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Electricity in the Third World

Peter Pearson (editor)
with papers by Andrew Barnett, Gerald Foley,
Francis McGowan and Peter Pearson

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Enquiries about SEEC may be made to:

Director of SEEC: Peter Pearson, **Secretary**: Isobel Hildyard

SEEC, Economics Department, University of Surrey,
Guildford GU2 5XH, UK.
Telephone: +44-483-509379 Fax: +44-483-303775

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CONTENTS

PREFACE: ELECTRICITY IN THE THIRD WORLD

This Discussion Paper contains four papers on the theme of *Electricity in the Third World*. As noted below, they arose out of a meeting of the Third World Energy Policy Study Group, held at the University of Surrey in December 1992.

In the first paper, *Electrification in the Developing World: Where are we Going?*, **Gerald Foley** draws on his experience of work with the multilateral and bilateral donor agencies. He concludes that there is little satisfaction for the donor agencies in what has been achieved over the past 15 years; indeed, many agencies are now asking whether they should be putting any more money into the power sector. Foley himself remains an enthusiast for electrification: "If only on the grounds of fairness, we should be making major efforts to ensure that the benefits of electricity are more widely available." However, there is a clear need to avoid the mistakes of the past by changing the approach to electrification.

In Foley's view, the problems are primarily institutional and financial rather than technical: developing country utilities are, in general, not managed well, especially on the financial side. This is partly the result of low tariffs and the chain of problems they engender. Foley argues that tariffs of 10-15 US cents/kWh are reasonable for all electricity users, given the benefits that electricity offers.

Foley discusses the question of providing increasing power supplies to industry. For poorer countries with small grids, he suggests that it would be better to keep the electricity utility as small as possible and leave it largely to industry to supply its own needs - once the utility is operating efficiently, both managerially and financially, it can then take over the industrial supply. To do so before this often means doing no more than increasing the utility's capacity to dig itself deeper into the managerial and financial pit it is already in.

Foley writes that it is particularly important to provide domestic electricity supplies in urban areas. The main problem with electricity for the poor in urban areas is often the high initial expenditures needed for connection and house-wiring. Here Foley discusses what he regards as a breakthrough in low-cost electrification, the approach taken by ESKOM in bringing electricity to black townships in South Africa and Namibia.

On rural electrification, Foley distinguishes between the provision of electricity to provincial towns ("...what rural electrification is about in the less economically developed countries. ..."), and the provision of supplies to small isolated villages located beyond the reach of the grid. He recommends different approaches to these two distinct tasks.

In the second paper, *Reforming the Electricity Sector: the North as a Model the South as a Market*, **Francis McGowan** notes that countries across the globe have implemented or are contemplating reforms of the electricity supply industry (ESI). He considers the debates on these reforms in both the developed and the developing worlds and focuses on the interaction between them. He looks at the broader context within which the reform takes place, including the motivations of the key players and the environment within which policy interventions are developed.

In the first section, McGowan sets out some theoretical approaches which help to understand why the reforms are taking place, including the ideas of public choice theory and the concept of policy convergence. He argues that there is a market for electricity reform, in the sense that there are 'sellers' of 'products', models of reform, which are on offer to other countries. The market for reform can take two forms: the North as a model for the South and the South as a market for the North.

In his second section, McGowan looks at the development of the ESI and considers the historical reasons why reform has occurred. He notes that for much of its history the ESI has reflected a broader trend towards greater public participation, and argues that the electricity sector can be seen as a microcosm of the reasons for intervention in the economy as a whole. The policy environment, especially after the Second World War, was open to the idea that market failures could be corrected by intervention and ownership. For most developed countries that were thinking about reform of the ESI after the apparent successes of the British and French nationalisations, the transfer to public ownership was the model of first resort. Recently the trend has changed. There has been much widespread dissatisfaction with a number of the problems manifested by publicly-owned ESIs and criticisms of the extent of government intervention in their conduct.

In developing countries also, many of these problems of poor performance have been considerable, along with an inability to fund increasing investment in countries where demand is still rising rapidly. This has stimulated a

reassessment in many developing countries of how far public funds can meet all requirements and has led to increased interest in private participation.

McGowan asks how bad has been the record of the ESI (as opposed to other sectors) in public ownership. He suggests that there is little evidence to show that privately-owned utilities have performed better than publicly-owned ESIs, while for developing countries some commentators have argued that many of the problems lie beyond the industry's control (Barnett, in the third paper printed here, also discusses this view). Nevertheless, while in McGowan's view it would be incorrect to argue that overall the ESI's performance has deteriorated solely because of public ownership, he accepts that there are sufficient examples of problems, particularly in the developing countries, to stimulate reconsideration of structures and reforms. The legitimacy of the existing structures has been undermined to different extents in many countries and has been open to new policy initiatives associated in particular with privatisation and structural change.

McGowan argues that there is no single ideal structure for reform of the ESI to adopt - there are different models for reform. Two opposed examples of change are, on the one hand, the model of privatisation, reorganisation and competition, best exemplified by recent UK developments, and on the other hand, the model of 'perfecting the system', best illustrated by the French state-owned utility Electricité de France (EdF) - this is a model where the basic structures are left intact but new internal mechanisms are established to improve performance. However, McGowan notes that in practice the extent to which the changes in the UK and French industries have been regarded as models for change in developing countries has been modest, although the French model may hold more appeal. Moreover, the World Bank has drawn on aspects of the reforms in both countries as offering lessons for developing countries.

In his third section, McGowan considers the South as a market for the North in ESI reform, asking to what extent developing countries are becoming targets for everything from advice to investment by developed country firms. He notes that there is an increasing role for Northern ESI's (including - ironically - state-owned firms with protected domestic markets, like EdF) in advising, managing and even partially-owning developing country electricity systems. The growing internationalisation of the ESI means that developing country industries may become less national, which marks a reversal of the trend in recent years.

In the third paper, *Technology Transfer, Technological Capability and the Performance of the Power Sector of Developing Countries*, **Andrew Barnett** considers the extent to which current proposals to improve the power sectors of developing countries deal with the role that technical capability plays in responding to new regulatory regimes and in absorbing technology imported from abroad.

Like Foley and McGowan, Barnett considers the problems that face developing country ESIs. He notes four inter-related problems: utility insolvency, poor performance of generating plant, shortage of capital for constructing new capacity, and pressure to restrain the growth of pollutant emissions that damage local and global environments. The factors that have contributed to produce a vicious downward cycle in power sector performance include: rising fuel costs (oil), the deteriorating macroeconomic environment, poor utility management, and strong pressures not to add to inflation by raising tariffs nor to add to unemployment by shedding labour. the inadequate cash flow leads to cuts in maintenance, training and investment in distribution. This in turn results in a more unreliable supply and reduced willingness by customers to pay more for a service of declining quality.

Barnett contrasts two sets of views from analysts from the South and analysts from the North (led by financial institutions, including the World Bank). Analysts from the South tend to see the causes of the current problems as being of relatively recent origin and largely associated with the harsh macroeconomic conditions that have faced many countries as a result of world recession. Although it is accepted that there is room for significant reform within the utilities, many of the problems are viewed as lying beyond their control. Against this Southern view, a new Northern conventional wisdom has been developing. This has taken its most explicit form in the publications of the World Bank, whose influence as a financial catalyst has enabled it to, "largely determine the intellectual agenda covering power system development in much of the Third World."

The World bank's new strategy, by contrast with the Southern view, sees the problems of power utilities as long-standing. It looks for solutions largely within the utilities themselves and in their relationship with government. The new strategy is based on five principles:

- arms length regulation
- commercialisation and corporatisation

- importation of services (to improve the financial and technical efficiency of utility operations in lower income countries)
- "commitment lending"
- private investment

Barnett commends some aspects of this strategy and is critical of others. He is most critical of the role that the Bank attaches to the importation of services to improve power sector performance - in his view it is this which, "appears to be most short-sighted and at odds with the evidence of what drives efficiency improvements."

Barnett reaches a number of conclusions:

(1) The evidence strongly supports the view that the import of technology and skills is complementary to, rather than a substitute for, the development of capabilities locally.

(2) Experience in the industrialised countries suggests that there are some essential preconditions for effective regulation, and limits to what regulation can be expected to achieve on its own.

(3) Improvements in power sector performance are unlikely to be realised through reforms that are limited to changes within utilities and in their relationships with government.

(4) A precondition for an effective response on the technology front will be the acceptance by aid agencies of five broad principles (which Barnett sets out in the paper).

Barnett concludes that there are promising signs that some sectors of the international community have recognised that the management of technical change must be more effectively integrated into their development assistance programmes, even if this has not yet penetrated through to many of the departments concerned with the power sector. Moreover, a number of multilateral agencies have begun to put more emphasis on the technological aspects of their assistance, although the World Bank's Energy Department, unlike other parts of the Bank, "remains peculiarly reticent on these issues.

In the final paper, *Energy Related Environmental Priorities at Different Levels of Development; the Case of Electricity Generation*, **Peter Pearson** outlines the thinking behind a research project supported by the UK Economic and Social Research Council's Global Environmental Change Research Initiative. The paper makes a case for investigating the nature and extent of variations in energy-related environmental priorities as countries develop. Pearson suggests that the differences between developing countries and industrialised countries in the policy priorities given to different categories of environmental issue and types of environmental quality have not been sufficiently analysed. Here he suggests that there are two key questions that need to be addressed:

(1) Are there clear reasons why developing countries might be expected to take a different view of energy-related environmental issues and so have different priorities from those of industrialised countries?

(2) How might such differences be reflected in practical energy-environment decision-making and in the perceptions of the various actors involved in decision-taking?

Pearson's paper focuses mainly on electricity generation because it raises significant issues about possible conflicts and complementarities between environment and development.

Pearson argues that although it is not difficult to specify circumstances in which electric power would be an essential element in a development strategy, and in which expenditures on environmental quality could crowd out investment in electricity supply, views of the centrality of electricity's role in development and of the competitive nature of the trade-offs between electricity supply and environmental quality should not be accepted uncritically.

Nevertheless, in the case of the enhanced greenhouse effect, the present costs of reducing fossil fuel-related greenhouse gas emissions and of adapting to expected climatic and environmental changes imply the possibility of some difficult trade-offs of present against future living standards - particularly, of course, for developing countries with significant reserves of coal. Pearson argues that, given the uncertainties and the long time-scale, many developing countries will be tempted to take an optimistic view of the damage that could be associated with global warming, and will tend to set lower targets for carbon dioxide emissions control than the developed, industrialised countries. Indeed,

one of the reasons behind the difficulties associated with developing country participation in greenhouse gas limitations strategies is that richer countries would like poorer countries to take the decisions and make the trade-offs that make sense to richer countries. This highlights the difficulties that poorer countries face when deciding which energy and environmental pathways to follow. It also reminds us that both the costs and benefits of pollution abatement can differ significantly between countries at different levels of development.

Although it can certainly be argued that there are circumstances in which it makes sense for developing countries to have different priorities from those of countries at other levels of development, Pearson suggests that it is also clear that many of the choices that authorities actually make imply some very costly tradeoffs. This is why further research is needed in order to say more about the factors that influence appropriate energy-environment policy trade-offs, and about the nature of the constraints that can inhibit the policy choices open to developing countries.

In the remaining sections of the paper, Pearson examines environmental issues associated with electricity and explains the internal and external reasons why they have become more prominent. He considers why there might exist significant differences in environmental priorities for countries at different levels of development. He uses a simple matrix to classify environmental issues according to four spatial and three temporal categories - and suggests that it is not surprising if developing countries tend to give relatively higher priority than developed countries to short-term local environmental impacts compared with long-term global effects. He also explores a number of theoretical reasons why developing countries might choose policies that reflect different levels of environmental quality in the electricity sector from those in industrialised countries.

The papers reproduced here arose out of a workshop meeting of the Third World Energy Policy Study Group (TWEPS) on the theme of *Electricity in the Third World*, held in December 1992 at the University of Surrey. The workshop was organised by Peter Pearson and Paul Stevens of Surrey Energy Economics Centre, where the organisation of the Study Group is based. The Group has been assisted by a grant from the Royal Economic Society (which is, of course, not responsible for the views expressed in this discussion paper).

Peter Pearson
Director, Surrey Energy Economics Centre

I ELECTRIFICATION IN THE DEVELOPING WORLD: WHERE ARE WE GOING?

Gerald Foley, Nordic Consulting Group

1 INTRODUCTION

My topic is "Electrification in the developing world: where are we going?" Primarily I look at it from the only viewpoint of which I have any experience - which is that of the multilateral and bilateral donor agencies.

When looking back over the experience of the past decade and half, it is fair to say that there is little satisfaction for any of the donor agencies in what has been achieved. In general, and despite very large funding, utilities are more run down, their finances are worse, the quality of service has fallen, the proportion of people with a supply is at best stable, in many cases it is falling. Many donor agencies are asking whether they should be putting any more money into the power sector.

I myself remain a fairly unabashed enthusiast for electrification. One has only to think for ten seconds on how totally dependent every aspect of modern existence is upon reliable electricity supplies to realise the enormous gulf between societies and individuals which have access to electricity and those which do not. If only on the grounds of fairness, we should be making major efforts to ensure that the benefits of electricity are more widely available than they are today.

