

The everyday energy use and life-styles of families in single-family houses in Finland

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1. SYNOPSIS

The study provides an analysis of the connection between differences in the residential energy use and life-style of fifty families with two teenage children.

2. ABSTRACT

The study examined the residential energy use (electricity and district heat) of 50 families of four between 1989-1990. It further investigated the connection between the change taking place 1982-1990 and the life-styles of the families. *The goal was to gain a better understanding of the trend in energy consumption and the families' own view of their energy consumption.* Quantitative and qualitative methods were used in the study. The houses chosen for the study had electric or district heating. Any use of wood for heating purposes was equated with energy saving. The families differed greatly in their energy consumption, and the differences increased during the period for examination. The majority of the families did not keep track of their energy consumption, and the methods used by those who did keep a check were deficient. Nor did the families consider that the general need to conserve energy applied to them. Three basic types differing in their life-styles and energy use were distinguished, along with their sub-types.

- (1) The energy consumption of the "thrifty wood-burners" remained at a constant low level. The "habitually frugal" among them were not consciously aware of their energy habits. By contrast the "technically oriented" saved energy by means of technology.
- (2) The level of energy consumption of the "ordinary middle-class people" was average and their consumption had risen on average. They were not personally aware of any change in their consumption. The sub-types "water users", "heaters" and "airers" were distinguished.
- (3) The high energy consumption of the "comfort-seekers" had continued to rise. These people saw no reason to save energy. Those who "ensured their comfort by means of technology" had invested in energy-saving technology, which lowered their consumption level.

3. INTRODUCTION

Despite the widespread opinions in favour of environmental protection and energy conservation, the energy consumption of Finnish households has continued to grow. The specific consumption of heating energy has also taken an upward turn since the mid-1980s. A good half of the energy consumed by Finland's single-family houses goes to space heating, the remainder being distributed among water heating and the operation of household appliances, i.e. household electricity.

The present study set out to determine the role played by energy consumption in people's everyday lives and the link between various life-styles and energy use. It concentrated on the families' lasting or recurring habits. The present research aimed, firstly, to determine the similarities and dissimilarities between families as consumers of energy. Secondly, it aimed to bring out the families' own view of their energy consumption.

The study was concerned primarily with the behaviour associated with families' energy use, its history and the decisions governing it. The idea was that it is difficult for people to forecast their future behaviour. They can, however, explain how they have arrived at their present behaviour patterns. It may be assumed that the factors influencing the establishment of the present patterns will also continue to apply in the future,

either promoting energy saving or competing with it.

4. METHODOLOGY

4.1. The choice and collection of the data

Since the aim of the study was to discover the reasons for the behaviour affecting the residential energy use, the bulk of the data was collected by unstructured thematic interviews. This explains why only 50 families were selected. The families lived in Southern Finland and were chosen by random sampling from the Buildings Register. The following constraints were also imposed on the data: (1) The families consisted of both parents and two children aged 10-24. (2) The families owned the single-family houses in which they lived. (3) All the houses had been built since the energy crisis, in 1975-1982. (4) The houses were occupied by the same people from 1982 to 1990. (5) The houses had direct electric space heating or district heating. (6) The houses were in single-family house areas connected to the public water supply network. The consumption data were collected from the energy and water utilities.

The thematic interviews concentrated mainly on the history of the families' own energy behaviour. The study did not employ any a priori hypotheses on the connection between life-style and energy use. The interviews were conducted in February-April 1991. Before the interview the parents filled in a questionnaire mailed to them. The husband and wife took part in the interview together. All the interviews were taped and covered the following themes: (1) the purchase of the house, (2) changes in conditions 1982-1990, (3) the purchase of electric appliances, (4) ventilation, (5) room temperature, (6) regulation of heating, (7) use of wood, (8) cooking and washing up, (9) laundry, (10) use of shower and bathing, (11) use of the sauna, (12) use of a car, (13) holiday practices, (14) life-style in general, (15) orientation to energy use and (16) keeping a check on energy consumption.

The advance questionnaire looked into the behaviour of the family affecting the energy use at that moment and certain technical points. The interview then enlarged on the picture of the behaviour and tried to discern any changes in it. Reasons were sought via the accounts of the change history and the family's decisions. The indoor temperature was measured at the time of the interview.

