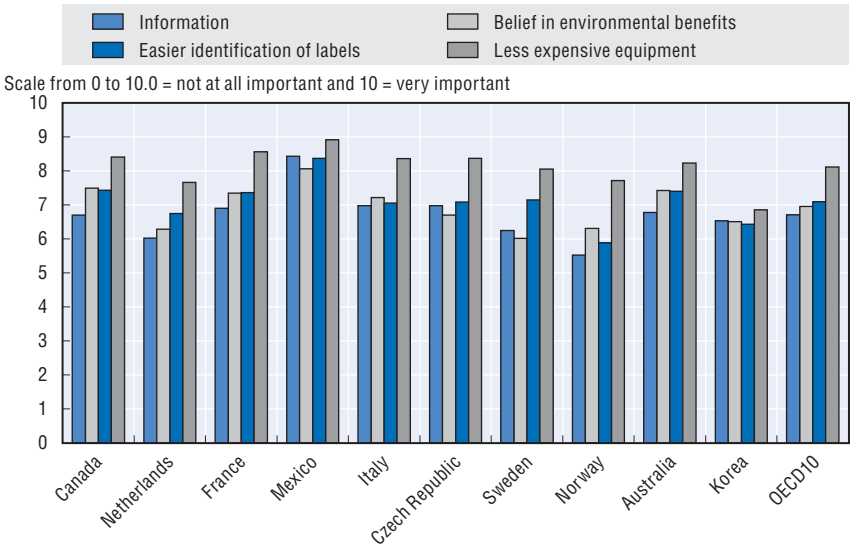
Figure 3.1. **Motivation to reduce energy consumption at home, OECD10**



Note: The y-axis shows the average importance of each factor. Respondents were asked how important the listed factors were in encouraging them to reduce their energy consumption and these were given weights as follows: Not at all important (0), Not important (3.33), Fairly important (6.66) and Very important (10).

Source: OECD Project on Household Behaviour and Environmental Policy.

Figure 3.2. **Importance of selected factors on the motivation to reduce energy consumption, by country**



Note: The y-axis shows the average importance of each factor. Respondents were asked how important the listed factors were in encouraging them to reduce their energy consumption and these were given weights as follows: Not at all important (0), Not important (3.33), Fairly important (6.66) and Very important (10).

Source: OECD Project on Household Behaviour and Environmental Policy.

to note that the greater availability of energy-efficient appliances is ranked high in the same countries. Importance attached to the belief that environmental benefits of energy savings are significant appears to be the greatest for Australia, Canada and Mexico. Results also suggest that the provision of more practical information on energy conservation measures is generally not ranked high, with the exception of Mexico.

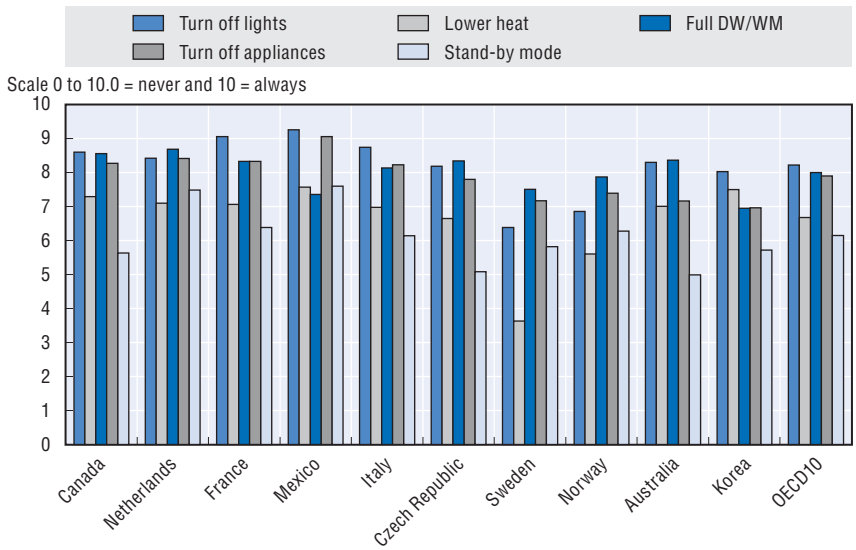
Main determinants of energy saving behaviour

Data were collected on households' energy saving behaviour. Five types of energy-saving activities are distinguished: switching off lights when leaving a room, cutting down on air conditioning or heating to limit energy consumption, energy-efficient use of washing machines or dishwashers, turning off appliances when not in use, and turning off the stand-by mode of appliances/ electronic devices.

Energy saving patterns

General patterns in energy saving behaviour in the 10 countries surveyed are presented in Figure 3.3. The survey responses show that turning off the light when leaving a room is the most common energy-saving activity, followed by economical use of dishwashers and washing machines, and

Figure 3.3. **Differences in energy saving behaviours, OECD10**



Note: The y-axis shows the reported frequency of each practice. Responses were given weights as follows: Never (0), Occasionally (3.33), Often (6.66) and Always (10).

Source: OECD Project on Household Behaviour and Environmental Policy.

turning off the appliances when not in use. On the other hand, cutting down on heating and air conditioning to limit energy consumption is not performed very often and turning off the stand-by mode of appliances and electronic devices is the most rarely reported.

