GLOBAL ENVIRONMENT FACILITY

India

Optimizing Development of Small Hydel Resources in the Hilly Regions

Project Document

This Project Document has been edited to facilitate public dissemination.
The original is on file in the GEF Office at UNDP Headquarters in New York.

ABBREVIATIONS

AHEC	Alternate Hydro-Energy Centre
CEA	Central Electricity Authority
DEA	Department of Economic Affairs
DPR	Detailed Project Report
DST	Department of Science and Technology
Hydel	Hydroelectric
IPPP	International Project Professional Personnel
İREDA	Indian Renewable Energy Development Agency
KW	Kilowatts
MNES	Ministry of Non-conventional Energy Sources
MOEF	Ministry of Environment and Forests
MW	Megawatt
NGO	Non-governmental organization
NPPP	National Project Professional Personnel
PFC	Power Finance Corporation
PIC	Project Implementation Committee
REC	Rural Electrification Corporation
SNA	State nodal agencies
STAP	Scientific and Technical Advisory Panel (of the Global Environment Facility)
TCDC	Technical cooperation among developing countries
TI	Technical institutions

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UNITED NATIONS DEVELOPMENT PROGRAMME

GLOBAL ENVIRONMENT FACILITY

Project of the Government of India

Title:	Optimizing Development of Small Hydel Resources in the Hilly Regions
Number:	IND/92/G 31
Duration:	Five years
Project Site:	India: Himalayan and sub-Himalayan regions
UNDP Sector:	Energy
Subsector:	New and Renewable Sources of Energy
Government Sector:	Energy
Subsector:	Non-conventional Energy Sources
Executing Agency:	Ministry of Non-conventional Energy Sources
Cooperating Agency:	Department of Economic Affairs, Ministry of Finance
Estimated Starting Date:	April 1994
Government Inputs:	Rupees (Rs.) 224,805 million (in kind) (US$ 7.14 million)[1]
GEF/UNDP Inputs:	US$ 7.5 million

Brief Description:

This project is designed to assist the Government of India in the optimum utilization of small hydroelectric (hydel) resources in the Himalayan and sub-Himalayan regions. This goal will be achieved through the installation of twenty commercially viable, hydel, demonstration projects. Institutional and human resource capabilities from the local to the national level will be upgraded.

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[1] According to the United Nations official exchange rate at the time of signature of the Project Document, US$ 1 = Rs. 31.50.

A national strategy and master plan will also be formulated in this sector. By developing environmentally sound technologies and people-centered management and ownership models, the project will reduce deforestation, protect biodiversity in the fragile Himalayan and sub-Himalayan regions, and reduce the emission of greenhouse gases. These environmental benefits will be achieved by providing local people with low-cost electricity to replace fuelwood for cooking, heating, and other purposes.

A. CONTEXT

The Ministry of Non-conventional Energy Sources (MNES) of the Government of India has identified a project for optimizing the development of small hydel resources in the hilly regions of India. The project will be funded as a technical assistance project under the Global Environment Facility (GEF) fund. The project is intended to:

- Reduce global warming through the use of renewable, perennial, non-fossil-fuel energy sources, namely small hydroelectric energy sources.

- Protect biodiversity in the Himalayan and sub-Himalayan regions by reducing deforestation. Electricity from locally available small hydel resources will replace fuelwood for cooking and heating, support agricultural and commercial loads, and cater to lighting needs. Small hydel projects will also encourage the adoption of irrigation-based cultivation instead of shifting cultivation.

- Create enhanced economic opportunities locally through the availability of electricity generated by the small hydel projects, thereby reducing migration from these remote areas to urban centres.

This project meets several of the goals of *Agenda 21*, including: assisting developing countries in the efficient use of environmentally sound technologies; encouraging the sustainable use of renewable natural resources; promoting energy efficiency; and developing institutional, scientific, planning, and management capacities, particularly in developing countries, to develop, produce, and use increasingly efficient and less polluting forms of energy.

1. Description of subsector

India has an estimated potential of over 10,000 (megawatts) MW of small hydel power at canal drops and irrigation dam-based sites, run-of-rivers, and natural streams in the hilly regions. Only a fraction of this potential has so far been utilized. The focus has been on large hydel and thermal power projects to meet the rapidly increasing demand for electricity. To increase the development of small hydel resources, the programme was transferred from the Ministry of Power to the Department of Non-conventional Energy Sources in February 1989. To date, 111 projects with an installed capacity of 94 MW have been built, and 128 projects with an installed capacity of about 150 MW are under construction.

In July 1992, the Department of Non-conventional Energy Sources was upgraded to a full-fledged ministry—the Ministry of Non-conventional Energy Sources (MNES). The MNES strategy and action plan emphasizes the generation of electricity from non-conventional energy sources. Accordingly, the targets for the Eighth Five-Year Plan have been significantly enhanced. The plan aims to generate 2,000 MW of power through wind, small hydel, solar, bio-energy, and other non-conventional sources. The target for small hydel power is 600 MW: 300 MW from canal drops and dam-based sites in the plains, and 300 MW from run-of-river and natural streams in the hilly regions. About 1,400 small hydel power sites capable of generating 1,500 MW have so far been identified by state governments.

The broad-based programme involves:

- Assessment of potential project sites, survey and investigation, and preparation of detailed project reports
- Development of capability and capacity for standardization, manufacturing, and the implementation of private, public sector, and State Electricity Board projects
- Installation, operation, maintenance, and management of small hydel projects
- Research and development of hydel resources
- Promotional policies and institutional and infrastructure development.

Through this multi-dimensional and systematic approach, it is anticipated that small hydel power will emerge as a viable and cost-effective energy option. These projects will: provide electricity to the remote and hilly areas on a stand-alone basis, reduce deforestation, and preserve the ecology and environment of the region.

The target of 600 MW for small hydel power is to be achieved by adopting a three-fold strategy. For the first category of projects (with a total capacity of 200 MW), a capital subsidy from MNES will cover 25 to 50 percent of the costs of civil works, and the electrical and mechanical equipment required, whether the projects are in the government, private, or cooperative sectors. For the second category of projects (200 MW capacity total), soft loans will be provided to private and public sector enterprises by the Indian Renewable Energy Development Agency (IREDA), under the authority of the MNES. Following the Energy Sector Management Assistance Program (ESMAP) study conducted by the United Nations Development Programme (UNDP) and the World Bank, the World Bank will provide US$ 70 million in credit to supplement IREDA's resources. These funds will finance 100 MW of small hydel power projects at canal drops and dam-based sites. Projects which qualify for World Bank assistance through IREDA are not eligible for subsidy by the MNES. The third category of projects (200 MW capacity total) will be developed through private investment, and boosted through promotional and fiscal incentives.

The Himalayan and sub-Himalayan regions of India, which extend from Jammu and Kashmir in the northwest to Arunachal Pradesh in the northeast, cover an area of more than 400,000 square

kilometres. These regions have numerous perennial streams and run-of-rivers with abundant resources for the development of small hydel energy. These resources are currently greatly underutilized. The existing small hydel projects are neither efficient nor cost-effective. Since they were designed and constructed as scaled-down models of major hydel projects, the electricity they produce is very expensive.

The government plans to harness the small hydel potential available in these hilly regions by constructing a large number of efficient and cost-effective projects to develop electricity at reasonable costs. Twenty demonstration projects will be built using the latest technology available to suit various hydrological and climatic conditions at different altitudes. It is hoped that these demonstration units will dispel any apprehensions about the functional and commercial viability of small hydro systems under varying social and geographic conditions. The projects will serve as models for adaptation and replication throughout the hilly regions of India. In addition, a national strategy for the commercialization of technology packages through enabling provisions, incentives, and other methods will be developed to encourage investment in small hydel projects.

Brief description of project area

The area covered by this project can broadly be divided into three zones:

Zone I

High altitudes, with low rainfall and freezing temperatures. Altitudes ranging above 3,000 metres, rainfall 600 to 800 millimetres per year, and temperatures falling to -40 degrees C. The population density is generally low. The upper reaches of the area are snowbound all round the year, and the lower reaches are snowbound for a period of 4 to 6 months.

Zone II

Medium altitudes, with medium rainfall and moderate temperatures. Altitudes ranging from 1,000 to 3,000 metres, rainfall of 1,000 to 3,000 millimetres per year, and temperatures of 35 to -10 degrees C. The population density is generally medium. The upper reaches receive snowfall during the peak winter periods.

Zone III

Low altitudes, with high rainfall. These form the foothills of the sub-Himalayan regions. Altitudes range from 300 to 1,000 metres, rainfall 2,000 to 5,000 millimetres per year, and temperatures of 0 to 40 degrees C. The population density is generally high.

In the medium and low altitude areas, there is dense vegetation with herbal medicinal plants and other rare plants for extracting essences for perfumes and other uses. Several unique species of wild animals and rare birds also make this fragile region ecologically invaluable.

The total population affected by the project is around 23 million, belonging to indigenous tribes of several distinct ethnic groups. The livelihood of the people living in the medium and high

altitudes is based on shifting cultivation, hunting and gathering, and, to a limited extent, fishing. Their livelihood is based predominantly on agriculture, with practically no industries. The majority of the people live below the poverty line.

2. Host country strategy

The Ministry of Non-conventional Energy Sources (MNES) was created to focus attention on these resources, and to provide global leadership in this emerging energy sector. The MNES strategy and action plan uses a market orientation with active private sector participation to remove barriers and provide incentives to bring about full commercialization as quickly as possible. National infrastructure is being developed to deploy renewable energies on a large scale. The strategy involves state governments, electricity boards, industry, entrepreneurs, non-governmental organizations (NGOs), technical institutions, and local bodies. The MNES has been restructured to coordinate the efforts of these groups and support policy development to enable India to take the lead in hydroelectric power. A new power group has been created to coordinate all activities connected with wind, hydel, solar, bio-energy, and other non-conventional energy sources.

An MNES strategy for the promotion of non-conventional renewable sources of energy (NRSE) includes:

- Providing government resources for demonstration small hydel projects
- Securing institutional financing from IREDA and other financial institutions, as well as external assistance from institutions such as the World Bank, UNDP, GEF, and the Danish International Development Agency (DANIDA) for commercially viable projects with private sector participation
- Providing incentives for private investment through tax exemptions, depreciation allowances, facilities for wheeling and banking of power for the grid, and a remunerative price for the power provided to the grid.

The MNES intends to promote a new community of "energy entrepreneurs" with the government acting as the "mission leader," giving focus and direction to the NRSE sector. The new MNES plan aims at generating 2,000 MW of power from wind, small hydel, solar and bio-energy. This plan includes generation of 600 MW of power from small hydel projects. It also envisions programmes for electrification in non-electrified remote rural areas through the application of various non-conventional energy technologies. In the remote hilly regions of India, the government intends to use small hydel technology to supply electricity to previously non-electrified areas.

