Proposal for an International Science Panel on Renewable Energies (ISPRE)

There is a broad, growing consensus that modern renewable energy technologies must become a major part of the world's energy supply mix in the coming decades, in order to transform the energy systems in both industrialized and developing countries towards more sustainable pathways. Ongoing technological innovation resulting from basic R&D efforts will be an essential element in this process. Assuring that the needed innovations occur as swiftly and cost-effectively as possible will require mechanisms for objective scientific and technical guidance, and for greater interaction among national- and sectoral- based energy R&D activities. The efforts proposed herein, for establishing an International Science Panel on Renewable Energies (ISPRE), are designed to meet this pressing need, as was called for in the International Action Programme of the Renewables 2004 conference in Bonn.

The mission of ISPRE is to provide strategic guidance for renewable energy R&D efforts worldwide, in order to improve the effectiveness and coherence of R&D efforts being implemented at national, regional, and international levels. The Panel's tasks will include compiling information about the current state of R&D efforts, identifying critical gaps in existing efforts, and recommending future R&D priorities and strategies. In order to assure that ISPRE assessments are responding to the information needs of a clearly-defined and relevant audience, efforts will be made to have ISPRE linked directly with REN21 (the Renewable Energy Policy Network for the 21st Century). The International Council for Science (ICSU), working together with partner organizations as appropriate, will serve as a sponsor of ISPRE, to help ensure balance and scientific rigor in the Panel's efforts.

1. *Historical Context*

Energy lies at the heart of the sustainable development challenge as it is closely linked to both development and environmental issues. Reliable and affordable energy services are an essential prerequisite for combating poverty, and at present at least one third of the world's population lacks access to modern energy services. At the same time, the use of fossil fuels in industrialized and rapidly developing nations is responsible for an array of serious environmental and public health threats, ranging from indoor and local-scale air pollution to global-scale climate change. Against this background, Member States of the United Nations agreed at the World Summit on Sustainable Development in Johannesburg 2002 to improve access to "reliable, affordable, economically viable, socially acceptable and environmentally sound energy services and resources" and "with a sense of urgency, to substantially increase the global share of renewable energy sources with the objective of increasing its contribution to total energy supply".

The Renewables 2004 conference in Bonn became part of the international response to these challenges. Delegates from 154 countries, as well as representatives from international organisations, the private sector, non-governmental organisations and other stakeholders – shared the vision "that renewable energies, combined with increased energy efficiency, will become a most important and widely available source of

energy and will offer new opportunities for co-operation among all countries". The International Action Programme from this event contains ambitious national targets for the expansion of renewable energy in more than 20 countries, financial commitments by governments and financing institutions, commitments in the area of research and development, and initiatives for an increased co-operation with developing countries. A subsequent international conference in Beijing in 2005 reviewed and strengthened the commitments made in Bonn. In February 2005 the Kyoto Protocol came into effect; and it is widely agreed that achieving the CO_2 emissions reductions mandated by the Protocol will require substantially broader deployment of renewable energy technologies.

These developments make clear that renewable energies are assuming a place of central importance on the international political agenda. Achieving the goals and commitments that have been made in recent years will require mechanisms for rigorous, objective scientific analyses and technical guidance. The efforts proposed herein, for establishing an International Science Panel on Renewable Energies, are designed to meet this pressing need.

We suggest that ICSU, working in partnership with other organizations, would be an appropriate entity to oversee such an effort. Achieving a global transition to more sustainable energy systems will require harnessing the full expertise and creative power of the world's research communities. It will require much greater interaction among scientists and engineers in different parts of the world, and among the wide array of technology sectors and scientific disciplines that can potentially contribute to this challenge. Building these types of international and interdisciplinary linkages is a core part of ICSU's mission. ICSU's standing as an objective voice for the international scientific community is also of great value in this context, given the highly politicized nature of energy issues and the consequent difficulties of finding truly independent platforms for discussion and assessment.

