Electrification Planning
An International Review

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1. Overview

This paper is an attempt to present, in the very briefest of terms, diverse electrification experiences from a range of countries. The case studies have been selected to illustrate a number of different aspects of electrification planning, although the common theme concerns the institutional structure of the electricity supply industry and mechanisms by which electrification planning has occurred. There is a bias in the review towards rural electrification, since it is distribution projects outside of the urban areas which are generally not financially viable (at least in the short term) and hence require special attention.

Probably the most important issue concerns the role of national governments in electrification. In all cases reviewed here there has been some level of state involvement. At the very least, the state has been responsible for initiating electrification planning and in many cases has established a fairly comprehensive electrification policy. Korea is probably the extreme case (outside of centrally planned economies) where the government promulgated a law outlining detailed procedures for electrification planning and implementation. In most cases, the state has delegated responsibility for designing and implementing the details of electrification to other bodies, generally public institutions of some form. In Zimbabwe, Ireland, Greece and Thailand, responsibility for electrification planning was passed onto existing national utilities. In a number of countries, the government created special state bodies to coordinate electrification planning - both India and Bangladesh established electrification boards with the task of planning and financing electrification projects. Even in the United States, despite (or perhaps because of) the presence of private utilities, rural electrification was initiated and financed by the state, and implemented by non-profit cooperatives. Clearly, where utilities are public bodies, and where there are a limited number of utilities (often only one), it is much easier for the government to task them with the responsibility of carrying out government policy. Where utilities are more independent, or even privatised corporations, the ability of the state to direct electrification would depend very much on the regulatory regime in place.

It is worthwhile distinguishing the various functions involved in electrification. Initiating, planning and coordinating an electrification programme are often perceived as legitimate areas of government concern. These functions require a policy framework, and it might be argued that it is the development of this framework which is government responsibility, and more detailed planning should be left to a utility or dedicated state body. Financing is a critical aspect and the options will be constrained by the structure of the industry, the relationship between utilities and the state, the financial position of the utility a well as the scale of the requirements. Financing is an area where it is not uncommon for government, utilities, development agencies and the private sector to be involved. Lastly, implementation and operation would almost always be a utility function, although the nature of these activities would depend on industry structure.

There is some debate concerning the advisability of establishing a separate utility to tackle electrification, and in particular rural electrification projects. In Thailand, the utility concerned was an entity entirely responsible for distribution in non-metropolitan areas of the country, with minimal generation or transmission responsibilities, or any involvement in the rapidly growing Bangkok metropolis. In Ireland, the national utility created a special division within itself to deal with electrification projects. A number of countries, for example Bangladesh and the Philippines, have attempted to follow the US model of rural electrification cooperatives, supported by state finance. However, these have not always been successful and in some countries cooperatives have been short lived, generally being taken over by a larger utility. Countries such as Greece and Korea have tasked the national utility with implementing electrification programmes, with apparent success. In other countries where a single national utility does not exist, and distribution is handled by a number of separate utilities, it hardly seems appropriate to fragment the industry still further, and this has rarely happened. In these cases the trend has been to

establish some sort of national coordinating body (REC in India and GEER in Brazil) in order to promote electrification projects.

Almost all large scale electrification programmes have relied on (1) government financial resources and (2) cross-subsidies from urban consumers. In some cases government financial support has been in the form of direct grants, as in Ireland, where policy was to provide 50% of capital costs from the national treasury. In other cases government financial support has been in the form of low interest loans (as in India and Korea), or guarantees on concessionary finance (as occurred in Thailand). Cross-subsidies from urban consumers have been an essential part of virtually all successful electrification programmes. In many cases these cross-subsidies have occurred within a single national distribution utility, and hence have been easy to implement but difficult to monitor. In other cases, where separate institutions have implemented electrification programmes, other mechanisms have had to be found. In Thailand, the urban-rural subsidy came in the form of different bulk tariffs to the urban and rural distributors. Even where financial transfers such as these have been arranged, there has been pressure on a distributor to build up its revenue base as quickly as possible. This reduces the relative significance of cross-subsidies as well as easing access to further financing.

In some cases, electrification programmes have led to high tariff increases (as in Korea), although in other cases the opposite has occurred, with government refusing to allow tariff increases in an attempt to contain inflation and hold down industry input-costs and household expenses. In fact, the World Bank has identified this control on tariffs as being one of the contributory factors to the deterioration in financial and technical performance of many utilities in developing countries (Schramm 1993).

Not all countries have attempted to produce national master plans. Thailand is an example where a national plan was developed at the outset of the programme and used as the basis of electrification thereafter. Barnes (1995) suggests that the existence of this well-structured and feasible plan enhanced the ability to raise adequate finance from multilateral and bilateral agencies. In other cases electrification has been largely demand-driven, with long-term planning concerned with the establishment of procedures on how to select projects. Examples of this approach have occurred in Korea and Ireland. In the case of Brazil, the existence of a fragmented distribution industry with a complex governance system meant that electrification has occurred in a piecemeal and uncoordinated fashion. The usefulness of masterplans and the capacity to produce them is probably related to the type of political system. Where a country is structured as a federation of states (as in Brazil and India), it is much harder plan at the national level. In other countries where there is a strong central government, as in Korea and Thailand, national control over planning and implementation is easier. In small countries, such as Ireland and Greece, national planning is easier given the relatively reduced scale of the task.

Project selection procedures have generally been designed to ensure that least-cost and high-revenue settlements receive higher priority. The rationale for doing this has been to minimise the negative financial impact on utilities, and to maximise the benefits of investments in electrification. The Zimbabwean example shows how an attempt has been made to identify potential 'growth' sites in order to prioritise electrification projects. It is reasoned that if such sites can be identified, then the positive economic spin-offs associated with electrification will be maximised. In countries where the interaction between the implementing authority and communities has been important, for example in countries where cooperatives have been used, or in Ireland where the rejection of the programme was a possibility, selection and prioritisation has generally been influenced by the need to address this.