The MNES is introducing policies to facilitate greater private sector participation in the small hydel sector in the hilly regions. Besides investment subsidies by the MNES and soft loans by IREDA, several other financial institutions such as the Rural Electrification Corporation (REC) and the Power Finance Corporation (PFC), have agreed to advance loans for these projects. A few state governments have agreed to allow the leasing of sites. Several electricity boards have introduced packages which allow wheeling and banking, and have fixed remunerative tariffs for the purchase of energy. A tax break for power projects has already been announced. As in the case of other non-

conventional energies, a 100 percent depreciation and exemption from taxes and duties on equipment is likely to be extended to small hydel projects. Manufacturers are working towards standardization and continuously updating technology. Nine manufacturers are pursuing these goals based on indigenous technology or collaborative arrangements.

Considerable work on small hydel power generation has already been done in Australia, Brazil, China, Finland, Sweden, Thailand, and other countries. The project will draw upon the experience and expertise available from these countries through the Alternate Hydro-Energy Centre (AHEC) and other technical institutions. Consultancy organizations within the country are also surveying, investigating, and reporting on small hydel projects.

To popularize small hydel projects, an extensive media campaign is being mounted to attract entrepreneurs, developers, investors, manufacturers, State Electricity Boards, NGOs, local communities, and others, to this very large market-oriented programme.

The government is fully conscious of the importance of protecting the environment by reducing deforestation and preserving biodiversity. The use of firewood for cooking and heating, coupled with the practice of shifting cultivation in these regions, is accelerating deforestation. By making low-cost energy available to remote regions, the government will encourage people to use electricity instead of fuelwood for domestic purposes. In addition, these small hydel projects will provide the local people with energy to adopt irrigation-based cultivation instead of shifting cultivation (jhoom cultivation).

Under this project, the government will commission twenty demonstration projects, with capacities ranging from 100 to 500 (kilowatts) KW, at selected sites throughout the region. These demonstration projects will provide a total installed capacity of around 5,000 KW, and will serve as model projects for a large programme to be taken up later during the Ninth Five-Year Plan.

Conditions vary greatly over the large area to be covered. The wide ranges in temperature (-40 degrees C to +40 degrees C), rainfall (1,000 millimetres to 5,000 millimetres), heads of water (6 metres to 300 metres), and altitudes (300 metres to 3,600 metres), necessitate the use of different types of turbines. Possible turbine types include cross flow, vertical flow, horizontal flow, semi-Kaplan and full Kaplan, reaction, turbo-impulse, and pelton. In addition, the sociocultural diversity of the region would influence not only the energy-use pattern, but also the ownership and management structure of these units. In light of these widely varying conditions, at least twenty locations should be selected for these demonstration projects.

The state governments have identified several sites for the projects. These sites will be examined in cooperation with international consultants, and locations will be finalized as appropriate. The government also plans to upgrade existing water mills, of which there are several thousand. These mills use old technology and operate at very low efficiency. With modern add-on devices, they can be converted into multipurpose efficient units to generate electricity. Taking into account the large area to be covered, with heads of water varying from 1 metre to 6 metres, and discharge varying from two cusecs to ten cusecs, as well as different turbine types, at least 100 locations should be selected for upgrading the water mills. The demonstration projects and upgraded water mills will continue to be maintained even after GEF funding. The lessons learned and the experience

gained through these projects will be invaluable in developing the large number of small hydel projects in the hilly regions proposed for the Ninth Five-Year Plan. The project will be completed in a period of three and a half years to coincide with the end of the Eighth Five-Year Plan.

The project aims to combine local and national experience with the international knowledge available in a comprehensive and scientific manner. This knowledge base will enable the government to generate an array of cost-effective models which would be the basis for replication in different contexts during the later investment phase. The models generated for these projects will become part of a national strategy and master plan for the development of small hydel projects. This comprehensive national plan will also help private participants to select projects without further investigation and delay.

The small hydel projects in the hilly regions will not require any submergence of land or relocation of local population. No deforestation will result from these projects; on the contrary, the projects will reduce deforestation and contribute to the preservation of biodiversity in the fragile Himalayan regions. Every effort will be made to ensure that the project involves all the stakeholders, and complies with national Environmental Impact Assessment guidelines, and the Environmental Overview and Project Management Strategy (EOPMS) developed for this project.

As indicated before, one of the major outputs of this project will be a master plan for the utilization of small hydel resources in the hilly regions of the country. The planned demonstration projects will be undertaken through state nodal agencies in order to upgrade their capabilities for project planning and implementation. These projects will also create an awareness of the potential for harnessing the vast hydel potential available in the hilly regions. The demonstration projects are expected to be completed within thirty months of commencement of this project.

After a six-month evaluation period for these demonstration projects, private sector participation will be invited for some of them. The government proposes to establish a revolving fund with GEF assistance to provide concessional loans to private investors for procuring equipment for small hydel projects in the hilly regions. The revolving fund, the operational modalities of which would be determined in consultation with UNDP, will be administered by IREDA, with AHEC providing the necessary technical support. Using the revolving fund, projects up to 100 KW capacity, aggregating to 1 MW capacity, will be developed in clusters for the three sub-regions. This approach will test the utility of private sector participation in harnessing the vast hydel potential in the hilly regions. Depending upon the success of this exercise, a large-scale programme for utilization of these resources with private sector funding could be planned.

With the construction of small hydel projects in the hilly regions, there will be a corresponding reduction in load production by other fossil-fuel based electricity generating plants. In order to encourage the development of small hydel projects in the hilly regions, the MNES could:

- Employ state of the art technologies. Siphon-intake technology has already been successfully used in one low-head project, and more projects are under construction using this technology.

- Initiate efforts for standardization of the electro-mechanical and civil works to reduce the costs of installed capacity, and the cost of electricity generated per kilowatt hour.

- Announce incentives for detailed survey, investigation, and preparation of detailed project reports (DPRs) by consultants or project personnel available with State Electricity Boards, so that a list of project investment opportunities is available.

- Announce capital cost/interest burden-sharing schemes to divert the existing budgetary and extra-budgetary resources of state agencies, financial institutions, private sector, and other investors to the small hydel subsector.

- Increase the manufacturing base for small hydel equipment including turbines and generators by private entrepreneurs.

- Publish standard guidelines on various types of small hydel projects.

- Initiate studies by NGOs and other qualified organizations for upgrading the thousands of village water mills into multipurpose generating units.

- Educate the local population on the advantages of small hydel generation compared to diesel generation in remote areas that are not connected by grid.

- Using state forest departments, encourage reforestation of catchment areas to ensure adequate minimum discharge from the small hydel projects. Land made available by switching from jhoom (shifting) cultivation to irrigation-based cultivation can also be reforested.

3. Prior and ongoing assistance

Based on a UNDP/World Bank ESMAP study, a World Bank loan of US$ 70 million is available to IREDA for the installation of about 100 MW-capacity small hydel projects on canal drops and irrigation dams. This World Bank-funded project addresses different problems and situations (such as low heads and grid operations) from those of small hydel projects in the hilly regions. Small hydel projects will involve high heads, different climatological conditions in remote areas, and difficult transportation and maintenance problems. The end-use emphasis will also be different. The former will provide electricity and stability to the grid. The latter will generate electricity on a stand-alone basis to serve local electricity needs such as cooking and heating. These small hydel projects have added environmental benefits such as preserving biodiversity in the fragile Himalayan region and reducing the emission of greenhouse gases. Apart from these programmes, there are no bilateral or multilateral programmes in the subsector.

4. Institutional framework for subsector

The Ministry of Non-conventional Energy Sources (MNES) is responsible for the coordination of all matters related to non-conventional energy, including small hydel projects. The Secretary of this Ministry reports directly to the Minister of State for Non-conventional Energy

Sources. For small hydel projects, the Secretary is assisted by an Advisor (Power), a Director (Power), and other staff who are responsible for all matters pertaining to small hydel projects.

Projects are executed by the MNES through state governments, using their nominated nodal agencies and electricity boards. Funds for these projects are allotted by the MNES on a cost-sharing basis to state governments, or through soft loans from IREDA. Funds are also available through a public sector undertaking under the MNES, the Rural Electrification Corporation (REC), and the Power Finance Corporation (PFC).

The revolving fund proposed under this project will also be administered by IREDA, with technical support from AHEC, to provide concessional credit to private entrepreneurs for the purchase of equipment.

AHEC, an institution initially set up by the MNES and affiliated with the University of Roorkee, Uttar Pradesh, provides technical guidance and training for interested agencies executing small hydel projects. In addition, there are a number of organizations in the country which provide technical guidance during the execution of such projects.

B. PROJECT JUSTIFICATION

1. Problem to be addressed and the present situation

There is no electricity in most of the remote hilly villages. In a few villages, electricity is supplied for lighting through diesel generators for a period of four to six hours in the evenings. Electricity from major hydel or thermal projects is not supplied to these remote villages due to the high cost of transmission lines, and limits in the capacity of major hydel and thermal projects.

Existing small hydel projects are neither efficient nor cost-effective. This is because they have been built by scaling down the designs and other construction parameters used for large hydel projects. This practice has resulted in "sick" projects, with a failure to incorporate the latest technologies in small hydel projects. The multiplicity of designs and sizes of turbines in such projects have made their electricity production uneconomical. All these factors make these systems commercially inviable and unattractive to private investors. Two important reasons explain why the small hydel option has not been widely used in the hilly regions of India: lack of information within the local communities, and the scarcity of initial capital investment.

There is a lack of cost-effective testing facilities for small hydel equipment such as turbines and generators. Testing and other related activities are conducted on an *ad hoc* basis. There are limited research facilities and very few training courses connected with small hydel projects. There are also very few agencies that offer consultancy services or scientific information on small hydel projects. To reverse this trend and enable the country to meet its planned objectives, institutional and human capacities must be developed at the national, state, and local levels.

There are several thousand water mills with very old technology operating in India. Despite attempts by government agencies and NGOs, they have not been upgraded. They therefore operate at very low efficiency for a few hours a day, and many remain unserviceable over long periods.

For agricultural cultivation in the remote villages of the Himalayan and sub-Himalayan regions, shifting cultivation is practiced. In this traditional form of agriculture, the land is left unused after harvesting for a period of several years to allow the soil to recover its nutritional value through natural processes. Shifting cultivation has been practised for centuries due to the lack of fertilizers and irrigation. It requires several times the area of land used for cultivation with irrigation and fertilizers. To meet the needs of a growing population, villages are using more land for agriculture, thereby increasing deforestation.

The use of fuelwood for domestic purposes in these remote regions is further depleting forests. This cumulative deforestation affects the region's biodiversity, destroys carbon sinks, and adversely impacts the health of the local population. Alternative options, such as using liquefied petroleum gas or coal, have not proved viable due to the high costs of transportation and unreliable supply.

2. Expected end-of-project situation

By the end of this project, twenty small hydel projects will have been commissioned at various sites to serve as models for replication on a major scale throughout the hilly regions of India. These will exemplify economical designs based on the latest available technologies modified to suit local conditions, as well as the methodology and approaches required for the execution of small hydel projects. Progress will have also been made in the standardization of equipment for small hydel facilities in the hilly regions.