But in advocating more electrification, it is obvious we need to change the way things have been done in the past. If we do not, we will simply ensure that we repeat the mistakes and problems of the past.

2 INSTITUTIONAL AND TARIFF PROBLEMS

In thinking about how things might be done differently, it is clear that the problems are institutional and financial rather than technical. It is not that the technical knowledge for building and running power stations and electricity networks is lacking. It is that developing country utilities are, in general, not well managed, especially on the financial side.

In such a context, it is tempting to say privatise. This may make some sense in some of the better off countries, but in the poorer countries, with a negligible industrial infrastructure and major shortages of management and technical skills, it is hard to see it being possible let alone achieving very much. My own feeling is that, in most cases, we have to go with what we have got - which is the utility - and see how progress can be made by a series of incremental reforms.

The most obvious target is, of course, tariffs which are, in general, extremely low throughout the developing world - in a number of Indian states, electricity is supplied free in the rural areas. Tariff reform has, of course, been widely discussed in recent years. But we must not confuse talk with action. Putting up electricity tariffs is politically difficult and even when governments agree on its necessity, they tend to move as slowly as they can on it.

Meanwhile, the problems caused by low tariffs and the consequent need to subsidise the utility, continue to mount. Maintenance of the system is reduced, supplies become increasingly unreliable, technical losses grow higher. Staff are not properly paid, which means that there is poor motivation, corruption, and many of the best leave - the catalogue is familiar.

As the running of the organisation deteriorates, the need for subsidies becomes even greater. Financial resources are diverted from health, education and other developmental needs. The overall effect can be a major brake on the general economic development of the country.

The only way out is to raise tariffs to a level which covers costs and keep them that way - not letting them slip behind inflation. Nor is there any reason to say tariffs should just cover long run marginal costs. In many cases, there is no reason why the utility should not be a major source of finance for the government.

The key point which is missed by many developing country governments is that even at much higher tariffs than they are charging, electricity is still exceptionally good value. Two examples I often quote are:- a 500 watt power tool used for an hour provides the equivalent of a day's work by an adult male; and 1 kWh of electricity, used in a 60 watt incandescent bulb, produces as much light as 12 litres of kerosene.

With such benefits, charges of 10-15 US cents/kWh are perfectly reasonable for all electricity users - even quite poor families. If they were imposed, they would go a long way to dealing with the financial problems of utilities.

Nevertheless, I must also admit, even high tariffs do not necessarily solve all the problems. In Benin, for example, the average electricity charge is around 18 US cents/kWh. But the utility is responsible for both water and electricity and does not manage the finances of each separately. There is a substantial overall loss, which is clearly attributable to the water operations. But the fact that the accounts are lumped together blurs lines of responsibility and removes management incentives.

3 POWER SUPPLIES TO INDUSTRY

Another area which I think needs to be looked at very critically is the supply of electricity to industry. I would emphasise that I am now talking about the poorer countries with small grids rather than newly industrial countries.

When utility plans for new power stations are being examined by funding agencies, the first thing to be looked at is the load projections. These normally include a couple of industrial developments, perhaps a plastics or fertiliser factory, a brewery, an agro-industrial plant or whatever.

The loads to be taken by these plants are usually a major part of the justification for the power plant or transmission line. They also tend to be rather uncertain. But the implication which is made clear to the potential funders, and puts considerable pressure on them, is that without the additional capacity, the industrial development will not happen. So the evaluation mission caves in and the power station goes ahead.

The industrial load may or may not materialise. But what has happened, is that there has been an addition to the supply capacity of the utility. If, as is so

often is the case, it is badly run and its tariffs do not cover its costs, what the well-meaning intervention has done is increase its capacity to dig itself deeper into the managerial and financial mess in which it already finds itself. Its subsidies will have to become even greater.

The irony of all this is that industry is perfectly capable of supplying its own electricity. Any manufacturing plant has, or certainly should have, the technical and managerial skills to maintain and run a diesel plant. The real question, which should be asked in such a case, but rarely is, is whether the utility should be involved at all - or whether it is better all round to let the industries get on with providing their own supplies.

The immediate reaction to this kind of suggestion is that it runs counter to economic logic because it ignores the economies of scale that come from an electricity grid. All I am saying is that, rather than automatically assuming there must be such economies of scale, it matters to check that they actually do exist.

In many developing countries, at present, it is clearly better to keep the utility as small as possible and leave it to industry to supply its own electricity needs. When the utility has been sorted out managerially and financially, and when it is able to provide a cheaper and better service, it can take over the industrial supply leaving the diesels to be shifted somewhere else.

4 THE DOMESTIC SECTOR

Turning next to the domestic sector, I am, as I wrote at the beginning, an enthusiast for extending supplies for social or equity reasons. I think it is particularly important to provide domestic electricity supplies in the urban areas.

The cities have tended to have a bad press in development circles. They are often referred to in highly derogatory terms such as cancers, burdens on the rural areas, sprawling centres of squalor from which people should be discouraged. I have even heard people say that urban domestic electrification should not be carried out because it would encourage people into the cities.

In fact, historically and in the contemporary developing world, cities are markets, centres of innovation, places of opportunity - and despite their awful

misery and poverty they provide people from the rural areas with hope and opportunity. If there is any hope of economic development and a reduction in pressure on the natural environment in the developing world, it rests on urbanisation.

It will be said that the urban poor cannot afford electricity. I am not so sure. The main problem facing the poor in many cities is not the cost of electricity itself - this is often cheaper than wood or kerosene. The main problem is the high initial expenditure on the connection and house-wiring costs. Where the utility sets building construction standards - often based on old European standards - the poor are completely excluded.

When I was in South Africa and Namibia in 1992, I saw this problem being tackled in an extremely interesting way - I would call it a major breakthrough in low cost electrification. The utility, ESKOM, is engaged in a major programme of bringing electricity to the black townships - a task which has been given added urgency by the political changes taking place in the country.

Instead of laying down construction and wiring standards, which would exclude a high proportion of their potential customers, they are using what they call a Reddi-board. This is a moulded plastic fuseboard with a light socket and two or three socket outlets. It is fixed to an inside wall of the house - or if it is of traditional construction, the board can be mounted on its own post. Everything beyond the board is the family responsibility.

Even more interesting is the metering system being used. This relies on a prepaid electronic meter which is built into the Reddi-board. Instead of using electricity and getting a bill, the consumers pay in advance for whatever electricity they want at the nearest ESKOM office. The amount is recorded on a prepayment card - like a phone card - which they simply slip into the meter which tells them how much they have left. The connection fee is either zero or very small.

On the consumer side, this completely eliminates the entry barrier. Anyone with a house can have electricity. Even the poor become able to realise savings, where these exist, from shifting away from firewood or kerosene. Families are able to budget exactly how much they want to spend on electricity - and there is no bill to pay if they do not use any. On the utility side, the system cuts out the whole metering and billing problem and drastically reduces administration costs.

5 INSTITUTIONAL REFORM

No review of where we are going with electrification can omit the question of institutional reform. It is easy to say, but it is an extremely tough nut to crack.

There is a reasonable consensus on what needs to be done - improved management, better training, better planning, better financial control, better disclosure of information, less government interference and so on. The question is getting it done.

All I can say is that it is an area in which there has to be a much greater degree of donor coordination. The World Bank, as the lead agency, can do a great deal. But other donors have to play a role too -and not be afraid to say no to new projects.

6 RURAL ELECTRIFICATION

Finally, rural electrification - on which I have spent quite a bit of time over the past few years.

I think we need to distinguish between the provision of electricity to provincial towns - which is what rural electrification is about in the less economically developed countries - and the provision of supplies to small isolated villages outside the reach of the grid.

Electrifying towns should normally be a profitable business or at least able to cover its costs. Everything I have been writing up to now about tariffs and utility management applies to this kind of rural electrification.

But when it comes to the supply of the smaller villages, this is an entirely different question. There is no historical precedent which says this kind of rural electrification can be done profitably. But at a certain stage in the development of a country it becomes socially and politically necessary - and is none the less justifiable because of that. In Namibia, for example, the SWAPO fighters all live in Owambo in the north. They want electricity in their villages - it is one of the things they fought for - and the government is determined that they should have it.

This kind of rural electrification simply has to be done in many cases. Usually the utility will play a lead role, but it is important that the institutional

arrangements are given a great deal of thought. There is, in my view, an overwhelming case for ensuring that rural electrification is carried out by autonomous agencies with a proper mandate and clearly defined budgets and targets. The aim should be to carry out programmes carefully, charging proper tariffs, involving the local community, and generally avoiding the slide into a system of open-ended subsidies which will eventually end by swallowing the whole GNP.

Finally, I would like to write a couple of words about the huge number of people who live in small isolated villages and are far outside the scope of any utility activities. In many countries, the people living in these villages make up the great majority of the population. On present policies there is no prospect that they will see an electricity supply within the next fifty years.

If the people living in these villages are to obtain an electricity supply, it will have to be by the use of decentralised community-managed generating sources. Most of the discussions which take place on such systems are still technical - and often focused entirely on renewables. Should we use solar, biomass gasifiers, wind or whatever.

In fact the issue is almost entirely institutional. It requires the mobilisation of village resources - probably in cash and certainly in kind - and the development of local management capacities. Moreover, it needs to be done on a large scale - we are talking of tens of thousands of villages in some countries.

The only way in which this is going to happen on a significant scale is if it is tackled on a strategic rather than an individual project basis from the very beginning. The need, therefore, is for the establishment of coordinating and supporting organisations which can select off-the-shelf proven and effective solutions, package them, and deliver them in significant numbers to villages which have the communal will and the resources to operate them on a sustainable basis.

7 CONCLUSION

In this brief presentation, I have obviously just touched on the surface of a number of highly complex points. They all need to be elaborated, qualified, and adapted to their context.

As I noted at the beginning, I think we should be doing lots more electrification. But I hope I have conveyed the impression that there are quite a few areas where I think we can usefully look at ways of doing things differently from the past.

II REFORMING THE ELECTRICITY SECTOR: THE NORTH AS A MODEL, THE SOUTH AS A MARKET

Francis McGowan
Science Policy Research Unit, University of Sussex

1 INTRODUCTION

This paper examines the debate on the reform of the electricity supply industry (ESI) in the developed and developing worlds and particularly the interaction between the two. There is no doubt that the industry is undergoing a bout of restructuring which touches countries of all levels of development: countries across the globe have undergone or are implementing or contemplating reform of the ownership, organisation or regulation of the industry. Although the reforms under consideration or in place do not follow a set pattern, there is a general orientation in most initiatives away from public participation and (to a lesser extent) monopoly.

What is driving this debate? Is performance the only factor or are other factors at work beyond the need to remedy shortcomings? How far, for example can we interpret events as a result of international pressures, implicit or explicit? Can we see the debate on change as self-sustaining, its momentum fostered by, on the one hand, countries seeking to at least legitimate, at best profit from, their own reforms by "selling" them to others, and on the other by utilities and governments anxious to be seen to absorb new ideas or "conventional wisdoms" (whether for reasons of credibility, international pressure or personal benefit)? In this paper we attempt to look at the debate on electricity industry reform as a consequence of more than a simple need to improve performance. While not disputing the importance of that factor, we look at the broader context within which reform takes place, in particular the motivations of key players and the environment within which policy initiatives are developed.

The paper is in three parts. In the first section, we briefly elaborate some theoretical approaches or heuristics which may help us understand why reform is taking place, such as those offered by public choice theory and the concept of policy convergence. In the second section we examine the development of the industry and consider why reform has taken place historically. We also look at the current explanations of the need for reform, noting some of the

internal factors which have given rise to the debate on reform, both in developed and developing countries and assessing whether they provide a sufficient explanation for change. The third section focuses on some of the major reforms in the developed world, particularly the contrasting models of France and the UK, and considers how these models are being absorbed elsewhere, if at all. In the context of the internationalisation of the industry, we consider not only if the North is offering a model for the South but also if the South constitutes a market for the North. We finish by offering some highly tentative conclusions on the nature and dynamics of change in the electricity supply industry.

2 UNDERSTANDING ESI REFORMS

How do we understand the changes of the last decade in the ESI? There is now a considerable literature on the related subjects of public sector reform, deregulation and privatisation, a growing proportion of it dealing directly or indirectly with the ESI (Vuylsteke, 1988, World Bank, 1990, Ramamurti and Vernon, 1991; for critical reviews see Suleiman and Waterbury, 1990 generally and de Oliveira and MacKerron, 1992 and Barnett, 1993 on the ESI). The explosion of material, moreover, has paralleled the phenomenon it describes, analyses or criticises. More so than in other cases, the line between theory and practice is extremely blurred. The partisans of reform are not only practising what they preach; in a manner scarcely found outside the pages of policy analysis textbooks (Hogwood and Gunn, 1984 and Lindblom, 1959), theories are themselves an important component of policy design and implementation (Meier, 1992). Diagnoses of shortcomings in the performance of "unreformed" industries and prescriptions for change find a rationale in those ideas of property rights, rent seeking, capture etc which cluster round the theory of public choice (Downs, 1965, Stigler, 1970 and Krueger, 1974). The use of ideas in policy making has seldom been so explicit (for past and present examples of this relationship see Gamble, 1989, Hall, 1990 and Furner and Supple, 1990).

