No.

IThe Project Study on

Technical Cooperation and Utilization of

Clean Development Mechanism (CDM) for

Renewable Energy

Final Report

(Summary Report)

March 2006

Japan International Cooperation Agency
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Preface

The Japan International Cooperation Agency (JICA) has thus far implemented many projects of technical assistance for utilization of renewable energy such as hydropower, photovoltaic systems and geothermal power. These projects have contributed to the conditioning of the economic infrastructure and promotion of rural electrification in developing countries. The effectuation of the Kyoto Protocol is raising expectations for assistance that takes account of application of the Clean Development Mechanism (CDM) and is linked to the diffusion of renewable energy.

The implementation of technical cooperation projects and development studies is assisting the compilation of basic technical data for renewable energy utilization as well as the transfer of technology and human resource development in the host countries, where it has been confirmed that the necessary technology and know-how are taking root. Meanwhile, renewable energy is moving out of the stage of technology development and into that of diffusion in use. It has become clear that a quantitative expansion of renewable energy utilization will demand the resolution of issues in the aspects of fund procurement, organizations/institutions, operation and maintenance upon placement into operation, and sales. The study that is the subject of this report was aimed at examining these issues. To this end, besides a survey of existing documentation, it consisted of field studies in the countries of Indonesia and Philippines to collect additional information and analyze issues.

Renewable energy is saddled with many drawbacks relative to conventional energy in the cost aspect, and demands some systemic arrangements for support. In the determination of policy and institutional conditioning, the instatement of economic incentives must be termed a vital option. The CDM application considered in this report is a constituent of such arrangements. Sustainability is a minimum prerequisite for the execution of projects for utilization of renewable energy, and JICA assistance should reflect awareness of the importance of this point. In assistance to date, the subject projects and counterparts have been confined to the public sector and residents. For the future, it will also be necessary to involve the private sector and market mechanism in projects. To this end, it is absolutely essential for JICA and other entities on the Japanese side to adapt their provisions of support to these changes, widen the framework of support, and expand the scope of application.

Undertaken with this awareness of the issues, this study examined the positioning of renewable energy in JICA projects and assistance policy for its spontaneous diffusion and contribution to social development, along with recommendations regarding specific advisable action.

We hope that this report will be of some value to future programs of assistance promoted by JICA. The study was conducted jointly by Chubu Electric Power Co., Ltd. and Nomura Research Institute, Ltd. on commission by JICA. It should be noted that the report presents the results of survey and analysis by the Study Team and does not necessarily represent the views of JICA.

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List of Abbreviation

BHN	Basic Human Needs
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
COP	Conference of the Parties
DAC	Development Assistance Committee
DNA	Designated National Authority
GEF	Global Environment Facility
GHG	Green House Gas
IPP	Independent Power Producer
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
JIS	Japan Industrial Standards
NGO	Non Governmental Organization
ODA	Officaial Development Assistance
OECD	Organization for Economic Cooperation and Development
O&M	Operation and Maintenance
PLN	Perusahaan Listric Negara PERSERO
PV	PhotoVoltaic
RE	Rural Electrification
RPS	Renewable Portfolio Standard
SHS	Solar Home System
TA	Technical Assistance
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
WB	World Bank
WSSD	World Summit on Sustainable Development

Chapter 1 Introduction

1.1 Background and aim of this study

Since the adoption of the Kyoto Protocol in 1997, inclinations for active promotion of renewable energy utilization have been mounting inside and outside Japan, not only for energy supply in rural areas in developing countries but also for improvement of the global environment and diversification of energy sources. The Japan International Cooperation Agency (JICA) instituted a partnership promotion committee on the subject of electrification through use of renewable energy in fiscal 2000 and a study group concerning rural electrification (RE) projects based on renewable energy in fiscal 2001. In their work, these groups also proposed cooperation centered around support in "soft" aspects such as institutional and schematic preparations to heighten the sustainability of RE projects utilizing renewable energy, and approaches to long-term funding problems.

Internationally, the summit conference held in Okinawa in 2000 led to the establishment of a G8 Renewable Energy Task Force whose mission is to make studies with a view to bringing electricity to all the people of the world (and especially those in developing countries) through the utilization of renewable energy resources. The Task Force subsequently prepared a report setting forth the utilization of renewable energy for improvement of living conditions, with special attention to the factors impeding diffusion and measures to counter them. In 2002, the World Summit on Sustainable Development resulted in preparation of the Johannesburg Plan of Implementation, which advocated the spread of renewable energy for diversification. This was followed in 2004 by the Bonn International Conference for Renewable Energies, which culminated in the adoption of the Political Declaration underscoring the importance of renewable energy as a means of energy access for the impoverished. The Conference also saw the adoption of policy proposals regarding international action plans and renewable energy. As an outgrowth of these international forums, it should be noted that photovoltaic (PV) generation and other types of renewable energy are moving out of the age of technology development and into that of diffusion in use. In this climate, the Kyoto Protocol was effected in February 2005, and renewable energy is now positioned as a key element for sustainable development in developing countries in light of its low environmental impact as well as its merits as an energy source.

JICA has thus far implemented renewable energy projects for rural electrification based on PV and small-scale hydropower generation, and utilization of geothermal energy, for example. The climate surrounding technical assistance (TA), however, is changing substantially due to factors such as technical advances and trends in related policy in developing countries. Furthermore, the effectuation of the Kyoto Protocol is raising expectations for assistance that takes account of application of the Clean Development Mechanism (CDM) and is linked to the diffusion of renewable energy.

In light of these environmental changes, this study examined the positioning of renewable energy in JICA projects and assistance policy for its spontaneous diffusion and contribution to social development, along with recommendations regarding specific advisable action.

Undertaken from November 2005 to March 2006, this study concerned small-scale hydropower, biomass, geothermal, and wind power technology. It consisted of a survey of documentation concerning RE utilizing renewable energy by Japanese and non-Japanese aid institutions and CDM, and field surveys in the two countries of Indonesia and the Philippines.

Chapter 2 Current status of renewable energy

2.1 Renewable energy utilization - current status and issues

Approaches are being taken to utilization of renewable energy around the world for considerations of energy security and mitigation of global warming. In the power sector, renewable energies such as small hydropower, biomass, wind power, geothermal energy, and solar energy are being used as alternatives to diesel oil and other fossil fuels. In developing countries, governments are determining policy aims and promoting projects for development of renewable energy to meet them.

In spite of this situation, renewable energy systems are generally not economically feasible in developing countries. Electrification applying renewable energy is not yet firmly established in certain respects, and arrangements in developing countries tend to be inadequate in the institutional and policy aspects. For this reason, it is essential to set reasonable development targets with full consideration of the renewable energy potential and technology situation in the host country, and make the systemic provisions needed for promotion. The current status of power generation technology harnessing renewable energy and the prospects for application for RE may be summarized as shown in Table 1.

Table 1 Current status of renewable energy power generation technology and prospects for application for RE