The principle conclusion of this review is that electrification planning is closely associated with the institutional structure of the electricity supply industry. Options for government policy, planning procedures, financing arrangements and implementation strategies have to be seen in the context of the prevailing institutional structure.

2. Country case studies

This section presents very brief descriptions of a number of countries' electrification programmes. In most cases only a certain aspect of the programme is covered, although in some cases, such as Korea and Thailand, a more complete description is given.

The first two case studies are of Thailand and Korea - two East Asian countries with very rapid and successful electrification programmes. The following two cases are of Brazil and India, both countries with a federal political system and a fragmented electricity supply industry with separate utilities in each state. The Bangladesh example presents a case where rural electricity cooperatives have been used, attempting to follow the model presented by the United States. For comparison, a brief description of the US example is also presented. Greece and Ireland are two relatively small and less wealthy European countries where electrification has been the responsibility of a national public utility. Both present examples of how government has used these public bodies to implement national electrification policies. Lastly there is a presentation of Zimbabwe's attempt to rank electrification sites on the basis of their potential to contribute to economic growth.

2.1 Thailand - a nationally planned electrification programme

Thailand implemented an accelerated national electrification programme over the period 1977 to 1991. During this time the level of access to electricity outside of the Bangkok Metro area rose from 17% to 80%. Almost all villages were connected to the grid during this period.

The key elements of Thailand's electrification programme can be summarised as:

- the development of a comprehensive national plan,
- appropriate institutional arrangements,
- financing arrangements designed to promote cross-subsidies and to ensure the financial viability of the rural electrification agency, and
- political support for the programme.

Figure 1 presents the institutional configuration of Thailand's power sector. There is one agency responsible for all generation and transmission - the Electricity Generating Authority of Thailand (EGAT). Two distribution authorities purchase electricity from EGAT: the Metropolitan Electricity Authority (MEA) is responsible for electricity supply within the Bangkok metropolitan area; and the Provincial Electricity Authority (PEA) is responsible for distribution to provincial towns and rural areas. All three authorities are publicly owned, and the electrification programme enjoyed full support from the government and the King.

The establishment of MEA as a distribution authority without responsibilities for generation and transmission, or for distribution within the rapidly growing Bangkok metropolitan area, meant that MEA could focus its attention on the electrification programme.

Before any electrification projects were undertaken, a national plan was developed and a feasibility study conducted in collaboration with international consultants (from USAID). This plan was divided into five stages, each of five years duration and each targeting a specific region of the country. The first stage was targeted at the more economically and politically backward north-east region. The stages were later designed to overlap in order to accelerate the implementation of the programme. These five year plans were integrated with the successive National Economic and Social Development Plans (Dingley 1988).

The national plan contained details for managerial, technical and financial requirements; criteria for designating priority areas and selecting villages; load promotion and pricing policy as well as implementation, operation and maintenance standards and procedures.

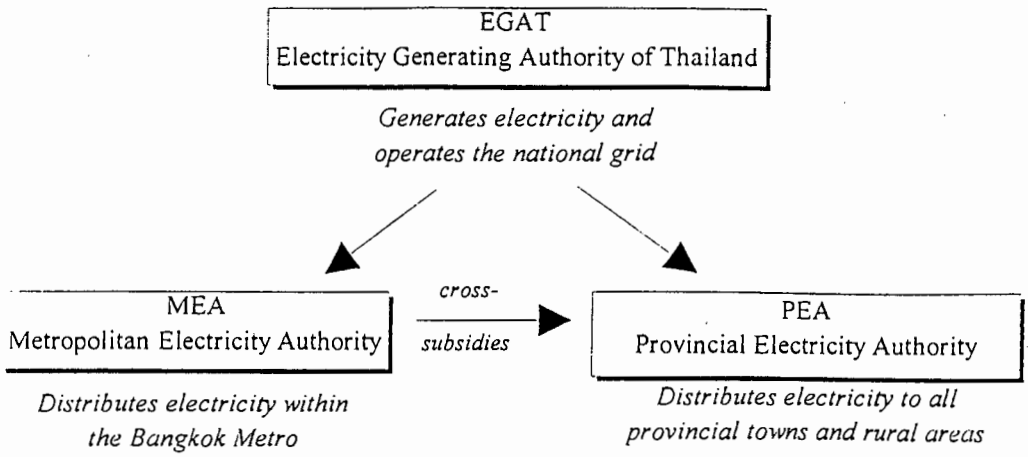

FIGURE 1 Institutional configuration in Thailand

Village selection policies were based on the precept that more economically developed localities should receive higher priority. The rationale for this was that these places would make more use of electricity, and so the benefits and revenue generated would be greater. Each province was assessed on the basis of a set of 26 socio-economic variables, and a composite score obtained for the province. This was then used to decide the extent of electrification to achieve within each province. Once the number of villages to be electrified had been established, villages were prioritised on the basis of six key variables: (1) proximity to the existing distribution system; (2) access to roads; (3) village size; (4) load potential; (5) number of commercial establishments; and (6) number of public facilities.

Stage	Period	Targeted villages	Accumulated villages	Area
1	1977-81	5 200	5 200	North East
2	1980-84	8 000	13 200	South
3	1983-87	13 500	26 700	North
4	1986-90	14 500	41 200	Central
5	1989-91	5 800	47 000	Countrywide

TABLE 1 Thailand's National Plan for Rural Electrification
Source: Tuntivate & Barnes 1995

Adjustments to this prioritisation were then made on the basis of technical considerations, and villages excluded from the selection would be included if the residents were prepared to pay for a portion of the capital costs. In practice the electrification programme comprised of three types of projects. In the standard case PEA paid for all capital expenditure and villages were selected and prioritised in the normal way. Secondly there was the contribution scheme where villages prepared to pay for 30% of the capital costs would be electrified much sooner than otherwise. Lastly there were cases where villages paid for the full construction costs and these received top priority.