Of course, the power of these ideas would not have prevailed had there not been a problem in the first place: there has been plenty of raw material to substantiate the assertions of this theory in both developed and developing countries. Few would dispute that performance has in various aspects fallen short. However, would the solutions being proposed have been the same without the sustained critique of the last decade?

This paper is not primarily concerned with the merits of such theories (see Dearlove, 1991 and Dunleavy, 1991), nor with the match between the problems of the sector and the explanations offered by such theories. However, in the context of understanding why change has taken place, this match between theory and practice is important. Moreover, it is worth considering how far such theories might explain the process of reform itself. In other words, if we want to understand why reform occurs, we have to look at the motivations of those engaged in the process (see for example Pirie, 1988). Without denying that serious problems have emerged in many electricity industries, therefore, we might consider whether, given the motivations for reform, the problem is perceived wholly objectively, or whether there may be some who have a vested interest in reform.

From a public choice point of view, therefore, reform can be seen as motivated by 'entrepreneurs' within (both the utility and the government) or around (external advisors and consultants and international agencies) the public sector. Given the narrow subset of human motivation permitted by this theory, we should not accordingly regard the implementation of reform as necessarily enlightened or altruistic; self-interest itself is important. However, we should not ascribe all change as driven by such factors. We should also consider how policies are spread, within and between countries. Here, perhaps a slightly different set of factors come into play: the "community" within which ideas are transmitted. Here again, the blurredness of theory and practice is important to recall. The process of "lesson drawing" or "policy convergence" can take a variety of forms and stem from a range of factors beyond the failure of the existing system and the motivations of policy makers (Bennett, 1991 and Rose, 1991). A possibly important factor might be pressures from particular countries or organisations, especially in the context of developed-developing economy relations (Bierstecker, 1990 and Ikenberry, 1990).

In this light, therefore, in what sense can we talk about a market for electricity reform? There are 'sellers' of 'products', models of reform, which are on offer to other countries. This is not always an explicit transaction, though often it is - expertise is bought and sold. There is also a much more tangible and lucrative market: that of the industries themselves. Here acquisition is a part of the reform process itself. The market for reform can, therefore, take two forms: the North as a model for the South and the South as a market for the North. At times it becomes difficult to distinguish between the two: when does the promotion of a model of change in another country become part of the process of reform in that country. The dynamics of both of

these markets need to be seen in the context of the amalgam of public choice and policy convergence ideas noted above: the spread of ideas takes a more complex form than just the specific economic motivations of key players, but neither factor can be ignored.

3 THE DEVELOPMENT OF THE ESI

For much of its history, the ESI has reflected a broader trend towards greater public participation in the economy. The tendency in this sector has been towards a concentration of firms under public control, and often, though not always, that control has extended to public ownership. The consolidation of the industry has been perceived as almost inevitable: the economies of scale and of coordination which technology has permitted pushed the industry in the direction of regional or national monopolies, for the most part integrating different aspects of supply such as production, transmission and distribution (Bouttes and Lederer, 1991).

Why should that rationalisation have taken the form of public ownership? It is worth noting that in some countries, public authorities were involved in the industry almost from the start, primarily at a local level as a consequence of its role in municipal services and its control of rights of way, etc. State intervention at a national level was often needed to trigger the consolidation of the industry, to exploit scale economies and even out imbalances in quality and cost of supply. In many countries this took the form of ownership of all or part of the industry. In other cases, state intervention was seen as necessary to counter monopoly power which ESI operations involved (Persky, 1991, Chick, 1991). Elsewhere, intervention was an act of strategic planning, using the sector to foster economic development. In short the sector is a microcosm of the reasons for intervention in the economy as a whole.

Thus for the ESI in the developed and developing world, it has been the norm for public ownership to prevail, whether at the local or the national levels, whether through a gradual process of mergers and local franchise battles or sudden changes such as complete nationalisation. While much of this reorganisation took place in the post war period, there were some important steps taken earlier on. Often these had wider implications, triggering interest in other countries. A major catalyst for public ownership during the interwar period was the creation of the Tennessee Valley Authority in the US. This major publicly owned hydro-electric project demonstrated the important role

which the state could play in the electricity sector, a principle which others sought to emulate. It was, for example, particularly important in contributing to efforts by Latin American governments to gain control of their power industries, many of which were, ironically, owned by US holding companies (Wilkins, 1974). In the post war period, as the model of nationalisation and concentration of the ESI was seen to offer considerable benefits *vis à vis* the limits of fragmented systems, it spread, offering a good example of the principle of lesson drawing discussed earlier. For most developed countries contemplating reform of the industry after the apparent successes of the British and French nationalisations, a more-or-less wholesale transfer to public ownership was the model of first resort. Greece, Italy, and Portugal have followed this option, as have a number of developing countries often explicitly drawing on the successes of those earlier nationalisations. Aspects of the model were also absorbed by some developing countries particularly former colonial countries.

Can these developments be understood in terms other than those of solving a problem of performance in the industry? On the one hand they can be interpreted as initiatives of entrepreneurial public sector managers and politicians. On the other, they can be seen both as responses to real problems and ideas which were widely shared in the "policy community". In truth, both sets of motivations were in operation to some extent. The policy environment, particularly in the post war period, was much more open to the idea that market failures could be corrected by intervention and ownership. These rationales, however, converged with the interests of Hannah's (1982) "engineers, managers and politicians" who dominated the industry at the time.

More recently of course, the trend has begun to change, mirroring broader shifts in the ownership debate. Just as before, there has been a problem to be solved. The performance of many utilities has faltered, as development on the basis of technological improvement appeared to have reached its limits. Economies of scale have been exhausted and diseconomies have set in; where poor investments have been made in large plant, the costs of compensation and replacement have been considerable. The industry's record of using technology to meet the public good has also been shaken by forays into nuclear power and a broader public perception that the industry has become unaccountable. The industry has also been subject to the sort of governmental interventions highlighted by critics of public ownership. Governments have intervened in the industry's conduct to hold down prices, to protect local supplier industries and to promote national competitiveness often with poor outcomes.

In developing countries, meanwhile, many of these problems of poor performance have been magnified (as reflected in anything from shortcomings in management conduct to widespread corruption). Moreover, they have been compounded by the deeper economic crisis. The inability to fund investment has created severe shortages in many countries where demand is still rising rapidly. This has prompted a reassessment in many developing countries of how far public funds can meet all requirements and increased interest in private participation.

Despite these problems it might be asked just how bad the record of the ESI (as opposed to other sectors) in public ownership has been (McGowan, 1988; de Oliveira, 1992). Many of the shortcomings noted were experienced by private utilities as well and there is little evidence to suggest that privately owned utilities have performed better than publicly owned ESIs. Given the structure of the market, and the limited scope for competition in the industry, there is some evidence to suggest that the public utilities perform as well as their private counterparts (Millward, 1982). Indeed, the emphasis of many commentators is on market structure rather than ownership has indicated that as the determinant for performance (Vickers and Yarrow, 1988). Moreover, particularly for developing countries, some commentators have argued that many of the problems are in a real sense beyond the industry's control (de Oliveira, 1992; Barnett, 1993).

Nonetheless while it would be wrong to say that, overall, the industry's performance has dramatically deteriorated solely as a result of public ownership, there are enough instances of problems to prompt reconsideration of structures and reforms. These problems are probably more acute in developing than in developed countries, though in both there is a constraint upon public funds. The debate on improving the performance of the ESI has accordingly come to focus in part on privatisation and structural change. The legitimacy of the existing structures has to varying degrees been undermined in many countries and been open to such new policy initiatives.

4. REFORM IN DEVELOPED AND DEVELOPING COUNTRIES - WHAT SORT OF INTERACTION?

4.1 The North as a Model for the South

Adherents of particular models may claim otherwise, but there is no single ideal structure for the ESI to adopt. Nonetheless, since there are broad

characteristics of reform which industries undergoing restructuring might adopt one can speak of models of reform. Moreover, it is possible to oppose two particular examples of change as exemplars which others might choose to emulate (which were rooted in a similar starting point - that of the vertically integrated publicly owned utility). On the one hand, there is the model of privatisation, reorganisation and competition, best illustrated by recent developments in the UK. This model involves a substantial restructuring and reorientation of the industry from its traditional trajectory of development. On the other there is the model of "perfecting the system" where the basic structures are left intact but new internal mechanisms are devised to improve performance. This model is best illustrated by the French state-owned utility Electricité de France (EdF).

The origins of the UK experiment are well-documented elsewhere and it is not necessary to outline their importance here (Vickers and Yarrow, 1992, McGowan and MacKerron, 1993). Suffice it to say that the privatisation involved not only a transfer of ownership but also a reorganisation of the industry and the "injection" of competition into the industry (breaking up the former public company and permitting large consumers to contract with whichever supplier they desired). This latter development is the distinguishing characteristic of the UK 'model' and marks a break with the prevailing system in the industry. Introduced in large part as a response to critics of previous privatisations, where they had argued that the government was transferring public monopolies to the private sector, the new model put a much higher priority on competition.

However in considering the UK as a model for change, we should recall that it was not until late on in the programme of British privatisation that privatisation of the ESI took place. By then a number of more modest "privatisations" had taken place in countries such as Austria, Chile, Germany and Spain. With the possible exception of Chile, however, these were primarily ownership transfers (and only partial ones at that). Clearly, therefore, we cannot speak of the UK model as a catalyst for change (though the overall programme may have had an influence). Now that the UK ESI privatisation has taken place, what has been the effect on other countries' policies?

For the most part the prevailing model of ESI organisation is maintained, even where privatisation takes place. Indeed there is (largely anecdotal) widespread evidence that other countries are rather resistant to the non-ownership aspects of the experiment, even though the government and its advisors claim it to be the model for future reforms (Holmes, 1991). While one of the main architects

of the new system has claimed that "the chances are that the UK approach will be the model eventually adopted for other countries brave enough to make the leap" (White, 1991), most other governments and utilities have looked on the introduction of competition as a high risk policy and rejected it. As one commentator indicated, "It is always interesting for economists to witness large scale experiments but I must admit to a feeling of relief that this particular experiment is not taking place in my own country" (Rochet, 1991, p.227.) It would be wrong to say that the model is not being examined and in some respects copied: in Scandinavia and in some Anglo Saxon countries (such as Australia and New Zealand), the idea of introducing competition into the system has been adopted (often without privatisation). Undoubtedly UK experience has been an important example in these cases, though not the only one.

What of the developing world? As noted the first major transfer of ownership took place in Chile and this system has evolved in the direction of competition. Both the Chilean and the UK models have also been important in shaping reforms in the Argentinian system. Elsewhere the moves are more modest, focusing on transfer of ownership and increased access for non utility generators.

The French reforms have largely involved a restructuring of the internal management of the utility through a mixture of contracts and yardstick competition (Bouttes Lederer and Trochet, 1991). In effect, EdF is trying to hold onto the advantages of being a centralised utility (in terms of scale and scope economies in operation, dispatch and planning) with trying to create the advantages of a more decentralised structure (human size for customers and management, greater autonomy etc). They came in the wake of a wider debate on the industry's future which considered but rejected radical change (Criquet, 1992). To that extent they can be seen as both a reaction to developments in the direction of greater competition, and as a means of justifying the existing system. They are also rooted in a longer tradition of reforming public enterprise.

Has this model been one which is imitated? To some extent, yes. The model of a planning contract in particular has been adopted by developed (Italy) and developing (Africa) countries. The more detailed internal reforms have not however been imitated, partly because they hinge on the unique characteristics of the French system (a range of broadly comparable production units). Other countries have drawn upon the same ideas of incentive regulation, however,

though it is debatable whether or not EdF's initiative was an important influence.

Overall then, the extent to which the changes in the UK and French industries have been regarded as models for change is modest. In the case of France, there has been a major effort by EdF to defend their reform strategy often in the face of more radical reform proposals (such as those proposed by the Commission of the European Communities). It appears, however, that for developed countries, there is less interest in it as many of the characteristics have prevailed in the past. For developing countries, however, it may hold more appeal as more replicable, at least in theory. Although the experience of planning contracts in those countries has not been too successful, and the problems may be substantial in terms of governance, the model may be one which can handle the process of reforming a utility which is undergoing rapid change. There is, arguably, another advantage to this model: it may also appeal as a less radical and more predictable and manipulable model than outright competition.

The UK model has certainly been more analysed and observed as a model than any other available, though it is true that much of the interest is concerned with understanding its faults as much as its virtues. Elements of the system are finding their ways into reform proposals in the developed world, though many countries remain uneasy about the consequences of such reforms and remain reluctant to consider it. For developing countries, the applicability may be even more limited, at least in its fully fledged state. It is unclear how such a model can be applied in a system undergoing rapid expansion. Nonetheless, as we noted some countries are emulating the system, and there may be elements which could be applied more widely (e.g. the development of an independent regulator).

