Germany's energy transition –

A collective project for
the future

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**Ethics Commission for a
Safe Energy Supply**

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Ethics Commission for a Safe Energy Supply

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Dr. Ina Sauer (Organisation)

Office of the Ethics Commission for a Safe Energy Supply in the Federal Chancellery

MR Dr. Rudolf Teuwsen M.A.
RR Gerd Thiel

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1 Recommendations of the Ethics Commission for a Safe Energy Supply

The Ethics Commission is strongly convinced that the withdrawal from nuclear energy can be completed within one decade using the measures presented here for the energy transition. Society should commit to this objective and the necessary measures. It is only by having a clear, scheduled objective as a basis that the necessary decisions on planning and investment can be taken.

It will be a huge challenge for politics and society to implement the collective project on “Germany's Energy Future” within one decade, as it will involve difficult decisions and burdens as well as particular opportunities.

This objective demands a consistent, target-oriented and politically-effective monitoring process (analysis, evaluation, guidance) which the report on the approach and institutions describes in more detail.

The Ethics Commission proposes that the post of an independent Parliamentary Representative for the Energy Transition is established in the German Bundestag and that a National Forum for Energy Transition is created. Progress must be inspected on an annual basis by the Parliamentary Representative for the Energy Transition within the monitoring process.

The Ethics Commission puts forward this proposal in the understanding that the Federal Government will draw conclusions to enable the most effective and target-oriented strategy possible for the energy transition and to ensure efficient cooperation with the federal states. The energy transition is an extremely demanding task on an organisational level; it requires extensive project management, which poses a particular challenge for policy-makers.

The withdrawal from nuclear energy is necessary and is recommended to rule out future risks that arise from nuclear in Germany. It is possible because there are less risky alternatives. The withdrawal is to be structured in such a way that the competitiveness of the industry and the business location is not put at risk. Thanks to science and research, technological advances and business initiatives for developing new business models for a sustainable economy, Germany has alternatives available: electricity production from wind, the sun, water, geothermal energy, biomass, the more efficient use and increased productivity of energy, as well as the climate-compatible use of fossil fuels. Changes to people’s lifestyles also help to save energy if these respect nature and are sustained as a basis for supply.

Above all, “withdrawal” means removing nuclear power plants from the grid. The Ethics Commission is however aware that, even after they have been removed, nuclear power plants still require intensive work over a long timescale, which ranges from ensuring their safety to dismantling them.

Collective project

The Ethics Commission emphasises the fact that the energy transition will only succeed through a collective effort spanning all levels of politics, business and society. The proposal of a collective project entitled “Germany’s Energy Future” is representative of this. It is a great opportunity but also involves many challenges. The international community is following Germany with great interest to see if it succeeds in withdrawing from the use of nuclear energy. If the strategy is successful, it will have a huge impact in other countries. If it fails, the consequences in Germany itself will be serious and many of the successes of renewable energy sources will be called into question.

The experiences of the last few years show that the concept of a collective project cannot be taken for granted. The fear that achieving the energy transition may be subject to delays is completely justified. Equally well-founded is the expectation that Germany could make use of its creativity and ability to learn to achieve the move away from nuclear significantly faster than is currently anticipated.

Germany has to take the path away from nuclear with the courage to try something new, confidence in its own abilities and a committed process for monitoring and control. At local level, in many companies, initiatives and civil society establishments, the Ethics Commission has observed that the whole cross-section of German society has long since been on the way to creating a future that can dispense with nuclear energy. This is something to be supported. The German economy gains its strength from its creativity and ability to manufacture products to the highest possible standard of quality. An increasingly large share of companies orients their business portfolio towards sustainable economic management. The withdrawal from the use of nuclear energy offers this many more opportunities. Science in Germany is in an excellent position and can be relied upon to provide further significant innovative and highly-efficient solutions for the energy transition.

It is for this reason that science and research assume a special role in the collective project. This applies to scientific and technical as well as to social and social sciences research. The Commission therefore greatly welcomes the fact that the German National Academy of Sciences Leopoldina is publishing updated recommendations on energy policy and for comprehensive research into energy. The withdrawal from nuclear energy in Germany also requires further research into the safety of nuclear plants as well as how to deal with nuclear waste – considering the fact that we continue to live in a world in which many countries operate nuclear power plants and further nuclear plants are being built.

The National Forum for Energy Transition proposed by the Ethics Commission is to stimulate and intensify social dialogue. In towns, cities, communities and companies, individual decisions will determine whether the timescale for phasing out nuclear can be shortened successfully and whether the withdrawal and energy transition can be mastered successfully. Discussions and forums with citizens are practical instruments for pushing forward decisions on the energy transition at all levels.

Monitoring and support process

The quickest possible withdrawal from the use of nuclear energy is ethically well founded, imperative from the perspective of the Commission and achievable subject to the measures being implemented. In the best case scenario, the previously established period of ten years for withdrawal can be shortened.

The monitoring process recommended by the Ethics Commission and the Parliamentary Representative for the Energy Transition are to provide the foundations on an annual basis for the decision on when and which nuclear power plants can be shut down.

The monitoring process should draw attention to any delays that occur during the withdrawal in good time and determine supplementary measures so that the withdrawal can be completed within one decade. Advances in science and technology are to be taken into account in the monitoring process.

Sequence for shutting down nuclear plants

For ethical reasons, the nuclear power plants should only be operated until their capacity can be replaced by a less risky energy supply.

The current 8.5 gigawatts of surplus capacity from the nuclear power plants are to be taken off the grid permanently. The temporary shutdown of the seven oldest nuclear power plants and the Krümmel nuclear plant shows that these 8.5 gigawatts of capacity can be replaced by a less risky energy supply. The peaks in electricity demand in the summer and winter will have to be ensured by other types of energy.

The sequence for removing the nuclear power plants from the grid should be determined by the remaining risk of the plants and their significance in the regional electricity grid unless other or additional risks for the nuclear plants have been proven by intensified analyses on reactor safety.

For the economy and society, planning reliability is a valuable asset. It has a large stake in competitiveness and also plays a central role when calculating the profitability of investments. On a global scale, Germany has an important role as a pioneer and responsibility for the withdrawal from using nuclear energy. A stable strategy for investments in energy supply systems and energy efficiency as well as the provision of infrastructure are important variables.

Final disposal and nuclear safety

The final disposal of nuclear waste must be carried out with the highest safety requirements so that the waste is retrievable, as it must be ensured that future generations have the option of reducing the hazards and scale of nuclear waste should the appropriate technology become available. The safety of nuclear plants and the development of a future energy supply are a subject of major importance for European and international politics and cooperation. The Ethics Commission recommends that the Federal Government makes a move at European and international level to seize upon the safety aspects of nuclear energy on a global scale and to drive forward the progress and alignment of the work of the International Atomic Energy Agency (IAEA).

The Ethics Commission regards the incorrect transfer of radioactive materials from nuclear power plants as a very serious hazard. Here too, the Commission proposes further efforts by the Federal Government.

Summary

The range and complexity of the proposals on the process, measures and institutions for the energy transition make it clear that this is in fact a collective project.

The Ethics Commission views the gradual withdrawal from the use of nuclear energy as an exceptional challenge for everyone involved as well as being a source of new opportunities for getting citizens involved in decentralised decisions.

2 Cause and mandate

For a long time, Germany has been holding an intensive debate on energy supply and in particular on the use of nuclear energy. In 2000, the Federal Government of the time and business reached an agreement on nuclear safety requirements, a specification of the service lives of the nuclear power plants and their flexible management. Last year, the Federal Government decided to significantly extend the plants' service lives. However, the disaster at the Fukushima nuclear power plant in Japan has once again placed the question of whether the use of nuclear energy can be justified at the centre of political and social debate. Based on comprehensive information, it is necessary to make responsible decisions on the new energy supply strategy for sustainable development in Germany. Germany must and wishes to structure its energy supply so that energy can be provided in a reliable and environmentally-friendly way and at competitive prices – so that energy also ensures future prosperity.

The Federal Government has appointed the Ethics Commission for a Safe Energy Supply to consider the ethically responsible basis for decisions and their conclusions in their entirety. A safe future for Germany is based on the three pillars of sustainability: an intact environment, social justice and healthy economic strength. An energy supply that is oriented towards these principles is the long-term basis for an internationally competitive economy, for employment, prosperity and social harmony in Germany.

The Ethics Commission has worked under considerable time pressure and with due regard to the expertise of a range of stakeholders in energy policy. The public dialogue on 28th April 2011 in particular demonstrated the range of perspectives, as it gathered points of view and arguments from as many relevant areas as possible. The Ethics Commission wishes to thank everyone involved from the energy production and consumer industry, the renewable energy and grid operation sectors, from natural, engineering and social sciences as well as the experts and opinion leaders from local authorities, workforce committees, the tenant association, non-governmental organisations and the environmental movement. It would also like to thank the people and institutions who have leant their voices over the last few weeks by sending written contributions. With its public dialogue, the Ethics Commission also sent a signal against the defamation of firm positions on nuclear energy, which are the result of a poisoned social atmosphere. Assessments of nuclear energy must not lead to value judgements on those who hold a different view. This attitude has also characterised the discussion within the Ethics Commission.

The members of the Ethics Commission represent different positions on important issues regarding risk assessment and energy supply, which have been argued with great openness and respect. Without surrendering these fundamental positions, the members of the Ethics Commission have come to an agreement on the practical consequences, which have been presented in the report. With this report, the Ethics Commission aims to contribute to an informed and reflective culture of discussion.

3 Collective project “Germany’s Energy Future”

Germany’s future, safe energy supply demands a collective effort from society, business and politics with far-reaching consequences in terms of content, financing and the timeframe.

The energy transition must be structured as a collective project for the future in such a way that energy is supplied safely, in an environmentally and socially compatible manner and at competitive prices. Together with the manual trade and the service sector, industry forms the basis for employment in Germany and secures the prosperity of current and future generations. The transition into an age with the consistent improvement in energy efficiency and the use of renewable energy is a process that requires society as a whole. It demands – and enables – participation, conviction and decisions from many people in parliaments and governments, in towns, cities and communities, at universities and schools, and in businesses and institutions. It provides huge opportunities for people whose choice of training and profession build the foundations of sustainable work and prosperity, for social cohesion, and also for businesses and their competitiveness and innovation. Above all, society’s debate on the withdrawal from nuclear energy provides the opportunity to deal with the damaging atmosphere that has arisen in our society due to the conflict regarding nuclear energy.

Shutting down nuclear power plants does not in itself constitute a withdrawal from nuclear energy. Whereas the shutdown is a technical and legal procedure, the withdrawal demands a far-reaching process. It requires clear objectives and indicators for sustainability, i.e. it must integrate the aspects of long-term availability, economic viability and environmental and social compatibility. Testable interim objectives (milestones) and indicators are necessary and demand the maximum possible level of transparency. The process must also take Germany’s international and particularly its European involvement into account.

Only this type of process enables a far-reaching consensus on the basis and future of prosperity, the idea of progress, the willingness to take risks and safety to be achieved. This consensus is the basic requirement for changing the energy supply structure. Democratic societies require consensus of this kind to make ambitious social changes. The consensus to be achieved must be sustainable in the long term and focus on attaining an energy supply that dispenses with nuclear energy as quickly as possible and advances Germany’s route towards sustainable development and new models for prosperity.