A national strategy and a master plan with detailed investment proposals will have been prepared for the development of small hydel projects, with up to 3 MW capacity for each project, for the entire Himalayan and sub-Himalayan regions, based on the experience of the demonstration projects.

The energy produced will have been delivered to the communities around each project area on a stand-alone basis, as these loads will not be linked to any power grid. In the few areas where electricity is produced from diesel generators, existing transmission lines, street lighting poles, and fittings will be used, whenever feasible.

Management and ownership models will have been developed for village-level elected bodies, cooperatives, NGOs, citizens' groups, and others. The demonstration units could be entrusted to selected local agencies for operation, maintenance, collection of revenue, and expenditure. Local personnel will have been trained in the operation and maintenance of these projects. A report will have been prepared on the management of these small hydel projects, including cost-benefit analysis, electricity tariffs, and revenue collection. The recommendations included in the report will also have been implemented.

One hundred water mills in different regions will have been upgraded with new technology, such as add-on multipurpose devices for electricity generation. These projects will serve as prototypes for upgrading the remaining water mills in these regions.

Energy produced by these demonstration projects and the upgraded water mills will be used for cooking, heating, and other purposes, thereby saving fuelwood and reducing deforestation. Low wattage appliances for cooking, heating, and storage will have been developed with improved designs at lower costs. People in the remote villages will have been trained in the use of these appliances by social marketing personnel and NGOs. Availability of electricity for pumping water for irrigation will change the type of cultivation from jhoom cultivation to irrigation-based cultivation. This will considerably reduce deforestation, saving approximately 7,000 tons of fuelwood per year, and reducing carbon emissions by about 3,200 tons per year.

During the Eighth Five-Year Plan, all 500 small hydel projects in the hilly areas will be completed, providing a total capacity of 300 MW. Carbon emissions will be reduced by approximately 189,000 tons per year, and approximately 420,000 tons of fuelwood will be saved each year (see Annex 2).

The testing, training, research, and information capabilities of selected institutions in the three different regions will have been developed and upgraded. The planning and preparation capabilities of the MNES and selected project personnel to handle small hydel projects will also have been upgraded. These personnel will determine optimal investment promotion policies, and organize funding for small hydel projects. Reforestation of catchment areas, where necessary, will have been carried out by the forest departments of the state governments.

A revolving fund to provide soft loans for the purchase of equipment by private parties will have been established towards the end of this project. Methodology for operating the fund will have been developed in consultation with UNDP. The project will also have generated considerable interest in the private sector for investment opportunities related to small hydel resources in hilly areas.

3. Target beneficiaries

The target beneficiaries of this project are the mostly tribal, poor, and illiterate villagers in the remote hilly regions. Each project will serve an average of 200 families with a total of about 900 individuals. The twenty demonstration projects will benefit approximately 18,000 people. This group of affected people will be consulted throughout the project by the implementing agencies and institutions associated with the planning, design, construction, operation, and maintenance of small hydel projects. These agencies will acquire testing facilities, information, and consultancy services for small hydel projects. Other beneficiaries include:

- MNES
- State Electricity Boards and any other state project authorities involved in this project
- Selected technical institutions providing testing and research facilities, training courses, and consultancy services
- NGOs associated with development and demonstration projects related to water mills

- Women who use, and train others in the use of, the different appliances that are part of the load development programme

- Local generation and distributing agencies

- Private sector manufacturers, designers, and retailers of identified appliances and processes

- National institutions and NGOs who undertake different field-level studies.

4. Project strategy and implementation arrangements

The project seeks to achieve electricity cost reductions in the order of 30 to 40 percent. Energy generated by small hydel projects will enable people to switch from fuelwood to electricity for heating and cooking, and, when feasible, for pumping water for irrigation. The electricity generated will also be used for the lighting and warming of greenhouses for agricultural and horticultural purposes, and for setting up small-scale industries like fruit processing.

The project will achieve these cost reductions by optimizing and standardizing the equipment for small hydel projects. The standardization of equipment yields technological cost reductions and increases the efficiency of the operation and maintenance of these projects. The reduced cost of the electricity produced makes it affordable for local villagers. Free electric stoves and heaters will be provided by the government to encourage villagers to switch to electricity for domestic purposes. Subsequently, the improved design, standardization, and mass production of these appliances will make them available at affordable prices. The villagers will be trained in the use of these appliances by extension workers and NGOs.

Additional cost reductions will be achieved by improving agricultural practices. To encourage irrigation-based cultivation, UNDP funds will provide pump sets at ten representative locations to encourage villagers to abandon jhoom cultivation.

The project seeks to develop cost-effective packages appropriate in different social and technological conditions. It also aims to enable the government to move away from subsidies to a non-subsidy regime involving private sector enterprises. After the demonstration projects have reduced generation costs, there will still be a need for incentives for private sector investment in these projects. The MNES supports this approach and will use the proposed revolving fund to provide necessary loans to the private sector for equipment.

An alternative strategy would be to supply electricity from major hydel projects to these remote villages. This option is not financially viable due to the high costs involved in laying transmission lines, and other problems such as power losses. This option would also increase deforestation by cutting trees on either side of the planned transmission lines, and along the access paths for these transmission lines. Use of liquefied petroleum gas, coal, or other fuels for cooking and heating is also not practicable due to their high costs, unreliable supplies, and other limitations.

This project will be executed by the MNES. A senior officer of the MNES will be appointed National Project Director, and he/she will be assisted by a full-time National Project Coordinator. The government will set up a Project Implementation Committee (PIC) with the Secretary, MNES, as its chairperson, and the National Project Director as its Member Secretary. PIC members will include representatives from government departments such as the Department of Science and Technology (DST), Ministry of Environment and Forests (MOEF), Central Electricity Authority (CEA), Planning Commission, Department of Economic Affairs (DEA), as well as NGOs, IREDA, AHEC, and private enterprises. The Committee will monitor project activities, and provide direction and guidance for project implementation. IREDA will handle the financial aspects of the project and administer the revolving fund. Service charges for IREDA will be met by the government. AHEC will provide technical support for the MNES and IREDA in administering the revolving fund.

Technical institutions in three different regions will be selected to support the hydel projects. AHEC will be the apex technical institution for the northern region; the Institute of Science and Technology, Itanagar, for the northeastern region; and the College of Engineering, Jammu, for the northwestern region. These institutions will provide facilities for testing, training, applied research, information, and consultancy services. Three regional offices will be set up to assist the National Project Director in monitoring project activities covering these regions.

The execution of the twenty demonstration small hydel projects and the upgrading of the hundred water mills will be carried out through state agencies under the direction and guidance of the National Project Director. These projects will be owned and maintained by the state nodal agencies until local organizations are prepared to assume responsibility for them. UNDP and select international and national institutions will provide guidance in their areas of expertise. Procurement of equipment for the project financed with UNDP funds will be carried out in accordance with established UNDP procedures.

5. Reasons for assistance from GEF/UNDP

The Scientific and Technical Advisory Panel (STAP) of the GEF has recommended that:

- Emission of hydrocarbons released into the atmosphere in the hilly regions of India be reduced
- Deforestation be controlled or reduced by providing alternative renewable energy through small hydroelectric projects in the hills
- The biodiversity of Himalayan and sub-Himalayan regions be protected
- Reduction in global warming be achieved through the use of renewable, perennial non-fossil-fuel energy sources, namely small hydro energy.

Assistance from GEF/UNDP is requested for this project because:

- The project addresses two of GEF's focal areas: global warming and loss of biodiversity

- It addresses the six UNDP priority issues: poverty eradication and grassroots participation, environmental problems and natural resource management, transfer and adaptation of technology for development, women in development, technical cooperation among developing countries, and management development

- The UNDP has global access to technologies and developments in the area of small hydel machinery and equipment

- GEF/UNDP assistance will encourage private financing of the small hydel projects identified under the master plan from bilateral and multilateral sources.

The project will demonstrate a means for emissions-reduction technologies in the small hydro sector to reach their full potential. This will be achieved, as suggested in the GEF/STAP guidelines, by making the technology "right" through innovation and adaptation. The costs will be made more appropriate by increasing cost-effectiveness, while the market environment will be improved by eliminating market barriers. The project will lead to the development of a rational strategy for sustainable production and use of clean energy in ecologically fragile areas.

GEF funds of US$ 7.5 million have leveraged a sum of Rs. 224.805 million (US$ 7.14 million) for this project from the Government of India. This large investment emphasizes the government's commitment to the project.

6. Special considerations

Environmental protection and natural resource management

The project will lead directly to the reduction of deforestation in the hilly regions of India. This will be achieved through the reduced demand for fuelwood for domestic purposes by substituting electricity for fuelwood. With affordable electricity, and free or low-cost cooking and heating appliances being provided, it is expected that more and more villagers will switch to electricity from fuelwood. The use of electricity for pumping water for irrigation will change the pattern of cultivation from jhoom cultivation to irrigation-based cultivation, further reducing deforestation.

The protection of forests has implications for the preservation of biodiversity, and for the prevention of soil erosion, which in its turn can reduce the intensity of floods in the foothills and plains. As the electricity generated by small hydel projects replaces fuelwood, there will also be a reduction in carbon emissions. In addition, the small hydel projects will replace carbon-emitting diesel generators.

The negative environmental impacts of this project will result from the necessity of cutting trees and denuding topsoil for the construction of power houses, water channels, and forebays, and for the laying of penstock pipes. Measures to limit soil erosion will therefore be required, along with afforestation programmes for the areas released by jhoom cultivation. Environment-friendly fertilizers and pesticides will also be selected with care.

Poverty alleviation and grassroots participation in development

The per capita income in the Himalayan and sub-Himalayan regions is about 35 percent of the national average. Most of the hill tribes live at subsistence level, and more than 50 percent fall below the poverty line. There are practically no industries in the region, and the people live mainly on rain-dependent agriculture through which they produce for their own consumption, and not for export. A very limited amount of handicrafts are made here for sale in other parts of the country. Local and national regulations to prevent the cutting of trees are not seriously enforced for reasons that include the socioeconomic status of people in these remote areas.

In fact, the hilly regions offer many opportunities for producing fruits, vegetables, and other agricultural products, provided electricity and infrastructure were available. With low-cost electricity made available through this project, food processing units could be built by small industries. Similarly, wool processing and other light industries could be started to serve local areas. Villagers could be trained in the necessary skills for setting up and running small-scale industries. Soft loans by appropriate development agencies and state governments could support this training.

The provision of low-cost energy could thus alleviate poverty by providing self-employment for some, and job opportunities for others. Local opportunities would also reduce migration from these villages to urban centres in search of work.

Local participation will gradually be phased in over the life of the project. The demonstration projects include 15 to 20 percent of project costs for unskilled labor. Local citizens will also be trained in the operation and maintenance of these projects. Local involvement throughout the life of the project will give the villagers a sense of ownership, thereby increasing operational efficiency, reducing maintenance costs, and aiding cost control. NGOs and village communities will encourage the participation of villagers, who will be given priority in employment in these projects.