4.2. Analysis of the data

The term residential energy was used for the electricity and district heat used to heat the rooms and the water, and the household electricity consumed by appliances. The majority of the families also burnt wood in an heat-storing or open fireplace, stove or sauna. This wood was not, however, included in the energy use examination and was equated with energy saving. Adjustments for weather were made for the heating energy consumptions (the adjustment was not made for the estimated water heating consumption or household electricity). Average and specific consumptions were calculated for the families for the periods 1982-1985, 1986-1988 and 1989-1990, and the percentage and absolute changes in consumption from the first to the last period.

The families fell naturally into the following three divergent groups. The houses in group 1 and group 3 differed in both the absolute change that had taken place in their consumption and the level of their total energy consumption. Emphasis was laid on the change in energy consumption, because it reflected behavioral changes and did not depend on the technical differences in the buildings. The qualitative part of the study was based on these groups.

- (1) Both the rise in consumption and the level low
(change < +2000 kWh and level < 21 000 kWh)
- (2) Neither the rise in consumption nor the level particularly high
(change < +4000 kWh and level < 27 500 kWh)

- (3) Large rise in consumption, level average or high
(change $\geq +4000$ kWh and level $\geq 21\ 000$ kWh)

The most obvious connections in the quantitative material were described by means of correlations before starting the qualitative analysis. The aim of the correlation analysis was not, however, to make a model or to show the pure effects of single factors affecting energy consumption.