A collective project on “Germany’s Energy Future” must resolve any conflicts of objectives that arise and incorporate the necessary direct and indirect contributions from all participants, i.e. from energy suppliers and consumers, grid operators, politics, environmental organisations, trade unions and other parties, such as developers of new products. Responsibility may not just be claimed by someone else, but must be assumed for the consequences of individual actions and decisions.

The accident in Fukushima has shaken the confidence in expert judgements on the “safety” of nuclear power plants. This is particularly the case for those citizens who until now have relied on such judgements. The issue of how to deal with the fundamental possibility of an uncontrollable major catastrophe is something that even citizens who are not part of the anti-nuclear movement no longer wish to leave up to expert committees to answer.

With this broad approach, the proposed collective project provides the necessary opportunity to restore confidence using transparency to ensure it; the Ethics Commission is promoting a monitoring process to do this and is making suggestions on how this could work. The Ethics Commission is aware that in many sections of society, it is no longer a question of “Nuclear power – yes or no?”, but rather a question of structuring its withdrawal - “Withdrawal sooner or later?” There is however also the fear that the restructuring of the energy supply will have negative effects on economic development, employment and for people on lower incomes.

Expert information on the probability of procedures in complex processes, as will surely be the case for the nuclear withdrawal, are generally based on experiences, assumptions and expectations which are uncertain and are to be addressed as an element of planning for the future. For this reason, the Ethics Commission emphasises the connection between the ethical position, a decision to withdraw from nuclear and the monitoring process, which will enable the energy transition to be observed step by step and to be adjusted if necessary. The Commission views this task as a collective project that whilst demanding huge efforts to be made, also signifies a major step towards a sustainable economy and society.

4 Ethical positions

Every decision on the use of nuclear energy, its shutdown and its replacement with alternative forms of generating energy is based on society's value judgements, which precede technical and economic aspects. Key terms for the ethical evaluation of future energy supply and nuclear energy are sustainability and responsibility. With the guiding principle of sustainability, the objective of ecological compatibility stands alongside social equilibrium and economic efficiency for collectively achieving a future-oriented structure for society.

The progressive destruction of the environment has prompted the call for ecological responsibility – not only since nuclear accidents and not only in this area. It is a matter of how humans interact with the natural environment and the relationship between society and nature. A special human duty towards nature has resulted from Christian tradition and European culture. The ecological human responsibility for nature is oriented towards sustaining and protecting the environment and not destroying it for one's own purposes; instead, its resources are to be enhanced and opportunities for ensuring future living conditions are to be gained. The responsibility for future generations therefore also extends in particular to the provision with energy and a fair distribution of risks and burdens in the long term and those which cannot be limited in terms of time, as well as the associated consequences for action.

4.1 Risk and perception of risk

An overview of the extent of the Japanese reactor catastrophe is yet to be performed at this point in time. We have deep sympathy for the victims of the natural disaster and with the people who are faced with worrying about their lives, health and futures in the aftermath of the reactor disaster. We have high regard for those whose dedication is to be thanked for the fact that the consequences of the disaster have up until now not reached even greater proportions.

The risks of nuclear energy have not changed since Fukushima, but the perception of the risks has. More people have become aware that the risks of a major accident are not merely hypothetical but that such a major accident can actually happen. As a consequence, the perception among a significant section of society has been reoriented to the reality of the risks. Significant factors for the change in the perception of risk are:

- firstly, the fact that the reactor disaster occurred in a high-tech country like Japan. This has caused people to lose faith that such an event could not happen in Germany. This applies to both the accident itself and the long period of helplessness in the subsequent attempts to get it under control;

- secondly, the sustained inability for weeks after the accident to see an end to the catastrophe, to come to a final estimate on the damage, or to specify a definitive geographical boundary for the affected area. The widespread view that the extent of damage even for accidents on a larger scale is limited and can be sufficiently ascertained, which enables this damage to be compared with the disadvantages of other energy sources in a scientifically-based assessment process, has lost a considerable amount of its persuasive power.

- thirdly, the fact that the disaster was triggered by a process that the nuclear reactors were not “designed” to withstand. These circumstances shed light on the limitations of the technical risk assessments. The events in Fukushima have made it apparent that such assessments are based on specific assumptions, for example on seismic safety or the maximum height of a tsunami, and that reality can disprove these assumptions.

4.2 Assessing risks in summary

Considerations regarding a “safe energy supply” are connected with fundamental issues on social development. The basic principle that man may not do everything that he technically can, must also be taken into account when making an assessment of nuclear energy. A critical assessment is especially important, in particular when the consequences of technologies assume the character of “eternal burdens”. The responsibility to make decisions which favour short-term gain, yet where the burden is faced for many future generations, must be tackled by society in order to decide what should be judged as acceptable or unacceptable.

The progression towards an energy supply that is accountable from all possible perspectives demands an integrated approach. Consequences in terms of the environment and health should be paid the same amount of attention as the cultural, social, economic, individual and institutional implications. Reducing the risks down to purely technical aspects would not fulfil the requirement for an integrated approach und comprehensive assessment. The approach also includes the basic principle that the burdens are not passed along to the general public, although this happens all too often, as can be seen in the example of climate change. Awe for the task and humility in one’s own thoughts and actions are essential. The central problem is not what can be imagined but what cannot. In connection with the risks of nuclear energy and the effects of climate change on humans and nature, the term “world risk society” emphatically draws attention to the fact that risks have an effect across national borders. The term marks a turning point, which presents the world with a shared destiny and makes a global policy a necessity. Up to this point, the peaceful use of nuclear energy, in particular at the time of its emergence, represented for many people the promise of progress, prosperity and an almost unlimited supply of energy with manageable risks. Viewed from today’s perspective, it was however a huge future utopia that, according to the knowledge of the time, could also be justified with ethical arguments. Today, this no longer holds true, for Germany at least.

4.3 The basic conflict: categorical rejection vs. relativising assessment

At the heart of the nuclear energy conflict are irreconcilable views on how the fundamental possibility of a major accident, including present and future damage from radioactive waste, is to be dealt with. Here, the positions of a categorical rejection and a relativising assessment are set against each other.

The evaluation of the risk for both positions is not restricted to purely health and environmental risks. Risk also includes the broad range of cultural, social and psychological consequences. One subject of the ethical judgement must also be the consequences that result from the poisoning of the social atmosphere, which has a justifiable place in the discussion with respect to nuclear energy in Germany. Likewise, a comprehensive concept of risk and safety includes the dimensions of security of supply and economic stability as well as environmental protection. Ecological, economic, social and technical risks are, in addition, closely interlinked. By only looking at one aspect in isolation, the view of the whole issue is lost.

The discussion of the ethical positions presupposes that there are alternatives to choose from. The statement that there is “no alternative” to something is no longer accepted by the public. This is also true for the use of nuclear energy. The claim of a “lack of alternatives” undermines the confidence in open, parliamentary democracy. It is more the case that alternatives create freedom for making decisions. Also, alternatives will be available to a greater extent, the more decentralised and differentiated that the energy supply is structured. This increases the citizens’ opportunities to participate in the decision-making process and to get involved in cooperatives and other models, for instance, which enable them to organise their own responsibility themselves. This will strengthen the civic society.

Categorical judgement

The disaster in Fukushima clearly demonstrates that concepts like safety, risk and danger must be reviewed and redefined in terms of what they mean. The technical definition of risk of weighting the scale of an incident with the probability that it occurs, is not suitable for the assessment of nuclear energy and systematically leads to an unacceptable relativisation of risk. For one thing, the probabilities can only be reasonably calculated in terms of assumptions on the course of an incident and in the context of design limits. The particularly high potential for catastrophe of nuclear energy means that it is not ethically acceptable to dismiss as “residual risk” those sequences of events and consequences of a disaster that lie outside of these (set) limits and that were evidenced at Fukushima. The nuclear disaster in Fukushima illustrates the limitations of human precautions against catastrophes and of measures taken in an actual emergency in a highly organised and high-tech country such as Japan. All kinds of consequences that are impossible or very difficult to limit are the result for the natural environment, food production, people in the area and the global economy.

The categorical rejection of nuclear energy evaluates the potential for catastrophe, the burden for future generations and the possibility of nuclear radiation that will damage our heritage as being so far reaching that a trade-off of the risks should not be permitted. From this perspective, the damage from a nuclear disaster lies outside of the area that can potentially be assessed in terms of the balancing of interests. It is a matter of the practical consequences of an accident that cannot be planned for or calculated. There is a methodical reason for this: whereas in normal strategies to deal with limited risks such as road or building safety it is assumed that the damage actually occurs and that lessons can in turn progressively be learnt to make precautions, this step of the learning process is ruled out for nuclear plants. If the last serious incident is factored out, safety concepts lose their testable rationality. The risk can then not be deduced from experiences with real accidents because the consequences of a nuclear disaster in the worst case scenario are unknown or can no longer be assessed. These consequences cannot be confined either in geographical, temporal or social terms. Consequently, it is concluded that nuclear technology should no longer be used in order to rule out instances of damage.

Within a categorical evaluation, assessable variables can still be weighed up in a careful manner. Beyond the limits of what is assessable, however, a categorical decision must be made from an ethically-responsible point of view. Alongside the relative and assessable risks (respective opportunities and risks), there is absolute and non-assessable risk. If an event that is considered improbable actually occurs, then something happens that no one wants and that no one is authorised to ask of other people. Ruling this out is the essence of a preventative strategy.

Relativising assessment of the risks

The starting point for the risk assessment is the reasoning that there can never be zero risk for large-scale technical installations and that the risks when using coal, biomass, hydro power, wind and solar power as well as nuclear energy are different but are comparable. As none of the energy options is risk free, the judgement for acceptability rests on a comparative assessment of the anticipated consequences of all available options on the basis of scientific facts and ethically-founded and mutually-agreed assessment criteria. This requires all of the risks and opportunities to be evaluated as well as is scientifically possible, whereby direct and indirect consequences over the whole lifecycle must be included. Alongside the scale of the consequences, the probability of them occurring must also be taken into account. In connection with the impact evaluation, the risks and opportunities must be weighed up against each other. Ethical considerations assist in making the most rational and fairest assessment possible. Lastly, it comes down to the political decision-making process, which determines which assessment criteria are weighted higher or lower.

Assessments are always dependent on the initial and contextual conditions. In this respect, it can also be justified that an overall positive judgement on nuclear energy is reached in one country or at another point in time, where in another country or at another point in time, an overall negative judgement is arrived at. It is therefore necessary to weigh up the risks and opportunities of nuclear energy with the risks and opportunities of alternative means of generating energy, according to how they present themselves at the relevant point in time.

If this assessment is carried out in the context of the current situation in Germany, it can be reasonably established that nuclear power plants can be replaced by less-risky methods for generating energy and that, as a consequence, this should be undertaken. This is substantiated by the fact that almost all scientific studies come to the conclusion that renewable energy sources and the improvement of energy efficiency yield lower health and environmental risks than nuclear energy. Furthermore, the economic risks of these alternative energy sources appear assessable and delimitable from a current perspective. This also applies to a lesser extent for the use of fossil fuels, if the agreed targets for protecting the environment are adhered to.

