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Ninth Session
16 - 27 April 2001, New York

ENERGY AND SUSTAINABLE DEVELOPMENT:

CASE STUDIES

BACKGROUND PAPER NO. 4

Compiled by the

Division for Sustainable Development

DESA/DSD/2001/4

Energy and sustainable development: case studies

Background Document

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*The case studies are reproduced as submitted by interested governments and UN agencies

Introduction

At the first session of the Ad Hoc Open-ended Intergovernmental Group of Experts on Energy and Sustainable Development, discussions took place on the Report of the Secretary-General entitled Energy for sustainable development: key issues (E/CN.17/ESD/2000/3, 1 February 2000), on the basis of which several key issues pertaining to energy and sustainable development were identified for more detailed discussion at its second session to be held in February 2001. The key issues highlighted in the report of that session (E/CN.17/ESD/2000/12, 27 March 2000) for consideration at the ninth session of the Commission are: accessibility of energy, energy efficiency, renewable energy, advanced fossil-fuel technologies, nuclear energy technologies, rural energy, and energy and transportation. In relation to each of these key issues, the Group of Experts emphasized that the following overarching issues should receive serious consideration by the international community: technology transfer, capacity building, mobilization of financial resources, and international and regional cooperation.

One of the agenda items for the second session of the Group pertains to "lessons learned". The Group was of the view that in order to enrich the dialogue process at its second session, information in the form of case studies describing lessons learned and experiences gained at the national level in translating sustainable energy policies into concrete actions would be helpful. It was suggested that this kind of information might also prove useful in gaining further insights into the key issues by learning from national experiences in the implementation of energy policies to promote sustainable development. Furthermore, learning from the experiences of others can prove useful in identifying future courses of action including consideration of the replication of such approaches in similar situations elsewhere.

Therefore, case studies were invited from Member States, relevant UN agencies and interested stakeholders. To assist in the preparation of such case studies and to ensure some degree of uniformity in their presentation, a set of guidelines were provided by the Secretariat. A copy of the case study guidelines is contained in the annex to this report.

Case studies received from Member States have been compiled in one section of this report followed by case studies submitted by UN agencies. Only submissions that contained the results of policies to promote energy for sustainable development and "lessons learned" have been included here. Editing of case study reports has been the responsibility of their authors.

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UNDESA

UNDP

UNEP

UNESCO

World Health Organization (WHO)

Australia

Title: Energy Market Reform in Australia

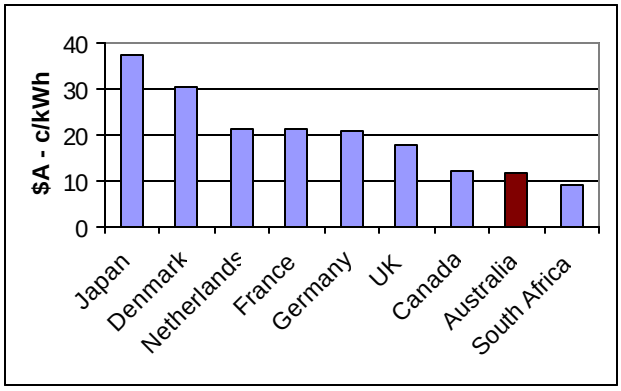
Abstract

Energy market reform in Australia has generated significant economic benefits for the nation, estimated at some A$5.8 billion a year. Electricity and gas reform have resulted in an average reduction in electricity prices of some 24 per cent and considerable investment in energy infrastructure. Over time, the reforms are expected to result in environmental gains, especially in regards to greenhouse gas emissions, through increased efficiency and gas increasing its market share compared to coal. These arrangements have been complemented by initiatives to increase the share of renewable energy technologies in grid based electricity generation to reap even further environmental gains. The provision of more efficient and environmentally sound energy services that have resulted are relevant to the issues that will be considered at CSD9.

Country Profile – Background on Australia's energy resources

Australia is the fourteenth largest industrial economy in the world, with a gross domestic product of A$560 billion (around US$350 billion) in 1997–98. Australia has a population of just over 19 million people, which is projected to grow to almost 25 million by 2020.

Australia is more dependent on fossil fuels than any other OECD country, primarily because low cost coal is abundant, hydroelectric resources are limited, and nuclear power is not utilised. The potential exists to make greater use over time of renewable energy sources such as wind, solar and biomass. Coal, including black coal and lignite, accounts for some 84 per cent of electricity generation in Australia while hydro and gas account for 9 and 7 per cent respectively. The Australian Electricity Supply Industry (ESI) has assets valued at some A$60 billion, employs about 33,000 people, and has an annual turnover of around A$21 billion (ESAA 2000). In 1998–99 it accounted for 1.42 per cent of GDP. Electricity accounts for more than 18 per cent of Australia's total final energy consumption.



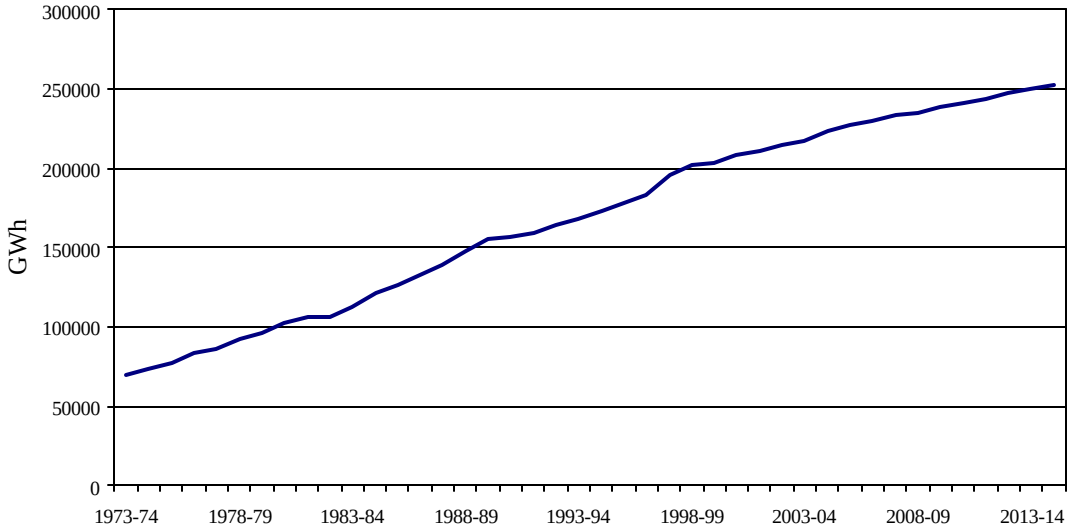
Enhanced competition, excess capacity in some markets and improved cost efficiency in coal-fired power stations due to market reform, have also produced a downward trend in market prices. Consequently, residential electricity prices in Australia, at 11.9 c/kWh, are one of the lowest in comparison to a number of developed countries (Figure 1).

In contrast to other OECD countries, the impact of the shift towards the service sector has been significantly offset by a shift towards energy-intensive production. The net effect of the structural change towards both energy-intensive and service industries has been to decrease the energy intensity of the Australian economy between 1973 and 1998 by 12.3 per cent (Harris and Thorpe 2000). Figure 2 displays the considerable growth in electricity consumption since 1973.

1 International residential electricity prices as at January 2000

Note: Prices represent largest city regions
Source: ESAA (2000)

2 Australian Electricity Consumption



Source: Bush et al (1997), Bush et al (1999)
Note: Forecast figures for 1997-2014

Sustainable Development Issue – Energy Market Reform

Australia has a central Commonwealth Government, eight self-governing States and Territories, and more than 600 Local Governments. In regard to international issues, the Commonwealth has a specific role to ensure that Australia's obligations are fulfilled and to promote Australia's trade and investment interests. State Governments have responsibility within their borders for energy production, transport, land use, infrastructure provision and urban planning. States and Territories also have constitutional power over development of energy resources such as coal, gas and hydro within their jurisdictions. Local governments have responsibility for implementing planning policies and regulations, which impact on energy use and energy efficiency at a local level. This covers areas such as urban design, road planning, and planning regulations, which affect the implementation of energy efficiency practices in houses, businesses, waste management and utilities.

Prior to the introduction of energy market reform in Australia, each State and Territory government provided for its own energy needs with relatively limited interstate trading. Energy systems were developed on a stand-alone basis within large centrally planned systems, resulting in vertically integrated structures to meet local needs. Co-operation between governments on projects such as the Snowy Mountains Hydro-Electricity Scheme was the exception rather than the normal situation. Jurisdictions were inclined to manage energy within their boundaries and, despite constitutional provisions to the contrary, had in place legislation that inhibited interstate trade. The level of energy cross-subsidies have been reduced in Australia post reform, and on-going reform will continue to remove energy cross-subsidies which distort accurate price signals to the market.

Objectives and Implementation – Energy Market Reform

Pressure for reform grew over the late 1980s and early 1990s in response to an excess of capacity, particularly in electricity, reflecting over-optimistic demand assumptions in some jurisdictions, and rising public debt burdens. In July 1991, the Council of Australian Governments (CoAG) agreed to improve competitiveness in the ESI, to replace state markets in the eastern States with a competitive national electricity market, and to separate monopoly elements in the industry to provide greater contestability. CoAG provided the vehicle through which consultation took place between States and the Commonwealth, a four year process that culminated in the establishment of the National Electricity Market Management Company.

In April 1995, CoAG reaffirmed its commitment to implement competition reform in electricity and gas markets. The key objectives were to:

- improve economic efficiency;
- reduce input costs to business and end users;
- improve inter-state trade, resource allocation and investment decisions;
- enable consumers to choose their retail supplier on a contestable basis;
- clarify the roles of regulators and encourage a uniform/national approach to regulation where needed and reduce "regulatory risk"; and
- increase capacity for interstate transfer of energy to open up larger markets and reduce the State-centric system origins.

Central to the reform of the electricity supply industry is the National Electricity Market (NEM). The NEM is a centralised wholesale market which operates across southern and eastern Australia for the supply and purchase of electricity combined with an open access arrangement for use of the transmission and distribution network. The National Electricity Market formally commenced operation on 13 December 1998, although the process of open market development, the break-up of strongly vertically integrated monopoly structures in individual States (representing generation, transmission and distribution), and the freeing up of cross-border competition, had been developing since the early 1990s, following commitments by Governments.

Changes to current regulations requires extensive public consultation processes through: the National Electricity Market Management Company, the Australian Competition and Consumer Commission and the National Electricity Code Administrator.

Significant scope remains for further reforms, including:

- Implementation of full retail contestability for small energy consumers (so they can chose their own retailer);
- Network development through improved locational pricing, demand side management and development of an ancillary energy services market;
- Greenhouse abatement consistent with competition reform objectives; and
- Governance principles such as clarifying roles, responsibilities and accountabilities of jurisdictions and market institutions, to remove conflicts of interest.

Economic and Social Benefits of Reform

Competition reform in the electricity sector has delivered a competitive wholesale spot market for electricity (the NEM), a financial contract market to manage risk, an emerging ancillary services market and open access to transmission and distribution services. The reform process has also involved corporatisation, and in some cases privatisation, of publicly owned electricity businesses. The competitive position of energy intensive industries has improved, investment in energy activities is growing strongly and there is evidence suggesting the emergence of a more integrated energy market, particularly at retail level.

Similarly, competition reform in natural gas has delivered structural reform of publicly owned pipeline and retail business, open access to transmission and distribution services and established arrangements which should lead to more competition in the upstream sector.

Price Reductions

The Productivity Commission has estimated that real prices for electricity have fallen by 24 per cent on average for all end users since 1991–1992. More recent figures published by the Business Council of Australia (March 2000*)* suggest that electricity prices have halved for large users in the major markets of New South Wales and Victoria since the commencement of reforms.

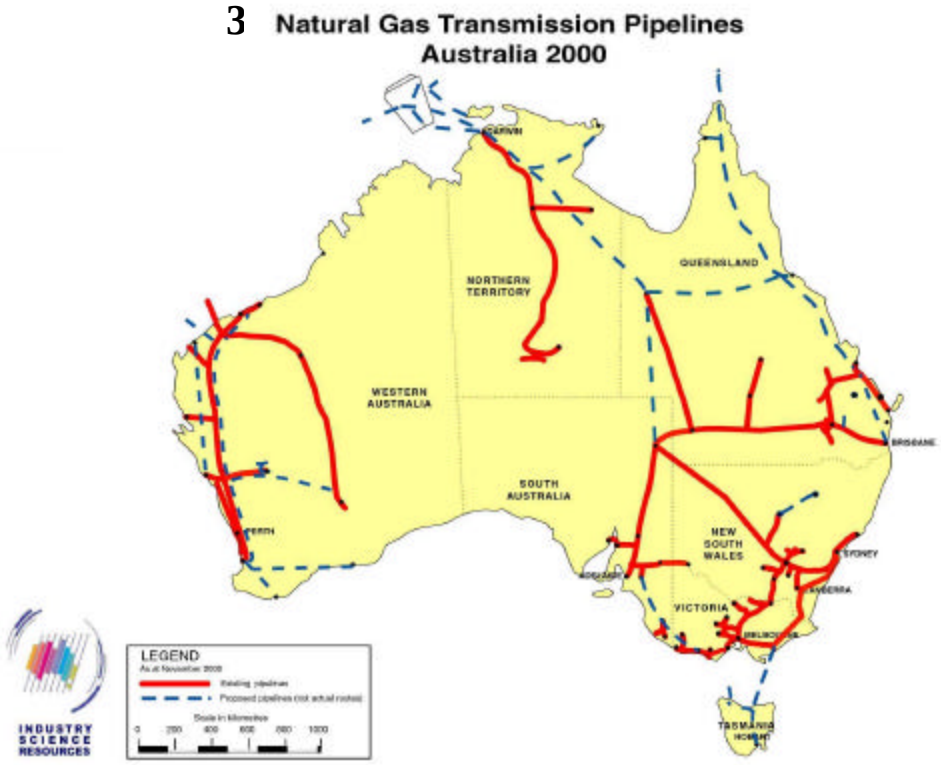
Productivity Growth

The Productivity Commission has estimated that productivity in the electricity, gas and water sectors has grown by around 10.7 per cent per annum between 1993–94 and 1997–98 as a result of competition reform (Parham 1999).

Competitiveness & Investment

Reform has improved the competitive position of energy intensive industries, while investment in energy activities (eg. generation and network investment) is growing strongly, with around A$6 billion of new generation and network projects either proposed or under construction.

In addition, competition reform in the natural gas sector has stimulated considerable new pipeline investment, which will introduce competitive pressures in gas supply. Figure 3 below shows existing and proposed pipelines in Australia. Accordingly, from around 2005–6 many of the marginal cost advantages currently enjoyed by coal-fired generation will have decreased, by which time it would be reasonable to expect new gas-fired generation to emerge.



Economic Growth

Energy market reform has contributed markedly to Australia's robust economic performance over the last two years, with the economy growing at a rate in excess of 4 per cent per annum. Economy-wide benefits from energy market reform have been estimated by the Industry Commission (1995) at around A$5.8 billion per annum (in 1993–94 dollars), or around A$8 billion in current terms, equivalent to a 1.4 per cent increase in gross domestic product.

Environmental Benefits of Reform

Policy Context

Commonwealth policy statements, including the Prime Minister's November 1997 *Safeguarding the Future* statement, the National Greenhouse Strategy (NGS), and the Prime Minister's May 1999 *Measures for a Better Environment* statement, indicate the role of the energy market in contributing to achieving reduced greenhouse gas emissions.

The wider policy context for energy market reform is related to Australia's broader economic and social policies as well as the current energy policy framework. These policies encompass initiatives in energy efficiency, cogeneration (also known as combined heat and power), renewable energy, co-operative agreements, innovation and Research and Development (R&D) investment, site planning and reforming regulatory arrangements. These policies are consistent with energy market reform principles. Measures to encourage the sustainable achievement of these goals are in place.

Climate Change

To address greenhouse issues Australia has developed a national strategy, established the Australian Greenhouse Office – the first specialised national greenhouse agency in the world, and the Commonwealth Government has committed almost A$1 billion over 5 years. Internationally, Australia is now at the forefront of countries with both strategies in place and resources committed to tackling climate change.

A key mechanism through which Australia's international commitments will be met is the National Greenhouse Strategy released in November 1998. The NGS has been developed by the Commonwealth and all State and Territory Governments. The Australian Local Government Association, industry and community consultations have also made an important contribution to its development.

The NGS provides the framework for advancing Australia's domestic greenhouse response. Key sectors covered by the NGS include energy, transport, industry, waste, agriculture and vegetation and households. The strategy details both existing actions and additional measures. The document may be viewed at www.greenhouse.gov.au/pubs/ngs/ngs.html.

A key benefit of energy market reform is that it promotes the development of fuel supply infrastructure that will facilitate fuel switching in the event of the implementation of measures such as emissions trading. For example, integrated frameworks for gas and electricity can support greater penetration of natural gas into electricity generation and energy end use, noting that natural gas is a more greenhouse friendly fossil fuel than coal. Efficient economic signals can provide greater impetus for the uptake of cogeneration, renewable energy and other more greenhouse-friendly supply options. These trends, together with the fact that competitive gas-fired generation is more flexible, more thermally efficient and less expensive to construct and with shorter lead times than coal-fired generation, may encourage a progressive switching away from coal to meet future capacity requirements, but only over the medium to longer term as excess capacity is absorbed by the market.

Renewable Energy

The Commonwealth Government has undertaken to increase the use of renewable energy sources in electricity generation by recently passing legislation that requires wholesale electricity purchasers to source an additional 9,500 GWh of electricity from renewable generators by 2010. Potential suppliers of renewable electricity are free to choose from the range of available technologies. This measure aims to accelerate the uptake of energy from renewable sources; provide an on-going base for the development of commercially competitive renewable energy; and contribute to the development of internationally competitive industries, which could participate effectively in the burgeoning Asian energy market.

Australia recently approved the implementation of a Renewable Energy Action Agenda aimed at developing the Australian renewable energy industry. The scope of the Renewable Energy Action Agenda includes sustainable transport fuels, solar, wind, biomass, tidal, wave, hydro-power, geothermal, renewable hydrogen and emerging technologies such as fuel cells. A copy of the document can be found at: www.isr.gov.au/agendas/Sectors/energy/index.html.

Replicability

Energy market reform must be situated within a broader policy context of microeconomic, and specifically competition policy reform. The legislative base for achieving competition reform across the Australian economy is the *Competition Policy Reform Act 1995*. The Act, which became operative on 6 November 1995, established Part IIIA of the (Commonwealth) *Trade Practices Act 1974* which provides a right for third party access to 'essential' facilities, including natural monopoly infrastructure such as electricity transmission assets and natural gas pipelines.

Regulation of the electricity supply industry traditionally has rested with the individual State/Territory governments. However, in line with the economy-wide push for broader national competition policy reforms, regulatory functions are shifting from the State to the national level and to agencies which are becoming increasingly independent from government.

As part of CoAG's agreement in April 1995, and within the overall context of competition policy, the Commonwealth will provide financial assistance payments to the States and Territories totalling A$4.2 billion over the period to 2005–06. The payments are conditional, in part, on satisfactory progress in reforming the electricity and gas sectors.

The National Gas Access Code was implemented to promote competition on conditions that are fair and reasonable for both pipeline owners and gas users. The Government wants to encourage private infrastructure investment and is therefore keen to ensure that the operation of the Code is producing reasonable outcomes for investors as was intended.

The resultant investment downstream with increased competition has in turn encouraged the development of new pipelines. Many of the new and proposed pipelines are through regional

areas and provide an alternative and cheaper energy source to sustain the competitiveness of local industries and enhance the potential for the development of new industries.

The key design parameters for the competitive national market include:

- open and free competition between suppliers of energy;
- separating generation, transmission, distribution and retail activities;
- non-discriminatory access to the interconnected networks;
- customers' choice of supplier;
- uniform network pricing methodologies encompassing cost reflective transmission pricing;
- non-discriminatory access for new industry participants; and
- uniform regulation based on an industry code of conduct.

Further information on how Australia has progressed energy market reform can be found on the following website: www.isr.gov.au/resources/energy_reform.html.

Lesson Learned

The Australian experience of energy market reform is that competition has delivered tangible economic and social benefits. The process of energy market reform in Australia is on-going. There is a continuing need to update and revise market rules to reflect dynamic market development and encourage and stimulate maturity to a sustainable market. In this changing environment it is important to keep stakeholders involved in the process. A highly consultative process has been established in the National Electricity Market.

Market rules as they currently exist permit small scale electricity generation and local level capacity; however, there has been little evidence of participation to date. Difficulties associated with investment and planning have been cited. These concerns are being addressed through demand side participation and locational pricing strategies.

Further Information

For further information related to this case study please contact:

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Austria

Title: Solar Energy Co-operation Austria – Zimbabwe To Reduce CO_2 Emissions

Abstract

Based on the current unequal and non sustainable world's energy supply a know-how transfer project was carried out by Zimbabwean and Austrian institutions and companies to establish a production, sales and consulting infrastructure for solar thermal plants. Since the beginning of the project about 230 solar systems have already been manufactured and installed.
The project so far has shown that it is possible to transfer knowledge gained in successful Austrian solar campaigns and adjust it in co-operation with Zimbabwean organisations to the needs and circumstances of an African country. The project created the basis for a broad dissemination of solar technologies which leads to a global sustainable energy future.

Sustainable development issue that was addressed in the case study

The increase in greenhouse gasses in the atmosphere and the potential global warming and climatic change associated with it, represent one of the greatest environmental dangers of our time. The anthropogenic reasons of this impending change in the climate can for the greater part be put down to the use of energy and the combustion of fossil primary sources of energy and the emission of CO_2 associated with this.
Today, the world's energy supply is based on the non-renewable sources of energy: oil, coal, natural gas and uranium, which together cover about 82% of the global primary-energy requirements. The remaining 18% divide approximately 2/3 into biomass and 1/3 into hydro power.

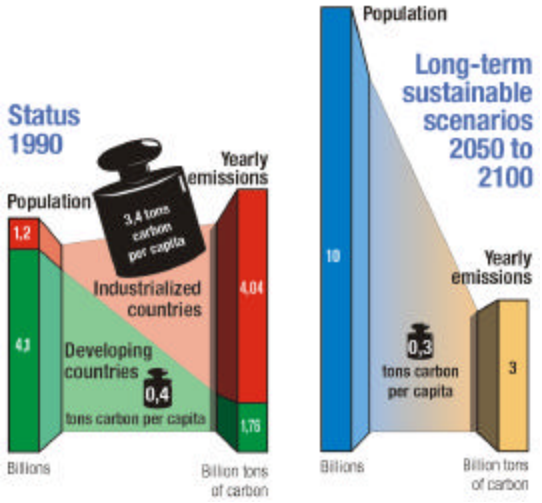

Fig. 1: Per-capita emissions of carbon into the atmosphere required to meet climate stabilisation agreements with a doubling of population levels.

The effective protection of the climate for future generations will, according to many experts, demand at least a 50% reduction in the world-wide anthropogenic emission of greenhouse gases in the next 50 to 100 years.

A reduction of CO_2 emissions on the scale shown in figure 1 will require the conversion to a sustained supply of energy that is based on the use of renewable energy with a high share of direct solar energy use.

Implementation

Solar energy use in Austria

In recent years the sensational rate of growth in Austria in the use of thermal solar systems for domestic hot water preparation and space heating has shown that this systems are both mature and technically reliable. Every day, thousands of installations demonstrate the possibilities of this undisputed ecologically harmless source of energy. By the end of 1999, a total collector surface area of 2,05 million m² had been installed in Austria. This figure puts Austria amongst the leaders of the European countries for the amount of newly installed collector surface area per head of population per year. The CO_2 reduction obtained by the 2,05 million m² of solar collectors is 620.300 tons/ year.
Furthermore a total number of about 2,100 jobs could be created in the field of solar thermal energy (employees in the primary and secondary sectors).

One of the main reasons for the upward trend in the field of solar installations in Austria has been the activities of AEE (Arbeitsgemeinschaft Erneuerbare Energie). The dissemination strategy of AEE is based on research and development of adjusted systems and system components, as well as wide-spread information campaigns.

Corresponding to the demand of the Kyoto-Protocol some years ago it was decided by the AEE and strongly supported by the Austrian government to transfer the know-how gathered in the Austrian projects to other interested countries to speed up the dissemination of solar technologies.

Know-how Transfer to Zimbabwe

For several years now, AEE has been conducting solar energy projects in Africa especially in Zimbabwe and Uganda. Since 1995, they have been working in co-operation with local organisations on the development of gravity driven solar installations and on setting up of a local production and distribution infrastructure. At the same time, together with the University of Zimbabwe, a know-how transfer agency is being set up to support the market introduction of solar installations.

Country Information

The frame conditions for solar technologies in Zimbabwe are characterised by three main factors: The houses in the townships of the urban suburbs may well, for the most part, be supplied with water and electricity, however the current is limited to 5 amps due to the lack of

available meters and often also for only limited periods of time. With these frame conditions it is more often than not the case that one can only get cold water from the usually badly insulated water storage tanks.

In rural areas the water is usually heated with the help of paraffin stoves or on open fires. Getting firewood is mostly the job of the women who often have to go many miles for it.
Introducing solar installations into rural areas would above all relieve the women of some of their daily burden cutting down the collection of fuel as well as increase comfort and improve the standard of hygiene.

Fig. 2: Absorber manufacture using simple bending tools

At governmental and university levels steps are being taken to increase the popularity of solar technology by holding international congresses. With this aim the "ISES Solar World Congress" and the "World Solar Summit" were held in Harare in co-operation with UNESCO in 1995 and 1996 respectively.

These events stimulated great interest in the uses of solar technologies especially at a university level. On a commercial level five companies provide solar installations at present. However these are, without exception, imported from Europe, Japan or the USA, thereby putting the price relatively high and hardly within the reach of the populace. The number of pieces sold is minimal.

Thus, the project imparts the requisite practical and theoretical knowledge for the production of thermal solar systems such that a sustainable structure producing installations using material available in the country is possible. By using local base materials and local production the aim

was to halve the price in comparison to the imported products. The experience from work done so far shows that this is possible.

Outcome and Impacts

So far 75 students and craftsmen have been trained in 5 training courses held since 1999 at the University if Zimbabwe in Harare.

The first 230 solar systems have already been manufactured and installed. They function to the satisfaction of the operators. This proves that it is possible to manufacture the units under local conditions and using nearly exclusively material which is available locally.
The units manufactured to date are spread over both urban townships and rural areas. Furthermore it was possible to considerably improve the standard of hygiene at rural clinics by installing solar thermal systems to supply the showers. Photovoltaic systems were also installed at the Chitangazuwa Clinic to enable the treatment of patients after dark to be conducted by electric light instead of in the light of a kerosene lamp.

fig. 3: Solar water heating systems and the photovoltaic unit at the Chitangazuwa Clinic

The work successfully carried out is subsidised by the Austrian Federal Ministry for Foreign Affairs.

Project Status

To date three separate local companies are supported by the project in the production of solar thermal systems. As well as organisational and technical support a training programme forms the bulk of the project. Training and know-how transfer are carried out on two levels. On the one hand companies receive the necessary practical skills for the manufacture of solar installations and on the other hand in co-operation with the University of Zimbabwe students and technical personnel obtained theoretical as well as practical training.

This should create a sustainable structure enabling the continuation of production and further development even after expiring of the project by the end of 2001.

A further important aim of the project is to build up a distribution and maintenance infrastructure. To ensure that the systems may be offered at favourable prices during the difficult initial phase, for the first year each unit sold was subsidised by ca. 50% from project funds. This support will be gradually withdrawn in the following years so that within three years a realistic market price, autonomous from project support, can be achieved.

The production of solar installations achieved several important goals at the same time. Jobs were created in an environmentally based sector with a promising future in a country where there is an abundance of solar energy, the fragile ecosystem is nurtured through the reduction of deforestation in rural areas and the reduction of emissions in urban townships due to the substitution of lignite and finally the standard of living is raised.

Replicability

In general the project is replicable for other countries as well as for other renewable energy technologies such as biomas or wind energy technologies.

A project similar to the one described above is going to be started in Uganda in spring 2001 in co-operation with the Uganda renewable Energy Association.

Lessons Learned

The project so far has shown that the production of solar thermal systems using material available in Zimbabwe is feasible. Furthermore, due to the local production it was possible to halve the price in comparison to the imported products, which led to systems affordable for the people of Zimbabwe even under very bad economical conditions. The demand at the moment is bigger than the capability of the companies to produce the systems. The majority of the customers so far come from urban areas. The dissemination of solar thermal systems in rural areas is difficult because of social and economical reasons.
The project so far has shown that it is possible to transfer knowledge gained in Europe and adjust it in co-operation with local organisations to the needs and possibilities of an African country.
The project created the basis for a broad dissemination of solar technologies which leads to a sustainable energy future.

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Title: Case Studies for CSD 9 ÖKOPROFIT â Graz, Austria

Introduction

The „ÖKOSTADT 2000“ project (‘Eco-city 2000’) represented the practical application for the city of Graz of Agenda 21, the key document from the UNCED Conference in Rio de Janeiro in 1992, the project being a comprehensive action programme for the transition into the 21st century. The programme „ÖKOSTADT 2000 – Auf dem Weg zu einer nachhaltigen Stadtentwicklung in Graz (‘Eco-city 2000 – en route to sustainable urban development in Graz’)“ presents the city with an integrated plan to enable it to take account of the numerous aspects of the various environmentally relevant issues, problems and framework conditions in its local environmental policy.

The programme was adopted unanimously by the Graz Municipal Council on July 6, 1995, and the process of broad and focused implementation was initiated. In recognition of this, in 1996 the City of Graz received the first „European Sustainable City Award“ presented by the „European Sustainable Cities and Towns“ initiative founded in 1994.
The idea behind this project is to achieve a new quality level in environmental policy at the local level. The traditional understanding of environmental policy is that of a guarantee or a restoration of the quality of soil, air and water required for human health and nature conservation (i.e. the preservation of areas of the countryside or natural landmarks deemed worthy of protection. This traditional understanding is to be extended and developed into a preventative environmental policy whose essential feature consists of not allowing (further) environmental damage and harmful effects on the ecological balance to arise in the first place. The main thrust is in the shift in the perception of possible solutions away from environmental problems using philosophies based on cleaning up and restoring (as in so-called „end of pipe“ technologies) towards a sustainable strategy (e.g. as represented by „clean technologies“).
These ambitious aims cannot be realised by a one-off creation of objective conditions alone, for example by prescribing emission limits or by banning certain substances. They require creative processes at local level, whereby activities which strengthen the urban ecosystem are encouraged and procedures which disturb the ecological balance are quickly identified and halted. Decision-makers in the Graz City Administration are involved in these processes as much as local residents in the city.

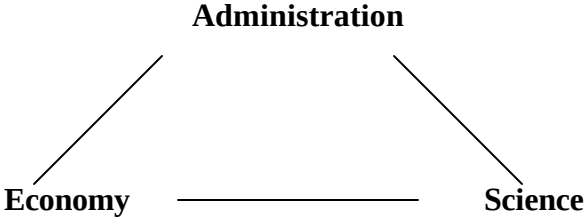
In 1999, the environmental programme was assessed and evaluated by the Graz „ÖKOTEAM“ (ECO-TEAM).

ÖKOPROFIT® - A local co-operation project to satisfy LA 21

„ÖKOSTADT Graz“ is successfully attempting to improve the quality of life for the local population on a sustainable basis via its lead projects on the environment: „ÖKOPROFIT®“, „THERMOPROFIT®“ and „ÖKODRIVE“. It is thereby making a decisive contribution to environmental protection.

ÖKOPROFIT® – **Öko**logisches **Pro**jekt **F**ür **I**ntegrierte Umwelt**T**echnik ('Ecological project for integrated environmental technology').
This project has been running in Graz since 1991. ÖKOPROFIT® is a co-operation project aiming to strengthen companies in Graz economically through preventative environmental protection, with the aim of making a contribution towards improving the environmental situation within the City of Graz. If initially it was „only" a few case studies, carried out with 5 companies based in Graz, this project to eliminate waste and avoid emissions has meanwhile developed into a comprehensive preventative environmental programme, in which well over 100 companies have participated in Graz alone to date, implementing over 1,000 separate projects or measures. The programme has existed in its current, successful format since 1993. Active co-operation between Graz-based companies, the Graz Environmental Office and expert advisors forms the cornerstone of the success of ÖKOPROFIT®-Graz, operating under the slogan „Advice and encouragement instead of regulation and punishment".

ÖKOPROFIT-GRAZ:
Sustainability as profit



ÖKOPROFIT® offers the following to participating companies:

- Environmental protection, to the company 's own benefit
- A reduction in use of raw materials and energy
- Greater transparency in the allocation of costs
- Motivation and team spirit within the company
- An overview of the laws and regulations applicable to the company
- Co-operation on projects with the authorities and experts
- Support from the city, involving little financial outlay
- Recognised acknowledgement of efforts made, and involvement in PR activities

An essential component in the ÖKOPROFIT®-Graz project is the on-going development of the project in the direction of sustainable economic development. Linked to this is also the involvement of new co-operation partners and improved networking of existing structures.
In addition, ÖKOPROFIT® Graz offers participating companies comprehensive transfer of information and expertise through co-operation partners such as Aktiver Technologietransfer ('Active Technology Transfer') and the Österreichisches Informationszentrum für umweltgerechte Produktion ('Austrian Information Centre for environmentally sound manufacturing', or CPC), which is based in Graz partly on account of the success of ÖKOPROFIT®, and the information and co-ordination offices which carry out functions on

behalf of the EU. To that end, CPC Austria runs the training institution ÖKOPROFIT®-Akademie as an international centre for training and expertise in this field. This ensures expansion of the international capacities of this successful product.

®ÖKOPROFIT is a registered trade mark for the City of Graz.

Additionally, ÖKOPROFIT® has been implemented equally successfully for tourism companies, just as „ÖKOPROFIT® Micro", which is due to start in 2001, has been developed as a programme for avoiding waste and emissions, specially adapted for very small companies and following the ÖKOPROFIT® methodology. The ÖKOPROFIT® series of publications is available in several languages on CD-Rom, and the ÖKOPROFIT®-Journal is produced quarterly as a channel of information for the Europe-wide network of all partners and those interested in ÖKOPROFIT®.

The Methods

The basis of every ÖKOPROFIT® programme is a co-operation based on trust between companies, advisors and the authorities. Participants familiarise themselves with various aspects of preventative environmental protection in workshops. The main emphases are on the areas of energy (energy efficiency, etc.), water, waste and transport. In addition to this, support is also made available in between the workshops through advice from experts given during on-site visits. Data are collected, evaluated and analysed for potential energy savings. Finally, partners work together to elaborate improvement measures. In addition, laws and regulations which are relevant to the company are discussed and the participating companies are supported in applying these regulations efficiently. After each year in the project, successful companies are awarded the city's site-related title of „Grazer ÖKOPROFIT®-Betrieb d.J." ('Graz ÖKOPROFIT® Company of the Year') which they hold for one year. As of the second year in ÖKOPROFIT®, companies can join the ÖKOPROFIT® Club. Here workshops are fewer, the topics are more specific, and the exchange of information and the co-operation of businesses with one another is the most distinctive aspect.

The criteria required to achieve the award of this title are as follows:

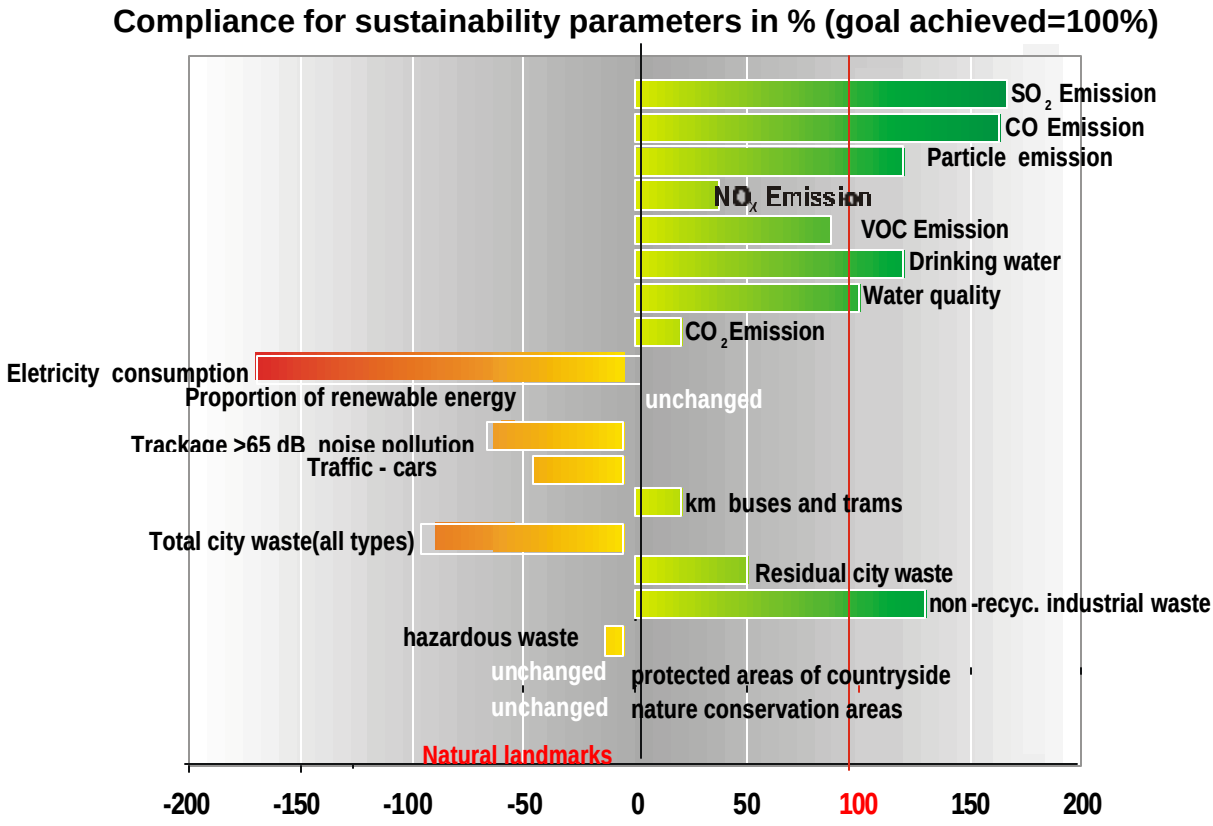
the environmental guidelines/environmental policy of the company, the environmental performance of the company, the company's environmental programme for the coming year, a plan for waste management, an internal audit for legal compliance, and a checklist covering organisational and legal aspects.

In addition, the Graz Environmental Office makes inquires of various authorities (Office for Trade and Commerce, Office for sewer construction, the environmental ombudsman for the Province, the Provincial government) to establish whether complaints or criminal offences relating to environmental matters have been reported in respect of that company.
The costs for the company involved are based on the number of employees in manufacturing companies, or on the volume of earnings from tourism in the preceding year for hotel and catering companies. This sum is a once-only payment, and covers all the services referred to above. The remaining 2/3 of the costs of the project is borne by the City of Graz.

Results-Examples

1) In general: ÖKOSTADT 2000

The environmental programme „ÖKOSTADT 2000“ was evaluated in 1999 by the Graz ÖKOTEAM (representatives of the universities, the Provincial government, the City of Graz, and NGOs). As part of that evaluation, the extent to which the quantitative goals (parameters for sustainability) set out in the „ÖKOSTADT 2000“ programme had been achieved was established, and presented in summary form in the diagramme below. Full realisation of a stated objective corresponds to a compliance level of 100% (shown by the 100% line). Negative percentage figures indicate that in these areas the trend has been in the opposite direction.



2) Specific examples: ENERGY and CLIMATE

Objectives

As the most restrictive target for the energy sector, under the obligations imposed in the context of the Climate Alliance, it was decided on the basis of an unanimous decision of the Graz Municipal Council in 1990 that CO_2 emissions should be reduced by the year 2010 by 50% in comparison with the reference year of 1987. At the time the programme was put in place, the level of CO_2 emissions was around 1.88 million tonnes of CO_2 per year.

The aim of the city's energy plan, to raise the proportion of renewable energies to 40% by the year 2010, and to reduce the level of electricity consumption (compared to 1994) by 18% by the year 2010, should also be considered in the light of this target. At the time the programme was put in place, the use of renewable energy sources (particularly biomass and hydroelectric production of electricity) was around 3,550 tonnes/year or 16% of total energy use.

The following interim goals for the environmental programme were derived from these targets:

- CO_2 emissions: -10% by 1996, -15% by 1998 and -20% by 2000
- Electricity consumption: -2.5% by 1996, -5% by 1998 and -7% by 2000
- Proportion of renewable energy: 19% by 1996, 22% by 1998, 25% by 2000

CO_2 emissions – Results of the evaluation

The company ADIP has been commissioned by the Provincial government of Styria to produce energy balance sheets, with a planned completion date at the beginning of April 1999. However, because these energy balance sheets for districts in Styria (including for Graz) are not yet available, data for the comparison were taken from the 1995 Graz Emissions inventory („Grazer Emissionskataster 1995") and the Energy and Emissions inventory („Energie- und emissionskataster") (Pischinger).

In this context it has to be stressed that there are no reliable data for Austria with regard to CO_2 emissions.

The figures contained in the 1995 Graz Emissions inventory for CO_2 emissions only relate to the Graz city area, and do not contain the emissions caused by electricity consumption, while they do contain emissions from wood-fired heating (which is CO_2-neutral). There is no comparative data from 1988 for Graz-based companies.
A comparison of the Emissions inventories for 1988 and 1995 indicates the following scenario for CO_2 emissions:

Comparison tonnes/year	**CO_2 1988**	**CO_2 1995**
Transport	289,600	287,000
Domestic heating	592,000	458,500
Trade/Industry	no figures	281,500

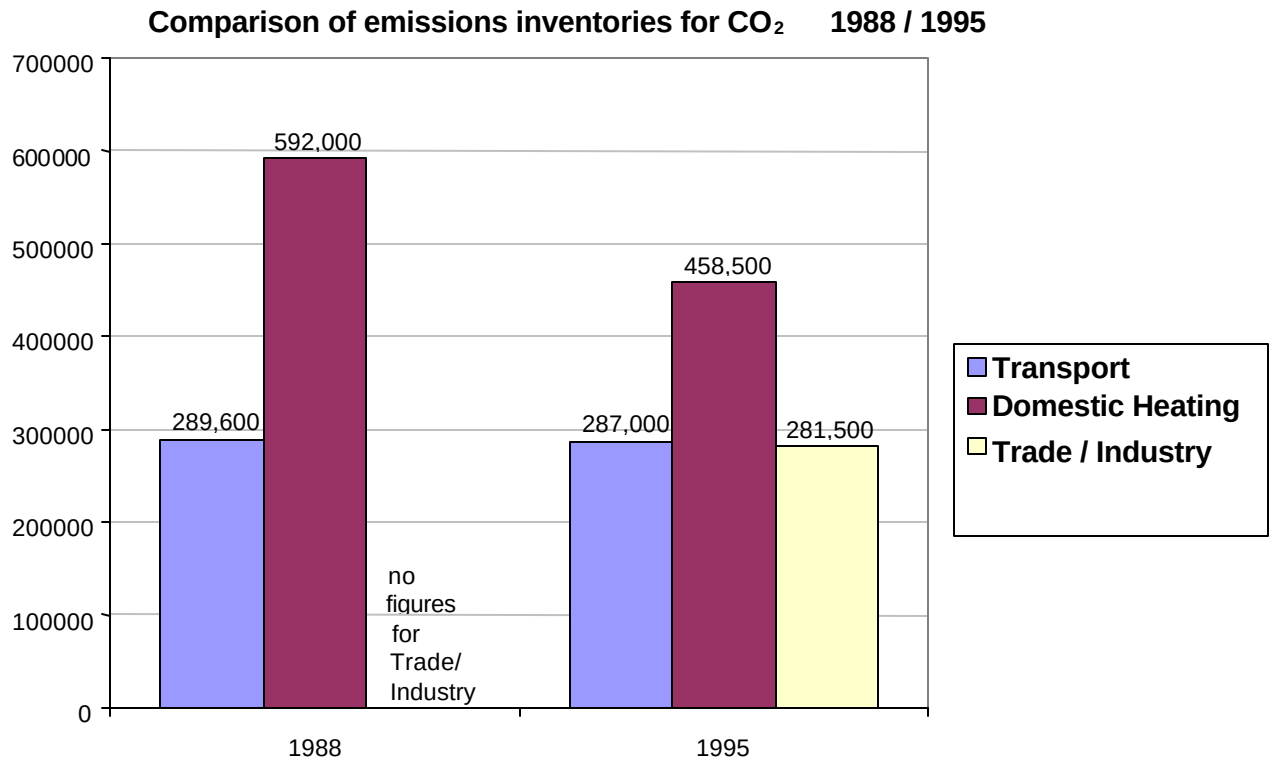


Fig.7: Comparison of CO_2 emissions from the Graz Emissions inventories for 1988/1995

For the transport and domestic heating sectors, the Graz Emissions inventories indicate a

- Reduction in CO_2 emissions between 1988 and 1995 of -15% (–136,100 tonnes/year)

The Energy and Emissions inventory for 1995 (Pischinger), drawn up in 1997, shows the Overall balance sheet for CO_2 emissions for Graz, which differs from the Graz Emissions inventory in that the latter only takes account of CO_2 emissions which are directly produced in Graz whilst the overall balance sheet also assesses energy consumption. It should therefore be noted that a significant portion of room heating in Graz is produced by district heating, and that emissions resulting from this type of heat production are only included in the Graz Emissions inventory as far as they are produced by the Puchstraße district heating power station.

In the Overall balance sheet for CO_2 emissions for Graz, district heating and electricity used for heating purposes (for room heating and for heating water) are assessed as having a high pollutant impact, which is reflected in the higher figures for CO_2 emissions for the household fires sector by comparison with the data from the Graz Emissions inventory. No account is taken of wood-fired heating (which is CO_2-neutral) in the Overall balance sheet.

A comparison of the CO_2 balance sheets for 1988 and 1995, taking all emissions-producing sectors into account, reveals the following trend:

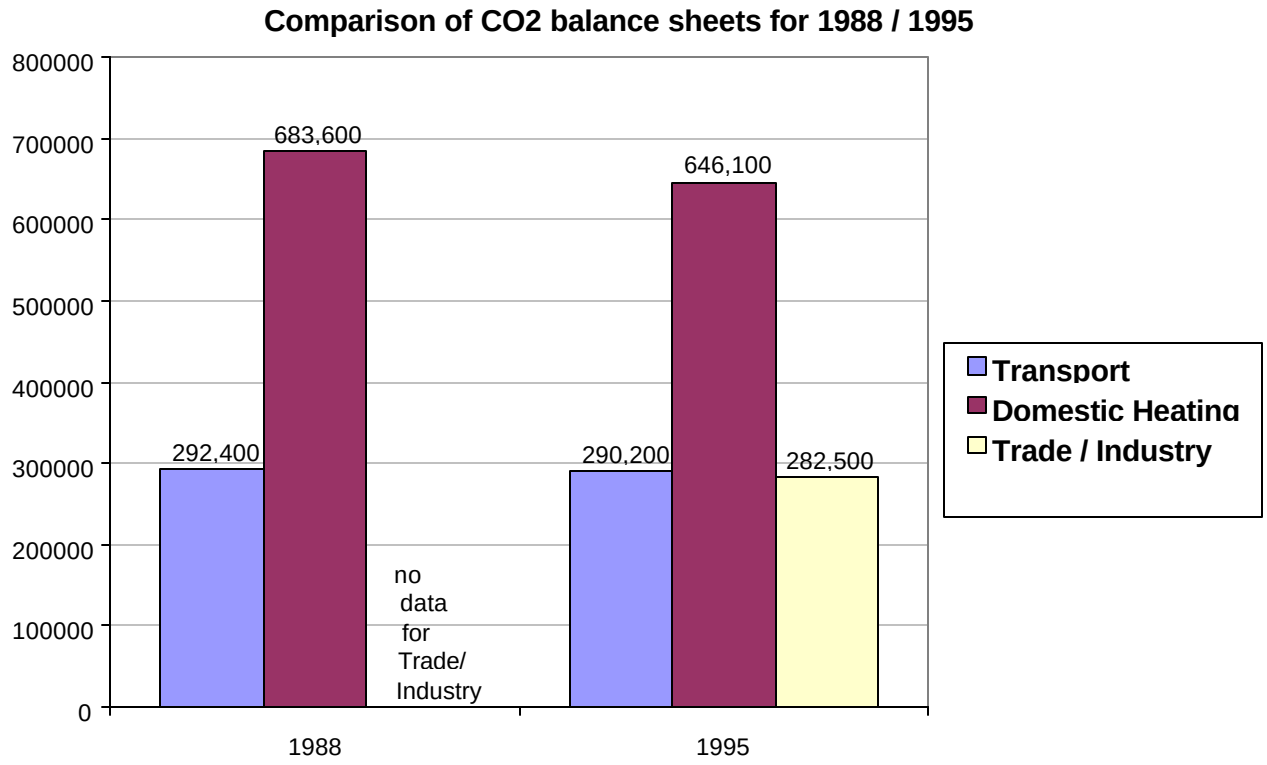


Fig.8: Overall balance sheet for CO_2 emissions for Graz in 1988/1995; no data are available for Trade and Industry for 1988

The comparison of the balance sheets thus indicates for the Transport and Domestic Heating sectors a

- Reduction in CO_2 emissions between 1988 and 1995 of –4% (–39,725 tonnes/year)

On the assumption that energy efficiency within industry has surely increased over the past few years as a result of various changes (e.g. by switching to gas), the results indicated above certainly enable one to speak of a trend reversal, even if the latest research in the transport sector indicates that one must now reckon with an increase in CO_2 emissions. However, the goal of –20% CO_2 emissions by 2000 cannot be achieved.

International Agreements on the reduction of CO_2 emissions

Toronto Target 1988: In the Closing Statement of the „World Conference on the Changing Atmosphere", a reduction in CO_2 emissions of 20% by the year 2005 was recommended, taking data for 1988 as the reference base. In the Energy Reports („Energieberichte") for 1990 and 1993, the Austrian Federal Government acknowledged acceptance of this target.

Climate Alliance 1989-1995: Over 400 European towns, cities and Federal provinces opted to join the Climate Alliance to protect the earth's atmosphere and to lower CO_2 emissions in the areas under their jurisdiction by 50% by 2010, in comparison with the 1987 figures.

UNCED – Rio de Janeiro 1992: 154 national states and the EU signed the United Nations Framework Convention on Climate Change (UNFCCC). The objective was to stabilise concentrations of greenhouse gases at a „non-dangerous level". Following ratification by around 50 states, in 1994 the UNFCCC achieved binding force in international law. Austria also ratified the UNFCCC in 1994. Currently over 180 states are party to the Convention.

