REPORT NO 01·89

NVE
NORWEGIAN
WATER RESOURCES AND
ENERGY ADMINISTRATION

SEMINAR ON RURAL ELECTRIFICATION AND NORWEGIAN DEVELOPMENT ASSISTANCE, HOLMEN, MARCH 14 - 15, 1989

PROCEEDINGS, including seminar conclusions

NVE
NORWEGIAN
WATER RESOURCES AND
ENERGY ADMINISTRATION
Division of development
assistance

NORAD
NORWEGIAN AGENCY
FOR INTERNATIONAL
DEVELOPMENT

NVE
NORWEGIAN
WATER RESOURCES AND
ENERGY ADMINISTRATION

Tittel/Title	Nr/No
Seminar on Rural Electrification and Norwegian Development Assistance, Holmen, March 14-15, 1989	01-89
	Dato/Date June 1989
Forfatter(e)/Saksbehandler(e)/ Executive Officer(s) Organizing Committee: Eyolf Dahl, Erik Helland-Hansen, Bjørn Lunøe, Klaus Endresen, Egil Skofteland Invited Key-Speaker: Gerald Foley	ISBN

Sammendrag/Abstract

The report provides the papers presented at the seminar on rural electrification and Norwegian Development Assistance, Holmen, March 14-15, 1989.

Furthermore, the seminar conclusions including a proposed next step are presented for the consideration of the Norwegian Agency for Development Cooperation (NORAD).

Emneord/Subject Terms

Rural Electrification
Norwegian Development Assistance
Energy

Ansvarlig underskrift/
Project Co-ordinator

Egil Skofteland
Chief Engineer

NVE
NORWEGIAN
WATER RESOURCES AND
ENERGY ADMINISTRATION
Division of development
assistance

NORAD
NORWEGIAN AGENCY
FOR INTERNATIONAL
DEVELOPMENT

Cover photo: Knut Ove Hillestad,

Norwegian Water Resources and
Energy Administration

LIST OF CONTENTS

1. INTRODUCTION

by Erling Diesen, Norwegian Water Resources and Energy Administration (NVE)

Rural Electrification: A Developmental Challenge

Norway has provided funding for rural electrification in a variety of countries over the past fifteen years, and new projects are being planned or considered elsewhere. The main emphasis in the programme to date has been upon providing financial and technical support for decentralised small hydro schemes.

In part this focus upon hydro has been in response to the difficulties experienced by many developing countries in meeting their import bills for oil following the price rises of the 1970's; it has also been in line with the broadly favorable view of renewable energies taken in the Brundtland Commission Report and other studies of energy and the developing world. Moreover, the promotion of hydro power plays to one of Norway's strengths and provides an opportunity to utilise Norwegian professional skills and manufacturing expertise.

In the past few years, however, it has become apparent that providing support for small isolated rural electrification projects is not necessarily the best use of the available development assistance resources. Even though such projects may be justified on their local merits, they do not fit within an overall strategic view of rural electrification and the role it plays in rural development - and where Norwegian development assistance can best be deployed in this context.

It has also become clear that the predominantly technical focus in most projects has led to a comparative neglect of social issues and a failure to define adequately the development goals of some programmes. This has led some commentators to ask whether rural electrification even has a legitimate part in the Norwegian development assistance programme.

Because of such questioning within the Norwegian development assistance community, it was decided last year that the time was opportune to hold a two-day national seminar to discuss the issue. This was held under the auspices of the NVE in the Holmen Fjordhotel on 14-15 March 1989. It was attended by some 40 people with representatives from NORAD and a variety of academic, manufacturing and consulting organisations.

A high level of agreement was reached on the importance of rural electrification in the development assistance context. The challenge facing the Norwegian development assistance community is to create the policy framework and institutional mechanisms which will enable rural electrification programmes to be targeted and implemented in a manner which maximises their developmental impact.

A Social and Political Issue

There is no question about the overall relevance of rural electrification to development. This is clear from the experience of Europe and North America, as well as that of the newly industrialising countries of the developing world.

Communities without an electricity supply are excluded from a high proportion of the benefits of modern society and are inevitably condemned to a marginal existence in overall social and economic terms. In the longer term, it is therefore clear that rural electrification is a developmental necessity and must ultimately be provided.

This does not mean that electrification is a priority everywhere. Still less does it imply that electrification, in itself, will bring about development. But it is nevertheless clear that without reliable electricity supplies at prices which people can afford, the potential for development is extremely limited.

Rural electrification is, however, expensive. Very few programmes are able to cover their running costs, let alone their capital investments, during the first five to ten years after construction. Given that so many basic needs remain unfulfilled in the rural areas, it is legitimate to ask what priority should be given to the provision of subsidies to rural electrification; some would say that only those programmes which can pay their way should be implemented.

This is a valid argument from the economic point of view. The problem is that the issue of rural electrification is to a large extent social and political. If a strict policy is followed of targeting only those areas where there is a reasonable chance that programmes will pay their way, the pace of rural electrification will be extremely slow in the majority of countries.

Those living in the remoter and poorer areas will have little prospect of obtaining a supply within the foreseeable future. Following the optimum course dictated by economic considerations is therefore likely to widen the gap between those living in areas already experiencing a certain degree of economic development and those caught in the trap of subsistence. From the point of view of most Third World governments this is not acceptable at a social or political level.

It is clear that economics cannot be ignored in the planning of rural electrification; programmes must be targeted in accordance with clear economic criteria. But a major effort is also required to see if it is possible to make electricity supplies available to communities which do not meet such strict criteria but for whom an electricity supply is a genuine priority.

Not only a question of supply technology

There is a tendency to see rural electrification primarily in technical terms. In the design and planning of a project, the supply technology to be used is often the major focus of attention.This is particularly the case when decentralised generation systems are being established.

This can easily lead to the demand side being largely ignored. Yet, arguably, this is even more important than the supply technology. There is no point in providing a supply if people cannot afford it or are not in a position to use it effectively. When programmes are being planned, it is therefore essential that the demand issue is thoroughly considered. It may, in fact, be necessary to allocate a proportion of the project budget to investments which will help stimulate demand.

Simply installing the necessary supply technology will not, in itself, cause development to occur. If projects are to have a significant developmental impact, they must be carried out in areas where the necessary conditions for development already exist or can be provided as complementary inputs to the Programme.

Projects also need to be placed within the context of the overall national rural electrification policy of the country concerned. Isolated technical gestures serve little purpose. Support to particular projects should be provided as part of a sustained programme designed to reach an increasing proportion of the rural population.

The equity issue

It is clear that the benefits of rural electrification are not uniformly distributed. Those families which are able to afford a connection and pay their consumption bills are obviously going to benefit more than those for whom electricity is beyond their financial reach.

This is not an argument against rural electrification. Virtually all rural infrastructural investments have a tendency to provide greater opportunities to the better off than the very poor. But it does point to importance of the equity issue and the need for careful analysis of the likely social and economic effects of rural electrification programmes.

When programmes are being planned it needs to be clear whether, and for whom, an electricity supply is a priority. Measures also need to be taken to ensure that the benefits are distributed as equitably as possible. In this context, careful attention needs to be given to the tariff structure which is going to be used.

The equity issue also raises important questions about the level and allocation of subsidies. It may make sense on general developmental grounds to provide rural electrification as part of the rural infrastructure. It is much harder to justify the supply of electricity at below its production costs in order to provide the rural rich with a higher standard of domestic living conditions. The issue of tariff structure needs extremely careful analysis.

Off-grid Supply Systems

In many countries, the grid is still extremely limited in extent. For the vast majority of the rural population, there is therefore little hope of being served by a grid-based rural electrification programme for a long time to come. The only chance such communities have of obtaining an electricity supply is by means of off-grid supply systems.

If such systems are utility managed, their costs tend to be prohibitively high. The main hope for keeping costs at an acceptable level is the creation of community-managed systems.

But achieving success with community-managed programmes is not simply a matter of the right technology choice, as has sometimes been thought in the past. It requires the creation of institutional structures which can provide local communities with the necessary training and technical support for the operation of systems.

It also requires the provision of effective institutional mechanisms for the maintenance and repair of generating systems. If the community cannot rely on having repairs to its generating equipment carried out promptly, effectively and cheaply, the electricity supply system will inevitably be condemned to marginal developmental significance.

Local Participation

The majority of rural electrification programmes in the developing world are planned and implemented without any serious involvement by the local community. As a result, many opportunities for increasing the impact of providing an electricity supply are lost.

Local participation is particularly important in the case of off-grid supplies. But simply involving a small number of local communities in a random series of projects will achieve little in overall developmental terms. The aim should be to develop systems which are both locally self-sustaining and at the same time replicable on a broader scale.

The question of local involvement must therefore be viewed strategically. This will require the establishment of support organisations at a national or regional level.

Need for continuing analysis

It is clear that rural electrification is a major developmental challenge for many countries in the developing world - and for the development assistance agencies supporting them.

Institutions which are capable of handling large scale rural electrification programmes need to be created in the developing world. But equally there is a need for the creation of institutional capacities in the development assistance agencies which will provide a more effective method than presently exists for learning from experience and developing new approaches.

In summary, the over-riding view of the seminar, clearly reflected in the papers and conclusions, was that rural electrification has an important contribution in promoting the development in the Third World. It is therefore an area in which funding is justified at present and which could well justify increased assistance in the future.

But it is also clear that indiscriminate expansion of assistance programmes is not likely to be particularly effective. There is a major need for further analysis and review of the experience to date. A great deal more needs to be learned about how to target programmes more effectively and how to increase their developmental impact.

2. SEMINAR CONCLUSIONS

The following conclusions including a proposed next step were agreed upon at the seminar.

1.0 The Relevance of Rural Electrification in Norwegian Development Assistance

Rural electrification can make a positive and important contribution to rural development.

Rural electrification thus has a valid and important part to play within the overall context of Norwegian development assistance.

Rural electrification also provides opportunities for the utilisation of Norwegian managerial and technical expertise for the benefit of the developing world. Where programme conditions are appropriate, it allows substantial sums of money to be spent in ways which produce visible results and tangible benefits at a local community level.

2.0 Conditions for Effective Rural Electrification Programmes

In order to realise the potential impact of the funds available for rural electrification, it is therefore essential that programmes are targeted effectively. This requires detailed local knowledge and adequate participation by recipient communities.

It is particularly important that rural electrification programmes should only be implemented in areas where they have genuinely high local priority. Due attention must also be paid to questions of local equity and distribution of benefits.

When off-grid community managed supply systems are being considered, the establishment of the necessary institutional structures for their management, maintenance and repair needs to be given adequate consideration.

Care should be taken to ensure that rural electrification programmes which are being promoted are compatible with the overall policies and technical standards already in existence in the recipient country.

The technologies used for rural electrification programmes should be suitable, proven and available. Programmes should not be technology-led, but should be designed around the requirements of the users.

The potential need to make investments to stimulate demand and allow the full benefits of programmes to be realised should also be borne in mind.

3.0 Economic and Financial Aspects of Programmes

In general, rural electrification programmes will need to be subsidised.

In many programmes, the economic value of the electricity exceeds the resource costs of production, or at least represents the lowest cost of providing the energy. In such cases the programme can be justified in economic terms even though it may not show an adequate rate of financial return.

In some instances, however, it may be necessary to justify programmes on social and developmental grounds.

4.0 Potential Areas for Norwegian Development Assistance

At present the primary focus of the programmes being supported, particularly in Africa, is upon the electrification of growth centres, including where appropriate, isolated communities. The seminar was in agreement that this should remain as the major thrust of the programme.

The seminar also recognised that Norway has the capacity to provide assistance to rural electrification programmes across a broad spectrum of activities.

The potential areas of support include the following:

- *assistance in cost-effective design*
- *institution building - technical and managerial training*
- *provision of scholarships*
- *establishment of operation and maintenance systems*
- *economic modelling*
- *and general professional support*

Norway is also professionally well placed to offer recipient countries assistance in the formulation of overall electrification policies as well as the selection and design of individual projects. Norwegian capabilities can also be used in assessing the environmental and social impacts of rural electrification projects and programmes.

In addition to the provision of expertise and equipment, Norway can also provide assistance to developing countries in setting up their own equipment manufacturing facilities and small electricity-using industries.

5.0 Specific Next Steps

A multi-disciplinary rural electrification task force should be set up under the auspices of NORAD to gather relevant information on the state of the art in rural electrification.

The task force should produce policy proposals for future Norwegian technical assistance for rural electrification. Such recommendations would form an input to NORAD in its sector policy review which is presently under way.

In order to give practical point to its discussions, the task force should formulate its policy recommendations with reference to specific countries in Africa, Asia and Latin America.

3. OPENING ADDRESS

by S.A. Holmsen, NORAD

Dear participants, ladies and gentleman.

It was with great pleasure I accepted the invitation from the Seminar organisers to participate in this Seminar - and needless to say, I do consider it a great honour to be asked to facilitate its opening.

Rural electrification has for some time been on the MDC's *) agenda. However, as I feel we shall reveal during the Seminar, we all have different conceptions and understanding as to what "Rural Electrification" really is or means. To some - probably to most of the engineers - it is medium and small hydro schemes possibly with some kind of distribution net connected with it. To others, but possibly to the very few, it may mean alternative technology it terms of thermal power, wood fuel, solar power etc, - not to speak of the cultural, social and gender dimensions - where do they fit in to this? - and so on and so on.

One glance at the programme reveals, as of course would be expected, that all these aspects are being considered during the course of this Seminar.

Although this also has been presented to you in the invitation, I feel it is appropriate at this stage to remind you of the definition of Rural Electrification as suggested by the Organisers, - this must necessarily form an important base for the Seminar presentations and discussions, and for the ensuing results, for that matter:

"Rural Electrification is to provide rural people with an electricity supply appropriate with their social and economic context by means of the most suitable technology available".

As you have already seen from the invitation, the overriding objectives of this exercise, which are welcomed an supported by the MDC, are:

* to discuss the role of Rural Electrification in relation to Rural Development in Developing Countries and relevant conditions to be met to satisfy the overall development objectives.

* to review and discuss the present methodology and approach being used by the Norwegian expertise in the Third World.

* and finally, to discuss the possible future role of Rural Electrification in Norwegian Development Assistance.

It is also with pleasure I note that the Seminar aims at developing an action programme to satisfy the above objectives. This should ensure that the presentations and discussions will be action and future orientated and that the results should be concrete and manageable.

At this stage of my introduction, I feel sure that most of you have noted that it is being presented in the Queen's English. There are reasons for that, of course, - the main one being that we are lucky enough to have with us throughout

*) MDC: Ministry of Development Cooperation

the Seminar, Mr. Gerald Foley of the Panos Institute in London. You have all received information on Mr. Foley so I shall not go into details. It is with great pleasure, however I wish Mr. Foley welcome to this session. Those of us who have been dealing with the subject of Rural Electrification all know of course that Mr. Foley is an international capacity on the subject - however, I do think it is the first time we have the opportunity to work with him in Norway. You are most welcome, Mr. Foley and I trust the audience to make sure we make the most of picking your brain while you are with us at the Seminar. I do also extend my welcome to include an invitation to visit relevant personnel at the Ministry, should you find that of any interest. I feel sure you will be able to establish the right contacts and make the appropriate appointments during this Seminar.

The Ministry is naturally concerned that the Rural Electrification subject is discussed within the framework of the Ministry's prime objective, namely that of reaching the poorer part of the population and that also the women's position and role is considered in this context. Further elaborations on this, for the Ministry important issues ,will be given in Mr. Storløkken's presentation. With this in mind it is with special interest I am looking forward to the presentations of Ms. Vestøl on Motivation and Training of Women and Ms. Klaussen on the Socio Cultural Dimension - special because as an engineer I do realise that our breed cannot often enough be reminded of the importance of also including such non-technical, softer elements, as it were, in the planning process of what we normally tend to consider a technical project.

Dear friends, before I give the floor to our distinguished guest speaker, Mr. Foley, I take this opportunity to thank the organiser and host, NVE for this initiative and to wish you all a successful Seminar, professionally and socially.

Thank you.

RURAL ELECTRIFICATION IN A DEVELOPMENT CONTEXT

Presentation at seminar on Rural Electrification and Norwegian Development Assistance, Oslo on 14 March 1989.

Gerald Foley, Panos Institute, London.

The long term relevance of rural electrification to rural development is not in question. Electricity is a passport to the modern world. Without it, the people of the rural areas in the developing world are denied access to that expansion in the range of opportunities for human fulfilment which is the most characteristic feature of the late 20th century.

The problems facing development assistance agencies when they come to consider rural electrification have nothing to do with finding a fundamental justification for its promotion. They are to do with what priority it should be given at any particular stage in the development of a particular area. They are also concerned with such short term issues as defining the context and conditions under which programmes will work, making the correct technical decisions, and ensuring that the institutional capacities, funds and technical expertise are available to sustain the system on a long term basis.

Before turning to a discussion of rural electrification it is, however, useful to look briefly at the energy context within which programmes are carried out. Rural electrification is a means of providing an energy supply; it can be seen as a response to an evolving pattern of rural energy demands.

1.0 The overall energy context

The rural areas of the developing world contain about 2.5 billion people, about half the human population. The proportion of these without electricity varies greatly between continents and between countries. Very roughly, it is about 75% in Latin America, 80% in Asia and North Africa, and 95% in sub-Saharan Africa (Menanteau, 1987). The total number of people without electricity is therefore about 2 billion people.

But the diversity of the Third World should never be forgotten. It is, in fact, far greater than that of the industrial world which is increasingly homogenised. The Third World, in comparison, contains a much broader range of social, economic, cultural, and environmental conditions.

Looked at in purely economic terms, the largest group of rural people consists of those living a life of subsistence or near-subsistence farming. Their dwellings are made of non-commercial materials: poles, straw and mats. They have total family incomes which are below say $500 per year. This means they have to provide themselves with everything they cannot grow or collect from their surroundings with a total cash outlay of just over one dollar per day.

The economic range extends upwards to families with disposable incomes in the range $1000-1500 who are beginning to possess some of the

comforts and artefacts of modern life. Above these come the larger cash crop farmers and the business people in villages. And then there are those, such as the white farmers in Africa and the hacienda owners in Latin America, with very large incomes indeed; but these are a tiny proportion of the total. In Zimbabwe, for example, the white farmers account for about 4% of the total rural population.

1.1 Energy for cooking

The largest energy need of all these people is for cooking, and in some cases, for heating. This is met virtually entirely by wood and other biomass fuels. Most of this is collected from people's own farms or nearby communal lands without any payment. In other words, this is non-commercial energy consumption.

There is at the moment, a debate going on about the exact nature of the "woodfuel crisis", or indeed whether there is one at all. A lot of money has been spent trying to promote fuelwood plantations of various kinds throughout the developing world with very little result. People do not seem to be interested in it. They may be prepared to grow trees for timber or poles; but they are not willing to do so to produce woodfuel.

The reason appears to be that when good quality fuelwood becomes hard to get, people substitute twigs, bushes, dung and agricultural residues. Although these are not such good fuels as wood, they are abundantly available. In other words, if the local biological system can produce enough food to feed people, it will more or less automatically also produce enough fuel to cook it with. Again, this is non-commercial fuel.

This has considerable importance for rural electrification planning. Shortage of fuelwood does not drive people towards electricity use; it generally makes them substitute other biomass fuels. There is, therefore, no reason, in energy terms, why rural people should use electricity for cooking or heating. If people are to switch to electricity it will almost invariably be because they have reached a level of economic prosperity at which they can can afford the extra comfort and convenience it brings.

1.2 Lighting and motive power

For those at the lowest income levels in the rural areas, the open fire is often the only source of light.

Once there is any money available beyond that needed for the absolutely basic needs of subsistence, however, light appears to have a very high priority for rural people. Hundreds of millions of families use kerosene lamps. The poorer tend to use simple wick lamps; the rather better off use pressure lamps with incandescent mantles. Gas lamps are also used, but not so often. It is also surprising how often electric torches are used.

Most of these light sources are very inefficient in energy terms and generally poor value for money. Up to recently there has been little factual information on this but the gap has been filled by a very

useful World Bank study of the comparative energy efficiencies and costs of different lighting methods (Plas, 1988).

It shows that people using candles and kerosene wick lamps have to endure extremely low lighting levels. About 60 candles or 18 kerosene wick lamps are required to match the output of a 60 watt tungsten filament light bulb. The pressure lamps with incandescent mantles are much better and provide slightly over half the light of a 60 watt bulb. But the light distribution is mainly horizontal and hence they do not provide the same degree of useful illumination on a horizontal surface as a suspended light bulb.

In terms of energy efficiencies, the tungsten filament lamp is about 12 times more efficient than oil or gas pressure lamps which, in turn, are about 8 times more efficient than wick lamps. This is based on a 30% efficiency of electricity generation.

Looking at motive power, the vast majority of rural people rely on human or animal muscle power for ploughing, harvesting, water pumping, crop processing, and small scale artisanal activities. The quantities of energy involved are extremely small. A full-grown adult male working an eight hour day is likely to have a total output of about 0.5 kWh. The output of a bullock is unlikely to exceed about 5 kWh.

Some of the more prosperous farmers and business people in non-electrified areas of the developing world use diesel engines to provide motive power for pumping and a variety of tasks. This can be seen, for example, in the large commercial farms in Zambia or in parts of India where there is no rural electricity supply or where it is so unreliable that farmers cannot depend on it.

2.0 Rural electrification

The term rural electrification means different things to different people. When a country is at the beginning of its national electrification programme, rural electrification may simply mean bringing electricity to large provincial towns. Much later in its programme, rural electrification may come to mean bringing a supply to tiny villages and isolated farmhouses.

The term rural electrification may also have technological connotations. For many utility engineers it simply means extending grid supplies into the rural areas and the provision of utility managed off-grid generation systems. For others, it may include small private diesel or petrol generation systems, microhydro installations, and solar lighting systems with an output of a few tens Discussion of all of these is relevant to this seminar. It was to ensure they were all included that the definition of rural electrification used by the conference organisers was drawn up. It says that rural electrification means "To provide rural people with an electricity supply which is appropriate to their social and economic context by means of the most suitable available technology".

It is a slightly tortuous definition but it is worth thinking about for a moment or two. It says: "appropriate to their social and

economic conditions". This means that it is not simply a question of providing an electricity supply; the social and economic conditions of the people being supplied must enter into the design and planning of the system. It also says "the most suitable available technology". Rural electrification is not about technical experiments or pie in the sky. It is about the use of proven available technology to provide reliable supplies of electricity.

2.1 Rural electrification myths

There are a number of persistent myths about rural electrification which it is worth getting out of the way at this stage. The point is not purely polemic or academic; it also affects the way in which programmes are conceived and planned.

* First myth: rural electrification causes rural development.

A moment's thought shows that rural electrification by itself cannot cause development. When development is taking place, a variety of new energy demands emerge people as the local economy expands and diversifies. Some of these may require an electricity supply but they are not caused by it.

Electricity consumption, like all energy consumption, is a derived demand. It is quite unlike the demand for food or video cassettes which people want for what they are. Nobody wants electricity for itself; they only want it because they want something else which needs it. Thus, electricity consumption may be associated with rural development, but it does not bring it about.

* Second myth: rural electrification increases agricultural production.

The vast majority of rural electrification programmes have little or no direct effect on agricultural production. Depending on pricing policies, electricity may, however, provide farmers with a cheaper alternative to diesel for pumping and some other uses.

The main stimulus to increased agricultural output tends to be improved agricultural product prices and wider market opportunities. The availability of electricity supplies can improve the ability of farmers to benefit from such opportunities.

* Third myth: electricity slows down the rate of migration from the rural areas to the towns.

There is no evidence that it does any such thing. In general, rural development brings about a reduction of the rural population in relative and absolute terms. This has been the universal experience of the industrial world over the past two hundred years and it has been repeated in the newly industrialising countries in the period since the Second World War.

In so far as rural electrification is associated with the process of rural development, it can therefore be expected to lead to a reduction in the rural population.

* Fourth myth: rural electrification eases the pressure on fuelwood resources and helps protect the environment.

Again, there is no evidence that this is the case to any significant extent. Most fuelwood is used for cooking and is collected without payment. Electricity is completely out of the question as a cooking fuel for the vast majority of rural people presently relying on fuelwood.

* Fifth myth: rural electrification causes a reduction in the rural birth rate.

This is normally mentioned as a kind of joke; but some people appear to believe it. It is not the availability of light which prevents people producing children; if it were, procreation would stop completely in Scandinavia in the summer months. The most that can be said is that the use of electricity in the rural areas is part of a general process of economic development, improved education, and increased access to birth control measures and may therefore be associated with a decline in birth rates.

2.2 The role of rural electrification in development

None of this is to suggest that rural electrification is irrelevant to development. In fact it is essential.

Development, in broad terms, means a progressive increase in access to the benefits of science and technology. It means better health care, improved quantity, quality, variety and reliability in food production. It means increased and diversified leisure opportunities; improved information and communication services; and access to new and more effective methods of producing goods and services.

Increasingly, all these depend upon electricity. The society which does not have electricity is extremely restricted in its development opportunities. With the increasing electrification of modern society, the developmental threshold at which at electricity supply becomes a condition of further progress is, arguably, becoming lower all the time.

Moreover, when development takes place, the availability of electricity profoundly affects the form it takes. The household or the village which is able to invest a proportion of its disposable income in goods and services which use electricity is very different from that where there is no electricity use. Nor is there much doubt that the majority of people prefer to have development with electricity rather than development without it.

The availability of electricity can also provide a considerable stimulus to development. It opens the possibility of providing people with a wide variety of goods and services which would not otherwise be available. In other words it contributes to the expansion and diversification of the rural economy.

But simply providing an electricity supply may achieve nothing at all. The most notorious example of this comes from Orissa in India where one study found that only ten out of 64 villages which had been

electrified between 1978 and 1981 had any connections at all. In those ten villages, the total number of connections was 52 and half of these were in one village (Smith et al, 1983).

In short, the availability of electricity is a necessary but not sufficient condition for rural development to occur beyond a certain level. Providing a supply will not in itself cause development to occur; but withholding it can prevent development taking place.

Planners cannot therefore assume that implementing a rural electrification programme will necessarily have any beneficial effect. They have to establish that the other conditions necessary for development are there or can be provided at the same time as the rural electrification programme. Put another way, rural electrification must be an investment priority at the local level.

2.3 The problem of costs

Granted that a role can be identified for rural electrification, the next problem which must be faced is that of costs. Rural electrification is, in fact, extremely expensive. If consumeds are charged the full costs, there will be very few programmes.

The vast majority of rural electrification programmes lose money in the sense that they do not cover their capital costs within the first ten years of operation. Many cannot even cover their running costs within the first five years. If rural electrification is to be carried out, it will require a subsidy.

This means that programmes are in competition with other calls upon the available financial resources of govenments and donor agencies. There is no easy answer to this. The priority given to rural electrification, and the funds allocated to it have to be decidded in the light of the general economic position of the country. The position will also tend to change, with rural electrification acquiring a higher priority as development proceeds.

2.4 Conditions for successful rural electrification programmes

In the broadest terms, a successful rural electrification programme is one which results in a widespread use of electricity; there is no point in providing a supply if people cannot or will not take advantage of it. Moreover, successful schemes will not place an undue financial burden on the supply and will, for example, be able to meet most of their running costs within say five years.

Given such a definition of success, certain preconditions for it are relatively obvious. The area to be electrified must already have reached the level of economic development at which family incomes are high enough for people to afford the connection fees, house wiring expenses and regular bills.

If farmers are to invest in electrical equipment they must believe that there is a market for the extra goods or services which electricity will enable them to provide. The same is true of entrepreneurs and business people.

When the community is expected to pay for street lighting, pumped water, communal television or other facilities, there must be a local consensus that these have a priority. This normally presupposes that a certain level of more basic infrastructure already exists.

The World Bank has suggested that the following indicators as a guide to areas which are suitable for rural electrification programmes:

"* the quality of infrastructure, particularly of roads, is reasonably good;

* there is evidence of growth of output from agriculture;
* there is evidence of a growing number of productive uses in farms and agro-industries;

* there are a number of large villages, not too widely scattered;

* income and living standards are improving;

* there are plans for developing the region;

* the region is reasonably close to the main grid (if the demand is particularly strong, remote regions may be considered too)" (World Bank, 1975).

The exact weight to be given to the various factors in the above list will depend upon local physical, economic, and social conditions. Nevertheless in any particular country, such a set of criteria can be drawn up and used in the selection of the most promising areas for rural electrification.

Where these conditions apply programmes will normally succeed. Investments which depend on electricity being available will be made; new productive enterprises relying on electricity will be launched; there will be widespread use of electricity among domestic consumers; and the general pattern of development will be shaped and influenced by electricity use. Moreover, the financial losses will not be excessive; some programmes will even make a profit.

2.5 Areas of need but no demand

The application of such criteria will, however, mean that rural electrification is confined to the more economically prosperous areas with immediate development potential. This excludes a high proportion of the rural population in a large number of developing countries.

Moreover, the fact that the economic conditions for successful rural electrification programmes do not exist does not mean that there is no pressure to provide it. Neither does the absence of an economic demand for electricity mean there is no need for it.

The basic problem facing a large number of developing countries is the economic deterioration of their rural areas. For many rural people there is literally no alternative to the slums and shanty towns of the major cities if they are to survive.

These cities are often castigated as being parasites upon their rural hinterlands. In fact, they represent an economic opportunity not only for those migrating to them but for those who remain in the rural areas. The urban population has to be fed, supplied with timber, poles, firewood, leather, mats, baskets, carpets, fabrics and a myriad of other products. These can all be supplied by producers in the rural areas of their own countries.

One of the most telling indicators of the declining economic position of the rural areas in some of the poorest countries is the way in which they are losing these urban markets. In West Africa, meat from Argentina is displacing that formerly supplied by the pastoralist herdsmen of the Sahel. Wheat from the United States, rice from India, dairy products from the European Community increasingly flow into the cities of some of the poorest countries of the world.

There has been a major focus on the burden of fuel imports in the balance of payments of many Third World countries. This has diverted attention from the fact that these, almost entirely agricultural countries, are failing to produce enough food to feed themselves. In 1985, food imports to Ethiopia and Senegal were twice those of fuel. Bangladesh, Burkina Faso, Niger, Benin, Somalia, all spent more on food imports than fuel in the same year; Bangladesh's food imports amounted to 60% of its export earnings (World Bank, 1987).

