Germany's Energy Turnaround –

A Collective Effort for the Future

presented by the

Ethics Commission on a Safe Energy Supply

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The Ethics Commission on a Safe Energy Supply

4 April to 28 Mai 2011,

on behalf of Federal Chancellor Dr. Angela Merkel

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The Ethics Commission is convinced that with the help of the Energy Turnaround measures presented here, nuclear power can be completely phased out within one decade. Society should commit itself to this goal and to carrying out the necessary measures. The requisite planning and investment decisions can only be made on the basis of a clear timetable.

Implementing the collective effort "Germany's Energy Future", with its difficult decisions and its costs, but also with the special opportunities it offers, within one decade is a major challenge for the political institutions and all the forces of society.

This target requires consistent, goal-oriented and politically effective monitoring (analysis, assessment, recommendations for action), whose approach and institutions are described in more detail in this report.

The Commission suggests that the office of an independent Parliamentary Representative for the Energy Turnaround should be established immediately in the German Bundestag and that a National Forum for the Energy Turnaround should be set up. The Ethics Commission makes this proposal on the understanding that the Federal Government will take the appropriate steps to ensure as effective and specific actions as possible in the Energy Turnaround and an efficient collaboration with the federal states. Its progress must be checked annually by the Parliamentary Representative for the Energy Turnaround in the course of the monitoring process.

The Energy Turnaround is a highly demanding task in organisational terms and requires comprehensive project management, posing a special challenge to politics. The phase-out is necessary and is recommended in order to rule out the risks posed by nuclear power in Germany in the future. The phase-out is possible because lower risk alternatives are available. The phase-out should be carried out such as not to endanger Germany's competitiveness as an industrial and business location. With the help of science and research, technological developments and the entrepreneurial initiative to develop new business models for a sustainable economy, Germany does have alternatives: generating power using the wind, sunlight, water, geothermal sources and biomass; a more efficient use of energy and increased energy productivity; as well as the climate-optimised use of fossil fuels. Changes in people's lifestyles can also help save energy, if they respect nature and preserve it as the foundation of the Creation.

"Phasing out" nuclear power initially means taking nuclear power stations offline. The Ethics Commission is however aware that a great deal of work will be necessary for a long time after this, from securing the power stations through to dismantling them.

<u>Collective effort</u>

The Ethics Commission would like to emphasise that the Energy Turnaround can only succeed if all levels of politics, business and society make a joint effort. This is what the suggested collective effort "Germany's Energy Future" stands for. It represents a great opportunity, but also involves certain challenges. The international community is watching with great interest to see whether Germany succeeds in phasing out nuclear power. If it does succeed, it will have substantial effects in other countries. If it fails, the consequences will be severe, also in Germany, and much of what has already been achieved with regard to renewables would be called into question.

The experiences of recent years show that talking about a collective effort is not something that can be taken for granted. There are perfectly justified concerns that there might be delays in implementing the Energy Turnaround. However one is equally justified in expecting that, thanks to creativity and the ability to learn, Germany could implement this phase-out much more swiftly than is currently assumed.

Germany must walk down the path of phasing out nuclear power with the courage to try out the new, with confidence in its own strengths, and with a fixed procedure in place for monitoring and guiding the process. Looking at the local level and at the many companies, initiatives and institutions of civil society, the Ethics Commission finds that the entire range of German society has long set out on this path into the future, a path which makes the use of nuclear power dispensable. It should be supported in this. The German economy draws its strength from its creativity and its ability to manufacture products of the highest quality. An increasingly large proportion of companies are aligning their areas of business towards sustainable business operations. Phasing out nuclear power will offer them many further opportunities. Science in Germany is in an excellent position from which crucial innovative and powerful solutions for the Energy Turnaround can continue to be expected.

For this reason, science and research have a special role in this collective effort. This is true of research in the natural sciences and technology, but also in the social sciences. The Commission therefore very much welcomes the fact that the National Academy of Sciences Leopoldina has presented up-dated recommendations for energy policies and comprehensive energy research. Phasing out nuclear power in Germany also calls for further research into the safety of nuclear facilities and into the handling of nuclear waste – with a view to the fact that we continue to live in a world in which many countries operate nuclear facilities and in which additional nuclear power stations are being built.

The National Forum for the Energy Turnaround proposed by the Ethics Commission is meant to stimulate and intensify the dialogue within society. Towns, local communities and companies must make their own individual decisions, which will determine whether the time required for the phase-out can be successfully reduced and whether the phase-out and the Energy Turnaround can be successfully mastered. Dialogues with citizens and citizens' forums are suitable tools for promoting decisions concerning the Energy Turnaround on all levels.

Monitoring, supporting the process

There are very sound ethical reasons for phasing out nuclear power as quickly as possible; the Commission considers the process to be necessary and possible based on the implementation of the measures. Under ideal conditions, the previously mentioned period of ten years for the phase-out could be reduced.

Every year, the monitoring process and the Parliamentary Representative for the Energy Turnaround recommended by the Ethics Commission should provide the basis for deciding which nuclear power stations can be shut down and when.

This monitoring process should draw attention promptly to any delays in the phase-out that may arise, and propose additional measures to ensure that the phase-out can be completed within a decade. Scientific and technological progress should be taken into account by the monitoring process.

Sequence of the phase-outs

For ethical reasons, nuclear power stations should only continue to operate until the power they produce can be replaced by lower-risk sources of power.

The output of nuclear power stations that is already dispensable today, amounting to 8.5 gigawatts, should be taken from the grid permanently. The temporary shutdown of the seven oldest nuclear power stations and of the Krümmel nuclear power station demonstrates that the 8.5 gigawatts of power they supplied can be replaced by lower-risk sources of power. Peak power demand in the summer and the winter must be met using other capacities.

The order in which nuclear power stations are taken from the grid should be determined by their residual risk and by their importance to the regional power grid, unless more detailed reactor safety analyses reveal different or additional risks associated with the nuclear power stations.

Planning dependability is a valuable commodity for businesses and for society. It contributes crucially to competitiveness and also plays a key part in determining the economic viability of investments. Germany has an important pioneering role throughout the world and carries great responsibility for the phasing out of nuclear power. Providing stability for investments into energy supply systems and energy efficiency, and creating the necessary infrastructure are key regulating variables.

Final storage and nuclear safety

The final storage of nuclear waste must meet the highest safety standards and it must be reversible, because future generations must retain the possibility of reducing the hazards and the volume of nuclear waste should appropriate technologies become available.

The safety of nuclear power facilities and the creation of a future energy supply are an issue of major importance to European and international politics and cooperation. The Ethics Commission recommends that the Federal Government should make a concerted European and international effort to follow up the safety aspects of nuclear energy on a global level and to expedite the continuing development and adjustments to the work of the International Atomic Energy Agency (IAEA).

The Ethics Commission considers that inappropriately supplying radioactive materials from nuclear power stations to others constitutes a very serious threat. Here too, the Commission urges the Federal Government to make further concerted efforts.

Conclusions

The diversity and complexity of the proposals for procedures, measures and institutions for bringing about an Energy Turnaround make it clear that this is indeed a collective effort.

The Ethics Commission views the step-by-step phasing out of nuclear power as an extraordinary challenge for all those involved, and at the same time as a source of new opportunities for citizens to join in decentralised decision-making.

Circumstances and Mandate

Germany has for a long time been engaged in an intense debate over its energy supply, and in particular about the use of nuclear power. In the year 2000, the Federal Government of the day and the business world reached a consensus on safety standards and laid down the remaining operating times of nuclear power stations and their flexible handling. Last year, the Federal Government established substantially longer operating times. The accident at the Japanese nuclear power facility in Fukushima placed the question whether the use of nuclear power could be justified at the centre of political and public debate once again. Responsible decisions must now be reached, based on comprehensive information, to define a new direction for the energy supply in the interest of a sustainable development in Germany. Germany needs to and wishes to organise its energy supply such that energy is made available in a way that is reliable, environmentally friendly and competitively priced – so that energy can ensure prosperity in the future too.

The Federal Government appointed the Ethics Commission on a Safe Energy Supply in order to examine the ethical principles and implications of the decision as a whole. Germany's safe future rests on three pillars of sustainability: an intact environment, social justice and a healthy and powerful economy. An energy supply that is guided by these principles can serve as the long-term basis for an internationally competitive economy, for employment, prosperity and social harmony in Germany.

The Ethics Commission has worked under huge time pressure and taken into account the expertise of many different protagonists in the field of energy policy. In particular, the public dialogue on 28 April 2011, whose aim was to ascertain positions and arguments from as wide a range of relevant fields as possible, revealed the diversity of perspectives. The Ethics Commission would like to thank all those persons involved on behalf of energy suppliers and energy consumers, from the field of renewables and grid operation, from the natural, engineering and social sciences, the experts and opinion-leaders from municipalities, employees' associations, tenant associations and NGOs and from the conservation movement. It would also like to thank those individuals and institutions which have expressed their positions in writing in recent weeks. Through its public dialogue, the Ethics Commission set an example against the defamation of determined attitudes towards nuclear power, which are the result of a poisoned atmosphere in society. Differences in the assessment of nuclear power must not lead to value judgements on people who hold different opinions. That attitude has also characterised the discussions within the Ethics Commission.

The members of the Ethics Commission differ in their opinions about important questions of risk assessment and energy supply, which were discussed with great openness and respect. Without giving up these fundamental positions, the members of the Ethics Commission have reached a consensual agreement about the practical consequences in terms of actions to be taken, as detailed in this report. The Ethics Commission hopes that the report can contribute to a culture of informed and considered discussion.

Collective Effort “Germany’s Energy Future”

For Germany to have a safe energy supply in the future, society, the business world and politics must act together, with far-reaching consequences in terms of content, finances and timing.

The Energy Turnaround must be organised as a collective effort for the future, such that energy can be supplied safely, in an environmentally friendly and socially acceptable way, and at a competitive price. Industry, the crafts and the service sector together form the basis for employment in Germany, and ensure the prosperity of present and future generations. The transition to an age of rigorous improvements in energy efficiency and the use of renewables will make demands on the entire society. It calls for – and allows – the participation, the conviction and the decisions of a great many people in parliaments and governments, in cities and local communities, at universities and schools, in companies and institutions. It offers enormous opportunities for people whose choice of training and profession will form the basis of their future employment and prosperity, for cohesion within society, but also for companies, their competitiveness and innovation. Most of all, the discussion within society about phasing out nuclear power offers the chance of dispelling that harmful atmosphere which has befallen our society as a result of the argument over nuclear power.

Shutting down nuclear power stations does not in itself mean phasing out nuclear power. Shutting down a plant is more of a technical or legal procedure, whereas phasing out is a far-reaching process. Clear goals and sustainability indicators need to be defined, meaning that it must bring together the aspects of long-term availability, economicalness, environmental friendliness and social acceptability. Testable intermediate goals (milestones) and indicators are needed – with the utmost transparency. The process must also take into account Germany’s international, and in particular European, integration.

Only through such a process can a far-reaching consensus be reached concerning the basis and future of prosperity, the idea of progress, the willingness to take risks, and safety. This consensus is the fundamental prerequisite for restructuring the energy supply. Democratic societies need this form of consensus when facing demanding changes in society. The consensus that is to be achieved must be lasting, and it must direct its attention towards an energy supply that dispenses with nuclear power as quickly as possible and that promotes Germany’s path towards a sustainable development and new models of prosperity.