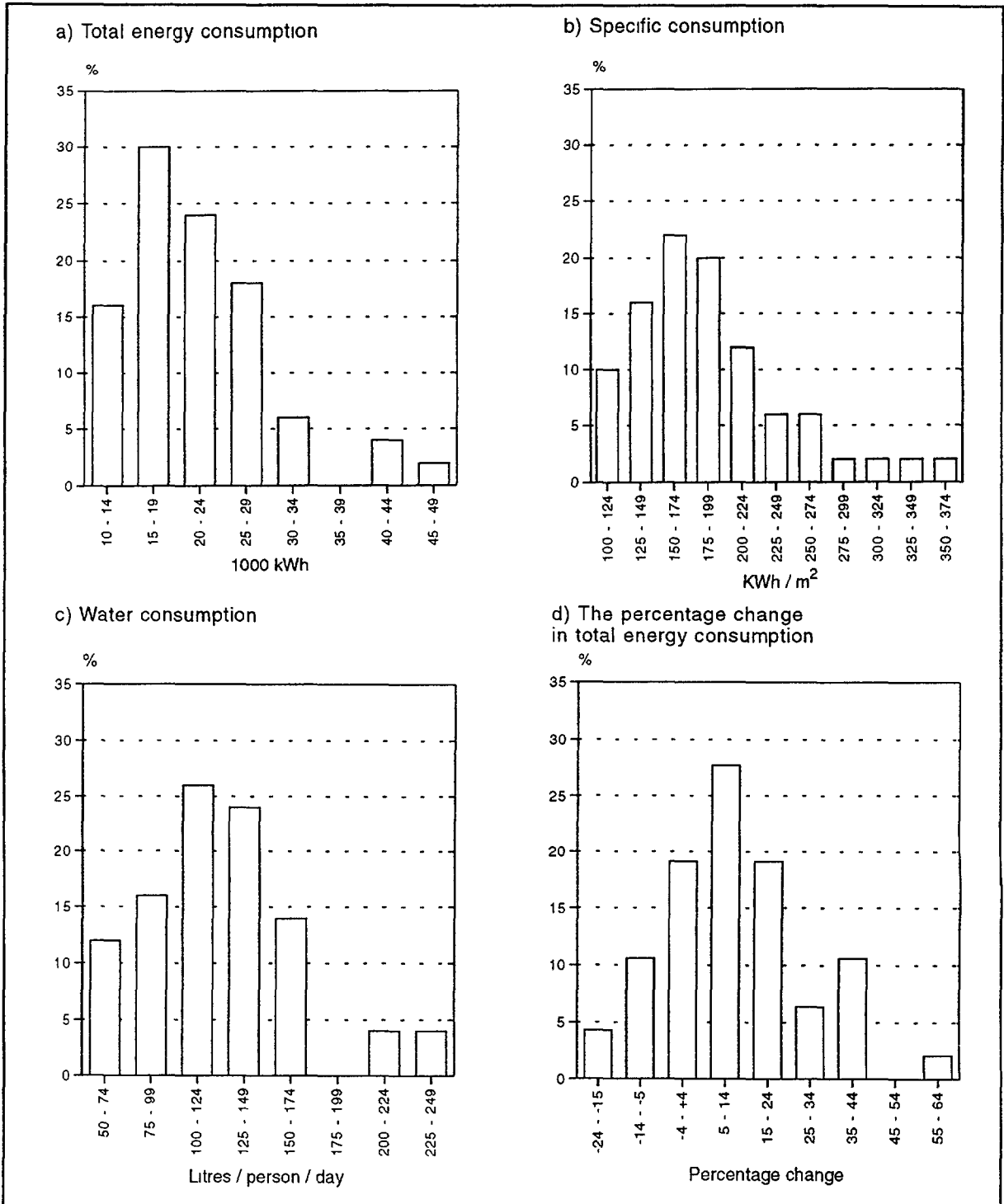


Figure 1. The distribution of families (%)

The definition of the different types according to energy consumption and life-style was made by examining the family profiles founded on the quantitative and qualitative material by consumption group. Within the groups e.g. the families' energy awareness was examined.

The aim of the search for types was not to divide the families into mutually exclusive groups, nor to produce a quantitative profile of the behaviour of those belonging to the different consumption groups. Instead it aimed to yield a qualitative picture of the features that applied particularly to a) small consumers with no notable rise in their level of consumption, b) large consumers whose consumption had risen considerably and c) those in between. The principal aim of this study was to generate new hypotheses. The quantitative estimation of the percentages of families in the different groups remained the task of further research with more numerous data. The resulting types revealed characteristics distinguishing families from one another. The actual families were often of mixed type.

4.3. House and family profiles

The majority of the houses were bought semi-manufactured and erected partly by the families themselves. Most of them had a useful floor area of 100-120 square metres, the average size being 116 square metres. The houses also had storage space not included in the useful floor area. 23 of the 50 houses were heated by district heat and 27 by electricity. The district heated houses usually had water radiators regulated by outdoor and individual thermostats and the electrically heated houses electric radiators fitted with individual thermostats. Not many of the houses had central timers regulating the temperature, but about one third did have a switch reducing the temperature of all the radiators by a few degrees. Seventeen had mechanical ventilation systems, seven of them with heat recovery devices. 41 houses had some kind of fireplace.

In almost all the families both the parents were in gainful employment. In 21 families both the parents were white-collar workers and in 9 families both were blue-collar workers. There were four entrepreneur families. In the remaining 16 families the husband was usually a blue-collar worker and the wife a lower-level white-collar worker. The majority of the white-collar men were upper-level ones and of the women lower-level ones. In a good half of the families the parents' combined gross income was between 2 687 and 3 881 ECU per month (FIM 18 000 - 26 000 a month). One fifth of the families earned less than this, and one fifth more. The majority of the children were still at school or studying.

5. RESULTS

5.1. Differences in consumption and changes in them

The differences in total energy consumption, specific consumption (kWh per square metre of useful floor area) and water consumption were extremely great between the different families (Figure 1, a-c). (The figure shows the distribution of families (%) according to their total energy consumption in 1989 - 1990, their specific consumption and water consumption and the percentage change in their total energy consumption between 1982 - 1985 and 1989 - 1990. New houses occupied by families of four and heated by electricity or district heat (N=59). Of the total energy consumption, 53% was estimated to be going to heating the house, 20% for heating the water and 27% went to other uses. The relations between these percentages nevertheless differed considerably.

In the houses studied, the energy consumption rose 12% on average between 1982-1985 and 1989-1990. The consumption of water and household electricity both rose one fifth on average. The percentage change the total energy consumption varied, however, substantially (Figure 1, d). The differences in families' energy consumption had grown in the latter half of the 1980s. Figure 2 shows the correlation between the level of consumption of the families interviewed and the change taking place in consumption. The consumption of the families whose consumption was high in 1989-1990 had also risen considerably ($r = .77^{***}$)¹. Correspondingly, the consumption of the families consuming least of all had remained at the level of the early 1980s. In a few families it had even fallen.