Increasingly the small farmers of the developing world are unable to produce the types of foodstuffs, in the necessary quantities, and at a price and standard of quality which enable them to compete in the urban markets of their own countries. The same is true of a variety of other goods which could be produced at a village level; they cannot find a place in competition with cheap mass-produced imports. The result is that the rural areas are increasingly being marginalised and isolated from the urban economy; and they have nowhere else to turn.

If rural producers are to have a chance of competing in the urban markets of their own countries, major changes in production systems will be required. Farmers will have to look to new products, higher quality standards and greatly increased output. There will be a need for irrigation, processing, freezing, packaging and other developments. Improved techniques for handicrafts and small scale manufacturing will have to be introduced and disseminated.

None of this essential restructuring of the rural economy will happen if rural development efforts focus primarily on subsistence production and basic needs. The option of standing still in the rural areas is no longer available; either the rural economy diversifies and becomes more productive or it will continue to slide into increasing destitution and economic irrelevance.

Rural electrification on its own is certainly not going to bring about the kind of rural revolution required. Neither, on the other hand, is it going to happen without electricity. No other form of energy supply can match its versatility, flexibility and efficiency in meeting the wide range of energy needs which emerge as the rural

2.6 The rural electrification dilemma

Throughout the developing world, the number of rural families obtaining an electricity supply each year is rarely more than 1-2% of those still unconnected. Between 1971 and 1987, the proportion of rural people with a supply in Latin America and Asia increased by only 4%; in sub-Saharan Africa it did not change. In the poorer countries, the rate of new connections is lower than that of population growth; the possibility of obtaining a supply is receding for the majority of their rural families.

At a social and political level, this is quite unacceptable. Rural people know about electricity and increasingly they want it. The pressure being placed upon politicians and supply utilities to step up their rural electrification programmes is intense.

National political leaders cannot tell a delegation from one of the provincial areas that they will not be able to provide them with an electricity supply for the next half century. They must to be able to offer a greater degree of hope if rural people are not to feel even more marginalised than they do at present.

But mounting political and social pressures do not alter the underlying economics of programmes or make it any easier for utilities to accelerate the pace of rural electrification. The need may be great but the conditions for successful programmes simply do not exist in the majority of areas. Nor are the resources available which would enable governments to relax the normally applied financial and economic criteria and provide programmes with increased subsidies.

The dilemma facing governments, electricity utilities and rural electrification planners is thus an acute one. It is to find a way of affording a necessity which logical analysis clearly shows to be unaffordable.

3.0 Improving the conventional approach

There is no magic solution to this dilemma. There is no new technology which provides "the answer". The way forward is partly by improving the effectiveness of the existing approach to the design and implementation of rural electrification programmes, thus permitting the available resources to go further. It will also involve the development of innovative approaches which will be able to supplement the conventional approach.

But there is no doubt that the conventional grid-extension approach will continue to play the central role in rural electrification for the foreseeable future. It has proven itself historically and has self evident technical and operational advantages.

There is, however, considerable room for improving the effectiveness of this approach. If the pace of rural electrification is to be increased and the limited resources available are to be used to the best effect, it is vitally important that there is a continued

questioning of methods and a search for better ways of implementing programmes.

The following are a some of the main areas where there are opportunities for improving the effectiveness of programme design and implementation.

3.1 Need for autonomous rural electrification agencies

Rural electrification is difficult to reconcile with the primary concerns and priorities of most utilities. It is high in its demands on staff and resources and low in its financial returns In many cases, the efforts and resources required to bring a loss making supply to a few hundred rural consumers if applied in an urban area would produce several megawatts of profitable connections. It is small wonder that rural electrification almost inevitably has to take second place to the more urgent needs of urban and industrial consumers when there is competition for resources within the supply utility.

These conflicts can only be resolved by ensuring that rural electrification is made the responsibility of a separate implementing agency. The exact institutional structure can vary. It may be a division within the national supply utility; an external body which is linked to it in some statutory way; or a completely autonomous agency. There is a variety of successful working models to choose from. What they all have in common is a high degree of autonomy and control over their budget, manpower, and materials.

There is no conflict of interest within such an autonomous agency; rural electrification is its only area of concern. This also ensures that there is a clear division of financial responsibilities between it and the utility. Electricity utilities should be able to make a profit on their overall operations; rural electrification normally needs to be subsidised. It is therefore important to separate the two areas of activity so that both can be set their own financial performance targets.

The existence of a separate implementing agency also makes it easier for donor agencies to support rural electrification. Many donor agencies have funds which are specifically allocated to rural development programmes. Such funds cannot normally be given to national electricity utilities, or even channelled through them. A clearly identified rural electrification agency would often be able to attract such funds.

3.2 Savings in the design and implementation of programmes

It is widely accepted that major savings can be made in a large number of rural electrification programmes by attention to the standards and design methods presently in use. Frequently the individual savings are relatively small but a number of studies have suggested that collectively they can be in the range 30-37%.

One particular area of potentially large savings is that of design standards. There can be no suggestion of lowering safety standards.

But equally there is no point in designing systems which will only be supplying small domestic appliance loads as though they had to meet the cooking, central heating or air conditioning demands of urban Europe or America.

Other areas of over-design which a variety of studies have noted include the use of steel or concrete poles where wood would be perfectly adequate; attempts to maintain ±5% voltage limits which are not justified by the end uses, or even possible given the quality of the generating system; the use of 3-phase supplies where single phase is adequate; and the metering of supplies which could be provided under a much simpler and cheaper load limited system.

3.3 Improved liaison with other rural development agencies

The stated aim of most rural electrification programmes is to promote rural development. In the majority of cases, however, rural electrification programmes are approached and planned on a purely technical and economic basis. There is little, if any, detailed collaboration or liaison with other agencies concerned with rural development.

Often this means that when rural development programmes are being planned, rural electrification is only considered as an afterthought; and often it is not considered at all. If there were better liaison with the rural electrification agency, rural development organisations would be encouraged to consider the relevance of rural electrification at an early stage in planning their own programmes. This would lead to more rural electrification programmes being directed into areas where other complementary investments were being made and would increase their chances of having a significant developmental impact.

Improved coordination with other rural development efforts could also be helpful in increasing the flow of financial resources into rural electrification. Donor agencies presented with a comprehensive development programme, including a rural electrification component, might well be prepared to provide it with support which they would not be prepared to give to a rural electrification proposal on its own.

The degree of coordination to achieve such objectives would not require elaborate institutional arrangements; and any attempt to establish them would almost certainly be counter-productive. The last thing wanted is unwieldy high-level committees of senior government officials trying to protect their departmental interests. The need is to ensure that other agencies are informed of the plans of the rural electrification agency and that it, in turn, is aware of other development programmes in its areas of activity.

The overall objective should be to ensure that the potential relevance of rural electrification automatically appears on the agenda when national and international development agencies are discussing their rural investment programmes. The rural electrification agency should aim to be seen as a resource upon which other organisations can call for information on where electricity might be relevant, how it might be supplied and how much it would cost. Where detailed coordination of rural electrification with other development programmes is required this can be carried out on a case by basis.

3.4 Actively selling rural electrification

There is no point in carrying out rural electrification programmes which do not result in a substantial and growing demand for electricity. If electricity is to be an agent of change, it has to be used.

There is, however, a tendency among many electricity supply utilities to concentrate almost exclusively upon the analysis, design and construction of rural electrification schemes. An electricity supply is provided as though it were simply a basic infrastructural service like water or sewerage, and there is little, if any, attempt to promote its use. Some utilities act as though their task has been accomplished once the supply lines have reached the village and there is no attempt to sell the service to as many consumers as possible.

In fact, the utility can do a great deal to boost the demand for its product. Large numbers of people have only a vague idea of what electricity can do for them. They know it can provide light and provide power for a radio or television but may have little awareness of its other uses.

Many people also believe that electricity is extremely expensive and are afraid to use it once they have a supply. The fact is that electricity can be extremely good value for money in many uses. The relatively high cost per unit of energy is offset to a considerable extent by its efficiency in use.

The passive attitude of many rural electrification agencies towards their potential markets therefore needs to give way to a vigorous policy of promoting electricity use. Information campaigns can be supported by demonstrations of the use of electrical equipment; a portable generator can be used to show the benefits of electricity in areas where there is not yet a supply. Appliances can be sold at a discount or easy credit terms to encourage their wider use.

4.0 Utility operated off-grid systems

The principal alternative to grid extension for rural electrification at present is the use of utility-operated diesel generators. They play an extremely important part in extending the geographical range of electricity supplies and will undoubtedly continue to do so in the future.

Typically, these systems are installed in provincial towns or other relatively large demand centres. They employ a number of diesel generating units which allows flexibility in load following and provides stand-by plant for use in emergencies or during routine maintenance.
With load development, these isolated generators may become part of a local grid system in which electricity supply lines are extended outwards from the town to supply nearby villages or households. Eventually, the majority of these isolated plants are connected into the main national system as it gradually extends throughout the country.

Big is beautiful is the general rule in virtually all utility-managed isolated generating systems. The reason is cost. All plant requires skilled operation and maintenance, with staff in permanent attendance during operating hours. With diesel there is also a major increase in energy efficiency with size.

The result is that there are considerable economies of scale. The overall generation cost per kWh from a 1 MW plant may be half or less that of a 100 kW plant. Once the installed capacity drops below, say, 100 kW, the costs become extremely high and may well be $1.00/kWh or more. But even with the larger units, the costs are generally very much higher than those in the grid system.

Close examination of individual systems is likely to show a variety of ways in which their technical and financial performance can be improved. But in all cases, the smaller the load the more difficult it is to provide electricity at an acceptable or affordable cost.

4.1 Small hydro systems

Small hydro plant may be used to substitute for diesel where suitable water resources are available. The technology is well proven and under appropriate conditions can provide an economically competitive alternative to diesel.

Hydro may also be used in conjunction with diesel. It may, for example, be possible to use hydro to provide base load supplies with diesel being employed for peak or dry season loads.

It is, however, important that the existence of water resources in an area does not become the primary reason why an electricity supply is provided. Still less, should the size and quality of these resources be the factor which determines the type of supply which is provided.

Electricity is not supplied for its own sake. The supply system needs to be designed so that it is matched to the social and economic role which electricity can play in the community. It is this which has to be determined in advance. Only then, can the decision be made as to whether the available hydro resources can be used effectively.

5.0 Community or privately managed off-grid systems

When it comes to providing electricity for the myriads of small villages in which the majority of the rural population of the developing world live, utility managed off-grid systems are more or less irrelevant. These villages have electricity demands in the range 10-100 Kw. Only a tiny proportion of these can be provided with a utility-operated supply.

Senegal is just one example. It has a total of 13 000 villages. Under the rural electrification Master Plan which began in 1985, approximately 100 of these, about 0.75% of the total, are likely to obtain a supply by the year 2005.

If even a small proportion of the small isolated villages of the Third World are to be provided with an electricity supply within the next

half century, it will have to be by means of community or privately managed off-grid systems. Moreover, communities will also have to make a contribution from their own resources to the capital cost of these systems. This is the only available method which offers hope of mobilising new funds for rural electrification and reducing operating and maintenance costs to acceptable levels.

There are other advantages to this approach. Because it depends on people making the choice to commit their own resources to rural electrification, it ensures that programmes will tend to focus on areas where local people themselves feel that electricity is a priority and likely to used.

It also helps defuse the political pressures for rural electrification. Communities who feel that they want a supply do not have to wait passively for some indefinite future date when the utility can fit them into its programme. They can invest their own resources if obtaining an electricity supply has a sufficiently high priority for them.

5.1 Primarily a management problem

When electricity supply systems for remote villages are being considered, there is a common tendency to think primarily of the type of technology which should be used. In fact, the choice of technology is relatively unimportant.

There is a variety of fully developed small-scale methods of generating electricity. The key questions are concerned with the delivery, operation, maintenance and repair of the systems used. These are primarily management issues. They are rarely given the attention their importance warrants

The first requirement is a national focal organisation which coordinate and implement a programme which has the technical and managerial capacity to develop and deliver the necessary systems. Single projects, however successful, are irrelevant in the overall context unless there is a national organisation which replicate them on a substantial scale.

There must be a means by which village communities can be made aware that there is a possibility of obtaining a locally managed supply. This requires the production and distribution of publicity material and the creation of a means of following up requests for further information.

Local communities need to be provided with the necessary information for making rational choices between the various supply options available to them cannot be over-emphasised. They need to be told honestly and in an unbiased manner about each of the options and how they compare with each other. How much will it cost to have a small diesel or petrol generator, a micro hydro, a solar photovoltaic system? What kind of service does each of these deliver? What are the limitations on the appliances which can be used? How much does fuel cost? How much does it cost to have the system repaired when it breaks down and how long is it likely to take? How difficult is it to manage and maintain the system?

The availability of this kind of information is taken for granted by people purchasing cars and consumer durables in the industrial world. It is surprising how often it is not available to rural people in the developing world when they are being urged to adopt particular energy technologies.

The procedures by which villages apply for and obtain a supply once they have made a decision to obtain a supply must be established. Standard contracts between the rural electrification agency and the villages concerned have to be drawn up. The procedures for making a cash deposit, having the installation checked and approved, and making final payments need to established.

Installation crews must be assembled and trained. Construction and operation manuals have to be prepared. Packaging and transport arrangements have to be made. Methods of training community members in the operation of systems need to be developed.

Village communities may also need to be provided with guidance and help in the management of systems. This is particularly the case with financial matters. Many are unable to build up adequate reserves to deal with repair and replacement bills.

Even the best equipment breaks down. If communities are going to operate supply systems on a long term basis, they have to be provided with a service which will regularly inspect installations and carry out repairs when necessary. These services have to be easily accessible to local communities in case of emergencies and must be able to carry out repairs within a reasonable period of time.

If electricity supply systems are liable to lie idle for months waiting for repairs, the community dare not allow itself to be dependent upon them for any important functions. Providing villages with generation systems without an adequate repair service is an infallible way of ensuring that whatever electricity is produced will be of marginal developmental importance.

Repair and maintenance are ultimately likely to be the principal factors which decide whether off-grid generation systems succeed or fail.

5.2 Choosing and testing supply options

The technical options available for producing electricity at a local level include diesel and petrol generators, micro and mini hydro, solar photovoltaics, and perhaps others on certain occasions. In each case, the technology itself is well known. The task is to put such technologies at the disposal of local communities so that they can obtain a safe, reliable, and affordable electricity supply.

In each country, therefore, a range of practical small scale generating systems needs to be developed from which local communities can choose that which is best suited to their needs and economic means. This will go beyond simply selecting the type of device which will be used for producing the electricity. It will have to include the complete system or technical package required to provide the local community with a working electricity supply.

The cheapest and simplest package might only be able to meet a demand for lighting and some small power uses. Where there is a potential for irrigation and other productive uses, a system with a considerably larger output would be needed. The range of outputs would depend upon the possible applications in each country. In Fiji, for example, the generator sizes installed under the village electrification programme range from 3.5 kW up to 90 kW.

In developing such systems, the practical reality of village operation must to be borne in mind. The need for simplicity and reliability is paramount if systems are to be operated and maintained by rural people with little technical training and experience. Systems should also have an adequate degree of flexibility to enable them to be expanded relatively easily to accommodate the growth in demand which will almost certainly occur if projects are successful.

Each technical package needs to be fully comprehensive. It should provide all that is needed for housing and installing the generator, setting up the local distribution system, wiring the houses, and providing the local people with the lights and other appliances they are likely to use. Technical manuals for installation and training of local people in operation and maintenance procedures also need to be prepared. Unless the whole package is provided down to the last screws and fixings there will installation mistakes, omissions, and improvisations at a local level, and systems will not work.

Field trials of each package, carried out in close consultation with the local community in selected villages are essential. These will permit installation problems to be identified and dealt with; they will provide information on the performance, safety and reliability of systems; and they will be an opportunity for the development of manuals on the operation and maintenance of installations.

Such testing is slow, difficult and often discouraging; little can be firmly established without at least a year's working experience under actual field conditions. But if it is omitted or skimped, there is little hope of developing practical and reliable systems. Unless all the likely problems are identified and solved before programmes are launched, installations will fail under working conditions as experience has so frequently shown in the past.

The question of costs must also be dealt with realistically from the beginning. There is no point in testing and developing systems which are too costly for their widespread dissemination to be practicable. Neither should communities be provided with free supplies of electricity as this will not happen in practice. Some compensation for the fact that the village is being used as a testing ground should be allowed; but the understanding should be that the community will pay for the supply and that it will be maintained in use after the trial period is over.

The development of a range of practical working electricity supply systems for use in isolated villages is thus a substantial and time-consuming task. It requires an organisation with technical and managerial expertise and an ability to enter into an effective dialogue with village communities. Although it may not be able to fulfil the full of tasks required, the key role is likely to be played by the rural electrification agency. It should, however, be prepared

to enter into coalitions and collaborative working arrangements with NGOs, the private sector, and any other organisations whose help it can use in meeting its goals.

6.0 Programme funding and mobilisation of community resources

The majority of community-based rural electrification schemes are no more likely to be able to pay for themselves than grid extensions. This means they will have to be subsidised.

The level of this subsidy, like that for conventional rural electrification programmes, will be a matter for government decision in each country. It will depend on the availability of funds and the degree of national priority which is given to rural electrification. It might, for example, be based upon the level of subsidy enjoyed by consumers provided with a supply in grid-based rural electrification programmes.

There should be no question of making donations of electricity supply systems to local communities. Experience has shown that giving free gifts of generating equipment leads to a high rate of damage and neglect. Electricity supplies should only be provided to communities which are interested enough to make a significant cash contribution to their cost. This is the case when supplies are provided from the grid and it should also apply in the case of off-grid options.

Unless there is a reasonable level of contribution, there is no means of knowing whether obtaining an electricity supply has a high priority for the community. If it has and people are making a cash payment for their supply, there is a reasonable chance they will exercise their ingenuity and ensure that the electricity is used to the maximum effect to improve their living standards and economic conditions.

There are numerous precedents for this kind of self-help in other areas of rural development. One of the solar photovoltaic pump programmes in Mali, for example, relies on the same principle. Pumps are only installed in villages which are prepared to make a substantial contribution to their cost.

Many villages also make contributions for other facilities they wish to obtain and may establish a fund for building a school, a church or mosque, obtaining a water supply, or constructing a road. A similar fund could be created for rural electrification. Village people working in the cities and abroad would probably be willing to subscribe it and they could also help by providing their families with electrical appliances and equipment. Such gifts are commonly given and have the additional effect of making electrification a more attractive investment for the village. Part of the village contribution to the cost of a supply can also be made in kind by providing labour and locally available materials for the construction work.

In community-managed schemes, the village, in addition to making a contribution to the capital costs of the supply will also be obliged to manage the system and pay for the necessary fuel, lubricating oil, distilled water and any other operating requirements. Arrangements

will also have to be made for meeting at least a proportion of the costs of repair and maintenance from village funds.

Mobilisation of community finances and labour in this way can accelerate the pace, widen the scope, and increase the effectiveness of rural electrification programmes in many areas. It not only increases the flow of resources into programmes; it also improves their targeting since villages which are prepared to put such efforts into obtaining a supply are likely to be those where people feel confident they will benefit and where the demand will tend to be relatively high.

7.0 Keeping renewables in perspective

Over the past ten to fifteen years a major emphasis has been placed upon renewable energy technologies. They have frequently been seen as having a specially relevant role to play in the developing world. This, for example, was one of the major themes of the UN Conference on New and Renewable Sources of Energy held in Nairobi in 1981. The result has been a certain amount of rather blinkered thinking about renewables which has, at times, caused them to be chosen for projects for which they were clearly inappropriate and considerably more expensive than conventional options.

There is, in fact, no justification for any special treatment of renewable energy technologies in rural electrification programmes. They provide a means of supplying electricity which needs to be evaluated strictly on its technical and economic merits and overall capacity to perform satisfactorily in the programme in question. Where a renewable technology can demonstrate that it is the best available option, it should, naturally, be chosen; but it should not be given preferential treatment in the analysis.

It is sometimes argued that without extensive practical experience and a reasonable market for manufacturers, renewable technologies will never become technically and commercially viable. This is true. It does not necessarily mean that the villages of the Third World should be used as a test-bed for the development of technologies which will primarily benefit manufacturers in the industrial world. There may, indeed, be cases where such projects can usefully take place with the informed consent of all concerned; but it is important that this kind of commercial product-development should not be disguised as aid or take its place.

7.1 The question of petroleum fuel supplies

One of the reasons for the interest in renewable energy sources is the burden of oil imports on the balance of payments in many Third World countries. This was particularly acute after the 1979 petroleum price rises. In recent years, oil prices have fallen drastically; the autumn 1988 price of $12 per barrel brought the price in real terms back to its pre-1973 level. Oil imports, nevertheless, remain a source of worry for many developing countries, particularly those in which a fall in the value of their currencies has reduced the benefit of lower oil prices.

The quantities of oil required to meet off-grid rural electrification demands are such a tiny proportion of the total national consumption in most developing countries, however, that it makes no significant difference whether they are supplied by oil products or renewables. A comparison with the transport sector, which typically accounts for 60-70% of the total petroleum used in a developing country, shows this clearly and puts the problem in perspective.

In the majority of cases, the initial electricity demand of a small or medium size village can be supplied with a generator of not more than 50 kW output; this is roughly equivalent to the engine of a small Japanese or European car. The needs of a large village or provincial administration centre can usually be met with a 100-200 kW diesel generator. This is roughly equivalent to putting another commercial vehicle on the road.

Such comparisons show that the petroleum fuel required for a large scale programme of off-grid village electrification is negligible in comparison with the amounts required for transport in the majority of developing countries. In Kenya, for example, the total number of motor cars in the country in 1985 was 126 000; the growth rate over the previous few years was about 3000 vehicles per year. The total number of trucks and buses in the country in the same year was about 104 000 with a growth rate of around 5000 vehicles per year (Kenya, 1986).

If the country embarked on a truly massive rural electrification campaign, aiming at say 1000 large centres and a further 5000 smaller villages to be electrified by the year 2000, the additional impact on the total national consumption of petroleum fuels would be equivalent to that of about three months normal growth in the transport fleet. There is, therefore, no reason, on balance of payments grounds, why diesel generators should not be used for rural electricity supplies - provided they are otherwise the best choice.

There are also fears that the present period of low oil prices is a temporary phenomenon and that the world price of petroleum is likely to rise again in the future. This is, indeed, likely; oil is a finite and diminishing resource and is certain to become scarcer in the future. The timescale on which this happens and the extent of the price rises likely to occur are, however, subject to considerable doubt.

At present there is a massive surplus in oil production capacity in the world. The OPEC nations, for example, are producing at little more than 50% of their available capacity; their present shut-down production is greater than the total consumption of Europe. The reason for this surplus is that world oil consumption has not grown as expected; it was virtually the same in 1987 as it was in 1977. Such surpluses will disappear only after a sustained period of growth in world consumption which has not, as yet, shown any sign of happening. It is therefore unlikely there will be any radical change in world oil markets within the next 7-10 years, roughly the working life of most of the technologies used for off-grid electricity generation.

The implications of this are considerable. It has often been suggested that investments in renewables should be seen as providing a safeguard against future increases in the price of oil. But there is

no point in investing in technologies which are presently more expensive than diesel if they are not likely to become competitive before they reach the end of their working life. It is better to defer such speculative investments and continue to use the cheapest available options until the prospects for future oil prices become clearer and dictate otherwise.

8.0 The role of donor agencies

This paper has attempted a broad review of the whole rural electrification scene. It has skated rapidly over a variety of complex questions. Its treatment of the technical side has been, to say the least, fairly sketchy; other important issues like tariff policy have not been touched at all. It is not possible in a short presentation, or even a relatively lengthy paper like this, to cover all aspects of such a complex subject as rural electrification. The aim has been to highlight some of the key issues which have to be examined when rural electrification strategies are being developed.

Before finishing, it is however important to draw some of the strands of the discussion together and look at the implications for donor agency policies. That, after all, is the prime purpose of the present seminar.

8.1 Develop a recipient-oriented policy framework for assistance

The most basic requirement is to develop a recipient-oriented policy framework for rural electrification assistance.

A great deal of donor assistance in the rural electrification area is technology driven. Donor agencies focus upon certain technologies in which they feel they have a particular interest or expertise. Some agencies, for example, have programmes which are confined to solar energy or renewables. Others use their assistance programmes primarily to create markets for their own manufacturing industries.

In practice, such technical assistance programmes often turn out to be complete failures. This is true of a high proportion of the solar energy projects which have been carried out. There have been few successes with programmes to promote the use of biomass fuels for electricity generation. Neither have there been many successes in the promotion of small scale hydro systems.

Nor are such failures confined to renewables. A programme in the Sudan in which 200 diesel generators were imported from France during the 1970s was also a more or less complete failure. A high proportion of the machines were not even installed. Of those that were, most fell into disuse.

Many technical assistance programmes also have the effect of fragmenting recipient country rural electrification policies and programmes. They impose different design standards and types of equipment on countries which accept their assistance. They introduce different planning methods and approaches. Some insist that the private sector be given a particularly large role. None of these, in themselves, is necessarily wrong but their cumulative effect in a

developing country dealing with a variety of development assistance agencies can be totally chaotic.

To avoid such failures and counter-productive initiatives it is essential to develop a recipient-oriented policy framework. In other words, rather than starting with what Norway has to offer, it is necessary to look at what the potential recipient country needs.

This means a collaborative review with the country in question of its rural electrification policies and programmes and an identification of areas where support and assistance are actually needed. This should involve more than simply picking items from a shopping list provided by the recipient country. It requires a significant and creative input from the donor side.

8.2 Potential areas of support

In some countries, which have their own effective rural electrification programmes already under way, the most useful contribution will simply be money to enable them to continue.

Others will also need money but may be able to benefit from a variety of other kinds of assistance. Institutional support may be required for setting up a rural electrification agency and providing its staff with equipment and training. Study trips to enable staff to obtain experience in the methods and approaches used in other developing countries and the industrial world could be provided as part of this.

Expert assistance may also be required to carry out a review of design standards and implementation techniques in order to achieve savings. Support can also be given to efforts to develop standard specifications for electrical equipment which is being provided under technical assistance programmes.

Assistance can also be provided on methods of administration and financial control. The installation of computer systems for materials control and consumer accounts can be of enormous benefit.

Assistance in the development and testing of systems for community managed supply schemes can also be provided. These need to be thoroughly tested for safety, suitability for their intended end use, and reliability. They also need to be thoroughly field tested, an expensive and time-consuming task.

Local manufacture of equipment for rural electrification is highly desirable. If it does not happen, developing countries find themselves faced with a continuing drain on their foreign currency resources. Donor agencies can provide funding and technical assistance which will help promote local manufacture.

Hardware is deliberately placed last in the list. This is not to say that it is not needed. It is simply to emphasise that the management and institutional issues involved in rural electrification have to be analysed and resolved before the technology can be discussed rationally. Once there is an effective institutional structure in place in the recipient country it becomes possible to define and meet the technological needs.

8.3 Need to build up donor expertise

Donor agencies themselves also need to build up their own expertise in rural electrification and treat it with the seriousness it deserves. Often this is not the case; rural electrification may even be treated as a unified programme area. Grid extension schemes may, for example, be tacked on to the power sector where nobody has any time for them, while off-grid schemes are included in the renewable energies section.

Under such conditions there is no hope of producing a sensible policy for rural electrification assistance. There are numerous examples of off-grid systems, usually based upon renewable energies, which have been built by technical assistance funds without any serious consideration of where they in the overall rural electrification plans for the recipient country. They have no local institutional support and the utility, which is reluctantly having to take them over, wants nothing to do with them. Such schemes are no more than random technical gestures with no long term developmental significance.

It technical assistance for rural electrification is to be productive and effective, it requires a considerable amount of research, experiment and analysis on the part of the donor agencies. Moreover, this needs to be carried out on a continuous basis allowing for the development of long-term collaborative arrangements with recipient countries. External consultants can provide detailed technical and economic advice for specific projects but this needs to be fitted within a broader and more comprehensive concern for rural electrification as a programme area within the donor agency.

Just as electricity supply authorities need to create relatively autonomous organisations with a continuing responsibility for rural electrification, donor agencies also need to create "cells" of expertise to develop and sustain their own policies for rural electrification assistance. Put another way, it is not just the the people in the recipient countries who need to be trained; donor agencies have to devote a certain amount of resources to training themselves as well

Such a "cell" would accumulate and analyse information on rural electrification. It would establish collaborative relationships with electricity utilities, relevant NGOs and other organisations in the countries on which the assistance of that particular donor agency is focused. It would help sponsor and monitor experiments and new initiatives.

It would become a resource, not just for policy making within the donor agency, but also for promoting creative rural electrification initiatives in the developing world. It would also ensure that the available funds were dispensed in the most effective manner possible.

7.0 Conclusion

The long term relevance of rural electrification to the development of the Third World is not in question. Neither is there any doubt that programmes which are effectively targeted and competently executed will provide major benefits to the rural people concerned.

The conventional approach, in which programmes are based upon grid extensions, has proven its effectiveness and will continue to be the principal focus for programmes in the majority of countries. But there are mounting social, political and economic pressures to widen the scope and increase the pace of rural electrification. These can only be met by flexible and innovative approaches which lead to the development of small scale off-grid community managed or privately run generating systems.

There is no competition between these two approaches. Both should be seen as complementary rather than in competition with each other; and both need to be supported.

Rural electrification provides an opportunity for donor agencies, particularly those in the energy area, to contribute creatively and effectively to the rural development and overall well-being of recipient countries. There is little doubt that the funds allocated to it should and will substantially increase in the future.

References

MENANTEAU, P. (1987) "L'electrification rurale dans les pays du Tiers Monde; les conditions economique d'un projet technique approprié." CIRED, Paris.

KENYA, GOVERNMENT OF (1986) "Statistical Abstract" Central Bureau of Statistics, Ministry of Planning and National Development, Nairobi.

PLAS, R. van der (1988) "Domestic Lighting." Working Paper, Industry and Energy Department, World Bank, Washington, DC.

SMITH, D.V. et al (1983) "Report of the regional electrification survey to the Asian Development Bank." Draft. Asian Development Bank, Manilla.

WORLD BANK (1975) "Rural electrification." World Bank, Washington, DC.

WORLD BANK (1987) "World Development Report." World Bank, Washington, DC.

