Surrey Energy Economics Centre

AID AND ENERGY IN THE THIRD WORLD

Edited by: P J G Pearson

With papers by:
Joanna Cochrane, David Festa,
Gerald Foley and Mick Howes

SEEDS 56 March 1991

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The papers were presented at a Workshop on 'Aid and Energy in the Third World', arranged by the Study Group on Third World Energy Policy, at the University of Reading in September 1990.

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PREFACE

Because of the roles that energy can play as a facilitator of and a constraint on sustainable development, it is not surprising to find both that energy tends to absorb a significant proportion of Third World aid funding and that energy-related aid has been the source of some controversy. The papers reproduced here approach three different facets of aid and energy:

(a) For oil-importing Third World countries (TWCs), the oil price shocks of 1973-74 and 1979-80 precipitated an unprecedented energy and debt crisis, the impacts of which have been widely analysed. The onset of the 1990 Gulf Crisis led to a number of severe immediate practical and financial problems for Third World oil importers, and raised the spectre of their being once again particularly hard-hit by any prolonged rise in oil prices.

(b) The 'woodfuel crisis' was identified in the mid to late 1970s, some time after the 'oil crisis'. It was associated with widespread deforestation and was identified with local 'shortages' of traditional fuels. It had two aspects: (i) a poverty/equity problem of fuel availability for the poor (especially women), mostly in rural areas, reflected in increasing prices for traded fuel and increased collection time for untraded fuel; (ii) an environmental/efficiency problem associated with deforestation, soil erosion, desertification, sedimentation of watercourses and flooding, and arising out of the unpriced externalities associated with the supply of woodfuels. The crisis was for some time seen as a classic, simple problem of an ever-growing gap between demand and supply; the obvious remedy was to increase supply by growing more trees for fuel and halve the consumption of woodfuel by doubling the efficiency of traditional stoves.[1] This overly-simplistic approach has been called 'the fuelwood trap' - governments and aid agencies tended to assume they had identified a simple problem and so there had to be a simple solution. It is now widely accepted that what is required is an approach based on a fuller understanding of both the causes of deforestation and the role of woody biomass in rural and urban areas.[2]

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1 Leach, G & Mearns, R (1988) Beyond the Woodfuel Crisis: People, Land and Trees in Africa, Earthscan.

2 Munslow, B, Katerere, Y, Ferf, A & O'Keefe, P (1988) The Fuelwood Trap: A Study of the SADCC Region, Earthscan. See also, O'Keefe, P & Munslow, B (1989) 'Understanding Fuelwood. I. A Critique of Existing Interventions in Southern Africa', 'Understanding Fuelwood. II. Starting with the People', Natural Resources Forum, 13(1), 2-11, 11-19.

(c) Apart from trying to deal with their own serious domestic energy-environment problems, TWCs will also play an increasing part in contributing to, and perhaps cooperating in the resolution of global environmental problems, like the enhanced greenhouse effect and damage to the ozone layer. In particular, the scale of fossil-fuel related air pollution emissions is expected to grow substantially in TWCs. Although it is as yet a relatively small proportion of global consumption, TWC fossil fuel consumption has been growing much more rapidly than in industrialised countries and this trend is expected to continue. For example, the Inter-Governmental Panel on Climate Change (IPCC) 'business-as-usual' scenario envisages the following increases in commercial energy consumption over the next 35 years: Africa, 124%; Latin America, 145%; India, 273%; China 158%; with OECD and Central Europe at between 45% and 90%, and with carbon emissions more than doubling (although it must be said that these figures have been questioned because of the enormous capital funding requirements implied).

There have been suggestions that by taking advantage of the latest technologies of energy production and consumption, TWCs might be able to avoid following the energy- and carbon dioxide-intensive histories of the industrialised countries. However, it is unlikely that TWCs could afford to finance such a strategy themselves; nor until recently has there been much motivation for the industrialised countries to help them to do so. The global nature of the enhanced greenhouse effect means that international cooperation is necessary if greenhouse gases in general, and carbon dioxide in particular, are to be controlled. As TWC delegates to conferences on global warming and the ozone layer have not been slow to point out, because of their low levels of per capita income and energy consumption, the participation of TWCs in global limitations of emissions cannot be assumed. Thus the TWCs are likely to cooperate with the industrialised world only at a price - if they are, in various ways, subsidised or otherwise compensated, whether financially or through the transfer of technology.

Everything we know about the nature and scale of global warming suggests that it will be very difficult to establish a global warming fund and to ensure successful technology transfer. What will be needed is a system of international public finance to implement and monitor a new set of arrangements for regulating the global commons. The suitability for this task of the existing institutions for international financial cooperation has been widely questioned.