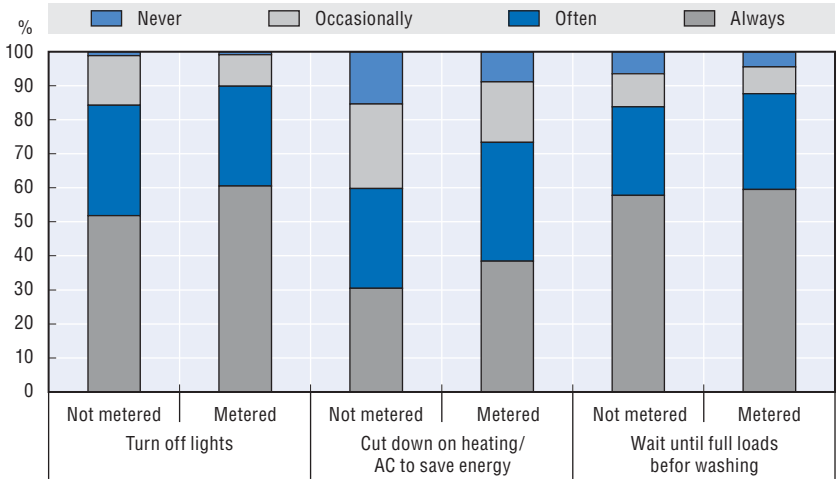
However, great variations across countries exist. The Dutch are the most likely to turn off their electronic appliances and devices while Australia, the Czech Republic and Korea have the highest percentage of respondents reporting that they never or occasionally switch off stand-by mode (approximately 50%). Norwegians and Swedes reported turning off lights when leaving a room less often than respondents from other countries. Results also suggest that Koreans are the least likely to wait for full loads before using washing machines or dishwashers.

The role of metering

The results confirm the impact of economic incentives on household behaviour. Econometric analysis of the determinants of energy saving behaviour points to the significant and positive effect of energy metering. As shown in Figure 3.4, respondents who are charged for the energy they use reported significantly more frequent energy saving behaviour, with the exception of turning off appliances when not in use and turning off the stand-by mode.

In OECD countries, some households pay a variable electricity price according to the time of use. They generally pay a lower price during off-peak period (*e.g.* night time) and a higher price during peak period (*e.g.* early evening). Respondents were asked if they were charged according to the time

Figure 3.4. **Energy saving behaviour: Influence of being metered**

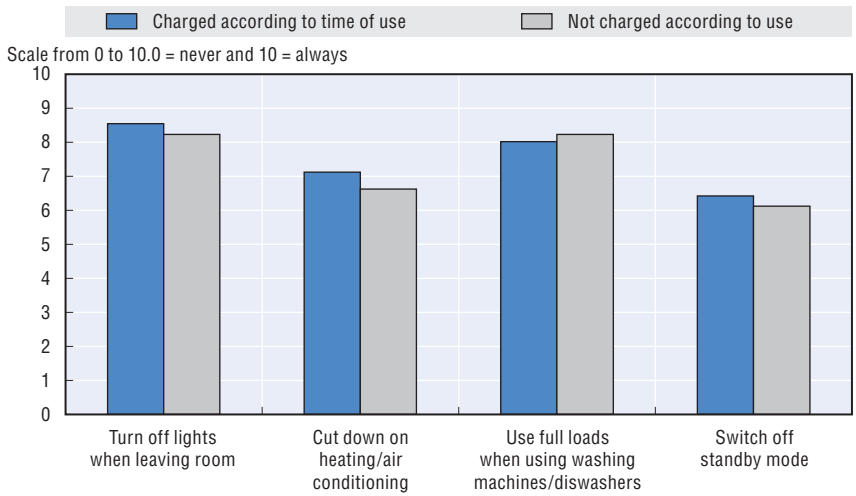


Source: OECD Project on Household Behaviour and Environmental Policy.

of use. The proportion of households who reported paying a lower price during off-peak period and a higher price during peak period varies widely by country, from 11% in Norway to 75% in Mexico.

Households who are charged a variable electricity rate were in general more likely to undertake energy saving behaviour with the exception of running only full washing machines and dishwasher loads, where the responses were similar. Variable charging has less of an impact on this particular energy-saving behaviour since households may prefer to take advantage of lower rates during off-peak hours and use their washing machines even if not fully loaded. This suggests that time-of-day pricing may lead to higher consumption as households substitute some usage from one part of the day to another (see Figure 3.5).

Figure 3.5. **Energy saving behaviour: Influence of variable electricity charge according to time of use**



Note: The y-axis shows the average frequency of behaviour. Respondents were asked how often they performed the listed behaviours: Never, Occasionally, Often and Always. The responses were given a weight of 0.00, 3.33, 6.66, 10.00 respectively.

Source: OECD Project on Household Behaviour and Environmental Policy.

The role of environmental concerns and other factors

Econometric analysis indicates that men generally tend to perform energy saving activities less often than women, as well as wealthier people. This negative and significant effect of income on all energy-conserving behaviours examined contrasts with previous studies where income is frequently found to have a mixed effect. High-income households might be less willing to trade their comfort and time for energy savings and/or they tend to invest in energy efficient equipment to achieve energy savings as discussed in the next section.