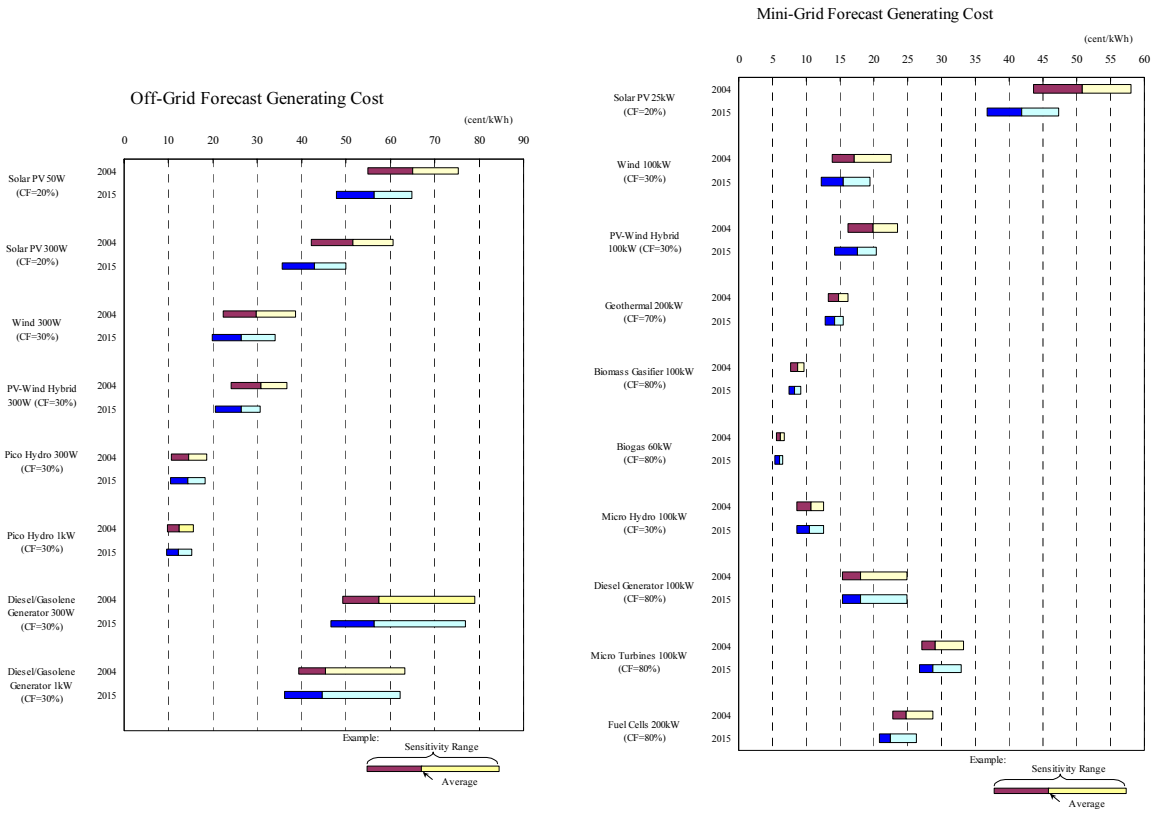
Power generation technology		Determination of the respective renewable energy generation technologies
Regions/countries (potential)		River flow quantity and situation, quantity and quality of agricultural products, wind circumstances, geothermal potential, and other items of basic potential, as well as the prospects for year-round supply
Technical level	Degree of establishment of technology in each power source field, actual level and utilization of technology in the host country, and possibilities for acquisition of equipment	
	Small hydropower	Hydropower has a history of more than 100 years and is fully established technically. Systems with capacities ranging from low (a few kW) to high (a million kW) are installed around the world. The tasks include reduction of the cost of equipment (turbines and generators) and resolution of issues related to the environment and operation & maintenance, such as sedimentation in dams accompanying operation.
	Biomass	Conventional fluidized bed and grate boilers are applicable for combustion of chaff, coconut shells, and bagasse. Biomass has consequently long been used as fuel for steam generation. Projects to add value to steam generation in the form of electricity are now under way even in developing countries.
	Wind power	Wind power is basically established as technology and allows development on commercial footing. It is being extensively applied in India and China. Recent years have seen a trend toward construction of large-scale wind farms in pursuit of higher economic merit. If output is unstable, it can have an substantial adverse impact on the grid. Off-grid wind power facilities with a capacity of less than 1 kW require batteries and a higher initial cost.
	Geothermal	Rapid technical advances are being achieved in the fields of physical exploration, geochemical exploration, boring, and power generation. Nevertheless, the various risks accompanying development remain a problem because of the large weight occupied by drilling costs. Binary generation, which is adapted to medium- and low-temperature geothermal water, has a complex mechanism that is apt to present O&M problems. The flush system requires geothermal resources of a fairly high quality (temperature).

Power generation technology		Determination of the respective renewable energy generation technologies	
Scale and model	Prospects for application to RE considering power source scale and model		
	Small hydropower	Hydropower systems may be either dispersed (off-grid) or connected to the grid, and they have been extensively installed in developing countries. In the RE field, the runoff-river-plant type is selected for small-scale generation that is environment-friendly. In the case of dispersed systems, the flow must be sufficient for supply of power at least 300 days of the year. The optimal capacity factor therefore differs from that of systems connected to the grid.	○
	Biomass	Biomass has long been used as a source of heat in homes, and there is little incentive to deliberately use it for power generation. Assurance of a stable supply as fuel for RE would not be a realistic option, considering the handling problems.	△
	Wind power	Wind power systems are generally connected to the grid, but could conceivably be applied in dispersed hybrid systems that combine mini wind power and diesel generators.	△
	Geothermal	Quality geothermal deposits are on a fairly large scale, and the power generation system applying them has a commensurately large size and is therefore generally connected to the grid. There are prospects for dispersed systems in the case of geothermal resources with a medium or low potential and areas on the periphery of quality geothermal zones, or when connection to the grid would be economically unviable even if the geothermal resources are fairly large.	△

（Source: prepared by the Study Team from various data）

The power generation cost per unit of output (kWh) exerts a big influence on the application of renewable energy. The World Bank (WB) has made trial calculations of the cost of RE systems including those applying renewable energy.

Figure 1 shows the generation cost of off-grid sources (with capacities of less than 1 kW) and mini-grid systems (with capacities of less than 500 kW) as estimated by the WB. The findings suggest that, among off-grid systems, pico hydropower and wind power have lower costs than diesel generators. They also show lower estimates for biogas (landfill gas), micro hydropower, geothermal, and wind power systems than for diesel generators.



（Source：Off-grid, Mini-grid and Grid Electrification Technologies, 2005.11）

Figure 1　Generation cost of various power sources

2.2　Implementation setup and effective use configuration

Observers have pointed out various problems related to the management of projects for electrification utilizing renewable energy, in aspects such as official policy, legal framework, institutions, business operation, financing, and schemes for assistance.　This section presents an account of some such items, illustrated with examples from the field studies in Indonesia and the Philippines.

（a）RE funding sources

Assurance of funding is always a problem in RE, which has a low payability.　Schemes for internal cross-subsidization in the finances of state-owned electric corporations, whereby surpluses from services in urbanized areas are used to cover deficits in those of rural areas, have succeeded in countries that have achieved fast-paced economic advancement, such as Thailand and Malaysia.　In other countries, however, it is not unusual for these schemes to further worsen the financial position of public power corporations and electrical cooperatives, and even grow into a sector-wide problem.

Generally speaking, the financing for RE projects is often supplied by grant aid from donors and national governments.　In Indonesia and the Philippines, there are apparently no standards regarding the method of funding procurement and transfer.　To make RE projects based on public funding

sustainable, it is necessary to endow supplementation measures with transparency and establish clear rules regarding the use of financial sources.

Another approach is to encourage the participation of private enterprises in promoting RE projects, but these projects usually have a low payability, and the enterprises often cannot shoulder a heavy financial burden. Project promotion therefore requires a setup of support for procurement of funds. In the case of the Philippines, a guarantee fund has proven effective for utilization of existing financial institutions.

(b) Application of local technology

Application of local technology is very effective for curtailing the initial investment and facilitating maintenance after the start of operations. In addition, the hiring of local consultants for the design and construction of the facilities makes it possible to respond to breakdowns and other trouble after they are placed into operation.

The leading role in provision of technology in these areas is played by non-governmental organizations (NGOs) in Indonesia and universities in the Philippines. It would be extremely effective to partner with these organizations in TA provision by Japan.

(c) Development of projects using the energies of equipment manufacturers

When RE is viewed as a business, the parties most profiting from it are obviously the manufacturers of the equipment. As such, the construction of a framework to induce these manufacturers to participate in RE projects could yield a certain degree of effect. The EC-ASEAN COGEN program is a good example of this. In installation of Japanese-made mini hydropower systems, it would be worthwhile to study options such as the institution of a J-Hydro program whereby incentives are offered by the Japanese government (or Japanese equipment manufacturers).

(d) Potential Study related to wind power and geothermal energy

Application of wind power and geothermal energy in RE requires advance confirmation that the prospective site has fully sufficient potential. Generally speaking, the studies for such confirmation take a certain amount of time and money, and it would not be realistic to have them carried out by the project principal. In addition, the case of Japan indicates that proactive studies by the government to expose such potential are important for the diffusion of such energies. If developing countries are short of funds for such studies, the preparation of master plans with TA from Japan would presumably be extremely effective.

(e) Project operation setup

In projects for RE, and particularly in districts that cannot be connected to the grid, one formula is to detach the project completely from the ordinary power company (or public utility) responsible for on-grid service and have the operation run as closely as possible to the on-site realities. (Even in

RE implementation by the established utility, it is advisable to keep the project account separate in order to avoid the squeeze on earnings of the main business due to cross-subsidization.) One obvious example of such an approach is operation by an autonomous organization led by NGOs and residents. More recently, there has also surfaced a movement for operation purely as a private undertaking based on a business rights contract.

In Indonesia, power tariffs were set on low levels, and this left almost no reserves for future renovation of facilities as originally scheduled. These power plants are not slated for any extensive repairs for the time being, but eventually will have to replace their turbine generators and execute other such large-scale renovation for which they will have to devise a funding method. This points to the need for repeated transfer and sure rooting of technology for the drafting of long-term plans for steady O&M as well as guidance and supervision of the business management to achieve the plans.