4.4 Mutual judgement of the Ethics Commission

In its consultations, the Ethics Commission has attached particular importance to the basic understanding of risk. It does not claim to have fundamentally resolved the conflict between both positions. There are good and serious arguments for both the categorical and relativising approaches. Both points of view are strongly represented in the Ethics Commission. Nevertheless, convergences also emerged during the discussions. From the categorical position it is possible to learn that making justifiable decisions with regard to nuclear power is not simply a question of quantifying and offsetting the extent and probability of damage of energy alternatives. In particular, there is no requirement of a rational approach that forces the observer to orient themselves towards the so-called expected value (extent of damage multiplied by probability of damage) of the available alternatives. It is not unreasonable to evaluate major damage as being more serious; according to the technical formula for risk, major damage can be multiplied by its low probability and hence relativised compared against a number of smaller incidents with higher probabilities.

From the relativising position, it can be deduced that society has a duty to take the consequences of dispensing with nuclear energy into account, whereby international obligations and different cultures of risk in other countries are to be incorporated. In addition, it is rational to consider the probability of an incident when assessing the risks without having to conform to the formula of the product[1] of the probability and the extent of damage.

In practical terms, both positions reach the same conclusion with respect to nuclear energy; ending the use of nuclear plants as soon as their capacity can be replaced by less risky energy sources in accordance with ecological, economic and social compatibility.

With this reasoning, a bridge of understanding between the critics and supporters of nuclear energy can be built. In order to agree with the judgement of the Ethics Commission, one does not have to be fundamentally opposed to nuclear energy. It suffices if one shares the unanimous opinion of the Ethics Commission that Germany has the opportunity to replace nuclear energy with less-risky technologies which are ecologically, economically and socially compatible.

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[1] "Product" is understood as the mathematical result achieved by multiplying two initial variables.

5 Basic principles for the collective project “Germany’s Energy Future”

5.1 Collective project

The Ethics Commission has formulated the results of its discussions as basic principles. The results are placed in the responsibility of the people who have to make the decisions on the energy transition. National, state and local parliaments and governments provide the focus. Businesses from industry, commerce, financial services and manual trade, foundations and non-profit organisations also play a decisive role in many areas. The success of the energy transition also depends not least on the individual decisions of citizens.

The nuclear withdrawal process must start with a decision on the basic principles. It then requires continual further decisions over the following years, which depend on the state of the withdrawal that has been reached. The withdrawal concerns economic and social development prospects as well as matters of fundamental principles regarding securing prosperity in a world where issues of resources are becoming more and more important. It relates to the generation and supply of energy, the role of infrastructure, environmental protection, economic impacts on prices, costs and profits as well as the level of research and citizen involvement. This process goes hand in hand with the further anchoring of sustainability as the foundation for further developing society and people’s lifestyles.

This will see the emergence of conflicts in terms of objectives. These must be discussed in a frank and open manner and negotiated in the proposed monitoring process.

This large-scale collective project can represent a significant impetus for development for Germany as a business location. The Ethics Commission has come to the opinion that a safe energy supply can be achieved which provides more jobs in business and manual trade without compromising environmental protection, whilst also avoiding a power shortage and having to import nuclear power. In the course of the energy transition, countless new businesses will be established and existing operations will extend their capacity and create new jobs. They will have to be committed to the successful principles of social partnership. Respect for employee rights and their stakeholders is also an ethical prerequisite for a sustainable energy transition.

The electricity grids and their expansion are an important criterion for the collective project. It is vital that the consensus reached is structured in the long run so that long-term reliable basic conditions can develop for planning the investment of citizens and business. This will prove itself to be a major competitive advantage in the global markets. The withdrawal will succeed to a greater extent if it becomes a departure and advancement and if the collective project on “Germany’s Energy Future” is supported across all political parties.

The Federal Government has oriented its energy and climate programme of October 2010 towards the year 2050. The Federal Government’s climate targets remain unaffected by the withdrawal from nuclear energy. Nevertheless, important foundations must be laid during the withdrawal decade to ensure that the ambitious climate targets for the middle of the century are achievable.

5.2 Taking conflicts of objectives seriously

The path towards a safe energy supply is characterised by conflicts in terms of valid objectives and interests. The economic viability of energy prices, environmental protection, socially-fair distribution of burdens and opportunities and the changeover to renewable energy sources do not automatically add up to a perfect set of circumstances.

There are potential conflicts of contrary objectives where the removed quantities of nuclear power

- cannot simply be balanced out by buying additional power from nuclear plants in neighbouring countries, as this contradicts the basic principle of a responsible withdrawal;
- cannot simply be replaced by CO_2 emitting fossil fuels due to environmental policy restrictions;
- cannot simply be replaced by another accelerated expansion of renewable energy sources because there are limits in terms of the extent that natural habitats can be used and the technical feasibility would quickly be exceeded;
- cannot simply be saved by the forcible rationing of power, as this contradicts the needs of people and economy of a high-tech country;
- cannot simply be compensated for by high energy prices because the companies are in global competition and there are social disparities in Germany;
- cannot simply be dispensed with by state specifications, as this does not meet the rules of democracy and the social market economy.

The appropriate assessment of these conflicts of objectives can only be achieved under the responsibility of a national collective project from the perspective of sustainable development. Benefits must not be overvalued and drawbacks must not be ignored. This is also a lesson that can be learnt from the use of nuclear power: the necessary practice of insuring large-scale technologies such as nuclear power plants or barrages in social instead of commercial terms can all too easily lead to the benefits being overvalued, even though this is exactly what should not happen. The scale of insurability and liability can therefore lead to flawed price signals. An overvaluation of the benefits whilst underestimating the risks to society can be observed where the liability for the risks and the actual act of bearing them are disconnected. The economist and Nobel prize winner Joseph Stiglitz recently expressed this view in a comparison of risk management in the financial and 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].

[2] Source: The Guardian, 6.4.2011.

5.3 Consumer demand and citizen involvement

As a collective project, a new energy and climate policy must give more in-depth consideration to private demand than has been the case in the past. The more energy policy focuses on decentralised participation and the individual decisions of citizens, the sooner a consensus on the energy transition will be reached.

Consumers do not want energy “in itself”, they want energy services, i.e. to be mobile, travel, live and live well. An attractive urban infrastructure and accompanying financial and regulatory incentives for energy-efficient behaviour, e.g. exchanging inefficient household appliances or heating systems, are important stimuli for converting to lower-energy / energy-saving lifestyles. Clever policy concepts put in place the changes which go hand in hand with demographic changes. Demographic change, the ageing population and healthy and active working lives later in life demanding new living styles, as well as renovations to reduce upkeep and the proximity of social services are all factors that have already been picked up on by many towns and cities as a signal for urban redevelopment. Where the renovation of existing buildings into generation-oriented homes is already taking place, this can be combined with energy-efficiency measures.

Consumers have several roles: they are participants in the market (demanders), “consumer citizens” and “co-producers” in the energy system. Consumers can contribute to the energy transition as market participants by demanding more energy-efficient products and services and using them economically; they can contribute as “co-producers” by renovating their homes, producing energy themselves decentrally and supplying it on a flexible basis (smart homes, smart grids, “home power plants”); and as political citizens they can get involved by participating in processes, for example in their local area, for expanding the grid and attempting to deal with conflicts of objectives appropriately and for the common good in a committed manner.

According to surveys, many consumers are prepared to pay more for a nuclear-free and safe energy supply; they also recognise the sense of investing in building renovations, efficient heating systems and a decentralised energy supply. Often, there is a lack of clear and proper clarification regarding the advantages of the associated measures and the positive effects for future generations. As in tenancy law, however, the advantages, benefits and costs are often so unfavourably distributed between investors and beneficiaries that it impedes economically profitable energy innovation. Private households – as well as public and private large households – can potentially make a great contribution to a flexible and intelligent energy supply and the balance of peak loads (virtual large power plants with interconnected combined heat and power). This would however require attractive financial incentives and/or the regulatory framework to provide the appropriate signals.

The participation of citizens in state planning is essential for the prompt withdrawal from nuclear energy and for the development of regenerative supply structures. This presupposes infrastructure measures such as the expansion of networks and storage power plants as well as the construction of efficient fossil-fuelled power plants. This expansion to infrastructure cannot be regulated from above, rather it must be accompanied by constructive and innovative forms of public participation. It is not a matter of a “skilful creation” of acceptance, but rather of public participation in the widely supported energy transition and of a fair balance of impact and benefit.

The Ethics Commission fundamentally believes that an effective and results-based inclusion of citizens is always desirable. Rights to participate are the indispensible characteristics of planning law, which enable successful and fair planning. However, today’s legally established forms of participation are often viewed as too lengthy as a way of establishing all the necessary lines and grids appropriate to requirements.

New operator models such as cooperatives or the opportunity to acquire ownership rights on the proceeds are also to be introduced alongside direct forms of participation, for instance public forums, round tables and future workshops. The participation of local authorities is however also to be improved by making changes to the attribution of trade tax when expanding the grids (see chapter 7).

Furthermore, the society-wide discussion on the energy transition should be continued to sustain the motivation of the citizens even when the memories of the accident in Fukushima fade. The subsequent recommendation in this report to establish a National Forum for Energy Transition takes this into account.

The major subjects of efficient energy consumption, investment in renewable energy and acceptance of energy infrastructure do not sell themselves. The government should set up an active funding, information and participation policy for consumers, which would enable them to elaborate the contentious areas of energy-efficient building renovation, the expansion of combined heat and power, innovations for using less energy, extending the power grids and the construction of new power plants. This approach should be participative and oriented towards consumers’ geographical location.

5.4 Test criteria

When assessing the conflicts of objectives, the following criteria must be considered carefully:

- environmental protection,
- security of supply,
- economic viability and financial feasibility,
- the social aspects of cost distribution,
- competitiveness,
- research and innovation and
- the avoidance of Germany’s one-sided dependence on imports.

Corresponding indicators are the basis for monitoring during the energy supply transition.

5.4.1 Environmental protection

Climate change is a huge challenge for all sections of society, politics, the economy and science. It will be a lengthy process and require ethically and economically founded decisions, which will be far reaching, in order to achieve a substantial reduction in greenhouse gas emissions by the middle of the century.

There are various answers to the question of whether the climate problem is greater or smaller than the problems resulting from nuclear disasters, but essentially there is no reasonable basis for comparison. It remains a matter of ethical responsibility to fight climate change just as seriously as guaranteeing the safety of the energy supply. For the period of the nuclear withdrawal, the climate policy targets are fixed. The assumption that targets may be compromised by the nuclear withdrawal is not founded.

Germany has committed to ambitious climate targets in a global and European context. According to current estimates, CO_2 emissions in Germany increased by 4.8 percent in 2010 compared with the previous year as a result of the economic recovery from the financial and economic crisis[3]. The consequence is that the speed of emissions reductions would have to be increased dramatically – even without the withdrawal from nuclear energy. In order to achieve the European climate targets (Europe 2020) for the year 2020, significantly greater greenhouse gas emissions would have to be saved each year (20 million tonnes instead of the current 15 million tonnes of CO_2 equivalent (from 2000 to 2010 a mere 8.4 million tonnes per year)). Energy productivity would have to be more than doubled by 2020, from approx. 1.6 percent currently to almost four percent. If all other conditions remain the same, the CO_2 emissions could even increase due to the withdrawal from nuclear energy; however, the climate protection system of the European Union (EU) is in force and will work to counteract this. In the areas of heat supply, building renovation and the mobility markets especially, the climate policy efforts are to be intensified[4]. The energy transition is therefore not just confined to the electricity sector, but also systematically concerns heating, cooling and mobility.