5.2. Factors correlating with consumption

The connections in the quantitative material were described by a simple correlation analysis prior to starting the qualitative analysis. The interactions of the different factors were not excluded.

The size of buildings affected the total energy consumption ($r = .33^*$). The correlation between the specific consumption (kWh per square metre of useful floor area) and the level of consumption was, however, much more pronounced ($r = .72^{***}$). Regular use of a heat-storing fireplace was one reason for the low total consumption and in particular the low specific consumption ($r = -.28^*$ and $r = -.52^{***}$). Both consumption figures were influenced by the fact that the sauna was heated with wood ($r = -.43^{**}$ and $r = -.37^{**}$). It was especially notable that these both tied in with the steady energy consumption rate or the below-average rise ($r = -.30^*$ and $-.37^{**}$).

A large water consumption was in turn common in the families where the overall and/or specific energy consumption was high ($r = .52^{***}$ and $r = .47^{***}$). The high energy consumption was also influenced by the large number of showers taken by the family during the week ($r = .39^{**}$) and the habit of using large quantities of water for each shower ($r = .36^{**}$). The large water consumption was also affected by the number of times clothes were washed during the week. In the families with a high water consumption the energy consumption also rose more than average ($r = .34^*$).

The family's income influenced the total consumption of residential energy ($r = .34^*$), especially since the houses of those with higher incomes were larger than average ($r = .35^*$). Those in the high income bracket also consumed more water ($r = .31^*$) and household electricity ($r = .47^*$). Those with high incomes had fewer wood-burning saunas than average ($-.32^*$). The consumption of upper white-collar worker families had clearly risen more than that of blue-collar families.

Families in which the wife was a blue-collar worker were on average more sparing in their use of the shower and did less laundry. They also had fewer electric appliances than average. One significant observation was, however, that the change in consumption was more clearly connected with the parents' professional status than with their income. This indicates that a change in consumption also depends on cultural differences.

The specific consumption levels of families using cheap district heat were higher than those heating with electricity. The families living in district heated houses used less wood and more water than those living in houses heated by electricity. The indoor temperature was on average also one degree higher than in the electrically heated houses. The observed differences appeared to be connected with differences in the price and billing practice. Not only was district heat cheap: the fixed basic charge was also high in proportion to

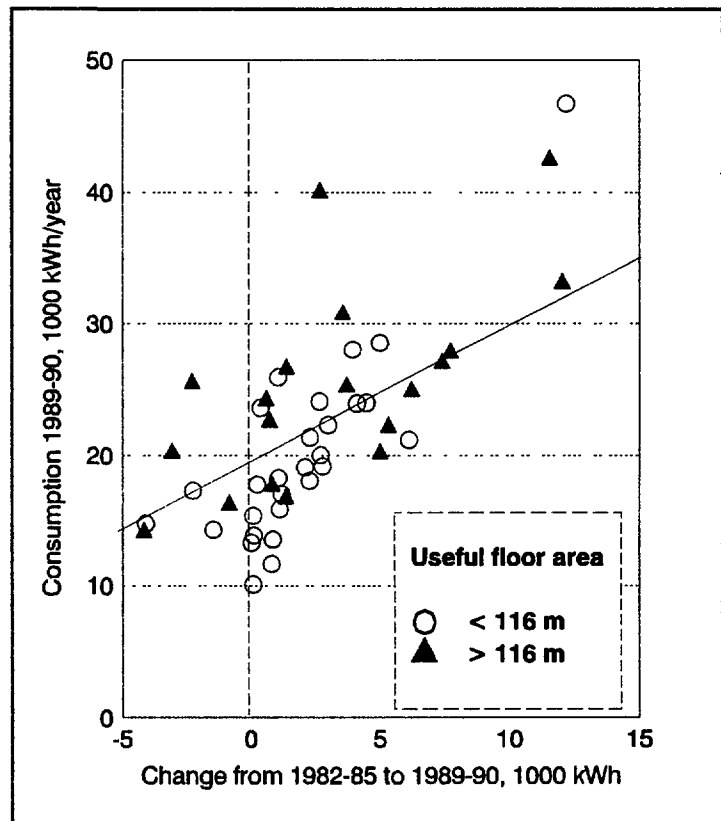


Figure 2. The correlation between the 1989-1990 level and the change in the level from 1982 to 1989-1990 of residential energy consumption.

the rest of the sum, which varied according to consumption.

