No.

Committee for the Promotion of Cooperation on Electrification Using Renewable Energy

Report

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Japan International Cooperation Agency

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Foreword

Today, an estimated 2 billion people worldwide lead their lives under conditions that make it impossible for them to have use of electrical power, which must be termed one of the very foundations of modern living. Most of them are to be found in developing countries, and in those districts that are least likely to benefit from development. Many developing-country governments have positioned the supply of power to these people as a variety of basic human need (BHN) and are working to resolve this problem as one of their official duties. With a view to supporting the country's overall socioeconomic advancement as well, they are taking steps to accommodate the increase in the demand for power along with development while also addressing the contemporary requirements for structural reform of the power sector and environmental preservation.

Renewable energy resources such as solar (photovoltaic) power, small-scale hydropower, and wind power are types of clean energy that are fully capable of utilization even in developing countries as alternatives to oil resources, which are steadily being depleted around the world. Besides its contribution to the prevention of global warming caused by massive consumption of fossil fuels, the promotion of electrification using such renewable energy is gaining increasing recognition as an effective means of community advancement and improvement of the standard of living in disadvantaged areas.

This perception lay behind the explicit statement, in the medium-term policy on Japan's Official Development Assistance (ODA) determined by the Cabinet in August 1999, of the importance of aid for promotion of use of renewable energy in the ODA context toward the ends of curtailing emissions of greenhouse gases and achieving sustainable development. This was followed by the pledge of financial and technical support for developing countries to promote use of renewable energy in them as part of the joint statement resulting from the summit conference of the Group of Eight countries in Okinawa, Japan in July 2000.

In light of these rising needs for development in the field of renewable energy in developing countries, the Committee held a series of five meetings for discussion and conducted field studies in two areas for the purpose of examining the orientation, strategy, and issues related to Japanese assistance in this field (and particularly projects for electrification using renewable energy). This work was carried out with a focus on the advisable approach to collaboration with concerned domestic institutions and other such principals. This report presents the results of these operations.

It should be added that the contents of the report were prepared on the individual responsibility of the members of the Committee and do not necessarily represent the views of the organizations to which they belong.

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As of March 27, 2001

Committee Meetings

Committee Meetings	Major items of deliberation
First meeting (31 July 2000)	● Establishment of the FY2000 Committee ● Technical cooperation in the field of use of renewable energy - history and future outlook ● Research and development of new energy mainly in developing countries - history and future outlook ● Overview of cooperation with diffusion of new energy in developing countries ● Report on participation in World Bank Energy Week ● Orientation of Committee discussion
Second meeting (29 September 2000)	• Future outlook for renewable energy projects based on grant aid • Approaches to rural electrification in Bangladesh • Domestic cases of renewable energy use and application to developing countries • Outline of the joint international cooperation subcommittee of the new energy and energy conservation sections of the Combined Energy Study Association • Possibility of Japanese cooperation with projects for electrification using renewable energy
Third meeting (27 November 2000)	• Perspectives on rural electrification models • Activities of international institutions in the field of renewable energy use • Field studies
Fourth meeting (6 March 2001)	• Advisable approach to international cooperation by Japan for diffusion of new energy and energy-saving technology in developing countries • Field study reports • Lessons of the field studies • - Framework of the final report (draft)
Fifth meeting (27 March 2001)	• Final report (draft)

Field Studies

Period	Country	Main institutions visited
1/15-1/24/2001	The Philippines	World Bank office, ADB office, UNDP office, Department of Energy, Development Bank of the Philippines, National Electrification Administration, National Power Corporation, Philippine National Oil Corporation, Japanese Embassy, JBIC office, JICA office
1/14-1/23/2001	India	World Bank office, UNDP office, USAID office, Ministry of Non-Conventional Energy Sources, DEA-MOF, India Renewable Energy Development Agency, Rural Electrification Corporation, West Bengal Renewable Energy Development Agency, Ministry for Power & Non-Conventional Energy Sources, Govt. of West Bengal, RKM, Tata Energy Research Institute, Aditya Solar Shop, Japanese Embassy, JBIC office, JICA office
1/23-1/27/2001	Sri Lanka	World Bank office, UNDP office, Ceylon Electricity Board, National Development Bank, DFCC Bank, Sarvodaya, Sri Lanka Business Development Centre, JBIC office, JICA office
1/27-2/3/2001	Bangladesh	World Bank office, ADB office, Planning Commission, Ministry of Energy & Mineral Resources, Power Cell, Bangladesh Power Development Board, Rural Electrification Board, Grameen Shakti, Japanese Embassy, JICA office

Committee for the Promotion of Cooperation on Electrification Using Renewable Energy

Summary of the Report

1. Aims of the Committee studies

- Developing countries, too, exhibit a qualitative change in conditioning of the economic infrastructure including electrical power, and are shifting away from the conventional approach based on investment by governments and toward use of private-sector energies. In this situation, Japanese Official Development Assistance (ODA) has begun to attach more importance to intellectual support based on structural changes in the power sector, in the form of help with policy-making and institutional arrangements for related preparation of the project environment.
- Concerns are hardly confined to the structural issues in the power sector; the reduction of emissions of carbon dioxide (CO_2) accompanying energy consumption has come to the fore as a new task to be tackled in this field. CO_2 emissions are now a major factor that must be considered in promotion of assistance for developing countries in the power sector by the Japan International Cooperation Agency (JICA), one of the country's ODA institutions.
- In light of these changes in the environment surrounding assistance for developing countries, the Committee directed its attention to rural electrification using renewable energy as a way of addressing two tasks: 1) rural electrification, a power sector segment which has little prospects for use of private energies and continues to depend largely on official support; and 2) use of renewable energy[1], which has great potential as a future power source and merits promotion for its emission-reducing effects. In so doing, it conducted studies aimed at deepening discussion on the question of the kind of collaboration needed for Japanese ODA to provide effective support in this field.

[1] The term "renewable energy" includes solar (photovoltaic) power, small-scale hydropower, wind power, geothermal energy, and biomass energy. For this report, it was decided not to take up any particular type of renewable energy and to have discussions include so-called "natural energy."

2. Significance of use of renewable energy for rural electrification

Need for promotion of rural electrification

- Most developing-country governments view the provision of universal services as a national obligation in the field of electrical power supply, as in other fields of the socioeconomic infrastructure. For this reason, rural electrification has in many cases been incorporated into national plans for power development, and electric utilities arrayed under the nationally-owned power corporations are promoting it through extension of their transmission and distribution networks.
- There is also a parallel promotion of electrification projects as a means of raising the standard of living in rural areas. In other words, electrification is being pushed toward the end of social advancement focused on rural areas which have been lagging behind urban areas, based on the concept of basic human needs (BHN). Viewed from this standpoint of social advancement, the key goals associated with electrification are a qualitative improvement in daily community life, increase in income on the individual level, and stimulation of local economies.

Possibilities of use of renewable energy in rural electrification projects

- Under ordinary conditions, use of renewable energy has numerous disadvantages as compared to conventional power sources such as thermopower and large-scale hydropower in respect of the amount of heat and output per unit of input, and convenience. By the same token, the supply of power based on large-scale generation facilities and a grid (i.e., transmission and distribution network) entails immense initial investment, and therefore is saddled with a different problem, in the form of extremely high electrification costs in remote areas with a low demand density that rule out an adequate economy of scale.
- In contrast, renewable energy can be utilized as local energy and does not necessarily entail huge amounts of investment.
- For these reasons, the following prospective modes of incorporating renewable energy would presumably make it possible to overcome their potential disadvantages, considering the connection with economy of scale and the order of investment priority in plans for extension of the national grid.
  - ① Use as dispersed energy sources in areas where it would be difficult for the foreseeable future to extend the grid owned by the national government or

the state-run or regional electric utilities

② Effective use as a domestically produced energy for diversification of power sources

3. Basic perception of promotion of rural electrification using renewable energy

- The promotion of rural electrification using renewable energy encompasses a wide range of programs, from those conducted as part of plans for power development prepared by the national electric utility to extremely small-scale projects executed by community groups.
- As such, the setup for promotion and the concerned principals vary depending on the project, and this rules out formulation of a single fixed model for all. The great diversity of principals involved in these projects include national government, local government, electric utilities, citizens as the final beneficiaries, financial institutions as the seats of financing, non-governmental organizations (NGOs), universities and other educational institutions, private investors, equipment vendors, and aid institutions.
- This diversity presents the various principals with numerous difficulties. On the governmental (administrative) level, for example, project implementation is apt to be hindered by a lack of policy conformance among different agencies, low capabilities of execution on the part of the promoting institutions, and weak backing in the financial aspect. This institutional frailty becomes more pronounced among the more subordinate entities. Players including not only the electric utilities and local electrification cooperatives but also the financial institutions providing the funds are saddled with problems in respect of operating capabilities and specialized knowledge.
- NGOs play an important role in socioeconomic advancement in rural areas, but this does not mean that they have expertise in the field of rural electrification. Their efforts to support local residents in such projects are also under formidable constraints in the aspect of human resources and funding.
- As for private investors and equipment vendors, it may be noted that, although the seeds of business development through the market mechanism have begun to sprout, the business environment remains unconditioned. Moreover, deficiencies in areas such as the scheme of guarantees for purchased equipment is causing problems that are lowering the user confidence in the projects.
- Similarly, aid institutions do not always have a shared perception and

understanding of rural electrification. International institutions such as the World Bank appear to be laying emphasis on the market mechanism and offering financing schemes premised on a revision of institution- and policy-related rules to establish the proper norms. Japanese ODA institutions, on the other hand, tend to emphasize the strengthening of capabilities in the practical aspect, in accordance with their focus on actual on-site application. While a certain synergistic effect can be generated in projects when there is effective coordination between both sides with awareness of such differences, it cannot be denied that there is also a risk of a mutual cancellation of benefits when coordination is lacking.

