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Federal Ministry
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Foreword

The conveners of the International Conference for Renewable Energies, Bonn 2004, present this issue paper as the main substantive preparatory document for the conference. Its role is to develop the key issues before the conference, and to help conference participants identify the scope and the background of the conference. Responses to the issues will be developed through the conference, and captured in the documented outcomes.

Drafts of the issue paper have been discussed by the International Steering Committee and the National Advisory Committee, both formed to advise the conveners in the preparation for the conference. The paper has benefited greatly from these discussions and from the profound experience brought to the table by the participants in the two groups.

A final draft was made available to the public for an open web-based discussion, which generated many useful inputs.

The conveners were assisted by a drafting team, which included Tilman C. Herberg, Mike Enskat, Dirk Aßmann (all Deutsche Gesellschaft für Technische Zusammenarbeit [GTZ] GmbH) and Uwe R. Fritsche (Oeko-Institut Darmstadt).

Contents

List of Abbreviations

ACE	Asian Centre for Energy
ADB	Asian Development Bank
AfDB	African Development Bank
APEC	Asia Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
BASE	Basel Agency for Sustainable Energy
CDER	Centre for the Development of Renewable Energies (Morocco)
CDM	Clean Development Mechanism
CHP	Combined Heat and Power
CSD	Commission on Sustainable Development
Dena	Deutsche Energie-Agentur
DOER	Massachusetts Division of Energy Resources
DSM	Demand Side Management
EBRD	European Bank for Reconstruction and Development
ECA	Export Credit Agency
EDA	New Jersey Economic Development Authority
EIB	European Investment Bank
EJ	exajoules
ESD	Energy Services Delivery
ET	Emissions Trading
EU	European Union
EUEI	European Union Energy Initiative for Poverty Eradication and Sustainable Development
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GEF	Global Environment Facility
GFSE	Global Forum on Sustainable Energy
GHG	greenhouse gas
GNESD	Global Network on Energy for Sustainable Development
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH
GVEP	Global Village Energy Partnership
IDAE	Instituto Para La Diversificación Y Ahorro De La Energía (Spain)
IDB	Inter-American Development Bank
IEA	International Energy Agency
IFI	international financing institutions
IIASA	International Institute for Applied Systems Analysis
IPCC	Intergovernmental Panel on Climate Change
IPP	independent power producer
JI	Joint Implementation
JREC	Johannesburg Renewable Energy Coalition
KfW	KfW Bankengruppe (KfW group)
LPG	liquefied petroleum gas
MEDREC	Mediterranean Renewable Energy Centre
MEDREP	Mediterranean Renewable Energy Programme
MW	megawatt
NEDO	New Energy and Industrial Technology Development Organization
NEPOOL	New England Power Pool
NGO	non-governmental organisation
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
OLADE	Latin American Energy Organisation
PCF	Prototype Carbon Fund
PERMER	Renewable Energy in Rural Markets (Argentina)
PPP	public-private partnership
PV	photovoltaic
R&D	Research and Development
RECS	Renewable Energy Certificate System (Netherlands)
REDP	Rural Energy Development Programme
REED	Rural Energy Enterprise Programme
REEEP	Renewable Energy and Energy Efficiency Partnership
RTD	research and technology development
SBC	System Benefits Charges
SEFI	Sustainable Energy Finance Initiative
SME	small and medium-scale enterprise
T&D	transmission and distribution
TBP	Thematic Background Paper
TERNA	Technical Expertise for Renewable Energy Application
UN	United Nations
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
WBGU	German Advisory Council on Global Change
WEC	World Energy Council
WSSD	World Summit on Sustainable Development

Executive Summary

This paper sets the scene for the International Conference for Renewable Energies, Bonn 2004 *(renewables 2004)*, by highlighting the key issues related to the use of renewable energies for a sustainable global energy future. The paper identifies the most urgent matters that have to be addressed in order to achieve a widespread use of renewable energies, so that determined and practical steps can be taken to increase substantially their global application.

Manifold studies, based on different approaches presented by various institutions from a broad range of political leanings, reach one conclusion: today's global energy system is unsustainable in economic, social and environmental terms. Over one and a half billion people globally have no access to modern energy services, inhibiting their ability to lift themselves out of poverty; most economies increasingly depend on fuel imports; global energy production is one of the main causes of global climate change; people around the world suffer from air-pollution caused by the burning of fossil fuel resources; and fossil energy resources are limited and will become more expensive as energy demand in many regions of the world dramatically increases. The first section of this paper briefly illustrates this **Challenge**. It also shows the benefits of an increased use of renewable energies and how it can substantially help to address this challenge.

The three subsequent sections discuss **the main issues** that need to be dealt with to allow renewable energies to play their role in the future, namely:

- **Policies for Renewable Energy Market Development,**
- **Financing Options for Renewable Energies,** and
- **Developing Capacity for Energy Market Transformation.**

The section on **Policies for Renewable Energy Market Development** lays out some of the most important issues concerning the formulation of an enabling policy environment for the promotion of renewable energies by market forces. It deals with regulatory issues in liberalised energy markets, questions concerning the usefulness of specific targets for renewable energies, and the importance of a level playing field for renewables vis-à-vis conventional energy sources. In particular, it addresses the issue of external costs and how they can be priced in.

This discussion is followed by a comparative presentation of the most important policy support schemes for electricity production from renewable energies, such as quota systems, feed-in tariffs, green certificates and approaches for the improvement of energy access in rural areas of developing countries through specific support schemes for renewable energy solutions.

The remaining paragraphs of this section elaborate upon policy measures for market development of renewable energy in the heat and transport sectors. The heat sector (with biomass, geothermal and solar being the most important renewable energy resources) can benefit from a wide range of possible support schemes for investments in equipment, especially in the housing and construction sector. In the context of developing countries, the unsustainable use of biomass for cooking and other purposes is a central challenge for energy policy-making. The paper argues that there are a number of models for the transition to a modern, sustainable use of biomass. In order to manage the rapid increase in global energy consumption for transport purposes, integrated policy approaches are required that offer a combination of better traffic management, improved energy efficiency and the development of fuels from renewable energy sources.

Section three of this conference issue paper is concerned with **Financing Options for Renewable Energy**. It raises the question of how to finance investments in renewables at the project level. Finance-related risks and barriers hinder renewable energy investments. As most renewable energy projects have high upfront investment costs relative to fossil-fuel technologies, and often low rates of return, their financial attractiveness depends on assumptions made by investors on future market developments. The risks and returns vary widely between markets and technologies: large grid-integrated wind farms in developed countries differ substantially in form and magnitude from village-level micro-hydro or solar photovoltaic (PV) systems in developing countries. A wide range of financing strategies is needed to reflect this diversity, as well as specific financial tools for different technologies and market sectors.

In the discussion about new or adapted financing instruments the section draws a distinction between on-grid and off-grid renewable energy solutions. Whereas on-grid project financing is usually based on the revenue stream from energy sales to the grid, most off-grid solutions involve financing risks that are concerned with the end user of the energy services.

Some of the other issues raised in this section are the potential of public-private partnerships for financing renewable energy projects, the catalytic role of Official Development Assistance (ODA) for increasing energy access through renewables and energy efficiency, and the potential of new financing models and instruments. Carbon financing (CDM, JI, emission trading) is also elaborated upon as an additional opportunity for financing more renewable energy projects.

The third main issue that this paper deals with concerns **Developing Capacity for Energy Market Transformation**. This section addresses three more specific issues that relate to capacity. The increased use of renewable energies requires enhanced public awareness, well-trained professionals ("brainware"), a coherent and functioning institutional framework ("orgware"), and the availability of appropriate and affordable technologies ("hardware"). Capacity development in all three areas is essential for the development of sustainable renewable energy markets; it should be viewed in a broad sense: individual human capital, institutional capacity, as well as research and development including the promotion of innovation.

Human development through education and professional training in the field of renewable energies, and increased general awareness about their potentials and benefits, is seen as the responsibility of national governments as well as the international community. Similarly, appropriate institutional development has to take place at all levels, local, national, regional and international. This can involve national energy agencies, specialised administrative or ministerial units, special focal points in national or international development banks, etc. With regard to the international arena, the paper argues that it is necessary to identify any **functional deficits** in the current international institutional set-up, such as a lack of coordination of research efforts or of systematic opportunities for consultation of national-level policy-makers, and to identify ways in which these deficits should best be addressed. It is widely considered that some form of strengthening of the international scheme is required.

The last paragraphs in this section highlight the needs, for more intensive efforts in research and development if the technologies are to reach their potential and their costs are to be reduced. Research and development has already led to visible results for wind, biomass, and solar energy, and there is significant potential for further improvements. Priorities for the future should encompass a wide range of technological and non-technological issues including such fields as:

- Technologies for renewable energy conversion, storage, transmission, distribution and use.
- Economic, political and institutional schemes for renewable energy systems at all levels (local, national, regional, global), and regulatory solutions for renewable energy.
- Methods of policy-making and planning.
- Aspects of liberalisation, distributed generation and grid optimisation.
- Methods of financing.

This section devotes special attention to the need for increased technology transfer, ideally through market mechanisms.

The last section of the conference issue paper – based on the analysis of the three main issues – addresses **Stakeholders and Their Roles** in overcoming the previously identified barriers to an increased use of renewable energies. It focuses on the role of governmental and legislative actors at national and local level, international institutions, business and the private sector, as well as civil society.

1. The Challenge

This paper sets the scene for the International Conference for Renewable Energies, Bonn 2004 *(renewables 2004)*, by highlighting the key issues related to the use of renewable energies for a sustainable global energy future. The paper identifies the most urgent matters that have to be addressed in order to achieve a widespread use of renewable energies, so that determined and practical steps can be taken to increase substantially their global application.

Energy services are fundamental for human welfare and an important precondition for social and economic development. However, while some economies rely on an excessive use of energy, with high shares of fossil sources, others have only limited modern energy services and overexploit their natural biomass resources. Manifold studies, based on different approaches presented by various institutions from a broad range of political leanings, reach one conclusion: today's global energy system is unsustainable in economic, social and environmental terms.

The challenge is to change course towards a sustainable future; the goals have been set by the Johannesburg Plan of Implementation and the UN Millennium Declaration. This challenge is, however, highly complex and implies different priorities for action for different parts of the world. In facing this challenge the people of the world have a common but differentiated responsibility:

- Over 1.5 billion people, mostly in rural areas in developing countries, have **no access** to reliable, affordable, economically viable, socially acceptable and environmentally sound energy services – a fundamental impediment to their development opportunities and thus the reduction of poverty.
- Increasing **dependence** on fuel imports threatens the security of national energy supply.
- Fossil energy use is by far the largest source of man-made greenhouse-gas emissions, causing global **climate change** with potentially vast adverse social, environmental and economic consequences.
- Energy-related **air pollution** poses major health and environmental risks.
- While known **reserves** suggest that fossil fuels will still be available throughout the 21st century, sources – especially oil and gas – will be concentrated in a few regions and the **costs** of their provision will increase.

The broad question is how to change to a sustainable energy system in an active and timely manner, while allowing for the social and economic development of both industrialised and developing countries and taking into account divergent and specific national conditions. Looking into the future, global energy scenarios reveal a broad corridor of potential developments for energy demand. Building up the necessary supply capacities will to a large extent depend on the commitment to address actively the above-mentioned challenges. The World Energy Assessment (UNDP/UNDESA/WEC, 2000) has studied various scenarios, from a high-growth future of vigorous economic development and rapid technological improvement, to an ecologically driven and sustainable scenario that incorporates challenging policies to protect the environment and to promote development in the countries of the South. But even the most ambitious scenario, assuming massive increases both in energy efficiency and in the use of renewable energies, still predicts a growing consumption of primary energy over the coming 50 years. This increase will – to a large degree – stem from rising demand in developing and newly industrialising countries, driven by rapid economic and population growth.

Gender and Energy

Information about gender and energy in the South has begun to emerge but there is very little information about the situation in the North. The systematic collection of gender-disaggregated statistical data by energy ministries is non-existent and it is very rare to find an energy project evaluation that uses gender analysis. There has been little research on the gender-differentiated impacts of energy policies. However, some experiences provide indications that might be a starting point for further assessment:

- Levels of access to energy services, as well as the types of energy service available, are different for men and women, and so are the resulting social and economic impacts and benefits.
- Renewable energy can play an important role in increasing access to modern energy services, which reduces the time women spend on domestic tasks, permits home study and reading, enables access to educational media and communications in schools and at home, mitigates the impacts of indoor air pollution on women (for a project example, see Annex 3.1), allows access to better medical facilities, and permits income-generating activities.
- As women generally manage household budgets, they are important for energy-related decisions and can increase sustainability in the use of renewable energies.
- Policies for the promotion of renewable energies are not always without gender-related risks. High prices often affect women and children more than men, as their living standards depend on cash disbursements e.g. for energy services. Low-income single parents, mostly women, also suffer particularly from price increases.

Therefore, evidence exists that it is important to combine the policy objectives of promoting renewable energy technologies and promoting gender equity.

As a consequence of these developments and in order to modernise existing energy systems, the requirement for capital investments in the coming three decades will be of unprecedented size: the IEA estimates an investment, for a reference scenario, between 2001 and 2030 of a staggering 16 trillion euro, with a very uneven distribution among the world's regions (for more detailed data, see Annex 2). In particular, developing countries in Africa and many economies in transition will have to spend a significant amount of their GDP on energy investments. Countries will largely depend on energy imports, considerably affecting government budgets and requiring secure supply sources for their economies, if they rely on conventional energies.

Therefore, decisions taken in the coming years will be decisive for a move towards more sustainable energy systems.