Berlin World Climate Summit 1995: Signatory states convened for discussions at the first Conference of Contracting Parties of UNFCCC agreed in Rio in 1992. In the Berlin Mandate it was clearly stated that the obligations established under the Convention were not adequate to achieve its objectives, and that therefore immediate steps should be taken to strengthen the agreement. Negotiations about a Protocol began.

World Climate Summit, Kyoto, 1997: 159 states agreed on a Protocol setting out a reduction in greenhouse gas emissions for the period from 2008 to 2012 by a global average of 5.2 per cent compared to the 1990 level. In the context of the Kyoto Protocol and internal EU burdensharing, Austria has committed itself to a reduction in greenhouse gas emissions of 13% over that period.

3) Specific example – 3 CASE STUDIES: ÖKOPROFIT **â**

a) Energy consumption – results of the evaluation
The goal of reducing energy consumption between 1994 and 1998 by -5% (-7% by 2000) could not be achieved.
Electricity consumption during the observation period (1993-1997) increased by approximately 12%.
This corresponds to an absolute increase from

- approximately 4,820 tonnes/year (1993, KEK report No. 6:)

to

- approximately 5,417 tonnes/year (1997)

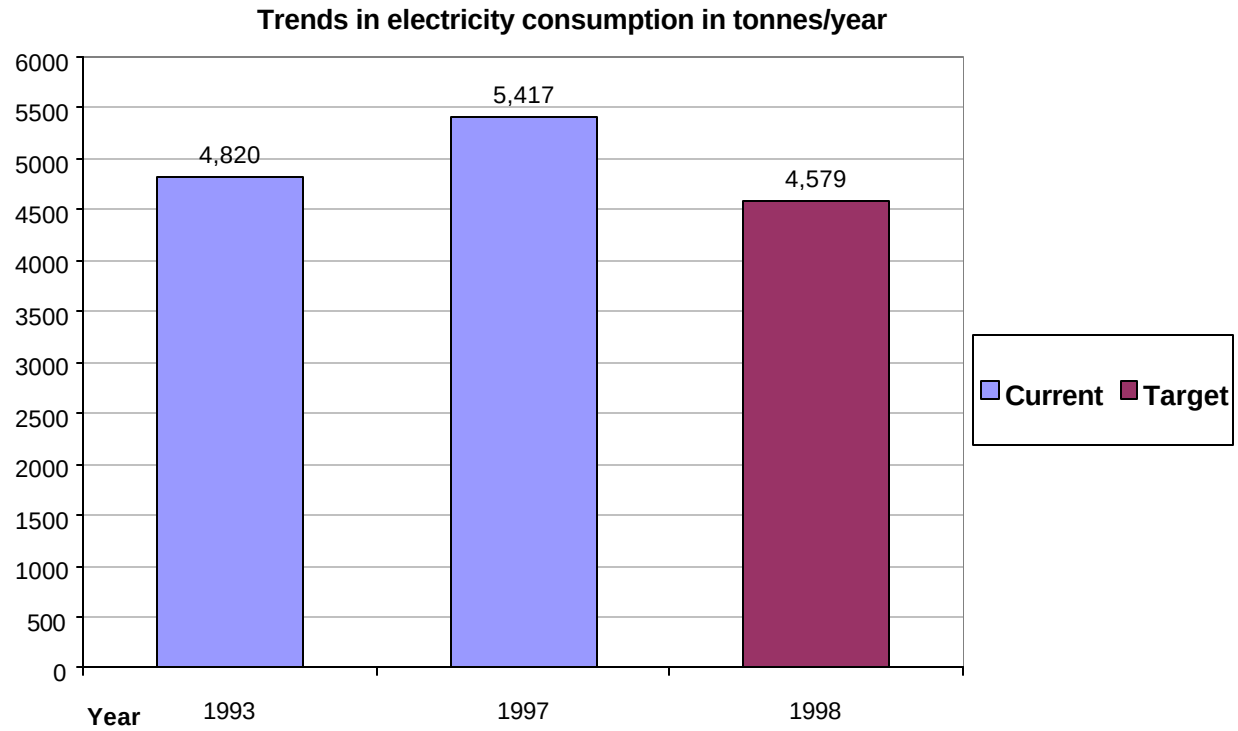


Fig.9: Trend in electricity consumption for Graz

The causes of this trend can be found above all in the constant increase in electrical appliances for everyday use, and increases in production and extensive automation/mechanisation within companies. Action to reverse this trend, using consciousness-raising measures focusing on the issue of saving energy in the home, is recommended.

However, particular emphasis should be given to the electricity savings which have been achieved as part of the ÖKOPROFIT® project in the period from 1993/94 to 1997 with 24 Graz-based companies (Source: ÖKOPROFIT® data assessment 1994-1997).

In 1994 these 24 companies had a total electricity consumption which amounted to around 50% of the entire electricity consumption for trade and industry in Graz.

In the years from 1994 to 1997, the ÖKOPROFIT® companies recorded an absolute increase in consumption of approximately 77 million kWh. This is attributable to increased production and to extensive automation/mechanisation within some companies. Taking account of the fact that production-specific performance indicators (production and turnover figures, etc.) for the companies studied showed an average increase of 19% (and 34% for turnover), the hypothetical savings over this period amount to approximately 58 million kWh. Given the same trends, one would have expected an increase in consumption of approximately 31 million kWh for 1997 in comparison with 1994, if the companies had not undertaken energy-saving measures. This

corresponds to a hypothetical financial saving (profit) of approximately ATS 46 million (€ 3,342,950).

Further results – ELECTRICITY: ÖKOPROFIT Data assessment 94-98 in the Supplement.

b) Industrial and trade waste – results of the evaluation

Since there is no comprehensive data available for industrial and trade waste for Graz, reference was made to the data assessment for 1993/94 – 1997 of the Graz ÖKOPROFIT® project („ÖKOPROFIT®-Datenauswertung 1994-1997“) for this sector in assessing the interim targets for industrial and trade waste for 2000 contained in the programme as parameters for sustainability:

- Reduction in total non-recyclable trade/industrial waste by -30% (against 1993 figures)
- Reduction in hazardous waste by -50% (against 1993 figures)

The measures adopted by the 18 selected ÖKOPROFIT® companies over this period to optimise processes and increase efficiency in the use of materials meant that in 1997 these companies

- reduced overall expenditure on non-recyclable trade/industrial waste by -39% (against 1993/94 figures).

Parameter	**1993/94 tonnes/ year**	**1997 tonnes/ year**	**Reduction %**	**Target 2000 %**
Total trade/industrial waste (18 ÖKOPROFITâ companies)	3,063	1,880	-39	-30

The absolute savings realised in the years 1994-97 (the difference in volumes of non-recyclable waste for each year, added together for each company) for the ÖKOPROFIT® companies already mentioned amount to

- absolute savings in non-recyclable waste for 1994-97 of approximately –2,370 tonnes

The reduction which has been achieved is the result of measures for improved waste management (new containers, additional sorting, employee motivation) and is all the more remarkable if one also considers that over the same period the production performance indicators show an increase of 34%, with turnover increasing by 38%.

By reducing waste volumes over the period 1994-97 the companies have been able to make financial savings amounting to

- absolute savings of approximately ATS 2.4 Mio. (approximately € 174,400),

which translates as

- approximately ATS 4.9 Mio. (approximately € 356,100), including production costs/turnover

HISTORY

1988/89 Smog winter

The oppressive situation with regard to air quality in Graz reached its notorious low point in the Smog Winter.

1990 Graz takes a new direction

The Graz Environmental Office began to put together a comprehensive programme for lasting improvement in the environmental situation. In the forefront of this was a move towards an environmental policy preventing environmental damage and harmful effects on the ecological balance from arising in the first place.
By joining the Climate Alliance of European cities in 1990, associated with an undertaking to reduce drastically the CO_2 emissions mainly responsible for the greenhouse effect, the city of Graz gave further evidence of its commitment in this area.

1992 United Nations Conference on Environment and Development in Rio de Janeiro/Agenda 21

Agenda 21 was approved by the United Nations Conference on Environment and Development in Rio de Janeiro. Agenda 21 is a comprehensive action programme for the transition into the 21st century, involving all ecological, economic and social aspects. Since many initiatives and tasks involved in the implementation of Agenda 21 are rooted at the local level, cities and communities were called upon to develop a local Agenda 21.
In Graz, this call met with a quick response, and a joint approach involving the local population and a wide range of institutions was initiated to develop a plan for an integrated environmental policy taking full account of all aspects relating to health, society and the economy.

1993 „Greenpeace Climate Protection Prize "forGraz These joint efforts were rewarded for the first time. The city's special commitment to the objectives of the Climate Alliance was decisive in gaining the „Greenpeace Climate Protection Prize".

1994 Graz joins the network of „European Sustainable Cities"

In Aalborg/Denmark, the „European Sustainable Cities and Towns Campaign“ was founded, in which the City of Graz participated from the beginning. For the first time, the concept of „sustainable development“ was given firmer definition in this context: „Sustainable development requires of us that we use natural resources only to the extent to which they can be replaced and renewed

1995 „Ökostadt 2000 – Auf dem Weg zu einer nachhaltigen Stadtentwicklung in Graz – Lokale Agenda 21“ (‘Eco-city 2000 – en route to sustainable urban development in Graz – Local Agenda 21’)

As a logical progression in the new direction already taken towards sustainable urban development, the “Ökostadt 2000– Auf dem Weg zu einer nachhaltigen Stadtentwicklung in Graz – Lokale Agenda 21“ programme was unanimously adopted by the Graz Municipal Council.

1996 EU Award for Graz as „the most sustainable city in Europe“

The „Ökostadt 2000 – Auf dem Weg zu einer nachhaltigen Stadtentwicklung in Graz – Lokale Agenda 21“ programme, and particularly the commitment to implement new ideas and projects which point the way for the future, were decisive in securing for the city of Graz in 1996 the honour of being selected as the first European city to be presented with the „European Sustainable City Award “. Thus, the former „smog capital“ Graz became the „most sustainable“ European city within six years.

1999 First Impression of Ökostadt 2000 by the Graz Öko-Team.

The first meeting of the Graz Öko-Team in February 1999 was the starting-point for the first examination of the progress of Ökostadt 2000. All environmental organisations, the City and the Provincial administration, the universities and commerce and industry of Graz were invited to play an active part in this assessment. This call did not go unheard! Numerous representatives from the most diverse fields took advantage of the unique opportunity to feed in their ideas and aspirations for the sustainable development of Graz.
14 exciting months later, the final report of the „Graz Öko-Team“ was finally unanimously approved by the Graz Municipal Council.
In the intervening period, there were 24 meetings of six working groups involving a total of 68 representatives from 49 different institutions and 8 meetings of the „Graz Öko-Team“ – an enormous effort, not only by the Environmental Office, but particularly by those involved in the working groups who were all engaged voluntarily and with a great deal of commitment in this difficult task. There were volumes of data to be collected and assessed, new problem areas to be identified and joint strategies for solutions to be worked out. Of course, it was not always easy to bring together opinions and aspirations which were sometimes very far

apart, but ultimately it was precisely this diversity of opinions which animated the whole process and led to a remarkable outcome

Most important, however, is that this process of joint assessment and development has provided the environmentally friendly City of Graz with a new quality of co-operation which allows the city to face the future with optimism.

Sources

www.graz.at

ÖKOSTADT Evaluierung; Stadt Graz, Umweltamt, 1999

ÖKOPROFIT® Graz, Auszeichnung ´98; Stadt Graz, Umweltamt, 1999
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Canada

Title: Project Synopsis: SADC Industrial Energy Management Project

The SADC Industrial Energy Management Project (SIEMP) is sponsored by the Canadian International Development Agency (CIDA) in partnership with the SADC Energy Sector. The project began in 1994, and provides assistance to the ten countries which comprised SADC at that time: Tanzania, Zambia, Malawi, Angola, Zimbabwe, Botswana, Mozambique, Namibia, Swaziland and Lesotho.

Its goal is to improve the efficiency of energy use in the region's industries, by supporting the development of locally-delivered energy management training. Its objectives are to:

- provide hands-on, practical training in energy management to engineers, technicians and managers working in SADC industries.
- establish the capability to deliver professional energy management training in the SADC region, by supporting the development of local training providers.
- develop appropriate training resources and materials and make them available to training providers.
- disseminate information to industries and other end-users in order to demonstrate the potential benefits of better energy management and establish a market for training services.

The project is based in Harare, Zimbabwe and is delivered by a staff of 4-5 professionals.

SIEMP's approach is relatively unique among donor-assisted energy efficiency programmes. Most programmes emphasise technology transfer through the implementation of energy audits and introduction of "better practice", utilising technical expertise from the industrial countries. By contrast, SIEMP has focussed its efforts on establishing a *local framework for continuing human resource development in practical energy management*. Rather than introduce training materials from Canada or other industrial countries, both the materials and the overall framework of the SIEMP training programme have been developed and tested in the region, following close consultation with industry and local training providers.

Emphasis on Practical Learning

The project delivers two broad types of training:

- training of technical personnel and management through a "Core Training Programme" (CTP)

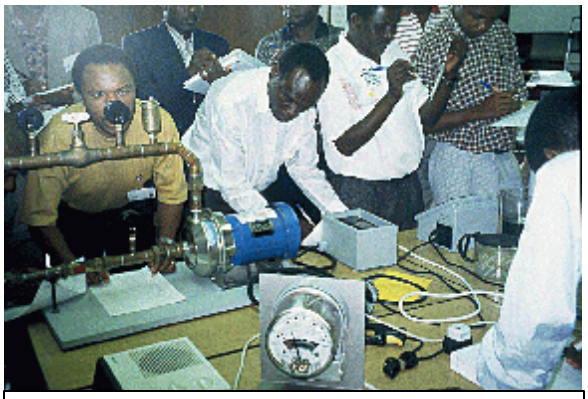
- training of trainers through an "institutional support" programme (ISP) .

The CTP is implemented at least once in each member State, and consists of sixteen technical modules delivered as three 3-day workshops targeted at industry technical personnel, plus a half day workshop targeted at top management. To date, the CTP has been presented in ten SADC countries, the latest being Lesotho.

In addition to industry trainees, the CTP also encourages participation by local training providers. These providers are later supported through the ISP in order to enhance their capacity to implement similar training programmes in future.

The Institutional Support Programme is based on detailed partnership agreements with trainers in the region, which specify the risks and obligations of each party as they move towards establishing an energy management training programme. Typically, these agreements include (i) participation in a TOT workshop, which is delivered once a year and covers such topics as needs assessment, instructional and programme design, teaching methodology, and training resource development; (ii) further technical training (if required) of partner trainers; (iii) transfer of project training resources, and (iv) cooperation in delivering energy management training programmes in both in-service and pre-service forms. The emphasis in the ISP is on developing market-driven, commercially viable training programmes, recognising that most training providers in the region have been forced to reduce their dependence on government and donors and develop new sources of revenue.

The project also includes a *Training Resources Development Programme,* which produces training materials and maintains support activities for training providers in the region, with the aim of enhancing their capacity to develop new materials and further contextualise the project's own materials. Materials developed to date include a detailed Training Manual for the CTP, a Trainers' Resource Manual, manuals for two short courses on Awareness and Implementation, and a series of twelve videos based on the CTP. The project has also developed and is now replicating locally a set of classroom demonstration equipment for trainers.

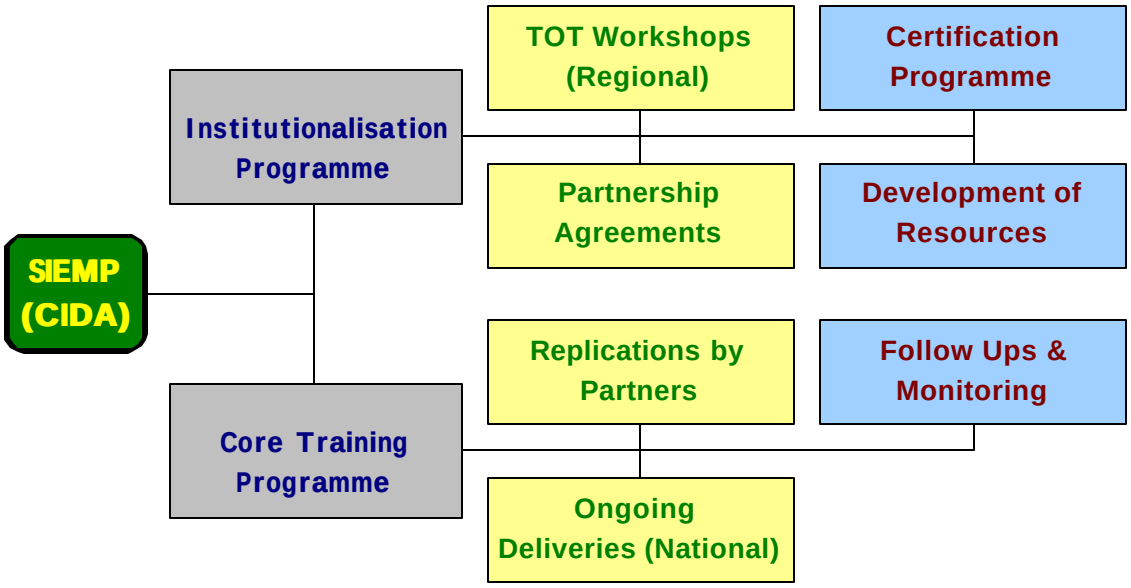


Classroom Demonstration Equipment

In order to consolidate its work and ensure sustainability, the project has recently embarked on an initiative to establish an *Energy Management Certification Programme.* This activity will attempt to develop a standardised body of knowledge and a network of certifying organisations. The certification programme is to be reviewed by a series of stakeholder workshops, in order to ensure ongoing support from potential implementing organisations.

The project also has an *Information Support Programme*, which provides a range of informational materials on the project, including a regional newsletter, a project Website, and a series of information sheets on specific aspects of energy management.

The overall framework of the project is summarised in the following graphic:



Title: Introduction of CNG Conversion Technology For Two-Stroke Auto-Rickshaws In Dhaka, Bangladesh

Abstract

The Canadian International Development Agency and Government of Bangladesh are co-funding the Bangladesh Environmental Management Project (BEMP) to assist the Bangladesh Department of Environment (DoE) to reduce emissions. Rapid progress has been made in just over 8 months to raise awareness of the converting from more than 50,000 two-stroke three-wheeler auto-rickshaws in Dhaka City. This has been accomplished through the:

- formulation of a self-sustaining plan to convert auto-rickshaws to Compressed Natural Gas (CNG);
- careful stakeholder analysis and consultations;
- technological demonstrations; and
- strategic publicity campaigns to maximize exposure.

With the vast reserves of natural gas in Bangladesh, the project is now poised to rapidly expand the usage of CNG by two-stroke auto-rickshaws. Plans to commercialize CNG conversions in Dhaka with a government-led institution are now getting wide acceptance. There have been numerous requests to replicate the program in other cities within Bangladesh and for other two-stroke models.

Background

Bangladesh has a number of serious environmental problems ranging from air to water pollution to land degradation, deforestation and overcrowding. The Canadian International Development Agency (CIDA) and Government of Bangladesh (GoB) are co-funding the Bangladesh Environmental Management Project (BEMP) to assist the Bangladesh Department of Environment (DoE) to build its capacity to enforce environmental legislation. One of the activities of BEMP is to assist the DoE to prioritize its environmental concerns, one of which is vehicular air pollution.

The level of air pollution in Dhaka has been steadily increasing over the past decades. With the increasing number of vehicles and aging vehicle fleets comprised of old technology engines burning poor quality fuels, the pollution generated by vehicle activity is contributing a significant portion of the overall inventory of emissions. This includes emissions from more than 50,000 two-stroke three-wheeler auto-rickshaws in Dhaka City. Reducing the emissions from these auto-rickshaws appeared to be the best strategy for improving Dhaka's air quality. BEMP has been assisting the DoE in formulating such a project.

Bangladesh also contains vast reserves of natural gas. Current gas distribution within the country is improving with sizeable foreign investments being made to improve distribution infrastructure. CNG is being used by 1100 light-duty vehicles in Dhaka with the price of CNG

being substantially lower than petrol; however, supply of CNG in recent years has become unreliable due to poor infrastucture maintenance and varying gas pressure.

Basic Problems

Higher emissions from two-stroke auto-rickshaws are primarily due to poor mixing of leaded gasoline and oil by the operator. Though the operator is supposed to blend the gasoline and oil to specified ratios, the exact quantities are often difficult to measure to provide consistent lubrication for the engine and crankcase. To compensate for this difficulty, the operators usually add more oil to the gasoline than specified, resulting in the burning of excess oils and elevated emissions of hydrocarbons and particulates. Other contributing factors to higher emissions from two-stroke auto-rickshaws include:

- Use of lower grade fuels and lubricating oils to maximize profitability for operators. Cheaper engine oils are often used are more viscous and do not mix as well as two-stroke engine oils with the fuel;
- Poor maintenance; and
- Lack of legal enforcement to discourage operation of polluting vehicles.

When BEMP introduced the project concept of converting two-stroke auto-rickshaws to CNG, there was some initial scepticism due mainly to past failures on similar initiatives. Initial discussions with all stakeholders concluded with a common remark "seeing is believing". In addition, the project concept was in conflict with existing GoB policies, which included:

- Raising import duties to discourage the import of two-stroke auto-rickshaws; and
- Banning two-stroke auto-rickshaws from the streets of Dhaka.

These policies, however, were viewed by many citizens of Dhaka to have minimal impact on reducing air pollution and traffic congestion.

Overcoming Problems

BEMP's project to reduce emissions from two-stroke auto-rickshaws consisted of:

formulating a successful and self-sustaining project plan. This involved introducing the concept of CNG conversions for two-stroke auto-rickshaws justified with sound economic, social and environmental benefits;

merging the project plan with existing policies. The project plan was presented as an alternative to the existing policies and also questioned the possible negative socio-economic impacts of a ban that may affect more than 250,000 persons directly and indirectly in the auto-rickshaw sector. This number does not include the thousands of passengers who use auto-rickshaws on a daily basis;

identifying and providing the outreach to stakeholders on behalf of the DoE. A key spokesperson for this project is the president of the auto-rickshaw owners association. With the policies in place to ban the use of their vehicles, they have fully embraced the concept of clean fuel to operate their vehicles. To date, there were no other alternatives for maintaining their livelihoods. In addition, a newly formed CNG distribution company in Dhaka (public-private joint venture) has been providing very strong support for this project;

facilitating discussions between DoE and stakeholders to plan the project and agree on roles and responsibilities. Project stakeholders were committed to both the demand and supply management of the development of CNG as a vehicular fuel. This included interested government ministries, private sector organizations and the developers of one of the more efficient CNG conversion technologies for auto-rickshaws;

conducting a study to establish technical and economic credibility of the project. The study was designed to generate widespread interest and overcome initial scepticism;

organizing press briefings to raise the profile of the CNG auto-rickshaw to the public. This has resulted in numerous requests to BEMP and its stakeholders on more information of the CNG auto-rickshaw;

organizing a high profile pilot technology demonstration consisting of four CNG converted auto-rickshaws in May 2000. The converted auto-rickshaws were introduced to the public during the DOE's World Environment Day festivities on June 5, 2000.

Current and planned BEMP activities include:

Monitoring performance of the converted and gasoline-fuelled auto-rickshaws including fuel consumption, revenue generation and tailpipe emissions. Thus far, tailpipe emissions of carbon monoxide and hydrocarbons have been reduced by over 75%, and SO_x and NO_x are barely detectable. There is also a substantial increase in revenue generation of CNG auto-rickshaws in comparison with gasoline run units. Data from this program will be used to increase the confidence of potential investors on the supply and demand sides of the project;

Organizing a larger-scale technology demonstration in October 2000 to increase the fleet to 30 CNG converted auto-rickshaws. This will assist in overcoming minor problems encountered in the pilot technology demonstration. The experience from this demonstration will used during the commercial phase of auto-rickshaw conversions;

Working very closely with the public-private natural gas distribution company. In the best interests of investors in this project, this would ensure CNG demand does not exceed supply and vice versa;

Designing a business model to commercialize CNG auto-rickshaw conversions. The model will be designed with participating stakeholders (e.g., auto-rickshaw owners and drivers, mechanics, suppliers, and CNG station operators) to allow a lead government organization to establish and implement national standards for CNG conversion work. Following successful commercialization, the GoB will have the option to privatize the CNG conversion operation. Other donors are being attracted to the capacity building required for government commercialization of the program;

Facilitation towards commercialization. BEMP will facilitate activities towards commercialization of CNG auto-rickshaw conversions. Once a commercial operation is established (scheduled for February 2001), BEMP will build DoE's capacity to monitor tailpipe emissions and enforce national emissions standards.

Barriers Encountered

Surprisingly, few barriers have been encountered during the implementation of this project to the time of the writing of this report (August 2000). The sound economic, social and environmental benefits of the project have garnered solid support from all sectors: suppliers, owners, government, passengers, etc. One barrier in the capacity building aspect of the BEMP has been the baseline skills of the DoE in stakeholder outreach and in dealing with the energy sector. Past contact with the private sector and other government ministries has been limited. In addition, basic understanding of the energy sector and fuel applications has been limited to BEMP's presentations to the DoE. However, given that the CNG auto-rickshaw project has raised the profile of the DoE, there has been a sincere effort by DoE officers to improve their understanding of the project.

Anticipated barriers and difficulties are with:

Competing technologies. There have been efforts to promote widespread use of liquid propane gas (LPG). While these efforts are commendable, most of Bangladesh's supply of LPG is imported and does not decrease the country's foreign expenditures. Furthermore, the safety of the competing technology has not been fully addressed; and

Maintaining quality standards. In the absence of any national standards for CNG conversions, the project is working towards formation of a government-led organization to set and implement these standards. Difficulties, however, may be encountered in the setup of such an agency that will consist of private and public sector personnel.

Outcome and Impacts

One of the outcomes of BEMP's auto-rickshaw conversion project is a heightened and positive public awareness that the GoB are taking initiatives to curb air pollution. A BEMP sponsored survey on CNG auto-rickshaw awareness revealed the public is also very supportive of the use of clean fuels such as natural gas to reduce air pollution.

The auto-rickshaw demonstration has also fostered activities towards inter-ministerial cooperation. Official lines of communication are being setup between ministry departments such as the DoE and Rupantarita Prakritik Gas Company Limited (RPGCL), the state owned natural gas company under the Ministry of Energy and Mineral Resources.

Project Status

At the time of the writing of this report, BEMP is arranging to increase the fleet size of CNG converted auto-rickshaws from 4 units to 30. In addition, BEMP is organizing a stakeholders meeting to discuss commercialization plans. Personnel from the auto-rickshaw owners and drivers association, private sector maintenance shops, RPGCL, the Ministry of Energy and DOE will sit to discuss roles and responsibilities of a government-led organization dedicated to conversion and maintenance of CNG fuelled vehicles. A work plan will be agreed upon with time lines set for each activity.

Replicability

Thus far, the success of the project is measured in the positive responses of the participating stakeholders of the project. Its replicability is dependent on sound economic benefits for all stakeholders. Without the lower price of CNG in comparison to competing fuels, interest and investment into this project would not have been possible. Unfortunately, environmental and health benefits alone would not have helped this project achieve the successes thus far.

The experience of this project can also be replicated in other satellite cities of Bangladesh. There have already been inquiries to setup similar conversion programs in Chittagong, Sylhet and Khulna. In addition, owners of Tempo two-stroke mini-buses have also requested conversion of their vehicles to CNG.

Lessons Learned

Lessons learned:

- After stakeholder analysis, the setup of relationships with the correct decision makers is crucial project success;
- Perseverance is required to keep all government project officers and stakeholders informed;
- Support for the project must be garnered from all levels (i,e., knowing there are substantial economic benefits for each stakeholder); and
- Publicity campaigns must be properly managed to ensure maximum impact.

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Title: Introducing Retscreen As Universal; Analytical Tool for Renewable Energy Projects

Abstract

The harnessing of renewable energy technologies in many developing countries has been hampered by the lack of knowledge and information about technologies, opportunities, costs and benefits which are further compounded by deficient institutional capacities to assess and plan viable projects as well as the high inherent transaction costs involved. Consequently, renewable energy technology projects are seldom considered by government policy makers, utility planners, developers and other decision makers at the critically important initial planning stages.

RETScreen is a standardized renewable energy project analysis software that was developed to help identify and evaluate the most viable opportunities for cost-effective implementation of renewable energy technologies.

As a cost-free downloadable software, RETScreen was developed by the CANMET Energy Diversification Research Laboratory (CEDRL) (a research facility of the Department of Natural Resources Canada) with additional financial support from the United Nations Development Program (UNDP). In addition, a number of other organizations and agencies B e.g. the United Nations Environment Programme=s (UNEP) Division of Technology, Industry and Economics, and the contributions of over seventy experts from industry, government and academia B provided intellectual support in the development of RETScreen. Its scope has also been greatly enhanced with the use of a global weather database that was developed in cooperation with the National Aeronautics & Space Administration (NASA).

The software was first released in May 1998, and has been widely used by hundreds of electric utilities, independent power producers, governments and development agencies who took advantage of RETScreen=s chief advantage - the significant cost savings realized from the reduction of cost and time required to identify viable electricity generation and space heating renewable energy technology projects anywhere in the world, with reliable data and results.

Key Issues Addressed

The potential for sourcing a significant portion of their energy needs from renewable sources is very high in many areas of the developing world, and these include solar, wind, tidal, geothermal and biogasification. If planned and implemented properly, renewable energies could be tapped reliably to meet a major part of a developing country=s needs particularly where its economy has been growing faster than can be met by its current power infrastructure, for example, China and India. The key stage at which a particular renewable energy technology can be considered for implementation or integration into an existing power grid is at the initial phase where a preliminary feasibility study should be undertaken to assess its viability vis-a-vis conventional energy technologies. Unfortunately it is at this stage that the lack of reliable information and knowledge about technologies, opportunities, and capacity to conduct sound assessments have

combined to prevent even a cursory consideration of renewable energy technologies in many national energy planning policies or infrastructure project proposals.
RETScreen=s standardized approach to project analysis is one of the major reasons for its success. The core of the software consists of well-designed, user-friendly and technology specific Microsoft Excel spreadsheets. Users can evaluate the annual energy production, life-cycle costs, financial viability, and even greenhouse gas emission reductions of renewable energy projects anywhere in the world by providing inputs to predefined variables/cells in the spreadsheets. The software also includes information on different technologies, costs and weather data. The ability of the software to provide assessments in any part of the world arises from its link to NASA=s global weather database that provide RETScreen users free access to satellite data such as the amount of solar energy striking the surface of the earth, global temperatures and wind speeds. The inclusion of this database results in significant cost savings for users in evaluating renewable energy resource potential, and indirect boosts to a nascent market that hitherto has had difficulties in attracting a sufficiently sizable client base that would consider renewable energy technologies as part of their energy planning policies and programs.

Outcome and Impacts

Since its release in May 1998, the RETScreen software has been well received by 10,000 users in more than 170 countries around the world for a variety of purposes, including preliminary feasibility studies, market studies, due diligence assessments, policy analysis, project development and management, and product R&D development and marketing. Demand has been growing at about 100 new users per week and is increasingly being driven by requests from the developing world.

The software=s comprehensiveness and adaptability while delivering real cost savings is clearly the key factor in its growing demand. As an example, RETScreen was instrumental in helping a team of eleven consulting firms prepare preliminary feasibility studies for 56 potential renewable energy projects at a cost of less than Can$2000 each, which is a fifth to a tenth of what it would have otherwise cost in previous similar studies.

In addition UNEP=s Division of Technology, Industry and Economics is currently cooperating with CEDRL and the UNEP Collaborating Centre on Energy and Environment to enhance the software=s usefulness by developing a new greenhouse has emissions (GHG) mitigation model that allow users to calculate the estimated GHG emission reductions and their consequent financial impact for the development of Clean Development Mechanism (CDM) and Joint Implementation (JI) renewable energy projects. This cross connection with international climate change policies and activities will only enhance the awareness of the international community on renewable energy and environmental issues, and provide further justification for key stakeholders= commitments (for example, national governments, municipal authorities, power utilities) to develop and implement sustainable development initiatives in their respective countries.

Program Status

The new databases from NASA and the GHG mitigation model from the UNEP are still being updated and integrated with the RETScreen software, and their use will contribute to establish RETScreen as an international standard for renewable energy project evaluations. The latest version was released in August 1999 and included not only wind, solar, photovoltaics, solar air heating and biomass heating technologies but also solar water heating, passive solar heating and ground-source heat pumps technologies. Current proposals are to make it available in the Spanish language in addition to English and French, and in the near future additional languages to make the software more widely accessible.

Replicability

The software was developed with the support of the UNEP and NASA for the sole purpose of providing a cost-effective and comprehensive assessment tool for potential renewable energy projects to any user around the world free of charge. Given the global weather database that is used in conjunction with RETScreen, it is not anticipated that the software be replicated as such unless the user requires certain specialized results not intended by this program.

Lessons Learned

Although part of the wide acceptance of the software is evidently due to its cost-free nature, adaptability and comprehensiveness, it cannot be denied that the support of the United Nations Environment Programme has been instrumental in disseminating information about RETScreen to all its partners in the technical assistance and development fields. In addition, the assistance provided by NASA=s Earth Science Enterprise Program, the UN Collaborating Centre on Energy and Environment, and the Global Environment Facility (GEF) have helped to improve the software=s reach and scope to all parts of the world, and this was key to making it an acceptable international standard by which to assess viable renewable energy projects.

As such, RETScreen has helped to eliminate a substantial institutional barrier in terms of the capacity to perform preliminary analyses of potential renewable energy projects, as well as to disseminate knowledge of the different kinds of technologies available in the market. As accessibility to the software is improved through its translation to different languages, it is expected that individuals and local communities will be correspondingly empowered to undertake their own assessments to meet their specific energy needs. This should also improve their capacities to present and market their demands to interested investors searching for viable opportunities in the energy infrastructure market.

Further Information

For further details on the RETScreen program or software, inquiries can be directed to:

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Title: Introducing Advanced Small Hydro Technology in Hangzhou, China

Abstract

Due to a rapidly expanding economy, coupled with an inadequate and deficient energy infrastructure, China has been actively exploring and promoting the use of alternative and renewable energy technologies, particularly in remote regions which are not served by the main power grids or where energy supplies have been seriously deficient. One of these is small hydro technology. The Chinese small hydro market is immense; about 1500-2000 MW of small hydro is developed annually which represents half of the world=s annual aggregate development. However, much of this development is derived from conventional technology which limited its scope of application as well as not providing for optimal performance. In December 1997, with the support of the Canadian and Chinese governments, a joint venture agreement was reached between Powerbase Automation Systems Inc. and the Hangzhou Regional Centre to manufacturer automated turbine control units (TCU) for the Chinese market.

Key Issues

This agreement was facilitated through a Canadian government-supported technology deployment project which called for the establishment of 12 demonstration units at five sites, the creation of business and technical relationships, and a training program to equip selected personnel with the skills to operate the equipment. One of the objectives of this project was to address the critical energy supply deficiency caused by a rapidly expanding economy, as well as to provide the Chinese with an alternative to coal-based power sources which would only have served to increase an already high level of GHG emissions. Given the existence of thousands of small-hydro plants currently sitting idle in China due to their non-viability, this project sought to increase their operating efficiencies, thus permitting their rehabilitation, as well as make the construction of new plants more economically viable.

The technology also has a proven record of reducing significant amounts of GHG emissions, and implementation of this project alone helped to reduce approximately 30,000 tonnes of CO_2 per year, through a combination of increased efficiency and the avoidance of coal-based power generation. Implementation of this technology throughout China could involve as many as 3,500 systems annually, representing approximately 350 MW of power, and CO_2 reductions of more than 2 million tonnes per year.

Outcome and Impacts

The project has been a complete success in terms of rehabilitating unused small-hydro plants, as well as providing an off-grid energy supply to complement the existing main power grid. The project has led to the total retrofit of 15 sites to date, and plans have been made to retrofit another 40 sites the following year. Total GHG emission reductions from these retrofits are estimated to amount to 310,000 tonnes of CO_2 annually. One the elements of the project called for the training of 24 Chinese technicians in Canada to better understand the technology they would be involved with. The hard technology transfer would not have been possible without ensuring the human resource employed in operating it were trained properly, thus establishing a core group of local expertise upon which the company could rely on in the future when they replicate the technology elsewhere in China.

The Canadian government support for this project will also enable Powerbase Automation Systems Inc to market the technology to neighbouring Asian countries; assuming this capacity replace fossil fuels, this could in principle result in further savings of more than 1.75 million tonnes of CO_2 per year.

One of the other factors which contributed to the success was the strong support by the Chinese Ministry of Water Resources which is responsible for the Hangzhou Regional Centre for Small Hydro. This support arose from the bilateral agreements between Canada and China on small hydro development in 1984 and 1995, as well as a bilateral agreement on environmental cooperation signed in 1997. The spirit of cooperation embodied by these agreements generated the necessary momentum and good will from both parties that helped to establish the level of confidence necessary for the Canadian company to transfer a highly sophisticated technology to a developing market.

Project Status

The project is still completing the set up of the first phase involving the initial 15 site retrofits. The training of Chinese technicians to operate the sites has also been completed. Once this phase is over, the project will then enter into its second phase where the company will retrofit 40 additional sites which once completed are expected to generate savings of close to 240,000 tonnes of CO_2 annually.

Replicability

Small hydro technology is most suited to a terrain where there is reasonable access to low-head rivers, and where connections to main power grids are more the exception than the rule. This is evidently the case in many remote areas in China, Indo-China, India and Nepal, where thousands of small hydro plants were constructed to take advantage of the plentiful natural resource. The majority of them however currently lie idle due to their inefficient technologies and have been unable to justify their operational and capital costs. TCU technology as implemented in the project described above could lead to the rehabilitation of these plants thus bringing them back into viable operation again. The rehabilitation of existing small hydro plants will also avoid the unnecessary building of new power plants using traditional fossil fuel sources such as coal to meet growing energy demands, and this will indirectly lead to greater savings of GHG emissions.

Lesson Learned

Given the involvement of the state in power generating activities in China, it was necessary to establish a clear understanding and strong relationship with key government players in order to secure their support for any eventual technology transfer projects. Particularly when the technology transfer in question involved highly sophisticated pieces of engineering and the proprietary rights of such technologies normally belong to the private sector, it is incumbent upon governments to provide sufficient reassurances that the intellectual property rights would be protected. This is especially important when the receiver of such transfers is located in markets that have relatively weak regulatory frameworks on foreign investment, intellectual property rights and contractual dispute settlement.

Secondly, the degree to which a technology transfer initiative is successful is also dependent upon the capacity of the local expertise to understand, manage and operate the new technology as was the case illustrated above. An essential element in any such initiative

therefore involves some form of capacity building in terms of training and skill upgrades for local personnel, as well as general exposure to the regulatory and operations context that would be expected to manage an economically viable facility (e.g. environmental restrictions, safety and technical standards, and project management skills). The receptivity of the local community to being involved in the TCU project was also partly conditioned by the direct involvement of local authorities in the central government=s policy approach to the use of renewable energy technologies in communities where access to the main power grids was either difficult or not available. In fact, the Chinese partner in this particular joint venture, the Hangzhou Regional Centre, given its role to promote the development of small hydro power in Asia-Pacific developing countries as well as being an agency responsible to the Chinese Ministry of Water Resources, was well placed to identify suitable test sites as a result of their wide network of local industry and municipal contacts with whom they had worked closely to address sustainable development and energy issues.

Further Information

For further details on the Canada-China small hydro (TCU) project, the following contact may be useful:

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Title: Introducing District Heating System Into Remote First Nation Community

Abstract

In 1992, the Oujé-Bougoumou Cree Nation (population 650) was the first community in North American to implement a village-wide district heating system based on biomass resources. The success of this project which allowed the community to become self-sufficient led it to receive a United Nations award in 1995 for being a Asustainable community@. The development of an environmentally-sustainable energy system for the community was selected as a priority because of the potential for providing long-term community development, employment generation, and economic development benefits. In spite of the higher initial costs compared to oil-based or hydroelectric heating, the payback period however was sufficiently attractive to persuade the community to adopt the system as it would eventually cost them less on home heating than if they were tied to conventional oil or electric systems. The 2400kW system includes a 1400kW
wood waste boiler and a 1000kW oil boiler for meeting peak needs and for back-up. The system is fuelled mainly by waste woodchips and sawdust which account for 15% of the fuel costs of the system but provide 85% of the energy used to fuel it.

Key Issue Addressed

The Oujé-Bougoumou Cree Nation is located approximately 960 kilometres north of Montreal, Canada. The Cree people reside in an area rich in mineral deposits, and throughout the previous fifty years of mining development the community had suffered continuous displacement and consequent disruptions not only to their way of life but also their abilities to support themselves without considerable assistance from both the federal and provincial governments. Following agreements with the provincial government in 1989 and the federal government in 1992, the community received significant financial contributions for the construction of a new and permanent village. In considering the energy options for the new village, the Oujé-Bougoumou community evaluated the potential long-term benefits associated with district energy. The community adopted a comprehensive view of community economics to ensure the long-term viability and sustainability of the project to the people of Oujé-Bougoumou.

Originally, all energy requirements of the community were supplied by outside sources, e.g. oil and hydroelectricity (estimates from subsequent similar projects indicated that only 10% of expenditures on oil remained in the local community in the form of indirect economic benefits, compared with 90% for waste fuels). Rising energy costs were also affecting the community=s socio-economic development. In keeping with the Cree philosophy of environmental protection, district heating was selected to provide space and water heating to the new village. Several factors led to the decision to investigate a biomass-based (wood waste) district heating system:

- the availability of an adequate supply of sawmill waste in the area;
- support from the federal government; and
- the familiarity of the village members with district heating technologies due to the existence of a similar system at a nearby Canadian Forces military base.

After a feasibility study funded by the Canadian government was concluded, and following extensive community-wide consultations, the community leaders agreed to adopt the district heating system due to the following benefits:

- $ Capturing capital for internal circulation which otherwise would have left the community for fuel or electricity purchases;
- $ creation of local employment, and potential for spin-off enterprises which could utilize excess energy for greenhouses or aquaculture;
- $ long-term reduction of heating energy costs through the displacement of conventional heating systems;
- $ contribution to the community=s innovative local housing program (this program collects a fixed percentage of residents= income for a community housing fund. In effect, the financing mechanism for the district heating system would end up freeing money for future housing development by covering heating costs that would otherwise be the responsibility of the housing authority.)

Outcome and Impacts

The district system was financed almost exclusively from local development funds with small contributions from the Department of Natural Resources Canada and Hydro Quebec. The project was completed in late 1992, and included a central plant with a 1.4MW waste wood chip boiler, a peaking oil boiler of 1.4MW, and a 1MW oil backup system. The system was connected to 135 homes and 16 public buildings; each of the homes consuming about 10kW for space and water heating, and 450kW of consumption for the public buildings. The buildings were connected to the central boiler through a 12,000 meters network of piping consisting of pre-insulated plastic PEX and steel pipes, a unique and innovative approach in Canada at the time. The plastic piping was designed especially for small-scale district heating systems with low heat density which provided significant savings in both material and installation costs.

All buildings were equipped with energy meters to measure the monthly energy consumption, and customers were billed in a similar fashion to electric utility customers. The system was also equipped with a telecommunications modem for remote troubleshooting and supervision. In 1995, biomass provided 85% of the energy used to fuel the system but only accounted for 15% of the fuel costs.

One other result of following the decision to implement the biomass-fuelled district heating system was that all of the homes in Oujé-Bougoumou were designed to the highest energy efficiency levels, exceeding the R-2000 standard. This decision was based on the assessment that the project=s long-term benefits far outweighed its short-term costs.

In terms of reduction of greenhouse gas (GHG) emissions, latest estimates revealed that as a result of this project, there were annual reductions of CO_2 emissions by 2,300 tonnes, SO_x by 3.8 tonnes, and NO_x by 1.0 tonne.

Project Status

Further biomass capacity was installed in 1997 with a 1.5MW wood waste boiler after the first successful stage of the system=s implementation.

Replicability

Given the large numbers of remote native communities in Canada which are dependent on external power connections for their heating needs, the successful approach undertaken with the Oujé-Bougoumou obviously served as a very appropriate model to be replicated in similar communities as well as in certain urban areas (e.g. Charlottetown, Prince Edward Island) which have adopted or are adopting community-heating approaches. Following the experience with the Oujé-Bougoumou Cree Nation, the system was also introduced to the Grassy Narrows Ojibwa community in northern Ontario, and discussions have been on-going with several other interested First Nations communities.

Lessons Learned

Due to the interdependent nature of the relationship between the First Nations people and the federal government, and to some extent, provincial governments, financial and technical support from the both tiers of government were necessary to help investigate and implement alternative energy systems without which would never have seen the light of day given the high initial capital outlay and training costs involved.

Furthermore, in the case illustrated above, the founding leaders of the Oujé-Bougoumou made a conscious decision to develop a livable community based on traditional Cree values, and encompassing the objectives of local economic development, self-sufficiency, community participation, and environmental sustainability in their plans. In other words, the community decided as a whole to pursue a long-term development plan which they saw as vital to the survival of their culture and way of life. This community-wide commitment was key to the success of the district heating system implementation , and to this day the people of Oujé-Bougoumou continue to enjoy one of the most cost-effective and self-supporting power generation systems in the country.

Further Information

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Germany

Title: Photovoltaic Water Pumps (PVP) – An attractive Tool for Rural Water Supply

Win-Win Solutions for economy, Environment and an increasing Quality of Life

Abstract

Over the past 20 years, the German development cooperation has funded various projects to investigate photovoltaic applications in rural areas of developing countries. These projects focused on basic electrification of rural households, drinking water and irrigation water supply. Within the scope of two different PV water supply projects presented, a total of 100 photovoltaic water pumps (PVP) were installed, operated and monitored at selected sited in nine developing countries. The standard-type PVP systems convincingly demonstrated their reliability within the applied power range. Economic efficiency analyses, focusing on rural drinking water supply, showed PVP to be competitive within the power range of small diesel pumps, where they often even constitute the least-cost option. First results of photovoltaic water pumps applied in small-scale irrigation systems are promising. Social back-up measures helped secure sustainable higher acceptance and better integration of PVP into project communities. With a view to generating added confidence in PVP technology and to promoting the dissemination of PVP, it is necessary to establish a well-functioning service structure and assured availability of spare parts by PVP suppliers in the project countries.

Key Issues Addressed

German development cooperation promotes the use of renewable energy resources in order to improve people's living conditions and to shape climate policy. Persuant to the aim of sustainable development, the key areas have been defined as poverty alleviation, environmental protection and conservation of natural resources, education and training. The results in further fields of action that are particularly significant with respect to the dissemination of renewable energies, such as the promotion of the private sector, technology transfer and rural development.

Country Profile

Location- The Deutsche Gesellscaft fur Technische Zusammenarbeit (GTZ) GmbH has implemented the *International Programme for Field Testing of Photovoltaic Water Pumps (PVP-Programme)* in cooperation with national energy and water authorities in Argentina, Brasil, Indonesia, Jordan, the Philippines, Tunisia and Zimbabwe. The pilot project entitled *Resource-conserving irrigation with Photovoltaic Pumping Systems* is being implemented in Ethiopia, Chile and Jordan

Project Area Profile- In many developing countries, the inadequate supply of drinking and irrigation water is a sever problem. In rural areas with no access to grid power, national water authorities and private farmers have to rely on hand pumps and diesel-driven pumps, many of which are out of service due to technical defects or a lack of fuel. Especially for developing countries with no fossil fuel resources of their own, both the cost of importing such fuels and the fact that this dependence on imported energy also

makes them politically dependent on its suppliers are a problem from the standpoint of development policy. In rural areas, photovoltaic pumps represent a reliable alternative means of water delivery but are rarely chosen for lack of pertinent experience.

Sustainable Development Issues that were addressed in the Case Studies

Though a reliable supply of clean drinking water is a basic need, the World Bank estimates that approximately one billion people in remote, rural areas of developing countries have no adequate access to clean drinking water. In rural areas people often draw their water by hand from water holes, rivers or wells. According to the FAO, 78% of all diseases in developing countries are regarded as "water induced". In most countries, the provision of drinking water is regarded as the task of the governmental infrastructure, but the quality of this service is inadequate, especially in rural areas, for lack of financial resources.

In regions with high insolation levels, photovoltaic water pumps could constitute an additional option but although the advantages of solar technology are evident, purchase decisions are often taken in favor of the competing diesel-powered systems. The comparatively high investment costs of the solar system are critical here. Today the operator of a ready-to-use solar pump pays about 3 times as much as would be needed for a diesel pump with the same performance. However, it is frequently overlooked that after the installation the solar system incurs only a fraction of the operating coasts of a diesel pump. Consequently it does not make economic sense to compare different technologies solely on the basis of the investment costs. Due to the fact that the high initial investment costs are still the main obstacle to distribution of PV pumps, it is necessary to compensate for the high investment costs by providing loans on favourable terms via development banks or through other suitable financing models.

Objectives

The objectives of the field-testing and demonstration activities are to:

- Demonstrate the technical maturity of PVP,
- Determine the conditions for a cost-effective utilization of PVP
- Clarify the ecological benefits and the level of acceptance on the part of users and operators
- Adapt PVP technology to the user's need and to the climate conditions, the aim being to develop a marketable product
- Clarify the opportunities for future PVP applications as well as their potential for dissemination
- Support of cooperation between German equipment suppliers and contractors in the developing countries.

Implementation

Together with national project executing organizations, the Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ) GmbH has implemented the PVP field-testing and demonstration projects in Africa, Asia, Latin America and the Middle East (see Location under Country Profiles)

The results of the PVP projects provide a decisionj-making basis for:

- National or regional water utilities and private farmers to assess PVP as a viable, least-cost option for rural water supply, and
- PVP suppliers/distributors for product adaptation and marketing

The overall idea is to achieve a major advance towards commercialization of PVP technology by demonstrating its feasibility at a significant number of sites. This is to be done in combination with thorough preparation of counterpart institutions and personnel, intensive interlinking with industry and an extensive performance monitoring programme. The transfer of expertise to counterparts and PV industry is of crucial importance with respect to the desired market effects.

Outcome and Impacts

In the course of the *PVP-Programme*, a total of 90 PVP systems have been installed at selected sites in the project countries where they supply drinking water for about 150,000 people and their domestic animals. The irrigation of allotments with surplus pumped water contributes to guarantee the base of survival. For preservation of water quality and improvements of the hygiene, sanitary facilities such as wash-places for clothes and simple latrines have been installed at locations. Additionally, the consumers were familiarized with the technologies for the rational use of water. Social scientific measures accompanied the programme and at the same time gave information about the acceptance of the population with regard to the new technology.

