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Bioenergy sources and developing countries

Summary

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SUMMARY

The TA project »Bioenergy sources and developing countries« is the result of proposals by the Committee for Education, Research and Technology Assessment and the Committee for Economic Cooperation and Development. The objective of the project, started in October 1999, is to investigate the opportunities and problems of greater use of biogenic fuels in developing countries and the possibilities for shaping development policy, climatic protection policy, research and technology policy in this thematic area.

USE AND PROSPECTS OF RENEWABLE ENERGY IN DEVELOPING COUNTRIES

The current status and prospects for the use of renewable energy is described with the help of a comparison between various scenarios. Analysis of this kind is carried out on the basis of assumptions and statistically identified trends in economic indicators, and needs to be interpreted accordingly. Currently, circa 9.25 GTOE of fossil and renewable energy are used worldwide, 3.8 of them in developing countries. By 2050 is expected this consumption to at least double and at most quadruple worldwide. Energy consumption will rise faster in developing countries than in the industrialised nations. According to the World Energy Council, the share of renewable energy in the energy mix will rise from 1.09 to 3.23 GTOE, or almost one third of total primary energy consumption of the developing countries.

Within the group of renewable energy, biomass is regarded as having more significance initially than solar energy or wind or hydro power. All scenarios show hat this is a »robust« trend, and that there is substantial market potential available for energy generation and transformation plant in this sector. The period up to 2020 is characterised by moderate growth rates. After this, the scenarios assume increasing acceleration in the use of renewable energy, so that this market will be at least as large as the market for plant using fossil energy.

USE OF BIOENERGY IN DEVELOPING COUNTRIES

Solid biomass

In the developing countries, solid biomass are used primarily in the form of wood, by-products from agricultural production (harvest residues) and animal dung. Wood is by far the most important share of biomass. If we divide the

developing countries into three regions (Africa, Latin America including the Caribbean, Asia), we see that biomass is used in very different forms and quantities. The biomass share in the fuel mix is three times as high in Latin America as in Asia and twice as high in Africa. In most countries of sub-Saharan Africa, the share of biomass is even 70–90%. Of this again, the largest share (up to 90%) is used by households for cooking (as wood, charcoal and harvest residues).

Of the biomass share, wood (or charcoal) dominates in all three regions. Harvest residues are used as energy primarily in Asia, although a high unused potential can be assumed in Latin America specifically. In many developing countries (and particularly in Brazil), bagasse from sugarcane processing is increasingly important. Animal dung is primarily used in those parts of Asia where higher quality energy are only available in inadequate quantities if at all.

If we consider the individual economic sectors in the three regions, it is clear that much of the biomass is used in private households for cooking and heating. However, commercial use of biomass is not insignificant, and many farms, breweries and brickworks and similar establishments rely on biomass for their primary source of energy.

Cooking stoves, burners and ovens are the conventional conversion technologies for converting primary energy sources to useful energy in the developing countries, and an important indicator of the use of biomass is the efficiency of these units. In line with economic development, the degree of use of these technologies is highest on average in Latin America (up to 35%) and lowest in Africa (up to 21%). In the past, there were many attempts to boost the average efficiency of the units by strategic distribution of improved cooking stoves and ovens. This strategy was, however, only partly successful, as the new technologies were often not culturally adapted, or had technical shortcomings. Exceptions were China (for the distribution of improved cooking stoves at household level) and Brazil (for almost nation-wide improvement of efficiency in charcoal production).

The use of solid biomass must be seen both today and in the future as competing with the use of fossil energy sources. In most developing countries, with the exception of a few African countries (e.g. Zimbabwe), fossil energy sources dominate the overall energy mix. In all three regions, moderate economic growth and corresponding growth in energy consumption is expected over the next years. In Asia and Africa in particular, this consumption is growing even faster as a result of the rapid population growth. In this connection, the advantage of solid biomass is that they provide energy largely without additional emission of carbon

dioxide and other gases which have climatic impact. Even today, generation of large volumes of carbon dioxide is avoided by the use of biomass.