4. Approaches to rural electrification using renewable energy

- Japanese ODA institutions would favor strategic approaches that have the flexibility to accept this kind of diversity and take full advantage of it while preserving the project's sustainability.
- Projects that depend on grants (i.e., gratis aid) from aid institutions for all of their requirements do not have a sustainability of their own. Although rural electrification projects certainly require support in both the financial and non-financial aspects, the market mechanism has begun to function for certain portions.
- In the portions where the market mechanism can do the job, the role of aid institutions should consist mainly of preparing an environment conducive to the related business. Conversely, in portions where projects cannot proceed on the strength of the market mechanism alone, their role lies in laying the foundation for projects by nurturing the self-help capabilities of the beneficiaries and in raising the socioeconomic level to permit application of economic principles as far as possible.
- As such, even in projects on the grant basis, steady continuation of the work requires the construction of a setup enabling acquisition of the funds needed for operation and maintenance (O&M) and replacement of facilities in the form of revolving funds during the project term. Naturally, this must not be completely equated with a scheme of beneficiary burdens since, in some cases, not all of these costs can be recovered directly from beneficiaries.
- The important points are that assurance of revolving funds is absolutely necessary for preservation of the project's sustainability, and that a definite

mechanism for appropriate recovery of costs from beneficiaries and compensation in the event of shortages must be established as a social institution.

- Projects for rural electrification using renewable energy therefore would differ greatly in nature from the conventional projects of large-scale power development. Their promotion requires support not only for their operation but also for the management of funds and technical aspects. The aid institutions must have the cooperation of local institutions with the practical power to provide these functions. For Japanese ODA institutions, the list of counterpart principals is not confined to governmental institutions in the other country; it extends to financial institutions there able to provide petty loans, universities in possession of the needed know-how, and NGOs able to assist the promotion. Involvement of all these parties is a vital key to success in rural electrification projects.

5. Need for diverse collaboration

- For the future, the spread of rural electrification projects using renewable energy will demand cooperation with concerned institutions, NGOs, and private-sector parties, both domestic and foreign.
- **Collaboration among Japanese ODA institutions:** The prospects here include collaboration with other JICA projects of electric power and social development, grant aid projects which spur the formation of rural electrification projects, onerous aid projects for provision of funds to the country in question, and projects of technical research and development aimed at expansion of the market and sharing of data stores through cost reduction.
- **Collaboration with developing-country governmental institutions**: Japanese ODA institutions can provide intellectual support at the stage of proposing and drafting basic policy and master plans for energy development by developing-country governments.
- **Collaboration with developing-country financial institutions**: In the provision of funds to developing countries, the interposition of financial institutions there can facilitate the funding of numerous small-scale projects and thereby further electrification. To this end, support should be furnished for the building of financing schemes for the promotion of rural electrification projects. These schemes should encompass programs for development of the

capabilities of these institutions and their staff.

- **Collaboration with NGOs**: NGOs which have an extensive record of achievement in community development in rural areas and strong human-network ties with local communities could be offered technical support and financing to enhance their capabilities.
- **Collaboration with private companies**: In some developing countries, projects on the private-sector basis are beginning to emerge in the form of rural energy companies (RESCOs). Support in "soft" aspects can be provided to make the environment for business based on the market mechanism more solid. This encompasses a wide range of intellectual assistance in all phases from bolstering the capabilities of fund recipients with low credit ratings to technology transfer to the private sector.
- **Collaboration with international institutions**: The institutions in question may be exemplified by the World Bank and Asian Development Bank (ADB), which are spearheading programs of structural reform and institutional design in the power sector; the United Nations Development Programme (UNDP), which provides technical aid on the grant basis; and the Global Environment Facility (GEF). Collaboration with them consists of a division of roles accenting respective fields of special competence, interproject complementation, and suggestion of new projects.

6. Tasks for promotion of collaboration

- The following tasks must be addressed in advance of promotion of the collaboration described above.
- **Policy dialogue**: Advance agreements must be reached with the developing-country government and international institutions collaborating in the project on items such as policy ends, means of implementation, and the time schedule.
- **Preparation of a coordinating scheme**: A scheme must be constructed for discussion with the domestic institutions involved in technical or financial cooperation and technical research and development, to make arrangements for prompt sharing of information on specific sites and for cooperation and partnership in the project. In interaction with the developing-country institutions, the aid institution must reach an agreement on the basic framework of collaboration and fully define the division of roles as regards the actual

planning of the project and its implementation.

- **Study of past cases**: Past projects implemented by other institutions, domestic and foreign, must be studied with attention to their setup and factors of success or failure, for reflection of the findings in the collaborative work for the future.
- **Evaluation of the capabilities of developing-country institutions**: Advance evaluation must be made of the capabilities and achievements of financial institutions, NGOs, and other prospective partners in collaboration on the developing-country side, in order to ascertain the proper division of roles.
- **Verification of collaboration efficacy**: The effectiveness of the prospective collaboration model must be checked through the execution of a small-scale pilot project as part of a larger existing project. This should make clear any latent problems and issues. It would be advisable to perform such checking not only in the context of ongoing Japanese projects, but also through joint projects with other international institutions implementing or planning analogous rural electrification work, in order to ensure complementation and conformance with them.

Contents

Abbreviation

ADB	Asian Development Bank
BHN	Basic Human Needs
CDM	Clean Development Mechanism
COP6	Sixth Annual Conference of Parties
GEF	Global Environment Facility
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
NEDO	New Energy and Industrial Technology Development Organization
NGO	Non-Governmental Organization
ODA	Official Development Assistance
O&M	Operation & Maintenance
PV	Photovoltaic
RESCO	Rural Energy Service Company
SEED	Sarvodaya Economic Enterprise Development Service
SHS	Solar Home System
SPP	Small Power Producer
TA	Technical Assistance
UNDP	United Nations Development Programme

1. Aims of the Committee studies

Developing countries, too, exhibit a qualitative change in conditioning of the economic infrastructure including electrical power, and are shifting away from the conventional approach based on investment by governments and toward use of private-sector energies. Under these circumstances, the type of aid extended by the World Bank, Asian Development Bank (ADB), and other international institutions in the power sector has changed significantly. More specifically, emphasis in the aid policy of these institutions has shifted from support in the conventional "hard" aspects to assistance in the "soft" aspects for the establishment of self-sustaining electric power enterprises harnessing the market mechanism.

In this situation, the Japanese government has been reviewing approaches to aid in the power sector. Recognizing the need for collaboration and cooperation with the private sector, it has moved new policy to this end into effect in its Official Development Assistance (ODA). In essence, in fields with good potential for utilization of private energies, it has begun to attach more importance to intellectual support based on structural changes in the power sector, in the form of help with policy-making and institutional arrangements for related preparation of the project environment.

Concerns are hardly confined to the structural issues in the industry; the reduction of emissions of carbon dioxide (CO_2) accompanying energy consumption has come to the fore as a new task to be tackled in this field. CO_2 emissions are a serious problem in developing countries as well as developed ones. They are now a major factor that must be considered in promotion of assistance for developing countries in the power sector by the Japan International Cooperation Agency (JICA), one of the country's ODA institutions.

In light of these changes in the environment surrounding assistance for developing countries, the Committee directed its attention to rural electrification using renewable energy through combination of two tasks: 1) rural electrification, a power sector segment which has little prospects for use of private energies and continues to depend largely on official support; and 2) use of renewable energy[2], which has great potential as a future power source and merits promotion for its emission-reducing effects. In so doing, it conducted studies aimed at deepening discussion on the question of the kind of collaboration needed for Japanese ODA to provide effective support in this field.

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(1) Changes in the subjects of aid in the power sector

Although phases of power development in developing countries differ depending on the stage of economic advancement, there has clearly surfaced a movement away from infrastructural conditioning in the form of construction of power plants by state-owned electric power corporations to use of private energies and privatization based on the market mechanism, as exemplified by the rise of independent power producers (IPPs).

Meanwhile, in contrast to the steady progress of development in the core portions of the power sector infrastructure, there remain many people without access to electricity in rural areas. The World Bank estimates that, even today, about 2 billion people in about 400 million households live without electricity. Even in the same developing country, there is a growing social polarization associated with widening economic disparity between urban areas, where development is rapidly moving forward, and rural areas, which are being left behind and without electricity.

The promotion of rural electrification is therefore a major policy task for the governments of these countries. It goes without saying that rural areas are not equipped with markets permitting adequate development led by private investment and remain difficult to electrify without official support.

JICA views assistance for a stable supply of electricity in developing countries as a vital part of its mission and also accords importance to its dimension of social advancement, i.e., of helping to improve the lives of the roughly 2 billion people worldwide living without electricity.

In light of these changes in the environment of aid to developing countries, the subjects of JICA aid in the power sector are broadening from programs for development of specific sources and conditioning of transmission and distribution facilities under the leadership of the national electric power corporation to include a wider range of fields with a focus also on electrification in rural areas now without power.

(2) Response to rapidly worsening global environmental problems

Developed and developing countries must work for resolution of the problem of global warming from the same standpoint. Various measures for reduction of CO_2 emission in accordance with the United Nations Framework Convention on Climate Change are subjects of continuing discussion. Against this background, the Sixth Conference of Parties (COP6) to the Convention debated the question of whether or not ODA ought to be extended for clean development mechanisms (CDM), but failed to reach a conclusion on the matter, which was left open for the next session.

Nevertheless, the participation of the private sector, in forms including investment, is indispensable for action on global environmental problems in developing countries, and ODA is thought to have a crucial role to play in assistance for inducing deep involvement by private enterprises.

Within Japan, a joint subcommittee on international cooperation was instituted under the new energy and energy conservation sections of the Combined Energy Study Association in the Ministry of Economy, Trade and Industry. This subcommittee was given the assignment of deliberating on the proper shape and promotion of Japanese cooperation with developing countries for a both self-sufficient and sustained diffusion of energy-saving technology and new energy, inclusive of renewable types.

With these needs for construction of concrete schemes for mitigation of global environmental problems, expectations for use of renewable energy are steadily rising.

In keeping with the standpoint of JICA as an organ for extension of ODA, the Committee did not discuss use of renewable energy merely in the aspect of response to global environmental problems. Besides such problems, it had to take account of all other factors, such as programs of socioeconomic advancement in developing countries, promotion of electrification in support of such programs, and mitigation of the environmental impact of this advancement.

The use of renewable energy as a means of resolving the lack of electricity in developing countries would, of course, have only a limited effect as compared to the total quantity of CO_2 emissions. However, even if the direct effect is small, it is clear from their ripple-effects into the future (expanded use not only for rural electrification but also as a system source) that they will make a substantial contribution to easing environmental and energy problems.