As a collective effort, “Germany’s Energy Future” must solve the conflicts between goals that emerge during the process and incorporate the necessary direct and indirect contributions of all stakeholders, i.e. energy suppliers and consumers, grid operators, political institutions, environmental organisations, trade unions and others, such as the developers of new products. It is not reasonable to call only upon others to act responsibly; such responsibility must also be taken for one’s own actions and decisions.

The accident in Fukushima has shaken people’s confidence in experts’ assessments of the “safety” of nuclear power stations. This is also and particularly true of those citizens who have until now relied on such assessments. Even citizens who do not reject nuclear power categorically are no longer prepared to leave it to committees of experts to decide how to deal with the fundamental possibility of an uncontrollable, major accident.

Through its comprehensive approach, the proposed collective effort creates the necessary venue for restoring confidence and consolidating it through transparency. To this end, the Ethics Commission suggests introducing a monitoring process and offers some suggestions as to what this might look like. The Ethics Commission is aware that some sections of the general public are no longer concerned with the question “Nuclear power, yes or no?”, but with the question how the phase-out should be conducted, in other words: “phase out, sooner or later?” At the same time, however, there are concerns that reorganising the energy supply could have negative effects on economic developments, on jobs and on people with low incomes.

The information provided by experts about the probability of certain courses of events in complex processes – as the phase-out will undoubtedly be – are generally based on experiences, assumptions and expectations which are tainted by uncertainties, and these must be discussed when deciding how to provide for the future. For this reason, the Ethics Commission wishes to emphasise the connection between the ethical position, a decision to phase-out nuclear power and the monitoring process, in which the Energy Turnaround will be monitored step by step and if necessary corrected. The Commission views this task as a collective enterprise, which calls for a major effort, but also as a crucial step on the way to a sustainable economy and society.

Ethical Positions

Any decision about the use of nuclear power, its discontinuation or its replacement by alternative means of power production will be based on value-based decisions of society, which precede technical and economic aspects. Sustainability and responsibility are key concepts in the ethical assessment of a future energy supply and of nuclear power. With the guiding principle of sustainability, the goal of environmental compatibility joins that of social balance and economic efficiency, to shape society appropriately for the future.

The growing destruction of the environment has led to calls for environmental responsibility, not only since the nuclear accidents and not only in connection with them. It is a question of how human beings treat nature, or the relationship between society and nature. The Christian tradition and European culture indicate a special responsibility of humankind for nature. The ecological responsibility of human beings for nature sets out to preserve the environment and protect it, and not to destroy it for selfish purposes, but to increase its usefulness and preserve the chances for securing future living conditions. The responsibility for future generations therefore also extends in particular to the energy supply; and to sharing fairly the long-term risks and burdens, or those on which a time limit cannot even be placed; as well as to the actions resulting from these.

1.1 Risk and Risk Perception

The full extent of the Japanese reactor disaster cannot be determined as yet. We sympathise deeply with the victims of the natural disaster and with those people who fear for their lives, their health and their future as a result of the accident in the nuclear reactor. We have the greatest respect for those whose efforts have until now prevented the consequences of the accident from becoming far more extensive.

The risks of nuclear power have not changed as a result of Fukushima; the perception of those risks has, however. More people have come to realise that the risk of a major accident is not just hypothetical, but that such major accidents can indeed occur. Thus the perception of a relevant portion of society has adapted to the reality of the risks. Three things are important for this change in the perceived risk:

- Firstly, the fact that the reactor accident occurred in a technologically advanced country like Japan. In view of this, the conviction that such an event could not occur in Germany, is waning. This applies both to the accident itself and to the long helplessness of the subsequent attempts to bring it under control.

- Secondly, the impossibility even weeks after the accident of predicting an end to the catastrophe, of assessing the final extent of the overall damage or of conclusively defining the geographical region affected. The widespread view that the extent of the damage due even to major incidents can be adequately determined and limited in order to be weighed up, in a scientifically informed process, against the disadvantages of other sources of energy, is becoming considerably less persuasive.

- Thirdly, the fact that the accident was triggered by a process which the nuclear reactor was not “designed” to withstand without sustaining damage. This fact casts a light on the limitations of technological risk assessments. The events in Fukushima have made it obvious that such assessments are based on certain assumptions, for example about earthquake resistance or the maximum height of a tsunami, and that reality can prove these assumptions wrong.

1.2 Summary Assessment of Risks

Thinking about a "Safe Energy Supply" touches on fundamental questions in connection with the development of society. The principle that human beings are not allowed to do everything that technology enables them to is one that must also be considered when assessing nuclear power. In particular, if the consequences of a technology are of such a nature as to constitute "pollution for eternity", a critical assessment is especially important. The responsibility for decisions in favour of a short-term benefit, whose costs will be felt by many future generations, is one that society must face up to in order to decide what should be deemed acceptable and what inacceptable.

A holistic approach is needed in order to develop an energy supply for which responsibility can be accepted preferably from all angles. Ecological and health-related consequences must be taken into account, as must the cultural, social, economic, individual, and institutional implications. Narrowing down and reducing the risks to purely technical aspects would not do justice to the requirements of a holistic approach and a comprehensive assessment. This also includes the principle that costs should not be passed on to society in general, though this is far too often the case, as can be seen in the case of global warming. Reverence for the task in hand, and humility in one's own thoughts and actions are essential. The central problem is not what can be imagined, but what cannot be imagined. In connection with the risks associated with nuclear power and the effects of climate change on human beings and nature, the expression "world risk society" vividly brings home the fact that the effect of risks extend beyond national boundaries. It marks a turning point which transforms the world into a community with a shared destiny, one that makes a global domestic policy necessary. Up until now, but particularly when it was first being developed, the peaceful use of nuclear power held for many people a promise of progress, prosperity and virtually limitless energy involving controllable risks. From today's vantage, this was in fact a hugely utopian view of the future, which could also be justified using ethical arguments based on the information available at the time. This is no longer true today, at least for Germany.

1.3 The Basic Conflict: Categorical Rejection vs. Weighing up Relative Merits

At the heart of the conflict over nuclear power lie irreconcilable views on how to deal with the fundamental possibility of a major accident – taking into account current and future harm caused by radioactive waste. Here a position of categorical rejection faces one of weighing up relative merits.

In both positions, the assessment of the risk is not confined to the health and environmental risks. The risks also include the broad range of cultural, social and psychological consequences. The ethical judgement must also look at the consequences of what can justifiably be described with respect to nuclear power in Germany as the poisoned atmosphere in society at large. A comprehensive concept of risk and safety must also include the dimensions of security of supply and economic security, as well as climate protection. Furthermore, ecological, economic, social and technical risks are very closely intermeshed. To view only one aspect means losing sight of the whole.

Discussing ethical positions presupposes the existence of alternatives between which one can choose. The assertion that there is "no alternative" to something is one that the general public is no longer prepared to accept. This also applies to the use of nuclear power. The claim of there being "no alternative" undermines the confidence in an open, parliamentary democracy. Alternatives actually create room to choose. Also, the more decentralised and differentiated the overall energy supply is designed to be, the more alternatives will be available. This increases the chances for citizens to participate in decisions and to be involved in cooperatives and other models, for example, which allow them to organise their responsibility for themselves. This strengthens civil society.

<u>The categorical verdict</u>

The accident in Fukushima brings home the fact that words such as safety, risk and hazard need to be reviewed and their meaning must be redefined. The technical definition of risk, weighting the magnitude of an incident using the probability of its occurrence, is inadequate when it comes to assessing nuclear power and systematically leads to an inacceptable relativisation of the risks. On the one hand, the probabilities can only be meaningfully calculated in connection with assumptions about the course of an accident and within certain limits of interpretation. In the case of nuclear power, with its particularly high potential for disaster, it is not ethically acceptable to dismiss as a “residual risk” certain developments during an accident and their consequences which lie outside these (defined) limits and which have been demonstrated by Fukushima. In a highly organised, technologically advanced country such as Japan, the nuclear accident in Fukushima demonstrates the limitations of human precautions against disasters and of the immediate measures taken during an emergency. There are all manner of consequences for nature and for food production, for the people on the ground and for the global economy, which are difficult or impossible to demarcate.

The categorical rejection of nuclear power considers the potential for disaster, the cost to subsequent generations and the possibility of genetic damage through radioactivity to be so far-reaching that a relativising risk assessment is not deemed acceptable. From this point of view, the damage done by a nuclear accident goes beyond the scope of what can potentially be weighed up in a choice between conflicting rights. It is the consequence of actions leading to an unplannable and incalculable accident. The reasons for this are systematic: whereas normal strategies for dealing with limited risks, such as traffic safety or building site safety, are based on the assumption that adverse events will indeed occur and that one can gradually learn from them to take suitable precautions, such a learning process is ruled out in the case of nuclear facilities. If the ultimate disaster is ignored, safety concepts cease to be rational in a testable way. In this case, the risk cannot be deduced from experience with real accidents, because the consequences of a worst-case nuclear incident are unknown or cannot be fully grasped. No spatial, temporal or social limits can be placed on these consequences. Accordingly, the conclusion drawn is that, if adverse events are to be ruled out, nuclear technology must no longer be used.

In the context of a categorical assessment, it is perfectly possible to continue to weigh up carefully that which can in principle be weighed up. However once you go beyond the limits of what can be weighed up, the question of ethical responsibility must be decided categorically. Aside from the relative risks which can be weighed up (i.e. the risks and opportunities), there is also an absolute risk which cannot be weighed up. If the improbable did in fact occur, something would happen that no one wants and that no one is entitled to expect any other person to endure. Ruling out that situation is the essence of preventive precautions.

Weighing up of the relative risks

The starting point for weighing up the risks is the realisation that there is no such thing as zero risk in a large technical facility, and that the risks associated with the use of coal, biomass, water, wind and solar power as well as nuclear power though different are ultimately comparable. Since no energy option is free of risk, judgements about the acceptability are based on comparing and weighing up the consequences to be expected in the light of all available options, based on scientific facts and jointly agreed, reasoned ethical assessment criteria. In doing so, all risks and opportunities must be estimated as well as is scientifically possible, taking into account the direct and indirect consequences throughout the entire lifecycle. Apart from the extent of the consequences, the probability of their occurrence must also be taken into account. Following this assessment of the consequences, the opportunities and risks are then weighed up against each other. Ethical considerations help to ensure that such weighing up is as rational and fair as possible. Ultimately, however, it is the political consensus-building process which determines the weighting of the criteria.

Weighing up always depends on the starting conditions and the context. In this sense, it is perfectly reasonable to reach a positive overall verdict about nuclear power in one particular country or at one particular point in time, but to reach a negative verdict in a different country or at a different time. Because of this, the risks and opportunities of nuclear power must be weighed up against the risks and opportunities of alternative means of power production as they exist at a particular point in time.

When the risks and opportunities are weighed up in the context of the present-day situation in Germany, it can be plausibly reasoned that nuclear power stations can be replaced by lower-risk methods of power production and that this should in fact be done for the sake of consistency. Because virtually all scientific studies come to the conclusion that renewables und the improvement of energy efficiency are associated with fewer health and environmental hazards than is nuclear power. Furthermore, the economic risks associated with such alternative energy sources seem, from today's point of view, to be manageable and confinable. This also applies, to a lesser degree, to the use of fossil fuels, provided the agreed targets for combating global warming are met.

