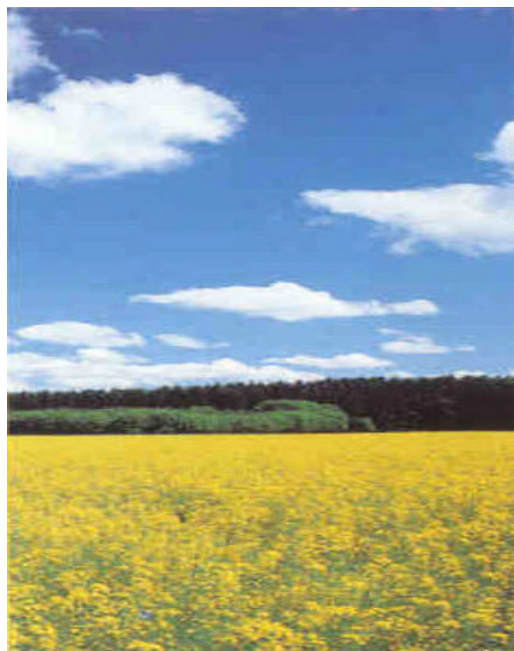




WORLDWIDE CONSULTANTS FOR 50 YEARS



RURAL ELECTRIFICATION

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One of the major constraints to rural development is the lack of adequate energy infrastructures: actually, any sustainable socio-economic development strategy aimed at improving the living standard of populations must rely on the access to affordable energy sources, in particular electricity. It is estimated that at present approximately 2 billion people throughout the world do not have access to electricity, even to fulfil their basic needs.

The major international institutions, including the World Bank Group, the Agencies of the United Nations and the Regional Development Banks, are well aware of this situation. In fact, over the past decade financial support in the field of electricity generation has progressively been shifting from large size commercial projects, with a capacity in the order of hundreds of MW, to small decentralized systems, with emphasis on the utilisation of renewable energy. This change of policy finds a further justification in the growing concern about the adverse environmental impact induced by commercial generation.

THE CHALLENGE OF RURAL ELECTRIFICATION

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The introduction of electricity in rural communities brings on a series of benefits, which can be hardly expressed in monetary terms, but have a paramount importance in the improvement of livelihood and in the poverty alleviation, such as:

- Lighting for homes, streets and community centres;
- Enhancement of education and health-care facilities;
- Possibility of use of household appliances (TV, refrigerator, telephone, etc.);
- Availability of safe drinking water;
- Introduction of agricultural and industrial opportunities.

The implementation of small electrical systems is, to a certain extent, even more complex than for large projects, due to the existence of specific barriers that hinder the marketing of the systems themselves. The most significant barriers refer to:

- Low level of demand;
- Lack of renewable energy data;
- Lack of appropriate expertise, technology and manufacturing capacity in the country of operation;
- High capital investment;
- Lack of information and of public perception;
- Failure to express external costs (benefits related to improvements in climate change, acid rain, air pollution);
- Lack of suitable financing mechanism;
- Lack of institutional structures for promotion of renewable energy applications;
- Lack of political will.

Under this situation, the studies for the removal of the barriers and hence for the successful implementation of a rural electrification project require an innovative and flexible approach, where institutional and financial aspects own equal dignity as technical ones. It is therefore essential that the consulting support for the execution of any program be provided by companies with an extensive, worldwide experience in projects characterized by a multi-disciplinary and complex nature.

ELC Electroconsult feels that it fully satisfies the above stated requirements and is ready to face the challenge of rural electrification programs with the confidence of being able to provide high quality consulting services and to optimise the chances for a successful outcome of the enterprise.

ELC Electroconsult has been operating in the field of electricity generation, transmission and distribution since 1955. During this period it has provided consulting services and technical assistance in over 80 projects, that range from the 12,600 MW hydroelectric plant of Itaipu (Brazil) to the 10 MVA tapping substations in Indonesia installed to electrify rural areas.