Nevertheless, use of renewable energy in the system power grid based on the conventional large-scale sources for the purpose of alleviating global environmental problems is still saddled with numerous disadvantages in the technical and cost aspects, and leaves many issues to be resolved. In rural areas, on the other hand, electrification would be difficult to achieve through extension of the power system because of the high investment costs entailed, and there are many conditions facilitating use of renewable energy while preventing actualization of its latent drawbacks. This field therefore holds prospects for the spread of renewable energy over the shorter term.

2. Significance of use of renewable energy for rural electrification

2.1 Need for promotion of rural electrification

(1) Promotion of electrification as part of national power development plans

Developing countries have thus far pursued improvement of the power supply infrastructure at the responsibility of national government, on the grounds that it is a key support of the national economic development. In all these countries, electrification has accorded precedence to urban areas as the centers of economic activity and to districts with a build-up of industry. These areas have been at the focus of investment for power source development and extension of the transmission and distribution network (grid) as the means of supply.

Most developing-country governments view the provision of universal services as a national obligation in the field of electrical power supply, as in other fields of the socioeconomic infrastructure. For this reason, rural electrification has been incorporated into national plans for power development, and projects to this end have been led by power sector entities such as nationally-owned electric utilities, regional distribution firms, and regional electrification cooperatives. In many cases, it is been approached through expansion of the service area based on extension of the existing transmission and distribution network. In areas where it is difficult to extend trunk transmission lines such as outlying islands and remote districts, rural electrification is being promoted through installation of independent systems powered by diesel-engine generators.

(2) Promotion of electrification as part of social development

There is also a parallel promotion of electrification projects as a means of raising the standard of living in rural areas. This evidences a perspective that is rather different from the aforementioned preparation of the national infrastructure. In other words, electrification is being pushed toward the end of socioeconomic advancement focused on rural areas which have been lagging behind urban areas, based on the concept of basic human needs (BHN).

On the household level, for example, the replacement of the kerosene lamps now used in many homes with incandescent bulbs would help to improve the indoor environment (with cleaner air) and to prevent burns and fires.

On the village and community level, a major aim is improvement of the life of residents through illumination of community facilities and medical facilities with

electric lights, and preservation of vaccines and other medicines in freezers.

In promotion of social advancement, stimulation of the local economy ranks alongside a rise in the standard of living as a key priority. One of the typical social problems in rural parts of developing countries is that ways of earning cash income are extremely limited, and this prevents residents from extricating themselves from poverty. A breakthrough in this respect will demand stimulation of the community economy through income generation on the individual level and cultivation of local industries.

On the income generation front, supply of electricity could help to boost earnings by making it possible to lengthen the hours of store operation and to work at night. Regarding the latter, it could pave the way for higher cash income on farms by expanding opportunities for handicrafts and side work as well as for simple processing of agricultural products.

The following can be cited as possible means of economic stimulation based on cultivation of local industries.

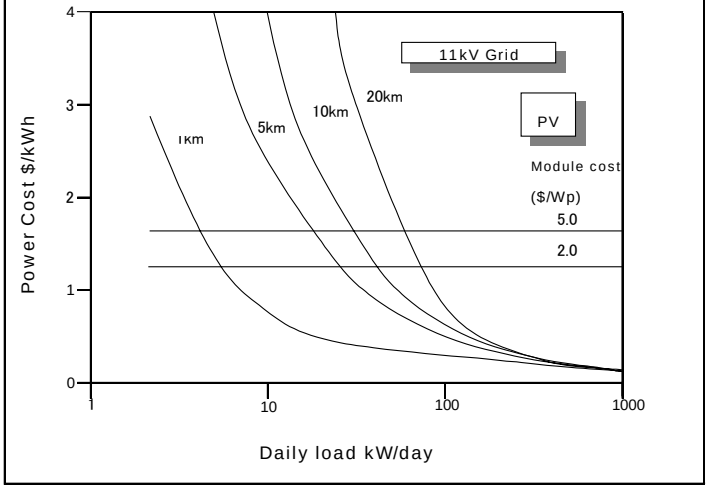
- Increase in farming productivity by provision of power sources for irrigation pumps, for example
- Provision of power sources for collaborative work at the stages of crop collection and processing, e.g., rice-cleaning, drying of nuts, grinding, and screening
- Increase in fishery productivity and value-added level by provision of power sources for cold storage of marine products, for example

Another major task as viewed from the standpoint of social advancement is resolution of the widening information gap between urban and rural areas. The "digital divide" and other facets of this gap are beginning to surface as one of the factors expanding the economic disparity between urban and rural regions. This is accelerating the gravitation of population into cities and also triggering new problems of poverty in them.

Resolution of this information gap is becoming a key issue for study in the context of future aid for developing countries. In this way, too, promotion of rural electrification is an important part of preparing conditions for socioeconomic advancement in rural areas.

2.2 Possibilities of use of renewable energy in rural electrification projects

Under ordinary conditions, renewable energy is saddled with numerous disadvantages relative to conventional power resources such as thermopower and large-scale hydropower plants in respect of the amount of heat and output per unit of input as well as convenience.



This figure compares the equalized cost of extension of the 11-kilovolt transmission system down to the level of small villages and the cost of installation of PV panels in each household. It can be seen that, where the load is low, PV is more cost effective unless the distance from the transmission line is very short. However, PV's advantage declines as the load density rises. The point of equilibrium between the cost of transmission line extension and PV panel installation varies greatly depending on the situation in the area.

(Source: Jenniy Gregory, et al. (1997), Financing Renewable Energy Project, Intermediate Technology Publication, London)

At the same time, however, supply of power based on large-scale facilities and the transmission and distribution system entails an enormous initial investment. It therefore presents a different problem, in the form of extremely high electrification costs in remote areas with a low demand density that rule out an adequate economy of scale (see the figure below).

For electric utilities in developing countries, this poses financial obstacles to promotion of rural electrification. In contrast to the economic prosperity in urban areas, a fairly large proportion of rural areas are consequently left without electricity.

In addition, in most countries, the supply of power based on large-scale generation facilities and the transmission and distribution grid is premised on a monetary economy in all processes from procurement of fuel to operation of facilities. In contrast, renewable energy can be procured on a local basis and does not necessarily have to be a subject of monetary transaction.

For these reasons, there are thought to exist a fair amount of situations that would make it possible to overcome the potential disadvantages of renewable energy while taking account of the connection with economy of scale and the order of investment priority in plans for extension of the national grid.

(1) Use as dispersed energy sources in areas where it would be difficult for the foreseeable future to extend the transmission and distribution network (i.e., grid) owned by the national government or the state-run or regional electric utilities

As a specific measure, dispersed power sources and mini-grid systems using renewable energy could be realistically positioned as interim sources over the medium and long terms (the next five to ten years), until the grid can be extended.

The biggest benefit of dispersed power sources lies in ready supply of electricity to areas that have thus far been without power through selection of systems with a size adapted to the needs of the final beneficiaries. Even if subsequent economic growth expands the demand, makes electrification through extension of the grid economically feasible, and results in connection to the grid, thereby eliminating the need for them, dispersed sources could be equipped with sufficient value as interim measures.

One of the advantages of dispersed sources is the ability for reuse at another location. As long as the sources are units like photovoltaic (PV) panels, they can be installed in another area lacking electricity once the grid is extended to the one in question. (In its PV panel business, Grameen Shakti buys back panels from customers who are in arrears at their residual value for resale to different customers.) Although facilities such as small-scale hydropower and wind power systems would be difficult to relocate, they could be connected to the grid and remain in use as supplementary sources on the terminal end of the distribution network, which is apt to be frail.

Generally speaking, systems that are compact and simple are applied for generation facilities using renewable energy. As such, they make operation and maintenance (O&M) easier than the conventional large-scale generation facilities. In the aspect of economic feasibility as well, when the total cost of electrification is considered in terms of the monetary component and the non-monetary components (e.g., provision of labor by residents), renewable energy could be demonstrated to have an advantage.

However, renewable energy would coexist and compete with diesel generators in the field of dispersed systems. Decisions on system composition therefore must be preceded by full study of the advantages and disadvantages of each type from all perspectives, e.g., total cost, ease of O&M, and operational flexibility including load-following ability.

(2) Power source diversification using domestically produced energy

Systems using renewable energy could make effective use of the energy resources available in the area in question. Installation would be fully possible in areas that

possess such resources and offer a certain rationality as regards economic merit. The concept of economic rationality as applied here consists of the following perspectives.

- The temporary burden on consumers is not excessive and there is a wide range of payment options
- As compared to sources using fossil fuels, the system could be made extremely small and thereby lighten the initial investment burden.
- Part of the O&M cost could be replaced with a burden not accompanied by monetary payment to an outside party (e.g., independent management by residents would be an alternative to part of the payments).

As viewed from the standpoint of use as domestically produced energy (i.e., of energy security), if renewable energy holds sufficient merit as compared to conventional energy, it should be considered not only for dispersed sources but also for sources that are connected directly to the grid.

3. Basic perception of promotion of rural electrification using renewable energy

3.1 Various principals and their roles in project promotion

The promotion of rural electrification using renewable energy encompasses a wide range of programs, from those conducted as part of plans for power development prepared by the national electric utility to extremely small-scale projects executed by community groups.

As such, the setup for promotion and the concerned principals vary depending on the project, and this rules out formulation of a single fixed model for all.

Promotion of small-scale electrification projects on the "grassroots" citizen level requires the resolution of various issues in all phases, from the building of organizations and acquisition of funds to instruction for personnel and proper O&M for facilities. This, in turn, demands the involvement of numerous parties.

Non-governmental organizations (NGOs) assisting programs of socioeconomic advancement in rural areas often collaborate with electrification projects as a part of these programs. Some of them construct schemes for socioeconomic advancement based on promotion of electrification through micro-financing and creation of opportunities for residents to earn income applying the supply of electricity.

The various concerned parties therefore do not necessarily have a shared perception and act in coordination with each other. Moreover, the diversity is compounded by differences of country and region as well as social structure and conventions. It consequently must be borne fully in mind that the awareness and perspectives commonly found in Japan can in many cases not be applied without modification.