2. Vision and Rationale for ISPRE

Today's global energy supply is mainly based on fossil fuels and nuclear energy. Approximately 13% of the primary energy supply comes from 'traditional' renewable technologies such as hydropower, biomass, and geothermal. 'Modern' renewable technologies such as wind, solar hot water, solar photovoltaics, and advanced bioenergy, are starting from a much lower base, but have the potential to become a major part of the world's energy mix in the coming decades. Such a transition would contribute substantially to the protection of the earth's natural life-support systems, would promote peace and security by further decentralizing energy sources, and would help improve the well-being and economic prosperity of billions of people around the world who currently lack reliable, affordable energy services.

The process of transforming global energy systems towards more sustainable pathways will need to be driven in large measure by appropriate economic policies and incentives enacted by governments and the private sector. Just as important however, is the need for ongoing technological innovation. The degree to which the potential of renewable energy technologies will be realized depends heavily upon R&D strategies and investments now and in the coming decades.

Although many renewable energy technologies are rapidly developing, and some of these technologies are now economically competitive and widely used, it is acknowledged that no existing solutions are yet sufficient for meeting the tremendous, diverse global energy needs of the coming decades. Much more work will be needed for a new generation of clean technologies for heat, fuels and electricity to reach the mainstream market. Advancing cost effectiveness and market penetration of renewable energy systems requires improved energy conversion techniques, supply structures and end-user technologies. It also requires more effective strategies for disseminating new technologies, innovative market development and financing mechanisms, and enhanced efforts in capacity building and public education. These advances must be driven by strategies that encompass basic research in the physical and social sciences, early deployment and identification of niche markets, and eventually the development of large markets.

Innovation and development of energy technologies occur over a range of different timescales. In the near-term (<10 years), relatively incremental changes can be made to existing technologies (e.g. to enhance efficiency or cost-effectiveness), which may help to expand market niche and penetration. In the mid-term (10-30 years), substantial new advances could lead to the deployment and implementation of currently embryonic technologies. In the long-term (>30 years), fundamental new scientific discoveries may being about dramatic transitions in global energy systems. There are a number of factors that currently impede progress across all of these timescales. For instance:

- There are no accessible, comprehensive sources of information about the current status of renewable energy R&D efforts around the world, particularly for the developing countries that are not included in OECD analyses. Without a central, objective source of information and analysis, it is difficult for policymakers, funding agencies, industry leaders and other relevant stakeholders to design optimally effective R&D strategies. Although many national-level assessment and strategic planning reports exist, there is no mechanism to compile such reports and assess what important topics are not being addressed, and what types of new efforts and collaborations are needed to fill the identified gaps. Stronger communication and coordination among national-level R&D efforts could help avoid unnecessary redundancies, missed opportunities for productive collaboration, and problems of critical R&D topics 'falling through the cracks' between national programmes.

- The different renewable energy technology sectors (solar, wind, biomass, etc) are highly fragmented, with little interaction or collaboration among them. Yet many key research topics (e.g., energy storage, hydrogen production) are relevant to more than one type of renewable energy technology. When development prospects for these different technologies are viewed in isolation from each other, one misses important linkages and opportunities for synergies in R&D and implementation strategies.

- Government investments in renewable energy R&D, as a share of total energy R&D spending, have been declining over the past three decades. At the same time, deregulation and competitive forces in the energy industry have led to private sector R&D investments being redirected from longer-term, basic research towards low-risk, market-oriented research. There is clearly insufficient support for the fundamental research that is needed as a foundation for major steps forward in technological innovation. The need however, is not only to expand the base of funding, but also to ensure that the available funding is used as strategically and efficiently as possible, and to move beyond 'black-box' indicators of R&D progress (based on simple tracking of funding trends), towards more substantive evaluations of the effectiveness and outcomes of these investments.

- Many efforts to disseminate new energy technologies within developing countries have had limited or no success, because the introduced technologies were poorly adapted for local needs. Likewise there have been instances of unanticipated public opposition to new renewable energy projects in many parts of the world. Understanding and anticipating such problems requires a much greater role for the social sciences in designing and implementing renewable energy R&D efforts.