Attainment of a higher education level is found to have only a weak and negative effect in the case of switching off the light, a pattern that has also been identified in the literature. Previous studies, however, generally show mixed results. On the one hand, higher education appears to lead to a better understanding of energy conservation (Black *et al.*, 1985; Laquatra and Chi, 1988) and tends to be associated with environmental consciousness and thus with higher frequency of energy-conservation practices (Hogan, 1976). On the other hand, education is also sometimes associated with a negative effect on energy conservation behaviour (Hirst and Goeltz, 1984; Peters, 1990; Curtis *et al.*, 1984).

Other variables of importance include the area of residence and those living in urban areas appear to be less likely to perform energy-saving activities. Besides, we can note that respondents who reported taking into account environmental labels when purchasing a good were also more likely to undertake energy-saving activities.

Last but not least, the analysis points to the positive and relatively strong effect of concerns for the environment and environmental attitudes on energy-saving behaviours, which is another policy-relevant finding. The effect of concerns appears to be somewhat stronger than that of attitudes. Respondents concerned with the environment tend to perform energy-saving activities more often. The relatively significant effect of attitudes and values is new, as much of the previous research has suggested that these variables are only indirectly related to actual energy-saving behaviour.

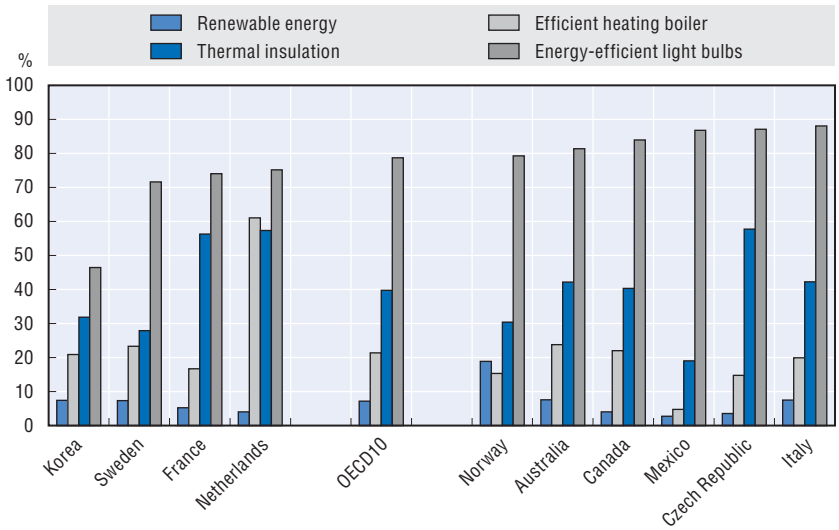
3. Main determinants of investment in energy-saving equipments

Responses to the questionnaire also provide information on investment in energy-saving equipment. Respondents were asked if they had installed in their current primary residence any of the following five items over the past ten years: energy-efficiency-rated appliances (*e.g.* top rated washing machines, refrigerators), low-energy light bulbs (compact fluorescent), thermal insulation (*e.g.* walls/roof insulation, double-glazing), efficient heating boiler (*e.g.* condensing boiler), or renewable energy (*e.g.* solar panels, wind turbines).

Investment in energy-saving equipments: general pattern

The percentage of respondents who reported having installed low-energy light bulbs in their current primary residence over the past ten years is quite similar in all ten countries (around 70% for the whole sample), except for Korea (28%). Investment in low-energy light bulbs and in energy-efficient appliances is followed by insulation and the installation of efficient heating boilers. As expected, the percentage of respondents reporting having installed renewable energy is very low (around 5% for the whole sample). Norway is an exception with more than 15% (see Figure 3.6).

Figure 3.6. **Investment in energy-saving equipment**



Note: The proportion of households installing energy efficient equipment in the last 10 years in their primary residence, by country. The results are calculated excluding those households that were already equipped and those who reported that it was not possible to install such equipment.

Source: OECD Project on Household Behaviour and Environmental Policy.

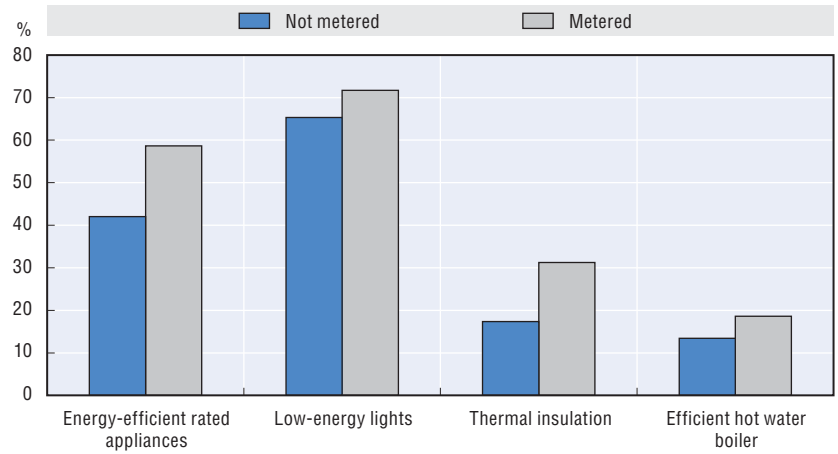
The importance of being metered

The results of econometric analysis show that metering matters. The role of energy charges in encouraging energy-saving investments is clearly evident in the survey responses. As in the case of energy-saving behaviours, respondents who are charged for the energy they use reported significantly greater probability of having invested in energy-saving equipment (see Figure 3.7).