Table 1: Principals involved in rural electrification using renewable energy, their roles, and typical problems

Principals	Roles	Problems
Central/national government	● Formulation of energy policy ● Formulation of policy on the power sector and rural electrification ● Establishment of governmental institutions ● Preparation of institutional arrangements needed for policy execution	● Unclear policy on energy and the power sector ● Insufficient environmental measures (e.g., discarding of batteries for PV systems) ● Incomplete institutional arrangements ● Lack of capabilities at concerned institutions ● Shortage of treasury funds
Local government and communities	● Drafting of policy on regional development ● Execution of development plans	● Lack of planning capabilities ● Shortage of funds
Electric utilities	● Preparation and execution of power development plans	● Lack of execution capabilities ● Shortage of funds
Electrification cooperatives	● Execution of regional power supply	● Weakness of organization system ● Shortage of human resources and skills ● Shortage of funds
Residents (final beneficiaries)	● Formation of local organization for electrification	● Lack of capabilities for economic payment ● Lack of capabilities for operation of citizen organizations (collection of charges, management of funds, etc.) ● Lack of understanding of (shortage of information about) power (electrification)
Financial institutions (banks and credit suppliers)	● Financing for individuals and businesses with low credit standing ● Provision of opportunities (seminars, etc.) for education and training to people involved in the project	● Lack of expertise in electrification projects ● Lack of financial screening capabilities
NGOs	● Improvement in the life of residents ● Support for regional socioeconomic advancement (provision of education and training for residents)	● Weakness of organizations and skills (for project operation, education and training for residents, etc.) ● Shortage of funds
Educational institutions (universities, etc.)	● Provision of technology to beneficiaries ● Education and training for the project principals	● Lack of mechanisms for involving developing-country educational institutions in project programs
Private investors (RESCOs, SHS leasing companies, etc.)	● Investment in electrification projects ● Supply of facility systems and provision of O&M services	● Weak payment capabilities of final consumers ● Weak mechanisms for supply of funds to small businesses and individuals
Vendors of equipment (PV panels, generators, etc.)	● Supply of equipment	● Lack of provisions for after-sales service ● Insufficient standardization ● Insufficient guarantee of quality
Aid institutions	● Assistance for education and training to strengthen organizations and human resources ● Provision of funds ● Provision of technology	● Lack of understanding of arrangements and circumstances in developing countries (as regards the government, enterprises, financial institutions, NGOs, etc.) ● Weak collaboration with aid institutions in Japan and other developed countries, international institutions, and developing-country governmental institutions

NGO: Non-Governmental Organization
RESCO: Rural Energy Service Company
SHS: Solar Home System

3.2 Obstacles appearing in project promotion

(1) Administrative level

On the administrative (governmental) level in developing countries, the promotion of rural electrification or use of renewable energy is often not clearly defined in the context of official policy. In addition, rural electrification and use of renewable energy are frequently being pursued by two mutually distinct agencies with little coordination between them.

Under these circumstances, projects for rural electrification using renewable energy have in some cases been attempted without a clear statement of their priority in national policy or a fundamental strategy (e.g., cases 1 and 2).

Similarly, rural electrification using renewable energy often has a low priority even in the competent agency, which is hampered by a low level of executive powers and lack of funding from the national treasury.

Case 1: ERAP Program in the Philippines

Former President Estrada started a program to accelerate to take steps for non-electrified villages as part of the poverty measures. The original year of complete electrification accomplishment, 2008, was rescheduled 4 years earlier according to the former President's tenure of office, and therefore, the program became very ambitious plan in terms of political shade of meaning as well.

However, in order to accomplish this program, electrification of 2000 villages had to be completed per year. But, only half of the target could be accomplished by merely extending transmission/distribution lines. Mr. Estrada tried to adapt renewable energy positively to fill up such gap, though no budgetary backing was actually ensured.

Due to such reasons, the government budget was allocated to individual projects respectively to ensure financial base, and the government expected to obtain aid funds from foreign countries as well. There were actually many doubtful opinions about accomplishing the target of the program within the country at that time. Under such circumstances, the President finally resigned during his tenure.

Case 2: Narsindhi PV project in Bangladesh

In Narsindhi, on the outskirts of Dacca, PV battery charge stations and solar home systems (SHS) were installed with French aid.

Although there had not been any plans for construction of distribution lines in this area, a local assemblyman made a pledge during an election campaign to work for an extension of distribution lines to residents, and made good on this promise. As a result, the area became a mixture of dispersed and grid power sources.

This development ignited dissatisfaction among those residents who were the first to opt for the dispersed systems, and also prevented selection of PV systems by neighbors in anticipation of a further extension of the grid.

(2) Electric utilities and electrification cooperatives

In any country, the supply of electricity is basically the role of electric utilities or regional electrification cooperatives (distribution firms).

However, the promotion of rural electrification by these parties ordinarily proceeds through extension of the system. Investments are determined with reference to the cost of extending the grid. Naturally, extension of the grid into areas which do not afford prospects for retrieval of investment costs (i.e., would not be payable) cannot be

expected in the near future.

The management of small electrification cooperatives in rural areas often faces problems with funding. Those in such a state obviously are very reluctant to extend service to districts that would swell their deficits.

In addition, rural distribution enterprises such as these cooperatives usually do not have much experience in power distribution based on use of renewable energy, stand-alone dispersed sources, or mini-grids, and have not made arrangements for such distribution.

(3) Residents (final beneficiaries)

In areas without electricity, the economy is forced to rely solely on primary industry (agriculture, forestry, and fishery). At the same time, it is difficult to increase the value of products because of the long distance from the market and the underdeveloped state of the general infrastructure, including electricity. This narrows the avenues for cash income and sets the stage for the vicious circle of poverty.

The income level of people living under these conditions is very low as compared to the average level in urban areas. For this reason, the payment capabilities of residents as the beneficiaries pose a great problem to electrification.

Furthermore, it is liable to be hard to gain the understanding of residents as to how electricity can raise their standard of living or increase their income.

In outlying islands and mountainous districts, electrification is sometimes promoted through the formation of cooperatives as organizations run by the residents. However, these organizations often cause problems on the order the basic operational skills, such as inability to collect charges or to manage and use funds well.

(4) Financial institutions (banks and credit suppliers)

Because a business model for it has not yet been solidly established, electrification using renewable energy involves a wide range of principals including individuals, communities, and small-scale cooperatives. In the eyes of financial institutions, electrification projects and their principals therefore by no means rank high as recipients for credit.

On their side as well, financial institutions generally have not yet established schemes for financing in this field and often appear to be deficient in specialized knowledge of rural electrification and screening capabilities for individual projects.

(5) Non-governmental organizations (NGOs)

It is the role of NGOs to provide support needed for improving the lives of residents and achieving socioeconomic advancement. As such, they are expected to play an important role in promotion of rural electrification.

However, rural electrification is generally not a direct goal of NGOs, which consequently may not have any particular expertise in use of renewable energy and electrification.

Case 3: ANIAD

The Antique Integrated Area Development Foundation (ANIAD) is an NGO promoting social advancement on the island of Panay in the Philippines. It was organized by 12 persons and is headed by a woman who had been in a management-level position in the local government. Because financial self-sufficiency would be difficult to attain, its members are paid by the local government. Its establishment was assisted by provision of a program package of technical assistance from the government of the Netherlands.

As none of the ANIAD members had expertise in electrification, young researchers at a local university (on the order of graduate students) supported the NGO in implementation of projects.

Because it is deficient in personnel who can furnish technical support in rural areas, the national Department of Energy also concludes contracts with local universities for such technical support on site.

Naturally, their operation is also under considerable constraints in both the personnel and funding aspects (see Case 3).

(6) Educational institutions (universities, etc.)

Local universities also can provide technical assistance for grassroots projects of rural electrification. Nevertheless, they do not necessarily have an abundance of personnel and financial resources, and also need a reinforcement of their capabilities in areas such as understanding of new technology, technical assessment, and formulation of technical standards.

(7) Private investors (RESCOs, SHS leasing businesses, etc.)

Market-based business related to electrification projects is beginning to bud, as evidenced by the leasing of PV panels by oil majors and by sales of solar home systems (SHS) through micro-credit schemes in Southern Asia (see Case 4).

Case 4: RESCO projects

The rural energy service companies (RESCOs) affiliated with European oil majors are leading business in SHS leasing.

Although the business appears to be developing on a continuous basis, it is not yet completely feasible on the strength of SHS leasing alone; the overall balance is presumably being maintained by parallel sales of petroleum products.

However, the market environment is still insufficient for full-fledged development on the business level. For example, electrification business that has finally begun to take

root has in some cases been impeded by the promotion of grant-based projects in an adjacent district.

This points to the need for effecting a mutual complementation between support from aid institutions and establishment of the market by private enterprises, and linking this to socioeconomic advancement in the areas in question.

(8) Vendors of component equipment

Cost reduction remains a major task for expansion of the market for equipment for use of renewable energy. Technology development is required to the same end.

Such equipment generally consists of new kinds of products for which full arrangements have not yet been made as regards standards, performance measurement, and quality guarantees. In some cases, the adoption of developing-country products that were reasonably priced but low in quality has lowered consumer confidence in such equipment.

(9) Aid institutions

Aid institutions do not always have a shared perception and understanding on the subject of rural electrification.

International institutions such as the World Bank apparently lay emphasis on the market mechanism and offer financing schemes premised on a revision of institution- and policy-related rules to establish the proper norms.

Japanese ODA institutions, on the other hand, tend to emphasize the strengthening of capabilities in the practical aspect, in accordance with their focus on actual on-site application. This is a point of difference from the strategy of international institutions.

Because of this difference, there is a risk of a mutual cancellation of effects in application of both a scheme for long-term intellectual support by international institutions and a scheme for project-based, hardware-centered support by Japanese institutions to the same developing country.

4. Approaches to rural electrification using renewable energy

As described above, the promotion of rural electrification using renewable energy is characterized by the involvement of numerous principals, a variety of modes of promotion, and a diversity of support.

In light of this situation, Japanese ODA institutions, like other principals, must apply strategic approaches that have the flexibility to accept this kind of diversity and take full advantage of it to preserve the project's sustainability.

4.1 Proper involvement of aid institutions in rural electrification using renewable energy

Projects that depend on grants (i.e., gratis aid) from aid institutions for all of their requirements do not have a sustainability of their own. They are liable to deepen the sense of dependence on the part of beneficiaries and to nip self-help efforts in the bud.

The assumption that rural electrification cannot proceed without public support in all cases fails to grasp the larger picture. Although rural electrification projects certainly require support in both the financial and non-financial aspects, there are also certain portions in which the market mechanism can be applied. For these portions, there should be efforts to prepare an environment conducive to the operation of economic principles and to make electrification projects sustainable.