Worldwide, there are about 104 EJ/year available from solid biomass. Currently, only one third of this is used for energy. A point to bear in mind is that solid biomass are not always available where they are needed. In Asia, for example, there is virtually no unused biomass potential, and in many places there is ecological damage from overutilisation of forests. In Africa at most there are still regions with a surplus supply of biomass. Another point which is important in this context is that a growing part of the solid biomass used for energy comes from agricultural land, although in future there will be increased competition with food production. In the interests of sustainable energy use of biomass potential, two different goals should be pursued. First, sustainability in the supply of solid biomass should be ensured, particularly at the regional level – i.e. use of biomass may not exceed regrowth rate, and forests must be managed appropriately if necessary. Second, the efficiency of energy conversion must be raised, to reduce consumption. Another continuing possibility of interest for development policy is the conversion of solid biomass into electricity or gas.

Oil plants

Oil plants and specifically oil palms are the second category of bioenergy sources studied under the TA project. Besides their importance as food fats and in the oleochemical industry, use of plant oils has gained particularly in significance, with signs of replacing fossil fuels. Worldwide, production of plant oils rose almost 250% in the past 30 years.

The »physic nut« (Jatropha curcas linn) is an oilplant for arid zones, which can be used e.g. as hedges for both erosion protection and fuel winning.

The most productive tropical oil plant is the oil palm, cultivated particularly in West and Equatorial Africa, south-east Asia and Central and South America, characterised by relatively high yields for low fertiliser application. A relatively industrial form of both production and processing (i.e. extraction of palm and palmnut oil) has established itself. However, despite the lower yield, smallholder production is economically relevant and is seen as deserving promotion, as it causes lower pollution.

Both industrial and smallholder production can be substantially optimised in terms of energy efficiency by using by-products and secondary products (e.g. fruit and stone skins and wastewater from oilmills).

Potential for reducing emissions through plant oils is seen primarily in substitution for liquid fuels in the transport sector. For this purpose, plant oil can be made usable as fuel either directly or in modified form, e.g. through conversion at petroleum refineries or esterification.

Expansion of plant oil production depends on a range of different factors. Economically, the price for plant oil competes with the petroleum price, and as fossil energy is widely subsidised, plant oil has so far only been competitive in isolated instances. There is also competition between the use of plant oil for fuel and its use as food. A price increase due to a policy-driven increase in demand for plant oil for use as fuel would exacerbate the already precarious food supply situation, particularly in countries which import plant oil (e.g. China and India). In addition to food production, there is also competition between the use of plant oil for fuel and their chemical and industrial use.

Ultimately, the shortage of suitable cropping areas puts a ceiling on growth in plant oil production. Ecologically, the only acceptable expansion is to degraded areas (e.g. savannah) or a shift in the use of land already used for agriculture. Further, an increase in yield is also conceivable through process optimisation and selecting improved varieties. In the long term there is also a question of the availability of agricultural labour in some countries. Compared with solid biomass, there are incomparably more problems with plant oils as energy source. The potential for reducing emissions is also much lower than with solid biomass or biogas technology.

Biogas

The advantages of biogas technology are its doubly positive contribution towards reducing greenhouse gas emissions. A fermenter is used to ferment organic waste and excrement in the absence of oxygen; the resulting gas mixture is 60–70% methane. First, the climate-changing emissions are avoided through the natural decomposition of these materials, and second other fossil energy sources are replaced by using this gas. Biogas can be used like natural gas for heating, cooking and operating engines and cogeneration heat and power stations. This technology is being successfully used in Asia in particular, but also in Latin America and some regions of West Africa. Its dissemination is, however, constrained by climatic conditions and the availability of fermentation substrates. Contact with fecal matter also has bad associations in some cultures.