In the course of the pilot project *Resource-conserving Irrigation with Photovoltaic Pumping Systems*, 10 pilot systems are being field-tested for small-scale irrigation purposes. The use of PVP for irrigation represents a promising option for using solar energy productively and for generating income. The field-testing of PV-based irrigation systems is intended to enable the users and operators of the pilot facilities to assess and evaluate the technology. Therefore the project places great emphasis on upgrading of project partners and training of system users. The aforementioned pilot systems have been in operation for about two years and first results are promising.

Programme Status

The *PVP-Programme* concentrating on drinking water supply was finished in 1997. Supported by the favorable experience gained in the drinking water sector, the pilot project entitled *Resource-conserving Irrigation with Photovoltaic Pumping Systems* was started early in 1998 with a duration of four years.

Replicability

Experience to date shows that the standard type PVP systems used in the projects, meet user's expectations and have already gained the confidence of many people in and around the project sites. Although the project institutions have become significantly more willing to include PVPs in their national programmes, the high initial investment costs are still the main obstacle to distribution of PV pumps.

In the drinking water sector GTZ has demonstrated the cost advantages of solar pumps in the performance range up to 2kWp in six out of seven project countries (Asia, Africa, Latin America). First results of photovoltaic water pumps applied in small-scale irrigation systems are promising. However, due to the variability of country and site-specific cost factors, no generally valid conclusion can be drawn with regard to the overall viability of photovoltaic pumps.

Lessons Learned

Photovoltaic pumping systems are technically fit for use, beneficial for the environment and economically competitive, and therefore, in small output ranges of a few kilowatt, they are an attractive alternative to diesel-driven pumps. In some countries and demand sectors PVPs are by far the most cost-effective option.

In many countries security of supply and an operation which requires low maintenance are more important arguments than the financial benefits of PVPs.

Generally it can be stated that PVPs reveal special advantages if

Technically:

- Constant high exploitation is guarantaeed
- Optimized PVP standard systems are used
- The system output is low

Organizationally:

- Locations are remote,
- There are problems with maintenance and supply of diesel-driven pumps
- No operating staff is required
- The costs for water storage tanks can be kept low by involvement of the users in the construction works

Financially:

- Reasonable loan conditions are available,
- No or low import duties exist

Further Information

For further information about the projects, please contact:
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PVP proposals should be sent to the German Embassy via the responsible ministry of the country concerned

Title: The German Electricity Feed-In Law to Foster Renewable Energy driven Power Plants

Abstract

The German Electricity Feed-In Law has fostered the dissemination of renewable energy systems for electricity ge neration ' ' It was introduced in 1991 and was very successful. In spring 2000 the new law, the Act on Granting Priority to Renewable Energy Sources, came into force. This law requires the electricity grid operators to buyelectricity from renewable energy driven power plants at premium prices. This regulation is surrounded by,some additional instruments important for the success of this law. Mainly due to this law, Germany has the highest capacity of wind power plants world wide. This wind power capacity was expanded by on average 50 % each year in the last decade. A new and still fast growing wind power industry with approximately 25000 employees has been established.

Key issue addressed

This case study shows how renewable energies as a key element for the sustainable development of the electricity supply system have been supported in Germany in the past decade.

Country Profile

The Electricity Feed-In law as well as some supplementing regulations were introduced on a national level in Germany.

German electricity generation is mainly based on nuclear power, coal and I i gni te. In 1990 renewable energi es, i . e. at that ti me mai nly large hydro power plants, contributed only with 4 % to the total generation. The electricity supply industry was a monopolised industry until 1998. Tha . t meant, that the electricity customers did not have the freedom to choose their supplier, but only one supplier was active in every region.

Sustainable development issue

Since the two energy price crises in the seventies a lot of efforts have been made in the research and development of renewable energy systems in Germany. In the mid eighties, a lot of different technologies were feasible for market introduction. Due to the drop of energy prices, however, these technologies were very often not cost competitive thus suffering from a lack of application. Moreover', the then monopolised electricity supply industry had built up surplus capacities in conventional generation technologi es and showed little interest in installing new environmental sound power plants fuelled by renewable energies. Additionally, the traditional

electricity supply industry has very much the economies of scale in mi nd, thus preferring large power plants to small decentrali@sed units like many renewable energy applications are. Due to t h i s situation, also independent power producers could n . ot achieve reasonable price for their generated electricity.

Objectives

- To increase the application of renewable energies in the national electricity supply system
- To,introduce renewable energy systems in the market as aconsistent follow-up of research and development efforts
- To create a new.industry

Implementation

The parliament introduced the Electricity feed-In Law in 1991 supported by a large coalition of all parties. This law ensures grid access for electricity generated with hydro power, biomass, biogas, wind power or solar radiation. Moreover, it obliges the electricity supply company operating the public grid to pay premium;prices for the electricity fed in from these power plants. The premiums are calculated annually as a percentage of the mean specific revenues for all electricity sold via the public electricity grid in the previous year. The remuneration differs according to the technology and the plant size. Wind power plants and solar power plants get the highest remuneration with 90 % of the mean specific revenues, followed by small hydro, biomass and biogas power plants smaller than 500 kW with 75 %, the latter raised to, 80 % some years later ' Hydro, biomass and biogas power plants bigger than 500 kW, but smaller than 5 MW receive 65 % of the mean specific revenues. Plants bigger than 5 MW are@ not covered by this law. Thus, the predominant share of generation facilities based on , renewable energy sources that existed at the time of introduction of the Feed-In-Law was excluded. This way it was ensured that mainly new facilities gain advantage of the law.

Table 1: Development of premium prices according to the German Feed-In-Law (DEM/kWh).

Power plant technology	(a)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	%	DEM/kWh								
Hydro & biomass < 500 kW	75/80	0.1384	0.1378	0.1381	0.1411	0.1536	0.1530	0.1525		0.1469
Hydro & biomass 500 - 5 MW	65	0.1199	0.1194	0.1197	0.1223	0.1248	0.1243	0.1239		0.1193
Wind & Solar	90	0.1661	0.1653	0.1657	0.1693	0.1728	0.1721	0.1715	0.1679	0.1652

(a) Percentage of specific mean annually revenues

The Fed-In-Law was mainly intended to independent power producers.

Table 1: Development of premium prices according to the German Feed-In-Law (DEM/kWh).
(a) Percentage of specific mean annually revenues ,

The Fed-In-Law was mainly intended to independent power producers. However, plants operated by the electricity supply company may receive the premium prices if they are situated outside the supply area of the individual company.

In a regulated electricity market as it existed in Germany until 1998, the electricity s ; upplier who were obliged to pay the premium prices, could transfer the additional costs to the captured customers. Public budgets are not needed to finance the ElectricityFeed-In-Law, making it-very attractive to politics. There.has been a long discussion going on about the extent of the additional costs. This discussion mainly focussed on the question of value of the electricity fed in. Since a market price does not exist in a regulated environment the concept of avoided costs was applied. The electricity supply industry argued that due to their fluctuating character, electricity from renewable energies does not have any capacity effect. Thus the only costs avoided are the fuel costs. Others argued that a growing number of renewable energy power plants do have capacity effects. Additionally, transmission losses can be reduced since renewable energy plants are mostly smaller and more decentralised than conventional power plants. Calcul,ating with 0.10 DEM/kWh as reasonable mean avoided costs, the additional costs of the Electricity-Feed-In-Law amounted to 330 million DEM in 1999, which means that the price of any generated kilowatt-hour increased by merely 0.0007 DEM.

In addition to the Feed-In-Law, some supplementing regulations were established to foster the market introduction of renewable energies in the electricity sector. In the early nineties, an additional subsidy (4 Pf/kWh) was introduced for the,first 250 MW of installed wind power in Germany as an aid for market introduction within the "250 MW field test programme". Also the federal states launched support programmes for different technologies. The total public
Support for electricity generating -renewable energy technologies amounted to 200 million EM in 1999, not taking into account the costs of the Electricity-Feed-In-Law.

A federal public bank is distributing soft loans with low interest rates (2 % points below market level) and favourabte discharge conditions. The availability of capital is a very important precondition for applying renewable energies, since specific capital demand is high compared to fossil fuelled power plants. Especially small independent power producers suffer from a lack of access to inexpensive capital.

The building codes have been changed giving renewable energy technologies the same legal status as any other power generation technology. Moreover, the municipalities were forced to allocate potential sites for wind power plants, in their land development plans. The requirements on such sites were legally defined.

Outcome and Impacts

Due to the Electricity Feed-In-Law and its accompanying measures, Germany has experienced a rapid growth of wind power generation in the past decade. From 62 MW in 1990 the overall installed. capacity of wind power has increased to nearly 5000 MW by June 20@E) (see Figure 1), which meant that the installed capacity increased by an average 50 % between 1991 and 1999. Wind power plants have generated 1.2 % of Germany's total net electricity production. And this share is still increasing. At the same

time, this rapid growth also triggered the technological development of wind power. The average size'of new power plants could be increased from 170 kW in 1992 to nearly 1 MW in 1999. New players could be established in the power market.

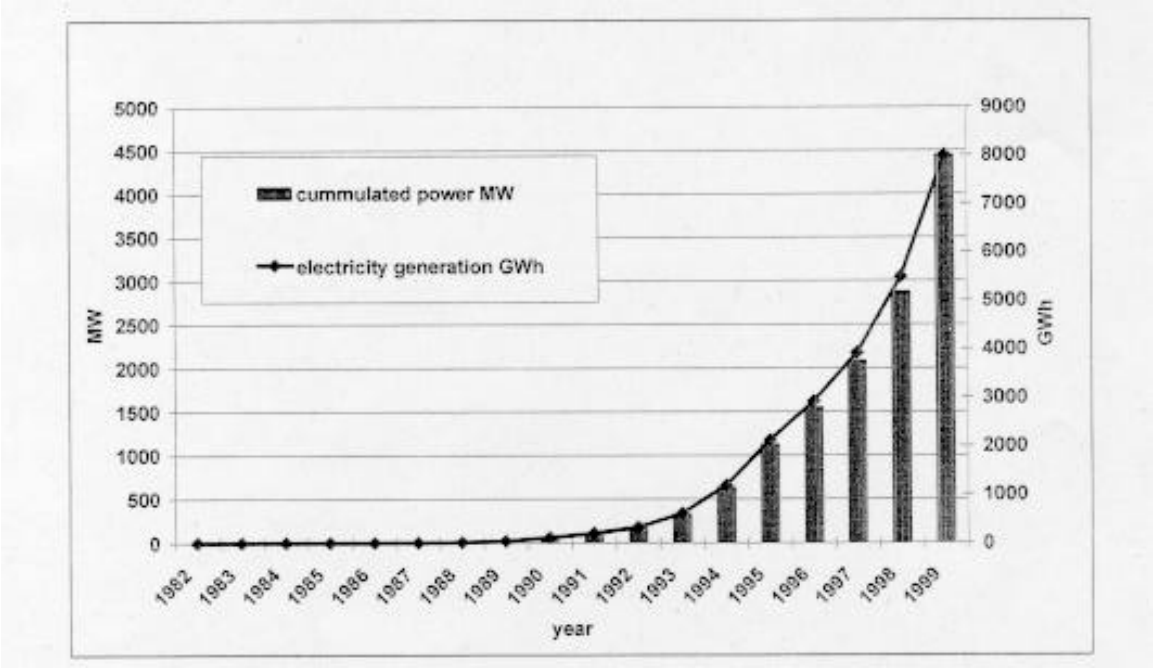

Figure 1: Development of wind power in Germany.

The. potential for large hydro power plants is almost totally exploited. Moreover., environmental regulations for the energetic use of water resources are very strict in Germany to protect the few remaining natural flows from human impacts. In terms, of totalinstalled power, hydro power has therefore not grown significantly in the last ten years. However, the number of power plants have been increased by 20 % since 1990 exploiting especially abandoned hydro power resources in smaller flows,.

Biomass technologies could not profit from the Electricity-Feed-In Law to the sa me extent as wind power. The remuneration according to the Law has not been sufficient to motivate investors to overcome the hindrances connected with the realisation of biomass power plants. The energetic use of biomass is most favourable in combined heat and power plants (CHP). To supply the generated heat, a district heating system is needed in many cases causing additional obstacles for realisation. Organising the supply of appropriate bio fuels is a rather complex process. Moreover, there is a wide range of different bio fuels, conversation technologies and applications hindering the standardisation of projects.

Looking at the present generation costs of photovoltaic power plants it is evident that the remuneration as it was fixed in the original Electricity-Feed-In-Law is not sufficient for establishing this technology in the electricity market. Other instruments like the "1@E)G-roof-programme" and lately the "lE)0.000-roof programme" give high

investment subsidies to owners of photovoltaic power plants making the operation economical feasible.

Around 25.000 new jobs have been created solely in the German wind power industry. Annual turnover was 4 billion DEM in 1999. Almost 20 % of the wind turbines manufactured in Germany are exported.

Status

Looking at the deployment of wind power plants, the ElectricityFeed-In-Law can be assessed as a very successful support mechanism. However, other technologies like biomass, biogas or photovoltaics have not experienced a comparable development in the past decade. Additionally, a number of problems have occurred since the law was established in, 1991. Mainly the electricity supply industry violently attacked the Electricity-Feed-In-Law. They crititised that the premium tariffs fixed by law does not reflect the value of the generated electricity. From their point of view there was no sufficient competition to induce cost reductions. Since most of the power plants favoured by the law i e. mo,stly wind power plants are situated in the north of Germany, the total burden of costs were higher for electricity customers in the north than for southern customers. With the liberalisation of the electricity markets in 1998 the question of a competition neutral compensation of costs got even more important. As another effect of liberalisation, the average prices thus also the average revenues
for electricity in Germany dropped significantly, Due to the calculation. method of the premium prices these premium prices dropped, too. Since operators of

the renewable energy plants calculated with stable remuneration over the lifetime of the power plants - which was reasonable under a monopoly situation - the drop of premium prices caused severe financial problems to the operators. Since generation costs.of wind power plants depends very much on the wind speed at the specific sites, the remuneration.was not often not sufficient for plants,oh inland sites whereas plants on the coastal sites received extra profits.

Taking the crucial points and the new requirements occurring from the li'beralisation into account, the Electricity-Feed-In-Law has been renewed and extended to the Renewable-Energy-Law in March,2000. The most important changes are

- The level of the remuneration is fixed on the basis of the electricity generation costs of theindividual technologies. . Photovoltaic appliances built before 2002 will receive 0.99 DEM/kWh, for small hydro power 0.15 DEM/kWh, for geothermal powe.r between 0.14 and 0.175 DEM/kWh and for electricity generated with biomass between 0.17 and 0.20 DEM/kWh.-
- Remuneration for wind power plants takes the specific wind speed at the individual site into account. At. an average site, wind power is remunerated in average with 0.164 DEM/kWh over a lifetime of 20 years
- The remuneration rates will be lowered annually for new installation by 5 % (photovoltaic) or 1.5 % (all other technologies), respectively. This measure should induce further cost reductions

- Also utilities may how get full advantage of the law.

- Costs and electricity are equally distributed on all electricity suppliers nation-wide.

- It is legally fixed, that plant operators have to pay the grid connection, but the grid operator has to'bear.the grid enforcement if necessary.

With this Law and some accompanying instruments the German government aims at doubling the share of renewable energy technologies on electricity generation from presently 5 % to 1E) % by 201E). The aim is to have 12500 MW wind power plants installed in Germany by 2010.

Replicability

A minimum price standard for electricity from renewable sources as it is fixed in the Electricity-Feed-In-Law may be implemented successfully both in regulated as well as in liberalised electricity markets. Minimum price standards may be introduced on a regional,
national or international level..

Lessons Learned
The Electricity-Feed-In-Law and its successor the Renewable-EnergyLaw are the central instruments to support renewable energy technologies for electricity generation. Compared with other European countries having implemented renewable port-folio standards (also called Quotas), European countries with minimum price standards showed a larger and faster growth of renewable energy technologies. New actors could be involved, spreading the idea -of an environmentally sound electricity production in the population, which ensures a good public backing.

However, a successful market introduction policy cannot be based on . one instrument only. , For a fast and continuous. growth a whole package of measures is needed to foster. a further research and development and to establish these technologies in the legal and political framework. Favourable economic conditions help to overcome the non-economical barriers.

Further Information
Renewable-Energy-Law

(in English http://www.bmu.de/enalish/fset8@O.htm)

The significance -of renewable energy sources for a sustainable energy policy in Germany.
(http://www.dlr.de/TT/system/publications/download/Significance.pdf)

Climate protection through the use of renewable energies, Study.
Summary.

ECONOMIC COMMISSION FOR EUROPE (ECE)

Title: Promotion and Development of a Market-based Gas Industry in Economies in Transition

Submitted by ECE Gas Centre

Abstract

The Gas Centre was established in 1994 in response to the needs of countries with transitional economies for an efficient transfer from western ECE countries of knowledge and know-how on market-based policies and practices for their natural gas industries. The programme is extrabudgetary and financed by 26 major gas companies, state-owned and private, from Europe, the United States and the Mediterranean Basin.

Its principal aim is to facilitate the implementation of market-based policies in countries with economies in transition (through greater convergence of norms and practices), to promote co-operation, and to facilitate the integration of the natural gas industry in Europe.

During its early years, the programme of work of the Centre was focussed mainly on the transfer of know-how and exchange of experience among the gas industries of western, central and eastern Europe. More recently, the mandate of the Centre was expanded to deal with strategic ECE-wide policy issues. Therefore, in addition to its initial mission, the Centre today acts as a platform for discussion of key strategic issues and developments in the European gas industry and for developing common understandings and approaches.

Key issues addressed

The case study addresses the following key issues:
(a) Technology transfer (transfer of know-how and experience on market-oriented structures);
(b) Capacity building in principles, policies and practices of a market-oriented gas industry;
(c) Enhancement of international and regional cooperation in the gas industry.

Country Profile

Location: While the programme is ECE wide, particular attention is given to economies in transition from central and eastern Europe (26 countries). Within the framework of its activities, the Gas Centre also provides technical assistance to specific countries (e.g., Bosnia & Herzegovina, Romania, Ukraine) through Technical missions.

Project Area Profile: Transition countries, notably the Russian Federation, today produce 35% of the world's natural gas and possess 40% of total gas reserves. They also represent the world's largest natural gas market.

Significant interdependence exists among countries of eastern, central and western Europe. For instance, western Europe receives 40% of its imports from the Russian

Federation, the world's leading gas exporter. Likewise central Europe occupies a strategic position in the transit of natural gas to western European markets.

Faced with serious environmental problems, the countries with economies in transition are increasingly turning to natural gas as a fuel of choice and implementing policies to increase its use and diversify their supply sources.

Sustainable development issue addressed in the case study

With the political changes at the beginning of the 1990s, major initiatives were undertaken in central and eastern Europe to restructure and reform the gas industry to market-oriented systems. Governments and gas companies sought to set in place new market and industry structures adapted to the new political and economic environment in the region. Price liberalization, the introduction of hard currency foreign trade and the severe economic downturn during the first years of transition from a command to a market economy, proved decisive in modifying the energy and natural gas industries.

For a successful transition, a number of criteria have to be met. It is imperative that the restructuring process is conducted in a reliable and efficient way, that Governments implement sound legal and regulatory frameworks within which the industry can operate, that effective rate-making and pricing policies are adopted, and that the role of the different actors in the marketplace is clearly defined and understood. Only within such a framework will investments take place and market growth proceed. These are prerequisites for the development of a sound gas market and for the inflow of domestic and foreign private capital.

While governments in countries with economies in transition are in the process of laying the foundations for the future viability and competitiveness of their natural gas industries, many problems remain. The implementation of market-oriented reforms has been uneven across countries and, in some cases, fragmentary. Energy laws, which have been under preparation in most countries, have still not yet been approved by Parliaments or fully implemented in numerous jurisdictions. In many cases, independent regulatory entities have not been created. While the corporatisation and commercialization of state-owned natural gas companies have progressed, the restructuring and privatization of the natural gas sector, and the creation of competition in the marketplace, have not progressed as far. In most cases, natural gas prices, while being raised, have still not reached economic levels, and tariff structures are still wanting.

Generally speaking, the institutional framework required to induce and support private sector investment in a market economy environment in many of the countries with economies in transition is still lacking. Property rights, commercial and bankruptcy laws, and more generally the rule of law are not sufficiently entrenched to adequately safeguard private sector investment. The institutions to enforce these laws are sometimes weak and poorly functioning. Skills in business planning, financial engineering and, more generally, entrepreneurship are also not as well developed as in western ECE countries.

The transformation is most advanced in transitional countries of central Europe where many of the problems noted above have been addressed and resolved. On the other hand,

the pace of reform has been less pronounced in eastern European countries, including southeastern Europe, as well as in the Commonwealth of Independent States (CIS).

Objectives

The basic functions of the Centre are the following:

- to provide assistance to Governments and gas industries in Transition Economies in the implementation of market-based policies, practices and principles in the gas industry;
- to act as a focal point for the transfer of knowledge on these issues to economies in transition; and
- to foster cooperation and greater convergence of norms and practices among gas companies and governments in the ECE region.

Implementation

To achieve its goal, the Centre has developed a network of key representatives from Governments and gas companies. Today, 26 major gas companies from 20 countries support the activities: Algeria (Sonatrach), Austria (OMV), Belgium (Distrigas), Croatia (INA), Czech Republic (Transgas), France (Gaz de France), Germany (BGW, Ruhrgas, VNG, Wintershall), Hungary (MOL), Italy (ENI, SNAM), Latvia (Latvijas Gaze), Netherlands (Gasunie), Norway (Norsk Hydro, Statoil), Poland (PGNiG), Romania (Romgaz), Russian Federation (Gazprom), Slovak Republic (SPP), Slovenia (GEOPLIN), Tunisia (STEG), Turkey (BOTAS), Ukraine (NAK/Ukrtransgas), United States of America (El Paso).

Initially, the Centre developed five main lines of activities:

- A programme of seminars and conferences focusing on gas industry policy issues, reform and restructuring, legal and regulatory measures, rate-making, contracting, financial aspects and investment in transition countries.

- Dissemination of information by publishing of proceedings and reports on the restructuring and reforms.

- The development of an on-line database on major gas markets in the ECE region. This unique, comprehensive and internationally comparable database includes key aspects of a market-based gas industry.

- A training manual project, aimed at providing extensive information and understanding of market-based pricing and assisting in its implementation. The project includes a reference book on gas rate-making in western economies and transition countries, a model on cost-based rate-making and cost accounting, and training courses on natural gas rate-making in the ECE region.

- Advisory services dedicated to specific issues in dedicated economies in transition to better understand the ongoing reforms in the gas sector and attract foreign investments in the gas industry.

In response to the profound changes facing participants in the natural gas markets of Europe, the Centre established task force groups to consider and discuss strategic issues:

- Implementation of the European Union Gas Directive in the ECE region – The objective of the task force is to report and inform on the status of the transformation and the transposition of the Gas Directive of the European Commission into national law in EU Member States, to discuss the business implications of the implementation and interpretation of the Gas Directive, and to transfer experiences developed in EU Member States to Accession candidates and other countries affected by the Gas Directive.

- Transportation and tariffs (GATE 2010) - The objective of the task force is to create a platform for the establishment of a compatible business practice in natural gas transportation and pricing, to establish a framework for European gas transmission, and thirdly to provide a platform for the exchange of knowledge and experiences among key players of the gas industry.

Outcome and Impacts

As mentioned earlier, during its first years of operations, the Centre focused on the transfer of market-oriented practices to economies in transition. Market-based policies, tools and principles were discussed and implemented. A number of conferences, workshops and training events were organised focusing on policy issues, legal and regulatory measures, rate-making, contracting, etc. Since its creation, the Centre has organised 15 workshops/conferences, making possible for over 1000 key experts from more than 30 ECE countries to exchange views and experience. The Centre produced a Training Manual for natural gas rate-making and developed a comprehensive database on gas market. The Centre also organised high-level meetings with its members and issued several publications on the progress achieved in reforming and restructuring the gas industry in countries with economies in transition. These activities played a pre-eminent role in promoting further integration of the European gas industry, for the benefit of all.

At present, the transition process is well underway in many countries but is still lagging behind in others. Therefore, a significant part of the Centre's programme of work continues to be focussed on encouraging the implementation of market reforms and promoting a greater convergence and harmonisation of norms and practices.

But because of the profound changes underway in the gas markets and industries of Europe, the Centre is now devoting more attention to strategic issues and their implications for the European gas industries. For example, the EU Gas Directive regarding the liberalisation of gas markets will affect not only EU member countries and their gas companies but also other ECE countries and their gas industries (producers, transporters, exporters, importers and distributors). As a result, the Centre is increasingly becoming a key forum for reflection on the fast evolving legal, regulatory and policy framework across the whole of the ECE region. In liberalised markets, the value of information is going to increase. Here again, with its database, the Centre offers benefits, which should enhance the integration and the efficient functioning of the marketplace.

The rapid growth of gas demand in Europe will require new investments in gas exploration, production, transport and storage to secure long-term gas supplies. Co-operation between European gas companies and governments – promoted by the Centre – should enhance sound decision making regarding investments and market expansion. Getting the right tariff structure and establishing a sound and transparent legal framework will therefore remain a cornerstone of the Centre's programme of work.

Project/program Status

The Centre has been in operation for over five years. As described above, the programme of work has been adjusted and reoriented over this time period to reflect the changing policy and market environment. In all likelihood, the programme of work will continue to evolve in response to the needs of countries and their gas industries.

For the immediate future, activities can be categorised or grouped under the following headings:

- Provider of information on developments in member countries on an ongoing basis through the database and regular reports/surveys of the Gas Centre on key issues regarding market-based restructuring.

- Organiser of training sessions.

- Organiser of discussion forums for current topics of strategic importance, where companies and governments can freely exchange views, information, knowledge and skills.

- Organiser of conferences on market-oriented issues.

- Organiser of technical missions dedicated to specific issues in one particular country.

Replicability

The "Gas Centre" experience, as a unique interface between public and private interests, could be replicated in other economic sectors, namely where infrastructure is involved (electricity interconnections and oil pipelines in the energy field; road / railway transportation, etc.). The experience could also be transposed in other geographic areas where capacity building in the gas sector is required (Africa, Asia).

Lessons Learned

Over the past five years, the Gas Centre has offered a pan-European forum to the gas companies and governments of the ECE region, where different interests and, sometimes, conflicting interests could meet and develop common understandings.

Since the beginning of the programme, thanks to the fruitful exchange of experience and know-how between western and eastern European gas companies and Governments,

there have been improvements in the legal, regulatory and energy policy frameworks. Energy laws specific to natural gas, involving regulation, licensing requirements, public service obligations, and in some cases TPA, have been passed in many transition countries.

Intense restructuring of the gas companies has also occurred. Many national monopolies have been corporatized into semi-autonomous legal entities and joint stock companies. Auxiliary activities have been separated and privatized. In some countries, distribution assets have been demerged in view of their eventual privatisation. Partial privatisation has also occurred in some vertically integrated state-owned companies.

Selective competition has been introduced in the gas sector. Joint ventures have been established in exploration, production, storage and gas marketing. In addition, the opening up of the power sector in some countries to private investment has spurred new growth in gas markets in these areas. Efforts have been made to attract the investment capital required to modernize and expand the gas infrastructure.

Gas pricing reforms have been implemented. Industrial price levels for gas are now approaching economic levels. However, further tariff reforms necessary to eliminate cross-subsidization of the household sector are not very widespread in transition countries. Gas pricing is still distorted and prevents the financial viability of gas companies. This is an area where conflicting goals between social, political and economic reforms has often impeded the establishment of sound and clear price reforms, thus inflicting additional costs to society at large.

Privatisation of the gas industry is occurring, even if only very slowly. The gas industry, as well as other energy industries, is often considered as a strategic sector and governments are reluctant to privatise them. Nevertheless the experience in some countries (Hungary and Latvia, for instance) shows that the development of a sound gas market is promoted through the privatisation of the gas sector to strategic foreign investors, who bring capital, gas supplies, technical and management know-how.

Nevertheless, a fully-fledged market-oriented structure and legal and regulatory framework have yet to emerge in economies in transition. The gas industries in that sub-region still have to enhance operating efficiencies, reduce costs and energy waste, and promote investment for the modernisation and expansion of the gas infrastructure. In particular, the capacity of countries to finance the infrastructure required to meet the expected growth in gas demand is questionable at this time.

Foreign participation is growing. However, investors are interested in a fair return on investment, which is undermined by the present low prices prevailing on the domestic market in most transition countries. The enforceability of the provisions is also weak, or insufficient, in a number of countries.

In the future, adequate investment in countries with economies in transition will depend to a large extent on the implementation and quality of their investment, fiscal and regulatory regimes. To attract private sector financing, selective measures will have to be designed and implemented. This implies raising prices to economic levels, even

gradually, passing consistent general economic and energy laws, and undertaking the restructuring and streamlining of the sector.

Further Information

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Title: Rehabilitation of a Coal-Fired Cogeneration Power Plant

Submitted by ISPE S.A , Romania

Abstract

The energy sector of Romania is nowadays facing major difficulties caused by the physical wear, the obsolete technologies, the low efficiency in operating the primary resources and the environment pollution.
The rehabilitation of the 210 MW coal-fired unit no 1 of TPP Deva is in agreement with Romania's energy strategy. This one envisages to direct towards the energy demand management and energy efficiency promotion in the sectors of power production, distribution and transmission aiming to set up the energy market in the future.
The rehabilitation works of this unit intend to extend its lifetime with at least 20 years and also obtain higher performances both as against the present state and as against the initial design.
The rehabilitation solution decided (the steam turbine complete substitution and the steam boiler partial replacement with similar, upgraded equipment) was requested by the existent financial, social, political and productive constraints.
The project financing schedule contains a combination of financing sources: budgetary grant from receivables, foreign credit and barter-type indirect financing (a share of the electricity selling's).
The project efficiency, determined on the basis of cash flows and financial flows establishing, will result in usually acceptable values for the efficiency parameters.

Key issue addressed

- Energy Efficiency – this case study deals with the increase of power and heat combined generation efficiency in the coal-fired power plants.
- Accessibility of Energy – the case study has in view the increase of safety in the heat supply for the consumers of Deva city, connected to this plant.
- Mobilization of Financial Resources – the case study emphasizes the capability to perform such type of projects by attracting multiple financing sources.

Country profile

Location- TPP Deva is located Westward Romania, in Hunedoara Country, about 7 km North-West from Deva city.

Project Area Profile- The project presented by this case study takes into account the issues raised by rehabilitation of a coal-fired power and heat generation plant, in Romania, an economy-in-transition country.

Here is some general trend characteristic, now, of Romania's energy sector.

- gap between the energy demand (low at present) and the actual productive capacity (high)
- non-correlation between the energy supply demand for residential and industrial consumers and their reduced payment capacity
- exhausted lifetime and poor efficiency of the existent plants in the power sector mainly in the power generation branch involving the request for rehabilitation capacity costs
- absence of local capital and difficulties in setting the necessary investment funds due to both their amount in the power sector and to these countries-risk associated degree
- non-finalized institutional and legal background, under continual change as a result

(a) of the restructuring processes in progress and (b) pressure of the other economic sectors to perform the energy system reform.

Sustainable development issues that was addressed in the case study

The case study envisages the increase of the energy efficiency and furthers on to be applied to power and heat generations, coal-fired plants of Romania, an economy-in-transition country.
Parallel, the steps taken to increase energy efficiency have been correlated with the increase of safety in the connected consumers' heat supply and especially with the opportunities to attract financing sources under the economy transition conditions.

In the field of power and heat generation the Romanian power sector developed power plants that from history point of view, had been designed and equipped with performant technologies on the commissioning date, correlated with Romania's geographic, economic and social peculiarities.
We therefore developed combined power and heat generation plants. Power is generally delivered to the National Power Grid and heat is delivered to both residential and industrial consumers of the plant impact area.

Nowadays, the biggest power and heat producer of Romania is SC Termoelectrica SA a producer derived from the ex-National Electricity Company restructuring – CONEL SA.
SC Termoelectrica SA consists of over 30 power generation plants. The total installed powers of these plants widely range between 4 MW - 2300 MW whereas the unit power ranges through 2 MW - 330 MW.
Out of the total installed power of about 13 900 MW, produced by these power plants, a percentage of 60% is generated by coal-fired power plants.

Many of these installed capacities approach their lifetime exhaust.
The absence of funds necessary for modernizing and developing the energy sector, felt since the '80s and deepened after 1990, lowered some of the power plants performances and reliability.

Besides the funds shortage, the lack of information and experience in finding the best financing methods for energy efficiency, energy management and power efficient technologies, represent another hindering obstacle to upgrade and render profitable the power equipment.

The 210 MW unit on which the present case study focuses, pertains to TPP Deva, one of SC Termoelectrica SA power plants, TPP Deva is one of the most used sources due to both the installed capacities reliability and to the highly qualitative management and operation.

The 210 MW unit is the first of the six identical units with which the power plant is equipped. It was made in Russia, commissioned in 1969 and coal-fired. It can generate 210 MW under condensation regime whereas under cogeneration it generates 50 Gcal/h, too, from its turbine extractions.
The unit lifetime has practically exhausted and its performances worsened as against the design stage.

The issues raised by the concrete case of this unit rehabilitation emergency are valid, generally speaking, for all economy-in-transition countries, facing difficulties in all socials, political, economic sectors.
Such countries cannot always take the most optimal steps due to various obstacles and constraints.

An usual, world-wide rehabilitation procedure for increasing efficiency would be therefore, for this particular case, a combined cycle solution by providing a gas turbine that could efficiently process the primary resource and the conversion of the existent boiler into a heat recovery boiler.

Following the different local conditions and national constraints, we therefore chose rehabilitation solution by completely substituting the turbine and partially replacing the steam boiler with equipment provided by the original Russian supplier.

The constraints facing this project performance are the following:

- *social constraints:* the obligation to use the local, low value-coal instead of imported fossil;
- *financial constraints*: absence of the own funds, difficulty in attracting the necessary foreign capital by own efforts, nationally regulated tariffs
- *production constraints*: local excess of energy the trade operator inexistence (which could control the producers access to the market by strict, efficiency criteria and implicitly, low costs).

Objectives

- Life-time extension with 150,000 hours
- Power production at a competitive around price by:
  - increasing efficiency
  - increasing availability
  - reducing specific fuel consumption
  - raising the system - delivered power
- Environmental impact reduction by decreasing NO_x content of the released flue gases
- Heat supply improving for the consumers connected to the district system supplied from TPP Deva , by increasing the heat supply availability and reliability .

Implementation

The project performance assumes the implementation of the national strategy claiming the prior use of Romania's primary resources by performing some combined structures, coal extraction units (mines) – power and heat generation plants .
The assumed market mechanisms involved rehabilitation in order to reduce the own fuel and technological consumption, pollution costs and optimize all internal flows, finally aiming to reduce the operation cost and increase efficiency.

The outcome that could be obtained under the particular circumstances of the world-spread combined- cycle solution non- adoption reflected the capacity to overcome some important constraints such as:

- social constraints that determined the choice of a solution permitting the use of local coal
- financial constraints (absence of the own funds, difficulty in attracting necessary foreign capital by own efforts, nationally regulated tariffs) that led to some upgrading and rehabilitation works with an impact upon the increase of power and time of availability, of the reliability and of the overall efficiency so that they might cover costs from the obtained profits without increasing tariffs (rates)
  The chosen financing schedule contains a combination of financing sources: budgetary grants from receivables, foreign credit and barter-type indirect financing (share from power selling)
- production constraints (national-level power excess) and the trade operator inexistence who could control the producers access to the market by strict efficiency criteria and implicitly, low cost, determined the choice of a rehabilitation solution without considerably increasing the existent output capacity and with a rigorous impact on the over all productivity achieved by the plant.

Outcome and Impacts

The positive outcomes afferent to the performance of this project also represent the elements competing for the project long-time sustainability, as follows:

- the unit lifetime increase with 150,000 hours around and, implicitly, the capability to further supply power and heat
- increase of the fuel usage efficiency from 40% to 55%
- fuel specific consumption reduction as such:
    - for the global power production: from 362 gcc/kWh, at present, to 316 gcc/kWh
    - for heat production : from 169 kgcc/ Gcal at present to 163 kgcc/Gcal
- power and heat outputs increase as follows :
    - power from 1100 GWh at present to 1300 GWh
    - heat from 115,000 Gcal/year to 350,000 Gcal/year
- environmental impact reduction by decreasing the NO_x content in the released combusted gases up to 350 mg/Nmc

The main elements characterizing the project efficiency are:

- Estimated total cost: about 85 mil.$ USD
- Internal Rate of Return: 16 %
- Return on Investment: 14 %

Project status

The project is undergoing, with financial and technical offers in analysis

Replicability

The project replicability is based on the fact that many of the existent installed capacities in the power plants in Romania approach their life time exhaust, being under advanced physical wear, with obsolete equipment and technologies and a low efficiency in using primary resources, a low reliability and a negative environmental impact.

Lessons learned

The development of the above-showed project resulted in the following lessons :

- even under the presence of various constraints (social, financial, production) we can develop a project that could increase the energy efficiency
- the necessity of finding various financing sources to perform such a project

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Title: Subsidies to Coal Industry in the Context of Sustainable Development

submitted by the Government of Russian Federation

Abstract

It is too early to talk about sustainability of the Russian coal sector, as it still needs substantial support to complete the restructuring process. At its initial stage, subsidies were mainly used for covering losses of coal companies with "frozen" coal prices. This position was kept for over three years of transition to market economy (1993-1996). Then, subsidies were essentially re- oriented to the closure of 200 unprofitable mines, mostly in term of social support to redundant personnel. Thus, the lack of funds for investment, since 1997, has resulted in sharp lagging behind of the modernization and renewal of capital assets and equipment. Having completed the first stage of industry restructuring and haltered the continuous production decline until 1999, we are now contemplating new solutions to make coal more competitive in the market and ensure continuos support to the longer- term sustainable objectives of Russian coal sector. One of these solutions is the current reform of budget subsidies structure. The purpose is to minimize subsidies for operational losses while allocating as maximum as possible, for investments and development.

Key Issues Addressed

Undoubtedly, the most sustainable will be energy based on various fuels, which rationally harmonized the use of coal, gas, oil, hydrolic and nuclear power. Coal is the most sustainable fuel taking into account the following factors:

- coal reserves are considerably larger than other fossil fuels;
- coal transportation and storage are simpler and more reliable than gas and oil from the point of view of safety and ecology;
- the modern technology and equipment for coal production and ecologically clean utilization are available for broad practical application.

Today, there are high-performance mechanized complexes for underground mines and modern technologies for opencast mining. New clean coal technologies are developing such as coal-water fuel, fluidized-bed coal burning, energy blocs of coal-based power stations with high energy efficiency (45-50% and more) and sharp reduction of greenhouse gas emissions. Land reclamation is successful. Such advanced technologies are becoming widely applicable, which considerably increases the significance of coal as the basic fuel for sustainable development of electricity and the heat generation.

At the same time Russian coal industry has not completely overcome the consequences of the systemic economy crisis and socialist methods of state funds allocation which resulted in the obsolete coal mining capital assets and their unprofitability. Such situation is caused by the fact, that for decades capital investments in coal industry development were insufficient, since during the last third of the 21th century the state policy was the priority development of gas and oil industries.

Summarizing the first stage of Russian coal industry restructuring (1993-1999) it is essential to record its three main successful results. Firstly, the most valuable part of industry capital assets was preserved. Secondly, the industry entered the sustainable phase of coal production increase and now can provide for the substitution of gas for coal at power stations. Thirdly, today coal industry pays to the state budget more than recieves from it. The last result is of special importance, since in 1993 the coal industry was almost completely (77%) financed from the budget.

The closure of especially unprofitable and dangerous mines resulted in considerable cut of production costs and in record-breaking increase of productivity and face output. For last two years the rates of coal production increase are higher than in other fuel industries. It is worth noting that productivity growth rates are higher than those of coal production.

Russian coal companies have completely adapted themselves to market conditions and now almost three quarters of coal are produced by private joint-stock companies in which state share package is less than 30-40%. The largest coal companies are holdings. Thus Russian coal industry is now practically demonopolized.

The main purpose of the second stage of coal industry restructuring is the increase of the capacities of profitable coal companies. The peak of unprofitable mines closure has already passed. By 2003 coal production will be stopped at remaining23 unprofitable mines which will result in higher profitability and better safety. Now it is necessary to invest in efficient coal production with raising funds of external investors. But at the same time the preservation of state budget investments is needed since coal industry is not very attractive for investment business.

The transition period is needed when state subsidies will be reoriented from unprofitable mines closure to new capital construction, technological refurbishment and reconstruction of potentially profitable coal enterprises. It will be some kind of guarantee for external investors funds raising.

Consequently, among key issues that will be discussed at CSD 9 “Mobilisation of Financial Resources” is the most important for us since the Russian state budget resources of subsidizing coal industry are insufficient.

The amount of all state subsidies in 1998 was the smallest for the whole period of coal sector restructuring. It was 5.3 billion roubles (18.8% less than in 1997 disregarding inflation) and predetermined considerable difficulties in completing restructuring and achieving its main objective - profitable coal production.

The increase of the state budget support in 1999 to 10 billion rubles positively influenced the industry performance. But it is expected that in 2001 it will be reduced to 8 billion roubles (USD 250 million or about 90 cent per ton of coal production). In order to assess the amount of such subsidies it needs to point out that in 1980s specific size of budget support of coal industry in economically developed countries of Western Europe was 10-15 times higher.
Thus, in five forthcoming years the Russian coal industry will require USD 10 million of budget or external investments annually. According to the calculations made by the

Committee of Coal Industry the minimum amount of budget subsidies required in 2001 for investments in technological refurbishment, reconstruction and capital construction is 3 billion roubles. If to add 203 million roubles for setting up the centralized reserve foundation of coal industry restructuring the total required funds will be USD 100 million.

Country Profile

All above financial support amounts are needed mainly to renew the equipment of Russian coal enterprises and to realize some investment projects in Kuznetsk and Kansko-Achinsk coalfields. Some of these projects connected with clean coal technologies.

Present political and economic situation in Russia has stabilized and is constantly improving. In the course of industrial production increase the solvent demand for coal in the country is smoothly increasing. Coal production is expected to be 260-265 Mt in 2000 and 300-350 Mt by 2010.

Sustainable Development Issue that was Addressed in the Case Study

The above coal production growth is essential in particular because gas production in Russia started to decrease. In the first half of this year the fall was 2% and it is necessary to substitute gas by coal in the country fuel balance to maintain its stability. Considering the problem of coal production increase in Russia in the context of sustainable development it is necessary to note that this growth is only the restoration of Russian indusrtial and economic potential which sharply fell in 1989-1999. Coal production in 1992 (just on the eve of the adoption of industry restructuring programme) was 335.8 Mt and obviously this coal production level in Russia will be restored not earlier than in 2009-2010. The maximum coal production in Russia (425.4 Mt) was in 1988 and it will take about 20 years to reach this level. Practically all long-term forecasts of the development of the country fuel and energy complex predict considerable reduction of industrial energy consumption. Thus, Russia undoubtedly observes generally accepted principles of the solution of sustainable development problems.

Objectives

In 2001-2004 Russian coal industry still requires budget subsidies since it did not recieve them in necessary amounts in previous years. But the structure of these subsidies utilization will be changed considerably in favour of investing funds in sector development. Russian coal industry needs privileged investment credits in addition to budget subsidies. It would be desirable to get them with the aid of international economic organization.

Implementation

The crisis decade of 1990-1999 was characterized by high inflation and consequently by very high (dozens per cent annually) bank credit rates. The financial state of the majority of Russian coal enterprises is unstable. Many of them are formally bankrupts and can not

get long-term bank credits. Now the situation is gradually improving and state can reduce subsidies for covering losses which were allocated to some companies. But from one third to a half of coal companies have thier own current assets and accumulated funds which are insufficient and objectively they can not dispense with subsidies for technological refurbishment and extended reproduction.

Outcome and Impacts

The experience of previous years testifies that state financial support is closely connected with the effectiveness of structural reforms in coal industry. The increase of state support to 10 billion roubles in 1999 positively influenced sector performance. This year was the most successful for the coal industry during the whole period of its restructuring. For the first time coal production increased by 15.6 Mt against 1998 owing mainly to profitable underground and opencast mines. The concentration of mine workings has been improved. Daily production face output increased by 12.4% and thier number decreased by 22. The situation of roadway heading and maintenance is improved. 4.2 Mt of new capacities were commissioned and a half of them was put into operation at new coal enterprises. Financial support of environmental measures became better.

Project/Program Status

Starting with 2001 the funds of state support of coal industry for partial covering production losses and realizing tariff agreements are considerably reduced.

According to "Programme of Closure of Especially Loss-Making Underground and Opencast Mines of Russia for 2000-2002" it is envisaged to start works for closure of 5 mines in 2001. During the same year coal production will be stopped at 20 mines which are not promising according technical and economic factors. The process of stopping coal production at enterprises is planned for the whole calendar year and they need funds for the partial compensation of their losses connected with coal production and for the realization of tariff agreements till the complete stopping coal production. In 2001 three especially loss-making mines will be still in operation. Their closure is planned for 2002.

At the same time there will be 35 mines in operation in 2001, which are promising and are not planned to be closed down. But at present they can not cover all costs of production by coal selling. The annual production capacity of these mines is 30.1 Mt including 11.1 Mt of coking coal. Actual coal production of these mines is 23.4 Mt. That is why it is reasonable to use state subsidies in 2001-2002 to finance measures of making these mines profitable. These funds are needed in 2001-2002 since they will be able to be repaid not earlier than in a year. Qtherwise these mines will not be able to normally operate in 2001 and become profitable in nearest future.

In 2000 the total amount of state budget subsidies for partial covering losses is 614 million roubles, which are given to 77 mines. The total losses of these mines as a result of their production operation are expected at the level of 1297.3 million roubles.

In 2001 the state support of coal enterprises is planned to be 320 million roubles or twice less. These funds will be used to cover losses of 60 mines of which 25 mines are to be closed.

Replicability

The principal distinction of coal industry restructuring in Russia from similar measures in the countries of Western Europe is that it has been realizing under the circumstances of long economic crisis, when the solvent demand for coal twice dropped and the economically weakened state could not subsidize nationalized coal enterprises adequately. In Great Britain, France, Germany and other countries the closure and sanation of unprofitable mines were carried out not in crisis periods of their economic development. Besides, the restructuring of unprofitable enterprises in Western Europe was accomplished because of the competitive pressure of world coal market in the process of economic globalization and integration. In Russia the character of coal sector restructuring was determined by the change of social and political system with minimum influence of world coal market.

Lessons Learned

It is necessary to develop the principal directions and strategy of subsidies policy for the nearest, middle- and long-term perspective taking into account the secession and agreement of purposes. Both aims and possible means of the implementation of subsidies policy essentially change in time. The interaction and stability of the realization of subsidies programmes are of special importance.

That is why the problem of the investigation and preparation of the sectorial and regional programmes of the perspective coal industry development are actual with special emphasis on the financial provision of these projects and repaying budget support funds.

Further Information

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Title: Rehabilitating and Re-fitting Coal-Fired Power Plants

Submitted by the World Coal Institute

Abstract

The coal-fired boilers of public and industrial power generation, cogeneration and district heating plants are some of the largest sources of pollution in central/eastern Europe and many developing countries.

Opportunities exist for the rehabilitation and re-fitting of coal-fired power plants to increase efficiency, output and to reduce emissions – actions that achieve significant environmental improvements for regional communities who depend on the use of indigenous energy resources. Many coal-fired power plants operating in developing countries also require upgrading/overhaul to raise their performance up to current standards of efficiency and environmental performance.

This case study reports on the achievements of two such projects, involving east-west partnerships to deliver environmental improvements to communities dependent on coal as a key energy source.

Key Issues Addressed

The significant environmental gains to be made from increasing efficiency and upgrading coal-fired power plants to current levels are highlighted. The environmental gains include reduced greenhouse gas emissions and reduced local pollution levels bringing immediate benefits to the local community. This demonstrates that for many countries dependent on indigenous (local) coal resources for energy that it is not the use of coal, but how the coal is used that must be the focus for action.

Environmental benefits are generated via significant improvements in air quality with lower particulate discharge, reduced SOx, NOx and other emissions such as carbon dioxide via the achievement of higher efficiency.

The projects outlined demonstrate the effective use of existing power plant infrastructure and thereby minimising the financial exposure to achieve significant environmental improvements.

Sustainable Development Issues Addressed

The goal in rehabilitation and re-fitting of older coal-fired power plants is to significantly reduce the environmental footprint in parallel with improvements in social and economic indicators. These latter benefits arise through a reduced financial burden, lower fuel cost to output and greater availability and reliability of energy to the local/regional communities. Improved air quality standards reduce adverse health impacts and lead to improved living standards for these communities.

Country/Project Profiles

(i) Repowering of Turów Power Plant (Poland)

Turów Power Plant, located in southern Poland near the small town of Bogatynia, is the country's second largest power producer. Turów's first unit began operating in 1962, the tenth unit in 1971. The station was noted for producing the lowest-cost power in Poland. Each of the 10 pulverised coal-fired units had a rated capacity of 200 megawatts (MWe) of electricity. The plant is also a supplier of thermal energy – some 703,000 GJ in 1998 – to the district heating company serving the town of Bogatynia.

Due to the large reserves of lignite still remaining in the Bogatynia area by the late 1980s, it was decided to repower the station. This decision would extend the life of the plant, improve its output and efficiency and, importantly, reduce the facility's emissions to meet EU standards.

Turów is owned by Poland's state-owned Elektrownia Turów, which opted to upgrade the station in several phases. The primary objective was to achieve higher output and lower emissions levels. In 1993, the company began a retrofit programme for the newer units 8, 9 and 10 designed to ensure these units meet environmental protection requirements until at least the year 2012. Key elements of the retrofit included:

- modifications to the fuel burners and other combustion components were made to lower NOx levels to 170 g/GJ;
- boilers were equipped with dry flue-gas desulphurisation (FGD) systems that used the injection of milled limestone sorbent at the burners for SO_2 reduction;
- advanced electrostatic precipitators were installed to meet the EU particulate limit of 50 mg/Nm^3 and to accommodate higher loadings from the FGD system sorbent injection.

Data for 1998 reported by the station for units 8, 9 and 10 show that the programme has been successful – compared to previous years, emissions of particulates have been reduced by 86%, SO_2 by 47% and NOx by 12%.

Elektrownia Turów officials then decided to repower the balance of the station with Foster Wheeler CFB boilers, which will increase the output of the station as well as extend its life by some 30 years.