Although projects targeting the very poor will probably have to rely on public support for most portions, the SHS projects of Sarvodaya and Grameen Bank show that, even among the poor, the autonomous activities of the beneficiaries can operate for a significant part (see Case 5).

Case 5: SHS sales based on micro financing

Sri Lanka's Sarvodaya and Bangladesh's Grameen Bank have achieved a certain degree of note as institutions providing micro financing. Both sell SHS to rural poor through ancillary organs.

These projects are not aimed primarily at electrification, but are instead being promoted toward the goal of social advancement. In other words, the purpose is to quicken economic activities on the individual and community (village) levels by making electricity available to the rural poor, who can use it as a tool to increase their income.

However, the provision of micro financing to this end must rest on economic principles, and these institutions tell recipients that the loans must be repaid, and with interest. Obviously, the substance of these activities is not mere lending; the institutions also offer support in the form of instruction for smooth repayment and advice for expanding individual income.

Sarvodaya is selling about 200 PV panels per month, and Grameen Bank announced that it had sold more than 3,500 units cumulative as of the end of 2000.

In the portions where the market mechanism can do the job, the role of aid institutions in the promotion of not only rural electrification but also other types of ODA projects should consist mainly of preparing an environment conducive to the related business. Conversely, in portions where projects cannot proceed on the strength of the market mechanism alone, their role lies in building the framework for development of the market mechanism while nurturing the self-help capabilities of the beneficiaries and in raising the socioeconomic level to permit application of economic principles as far as possible.

In addition, in this conditioning for project promotion, residents must be made aware of the existence of a fundamental rule of society: that the benefits accruing from electrification are always accompanied by related rights, obligations, and responsibilities. Nevertheless, developing countries each have their own distinctive cultural and moral perspectives, and this rule may fail to function if projects ignore these background factors.

For these reasons, assurance of project sustainability calls for full consideration of local outlooks on social rules in provision of assistance.

4.2 Clear definition of economic burden

The most elementary type of rural electrification project is that promoted through grants. However, it must be noted that aid institutions do not provide assistance for such projects indefinitely.

Case 6: PV electrification project on Rapu Rapu island in the Philippines

On Rapu Rapu island, a PV plant in the 25-kVA class was constructed with aid from the Belgian government and is supplying power to about 130 private homes.

In this project, the plans initially envisioned collection of 16 pesos per day per housing unit for O&M costs and future renewal of facilities. However, this was lowered to 7 pesos (210 pesos on the monthly basis) due to the low level of payment capabilities among residents.

It might be added that income levels among the residents average about 1,500 pesos per month, and the monthly amount of 210 pesos comes to about 20 percent of this figure.

To make projects firmly sustainable requires the construction of a setup to generate the funds needed for operation and maintenance (O&M) and replacement of facilities during the project term. More specifically, projects must build a scheme enabling use of the income from power supply as revolving funds.

Naturally, on the level of individual projects, this must not be equated solely with a scheme of beneficiary burdens since, in some cases, not all of these costs can be recovered directly from beneficiaries (see Case 6).

The important point is that assurance of revolving funds is absolutely necessary for

preservation of the project's sustainability. Answers must be found to questions such as the extent to which costs can be recovered from beneficiaries and the kind of mechanism which can be built for compensation in the event of income shortages.

In setting rates, it is also vital to consider not only the burden which beneficiaries would be willing to shoulder but also their actual payment capability and how it can be increased through support of their economic activities based on the supply of electricity.

4.3 Need for cooperation with capable developing-country institutions

For Japan's ODA institutions, the main counterparts are the governmental agencies in the other country. Nevertheless, collaboration with these agencies alone is not sufficient for the formation of sustainable projects of rural electrification.

Financial aid for such projects differs from that for large-scale projects involving electric utilities (e.g., construction of base-load power plants and high-voltage transmission lines) in respect of the scale of both the facilities and cost. In addition, there are many such projects.

On this front, it is therefore essential to work with counterparts that are able to manage funds, and to make in-depth assessments of and provide support for individual projects.

Almost all developing countries have governmental agencies with jurisdiction over rural electrification. However, there are also many other types of institutions outside government that have the power to assist electrification projects. More specifically, the list of prospective counterparts should include development banks financing industrial activities, local universities able to supply know-how, and NGOs in a position to support projects.

Case 7: Window III program of the Philippines Development Bank

The Philippines Development Bank furnishes funding for projects that are feasible as businesses and contribute to social advancement. As a part of this policy, it has earmarked revolving funds of 100 million pesos for projects centered around new or renewable energy. The eligible projects include PV generation, wind power, and small-scale hydropower.

In connection with this scheme, the Dutch government is providing funds for technical assistance (TA) through the UNDP to reinforce the project assessment capabilities of the Bank's staff.

In the Philippines and Sri Lanka, funding from developed countries and international institutions is already being lent to local banks via the national government. These banks are then using it for loans to parties ready to undertake rural electrification projects, such as electrification cooperatives, NGOs, and private enterprises (see Case 7).

5. Need for diverse collaboration

As might be gathered from the diversity of rural electrification principals in developing countries, Japanese ODA institutions should not promote projects in the manner of closed systems. There is a limit to the roles which can be played by them; they cannot provide assistance in all aspects.

For this reason, the spread of rural electrification using renewable energy over the coming years requires collaboration among concerned institutions, NGOs, and private enterprises, domestic and foreign.

5.1 Cooperation of ODA Organ of Japan

The following may be cited as the three major roles of Japanese ODA institutions in the field of renewable energy.

① Provision of technical assistance (TA)
② Provision of funds
③ Technology development

The purpose of collaboration among ODA institutions lies in effective linkage of these roles for mutual complementation to cover problems that cannot be resolved by any one separately in the flow of rural electrification projects. It could also consist in cooperation through advance conditioning of the program or project environment by one institution to facilitate participation by others.

(1) Collaboration within the Japan International Cooperation Agency (JICA)

The promotion of rural electrification using renewable energy as part of programs for social advancement in developing countries can induce a synergy with economic development in the area in question.

As such, it is necessary to consider coordination with other JICA projects for social development and industrial promotion. The following items would merit particular attention on this occasion.

- Improvement of the status of women
- Promotion of children's education

- Establishment of setups for medical care in remote districts
- Increase in the productivity of agriculture, forestry, and fishery
- Promotion of the growth of local industry
- Alleviation of the negative influence of project promotion (e.g., the battery waste problem and other factors of environmental impact due to the installation of PV panels)

(2) Collaboration with grant-based aid projects

Project promotion based on grants can help to spur the emergence of rural electrification business

The chief objective of grant-based cooperation is contribution to improvement of living conditions for local residents; it is not a type of model project. Its implementation requires involvement of the concerned residents in operation and maintenance in various aspects. Even if the initial investment is made for cooperation based on grants, a scheme must be constructed for subsequent operation of revolving funds based on charges collected from beneficiaries so that the project can be sustained.

This underscores the need for assistance in the technical aspect to be combined with that in the operation aspect.

(3) Collaboration with projects based on onerous funding

As far as the Japan Bank for International Cooperation (JBIC) is concerned, the main problems presented by the field of rural electrification are the small funding lots and the generally low capabilities for project (or business) implementation on the part of the borrower.

The problems associated with the implementation capabilities of the borrower could be resolved with TA by JICA in the interest of smoother receipt of loans from the JBIC.

Some specific options for collaboration between JICA and the JBIC are as follows.

- Active proposal of programs of assistance combining JICA TA and JBIC financing in a single package
  - Support, through various JICA schemes, for improvement of the capabilities of borrowers, preparation of the setup for project promotion, and formulation of the scheme for electrification with onerous funding
  - Provision of JBIC loans to borrowers that meet a prescribed standard of capabilities and have prepared the physical scheme for electrificationOffer financial funds from JBIC to debtors who satisfy a

certain ability level and is expected to take actions in accordance with feasible electrification project scheme.

- Study of the possibilities of petty yen loans
  - Study of grassroots-type yen loan schemes and their possibilities of implementation, including prospective recipients

(4) Collaboration with technical research and development projects

There remain strong demands for reduction of the cost of technology for use of renewable energy. In fields such as PV panels, the market could be expected to expand with a decline in the cost of facilities. First and foremost, quality yet low-cost equipment must be developed. This points to a need for collaboration with organs of technical research and development, such as the New Energy and Industrial Technology Development Organization (NEDO), for the development of products with specifications adapted to developing-country markets and inclusive of arrangements for transportation, installation, and maintenance.

The tough requirements as regards cost have in some cases led to the introduction of equipment with sub-quality components and products manufactured in the developing country in question. Such equipment has hurt dependability on the system level and created a new hindrance to diffusion. Response to this problem requires not only measures in the "hard" aspect such as establishment of norms of quality and diffusion of test equipment, but also measures in the systemic and "soft" aspects such as the institution of schemes of manufacturer certification and guarantee as well as definition of standard-type guidelines in the course of project promotion. However, this work must take account of the stage of development as regards the growth of the market and level of technology; in the initial stage, at least, developed-country standards could not be applied without modification. There is a critical need for intellectual collaboration with the developing country in this area.

In addition, institutions must assist the establishment of guidelines for the standard composition of systems in correspondence with the various levels of need in developing countries. More specifically, guidelines must be set for the selection and combination of system constituents, upon confirmation of the quality of equipment in the country in question. This will define the minimum requisite standard, help to foster the growth of industry by presenting a qualitative target for its products, and increase the applicability and extensibility of the systems. Here, too, the work should be undertaken as a form of intellectual assistance, provided in advance of the hardware-related aid, for developing countries that already have a certain store of experience. (For example, the

establishment of standard models for a generic composition for SHSs, pump systems, centralized village systems, and vaccine storage systems will bring benefits in areas such as assurance of materials needed for subsequent maintenance, consistency of training in maintenance technology, shortening of the time required for installation, and uniformity with projects of aid from other countries. In the final analysis, it will therefore be in conformance with the interests of consumers in the country.)

With a view to effecting collaboration among projects being promoted by various institutions, it would be desirable for data obtained through pilot projects led by NEDO, for example, to be furnished to JICA aid projects and JBIC loan projects. In some cases, projects of technical research and development collect basic data for long periods of time. Arrangements for sharing of such data with JICA development survey teams could raise the efficiency of projects promoted by the latter.