In China and India, biogas technology is particularly highly disseminated in smallholder farming. Together, there are some 8 million biogas plants in these

two countries. In India some 6 million tons of firewood was replaced by biogas in 1996. In all developing countries, however, biogas technology needs to be further optimised in terms of technology and process technology. Often, technical deficiencies, inadequate maintenance and lack of operator competence lead to outages. In the two countries cited earlier, biogas technology today is part of the standard. In future, however, increased demand is anticipated for process solutions for treating organic residues and waste and wastewater from the food and biological raw materials industry. However, the appropriate technologies for this have been largely developed in the industrialised nations, and so far not been adapted and used in all developing countries, so that there could be potential for technical cooperation here in future.

CONSTRAINTS ON IMPLEMENTATION

Promotion of bioenergy sources generally and implementation of projects in development cooperation specifically are subject to a large number of technical and other obstacles. These are partly a result of current and future changes in the energy sector, and partly of the highly diverse economic, ecological and social conditions in developing countries. In the past technical constraints occurred particularly if an attempt was made to introduce technologies without regard to the climatic conditions, production technologies or infrastructural shortcomings of developing countries. Nontechnical constraints by comparison are much more complex. We distinguish between economic, ecological, sociocultural and political and institutional sectors whose prevailing conditions a strategy has to address. Most proposals for removing nontechnical constraints relate to dealing with the economic and institutional framework conditions of the energy sector in the relevant countries. A decisive role is played by the prices of fossil energy sources in particular (often changed by government intervention) and the political and institutional regulations for energy suppliers. Further possibilities are offered by closer consideration of the sociocultural features of a country or target region, with better training for specialist staff and users.

Bioenergy sources must not be considered in this context as a homogeneous group, because if we take into account sociocultural criteria, optimal conditions of use differ very greatly in part for solid biomass, plant oils and biogas. As the optimal solution of energy problems generally requires simultaneous use of a number of technologies, there seems no point in pursuing one-sided promotion strategies for bioenergy.

THE EFFECTS OF IMPROVED AND EXPANDED USE OF BIOENERGY SOURCES

Ecological consequences

One of the decisive reasons for promoting bioenergy sources is to avoid greenhouse gas emissions, the emphasis therefore, is on the positive ecological effects and ist improved and expended use. Specifically in the case of Asia and Latin America, a major contribution can be made in future towards reducing the emission of carbon dioxide (CO_2), laughing gas (N_2O) and methane (CH_4). The use of solid biomass has already avoided production of c. 1,300 million tons of CO_2. In the optimal case, i.e. exploiting the entire technological potential and with sustainable management of the corresponding resources, some 3,580 million tons of CO_2 can be saved each year by using solid biomass. As the climatic impact of methane and nitrous oxide is a multiple of that of carbon dioxide, the emission factors of these two gases have to be taken into account in developing improved technologies.

In oil plant cultivation emissions are directly caused by agricultural activity and the production inputs needed for this and indirectly caused by the release of nitrous oxide from nitrogenous fertilisers. In further processing of the plant oil, different levels of emissions result depending on the process, and the ecological balance sheets for these processes vary depending on the scale of energy use of by-products. In principle, the potential of plant oil for reducing greenhouse gas emissions of 40 million tons of CO_2 a year world-wide is substantially lower than for solid biomass. In addition, the positive emissions balance sheet for palm oil and palm nut oil (and also of other plant oils) in energy use depends to a great extent on the design of the process and choice of location, which is why these should be optimally determined. To date, plant oil has only been used as fuel on a very restricted scale, so that there is virtually no experience of its large-scale use.

The goal of biogas use in developing countries is to satisfy demand for energy due to a lack of energy infrastructure or fuel, or to replace traditional fuels and injurious energy transformation technologies. Particularly in Asia, biogas technology is entirely suitable for these requirements. Biogas technology has further advantages, such as reducing hygiene problems and odour emissions, and improved availability of plant nutrients. While these environmental aspects have to date had relatively little weight of relevance for promotion, they have at least as much priority for users in industrialised nations as substitution for imported fossil fuels. There is still a problem in managing the relatively complex technology, particularly if its design is not sufficiently user-friendly. In larger communal

plants, or in combination with commercial animal fattening plants, smooth operation is easier to ensure than in a large number of plants at household level. The success in environmental terms of a strategy to promote biogas technology accordingly stands and falls with the degree to which the technology is adapted to the sociocultural situation.