Women in development

Heavy loads of fuelwood are carried from the forest to the village by the women and children, adversely affecting their health. Smoke and carbon monoxide released due to inadequate combustion further damages their health. The switch from fuelwood to electricity brought about by this project will therefore prove beneficial to the health of both women and children.

The electricity made available to these remote villages will also allow for the creation of small-scale and cottage industries. These economic opportunities will benefit women in particular. Freed from the task of collecting fuelwood and able to complete other household tasks more efficiently, women will have the time to take income-earning jobs in small-scale industries. With the prevalent joint-family system, children can be cared for by elders. Women will be encouraged to seek employment in these industries by being given preference in recruitment and part-time employment. The project will therefore indirectly enhance the welfare of women.

Transfer and adaptation of technology for development

The technology for small hydel projects in India is not as yet fully developed. This project seeks the transfer of technology for such projects from developed countries to India, where it will be adapted to suit local conditions.

Technical cooperation among developing countries

Experience from this project can be utilized in the Himalayan and sub-Himalayan regions of Bhutan, China, Nepal and Pakistan, where similar conditions exist. The lessons gained can also be applied to similar regions elsewhere in the world.

Management development

The project promotes the development of human and institutional capabilities from the national to the local levels. By developing appropriate management models suited to different contexts, the project will also foster management skills.

7. Coordination arrangements

The MNES will be the government executing agency for the project. One of the main functions of the MNES is the coordination of planning and policy with other central government ministries. The MNES also coordinates government policy with various state nodal agencies, State Electricity Boards, financial and technical institutions, and other bodies. With this background, MNES is well-suited for coordination of the activities of this project.

The MNES will establish a PIC for guiding and monitoring the activities of the project. A senior officer of MNES will be the National Project Director and coordinate the activities of the project with the assistance of a full-time National Project Coordinator and complementary staff. The MNES will also establish project offices in the three regions to assist the National Project Director in performing his/her duties. The MNES will establish formal technical advisory groups to resolve important matters pertaining to small hydel projects.

8. Counterpart support capacity

In its policy paper, the MNES places high priority on small hydel development. Reflecting this importance, the MNES has allocated Rs. 180 million (US$ 5.71 million) in its 1993-1994 budget for the development of small hydel projects. The MNES has already started working with various financial institutions and agencies towards this end.

The MNES and the concerned states will make the necessary provisions in their budgets for 1994-1997 for personnel, training, equipment, and miscellaneous items described in the project budget. The MNES will also provide national counterparts for international consultants, and national professionals, throughout the duration of the project.

C. DEVELOPMENT OBJECTIVE

The development objective of the project is to protect biodiversity and reduce global warming. These objectives contribute directly to protection of the environment, which is given high priority in the national development plan.

D. IMMEDIATE OBJECTIVES, OUTPUTS AND ACTIVITIES

IMMEDIATE OBJECTIVE 1

To develop a national strategy and a master plan with detailed investment proposals for the optimum utilization of small hydel resources in the Himalayan and sub-Himalayan regions.

Achievement Indicators

One criterion of this project's success would be the acceptance of the master plan by the MNES, and the plan's inclusion in the Ninth Five-Year Plan, with the necessary budget provisions. Another criterion would be the interest evinced by potential international donor agencies, and the commitment of funds for some of the projects included in the master plan.

The following abbreviations have been used in this section for the persons responsible for activities:

IPPP	International Project Professional Personnel
NPPP	National Project Professional Personnel
MNES	Ministry of Non-conventional Energy Sources (represented by a National Project Director)
SNA	State nodal agencies
TI	Technical institutions

All activities will be carried out in New Delhi, at the twenty demonstration project sites, and at the three technical institutions, as appropriate.

Output 1.1

Review and assessment of available data on the existing infrastructure and other facilities, and investigation of the untapped small hydel potential. These assessments and investigations will be consolidated in a detailed report.

Activities for Output 1.1

1.1.1 Review and assess available data, including seismic and remote sensing data.

Starting date:	Month 1 (from the starting date)
Duration:	2 months
Responsible party:	NPPP and MNES.

1.1.2 Review and assess programmes and services offered by existing institutions regarding small hydel projects.

Starting date:	Month 1
Duration:	2 months
Responsible party:	NPPP and MNES.

1.1.3 Review and assess existing facilities, infrastructure, load development strategies and technologies used.

Starting date:	Month 1
Duration:	2 months
Responsible party:	NPPP, MNES and SNA.

1.1.4 Review and assess development plans and options.

Starting date:	Month 1
Duration:	2 months
Responsible party:	NPPP, MNES and SNA.

1.1.5 Review and assess untapped small hydel potential in the Himalayan and sub-Himalayan regions.

Starting date:	Month 1
Duration:	3 months
Responsible party:	NPPP, MNES and SNA.

1.1.6 Review and assess the existing design and performance standards of water mills in the Himalayan and sub-Himalayan regions.

Starting date:	Month 1
Duration:	3 months
Responsible party:	IPPP, NPPP, MNES and SNA.

1.1.7 Finalize report on the existing infrastructure and other facilities, untapped small hydel potential, and status of existing water mills in the Himalayan and sub-Himalayan regions.

Starting date:	Month 4
Duration:	1 month
Responsible party:	IPPP, NPPP and MNES.

Output 1.2

A zoning plan will have been prepared, identifying different types of areas suitable for different techniques for small hydel generation.

Activities for Output 1.2

1.2.1 Analyze hydrological and geological data from different areas to determine the different techniques required for the development of their small hydel potential.

Starting date:	Month 2
Duration:	1 month
Responsible party:	NPPP, MNES and SNA.

1.2.2 Identify and designate areas for demonstration projects.

Starting date:	Month 3
Duration:	1 month
Responsible party:	NPPP and MNES.

1.2.3 Prepare zoning plan identifying different types of areas for different techniques for hydel generation.

Starting date:	Month 4
Duration:	1 month
Responsible party:	IPPP, NPPP and MNES.

Output 1.3

Long-term objectives and investment strategies will have been prepared and established.

Activities for Output 1.3

1.3.1 Draft long-term objectives and investment strategies for the small hydel projects.

Starting date:	Month 1
Duration:	2 months
Responsible party:	NPPP and MNES.

1.3.2 Circulate the draft to appropriate government departments, NGOs, and other agencies for comment.

Starting date:	Month 3
Duration:	2 months
Responsible party:	NPPP and MNES.

1.3.3 Prepare final report with long-term objectives and investment strategies.

Starting date:	Month 5
Duration:	2 months
Responsible party:	IPPP, NPPP and MNES.

Output 1.4

Plans for the development of small hydel projects in each zone will have been prepared.

Activities for Output 1.4

1.4.1 Analyze potential of small hydel in relation to the long-term objectives and investment strategies.

Starting date:	Month 5
Duration:	2 months
Responsible party:	IPPP, NPPP and MNES.

1.4.2 Determine optimum clusters of small hydel projects, taking into account the energy requirement for cooking, heating, lighting, irrigation, and other needs.

Starting date:	Month 5
Duration:	2 months
Responsible party:	IPPP, NPPP and MNES.

1.4.3 Determine the financial and institutional requirements for zonal development plans.

Starting date:	Month 7
Duration:	1 month
Responsible party:	IPPP, NPPP, MNES and SNA.

1.4.4 Analyze implementation complexities and environmental effects, taking note of the Environmental Overview and Project Management Strategy (EOPMS) and the Environmental Impact Assessment requirements of the Ministry of Environment and Forests.

Starting date:	Month 7
Duration:	1 month
Responsible party:	IPPP, NPPP and MNES.

1.4.5 Prepare plans for the development of small hydel projects in each zone.

Starting date:	Month 8
Duration:	2 months
Responsible party:	IPPP, NPPP and MNES.

Output 1.5

Studies on the important issues identified in the master plan will have been prepared.

Activities for Output 1.5

1.5.1 Prepare report on the ownership and management of small hydel projects, including administration, maintenance, and related issues.

Starting date:	Month 4
Duration:	3 months
Responsible party:	IPPP, NPPP, MNES and national institutions, as necessary.

1.5.2 Prepare report on load development strategies, including the modalities for low-wattage devices for storage, lighting, cooking, and heating.

Starting date:	Month 4
Duration:	3 months
Responsible party:	IPPP, NPPP, MNES and national institutions, as necessary.

1.5.3 Prepare Environmental Impact Assessment report on both the positive and negative aspects of the proposed projects.

Starting date:	Month 5
Duration:	3 months
Responsible party:	IPPP, NPPP, MNES, SNA and other institutions/NGOs, as necessary.

1.5.4 Prepare report on potential development conflicts with other renewable energy options.

Starting date:	Month 5
Duration:	3 months
Responsible party:	IPPP, NPPP, MNES and other institutions/ NGOs, as necessary.

1.5.5 Prepare comprehensive report on important issues from the master plan.

Starting date:	Month 8
Duration:	2 months
Responsible party:	IPPP, NPPP and MNES.

Output 1.6

A master plan, incorporating the national strategy, with detailed investment proposals for the optimum utilization of small hydel resources in the Himalayan and sub-Himalayan regions, will have been finalized.

Activities for Output 1.6

1.6.1 Analyze development plans based on long-term objectives, investment strategies, and implementation requirements.

Starting date:	Month 10
Duration:	2 months
Responsible party:	NPPP and MNES.

1.6.2 Identify project priorities based on long-term objectives and investment strategies.

Starting date:	Month 12
Duration:	2 months
Responsible party:	NPPP and MNES.

1.6.3 Draft the master plan with detailed investment proposals for the optimum utilization of small hydel resources.

Starting date:	Month 14
Duration:	2 months
Responsible party:	IPPP, NPPP, MNES and SNA.

1.6.4 Prepare a national strategy document after a review of the existing environmental, legal, economic, and policy framework for the development of a hydel system in the hilly regions of India.

Starting date:	Month 30
Duration:	3 months
Responsible party:	MNES.

1.6.5 Update the master plan, including the national strategy and detailed investment proposals, on the basis of experience gained from the demonstration projects.

Starting date:	Month 36
Duration:	4 months
Responsible party:	MNES.

1.6.6 Organize and conduct a workshop to finalize the national strategy and the master plan for small hydel projects in the hilly regions.

Starting date:	Month 40
Duration:	3 months
Responsible party:	MNES and SNA.

IMMEDIATE OBJECTIVE 2

To develop a package of commercially viable and environmentally sound technologies based on the installation of twenty demonstration units for the generation of hydroelectric power, and to develop appropriate models for ownership, management, and maintenance of small hydel projects through a people-centered and participatory approach.

Achievement Indicators

One criterion of the project's success would be the adaptation and replication of these demonstration projects on a major scale throughout the hilly regions of India. Another criterion would be the reduction in the cost of installed capacity per kilowatt, and in the cost of electricity per kilowatt hour brought about by the project and the increased acceptance of end-use appliances by the people. Finally, the participation of local people in the ownership, management, maintenance, revenue collection, and expenditure related to small hydel projects would be a sign that the project had achieved its objectives.