（f） Tariff setting

One of the problems always tied to RE is the low level of resident income levels, meaning a limited ability to pay for service. In response, projects are apt to have artificially low tariff levels and high rates of arrears, and thereby fall into a vicious circle as regards tariffs and revenue. As such, the question of reasonable tariffs must be studied from a variety of perspectives in order to find levels that are acceptable to the customers.

Naturally, tariffs may be subsidized, but the subsidies must not be allowed to detract from enforcement of the rules of the business. Viewed from the standpoint of fund procurement, it is crucial to examine the issues of how to acquire public funds (including grant aid and onerous loans from donors) and the means of mobilizing funds from the private sector to supplement the former. In other words, projects must be preceded by studies aimed at building highly transparent tariff schemes.

（g） Application of the RPS Law (conditioning of domestic law)

Biofuel is highly portable and there a high hopes for its application for the Renewable Portfolio Standard (RPS) in Japan as well as in the country of origin. At present, however, domestic legislation is not sufficiently conditioned as regards problems in marine transport and quality standards. Use of biodiesel fuel for diesel vehicles could probably expand with the instatement of items for it in the Japan Industrial Standards (JIS), and such conditioning is therefore also a task of importance.

（h） Related policy and capacity-building concerning CDM, etc.

In the Philippines and Indonesia, schemes offer incentives for utilization of renewable energy, but are not being extensively used due to procedural complexity and lack of knowledge about them. Similarly, although parties may be aware that the CDM can facilitate RE, lack of detailed knowledge among project principals prevents its application. Incentives and the CDM could find more effective

application with proper capacity building (in terms of districts and types of power source).

As described above, the diffusion of renewable energy and the realization of sustainable RE require arrangements not only for TA but also for approaches from upstream areas such as policy, legal frameworks, institutions, operation, and financing, as well as a setup for cooperation in the subject district.

Chapter 3 Assistance approaches

3.1 Need for coordination among fields and sectors

Renewable energy is used as a means of attaining larger goals in developing countries through RE (e.g., assurance of human security, mitigation of poverty, and community development). Aside from electrification, geothermal energy and biomass are means of supplying district heat, while water and wind are used directly to power wheels and vanes. Renewable energy supports the socioeconomic life of the districts in question. Its use requires intersectoral approaches that take full account of the socioeconomic needs and technical level of the district and are both economical and sustainable.

Projects for improvement of the social infrastructure and support for self-reliance (e.g., projects for community development, health and medical services, and education) can incorporate renewable energy as a component if the district is unelectrified. More specifically, the primary candidates for potential RE customers are resident households and public facilities such as schools and clinics. The demand among such customers is limited, however, and it would be fairly difficult to generate revenue sufficient for subsistence as a business through them alone.

To assure the presence of a stable power demand on a significant scale, it is necessary to induce the emergence of an industrial demand in the district. Promotion of industry through electrification is also required to raise the income levels of residents. For these reasons as well, the linkage of electrification to a quickening of the local economy through its effects for increasing productivity in agriculture and/or fishery and raising value added levels in the processing of produce and manufacture of processed fishery products is a major prerequisite for stabilization of the RE project.

To this end, efforts must be made to coordinate things with the concerned ministries and agencies (as the owners of the public facilities) or private sector (for the purposes of social advancement and cultivation of industry) right from the formative stage, determine orientations, make proper estimates of demand on this basis, and decide the project size accordingly.

3.2 Assistance programs

Renewable energy, RE, and CDM have the potential for combination in single projects through interrelation, but the three should not be haphazardly combined. This is particularly true as regards CDM, which demands consideration from the standpoint of investors. It goes without saying that investors will look for a proper balance with the return on their investment, inclusive of the credits earned through reduction of greenhouse gas (GHG) emissions. For this reason, too, whatever model they apply, it is essential for projects to enforce business rules[1].

[1] Organizations certifying CDM projects consider only whether feasibility will be increased by incorporation of

Incorporation of CDM into RE projects applying renewable energy also necessitates an expansion of business stability and reduction of business costs in the eyes of investors. The expanded stability in question here means a widened market, tariffs on levels that pay, and mechanism for reducing or hedging risks of arrears. The scope of cost reduction is by no means confined to the cost of facilities and O&M; it is even more important to reduce added costs arising from regulation as a power supply business and the sunk cost of launching the business.

3.2.1 Technical Assistance (TA)

（a）Capacity development

Developing countries ordinarily have a shortage of personnel capable of applying technology for utilization of renewable energy (meaning project management as well as generation hardware). The development of human resources is consequently indispensable for the diffusion and promotion of such technology. Programs for human resource development were a part of past pilot projects, but unfortunately did not yield enough results.

（b）Development of TA projects in the RE field

Technical cooperation projects integrating the dispatch of experts, acceptance of trainees, and provision of equipment are programs for efficient and effective RE support. They must be implemented in packages such as the following, in correspondence with the host country's level of technology and status as regards organizations and institutions.

- Technical cooperation project based on dispatch of ad-hoc experts (Philippines)
- Technical cooperation project based on development survey (Ghana)
- Technical cooperation project consisting of dispatch of ad-hoc experts and development survey

3.2.2 Grant aid

Grant aid is furnished to support socioeconomic activities for satisfaction of basic human needs (BHN) in the district. While there are some grass-roots programs of grant aid on a small scale, grant-aid projects are generally on the order of hundreds of millions of yen. Because the beneficiaries receiving the facilities and equipment are liable to consider them gifts, such projects may have problems of continuity because of the lack of a sense of ownership and the attendant responsibility. Therefore, in provision of support for RE projects based on grant aid, steps must be taken to assure continuation by incorporating TA to strengthen capabilities in the operational aspect.

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the CDM, not whether the project will turn a profit. In contrast, investors always look for a return and will not accept a loss in excess of the GHG credit valuation in the actual market.

3.2.3 RE project support combining financial and technical assistance

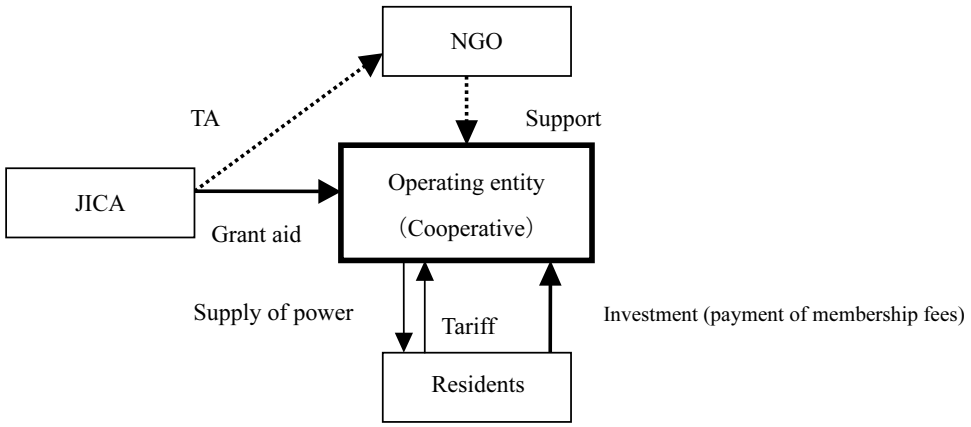
There are various business model options for promotion of RE projects. Ordinarily, RE projects are promoted by the state power utility, which is endowed with a monopolistic position, on the responsibility of the national government. However, projects may also have an independent setup or promotion limited to the subject district so as to complement the activities of the state utility. Local electrification cooperatives are a typical example. Through such cooperatives, the beneficiaries, i.e., the local residents, take the leading role in operation of the project.

Meanwhile, amid current of privatization of public utilities and structural reform, there have recently emerged attempts to have RE promoted through operation by private enterprises based on business right contracts. The following sections indicate the possibilities for provision of support under each of these models for business operation by residents or private enterprises by transforming them into conceptual models.

Model 1: Operation by a resident organization

This is the simplest type of operational model. Grant aid from a donor institution is used to organize an electrification project, and the beneficiaries (residents) pay a fee to the project entity (cooperative) for membership. Once they have qualified to receive a supply of electricity, the members pay a tariff for their use of power.

Normally, project operation requires support in both the management and technical aspects, and the circle of supporting organizations consequently includes NGOs and local universities. In light of its position, JICA's role lies in support for the initial investment and TA for launching the project.