10 March 1989

MDC and Norwegian assistance in the field of Rural Electrification

Kjell Storløkken, NORAD

The World Commission on Environment and Development, chaired by Norway's Prime Minister, has made the energy questions one of their main topics. The report draws our attention to the world energy crisis, and highlights the growing awareness that energy planning, like all other development planning, has to be seen in a perspective of sustainable development. The recent reports on the heating of the earth's atmosphere, the unabated destruction of the world's forests and greenland and the natural disasters in countries such as Bangladesh and the Sudan, make us fully realize the important linkages between energy, society, environment and development. Increasing consumption and depletion of traditional fuel supplies leading to desertification in many parts of Africa, keep energy problems in the forefront of economic concerns in developing countries today. The Brundtland report opts for a low energy future, conservation and the aggressive development of new and renewable sources.

Hydropower is not a new but at least a renewable energy resource, and it is one of three large-scale available sources of electricity, the two others being fossil fuel and nuclear power. Moreoever, as we all know, hydropower is by far the cleanest form of energy. This aspect has gained particular importance in view of the growing international concern with pollution of the human environment. The relatively easy access to hydropower for electricity has been perhaps the most important precondition for the economic development and industrialization of modern Norway. The first hydropower plant in Norway was built in Hammerfest in 1891, followed by

the country. It may be worth noticing that they were established as a response to local needs and initiatives.

It is this long experience and acquired know-how in the field that has made the energy sector a natural and important part of Norwegian development assistance. Oil dominates the commercial energy market in the Third World, but hydroelectric power projects have for long been in favor with development financing agencies. There has in the past been a strong emphasis on activities connected to the use of commercial energy commodities with focus on large hydropower based projects. The environmental disasters associated with some of the larger dams planned and built during the 1960s, brought hydropower in discredit. MDC is still haunted by "white elephants" like the Stiegler Gorge project in Tanzania. However, a renewed interest in hydropower has surfaced in recent years, especially in small and medium scaled power plants where the possible negative impact on the environment is less serious.

It is only during the nineteen-eighties that MDC/NORAD has engaged in some smaller hydroelectric projects within the framework of rural electrification. We also support the construction of several small hydropower plants, among others in Nepal and Zaire, through contributions to NGOs dealing with this sector. This does not mean that larger hydroelectric facilitites will not continue to be competitive for industrial, urban markets, but the smaller markets and isolated rural areas may be better served by smaller, local plants. There are a great number of sites in developing countries suitable for medium to very small hydro installations. The Chinese, f.ex., have been able to provide most of the electricity for three-quarters of their rural communes with mini-hydro generators.

Energy is a main sector in the Norway-SADCC co-operation. Several SADCC States still have to rely on significant power imports from South Africa. Norway finances regular SADCC projects aimed at strengthening the countries' economies and

independence from South Africa, and seeks to encourage a better economic co-operation between the Nordic and SADCC countries. The SADCC region is producing surplus electricity in some parts, and encounter deficits in others. Norway has been engaged in several projects aimed at interconnecting the member States' grids, in order to address the deficit problems, reinforce their rural distribution network as well as foster regional unity and co-operation. A major part of the region is at an early stage of electrification, in particular the rural areas. For the SADCC countries rural electrification is a major challenge, and a high priority area. This was confirmed at the SADCC seminar on "Rural Electrification" taking place in Malawi in November 1987.

Lesotho is a small country geographically landlocked by and economically dependent on South Africa. The water resources of the country are ample, and there are good opportunities for developing hydropower schemes. As a part of the SADCC energy programme, Norway is financing the construction of two mini-hydro plants in Lesotho's countryside, one in Mantsonyane and the other in Semongkong. They are the first two hydropower plants in the country. For the benefit of the local population part of the Mantsonyane project includes the supply of electricity to a mission station and a local co-operative, building of roads and training of manpower. The village Semongkong has been selected for a pilot project by the Government of Lesotho in their decentralized rural development programme. Some infrastructure has already been developed in the area, like an airport, an all year road from the capital Maseru, watersupply, schools, a clinic and a hospital financed by DANIDA. It is a goal that the population of the area should sustain itself economically by motivating them to fully utilize local resources. During the last four years the total number of business establishments in possession of legal titles in Semonkong has increased from 17 to 50. 30 of these businesses are operated by local Semonkong people. The construction of the 180 KW mini hydro electric power plant will deliver stable electicity to these new activitites.

Norway is also co-financing another rural electrification project in Lesotho implemented by SIDA. It is a part of the Lesotho Electricity Cooperation's program for electrification of the districts. It includes construction of transmission lines, transformer stations and distribution networks.

The Norwegian bilateral aid to the energy sector in Mozambique is, apart from a petroleum-agreement, mainly devoted to the production of electricity, and is channelled through the national energy utility. Electricity plays an important part in any national energy plan, and Mozambique today has the clear intention of increasing the share of this form of energy in their total future energy consumption. Norway has funded two mini-hydro power projects in rural Mozambique.

A mini-hydro plant in Lichinga has been running since 1983, and has so far been functioning well. The construction of a small-scale hydropower plant in Niassa Province in Cuamba was completed recently. The plant was officially opened in November 1988. Before the construction of the plant, Cuamba had to rely on a small diesel power station, which due to diesel shortages only worked a few hours per day. The immediate potential demand from domestic consumers at the village level is likely to be quite small. The potential demand from communal uses is considerably higher. Even if the poor cannot afford to use electricity directly in households, they may still benefit indirectly as street lighting allows more nighttime activitites, refrigeration in stores increases the availability of fresh food, and health clinics are able to keep medical supplies refrigerated. With easy access to electricity, sawmills and mines in the area are expected to increase their production.

During the construction of the power plant the national and local electricity authorities and NORAD joined forces to try to create some spin-off activities based on local raw materials and benefitting from the hydro power production. A small spinning and weaving factory is already working, pro-

ducing blankets based on local cotton, and other small scale industry, like pottery, food-oil and soap production, is under implementation.

To improve NORAD's background knowledge and to prepare the terms of reference for later consultancy services in the development of small hydro power plants, a mission was sent to Pakistan in October 1988. A professor in social anthroplogy was among the mission members, and he made several interesting observations on the socio-cultural effects of rural electrification. In the mission's report he concludes that in the rural areas presently supplied, electric power for domestic use has had a marked welfare effect,benefitting women and children equally with men in their daily lives. Provision of electric light is strongly desired by the whole population, and is particularly attractive as it is made available at a price within the means of nearly all households. It also serves as a stimulus to the development of cottage industries and small enterprises. According to the professor there is no doubt that extension to further areas would be beneficial.

As a result of the mission's visit to Pakistan, there was a certain shift in NORAD's plans and engagement. The team stressed the importance of refurbishing and upgrading of the old power plants before new schemes are started. There exists an obvious need to improve the maintenance procedure of the existing power stations, and the implementation of a mechanical workshop to carry out maintenance work will be given priority. This is probably valid for many other developing countries too, and special attention should be paid to the possible rehabilitation of old power plants, training of local counterparts and to ensure availability of spare parts in order to make projects self-sustainable.

It is generally accepted that electrification is essential to the long-term development of any country. Most countries have viewed electrification both as a stimulus for irrigation or other agricultural or industrial development, and as

means of raising the standard of living of the masses. But energy investments in developing countries tend to favorize the urban areas, where the demand is more concentrated and the return of the investment higher and safer. The distribution of electric power within most developing countries is thus reinforcing existing inequalities. In many rural areas the access to centrally generated electricity is still negligible. Despite the "woodfuel-crisis" and the migration of rural populations to cities, the trend of unequal energy distribution policies continue.

The benefits of electricity to the rural villages are obvious. Electricity is cheaper, more convenient, safer and more effective than kerosene. The positive effects are numerous. It may

- slow down migration to the urban areas by ameliorating the living conditions in the rural areas,

- hopefully reduce consumption of firewood and thus contribute to the fight against desertification,

- reduce consumption of diesel and kerosene and thus reduce the foreign exhange burden,

- make life easier especially for the women in the countryside, who are the main producers and users of household energy,

- serve as an incentive for local initiative and development of small enterprises,

With all these obvious advantages, why is it that rural electrification has not been regarded as a priority domain in Norwegian development assistance so far?

Unfortunately, there are two principal limitations on the

contribution of electricity to development: cost and access. It is naive to believe that bringing electricity to a remote village, will automatically change the villagers daily life and give them access to the fruits of electrification. It is a regrettable fact that most of the poor peasants in the Third World can simply not afford to pay the monthly electricity bill. Many live on a day-to-day basis, their main concern being survival. Costs of hookup and electricity are high due to the dispersed and small scale nature of demand. Even where subsidized, electricity has not generally proven a suitably inexpensive energy source by the poor in rural areas. So far experience has too often shown that electricity consumption is restricted to the middle and higher income groups.

Energy and poverty are both politically charged subjects where the Ministry has to proceed with caution. The official aid strategy of MDC is focusing upon the needs of the poorest people. The general orientations of Norway's official development assistance policy will have to form the basis for any future policy on rural electrification. Many aspects have to be taken into consideration:

1. ENVIRONMENT-ORIENTATION

All development aid projects will to a greater or lesser extent tend to affect the environment. Two Norwegian White Papers (Nos. 36 1984-85 and 34 1986-87) on major questions concerning Norwegian aid, have stressed the importance of taking environmental issues into account in Norwegian-financed development aid projects. A booklet has been compiled by MDC/NORAD to help project planners to integrate environmental considerations into various types of aid projects at an early stage in the planning system. Environmental impact assessment (EIA) of hydro power projects is necessary to avoid or reduce the chances of heavy siltation, floods, damage to aquatic species and other negative ecological effects. Environmental goods may be valued less highly in developing areas. Nevertheless,

lasting economic and social development must be based on an understanding of the environmental situation and farsighted management of natural resources.

2. RECIPIENT-ORIENTATION

Another important aspect is whether electrification fits within the system of rural priorities of the recipient. The assistance shall be geared to the recipient and based on the needs, plans and priorities of the developing countries. Due to elements such as the power structure, decision-making processes and cultural traditions, poorer and neglected groups may not be considered when central authorities make their requests for development aid. It is important to have good relations with the governments, but orientation towards the recipient should not prevent Norwegian authorities from working to secure the interests of the weaker groups in development assistance consultations. There is a need to diversify and make use of local authorities, associations and organizations.

3. WOMEN-ORIENTATION

Norway, together with the Nordic countries among others, has gradually taken on a leading role as an initiator of measures in international and bilateral development assistance activities directed at women. The goal is to make women-oriented assistance a routine part of general development cooperation. Women are main providers and users of household energy as well as of energy for activitites in the informal sector, and they should play an important role both in the planning and implementation of energy programs.

4. POVERTY-ORIENTATION

Development assistance must be used so as to achieve the greatest possible development effect for the poorest sectors of the populations. Experts have argued

that poor people are caught in the so-called "poverty trap" and do not have the necessary drive to initiate new activitites and to follow up. One should invest in the middle-class and hope for a "trickle-down" effect, they maintain. After more than 25 years of development assistance there is unfortunately not many signs of anything trickling down to the poor masses. Only the developing countries themselves can solve the complicated problems of economical, social and political nature which constitute the basis of the poverty of their masses. How to reach the poor when the rich has the education, money and political power, is one of several dilemmas we are confronted with in our development cooperation efforts.

5. SUSTAINABLE GROWTH-ORIENTATION

One of the main goals of the development assistance is, after all, to stimulate to development and economic growth. It is important not to lose this overall perspective in our eagerness to respond to the international call for environmental protection and conservation. The process of rural development is a complex system where failure to provide for one input can limit the effectiveness of the whole process. Many rural development programmes fail to mobilize the development potential of rural electrification. Electrification should not be put as icing on the integrated rural development cake, but wherever economically justifiable it should be added as yeast in the dough. The new level of concern for the broad social and environmental consequences of rural development, should not rule out rural electrification, but on the contrary integrate the different possibilites and options of energy supply in an early stage of the planning process. Different countries will have different options, and hydropower is only one of them. Coal, natural gas, geothermal and new renewable sources like solar and wind can all play important roles in generation of electricity. Participation at an early stage in the rural development planning, is essential to identify the most suitable supply

technology available in the area concerned.

The actual development effect is not primarily determined by the number of power plants constructed or kilometers of road built in the course of a short period, but by the development of the recipient country's own capacity to continue activity based on local conditions in an efficient manner. The main emphasis must be placed on gradually building up developing countries' ability to solve their own poverty and development problems. Training and institution building are key words in this connection.

The above mentioned objectives do not always coincide and in practical work, the various objectives and purposes must be ranked according to priorities. But when we are going to discuss the role rural electrification ought to have in the context of Norwegian development assistance in the years to come, we have to bear these basic principles in mind.

RURAL ELECTRIFICATION AND NORWEGIAN DEVELOPMENT ASSISTANCE.

Integrating the energy issue and Rural Electrification in general program and project assistance

by K.A. Endresen

The presentation made by Mr Foley discussed rural electrification in a development context. The discussion took departure in the role of the energy suppy and rural electrification in the rural development process.

This presentation will also discuss rural electrification in the development context. But this time with a view to highlighting important aspects related to practical project and programme work; and in particular in relation to the donors role in the process. In line with Mr. Foleys urgings to make aid more recipient oriented, a good starting point is to take note, at least, of what the SADCC recipients have requested of donors; this was in the form of resolutions arising out of a seminar on rural electrification held in Blantyre, Malawi in Novemeber 1987. Thus SADCC Resolutions refered to below relate to that seminar.

The following points will be discussed in the presentation:

1. The role of rural electricity in general rural development project and programme work.

2. The "supply" focus; and the costs and benefits of giving increased attention to the demand side; financially and technically.

3. The tendency to concentrate on the investment phase and investment criteria.

4. The importance of using appropriate methodlogy and criteria for project selection, planning and design.
4b. The target group/rural electrification/affordability conflict

5. Certain aspects related to the exchange of longer term financial and planning information between donor and recipient.

6. The use and development of local resources.
   - -human resources/training
   - -material resources

8. Project versus Programme.

---

1. Rural electrification in general project and programme work.

Most of us will agree, in principle, that an economic and reliable supply of an appropriate form of energy is essential to the rural development process. Equally, we will agree that certain other conditions must be met for a rural electrification project to be successful. For example, there should be no disagreement that one

will need a market that can afford the electricity so that the project can pay its running and financial costs; that there must be adequate technical and other staff available for the project; that there must be a certain form or level of support and operational infrastructure for the project; etc.

In other words, most people would agree that energy, in this case electricity, is essential for economic development. And that certain developments in other sectors often is a precondition for the success of any rural electrification project.

Yet, in practice things tend to be treated in splendid isolation. We will, later in this seminar, come back to the practicalities in terms of methodlology etc. But let me here point to the fact that in most rural electrification projects it is assumed that an adequate and skilled manpower supply is available for the project, so that the project need not be concerned with the training side of development.

It is assumed that the local demand for the electricity will pick up, and that adequate revenue will be collected from the demanders of the energy. Somehow the demand will adjust itself and fit the requirements of the supply side, in terms of timing and capacity, and in financial terms. The project need not therefore, concern itself with general economic development.

It is assumed that the power utility, be it the national power corporation or whatever, has the adequate clout in the foreign exchange system, to arrange the required imports of essential spareparts, fuels, etc. The project need not be concerned with overriding macroeconomic and balance of payment problems.

It is assumed that the power utility is properly organised to run the project; to operate and maintain it adequately. The project need not concern itself with organisational development.

And yet, we know that in real life, in practice, any of these things listed above will be a constraint to successful project development. They are actually what development is all about. They are key examples of what the national and local authorities, with the assistance of donors etc, all struggle to improve. These things do not automatically sort themselves out; they require a careful and well planned approach in order to be successfully resolved.

At the same time, we know that other sectors have a very relaxed attitude towrds the energy side of development; often leading to suboptimal energising patterns, and suboptimal economic and functional efficiency. I am thinking about the health sector viz energy (clinics without operating ligths, or failing energy destroying the vaccines), water and energy (waterpumps requiring nonavailable forms of energy; rendering the whole watersupply practically useless), education and energy (lack of energy causing very low utilisation degrees of installed classroom etc capacity); etc.

Or, the other extreme, where each and every clinic, school, staff compound, public office, etc shall have their own, small exclusive

power supply in the form of a diesel generator that the individual institutiion shall operate, maintain, repair, arrange fuel for, etc.

Practical rural electrification work should thus be an exercise where all the various factors listed above, and several others, must be dealt with in a realistic and constructive manner. Rural electrification is a multisector task. This is not only a challenge to the Government, the planner and the donor. It is equally a challenge to the designer, the manufacturer of the equipment, and the power utility.

2. Focus on the supply side.

Rural electrification projects usually come up through a cooperation with the national authorities and electricity corporations. The electricity authority usually has as its main task, the generation and distribution of energy. Project work therefore tends to be very "supply" oriented. Assumptions and estimates are made regarding the size, composition and future developments of the demand. Together with technical and resource information the generation and supply system are planned and dimensioned. (It happens that the scheme is dimensioned to the capacity of the source; regardless of the demand for the output it shall produce). The donors role is often to finance the planning and the construction of the "supply" investment.

The fact that the donor contributes finance to the investment will in some cases indirectly be a subsidy to the consumer in the sense that he or she will be faced with lower tariffs and/or connection costs than if the scheme was commercially financed. However, this is not always the case. The donors contribution is usually in the form of foreign exchange because the country has a balance of payment problem. The electrical utility may run its operation based on a set of pricing principles, which may for example be the Long Run Marginal Cost. Thus, even if a donor contributes finance to the country, the utility and the consumer may not benefit from this other than in the form of the installation being implemented at all; the consumer may still be requested to pay the full price of electricity.

There is a major challenge here, for the donor to look further at the demand side. Both the demander and the supplier have an investment problem. The demander may <u>not</u> be able to use the electricity if he cannot afford the initial connection to the scheme, buy a stove, buy an electric motor for his cottage grinding mill, etc. So, even if the tariff is lowered reflecting the subsidy from the donor, the demand may not take off. The donor could in his approach at the project and programme level consider more also providing investment support to the demander of electricity. Then the probability of an economic and ecological fuelswitching may be grossly enhanced.

I am sure that we have all come across project proposals where the socio/economic justification for an electrification scheme is given in terms of alleviating the pressure on the environment and on women etc., but where in practice, the electricity produced has

not been affordable to any but the highest income groups who were in any case using their own generators before.

Most manufacturers launching a new product in a modern economy do very careful market research beforehand to build up a profile of the potential users and to find out within which parameters the product must operate in terms of price, colour, size etc., and in which ways one can best reach ones target group. Yet in most rural electrification projects it seems that no such research is done, so that very often the end product is one which is not suitable for and is not purchased by the target group!

An important area of building up a profile of the target group is in the area of gender relations, since a proper understanding of this could have certain implications for the type of energy to be provided and the subsequent level of demand. It is usually the women who are responsible for providing household energy needs with traditional fuels, and yet as soon as there is any question about using electricity, it immediately becomes a totally male dominated sphere; systems are designed, planned, constructed and maintained by men. More involvement of women at all stages is necessary. To take an example, when rural grids are being extended, it is not uncommon for quite a lot of male casual labour to be employed and yet if the same amount of money was poured into the local economy through female workers, it is likely that, given the different spending patterns that men and women seem to have, the impact on the local communities would be very different. In addition, it would enable women to build up some sort of a relationship with and understanding of electricity and its benefits, and could affect the priority which they would give it.

Thus proper research and planning, dwelling with the demand side, in the form of socio/economic base line studies, market research, potential industrial and commercial uses and so on, will both increase the cost of the project and delay the start, but these should be totally overshadowed by the longer term benefits in the form of higher participation/demand rates.

3. Overconcentration on the investment phase and investment criteria.

In project and programme work, one often tends to concentrate too much on the investment phase. This is in a way logical; the investment phase is near and therefore more concrete. The operational phase is future, and thus more of an unknown quantity.

The concentration on the Investment phase reflects the bias on the supply side.

A financial concentration of the Investment phase is very unfortunate, in the sense that lack of funds for Operation and Maintenance, for the central spare part, will in most cases if not render the whole Investment useless; at least grossly reduce the amount of output it produces. From an output point of view there is not any difference between installing a 25 % larger capacity, or providing more resources to improved Operation and Maintenance to enable a 25 % higher efficiency. But, from an economic and

financial point of view there is usually a vast diference, to say it mildly. A narrow investment focus will generally lead to a sub optimal resource allocation.

Forgeting about the finance for a moment; the multitude of non financial issues dictate a wider focus that the investment phase.

Such issues would generate questions like: Are the various Departments in the Utility strong enough to cope with the additional burden of an expansion of the grid - will the revenue department have enough people? Is there an efficient accounts dept. and system to cope with such an expansion? Will spare parts be available? Does the utility have the foreign exchange or local funds to purchase spare parts? Is an improved stores system needed to cope with the enlarged scope of work? The list of questions is extremely long, and many of them will, I hope, be covered in the detailed presentations later on in the seminar, since a negative answer to any of these questions can threaten the whole "viability" of the project.

In our session tomorrow, it might be useful to produce a comprehensive list of such questions which must be satisfactorily answered or catered for in future project and programme planning.

4.

4.A. The importance of appropriate methodology and criteria for project selection, planning and design.

At present there is no <u>one</u> methodology used to evaluate rural electrification projects. Decisions are too often based not on any quantative, but rather on vague qualitative assessments. It could be useful to develop a model methodology which , taking account of financial and socio economic parameters, in the framework of cultural factors, answers the question "Does this project represent an optimal resource use ?"

In developing a methodology, one needs to bear in mind SADCC resolution 5.4 which requests that donors accept socio-economic criteria as the key parameters for project selection and formulation, and not focus on conventional financial criteria.

I know that a later presentation will discuss this more in depth. What matters is that the individual project should represent a sound utlisation of the resources to the country and the people. Conventional financial techniques do not reflect this. Partly because the prices and costs in many countries do not reflect the value of what they represent. And because the purchasing power, or convertability, of many third world currencies are rather limitted. This sharpens the requirements to the methodology and criteria to be used by the Government and the donor; the donors decision whether to support or not support can <u>not</u> be based on the same criteria and considerations as in his home country.

In real life projects are often justified with vague sentences such as the following: (All the quotes are from the documents for one particular project sponsored by a Scandinavian donor agency):

"X is one of the countries worst affected by deforestation, an (alternative) energy supply, especially to the districts, is critical."

"The project will stimulate productive activity in the rural areas"

"The objective of this project is to extend the service and decrease the costs of electricity to the consumer".

However, nowhere in the project document is there any reference to what the cost of the supply will be and whether it will be affordable. As it turned out, in this particular project, the electricity was unaffordable to all but the highest income groups, and even small shops and other services were unable to afford the connection.

In other projects, attempts are made to calculate an IRR, but there are two problems with this. Firstly, many countries do not even have the relevant information available to do this . Although a team of consultants could probably come in and put together the necessary information, there would be little point. The very fact that the information is not available would indicate that some kind on assistance is needed in the organisation of the Utility before or in conjunction with any new project.

Secondly, the assumptions on which the IRR calculations are based will vary from country to country depending on their rural electrification policies (if any) and tariff structures etc.; this makes it very difficult to compare alternative projects in different countries. In this respect, the development of a standard type of methodology and criteria for comparing different projects could be very useful.

I think Norad, NVE and the Norwegian milieu could together come up with quite a contribution in this respect. I am thinking about the development of a standardised, PC-based appraisal and planning tool for new rural electrification projects. The software should be developed here, based on the perceived needs, and the professional experience and knowledge available in the Norwegian milieu. The PC-based model should then be distributed free to relevant ministries, utilities and organisations in the third world; courtesy of the Norwegian Government. In addition to the marketing effect for Norway and Nowegian technology and know how, the tool could make a major contribution towards:

1)developping a standardised socio economic and financial appraisal and planning methodology;

2)secondly, but very important, lifting the international standard when it comes to such appraisals and planning of rural electrification projects in the third world.

Another useful role for the donor would be to be more active in entering into a dialogue with the Government/Utility over alternative ways to approach the issue in terms of technical solutions, marketing, alternative cost recovery policies etc. This could result in a larger percentage of the population being reached and a higher IRR than would have been achieved with previous policies and a very small number of consumers.

4B.

An important question in relation to the selection and planning of projects is how to reconcile the whole issue of aid target groups-/affordability/rural electrification or energy supply. NORAD projects are supposed to have as their main objectives to improve the standard of living of the poor, women, and to have a positive impact on the environment. Often rural energy projects achieve these objectives (if at all) in a rather indirect way through access to improved health services, schools, government facilities. However, one should perhaps consider ways of having a more direct impact on these areas by making electricity or other appropriate forms of energy available to a wider range of the population, both for private consumption and for small commercial and industrial enterprises. Access to clean water, good health facilities, schools, roads, have all come to be regarded as basic social rights to which people contribute, but are rarely expected to pay the full investment cost; so why should electricity or energy supply be regarded any differently ? Alternative approaches could range from providing a basic one phase connection to each dwelling as part of the projects investment cost, to connecting certain communal facilities (based on each villages priorities) against a small levy, providing a revolving loan fund to cover connection costs for homes and small businesses, making available electric machinery and equipment on a non profit basis and so on. This is another area that could be discussed in more detail during tomorrows session, by which time some of the other speakers may well have put forward some more ideas on the problem of how to reach the target groups or objectives better than hitherto.

5. Supply the recipient with longer term planning information

Norad has a very good practice in its work with the main cooperating partners; the "Hovedsamarbeidsland"; of giving indicative longer term planning figures for the NORAD grant to various sectors in the respective countries. This makes it much easier for the recipient country to plan ahead, and it is not that exposed to annual fluctuations in donor policies and programmes. Possibly this system could be further refined, and even longer term <u>sub sector</u> allocations could be blinked out. With a final reference to SADCC; Norad could even give SADCC a longer term planning figure for its support to projects in the Regional rural electrification portfolio. And, in this way possibly inducing other donors to do the same.

6a. The use of local resources - human resources/training

It should definately be a pre-requisite of all projects that a training component not only be included, but given the highest priority. The training issue is the subject of a separate presentation tomorrow, but there are just three points I would like to make here.

Firstly, any training programme developed must bear in mind the SADCC resolution 4.4. which states that donors should streamline their scholarship and support arrangements to acommodate electricity-related training in third countries (in and outside SADCC). And to facilitate opportunites for training not available in SADCC, in outside countries. There is a current SADCC project (3.0.2.)looking at the question of specialised training in the field of electrical power. One should aim to try and coordinate all training within this field so as to avoid the piecemeal attempts being made by each country individually.

Secondly, the choice of implementation method is critical for the element of on-the-job training. If the task in an area is to find out which form of energy supply is best suited to the specific needs of that area, it is no good just sending in a team of foreign consultants to do some investigation and come up with an answer. The choice of which type of energy source, be it hydropower, connection to the grid or solar power, is one which the energy corporations will be faced with over and over again in the coming decades, so they need to build up the capacity to be able to do it for themselves. Likewise, if it is decided to extend the grid, it is no good just bringing in a firm of contractors to build the line, supplying them with some local labour and telling them to do on-the-job training(as has indeed been done in recent projects). Contractors are not by nature trainers and there is no point in expecting them to be so - they are used to working against time, and speed and training objectives will always come into conflict. To quote from a recent evaluation of a NORAD/SIDA financed rural electrification project: "The importance of training in a project like this can not be overstressed. In fact one of the justifications for the project was that great stress would be laid on training. However, the training element seems to have suffered as a result of the speed of implementation, budget restrictions, and because the different training components were not clearly defined.... very little technological transfer has taken place in the principles of planning, surveying, designing and setting out of power lines." Situations such as this must be avoided in the future.

The third point relates to the gender bias in the electricity field as already mentioned above. Training schemes must be designed to try to overcome this bias and to give women the chance to enter this field.

6b. The use of local resources - material

Just as it is important to develop the human resources in developing countries, it is also important to develop local resources. All too often a large percentage of the material for rural electrification/other energy projects are imported from the donor

country. When spare parts are needed, then the recipient country is forced either to use sorely needed foreign exchange to purchase replacements; or, they may purchase a similar part locally or from a neighbouring country, which is not quite the same and therefore reduces the efficiency of the system. A more appropriate policy in development terms would be to look at the local and regional market to see if certain materials are already available or whether certain parts could be produced in one of the countries to serve the whole region. In the SADCC countries, for example, most of the countries are at varying stages of a rural electrification process and will be involved in such projects for many years to come. Thus it would seem appropriate to try and produce some of the basic materials and parts , each country producing whatever it would be best suited to, for the whole region. Otherwise you get the situation, as in a recent project in SADCC, where all the electricity poles were imported from Sweeden, and yet in Botswana, for example, you have vast areas of unexploited forests.

7. Project versus programme

Finally, to discuss a question which might have appeared more appropriate at the beginning of this paper; namely project versus programme type of assistance. However I think that it is only after mentioning some of the issues to be taken into account in rural electrical projects that it becomes clear that really there should be no such thing as a "project", in the strict sense of the word. When considering the introduction of an energy supply, be it electricity or solar power, into a rural area, there will always be many facets to be taken care of besides the straight "implementation" or hardware. This may be in terms of associated training, loan schemes, baseline studies, associated infrastructure etc. Thus, it should be the responsibility of the donor wither to finance the full package or go into joint financing packages with other donors (a good chance for Nordic cooperation) to ensure that all necccesary aspects are financed.

Thank you.

"Experiences from Rural Electrification in Nepal,motivation and training of women"

by Dorothea Vestøl

1.Some facts about Nepal.

Population	17 million
Densety	122 pr.sq.km
Populationgrowth	1.8% in the mountains 2.6% in the hills 4.2% in Terai
Annual pr.cap.income	150$
National literacyrate	33% (12% for women)
Average life-expectancy	53 years
Infantmortalityrate	107 pr.1000 livebirths

6.300 km motorable roads,most in Terai

35 different languages

91% have their living from agriculture(and forestry and fishing)

2.ANDHI KHOLA HYDEL AND RURAL ELECTRIFICATION PROJECT (AHREP)

AHREP is one of the 11 projects of United Mission to Nepal (UMN). UMN has been in Nepal since 1954,working in health,education,agriculture, industry etc.
Total budget for 86/87 was about 4.5 mill.US$. 400 expatriates work with UMN,about 260 in assigned posts.

AHREP is a joint project between HMG of Nepal and UMN,based on a 5 MW hydroelectric powerplant utilizing water from the Andhi Khola river.

