# The Empirical Investigation of Citizens' Preferences with Respect to Four Energy Scenarios

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## INTRODUCTION

"How can polarized social conflict involving risk be reduced and replaced by an atmosphere of trust and mutual respect among the opposing parties? What research is needed to design an environment in which effective multiway communication, constructive debate, and compromise can take place?" (1)

This quote taken from a list of 10 relevant research questions in the field of risk and technology assessment refers to one of the most promising and demanded, but at the same time most ambitious tasks of social science research: the promotion of social integration. This task is based on the assumption that science could not only provide data for clarifying relationships between given phenomena, but could also offer procedural advice on how to accomplish means of conflict resolution. But can science, and in particular social science, contribute to conflict management? Is science the appropriate instrument for interfering with political debate and facilitating the formation of compromises? Is the role of science overstressed by aiming toward a mediating function between social interest groups?

Most sub-systems of society perceive themselves as central agents for the well-functioning of society in general. They consider their contribution an essential effort to support the present coherence of social forces and a decisive means for shaping the future performance of society. The sub-system of science might also overstate its social influence by demanding a superior position as an arbiter in social conflict.

What kind of services can science offer to the policymaker in order to facilitate conflict resolution? There are basically

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four possible contributions of utilizing scientific expertise for political consulting. 1) Discussion of false inferences: Using the methods of scientific inquiry it is possible, at least in principle, to investigate the likelihood of various consequences of proposed policy actions and to exclude statements which can be proven wrong; 2) Modeling of causal structures: Since reality is characterized by a high degree of complexity, any policymaker is unable to overlook the consequences of his political action. With the aid of an abstract model, scientists can create a simplified picture of causal interdependencies and provide some insights into the probable consequences of policy options; 3) Forecasting of future developments and consequences: In addition to causal relationships between policy actions and social consequences, scientists can describe the direction and probability of technological and social change by combining data from past experiences and revealing general trends of social and economic development. They might also provide information by which politically desirable states of society can be achieved; and, 4) Providing arenas for conflict resolution: Scientists can propose procedures and formal methods for facilitating conflict management. The process of decisionmaking can be designed in such a way that the affected interest groups perceive a fair chance to participate in the final decisionmaking process and the general public can gain the feeling that their concerns have been taken seriously. Such a mediating role of science can only be accomplished if the arena is being shaped by scientists without interfering in the arbitration process by means of their own values and preferences (2).

These four principal contributions of science to policymaking have been challenged by the actual performance of scientific expertise in the political arena. First, experts themselves are bound into the network of social interests and often act as advocates of policies or ideologies. Second, the separation between values and facts which underly the cooperative function of policymakers and scientists is rather artificial and dubious. As a result, either the scientists come up with only those facts that support their own preferences (technocratic planning) or the politicians use factual expertise merely as a justification of preformulated political decisions. Third, interest groups are more interested in scientists as advocates (of their own case) and less interested in scientists as mediators. By utilizing scientific expertise to legitimize one's own claims, it is more probable to gain a higher proportion of social influence at the end. It can also be expected that one-sided scientific support reinforces the motivation and mobilization of all group members (a vital interest for survival, if the interest group is not yet institutionalized). Only when groups involved in the conflict

realize that polarization does not help any of them to proceed and when policymaking is paralyzed might scientists be called in to initiate a first move.

Overlooking the past experience of policy consulting, the results are rather discouraging--even simple facts are disputed among scientists. They construct models to back-up their own political point of view; the scope of forecasting ranges from predicting extinction of all life on earth to a coming age of paradise; and, no one seems to show any interest in the integrative role that science is able to play. On the other hand, a German official of the Federal ministry for Research and Technology stated recently: "We knew in advance what was right or wrong. But since we faced public opposition, we spent millions of dollars for scientific consulting. But what we got is even a bigger mess. Now we are in real trouble!" Instead of reconciliation, a lot of conflicts in society were aggravated by engaging scientists as consultants.

There is no easy way out. On one hand, the potential of scientific expertise has not been utilized in a proper way; on the other hand, there is an increasing demand for scientific expertise in the policymaking process. This is due to four reasons: 1) Modern industrial societies have developed such a high level of complexity that merely "guessing" remains as the only viable alternative to scientific inquiry. Common sense or political experience are not sufficient anymore to foresee the consequences of political actions; 2) Modern industrial societies are characterized by a high degree of interdependencies between economic, social, and political parameters resulting in a high sensitivity of the system for minor changes. Policy actions in one field might affect the outcomes of a completely different social segment. This requires more scientific research and advice; 3) Because of the high degree of industrialization (connected with overpopulation), the potential of modern technologies and the interaction between political decisionmaking and the physical and social environment, the magnitude of possible outcomes has reached a level where global catastrophes can be caused by human activities. Ecological collapse, atomic war, famine, or systems breakdown are the most serious problems in the modern world. Since major political decisions might create irreversible consequences which make such catastrophes more probable, it is vital that any social system has access to at least a rough scientific estimation of the magnitude of consequences which are connected with one or the other policy option; and 4) As the public in industrialized countries is better educated than in former times and is thus aware of the complexity, interdependencies, and increase in the potential magnitude of consequences, they demand more scientific reasoning in the policymaking process

and show a high degree of awareness to arguments which are put forward to policymakers by scientists. At the same time, they are not willing to accept all the decisions that are formed by the legitimate policymaking bodies. They claim that their interests have to be considered in the process of decisionmaking and hence they demand more means of public participation. The incorporation of public concerns and the implementation of participation requires scientific consulting to design procedures and arenas which guarantee high quality of the decision output as well as social stability and public transparency.

Hence, modern societies are in urgent need of all four contributions that science can offer in principle. But we have not yet developed viable ways of structuring the necessary cooperation between science and politics. There have been excellent records in small-scale applications of scientific consulting, when defined problems have to be solved within local communities. But on a national or even international level, the past experiences are less promising. In particular, models are missing of how to make use of the potentials of scientific expertise, without being caught in the trap of ideology, technocracy, or post-rationalization.

One attempt to structure a model is the study of social compatibility of energy supply systems which is carried out by the research group "Technology and Society" of the Nuclear Research Center, in Julich (Federal Republic of Germany). The following article and the contribution by H. Jungermann, D. von Winterfeldt, and R. Keeney (all in this volume) are devoted to this approach.

## ENERGY POLICIES: A SERIOUS CHALLENGE FOR SOCIAL SCIENCE CONSULTING

The "Julich Social Compatibility Study" is based on the general assumption that the contribution of Social Sciences to facilitating conflict resolution can only be effective as long as the role of the scientist is confined to the process of catalysis--a term borrowed from chemistry meaning, in our context, "aiding or speeding up the social process of finding compromises without interfering with one's own values or preferences." Based on this general hypothesis five more refined assumptions were formulated which directed the empirical conceptualization of our approach: 1) Science and politics pursue different interests when cooperating with each other. The ideal scientist has the ambition to help the

politician to find the best solution to a given problem, hence he looks for an optimization rule to choose between options according to expected outcomes. The ideal politician, however, wants to maximize public support and to retain the general trust in the principal ability of the political elite to handle complex issues and to master social conflicts. Hence, in his sense, the justification of a decision is more important than the quality of its outcomes. This divergence of interests is inherently based on the specific functions that both subsystems perform within the overall societal system, regardless of whether more personal goals, like gaining reputation, prestige, power, or money are involved. So the first requirement of our approach was to provide not only facts and models to assist the process of choosing the right option, but also to address the problem of legitimizing and implementing the best choice. If this problem turns out to be too difficult, the process has to be iterated until a second best solution is to be created with both aims in mind. This could serve a dual purpose: improve both political efficiency and progress in scientific rationality. 2) Following our general requirement that a scientist should not insert personal values and preferences into the consulting task, some kind of a distinction between facts and values has to be made. At least, we assume that scientists belonging to different stake-holder groups can reach agreement on basic properties of objects or policies, if those properties can be measured physically (amount of emissions, cost, technical performance, reliability, and so forth). Furthermore, we are convinced that even the spectrum of possible conclusions referring to uncertain events of future effects can be restricted to a limited range, provided that scientists with different value backgrounds are willing to cooperate and that the situation in which the judgments have to be formulated facilitates agreement. It should be noted that we are not demanding value-free research or neutral scientists. Instead, we are pursuing a procedure in which factual knowledge is based on the agreement among scientists with various value commitments. 3) With respect to the value side, we consider value-based preferences of any citizen as important as any preferential judgment expressed by politicans or professionals. According to the democratic goal "one man-one vote," the sum of revealed public preferences should have the highest legitimative power. 4) In order to measure preferences of citizens in a valid way, two assumptions must be made: first, that the amount of knowledge which is necessary to express national preferences (referring to the expected consequences and their probabilities) can be gathered and transferred to the public; and second, that a common set of evaluative criteria can be established. The knowledge has to come from the experts in this field (c.f. assumption 2). The criteria can best be formulated by those who are regarded as

stakeholders in the respective issue. 5) Any compromise aiming towards conflict resolutions can only be implemented, if at least the moderate stakeholder groups find a common agreement and the general public gains the feeling that their concerns were handled in a fair and serious manner.

Based on these five assumptions, our complex model of consulting in energy policies consists of three basic elements:

Step 1: Identification and selection of concerns and evaluative criteria.
For this step, the technique of value-free analysis was used to elicit the general concerns and values present 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. The objective of this exercise was to collect all relevant values and concerns and to construct a common catalogue of criteria which all German stakeholder groups were able to agree on. This catalogue was used as a general yardstick for the assessment of probable consequences of each energy option (Step 2) and as a reference list to elicit the general preferences of the public (Step 3). (The concept, procedure, and the results of this analysis are described in more detail by R. Keeney and D. von Winterfeldt in their articles.)

Step 2: The 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. Those indicators were formulated in such a way that they could be applied to energy systems as well as energy scenarios. Experts with different value preferences were asked to judge various energy systems and energy scenarios according to each indicator. In a joint venture, the experts who had strongly disagreed on one or the other indicator were urged to find either a compromise or to define a range of possible solutions. This task was facilitated by an informal situation of face-to-face interaction. For the social and political impacts, a delphi method was used to reach final agreement. In addition, some highly distinguished scientists of well-known insti-

tutions, like the Prognos Consulting Corporation in Switzerland, brought in their expertise to validate our ratings. The indicators and the final measurements were listed in a report without constructing indices or assigning weight to any of the 71 indicators (3). Step 2 is also described by Jungermann in his article on the two social compatibility studies.

Step 3: Aggregation and weighting of the imppact profiles by randomly selected citizens:
In a four-day seminar, randomly selected citizens received all the necessary information to understand and handle the impact profile. They were also confronted with scientific and political arguments (via hearings) in support for each of the possible energy options. In order to restrict the scope of options, three to five local energy supply scenarios and four national scenarios (constructed by the Enquete Commission of the German Federal Parliament) had to be evaluated. It was the task of the participants to assign weights to each subcriterion and criterion of the indicator list (knowing the range of all scientifically derived ratings for each option) and to evaluate the overall performance of each scenario. Finally, they had to give recommendations with respect to the demanded priorities in future energy policymaking.

The following chapters will only deal with the third element: the elicitation of public preferences. This part of our study is not only the most ambitious one, but encompasses a very new method of preference measurement: the concept of planning cells. As a matter of fact, this concept was used in our study for the first time on a national level. The instrument of planning cells claims to serve two basic purposes: measurement of public preferences and direct citizen participation.

## "THE PLANNING CELL" AS POLICYMAKING INSTRUMENT IN THE DECISIONMAKING PROCESS

The procedures for participation of the public in complex planning tasks which have been introduced and practiced up to now remain unsatisfactory in many respects. Peter C. Dienel has developed a new instrument for citizens' participation, the

so-called "planning cell." The research unit "Citizens' Participation and Planning Procedures" at the University of Wuppertal has up to now tested this procedure in the field of siting, town planning, and urban renewal. This model claims to open up new possibilities of participation for the private citizen and to improve the efficiency of decisionmaking in the planning process.

Dienel defines the planning cell as "a group of citizens who are selected by a random process and are given paid leave from their workday obligations for a limited period of time in order to work out solutions for given, soluble planning problems with the assistance of advisors on procedure." (4)

The group, random selection, time limit, and the advisors on procedure are to be regarded as the significant structural elements in the planning cell. A group of the citizens actually means a small group of about 25 people who work on the predefined task in a group process. Since the citizens involved have been selected by a random procedure, they are not individually concerned with the planning problems to be solved. To encourage them to participate, they are assigned the socially highly esteemed role of a "consultant" in the public planning process. The seriousness of the planning task to be solved is also made clear by the honorarium which the citizen receives for his function 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. Moreover, this limited period prevents personal interests specific to the proceedings from arising and possibly hindering planning appropriate to the task. The essential task of the advisors on procedure consists of ensuring that the necessary specialized information is presented and processed, and making an effective group process possible.

Figure 1 illustrates the course of a planning cell's work. The flow-chart shows that evaluation procedures take place in all phases of implementation. Individual evaluations, evaluations by the working groups and plenary sessions are collected with the aid of standardized evaluation questionnaires. The completed evaluation questionnaires represent in a certain way the skeleton output relevant to the planning task. The evaluation and processing of these results according to statistical methods is the main concern of the final working phase. The so-called "citizens' report" is compiled and published as the last step from the insights and recommendations obtained with respect to solving the problems.