5.3. Energy consumption awareness

The majority of the families openly admitted that they did not keep a check on their energy consumption. They merely checked that their bills were approximately right. Some kept a record of the sums paid, but not of the kilowatt-hours consumed.² None of the families made systematic allowance for the effect of the weather. They kept even less check on their water consumption than on their energy consumption. Many of them had kept a check on their consumption for a time after moving into the house, but they stopped when they thought their consumption had stabilised.

The technical interest in energy consumption, such as knowledge of how to operate and regulate the heating devices, varied from one family to another. The interest lay not necessarily in saving energy but rather in the technology itself. The influence of the house designers and various experts on investments in energy saving technology was in many cases considerable. Regular supplementary heating with wood was in most cases motivated by the availability of cheap waste wood.

The indoor temperature was not kept below comfort level in order to save energy. The temperature which was considered comfortable depended very much on the family or individual. Awareness in constituting the target temperature and in regulating the temperature varied, too. Some turned the thermostats up or down according to how they felt. The majority of the interviewees assumed that the room temperature was 20-22 °C. In half the houses studied the measured temperature was, however, at least two degrees higher. Very few lowered the temperature according to the time of day or when they went away for a long time.

There were major differences in ventilating habits, but the real amount of ventilation could not be measured in the study. Estimating the need for ventilation in new, tightly-insulated houses was clearly a problem of which residents were not themselves aware. Not all were aware of the great significance of ventilation with respect to energy consumption in mild winter weather. Windows were sometimes left ajar for long periods without altering the thermostats. The increase in ventilation during the exceptionally warm winters of 1989 and 1990 was the probable reason for some large rises in weather adjusted consumption.

The families did not, as a rule, have any clear personal energy saving motivation. The rather general rise in energy consumption had come at a time when the family's financial situation had improved and the real price of energy had fallen.³ Nor did families consider that the general need to conserve energy applied to them. Many thought, for example, that more nuclear power would be constructed in any case. They generally expected the government to carry out measures to save energy. When asked about their personal or the household's potential for saving energy, they usually claimed that there were quite definitely possibilities for saving energy -- if necessary. Those who already had a low energy consumption saw least potential for saving without compromising over well-being. Most people nevertheless interpreted the need to save as applying to some state of emergency and did not see any clear need in the present situation. They considered the possible rise in the price of energy regrettable. On the other hand, they felt that habits are difficult to change unless forced by a clear rise in price. Some of the respondents thought that existing habits could well be changed without their well-being suffering in the least. Others, in turn, doubted that, for example, lowering the temperature or using their electric saunas less would mean a drop in well-being. Burning wood was, by contrast, widely offered as a means of saving energy.

5.4. Other factors influencing consumption

The families differed in their demands for cleanliness. In one third of the families no one had a shower every day, whereas in one quarter all members of the family showered daily. 10% of the young people took showers morning and night, and many of them spent a long time in the shower.

Some considered that clothes are washed too often these days, while others stressed the importance of cleanliness. Some always followed the washing instructions, i.e. used the highest permissible temperature, but many washed almost everything at 40 °C and were satisfied. Some felt that the dishwasher had

increased the amount of washing up. This is because in addition to making washing up easy, the machine meant the kitchen was kept neat and tidy. Habits and opinions on leaving the dirty dishes in the machine until the following day also varied.

Almost all the families made considerable use of their saunas. The effect of the sauna on energy consumption depended chiefly on how it was heated (wood or electricity). The majority of the families heated their saunas at least three times a week, regardless of whether it was electric or wood-burning. The freedom to take a sauna bath whenever one felt like it was considered an important advantage of living in a detached house.

The families' eating and cooking habits varied considerably. The majority regularly had a hot meal on weekdays, some irregularly and some never. Some used a lot of raw materials, others semi-processed foods. For some the coffee-maker and microwave oven had replaced the use of a stove almost completely. There were also considerable differences in the use of electric oven and freezers.

The mother's going out to work might cause a fall or a rise in consumption. There was less cooking and baking, but sometimes also less burning of wood. Another reason for a rise in consumption might be that while the mother was at home the children's use of energy was more controlled. The room temperature, washing and laundry were in any case the same regardless of whether the mother was at home.