Many years ago(25?) the Norwegian electroengineer Odd Hoftun walked through the area and saw that this place was nearly perfect for a hydroelectric scheme. At one point only a low ridge seperates Andhi Khola river to the north from Kali Gandaki to the south. The distance between the two rivers is about 2 mk,and hightdifference about 250 m.

We are building a 5 m high dam in the Andhi Khola river. Water will be taken through a 1300 m headracetunnel,down the 245 m vertical shaft to the powerhouse.From there through a 1000 m long tailracetunnel and end in Kali Gandaki.
A 33 KV Transmissionline will link the powerplant to the National Grid.
We are building distributionlines to the district headquarter and throughout Syangja District.

AHREP is an Integrated Rural Development Project,with following programmes:
-rural electrification
-irrigation
-drinkingwater and sanitation
-agriculture
-resource and soilconservation
-industry
-non-formal-education

Through the project we will build up two nepali companies that should be able to plan and build hydroprojects in the future.
Training of staff as well as local labour is another important task.

Dwain and Joy Poppe moved to Andhi Khola in 1981 to learn to know the local people,and they wrote a socio-economic report that has guided the work in Andhi Khola.

3.WHY I AM HERE TODAY?

My background is teaching.I came to Andhi Khola 4 years ago as an engineers wife,not to fill a post. We had two children,3 1/2 and 2 years old. We have rented a local house in a village about 40 min. walk from site and offices,after we finished a 5 months language-course in Kathmandu.It is a simple house,with no regular water or electricity or other luxeries we were used to.
In the beginning we spent a lot of time to learn to survive and to adjust to the new situation.We were the only expatriates in our village. The other foreigners lived within 1 1/2 hours walk,about 20 from 8 different countries.

My best education for the work I have been doing the last year,is the time I spent with neighborwomen in my village. Sometimes just watching, asking,discussing,or working together with them in the fields or helping with sick children. I learnt about their role in society and in their family,their way of living,their values,their workload,how serious they every day do their rituals and offerings,how important traditions are for them.

With the limitation 3 children give you,I have been involved in training young people as villagemotivators.They will work with villagepeople,and especially women.

4.ELECTRICITY IN ANDHI KHOLA

Nepal is not able to produce enough food for all 17 mill.people. In our area we know that 70% of the households are dependent on buying grain some months of the year.

There are very few possibilities for work and income in other sectors than agriculture. The alternative has been to go to India for work,like about 50% of the men in age 20-40 years do in our area.

Experts tell that the last 20 years about 1/3 of Nepals forest has been cut down. Most of it is for firewood or fodder. Less than 1 % for commercial use.

my neighbors tell that 30 years ago they spent about 1 hour to collect one load of firewood. Today they need 4 hours for the same load.

Deforestation is resulting in erotion.Every year tonns of the best soil is washed away and deposited in Bangla desh.

The 5 MW powerstation is planned to give about 250.000 people in 650 villages in Syangja district electricity in the next 15-20 years. One of the main ideas is that electricity should be available for everybody,so it has to be cheap. The way to achieve this is to keep administration-and constructioncosta down, and get a high loadfactor.

We plan to set up local "Users Associations" that will be responsible for parts of constructionwork. They will collect fees and be responsible for contact between the Power Company and the individual consumers.

We will encourage and teach consumers to use electricity for cooking. A "low watt cooker" consisting of two pans inside each other with a 200 W microelement is developed in Butwal,another UMN project.
This cooker will help to level out peakhours and reduce pressure and need of firewood.
We have made tariffs suitable to encourage not only electricity for light,but also for cooking and for attracting industry.
We hope that electricity will make lift-irrigation possible,so farmers can produce more grain.

5.PRESURVEY ON TODAYS SITUATION

Electricity will make many changes in a rural area like Syangja. 20 months ago we started a survey to registrate todays situation. The emphasis was on use of firewood and related activities.

60 households from our Pilot Project (see below) in two bazaars and two villages has been visitted regularly.

We have gathered information about:

1.Different uses of firewood
-cooking for people and animals
-fodder
-making alcohol
-washing clothes (with ashes)
-heating water

2.Time spent on
-gatherting firewood
-above mentioned activities (1.)

3.Money spent on
-firewood
-kerosene
-batteries (flashlights ,radios)

4.Who is doing what work?

We have now valuable statestics for measuring changes.
We have built up good relation between consumers and the Company.
We know who need training and motivation.
We have had the posibility to share plans and information about the Companys work regularly with a group of interested people.

In all the households we have watched the mother cooking one main meal. We have regstrated what they cook,time spent on cooking,firewood needed,what she has to do all the time through a meal (stiring,pushing the firewood etc).We have drawn simple drawings of their kitchen (for later installation of electricity) and we have watched and registrated taboos etc connected to cooking.

6. PILOT PROJECT

Pilot Project is needed to test out and get experience in rural electrification.
3 villages and 2 bazaars (shoppingareas) were chosen mainly because they are close to site.

We test -different installations and wiring

-tariffs , cut-outs,meters
-Users association
-organization and administration

Installation started in Pilot Project in Dec.88

7.MOTIVATORS TASKS

Since supplying electricity is not only a technical challange, but will have inpact on cultural factors,we want to prepare people and give them training and time to adjust to the new situation. We want changes,and local people want to, but we do not want to destroy their cultural identity.

Motivators trained by the Company will work full time in the villages to:
1. Teach people about electricity.to use it in a safe and wise way.
2.Teach people to use the low-watt-cooker.
3.Support people through the changes.
4.Explain and discuss the Power Companys plans,policy and rules.
5Encourage people to start small industries.
6.Encourage (and supply ?) different kinds of training (nutrition,handicraft,forestry,health etc)

8.SELECTING MOTIVATORS

Our team discussed how to find the right poeoplefor the job. After interviewing about 25 persons,we invited 12 of them for a 2 weeks trialperiode.We wanted to test their:

-communicationpotentiale
-ability to work in team
-are they willing to make their fingers dirty
-flexibility
-how do they relate to people from different casts
-do they ask questions
etc

From this group we selected 3 couples and 2 men for a 6 months motivatorcourse.

We selected young people,because they are often more flexible. We did not want high educated people,because their tasks will not demand high education. (and their salary is low).
Local people had preferance,because they know their area.
We need women to reach women,since mens and womens "worlds" are very different. We thought it would be best if our female motivators were "one of them",an ordinary daughter in law,who know the local womens life and thoughts.

9.THE 6 MONTHS COURSE

We rented a building and installed electricity in it. It was used as a base for our work, but we were out "in the field" as much as possible.

Workhours were 44 a week as for the Company in general.

An Australian with 10 years experience from Nepal (now working in forestryprogramme) and myself were responsible.

Training/teaching was given in 3 main areas:

1.Communication (learning by doing,self-esteem,traditions, teamwork,discussions,drama,singing and dancing etc)

2Integration We had input from all different programmes in our project (forestry,drinkingwater,non-formal etc)

3.Electricity (theory,safety,cooking,tariffs,mathematics etc)

It was a challange for us.
In the nepali schoolsystem you are a good student if you are able to repeat what the teacher or the book say,word by word. It does not matter thet you donot understand. Teachers in rural Nepal have often no proffetional education,they have 80-90 students to teach in one clas.
We had 8 students,and sometimes we gave them extra classes, one by one student.
We knew we had other ideals for a good student,and tried from the beginning to discuss and chasllage them.
We had to have in main that nepalis often want to satisfy people,they do not like to hurt you.And that a persons or familys hounor might be more important than the truth.

We had to have in main all the time that the aimgroup for our motivators,will most of the time be illiterated women, proud and traditional people,used to manage themselves for generations.

As often as possible we gave the motivators work "in the field". Sometimes they had to ask questions to gather exact informations,sometimes they just had to listen to ongoing discussions or watch what people are doing in different situations. They were local but we saw (and they saw) the importance to of learning to know their area in a more organized way. They came aware of things they did not know.

Using the low-watt-cooker was a fun activity. We cooked different food and measured time and compared taste etc with the traditional way of cooking. We invited a nutritionexpert with 25 years of experience from Nepal. Motivators learnt about traditional nutrtiuos nepali food,and they shared willingly their own knowledge. This was a good area to show them that we wanted to build on local/national traditions.

Young people easy think they have found the answer to all the worlds problems. We stressed that electricity is one of many answers to Nepals problems,and that they had to see many variations of the right answer.
Every week they were involved in the othe5 programmes in our project to see that integrated approach is the right one. They planted trees,walked to distant areas to see drinking-watersystems be built,they visitted healthposts, spent time in a more industrialized area etc.

It was one of the most inteesting things to see how the 3 girls developed from shy and nearly non-verbal to eager and active participants. It was like the girls developed or found their dignity through the course

The last few weeks before we left Andhi Khola,the motivators were busy visitting households in Pilot Project,to explain rules,tariffs,cut-outs,meters etc,and they wrote down what people wanted to buy of electricity.
They gave a drama with songs and dances in the different villages about safe and good use of electricity. They walked around to all households with the low-watt-cooker to explain the use of it.
One house only had electricity when we left,and two of the motivators went several times a day to teach and follow up.

We know changes will need time and efforts from expatriates and local people. They have to take the steps themselves,but we together with the local motivators will walk together with them the first difficult part of the way.
Our most important role or task will be to find people with potentiale to help their own country.

Project appraisal and selection,
Methodology and criteria
A critical review of current practices,thoughts of the future.

by Eyolf Dahl, NVE

Selection - Criteria

I refer to the document presented by Mr Storløkken ,NORAD, earlier today and quote:"It is only during the nineteen - eighties that MDC/NORAD has been engaged in some smaller hydroelectric projects within the framework of rural electrification."

We know that the official aid strategy of MDC is focusing upon the needs of the poorest people.So far NORAD has experienced that electricity consumtion too often is restricted to the middle and the higher income groups. So NORADs selection of rural electrification projects is in general in my opinion based on this official development assistance policy , taking into account

Environment-,recipient-,.woman-,poverty-,sustainable growth - orientation.

Appraisal

The following rural electrification projects are to my knowledge up til now financed through NORAD funds alone or through cofunding with other agencies or in cooperation with NGOs among which may be mentioned; these being in:

-Africa: Mosambik, Lesotho,Zaire and Zanzibar.
-The far east: Pakistan and Nepal.

1. Mini hydroproject combined with existing dieselgeneration and including extention of small hightension network at region centres in the north of Mosambik; Lichinga and Cuamba .In Cuamba the project includes development of operation and maintenance system methods , energy sale-, accounting-, tariff- and payment procedures. Both projects include production planning advice of the hydropower-diesel combination, At Cuamba private owned diesel machine production may also be considdered included in the system.
The projects strengthen and secure electricity supply to the two centres, making the system less dependent of diesel supply,mostly local small industry offical buildings and ocational households being connected to the system initially.
Spinn - off activities,through electricity supply, are initiated,as mentioned by Mr Storløkken in his paper.

2. A study ,implemented and sponsored by NORAD of a rural electrification prosject including maintenance workshops in Pakistan, as mentioned by Mr Storløkken, has proved to benefit most households,cottage-industries and small enterprises, empahsis being payed to the socio - cultural effects through rural electrification.

3. Two mini hydropower stations with local networks in Lesotho at the 2 centres of,Mantsonyane and Semongkong with local networks supplying electricity to households, small scale industry and tourism activities having no other possibilities of electricity supply from outside.
Together with a transmission line - distribution network prosje ct, these activities are together with the authorities initiated and funded by NORAD and SIDA to reduce
dependency of energy supply from South--Africa and boost the Lesotho industry capacity through improved energy supply conditions.

4.Mini hydro power stations Andikola and Jhimruk with local distribution network in Nepal (Mr, Odd Hoftun, The Norwegian Tibet Mission,The United Mission of Nepal).NGOs have established private local firms for consultancy services,construction ,workshop activity, training.The project includes Irrigation.

5. Rural electrification of Zanzibar Ilands is a project including the building of ca 300 km of 22kV lines for NORAD funding including local cost covered by the local electricity company.The electricity company personnell is trained by Norwegian engineers to organize and build the network themselves-.The prosject is a part of a governmental development prosject for the Iland including f. inst the road system on the Iland and creating employment in the outskirts making the Iland more selfsufficient of aggricutural products and making rural people stay .

6. 3 projects in Zaire including mini-hydropowerplants as a replacement of diesel generators originally supplying small local systems.These projects at Monga,Kaziba and Bakau are all initiated through the initiatives of missionaries (Pente Costalite)

Critical Review

These projects,mentioned above , implemented through initiatives of the governments, regional authorities or NGOs, may have been based on :

Political necesities of attaining electricity supply to a region with the aim primarily to supply smallscale industry and official buildings in the area or strenghening an existing supply system, having been dependent on diesel generators.Households are usually connected to the system when

conveniant and monitary income, among people living there, makes it possible.
The plants may or may not be economical sustainable at an early stage, but are expected to become profitable later.

The following conditions seem to need further study to improve the ties between the electricity systems and the low income housholds:

a)The project in question may only include monetary means for hightension distribution lines with distribution transformers.The local electricity company is responsible for the necessary low tension equipment for connection of supply. This equipment may not be awailable in remote places when it should, even if this responsibility is defined during negotiations with the authorities earlier or the local peopåle are not ready to use electricity.The economic conditions regarding connection to the system may also not be clear.

b) The general plant construction of rural electrification projects ,is usually handeled satisfactorily by the company in charge, probably with assistance of consultants although maintenance instructions and information may be lacking and also necessary funding to this extent .Marketing problems as mentioned above, or similar matters, may also often be forgotten or has not been strongly enough stressed at the time of negotiations.
This condition may be handled more satisfactorily when the projects are administrated through NGOs being closer to the community population.

The above projects do in my opinion meet the requirements stated in the MDC official aid strategy as mentioned initially, however at a varying degree, the" poorest" and low income people being slowly included as subscibers in the electricity system in time, when the rest of the rural development activities make them able and motivated consumers.

The Norwegian rural electricity system in outskirt areas has been developed similarly to the present development in the 3rd world through 50 - 100 years through local initiative ,partly by state aid funds, the local populationm building their own system with local hydropower station fed networks, organized with local ownership, having later on expanded to a countrywide grid system wihin larger utilities, at present a countrywide system of 250utilities, supplying electrical energy to everybody in Norway,

Hence The Norwegian State Authority has since 1938 initiated the building of distributionnetwork to supply about 700.000 innhabitants in difficult outskirt districts without supply,through state funding, partly or totaly, in cooperation with the local population, utilizing their impact from activity within the total picture of overall rural development.

The country has cheap waterpower energy being distributed on farly heavy loaded long distribution system lines to subscribers in diffcult outskirt positions paying a relatively low unit price.

The national electricity distribution system hence dispose of traditional expertice which may be a conveniant resource for NORAD in implementing its policy on rural electrification.

Future

The general Norwegian development assistance policy on rural electrification should in my opinion include :

1.Provisions for electricity supply of rural population must be appropriate to the population social and economic context and carried out by means of the most suitable supply technology available.

2.Energy planning, market studies stating districts ready for electrification, and districts where energy has to be supplied through other energy carriers.

2.1 Areas not ready for supply from network;In this case energy should be produced by low cost means,to the outmost extent by the low income population living there, intermediate technologies beeing used.The energy carriers may be wood,biomas,water,sun and wind, introducing agroforestry.(Schumachers ideas from early 1960)

2.2.Areas chosen for rural electrification;Socio-economic studies to carify market for power sale.cottage industries,tourism,official buildings,agriculture-irrigation,households only or partly and the study of the the sequence of possible connection to system.

Financing of project.Regarding the monitary inncome , if heavy consuming subscribers dominate, it may be possible to attain economic ballance early in the plant life.Supplying countryside low inncome farmland subscribers may not be profitable for the company within a 10 to 15 years period.A political,decision is nessesary on wether to build or not.and state funding is decisive.

Information aspect to be introduced early,possible population traing on the idea of electricity supply, on long term through schools or short term training through officially governed demonstration of equiment and use thereof.

3. For both alternatives 1. and 2 choise of responsible organisation and of consultant for project implementation, with experience on the above items by the use of local engineering resources at the maximum.

Think less of development - more of solidarity.
"You cannot become a specialist on development if you are not one on human beings."

RURAL ELECTRIFICATION. ECONOMIC AND FINANCIAL ANALYSES

by Odd K. Ystgaard

1. Objective

This presentation will highlight some aspects of economic and financial project appraisal of rural electrification.

To set the scene, the conceptual difference between economic and financial analyses will be outlined.

Departing from this outline of Financial and Economic Analyses or cost/benefit analyses, the following elements of the analyses will be addressed in more detail:

- Electricity demand
- Supply options including illustration of Economic Analyses in investment decision
- Norwegian Development Corporation and Rural Electrification - Some economic considerations.

2. Economic and Financial Analyses - What are they?

The financial analysis is designed to examine the profitability of a project as it relates to the producer, - in our case of rural electrification normally a utility.

The financial analysis includes estimates of investment costs, operating expenditures, debt servicing and revenues throughout the economic lifetime of the project.

Load forecasts have to be made and prices used to calculate revenues and expenditures are those observed in the market. In consequence, prices will include subsidies and duties, imports and exports will be valued at the official exchange rate etc.

The financial analysis also includes examination of the profile of liquidity throughout the project lifetime.

To compare revenues and expenditures at different points of time the discounted net present value technique is applied. This technique measures the time preference between consumption today and in the future. Investments imply consumption in the future. The relevant interest rate prevailing in the financial market is used as the discount rate in the financial analyses.

Consequently, the financial analysis is a business test to see if the project will generate sufficient revenues to cover expenditures including debt servicing and leave enough surplus to embark on additional investments. As such, it is of great interest to the foreign investor even though he needs to evaluate it carefully to assess his interpretation of the financial viability of the project including risks involved.

Critical parameters in the financial analysis of rural electrification schemes include load level and growth, tariff development, investment costs and convertibility of the domestic currency.

Specifically foreign currency aspects should be of interest to a donor. If the country is not credit worthy, this will block several options of foreign finance including mixed credits.

The method of <u>economic analyses</u> is a bit tougher to illustrate than the financial analyses.

In short, the economic analyses address the issues relating to efficient allocation of scarce resources like arable land, mineral deposits, labour and capital to maximise benefits to the society from use of these resources.

Primarily, the need for an economic analysis arises from the fact that in most economies and specifically in developing countries, prices observed in the market normally do not reflect the value or cost to society of spending scarce resources efficiently. To put it

another way, observed prices like wages, official foreign exchange rates, interest on loans, electricity tariffs and commodity prices deviate from those which would materialise in a true competitive market. This is called price distortions and often causes an opportunity loss to society.

To try to illustrate, let me take an example. In the electricity sector, tariffs are often determined by politicians. The electricity tariffs are so-called administered. As a result, the price of electricity may neither reflect production costs, nor scarcity in an appropriate manner. A tariff below marginal production costs will in the short run tend to stimulate demand for power beyond production capacity. In the long run, revenues will not be sufficient to trigger investments in additional generating capacity. The excess demand will cause physical rationing.

In the free market, an excess demand would put upward pressure on the tariff and thus adjust demand to supply. However, the politicians will not necessarily adjust the administered price. In that case, no market clearing will develop.

The resulting market imbalance will create a loss to society as some of the consumers rationed out are willing to pay a higher tariff than that administered and some of those supplied would not. To put it another way. Some of the consumers not supplied put a greater value to electricity than some of those supplied. By reallocating the use of power, a potential net benefit would be gained by society. This can be done through the market mechanism by adjusting the electricity prices.

The main objective of the economic analysis is to avoid the said type of opportunity loss in investment decisions by adjusting market prices used in the analyses to reflect the use of scarce resources. In effect, the economic analysis is designed to secure maximum benefit to society as a whole.

The main market imperfections causing price distortions are:

- Administered prices like electricity tariffs, fuel prices, minimum wage rate and official foreign exchange rate
- Indirect taxes and subsidies
- Monopolies
- Externalities like pollution.

In developing countries, the major price distortions are in labour and capital markets, some product markets like energy and the foreign exchange market.

To adjust for these price distortions the economist establishes resource efficiency prices or shadow prices. These replace market prices in the economic analysis. As an example, let us consider imports to a project. Prices of imports are determined in the international market and valued at prices including production costs, insurance and freight (CIF). If government adds import duties to raise revenues, this is a transfer of money from importer to government, i.e. an internal transfer in the domestic economy. For the nation as a whole this adds no value. To society, the value of imports is the CIF price, i.e. exclusive of duties. If the duties were included in the economic analyses, one risks to reject the project because imports are valued at a cost higher than the real value to society. This would then cause a wrong decision.

In general all domestic transfers like indirect taxes, duties and subsidies are excluded in prices used in economic analyses.

Another example of efficiency price is the shadow exchange rate. If the value of domestic currency is given far too high value officially compared to the purchasing power of foreign exchange, then the official exchange rate has to be adjusted to reflect the real purchasing power of the domestic currency.

Economic analyses address the issue of efficient resource allocation. Therefore real prices are used. A financial analysis might be based on current prices including inflation. The financial interest rate

includes compensation for inflation while in the economic analysis opportunity cost of capital is a "real price" parameter.

The economic analysis includes benefits and costs which are relevant to society but not to the producer and therefore not included in the financial analysis.

Examples are consumer surplus resulting from consumers savings by switching from more expensive fuels like kerosene to power, and environmental impacts. The relevance of these benefits and costs varies with demand patterns, income level and distribution, energy consumption pattern, etc. Thus they are site specific.

Both the financial and economic analyses have to be carried out in project appraisal. In many ways they are complementary.

As for the financial analyses, the economic analyses are dependent on estimation of a vast number of data. In the developing countries and specifically in rural areas where available economic data are scarce, these data requirements open for uncertainty in the calculations. Techniques to quantify the risks explicitly in the calculations have been developed and are to an increasing extent being used. Regardless, the economic and financial analyses remain within a field of deductive rather than exact science and this calls for expertise and experience if they are to be carried out in a justifiable way.

In the rest of this presentation, some elements of an economic analysis will be addressed to illustrate the technique, its strength and limitations.

3. Electricity Demand

The very first step in a cost/benefit analysis is to establish the present level and likely future growth of demand for project output - in this case for electricity in a rural area. Specifically in projects like rural power supply with heavy investments and long lifetime, economic viability is sensitive to initial capacity utilisation and sustainable demand for power generated for a long time. Proper

demand estimates thus become essential in project appraisal both in the economic and the financial analyses.

Strangely enough this phase of project evaluation has often been given low priority and even in some cases been neglected. The outcome of the project appraisal becomes accordingly weak and random with the risk of recommending resource-inefficient solutions. There is only one solution to this and that is to allow the energy economist to come in to play before or at the latest together with the power engineer.

Numerous factors contribute to determine actual demand including the size and growth of population, the spread of productive activities in the rural area under consideration, purchasing power of consumers and price of electricity. Population is not enough. They need purchasing power to buy electricity at affordable prices if the potential demand is to be released in actual electricity consumption.

The rural areas of developing countries are often characterised by a predominantly subsistence economy or the area may be characterised as in the take-off phase of industrialisation, defined as when per capita GDP growth is positive or put in another way, income growth exceeds population growth.

For the evaluation of the power market in rural areas it is essential to pinpoint the development phase. This is site specific, however some general observations should be valid.

For the illustration, let us use a familiar example - the development of Norwegian power production.

At the turn of the century, power consumption was low and remained so for a long time till it accelerated quickly after the Second World War (Fig. 1). Growth has slowed down during the recent decade or so.

The development is typical for any economy in transition from a predominantly subsistence to a post-industrialised society. It follows the pattern of development in productive activities and the steepness

of the curve representing commercial energy consumption during industrialisation will much depend on the domestic primary energy resource base influencing the extent of viable energy-intensive industries. Regardless, per capita energy consumption will increase during industrialisation.

The transition from a subsistence to industrialised economy is also characterised by change in the mix of energy sources from non-commercial like wood, dung and crop residue to commercial like hydropower and hydrocarbons. In Norway the development has been as presented in Fig. 2. In the SADCC area, the status is as described in Fig. 3.

Now let us consider two phases of rural development:

- the very early termed subsistence, and
- the early industrialisation termed take-off.

In the subsistence situation, energy consumed is predominantly non-commercial even though some electricity may be in use from autogenerators (like diesel and windmills). Introduction of additional electricity will primarily have a potential to substitute woodfuel in cooking and lighting. Furthermore there is a limited potential for expansion in electricity consumption in domestic use, government for air-conditioning/heating or lighting, handicrafts and small-scale industries. However, the per capita level of energy consumption is low, purchasing power very limited and the expected short-term growth in electricity demand very moderate.

The postulate that supply of electricity will reduce deforestation through less consumption of woodfuel is not automatically true. In fact, a recent study of the woodfuel situation in SADCC clearly brings out that lack of energy is not considered the main constraint for development by the rural population. In general, the multiplier effect to a rural subsistence society of introducing electricity still has not been convincingly demonstrated where attempts have been made to introduce electricity for this reason. We will return to a technique for estimating the value of deforestation when introducing electricity in a rural area.

In general, project appraisals of rural electrification in the subsistence phase often turn out not to be economically viable. The exceptions are often where one or a few relatively large consumers exist. If not, even handsome estimation of indirect benefits due to increased use of public lighting, reduced deforestation, reduced urbanisation, etc., often is not enough to make the projects viable.

When approaching the take-off phase, the preconditions for justifiable introduction of electricity to a rural society increases. The per capita level of commercial energy consumption is higher, purchasing power improving and the expected growth in electricity demand encouraging.

Thus electricity supply to the rural areas has to be seen as tuned in with the whole transition from a subsistence to an industrialised economy. When commercial energy consumption increases, electricity demand will be a crucial component also in rural areas where the competitive advantage of electricity is specifically in lighting, air-conditioning/heating, refrigeration and motive power. Rural electrification will thus have to be part of an electrification strategy for the whole of the economy. It will naturally start out from the major demand centres and gradually increase through local generating plants and grid extensions - both in the distribution and transmission network.

In my opinion, the main question in rural electrification is not whether or not to go ahead - but when and with what combination of supply options.

The timing as to when to start is the most critical decision to make.

4. Supply Options

Broadly speaking, African countries are in the subsistence phase in rural areas using probably some autogeneration. Public supplies are brought to the larger demand centres.

Asian and Latin American countries are in general more mature in electrification. In many places these countries are in the process of combining various supply options of electricity to rural areas including autogeneration by mini-hydro or diesel stations and grid extensions.

When now turning to supply options of electricity in rural areas, one should not forget that the viable project solution results from an optimisation simultaneously taking into account demand and supply characteristics. To handle the problem in practice, however, we have to constrain the problem into partial analyses.

For lack of time, we will not address the issue of optimising plant size and the total combination of supply options under restrictions given by demand and supply characteristics. In the case of a mini-hydro these supply characteristics include hydrological characteristics, flow of river, plant size characteristics as to topography, dam size, environmental impacts and location of plant site in relation to demand centres.

Here, the objective is simply to illustrate some economic and financial characteristics of mini-hydro schemes assuming fixed demand projections and plant size - i.e. we have already decided on the design of the mini-hydro scheme including electromechanical equipment, dam, headrace tunnel, penstock and tailrace canal. Costing of the mini-hydropower scheme is thus straightforward.

The two situations sketched above are recalled, i.e. the subsistence and the take-off phase of development.

In the subsistence phase the question is whether or not to invest in electricity generation. The alternative to electricity is predominantly biomass.

The technique used to decide whether to implement the electrification programme is to calculate the NPV, For the project to be viable in economic terms, total discounted net benefits have to exceed 0, i.e. total discounted benefits have to be greater than total discounted

costs. In this case, estimation of costs is relatively straightforward. However, quantification of benefits is more difficult:

1. Because of lack of data for demand of project output
2. No market to indicate value of indirect benefits.

The benefit of substituting wood by electricity may be measured by the price paid for wood in the market if it exists. However, if non-existent, the value has to be estimated considering elements like:

* Value of time used to collect wood according to the revenue foregone by not putting this labour to use in a next best alternative, i.a. agricultural production.

* Loss in productive capacity of the land surrounding the forest due to hydrological repercussions of wood felling or more general, - a forest depletion premium.

If the alternative cost of labour is low and wood felling not significantly in excess of the reproductive capacity of the forest, these direct benefits become small. This is often the case in rural areas of countries in Southern Africa.

Only when direct benefits are high as in cases with fuel-switching from kerosene for lighting and cooking rendering the Economic Internal Rate of Return close to the acceptable level, indirect benefits like street lighting, increased use of public infrastructure, etc. may play a decisive role to make the project economically viable.

One way to facilitate the presentation to politicians is to residually determine the value of wood for energy. This is done as follows: Consider a situation where the cost estimates of a mini-hydro scheme are available. Data on wood consumption are also estimated. The price of wood is then determined as the price that makes NPV equal to zero. Politicians will normally be able to relate to this price of wood and decide whether wood is more or less worth. If wood is considered to be less worth than the residually determined price, then the mini-hydro scheme is not economically viable.

In the take-off case, let us assume that the decision to electrify has been taken.

In this case, benefits are equal regardless of supply option. The problem is reduced to identifying the least-cost option of the alternatives at stake. These are normally:

* Mini hydropower plant
* Diesel generator
* Grid extensions.

Other options include photovoltaic cells and wind power.

The cost characteristics of these options vary with size and capacity utilisation of plant, distance between consumer centres, distance between consumers and generation site/transmission grid, specifics of the hydropower scheme site - specifically dam size and shape, etc.

Normally, autogeneration will have an advantage over grid extension in the early phases of rural electrification. However, when grid extension is introduced, substantial economies of scale are inherent in marginal extension of the rural distribution network as the already implemented extensions are sunk cost.

In our case study we have chosen to compare a mini-hydro scheme with a diesel generator set-up. This situation is considered of relevance as these in many cases are competing options for electrification in rural areas of the main comparative partners of Norwegian development assistance.

The indicator to be used here for selection of the least-cost option of rural electrification is the EUEC (Economic Unit Energy Cost) defined as

$$EUEC = \frac{\dfrac{q_{j,t}}{(1+j)^t}}{\dfrac{X_t}{(1+i)^t}}$$

i = opportunity cost of capital

q_j,t = cost of component j in period t

X_t = power sales in period t

This formula describes variations in EUEC by changes in the opportunity cost of capital when the cost structure and development of the power scheme (q_j,t) and electricity demand (X_t) are given.

The EUEC is thus suited to rank projects dependent on the opportunity cost of capital.