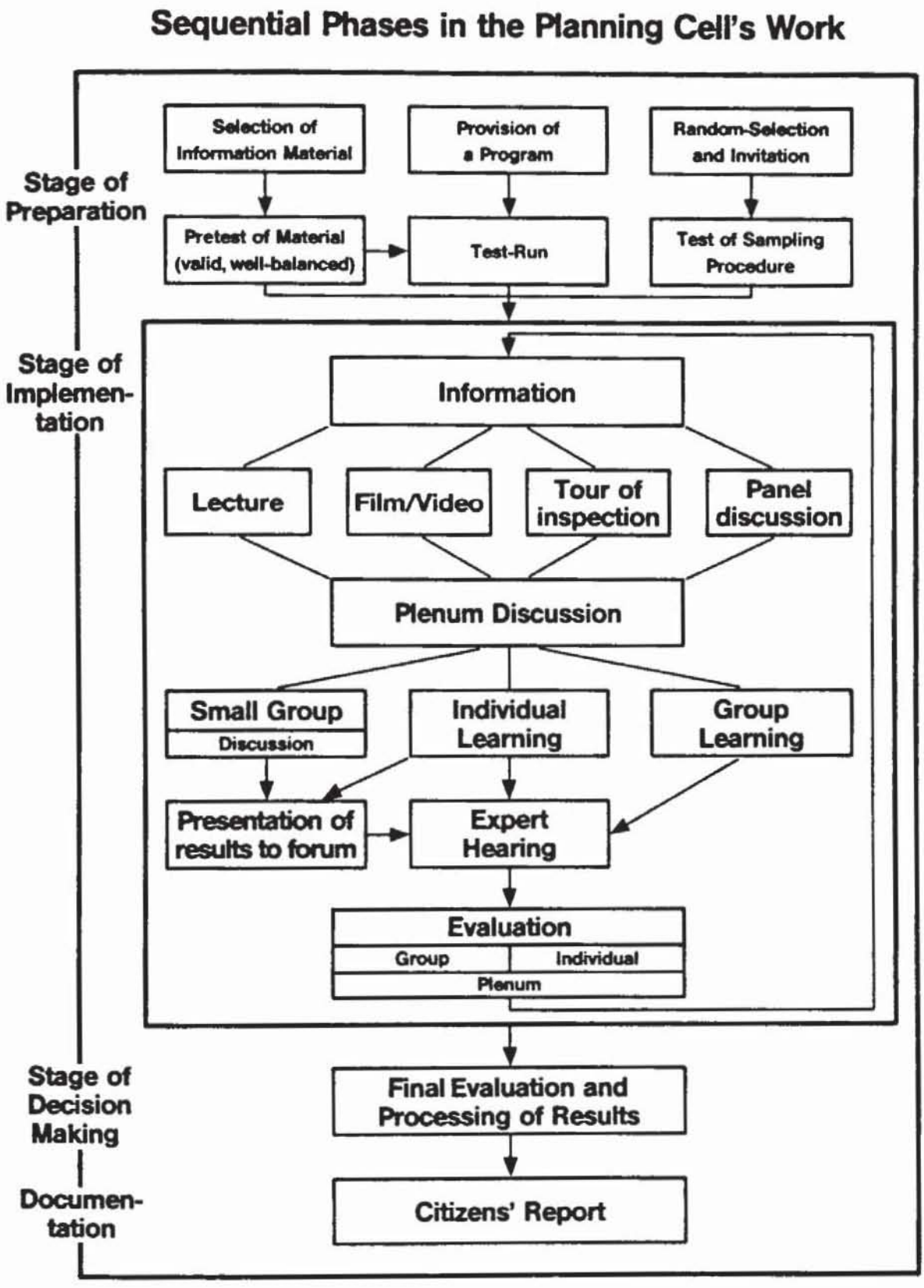


Fig. 1: A Flow-Chart of the Planning Cell Procedure

An advantage of the planning cell is the random distribution of participants, for this selection procedure distributes the changes of participation evenly. The social selectivity (which in other procedures leads to a preponderance of members of the middle and upper classes) is thus offset; citizens of all classes are involved in a planning cell procedure. It is even more significant that by means of random selection a panel results in which the factor of direct interest is largely ruled out. In contrast, other technocratic and popular planning procedures are very strongly influenced by pressure groups; they are thus susceptible to strategic maneuvers and are often unable to form a consensus. The planning cell specifically offers those not concerned and thus not directly interested a possibility of mediation between polarized interest groups. In this way the unproportionate influence of pressure groups is avoided and the production of solutions to the problem is also encouraged.

An increase in the efficiency of complex planning processes is derived from the following points: 1) It is founded on a broad database due to the inclusion of heterogenous social positions; 2) The tendency of traditional policymaking bodies to no longer fulfill the planning tasks in a way appropriate to the tasks themselves but rather to the benefit of their own institutions, increased by bureaucratization and technocratic planning structures, is largely mitigated by the random selection and limited duration of the planning; 3) New, unpredictable solution approaches can be achieved on the basis of immediate practical experience and special needs of the citizens; and, 4) the inclusion of social values, which takes place by introducing the subjective values of the individual citizen, contributes to the ability to form a consensus on the solutions discovered.

In order to guarantee comparability of results, the information and evaluation procedures and the whole sequential situation must be standardized. This parallel connection neutralizes randomly occurring biases and distortions and thus increases the representativeness of the planning output. This then provides the planning process with increased immunization against external pressure. The implementation of several planning cell runs with similar results improves their validity, since even in the case of different constellations of interests, the same solutions might be worked out. Finally, this procedure is intended to render complex planning processes more controllable.

This last advantage seems to be doubtful at least, because the planning cell depends to a large extent on the amount of given information and the preliminary work by the sponsoring agency.

Moreover, it can hardly control the process of decisionmaking itself.

The complex of information is in general a problem for this procedure. The quality of the output relevant to planning is decisively dependent upon the quality of the factual information fed in. There is a great danger of manipulating the results via the selection and provision of information (5).

Another negative aspect should be mentioned. Probably the citizens will tend to prefer traditional solutions since as representatives of the "silent majority" they will hardly be capable of suggesting innovative approaches. The extensive integration of the procedure into the official planning processes is also criticized because this could lead to a rapid adaptation to existing schemes of decisionmaking (6).

The random selection of the citizen is at the same time an exclusion procedure. This results in the disregard of an important principle of citizens' participation, namely, that every interested party can participate in the planning.

Even more important are the constitutional misgivings which imply that a type of "ancillary parliament" could be constituted by the planning cells (7). Even though it is clear that the citizens' report only makes recommendations and that parliamentary competence will not be encroached upon, it cannot eliminate the emerging problem of the double legitimation of political decisions.

Although the weakness of the procedure mentioned above should not be ignored, it still seems that the "planning cell" model offers specific advantages which justify its application in our project. In our opinion these are particularly to be found in the acquisition of public preferences, the representation of social values, and in the fact that those involved are not committed to any interest group.

This procedure can assist in gathering insights which can contribute to improving the legitimation and also the efficiency of planning processes.

## THE BASIC FUNCTIONS AND TASKS OF PLANNING CELLS IN THE JULICH "SOCIAL COMPATIBILITY" STUDY

In addition to the assumptions and requirements which were stated in the first chapter, it is necessary for the appli-

cation of the planning cell concept to consider the conditions and 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 is characterized by the following three major features: 1) lack of unanimity among the scientific experts about facts; 2) lack of credibility with respect to scientists and policymakers on the side of the public; and 3) lack of readiness of the stakeholders to engage themselves in the process of forming a compromise.

Any participation model aiming toward improving the decision-making process has to take these problems into account. A functional solution is only to be achieved if the following three requirements are met: 1) the scientific dissent must be represented within the participation process without frustrating people; 2) the legitimative power of the political decisionmaking process must be strengthened by introducing participation; and 3) a mediating force between the polarized stakeholder groups has to be fulfilled by the participatory agents.

The planning cell model seems to serve these requirements. By compiling the necessary information profiles of performances for each energy option--constructed by scientists with different points of view--a legitimate way of conveying the basic facts to the participants was found without oppressing dissent, but also without creating frustration caused by confusion.

In addition, experts with different opinions were invited to present their arguments. Small working groups within the planning cells were formed to process all the given information and to extract the factual input. The purpose of improving the legitimacy of the political decisionmaking process and the depolarization of the conflict was pursued by a random selection procedure. Since everybody was eligible to serve as a participant in the planning cell, the uninvolved citizen's opportunity of identifying with members of the planning cell was guaranteed to a greater extent than in the case of traditional decisionmakers. Without interest groups being represented, the effect of polarization could be reduced, because a large number of participants with "in between" points of view were able to act as mediating agents.

Most specifically, we expected three different types of outcomes as a result of the planning cell procedure:

1) Task-oriented outcome: In order to avoid the mistake of overtaxing the ordinary citizen by filling up his schedule with numerous sophisticated tasks, we reduced the amount of evaluative task to the following essential questions:

   - o Evaluation of various energy systems and conservation technologies via multiple choice questions (simple attitude measurement)
   - o Evaluation of one's own energy situation and description of future plans referring to energy installations and insulation
   - o Weighting of the criteria and sub-criteria to evaluate energy systems and scenarios
   - o Using the criteria-set to rate the overall performance of large-scale power plants and to rate the proposed consequences of four energy scenarios developed by the Enquete-Commission of the German Parliament
   - o Making a final decision on the four energy scenarios and comparing this decision with the calculated result of the former ratings (using the algorithm $\Sigma$ criteria weight times score of rating)
   - o Evaluating the local energy supply situation and suggesting new solutions to meet local energy problems
   - o Trying to establish a compromise between centralized and decentralized energy systems (group task)

2) Knowledge-oriented outcome: The classical data collection via survey techniques provide more or less random opinion profiles. In case of the planning cell, however, the gathering of opinions is proceeded by an information process. Thus, it is possible to measure opinions or beliefs, after they have gone through the cognitive stress of information and controversial discussions. In particular, it is interesting to investigate the changes in opinion after information and discussions have taken place and to study the attitude-forming process as a function of social

positions, general values, and demographic variables.

3) Policy-oriented outcome: As a combination of the results referring to the evaluative tasks and the revealed social structure of preferences, general inferences should be possible dealing with:

   - o Suggestion of means to overcome polarization and to form compromises
   - o Identification of elements in energy policies which will probably meet serious public opposition
   - o The range of possible elements for constructing acceptable compromises

## THE AGENDA OF THE PLANNING CELLS

The program of the planning cell's seminar was arranged in such a way that information, discussions, small group working periods and evaluations via questionnaires alternated with each other.

The first day of the program started with a general introduction into the purpose and the procedure of the seminar. This introduction was followed by an inspection tour to one of the close-by energy facilities. By visiting a power generation station or a central heating system, some of the key-problems of energy supply and demand were discussed. The local context was further described by the first lecture focussing on the possibilities and options to improve the local energy situation. After lunch this discussion was broadened to include the national perspective. Based on a short introduction of energy policies in Germany, the participants-divided into small working groups-had to deal with some of the major problems of today's energy debate (e.g. waste heat utilization, oil supply, energy consumption, or new energy sources). The purpose of these small group-arrangements was to impart familiarity with the present energy situation in Germany.

At the end of the day, the criteria to evaluate energy systems were introduced and explained. Again, working groups were formed (by random assignment) to simulate some practical applications of the criteria and subcriteria. The list of

criteria and subcriteria are summarized in Table I. The first day was completed by handing out a questionnaire asking for a rank ordering of the criteria by each participant individually. The four days' schedule of each planning cell procedure is summarized in Fig. 2.

The second day was characterized by lectures containing the necessary information about energy technologies and their impacts. After each lesson the participants, gathered in small groups, discussed the important topics and directed specific questions to the lecturer. At the end of each session a questionnaire was handed out to all participants asking for the general feeling of favorableness or uneasiness with respect to the discussed topic. The lectures dealt with the following subjects: fossil fuel, heating systems, energy conservation, renewable energy sources, power generation, and nuclear energy. For each of these subjects, an expert from universities or from other uncommitted research institutes was invited to present the basic information.

In the preliminary test runs of the planning cells, the controversial issues of nuclear and solar energy were presented by two speakers holding opposite points of view. But this procedure turned out to be very time-consuming and frustrating with respect to the confusion caused by the controversial live debate. Instead, we prepared two video films containing precise statements of the nation's leading pro- and anti-nuclear, as well as pro- and anti-solar advocates. These statements were ordered according to the criteria lists which we had already introduced to the participants at the first day of the seminar. In addition, we invited two technical experts (one with a moderate pro-nuclear, one with a moderate pro-solar point of view) to present the technical information and to answer questions. With the exception of the planning cell run at Berlin where the energy seminar had been conducted for the first time, this procedure was regarded as neutral and well-balanced by all participants.