1.4 Joint Verdict of the Ethics Commission

In its consultations, the Ethics Commission attached particular importance to the fundamental understanding of risk. It does not claim to have fundamentally resolved the conflict between the two positions. Sound arguments exist for both approaches – the categorical and the relativising – which should be taken seriously. Both points of view are outspokenly held within the Ethics Commission itself. Nevertheless, some convergence was found in the discussion. The categorical position teaches us that defensible decisions in the field of nuclear power are not simply a question of assigning numbers to and calculating the extent of damage, and of the probabilities of damage associated with alternative energy policies. In particular, there is no law of rational behaviour stating that an observer must be guided by the so-called expected value (the extent of the damage multiplied by the probability of damage) of the available alternatives. It is not unreasonable to assess major adverse events, which are relativised by the technical equation when multiplied by the low probabilities of their occurring, as being more serious than a large number of smaller incidents with higher probabilities.

From the position of weighing up the risks, it can be deduced that society is obliged to look also at the consequences of doing without nuclear power, whereby international obligations and different cultures of risk-assessment in other countries need to be taken into consideration. Beyond this, it is rational to take into account probabilities of adverse events when assessing risks, without having to stick to the formula that uses the product[1] of the probability and the extent of the damage.

In practical terms, both fundamental positions come to the same conclusion concerning nuclear power, namely to end the use of nuclear power stations as quickly as the power they supply can be replaced by lower-risk sources of energy, based on ecological, economic and social acceptability.

This argument opens up a bridge of understanding between those who are critical of nuclear power and the proponents of nuclear power. One does not have to be opposed to nuclear power on principal in order to agree with the Ethics Commission's verdict. It is sufficient to share the unanimous opinion of the Ethics Commission that Germany is able to replace nuclear power by lower-risk technologies in an ecologically, economically and socially acceptable way.

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1 In this context, the "product" is defined as the result of multiplying two quantities.

Guiding Ideas for the Collective Effort "Germany's Energy Future"

1.5 Collective Effort

The Ethics Commission has formulated the results of its deliberations in the form of guiding principles. It is handing over its results to those people whose responsibility it is to make the decisions concerning the Energy Turnaround. The focus is on the Federal, state and municipal parliaments and governments. Companies in the fields of industry, commerce, financial services and crafts, foundations and charitable organisations will also play a key role in many areas. However, the success of the Energy Turnaround ultimately depends just as much on the decisions made by individual citizens.

The process of phasing out must begin with a fundamental decision. It will then call for further decisions to be made continuously over the forthcoming years, depending on the stage of the phase-out that has been reached by then. Phasing out nuclear power is about the prospects of development for the economy and for society, as well as fundamental issues of securing our prosperity in a world in which the question of resources is becoming increasingly important. The process concerns energy production and supply, the role of the infrastructure, protection of the global climate, the macroeconomic effects of prices, costs and revenues, as well as the state of research and the involvement of citizens. This process must be accompanied by a further consolidation of the principle of sustainability as the foundation for the future development of society and people's lifestyles.

Conflicts among these goals are bound to arise. They must be voiced openly and discussed transparently in the proposed monitoring process.

The major collective effort has the potential to be an important impulse for the development of Germany as a business location. The Ethics Commission is convinced that a safe energy supply can indeed be achieved without compromising climate targets, while increasing jobs in the commercial and trade sectors, but also without a shortage of electrical power and without having to import electricity generated by means of nuclear power. In the course of the Energy Turnaround, numerous new companies will be set up; existing ones will expand their capacities and create new jobs. They must be committed to the successful principles of social partnership. Respect for the rights of employees and their representatives is an ethical prerequisite for a sustainable Energy Turnaround.

The power grid and its expansion will be an important touchstone for the collective effort. It is crucial that the consensus that is reached should be based on permanence, so as to create long-term, reliable framework conditions for citizens and the business world to plan their investments. This will turn out to be a major competitive advantage in global markets. The phase-out will be all the more successful if it becomes a fresh start and a move forward, and if the collective effort "Germany's Energy Future" is supported across all political party boundaries.

The Federal Government's energy and climate programme of October 2010 was oriented towards the year 2050. The Federal Government's climate targets remain unaffected by the phasing out of nuclear power. However if these ambitious climate targets are to be met along the way to the middle of the century, some important foundations must already be laid during the decade of the phase-out.

1.6 Taking Goal Conflicts Seriously

The path to a safe energy supply will be marked by conflicts between legitimate goals and interests. Profitable electricity prices, climate protection, the socially just distribution of costs and opportunities, and a switch to renewables do not automatically add up to an optimal solution.

The conflicts that could potentially arise between different goals dictate that, in order to make up for the missing nuclear power, one must not

- simply buy power from nuclear power stations in neighbouring countries, as this would contradict the principles of a responsible phase-out;
- simply replace it by carbon-emitting fossil fuels, since their use is restricted by climate policy;
- simply replace it by drastically speeding up the increased use of renewables, because there are limits to the strain that can be imposed on natural habitats and because the technical feasibility can easily be overestimated;
- simply save electricity by rationing it, since this would contradict what people and businesses in a high-tech country expect from life;
- simply compensate by imposing higher energy prices, because companies have to compete globally and social disparities exist within Germany;
- simply make it dispensable by dictating state-imposed quotas, because this would not agree with the rules of democracy and of a social market economy.

These goal conflicts can only be weighed up appropriately if that process is the responsibility of a national collective effort with the perspective of a sustainable development. The advantages should not be overestimated, and the drawbacks must not be ignored. That is also a lesson that can be drawn from the use of nuclear power: the fact that major technologies, such as nuclear power plants and dams, have to be underwritten by society rather than by private enterprises, does not have to but certainly can lead to their benefits being overestimated. The extent of their insurability and liability can therefore result in inappropriate pricing signals. An overestimation of the advantages while underestimating the risks to society can be observed in situations where those who are liable for risks are different from those who actually bear the risks. The economist and Nobel Prize winner Joseph Stiglitz recently expressed this as follows, when comparing risk management in the financial and in the nuclear industry: "When others bear the costs of mistakes, the incentives favour self-delusion. A system that socialises losses and privatises gains is doomed to mismanage risk"[2].

1.7 Consumer Demand and Civic Involvement

As a collective effort, a new energy and climate policy must take into account private demand to a greater extent than has hitherto been the case. The more energy policy backs decentralised participation and the individual decisions of citizens, the more a consensus will be achieved concerning the Energy Turnaround.

Consumers do not want energy "in itself"; they want energy services, i.e. they want to be mobile, to travel, to live in a home and lead a good life. An attractive urban infrastructure along with financial and regulatory incentives for energy-efficient behaviour, for example replacing inefficient household

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[2] Source: The Guardian, 6.4.2011

appliances or heating systems, are important stimuli for a transition towards a "energy-lighter", i.e. energy-saving, lifestyle. Wise political concepts will make use of the adjustments associated with demographic change. Demographic change – an ageing population desiring a healthy and active life in old age – is leading to demands for new habitation layouts, but also means remodelling buildings to make nursing easier and the "proximity" of social services, and many towns have already taken this as a signal for urban restructuring. If existing buildings are being converted into suitable housing for this generation anyway, such refurbishment can also be combined with energy-saving renovation.

Consumers have several different roles: they are market participants (buyers), "citizen consumers" and "coproducers" within the energy system. Consumers can contribute to the Energy Turnaround as market participants by demanding more energy-efficient products and services and using them sparingly; as "coproducers" they can contribute by renovating their houses, and by producing energy decentrally themselves and providing it flexibly (smart homes, smart grids, "in-home power plants"); and as political citizens they can contribute by taking part in participatory activities, for example in municipalities, to expand the power grid, and by trying to deal with goal conflicts appropriately and in the interest of public welfare.

Opinion polls show that many consumers are willing to pay somewhat more for a nuclear-free and safe energy supply; they also consider it sensible to invest in renovating buildings, in efficient heating systems and a decentralised energy supply. Often, not enough suitable or clear information is available about the advantages of such measures and their positive effects for future generations. However, the advantages, benefits and costs are also often shared so unfavourably between the investor and the beneficiary – for example due to existing rent laws – that economically profitable energy innovation is impeded. Private households can potentially contribute a great deal to a flexible and intelligent energy supply – just as large public- and private-sector households can – and to making up for peaks in demand (forming large virtual power plants by coordinating individual combined heat and power plants). However, the financial incentives must be attractive and/or the regulatory conditions must send suitable signals.

Civic participation in state planning is essential in order to phase out nuclear power swiftly and to create the necessary infrastructure for a regenerative power supply. This requires infrastructural measures such as expanding power grids and building storage power plants, as well as the construction of efficient fossil-fuelled power plants. These infrastructural developments cannot be imposed from above, but must instead be accompanied by constructive and innovative forms of public participation. It is not a matter of a "clever procurement" of public acceptance, but of involving the general public in an Energy Turnaround that is supported by a majority, and about providing fair compensation for costs and benefits.

The Ethics Commission believes that in principle the effective and result-oriented involvement of citizens is always desirable. The right of public participation is an indispensible feature of existing planning legislation, and permits successful and fair planning. However the methods of participation currently provided for by law are often considered to be too long-winded for putting into place the power lines and grids that may be necessary.

New operator models, such as cooperatives or the option of acquiring ownership rights in revenues, should be introduced, as should direct forms of participation, for example in the form of civic forums, round tables and workshops for the future. However the participation of municipalities can also be improved by changing the way in which trade taxes are allocated when the grid is expanded (see Chapter 7).

Beyond this, the discourse about the Energy Turnaround should continue within society as a whole, in order to maintain the motivation of the citizens even after the memories of the accident in

Fukushima have faded. To this end we would already like to draw attention to a later recommendation: setting up a National Forum for the Energy Turnaround.

The big issues of energy-efficient consumption, investment in renewables and the acceptance of energy infrastructure cannot be expected to be an automatic success. Instead the political authorities must come up with active promotional, informational and participational policies for consumers, which deal with potential areas of conflict – such as energy-saving renovation, increased use of combined heat and power plants, innovation in the field of economical energy use, and the expansion of the power grid, as well as the construction of new power plants – by participatory means appropriate to the specific site.

1.8 Testing Criteria

When weighing up the goal conflicts, careful consideration must be given to the following criteria:

- climate protection
- security of supply
- economic and financial viability, also taking into account social aspects
- competitiveness,
- research and innovation, and
- avoiding one-sided import dependencies for Germany.

The corresponding indictors form the basis of the monitoring process for the restructuring of the energy supply.

1.8.1 Climate Protection

Climate change is a major challenge for all areas of society, politics, business and science. It will continue, and it will demand decisions that are ethically and economically reasoned and that will have far-reaching consequences, in order to achieve an extensive reduction in the emission of greenhouse gases by the middle of the century.

The question whether the climate problem is bigger or smaller than the problems caused by nuclear accidents is one that gets different answers from different people; but basically there is no sensible basis on which the two can be compared. What remains is the ethical responsibility to combat climate change just as earnestly as ensuring the safety of the energy supply. The climate targets for the period during which nuclear power will be phased out have already been established. There is no clear evidence for the conjecture that these goals would be compromised by phasing out nuclear power.

Germany has undertaken to meet ambitious climate targets in a European and worldwide context. According to the latest estimates, Germany’s carbon emissions increased by 4.8 percent in the year 2010 compared with the previous year, as a result of the economic upswing after the financial and economic crisis.[3] As a result of this, the reduction of emissions needs to be speeded up considerably

[3] Cf. Hans Joachim Ziesing in Issue 4 of the journal Energiewirtschaftliche Tagesfragen (2011). The reasons given are: increase in the gross domestic product, and the cold winter.

