Energy Policy Options

- from the Perspective of Public Attitudes and Risk Perceptions

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Abstract

In the present study a representative sample (N = 797) of the Swedish population was surveyed, with regard to attitudes related to energy policy issues (e.g., environmental attitudes, risk perceptions, and attitudes towards different energy production systems) and self-reported electricity saving behavior. These factors were considered relevant in a Swedish energy policy context, because of the planned phase-out of nuclear power. Citizens' attitudes have traditionally been important factors in energy policy-making, especially nuclear policy, and one of the conditions for a successful phase-out is increased levels of electricity savings among households and in industry, in order to compensate for the loss in energy production. Respondents reported positive attitudes to the environment in general and to electricity saving, while the attitudes to nuclear power as an energy production system in Sweden were relatively negative. Perceived risk was an important predictor of these attitudes and it was concluded that it is important to investigate mechanisms behind this variable. The relationship between attitudes towards electricity saving and electricity saving behavior was weak. It is discussed whether the contribution of psychological knowledge in energy conservation campaigns could be to elaborate on people's willingness to be moral and public-spirited citizens in combination with their pro-environmental attitudes. This work was supported by grants from NUTEK and FRN. Viklund (1999) presented more data from the survey referred to here.

Keywords: energy policy, electricity saving, risk perception, attitudes, behavior

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Introduction

Policy-making in modern society is a complex art. In a representative democracy, there is a wide range of factors, which must be taken into consideration in the decision-making process. Policy-makers must always be aware of the economic consequences of their decisions. Furthermore, in modern society there is very often a need for risk analysis before making important decisions. Such an analysis includes assessment of the probabilities of the occurrence of different events, together with an evaluation of the consequences if these events should occur, in terms of effects on public health and the environment. Policy-makers must also reflect on demands by various interest groups and stakeholders in society (e.g., organizations representing industry, environmental organizations, and consumer movements). There are also a variety of political factors to take into account, such as the distribution of mandates among political parties, which is the key to practical possibilities of making political decisions. Naturally, the policy-maker is guided, and should be guided, by his or her convictions, as well as the ideology and opinions of the party he or she represents.

But, as the power of the policy-maker is dependent on the will of the voters, he or she must also have some knowledge of their political attitudes and behaviors. Granted, the citizens delegate much responsibility to politicians in elections, but the act of voting is not the only way in which voters can influence policy. One obvious way is to form civic associations, some of them with the explicit aim to influence policy. However, even citizens who are relatively inactive politically can influence policy by participating in polls and other kinds of surveys. Thus, there is a fairly important participatory element in modern democracy, which is also included in most models of ideal democracy, where people have much influence over policy. A popular influence is not only preferable from a normative viewpoint, though, since knowledge of citizens' opinions also could be viewed as a very constructive decision support tool.

Knowledge of citizens' attitudes and behaviors may be especially important in energy policy, since it is traditionally an area where Swedish citizens have had a comparatively large influence. Of course, people can have their say in national elections, but the nation's energy policy has also been considered important enough to arrange a referendum concerning the nation's future use of nuclear power as energy source. There have only been four other referenda in Sweden. These referenda concerned prohibition (1922), right-hand traffic (1955), a new pension system (1957), and membership in the European Union (1994). The referendum concerning nuclear power was held in 1980 and it was decided that the nuclear power would be successively replaced by other energy sources and that it should be completely phased out by 2010. Risk was a prominent issue in the discussions of nuclear power. Still today, it seems as energy policy to quite a large extent is influenced by the citizens' attitudes towards energy sources and perceptions of (especially nuclear) risks. Viklund (1999) notes that there are voices that doubt that the government is very interested in implementing the phase-out decision, because of the current (relatively) positive opinion towards nuclear power in Sweden.

Finally, yet another possibility for citizens to influence energy policy is, of course, by their consumption of electricity. In fact, because of the problems associated with phasing out nuclear power, it has been proposed that it is necessary for households to change their energy consumption (i.e., electricity saving must increase).

Thus, it is clear that Sweden's energy policy historically has been influenced, to some extent, by people's attitudes (mainly towards nuclear power) and behaviors (mainly their electricity consumption). The need for public guidance over energy policy today is greater than ever before, because of the many challenges policy-makers are facing.

The long-term policy decision taken by the Swedish government in 1997 is a good starting point for describing today's complex energy situation. The overall goal in that decision was to accomplish a redistribution of the use of different energy sources in the production and consumption of electricity in Sweden (Energimyndigheten, 1998). In the end of the 1990s, 46% of the electricity consumed in Sweden was based on nuclear power (and approximately the same amount was based on hydro power). Nuclear power as an energy source will be phased out and replaced by other energy sources, according to the Government.

The purpose of this transformation of the energy system is to make it more economically efficient and friendlier to the environment, but one important objective is most likely also to decrease the risks to the public. Risks associated with nuclear power are usually considered risks of the type "small probability – large consequences" and people tend to worry more about these risks, compared with other types of risks (Drottz-Sjöberg et al., 1994; Drottz-Sjöberg & Sjöberg, 1990). It was the fear of a nuclear accident that was the major driving force in the arguments against nuclear power at the time of the referendum and it was probably this fear that contributed most to the phase-out decision. Another objective is most likely that the Government, by following the referendum decision, hopes to avoid a debate regarding them deceiving the Swedish public, and the possible loss of public trust that could be the result of abandoning the phase-out plans. To achieve these goals, the Government thus has stated its determination to replace nuclear power (Energimyndigheten, 1998). However, at the present time, it seems unlikely that all nuclear power plants will be closed down by 2010. In the policy decision from 1997, it was stated that the phase-out process would start with closing the two reactors of the nuclear power plant in Barsebäck. The first closure took place in 1999, but the second reactor has not yet been closed, since it was not guaranteed that new electricity production and decreased electricity consumption could compensate the loss of electricity production.