PEA was required to operate as a financially viable enterprise. In practice this was achieved through four mechanisms:

- The prioritisation of low cost and high revenue villages in order to build a substantial revenue base as soon as possible. Aggressive load promotion and marketing strategies were adopted by the utility.
- The use of cross-subsidies from urban consumers and higher consuming rural consumers. Cross-subsidies from PEA customers were facilitated through internal transfers (it should be

noted that PEA supplied all urban centres outside Bangkok); and subsidies from the Bangkok Metro were made available through a mechanism whereby PEA paid 30% less than MEA for bulk supply.

- The use of concessionary loans from bilateral and multilateral agencies - approximately half of all funding was on concessionary terms. Since PEA was a state corporation, these loans were guaranteed by the Thai Government (World Bank 1992).
- The use of strategies to reduce costs, and the contracting out of revenue collection to local leaders.

Pricing policy was to apply uniform tariffs, approved by the Government, throughout the country, to both PEA and MEA customers. All tariffs were inclining block tariffs designed so that the average price was close to the long-run marginal costs of supply. Monthly consumption below 35 kWh was charged at a 'life-line' tariff.

2.2 Korea - electrification planned by central government

In 1965 the Korean government passed an 'Electrification Promotion Law' which set out, in detail, the procedure for extending electricity supply throughout the country. At that time only 12% of the population had access to electricity. Ten years later this had risen to 75%, and by 1980 over 99% of the population had an electricity supply.

Korea is probably unique in both the pace of the national electrification programme, and the extent to which electrification planning procedures were laid down by law. The Electrification Promotion Law consisted of 23 articles dealing with, among other things, project selection procedures, financing, responsibilities of the public utility (KEPCO[1]), local and national government, planning, budgeting, implementation and operational procedures.

Financing is shared between local government, central government and KEPCO. Customers are expected to pay a small portion of the connection costs and this is limited to less than R500 per customer. A long-term loan from the government accounts for the bulk of the costs, and this is limited to R5 000 per customer. The loan is repaid over 30 years, with a five year grace period. Any remaining costs were meant to be split between central government, local government and KEPCO in the proportion 25:25:50. However, it appears that in most cases KEPCO covered all remaining costs and no grants were forthcoming from central or local government. It is only after 1983, when projects were situated in remote localities that were expensive to electrify, that government began to contribute substantial grants to the programme. Figure 3 presents the costs for the programme. KEPCO recovers its investment through the tariff, and this led to large tariff increases during the 1970s when much of the electrification programme was being implemented. Since KEPCO is the national monopoly utility, cross-subsidies from existing consumers could be used to cover losses.

A distinction is made between settlements on the mainland, which can be connected to the national grid, and island settlements where local grid networks are necessary. In the former case, KEPCO takes primary responsibility for most of the planning, implementation and operation of the project. In the latter case, the local government manages the project, with technical support from KEPCO. Since procedures for mainland and island sites are different, it is worth describing each case in turn.

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1 KEPCO used to be a completely state owned utility. Some 15% of the stock is now privately owned.

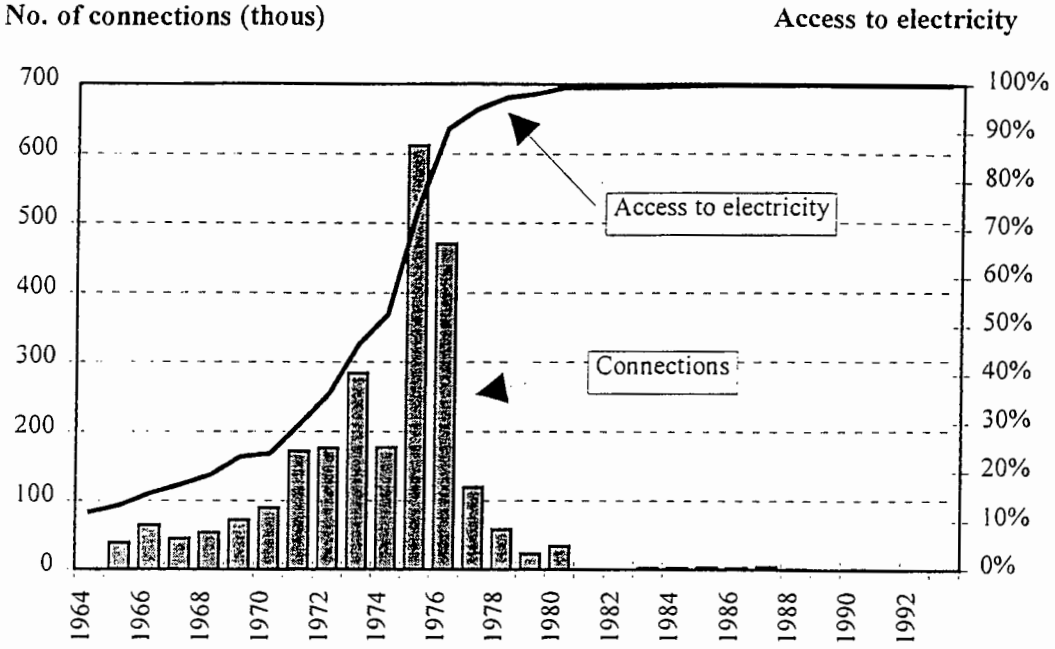

FIGURE 2 Progress of Korean electrification programme

In cases where the project is to be connected to the national grid, KEPCO assumes primary responsibility for the project. Planning is conducted on an annual basis: applications from local government must be received by KEPCO 12 months before possible project initiation. This allows financial planning for the following year to be conducted, i.e. for KEPCO, local government and central government to include the electrification project in their next year's budget. The Ministry of Commerce, Industries and Resources (MCIR) plays a central role in this planning process and is responsible for approving the final plan for each 12 month cycle. The Ministry adopted a policy of selecting projects in order of least cost, thus ensuring that the distribution network grew incrementally with each project.

The government loan is provided to new customers, but is administered by KEPCO. The monthly electricity charges include pro-rata repayment of the loan, and this must be repaid by KEPCO to the government on a quarterly basis. All risk for the loans is carried by the government.