It should also be noted how far these 'models' are invoked by international agencies. The World Bank, most notably, has drawn upon aspects of the reforms in both countries as having possible lessons for developing countries (though see Teplitz-Sembitsky, 1990 and more generally Mosley, 1989 and Babai, 1988). It would be wrong to say that these examples are offered uncritically to the South, but they are a major source of ideas which impact on developing countries to different degrees. How far they are being imposed by such agencies is difficult to say. As in other areas of reform, opinions vary on how far the World Bank makes such changes conditional for further support.

However, they do form the basis of ideas which a range of lenders and other agencies draw upon.

4.2 The South as a Market for the North

This brings us on to the question of how far the South is becoming a market for the North in ESI reform. To what extent, in other words, are developing countries becoming targets for everything from advice to investment by developed country firms in the area of ESI reform? Certainly there seems to be a gathering pace to the "internationalisation" of the industry, extending well beyond the recommendation of a particular reform or structure by various agencies and governments. However, before examining recent developments and the motivations driving them, it might be useful to recall that at least in the developing world, the industry has never been purely national.

Foreign investment played an important role in both developed and developing countries in the early years of the ESI. Indeed it could be argued that such investment was a vital mechanism in the diffusion of the technology and the capabilities to manufacture it. The Edison company for example invested in both the equipment and the supply industries of Europe (Chandler, 1990). By the early 20th century investments in developing countries were flowing, from a variety of developed countries though in the 1920s and 30s the primary investor was large US holding companies. These had expanded primarily in the US domestic market and looked abroad to diversify, often taking over from other foreign investors in Latin America and Asia (Wilkins, 1970 and 1974).

In the, 1940s however the pattern began to change and the momentum of foreign investment faltered, due to two factors - depreciating currencies and controls on rate making. Rate increases did not keep pace with foreign exchange losses. In this environment, relations with host governments deteriorated. As a result the foreign companies cut their investment in local systems leading to performance problems and further tensions with governments. These were becoming emboldened by a new phase of economic nationalism in developing countries, reinforced by developments in the US (where the example of the TVA was, as noted, seen as a model for many developing countries). As a result the US interest went into decline and divestment followed in the 1950s and 60s (Wilkins, 1974). In the subsequent period, international linkages did not totally disappear but they were largely confined to extensions of aid budgets whereby national utilities along with engineering contractors and manufacturers would advise on the construction and operation of aspects of developing country systems.

What has changed now is that reform is leaving the industry more open in many developed and developing countries: the industry is no longer obliged to develop solely in its own territory, nor is it always protected from "incursions" from abroad. It is now more able both to engage in speculative ventures abroad and to act as a host to them. While this trend is visible in a number of developed countries, the main flow of activity is from the North to the South. There is an increased role for Northern ESIs in advising, managing and even partially owning developing country systems. Such intervention is following a broader pattern whereby privatisation in those countries often involves a Northern partner acquiring a major share in the company.

In this respect, the activism of the British and French industries is greatest (though players from the US and Spain are also highly active in this field). On the basis of the expertise derived from the UK privatisations and in the post privatisation environment in the ESI, a number of consultancies have been active in efforts to sell services to developing countries. Equally the power companies themselves have sought to diversify into international markets as a way of spreading their sources of revenue and moving away from regulated activities.

For France, there has been, if anything even greater activism. EdF is now engaged in projects across the developed and developing world, increasingly as a shareholder. While profits must be a major consideration in such ventures, the potential for entrenching their model must also be a side-benefit of these activities. Indeed the greater presence of EdF may be because it is not as constrained to show a high return from these ventures as are the British utilities. This activism may also stem from the fact that EdF is able to venture forth into other open markets on a nonreciprocal basis: its domestic market is not yet open to foreign investment or competition. This imbalance is not without its ironies: in some cases EdF is engaged in markets operating on the likes of the new model, perhaps the most notable being its leadership of the successful consortium to take over the distribution company for Greater Buenos Aires, part of a system operated along the UK lines (Power In Europe, 1992).

5 CONCLUSION

The reform of the electricity industry has taken on a new form in recent years. For the most part, the industry is no longer moving in the direction of greater public ownership and integration, and in many cases reform is directed at

reversing the historic trajectory of the sector. Even those countries which maintain the old model are relying on market-type mechanisms to improve performance. Thus while there are differences between national reforms, there is arguably a common core of ideas and policies which are drawn upon when problems are diagnosed and change considered.

There are grounds for concern over the performance of the industry in many countries though it is not obvious that they are the worst cases or that their problems hinge on those factors highlighted by the critique which recommends privatisation and deregulation. Why then has this 'common core' become the norm for reform?

In part 2 we suggested some possible explanations for the change, primarily the motivations of civil servants and officials in the countries themselves and of advisers, consultants and utilities internationally. We also suggest that in this community of officials and experts, the new orthodoxy of privatisation has become an idea which they have had to address. In practice it appears that our model applies but only to a limited extent. The ideas are not absorbed wholesale - indeed there is often resistance to them. Yet they have become the reference point for reform.

Moreover, the likelihood is that they will continue to do so, as our discussion of the "real" market for reform indicates. The growing internationalisation of the industry means that developing country industries may become less national. While this is not a new phenomenon, it marks a reversal of the trend in recent years.

However, one ironic development of this growing internationalisation is that it has been in part to the benefit of a utility which has continued to operate and reform on the basis of the old model of development. Such investments can be understood both as shrewd business activism on the part of the company and as an exercise in reinforcing the credibility of the model on which it has itself developed. This is particularly so where the intervention is in the direction of ownership rather than organisation. Whether this policy could be sustained in an environment where developed and developing countries moved towards greater competition along the lines of the UK, is less clear.

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III TECHNOLOGY TRANSFER, TECHNOLOGICAL CAPABILITY AND THE PERFORMANCE OF THE POWER SECTOR OF DEVELOPING COUNTRIES[1].

Andrew Barnett, Science Policy Research Unit, University of Sussex

1 INTRODUCTION

The purpose of this paper is to critically examine one aspect of the current proposals to improve the performance of the power sectors of developing countries. It looks particularly at the extent to which these proposals deal with the role that technical capability plays in responding to the new regulatory regimes and in absorbing technology imported from abroad.

Recent reviews of the power sector in many developing countries suggests that all is not well[2]. While there are notable exceptions most developing countries are currently facing four inter-linked problems:

- insolvency of utilities, arising from an inability to contain cost rises and an inability to raise prices and other sources of income (such as subsidies) to adequately cover these costs;

- poor performance of generating plant that threatens the sustainability of entire power supply systems and undermines the viability of new investment;

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[1] This paper forms part of SPRU's contribution to the Cooperative Programme on Energy and Development 1991/2 with financial support from the Commission of the European Communities DGXVII.

[2] See De Oliveira, Adilson, 1991, *The Key Issues Facing the Electricity Systems of Developing Countries:* **The Synthesis Report of the Co-operative Programme on Energy and Development,** Directorate General for Energy, Commission of the European Commission, reference EUR 13461 EN, Brussels; and De Oliveira, Adilson, 1992, *Electricity Sector Performance: Options and Opportunities for Developing Countries,* **Synthesis Report of the Co-operative Programme on Energy and Development,** reference EUR 14577 EN, Brussels; and Andrew Barnett, 1992, *Aid Donor Policies and Power Sector Performance in Developing Countries,* **Energy Policy,** September; and World Bank, 1989, **A Review of World Bank Lending for Electric Power,** Working Paper Series Number 107, by Mohan Munasinghe, J Gilling and Melody Mason, Industry and Energy Department, World Bank, Washington, USA.

- shortage of capital to build new capacity to meet the electricity needs of industry and other consumers;

- pressure to curb the rate of growth of emissions that are damaging to the local and global environment.

The lack of reliable power continues to undermine many attempts to improve the international competitiveness of industry in developing countries; it also leads to a growth in the self-generation of electrical energy by users, often using scarce capital and premium fuels relatively inefficiently. The concern over scarcity of primary fuels which dominated much policy discussion in the 1970s and early 1980s has now returned to the more long-standing concern that capital and human skills are the scarce resources facing the power sector in the 1990s[1].

2 THE DIAGNOSIS

There is little disagreement that utility performance in many developing countries *has* deteriorated, and there is much common ground about what to do about it. Certainly a number of factors in the past have combined to produce a vicious downward cycle in power sector performance:

- rising fuel costs (oil),

- the deteriorating macro-economic environment (including rising debt, world recession and the subsequent reduction in the demand for electricity),

- poor utility management, and

- strong pressure not to add to inflation by raising tariffs, nor add to unemployment by shedding excess labour.

[1] While the focus of this paper is on the performance of the electricity supply industries, this should not detract from the substantial improvements that can be made on the demand side.

The inadequate cash flow that results inevitably leads to cuts in maintenance, training, and necessary investment in distribution. This in turn results in a less reliable supply and an unwillingness of customers to pay more for a declining service.

Analysts from the South tend to view the causes of the current problems as being relatively recent in origin and largely associated with the harsh macro economic conditions that many countries find themselves as a result of world recession[1]. While it is accepted that there is substantial room for reform within utilities, many of the problems are seen to be located outside their control. Utilities are faced with historically high interest rates on their existing debt, their ability to raise wages or tariffs is restricted by macro economic policies and they are unable to obtain adequate supplies of new financial capital at any price. At the same time utilities face the unrelenting pressure from government and the public to extend the availability of electricity to more and more people[2].

Against this Southern view a new conventional wisdom is taking shape lead by the financial institutions of the North. This takes its most explicit form in the publications and procedures of the World Bank. Despite recent changes, the World Bank still remains the largest single external source of capital to the power sector of developing countries and is able to exert considerable influence by acting as a financial catalyst that attracts other sources of finance to power sector projects. This influence has enabled to the World Bank to largely determine the intellectual agenda concerning power sector development in much of the Third World.

The staff of the World Bank have long recognised the deterioration in performance of the power sector of developing countries and over recent years the Bank has commissioned a large number of studies to diagnose the problems

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[1] De Oliveira, op cit, 1991.

[2] While many aspects of utility performance have been deteriorating, people's access to the power system has continued to increase. The average growth rate in the number of new consumers to be connected to the power system for 29 projects for which the Bank had data was 9% per year. This is over two and a half times the rate of population growth (World Bank, 1989, WPS 107, p 10-11). Such expansion of the service appears even in countries with low economic performance.

and explore options. These studies have now culminated in a summary of the issues and options and new policy directives that make a strong claim to be the new conventional wisdom for reforming the power system[1].

The Bank's position has evolved significantly over the years. As it became clear that the viability of its capital investment projects were undermined by inadequacies elsewhere in the system, so the Bank widened its focus of attention. The early concentration on power generation projects gave way to a more general concern about the viability of the power sub-sector. Over the years greater emphasis has therefore been given to energy policy, management and non-project finance. This is given expression in the current phase in "policy based" lending (as distinct from the earlier forms of project based lending)[2].

Given its particular role and location within the organisation, the Bank's Energy and Industry Department take a particularly narrow view of electricity supply industries and their role in economic development. In contrast to the views from the South, the Bank sees the problems of power utilities as long-standing and seeks solutions largely within the utilities themselves and their relationship with government.

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[1] The main summary is provided by John E Bessant-Jones' *Reforming the Policies for Electric Power in Developing Countries*, Industry and Energy Department, The World Bank, December 1992. In addition 1992 saw a number of power sector policy papers being submitted to the Board for Approval, such as "The Bank's Role in the Electric Power Sector: Policies for Effective Institutional, Regulatory and Financial Reform", Industry and Energy Department, OSP, The World Bank, 21 February 1992 .

Nicholas Lenssen provides some insight into this process in his **World Watch Paper 111** called *Empowering Development: The New Energy Equation* (November 1992):

> "...in July 1992, energy staff presented a new policy paper to the Bank's Executive Directors laying out the strategy it will follow for future lending to electric utilities. Disturbed by the proposal's reliance on old, failed measures, the Bank's Directors refuse to approve it, requesting that more emphasis be placed on efficiency. By October 1992, the Bank's directors were pleased enough with the redrafted paper to adopt it as Bank Policy" (page 41).

[2] See Andrew Barnett, 1992, *Aid Donor Policies and Power Sector Performance in Developing Countries*, **Energy Policy**,

The recent policy statements from the Bank reflect this concern with the overall viability of the power system and focus their policy response on isolating the electricity supply industries from the "interference" of governments and the wider concerns with macro economic development.

The new strategy is based on five principles:

Arms Length Regulation

an independent and transparent regulatory process between government and power suppliers which defines the roles of government, utility and consumers.

Commercialisation and Corporatisation

the operation of power supply industries according to commercial principles in which they seek to maximise profits within regulatory ceilings, and in which they have responsibilities for borrowing, procurement, salaries and staff conditions. They should pay taxes and dividends.

Importation of Services

In lower income countries the Bank should finance the importation of services in order to improve the financial and technical efficiency of utility operation. This could be achieved either through utility management service contracts or the twinning of domestic and foreign utilities.

"Commitment Lending"

Bank support should be restricted to those utilities that show a clear commitment to improving sector performance.