Another major change on the electricity market is the deregulation of the market. The decision to deregulate the market is related to the phase-out of nuclear power. There is a hope that a market deregulation will make people more efficient in their electricity consumption; that is, they will simply consume less electricity without having to decrease their standard of living (Bernström, Eklund & Sjöberg, 1997). If the Swedish electricity market will actually be more efficient, in terms of more cost-efficient electricity consumption, the nation will be more capable to manage a possible shortage on electricity (which might be the consequence of a phase-out, if no alternative sources of energy have been found at that time).

Thus far, everything is fairly simple – the deregulation has already taken place and should, according to the logic described above, contribute to solving an important problem (possible shortage of electricity) associated with phasing out nuclear power. However, things are rarely that simple in the real world. It is quite unusual that one policy decision (deregulation) leads to the predicted result with complete certainty, since there is more than one dimension at play in the real world – and in some cases one event can even cause two contrary effects. In the present case, this means that deregulation not necessarily leads to decreased consumption of electricity, since deregulation <u>also</u> leads to increased competition and lower prices, which is strongly related to an <u>increase</u> in electricity consumption (Viklund, 1999). Yet another factor is the long-term trend towards higher levels of consumption, which is largely due to usage of new household appliances and electronics (Energikommissionen, 1995).

There are other complications with phasing out nuclear power. One important factor is that of effects on the environment and another factor is cost-efficiency. The main threat to the environment is that of carbon dioxide emissions, which have been estimated to increase in case of a phase-out of nuclear power (Energikommissionen, 1995). In short, nuclear power is a clean, “green”, and inexpensive energy source and it is a major technological challenge to find an energy source with similar advantages.

The government has two options. The first option is to (continue to) postpone the nuclear phase-out or even decide to continue using nuclear power as an energy source in Sweden, due to the many problems associated with a phase-out. It would perhaps be possible to choose this option, considering that people in Sweden currently are relatively positive towards nuclear power and that fewer than ever before (but still a majority) are proponents of a phase-out. There is an evident risk, however, that people’s trust in the government would be seriously damaged if the government would change course completely and decide to ignore the result of a referendum, regardless of how distant in time it is. Moreover, the main reason for skepticism towards nuclear power to begin with – the risk; mainly the consequences of an accident, but also risks relating to the management of nuclear waste – would not disappear.

The second option is to continue the process of phasing out nuclear power, despite potential problems with environmental effects and the cost-efficiency of alternative energy sources, and the risk of shortage of electricity, causing problems in well-being and higher electricity prices. The reader may object, arguing that higher prices would be good, since they would increase levels of electricity saving. The problem is, however, that long-term savings are desirable before nuclear power is phased out. The trend of the late 1990s was that prices were decreasing, because of the increased competition caused by the deregulation of the electricity market (Viklund, 1999), but this trend is less clear at the time of writing (January, 2002).

The government will most likely continue to phase out nuclear power, although a complete phase-out by 2010 is probably a too ambitious goal, by successively replacing it with energy based on new, inexpensive and "green" technology. And if the electricity prices will continue to be on quite low levels, there is a hope that other incentives than purely economic ones will lead to increased levels of savings.

Thus, there appears to be a need for psychological research in the area**.** It is perhaps possible to find non-economic factors, which explain some of the variation in people's electricity consumption. It is important to note that when the term "electricity saving" is used, it does not necessarily refer to actual savings of money (even if electricity saving often leads to such savings). The broader term "energy conservation" is, however, not used instead of electricity savings, simply because it is too broad; the present study is based on empirical data on electricity saving. A review of research (see below) on the area suggests that there is room for important psychological explanatory factors.

Earlier Research and Objectives of the Study

In the present article, a representative sample of the Swedish population is investigated, with respect to perceptions of risks in general, and nuclear risks in particular, attitudes towards different aspects of the energy policy issue and towards electricity saving, as well as self-reported electricity saving behavior. The emphasis when it comes to electricity saving is to find psychological explanations of attitudes and behavior.

The specific questions in the article are:

1. How do Swedes perceive different kinds of risks, including nuclear risks, and what risks are perceived as biggest?
2. What attitudes do Swedes hold in different energy policy related issues?
3. Does people's risk perception influence their attitudes related to energy policy and electricity saving?
4. What is the relation between attitudes towards electricity saving and self-reported electricity saving behavior?
5. To what extent can psychological variables explain people's attitude towards electricity saving?
6. To what extent can psychological variables explain people's self-reported electricity saving behavior?

Earlier research in the area suggests that psychological factors may be of importance when trying to explain pro-environmental behavior. Cameron, Brown and Chapman (1998) tried to estimate the influence of social value orientations on actual pro-environmental behavior. It was found that pro-social participants (i.e., a person who made more cooperative/altruistic choices in a series of decomposed games) in the study were more likely to send letters supporting a transportation pollution reduction program, compared with pro-self participants (i.e., a person who made more competitive/individualistic choices), who were more likely to send letters opposing the program.

Sadalla and Krull (1995) investigated possible psychological barriers to energy conservation. Their hypothesis was that conservation measures could negatively affect (as perceived by the individuals themselves) a person, by stigmatizing the individual and reducing his or her status. This hypothesis received some support in data and it was concluded that, since consumption seems to be equated with status, it might be easier to promote the consumption of products that conserve energy than to discourage energy consuming behavior.

De Young (1996) focused on how people can be intrinsically satisfied, by adapting pro-environmental consumption behavior. The recommendation based on the results from the study was that, in order to frame consumption behavior, these intangible, intrinsic, but positive payoffs should be highlighted.