Output 2.1

Twenty demonstration small hydel projects will have been identified in selected areas.

Activities for Output 2.1

2.1.1 Identify twenty small hydel projects in various zones to serve as demonstration projects.

Starting date:	Month 2
Duration:	2 months
Responsible party:	IPPP, NPPP, MNES and SNA.

Output 2.2

Designs will have been prepared for the selected demonstration projects using the latest available technology to improve their operational and cost efficiency.

Activities for Output 2.2

2.2.1 Collect and update information on the latest available technology for small hydel projects.

Starting date:	Month 4
Duration:	1 month
Responsible party:	IPPP, NPPP and MNES.

2.2.2 Prepare designs for the demonstration projects using the latest available technology modified to suit local conditions.

Starting date:	Month 5
Duration:	2 months
Responsible for activity	IPPP, NPPP and MNES.

Output 2.3

Drawings, specifications, and tender documents will have been prepared. Bids will have been invited and contracts will have been awarded for the demonstration projects.

Activities for Output 2.3

2.3.1 Prepare drawings, specifications, and tender documents.

Starting date:	Month 7
Duration:	2 months
Responsible party:	IPPP, NPPP and MNES.

2.3.2 Invite bids and award contracts.

Starting date:	Month 9
Duration:	4 months
Responsible party:	NPPP, MNES and SNA.

Output 2.4

The demonstration projects will have been completed and will have begun to generate power.

Activities for Output 2.4

2.4.1 Execution and commissioning of twenty demonstration projects.

Starting date:	Month 13
Duration:	18 months
Responsible party:	IPPP, NPPP, MNES and SNA.

2.4.2 Collect and disseminate information on the demonstration projects through print and electronic media.

Starting date:	Month 13
Duration:	18 months
Responsible party:	IPPP, MNES and SNA.

Output 2.5

The demonstration projects will have been studied during the construction stage to prove the viability of the identified new technologies, designs, and approaches. Equipment

procurement, design, construction, and installation will have been monitored to ensure quality control, design safety, reliability, and cost-effectiveness of the identified technologies.

Activities for Output 2.5

2.5.1 Examine the viability of the identified new technologies, designs, and approaches. Make appropriate modifications as necessary to increase their efficiency.

Starting date:	Month 13
Duration:	18 months
Responsible party:	IPPP, NPPP, MNES and SNA.

2.5.2 Monitor implementation of the projects.

Starting date:	Month 13
Duration:	18 months
Responsible party:	IPPP, NPPP, MNES and SNA.

2.5.3 Ensure quality control, design safety, and reliability of the new technologies.

Starting date:	Month 13
Duration:	18 months
Responsible party:	IPPP, NPPP, MNES and SNA.

2.5.4 Prepare completion drawings.

Starting date:	Month 31
Duration:	6 months
Responsible party:	MNES and SNA.

2.5.5 Assess the cost-effectiveness of these projects.

Starting date:	Month 31
Duration:	6 months
Responsible party:	NPPP, MNES and SNA.

2.5.6 Organize an international workshop for the finalization of technology packages for the design of small hydel projects.

Starting date:	Month 37
Duration:	3 months
Responsible party:	MNES, SNA, TIs and IPPPs.

Output 2.6

A survey of the use and cost-effectiveness of the electricity generated, and fuelwood savings, in the demonstration project areas will have been completed.

Activities for Output 2.6

2.6.1 Conduct detailed surveys on the use of hydel power in the demonstration project sites. The survey will include the cost of electricity generated per unit compared to the cost of electricity before the project, if any was available. Also include a comparison of the amount of fuelwood used before and after the units were constructed.

Starting date:	Month 31
Duration:	6 months
Responsible party:	MNES, national institutions and NGOs.

Output 2.7

Operation and maintenance manuals, in English and the local languages, will have been prepared for the operation and maintenance of the demonstration projects. Maintenance schedules and spare-part management schedules will also have been prepared.

Activities for Output 2.7

2.7.1 Prepare operation manuals for the selected projects.

Starting date:	Month 31
Duration:	9 months
Responsible party:	MNES and SNA.

2.7.2 Prepare maintenance schedules and spare-part management schedules for the selected projects.

Starting date:	Month 31
Duration:	9 months
Responsible party:	MNES and SNA.

2.7.3 Prepare maintenance manuals for the selected projects.

Starting date:	Month 31
Duration:	9 months
Responsible party:	MNES and SNA.

Output 2.8

On-the-job training in the operation and maintenance of the demonstration projects will have been provided to local personnel.

Activities for Output 2.8

2.8.1 Provide on-the-job training to local personnel involved in the operation of the selected projects.

Starting date:	Month 31
Duration:	12 months
Responsible party:	MNES and SNA.

Output 2.9

Fuel-use patterns will have been surveyed. A load development programme, and strategies to reduce carbon emissions, will have been developed in the selected project areas.

Activities for Output 2.9

2.9.1 Conduct a survey on the fuel-use pattern of the people in the demonstration project sites, including the quantum of fuelwood used and approximate carbon dioxide emissions.

Starting date:	Month 13
Duration:	4 months
Responsible party:	MNES, national institutions and NGOs.

2.9.2 Design load development programmes and strategies for the use of electricity for cooking and heating, as well as for small industries, agriculture, water supply, and other uses.

Starting date:	Month 19
Duration:	6 months
Responsible party:	IPPP, MNES and SNA.

Output 2.10

Load development programmes, and strategies to reduce carbon emissions, will have been implemented. Specifications will have been developed and manuals will have been prepared for the operation and maintenance of load development appliances.

Activities for Output 2.10

2.10.1 Implement load development programmes for the use of electricity for

cooking and heating, as well as for small industries, agriculture, water supply, and other uses.

Starting date:	Month 25
Duration:	12 months
Responsible party:	IPPP, MNES and SNA.

2.10.2 Train villagers, especially women, in the use of electric appliances for cooking and heating. Encourage them to convert from fuelwood to electricity for cooking and heating.

Starting date:	Month 25
Duration:	12 months
Responsible party:	IPPP, MNES, SNA and NGOs.

2.10.3 Train villagers, including women, in the use of irrigation-based cultivation, and encourage them to convert from jhoom cultivation.

Starting date:	Month 25
Duration:	12 months
Responsible party:	IPPP, MNES, SNA and NGOs.

2.10.4 Identify manufacturers who will produce the requisite appliances and encourage them to increase their production.

Starting date:	Month 25
Duration:	12 months
Responsible party:	IPPP, MNES and SNA.

2.10.5 Prepare specifications and manuals for the procurement, operation, and maintenance of these appliances.

Starting date:	Month 31
Duration:	9 months
Responsible party:	MNES and SNA.

Output 2.11

One hundred water mills will have been identified, developed, and tested, adopting new designs to convert them for electricity generation. Mills will have been improved and commissioned in the selected project areas.

Activities for Output 2.11

2.11.1 Identify one hundred water mills for developing and upgrading in the selected project areas.

Starting date: Month 1
Duration: 2 months
Responsible party: MNES and SNA.

2.11.2 Develop, test, and adopt new designs for these water mills.

Starting date: Month 3
Duration: 8 months
Responsible party: IPPP, MNES and SNA.

2.11.3 Develop add-on multipurpose devices, including electricity generation units, for water mills to make them functional for twenty-four hours each day.

Starting date: Month 3
Duration: 8 months
Responsible party: IPPP, MNES and SNA.

2.11.4 Construct modifications for upgraded water mills.

Starting date: Month 11
Duration: 18 months
Responsible party: NPPP, MNES and SNA.

2.11.5 Prepare operation and maintenance manuals, in English and local languages, for these upgraded water mills.

Starting date: Month 29
Duration: 12 months
Responsible party: MNES and SNA.

2.11.6 Train local personnel, including women, in the operation and maintenance of these water mills.

Starting date: Month 29
Duration: 14 months
Responsible party: MNES and SNA.

Output 2.12

The villagers, including women, will have been trained in the skills necessary to work in small-scale industries. This will also allow them to set up their own small-scale businesses.

Activities for Output 2.12

2.12.1 Train villagers in different skills needed to work in small-scale industries, and in setting up their own industries.

Starting date:	Month 25
Duration:	12 months
Responsible party:	MNES, SNA, NGOs and government departments.

2.12.2 Assist in arranging loans from appropriate development agencies for villagers to set up small-scale industries.

Starting date:	Month 25
Duration:	12 months
Responsible party:	MNES, SNA, NGOs, small-scale industries, and other government departments.

Output 2.13

Following UNDP guidelines, a revolving fund to provide soft loans to the private sector for equipment will have been created.

Activities for Output 2.13

2.13.1 Identify clusters of small hydel projects to be developed by the private sector.

Starting date:	Month 31
Duration:	3 months
Responsible party:	MNES and SNA.

2.13.2 Prepare guidelines in consultation with UNDP for the revolving fund.

Starting date:	Month 31
Duration:	6 months
Responsible party:	MNES and IREDA.

2.13.3 Establish the revolving fund to provide loans to private entrepreneurs.

Starting date:	Month 37
Duration:	Continuing activity
Responsible party:	MNES and IREDA.

Output 2.14

A report on the management of the small hydel projects, including cost-benefit analysis, electricity tariffs to be charged, and revenue collection, will have been prepared.

Activities for Output 2.14

2.14.1 In cooperation with local people, prepare a report on the management of small hydel projects, including cost-benefit analysis, electricity tariffs, and revenue collection.

Starting date:	Month 31
Duration:	6 months
Responsible party:	MNES and SNA.

2.14.2 Organize and conduct a national workshop to develop various models for the operation, maintenance, management, revenue collection, and expenditure for small hydel projects.

Starting date:	Month 37
Duration:	3 months
Responsible party:	MNES, SNA, NGOs and local bodies.

2.14.3 Implement the above report in the demonstration projects for the sustainability of operation and maintenance.

Starting date:	Month 37
Duration:	Continuing activity
Responsible party:	MNES and SNA.

IMMEDIATE OBJECTIVE 3

To develop the necessary institutional and human resource capabilities from the local to the national level for the execution and implementation of this project. To foster sustainable development of the small hydel sector in the hilly regions.

Achievement Indicators

One criterion for the project's success would be the establishment of a team of officials at the national and state levels to handle the planning, design, construction, maintenance, operation, and management of the projects. A second criterion would be to have a large number of local people, in village *panchayats* or other local bodies, trained in the management and maintenance of small hydel projects. A third criterion would be the extensive use of the three selected technical institutions for testing, training, applied research, consultancy, and information services for small hydel projects.

Output 3.1

Fifty-three individuals from the MNES, state nodal agencies, equipment manufacturers, industry associations, local bodies, and NGOs will have been trained in the planning, design, construction, operation, maintenance, management, revenue collection, and expenditure related to small hydel projects. Education will have been provided through fellowship training, study tours, and on-the-job training.