The contract for the project was awarded to a consortium led by ABB Alstom Power (Switzerland) Ltd. The first phase of the repowering project was completed in 1998 with consortium member Foster Wheeler responsible for replacing two of Turów's existing 200 MW pulverised-coal (PC) units with two Foster Wheeler 235 MWe CFB boilers. A second phase was to replace a further unit with another Foster Wheeler 235 MWe CFB boiler. These new CFB units installed in phases one and two use approximately the same amount of fuel as the PC boilers they are replacing, but significantly provide increased power output and lower emissions. One of the major reasons for selection of the Foster Wheeler CFBs in Turów was their fuel flexibility – ideally suited to burn low-heating-value fuels such as the local lignite – while producing low levels of emissions such as NOx, SO_2 and particulates.

Since the first CFBs were commissioned (replacing the old PC Units 1 and 2) in 1998, they have met all performance expectations: net maximum continuous rating above 216 MWe; heat rate below 9,795 KJ/kWh; and emissions of NOx, SO_2 and particulates in full compliance with the even stricter environmental standards that Poland imposed in 1998.

Under a third phase, scheduled for commissioning in 2005, Foster Wheeler will supply three CFB boiler islands (to replace existing PC units 4, 5 and 6), each with a rated output of nearly 260 MWe and a guaranteed boiler efficiency of 92%. ABB Alstom will supply the turbine island, electrical and control systems and other auxiliary equipment. The consortium's contract for this third phase is valued at $667 million.

The three new Foster Wheeler compact CFBs will employ the latest fuel-flexible and environmentally friendly advanced design and technology leading to lower costs of both operation and maintenance – and the higher steam pressures used will mean increased thermal efficiency.

To fully appreciate the significance of the modernisation of Turów, it is important to recognise that the plant is located in the border region of Germany, Czech Republic and Poland known as the "Black Triangle". The "Black Triangle" reflects decades of uncontrolled coal burning with old, outdated equipment creating one of the most polluted air basins in Europe.

Turów's management plan calls for unit 7 to be shut down permanently when the new CFB units 4, 5 and 6 enter commercial service in 2005. Since these CFB units will be rated higher than CFB units 1, 2 and 3 – 260 MWe compared with 235 MWe – total output at Turów will still exceed 2000 MWe.

Other steps were also taken to make overall operations at Turów environmentally friendly. Dust-reducing hoods were installed on a 14 km length of conveyor belts delivering coal to the power plant from an adjacent strip mine and a new conveyor system was installed to carry combustion products from the plant to the strip mine for use in land reclamation.

In addition, because the plant draws water from a nearby river, advanced equipment was installed to treat waste water before it is returned to its river source. In 1998, the concentration of suspended matter in

waste water averaged 14.2 mg/m^3, a level actually lower than the average level of suspended matter in the make-up water the plant draws from the river.

Emissions Reductions at Turów Power Plant

	Emissions before repowering	**Emissions after repowering**	**% reduction**
SO_2	1170 mg/MJ	90 mg/MJ	92
NO_2	172 mg/MJ	140 mg/MJ	19
Particulates	487 mg/MJ	40 mg/MJ	91

Project Finance

The project was financed by a consortium of Polish and western banks, supported by export credit guarantees and a Polish Government guarantee. It took almost four years to put together. The loan will be re-paid by revenues from the station, which will continue to operate throughout the repowering project.

(ii) Rehabilitation of the TES 3 Power and District Heating Plant, Mongolia

TES 3 Coal-Fired Power Station, located in Ulan Bator, Mongolia and owned by the Central Energy System, is a power and district heating resource of strategic importance to the region. The local community relies on the energy available from the plant, particularly the supply of district heating, to help combat and endure the harsh Mongolian winters with their long periods of sub-zero temperatures. Ulan Bator is reportedly the world's coldest capital city.

The TES 3 plant was originally constructed during the 1970s using former USSR technology to supply electricity and district heating. The plant consists of:

- low pressure section – 6 x 75 t/h boiler and 4 x 12 MW turbines
- high pressure section – 7 x 220 t/h boilers and 4 x 25 MW turbines

The high pressure boilers were originally provided with an indirect firing system, a tube ball mill coal pulverising system and pulverised coal storage bins. Primary air was used for coal drying and delivery of the pulverised coal to the burners.

Prior to rehabilitation, the plant had been operating with a low utilisation factor, corresponding to an average annual operation of approximately 4,500 hours. Despite this low level of utilisation, the status of the coal-fired boilers before rehabilitation (as summarised in Box 1) was very poor with high particulate and NOx emissions. There was also significant deterioration to pressure components and air heaters and some entire sub-systems had failed. This situation had led not only to very poor availability and reliability but also to poor operability combined with major safety and environmental risks.

Additionally, in 1992 the fuel supply was changed to locally produced high volatile, high moisture, low rank sub-bituminous/lignitic coal from the Baganuur Mine. The use of this highly reactive fuel in the indirect firing configuration led to the risk of explosion. Prior to rehabilitation several fuel explosions had occurred due to the basic incompatibility of Baganuur coal with the original fuel management system.

Box 1: Summary of plant boiler status before rehabilitation:

- Capacity limited to about 65-75 % (170 t/h out of 220t/h in the best case)
- Extremely low efficiency (about 80%)
- High environmental impact (particulate and NOx emissions)
- Furnace, pressure components and air heaters highly deteriorated
- Massive furnace roof gas leakage (30%)

- Damage to all main auxiliaries
- Non-operational control system

The main scope/elements of the rehabilitation were: conversion to direct firing, partial pressure component replacement, milling/drying system refurbishment, complete replacement of the firing system, and upgrading of the instrumentation and control system. In the new direct-fired configuration pulverised coal storage is no longer needed as the pulveriser, operating under negative pressure, is directly connected to the boiler load.

A key challenge for the project was the limited budget, which required the retention of the main equipment and minimisation of impact on operations whilst work was carried out.

The project encountered a number of unique problems. With the original indirect firing system, the existing tube ball mills served as reservoirs containing large amounts of coal in a potentially explosive environment, particularly during load variation when the dynamics of air-coal ratio, air inlet temperature and pulverised coal/unpulverised coal inside the mill could generate optimum explosive conditions.

As the oxygen content in the primary air was incompatible with the safety requirements for preparation of Baganuur coal (ie Baganuur coal requires about 12% max oxygen inside the mill), a new gas drying and mill bypass was specifically designed in order to overcome this problem. Hot gas is now used for coal drying, while cold gas is use for oxygen control and to create inert conditions until the fuel is transferred to the furnace.

Project Achievements

Rehabilitation of the first two boiler units and their conversion to direct firing began in early 1996, with the first unit being successfully completed in early 1998 and the second unit in early 1999. The third and fourth units were both commissioned in the third quarter 2000.

Following rehabilitation, the boilers are now operating at their original design capacity allowing them to reach a steam output of 220 t/h. Adjusting the control system and removing weak spots in the auxiliary equipment has resulted in constant improvement in boiler availability and reliability. The new milling and firing system has also proved to be much safer than the previous system due to removal of the potential explosion risk area and the improved mill inertisation system.

The plant's internal environment has been greatly improved by eradicating gas leakage and dust emissions in the boiler area, thereby reducing the risk of these potential health hazards to the plant workers.

The TES 3 rehabilitation project has led to a significant reduction in greenhouse gas emissions per unit of energy output through improved efficiency. The combined recovery of boiler efficiency, refurbishment of the dust separator and correction of the high boiler

gas leakage has resulted in a reduction of approximately 35% in dust emissions and 30% in NOx emissions.

The successfully rehabilitated units are the main power and steam resources for the TES 3 coal-fired power plant due to their low failure rates and higher reliability and efficiency than the other units. The TES 3 coal-fired power plant is now a reliable and environmentally-friendly source of power that will enhance the living conditions of the inhabitants of Ulan Bator.

TES 3 Rehabilitation Achievements

- Restoration of original design capacity from 170 t/h to 220 t/h
- Improved boiler efficiency from 80% to 91.2%
- 30% reduction in NOx emissions
- 35% reduction in dust emissions
- Increased plant safety and reliability
- Extended plant life
- Reduced environmental impact

Project Finance

The TES 3 rehabilitation project contract, financed by a soft loan from the Asian Development Bank, was awarded to a consortium led by ABB Sadelmi, now Alstom Power Italy, in October 1995 and consisted of the rehabilitation of five coal-fired high pressure boilers, each with a design capacity of 220 tonnes of steam per hour.

Replicability

Both the Turów and TES 3 power plant rehabilitation projects serve as a model for upgrading other central/eastern European and developing country coal-fired power facilities.

Lessons Learned

Major environmental improvements can be achieved by focussing on the rehabilitation of existing facilities and at lower cost. These projects demonstrate the opportunities for communities who rely on coal, as a key strategic source of energy, to enjoy a cleaner environment and improved air quality by the application of modern clean coal technologies and practices.

The projects clearly illustrate that the technology exists today to turn outdated, uneconomic power plants into highly efficient, environmentally friendly coal-fuelled facilities.

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Economic and Social Commission for Asia and the Pacific (ESCAP)

Title: Eco-friendly Electrification in Off-grid Areas (West Bengal, India) with Grid Quality Power

Abstract

Solar energy, a traditional source of energy, plays an important role in energy supplies in terms of heating and drying in a traditional way in many developing countries of Asia and the Pacific. However, the recent rapid development of the modern solar energy technologies, such as, solar hot water system, solar cooker, solar drier and the solar electricity through the photovoltaic application or though solar thermal applications (solar parabolic concentration or solar pond), has brought international attention on the solar energy potential for large scale development. In most countries of the region, these technologies are being tried and tested in one form or the other. Particularly, it is widely believed that with the rapid advancement of the SPV technology and reduction of its cost, solar energy could play an important role in supplying much needed electricity in rural areas, where there is no immediate prospect of bringing electricity through extension of the grid.

West Bengal Renewable Energy Development Agency (WBREDA) of India in collaboration and support of the Ministry of the Non-Conventional Sources of Energy (MNES) and Indian Renewable Energy Development Agency (IREDA), has successfully started a project in one of the islands, named Sagar Island, in Sudarban area. Solar PV power plants have been built in several sites in the island, where village level electricity supplies are being made available to a cluster of villages from solar power plants through local mini grids. From the enthusiasm observed from a large number of villagers and their readiness to pay for the extension of the lines to additional households, it appears that the system has generated interests and confidence among the users on the quality and reliability of the system. What is unique in the system is its grid quality power, that is, it is like traditional electricity supply that can power any off the shelf end-use equipment.

The WBREDA, IREDA and the MNES have expressed their willingness to share the experience of India with other developing countries in solar grid quality electricity through training, exchange-visits and study tours.

Key issue addressed

This case study has the components related to at least three key issues namely, accessibility of energy, renewable energy and rural energy. It demonstrates how renewable energy technology can enhance the supply of high quality energy services for widening the accessibility of rural population. The focus is however on the policy and its implementation on the key issue “accessibility of energy”, in particular the participatory approach involving the stakeholders which has contributed to the success of the project.

Country Profile

Location- The project is located in Sagar Island, with an area of 350 km^2 , is a large island in the estuary about 90 km south of Calcutta, the capital city of the province West Bengal, India.

Project Area Profile- With a population of 150,000 spread over 16 villages, farming and fishing are the main occupations on the island. Farming practices include usual food crops such as rice, been and vegetable and cash crops like betel leaves, chilies water melons etc.

Sustainable development issue that was addressed in the case study

The mail problem of the island has been the lack or inadequacy of modern quality energy service like electricity. Since linking the island with the national grid was impractical, diesel generators used to provide limited supply of electricity in densely populated areas like local administrative headquarters and markets.

On the proposal made by the WBREDA in 1993, the local government responded positively and agreed to share infrastructure costs. It was then decided to set up a rural energy cooperative with the participation of all the beneficiaries as its members for the efficient operation of solar power plants. The cooperative was given the responsibility of both the installation and day to running of the solar plants.

The first phase of the project with 26 W(p) of SPV which was completed in 1997 provides power to 50 households in two villages. A few more plants are under construction, which would be able to meet demands of more villages. Power is supplied through local mini-grids of distribution lines. The unique concept of the project is to provide not just light but to provide grid quality electricity so that the consumers are able to use all off the shelf accessories or appliances that can be connected without any alteration.

There has been no apparent technical problem related to the project. However, as the technology is not fully commercial the leading role was played by the WBREDA in securing funding support from the MNES. Operational costs are largely met from the revenues received from the consumers.

Objectives

- To provide access to modern energy services, that is, independent electric power and lighting, to people living in isolated rural areas that are far from the grid power.

- To enhance the quality of life through use of use energy services for economic and social activities of rural population.

Implementation

While the project is developed with the assistance and support of the WBREDA, the day to running of the project is entrusted with the cooperative, the Sagardweep Rural Energy Development Cooperative Society Ltd., constituted in 1994 by all the potential consumers of the central solar power plant installed in Sagar Island.
The consumers are required to sign a memorandum of understanding with the cooperative to abide by the simple rules and regulations. They are to make a small deposit to get the connection and pay a flat monthly charge on a regular basis.

The tariff rate as of 1997 was as follows:

a) domestic Rs. 60 (US$1.5) per month for 4 hours operation
b) commercial Rs. 90 (US$2.25) per month for 200 W connected load for 4 hours operation. (Commercial connections are available to the consumers who are connected with diesel generators, installed capacity 300 kW)
c) Street lights : free

Outcome and Impacts

The solar PV project has created a high hope to the local residents for better energy services. The villagers, who have been connected are satisfied with the services, while those do not have are very eager to get the services. From the limited experience so far it appears that with support for the installation, most of the villages, if not all could be provided with grid quality electricity to the satisfaction of the potential consumers.

Project/program Status

As of March 1997, one project (26 kW(p) was completed and another similar power plant was under construction. More projects are expected to be constructed in the near future

Replicability

This type of projects has excellent prospects of being replicated not only in other areas of India but in other parts of the world. Towards that direction, there is a need for cooperation at the national, regional and global level. The concept of the South-South cooperation should be encouraged to transfer the experience gained in this project with other interested countries. The Government of India has shown interests in sharing such experience with other countries.

Lessons Learned

Two important lessons learnt from this project are worth noting:

That it is possible to provide grid quality electricity using solar energy to rural remote areas; and that the participatory approach plays a key role in the success of a project implementation both at the construction phase and in particular on day to day running of the project.

Further Information

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Title: Commercialization of Renewable Energy Technologies, India[1]

Abstract

Affordable financing is one of the crucial factors inhibiting the use of renewable energy, especially at the small-user level. Experiences have shown that initial subsidies or other help is necessary.

Taking into account the limitations of the conventional banking approach and to accelerate the momentum of development and large scale utilization of renewable energy sources, the Indian Renewable Energy Development Agency Ltd. (IREDA) was established in March 1987 under the Ministry of Non-Conventional Energy Sources, Government of India.

IREDA operates a revolving fund to develop and promote commercially viable new and renewable energy sources (NRSE) technologies in the country. Acting as a financial intermediary, it offers loans for project and equipment funding to manufacturers and users for the promotion of the rapid commercialization and enhancement of the utilization of renewable energy.

IREDA conducts various promotional activities through business meetings, seminars, workshops, etc. The agency also encourages rural development, self employment and self reliance through activities in rural areas.

Key issue addressed

The issues of Renewable Energy and Mobilization of Financial Resources are addressed by providing financial assistance through loans, by attracting international assistance and private sector participation, and by promoting renewable energy among all stakeholders. Also, Rural Energy is addressed by IREDA through the focus on decentralized stand-alone applications in its lending schemes.

Country Profile

India is blessed with renewable energy sources. Solar energy, wind energy, biomass, small hydro etc. are widely distributed across the country. The estimated potential of various renewable energy resources excluding solar energy amounts to a total of 158 000 MW. Solar alone is estimated to 20 MW per sq. km. Currently only 2 700 MW[2] of this potential is utilized.

India's energy development has been put under severe pressure with the ever-increasing demand, supply gap and mismatch of resources coupled with a non-uniform growth curve. The present energy requirement has negative environmental impacts and is leading to the depletion of available resources such as fossil fuels.

[1] This paper is based on brochures/information provided by IREDA. See page 5 for contact details.
[2] Includes only current capacity for electricity generation.

Sustainable development issues

Energy input from renewable energy sources and the exploitation of these resources are important factors to consider to ensure a high and sustainable level of security and comfort and a proper energy mix. While the need for large-scale adoption of renewable energy is recognized, there are several obstacles which impede their wider adoption at this stage. They include:

- Limited access to financial resources and the high cost of finance.
- Uncertainty regarding the efficiency and durability of technologies;
- Difficulty in commercializing renewable energy technology on account of subsidies (open and hidden, direct and indirect) given to fossil fuel technologies;
- Absence of appropriate policies and organization (government and non-government) to foster and nurture renewable energy use.

IREDA operates a financial model based on cost recovery principles to ease the removal of such barriers. A major role of IREDA is to provide renewable energy users, manufacturers and producers with credit that initially features concessional terms but progressively approaches commercial market rates as the technology gains wider acceptance. By financing new ventures in renewable energy, IREDA helps create performance track records for NRSE technologies, facilitating their transition from novelty to mainstream status. Also, IREDA seeks to encourage greater participation by private entrepreneurs which is of high relevance for developing countries such as India.

IREDA encourages entrepreneurship development through its entrepreneur development programmes and also gives due importance for women entrepreneurs. In order to encourage greater participation of women entrepreneurs, special concessions in the lending norms are provided.

IREDA supports a number of NGOs and cooperatives set up in rural areas to take up various promotional activities on behalf of IREDA.

IREDA also builds up technical manpower to strengthen the existing infrastructure as in the case of solar power where a number of training courses are conducted for the technicians and market developers in the rural areas. IREDA encourages manufacturers and private entrepreneurs to set up energy stores in different parts of the country to facilitate a wide market network for renewable energy products, for spares and services, in both the rural and urban areas.

In order to promote the renewable energy technologies and to cover various sectors, IREDA takes up various promotional activities for information dissemination, guidance of the entrepreneurs, interaction with the end users, discussions with the policy makers and project developers in the different states of the country. IREDA gives wide publicity to its activities through different media and also conducts workshops, seminars, and business meetings. Though IREDA is located in the capital of India, it strives to reach far flung places through its business development partners/associates and intermediaries for the guidance of the entrepreneurs in promoting and monitoring of projects.

Objectives

IREDA's mission is:

> *"to be a pioneering, participant friendly and competitive institution for financing and promoting self-sustaining investment in energy generation from renewable sources and energy efficiency for sustainable development"*

The main objectives of IREDA are:

- To operate a revolving fund for promoting and developing new and renewable sources of energy (NRSE);
- To assist in the rapid commercialization of NRSE technologies, systems and devises;
- To assist in upgrading of technologies in the country through NRSE;
- To extend financial support to energy efficiency and conservation projects and schemes.

Implementation

The maximum extent of assistance through IREDA is determined by IREDA's exposure limit which is set according to the client's creditworthiness and the security/guarantees offered for the term loan. In order to qualify for IREDA loan assistance, the projects are verified based on the following criteria:

- The project must be technically feasible;
- It must represent the least cost option;
- The borrowers' capability to undertake the project in terms of their performance track record, soundness of financial operations and adequacy of organizational and technical capabilities must be satisfactory;
- The project must be financially viable with an internal rate of return of not less than 12 per cent;
- The project must be economically justified with satisfactory social cost benefits in terms of generation and/or conservation of energy, employment generation and balanced economic growth in the region;

Outcome and Impacts

Commercially viable technologies in solar power, biomass, hydropower, wind energy and cogeneration are already making rapid progress in the country. Besides international assistance, enhanced budgetary support and wide-ranging incentives offered to private sector energy entrepreneurs have created the right climate for an accelerated development of renewables.

Since its funding, IREDA has pledged resources for 1316 renewable energy projects. Highlights of cumulative lending operations are given below:

- Installed power generating capacity: 1,401 MW

- Conventional fuel replacement: 883,706 MTCR[3]/year
- Loan commitment: Rs. 3,708.61 Crore[4]
- Loan disbursements: Rs. 1,642.84 Crore

The achievements of IREDA in the renewable energy sector and past tract record have attracted many international investors. Renowned multilateral and bilateral agencies have come forward to join hands with IREDA in the renewable energy movement for sustainable development. International resources mobilized are given below:

- Asian Development Bank: 100 million US$
- Danida: 15 million US$
- GEF grant: 5 million US$
- Government of the Netherlands: 18 million Dutch guilders
- Kfw Germany: 120 million DM
- World Bank: 130 million US$
- World Bank/GEF/SDC: 145 million US$

Project/program Status

At present, the bulk of the lending activities is in the following areas:

- Solar energy technologies - manufacture and utilization of solar thermal and solar photo voltaic systems;
- Wind energy - setting up grid connected wind farm projects;
- Small hydro - setting up small, mini and micro hydel projects;
- Bio-energy technologies - support to biomass based cogeneration and power generation projects, biomass gasification, energy from waste and briquetting projects;
- Hybrid systems;
- Energy conservation and efficiency.

IREDA targets installation of an additional 2,993 MW from 1997-2010, equivalent to 0.976 million MTCR/year.

Replicability

With sufficient political support the IREDA programme could be implemented in several countries to enhance the application of renewable energy resources and technologies.

However, it may be noted that no single solution or institutional model becomes a universal solution for accelerated commercialization of renewable energy technologies. Models have to be devised based on the needs and local conditions. Therefore, a multiple approach based on the social, political, economic and cultural situation in the country where the programme is being implemented is necessary.

[3] MTCR = Metric Ton Coal Replacement
[4] 1 Crore = 10 million
1 US$ = 46.1 Rs. (United Nations exchange rate for November 2000)

Lessons Learned

IREDA programmes have a demonstrated track record in renewable energy investment and have proven that renewable energy can be seen as a sound business. As a profit earning entity, IREDA has become a role model in the renewable energy sector and is found to be financially sound.
One lesson learnt is, that after establishing appropriate institutional mechanisms to remove various barriers and after providing adequate resources, a suitable policy framework needs to be developed for the implementation of the programmes. Moreover this has to be closely followed up with the industry where sustained movement is possible by greater production economics, technological innovations and close monitoring of the entire programme.

Further Information

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Food and Agriculture Organization of the United Nations (FAO)

Title: Development of a National Biogas Programme – a case in Nepal

Abstract

A National Framework for Biogas Policy in Nepal was developed which will assist in consolidating the Government financial and technical policies for biogas development and serve to develop institutional capacity in the biogas sector.

District Level Officers Training courses were attended by 130 officers from various Government organizations and 21 persons from Non-governmental Organizations (NGOs), banks and other agencies. On the basis of the feedback from the participants and suggestions from technical staff servicing the project a practical manual entitled "Biogas Technology: a Training for Extension" was prepared jointly by FAO and national biogas companies. 30 master masons, 150 new masons and 150 female biogas users were also trained. These courses contributed to providing private companies with competent masons trained to build plants which satisfy the prescribed quality standards. Most of these activities took place during 1996.

Key policy issues

3.1 – Barriers

There are two main barriers to the diffusion of biogas systems in Nepal. The first, common to all efforts related to the dissemination among the rural poor of a new technology, energy-related or otherwise, is the very low purchasing power of these populations. This requires innovative and socially geared financial policies and mechanisms. The second is the lack of an institutional set up capable of tackling the intrinsic complex multidisciplinary characteristics of biogas diffusion. No single institution or sector can alone deal with the agricultural, environmental, energy and social implications that need to be considered comprehensively if biogas diffusion is to be sustainable.

3.2- Enabling framework

The main factor facilitating the diffusion of biogas systems in Nepal is the urgent need for alternatives from fuelwood because of both environmental and economic reasons.

Thirty seven percent of the country's area is under forest cover, of which eleven percent is degraded and 26 percent has less than 40 percent crown cover. Seventy five percent of the country's energy requirements are met by fuelwood. Per capita fuelwood consumption in the Hills and Terai is 708 kg and 689 kg respectively.

Forests provide rural energy needs in the form of fuelwood for cooking and heating. The present demand for fuelwood far exceeds the supply. This consumption is one of the main reasons of the present deforestation which consequently leads to soil erosion, desertification and environmental deterioration. This situation already has brought adverse effects on the ecosystem in many places. In recent years, the demand for energy has steadily increased, not only due to the population growth, but also due to the modernization of the agricultural and

industrial sectors. Nepal does not have any known commercially exploitable deposits of fossil fuels; therefore it must import it by spending export earnings. This situation has lead to the Government to give priority to the utilization of renewable energies in rural areas. Among these, biogas has the highest potential especially in the Terai and the Low-and Mid-Hill Areas, which offer the most favourable conditions for its application.

Another enabling factor to the use of biogas is the production of digested slurry, which is an ideal fertilizer for agricultural use, helping to prevent soil degradation and improving farm output.

3.3- Regulatory issues

Besides grating priority to biogas development and providing considerable subsidy to its diffusion, no national regulatory framework existed. The project assisted in the formulation and discussion of a National Framework for Biogas Policy in Nepal. This framework should assist in consolidating the Government financial and technical policies for biogas development and serve to develop institutional capacity in the biogas sector.

3.4- Funding modalities

The development of biogas in Nepal has received the support of various donors. The support has included a considerable amount of funds to subsidies the initial investment costs. Flat rates of subsidy i.e. NRs (Nepalese Rupies) 7000, and NRs. 10 000 per plant for terai and hill districts respectively have been found attractive and demand for biogas plants has started generating. Already, more than 25 private companies have been identified for the construction of biogas plants since during 1996 under the Biogas Support Programme (BSP) assisted by the Government of the Netherlands. An association of the companies called Nepal Biogas Promotion Groups (NBPG) has been functioning since August 1995 as a network between these companies and the BSP office.

In addition, the Agricultural Development Bank of Nepal (ADBN), the Nepal Bank Ltd. (NBL) and the Rastriva Banijya Bank (RBB), have provided lending facilities for biogas plants.

3.5- Partnerships

The only partnerships to highlight have been the links among the various financing institutions, i.e., banks, ministries, companies and donors. Few institutional arrangements were made for technical backstopping. In general, line ministries and departments were not actively involved in the implementation of the Biogas Programme, particularly at the district level. Efforts to integrate the Biogas Programme with the district development plans have been made. The district level officers training created interest among those officers who have shown willingness to organize users' courses, provide publicity and extensions and to coordinate and monitor responsibilities.

Recommendations for policy makers

The following were the main recommendations put forward by the project. These are at various levels of implementation.

Adoption of the National Biogas Policy

The suggested National Biogas Policy Framework should be adopted by the Government of Nepal, with modifications where necessary. In the context of this policy, an ambitious and integrated biogas programme should be developed for implementation in future National Plans. The new programme could be presented to donors.

Training

Considering the demand for the training manual developed by the project, and its success in the training courses, it was translated into the Nepalese language and published for wider dissemination and use. The English version of the manual could also be published for use in other countries. (This last recommendation faced financial problems).

Technical Assistance - Energy Promotion Centre

The Alternative Energy Promotion Centre or its equivalent could formulate a proposal for requesting bilateral funding on the following subjects:

i. Development, adaptation and field evaluation of low cost models of biogas plants suitable for hill and mountain districts in Nepal;
ii. Field demonstrations on the use of digested slurry as fertilizer and animal feed;
iii. Identification and adaptation of high rate biogas technology for cost effective treatment of industrial effluents.

GEF Project

A project proposal on "Biomethanation of Municipal and Industrial Wastes to Recover Energy with Reduction in Emission of Greenhouse Gases" could be formulated for funding under the Global Environment Facility (GEF) of the World Bank. A proposal based on the Kyoto Protocol CO2 emission-trading schemes, such as the clean development mechanism could be also prepared.

Country profile

5.1- Location

Nepal, situated in the central Himalayas, is a country with an area of 145 390 square Kilometers and a total population in 1996 of just over 21 million persons, with 90%. living in rural areas. Two-thirds of its area is occupied by hills and mountains with steep to very steep slopes, and the remaining one third is low land called Terai, which has rich alluvial soils. Basically agriculture is the mainstay of more than 90 percent of the population.

Rural energy issues addressed

In Nepal, forests provide rural energy needs in the form of fuelwood for cooking and heating. The present demand for fuelwood exceeds the supply. This high consumption of fuelwood is one of the main reasons for the present deforestation that consequently leads to soil erosion, desertification and environmental deterioration. On the other hand the country's high cattle population offers a tremendous potential for the development of household biogas systems in the rural areas. The estimated technical potential is about 1.5 million biogas plants. However, only 2 percent of this potential has been used so far.

Another potential yet to be tapped in Nepal is the production of biogas for the energizing of productive activities related to agriculture, cottage and small agroindustry. The proposed National Biogas Programme Framework considers these new rural energy applications.

Objectives

- assist the Government of Nepal in designing and developing a National Biogas Programme;

- upgrading the human resources necessary to implement it.

Implementation

The following are the main activities carried out by the project:

- Development of an appropriate curriculum and of training material for the biogas construction and user sector, for Government extension services and private companies, and for the rural mass media (radio, TV).

- District Level Officers Training courses were attended by 130 officers from various Government organizations and 21 persons from Non-governmental Organizations (NGOs), banks and other agencies. On the basis of the feedback from the participants and suggestions from technical staff servicing the project a practical manual entitled "Biogas Technology: a Training for Extension" was prepared jointly by FAO and national biogas companies. 30 master masons, 150 new masons and 150 female biogas users were also trained. These courses contributed to providing private companies with competent masons trained to build plants that satisfy the prescribed quality standards.

- Assessment of the overall biogas situation in Nepal and formulation of a National Biogas Programme.

Outcome and impacts

The project aimed to assist the Government of Nepal in designing and developing a National Biogas Programme and in upgrading the human resources necessary to implement it. The first objective was achieved through the preparation of a National

Framework for Biogas Policy in Nepal that should assist in consolidating the Government financial and technical policies for biogas development and serve to develop institutional capacity in the biogas sector. The training of human resources for the implementation of the programme was achieved through the organization of training courses for 130 district level Officers, 150 new local masons, 30 master masons and 150 female biogas users. A draft training manual was drawn up and used in the five training courses for district level officers. A comprehensive manual on "Biogas Technology: A Training Manual for Extension" was developed. This is considered to be an important guide and reference book for promoting biogas technology in Nepal and in other countries.

Both the proposed national policy framework and the training courses approached the biogas sector in a holistic manner with due consideration of the energy, environmental, sanitation and fertilization issues involved.

Replicability

The adoption of a new technology requires an appropriate framework and a sufficient time. A technology such as biogas requires also the will from the end user to participate in its operation. This will must be supported with the necessary knowledge and understanding of the technology in order to maintain good performance and the minimum of problems, interruptions and failures. Biogas technology is very different from other energy technologies since it requires considerable human intervention, including the unpleasant handling of manure and other residues. In some parts of Nepal manure handling was not an unknown action as it has been used as fuel through its direct drying and combustion. The scarcity of fuelwood created an urgent need for an alternative fuel. These conditions paved the way to a widespread interest and utilization of the biogas option.

Replicability can therefore be expected in places where these or other conditions eliminate barriers to the handling of manure and to the technical participation of the end users. If these barriers exist, it will only be possible to establish biogas systems at the communal level, which allow a higher level of automatization and of hired labour, with the end users benefiting of the provision of gas without their personal involvement. This of course has a cost.

Lessons learned

Besides the ones already reflected above, the following seem relevant:

- it is critical to integrate and synergize the roles of all stakeholders;
- technical and economic studies are required to mobilize financial assistance schemes;
- information and technical training at various levels (constructors, technical services, users) is key to success;
- under Nepalese social and natural resources conditions, biogas can make a very important contribution in energy, environmental and fertilizer provision terms.

Further information

The following persons can be contacted for further information:

Dr. Amrit Bahadur Karki	Consolidated Management Services Pvt. LTD. Dr. Karki has many years of international experience in the biogas field. He has been the most important promoter of biogas in Nepal and has formed a team of experts comprising national professionals with ample experience and expertise. Address: GPO Box 10872 Lazimpat, Kathmandu Nepal E mail: cmsnepal@cms.wlink.com.np
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Global Environment Facility (GEF)

Title: GEF Experience with Energy-Efficient Lighting in Developing Countries

Submitted by Global Environment Facility

Abstract

The GEF has supported several energy efficiency projects with efficient lighting components: This case describes the Mexico High Efficiency Lighting project, the Poland Efficient Lighting project, and the Jamaica Demand Side Management Demonstration project. These projects primarily promote compact fluorescent lamps (CFLs) for residential use. The Poland and Mexico projects have been fully completed, after successfully selling to households the targeted number of CFLs (3 million total for both countries) during project implementation. Experience and lessons from these projects show a successful approach to utility-based "demand-side management," the use of so-called "market transformation" programs to reduce retail prices to consumers, and the importance of consumer awareness and education in stimulating markets for high-efficiency lighting**.**

Introduction

The GEF has funded three energy efficiency projects with efficient lighting components in Mexico, Poland, Jamaica, and Thailand:

*Mexico High Efficiency Lighting Project (1993-95)***.** Under this project, the national electric utility (CFE) purchased CFLs and sold them directly to consumers through its offices. The utility purchased the CFLs in bulk under competitive procurement from manufacturers, receiving a significant discount over retail market prices. The programmatic approach was essentially a utility DSM program with extensive consumer marketing and outreach. The project took place in two states in Mexico, Nuevo Leon (capital Monterrey) and Jalisco (capital Guadalajara). These two capital cities are the largest in the country that the national electric utility serves. Low-income consumers were particularly targeted, because of the large subsidy paid by the utility for electricity purchased by these consumers.

*Poland Efficient Lighting Project (1995-97)***.** This private-sector project was designed to stimulate the national market for energy efficient lighting in Poland and accelerate the market by five years through four components: (1) CFL subsidies were provided on a competitive and contractual basis through manufacturers to reduce wholesale prices to dealers and retail prices to consumers (also called "wholesale buy-down"). Manufacturers competed to provide the largest guaranteed sales at the lowest project subsidy cost, and contributed additional price reductions themselves. (2) A pilot peak-load-shaving DSM program in three towns was conducted by municipal governments and local electric utilities. Through a special promotion program, discounted CFLs were sold to residents in specific districts where peak electric capacity was constrained. (3) A wholesale buy-down was also conducted for CFL luminaires. (4) A public education program, with the participation of non-governmental organizations, created a special logo to promote CFLs, conducted television and press advertising campaigns, and conducted

an energy/environmental education program in over 250 primary and secondary public schools.

Jamaica Demand Side Management Demonstration Project (1995-). This project created a DSM program unit within the Jamaica Public Service Co (JPSCo) utility and is demonstrating a broad-based utility DSM program. As part of this program, the utility gave free CFLs to 100 homes (about 300 lamps) to test them and to establish technical criteria regarding equipment performance, customer response, and installation problems. Subsequently, the utility has begun to sell a planned 100,000 CFLs to approximately 30,000 households at discounted prices. The utility sells CFLs to consumers as part of an overall energy savings package along with combinations of other equipment like low-flow showerheads and outdoor lighting controls. Consumers have the option of paying cash or applying for financing with 12 monthly payments through electricity bills. The program also involves a substantial public education and information campaign through utility mailings, offices, and the media.

Project Experiences and Lessons

GEF projects for efficient lighting have take five main approaches:

- Reduce retail prices of lighting technology
- Pilot new distribution mechanisms through retailers, dealers, or electric utilities
- Educate consumers/users about the characteristics, costs, and benefits of technologies
- Develop technology standards and/or certification mechanisms
- Conduct utility-based DSM programs

Illustrations of some of these approaches are described below in the cases of the Mexico, Poland, and Jamaica projects:

Reduce retail prices of efficient lighting technology

Retail price reductions achieved were quite significant. For example, In Poland, retail prices of CFLs were lower by approximately 30% in real terms after the project. The Mexico and Jamaica utility DSM projects also lowered retail CFL prices. In Mexico, consumers received a very favorable retail price estimated at about $5 to $8 (compared with a market price of up to $25 or more) as a result of a utility subsidy (estimated at about $7 to $10 per lamp) and economies from bulk purchases by the utility. The Mexican utility sold 1.7 million CFLs with no difficulty. In Jamaica, an estimated subsidy of $6 per lamp, combined with bulk purchases by the utility, led to an estimated retail price of around $6 per lamp (price data are sketchy, however).

In Jamaica, a CFL sales program by the utility began slowly with mail solicitation only, but participation greatly accelerated once a direct-contact strategy, in which applicants could interact with a customer service office staff, was tried. Half of the consumers paid for the energy efficiency measures with credit provided by the utility, suggesting the high-first-cost barrier is significant.

Educate consumers/users about the characteristics, costs, and benefits of technologies

The educational and marketing effectiveness of these programs is more difficult to assess, and evaluations are generally limited to anecdotes. For example, in Poland survey results indicated that a majority of consumers felt that special labeling for environmentally friendly products was of "great or decisive importance" in their decision making. The school education program was commended by the Polish Ministry of National Education, which wrote a letter to the project management in June 1997 saying "it is apparent that as a result of the project large numbers of students and teachers have gained a useful insight into the use of energy and its impact on the environment." In the view of project management, the public education component was most successful with print media and educational efforts involving NGOs and local governments.

The Poland project led to a large change in consumer awareness about CFLs and the number of households with CFLs increased from 11.5% to 19.6% of all households. The percentage of retailers stocking CFLs climbed from 70.5% to 74.6% of retail lighting stores. A sustainable market is also aided by word-of-mouth from those with positive experiences; in one survey, 97% of consumers said they were "satisfied" or "very satisfied" with the CFLs, while in another, 43% said CFLs performed better than expected—and only 3% said they performed worse. One set of obstacles to market transformation in a situation like Poland's is that high inflation, electricity tariff increases, and quarterly or semiannual utility billing can obscure the bill savings from CFLs because utility bills keep changing. This tends to diminish the verification of savings by the public over the longer term.

Conduct utility-based DSM programs

The Mexico project resulted in the targeted number of CFLs being distributed through the utility among its customers. But in this case continued replication of the program depends upon continued utility implementation and financing. When program participants were asked in a survey if they would buy CFLs in the future at market prices, however, only 30% answered no. However, the CFLs installed under the program are likely to have a demonstration effect. It appears that wealthy consumers are leaders in technology adoption, because of their ability to pay, knowledge, and/or higher electricity rates. Surveys of program participants have shown that 50% already knew about CFLs before the program, both through seeing them in supermarkets and hearing about them through friends. Between 9% and 19% of participants had already purchased CFLs before participating in the program. No survey data are available of non-participants to see how overall public awareness has changed.

In Mexico, the utility has gained extensive experience in implementing CFL projects and considers the project successful. With the revenue from the sales of CFLs already purchased under the program and with additional contributions, the utility was reportedly planning to purchase an additional 900,000 lamps, which would bring the project total to 2.5 million. It is also planning a nationwide CFL project to sell consumers four million

CFLs by the year 2000 using the Ilumex model. In Poland, there are plans for a new program to push purchases of hard-wired luminaires by housing cooperatives, and a new "Green Lights" program is beginning with demonstration lighting replacements in a few schools.

References

This case is adapted from the GEF publication *Promoting Energy Efficiency and Renewable Energy: GEF Climate Change Projects and Impacts* (2000) and the GEF/IFC Efficient Lighting Initiative project brief (1999).

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GEF web: www.gefweb.org

Title: The GEF Solar PV Portfolio: Emerging Experience and Lessons[5]

Since 1991, the GEF has provided grant financing for 21 off-grid solar photovoltaic (PV) projects in 20 countries (see Annex for descriptions of some projects). In addition, four more projects are under preparation in the pipeline. Though specific objectives vary, the projects are aimed at stimulating and achieving commercialization of solar PV systems for rural households (called "solar home systems"). These 20 projects together account for about US$ 210 million in GEF allocations, and about $1.4 billion in total project costs.

This review highlights a number of important issues associated with solar home systems projects that future initiatives should explicitly address, depending on the delivery model employed. They include:

- Technological credibility
- The role of solar PV within rural electrification programs
- Government policies vis-a-vis electricity as a basic need
- Household affordability and willingness to pay
- Marketing strategies, costs, and purveyors
- Concession selection and regulation
- Commercial creditworthiness and access to business finance
- Sustainability of development finance

Projects in the portfolio employ either or both of two primary approaches. In the *sales model* (8 projects), private dealers sell solar home systems to rural households. The system is owned and maintained by the household, which is also responsible for servicing any debt if the system is purchased with credit. In the *service model* (10 projects), an energy service company provides electricity for a monthly fee to rural households. In this case, the system is owned, financed, and maintained by the energy service company. Since a large share of the portfolio is still under implementation, it is too early to draw definite conclusions regarding impacts. Nevertheless, the review of the GEF solar PV portfolio suggests ten emerging lessons:

1. Viable business models must be demonstrated to sustain market development for solar PV.

2. Delivery/business model development, evolution, and testing require time and flexibility.

3. Institutional arrangements for project implementation can greatly influence the value of the project in terms of demonstrating viable business models and thus achieving sustainability.

[5] This case is an excerpt from the full paper of the same title, authored by Eric Martinot, Ramesh Ramankutty and Frank Rittner, and published by the GEF as a Monitoring and Evaluation Working Paper in August 2000.

4. Projects must explicitly recognize and account for the high transactions costs associated with marketing, service, and credit collections in rural areas.

5. Consumer credit can be effectively provided by microfinance organizations with close ties to the local communities if such organizations already have a strong history and cultural niche in a specific country.

6. Projects have not produced adequate experience on the viability of dealer-supplied credit under a sales model, and no project in the portfolio appears set to provide such experience.

7. Rural electrification policies and planning have a major influence on project outcome and sustainability, and must be explicitly addressed in project design and implementation.

8. Establishing reasonable equipment standards and certification procedures for solar home system components that ensure quality service while maintaining affordability is not difficult, and few technical problems have been encountered with systems.

9. Substantial implementation experience is still needed before the success of the service approach can be judged.

10. Post-project sustainability of market gains achieved during projects has not yet been demonstrated in any GEF project; it is too early in the evolution of the portfolio.

The global environmental benefits from rural solar PV projects are primarily indirect, and depend on the degree to which the GEF can help catalyze markets for rural PV applications that serve large shares of the two billion people in developing countries currently without electricity. Development benefits to households and rural communities are clearly connected with these projects, although further surveys of households are desirable to quantify income-generation effects, customer satisfaction, and delivery costs.

Future projects in the GEF portfolio are likely to focus on four key issues:

- Affordability through fee-for-service or consumer credit approaches
- Use of GEF resources for non-recurring costs related to business and market development
- Access to finance and incremental risk sharing
- Explicit linkages to rural electrification policies and planning
- Commercially feasible business models that are sustainable and can be replicated.

Projects must be careful to avoid an "equipment demonstration" mentality where the main objective is installation and maintenance of a certain number of systems. By project completion, the number of systems installed is much less significant than whether the business, delivery and credit models are viable, sustainable and being replicated. This emphasis requires implementing agencies to rethink traditional development assistance patterns and evaluation techniques.

In question is whether purely private delivery models, by themselves, are able to achieve

the widespread market penetration in poorer countries that will satisfy both global environmental and development objectives. Experience from some countries shows that the private sector can achieve substantial market penetration without much support from subsidies or government or multilateral agencies. Still, projects that involve government measures are likely to result in greater penetration and larger shares of rural households able to benefit from PV than purely private-sector models. Regardless of government involvement, service models seem more likely to result in larger markets because they provide greater affordability for poorer households. More definitive conclusions must await further experience from the portfolio in the coming years.

ANNEX: PROJECT DESCRIPTIONS AND EMERGING EXPERIENCE

Projects in Africa: Ghana, Uganda and Zimbabwe

Three UNDP/GEF African projects illustrate the two primary approaches to solar home systems. The Ghana project employs the fee-for-service model, while the Uganda and Zimbabwe projects employ a dealer-sales model. While Ghana and Uganda have been under implementation for less than a year, the Zimbabwe project was the first solar home system project in the GEF portfolio to be completed (in 1998).

The goal of the Ghana project is to establish a sustainable capacity in Ghana to provide decentralized renewable energy-based electricity services to rural communities through the fee-for-service model. The project is under implementation through a special office -- Renewable Energy Services Project (RESPRO) – established in the Ministry of Mines and Energy (MOME). RESPRO is intended to act as a for-profit enterprise to be "spun-off" as a private sector company towards the end of GEF project design. This is a departure from the original project design, where the project was to have been implemented by the Volta River Authority/Northern Electric Department (VRA/NED) the electricity utility in Ghana, which is expected to be privatized in the future. The current implementation structure does raise questions about the potential for privatization of RESPRO, as it is currently housed within a Ministry.

The project, which has just started implementation, targets some of the poorest households in northern Ghana, and expects to sell electricity through installation of 50 Wp (for US$7 equivalent per month) or 100 Wp (through US$12 per month) in households. Willingness to pay surveys and demand from households show that these rates are affordable. However, it is unclear whether these rates can generate enough revenue to offset expenses, including capital, operation and maintenance costs.

In contrast, the Uganda project is based on the sales model. Consumer credit is provided through two local credit institutions: a private rural development bank and a credit-union-type women's trust. In addition to the GEF grant, UNDP has provided cofinancing to guarantee credit lines of these institutions. The project is at very early stages of implementation, and hence it is not possible to assess the likelihood of overall project success. But there is a clear contrast in this approach to the Ghana project, in that in Uganda the project is clearly targeted towards those who are credit-worthy and can afford the cost of credit (perhaps only the top 10% wealthiest households). Households that cannot afford commercial credit still constitute the vast majority of the rural population.

The Zimbabwe project was also based on the sales model. From 1995 to 1998, over 10,000 solar home systems were sold, primarily through private dealers. A utility-sales model was also piloted, through the national electric utility, which sold about 200 systems under the project but appeared to lack sufficient interest to continue after the project completed. Expected experience with sales by NGOs was limited. Consumer credit was provided by the Agricultural Finance Corporation (AFC), a development institution, through a revolving fund mechanism. The AFC provided credit to 4,200 households but has been unable to replenish the fund, which will deplete without replenishment.

The Zimbabwe project was designed to enhance and upgrade indigenous solar manufacturing and delivery infrastructure, to develop an expanded commercial market in rural areas for affordable domestic solar electric lighting by providing low-interest financing through existing institutions, and to establish new credit mechanisms at the grassroots level to benefit lower income groups in rural areas (both households and community-based institutions). The project has had a number of impacts on the market for PV systems in Zimbabwe, including a greatly expanded network of dealers, reduced market prices (partly through elimination of import duties on imported components), improved technical knowledge among firms, PV module standards that were being used to certify and warranty installed systems, development of equipment certification institutions and procedures, and much greater awareness of PV by consumers, NGOs and government.

In comparing these projects, the fee-for-service delivery model seems to be more oriented towards the poorer of the rural population compared to the sales model. Also, the fee-for-service model looks affordable to larger sections of the rural population, and hence might have better potential for developing large markets for rural solar PV applications. Regardless of the model used, however, continued finance after the project, either from private or public sources, will be essential for the sustainability of the energy-service businesses or the delivery of consumer credit through development-finance or credit-union institutions.

Project in Sri Lanka

The Sri Lanka project demonstrates the initial viability of a "microfinance model" in which solar homes systems dealers market, sell, service, and warrantee their products to rural consumers through their own local sales/service offices. Consumers obtain loans from Sarvodaya, a national microfinance institution (MFI) with many local branches and strong ties to the communities in which it operates. A customer signs a credit agreement with Sarvodaya, Sarvodaya pays the supplier, and Sarvodaya is responsible for repayment and collections. The supplier provides maintenance service for the first three years, a one-year warrantee for the system and a ten-year warrantee for the PV module. The credit provided by the microfinance organization for purchase of solar home systems is similar in kind to that provided for enterprise development: $500 with 20% down payment, terms of up to five years, and a 24% interest rate. "This is the only way to go," said the two major suppliers in the market, who are now selling more than 90% of their systems this way (50-100 systems per month). For the year 2000, Sarvodaya has signed agreements with these suppliers to provide credit for an additional 5,000 systems and is looking towards extending credit for 10,000 systems in 2001.

However, Sarvodaya is currently "the only game in town" in terms of consumer credit and there is a need for other MFIs to participate in the SHS market. It appears that the market is being constrained by the lack of other MFIs with whom suppliers can sell systems on credit. "Help us to strengthen the rural credit structure," advised the two suppliers. "Sarvodaya is a social mobilization organization, not really a business," said one industry observer. Sarvodaya sees these projects as primarily social projects and thus does not approach the market with the aggressiveness of a private company. Without

other MFIs in the market, credit delivery through Sarvodaya may simply be too slow for the market expansion desired by suppliers.

The project also demonstrates the initial failure of a fee-for-service model in that country. Initially, one dealer provided 140 systems on a fee-for service basis and thought this approach held promise. But it soon stopped offering systems this way because it did not want the expense of monthly collections in a fee-for-service scheme. "Collection costs were eating up our entire profit margin," the dealer said. "You need a strong fee collection system with good timing, otherwise customers will spend the money on something else (if your timing is off) and default. Or they say they will pay next month and ask us to wait, or cite poor performance. It's a continuing problem. Also, we found that if customers don't own the system, they won't take proper care of it and this increases our costs."

Dealer credit through the project suffered the same fate. In the early stages of the project, suppliers found collections too difficult and time consuming. "Building a rural service infrastructure with technicians is a very different business from building a rural credit delivery and collection infrastructure," said the suppliers. "Credit is not [the suppliers'] business, it is the business of microfinance institutions," echoed one industry observer, "and the success of credit depends on local connections, knowledge, and institutions already in place." One factor affecting the viability of dealer credit is a very low rural population density in Sri Lanka. Transport and labor costs involved in collections are substantial because of the long distances and time required to travel those distances by supplier personnel. Population density and transport costs also greatly influence supplier costs for marketing and service.

Both suppliers and Sarvodaya have had no problem obtaining business financing from commercial banks and do not anticipate having problems in the future. But other MFIs besides Sarvodaya may face more difficulty, as commercial financiers see lending to MFIs as too risky and a marginal business. Because MFIs do not have assets, some observers felt that commercial banks would not lend to them, but this has not been tested yet in the project.

In 1999, Shell Renewables International purchased one of the existing dealers and observers saw Shell's entry into the market as a very promising sign, one directly attributable to the GEF/World Bank project. "Anybody who is really going to advance the market here has to have deep pockets," said one long-time participant and observer of Sri Lanka's market. Shell also signed a memorandum of understanding with the national electric utility which included a statement by the prime minister that the government would promote the private industry. "The credibility of solar homes systems has increased several notches" within the government due to the project and Shell's entry into the market," said an industry observer.

Projects in the IFC/GEF Small and Medium Scale Enterprise Program

Business financing is being provided under the IFC/GEF Small and Medium Scale Enterprise Program to solar home systems businesses in Bangladesh, Vietnam, and the Dominican Republic.

