# Public perceptions of the future of nuclear energy

Ortwin Renn

'Since the mid-seventies we have all observed the following situation: if you wish to turn a peaceful cocktail party into a wrestling contest, or cause a happily married couple to face a serious crisis, or transform a nice friendly conversation into a wild west showdown, you have only to bring up the issue of nuclear energy. Immediately friends will become enemies, and business partners will cancel their cooperation. If I am opposed to nuclear energy, all persons in favour of this energy source must be morally inferior, since all morally outstanding persons (like me and my friends) are fully aware of the cynical view of the world that only a pro-nuclear person can share. If I am in favour of nuclear energy, I can only despise those ignorant day-dreamers who believe in such disgusting things as solar energy and conservation'[1].

This quote, taken from an article by a well-known German philosopher, highlights the present situation in the western world. The standpoint one chooses in the debate on nuclear energy determines who can be one's friends. The symbolic value of energy systems in everyday life has reached a point where people do not speak to each other any more, and neighbours take each other to court when they discover that their views on nuclear energy diverge. Recently a German couple applied for divorce because of irreconcilable attitudes towards nuclear energy: fortunately the court did not accept this line of argument.

All these observations concerning the present state of nuclear energy point to a persistent tendency towards polarization between the pro- and anti-nuclear factions in western societies. Politicians face serious opposition within their own party, as well as in public. Energy planners are accused of technocracy if they try to use rational models for decision-

making. Representatives of utilities are often perceived as reckless, profit-seeking cynics if they are in favour of the greater utilization of nuclear energy. In many countries, like the United States and Germany, political paralysis has occurred, with no possibility for movement, either forward or backward[2,3].

**Present energy situation in Germany**

What kind of actions are necessary to overcome this energy polarization and to rebuild public support for a rational energy policy? What kind of input data do we need in order to make energy planning more appropriate to the world's energy needs, and at the same time more compatible with the public's wishes and social requirements?

To find an answer to these questions the Ministry of Research and Technology of the Federal German government asked the technology and society programme group of the Nuclear Research Centre, Jülich, to investigate the possibilities of designing an energy policy programme which would not only satisfy the needs and requirements of an energy-seeking society, but also provide a way of resolving the related conflicts within German society. The Jülich study group was asked to look into the conditions and prerequisites which are essential if we are to end up with a social concensus regarding an acceptable and viable path for future energy policies[4]. In particular the prospective outlook and the further development of nuclear energy were to be investigated, taking into account social and psychological aspects and constraints.

The project group at Jülich was formed in summer of 1982 from professionals drawn from the natural and social sciences. Research started in September of the same year. The final report was finished in mid-1984 and is due to be published at the end of the year.

When designing the research programme the study group had to consider the characteristics of the political arena in which energy policies have to be formulated and implemented.

In contrast to some other political arenas the energy scene in Germany, as in many other western countries, is characterized by the following four major features:

- A lack of unanimity among the scientific experts (or those regarded as experts) about facts.
- The public's lack of confidence in scientists and policy makers.
- The assignment of symbolic values to nuclear energy, including moral and ethical considerations regarding industrial society as a whole.
- The unwillingness of the stake-holder groups to move towards a compromise.

The lack of general agreement about future energy policies among experts, politicians and interest groups has led to frustrations amongst the general public and has promoted a feeling of distrust and scepticism towards official decision-makers. The media and opinion leaders have transferred the controversy to the public, forcing people into the role of arbitrators between scientific camps. Needless to say, most people have found this too difficult and stressful. As long as every side claimed to be right, and in the eyes of the public nobody was able to prove which assessments were correct, a more cautious strategy was generally recommended. The result was a *de facto* moratorium on nuclear energy, though with the proviso that the nuclear option should be at least kept open[5].

The threat of environmental deterioration, fears of nuclear accidents and distrust of the political establishment were sufficient reasons in Germany for the rise of a new environmental party, called the Greens. The Green Party was very successful during the last elections, and is now competing with the Liberal Party for the third position in the political arena of Germany.

In the state of Hesse the Greens agreed to support the Social Democratic government, thus providing the necessary votes for the minority party cabinet of state leader Holger Börner. There is a good chance that the Social Democrats will form a coalition together with the Green Party in the state of Northrhine-Westfalia, should neither the Conservatives nor the Social Democrats gain the majority in the next election.