– even if nuclear power were not phased out. In order to meet the European climate targets (EU 2020) for the year 2020, distinctly more greenhouse gas emissions need to be avoided every year (20m tonnes of carbon-dioxide equivalents instead of the current 15m (from 2000 to 2010 only 8.4m tonnes per year). Energy productivity would have to be more than doubled by 2020, from currently approx. 1.6 percent per year to just under four percent. If all other conditions are kept constant, CO_2 emissions might actually increase as a result of phasing out nuclear power; however the EU climate protection regime is in place and will counteract such an increase. In the field of heat supply, building renovations and in particular the mobility markets, the climate political efforts need to be intensified.[4] The Energy Turnaround is therefore not limited only to the electricity sector, but systemically also affects the fields of heating and cooling, as well as mobility.

The second commitment period of the EU Emission Trading Scheme is due to begin in 2013. Based on the average emissions between 2008 and 2012 and with an eye on the climate targets to be met by the year 2020, the number of carbon credits has been fixed at 2 039 152 882 tonnes of carbon-dioxide equivalents. This means an annual reduction by 1.74 percent. The carbon credits will be sold by auction. Special regulations will apply to energy-intensive industries, which will only have to obtain a small proportion by auction while most of their credits will be allocated to them. The nuclear phase out is expected to amplify the existing increase in carbon prices.

The climate targets for the year 2020 can be met through the collective effort for a safe energy supply provided a new cycle of investment is triggered, future technologies are linked realistically to people's everyday experience and they are thus given new and greater opportunities for making decisions.

1.8.2 Security of Supply

Today, the power potentially available from all conventional, fossil-fuelled power stations in Germany (gross installed capacity) is far greater than the demand for energy.[5]

In order to ensure the security of the energy supply, the guaranteed supply must clearly exceed demand; and this must be true for a maximum "load" (demand), not for average levels. In addition, safety reserves must be maintained as a back-up, as well as a margin for system services.

According to the Federal Network Agency[6], the security of the supply will remain adequate if the 7+1 nuclear power stations are decommissioned. However, this would leave no safety buffer for the long-term decommissioning of additional power plants, unless new power plants became available. The effects of the moratorium on the transmission grids and the security of the power supply need to be monitored closely and in a timely fashion. The Federal Network Agency recently confirmed that the supply risk of the grids will remain manageable over the summer season and recommended that decisions as to whether additional measures are needed to supply power should be left open.[7]

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[4] Cf. the National Platform for Electromobility,
http://www.bmu.de/verkehr/elektromobilitaet/nationale_plattform_elektromobilitaet/doc/45970.php

[5] The total supply is the total power capacity of all energy-producing facilities. It must be distinguished from the amount of electricity that is guaranteed at all times (i.e. that can be reliably drawn from the grid). The latter is lower.

[6] Report by the Federal Network Agency to the Federal Ministry of Economics and Technology on the Effects of the Moratorium for Nuclear Power Stations on the Transmission Grids and the Security of the Supply, of 11 April 2011,
http://www.bmwi.de/BMWi/Navigation/energie,did=386714.html

[7] Federal Network Agency: Update of the Report by the Federal Network Agency on the Effects of the Moratorium for Nuclear Power Stations on the Transmission Grids and the Security of the Supply, 27 May 2011

At present, 90 gigawatts of secure power are available in Germany[8]. Nuclear power stations account for a proportion of approx. 20 gigawatts. This secure supply of power faces a peak demand of some 80 gigawatts. The nuclear power plants that were taken offline during the moratorium and the nuclear power plants that had already be decommissioned before this, supplied 8.5 gigawatts, meaning that a secure supply of some 81.5 gigawatts still remains.

By 2013, fossil-fuelled power stations with an output of about eleven gigawatts will go online, while power stations producing approx. three gigawatts will be decommissioned for reasons of age[9]. Balancing this additional capacity, the nuclear power stations that are currently offline have a power output of 8.5 gigawatts; if all nuclear power stations are decommissioned, their total nuclear power output adds up to about 20 gigawatts.

Considerable additional resources need to be created in the field of renewables over the coming years. This creation of additional resources is important in order to meet the target of climate-friendly power production. Wind, solar thermal, photovoltaic (PV), geothermal and other innovative approaches, together with accompanying measures for power storage, can thereby contribute to securing the base load power needs. Biomass power plants are already able to supply secure power capacities.

The power capacity that will be lost by phasing out nuclear power must be made up for by additional power capacities of at least ten gigawatts, with a view to achieving an even greater safety margin of about 20 gigawatts. By the year 2020, though potentially even a few years earlier, the proposed measures for combined heat and power generation could generate twelve gigawatts, biomass electricity generation could produce up to 2.5 gigawatts (two gigawatts of this from additional resources that would be created anyway), and a selective capacity market for newly built conventional power plants could produce up to seven gigawatts. 2.5 gigawatts of peak load and four gigawatts in the low load sector can be achieved through additional energy efficiency measures. The investment into modern, highly efficient plants will produce “climate dividends”; using the instrument of the EU Emission Trading Scheme, capping the maximum amount of carbon dioxide that can be emitted will serve to drive innovation.

The Federal Association of the Energy and Water Industry goes even further in its figures for the creation of additional power capacities: by the year 2019, it predicts, some 50 power plants (powered by wind, gas, coal, lignite, biomass, refuse, running water; also pumped storage, compressed air) will be built, with a power capacity of approx. 30 gigawatts[10].

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[8] This secure power supply takes into account a deduction of ten gigawatts of installed conventional power capacity due to repairs, disruptions, and maintenance work and includes 50 percent of the running-water power stations, 100 percent of biomass power stations, seven percent of wind power facilities, and 100 percent of the installed power rating of pumped storage plants. Solar power does not contribute to the secure supply, however, due to the strong fluctuation of its output.

[9] These and other details of power station capacities are drawn from the data of the Federal Network Agency, the Federal Association of the German Energy and Water Industry, the Association of Municipal Companies, and our own research data collected by Felix Matthes and Hans-Joachim Ziesing (2011): Accelerated Renunciation of Nuclear Power in Germany: Elements of a Supporting Starter Programme. Brief Analysis for the Ethics Commission “Safe Energy Supply”, Berlin. Expected with great certainty to go online by 2013: Boxberg R, Neurath F and G, Duisburg-Walsum G, Karlsruhe RDK 8, Lünen 4, Mannheim GKM-9, Moorburg 1 and 2, Westfalen D and E, Wilhelmshaven, Eisenhüttenstadt, Höchst, Bonn HKW Nord, Hannover- Linden, Irsching 4, Karlsruhe RDK 6, Saarbrücken GuD Süd. For reasons connected with the energy industry, old fossil-fuelled power stations will be closed down over the coming years. About three gigawatts are expected to go offline by 2012 (Frimmersdorf E to O, Niederaußem A to D, Staudinger 3, GKM 3 and 4, Pleinting, Mittelsbüren 3). By 2020, eight gigawatts of capacity from fossil-fuelled power stations are expected to go offline.

[10] See www.bdew.de

1.8.3 Economic and Financial Viability

Replacing the electricity currently generated by means of nuclear power will call for a high expenditure of financial resources and for large investments. The Energy Turnaround will add to the increase in the price of energy and carbon credits that is already observable. Experts agree about this[11], though not about the size of those price increases. For this reason, the monitoring process should pay special attention to the development of energy prices and its effect on the cost sector, so as to initiate corrective action if necessary.

Phasing out nuclear power can drive growth, because investments into the energy supply and its infrastructure will promote macroeconomic growth. The costs are balanced by proceeds. Similarly, public funds – public-sector procurement and financing of market incentives – may have a strong productive effect on the markets, creating jobs and promoting innovation[12]. As a matter of principle, budgetary discipline and debt limits must be taken into account when allocating public funds. The fiscal income situation, in particular from auctioning off carbon credits, must also be considered[13]. Private-sector investments play an important role too. New financial instruments could be considered here. In particular, they could include new investment fund solutions and the offer of financial products for investing in a sustainable economy[14].

1.8.4 Social Aspects of the Distribution of Cost

The monitoring process will also have to examine how multiplicative effects of the market incentives, investment effects and other economic effects can be exploited.

Attention must also be paid to assessing the social distribution of the cost. The German Institute for Economic Research (DIW) comes to the conclusion that the moratorium has only led to a slight increase in the price of electricity for private households, by at most 1.4 percent. The DIW largely attributes this increase to the increase in the prices on the electricity exchange, by about 0.4 cents per kilowatt-hour (six percent). The DIW believes that if further nuclear power stations are to be shut

[11] For example: **Enervis** energy advisors GmbH (2011): Nuclear Phase-out by the Year 2020: Effects on Investments and Competitiveness in Power Generation, Short Expertise for VKU, Berlin, 9.5.2011; **r2b** (2011): Energy and environmental analysis of phasing out nuclear power in Germany by the year 2017, http://www.r2benergy.com/pdf/Kurzfassung_Ausstieg2017.pdf, **Samadi,** Sascha; Manfred **Fischedick,** Stefan **Lechtenböhmer,** Stefan **Thomas** (2011): Short study on possible effects of an accelerated phasing out of nuclear power on the price of electricity, on behalf of the Ministry of Climate Protection, Environment, Agriculture, Nature Conservation and Consumer Protection of the state of NRW, Wuppertal Institute, Wuppertal, 18 May 2011,
http://www.wupperinst.org/uploads/tx_wiprojekt/Strompreiseffekte_Endbericht.pdf; **Kemfert**, Claudia (2011): How expensive will the Energy Turnaround be?; **DIW** (2011), Weekly Report No. 20 / 2011,
http://www.diw.de/documents/publikationen/73/diw_01.c.372712.de/11-20-1.pdf
http://www.claudiakemfert.de/no_cache/todaysclimate/
detailansicht/period/1305629712///article/10/wie_teuer_wird_die_energiewende.html; **Edenhofer**, Ottmar (2011): The price of electricity will not increase substantially, in: Handelsblatt v. 16.03.2011, cf. also http://www.pik-potsdam.de/aktuelles/pik-inden-medien/die-strompreise-steigen-nicht-wesentlich/view

[12] The balance of payments by the Kreditanstalt für Wiederaufbau to encourage building renovation shows that every euro of funding triggers investments of six to eight euros in the trade and industry sectors.

[13] The government will achieve revenues by auctioning off carbon credits. As of 2013, European carbon credits will be auctioned off. On the assumption that the current price of 15 euros per tonne of CO_2 increases linearly to the level estimated by the European Commission for the year 2020, revenues worth 150 to 190 billion euros can be expected until 2020. Germany could count on revenues worth 37 to 46 billion euros. The revenues would increase to a total of 200 to 310 billion euros should the European Union increase its target for the year 2020 to a 30 percent reduction in emissions, rather than the currently agreed reduction of 20 percent. The upper price for CO_2 in the EU in 2020 is estimated to be 25 euros per tonne of CO_2. If the EU agrees on a climate target of 30 percent by the year 2020, the price of CO_2 will increase. In this case, it is estimated that the price of CO_2 will reach 55 euros per tonne of CO_2 in 2020, or 30 euros per tonne of CO_2 (taking into account the purchase of CDM compensation payments). Cf. **Cooper, Simone; Grubb, Michael** (2011): Revenue Dimensions of the EU ETS Phase III, Draft, 10.04.2011

[14] Cf. discussion of energy-efficient urban restructuring in this report.

down, additional power capacities will have to be provided and existing ones replaced[15]. In the foreseeable future, the price for consumers is likely to increase only slightly overall, since the size of the effects increasing and decreasing the price are roughly equal. The price is increased by the increase in the emissions trading price due to additional emissions. The necessary construction of additional power stations and the expansion of the power grid could potentially increase the price too, though the expansion of the power grid is expected to be the smaller of these components and the additional power capacity would tend to have the effect of lowering the price.