In cases where the project is located on an island, the policy is to provide local generating facilities and to utilise a local grid network. In these cases local government assumes primary responsibility, and KEPCO provides technical, managerial and financial support. Applications for supply are received by the MCIR which then compiles the annual plan. Financing arrangements are the same as for mainland distribution projects, with the exception that the government loan is administered by local government rather than the utility. Although local government is responsible fro the construction, maintenance and operation of the project, it is possible for these activities to be subcontracted to agents. KEPCO has the responsibility of providing technical support if required, and in cases where there are 500 or more customers, can undertake to operate the system. If there are operating losses on the project, that is, a shortfall between costs and revenue (excluding revenue earmarked for loan repayments), KEPCO is required to cover 75% of these losses. This mechanism ensures that cross-subsidies available for mainland projects are also available for island projects.

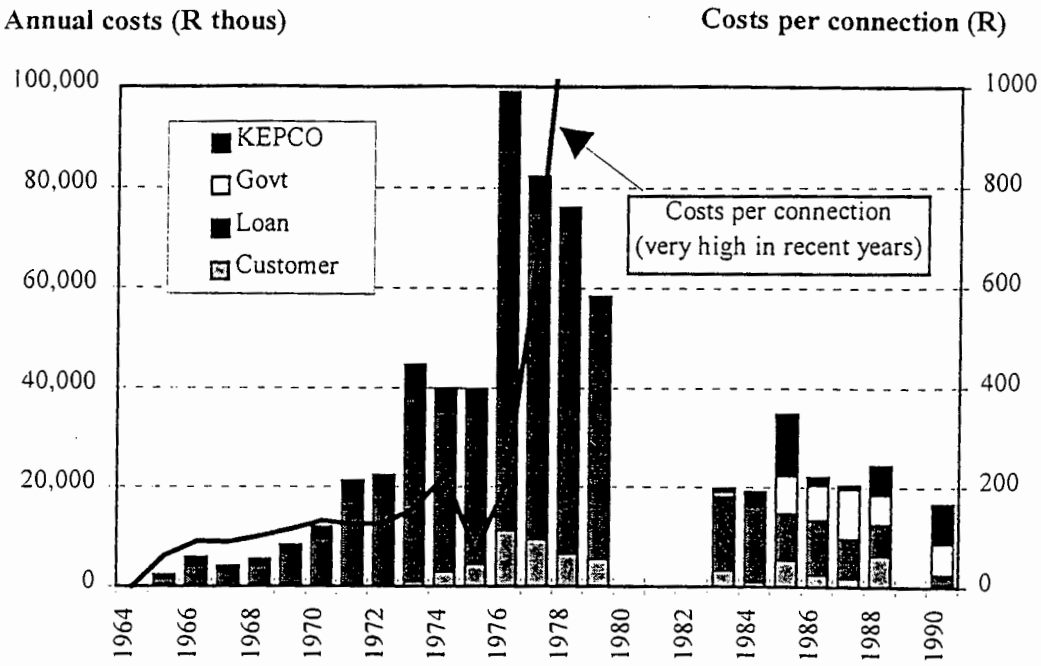

FIGURE 3 Costs of Korea's electrification programme

In recent years electrification costs have been exceptionally high. This is because the remaining unelectrified settlements are extremely costly to reach. In these cases, the bulk of the costs have been covered by government grants.

Korea's successful and rapid electrification programme must be seen in the context of the rapid economic growth which Korea has experienced during this period, and the commitment of the military government to achieving full electrification. The first point has meant that the programme has been affordable - cross-subsidies from the rapidly developing urban centres have supported KEPCO's operations and real incomes have risen, making electricity an affordable commodity to many households. The high priority which the government gave to mass electrification ensured that sufficient funds were available, and at concessionary rates.

2.3 Rural electrification in India - the rationale of irrigation pumping

India's rural electrification programme is one of the most widely known case studies in the world. Part of the reason for this lies in the focused targeting of rural electricity for irrigation purposes. This specific objective must be seen in the light of the 'green revolution' in which certain areas were identified for intensive investment in new agricultural technologies.

In 1969 the Rural Electrification Corporation (REC) was established as a national body tasked with the responsibility of coordinating and supervising rural electrification. It provides financial assistance to state electricity boards and rural cooperatives, and determines the conditions of these loans.