The opportunity cost of capital is society's measure of the return from the best alternative investment foregone by investing in the project under consideration.

Based on Norconsult computer software and data from one of our studies of mini-hydro schemes in rural electrification in Africa, a base case has been computed with the following results (Fig. 4).

The steepest upward sloping curve is the mini-hydro alternative, the flattest diesel.

The diagram shows that the switching value of opportunity cost is 7.5 per cent. The interpretation of the diagram is that if capital is scarce to the extent that only projects yielding more than 7.5 per cent in economic terms are allowed to be implemented, then diesel is the least-cost option. The reason is that diesel is less capital-intensive than mini-hydro in the early phase thus making running expenses of less importance as opportunity cost increases.

Thus, governments by deciding on the numeric value of the opportunity cost give signals as to the ranking of development projects dependent on capital intensity.

Through our stylised example effects of changes in the following parameters are illustrated.

<u>Diesel scheme parameters</u>

- Maintenance	(- 20/+ 60)	Fig. 4.1
- Real cost of fuels	(+ 3% annual growth rate)	Fig. 4.2
- Economic lifetime of diesel generators	(10 and 15 years)	Fig. 4.3

SHP scheme parameters

- Civil works SHP - Labour-intensive technology

Electricity demand forecast

- Growth: 4% and 12% Fig. 4.4
- Initial annual demand: 8 GWh Fig. 4.5

Foreign exchange rate Fig. 4.6

- Adjustment factor: 2

These sensitivity analyses clearly demonstrate the usefulness and limitations of the cost/benefit analysis. It is a partial analysis. By choosing assumptions the analysis may be twisted to serve specific predetermined solutions. Thus care has to be taken to avoid that the analysis is used for window dressing. Accordingly ample funds should be made available in project budgets to secure proper economic and financial screening of the project. Expertise, experience and time are required to identify the viable investment options and avoid investments in resource-inefficient projects.

5. Norwegian Development Cooperation and Rural Electrification - Some Economic Considerations

In some cases rural electrification projects may not be financially viable with commercial finance while the economics of the project to society are sound. Development assistance through grants or soft credits will then be justified to make the project financially viable. In these cases the economic analysis may act as a rationale for the donor to enter into the project, even though the financial analysis turns out negative with commercial finance.

However, the arguments from utilities for grant finance should always be carefully screened. Even if the project is financially sound with commercial finance, the utility will always want soft finance to further improve its profitability. Donors have to examine whether the project is economically sound and whether their soft finance is required to make the project financially viable.

Some might argue that grants are free of charge and thus capital costs to the recipient is zero. This is true in financial terms. However, as a productive asset, the capital has a value to society regardless of the financial costs. Thus the opportunity cost of capital is not dependent on financial cost. Society would always have an incitement to put all finance available to the best productive use.

The reasoning in economic analyses assumes free movement on production factors like labour and capital. This means that if money is not spent for one alternative it can be used for any other project in the country. In Norwegian Development Assistance some funds are allocated by sectors. Budget constraints in Norway and also practice may thus violate this precondition of free factor movement for efficient resource allocation, thus imposing a price distortion on the recipient country. For instance, if funds are allocated for energy projects, but could be more economically spent in education and Norway is not prepared to change funds into education, this would impose misallocation of resources.

If development assistance is tied - either formally or by practice - to deliveries from the donor country, this may impose another opportunity loss on the recipient. This happens when donor country suppliers are not competitive and sell at higher prices than those prevailing in the international market for comparable goods and services. There are exceptions to this like the Norwegian rationale behind matching funds. We may revert to that during our discussions.

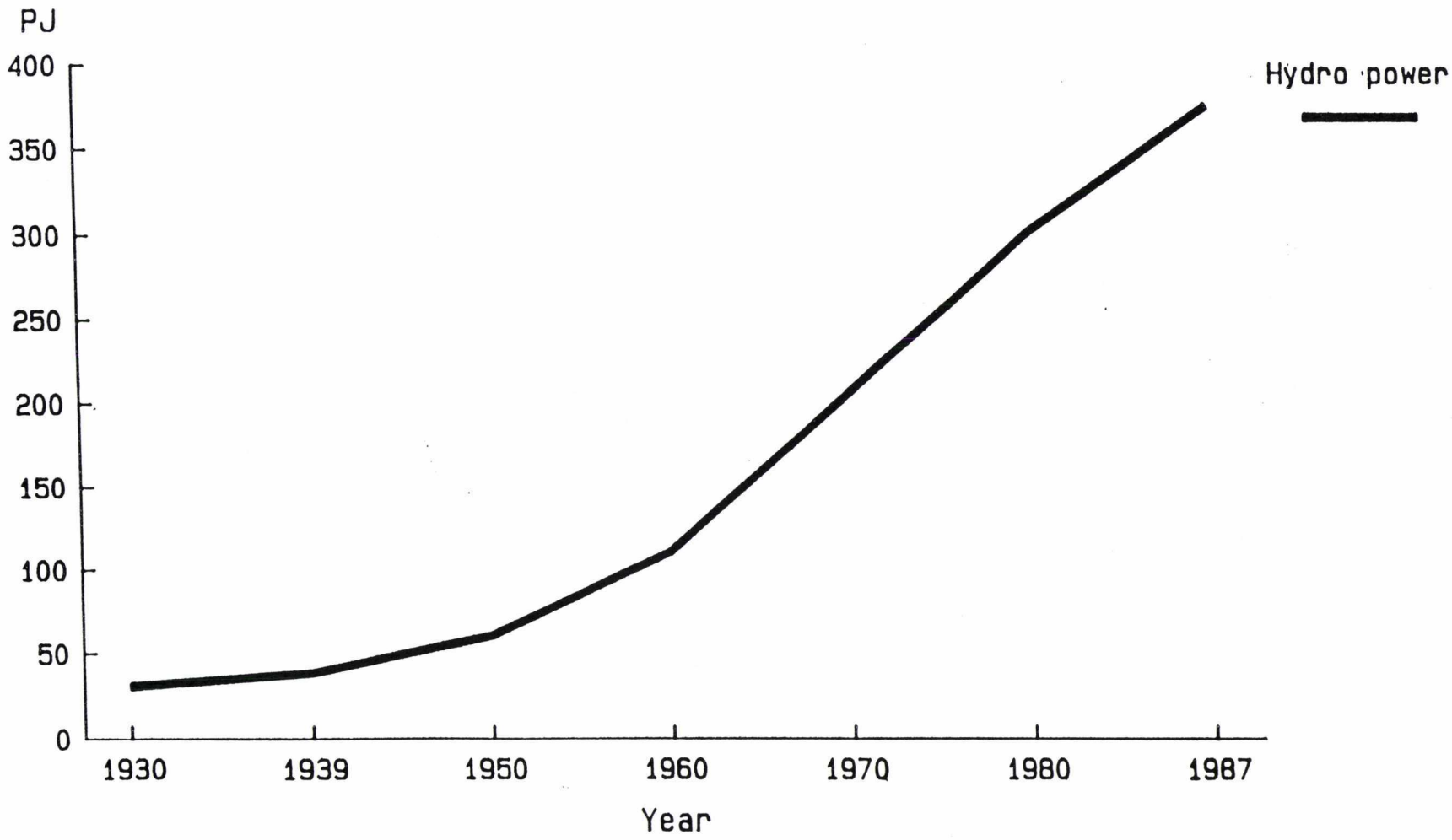
A last issue for debate relates to whether Norwegian development assistance has a specific role to play in rural electrification. Norway has electricity sector expertise and technology of relevance to the developing world - not least in small-scale hydropower schemes. However, we risk losing our expertise as our domestic market of new investments slows down while there still is some time till the markets in developing countries leap forward. The question then arises whether Norwegian development assistance has a specific role to play to secure availability of our technology in rural electrification by bridging the gap between our tail-end phase of development and the take-off phase of our main cooperating partners.

In my opinion our expertise and production facilities for rural electrification have primarily to stand on their own feet in international competition if our expertise etc. is going to be useful to the developing countries. A donor-financed share of Norwegian production of small-scale hydropower equipment beyond a certain percentage - probably not higher at any one point than 20-30 per cent - would hardly be recommendable.

Small-scale hydropower technology is a mature technology well suited to be transferred to low-cost countries. To transfer our technology in this field, joint ventures between Norwegian companies in rural electrification and suitable counterparts among our main cooperating partners should be promoted.

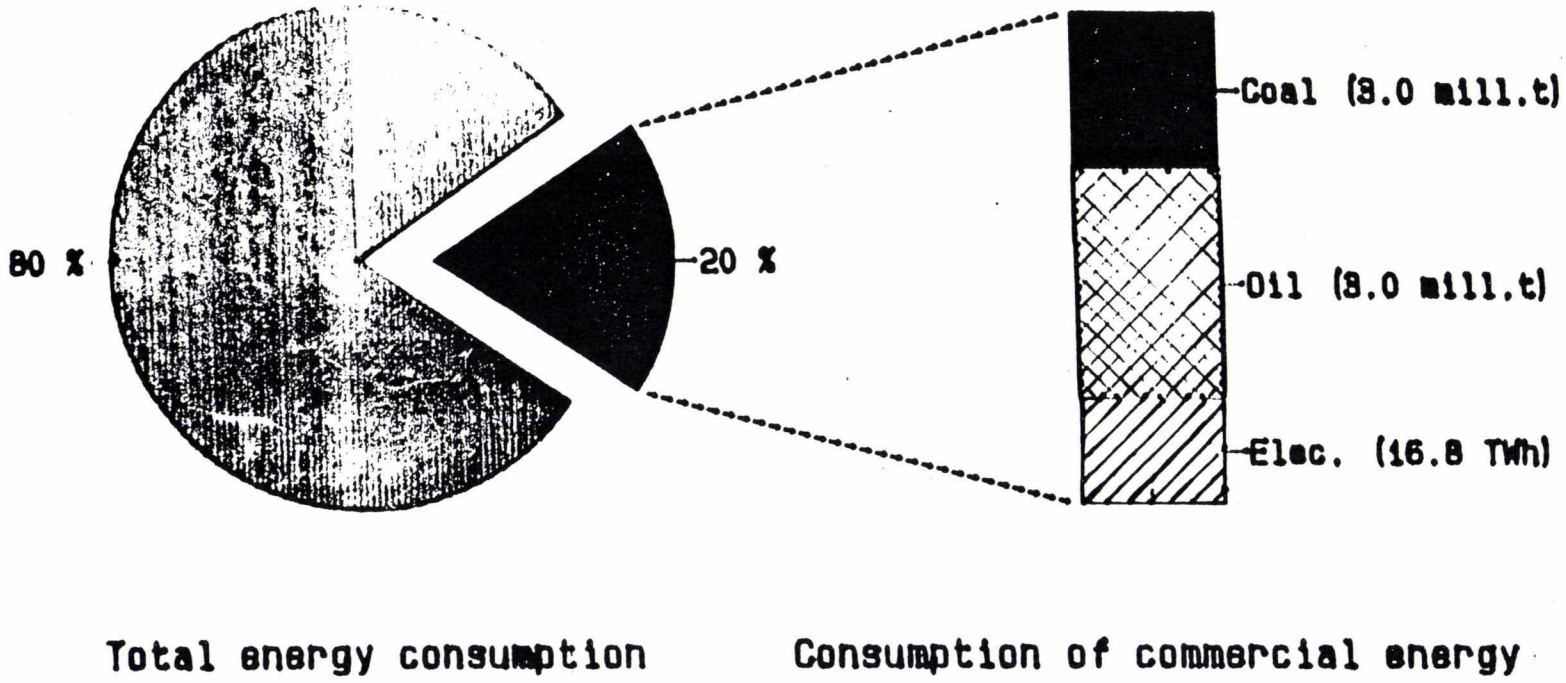
FIGURES

Hydro Power Production in Norway



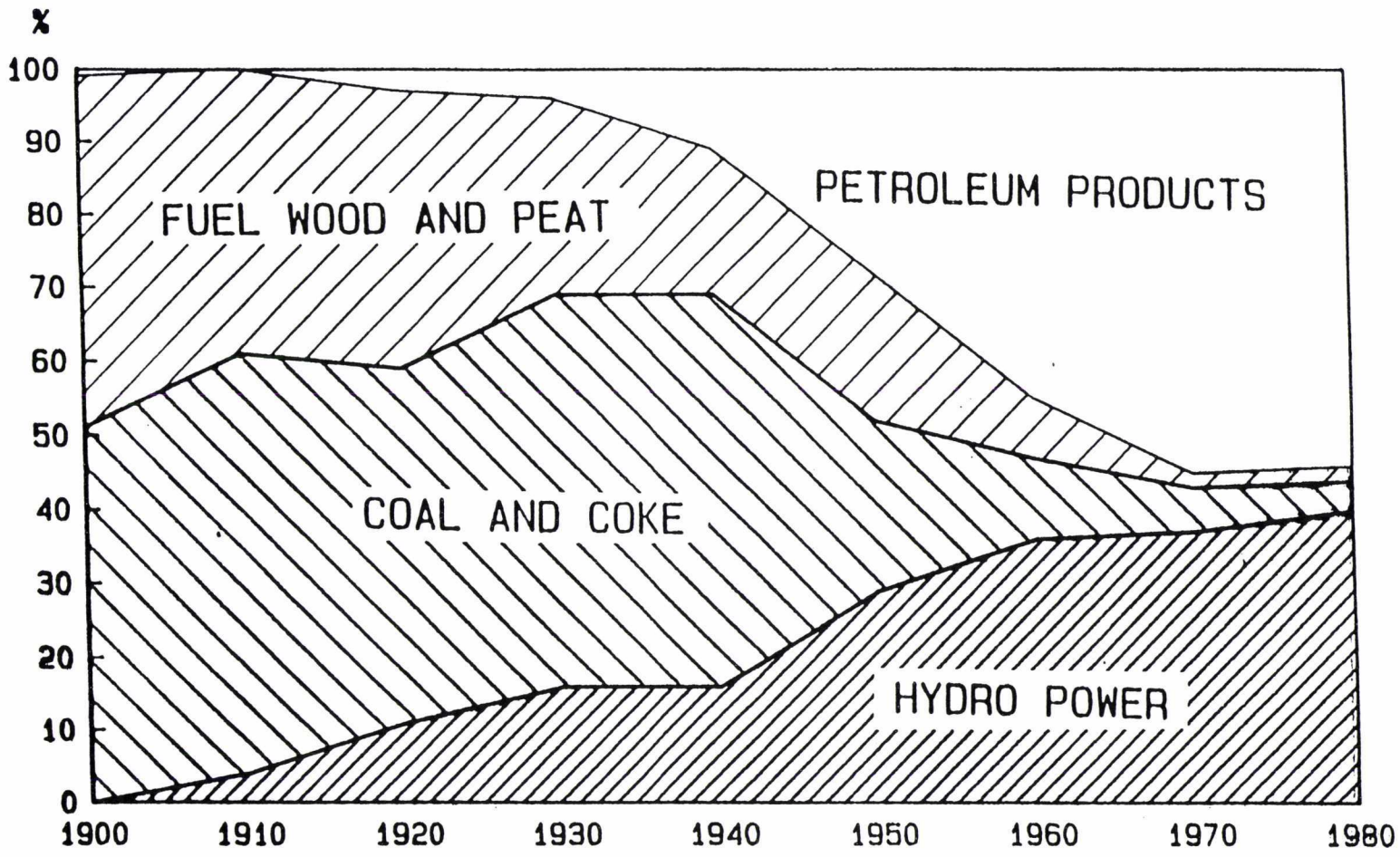
Source: Central Bureau of Statistics (CBS), Norway
630-lmei/primen2.110/4340

SADCC Energy Consumption
1984

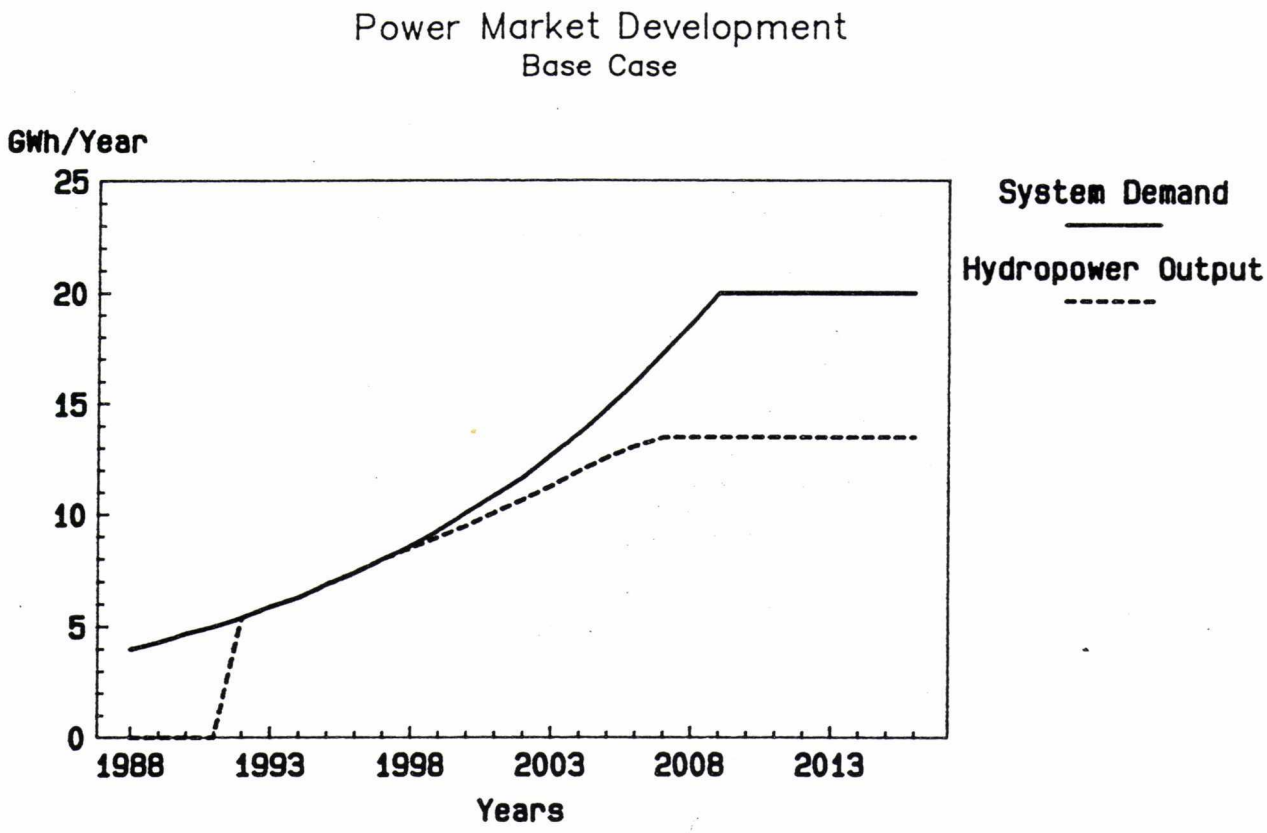


Source: SADCC Energy Sector, Angola

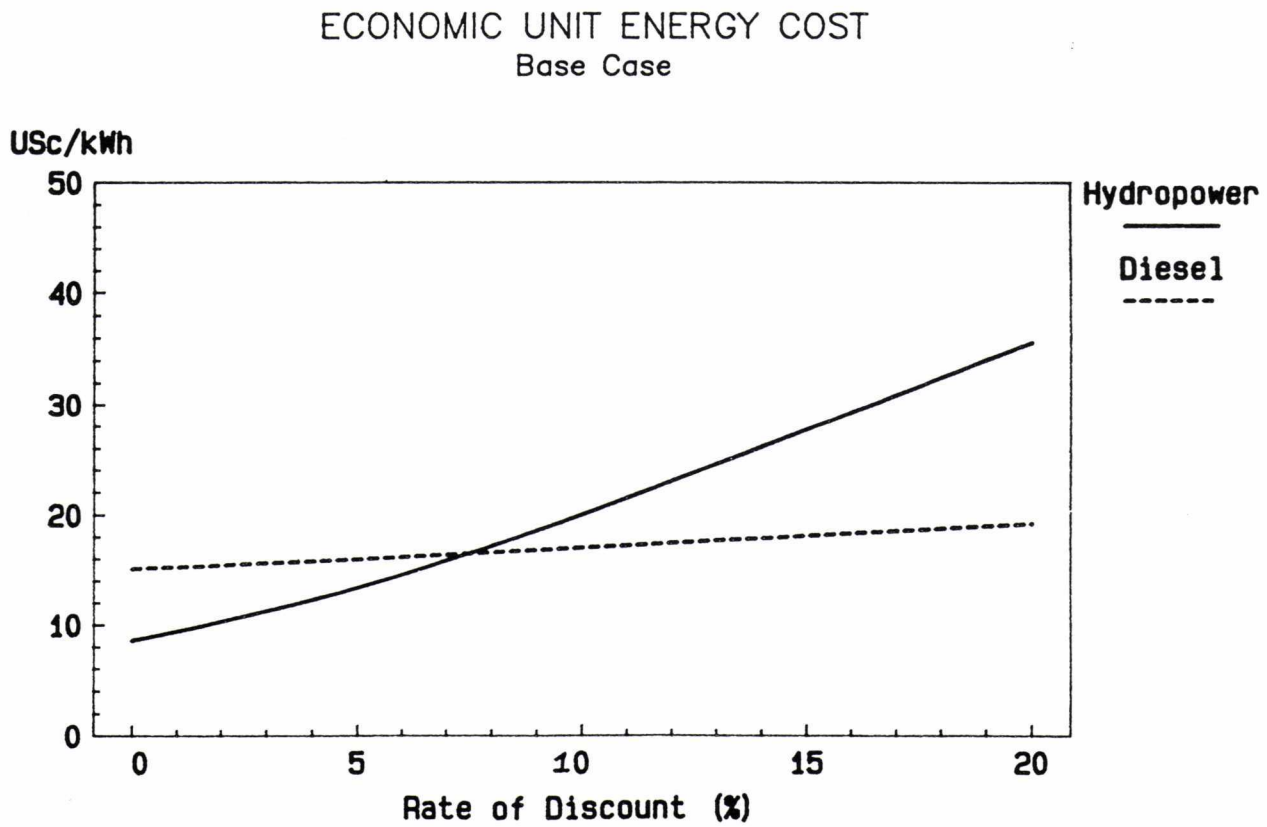
Energy Consumption in Norway by Source 1900-1980



Source: WEC 1986, Session 1.1
Evolution of the Norwegian Energy System
830-lme1/Encon1.120/4340