(Source: JICA Study Team)

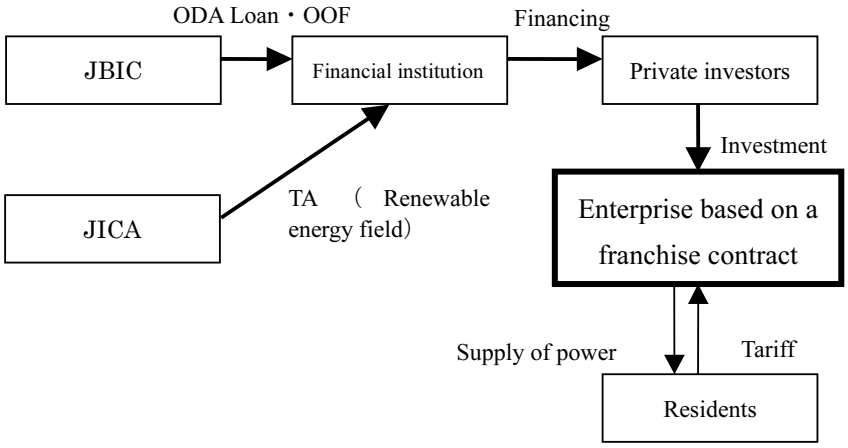
Figure 2 Operation by a resident organization

Model 2: Operation by a private enterprise

This may be regarded as a derivative of Model 1. It is designed for running an RE project as a private enterprise based on a business rights contract. Investors or NGOs in the host country acquire the business rights and supply power to residents within that scope. Part of the necessary funds come from donors, which provide them to investors at low interest through the medium of

host-country financial institutions.

As compared to Model 1, this model is more adapted to observance of rules in management, but also requires a size (in terms of tariff levels and demand scale) large enough to support a profitable business.

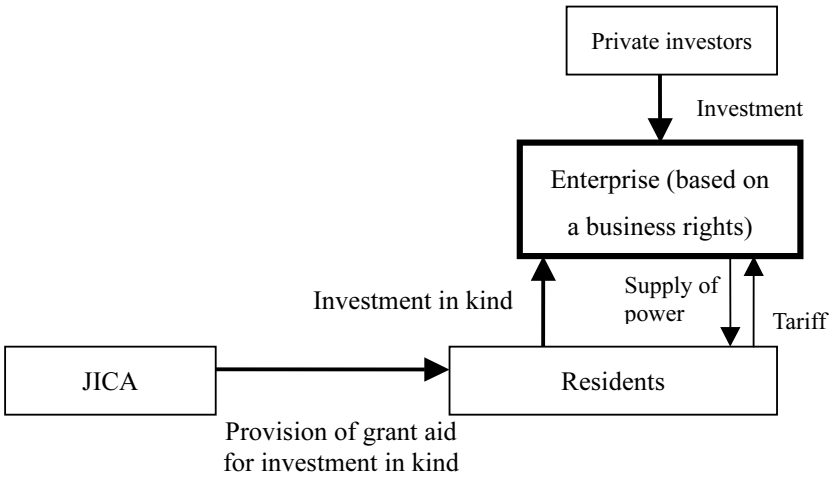


（Source: JICA Study Team）

Figure 3　Operation by a private enterprise

Model 3: Hybrid of operation by a private enterprise and residents

This model consists of a joint venture between residents and private investors, with tariff income shared in accordance with rates of investment. The investment by residents takes the form of payment in kind based on grant aid. The operation is secured by consignment to the private investors.



（Source: JICA Study Team）

Figure 4　Hybrid of operation by a private enterprise and residents

Regardless of which model is applied, promoters must consider measures to be taken for the project exit, i.e., the division of roles between ordinary power companies and the RE entity in the event of extension of the grid to the vicinity of the district a few years after the start of the project.

One conceivable option is transfer of the business rights to the public utility (or power company) once the grid reaches the district. At this time, the entity would harness its generation facilities for evolution into a power producer selling to the grid. Another option would be to make it clear in the franchise contract that the entity is to have exclusive supply rights for the term of the contract even if the district is reached by the grid, and to dissolve the entity when the contract expires.

3.2.4 ODA loan assistance

ODA loan assistance is outside the framework of JICA support, but could conceivably be offered by the JBIC to support the procurement of funds needed for RE projects. Decisions on whether or not to offer such assistance must consider the requisite amount of loans as well as the payability of the RE project. In general, the scale of RE projects does not rise above a few hundreds of millions of yen, and therefore does not reach the lending order of billions. This suggests a need to examine the approach of incorporating RE into projects of social development in fields such as agriculture or lumping similar RE projects together.

3.2.5 Need for conditioning of the assistance setup in Japan

Even if the capabilities and temperament needed for programs of RE support are present along with the will to promote them, it is no easy task in reality to get access to schemes for project assistance and information on them. Today, the focus of Japanese TA is shifting from technology to project continuity inclusive of organizations and institutions. There are many opportunities for contributing to RE in developing countries by providing know-how related to enterprise operation in the possession of power companies, but arrangements for this purpose are not fully in place. Some fields (such as PV technology and systemic/policy support) call for a high level of expertise, and it is also true that power companies cannot meet all needs in them on their own. Japan therefore must make arrangements for capacity development and condition schemes for assistance linked to the cultivation of the needed human resources.

To resolve these issues, JICA could take steps such as widespread publication of the results of its development studies and project research through seminars (for consultants, manufacturers, and NGOs), and establishment of projects for business-oriented TA (corporate contracts). Extensive application of such methods could be expected to stimulate participation from a broad range of parties.

3.4 Prospects for renewable energy utilization in each region

3.4.1 Regional outlines

Table 2 outlines the socioeconomic situation, issues in the energy sector, and renewable energy potential in each region.

Table 2　Socioeconomic situation, energy sector issues, and renewable energy potential in each region

	Socioeconomic situation	Energy sector issues	Renewable energy potential
Southeast Asia	Rapid economic growth from the 1980s to the early 1990s Implementation of measures to promote utilization of renewable energy	Increase in energy use due to fast-paced economic growth	● Abundant biomass resources ● Geothermal energy potential in the Philippines and Indonesia ● Policy-directed promotion of use of biomass in Malaysia ● Extensive private-sector and NGO activities ● JICA provision of RE assistance in the past
Indochina	Swift recovery after 20 years of internal strife	Rapid reduction and deterioration of forest resources	● Abundant biomass resources ● Extensive private-sector and NGO activities ● JICA provision of RE assistance in the past
East Asia	External economic liberalization and promotion of rural economic reform Reduction and depletion of forest resources Enactment of law for renewable energy (China)	Increase in use of energy by China and other countries achieving rapid economic growth Inefficient use of energy by outdated facilities	● Abundant biomass resources ● Potential for development of geothermal, mini hydropower, and wind power resources in China
Central Asia/Caucasus	Transition from planned economies to market economies Infrastructure conditioned by the former Soviet Union	Runaway energy consumption with top priority on economic growth and inefficient use of energy by outdated facilities	● Production of biogas from livestock manure ● Potential for development of wind power resources near the border with China
Southeast Asia	Absolute poverty and population growth Reduction and depletion of forest resources	Expansion of poverty problems due to population pressure Consumption of coal as fuel and inefficient use of energy due to deterioration of production facilities	● Diffusion of biomass generation ● India: ranks 5th in the world for wind power generation ● Potential for development of geothermal resources in India
Oceania	Low population and few resources other than primary products and tourism	Increase in energy demand due lifestyle changes	● Limited biomass and water resources ● Abundant solar energy
Central America and the Caribbean	Socioeconomic exhaustion due to revolutionary movements and military conflict	Increase in energy demand accompanying population growth in cities	● Terrain with substantial elevation differences ● Abundant water and geothermal resources
South America	Frail economic structure dependent on export of specialized primary products Reduction and depletion of forest resources	Rampant exploitation of natural resources and increase in energy demand accompanying the population increase in cities	● Abundant biomass resources and terrain with substantial elevation differences
Africa	Increase in accumulated debt and economic collapse due to the oil crisis and plunge in prices for primary products Progressive desertification, and reduction and depletion of forest resources Worsening water problems	Rampant exploitation of forest resources and increase in energy demand accompanying population growth in cities	● Abundant solar radiation ● Potential for use of biomass resources (livestock manure, etc.) in some countries ● Some possibility for mini hydropower
Middle East	Economic gap between oil producers with abundant oil and natural gas reserves, and non-oil producers Worsening water problem	Runaway consumption of energy in oil-producing countries	● Abundant solar radiation
Eastern Europe	Admission into the EU following the end of the Cold War	Deteriorated production facilities and inefficient use of thermal energy in inefficient buildings	

（Source: prepared by the Study Team from various data）

3.4.2 Regional differences

(a) Southeast Asia region

In general, this region has comparatively abundant hydropower potential and good prospects for development of renewable energy in the form of small-scale (mini, etc.) hydropower. The large rural population points to potential for labor-intensive power generation applying biomass resources from livestock and agricultural products as well as wind power and geothermal energy. Communities in unelectrified districts are fairly clustered, and this suggests good prospects for efficient distribution.