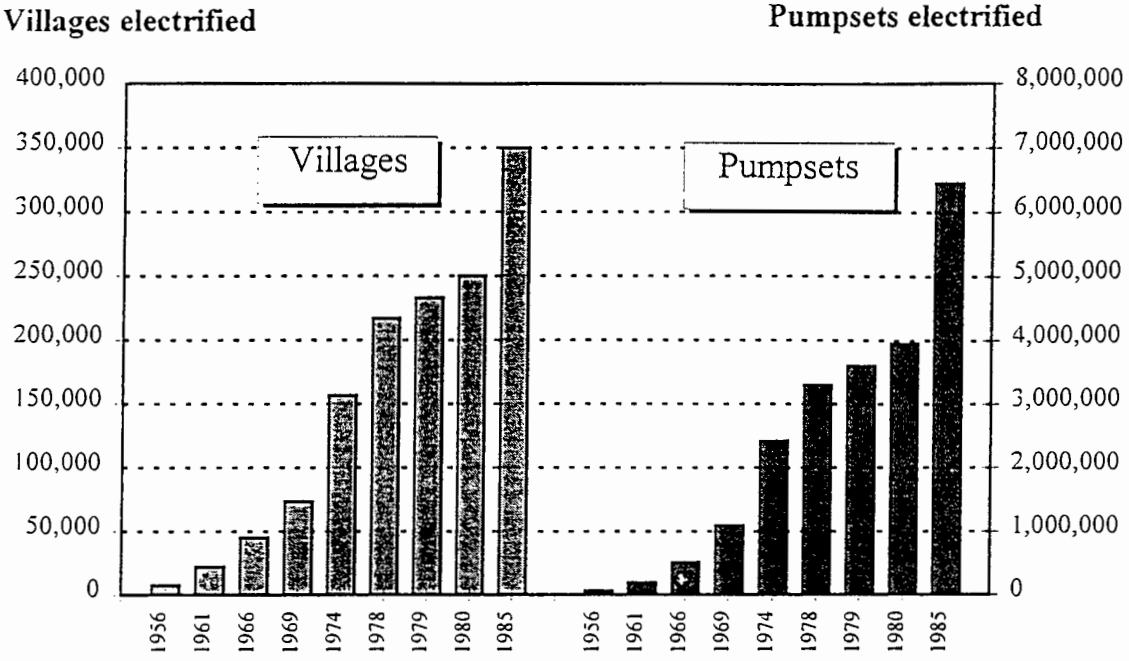

FIGURE 4 Rural electrification achievements in India

Although India has invested massively in its electrification programme, there have a number of notable criticisms. Firstly, the programme has been heavily subsidised in order to promote the use of electricity for water pumping. Although this means that farmers have benefited from low cost inputs (in the form of cheap power), studies have pointed out that the benefits of diesel pumping equal those of electric pumps, yet the economic costs are often lower (Barnes 1988). Financially stretched utilities have been unable to provide sufficient capacity to meet demand growth, resulting in poor reliability in many rural areas. It is not uncommon for farmers to use a diesel pump as back-up to their subsidised electric system.

The focus on electrical power for irrigation has tended to lower the priority given to household electrification. Although more than 60% of all villages have access to electricity, it is not uncommon for actual take-up rates to be in the region of 10-20% and household access remains low.

The planning mechanism has involved the adoption of five year plans, each with a set of electrification targets. The World Bank (1986) has commented that 'more emphasis seems to be given to meeting centrally-established targets for village electrification than to expanding power use.'

2.4 Brazil - unstructured electrification planning

Brazil is the world's fifth largest country in terms of area, with the sixth largest population. It is also among the world's ten largest economies. Rapid economic growth in the 1960s and 1970s was curtailed during the 1980s - the 'lost decade' for much of Latin America - when the debt crisis and high inflation served to slow down the economy.

The political system is a federation of 23 states, and the current structure of the power sector reflects this. Electrobras is the federal public utility, created in 1961 to take responsibility for the development of Brazil's power sector (De Oliviera 1993). There are also public utilities in each state, which take primary responsibility for distribution (although some also own generation plants).

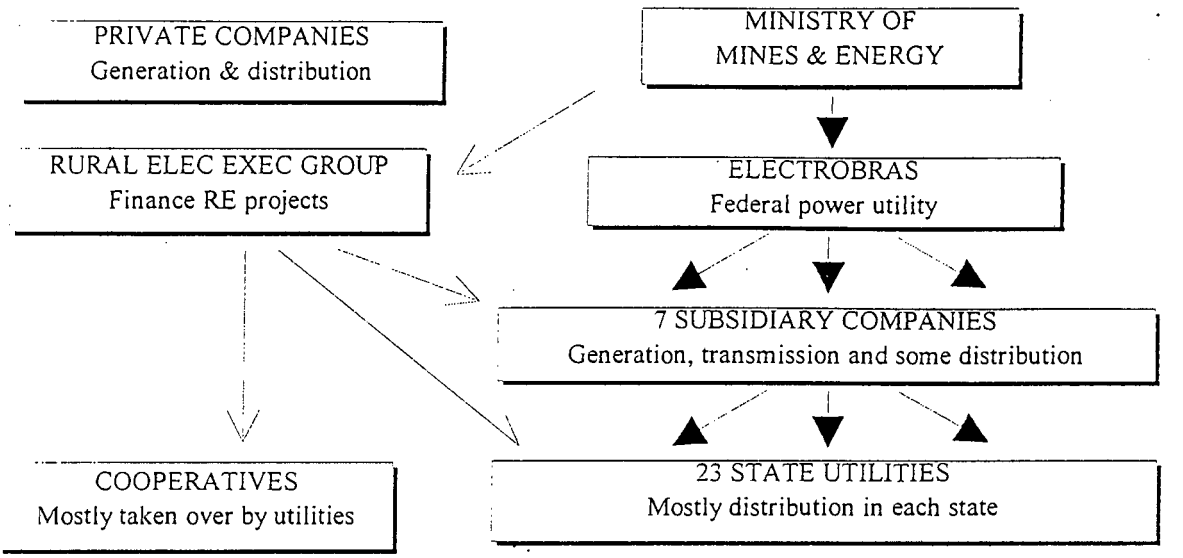

FIGURE 5 Institutional structure in Brazil

Rural electrification projects were initiated in the mid-1960s by the federal government and led to a programme of establishing rural power cooperatives. In 1971 the ministry set up the Rural Electrification Executive Group (GEER) to arrange for the financing of electrification projects. Funds were raised primarily from the government and foreign lending agencies. In the late 1970s the Ministry embarked on its own electrification projects through Electrobras, and about the same time many state utilities began electrification projects in their own areas, particularly in the wealthier states (Dingley 1988).

Although these unstructured programmes have been relatively successful in some states, electrification has been uneven through the country, with poorer areas making the slowest progress. Although the federal Ministry takes an active interest in electrification programmes, there is no institutional mechanism whereby national electrification planning can occur.

2.5 The United States - the use of rural cooperatives

The use of rural cooperatives to further electrification is best demonstrated by the experience in the US. The American example has inspired a number of countries to adopt this model (with encouragement from the umbrella body of US cooperatives, the NRECA), with varying degrees of success. The Philippines is an example where rapid rural electrification has been achieved, much of it through the use of cooperative structures (Santos 1990). However, political pressure in this country has encouraged over-ambitious projects and kept tariffs low, resulting in financial difficulties for the National Electrification Administration, as well as for a number of cooperatives (Foley 1992). Bangladesh has also followed the US system, evidently with considerable success, and this is dealt with in the next case study. Attempts in other countries have not always met with the same promising results (Foley 1992).

