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# UNIDO INITIATIVE ON RURAL ENERGY FOR PRODUCTIVE USE

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

economic and income employment

# UNIDO INITIATIVE ON RURAL ENERGY FOR PRODUCTIVE USE

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna, 2004

# Rural Energy for Productive Use a UNIDO strategy

## 1. The issue

Over 1.6 billion people lack access to modern forms of energy services. The vast majority of these people live in the rural areas of the poorest regions of the world, especially in sub-Saharan Africa and Southern Asia. Many are either too poor, or too isolated to attract commercial energy-related investments since they do not constitute a market that can generate an adequate return on those investments.

In addition, currently used sources of energy for cooking and heating (wood, crop residues, charcoal, etc.) are a significant source of indoor pollution and the cause of serious health problems, specially, but not only for small children. Furthermore, the use of fuel wood is an important contributor to deforestation.

Recently a global consensus has been reached that acknowledges that enhanced international cooperation is required to bring energy services to those currently without access to modern energy. As these segments of a population are not easily attracting private sector activity, there is agreement that a combination of international cooperation, strong national commitment and public funding is necessary to build the necessary basic energy service delivery structures.

Energy is a prerequisite for sustainable development and for fighting poverty. Availability of affordable and sustainable energy to all people is critical to the achievement of the Millennium Development Goals and its contributions impact in various ways:

- "**Halving extreme poverty**": Energy can provide an important contribution by freeing time otherwise used for fuel gathering, food grinding and preparation which can then be used for income generating productive activities.
- "**Halving the number of people who suffer from hunger**": Energy is required for pumping water (for drinking, irrigation); for processing/grinding food and cooking, as well as food conservation.
- "**Achieve universal primary education**": Energy contributes through powering information and communication, including distance learning, reducing the time spent on daily chores like fuel and water gathering and food preparation, and through lighting by allowing study in the evening hours;
- "**Promote gender equality and empower women, also in primary and secondary education**": see above, as well as through increased opportunities for productive activities;
- "**Reduce Child mortality**": Sustainable energy contributes through reducing indoor pollution, as well as through making refrigeration available and powering modern health equipment;
- "**Ensuring environmental sustainability**": Renewable sources of energy can contribute by reducing greenhouse gas emissions and deforestation.

A special situation exists in the Small Island Developing States (SIDS), that are currently in most cases dependent on expensive fossil fuels and conventional biomass (wood) for energy generation. The negative impacts of these dependences on the environment as well as the heavy financial burden on SIDS combined with the low efficiency of energy use, make these vulnerable countries a special case.

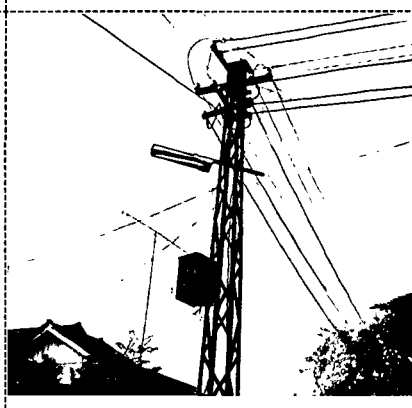
## 2. What is needed

Considering the scale of the problem, it is essential to formulate well-structured and focused approaches to reach the 1.6 billion people that currently do not have access to reliable and affordable sources of energy. It can be expected that future electrification and other infrastructure programmes will mainly concentrate on improving access to modern energy for households in urban areas and medium-sized settlements, hence specific programmes need to be formulated for those communities in rural areas and SIDS.

In order to be affordable and sustainable in rural areas, energy programmes would have to be largely based on the utilization of indigenous and renewable sources of energy (essentially biomass, solar, wind and mini-hydropower), taking into account the development priorities of the national government and the suitability of different energy sources for different applications. It is also likely that such energy systems, based on decentralized and cleaner energy, are better suited to meet the needs of the rural poor. While promoting renewable energies, energy efficiency should not be forgotten. Efficient use of energy in general and that of renewable energy in particular, help to generate more income from the same amount of energy and make renewable energies both more affordable and sustainable.

The target group for this programme strategy are those people that are without any access to modern energy delivery systems, i.e. people living in remote areas, too far from existing energy sources or the electrical grid, and too poor to pay for the initial investment cost of energy-related installations. At present, these people cater for their basic energy needs using a large amount of time and labor in order to gather what they need. Any level of additional cash expenditure on a daily basis is considered to be a major burden.