In 2013, the second commitment period of the European Emissions Trading System will begin. Based on the average emissions between 2008 and 2012 and taking the climate targets that should be achieved by 2020 into account, the number of certificates has been set at 2 039 152 882 tonnes of carbon dioxide equivalent. This amounts to an annual reduction of 1.74 percent. The certificates are auctioned. Special regulations apply for energy-intensive industries, which only have to purchase a small number of certificates at auction and are allocated the majority of them. It is expected that the withdrawal from nuclear energy will reinforce the existing trend of an increase in CO_2 prices.

[3] See Hans Joachim **Ziesing** in issue 4 of the magazine Energiewirtschaftliche Tagesfragen (2011). (In German). The following reasons were named: the increase in GDP and the cold winter.
[4] See the National Platform for Electric Mobility, http://www.bmu.de/verkehr/elektromobilitaet/nationale_plattform_elektromobilitaet/doc/45970.php (in German).

The climate targets for the year 2020 can be achieved through the collective project on a safe energy supply, if a new cycle of investment is established, the future technologies are linked realistically to people's everyday experiences and are provided to them by making use of new and broadened decision-making options.

5.4.2 Security of supply

Currently, the potential available capacity of all conventional, fossil-fuelled power plants in Germany (installed gross capacity) is way above the demand for energy[5].

In order to secure the energy supply, the secured capacity must significantly exceed the demand; this refers to the highest load (demand), not the average demand. Safety reserves and a margin for system services must also be available.

According to information from the Federal Network Agency,[6] there will be sufficient security of supply with the shutdown of the 7+1 nuclear power plants. However, there would then no longer be a mathematical safety buffer to deal with the long-term additional shutdown of power plants unless further power plant capacity is supplied. The impact of the moratorium on the transmission networks and security of supply are to be followed in a timely and intensive manner. The Federal Network Agency currently confirms that the risk to supply for the networks remains manageable for the six summer months and advises that decisions on whether additional measures are necessary for generating capacity are kept open.[7]

At present, Germany has 90 gigawatts of secured capacity available[8]. Nuclear power plants account for approx. 20 gigawatts. This secured capacity is confronted with a peak demand of around 80 gigawatts. The nuclear power plants that were shut down as part of the moratorium or had already been taken off the grid amount to a loss of 8.5 gigawatts, leaving a secured generating capacity of 81.5 gigawatts.

By 2013, fossil-fuelled power plants with a capacity of around eleven gigawatts will be added to the grid, whilst power plants with approx. three gigawatts will be removed from the grid on grounds of age[9]. This additional capacity is confronted with nuclear

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[5] The total supply is the total generated capacity of all energy-generating facilities. It is to be differentiated from the amount of electricity that is secured at any time (i.e. electricity that is reliably supplied to the grid). The latter is lower.

[6] Report by the **Federal Network Agency** to the Federal Ministry of Economics and Technology on the impact of the nuclear power moratorium on the transmission networks and security of supply, 11th April 2011 http://www.bmwi.de/BMWi/Navigation/energie,did=386714.html (in German).

[7] **Federal Network Agency:** Continuation of report by the Bundesnetzagentur on the impact of the nuclear power moratorium on the transmission networks and security of supply, 27th May 2011.

[8] This secured capacity takes into account a deduction of ten gigawatts of installed conventional power plant capacity due to repairs, faults and maintenance. It also includes the following percentages of installed capacity for the named energy sources: river power plants (50 percent), biomass capacity (100 percent), wind power capacity (7 percent), pumped storage plants (100 percent). Due to its highly fluctuating availability, solar power cannot be included as secured capacity.

[9] This information and other data on power plant capacity are compiled from data from the Federal Network Agency, the German Association of Energy and Water Industries, the Association of Local Utilities and individual research by Felix **Matthes** and Hans-Joachim **Ziesing** (2011): Beschleunigter Verzicht auf die Kernenergie in Deutschland: Elemente eines flankierenden Einstiegsprogramms. Kurzanalyse für die Ethik-Kommission „Sichere Energieversorgung", Berlin. (*Accelerated withdrawal from nuclear energy in Germany: elements of a supporting entry programme. Brief analysis for*

power plants with a capacity of 8.5 gigawatts which have currently been put out of operation; in total, the nuclear capacity when all nuclear plants are decommissioned amounts to around 20 gigawatts.

For renewable energy sources, a considerable expansion is required over the next few years. This expansion is important for achieving the objective of generating environmentally-compatible energy. Wind, solar thermal energy, photovoltaics (PV), geothermal energy and other innovative approaches, alongside supporting measures for storing electricity, can tend to contribute to ensuring base load requirements. Biomass power plants are already in a position to provide secured capacity.

The capacity lost by the withdrawal from nuclear energy must be replaced by additional power plant capacity of at least ten gigawatts and with the aim of providing even greater security of around 20 gigawatts. By the year 2020, or potentially a few years earlier, the proposed measures for combined heat and power could generate twelve gigawatts, the conversion of biomass could yield up to 2.5 gigawatts (of which two gigawatts is scheduled expansion) and strategies for a selective capacity market for new conventional power plants could bring in up to seven gigawatts. Additionally, measures promoting energy efficiency would produce 2.5 gigawatts of peak load and four gigawatts for the low load range. Investment in modern, highly-efficient plants yields a “climate dividend”; the EU Emissions Trading System’s mechanism for capping the highest amounts of carbon dioxide emissions acts as a driving force for innovation.

The German Association of Energy and Water Industries (BDEW) goes even further with its figures for the expansion of power plant capacity: by the year 2019, around 50 power plants (wind, gas, hard coal, lignite, biomass, waste, river water; also pumped storage and compressed air) of approx. 30 gigawatts are expected to be constructed[10].

5.4.3 Economic viability and financial feasibility

Replacing the power generated from nuclear energy requires great expenditure in terms of financial resources and investment. The energy transition will contribute to the increase in prices for energy and CO_2 emissions certificates that has already been observed. Although experts are in agreement with this statement[11], they do not agree

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the Ethics Commission on “Safe Energy Supply”). (In German). The introduction is expected by 2013 under high safety requirements at: 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 (*CHP*), Hannover-Linden, Irsching 4, Karlsruhe RDK 6, Saarbrücken GuD Süd (*combined cycle gas and steam turbine power plant*). For economic reasons, old fossil-fuelled power plants will be decommissioned in the next few years. By 2012, approximately three gigawatts will be lost (Frimmersdorf E to O, Niederaußem A to D, Staudinger 3, GKM 3 and 4, Pleinting, Mittelsbüren 3). It is assumed that by 2020 eight gigawatts of capacity from fossil-fuelled power plants will be decommissioned.

[10] See www.bdew.de

[11] For example: **Enervis** energy advisors GmbH (2011): Atomausstieg bis zum Jahr 2020: Auswirkungen auf Investitionen und Wettbewerb in der Stromerzeugung, Kurzgutachten für den VKU, Berlin, 9.5.2011 (*Nuclear withdrawal by 2020: effects on investment and competition in electricity generation, summary report for the Association of Local Utilities*), (in German); **r2b** (2011): Energieökonomische Analyse eines Ausstiegs aus der Kernenergie in Deutschland bis zum Jahr 2017, (*Energy economy analysis of a withdrawal from nuclear energy in Germany up to 2017),* http://www.r2benergy.com/pdf/Kurzfassung_Ausstieg2017.pdf, (in German); **Samadi,** Sascha; Manfred **Fischedick,** Stefan **Lechtenböhmer,** Stefan **Thomas** (2011): Kurzstudie zu möglichen Strompreiseffekten eines beschleunigten Ausstiegs aus der Nutzung der Kernenergie, im Auftrag des Ministeriums für Klimaschutz, Umwelt, Landwirtschaft, Natur- und Verbraucherschutz des Landes NRW, Wuppertal-Institut, Wuppertal, 18. Mai 2011, (*Brief study on the potential effects on electricity prices as a result of an accelerated withdrawal from using nuclear energy, on behalf of the*

on the extent of the price rises. For this reason, the monitoring process should dedicate particular attention to price trends and their impact in terms of costs in order to prompt adjustments.

The withdrawal from nuclear energy can be a driver for growth, as the investment in the energy supply and its infrastructure stimulate economic growth. These costs are accompanied with revenues. In the same way, public funds – public provision and financing of market incentives – could have a huge productive impact on the markets, for jobs and for innovation[12]. The provision of state funds must strictly consider budgetary discipline and borrowing limits. The fiscal revenue situation, in particular from the auctioning of emissions certificates must also be factored in[13]. Commercial investments too play a significant role. New financing mechanisms come into consideration in this regard. In particular, these could include new funding solutions and the provision of financial products for investment in sustainable business[14].

5.4.4 The social aspects of cost distribution

The monitoring process is to check how the multiplicative effects of market incentives, investment effects and other economic effects can be used.

A further focus for this is also on the assessment of the social distribution of costs. The German Institute for Economic Research (DIW) has come to the conclusion that the moratorium will only lead to a slight increase in electricity prices for households, amounting to a maximum of 1.4 percent. The DIW predominantly puts this increase down to the increase in the exchange price of around 0.4 cents per kilowatt hour (six percent). The DIW views the expansion and replacement of power plant capacity as vital to deal with the shutdown of further nuclear power plants[15]. In the currently assessable period, the consumer price is expected to only undergo a slight increase overall, as the extent of price-increasing and price-reducing effects is more or less the

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Ministry for Climate Protection, Environment, Agriculture, Nature Conservation and Consumer Protection of the German State of North Rhine-Westphalia),
http://www.wupperinst.org/uploads/tx_wiprojekt/Strompreiseffekte_Endbericht.pdf; (in German), **Kemfert**, Claudia (2011): Wie teuer wird die Energiewende?; **DIW (German Institute for Economic Research)** (2011), Wochenbericht no. 20 / 2011, (*How expensive will the energy transition be?*)
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, (in German), **Edenhofer**, Ottmar (2011): Die Strompreise steigen nicht wesentlich (*Electricity prices will not increase significantly*), in: Handelsblatt, 16.03.2011, see also
http://www.pik-potsdam.de/aktuelles/pik-in-den-medien/die-strompreise-steigen-nicht-wesentlich/view,(in German)

[12] The trade balance for funding building renovation by the KfW promotional bank shows that one euro of funding triggers investment amounting to between six and eight euros in trade and industry.

[13] The state will generate income from the auctioning of CO_2 emissions certificates. The European emissions certificates are auctioned from 2013. Given the assumption that the current price of 15 euros per tonne of CO_2 will increase linearly to the amount forecasted by the European Commission for 2020, revenue of between 150 and 190 billion euros can be expected by 2020. Germany could expect to generate revenue of between 37 and 46 billion euros. The income would increase to a total of between 200 and 310 billion euros if the EU raises its target for the year 2020 to a 30 percent reduction in emissions instead of the presently agreed 20 percent. The upper CO_2 price for the EU for 2020 is estimated at 25 euros per tonne of CO_2. Provided that the EU agrees to a climate target of 30 percent for 2020, the CO_2 price will rise. For this, CO_2 prices of 55 euros per tonne of CO_2 in 2020 or 30 euros per tonne of CO_2 (with a purchase of CDM (*clean development mechanism*) compensation) are estimated. See **Cooper, Simone; Grubb, Michael** (2011): Revenue Dimensions of the EU ETS Phase III, draft, 10.04.2011

[14] See statements on energy-efficient urban renovation in this report.