The Bangladesh project demonstrates a dealer-credit model in which one organization (Grameen Shakti, legally a non-profit), performs all functions: marketing, sales, service, credit provision, collections, and guarantees. From 1997 to 1999, Grameen Shakti installed 1500 systems using this model (about 1100 systems since IFC financing began in July 1998), and plans to install 2000-2500 systems in 2000 (consistent with their original business plan). Grameen Shakti is so far the only player in the Bangladesh solar homes systems market. Before the IFC loan, Grameen Shakti was installing about 20 systems per month using exclusively Grameen Bank financing, which was for terms of one year only. So Grameen Shakti was only able to extend credit for one year terms, which limited demand greatly. With the IFC SME loan, Grameen Shakti is able to extend three-year credit to customers, which has made a large difference in its business. Grameen Shakti believes they will ultimately be able to receive loans from commercial banks in another 3-4 years after they demonstrate profitability.

In Bangladesh, Grameen Shakti is selling to households which have incomes two or three times higher than Grameen Bank "members" (those eligible to borrow from the Grameen Bank). Grameen Shakti's customers represent the top 10% to top 15% of income status among rural households. The organization's biggest problem is the cost of marketing and consumer education. They are spending their own money (financed through business loans) on this, and do not receive grants from the government or Grameen Bank for this purpose. Grameen Shakti finds the process of building customer demand and confidence to be enormously draining on their time, resources and profitability. However, after a "critical mass" is reached in a particular community (perhaps 100 systems), word spreads among friends and relatives, people see systems in operation, and marketing is easier.

In Vietnam, sales by a private dealer (SELCO) are assisted by a complex credit delivery scheme involving the Vietnam Women's Union (VWU), an NGO, and the Vietnam Bank for Agriculture and Rural Development (VBARD), a development finance institution. The union markets SELCO's systems and administers consumer loans provided by the bank (VWU collects fees for these services). SELCO provides systems (receiving full cash payments) and is responsible for service. VBARD provides consumer loans, assuming risk for 75% of the purchase price. Of the remaining 25% of the purchase price, SELCO provides a collateralized guarantee to VBARD for 5-10% and the customer pays 15-20% as a down-payment. SELCO covers its collateralized guarantee to VBARD with IFC/GEF financing. If a purchaser defaults on the VBARD loan, SELCO repossesses the system, refurbishes it, and VWU finds a new buyer for it. If there is any loss in this repossession/refurbishing/resale process VBARD has access to the SELCO guarantee. Despite instructions from the head office, some conservative branch managers of VBARD have been reluctant to participate in the SELCO business. Where this has happened, SELCO has extended consumer credit itself. So far SELCO has sold 500 systems in Vietnam.

In the Dominican Republic, the U.S. firm Soluz has been developing a subsidiary, Soluz Dominicana, into a successful fee-for-service business that targets up to 50% of the population in the rural communities it serves and charges $10 to $20 per month for

electricity service from SHS.[6] The Soluz business model revolves around a "service center" for up to 2000 customers and "zones" of about 500 customers served by technicians collecting payments at "collection points" covering 20 to 100 customers. Collection rates have been typically over 95%, although to maintain high rates Soluz Dominicana has needed to make household visits to a portion of customers. Through continuous improvement to the business model, including business and technical systems optimization, Soluz expects to complete a robust "proof of concept" with Soluz Dominicana at a scale of 5000 fee-for-service customers. As of April 2000, Soluz Dominicana had installed over 3500 systems and had passed the break-even point where revenues cover the direct costs of operations. About 1700 of these systems have been installed on a fee-for-service basis. Soluz also established Soluz Honduras to enter the Central American market and diversify.

Soluz is now working on developing its business model to the point where eventually it will be able to support 25,000 customers. Soluz finds such "business-model R&D" very difficult to fund from operating revenue alone at the proof-of-concept scale. Thus Soluz sees the need for concessional funding to help it cover first-time commercialization costs including financial transaction engineering and optimization of its business and technical systems. Said Soluz of its commercialization efforts, "We are doing the work to prepare for a $5-10 million company (25,000-50,000 customers), but we are concerned about burdening a $1 million company (5,000 customers) with the overhead and first-time costs of building an energy-service company on a larger scale. The business is risky and the GEF still has a legitimate role. This is a lean margin business, so a small difference can affect profitability greatly. Over the next three years we need to create a strong franchise. There are necessary overheads as well as first-time innovation and transaction costs to keep the thing going on a solid path--the question is how to cover these costs. To rely only on equity would place high pressure for rapid and more difficult-to-achieve growth to meet return requirements, which adds risk."

[6] Monthly fees are $10 for a 20 Wp system, $15 for 40 Wp, and $20 for 50Wp. Customers own and are responsible for the battery, although Soluz Dominicana can include financing for batteries in the monthly fees.

Title: Thailand Sees Economic Power in Energy Savings

Global Environment Facility (GEF)

Summary

In 1993, Thailand launched a $189 million[7] initiative to curb electricity demand and promote more energy-efficient equipment and cost-effective energy services. Thailand's Electricity Generating Authority (EGAT) developed a strong portfolio of demand-side management measures, including 19 programs targeting a wide range of sub-sectors and end-uses, and far surpassed its original peak reduction and energy conservation targets. EGAT also created substantial public awareness of energy conservation and actively promoted private sector participation under the slogan "Save Your Money. Save Our Energy. Save the Environment." Its demand side management office has been recognized internationally for its success in forging partnerships with other agencies and designing programs that fit within an Asian context. While the overall results have been positive, EGAT has experienced a number of implementation issues, which are beginning to be resolved. This study examines results to date, offers an analysis and lessons learned, and discusses prospects for DSM programs in Thailand and elsewhere.

Saturday, September 20, 1884. That's when King Rama V of Thailand celebrated his 31st birthday. To mark the occasion, the inside of the Grand Palace was brightened by Thailand's first electric bulb. Only two years and a fortnight had elapsed since the first electric bulb lit up a New York City office block. Fast forward to Friday, March 22, 1996. At one point on that day, Thailand's demand for electric power reached 13,310.9 megawatts. That demand, just short of the then total installed capacity of about 14,000 megawatts, sent shivers of concern down the spine of officials of the Electric Generating Authority of Thailand (EGAT).

Then there is Monday, September 20, 1993. On that day, exactly 109 years after that bulb first lit up a Thai palace and nearly three years before the scare of 1996, the government launched an ambitious $189-million program which has put Thailand at the regional forefront in energy conservation initiatives. At issue were an 8 percent annual growth in the economy and a 14 percent annual increase in the demand for power. However, the government was also concerned about the potential impact on both the Thai and the larger global environment. "EGAT recognized," according to the website of its Demand Side Management Office, "that if the growth trends seen in Thailand (and other developing countries) were to raise per capita energy use by even one fourth the current industrial country level, this alone would increase world energy use 60 percent by the year 2025. From the environmental standpoint, this global increase could make these countries electrified but unlivable."

The international community is working closely with the people and government of Thailand on this effort. The Global Environment Facility (GEF) has chipped in with a US $9.5 million grant, which the World Bank is administering on its behalf. A key feature in GEF approval of the project was the expectation that it had significant potential to be both sustainable (to continue after external funding ended) and replicable in other countries. The Overseas Economic Co-operation Fund of Japan is providing US$25

[7] As program strategies evolved, emphasizing manufacturer negotiations over rebate programs, fewer financial resources were needed. About $60 million was spent through the project, with targets still surpassed.

million and the Government of Australia US$6 million. The lion's share, $148.5 million, comes from Thailand itself. Another measure of the size and seriousness of Thailand's commitment are the 375 EGAT employees dedicated to load management and energy efficiency.

The investment is beginning to pay off. Within five years, peak demand for electricity was reduced by 317 megawatts, well over the original target of 238 megawatts. Part of the reduced electricity consumption stems from more energy-efficient T-8 compact fluorescent lamps in place of the T-12 fluorescent lamps traditionally used in Thailand. The country's five fluorescent lamp manufacturers, as well as its only importer, agreed to transform the entire market of over 40 million lamps sold per year. From now on, all lamps sold will be the more efficient models. This particular win-win solution was attained without a penny of public funds. The private sector met its own costs for making the change from the savings in production costs. The main contribution of DSMO was to launch a marketing and public awareness program aimed at consumers.

DSMO also facilitated an arrangement between manufacturers and convenience ("7-11 type") stores for the bulk purchase of CFLs and their distribution at about 40 percent below the normal retail price. Similarly, the office planned to promote the use of low-loss magnetic ballasts through a bulk purchase arrangement.

According to Eric Martinot of GEF's climate change staff, this case shows "that successful voluntary negotiations and agreements with manufacturers and importers can be conducted on a comprehensive market-wide basis in a short period of time, provided their suppliers are few in number and the utility has a good relationship with the private sector."

Less wasteful fluorescent lamps are only one aspect of demand-side energy management in Thailand. There are 13 programmes involving various social and economic sectors, among them:

- load-management systems, industrial motors, lighting, chillers, etc. to get commercial and industrial enterprises (everything from offices to hotels to manufacturing plants) to cut down on energy use (taking into account that 80% of the energy used by Thailand's industrial sector is consumed by motors, almost all of which are low-efficiency models);
- the use of such alternatives as stand-by generators, where appropriate;
- special tariffs and public-awareness campaigns designed to induce Thais to use less energy, especially during periods of peak electricity consumption;
- a "green buildings" programme through which DSMO offers free energy audits and technical assistance which facilitate compliance with the mandatory energy-efficiency codes; and
- the "Thai Green Label" programme which encourages Thais to purchase more energy-efficient, and generally more environmentally friendly, products.

There are two particularly interesting, perhaps even unique, elements about the Thai program. One is the emphasis on spreading the message among children and youths — the "consumers of tomorrow". The Green Learning Room offers interactive energy-environment learning tools, including a CD-ROM, to educate school children on the link between energy use and the environment. The other: by pitching its message of energy

conservation even to smaller users, the agency seeks to lay the foundation for sustainable progress by creating what it calls "a permanent attitude in their minds to that future generations would think of energy efficiency as a matter of course and culture".

One of the intentions of the framers of the GEF segment of the Thai program was that the energy savings achieved would "generate interest in and a commitment to similar demand-side management by utilities in other developing countries". This was not a misplaced hope. According to Andrew Yim, an international advisor to EGAT, "Many countries are visiting Thailand to learn the lessons from this project. In fact, Thailand is setting a very unique example for many countries in the region regarding the strategies we have implemented. ... I would say so far it has been very successful and many countries are interested in learning about that."

Visitors are learning that the leaders of Thailand's energy conservation movement do not see demand-side management essentially as a sacrifice. In fact, one of the slogans used is: "Save Your Money. Save Our Energy. Save the Environment." Thailand's leaders like to say that they have discovered, for themselves and on behalf of future generations, "the economic power of energy conservation".

GEF Strategy and Rational for Support

GEF is supporting country efforts to reduce greenhouse gas emissions in its climate change focal area. A variety of short, medium, and long term approaches are supported by three GEF operational programs that:

- Remove barriers to energy efficiency and energy conservation
- Promote the adoption of renewable energy by removing barriers and reducing implementation costs
- Reduce the long-term costs of low greenhouse gas-emitting energy technologies.

The first of these programs puts the climate change challenges in a strategic, medium, and long term perspective: removing barriers to large-scale application, implementation, and dissemination of cost effective energy-efficient technologies; and by promoting more efficient energy use. In this Thai five-year demand-side management plan, GEF financing helped build institutional capacity in the Thai electric power sector and throughout the economy. The GEF project aimed at pursuing policies and actions leading to the development, manufacturing, and adoption of energy efficient equipment and processes. The project has demonstrated both financial and environmental savings from reducing the use of fossil fuels for electricity production.

. A key feature in GEF approval of the project was the expectation that it had significant potential to be both sustainable (to continue after external funding ended) and replicable in other countries. Requirements for monitoring and evaluation were included to assess project performance including progress in achieving these larger goals. As discussed below, the project met expectations from both the narrow and wider perspectives.

Analysis and Lessons Learned

Based on the overall results and recent evaluation findings, a number of lessons have emerged and are under consideration by EGAT as it plans future activities. They include:

- *Design Programs Based on Local Context:* EGAT's most effective initiatives did not simply import program models, but were implemented using a Thai approach of combining manufacturer collaboration and public promotions. The lesson here is that outside expertise should be limited to discrete assignments and training activities, leaving the local utility staff to design the programs based on market research conducted and strategies developed in-house.
- *Identify DSM Champions:* Without the strong proactive approach taken by the first DSMO director, it is unlikely that EGAT's program would have developed and grown over the years.
- *Define DSM Program Objectives:* The DSMO has continually had to confront the issue of competing objectives and interests. An important lesson for future programs in Thailand is that DSM objectives should be clearly defined up front: public purpose or commercial; load management or energy conservation; economic/environmental benefits or financial gains; sectoral priorities, etc. The priorities identified will drive how programs develop.
- *Establish DSM Programs in Context of Reforms*: EGAT's eventual privatization was not considered at the time the DSM Program was first established. Potential privatization and restructuring, tariff reforms, etc., should be taken into consideration at the time DSM programs are considered, and an appropriate framework designed. Program financing is a key component of this framework, and should be able to accommodate eventual pricing reforms and include appropriate regulation, oversight, institutional and incentive schemes.
- *Generation Versus Distribution Utility DSM*: While EGAT's overall DSM Program has met its objectives, some specific programs were partially constrained because EGAT does not sell directly to end-users and, therefore, did not have previous relationships with consumers. Distribution utilities are a more logical home for DSM programs. In those countries that still have vertically-integrated utilities, any introduction of DSM efforts should explicitly involve the distribution staff and provide for gradually shifting DSM program responsibilities to distribution utilities as reforms progress.
- *Systematic Planning and Evaluation*: Proper program prioritization and screening play a key role in designing and implementing DSM programs. Evaluation plans should be developed concurrently with program plans to identify clear objectives and performance indicators to assess program performance. Program design should also include proper development of end-use consumption patterns, market research, and baseline data.
- *Phased Implementation*: EGAT's experience demonstrates the importance of implementing programs using a phased approach. It is preferable to implement pilot initiatives, and then evaluate and refine them before expanding and scaling-up

implementation efforts. A second advantage is that it allows staff to gradually build their competency and improve their program design and analysis skills.

- *Financing Facilities*: EGAT's limited success in its commercial and industrial sector programs is largely due to a lack of viable financing sources. EGAT's future DSM efforts, and programs elsewhere, should actively address this barrier and arrange for complementary financing programs to support industrial and commercial energy audit programs, ESCO development, and non-residential end-use programs, such as motors and chillers.
- *Voluntary Versus Mandatory Labeling*: Based on EGAT's experience, it is evident that voluntary labels are not effective as rating mechanisms, since they provide no incentives for manufacturers to label lower efficiency models. In those countries where voluntary labels are the preferred option, a simple quality brand label would be the preferable option.

Conclusions

Overall, EGAT has substantially met its DSM Program objectives of creating substantial institutional capability within EGAT to design, implement, and evaluate DSM programs and achieving increased supply and adoption of high-efficiency equipment in Thailand. EGAT has maintained strong ownership of the initiative and has developed DSM programs suited to Thai conditions and culture. EGAT has fully met and even exceeded its energy savings targets based on verified evaluation figures. EGAT has also worked well with several other Thai governmental agencies to jointly develop programs that meet shared goals and to address a number of areas in which the programs can be improved in the future.

Implications for DSM Programs Elsewhere

DSM program implementation should depend on a country's or utility's objectives for power sector development and whether DSM can offer a cost-effective, viable option. Objectives relating to environmental protection, commitment to energy efficiency, energy security, and other related concerns also need to be defined. While DSM can be considered a viable tool to help address some of a country's concerns, it remains a contentious intervention mechanism. In countries with severe power shortages and capacity constraints, utilities may have incentives to reduce peak loads to delay new capacity investments or to target load management programs in areas of high network congestion. Other potential incentives include implementing energy conservation in low tariff customer premises, and bundling DSM services in order to recruit additional customers. Such concerns need to be carefully weighed against potential conflicts between DSM and utility revenues, introduction of appropriate incentives for all stakeholders, equity of financing mechanisms, and administration costs of such efforts.

Financing DSM remains a significant issue in most places. Many countries, like Thailand, have imposed DSM taxes within power tariff schemes – usually with greater demands for accountability than those imposed on EGAT. Other governments have opted to fund DSM programs for low-income customers as a social program, and effectively pay the utility to implement the program. Some countries are interested in

introducing DSM as an integral part of their power sector development plans, but face considerable hurdles with bringing electricity tariffs to cost recovery levels that make DSM surcharges unfeasible at present. In any case, DSM financing should be linked to the decision to implement DSM programs at all, and the financing mechanism designed in the context of the goal the program is to achieve.

Regardless of the objectives and mechanisms a country might prefer, Thailand's DSM program offers considerable insights into the major issues associated with implementing DSM programs, and of the potential benefits that can accrue. At the time EGAT began its DSM Program, it was unable to keep up with projected demand. Not all of its DSM programs have achieved their intended impacts, but EGAT achieved its overall peak and energy reduction goals at a cost less than would have been needed to add new generation during this period, benefiting the country from an economic point of view. While every country's and utility's context is unique, EGAT's experience offers a number of useful lessons that cut across geographical boundaries.

Title: GEF Experience with Grid-Connected Renewable Energy in Developing Countries

Introduction

Grid-connected renewable energy—wind, small hydro, biomass power and geothermal power—has made great inroads in the 1990s. Since 1991, the GEF has approved 15 projects with its implementing agencies to promote grid-connected renewable energy in developing countries.[8] Eight of these projects promote wind power (in Cape Verde, China, Costa Rica, India, Kazakhstan, and Sri Lanka), five promote small hydro (in India and Sri Lanka), five promote biomass and bagasse power generation (in China, Cuba, Hungary, Mauritius, and Thailand), one promotes power from biomethanation (in India), and one promotes geothermal power (Philippines).

GEF-supported projects are significant relative to the installed capacities of most of these renewable energy technologies in developing countries. For example, the GEF is co-financing 600 MW of hybrid solar thermal/gas turbine power plants in developing countries, which for now will represent almost all of the solar thermal capacity to exist in these countries. A GEF-supported project in India has indirectly influenced 1100 MW of wind power development there, which represents more than 75% of the wind turbines installed in developing countries (directly financed wind power installations as part of approved GEF projects will total about 250-300 MW). And a project is adding about 440 MW of geothermal in the Philippines, which represents about 12% of geothermal capacity in developing countries. Some projects provide pilot-size demonstration projects—like wind farms in Cape Verde (8 MW), Costa Rica (20 MW), and Sri Lanka (3 MW).

More significant than hardware, however, is assistance to support sustainable market development—through supportive regulatory frameworks, financing availability, and increased awareness and skills among project developers, financiers, technical institutes and policy-makers to support renewable energy. In general, GEF projects take four main approaches to promoting grid-connected renewable energy:

- Demonstrate technologies and their commercial and economic potential
- Build capacities of project developers, plant operators, and regulatory agencies
- Develop regulatory and legal frameworks that encourage independent power producers and establish transparent, non-negotiable tariff structures
- Create financing mechanisms for project developers.

This paper reviews the emerging experience and lessons from two projects which have been completed (in Mauritius and India) and a third with substantial implementation experience (in Sri Lanka). The remaining projects are just starting or in very early stages of implementation, although emerging experience from China and Costa Rica is also covered.

[8] The GEF-supported projects described in this paper are implemented by either the World Bank or UNDP, often with substantial co-financing from recipient governments, the private sector, and other international agencies.

India

In India, GEF support for wind power occurred in parallel with the explosive market growth that emerged in the mid-1990s fueled by favorable investment tax policies and a supportive regulatory framework. Besides investment tax credits, transparent power purchase tariffs, transmission wheeling, third-party sales, guarantees for local utility power-purchase contracts and power "banking" all contributed to the development of the market.[9] By 2000, almost 1200 MW of wind capacity had been installed in India, virtually all of that by the private sector. In addition, dozens of domestic wind turbine manufacturers had emerged, many of them joint ventures with foreign partners. Exports of turbines began and high-technology turbine designs with variable-speed operation were being produced. During the 1990s, the GEF and World Bank directly financed 41 MW of wind turbine installations and 45 MW of mini-hydro capacity in India through the Renewable Energy Development project.[10]

More importantly, the India project also strengthened the capabilities of the India Renewable Energy Development Agency (IREDA) to promote and finance private sector investments, and more than 360 MW of wind projects and 65 MW of mini-hydro projects have been financed through IREDA. Another 65 MW of mini-hydro capacity is scheduled for financing and completion through 2001. The project also helped to raise awareness among investors and banking institutions of the viability of wind power technology and helped to lobby for lower import tariffs for wind systems. During the 1990s, many financial institutions decided to offer financing for wind farms, which was a key project goal.

One lesson from the India case is that it is difficult to separate the influence of GEF interventions from other trends and forces at work. The net result, in terms of existing manufacturing capacities, financing, and volume of installed capacity, comes from a complex set of many influences, of which the GEF is just one. Certainly the investment tax credits have been a powerful stimulus to technology transfer and market development while the credits existed. But longer term market sustainability may rest on the awareness, capabilities, supportive regulatory conditions, and commercial financing arrangements put in place, in part through World Bank/GEF assistance.

Another lesson from India is that more understanding is needed about the relative effectiveness of production-based incentives relative to capacity-based incentives. In the 1990s, one-year 100% investment tax depreciation provided large economic gains for installation of wind farm capacity, regardless of the electricity generation from that capacity. This incentive is shifting, as capacity-based tax incentives have decreased due to the reduction in marginal corporate tax rates from 55% in 1992/93 to 35% in 2000, at the same time that power tariffs, production-based incentives, have continued to rise. In

[9] "Policy Approaches: The India Experience," Ajit Gupta, paper presented at the International Conference on Accelerating Grid-Based Renewable Energy, Washington, DC, 7-8 March 2000 (Washington, DC: World Bank); "Wind Energy Development in Tamil Nadu and Andhra Pradesh, India—Institutional Dynamics and Barriers," A. Jagadeesh, *Energy Policy* 28(2000): 157-168.

[10] Additional hydro capacity was under development in 1999 and 2000, and a second World Bank renewable energy project for India, which would finance additional mini-hydro, was approved in 2000.

addition, IREDA offers incentives for wind farms it has financed to achieve higher capacity factors—in the form of interest-rate reductions.[11]

Finally, a possible lesson from India may parallel that gained in California in the 1980s: it takes a substantial amount of time and a large, growing wind industry to work out technical and operational difficulties and gain enough experience to enable superior wind farm performance. The recent decline in wind farm development in Tamil Nadu, for example, has been attributed to variety of factors. In addition to financial and policy factors, the decline has been attributed to inadequate capacity of substations, weak distribution connections, poor maintenance, inadequate facilities for repair, rotor blade failures due to manufacturing defects and lightning, control system failures due to disregard for grounding regulations and lightning protection, and inadequate wind speed data resulting in differences in actual and expected energy production.[12]

Mauritius

In Mauritius, a World Bank/GEF Sugar Bio-Energy project indirectly catalyzed dramatic changes in electricity generation in Mauritius. From 1994 to 1996, the project dispersed $6 million for efficiency investments in sugar mills to provide surplus bagasse for power generation. The project also provided technical assistance and technology demonstrations to promote private/public sector cooperation in power plant ventures and evaluate ways to decrease the transport costs for bagasse and to optimize the use of sugar cane for power generation. A planned demonstration bagasse plant under the project was never constructed. Electricity generation from bagasse increased from 70 GWh/yr in 1992 to 118 GWh/yr by 1996. Several sugar mills have completed or embarked upon bagasse power plant investments on their own, independent of the GEF project, including the original mill that had been targeted for the bagasse power plant under the project. The European Investment Bank has agreed to finance a bagasse/coal-fired power plant. A project completion report states that "extensive dialogue between the public and private sector on design work, the least-cost power development plan, and power purchasing agreements have directly or indirectly led to the development of other power plants."

One of the lessons from the Mauritius project is how creating an investment climate for renewable energy power projects, and creating public-private partnerships, can lead to supportive regulatory frameworks. In this case, the project led to the establishment of a framework for independent power producer (IPP) development and an administrative focal point for private/public sector partnership in IPP development. A project evaluation states that "the project's major accomplishment was progress in helping to establish an institutional and regulatory framework for private power generation in Mauritius and the provision of technical studies and trials to support technologies for improved bagasse production and improved environmental monitoring." Another lesson may be that technical demonstration (in this case the planned demonstration bagasse plant that was

[11] Interest rate reductions are 0.5% for plants exceeding 18% capacity factor (1.6 GWh/MW/yr), 0.6% for exceeding 23% capacity factor (2.0 GWh/MW/yr), and 0.75% for exceeding 27% capacity factor (2.4 GWh/MW/yr).

[12] "Wind Energy in India—A Critical Review," A. Jagadeesh, unpublished paper, Nellore, Andhra Pradesh, India.

never constructed) has less of an influence on promoting markets for a technology than other types of project interventions.

Sri Lanka

In Sri Lanka, the GEF/World Bank Energy Services Delivery project begun in 1997 points to the difficult and time-consuming nature of evolving business and regulatory models suitable to a given country and the flexibility needed to support approaches that show promise. Prior to the project, all mini-hydro development was done by the national electric utility. The project has opened up the market to third-party, mini-hydro developers. The project has financed more than 21 MW of small hydro by independent power producers (IPPs) and has been developing regulatory frameworks for IPPs, including standardized "non-negotiable" power-purchase tariffs and contracts (PPAs). This project provided enough incentive for the national utility to adopt IPP frameworks and agree to PPAs, which together with demonstration effects of prior mini-hydro installations and new incentives for developers (such as import duty waivers and income tax concessions) spurred the market.

However, one of the lessons from the Sri Lanka project is that variable power-purchase tariffs can hinder market development. In this case, tariffs were tied to *short-run* avoided utility costs based on the international price of oil. In 1997 and 1998 tariffs were set at the equivalent of 5 cents/kWh and mini-hydro development flourished. However, because of the downturn in oil prices in 1998-99, prices were only the equivalent of 3.5 cents/kWh in 1999. As a result, all development essentially stopped in 1999. And this fluctuation has seriously hurt the longer-term interest of private mini-hydro developers in Sri Lanka. "The low tariffs and unresolved dispute [on tariff calculation methods] have caused a deep slump in mini-hydro development" said a project status report in 2000.

Another lesson from Sri Lanka is that attention must be paid to proper structure of power-purchase tariffs so that renewable energy receives credit for the value it creates, in terms of both energy and capacity. The original power-purchase arrangements negotiated with the national utility (a "single buyer" market given the utility's monopoly status in transmission and distribution) called for only energy-based tariffs, with no credit given for capacity. Negotiations were on-going between a mini-hydro industry association and the national electric utility to incorporate capacity credits into what was an energy-only tariff; but for now the mini-hydro industry has to make do with energy-only tariffs. Finally, bureaucratic bottlenecks in getting PPAs approved and in getting physical connections to the grid have been cited as other factors hindering market development.[13]

A parallel GEF/UNDP project in Sri Lanka has sought to build the professional capacities of the renewable energy industry in project design, implementation, and maintenance; to assess wind and small hydro resources and conduct pre-investment

[13] "Grid-Connected Small Hydro Power in Sri Lanka: the Experiences of Private Developers," Romesh D. Bandarenke, paper presented at the International Conference on Accelerating Grid-Based Renewable Energy, Washington, DC, 7-8 March 2000 (Washington, DC: World Bank).

studies, and also to facilitate technical performance testing. These currently ongoing activities should strengthen the industry.

Costa Rica

In Costa Rica, a significant private sector wind-power industry has emerged from new dialogue and policy frameworks engendered by the GEF project even though the project has not yet installed its planned 20 MW demonstration wind farm (the installation component of the project has been delayed). However, the private sector installed a 20-megawatt wind farm and began operating it in 1997. Apparently, early project preparation activities, including institutional and technical feasibility studies, have engendered favorable perceptions and regulatory frameworks for wind (including "iron clad" power-purchase agreements). Private-sector investments could be considered indirect project impacts. In addition, other countries in Central America are taking note of Costa Rica's experience. Technical performance questions still remain, as about one-third of the wind turbines in the existing 20-megawatt wind farm have reportedly been damaged by lightning and other climate conditions.

The emerging lesson from Costa Rica may be that regulatory frameworks, technology perceptions, and studies that address non-technical issues (and reduce non-technical risks) may be more important than mitigation of perceptions of technical risk through hardware demonstrations. The GEF project may already have achieved a significant share of its influence before the 20-MW demonstration wind farm was even constructed. This lesson is similar to that suggested by the Mauritius project described above.

China

The emerging experience from a GEF-supported Renewable Energy Development project in China highlights the pressing need to address regulatory frameworks and find ways to reduce risks to project developers. The project is designed to finance four newly formed windfarm companies for construction of 190 MW of wind farms in Inner Mongolia, Hebei, Fujian, and Shanghai provinces. These companies are jointly owned by the State Power Corporation and subsidiary electric power utilities (at regional, provincial or municipal levels) and will sell power to utilities under power-purchase agreements developed through the project. The costs of wind-generated electricity from these wind companies are of course higher than those of conventional electricity generation, but utilities in three provinces (Hebei, Fujian and Shanghai) appear willing to purchase this power from the project developers (and in fact are required by government policy to do so, at production-cost-based tariffs).

However, a planned 100-MW wind farm in Inner Mongolia as part of that project has been called into question because the Inner Mongolia utility has been unable to sign power purchase agreements with neighboring provinces. Originally, a regional power company had said it would purchase wind power from Inner Mongolia. But the regional company was split into three provincial utilities with a more explicit mandate to operate on commercial terms, and Inner Mongolia has been unable to persuade any of these three provincial utilities to sign power purchase agreements. Unable to use and pay for this

power itself—given the small size of the Inner Mongolia grid—it may prove unable to undertake this investment.

The general lesson suggested by China is that some means must be found to supply the additional costs of wind power until commercial-scale application reduces costs to be strictly competitive at the wholesale level. This will be a recurring problem with wind power in developing countries. So far, in both developed and developing countries, these additional costs have been borne by various entities—for example, from all customers of a given utility when a Feed-in Law (Germany) or Green Certificates (Netherlands) are applied, from explicit voluntary contributions by retail consumers who choose to purchase "green power" (in the U.S.), or from general government revenues like when investment tax credits for wind were applied in India.

Regulatory Frameworks Supportive of Grid-Connected Renewable Energy

The experience from the Sri Lanka project described above shows how even one of the very basic steps—allowing IPPs and PPAs into a previously monopoly system—can face many challenges. The experience from India shows that supportive policies for renewables can have a large influence on the market—policies such as transmission wheeling according to pre-established norms and tariffs, energy "banking" of renewable-generated power, and third-party sales by renewable-based independent power producers.

The experience from China shows that regulatory frameworks must address the question of how the additional cost of wind power (relative to conventional sources) can be covered—and especially the questions of who will pay this additional cost and what policy/institutional mechanisms allow the additional cost to be collected and channeled to wind power development. Variations on this issue can be seen in India, where the government adopted very favorable investment tax credits for wind (the "who" in this case being all Indian taxpayers), and in Sri Lanka, where definitions of "avoided cost" and levels of power purchase tariffs lie at the heart of market viability.

Project experience may also be showing examples where national level policies for technology market development and industry incentives depend first on technical demonstrations. For example, in India, novel technical experience and economic benchmarks are being gained from a UNDP/GEF project to promote the use of high-rate biomethanation for power generation. The project has resulted in seven demonstration power plants totaling 1000 kW. These plants run on biogas generated from sewage treatment plants. Another 1-MW plant has been commissioned that burns biogas produced at a sugar processor. But further progress likely depends upon development of a national plan for waste-to-energy that was being fostered by the project. The technical/economic results of the demonstrations can also help policy-makers decide on the types and levels of incentives necessary to spur investments in these applications.

United Nations Department of Economic and Social Affairs (UNDESA)

Title: China Green Lights Programme

Abstract

This case study describes an ambitious social engineering project aimed at transformation of the inefficient lighting market in China. Its goals were the broader diffusion of high quality, compact fluorescent lamps (CFLs) in the Chinese market and their wide-scale application in the public, residential and commercial sectors. It accomplished these goals through a series of activities that pushed technological improvement on the part of manufacturers and that spurred consumer demand for efficient lighting products. A number of policy incentives and market-based mechanisms were employed to further both sets of activities. It was highly successful in overcoming a number of barriers, including: poor public perceptions, high product cost and low product quality, lack of effective market mechanisms and lack of both product quality and performance standards.

Key issue addressed

This case study describes the effectiveness of energy standards for lighting products as a means of realizing energy efficiency gains in the commercial and residential markets.

Country profile

Lighting accounts for more than 10% of the electricity consumption in China. The demand for electricity due to lighting has grown at a rate of 15% per year since 1990. This growth is expected to continue as the economy expands and people's living standards improve.

Lighting systems in China are generally very inefficient resulting in considerable waste of electricity. Table 1 shows that the least efficient lighting source, ordinary incandescent lamps, remains the major output of the Chinese lighting industry. Improved lighting efficiency could result in significant energy savings in China. For example, if 300 million compact florescent lamps (CFLs) are used to replace incandescent lamps in the year 2000, then 15 GW of new electric generating capacity will be avoided, representing 30Twh of electricity savings in that year. This would result in financial savings of approximately 60 billion renminbi in avoided powerplant construction. In addition, the use of efficient lighting systems would considerably reduce sulfur dioxide, nitrogen oxides, particulate matter and carbon dioxide emissions. The avoidance of 15 GW of new capacity will result in a reduction in carbon emissions of approximately 8 million tons per year.

In light of these problems and the potential environmental benefits to be gained, the State Economic and Trade Commission (SETC) launched the China National Green Lights Programme in October 1996. UNDP then formulated this project to support that initiative.

Sustainable development issue addressed

The introduction of energy efficient lighting in China faced a number of barriers that may be common to other countries. It was highly successful in overcoming a number of these barriers, including: poor public perceptions, high product cost and low product quality, lack of effective market mechanisms and lack of both product quality and performance standards.

Objectives:

- to increase consumer awareness of benefits of efficient lighting
- to develop market-based mechanisms to increase demand for green lights
- to develop quality control and performance standards for efficient lighting products
- to develop strategies for Government financial support to green light manufacturing

Implementation

Energy efficiency standards program.

This was recognized as an important area of intervention by the project due to the wide range of efficiency and reliability among the "efficient" lighting products available in the Chinese market. Project activities were responsible for financing two annual surveys of manufacturing plants that evaluated manufacturing production capabilities. The financing of these surveys by the project was deemed critical to the establishment of closer working relations with manufacturers, which then led to provision of technical advice on how to improve products. The project strengthened the capacity of the government for testing and certification of lighting products by procuring new measuring equipment required to replace outdated equipment and by sending officials on study tours abroad to review international experiences. The project also provided training in new test protocols for efficient lighting products, as well as support to the evaluation and analysis required for the setting of the new standards for two efficient lighting products. Project support for the market research and analysis required for the setting of standards was deemed critical to the success of that effort. To promote transparency and dialogue, workshops and seminars on the new lighting performance standards were held for all stakeholders to provide them with opportunities to provide input to the process, as well as to provide them with technical support related to compliance. Finally, the project organized workshops on performance standards, certification and quality control for manufacturers to assist them in complying with the new standards.

Consumer awareness program.

To raise consumer awareness and promote demand for energy efficient lighting products, a host of information outreach activities were launched by the project. Three international symposia and six workshops were held on the Green Lights initiative with media coverage. Two poster campaigns were carried out and two brochures on the China Green Lights Program were printed and disseminated. Articles or special issues were printed in many major newspapers and trade journals, and ten bulletins on the Progress and Status of the CGLP were published. Two television programs were produced and aired on three

broadcasts of the most important domestic television network. Finally, a catalogue of energy efficient lighting products was compiled and published to inform consumers about the variety of available products and where they can be purchased.

With co-financing from SETC and LETC offices, a range of exhibitions and demonstration activities were also undertaken. The public information campaign launched by the project has also been augmented by the manufacturing sector. Manufacturers interested in exploiting this niche of the market and wishing to enhance their reputation with consumers for producing environmentally friendly products have been waving the CGLP banner in advertisements and promotional materials.

Introduction of market mechanisms.

Various activities were undertaken to identify appropriate policy options and market-based mechanisms and to analyze their likely effectiveness. A study tour was organized to the U.S. and Japan to learn about green light programmes in those countries, with a focus on the various "carrot and stick" policy measures employed. An in-country training course on green lights policy options was conducted for government officials from the various state agencies involved in the project.

Specific market-based mechanisms implemented included:

a) *A consumer purchase rebate program.* This mechanism was employed widely with the rebate being paid for by the local electric utility. High quality CFLs are typically priced around 25 yuan per lamp in the Chinese market, and the rebate reimbursed the consumer 5-10 yuan per unit purchased. In Hunan province, large users who purchased over 1000 lamps were given an additional 10% discount. An indicator of the success of the rebate program was increased sales for those products for which rebates were offered. Chinese consumers are very cost conscious, so such a policy proved to be very convincing at the point-of-sale.
b) *Provision of soft loans.* SETC made soft loans available to manufacturers for upgrading or expansion of their CFL production facilities. They did this by paying money to reduce the interest rates of commercial loans. Y220 million was provided in soft loans and Y3.5 million in grant money. These loans catalyzed a total of approximately 300 million renminbi in investment by manufacturing enterprises. Practically all the major efficient lighting manufacturers took advantage of this program to improve and expand their factories.
c) *Incentive policies for newly constructed buildings.* Owners of new buildings in China have to pay a significant up front charge to the electric utility associated with the provision of incremental service to that building. Incentives were provided to building owners who agreed to utilize efficient lighting products throughout the building. The incentives included a reduced up front service charge and a lower tariff rate for subsequent usage.
d) *Framework of incentives and penalties.* Local governments and electric utilities developed a framework of incentives and penalties for commercial companies to encourage the use of green lighting products. In Shanxi, agreements were drawn up with major electricity users that identified enterprise-level electricity consumption targets. If the enterprises consumed electricity over the target

amount, then they were assessed some monetary penalty; if they consumed less electricity than the targeted amount, then they were given some additional credit on their next electricity bill. Similarly, other commercial enterprises were given electricity load quotas to encourage the use of efficient lighting. In this case a penalty of 3000-4000 yuan was assessed for each kW over the quota that was used.

e) *Variable tariff structure based on time of usage.* Tariff rates specific to the time of usage support green lights because lighting is required during peak load periods when the tariff is highest. CFLs reduced electricity usage and provided an economic benefit. This measure had only limited impact because billing requires the use of special meters that take into account the time of day, so this was only employed at the sites of large electricity users, such as shopping centers.
f) *Involvement of ESCOs.* In Sichuan, Shandong, Shanxi, Liaoning and Beijing, experiments with the involvement of ESCOs were made. Small enterprises did not have the resources to publicize their efficient lighting products so they used ESCOs to advertise their products. When contacted, the ESCOs provided free efficient lighting equipment to the requesting enterprise and was reimbursed with the savings that were realized on the monthly electricity bills. This mechanism was employed successfully at livestock and chicken farms and at commercial complexes.
g) *Leasing arrangements.* Manufacturers were encouraged to overcome the higher up front cost of CFLs by leasing the lights to large users, such as apartment complexes, shopping centers or farms. The manufacturers provided the lighting free of charge and then collected Y2 per month for each lamp installed. At the end of one year the lamps were completely paid for. This was employed successfully in several cases, however Chinese people are not very familiar with credit or leasing arrangements, so there was little demand for this option.
h) *Quality assurance desks.* Local governments created "Quality Assurance" desks at shopping centers where high quality CFLs were displayed. Only the most energy efficient and reliable CFLs could be sold there, so consumers came to learn which were the reputable brands. This quality assurance programme was carried out for twelve lighting products in four cities – Beijing, Shanghai, Nanjingand Zhenzhou.

Innovative financial strategies.

To support the development of appropriate strategies for the provision of financial support, technical surveys and research were carried out on domestic manufacturers of efficient lighting parts and products. A workshop was organized on financing requirements for enterprises to achieve quality assurance standards manufacture of efficient lighting products. Finally, the policy proposal on soft loans and grant financing for the CGLP was drafted and adopted by the Government (SETC).

Outcome and Impacts:

Energy efficiency standards program.

The outcome of these activities has been somewhat dramatic with a large increase in the stock of efficient lighting now available to Chinese consumers. This has clearly been as a result of the setting of performance standards for two compact fluorescent lighting products – single pin CFLs and self-ballasted CFLs. Two product safety standards were also developed. Another indicator of this successful outcome comes as a result of the findings of the annual market survey. The surveys showed that in 1998, 40% of efficient lighting products exceeded the national standard; whereas in 1999, that figure increased to 58%. A third such survey will be conducted by the Government in 2000 to continue monitoring that change. It should be noted that, although the standards are voluntary and not mandatory, they have effectively established the basis for market competition.

Introduction of market mechanisms.

The anticipated outcome of this project objective was not overly ambitious, however several interesting initiatives did arise. It should be noted that China has little experience in developing policies for market transformation and thus a cautious or step-by-step approach was preferred. Seven different policies or market-based mechanisms were implemented at the local level in several cities and provinces. The policies piloted can be characterized as both market push and market pull. Some initiatives were extremely successful, others moderately so, and a few had only limited impact.

Consumer awareness program.

The principal outcome of this program is that consumer awareness of the Green Lights Program and demand for energy efficient lighting products has risen markedly. Two indicators of this awareness are the broad spectrum of retailers that carry efficient lighting products and the strong growth in sales of such products. Green lighting products can now be found in all major department stores, shopping centers and retail lighting outlets. Domestic sales of compact fluorescent lamps leaped from 27 million units in 1995 to 80 million units in 1998. The total production of CFLs was substantially greater taking into account exports; for 1995 66 million units were produced, while in 1998 that number grew to 180 million units.

After the project was completed, a survey was conducted in four major cities to gauge consumer awareness of the CGLP. Sixty per cent of those surveyed knew of the CGLP and understood its benefits. Among those surveyed in the industrial and commercial sectors, that figure rose to 75%. Information on the utilization of efficient lighting products in the four cities is shown below.

Percentage of Utilization of Green Lighting Products in Four Cities
1998

	Congqing	Nanjing	Harbin	Guangzhou
Government buildings	17.3	90.0	26.7	n.a.

Schools	23.5	95.0	27.5	21.5
Hospitals	48.0	90.0	60.7	33.2
Hotels	65.6	64.5	31.1	44.6
Restaurants	n.a.	n.a.	58.8	n.a.
Households	88.0	85.0	29.2	n.a.

n.a. = not available

Source: Beijing Energy Conservation Centre

Innovative Financial Strategies.

The outcome of this program is that government soft loans and grants have catalyzed significant investment on the part of manufacturers for expansion of efficient lighting manufacturing facilities. Manufacturers stated that the financing became available at the time when their businesses were growing rapidly due to increasing sales of compact florescent lights. The amount of soft loans disbursed to date was Y220 million, while the amount of grant money provided was Y3.5 million. These loans catalyzed a total of approximately 300 million renminbi in investment by manufacturing enterprises. Practically all large efficient lighting manufacturers have participated in the financing program. The key project output responsible for this outcome was the innovative stategy on financing for CGLP. The targeted enterprises were those already producing efficient products that wanted to expand their facilities, and those wishing to upgrade their production facilities to produce lighting products that meet the new performance standards.

Suggestions for increased impact:

a) Labels are an important means of providing information to consumers at the point of sale, allowing them to make an informed choice among different products. It was therefore unfortunate that the labeling activities of the project did not proceed as envisioned. The label could be either informational or endorsement in nature. An informational label could provide consumers with key performance indices, such as product lifetime, lumen output, color rendering and power factor. An endorsement label would identify those lighting products that meet certain performance standards with regard to the above-mentioned indices. The endorsement label allows consumers to quickly identify the best lighting products available and should be reserved for, say, the top 25% performing products.

b) The four standards for safety and performance established for green lighting products have had a marked impact on the availability of efficient lamps in the market. It should be noted, however, that the performance standards are voluntary and not mandatory. A mandatory standard is always more effective and would have had considerably more impact. In addition, mandatory standards then set the stage for product labeling schemes as described in the above paragraph. Mandatory energy efficiency standards also allow for enforcement schemes, and these should be rigorous.

c) One market mechanism that would have been very useful to pilot is a government mass purchase programme for CFLs and other fluorescent lighting products. Government mass purchase programmes have been shown to be powerful tools for market transformation in North America and Europe. Governments are typically the largest

buyers of a variety of products, including light bulbs. Large users such as governments typically pay lower prices and get better warranties. By incorporating technical specifications into the bid document, such programs could ensure a certain quality level of product – creating a level playing field for competing manufacturers. This would address the problem of competition based on price alone, which generally tends to result in lower quality products winning the bid competition.

d) The information campaign appears to have been successful. Its impact might have been greater if a professional market research study had been undertaken at the outset of the project. There is a strong need for better market data on the sales and use of lighting technologies by market segment, as well as better information on how lighting design and purchasing decisions are made. This information would have helped to optimize the efforts of the information campaign. For example, such a study might have better characterized the awareness, attitudes and perceptions of consumers in the various lighting end-use sectors – public, commercial and residential. This might have more clearly identified specific attitudinal or usage barriers and allowed the information campaigns to better target those barriers.

Program status

The multiple impacts and positive outcomes of the project convinced the Government and donors that this type of interventions deserves further support. As a result, a large UNDP/GEF technical assistance project is being formulated to support expansion of the China National Green Lights Program.

Replicability

While development conditions and institutional structures vary from country to country, energy efficiency standards have been shown to be one of the most cost-effective means to achieve energy efficiency gains and green house gas reductions.

Lessons learned

In evaluating the lessons learned from this UNDP project, key participants -- both implementers and beneficiaries -- were interviewed. The points that arose could well be considered a discussion of the value of project-based interventions to national programmes.

Technological advancement.

The main lesson learned is that appropriate technology push policies can result in technological advancement arising from domestic enterprises. An example of this was the setting of energy efficiency standards for CFLs. The manufacturing enterprises involved in the green lights programme felt that the most important impact of the project was the setting of the energy efficiency standards for the electric lamps. This forced them to upgrade their products, which they would not otherwise have done. The manufacturers acknowledged that meeting the standards put them under a lot of pressure, but they now recognize the great value to their company that the improved product provides.

Promoting innovation

The project promoted innovation in several ways. The provision of international expertise and study tours which promote the exchange of experiences in other countries were viewed as catalysts to such innovation. For example, the report of the workshop on policy options held under the project provided new ideas and concepts, based upon which policies were later piloted. The range of innovative market mechanisms piloted included a) a consumer purchase rebate program, b) provision of soft loans to manufacturers, c) incentive policies for newly constructed buildings to use green lighting products, d) quality assurance desks at shopping centers for reputable brands, e) variable tariff structures based on time of usage, f) involvement of ESCOs, and g) provision of leasing arrangements for efficient lighting products.

Stakeholder buy-in and coordination

It has previously been mentioned that this was a social engineering project that required the collaboration of a host of government agencies. The project was implemented very effectively by the Beijing Energy Conservation Center (BECon). According to BECon, the principal value of the project was that its activities were responsible for bringing all the stakeholders together, ensuring their buy-in, and redirecting the priorities of the stakeholder organizations so that they all focused on the CNGLP at the same time. Otherwise each institution would have pursued the Green Lights Programme in its own way and in its own time.

Creating programme momentum

The project played a significant role in building momentum within the CNGLP. This project was launched almost simultaneously with the China National Green Lights Program. Coming on-line at the inception of that program, it was in a position to provide inputs at a critical time. Several project participants stated that the workshops, seminars and exhibitions organized under the project had the effect of mobilizing the national stakeholders and creating a critical momentum at the outset of the national program, which the program was then able to maintain.

Public outreach, information campaigns and exhibitions

The public information campaign undertaken by the project had a significant impact on market transformation. The manufacturing enterprises producing efficient lighting products stated that the public information campaign launched under the project had a significant impact on their business. On the one hand consumers gained more confidence in the new products and the result was seen in rapidly growing sales of compact fluorescent lights. In addition, the reputation and image of the enterprises were enhanced because consumers now viewed them as supporting environmental improvement, which is very important to the Chinese population, in general.

Capacity building

This project had important capacity building activities, particularly with respect to standard setting, testing & certification, and modification of manufacturing production for quality control. In general, the results of project-based capacity building efforts are most evident in increased program momentum, stronger technical leadership, better-formed policy initiatives, and increased innovation.

Further information

The project was implemented by the Beijing Energy Conservation Centre (BECon). For further information contact:
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Table 1. Industrial Output of Lighting Products in China
(million units)

		1995		1996		1997		
		Output	Export	Output	Export	Output	Export	Output
Output		5500	453	6395	618	6033	536	5608
ary bulb		2900	150	3413	142	3053	98	2624
pressure bulb		340		338		304		300
escent Lamps	Total output	410	39	414	70	493	80	684
which:	T8	18		50		70		84
	T9-12	328		364		423		336
	CFL	66	39	120	70	150	80	180
	T5							
al Lamps	Total output	1850	264	2230	405.8	2184	358	2000
which:	High pressure mercury	11	3	15	5	17	7	19
	High pressure sodium	3.7	0.3	4	0.5	5.1	0.8	5.9
	Metal halide	0.9	0.2	1.2	0.3	1.31	0.4	1.5
	Halide-tungsten	278	180	300	300	350	230	400
	Lamps for vehicles	666	80	650	100	650	120	650
onic ballast		10	21	15	5	20	8	25
etic ballast		120	40	130	45	140	45	150

e: Beijing Energy Conservation Centre

Title: Development of Coalbed Methane Resources in China

Abstract

In the 1990s, the United Nations system (UNDP and UNDESA) utilized GEF resources to assist China in its efforts to recover and develop coalbed methane (CBM) resources as a means of mitigating environmental pollution and providing a new and cleaner energy source. The project transferred advanced fossil fuel technologies and worked with government planners to establish a policy framework to support this new industry. Investment promotion activities succeeded in attracting substantial private sector investment.

Key issue addressed

The case study describes the transfer of advanced technologies to China for the recovery and utilization of coal bed methane resources. It also describes related investment promotion activities that have succeeded in replicating coal bed methane development across the country.

Country profile

China, as the largest coal producing country in the world, is also a leading emitter of methane from coal seams, venting 4.4 billion m^3 to the atmosphere or 1/3 of the world's total. Methane is a major greenhouse gas, second in global impact only to carbon dioxide (CO_2). As a greenhouse gas, it is over 20 times more reactive than CO_2 on a mass basis. In addition, it tends to increase tropospheric ozone and smog formation, and may contribute to stratospheric ozone depletion. However, if captured and used to displace coal, it can reduce greenhouse gas emissions, improve the safety and productivity of coal mines, produce revenues, and provide an important new energy source for China.