It is therefore clear, also based on experiences with energy programmes for rural areas in the past, that in order to be successful and sustainable, an approach is needed that combines the provision of the necessary infrastructure for the generation and distribution of energy with complementary activities that address related economic, social and regulatory issues. Programmes targeted at these rural populations should aim at developing energy services that are both reliable and low-cost, requiring minimal maintenance and repair, and incorporate the development of income-generating activities, made feasible through the access to reliable and affordable sources of energy.



**In conclusion, a programmatic approach is required that is easy to replicate and that demonstrates the economic and technical viability of the selected energy generation system, based on locally available, renewable sources (biomass, solar, wind, mini-hydro) and that builds the productive capacities to sustain those systems.**

## 3. The response

Given the many links between the availability of sustainable energy and the millennium goals as outlined above, considerable investments and technical assistance programmes are required if the global community really means to achieve the goals of the Millennium Declaration. UNIDO considers that an effective approach to reduce/ remove those obstacles that hinder access to affordable and sustainable energy in rural areas would have to contain three essential elements: facilitation of access; creation of employment; and technology transfer. This, it is believed, could best be done through the effective "packaging" of a set of well-structured and complementary activities or services.

Building on its experience in this field, UNIDO has developed a programme aiming at:

- Demonstrating the social and economic viability of the selected energy generating approach;
- Demonstrating the creation of sustainable local enterprises that can deliver reliable energy services based on renewable energy technologies, and
- Demonstrating the identification of income-generating activities related to the production or use of energy in rural areas.

A unique feature of the UNIDO strategy is the priority it gives to the creation and/or strengthening of local capacities to participate in the design, manufacture, assembly, operation, repair and maintenance of energy facilities. This approach has a number of impacts on the sustainability of rural energy projects. They are, among others:

- Demonstrating that investment costs are reduced;
- Demonstrating that sustainability is increased through better maintenance and operation and
- Demonstrating that new jobs and income are created.

The beneficiaries of the programme would be the rural poor who would gain access to affordable and reliable energy services for basic needs (cooking, heating and lighting) as well as for income generating activities.

Although the distributed rural energy projects, particularly those based on renewable energy technologies, do not have large individual sizes, when bundled they may reach sizes, which become attractive to the Climate Change Convention, as well as the

Kyoto Protocol with the contained Clean Development Mechanism. Therefore, rural energy projects should be designed by taking climate change issues into account.

It is evident that the approach followed will vary greatly between countries and regions, as the causes for the lack of access to modern energy, as well as the opportunities present are very different in rural areas in South Asia compared with Central America or sub-Saharan Africa. Individual, tailor-made packages will have to be designed for different situations. However, the overall approach for formulating a programme at the country level, consists of four distinct stages:

## Stage 1: Determination of suitable pilot locations

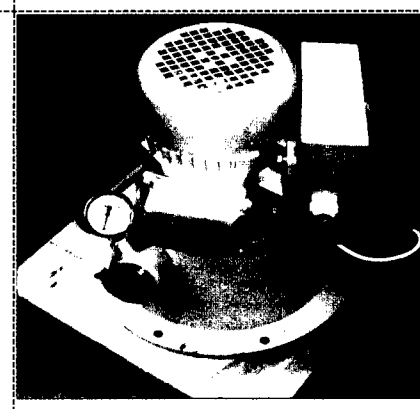
*The first step concerns the identification of suitable pilot locations with sufficient availability of renewable resources (biomass, wind, solar or hydropower), taking into account the potential for income generating activities that can be undertaken with those sources of energy in the selected rural areas. In close consultation with the government and other local stakeholders, areas of the country and parts of the population that are not being, or soon going to be reached, by commercial energy providers are identified. This is followed by a survey in these areas to assess potential sources of (renewable) energy and suitable technology options. Also this stage will assess all technical, economic and regulatory obstacles affecting access to modern energy. While UNIDO is aware that there are energy needs in energy-poor rural areas which might be best addressed through traditional fuels, the eventually proposed mix of "energy solutions" would preferably be based on stand-alone energy-generating facilities (including possible "mini-grids") using renewable sources of energy.*