[15] See DIW Wochenbericht 20 / 2011 http://www.diw.de/documents/publikationen/73/diw_01.c.372712.de/11-20-1.pdf (in German)

same. The increase in the emissions trading prices has a price-increasing effect due to additional emissions. The necessary additional installation of power plants and grid expansion have a potentially price-increasing effect, even though grid expansion is evaluated as one of the more minor components and additional power capacity tends to have a price-reducing effect.

The measures proposed by the Ethics Commission correspond with this view. It points towards the fact that the question of the costs of withdrawing from using nuclear energy must also establish the comparison with the costs of dealing with a nuclear disaster, which are currently being accumulated in Japan: these costs would exceed all of the anticipated costs for the energy transition in Germany.

5.4.5 Competitiveness

Germany currently still has almost complete value chains, in which energy-intensive basic commodities are produced, which are linked to the manufacturing and processing industry, trade and the service sector. This network represents an important reason for the success of the German economy. It secures and creates jobs. These value chains make a significant contribution to social security and to solving the huge challenges of today and tomorrow.

With respect to competitiveness, it is not only electricity prices that are important, but also the security of a stable energy supply. This applies in particular for sectors of industry and life-saving medicine as well as for information technology and computer-based control processes.

In order that this remains the case in the energy transition process, competitive basic conditions are required for all links of the value chains.

The energy transition is to take place in a world where energy, electricity, gas and CO_2 prices are tending to increase. It is however not possible to determine in advance what share of the price trend is connected to the nuclear withdrawal and what share is due to global developments, local conditions and other reasons. The monitoring process is therefore of particular importance in this regard.

5.4.6 Research, education and innovation

The contribution of science is of huge significance for the collective project. The German economy and society draws its innovative strength and creativity from participation, cooperation and the courage to take new paths, but especially from science and research.

Science and research in Germany is in an excellent position, from which increasingly innovative and highly-efficient solutions are to be anticipated for the energy transition. Nevertheless, this is an area that can be improved further. The configuration of the collective project should drive this forward. The monitoring process should demand and incorporate research results in a targeted manner. It should provide room for progress studies and the dialogue between science and society should be intensified. This can facilitate the establishing of research priorities.

It is a matter of strengthening the social ability through research and development, developing and applying new solutions and thereby also providing momentum for education as well as occupational training and further education.

5.4.7 Dependence on imports

Electricity imports and exports are part of the European Single Market, which will also be integrated as the electricity market for all EU member states from 2015. The exchange of goods and electricity calls attention to comparative advantages and disadvantages. Even given sufficient available import capacities, Germany would be ill-advised to strive for complete self-sufficiency for its electricity. With a view to oil, gas and uranium, Germany is a very import-dependent energy consumer; this is equally applicable to many other natural resources. In principle, the aim should be to import resources to an extent that does not engender one-sided dependence and to maintain an energy mix that is as varied as possible.

With the improved infrastructure of the European grids (connection points), the exchange of electricity will increase. Imports and exports are necessary for load management. They typically differ for the North and South of Germany. Electricity imports will only become critical if they go against national conversion targets.

6 Institutions for the energy transition

In order to ensure a high level of public acceptance for the energy supply, transparency in the decisions made by parliament and government as well as participation by social groups in the decision-making process is a prerequisite. This will require creativity and new ways of thinking to fully exploit the opportunities provided by the withdrawal from nuclear energy.

The Ethics Commission recommends that the withdrawal process is supported by institutional reforms. It proposes that two independent committees are established: a Parliamentary Representative for the Energy Transition and a National Forum for Energy Transition.

The Ethics Commission puts forward these proposals in the understanding that organising the collective project "Germany's Energy Future" is all in all an extremely demanding task for all levels of the German government and its federal states. The Commission assumes that the Federal Government will also monitor its organisational consequences in order to structure the energy transition in a targeted manner and as effectively as possible.

Parliamentary Representative for the Energy Transition

The Parliamentary Representative for the Energy Transition is to organise and supervise the monitoring and management of the Federal Government's energy programme. It will examine whether the measures taken are actually translating into the desired objectives and will monitor the shutdown of the nuclear power plants in Germany, including all flexible options for ensuring a safe energy supply. The milestones are to be substantiated with indicators, defined data requests and responsibilities for data collection. The post of the Parliamentary Representative for the Energy Transition is to be issued with the same rights as any other representative appointed by the German Bundestag. The Parliamentary Representative for the Energy Transition is to present an energy transition report at least once a year or more frequently, if deemed appropriate; the report will subsequently be published. The Parliamentary Representative for the Energy Transition is to be appointed immediately. The post will initially last for the period up to the decommissioning of the last nuclear power plant.

The Parliamentary Representative for the Energy Transition should issue a warning in good time if the transition measures are not achieving the specified objectives and if the impression arises that the conversion of the energy supply is not being carried out on the anticipated scale.

National Forum for Energy Transition

The National Forum for Energy Transition is to organise the public discussion on the energy transition. All interested and affected parties may take part. As a general rule, the events will be public; transparency is the top priority. To this end, a suitable responsible agent must be found or established. It should pick up on the suggestions and proposals of the citizens and direct those responsible for making policy. The Forum should also enable the exchange of arguments for the energy transition, gather new suggestions, questions and new approaches for solutions, and put them up for discussion. Participative scenarios and other methods focused on participation are to be applied. The instrument of public dialogue provides a suitable environment for this.

In the first year, a launch event on the energy transition is to take place; afterwards, the Forum will organise a discussion on the status report of the Parliamentary Representative for the Energy Transition. It may also be sensible to set up individual expert forums under the umbrella of the National Forum for Energy Transition. The National Forum for Energy Transition will organise the pluralistic participation of the professional public and civic society as well as science and business. It will ensure that assumptions and scenarios on energy policy are justified and are made accessible to the general public. It forms the marketplace of the energy transition.

The National Forum for Energy Transition relies on the contribution of regional and local decision-makers on the energy transition. As the safe energy supply will focus on decentralised structures to a greater extent than ever before, the forming of opinions at local level is of greater significance. Towns, cities, communities, regions and federal states will take different paths and set different priorities so that they can fully supply their areas using renewable energy sources. Alternatives and basic conditions are to be carefully monitored. Where decisions are to be made at their level, “regional” and “local forums for energy transition” should be convened. This is especially the case for setting priorities for energy-efficient urban renovation, for infrastructure work and pilot projects that are of regional importance.

This type of consultation process is a practicable way of backing up the basic consensus. It will mean that ideological divergences will also arise again and again. These include issues such as the extent to which the prevention of risks should have priority over the protection of quality of life. They concern different assessments and attitudes on the importance of material consumer goods for a fulfilled life or on the advantages and disadvantages of strengthening geographically decentralised decision-making processes. In addition, there will also be the issue of the social distribution of advantages and burdens, which must form part of discussions to be clarified.

7 Proposals for the energy transition

7.1 Efficient energy use

In the past, energy policy has essentially placed the emphasis on the supply of energy. Now, it comes down to giving the same priority to the demand side. Phasing out nuclear energy has an initial and direct impact on the generation and consumption of electricity. As, however, thermal insulation in buildings can for instance lead to a reduction in energy consumption, and as CO_2 emissions are systematically linked to energy supply, the issue must be tackled systematically. The significance of mobility and other factors, such as gas supply, whilst being important, do not have priority here.

The efficient use of electricity is still only in its infancy, despite many previous efforts. In private households there is still a huge potential for increasing efficiency of up to 60 percent. There is also significant potential in sectors of industry and manual trade. Energy efficiency figures for production lines and sectors should in future establish important benchmarks and stimulate competition for finding the best solution. The notion that efficiency potentials are <u>the</u> resource of the future has been around for some time, yet energy productivity has in actual fact not been significantly increased so far. There is great potential for this and its exploitation is also urgently demanded from ethical perspectives.

7.1.1 Participation effects and supporting role models

Until now, strategies for energy efficiency have essentially aimed at promoting good technical examples and models. In future, however, it will be a question of developing financial strategies (from the logic of promotion to the logic of financing), of consolidating regulatory standards on product quality and combining technical efficiency with consumer behaviour (lifestyles). Energy efficiency should become a principle that is applied in everyday life. In other words: business models for energy efficiency must increasingly be developed. This challenges the Federal Government to provide the market with supplementary measures, including those of a regulatory nature. The measures should be broadly-based, allow for participation effects and work from a revolving financing structure.

The state must set an example by being firm and transparent. Energy contracting[16] is an important tool in energy efficiency. State-owned properties should be the leading user of this tool. It has a major impact, calls on schools and hospitals, for example, to take part and extends across many areas. Energy contracting is suited to the financial landscape; it does not require any start-up capital and the financial savings benefit the budget of the institutions that own the properties.

[16] In energy contracting, the owner of the property contracts out the supply for cooling, heat, electricity, compressed air or other forms of energy to a third party. Obtaining energy from a third party (contractor) often brings benefits in terms of efficiency and cost.

Huge efficiency savings are also still possible in industrial electricity use, for example with regard to electric drives. State-owned properties should have to routinely justify why they are not making use of the savings that can be acquired from energy contracting.

Individuals must be able to take part in the energy transition. It gives them more self-determination and makes it easier for them to control their own electricity consumption. A private household can save electricity by using smart meters. With the aid of these and comparable, simple means of acquiring information, it is expected that many people will decide much quicker than previously to replace their main energy consumers, generally the fridge and heating system, with more efficient appliances.

The prevention of rebound effects[17], i.e. increasing electricity consumption in spite of efficiency savings, is a major challenge. The Ethics Commission is aware that effective tools are necessary to counteract this. Options include the aforementioned smart meters, energy-efficient default settings for technical appliances and supply structures, as well as displays on the appliance that show the user how much energy they are consuming. Product design, research and development should give greater consideration to this. The Ecodesign Directive 2009/125/EC provides essential approaches.

Following the example of the British government programme on the energy efficiency of appliances, their use and building technology, the Ethics Commission recommends the introduction of a replacement programme for energy-efficient appliances in private households and to link this with the regulatory introduction of smart meters. Its introduction should be met with improved efficiency among appliances. One example of this is provided by the current energy efficiency policy in the United Kingdom[18].

7.1.2 Enabling large-scale applications for "smart electricity usage"

Technical and economic issues are to be connected with people's lifestyles and living conditions in order to make the more efficient use of electricity an everyday occurrence. The most important example is the introduction of new concepts for using electricity. Smart electricity measuring and usage concepts need support to break through to the market and to enable innovative technologies to provide load-dependent and consumer-controlled electricity usage (smart grid).

The collective project should initiate large-scale and pioneering applications and projects, where the cooperation of many parties will obtain creative results. Targeted are businesses, grid operators, the manufacturing industry and logistics sector. Industry employees, customers and consumers can also play a part. Foundations can play a special role in this regard.

[17] A rebound effect occurs in where a significant amount of energy is saved per appliance but, overall, more and larger appliances are used, or the appliances continually consume electricity, for example the standby function on computers and TV sets. On balance, more and not less energy is then consumed.
[18] http://www.greatbritishrefurb.co.uk/

For example, a smart electricity and load management system (smart grid) could be demonstrated at large airports and among large electricity customers, as a range of electricity applications can be decided upon here with the aid of clear structures. The demonstration would combine innovative products, the storage of electricity, for example in cold storage houses, cooling and heating systems and fleets of electric vehicles. Its innovative nature consists in the systemic approach, which links instrument innovation and energy management with an increase in the power to make decentralised decisions.