Axelrod and Lehman (1993) investigated possible predictors of environmentally concerned behavior and noted that although many people according to research results are concerned about the environment, this concern does not correlate with action. Three theoretical concepts were in focus as possible explanations – attitudes towards behavior, personal efficacy in relation with behavior, and motivational forces behind behavior. Six factors were included in the final multivariate model, which accounted for 49% of the variance in environmentally concerned behavior. These were principled outcome desires (the extent to which respondents act in accordance with deeply held values for the environment), issue importance (absolute importance of the environment to the individual as well as its relative importance with other social concerns such as AIDS and poverty), self-efficacy (respondents' beliefs that they, personally, have the capability to engage in actions that can help solve environmental problems), social outcome desires (the extent to which family, friends, and the community served as guides to one's behavior with respect to the environment), channel efficacy (perceived difficulty the individual expected to encounter, when attempting to act in environmentally-protective ways), and threat perception (perceived likelihood, severity, and immediacy of environmental problems).

In a similar study, structural equation modeling was used to investigate the multivariate relationship between environmental attitudes and pro-environmental behavior (Grob, 1995). A model with the following five components was tested, confirmed and found to account for 39% of the variance in behavior: (a) factual knowledge about the environment and recognition of environmental problems (the only variable that did not correlate significantly with behavior); (b) the emotional value which the individual places on aspects of the environment and the disturbance resulting from his/her perception of the discrepancy between ideal and actual environmental conditions; (c) openness: post-materialistic beliefs and readiness to adopt new attitudes (the factor that correlated the most strongly with behavior: 0.45); (d) perceived control: beliefs about the efficacy of science and technology and beliefs about self-efficacy; and (e) direct actions that impact the environment.

When it comes to electricity saving, Cialdini (1993) referred to a study in which a chance for people conserving energy to have their names in newspaper articles, where they were described as public-spirited and fuel-conserving citizens, motivated them to substantial conservation efforts within a short period of time (a month). A sense of commitment thus seems to have an impact on people's energy-saving behavior. One issue of interest is whether the effects obtained would persist. It is possible that the effects could have been the result of "energy-conscious" behavior for a relatively few days that then faded as the utility month progressed. However, when this possibility was further investigated, it was shown that public commitment resulted in lower energy consumption throughout a 12-month period (Pallak, Cook & Sullivan, 1980).

Bernström et al. (1997) investigated the issue of electricity saving, using many of the variables included in the present study, although their results were not based on a strictly random sample of the Swedish population. They presented a regression model that explained 27.0% of the variance in the households' electricity saving behavior. Four variables were included in this model: (a) electricity payments; (b) perceived personal risks due to saving electricity; (c) general hazards as reasons to save electricity; and (d) development of the electricity consumption (during the last 5 years). It could also be noted that although the households were positive towards electricity saving, this attitude did not directly affect their saving behavior.

According to the study performed by Bernström et al. (1997), risk perception could be important in understanding electricity saving. Risk perception research has dealt with how people tend to perceive the risks in their environment, which means that some of the work has also focused on risks stemming from different energy sources. It has in many studies been shown that the attitude towards different energy production systems to quite a large extent is due to the risks associated with these systems (see for example Bernström et al., 1997; Sjöberg, 1999). Perceived risks are more important in explaining the attitude than the perceived benefits with the systems. A rather impressive result is that perceived risks and benefits associated with nuclear power in general accounted for approximately 60% of the variance in attitude towards nuclear power (Bernström et al.; Sjöberg & Drottz-Sjöberg, 1993).

Nuclear power is a particularly interesting area in risk perception research. The public tends to worry more about nuclear risks in comparison with other risks (Drottz-Sjöberg & Sjöberg, 1990; Drottz-Sjöberg et al., 1994). It is worth mentioning that there exists a notable difference between the public and experts when it comes to perceived risks associated with nuclear power. The public perceives nuclear risks as much greater than the experts do (Sjöberg &

Drottz-Sjöberg, 1994). This distinction between experts and the public is obviously an important aspect in decisions about energy policy, which ideally include opinions from both parties.

Summing up, the purpose of the present study is to map environmental attitudes, attitudes towards different energy systems, and risk perceptions of a large representative sample of the Swedish population. By doing so, the aim is to clarify psychological mechanisms of importance for some of the energy policy options Swedish decision-makers currently are facing and to describe the degree of popular support these options may receive. Psychological mechanisms underlying attitudes to electricity saving and self-reported behavior are especially in focus. One of the cornerstones of the long-term energy policy decision (that includes the decision to phase out nuclear power) in Sweden is to enable a transformation to a more economically efficient energy system, which is also friendlier to the environment, by means of increased levels of electricity saving in households as well as in industry.

Method

A mail survey was used as means of collecting data. The questionnaire was intended to cover a wide range of issues and the respondents were therefore asked to answer 313 questions on a total of 37 pages. The questionnaire was sent out in May 1998. The net sample consisted of 1202 and since 797 questionnaires were completed and returned, the response rate was 66.3%.

One objective of the study was to work with a sample representative of the Swedish population, in order to be able to generalize the results. According to the sample results regarding background variables, this objective seems to have been reached. The respondents were representative of the Swedish population in terms of gender distribution and average age. With regard to income and education, there was a difference between the respondents and the

Swedish population (on average, respondents had higher income and were better educated than the population at large). Income is not, however, an important explanatory variable and level of education tends to be only weakly related to risk perception data. Level of education turned out, furthermore, to be only moderately related to attitude towards electricity saving (Pearson's r = 0.19) and not at all related to reported electricity saving behavior. The structure of employment status among the respondents was quite similar to that of the population, but there were differences since there were fewer students and more retired people in the sample. This is a well-known phenomenon, which is probably due to the fact that retired people have more time to fill out extensive questionnaires. Moreover, there was a notable difference between the share of unemployed people in the sample and the share in the population, which is probably at least partly a consequence of the fact that unemployment rates had decreased somewhat in Sweden from 1997 (population data on unemployment are dated to this year) to 1998. The respondents were also representative of the population in terms of employer and occupational status. To conclude, the main conclusion is that the sample on the whole is representative of the population, especially with a response rate as high as 66.3%.