The differences in behavior were not very clearly linked to differences in energy consumption awareness. Nor was it always easy to determine, even in the examination of one family, which factors accounted for the change in consumption or for the level of consumption.

5.5. Different types of energy consumption and life-styles

The following types of energy consumption and life-style could be traced, in spite of the variety of factors operating in different directions.

5.5.1 "Thrifty wood burners"

The energy consumption level of the "thrifty wood burners" was clearly below average and the consumption had not risen. Wood was regularly used to provide supplementary heating in a heat-storing fireplace or to heat the sauna. The "thrifty wood burners" were also economical in their other habits affecting energy consumption. The room temperature was not necessarily lower than in the other families, but they burnt wood to provide heat. The parents adhered to their modest life-style. New electric devices, such as videos, were introduced into the family by the children. These parents spent much of their free time at home, and typical leisure pursuits were watching TV, reading, walking and jogging, for women baking and handwork and for men doing odd jobs in the garage. The mother was often a traditional home maker. Outside the home these parents' interests most often consisted of participating in their children's sporting activities.

The mother was usually a blue-collar worker. Although the family's financial conditions did tie in with frugal habits, the economy was not considered the primary reason for them. These people took thrift as a matter of course, internalised long ago in childhood and youth. The "thrifty wood burners" did not in their opinion compromise over their well-being. The "habitually frugal" did not consciously pay any attention to energy; their energy-conserving habits were part of the traditional frugal way of life often associated with a rural background. In the "technically oriented" families the husband tended to put his technical know-how to economic use by applying it to the heating system.

5.5.2 "Ordinary middle-class people"

The "ordinary middle-class people" as a general rule represented families with an average energy consumption level and an average rise in consumption. Compared with the "thrifty wood burners" they were more urban and modern. The mother was typically a lower white-collar worker. Parents of this type were not in principle opposed to various innovations and fashions. They also had more interests outside the home than

the "thrifty wood burners". Their hobbies were modern, such as aerobics or squash. Slalom skiing was a typical hobby for the whole family.

The "ordinary middle-class people" also burnt wood in their fires or saunas, but they were motivated by the desire to create a cosy atmosphere or to achieve the right kind of sauna steam. The people familiar with the energy technology of this type were interested in the technology itself rather than in using it as a means of saving. Their attention to energy technology also tended to be a passing interest, unlike the "technically oriented thrifty wood burners".

Although the house had been equipped when built with the main high-consumption electric appliances -- a fridge, freezer, washing machine and dish washer -- the number of light fittings and other electric appliances had increased. These people assumed that the influence of lighting and the use of devices on energy consumption, taken as a whole, was small. The "ordinary middle-class" families were typically unaware of the rise in their consumption. They believed their consumption had remained stable because there had not in their opinion been any major changes in the house or their living habits. They thought, however, that it is important to avoid wasteful habits.

The following clear sub-types were discernible among the "ordinary middle-class" families. (1) *The "water users"* used more hot water for shower. The amount of laundry had also increased. The children in particular spent long periods in the shower and frequently changed their clothes, whether they were dirty or not. (2) The indoor temperatures of *the "heaters"* were higher than they thought. E.g. the thermostats were out of order, their markings or the thermometers gave unreliable readings or the thermostat had remained at a higher setting when adjusted by a family member who did not properly understand its operation. (3) *The "airers"* kept the windows ajar for long periods in mild weather during the heating season (day or night) without turning off the thermostats.

5.5.3 "Comfort-seekers"

The high consumption of *the "comfort-seekers"* had risen further over the period under study. In many respects they resembled the "ordinary middle-class people". They differed mainly from the "ordinary middle-class people" in that they more openly accepted their "wasteful" habits. They had above-average incomes, they were in most cases upper white-collar workers and active outside the home. Some of the families were completely indifferent to the question of saving energy, while for others the indifference was explained by having more important things to think about. *Those who "ensured their comfort by means of technology"* had as a result a lower consumption level than others with similar behaviour patterns. The representatives of this sub-type were generally interested in technology. Their interest in energy saving was, however, confined to the installation of technical devices.

6. DISCUSSION

Three separate subjects (a-c) are discussed here.