Objectives

The project was initiated in 1992 against two settings: a) China was intensifying its efforts for rapid economic and social development which required more coal-based energy production and caused serious atmospheric pollution; and b) after UNCED in Rio, the international community was very concerned about global environmental issues including climate change associated with greenhouse gas emissions. The main objective of the project, therefore, was to reduce methane emissions by developing the capacity for China to effectively capture and utilize coalbed methane.

Sustainable development issue addressed

The transfer of advanced fossil fuel technologies for CBM development in China faced a number of barriers, including:

1. Coalbed methane was seen to be only a nuisance; it created hazards in the coal mines.
2. The CBM that was produced and utilized was used primarily for CMA employees for residential cooking.
3. Industry, which accounted for 90% of natural gas and 75% of all energy consumption, used a very small proportion of CBM.
4. CBM recovery, exploration and production technologies were lacking.
5. Government policies did not support recovery and use, specifically:
   - the environmental problems created by methane release to the atmosphere were not understood or considered in decision-making;
   - the comprehensive benefits of CBM were not recognized by the concerned Chinese departments;
   - funding for methane recovery systems was derived from mine safety budgets, not energy supply and environment protection budgets;
   - methane drainage was considered to be a cost of coal production, not as a source of additional revenue;
   - mines received no credit for CBM recovery, therefore, there was no incentive to recover the methane (except for safety reasons);
   - since the price of CBM was held below market value and below production costs, capital formation for CBM projects was difficult;
   - China lacked technologies and techniques for producing CBM, especially for coal seams with low permeability, therefore, very little recovery occurred for these coals that represent 70% of China's coal resources.

Implementation

To address those barriers, the project was designed to work on three frontiers:

1. Strengthening the technical capacity of national experts. Extensive training addressed CBM resource assessment, as well as analysis of technical, economic and environmental feasibility of CBM development. The China Coal Research Institute, as a national focal point, carried out a series of activities including: organized training, through either overseas study tours or domestic workshops, for over 40 senior geologists and engineers; conducted, using a set of testing instruments provided by the project, CBM resource assessment over 17 coal basins; and formulated a work manual on CBM resource assessment technologies and procedures.

2. Demonstrating the technical and economic viability of advanced technologies for CBM recovery and utilization. The project selected three coal mines as pilot sites to demonstrate and transfer technologies required for CBM development, including: vertical drilling in advance of mining operation at Kailuan, gob well drilling for maximized methane collection at Tiefa, and long hole in-seam drilling at Songzao.

3. Enhancing the awareness of government agencies and coal/natural gas industries about the environmental impact of CBM emissions, and the benefits, once captured and used, to mining safety, energy supply and environmental protection. The project exposed decision-makers in government and industry to international best practices related to appropriate policy and economic instruments, and institutional structure. A few policy studies identified the existing institutional constraints to the development and utilization of CBM and suggested corresponding recommendations.

Outcome and Impacts

The project started in mid-1992 and concluded in late 1998. The development of coalbed methane has far exceeded the expectations of the Project Document. The climate for significant growth in energy supply, environmental protection, miner safety, and technology development is much improved over the situation at the beginning of the project. Specifically the accomplishments of the project can be summarized as follows:

- CBM is now a national priority in China; production goals, incentives and strong support for CBM capture and utilization can be found in China's Eighth and Ninth Five-Year Plans and in many environmental, energy and policy speeches and papers presented by senior Chinese officials. This strong interest in CBM recovery and use has been tranmitted to universities where advanced curriculum is now being offered in CBM development.

- Methane release from coal mining operations is recognized by senior Chinese officials as an environmental issue of local and global importance. This is reflected in government documents as well as the country communication to UNFCCC. Natural gas and coal mine industries view CBM development as a triple-win scenario with respect to the environment, mining safety and new energy resources and they are pursuing an ambitious development plan to recover and utilize 10 billion cubic meters by 2010. A fledging CBM industry has been created, attracting significant domestic and foreign investment.

- The China United Coalbed Methane Corporation (CUCBM) was created in 1997 by the Central Government and given authority and position within China to direct the national CBM program. That completely changed the situation where three ministries (Coal Industry, Geology & Mineral Resource, and Oil & Natural Gas) shared the responsibility, which had resulted in the lack of overall planning, coordination and investment. Based on its studies and CBM development programmes, CUCBM has proposed, for the Government's consideration and adoption, planning targets, supportive policies, regulations and incentives.

- Coalbed methane production and utilization has increased with the project participants leading the way. As a direct result of the project, over 47 million m^3 were utilized in the three pilot mining communities and some 24 million m^3 CO2 were reduced by the substitution of methane for coal in combustion process. Significantly more benefits are likely as the knowledge gained from the project spreads and plans to expand the capture and utilization of CBM are implemented. For example, in Tiefa, the utilization of an additional 35 million m^3/year of CBM will be utilized in a project in the next few years.

- Air quality in the mining towns that have participated in the project has improved as CBM has been substituted for coal and coal-derived gas especially for cooking. Other uses for the CBM in traditional coal applications have also been demonstrated.

- The full range of advanced CBM recovery technologies have been demonstrated, and have resulted in increased and more economic production. For instance, the pre-mining vertical drilling technology, first introduced at Kailuan, is being widely used in CBM exploration and development. A team of international experts reviewed the assessment reports and manual produced by China Coal Mining Research Institute and regarded them as being of high quality.
- Safety in the coal mines employing the advanced technologies has improved dramatically while the demand for electricity for air ventilation systems has declined substantially. At Tiefa, gas explosions in the coal mine have been completely eliminated (down from an average of 5 per year) and electric power demand was reduced by 50% for coal mine ventilation, saving 300,000 Yuan/year; at Songzao, explosion accidents were cut by ½and electricity consumption was reduced by 20% in the last year of the project.

Replicability

The culminating event of the project was the success of the *United Nations Investment Promotion Seminar on Coalbed Methane Development in China* held in December 1998. The meeting brought together those senior policy makers in China with a role in advancing CBM and all of the foreigners currently interested in CBM development in China. The seminar was unique in that it afforded significant frank and open discussion and debate on the most serious issues impeding wide-scale CBM production using foreign investment. The proceedings of the seminar were of value in assisting the appropriate Chinese policy-makers to create policies conducive for attracting foreign investment in China.

As a result of the meeting and other project activities, CBM development and utilization became a hot spot for joint venture and foreign investment within the framework of China's environment protection and energy development. Between 1998 and 2000, over ten international oil and gas companies have worked with CUCBM on CBM joint ventures. Contracts amounting to over US$ 500 million have been signed and, at present, US$80 million has been utilized.

Lessons learned

The emphasis of all project activities was to use market forces to achieve sufficient momentum toward the establishment of a new industry that is responsive to the need for environmentally sound energy supplies. The implementation of the project has proven that not only is the activity sustainable, but interest is burgeoning into commercial ventures that are market driven. The technical results are attracting investment capital that can make these demonstration projects truly profitable ventures. The objectives of a clean burning energy source, reduction of greenhouse emissions, and improved coal mine production and safety have all been realized.

The project assigned high priority to two cross cutting issues: capacity building and investment promotion. Capacity has been built to allow for continued expansion and improvement of China's CBM industry on a commercial basis after the completion of the project. Training programs and demonstration activities focused on advanced CBM sampling, testing, and drilling technologies under Chinese conditions. The result is that the capacity has been developed for China to move forward on its own to commercially develop its CBM industry.

The project had great impact on the form of a CBM industry in China. First, it was influential in building Chinese awareness to CBM, and creation of policy measures and incentives needed to develop the industry. Second, it greatly strongly supported the creation of China United Coalbed Methane Corporation, an organization found to be critical to foreigners seeking to participate in China's CBM industry. Thirdly, the project was instrumental to the formulation and promulgation of regulations, tax reduction/ exemption incentives that are attracting domestic and foreign developers.

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United Nations Development Program (UNDP)

Title: Nepal rural energy development programme

Case Studies On Sustainable Energy And Climate Change Prepared by the UNDP Bureau for Development Policy

This article is based on a case study developed for a UNDP regional programme entitled *Energy and Women: Generating Opportunities for Development*, and REDP website http://www.redp.org.np/redp/.

Abstract

The Government of Nepal has focused on poverty alleviation in its current Ninth Five Year Plan. For achieving this goal, the government has formulated different policies including one on the promotion of renewable energy systems for the development of rural areas. The Rural Energy Development Programme (REDP) is based on this development plan emphasizing enhancement of rural economies by mainstreaming issues of women and utilizing renewable energy systems. This UNDP-supported programme aims to enhance rural livelihoods and preserve the environment by supporting micro-hydropower, biogas, and photovoltaics as an entry point for sustainable rural energy systems development. REDP supports the government in: (1) institutionalization of a rural energy development agency and formulation of policies; (2) capacity building at the district level to plan and manage rural energy systems; and (3) mobilization of community organizations and private entrepreneurs to plan, implement and operate rural energy systems. The programme uses decentralized management with emphasis on community organizations or private entrepreneurs to manage rural energy development. The guidance for community-managed efforts is provided from the district level with the involvement of the district and village agencies, private sector organizations, and NGOs. The development of micro-hydropower development with the effective utilization of water resources and, hence, its linkage with irrigation, water supply, sanitation, agriculture, natural resources (biomass coverage) and cottage industries has been the primary focus, however other renewable energy systems are now included in the programme..

Key issues addressed

This project addresses the issues of renewable energy, rural energy, capacity building, and mobilization of financial resources, and accessibility of energy. Using a decentralized approach, this project has been successful in using micro-hydropower and other renewable energy technologies to provide power to rural areas of Nepal that have no grid connection. Built into this project are the necessary institutional frameworks to promote policies for rural energy development.

Country Profile

Location- Rural villages of Nepal that are not connected to the country's central electricity grid are the focus of this programme.

Project Area Profile- Nepal's social and economic indicators are amongst the worst for a South Asian nation. Social development indicators such as access to sanitation (Nepal: 9 %; Bangladesh: 30%) and access to safe drinking water (Nepal: 48%; India: 63%) lag behind other South Asian neighbours. Eighty per cent of its population of 22.8 million (1998 estimates) resides in rural villages and is dependent on agriculture for their livelihood. Agricultural land is scarce and fragile and the pressure of a growing population has resulted in the benefits of better education or irrigation being outweighed by more fragmented land holdings, reduced availability of fodder, biomass and firewood.

Though the country has the potential of generating 43,000 MW hydropower, only 319 MW has been developed thus far. Nepal's electricity consumption is amongst the lowest in the world with only 13 per cent of the population having electric lighting in their homes. In rural areas, of the country less than 5 per cent of the population has access to electricity.

Sustainable development issue that was addressed in the case study

The primary development objectives of REDP are to provide energy for reducing drudgery (especially for women), conserving and utilizing resources, generating employment and increasing income. One of the major activities of REDP is to link up rural energy planning with the participatory village and district planning and development process. This involves building of institutional frameworks to promote policies for rural energy development.

Objectives

The key mandate of the REDP is to integrate sustainable rural energy development in Nepal. Through the promotion of renewable energy systems as its entry point, the programme aims to achieve improvements in the living standards of rural people where possibilities of commercial energy supply do not exist. Specifically, it aims to:

- Promote energy efficient end-use technologies;
- Improve the quality of life of the villagers, especially for women and children;
- Restore the natural environment; and
- Build rural capacity in rural energy service delivery.

Implementation

The approach taken with the REDP in Nepal stresses community mobilization, bottom-up participatory planning and decentralized decision-making in dispersed rural communities for sustainable energy development. In implementing projects, community organizations are used to organize the community, enhance the skills of the local people, mobilize capital, introduce the technology, empower women, and manage the local environment. An alternative approach involves direct investment by entrepreneurs. Technical services and assistance to the entrepreneurs to gain access to the credit schemes of commercial banks, including the Agricultural Development Bank are utilized in this approach. The financial resources for implementing an energy project are the responsibility of the

community or the entrepreneur. Investment can be from the community or the entrepreneur themselves, local governments, the national government in the form of subsidies that it provides for micro-hydropower, solar and biogas projects, bank loans, and donor agencies.

A necessary step in the implementation is a study of the feasibility of a selected energy scheme in terms of its output capacity, necessary design features and cost estimates. Since all subsequent stages of implementation of the schemes notably fund mobilization and construction will be based on the results of this study, it is important that this study be carried out with care.

The next stage involves installation of the equipment which includes:

1. Preparation of a work plan: This plan takes into account the equipment manufacturers fabrication schedule, the seasonal farming work load of the community members, the seasons specially monsoon and any other factor that is identified as being crucial to plan beforehand. Procurement and ordering of non-local materials as well as collecting local materials is the next step.
2. Construction and Installation: This phase is the most intense phase and requires maximum technical support from outside. The construction requires the close supervision of at least an overseer level staff with experience in sustainable energy technologies.
3. Commissioning: This is the last phase to get the system fully operational. The community or entrepreneur must ensure that the operators selected for the schemes are fully involved during the installation and commissioning stages so that they are fully aware of all possible problems that may come up later.

The sustainability and success of an energy project will depend on how effective its operation and maintenance is. This concept has been incorporated into the REDP in Nepal. Therefore, effective operation and maintenance will result in reduced down time and repair cost of the plant. This, in turn will allow for a lower tariff rate which the community members can pay and thus ensure timely collection of tariff which will be sufficient to pay the expenses required to run the plant effectively and make provisions for future maintenance and expansion.

The organizational structure for the REDP is quite innovative because of the involvement at both the district and community levels. At the District level, a District Energy Committee (DEC) is established under the umbrella of the District Development Committee (DDC), and both committees are headed by the chairman of the DDC. The DDC is responsible for establishing the District Energy Fund as well as being responsible for the promotion of natural resource management. The District offices promote rural energy planning and carry out district plans in the communities. With help from the Support Organisations (SO), the village members take their own initiative in forming male and female Community Organisations (COs) to tackle the identification, planning, implementation and management of energy systems. Special functional groups (both male and female) (FGs) are formed to carry out specific activities when needed and

consist of members of the COs, including micro-hydropower function Groups (MHFG). Other Functional groups deal with forestry and soil and water conservation.

Outcome and Impacts

Since its initiation in 1996, REDP has either commissioned or is constructing 64 micro-power demonstration schemes in 15 remote and hilly districts of Nepal. The micro-hydropower plants range from 7 kW to 42 kW. By end of June 2000, 31 micro-hydropower demonstration schemes generating about 527 kW benefiting 4,349 had already been installed. Different energy technologies, such as solar photovoltaics, biogas and improved cook-stoves have also been introduced by this programme. Thus far, 704 solar photovoltaic systems, 487 biogas plants, and 3,440 improved cookstoves have been installed by the programme. The technologies have either increased productivity or reduced drudgery of the men, women and children, as well as been beneficial for the environment. Energy end-uses realized through the REDP include rural bakeries, broilers for chicken, agro-processing mills, and saw mills. Beneficiaries have initiated income generating activities such as incense stick making, photo studio, thanka painting (Buddhist paintings) and cardamom farming.

The linkages established by REDP extend from the village to the district, amongst the participating districts, to the central planning and development agencies and extend even beyond the boundaries of Nepal. The wider perspective adopted by the programme aims at not only networking but also at creating wider acceptability of the programme's paradigm and augmenting its funding through other sources. Besides the resources of the community, the programme has mobilized resources from the District Development Committees (DDC), the Agricultural Development Bank of Nepal, and from the government. More than Rs. 129 million had been mobilized, out of which only 42 percent of the cost is REDP's contribution (by providing 50 percent grants in non-local costs), followed by 22 per cent contribution by the Government as subsidy for electrical equipment and poles, 14 percent from voluntary labour from the community, and 11 percent of the costs covered by loans. The funding made available from the district (4%) and village (10%) is in the form of investments which have to be returned once the plants start making a profit. The community's contribution in cash has been calculated to be Rs. 1,288 per household (1US$ = Rs. 74). The guidelines explaining the project design and management details, entitled District Energy Planning and Implementation Guidelines, have been published by REDP, and would be useful for rural energy planners and developers (see contact information below).

Project/Programme Status

This programme is still ongoing, and the success of the programme has not only meant expansion to an additional five districts within a short time frame of four years, it has also meant national and international recognition. REDP was awarded the Energy Global Award 2000 at Linz, Austria in March 2000. REDP was placed second in the public investment category among the 900 projects and initiatives participating in the contest. The Energy Globe Award is an awards for sustainable energy solutions and honours

successful projects and initiatives around the world in the field of energy efficiency and renewable energy sources. REDP is also being featured at the EXPO 2000 in Hanover, Germany since June 2000 as one of the best projects in the world.

Replicability

With the promotion of sustainable energy systems, the pace of development of rural areas can be geared up. Thus, REDP can accelerate the development process of rural areas. The institutionalization of the sustainable energy systems development at the district level will have long term impacts on economic and social development, including poverty alleviation.

Lessons Learned

REDP has proven that energy needed for the transformation of the rural society can be produced through the local efforts with little assistance from outside. The programme has demonstrated that capital can be mobilized through saving and credit schemes at the local level. Similarly it has also emphasized the importance of building capacity among the local people leading to the successful establishment of sustainable energy systems in their villages.

This programme has also proven that rural energy systems can be an effective entry point for alleviating poverty through the community mobilization process. Another important lesson learned from the programme is that as women are both consumers and managers of rural energy sources, adaptation of any rural energy technology has a direct positive impact on women's lives.

Further Information

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Title: Advanced Biomass Project in Jilin, China

This article is based on a UNDP project document for *Modernized Biomass Energy in China: Jilin*, and consultants' mission reports.

Abstract

In densely populated countries that are largely self-sufficient in food production and are prolific generators of crop residue, gasification of crop residues can provide an attractive means to providing both clean cooking fuels (heat) and electricity (power), or combined heat and power (CHP). In March 2000, a UNDP-supported project was launched to demonstrate CHP systems based on agricultural residues in the Jilin Province, China, with replication potential to rural areas in other developing countries. The project involves establishing the human and technical capacity to design, install, and operate CHP both domestically and abroad; providing technical innovations related to gas production and systems automation; demonstrating the capability of a CHP system to provide heat, cooking gas and electricity in a village in Jilin; and disseminating results and experiences in China and abroad.

Key issue addressed

This project deals with the issues of renewable energy, rural energy, capacity building, technology transfer, and mobilization of financial resources. As this project is implemented, it will demonstrate the use of modernized biomass system which will support local economic growth and development, as well as protection of the local environment. By using the most advanced technologies and building capacity on the installation, operation, and maintenance of the system, it will be possible for Jilin to be a leader in the dissemination of the technology to other parts of China and abroad. A key aspect of this project is the formulation of the necessary policies and regulations to allow for utility purchase of the electricity using means that will support the adoption of renewable energy systems.

Country Profile

Location- Hechengli village in Longjing City, Jilin Province, China, is the site of the advanced biomass project. Hechengli village consists of 224 households and 5 major village industries (fertilizer factory, poultry breeding, and beverage processing, fish farms and village offices). The farmers currently use firewood, coal, stalk and LPG as fuels and the annual consumption of energy for the village, is 512.833 tce/year. The electricity consumption is 24.6 tce/year.

Project Area Profile- In China, as in other developing countries, the availability of rural energy services is essential to support local growth and development. Agricultural residues are the chief source of fuel for rural heating and cooking and are used most often in low efficiency stoves. Jilin province is a main source of grains and corn in China, and the annual grain output reached 20 million tons in 1997, the highest on a per capita basis

in China. Jilin Province accounts for 14% of total Chinese corn production but only 2% of China's population which numbers 26 million for the province.

A growing concern in Jilin Province is that as farm incomes rise, the pollution problems associated with cooking and heating are exacerbated. The new pollution problems are arising as a result of the fact that as farmers get richer, they are becoming less willing to gather biomass residues from the field and store them for cooking and heating use throughout the year. Farmers prefer coal briquettes instead if they can afford to buy them. However, coal briquette stoves tend to be even more polluting than biomass stoves. Gaseous cooking fuels can be used far more efficiently and conveniently than solid fuels, while also emitting far fewer toxic pollutants.

In China it is reported that there are about 70 million peasants who have no chance to use electricity. There is rising demand for increased electricity services for both household consumption and to support rural industry development. With continuing market reform and utility restructuring in China, decentralized power generation and distribution will gradually become possible for economically viable technologies and approaches. Furthermore, the large abundance of agricultural residues in Jilin province offers the potential to combine electricity generation along with the provision of cooking and heating services through a combined heat and power application of biomass gasification technology.

Sustainable development issue that was addressed in the case study

Modern biomass-based power in Jilin would increase living standards and would be helpful in promoting rural industrialization and the creation of new jobs in rural areas, which would help stem unsustainable urban migration. The inefficient biomass stoves that are now used for cooking and heating in rural areas of developing countries account for nearly 60% of total human exposure to particulate air pollution worldwide in the form of indoor air pollution creating serious human health problems—especially for women and children. Finally, since the use of biomass provided sustainably leads to no net increase in CO_2 emissions, there would be climate benefits arising from the widespread use of biomass for power generation. This benefit is increased further in cases where modernized biomass displaces coal for home heating and cooking.

Objectives

Through the use of combined heat and power generation, this project hopes to create both the technical and economic basis for the sustainable replication of biomass gasification systems based primarily on market mechanisms. The long-term goal of this project is the widespread use of gasified biomass to meet the cooking, heating and electricity needs of rural communities not only in China, but also in other developing countries.

Several near-term objectives have been identified for this project, which meet important social, technical and environmental needs. These can be summarized as:

- Improving local environmental conditions. By providing a clean fuel for heating and cooking the project will reduce indoor air pollution and its associated health impacts on women, and by reducing field burning of excess agricultural residues the project will reduce outdoor air pollution. Both these actions will help reduce respiratory disease, which is leading cause of death in China.
- Enhancing living standards. By improving heating and cooking methods, the project will create free time, especially for women, which the rural families can devote to education, income generation and recreation.
- Enhancing local commerce. By converting agricultural residues, which are currently a waste material, into a valuable commodity, the project will generate revenues and pay villagers for collecting and delivering residues. This will create value-added activities in the rural areas and benefit the less well-to-do portion of the population.
- Utilizing a renewable resource. By generating electricity through utilization of a renewable resource, this project will provide global environmental benefits by displacing coal (and the resulting CO2 emissions) from conventional power plants.
- Training Chinese experts and officials. If this project is to be replicated, a strong economic and institutional basis must be established beyond just proving the technology. In this regard, the project incorporates multiple training workshops to familiarize Chinese experts and officials with the technical, financial, business management and institutional issue surrounding combined heat and power systems.
- Identifying supportive policies and regulations. The project will work cooperatively with other related activities in China to support policies and regulations that will promote project replication. In general, these will include policies to promote utility purchase of renewable generated electricity, such as the Renewable Portfolio Standard, and the promotion of Rural Energy Concessions that encourage local entrepreneurs to provide rural energy services. Of particular importance to this project are the institutional and financial arrangements for this project to sell electricity to the grid.

Implementation

The project is in its initial stages, however a detailed workplan has been formulated to see the project through its completion in 3 years. There are four components to the project:

1. Capacity building

    - Familiarizing Chinese local officials and technical experts with CHP general strategies, technical approaches and development objectives related to sustainable energy, local development, environmental protection and improved social conditions.
    - Developing a local institutional and market assessment of gas and electricity distribution options. This included a review of existing energy use patterns for heating and cooking in rural Jilin and a policy and institutional review of regulations, roles and resources, and a market study to determine minimum thresholds (mechanical and economic) to reach financially viable village CHP.

- Establishing local institutional mechanisms for operations and management of electricity and gas distribution system at the demonstration site. This involves the creation of the appropriate enabling environment for the demonstration site and biomass utilization.
- Developing a business plan for replication/dissemination of CHP system approach more broadly in China to achieve economies of scales. In addition, a commercialization and enterprise strategy will be developed for a new CHP industry to consider industry development options when aggregating demand. This "scaling-up" strategy will include investment costs, expected revenues and alternative organizational structures based on a jointly established research design.

2. Improving producer gas production

- Developing the ability to produce high quality producer gas at existing demonstration sites as a basis for more advanced CHP technology. This includes improved heat value and purity of producer gas.
- Developing the capability in Jilin to undertake dry gas storage and distribution.
- Designing the gasification system automation. This would include an evaluation of different approaches and technical training.

3. Technology demonstration of combined heat and power (CHP)

- Performing a pre-feasibility study for village scale CHP focusing on technical and economic aspects;
- Selecting and designing the CHP demonstration site. Considerations included institutional, physical, economic, social and resource issues including local demand for electricity.
- Establishing new business enterprise and mobilizing domestic capital mobilized to operate the pilot CHP demonstration site. Workshops and training planned on business management and administration.
- Preparing demonstration site and commissioning equipment. This involves preparing the technology specifications and the equipment tenders for international bids.
- CHP system functioning producing gas and electricity on trial basis. Extensive evaluation of the operation and adjustments to enhance performance.
- Gas and electricity distributed on a village scale to households and factories. There will be economic and technical evaluations of the pilot phase including gas testing, heat value, electricity and by-product outputs, consumption and cost ratios.

4. Information gathering and dissemination

- Documenting initial conditions, existing experience and rural energy use patterns in Jilin to profile pre-project conditions.
- Preparing materials describing the design and evaluation of the CHP pilot system

- Developing a comprehensive evaluation report on pilot phase experience including recommendations and conclusions on key economic, technical and institutional factors needed for CHP to function successfully at the village level
- Documenting of technical, economic, social and environmental outcomes to be distributed in China and abroad.

Outcome and Impacts

Since the project is still in its very early stages, it is only possible to state the planned outcomes and impacts of the project. The primary end result of the project will be an operational CHP demonstration site in Hechengli Village, Jilin. In addition, the project will likely result in the following:

1. Improved local environmental conditions due to the introduction of gas for indoor heating and cooking because gas combustion is cleaner and more efficient than the burning of traditional fuels

2. Established local market and collection system for post harvest agricultural residues which are to be used as an input for gas production. In other words, turning a waste product into a local economic resource.

3. Improved heating, cooking and illumination services will be available in rural homes leading to improved living standards, especially for women, and increased options for education, recreation and income generating activities for farming families.

4. Chinese technical experts and local officials will be familiar with the technological, economic and organizational aspects crucial to the successful use of CHP systems. The studies and experiences produced by this project will provide Chinese authorities with a basis for developing a broader strategy to replicate the CHP experience and the development of a new rural energy industry suited to national conditions.

6. Better understanding of the economic and institutional barriers will lead to the formulation of regulations and policies that will create the appropriate business enabling conditions for the development of modernised biomass systems. Options currently under consideration are a renewable portfolio standard, rural energy concessions, and power purchase agreements that are favorable for renewables.

Project/programme Status

This programme has been underway for 11 months and is progressing along schedule. The current status is that the regional planning commission in Jilin approved the feasibility report. The CHP equipment is planned for installation in July, 2000. A key aspect of this project will be the eventual formation of a private sector company who will take over after the 3 year demonstration and evaluation of the current project is complete. This company is currently being put together in Jilin.

Replicability

If this project is to be replicated, a strong economic and institutional basis must be established beyond just proving the technology. In that light, the project will work cooperatively with other related activities in China to support policies and regulations that will promote project replication. In general, these will include policies to promote utility purchase of renewable generated electricity, such as the Renewable Portfolio Standard, and the promotion of rural energy concessions that encourage local entrepreneurs to provide rural energy services. Of particular importance to this project are the institutional and financial arrangements for this project to sell electricity to the grid.

Lessons Learned

A key aspect of the advanced biomass gasification project in Jilin, is the evaluation of the project and dissemination of lessons learned. The distribution of the outcomes and experiences from this project will be critical to the replication and future project successes. As the projects is still at an early stage, it is not possible to provide lessons learned, however this information will be gathered as the project moves forward.

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Title: The Multifunctional platform in Mali

This article is based on a case study developed for a UNDP regional programme entitled *Energy and Women: Generating Opportunities for Development*, and Multifunctional Platform website http://www.ptfm.net

Abstract

This programme is designed to reduce poverty among rural women using a multidimensional approach that includes: promoting rural women's status; increasing their income-generating opportunities and reducing labour time, particularly unproductive labour. These objectives are achieved through the introduction of multifunctional platforms, which are built around a simple diesel engine, that can power various tools, such as a cereal mill, husker, alternator, battery charger, pump, welding and carpentry equipment, etc. It can also generate electricity and be used to distribute water.

In Mali a project is under way to introduce, by 2003, 450 multifunctional platforms to provide, at the village scale, mechanical power and electricity through diesel engines to 10 percent of the country's rural population. The project, which is supported by UNDP, is explicitly targeted at reducing poverty and achieving gender equality in villages in Mali and, through a regional project, other countries in sub-Saharian Africa. The platform employs simple and appropriate technology and is an economic, practical and sustainable solution for many of the problems faced by rural communities.

Key issue addressed

This project deals with the issues of rural energy, capacity building, mobilization of financial resources, accessibility of energy. This project demonstrated in its pilot phase that the multifunctional platform is an effective means to provide energy services for many different income earning applications that can have a dramatic impact on women's lives. Each project requires technical and financial capacity building to ensure that the local community will be able to maximize the benefits from the multifunctional platform. A large part of the project is financed by the beneficiaries, requiring them to mobilize capital for the initial investment.

Country Profile

Location- Rural villages of Mali.

Project Area Profile- Mali is one of the world's poorest countries with widespread illiteracy and a short life expectancy. It has a per capita gross national product estimated at CFAF 159,585 (approximately US$ 280) in 1996. The human development index indicators reveal a difficult socio-economic situation: life expectancy at birth, 58.5 years; health coverage (a minimum package) is available within a 15-km radius of clinics for an estimated 40 per cent of the population

Agriculture dominates Mali's economic life, providing livelihoods for more than 80% of the population. However, the constant threat of drought, fluctuating world prices for the country's main export crops, rapid demographic growth and harmful cultivation techniques are threatening the environment and creating strong pressure for rural-urban migration. Yet urban employment opportunities are scarce: the formal sector employs only 6% of the population, and the government no longer provides large numbers of public sector jobs. Between 1989 and 1994, as a result of the economic downturn and adjustment measures adopted by the government, the share of the population living in poverty increased from 40% to nearly 69%—reaching the participation of women in economic activity.

Sustainable development issue that was addressed in the case study

The primary development objectives of the Mali project are to alleviate the many aspects of poverty in rural areas, focusing on its gender dimensions. Two fundamental characteristics of rural settings in Sub Saharan Africa, illustrate the problem that is faced in Mali. One is the multiple time and human energy intensive activities of women specifically, both in agricultural or livestock production and in the productive and reproductive activities that make production possible. The other is the remote, dispersed and small scale nature of rural settlements.

Seventy percent of the women and girls are illiterate and only 37% of girls are enrolled in school. Women do not own and control land, the primary economic asset. They do not own and have little access, if any, to productive equipment and tools, including means of transport. Often, they do not form part of the information networks within and outside the village. The resources which women and girls have at their disposal to engage in productive and reproductive activities are essentially their own human energy and time. The physical arduousness of the activities and their time consuming character is complicated further by the multiplicity. Even when transport or other mechanical equipment is available in the household, they belong to and are used by men. Women have no access to them. When activities become mechanised and /or income generating, the tasks which were previously seen as women’s roles tend to be appropriated by men.

The multifunction platform has thus been designed to take into account the multiple end uses in rural economies, to substitute for human energy and to provide a decentralised energy supply. The programme aims at improving living conditions through increased production efficiency and income-generating activities, as well as improvements in the quality of life, particularly through the time and energy saved by the new technology. The programme also aims at strengthening women's capacity to manage the process of development and change, thereby increasing her social status.

Objectives

The key mandate of the multifunctional platform project in Mali is to integrate sustainable rural energy development in to the promotion of income generating activities. This is done by achieving the following:

- Providing better access of the poor to financial services and other productions factors;
- Promoting the development of agro-industries;
- Ensuring access to education and training; and
- Ensuring access of the poor to basic health needs, nutrition, drinkable water and sanitation.

Implementation

The project strategy is to provide women's associations that request the multifunctional platform with the equipment, with the capacity to sustain ownership and control of the systems, and to develop the managerial and entrepreneurial competencies needed to enhance technical and economic viability. The elements of the strategy include:

1. Flexibility, decentralisation and voluntary participation A flexible, decentralised and client-oriented approach is used. The programme's Advisory Units are established in different regions, with full management autonomy. The participation of villages in the programme is voluntary -- their financial contribution toward the purchase of the platform being proof of their engagement. The configuration of tools attached to the basic platform engine is village-specific (dependent on the needs and the capacity to manage and pay for the upkeep and amortisation of the equipment).

2. Demand-driven The project responds to expressed demand from villages for a multifunctional platform. This ensures ownership and appropriation of the platform by the villages and its autonomous management.

3. Ownership and management by women To ensure maximum benefits to women, the ownership and management of platforms is entrusted to a group of organised village women. Training and technical support are provided to build up their management capacities.

4. Value added for national resources and competencies All technical operations required by the platform are handled by the private sector (purchasing, installation, repair, and maintenance). The programme only intervenes in this area to network mechanics with villages and, in some cases, to upgrade their skills. The programme informs villages of existing financial and management support facilities in order to allow them to finance the platform.

The costs of equipment and of the installation of the basic module (e.g.: engine, mill, dehuller, alternator, battery charger, house) is about US$3,400 dollars, with 60 % financed by the beneficiaries and US$1,500 subsidised by the project. Depreciation and variable costs (maintenance, remuneration for female operators) are borne entirely by the Women Management Committee.

The approach involves implementation at three different levels.

Decentralized level

Advisory Units located in four different cities in Mali (Sikasso, Bougouni, San and Sévaré) are responsible for advising villages wanting to purchase a platform -- from the initial feasibility study to the installation and management of the platform. Their mission includes social and economic feasibility studies, assisting beneficiaries to fulfil bank loan conditions, helping women to organised themselves in groups, training managers and operators of the platform, verifying orders and installation of the platforms.

National level

At the national level a Coordination Unit monitors and evaluates the Advisory Units. It is also responsible for the overall programming, management and implementation of the programme's daily activities in the field, including financial and purchasing activities, for training activities, and for collecting and analysing data. This Unit is under the responsibility of a National Coordinator who prepares workplans and budgets and presents progress reports every three months.

Government level

At the Government level a National Director represents the Government in the programme and is accountable for its overall financial and strategic management.

Outcome and Impacts

The Platform concept was developed in Mali. After two years of a pilot phase, which has permitted the installation of 65 Platforms, the project aims to equip 450 villages. Although specific to Mali, the implementation modalities at the national level serve as a model to others countries interested in the concept. Therefore, UNDP has created a Regional Cell whose objectives are to ensure the transfer of knowledge and skills to the others countries.

The gender impact of this project has been to reduce women's work hours and to create new income streams. For example, with the ability to grind millet and pump water using the multfunction platform , work time is reduced six-fold and there is the possibility to sell water or electricity. The increase in discretionary time has allowed women to get involved in self-development and income generating activities, and to attend to family needs. Moreover, as they own and manage the village's source of energy and have acquired basic education skills, their status is improving as economic and social interactions increase around the platform, making them key actors of the community's development.

At the village level, in addition to industrialization and employment effects of installing and maintaining a platform, the availability of energy has improved access to maintenance services for agricultural implements. It has also direct effects, by connecting the health clinic and the school to the electricity network, on the availability and quality of social services provided. Medical and education personnel are more willing to work in villages where electricity and water is available; water-borne diseases are diminished and

health care, specially for children, is available even at night. Adults can attend school in the evening, after working hours and there is a greater possibility for children to attend school.

In addition, these platforms have had the following direct impacts:

- Direct ownership by the private sector, who are responsible for installing and maintaining the equipment. 19 platforms have been installed without any intervention from the project.

- Increase in time for rest, for physical recuperation, and better health (sleep time is 2.5 hours longer because water is available in the village: women no longer have to wake up at 3:30AM to fetch water).

- Increased consumption of food (when time and energy levels are depleted at harvest time, for example, women simply cannot cook food in time for work or school. Introduction of the platform frees time for food preparation)

- Increased capacity to produce (on self-owned plots and husbands' plot).

- Better health through safe water from boreholes.

- Increase in education levels (schooling of young girls who are released from time-intensive activities, training and literacy classes for women).

Project/programme Status

This programme is still ongoing, and they have set the following goals for the next phase of the project:

- By 2003, install 450 platforms

- Establish linkages with private self-funded entrepreneurs (i.e. at least 10 manufacturers and 45 technicians capable of handling all technical aspects of the platforms).

- Create increased capacity for women in rural area to manage community infrastructure and micro-enterprises (8,000 women).

- Increase income-generating activities, including oil extraction, production of shea butter, food pastes, extraction of pourgher oil and soap manufacturing.

- Increase use of pourgher oil fuel (instead of diesel) for at least 15% of the installed platforms, especially in southern of Mali.

Replicability

Although specific to Mali, the implementation modalities at the national level serve as a model to others countries interested in the concept. UNDP has created a complementary programme (Regional Cell) whose objectives are to ensure the transfer of knowledge and skills to the applicant countries. In order to promote replication of the project concept, UNDP seeks to assist development partners and projects to integrate the multifunctional platform in their activities to reinforce their impact in the field, especially in their fight against poverty affecting rural women. Secondly, the UNDP is developing a data base related to methodological, technical, financial, economic and social information on the platform in order to ensure the transfer of knowledge and skills and to disseminate the information related both to the implementation of the different national projects and to the understanding of the platform concept and approach. Interest for the platform has been expressed by several countries in Africa as well as Pakistan and Haiti. A regional hub, located in Bamako (Mali) has started working with Guinea, Senegal and Côte d'Ivoire to start pilot projects aiming at testing the platform approach in these countries

Lessons Learned

A pilot phase from 1996 to 1998, validated the socio-economic feasibility of the multifunctional platform. During the pilot phase, the programme collaborated with various partners (UNCDF, European Union, French Co-operation, international NGO's such as World Vision) with the objective of integrating multifunctional platforms into ongoing projects and programmes. The principle lessons learned during the pilot phase include:

- Importance of reinforcement of local, private mechanics for the installation and maintenance of platforms and their related equipment. In addition a consideration of the private sector's capacity to respond to the demand is critical;

- Need to adapt the platform to a variety of specific village needs and situations, including analysis of the platform's technical and economic feasibility in different village contexts;

- Need to evaluate the potential demand for and of the ownership/management capacities of village women and development of a methodology for the management; and

- Importance of defining the purchase and payment conditions of the platforms by the beneficiaries.

Further Information

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United Nations Environmental Program (UNEP)

Title: Power Sector Reform in Ghana

Abstract

The case study presents the results of a long-term collaborative effort between various government and research institutions in Ghana and the UN Environment Programme. The collaboration focused on supporting the power sector reform process in Ghana and in parallel analysing the potential environmental consequences and possible options for ensuring that the reforms result in environmental improvements.

Institutional reforms are on the agenda in many developing countries and common to most efforts is the ambition to ensure increased economic development through reforms of many of the key sectors, encouraging increased private sector involvement in areas traditionally dominated by government or parastatal companies. The power sector is seen as crucial for most countries in pursuing sustained economic growth, and significant sectoral reforms have taken place in many Latin American and Asian countries. In the last few years countries in Sub-Saharan Africa (SSA) have initiated different types of reform programmes as well. An analysis of the power sector reform process in six SSA countries show that reforms are mainly driven by the need to improve efficiency and financial performance of utilities and the desire to obtain private sector capital for necessary investments in all parts of power supply. (Turkson edit., 2000)

Key issues addressed

Sector reform programmes address a number of the key issues identified for CSD 9 and if implemented in an efficient and well managed way they will contribute significantly to:

- Accessibility of energy through ensuring adequate expansion of electricity services
- Energy efficiency by introducing competitive institutional and market structures, and focusing attention on cost based pricing
- Mobilization of financial resources by introducing market structures and regulatory frameworks that are attractive to investors.

Depending on the specific conditions governing the national reform process energy sector reform could also contribute to issues such as rural energy development, technology transfer and capacity building.

Ghana is one of the first SSA countries to initiate power sector reforms and the collaboration with UNEP has both served to support specific parts of the national activities and to extend the Ghanaian experience to other countries in the region through documenting and sharing the experiences gained. (Turkson edit., 2000)

The power sector in Ghana

Ghana is predominantly an agricultural country. The agricultural sector accounts for more than 40 % of GDP, 50% of export earnings and 70% of employment. In the industrial

sector the dominant activities are related to mining and mineral processing. A specific feature of the power sector in Ghana is the presence of the Volta Aluminium Company (VALCO) which at present consumes 45% of the power produced in Ghana and was a determining factor in the initial structuring of the sector.

Prior to the reforms of the power sector, the generation and transmission of electricity was vertically integrated in the Volta River Authority (VRA) – a state owned company established in 1961 to establish, generate and sell electricity from the power stations established as part of the Volta River Dam, construction of which was partly linked to VALCO's establishment.

VRA serviced VALCO and several large mining and industrial consumers directly from the grid and had export/import arrangements with utilities in Cote D'Ivoire and Benin/Togo. Distribution was handled through two state enterprises. The Electricity Corporation of Ghana (ECG) was initially set up to service primarily the Southern Part of the country, while the Northern Electricity Department (NED) was later established as a semi-autonomous unit under the VRA in 1987 to ensure distribution in the Northern provinces.

Motivations for Reform

With institutional reforms taking place in many countries around the world there are both some generic and some specific reasons for a country to embark on the reform processes.

Specific motivations for institutional reforms in Ghana are rooted in the general economic decline in the country in the late 1970s and early 1980s, when the country went through periods with even negative GDP growth linked with decline in industrial and agricultural output and rapid infrastructure deterioration. This led to a major structural adjustment programme in 1986, which included a number of institutional changes including those in the power sector.

As part of the programme a government policy on divestiture was put in place in the early 1990s, under which a large number of state owned companies were converted into public limited liability companies, including the ECG. This policy partly provided the legal framework for the later restructuring process.

Another major motivating factor was the renewed growth in the economy in the last decade, which lead to increased electricity demand at a time when supply and distribution were facing increasing problems and power shortages had become common.

A major factor behind the actual reforms wase the growing problem of finding financial resources for new power sector projects. Estimates show that around US$1.5 billion is required for power expansion in the coming decade and the traditional financier, the World Bank, has as a matter of policy been pushing for reforms, particularly in view of the decrease in Bank resources available for the power sector.

Finally, there is an emerging interest from new independant power generators in establishing new supply options, provided the transmission, distribution and pricing issues are resolved.

Key Issues for Reform

The key issues facing the power sector reform were formulated in the early 90's based on a diagnostic study performed with external assistance:

- How to introduce more effective commercialization and competition in the operation of the existing utilities;
- How to engage private sector investments in the sector through independent power production (IPP) schemes and the provision of "open access grid" that would facilitate direct electricity sales by IPPs to consumers;
- How to establish a regulatory framework that ensured both transparency and competition in the power market and incentive based regulation in the regulated segment of the industry .

It is worth noting that the emphasis is on private sector participation and not privatization, recognising the strengths of also having public utilities in a market based structure.

The reform process, which is still underway, is described in more detail in Opam & Turkson[14] and Turkson & Amadu.[15] The description here only summarise the new envisaged structure and discusses its relevance for sustainable energy development issues.

A Power Sector Reform Committee was set up in 1994 and submitted its recommendations to the Government in 1997, which led to the Public Utility Regulatory Commission (PURC) Bill. This bill established the PURC to implement the recommended reforms, described below:

Generation

a) Generation of electricity is opened up to other generators besides VRA within the framework of a competitive market structure.
b) The VRA will compete as a generator and will not be privatized.
c) Power generators can trade power among themselves or sell power directly to distribution enterprises, major consumers, intermediaries, or the system.

[14] "Power Sector Restructuring in Ghana: Reforms to Promote Competition and Private Sector Participation", by Michael A. Opam & John K. Turkson. *in Power Sector Reform in Subsaharan Africa*, MacMillan 2000, edt. John K. Turkson.
[15] Environmental Protection – Implications of the Electric Power Restructuring in Ghana by John K. Turkson & Martin Bawa Amadu, Risø National Laboratory, 1999.

Transmission

Transmission will be operated by a publicly owned national grid company as an open access and non-discriminatory facility.

Distribution

The country is divided into five concession zones with separate distribution companies required to sell distribution voltage supply to retail customers.

Final consumers

The final consumer market is divided into a de-regulated part for consumers above 5 MW demand (nine consumers) and a regulated part for the consumers with individual demands of less than the 5 MW (around 400,000 consumers, mainly residential).

The implementation of such a structure requires naturally a whole new legal framework, regulatory principles and operating guidelines which will lead to far to discuss here.

Key lessons

A number of lessons have been learned in the process of reforming the power sector, which may be valuable for other countries facing a similar situation:

- The Governmen'ts macroeconomic policy needs to be developed to facilitate private sector investment e.g., ensuring exchange rate and interest rate policies, and relevant financial incentives are clearly defined.
- The political will to reform must be clearly articulated and demonstrated; mixed political signals can easily disturb a well designed reform process.
- There is a need for a strong framework for the policy and implementation of the reforms involving a broad group of interests, including the existing power sector institutions but not leaving the responsibility with them. The Power Sector reform Committee that successfully provided the input to the Act was composed of individual from the private sector, academics, government agencies, and the existing utilities.
- Management of the process is complex and takes time, so well defined goals and objectives for the different part of the process have to be established and monitored.
- Implementation must be sensitive to the potential adverse impacts and political constraints e.g., a badly timed tariff increase in 1997 created a national public uproar and risked putting an otherwise reasonable process to a halt.
- Finally it was a clear positive lesson to engage people who have been involved in similar processes, indicating that the Ghanaian experience will also be valuable for others.

Outcome and Impacts

It is still to early to judge the final outcome of the power sector reform process in Ghana, but it will clearly aim to address the key issues for sustainable energy development outlined in the introduction:

- Accessibility of energy through ensuring adequate expansion of electricity services.
- Energy efficiency by introducing competitive institutional and market structures, and focusing on cost based pricing.
- Mobilization of financial resources by introducing market structures and regulatory frameworks which are attractive to investors.

On the environmental implications the situation is less clear. Traditionally the VRA supply is almost entirely hydro based, but already before the reform process started it was clear that additional supply primarily had to be based on thermal generation plants and renewable energy technologies, although some additional hydro capacity also is an option.

The existing electricity laws do not explicitly provide for environmental protection and the institutional framework on the environmental protection issues need to be developed to reflect the new market based power markets. Traditional command and control measures are not very effective in a process striving to move towards economic efficiency, and the limited enforcement capacity does not make such approaches easier.

The reform process may therefore need to be supplemented with development of a parallel legislative framework and institutional capacity to develop and enforce more market based instruments to ensure that environmental factors are taken fully into account in the expansion of power supply. This is one of the main objectives of the reforms.

UNEP has been working with relevant institutions in Ghana throughout the reform process and will continue to do so to promote more full inclusion of environmental considerations in the implementation of the reform policies. It must be emphasized that environmental concerns at this time are seen as secondary to the need to ensure economic development through adequate power supply, but the collaboration shows that there need not be any contradiction between the development and environment priorities.

Title: RET/EE Investment Advisory Facility

"The (proposed) facility has energy requirements of over 55 Megabytes for the first phase. Can this demand be satisfied cost-effectively and technically with wind and sun? Excuse my ignorance, but we know very little about alternative energies."
---- Anonymous banker

Abstract

UNEP is implementing a Global Environment Facility (GEF) medium sized project aimed at promoting renewable energy technology (RET) and energy efficiency (EE) investments in developing and transition economies. The *RET/EE Investment Advisory Facility (IAF)* provides targeted expertise to banks and financiers to help them evaluate proposals in the renewable energy or energy efficiency sectors. The project also helps financial experts develop the skills to evaluate such projects independently[16].

UNEP believes – and financial institutions are starting to appreciate – that expanding a bank's portfolio to include investments in such sustainable projects can contribute significantly to the institution's positive environmental and social impacts. As importantly, such investments can also improve a bank's portfolio balance and financial return. This case study explains the main concepts, introduces the facility and its objectives, and describes (in text boxes) some of the interventions.

Key Issues Addressed

The *RET/EE Investment Advisory Facility* was created to assist financing organizations mobilize financial resources into the sustainable development areas of renewable energy and energy efficiency.

In Tanzania, a timber plantation was proposed to provide a sustainable supply of wood for evaporating brine at a large salt mine. UNEP provided the funds to hire a forestry expert who advised loan officers at the Dutch and German Development banks on plantation feasibility. This investment has been approved and will create a plantation to replace the one million trees that are currently being taken unsustainably from local forests each year.

Box 1

Regional Profile

The facility is open to any developing country that is a signatory to the UN Framework Convention on Climate Change, as well as countries in Central and Eastern Europe. Interventions to date have involved prospective investments in Costa Rica, Guatemala, Jamaica, Tanzania, the Slovak Republic, and Vanuatu.

Sustainable Development Issue Addressed

Many RET and EE technologies are no longer considered experimental; they have been proven

[16] The IAF is managed jointly by UNEP Energy and the UNEP Collaborating Centre on Energy and Environment.

to work well in commercial settings throughout the world. However, even though such RET and EE investments are 'bankable', these technologies have not found wide-spread acceptance in the financial community.

Financiers undertake a well defined appraisal process for loan and investment proposals, which consists of defining a risk/return profile that considers both the various project and sponsor risks involved, and the financial returns expected. When a proposal involves a new technology or business activity, the risk assessment needed is more rigorous and the necessary information scarce. The up-front *transaction costs* of evaluating such proposals are greater than for more conventional energy investments.

Some of the common barriers to RET and EE finance include:

- *higher real and/or perceived risk*
- *lack of in-house skills to evaluate/negotiate projects*
- *absence of sound operational data*
- *operating modalities that require new financing norms*
- *limited access to reliable technical information*
- *increased transaction costs with initial investments.*

In the sustainable energy sector, the cautious attitude of financial institutions combined with their difficulty in correctly assessing the risks often lead to decisions against extending financing for otherwise sound projects. In the end, projects that might really be good investments and yield a global environmental benefit fail to go forward.

These up-front issues (or barriers) are the key targets of the *RET/EE Investment Advisory Facility.* If a financier is willing to invest his/her time and resources in considering a RET or EE project for investment, the IAF is able to *buy down* some of the incremental transaction costs. For example, preparing a financial risk analysis for an energy crop (Box 1) is more complex than for a more conventional business activity, such as thermal power generation, thus the additional incremental[17] effort can be supported by the IAF.