Widescale rural electrification was initiated by President Roosevelt in 1935 when the Rural Electrification Administration (REA) was established. The REA was the administrative body which dealt with government loans to rural electrification projects (later extended to rural telephone systems). Initially an annual amount of US$ 40 million was apportioned by the state to the REA and loan rates, at this time, were based on government long-term debt and repaid over 25 years. Although private and state utilities could qualify for loans, cooperatives soon became the principle vehicle for organising new supplies. Nye (1990) points out that in the early years there was some conflict between the new cooperatives and private utilities, who on occasion resorted to 'snake lines' - distribution lines which quickly reached the most profitable consumers in a rural area, thereby pre-empting any attempt by a cooperative venture to provide 'area coverage'[2] supply.

Cooperatives were actively encouraged by the REA and were specifically excluded from regulation by state commissions (REA 1966). In 1942 the National Rural Electrification Cooperatives Association (NRECA) was formed to represent the interests of the cooperatives. In 1944 the pace act was passed which lowered the interest rate on loans to 2% (compared with 2.5% to 3% over the previous ten years) and extended the repayment period to 35 years. After the second world war, annual allocations from the state increased six-fold to US$ 250 million and by 1957 some 95% of all US farms had been electrified.

The experience in the US is often presented as an example of how electricity supply to rural areas can result in agricultural-productivity improvements associated with the use of mechanised equipment. However, Foley (1990) points out that US farmers were considerably wealthier than most rural residents in developing countries today, and so electrical appliances, machinery and electricity bills were more affordable. In addition, it took a long time before average consumption rates reached the level at which electricity was being used to power agricultural equipment on a widespread basis. In 1942 average electricity consumption in rural areas was 50 kWh per month and ten years later was still at only 150 kWh per month (REA 1966). By 1965 this had tripled to 450 kWh per month.

Although much of the US power industry is comprised of privately-owned utilities, it is noteworthy that the rural electrification programme was dependent on (1) direct intervention by the state to initiate the programme, (2) consessionary state loans, and (3) the use of non-profit cooperatives to implement electrification projects.

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[2] Area coverage refers to the principle whereby all potential consumers in an area are supplied with electricity. In 1950 this principle was made a condition of REA loans.

2.6 Institutional arrangements in Bangladesh - following the US model

Bangladesh ranks as the second poorest nation in World Bank statistics. It suffers from frequent natural disasters - given that the country is extremely flat, annual floods often cover more than 40% of the land. Road and rail transport is extremely difficult due to the many river crossings. Bangladesh is also the most densely populated country in the world - a total population of over 100 million with an average density of 730 people per square kilometre.

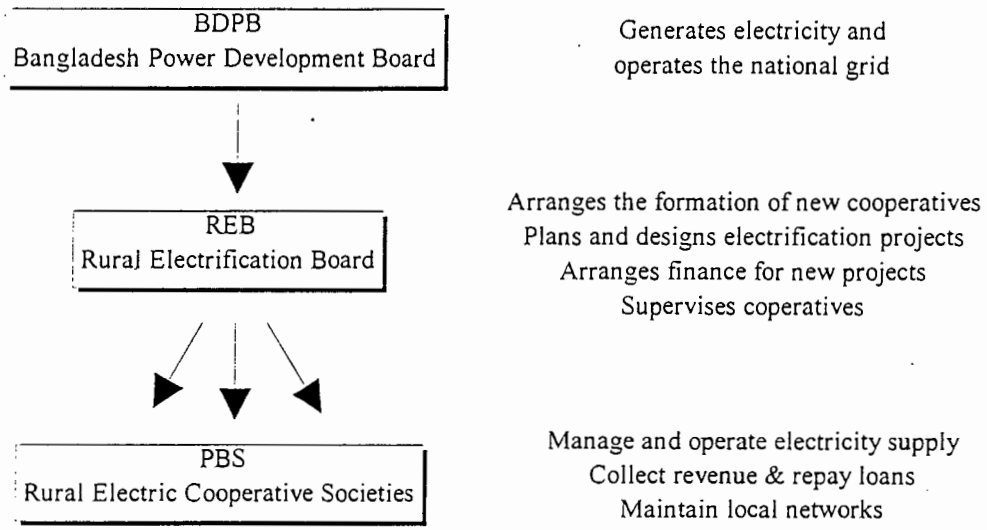

FIGURE 6 Institutional structure for rural electrification in Bangladesh

The country's rural electrification programme (over 90% of the population live in rural areas) is based on the US model of area coverage supply through user cooperatives. In 1977 the Bangladesh Government established the Rural Electrification Board (REB) which was given the task of providing electricity in rural areas. This public entity purchases power from the national utility (BPDB) and distributes it to rural electricity cooperatives. Each cooperative covers a population of 500 000 to 1 500 000 and has full responsibility for the operation, management and finances of electricity supply in its area. The cooperatives are run as non-profit associations and are allowed to set their own tariffs. Any rent associated with electricity supply is thus transferred back to consumers in the form of lower tariffs.

During the first ten years of its existence the REB facilitated the establishment of some 37 cooperatives supplying 312 000 connections. Given that a customer is allowed to sell electricity on to neighbours, the total number of rural households with access to electricity is in the region of 600 000; with a further 47 000 shops and 10 700 irrigation pumps also supplied (Foley 1990). Given the density of the population, average costs per connection are relatively low with a minimum of 75 customers per kilometre of line.

The financing of rural electrification is based on concessionary loans from the Bangladesh Government and foreign grants. Approximately 60% of total costs have been supplied by donor countries (covering the foreign exchange component of the costs), and the remainder is loaned to cooperatives at low interest loans over 30 years.

2.7 Ireland - state supported rural electrification

Ireland commenced its electrification programme in 1946, at which time 60% of the population of 2.9 million people lived in rural areas. Although the countryside was dotted with small villages, much of the rural population lived on isolated farmsteads spread across the countryside. At the start of the programme, the total generating capacity was small (175 MW), yet a reasonably extensive grid connected all the main urban centres as well as many of the smaller towns.