There is no doubt that the Green Party is totally anti-nuclear, although its major concern has shifted from anti-nuclear protest to pollution control of coal-fired power stations and car exhausts. It regards all large technical facilities as undesirable, and favours total decentralization of energy production, concentrating on conservation, solar energy, and small gas and coal-fired power units providing co-generation of heat and electricity. A first programme for decentralizing Hesse's energy production has been launched by the state government, but the bill has not been passed by the state parliament. The planned extension of the Biblis nuclear power plant has been postponed, and plans for constructing a reprocessing plant in Hesse have been cancelled.

Yet the prospects for nuclear energy in Germany are not entirely discouraging. Because of the alarming consequences of acid rain, and the growing awareness of the environmental effects of coal combustion; because of the absorption of some potential protest groups into the peace movement; and because of a world-wide renaissance of conservative values and free enterprise virtues[6], opposition to nuclear energy has calmed down lately. A number of nuclear plants are now under construction, without major disturbances or riots. According to national opinion polls the majority of people when asked about their feelings towards a nuclear future still favour a nuclear moratorium in Germany[7]; but the nuclear issue

has lost its outstanding position in the rank order of national concerns. Thus the motivation for overt protest has decreased over the past two years.

It is interesting that among young people a strong minority of 28 per cent does not approve anti-nuclear actions, and does not sympathize with anti-nuclear initiatives[8]. The nuclear issue is the only political topic amongst young people where a considerable number of youngsters stand on both sides of the fence. There is a unanimous vote for more pollution control, against the stationing of nuclear weapons in Germany, and for new political institutions like citizens' initiatives. Only with nuclear energy can a strong polarization be observed (Table 1).

**Steps towards a socially acceptable energy policy**

Government and local authorities face a serious dilemma. If they promote nuclear energy, they lose ground among their environmentally concerned voters, and run the risk of strengthening the Green Party. But if they reject nuclear energy, they face serious opposition from their traditional supporters of business people in the case of the Christian Democratic Party, or of blue collar workers in the case of the Social Democratic Party. This situation can best be illustrated by recent political developments in the city of Hamburg. The mayor had to resign, partly because he expressed strong support for the construction of the nearby nuclear power plant at Brokdorf. His successor had to resign after he insisted on withdrawing the city's support for the power plant. The third mayor remained undecided; he is still in office.

What are the lessons to be drawn from this puzzling situation? There is no use in blaming politicians for their ambivalent viewpoint, since their duty is to find public support for their political programmes, and their main interest is to be re-elected. It is useless to blame journalists for making the nuclear controversy so public, since it is their duty to report on all the events and thoughts that they observe in society and science. The fact that bad news sells better than good news is true of any topic in society, and is unfortunately in accordance with public taste. Nobody could sell a newspaper which limited its coverage to positive news. Nothing is more attractive than scandals and mishaps to other people.

Hence decision-making in the field of energy policy can only be effective and rational if the physical and economic aspects of the problem are enriched with social and political considerations. At least for democracies a solution that was sub-optimal from an engineering point of view might be preferable to an optimal solution if the second best strategy commanded considerably more public support[9]. But even if we accept this thesis, quite a few questions remain to be answered: who has the right to determine the

**Table 1. Organizational ties of 15 to 30 year old participants (%)**

| Organization/Groups | I am a member of this organization or group | I don't belong to this organization, but I share its view | I don't share the view of this organization | I am totally opposed to this organization |
|---|---|---|---|---|
| Peace movement | 11 | 64 | 5 | 0 |
| Ecologists | 10 | 74 | 1 | 0 |
| Church groups | 9 | 35 | 8 | 1 |
| Nuclear opponents | 8 | 37 | 23 | 5 |
| Citizens initiates (Action groups) | 4 | 67 | 4 | 0 |
| Young union members | 4 | 34 | 8 | 1 |
| Amnesty International | 2 | 66 | 5 | 1 |
| Young Christian Democrats | 2 | 19 | 20 | 5 |
| Feminist movement | 1 | 14 | 29 | 6 |
| Gay movement | 0 | 10 | 32 | 10 |
| Punks | 0 | 5 | 46 | 17 |

borderline between an 'acceptable' second-best solution and an 'unacceptable' third-best (or worse)? What difference does it make if public reactions are based on ignorance or fear, and do not rely on commitments to legitimate values? Who bears the responsibility if politicians act in accordance with peoples' preferences when, later on, these preferences change after the impact of the second best programme has become visible to every citizen? For such reasons our study group, in performing the task of investigating socially feasible energy policies, had to overcome the difficulty of determining the right balance between technical and economic rationality on one hand, and political and social acceptability on the other.