Development cannot be sustained without the active participation of the beneficiary communities. To this end, it would presumably be effective to engage in dialogue with them right from the planning stage and heighten their awareness that the project per se will be a community asset. This region is characterized by strong ties of trust among residents in unelectrified districts, and residents consequently may be expected to take an active part in projects.

There are fairly many unelectrified districts in which residents can purchase motorscooter batteries and battery fluid, for example. Effective use of batteries and other such property owned by residents themselves in PV generation projects could increase the project prospects for continuation and extension because of the resident motivation to care for their own belongings.

Southeast Asia is also marked by widespread activity by Japanese research institutes, private enterprises, and NGOs. Projects executed by JICA could very well prompt assistance from other donors, NGOs, and private firms (applying CDM) by utilization of a variety of schemes, including aid for the host-country government (?), yen loans, and grant aid. Project feasibility would be increased by substantial partnership with other such parties beginning at an early stage.

(a) African region

Overall, Africa has few regions that have great elevation differences and rainfall throughout the year. There are consequently not very good prospects for small-scale hydropower development. Exploitation of biomass resources requires improvement of circumstantial conditions, such as conditioning of the infrastructure and cooperation of concerned institutions for stable supply of fuel.

Solar energy can play a certain role in provision of social services for mitigation of poverty, through lighting and refrigeration for medical and educational facilities and pumping of water, but it cannot be used for heat or motive power. Assistance institutions therefore must remember that it is unlikely to catalyze industrial activities.

Women commonly perform the chores of gathering firewood and cooking food indoors, which detracts from health due to the smoke. As viewed from the perspective of gender-based roles, utilization of renewable energy is important in this region. However, rural communities tend to be

scattered, and this works against the drafting of plans based on labor-intensive systems. This feature also must be borne fully in mind in efforts to build cooperative schemes with community participation.

There is thought to be little possibility of cooperation by Japanese private enterprises and research institutes in this region. As such, the main option would be to rely entirely on official development assistance (ODA) as far as possible or to probe avenues of assistance in coordination with the World Bank, United Nations Development Programme (UNDP), Global Environmental Facility (GEF), and other donors through initiatives to mitigate poverty.

Chapter 4　Renewable energy and prospects for CDM application

4.1　Projects registered with the UNFCCC

4.1.1　Outline of registered projects

As of 31 January 2006, a total of 79 projects were registered with the United Nations Framework Convention on Climate Change (UNFCC), and 42 of them applied simplified methodology for small-scale CDM.

Table 3 shows the number of projects registered for each type of renewable energy. On-grid small and mini hydropower projects applying simplified methodology number 21 and account for the vast majority. Off-grid hydropower projects number only one.

Table 3　Number of projects in each category of renewable energy

Type	Methodology	Number of projects and average output
Hydropower	AMS-I.D.　(Small-scale on-grid)	21 (8.1MW)
	AMS-I.A.　(Small-scale off-grid)	1 (0.07MW)
	AM0005　(Grid connected)	1 (45.0MW)
	ACM0002　(Consolidated grid connected)	1 (17.6MW)
Biomass	AMS-I.D.　(Small-scale on-grid)	7 (8.3MW)
	AM0004　(Biomass grid connected)	2 (29.8MW)
	AM0015　(Bagas grid connected)	1 (22.0MW)
Wind power	AMS-I.D.　(Small scale on-grid)	2 (10.4MW)
	AM0005　(Grid connected)	1 (25.8MW)
	ACM0002　(Consolidatee grid connected)	2 (130.0MW)
Geothermal	None	

(Source：prepared by the Study Team based on data from the UNFCCC website)

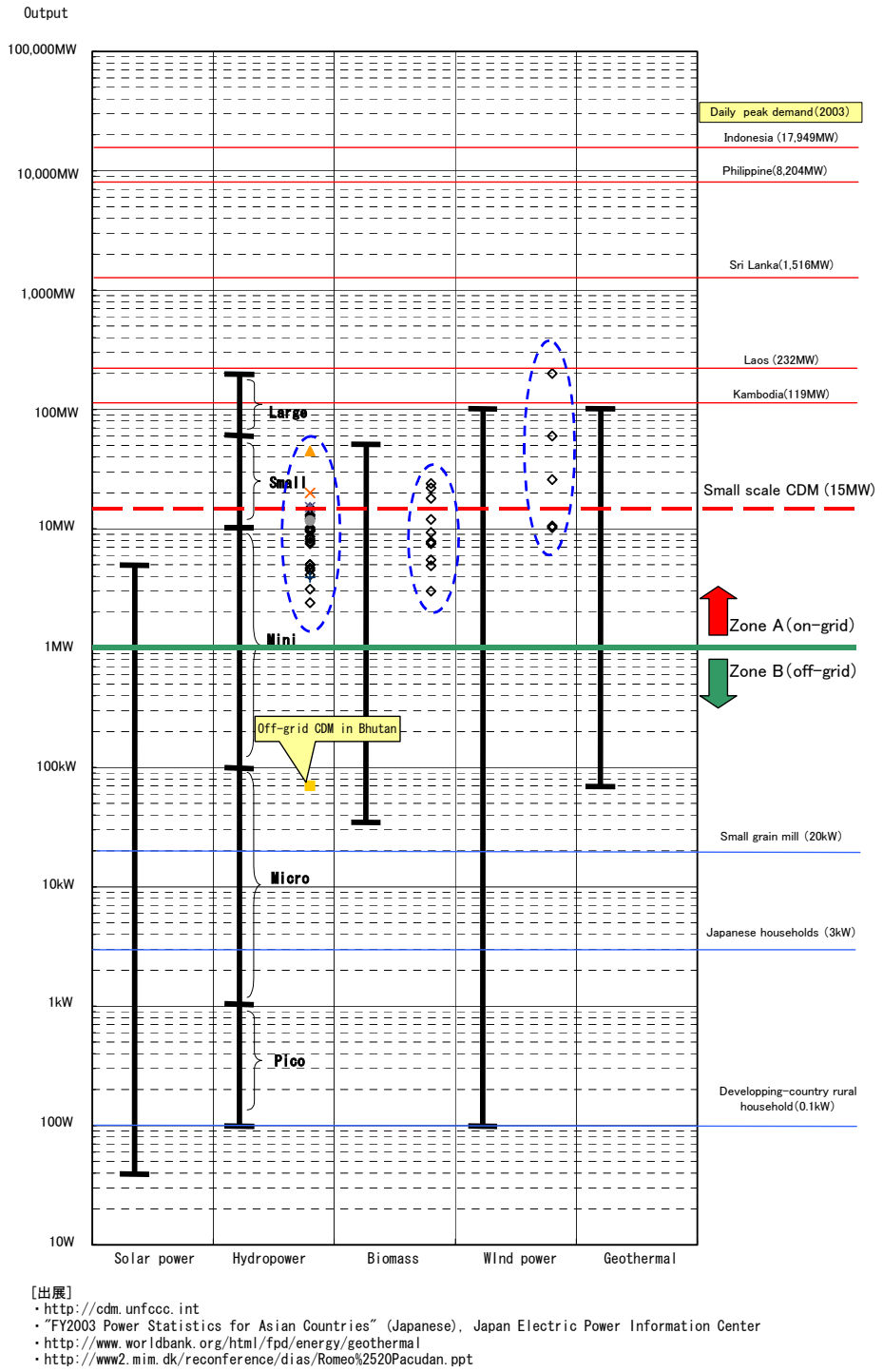
Table 4 presents the number of registered CDM projects in each region. Many small and mini hydropower projects are registered in the countries of Central and South America, which have a lot of potential for the same. India is vigorously promoting registration of small and mini hydropower and biomass projects. The list indicates the countries that are actively developing the exploitable potential and conditioning institutional arrangements for CDM application.

Table 4　Number of registered CDM projects in each region

	Asia	Central and South America	Oceania
Small and mini hydropower	9 (India 4, Sri Lanka 3, Bhutan 1, China 1)	(Colombia 1, Guatemala 3, Peru 1, Panama 3, Honduras 6, Chile 1)	1 (Fiji)
Biomass	9 (India)	1 (Brazil)	－
Wind power	3 (Morocco)	2 (Argentina 1, Mexico 1)	－

(Source：prepared by the Study Team based on data from the UNFCCC website)

Figure 5 shows plots for CDM projects registered with the UNFCCC. It can be seen that, in the case of all power sources except the off-grid micro hydropower plant (70 kW) in Bhutan, the systems are on-grid and have a capacity of at least 2MW (as contained on the application form).