The role of labelling

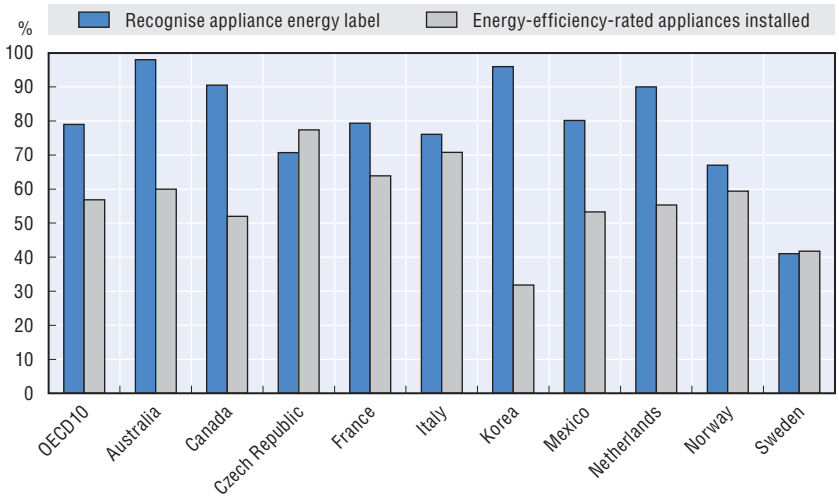
There is a high level of recognition of energy-efficient appliance labels in the majority of the ten surveyed countries (Figure 3.8). Nearly 80% of survey respondents recognise energy-efficient appliance labels. Label recognition was highest in Australia, Korea, Canada and the Netherlands at 98%, 96%, 91% and 90% respectively, and lowest in Sweden (41%) and Norway (66%). The Czech Republic has the highest reported installation rate of energy-efficiency-rated appliances at 77% despite their relatively low levels of label recognition and use compared with other countries. The gap between the level of recognition of appliance energy-efficiency labels and reported installation is high in Korea, Canada, Australia and the Netherlands, and the lowest in Sweden and Norway.

Figure 3.7. **Investing in energy-saving equipment: Impact of metering**



Source: OECD Project on Household Behaviour and Environmental Policy.

Figure 3.8. **Proportion of households who recognise appliance energy labels and who have installed energy efficiency rated appliances in the last 10 years, by country**

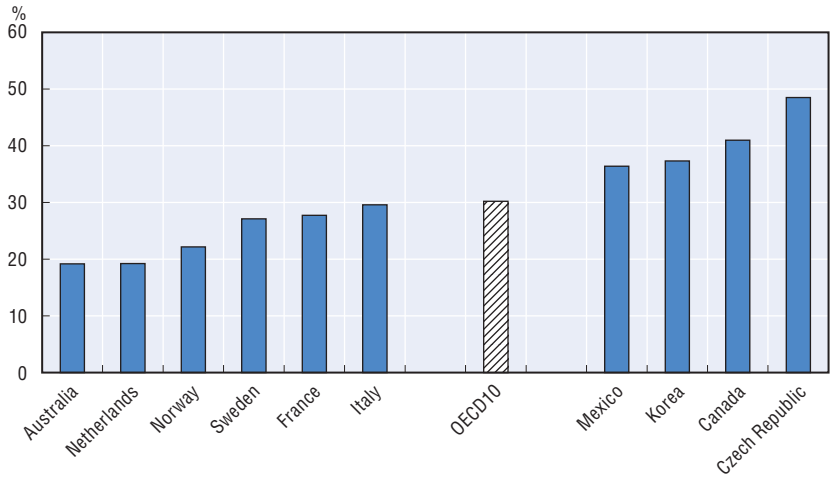


Source: OECD Project on Household Behaviour and Environmental Policy.

Simpler labelling of energy efficiency was ranked on average as the third most important factor of energy savings but it appears to be less important in Korea, the Netherlands and Norway. Moreover, Czechs, Dutch, Mexicans and Swedes ranked simpler identification of labels as being more important than environmental benefits.

Households were also asked if they took energy costs into account when purchasing or renting their home (Figure 3.9). Overall, 30% of respondents took energy costs into account and this varied from 49% in the Czech Republic to 19% in Australia and the Netherlands. France and Canada have introduced labels that indicate the relative energy efficiency of houses, these have similar levels of recognition in both countries (60%).

Figure 3.9. **Proportion of households taking into account energy costs when purchasing or renting their current primary residence**



Source: OECD Project on Household Behaviour and Environmental Policy.

Respondents were asked to rank different sources of information on environmental issues in terms of their trustworthiness. It is interesting to note that people who trust the government are more likely to use energy efficiency labels, 62% compared to 56%. Trust in information provision is likely to be particularly important in the face of cases of product information compliance breaches, such as those recently reported in the United Kingdom for household appliances not meeting the energy performance levels displayed on energy-efficiency labels.