## Stage 2: Identification of "productive uses" of energy

*In this subsequent phase, a particular emphasis is placed on the identification of "productive uses" of energy as such productive activities that will assist the rural poor to generate the necessary income to afford the modern energy services and to fight poverty. The activities of this stage would encompass an analysis of those sectors, such as agro-industries (e.g. food processing), transport, telecommunications and tourism, which have a good potential for economic growth and employment creation, when provided with access to clean and affordable energy services. Among others, it will be important to look during this stage at the institutional infrastructure needed to convert renewable energy technologies into viable business opportunities.*

## Stage 3: Development of a comprehensive programme ("package")

*In this pivotal phase, the formulation of a comprehensive programme for the development of rural energy systems/ services is undertaken. This is done in close cooperation with*



*national institutions and other interested partners and requires extensive consultation. Depending on the selected energy solutions and the productive-use opportunities identified earlier, an integrated support programme will be developed typically containing the following components:*

- *Installation, demonstration and promotion of selected energy technology option(s), giving particular emphasis to aspects of local assembly/ manufacture of equipment, capacity building of local partners/ stakeholders, financing schemes, maintenance and repair facilities, etc.;*
- *Assistance to local entrepreneurs that could participate in the programme implementation, that could operate and maintain the energy facilities, and that could replicate the demonstrated energy solutions locally as well as in other locations in the country. This could include assistance in business development, including business planning and energy delivery models, marketing, etc.;*
- *Assistance to the targeted population (energy users) in the development of income generating uses of the energy.*

## Stage 4:
## Implementation of the comprehensive programme and design of mechanisms for replication

*This stage envisages the installation of demonstration systems for testing the viability and sustainability of selected energy technologies, and their operation as pilot systems in order to demonstrate the technology and economic viability. Local entrepreneurs would be supported in order to run effective energy delivery services with the necessary maintenance systems also being set-up. Local assembly or manufacture of energy equipment will be promoted through effective transfer of technology, including training and financing schemes. The maximization of local inputs and/or manufacture in the applicable energy solutions is a central element of the approach. Apart from the immediate benefit of job creation and capacity building, this also aims at the reduction of the cost of the energy solutions, increasing the economic viability as well as ensuring the absorption of the technology and capacity to replicate.*

*Following the successful installation and operation of the pilot systems, work will start with the local entrepreneurs that have been involved in order to help them replicate the systems in other areas, or market and sell suitable energy generating equipment, provide services for maintenance and repair. Cooperation with other parties, including for instance investors will be actively promoted.*

*Energy development should be accompanied by the establishment of appropriate support networks for rural (micro and small) enterprise development as well as a solid system for the provision of services for maintenance and repairs. In rural settings, specialized business development services are often not available nor affordable for rural entrepreneurs. Working directly with existing local organizations, rural entrepreneurs, mechanical workshops and service providers for agro-machineries, maintenance and repair have to be duly assisted in its capacity building for small business development, small industry advisory services, and technical skill upgrading. For this purpose, practical and effective*

*methodologies and tools have been developed by UNIDO with a view to tailoring the business and technical skill development programmes to fit to the needs and the absorption capacity of the entrepreneurs and existing support institutions. With the improved accessibility of energy sources, these services will help entrepreneurs to improve their production processes and management techniques and increase their prospects for starting up, expanding and diversifying their enterprises.*

The above-outlined strategy, ultimately focusing on assistance to local entrepreneurs for creating/ improving sustainable enterprises, can be considered an innovative approach to facilitate access to modern energy for large parts of the population in rural areas. Moreover, the "productive use" of energy by the rural population is expected to result in a measurable impact on poverty alleviation, brought about by the creation of new opportunities for establishing micro and small-scale businesses.

It is hoped that the above strategy, through demonstrating the validity and effectiveness of the approach will attract more financial resources for replication of the approach in other areas and will encourage public and private sector entities to adopt similar approaches.

Regional cooperation will be explored when identifying the potential for and promoting the assembly and manufacture of renewable energy equipment for which economies of scale are important. UNIDO considers it essential to get involvement of the private sector early on in such activities and therefore seeks to package it's programmes and projects in such a way as to make them feasible for private sector participation. To aim for long-term sustainability and commercial profitability is central to UNIDO's approach.