Electricity saving behavior was measured as an index; a mean was computed on the basis of reported frequency of different electricity saving activities. The general attitude towards electricity saving was based on one question. Risk perception was measured by ratings of general and personal risk of 37 hazards, on 8 step category scales. A "don't know" response category was also used and these responses were throughout treated as missing. Attitudes towards eight energy production systems, as well as perceived risks and benefits associated with these systems, were measured by 5 step Likert scales. Perceived risks were also measured by asking questions about the magnitude of risks associated with saving and not saving electricity, respectively.

There was a particular focus on nuclear power, based on its importance for the Swedish energy production system today and the interesting questions arising from the planned phase-out. Examples of such questions, which were included in the questionnaire, relate to if it is at all possible to phase out nuclear power and what the likely environmental, economic, and social consequences of a phase-out are.

Finally, some questions of a more practical nature were also included. These were mostly related to the respondents' living arrangements (e.g., place of living, type of living, size of apartment or house, and possible ownership of different kinds of electrical appliances).

Results

As noted before, the current trend in people's attitude towards nuclear power in Sweden seems to be that they are becoming more positive and more open to a continued use of nuclear power as a source of energy in Sweden, even after 2010. However, when comparing the attitude towards nuclear power with the attitude towards other energy production systems, it is evident that Swedes were still relatively negative towards nuclear power. According to Table 1, it appears that perceived risk was more important in explaining attitude, compared with perceived benefits. Nuclear power, to which people were relatively negative, was considered quite risky, but also as yielding many benefits.

Table 1

Means of Attitude, Perceived Risk and Benefit of Energy Production Systems

Energy source	Attitude	Personal risk	General risk	Personal benefit	General benefit
Solar	1.49 (0.76)	4.69 (0.68)	4.68 (0.67)	2.85 (1.48)	2.81 (1.43)
Wind	1.62 (0.89)	4.73 (0.65)	4.69 (0.66)	2.93 (1.50)	2.79 (1.43)
Hydro	1.84 (0.90)	4.53 (0.75)	4.38 (0.81)	2.17 (1.17)	1.81 (0.96)
Biomass	2.28 (1.01)	3.61 (1.00)	3.53 (0.99)	2.86 (1.25)	2.76 (1.16)
Natural gas	2.44 (0.99)	3.54 (0.95)	3.46 (0.93)	2.49 (1.29)	2.95 (1.07)
Nuclear power	3.04 (1.41)	2.79 (1.37)	2.65 (1.34)	3.27 (1.14)	1.98 (1.16)
Oil	3.61 (0.97)	2.54 (1.00)	2.42 (0.97)	3.09 (1.19)	2.64 (1.13)
Coal	4.17 (0.93)	2.13 (1.05)	1.97 (0.93)	4.06 (1.08)	3.73 (1.10)

Note. With regard to the attitudes, the respondents were asked to mark their opinion by selecting a number on a scale from 1 to 5. The steps on that scale were (1) strongly positive, (2) quite positive, (3) doubtful, (4) quite negative and (5) strongly negative. The risk and benefit scales also ranged from 1 to 5, where 1 = very large risks/benefits and 5 = very small risks/benefits. Standard deviations are presented within parentheses.

The pattern that perceived risk is more important than benefits in explaining attitudes is established in Table 2, where ratings of attitude to the eight energy production systems are regressed on judgments of risk and benefit of these systems. Moreover, it is interesting to note that the highest amount of attitude accounted for was in the case of nuclear power.

Table 2

Multiple Regression Analysis between Risks and Benefits associated with different Methods of Producing Electricity and the Attitude towards each method

Energy source	β, personal risk	β, general risk	β, personal benefit	β, general benefit	R^2 adjusted
Coal	-0.09*	-0.42***	0.18***	0.15***	0.43
Hydro power	-0.20***	-0.14**	0.29***	0.19***	0.38
Oil	-0.27***	-0.30***	0.18***	0.10*	0.41
Nuclear power	-0.42***	-0.18**	0.24***	0.07*	0.59
Natural gas	-0.13*	-0.36***	0.14***	0.18***	0.38
Bio-mass	-0.32***	-0.20***	0.17***	0.17***	0.44
Solar	-0.07	-0.25***	0.17***	0.13*	0.17
Wind	-0.11*	-0.23***	0.21***	0.17***	0.22

* $p < 0.05$. ** $p < 0.005$. *** $p < 0.0005$.

One explanation of the fact that people perceive more general benefits with nuclear power compared with most other energy sources is most likely that other energy sources, such as solar power and wind power, currently are used to a small extent. When asked about their preferences for the method of producing energy in the future, however, respondents wanted to see more of solar power and wind power. On a scale from 1 (definitely negative towards using that source in the future) to 5 (definitely positive towards using that source in the future), the means for solar and wind power were 4.41 and 4.38, respectively. This could be compared to the current major energy sources in Sweden, hydro power and nuclear power, where the means were 3.97 and 2.83, respectively. The lowest scores were assigned to oil (M = 2.30) and coal (M = 1.61).

The main conclusion as to the future use of nuclear power as an energy source in Sweden is that, despite the trend towards more acceptance of nuclear power, there is a fairly strong will among the Swedes; that will is to use environmentally friendly energy sources such as solar power and wind power. It is important to note that nuclear power is quite a clean energy source, when it comes to emissions, but the popular skepticism is more due to perceived (mostly personal) risks associated with using nuclear power to produce energy.

On the attitudinal level, there also seems to be a widespread support for the governmental policy of trying to phase out nuclear power, and at the same time increase electricity savings. One question to the respondents were: “If a phase-out would mean a need to increase the electricity savings, are you ready to save electricity?”. The scale ranged from 1 to 5 and the mean was 4.01. See Table 3 for frequencies.