In accordance with the worldwide trend, the firm, while still active in several "conventional" projects,

such as the construction on the 200 MW hydroelectric power plant of Gilgel Gibe in Ethiopia, is more and more dedicating itself to the participation in *local* enterprises, due to have a direct and immediate beneficial effect on the living conditions of the neighbouring populations.

It is worth mentioning that the large majority of the ELC Electroconsult projects have been or are being carried out in developing countries, especially in South East Asia and Latin America. In fact, all the technical employees and permanent consultants of the firm spent long periods of their professional life abroad, working in close cooperation with the local counterpart and regional/local institutions and acquiring a direct knowledge of the prevailing rural conditions. Such first-hand experience constitutes a formidable tool for designing rural electrification programs that are tailor-made for the specific situation of the area and are affordable under the existing socio-economic background.



The issues affecting a rural electrification program can be basically subdivided into three general categories: technical, institutional and financial. In the following pages these issues are individually examined, showing for each one the availability of experts within the Association together with a broad indication of their potential tasks.

Here after a schematic flow chart of the activities required for executing a “typical” rural electrification program, all the way from the identification of the needs and financial possibilities of local people and the assessment of the resources up to the operation stage, is shown. In the same chart the involvement in each individual activity of the experts mentioned in the following pages is indicated.

LIST OF PROFESSIONALS FOR RURAL ELECTRIFICATION PROJECT

A1 – Micro-hydro Expert
A2 – Solar Expert
A3 – Wind Expert
A4 – Biomass / Biogas Expert
A5 – Diesel Expert
A6 – Rural Electrification Expert
A7 – Environmentalist
A8 – Agricultural Expert

B1 – Sociologist
B2 – Institutional Specialist
**B3 – Poverty Alleviation / Rural
Development Specialist**
**B4 – Dissemination, Training and
Capacity Building Specialist**

C1 – Economist
C2 – Financial Analyst
C3 – Private Investment Specialist



Technical issues basically relate to the exploitation of energy resources, in particular **renewable** ones, in an efficient and sustainable manner. Renewable energy technologies (especially photovoltaic, micro-hydro, wind power and biomass) are suited to meet the challenges imposed by development and environmental concerns, especially where remoteness of the area makes grid connection uneconomical.

The cost of electricity from renewable sources has progressively decreased during the last decade, because of improved efficiency and reliability of the components, as well as of higher production volume. Although initial investment costs still remain relatively high, where compared with commercial generation, life-cycle costs are becoming competitive, even more so if externalities, that is environmental benefits derived from renewable energy applications and non-market priced factors, are taken into account.

The choice of the most suitable technology is the main task facing the Consultant. This choice shall depend essentially on the availability of local renewable resources, on the needs and financial resources of potential end users, on the state of art of technology in the country of operation and on the cost of the components estimated on a life-cycle basis.

TECHNICAL ISSUES

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Once the choice has been made, the **Action Plan** for development can be formulated, taking into account the environmental, socio-economic, institutional and financial framework, as well as the potential impact on rural development. The detailed design of the generation and distribution system is then carried out, leading to the procurement and installation of the equipment, and the agricultural and industrial applications are evaluated.

The professional figures and broad tasks of the consultants expected to participate in a rural electrification program for tackling the technical issues are shown here below. The list includes the diesel expert, who is due to be part of the team only

in the few cases where exploitation of renewable resources results to be not viable.

A1 Micro Hydro Expert

- Assess the hydraulic resources in the area
- Design and estimate cost of hydraulic generation

A2 Solar Expert

- Assemble climatic data of prevailing solar resources
- Assess solar electricity generation/conversion potential
- Assess local industry capability (manufacturing, supply, distribution)
- Design and estimate cost of solar home systems (individual, centralized or hybrid)



A3 Wind Expert

- Assemble climatic data of prevailing wind resources
- Assess wind electricity generation/conversion potential
- Assess local industry capability (manufacturing, supply, distribution)
- Design and estimate cost of wind generator systems

A4 Biomass - Biogas Expert

- Assess biomass - biogas resources
- Assess biomass-biogas electricity generation/conversion potential
- Assess local industry capability (manufacturing, supply, distribution)
- Design and estimate cost of biomass or biogas generation systems