The Irish Government identified rural electrification as a mechanism to address rural poverty and requested the Electricity Supply Board to prepare plans for an extensive electrification programme. In response, the Board established a separate division to plan and implement rural electrification - the Rural Electrification Office (REO). By 1976 rural electrification was officially complete with virtually all households connected to the grid. Over the thirty year period a total of 506 000 new connections had been made.

Key features of the electrification programme in Ireland included the following:

- A 50% capital subsidy from the Government. In fact, this subsidy was withdrawn at times when national finances could not afford it.
- The establishment of a division within the national public utility tasked with the full responsibility of planning and implementing the programme.
- Close interaction with rural communities and the contribution of voluntary non-government agencies. There was a strong focus on promoting the use of electricity on farms and in homes.

2.8 Greece - electrification by one national utility

There is a single power utility in Greece - the Public Power Corporation (PPC). It was formed in the early 1950s with the intention of rationalising the electricity supply industry under one public body. At the time of its formation, only 7% of settlements in Greece had access to electricity - over 90% have now been electrified.

The development of PPC followed three phases:

- The creation of centralised and more efficient generation facilities
- The take-over of distribution from the many small private companies which supplied towns and cities in Greece. In 1956 PPC was given the exclusive right to distribute electricity, and by 1965 had upgraded and extended the urban distribution systems.
- The extension of electricity supply to rural areas. The rural electrification programme was initiated in 1965 and virtually completed by 1988.

Governance of PPC is effected through two bodies: the board of directors (six directors are appointed by government and three are elected by employees); and a stakeholder council representing government, PPC management and staff, local government and civic organisations.

Electrification planning was based on a project selection plan, updated every two years to reflect progress made and changes in priorities. Selection policies were guided primarily by settlement density, although special priority was given to irrigation projects. Government also played a role in selecting settlements based on 'social factors'.

Financing of the programme was covered by retained earnings, as well as foreign and local loans. As a public corporation, all loans were underwritten by the government. Over the five year period 1983 to 1987, PPC connected some 600 000 customers at a cost of R2.1 billion, equivalent to R3 500 per connection (Dingley 1988). As a single national utility, PPC is able to utilise cross-subsidies from urban consumers to cover losses from rural consumers.

Domestic tariffs are inclining block tariffs, designed to allow life-line rates as well as encouraging conservation. The lowest block, valid for the first 50 kWh per month, is still higher than PPC's average costs. Average domestic consumption is in the region of 160 kWh per month. Although PPC has the right to disconnect non-paying consumers, there is public and political pressure not to do this.

In addition to PPC's rural electrification programme the Ministry of Agriculture has operated, in conjunction with PPC, a special farm electrification programme. This has a particular emphasis on supplying electricity to livestock farms. In general these are non-residential holdings, with farmers residing in nearby villages. There are approximately 90 000 of these unelectrified farms (compared with 30 000 remaining unelectrified homes), and the Ministry aims to connect 6 000 of them per year. Costs are shared between PPC (43%), the Ministry of Agriculture (29%) and the farmers (28%). Farms with a higher revenue potential are prioritised, and these farmers are expected to pay a smaller portion of the capital. Costs to date appear to be in the region of R20 000 per farm.

2.9 Rural electrification planning in Zimbabwe - identifying settlements with a high growth potential

At independence the government of Zimbabwe inherited a spatially and economically divided country. On the one hand there were the cities and towns, where well established manufacturing and commercial activities existed. These centres were economically linked to the wealthy commercial farming districts. On the other hand there were the scattered and impoverished subsistence farming areas, which lacked adequate physical and social infrastructure.

In response to these inequities, the government adopted a strategy of extending public administration, commercial services, physical infrastructure and community facilities throughout the country - a policy of 'growth with equity'. In order to facilitate the most cost-effective allocation of resources within this investment programme, a hierarchy of rural settlements was established whereby localities were ranked according to their economic growth potential. At the top of the list were designated 'growth points' and 'rural service centres' - deemed to represent the greatest potential for rural economic growth and accessible to rural populations of between 10 000 and 50 000 people. Ten years after the adoption of this classification system it was clear that not all the designated growth centres were actually growing; and that many centres which had grown did so as a result of the expansion of the public sector rather than any increase in productive economic activity. In cases where settlements had failed to 'take off', the government found itself in the position of having invested in under-utilised physical infrastructure. Conversely, some centres had achieved rapid growth despite being relatively low on the priority list and consequently having received only secondary priority for investment resources.

A reassessment of this classification system concluded that the essential ingredients of a 'growth point' were (1) the existence of at least one productive enterprise, marketing produce to other areas; and (2) an active hinterland providing the necessary primary inputs for the productive activities in the centre. It was also concluded that the only essential element of public infrastructure was water provision. Other services such as electricity, while greatly improving the quality of life, should be regarded as facilitators rather than generators of economic growth. Bearing these points in mind, a new hierarchy of rural settlements was proposed, ranging from high growth centres to stagnant or declining areas:

- Group 1: **High growth centres with high population**
  Average population of 6 400 people, growing at an estimated 6% - 9% per annum.
  A productive economic base and economically active and supportive hinterlands.

- Group 2: **High growth centres with medium population**
  Average population of 1 400 people, growing at an estimated 7% per annum.
  A productive economic base and economically active and supportive hinterlands.
- Group 3: **Active commercial centres with high population**
  Average population of 1 850 people, growing at an estimated 3.7% per annum.
  Limited manufacturing base, but with an active commercial sector.
- Group 4: **Active commercial centres with medium to low population**
  Average population of 1 010 people, growing at an estimated 2.7% per annum.
  Limited manufacturing base, but with an active commercial sector.
- Group 5: **Service/administrative centres**
  Average population of 300 people, growing at an estimated 2.7% per annum.
  A focus for public sector such as schools, clinics, administration etc.
- Group 6: **Stagnant or declining centres**
  Average population of 170 people with continual out-migration.