**Investigation of social preferences**

In providing the German government with reliable data and reasonable strategies we had to meet four different requirements:

- First, we felt that we could make an effective contribution towards resolving conflicts in the energy debate only by acting as catalysts. This term, borrowed from chemistry, means in our context aiding or speeding up the social process of finding compromises, without interfering with society's values and preferences.
- Secondly, we had to provide sufficient data to the decision-making bodies, offering them a general assessment of the technical, economic and sociopolitical impacts of each energy system.
- Thirdly, we had to elicit the values and concerns that are prevalent in today's energy debate, and construct a catalogue of decision criteria, which all stake-holder groups within society could in principle agree with.
- Fourthly, our task was to identify public preference and value commitments concerning the futures of various energy systems.

In pursuing these four requirements we developed a complex model of investigation which consists of three basic elements:

*Step 1: Identification and selection of concerns and evaluation criteria*

For this purpose the technique of value-tree analysis was used to elicit the general concerns and values which exist in contemporary German society. We interviewed representatives of nine leading social interest groups, and asked for their values and concerns with respect to energy policy. Our purpose was to construct a complete catalogue of criteria that all German stake-holder groups were able to agree with. This was then used as a

general yardstick for the assessment of the probable consequences of each energy option (Step 2), and as a reference list to identify the general preferences of the public (Step 3).

*Step 2: Identification and measurement of impacts and consequences related to different energy options*

The criteria derived from the value-tree were operationalized and transferred into indicators, which were formulated in such a way that they could be applied to energy systems as well as to energy scenarios. Experts with different value preferences were asked to judge various energy systems and energy scenarios according to each indicator.

*Step 3: Aggregation and weighting of the impact profiles by randomly selected citizens, and elicitation of citizen's preferences*

The weakness of public opinion polls or surveys in determining public preferences is mainly due to the ignorance of most respondents about the consequences of their own judgements. Since many people incorrectly associate quite a few erroneous impacts with different energy systems, while others feel frustrated by the ongoing scientific debate, it was first necessary to educate our sample of respondents before recording their judgements. This effort of informing people about the consequences of their preferences in advance might be regarded as manipulation to achieve favourable responses. But we succeeded in selecting both serious proponents and opponents of nuclear energy, who were allowed to present their arguments. Scientific facts were reported as facts, while opinions or assessments were presented as interpretations of facts, and were covered in a most representative way. The idea was to build up a procedure similar to a jury trial, in which hearings, lectures, video films, inspection tours, written information, and mutual discussions provided a sound basis for a well-balanced judgement on individual or group preferences. For this purpose the method of the so-called 'planning cell procedure' was developed at the University of Wuppertal. A planning cell consists of a group of citizens who are selected by a random process and are given paid leave from their workday obligations for a limited period, in order to work out solutions for given, soluble planning problems with the assistance of advisors on procedure[10].

A group of citizens in this context actually means a small group of about 25 people who work on a predefined task in a group process. Since the citizens involved have been selected at random they are very unlikely to be individually concerned in the planning problems to be solved. In order to encourage them to participate they are assigned the socially highly-esteemed role of a 'consultant' in the public service. The seriousness of the

planning task to be solved is also made clear by the honorarium which the citizen receives for his work as a 'consultant'. The limited participation period prevents the citizen from being alienated from his real social role: he only changes his perspectives for a brief period.

In our study, 24 planning cells all over Germany were organized and confronted with our impact analysis of the energy systems and scenarios. The task of each participant was to rate each energy system according to the given criteria, to attribute relative weights to each criterion, and to come up with a balanced recommendation as to which energy scenario should be implemented to meet future energy demands.

It should be emphasized that all the results of the planning cells were regarded as inputs to the decision-making process. These inputs provided a decision aid, helping to shape political judgements according to both the latent and the overt value-structures of the concerned public. If this assumption is accepted, the planning cell proved to be a good instrument for collecting the relevant feedbacks from society, and for revealing the intuitive preferences and values of the general public after learning about the consequences of each option.

**Results of the study**

As part of the value-tree analysis we interviewed individuals or representatives of nine important social groups, ranging from the largest power plant manufacturer in Germany to the Federation of Nature Protection Groups. The purpose of each interview was to determine the relative values and concerns of each group with respect to energy policies. Values identified in personal interviews were organized into a value-tree, representing the hierarchy of values of each particular group. All individual value-trees were combined into a joint value-tree, comprising the sum of social concerns and criteria.