Private Investment

The Bank should encourage private investment in the power sector by programmes that reduce the cash flow risks of investors[1].

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[1] "The Bank's Role in the Electric Power Sector: Policies for Effective Institutional, Regulatory and Financial Reform, Industry and Energy Department, OSP, The World Bank, 21 February 1992

The Bank's approach is driven by the "realities" that it faces, but such realities may not apply with equal force to other suppliers of finance nor to the governments of developing countries. There is therefore a particular risk if the Bank's approach is incorporated uncritically into the new conventional wisdom.

The Bank sides with many utility managers in seeking a strong cash flow. The Bank believes that this strong cash flow is more likely to be achieved if utilities are operated on commercial lines which are not "compromised" by the historical requirement to meet wider "national objectives" of supplying power to rural people or stimulating industrial development, either through procurement policy or the supply of cheap power. The Bank is also likely to be driven by the inability of international capital markets to meet the needs of the power sector for additional capital to build new capacity. It is this "gap", as much as an ideological preference for private sector involvement, that drives the Bank's to encourage additional funds from any source. Third, the Bank's strategy implicitly recognises that it does not have the capacity to provide "intensive care" to more than a few of the utilities currently in crisis. This lack of resources forces the Bank to ration its services, and it plans to do this by limiting its support to those utilities that do what it says.

There is much to commend a more transparent arrangement between governments and utilities, and the evaluation of the many policies and practices that have built up over the past expansionary period. But the Bank's approach to reform in the power sector appears to deny the realities faced by governments required to manage an economy at the macro level and required to reconcile the conflicting demands of its people.

But it is the role that the Bank attaches to the importation of services to improve power sector performance that appears to be most short sighted and at odds with the evidence of what drives efficiency improvements[1].

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[1] "in [..] institution-poor countries, a priority is to find imaginative ways to draw on international hands-on experience as a means of developing local manpower, skills and institutional capacities....an efficient productive power sector can set an example that will be more valuable than merely training a few selected engineers in an environment filled with disincentives. Learning by doing is a time-tested process, but guiding the learning process is essential" World bank, 1992, op cit, page 30. The Bank's stance in relation to the power sector is particularly surprising in that much of the new evidence about the nature and causes of technical change have come from authors funded by the Bank (for instance the work of Dahlman , Westphal, Goldman, and Sagasti).

Part of the explanation for the Bank's current position is likely to be due to the influence of particular internal restrictions that its support for power projects has faced over the years. For instance normal Bank policy precludes financing recurrent costs for revenue-earning entities, such as power utilities[1]. This means that support for foreign contractors to undertake intermittent capital projects to "rehabilitate" power stations is acceptable, but support for local staff to undertake routine maintenance is not. Similarly the pressures of project funding force the Bank (and many bilateral aid programmes) to use foreign contractors rather than local people for many of its tasks. Such practices arise in part because of the pressure to implement projects quickly and because the benefits of building local capabilities are difficult to reflect in conventional project appraisal techniques that consider individual projects rather than a sequence of 'sustainable' activities over a period of years.

But despite such mitigating circumstances, the Bank's advocacy of imported skills appears to neglect much of the current understanding of the processes that drive improvements in industrial enterprises and the nature of the skills required to improve performance in response to new regulatory regimes.

3 THE EXPERIENCE OF TECHNICAL CHANGE IN OTHER SECTORS

Much of the improvement in the performance of power systems in the past derived from the expansion of grids which allowed new "vintages" of technology to be incorporated into the system. These new plant tended to be larger and more efficient than the existing plant and were also capable of using cheaper, less refined, fuels. With the slowing down of investment in new plant, the main improvement to system performance will in future have to come from incremental changes to the existing stock of plant and equipment[2].

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[1] World Bank, 1987, OMS, para 8.6.

[2] A recent study commissioned by the US Congress Office of Technology Assessment reviewed a wide range of new technologies in the power sector and concluded that "whatever the applicability of these technological innovations, the real issue is to properly apply current technology" IDEA Inc, 1991, *Improving Power Sector Efficiency in Developing Countries*, Paper prepared for the Office of Technology Assessment of the US Congress, OTA, Washington DC.

This "incremental technical change" involves large numbers of small improvements being made to the existing techniques of production and to the way that production is organised. Such "post-investment technical change" has been found to account for a very significant share of productivity improvement in industrialised countries. Such changes is particularly widespread in dynamic economies, where "learning firms" are systematically seeking out ways to improve their operations.

Research also shows that these dynamic firms seek to utilise all their resources efficiently. This means that improvements in energy efficiency arise from attempts to improve the whole process, rather than minimise the use of a particular input such as energy. Such changes may well be disconnected from changes in the relative price of inputs, and it is therefore not unusual to find energy efficiency improving in dynamic firms even when the price of fuel is falling in real terms[1].

However such forms of technical changes require a substantial and complex set of capabilities within the productive enterprise, and these capabilities need to be supported by an external infrastructure. Much of the knowledge associated with the building, operation, maintenance and adaptation of power systems is not codified and documented, but forms part of the experience of particular individuals[2]. Particularly important from the point of view of World Bank policies, experience shows that such capabilities are not easily bought in the international market.

The new World Bank strategy suggests that these skills can be acquired through the "time-tested process of ...learning by doing" (page 30). But what time has shown is that the process of 'Technological Learning' can no longer be considered an automatic result of the passage of time - 'learning by doing' is not a largely passive process[3]. Rather the acquisition of skills and know-how

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[1] This evidence is summarised in Martin Bell, 1990. Similar results have been found in the dynamic firms in Brazil's steel sector, in doctoral research at SPRU by Mauricio Piccinini.

[2] These arguments are described in more detail in relation to industry in general in Bell and Pavitt, 1992.

[3] Martin Bell, Bruce Ross-Larsen and Larry E Westphal, (1984).

required to absorb and utilise foreign technology effectively requires the investment of time, money and institutional resources ('generating change related human capital'). Just how large these resources may need to be is illustrated by a recent study which suggests that leading companies' investment in knowledge now exceeds their investment in fixed capital[1].

A number of arguments can also be put forward to explain why enterprises operating on the commercial principles advocated by the Bank are likely to invest less in learning than is required by an economy. First firms are reluctant to train people who are likely to leave and work elsewhere in the economy. Second, investments in such intangible assets as human capital are less obvious than other forms of investment; conventional investment analysis of the cost-benefit-type may well be useful in the straight choice between production techniques, but it tends to under-value these intangible effects; this means that such forms of analysis are unlikely to select options such as human resource development which have the capacity to exploit *future* technological opportunities. And third, deliberate firm-specific investment in technological learning may well involve extra short-term costs and risks, which companies (and their bankers) usually wish to minimise[2].

Aid programmes have also shown a tendency to under-invest in the capacities associated with technical change. In part this is the result of the limitations in analytic tools mentioned above. But it is also the result of a model of development which over-simplifies or neglects the role of technical change. For instance, an authoritative evaluation of multilateral aid comments that there is "a striking weakness in the intellectual underpinnings of institution building, human development, and associated technical co-operation compared with the theoretical and quantitative tools used to plan physical investment"[3].

However sections of the aid establishment have begun to question the adequacy of many aspects of this current model. For instance, the 1990 Statement by Development Co-operation Ministers and Heads of Agencies expressed "growing concern over the quality and effectiveness of technical

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[1] F. Kodama, (1991).

[2] These arguments are described in more detail in Bell and Pavitt, 1992, pages 10,11 and 25.

[3] See Robert Cassen and Associates, (1986), p 217.

assistance"[1]. Elements within the World Bank have also noted the "devastating" implications of the failure to invest adequately in the academic and technical skill levels of the labour force[2]. A number of these ideas are now filtering into current practice, most noticeably in the renewed interests in "human resources" led development[3].

But at a more pragmatic level, much of the day to day practice of international aid also has detrimental impacts on the building of indigenous technical capability. The tying of aid to the goods and services supplied by the donor country is only the most prominent of a number of these mechanisms. Out-of-country training and the excessive use of foreign consultants can further significantly reduce the development of local capacities to diagnose problems, appraise the options, and manage their implementation[4]. There are examples where foreigners have been preferred when their costs (even excluding expenses) have been as much as fifteen times the cost of local, equally qualified, people[5].

The development of more complex skills and capabilities in the local economy through international "technology transfer" has been very modest over the past

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[1] From the 1990 statement of Development Co-operation Ministers and Heads of Agencies reported in OECD, (1992), page 27.

[2] See for instance the remarks attributed to sources in the World Bank in 1988 by Rutherford Poates in OECD, (1991), page 69.

[3] These trends are also noted in the World Bank's 1992 World Development Report.

[4] The aid provided by the CEC is potentially highly innovative in this respect, with the transfer of responsibility for the administration of aid funds under each European Development Fund to the recipients. But in practice foreign consultants are frequently hired to diagnose local problems, review options and design projects in order to disburse the funds quickly. However, the poor performance of many aid funded enterprises, suggests that the potential trade-off between the slow process of building local capacities and the speedy implementation of schemes is not very large in practice. See for instance House of Lords, (1990); for the EC's role in the energy sector, see Sussex Research Associates Limited, (1988); and for examples of ODA's experience in the Electric Power sector see, Andrew Barnett, Garth Armstrong, and Jim Munday, (1990).

[5] Personal communication ODA Evaluation Department.

20 years[1]. This is despite the considerable trade in capital goods between the North and South and widespread use of foreign expertise. In explaining inadequacies in the process of technology transfer, policy makers initially focused on the disparity in bargaining power between the sellers and buyers of technology and the belief that the prices paid were considerably above fair market prices. While there is evidence of monopoly pricing, and some of the procedures to reduce prices have been effective, efforts to reduce prices were frequently met by a reduction in the "quality" or range of services included in the technology package that was transferred.

The focus of negotiations then shifted to the content of the technology package itself. While the "hardware" aspects of the package often attracted the greatest attention and are most easily quantified, it emerged that the "software elements" were equally important. But so far there is very little knowledge about how such "software elements" should be transferred and the skills built up. Little research has been undertaken to determine precisely what is required in particular sub-sectors, such as electricity.

Current thinking about the transfer of technology shifts the focus still further from the motives and inadequacies of the technology supplier, to the tasks that the technology buyer must perform in order to utilise imported equipment and skills. In particular, it appears that there is frequently a substantial 'gap' between the depth and breadth of the knowledge and skills sought by firms in developing countries and technology that the supplier is not willing to transfer because of its strategic significance[2].

This view is supported by a wide range of literature on technology transfer. One review in particular concludes that much of the responsibility for a lack of genuine technology transfer over the past twenty five years lies with recipient country governments which failed to demand the transfer of specific skills at the managerial and higher technical level[3]. But the removal of such barriers calls

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[1] A useful summary is provided by Amitav Rath, (1992).

[2] Hoffman and Girvan, (1990). In recent years there have been a very limited number of countries, mainly the NICs of South East Asia, that have complained that they cannot gain access to cutting-edge technology from industrialised countries.

[3] Hoffman and Girvan, (1990), page 161.

for the building up of capacities, particularly within enterprises, to define problems and to select solutions from a wide range of options.

Nonetheless, developing countries still face a formidable task. Evidence from a wide range of industrial enterprises indicates (unfortunately) that the capacity to manage technical change in the future appears to be highly correlated with having made similar changes in the past[1]. So not only is the necessary knowledge difficult to acquire through international trade, but the competencies that are required are cumulative, often firm specific and have to be built up over many years.

4 THE EVIDENCE FROM THE POWER SECTOR

Very few studies have yet been carried out on the nature and form of technological capabilities required in the power sector[2]. In other industries powerful insights have been gained by observing performance at the factory level over an extended period of time. In the power sector this type of longitudinal data is rarely published for individual plants. Rather the data that is available is a weighted average of the performance of all plant, or at least all plant of a particular fuel type. While this view of system performance is appropriate for many purposes, it does obscure the changes in performance of particular plant over time. Even where data are available at the plant level, the changes in the load on particular plant as a result in the growth in demand and changes in operating regime dictated by merit order plant operation further complicate the interpretation of results. A potential source of information is the ex-post evaluations of aid projects which finance individual power plant, but the timing of such evaluation tends to be too early in the life of the plant to provide the necessary span of years and only rarely are attempts to explain variations in performance sought from factors within the plant (rather than in the system as a whole).

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[1] Bell and Pavitt, 1992, page 11.

[2] The exception has been the work over many years carried out under the auspices of UNCTAD with finance from the Swedish Aid Programme (SAREC). Their work is summarised in Technology Policy in the Energy Sector: Issues, Scope and Options for Developing Countries, UNCTAD/TT/90 15 June 1989.

However, certain insights into the nature and scale of effort required to improve plant performance over time is provided by the literature on developed country experience. For instance the introduction of 500 and 660 MW coal fired plant in the UK in the 1960s were plagued with problems. It took 18 years before the new plant were in aggregate able to meet the target set of providing 90% availability during the peak winter period (in the worst year, 1969/70, the availability was 53.9%).

