

■ Opening Introductory Notes

- The Significance of Research and Education for Renewable Energies
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The Significance of Research and Education for Renewable Energies

Ladies and Gentlemen,

I am pleased to have this opportunity to address a few words to you, the participants in the Science Forum. This is an area in which I take a great interest against the background of the Renewables 2004 Conference which has just started. First of all, however, I would like to pass on greetings and best wishes from Minister Bulmahn who is unfortunately unable to be here today.

The agenda of the Science Forum is topical in the best sense and gives us good reason to expect an animated and result-oriented discussion. I support the Forum's objectives to analyse and improve the effects of research and education in the field of renewable energies under the different social conditions prevailing in the different countries of the world.

The Renewables 2004 Conference, at which, as I have heard, more than 1000 representatives of governments, international organizations and industrial companies are expected, is intended to advance the development and expansion of renewable energies world-wide in a win-win strategy for both industrial and developing countries. The Conference's political message is that renewable energies are of great importance for climate and resource protection, for fighting poverty, and for development, as well as for technological innovation, trade and industry, and employment.

Energy is a key issue for the future development of the world.

The World Summit for Sustainable Development in **Johannesburg** once again underlined the prominent role of access to energy. The global demand for energy is increasing rapidly, particularly in developing and threshold countries which want to catch up with the economic development of the industrial nations. At the same time, approximately 1.7 billion people,

particularly in the southern hemisphere, have no access to electricity. Access to clean and affordable energy is a precondition for combating poverty, for economic development, and for improving the health of the population and their educational systems.

The catching-up process which is currently taking place in developing, threshold and transitional countries exacerbates the risks to the climate, the environment and safety which already prevail as a result of the largely unrestricted use of fossil sources of energy in the industrial states. The challenge which we are facing is to satisfy this demand for energy sustainably and to support renewable energies and the use of energy efficiency potentials as an alternative in all parts of the world.

However, sustainable development is not conceivable without the extensive reform of energy systems world-wide. To achieve this, we must increase efficiency at all levels of the energy system, reduce global emissions, and extend the technical-industrial energy base. All this must be done primarily through the mass use of renewable energies.

This means that the change in course towards sustainability in the field of energy is the first step into the solar age.

Sustainability begins in one's own country.

Allow me therefore to make a few brief observations on the Federal Government's energy policy. The Federal Government approved a strategy on sustainable development in 2002. The aim is to harmonize ecology and the economy in order to be able to ensure that the German population can continue to enjoy a high quality of life in future.

When we speak of sustainability on a national scale, we are talking first and foremost about the use and the consumption of energy. However, the emphasis on the promotion of renewable



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energies does not mean that only the use of renewable energies or renewable resources is compatible with the guiding principle of sustainability. After all, the use of renewable energies, solar energy for example, is always linked with the use of non-renewable resources, for example non-energetic commodities and materials, whose supplies are also limited. The use of limited energy resources is only sustainable as long as we succeed in making a technically and economically usable energy basis available for coming generations which is at least equally large. Awareness of this fact is essential because we are dealing with a change in energy supply structures which will continue over several decades and in which non-renewable energies will continue to play a decisive role.

Economic efficiency is a central principle for the realization of a sustainable energy supply in this context, and it must also be the objective of research and development in the energy sector. Research must compensate for the consumption of resources. Energy research – energy consumption.

Germany aims to double its energy efficiency by 2020 (compared with 1990). This is not only wise from the environmental point of view, it also makes sense economically: only the prudent and responsible use of energy can release resources, extend economic opportunities and trigger a surge of innovations which create employment.

The Federal Government's energy policy is consistent. The environmentally friendly expansion of renewable energies is a cornerstone of sustainable energy supplies. We have succeeded in introducing new framework conditions with the Law on Renewable Energies (EEG), the "100,000 Roofs" programme and other funding programmes.

Renewable energies currently account for 2.9% of overall primary energy consumption in Germany and 7.6% of electricity production, with a rapid upward trend. Today Germany accounts for half the wind turbines that are built world-wide. In the meantime, the installed capacity of wind power plants totals approximately 13 GW. The Law on Renewable Energies

(EEG), which is due to be amended soon, aims at increasing the share of renewable energies in electricity production to 12.5% by 2010 and to at least 20% by 2020. In its latest study entitled "Energy – the change of course towards sustainability", the Federal Government's scientific advisory council on global environmental changes assumes that renewable energies will cover over half of energy consumption by the middle of the century.