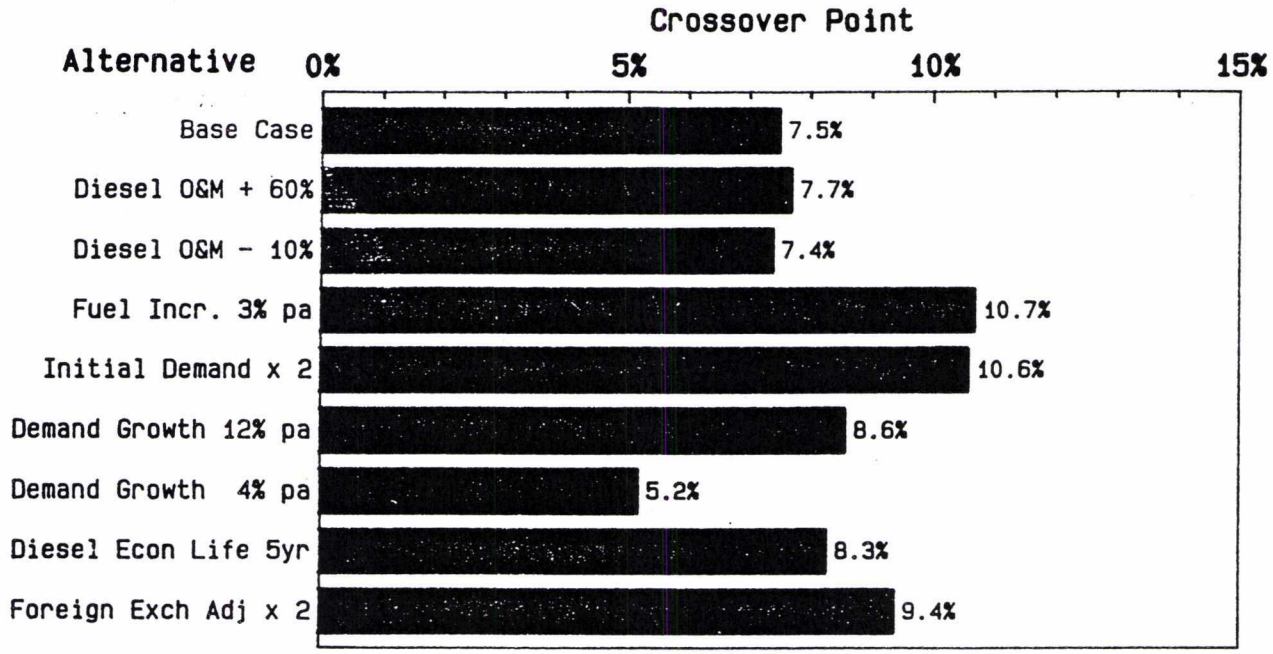


emb140/BASE-MKT.CHT



emb140/BASEEUEC.CHT

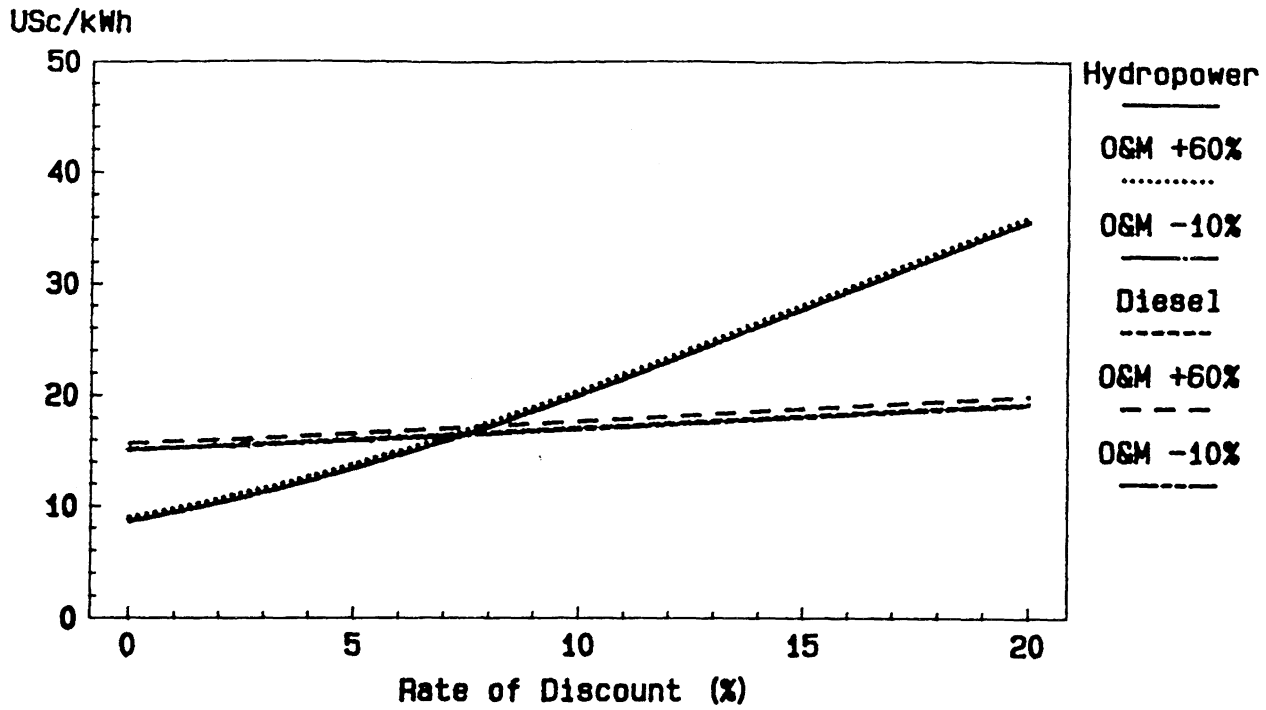
CROSSOVER POINT ON DISCOUNT RATE



Crossover point is that Rate of Discount at which EUEC hydro equals EUEC diesel

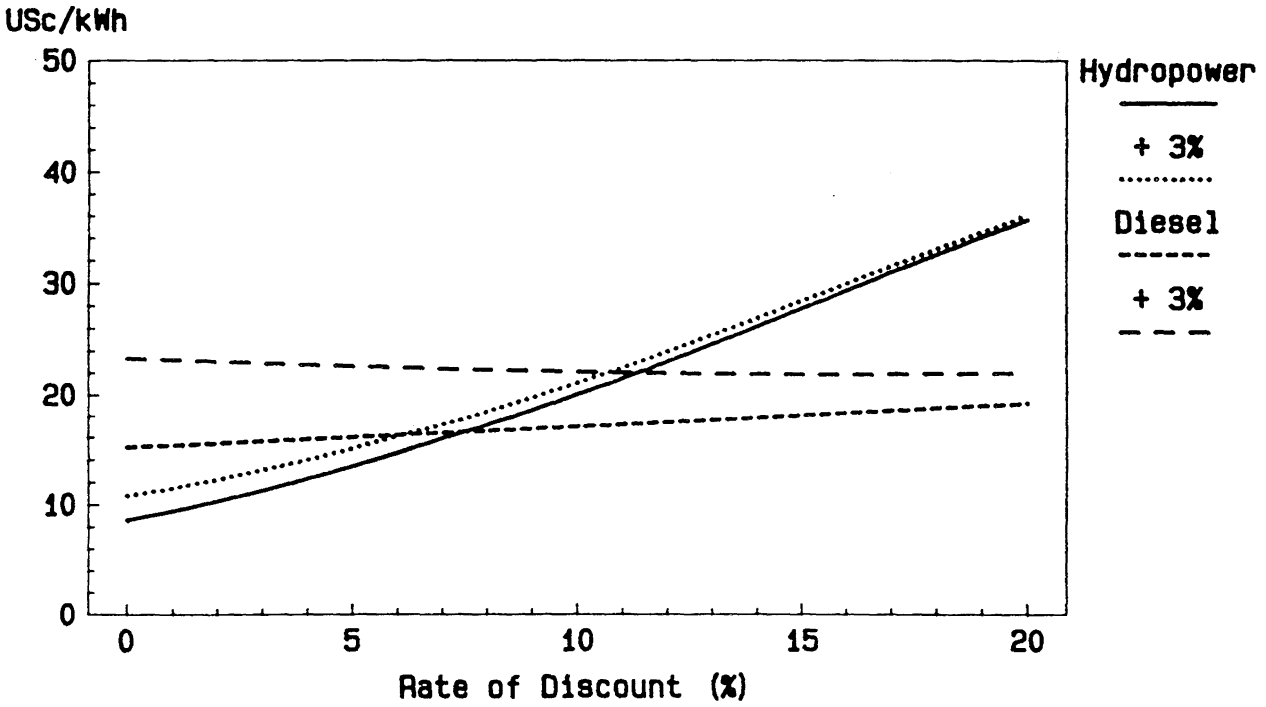
emb140/CROSS.CHT

ECONOMIC UNIT ENERGY COST
Sensitivity on Diesel Operation and Maintenance



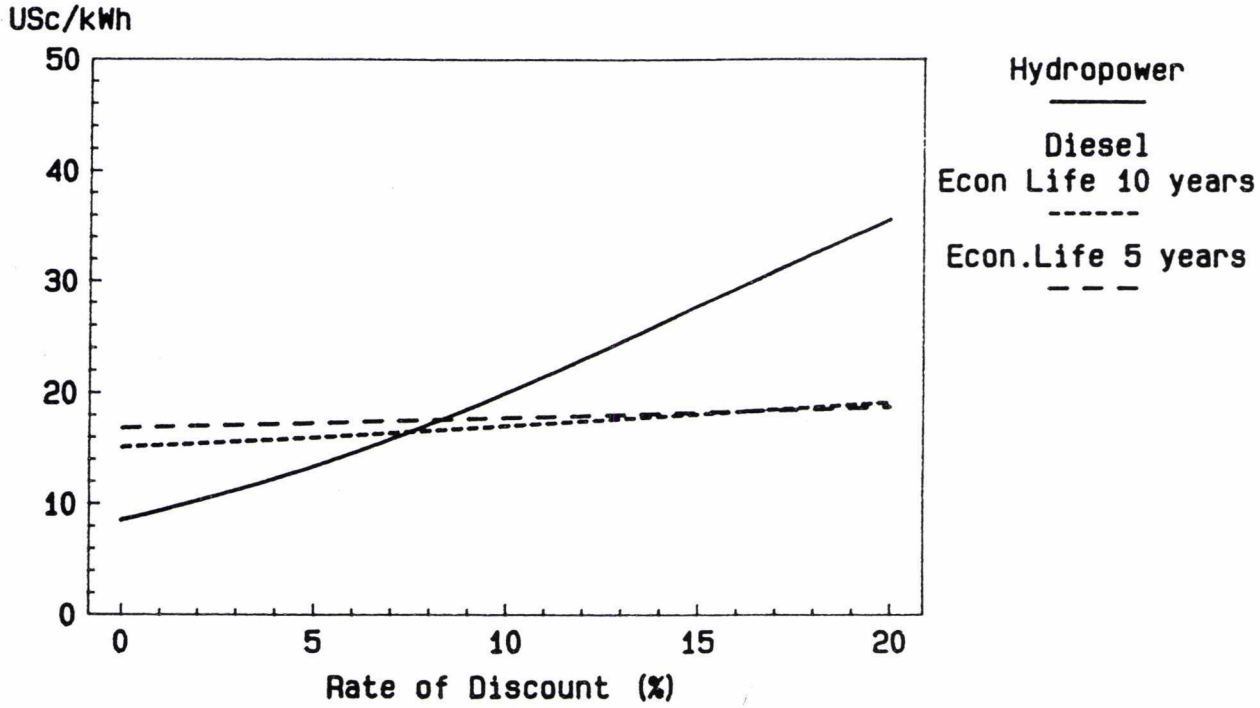
emb140/D1D2.CHT

ECONOMIC UNIT ENERGY COST
Sensitivity: Real Increase Cost of Diesel



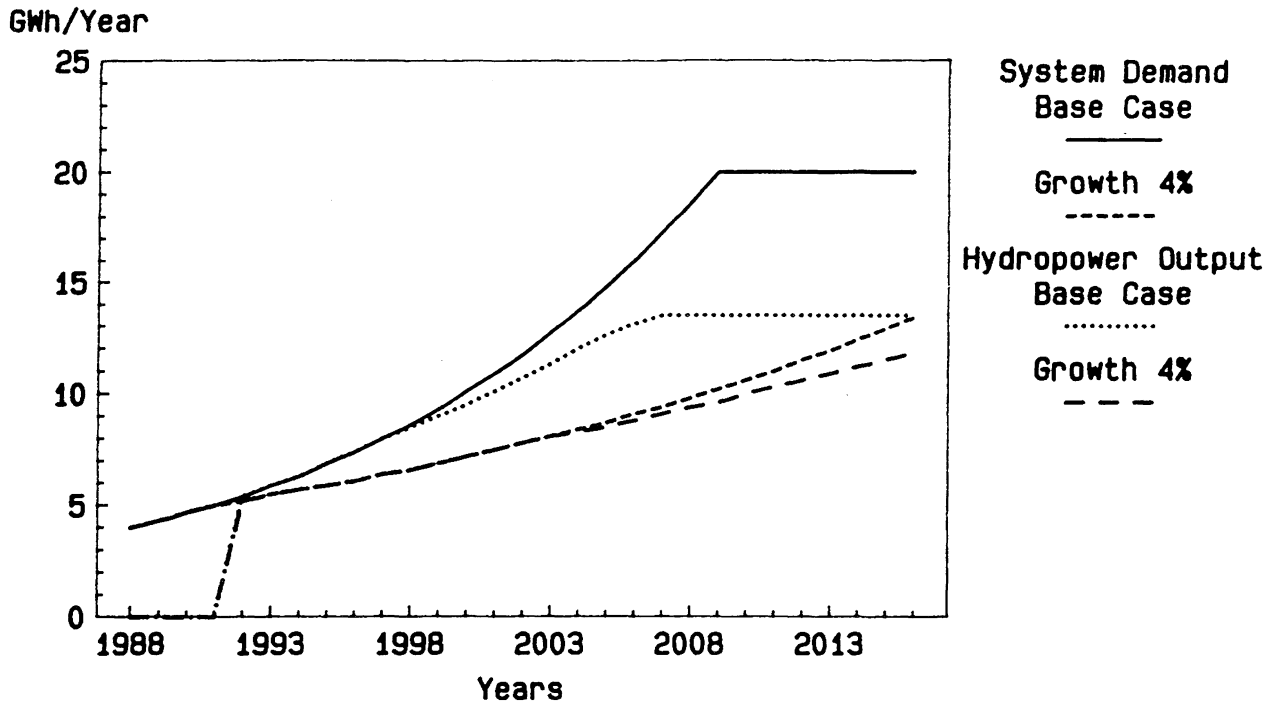
emb140/D3D4.CHT

ECONOMIC UNIT ENERGY COST
Sensitivity on Economic Life of Diesel Units



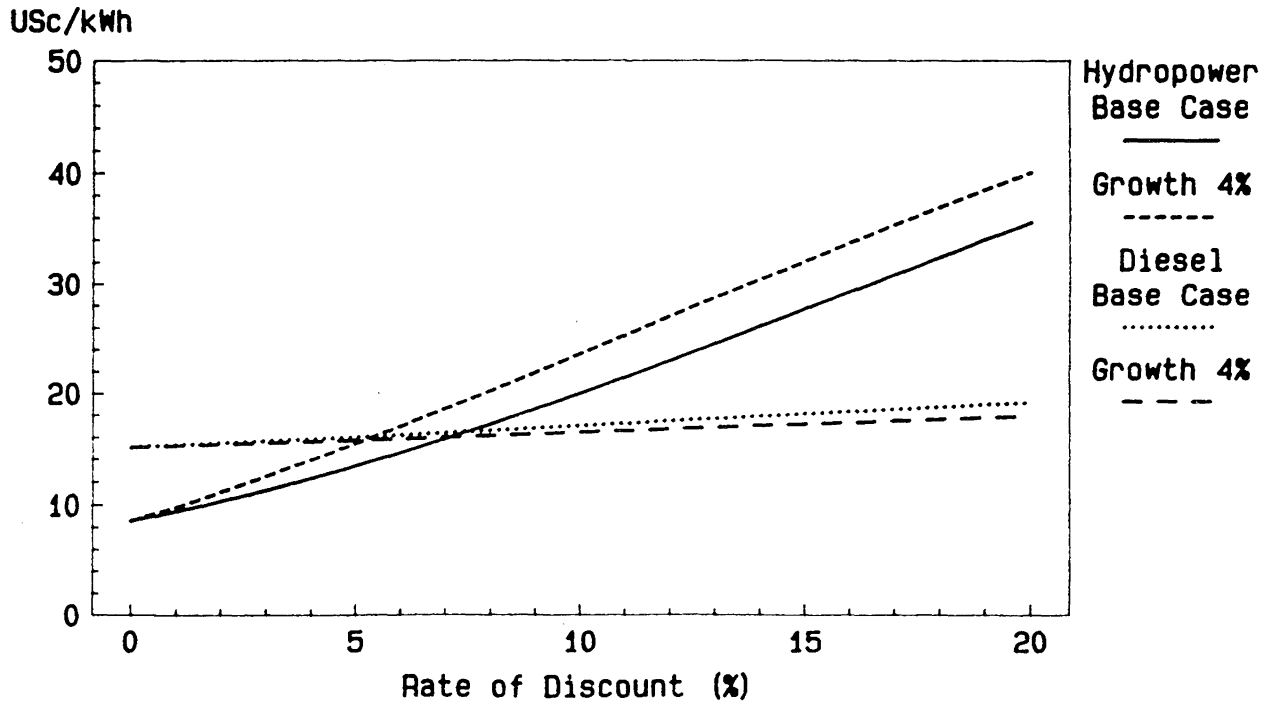
emb140/D5.CHT

POWER MARKET DEVELOPMENT
Sensitivity on Annual Growth in Demand 4%

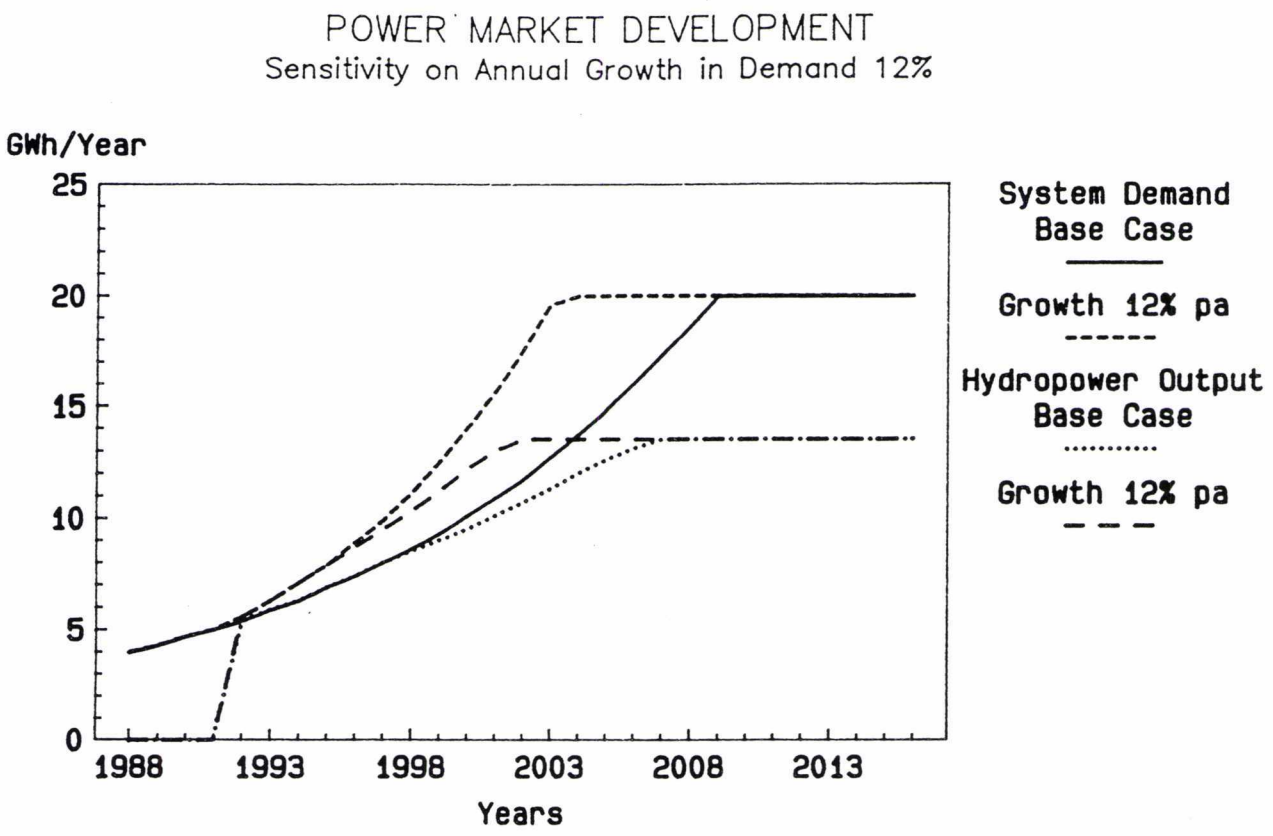


emb140/M4.CHT

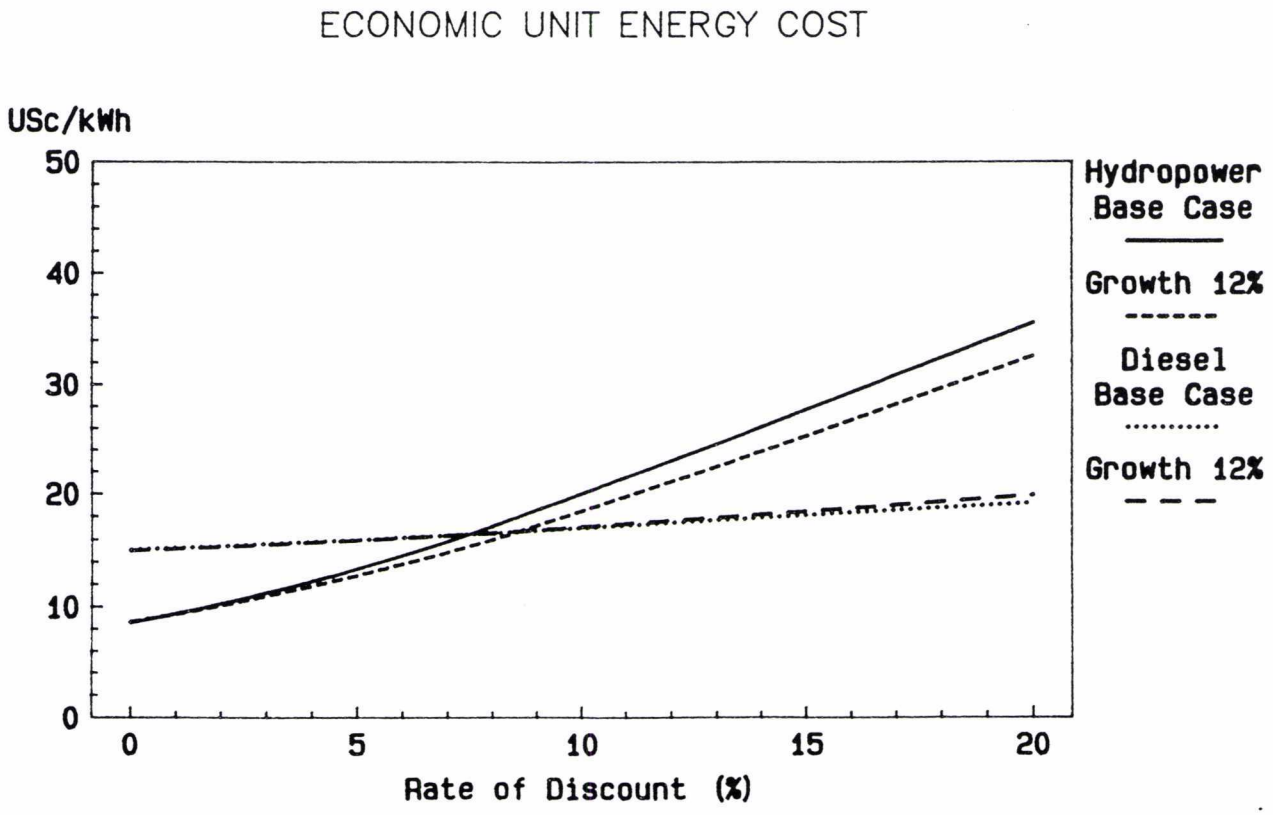
ECONOMIC UNIT ENERGY COST



emb140/EUEC-M4.CHT

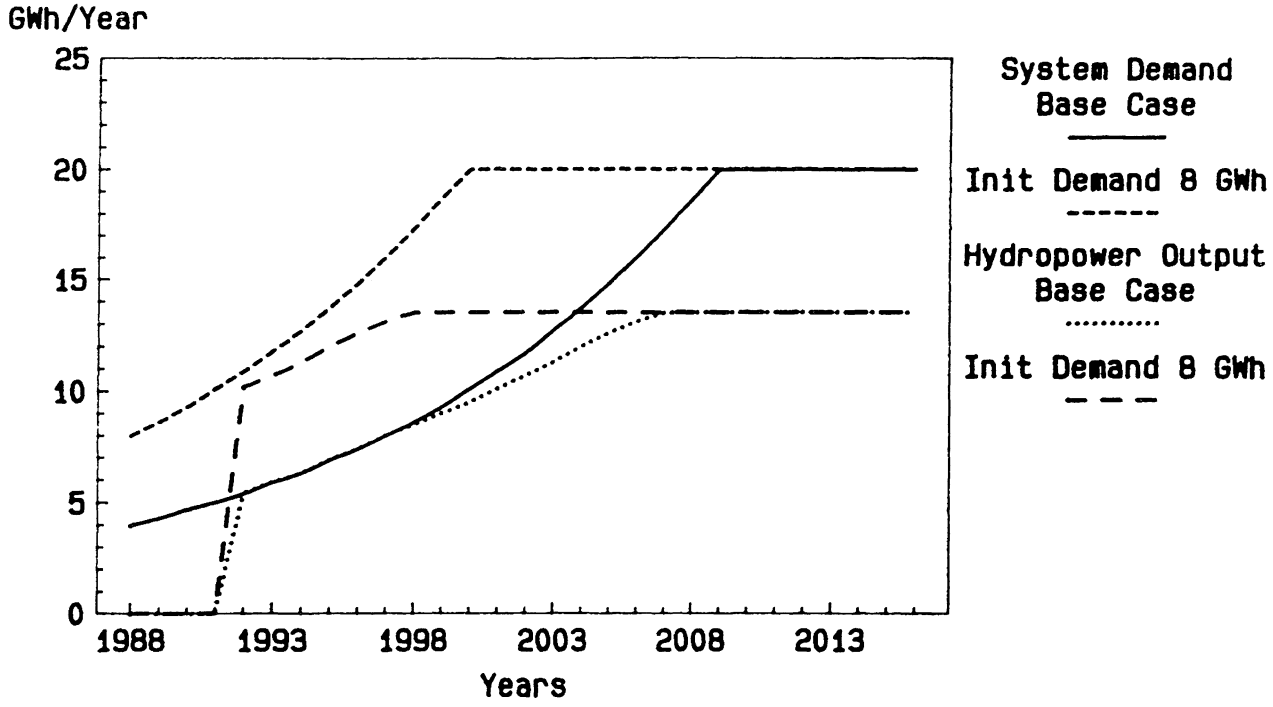


emb140/M3.CHT



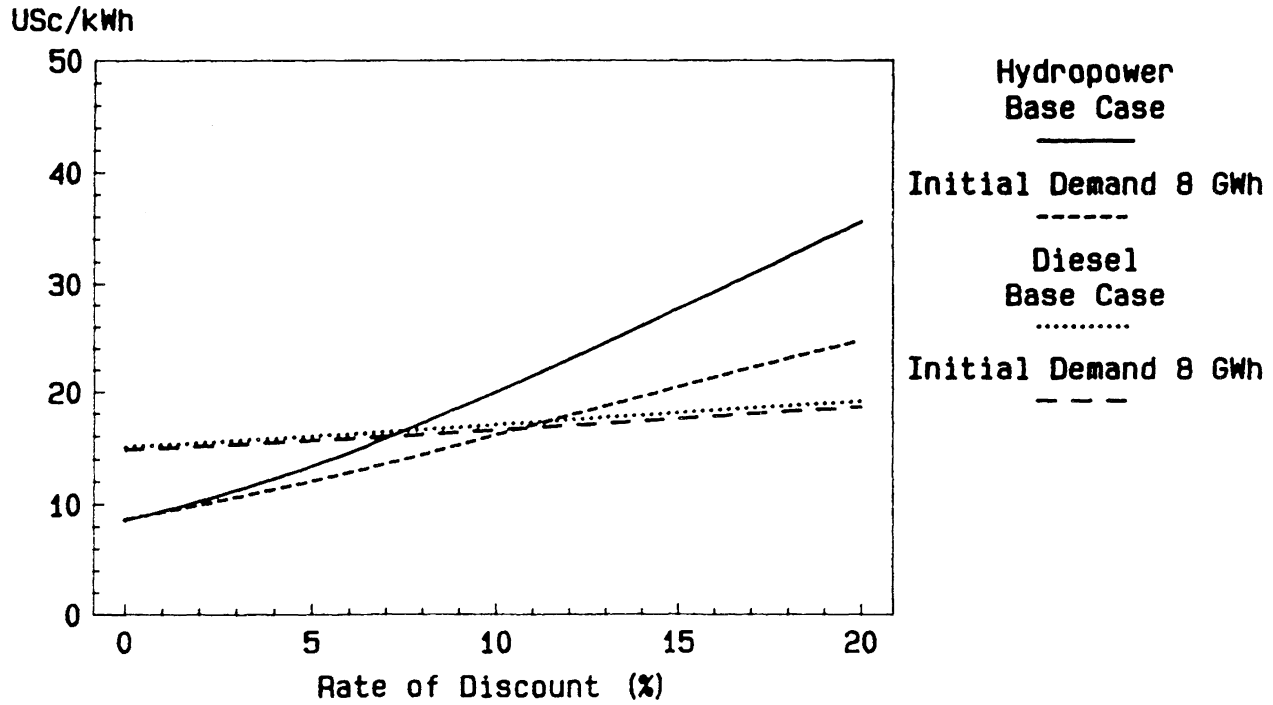
emb140/EUEC-M3.CHT

POWER MARKET DEVELOPMENT
Sensitivity on Initial Demand Level (8 GWh/yr)

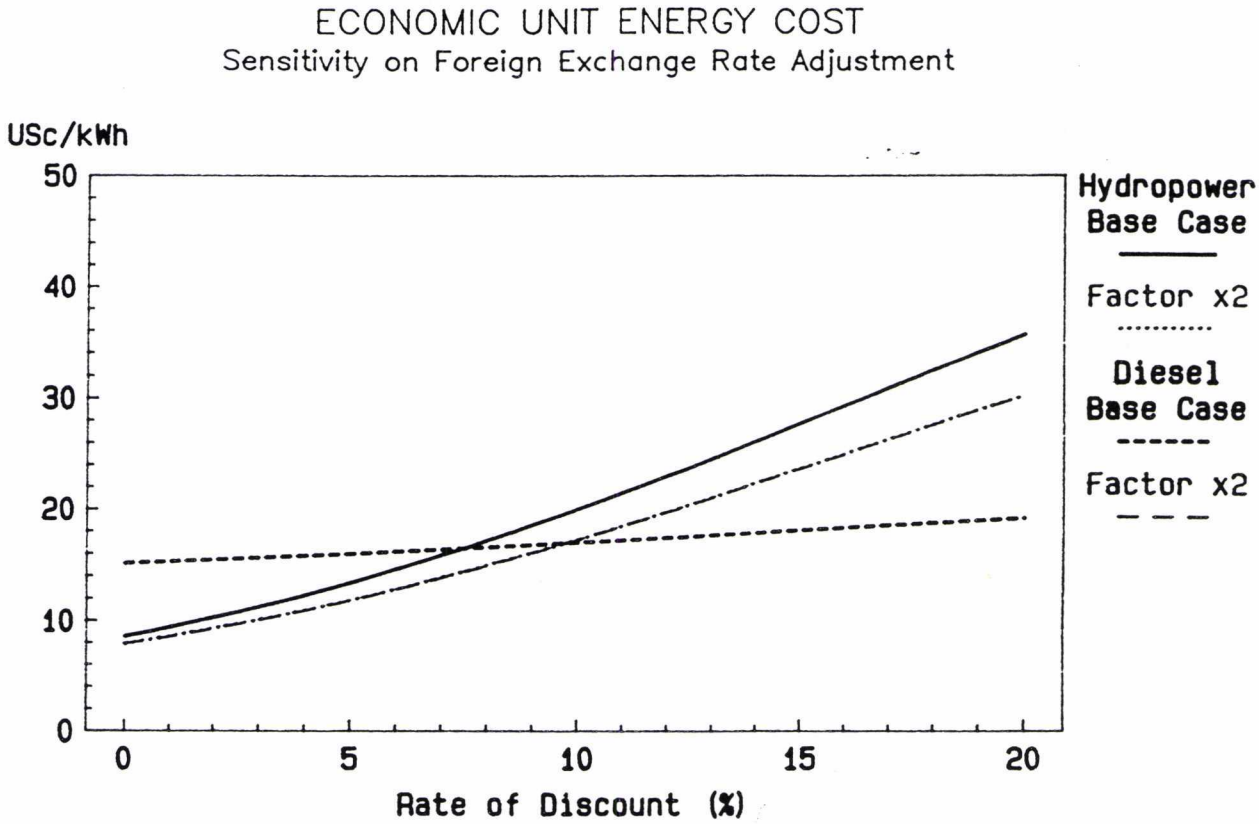


emb140/M2.CHT

ECONOMIC UNIT ENERGY COST



emb140/EUEC-M2.CHT



emb140/EUEC-E2.CHT

Foreign Exchage Rate adjusted with a factor of 2

RURAL ELECTRIFICATION - FOCUSSING ON THE IMPLICATIONS FOR THE SERVICE TARGET GROUPS.

Presentation at Seminar on Rural Electrification and Norwegian Development Assistance, Oslo, 14-15th March 1989.

Anne-Lise Klausen, Nordic Consulting Group A/S.

1. Introduction.

A programme of rural electrification is understood to be the provision of a certain type of technology i.e., a reticulated electricity net. The basis for this seminar is to discuss the provision of this type of technology to rural users, how and where.

In my view, this is not the correct starting point. Rather, the question should be: does energy have priority at all for people - and is a change of present energy sources even a matter of concern. This angle to policy formulation and planning, which is often described as the socio-cultural approach, should be the starting point rather than the technology options.

With this in mind it is still the topic of the seminar to discuss rural electrification. A lengthy debate about the definition and use of the concept "rural electrification" should be avoided. On the other hand, it is crucial, from my viewpoint, because I intend to discuss the implications of electrification upon the beneficiaries or service target groups.

Does rural electrification encompass "rural" in the meaning of:

a. village, in the sense of a limited number of subsistence farming households but one which is not a service centre.

b. service centre, within a rural setting at district and sub-district level i.e. a society which has developed certain urban characteristics.

I will in the following use the concept "rural electrification" covering both of these meanings.

Initially I will take up the implications for rural dwellers in the village setting, and secondly for a service centre situated in a rural area. It is my view that the implications for the target groups to be served are quite different in those two situations. It is however important to take up these two situations for review at the stage of policy formulation.

Scandinavian donor agencies are charged with the political responsibility of channeling aid to poverty groups in the Third World, especially the rural poor. These comprise, in African countries, between 70-90% of the population. These are mainly subsistence farmers in rural villages with very few economic resources. Are they also the target group identified by donor agencies to benefit from rural electrification ?

In the following I will describe two situations and the implications of an electrification programme upon the service target groups in the two situations. From this will follow a project example. I then intend to relate it to a planning situation, i.e. how to establish relevant knowledge of the users and to predict impact. And finally, how to have the socio-cultural aspect as the starting point for a donor funded rural electrification programme.

2. Two Situations.

All countries, areas, ethnic groups, have their peculiarities based on environmental adaptation, social and economic organization etc. However, I will still argue that there are certain common features. For the purpose of this paper, my examples will be limited to eastern Africa, south of the Sahara.

2.1. The Village.

In village situations there are different levels of specialization and different kinds of agricultural production depending on country, area, social organization etc. But more general features are: low population density, the majority of the population living as subsistence farmers, very little potential for irrigation, both because of lack of a (reliable) water source and lack of capital for investment. The level of service provision is low, that is in terms of access to drinking water, health and education facilities and all extension services. There are, in many of these rural societies, a higher percentage of women, because men have migrated to a town in search of wage labour. In general there is hardly any specialization and very limited circulation of cash. In most countries between 70-90% of the population are said to live under these circumstances.

They can be considered as being *poor*, both in economic terms and also with regards to access to services. Reading the policy programmes of Scandinavian aid agencies, these societies are in essence those who fall within the defined target groups for donor funded assistance.

Is electricity a priority here and what implications would electricity have for people in such circumstances ?

I would argue that electricity is <u>not a priority</u> for these households. Other issues are at stake, mere survival, education, health, and access to water. There are no small industries and little potential for this kind of activity. A

clinic and a school would benefit from the use of radios, fridges and lights. But this limited need could also be provided by energy sources such as solar panels. Households would at the most use a 40w light bulb a couple of hours every day. The energy source for cooking would still be firewood, because provision of electricity does not mean that poor households can acquire cookers. Electricity in such a rural society would mean light only.

It can be argued that electricity would improve quality of life but not to the extent of providing more essentials, such as a guaranteed harvest output, etc. Electrification is not a priority for poor rural households.

Considered in more economic terms, people would not be able to invest in connections unless the connection fees are held very low; in this case the electricity corporation would not be able to recover either its investment or cover its running costs.

To summarise I do not think rural electrification, using rural in the sense village outside the service centres, and thereby encompassing areas with definite poverty characteristics, are feasible target areas for electrification. Neither from the user point of view or the supplier point of view - and the donor would therefore also have to accept that this target group will not be reached.