Plant availability after five years in service of UK thermal power plant

Unit Size (MW)	Weighted Mean Annual Availability (%)	Standard Deviation
60	87.7	4.2
120	71.2	12.9
500/660	56.1	10.2

Percentage availability of UK 500 AND 660 MW thermal power plant at daily peaks on December, January and February

1968/89	56.3	1978/79	84.6
1969/70	53.9	1979/80	83.9
1970/71	62.8	1980/81	87.3
1971/72	62.5	1981/82	83.8
1972/73	69.4	1982/83	89.3
1973/74	69.1	1983/84	87.2
1974/75	75.2	1984/85	81.9
1975/76	70.8	1985/86	91.3
1976/77	74.2	1986/87	88.2
1977/78	75.3	1987/88	89.0

A number of explanations have been put forward for this performance record, but for the current purpose it is particularly interesting to note that the UK's Central Electricity Generating Board not only had to invest huge additional

resources in repair and maintenance to rectify these problems (a sum estimated to equal to 10% of the initial capital costs, spread over a ten year period), but it also had to develop specialist teams that were separate from and additional to the normal O and M work force[1].

This requirement to develop capabilities to manage incremental technical change in separate units was also noted in a study of the ways the German utility Rheinishch Weltfalishes Elektrizitaatswedrk AG also approached the improvement of its plant availability[2].

In developing countries there are examples in the research literature that provide insights into the processes of technical change in power stations. At one level there is the evidence provided by the wide range of plant performance that exists within particular countries. Such plant faces a common macro economic environment of tariffs, wage rates and skill levels, and yet performance levels vary widely. Some of the variation is likely to be a function of the type and age of the plant (the "vintage"); but variations in performance for similar plant are likely to be the result of variations in management and technical skills at the plant level (and luck!).

Examples can be found in all countries for which plant specific data exist. For instance, the 1989-90 annual report of the Ministry of Energy in China shows that for 300 MW thermal plant the net coal consumption for the most efficient plant was 337 tce/GWh while the worst for this scale plant was in the region of 382 (an increase of 13%)[3].

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[1] See G MacKerron, "Plant Availability, plant breakdown and remedial measures in an industrialised country - UK fossil-fired-plant", Paper to the COPED Annual Meeting 1990/91, Mimeo, Science Policy Research Unit.

[2] See Siddons et al, 1989 and Bell, 1990.

[3] See *The Electric Power Industry in China 1989-90*, Information Research Institute of Water Resources and Electric Power, Ministry of Energy, 1990. See also *Regulation, Institutional Structure and the Performance of the Electricity Sector in Developing Countries: A case Study of China*, by Prof Liu Deshun, and Dr Guo Yuan, INET, Tsinghua University, Beijing, COPED Discussion Paper edited by I A Household.

In another data set from the same source, the weighted average forced outage rate by plant size was lowest for the two 350 MW (1.88%) units and worst for the single 600 MW unit (12.46%) and the two 120 MW units (10.3%).

In the case of specific plant there are examples of dramatic increases in plant availability as a result of improved working practices and technical expertise, again within a largely hostile macro economic environment. The table which follows shows the massive improvement in efficiency that appears to have resulted from an intensive training and human resource development project funded by the British aid programme in Indonesia in the late 1980s[1]. The expatriate staff involved attribute the gains to a particularly able manager within the local station who was receptive to new ideas, and the systemisation of O and M procedures using conventional approaches ("no magic tricks and nothing fancy"![2])

Performance indicators for two 400 MW plant Suralya, Indonesia

	Availability %		Plant Factor %	
	Unit 1	Unit 2	Unit 1	Unit 2
1985/6	64	55	42	38
1986/7	58	73	44	57
1987/8	87	81	73	68
1988/9	91	85	77	71

[1] World Bank ESMAP study for Indonesia.

[2] Personal communication, BEI Ltd, London.

The most dramatic evidence of the importance of local capabilities in performance improvement is provided by the case of Korea. This example is most frequently cited because of the way the Koreans were able to raise the local content of new power projects after 1976. But it is also interesting to note that in the period 1964-76 the Korean system expanded very rapidly and in ways that share a number of characteristics with the recent past of many developing countries. In particular, the choice of technology was driven largely by the availability of foreign capital. This resulted in a wide range of different plant types: 16 firms from 6 countries supplied the boilers and 14 firms from 7 countries supplied the turbines. This placed a particular burden on the operation and maintenance of so many different types of equipment and required the management of a diverse stock of spares. But despite of this the Koreans were able to improve the performance of the plant over time.

The Koreans were able to do this because they had a clear objective to acquire the necessary knowledge and they made available substantial resources to invest in learning. They negotiated contracts with overseas consultants and machinery suppliers that paid particular attention to the transfer of the necessary knowledge and skills. They invested heavily in training overseas, in-house and on the job. A style was developed within the national utility (Kepco) to encourage training and to help staff at all levels to learn. Staff were given financial incentives to improve performance There was considerable emphasis on practical training and a great deal of "peeking over the shoulder" of the foreigners to learn what they were doing and why. They took a strategic rather than a project by project approach to performance improvements. And at times this meant that improvements in performance in the short run were traded for in order to gain higher performance in future [1].

[1] See *The technological impact of public procurement policy: the experience of the power plant sector in the Republic of Korea*, UNCTAD study on Technology Issues in the Energy Sector of Developing Countries, UNCTAD/TT/60, 1985.

A rather different example of what can be achieved by building in-house capability is provided by the Shajiao B power station in south China's Guandong Province[1]. This scheme is again remarkable for a number of reasons, not least of which being that it was the first successful Build Own Operate and Transfer project in the power sector of a developing country and the first foreign owned power plant in China. This 600 MW coal-fired plant was built and operated by a Hong Kong company using capital raised internationally. The project has been highly successful in that it was constructed in a world record time of 22 months and has operated for over four years at over 95% availability and 36.8% thermal efficiency. It appears that the returns to the foreign investors and the Chinese authorities are well balanced.

One feature of the current high levels of performance has been the aggressive way in which the operators have sought to acquire the knowledge and skills necessary to operate and maintain the plant. They have also adopted highly innovative ways of transferring this knowledge and skills to the local work force. The replacement of high cost expatriates with local staff has been rewarded by considerable reduction in operating costs, and was managed without incurring the high cost of reduced performance. Hugh amounts of resources have been invested in the training schemes, and in the capturing of knowledge from expatriates brought in during the early phase of the project to install and overhaul equipment.

5 CONCLUSIONS

These specific examples, together with the more general experience of technical change in other sectors, have a number of implications for the technological aspects of the new conventional wisdom for the reform of the power sector. First, while foreign suppliers of services may well have a role to play in improving the performance of utilities in the short-run, more sustainable results will require complementary activities to develop the local capacities to manage

[1] See Barnett, Andrew and Ian Household, (1992), *ShajiaoB: China's First Foreign Owned Power Project*, January, Science Policy Research Unit, University of Sussex, UK.

technical change and to sustain an upward trend in performance. These activities will require substantial investment of time and money. The evidence strongly supports the view that the import of technology and skills is complementary to, rather than a substitute for, the development of capabilities locally. Investment in human capital is therefore likely to be at least as important as investment in physical plant in sustained programmes of reform within the power sector. Much of the skill required involves 'tacit knowledge' that is difficult to obtain on international markets.

Second, experience in northern industrialised countries suggest that there are a number of essential pre-conditions for effective regulation and that there are clear limits to what can be achieved by regulation alone[1]. A number of these preconditions relate to the technical capacities at the firm level, while others relate to the wider infrastructure that supports it. At the firm level a relatively high level of technological and managerial competence are likely to be required to respond flexibly, creatively and effectively to the incentives generated by the new regulatory systems. But the development of this capability itself depends on a favourable environment, and certain types of infrastructure that enterprises cannot economically provide themselves.

This infrastructure ranges from stable government, the reduction of corruption, the regulation of trade, the constellation of tax and other incentives, the institutional arrangements that supply finance, credit, and standards, to the institutions specifically designed to undertake scientific and technological research, education and training.

Since the 1980s many governments have been forced to reduce the absolute and relative amounts of resources allocated to this infrastructural support for technological capacity. Many of the institutions were based on inappropriate models and were both costly and ineffective.

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[1] For a general discussion of the limits to regulation see for instance Francis McGowan's paper to COPED, 1992, *Reforming the Developing Countries' Energy Supply Industries: Lessons from the British and French Experience*

But some elements remained essential and yet it rarely proved possible to determine precisely what should be retained in the wholesale destruction of public sector institutions. It is these elements that now must be identified on the basis of proven need to support in firm capacities (rather than ideology). Ironically the destruction in the South occurred at a time when the industrialised world was increasing its investments in such supportive infrastructure.

Third, improvement in power sector performance is unlikely to be achieved with reforms that are restricted to changes within utilities and their relationship with government. At one level this is illustrated by the efforts to pay adequate salaries and to reward initiative and increased learning in the power sector being hampered by concerns about its effect on salaries elsewhere in the economy. At another level it is the conflict between short term commercial concerns to buy the cheapest fuel or obtain the most cost effective capital goods and the longer term national interests over the environment, fuel security, or the capacity to build local supply capacity in capital goods or technical services. Experience of the new regulatory regimes in industrialised countries suggest that these traditional areas of national energy policy still require guidance from the not so invisible hand of the state.

The fourth implication for the reform of the power sector concerns the reform of the way aid agencies provide support to the power sector. A precondition of an effective response on the technology front will be the acceptance by aid agencies of five broad principles which emerge from the evidence outlined above:

- that the 'knowledge intensity' and 'change intensity' of economic activity has fundamentally changed over the past 50 years, and in consequence **the development of capacities to manage technical change has now become an essential element for the social and economic well being of all societies**, including those of developing countries;

- that the management of technical change will require substantial **increases in the scale and quality of investment in human resources;**

- that the management of technical change necessitates the **integration of a range of scientific and technological activities into all financial, trade and investment activities within the domestic economy** (whether in the public or private sector) and that they are **complementary to, rather than a substitute for, imports of technology;**

- that **firms are producers of human capital as well as users of it** in that much of the development of human capital can only be gained by the purposeful acquisition of knowledge and experience within productive enterprises (and that this is quite different from the more passive interpretations of "learning by doing").

Fortunately there are promising signs that some sections of the international community have recognised that the management of technical change must become more effectively integrated into their development assistance programmes, even if these have not yet percolated through to many of the departments concerned with the power sector. As noted earlier there is renewed interest in these issues at the Development Assistance Committee at the OECD and the 1990 Statement by Development Co-operation Ministers and Heads of Agencies pledged that "the nature and quality of technical assistance will often have to be significantly re-thought or up-graded to contribute better to longer-run institution building[1].

A number of multilateral agencies have also begun to lay more emphasis on the technological dimension of their assistance. For instance, the Commission of the European Communities (CEC) currently attempts to affect the

[1] OECD, (1992), page 27

Scientific and Technological capacities of developing countries in a wide array of programmes and projects. Article 16 of the agreements which provide support to the countries of Africa, the Pacific and Caribbean (the ACP of the Lome conventions) specifically states that their overseas aid is directed mainly at "supporting ACP States' efforts to achieve self-reliant development by stepping up their capacity to innovate, and to adapt and transform technology"[1]. For the non-ACP states of Latin America the EC agreed a new policy June 1990, following a fundamental review of 13 years of experience. Part of the future programme in this area "aims to mobilise the resources (such as capital, technical know-how, marketing networks and managerial capacity) of European economic operators and to transfer those resources, under market conditions"[2].

The UK has also recently returned to the theme of technology transfer in its programme of Technology Co-operation outlined as a contribution to the UNCED conference. Here it is explicitly recognised that sustainable development requires not only "technology transfer, but also [...] the economic circumstances and the technical and managerial skills to be in place to ensure that technologies can be absorbed, adapted, used and diffused in the recipient countries"[3].

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[1] Commission of European Communities' **Manual for Preparing and Appraising Project and Programme Dossiers**.

[2] **Guidelines for Co-operation with the Developing Countries in Latin America and Asia,** COM (90) 176 11, Brussels, June 1990. The new policy defined two categories of future assistance: "development aid" to the poorest countries, and "economic co-operation" to regions or countries for the mutual benefit of those countries and of the Community. Economic Co-operation is seen as "promoting exports and European investments, by means training, and co-operation in the fields of industry, energy, science and technology. Its purpose is to strengthen institutional capacity in the partner country and to make it more favourable to [European] investment and development".

[3] See *Technology Co-operation: Britain's experience*, May 1992, Department of Trade and Industry. It is interesting to note that while the Official Aid Programme, ODA, is mentioned in the text, the study was undertaken jointly by the DTI and the Department of the Environment.

The World Bank's Energy Department remains peculiarly reticent on these issues, even though other parts of the Bank appear to be shifting the balance of their support further towards investment in human resources and programmes to strengthen local capacities to manage technical change in the industrial sector[1].

[1] An example of new trends in this area has been the support provided to a number of countries for "industrial technology development". For instance a $200m loan has been provided to strengthen India's capacity for technology upgrading in industry. This programme attempts to provide finance for technical change at the level of the enterprise, to make more available technology service institutes (in the public sector) and to use domestic resources more efficiently to complement what can be obtained from abroad. See India Staff Appraisal report Number 7864-IN, August 1989, para 1.2.