At the end of the second day we arranged a first trial for the participants to work with the given set of criteria. The task was to evaluate different power plant systems according to the eight criteria and the 31 subcriteria. Small groups of three to five participants were asked to assign ratings ranging from -2 to +2 to each subscriterion. The rating referred to the evaluation of nuclear, coal, hydro, oil, solar, and wind power. Then an index was constructed summarizing the overall intentions of all subcriteria and reflecting the final evaluation of a given power plant with respect to each main criterion. This complex task was not entirely performed by

## Social Compatibility of Energy Systems: Agenda of the Planning Cells

| | Tuesday | Wednesday | Thursday | Friday |
|---|---|---|---|---|
| Session 1 | Introduction: The Energy Situation | Fossil Energy | City Planning and Energy Supply or Continuation of Session 4 of Wednesday | Generation of Goals and Aims for Energy Policies |
| | | Heating Systems | | |
| Session 2 | *Inspection Tour of* Local Energy Facility | Energy Conservation | Introduction to 4 Energy Options* | Final Evaluation: Local Energy Situation (Recommendations) |
| | | Renewable Energy Sources | Group Evaluation of Options | |
| | Lunch | Lunch | Lunch | Lunch |
| Session 3 | Local Energy Supply and Demand: Situation and Options | Nuclear Energy | Political Hearing | Individual Evaluation and Decision on the four Energy Options |
| Session 4 | Introduction of Evaluation Criteria | Electrical Power Generation | | Continuation of Session 3 |
| | | Evaluation of Power Generation Plants | | Evaluation of the Seminar and the Participatory Process |

*The four energy options have been developed by the German Parliamentary Enquete-Commission on nuclear energy

Fig. 2: Agenda of the Planning Cells

Table I: List of Criteria and Subcriteria to Evaluate Energy Systems or Scenarios

| | |
|---|---|
| 1. | Financial and Material Requirements |
| 1.1 | Cost of Today (Consumer, Investor) |
| 1.2 | Cost Development |
| 1.3 | Technical Material and Efficiency |
| 2. | Security of Supply |
| 2.1 | Availability |
| 2.2 | Susceptibility to Technical Failures |
| 2.3 | Reserves and Resources of Energy |
| 2.4 | Potential to Meet Energy Demand |
| 2.5 | Flexibility |
| 3. | Economic Effects |
| 3.1 | Labor Market |
| 3.2 | National Competitiveness |
| 3.3 | Structural Development |
| 4. | Environmental Impacts |
| 4.1 | Local Consequences |
| 4.2 | National Consequences |
| 4.3 | Global Effects |
| 5. | Health and Safety |
| 5.1 | Risks for the Employees |
| 5.2 | Risks for the Public |
| 5.3 | Potential Threat of Catastrophes |
| 5.4 | Problems for Future Generations |
| 6. | Social Impacts |
| 6.1 | Standard of Living |
| 6.2 | Social Justice |
| 6.3 | Social Security |
| 6.4 | Impacts for the Working Place |
| 6.5 | Flexibility for Life-Styles |
| 6.6 | Personal Well-Being |
| 7. | Political Impacts |
| 7.1 | Impacts on Constitutional Rights |
| 7.2 | Impacts on Decisionmaking Process |
| 7.3 | Level of Self-Determination |
| 7.4 | Impacts on Political Stability |
| 8. | International Effects |
| 8.1 | Impacts of International Trade |
| 8.2 | Peace |
| 8.3 | International Justice (Distribution of Wealth) |

each small working group. Only two criteria and the corresponding subcriteria were assigned to each group for evaluation. After the rating procedure, the speakers of the small groups had to report on their rating and to explain the reasons, why they had chosen a certain rating to represent their view. No instructions were given on how to come to an agreement within one working group. Except for two cases, unanimity could be achieved without interference by the chairman.

In order to facilitate the rating procedure and to make the evaluations more accurate, the results of our impact analysis were handed out to all participants and explained to them. The impact analysis contained only the scores of the selected 71 indicators and left open the spaces for the evaluation of the subcriteria and criteria; thus factual information was given without prejudicing the subjective ratings of each group. As already mentioned, the impact analysis contained only those indicator scores which were not contested by one side or the other. If there was a dissent, this was indicated by reporting both estimations.

The evaluation of the five options to generate electricity consumed more time than we initially anticipated. On an average, each group took around one to two hours to make the evaluation of one criterion (summarizing up to four subcriteria). Although we occasionally observed strategic response patterns assigning only positive evaluations to the most favorite candidate and negative ones to the least favorite, most participants were highly motivated to fulfill their task as accurately as possible. Since our main goal was to end up with a well-balanced judgement by the participants, we tried not to push the citizens to hurry up with their ratings, but extended this session to the morning of the next day, skipping the planned session on city planning and energy demand.

Accordingly, the third day started with the completion of the questionnaire for the power plant evaluation. In the second session, two members of the scientific secretariat of the German Enquete Commission of the German Parliament on Nuclear Energy presented the four energy scenarios dealing with possible energy futures in the Federal Republic of Germany. The scenarios were constructed in such a way that different political options were operationalized in terms of consistent energy supply and demand models for the year 2000 and the year 2030. One of the two speakers explained the four scenarios to the audience and pointed out the main differences between them (the four scenarios are illustrated in Fig. 3).

In particular, the role of nuclear energy (options 1 and 2 utilizing this technology to a large extent, options 3 and 4 rejecting it) and the role of energy conservation and solar systems (options 1 and 2 with a moderate amount of conservational and solar technologies, options 3 and 4 concentrating on these two) were discussed in detail. A working-group session was organized after the lecture to make the participants more familiar with the fundamental structure of the scenarios. They could also raise questions and direct them to the two speakers of the scientific secretariat. One speaker was more in favor of options 1 or 2 and the other of options 3 or 4. Before lunch the participants went through the same exercise as the day before. They were asked to evaluate the four scenarios according to the subcriteria and to form indices for each criterion. As an additional task, they had to perform a provisional weighting of the subcriteria in order to make the construction of the indices more valid. Again, this task was done in small groups.

After lunch a hearing was organized between the audience and politicians from the German Parliament representing the four parties (Christian Democrats, Social Democrats, Liberal Party, and Green Party). The objective of this hearing was to make the participants familiar with the political arguments related to each of the four options. Also, the hearing served the function of strengthening the level of self-confidence with regard to the participant's own judgment. After two and a half days of intensive learning, most citizens had gained a degree of expertise which sometimes turned out to be superior compared to the knowledge of the politicians represented at the podium. The reactions of the politicians varied from astonishment to anger after realizing that ordinary citizens were able to detect technical mistakes or biased argumentation.

Supported by this experience, the participants were asked to give their final judgment on the fourth day. In a first session they went through an exercise of generating their own evaluative criteria by defining social goals and aims which should be met by energy systems. The new set of criteria was later used as a second cluster of independent variables to predict the intuitive judgment of each individual. Afterwards the local energy situation was discussed again. Some recommendations were formulated to improve the work of the regional planning agency.

Both afternoon sessions were reserved for the individual evaluation of the four energy options of the German Enquete Commission. The evaluation process was divided into seven steps: 1) Rank ordering of the criteria; 2) Assignment of cardinal weights to each criterion; 3) Rating each of the four

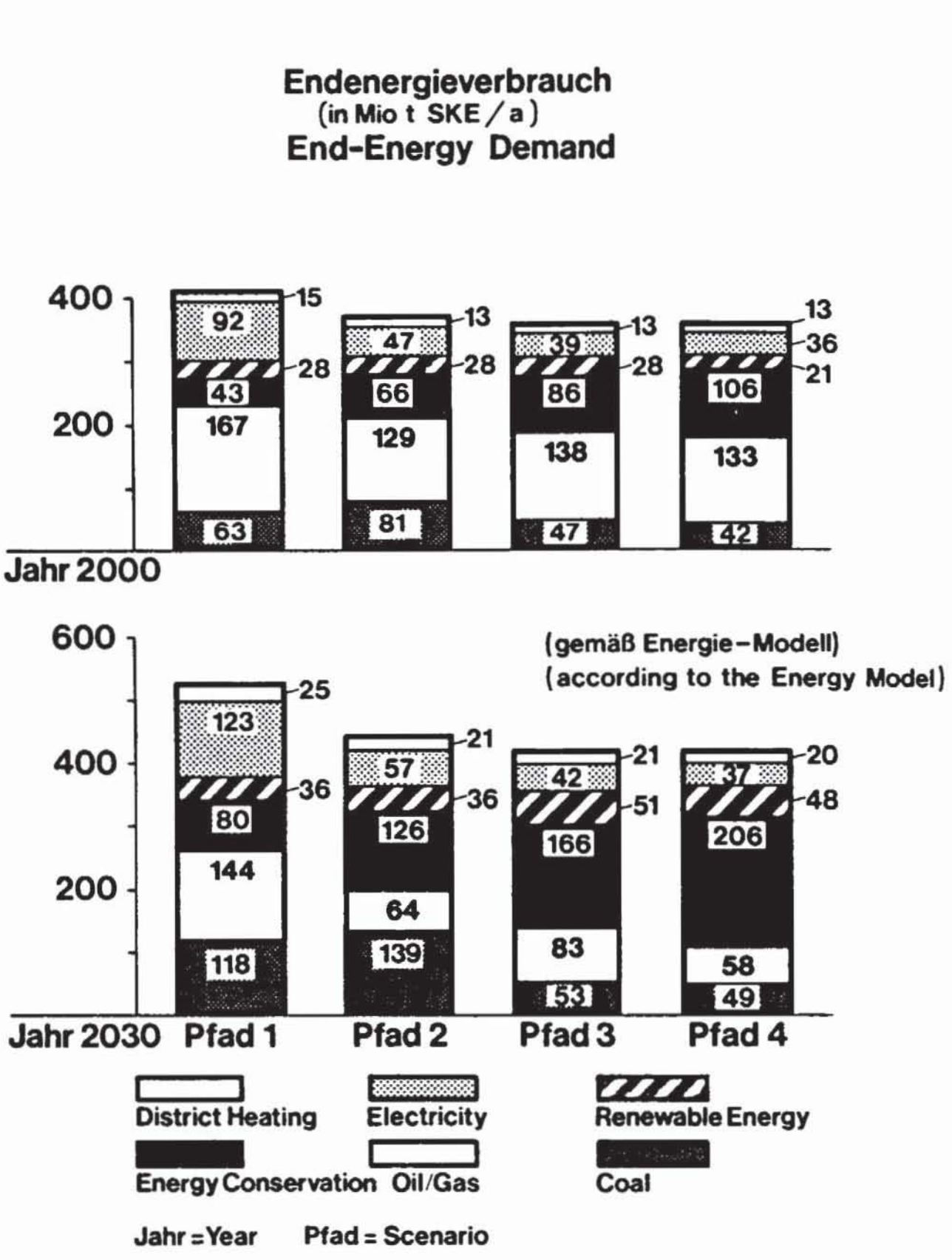


Fig. 3: The End-Energy Demand according to the Four Energy Scenarios of the German Parliamentary Enquete Commission

scenarios according to each of the eight criteria (scores ranging from -2 to +2) on the basis of our impact profiles; 4) Intuitive judgment about the best and second best scenario; 5) Contrast of the intuitive judgment with the calculated result of the rating and weighting process (using the formula criteria weights multiplied by scenario ratings); 6) Subjective explanation of resulting discrepancies between the intuitive and the calculated results; and 7) Collection of political arguments to "sell" one's own decision to the general public.

Whereas steps 1 through 4 and 7 are self-explanatory, steps 5 and 6 need a little more elaboration. After the participants had indicated their intuitive preferences with respect to the four options, they could relax during a coffee break. During this time, the individually assigned weights for each criterion and the ratings for the evaluation of the four options were multiplied and summed up for each of the four scenarios. The procedure, the mathematics, and the results were then presented to the participants. If a discrepancy between the intuitive and the calculated preference order occurred, the respondent was handed a questionnaire to write down the possible reasons for this gap. Specifically, we asked if the list of criteria was regarded as incomplete, if there were interactional effects between the criteria (non-linear relationships) or if the respondents had objections concerning our model. These questions came close to the border-line of the mental ability of many participants and caused some frustration and demotivation. But by explaining the task to each individual separately and giving him the feeling of doing extremely well, we were able to regain his attention and to reveal some of the underlying causes that probably initiated the gap between the intuitive and the calculated results.

Finally, each participant evaluated the whole seminar as well as his own role as a lay consultant. Before departing, participants were also asked to fill out a questionnaire with regard to their personal data (age, sex, income, education, profession, party affiliation, opinion leader scale, religion, family status, and others). A glass of champagne and a check for the honorarium of being a consultant marked the end of the seminar.

## THE IMPLEMENTATION OF THE PLANNING CELLS

In the time period from June to April 1983, we organized 24 planning cells at seven German locations. Four test runs had been carried out at two German towns to develop valid and

reliable scaling techniques and to test our program agenda. Substantial changes were made after the pretests. Therefore, fully comparable data is only available for 20 planning cells.

Since the number of citizens who participated at each planning cell seminar varied from 12 to 32, we did not end up with 500 persons, but only with 427. Including the participants of the pretest, 482 citizens took part in our study.

The selection of the locations to run planning cells was made according to the following specifications: 1) Representation of all major regions in Germany; 2) Variation in size of population; 3) Variation of building structures and housing development; 4) Variation of environmental quality; and 5) Representation of familiar and unfamiliar energy supply situations (including renewable energy sources).

As a further selection rule, we considered only those locations where investigations of the local energy structure had been carried out before, so that we could use existing reports or written material that could provide us with the necessary information to prepare the local options and to describe possibilities to improve the regional energy situation. By following these rules to choose the appropriate towns and cities, we found seven locations which seemed to fit into our list of requirements: 1) Berlin-Neukolln - part of the city of Berlin, 300,000 inhabitants of predominantly low social stratus, mainly old buildings, reconstruction measures underway (sanitation), large amount of old-fashioned heating systems, high pollution; 2) Gelsenkirchen - larger city in the Ruhr-district of about 300,000 inhabitants, 100,000 living in the center, predominantly members of the working class, densely populated and highly industrialized area, high proportion of foreign workers, mainly old, some renovated buildings, high amount of coal-fired systems, extremely high pollution; 3) Offenbach - small city of about 110,000 inhabitants of predominantly medium social stratus, in the center of the southwest, densely populated industrial areas, mixture of old and new buildings, high potential for district heating because of industrial waste heat, high pollution; 4) Norderstedt - typical affluent suburban area at the outskirts of Hamburg, about 66,000 inhabitants of medium and high stratus, predominantly new buildings, single-family homes with backyards, some applications of solar energy, medium pollution; 5) Viersen - medium-sized town of around 80,000 inhabitants of predominantly high-medium stratus, mixture of rural and industrial structure, more new than old buildings, high amount of electrical heating systems, low to medium pollution; 6) Soest - medium-sized town in the neighborhood of a densely populated industrialized area (Ruhr-district), 40,000

inhabitants of predominantly medium stratus, mixture of old and new buildings, mainly gas and oil heating, resort area for the industrial center nearby, medium pollution; and 7) Neustadt an der Waldnaab - small rural town of 5,600 inhabitants of predominantly low and medium stratus, small center with old buildings, new single-family homes in the development areas, mainly oil or wood heating systems, good chances for renewable energy (in particular biogas), low pollution.