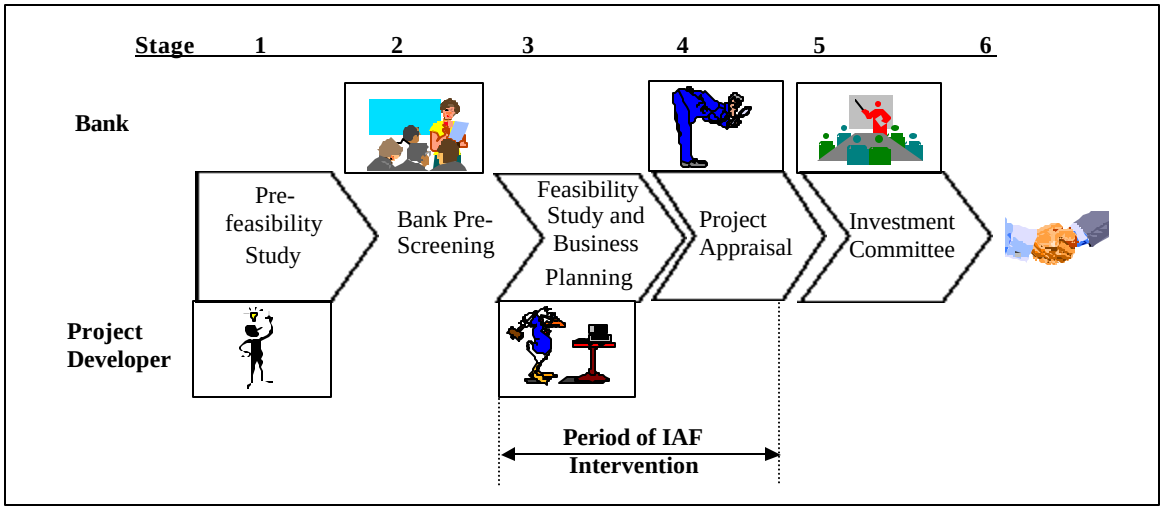
Some examples of the types of incremental issues being supported by the facility are:

- independent project assessment
- financial risk analysis
- regulatory compliance and framework review
- legal review of intellectual property and patent rights
- market sizing for a manufacturing concern
- independent valuation of a project or company.
- operational & maintenance cost review
- legal review of performance or power purchase
- environmental liability risk analysis contracts

[17] Incremental costs are those that relate to

By supporting such efforts the IAF helps investment officers prepare financing proposals for consideration by their internal investment committees (Figure 1 shows a typical investment evaluation process). To secure approvals, besides being financially viable, sustainable energy investments must be as well documented as the conventional (and better understood) power sector investments. This is challenging for any new type of investment, let alone RETs or EE which often have complicated risk/return profiles. After investing in 10 coal fired power plants, it is far easier to invest in an 11th than to consider a wind farm investment instead. The IAF aims to level this 'information planning' field.

This is part of UNEP's two-fold approach to encouraging a greening of the finance sector. First, UNEP secures high level environmental commitments from bank and insurance CEO's through its Finance Services Initiatives (170 banks and 85 insurers have signed to date). Second, UNEP efforts such as the IAF help these organizations meet their commitment by working directly with loan officers to develop investment activity in the various sustainable development sectors. The IAF is not reserved exclusively for use by institutions who have signed UNEP's Finance Initiatives, but often supports those which have recently signed, or are planning to do so.



Objectives

1. Increasing investment in commercial RET and EE projects in developing countries.
2. Building capacity and confidence amongst financial institutions in the sustainable energy investment sector.

Implementation

The IAF provided a third party technical assessment to the Inter-American Investment Corporation for a proposed small hydro 'peaking' power plant in Central America. Although the US$ 36 million project had been approved, concerns about a new dam design delayed the disbursement of funds. The UNEP-funded technical assessment of the new dam design allowed the funds to be released and the project to proceed.

Box 2

To obtain support from the IAF, a financing institution is asked to submit a brief letter of request which summarises the project and the issues which must be resolved before an investment decision can occur. If these issues are incremental in nature, and if the project seems sound and the financier has shown an adequate level of commitment to pursuing its development, then the IAF will review the request.

If approved, the IAF will provide the financing institution with up to $50,000 for hiring expert consultants. UNEP understands that the choice of consultant and terms of reference for the work carried out are key factors in the (perceived) quality of the information provided, and therefore the IAF deliberately channels support though the financier, so that they can source the expertise that they find most credible.

On the Pacific island of Vanuatu, a proposed geothermal power plant would be a valuable contribution to the island's development and able to supply 60 per cent of electrical demand from a renewable energy resource. The Facility has paid for a geothermal consultant to advise the equity investor and two development banks on pre-exploration phase feasibility analysis.

Box 3

The IAF will not usually provide support to an investment evaluation until it has passed the pre-screening stage. UNEP uses this stage as a filter to signal that a project has in fact made it in the 'front door' of the financial institution; the support of the IAF is intended to help such projects make it out again, money in hand. UNEP also requires that requests come from the financiers and not from project developers. Without such proxies of project maturity, UNEP would need to spend significantly more time and resources evaluating IAF requests.

Financiers are not used to coming to a UN institution for such support, therefore much of the work in setting up the IAF has involved building credibility with banking sector clients. This has included setting up of rapid administrative procedures that can operate within a bank's short proposal evaluation cycle. Banks have evaluation procedures that typically take from three to six months to get a project from stage 2 through 5. To be effective, the IAF must therefore be able to provide expertise in a one to three month timeframe. UNEP has structured the IAF to follow an accelerated approval and administration procedure which requires only 10 days to approve a request, and a further five days for contracting.

Outcome and Impacts

To date the IAF has worked with the development banks IFC, IADB, ADB, FMO and DEG; with a commercial European banking group; and with a few private investors. The following table gives a breakdown of UNEP/GEF contributions to individual advisory services and the total size of investments(i.e., the funds being leveraged).

Bank / Financier	**Investment Description**	GHG Emissions avoided 20 year cumul. **(tons CO_2)**	**UNEP/GEF Contribution**	**Total Investment**
Inter-American Investment Corporation (part of IADB)	20MW Small hydro peaking plant in Guatemala.	)00	$25,000	)0,000
Dutch and German Dev. banks (FMO, DEG)	Sustainable forestry plantation in Tanzania		$26,000	$1,200,000
European commercial bank	Biomass coffee waste utilisation in Central America	)00	$34,000	)0,000
European commercial bank	District heating co-generation plant in Eastern Europe		$38,000	$1,000,000
RES Ltd.	20MW Wind farm in Jamaica	,000	$38,115	)0,000
International Finance Corporation, Pacific Hydro	5 MW Geothermal power plant on Vanuatu	324,000	$37,000	)0,000
			$198,115	**)0,000**

The first two investments whose evaluations were supported by the IAF have now gone forward. One is a $36 million small hydro peaking plant in Guatemala (Box 2), and the other is the $1.2 million biomass plantation in Tanzania (Box 1). The IAF provided $25,000 in technical support for the first investment and $26,000 to the second, allowing both to overcome problems encountered in the evaluation and due diligence process.

In parallel with these specific project interventions, UNEP has also been doing some broader capacity building within these client institutions. A training seminar on *Investment Opportunities in the Sustainable Energy Sector* has been developed for raising awareness amongst development bank loan officers. It has been run five times, responding to direct requests from client banks. The Dutch development bank FMO is a good example of UNEP's efforts to build environmental and sustainable energy capacity through a combination of high level commitments, training and direct assistance evaluating specific investments. In 1999, UNEP provided investment advisory support for the sustainable forestry investment in Tanzania, and ran a series of training seminars for FMO loan officers and for their local partner banks. At this time, FMO's CEO decided to sign the UNEP Financial Institutions Statement on the Environment, to increase the size of the bank's environmental unit, and to shift more emphasis to sustainable development investment activities. In 2000, UNEP is completing its RET/EE

related capacity building through a train the trainer session that will leave FMO with the in-house capacity to regularly run programmes on sustainable energy investments.

One of the more innovative uses of the Facility has been to try to link conventional financing organisations with the evolving markets for carbon trading. The Jamaican project (Box 4) is a good example of marrying sustainable energy financiers to carbon-traders. As a result of their Jamaican exercise, and the evolving markets for carbon abatement, RES may now be encouraged to look at projects in other developing countries that may also offer a carbon value. With another client, UNEP is supporting the preparation of a carbon investment fund (Box 5). UNEP promotes such activities not only as a means of shifting financial flows towards environmentally-sound, sustainable energy choices, but also to send a the signal that many RET and EE projects are ready for deployment.

Program Status & Replicability

The pilot is approaching the mid point. A little less than $200,000 has been on IAF advisory services and, to date, two of the investments have been formally approved (a small hydro plant in Guatemala and a sustainable plantation in Tanzania) while the rest are still under development or evaluation. None have so far been rejected.

An external review was carried out of the IAF in summer 2000, which led to some clear conclusions and to the development of recommendations for the future[18]. The review was carried out by a former EBRD investment manager, someone able to critique the facility from the client's perspective. Some of the conclusions of this review were that,

The Consultant feels that the Facility responds well to the task set for it when it was established and that its take-off has been successful both from the point of view of image and, from the point of view of the first results obtained.…{T]here is a great degree of satisfaction among users of the procedure, from private and public financial institutions on the one hand, and private promoters on the other.

However, the review did uncover some facets of the facility that could be improved:

The commitment to maximum delegation of financial, technical and procedural responsibility to the agency applying for support from the Facility, while correct in principle, in practice, is converted into a certain

Under UNEP's Investment Advisory Facility, RES Ltd., the UK's largest wind developer, was able to hire EcoSecurities, an environmental finance consulting firm, to assess the feasibility of pre-selling carbon credits as part of the financing package for Jamaica's first wind farm.

Box 4

The Facility is also supporting a new carbon fund under development by a major European banking group. UNEP is providing assistance to help build and evaluate a stream of potential sustainable energy investments in developing countries for the fund.

Box 5

[18] *Review of the RET/EE Investment Advisory Facility*, October 2000.

opacity with regard to the precise status of the planned operation and, by a total loss of control over the work of the consultant selected with the assistance of the Facility.

This conclusion is the basis for some reengineering of IAF procedures, whereby the financing organisations will still manage the use of funds, but based on a refined set of operating procedures.

Since the IAF was launched, a second pilot called the Sustainable Energy Advisory Facility (SEAF) has been launched to offer similar support to public sector decision makers. These facilities are key components of UNEP's new Energy strategy, which focuses on helping decision makers overcome targeted issues related to sustainable energy policies, projects, investments, technologies and financing.

As well, UNEP is in the process of developing a Sustainable Business Alternatives Network with the GEF, aimed at playing a 'proactive' clearing house function for the UNFCCC on climate change issues. The operation of the IAF and SEAF is providing new insight into the information dissemination process; if successful, they will form central components of this new network.

Lessons Learned

The more pertinent *lessons learned* relate to how to influence the decision making process within a financial institution:

1. When attempting to build 'sustainable energy' capacity within a financing organization, the approach needs to be flexible as different institutions follow different 'product development' paths. To get into a new sector, some banks want to first focus on creating the right policies, others want to focus on training personnel, others want to learn 'hands-on' by taking their first investments, whilst still others want to develop entire investment funds. A facility such as the IAF must be opportunistic in its dealings with new clients, in other words, flexible enough to respond to the specific needs of a particular institutional context.

2. When providing information to a financial decision maker, the messenger is as important as the message. It is important that the financier selects the messenger (i.e., the consultant) and defines the work to be completed (i.e., the Terms of Reference), otherwise the advice they receive is likely to be shelved rather than taken. Bankers relate best to other bankers, or at least to other deal-makers, therefore wherever possible the consultants should be finance specialists. Documentation prepared for technology or policy decision-makers is generally not appropriate for the finance sector.

3. In a broader sense, pursuing change in a financial institution takes time and commitment at all levels. To be successful across the institution, changes are often needed in the incentive structure. Although the CEO may desire sustainable energy investment activity for its policy implications, loan officers are usually focused on

narrower targets, such as simply meeting the traditional benchmarks of rapid loan disbursement with minimal risk. Without stronger incentives, loan officers may pay only limited attention to sustainable energy investments.

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Title: Implementation of Renewable Energy Technologies (RETs) – Opportunities and Barriers

Submitted byUNEP

Abstract

National institutions in Egypt, Ghana and Zimbabwe carried out studies in which they identified barriers to renewable energy projects and measures for their removal using a basic methodological framework provided by the UNEP Collaborating Centre on Energy and Environment. An important part of the studies was involvement of stakeholders. PV systems for rural electrification, solar water heaters (SWH) and large-scale biogas system were analysed for barriers in the Egypt country study. Economic, information and policy barriers were identified as major barriers for these technologies. Solar water pumps (SWPs), biogas and small hydro were the focus of study in Ghana. In this case also, economic, information, and policy barriers were important. The Zimbabwe study focused on identifying primary and secondary barriers to RETs dissemination. These included lack of capacity to develop proposals, lack of information for making good policies, and lack of a framework for information dissemination. Measures to remove the identified barriers were suggested by stakeholders in the three countries.

Key issue addressed

Strengthening of capacity to identify barriers retarding renewable energy project implementation and measures to remove those barriers.

Country Profiles

The project was carried out by national institutions in the three case study countries. These were:

1. New and Renewable Energy Authority, Ministry of Electricity in Egypt
2. Kumasi Institute of Technology and environment, Kumasi in Ghana, and
3. Southern Centre for Energy and Environment in Zimbabwe.

Sustainable development issue that was addressed in the case study

Removing barriers that hinder diffusion of renewable energy technologies is an issue of high interest for sustainable development. RET barriers were analysed in detail and measures to remove them were identified for selected technologies in the case study countries.

Objectives

The project as a whole had three main objectives:

1. improve knowledge, skills, and confidence on the part of project partners so they could identify situations in which renewable energy technologies can contribute to national energy needs

2. strengthen institutional capacity for analysis and implementation of RET projects in the participating countries, and

3. generalise the experiences from the three participating countries and disseminate the findings internationally so other groups could benefit from the knowledge gained.

Implementation

Outcome and Impacts

The national institutions conducting the projects identified RET barriers and opportunities for the selected RETs in their countries. Two national workshops (mid term and final) in each country were well attended by stakeholders, including consumers, manufacturers, RET experts, NGOs and policy makers. The involvement by all groups of stakeholders in the project has helped ensure that the important barriers and measures were identified, and that action taken to remove barriers will have stakeholders' support. The project sensitised policy makers regarding the need for regular consultation with stakeholders on these issues. The national institutions in the case study countries will apply the knowledge and experience gained to analyse other RETs of interest. If required, they should also be able to help other countries carry out similar analysis for RETs.

Project/Program Status

The final project report has been submitted for Ghana, with those for Egypt and Zimbabwe expected by October / November 2000. Presentations are planned for the Regional African Workshop on Energy and Sustainable Development in November-December 2000 with the aim of providing input to African policy makers, particularly regarding CSD9.

Lessons Learned

In the Egypt case study, the focus was on PV systems for rural electrification, solar water heaters (SWH) and large-scale biogas systems. One of the main barriers to PV systems identified is high capital costs, which are partly due to high tariffs and taxes. Lack of information and subsidized electricity are other important barriers. For SWH systems the barriers are high cost, lack of information about technology, technical problems in usage, and a lack of institutional structure to promote and support SWHs, in that order of importance. In the case of large-scale biogas plants, the barriers in order of importance are: a lack of institutional structure to promote the technology, lack of skills, the small size of the market, costs of technology, and awareness.

The measures recommended by the stakeholders to overcome the barriers and improve economic viability of these RETs included:

- setting up of new financial schemes
- reducing taxes and duties on imports of RET equipment and components, and
- better designed incentive schemes.

To address technical barriers, stakeholders recommended the following:

- standardization and certification requirements through legislative measures and
- easy consumer access to the equipment suppliers for fault rectification.

Finally, the two measures identified to overcome information barriers were:

- awareness and promotion campaigns
- training courses and seminars for targeted users and educational institutions.

In the Ghana case study, three solar energy technologies (solar water heaters, solar crop drying and solar water pumps), biogas and small hydro were studied. Of three solar energy technologies, solar water pumps (SWPs) were identified as a promising technology with the fewest barriers. High initial costs and a lack of information on technology and its benefits were major barriers to SWPs. Although biogas was identified as one of the RETs with promise, resource constraints (for example, minimum dung needed for a household biogas plant) was found to be a major barrier on detailed scrutiny of its potential for large-scale application. An interesting finding was the suggestion of the stakeholders to promote biogas projects in Ghana as a sanitation or agricultural project, with fertilizer as an output and energy as a spin-off benefit. In case of small hydro, no development has taken place in Ghana despite some potential. Absence of a coherent energy policy framework was identified the reason for this.

In general, the existing renewable energy policy framework in Ghana was found to be inadequate for promoting RETs and harnessing their full potential. RETs promotion relies heavily on governmental budgetary allocations and donor funding, which are inadequate and unsustainable. The stakeholders identified a need for clearly defined targets, investment plans and financing mechanisms in the national framework for renewable energy. Specifically, need for a role for renewable energy in the governmental 'National Electrification Scheme' was recommended. Similarly, it was suggested that Rural Electrification and Self Help Electrification scheme of the government should shift its focus from grid-extension to renewable energy. Need for a review of the existing low electricity tariff in urban areas was also stressed. Donors also have a role to play in cases where renewable energy is expensive.

The Zimbabwe case study focussed on RETs barriers analysis on a conceptual level. Participants in the workshop said that they were pleased that all the stakeholders had for the first time a chance to discuss barriers together. They also mentioned that clear targets for the numbers of RETs installed in the country in the future are needed.

RETs barriers in Zimbabwe were categorised as primary and secondary barriers, the latter arising from the primary barriers. Interesting to note is that stakeholders may see or experience only the secondary barriers that stem from the primary barriers. It is important to identify and remove primary barriers but it is equally important to remove "lingering effects" produced by secondary barriers. For example, banks have been reluctant to fund RETs due to poorly developed proposals and rate RETs as a poor investment. Therefore, banks may be reluctant to fund RETs even when convincing proposals are made.

The barrier effects were often co-related, with barriers effects indicating impacts of the barriers on RETs dissemination. Primary barriers include:

- inability to develop and present sound project proposals
- lack of capacity to assess cost and benefits
- ineffective lobbying with the government
- lack of information with the government for policy making
- poor fiscal support to RETs and
- lack of information dissemination on RETs from school level.

Measures to overcome these barriers include developing guidelines for project proposals, setting up financing schemes, capacity building on technology assessment within government and industry, regular stakeholders' interaction with the government, setting up a technology information exchange on RETs, and development of curricular and information programs on RETs for schools.

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United Nations Educational, Scientific and Cultural Organization (UNESCO)

Title: Publication and Distribution of the Vernacular Language Textbook of "THE SUN" for Primary Education

Summary

To enhance the active use of renewable energies for sustainable development around the world, educational efforts to teach renewable energies are continuing, notably in developing countries. To raise public awareness of renewable energies in every day life, an introductory textbook about the sun and solar energy entitled "THE SUN" was published by the Asia/Pacific Cultural Center for UNESCO (ACCU) in Japan, in co-operation with UNESCO and UNESCO Member States in Asia and the Pacific. The original version was in English, for the primary educational purpose. ACCU has since promoted publishing vernacular language versions of this book for wider distribution in institutions such as schools, libraries and other educational organizations. UNESCO financially supported ACCU and three UNESCO Member States - Indonesia, Philippines, and Thailand - contributed in translation, printing and distribution of the books to schools in their respective countries in 1999 and 2000. Even though the first phase of the project has been completed for three Asian countries, this enterprise could and should become one of UNESCO's long range projects.

Introduction

Educational activities are classified into three levels; primary, middle and higher. Higher education is expected to answer immediate needs by society. Therefore practical programmes are usually designed for this level of education. On the other hand, primary and middle levels of education look to the future and most efforts are made to teach basic ideas and foster future engineers. An adult who has no background of science in his educational experience cannot be an engineer, an educational programme, which will influence future sustainable development, must be developed at the primary school level. However, this kind of activity is difficult to develop especially in developing countries. Even if an excellent basic textbook is published in the developed countries, the textbook cannot be used in developing countries because of its language problem.

THE SUN

The Asia/Pacific Cultural Centre for UNESCO (ACCU) which is a non-profit organization located in Tokyo promotes co-operative activities in Asia and the Pacific and with UNESCO has published an ecology series for primary and secondary students in English. "THE SUN" is one of these series and consists of three chapters as described below:

Chapter 1: Our Sun - Power House for the World!

This chapter introduces current technologies using solar energy as well as physical knowledge about the sun and its energy.

Chapter 2: Our Sun - Traditions, Legends and Beliefs
Traditional tales relevance of the sun in various countries is introduced in this chapter to show how the sun has been respected and venerated by people.

Chapter 3: Our Sun - Respect It!

This last chapter is devoted to show the environmental influence of solar energy and provides information on how to use the sun for a sustainable future.

Counter-partners of ACCU in each country prepared national tales and topics which were collected by ACCU to create this book. Thus it was published through wide co-operation with many local and regional organisations.

This book was presented on the occasion of "International Senior Executive Seminar on Renewable Energy: Education and Training" held in February 1999 in Bangkok, Thailand. One of the conclusions of the Seminar was to stress the importance of publishing the vernacular versions of "THE SUN" and their distribution to schools.

In reply to this conclusion, UNESCO Jakarta Office, in conjunction with the ACCU, organised the project of publishing the Indonesian, Tagalog and Thai versions of "THE SUN" and of distributing them in 1999 and 2000.

Background of the Southeast Asia

In the wide region of the Southeast Asia, publishing activity has not yet been developed. Indeed the number of publications in the region is very small taking into account the large population. Most textbooks are imported from Europe and USA without translation. This means that the textbooks, which are used in the region, do not fully reflect the real situation of the curriculum in the schools. It has been pointed out that teachers are not able to teach about their national and local environment and problems with such books.

Taking Philippines as an example, the country seriously lacks the pulp necessary for printing books. Besides this reason, due to their long history of colonisation by Spain and USA, their education has been based on Spanish and English textbooks, not Tagalog ones. When colonised by USA, most teachers of all levels came from USA and the teaching language was, of course, English. This educational structure still has some influence on the present school education. Although there are many debates on the education languages in the country, the Government of Philippines has decided to strengthen teaching with Tagalog in schools. Tagalog publications will be published and distributed. As for the universities, national universities have started to teach in Tagalog to support this decision while private ones still insist on studying in English. Eighty percent of school textbooks used in the Philippines are still imported from Europe and USA.

The present activity of publishing "THE SUN" written by Asian authors in vernacular languages seems to be welcomed by teachers, schools and libraries. Real reactions to this activity have not been received from partners and participating organisations since the activity was completed only recently. Reviewing the results will be carried out next year.

Publication and Distribution

Indonesia

The counter-partner, GRASINDO, which is a publisher in Indonesia, translated "THE SUN" from original English version into Indonesian. Roughly 600 copies of the Indonesian version were delivered to 238 schools and 27 national libraries over the country.

The Philippines

A national institution, Children's Communication Center, printed 4000 copies of Tagalog version of "THE SUN" and the National Library of Philippines delivered them to most public libraries and schools. As mentioned above, the cost of publishing is high due to the lack of pulp. Moreover the large number of islands make the transportation fee very high. For this reason, the total cost of the activity was roughly twice of other countries and ninety percent of the funds were subsidised by UNESCO.

Thailand

The Book Development Centre, which is an institution under the Ministry of Education of Thailand, produced 6000 copies of Thai version. These copies were sent to about 5700 lower-secondary schools in 76 provinces over the country.

Concluding Remarks

Roughly 10,000 copies of the three different language versions of "THE SUN" were distributed in three countries to facilitate students education on solar energy and to provide an opportunity of reflecting on their environment and its energy sources. These educational efforts will enhance the use of solar energy in the future when these children and students become responsible for organising their lives and societies.

To complete this work, we need to hear the voices of students and pupils who read "THE SUN" and of teachers who use the book in the class rooms.

SOLAR VILLAGE "JOSE CECILIO DEL VALLE" IN HONDURAS

Abstract

Following the destruction caused in 1998 by hurricane Mitch in four Central American countries, the Director-General of UNESCO proposed to the governments of El Salvador, Guatemala, Honduras and Nicaragua the installation of several "Solar Villages" in order to equip the rural communities concerned with electricity from renewable energy sources. Honduras was the first country to react and proposed the installation of a demonstration project in the rural village of San Ramón Centro of the Department of Choluteca. The project was inaugurated in July 1999 by the President of Honduras and was named *"José Cecilio del Valle"* in honour of a distinguished Honduran scientist.

Key Issues Addressed

The electrification of the community areas of the village using solar photovoltaic energy has demonstrated the viability of providing basic energy services to rural and/or remote human settlements through a decentralized energy system. The project addresses the key issue of energy accessibility, improving the quality of life of the population concerned and opening quality education opportunities.

The project also proves that renewable energies - in this particular case, solar photovoltaic - have the potential to provide basic energy services at a reasonable cost and simple maintenance. It is a good example of how the rural energy needs can be met quickly and efficiently using renewable, environment-friendly energies.

Country Profile

The *"José Cecilio del Valle"* village has a population of 840, of which 215 are children attending 1st to 6th primary education grades. It is a rather poor village, located 39 km north of the town of Choluteca, in southern Honduras. The village is built in an area difficult to access (it takes 3 hours to travel the 39 km in a four-wheel drive vehicle).

The villagers grow basic grains (corn, sorghun and beans), mostly for local consumption; they also raise pigs, chickens and other domestic fowl. The health centre is run by a nurse living in the village, who provides basic and emergency services. Only 40% of homes have latrines and the garbage is mostly burned. Water supply for 105 of the 150 dwellings comes from a small dam, built by the villagers themselves. The village has never been connected to the national power grid, which ends 23 km outside. Hurricane Mitch having seriously damaged the school, it was urgent to repair and equip it properly so as to provide a good level of education to the 215 primary level children (there are no pre-school, secondary or adult education facilities).

Sustainable Development Issued Addressed in the Case Study

Following completion of the feasibility study, the project took two months to build and cost much less than the $150.000 allocated by UNESCO. This was due to the fact that Honduras already has a solar radiation map of the and that a local company, an authorised distributor of Siemens equipment, provided locally most of the parts required; the same company carried out the feasibility study. The savings obtained were used to repair and equip the school. In the end, electricity was provided for the rural health centre, the cultural/community centre, the church, the school, water pumps, solar dryers, and a limited amount of public lighting. Improvement of education, health and water supply were three of the sustainable development concerns addressed by this project.

Objectives

The general objective was to show that decentralised energy systems that renewable energies permit can respond quickly to the needs of rural communities, which would otherwise remain without electricity because the national utility is not interested in extending the grid to them. It is true that the concept of "solar village", as developed by UNESCO and the World Solar Commission, does not entail the electrification of individual homes, but rather has a demonstration value that incites replicability.

As indicated above, improvement of education and health, access to information, improved water supply, drying possibilities for agricultural projects and involvement of the population concerned in the maintenance and management of the equipment can be cited as positive developments.

Implementation

Financed entirely by UNESCO, the "José Cecilio del Valle" solar village was implemented in co-ordination with the Honduran Ministries of Public Education and Science and Technology, with the collaboration of the municipal government of Choluteca, the Honduran Council of Science and Technology and the private firms SOLARIS and HONDUCOMP.

The details of the project can be summarised as follows:

(a) School: lighting for six classrooms, library, kitchen and main corridor; outlets in each classroom and the library to plug in TV/VHS equipment;

(b) Cultural Centre: lighting for an average of four hours daily; plugs for computers and to plug in the TV/VHS equipment;

(c) Health Centre: lighting for the clinic, pre-clinic, pharmacy, waiting room and corridor; one plug for computer and several for electric fans; one refrigerating

system for vaccines and other medical supplies; a solar thermal equipment to produce hot water;

(d) Church : lighting for an average of three hours daily;

(e) Public Lighting : five sodium lamps for an average of six hours daily, installed in the main street;

The total budget, provided by UNESCO, was $150,000.

Outcome and Impact

The "José Cecilio del Valle" solar village was officially inaugurated by H.E. Carlos Flores, President of Honduras, and the first Lady, 8 July 1999. After visiting the installation and speaking with the local authorities and the villagers themselves, the President expressed the hope that, in the near future, many more such villages could be built in the rural areas of Honduras. In any case, the project can be considered an unquestionable success, as the villagers are very satisfied, and the inhabitants of neighbouring villages are keen on having their own solar installations. CNN television did a short documentary, which was broadcasted twice throughout Latin America, within its programme "Economics" and within that of "Technological Innovations". The number of queries received at UNESCO and in Honduras shows that the CNN broadcast has had a considerable impact.

The UNESCO Office in San Jose, Costa Rica, whose Head is the accredited Representative to Honduras, ensures the follow-up of the project, in collaboration with the UNDP Office in Tegucigalp and the government Ministries concerned. Given the level of satisfaction of the beneficiaries, and of the political support at the national level, there is no problem about its sustainability. The above-mentioned follow-up by UNESCO will ensure that quality primary education is provided on site, thus well-preparing the young children for entrance into the secondary education.

Replicability

According to the information provided by the Honduran Permanent Delegation to UNESCO, financing for the installation of a second solar village has been made available by the Organisation of American States. The Government is negotiating with other multilateral financing institutions with a view to establishing additional villages. Prospects for replicating the project are good.

Lessons Learned

The first lesson is that, despite initial scepticism on the part of the villagers, their early involvement at the feasibility study stage went a long way towards eliminating obstacles at the local levels.

The second lesson is that political support at the highest possible level is a guarantee of success. In this particular case, support came from the President of Honduras, who was enthusiastic about the project. One should not forget that rural electrification using environment-friendly sources of energy can have considerable electoral value.

The third lesson is that the support of the women villagers is a great asset. In this particular case, women were solidly behind the project as repairing and equipping the school meant a better education for their children.

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Title: UMBUJI VILLAGE SOLAR ELECTRIFICATION PILOT PROJECT

Introduction

It may be useful to recall that this project, which is included in the World Solar Programme 1996 – 2005 under the heading "Small Islands Solar Power Supply", originated at a meeting of the Chief Minister, (i.e. Prime Minister) of Zanzibar with a member of the Secretariat of the World Solar Commission in 1996. The Chief Minister, who is a trained physicist, requested assistance from the Commission and UNESCO in the electrification of the Zanzibar archipelago using the decentralized power systems that renewable energies allow.

Following the World Solar Summit in September 1966 and the approval of the World Solar Programme 1996-2005 in June 1997, steps were taken to prepare and implement a pilot demonstration project in Zanzibar. UNDP and UNESCO provided funding support following submission by Zanzibar of cost estimates of need. The Chief Minister called upon a local supplier to provide solar energy equipment, including installation, operator training and maintenance..

Abstract

The case study covers the installation and use of a 3 kWp photovoltaic (pv) plant at Umbuji village, in the island of Zanzibar. The PV system is installed to provide power supply for a village school, health centre, school staff quarters and mosques.

Key issue addressed

The Umbuji Solar Electrification Pilot Project is the first of its kind in Tanzania. It is a decentralized solar power system that provides energy for a village school, health centre, residential houses, community centre and religious buildings. The village community is responsible for its management and operation.

The Umbuji Solar Electrification pilot project has been implemented with the following objectives:

(i) to improve the quality of life of the rural population through improvement of community services, education and health care facilities;

(ii) to facilitate better communication and knowledge transfer through audio-visual facilities in the village as a consequence of introducing electricity;

(iii) to establish a solar energy demonstration site, thereby stimulating private and public demand through demonstration and training, and

(i v) to train potential operators and technicians in the village who could perform day-to-day monitoring and maintenance of the equipment installed.

Country Profile

Location- With a population of 2,450, the Umbuji village is situated east of Zanzibar town.

Project Area Profile- The Umbuji village has quite fertile soil with many fruits and coconut trees. Other food crops such as cassava, bananas, etc., are also grown. The village is about 25 km from Zanzibar town and can be reached by a road leading to the village. It takes about 50 minutes by a four-wheel drive vehicle and two hours by a village bus from Zanzibar town. There is no commercial centre in the village but only a few small shops. Most of them are staked with essential commodities, such as flour, salt, kerosene, etc.

Sustainable development issue that was addressed in the case study

The runaway population growth has raised serious questions of future energy supply, with half of the world's population not having access to commercial energy. In 1992, UNCED highlighted the role that renewable sources of energy could play in helping to address the twin challenges of promoting development and protecting the environment.

Poverty is generally assessed in terms of incomes and consumption. It is well known that the poor have low access to education and health facilities, have larger families and are confined to areas of acute environmental degradation. Even in those countries where national incomes are high, there are still poor and deprived people.

A large proportion of the population of Tanzania live in remote rural and/or island areas where conventional energy supply is uneconomical and commercially unviable. In these areas, energy is needed for water pumping, irrigation, cooking, lighting and to run small-scale industries. At present, fire-wood and charcoal are the main sources of energy for both heating and cooking, while lighting uses liquid fuel. Cutting trees for firewood poses a great threat of deforestration if not controlled.

Whereas there is a high shortage of fire-wood in many parts of Tanzania, the country is however blessed with sunshine throughout the year. Tanzania lies within a geographical zone which receives annual daily mean radiation between 4.0 and 6 0 kWh/m2. What is required is a technology to tap it to service the people.

Objectives

Improvement of the quality of life of the villagers as a whole. Education and health will improve significantly and household chores diminish so that more labour is devoted to income-generating activities.

Availability of solar energy for water pumping will contribute to mitigate the environmental degradation in communal areas as more trees/shrubs are planted and less wood is harvested,

Lighting the rural schools at night provides opportunities for extra classes and adult education, and teachers have power for operating audiovisual equipment. Cooling is provided for vaccines and other medical supplies at the health centre.

Solar energy demonstration sites, e.g. village school, health centre etc, can serve as photovoltaic technology pilot projects thereby stimulating demand.

Involvement of the population concerned through training potential operators and technicians in the village who can perform day-to-day monitoring and maintenance of the equipment installed.

Implementation

1. Regular visits to the village are made by members of the Umbuji Solar Energy Project Committee in order to assess the performance of the PV system and the individual components.

2. The Umbuji Solar Energy Project Committee is collaborating with the Ministry of Science, Technology and Higher Education and the University of Dar es Salaam in a training programme for both operators and technicians.

3. Energy end users are trained (educated) in the conservation of energy, particularly on days when there is no direct sunlight.

4. Villagers ensure that the module arrays are not shaded by any object, including trees, leaves, dust, etc.,

5. 'The entire area that accommodates the module array, control and storage battery is fenced.

6. The Umbuji Solar Energy Project Committee in collaboration with the office of Zanzibar's Chief Minister has initiated a Maintenance Fund which will be used to service the plant and make any replacement of components when necessary. Villagers should be encouraged to contribute to the fund.

7. The Umbuji Solar Energy Project Committee in collaboration with the University of Dar es Salaam conducts actual solar radiation measurements in the selected site in order to get an accurate picture of the project.

8. The Tanzania Commission for Science and Technology and the University of Dar es Salaam in collaboration with the Umbuji Solar Energy Project Committee will, after one year, make an assessment study on the performance of the solar PV system, its social acceptability and impact on the development efforts in the village.

Project/program Status

The pilot Project has been completed with all the necessary elements of the programme developed as foreseen in the implementation process.

Replicability

In view of the success of the project, the Government of Zanzibar has asked the UNESCO Director General during his official visit to the United Republic of Tanzania (17^{th} - 19th May, 1999), the extension of the Umbuji Solar project and the establishment of another solar Village in Zanzibar. The establishment of the Umbuji Solar Energy Project in Zanzibar as well as the establishment of a second pilot project in the mainland at Mangaka (South of Tanzania), are steps towards the further extension of decentralized energy systems in the country.

It is envisaged that efforts will be made to enhance this development further particularly in view of the launching of the African Solar Programme, within the framework of the World Solar Programme 1996 - 2005.

Lessons learned

Two key factors have contributed to the success of this project:

a) the knowledge of top decision-maker (in this case, the Chief Minister of Zanzibar) of the potential of solar photovoltaic energy to provide electricity to rural and isolated areas of the Zanzibar archipelago;
b) the early involvement of the village population concerned in the preparation of the project.

In addition to the above, the support of the Government of Tanzania (the President of Tanzania is a scientist) through the Ministry of Science, Technology and Higher Education and of the University of Dar-es-Salaam have also been very important, and will no doubt play an essential role in extending the use of renewable energies (especially solar photovoltaic, wind and biomass) within the country.

It is worth mentioning that the different actors are satisfied with the implementation process (government of Zanzibar, the Umbuji Solar Energy Project Committee, the Ministry of Science, Technology and Higher Education, the University of Dar es Salaam and , last but not least, the village population).

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World Health Organization (WHO)

Title: A Micro Hydropower Project In Ganzhou, Jiangxi Province, China.

Submitting Agency: WHO-Dept. of Health in Sustainable Development

Abstract

The development of micro hydropower in China has demonstrated that it is an effective approach to improving living conditions of households, promoting economic development, and alleviating ecological erosion. In this case study, two key issues are discussed. Firstly, the report details a micro hydropower system constructed in a village of Ganzhou City, Jiangxi Province of China, from which lessons could be extracted, of value to 88 300 micro hydropower stations developed throughout China. Secondly, the report relates to current governmental approaches and policies. Furthermore, some proposed projects/programs are outlined, which will promote the future development of the micro hydropower system, and for which potential funders might be identified.

Introduction

In concept, a micro hydraulic system is defined as the equipment that transfers the potential energy of streams and small flows, to electrical power, according to the power needs of one or tens of households. Differing from small hydropower stations, the power output in a micro hydropower system ranges from 100 W to 10 kW. With relatively low levels of investment, one household, or a small village with tens of households, can build a micro hydropower station to supply electricity. Currently, micro hydropower systems are well developed in Guangxi, Jiangxi, Hunan, Yunnan, and Guizhou Provinces in China.

By 1998, around 88 300 micro hydropower stations had been constructed in China. These micro hydropower stations not only provide power to households likely to have difficulty in accessing the national electricity grid in the near term, but also improve the local ecological environment by decreasing deforestation as a consequence of the harvesting of wood for fuel use. The overall benefits are substantial.

Country Profile

1. Location

Ganzhou Prefecture of Jiangxi Province is about 800 km from the provincial capital. It is a mountainous agricultural area, with rice and fruit being the main crops produced.

2. Project Area Profile

As a developing country, China still has a significant proportion of the population living in remote and mountainous areas, without access to an electricity supply. Ganzhou Prefecture is one such region in Jiangxi Province. On average, the per capita income of rural households in Jiangxi Province is much lower than the national average, due to the constraints posed by the mountainous land.

Sustainable Development Issue Addressed in the Case Study

Prior to the construction of the micro hydropower station, the village was without an electricity supply, due to its remote location. At the same time, the houses in the village are widely dispersed, requiring a relatively large investment to connect all households to the nearby national grid.

The per capita income in Jiangxi Province in 1999 was lower than the national average, and it is prohibitively expensive for households to invest in the micro hydropower station, without external support. Therefore, as a demonstration project, a preferential policy on credit, a grant, as well as technical support was necessary from the government for policy interventions on poverty alleviation and renewable energy development in the area. For further, sustained development of the micro hydropower project on a wide scale in the prefecture, even on provincial scale, the contribution from government grants will be eliminated, and the government would instead focus on credit and technical services.

Due to the lack of availability of suitable, alternative sources of energy, households rely on firewood as the main cooking fuel. Associated water and soil erosion have become a serious problem, worsening ecological degradation, with concomitant implications for health.

Objectives

The objectives associated with the development of a micro hydropower project in the village are:

- To provide power to households to improve their living conditions;
- To eliminate environmental damage and health risks by replacing firewood with hydro-electric power for cooking;
- To demonstrate the technical feasibility of micro hydro generators;
- To study the affordability levels of households;
- To assess the feasibility of a larger scale expansion of the technology, in a sustained manner.

Implementation

The construction of the micro hydropower system in the village lasted for about two months. Fund-raising by local households was encouraged, to supplement the grant from the government. The Center for Testing and Monitoring of Micro Hydropower Products provided the technical support.

Outcome and Impacts

The outcome and impacts of the micro hydropower station constructed in the village are being analyzed in relation to the following aspects:

- Technical scenario and performance;
- Investment and fund raising;
- Households supplied with the power;
- Financial and economic analysis; and
- Environmental and social impact analysis.

Project/Program Status (If Applicable)

From the case study on the village-scale micro hydropower station, a program that could promote micro hydropower development in the areas of both extension and technical research and development, has gained the interest of the Chinese Ministry of Agriculture. For the extension of micro hydropower on a wider and larger scale, a preferential credit or grant might be appropriate due to its role in poverty alleviation. In addition, the re-orientation technically, of micro hydropower equipment manufacturers is also necessary for commercialization.

In terms of research and development, studies of the baseline situation of resource availability nationwide, aspects of the introduction of advanced technology or equipment, and essential national training courses may be necessary.

Replicability

According to data published by the Ministry of Agriculture, the potential exists for the production of 80 000 000kW of energy from micro hydro-electric power in China. By 1998, about 88 300 micro hydropower stations had been constructed with a total installed capacity of 164 000kW. The annual power generation was over $2.72 * 10^9$ kWh, amounting to 0.25% of the total capacity potentially available. At present, there are around 43 million inhabitants living in remote areas in china, without any electricity supply. Around half live in the mountainous areas of southern China, where micro hydro

power resources are abundant. The electricity requirement is about 3 200 000 kW. With living conditions being improved, those living in mountainous areas can increasingly afford household electrical appliances, and are showing increasing interest in the newly developed micro hydraulic generator model. If the proportion of the population using micro hydro power resources is raised to 5%, the installed capacity will equal 6 400 000 kW in all of China, and could provide power for over 30 000 households in rural areas.

Lessons Learned

Primary barriers to restricting the development of micro hydropower are summarized briefly as follows:

- Lack of policy support: Although the Ministry of Agriculture is in charge of micro hydro power systems, and users are mainly rural peasants, the micro hydro generator has not been included on the government listing of farm machinery, which would confer on it special treatment. It has been difficult to talk about the development of, and popularize, the micro hydo generator in government agendas.

- Lack of scientific research: The development and expansion of the use of micro hydro generators is complex. After ten years work, there is now greater understanding of the main research priorities, their rationale, and the key methodologies which require examination. Due to a lack of financial support, it has been difficult to form a stable scientific research team, to address the key issues. In the past 15 years, little research has been undertaken in relation to the micro hydro power generator in the province, despite a ministerial research budget of more than 50,000 RMB.

- Lack of advertisement and effective promotion campaigns: Because the users live in remote, dispersed areas, communication mechanisms, including transport, are poor. Given that alternative enterprises are poorly represented in these areas, it will fall to local governments and local rural energy stations, to undertake the important work of popularizing and publicizing the micro hydraulic generator.

Further Information

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Title: Achieving sustainable reductions in indoor air pollution and improving health through participatory community technology development in rural Kenya

Submitting Agency: WHO – Dept of Health in Sustainable Development: ITDG PROJECT, KENYA

Abstract

Around 80% of people in rural sub-Saharan Africa depend on biomass (wood, dung, crop residues) for domestic energy. There is mounting evidence that the resulting indoor air pollution increases common, serious health problems including childhood pneumonia and chronic lung disease. Previous attempts to reduce this have often failed due to lack of community involvement in developing appropriate, sustainable solutions. Working with 50 households in poor rural Kenyan communities, participatory technology development has been used to alleviate smoke pollution. Evaluation of changes in pollution levels and community views about the process and interventions is being carried out.

Key Issue Addressed

The key issue addressed is ***rural energy***, with a focus on reducing the very high levels of indoor air pollution through participatory development of housing and energy use interventions. This has relevance beyond the specific communities described here, to include the many millions of (mainly) women and young children affected by indoor air pollution in other developing countries.

Country Profile

Kenya remains one of the poorer East African countries, with a large rural population dependent on biomass fuels. Key national health and economic data is summarised in the table below, and demonstrate not only the overall level of poverty and poor health, but also the relatively slow pace of development (and no change or deterioration in key child health measures):

Indicator	Year(s)	Value
• Population	1999	27 million
• Infant Mortality rate (per 1000 live births)	1980	75
	1998	76
• Under 5-year mortality rate (per 1000)	1980	115
	1998	124
• Rural population	1999	68%
• Per capita GNP (US$) and [Rank]	1999	360 [170th]
• Average annual growth rate	1998-1999	0.1%
• Percent population below poverty line	1992	46.4% (rural); 29.3% (urban)
• Percent population without access to improved water supplies	1990-1996	47%

Source: World Development Report 2000/2001

Project location: *The work is being carried out in two rural areas of Kenya:*

- Kajiado, some 80km to the south of Nairobi
- West Kenya, in the communities of Kisii (50 km SE of Kisumu) and Ichingo, around 50km west of Kakamega.

Project area profile

Kajiado: A rural area populated by Maasai, who have begun to build more permanent settlements, whilst maintaining their pastoral lifestyle. This is a poor area, with little or no economic activity other than herding. Within the project families, most rely on the sale of milk, livestock and other small enterprises (sale of charcoal, beer, manure). In about a quarter of the households, the husbands and sons work as watchmen, etc. The Maasai rely almost exclusively on biomass (wood, cattle dung, crop residues) for cooking and space heating, with some use of kerosene in simple wick lamps for lighting. Families live in *bomas*, made up of a cluster of mainly traditional wood and mud homes. Families are polygamous, with each wife living in her own home with her children. The homes are squat, flat roofed buildings, with tiny windows, typically no more than 2-4 inches across (Fig 1). Fuel is burned on open fires in the kitchen area, with no flue or other ventilation apart from the small windows. Fires are often kept smouldering between periods of cooking, including at night, leading to very high levels of indoor air pollution to which women and young children in particular are exposed. It is the role of women to collect fuel and cook.

West Kenya: Both communities in West Kenya are poor rural areas, typified by subsistence farming. As in Kajiado, households are almost totally dependent on biomass fuel, although kerosene is used for some cooking tasks, especially for visitors. Recent increases in the kerosene price have tended to reverse any trend towards greater use. Cooking is typically carried out on open fires (Fig 2) which are located either in small, separate kitchen buildings, or in the main house. Windows are larger than in Kajiado, but still small or poorly positioned with regard to smoke removal. Some homes have eaves spaces, although often these are small or closed off for reasons of security and exclusion of animals which might attack poultry. *Upesi* stoves have been developed and marketed extensively in this area of Kenya, and have been adopted by some 30% of homes. As a result of the layout of these homes, larger windows, and the quite widespread use of Upesi stoves, indoor air pollution levels are generally lower than among the Maasai community, but still very high by international standards.

Figure 1 (above): a traditional Maasai house, showing squat construction and tiny windows. The flue was fitted some years previously in a local government initiative, but no longer works (see

Sustainable Development Issue Addressed by the Case Study

The challenge addressed by this project was to find effective, appropriate and sustainable means for bringing about a substantial reductions in exposure of women and young children to indoor air pollution, thereby contributing to improved health. This work was to build on earlier initiatives in both areas:

- ***Kajiado:*** work in this area built on the ITDG Maasai housing project which used participatory community development methods to work with women to improve the quality of housing (roof height and materials), provision for water collection from roof run-off, etc. Some, very small scale work (a few houses) had been carried out by ITDG on smoke level monitoring and the development of hoods/flues to remove smoke[19]. There had also been attempts some years earlier by the district health authority to develop enclosed mud stoves with flues, but as has been the experience elsewhere, these quickly became blocked and fell into disuse (Ref: Figure 1).
- ***West Kenya:*** although less work had been done on housing improvement than with the Maasai, efforts in West Kenya built on the very successful ITDG Upesi stove programme which was well established and also used a participatory approach with groups of women producing and distributing ceramic stoves. These stoves had been designed primarily with fuel conservation in mind, although the improved combustion has also been shown to result in some reduction in emissions and pollution levels[20].

[19] A breath of fresh air for smoky houses; Pete Young; *Boiling Point 34* - Smoke removal, ITDG September 1994

[20] Ezzati M, Mbinda MB, Kammen DM. Comparison of emissions and residential exposure from traditional and improved cookstoves in Kenya. Env Science and Technol 2000;34:578-583.

The main barriers to developing more effective interventions are summarised in the table below:

Type of barrier	Kajiado	West Kenya
Economic	Poor pastoral nomadic people now settling. Poor national economy.	Poor rural subsistence farming community. Poor national economy.
Cultural	Maasai traditionally quite resistant to change, although have responded well to participatory development in e.g. the housing project.	
Social	Women value privacy and security, hence resistant to larger, non-closing windows to improve ventilation.	Security and protection from animals is a concern with respect to larger/more windows, eaves spaces, etc., that could improve ventilation.
Technical	Almost no successful prior experience with improved stoves or smoke extraction (e.g. with flues).	Good prior experience with Upesi, but none with chimney stoves which may be needed for effective smoke removal. Some concern about risk of sparks starting thatch fires.
Environmental (including fuel sources)	Both communities almost wholly dependent on stressed biomass resources for fuel. Recent price rises have limited use of kerosene. For foreseeable future, and without new income generation activities, there appears to be little prospect of a substantial transition to cleaner fuels such as kerosene or LPG.	

Objectives

The main objectives of the project are as follows:

1. Carry out baseline assessment of pollution and exposure, fuel use and house structure.
2. Identify ways of alleviating indoor air pollution, thereby improving human health
3. Participative development and installation of interventions.
4. Evaluate changes in pollution and exposure, and community views of the process used, and acceptability and affordability of the interventions.
5. Develop strategy in national context for dissemination and sustainability within the market constraints of the communities.
6. Exchange experience internationally to strengthen Kenyan work and to contribute to implementation of best practice in other countries.

Implementation

In summary, project implementation has involved the following steps:

1. Baseline assessment (carried out in two rounds to cover wet and dry seasons) of pollution and exposure, fuel use and household characteristics, socio-economic factors
2. Working with households, identified a range of potential smoke-alleviation interventions that would be acceptable and appropriate to culture and everyday needs.
3. With involvement and financial contribution of households, developed and installed interventions
4. Follow-up measurement of changes in pollution, exposure and related factors, and analysis of effect of interventions, allowing for changes in other factors.
5. Development of strategy for dissemination and market sustainability.
6. Disseminate and exchange experience through networks and other for a (meetings, etc.)

Further detail is provided below on each of these steps, barriers encountered and how addressed.

1. Baseline assessment: Survey and pollution sampling methods have been based on standard techniques involving interviews (households and socio-economic factors, time-activity patterns), air sampling with pumps and gravimetric analysis for particulates, and diffusion tubes for Carbon Monoxide. The selected households have been fully involved from the start, and have accepted well the two rounds of baseline assessment.

2. Identification of interventions: Discussion was held with individual households and groups of women to identify the types of interventions that they would like to try. Some demonstration (of existing innovations) and exchanges have also been carried out.