The Benefits of Renewable Energy

Renewable energies can significantly contribute to addressing the challenges as they have been outlined:

- Renewable energies reduce the reliance on energy imports, and diversify energy supply mixes by making use of locally available resources. Renewable energies thus contribute to energy security and to the reduction of the foreign exchange burden.
- As they generate very low greenhouse-gas emissions, renewable energies reduce human-induced climate impacts caused by the use of fossil fuels.
- Renewable energies help to reduce negative health impacts and physical damage from airborne emissions.
- For many remote areas, renewable energy technologies are cost-effective and competitive supply options, and can contribute to offering access to modern energy services for large parts of the unserved rural population in the developing world.
- Renewable energies can create decentralised markets, thus contributing to local economic development by creating employment, introducing new capital and innovation, and by developing new sources of revenue for local communities.
- Especially in the case of traditional biomass use, improved technologies can help slow the depletion of natural resources and can help revitalise local economies in agriculture and forestry.

- In industrialised countries, renewable energies have already spurred the development of new industries and services for planning, manufacturing, operating and maintenance, and have demonstrated their potential to create highly qualified employment in new small and medium-sized enterprises.
- Being modular, diverse and distributed, renewable energies offer the potential for decentralised use (thereby avoiding transport and transmission losses), technological innovation, and allow for wider participation of people in decision-making about energy options.
- Combined with increased efficiency in the use of energy, renewable energies have the potential to cover almost all the energy needs of a modern society.

The benefits pertaining to individuals, such as health, education or energy services for productive use, may differ between men, women and children, partly due to existing inequalities in access to resources and women's institutionally weaker position.

The potential of renewable energies is substantial in most countries, and is mostly untapped (see Annex 1).

What Renewable Energies?

In the context of **renewables 2004**, renewable energy sources or technologies shall include:

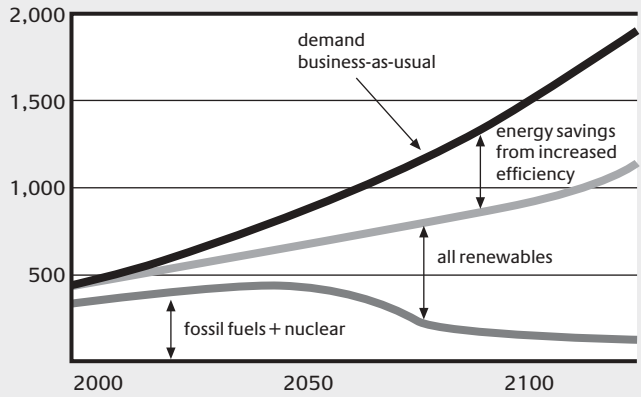
- **Solar energy:** Solar photovoltaics (PV), thermal electricity for decentralised and grid-connected electricity generation, collectors for heating, drying, and cooling, PV for water pumping, etc.
- **Wind energy:** Grid connected and decentralised electricity (on- and offshore), mechanical wind pumping, etc.
- **Biomass energy:** There are many traditional and now also "modern" ways to utilise the energy contained in biomass. Unsustainable use of biomass is often linked to poverty. Biomass (including the **biodegradable part of waste**) is considered part of a forward-looking energy mix only if it is provided and used in a sustainable manner.
- **Geothermal energy:** from aquifers, steam wells and hot dry rocks.
- **Hydropower:** Hydropower solutions range from pico-systems to large dams. The World Commission on Dams and a stakeholder dialogue sponsored by UNEP have addressed issues concerning the sustainable use of large hydropower systems.
- **Other renewable** energy technologies such as energy from oceans (waves, tides, currents) look very promising for the future.

An Outlook

A vision of a future sustainable energy system is crucial to guide today's decisions in ways that meet the challenges and make optimum use of the benefits offered by renewable energies. Various visions have been formulated and tested in diverse scenarios that analyse the options available to achieve multiple objectives.

The vision for a sustainable energy future presented in the following figure is based on a massive expansion of the use of renewable energy and drastic improvements in energy efficiency. Energy services would grow but the increase in energy demand would be drastically reduced by energy efficiency measures (some 30 % by 2050), and supply would increasingly be secured by renewable energies (approximately 50 % by 2050). A large part of the presently unserved population will have gained access to modern energy from renewable energies (1 billion by 2010 is an ambitious objective formulated by the G8 Renewable Energy Task Force). By 2100 the global share of fossil and nuclear energy would have reduced to 10 %.

Primary Energy Use (EJ/year)



Source: generic scenario based upon analyses from WEC/IIASA, IPCC, WBGU, G8 and IEA

Such a vision is ambitious – but it would allow an appropriate response to the fundamental challenges. Following this path would help to reduce poverty through improved energy access, contribute to protect the world from devastating climate changes, curb negative health and gender-specific impacts, and generate additional employment – for both women and men – all over the world. The vision also underlines that a substantial increase in the global share of renewable energies requires major improvements in energy efficiency – especially on the demand side.

What Are the Costs of the Energy Transition?

The IEA's World Energy Investment Outlook 2003 describes an "Alternative Policy Scenario" which addresses electricity supply from renewables, and energy efficiency in OECD countries. This scenario would reduce investment needs by some 20 %, mainly by saving on grid extensions through increased use of distributed generation, and reducing supply investment through demand-side efficiency improvements. The higher investment costs specific to renewables are more than offset by these factors. However, overall electricity **prices** would be higher than in the reference case, and demand-side investments were not accounted for. This scenario only addresses electricity – other analyses show that when including all energy sectors and services (heating, transport, industry, etc.), the overall long-term costs of scenarios with high shares of renewables in combination with increased energy efficiency are about the same as those of business-as-usual scenarios. It must be noted however that there is a cost differential in the early years to bring renewables onto the market. This cost of a transition to renewables must be seen in conjunction with the benefits renewables offer to society.

Renewable energies have already made significant contributions to energy supply in the past (see Annex 1.2). Experience with technology learning curves strongly suggests that renewable energies will become more economic and socially beneficial in the future. We have to be aware, however, that learning needs to be initiated actively and in time.

The Issues

A clear political determination can realise such a vision and allow the world to benefit from the advantages of both a wide use of renewable energies and significant energy efficiency improvements. Powerful national commitments create the enabling environment necessary to mobilise the dynamics for a rational and effective use of existing renewable energy potentials. Such policies need to address three **main issues** that will also orient *renewables 2004*:

1. The substantial increase in the use of renewable energies can only be secured by a massive development of relevant markets. Today, however, renewable energies do not find the necessary enabling **policy framework** to develop fully their market potentials, and the risks of relying upon fossil energy sources are not well translated into appropriate market signals.

2. The characteristics of renewable energy technologies imply high upfront investments that require particular financing solutions. In addition, markets for financing tend to rate risks of innovative technology higher than those of their conventional competitors. This makes **financing** renewable energies unreasonably expensive. Moreover, renewable energies are frequently decentralised, and small-scale in nature, and hence appropriate for markets in rural areas. However poor rural people, especially women, often do not have access to the proper financing or support schemes to afford renewable energy.

3. When dealing with renewable energies, political decision-makers, administrations, technology and project developers, financiers and users are confronted with new and rapidly developing challenges. Individual knowledge and institutional structures are not yet sufficient to overcome the market failures and barriers to financing. **Capacity and institution building** together with well targeted **research and development** on technologies should thus be high on the agenda.

The Cheapest "Energy Source": Energy Efficiency

Today, approximately two-thirds of primary energy used is globally wasted in the transformation into the desired services such as heating and cooling, light and motion. But such services only reach a privileged portion of the world's population. Energy use is also responsible for approximately 75 % of all GHG emissions so that the efficient use of energy is key to combating climate change. While present known reserves suggest that fossil fuels – especially oil and gas – will still be available throughout the 21st century, the costs of their provision will increase substantially. Economies will compete for the same, steadily decreasing, fossil fuel sources. Combined with measures to internalise environmental effects of energy use, prices for energy will be higher in the future. These issues illustrate that powerful means to improve energy efficiency are essential, both from an economic and, more broadly, a sustainable development perspective.

The technical and economic potentials for improving energy efficiency are enormous. In various cases, energy efficiency can be the most economic way to meet a growing demand for energy services. Energy efficiency investments often have short payback periods; some require just an extra managerial effort.

It is the poorest that have to pay, in relative terms, the most for energy services. The lack of capital and know-how oblige them to apply the simplest, most inefficient, energy transformation, supply and end-use technologies in order to minimise upfront investment. These technologies cause the highest long-run marginal costs. But even in comparatively rich industrialised countries, market signals, regulation and other legal conditions hamper the use of the most efficient technologies even where they are the most economic options.

Energy systems are typically characterised by long-lived infrastructure, and today's decisions on new investments will determine the efficiency of our energy systems for the coming decades. Power plants, refineries, transmission and distribution systems will live for 30 years or more; the vehicle fleet bought tomorrow will determine the fuel requirements for the next 15 years; the design and insulation of new buildings will decide the energy bill for the coming 50 to 100 years. Household appliances such as heaters, air-conditioners, washing machines and lighting systems tend to remain unchanged for well over a decade. Given the extremely slow turnover of our energy technologies, today's decisions will establish whether **we use or we lose** the vast opportunities for a sustainable energy future. Massively increasing energy efficiency is therefore a central challenge for any sustainable energy policy.

As in the case of renewable energies, there are many barriers to improved energy efficiency. Most conditions recognised as barriers today developed in times when the price for energy was dropping, when there was little awareness of the environmental effects of energy use, and when commercial interests overruled the notion of sustainability. The inefficient energy consumption patterns established in developed countries tend to be followed by developing countries. However, developing countries can benefit from technological innovation and positive experience in industrialised countries, mainly through transfer of know-how and technology. Developing countries could leapfrog today's inefficient energy patterns and integrate more sustainable approaches while expanding their energy systems.

2. Policies for Renewable Energy Market Development

The main challenge is to design and implement a **coherent policy framework** that levels the playing field for renewables, **internalises external costs**, provides specific and targeted incentives for the market development of renewable energy as well as energy efficiency, brings down technology costs through targeted research and development efforts, and encourages energy service supply for rural areas for poverty reduction. No single policy instrument can ensure solutions for each application, energy carrier, branch or sub-sector, and certainly not for every socio-political situation. Thus an optimal mix of different policy instruments is required.

2.1 Policies for Markets

The restructuring process, particularly in the electricity sector over the last two decades, has implications for renewable energies. Liberalisation can create options for a variety of new approaches to foster both renewable energies and energy efficiency. However, all recent experiences clearly indicate that with restructuring, liberalisation and privatisation, the need for **regulation** increases. In order to implement a sustainable energy system, mobilising market dynamics in infrastructures seems to be a successful approach – but target setting, resource portfolio standards, regulation capacities, access to grids and certain tax incentives are just as necessary.

Experience seems to suggest that independent power producers (IPP) can significantly increase the dynamics of market development for renewable energies, because they enhance the use of the local potential. The involvement of IPPs requires fair access to energy transmission and distribution grids by producers (electricity, natural gas, or heat), and, in consequence, appropriate access regulations set by national authorities. The incorporation of renewable energies into fully liberalised electricity markets (spot markets), however, can pose additional regulatory challenges.

Market development needs to have an enabling environment for the various actors, especially at the local level. For the construction of solar collectors on roofs for example, commercial actors and technical experts are necessary (see chapter 4). Apart from the capacities that need to be developed, further stakeholders, including retailers, appropriate administrations or planning firms are also essential for local markets.

In that context, the role of consumers, including public procurement, needs to be highlighted as well. They are essential for driving a market and thereby reducing production costs. Furthermore, governments at all levels, and private sector businesses, represent a huge "purchasing power" which could create a significant pull for renewable investments. In governmental and private sector procurement, priorities for renewable energy service contracts, or direct investments in renewable supply options could be given. Procurement schemes targeting renewable energy investments could bring down costs by bundling projects, offering lower transaction costs for developers.

2.2 Strategies and Targets

Based on the knowledge of renewable energy potentials and benefits, the formulation of **strategies** for the future expansion of renewables – at local, national, regional or international level – can be an important instrument to give long-term overall direction and to send signals to market actors. Ideally, such strategies include medium to long-term targets ranging from planning targets, to indicative, to legally binding targets, depending on the policy or sector level at which the strategy is developed.

Clear short and medium-term policy strategies and commitments, taking into account social and gender equity issues, help create a conducive environment for long-term investments and provide planning certainty for industrial stakeholders and consumers. The formulation of strategies, including setting of targets, depends to a great extent on the ultimate goals pursued within the renewable energy policy, e.g. reduction of GHG emissions, energy access or security of supply, sustainable agriculture, etc.

2.3 Levelling the Playing Field

The continuing large-scale **subsidies for conventional energy**, complex licensing procedures, technology or market immaturity, or vested interests in conventional energy make it difficult for renewable energies to fulfil their potential. In 1992, a study by the World Bank estimated global energy subsidies at around US$ 230 billion per year, much more than the Official Development Assistance disbursed. This was confirmed in a 2001 study which shows that in non-OECD countries subsidies are about twice as high as those in industrialised countries (see TBP 4).

The reality of energy subsidies in the developing world often leads to situations in which the better-off sections of society are the true beneficiaries, as large parts of the poor population do not have access to publicly provided, and thus subsidised, energy services. Nevertheless, where energy markets by themselves do not reach the poor, given their limited purchasing power, targeted, temporary and close-to-market subsidies can be appropriate. Even in

grid-connected areas, **"smart subsidies"** can help to push the market introduction of renewable energies, e.g. the solar panel market in Japan. Direct investment subsidies, in consideration of existing targets, can reduce consumer prices for new renewable technologies, allowing for technological learning in pioneering markets. Over time, this reduces costs so that renewables become more competitive vis-à-vis conventional alternatives. (See Annex 2.10 for a comparative overview of generation costs of selected technologies for electricity from renewables).