For the purpose of this paper, it is unnecessary to look in great detail at the structure of the joint value-tree. But it is worthwhile mentioning that all groups agreed that economic and technological criteria should not be the only yardsticks for evaluating different energy options. Respondents from industrial groups put a higher weight on economic criteria, but conceded that environmental and social concerns should be considered on an equal footing. Environmental groups on the other hand emphasized the importance of social and environmental impacts but agreed that economic criteria must also be taken into account. Thus, while the relative weights of the criteria were strongly disputed, this was not true of their composition.

By using the joint value-tree to give a list of criteria we were able to win approval from all the different controversial society groups. The political decision-makers were also satisfied with the catalogue of criteria, since it

reflected the concerns of all groups relevant to society; hence the list was on the whole accepted as a useful tool for looking into the consequences of different energy systems. Since the main interest of our study was directed towards social concerns, only the social and political criteria of the joint value-tree are reproduced here (Tables 2 and 3).

**Table 2. Part of joint value-tree — social aspects**

- Social impacts
  - Quality of life
    - Cultural and moral quality of life
      - Preservation of culture goods
      - Threats to cultural values
        - Loss of fantasy
      - Aggression
        - Apathy
        - Uniformity
        - Wastefulness
        - Induced increase in consumption
      - *Threats to the human identity*
        - Anonymity
        - Restriction of individual development options
        - Fears
        - Disturbance of the relation between humans and nature
      - Social quality of life
        - Social justice
        - Social peace
        - Social security
        - Stable living
      - Economic quality of life
        - Employment
        - Wealth
        - Energy services
          - Heat
          - Light
          - Comfort
          - Improvement of working conditions
- Keeping societal options open, ability to change
  - Keeping options open for future generations
  - Enabling alternative lifestyles
    - For individuals
    - For groups (eg religious, rural)

**Table 3. Part of joint value-tree — political and international aspects**

- Political impacts
  - Quality of political process
    - Improvement of decision processes about energy systems
      - Trust
      - Truthfulness
      - Factualness
      - Willingness to compromise
      - Reason
    - Support by majorities
    - Consideration of minorities
      - Protection of minorities
      - Protection of the majority from disruptions by minorities
  - Enhancement of justice and democracy
    - Conformity with laws
      - Basic constitutional law
      - Other laws
    - Local and regional distributional justice
    - Enhancement of pluralism
      - Reduction of totalitarian tendencies
      - Reduction of expert rules and elitist tendencies
    - Enhancement of autonomy
      - Individuals
      - Institutions
      - Local/regional autonomy

- International impacts
  - Securing peace
    - Reduction of the potential for conflicts
      - Threat potential
      - Terrorism potential
      - Blackmail potential
    - Reduction of potential for crises
  - International distributional justice
    - Aid for developing countries (eg technology, economic)
    - Keeping options of other countries open
      - Preservation of cultural values
      - Preservation of resources
  - Degrees of freedom in international politics
    - National independence
    - International co-operation
    - (eg labour unions, scientific organizations)

On the basis of the joint value-tree the study group developed a list of indicators that allowed us to make measurements or assessments of different energy systems and scenarios. Both the list and the values for each indicator were validated by different groups of experts. The Delphi method was used to reduce the range of assessments between different experts. A sample of the indicator list is reproduced in Table 4.

**Table 4. Catalogue of criteria and sub-criteria**

- Operational aspects of the energy system
  - Technical efficiency of energy installations
  - Potential for meeting energy demand
  - Demand for capital, manpower, energy
  - Emissions
- Environmental impacts
  - Quality of air, soil, water
  - Change of climate
  - Effects on flora, fauna
  - Potential for catastrophic damage, pollution
  - Change of scenery
  - Change of settlements
- Health and safety
  - Risks for the employees
  - Risks for the public
  - Potential threat of catastrophies
  - Problems for future generations
- Security of supply
  - Geological availability
  - Political availability
  - Economic availability
  - Technical availability
  - Flexibility
- Economic effects
  - Profitability
  - Expenditures
  - Capital investment
  - Standard of life
  - Labour market
  - Export competitiveness
  - Balance of payments
  - Influence on innovation
  - Compatibility with the market economy
  - Homogeneity of regional development
- International effects
  - Freedom of action
  - Security
  - Co-operation
  - Economic relations
- Political impacts
  - Regulation of energy consumption
  - Legal rights
  - Control and participation
  - Potential for gaining public consent
  - Continuity of the democratic system
- Social impacts
  - Equal opportunity
  - Social security
  - Quality of labour
  - Openness for various life-styles


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**Table 4 continued**

| |
|---|
| Ecological sentiment |
| Personal impacts |
| Contentment with the conditions of life |
| Fears |
| Alienation |
| Self-determination |

Value-tree and indicator lists were also used as important inputs for the third step of our investigation: the elicitation of people's preferences and values with respect to energy systems and scenarios. In order to limit the number of scenarios to something which could be easily comprehended, four scenarios were selected as being the best representations of the contemporary views on energy in German society. These scenarios were constructed by a Parliamentary Enquete-Commission on 'Future Nuclear Energy Policy'. The commission consisted of seven members of parliament and eight experts representing the fields of engineering, natural and social sciences, including both advocates and opponents of nuclear energy[11].