After the seven towns had been chosen, the random selection of participants for our seminar took place. For this purpose we used the central register at the town hall in which the addresses of all inhabitants are listed. (In Germany any resident has to register in his home town.) According to previous experiences with planning cells, we needed about 100 addresses to end up with 25 participants. Thus, we counted on 75 percent failures or refusals. This assumption was even too optimistic. On an average, only 20 percent of all persons that we invited to participate actually attended our seminar. The invitation process itself underwent three stages: 1) Formal invitation letter containing the purpose of the seminar, the general idea of the planning cell method and some details of the contract that had to be signed by the participants (for example concerning the honorarium); 2) Personal visit to each potential participant by one member of the research team to explain personally the details of the planning cell and to prepare the contract; and 3) If necessary, personal or telephone requests to the employer of each potential participant asking for the permission to grant his employee four days of vacation.

The organization of planning cells is a highly complex task. Babysitting services have to be provided, adequate rooming has to be found, the local authorities have to be consulted and the local press informed. All this necessary preparation was carried out by the University of Wappertal (Prof. P. Dienel and his colleagues). Also, the contract was signed only by Prof. Dienel or his substitute to avoid any commitment or compliance effects which might occur if the name "Nuclear Research Center" appeared on the contract. (Working out the program, setting up the agenda, preparing the evaluations and running the scenarios were all a joint venture of the Nuclear Research Center and the University of Wuppertal).

The high amount of refusals to participate (about 80 percent) was mainly due to job or family ties which prevented many potential participants from accepting the invitation. Some persons were not satisfied with the honorarium that we offered, some expressed their lack of interest in the subject, some were opposed to the procedure in general or were just irritated,

some had other commitments, and so on. It was surprising, though, that few respondents refused because of self-perceived incompetence. Although some women insisted that their husbands or sons would have been a much better choice, they were frequently persuaded to attend the seminar. It was sufficient to explain the random selection technique and its relevance for the representativeness of the results. Of course, it is possible that the feeling of incompetence was a latent cause for refusal, but for social status reasons it was not explicitly expressed to the research team.

Provided the case that the invitation was accepted, there were only four persons out of 487 who did not show up at the first day of the seminar, and only one person who dropped out of the seminar before it ended. In spite of this encouraging experience, a success rate of 20 out of 100 makes it difficult to draw statistical inferences and to predict the general public attitudes or beliefs. Since family or professional commitments are not distributed equally, we expected some systematic distortions. Surprisingly, the dispersion of demographic characteristics came very close to the general distribution reported for the population of Germany. As can be seen in Table II and III, there were only minor differences in the distribution of sex and age classes (considering the fact that we restricted our samples to persons older than 18 years).

There was also a fairly good representation of all social classes in our samples, with a slight over-representation of middle classes and a slight under-representation of high classes. The strongest bias that we were able to detect referred to professional affiliations. Compared with the national average, we had attracted far too many white collar workers (in particular, government employees) and not enough members of the working class. This is indicated in Table IV.

We also were confronted with an over-representation of students, both from high school and college. Since students have more time to spare, this bias is not astonishing. The percentage of housewives, unemployed, or retired persons did not deviate from the general average in spite of the expectation that these groups are likely to be over-represented when paid for attendance.

Looking over these results, we may conclude that the samples cannot be regarded as representative for the whole German population nor for the locations that we had selected. But the dispersion of demographic characteristics and professions within the samples justifies the use of inferential statistics with respect to relations between defined social groups. By comparing the results of the planning cells with similar

Table II:

SEX DISTRIBUTION

(Comparison of Planning Cells with German Population)

| SEX | Planning Cells (n = 482) | Total* Population (n≈47 Mio.) |
|---|---|---|
| male | 53.1 % | 47.7 % |
| female | 46.9 % | 52.3 % |

* West-German Population ≙ 18 years

Source: Statistical Yearbook of the Federal Republic of Germany 1981, edited by Statistisches Bundesamt Wiesbaden 1981

Table III:

DISTRIBUTION OF AGE CLASSES
(Comparison of Planning Cells with German Population)

| Age | Planning Cell | Total Population* |
|---|---|---|
| 18-25 | 16.6% | 13.9% |
| 26-35 | 22.2% | 17.3% |
| 36-45 | 21.0% | 20.0% |
| 46-55 | 17.2% | 16.0% |
| 56-65 | 16.0% | 12.5% |
| > 65 | 6.0% | 20.3% |
| Missing | 1.0% | |
| | 100.0% | 100.0% |

* West-German Population $\geq$ 18 years

Source: Statistical Yearbook of the Federal Republic of Germany 1981, edited by Statistisches Bundesamt Wiesbaden 1981

Table IV:

DISTRIBUTION OF PROFESSIONAL AFFILIATIONS

| | |
|---|---|
| Self-Employed | 3.73 % |
| Employees | 31.33 % |
| Government and Public Employees | 9.34 % |
| Workers | 10.79 % |
| Housewives | 19.09 % |
| Students | 9.75 % |
| Retired Persons | 13.90 % |
| Missing | 2.10 % |
| n = 482 | 100.00 % |

results of national surveys, we might also be able to validate some general conclusions. These can be found by combining specific results of the planning cells with similar tendencies revealed in representative surveys.

## THE RESULTS OF THE PLANNING CELLS

The last run of a planning cell seminar took place in April, 1983. In the following months the phase of data processing was started, but has not been completed up to now. Thus, we are only able to report on a selection of results which have been analyzed so far. Specifically, we concentrated our efforts to study the preference structure of the citizens with respect to

the four energy scenarios. But we also looked into the general attitude and belief structure. For this article, we selected the following topics: 1) Beliefs about different energy systems; 2) Weights and rank order of criteria; 3) Preference structure with respect to the four energy options of the Enquete Commission; and 4) Predictive power of the utility and factor models reflecting the intuitive decision.

After the presentation of the results, we will draw some general conclusions about the lessons we learned about the merits and pitfalls of the planning cell instrument.

## Beliefs About Different Energy Systems

In all planning cells we found rather clear-cut beliefs concerning the different energy systems. Coal energy was perceived as a native energy source and thus beneficial to society, but also as environmentally harmful. There was an overwhelming majority who favored strict antipollution laws with respect to coal-fired power stations, even if the consumers had to pay high prices for their electricity. Many participants refused to make tradeoffs between environmental quality and cost when deciding about the impacts of coal energy. In order to prevent acid rain problems and the deterioration of the German forest--the "hottest" political issue in Germany in the year 1983, at least with respect to the environment--they demanded immediate action to be taken regardless of the cost.

With respect to oil and gas, most people were afraid of dependencies from the supplier nations, but this topic did not have the same saliency or emotional power as the issue of environmental quality. The reliance on more native energy sources was unanimously requested, but not for the price of major economic disadvantages or consumers' reduction of utilities. Since coal was regarded as environmentally harmful and oil and gas as politically dangerous, the future hope focused on solar energy and conservation. There were high expectations concerning the potentials of the alternative technologies or solar systems, but a very low personal interest in purchasing one. Most people believed that solar energy was not yet technically feasible and that the systems would be improved over time. Most participants agreed with the statement that the Federal Government of Germany should spend more money for research and development of solar systems. These programs should be financed by reducing the research grants for nuclear energy, by raising the price of electricity (but only modestly), or by transferring money from other parts

of the federal budget. As expected, tax increase was the least favorite method to finance solar research.

Technologies for energy conservation (insulation, heat pump, passive solar utilization) were also highly approved by most of the participants. There were hardly any objections against state interventions into the market economy in order to speed up the market penetration of conservation technologies. Also, stricter laws or regulations concerning insulation or building permits were demanded from government, even if the participants were aware that it would increase the cost of building new homes. However, there were clear indications that governmental regulations restricting consumption or controlling individual heating behavior were unanimously rejected.

In spite of the general favorableness toward conservation, each individual perceived only a limited scope of possibilities to save more energy in his home. A vast majority (over 70 percent) of all participants indicated that they either perceived no chance of implementing new conservational installations or that they were convinced that they had already done everything possible. Institutional, economic, structural, and social barriers restraining an effective conservational program were frequently mentioned, but only few generic ideas were expressed about how to overcome these difficulties. There was high support for the suggestion that the government should finance conservational installations in advance and should then be paid back by the customer out of the surplus money he had saved by consuming less energy.

We experienced a very ambivalent reaction toward nuclear energy. Around 30 percent of all participants were fundamentally opposed to any use of nuclear power. This group perceived nuclear energy as very expensive, environmentally harmful, dangerous, and socially unacceptable. Information which contained positive arguments was rejected either as interest-driven manipulation or as short-term thinking. This specific group also criticized the ratings or our impact analysis as soon as they discovered any positive scoring with respect to nuclear energy. The distrust concerning the nuclear ratings was not extended to the scores of the other energy systems.

The vast majority of all participants showed a strong degree of ambiguity: on the one hand, 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 generating electricity. Most people supported the recommendation to confine the use of nuclear energy to that amount that all other energy sources together could not meet.

The difficulties encountered in this limitation of nuclear growth were well understood, particularly the question of who determines the amount of nuclear energy that cannot be substituted for. In spite of this problem, most participants expressed their feeling that the nuclear program should be restricted to the minimum of what should be regarded as necessary and that nuclear installations should be replaced, if other technically or economically feasible solutions were available. However, almost everyone of this majority group voted against a complete shutdown of nuclear power plants. They were convinced that after all nuclear energy might play a major role in the future, provided that the safety problems, the reprocessing and waste disposal problems, and the 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 the appropriate technology for this purpose was still to be developed.

## Weights and Rank Order of Criteria

For the purpose of evaluating the four options of the Enquete Commission of the German Parliament, eight criteria and 31 subcriteria had been handed out to the participants. The task of the participants was to assign weights to each subcriterion and criterion and later on to evaluate the four options according to each criterion. The theoretical approach was based on a modified MAU-model by simplifying the utility measurement. Since we deliberately provided extensive information about the four options and the criteria, we had to control the effects of our information input on the participants' scoring behaviour. We assumed that the rank order of criteria was derived from personal values and should therefore not be altered by the information process; for our information was meant to focus only on facts and their (controversial) interpretation. In order to test the influence of the information process, we asked the participants to make a rank order of the main criteria on the first and the last day of the seminar.

Figure 4 illustrates the medians of the rank order for all eight criteria comparing first and second measurement. Evidently all observed changes are only of minor magnitude and the sequential order remains the same. Based on the individual scores, however, there is a high degree of change between the first and the second measurement. But these differences vary in general between one or two places up or down the rank order. The reason for these alterations is probably based on

random effects (lack of memory) and not on real shifts in value preferences. The contingency coefficient[1] exceeded the amount of 0.60 for all criteria. We were also able to prove that the preference structure of our samples was rather similar to the preference structure which has been measured in previous commercial survey studies (for instance, Infratest Poll 1981). We are justified in concluding that our samples represent the general populations, view fairly well and that our information process has obviously not changed the preference order.

Looking at the priorities revealed by the weighting procedure, it does not seem surprising (knowing the general beliefs) that health/safety and environmental quality form the top of the hierarchy. The general economic concerns, in particular security of supply, are rated higher than the more specific concerns of financial and material requirements. This criterion gained more importance over the four days' information period, whereas the relevance of the environmental effects was rated slightly lower at the last day compared with the rating of the first day. Political, social, and international aspects were regarded as less important for the evaluation of energy systems.

We performed a subdivision of the cardinal weighting scores (ranging from 0 to 100) according to the intuitive preference for one of the four energy scenarios in order to analyze how the importances of criteria vary when individuals prefer a more nuclear or a more solar-oriented energy option. In Table V the criteria weights are listed according to the scenario preferences. The table conveys the immediate impression that the weighting scores do not differ dramatically, even in the most prominent cases of scenarios 1 and 4. The means of the weights for economic impacts, health and safety, political impacts, and international effects are not significantly different between the respondents in favor of the pro-nuclear scenario 2 and the respondents in favor of the non-nuclear scenario 3.

It is probably no surprise that proponents of a nuclear scenario assign more weight to cost and less to environment and social impacts. More astonishing is the unexpected homogeneity between the different preferential groups. The saliency of social values connot be the decisive factor in forming energy preferences.