An econometric analysis of the factors affecting the recognition of energy efficiency labels for appliances and for houses when they are available shows that men are more likely to recognise energy-efficiency labels, while women know the general ecological labels better. Older people are found to have generally less knowledge of the labels displayed. Furthermore education increases the probability of recognising general environmental labels. Income has a positive and significant effect only in the case of the efficient appliance label and general ecological labels. Results also suggest that people who live in

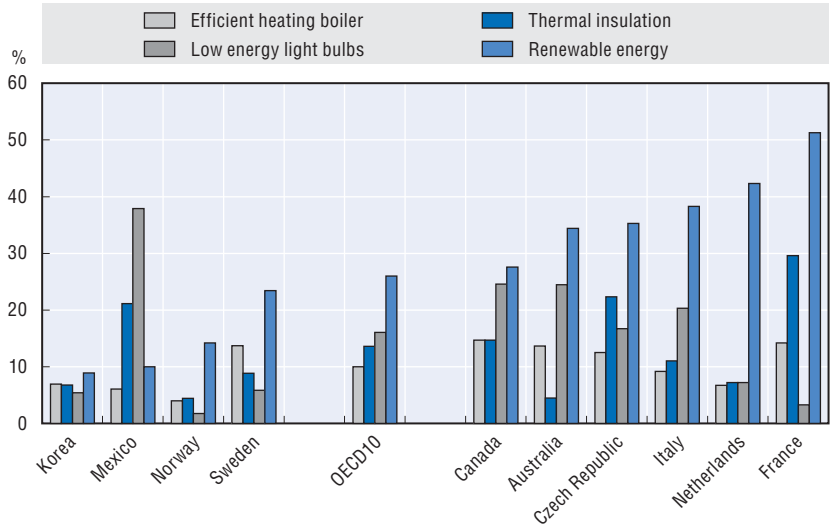
larger cities know the ecological labels better, but they have less knowledge of the energy-efficiency labels for houses than people living in rural areas. The label for energy saving houses is known better to those who own their dwellings. In all cases, pro-environmental attitudes and concerns increase the probability of label recognition.

The use of government support schemes

The proportion of households receiving government support when installing energy-efficient items varies depending on the country and the item, rates being higher for renewable energy and in general lower in countries such as Norway and Korea. While the French are most likely to have received support for installing thermal insulation and renewable energy technologies, few respondents in all the countries surveyed report having received government assistance for those investments.

Figure 3.10 shows the proportion of households receiving government support who have installed energy efficiency rated appliances, low energy light bulbs, thermal insulation, efficient heating boilers or renewable energy generators in the last 10 years. Measures considered in this question include monetary support such as grants, preferential loans and non-monetary support, for instance energy audits.

Figure 3.10. **Proportion of households benefiting from government support when installing energy efficient equipment, by country**

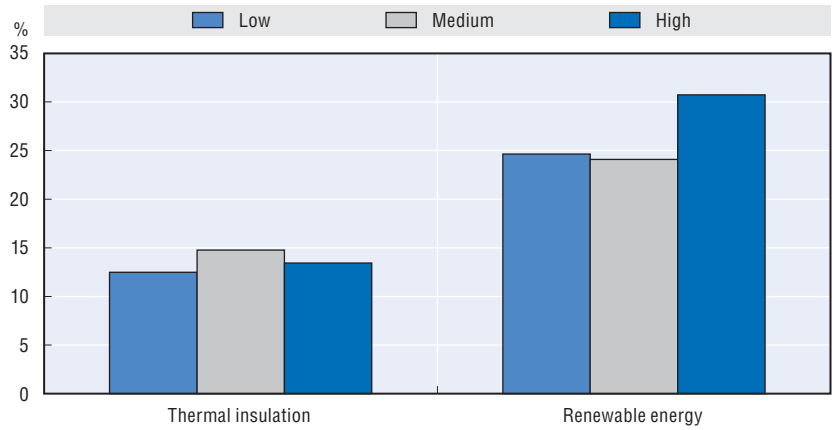


Source: OECD Project on Household Behaviour and Environmental Policy.

The proportion of households receiving government support when installing energy-efficient items varies depending on the country and the item, rates being highest for renewable energy and lowest for efficient heating boilers. Thirteen per cent of those installing efficiency rated appliances received some type of government support. A significant proportion of those installing low energy light bulbs have received government support, 16% on average with the top three countries being Australia (24%), Canada (25%) and Mexico. The rate of government support for thermal insulation is 14% for the survey countries with the top two being France (30%) and the Czech Republic (22%). Support rates for installing energy-efficient heating boilers vary from 4% in Norway to 15% in Canada, with 10% overall. Renewable energy, for example solar panel and wind turbines, has the highest proportion attracting government support with 51% in France, 42% in the Netherlands, 38% in Italy, 35% in the Czech Republic and 34% in Australia.

The results show that nearly one quarter of households installing one of the listed energy efficient items received some type of government support. Government support rates are lowest in Norway, Sweden and Korea at 5%, 10% and 13% respectively. The rate of households receiving government support to install thermal insulation and renewable energy does not differ notably by income level, with the exception of those installing renewable energy, where a greater proportion of high income households (31%) received government support when compared to medium (24%) and low income households (25%) (see Figure 3.11).