7.1.3 From building renovation to energy-efficient urban renovation

Building renovation turns sustainable energy supply into a cross-generational project for the whole of society. The financial incentives provided by the KfW promotional bank contribute to making buildings energy efficient, irrespective of the technology used, for example through insulation, heating systems and renewable energy. This is an economically efficient solution and provides important standards for renovations and the construction of new buildings which form a basis for orientation and create transparency. In 2010, around one million residential dwellings were renovated to improve energy efficiency. This ensured over 300,000 jobs (for one year) and generated investment in equipment and materials totalling 21 billion euros. One million tonnes of carbon dioxide is saved each year. An expenditure of 1.3 billion euros from budgetary funds is offered as an incentive. The huge potential of energy-efficient urban renovation becomes clear when you keep in mind that the one million tonnes of CO_2 saved does not even amount to one percent of the direct CO_2 emissions from private households.

The continuation of this success must be ensured. This will require long-term financing mechanisms. The number of homes renovated each year can and must be increased beyond the current maximum of one million of the more than 24 million residential dwellings that require renovating. A new stage in building renovation must now be started, which tackles energy-efficient urban renovation in particular for major residential areas and solutions for whole communities. In this regard, an independent regulatory framework similar to that of urban development should be set up. It should turn building renovation into energy-efficient urban renovation as part of local authority sustainability strategies. Energy-efficient urban renovation can benefit from demographic change. The ageing society is calling for different types of housing and styles of living. In many places, the housing sector and private homeowners are acting on this. This social change can be combined with energy requirements. This is a further reason why the continued development from building renovation to energy-efficient urban renovation is urgently needed.

The funding invested must be significantly increased, which is also possible by using revenue from the auctioning of certificates from the EU Emissions Trading System. The Ethics Commission particularly encourages the introduction of additional financing mechanisms for building and energy-efficient urban renovation. Inefficient domestic heating systems and electricity consumption measurements should be incorporated. These funds could be refinanced by the successful savings measures and / or by the tax deductibility of investments for modernisation. The funds should be set up on a revolving basis. This means that the monetary profits that arise from energy savings and increased energy efficiency are in turn reinvested in the fund to finance further measures. Revolving funds meet the basic principle of ensuring equality across all generations and a fair distribution of the burdens. It could also represent a safe investment for private investors.

Development funds could be introduced more effectively if the basic legal conditions are adjusted. This would include the following measures: property owners would have to check the options for energy contracting, tenancy law would be changed from the (still existing) requirement where all owners must agree to energy-efficiency renovation measures to a principle of majority rule, tenants would obtain legal means in the event that energy-efficiency renovations are neglected, and an “energy rental index” would be introduced. The guideline for this could be the idea proposed in the Ethics Commission’s public dialogue, whereby financial responsibility for performing energy-efficiency renovations would be assigned in equal parts to the landlord, tenant and state allowance.

The necessary basic legal conditions are to be established. Start-up capital must be provided from budgetary funds.

7.1.4 A new orientation for new buildings

The consistent orientation towards energy-efficient innovations for new buildings will provide important momentum to the market and contractors. Examples of this are the zero energy house, which can already be achieved, and the plus energy house, which is no longer a utopian dream. In addition, modern insulating materials, photovoltaic applications in building facades and other technologies where German companies are global market leaders provide a good basis for orientation. All of these are both challenges and huge opportunities for the solar architecture industry.

The efficiency standards of the German Sustainable Building Council and the standards for efficiency homes from the KfW fund provide good foundations. They implicitly demand the inclusion of renewable energy sources in new building projects. If this should not be effective for all new buildings, a regulatory connection and usage requirement should be tested, as has been carried out for urban development in Germany with the example of water supply. Efficiency parameters for new buildings should be specified in regulatory law.

The calculation of costs for properties should fundamentally include the construction costs as well as any costs for the lifetime of the buildings. It is only at this point that energy costs really come into play.

7.2 Renewable energy sources

Renewable energy sources, and in Germany in particular the exploitation of wind and solar power, as well as geothermal and biomass energy to an increasing extent, are oriented towards strong growth. Renewable energy sources are viewed as success stories across the globe. The growth in their electricity generation over the last 20 years is substantial. It is essentially pushed forwards by the highly innovative character of the technologies involved and by state funding. A further incentive lies in the fact that a huge number of people are able to make their own decisions in support of these types of energy, which gives rise to strong motivation to try out, get involved in and find collective energy solutions.

However, the expansion of wind power in particular, with regard to offshore wind farms especially, remains below expectations to some extent up until now. Likewise, the replacement of old onshore wind turbines with new, more efficient turbines (so-called repowering) has not been as successful as was originally anticipated. In both cases, a whole host of technical, economic and planning reasons appear to be responsible for this. Expectations for the expansion were also possibly too high. The further ambitious expansion, particularly of wind power, still remains necessary however and should receive special attention. The expansion efforts must be strengthened further and a legal framework must be established, if required.

Ambitious research concepts can in future tap into further renewable energy sources (e.g. geothermal energy, tidal power, wave power) and make social and ecological innovations socially viable. Solar thermal energy also offers huge opportunities in the medium and long term for cooperation with southern Europe and Africa with regard to energy investment, which would additionally provide Africa with development possibilities. The “Desertec” initiative is an important first step.

As soon as photovoltaics reach grid parity (the market situation where electrical energy from a photovoltaic system can be offered at the same price as the electricity price for end consumers), a new level of expansion is to be taken into account. “Dumb” PV systems (electricity is produced depending on the weather) are becoming “smart” thanks to their connection to smart grid applications (electricity is consumed, stored or supplied to the grid depending on the load). This creates a new culture of consumer power and could be an incentive for getting modern energy efficiency technologies into society more quickly. Photovoltaics are being requested and pursued by many people. As soon as they exceed the profitability threshold, they will offer further opportunities for efficient electricity usage, for instance by being used to store electricity in decentrally rechargeable electric cars.

The further expansion of renewable energy sources depends in the long term on the options for storing electricity and then only using it when it is needed. Electric mobility is just one area that provides relevant storage options for electricity in the longer term. In general, it is certainly the case that storage technologies must urgently be expanded as a whole and on a large scale. Technical options are available and are also the subject of advanced research. There are also technical, chemical and natural stores that are still to be researched and tested. Solving the as yet unresolved problems regarding electricity storage is to be pushed forward and advances in storage are to be taken into account in the monitoring process.

With regard to decentralisation, technologies such as photovoltaics, geothermal energy and the use of biomass for energy have an advantage over centralised facilities, as they allow greater networking (retinity), are generally less prone to faults and are easier to regulate than centralised large systems. The networking of technologies yields new possibilities for corrective intervention and for avoiding irreversible problems.

The effects of and interplay between the energy supply and the global food supply must be paid particular attention. Securing the global food supply is a very difficult issue and represents one of the central challenges that all the world faces due to famine and accumulated needs in many parts of the world, increasing population figures and growing demands for food. The competition between using land for agricultural use and using land to generate energy is a problem that is becoming increasingly important. Agricultural products such as wheat, corn and soya, which are perfectly suitable as a human food source, are being cultivated for the purposes of energy generation, which stirs up the conflict between “tank and plate”. The future can however only lie in giving priority to the production of food and cultivating biomass for energy in line with principles of sustainability. The certification of biomass production should ensure the sustainability of land utilisation, cultivation methods and the use of products. The use of bio energies must inherently be limited to the use of combined heat and power. An internationally binding commitment to this should be sought.

For the future acceptance of renewable energy sources and to push forward their constantly increasing share in the energy supply, subsidies should promptly be scaled back. The ability of German manufacturers to innovate and develop systematic product applications with renewable energy sources with multiplicative advantages must be maintained and increased. Reasonable methods for this can be found in research and in supporting market launches.

7.3 Capacity markets: securing base load, system stability and supply

The generation of sufficient electricity at any time it is requested is of vital significance for Germany. A fluctuation-free energy supply is crucial for every load situation, not only for people’s lives, but also especially for industrial manufacturing.

The market currently only obtains signals for the sold kilowatt hour, not for the generated kilowatt capacity. It also does not adequately appreciate the system stability of the grid. This market design must be adapted to meet the changed conditions.

In future, the service for the system stability of the grid and the generation of capacity must be incorporated into the profitability calculations of the energy supply, alongside the kilowatt hour value. Adapting the market design requires the use of so-called capacity markets. Capacity markets are a market-based instrument, for which international experience is available and which can be specially adapted to the German conditions. Capacity markets for the energy transition should be developed step by step, if possible at European level, where Germany should take on a leading role.

In a capacity market, specifically required power plant services are tendered via the regulatory authorities, independent of the technology used and in a non-discriminate manner. This is already feasible in certain cases; the legal basis of the Federal Network Agency makes this possible. If supply security demands it, new capacity or energy-efficiency and demand-management measures can then be tendered. The capacity should not just be publicly announced including the price per kilowatt hour, but also the service for the system stability of the grids and the surplus capacity. The announcement can reasonably also set parameters for the geographical localisation of power plant capacity in order to optimise the effect for power transmission.

Capacity markets combine the view of individual generators with the overall picture of an infrastructure required for the energy transition. They form the core of the collective project. Due to the amount of capacity, they can at best have an impact on price stability. The creation of more capacity can reduce the impact on the electricity price. It is obvious that attention must be paid to the efficient allocation of investment. In principle, alternative instrumental approaches are also conceivable. The Renewable Energy Sources Act (EEG) should be developed further. The EEG is currently merely oriented towards quantity and promotes renewably generated kilowatt hours independently of the other constraints. In future, further pricing signals for system services and for the generation of capacity should become effective in the EEG. In general, all approaches should be restricted until sufficient electricity stores – taking into account the issue of time for phasing out nuclear energy – are available to balance out the fluctuating supply from renewable energy sources and until the path towards a full supply with renewable energy sources is assured.

7.4 Fossil-fuelled power plants

The withdrawal from nuclear energy should not be at the expense of environmental protection. With regard to fossil-fuelled power plants, the climate target proceeding from the EU Emissions Trading System and its upper limit for CO_2 emissions is guaranteed. The upper limit set for emissions is mandatory throughout the EU. It also applies given the withdrawal from nuclear energy.

The gap in supply caused by the withdrawal from nuclear energy is mainly to be filled by the use of renewable energy sources and improving energy efficiency as well as with the aid of fossil fuels, especially gas. They provide security of a long-term available power supply. This gap can be filled without compromising the ambitious climate targets and within the upper limits for greenhouse gas emissions which are legally established in the EU. Natural gas has an important role to play in this regard. In the Federal Government’s energy concept from last year which set out to extend the service lives of power plants, gas is not mentioned as an energy source. This will now have to change. Natural gas is the fossil fuel with the lowest CO_2 figures and is definitely available for the transitional period. Germany's dependence on gas deliveries can be counteracted by the infrastructurally-sound access to various sources of supply.