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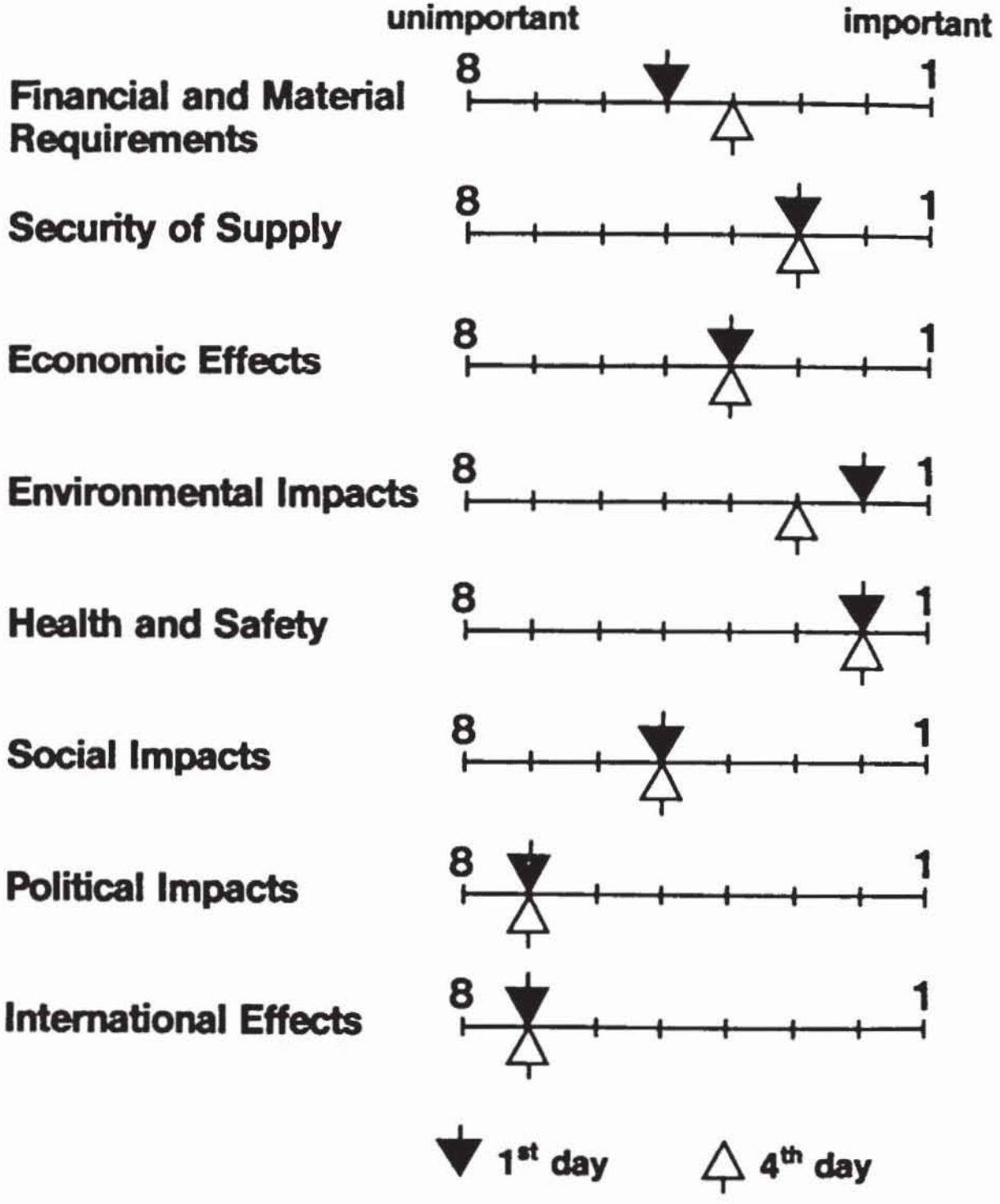
1 Pearson contingency coefficient:

$$C = \sqrt{\frac{\chi^2}{N+\chi^2}}$$

## Comparison of rank order of criteria at the beginning and at the end of the planning cell run (medians)



The preferences for one of the four energy scenarios are much more determined by the perceived performance of the four energy scenarios with respect to the eight criteria. This is illustrated in Table VI. This table lists some selected ratings of the four energy scenarios again according to the intuitive scenario preference. The range of possible evaluations is restricted from -2 to +2.

In contrast to the weights given to each criterion, the ratings for the performance of each scenario differ considerably. All respondents believe that environmental quality and health/safety impacts should be regarded as the most important criteria for different energy systems. But the judgment--whether nuclear or solar scenarios should be evaluated as superior when those criteria are used as yardsticks--reveals the gap between the different preferential groups quite clearly.

Thus, there is much more agreement on the weights to be assigned to various criteria than on the perceived properties of each evaluated option with respect to this criterion. This conclusion can be confirmed by a variety of other studies in Germany and the United States (8).

The Intuitive and Calculated Preference Structure with Respect to the Four Energy Scenarios

Figure 5 shows the results of the intuitive preference measurement and the calculated preferential order. The moderate pro-nuclear option 2 gained the highest approval, followed by the most moderate non-nuclear option 3. Most of the respondents who gave first priority to option 2 or 3 also assigned the second priority to the other moderate option (either scenario 2 or 3). Thus, there is a clear indication that more moderate scenarios are preferred.

The two pro-nuclear options together were chosen less frequently than the two non-nuclear options. Around 16 percent of participants preferred the extreme solar and conservational scenario 4 as opposed to only three percent who preferred the extreme pro-nuclear scenario 1. Thus, there is a considerable group of highly motivated and convinced citizens with a strong anti-nuclear commitment, but there is not an equal sized pro-nuclear fraction. Also, more than 70 percent of the persons who preferred option 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 percent assigned their second priority to scenario 2, the other 50 percent to scenario 4. So, in spite

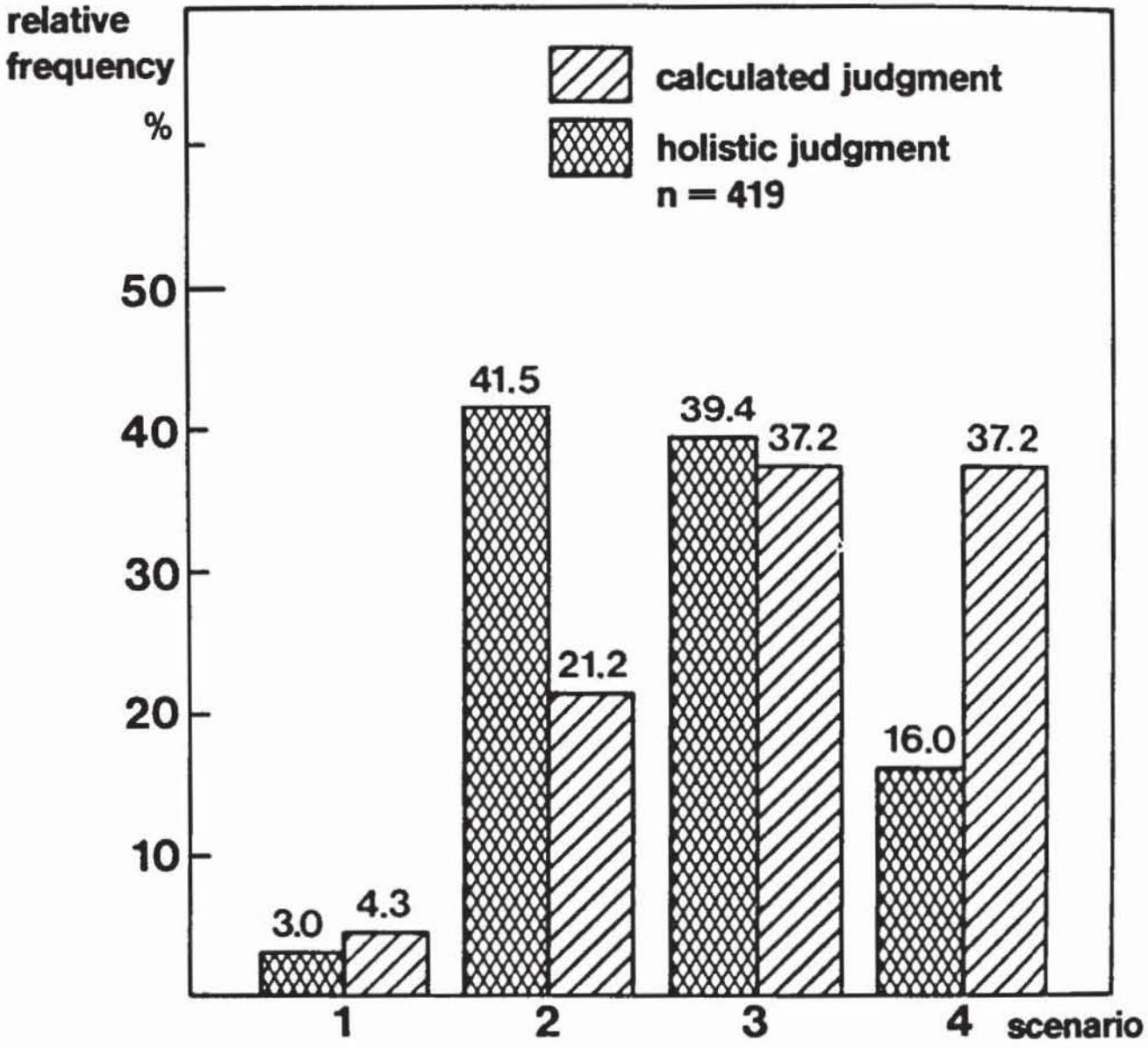
Table V: The weights of the eight criteria as a function of the preference for one of the four energy scenarios (means)

| | 1 | 2 ↔ 3 | | 4 | t-Test p (2vs3) |
|---|---|---|---|---|---|
| 1. Financial and Material Requirements | 16.25 | 12.65 | 9.49 | 8.48 | 0.00 |
| 2. Security of Supply | 20.42 | 17.72 | 15.23 | 11.83 | 0.00 |
| 3. Economic Effects | 18.33 | 13.26 | 13.04 | 10.0 | 0.71 |
| 4. Environmental Impacts | 12.25 | 16.20 | 19.10 | 22.66 | 0.00 |
| 5. Health and Safety | 13.08 | 18.89 | 20.14 | 20.60 | 0.08 |
| 6. Social Impacts | 8.75 | 9.57 | 11.52 | 13.98 | 0.00 |
| 7. Political Impacts | 7.67 | 6.51 | 7.36 | 8.0 | 0.05 |
| 8. International Effects | 8.5 | 6.71 | 7.12 | 9.30 | 0.37 |

Table VI: The unweighted ratings of the four energy scenarios as a function of the preference for one of the four scenarios (means)

| Preference for: | | 1 | 2 ↔ 3 | | 4 | t-Test p (2vs3) |
|---|---|---|---|---|---|---|
| Economic Effects | Scenario 2 | 0.58 | 0.82 | 0.26 | -0.37 | 0.00 |
| | Scenario 3 | -0.42 | 0.15 | 0.55 | 0.51 | 0.00 |
| Environmental Impacts | Scenario 2 | -0.50 | -0.16 | -0.65 | -0.95 | 0.00 |
| | Scenario 3 | 0.85 | 0.40 | 0.69 | 0.26 | 0.00 |
| | | | | | | |
| Political Impacts | Scenario 2 | 0.33 | 0.3 | -0.31 | -0.93 | 0.00 |
| | Scenario 3 | -0.58 | 0.25 | 0.68 | 0.70 | 0.00 |
| International Effects | Scenario 2 | 0.08 | 0.16 | -0.28 | -0.95 | 0.00 |
| | Scenario 3 | -0.08 | 0.27 | 0.59 | 0.74 | 0.00 |

## Holistic and calculated judgment on the preference for one of the four scenarios




(replacement of missing data by means)

of the highest score for the moderate pro-nuclear option 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 solar systems. The later group is less willing to sacrifice its anti-nuclear option as the former group is willing to abandon its nuclear preference.

This tendency is also clearly indicated by the calculated preference structure which was constructed by multiplying the weights of each criterion with the perceived performance of each scenario and summing up all the products for the eight criteria. According to the calculated results, three quarters of all participants gave the highest priority to options 3 and 4. There is quite a good correspondence between the calculated and the intuitive judgment in case of scenarios 1 and 3, but a big gap in the case of scenarios 2 and 4. In particular, the calculated preference of 37.2 percent in favor of scenario 4 strongly contrasts with the intuitive preference of 16 percent for this scenario. In the last paragraph of this chapter we offer some hypothetical explanations for this deviation.

The high degree of ambiguity revealed by this comparison between the two different preference measurements can also be studied by looking at the two components of the calculated index: weights and ratings. We have already shown that the weights themselves do not highly discriminate between the different preferential groups; we will concentrate our analysis on the ratings. Table VII provides an overview of the unweighted ratings (arithmetic means), Table VIII of the weighted ratings (means of weights times ratings).