Activities for Output 3.1

3.1.1 Identify candidates from the MNES, state nodal agencies, equipment

manufacturers, industry associations, local bodies, and NGOs for training in the fields of planning, design, construction, operation, maintenance, management, revenue collection, and expenditure related to small hydel projects.

Starting date:	Month 1
Duration:	18 months
Responsible party:	IPPP, NPPP, MNES and SNA.

3.1.2 Identify training programmes, including study tours, for the training abroad of selected candidates in various fields.

Starting date:	Month 1
Duration:	24 months
Responsible party:	IPPP, NPPP and MNES.

3.1.3 Training of the identified candidates by individual fellowship training and through study tours.

Starting date:	Month 7
Duration:	24 months
Responsible party:	IPPP, NPPP and MNES.

3.1.4 On-the-job training of the counterpart staff by international consultants and national professionals.

Starting date:	Month 1
Duration:	42 months
Responsible party:	IPPP and NPPP.

3.1.5 Organize a workshop on the mode of execution and implementation of this project.

Starting date:	Month 4
Duration:	3 months
Responsible party:	IPPP, MNES and SNA.

Output 3.2

Facilities will have been developed at the selected technical institutions in the fields of testing, training, applied research, consultancy, and information services.

Activities for Output 3.2

3.2.1 Review existing facilities and testing equipment, and identify new facilities and equipment required.

Starting date:	Month 1
Duration:	5 months
Responsible party:	NPPP, MNES and TI.

3.2.2 Plan and construct new facilities as required.

Starting date:	Month 6
Duration:	24 months
Responsible party:	IPPP, NPPP, MNES and TI.

3.2.3 Prepare specifications for testing the required equipment, and arrange for its procurement, installation, and commissioning.

Starting date:	Month 6
Duration:	30 months
Responsible party:	IPPP, NPPP, MNES and TI.

3.2.4 Review existing training facilities, assess training needs, and prepare training syllabi, taking into account the training needs assessed.

Starting date:	Month 1
Duration:	8 months
Responsible party:	IPPP, MNES and TI.

3.2.5 Identify candidates for the preparation of training syllabi and for conducting training courses, and prepare them through fellowship training abroad.

Starting date:	Month 9
Duration:	16 months
Responsible party:	MNES and TI.

3.2.6 Identify, procure, and install equipment for training.

Starting date:	Month 7
Duration:	16 months
Responsible for activity	MNES and TI.

3.2.7 Organize and conduct pilot training courses.

Starting date:	Month 25
Duration:	18 months
Responsible party:	MNES and TI.

3.2.8 Review existing facilities available for applied research and identify new facilities and equipment to be provided.

Starting date:	Month 1
Duration:	5 months
Responsible party:	MNES and TI.

3.2.9 Arrange for the provision of new facilities and equipment for applied research, and undertake their installation.

Starting date:	Month 6
Duration:	30 months
Responsible party:	IPPP, MNES and TI.

3.2.10 Identify candidates for training in applied research, and arrange for fellowship training abroad.

Starting date:	Month 6
Duration:	30 months
Responsible party:	MNES and TI.

3.2.11 Review existing facilities for consultancy and information services on small hydel projects. Identify new facilities and equipment required.

Starting date:	Month 1
Duration:	4 months
Responsible party:	MNES and TI.

3.2.12 Arrange for new facilities, and the procurement and installation of the equipment required for consultancy and information services.

Starting date:	Month 6
Duration:	30 months
Responsible party:	IPPP, MNES and TI.

3.2.13 Identify and arrange for fellowship training in consultancy and information services.

Starting date:	Month 6
Duration:	30 months
Responsible party:	MNES and TI.

E. INPUTS

1. Government of India

Rs. 224.805 million (US$ 7.14 million)

Personnel

Rs. 17,055,000 (US$ 541,000)

National Project Director

The government will appoint a senior officer of the Ministry of Non-conventional Energy Sources (MNES) as the National Project Director. The Director will manage and coordinate the overall project, and ensure that the national counterparts, facilities, and support services are provided in accordance with the workplan.

Project Implementation Committee (PIC)

The government will create a PIC with the Secretary, MNES, as its chairperson, and the National Project Director as its Member Secretary. The PIC will include persons from concerned government departments, agencies, NGOs, and private enterprises. The PIC will monitor project activities and provide necessary direction and guidance for project implementation.

Project management cell

The government will also appoint one National Project Coordinator and one Technical Officer to assist the National Project Director in coordinating the work of consultants, project staff, and state agencies. They will form part of the project management cell, which will be headed by the National Project Director.

Regional project offices

The government will appoint three project managers, three assistant project managers, and six technical officers for the regional project offices. These officials will assist the National Project Director in the implementation of project activities.

Technical institutions

For the three technical institutions selected for this project, the government will appoint three directors and twenty scientists to assist the National Project Director in the implementation of project activities. In addition to these officials, the MNES will provide necessary technical support personnel in various disciplines to facilitate the implementation of the various activities.

Assignment of national counterparts

The MNES will ensure that the following personnel be assigned as national counterparts to the UNDP consultants:

- National Project Director (one)
- National Project Coordinator (one)
- Technical Officer (one)

- Directors of technical institutions (three)
- Project Managers in the regional project offices (three).

Assignment of administrative support personnel

The MNES will also provide funds for the following administrative support personnel for the duration of the project:

- Personal assistants/stenographers (nine)
- Drivers (two)
- General service staff (twenty-six).

In addition, the government shall make officials available to undertake fellowship training, as specified by UNDP. These officials will continue to receive their salaries and benefits during the training period.

Training

Rs. 3.5 million (US$ 111,000)

In addition to the fellowship and group training specified by UNDP, the government will arrange training courses, seminars, and workshops at the three selected technical institutions and in the central project management cell. The government will provide Rs. 3.5 million (US$ 111,000) for training during the life of the project. These funds will cover the cost of travel; per diem expenditures for the participants; expenses for organizing and conducting the training courses, seminars and workshops; honorarium for guest lecturers; and other miscellaneous training expenses.

Equipment

Rs. 196.5 million (US$ 6.24 million)

The MNES will provide Rs. 1 million (US$ 32,000) for expendable equipment for the duration of the project. The MNES will also provide Rs. 65.5 million (US$ 2.08 million) for land, buildings, and civil works for the demonstration projects. These funds will also be used for upgrading the facilities of the three technical institutions. The MNES will provide Rs. 130 million (US$ 4.13 million) for non-expendable equipment for the demonstration projects.

Miscellaneous

Rs. 7.75 million (US$ 246,000)

The MNES will provide Rs. 7.75 million (US$ 246,000) for miscellaneous expenses for the duration of the project. This sum will cover operation and maintenance of project vehicles provided through UNDP, equipment purchase, equipment maintenance, and other miscellaneous expenses. These funds will also cover rent for offices, furniture, consultants, national professionals, and other project staff.

2. GEF/UNDP

US$ 7.5 million

Personnel

US$ 1,030,500

International consultants

Consultant	*Work months*
Micro Hydel Consultant	18
Equipment Design Consultant	12
Water Mills Consultant	3
Load Development Consultant	12
Training Consultant	3
Rural Development Consultant	3
Environmental Assessment Consultant	3
Multi-Media Consultant	3
Total	57

Details for the deployment of consultants are described in the workplan (Annex 1).

National professionals

Professional	*Work months*
Micro Hydel Expert	24
Equipment Design Expert	12
Water Mills Expert	6
Rural Development Expert	12
Environment Expert	6
Social Marketing Expert	6
Economist	6
Total	72

Due to the restricted environment in the government, the assigned officials have not been exposed to the advanced technology involved in the development of small hydel systems. It is necessary, therefore, to draw upon the services of private personnel with experience in small hydel projects. The pay structure and regulations of the Government of India would not be sufficient to entice private individuals into service for the project. To overcome this obstacle, UNDP inputs will be used to employ these personnel as national professional staff.

In-country travel

A sum of US$ 95,000 will be provided for in-country travel for international consultants.

Mission costs

Following UNDP procedures, US$ 100,000 will be provided for independent mid-term evaluation and terminal evaluation of the project.

Subcontracts

US$ 650,000

To cover costs not provided through subcontracts, US$ 650,000 will be provided to cover activities, including:

- Analysis of hydrological and geological data
- Preparation of long-term objectives and investment strategies for small hydel projects
- Preparation of thematic studies described in the master plan, including social marketing studies
- Preparation of report on the administration and management of small hydel resources, including tariff structure and collection of revenues
- Formulation of load development strategies
- Development of appliances for heating, cooking, low-wattage storage, and other uses
- Environmental Impact Assessments
- Determination of potential conflict with other renewable energy sources
- Survey of fuel-use patterns before and after the demonstration projects, fuelwood savings, and carbon emissions reductions
- Survey on the use of hydel power generated by the demonstration projects
- Training of personnel in optimal investment policies for small hydel projects
- Survey of employment opportunities created by the projects and reduction in migration to urban areas.

Subcontracts will be assigned to qualified national institutions, private bodies, and NGOs to achieve these goals.

Training

US$ 503,600

Forty-two individual fellowships for a period of eighty-four months, and twenty group fellowships for a period of twelve months, will be provided at a total cost of US$ 503,600. These funds will cover the travel costs of fellows and per diem allowances. Salary costs will be paid by the government during their training period.

Equipment

US$ 3.6 million

US$ 3.6 million will be provided to cover expendable and non-expendable equipment. The equipment will be transferred to the government at the end of the project.

Miscellaneous

US$ 1,715,900

US$ 1.4 million has been earmarked for a revolving fund to provide soft loans for private sector investments in the small hydel projects in the hilly regions. This amount has been budgeted under the equipment component of the UNDP budget. A sum of US$ 315,900 will be provided to cover operation and maintenance of equipment, reporting costs, UNDP field administrative costs, and other expenses.

F. RISKS

Initial risk	*Estimated likelihood*
Failure of the government to assign National Project Director and other project officials	Low
Failure of the government to assign counterpart national staff for international consultants and other project staff	Low
Failure of the government to identify and provide candidates for fellowship training abroad in time	Low
Failure of the government to provide for administrative support, office premises, furniture, and other materials in time	Low

Delay in the recruitment of international staff	Low
Drastic changes in the project area's hydrology or geology	Low
Adverse climatic conditions during survey and execution of demonstration projects	Low
Insufficient coordination between MNES, state governments, and the selected institutions	Low
Local resistance to switching from fuelwood to electricity for cooking and heating	Low
Local resistance towards the change of life-style with the provision of electricity	Low.

G. PRIOR OBLIGATIONS AND PREREQUISITES

1. Prior obligations

The Government of India will ensure that the necessary budgetary resources are available to ensure the mobilization and delivery of the government inputs specified in the Project Document. As a signatory to the document, UNDP's assistance to the project will be provided only if the government's prior obligations have been met to UNDP's satisfaction.