In practice, these pilot projects could trigger the diffusion of the subject technology in these countries. There is consequently also a crucial need for the construction, through collaboration among the concerned institutions, of a mechanism for linkage to succeeding aid based on grants or onerous loans.

The following fields can be cited as options for collaboration.

- Definition of guidelines and standard model specifications for system composition in the developing country in question
- Preparation of models for schemes of guarantee, certification, assistance, etc.
- Compilation and sharing of data on renewable energy resources

5.2 Collaboration with developing-country governmental institutions

As a primary task, the developing-country government should prepare basic policy and a master plan for energy development and supply. The policy must set forth basic strategy on development of power and use of renewable energy and other types of non-conventional energy (this term generally refers to energy other than oil, natural gas, coal, large-scale hydropower, and nuclear power).

Rural electrification using renewable energy ought to be accorded a definite status in the context of power sector policy.

Promotion of projects without clear and coherent definitions of power sector policy and electrification plans can invite financial difficulties or result in other problems if the grid is extended a few years after installation of dispersed sources using renewable energy.

The electrification costs must be recovered in some form. If this is not possible, official aid must be provided, and the scheme for extension of this aid must be constructed.

In light of these necessities, the developing-country government has to be furnished with intellectual assistance at the stage of policy-making and the drafting of plans as the premises of project promotion.

The following can be cited as detailed options for such collaboration.

- Drafting of basic policy on energy
- Drafting of policy on power development
  - Intellectual support by policy experts
  - Invitation to personnel in charge of policy preparation for training in the developed country, and preparation of arrangements for receiving them
- Preparation of rural electrification plans and incorporation of renewable energy
  - Intellectual support by experts in power sector planning including rural electrification
  - Intellectual support by experts in renewable energy
  - Preparation of arrangements for receiving personnel in charge of power sector planning and renewable energy for training in the developed country
- Establishment of a forum for regular policy discussion with parties including the developing-country government and other aid institutions

5.3 Collaboration with developing-country financial institutions

The implementers of rural electrification projects are hardly confined to the state-run electric utilities; they include local electrification cooperatives, NGOs, private investors, SHS leasing businesses, and RESCOs.

Although there should be a flexible scheme of financing for these parties, many obstacles stand in the way. Most of the principals are small in size and do not have sufficient collateral for ordinary bank loans.

Nevertheless, many of them are also promoting grassroots projects in the subject area, and deserve financial support for their activities.

As viewed from the vantage of Japan, projects of rural electrification using renewable energy tend to have a petty scale of financing per project, while the large number

complicates screening work.

These problems can be mitigated by interposing a financial institution able to supply credit in the developing country, and letting it extend the actual financing to the final borrowers.

The specific options under this heading are as follows.

- Construction of a financing scheme for projects of rural electrification using renewable energy in developing countries
  - Grooming of financial institutions capable of assessing and managing individual projects (human resource development in the fields of rural electrification and use of renewable energy)
  - Strengthening of the capabilities of personnel involved in projects (holding of on-site training programs and seminars)

5.4 Collaboration with NGOs

The importance of project sustainability points to a need for reinforcing the setup of support for electrification projects in developing countries. To this end, it is essential to collaborate with NGOs, which already have extensive experience of programs for social advancement in rural areas and strong human-network ties with local communities.

It is vital for the scope of subjects for TA offered by JICA to be broadened to reinforcement of the capabilities of the on-site NGOs supporting the project so that the range of assistance is widened instead of being confined to specific projects.

NGOs exhibit considerable diversity. Some engage in various activities of support for the purpose of social advancement in the local area. As exemplified by Sarvodaya and Grameen Bank, others engage in actual sales of PV panels (for SHSs) on a commercial basis while offering micro financing toward the objective of social advancement. (Although some are of the opinion that the Sarvodaya

Case 8: NGO programs for youth education and creation of employment opportunities

In developing countries, many talented youths may fail to find employment due to a lack of opportunity because of the limited market even if they have received an education.

In India, NGOs offer a program for training such youths and turning them into "barefoot engineers" who perform simple maintenance for power generation systems using renewable energy. The program helps to create employment opportunities for youths and also to reduce O&M costs.

In Bangladesh, the SHS lease-sales business of Grameen Shakti has a similar scheme for employment of rural youths without other job opportunities.

Economic Enterprise Development Service (SEEDS) and Grameen Shakti do not belong in the NGO category, they both have the status of non-profit organizations and are considered NGOs in the broad sense in this report.)

The idea behind all NGOs is support to foster the autonomy of the community life. NGOs work to encourage the self-help efforts of residents, provide all sorts of training, and are available for consultation about lifestyle design (see Case 8). They have a network of organizations for these activities, and collaboration with these organizations in JICA TA programs would be extremely effective for broadening the base of support while deepening its content as well as for building a scheme for on-going TA.

The options for collaboration with NGOs are as follows.

- Assessment of the activities and capabilities of NGOs in the developing country in question
- Strengthening of NGO capabilities and provision of financing schemes
  - Direct aid for NGOs based on grassroots grants and development partnerships
  - Use of the energies of the Japan Overseas Cooperation Volunteers and senior volunteers
  - Provision of training in Japan for NGO members
  - Human resource development and technology transfer by JICA experts and consultants
- Instruction of residents (beneficiaries) about the implications of electrification

5.5 Collaboration with private companies

Even for rural electrification, the prospect of promotion mainly by private enterprises working in accordance with the market mechanism must not be overlooked.

In some developing countries, private firms of the RESCO type are engaging in business in supply of electricity and sales of petroleum products.

In fields where such private-sector activities have begun to take root, ODA institutions should avoid competition in the market of facility (hardware) supply and support these activities by conditioning the climate for them.

Basically, if the acquisition of hardware and provision of software can be made through the workings of economic rules, the initiative ought to be given to the private sector. Meanwhile, the ODA institution must make efforts to furnish support in the "soft" aspect for solidifying the environment for business.

Parties such as local investors, electrification cooperatives, small power producers (SPPs), and RESCOs generally find it hard to get ordinary bank loans. Japanese ODA institutions therefore should assist them by offering programs for bolstering their capabilities as loan subjects and providing them with funding resources.

The options for collaboration with private firms are as follows.

- Technology transfer to private firms
- Standardization of equipment, quality guarantee, and certification through cooperation between the public and private sectors

5.6 Collaboration with international institutions

Promotion of rural electrification requires clarification of the proper approach to subsidies for beneficiaries.

The problem with subsidies lies not in their provision per se but in difficulties that can arise when the structure is not clear, as in the case of internal cross-subsidization. These include an immense strain on the national finances and the collapse of the finances of the state-run utilities undertaking the electrification projects for the government. A fundamental solution of this problem calls for clear definition of the parties to shoulder the burden and the burden amount as well as guarantee of the resources needed for subsidization.

One response along this line is the scheme of special taxes (universal levies) on electricity charges, as is being considered in the Philippines. Subsidization for rural electrification must be viewed as a concern of the entire power sector.

In other words, rural electrification must not be considered in isolation; perspectives must be expanded to design of the overall power sector system. This, in turn, points to a need for coordination with the programs of sectoral reform being promoted by international institutions such as the World Bank and the ADB.

Similarly, in programs of TA on the grant basis in this field, there should be a division of roles and cooperation with the UNDP and GEF. The UNDP provides TA in connection with financing schemes of the World Bank, and GEF grants are coordinated with the loan programs of the World Bank and ADB.

Japanese TA has an extensive record in fields of technology. As such, coordination with the TA provided by international institutions in other fields (such as institutional and legal issues) could induce synergistic effects of benefit to the efforts of both.

The options for collaboration are as follows.

- Mutual understanding of and cooperation in aid strategies
  - Sharing of information and alignment of basic perceptions
  - Division of roles keyed by fields of special competence
- Construction of a setup for promotion of rural electrification in the context of programs of structural reform in the power sector promoted by international institutions
  - Clear definition of the responsibilities of governmental institutions
  - Increase in the transparency of the rate-setting mechanism and subsidization structure
- Challenge of new rural electrification programs combining the grant and onerous aid of international and Japanese institutions
  - Exchange of information and regular consultation with other aid institutions at offices in the country in question

6. Models for collaborative programs

This chapter presents several models for collaboration with various principals. It should be noted that these models are only examples; there is no attempt to set forth all conceivable models, and the models are nothing more than patterns developed through studies of collaboration possibilities.

6.1 Model for support in collaboration with developing-country governmental institutions and international institutions

(1) Formulation of basic policy on energy and electrical power incorporating use of renewable energy

The economic feasibility of renewable energy varies greatly depending on the conditions. If it is promoted without being clearly positioned in the context of overall energy policy, it is liable to require enormous subsidization at a certain point or to be driven out of the market as a result of head-on competition with conventional energy.

As this suggests, the promotion of rural electrification using renewable energy must be preceded by performance of the prerequisite tasks of formulating basic policy on energy in general and the power sector in particular, preparing a master plan for the same, and drafting plans for facility construction in accordance with this master plan.

Furthermore, in the process from the formulation of basic policy to the preparation of

the master plan, a review must be made of related systemic institutions to find solutions for problems in numerous areas, such as the handling of energy prices including tax and proper arrangements for subsidization.

Naturally, Japanese ODA institutions could not be expected to resolve these fundamental problems by themselves; solution requires cooperation and complementation with not only the developing-country government but also the international institutions making advance approaches to problems on the order of sectoral setups.

(2) Rationalization of rate-setting standards and establishment of a rural electrification fund in the context of power sector restructuring

The promotion of rural electrification is also accompanied by the problem of the payment abilities of the beneficiaries and the level of rates acceptable to them. In fact, there is a considerable gap between the two, and this gap must be filled by subsidies, as has been evidenced by almost all rural electrification projects to date.

This problem cannot be resolved on the basis of individual electrification projects; a genuine answer will not be found without resolution in the context of arrangements for the entire power sector.

In this connection, it must be remembered that power sector restructuring including rate rectification is already moving ahead in many developing countries with the assistance of international institutions for structural reform and related legislative conditioning. As such, provisions should also be made for cooperation with these institutions.

(3) Joint implementation of projects for rural electrification using renewable energy with non-Japanese aid institutions

A conformance must be achieved between the projects of international institutions and Japanese projects in respect of standards for the systems applied as well as rate levels and subsidization.

If, for example, different institutions applied different design concepts in their projects of rural electrification using renewable energy, they would also presumably make different recommendations as regards optimal system scale and rate-setting. This, in turn, could very well impede diffusion throughout the country in question.