Comparing scenario 2 with 3, it is easy to detect that the anti-nuclear scenario 3 receives better ratings in four out of eight criteria (environment, health/safety, political effects, and international consequences). Only in one case (security of supply) is the pro-nuclear scenario regarded as superior. When we take a look at the weighted profiles, the evaluations are somewhat more balanced. According to the three economic criteria, option 2 has been associated with slightly higher advantages as opposed to the ratings of option 3. According to the social, political, and international consequences, scenario 3 is still superior compared to scenario 2. With respect to health/safety and environmental quality, all participants rated the non-nuclear scenarios much more positively than the nuclear ones. Thus, the question arises: Why is there a strong tendency toward a positive evaluation of options 3 and 4, when the intuitive decision turned out to be in favor of option 2, at least for the relative majority? This quesion can only be

Table VII: The mean values of the perceived performance of the four energy scenarios with respect to eight evaluative criteria (unweighted ratings)

| Criterion | SCENARIO PREFERENCE | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | |
| | Mean | Median | Mean | Median | Mean | Median | Mean | Median |
| Financial and Material Requirements | -0.75 | -1 | 0.25 | 0 | 0.32 | 0 | -0.53 | -1 |
| Security of Supply | -0.2 | 0 | 0.41 | 1 | 0.46 | 1 | 0.12 | 0 |
| Economic Effects | 0.12 | 0 | 0.5 | 1 | 0.29 | 0 | -0.1 | 0 |
| Environmental Impacts | -1.2 | -1 | -0.5 | -1 | 0.48 | 1 | 1.0 | 1 |
| Health/Safety | -1.0 | -1 | -0.32 | 0 | 0.63 | 1 | 1.2 | 1 |
| Social Impacts | -0.4 | 0 | 0.25 | 0 | 0.35 | 0 | -0.1 | 0 |
| Political Impacts | -0.6 | -1 | -0.1 | 0 | 0.44 | 1 | 0.1 | 0 |
| International Effects | -0.6 | -1 | -0.1 | 0 | 0.45 | 1 | 0.4 | 1 |
| Summed Mean | -0.58 | | 0.05 | | 0.43 | | 0.26 | |

Table VIII: Mean values of the perceived performance of the four energy scenarios with respect to eight evaluative criteria (weighted ratings)

| Criterion | SCENARIO PREFERENCE | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | |
| | Mean | Median | Mean | Median | Mean | Median | Mean | Median |
| Financial and Material Requirements | -7.9 | -10 | 4.2 | 10 | 3.7 | 0 | -6.3 | -5 |
| Security of Supply | -3.8 | 0 | 8.3 | 10 | 7.1 | 5 | -0.2 | 0 |
| Economic Effects | 2.2 | 0 | 7.1 | 5 | 2.8 | 0 | -3.1 | 0 |
| Environmental Impacts | -23.5 | -20 | -9.6 | -10 | 9.2 | 10 | -18.9 | 20 |
| Health/Safety | -22.1 | -20 | -6.1 | 0 | 12.4 | 15 | 22.6 | 20 |
| Social Impacts | -3.2 | 0 | 2.5 | 0 | 5.0 | 0 | -1.2 | 0 |
| Political Impacts | -4.8 | -5 | -0.3 | 0 | 3.3 | 0 | 0.4 | 0 |
| International Effects | -4.6 | -5 | -0.7 | 0 | 2.9 | 0 | 3.0 | 0 |
| Summed Mean | -58.2 | | 4.7 | | 43.1 | | 28.5 | |

answered by investigating the predictive power of our evaluation matrix and the statistical analysis of the resulting errors in prediction.

## Predictive Power of the Utility and Factor Models

Before elaborating on the different models of predicting the intuitive judgment with respect to the four energy scenarios, it seems worthwhile to take a closer look at the distribution of MAU-scores which characterize the overall performance of the four scenarios. Figure 6 shows the frequency curves for all four scenarios.

There is a clear indication that scenario 1 (highly pro-nuclear) has been evaluated as inferior compared to the three other options. The more moderate pro-nuclear scenario 2 has a peak at the zero-point. This supports our impression that option 2 is associated with a high degree of ambiguity. In contrast, scenario 3 has been evaluated much more positively (see the two peaks, one at +50 and the other one at +85). Also, the variance of evaluations is smaller compared to scenario 2. This indicates that scenario 3 has never been rated as totally negative; scenario 2 has been rated occasionally and very rarely as totally positive (which is also true for scenario 2). Scenario 4 (the most pro-conservation, pro-solar, anti-nuclear scenario) has a particularly interesting shape, because there are two peaks of around equal size, one at the zero point and one at 50. If we only consider this distribution of evaluations, we are able to describe more precisely the scoring behavior of the respondents.

If a participant of our seminar evaluated the extreme scenario 4 as ambivalent in its outcomes, and the scenarios 3 and 2 as positive, he would probably prefer scenario 2 over all other options. If a participant perceived scenarios 3 and 4 as rather positive and scenario 2 as more ambivalent, he chose scenario 3 when asked for his intuitive preference. An intuitive priority for the two extreme scenarios 1 and 4 was always accompanied by an extreme positive evaluation of the chosen alternative and a clear cut negative perception of the three remaining options. This conclusion can be further reaffirmed when the ranges of the overall evaluations (calculated preferences) are subdivided according to the intuitive preferences. Figure 7 illustrates this relationship.

Most difficult to explain is the scoring behavior of the relative majority preferring the more moderate pro-nuclear option 2. This group assigns almost equal scores to scenarios 2 and 3. Also, the most anti-nuclear scenario 4 gains a high

**Verteilung der summierten Pfadbewertung für die 4 Pfade der Enquete-Kommission.**
**Distribution of evaluation scores with respect to four energy scenarios.**

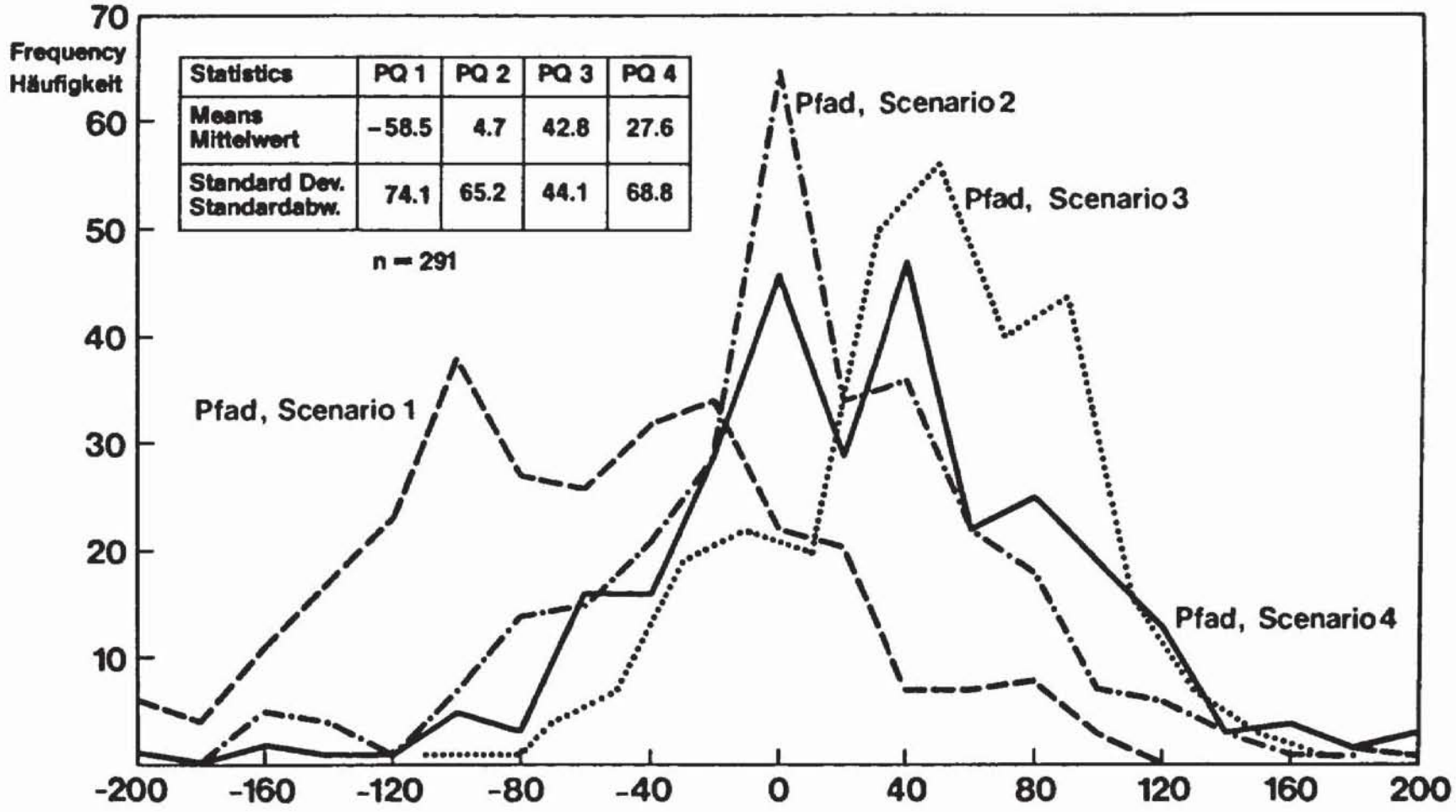



Fig. 6: The frequency distribution of respondents's MAU-scores to evaluate the four energy scenarios
(Pfad = scenario)

degree of appreciation. Participants who voted in favor of scenario 3 evaluated scenario 4 as at least equally positive. But why then did they decide to give priority to scenario 3?

In order to explain the difference between the intuitive and the caluclated preferences, it is necessary to compare inconsistencies on an individual level. For this purpose, we considered two basic models, one based on the sum of the unweighted ratings for each scenario and the other one based on the sum of the weighted ratings. We performed a cross-tabulation between the intuitive preferences and the model-based calculated preferences. Those preferences were simply derived by choosing the scenario which reached the highest score on the summed ratings (weighted and unweighted). Figures 8 and 9 illustrate the results of this comparison for both models.

As can be expected from the analysis so far, most errors in prediction occurred for the group preferring scenario 2. For both models, the proportion of errors amounts to around 56 percent. According to the MAU model, 25 percent belonging to this group scored highest on scenario 3 and the other 25 percent on scenario 4. Looking at the group of respondents who intuitively favored scenario 3, both models reveal that only a marginal percentage assigned a higher score to options 1 or 2, but that virtually all errors were due to a calculated preference toward option 4. The calculated preference is much more likely to be one step further toward a "softer" scenario compared to the intuitive preference. If we look at the diagonal line where the perfect fits are described, we can detect hardly any error below that line (meaning that few participants rated the more nuclear option better on an analytical base than on an intuitive base). The vast majority of all errors are above the line.

Another interesting result can be found by looking at the two models. There is hardly any difference between the weighted and unweighted version of the model. The total percentage of correct prediction is 50.13 percent for the weighted and 51.07 percent for the unweighted model. We can even detect that the weights bias our model even more toward a soft preference structure. It is clearly reaffirmed, though, that the weights do not play a decisive role in the formation of preferences.

This result appears to be counter-intuitive. We had expected that the scaling process based on arguments and rational reasoning would reveal a stronger priority for options 1 and 2, whereas the intuitive judgment influenced by evaluations, visions, and affects would focus on options 3 and 4. But just the opposite was the case.

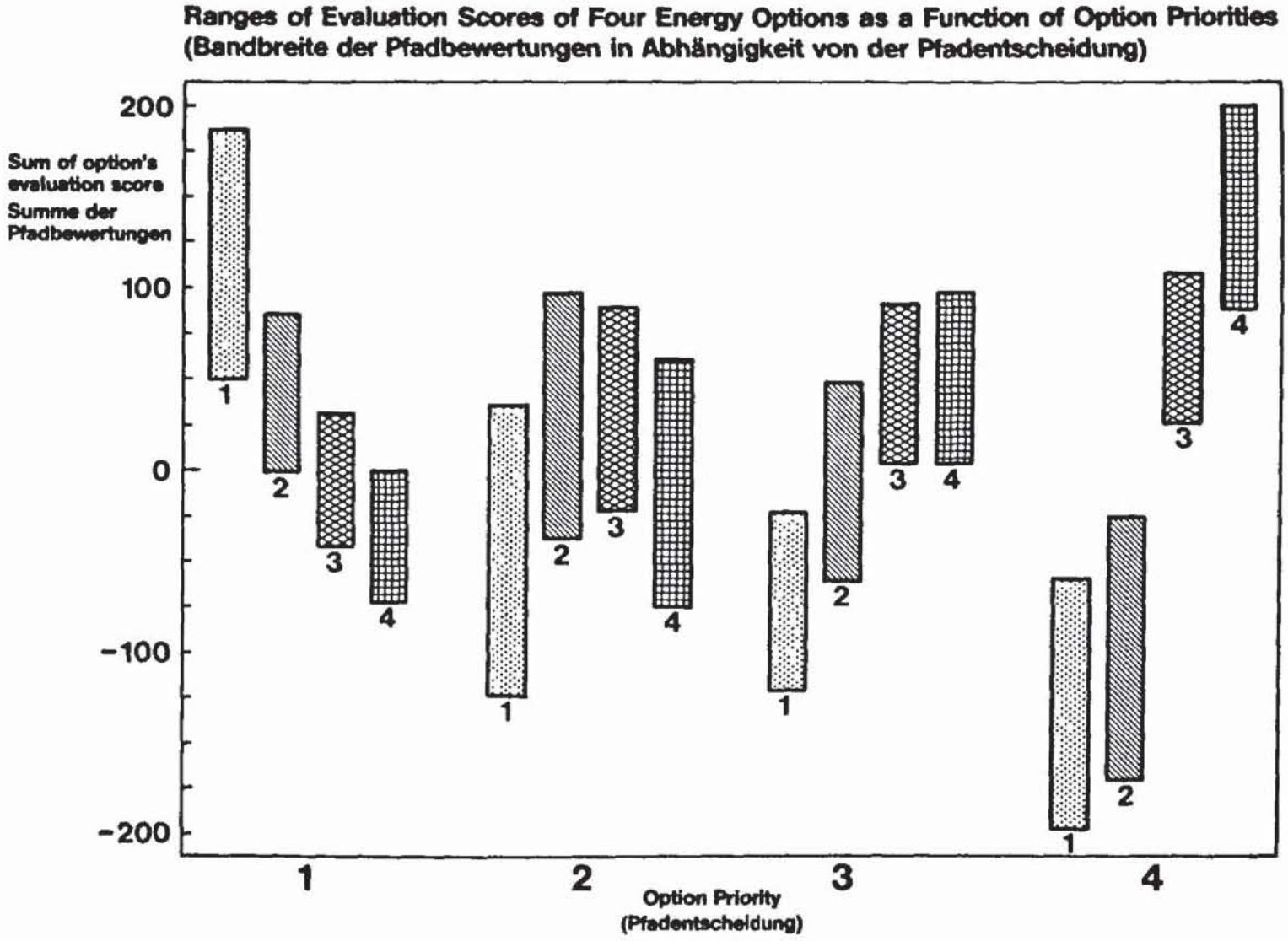



Fig. 7: The ranges of scores for each scenario evaluation as a function of the intuitive preference for one of the four scenarios