Figure 3.11. **Proportion of households benefiting from some government support who have installed thermal insulation or renewable energy in the past 10 years by income bracket**

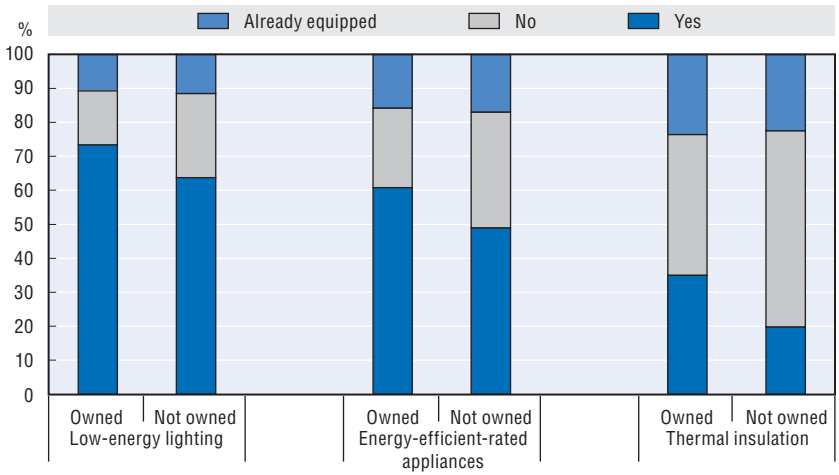


Source: OECD Project on Household Behaviour and Environmental Policy.

Differences across households

The results of an econometric analysis of the decision to install different types of energy-efficient equipment clearly indicate that the status on the property market matters. Home ownership has a positive effect on the probability of installing energy-saving equipment or renewable energy technologies (Figure 3.12). This pattern can be explained by the importance of "split incentives", with renters being less likely to recover the sunk costs associated with such investments. However, it is striking that this also seems to be the case with the installation of low energy bulbs, which are relatively low-cost and transferable. These results underline the usefulness of targeting measures according to home ownership status as in the United Kingdom where the Landlord's Energy Saving Allowance (LESA) has been introduced.[3]

Figure 3.12. **Percentage of households having installed energy-saving equipment according to home ownership status**

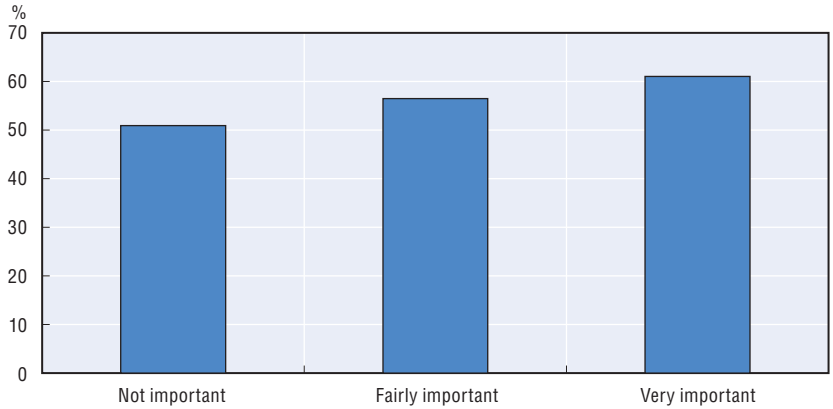


Source: OECD Project on Household Behaviour and Environmental Policy.

The role of environmental concerns

Econometric analysis shows that environmental concerns have a significant and positive effect on investment in energy-efficient equipment. The effect of environmental attitudes is less marked. Results indicate that environmental awareness and membership in an environmental organisation is highly correlated with the decision to invest. Households for whom environmental benefits are ranked high as factors which encourage them to reduce energy consumption are more likely to have installed energy-efficiency-rated appliances in their primary residence in the last 10 years than other households (see Figure 3.13).

Figure 3.13. **Households installing energy-efficiency-rate appliances in the last 10 years by the importance of environmental benefits in encouraging households to reduce energy consumption**



Source: OECD Project on Household Behaviour and Environmental Policy.

4. The demand for renewable energy

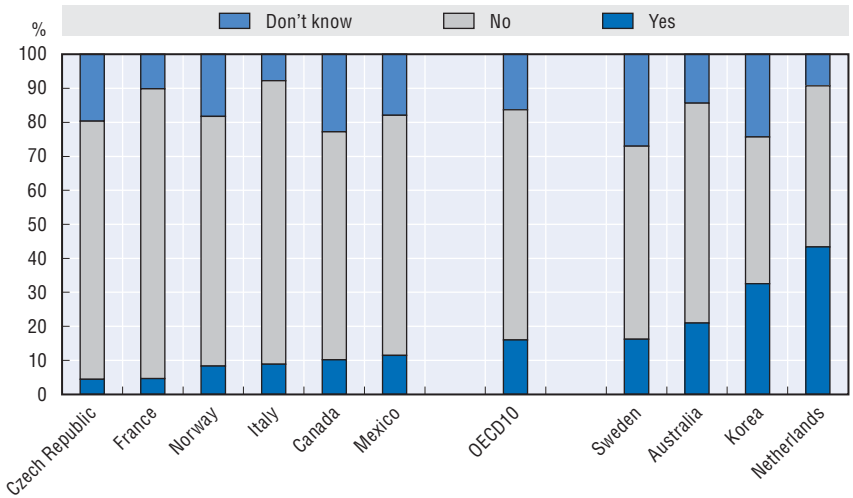
The survey responses provide information on households' demand for renewable energy by asking respondents if they take special measures to buy renewable energy from their electricity provider and how much they would be willing-to-pay to use "green" energy.

Taking special action to buy "green" energy or to invest in renewable energy

Just under 20% of households state that they "take special measures to buy renewable energy from their service providers".[4] Results show variations across countries with the Netherlands and Korea having the highest percentages of respondents stating this to be the case. As expected, countries with a large percentage of hydroelectric energy in their standard fuel mix, like Canada and Norway, report low percentages. It is interesting to note that almost 20% of the people surveyed do not know if they take special measures to buy renewable energy from their electricity provider, suggesting that improved information campaigns have a role to play (see Figure 3.14).