Levelling the playing field is not just an issue of subsidies. For renewable energies, technologies, new actors and new approaches need market conditions similar to those for existing competitors. In particular, technological **standards**, **codes** or non-discriminating, free third-party **access to heat or electrical grids** can be significant for the development of renewables.

Tax incentives are also an option for reducing costs for renewables. At the same time, taxes or import tariffs on imported renewable energy technologies should be phased out or at least be treated under promotional tariff regimes. In addition to a wide set of non-tariff barriers, adverse taxes and tariffs often pose a significant problem for retailers, especially in developing countries.

Monetary measures such as the removal of subsidies and carbon taxes for fossil fuels, or tax incentives for renewables, are all part of the **internalisation of external costs**. Although social and ecological damages are difficult to account for and can vary widely between regions, for some of the impacts scientific results provide evidence that monetary valuation can be reached, at least to the right order of magnitude. These estimates and assessments can be used as guidelines for the development of coherent price signals.

2.4 Regulatory Instruments for the Promotion of Electricity from Renewable Energy

Under **quota systems** the government or regulator mandates producers, distributors or consumers for a certain capacity (generation or consumption) to come from renewable energies. Although mainly used for grid-connected electricity, this instrument is also suitable for fuels (e.g. bio diesel, ethanol). Under the quota system, the additional costs of renewable energy are usually paid through a special tax on electricity or by a higher rate charged to all electricity consumers (see Annex 3.2 for an example of quota systems in the New England States of the USA). Schemes to ensure effective achievement of obligatory targets by participants are important for the success of quota systems, for example the implementation of effective sanctions in case stakeholders do not reach their targets. Different renewable energy technologies can usually compete for inclusion in a given quota, as they are typically kept low at an early stage. As the quota system usually functions with competitive auctions, experiences show that it leads to solutions based on technologies that already stand at the more advanced end of the learning curve and, thus, creates no medium-term dynamics in terms of technology development. On the other hand there is the advantage that quota systems can be linked to an international green certificate-trading regime.

Feed-in laws and tariffs oblige utilities or other operators of electricity transmission systems to provide grid access to renewable energy plants at a fixed, minimum price (for the example of the German guaranteed feed-in tariffs, see Annex 3.3). Payment of such a price is guaranteed over a longer period of time and it is usually set higher than the regular market price for electricity. This premium is justified as an internalisation of environmental and socio-economic advantages. The countries with the greatest success in expanding the use of renewables are certainly those that have used feed-in laws. The outstanding examples are the wind energy industries in Denmark, Spain and Germany. In these cases, feed-in laws have generated such a strong response because they fit well with the business perspective of investors. Additionally, further technological development is supported by the "no-cap" nature of this incentive scheme and the fact that cost-savings in the short term benefit the operator. This results in a long-term but significant decrease of technology costs. Bringing down tariffs over time for specific technologies ensures the efficiency of this instrument, and avoids the degeneration of incentive schemes into subsidy regimes.

Green certificates can be used as a flexible verification mechanism for different support instruments for renewable energies. The most common use is the combination of a certificate system with a quota obligation to cover a certain amount of the electricity market with certificates. Certificates are also being used for verification of green power products, which are offered to cover voluntary demand from domestic and commercial consumers, as well as public bodies. Certificates have also been employed to implement electricity disclosure schemes, which require electricity suppliers to disclose to their customers the fuel mix and other indicators of their electricity supply (which might also be necessary under quota or feed-in schemes).

In this case, certificates might be issued for all electricity generation, not only renewable energies. There is no practical experience yet how feed-in systems could be based on certificates.

National policy-making for the **electrification of rural areas** in developing countries is still a major theoretical and practical challenge. Both the public and the private sectors have demonstrated examples of failure and success in this field. More recent models for rural electrification and for scaling-up decentralised renewable energy technologies build on public-private partnership approaches.

Rural energy provision and electrification policies have begun to promote entrepreneurship, which is increasingly recognised as a key condition for fulfilling sustainable rural energy goals. Promising approaches are emerging that support rural entrepreneurs with training, marketing, feasibility studies, business planning, management, financing, and linkages to banks and community organisations (the Sri Lankan Energy Services Delivery Project provides a good example, see Annex 3.4).

2.5 Policies for the Heat Sector

Space heat, hot water, cooking, and cooling, as well as process heat for industrial applications are usually delivered by a variety of competing fuels – from traditional biomass to oil-based liquids, natural gas, etc. The renewable options include sustainable biomass, solar, and geothermal energy. Specific policies for renewable market development have so far dealt mainly with **supporting schemes for investments in equipment** (e.g. reduced interest rates or grants for private households and small and medium enterprises). Compared to renewable electricity production, and renewable traffic fuels, renewable heat applications need less financial support and will consequently gain importance in renewable energy policies.

Increased use of **renewable energies in buildings** offers significant potential. In the southern hemisphere, heat in buildings is mainly used for cooking and boiling water. Certain countries and regions have successfully achieved a high penetration of renewable heat technologies, such as the use of solar water heating in Greece, Austria and Israel. The use of appropriate building regulations and codes (e.g. in Barcelona, Spain) could help to accelerate the uptake of renewable energy in buildings, and innovative micro-credit facilities can cover the initial investment required; options for further sharing of experiences between countries and regions should be explored.

In the northern hemisphere the situation is different. The main contribution to the energy balance of the household sector – up to 90 % – is based on the demand for space heat. There exist various technical solutions for different energy requirements, e.g. wood pellet boilers, small and large-scale biomass district heating, large-scale biomass CHP plants, heating from heat pumps and geothermal heat, solar-assisted heating, and the conventional fossil fuel solutions. In a number of applications renewable solutions are very close to competitiveness and already show dynamic market development, for instance in pellet-based biomass district heating (for an Austrian example, see Annex 3.5). Different policy approaches are necessary to address both individual heating solutions for buildings and solutions based on small or extensive heating grids.

In the North and in the South cooling is increasingly important, mainly in service sector buildings. Cool air can be produced by using electricity or through combination with heating systems; therefore renewables can play a significant role, especially through solar cooling facilities. Architecture as well as technical planning should take account of these challenges, which need to be tackled by specific measures.

In the case of industrial heat processes one can only find very few examples using renewables and there is also a lack of attention to this issue. Solutions for industry are much more complex than for households, but nevertheless they need to be developed. This cannot be done by industry alone. Development of long-term strategies seems to be necessary.

In each case the increased use of renewable thermal applications has to go hand in hand with dramatic improvements in energy efficiency standards. In particular in buildings, a large potential for energy efficiency measures lies untapped (e.g. in Germany this is estimated at more than 70 % in existing buildings).

In the context of heat, it is important to find differentiated responses to the situations in industrialised and developing countries. As far as the latter are concerned, the **unsustainable use of biomass** resources, in particular in the form of fuel wood, has to be addressed in its interrelationship with issues of forestry management, health and gender. Given the extent of biomass use in developing countries, a full transition to modern fuels is unlikely in the short term. Improving biomass use (e.g. through improved cookstoves), together with improving biomass provision using sustainable forest management practices, for example, are essential aspects of sustainable energy development in many developing countries. A number of technologies have

been developed for the "modern" use of biomass either for the production of electricity, or energy liquids and gases. Based upon existing experiences with renewable technologies for the provision of heat (such as solar cookers in South Africa or biogas-fired combined heat and power plants in China), further work is required to broaden the market for these technologies, taking into account local economic, environmental and social conditions.

Space heating and cooking, as areas of policy intervention, call for a highly gender-sensitive approach. Given the central role of women in households in many societies in both the North and the South, decisions about, for instance, energy pricing often have direct impacts on the livelihoods of women or their position within the family.

2.6 Policies for Renewable Transport Energy

Various activities have been initiated to address energy use in transport. The ninth session of CSD identified transport as a key issue in the context of energy as well as a separate issue in its own right. Transport was also considered at the World Summit in Johannesburg and is included in the Plan of Implementation. Some governments have undertaken measures to improve fuel efficiency in vehicles, to improve fuel quality and to encourage hybrid vehicles and fuels utilising ethanol.

The transport sector, which consumes about one-third of the global primary energy consumption, currently remains neglected from an energy perspective. Energy use for transport is growing faster than in most other sectors in many parts of the developed world, and with development the demand for transport services will increase significantly in the developing world. Apart from **technical measures to increase engine efficiency** (an increase by a factor of 4 compared to the world average consumption is technically feasible), modal switching and demand management, renewable energies can be used to reduce carbon and other harmful emissions from the transport sector. In that context it is an open question to what extent renewable energy would have the potential to meet the demand of the transportation system.

While a transport sector based on hydrogen produced from renewable energy sources will take some decades to develop, **fuels from various forms of biomass** are already available. Renewable energy transport fuels (alcohols, bio-diesel, etc.) have been developed, and are being produced successfully, in various forms in different parts of the world. With a few exceptions, however, these are currently produced only in small volumes. The Brazilian ethanol programme stands out as a frequently quoted example of a large-scale programme.

Due to the existing lack of competitiveness, renewable transport fuels will not penetrate the market to a greater extent without the implementation of targeted policies and measures. **Tax incentives** and **standards** seem to be some of the most effective instruments for both substantial increases in energy efficiency and a fuel switch from fossils to renewables. Therefore, the European Union recently adopted a transport bio fuels directive, which encourages Member States to ensure a minimum proportion of bio fuels in their markets through the adoption of targets (5.75 % by the year 2010).

2.7 Key Questions on Policies

- What are the first steps that have to be taken in order to level the playing field for renewable energies vis-à-vis fossil and nuclear energy?
- What role can goals, objectives or targets for renewable energies play for strategic decisions of industry and the finance sector? How should such goals, objectives or targets be designed?
- What criteria are essential for policy instruments that aim at accelerating market development of renewables (e.g. quota systems, feed-in tariffs)? How should they be designed, taking into account the specific situation of countries ? What other incentives or supporting mechanisms are essential (market penetration, standardisation, etc.)?
- What is needed in order to formulate differentiated support policies and to find specific instruments for different forms of renewable energy (electricity; heat; fuels; mechanical power) and for on/off-grid systems?
- How can consumers better contribute to the expansion of renewable energies, and how can transparency for consumer choice be improved?
- How can local markets for renewable energy services be developed, particularly in rural areas of developing countries?
- How do the various actors find a concerted and integrated response for the promotion of renewable energy **and** energy efficiency?

3. Financing Options for Renewable Energy

Enabling regulatory frameworks and appropriate incentive structures, as discussed in the previous section, are prerequisites for the second key issue: how to finance investments in renewables at the project level.

The finance and banking community responds to policy and regulatory signals, but applies its own logic in analysing the "bankability" of projects. Similarly, investors and fund managers see renewable energy as just options in a portfolio of competing alternatives, and thus make judgements about their profitability, and risks.

Worldwide, renewable energy is already **the most dynamic sector of the global energy market** – bringing down costs, and increasing market experience. However, finance-related risks and barriers hinder renewable energy investments. As most renewable energy projects have high investment costs relative to fossil-fuel technologies, and low rates of return, their financial attractiveness depends on assumptions made by investors on future market developments. Most prominently, future fossil fuel prices in relation to operating costs of renewables is perceived as a key risk, followed by the security of future revenues from renewables.

As energy markets become more competitive, the market reality is that investors have short investment horizons. In markets characterised by short-term energy sales and price volatility, investors prefer technologies with short lead times, low transaction costs and risks. Funding for risky, capital-intensive renewable projects will be expensive and difficult to obtain, even if they are expected to produce more cost-effective power than fossil plants over their lifetimes.

For private sector financing, renewable energy is usually **a new kid on the block** – with different characteristics, customer relations, etc. Since financiers are typically averse to things unknown, it is these differences and the risk perceptions that can become the most significant barriers to investment, even for renewables that are cost-competitive when compared to conventional energies.

However, investing in renewables can also reduce risks when compared to conventional investments – especially risks of increased fossil energy prices, and the risks of carbon restrictions on fossil-fuel projects.

The risks and returns vary widely between markets and technologies: large grid-integrated wind farms in developed countries differ substantially in form and magnitude from village-level micro-hydro or solar PV systems in developing countries. A wide range of financing strategies is needed to reflect this diversity, as well as specific financial tools for different technologies and market sectors.

Hybrids: Blending Renewables into Fossil Systems

A viable short-term approach to address the risk problem is to **combine renewables with conventional energy investments in hybrid schemes** – e.g. to feed steam generated in a solar thermal plant into a gas combined cycle plant. Here, the "risky" renewables benefit from the trust investors have in the conventional part, and the high upfront costs are reduced.

Hybrid schemes could be important *interim* steps that secure fuel logistics, customer relations (sales), and increase trust in renewable technologies and projects among the finance community.

3.1 Financing On-Grid Renewables

The financing of renewable energy projects that feed into grids, be it electricity, biogas or heat, requires the provision of equity, loans (debt), or other financial products to cover the upfront costs. The variety of capital forms involved with on-grid renewable energy financing create a "universe" in which gaps exist – to fill these gaps, specialised tools and measures must be developed. (See the On-Grid Finance Continuum in Annex 4.1).

The bankability and profitability of on-grid renewables mostly relies on the revenues generated from grid sales. In principle, these revenues must be high enough to recover the investment plus interest, to cover operating and maintenance costs, and to return a profit on the investment as well. Here, incentives such as fixed feed-in tariffs for renewables have demonstrated their function to attract capital providers, as they offer secure and stable revenues. With **favourable conditions** set out in national policies, private sector financiers have already demonstrated that they will actively engage in renewable energy as a normal business. Here, good governance, respect for property rights and contract enforcement are needed in parallel with anti-corruption policies and transparent regulation.