The scenarios were constructed in such a way that different political options were expressed in terms of consistent energy supply and demand models for the years 2000 and 2030. The four scenarios are illustrated in Fig. 1, and are described in more detail in the appendix to this paper.

In particular the role allocated to nuclear energy differs between the four scenarios: Scenarios 1 and 2 utilize nuclear energy to a large extent, scenarios 3 and 4 reject nuclear energy. With respect to energy conservation and solar systems, scenarios 1 and 2 provide for only a moderate amount of conservation and solar technologies, while scenarios 3 and 4 concentrate on these two aspects.

The advantage of using the four energy scenarios of the German Enquete-Commission is again the approval they command from most social groups, including pro- and anti-nuclear activists. Both sides were represented within the four scenarios.

For the purpose of evaluating the four scenarios of the Enquete-Commission of the German parliament, 8 criteria and 31 sub-criteria were handed out to the members of the planning cells. The task of the participants was to assign weights to each sub-criterion and criterion, and later to use these to evaluate the four scenarios. We assumed that the rank order of criteria was derived from personal values, and should therefore not be altered by the information process; our information was meant to focus only on facts and their interpretation — which of course may have been controversial. In order to test the influence of the information process, we asked the participants to rank the main criteria on both the first and the last days of the seminar.

Fig. 2 illustrates the medians of the rank order for all eight criteria,

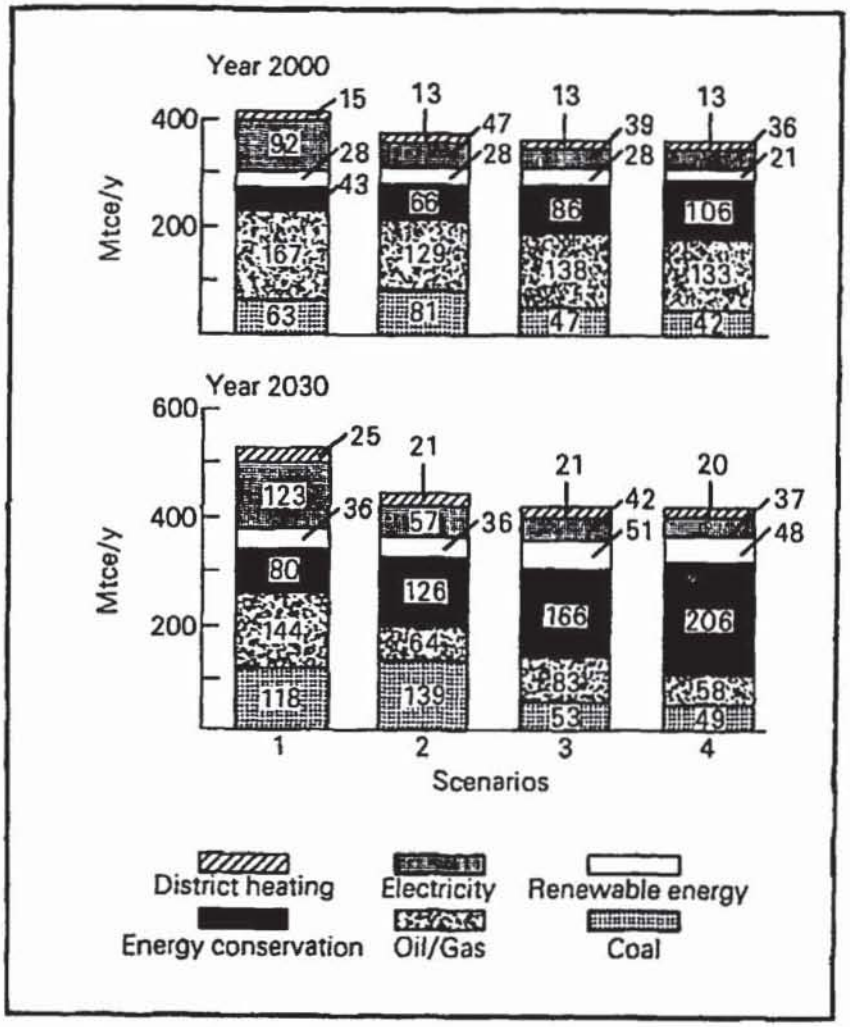


*Fig. 1. The end-energy demand according to the four energy scenarios of the West German parliamentary Enquete-Commission.*

comparing the first and second measurements. It will be seen that the observed changes as a result of the information process were only minor, and that the sequential order remained the same.