**Contrast between the holistic judgment and the calculated preference via the sum over the multicriteria ratings (unweighted) with respect to the four energy scenarios***

| Scenario Priority | Model: max $[\sum_{1}^{8}$ ratings] | | | | total |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | |
| 1 | 61.54 | 23.08 | 15.38 | 0 | 13 (= 100%) |
| 2 | 6.32 | 44.25 | 29.31 | 20.11 | 174 (= 100%) |
| 3 | 1.21 | 4.85 | 57.58 | 36.36 | 165 (= 100%) |
| 4 | 1.49 | 2.99 | 44.78 | 50.75 | 67 (= 100%) |
| total | 5.25 | 21.48 | 42.48 | 30.79 | 419* (= 100%) |

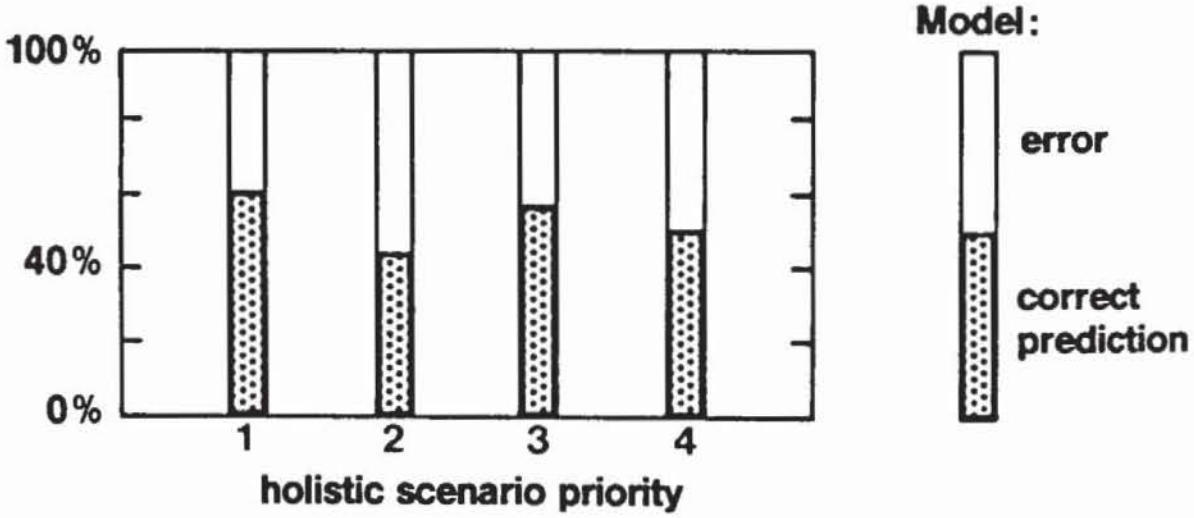



Fig. 8:

**Percentage of correct prediction for the overall model: 51.07%**

*replacement of missing data by means

**Contrast between the holistic judgment and the calculated preference via a simplified MAU-model (weights x ratings) with respect to four energy scenarios***

| Scenario Priority | Model: max $[\sum_{1}^{8}$ weights x ratings] | | | | total |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | |
| 1 | 53.85 | 38.46 | 7.96 | 0 | 13 (=100%) |
| 2 | 5.75 | 43.86 | 25.86 | 24.71 | 174 (=100%) |
| 3 | 0.61 | 3.64 | 52.12 | 43.64 | 165 (=100%) |
| 4 | 0 | 2.99 | 35.82 | 61.19 | 67 (=100%) |
| total | 4.3 | 21.24 | 37.23 | 37.23 | 419* (=100%) |

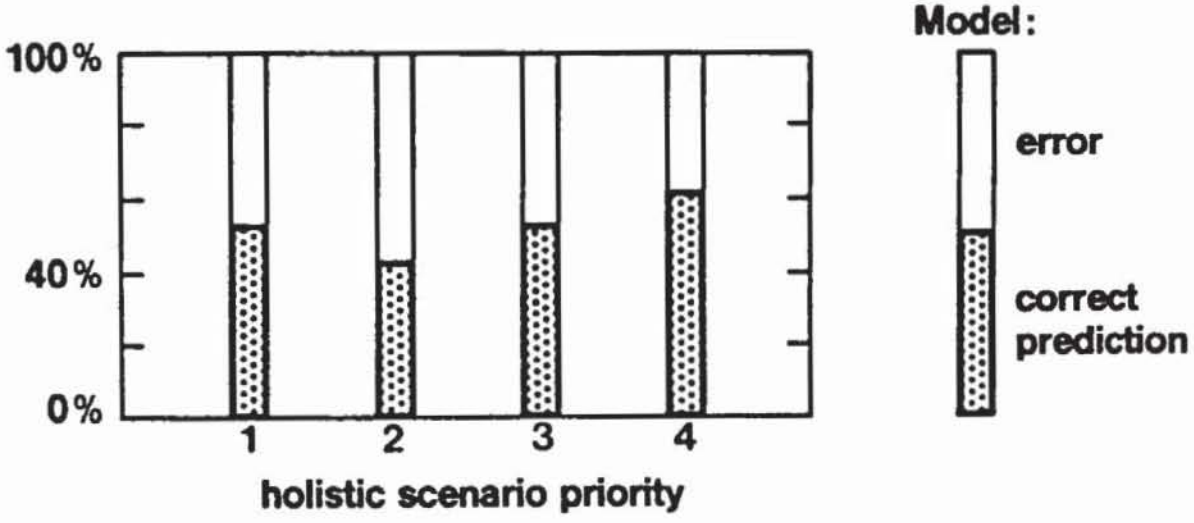



Fig. 9:

**Percentage of correct prediction for the overall model: 50.13%**

*replacement of missing data by means

What kind of explanation could we find to understand this scoring behavior? First, we tried other models to construct a meaningful index of summarizing the ratings of the participants. In order to rule out the strong ties between health/safety and environmental aspects, we combined the ratings for those two criteria into one and based our calculation on a seven-criteria set. But the results did not differ from those of the two original models. After this exercise we used some statistical procedures to construct appropriate models based on multiple regression and factor analysis. Neither model showed any improvement in the percentage of correct prediction. For the purpose of comparison, Fig. 10 illustrates the relationships between the intuitive judgment and the calculated results of a factor model. All ratings were multiplied by the factor score coefficient (standing for an indirect measurement of importance for each criterion with regard to the overall intention of all criteria).

Since the factor and the regression models were characterized by the same biases as the previous models, there is little support for the assumption that the discrepancy between the calculated and the intuitive judgment is due to a latent structure of values which were not overtly expressed by most of the participants. For example, because of social desirability reasons most proponents of scenarios 1 and 2 did not admit that in their view economic values were superior to health and safety values. The weights expressed by the advocates of scenarios 3 and 4, however, came close to the real preference structure of the group. We are still testing the hypothesis of latent value biases by constructing more refined models. But to draw a preliminary conclusion, there is no doubt that the ratings themselves are extremely biased toward a positive evaluation of scenarios 3 and 4, and even latent weights assigned to each criterion cannot compensate for this effect. Of course, there is also the possibility that we chose the wrong criteria or omitted decisive ones which could be regarded as the underlying causes for the superiority of option 2 in the intuitive rating process. Since we had asked all persons to give explanations for resulting discrepancies between the intuitive and the calculated judgment, we were able to test this hypothesis, at least to the extent that the participants could consciously recall their judgments. Indeed, we found some evidence that the list of criteria induced three biases toward scenarios 3 and 4: 1) Many respondents indicated that the three economic criteria (cost, security of supply, and economic consequences) should have more weight for the decisionmaking process, if all three of them received negative evaluations. They thought it would be inadequate to add up the weights for each single economic criterion; extra weight should

**Contrast between the holistic judgment and the calculated preference via factor analysis and the unweighted ratings (factor score coefficients times ratings) with respect to four energy scenarios***

| Scenario Priority | Model: max $[\sum_{1}^{8}$ coeff. x ratings] | | | | total |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | |
| 1 | 61.54 | 15.38 | 15.38 | 7.69 | 13 (=100%) |
| 2 | 6.90 | 42.53 | 30.46 | 20.11 | 174 (=100%) |
| 3 | 1.82 | 4.24 | 58.18 | 35.76 | 165 (=100%) |
| 4 | 1.49 | 0 | 46.27 | 52.24 | 67 (=100%) |
| total | 5.73 | 19.81 | 43.44 | 31.03 | 419* (=100%) |

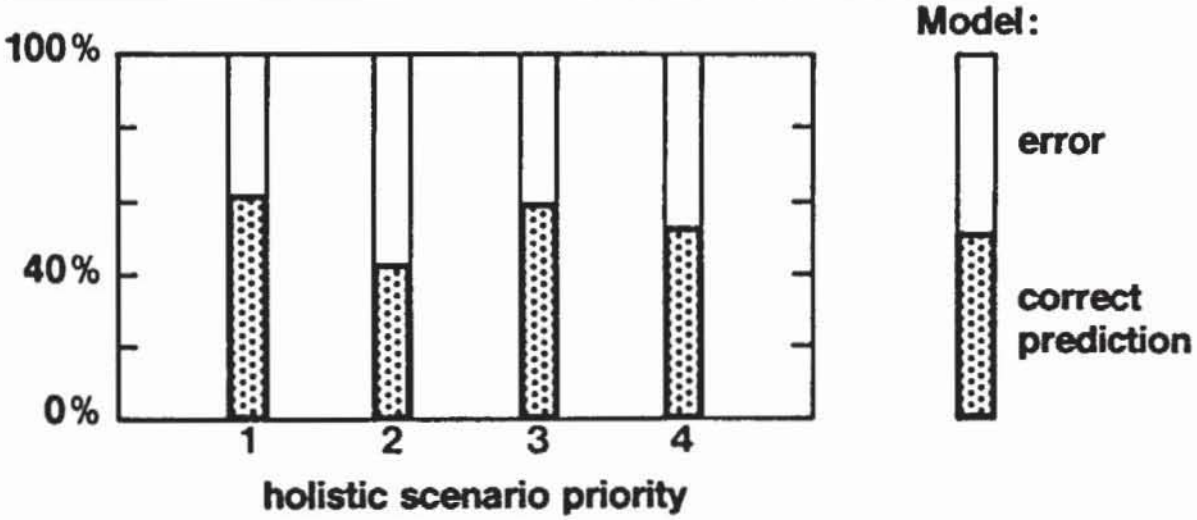



Fig. 10:

**Percentage of correct prediction for the overall model: 50.83%**

*replacement of missing data by means

Table IX: The preference for energy scenarios 1 or 2 versus 3 or 4 as a function of age (n = 419)

| Age | Energy Scenarios 1/2 | Energy Scenarios 3/4 | |
|---|---|---|---|
| 18 - 40 | 32.7 % | 67.4 % | 191 (= 100 %) |
| ≥41 | 55.2 % | 44.8 % | 223 ( = 100 %) |
| | 185 | 229 | 414 |

be given to the joint effect of all three criteria; 2) Many respondents expressed some objections to the placement of technical feasibility as a subcriterion of the criterion security of supply. They suggested that feasibility should be a separate criterion independent from economic security; and 3) Some respondents missed the criterion "political implementability." They expressed the opinion that option 4 could not be implemented because of pressure group influence. This reason was most frequently expressed by those participants who voted for option 3, but ranked highest on option 4.

Apart from these explanations there were only three participants who suggested completely new criteria or modified the criteria list. Some could not give any explanation for the discrepancy. But the most striking result was that during the discussion most of the respondents who had to explain the deviation between intuitive and calculated preference referred to non-cognitive reasons. They admitted that most of the arguments would lead to a more favorable view of options 3 or 4, but they trusted the official policymakers in Germany who were believed to have a better insight view on the subject and were thus more competent on this issue. Since most German institutions are in favor of options 1 or 2, the participants accepted this judgment and acted accordingly. Reference groups, such as parties, unions, or professional societies, were also cited.

There was no sharp distinction between cognitive and noncognitive explanations. Since most of the respondents gave more than one answer, the criticism of the criteria list and the reference to social group judgments were mixed. By

reviewing the results, we gained the impression that the cognitive aspects reflected the degree of rationalization of reference group influence to a large extent.

There are some indications to back up this impression. Figures 11, 12, and 13 provide an overview on the distribution of option priorities as a function of sex, age, and party preference. Whereas sex had no impact on the intuitive preference for one of the four options, we detected quite intensive relationships between age, party preference, and option priority. The more conservatively people voted in national elections and the older they were (in particular over 40 years old), the more they preferred options 1 or 2.