Table 3

Whether the Respondents would Save Electricity if it was needed as a Consequence of a Phase-Out of Nuclear Power

Statement	Frequency in percent
No, definitely not	3.3
No, probably not	8.6
Maybe, maybe not	14.3
Yes, maybe	31.6
Yes, definitely	42.1

The respondents were, however, not as sure about the possibility to replace nuclear power. When this question was based on the same type of scale as in Table 3 above, the mean was 3.46. One important point for policy-makers who want to pursue the policy of phasing out nuclear power, and to increase electricity savings, is to make sure that the citizens are aware of the connection between these two factors. The respondents were asked about their beliefs about possible consequences of a phase-out of nuclear power and it turned out that the most likely consequence was a factor termed "Increased needs for savings" (which included the following variables: "Increased electricity prices", "Increased need to save electricity in the households", "Increased need to save electricity in the industry", and "Increased effluent of carbon dioxide"). On a scale from 1 (very unlikely) to 7 (very likely), the mean for this factor was 5.64, which could be compared with the three other factors: "Reduction of environmental hazards" (M =

4.80), “Reduced standard of living” (M = 4.54), and “An alternative source of electricity” (M = 5.23).

Respondents’ risk perception was investigated by asking them to rate how big they perceived different risks to be, in terms of risky to themselves as well as risky to Swedish people in general. The scale ranged from 0 (non-existent risk) to 7 (very large risk) and the mean personal risk for almost all risks was less than 4 (except for East European nuclear power, with an average personal risk of 4.73). There was a strong tendency to rate general risks as higher than personal risks; this was particularly the case with so-called lifestyle risks, such as alcohol consumption and AIDS. The type of risks where personal risks were considered as big as general risks were risks associated with nuclear power (this category also included items such as “nuclear arms” and “nuclear waste”). People perceived these risks higher to themselves, when compared to non-nuclear radiation risks (e.g., irradiated food and natural background radiation) and other risks (e.g., floods and air pollution).

Does risk perception affect attitudes towards electricity saving and electricity saving behavior? This question was tested by using three types of risk perception items: (1) risks associated with different energy production systems, (2) factors of nuclear risks, non-nuclear radiation risks, and other risks, as constructed on the basis of the extensive list of separate risk items, and (3) perceived risks with saving and not saving electricity. In Table 4, correlations between perceived risks and attitude towards electricity saving as well as electricity saving behavior are presented.

Table 4

Risk Perception versus Attitudes towards Electricity Saving and Electricity Saving Behavior (Pearson's r)

Risks	Attitude	Behavior
Personal risks with nuclear power	0.12**	-0.11**
General risks with nuclear power	0.13***	-0.11**
Personal risks with solar power	-0.19***	0.14***
General risks with solar power	-0.20***	0.08*
Personal risks with wind power	-0.16***	0.07
General risks with wind power	-0.20***	0.07
Personal nuclear risks	-0.11**	0.16***
General nuclear risks	-0.12**	0.17***
Personal non-nuclear radiation risks	-0.06	0.12**
General non-nuclear radiation risks	-0.07*	0.13**
Personal other risks	-0.04	0.13**
General other risks	-0.05	0.15***
Personal risks with saving electricity	0.40***	-0.16***
Risks to society with saving electricity	0.34***	-0.14***
Personal risks with not saving electricity	-0.19***	0.08*
General risks with not saving electricity	-0.31***	0.10*

* $p < 0.05$. ** $p < 0.005$. *** $p < 0.0005$.

There was no common pattern as to any possible difference between effects of personal and general risks. The main conclusion based on the results reported in Table 4 is that perceived risks generally have weak effects on attitude towards electricity saving and electricity saving behavior. However, when looking at specific perceived risks, directly related to the issue of electricity saving, these had an important bearing on attitude towards electricity saving. Since perceived risk was important also in explaining attitude towards different energy production systems, it seems that risk is an important aspect of attitudes related to energy policy issues. One might suggest that a risk associated with saving electricity is a fear of decreased standard of living and/or level of comfort (due to changed habits), and that a risk with not saving electricity could be that there would eventually be a shortage of electricity.

As noticed above, it seems to be possible to pursue a policy of replacing nuclear power and at the same time increase electricity savings, based on the attitudes reported by the respondents. Overall, the respondents could be considered as very pro-environmental and pro-electricity saving. For example, it was found that 94.7% of the respondents reported that they, at least to some degree, “act to maintain and protect the environment”. When asked about their general attitude towards electricity saving, almost 60% considered it an extremely good or very good thing. When also including those who answered “rather good”, the figure increased to approximately 90% of the respondents.

However, the step from having an attitude to actually take some pro-environmental action can be difficult to take. When using general attitude as single predictor of electricity saving behavior, it turned out to explain only 5.2% of the variance. Although a statistically significant relationship, it clearly shows that general attitude is very far from being a powerful predictor of behavior. This was also shown in the multiple regression models for explaining attitude and behavior. Four variables (personal risks with saving electricity; general risks with not saving electricity; perception of whether Sweden can save electricity; interest in environmental issues) that explained 32% of the variance in general attitude towards electricity saving only accounted for 8.8% of the variance in self-reported behavior.

The variables affecting behavior were mostly of a different sort than those affecting general attitude. One interesting exception was a factor called "altruistic reasons for saving electricity", which correlated on an approximate level of 0.30 with both attitude and behavior. This factor included the following reasons for saving electricity: (a) out of concern for the environment; (b) out of concern for future generations; (c) out of concern for health factors; and (d) out of concern for Swedish society. Otherwise, the predictors of self-reported electricity saving behavior clearly reflected that electricity saving to a large extent is dependent on practical circumstances (see Table 5). The amount of variance accounted for (approximately 20%) is most likely a reflection of the fact that economic factors (saving money) are at least as important as psychological ones. It should be noted, though, that 20% explained variance is still a rather strong result in a social science context.