The results also indicate that those who invest in renewable energy technologies are different in some dimensions from those who have chosen not to. Information about investment in renewable energy equipment in the past 10 years collected in the survey shows that an "investor" is more likely to be: Italian, Norwegian or Korean (and less likely to be a Canadian); a man; living in a detached house; a member of an environmental organisation, and

Figure 3.14. **Taking special measures to buy green energy**



Source: OECD Project on Household Behaviour and Environmental Policy.

to have also installed energy efficiency equipment (*e.g.* a condensing boiler). Because only about 5% of the sample has invested in renewable energy equipment, these results need to be interpreted with caution.

An econometric analysis of renewable energy demand drivers was undertaken. The results indicate that a respondent who is active in the market for renewable energy is more likely to be active in an environmental organisation and to be "environmentally concerned". The survey confirms that general attitude towards the environment influences demand for renewable energy. This is consistent with earlier studies showing membership in environmental organisations to be an important factor in the residential market for renewable energy.

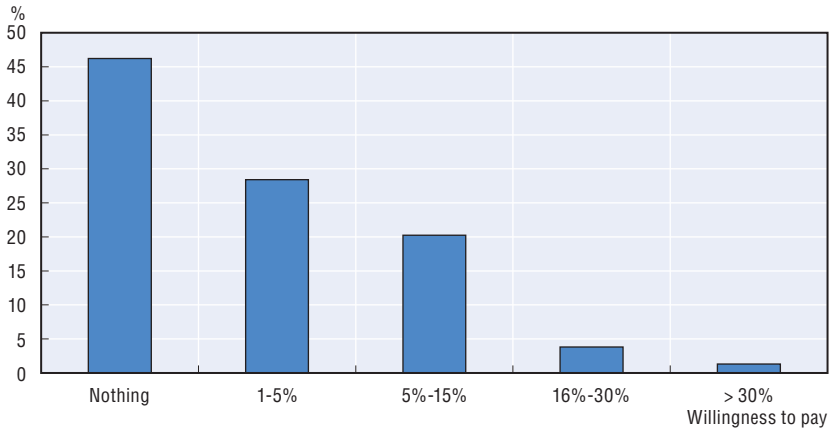
Active respondents on the renewable energy market are more often found to be conscious of energy costs when renting or buying their residence. Besides, when looking at gender, women have a higher estimated probability of not taking special measures to buy renewable energy from their electricity provider and the number of children in the households seems to matter as well. In addition, there is some indication that the age group 45 to 55 has a significantly higher probability of saying that they do not take special measures. It is worth noting that there are significant differences between several countries unrelated to the sets of explanatory variables.

Willingness-to-pay more to use renewable energy

Respondents were also asked what was the maximum percentage increase on their annual bill they were willing to pay to use only renewable energy, assuming that their energy consumption remained constant.

Survey responses indicate that respondents are not willing to pay much. Figure 3.15 shows that almost half of all respondents are not willing to pay anything to use only green energy and that respondents are not ready to pay more than 5% above their current electricity bill, on average, to use only green energy.[5] These findings are in line with previous studies. However, there is significant variation across countries with Dutch respondents showing the lowest mean willingness-to-pay a price premium to use only green energy, followed by France and Korea. One could argue that the market in the Netherlands is saturated because a large amount of green energy is already provided in the energy mix, so that WTP at the margin is not very high.

Figure 3.15. **Willingness-to-pay for renewable energy**



Source: OECD Project on Household Behaviour and Environmental Policy.

The econometric analysis of the determinants of willingness-to-pay (WTP) to use renewable energy undertaken proceeds in two steps: those who are "enter the market" (willing to pay something) are first examined and a particular analysis is then undertaken on the decision to "enter the market" or not.

The model predicts a lower WTP for women, which, to some extent, contradicts earlier findings in the literature on the valuation of environmental quality (see Farreras *et al.*, 2005 for a review). Next, people who find environmental issues relatively unimportant display a lower WTP. Finally, being a member of an environmental organisation has a significantly positive effect on

the level of WTP to use "green" electricity. These results stressing the importance of attitudinal factors are in line with previous studies (Rowlands *et al.*, 2003; Roe *et al.*, 2001).

Surprisingly, household income seems to play little, if any role when the WTP is positive. However, the link between income and the decision to "enter the market" is positive in the model used. In the econometric analysis, age is also found to be a significant predictor for the decision to pay something, but not for the level of WTP. Thus, older people are less likely to pay a premium to use renewable electricity. In addition, the probability of entering the market increases with education. Finally, attitudes towards the environment and activities/membership of environmental organisations have a positive impact on the decision to pay more to use renewable energy.

5. Conclusions and policy implications

Several policy implications emerge from this new work on the determinants of household residential energy use. First of all, the survey clearly confirms the significant role played by incentive-based policy instruments to reduce energy demand from households. Electricity metering (and charging) encourages energy-saving behaviour. Results show that respondents paying charges are more likely to save energy, whether by adopting energy-saving behaviour like turning off lights, or making investments in efficiency-rated appliances and thermal insulation.