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IV VARIATIONS IN ENERGY-RELATED ENVIRONMENTAL PRIORITIES AT DIFFERENT LEVELS OF DEVELOPMENT: THE CASE OF ELECTRICITY GENERATION

Peter J G Pearson
SEEC, University of Surrey

1 INTRODUCTION

This paper outlines some of the thinking behind a research project on which the author has recently started work, under the UK Economic and Social Research Council's Global Environmental Change research initiative.[1] The paper makes a case for investigating the nature and extent of variations in energy-related environmental priorities between countries at different levels of development.

2 ENVIRONMENTAL PROBLEMS AND PRIORITIES

2.1 Environmental Problems and Development

The issue of global environmental change not only raises questions about cooperation between countries in relation to energy-related global problems like the enhanced greenhouse effect. It also raises wider conceptual and empirical issues. An important empirical question is: how do energy-related environmental problems vary with different levels of development? Here there is still limited evidence available, even on the more general issue of how environmental problems relate to income levels. The *World Development Report 1992*, discussing data analysed by Shafik and Bandyopadhyay (1992), presents a figure (World Bank, 1992, Figure 4, 11) illustrating cases where: (a) some problems (e.g. poor sanitation and limited access to safe water) tend to decline as income

[1] GEC Research Fellowship: *Energy-Related Environmental Problems and Priorities at Different Levels of Development*. Award reference number: Y 320 27 3053.

rises to levels where resources for improved public services become available; (b) some problems initially worsen but then improve as incomes rise and if countries decide to allocate resources to deal with them (they suggest that most forms of air and water pollution fall in this category); (c) some problems worsen with income (including emissions of carbon and nitrogen oxides), and abatement costs seem high in relation to the perceived environmental damage costs. However, the World Bank argue that their evidence: ... does not imply an inevitable relationship between income levels and particular environmental problems; countries can choose policies that result in much better (or worse) environmental conditions than those in other countries at similar income levels. Nor does it imply a static picture; as a result of technological progress, some of these curves have shifted downward over recent decades, providing an opportunity for countries to develop in a less damaging manner than was possible earlier.

2.2 Environmental Priorities and Development

A second set of questions concerns what priorities are and should be given by countries at different levels of development to the environmental problems of the energy sector, compared with: (a) energy policy objectives *other than* the pursuit of environmental quality; and (b) environmental problems associated with other sectors. Of particular interest in this paper are the under-analyzed differences between developing countries and industrialised countries in the absolute and relative policy priorities given to different categories of environmental issue and types of environmental quality. Here there are two key questions that need to be addressed:

(1) Are there clear theoretical reasons why developing countries might be expected to take a different view of energy-related environmental issues, and so have different priorities from those of industrialised countries?

(2) How might such differences be reflected in practical energy-environment decision-making and in the perceptions of the various actors involved in decision-taking?

Even within the energy sector alone these issues are complex and diverse. Consequently this paper focuses mainly on electricity generation - an area whose importance is clear along several dimensions (e.g. variously

facilitator of and constraint on development processes, major absorber of domestic investment, and contributor to problems of developing country debt). Electricity generation is widely regarded as a vital input to economic growth and as a major source of environmental problems. It raises, therefore, most immediately issues about possible conflicts and complementarities between environment and development (Pearson, 1993).

In spite of the undoubted heterogeneity of developing countries, Munasinghe (1992) has identified a general attitude towards electricity and its environmental impacts. He describes the commonly-held view that developing countries feel that attempts to control pollutant emissions should not jeopardise the critical role played by electric power in economic development. Consequently countries tend to be reluctant to allocate funds to environmental programmes, if that means restricting the expansion of energy supplies. In relation to global warming, for example, developing countries often argue that: (a) it is not fair to ask them now to ration their use of the atmosphere as a waste sink for carbon dioxide, given that the industrialised countries used it freely for this purpose in the past; and (b) in any case they cannot afford it, since to do so would compromise their development plans.[1]

To some extent also, a form of support for this kind of position has come in the past from commentators in industrialised countries, who have suggested that environmental quality is a luxury that developing countries cannot afford. However, the recent emphasis arising out of work on sustainable development (e.g. Pearce et al., 1990) on the dangers of trading off tomorrow's sustained 'development' against today's short-term resource-degrading growth, reinforces the argument that there may be a deeper sense in which some aspects of

[1] For example, at the final meeting of Working Group 3 of the Intergovernmental Panel on Climate Change (IPCC) in 1990, the Chinese delegation is reported to have said that, '...if we stabilise emissions, that means we cannot develop the Chinese economy' (*The Environment Digest* (1990),35/36, 8-9).

environmental quality are necessities - but necessities that many developing countries cannot presently afford (Pearson, 1991).[1]

Although it is clearly not difficult to specify circumstances in which electric power would be an essential element in a development strategy, and in which expenditures on environmental quality could crowd out investment in electricity supply, views of the centrality of electricity's role in development and of the competitive nature of the trade-offs between electricity supply and environmental quality should not be accepted uncritically. Firstly, there are important questions about when the net social benefits of increasing electricity supplies may be outweighed by the net benefits of funds devoted to alternative non-electricity development projects - continually prioritising investments in electricity supply may not always represent the best use of scarce development resources.

Secondly, in recent years there has been much advocacy of the possibilities of adopting 'no regrets' (or 'low regrets') measures intended to improve energy efficiency and demand-side management but which also yield environmental benefits (Grubb et al.,1990, 1991). Consequently, up to a point such environmentally benign investments need not necessarily jeopardise the availability of energy services and may even increase them. Nevertheless, it is important to be aware of both the conceptual and practical limits to these processes. For example, while Wilbanks (1991, 137) praises the cost-effectiveness at the margin of investments in improving the efficiency of electricity service provision, he also questions how much efficiency improvement is likely to be achievable in practice in developing countries over the next few decades: The main reason is that realizing its full potential will call for wrenching redirections by many industrialized countries, developing countries and multilateral institutions - ranging from energy price reform to major changes in financial and technical assistance policies. In the meantime, it is illusory to think that efficiency improvements will obviate the need for investments in electricity supply facilities entirely. Rather if we are both determined and fortunate, efficiency improvements may be able to reduce the investment requirements for new supply facilities to a level that is feasible for most developing countries, avoiding a situation where energy conditions limit development itself. In this process, efficiency improvements can also significantly ease pressures on the global environment...

[1] It is, therefore, important to treat environmental quality not as a single aggregate but rather comprising many elements, some of which will be more important than others in particular times, places and economic circumstances.

2.3 Global Warming and Priorities

To continue the example of the enhanced greenhouse effect, a number of developing countries are potentially vulnerable to the impacts of a future global warming. However, the present costs of reducing fossil fuel-related greenhouse gas emissions and of adapting to expected climatic and environmental changes imply the possibility of some difficult trade-offs of present against future living standards - particularly, of course, for countries with significant reserves of coal, like China and India (Pearson, 1992). As Nordhaus (1991) puts it: 'The fundamental policy question involves how much reduction in consumption society should incur today to slow the consumption damages from climate change in the future.' For many countries, their development aspirations and their currently relatively low levels of per capita income and energy consumption, make them reluctant to lower the trajectories of their plans for short to medium-term economic growth. Given the uncertainties and the long time-scale, many developing countries will be tempted to take an optimistic view of the damage that could be associated with global warming in the middle of the next century and beyond. Consequently (and also for reasons of strategic bargaining), they will tend to set lower targets for carbon dioxide emissions control than the developed, industrialised countries (Pearson, 1991). Indeed, one of the reasons behind the difficulties associated with developing country participation in greenhouse gas limitations strategies is that richer countries would like poorer countries to take the decisions and make the trade-offs that make sense to richer countries.

This is not to suggest that developing country policy-makers necessarily dismiss the threat of global warming. Rather, it highlights the difficulties that poorer countries face when deciding which energy and environmental pathways to follow. It also reminds us that both the costs and benefits of pollution abatement, and therefore appropriate optimal pollution abatement levels, can differ significantly between countries at different levels of development.

2.4 Conflicts and Tradeoffs Between Policy Objectives

Conflicts between policy objectives are, of course, an ever-present aspect of energy and environmental policy-making in all countries. Importantly, however, it can be argued that the weighting of policy objectives and constraints does and in some circumstances should differ between industrialised countries and developing countries. For example, many developing countries appear to place relatively more emphasis on objectives relating to the reduction of poverty, the pursuit of equity and the maintenance of macroeconomic stability rather than on economic efficiency. This is both: (a) because of the greater incidence of absolute poverty in poorer countries; and (b) because the often restricted range and power of their economic and social policy instruments, including social security instruments, tends to make it more difficult to resolve conflicts between the pursuit of different objectives. Thus countries for whom poverty objectives are very important may be faced with, and be prepared to accept, significant losses of efficiency, and even equity, as the price of achieving them (for example, energy subsidies intended to relieve absolute poverty may achieve this aim at the price of benefitting richer groups even more than poorer groups because the richer groups consume more of the subsidised fuel).

On the other hand, it can also be questioned whether the policies adopted by developing country governments and utilities are always the result of a rational process of weighing trade-offs between different policy objectives. For example, according to the World Bank (1992, 117): Governments frequently intervene in the day-to-day operations of (electricity) utilities and they worry that price increases will exacerbate inflation. Utility mangers and their boards may have little say in pricing or investment decisions. Lack of accountability and transparency leads to poor management, either of the utilities themselves or of the state fuel companies that frequently supply them. Moreover, the World Bank is very critical of the widespread use of energy subsidies, not just in developing countries, on the grounds that they distort resource allocations, so creating losses of consumer and producer welfare, and stimulate energy use and associated environmental damage to be greater than they would otherwise be.

For example, on the basis of their work, Larsen and Shah (1992, 21) argue that: ... adjusting subsidized energy prices to world prices is the first step in an environmentally responsible and fiscally prudent development strategy. The emerging market economies and developing nations that adopt such policies sooner rather than later will reap rich economic gains, besides helping the global environment. Furthermore, Larsen and Shah claim that three countries with low existing energy taxes - Indonesia, India and the USA - could achieve substantial *local* environmental gains in the form of health benefits (e.g. from reductions of nitrous oxides, carbon monoxides, particulates and sulphur dioxides) which would exceed the efficiency costs of carbon taxes.[1]

Clearly then, the issue of policy priorities and tradeoffs is both complex and significant. Whereas it can be argued that there are circumstances in which it makes sense for developing countries to have different priorities from those of countries at other levels of development, it is also clear that many of the choices that authorities actually make imply some very costly tradeoffs. This is why further research is needed in order to try say something more about the factors that influence appropriate energy-environment policy trade-offs, and about the nature of the constraints that can inhibit the policy choices open to developing countries.

3 ENVIRONMENTAL ISSUES ASSOCIATED WITH ELECTRICITY[2]

3.1 Patterns of Growth in Electricity Generation

There are two main reasons why environmental issues connected with electricity generation and use in developing countries have become prominent: first, because of changing perceptions of the severity of the domestic and international

[1] See also Clarke (1993).

[2] This section draws on Pearson (1991, 1992, 1993).

environmental issues raised by electricity production and use (ranging from local issues, like urban air pollution or the siting of power stations or hydro dams, to global problems like the enhanced greenhouse effect); and second, because not only is developing country electricity consumption growing very rapidly but also the developing country share in world fossil-fuel generated consumption and its associated carbon dioxide emissions is expected to continue to increase well into the next century.

As Table 1 indicates, annual average growth rates of developing country electricity consumption were 8.5 per cent over 1971-89 (9.6 per cent for 1971-80 and 7.3 per cent for 1980-1989). Moreover, as Munasinghe (1992) notes, World Bank projections have indicated that electricity demand could grow at an annual average rate of 6.6 per cent for 1989-99, with total capacity additions of more than 380 GW during 1990-99 and annual energy consumption of over 3800 TWh by 1999. Asia accounts for nearly two-thirds of these requirements. In their study of eight large countries that account for more than half of total developing country energy consumption, Imran and Barnes (1990) found that electricity generation would represent the largest single need for energy in all eight countries by the late 1990s.

From an international perspective, developing country electricity production has been growing much faster than that of the industrialised countries, whose 1971-89 growth rate was 3.5 per cent per year, five per cent lower than that of the developing countries. Consequently, over this period the developing country share in global production doubled from 10 to 20 per cent, while the share in incremental production rose strikingly from 22.3 per cent for the period 1971-80 to 34.7 per cent for the period 1980-89 (Pearson, 1993) . Projections of electricity demand into the middle of the 21st century (Table 2) suggest that even though electricity demand will continue to decelerate in both the industrialised countries and the developing countries, the developing country growth rate will fall much more slowly, leading to a much increasing share in global demand (Eden, 1993).

Table 1: Growth Rates of World Electricity Consumption

	Compound growth rates (per cent per year)		
	1971-1980	1980-1989	1971-89
1 Africa	11.1	3.6	7.3
2 Latin America	9.2	5.7	7.4
3 Asia	9.1	8.5	8.8
4 China	9.0	7.9	8.5
5 Middle East	14.8	9.9	12.3
6 TWCs	9.6	7.3	8.5
7 OECD	4.3	2.7	3.5
8 World	5.2	3.6	4.4

Note: item 6 is the sum of items 1-5; item 5 excludes S. Africa.
Source: calculated from IEA [International Energy Agency] (1991), Energy Statistics and Balances of Non-OECD Countries 1988-89, OECD, Paris, 172-174.