- Although the transformation of the global energy system is an issue of critical concern for the entire world community, the vast majority of energy R&D work is carried out by a small number of industrialized nations. There is a need to move beyond a traditional 'technology transfer' mentality, towards a greater focus on building the indigenous technological capabilities and scientific knowledge of all nations.

There is a clear and compelling need for developing new ways to overcome such barriers – to foster more interaction among national and sectoral-based energy R&D efforts, and to provide guidance in the development of coherent strategies for advancing sustainable energy systems worldwide. Existing organizations such as the International Energy Agency may offer ways to address some of these issues for OECD member countries, but there is a need for comparable mechanisms that are truly global in scope, and that are firmly rooted in the scientific community. In recognition of this need, there have been calls at several international gatherings for establishing an International Science Panel on Renewable Energies (ISPRE). Most notably, the establishment of ISPRE was included in the International Action Programme of the Renewables 2004 conference in Bonn (www.renewables2004.de).

3. Mission and Tasks for ISPRE

It is proposed that the central mission of ISPRE should be to provide strategic guidance for renewable energy R&D efforts worldwide, in order to help improve the effectiveness and coherence of R&D efforts being implemented at national, regional, and international levels.

To carry out this mission, the main tasks of ISPRE may include some or all of the following:

- to compile information about the current state of renewable energy R&D efforts taking place worldwide;
- to identify critical gaps in existing efforts, and 'white spots' on the global R&D map where needed information is not available;
- to develop recommendations for future R&D priorities and strategies;
- to identify opportunities for enhancing synergies and R&D collaborations among public, private, and academic sectors at national, regional and international levels;
- to recommend strategies for fostering greater interaction among nationally-focused and disciplinary-focused R&D efforts;
- to help inform national and international financial institutions of the value of investing in renewable energy R&D efforts, and to help link targeted R&D efforts to existing economic development and technology demonstration projects.

ISPRE will not be directly involved in the development of energy policy or make policy-prescriptive recommendations, but rather will help bridge the way from science to sound policy-making.

ISPRE may recommend strategies for strengthening educational and training efforts, but will not itself organize or carry out educational and training programmes.

These analyses will be communicated in assessment reports, advisory briefs, and other publications as appropriate. The specific focus and timing of ISPRE reports will be determined in accordance with the needs expressed by the sponsors. It is anticipated that a major assessment report will be issued / updated approximately every two years, and that additional publications focused on specific technical topics may be carried out on a more frequent timescale as needed.

4. Audiences and Communication Plan

Past experience has shown that scientific assessment efforts have the greatest impact when they are carried out in response to specific requests from a well-defined audience, considering for example, the Intergovernmental Panel on Climate Change, a scientific assessment body whose work is targeted to meet the information needs of the parties to the UN Framework Convention on Climate Change. To this end, efforts will be made to have ISPRE linked directly with a relevant international policy body. Of particular interest is REN21 (The Renewable Energy Policy Network for the 21st Century; www.ren21.net), a global network of representatives from national, regional, and local governments, and intergovernmental, non-governmental, industry and finance organizations, aimed at expanding the use of renewable energies worldwide. As the scientific community is not yet sufficiently represented within the REN21 network, it is anticipated that ISPRE could provide a valuable contribution to the work of this organization.

At the same time however, ISPRE should be able to function as an independent entity that serves the needs of all governments, NGOs, and other audiences that need objective information and analysis related to renewable energy R&D. It is anticipated that ISPRE's efforts will be of value and interest to a wide array of policymaking bodies, funding agencies, and scientific and technical communities worldwide. ISPRE findings and reports can be communicated to this broader audience through a variety of channels, including presentations at major international conferences and meetings. ICSU's Regional Offices and National

Members will also provide a valuable conduit for disseminating information to the relevant stakeholders at the regional and national levels.