For **smaller-scale renewables** such as solar PV, micro-hydro, or biogas, even secure and favourable revenues might not be enough, as the more distributed projects are, the higher the transaction can be. For these options, other financial mechanisms might be more suitable such as dedicated funds, bundling of investments with services for small-to-medium-sized enterprises, or customer-based investments. Another option to reduce transaction costs is to create "fast-track" financing for standardised small-scale renewables.

A New Role for Customers

In addition, customer-oriented policies to offer **"green" electricity** – and in some cases also "green" gas and bio fuels – at a price premium can also help to ensure adequate financing of renewable projects by increasing their revenues. Here, certification of the renewable quality of the products is a major issue, and information for customers explaining the benefits is often lacking. Market development for green products could help to establish voluntary support schemes "from the bottom" in which virtually all customers, businesses and interest groups could participate.

3.2 Off-Grid Options

A huge variety of renewable projects will be *off-grid* – either because grids are not available close to the project, or because projects directly serve dedicated customer needs (e.g. cooking, heating, cooling). These projects are **usually smaller-scale** (depending on the customer), and face – from the financing point of view – the problem of unsecured revenues, and for larger-scale investors, higher transaction costs due to their distributed nature. On the other hand, these projects usually compete with higher-cost alternatives (e.g. LPG, batteries).

To attract private-sector investment for off-grid renewables, both "upstream" tools such as customer finance (e.g. micro-credits or dedicated funds), and "downstream" approaches such as fee-for-service models have been used successfully. Both options also improve the affordability of renewables investment so that individual households, small businesses, and communities can play a role in local financing. This entrepreneurship could drive forward energy markets, particularly in rural areas. Mixed with training for business development, viable rural energy markets can be developed which include "non-energy" business players from agriculture, the construction industry, or other sectors.

The **"finance continuum" for off-grid renewables** (see Annex 4.2) involves different players and activities when compared to on-grid investments, and also involves different gaps that need to be addressed.

With respect to the various roles in the finance continuum, both public and private involvement are possible. As a consequence, policies and measures to strengthen renewable energy off-grid financing must address a variety of actors and circumstances.

In countries where consumers have full access to energy services and can afford them, off-grid renewable options usually concern biomass and solar-based options for heating or cooling. Here, equipment vendors can "bundle" financial services with their products, or work with specialised third-party-financing firms to facilitate investments in medium-sized projects. However, policies to attract investors into off-grid heat markets are underdeveloped in most countries – some exceptions can be found in Austria and Scandinavia where bio fuel systems receive favourable tax and investment incentives.

In many developing countries, poor people – often in rural areas – have a pressing need for adequate, clean and affordable energy services, both for household needs and to provide access to income-generating opportunities. In most cases, those in poverty cannot immediately finance the costs of stand-alone modern renewables even if these would be the most attractive options. Simple and affordable measures can often address inefficient, unsustainable and dirty use of biomass; here, basic technical support, information and education programmes (see Section 4), and the provision of micro-credits are needed.

Financing of off-grid renewable energy solutions in developing countries has a special role when projects form part of **investments in social infrastructure** such as schools, hospitals, etc. Here, civil sector funds for ethical investments as well as international financial institutions (IFIs) could combine support and programs for poverty eradication directly with renewable energy projects, which would usually be only a smaller part of the overall investment, but would yield direct benefits such as reduced costs of operation.

3.3 Public-Private Partnerships

Public-private partnerships (PPP) aim to combine the particular competencies and resources of the public and private sectors. Many models exist, and there are both positive examples and some lessons to be learned. Several funds have been initiated in recent years to support the development of renewables through PPPs. Successes include, for example, the rehabilitation and expansion of micro-hydro plants in Armenia, funded through bilateral financial assistance from Germany, with Armenian private sector participation. **PPP funds** provide a variety of forms of upstream support, recognising that a number of preconditions exist for the formation of successful PPP projects. Contractual agreements between the different parties often require specific expertise. In developing countries, capacity development support may be required for one or more of the parties to a PPP agreement. More generally, as with other

project structures, PPPs need to operate within the context of a functioning and stable regulatory environment.

On the sub-national level of states and municipalities, public and private investment funds for renewables, of which numerous examples exist (for local and regional renewable energy investment fund in the USA, see Annex 3.6), can directly benefit the people. PPPs could play a crucial role in attracting more private sector funding for renewables, but potential problems of good governance (e.g. corruption, lack of transparency, fraud) need to be addressed in parallel.

3.4 Official Development Assistance and International Financial Institutions

The role of bilateral as well as multilateral Official Development Assistance (ODA) concerning renewable energy is increasingly recognised as principally being a **catalyst**, rather than a provider of grants for capital expenditure. Donor resources could be used strategically to **leverage** private sector investments in renewable energies, and to help developing countries in shaping their domestic markets, and in building adequate regulatory environments. Here, the role of PPPs could be more prominent.

In that respect, the lending policies and programmes of IFIs like the World Bank and regional development banks (e.g. ADB, EBRD, IDB) could play an important catalytic role for renewable energy investments in developing countries and economies in transition (see World Bank energy portfolio, Annex 5).

Though IFIs have started to invest in renewables (and energy efficiency) more prominently in recent years, there is a lively ongoing debate on whether they should shift their finance from fossil towards renewable energy projects. Given the huge investment needs and the leverage of IFI policies, clear objectives for renewable energies in IFI portfolios would send strong signals to the private sector. As IFIs operate various programmes concerning poverty alleviation, they should include renewables in these activities, targeting the poor in rural areas (for an example from Argentina, see Annex 3.7).

The role of **micro-credits** requires more attention. As most off-grid renewables are rather small-scale, investments will also be small – involving smaller-scale businesses, households, etc. Their access to conventional financing is very limited, and thus specialised instruments like micro-credits have proven successful. (See, for example, REED [Rural Energy Enterprise Development] as described in Annex 3.8). IFIs should consider disbursing an increasing share of their renewables financing through this mechanism.

In addition, full cost accounting including externalities could help to favour renewable financing through IFIs. Grants from IFIs could also provide **"seed money"** which needs to be combined with financial resources from the private (banking) sector.

Export credit agencies (ECA) use public resources to promote exports of their host country, through the provision of credits or guarantees. Until now, ECA support to renewables has been rather limited when compared with resources for conventional energies. In parallel, demand for ECA involvement usually comes from larger-scale projects, so that "bundling" of renewable projects could increase the potential for ECA support. It has been argued that ECAs could become bridges helping to mobilise private financing for renewables. Some changes would be required in the OECD guidelines for Tied Aid and Export Credits. These would have to be negotiated by governments.

IFIs and ECAs operate from public funds. **Information disclosure on their renewable financing**, and transparency regarding future PPP schemes, micro-credits, and similar new tools, would increase options for collaboration with the private sector as well.

3.5 New Financial Tools

To attract more (private) funding to renewables, **active outreach** towards the banking, insurance, and energy investment community is called for. In that respect, UNEP with support from the UN Foundation recently launched the Sustainable Energy Finance Initiative (SEFI) aiming to engage the finance sector in investing in renewable energy and energy efficiency. Such initiatives need more support and should be paralleled by national commitments, which might then be bundled with bilateral ODA.

In addition, renewable investments need new financing tools such as loan guarantees (potentially from ECAs), and **specialised insurance products** to hedge or reduce their risks for investors, and project financiers. As carbon finance becomes more relevant (see next section), guarantees and insurance concerning emission reduction credits, and greenhouse-gas reduction liability will be needed so that the insurance community can develop adequate options and services.

Financial tools such as dedicated renewable energy funds – possibly mixed public-private in nature – with low but secure rates of return ("patient capital") help to provide the necessary investment. Here, ethical investment funds have already demonstrated that renewables are attractive

options for long-term low-risk investors. Activities such as the Johannesburg Renewable Energy Coalition (JREC) Finance Initiative are investigating how to expand the attractiveness of such options, and could be strengthened by further efforts from the international community.

3.6 Carbon Financing

As ongoing UNFCCC activities imply a market value for greenhouse-gas emission reductions, a new financing opportunity for renewables arises. The Kyoto Protocol provides for three market-based mechanisms – **Joint Implementation (JI), Emissions Trading (ET)** and the **Clean Development Mechanism (CDM)**. All three aim at maximising the cost-effectiveness of climate change mitigation by allowing greenhouse gas emissions to be cut more cheaply abroad than at home, and by introducing a market value for avoided (or reduced) CO_2.

Early optimism in carbon financing gave a higher economic value to CO_2 reductions than is generally accepted today, due in part to the way in which the Kyoto Protocol has evolved until now, and the absence of certain key signatories to this regime. Nevertheless the value placed on CO_2 reductions will be of some benefit to renewable energy in the medium to long term. In many cases this extra value can help tip the balance and mobilise the private sector by making projects financially more attractive. The relative importance of carbon financing after the first commitment period will depend on negotiations ongoing in the Kyoto context.

The extent to which these mechanisms catalyse investment in renewable energies depends on the price of carbon on the international market, the extent to which renewables can compete with energy efficiency and other carbon-reducing measures, and the practical rules of the mechanisms. One issue of concern is that the relatively high transaction costs of developing small renewables projects may favour other types of projects under these mechanisms. To address this problem various initiatives have been proposed, or have been adopted; these include fast-track procedures and bundling of small-scale projects. Some interested national governments and international institutions have developed specific facilities to focus interest in the carbon market, facilitate interaction, and minimise project transaction costs. The Prototype Carbon Fund (PCF) has been developed by the World Bank (see Annex 3.9), alongside similar facilities such as the Carbon Fund to be launched by the KfW in Germany, for such purposes.

Emission trading is a mechanism under the Kyoto regime, which involves the transfer of carbon emission rights between signatories that have national targets. While this mechanism involves government-to-government agreement, and is not project-based, it could act as a stimulus for the increased development of renewable energy in some countries by including a carbon element into the risk formula of energy investments, but also into the ranking of individual companies on the financial markets.

Within the EU, a CO_2 emission-trading scheme has been developed by Member States, independently from the Kyoto Protocol. To a limited extent credits from JI/CDM can be fed into this EU system. This system will be operational in 2005, and will give insights into how this mechanism could support renewable energies.

The extent to which carbon financing stimulates the market for renewables in developing and developed countries crucially depends on the price that the market assigns to carbon.

3.7 Key Questions on Financing Options

- Which financial sources and mechanisms are appropriate and successful to cover incremental costs of renewable energies where they occur?
- Which financial instruments could help to better understand and reduce the (perceived and real) risks of renewable energy investments? Which options reflecting longer-term benefits of renewables in the risk analysis of private investors in deregulated power markets should be implemented?
- How can private (equity) funds be attracted to renewable energy investments, and which supportive role(s) could the finance sector play (e.g. banks, rating agencies)?
- What role should bilateral donors, IFIs, and ECAs play to increase or support (private) investments in renewable energies?
- How can instruments for customer financing in developing countries like micro-finance help to advance renewable investments in rural areas?
- To what extent could carbon financing and flexible mechanisms provide a new source of capital for renewable energy investments, or increase the attractiveness of (private) investments in renewables?

4. Developing Capacity for Energy Market Transformation

In addition to the more general issues of governance and finance, any significant strategy to increase the share of renewables also needs to address three more specific issues which relate to *capacity*, that is the overall ability of societies to deal adequately with renewable energy. The increased use of renewable energies requires enhanced public awareness, well-trained both female and male professionals (**"brainware"**), a coherent and functioning institutional framework (**"orgware"**), and the availability of appropriate and affordable technologies (**"hardware"**). Capacity development in all three areas is essential for the development of sustainable renewable energy markets; it should be viewed in a broad sense: individual human capital, institutional capacity, as well as research and development including the promotion of innovation.

Given the changing nature of energy markets, capacity development must address a broad range of public and private actors. Needs vary between developed and developing countries – while the energy sector in developed economies is well established in general, there is an imbalance between conventional markets (fossil fuel, nuclear, etc.) and renewable energy in the capacity available and resources dedicated to technology and institutional development. In developing countries, capacity is often much more limited in general, and priorities for renewable energy need to be viewed within the wider context of the development of the energy sector as a whole. As the subsequent section will illustrate, increased international cooperation between the whole range of actors involved must form a cornerstone in any strategy towards an increased use of renewable energy sources.

While the general need for improved capacity is widely acknowledged, ample evidence exists that capacity development is unsustainable if not paralleled by market developments to make use of those capacities.

4.1 Human Capacity Development

The importance of human and institutional capacity development is undisputed. Awareness of the benefits and applicability of renewables, and know-how about their use, are the most fundamental requirements for accelerated renewable energy deployment.

Education and General Awareness

Strengthened **educational efforts** in renewables are essential, particularly in less developed countries. Educators in a wide range of disciplines in schools and colleges need enhanced knowledge of the cross-linkages between renewables and their particular subjects. These linkages include the economic imperative of securing energy supplies by diversifying energy sources, the social benefits of enhancing energy services using renewables, in particular for gender equality, and environmental impacts of conventional energies. These issues have to be integrated into training programmes for teachers. In the context of developing countries, concrete initiatives that could be considered are also the development of textbooks addressing energy conservation, sustainable use of local biomass resources and basic instructions for using other renewables. With this objective in mind, *renewables 2004* can play an important role in effectively positioning renewables and energy efficiency in the **UN Decade of Education and Sustainable Development** (2005 – 2015).

The role of the state in education certainly varies between countries. In most societies, governments would have to be the main drivers of such development as they set the legislative framework and provide large shares of funding. However, it is clear that in many situations civil society groups and the business community will have to play an important role as well.

The **mass media** could play an important role in communicating the benefits of renewables to the public and thereby raising general awareness and acceptance. A wide range of popular but educational TV programmes about sustainable energy issues already exist, both for developing and for industrialised countries. Private companies, larger NGOs and public TV stations can promote such programmes in public-private partnerships. The provision of reliable consumer information on renewables and energy efficiency remains an important media task.