Looking at the priorities revealed by the weighting procedure it is hardly surprising (knowing what the public believes) that health/safety and environmental quality form the top of the hierarchy. General economic concerns — in particular, security of supply — are rated higher than more specific concerns for financial and material requirements. It is interesting to note, though, that this criterion grew in importance over the four days' information period, whereas the relevance of the environmental effects was rated slightly lower on the last day compared with the rating of the first day. Political, social and international aspects were regarded as of less importance for the evaluation of energy systems.

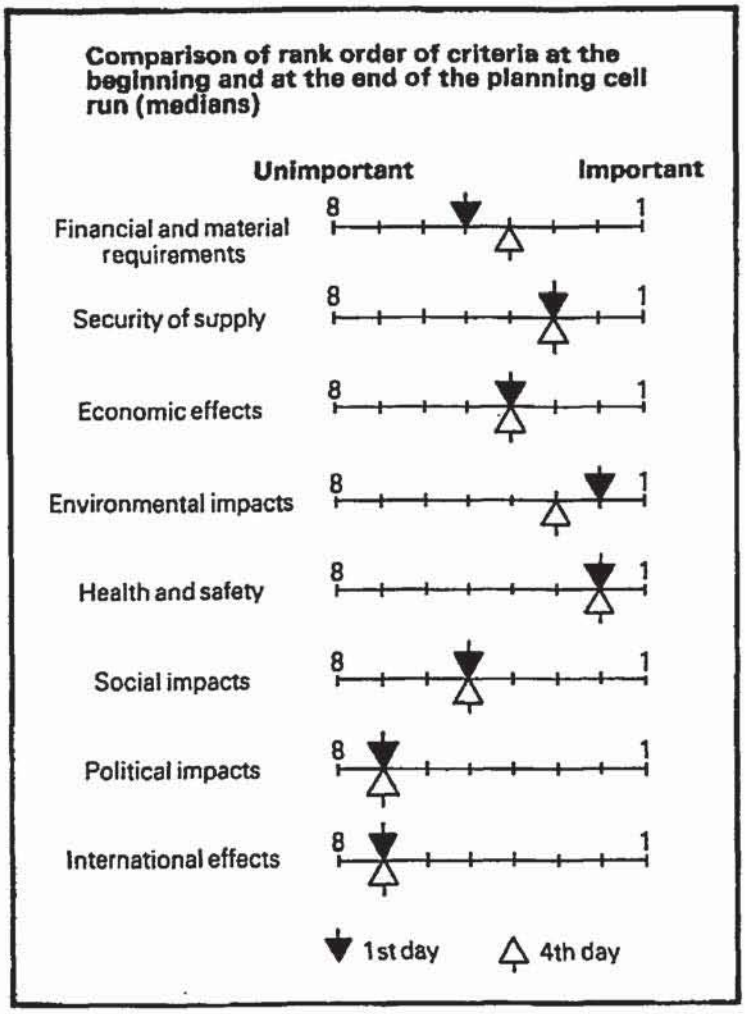


*Fig. 2. Importance of criteria.*

Fig. 3 shows the results of the intuitive preference measurement with respect to the four energy scenarios. Intuitively the moderate pro-nuclear scenario 2 has gained the highest approval, followed by the most moderate non-nuclear scenario 3.

Most of the respondents who gave first priority to scenarios 2 or 3 also gave second priority to the other moderate scenario (either scenario 2 or 3, respectively). Thus there is a clear indication that the more moderate scenarios are preferred.