An investigation into the success of rural electrification projects in rural settlements found that supply-side costs tended to dominate demand-side factors in determining the results of any financial or economic analysis. Despite this, it was noted that some remote settlements with high growth potential had benefited greatly from the supply of electricity (coordinated with other services). It was thus concluded that financial and economic criteria are inadequate in selecting electrification sites: in addition the growth criterion, based solely on demand considerations, should be utilised. It was felt that the 'growth classification' outlined above was an adequate tool to introduce these considerations into electrification planning (Robinson 1991).

References

Barnes, D 1988. Electric power for rural growth. Westview Press: Boulder.

De Oliviera, A (ed) 1993. *Institutional structure, regulation and the performance of the electricity sector in developing countries*. Commission of the European Communities: Brussels.

Dingley, C 1988. A review of electrification programmes in six countries. Unpublished paper. University of Cape Town.

Foley, G 1990. *Electricity for Rural People*. Panos Institute: London

Foley, G 1992. Alternative institutional approaches to rural electrification. In *Rural Electrification Guidebook for Asia and the Pacific*: 71-90, Saunier G (ed). Bangkok: Asian Institute of Technology.

KEPCO 1994. Welcome to KEPCO. Document provided to Eskom delegation. Seoul.

Nye, D 1990. *Electrifying America. Social meanings of a new technology, 1880 - 1940*. The MIT Press: Cambridge, Massachusetts.

REA 1966. *Rural Lines USA - the story of cooperative rural electrification*. Rural Electrification Administration: Washington.

Robinson, R 1991. Electrification Masterplan Zimbabwe. Policy and Planning for Electrification in Rural Areas. Report 2. Ministry of Energy and Water Resources and Development: Harare.

Santos, Z 1990. Managing rural electric co-operatives in the Philippines. In *Power Systems in Asia and the Pacific, with emphasis on rural electrification*: 402-406. United Nations: New York.

Schramm, G 1993. Issues and problems in the power sector of developing countries. Energy Policy, July 1993.

Tuntivate, V T and Barnes, D F 1995. Rural electrification in Thailand: lessons from a successful programme. The World Bank: Washington, DC.

World Bank 1986. Performance audit report: India: first and second rural electrification projects. World Bank: Washington, DC.

World Bank 1992. Project Performance Audit Report. Thailand. Second accelerated rural electrification project and provincial power distribution project. World Bank: Washington, DC.

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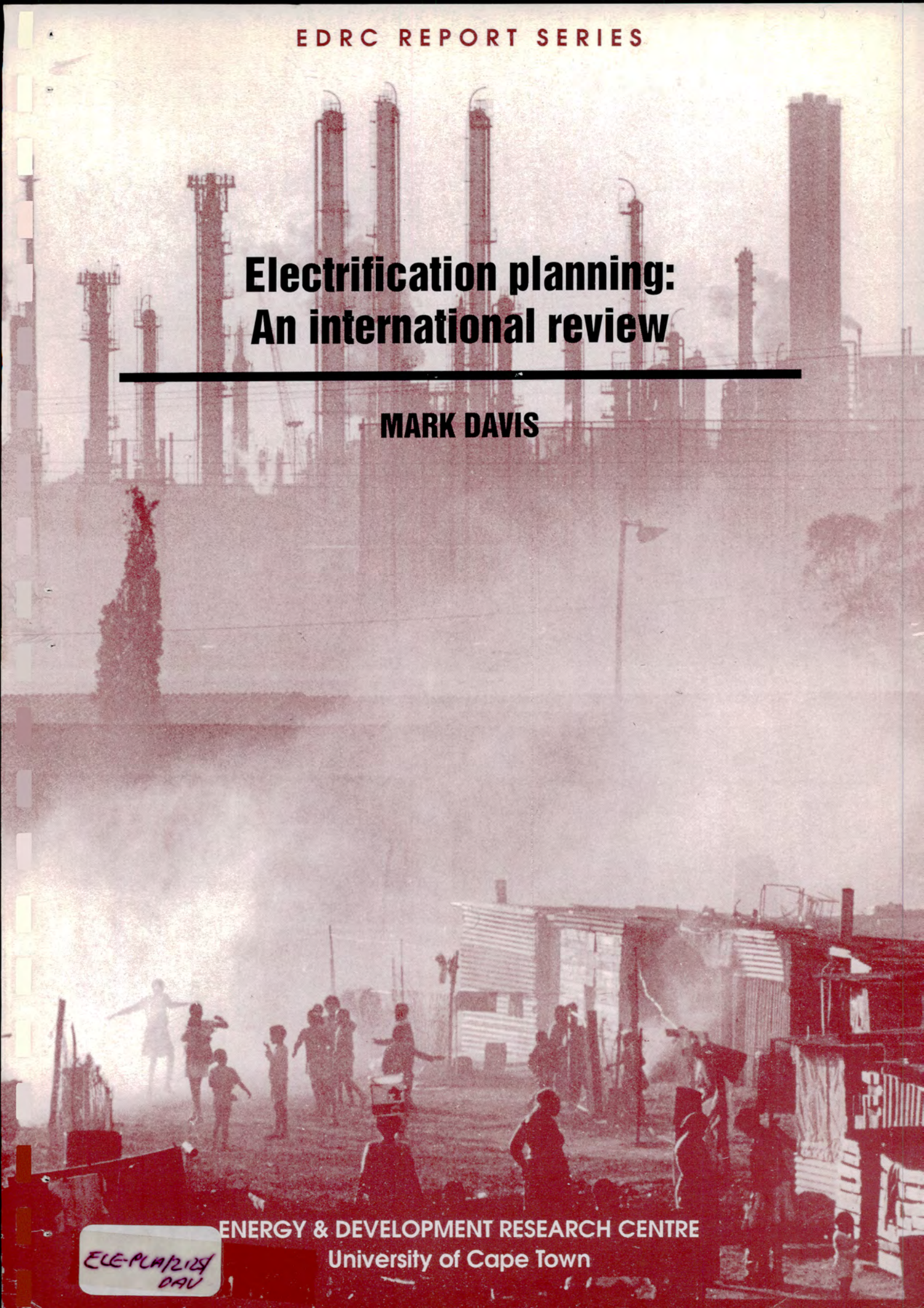

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