Developing Professional Skills

Higher academic and **professional training** institutions have key roles to play in bringing renewables into the mainstream by supplying appropriately skilled professionals. Sharing of curricula development, training experiences and materials at the international level (South-South, North-North, South-North) would bring benefits and could be enhanced. Here, the international community can play a powerful role in catalysing this sharing. Existing efforts by donor organisations need to be more fully documented, assessed and improved with respect to more coordination, and ownership by beneficiary countries – this requires appropriate institutional arrangements.

Dedicated professionals are needed to develop policies and programmes, plan projects, finance, regulate,

manage, install and maintain future renewable energy systems. One area with opportunities for action is the development of twinning arrangements between developed and developing countries, possibly involving exchange of personnel including public officials, scientists and lecturers, and professionals working in utilities. In addition to intra-firm technology transfer within multinational corporations, the private sector or semi-private utilities might also consider enhancing their activities for the transfer of knowledge and skills to other actors as an element of their corporate social responsibility agenda. Trade unions would have to play an important role in such activities, too.

Success in developing human capacities will depend on the options available to apply new skills in the real world – only if people find employment will they make use of their skills. So, market development of renewables and associated creation of jobs must be in tune with efforts to enhance human capacities. This is of particular relevance for women, as the energy sector in general – and with it also the renewable field – is still male-dominated. Women have the same right to have an interesting and well-paid career in the sector, but they need active encouragement and support to join industry.

4.2 Institutional Development

Local and Municipal Level Institutions

At the local level a number of institutions are essential for the development of renewables markets, particularly regarding decentralised applications. Civil society has a crucial role by acting as a voice for different constituencies representing industrial sectors, consumers, rural farmers, women, etc. NGOs can have an important influence, informing decision-makers of the energy needs of different groups and the suitability of renewable energies to meet those needs. In developing countries, service-oriented NGOs are often the most appropriate means for installation and maintenance of renewables. Local project promoters and financiers are catalysts in many cases in developing markets, stimulating activity by small and medium-sized enterprises that will supply the services needed for the retail, installation and after-sales side of the market. Moreover, these market actors operate under what could be termed "local policy frameworks", established by local public authorities. Therefore, developing the required capacity within **local and municipal administrations** seems to be a crucial element in the broader enabling environment.

National and Sub-national-level Institutions

At the level of **national governments and administrations**, suitably strong public institutions are essential to set priorities, plan, and establish policy and regulatory agendas to encourage renewable energy markets. In more decentralised or federal political systems, this certainly holds true also for the sub-national units of government and administration. Joint policy-making and priority-setting between energy ministries and rural development, health, education, water and other ministries can be a powerful means of advancing the case for renewables.

National agencies, including centres of excellence and research institutions, have an important role in performing country-specific research, data collection and analysis, training, education, and providing technical support to respective ministries. Many national agencies exist, either covering renewables specifically (e.g. the Moroccan Centre for the Development of Renewable Energies [CDER]), or as general energy agencies including renewables with their portfolio (such as the Spanish "Instituto Para La Diversificación Y Ahorro De La Energía" [IDAE], Japan's "New Energy and Industrial Technology Development Organisation" [NEDO] or the German Energy Agency [DENA]). Again, a number of good examples of similar agencies exist at sub-national level in many countries. Funding for such bodies needs to be adequate and stable for them to fulfil their potential. In addition to forming links within the energy sector, national agencies need to function across sectors. Further opportunities for improved networking between national agencies should be explored.

The need for well-functioning and independent regulatory bodies has already been addressed. In order to send the right signals to potential investors, regulators need sufficient authority to enforce their rules. Given the various levels of experience of regulation that exist, a forum for exchanging experiences on renewables in re-regulated markets may be useful. Developing countries and economies in transition may benefit from exchanges of staff at the regional or international level.

Banks and other financial institutions, be they public or private, have a central role as indicated earlier. In this regard, they need to offer special points of access for renewable energy developers and financial intermediaries. As financial institutions generally deal with conventional energies and large-scale projects, adaptation of structures may be considered necessary. Strengthening the institutions involved as financial intermediaries is also important, given that investments will be small-scale in many cases.

Regional Institutions

A number of different functions are required of regional organisations: coordination between countries in the region, information exchange, data analysis, undertaking specific research relevant to the region, etc. Economic integration and the creation of **common markets** for renewable technologies and services, mainly by reducing trade barriers and through standardisation, help market development.

Most **regional organisations** currently have bodies dealing either with renewable energy specifically, or energy in general, with renewables as a part of their mandate. Regional institutions can provide important political leadership, as well. For this, the European Union or the Asia Pacific Economic Cooperation (APEC) are good examples. Other regions have various forms of associations, agencies or regional centres of excellence, such as the Latin American Energy Organisation (OLADE) or the Asian Centre for Energy (ACE) of ASEAN. The African Union is about to form an African Ministerial Council on Energy. In addition, most UN Regional Commissions run dedicated programmes on energy with some activities devoted to renewables. A systematic stocktaking of the capacities and activities of these regional institutions seems necessary.

International Institutions

Many existing bodies already operate internationally in the renewables field. The UN CSD has already tackled the global dimensions of energy, and a future session will come back to the issue. A number of **UN agencies** are involved in renewables, among them UNDP and its programmes for capacity development; UNEP which manages specific renewable energy programmes; UNDESA, UNIDO, FAO, etc. The IEA, representing OECD countries, has increased its focus on renewables considerably. The World Bank group fulfils both the functions of financing and knowledge management, as do some of the regional development banks.

A number of **energy partnership initiatives** have evolved out of the WSSD process, including the EU Energy Initiative for Poverty Eradication and Sustainable Development (EUEI), the Global Village Energy Partnership (GVEP), the Global Network on Energy for Sustainable Development (GNESD), the Renewable Energy and Energy Efficiency Partnership (REEEP), or the Mediterranean Renewable Energy Programme (MEDREP, see Annex 3.10). Other platforms, such as the Global Forum on Sustainable Energy (GFSE), provide room for necessary dialogue and exchange of experience between decision-makers in the energy sector. As these initiatives have now been established, there might be a need to **efficiently coordinate** their activities.

A wide range of functions are required of the international system to meet the needs of an expanding renewable energy market in line with goals of the Johannesburg Plan of Implementation, such as exchanging information on good practice and lessons learned (technical, policy, finance, etc.) or promoting and coordinating joint activities at the international level, including research. An International Renewable Energy Agency has been proposed to serve these functions.

renewables 2004 will provide a good opportunity to identify any **functional deficits** in the current international institutional set-up, such as a lack of coordination of research efforts or of systematic opportunities for enhanced consultation of national level policy-makers, and to identify ways that these deficits should best be addressed. It is widely considered that some form of strengthening of the international scheme is required. There is much debate, however, on how this strengthening should be achieved. In any case, there is no doubt that it is very difficult for interested actors to efficiently access consolidated information about what is already going on in the field of renewables. Managing the available global knowledge, relevant experience and information should be a priority for the international community.

4.3 Research and Technology Development

Renewable energies are still less competitive compared to conventional energy sources. Therefore, it is vitally important to accelerate R&D aimed at cost reduction. Both non-technological and technological research and technology development (RTD) for renewable energy is essential if the technologies are to reach their potential. **RTD has already led to visible results** for wind, biomass, and solar energy, and there is significant potential for further improvements. However, of all publicly funded energy research of 23 IEA member countries between 1974 and 1998, only 10 % was dedicated to renewable energy, with the majority for nuclear fission and fusion. Research expenditure by these countries on renewable energies peaked in 1980 and has since declined to around one-third of its maximum level. It has been suggested that at least a ten-fold increase in the direct state expenditure for RTD in the renewable energy sector in industrialised countries is needed in one decade. At the same time, significant international support must also be directed to research in developing countries.

In order to step up global RTD efforts, energy research laboratories and universities must adapt to more holistic and coordinated ways of working. Synergies at an international level should be enhanced to avoid duplication of effort, possibly through networks of universities including the establishment of virtual RTD institutions. Developing countries in particular would benefit from increased South-South and North-South cooperation. The issue of intellectual property rights on renewable energy technologies needs to be addressed to enable such cooperation.

Priorities for future RTD encompass a wide range of technological and non-technological issues including such fields as:

- Technologies for renewable energy conversion, storage, transmission, output stabilisation technologies and its effect on grids, distribution and use.
- Economic, political and institutional schemes for renewable energy systems at all levels (local, national, regional, global), and regulatory solutions for renewable energy.
- Methods for policy-making and planning.
- Aspects of liberalisation, distributed generation and grid optimisation.
- Methods of financing.

This list of necessary fields of interventions clearly indicates that efforts in RTD have to be taken in view of the entire innovation chain (from research and development to demonstration projects, to cost buy-down, to widespread diffusion). Persisting barriers in one area of intervention will nullify progress made in other areas. Therefore, these issues have to be looked at also from an industrial and innovation policy perspective, particularly in OECD countries (see, for example, the Japanese R&D programme, Annex 3.11).

It is important to identify the appropriate level of, and approaches for, government-driven research and development efforts in the above-mentioned areas. In addition, such "supply-push policies" have to be complemented by "demand-pull" dynamics through privately-driven research and development, which should emerge as markets develop further in terms of scope and depth. It is actually in the widespread application of technologies in the market that the most significant learning and, thereby, reductions in costs is realised.

Research, Development and Technology Transfer

As research and technology development in renewables makes progress, the global dissemination of renewable technologies will depend heavily on adequate mechanisms to transfer such technologies across countries and regions. Once the aimed-for "level playing field" is achieved, competitive energy markets and international trade will be the **core drivers of technology transfer**. During the transitory phase the existing barriers will continue to hinder the free flow of technology. In addition, the lack of regional and national capacities to either offer or to assimilate renewable technologies will act as an obstacle.

Market introduction as well as financial schemes targeted to support the transfer of technology are needed. Successful technology transfer, especially in the field of renewable energy solutions, usually requires small and medium-scale enterprises (SME) to engage in **cross-border business**, working jointly with the technology developers. Therefore, cooperation of renewable technology institutions with local businesses is crucial and must be seen as a prime area for integrated capacity development. For this, active involvement of international development banks and other multilateral donors could help in addition to bilateral arrangements (see, for example, the TERNA programme of GTZ as described in Annex 3.12). Public-private partnership schemes can provide an effective mode of delivery, especially if they take into account the need for technology adaptation to specific local needs and circumstances.

4.4 Key Questions on Capacity for Energy Market Transformation

- Capacity development in the field of renewable energies – what should governments concentrate upon?
- How can decision-making of administrators and regulators, investors and financiers become more favourable for the development of renewable energy?
- What should be the focus of increased public expenditure on research in the field of renewable energy technology, with a view to complementing innovation driven by private market actors?
- Capacity development for renewable energy in developing countries – how can local services for renewables markets be strengthened? What is the catalytic role for ODA and other forms of international cooperation?
- How could international institutional arrangements be strengthened in order to support technology transfer and expansion of renewable energies?

5. Stakeholders and Their Roles

The various "pushes" and "pulls" required to increase the regional, national and, thereby, global shares of renewable energies call for action in which all actors and stakeholders must play their part – public sector, private sector and civil society. The roles of different stakeholders have to be strengthened with respect to renewables and energy efficiency. There is also a need for more joint work with better coordination – between and across sectors like agriculture, water, health, education, rural/urban development, as well increased energy efficiency at all levels.

The common but differentiated responsibility of different actors and stakeholders is not only called for when it comes to policy-making and implementation. Equally important will be a joint effort to monitor progress on the way forward. When discussing the roles and responsibilities of various actors, it is essential to bear in mind that in almost all areas of intervention in the energy sector, including renewables, decisions are mainly taken by men and that there is, hence, a general need for increased gender equality in the sector.

5.1 Governmental and Legislative Responsibility at National and Local Level

Governments play the central role in formulating appropriate national policies to expand renewable energy markets. Those policies should be embedded in a broader enabling environment for the overall energy sector that addresses issues of tariff setting, governance, public utility management, etc. Clear direction and stability in regulatory activity, as well as appropriate support for capacity building and research and technology development are needed. **Removing barriers against and providing incentives for renewables** are the key tasks, paralleled by implementing a level playing field for renewables in the medium term. In this context, sub-national actors such as federal states or municipalities are also very relevant actors, partly due to the decentralised nature of many renewable energy solutions. Decentralised decision-making for energy can help make energy systems more responsive to the needs of consumers, especially of women in the household sector and in small-scale industries. (See, for example, the Rural Energy Development Programme (REDP) in Nepal as described in Annex 3.13). Intergovernmental arrangements can be very pertinent as well. One prominent example is the Johannesburg Renewable Energy Coalition (JREC), a coalition of like-minded governments that has articulated its active support for renewable energies in the joint declaration "The Way Forward on Renewable Energy".

5.2 International Institutions

Different international institutions have helped shape a growing renewable energy consensus among the international community, which in turn helps governments to develop coherent national and regional renewable energy policies. This effort needs to continue in order to take forward the commitment that the global community made at the World Summit on Sustainable Development in Johannesburg, as agreed in the Plan of Implementation, as far as renewable energy and the expansion of access to modern energy services is concerned. In this regard, international institutions should consider focusing on facilitating the development and implementation of consistent international, regional and national **renewable energy strategies and policie**s, including strengthening the links between renewable energy, energy efficiency and broader development issues. The formation of specialised networks of international organisations could be a promising way forward. Clear objectives for renewable energies – possibly in terms of specific targets – are an option for international financial institutions.