To prevent this from happening, it is absolutely essential to provide for cooperation, coexistence without conflict, and complementation with other aid institutions.

6.2 Model for collaborative support focusing on final beneficiaries

This section sets forth two sample schemes when the target final beneficiaries are divided into the two categories of the poor and the middle class. One places relatively more emphasis on social advancement and makes use of NGO energies, and the other is aimed at support of beneficiaries with a focus on supply of funds.

The overall schedule was divided into the five-stage sequence of preparations for initiation, development survey, provision of funds, execution of the project, and follow-up study. The length of the project period was assumed to vary depending on the project scale and content, but basically to range from six to eight years.

(1) Support for the poor: model for electrification projects for the purpose of social advancement

Aim

The concept behind this model is promotion of rural electrification using renewable energy in the context of programs for social advancement in the area while utilizing the energies of NGOs. In it, the role of rural electrification is to form part of the infrastructure needed for social advancement.

The NGOs would furnish support for the area development and electrification project by providing local residents with assistance in a wide range of areas, including basic information, education, and training.

Social advancement program

The program for social advancement in rural areas would be launched under the leadership of experts and with full dialogue with the national and local governments. In the process, a basic consensus would be reached with the developing-country side on ideas about rural electrification.

The project would be taken up as a subject of a development survey culminating in preparation of a master plan for socioeconomic advancement through rural electrification. The master plan would encompass plans for the diffusion of rural electrification using renewable energy and clearly expound the involvement of the counterpart NGO in the project.

Rural electrification using renewable energy

As the second stage, the development survey would include the selection of proper

sites for rural electrification as described in the master plan for social advancement, and implementation of a pilot project.

In parallel with the pilot project, the members of the aid institution team would work to strengthen the capabilities of the NGO.

Support on these two fronts would lay the foundation for the project setup on the site and determination of the implementation arrangements and capabilities of the beneficiaries. This would be followed by procurement of the requisite materials with grants and installation of the facilities corresponding to the requisite initial investment.

As for the subsequent operation of the project, the final beneficiaries would, with the assistance of the NGO, collect charges and perform O&M on a continuous basis and on their own responsibility.

The last stage of the project would consist of a follow-up study to see whether the operation by the residents is in fact sustainable.

Figure 1: Electrification project model with a focus on social advancement

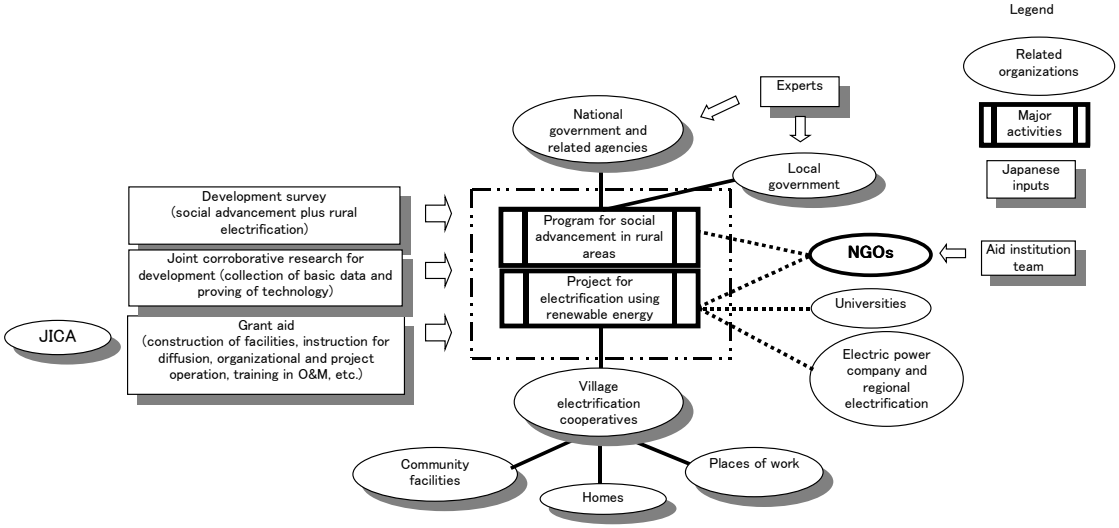


Table 1: Schedule for the electrification project model focusing on social advancement

Schedule	First stage	Second stage	Third stage	Fourth stage	Fifth stage
Joint corroborative research for development	Research for proving technology ● Survey of resource deposits ● Technology proving (PV, wind power, etc.)				
Dispatch of experts (including professional engineers)	Preparation of plans for social advancement through rural electrification ● Policy advice for socioeconomic advancement in rural areas ● Policy advice for rural electrification ● Exchange of information and alignment of opinion with related local institutions ● Coordination with NGOs	Promotion of the project for social advancement through rural electrification ● Policy support ● Preparation of a grant aid package ● Collaboration and coordination with the development survey team, NGOs, and aid team			
Development survey		MP for the project of social advancement through rural electrification ● Survey of village society (in the social and economic aspects, etc.) ● Survey of the demand for electrical power ● Selection of the optimal model for social advancement and electrification ● Study of the setup for operation ● Economic and financial analysis ● Study of the proper involvement for NGOs ● Preparation of the plan for diffusion of rural electrification	Pilot project for social advancement through rural electrification ● Project concept design ● **Economic feasibility (of both the electrification project and related industrial business)** ● Analysis of social ripple-effects ● Study of the setup for operation ● Construction of facilities and proving of the project scheme		
Dispatch of the aid institution team			Project of social advancement through rural electrification ● Support for the project ● Support for NGOs ● Consciousness-raising campaign ● Support for the establishment of village electrification cooperatives		
Grant funding				Provision of materials for the project Assistance for social advancement along with electrification	Follow-up study

Support for the middle class: model for collaborative projects of the yen loan type

Aim

The aim is the provision of "soft" loans for small-scale electrification projects implemented by cooperatives which have been established by the local residents themselves.

Financing scheme

The (yen-denominated) loans would be of the two-step type provided by Japan to financial institutions (private banks) in the developing country.

The banks would use the loans to furnish financing to individual electrification projects. The screening of loan requests would be executed on the responsibility of the banks themselves.

Combination with technical cooperation and onerous financial aid

The efficacy of the two-step loan would be the subject of an overall study, using the development survey framework, of marketability, loan project feasibility, and the capabilities for implementation at the developing-country banks. If necessary, the banks would be given technical assistance to heighten their capabilities.

Technical cooperation at this stage, however, would be aimed primarily at support to bring the projects up to a level permitting their selection as subjects of onerous financial aid.

If the development survey confirms feasibility, an in-depth study would be made of provision of two-step loans as the form of this aid.

Once the two-step loans have been approved and the loan program begins, JICA would support the electrification projects planned by residents in individual districts within the framework of its development surveys.

In addition, the possibilities of use of renewable energy would be assessed with reference to the results of joint proving research for development.

Program collaboration with Japanese ODA institutions

The application of this model would require advance arrangements for cooperation among the related ODA institutions, including JICA, the JBIC, and NEDO.

In this connection, all parts would have to be consolidated into a single program so that each player can discharge its role at each stage.

Figure 2: Model for collaborative projects of the yen-loan type

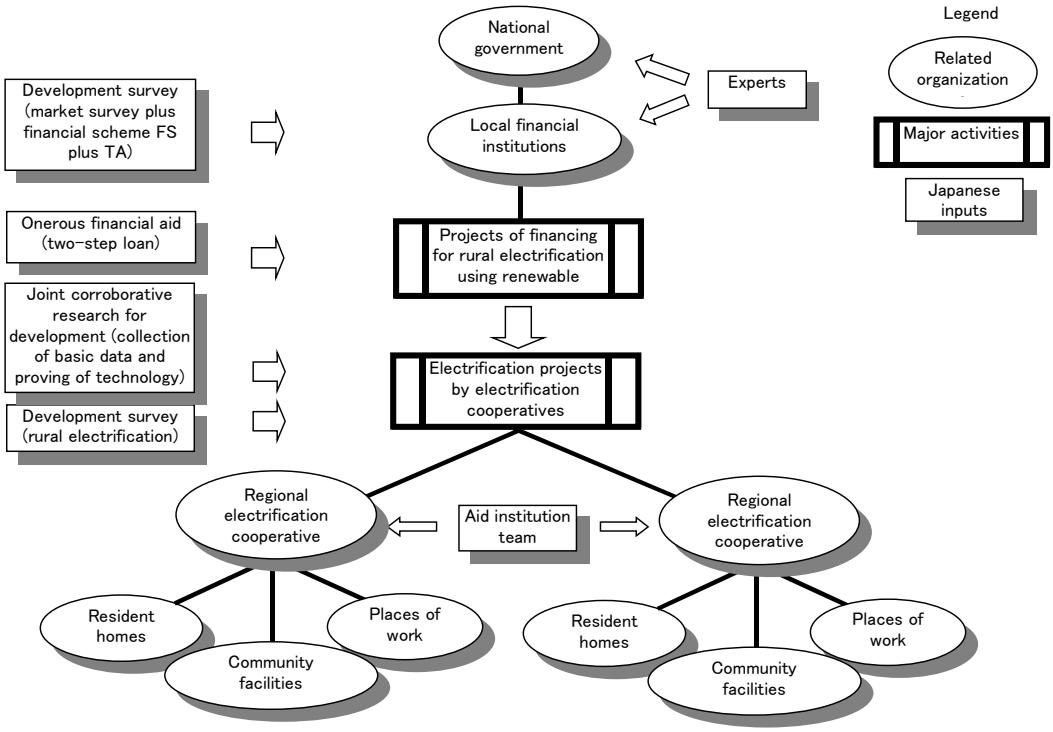


Table 2: Schedule for model for collaborative projects of the yen loan type

Schedule	First stage	Second stage	Third stage	Fourth stage	Fifth stage
Joint corroborative research for development	Research for proving technology ● Survey of resource deposits ● Technology proving (PV, wind power, etc.)				
Dispatch of experts	Preparation of plans for rural electrification using local financial institutions ● Policy advice for rural electrification ● Policy advice for preparation of the financial scheme for rural electrification ● Exchange of information and alignment of opinion with related local institutions	Promotion of the project for rural electrification using local financial institutions ● Policy support ● Preparation of an onerous funding package ● Collaboration and coordination with the development survey team and aid team			
Development survey		FS for rural electrification using financial institutions ● Survey of the market for funding for electrification projects ● Study of financial scheme concepts ● Determination of counterpart financial institutions ● TA required for the loan projects	Study of problems in loan projects and FS for individual electrification projects ● Project concept design ● Economic feasibility (of both the electrification project and related industrial business) ● Analysis of social ripple-effects ● Study of the setup for operationcountermeasures for them		
Dispatch of the aid institution team			Rural electrification project ● Support for the project ● Support for the local electric enterprise ● Consciousness-raising campaign		
Onerous funding			Provision of yen loans to local financial institutions		Follow-up study

Model for support in collaboration with the private sector

Aim

The aim is provision of "soft" loans to private companies promoting projects in the field of rural electrification.