Socioeconomic consequences

The socioeconomic impacts of using bioenergy sources are equally complex in both industrialised and developing countries. The impacts on the economy in industrialised nations of increased biomass utilisation in developing countries are particularly difficult to estimate.

A qualitative improvement in the energy supply to poor households (e.g. through improved cooking stoves or electrification of biomass) is expected to improve the quality of life and income opportunities in developing countries. Access to modern energy sources is particularly difficult for these population groups, as they not only have little purchasing power but generally also live in areas which are difficult to develop (in rural areas or in unplanned settlements) where access to modern energy sources is correspondingly expensive and often also complicated.

Here, a large number of new energy conversion technologies are offering new potential which also makes decentralised supply with modern fuels increasingly affordable in economic terms. If the private sector receives sufficient incentives and security to invest in such technologies, there is a chance of achieving a significant improvement in the energy supply to remote areas of developing countries in particular. A decisive point here is that the political and institutional shaping of the energy sector's framework conditions must actively support such a development.

Increased use of bioenergy sources in developing countries can impact industrialised nations directly or indirectly. A direct benefit would be a growing market for modern energy conversion technologies for solid biomass and biogas. Indirect effects in the long term would come from alleviating poverty in many developing countries which is due inter alia to an energy shortage. A rising standard of living and political stability for example, generally have a positive effect on international trade and the investment climate.

JOINT IMPLEMENTATION OF CLIMATIC PROTECTION MEASURES

Among the instruments for international climate protection provided for in the Kyoto Protocol, the Clean Development Mechanism (CDM) for promoting bio-fuels in developing countries plays a significant role. This allows the industrialised nations to offset reductions in emissions from projects in developing countries, and results from the fact that reducing emissions can be more economically achieved in many developing countries than in the industrialised nations themselves.

The CDM cannot be considered in isolation from a system of international trade in emission rights, and is rather an integrated element of this. As a result, the successful introduction of this instrument depends essentially on the course of international negotiations on climate protection. Economically, the CDM in the framework of an international trade in emission rights is an efficient means of achieving reductions in emissions, and is favourably regarded not least by industry in the developed countries. Whether the CDM also leads (as many developing countries require) to positive developments in the host countries, depends on its institutional configuration. The latter is still a matter of political negotiation, and although CDM pilot projects are already in execution, many questions (e.g. contract drafting, monitoring and sanctions, and the type of projects allowed) remain to be resolved. The Bonn Agreement of July 2001 provided answers to several of the outstanding questions.

POSSIBILITIES FOR ACTION

Based on the situation described above, a series of possibilities for action can be derived. A distinction is made between national and international opportunities for action.

NATIONAL LEVEL

At national level, various policy areas are covered (environmental and climate protection policy, development policy, research and technology policy) and cross-cutting responsibilities.

Environmental and climate policy: possibilities for action

In the environmental and climate policy field the primary issue is the compatibility of national and international measures, with the need to consider the further

course of international negotiations on climate protection. Currently, however, the following measures are conceivable:

> Creating a favourable national environmental and climate policy framework for the Clean Development Mechanism (CDM) and international trade in emission rights: Various climate policy instruments are available for this. A national certificate system has the advantage that the domestic reduction goal would be passed directly to the individual economic actors. An emission tax in turn reflects the external costs of greenhouse gas emissions in a realistic way. Certified Emission Reductions (CER) can, however, only be indirectly offset against a national energy tax, which is why this is only partly compatible with the Kyoto mechanisms. Offsetting foreign projects against regulatory requirements is generally not possible. The situation is different with a self-imposed commitment by industry, provided this is based on absolute emission targets. To clarify the numerous unresolved questions in this context, the process of debate within the national emission trading group of the German Ministry of the Environment should also be intensified.
> Implementing national environmental and climate policy goals as a prerequisite for technology development: Only national climate policy measures create the need for saving energy and the use of renewable energy in the industrialised countries themselves, and thus incentives for investment in technologies for long-term resource-conserving development. To ensure incentives for innovation, only part of the reduction target should be attainable by utilising the Kyoto mechanisms. For reasons of efficiency, a system of long-term rising emission taxes and falling credits from foreign projects instead of a fixed upper limit would have its appeal.