2. Prerequisites

To satisfy the UNDP, the government shall ensure the timely provision of all the items listed under government inputs. If the government's fulfillment of one or more prerequisites appears to be insufficient, UNDP may, at its discretion, either suspend or terminate its assistance.

H. PROJECT REVIEW, REPORTING AND EVALUATION

1. Project review

The project will be reviewed by representatives of the Government of India, GEF, and UNDP at least once every year until full implementation of the project. The National Project Director shall submit a Project Performance Evaluation Report (PPER) three months prior to this yearly evaluation. Additional PPERs may be requested, if necessary, during the project.

2. Reporting

Upon full project implementation, the final PPER will be submitted three months prior to the final evaluation by the government, GEF, and UNDP. A draft PPER will be available three months

in advance to allow review and technical clearance by UNDP, at least four months prior to the final tripartite review.

3. Evaluation

The project shall be subject to two in-depth evaluations, one during the course of the project and the other at the scheduled termination of project activities. The organization, terms of reference, and timing of evaluations will be decided in consultation among the parties to the Project Document.

The monitoring of the Environmental Overview of the Project and Management Strategy (EOPMS) will be carried out by a joint committee consisting of representatives from the MNES and UNDP, established for the purpose. The positive and negative impacts will be reviewed once every six months by the committee, which will make appropriate recommendations for implementation by all concerned.

I. LEGAL CONTEXT

This Project Document is the instrument referred to in Article 1 of the Standard Basic Assistance Agreement between the Government of India and UNDP, signed 20 October, 1959. The host country implementing agency shall be, for the purpose of the Standard Basic Assistance Agreement, the government cooperating agency described in that agreement.

The following revisions may be made to this Project Document with the approval of the UNDP Resident Representative only, provided he or she is assured that the other signatories of the document have no objections to the proposed changes:

- Revision of, or addition to, any of the annexes of the original Project Document
- Revisions which do not involve significant changes in the immediate objectives, outputs, or activities of a project, but are caused by the rearrangement of inputs agreed to, or by cost increases due to inflation
- Mandatory annual revisions which rephase the delivery of agreed project inputs, increased costs for experts, or other costs due to inflation or agency expenditure flexibility.

J. BUDGET

The Government of India and UNDP budgets are attached.

PROJECT BUDGET COVERING GOVERNMENT OF INDIA CONTRIBUTION
(in Indian rupee 100,000s (in kind))

Country: India
Project No.: IND/91/G 31
Project title: Optimizing Development of Small Hydel Resources in the Hilly Regions

Code	Description		Total		1994		1995		1996		1997	
			w/m	Rs.	w/m	Rs.	w/m	Rs.	w/m	Rs.	w/m	Rs.
10.	PERSONNEL											
	Project Management Cell											
11.01	National Project Director	(1)	42	5.30	9	1.05	12	1.50	12	1.55	9	1.20
11.02	National Project Coordinator	(1)	42	3.40	9	0.65	12	0.95	12	1.00	9	0.80
11.03	Tech. Officer	(1)	42	2.85	9	0.55	12	0.80	12	0.85	9	0.65
11.04	Personal Asst./ Stenographer	(3)	126	5.35	27	1.05	36	1.50	36	1.60	27	1.20
11.05	General Services Staff	(2)	84	2.00	18	0.35	24	0.55	24	0.60	18	0.50
11.06	Drivers	(2)	84	2.00	18	0.35	24	0.55	24	0.60	18	0.50
11.09	Sub total		420	20.90	90	4.00	120	5.85	120	6.20	90	4.85
	Regional Project Offices											
11.11	Project Managers	(3)	126	8.35	27	1.70	36	2.35	36	2.45	27	1.85
11.12	Asst. Proj. Mgrs.	(3)	126	7.40	27	1.50	36	2.10	36	2.20	27	1.60
11.13	Tech. Officers	(6)	252	8.35	54	1.70	72	2.35	72	2.45	54	1.85
11.14	Stenotypists/ Clerks	(6)	252	10.50	54	2.10	72	2.95	72	3.15	54	2.30
11.15	General Services Staff	(6)	252	6.35	54	1.30	72	1.80	72	1.85	54	1.40
11.19	Sub-total		1008	40.95	216	8.30	288	11.55	288	12.10	216	9.00
	Technical Insts.											
11.21	Directors	(3)	126	12.65	27	2.55	36	3.60	36	3.75	27	2.75
11.22	Scientists	(20)	840	44.20	180	9.35	240	12.60	240	12.70	180	9.55
11.25	General Services Staff	(18)	756	18.85	162	3.90	216	5.30	216	5.50	162	4.15
11.29	Sub-total		1722	75.70	369	15.80	492	21.50	492	21.95	369	16.45
11.99	Sub-component total			137.55		28.10		38.90		40.25		30.30

Code	Description	Total w/m	Total Rs.	1994 w/m	1994 Rs.	1995 w/m	1995 Rs.	1996 w/m	1996 Rs.	1997 w/m	1997 Rs.
15.	Travel		33.00		5.60		10.50		10.50		6.40
19.	Personnel component total		170.55		33.70		49.40		50.75		36.70
30.	TRAINING										
31.	Training courses, seminars and workshops		35.00		6.00		10.00		12.00		7.00
39.	Training component total		35.00		6.00		10.00		12.00		7.00
40.	EQUIPMENT										
41.	Expendable equipment		10.00		1.75		3.00		3.00		2.25
42.	Non-expendable equipment										
42.01	Land, buildings and civil works		655.00		100.00		390.00		165.00		-
42.02	Other non-expendable equipment		1300.00		115.00		500.00		500.00		185.00
49.	Component total		1965.00		216.75		893.00		668.00		187.25
50.	MISCELLANEOUS										
51.	Operation and maintenance		25.00		3.75		8.00		8.00		5.25
52.	Office Accommodn. rental		25.00		5.25		7.10		7.20		5.45
53.	Sundries		27.50		6.00		7.50		7.50		6.50
59.	Component total		77.50		15.00		22.60		22.70		17.20
99.	Grand Total		2248.05		271.45		975.00		753.45		248.15

Rs. 224.805 million

Note: IREDA's operational expenses would be met by the government. Accordingly, a provision has been made under the "Sundries" component of this budget.

PROJECT BUDGET COVERING GEF/UNDP CONTRIBUTION
(in US$)

Country: India
Project No.: IND/91/G31
Project title: Optimizing Development of Small Hydel Resources in the Hilly Regions

Code	Description	Total w/m	Total $	1994 w/m	1994 $	1995 w/m	1995 $	1996 w/m	1996 $	1997 w/m	1997 $
10.	PROJECT PERSONNEL										
11.	International Experts										
11.50	Consultants										
11.51	Micro Hydel Consultant	18	218,400	6	69,400	6	72,600	6	76,400	-	-
11.52	Equipment Design Consultant	12	147,600	6	69,400	4	49,800	2	28,400	-	-
11.53	Water Mills Consultant	3	36,700	3	36,700	-	-	-	-	-	-
11.54	Load Development Consultant	12	150,900	3	36,700	4	49,800	5	64,400	-	-
11.55	Training Consultant	3	36,700	3	36,700	-	-	-	-	-	-
11.56	Rural Development Consultant	3	40,400	-	-	-	-	3	40,400	-	-
11.57	Environmental Assmt. Consultant	3	40,400	-	-	-	-	3	40,400	-	-
11.58	Multi-media Consultant	3	38,400	-	-	3	38,400	-	-	-	-
11.99	Sub-total	57	709,500	21	248,900	17	210,600	19	250,000	-	-
15.	Duty travel		95,000		35,000		25,000		35,000	-	-
16.	Mission costs (Mid-term and terminal evaluation)		100,000		-		50,000		-		50,000
17.	National Project Professional Staff	(Note 1)									
17.01	Micro Hydel Expert	24	38,400	9	13,500	12	19,200	3	5,700	-	-
17.02	Eqpt. Design Expert	12	19,200	6	9,000	6	10,200	-	-	-	-
17.03	Water Mills Expert	6	10,200	-	-	6	10,200	-	-	-	-
17.04	Rural Dev. Expert	12	23,400	-	-	-	-	6	11,400	6	12,000
17.05	Environment Expert	6	11,700	-	-	-	-	3	5,700	3	6,000
17.06	Social Marketing Expert	6	11,700	-	-	-	-	3	5,700	3	6,000
17.07	Economist	6	11,400	-	-	-	-	6	11,400	-	-
17.99	Sub-total	72	126,000	15	22,500	24	39,600	21	39,900	12	24,000
19.	Personnel component total		1,030,500		306,400		325,200		324,900		74,000

Code	Description	Total w/m	Total $	1994 w/m	1994 $	1995 w/m	1995 $	1996 w/m	1996 $	1997 w/m	1997 $
20.	SUB-CONTRACTS										
21.	Sub-contracts		650,000		200,000		200,000		150,000		100,000
29.	Component total		650,000		200,000		200,000		150,000		100,000
30.	TRAINING										
31.	Fellowships	84	344,800	40	160,000	44	184,800	-	-	-	-
32.	Group training										
32.01	Study tours	12	158,800	4	51,000	4	52,600	4	55,200	-	-
32.02	Workshops(Note 2)		16,000								16,000
39.	Component total		519,600		211,000		237,400		55,200	-	16,000
40.	EQUIPMENT										
41.	Expendable equipment		70,000		20,000		20,000		20,000		10,000
42.	Revolving Fund		1,400,000		-		-		600,000		800,000
47.00	Non-expendable equipment										
47.01	Equipment for demonstration projects		2,930,000		100,000		1,130,000		1500,000		200,000
47.02	Equipment for instns.		500,000		100,000		200,000		200,000		-
47.03	Other non-expendable equipment		100,000		70,000		20,000		10,000		-
49.	Component total		5,000,000		290,000		1,370,000		2,330,000		1,010,000
50.	MISCELLANEOUS										
51.	Operation and maintenance of equipment		110,000		15,000		25,000		50,000		20,000
52.	Reporting costs		6,000								6,000
53.	Sundries (Note 3)		43,900		11,000		12,000		12,000		8,900
54.	UNDP field administrative costs (Note 4)		140,000		25,000		45,000		45,000		25,000
59.	Component total		299,900		51,000		82,000		107,000		59,900
99	Grand total		7,500,000		1,058,400		2,214,600		2,967,100		1,259,900

Notes:

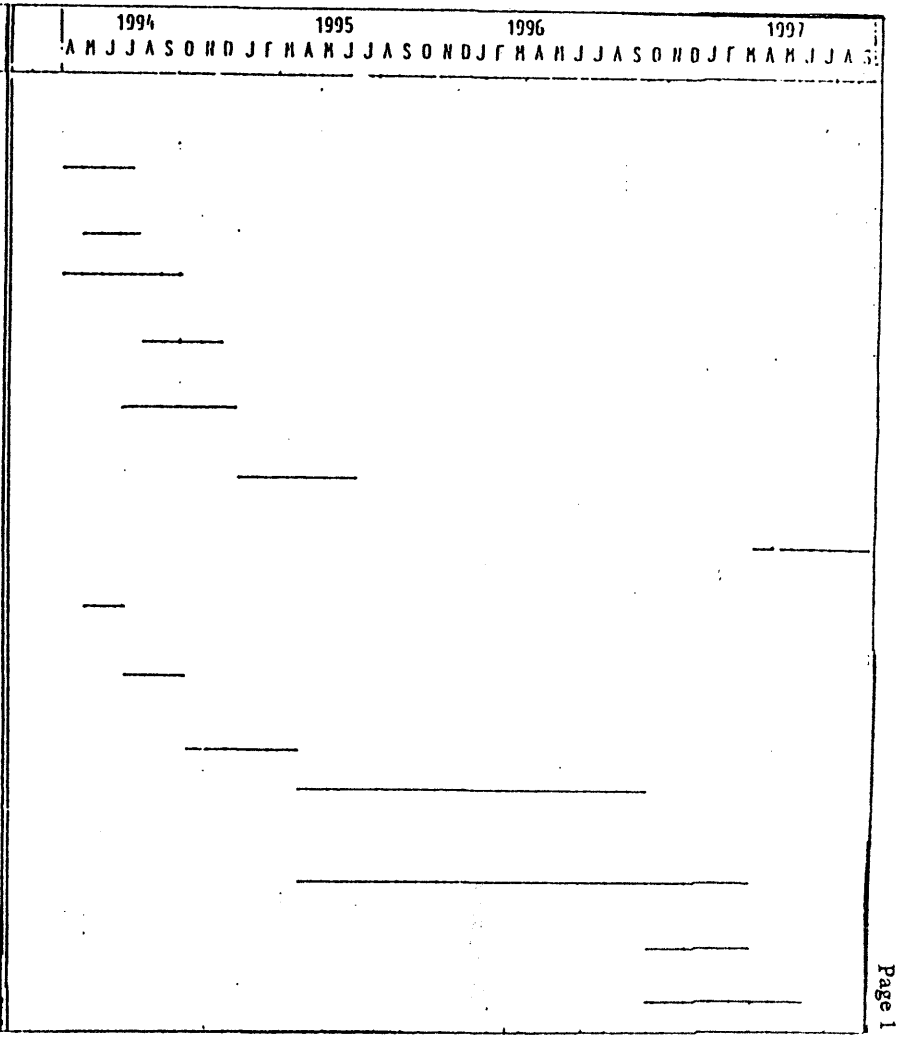
1. The budget includes the cost of internal travel and DSA as per govt. rates for the NPPPs.
2. This provision is for the technical inputs for the workshops. The rest would be borne by government.
3. "Sundries" includes the expenditure incurred by UNDP in the preparatory project formulation process and related activities.
4. This provision is for UNDP field office expenses for various technical and monitoring purposes, as considered necessary by UNDP.

Annex 1

PRELIMINARY WORKPLAN

Major activities

	Description
1.1	Review and assess all available data including existing infrastructure and facilities and untapped small hydel potential.
1.2	Prepare a zoning plan identifying different zones for different techniques of hydel generation.
1.3	Establish long term objectives and investment strategies.
1.4	Prepare development plans for development of small hydel projects in each zone.
1.5	Conduct thematic studies and prepare reports on various issues and aspects of importance to the master plan.
1.6	Prepare a master plan for optimum utilisation of small hydel resources in the regions.
1.7	Update the master plan on the basis of experience gained through the demonstration projects.
2.1	Identify twenty small hydel projects to serve as demonstration projects.
2.2	Prepare designs using latest available technology to improve the efficency of small hydel projects.
2.3	Prepare drawings, specifications, tender documents, call for bids and award contracts for the demonstration projects.
2.4	Execute the demonstration projects.
2.5	Examine proof of viability of the new technologies and designs, monitor project implementation and ensure quality control, design safety, reliability and prepare completion drawings.
2.6	Carry out survey on the use of electricity generated by the demonstration projects.
2.7	Prepare operation and maintaince manuals for these projects.

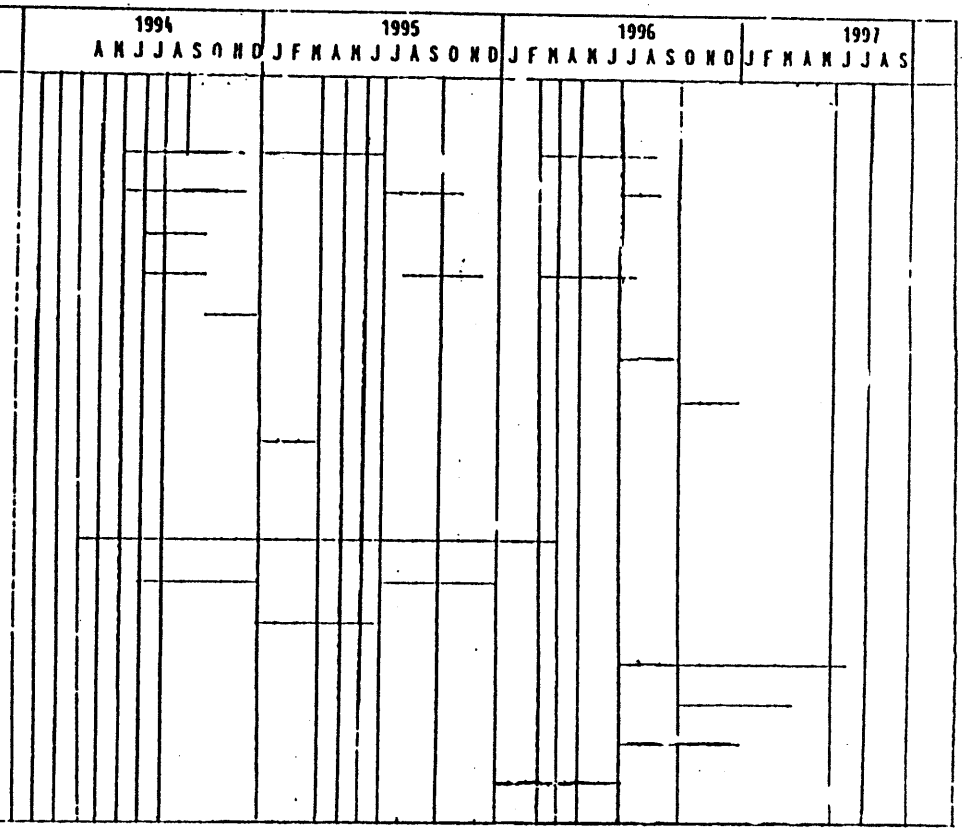


Major activities (contd.)

	Description	1994 A M J J A S O N D	1995 J F M A M J J A S O N D	1996 J F M A M J J A S O N D	1997 J F M A M J J A S.
2.8	Provide on-the-job training to the local personnel in the operation and maintaince of these projects.			———	
2.9	Carry out fuel use survey and develop load development programme.		———		
2.10	Implement load development programme.			———	
2.11	Identify and upgrade 100 water mills through improved designs and add-on facilities for electricity generation etc.	———	———	———	———
2.12	Train villagers in different skills, to work in small scale industries and also set up their own small scale industrial units.			———	———
2.13	Set up and operationalise revolving fund.				———
2.14	Prepare report and implement the management of small hydel projects.				———
3.1	Identify and train personnel in the planning, design, implementation, operation, maintaince and management of small hydel projects.	———	———	———	———
3.2	Develop/upgrade the capabilities of the three technical institutions in the fields of testing, training, applied research and consultancy and information services.	———	———	———	———

Deployment of international consultants and national professionals

Code	Description	Total v/m
11.	INTERNATIONAL CONSULTANTS	
11.51	Micro Hydel Consultant	18
11.52	Equipment Design Consultant	12
11.53	Water Mills Consultant	3
11.54	Load Development Consultant	12
11.55	Training Consultant	3
11.56	Rural Development Consultant	3
11.57	Environment Assessment Consultant	3
11.58	Multi-Media/other discipline Consultant	3
17.	NATIONAL PROFESSIONALS (NPPP)	
17.01	Micro Hydel Expert	24
17.02	Equipment Design Expert	12
17.03	Water Mills Expert	6
17.04	Rural Development Expert	12
17.05	Environment Expert	6
17.06	Social Marketing Expert	6
17.07	Economist	6



Annex 2

FUELWOOD SAVINGS AND CARBON EMISSIONS CALCULATIONS

1. A small hydel plant will produce 5,256 units of electricity per year for each kilowatt of installed capacity, at a normal load factor of 60 percent. It is expected that 50 percent of the energy produced (approximately 2,628 units) will be used for cooking and heating. These units will replace energy produced by fuelwood, with the remaining 50 percent to be used for lighting and other industrial and commercial purposes.

2. One kilowatt hour (unit) of electricity will produce the same amount of heat as 0.54 kilograms of fuelwood in open *chulah* burning, which is normally used for cooking and heating in the hilly regions of India.

3. 2,628 units will give the same heat equivalent as 2,628 x 0.54 kilograms, or 1.42 tons of fuelwood. Therefore, for each kilowatt of installed capacity, there will be a saving of 1.42 tons of fuelwood per year. The twenty demonstration projects will have a total installed capacity of 5,000 kilowatts, so that there will be a saving of 5,000 x 1.42 = 7,100 tons of fuelwood per year on completion of these projects.

4. Taking carbon at 45 percent of the woody biomass, there will be a reduction in carbon emissions by 7,100 x 0.45 = 3,200 tons per year, on completion of the demonstration projects.

5. The Advisory Board on Energy of the Government of India has estimated that 650 kilo calories of heat per person per day will be required for heating and cooking purposes. One kilowatt hour (unit) of electricity will give 324 kilo calories of heat for cooking and heating in open *chulah* burning, after taking into account the loss of heat by radiation and other factors. Thus, two units of electricity per day per person will be required for cooking and heating.

6. 5,000 kilowatt installed capacity will give 5,000 x 2,628 units (1,314,000 units) per year, for cooking and heating. This calculation amounts to 36,000 units per day, which will fulfill the requirements of 18,000 persons (36,000 divided by 2) for cooking and heating.

7. Out of the balance of 36,000 units per day which will be used for lighting, irrigation, industrial, and commercial purposes, it is estimated that 18,000 units per day will be used for industrial and commercial purposes, generating employment opportunities for 1,800 persons (18,000 divided by 10). Assuming five persons per family, there will be reduction in migration by 9,000 persons, as a result of the twenty demonstration projects.

8. At the end of the Eighth Five-Year Plan, 300 MW of small hydel projects are expected to be installed in the hilly regions.

9. With 1.42 tons of savings in fuelwood per one kilowatt of installed capacity, the saving in fuelwood at the end of the Five-Year Plan will be 300,000 x 1.42 = 426,000 tons per year. Similarly, the reduction in carbon emissions will be 0.45 x 426,000 = 191,700 tons per year. The reduction in migration of population to the urban areas will be 9000 x 300,000/ 5000 = 540,000 persons, at the end of the Eighth Five-Year Plan period.