The technology is tried and tested and has been highly efficiently advanced. Gas is highly suited to a decentralised supply. Networks are available and can be expanded. The planning and approval process of a gas power plant is estimated at approx. three years, the construction time a further three years. A lock-in effect (the change of situation that is evaluated as requiring change is however unprofitable or impossible) with regard to environmental protection and dependency on gas is not to be feared due to the limited amortisation period of the plants. The investment costs are approximately half those of comparable coal-fired power plants. This limits the effect on the electricity price and avoids the risk of unprofitable investments. It must be kept in mind that decentralised gas power plants with a capacity of less than 20 MW are exempt from the EU Emissions Trading System. Small plants could therefore cause an increase in CO_2 emissions.

Natural gas and even biogas to an increasing degree allow plants and the grid to be optimised as long as this does not compete with the production of foodstuffs. Combined cycle gas and steam power plants currently already have a globally unique efficiency level of around 60 percent. They could also further increase their efficiency by allowing decentralised electricity use. This is then the case if they contribute to energy-efficient urban renovation and particularly if they are geographically positioned in such a way as to optimise power transmission in the grids.

There is a further option which can increasingly be applied over the next few years if further intensive testing and research is carried out. It concerns the use of the gas network as a store for electrical energy. If an excess supply of wind power is generated, this can be used to produce hydrogen or methane, as long as in future electrolyte systems are available that are also efficient in alternating operation. Methane is suitable for use in the supply with gas; methane or hydrogen can be used as a storage medium. As soon as the generation of biomass is sustainable, biogas can also be converted in the same way. Model plants are already in operation and are to be expanded to efficient pilot plants. Given the expected supply of wind power, whose peak supply is not utilised by the market, these plants could be economically viable.

Modern, highly-efficient coal-fired power plants have a significant efficiency advantage over old coal-fired plants that are still on the grid with an efficiency rating of approx. 30 percent. These plants must be replaced with respect to both climate policy and energy economics. This path must be rigorously followed. The gas and coal-fired power plants that are currently under construction or whose plans have been approved should be added to the grid.

7.5 Combined heat and power plants

Combined heat and power plants (CHPs) are in a position to make a significant contribution to increasing energy efficiency and reducing CO_2 emissions. Their contribution to electricity generation currently amounts to 15 percent. In order to promote CHP, revised legislation (the Combined Heat and Power Act) has been in force since 1st January 2009, which aims to increase the share of CHP electricity in Germany's total electricity generation to 25 percent by 2020.

From today's perspective and given the plants under construction or in the planning stage, this objective cannot be achieved without making changes to the basic conditions[19].

Up until now, legislation limits the funding of this technology more or less strictly to heat-oriented operation.

In future, CHP plants should orient their operation much more towards the electricity market, be designed with larger heat storage systems and also be developed for industrial CHP potential. CHP based on natural gas is highly efficient for households and as mini CHP plants (block heating power plants) in particular are easy to control, it presents itself as a flexible supplementary technology for the electricity generated by wind power and photovoltaics which fluctuates depending on the weather.

The following modifications to the Combined Heat and Power Act could be fruitful and can be implemented in the short term:

- The deadlines for the inclusion of continuous operation at the plants should be extended to 2022. This would create incentives for investment and would take the current necessary planning procedures into account. CHP plants could also be used flexibly to ensure system stability. The dual constraint of 6 or 4 operating years should be abolished if the maximum 30,000 operating hours are maintained.

- Additional CHP generation curbs electricity prices for wholesale markets and could compensate for at least part of the effect on electricity prices associated with the phasing out of German nuclear plants and also help to stabilise electricity prices in the long term. A moderate increase in investment could support this. Consideration could be given to using income obtained from the European Emissions Trading System for this.

- The use of CHP plants so that industry can generate its own electricity protects energy-intensive businesses against fluctuations in electricity prices.

[19] In the following information on combined heat and power, the Commission refers to the expertise provided by **Mattes** and **Ziesing** (2011), see footnote 5.

- The Combined Heat and Power Act could create between approximately 10,000 and 12,000 MW of additional electrical capacity. Limitations with regard to heat generation potential do not restrict this scale of expansion at least in the medium term; this also applies to the economic lifecycle of investments made in CHP in the coming years.

7.6 Infrastructure and electricity reserves

In the future energy supply, the infrastructure will be of even greater importance than ever before. Alongside the power lines, it will include the gas networks, the water supply as a store and for energy production, the logistics of load management and the control of smart electricity use, as well as electricity storage media and the stores themselves. Latest recommendations on smart electricity distribution systems (smart grids), in particular with regard to the decentralised supply from renewable energy sources, are available from the German National Academy of Science and Engineering (acatech). Infrastructure is becoming the core of a high-tech economy. It is becoming an essential part of people’s everyday lives. Grids are no longer viewed simply from the point of view of market liberalisation and commercial access, but also in terms of their function as a commodity of general interest. Grid stability must remain secure.

Grid operators, public utility companies and energy providers are to make important contributions to the energy transition. In order to underline the credibility of the companies and their measures for the energy sector, it is recommended that these companies make clear that they are orienting themselves towards sustainable development in declarations on sustainability. Corporate responsibility, transparency and credibility are vital especially for obtaining approval and building infrastructure facilities.

Until now, the building up of a reserve electricity supply was not possible purely on technical grounds, as electricity cannot be stored in the grid. The specifications for holding stock in accordance with paragraph 50 of the Energy Industry Act therefore only refer to the quantities of oil, coal and gas that a plant operator requires to supply electricity for 30 days.

The specifications on holding stock should in future also be relevant for the electricity market. Creating electricity storage options will be of the utmost importance. Due to grid integration and the state of research, solutions with hydrogen or methane as well as pumped storage, for example, are soon to be feasible. The systematic storage of electricity will be ranked among new, unconventional infrastructure services. The electricity reserve will have a price-reducing effect. The creation of substantial storage capacity is admittedly not a prerequisite for the withdrawal from nuclear power. However, storage systems are so important in the future in many different ways that their research, development and testing must therefore be intensified from now onwards.

As soon as such solutions are economically viable, Germany should advocate at European level the building up of national or EU-wide reserve electricity supplies, for instance to cover half a year's production.

Grid regulation is also to be restructured. Current regulation forces the grid operators to take a view that is solely oriented towards costs. They have no opportunity to prepare the infrastructure for the change to the energy supply without incurring losses to revenue. Making changes to regulatory standards that are oriented towards future grid expansion can significantly speed up the transition.

New models for participation are to be established. Local authorities currently only have a negligible involvement in the economic advantages of grid investment. This impedes the acceptance for the necessary power line construction. In view of the experiences obtained when expanding wind power, the negotiating positions of local communities are to be clearly defined by the legislator, for example, preferably by changing the allocation of trade tax. This would improve grid expansion in a cost-neutral way. The trade tax of the grid operator would then no longer just go to the local authorities where the operator has created jobs, but also to the authorities that are affected by the transmission lines.

8 Further basic conditions

Energy and climate legislation

The creation of energy and climate legislation is to be monitored. It could combine the various measures that have been previously described, as long as they concern measures of national jurisdiction.

Financing and regulatory law

The financial requirements for the collective project “Germany’s Energy Future” are considerable. However, they also vary in nature and are based on different financial purposes, for example on building renovation, the efficiency of private energy consumption, grid expansion and other measures.

It has been pointed out in principle that regulatory measures can diminish the fiscal requirement for finance. Therefore, when it comes to improving energy efficiency in private households in particularly, it must be carefully monitored how regulatory requirements and financial incentives are optimised and socially supported. This comes into question especially when the equality between generations and between different regions can be achieved more effectively by creating a general regulatory framework than would be the case by offering incentives and subsidies.

Education and training

The collective project provides many opportunities for many people. A range of new jobs will arise, young people will receive professional training offering great prospects in new areas and new business models will benefit from economic opportunities.

However, a notable constraint for Germany’s energy future is the issue of whether enough and sufficiently trained skilled personnel, manual workers, engineers and scientists will be available. The shortage of skilled workers could significantly impair the strengthening of industrial manufacturing skills and productivity in the building and manual trades.

The collective project “Germany’s Energy Future” must be accompanied by an education and training strategy. Good and innovative approaches for promoting the idea of sustainability in schools, extracurricular educational centres and higher education institutions should be made more widespread. Examples include the projects of the “UN Decade of Education for Sustainable Development” as well as the broad and wide-ranging promotional activities undertaken by foundations. These should be extended and incorporate the topics of the energy transition.

9 Research for knowledge-based decisions

The Commission recommends the further and methodical research and testing of energy-related technical and economic alternatives, concerning renewable energy sources, grid load management, and increasing efficiency. Society and business must be won over with new forms of participation for the opportunities of the energy transition. In addition, in order to ensure options for the energy supply, the Ethics Commission demands more flexibility and openness with regard to technology, research and state funding.

Scientific research on energy and the environment should pay more attention to the systemic connections between development and testing, on the one hand, and the application of knowledge and the innovative further development resulting from practical stimuli, on the other hand. This will involve taking new paths in order to integrate research into the challenges of the energy transition and into the monitoring process. Priorities should fundamentally be derived from the systematic consideration of sustainable development.

Alongside programme-oriented research and development, science-led basic research in its full technical range is required to ensure safe energy generation and efficient energy use. Research efforts should also keep open as many options for future developments as possible and exploit new possibilities for a safe energy supply. A share of the available financial and human resources should expressly be given to research areas that are currently not in the mainstream. In the same way as the development of the energy system itself, research should also integrate the European and international perspective.

The following demands are in agreement with current reflections by the German economy, in particular by the working group of German scientific academies appointed by the Federal Ministry of Education and Research and led by the German National Academy of Sciences Leopoldina. It has discussed the scientific consequences of an accelerated withdrawal from using nuclear energy. Further important considerations on research-related issues have also been contributed by other scientific organisations and panels of experts, the German Advisory Council on Global Change and the Study Commission on Growth, Wellbeing and Quality of Life from the German Bundestag, which have begun their work on the issue of new models for prosperity and the value of growth.

In the short term, the following research recommendations in particular are relevant:

- Renewable energy sources

  For all renewable energy sources, research that could lead to quick cost reductions should particularly be pushed forward. Research on developing wind power plants that take over additional system services for the networks could contribute to using the severely fluctuating amounts of electricity in a way that is more compatible with the system. The role of combined heat and power must be analysed under the aforementioned premise of enhanced electricity capacity, a decentralised approach and integration with other measures. This also applies for the role of virtual power plants in light of new structures on the electricity market with respect to their system efficiency. With regard to solar thermal energy, the systematic application of the attained technical standard must be supported with research. The scientific and technical prerequisites are to be developed in order to tap into the potential of geothermal energy in an improved and targeted manner. This particularly applies to geothermal energy sources that are close to the surface, which can be used to heat buildings. Renewable energy sources, including geothermal energy, have significant potential with regard to development policy.

- Decentralisation

Innovative ways of participating in decentralised solutions for generating energy through local authorities or cooperatives, new forms of citizen involvement and operator models, and new formats for integrating the concerns and preferences of residents are to be developed and tested.

Local authorities have a significant role to play in the energy transition as many decisions, such as those regarding energy-efficient urban renovation and the planning and construction of plants and grids, are to be made decentrally in the authorities and regions. It is a matter of new processes for energy supply systems that can work in a decentralised way, and their multiplicative effects, synergies and the social interaction of the people.