Table 5

Multiple Regression Analysis of Variables Affecting Electricity Saving Behavior in Sweden

Parameters	Electricity saving behavior (β)
Whether received information about electricity saving	-0.13***
Whether try to act in order to maintain and protect the environment	-0.22***
Perceived amount of electricity consumed in comparison with other households	-0.15***
Pleasant temperature at home	-0.15***
"Nature people"	-0.16***
R^2 adjusted	0.198

*** $p < 0.0005$.

"Nature people" is one so-called lifestyle factor that could be identified on the basis of a factor analysis. In the questionnaire, a large number of lifestyle items were included, in order to enable a test of whether "lifestyle" was important in explaining attitudes towards electricity saving and electricity saving behavior. On the whole, these factors (e.g., "yuppie/consumption oriented" and "family oriented") were not very important since they together accounted for approximately 10% of the variance in attitude and behavior, respectively. However, one of the extracted lifestyle factors was important enough to be included in the regression model above. It should be noted, though, that the "nature people" factor is not very reliable (Cronbach's alpha: 0.52) and only included three items ("It is important to me to be out, in the natural environment", "Nature gives me peace of mind" and "I fish, hunt and/or pick berries to get more money to our household").

Finally, it is important to mention some limits to electricity saving. That is, although people may be positive towards electricity saving, there are practical limits to their possibilities to change their levels of electricity consumption. The most obvious limitations are physical: type and size of dwelling. If the area of the home of the respondent was large, the respondent was more likely to be active in electricity saving ($R^2_{adj} = 0.031$, $F = 26.62$, $\beta = 0.180$, $p < 0.0005$). There is also a limit on electricity saving when it comes to equipment; if the respondent had a thermostat at home, he or she was more likely to be active in electricity saving ($R^2_{adj} = 0.032$, $F = 26.93$, $\beta = -0.181$, $p < 0.0005$). Moreover, if the respondent preferred a low temperature at home, he or she was more likely to be more active in electricity saving ($R^2_{adj} = 0.042$, $F = 36.22$, $\beta = -0.209$, $p < 0.0005$). Where the respondent lived was also important for his or her stated electricity saving behavior – the respondent living in a small community was more likely to be active in electricity saving ($R^2_{adj} = 0.014$, $F = 12.64$, $\beta = -0.125$, $p < 0.0005$). Another type of physical limitation is whether the relation between the respondent and his or her home is characterized by owner or tenant status. Whether a respondent lives in a private house or in a rental apartment should be reflected in his or her electricity saving behavior. A person living in a small apartment does not have the same possibility to save electricity, because of the limited space as well as the fact that he or she usually does not pay for heating on a basis of level of consumption, but a flat rate independent of how much is consumed. This was the case when we tested the assumption on the data. A person living in a private house was more likely to be active in saving electricity ($R^2_{adj} = 0.041$, $F = 35.04$, $\beta = -0.205$, $p < 0.0005$), while a person living in a rented apartment was less likely to be active ($R^2_{adj} = 0.036$, $F = 31.03$, $\beta = 0.194$, $p < 0.0005$).

Discussion

One of the main results of the present study, with possible implications for policy, was that respondents wanted to replace nuclear power, mostly because of the risks they perceived associated with producing electricity based on this energy source. They were willing to pay more for electricity perceived as environmentally friendlier, and they appeared to understand the relationship between nuclear power phase-out and levels of electricity consumption. In general, perceived risks were potent predictors of various attitudes, in particular attitudes towards nuclear power. Specific risks related to electricity saving were, furthermore, successful in explaining attitudes towards electricity saving.

Perceived risk was, however, not at all as successful in explaining electricity saving behavior. Indeed, it was a main finding that behavior was more difficult to explain with psychological variables, partly because it was to a larger extent a function of practical circumstances (e.g., type of living). Electricity saving behavior is most likely also influenced by electricity prices. Earlier research has shown that energy prices have a great influence on Swedish households' energy demands (Andersson, 1994). The link between attitudes towards electricity saving and electricity saving behavior was weak. It seems as if people are environmentally concerned and positive to electricity saving, but these factors are weakly related to (self-reported) behavior.

It is thus interesting to divide the two main problems of energy policy into two categories. One category involves the study of attitudes, which has been shown to be important for policy, whereas the other category is more related to individuals' behavior.

Based on the fact that perceived risk appeared to be an important factor in forming Swedes' attitudes related to energy policy, it could be useful to conceive of energy policy as a case of risk policy, focusing on risks associated with nuclear power. Policy-makers base their decisions on risk judgments to a large extent provided by experts, but for various reasons (e.g., political legitimacy) it is also important to consider attitudes and risk perceptions of citizens. A main dilemma that has been noticed in risk perception research is that experts appear to have different risk perceptions and attitudes compared to the public. It has been found that experts' risk judgments have structural properties similar to those of the lay public, while they judge the level of risk differently as long as it is a risk in their own field of responsibility (Sjöberg, in press). This seems to be particularly true in the case of risks associated with nuclear power. Experts perceive nuclear risks as considerably smaller than the public does. A relevant question is, then, what causes people to perceive risks as high or low? Since the structural properties of experts' and the lay public's risk perceptions appear to be similar, the claim that experts give an objective and correct assessment of risk, while the public's risk perception is fraught with many biasing factors, does not seem credible.