The measures proposed by the Ethics Commission agree with this observation. It points out that the question about the cost of phasing out nuclear power must also include a comparison with the costs of dealing with a nuclear accident, such as those currently being incurred in Japan: such costs would exceed all the costs that may be expected for the Energy Turnaround in Germany.

1.8.5 Competitiveness

To this day, Germany has virtually complete value added chains in which electricity-intensive basic materials are produced, which are linked to the manufacturing and processing industries, the trade and services sectors. This network is a key reason for the success of the German economy. It secures and creates jobs. Such value added chains contribute crucially to social security and to solving the major challenges of the present and future.

In terms of competitiveness, it is not just the price of electricity that is important but also the security of a stable power supply. This is particularly true of industries that provide life-saving medical services, as well as information technology and computer-based control systems.

In order for this to remain true during the Energy Turnaround, competitive framework conditions are needed along the entire value added chain.

The Energy Turnaround will take place in a world in which the price of energy, electricity, gas and CO_2 will tend to be increasing. It is not possible to predict what proportion of the price developments will be due to the nuclear phase-out and what part will be attributable to global developments, location or other reasons. For this reason, the monitoring process is particularly important here.

1.8.6 Research, Education and Innovation

The contribution made by science is very important for the collective effort. Germany's economy and society draw their innovative powers and their creativity from participation, cooperation and the courage to adopt new paths, but most of all from science and research.

Science and research in Germany are in an excellent condition and can be expected to contribute considerable innovative and powerful solutions for the Energy Turnaround. Nevertheless the situation can be further improved. This should be done when deciding on the details of the collective effort. The monitoring process ought to specifically enquire into and take into account research findings. Space should be made for progress studies, and the dialogue between science and society should be intensified. This can make it easier to set priorities in research policies.

Society's ability to develop and apply new solutions must be strengthened through research and development, while at the same time providing impulses for education as well as vocational training.

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15 Cf. DIW Weekly Report 20/2011, http://www.diw.de/documents/publikationen/73/diw_01.c.372712.de/11-20-1.pdf

1.8.7 Dependence on Imports

Importing and exporting electricity are part of the internal European market, which will also be integrated as an electricity market for all EU member states as of 2015. The exchange of goods and electricity has comparative advantages and disadvantages. If sufficient import capacities are available, Germany would be ill advised to aim for complete self-sufficiency in terms of electricity. As a consumer of energy, Germany is very much dependent on imports when it comes to oil, gas and uranium; the same is also true of many other commodities. As a matter of principle, one should try not to let such imports produce one-sided dependencies and the energy mix should be kept as varied as possible.

As the infrastructure of the European grid improves (coupling points), the exchange of electricity will increase. Imports and exports are necessary in order to manage fluctuating loads. Typically, they differ between the north and the south of Germany. Importing electricity only becomes critical if it counteracts the national aims of the restructuring process.

Institutions for the Energy Turnaround

The transparency of the decisions made by parliament and the government, and the involvement of the various groups within society in those decisions are preconditions for a high public acceptance of the energy supply. This calls for creativity and a new way of thinking, in order to be able to make full use of the opportunities offered by phasing out nuclear power.

The Ethics Commission recommends that the phasing out process be supported by institutional reforms. It is suggested that two bodies be set up which should be independent of one another: a Parliamentary Representative for the Energy Turnaround and a National Forum for the Energy Turnaround.

In making these suggestions, the Ethics Commission realises that the organisation of the collective effort "Germany's Energy Future" is an exceedingly demanding task overall for all levels of national and regional government. The Commission assumes that the Federal Government, too, will check the organisational consequences, in order to steer the Energy Turnaround towards its intended goal as effectively as possible.

<u>Parliamentary Representative for the Energy Turnaround</u>

The Parliamentary Representative for the Energy Turnaround should organise and oversee the monitoring und supervision of the Federal Government's energy programme. He or she will check whether the measures adopted do indeed lead to the desired goals and will monitor the end of the deployment of nuclear power stations in Germany with all the flexible options for a safe energy supply. The milestones will be expressed in concrete terms by defining suitable indicators, data requirements and the responsibilities for data collection. The office of the Parliamentary Representative for the Energy Turnaround will be equipped with the same rights as other representatives appointed by the German Bundestag. At least once a year, or at shorter intervals should he or she consider this appropriate, the Parliamentary Representative for the Energy Turnaround shall present an Energy Turnaround Report, which shall be published. The Parliamentary Representative for the Energy Turnaround ought to be appointed immediately. The office should initially be set up to continue until the last nuclear power station has been decommissioned.

The Parliamentary Representative for the Energy Turnaround should give early warning if measures for the Energy Turnaround are not achieving the set targets and if the restructuring of the energy supply does not seem to be proceeding on the expected scale.

<u>National Forum for the Energy Turnaround</u>

The National Forum for the Energy Turnaround will organise the public discussion of the Energy Turnaround. All interested parties and all stakeholders can take part in this process. As a rule, the events will be public; transparency must be the top priority. A suitable body needs to be found or created to take responsibility for this process. This body should collect the ideas and suggestions of the citizens and pass them on to those who are responsible for policy decisions. The Forum should allow arguments for the Energy Turnaround to be exchanged, should collect new suggestions and questions, as well as approaches, and put these up for discussion. Participatory scenarios and other methods aimed at participation should be applied. The instrument of citizens' dialogues offers a suitable venue for this.

In the first year, an inaugural event should be held for the energy programme; after this, the Forum will organise the discussion of the status report presented by the Parliamentary Representative for the Energy Turnaround. It probably makes sense to set up a number of specialised forums under the umbrella of the National Forum for the Energy Turnaround. The National Forum for the Energy

Turnaround will organise the pluralist participation of the specialist public and civil society, as well as that of the scientific and business communities. It will ensure that the assumptions and scenarios for the energy policies have sound foundations and are accessible to the public. This will be the market square for the Energy Turnaround.

The National Forum for the Energy Turnaround relies on regional and local decision-makers contributing to the Energy Turnaround. To a greater extent than before, a safe energy supply will depend on decentrally operating structures; hence opinion-forming processes on the ground will be more important. Different towns and local communities, regions and states will adopt different paths and set different priorities in order to supply their own domain entirely with renewable energy. Alternatives and framework conditions need to be carefully examined. “Regional” or “Local” Forums for the Energy Turnaround must be set up wherever decisions have to be made on those levels. This applies particularly to setting priorities for energy-efficient urban restructuring, to developing the infrastructure and to pilot projects of regional significance.

Such a process of communication is a viable way of putting the fundamental consensus on a more concrete basis. Ideological differences will repeatedly arise along the way. These will concern questions such as the extent to which protecting against risks should have precedence over protecting quality of life. They will concern different assessments of and attitudes towards the importance of material consumer goods for a successful life, or the advantages and disadvantages of strengthening geographically decentralised decision-making processes. And there will of course also be the question of the social distribution of the benefits and costs, which must be the subject of clarifying discussions.

Proposals for the Energy Turnaround

1.9 Efficient Use of Energy

In the past, energy policy has focused mainly on the available supply of energy. Now the demand side must be giving the same priority. Phasing out nuclear power will first of all and directly affect the production and consumption of electricity. However, since the insulation of buildings can reduce energy consumption, for example, and carbon emissions are systemically linked to the energy supply, the energy supply needs to be tackled systemically. Mobility and other factors, such as gas supplies, are important, but not the main focus at present.

The efficient use of electricity is still at an early stage, despite the many different efforts so far. Private households still have a huge potential for increasing their efficiency, by up to 60 percent. Parts of the industrial and trade sectors also display significant potential. Energy efficiency performance indicators for specific lines of production and industries should in future provide important benchmarks and encourage competition to come up with the best solution. It has been known for a long time that efficiency is the resource of the future; but energy productivity has not in fact been significantly increased so far. There is enormous potential for improvement here, which should be utilised as soon as possible, also from an ethical point of view.

1.9.1 Supporting Participation Effects and Good Examples

To this day, energy efficiency strategies are primarily aimed at sponsoring good technical examples and models. In future, however, it will be a question of coming up with financing strategies (moving from a logic of sponsorship to a logic of financing), the link with regulatory requirements for product quality, and the connection between technical efficiency and consumer behaviour (lifestyles). Energy efficiency should become an active principle of everyday life. In other words: it is time to develop more business models for energy efficiency. Here it is up to the Federal Government to provide additional measures, also of a regulatory nature, to assist the market. These measures should have a broad impact, permit participatory effects and lead to a revolving system of finance.

The state must proceed emphatically and transparently, setting an example. An important instrument for achieving energy efficiency is energy contracting[16]. State-owned properties ought to be a leading user of this instrument. It is highly effective, encourages participation, in schools and hospitals for example, and rubs off on many different areas. Energy contracting fits the financial political landscape; it does not require initial liquidity, and the financial savings benefit the budget of the body in charge of the property.

Major improvements in efficiency continue to be possible in the industrial use of electricity, too, for example in terms of electrical drives. State-owned properties should routinely be obliged to justify why they are turning down the profits that would be available through energy contracting.

Individuals too must be able to participate in the Energy Turnaround. This gives them more scope for self-determination and more control of their own electricity consumption. Intelligent electricity meters can help private households to save electricity. Through these and similar, simple means of information, many people can be expected to decide much earlier than before to replace their main power consumers, usually their refrigerator or heating system, by a more efficient device.

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[16] In energy contracting, the owner of a property hires a third party to provide cooling, heating, electricity, compressed air and other forms of energy. Procuring energy via a third-party contractor often has advantages in terms of efficiency and cost.

Avoiding rebound effects[17], i.e. an increase in power consumption despite greater efficiency, will be a major task. The Ethics Commission is aware that effective instruments are necessary to counteract this effect. The above-mentioned intelligent electricity meters offer a means of doing so, as do energy-efficient default settings on technical equipment, and a supply infrastructure and device readouts that show the user how much power has been consumed. More attention should be paid to this aspect in the field of product design as well as research and development. The Ecodesign Directive 2009/125/EC provides important starting points in this respect.

Following the example of the British government programme for the energy efficiency of appliances, their use and building services engineering, the Ethics Commission recommends introducing a renewal programme for energy-efficient appliances in private households, and linking this to the regulatory introduction of intelligent electricity meters. Their introduction should be rewarded by an increased efficiency of the appliances. An example for this can be found in the current energy efficiency policy in the United Kingdom[18].

1.9.2 Enable Major Applications for "Intelligent Use of Electricity"

Technical and economic issues are associated with the lifestyles and living conditions of people, in order for the more efficient use of electricity to become an everyday habit. The most important example is the introduction of new concepts for using electricity. Intelligent concepts for measuring and using electricity need support in order to achieve a breakthrough in the market, and in order for innovative technologies to permit a controlled use of electrical power (smart grid).

The collective effort should initiate large and exemplary applications and projects in which the collaboration of many different protagonists brings about new, creative results. This appeal should be directed at companies, grid operators, the manufacturing industry and the logistics sector. Employees, customers and consumers can participate. Foundations could play a special role here.

An intelligent electricity and load management (smart grid) could, for example, be demonstrated at large airports and by major electricity consumers, because the decisions made here concern a multitude of electrical applications and are reached in a clearly structured setting. Such demonstrations would bring together innovative products, the storage of electricity, for example in cold storage facilities, cooling and heating systems, and fleets of electrically powered vehicles. The new aspect is the systemic approach, which combines innovation in devices and energy management with an increase in decentralised decision-making powers.