In this discussion paper these three aspects of aid and energy are addressed in reverse order. Thus, in the first paper David Festa and Joanna Cochrane examine the role of aid in limiting carbon dioxide emissions in TWCs. As part of this analysis they also consider the related issue of industrialised country investments in off-set mitigation (i.e. investments in carbon dioxide-limiting activities in order to off-set other carbon dioxide-

emitting activities). They report on studies which tried to estimate the capital cost and effectiveness of a range of potential carbon dioxide reduction technologies and activities in TWCs. Their two major conclusions are: firstly, that it is not feasible to estimate a generalised definitive cost curve which would indicate the levels of capital subsidy that could be required to induce TWCs to implement carbon dioxide reduction strategies; and secondly, that there is a difference between the type of carbon dioxide reduction activities that are appropriate for aid funding and for OECD off-set mitigation - aid agencies should channel their funding to lower the barriers to implementation which inhibit the adoption of reduction activities which would otherwise be attractive to TWCs.

In the second paper, Mick Howes summarises the findings of a study which aimed to identify the areas and groups most likely to be affected by biomass energy shortages in Sri Lanka, to review two major policy interventions (the Community Forestry Project and the National Fuelwood Conservation Programme) that were intended to address Sri Lanka's 'woodfuel crisis', and to suggest principles for a re-formulated biomass energy strategy. Howes argues that neither intervention had significant impacts on fuel shortages because they started from the incorrect premises that fuel shortages were severe, widely distributed and most seriously located in the rural areas - it then seemed to follow that 'command style' solutions, based on uniform technical packages and ambitious dissemination targets, represented the only way to proceed. In the future, to the extent that action needs to be directed towards the rural areas of Sri Lanka, it should be more purposefully aimed at the locations and groups most affected by shortage. Moreover, two principles need to be recognised: firstly, that conservation measures seem easier to implement than supply-enhancing options; and secondly, that rural people themselves should play a much more central role in any future search for new solutions. In Howes' view, a low-key but flexible approach would not only be more appropriate, it would also release resources which could be allocated to build up the search for solutions to more immediately pressing urban biomass energy problems.

In the third paper, Gerald Foley, writing in September 1990, considered the possible medium-term impacts of the Gulf Crisis and asked whether there might be a need for a significant reorientation of energy aid policies. In particular, he asked whether the balance should be shifted towards renewable energy sources and away from oil. His paper examined these issues with the aid of a range of scenarios. He concluded that even in the case of a major war and a catastrophic loss of Middle East production facilities, the medium term outlook for oil prices suggested a mid-1990s price range of $20-25 per barrel. Moreover, Foley suggests that the Gulf Crisis will not significantly change the position and aid priority of renewable energy technologies - and they should be assessed on the same technical criteria as conventional alternatives. Nevertheless, even oil prices

as low as $15 per barrel represent a serious burden for many TWCs, and there are major opportunities for effective energy aid in the area of petroleum fuel conservation. In Foley's view, substantial increases in economic output per unit of energy can be achieved through reducing the amount of energy needed for power generation and distribution, by cutting down on wasteful uses in transport and industry and by reforming prices and tariffs to reflect their costs. Finally, he suggests that collaboration with the USSR and the countries of Eastern Europe offers opportunities for energy assistance that provide probably the greatest chance of reducing greenhouse gas emissions.

The papers reproduced here arose out of a workshop meeting of the Third World Energy Policy Study Group (TWEPS), held in September 1990 in the Department of Engineering at the University of Reading and arranged by Anne Wheldon and Peter Pearson. The organisation of the Group is based at Surrey Energy Economics Centre, with the assistance of the office staff of the Department of Economics. The Group has received financial support from grants made by the UK Economic and Social Research Council. The final word-processing of the text of this discussion paper was carried out by Isobel Hildyard.

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THE ROLE OF AID AND OFF-SET MITIGATION IN LIMITING CO_2 EMISSIONS IN DEVELOPING COUNTRIES

By

David Festa and Joanna Cochrane

Environmental Resources Limited

1. Introduction

During the last several years concern has intensified over a possible global warming, caused by the release of certain gases into the atmosphere. These gases, often called greenhouse gases, come from a variety of natural sources and human activities. Though the volume of greenhouse gases arising from natural sources dwarfs the volume arising from human activities, the natural sources were in balance. Therefore, the emissions resulting from human activities are substantially increasing the the atmospheric concentrations of greenhouse gases.

In response to this concern, governments and non-governmental organizations are looking for ways to limit greenhouse gas emissions and working on calcuation of the cost and benefits of doing so. Because roughly 60% of all greenhouse gas emissions come from energy production and use and because carbon dioxide (CO_2) is by far the most important energy related greenhouse gas, much of the effort has been directed at limiting CO_2 concentrations in the atmosphere.

Environmental Resources Limited (ERL) has undertaken a number of projects analysing control strategies and costs of limiting CO_2 in the atmosphere. As a part of one of these projects, ERL was asked to:

(i) calculate the amount of money that will be needed to be spent in developing countries to limit CO_2 emissions;

(ii) provide a general framework that will help aid agencies direct their activities in limiting CO_2.

This work has brought us to the conclusion that it is extremely difficult to derive a generalised cost curve representing the capital requirements of reducing CO_2 emissions in the developing world. More important to our work to date, such a curve is of limited usefulness in estimating capital requirements of specific countries or in formulating a strategy for funding projects within given countries. The reasons for this constitute the first part of this paper.

