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Climate Change Mitigation and Energy Policy in Development Cooperation: What Role for Renewable Energy Technologies?

Renewable energy technologies (RET) play an important role in industrialised countries' strategies for reducing CO_2 emissions, and thus in mitigating climate change, as well as for achieving long-term energy security. Based on the principle of common but differentiated responsibilities, the North has an obligation to be a pioneer in this process. RET do not always have the same strategic importance in developing countries, since the latter are faced with other pressing development issues, and improvements in energy efficiency may entail major benefits for climate change mitigation. Development cooperation in the field of energy policy should thus be based on a broader strategy which includes both improvements in fossil fuel technologies and promotion of RET. A sustainable energy policy strategy has to consider partner country characteristics that affect the effectiveness and the desirability of policy instruments and overall responsibility for global climate change.

Partner countries can be classified in three groups: Group I consists mainly of sub-Saharan African countries where energy poverty and unsustainable biomass use patterns prevail. Group II consists of countries in transition, where institutional problems often lead to low energy efficiency and high CO_2 emissions. Group III consists of other developing countries and is dominated by dynamic economies with large populations and high and growing energy demand and CO_2 emissions.

Development cooperation in the field of energy should be based on three main strategies:

*A) The **energy poverty and sustainable biomass management approach** geared to country group I (also suitable for marginalized areas of country group III).*

*B) The **energy efficiency and energy market reform approach** geared to country group II (complementary approach for group III).*

*C) The **climate change and energy security approach** geared to country group III (also suitable for some countries of group II); this approach puts the strongest focus on RET promotion.*

Climate change: causes, responsibilities and consequences

Climate change poses one of the biggest challenges facing world politics. Its consequences are varied: While regions of the North will probably benefit from higher temperatures and expand their agricultural area, most countries of the South are likely to be affected by an increasing number of extreme weather events such as droughts, hurricanes and flooding. Food security will diminish and tropical diseases will spread into new areas. Depending on the extent of climate change, sea levels will rise several meters, and millions of people in low-lying countries and small island states will be displaced. Due to the complex nature of meteorological dynamics, we are not able yet to foresee all possible changes and their effects on ecosystems, the economy, and human welfare. But we do know that climate change is inevitable and that its consequences will be felt in day-to-day life in the coming decades. Mitigating climate change, and taking action to prevent it, is therefore one of the main priorities of international cooperation and national politics.

Climate change is caused by increasing levels of CO_2 and other gases in the atmosphere which reinforce the natural greenhouse effect and thus lead to global warming. The main source of CO_2 emissions is the burning of fossil fuels for purposes of electricity generation, heating and cooling, industrial processing or transport. The level of CO_2 in the atmosphere today is 31 % higher than it was in 1750. This dramatic rise is a direct consequence of the industrial revolution, which was fuelled first by coal and later by oil. The industrialised countries therefore bear the historical responsibility for climate change. Also, these countries have the highest CO_2 emissions per capita worldwide, and they concentrate the financial and technological resources for mitigating climate change and adapting to it. It is clear, however, that in the future greenhouse gas (GHG) emissions will show the highest growth in developing countries. According to calculations of the International Energy Agency, world CO_2 emissions will increase by 70 % in the coming 30 years if no turnaround is forthcoming in energy policy. Two thirds of this increase will occur in developing countries. These two facts, historical responsibility of industrialised countries for climate change and growing CO_2 emissions from developing countries, are reflected in the United Nations Framework Convention for Climate Change (UNFCCC), which states that international cooperation should be based on the principle of "common but differentiated responsibilities" for all countries.

Box 1: RET – Basic information

RET based on wind, solar, geothermal, tidal and wave energies are largely uncontroversial because these technologies do not imply any serious risks for human health or the environment. Wind and solar energy are the furthest developed and most widely diffused RET technologies available today.