The large-scale expansion of renewable sources of energy represents a huge technological and social challenge which can only succeed if considerable efforts are made in the field of research and development throughout the world. This includes research in science and technology as well as in the social sciences. Steps must be taken to identify barriers to the rapid expansion of renewable sources of energy, and strategies must be developed to overcome these barriers. At the same time, research is also needed into strategies for acceptance and dissemination, both in industrial and developing countries.

The promotion of research in the field of renewable energies is an integral part of energy research policy. The significance of energy research for sustainable development is derived from the basic fact that an increase in knowledge enhances the ability to shape advancements – and the resulting progress in technology creates the basis for maintaining and expanding the scope of future generations for development. It is a well known fact that research and development are the only systematic way to achieve progress and innovations in energy supplies which are both economically feasible and adapted to the needs of generations to come.

The Federal Government is currently providing funds totalling more than 400 million Euro per year to energy research, more than two fifths of which are available for research and development in the field of renewable energies and the rational use of energy. In addition, it is also providing more than 200 million Euro to promoting installations for the use of renewable sources of energy, with emphasis on the heat market and photovoltaic systems in schools, as well as gaining energy from biomass.

Should Germany, together with other states in the European Union, succeed in realizing the goal of spending 3 % of GDP on research and development in 2010, this will considerably extend the scope for energy research.

It is rightly expected that research and development should make a considerable contribution towards tapping the potential of renewable energies and offering corresponding energy services on the market. However, there are still a lot of problems to be solved from the technical point of view before energy from renewable sources can compete with energy from fossil sources or nuclear power as far as cost is concerned. We are on the right path, but we have not yet reached our goal.

In view of the long-term nature and the extent of the necessary changes in the technological and economic basis of energy supplies, the technology portfolio on which innovations are based must be sufficiently broad to ensure that new options for energy generation are available in good time. Priority should thereby be given to:

- Research into technologies which are essential for the long-term evolution of energy systems (e.g. photovoltaics, energy efficiency);
- The further development of technologies which only require small steps in order to open up new markets (e.g. solar-thermal power stations and wind energy in developing countries, biogenic synthesis gas);
- The optimization and adaptation of technologies which can already be used cost efficiently (e.g. solar and energy-efficient buildings, photovoltaic electricity generation for off-grid uses, the modern exploitation of biomass).

To this end, we are pursuing a funding policy aimed at securing Germany a top position internationally, ensuring technological diversity, the linkage of excellent basic research with technological development, the technical optimization of renewable energies, and integration in the national energy supply system.

I attach particular importance to one factor in achieving this task: The excellence of application-oriented and basic research in the use of renewable sources of energy. This is and will remain the precondition for the development of better conversion technologies and cheaper sustainable energy supply systems. Furthermore, important tasks must also be accomplished outside the field of energy research. Because, in principle, there are many different promising paths towards energy conversion, it is important to promote both application-oriented and basic research and market-oriented technological development. The BMBF is therefore providing 10 million Euro per year towards the specific formation of networks in the field of basic research between universities, institutes of the Max Planck Society and other non-university research establishments.

Let me briefly mention some important thematic focal points of national research funding:

- **Photovoltaics:** here the focus is on industrial processes to reduce the cost of producing solar cells and modules and to increase efficiency.
- Funding in the field of **wind energy:** here funding is aimed at the development of wind power plants for offshore operations. Research platforms are being erected in the North Sea and the Baltic Sea to test meteorological conditions and the effects on the ecological environment.
- In the field of **electricity generation using geothermal heat:** the hot-dry-rock process is being further developed at several sites. Furthermore, fundamental questions concerning the geo-scientific and economic conditions for the use of heat from hot deep waters are being examined.
- Research is being conducted into parabolic channels, tower and dish/stirling techniques for **solar-thermal power stations** with the aim of introducing these products onto the market. Apart from funding for new and further developments in receiver and storage systems, optics and controls, funds are also being provided for the construction of demonstration plants as the basis for commercial power station planning. The "Solarthermics 2000" programme is

examining the long-term performance of thermal solar systems using demonstration installations as well as techniques for the seasonal storage of heat.