## 4. Examples of renewable energy technologies

The proposed "energy solution" options will mainly be determined by the availability of local sources of renewable energy and could encompass technologies such as micro and mini hydropower, biomass (biogas, biogasification, fermentation, direct combustion, etc.), solar energy (photo-voltaics, water heaters, dryers, water desalinators, etc.), wind energy systems.

### 4.1 Small hydro-power (SHP)

The potential energy in falling water can be converted into mechanical and eventually into electrical energy. The amount of useful energy that can be captured is proportional to the vertical distance the water drops (the head) and the volume (flow rate) of the water. Hydropower stations connected to national electricity grids are often built as a part of large-scale investment projects including the construction of dams. UNIDO does not normally get involved in this type of hydropower generation.

In the context of this initiative UNIDO focuses on smaller-scale projects such as mini-hydro (less than 1,000 kilowatt, kW ? or 1 megawatt, MW), micro-hydro (less than 100 kW), and pico-hydro (less than 1 kW).

The main electro-mechanical components of a mini hydro system are the turbine and the generator. Other components include the physical structures to direct and control the flow of water, mechanical, electrical and electronic controllers, and civil structures to house the associated equipment.

For most hydro projects, water is supplied to the turbine from some type of storage reservoir. The simpler and more environmentally-friendly hydro system does not influence the amount or pattern of water flow that normally exists in the river or stream. Such "run-of-river" systems may use a special turbine placed directly in the river to capture the energy in the water flow. However, such "run-of-river" systems require uninterrupted water flow throughout the year. Consequently, the availability of adequate flow rates is critical to the feasibility of any "run-of-river" hydro project. Data is usually gathered over a period of time using flow-meters installed at the prospective site. Normally, one year is the minimum time that a site is monitored.

Considering the river basins extending to several countries as well as the similar climatic, hydrologic and geological conditions prevailing throughout regions, the development of regional hydropower programmes can be desirable. In such cases, it is particularly important to conduct environmental impact assessments (EIA) before such programmes are developed and realized.

## 4.2 Wind power

A wind turbine converts the energy in the wind into mechanical and/or into electrical energy. The most common wind turbines in operation today generate power from two blades revolving around a horizontal axis and are mounted on towers. Such horizontal-axis wind turbines usually include a gearbox, electrical generator, and other supporting mechanical and electrical equipment.

Wind turbines are rated by their maximum power output. For commercial utility-sized projects, large turbines in the range from 600 kW to more than 2 MW are used. The wind generators employed in UNIDO's rural energy projects are usually of stand-alone type and small in size (less than 50 kW.)

The power that can be generated from a modern wind turbine is practically related to the square of the wind-speed. Therefore, the availability of good wind-speed data is critical to the feasibility of any wind project. Data is usually gathered over a period of time using anemometers installed at the prospective site. Normally, one year is the minimum time a site is monitored.

In off-grid applications, wind generators can be combined with other energy sources, such as diesel generators. Although the wind resource for any site is intermittent, it

can be highly predictable and thus the output from wind turbines can be integrated into existing electrical grids (or mini-grids) with a high degree of confidence.

## 4.3 Bio-energy

Bio-energy is obtained from biomass–a term that generally refers to any plant or animal matter. Bio-energy in the form of heat or electricity can be produced by using biomass directly as a fuel or by converting it to biogas or liquid bio-fuels. The main sources of biomass include:

- Industrial and agricultural wastes and residues, such as sugar cane waste (bagasse), wood waste from forestry operations, and residues from other short rotation crops such as straw and husks;
- Organic wastes from animal husbandry;
- Energy crops, such as sugar cane, corn and trees grown in short-rotation plantations.

The main processes for utilizing these biomass sources include:

- Direct combustion, usually of solids, in boilers or furnaces;
- Gasification via a physical or chemical conversion process to a secondary gaseous fuel, followed by combustion in an engine, boiler or turbine;
- Biological conversion, via bacterial anaerobic digestion to methane-rich biogas for use as a gaseous fuel;
- Chemical or biochemical conversion to produce methanol, ethanol or other liquid fuels.

A bio-energy project can often be designed to co-generate both heat and electricity, increasing its overall energy efficiency and financial viability. Such projects may also create a cost-effective solution to the disposal of agricultural or industrial wastes that may otherwise become potential environment problems – for example, UNIDO's sisal waste processing project in Tanzania.