- Systematic character

Energy research must be systematic. Research activities are to be particularly directed at the interaction between technological development, the diffusion of innovations, legal and ethical assessment, state regulation and socio-political incentives and constraints. Research must be oriented towards continually exploiting efficiency potential. Beyond technological innovation, there is considerable potential for saving electrical energy by changing consumer behaviour. Researching demand and investigating the effects of incentives promise reductions in consumption with relatively little effort.

The increased use of combined heat and power to generate electricity is just as important a field of research as materials science issues on increasing efficiency and hydrogen electrolysis for storing electrical energy. In the longer term, technologies should be researched that no longer convert coal into electricity, but instead use coal and biomass as chemical natural resources and release oil. This would require a technological change from combustion to gasification as well as using hydrogen produced with no CO_2 emissions.

- Local strategies

  One of Germany's particular strengths is the regional and local foundation of decision-making powers and political structure. Research efforts must develop technologies, processes, content and mechanisms for the energy transition at local authority level. This applies for example for cost transparency, infrastructural public services and instrument engineering.

The results of further research are relevant for the period following the nuclear withdrawal and must therefore be started now.

As fossil fuels will continue to be of significance globally, all options for preventing CO_2 emissions from fossil energy sources, including carbon capture and sequestration (CCS) and carbon capture and utilisation (CCU), must be comparatively researched and their impact on the economy, environment and society must be assessed.

Research into innovative supply technologies must now be intensified if Germany wishes to reach the long-term goal of providing 80 percent of the electrical energy in the gross electricity consumption and 60 percent in the gross end energy consumption from renewable sources. Wind, photovoltaics, concentrated solar thermal energy (in South Europe and North Africa with the transportation of electricity to Central Europe) and geothermal energy offer great potential for Germany's energy supply. Research into developing wind power plants with additional system services for the networks could contribute to supplying the fluctuating electrical energy in a way that is more compatible with the system. Alongside improved efficiency, a particularly essential objective must be the reduction of costs. Fusion research should be pursued as an international collective activity with the potential to make huge contributions to the energy supply. Research into nuclear safety and dealing with radioactive material must also be continued.

The suitability of various types of biomass for use as energy should be reinvestigated and research should be pushed forward with due regard to system perspectives. Even greater potential for reducing CO_2 and energy use can be found in the material usage of biomass.

Flexible and cross-border grids with low energy losses should also be researched further. In particular, this concerns carrying out research into the interaction of grid design concepts with the countries involved. The combination of alternating current grids with direct current grids at all voltage levels is a research subject of huge significance. Energy storage devices could be key components in future energy grids. Research must develop efficient storage technologies for electrical, thermal, mechanical and chemical energy. In the long term, seasonal energy storage devices using hydrogen or methane will become important. Technologies for using such stores of substances must be developed.

For sustainable mobility concepts, electric mobility must be further developed and battery concepts including and extending beyond lithium-ion batteries should be researched. Another important aspect for the mobility sector is the research into the conditions for an enhanced integration of technological and social mobility concepts. More efficient supply technologies demand high-performance materials, for instance for flexible high-temperature power plants, wind turbines or heat carriers in solar thermal power plants. The strengthened expansion of materials research can provide urgently needed innovative materials for energy systems.

The basic understanding of energy-transferring processes at molecular level is to be deepened. Basic research in this subject area forms the basis for optimising existing processes and discovering and developing completely new technologies.

Research into demand is a key component in establishing a sustainable energy system. Research must be carried out into which economic, legal and political control mechanisms assist in meeting the energy and climate policy objectives effectively and efficiently, as well as in a legally and socially compatible manner, and how these mechanisms can be effectively incorporated into the global legal and governance structures. Research into acceptance is also of particular importance, as it represents a key area for the collective project.

10 Proliferation

The initial hope that the civilian use of nuclear energy could reliably be separated from the military production of nuclear weapons has not materialised. The technical and social risks of nuclear energy cannot be viewed in isolation from each other.

According to the latest figures from the International Atomic Energy Agency, 435 nuclear power plants around the world currently produce around 15 percent of the global energy supply. It is forecasted that this figure will double by 2030, and this doubling seems to be a conservative estimate, as the electrification of production, consumption and mobility is on the increase. Should the relative proportion of nuclear energy be just as high in 2030, twice as many reactors as today would have to be installed by 2030.

This prospect alone is a worrying thought for many people. Where terrorist attacks and the collapse of whole state regimes cannot be ruled out, people increasingly feel that they live in an unstable world. The proliferation, i.e. the distribution of fissile material, weapons of mass destruction and their launcher systems or construction plans represent a widely unresolved problem for the use of nuclear energy. Due to the number of reactors and the quantity of fissile material, the risk of criminal or even terrorist misuse has multiplied.

Attempts under international law to curb and control the proliferation of nuclear have so far only had limited impact. Until now, regulating the proliferation has not proved to be effective. It is to be assumed that a successful and complete avoidance of the propagation of fissile material can only be achieved if the sources are ultimately closed off themselves and are replaced by other energy sources.

11 Final disposal of nuclear waste

The problem of final disposal for nuclear waste must be solved, and regardless of the withdrawal scenarios and service lives. This entails a huge ethical obligation in connection with the operation of nuclear plants. The establishment of a social consensus on final disposal is critically linked with the naming of a definitive date for phasing out the nuclear power plants.

The prospect of having to secure highly radioactive waste for several millennia is a heavy burden for future generations to bear. Problems such as those at the Asse research mine, proliferation due to criminal or terrorist access, and due to abuse, as well as unforeseen natural events pose additional risks. For this reason, even the slightest possibility for reducing the potential risk for the present and the future must be pursued and these options are to be sustained for future generations. Admittedly, it is currently not possible on an industrial scale to render highly radioactive waste harmless or to significantly reduce the time required for highly secure storage. Therefore, large-scale optimism for reducing the quantity of nuclear waste using new technologies and shortening the time for secure final disposal has yet to be seen. Further success in basic research is still required in this regard.

The Ethics Commission therefore recommends storing the radioactive waste in a retrievable manner whilst adhering to the strictest safety requirements. This will extend the search area for final disposal sites for radioactive waste in Germany beyond the Gorleben site. However, the disposal of nuclear waste in Germany of the waste that was produced in Germany, must remain beyond dispute.

12 The international dimension of made in Germany

12.1 Environmental protection

The energy transition is also of great significance for Germany's position in international cooperation, development cooperation and in particular in the global negotiations on environmental protection.

Germany's example can counteract the internationally prevalent opinion that the use of nuclear energy is indispensible for environmental reasons. "Climate neutral" energy technologies are being driven forward. The faster expansion of renewable energy sources and the induced technical development are of major interest for many countries – alongside the effects for jobs and research strategies. The expansion of renewable energy sources and the use of efficiency potential are becoming visibly more widespread on an international scale. The German renewable energies concept is frequently being adopted and augments the energy strategy in countries such as China and the USA. German manufacturers of machines and systems are profiting from the international expansion of renewable energy sources, the systematic grid integration and the use of energy-efficient products and services.

The energy transition can bring enormous technical, economic and social opportunities for the further development of Germany's profile as an export nation with regard to sustainable products and services, if economic risks can be minimised. Germany could show the international community that withdrawing from nuclear energy is the opportunity for developing a high-performance economy. Germany should champion a binding implementation of the European Union's target for energy efficiency. The European Council has specified the target of a 20 percent increase in efficiency for 2020 but has not made this compulsory. In Europe and throughout the world, industry standards and figures for products and production plants are becoming more and more important. This also extends to energy efficiency and should be tackled with enhanced efforts favouring standardisation.

12.2 High-tech for clean coal and the use of fossil carbon dioxide

In the years since 1986, no other high-tech country with a strong industrial basis has been as successful as Germany in differentiating its decision alternatives for the energy supply and in expanding new energy supply systems. Even if they wanted to, many countries today could not rely on efficient energy use and renewable energy sources in the same way as Germany because their energy supply is committed to a different technological path. In general, this path concerns coal, other fossil fuels or nuclear energy. This is a serious problem for environmental protection and the security of the global energy system.

Globally, coal is the most widely used energy source of the 21st century. Its utilisation impedes the global transition to a low carbon economy. This represents a call for action. Germany's technical and inventive past has advanced the status of the use of coal and coal chemistry in a fundamental and multifaceted way. Converting coal combustion into a clean technology is therefore the responsibility of Germany in particular.

In the foreseeable future, Germany can potentially go without coal as an energy source; however, the world will continue to use it to generate energy. Clean coal is a feasible technical option. Nevertheless, determining the storage location of the carbon dioxide following capture in the power plant cannot be resolved. Storage in deep repositories is at an impasse in the long term. It is only when carbon dioxide is regarded as a reusable and saleable material that a solution comes close to being reached. A profitable use of carbon dioxide on a large scale is still however something for the future and requires major research efforts. Research programmes in Germany show that the notion of making carbon dioxide a valuable resource is not to be dismissed. It is to be fostered in a targeted manner. Germany's extensive technical knowledge in coal chemistry and combustion can provide additional opportunities in this regard.

Either the global community manages to sensibly use the CO_2 captured from fossil fuel energy sources and ultimately forms a cycle with it, or the global climate targets will be very difficult to achieve.

International research programmes on a completely new scale are required. Germany could and should take the lead in this respect and initiate an international research association.

12.3 International aspects on the safety of nuclear power plants

The safety of nuclear power plants, as well as the future energy supply in general, is a subject that is relevant at European and international level. Germany must ensure that as a high-tech country it continues to contribute to global safety even after it has withdrawn from using nuclear energy. To do this, Germany must retain its influence in the future international debate regarding the definition of safety standards and risk assessments of nuclear power plants. At European level, the regulation of liability of nuclear power plants appropriate to the level of damage must be advanced.

The national decision-making power to construct nuclear plants is at odds with the potential cross-border consequences of a disaster. Germany should neither detach and isolate itself from this international situation, nor should it allow itself to be controlled, directly or indirectly, by the pro-nuclear decisions of other countries. Following the disaster in Fukushima, it is high time that national policies on nuclear safety are harmonised at a European and international level.

In the European Union, the EURATOM treaty of 1957 applies to all members. In contrast to the EC treaty, it has never been subject to major modifications and therefore uses the language of the 1950s to refer to nuclear energy as an indispensible source of aid for economic development and growth and for peaceful progress. Ten years ago, the European Court of Justice pointed out the fact that the European Union is also responsible for the safety of nuclear plants. The determination of aims of the EURATOM Treaty of protecting the population and employees from the risks of radiation, was only taken into account via the 2009/71/EURATOM Directive as a secondary Community Law. Implementing this into national law in the EU member states with the deadline of 22nd July 2011 should be followed intently. Furthermore, the Ethics Commission recommends that the Federal Government makes a move to drive forward the continued development and alignment of the International Atomic Energy Agency (IAEA).

Nuclear safety and binding investigations into the risk of nuclear power plants should become part of European policy. The potential consequences of a nuclear disaster make it imperative to control risk prevention at European level and to establish mechanisms to take sanctions against poor plant design and poor operational management. The European Commission should assume legal authority in this respect. For a Europe that controls product details in the Single Market, this is long overdue.

It is also crucial that the criteria of the Reactor Safety Commission are taken into account in the criteria for the European stress test, in order to ensure that other European countries do not continue to operate nuclear power plants (and potentially attempt to export the electricity they generate to Germany), which despite passing the European stress test, would not meet the criteria of the Reactor Safety Commission.