One common hypothesis is that trust in risk management or experts is an important determinant of perceived risk; that is, the more trust people put in corporations, politicians, and experts, the lower they perceive risks. Perhaps is trust the answer to the mentioned risk policy problem? Would higher levels of public trust allow policy-makers to pursue a rational risk policy (that is, taking advantage of expert knowledge, while at the same time receiving the degree of popular support necessary for technological progress)? Some commentators argue that trust is the solution to many risk policy problems, pointing to the notion that so-called siting processes (of hazardous waste material) often seem to fail as a consequence of people's distrust in risk management. Current research suggests that such an explanation might be inadequate in some important respects. First, in an extensive, yet unpublished, empirical study, Viklund (2002, in preparation) found that trust was a significant, but rather moderate, predictor of perceived risk, within as well as across four West European countries. Sjöberg (2001) showed that an important explanation to the relatively modest explanation value of trust could be people's perceptions of knowledge and science. People may trust experts to be competent and honest, but still perceive risks as high, because they may think that there are limits to science, and, therefore, to experts' knowledge. Furthermore, distrust and low trust are not necessarily the same thing. Luhmann (1988) argued that people trust in order to reduce social complexity. If they choose not to trust, they still have to face complexity and uncertainty, forcing them to pursue different strategies in order to deal with that complexity. Instead of forming positive expectations, people are forced to form negative expectations; that is, they distrust instead of trust. These negative strategies give distrust an emotionally tense and often frantic character, which distinguishes it from trust. Thus, while the highly negative state of distrust might be important in explaining why people react with fierce negativity to risky projects, such as the siting of repositories of hazardous waste in their communities, this does not necessarily mean that low levels of trust will be the major predictor of high levels of perceived risk. Even though it may be beneficial for policy-makers to be perceived as trustworthy by the public, it should hardly be the (only) guiding principle for them in their management of risk policy problems. So far, the most powerful predictors of perceived risk have been found in proximal variables (e.g., perceived risk of nuclear waste is well explained by attitude towards nuclear power).

As to the other main subject of the present study, people's electricity saving behavior, it was found that the general attitude towards electricity saving was weakly related to levels of electricity saving. One argument, based on the results, could be based on a questioning of whether there is much room for psychological factors in explaining electricity saving behavior. Is it possible at all to induce people to increase their electricity savings without monetary incentives? Are people living in small apartments (thus with obvious limits to substantial savings) open to information campaigns about the need to conserve energy, if they perceive few possibilities to do so, and if the possible decrease in levels of comfort is not obviously matched by the amount of money to be saved? And, if there are ways to affect people's electricity saving behavior on a short-term basis, what about long-term habits? Is it possible to educate people to carry out long-term changes in electricity consumption patterns? Looking at the Swedes, environmentally concerned and aware, will they actually act in accordance with their pro-environmental attitudes if electricity prices will stay on low levels or decrease even further?

Based on research conducted previous to the present study, there seems to be room for behavioral changes, based on knowledge of the mechanisms underlying people's consumption patterns. In the present study, it was found that some environmental attitudes were indeed relatively important in explaining behavior. If knowledge of strong pro-environmental attitudes could be combined with knowledge of other important factors, perhaps information and education campaigns could have long-term effects. One possibility would be to induce people's perception of themselves with respect to ethics. In the present study, it was found that an altruistic factor was an interesting predictor of attitude towards electricity saving as well as electricity saving behavior. Cialdini (1993) referred to the fact that the description of people as being environmentally concerned and public-spirited seemed to make them feel more responsible for their energy conservation behavior. Thus, since being pro-environmental in modern society is most likely considered as morally "good", campaigns aiming to combine the environmental and moral aspects could be successful. A contemporary example of an energy conservation campaign that seems to have been successful (at least on a short-term basis, where success is simply operationalized as lower levels of electricity consumption) can be taken from California.

The California energy crisis involved an almost disastrous shortage of energy in 2001. The immediate cause of the crisis was a dramatic increase in electricity prices on the wholesale market in 2000 (Sioshansi, 2002). The utility companies paid the wholesalers far more for electricity than what is normally the case, while they were forbidden by law from passing along the high costs of electricity to their retail customers. Eventually, this had the consequence that utility companies were unable to provide consumers with sufficient amounts of electricity (and gas, since natural gas prices also spiked during this period), due to the unbearable costs of buying electricity from wholesalers. An interesting aspect is that California officials in 2002 filed a suit against the Federal Energy Regulatory Commission, seeking renegotiations of electricity contracts signed during the state's power crisis. The suit was based on the argument that wholesalers were involved in manipulations of California's electricity markets. The well-known economist Paul Krugman (2002) argued that the situation shows that the energy crisis was not mainly based on a flawed deregulation of the electricity market, as most commentators insist, but rather, "the flaw was in trusting markets too much, not too little". In early 2002, California policy-makers faced two urgent questions (Sioshani, 2002):

1. How to make it through the summer with demand expected to exceed available capacity for many hours.
2. How to manage the soaring costs of buying power from the independent generators, who were to gain from continued supply shortages.

Since the former question primarily is driven by conservation measures (and also summer temperatures; in California, high temperatures means higher need for electricity-consuming cooling equipment), that is the issue I will discuss henceforth. The demand response programs, in order to reduce demand of electricity in California, that were undertaken in 2001 basically consisted of five factors (Goldman, 2002): (a) higher gas and electricity rates; (b) discount programs directed to consumers who conserved energy; (c) utility companies' energy efficiency and demand response programs; (d) voluntary conservation and curtailment at governmental facilities; and (e) the Flex Your Power media campaign. Thus, in order to reduce electricity consumption in the state, it was considered necessary not only to inform and educate consumers on the matter, but also to offer financial incentives. Few analyses have so far been conducted, as to the effects of different programs. It is, however, very probable that the campaign itself was only one of many factors influencing the vast reduction in demand and consumption of electricity that actually took place in California during 2001, thereby eliminating the shortage of electricity. The media campaign informed about prices on gas and electricity, financial rebates, so-called black-outs in different areas, and how the consumers could conserve energy in the best way possible. It is difficult to directly compare the effects on electricity consumption, caused by the media campaign and economic incentives, respectively. This is because the media campaign and the economic incentives belong to different categories. Whereas the campaign was a source of information, prices and rebates were obviously very concrete incentives to conserve energy. Although the immediate reason to save electricity often could be due to economic incentives, campaigns are not redundant, since they provide information about how to conserve as much energy as possible and about opportunities to save money by doing so.

Moreover, it is likely that not only increased prices and financial rebates caused Californians to conserve energy, but also the information about black-outs; that is, the fact that in some areas, the electricity was shut off during short periods. People probably understood that if they did not conserve energy these black-outs could continue and perhaps even occur more frequently in the future. There is also a possibility that people regardless of economic incentives and black-outs wanted to conserve energy in order to be "good citizens". This possibility could, however, be partially related to the fact that the state was in a crisis situation, which is a short-term perspective, meaning that the ambition to be a good citizen will not necessarily persist on a long-term basis. One could further speculate about whether the possible willingness to be a good citizen, even in the short-term perspective, during the end of 2001 was influenced by the events of 11 September the same year.