2.2. District and Sub-District Service Centres.

A secondary centre at sub-district or even at district level, is often characterized by increased specialization and growth. Increased specialization also means social stratification and economic differentiation. Traders, possibly small industries, administrations, and social institutions such as hospitals and schools, provide a market for electricity. There are households at various income levels and these have different needs for electrical appliances.

In a society like this electricity will have a much more diverse use than provision of light alone. But it is also likely to have the impact of benefitting some groups in the society more than others and speed up the process of increased specialization. I think that in a small urban setting the users are likely to be much more interested and aware of the benefits of electricity. I am not certain that it is a priority for the poorer households, who will only use light.

The energy situation in a non-electrified service centre is likely to have the following characteristics: Firewood and charcoal is expensive, it is difficult to collect and for some households it is a major burden on the budget. When electrified the well-off households will attempt to switch

to electric cookers. But all other households will continue to depend on firewood for cooking.

Present light requirements are provided by kerosene and gas lamps; however, in general, it is uncommon for people in the rural areas to stay up after dark. Electric light will change this; it is likely to replace most other light sources and it is likely to be cheaper.

Services and administrations are likely to provide more efficient customer services. For small industries electricity can be the catalyst for adaptation of new production methods.

Electricity opens up new possibilities in small service centres, but the stumbling block for exploitation of these is access to capital. This implies that those with capital are in an advantageous position from the outset, while those without capital will have a more limited use for, (and benefits from) electricity.

The question is not only if there is a market for electricity in a service centre. It is also a question of the degree to which the society will change under the influence of electricity provision. If a donor decides to go into electrification projects in small service centres, it is important to realise that inputs in the form of additional support programmes might be necessary i.e. if the donor maintains that the poor should have a maximum share of the advantages and benefits provided by electricity.

2.3. An Example.

I will give an example of the two situations I have just outlined. A district in South Eastern Ethiopia, which is in the process of being electrified, based on donor funding.

2.3.1. A Service Centre.

The town or service centre has a population of 4000 people. It is an administrative centre, a trading centre and recently an army camp has been built in the vicinity. And now electricity will be another agent of change.

The town has for many years been an administrative and small trading centre. There is a sawmill with 65 people employed. The saw mill will not be able to expand its production, because of Government restrictions on cutting of trees. The only other small industries in the town are 12 grain mills which meet the demand for milling of various types of grain.

The army camp has changed the society profoundly. Business has become more lucrative, because money from the camp is recycled in the town in different ways. The service sector now has a dominant position in relation to trade and administration, both as a source of income and as a source

of employment. Business people come and settle from larger urban centres - only to do business in the town.

Four years ago the small town had 2 hotels. There are now 15 and another 26 are under construction. Hotels should be understood as simply built resthouses (brothels). A large number of women have opened local honey beer bars in their own house, and lowest on the scale are the suppliers, the honey beer brewers. According to Municipality Estimates, the service sector employs all adults in town who are not in the Government Service, nor are shop or grain mill owners. At present there are large bars and small bars with and without beds, but everybody can basically offer the same service, i.e. non-cooled drinks in candle light.

How is this going to change with electricity ?

The electricity corporation has proposed a very low connection fee, so most people in town should be able to afford a connection. Thus even the poorer strata are likely to benefit and have electric light. But how will electricity influence the society as a whole and effect the linkages between the various groups?

The main reason for the influx of business people, who come in from outside, is the possibility to make money. They know about the existence of the army camp and they have heard that the town will be electrified. They have capital for investments. They build their hotels, they have already bought videos, coffeemakers, fridges, "ghetto blasters", etc. When electricity becomes a reality, they will attract the majority of the bar customers. This category of business people will offer a range of entertainments and work in a situation of competition with each other.

The smaller bars, run by local people, face considerable difficulties. They do not have capital for investments in electrical appliances and they risk being left behind. Hence, electrification will become a catalyst for differentiation in the service sector. Many of the smaller bars are likely to close; some of their owners will, instead of running their own enterprise, become suppliers of homebrewed liquors and beers to the hotels. And the well-off business people will distance themselves further in terms of incomes from the rest.

It was clear in our survey that none of the business people, who expect to earn their fortunes in the service sector will reinvest their profits in the productive sector. And if they should do so, it would certainly be somewhere else (for example,their own home area). So the productive sector is likely to remain unchanged. There is very little initiative for any productive undertakings, apart from the existing grain mills and the saw mill. These will work cheaper and more efficiently with electricity than they do on diesel. Institutions such as the hospital and the school will be able to improve and extend their services.

The quality of life will undoubtedly improve for everybody. Because of light in the houses, streetlights, better quality of the hospital, and access to evening classes.

To summarise, everybody will benefit from electricity and even the poor. But not as much as the people who are better off, and who are in a position to turn the provision of electricity into an economic advantage for themselves.

The point is that, prior to the start of the project, the donor should analyse the projected impact of electrification, before supporting a scheme. Does electricity create an economic momentum in this case ? And if so, is this change in the society facilitated by electricity, something a donor, whose major concern is to support poverty groups should be engaged in? And if a donor knows the consequences of electrification and accept these, isn't it then necessary also to assist with support programmes related to the electrification programme. These could be, for example, assistance to more productive developments or small credit schemes to purchase electrical appliances.

The society I have quoted in my example above may be a special case, but I doubt it. However, the above example does show that it is valuable and important for the potential donor to acquire a structured and analytical knowledge of the project's socio-cultural context before the start of the project.

2.3.2. The Village Situation.

Outside the service centre we conducted a survey in two large villages 10km and 35km from the town centre. The aim was to look at the potential for extending the reticulation network. In accordance with Government policy, people have been "re-settled"in settlements with an average of 2000 people in each. In our sample, 35% of those interviewed did not know what electricity was, and of the ones who knew about electricity, only the teachers knew that it could be used for more than light.

In the village setting, firewood is the main energy source for cooking and for light. It is free - gathered in the forest by women and children. When there is a feast a kerosene lamp (i.e. an old beer bottle with a wick) is purchased. Such are the present energy uses.

There is poverty in these villages, it is difficult to make ends meet, the water supply is poor, the school is constructed from mud and so is the clinic. - Electricity is not a priority within this situation.

But here people are poor and an obvious target group for donor support. However, rural electrification does not seem to be an appropriate measure when people are so poor. Donor agencies have to consider whether the target orientation in

rural electrification programmes should be oriented at the poor.

It is my view that if this target orientation is insisted upon, then donors should not go into rural electrification. If, however, a pragmatic line is taken and the donor realises the socio-cultural consequences of rural electrification, I do believe that appropriate planning and support programmes will make it possible that electrification can also benefit the poorer strata in small service centres.

2.4. The Socio-Cultural Consequences for the Target Groups.

I have chosen this example from Ethiopia because, it shows a poor rural society with an urban enclave. In the service centre, electricity will have a major impact upon the lives of everybody, but those with capital will be able to use electricity as a means economic gain. So here ***the poor will also benefit,*** but not to the same extent as the ones who are better off. In the village situation, where people are very poor, electricity is hardly known, and there are more basic needs to be addressed. In this situation, the poor will hardly benefit from <u>reticulated</u> electricity.

One could have found examples where villages have a higher level of economic activity than the one brought forward here; as well as examples of service centres, which do not have a structure with a dominating service sector, but is more production oriented. This could mean that electricity will have a completely different impact. There are also many examples of how electricity has created a "take-off" situation for a small society.

The points are

- that the combination of village setting and low level of economic activity, should exclude an area from being considered for electrification programmes.

  From a Scandinavian donor point of view this means that the poorest of the poor cannot be the target group for rural electrification programmes.

- small service centres are likely to benefit from electrification. Those in the society with access to capital are likely to use electricity to further economic gains. The poorer will also benefit, but much more because electricity means comfort and convenience.

- The fundamental question is still that a focus on "rural electrification" is a technology decision. It is assumed - <u>without question</u> - that "rural electrification" is relevant. From the user angle it will be a need in certain societies, but other energy

solutions could be more relevant, or electricity and energy might not be a priority at all.

- Donors should realise that electrification speeds up the process of economic differentiation. If the poverty issue should be taken into account support programmes such as credit schemes and small industry support represent a possibility of lessening the economic differentiation and allow poorer strata to also benefit in economic terms from electrification.

- Who wants rural electrification in the third world countries?

  1. Is it rural people because electrification is seen as a means to alleviate certain constraints ?

  2. Is it the electricity organizations, which either have been given the task of electrifying rural areas as a political directive or consider it to be financially feasible ?

  3. Or is it just the donor agencies which would like to promote their own industrial products and sell equipment ?

These basic issues should be clear to policy makers involved in any rural electrification programme. Assuming that the answer to my points are that the ideal situation, as described below, exists:

> Electrification is a means to alleviate certain constraints in a rural society; in addition, the service target groups are, although not exclusively the poor, still acceptable to the donor agencies and, finally, the most appropriate technology happens to be available in Norway.

Then it can be relevant to suggest how the target group aspect can be taken up in the planning process. However, if it is clear from the beginning that this is not possible, then there is no need even to try and integrate socio-cultural issues into the planning process.

3. Incorporation of the Target Group Aspect in Planning.

The electricity organizations are essentially not interested in rural electrification. In some countries they have, for political reasons, been charged with the responsibility for dealing with the subject. To look at rural electrification from the user angle in socio-cultural terms, and not just in terms how many kilowatt hours a consumer is likely to use, that is not of the least interest to electricity organizations. Their main concern is that electrification of an area must be financially sound for the organization,

which of course means that there must be a number of commercial consumers.

There are, of course, some organizations that increasingly take an interest in the user angle. Tanesco in Tanzania is in the process of working out a set of criteria which combines socio-economic with financial criteria for electrification of rural areas. EELPA in Ethiopia is at present, through donor funding, having a socio-economist trained for this purpose.

But still, the incorporation of the target group aspect in planning is not a concern in most recipient countries .

In spite of this donor agencies should still ensure that this aspect becomes an integrated part of the rural electrification programmes that they support. This is still assuming that the purpose of the donor involvement is not exclusively to deliver technology.

In the identification and appraisal phases the donor should carry out a socio-economic/socio-cultural survey (I have presented the minimum requirements for such a survey in an Annex).

The result of this survey is that the structure of the society in question is analysed, and the likely impact of electrification upon the various groups of consumers of electricity is proposed. This knowledge allows the donor to foresee the consequences of the physical investments upon the user groups. It will be clear to what extent electrification is a priority and for who in the society. It will also be clear if alternative energy solutions would be more appropriate and if certain support programmes are needed to maximise the benefits for the poorer groups. This could be in the field of industrial development and thereby employment creation.

I will therefore argue that a proper planning phase incorporates a socio/economic analysis in the identification/appraisal phase. Only if this analysis meets the expectations of the donor and the recipient country should the project be agreed upon.

If a programme is agreed upon a thorough baseline study and an investigation of support programmes should be the basis for implementation. This would mean that the user would be in focus, and that as much consideration for the poorer strata as possible is taken into account.

4. Conclusions.

Donors should realise that rural electrification is an application of technology. It is not *per se* a solution to certain contraints identified in rural communities in the Third World. It is, however crucial at the policy stage to ask the basic question: **Who** needs electricity and for **what** ? and **who** benefits ? This is where the socio-cultural or user analysis comes in as a planning instrument.

Donors should also realise that in programmes of rural electrification it is difficult to tackle the poverty issue. It is not a relevant service to provide to the rural poor, because they cannot absorb such a service, and it is not a priority. Rural electrification should rather focus on service centres in rural areas, and in this connection it should be realised that the ones who are better off are likely to benefit more from the service than the ones who have fewer economic resources. In order to ensure that also the poorer groups benefit in more economic terms, activities where electricity can be identified as being a catalyst for development - such as creation of productive employment opportunities - should be supported.

Annex 1.

Guidelines for Minimum Requirements for a Socio-Economic/Socio-Cultural Analysis preceding a Rural Electrification Programme.

Focus of analysis:

1. *Population.* Ethnic Groups, employment structure, settlement and migration patterns.

2. *Social Organization.* Household structure, size, social stratification, distribution of income, interaction patterns, gender relations.

3. *Institutions and Services.* Health, education, political organization, cooperatives, donors, infrastructure, access to and affordability of services.

4. *Agricultural Production Systems.* Arable farming, livestock, off-farm income sources, survival strategies.

5. *Industrial and Commercial Characteristics.* Production, types of services, employment, and marketing.

6. *Use of Energy Sources.* For all sectors a sample survey including a selection of a control group of present sources of energy, access, volume and costs and the relative advantage of electricity.

This information should be used to

1. outline the existing structure of the society.

2. project the impact of electrification upon the user groups.

3. determine if electricity is at all a priority in the society.

4. if the consequences will be in accordance with donor policy, and if so which support programmes should be embarked upon. These are likely to be most beneficial to the users if they are administered locally, and with very few pre-conditions attached.

This type of survey should precede any decision by the donor.

Seminar on Rural Electrification

Project Appraisal and Selection, Methology and Criteria

Design and Engineering

by Oddvar Espegren

Some ten years ago I was working on the largest Norwegian funded energy sector project, Stiegler's Gorge Hydro Project in Tanzania. The project was a great challenge to the engineers involved and was a valuable transfer of Norwegian knowhow to a thirdworld environment. Unfortunately the project was premature in the Tanzanian context, and was early found to be not viable both economically and financially.

Since that time I have been involved in development management and less with my original profession. My presentation may therefore overlap with some of the other papers.

I have chosen to divide my presentation into 3 parts:

1. Some basic assumptions on rural electrification
2. Points on design and engineering practice
3. A model for appraisal and selection

BASIC ASSUMPTIONS

1. Rural electrification is primarily benefitting the middle class group in semiurban centers.

My proposition is based on observations in third world countries such as Sudan, Mali, Tanzania, Kenya, India and Bangladesh, and a grouping into three poor, middle class and rich. The rich and a large part of the middle class are found in urban areas where electricity is already available. In the rural areas the only people interested in electricity would be middle class: classified government employees, businessmenn, landowners, workshop operators etc.

New customers of electric power often view electricity as a symbol of affluence and status rather than a useful source of energy. Electric lighting announces a middle class lifestyle. Following lighting priority would be given to radio/TV, refrigeration, fans in the household and irrigation pumps, and sawmills and welding in the production sector. High consumption items like airconditioning, water heating, will normally only be found among the rich in urban areas only.

My point is that rural electricity demand follows social and economic patterns that require inputs from non-engineering professions.

2. Basic electricity demand inputdata are fundamental to the project success.

The forecast on peak energy and capacity for Tanzania may illustrate this point more clearly. Both project design and economic vaiability of the Stieglers Gorge Project were very sensitive to the chosen forecast. This is especially true in countries of low growth, low levels of income and education/training.

In addition to peak capacity and energy demand the utility factor in a day, week and year should be estimated carefully. Lowest level of energy and capacity may also be decisive for the design.

The initial consumption pattern before the project is implemented is usually one of sporadic use of diesel generators. The demand criteria and the forecast has to be based on interviews present and potential users. The middle class is here the main focus group. In addition, government and private sector investment plans must be identified and analized. Often the plans are far beyond the practical and possible economic growth levels. It may be quite a job to identify projects that have a firm level of commitment. The timing of the investment, the load factor, and the effect on peak capacily and energy forecast may become a massive guesswork if the engineers involved lack the experience required.

3. Use of local knowhow, local material and equipment and local practises will secure a higher level of success.

Looking at the distribution system in a third world village many Norwegian engineers shake their head in disgust. We may therefore make the great mistake of disregarding local knowhow, practices and equipment totally.

The local practices are usually a combination of the colonial history and adaptions to local conditions. There will be a logical reason behind most practices and choise of material. These should be carefully reviewed before suggested changes are introduced. I have personally seen time and again how each donor country supplies its own equipment making standardization for the host country impossible and requiring large inpute of "training" by donor country consultants. Training of Norwegian engineers may have been more appropriate!

My experiance is that there are more trained personell in the host country than usually expected, and that earlier studies and documentation is available on the most unexpected projects.

The legal side og electrical engineering projects is often ignored, areas that may cause costly redesigning at later stages of the projects.

POINTS ON DESIGN

Extension of existing network projects

Such rural electrification projects normally involve a medium voltage level transmission line, a substation and a low-voltage distribution network in the village or center to be supplied.

From my limited experience with such projects I will limit my comments to two issues: powerlines and control of voltage level.

Poverlines:
In Norway engineers are trained to emphasize strength of structures and equipment to withstand our climatic conditions. In tropical countries climatic and environmental factors are quite different.

Grassfires occur at the end of the dry season resulting in shortcircuiting and reduction of strength in structures and crossbars. Intense sooting from fire and later rain may result in operational and maintenance problems if not considered during design.

Termites, wild animals, though exotic, may need to be considered from past experience. Intense percipitation, often resulting in flash floods, has proved to be a problem that foreign engineers have not taken enough account of. I have only to refer to road and culverts undermined by erosion only few years after construction.

The other important factor in Norwegian engineering is a high level of reliability as the opurtunity cost of electricity is set very high.

In developing countries it makes more sense to give priority to COSTS, both for construction and for operation and maintenance. Material and equipment of local origin should be given priority economically by shadow pricing but also technically be improving quality and if necessary by reducing technical standards. With experience from many developing project, as well as the oil industry, I have seen shocking example of "cost unconsciousness" among engineers. Such days are now over in the oil industry and should be over also within development cooperation.
Costs are an integral part of design, especially in a country having to make tough priority decisions.

Voltage level control

We who have travelled in developing countries will know from experience that the voltage level varies from +10% to -30% depending on time of day, etc. In rural electrification this is a major engineering challenge because of long distances and minimum low "peak" load levels. This situation is seldom found in Norway and may require much local experience to find the right compromise in design, cost and future demand.

New independant electrification project.

Such a rural electrification project may consist of a power production unit, normally smallscale hydro or diesel, with necessary transmission lines, substations and distribution network. The small-scale hydro is the most interesting, both from engineering, but also from a development point of view. Hydro power is limited to countries with perennial streams/rivers within some 30 to 50 km of the main load center. To compete with diesel production in rural electrification the hydro plant would normally have to be of some size, 200 KW or more.

From an engineering point of view the challange is primarily costs, secondly operation/ maintenance.

From a development point of view the project lends itself to an integrated approach with establishment of vocational training, workshops of many kinds, small scale industry, local consultants, power company establishments, etc. Tibetmisjonens example from Nepal proves this point.
Using the project a 5 to 10 year multisector programme can be implemented.

By using open canals instead of tunnels, manual labour instead of machines, local wood poles instead of imported steel, local surveyors and engineers instead of expatriates cost are reduced and local development aims amplified. Such efforts will also increase demand for electricity and thereby secure the economy of the project.

I would especially emphasize the importance of the organization to operate and own the production and distribution facilities. In some countries local councils are allowed to develop hydro resources, and thereby augment their income for the benefit of a large population. If local private investors of consumers may be involved (with a minority share) it may be possible to combine the best of two worlds!

Production units using diesel, solar, wind or wave power will normally involve local resources and manpower to a less degree, and are therfore of less interest as an integrated development programme.

MODEL FOR APPRAISAL AND SELECTION

The following is a brief presentation of a model for economic assesment of a electrification project based on the cost-benefit model used for the Steiglers Gorge Project.

Assumption: An agreed upon demand forecast shall be supplied at lowest possible cost.

Note: An evaluation of priority of using scarce funds of electric supply vs. education, health or agriculture is assumed done outside the model.

Questions answered: Shall the identified project be developed? If so, at what time?

Procedure:

1. All options of supplying the defined demand must be identified and specified on:increment size, cost, energy and capacity, foreign exchange component, labour component, o and m costs, extraordianry limitations as to costs, environment, technical limitations, etc.

2. The contesting projects are placed in various feasable timing queues. One or more of the alternatives must exclude the identified project.

3. All costs identified for each option are placed in a yearly sequence for each alternative course of action and the net present value calculated at one basic calculation rate.

Results:
The identified project is justified if one or more of the "queues" with the project have a lower NPV than the one without.

The "queue" with the lowest NPV will give the most economic timing of the identified project.

Sensitiveity test on critical parameters will indicate how "firm" the main result is.

The analyses can be supplemented by calculating the benefit/cost ratio and internal rate of return.

The Norwegian engineer has a long tradition within rural electrification in a country that has the largest consumption of electricity per capita in the world.

However, in developing countries our track record is not the best. But it can be improved by listening and learning from experienced field personell. May this seminar and this presentation be a step in the right direction.

ENVIRONMENTAL ISSUES OF ELECTRIFICATION PROJECTS: PROBLEMS AND SOLUTIONS

by

M. Balakrishnan, Norwegian Centre for International Agricultural Development (NORAGRIC), Agricultural University of Norway, Box 2, 1432 Ås-NLH, Norway.

SUMMARY

Adverse effects of water development projects for electrification have been analysed with emphasis on sustainable rural development. Water development project creates environmental problems of various magnitude. Depletion of genetic resources and wildlife habitat, problems for natural movements of animals, soil erosion, landslide, earthquake, spreading of diseases and depletion of water resources on long run have been already identified as major adverse effects of water development projects. It is emphasized that proper environmental impact assessment should be made by the development aid agencies at the initial phase of planning of any such projects in the Third World.

THE ECOLOGIST has reviewed environmental impacts of a number of Multipurpose River Valley Projects in the Third World recently and concluded that "unfortunately, to persuade the Third World Governments to abandon plans to build water development schemes is a lost cause. The "think big" mentality is just too firmly entrenched. The only way to prevent their construction is to appeal directly to donor governments, to development banks and to international aid agencies without whose financial help the schemes could not be built". It is revealed that either the recipient governments are hiding the truth on environmental issues when projects are proposed or the donor agencies are not carefully evaluating such issues when projects are financed. This is a serious issue which will have reflections on international cooperation.

OUR COMMON FUTURE, the report of the World Commission on Environment and Development which is also known as the Brundtland Report, stresses the need for global environmental conservation for a sustainable development of the human race. This is a major and difficult task for which all nations, developed and developing, have to make a joint effort.

DEVELOPMENT VS ENVIRONMENT

No doubt, electrification is essential for the overall development of any region, state or nation. Many of the present day problems in the Third World can be solved by rural electrification and the concomittant development which may follow. However, these developmental processes should not adversely affect the nature and its balance. During the process of industrialisation, we committed several mistakes and the adverse impacts of such mistakes are now being revealed.

Nassar was highly regarded as the "universal provider" at the time when the Aswan High Dam was built in Egypt. "Nasser, Nasser, we come to salute you: after the Dam, our land will be a paradise" - Nasser was unanimously greeted by crowds of Egyptians in the streets of Cairo. Now the Egyptian Government is spending considerable amounts annually to get rid off some of the adverse effects of this dam. India's first Prime Minister, Pandit Jawaharlal Nehru, once remarked that large dams are temples of progress. After a short span of 20 years, his own daughter and the then Prime Minister of India, Mrs. Indira Gandhi, abandoned the proposal for a hydroelectric project in Silent Valley in Kerala in early 1980s after considering its environmental impacts. It is only during the past 2-3 decades that scientists could reveal the extent of adverse impacts of large dams on environment. Recent advancements in the field of environmental biology has revealed that any artificial developments obstructing the natural systems will have its adverse impacts in the long run. The impacts will be less if the artificial developments are small and would be drastic if such developments are bigger.

ENVIRONMENTAL IMPACTS OF RIVER VALLEY PROJECTS

The scope of this presentation is restricted to stress the adverse effects of River Valley Projects. The drawbacks of such projects whether meant for rural development, regional development or for national development can be broadly grouped into two. These are the ones related to the phase of the proposal and the ones related to the implementation and management of the whole programme. Very ambitious proposals without real socio-economic and environmental considerations are often proposed. During the initial stages, scientific investigations on long-term availability of resources are not properly made. Further, sustainable management of water resources is not carefully dealt with in detail at the initial phase of the planning. During the implementation phase, environmental aspects are often neglected, with the prime objective to boost the energy development. The planners seldom consider the socio-economic problems of the people including tribes who may have to be uprooted and resettled in order to implement the project.

Natural movement of aquatic organisms such as fishes is adversely affected by dams whether it is small or large. Many of the unknown genetic resources of the area of submergence are totally lost. Wildlife habitats are lost, reduced or irreparably damaged by reservoirs. Changes in the catchment areas result in reduced flow of water towards the reservoir or even affect the availability of spring water, ultimately resulting in the drying up of dams in summer months. In such cases, water resources would be depleted and the dam will be less useful on a long-term basis. Landslides are a common phenomenon observed in project areas as a result of negligence of environmental considerations. High dams in sensitive areas may also cause earthquakes of various magnitude. Unscientifically oriented implementation and management of River Valley Projects would also result in soil erosion, degradation of the surroundings and catchment areas and in the depletion of wildlife. Enhanced rate of spreading diseases (e.g. Malaria, schistosomiasis caused by schistosomes, onchocerciasis or river blindness, trypanosomiasis caused by

trypanosomes, filariasis, etc.) among the populations living near reservoirs and irrigation canals is a prominent feature linked with River Valley Projects.

POWER TRANSMISSION

Power projects are usually located in highlands and in forest areas where water resources are in plenty. This necessitates transmission of electricity for the users in villages and towns. Even though of less magnitude, the cable lines also necessitate clearfelling of natural forest. Further, the electric field created by high tension cables and the routine maintenance activities of these lines in the forest habitat may also create environmental problems especially conerned with migration and other behaviour of wild animals. It is also known that about 25 per cent of the produced electricity is lost during transmission in many cases. This extent of high loss of electricity produced after damaging the natural systems can not be justified. This aspect is less cared in many of the developing countries even when power shortage is experienced and power shedding is ordered. If proper attention is paid on this matter, much of the produced electricity can be saved. This would help in the conservation of already depleted natural habitats and wildlife to some extent.

DEVELOPMENTAL AID AND COMMERCIAL INTERESTS

The developmental aid agencies should consider it as their responsibility to see that the objectives of the project are achieved by the implementation of the same. Major objectives of such aid should be aimed at regional development, rather than aiming at commercial interests. Dams built just for selling electricity when local people have no access to power supply will have less developmental effects, irrespective of whether the dam is small or large. The sufferers should definitely have the right to enjoy the fruitful effects of such projects. Even though the Government of Kerala (India) announced that all villages in Kerala are electrified long back, many of the villages in Kerala are still under dark. Developmental agencies

should evaluate such statements clearly and should see that the aid is not with commercial interest and not used to damage natural habitats in the highlands.

SUSTAINABLE RURAL DEVELOPMENT

Rural development can be accelerated more meaningfully by exploitation of solar energy, wind energy, wave energy and bio-gas energy. Even though there are considerable scope for these means of developing power for the use of small groups of people, the Third World nations are not fully exploiting these resources. Environmental impacts of such projects would be much less than large River Valley Projects. They would also be more useful in terms of local needs. Transmission problems can be completely eliminated under these projects.

CATCHY WORDS AND DEVELOPMENTAL ISSUES

Catchy words such as "Rural Development", "Tribal Development", "Ecodevelopment", "Farm Forestry", Social Forestry", etc. have been projected in the recent past when requests are made for consideration of aid agencies. It would be more appropriate to say that these words have become fashionable slogans to project the issues rather than meaningful alternatives to solve the problems of the poor. There are social forestry programmes wherein none of the three major objectives of social forestry such as the fuelwood, fodder and shade are met; there are tribal development projects under which a good part of the fund is flowing into the hands of rich middlemen; there are ecodevelopment projects wherein environmental conservation is less attended to and farm forestry projects under which resourceful agricultural areas are being misused for growing eucalyptus and commercial crops. The sad state of never filled-in dams are also to be mentioned in this context. We have to think twice, how far rural development will take place just by electrification in the rural Third World by a development aid for a few years. What about the maintenance of these projects once the developmental phase is over? What about the traditional means of

THE TRAINING ISSUE

by Dagfinn K. Lysne

1. INTRODUCTION

The "training issue" implies the transfer of experience. Whatever textbook theory is involved, it is a left hand matter, nicely integrated into the training program, thus hardly noticable. Nevertheless written, supporting material, tailored to each specific program is a must!

Talking about this type of training, an experiance from my childhood comes to mind. My mother was a good cook. I remember that guests sometimes would ask her about resepies. That was one situation my mother found difficult, and her answer was most often: "I'm sorry, but I don't have a resepi."

The training issue is somewhat like the weather, we all talk about it, but nobody seems to be able to come up with a real answer. Even though I have taken part i some training programs, I am certainly not going to give a final answer.

In order to structure our discussion we may indicate the following type of training

1. Specific development project within limited time.
2. Courses and seminars
3. Long term training schemes
   a) Planned and implemented by semi-fixed groups of people (ref. Odd Hoftun)
   b) Implemented by an internationally oriented institution/organisation, but carried out by personell on limited time contracts.

I will mostly deal with training type 1, though as I am only presenting thoughts and personal opinions, they may also reflect on type 2 and 3.

My professional background is "River engineering", which in many engineering aspects is different from "Rural Electrification". The basic characteristics of training should not be much different, however. Training (as most important issues) deals with communication between people with individual personal background, and in an international context, cultural differences.

I will not deal with training related to energy comsumption or details about operation and maintenance, as this issue is being covered by others in this seminar

2. THE TARGET GROUPS (The trainees)

The people we work with, and are offering training, can be grouped as follows:

- Formen
- Technicians
  * field implementation
  * shops, operation, maintenance
- Engineers
  * planning
  * field implementation
  * shops, operation, maintenance
- Chief engineers
- Trainers

Norwegian friends may react to this way of grouping people as it may indicate a structified society. It is by no means my intention. These groups have their own charactistic professional background and professional objectives and goals.

Of course, in many countries these groupings may also reflect the social structure. Personally, I feel strongly that we, the outsiders (also called experts), should as a start accept the culture and the social structure we meet, and if we want to apply any input of our own, we should do so through our own behaviour and ability to communicate.

For all these groups the training procedure should include the following:

a) Discussion of characteristic aspects of the job, topic, project.
b) Professional application of theory and skills.
c) Exchange of experience and social contact with colleagues.

Considering the Formen, training should imply discussion of characteristic issues as -

- being a formen
- skills involved when doing the actual work.

Considering the Chief Engineer, training implies discussing:

- characteristic tasks for a chief engineer, such as responsibility for other employees, work planning, reports to superiors, input for decision-making, etc.
- development in theory and technical solutions also with respect to econmy and other relevant aspects.