In addition, people's attitude towards the environment appears to clearly influence energy demand. The survey shows that environmental awareness has a positive effect on energy-saving behaviour at home and on investments in energy-efficient equipment. Being concerned with the environment and membership in environmental organisations, is associated with increased demand for renewable energy. This evidence implies that "softer" instruments, based on the provision of information to consumers and education, can have a substantial complementary role to raise people's environmental awareness.

Furthermore, the survey highlights the importance of targeting measures on certain population groups in some cases, since not all households face the same incentives to make environmentally-friendly energy investments. Indeed, the findings reveal that homeowners are more likely than tenants to invest in energy-saving equipment such as thermal insulation or efficient heating boilers, as well as renewable energy technologies. Thus, policies where landlords are given incentives to "green" their rental properties and tenants are given the right to recover their costs for such investments from landlords could be usefully implemented. However, targeting policies can entail significant costs that need to be taken into account.

Finally, the results also suggest that the substantial support given to renewable energy in many countries contrasts with the fairly weak voluntary demand for "green" electricity reported in this survey. While there is significant variation across countries, the survey shows that respondents are not willing to pay too much more to use green energy. This is in line with previous studies. Indeed, relatively few households are prepared to pay more than 5% above their current electricity bill to use green energy, and almost half of them are not willing to pay anything. This finding implies that the increased use of green energy at home in the future is likely to be only weakly demand-driven, and thus might heavily rely upon policy measures targeting the supply side.

Notes

1. The impact of policies focussing on the supply side, such as government incentives to develop renewable energy technologies, is outside the scope of this study.
2. A set-top box is a small computing device that interfaces a television (TV) set or computer to a cable TV network, cable modem network and, perhaps, telephone network.
3. This scheme seeks to encourage energy efficiency in the residential rented sector by allowing landlords to deduct from their taxable profits the costs of acquiring and installing certain energy-saving equipment in properties they let.
4. Respondents who state that they were not given this option have been removed from the sample.
5. Calculations show that the conditional "mean" is in the interval 7.4%-9.1%. Factoring in the 46.2% zero WTP, we obtain the bounds 4%-4.9%.

References

Black, S., P. Stern and J. Elworth (1985), "Personal and Contextual Influences on Household Energy Adaptations", *Journal of Applied Psychology*, Vol. 70(1), pp. 3-21.

CEC (2009), "Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the Promotion of the Use of Energy from Renewable Sources and Amending and Subsequently Repealing Directives 2001/77/EC and 2003/30/EC", in *Official Journal of the European Communities*, 5 June 2009, L 140/16.

Curtis, F., P. Simpson-Housley and S. Drever (1984), "Household Energy Conservation", *Energy Policy*, Vol. 12(4), pp. 452-456.

Farreras, V., P. Riera and J. Mogas (2005), "Does Gender Matter in Valuation Studies? Evidence from Three Forestry Applications", *Forestry*, Vol. 78(3).

Hirst, E. and R. Goeltz (1984), *Comparison of Actual and Predicted Energy Savings in Minnesota Gas-heated Single-family Homes*, Oak Ridge National Laboratory, Oak Ridge, TN.

Hogan, M.J. (1976), *Energy-Conservation: Family Values, Household, Practices, and Contextual Variables* (Doctoral dissertation), Michigan State University.

International Energy Agency (2009), *World Energy Outlook 2009*, IEA, Paris.

Laquatra, J. and P. Chi (1988), "Why Home Owners Respond to Residential Energy Conservation", in Sixth Annual International Energy Efficient Building Conference and Exposition, Portland, pp. J.2-J.19, OR: Energy Efficiency Building Association, Portland.

OECD (2008a), *Environmental Outlook to 2030*, OECD, Paris.

OECD (2008b), *Household Behaviour and the Environment: Reviewing the Evidence*, OECD, Paris.

Peters, J. (1990), "Integrating Psychological and Economic Perspective of Thermostat Setting Behaviour", *American Council for an Energy Efficient Economy*, Washington DC.

Roe, B., M.F. Teisl, A.Levy and M. Russell (2001), "US Consumers' Willingness to Pay for Green Electricity", *Energy Policy*, Vol. 29, No. 11, pp. 917-925.

Rowlands, I.H., D. Scott and P. Parker (2003), "Consumers and Green Electricity: Profiling Potential Purchasers", *Business Strategy and the Environment*, Vol. 12, Issue 1, pp. 36-48.

From:

Greening Household Behaviour

The Role of Public Policy

Access the complete publication at:

https://doi.org/10.1787/9789264096875-en

Please cite this chapter as:

OECD (2011), "Residential Energy Use", in *Greening Household Behaviour: The Role of Public Policy*, OECD Publishing, Paris.

DOI: https://doi.org/10.1787/9789264096875-6-en

This work is published under the responsibility of the Secretary-General of the OECD. The opinions expressed and arguments employed herein do not necessarily reflect the official views of OECD member countries.

This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

You can copy, download or print OECD content for your own use, and you can include excerpts from OECD publications, databases and multimedia products in your own documents, presentations, blogs, websites and teaching materials, provided that suitable acknowledgment of OECD as source and copyright owner is given. All requests for public or commercial use and translation rights should be submitted to rights@oecd.org. Requests for permission to photocopy portions of this material for public or commercial use shall be addressed directly to the Copyright Clearance Center (CCC) at info@copyright.com or the Centre français d'exploitation du droit de copie (CFC) at contact@cfcopies.com.