5.3 Business and the Private Sector

The private sector – from small local entrepreneurs to multinational corporations – has a special role and responsibility to implement existing and to advance new and innovative renewable energy solutions. Energy utilities are among the most important actors and therefore hold a special responsibility. Private financial institutions, investment banks, as well as retail banks for consumer credit, also have to prepare to benefit from the new investment opportunities in the sector. This is first and foremost a task that needs action at the management level. Industry and commerce have enormous human, financial and technical resources at their disposal, resources which will be essential to fully realise renewable energy markets. Industry and commerce will have to adapt to the renewables transition, and can provide a dynamic force to drive the renewables market, working alongside the public sector and civil society. In many societies, access to energy is still an unmet need, and private sector participation needs to help meet those needs, whilst maintaining a commercial orientation. Legislation and regulation has a major role in safeguarding the public interest (equity, social and environment concerns) in markets where the private sector is operating. This can be complemented by the establishment of programmes to enhance corporate social responsibility and through the introduction of voluntary codes of conduct. In a number of developed countries, **corporate consumers** now have opportunities to selectively purchase renewable energy services; ultimately these consumers will be a very powerful force pulling the energy market towards renewables.

5.4 Civil Society

Similarly, **private consumers** of energy can send important signals in terms of preferences for energy from renewables. Over the last couple of years a number of outstanding examples have provided evidence that concerted consumer action can have a substantial impact on the operations of larger corporations, in particular in the energy sector, as well as on the behaviour of governments. In addition, in the field of **energy efficiency** the priorities of private actors in the building or transport sectors can have substantial impacts. The transition to renewables also needs more general civil society involvement in decision-making regarding future energy systems. Civil society groups have a wide variety of roles to play and skills to offer – from professional groups to unions and scientific organisations. The success of renewable energy will mainly be determined by consumer demand for technical solutions in this area. In order to put consumers in the position of demanding renewable instead of conventional energy, information and advice must be provided. This should be neutral and free of commercial interests. Consumers should be informed via labels and receive advice about best practice examples of using renewables as well as energy-efficient technologies. This will necessitate the building up of institutional structures for consumer information and advice.

Non-governmental organisations (NGO) can fulfil the key function of providing information to particular stakeholder groups, and can raise awareness and stimulate public debate. In developing countries in particular NGOs are often key to implementing renewable energy systems; acknowledging their strong presence on the ground, their role in disseminating, installing and maintaining decentralised renewable energies should be strengthened. In taking forward a call for action on renewable energy, dedication and partnerships at all levels between the public sector, private sector, NGOs and civil society will be essential if the full potential of renewable energy is to be realised.

6. Annexes

Annex 1: Technical Potential and Use of Renewable Energy

1.1 Technical Potential[a] for Renewable Energies (ExaJoules)

	Biomass	Hydro	Solar[b]	Wind[c]	Geothermal[b]	Ocean[c]	Total
Africa	63	7	783	91	242	–	1,186
Asia + Pacific	72	21	266	106	362	–	827
Europe	35	6	228	168	312	–	749
Latin America, Caribbean	61	10	112	64	235	–	482
North America	52	6	181	151	250	–	640
World (potentials)	283	50	1,570	580	1,401	730	4,614
Current use	50	10	0.2	0.2	2	0	62.4
Total primary energy consumption							420

a = In parallel to the term "resources" used for fossil and nuclear primary energies, the term "technical potential" describes the amount of renewable energy available annually from natural flows, taking into account technical limitations of capturing or collecting the theoretical flows, without considering practical feasibility, or costs.
b = data represent rough estimate; c = data represent 10 % of theoretical potential.
Source: Data compilation by Oeko-Institut based on IEA: Renewable Energies 2003;
UNDP/UNDESA/WEC 2000: World Energy Assessment; WBGU 2003: Global Energy Transition

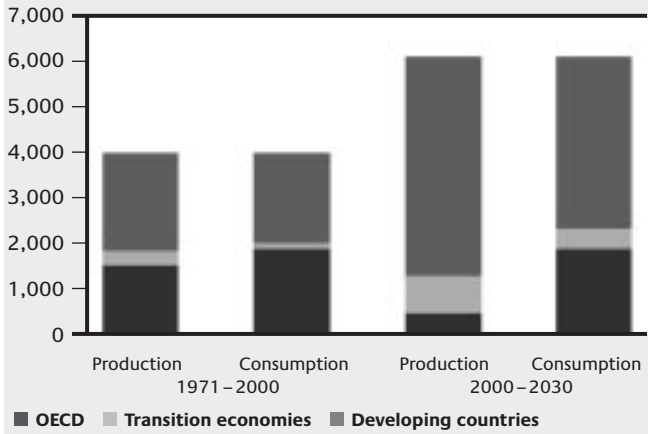
1.2 Contribution of Renewable Energies to Primary Energy Supply in 2001 (ExaJoules)

	Total primary energy	All renewables	Biomass	Hydro	Other renewables
Africa	21.5	10.8	10.5	0.3	0.0
Latin America	18.8	5.3	3.3	1.9	0.1
Asia	48.2	16.1	15.0	0.6	0.5
China	48.4	10.0	9.0	1.0	0.0
Non-OECD Europe	4.2	0.4	0.2	0.2	0.0
Former USSR	39.5	1.3	0.4	0.9	0.0
Middle East	16.3	0.1	0.0	0.1	0.0
OECD	223.3	12.7	6.8	4.4	1.5
World	420.3	56.7	45.2	9.3	2.1

Source: International Energy Agency: Renewables Information, © OECD/IEA, 2003.

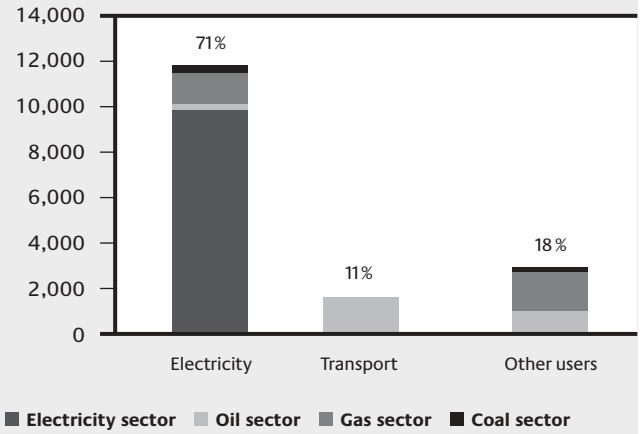
Annex 2: Energy Investment Scenarios

2.1 Increase in World Energy Production and Consumption



Source: International Energy Agency: World Energy Investment Outlook, © OECD/IEA, 2003.

2.3 Cumulative World Energy Investment, 2001–2030 (US$ billion in year 2000)



Source: International Energy Agency: World Energy Investment Outlook, © OECD/IEA, 2003.

2.2 World Energy Investment (US$ billion in year 2000)

	2000	2001–2010	2011–2020	2021–2030	Total 2001–2030	Share of total 2001–2030 (%)
Oil	87	916	1,045	1,136	3,096	19
Gas	80	948	1,041	1,157	3,145	19
Coal	11	125	129	144	398	2
Electricity	235	2,562	3,396	3,883	9,841	60
Total	**413**	**4,551**	**5,610**	**6,320**	**16,481**	**100**
Annual average	**413**	**455**	**561**	**632**	**549**	**100**

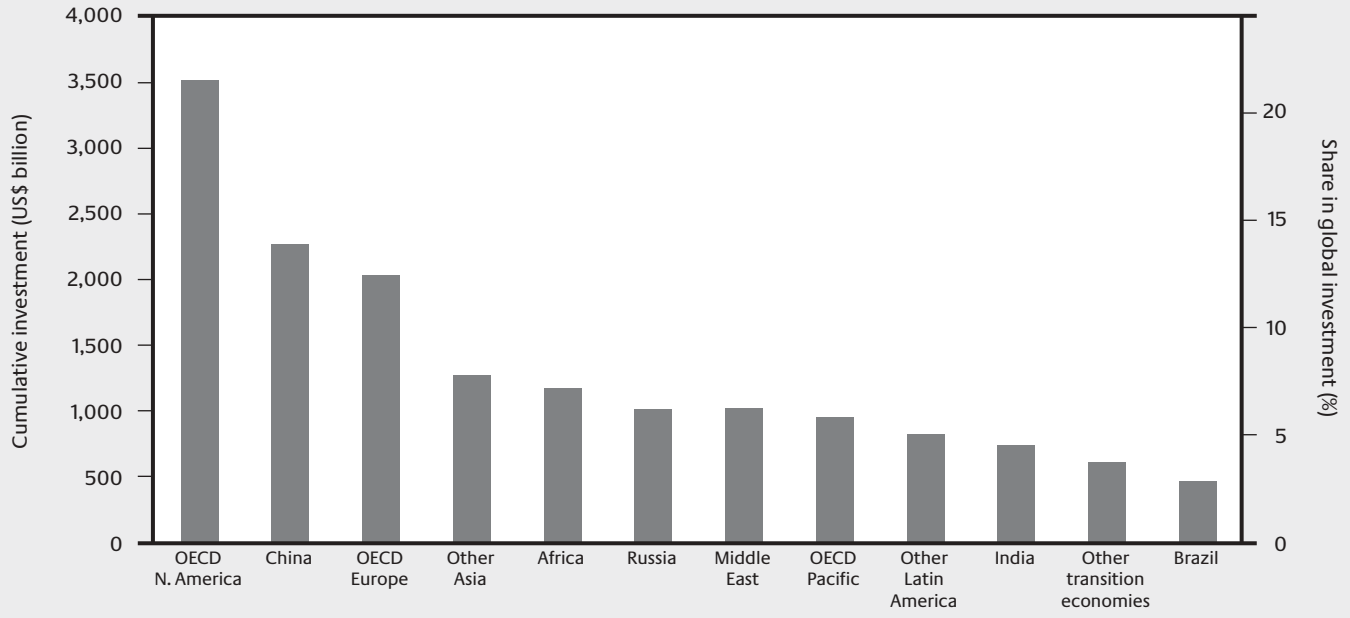
Source: International Energy Agency: World Energy Investment Outlook, © OECD/IEA, 2003.

2.4 Cumulative World Energy Investment by Region, 2001–2030 (US$ billion in year 2000)

	2001–2010	2011–2020	2021–2030	Total 2001–2030
OECD North America	1,062	1,179	1,247	3,488
OECD Europe	650	717	697	2,064
OECD Pacific	381	333	287	1,000
Total OECD	**2,093**	**2,228**	**2,231**	**6,552**
Russia	269	391	389	1,050
Other transition economies	168	221	233	622
Total transition economies	**438**	**612**	**622**	**1,672**
China	578	787	888	2,253
Other Asia (including India)	489	689	876	2,055
Middle East	268	332	444	1,044
Africa	248	393	567	1,208
Latin America	339	440	558	1,337
Total developing countries	**1,923**	**2,641**	**3,332**	**7,897**
Inter-regional transportation	97	129	134	360
Total world	**4,551**	**5,610**	**6,320**	**16,481**
Annual average	**455**	**561**	**632**	**549**

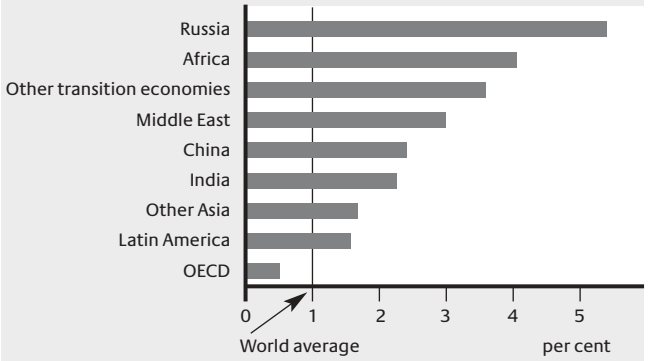
Source: International Energy Agency: World Energy Investment Outlook, © OECD/IEA, 2003.

2.5 Cumulative World Energy Investment by Region, 2001–2030



Source: International Energy Agency: World Energy Investment Outlook, © OECD/IEA, 2003.

2.6 Share of Energy Investment in GDP by Region, 2001–2030



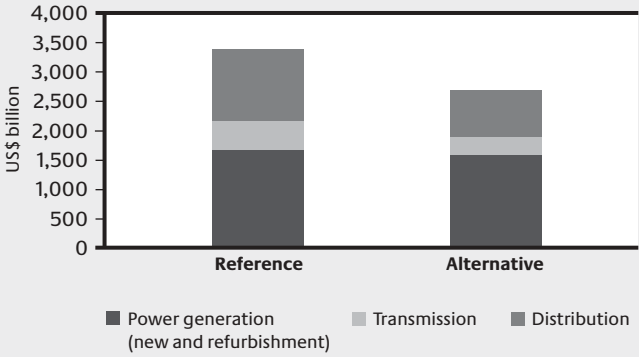
Source: International Energy Agency: World Energy Investment Outlook, © OECD/IEA, 2003.

2.7 Policies Considered in Power Generation (Alternative Policy Scenario)

Policy type	Programme/measure	Impacts on power-generation sector
Increased renewables	Renewable Energy Directive (EU) Renewable Portfolio Standard (United States and Canada)	Increased share of renewables
	Renewable energy targets (Japan, Australia and New Zealand)	
Increased CHP	Policies to promote CHP in end-use sectors	Increased share of electricity generation from CHP plants
Improved efficiency	Various policies and R&D to accelerate the penetration of even higher-efficiency coal and gas plants and new technologies such as fuel cells	Higher efficiency for new gas, coal and fuel cells plants

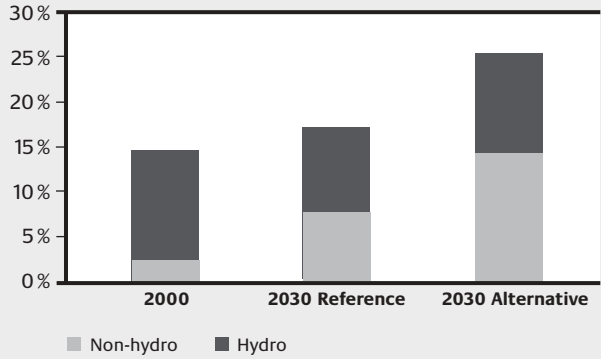
Source: International Energy Agency: World Energy Investment Outlook, © OECD/IEA, 2003.