[出展]
・http://cdm.unfccc.int
・"FY2003 Power Statistics for Asian Countries" (Japanese), Japan Electric Power Information Center
・http://www.worldbank.org/html/fpd/energy/geothermal
・http://www2.mim.dk/reconference/dias/Romeo%2520Pacudan.ppt

Figure 5 Projects registered with the UNFCCC (as of 31 January 2006)

4.1.2 Analysis related to registered CDM small-scale hydropower projects

Figure 6 shows plots for past JICA TA for small-scale hydropower and the registered CDM projects of this type. It can be seen that there is a trend toward off-grid mini hydropower as subjects of TA in development studies (particularly since 2000). Similarly, the circle of subjects for grant aid is confined to mini-hydropower systems with a capacity off less than 1 megawatt. In contrast, except for the aforementioned project in Bhutan, all of the registered CDM projects are for on-grid systems with a capacity of at least 2 megawatts (applied for), as noted above.

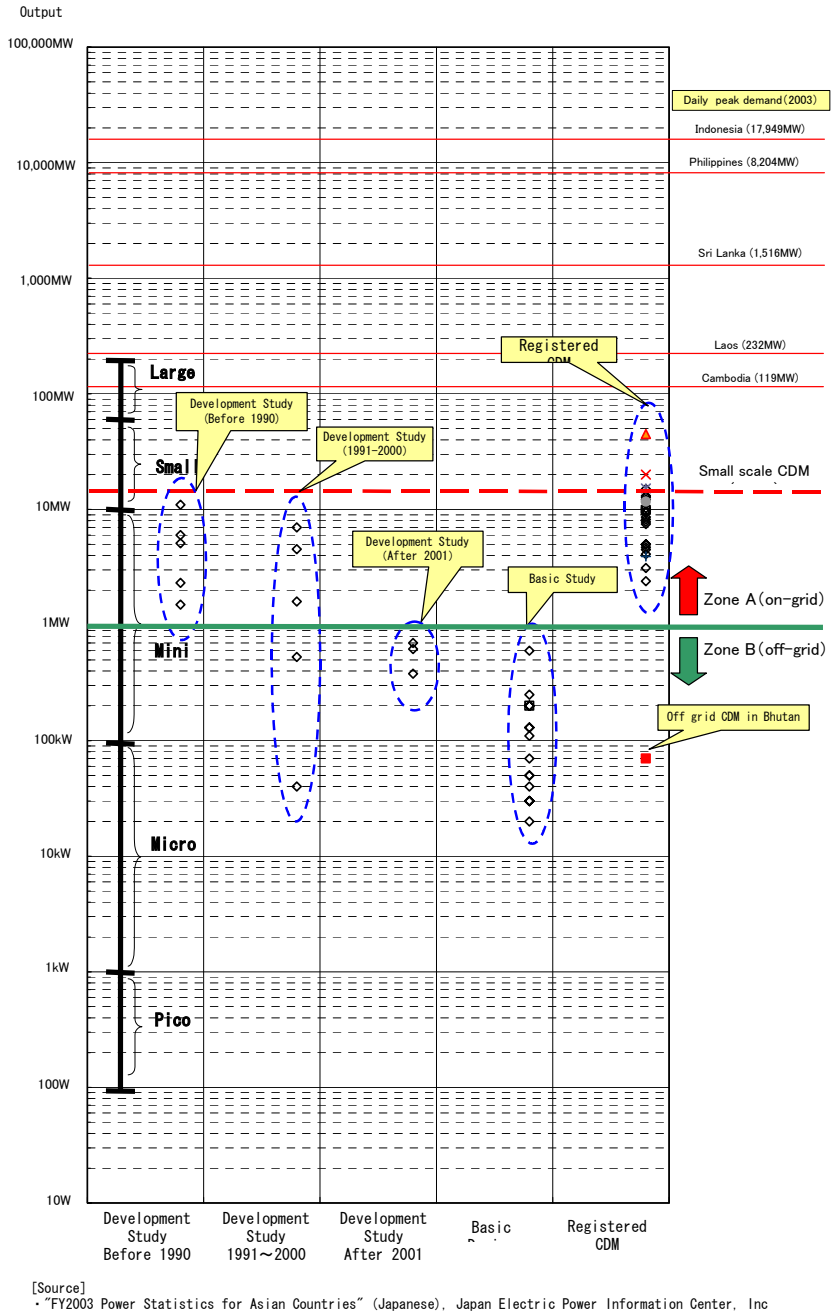


Figure 6 Past JICA TA for small-scale hydropower projects and registered CDM projects

4.2 Issues in promotion of CDM projects and related baseline monitoring method

4.2.1 Baseline monitoring method

Application of the CDM to RE requires the establishment of baselines. In so doing, particular attention must be paid to the question of alternative energy and increased energy. Renewable energy is an alternative to conventional energy, and baselines can easily be set for it when it is clearly linked to a reduction of GHG emissions.

In contrast, it is difficult to determine baselines for increased energy because it does not result in an actual emission reduction. The projects cannot apply the CDM without proposal of a proper alternative energy model. These points must be considered in setting baselines.

4.2.2 CDM value (CER)

In regard to the CDM, it is necessary to ascertain the trends in resolutions at the Conference of Parties (COP) to the UNFCCC and the future course.Provisions for voluntary trading in sulfur oxides began in the United States of America in 1990, and various countries have instated schemes for domestic GHG emission trading[2]. Such voluntary agreement models are characterized by cost efficiency and sure emission reduction, and are presumably applicable to RE in the same countries.

When the environmental value produced by the Kyoto mechanisms and other reduction of GHG emissions is viewed from the standpoint of investors, the trading price for CO2 credits must be considered part of the profit. In late 2004, this price was about 5.63 dollars[3] in terms of Certified Emission Reduction (CER; in trading based on the Kyoto Protocol). Euro-denominated market prices for CO2 continued to rise following the official start of emissions trading in January 2005 and reached 30 euro per ton in July 2005. Euro prices for CO2 remain on high levels; they came to 26.75 euro per ton on 30 January 2006.

4.2.3 Public funds and CDM

The Marrakech Agreement explicitly states that the public funds used for CDM projects must not come from ODA[4].

This passage had generally been interpreted as a total prohibition of the diversion of ODA. As a result of subsequent negotiation by the Japanese government, an agreement was reached at the OECD Development Assistance Committee (DAC) high-level meeting (in April 2004) to the effect that ODA could be used to defray the cost of CDM projects proper, within a scope that did not

[2] Denmark in 2001, the United Kingdom in 2002, and the EU and Norway in 2005
[3] State and Trends of the Carbon Market 2005 (International Emissions Trading Association)
[4] Decision 17/CP.7 Modalities and procedures for a clean development mechanism as defined in Article 12 of the Kyoto Protocol

constitute diversion. Specifically, the agreement states the following: "The DAC should agree that the value of any CERs received in connection with an ODA-financed CDM project should lead to a deduction of the equivalent value from ODA."

While abiding by international rules, Japan is presently implementing ODA-financed CDM projects that are conditioned on agreement by the recipient country. The Japan Bank for International Cooperation (JBIC) has concluded agreements for collaboration with institutions in other countries and has begun to make preparations for future application of public funds for CDM projects.

The environment surrounding CDM is changing, and conditions permitting the implementation of CDM projects in the context of grant aid projects are gradually taking shape. Therefore, JICA should be able to negotiate with host-country governments about CDM application in (ODA-financed) projects accompanied by the transfer of facilities as part of additional TA in the renewable energy field.

4.2.4 Orientation of JICA support

Thus far, JICA has furnished TA to developing countries in the field of renewable energy. In the segment of hydropower, this TA has covered a wide scope of systems with capacities ranging from tens of MW to tens of kW. Virtually all of the hydropower projects registered for CDM are small-scale ones for which procedural requirements are simpler. Their capacities range from a few megawatts to 15MW (the ceiling for small-scale CDM). This trend in application is anticipated to continue. The projects registered in the categories of biomass and wind power generation are still few, but exhibit the same tendency as hydropower projects. All of these projects are connected to the grid, and are not direct RE power sources. Dispersed (off-grid) RE sources are represented solely by the Chendbuji project in Bhutan.

The following sections probe the orientation of JICA support in each of the two zones in Figure 5, i.e., Zone A (with capacities ranging from one to tens of MW), which is premised on connection to the grid and contains the majority of the CDM projects registered so far; and Zone B (with capacities of no more than 1MW), which contain very small-scale sources for off-grid RE.

■ Issues in Zone A (on-grid projects)

In this zone, private enterprises are already busy filing applications for and executing projects registered for CDM. There are various problems in certain countries, including complex application procedures and delayed preparations. In many cases, needed information is provided only grudgingly. This suggests a need for support to stimulate the formation of CDM projects by addressing tasks such as related organizational and institutional conditioning, compilation of pertinent data, and human resource development as integrated themes. For example, there is a vital need for the preparation of setups to provide latent project principals with one-stop (help desk, etc.) services

for the promotion of CDM projects.