1.9.3 From Building Renovation to Energy-Oriented Urban Restructuring

Building renovation makes a sustainable energy supply a cross-generational project for society as a whole. The financial incentives handed out by the Kreditanstalt für Wiederaufbau (KfW) help to ensure that buildings are renovated in an energy-oriented way by means of insulation, heating technology and renewable energy, without giving preference to a particular technology. This is an economically efficient solution and provides important standards for new buildings and renovations which offer guidance and create transparency. In 2010, about one million housing units were renovated to improve their energy efficiency. Over 300,000 jobs were secured (for one year) in the process, and 21 billion euros worth of investments were triggered, into equipment and materials.

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[17] A rebound effect occurs when each device individually saves energy, but more and bigger devices are used overall, or else the devices consume power all the time, as with the standby operation of computers and televisions. In this case the overall result may be an increase rather than a decrease in power consumption.

[18] http://www.greatbritishrefurb.co.uk/

One million tonnes of carbon dioxide are being saved every year. On the other hand, 1.3 billion euros of public funds were provided as an incentive. The enormous potential still inherent in energy-oriented urban restructuring becomes clear when it is remembered that the one million tonnes of CO_2 saved constitute less than one percent of direct carbon emissions through private households.

It is necessary to ensure that this success continues. To this end, long-term financing instruments are needed. The number of homes that are renovated every year can and must be increased from the current maximum of one million out of a total of more than 24 million housing units that are in need of renovation. A new phase of building renovation must now begin; as an energy-oriented urban restructuring programme its priority must be to tackle the large housing settlements and town quarters. An independent regulatory framework must be created for this purpose, which should be analogous to urban development funding. It should turn building renovation into energy-oriented urban restructuring in the context of municipal sustainability strategies. Energy-oriented urban restructuring can make use of existing demographic changes. An ageing society calls for different forms of accommodation and different housing layouts. In many areas, the housing industry and private house owners are responding. Such social restructuring can be linked to the energy-related needs. This is a further reason why it is urgently necessary that building renovation be developed to become energy-oriented urban restructuring.

Public subsidisation must increase markedly, which can also be achieved by using the revenues from auctioning off credits under the EU Emissions Trading Scheme. The Ethics Commission encourages making additional financing instruments available, particularly for energy-oriented building renovation and urban restructuring. Inefficient home heating systems and power consumption measurements should be included. This fund could refinance itself through successful savings and/or the tax deductibility of the modernisation investments. It should be revolving in its structure. This means, monetary profits accrued by saving energy and increasing energy efficiency should be ploughed back into the fund to pay for further measures. Revolving funds fulfil the requirement of being fair to all generations and sharing the burden. For private investors they can represent a safe investment.

Subsidies can be used more effectively if the legal framework is adjusted. This includes requiring property owners to check the energy contracting options; changing the rent laws in favour of a majority choice rather than the (current) requirement that all owners should agree unanimously on carrying out energy-oriented renovation measures; giving tenants a means of taking legal action if energy-oriented renovations are neglected; and introducing an "energy-based rent index". The guiding principle could be the idea presented during the public dialogue held by the Ethics Commission, whereby the financial responsibility for energy-oriented renovation measures should be carried in equal parts by the landlord, the tenant and the government bonus.

The necessary legal framework needs to be created. The initial funding must be provided from budget funds.

1.9.4 New Buildings Mean a Reorientation

Strict orientation towards energy-efficient innovation in the context of new buildings will provide important stimuli to the market and to house builders. The zero-energy house, which can already be built today, can serve as an example, as can the energy-plus house, which is no longer utopian today. Further orientation and guidance can be provided by modern insulating materials, photovoltaic systems in building facades, lighting technology and other technologies in which German companies are among the world leaders. All this is both a challenge and a huge opportunity for solar architecture.

The efficiency standards proposed by the German Society for Sustainable Building and the standards for high-efficiency buildings used for awarding KfW incentives can serve as guidelines. They explicitly require that prospective new buildings be connected to renewable energy sources. If this is not effective for all new buildings, a regulatory connection and usage obligation should be examined of the kind used by urban development in Germany for example in the field of water supply. Key efficiency indicators for new buildings should be prescribed as legal requirements.

When calculating the cost of a building, the cost incurred over the lifetime of the building should as a matter of principle be included as well as the cost of its construction. Only then can the cost of energy truly be brought to bear.

1.10 Renewables

Renewables, in Germany particularly the use of wind and solar energy, as well as increasingly of geothermal energy and energy from biomass, are geared to strong growth. Renewables are viewed worldwide as a success story. The amount of power generated by them has grown considerably over the past 20 years. This growth is primarily driven by the highly innovative nature of the technologies and by government funding. A further incentive lies in the fact that a great many people are able to decide for themselves to use these forms of energy, and thus there is a strong motivation to try out, to join in and help to find communal energy solutions.

However, particularly the development of wind energy remains behind expectations, especially in the field of offshore wind farms. Also, the replacement of old wind turbines on land by new, more efficient units (known as repowering) is not going as well as anticipated. In both cases, a whole bundle of technical, economic and planning legislative reasons may be to blame. Perhaps expectations towards the expansion of this technology were too high. The further ambitious expansion, particularly of wind energy, remains necessary, however, and should receive special attention. The efforts to expand it must be further intensified and if necessary appropriate legal framework conditions must be put in place.

Ambitious research approaches could make additional sources of renewable energy available in the future (e.g. geothermal, tidal, wave power) as well as producing social and economic innovations that can be used by society. Solar thermal power also offers enormous opportunities for the energy industry to collaborate with Southern Europe and Africa in the medium and long term, which in the case of Africa also means a potential field for providing development aid. The “Desertec” initiative is an important first beginning.

As soon as photovoltaics has achieved grid parity (a market situation in which the electrical power produced by a photovoltaic plant can be offered at the same price as that paid by consumers) a new phase of development can be expected. “Dumb” PV systems (electricity is produced whenever weather conditions are appropriate) become “intelligent” (electricity is consumed, stored or fed into the grid depending on the prevailing load) when they are connected to smart-grid applications. This creates a new culture of consumer sovereignty and will serve as an incentive for modern energy efficiency technologies to infiltrate society more swiftly. Many people want and operate photovoltaic systems. As soon as photovoltaics passes the profitability threshold, it will offer further opportunities for the efficient use of electricity, for example by being used to store electricity in electric cars, which can be charged decentrally.

In the long run, the further expansion of renewables depends on having a means of storing electrical energy and only using it when needed. Electromobility is just one area which offers appropriate opportunities for storing electricity in the long term. Generally speaking it is certainly true that storage technologies urgently need to be expanded, as a whole and on a large scale. The technical possibilities already exist; additional ones are in an advanced state of research. Beyond this there are technical, chemical and natural means of storage which have yet to be researched and tried out. Solving the unsolved problems of storing electrical power must be pushed ahead, and the monitoring process should keep close track of the progress made in storage technologies.

In view of their decentralisation, technologies such as photovoltaic and geothermal power, as well as the use of biomass for energy production, are at an advantage compared with centralised facilities because they permit more extensive networks (retinity) and such networks are as a rule more tolerant to faults and can be adjusted more easily than large central facilities. Joining technologies to form networks offers new ways of intervening to make corrections and prevent irreversible developments.

The effects of the energy supply on world food affairs and the interaction between the two demand special attention. Securing the world's food supply is a source of great tension, and one of the central challenges faced by all countries in the world, due to hunger and the need to catch up in many parts of the world, increasing population figures and rising dietary demands. The competition between the use of areas for agricultural purposes or for generating power is becoming an increasingly important problem. Agricultural products that could be used immediately for human consumption, such as wheat, maize and soy, are instead being grown as a source of energy, stirring up the conflict between the "fuel tank and the food bowl". The future must be for food production to have precedence, while biomass should be grown (for bioenergy) according to the principles of sustainability. The certification of biomass production ensures the sustainability of land use, growing methods and the use of the products. As a matter of principle, the use of bioenergy should be limited to combined heat and power production. This should be the subject of a binding international agreement.

In the interest of their future acceptance, the subsidisation quotas for renewables should decrease rapidly as they account for more and more of the overall power supply. The ability of German producers to innovate and develop systemic product applications with renewables offering multiplicative benefits must be preserved and boosted. Research and supporting market launches are sensible means of doing this.

1.11 Capacity Markets: Securing the Base Load, System Stability and Supply

Producing sufficient amounts of electricity at any time that it is in demand is crucial to Germany as a business location. A power supply that does not fluctuate whatever the load is critical not only for people's lives but in particular for industrial production processes.

At the moment, the market only receives signals for the number of kilowatt hours sold, not for the kilowatts of power produced. Furthermore it does not adequately reward the stability of the grid. This market design needs to be adjusted to fit the altered conditions.

When calculating the profitability of the energy supply it will in future be necessary to include the contribution to the stability of the grid and the availability of power capacity in addition to the kilowatt hours used. The market design will have to be adjusted to use so-called capacity markets. Capacity markets are a market-based instrument for which international experiences are available and which can be specifically adapted to the situation in Germany. Capacity markets for the Energy Turnaround should be developed step by step, preferably on a European level, whereby Germany should lead the way.

In a capacity market, specifically required power station outputs are put out to tender by the government authorities without specifying a technology and without any discrimination. In certain cases, this is already possible today; the legal framework of the Federal Network Agency makes that possible. If the security of supply so requires, new capacities or additional measures for energy efficiency or for controlling demand can then be put out to tender. The capacity should be publically put out to tender, not only taking into account the price per kilowatt hour but also considering the contribution to the stability of the grid and the surplus capacity provided. It would make sense for the tender to also stipulate the geographical location of the power capacity in order to optimise power transmission.

Capacity markets combine the viewpoint of single-company energy producers with the overall picture of the infrastructure necessary for the Energy Turnaround. They form the core of the collective effort. The available capacity is the best way of influencing the stability of prices. By creating additional capacity, the price of electricity can be kept down. It goes without saying that care must be taken to ensure that investments are allocated efficiently. In principle, alternative instruments and approaches are also conceivable. The Law on Renewable Energy (EEG) should be developed further. At the moment, the EEG is only quantity-oriented and promotes renewably produced kilowatt hours irrespective of other framework conditions. In future, the EEG should incorporate additional pricing signals, for contributing system services and providing capacity. Generally speaking, all such approaches should be limited in time until sufficient electricity storage facilities are available – taking into account the temporal dimension of the nuclear phase-out – to make up for fluctuations in the supply of renewable energy, and until the path to an energy supply based entirely on renewables has been secured.

1.12 Fossil-fuelled Power Stations

Phasing out nuclear power must not happen at the expense of climate protection. In terms of fossil-fuelled power stations, the EU Emissions Trading Scheme and its upper limit for carbon emissions ensure that the climate targets will be met. The cap on emissions is binding throughout the EU. It will also apply if nuclear power is phased out.

The gap in supply brought about by phasing out nuclear power should primarily be closed by using renewables and by increasing energy efficiency, as well using fossil fuels, in particular gas. These provide the security of a power supply that is available at all times. This gap can be closed without interfering with the ambitious climate targets and the legal upper limits set for greenhouse gas emissions in the EU. Natural gas will play a key role in this. There is no mention of gas as a source of energy in the energy plans put forward last year by the Federal Government, when it argued for extending the operating life of nuclear power stations. That will now have to change. Natural gas is the fossil fuel with the lowest carbon emissions and will be reliably available during the transition period. Germany's dependence on gas deliveries can be counteracted by establishing an infrastructure that guarantees access to various different sources of supply.