A logo and standard publication design shall be developed to provide a unique visual identifier for all ISPRE products. In addition, a website for the organization shall be established to help ensure worldwide access to information about ISPRE efforts. (The website www.ispre.org has already been reserved).

5. Organisational Structure and Composition

The organizational structure for ISPRE will be designed to minimize bureaucracy, to use human and financial resources as efficiently as possible, and to assure effective communication among the Panel members and the target audiences.

The central ISPRE Advisory Panel will include not more than 20 members, and to be led by one Chair and two Vice-Chairs. Panel members will be appointed for a period of two years, with the possibility of being re-appointed one time. The initial Panel appointments will include three-year terms for half of the Panel membership, so that the subsequent turnover can be staggered, ensuring a degree of continuity in the Panel membership.

The Panel membership (especially those in leadership positions) should include people with broad-based experience and perspectives, who can help the group to look across the specific technical areas of expertise. The membership criteria shall be periodically revised or augmented as required, to best meet the needs of specific ISPRE tasks. Subsidiary working groups may also be established when needed, to provide in-depth focus on specific topics of interest. Individuals with expertise in topics of critical importance may be invited to contribute to the Panel's work on an ad hoc basis.

The primary consideration for selecting Panel members is to attract the most highly qualified experts in the critical areas of specialisation; however, a number of other balance factors will be carefully considered. For example, a concerted effort will be made to include female candidates, and to include representation from the private sector. The matter of geographic balance is particularly important, as ISPRE must be a truly international body that can take account of differing national and regional needs and perspectives. To this end, the Panel should include representatives from a wide array of developing and industrialized countries.

For the process of appointing panel members, the ICSU will seek nominations from its membership and from other relevant science, engineering and policy organisations. The ICSU Committee on Scientific Planning and Review (CSPR) and Executive Board (EB) will review nominations and select Panel members. The Panel may include experts coming from particular key institutions (such as IEA, UNEP, etc.), but they will be expected to serve as individual experts, not as institutional representatives or political appointees.

6. Scope of ISPRE Efforts

The range of topics to be addressed by ISPRE will include the optimization of renewable energy technologies that are already widely used, the further development of emerging technologies that have the potential to make substantial future contributions to global energy supplies, and the examination of numerous cross-cutting issues related to the design and implementation of energy systems and services. The Panel's focus will extend from basic scientific research to issues of technology development, demonstration, and deployment. Accordingly, it is expected that Panel membership will include expertise in areas such as those listed below. This list is intended only to give a general sense of the range of issues to be covered, not to suggest pre-determined slots to be filled on the Panel.

individual technical sectors:

- Biomass energy and biofuels
- Geothermal energy systems
- Ocean-energy systems

- Photovoltaics
- Small-hydro energy systems
- Solar heating, cooling, and dehumidification
- Solar-thermal power plants, solar chemistry
- Wind energy systems

cross-cutting sectors:

- Energy policy and economics research
- Energy systems (energy storage, grid integration, hydrogen, end-user applications)
- Environmental impacts and 'sustainable potential' of renewable technologies
- Planning and design of the built environment
- Public acceptance of energy technologies and policies
- Resource assessment and mapping, energy meteorology

7. Operational Support and Data Management

An ISPRE Secretariat shall be established, to provide a central point for coordinating and supporting the work of the Panel. It is expected that a full-time staff of three people (two scientific/management positions and one administrative position) will be needed for staffing the Secretariat. Responsibilities of the Secretariat may include, for instance:

- managing the organization's budget
- overseeing the development and dissemination of reports
- organizing Panel meetings
- collecting reports, data and other information for the Panel's analyses
- managing the organizations website and databases
- providing a central nexus of communication among all of the Panel members

ISPRE's assessment and advisory work may require considerable efforts to compile and analyze data and information on R&D funding and research activities around the world. The Panel will rely to the greatest extent possible on data that is originally collected by other organizations such as the IEA, though it will likely be necessary to augment and build upon this existing information. Sound data management mechanisms and protocols will be needed for effectively supporting the Panel's work. This must include for example, centralized databases that are transparent, user-friendly, and easily accessible by internet.