RET-related controversies are mainly concerned with hydropower based on large dams and traditional biomass use, due to their high environmental costs. While nuclear energy is not an RET, it is experiencing an upswing because it, together with hydropower, is the only non-carbon-emitting energy source with a noteworthy contribution to world total primary energy supply. Nuclear energy, however, poses serious security and safety problems which should exclude it from the range of alternatives to fossil fuels.

The industrialised countries thus have to be the pioneers in reducing CO_2 emissions and in meeting their obligations under the Kyoto Protocol (which should be ratified as soon as possible). They also have to commit additional financial

resources for measures aimed at reducing emissions and helping developing countries to adapt to climate change. But developing countries, especially the large emerging economies, will have to face their responsibility in reducing GHG emissions as well.

Substitution of renewable energies for fossil fuels and improvement of energy efficiency are the most important measures for reducing CO_2 emissions. Renewable energy technologies (RET) play a strategic role, since – aside from being non-emitting technologies – they operate with non-finite "fuels" (e.g. sunlight) and thus contribute to long-term energy security. However, today RET are usually not competitive with conventional fossil fuel technologies. Their introduction is faced with a number of obstacles such as high initial costs and low rates of return as well as the lack of specialised labour forces. Institutional arrangements often favour conventional energy technologies (e.g. public subsidies for fossil fuels, specification of technology choice in public energy investments, lack of competition in the energy sector). Special policies geared to promoting RET and correcting the bias towards conventional technologies are therefore indispensable. Industrialised countries bear a special responsibility here. Some efforts are being undertaken to take this responsibility seriously. The European Union has decided to double the share of renewable energies in gross domestic energy consumption by 2010, from the present 6 % to 12 %. Germany's stated intention is to reach a share of 20 % in 2020. In the US, several states have committed themselves to invest in RET. But is the promotion of "costly" RET also the most important and best solution for countries in transition and developing countries, and should a strategy of this kind be supported by development cooperation (DC)?

This question has been a matter of controversy between advocates of climate protection and advocates of an accelerated, growth-based catching-up process on the part of developing countries. This paper argues that promotion of RET in DC should be embedded in a broader strategy for sustainable energy development, one which takes into account the most pressing energy-related development problems, socio-economic conditions and partner-country responsibility for climate change mitigation. A general switch from fossil fuels to RET in DC is not recommended.

How can the promotion of RET contribute to sustainable energy development?

Energy policy as a whole has to pursue economic, equity-related and environmental goals, i.e. aim at the interface between the three dimensions of sustainability: economic efficiency, social equity and environmental sustainability. Any isolated measures undertaken by energy policy (and DC in this field) will most likely be biased towards one of these three dimensions and prove unable to reach a balance on its own. What is therefore called for to meet the sustainability criteria is a combination of public policies and measures as a whole.

What does the sustainability paradigm imply in the field of energy policy? In environmental terms, the case for more energy efficiency and a switch to RET has already been made and justified. In the long term, these objectives are valid for both developed and developing countries. In economic and equity terms, broad access to energy and long-term energy security are fundamental conditions for economic and social development. Here, developing countries are lagging far behind, and this is one of the reasons why growth in energy demand (and thus of CO_2 emissions) will for the most part occur in the South. The close relationship between the economic dimension and the equity dimension is further illustrated by the problem of costs: most developing countries are faced with strong constraints bound up with technological capacities and financial resources for investment in energy supply. These constraints reinforce the tendency to invest in conventional energy technologies and make innovations more dependent on transfers of financial resources and know-how.

What is the best way to integrate RET into a coherent strategy for DC?

Promotion of RET should be integrated into a coherent development strategy that is problem-driven and not guided by technology. A coherent strategy for the promotion of RET has to be embedded in a broader sustainable energy policy strategy and should

1. **consider partner country characteristics** that influence the effectiveness and the desirability of policy instruments and the responsibility for global climate change;
2. **follow an approach that includes an array of effective instruments** in which promotion of RET is, generally, just one option among others.