Development policy: possibilities for action

The far-reaching changes in the energy sector in developing countries put heavy demands on designing corresponding policy frameworks, but can also be seen as an opportunity in combatting poverty and environmental destruction. An important entry point for development policy is supporting the national energy policy. The CDM concept can also make a decisive contribution here, but must not be seen as the only opportunity for bilateral cooperation. Recommendations for development policy accordingly only partly relate to the Kyoto mechanisms.

> Supporting the creation of CDM secretariats and the implementation of CDM projects
  - Supporting the setting up of CDM secretariats in developing countries:

CDM secretariats serve on the one hand to evaluate projects from the point of view of the host country and on the other hand as a contact point for investors from industrialised countries. As not all developing countries can establish such secretariats from their own resources, corresponding support measures are an important basis for CDM projects to be realised.

- Early cooperation with CDM secretariats in developing countries and establishment of the first projects: Several African states, but also countries in the Caribbean and Pacific regions, have already established CDM secretariats. This provides an entry point for initial investment in the use of bioenergy sources.
- Networking and tenders for CDM: The CDM concept current enjoys a highly diverse degree of recognition in the German industrial sector. The German Federal Government could use public invitations to tender to raise awareness among and attract private-sector investors for implementing bioenergy projects in developing countries. The BMZ or GTZ could in future become contacts for investors considering investing in CDM projects or Joint Implementation as a result of the environmental policy situation. Co-ordinating such a development can only be ensured by creating corresponding information channels and networks.

> Conceptual focus of promotional measures in the field of bioenergy

- Increased user orientation: The starting point for technology selection should be the concrete problems as perceived by users. The most efficient technological solution can then be sought on this basis. This is not a new proposal, but we have repeatedly seen – even in the recent past – that only technologies which are culturally appropriate can be successfully disseminated.
- Using system approaches to consider the energy sector: Fuels are interchangeable to a high degree, and price changes easily lead to changes in the overall balance. A system approach means incorporating all options in solving an energy problem, taking into account feedback effects on other energy sources. The institutional framework should provide planning security to the extent that companies and public budgets can plan flexibly for the medium to long term.
- Focus on projects with multiplier function: In view of the enormous overall demand for eco-friendly energy, individual projects can only act as catalysts. The aim should be a self-supporting process of diffusion and innovation, which requires a technology focused on the specific needs and preferences in a way that is only possible through local technology development and adaptation, with the participation by the users.

> General promotional approaches in the sector of bioenergy sources
  - Access to information: A decisive constraint on the use of new technologies in the energy sector is the lack of information on the part of potential users and companies which could invest in the energy sector. Institutions seeking to promote the exchange of information exist in many areas. These could give stronger encouragement than in the past to putting a user-oriented and sustainable energy supply on the agenda, and carrying out the corresponding studies. There is specifically a lack of comparative studies on demand for energy and appropriate approaches for involving users in the planning process.
  - Technology development and adaptation: A range of proposals are on hand for international promotion of technology development. There is, for example, a call for an International Renewable Energy Agency (IRENA) on the lines of the International Atomic Energy Authority, to promote non-commercial technology transfer. Another possibility would be to set up so-called Regional Centres of Excellence for regionally appropriate technology development, which local consulting and cooperation with potential users could build on.
  - Training: Research centres can contribute towards training researchers and developers. However, priority should be given to improving the training of consultants and the population with regard to bioenergy sources. Appropriate curricula can be internationally developed and disseminated and adapted in the individual countries. Another aspect that could be promoted internationally is the integration into basic education of content on a sustainable energy supply and the possibility of increasing efficiency among users.