Biomass resources are generally renewable, but only if the resource is harvested at the same rate it is grown and soil nutrients are not depleted. In addition to potential greenhouse abatement benefits, bioenergy projects can address many other environmental issues such as decreasing soil erosion, controlling nitrogen depletion, and protecting watersheds.

## 4.4 Solar electricity: Photovoltaics (PV)

Semiconductors that convert solar energy directly into electricity are called photovoltaic (PV) devices or solar cells. There are three main technologies in commercial production: monocrystalline cells (most expensive but highly efficient), polycrystalline cells (moderately priced and moderately efficient) and thin-film cells (cheapest and least efficient).

Solar cells are encapsulated into modules, several of which are combined into an array. A PV array is usually part of a system that may also include energy storage devices (usually batteries), support frames, electronic controllers and inverters. The amount of power from a PV array is directly proportional to the intensity of the light hitting the array.

Typical PV system size varies from: 50 W to 1 kW for stand-alone systems with battery storage and small water pumping systems; from 500 W to 5 kW for roof-top grid connected systems and larger water pumping systems; and from 10 kW to megawatts for grid-connected ground-based systems and larger building-integrated systems.

Many of the developing countries are endowed with long daily sunny periods?this is particularly true in Africa. Therefore, there are windows of opportunities to develop PV solar projects in sun-rich countries. In this connection, both national and regional projects can be considered.

Hence, for rural areas in developing countries, PV technology may offer an immediate alternative to kerosene lamps and in some cases, such as powering information and communication technology equipment, may be the only cost-effective option.

## 4.5 Solar thermal: direct solar heating

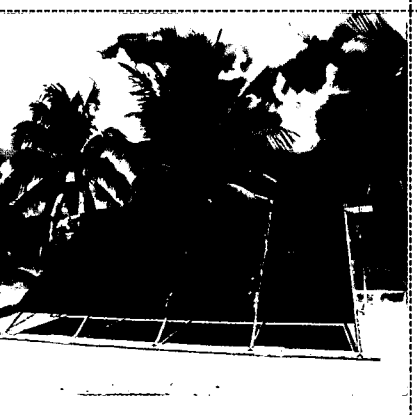
The sun's energy can be collected directly to create both high temperature steam (greater than 100°C) and low temperature heat (less than 100°C) for use in a variety of heat and power applications.

High temperature solar thermal systems use mirrors and other reflective surfaces to concentrate solar radiation. Parabolic dish systems concentrate solar radiation to a single point to produce temperatures in excess of 1000°C. The resulting high temperatures can be used to create steam to either drive electric turbine generators, or to power chemical processes such as the production of hydrogen.

Low temperature solar thermal systems collect solar radiation to heat air and water for domestic and industrial applications including:

- Space heating for buildings and greenhouses;
- Domestic and industrial hot water, including pool heating;
- Water desalination;
- Solar cooking, and
- Crop drying.

These technologies collect energy without (passive) or with (active) the need for pumps or motors. Energy is collected generally through the orientation, materials, and construction of a collector. These collectors are most commonly made of copper



tubes bonded to a metal plate, painted black, and encapsulated within an insulated box covered by a glass panel, or glazing.

## 5. UNIDO's activities and experience

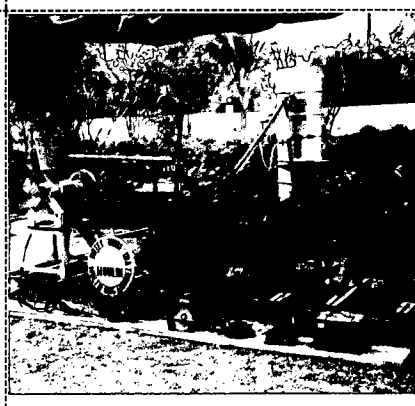
UNIDO's core mandate is to develop the productive capacity of developing countries in manufacturing through technology transfer and investment promotion. In its approach to rural energy, UNIDO brings this expertise (which is unique in the UN system) to the local manufacture of energy equipment and energy generation, transmission and distribution systems. UNIDO's comparative advantage in this specific approach is explicitly recognized by other players in international energy cooperation.

UNIDO has been active in other rural development work, mostly in the agro-industry sector especially when related to small- and medium-sized enterprises as well as general private sector development, investment and technology promotion and cleaner production.