The specific subjects would presumably be projects of social advancement and rural electrification based on micro financing and small-scale projects for power purchasing by RESCOs.

Financing scheme using onerous financial aid

Like the model for collaborative projects of the yen loan type, this model would be based on two-step loans; the financing from the aid institution would be extended to local banks, which would use it to provide loans for small- and medium-scale rural electrification projects implemented by private firms.

Role of technical cooperation

The development survey framework would be used to supply support for preparation of conditions for cooperation in the form of onerous funding.

Once the financing with two-step loans has started, Japanese NGOs will furnish assistance to the final beneficiaries (electrification cooperatives in many cases) receiving micro financing and services from RESCOs through the development partnership program.

Figure 3: Model for support in collaboration with the private sector

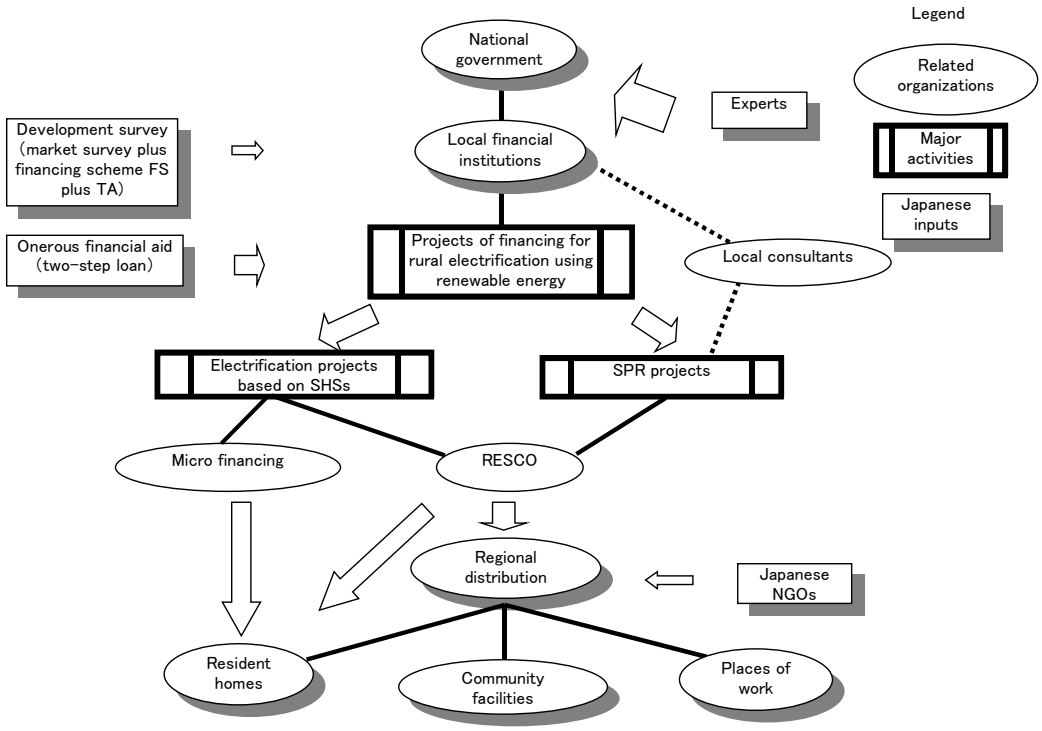


Table 3: Schedule of Assistance Model for Cooperation with Private Sector

Schedule	First stage	Second stage	Third stage	Fourth stage	Fifth stage
Joint corroborative research for development	Research for proving technology ● Survey of resource deposits ● Technology proving (PV, wind power, etc.)				
Dispatch of experts	Preparation of plans for rural electrification using local financial institutions ● Policy advice for rural electrification ● Policy advice for preparation of the financial scheme for rural electrification ● Exchange of information and alignment of opinion with related local institutions	Promotion of the project for rural electrification using local financial institutions ● Policy support ● Preparation of an onerous funding package ● Collaboration and coordination with the development survey team and aid team			
Development survey		FS for rural electrification using financial institutions ● Survey of the market for funding for electrification projects ● Study of financial scheme concepts ● Determination of counterpart financial institutions ● Study of problems in loan projects and countermeasures for them ● TA required for the loan projects	FS for micro finance and ESCO projects ● Evaluation of project concepts Evaluation of economic feasibility and potential for acceptance by beneficiaries ● Analysis of social ripple-effects (effects for increasing income and fostering the growth of local industry) ● Evaluation of the setup for operation ● Study of guidelines for protection of beneficiaries and cultivation of the business		
Japanese NGO			Rural electrification project ● Support for the project based on power purchasing from private enterprises ● Support for the local electrification cooperative ● Consciousness-raising campaign		
Onerous financial aid			Provision of yen loans to local financial institutions		Follow-up study

Tasks for promotion of collaboration

6.3 Policy dialogue

Collaboration with developing-country governments and international institutions requires advance determination of the preconditions.

There is a great variation among international institutions as regards their fundamental philosophy. For example, whereas some seek to promote social advancement in the developing country through their aid, others view even rural electrification as nothing more than a subject of financing.

In rural electrification projects in particular, there is a mixture of portions where attempts should be made to harness the market mechanism and portions which, in direct contrast to this outlook, require official aid through subsidization. In studies of questions such as the specific policy ends and means, there could surface a significant difference of perspective with the developing-country government and even other aid institutions.

For these reasons, there must be a constant and shared understanding by all concerned parties of perspectives on policy objectives, the method and means of attaining them, and the time schedule. The preparation of programs and projects enabling collaboration, and a clear definition of respective spheres of activity, in line with this mutual understanding is vital for the success of rural electrification using renewable energy.

6.4 Preparation of a coordinating scheme

(1) Coordination with domestic institutions

Teams must promptly build a mechanism for consultation among the implementing institutions in the fields of grant aid, onerous aid, and technical research and development on matters such as sharing of information on the level of specific projects, cooperation in projects, and mutual participation in each other's areas.

The intention is to coordinate the activities of the actual players, not to create another organization for coordination or new system for information sharing. The primary task would be an exchange of information on programs and projects in each field by principals on the order of their competent divisions or local offices. In addition, the arrangements would have to be flexible enough for the fine-tuning of existing projects and advance coordination on new ones about to start through mutual discussion.

In a separate development, in December 2000, the international cooperation subcommittee of the Combined Energy Study Association proposed the establishment of a council for ongoing Japanese cooperation in this field. The council would be composed of representatives of concerned governmental agencies, institutions, and industry. The subcommittee also proposed the construction of an information network bringing together the council members and experts from inside and outside Japan.

(2) Coordination with institutions in the developing country

There also must be full coordination with institutions in the developing country on basic philosophy and the possible extent of the division of roles in preparation of concrete programs and their implementation.

- There may be a fairly wide gulf between the basic stance of Japan and that of international institutions in discussions extending to the power sector structure and social advancement.
- If collaboration is premised on a country-specific basis, the setup for it can be made more flexible by giving the local offices of the various institutions more discretionary powers.
- If separately dealing with each nation, considerably flexible cooperation system could be carried out by increasing discretion of each organ's field office.
- Another option is the addition of consultants attached to international institutions in evaluation of the feasibility of proposed yen loans.

6.5 Study of past cases

Many programs and projects for social or economic advancement in rural areas of developing countries have already been implemented by aid institutions, domestic and foreign.

A study must be made of these projects, without restriction to those for use of renewable energy and rural electrification, to ascertain matters such as the type of setup and the degree of success or failure. This must be followed by analysis to determine causes and reflect the results in future projects.

6.6 Evaluation of the capabilities of developing-country institutions

(1) Commercial banks

Many development investment banks (as opposed to ordinary banks) have considerable potential. Nevertheless, collaboration demands preliminary study of their capabilities for fund management, their record to date, and their holdings of bad debt.

Banks may be expected to have special competence in some fields and to lack it in others. Teams must discern the kind of role that is right for each bank in light of its attributes.

(2) NGOs

Different NGOs have different areas of expertise. Teams must ascertain the capabilities of each.

Future projects must make use of the energies of not only NGOs in the developing country but also Japanese NGOs. However, it cannot be denied that Japanese NGOs compare unfavorably with those in developing countries, both quantitatively and qualitatively, in point of depth and experience. Assistance must extended to both NGOs in the other country and Japanese NGOs in order to build up their capabilities.

6.7 Verification of collaboration efficacy

(1) Implementation of pilot projects

The effectiveness of the prospective collaboration model must be checked through the execution of a small-scale pilot project as part of a larger existing project. This should make clear any latent problems and issues.

While several models for collaboration could have prospects for application, there would be many factors of uncertainty about their ability to work as anticipated. There may also be subtle differences among collaboration principals as regards their fundamental outlook and stance on aid. To surmount these differences as well, it would be advisable to coordinate opinions and develop more effective approaches to collaboration by implementing an actual pilot project.

(2) Implementation of joint international projects

In the event that other international institutions are implementing analogous programs in the context of projects now under way or planned, efforts must be made for complementation and conformance with them.

Institutional conflict between projects in the developing country could be prevented by, for example, ensuring a complementary relationship in terms of scale or mutual conformance in terms of rate-setting and the O&M scheme.

(3) ODA applying CDMs and coordination of private funding

Another objective is the incorporation an ODA function into CDMs. The scale of programs could be expanded by mobilizing private-sector investment and directing it to rural electrification.

Incentives in this direction would have to be provided by constructing a scheme under which investment from the private sector could be counted as a subject of emission level transfer based on CDMs.

However, this could require in-depth examination for the division of ODA and private funds, and clarification of the public- and private-sector roles.