> Priority setting in development cooperation and technical cooperation on promoting the use of bio energy sources
  - Cooker dissemination programme: Programmes to improve cooking stoves (including under CDM projects) should be implemented particularly where there is a scarcity of fuel, also from the viewpoint of the users. Even the dissemination of improved simple technologies (e.g. wood-saving cookers) poses high demands for those involved. In optimising the combustion process, equal account should be taken of all application-relevant criteria, such as reducing the burden on health and improving user friendliness. As the reduction of emissions with climatic relevance rarely plays any role in the view of users, it should be, as it were, a by-product of improvements in the above properties. Corresponding programmes should involve all levels (e.g. government, craft associations, local authorities, dealers, users) and various sectors (e.g. energy, forestry, agriculture).

- Commercially used biomass combustion plants: In the craft or industrial sector, measures and programmes to improve efficiency could also be carried out as CDM projects. Here again, appropriate technology and consideration of local conditions are of central importance. In the longer term, the use of solid biomass for heat and electricity generation inter alia in-company use of by-products (e.g. sawmills and drying plants) could be an interesting option. Even where the technical problems have been solved, climatic and structural features constrain the possibilities, so that combining electricity and heat production will not be a panacea.
- Establishing energy plantations: The primary goal of this measure is to conserve the resources of natural forests or permit new growth, and successively reduce the share of non-sustainable biomass use from forests. A particular point to consider is that energy plant plantations do not compete with food production. The use of agricultural land to cultivate energy-yielding plants is a possibility particularly in marginal areas and as afforestation of degraded land. In many cases, preference should be given to mixed cropping rather than monocultures. The biomass from plantations can be the basis for processing in nearby drying and other small craft facilities and for marketing. It is, however, still open to doubt whether such plantations – which not only promote energy use of biomass but serve as CO_2 sinks – will be accepted under CDM.
- Substitution of charcoal by standardised solid biomass: Besides improving the efficiency of charcoal production, it is also conceivable in the medium and long term that standardised solid biomass could be used (e.g. pellets for cooking fuel in urban households or as fuel for small-scale craft facilities). This would partly take the place of the use of charcoal, avoiding the high carbonisation loss (up to 70%). It would, however, require that costs (usually high at present) of collection, transport and processing be reduced and the use properties improved in terms of smoke and spark formation in urban use. These measures could prove acceptable under CDM, and also offer many people future employment in production and distribution.
- Creating sustainable forest management systems: Improvements in forest management are extremely important, as in many countries the population has little incentive to use wood resources sustainably because of land ownership conditions. Often, changes in general conditions (e.g. partial privatisation) are required for users and local authorities to assume responsibility themselves for their forests and their management and exploitation, and so become motivated to use their wood resources sparingly and make the supply of firewood more sustainable. Currently it is still uncertain how far such measures will be recognised within the

framework of CDM.

- Biogas plants for the food and bio-raw materials industry: In the context of the high technological development status of biogas technology in Germany, the need for large-scale processes to treat wastewater with heavy organic pollution and biogenic waste from the food and bio-raw materials industry in many Asian countries constitutes potential for future investment under CDM. Technology transfer should be the primary goal, with export only occurring if the plant involved cannot be manufactured locally.
- Biogas plants for households and local communities: In many developing countries, the potential for biogas production is far from exhausted. In the small plant sector, i.e. small biogas reactors or technologies for using biogas (gas stoves, gas lamps), it is important for plant to be produced or manufactured by local or regional companies using locally available materials. Projects must accordingly be adapted to local or regional circumstances. This type of project should be very promising in the framework of CDM.

Research and technology policy: possibilities for action

The research and technology policy options for action are concerned with improved use possibilities within the scope of development cooperation, in other words not improvements in research and development on bioenergy sources in Germany.

> Research emphasis on trading in emission rights and configuring CDM: International trade in emission rights will be a further step towards opening markets and hence globalisation. The consequences of this development can only be satisfactorily assessed when scientifically-based knowledge has been collected and processed on an adequate scale. Empirical research, e.g. analysis of initial experience from CDM projects and experience of other countries with emission rights trading (e.g. the SO2 Allowance Trading Program in the USA) would be important as a basis for implementation at national level.