3. Development and installation of interventions: Step 2 led on to the development and installation of (a) hoods with flues (b) larger/more and better positioned windows and (c) large eaves spaces. Concern about privacy/security for windows and eaves spaces is being addressed with the use of wooden shutters and metal mesh. Figures 3 and 4 illustrate some of these interventions now installed. Participatory technology development methods have been used. Initial designs for hoods/flues were prepared with the women through discussion and preparing sketches (drawn by women). These were then taken to the local technology institute in Kajiado, and prototypes prepared. Once installed, women then commented on convenience and smoke extraction efficacy, and further modifications made. This has led to designs which are known to be acceptable, meet needs, and through everyday experience, appear very effective (the formal evaluation – see below – will quantify these observations). During this pilot phase, financing has been shared between the project (ITDG and donors) and the community, with the project paying for the more expensive components. However, it is fully recognised that if these initiatives are to be sustainable, the local community (encompassing residents, artisans, distributors, local government and NGO agencies) will need to be able to pay for, produce and maintain these interventions. This is now being addressed (see below).

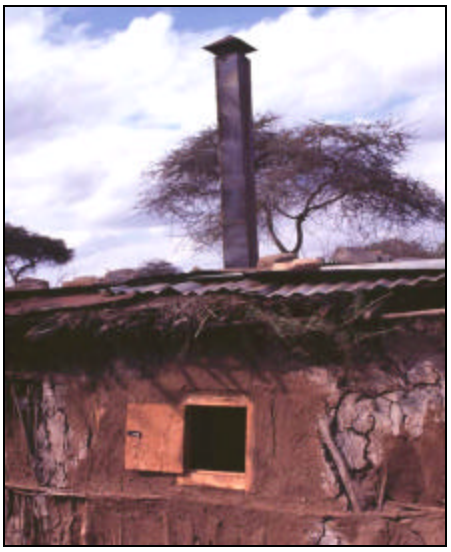

Figure 3: Newly installed hood and flue, Kajiado
Figure 4: The flue and new

4. Evaluation: Evaluation involves repeating the components of the baseline survey, but with additional qualitative (group and individual) discussion and recording of experience with the process of developing and installing interventions, and satisfaction.

5. Development of strategy for dissemination and market sustainability: This began with an assessment of the priority being given to the interventions under development by women in the project homes and in surrounding areas, and the consequent likelihood that they would be able to allocate scarce resources to these changes. Once the more resource-intensive development work has been done, costs of producing and installing the interventions on a more routine basis can be assessed. This work will be linked with the preparation of materials for disseminating the new information on the pollution problem, changes achieved, experience with the interventions, etc., and strategies developed for sustaining uptake and use. This will build on the successful experience of the *Upesi* programme in West Kenya. Arrangements are currently being developed with partners from within Kenya and the UK to use innovative media approaches (video, printed materials, puppetry, etc) to raise awareness, and build the necessary partnerships and commitment at community, district and national levels.

6. International dissemination*:* The collaborative group has good contacts with key networks involved in household energy, health and development, and these will be used to disseminate reports, arrange presentations, etc. These contacts include the Household Energy Development Organisation Network (www.ecoharmony.net/hedon) , Boiling

Point, and links through WHO, USAID and the World Bank and other relevant agencies developed through a recent WHO/USAID organised International Consultation[21].

Outcome and Impacts

- ***Levels of pollution***: Preliminary analysis of the baseline surveys have found median 24 hour values for respirable particles of 4605 $\mu g/m^3$ in Kajiado and 812 $\mu g/m^3$ in West Kenya. As expected, these are very high in comparison with the current annual EPA PM_{10} standard of 50 $\mu g/m^3$ (24 hour mean levels in these rural communities are a good guide to annual means due to consistency of daily routines). Levels of carbon monoxide are also very high, especially in Kajiado.
- ***Progress with interventions***: Interventions have been completed in Kajiado (all homes having new windows, 50% hoods with flues for comparison purposes). Interventions have been started in West Kenya and are due to be completed in November/December 2000 (all homes to have Upesi stove, larger and better position windows and eaves spaces, and up to one-third hood with flues subject to successful participatory technology development).
- ***Evaluation of outcomes***: The post-interventions survey work (quantitative and qualitative assessment) will begin in November 2000, so results of this are not yet available. Qualitative assessment will include diary keeping by field teams, observations (photography, video), interviews and discussions with women. Initial discussion during the installation phase has found very positive responses, with women reporting improvements in smoke levels, comfort (headaches, eyes), more light, and greater convenience around the home.
- ***Capacity building***: Development of capacity has included skills in survey work (include air quality assessment) and project management, data handling, technology development. This has involved new and existing IT field staff, partners and core team members, and will be consolidated through plans to expand the work within Kenya and in an international collaborative effort applying similar methods.
- ***Partnerships***: An effective and broad-based partnership has been established between the UK contributors (ITDG-UK and University of Liverpool), IT-Kenya, the University of Nairobi (air quality assessment, statistical analysis) and district-based resources including local government and technology institutes. Community participation has been a crucial and effective component of this. Joint-working with ETN (a UK and Nairobi based media and health development organisation) and AMREF is under discussion in respect of achieving wider dissemination and sustainability.

Project/Program Status

Stage	Status
Baseline survey	Completed
Identification of interventions	Completed

[21] WHO/USAID Global technical Consultation on the Health Impacts of Indoor Air Pollution and Household Energy in Developing Countries; May 3-4th 2000, Washington.

Installation of interventions	Underway, completion by December 2000
Follow-up evaluation	To be carried out November 2000 to May 2001
Strategy for dissemination and sustainability	Under development

Replicability

This participatory approach has wide application. Although the quantitative evaluation has yet to be completed, preliminary findings indicate that the methods adopted are both effective and have the potential to be sustainable. The women have been empowered to making their homes cleaner and safer. Specific knowledge about these interventions may also be quite widely applicable in Kenya, though since participatory approach is recommended the details would be expected to emerge in response to needs and circumstances of community involved.

Lessons Learned

Since the project is not yet completed, the following points are preliminary:

- Levels of smoke within the project communities are at a dangerously and unacceptably high level.
- The problems faced by women within the project are based in poverty - they have neither the time nor resources to make changes, even if they are aware of the problems of smoke. The project's role is to empower those women to make improvements to their (and their children's) quality of life.
- Women within the communities themselves, are in the best position to determine what will work for them, and strategies for smoke-alleviation must be worked out participatively for them to be sustainable. The abilities (assets) of these poor communities should not be under-valued.
- Women are very receptive to change, if they themselves instigate it from a position of knowledge and understanding.
- Much greater effort needs to be put into identifying low-cost, acceptable and financially sustainable mechanisms for alleviating smoke and improving the home environment.

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Title: Modernization of Fuelwood Use in Nicaragua with the EcoStove

Submitting Agency: WHO –Dept of health in Sustainable Development

Abstract

Less than 5% of fuelwood users (who comprise over 50% of all urban households in the Pacific region of Nicaragua) are aware of improved woodstoves which can reduce both fuel consumption and indoor emissions. To date, dissemination has been restricted to non-governmental organisations (NGOs) and the areas of their projects, and performance (efficiency and emissions) has generally been poor. PROLEÑA has developed a new EcoStove which has *higher efficiency (45% savings in fuelwood)* than the "three-stone" fire, and provides a *smoke-free* indoor environment. The EcoStove is portable and can be mass produced, *facilitating quick dissemination.*

PROLEÑA is pursuing an integrated sustainable dissemination project with a target 8 000 EcoStoves installed by 2002. This project combines assembly, promotion, marketing, finance, and techology transfer for private sector development.

Key Issues Addressed

The key issues addressed by this case study are :

- Energy efficiency, through development of a new woodstove which substantially reduces fuel consumption for domestic cooking.
- Renewable energy, since the widespread use of EcoStoves has the potential to significantly reduce the demand for fuelwood from natural forests, currently being harvested at an unsustainable rate, to a level more closely aligned with sustainable growth of the forests.
- Rural energy, since the most common household fuel used in rural areas of developing countries is fuelwood.
- Technology transfer, through the training of small private sector industries, to produce and disseminate EcoStoves in Nicaragua.

Country Profile

Nicaragua, as with many other less developed tropical countries, is still very reliant on wood for energy needs. In 1997, the Nicaraguan Energy institute (INE) reported that fuelwood accounted for about 47% of the internal gross primary supply of energy, petroleum products 24%, electricity 25% and other biomass residues 3%. Fuelwood consumption is predominantly for household use, with 90% used for home cooking, and 10% for industries including bakeries, lime, brick and charcoal production.

Location

The project is located in the Pacific region of Nicaragua, an area where about 60% of Nicaragua´s 4.5 million people live. This is the most important economic area of the country, with good volcanic soils, and major urban areas including the capital, Managua, but has suffered seroius overexploitation of forest resources. The region is also home to

the tropical dry forest, a fragile ecosystem, which has been severely overexploited, with 97% of its original cover removed.

Project area profile

According to surveys of 2050 households undertaken in seven of the main cities of the Pacific region of Nicaragua by ESMAP 98[22] and EMOLEP 99[23], over 50% of households use fuelwood as the primary fuel, followed by LPG and kerosene. These surveys showed that the preference for firewood as a main cooking fuel is due to its availability and usefulness in preparing food quickly. It is also relatively cheap, and can be burned in very simple stoves consisting of just three rocks. Finally, cultural values play a role, in that fuelwood is regarded as traditional, and gives food a better flavour.

Wood is also the traditional fuel in rural areas, for three main reasons. First, it doesn't require special stoves; second, access is relatively easy and the cost is low; and third, firewood has became a tradition due to the total absence of other market options and their corresponding stoves.

Nevertheless, those using firewood in urban areas recognize that traditional wood stoves generate a great deal of smoke, which results in a poor indoor environment and affects the family health. This disadvantage and the lack of knowledge about improved woodstoves could explain the tendency to substitute the use of firewood for the use of LPG and/or charcoal, which are cleaner fuels.

The main niche for the shift from fuelwood toward LPG in urban areas is concentrated in the middle class and in the upper lower class. The key reasons for this shift can be defined as:

- cleanliness in comparison to traditional woodstoves (clean indoor air and clean pots);
- reduced operational cost (lower fuel cost per meal cooked); and
- association with improved socio-economic status (quality of life improvement).

Although this trend might continue for the next ten years or more, as pointed out by EMOLEP, there will be some restrictions to a complete transition from fuelwood to LPG in this coming decade. For instance, the fact that fuelwood can be purchased in small amounts every day contrasts with LPG which requires a larger disbursement from the family budget when it is time to refill the cylinder. Low income familes (the traditional users of fuelwood), do not have enough saving capacity to accommodate such large financial outlays on household fuels. Important also is the fact that a traditional woodstove requires no financial investment, since it can be made from three stones.

[22] ESMAP,98: Energy Sector Management Asistance program, A joint World Bank-UNDP program. In Nicaragua, it evaluated in 1998, the household energy perspective in two main cities: Managua and León.
[23] EMOLEP,99: Strategy to improve fuelwood supply and its efficient use in the Pacific region of Nicaragua. Prepared by CATIE-PROLEÑA for the CNE.

Furthermore, as pointed out in a study by Barnes and Qian (1992) for ESMAP in eleven developing countries, LPG will not replace fuelwood if average per capita income of the family is below 25 dollars per month. The Nicaraguan Ministry of Social Affairs, in its 1998 report on poverty, showed that in the Pacific region, the percentage of the urban population in poverty grew from 28.1% in 1995 to 39.6%, while the rural population in poverty reduced from 70.7% to 67.1%. Also, 84% of the urban poor and 97% of the rural poor use fuelwood for home cooking. On the health side, the report mentions that acute respiratory infections among infants was the second leading cause of deaths (after diarrhea), the risk of which is increased by woodsmoke exposure.

The National Energy Commission's (CNE´s) EMOLEP project estimated that by the year 2010, at least 20% of urban households in the Pacific region will continue to use fuelwood. This will be due to saturation of LPG market penetration, limited by various factors such as restricted socio-economic development of Nicaragua, cultural traditions, and even more by other factors such as economic depression, higher international oil prices, serious problems with LPG imports and/or restrictive government policies. Indeed, since EMOLEP´s formulation in July 1999, international oil prices have more than doubled, from 12 to over 30 dollars per barrel, and LPG distribution in Nicaragua has gone through many crises, increasing scarcity and prices, and deteriorating consumer confidence.

Sustainable Development Issues Addressed

The problems facing the fuelwood sector in Nicaragua can be summarized as being very under-developed. First, almost all harvest or production is based on non-sustainable forestry and second, almost all fuelwood consumed is based on low efficiency stoves. In neither case is there any satisfactory regulation, control, incentives or any planning for the supply side. Despite fuelwood being the major energy source and forest product of Nicaragua, and strongly linked to the poor, there is no government agency whose priority concern is the planning and modernization of this sector.

In the case of the household demand side with woodstoves, recent studies done by the CNE within EMOLEP (1999) show that less than 5% of fuelwood users in the Pacific region are aware of improved woodstoves which can reduce fuel consumption as well indoor emissions. However, the same study showed that the overall efficiency of so-called improved woodstoves in the region was very poor (12.1%) and below that of traditional open fires like "three-stones" or U shaped semi-closed fires (14.9%).

The improved woodstove model most widely disseminated in the region is the CETA model, which was first developed in Guatemala by ICAITI[24] and later adapted for use in Nicaragua by DINOT[25]. Field surveys of the performance of the CETA stove, which was disseminated by many Nicaraguan NGOs, show that many of these stoves, usually made by local artesans, tend to deviate from the original design, lack of quality control and

[24] ICAITI: Central American Institute for Research in Industrial Technology, based in Guatemala
[25] DINOT: Departament of Research and Technological Approach of the UNI- National Engineering University of Nicaragua.

monitoring, are not properly finished, and use low quality materials. These factors combine with often inappropriate operation, resulting in poor efficiency. However, due to the presence of a chimney, these stoves do generally achieve a significant reduction in indoor emssions of carbon monoxide and particulates, in some cases reaching indoor levels near to those acceptable by the World Health Organization.

Furthermore, EMOLEP pointed out that the reasons for the limited dissemination of improved woodstoves in the Pacific region are the geographical restriction of programmes to areas where NGOs and projects are operating, the lack of widespread commercially available models and/or specialized masons for construction, lack of mass promotion, and lack of financial incentives.

Objectives

The purpose of this program is to modernize the use of fuelwood as a household fuel, through the introduction of a new improved woodstove called the "EcoStove" (economical and ecological), with the following advantages:

- Significant improvement of fuel efficiency, by reducing fuelwood consumption by an average of 45%
- Significant improvement of indoor air quality (and therefore of health), by dramatically reducing indoor smoke pollution
- Improved women´s working conditions, by allowing multiple cooking tasks simultaneously, keeping pots and pans free of soot, and a compact, portable and better looking stove.

Implementation

PROLEÑA, since 1995, has been pursuing the development of a new woodstove which could address the main concerns about traditional woodstoves, such as high fuel consumption and indoor smoke pollution. From the CETA stove model (an in-line 3 burner stove) which is used in Honduras, PROLEÑA introduced a metal griddle cooking surface which could avoid leakage of smoke indoors. In addition, the griddle or "plancha" allows cooking directly on it, like the "tortillas", a basic element of the diet of Meso America, as well as cooking with multiple pots, at the same time keeping the pots free from soot. The result was favorable, since Honduran women liked the smoke and soot-free characteristics of the plancha stoves. However, as expected, this stove was not as efficient as the CETA or even the open fire, due to radiation losses from the griddle.

In its efforts to produce a better stove, PROLEÑA with financial support from Trees, Water and People (a US NGO), invited, in the aftermath of hurricane Mitch which hit Honduras and Nicaragua in 1998, a group of volunteers from the APROVECHO Research Center in Oregon, USA. They visited PROLEÑA communities in Honduras and investigated the possibility of using the highly efficient Rocket woodstove to improve efficiency of local woodstoves in Honduras. The Rocket stove is a simple chimney-less wood burning device developed by Dr. Larry Winiarsky in the early 1980´s in the USA. This stove follows a number of principles to achieve increased combustion and improved

heat transfer. Unlike high mass stoves that absorb heat from the fire, the Rocket stove body is a low-mass insulated stove that is designed to maximize combustion chamber temperatures, increase combustion, and direct the hot flue gases to the pot. In Nicaragua it uses pumice stone as the low mass insulator. It is designed to burn only the ends of the wood and to limit the amount of particle fuel in the combustion zone. This reduces the rate of oil vapour (smoke) production to a volume that is more easily combusted.

Outcome and Impacts

APROVECHO´s team observed that women liked the smoke and soot-free features of the Plancha stove, and decided to combine both stoves, calling it, at first, the "Justa Stove". The Justa Stove is a combination of the Rocket stove's fuel-efficient combustion chamber with the user friendly attributes of the Honduran Plancha stove. This new stove, although not as efficient as the single-pot Rocket stove, produced a *higher efficiency* than the three stone fire. Furthermore, it provides a *smoke-free* indoor environment, thereby contributing to improved health, keeps *the pots free of soot*, allows for the *cooking of multiple pots* at the same time, *and improves the appearance* and aesthetics of the kitchen.

The Justa Stove utilizes the same principles of the Rocket stove and more:

- totally encloses the fire and its emissions, while not obstructing the combustion dynamics. It maintains aproximately the same cross-sectional area for the passage of hot flue gases through the combustion chamber, metal cooking surface, and external chimney.
- promotes heat transfer by forcing the hot flue gases to circulate under all the metal cooking surface, ensuring contact and increased heat transfer by the use of fins attached to it.
- channels all the smoke out through the chimney.

The great impact of the Justa Stove was to overcome the main negative features of traditional woodstoves, such as poor efficiency and indoor air pollution. The Justa Stove reduced fuelwood consumption by an average of 45%, resulting also in no noticeable indoor air pollution. In addition, the Justa Stove retained the good features of the plancha stove, such as multiple pot and food cooking, direct cooking on the plancha, and soot free pots. An additional advantage was the significant improvement in family quality of life (less fuelwood expenditure or collection time) and working conditions for the women (smoke and soot free enviroment).

However, the Justa Stove was being produced in the same traditional custom-made way, with a brick frame, the construction of which required the hiring of a specialized mason. Woodstove evaluation carried out in Nicaragua under EMOLEP, had concluded that all brick frame woodstoves promoted during the 80´s and 90´s had suffered from low perfomance due to poor quality control, and poor dissemination. With this in mind, in early 2000, PROLEÑA/Nicaragua started producing the Justa Stove with a metal frame instead, which resulted in a compact, portable, better looking and more marketable

product. Furthemore, it could be mass produced by specialized metalshops or assemby plants, guaranteeing quality and good perfomance, and above all, a potential for cost-reduction. This new stove was renamed the EcoStove in Nicaragua, due its sound economical and ecological features.

Program Status

In Honduras PROLEÑA and another local NGO called ADHESA, has produced over 400 Justa stoves since 1999. In Nicaragua PROLEÑA has produced over 150 EcoStoves during the year 2000 in a pilot assembly plant, including some models with an oven inserted. However, two factors still hinder limiting the promotion of the EcoStoves: first the cultural barrier of some traditional open fire users, who refuse to accept the new technology; and second, its price of US$60, which is a prohibitive price for many traditional fuelwood user households. To overcome these barriers to the rapid dissemination of the EcoStove, PROLEÑA is pursuing a project with financing from USAID, aimed at disseminating around 8 000 EcoStoves in the Pacific region of Nicaragua by 2002. The project is currently being implemented and will utilise an integrated strategy:

1. Establish a well equipped assembly plant to consolidate the technology and supply the initial market demand,
2. Promote the new EcoStove among NGOs and development projects with household energy components,
3. Implement a media campaign in radio, newspapers and TV, promoting the new features of the EcoStove and motivating fuelwood consumers for woodstove modernization.
4. Create a network among the main public markets of the region, to distribute the EcoStove commercially.
5. Channel most of the commercialization through microcredit financing agencies, which are very common in the region, and will facilitate sales to poor families.
6. Transfer the technology to 2 or 3 other regional assembly plants, to create a competitive supply market.

In a parallel initiative, PROLEÑA is joining forces with the National Energy Commision of Nicaragua, a government energy planning agency, to rapidly disseminate the technology into small household businesses such as tortilla and food preparation establishments in the Pacific region, and with financial support from the Brazilian Cooperation Agency, to transfer the technology to a Brazilian university, for future dissemination into rural areas of the Minas Gerais state in Brazil.

Furthemore, PROLEÑA/Nicaragua has requested technical assistance from ESMAP, a joint World Bank and UNDP
energy assistance program, to help with further development of the EcoStove design, and to evolve the business and marketing strategies. The assistance will also include technolgy transfer to Honduras and other neighbouring countries. This request has been approved and it is expected to be implemented by early 2001.

Replicability

The EcoStove dissemination strategy could be implemented in neighboring countries such Honduras, El Salvador, Guatemala and southern Mexico. Similar cooking habits and socio-cultural conditions in these regions favour the acceptance and dissemination of the Ecostove. Furthermore, it is expected that in parts of South America, such as Brazil and other countries, the EcoStove could also be successfully implemeted, given that its technology is more modern than existing improved woodstoves used in that region. In other parts of the world such as Africa and Asia, where fuelwood is also a common household fuel, detailed socio-cultural and logistical evaluations should be done to assess its market potential.

Lessons Learned

The main lessons learned through the process of developing the EcoStove are the following:

1. The fuelwood sector has traditionally been negletected by the government forestry and energy agencies in Honduras, Nicaragua, and in many other countries. Although being the major energy source, forestry product and the energy for the majority of the poor, no government agency is concerned with its planning and modernization, as they are with other energy sources as petroleum and electricity, or other forestry products such as timber, conservation and ecotourism. The role of a dedicated and profesional NGO to fulfill this government inaction regarding fuelwood, can produce excellent results, as shown by PROLEÑA in Honduras and in Nicaragua.
2. The role of collaboration between north and south NGOs is important, as occurred in this case amongst PROLEÑA, Trees Water and People, and APROVECHO. A joint effort by all these volunteers and low budget organizations can produce excellent results when work is done with perseverance, clear goals and self-motivation.
3. The role of the internet is significant, since the connection between these 3 NGOs mentioned above, was only possible through a woodstove discussion group which has been underway on in the internet since 1994.
4. Cooking with fuelwood does not have to be a contaminating task. With a simple but well designed appliance, wood cooking can be clean, efficient and practical, making it more desirable and compatible with life in the 21st century. In Nicaragua it has been observed that many wealthy families buy an EcoStove to use for entertaining or barbecuing in their modern houses.
5. The failure of many improved woodstove projects in Latin America in the past is related to the insistence by stove designers and development workers on fuel efficiency to save trees, and self construction technologies. The new EcoStove approach compromises on some of the efficiency in favour of other valuable features such as a smoke and soot free kitchen, and mass produced high quality stoves, and has resulted in a well accepted technology for people from all levels of economic status, and rapid dissemination.

Further Information

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Title: Community-wide Electricity Provision Programs in South Africa, and the Implications for Indoor Air Quality and Health.

Submitting Agency: WHO - Dept of Health in Sustainable Development

Abstract

For a major portion of the past decade, an aggressive electrification program has been underway in South Africa. As part of this initiative, around 450 000 households are being provided with electricity each year, or around 1000 households each day. An overall target of the program is to increase the proportion of dwellings supplied with electricity from 35% in 1992, to 70% by the year 2000, and around 85% in 2010.

South Africa's electrification program has provided a unique opportunity to assess changing energy use patterns and the impact of changes in indoor air quality (in this case associated with access to electricity) on health status. Research on the association between indoor air pollution and the health of women and young children has been identified as a particular priority in developing countries, in light of extensive use of polluting energy sources for cooking and space heating, and because women and young children are known to be exposed to the highest levels of indoor pollutants, over the longest periods. In this regard, an investigation into the feasibility of a large-scale community electrification, indoor air pollution and health study was recently funded by the World Health Organisation (WHO). Emerging from this feasibility investigation, as well as a number of other research projects focussing on aspects of electrification, have been a number of important issues associated with electricity provision programs, the dynamics of community transition to the use of electricity, and the implications for expected improvements in indoor air quality and health. This report will outline a selection of the key issues.

Key Issue/s Addressed

Accessibility (and use) of energy supplies (electricity), rural energy.

Country Profile

South Africa has a population of over 40 million people, distributed in 9 million households. In *per capita* terms South Africa is an upper-middle-income country. However, with the second highest Gini co-efficient (a measure of inequity) in the world, it is evident that the distribution of wealth and resources across the territory is highly inequitable, in terms of both geography and race. For example, 46% of African black and only 1% of white households live in informal or traditional housing structures. Similiarly, solid or liquid fuels are used for cooking purposes by 66% of the African black population, whilst less than 1% of white households use these fuels. In 1995 only half of South Africa's households had access to electricity - 75% and 20% in urban and rural areas respectively. As part of a broad process of addressing racially-based inequities, eliminating environmental threats, reducing exposure to indoor air pollution, and improving community health, a national electrification program was planned and

implemented. In terms of this program, around 450 000 dwellings have been provided with electricity each year in recent times, raising the percentage of electrified homes from 35% in 1992, to 70% by the year 2000, and an expected 85% in 2010.

Key Sustainable Devlopment Issues Addressed

South African rural areas are generally associated with high levels of poverty, low educational status, and a lack of basic environmental health and development infrastructure. The provision of electricity to rural households in South Africa has been seen as an avenue for the improvement of the quality of local ambient and indoor air, and reducing the threat of associated ill health, as well as a springboard for improvements in overall quality of life, through sustainable local economic development initiatives. This report discusses a number of issues of relevance to attempts to optimise the potential for promoting sustainable local development, offered by the national electrification program.

Objectives

The objectives of the South African national electrification programs have been briefly alluded to above.

The overall goal of the WHO feasibility investigation, was to obtain essential planning information in relation to energy use patterns, indoor air quality, and health service infrastructure in electrified and un-electrified areas. Specific elements of the study included :

- A program of indoor air quality monitoring in electrified and un-electrified villages;
- A description of patterns of fuel use in electrified and un-electrified villages;
- An indication of the length of the period of transition to the use of electricity once supplied; and
- An indication of fuel costs in electrified and un-electrified villages.

Outcome and Impacts

Basic Methodology

The study was undertaken in the village of Mareetsane, which had been supplied with electricity around 4 years earlier, and the un-electrified villages of Enselsrust and Brooksby. These villages were located around 50 kilometres from Mafikeng, the capital of South Africa's North West province. All the villages were situated in agricultural land, well away from busy highways or industrial sites. All dwellings in the study sites housing a child of 18 months or younger, were included in the study, giving a total of 110 dwellings, of which 57 and 53 respectively were in electrified and un-electrified villages. The study included the administration of a structured questionnaire survey administered

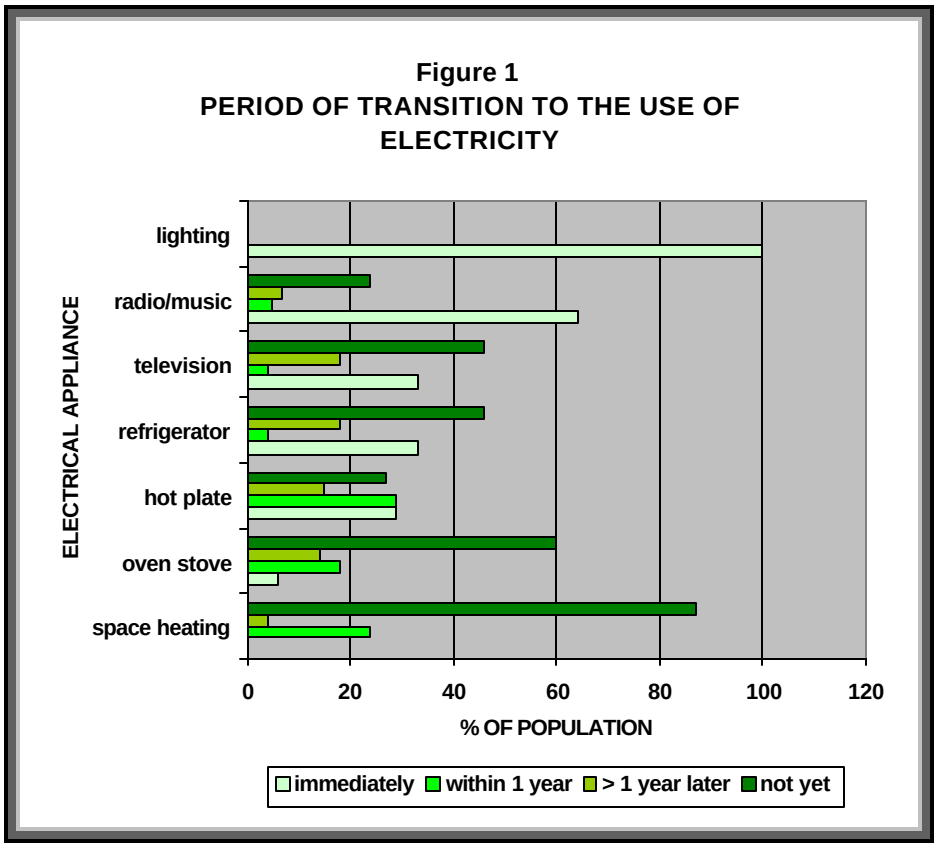
by trained fieldworkers, and a program of indoor air pollution monitoring in both electrified and un-electrified areas.

Selected Results

Levels of unemployment in both electrified and un-electrified areas were high, with around 65% of dwellings have no working adults. Levels of maternal education were low. Inquiries about access to a range of commodities showed that very few households had access to a microwave oven, video machine or motor vehicle. Relatively large proportions of households in both areas, on the other hand had access to irons, radios and television sets. There were few statistically significant differences in socio-economic status between the households located in electrified and un-electrified villages.

Inquiries into the period of transition to the use of electricity in the electrified village of Mareetsane showed that all households immediately used electricity for lighting (see Figure 1). A likely reason for this finding is the installation by Eskom, South Africa's electricity utility company, of a standard unit, which includes a light source. Following lighting, entertainment facilities such as radios, music centres and television sets, as well as refrigerators, were the items most likely to be powered by electricity immediately after supply. In respect of cooking, only 28% and 6% of respondents reported the immediate use of hotplates and oven stoves respectively. In 61% of households an oven stove had never been used. Reasons given for the failure to use electricity for cooking related mainly to financial constraints.

When respondents in the un-electrified villages were asked about priorities for the purchase of appliances in the event of electricity provision, the majority (63%) reported an expectation that an electrical cooking appliance would be the priority. This finding differs markedly from what transpired in the electrified village, where cooking appliances were frequently purchased well after the provision of electricity, or not at all. A possible reason for this difference could be the discrepancy between the perceptions of women (who comprised the main groups of respondents here), and the reality of decision-making and power relationships at the household level. Gender and power issues have also been identified in several other studies, to be an important determinant of energy choices at the household level.



The study showed that during summer months around 19% of un-electrified households were using solid fuels, whilst 43% were using liquid fuels (paraffin/kerosene), and 12% were using LPG for cooking. A further 26% were using multiple fuels for cooking. In electrified villages on the other hand, around 26% reported using electricity exclusively, whilst a further 28% reported using electricity in combination with alternative fuels. The remainder (46%) were making no use of the electricity provided. In contrast to the electrified village, in which fuel use patterns across the seasons

Figure2: the use of both an electrical and a coal/wood stove in a rural, electrified South African village appeared to be stable, considerable fuel switching was reported in the un-electrified villages. For example, solid fuels were used for cooking in 58% of un-electrified dwellings during winter months, compared with 19% in summer. In terms of household expenditure for fuels, the survey showed that weekly fuel costs in electrified villages averaged R44.00 (USD6) per week, compared to R60.00 (USD9) per week in un-electrified areas. These findings are in line with those emerging from studies of energy expenditure in other South Africa settings, which similarly indicate that average household expenditure in un-electrified dwellings exceeds that of households in electrified dwellings.

An indoor air quality monitoring program conducted as part of the study showed that levels of particulate matter (PM_{10}) ranged up 1328$\mu g/m^3$ over a 24 hour period. In electrified dwellings the maximum PM_{10} level equaled 472$\mu g/m^3$. The mean PM_{10} level was significantly lower in electrified (18$\mu g/m^3$) relative to un-electrified (78$\mu g/m^3$) dwellings ($p = 0.028$).

Conclusions

The study indicated that, despite the exclusive or partial use of electricity by only 54% of households in the electrified village, a significant improvement in the quality of indoor air in this setting could nevertheless be measured. The transition to the use of electricity was protracted. At the time of the study, an average of 4 years subsequent to the provision of electricity, 60% of households had no oven stove, and 27% had no hot plate. This despite the finding that average weekly household fuel expenditure was higher in un-electrified relative to electrified villages. Most households had first purchased electrical appliances such as radios or music centers, television sets and refrigerators, all of which have little impact on indoor air quality relative to cooking and space heating apparatus. The pattern of purchase of electrical appliance in the electrified village contrasted sharply with perceptions of what would be the priority purchase in un-electrified villages. This may have been due to the respondents having been mainly women, and that differences occurred, as determined in studies elsewhere in South Africa, between women's perceptions and preferences, and the competing realities of household decision-making and power dynamics once electricity had been supplied.

Project/Program Status

The South African national electrification program is expected to continue towards meeting its target of providing 85% of dwellings in the country with electricity by 2010.

The study outlined in this report was part of a feasibility investigation into the suitability of South Africa as a setting for the implementation of a large study of the impact of a reduction of indoor air pollution (associated with community-wide electrification programs) on the health of young children and women. An international panel is expected to review the findings of the feasibility study during November 2000, and advise on the following phases.

Lessons Learned

- Despite only partial utilisation of electricity services, the study nevertheless demonstrated significantly better indoor air quality in electrified, relative to un-electrified dwellings.
- In rural South African settings, transitions to the use of electricity may be protracted, despite evidence that energy costs in un-electrified settings are higher than costs in electrified villages.
- Over and above financial constraints, a wide range of factors may impact on energy choices at the household level, including, for example, household decision-making and power dynamics, gender, and, as indicated by studies conducted elsewhere in South Africa, cultural traditions, levels of understanding of power consumption rates of various appliances, and of the billing system.
- Extensive poverty may undermine government attempts to improve rural quality of life, environmental quality and health status through, for example, large-scale electricity provision, water supply and sanitation programs.
- What is needed in rural areas of poverty, is a holistic, integrated approach to local development, that takes account of the broad principles of sustainability. In this regard, the South African Independent Development Trust, is currently coordinating the implementation of around 50 pilot projects centred around energy provision, but within the context of holistic, integrated, cross-sectoral approaches to sustainable local economic development. These pilot projects will provide an opportunity to implement strategies aimed at addressing many of the energy choice concerns which have emerged from the WHO feasibility investigation outlined here.

Further Information

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Title: **The Oliver Thambo Community: Committed To Energy-efficient Housing, and Improving its Own Destiny**

Abstract

The Oliver Thambo Community is a shanty neighborhood within Gugulethu Township, located near the City of Cape Town in South Africa. As part of South Africa's Reconstruction and Development Program (RDP), efforts are being made to improve the township in terms of economic viability, and overcrowding is being alleviated through the agreed relocation of residents to other areas. Many of the residents of the Oliver Thambo Community residing in informal shelter have been assigned lots in an area close to Gugulethu, and funding from the RDP has been set aside to subsidize the development of formal housing on that site. However, due to years of neglect and delays, relocation or the building of formal homes had not taken place for several years. In 1998 the Oliver Thambo Community leaders decided to coordinate their own relocation, and take the initiative for the development of their housing.

Community leaders insisted on complete autonomy in respect of relocation, and housing plans and decisions. With little knowledge in this field, the Oliver Thambo community leaders approached PEER Africa, an engineering firm with demonstrated expertise in energy efficient and environmentally friendly community development and implementation, for assistance in planning and implementing the relocation and the development of housing.

Key Issue Addressed

This case study addresses the key issues of energy efficiency, technology transfer, and capacity building.

Country Profile

The Gugulethu Township is a large township located near Cape Town's International Airport. Gugulethu is part of a cluster of black townships in the Cape, which include Mitchell's Plain, and Khayelitsha. Residents are primarily Xhosa speaking, and the township itself includes both formal and informal (shacks) dwellings. The residents of the Oliver Thambo settlement live primarily in informal shelter. Some of the obstacles being faced were:

- insufficient subsidy funds to build shelter of even modest size (at least 30 m^2),
- most the residents qualifying for the subsidy or a portion of it, were unemployed or employed in the informal sector, and consequently, did not qualify for "top-up" loans,
- due to a "red-lining" policy by banks in respect of the Gugulethu township, obtaining "top-up" finance was difficult, even for those residents who were formally employed,
- funds allocated for building assistance to the community, made available through a local community development corporation, were being withheld,
- crime was soaring in the community, and

- most households were headed by single and/or elderly women.

Sustainable Development Issues Addressed in this Case Study

The sustainable development issue addressed in this case study relates to the role of community organization, and the development of skills and leadership capacity in community empowerment. The case study will demonstrate how these elements facilitated a community in overcoming resource constraints, and building a viable, environmentally friendly and health enhancing settlement.

Objectives

The key objectives of the project were to:

- Train a community to understand (and implement) the principles and benefits of energy efficient and environmentally friendly living structures,
- Plan and build a showcase community of energy efficient, environmentally friendly homes in a variety of price ranges, sizes, and building materials,
- Train a community to plan and implement its own showcase community,
- Train a community to follow the leadership of its chosen leaders,
- Train the community leaders to accept the responsibility of leadership,
- Train community builders in the construction of energy-efficient, environmentally friendly dwellings,
- Develop a community framework to ensure timeous completion of building, and to protect the community investment during the building process,
- Obtain financing mechanisms in "red-lined" areas to allow for building of an adequate standard to occur,
- To continue work with political structures within the township, towards encouragement and support for communities that display pro-activity and innovation in respect of energy-efficient, and environment and health enhancing housing.

Implementation

The integrated housing program, a component of the US-South Africa Gore-Mbeki Bi-national Commission, was introduced to the Gugulethu Township in September 1997. The US Government decided to build two pilot/demonstration energy efficient homes in the township in time for a series of bi-national meetings, which had been scheduled for 1998, in South Africa. The Gugulethu Community Development Corporation (CDC) selected the locations and designs for two homes, a single-family unit and a duplex. PEER Africa was requested to undertake the planning, and build the homes on behalf of the US Government. This work constituted a continuation of a similar, energy-efficient, integrated housing program initiated by the PEER Africa in the Kutlwanong Township in 1995.

The first step in the development and implementation of a sustainable housing and community development program in Gugulethu, was the preparation of a community

development framework (CDF), which took account particularly of the need for acceptance of the proposal and committed participation by all stakeholders, beneficiaries and "gate keepers". The CDF prepared for Gugulethu has been described elsewhere. In summary however, amongst the key foci of the CDF were aspects related to comprehensive training, technology transfer and capacity building. The key was to develop sufficient capacity among beneficiaries, to ensure thorough training in environmentally friendly, energy efficient and healthy housing , management and building skills, and to development confidence and empowerment towards a sense of community ownership and pride in the housing project, and the principles of environment, energy efficiency and health, embraced by it.

As part of the process of implementing the CDF in Gugulethu, PEER Africa conducted training programs for community members and held workshops over a period of at least six months. Subjects focused on in the training programs and workshops included planning and management of housing programs, the principles of passive-solar design for buildings, energy efficiency in buildings, and environment and health awareness programs for community planning and development. The workshops covered the entire spectrum of skills that are needed to successfully plan and implement sustainable economic development projects at the community level. Workshops were conducted while the pilot homes were being built, as well as subsequently, after the conclusion of the bi-national meetings. In addition to conducting capacity-development workshops, PEER Africa assisted the CDC in securing funding for the building program. Community builders were trained at local training institutions for the building sector, in the construction of passive-solar designed homes. Management training was also provided to community leaders selected to handle the management and administrative aspects of the program.

Following the series of workshops, the Oliver Thambo Community decided that it had sufficient training to proceed with the building program, which would constitute the first such initiative in the township. The community was also able to obtain a grant from the National Housing Department for the establishment of a housing support center. Through the Center, they were able to establish a material and supply yard, as well as purchase tools for housing construction. Funds were made available through the Center to pay small stipends to team managers, and builders were paid from the subsidy funds for building the homes. Initially, the community builders built four model homes. These homes varied in size, price, and style, and served as a demonstration project for the community. Over 300 subsidy application forms were completed, and there was a high degree of optimism and confidence in the completion of the project.

Following the period of high spirits associated with the identification of 300 applicants for energy efficient homes however, a number of potentially debilitating problems emerged. There was disagreement amongst the stakeholders about the process to be followed for housing delivery. The 300 applicants were allocated to a different builder, rather than the project and the trained community builders. Tension developed between the CDC and the Oliver Thambo Community leaders, and the CDC elected to withhold its support and assistance to the community. The situation deteriorated and the

community energy-efficient building program came to an end. The Oliver Thambo Community was now left to continue its building program with little or no financial support, and the subsidy funds allocated to the applicants who remained keen on energy-efficient housing, were insufficient to build any of the models. After a period of disillusionment and introspection, PEER Africa proposed a new approach to the project. It was decided to involve the building and management team of the Kutlwanong Civic Intergrated Housing Trust (KITCH) in the further development of the project. KITCH is a Section 21 organization active in a similar project in the Kutlwanong Township in Kimberly, the capital of South Africa's Northern Cape Province. Through the support of KITCH, in terms of management and building skills, the homes could be built for the subsidy amounts available to the new homeowners, albeit at much smaller dimensions than initially planned. Billed as "starter" homes, these dwellings included the basic elements of energy efficiency, for example proper orientation, window sizing and placement, and roof overhangs, and were designed in such a way as to facilitate later extensions and incorporation of further energy efficient features.

A new set of model homes, reflecting responses to the new financial constraints, were built. The new homes were smaller in size, and used the most inexpensive, but practical building materials. Because concrete blocks were used as the building material, the mass of the structure was increased by filling the block holes with sand. Wherever financially possible, insulated ceilings were installed. KITCH builders constructed three models, and after several months delay sufficient funds were secured to add to the allocated subsidies for the building of a further 10 homes. All these homes are now occupied, and a new building phase is being planned.

In the interim, leadership within the CDC changed hands, and a new working relationship with the Oliver Thambo community was established. The new cooperative arrangement has facilitated approval for building to continue on a more equitable basis, and on a larger scale. On a positive note, the challenges faced by the project, have resulted in a wider range of energy efficient homes being constructed and available to the community, and being affordable to a wider cross-section of households with varying incomes - from absolutely no income and an inability to augment the subsidy in anyway, to residents who are working and can afford to supplement the subsidy, as well as those who do not qualify for the subsidy, but are able to secure bonds and have a totally energy efficient and environmentally home built initially without the need to add on later.

Outcome and Impacts

PEER Africa's philosophy is to build model energy-efficient and environmentally friendly homes, in cooperation with a homeowner. Thus, all homes are occupied and the resident serves as the emissary to tout the benefits of energy-efficient housing, and the associated impact on lifestyle and health. Residents of the first four model homes built in the new Oliver Thambo community lived in their homes for a full year before the second round of building occurred. These residents were able to report to their neighbors living in energy-inefficient housing and informal dwellings, that they no longer needed space heating in winter, and that their homes were comfortably cool in summer. In so doing,

they were able to confirm to skeptics, that what had been promised in workshops, was true in real life, despite the sacrifice of some energy-efficiency features, due to financial constraints. As word of the benefits of the energy-efficient housing spread, and increased community demand for this type of home, it gave momentum to efforts to initiate further phases of delivery, and project leaders are now confident that energy-efficient housing delivery will take place at a more rapid pace and on a larger scale than originally envisaged.

The greatest challenge to this project was determining how to build passive-solar designed, energy efficient homes in an environment of insufficient funds, little political support, and a scarcity of qualified builders. Each of those barriers was overcome, and the project continues to be successful and addresses the key issues identified above and the overall quality of life issues as they relate to sustainable economic development.

Replicability and Lessons Learned

In the face of potentially debilitating obstacles, the Oliver Tambo Community leaders and PEER Africa, continued to seek innovative ways to make the program work. The solutions developed, insured replicability and sustainability of the project in that community, as well as other similar settings in South Africa and elsewhere. This project is an excellent example of one that could have failed, but succeeded because of the determination of the beneficiaries to continue to seek solutions and not assume defeat in the face of political and financial turmoil. Because the community had received adequate training, and knew what to expect, as well as how to get the work done, it was able to move forward with its plans for the building program. The community needed to find the necessary support services to keep going forward. The community leaders included both men and women. The women in particular, played a key role in ensuring that community members understood the nature and principles of the building program, and why this type of housing construction was so important to their health and well-being. Women make the key decisions in relation to energy choices for cooking and space heating, and usually also manage household finances. Women community leaders also emerged to take responsibility for management of the payroll for workers, and keeping hope alive, even in times of severe adversity.

Further Information

Additional information on this project can be provided by:

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Annexure

GUIDELINES FOR CASE STUDIES FOR CSD 9

Background and objectives

Energy for sustainable development will be discussed at CSD 9 in 2001. In preparation for CSD9, the Ad hoc Open-ended Intergovernmental Group of Experts held its first session from 6-10 March 2000 and identified the key issues with regard to energy and sustainable development that it wishes to address at its second session to be held in February 2001. The relevant information is contained in the co-chair's summary of the meeting which can be found at http://www.un.org/depts/esa/sustdev/enrexpert.htm. For ready reference, the list of key issues contained in the co-chair's report is reproduced below.

Key Issues

Accessibility of Energy
Energy Efficiency
Renewable Energy
Advanced Fossil Fuel Technologies
Nuclear Energy Technologies
Rural Energy
Energy and Transportation
Technology Transfer
Capacity Building
Mobilization of Financial Resources
International and Regional Cooperation

One of the agenda items for the second session of the committee pertains to "lessons learned". The committee was of the view that in order to enrich the dialogue process at its second session, information in the form of case studies describing lessons learned and experiences gained at the national levels in translating sustainable energy policies into concrete actions would be helpful. It was opined that this kind of information might also prove useful in gaining further insights into the key issues learning from national experiences in the implementation of sustainable energy policies. Furthermore, learning from each other's experiences could prove useful in identifying future course of action including the consideration of replicability of such approaches in similar situations elsewhere.

Therefore, it is proposed to invite case studies to be presented at the second session of the committee. To assist the preparation of such case studies some guidelines are set out below.

Scope of case study

A case study should attempt to present an objective and in-depth analysis of the extent to which the application of specific sustainable energy policies and policy instruments was able to address some or all of the key issues being addressed by CSD9 either at national or local levels. It should briefly describe the basic problems, conditions and general situation that existed before the policy intervention and or strategic action was initiated. The study should then clearly state the sustainable development objective of the activities to be undertaken. It should then characterize in detail the type of policy interventions, market mechanisms, financial instruments, and related activities that were implemented. Success is often built upon the ladder of previous failures; therefore the study should describe the problems and barriers that were encountered and the manner in which they were tackled and overcome. The outcome and impacts of the policies and instruments that were introduced should then be characterized and analyzed. Finally, the case study should describe lessons learned in the course of bringing about changes in the pathways to energy for sustainable development.

The case study should clearly elucidate the roles of the various stakeholders, as well as key partnerships, that were instrumental in bringing about the successful outcome. In retrospect it is often possible to identify ways in which the activities undertaken, or additional activities not implemented, could have led to increased impact; suggestions related to such activities would be useful.

Suggested Format for the Case study

The format suggested below is mainly intended for the purpose of maintaining some uniformity in the different case study presentations and also to serve as a guide in organizing the contents of the case study. ***The length of the case study paper should be no more than 5 pages.***

Title

Provide a concise title for the case study that refers to a project or a program or a plan.
Example: *Reducing Air Pollution In The City Of Benxi, China*

Abstract

Provide a 50-100-word abstract of the case study. The abstract should be self-contained and should clearly state the problem addressed and methods employed.

Key issue addressed

State briefly in this section which aspects of key issues identified above that the case study addresses. For example, with respect to the key issue “accessibility of energy”

the case study could be concerned with policy that might have substantially improved the situation of rural people in a particular area by providing increased access to modern energy services. Alternatively, it could be concerned with improved energy security in a given region through regional agreements. Likewise, the case study might be concerned about energy efficiency and successes achieved in implementing policies in this regard.

Country Profile

2. Location

Provide relevant information about the geographic location of the project or program.

2. Project Area Profile

Provide a profile of the socio-economic and other relevant base line information relevant to the project or program. This information outlined in a paragraph or two should be aimed at clarifying the impact of policy interventions that the case study attempts to illustrate.

Sustainable development issue that was addressed in the case study

Provide information on the problem or issue being addressed, and existing conditions or situation that acted to compound the problem. Previous efforts to address the issue or problem might be described.

Identify the technical, economic, social, environmental, legal and financial constraints and barriers that were faced or continue to be faced.

Objectives

State the aims and objectives in bulleted-form.

Example:

- To reduce air pollution in the central part of the city affected by frequent atmospheric inversions and suffering from a high concentration of pollutants (especially Nitrogen Oxide and dust).
- To improve the health status of local inhabitants and to improve the aesthetics of the area.
- To support strategic political goals of the city to become a city of tourism, to continue to attract service industries and visitors, and to offer new inhabitants a high quality of life.

Implementation

Efforts should be made to characterize in detail the strategy and type of policy interventions, market mechanisms, financial instruments, and related activities that were implemented.

It should be clearly stated how the strategy and various interventions addressed the various barriers and constraints. Also describe sources of conflict that arose and briefly sketch the policy and social implications of the conflict situations, as well as actions adopted to resolve them.

Outcome and Impacts

Discuss the results and impacts both in qualitative as well as in quantitative terms. Provide convincing evidence of results and impacts preferably relying on independent evaluations, wherever available. If the case study concerns a particular project at a given location, include assessment of the prospects for longer- term sustainability and state what makes the prospects look bright. If the case study concerns a national-level program, comment on its design for the general applicability. Relate the efforts made to overcome specific barriers to the results that were achieved. Discuss variability aspects of results and impacts and comment on the reasons for the variability. Describe the extent to which the project has contributed to capacity building and to enhancing the level of awareness of stakeholders on the issues concerning energy, environment, and development in the community. Comment on other relevant aspects such as political support, market reforms and stakeholder involvement that might have had an impact on the results of the case study.

Project/program Status

Provide brief information on status of the /project/program i.e. whether completed or still on going. Additional information as to whether all the necessary elements of the program are developed or still to be developed in more detail would be helpful.

Replicability

Describe briefly the prospects for replicating the types of actions that the case study illustrates.

Lessons Learned

Delineate the experience gained in the case study project or program. Describe the lessons learned with regard to roles played by the different actors. Include the experiences with regard to community awareness and their active involvement in influencing the direction of policy as well as in translating policy into action. Comment on women's role and their involvement. Include comments on local level capacities for adoption of sustainable energy strategies.

Further Information

Provide names, addresses (postal as well as email) and telephone/Fax of relevant institutions responsible for the project or program that constitutes the case study so that further information can be sought, if necessary.