The need for exchange of experience with colleagues is the same in principal. The need is unquestionable and equally important. Only the implementation is different. The formen will visit nearby districts, while the chief engineer will visit nearby countries (or other countries). It is important to note, however, that the cost aspect within a training program budget, is close to proportion to the scope and economic implications of ones job responsibility.

To train trainers is not alltogether different. However, how to implement professional application (train to become a trainer) should be considered more closely. Most trainers do not have a teacher's background and the trainer's job then becomes close to being a forman. Teachers are trained in an ordinary class with children or students, and with at supervisor present. This can be very diffucult to apply to non-teachers. Cultural aspects must also be considered in this respect.

I would recommend therefore that practical training of trainers take place within the group of trainers and a supervisor coming from outside. A hidden video camesa may come in as a useful tool in this respect, and can also be used by trainers in the ordinary classes or in a on-the-job-training situation. The supervisor and the trainer can then discuss the result afterwords.

3. THE SUPERVISORS

To be a supervisor in a training program is like being a teacher without the teachers professional training. (Also similar to becoming a professor, the only group of teachers for whom no professional teaching training is required!)

Would it therefore be appropriate to recommend a teachers training for all trainers supervisors? I do not think so, partly because it would not be practical as the training aspect will more and more be brought into focus and will require increasi personell resources. Partly also because a trainer/supervisors job is in many aspects different from a teacher.

Some of the main points to be considered are as follows:

* Genuine interest in working with people is imperative as well as the ability to communicate.
* Develop skills in systemasing experience type knowledge for presentation to others.
* Plan programs, prepare input to programs, and prepare yourself for each teach-training session (also after the third time around!)
* Have professional skills ahead of the best qualified participant of the group.

These points are important and must be considered closely. As a supervisor you are in a teaching position and the group will reveal anything about you. You have to be genuinally interested, if not you are at a loss, because your group consist of intelligent people and your "utstråling" does reveal your inner thoughts and feelings. In the process you will be more interesting to the group than your message. So, present your background, personally and professionally at the beginning, and if you have done your homework, you will be able to focus on aspects where you have common grounds with the group.

To systemise knowledge coming out of experience is time-comsuming. (For instance preparing for this small presentation have taken a good 20 hours - probably with a questionable result). Technical people want sketches, this takes even more time and possibly also assistance to cover up lack of skill on your part in making good sketches for teaching purpose.

Therefore, preparing plans and preparing input is very time-consuming, but must be carried out to the smallest detail. A preparation for each session is a must , otherwise the group will pin-point you within 5 mijnutes. Your technical professional skill is a necessary qualilfication, but not a sufficient qualification.

4. CULTURE AND FORGIVNESS

Many international workers claim that you must aquire sound knowledge about the culture, national and regional. The need for insight into the local culture is probably inversly proportional to the theoretical level of the trainees in the group you work with.

For many of us, being in contact with many countries, we have to accept that our knowledge about the local culture is limited. Luckily, therefore, there is a lot of forgivness available to you if you ask for it. What is needed of you is that you open up and discuss the fact that you do not have adequate knoqledge about the culture - and ask the group first to forgive you, and then to offer you the information you are lacking.

Of course, a minimum background information is required. You don't stick out your feet or raise your voice in a group of Thai-people, and you don't, when meeting a mother with her child, place your hand on the top of the head of the child, when in Malaysia. Or as quoted from a book: "All people are the same - it's only their habits that are so different".

5. MOTIVATION

A common topic of discussion and sometimes fustration among trainers/supervisors is the lack of motivation in the group.

I have already mentioned the need for the supervisor/trainer to be genuinely motivated. So consider closely if your own moderate interest is the reason for bringing the topic up for discussion.

Arguments very often refered to are: The participants are only interested in promotion, come into a position with less working load (they think), opportunity to travel abroad, etc. But let us be honest, why have we, ourselves, spent a good part of our time on education, seminars, etc. and we claim that we have to go abroad to be on top of our profession. Lastly, is the time efficiently spent at all seminars we attend?

As a supervisor it is imperativ to analyse the motivation aspects, accept them (even though you don't approve), and then, when good communication is established, you present the objectives, goals and impose the workload on the group. If you have managed to make the group accept both the target and the workload, then it is likely that your training program will be successful. But all of this is your job, not the group's!

6. TRAINING AS PART OF A SPECIFIC DEVELOPMENT PROGRAM OF LIMITED TIME

Training is normally part of the Objective and the Scope of Work in most Terms of Reference. However, during contract negotiations and during implementation of the contract, training gradually becomes a left hand matter.

The following three main reasons for this fact is pointed out:

- The contact negotiating prosedure.
- The training aspect being an integral part of the process towards the technical product!
- The personell and work plans do not reflect training aspects.

The training aspect must be handled as a separate issue. Probably, the most practical way of handling training is to split the contract negotiations into two parts.

1. Negotiate the contract for the technical product including personell and work plans.

2. Negotiate detailed prosedure and plans (including preparation of input) for the training aspect, including trainer/supervisor qualifications. Then estimate the time input needed, establish follow-up procedure and negotiate unit rates (hourly rates) for the supervisors/trainers.

3. See how 1 and 2 can be combined with respect to efficient input of personell resources and money.

The following 3 point in a training program does also indicate a reasonable follow-up procedure.

For each topic:

1. Presentation of topic and necessary theoretical/methodological input.
2. Carry out the job (on job, in the shop or in the office).
3. Follow-up session. Discuss work, results, additional theory, etc.

This takes time. Doubling the time input is probably a reasonable estimate.

7. CONCLUDING COMMENTS

Why does so many talk about training while sucessful training programs are few and far between?

We all remember a number of louse teachers, coming from our own culture. Carrying out training program in other countries of the world does therefore take some thourough consideration. In fact we must realise that it is a real challange!

THE OPERATION AND MAINTENANCE ASPECT

by Ole Kr. Sylte

1. INTRODUCTION.

Within Norwegian development assistance there has,over the latest years ,been increasing concern about the sustainability of development projects.We have seen that projects once constructed have needed continued support from outside sources to be able to operate.
Sustainability has in some instances been referred to as the ultimate test of development efforts.It requires not only that a project be successful in achieving its objectives during the project life ,but also that the benefits it generates continue beyond the time assistance.
Sustainability again ,is of course closely linked to operation and maintenance .Without successful operation and maintenance, the investments made in a project or a programme will fail to yield the benefits that were intended .
Operation and maintenance has ,therefore,come increasingly to the forefront of attention among donors and agencies financing development projects .Extensive additions to infrastructure facilities and other public utilities were financed in the 1960s and 1970s in the African countries ,and the bill of repair is now increasingly felt .
NORAD and other donors and development agencies have been concerned with this growing problem of operation and maintenance for many years ,and efforts to come to grip with the problem have been extended both in the form of financing of maintenance for supported projects and through projects specifically devoted to this purpose .

The history of donor assistance in Africa has demonstrated that operation and maintenance deserve even further emphasis than in the past ,but also that this is an area of assistance that have emerged as being more complicated than realised earlier .

Several different approaches to the problem have been tried,and the following table serves to illustrate the step by step changes that have occurred in the focus on different key issues .
Example from the highway sector .

PERIOD	KEY ISSUES OF ATTENTION
Before 1960	Support of maintenance was mostly for equipment and workshops. Covenants used extensively.
1960s	Reorganisation and reforms of administrations. Specialised technical assistance,and elaborate management systems .
1970s	Staff training ,mechanics and administration .
1980s	Institutional development.

The same evolution of concepts to solve problems of operation and maintenance may also be illustrated as in the figure below .
It illustrates first of all the recognition of the operation and maintenance problem as a structural and institutional one ,that needs to be looked at with a long -term perspective .The emphasis has shifted from technology and hardware to problem-solving capacities through institutional development .

FIGURE 1 :Evolution of Issues and Trends in Support.

Why then are successful operation and maintenance so difficult to achieve ?
In order to understand the constraints to maintenance ,it is important to recognise that maintenance is far from being only technical ,but that it spans across a broad spectrum of related issues that embrace technical,socio-economic,financial-economic and human and institutional ones .

We shall in the following chapters discuss these issues in some more detail .The basis for most of the statements are from experience from Africa and from infrastructure project.At the level of this discussion ,the concept of operation has been treated in general terms and would apply for most areas of development assistance .
But first we shall have a closer look at the present situation in African countries and the experience of NORAD in the infrastructure sectors of roads,water supply and hydropower.

2. THE PRESENT SITUATION.

During the past two decades economic development has been slow in most of the countries of Sub-Saharan Africa ,where most of Norwegian aid is channeled ,and it is no exaggeration to talk of crisis.The economy has been marked by slow economic growth,high rates of population increase ,low agricultural production and a severe balance -of-payment and fiscal situation.
At the same time the public infrastructure has been expanded ,in some countries dramatically.In the 1960s and 1970s the public infrastructure expanded much faster than the corresponding maintenance budgets and institutional capacities .Also the demand for services grew more rapidly than predicted .The traffic on the roads has become much heavier than expected,and the demand for services in the water and hydropower sectors have increased more than foreseen .
These ambitious programmes for new investment ,to which politicians ,planners and others have given priority have often been carried out at the expense of adequate funds for operation and maintenance of completed projects .A recent survey by the World Bank has shown that in six out of ten of the bank's borrowers,under-funding of both the construction of ongoing and maintenance of completed projects had assumed serious proportions.
An example from Zambia may be illustrative for the situation.

During the 1970s the total expenditure on roads in Zambia increased steadily ,whereas at the same time there was a decline in real terms in the allocation of funds for road maintenance,as shown in the figure below.

FIGURE 2 : Road Investment and Maintenance Funds.

Within the energy sector ,many countries have been forced to build excessive reserves of electricity generating capacity ,at considerable cost ,due to poor maintenance.The high returns to be obtained from restoring system efficiency through increased spending on maintenance are a vital but often absent consideration in system planning .

The situation in the water sector is not better .Studies of the situation in East Africa have revealed that as much as up to 40% of the rural water supply systems built have not worked as planned ,or not functioning at all .

The overall conditions of the road network and the corresponding maintenance needs in the Sub-Saharan countries ,have been estimated by the World Bank .These countries have a network of about 130,000 km of paved roads;355,000 km of gravel roads ;and 425,000 km of earth roads .The funds needed to prevent further deterioration of these roads and to clear the rehabilitation backlog within ten years has been estimated to be close to ten billion NOK per year .
These figures clearly indicate that there is an urgent need to switch away from new construction to maintenance ,and that even with a reallocation of funds to operation and maintenance ,there is a large shortfall in funding sources .
This is an important realisation also for donors involved in the road sector ,in that priorities among roads have to be made .Not all the roads should be maintained .Some roads have to be left to fail.

3.EXPERIENCES OF NORAD IN THE INFRASTRUCTURE SECTOR .

The infrastructure sectors have received high priority in the developing countries ,and in some cases the road sector alone has been allocated as much as up to forty percent of the total development funding .
Not surprising ,therefore ,that the infrastructure sectors also have received a high proportion of Norwegian assistance .
During the last two decades,the infrastructure sectors,roads, water and hydropower received more than one quarter of the total bilateral aid .
It would be of interest to identify whether the evolution of the maintenance crises has influenced the NORAD funding in any way .
Does the awareness of operation and maintenance reflect in the composition of the project portfolio today ?

There is a marked change in the type of projects supported and the

activities included in the projects ,as shown by the figure below.

FIGURE 3 : NORAD Infrastructure Project Portfolio.

The figure shows the portion of "construction";"maintenance"; and "technical assistance etc.",as a percentage of sector total.
This is shown at three different stages ;by aggregating projects completed by end of 1988 ,ongoing and budgeted/not started.
The mid point in time for these stages ,will be different for the three sectors,and any conclusion drawn should keep this in mind .
Nevertheless,it must be safe to conclude that there has been a dramatic change over time in the support of maintenance ,and that this change is most clear in the road sector .
In the road sector only about 4 % of completed projects was for "maintenance" ,whereas as much as 81 % of budgeted/not started projects .
The switch towards maintenance has been less remarkable ,although clear also in the hydropower sector .Whereas the completed projects did not include any significant portion for maintenance, the budgeted/not started projects included 28% "maintenance".

When the change in focus actually took place in the NORAD funded projects ,can not be said precisely .One could try to describe the evolution by talking about three generations of assistance projects:

FIRST GENERATION PROJECTS;
Took place from about mid 1960s to mid 1970s. Characterised by high portion for capital investment.The objective was construction of infrastructure .
Typical project : Turkana Road,KEN-006.

SECOND GENERATION PROJECTS;
Took place from mid 1970s to beginning of 1980s.Some of these project were a continuation of the first generation, and included typically a combination of reconstruction and maintenance.Main focus was on support of effective maintenance to save previous investment .
Typical project : Rural Roads Maintenance Programme ,TAN-036

THIRD GENERATION PROJECTS;
Took place from the beginning of the 1980s and onwards .
These projects have been typified by focus on community participation ,institutional development,appropriate technology and long-term commitment .
Typical project : Minor Roads Programme ,KEN-067.

Norwegian bilateral aid has as a matter of general assistance policy been targeted to the most deprived sections of society .
Much of the project and programme assistance has therefore been in the rural areas .
There is no doubt that this has magnified the problems encountered in respect of operation and maintenance for NORAD.

Facilities constructed in the rural area have generally a lower potential for cost recovery ,or less user benefits .The standards of construction will therefore be lower ,and with consequently higher cost of operation and maintenance . The local authorities are seldom effective in the rural areas,and they are typically left with more than limited resources to carry out the required maintenance .
Support of maintenance of public infrastructure in the rural areas poses a question of prioritising use of scarce public funds. If on a large scale ,it has to be considered if the funds could be better spent in other areas ,or if the support is out of balance with the present macro-economic resources .

4. KEY ASPECTS OF OPERATION AND MAINTENANCE .

As mentioned earlier in chapter 1 ,operation and maintenance as a concept comprise a number of components that have a bearing on the success of assistance .In this overview ,only the most dominant will be discussed .

4.1 Financial/Economic Aspects .

The economic issues will include:

* Budget /Finance Mechanisms
* Financial Control
* Foreign Exchange
* Cost Recovery

Operation and maintenance of development projects are concerned with sustaining the productive use of existing investment and with providing for rehabilitation of existing capital where necessary . NORAD has already for some time funded part of recurrent cost of maintenance .But the approach traditionally adopted by most donors is that responsibility for maintenance ,including in particular the recurrent cost of routine operations ,should be that of the recipient.They have taken the view ,at least in the past ,that foreign aid should be focussed on capital items,including equipment for maintenance ,workshops ,initial stock of spare parts and materials.This preference of aid agencies to finance capital rather than recurrent costs have sometimes introduced a bias against maintenance,as long as new construction would attract the maximum foreign financial participation .
The attitude to day is more liberal towards financing of recurrent cost of operation and maintenance ,also by the World Bank ,as this is seen as a necessary short-term requirement while the economy is turned around .

Studies made by the World Bank ,mostly on highway investments,have shown that the overall economic return on proposed maintenance projects have been very high .Completed maintenance projects show returns at ex-post evaluations that are sometimes several times the opportunity cost of capital .The high returns basically reflect the high profitability of small expenditures to maintain the full service value obtainable from large earlier investments

in construction .
Although this is the general case ,it should not be forgotten that there may be cases that do not warrant funds spent on maintenance .This could be due to need for priorities under budgetary constraints ,or due to large requirement of foreign exchange in a situation of scarcity .

The figure below illustrates the relationship between maintenance standard and net present value to society .It is also an illustration of the typical case in developing countries,in that there is a safe margin for investing in maintenance with high yield of benefits .

FIGURE 4: Net Present Value / Maintenance Expenditure Relation.

The great majority of infrastructure in developing countries would fall on the steepest part on the NPV/Expenditure curve .
When the maintenance budget is less than that required for an overall optimum ,the cost to the user will increase by more than the savings in maintenance costs.The net effect is an increase in total costs.
A drastic reduction in the maintenance expenditure ,will increase the user costs by many times the equivalent amount both in short- and long-term .In the long-term the net cost to the responsible agency will also increase as a result of expensive rehabilitation.

The illustration above apply for the road sector .In principle the same will also apply for the water and hydropower sectors ,with the difference that user costs in the first place have to be carried by the operating agency.

I would like to mention one matter that I personally have come to regard as very important when analysing future development projects ,namely the element of risk that is present in such cases .
The future costs and benefits of development projects are often estimated at the appraisal stage ,and some times a sensitivity analysis in relation to key parameters .But it has mostly been carried out under the wrong perception that normal maintenance would be forthcoming , which in fact has proved to be very wrong. What is missing is an analysis of the risks of deferred or neglected maintenance .
For the road sector the World Bank has recently developed an appropriate analytical tool in the form of a computer programme, the HDM model ,that can be used to estimate the consequences of different maintenance strategies .

4.2 Technical Aspects.

Technical issues could be a long list of items ,and would include among the most importance such as :

* Technology
* Equipment,Spares
* Design
* Technical Legislation

Since the engineering elements are covered by other speakers , I will limit the comments under this heading mainly to a discussion of technology .But let me first say that the people responsible for the day to day running of a hydropower plant ,will undoubtably mention the technical problems they have , and will most probably say that lack of spare parts is the single most serious constraint to effective maintenance .And there are certainly technical aspects of the design of infrastructure that may have most serious repercussions on the future operation and maintenance .But common to these sort of technical problems are that they seem to be solvable when they become known .
However ,the problem of lack of spare parts ,that may be traced to shortage of foreign exchange, may also be related to the question of choosing the right technology .
Several evaluations of NORAD projects as well as country studies have mentioned choice of technology as perhaps the most important element in reaching a sustainable operation .
In one NORAD project the technology was changed from mainly machine based to labour -based .The rationale behind the change was that there were little prospects of developing the capabilities to operate heavy machines and that machine based maintenance would require too much foreign exchange for the country's economy .

4.3 Institutional Aspects .

The institutional aspects of operation and maintenance would include such different issues as :

* Socio-economic/Cultural
* Organisational/Legal Powers
* Motivation/Incentives/Accountability
* Management
* Human Resources/Training
* Community Participation

Since we in this seminar are dealing with rural development , we shall discuss the last of these issues ; community participation. Many development projects built in rural areas have been undertaken with the assumption that they would be maintained by the local communities; but few have succeeded.This poor record may be linked to the limited extent of authentic community participation in planning and construction ,and little genuine involvement by the local people .

Community participation in maintenance requires acceptance of the task as a community responsibility .The future responsibility for maintenance ,has to be made clear to the community early in the project ,and the consequences of failure have to be explained. The experience from a number of development projects in the rural areas ,indicates that community participation at the planning stage ,increases the chances of adequate maintenance . Communities that have participated earlier in the project ,may be more willing to take responsibility for maintenance.

4.4 Systems,Logistics.

Under this heading would for example fall such issues as :

* Force Account /Contractors/Private Groups
* Cofinancing - Donor Co-ordination
* Standardisation policies
* Monitoring and Evaluation

Contracting for routine as well as periodic maintenance is being increasingly used by several African governments .Motives have varied.Some have turned to contractors when efforts to build up government institutions over many years failed to produce effective results or,when general hiring restrictions prevented force account organisations to tackle the growing maintenance need.
Contracted maintenance has proven to be a workable undertaking -- in countries at all levels of development and with all manner of organisations.
Of particular interest here may be the alternative approaches to maintenance that have been introduced in some projects ,based on participation from the local community .
Both the "lengthman system",used for example in the MRP in Kenya, and the "village responsibility " system used in Latin America , have proved to be viable alternatives to traditional force account organisations .

5. FUTURE DIRECTIONS .

Based on NORADs strategies of assistance ,what should be the key policy issues for future aid ?
Some points for consideration in respect of operation and maintenance could be :

* Support of operation and maintenance deserves even more attention than in the past.
* Assistance in this field need to be long-term and focussed on human resources development and institution-strengthening.
* NORAD should continue its commendable initiative in developing and implementing appropriate technologies .

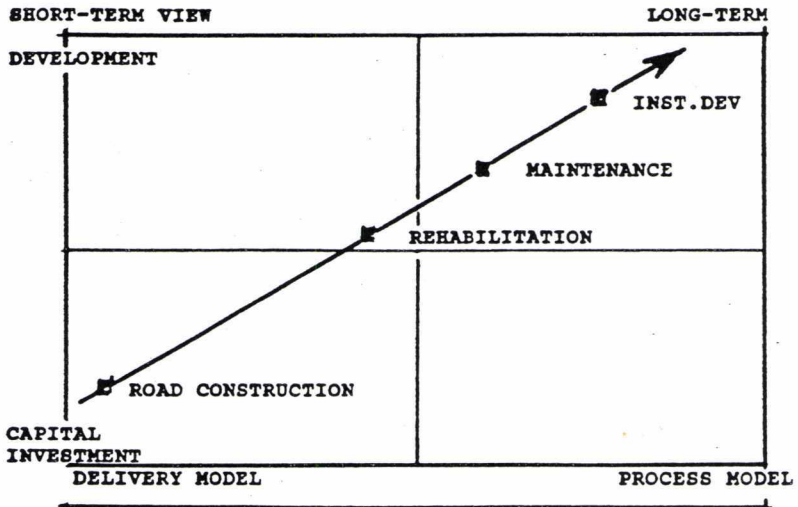


FIGURE 1 : ISSUES AND TRENDS

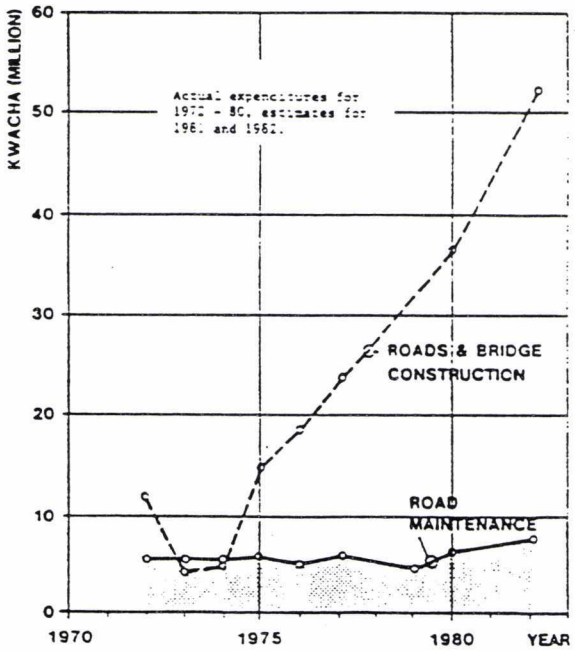


FIGURE 2 : ROAD INVESTMENT AND MAINTENANCE FUNDS
SOURCE : NORCONSULT EVALUAT.GLO 401

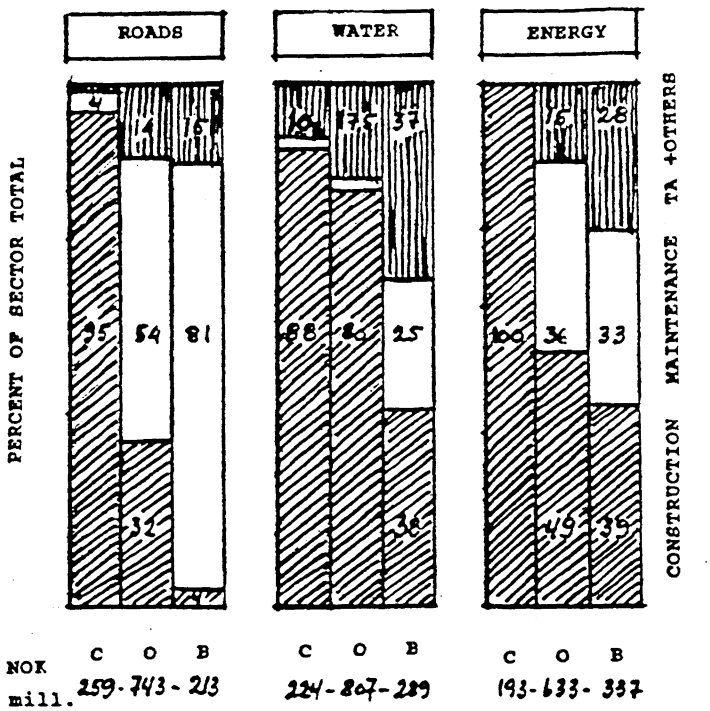


FIGURE 3 : NORAD INFRASTRUCTURE PORTFOLIO
SOURCE : NORAD

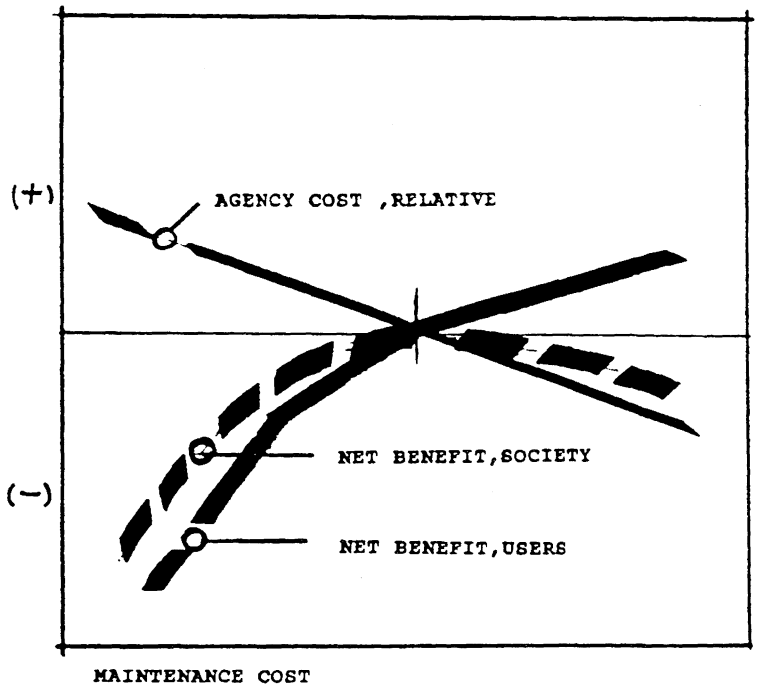


FIGURE 4 : NPV/EXPENDITURE RELATION

LIST OF PARTICIPANTS

Alshus, G.	Hafslund Engineering Slemdalsveien 37, 0303 Oslo 3
Arvesen, H.	Norges Eksportråd Drammensveien 40, 0255 Oslo 2
Aursand, M.	Noack Solar P.O. Box 79, Kjelsås, 0411 Oslo 4
Balakrishnan, Dr. M.	Noragric Postboks 2, 1432 Ås-NLH
Dahl, E.	Norges vassdrags- og energiverk, (NVE) Postboks 5091, Maj. 0301 Oslo 3
Diesen, E.	Norges vassdrags- og energiverk, (NVE) Postboks 5091, Maj, 0301 Oslo 3
Dyvik, K.	NORAD Postboks 8142, Dep., 0033 Oslo 1
Endresen, K.	Hifab International Vækerøvn. 8, 0281 Oslo 2
Espegren, O.	Pastor Strømmes Minnefond Huldertun 38, 4638 Kristiansand
Fredriksen, I.G.	NORAD Postboks 8142, Dep., 0033 OSLO 1
X Foley, G.	PANOS Institute, 8 Alfred Place, London WC1E 7EB United Kingdom
Halmrast, L.	Bærum Energiverk Postboks 21, 1351 Rud
Hammer, B.	Linjebygg Fannestrandv. 54, 6400 Molde
Haugland, C.	Departementet for Utviklingshjelp (DUH) Postboks 8142, Dep., 0033 OSLO 1
Helland-Hansen, E.	Norges vassdrags- og energiverk (NVE) Postboks 5091, Maj., 0301 Oslo 3
Holmsen, S. A.	NORAD Postboks 8142, Dep., 0033 OSLO 1
Jensen, T.	Norges vassdrags- og energiverk (NVE) Postboks 5091, Maj., 0301 Oslo 3

Klausen, A. L.	Nordic Consulting Group Rosengården 5, 2670 Greve Danmark
Klem, G.	NORAD-LADU Postboks 8142, Dep., 0033 OSLO 1
Lomøy, J.	Norges Tekniske Høgskole - Studieadministrasjonen 7034 Trondheim-NTH
Lindemark, J.	Norplan Plogveien 1a, 0679 OSLO 6
Lunøe, B.	Hifab International Vækerøvn. 8 0281 OSLO 2
Lysne, D.	Norges Tekniske Høgskole 7034 Trondheim-NTH
Madsen, J.	EB Nera A/S Postboks 10, 5061 KOKSTAD
Roti, M.	NORAD Postboks 8142, Dep., 0033 OSLO 1
Sande, S.	Linjebygg Fannestrandv. 54, 6400 Molde
Skofteland, E.	Norges vassdrags- og energiverk (NVE) Postboks 5091, Maj., 0301 Oslo 3
Storløkken, K.	NORAD, Postboks 8142, Dep., 0033 Oslo 1
Sund, E.	NORAD Postboks 8142, Dep., 0033 OSLO 1
Sundsnes, J.	A/S Noremco Construction Kongensgt. 6 0153 OSLO 1
Svendsen, K.	Ing. Chr. F. Grøner A/S Kjørboveien 14 1300 Sandvika
Sylte, O. K.	GICON A/S Lilleakervn. 4, 0283 Oslo 2
Teigland, A.	Kværner Brug Postboks 3610, Gb, 0135 Oslo 1
Vestøl, D.	Den norske Tibetmisjonen c/o Torvgaten 8 3770 Kragerø

X	Westeren, T.	Norpower Slemdalsveien 37, Oslo 3
	Woldstad, H.	Tron Horn a/s Bygdøy alle 21, 0262 Oslo 2
X	Ystgard, O.	Norconsult Kjørboveien 20, 1300 SANDVIKA
	Aasen, B.	Gruppen for ressursstudier Sagvn. 21, 0458 Oslo 4

PUBLISHED IN THE SERIES:

	Report no.
TAN 055-PHASE III. Water Supply and Sanitation Development. Kigoma and Rukwa Regions, Tanzania. Hydrological investigations 1986-1989. by Kjell Repp, Hydrological Department, NVE	01-88
Establishment of Hydrometric Stations within Quthing River Basin, Lesotho A Mission Report. By Egil Skofteland, Division of Development Assistance, NVE	02-88
Reorganization of the Technical Library at EDM. A Mission Report. By Trine Varkold, NVE	03-88
Small Hydro-Electric Power Development in the Northern Area, Pakistan. A Mission Report. By Fredrik Barth, Sverre Husebye and Torodd Jensen.	04-88