A5 Diesel Expert

- Based on energy demand pattern, select the most suitable equipment
- Design the fuel storage and supply system and estimate cost of diesel electricity generation

A6 Rural Electrification Expert

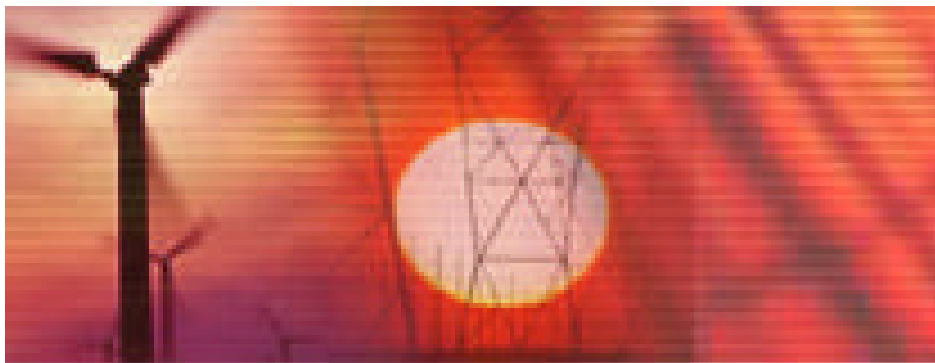
- Inspect the physical characteristics of the potential electrification sites (household density, location and number of public service centers, number of outlying customers, potential productive applications)
- Design and estimate cost of micro-grid distribution systems

A7 Environmentalist

- Conduct a study on the environmental impact related to rural electrification
- In case of negative impacts, propose mitigating measures and estimate associated costs

A8 Agricultural Expert

- Identify agricultural benefits to be produced by rural electrification (irrigation, milling, grain drying, processing, storage, fumigation)
- Assess the technical and economic viability of agricultural applications



The institutional framework represents a very important element in rural electrification. In fact, institutions can play a fundamental role in all aspects of the project, ranging from the provision of technical assistance to the support for credit access.

International institutions have lately been very active in the promotion of Renewable Energy Technology (RET) through transfer of technology, indigenous training, infrastructures development and project funding, as well as through post-project appraisal.

Government institutions, either at national, regional or local level, can give a strong impulse to RET by means of training programs, dissemination campaigns, products certification, research and development. At the same time it should be mentioned that the existence of hidden and direct subsidies to fossil fuel and of very high import taxation for renewable energy systems, as a result of the Government policy, may constitute a severe barrier to the utilization of RET.

INSTITUTIONAL FRAMEWORK

INSTITUTIONAL FRAMEWORK



Non-governmental Organizations (NGOs) can also play a significant role in disseminating technologies and providing feedback on the needs of the final electricity users, as well as in stimulating the users participation throughout the program implementation.

Finally, private companies, besides being potential contributors for project financing, can participate in the manufacturing, supply and installation of the equipment, maintenance and after sale services, training of installers and users.

In consideration of the critical role played by institutions in all phases of an electrification program, it is necessary that at the inception of the program itself the Consultant analyses in detail the institutional set-up and the local Government policy with respect to energy. The activities that can be undertaken by the different institutions, including NGO, will be pointed out and the possible areas of overlapping or of contrast identified.

The Action Plan must take into account the results of this analysis and present recommendations on the actions to be taken to improve the existing situation.

In the following phase, while the final design is completed and the equipment is procured and installed, programs of institutional strengthening and of training of local installers and maintenance technicians shall be undertaken and the infrastructures needed for managing the electric system shall be set up. During this phase, the opportunity to create rural energy service companies (RESCO) in charge of running the system (including maintenance of the equipment, procurement of spare parts, appraisal of results, bill collection, etc.) shall be evaluated. Moreover, the demonstration and dissemination activities, which are essential for the widespread development of RET, shall be planned.

The professional figures and broad tasks of the consultants expected to participate in a rural electrification program for tackling the institutional issues are shown here below.