- Funding in the field of **biomass** research focuses on obtaining fuels, improving both the technologies for using and the opportunities for exploiting heat, electricity and fuels from biomass, as well as obtaining biogas and the use thereof.
- Research funding in the area of **fuel cells** is focused on the development of technologies which can lead to less expensive production processes and more reliable operations.

The further development of existing energy supply structures in Germany will pay more heed to the increased use of renewable energies. This applies in particular to the structure of electricity grids, which in future must enable both a greater decentralization of energy production as well as stronger networks over in some cases greater distances. There are already signs that this is the case with the use of wind energy. Changes in the structure of fossil power stations due to the new buildings required must be included in measures to optimize the overall system. Approximately 60% of today's power station capacity will have to be replaced by 2020. The demand for replacement technologies in German power stations over the next two decades will thus create the necessary scope for far-reaching changes in the type of energy supplies. It is important to make use of this scope now, and in the future, by providing sustainable energy services both as required and in good time.

Sustainable energy supplies, as a national and global task, and the contribution of renewable energies to solving this task demand a strong international orientation: Research and technological developments for applications in southern climate zones and Eastern Europe will have to play a greater role in future. Here it is a matter of including the extremely wide range of user requirements – such as energy supplies in rural areas with poor infrastructure, energy demand in large conurbations and the preparation of drinking water by means of sea water desalination – in the funding concept and closely

linking the use of renewable energies with a very rational use of energy.

This means that international pilot projects are becoming essential in addition to national measures – always with scientific support and a sound evaluation of the experience gained.

One of the main obstacles to the broader use of renewable energies is the lack of knowledge about their functioning and lack of skills in their application. Providing such knowledge is the task of education and training.

Well-educated people are one of the most important driving forces for innovations and for economic and societal progress. Technologies which spare resources, ecologically and socially compatible forms of trade and industry, but also social modernization which concentrates on creativity, entrepreneurship and human responsibility cannot be realized without a corresponding range of educational services. The Federal Government together with the Länder has therefore introduced the so-called "Programme 21" for sustainable development. This will give important momentum in the following areas:

- Interdisciplinary teaching concepts which underscore the connection between ecological, economical and social aspects on the basis of concrete topics.
- Firms set up by school students to provide experience in sustainable commerce. The many forms of cooperation between schools, local authorities and companies within the framework of sustainable regional development are good examples of the opening of schools to practice-related activities. A good quarter of the schools involved gave clear priority to energy-related topics, including aspects of energy, energy consumption and energy savings. In the meantime, the operation of solar energy plants is a matter of course for a whole number of schools.
- In addition, the topic of energy is being discussed in more complex contexts in class, e.g. within the framework of a sustainability audit or cooperation in a Local Agenda 21 project.

The Programme 21 will be successfully concluded this summer. Now it is a matter of firmly anchoring this good practice in as many schools as possible and implementing the results of the programme in day-to-day activities. The Federal Government is in the process of tackling this task together with the Länder and is launching a corresponding transfer programme.

The United Nations have designated the years 2005 to 2014 the decade of "Education for Sustainable Development". During this decade, we will work intensively to expand and secure the position of education in sustainable development in the education system and to promote international cooperation in this field.

Apart from education in schools, there is also a growing demand for vocational training in the field of sustainable development. Considerable experience has been gathered at approximately 20 national conferences involving over 800 experts from various institutions in the field of vocational training at schools, firms and other educational establishments. This experience has been included in an orientation framework for vocational training. The following criteria have been established:

- Central competencies that are relevant to sustainability must be identified and taught as an integral component of professional activities. (Key words here are: systematic and networked thinking, the ability to deal with complex ideas and business cycle structures, social sensibility and a high degree of competency in the field of communications and counselling, also in an intercultural context.)
- Identifying and teaching specific vocational competencies. (The focus here is on the inclusion of the above mentioned aspects of professional activities by combining them with vocational and methodical topics in a general system of initial and continuing vocational training.)
- Recognizing future-oriented areas of activity in the field of sustainability at an early stage, training the necessary teaching staff, and developing new occupational profiles (preparing for the use of "clean" technologies); this also includes deliberations on "sustainable" mobility.