2.8 OECD Investments in the Reference and Alternative Policy Scenarios



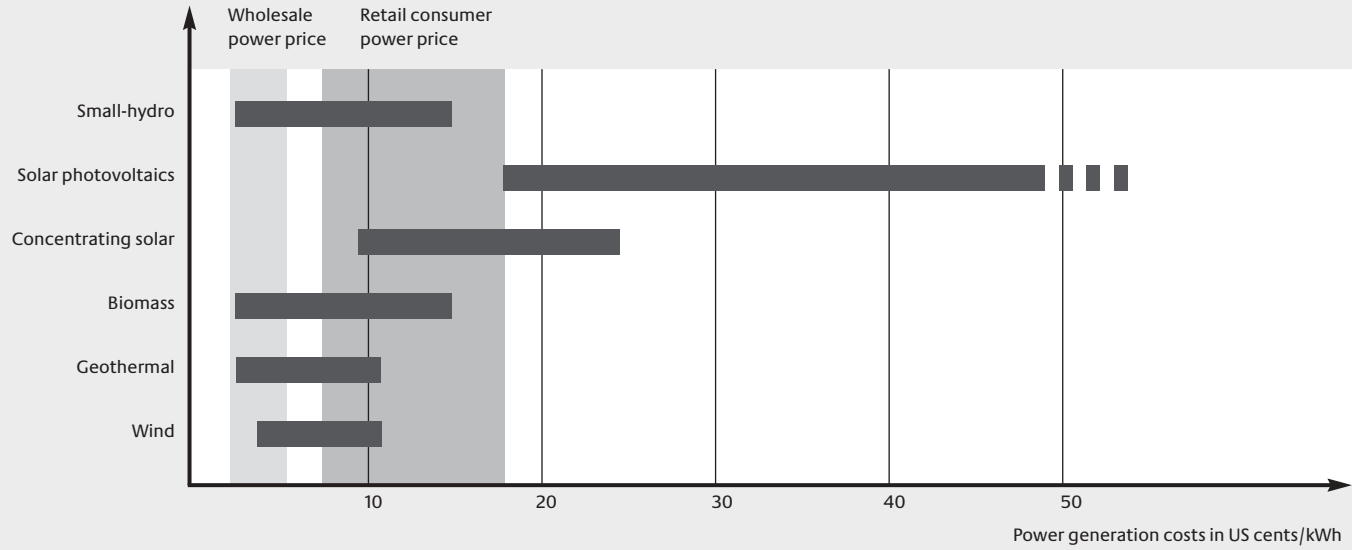
Source: International Energy Agency: World Energy Investment Outlook, © OECD/IEA, 2003.

2.9 OECD Share of Renewables in Electricity Generation in Reference and Alternative Policy Scenarios



Source: International Energy Agency: World Energy Investment Outlook, © OECD/IEA, 2003.

2.10 Range of Generation Costs of Selected Technologies for Renewable Electricity



Note: Cost calculation is based on system investment needed (capital cost is based on a discount rate of 6 % and an amortisation period of 15 – 25 years) and power output. Lowest cost range refers to optimum conditions (proven technology, optimised plant size and design, and high availability of system and resources).

Source: International Energy Agency: Renewables for Power Generation – Status & Prospects, © OECD/IEA, 2003.

Annex 3: Practical Examples and "Best Practices"

The following examples, "best practices" and programme descriptions represent a cross-section of initiatives and programmes that are supposed to provide some exemplary, empirical support to the arguments as they are presented in the main text of the Conference Issue Paper. Some of them stem from other published primary sources, such as the Thematic Background Papers for *renewables 2004*. The conference conveners would very much like to thank those members of the International Steering Committee and the National Advisory Committee who have proposed contributions to this Annex. For reasons of space it was, unfortunately, not possible to include all the proposals. The items in this Annex appear in the order in which references are made to them in the main text.

Annex to Chapter on The Challenge

3.1 Upesi Stove Project in Kenya

The Upesi project was initiated in 1995 to promote the adoption of more efficient stoves in rural areas of Western Kenya. Its goal was to improve living and working conditions of women in rural households by enabling a significant and increasing number of women and families to benefit from fuel-saving wood-burning stoves. The project has cooperated with women's groups and involved them in design and field-testing of the stove. The women have been trained in producing, distributing and installing the stoves. Additionally, their marketing skills have been improved. Therefore their ability to earn their own income from stove-related activities has increased. Over 16,000 stoves have been installed, providing significant poverty alleviation. The benefits to men and women in the project areas include improved health and time savings for users of the energy efficient stoves, as well as relief from pressures caused by wood fuel shortage. (Khatami-Njenga, 2001)

Source: Thematic Background Paper "Gender", renewables 2004

Annex to Chapter on Policies for Renewable Energy Market Development

3.2 New England States of the USA: Quota Systems for Renewable Energy

The state of Massachusetts introduced a quota obligation (Renewable Portfolio Standard) on all electricity suppliers in 2002. The regulation of the Massachusetts Division of Energy Resources (DOER), released in April 2002, requires all retail electricity suppliers to utilise "new renewable energy sources" for at least 1 % of their power supply in 2003, and increases this minimum share in annual steps of 0.5 % to 4 % by 2009. A further increase by 1 % per year is envisaged. Eligible renewable energies technologies include solar, wind, ocean thermal, wave, and tidal, fuel cells using renewable fuels, landfill gas, and low emission, advanced technology biomass. To qualify as a "new renewable" resource, the power plant must have been installed in or after 1998. Verification of the quota obligation is based on a green certificate system, which is part of the Generation Information System (GIS) operated by the New England Power Pool NEPOOL. The GIS system allows issuing, transfers and redemption of certificates for electricity from all energy sources and technologies, including renewables.

A similar system has been developed in New Jersey since 1999. The New Jersey quota obligation defines two classes of renewable energy technologies: Class I includes wind, solar, fuel cells, ocean energy, landfill methane and biomass, if the biomass is "cultivated and harvested in a sustainable manner." Class II includes hydro and waste-to-energy plants that meet the "highest environmental standards." The next compliance period is January 2006, when all electricity suppliers have to provide 0.5 % of their energy from Class I resources and another 2.5 % from Class I or II. In August 2003, the New Jersey Board of Public Utilities proposed to raise the obligation to 4 % from Class I (plus an additional 2.5 % from Class I or II, as before). The new proposal also includes a specific obligation for 90 MW of solar electricity generation by 2008, which would be equal to 0.16 % of total consumption. Again, certificates issued by the NEPOOL GIS system can be used for verification.

Quota obligations are also in place in other states such as Texas, and some 15 additional states are considering setting up such systems as well. In a recent initiative, the possibilities for a green certificate market across the US, Canada and possibly Mexico are also being explored.

Sources: Conference Secretariat / Oeko-Institut

3.3 Germany: Guaranteed Feed-in Tariffs

The German Renewable Energy Act of 2000 set specific feed-in tariffs for various renewable energy technologies for a period of 20 years (high investment security), based on their generation cost and generation capacity. The aim is to secure pioneering markets for renewables, and to support technological learning through large-scale market introduction. The law covers electricity from wind (on- and offshore), biomass plants of up to 20 MW, photovoltaic, hydro and geothermal. Generally, the tariffs decrease for newly installed plants.

The electricity from renewable energies is distributed proportionately amongst grid operators, according to the amount of electricity supplied to customers (flexible shares at the transmission system level). All electricity suppliers are obliged to purchase from their regional grid operator an equal share of electricity from renewable energy (flexible shares on the electricity supplier level).

So far, the Feed-in Tariffs have been a prominent success in massively increasing wind energy generation, and accelerating biomass and solar technologies. In 2004, the Law is being revised, covering also larger-scale hydro, and differentiating tariffs between biomass types, and size of plants. EU countries like Austria, Belgium, Denmark, France and Spain have adopted similar legislation, and Brazil (among other developing countries) is in the process of establishing a comparable scheme.

Sources: Conference Secretariat / Oeko-Institut

3.4 Sri Lanka: World Bank/GEF Energy Services Delivery (ESD) Project

The Sri Lanka Energy Services Delivery (ESD) Project, a uniquely designed and implemented project, can serve as a model for other rural electrification initiatives with renewable energy and energy efficiency components. In particular, it applies a multi-stakeholder approach in overcoming

the financial, institutional and market barriers traditionally associated with the implementation of small-scale renewable energy and energy efficiency options.

Significant gains have been made to commercialise grid-connected mini-hydro and wind power, off-grid village or micro-hydro power, and wide-scale use of solar home systems. Additionally, the ESD Project has helped strengthen the basis for adopting demand-side management (DSM) options to help reduce consumption of grid-based electricity. By successfully achieving its objectives, the ESD Project has laid the foundations for a wider-scale commercialisation program for renewable energy and energy efficiency in Sri Lanka.

Sources: World Bank/Sri Lanka Energy Services Delivery Project. Impacts Assessment and Lessons Learned, March 2003.

3.5 Development of Biomass District Heating in Austria

In the early 1980s, the first projects involving small-scale district heating based on biomass were realised in Austrian villages. Small heating stations with a power of between a few 100 kW and 5 MW produced heat by burning wood chips from forestry operation or sawmill wastes. In most cases the promoters of these plants were agricultural cooperatives trying to enter the energy market. As a result of the first successful projects, the Federal Ministry of Agriculture and the provincial governments introduced significant subsidies. Later, small-scale biomass district heating plants received additional subsidies from EU regional funds. Typically, subsidies amounted to up to 50 % of investment costs.

Next to the subsidies, several provincial governments began to offer consulting services that helped to identify new projects, gave advice to farmers, encouraged further development of the technology, and lobbied for financial support and other political measures. The provinces that offered consulting services were far more successful at disseminating biomass district heating than provinces without these services. On a national level, the installed biomass district heating capacity rose from almost zero in the early 1980s to over 800 MW in 2002.

The driving force for biomass district heating in rural villages in Austria was bottom-up interest in the new technology. This interest, together with the positive presentation of projects in the media, enhanced the supportive political attitude. It is noteworthy that market development of biomass district heating was not based on the result of a dedicated R&D programme. However, the experience from projects was fed into research activities that further improved the technology.

Source: Austrian Energy Agency (EVA)

Annex to Chapter on Financing Options for Renewable Energy

3.6 Renewable Energy Funds: State and Local Government Initiatives in the US

The introduction of renewable energy funds at the state level has been one of the most popular mechanisms for increasing investment for renewables in the US. Between 1998 and 2012, US$ 4.37 billion will be collected in fifteen states as System Benefits Charges (SBC) on conventional electricity bills, and pooled in SBC funds that invest in various ways in renewable energy projects.

Some specific examples include California, where the SBC fund will invest US$ 135 million/year in the renewable energy sector. In addition, in San Francisco voters have supported a proposition that allows the city to issue up to US$ 100 million in revenue bonds to finance renewable energy projects and energy efficiency measures in city and county-owned buildings.

The New Jersey State Board of Public Utilities' Clean Energy Program and the New Jersey Economic Development Authority (EDA) are combining technical and financial expertise to build several new financing partnerships that will make US$ 60 million available for energy efficiency and renewable energy projects and make it more affordable for businesses to invest in clean energy equipment. The financial incentives include long-term bonds, a loan and guarantee fund, and an interest-free innovation fund.

Source: Thematic Background Paper "Financing Renewable Energies", renewables 2004

3.7 Argentina: Concession Approach, Smart Subsidies, Feed-in Act

In conjunction with the World Bank, Argentina is implementing Renewable Energy in Rural Markets (PERMER), a rural electrification programme with a strong focus on renewable energies. PERMER offers unique concessions in rural areas to involve the private sector. The concessionaires are provided with the rights and responsibilities for electrification of communities within the defined area. Funding for the supply comes from the end user and the government. A unique feature of PERMER is its provision for subsidy minimisation. The government remains a critical participant however, providing resources and institutional support for long-term sustainability. The government of Argentina is now also implementing a feed-in act with price guarantees (valid for 15 years) and an 8 % target for 2013 (based upon an existing solar and wind energy act).

Sources: Report of the G8 Renewable Energy Task Force, 2001 and Renewables Preparatory Conference, Brasilia 2003

3.8 Rural Energy Enterprise Development (REED)

Initiated in 2000 by UNEP, E+Co, and a number of country partners, and backed by the UN Foundation, the Rural Energy Enterprise Development initiatives support sustainable energy enterprises that use clean, efficient, renewable, and affordable energy technologies to provide energy services to rural and peri-urban customers in seven developing countries. REED offers rural energy entrepreneurs a combination of start-up financing, enterprise development services such as business planning, management structuring and financial planning, and assistance in securing later-stage financing. 25 enterprises financed to date in Ghana, Mali, Senegal, Tanzania, Zambia and Brazil include crop drying, charcoal production, biofuels, wind pumps, solar water heating, and efficient cook stoves.

Source: Thematic Background Paper "Financing Renewable Energies", renewables 2004

3.9 Prototype Carbon Fund (PCF)

The PCF is similar to a closed-end mutual fund, with objectives to supply high-quality carbon offsets at a competitive price, and to ensure that buyers and sellers of offsets receive a fair share of the value added. The negotiated price of the carbon offsets covers the cost of additional emissions reductions measures over the baseline technology, as well as a margin representing equitable benefit sharing between the investor and host government. As of late 2003, the PCF has been capitalised at US$ 220 million.