When Californians were surveyed about their reasons for reducing electricity consumption, a large share of them (64%) stated that high energy prices was a very important reason. Fear of shortages and blackouts, environmental concerns, and weather conditions were less important reasons, although still important, since the share of respondents stating these reasons to be very important were 42%, 33%, and 21%, respectively (Hensler, LeBlanc & Seiferth, 2002).

Another important aspect in the California energy situation is that the state-funded (approximately 10 million dollars) Flex Your Power campaign actually provided a relatively small share of media messages, since so much information about the energy crisis was in the news. One could suspect that the reason for the media's large interest in energy conservation was the fact that there was a crisis situation, giving the energy issues unusually high news value.

Summing up, the heavy decrease in electricity consumption in California was most likely due to the acute crisis situation, which almost forced people to conserve more energy and also increased the amount of information in media considerably. The natural question, then, is whether there has to be a disastrous situation in order to make people conserve energy? Indeed, it should be noted that this was a situation in which a gradual increase in energy conservation would not have been enough, but there was an urgent need for much lower levels of electricity consumption.

Finally, another aspect to reflect upon is the short-term versus long-term aspects. Most actions undertaken to reduce electricity consumption were low-cost behavioral changes, rather than investments in expensive equipment (Hensler, LeBlanc & Seiferth, 2002). Low-cost activities do not automatically have long-term effects on electricity consumption. In order to achieve such effects, people need to make a habit out of saving electricity – how this is to be done without long-term economic incentives is still a question that remains largely unanswered.

References

Andersson, B (1994) ‘Bryr sig hushållen om elpriset?’ *Ekonomisk Debatt* **3** 275-282

Axelrod, L J, & Lehman, D R (1993) ‘Predictors of Environmentally-concerned Behavior’ *Journal of Environmental Psychology* **13** (2) 149-159

Bernström, M-L, Eklund, Y, & Sjöberg, L (1997) *Electricity consumption and electricity saving in the Swedish households* (RHIZIKON: Risk Research Report No. 27). Center for Risk Research, Stockholm School of Economics

Cameron, L D, Brown, P M, & Chapman, J G (1998) ‘Social value orientations and decisions to take proenvironmental action’ *Journal of Applied Social Psychology* **28** (8) 675-697

Cialdini, R B (1993) *Influence* (third edition) New York, Haper Collins College Publisher

De Young, R (1996) ‘Some psychological aspects of reduced consumption behavior. The role of intrinsic satisfaction and competence motivation’ *Environment and Behavior* **28** (3) 358-409

Drottz-Sjöberg, B-M, Rumyantseva, G M, Martyushov, A N, Arkhangelskaya, H V, Nyagu, A, & Ageeva, L A (1994) *Public reactions to the Chernobyl accident. Report from a data collection in 1993 in Russia, Belarus and Ukraine. Social and Psychological Factors, The Joint Study Project 2 of the European Community* Center for Risk Research, Stockholm School of Economics

Drottz-Sjöberg, B-M, & Sjöberg, L (1990) 'Risk perception and worries after the Chernobyl accident' *Journal of Environmental Psychology* **10** 135-149

Energikommissionen (1995) *Omställning av energisystemet* No. SOU 1995:139

Energimyndigheten (1998) *Energiläget 1998*

Goldman, C (2002, February) *Demand Response Programs: Configuring Load as a Resource for Competitive Electricity Markets* Paper presented for Tokyo Electric Company, Tokyo, Japan

Grob, A (1995) 'A structural model of environmental attitudes and behaviour' *Journal of Environmental Psychology* **15** (3) 209-220

Hensler, T, LeBlanc, B & Seiferth, D (2002, January) *California Energy Efficiency in 2001: Customer Actions and Perceptions* CA EE Residential Market Research Study

Krugman, P (2002, February 26) ‘The Power Perplex’ *The New York Times*

Luhmann, N. (1988). Familiarity, confidence, trust: Problems and alternatives. In D. Gambetta (Ed.) *Trust: Making and breaking cooperative relations* (94-108) Oxford, Basil Blackwell

Pallak, M S, Cook, D A, & Sullivan, J J (1980) Commitment and Energy Conservation. In L. Bickman (Ed.) *Applied Social Psychology Annual Volume 1* (235-253) Beverly Hills, CA, Sage Publications

Sadalla, E K, & Krull, J L (1995) ‘Self-presentational barriers to resource conservation’ *Environment and Behavior* **27** (3) 328-353

Sioshansi, F P (2002) ‘California’s electricity market: finally turning the corner?’ *Energy Policy* **30** 245 - 248

Sjöberg, L, & Drottz-Sjöberg, B-M (1993) *Moral value, risk and risk tolerance* (RHIZIKON: Risk Research Report No. 11). Center for Risk Research, Stockholm School of Economics

Sjöberg, L, & Drottz-Sjöberg, B-M (1994) *Risk perception of nuclear waste: experts and the public* (RHIZIKON: Risk Research Report No. 16). Center for Risk Research, Stockholm School of Economics

Sjöberg, L (1999) ‘Risk perception in Western Europe’ *Ambio* **28** 543-549

Sjöberg, L. (2001). ’Limits of Knowledge and the Limited Importance of Trust’ *Risk Analysis,* **21** (1) 189-198

Sjöberg, L. (in press). ‘The allegedly simple structure of experts' risk perception: An urban legend in risk research’ *Science, Technology and Human Values*

Viklund, M (1999) *Electricity saving: Attitudes and behavior of Swedish households* Center for Risk Research, Stockholm

Viklund, M. (2002, in preparation) Trust and Risk Perception in Western Europe: a Cross-National Study