- Recognizing new fields of technology and branches of growth in order to put them at the service of society and trade and industry.

The introduction of these processes requires measures and agreements on increased cross-border international cooperation and on the development of a structure for communication and dissemination that also takes particular account of the requirements of the developing countries.

In Germany, we are including the guiding principle of sustainable development in all training directives which regulate the company-based part of vocational training. Extensive activities are still needed in order to realize this aim. We are just beginning a programme of pilot schemes to test ways of introducing sustainable methods in initial and continuing training. By setting up an Internet portal and creating a community, the BMBF will establish a joint address for the numerous activities of the diverse stakeholders in vocational training as suppliers and demanders of knowledge and experience. We plan to steadily expand this communications platform and to give international partners the opportunity to participate in this exchange of knowledge and experience.

A sustainable supply of energy based increasingly on renewable resources is not feasible without qualified production and service staff, with responsibility for building and operating energy plants for example, as well as qualified personnel to advise users and clients. Qualifications are therefore a precondition and in a sense a synonym for innovative ability. Innovative ability means being fit for the future.

Thank you for your kind attention and thanks also to the organizers of the Forum [ForschungsVerbund Solarenergie]. I would like to wish this event every success.

Science and Education as a Key to Development

Mr. Chairman,
Your Excellency,
Distinguished Participants,
Ladies and Gentlemen,

As the head of UNESCO delegation participating in this “Science Forum on Research, Development and Education – the Basis for Wide-spread Employment of Renewable Energies”, let me first say how pleased I am to take part in this Opening Session of this Forum.

We live in the age of the “knowledge-based society” where knowledge plays an increasingly important role in sustainable social and economic development. Science and education is an essential and interlinked key to this very development.

Knowledge relates essentially to science and technology, and education and training are vital in networking and the transmission of knowledge to build capacity – so that knowledge can be applied where it is needed. For UNESCO, this includes a priority focus on the developing and least developed countries. For UNESCO, this also includes a focus on applications in science and technology – and this includes, importantly, energy and renewable energy.

The development of science and technology has brought tremendous changes to our lives. The exploration of outer space, the development of conventional, nuclear and now renewable energy technologies, the invention of electronic computers and a range of other innovations mark an epoch in the history of civilization. One is often tempted to ponder how many new discoveries and innovations are in the pipeline, and how they will affect our lives over the next few decades!

It is hard to imagine what our lives would have been like without all the benefits which scientific knowledge and engineering skill have given us. The crucial point here, of course, relates to

access, as these benefits are unevenly distributed – there are millions of people who do not have such access to these benefits of science and technology, who live in poverty and destitution. This presents an ongoing overall challenge for research, development and education in science and technology, particularly in such an area as energy – where access is very unevenly distributed.

Strategy for Sustainability

The World Summit on Sustainable Development and the United Nations’ Millennium Development Goals place the promotion of sustainable development and renewable energies high on the international agenda. In line with UNESCO’s Medium-Term Strategy and our contribution to sustainable energy and development, UNESCO will continue to advocate for energy efficiency, diversification and renewable energy. This includes capacity-building, development of human and institutional resources, awareness raising and prioritising the use of renewable energies and provision of related policy advice. There is an emphasis on improving the living conditions in rural areas of poor countries, especially in the developing countries and small islands states.

Within the Global Renewable Energy Education and Training (GREET) Programme and its regional component, with particular emphasis on its African Chapter, we emphasise capacity building and development of co-operation in the renewable energy sector to promote renewable energies. Activities focus on the improvement of use, maintenance and management of solar energy projects and programmes, and transfer of technological know-how.

This involves the design and field implementation of training platforms, the elaboration and dissemination of learning and teaching materials,



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introduction of training programmes at all educational levels, setting of educational standards and certification of centres of excellence to serve as a catalyst. Concurrently, support is given to the definition of national energy strategies and experimentation of pilot projects focused on development goals. We also foster advocacy and awareness-raising to stimulate the use of renewable energies to meet the Millennium Development Goals and to improve living conditions in rural areas. Further extra-budgetary resources need to be mobilised to extend the scope of activities.