Partner country characteristics

Four dimensions seem especially important in classifying partner countries with a view to a differentiated energy policy strategy: (i) patterns of energy consumption and GHG emissions, (ii) global responsibility for climate change, (iii) regional political and economic power, (iv) and socio-economic and technological development. Table 1 presents a rough and illustrative classification of countries in transition and developing countries based on these dimensions.

Table 1: RET strategy country groups

Group	*Characteristics*	*Country examples*
I	biomass-based, stagnant, low per capita emissions, low to average energy intensity, LDCs or low-income countries with low dynamics	Benin, Cameroon, DR Congo, Ethiopia, Ghana, Haiti, Kenya, Mozambique, Namibia, Nicaragua, Nigeria, Sudan, Tanzania, Togo
II	average to high carbon intensity, emissions stagnating at an average per capita level, average energy intensity with trend to stagnation, low or lower middle income countries with low dynamics	Albania, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Turkmenistan, Uzbekistan
IIIa	average to high carbon intensity with upward trend, increasing emissions from a low per capita level, low to average energy intensity, low or lower to upper middle income countries with mainly positive dynamics *and* global responsibility for climate change *and* high regional political & economic power *and* sufficient technological development	Argentina, Brazil, China, Egypt, India, Indonesia, Iran, Mexico, Pakistan, Saudi Arabia, South Africa, Thailand, Turkey
IIIb	*Idem group IIIa and* no global responsibility for climate change *or* low to middle regional political & economic power *or* low technological development	Bangladesh, Bolivia, El Salvador, Guatemala, Honduras, Jamaica, Jordan, Lebanon, Malaysia, Morocco, Nepal, Paraguay, Peru, Sri Lanka, Uruguay, Venezuela, Zimbabwe

Source: Own compilation based on Reusswig / Gerlinger / Edenhofer (2003) and Stamm (2004)

Group I consists mainly of sub-Saharan African countries. It is obvious that there is no justification to expect these countries to assume responsibility for global climate change, since their share in total CO_2 emissions is completely negligible. They have little regional political and economic power and are characterised by low levels of socio-economic and technological development. The most pressing energy-related problem of this country group is energy poverty: A high share of the population has no access to affordable modern energy services and for this reason suffers from low productivity and high health hazards. One severe environmental problem associated with energy poverty is the extensive and unsustainable use of biomass fuels observed in these countries, a practice which leads to land degradation and persistent degradation of natural resources. Lack of access to modern energy services in these countries led to a sharp decline in carbon intensity in the 1990s (measured in terms of modern fossil fuel consumption) which has been associated with an increase in traditional biomass use intensity. Accordingly, energy policy has to focus on (energy) poverty and the unsustainable use of biomass. The approach has to be centred on national development interests and should reflect the low technological capacities of this country group.

Group II consists mainly of Newly Independent States of the former Soviet Union. The most important problems of these countries are related to the heritage of the soviet-style energy system and are of an institutional nature. Their relatively high carbon intensity and high energy intensity are associated with an energy policy that has heavily subsidised the use of fossil-fuel-based energy services and failed to apportion individual responsibility and accountability for the use of energy sources. Another problem facing this country group has been the bad financial situation of many of the electricity utilities, a situation caused by the economic decline during the 1990s as well as by institutional weaknesses. This has led to a deterioration of physical infrastructure. Another factor associated with the economic decline of these countries is that total CO_2 emissions have stagnated or decreased over the last decade. Still, some countries of this group show per capita emissions that are well above the world average. DC should centre mainly on national development interests and focus on institutional reforms aimed at improving both energy and economic efficiency.