Taken together, the two pro-nuclear scenarios were chosen less frequently than the two non-nuclear options. Approximately 16 per cent of participants preferred the extreme solar and conservational scenario 4, as opposed to only 3 per cent preferring the extreme pro-nuclear scenario 1. Thus there is a considerable group of highly motivated and convinced

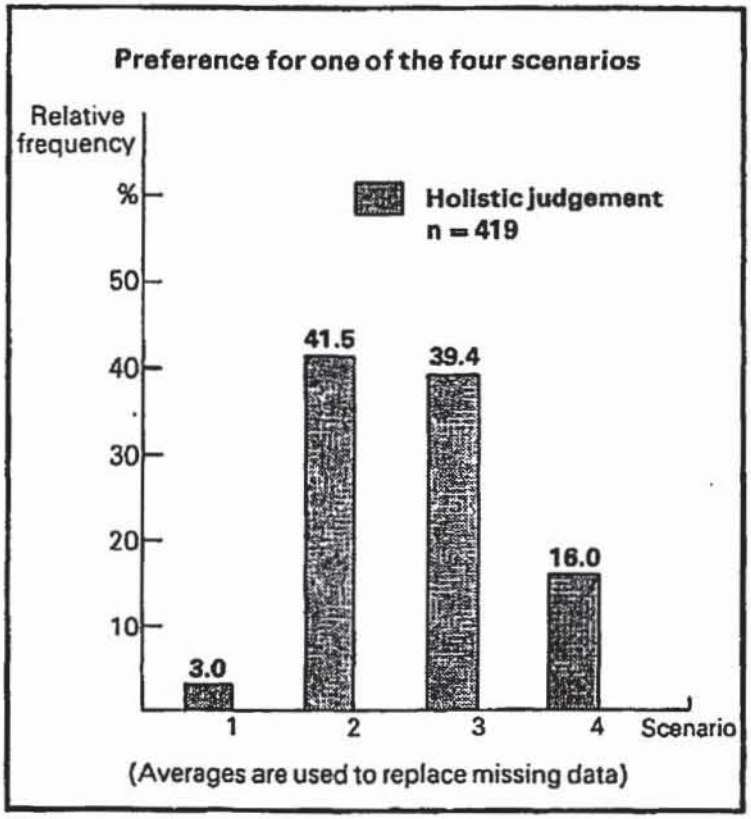


*Fig. 3. Judgement of energy scenarios.*

citizens with a strong anti-nuclear commitment, whereas there is no comparable pro-nuclear group. Also, more than 70 per cent of the people who preferred scenario 2 (moderate pro-nuclear) moved to the moderate non-nuclear scenario 3 when asked for the second priority. The proponents of scenario 3 however, were equally divided: 50 per cent assigned their second priority to scenario 2, the other 50 per cent to scenario 4. So in spite of the highest score for the moderate pro-nuclear scenario 2, there is a tendency to perceive the share of nuclear energy as a burden which almost half of the respondents are ready to accept for mainly economic reasons, whereas the other half would prefer this burden to be replaced by conservation or by solar systems. The latter group is less willing to abandon its anti-nuclear option than the former group is to abandon its nuclear preference.

This ambiguity in the perception of nuclear energy is even more visible if we look at the results of the questionnaire dealing with the future of nuclear energy. Approximately 30 per cent of all participants were fundamentally opposed to any use of nuclear power. This group perceived nuclear energy as being expensive, environmentally harmful, dangerous and socially unacceptable. Information containing positive arguments was

rejected either as interest-driven manipulation or as short-term thinking.

The vast majority of all participants showed a strong degree of ambiguity: on the one had they perceived nuclear power as necessary, economical, and promising; but on the other hand they expressed a strong degree of discomfort with this type of electricity generation. Most people supported the recommendation to limit the use of nuclear energy to the amount that all other energy sources taken together could not meet. However, almost everyone in this majority group voted against a complete shutdown of nuclear power plants. They were convinced that nuclear energy might play a major role in the future, provided that safety problems, reprocessing and waste disposal problems, and negative social impacts (like police-state methods) could be managed in a satisfactory way. Also most people believed that in the long run nuclear energy had the potential to be the most important energy source for the Federal Republic of Germany, but thought that the appropriate technology for this purpose had still to be developed.

More than 70 per cent of all participants were convinced that the problem of waste disposal had not yet been satisfactorily solved, but 60 per cent agreed with the statement that nuclear power is safe and clean. Most participants obviously believed that nuclear facilities are constructed and monitored in such a way that major accidents are almost impossible. The environmental quality of nuclear power was seen in the question of waste disposal (creating obligations and restrictions for future generations). Arguments referring to a lower energy demand, health detriments caused by radiation, social constraints caused by protection measures against sabotage and terrorism, and aspects of proliferation were also specified as reasons for a more sceptical or negative nuclear attitude. Among the positive aspects associated with nuclear power, security of supply received the highest score. The economic advantages of nuclear power and its prospective impact for the modernization and innovation of the economy were also frequently mentioned.