The promotion of renewable energies to address developmental goals will be pursued in association with UNESCO programmes in the Natural Sciences, Education, Social and Human Sciences, Communication and Information Sectors, and with intergovernmental programmes at UNESCO. Consultations with relevant and competent United Nations agencies and programmes will continue, including participation in the United Nations Ad hoc Inter-Agency Task Force on Energy and cooperation with competent national, regional and international NGOs.

Raising Awareness

UNESCO has contributed to the World Solar Programme in raising awareness on potential and opportunities for utilization of renewable energy. Projects implemented in this activity have created awareness at political and in particular government levels. The Honduran government, for example, used the Solar Village Demonstration Project to source funding for more solar village projects. Electrification of schools has provided a linkage between education and energy. Children have become aware of benefits of solar energy applications. The project has contributed to broaden children's knowledge through exposure to new educational technologies using computers, providing access to information, and communication via the internet.

Through such projects, rural business operators have realized opportunities to extend their business operating hours by using solar energy

for lighting. The Honduran project has also contributed to raising awareness of the people in the community about the opportunities in micro-enterprises through television and via internet. Solar village electrification has also contributed to raising awareness on HIV/AIDS through public media such as television.

Capacity Building

Capacity building in renewable energies through implementation of education and training activities is the main focus of the GREET Programme. These activities have focused on the organisation of summer schools, training of trainers and implementation of the Renewable Energy Training Platform. Training activities aim at enhancing knowledge of managers, engineers, technicians and trainers on use, application and maintenance of renewable energy technologies.

Learning and teaching materials produced within the GREET programme serve as a tool to assist in teaching courses on renewable energy in universities and also as a reference material for the scientific community. The Renewable Energy Training Platform to enhance local capacity and expertise in renewable energy use and applications will be duplicated and implemented in other countries and regions to develop and enhance local capacity building on the use and maintenance of renewable energy systems. This will improve the implementation of renewable energy projects and contribute to their sustainability.

Through the GREET Programme, a series of books for use in primary schools has been developed for incorporation into the school curriculum for English speaking countries in Africa. This material has contributed to enhancing knowledge on renewable energy systems. A series of text books, composed of six volumes, has been produced and distributed through the Ministries of Education in 14 Southern African countries. This links to UNESCO's wider activity under the New Partnership for Africa's Development (NEPAD) and cooperation with the African Union in science and technology.

UNESCO has also cooperated with Wiley Publications in the production of a “UNESCO Energy Engineering Series” of learning packages. This series includes, amongst others, titles on Solar Electricity, Geothermal Energy, Electric Power Generation, and Energy Planning and Policy.

This series has been most successful, with some titles already in second edition. Most recently, we have updated and republished the volume on Geothermal Energy and published a new volume on Solar Detoxification and two related volumes on Solar Photovoltaic Systems and Project Development. We have also produced a video and booklet entitled “Rays of Hope: Renewable Energy in the Pacific” – which examines the pioneering use of renewable energy in the Pacific islands.

Mr. Chairman,
Ladies and gentlemen,

Let me conclude by noting again the overall importance of research and development, education and training in the knowledge-based society and economy. This is particularly important in promoting the development and widespread employment of renewable energies.

I mentioned at the beginning that knowledge relates essentially to science and technology, and education and training are vital in networking and the transmission of knowledge to build capacity – so that knowledge can be applied where it is needed.

To do this, it is essential to create linkages, to develop and share models and information, learning and teaching materials. This is what has happened at the solar school project facilitating internet access in Honduras, and the solar village project raising awareness on HIV/AIDS in Zimbabwe.

I also mentioned at the beginning that we need to promote access to the benefits of science and technology for the millions of people who live in poverty. It is no small irony that our planet receives enormous quantities of solar energy and that much of this energy falls on

developing countries, where many poor people live.

We face a vital challenge to enhance our efforts to focus research, education and training on renewable energy for the benefit of developing countries. Promoting access to energy and the benefits of science and technology is a vital dimension for poverty reduction in developing and least developed countries.

Finally, let me say that, together with my colleagues from UNESCO, I look forward to the outcome of your discussions and hope that the Forum will succeed in laying the foundation and taking further actions that will result in a major drive to improve the world energy situation in this millennium.

I wish you every success in your important deliberations and look forward to the results of your presentations and discussions.

Thank you.