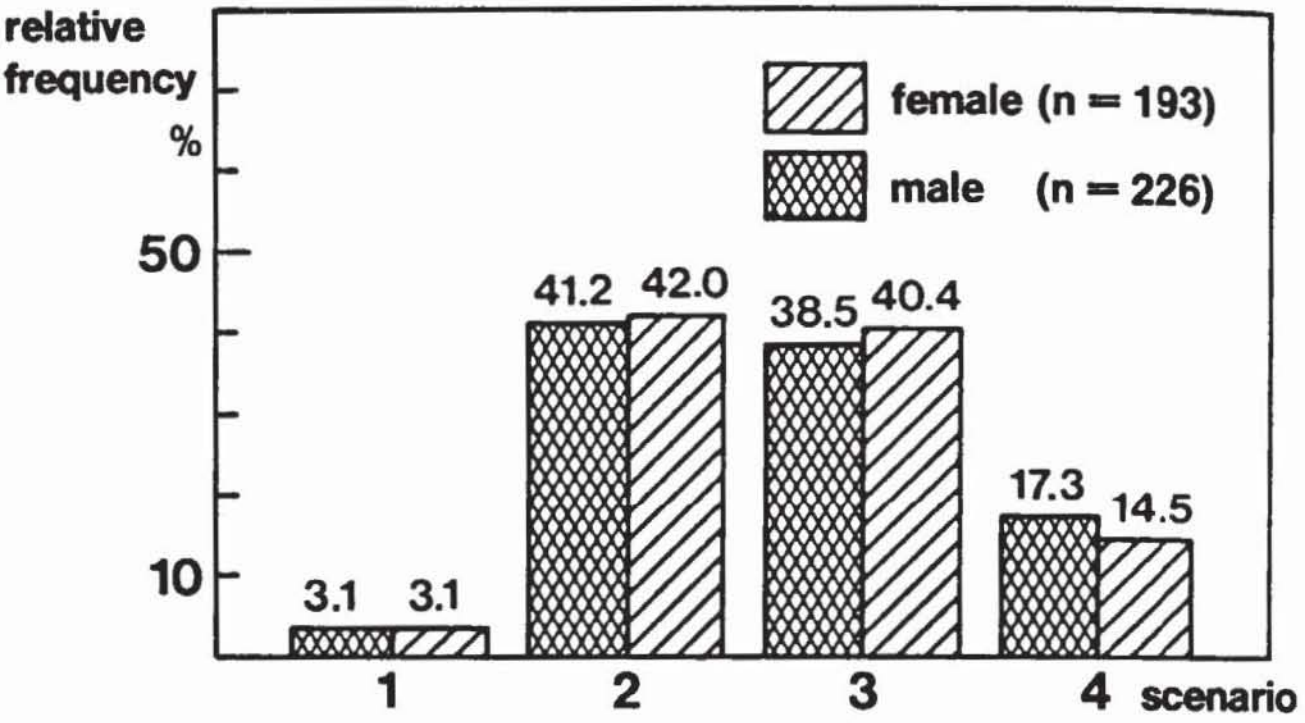
Older people and conservative voters tend to express more trust in established institutions and assign a higher degree of credibility to politicians and scientists. Indeed, we could prove that the majority of the proponents for option 2 having higher scores for option 3 or 4 belonged to the group of conservative and older people. We are still in the process of analyzing the motivational roots of the discrepancies, but right now it already seems justified to conclude that the discrepancies between intuitive and calculated preference is mainly due to loyalty vis-a-vis reference group judgments.

## CONCLUSIONS

The use of planning cells as a participatory element in the political decisionmaking context turned out to be a highly complex but rewarding effort. From the experience with more than 20 planning cells, we have gained a better understanding of the chances and the limits of this model. Also, we encountered some difficulties which were not visible when we started our program. Our experiences justify the further development of the planning cell concept, but at the same time revealed some of the serious problems and drawbacks related to the idea of picking random samples for policy evaluation. These problems have to be solved before this instrument is used in wider scope to facilitate decisionmaking under conflict.

The chances and advantages of the planning cell concept refer to the following purposes: 1) The elicitation of ordinary citizens' preferences concerning complex decisions (with input of appropriate information); 2) The understanding of underlying reasons for specific attitudes or beliefs; 3) The measurement of "popularity" or hostility towards proposed governmental policies (after relevant information has been presented); and 4) The prediction of opposition against certain objects or policies.

## The preference for one of the four energy scenarios as a function of sex




We believe that these four purposes of the planning cell have been fulfilled during our study and could even be improved. Since the participants of planning cells cannot represent the whole population, inferential statistics can only be applied with special care. By comparison with the result of national surveys, there was a good chance of validating common trends and describing more specific results from the planning cell sample. In contrast to these positive aspects, we faced quite a few limitations which should also be mentioned. These refer to: 1) The incapability of ordinary citizens to create new or generic solutions to conflict management or resolution; 2) The difficulty to elicit tradeoffs between different attributes; 3) The problems of aggregating individual wieghts or ratings and interpreting mean values because of differences between groups, different perceptions of what the weights and rankings mean, response sets, distortions because of social desirability and other latent factors; and 4) The limits of the legitimation effect in polarized disputes (results will be interpreted as manipulated as soon as they deviate from one's own opinion).

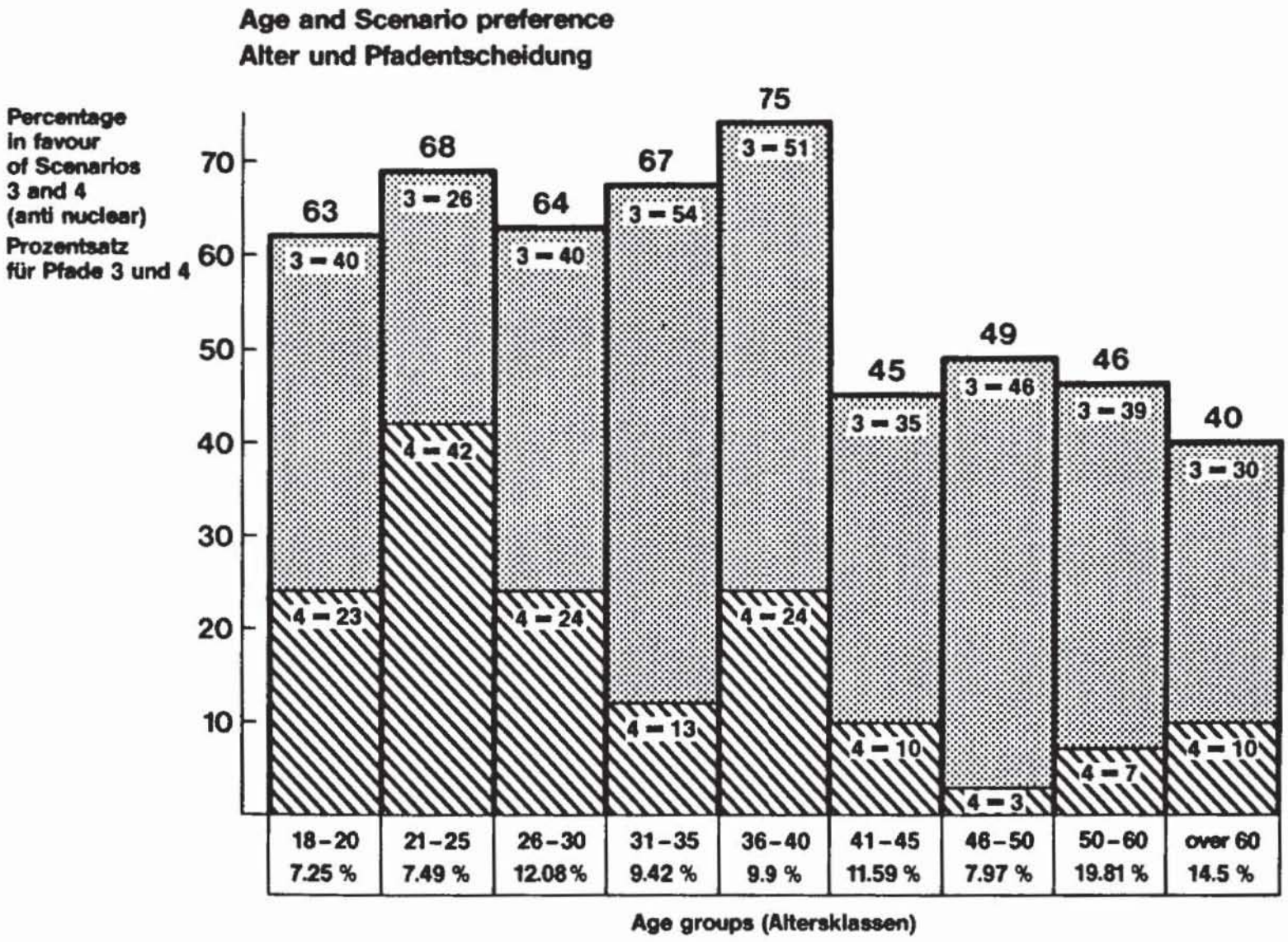



Fig. 12: The preference for one of the four energy scenarios as a function of age

**The preference for one of the four energy scenarios as a function of party preference**
(hypothetical voting behaviour in a national election)

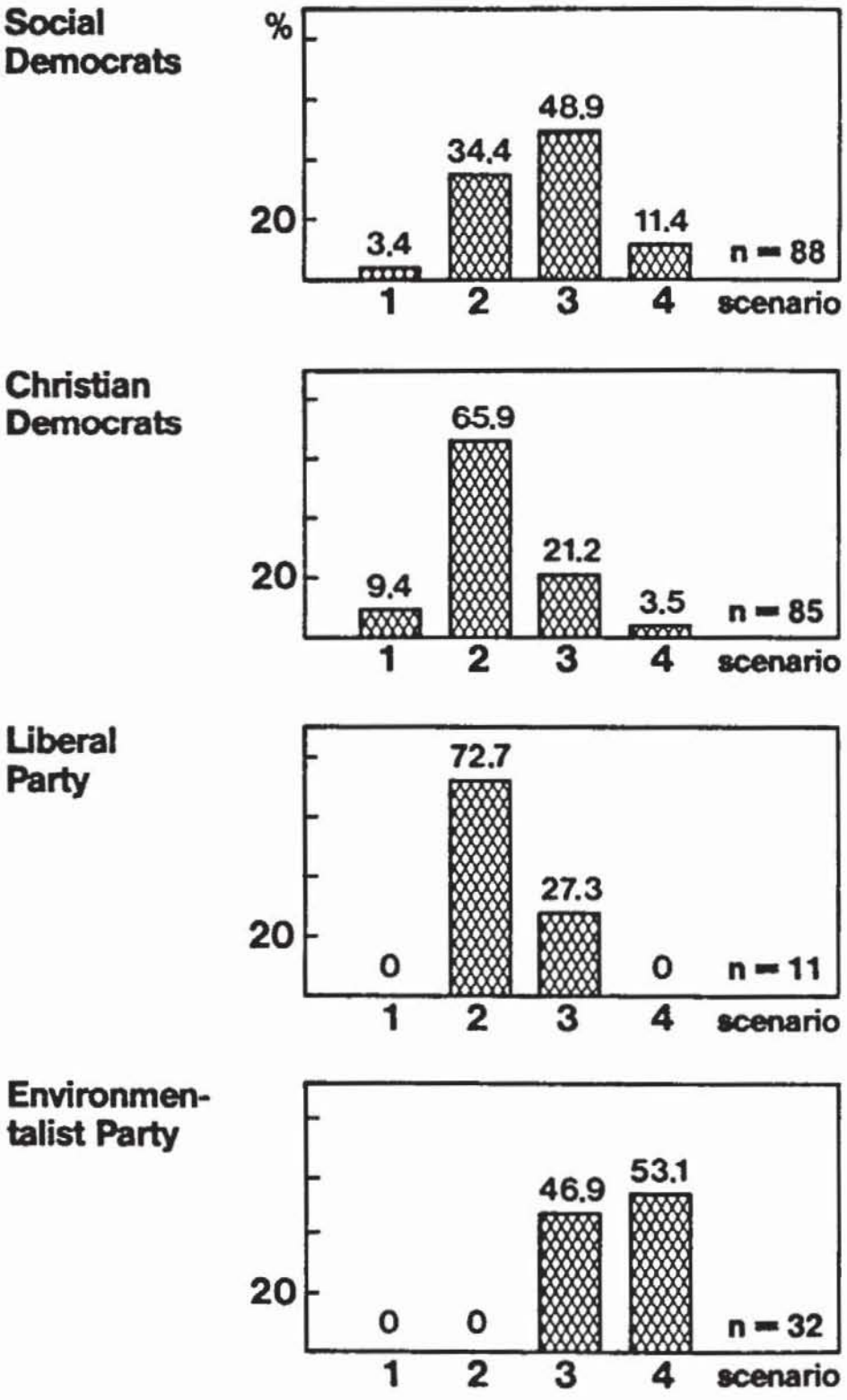



Fig. 13:

Considering these limitations, it is evident that planning cells can provide information about the acceptance of objects or policies (after all necessary information is given), but hardly any information about the acceptability of objects or policies, at least when highly complicated, national issues are at stake. Since our project is mainly directed toward testing the acceptance of energy policies--if all the impacts were known--we obviously had chosen the right instrument. Since we contented ourselves with the measurement of acceptable procedures, one question of course immediately comes up--what about participation? Was it not the goal of the whole exercise to introduce public participation into the decisionmaking process?

This question was one of the key problems within the planning cells, too. The participants expressed their discomfort with the double role they had to play. They were consultants and test persons at the same time. If they were regarded merely as a jury to make judgments with respect to given options, we should not be interested in the underlying motives or reasons. If they are regarded as test persons for improving our knowledge of people's preferences, we should not give them the impression of being our "consultants." In order to avoid this conflict, we pursued a double strategy: we promised the participants that their expressed preferences would be documented and handed over to the Federal Ministry of Research and Technology (Citizens Report) without speculating over motives or underlying reasons. But we also informed them that the policymakers had a viable and legitimate interest in receiving information about why people express special preferences and what kind of values might be involved. This interest can only be met by using survey methods and statistical data processing techniques.

Although this double strategy led to some irritation on the side of the participants, we had the feeling that we succeeded in conveying the purpose for creating such a double role of planning cell participants. The whole procedure reflects our main assumption that participation in complex matters cannot substitute for political decisionmaking. Rather, it should be regarded as a decision aid to form and shape political judgments according to the latent and overt value structure of the concerned public. If this assumption is accepted, the planning cell might be the ideal instrument to collect the relevant feedback from society and to reveal the intuitive preferences and values which should be the guideline of democratic policymaking.

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