It is interesting to note that in these perceptions of nuclear power there was no significant difference between male and female respondents. In national polls women usually perceive nuclear energy much more negatively than men. But if adequate information is provided — as we did in the planning cells — the gap between male and female respondents disappears. However, whereas sex had no impact on the formation of nuclear attitudes, we detected quite significant relationships between age, party preference, and the evaluation of nuclear power. The more conservatively people had voted in national elections, and the older they were (in particular over 40 years old), the more they preferred the pro-nuclear scenarios 1 and 2. Older people and conservative voters tended to express more trust in established institutions, and assigned a higher degree of credibility to politicians and scientists. Younger people with less conserva-

tive backgrounds were more inclined to adopt the arguments of the anti-nuclear experts. They also assigned higher weights to environmental values, and scored nuclear energy as more environmentally harmful than older or more conservatively minded people felt to be the case. These results back up the observation that nuclear energy has gained a symbolic position as representing industrial values in general. Those who favour the industrial society are more inclined to evaluate nuclear energy in a rather positive manner; people holding a sceptical view of the industrial society tend to reject nuclear energy.

## Conclusion

What can politicians and energy planners learn from the results of our study? First, it became obvious that the nuclear controversy has not yet come to an end. Most people still feel concerned about nuclear energy, and quite a considerable percentage of our sample expressed their readiness to protest against further expansion of the nuclear programme. But we also detected a diminished interest in the nuclear debate, and a growing awareness of other energy problems like acid rain and conservation.

Secondly, a vast majority of the sample expressed their willingness to accept a moderate expansion of the nuclear power programme, provided that a satisfactory solution to the problem of waste disposal can be achieved. The existing concepts were not regarded as satisfactory. The slightly positive commitment, on balance, to nuclear energy is caused mainly by the benefits of long-lasting supplies of uranium and an inexpensive way of generating electricity. But if the economic superiority of nuclear energy were to be challenged, as it is today in the United States, the support for nuclear energy could collapse rapidly, since even the proponents of nuclear energy seem to be convinced that the overall risks of nuclear facilities are high.

Thirdly, with respect to public information programmes, our planning-cell experiments proved that information containing arguments for or against nuclear power still has an impact on public attitudes. In spite of the fact that most people have developed a rather stable point of view in the nuclear controversy, and are usually not willing to change their overall attitude, the exchange of information during the planning-cell course resulted in a reshaping of some elements of participants' attitudes.

In particular, safety and environmental arguments put forward by the proponents of nuclear energy had a lasting effect on the attitudes of participants, and influenced their perception of nuclear facilities. The opponents of nuclear energy succeeded in convincing the participants that the nuclear waste problem continues to be an unsolved issue, and that it has the potential to be a political knock-out blow for further nuclear

expansion. This shows that more scientific study of the problems of waste disposal is necessary. More data are needed if we are to leave the public with the impression that the underground storage of nuclear waste is a safe and reliable method, and one which will not bother future generations.

To put it all in one sentence: a moderate and deliberate expansion of nuclear power is possible in Germany, and will not run into insurmountable acceptance problems as long as viable and convincing strategies for disposing of nuclear waste can be established, and as long as the economic advantages of nuclear energy can be made visible to the public. Nuclear energy in Germany has still a future — even in the perceptions of the public.

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# APPENDIX

**The scenarios**

The four scenarios of the German Enquete-Commission are technically consistent strategies showing how energy consumption could be organized in the years 2000 and 2030. There are two distinct features characterizing the main differences between the four scenarios:

(a) Electricity is widely used in scenarios 1 and 2, which are predominantly based on nuclear power. Scenarios 3 and 4 provide only a modest amount of electricity, which is generated by coal-fired power stations, windmills and hydroelectric power. According to the latter scenarios the use of nuclear energy comes to an end in the year 2000.
(b) All possibilities of energy conservation are widely used in scenarios 3 and 4, assigning them first rank in the list of means to meet the end-energy demand. Scenarios 1 and 2 put more emphasis on the traditional energy sources.

Scenario 1 reflects the present energy situation, which has been extrapolated to the year 2000 and 2030.

Scenario 2 comprises a joint strategy for combining nuclear energy with conservation measures.

Scenario 3 attempts to find an optimal balance between fossil fuels, conservation and renewable energy sources, under the assumption that nuclear power will finally be abolished.

Scenario 4 can be characterized as a minimum supply strategy focussing on maximum conservation, renewable energy and coal.