(a) Of the five energy-user roles distinguished by Stern and Aronson (1984), the role of problem-avoider was clearly enhanced in the families studied. No attention was paid to energy consumption since there were no external factors clearly indicating the need for saving energy.

The absence of personal saving motivation evident in the families studied can be interpreted using the conditions proposed by van Raaij and Verhallen (1983) for positive attitudes to energy saving to lead to energy-saving behaviour. The conditions are: 1) consideration of the costs and benefits of alternative modes of behaviour must be in favour of energy saving, 2) people must accept their own responsibility in saving energy, 3) people must realise the effects of their behaviour on energy consumption and 4) they must be seen that their action is of influence.

The price of energy was clearly no longer an incentive to save. Secondly, the family's own energy

consumption and the importance of households' activities in general were considered to be small in relation to the whole. Consumers' personal sense of responsibility in Finland has been further influenced by the fact that energy problems have primarily been regarded in the media as a problem of how energy should be produced. The reports of the consequences to Finland of the greenhouse effect have moreover been conflicting. The information received by families had also been misleading in the sense that they believed the amount of energy consumed by lighting and entertainment electronics was of no significance. The billing system does not, in addition, provide sufficient feedback. It appears that people also lack faith in the efficacy of their own actions, for judging from the comments, they have no confidence in the attempts by other sectors of society to save.

(b) The concept of life-style is very ambiguous. I think it might be useful to restrict its scope as Allardt (1986) has done. According to Allardt, (1) explanation models founded on life-style are based on the idea that people blindly adhere to habits and customs they have internalised, and which are slow to change. Studying life-styles and the changes in them specifically calls for an analysis of their objective prerequisites. (2) The explanations for human choices based on passing trends, fashion, place more emphasis on external, more rapidly changing stimuli. (3) Stressing rational consideration calls for examination of what makes a person choose a particular option. This type of explanation greatly underlines the individual and his conscious, goal-oriented choices. Determination of the alternative options also demands a statement of the choice criteria.

The significance of energy awareness and conscious choice on the behaviour patterns of the different families studied was not very great. Many energy-saving habits were part of an unconscious life-style. In the case of the "thrifty wood burners" the habits and attitudes assimilated in the conditions prevailing in their childhood and youth were significant. Wood burning was part of life-style in which one could save costs by one's own labour, while the high energy consuming habits of the "comfort-lovers" were simply taken for granted. In most of the families the purchase of new electric appliances, likewise the burning of wood, were the consequence of new, outside stimuli. The "water users", "heaters" and "airers" were not aware of their behaviour.

The three factors -- life-style, fashion and conscious choice, as defined by Allardt -- can be exploited in estimating measures aimed at saving energy. For example, the focal points of measures aiming at change may differ from one type of consumer to another. Efforts can be made to increase conscious choice by appealing to various rationalities and by trying to alter the conditions in order to support them. The conditions should also be made such that the habits assimilated by the new generation are energy-saving ones.

(c) The term "saving" has in the past few years been replaced by "more efficient use of energy". The most effective means is in this case enhanced technology. Savings that are technically feasible may, however, easily fail to be implemented. E.g. the families studied here did not pay any attention to energy consumption when they bought equipment. The saving effect of new appliances is further hindered by the fact that the scope of use also widens side by side with the purchase of new appliances. The fridges and freezers are getting bigger, clothes are washed more often and the economy programmes on washing machines may also create a false illusion of economical use. The replacement of baths by showers has probably meant that people wash more daily. Appliances are not always used in the proper way. Problems were encountered in this study in, for example, the use and servicing of heat-saving thermostats. All in all the growing number of appliances purchased will lead to greater consumption. It is thus obvious that technology alone is not enough, and that there is also a need for greater awareness of energy consumption, motivation to save energy and conscious choice concerning the needs to use energy.

ACKNOWLEDGMENTS

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ENDNOTES

1. The correlation risk levels are expressed as follows: *** = $p \leq .001$, ** = $p \leq .01$ and * = $p \leq .05$.
2. Electricity, district heat and water are as a rule billed in Finland in equal instalments according to the previous year's consumption. Only the final instalment for the year is based on the measured consumption.
3. At the beginning of 1990 the real price of energy for people with direct electric space heating was only 70% of the price at the beginning of 1982. The corresponding figure for district heat was 62%.

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