For the development of rural and women entrepreneurship, in particular, UNIDO placed a specific emphasis on technical and managerial skill development for increased competitive entrepreneurship, technology absorbing capacities and women's control over asset management. Food-processing activities in rural areas, particularly by women's groups and rural entrepreneurs, would benefit from the availability of rural energy provision, as it helps them to increase and diversify their food production a well as to improve the quality of their products. The Community-Production Centres (CPCs) where the combination of an organized apprenticeship scheme and a small-scale industrial village workshop are provided in rural areas, stable and constant supply of energy improves the effective use of common production facilities such as premises, equipment, tools, communication, management etc.

In recent years, and particularly after the WSSD held in Johannesburg in 2002, the interest of donor countries in rural energy-related issues has increased considerably. Several of UNIDO's integrated programmes developed in 1999-2001 already included, at the request of governments and industry, components specifically targeting rural energy needs and issues. In particular, UNIDO has accumulated extensive experience in the establishment and support of multi-purpose platforms in rural areas in Africa, the promotion and installation of mini-grids based on mini-hydro systems, biogas production, wind turbines, etc. UNIDO also promotes renewable-based information and communication technologies (ICT) in rural areas.

Therefore, UNIDO has a unique place and role in the UN with its capabilities, organizational structure and experience to address energy issues in developing countries, utilizing both global fora and technical cooperation programmes. The continuing development of world trade and the perceived threats to the global environment are also significant in creating a new envelope within which UNIDO



must operate. There is a need to adapt and redefine UNIDO's niche. This is particularly true of energy where demand still outstrips supply.

Taking all these factors into account, UNIDO's Energy Programme is based on the following competitive advantages of the Organization:

- Accumulated sectoral experience in energy intensive sectors as well as in the manufacture of energy equipment;
- Experience in the promotion of SMEs in general and those in the rural areas in particular;
- Experience in the promotion of international cooperation in and transfer of energy technologies;
- Vertical integration under the same roof of all services required in a typical project cycle: identification, formulation, implementation and monitoring.

Some examples of UNIDO's work are:

Cuba—Generation and Delivery of Modern Renewable Energy Services in Cuba; the case of Isla de la Juventud: The main objective of the project is to displace the additional and existing diesel-based electricity generation of the island's main electrical mini-grid with renewable energy alternatives. The project identifies, evaluates and prioritizes the barriers preventing increased uses of renewable energy sources for the provision of modern energy services (mostly electrical) and describes activities for their reduction/ removal on the Isla de la Juventud.

Ethiopia—Technical Assistance in Identification and Removal of Barriers in the Rational Use of Energy in Small-and Medium-Scale Enterprises (SME) and Application of Renewable Energy Sources: The project forms the energy component of UNIDO's Integrated Programme for Ethiopia (IPE). The objectives of the project is to contribute to raise awareness regarding the cost-effectiveness of rational energy use in productive activities; building institutional capacity (strengthening of the Basic Metals and Engineering Industries Agency (BMEIA)) for assisting Small-medium enterprises (SME) in both, the public and private sectors, in formulating and implementing energy conservation measures.

Regional Africa–The Multifunctional Platform Initiative: A Vision for Rural (Decentralized) Energy Supply: In many developing countries, particularly in Sub Saharan Africa, where less than 8% of the rural population have an access to electricity, poor people, especially women, spend many hours collecting water and firewood for food preparation and agro processing as well as the multiple other tasks that sustain rural livelihoods. Widening access to modern energy services can therefore be a catalyst for sustainable human development, given these patterns of energy use. However, increased income is necessary to be able to afford the required energy services.

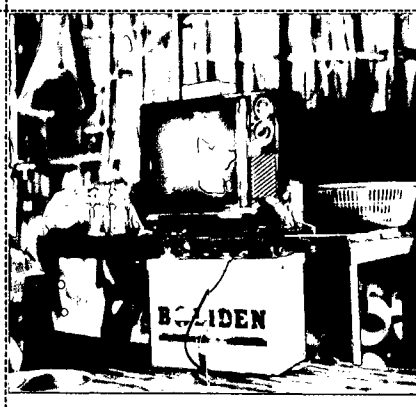
Zambia and Malawi–Renewable Energy Promotion through Information and Communication Technology Introduction in Off-Grid Rural Communities: While the social and economic development opportunities that are offered by

information and communications technologies (ICTs) are potentially far reaching, it has up until now been mainly the developed industrialized countries that have been able to capitalize on them. This is widening the 'digital divide' between the developed and developing nations, which in turn is creating another hindrance and threat to the development of developing countries. By the obvious nature of ICT systems, power supply is an overriding condition in their operation, national development and spread throughout any given country. Utilizing renewables will provide a means of providing a power supply and creating the potential for the introduction of these systems into rural regions of developing countries in general and least developed countries (LDCs).