■ **Issues in Zone B (off-grid projects)**

In Zone B, JICA has furnished TA for small-scale hydropower for the purpose of poverty mitigation and regional development. To quicken activity surrounding such projects demands capacity-building for expansion of scale based on bundling and extensive application of CDM. The prospective counterparts would be the entities with information on rural communities and the status of project implementation, such as the Ministry of Cooperatives in Indonesia and the Department of Energy (Energy Utilization Management Bureau) in the Philippines. JICA could provide effective support by transferring technology concerning CDM application procedures to the concerned units of such agencies while also assisting their studies of bundling.

At the same time, support is also needed in non-technical areas such as methodology for proper assessment of economic feasibility and use of provisions for assistance to promote electrification with renewable energy. This demands comprehensive development of capacity concerning CDM projects.In this field, implementation of (ODA-financed) projects accompanied by transfer of facilities could possibly be premised on CDM, and it would consequently be vital to negotiate with the host-country government.

4.2.5 Approaches for expansion of project scales

Expansion of the project (business) scale by consolidating two or more projects would rationalize the operation and enhance appeal to investors. It is necessary to consider measures of support with a focus on bundling.

Case 1: Bundling of RE projects

Funds for RE could be established with outlays from several investors. Because ODA could not be used for direct participation in such funds, JICA ought to consider capacity-building among institutions with the authority to bundle projects in advance, with a view to offering assistance for the private sector.

Case 2: Bundling with RPS projects

In 2002, Japan enacted a law of special measures for utilization of new energy by electric power companies as a new framework for promotion of natural energy utilization (referred to as the Japanese version of the Renewable Portfolio Standard). This RPS law can serve as an effective means of bundling CDM RE projects premised on use of biomass fuel, for example, with expanded projects in the RPS market based on import of surplus biomass fuel.

Although there remain certain problems such as difficulties in marine transport and the

instatement of (JIS) standards of quality for use as fuel in Japan, such bundling could stimulate rural economies and deserves further consideration as a model case.

Chapter 5　Recommendations

5.1　Technical assistance field

（１）Study of renewable energy resource potential

To promote widespread use of renewable energy, it is important to acquire a firm grasp of the potential for the same.　In developing countries, the potential for wind power and geothermal energy is not known as well as that for other types of renewable energy.

To determine the potential for wind power and geothermal energy requires a certain amount of time, money, and technology.　In Japan, the government has led surveys to determine hydropower and wind power potential, and disclosed the findings.　It is therefore in possession of the necessary know-how and actual experience.　In the context of Japanese TA, it would be worthwhile to provide support for studies of potential.

As a part of such studies, it would very valuable to confirm the contents of OECD-DAC agreements with the CDM designated national authority (DNA) in the host country and reach a basic agreement on future CDM application financed with ODA for individual projects.

（b）Technology transfer

■ Technology systematization and totalization

Application of local technology holds the key to the sustainability of RE projects utilizing renewable energy.　It curtails the initial investment and facilitates response to breakdowns and difficulties after the start of operation.　NGOs and universities would play a leading role in such TA, but human resources are limited.

Japan possesses a wealth of technology related to utilization of renewable energy, from low-tech (conventional) equipment to the very latest devices.　In some cases, universities and NGOs are at the center of programs of technical instruction for their application in developing countries.　It would be extremely useful to partner with such organizations in the transfer of Japanese technology.　There is a particular need for proper technical support in the areas of planning, study, design, construction supervision, and operation and maintenance (O&M).

■ Technology transfer with an emphasis on RE project O&M

Off-grid RE must apply a business model independent of the ordinary electric power companies (utilities) engaged in on-grid electrification.　In general, the projects are operated by local residents or cooperatives.　The field studies implemented for this study revealed the existence of problems such as a virtual lack of reserve funds for future renovation of facilities.

In the aspect of project operation, guidance must be provided for construction of a local O&M

setup. The need for extensive facility renovation may not be imminent, but it is bound to arise eventually. Capabilities in areas such as the preparation of long-term plans and project management as needed for steady O&M would have to be solidly implanted through repeated transfer of guidance and supervision know-how. The approach to technology transfer would vary with the level of technology and status of institutional arrangements in the host country, and would also have to be studied with full consideration of cost effectiveness.

（c） Capacity-development

■ Dispatch of experts to pilot projects

Reinforcement of areas of weakness in the aspect of human resources for pilot projects could be reinforced through the dispatch of experts (not necessarily for a long time), sending of members of the Japan Overseas Cooperation Volunteers (or Senior Volunteers) for work close to the site, and presentation of educational materials, in order to produce personnel that could be at the core of efforts to execute autonomous and ongoing projects on the developing country side. As a part of such support, JICA could also providing training for NGOs, private enterprises, and consultants as well as governmental agencies.

■ Fuller group training

The setup for acceptance of trainees in the field of renewable energy has been weak thus far. To strengthen it, JICA could review the program for "small-scale hydropower and clean energy power engineering", instate new programs, and consider South-South training.

（d）Coordination with universities, NGOs, local governments, and companies

Participation of entities such as universities, NGOs, local governments, and companies has been apt to center around receipt of work consignments from the public sector, as represented by the preparation of facilities for pilot projects. Recently, however, there has been much siting in other countries by private-sector parties, and various patterns must be considered for collaboration between the public and private sectors.

In this connection, there should be an increase in the range of options for active private participation in JICA TA programs as well.

JICA absolutely should adopt a more diversified strategy by widening the approaches to assistance, so that the programs can have more substantial results. To this end, it ought to examine approaches in this field from all sorts of perspective, including technology, business models, project regulation, business subsidies, and assurance of funding sources.

In the Finesse Program conducted by the UNDP, for example, efforts were made to prepare a climate conducive to an influx of electrification funding into the private sector by training experts in

banks providing loans and constructing the financing system. This program departed from the conventional wisdom that utilization of renewable energy and RE projects were generally not paying propositions and therefore should be led by the public sector. It was an attempt to harness private energies and the market mechanism even in these fields. The fact is that it has been yielding better results than the RE programs funded with grant aid by donors (in the Philippines and Sri Lanka).

The situation demands a widening of the framework of JICA TA and expansion of support for banks, parties investing in projects, and other private enterprises as well as NGOs and beneficiaries in the implementation of RE projects, inclusive of opportunities for loan assistance from the JBIC.

（e） Support for the formation of CDM projects in "soft" aspects

■ Policy support to promote renewable energy utilization

Incentives are offered to encourage utilization of renewable energy (Indonesia obligates the PLN (Perusahaanumum Listrick Negara) to purchase power from independent power producers (IPP), and the Philippines exempts privately-owned small and mini scale hydropower plants from the business tax), but they are being extensively used.

This lack of extensive use derives partly from the procedural complexity and lack of knowledge about the incentives. Governments must abolish limitations and make provisions facilitating application of the incentives. In Japan, prescribed results have been achieved by consistent measures of support, led by the government, for utilization of renewable energy in forms such as hydropower, solar energy, and wind power. It would presumably be effective to provide technical support combined with publicity activities. The measures to spur diffusion in Europe and North America also could provide models.

■ Support for institutional design to promote CDM projects

CDM can improve the economic viability of RE projects. At present, however, the only RE project registered for CDM application is the micro hydropower project in Chendebuji, Bhutan. Widespread CDM utilization is an agenda item.Developing countries typically have issues as regards ability to cope with the procedural complexity of applications for CDM projects and underdeveloped provisions for the same. These issues impede CDM utilization.

To help resolve them, JICA could offer comprehensive programs of capacity-building for governmental agencies in general charge of RE projects based on off-grid small-scale hydropower plants, such as the Indonesian Ministry of Cooperatives and Small & Medium Enterprises and the Philippines Department of Energy (Energy Utilization Management Bureau). Besides transfer of technology regarding the CDM and application procedures, this program would include methodology for assessment of economic viability, methods of having subsidy provisions applied, and other items related to CDM projects.

In the context of such TA, it would also be worthwhile for JICA to assist the construction of a scheme for provision of one-stop services related to CDM while simultaneously offering support to parties that are potential CDM project principals.

（f）Support for technology development

For types of renewable energy technology that are applicable for RE and thought to have future promise, efforts should be made to support technology development in both the technical and financial aspects, and accumulation of knowledge concerning RE utilizing renewable energy. As noted above, in presentation of facilities, discussions should be held with the DNA on the subject of CDM application to deepen understanding of ODA-financed CDM projects in the host country.

In Indonesia, the DNA has just been inaugurated, and it would be critical to apply this scheme for the TA for a power generation project utilizing cow manure (identified in the field study).