B1 Sociologist

- Assess socio-economic conditions (e.g. population, income, occupation, value of assets, pattern of energy use)
- Define potential demand of population for electricity use (households, schools, health, commercial, agricultural, etc.)
- Estimate "willingness to pay" of the different market segments and preferred payment system (rental, leasing, purchase, utilization of credit, etc.)
- Determine Local Government Units affordability / borrowing capacity
- Identify social benefits derived from rural electrification

B2 Institutional Specialist

- Examine the political and institutional framework (government plans/policies, legislative and regulatory situation, finance/credit, research institutions)

- Define role, responsibilities and functions of different organizations (at international, national, local and community level)
- Assess the institutional capacity of each organization to fulfil its role
- Identify the barriers (technical, institutional, economic, financial) to the implementation of the project
- Make recommendations on institutional strengthening and capacity building
- Define the opportunity to establish RESCO (rural energy service companies)
- Establish the project management infrastructure



B3 Poverty Alleviation / Rural Development Specialist

- Identify the type of livelihood and development projects that are likely to flow on from rural electrification
- Assess the contribution of these projects to poverty alleviation
- Define technical and economic feasibility of the development projects
- Assess responsibilities and capacity of existing national and local governments units and NGOs to develop and implement the projects

B4 Dissemination, Training and Capacity Building Specialist

- Develop programs for information dissemination, promotion and demonstration on Renewable Energy Technologies and other aspects relevant to rural electrification at national and local level
- Involve potential users in the determination of their rural energy needs and in the decision-making process
- Train local installers and maintenance personnel



The high capital cost of RET applications, combined with the general low-income of potential rural users, make financial issues related to rural electrification especially important. In fact, in order that RET becomes affordable to more people, it is necessary that associated costs are spread over an extended time frame, wherefore the introduction of long-term repayment schemes is essential.

Different financing schemes can be conceived for this purpose, namely:

- *Consumer financing*, whereby dealers and distributors of RE systems act as credit brokers between their customer and a source of finance, such as a commercial bank.
- *Lease financing*, whereby the customer signs a contract with an agent (utility, co-operative or NGO), who arranges on their behalf low-cost credit from a bank or similar financing source. The lessor owns the system throughout the period of the agreement, after which ownership can be transferred to the end user.
- *Service contracts or rental schemes*, whereby the service organisation supplies the installation, maintenance and spare parts of the system for a certain fee and a deposit, on the assumption that any removable equipment can be repossessed by the organisation in case of default on payments.

FINANCIAL ISSUES

FINANCIAL ISSUES

The choice of the most appropriate financing scheme depends on the particular situation of the country, including the willingness and ability to pay of the potential customers, the existing credit set-up (indigenous organisations, commercial banks, development banks) and the eventual availability of grants or soft loans. The **Business Plan** will then be developed, determining the financing scheme, the cost of management infrastructures, the risk exposure of stakeholders, the IRR of the project and the effects of inflation.

In this context the private sector can play a very important role, given its availability of technology

and of investment funds. The opportunity to promote the intervention of the private sector shall be evaluated, indicating the possible measures to be taken for this purpose, such as fiscal incentives, tax holidays and depreciation allowances.

The professional figures and broad tasks of the consultants expected to participate in a rural electrification program for tackling the financial issues are shown here below.

C1 Economist

- Assess local cost data for typical investment items and fuel costs
- Estimate investment costs for both wired and individual systems (diesel or NRE), as well as generation costs, based on the input of the different technical experts
- Define the technology most economic in the area (on a life cycle cost basis)
- Calculate "economic cost", both including and not including local/global externalities (environmental and non-marked priced factors)

C2 Financial Analyst

- Define the technology or system most viable, from the financial viewpoint, for the beneficiary
- Calculate financial cost of service delivery
- Calculate project IRR
- Calculate subsidy (tariff) and connection (service) rates
- Review existing set-up of rural credit, savings and rural banking
- Select the most appropriate financing scheme

C3 Private Investment Specialist

- Identify strategies to promote private investment through fiscal incentives, tax holidays, depreciation allowance
- Identify potential private stakeholders
- Prepare a scheme of regulatory framework