> Research focus on technology suitable for transfer: In Germany, R&D on bioenergy sources is mainly promoted by the specialised Agency of Renewable Resources. Production and use oriented, application-specific research, development and demonstration projects carried out with promotional funds of the Federal Ministry of Consumer Protection, Food and Agriculture, are concerned with applications in Germany. If increased technology transfer to developing countries is desired, corresponding key areas or promotional criteria should be

incorporated into this programme. In the case of solid biomass this should aim specifically at supplying links for further development of appropriate technologies for the SME sector. In the case of biogas, large scale processes in particular are becoming increasingly important in emerging Asian countries.

Cross-cutting tasks

The CDM in particular gives rise to a range of cross-cutting tasks requiring cooperation between the ministries involved. This applies primarily to the following areas:

- Climatic protection policy: If the potential of the CDM for increased development of renewable energy and specifically bio-fuels in developing countries and for economical compliance with the reduction obligations of German companies is to be realised, the national climate policy must also create favourable conditions for this, which would require cooperation between development policy and environmental policy. Close coordination between German and European policy would be just as necessary.
- Attracting investors for CDM projects: To attract companies for implementing projects in the field of bioenergy sources in developing countries, corporate information and awareness raising regarding the benefits and disadvantages of CDM are needed. As a result, the search for suitable companies for investing in bio-energy technologies is closely linked with educational and informational programmes addressing the private sector. To this end, cooperation is necessary between the Federal Ministry of Economics, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and the Federal Ministry for Economic Cooperation and Development.
- Technology transfer to developing countries: In this context, suitable companies or research groups working on developing technologies for bioenergy sources in Germany need to be identified, made aware of the problems in developing countries, and brought together with corresponding partners in these countries. Such steps require cooperation between the Federal Ministry of Consumer Protection, Food and Agriculture and the Federal Ministry for Economic Cooperation and Development and their downstream institutions. For concrete implementation work in developing countries, the aim should be to make use of competence and experience from previous development cooperation work.
- Research and development: If greater attention to possible uses of bio-energy technologies in developing countries is desired in German research promotion, this also requires interministry cooperation.

INTERNATIONAL LEVEL

At the international level there are two central issues: the unresolved questions on the configuration of the CDM, and the reorientation of national energy policies in developing countries.

Configuration of the CDM

At the international level the outstanding questions on the CDM should be resolved in a way which permits the broadest possible use and at the same time reduces the possibilities of abuse. The German Federal Government should accordingly seek to influence the international negotiations on the following aspects of the configuration of the CDM:

- The institutional configuration of the CDM should permit the most diverse possible applications. This is most easily achieved by allowing various options, i.e. not only bilateral agreements but also multilateral funds and unilaterally-offered CDM projects. This would meet the interests of various investors and project providers.
- The composition and responsibilities of the CDM Supervisory Board remain to be decided. The board should represent the broadest possible range of actors involved. Possible members would be representatives of governments, companies, environmental and development NGOs from various parts of the world. The Supervisory Board should be responsible specifically for the rules for applying reference scenarios, for drawing up monitoring protocols, for granting Certified Emission Reductions (CERs) and deciding disputes.
- The configuration of the certification process needs to be decided. The certifiers should be able to prove their independence of the parties involved in the project. After reviewing the reference case (»validation«) before the start of the project, the certifiers should review the results of the projects at intervals to be agreed with the parties involved in the project. Emission credits should only arise after certification. The CDM Supervisory Board should set minimum standards for certifiers and accredit them.
- Establishing the reference case, which is decisive for calculating the reduction in emissions, is a fundamental determinant of the success or failure of the CDM. It is important on the one hand for reference cases to be calculated in a transparent manner and on the other hand for the costs and potential for fraud to be kept as low as possible.
- Many developing countries would like to share in the emission credits from CDM projects. To be able to realise their commercial value, they must be freely tradable. Splitting the credits would reduce the concern of the developing

countries that CDM projects will exhaust the cheapest options for reducing emissions without allowing the host country to make an adequate income. If the host country subsequently had to achieve an emission target, it would only have expensive options available. To avoid this, agreements are conceivable under which the host country receives a growing share in the credits over time. For the host country, however, the call for splitting the emission credits raises the danger of competitive disadvantages compared with Joint Implementation projects.