（g）Technical support for the spread of biomass fuel

Many types of biomass fuel have come under study in recent years. Being highly portable, biomass fuel could help to quicken the economic life of growing districts by sale as an environment- and energy-related commodity in addition to use in the host country. At the same time, there is the risk of excessive clearing of tropical rain forest land to build plantations for production of biomass fuel. Therefore, in-depth studies must be made in each category of biomass fuel for fair and objective assessment of matters such as the level of technology, future potential, economic impact in the growing district, and the CO2-reducing effect, and determination of the feasibility of business models utilizing biomass fuel. For projects viewed as particularly promising, it would also be worthwhile to consider the prospect of furnishing R&D support in the form of a model project.

Import of biomass fuel for utilization in Japan would be a promising means of compliance with the RPS Law. This would require institutional conditioning to permit the diffusion of such fuel, inclusive of distribution routes, accompanying regulations (governing marine transport), and establishment of JIS standards for use as fuel in Japan.

5.2 Assistance based on grant aid

（a）Study of prospects for CDM application to (ODA-financed) projects involving facility transfer

In ODA-financed projects involving presentation of facilities, and in the basic design studies preceding them, JICA should confirm the contents of the OECD-DAC agreeement with the host-country DNA and reach a fundamental agreement on CDM application. In countries where CDM projects have not been implemented with Japanese assistance, the deployment of such activities would be extremely effective for deepening understanding of, and building a latent agreement on, ODA-financed CDM projects in the host-country government.

For example, the Manito-Lowland geothermal power plant in the Philippines covered by the field study deserves consideration for rehabilitation with ODA and transformation into a CDM project. The plant has a direct impact on stimulation of the local economy through the demand for heat, and its generation facilities are currently not in good condition.

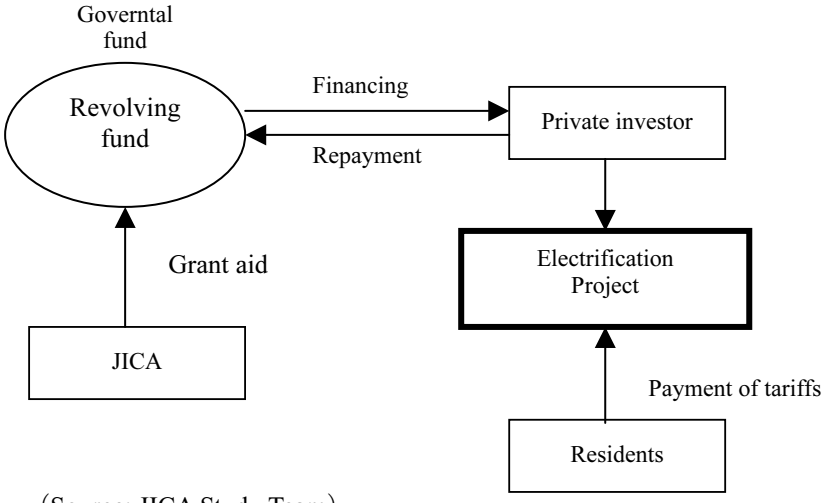
（b）Bundling of projects for receipt of grant aid

Assistance for procurement of funds for RE projects plays a vital role. Nevertheless, RE projects are often on a low scale, and may not be eligible for application of ordinary provisions for grant aid because of their small size. To overcome the scale limitations, it is necessary to incorporate RE into larger projects for social development in the agricultural or other sector, or to bundle analogous RE projects together. It is advisable for JICA to form project packages crossing field boundaries and promote measures for interfield coordination.

（c）Application of grant aid for revolving funds

In many cases, projects for installation of PV (or other) stand-alone equipment on the premises of each customer installed solar home systems (SHS) with grant aid, but the subsequent cost burden outweighed the demand and payment capabilties of individual beneficiaries. In such cases, the projects often came to a standstill, without having retrieved the funds invested, around the time for replacement of equipment that had reached the end of its service life a few years later. This risk could be addressed by temporarily putting the grant aid into a government fund, having the project implemented by enterprises (which are more likely to meet obligations than residents), and retrieving the cost for payment back into the fund within a few years.

In this model, the grant aid (including non-project collateral fund grants) would serve as the seed funds, but could be paid in kind instead of in cash. A loan would be made in kind from the governmental fund, and receive repayments in amounts equivalent to depreciation cost. The cash from these repayments would be used to finance the next project.



（Source: JICA Study Team）

Figure 7　Concept of revolving funds

（d）Establishment of guarantee funds for mobilization of private funds

RE projects with a low payability could be assisted with provision of funds from other countries and internal subsidies, but the amount of development would be limited due to quantitative constraints.

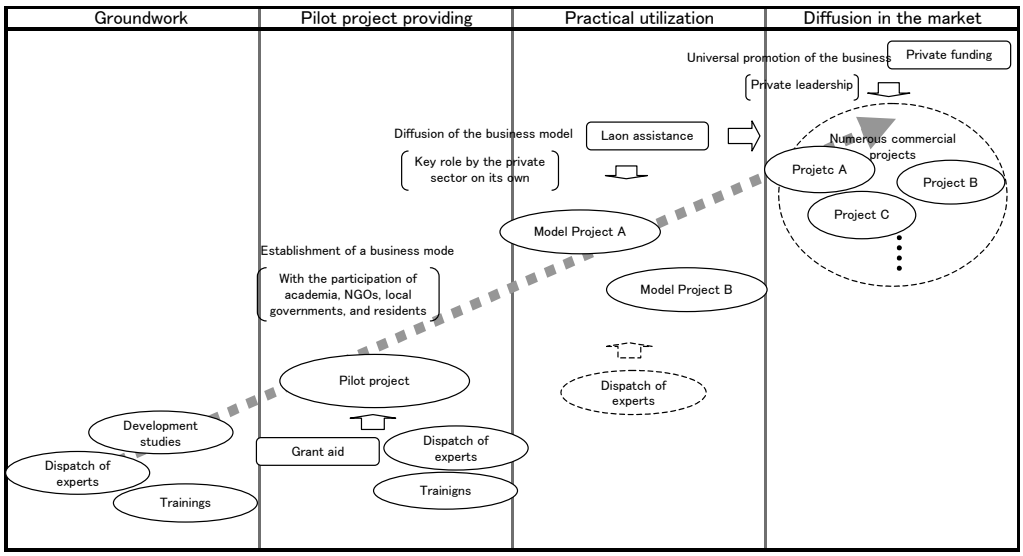
Because of the limit to provision of public funds for projects, there is a need for a wide range of avenues for fund procurement, including utilization of private-sector funds, to make projects sustainable. One option would be to establish a guarantee fund with grant aid to lower barriers in the event of borrowing from host-country financial institutions for the RE project and to stimulate investment from the private sector.

5.3 Partnership with Private Sector

In the process of assisting the commercialization of renewable energy, it is indispensable to pave the way for TA and financial aid that includes participation by the private sector in the project. As proposed in this report, schemes must also be considered for the establishment of a fund in a governmental institution with grant aid from JICA to furnish financial support for the development of business by private enterprises. As one pattern of coordination between loan assistance and grant aid, there should be provisions allowing JICA to furnish TA to borrowers in order to support financing projects of the Japan Bank for International Cooperation (JBIC). As such, the TA recipients would no longer necessarily be public-sector entities.

This perspective goes beyond the conventional ideas of TA and grant aid. However, it is an unmistakeable fact that economic advancement in developing countries is moving out of the age of sharp distinction between public and private roles, and into that of progress that is premised on the market mechanism and promoted through public-private partnership. There are high hopes that JICA, too, will devise a new assortment of options for support that anticipate these social and economic changes.

If it takes this sort of strategic approach, JICA would be able to apply each of its tools in the proper way, promote utilization of renewable energy, and lay down a path for development to realize the related goals. If this path may be termed a vision, JICA's main role in it would consist of support extending from the groundwork to proving and the initial stage of practical use (see Figure 8).



Examples of JICA assistance	・Survey of resource potential ・Technology systematization ・Examination of prospects for CDM application ・Drafting of business models ・Human resource development	・Dispatch of experts to the project ・Provision of equipment for the project ・Human resource development	・TA limited to project principals	
Systemic prerequisites:	・Necessary policy preparations	・Organic linkage of TA and grant aid	・Coordination between TA and loan assistance ・Strong commitment to the project by the national government	・Provision of policy support by the national government

（Source） JICA Study Team

Figure 8. Vision of JICA support in the field of renewable energy

The changes in the JICA role depending on the stage of evolution would be reflected in others in the ranks of parties involved (i.e., individuals, organizations, and institutions). As renewable energy reaches maturity in both technical and business terms, it would leave JICA's hands and spread in the market.