Group IIIa contains all countries that may be seen as having some measure of responsibility for global climate change; their total CO_2 emissions are relatively high and dynamic. These countries wield considerable regional political and economic power and have technological capacities that are sufficiently developed to permit them to adopt RET developed in industrialised countries and to establish the necessary maintenance services and quality control systems. The most important challenges in the energy sector are to provide sustainable energy supply for a growing demand, to tackle the persisting energy poverty of vast social groups, and to slow down GHG emissions per gross national product (GNP) unit produced. Economic growth and related lifestyle changes in these countries have been associated with substantial investments in the energy sector and increasing per capita CO_2 emissions. Thanks to this development, as well as to population growth, it is to be expected that this country group's share in world energy consumption and world CO_2 emissions will increase significantly in the future.

Group IIIa is therefore highly relevant for DC in terms of global climate change. The energy policy approach taken with these countries should centre on national interests of partner countries as well as on global interests (climate change). RET should be an important element of cooperation in the field of energy. Cooperation in the area of RET should be flanked by energy efficiency measures and support for institutional reform of energy markets.

Group IIIb contains countries which have energy and emission patterns similar to group IIIa but which bear little or no responsibility for climate change mitigation, since their total CO_2 emissions are small. Here, energy policy strategy should be case-specific and follow one of the approaches presented below.

Approaches for DC in the field of RET

With a view to the main energy-related challenges for sustainable development identified in our country group analysis, we will now outline three stylised approaches to cooperation:

A) The **energy poverty and sustainable biomass management approach** geared to country group I (also suitable for marginalized areas of country groups IIIa and IIIb).

B) The **energy efficiency and energy market reform approach** geared to country group II (complementary approach for group IIIa; also suitable for some countries of group IIIb).

C) The **climate change and energy security approach** geared to country group IIIa (also suitable for some countries of groups II and IIIb).

Promotion of RET may constitute an element of any of these three approaches (although approach C places the greatest emphasis on RET). Differences between the approaches include the reasons given for RET, the conditions required to implement them and the main intended effects. This distinction has implications for the choice of technology, the counterpart institutions required and the package of instruments to be used.

The main intended effects of **approach A** are to alleviate energy poverty and to prevent or overcome the related unsustainable use of biomass, problems which are especially pronounced in the rural areas of country group I. Thus measures have to be directed at the supply of affordable modern energy services for lighting, cooking, crop processing, irrigation, entertainment, educational and health services etc., with the ultimate goals of improvements in quality of life and productivity enhancement for income generation. These measures have to be complemented by the establishment of sustainable biomass management systems, since it is anticipated that biomass will continue to be an important energy source in these countries in a mid-term perspective, given its present high share in the energy mix. It is important that this energy policy approach be embedded in a broader rural development strategy since modern energy services are far from sufficient to achieve significant effects on quality of life and income generation in rural areas.

The technology chosen should be adapted to the specific energy-related problems, the market conditions and the low technological capacities of this country group. The main requirements for the choice of an energy technology are that it should deliver both the required load and reliable quality at minimum cost; it should also be a mature and proven technology, one that can be maintained with available local skills and spare parts. Depending on the specific conditions, these requirements may be met by RET (e.g. mini hydro systems, photovoltaic systems, improved stoves for cooking with sustainably managed biomass) or by a conventional technology (e.g. grid extension, diesel generators).

The main intended effects of **approach B** are to spur energy efficiency and economic efficiency in order to reduce CO_2 emissions per GNP unit and to support the economic recovery of country group II. Energy poverty (e.g. lack of access to electricity) is typically not a pressing issue in these countries. Their high energy intensity compared to other developing and developed country groups suggests that energy efficiency measures should be the priority field of action. Improvements in energy efficiency and economic efficiency require an integrated approach containing the following main elements:

- *Support of market-oriented reforms:* This field of action comprises the introduction of cost-covering energy prices (phasing out of untargeted energy subsidies for fossil fuels) in order to render energy services a "scarce resource" as well as the introduction of competition and commercialisation in order to improve productive and allocative efficiency and minimize energy losses and waste.
- *Capacity building in economic, social and environmental regulation:* The energy sector is characterized by important market failures. That is why a regulatory system is required to complement market-oriented reforms aimed at bringing about gains in competition and efficiency as well as balancing out undesired social effects. It would be important to secure the positive environmental impacts of modernization by establishing environmental standards for energy technologies and monitoring systems.
- *Financing of efficient supply-side technologies and technology transfer:* In order to spur energy efficiency, outdated physical supply and distribution infrastructure has to be replaced by modern technologies. Investments in physical capital have to be accompanied by investments in human capital in order to achieve technology transfer and secure maintenance services.
- *Support in demand-side management:* This field of action includes measures aimed at increasing public awareness for energy-saving and climate change as well as introduction and diffusion of energy-saving measures and technologies, including RET (e.g. energy-saving standards for civil construction and transport, efficient lighting, cogeneration in industrial processes, solar water heating systems etc.).

What role can RET play in this approach? RET will compete with conventional technologies in a setting marked by decreasing fossil fuel subsidies and increasing demand-side management incentives. Mature and low-cost RET have a chance to occupy markets that will grow, provided that research and development (R&D) efforts and economies of scale are used to bring down the costs of RET.

In countries of group IIIa approaches B and C (see below) should be combined. Approach B aims mainly at short- to mid-term effects, while approach C aims at mid- to long-term effects. Because of country group IIIa's high growth potential in terms of total energy consumption and total CO_2 emissions such a twofold approach seems recommendable.

The main intended effects of **approach C** for country group IIIa are of a long-term nature: to shift the mix of total primary energy supply towards a higher share of renewable energy sources in order to mitigate the effects of CO_2 emissions on global climate change and to achieve long-term energy security. The idea is to support the introduction of RET in the relatively big and growing economies of country group IIIa, since the potential size and the dynamics of markets there would facilitate the introduction of these new technologies. This strategy would make it possible to achieve significant impacts in the future, provided that RET grow in keeping with the overall energy sector. Once established in these countries, RET will be in a position to spread to the smaller economies of the respective regions. DC should bundle its efforts and engage in the following main fields of action:

- *Technology transfer:* Cooperation in applied R&D should be intensified. This is necessary to adapt RET developed in industrialized countries to local conditions and to spur leap-frogging.
- *Capacity building:* A number of activities are needed to implement RET and to make them marketable. These comprise financing of technical and economic feasibility studies as well as massive capacity building and professional training to build the necessary human capabilities for managing renewable energy projects, supplying maintenance services, training professionals etc.
- *Policy advisory services and institution building:* Incentive schemes and rules should be conceived for the sectors electricity (e.g. feed-in law), construction, transport etc. RET have to be integrated into public investment planning and funding for R&D, and there is a need to adapt professional training curricula.
- *Financing for RET:* An array of different financing instruments is needed to provide tailor-made solutions that are adapted to the innovation and diffusion chain of RET. DC plays an important role here, as it can help to close the related financial gaps and to cover overhead costs related to the introduction of new technologies. However, it is important to avoid promoting RET "whatever it costs."

Approach C with country group IIIa is definitely a very demanding task. Substantial progress can only be achieved if the main multi- and bilateral donors pursue a similar strategy, if development policy is coordinated coherently with other important policy fields (e.g. export promotion, foreign policy) and if partner governments are willing to assume responsibility for climate change mitigation. If partner governments are to move ahead in this direction, it is essential that industrialised countries take their pioneering role seriously, reduce their GHG emissions and fulfil their commitments under the Kyoto Protocol.

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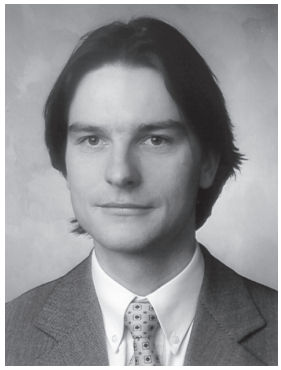

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