Source: http://prototypecarbonfund.org

Annex to Chapter on Developing Capacity for Energy Market Transformation

3.10 Mediterranean Renewable Energy Programme

The Mediterranean Renewable Energy Programme (MEDREP) was launched as a Type II Initiative at the World Summit on Sustainable Development (WSSD) in Johannesburg by the Italian government. Currently, a broad range of different national agencies of Mediterranean countries as well as international organisations are involved in MEDREP. The two different objectives of the programme consist of providing modern and sustainable energy services particularly to rural populations and of mitigating climate change by increasing the share of renewable energy technologies in the energy mix of the Mediterranean region. MEDREP uses different mechanisms to achieve these objectives, including the development of financial instruments, the strenghtening of policy frameworks, and the elaboration of certificate trading schemes. At the moment, two projects are being developed that will provide financial support to photovoltaic systems in Morocco and solar water heaters in Tunisia. In January 2004, the MEDREP partners agreed to establish a Mediterranean Renewable Energy Center (MEDREC) in Tunisia which will further promote renewable energy in the region.

Source: Italian Ministry for the Environment

3.11 Japan: Governmental Support for R&D of Renewable Energy

As early as 1974, the Japanese government started to support research and development (R&D) activities in the field of renewable energy. Through its "Sunshine Project", Japan began to develop renewable energy technologies (especially photovoltaics) on a large scale. In 1993, this project was replaced by the "New Sunshine Project" and the "Moonlight Project" that focused on energy conservation technologies. To coordinate renewable energy R&D, the New Energy and Industrial Technology Development Organisation (NEDO) was founded in 1980. Renewable energy businesses and scientific research institutions were actively involved in all R&D activities.

In the field of solar PV, mass production technologies, PV cells devised from novel materials and building-integrated PV panels were promoted with a focus on cost reduction. Large government R&D investments led to cost reductions of around 90 % between 1980 and 1990. Production costs declined by a further 50 % during the 1990s. At the moment, the government continues its support for R&D in order to reduce costs and improve performance of thin film modules and PV mass production technology. As a result of the Japanese R&D programme, sales of residential PV systems started to increase and a self-sustained PV market started to emerge. Together with government subsidies for renewable energy, demand for renewable energy led to a substantial expansion of the PV market. In 2002, cumulative PV capacity reached 637 MW – the highest volume of any country in the world.

Source: Ministry of Economy, Trade and Industry, Japan

3.12 Know-how and Technology Transfer for Renewable Energy Markets – TERNA

The TERNA (Technical Expertise for Renewable Energy Application) programme works with partners in developing and newly industrialising countries and aims to support them in planning and developing wind energy projects. Partners that are interested in exploiting wind energy commercially, for example ministries or government institutions mandated to develop BOT/BOO projects, government or private energy utilities, and private companies in liberalised energy markets (IPPs). Partners are enabled to conduct project studies on technical design, cost determination and feasibility analysis. TERNA also provides technical assistance on financial issues, closing the gap between technical wind potential on one side and investors and project developers on the other side. Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) has been implementing the wind energy programme on behalf of the Federal German Ministry for Economic Cooperation and Development (BMZ) since 1988.

Source: www.gtz.de/wind

Annex to Chapter on Stakeholders and Their Roles

3.13 Rural Energy Development Programme (REDP) in Nepal

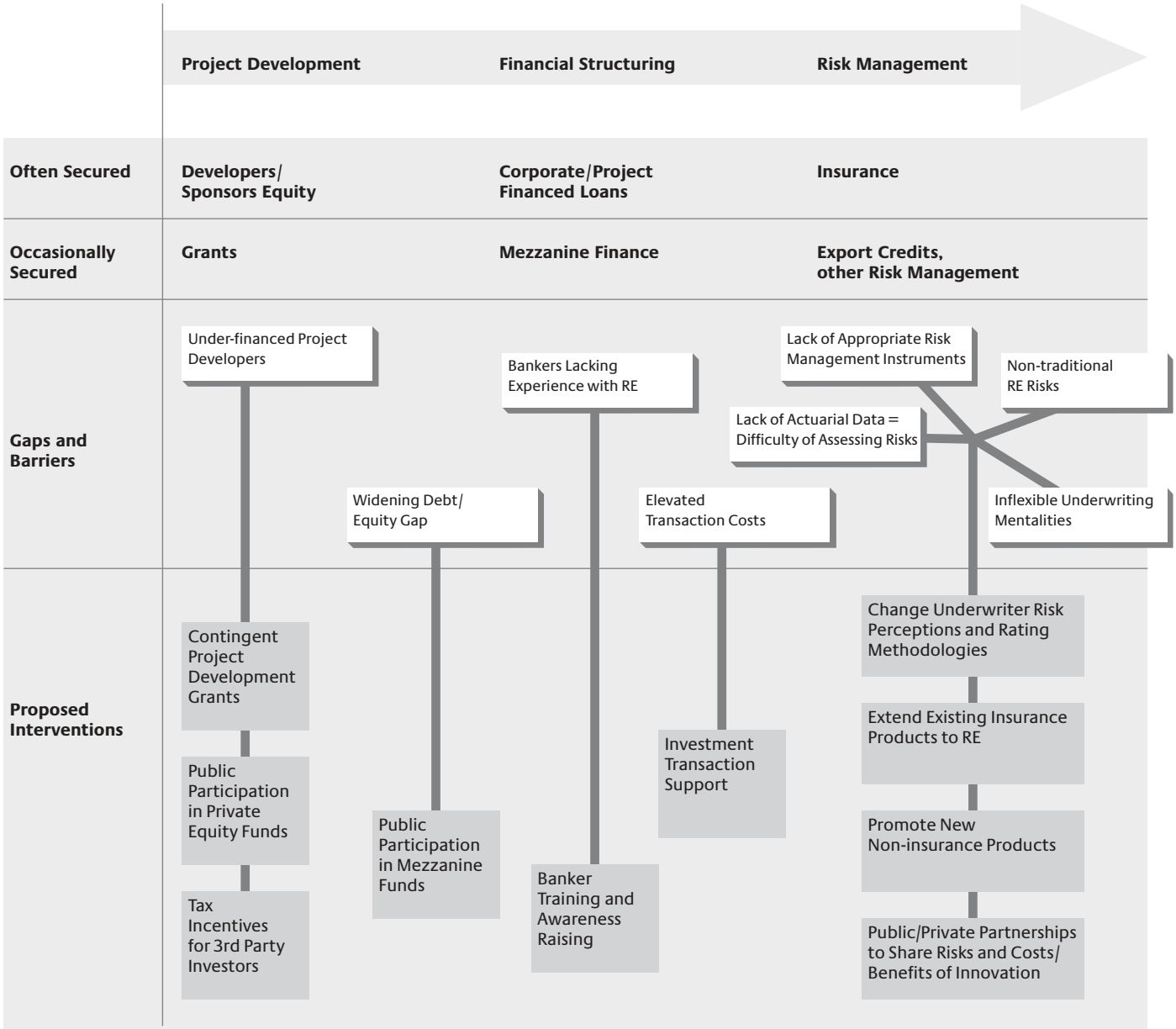
The Rural Energy Development Programme (REDP) in Nepal project aims to enhance rural livelihoods and preserve the environment by supporting the installation of micro hydropower systems. In 1996 the REDP established male and female community organisations with equal responsibilities to work on the project. Every participating household sends a male member to the male community and a female member to the female community. The segregation of women and men into separate community organisations encourages men and women to discuss and analyse specific problems they face. The community organisations meet every week. By the end of 2000 total membership was 20,258 women and 19,125 men in 1,021 female and 1,000 male community organisations.

Additionally, the project facilitates capacity building through training in reading and writing, management and leadership. The equal opportunities have had a very visible and positive impact in mobilising women and integrating them into mainstream activities. The women in community organisations have a distinct voice in local affairs and self-confidence has increased, as has their capability for independent and collective action.

Source: Thematic Background Paper "Gender", renewables 2004

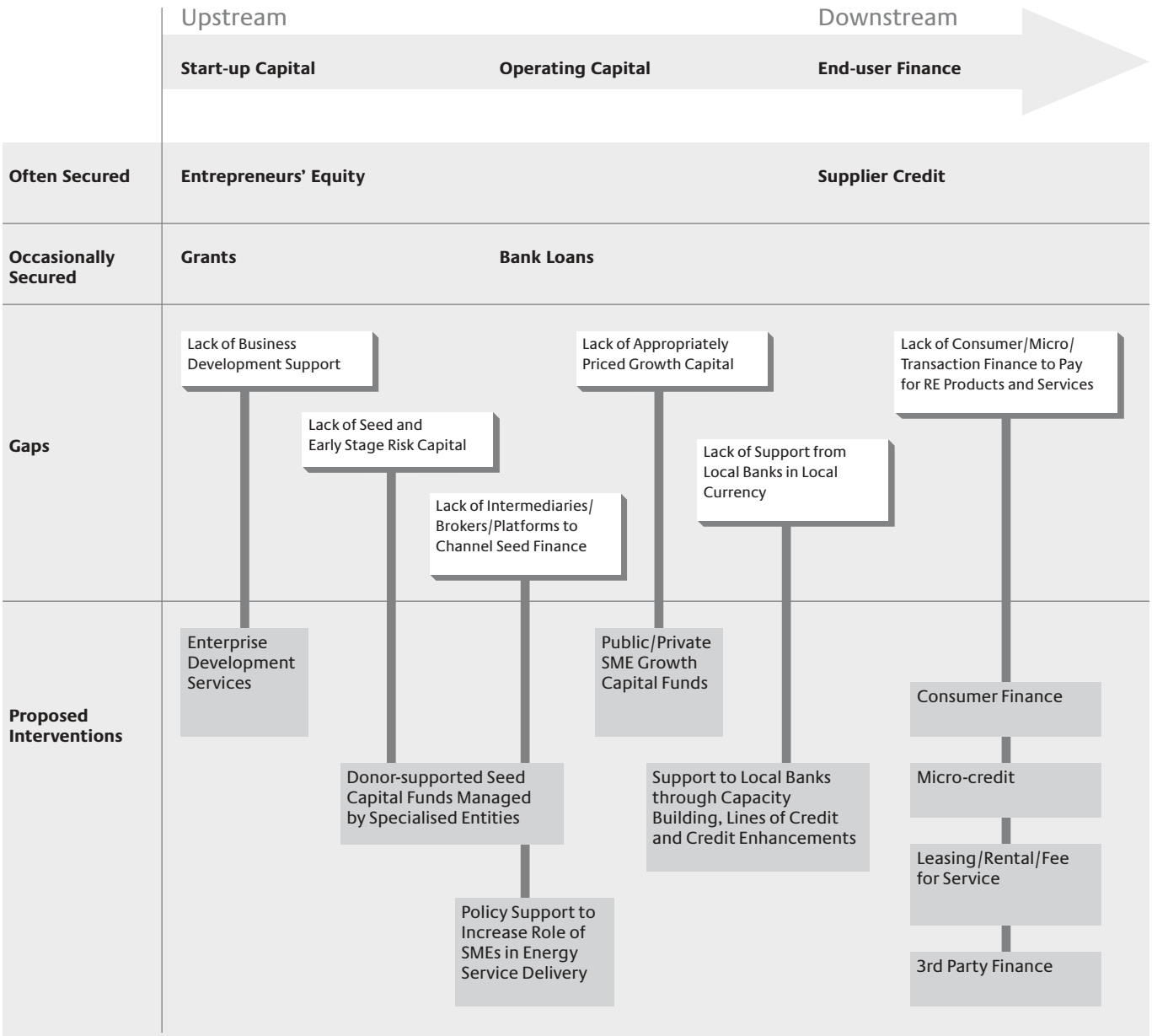
Annex 4: The Finance Continuum

4.1 The On-Grid Finance Continuum



Source: Thematic Background Paper "Financing Renewable Energies", renewables 2004

4.2 The Off-Grid Finance Continuum



Source: Thematic Background Paper "Financing Renewable Energies", renewables 2004

Annex 5: Breakdown of Energy Components in World Bank Operations

World Bank Group Statistical Data on Approved Energy Projects and Project Pipeline*

US$ million	2000	2001	2002	2003	2004
Energy projects & energy components	1,702	1,784	2,132	1,206	1,599
o/w District heating & energy efficiency	254	189	37	68	369
o/w Non-hydro renewable energy	27	8	150	53	214
Share of RE in energy portfolio	**1.6%**	**0.4%**	**7.0%**	**4.4%**	**13.4%**

* = includes all product lines (IBRD/IDA, SF, Guarantees, GEF, etc.)

IFC Statistical Data on Energy Projects and Project Pipeline

	IFC Total Energy Commitments			IFC Renewable Energy/ Energy Efficiency			
	Power	Oil and Gas	**Total**	Power Dept.	Other IFC Depts.	**Total IFC**	**Total IFC**
	Commitments (US$ million) – Gross figures*						**Share of RE/EE**
Fiscal Year 2002	208	65	273	0	12	12	4.4%
Fiscal Year 2003	315	344	659	45	90	135	20.5%
Fiscal Year 2004 (expected)	564	596	1160	0	NA	0	

*Gross figures include IFC B loans from commercial banks

MIGA Statistical Data on Energy Investments and Project Pipeline

US$ million	Renewables	Total Energy	Share of RE
Fiscal Year 2002	84	445	18.8%
Fiscal Year 2003	0	602	0.0%
Fiscal Year 2004 (expected)	22	306	7.2%

Sources: World Bank, Oeko-Institut

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Postfach 5180
65726 Eschborn,Germany
Tel +49-(0)6196-79 4404
Fax +49-(0)6196-79 4405
info@renewables2004.de
www.renewables2004.de

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