8. Budget and Funding

Initial seed funding was provided by German government to cover the activities of the ISPRE Planning Group; but for supporting the work of ISPRE itself, a broader, long-term funding base will be required. A rough preliminary budget of 1.5 million USD per year has been estimated as the minimum needed to adequately support the work of ISPRE. This is intended to cover the following costs:

- Three persons permanent full-time staff: 300,000 USD
- Operation of a secretariat, office and technical facilities: 200,000 USD
- Two panel meetings per year: 200,000 USD
- Operation of subsidiary working groups and external experts: 500,000 USD
- Publication and dissemination of ISPRE reports: 300,000 USD

Potential funding sources are likely to include many of the same organizations that are among the target audiences for ISPRE. This may include governmental and non-governmental organizations (national, regional, and international entities), industry consortia, and private foundations. It should be noted that REN21 has recently established a fund-raising group to seek long-term funding sources for the organization;

and if ISPRE were to become a formal part of the REN21 structure (as discussed earlier), it is possible that support for ISPRE could be covered as part of the general fundraising strategy for REN21 as a whole.

9. The Role of ICSU

The International Council for Science (ICSU), which has a long history of initiating and overseeing major international research and assessment activities (see www.icsu.org), has been asked to serve as the primary institutional home for ISPRE. ICSU's broad-based international and interdisciplinary membership can provide a strong, diverse scientific foundation for informing about ISPRE's work, and in turn can provide a valuable conduit for disseminating ISPRE reports among national-level policy makers.

Once the ISPRE activity is established, ICSU will provide general oversight and periodic reviews and will approve new Panel members. ICSU will not however, be involved in the day-to-day operations or management of the programme. ISPRE's funding will be independent of ICSU's larger operating budget.

10. Relations to Other Organisations

There are a large and growing number of organizations that play a variety of different roles in promoting a transition to more sustainable energy systems. For instance, there are numerous international organizations such as the International Energy Agency (IEA) and its Implementing Agreements (IA), the World Energy Council (WEC), the Global Network on Energy for Sustainable Development (GNESP), the Renewable Energy and Energy Efficiency Partnership (REEEP), and REN21 (described earlier), which engage in efforts such as the following:

- helping governments develop and implement sound energy policy;
- promoting the dissemination and use of clean energy technologies;
- gathering and sharing information about worldwide trends in energy production and use;
- initiating new partnerships and cooperative efforts among politicians, business leaders, scientific, technical, and managerial experts.

Essentially all such organizations are focused on expanding the implementation of mature renewable energy technologies[1]. ISPRE, in contrast will focus on promoting the further evolution of energy technologies though basic research and development efforts. This mission is unique, but is clearly related to the goals of other existing organizations. Close cooperation with these other organizations is thus expected.

Another organization that should be considered as a possible co-sponsor of ISPRE is the International Council of Academies of Engineering and Technological Sciences (CAETS). ICSU's membership is rooted primarily in the basic sciences, and CAETS' membership is rooted primarily in the engineering and applied sciences. As energy R&D efforts require a strong foundation in both ends of this spectrum, there is thus a strong rationale for having these two organizations to work together in assuring the quality and rigor of ISPRE activities.

[1] Within the European Union, there are a few existing organizations that do also focus on evaluating and recommending R&D needs in the field of renewable energies; this includes the Technology Platforms of the European Commission / Directorate General for Research, the European Renewable Energy Centres (EUREC), and the European Renewable Energy Council (EREC). Comparable organizations on the global scale, however, are lacking.

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Note: The Planning Group was convened as an ad hoc entity, for the purpose of developing the ISPRE proposal. It is assumed that the Planning Group will be disbanded after this task has been completed, although some members may be asked to serve on the ISPRE panel itself.