The technology is tried and tested, highly efficient and advanced. Gas can be decentralised to a high degree. Supply networks are available and can be expanded. Planning and authorising a gas-fired power station takes approx. three years, its construction another approx. three years. A lock-in effect (whereby changing a situation which is deemed worthy of change is found to be uneconomical or impossible) in terms of climate protection and dependence on gas supplies, is not to be expected in view of the limited depreciation period of the plants. The cost of investment is half that of similar coal-fired power stations. This limits the effect on the price of electricity and avoids the risk of unprofitable investments. It should be noted that decentralised gas-fired power stations with an output of less than 20 MW are not covered by the EU Emissions Trading Scheme. Small outfits can therefore lead to an increase in carbon emissions.

Natural gas and increasingly also biogas, provided it is not competing with food production, allow facilities and power grids to be optimised. Combined cycle power plants (CCPP) already have an efficiency of some 60 percent which is unparalleled throughout the world. Their efficiency can be further increased if they allow the decentralised use of electricity. That is the case if they contribute to energy-oriented urban restructuring and in particular if they are positioned such as to optimise power transmission within the grid.

A further option which could be used increasingly over the coming years – following intensive tests and research – is the use of the gas network as a means of storing electrical energy. If an excess of wind-generated electricity is produced, this can be used to produce hydrogen or methane, provided the necessary electrolysis systems that work efficiently in both directions are available in the future. Methane is suitable for adding to the gas supply; both methane and hydrogen can be used as a storage medium. Provided the production of biomass is sustainable, biogas can be converted in the same way. Model installations are already operational and are now being expanded into efficient pilot plants. In view of the expected supply of wind-generated electricity, whose peak output cannot be used by the market, such plants could be cost-effective.

Modern, highly efficient coal-fired power stations offer a distinct improvement in efficiency compared with older power stations that are still online with an efficiency of just 30 percent or so. Replacing them is essential from a climate political and energy economical point of view. This path must be pursued rigorously. The gas- and coal-fired power stations that are currently under construction or that have already received planning permission should be brought online.

1.13 Combined Heat and Power Production

Combined heat and power (CHP) plants can make a substantial contribution to increasing energy efficiency and reducing carbon emissions. At the moment, they account for around 15 percent of electrical power generated. In order to promote CHP plants, an amended CHP Law (KWKG) has been in force since 1 January 2009, whose aim is to increase the amount of CHP-generated electrical power to 25 percent of the total electricity generated in Germany, by the year 2020.

From today's point of view and knowing which facilities are currently under construction or in the planning stages, that target cannot be achieved unless the framework conditions are changed[19].

So far, the law has limited subsidisation to a more or less strictly heat-oriented mode of operation.

In future, CHP plants should be operated with a distinctly stronger electricity orientation and fitted with larger heat storage facilities, and better use should also be made of the industrial potential for CHP. CHP plants running on natural gas are highly efficient for households and, due to the a high level of control provided especially by mini-CHP plants (cogeneration units), lend themselves as a flexible auxiliary technology to augment fluctuating electricity generation by wind turbines and photovoltaic systems due to changing weather conditions.

The following modifications in the CHP Law may be profitable and can be implemented at short notice:

- The deadline for the plants to begin full-time operation should be extended until 2022. This would provide a stimulus for investments and take into account the planning lead times that are now necessary. Furthermore, CHP plants can be used flexibly to ensure system stability. The twin limit of 6 or 4 years of operation should be revoked, while maintaining the upper limit of 30,000 operating hours.

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[19] In the following remarks on combined heat and power production, the Commission is drawing on a report by Matthes and Ziesing (2011), cf. Footnote 5

- Additional CHP electricity generation will keep down electricity prices on the major exchanges and can therefore at least partially compensate for the effect that decommissioning German nuclear power stations will have on the price of electricity, while at the same time helping to stabilise the price of electricity in the long term. A moderate increase in subsidisation would support this. It is worth considering whether the proceeds from the European Emissions Trading Scheme could be used for this purpose.

- The use of CHP plants by industry to produce its own electricity will protect energy-intensive companies from fluctuations in the price of electricity.

- The KWKG could create 10,000 to 12,000 MW of additional electrical power. The additional power that can be generated will not be limited by the potential for using the heat generated, at least not in the medium-term – and therefore poses no threat to the economic lifetime of the CHP investments made over the coming years.

1.14 Infrastructure and Electricity Reserves

Infrastructure will be more important to the future energy supply than before. Apart from power lines, it will also include gas pipelines, providing water as a storage medium and for energy production, the logistics of load management, and managing the intelligent use of electricity, as well as the media for storing electricity and the storage facilities themselves. Current recommendations for intelligent electricity distribution systems (smart grids) are available from the German Academy of Technical Sciences acatech, in particular with reference to decentralised supply. Infrastructure will become a centrepiece of a high-tech economy. It will become an indispensible part of people's everyday lives. Grids must no longer be viewed only in terms of market liberalisation and private-sector access, but as a general-interest service. The stability of the grid must be guaranteed.

Grid operators, public utility companies and energy suppliers must make important contributions to the Energy Turnaround. To underscore the credibility of the companies and their measures in the energy sector, it is recommended that these companies make appropriate sustainability declarations in which they state their approach to sustainable development. Corporate responsibility, transparency and credibility are essential, especially when granting permission for and building infrastructure facilities.

Until now, technical reasons alone have prevented electricity reserves from being created, because power that is in the grid cannot be stored. The stockpiling requirements made in § 50 of the Energy Management Law therefore only apply to the amounts of petroleum, coal and gas that a plant operator needs in order to supply electricity for 30 days.

In future, such stockpiling requirements should be relevant to the electricity market too. Creating means of storing electricity will be of enormous importance. Grid integration and the current state of research mean that future solutions using hydrogen or methane, as well as pumped storage systems for example, are feasible. New, unconventional infrastructure services will include the systemic storage of electricity. This electricity reserve will keep down prices. While creating large storage capacities is not a prerequisite for phasing out nuclear power, storage facilities that work in many different ways will be so important in the future that their continued research, development and testing must be intensified at once.

On a European level, as soon as such solutions become profitable, Germany should urge for national or EU-wide electricity reserves to be established, amounting to about half a year's production.

Network regulations must be realigned. The current regulations force grid operators to take a purely cost-oriented approach. They have no way of adapting infrastructure for a restructuring of the energy supply without reducing their yield on capital. Switching the regulatory standards to a future-oriented expansion of the grid can speed up this process considerably.

New models for participation need to be set up. At the moment, municipalities only enjoy a small share of the economic advantages of investing in the grid. This reduces the acceptance of the necessary construction of power lines. Looking at the experiences in expanding the use of wind energy, for example, the negotiating positions of local communities must be clearly regulated by the legislators, preferably by changing the way in which trade taxes are assigned. This would improve the expansion of the grid without affecting the overall cost. The trade tax paid by the grid operator would no longer go only to the municipalities in which the operator creates jobs, but also to those municipalities that are affected by the power lines.

Additional Framework Conditions

Energy and climate laws

It should be investigated, whether a law on energy and climate ought to be passed. This could bring together the various measures described above, provided those measures are subject to federal jurisdiction.

Funding and administrative laws

The financial demands of the collective effort "Germany's Energy Future" are substantial, however the type and the purposes of the funds are also very varied, including building renovation, increasing the efficiency of private energy consumption, grid expansion and other measures.

It should be pointed out that regulatory measures can in principle reduce the need for fiscal funding. Thus particularly when it comes to improving the energy efficiency of private households, it is necessary to examine carefully how regulatory requirements can be optimised and flanked socially with the help of financial incentives. This is an option particularly when inter-generational and inter-regional fairness can be achieved better by creating a general regulatory framework than by offering incentives or subsidies.

Education and training

The collective effort promises plenty of opportunities for a great many people. A large number of new jobs will be created, new training programmes will give young people a vocational training that offers them an excellent outlook, and new business models will make use of the new economic opportunities.

A relevant impediment for Germany's Energy Future is the question whether enough specialists, craftsmen, engineers and scientists will be available with a good enough training. A lack of skilled workers could significantly reduce the creation of the industrial manufacturing competence and efficiency in the construction industry and trades.

The collective effort "Germany's Energy Future" must be accompanied by an offensive in the education and training sector. Good and innovative approaches to teaching the idea of sustainability at schools and non-school training facilities, all the way to universities, should continue to be disseminated. One example for this is the projects being carried out in association with the UNESCO Decade of Education for Sustainable Development, as well as the broad and varied sponsorship activities of charitable foundations. These should be expanded to include the issues associated with the Energy Turnaround.

Research for Knowledge-Based Decisions

The Commission recommends continuing to rigorously study and test alternative energy technologies and energy industry solutions in the fields of renewables, of grid and load management and of efficiency. Society and the business world must be won over for the opportunities offered by the Energy Turnaround by providing them with new forms of participation. To ensure that there continues to be a choice with respect to the energy supply, the Ethics Commission is calling for greater flexibility and openness in technology, research and state funding.

Research in the energy and climate sciences should pay more attention to the systemic connection between development and testing on the one hand, and the application of knowledge and innovative developments based on impulses provided by practical applications on the other hand. New paths must be pursued so as to integrate such research into the challenges of the Energy Turnaround and into the monitoring process. On principle, priorities should be deduced by looking at sustainable development from a systemic point of view.

Aside from programme-oriented research and development, secure energy production and efficient energy use also require the full range of fundamental scientific research. Research should keep open as many options as possible for future developments and come up with new ways of providing a safe energy supply. Some of the available financial and human resources should specifically be used in areas of research that lie outside the current mainstream. Like the development of the energy system itself, research too should incorporate a European and international view of science.

The following demands correspond to current thoughts within German science, in particular those of the team of German scientific academies headed by the Leopoldina and convened by the Federal Ministry of Education and Research. This team has discussed the consequences that an accelerated phase-out of nuclear power would have for science. Important thoughts about research-related issues are also being contributed by other scientific organisations and groups of experts, the scientific advisory board “Global Environmental Change” and the German Bundestag’s committee of enquiry “Growth, Prosperity, Quality of Life”, which have begun their work on prosperity models and the importance of growth.

The following research recommendations may be particularly effective in the short term:

- Renewables

  All research into renewable which can lead to a reduction in their cost should be driven forward. Research into developing wind energy facilities that can provide additional system services would help to use the strongly fluctuating amounts of electricity in a more system-compatible way. The role of combined heat and power production must be analysed in the light of the above premise of higher electricity output, a decentralised approach and its combination with other measures. The role of virtual power stations must be analysed in terms of its systemic efficiency against the background of new structures in the electricity market. In the field of solar thermal power, the systemic application of the technical status that has been reached must be supported by means of research. The scientific and technological conditions for a better and more specific utilisation of geothermal power need to be established. This applies in particular to near-surface geothermal power, which can be used for heating buildings. Renewables, including geothermal power, offer significant potential in terms of development policy.

- Decentralisation

Innovative forms of participation in decentralised solutions for the provision of energy by municipalities or cooperatives; new forms of citizen participation and new operator models; and new formats for taking into account the concerns and preferences of residents need to be developed and tested.

Municipalities will play a special role in the Energy Turnaround because many decisions, such as those about energy-oriented urban restructuring, as well as planning and building plants and grids, will have to be made decentrally in municipalities and regions. The research sector ought to develop technologies, procedures, contents and instruments for the Energy Turnaround on a municipal level. This applies for example to cost transparency, infrastructural general-interest services as well as to technical equipment which needs to be developed on an appropriate scale. It is a matter of developing new procedures for energy supply systems that can be decentralised, and of their multiplicative effects, synergies and the social interaction between people.