- The CDM adaptation and administration tax is a burden. This should be extended to other mechanisms, in order to avoid distortions of competition.
- The question who foots the bill for training and upgrading employees of national CDM institutions also needs consideration. In the »Activities Implemented Jointly« pilot phase it became clear that lack of training is a major obstacle to the approval and implementation of projects. Coordinated national programmes are needed for this. The World Bank programme for national CDM strategy studies is a good start. However, there is a realistic danger that development aid will be diverted for this. It could accordingly make sense to use the »administrative levy« here too.
- There is reason to fear that the expense of an application will be so great for small projects that promotion will only occur in exceptional cases. To make possible implementation of differentiated and locally adapted small projects, concessions should be introduced for these. This proposal could mean that in principle all projects supplying up to 20-30 MW from renewable energy sources are additionally assessed in the sense of the CDM, so that these could be directly applied for without prior review by third parties, and that several small projects could be consolidated and applied for as a joint proposal, provided that the total size does not exceed 20-30 MW.
- For many developing countries it will be necessary to provide support to set up CDM secretariats. Such support could prepare for practical implementation of CDM projects. CDM secretariats should make an initial assessment of project proposals in terms of their suitability under CDM. They would offer investors from industrialised nations a competent contact point in the host country and help with project-flanking monitoring and a final evaluation.

Energy policy in the developing countries

Irrespective of the emergence of a binding agreement based on the Kyoto protocol, developing countries can supply decisive stimulus to increased and more efficient use of bioenergy sources by reorienting their national energy policy.

- Enhancing the competitiveness of renewable energy: By reducing subsidies for fossil energy sources, price distortions should be eliminated and the handicap reduced to even modern bio-energy technologies. Environmental policy measures which have proved their value in the industrialised countries can also be successful in developing countries in adapted form. Energy prices should not be kept down by the government, but at least cover costs. This is the only way of passing on to the user an incentive to conserve energy, while at the same time maintaining installed capacity.
- Expanding the energy supply: Expansion of the energy supply can be achieved by giving private-sector energy suppliers access to the existing grids. In this context it is important to note that investment in power plants of any kind involve high specific costs. Such investment will accordingly only be made if there is a minimum level of sales security. Measures offering incentives to private investors include e.g. purchase contracts covering several years or competitively tendered concessions for specific regions, also secured for several years.
- Minimum quotas or increased sales prices for renewable energy: The competitiveness of renewable energy can also be explicitly promoted by requiring a minimum quota of electricity from renewable energy. The quota as an instrument has the advantage that renewable energy compete with each other, and technological progress is promoted. To the extent that these technologies can be offered more cheaply, increasing the quota also boosts the share of renewable bioenergy sources. One alternative is to introduce guaranteed higher purchase prices for electricity from renewable energy sources, which also represent a strong incentive to expand the renewable energy supply.
- Subsidising development costs: All the above measures can be similarly implemented for regions not yet connected to a supply grid. The costs in these regions will initially be higher than those in regions already developed. This may make subsidies necessary. The benefits of these subsidies can be maximised by using them for development costs, with as many providers as possible competing for the subsidy. Customers should also be involved in the decision-making process, and specifically the choice of technology, as well as in financing the measure.
- Expanding capital markets and financing possibilities: Besides promoting capital markets for entrepreneurs, the state can either create financing possibilities for consumers itself or create incentives which enable other institutions to offer loans to improve the energy supply.
- Improved coordination of energy policy with forestry and agricultural policy: Bioenergy sources specifically can benefit from increased coordination of energy policy with forestry and agricultural policy. Issues of energy use should accordingly be deliberately included in agricultural research and extension work. The government can also support documentation of existing potential for optimal use of by-products of energy supply and deliberate creation or promotion

of markets for biomass. One of the most important requirements for increasing the supply of bioenergy sources, and specifically those from sustainable production, is the clear definition and securing of use rights.

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