Zambia–Renewable energy based electricity generation for isolated mini-grids in Zambia: The main objective of the project is to support renewable energy based isolated mini-grids as a viable option to provide the electricity and energy services to remotely located rural households on sustainable basis in Zambia. The project primarily aims at identifying, evaluating and prioritizing the barriers preventing increased uses of renewable energy sources for the generation of electricity for isolated mini-grids, and to design activities for their reduction/removal.

China–Energy Conservation and GHG Emissions Reduction in Chinese Township Village Enterprises (TVEs): GHG emissions from industrial TVEs constitute a major share of China's overall GHG emissions. The project concept is to effectively remove the barriers to improving energy efficiency in the TVE sector and lead to a market transformation and the widespread dissemination of energy-efficient technologies in China's TVEs. Four sectors have been selected, foundries, cement, coking, and brick making.

Sub-Saharan Africa–Women entrepreneurship development (WED) in agro-industries: Food processing industries, be they rural micro businesses or formal SMEs, are one of the major sectors where a majority of women are found. Many women entrepreneurs are also engaged in the textile/garment and leather goods production at micro- and small-scale enterprise level. Yet the productivity and profitability of their activities suffer due to the lack of access to credit and financing, marketing information, technology options, skill development opportunities and affordable and reliable sources of energy. With the objective to facilitate access to required support services as well as improve their access to energy sources, the UNIDO WED programme is implemented in various countries, mainly in sub-Saharan Africa. To build capacity, direct training to women entrepreneurs and training of trainers are organized with emphasis on both technical and managerial skill development. In this context, the availability of energy sources for production often plays a key role to improve the efficiency of simple production processes and contribute to a sustainable income flow. Some of the projects provide training on new methods using locally available equipment and forms of energy.



## 6. Co-operation partners

As UNIDO has been working in the energy area since many years, it has established a network of links with specialist organizations and institutions at international and national levels. UNIDO is strengthening and formalizing these links and it will involve its partners more systematically in the design and delivery of capacity building services to developing countries. Among the main institutions and networks currently involved in this area, those that are of special relevance include: the International Centre on Small Hydro Power (IC-SHP, Hangzhou, China), the International Centre for Application of Solar Energy (CASE, Perth, Australia), the UNEP/UNIDO network of National Cleaner Production Centers, the UNIDO Investment and Technology Promotion Offices, etc.

In particular, the UNIDO/UNEP network of Cleaner Production Centers, which has been in operation since 1994, covering nearly 30 countries, serve as an important asset for UNIDO's activities in the field of rural energy. Specialized institutions, such as the afore-mentioned ICSHP and CASE, are expected to be involved in their field of expertise in the rural energy programme.

UNEP is already supporting a variety of activities in the field of sustainable energy and climate change. In addition to UNIDO-UNEP partnership in the existing network of Cleaner Production Centers, UNIDO is cooperating with UNEP in their initiative to establish a "Network on Energy for Sustainable Development."

Initial discussions were held with the Common Fund for Commodities (CFC) in respect of possible biomass based energy generation in view of their interest in the economic viability of commodities, many of which naturally generate a high volume of bio wastes. A project using Sisal waste for biogas generation is a good initial example of potential cooperation.

FAO and IFAD are striving to promote the conservation and sound management of natural resources through encouraging sustainable agriculture and rural development. In the latter area and particularly in projects aiming at promoting renewable energies to fight deforestation and/ or projects supporting agro-based income generation activities, joint FAO-IFAD/UNIDO activities could be developed.