Table 2: Eden's Scenarios for Electricity Demand Growth 1988-2050

	Electricity demand growth (per cent per year)		
Country Groups	Actual 1970-1988	'Targeted Growth' 1988-2050	'Targeted Efficiency' 1988-2050
DCs	7.8	4.1	3.5
OECD	3.8	1.0	-0.1
World	4.5	2.2	1.4

Source: Eden (1993, Table 8, 235)

Part of the explanation for the growth in electricity demand, of course, lies in the fact that on average developing countries have relatively high rates of growth of both population and domestic product, and are experiencing processes of urbanisation, mechanisation and industrialisation (each of which also brings its own set of non-energy related environmental problems). Furthermore, while demand from existing consumers of electricity rises with economic activity and incomes, this is augmented by additional users who will make transitions away from both fossil fuels and from dependence on traditional energy sources (biomass fuels) when they have the opportunity and resources to do so (Leach, 1992; Pearson, 1988). In view of all these influences on electricity demand, it is scarcely surprising that it tends to rise even faster than the demand for other commercial fuels.

Ranged against these forces of expansion in the future, however, is the likelihood that the investment in new electricity supplies may prove highly problematic because of funding difficulties experienced by utilities. These difficulties are already acting as a stimulus towards the adoption of higher electricity tariffs. As has already been suggested, electricity prices in developing countries have been a factor that has encouraged demand to grow more rapidly than it would otherwise have done. In over 30 developing countries studied by Kosmo (1987), electricity prices were below long-run marginal costs. Moreover, the World Bank (1992, 116-117) asserts that: Prices, on average, are barely more than one-third of supply costs and are half those in industrial countries. ... Whereas average tariffs in the OECD countries rose by 1.4 per cent a year in real terms between 1979 and 1988, they fell by 3.5 per cent a year in developing countries. ... Low prices give rise to excessive demands and, by undermining the revenue base, reduce the ability of utilities to provide and maintain supplies; developing countries use about 20 per cent more electricity than they would if consumers paid the true marginal cost of supply. Underpricing electricity also discourages investment in new, cleaner technologies.

3.2 The Nature and Potential Scale of the Environmental Issues

Nine major areas of environmental concern related to electricity generation can be identified: major environmental accidents, water pollution, land use and siting impact, radiation and radioactivity, solid waste disposal, hazardous air

pollutants, ambient air quality, acid deposition, stratospheric ozone depletion, and global climate change.[1] All are relevant in the context of developing countries.

The extent to which problems occur in each of these areas is influenced by choices about both the scale of electricity use and the technologies and fuels by which it is generated. Two factors that affect significantly the level and pattern of impacts concern on the one hand the efficiency of end-use technologies (particularly in lighting, heating, refrigeration and air conditioning), and on the other hand the efficiency with which electricity is generated, transmitted and distributed. In both these areas developing countries have well-known problems relating both to the stock of equipment and the management of electricity supplies (Munasinghe, 1992). Where, because of such problems, more electricity has to be generated (especially with old and/or poorly-maintained plant), emissions levels and environmental impacts tend to be exacerbated (Wilbanks, 1991). The World Bank (1992) suggests that losses during transmission and distribution, partly through theft, amount to the equivalent of about 75,000 Mw of capacity and 300 terawatt hours a year, representing a loss of roughly $30 billion per year through increased supply costs.

Given the expected continued growth in electricity generation over the next few decades, it is clear that in the absence of major changes in pricing, management and technology, the environmental impacts associated with electricity are also likely to grow very rapidly indeed. A number of scenarios for the period 1990-2030, relating to the expansion of electricity supply in developing countries and its implications for pollution emissions were prepared for the World Bank (1992, 121). The 'unchanged practices' scenario (in which pollution abatement technologies are not widely used) suggests that pollutant emissions could increase more than fourfold in the twenty years between

[1] See *IEE Proceedings-A*, 140(1), January 1993, for a selection of papers that examine various aspects of the environmental impacts of electricity generation.

1990 and 2010 and tenfold over the forty years between 1990 and 2030.[1]

3.3 Environmental Priorities and Pressures for Change

It was suggested in section 3.1 that there have been both internal and external reasons why electricity-related environmental issues have become more prominent. Imran and Barnes (1990) suggested that in the eight countries they examined in their study of energy demand (Brazil, China, India, Indonesia, Malaysia, Pakistan, the Philippines and Thailand), the environmental impacts of energy had been scarcely taken into account by policy-makers until very recently. The study suggests that overwhelming priority had been given to providing energy for economic development and, in any case, the volumes of damage had been perceived to be relatively small in relation to the overall scale of the environment. Awareness of the damage caused by some forms of pollution was not especially new (e.g. the health impacts of very high levels of smog from coal combustion in Chinese cities). Nevertheless, in many countries pollution has been and often still is widely accepted as an unfortunate but necessary by-product of economic progress (this attitude can be compared with that prevailing until very recently in Eastern Europe).

Nevertheless, attitudes towards energy-related environmental impacts have begun to change, partly because of the growth of internal and external public pressures, and partly because of increasing awareness that developing countries are not always following a path which is economically sound and consistent with sustainable development. For example, both domestic and international groups have put increasing pressure on governments and international funding agencies to raise the priorities accorded to the environmental and social impacts

[1] The World Bank classify policies that might address these problems under the following headings: economic and institutional reform (including higher tariffs and possible privatisation), conservation, environmentally improved technologies and practices (including fuel switching, coal cleaning, emissions controls, and fuel efficiency), and regulation. Their other two scenarios involve progressively greater degrees of efficiency reform and the introduction of pollution abatement measures and new technology.

of hydroelectric schemes (Goldsmith and Hildyard, 1984, 1986; Dixon et al., 1989). Nevertheless, internal pressures for changes in energy-related environmental priorities do not necessarily meet with approval from the authorities concerned: by no means all developing country governments encourage or even tolerate the free expression of environmental concerns. However, it seems not unlikely that if a number of developing countries experience some of the sorts of political and social changes that have taken place recently in Eastern Europe, then in these countries domestic environmental issues may claim higher priority in relation to electricity projects than has been the case until now.

External financial pressures can also influence the environmental impacts of electric power projects. MacKerron (1991) discusses the potential effects of recent changes in the World Bank's lending policies (and those of other agencies). He concludes that the adoption of a higher (implicit or explicit) cost of capital cannot be said in any *a priori* way to have either a net favourable or unfavourable environmental impact: total investment volumes are likely to fall, and it is not necessarily the case that because new projects may be relatively short-term in conception they will be more environmentally damaging than those they displace. Furthermore, interest rates can have a greater influence on environmental outcomes than any explicit environmental policies that a bank may pursue. MacKerron warns of the danger of inconsistent messages to developing countries from different elements in the international system: if, for example, global warming is viewed as *the* major environmental threat, then a higher cost of capital may encourage the use of fossil fuels while at the same time countries may be exhorted to use less fossil fuels so as to limit the growth of carbon dioxide.

3.3 Objectives, Tradeoffs and Priorities in the Electricity Sector

As has been suggested, concern with environmental issues has always to be balanced against other development objectives and these tradeoffs will influence decision-making priorities. At the level of overall priorities, it seems unlikely that the suggestion (MacKerron, 1991) that in the industrialised countries the electric power sector is perceived to be *the* major contributor to environmental problems, holds true in the same way for developing countries. This is not least because developing countries face a range of other severe environmental

problems, some associated with other energy sectors (including the traditional fuel sector) and others with non-energy sectors. These problems range from the prevention of natural resource degradation (including deforestation and desertification) to the provision of clean water and sanitation.

For electricity generation, it is not hard to see why there might exist significant difference in environmental priorities for countries at different levels of development - for example between developing and richer, industrialised countries. In Figure 1 below, environmental issues are classified according to four spatial and three temporal categories:

Figure 1: Categories of Environmental Issue

	Short Term	Medium Term	Long Term
Local			
National			
Regional			
Global			

Source: Pearson (1993, Table 6, 102).

Entries in the cells in the matrix (including both beneficial and harmful impacts, and possible null entries) could be made for each technology and fuel. For present purposes, however, I want to concentrate on the issue of choices and priorities. In relation to the spatial categories, MacKerron (1991) has noted that there are two problems. The first problem is about the difficulties in making meaningful comparisons of the relative importance of issues across the three categories. In principle, money can be used as the measuring-rod through the economic evaluation techniques of cost-benefit analysis. However, although much progress has been made in this direction (Braden and Kolstad, 1991),

there are still serious difficulties of data and measurement - and these tend to be exacerbated in a developing country context. The second problem concerns the perception of damage and MacKerron suggests that environmental issues have made little impact as yet in developing countries, and that where they have they tend to be about local, site-related issues, such as the effects of hydro schemes or of air pollution in specific urban centres. In his view the national and regional issues are both genuinely fewer in number (e.g. developing countries have fewer nuclear facilities and national acid deposition problems) and political consciousness in these areas tends not to be high relative to other more pressing problems. Not surprisingly, the global issues, especially the impacts on other countries, attract little attention as yet in many developing countries.

In general, therefore, it can be suggested that the local end of the spectrum is likely to get higher priority in developing countries compared with industrialised countries. Similarly it can be argued that lower levels of income and wealth mean that developing countries will give higher priority to the short and medium term impacts than to the long-term impacts. If this is correct then it implies, for example, that for developing countries impacts located in the top left-hand cell, such as the short-term local effects of air pollution or the disruption associated with the construction of hydro facilities, may well be assigned a much higher priority than say the long-term global impacts of the enhanced greenhouse effect, located at the bottom right-hand cell. On the other hand, industrialised countries might be expected to allocate relatively higher priorities to longer-term problems of a less local nature.

Suppose that we observe an apparent tendency for developing countries to choose policies or projects that reflect different (often lower) levels of environmental quality in the electricity sector from those in industrialised countries. What can be said about this? At its simplest it might be argued that countries have examined the costs and benefits of pursuing environmental quality and have reached different conclusions. A more detailed analysis might suggest some of the following possibilities (Pearson, 1991):

1) That developing countries have different preferences from those of richer industrialised countries.

2) That implicit discount rates are unusually high because of poverty and capital constraints, so that projects/policies associated with high levels of environmental quality are not selected even where they exhibit substantial internal rates of return.

3) That in any case the projects/policies do not exhibit sufficiently high internal rates of return because:

   a) What is taken into account in gauging costs and benefits is not the 'total economic value' of social benefits (including use values, option values and existence values - Pearce et al., 1991) but something much narrower, so that the stream of benefits is undervalued.

   b) Total economic value *is* accounted for but external beneficiaries (e.g. foreign governments) are not thought likely to compensate for the component of the benefits that will accrue to them (say, from a reduction in carbon dioxide emissions), so the project/policy becomes unattractive.

   c) Projects/policies with streams of environmental benefits far in the future mean that the present discounted value of net benefits may be low compared with other projects with more front-loaded benefits - consequently these types of environmental projects will not be high on the priority list (in terms of a criterion like the internal rate of return), especially if the undiscounted benefit streams are low because of points a) and b) above.

4) That the criteria for decision-taking are too narrowly-oriented towards efficiency-based cost-benefit analysis decision rules which have tended to neglect broader social and environmental project impacts (Turner, 1991).

Clearly, there are important differences between these possible explanations why developing countries might appear to choose different targets for environmental quality from those of countries at other levels of development. Furthermore, the policy implications range from relaxing income and capital constraints (e.g. through aid programmes) to the adoption of different practices and criteria in project/policy selection.

Analyses of the relationships between income and preferences for environmental quality include those of Baumol and Oates (1988), Pearce et al. (1990) and Kopp (1992). However, much more work remains to be done in elucidating these relationships in the context of developing countries and energy. As Kopp notes: Although there is probably little doubt that in developing countries a demand exists for the private and quasi-public services of natural assets, it is uncertain whether a demand exists there for the more intangible services of those assets. There is even greater uncertainty regarding the issue of when in the process of economic development that demand would manifest itself.

4 CONCLUSION

In this paper I have argued that there is a need to investigate further how and why energy-related environmental priorities vary at different levels of development, particularly in the electricity sector. An important question concerns the difference between priorities which might be desirable in pursuit of sustainable development and the ways in which actual decisions are influenced or limited by constraints of income and wealth, or by the acceptance of sometimes unnecessarily costly tradeoffs between policy objectives, or by inappropriate methods of policy and project evaluation and selection. More light needs to be thrown on areas where actions by richer countries, targeted at the areas which developing countries would anyway wish to pursue, might be particularly effective in assisting poorer countries to achieve development and environmental quality objectives. There is thus a need for both conceptual and empirical work. One aspect of this might be to investigate whether there is any evidence of a smooth and monotonic transition from the problems and priorities of a less-developed country, through those of a newly industrialised country to those of an industrialised country, or whether as we might suspect, the picture - and the underlying relationships - are much more complex.

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