- Systemic nature

  Energy research must be systemic. Research activities should aim particularly at the interaction between the fields of technology development, the diffusion of innovation, legal and ethical assessment, state regulations and socio-political stimuli and barriers. Research must be guided by constantly opening up new potential for efficiency. Changing the behaviour of consumers offers considerable potential for saving electrical energy, over and beyond that offered by technical innovation. Research into demand and the examination of the effect of stimuli hold the promise of lowering consumption at comparatively little cost.

  The increased use of combined heat and power production to generate electricity is just as important an area of research as are questions about improving efficiency through material science, and the use of hydrogen electrolysis to store electrical energy as a substance. In the long run, technologies should be studied which do not turn coal into electricity but instead use coal and biomass as a raw material and thus replace petroleum. This calls for a technology transition from combustion to gasification and the use of hydrogen that is produced without carbon emissions.

- Municipal strategies

  One of Germany's particular strengths is the way in which decision-making powers and political actions are embedded on a regional and local level. Research efforts need to develop technologies, procedures, contents and instruments for the Energy Turnaround on a municipal level. This applies for example to cost transparency, infrastructural general-interest services as well as to technical equipment which needs to be developed on an appropriate scale.

The results of this further research are relevant for the time after the nuclear phase-out and must therefore be started now.

Since fossil fuels will remain relevant throughout the world, all means for avoiding carbon emissions from fossil sources, including carbon capture and sequestration (CCS) and carbon capture and utilization (CCU), must be researched and compared, and their effects on the economy, the environment and on society must be assessed.

Research into innovative supply technologies must be intensified now, if in the long term Germany wants to produce 80 percent of its gross electric power consumption and 60 percent of its final gross energy consumption by regenerative means. Wind, photovoltaics, concentrated solar thermal power (in Southern Europe and North Africa, including the transportation of the electricity to Central

Europe) and geothermal energy offer a great potential for Germany's energy supply. Research into developing wind power plants that provide additional system services for the grids can help to feed fluctuating electrical power into the grid in a more system-compatible way. A particularly important goal, apart from improved efficiency, must be to lower the cost. Fusion research should continue to be pursued as a joint international effort, having the potential to make a very major contribution to the energy supply. Research into nuclear safety and into handling radioactive materials must also continue.

The suitability of different types of biomass for use as a source of energy needs to be reassessed, and research should be continued, taking into account systemic aspects. Using biomass as a material offers greater potential for reducing carbon emissions and energy expenditure.

Research should continue into low-loss and flexible, cross-border grids. In particular the interaction between the grid designs of the different countries taking part must be investigated. Combining alternating and direct current grids on all voltage levels is a key research issue. Storage facilities could be crucial components of future energy networks. Research must develop efficient storage technologies for electrical, thermal, mechanical and chemical energy. In the long term, seasonal energy reservoirs using hydrogen or methane will become important. Technologies for using such materials as reservoirs need to be developed.

The development of electro-mobility needs to be continued in the interest of sustainable mobility concepts; battery designs beyond and in addition to lithium ion batteries ought to be investigated. Research into the conditions for a stronger integration of technological and social mobility concepts is another key factor in the mobility sector. More efficient supply technologies demand high-performance materials, for example for flexibly deployable high-temperature power plants, for wind turbines or for coolants to be used in solar thermal power plants. Expanding research into different materials can provide desperately needed innovative materials for energy systems.

The fundamental understanding of how energy is transferred on a molecular level needs to be expanded. Fundamental research into this subject can provide the basis for optimising existing procedures, and for discovering and developing entirely new technologies.

Research into demand is a key component for establishing a sustainable energy system. Research is required to ascertain which economic, legal and political management systems can help to fulfil energy and climate policy targets effectively, efficiently and in a legally and socially acceptable way, and how these can be integrated effectively into the global legal and governance structures. Acceptance research is of particular importance, being of central importance to the collective effort.

Proliferation

The original hope that the civil use of nuclear power could be reliably separated from the military production of nuclear arms has not been fulfilled. The technological and social risks of nuclear power cannot be viewed separately from one another.

According to current data provided by the International Atomic Energy Agency, 435 nuclear power stations worldwide produce about 15 percent of the global electricity supply. That supply is forecast to double by 2030, a doubling that would appear to be a conservative estimate given that the electrification of production, consumption and mobility are increasing. If the relative percentage of nuclear power were similar to its present level in 2030, twice as many reactors would have to be online in 2030 as are installed today.

This prospect alone is worrying to many people. Terrorist activities and the collapse of public order in entire countries cannot be ruled out, and this is increasingly giving people the impression of living in an unstable world. Nuclear proliferation, i.e. the distribution of fissile material, weapons of mass destruction and their carrier systems or blueprints, is largely an unsolved problem in connection with the use of nuclear power. The large number of reactors and the amount of fissile material means that the danger of criminal or even terrorist abuse has multiplied.

Attempts under international law to limit and control proliferation have so far only been effective to a limited extent. So far, proliferation has proven to be impossible to regulate effectively. It must be assumed that the spread of fissile material can only be successfully and completely prevented if the sources themselves are ultimately shut down and replaced by other sources of energy.

Final Storage of Nuclear Waste

The problem of storing nuclear waste needs to be solved, irrespective of the details of the phase-out scenarios and the remaining operating times of the power stations. This too is a major ethical duty in connection with operating nuclear facilities. Creating a consensus within society about this final storage depends crucially on announcing a definitive date for phasing out nuclear power stations.

The prospect of having to keep highly radioactive waste safe for several thousand years imposes an enormous burden on future generations. Problems such as those encountered in the research mine Asse, proliferation through criminal and terrorist access and through abuse, as well as unforeseen natural events pose additional threats. It is therefore necessary to look into every possibility, no matter how remote, which could reduce the potential threat in the present and in the future, and to keep these options open for future generations. Until now, however, it is not possible to make highly radioactive waste harmless on a technological scale, or to significantly reduce the time period for high-security storage. It is not, therefore, appropriate to be overly optimistic about using new technologies to reduce the amount of nuclear waste or the time for which it must be kept in secure long-term storage. Further achievements in fundamental research will be necessary first.

The Ethics Commission therefore recommends that radioactive waste be retrievably stored according to the most stringent security requirements. This expands the area in which final storage sites for radioactive waste can be sought in Germany beyond Gorleben. However what remains indisputable is that nuclear waste which is produced in Germany must be put into storage in Germany too.

International Dimension of Made in Germany

1.15 Climate Protection

The Energy Turnaround is also highly relevant to Germany's position with respect to international cooperation, collaboration in the field of development policies and in particular the negotiations on global climate protection.

Germany's example can counteract the predominant international view that the use of nuclear power is indispensible in order to prevent global warming. Climate-neutral energy technologies are being driven ahead. The more rapid expansion of renewables and the technological development this induces are of great interest to many countries – quite apart from the effects they have on jobs and research strategies. Expanding renewable sources of energy and making use of efficiency potentials are becoming more and more widespread strategies internationally. German's renewable energy approach is often adopted and used to augment energy strategies in countries such as China and the USA. German manufacturers of machines and plants are profiting from the international expansion of renewables, the systematic integration of grids and the utilisation of energy-efficient products and services.

The Energy Turnaround can produce enormous technical, economic and social opportunities for Germany to continue to make a name for itself as an exporter of sustainable products and services, provided the macroeconomic risks can be minimised. Germany could demonstrate to the international community that phasing out nuclear power is the opportunity for a high-performance economy. Germany ought to encourage the binding implementation of the European Union's targets for energy efficiency. The European Council has set itself the target of increasing efficiency by twenty percent by the year 2020, but not made this binding. In Europe and throughout the world, industrial standards and key performance indicators for products and production facilities are becoming more and more important. This also includes energy efficiency and should be promoted by further efforts to achieve standardisation.

1.16 High-tech for Clean Coal and the Use of Fossil Carbon Dioxide

No other high-tech country with a strong industrial basis has differentiated the decision-making alternatives for its energy supply and developed new energy supply systems more successfully in the years since 1986 than Germany. Many countries could not today rely on the efficient use of energy and on renewables in the same way, even if they wanted to, because their energy supply systems are already committed to other technological paths. In most cases, this means coal, other fossil fuels or nuclear power. This is a serious problem for climate protection and the security of the world's energy system.

Coal is the most widely used source of energy in the world of the 21st century. Its use is making the transition to a global low-carbon economy difficult. There is a need for action here. Germany's technological and inventive past has moved coal utilisation and coal-based chemistry forward repeatedly and fundamentally. Germany therefore has a special responsibility to help turn coal combustion into a clean technology.

In the foreseeable future, Germany may be able to dispense with coal as a fuel; however the world will continue to use coal to produce energy. Clean coal is an achievable technological option. However it is not yet clear what should happen to the carbon dioxide once it has been separated in the power plant. Storing it deep underground is a dead end in the long run. Only if carbon dioxide is seen as a valuable commodity (and paid for as such), is a solution in sight. The large-scale commercial use of carbon dioxide still lies in the future and calls for major efforts in the field of research.

Research programmes in Germany show that the idea of giving carbon dioxide a value should not be dismissed out of hand. This notion should be encouraged. Germany's extensive technological know-how in the chemistry and combustion of coal can offer additional opportunities in this respect.

Either the international community succeeds in using the CO_2 separated out while producing energy from fossil fuels, and ultimately recycling it, or else the climate targets will be very difficult to achieve on a global level.

International research programmes of completely new dimensions are necessary. Germany can and should take the lead in this area and initiate an international research alliance.

1.17 International Aspects of the Safety of Nuclear Power Plants

Like the future energy supply in general, the safety of nuclear power stations is a European and an international issue. As a high-tech country, Germany must ensure that it continues to contribute to worldwide safety even after phasing out nuclear power. To this end, Germany must maintain its influence on the continued international debate over defining safety standards and assessing the risks of nuclear power plants. On a European level, progress must be made in the regulations ensuring that nuclear power stations can be held adequately liable for damages.

The national sovereignty of countries in deciding whether or not to build nuclear power plants stands in contradiction to the potential cross-border consequences of an accident. Germany must neither disconnect and isolate itself from this international situation, nor must it allow itself to be controlled directly or indirectly by the pro-nuclear decisions of other countries. Following the accident in Fukushima, it is high time the national regulations on nuclear safety were extended to the European and international level.

Within the European Union, the Euratom Treaty of 1957 applies for all member states. In contrast to the EC Treaty this has never undergone any major changes and therefore describes nuclear power in the language of the 1950s as an indispensible source of assistance in developing and invigorating the economy and achieving peaceful progress. The European Court of Justice already pointed out ten years ago that the European Union is also responsible for the safety of nuclear facilities. The purpose of the Euratom Treaty, to protect the general population and workforce from the hazards of radioactive radiation, only came to the focus of attention as secondary European Community Law through Directive 2009/71/EURATOM. Its transposition into national law in the EU member states by 22 July 2011 should be carefully monitored. The Ethics Commission further recommends that the Federal Government make a concerted effort to promote the continuing development and adjustments to the work of the International Atomic Energy Agency (IAEA).

Nuclear safety and the obligatory examination of the risks posed by nuclear power stations should become part of European policy; because the potential consequences of a nuclear accident make it inevitable that risk prevention be regulated on a European level and mechanisms be determined for imposing sanctions on inadequately designed facilities and inadequate operations. The European Commission must be given the necessary legal jurisdiction. This is long overdue in a Europe that regulates the details of products in its common market.

It is also crucial that the criteria issued by the Reactor Safety Commission should be included in the criteria for the European stress test, in order to ensure that other European states do not continue to operate nuclear power stations (and possibly try to export power generated by these to Germany) which while passing the European stress test would not have satisfied the criteria laid down by the Reactor Safety Commission.