In the context of the rural energy program, UNIDO will continue to seek to cooperate actively with other relevant partners, including those from the private sector. During WSSD for instance, contacts were made with two equity investment organizations interested in "green" investment in developing countries. Contacts were also made with organizations with specific interest in the energy situation of small island developing states (SIDS). Cooperation with such partners will be actively pursued either with a view to promote the initiative, strengthen the implementation and/or mobilize the considerable resources required for developing and implementing the programmes at the country level.

As a new member of the UNDP-chaired UN Development Group (UNDG), UNIDO will try to introduce rural energy considerations more systematically in

country-based cooperation frameworks, such as the UN Development Assistance Frameworks (UNDAF), or programming activities specifically linked to the Millennium Development Goals. Also Poverty Reduction Strategy Papers (PRSP) may be an important frame of reference for country level activities. Analytical work done by other organizations will be taken into account. In particular, "Stage 2" activities described above could greatly benefit from recent studies carried out in many countries by UNDP/ World Bank under their Energy Sector Management Assistance Programme (ESMAP).

## 7. The funding strategy

Given the volume and diversity of action required, a structured approach to funding is required that includes a broad variety of potential funding and other partners. In many cases, combining grants, local public funds, concessional loans from international/ regional banks, local private investment and foreign direct investment (FDI) is needed. This necessitates to carefully engineer financial packages.

As far as the grant financing of larger UNIDO programmes at the country and/or regional level is concerned, special purpose contributions will be sought from donors targeting the country or region in addition to energy-specific donors such as the GEF for components matching their mandate (see below). Potential donors will be approached in the analytical phase, and if so desired, involved in the formulation of the assistance programme.

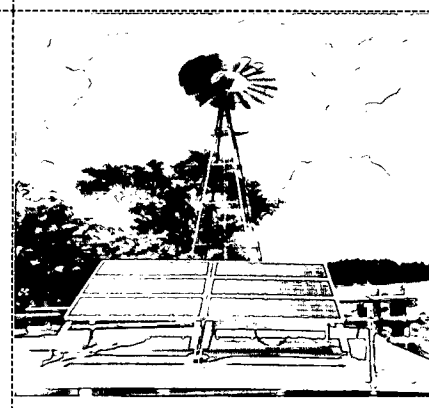
In addition a trust fund will be established by UNIDO initially aiming at the following types of activities:

- Preparatory and programme development activities;
- Formulation of projects for funding by for instance the GEF;
- Co-funding of projects funded by the GEF or UNFIP (as both require in most cases third party cost sharing as a condition);
- Funding of small projects of a pilot nature, or related to the local manufacture/ income generation projects;
- Projects in Small Island Developing States.

This trust fund is established to cover these activities because a stream of relatively small activities is expected. Seeking special purpose contributions for each such case is certainly not cost-effective. In addition, for the SIDS, hardly any bilateral funds are available.

Donors are invited to make contributions to this trust fund. These contributions can, if so desired, be limited to specific regions or purposes, for instance for formulation of large-scale projects for GEF funding only.

Two international funds will be approached that have an energy-specific mandate:



- **The Global Environment Facility (GEF)**, as one of the largest funding sources in the UN system for financing programmes and projects related to the global environment in general and climate change projects in particular, will be a very important partner in the area of rural energy and UNIDO will attempt to fully capitalize on its recently acquired new status as an "Executing Agency with Expanded Opportunities." It is to be remembered however, that GEF is a funding mechanism for the UN Framework Convention on Climate Change and hence has a "GHG emissions-reduction/ global environment mandate"–and not primarily a developmental–perspective. This means that neither the costs of capacity building, training and technology transfer required for local manufacture of energy equipment and related structures, nor the foreseen income-generation components, are fully fundable under the current GEF rules and strategies.

- **The UN Foundation (UNF)**, which is working with the UN system organizations to foster innovative partnerships that promote an integrated response to, among others, issues such as sustainable energy. One of its stated focus areas is the promotion of efforts to develop and demonstrate sustainable and commercial approaches to deliver clean and affordable renewable energy services to rural communities. UNIDO is already an active participant in the UNF Programme Framework Group on Sustainable Energy and Climate Change.

In addition UNIDO was involved in two other initiatives launched during the World Summit on Sustainable Development, one launched by the UK entitled the "Renewable Energy and Energy Efficiency Partnership" (REEEP)and one by the European Union entitled the European Union Energy Initiative (EUEI). These partnerships will be actively developed.

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