The only way to devise a detailed strategy is to perform in depth country studies. We do not intend to discuss the methodology for such country studies in this paper, however, analysis of the problem in the course of this work has led us to some general conclusions about the types of actions that are suitable for aid agencies to fund in developing countries.

As part of our analysis, we assumed that OECD countries would come under increasing pressure to reduce the speed of CO_2 build-up in the atmosphere. We also assumed that OECD countries would want to choose the most cost-effective option. These options would most certainly include off-set mitigation actions (such as reforestation in the tropics) that the OECD countries would take in the developing world.

Given these assumptions, we devised a rough categorisation of actions into those that are appropriate for aid agencies and those that are appropriate for off-set mitigation. The second is a sub-set of the former in that whilst many types of action may be suitable for aid, OECD off-set mitigation action should be limited to a few rather specific types of action. This is the theme of the second part of this paper.

2. Assessing the Capital Costs of Limiting CO_2 Emissions in Developing Countries.

ERL were asked to assess, on behalf of a bilateral donor agency, what the capital costs of implementing a variety of CO_2 emission reduction technologies in developing countries would be. In the course of our investigation it became clear that the pertinent question was not so much what the absolute capital outlay, in terms of 'hardware' would be, but how much money they would need to provide in order to induce a developing country to implement the project.

In some cases providing the initial capital would be sufficient, however in other cases the main economic barrier to implementation is not capital costs but operating costs, and unless these are also provided there is still no incentive to implement the project. An example of this would be installation of combined cycle gas turbines in place of planned coal or oil fired power stations. In this case the capital cost of the gas turbines would actually be less than that of the coal or oil fired station, so in pure financial accounting terms operating costs must be a greater barrier to implementation than capital costs.

In many cases, including the example given above, it may be some other factor altogether, such as resettlement or employment issues which are preventing an otherwise economically attractive option from being implemented.

In order to arrive at a sum which would have to be provided in order to induce an LDC government to implement a CO_2 emission reduction option, all of these costs (or benefits)[1] must be included in the calculation. The final sum would represent what ERL have referred to as the 'capital subsidy.'

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1 Benefits include such things as future energy savings, indirect social benefits etc. Whilst these benefits are an important part of any cost-benefit analysis, they are very difficult to quantify, and almost always very country and project specific.

2.1 Determining Overall Capital Subsidy Requirements

Having arrived at this definition of what we are seeking, we then run into a series of accounting difficulties, common to the assessment of all development projects to some extent. In particular, different projects are subject to different discount rates and have different lifetimes. As any capital subsidy would have to take account of operating and maintenance costs all potential projects would have to be normalised to take account of these factors, and generalised to include the whole of the developing world.

Assuming a capital subsidy for each CO_2 emission reduction option could be derived, how can these capital subsidies be arranged on a meaningful cost curve that a donor agency could use as a framework for decision making ?

The main problem is to do with the different magnitudes of projects and inconsistencies in the data. For example, how do you go about comparing the following three projects:

(i) rehabilitation of 60 MW of ageing diesel generators in Indonesia;

(ii) replacing a programme of new build coal and oil fired power stations in India (say 5000 MW) with combined cycle gas turbines based on comparative cost data from the USA.

(iii) the complete overhaul of the entire transmission and distribution network in Liberia.

Unless each CO_2 emission reduction option is scaled up to its maximum potential or alternatively down to some unit of CO_2 reduction, the options will not fall onto a meaningful curve.

To summarise, the country specific nature of the problem and the lack of comparable data on countries, sectors, case studies, and economic frameworks, makes it extremely difficult to arrive at meaningful cost curves showing the capital subsidy which would be needed to induce a LDC government to implement a variety of CO_2 emission reduction policies and/or technologies.

A number of studies have been done or are currently underway which do attempt to estimate the cost (both capital and net) of implementing CO_2 emission reduction policies and technologies. These studies provide a valuable first cut at possible global burden arising if certain reduction targets are to be met.

However, we found that the broad cost curves produced by these efforts (including our own) were of limited usefulness in developing a framework for setting priorities for aid agencies. For one thing, they can not address the issue of hidden costs (eg employment issues) with the same degree of rigour that is applied to economic costs. For another, the conclusions they suggest may not hold for an individual country or even group of countries. Consequently, we have attempted to develop a framework or decision tool that is more useful in this context.

3. **Aid and Off-set Mitigation**

There are two main categories of action which can be taken in developing countries in order to bring about CO_2 reductions, and these depend on the type of barrier to implementation which is operating in a developing country..

(i) **Where capital costs are the overwhelming barrier to implementation.**

These actions are unlikely to appear economically attractive to governments of developing countries, partly because of the capital requirements but also because the direct benefits to the country are limited. However they may well appear attractive to OECD countries who can fullfill their own CO_2 abatement requirements under a possible climate treaty or perhaps under a program of national regulation, by taking action in LDC's. This category includes such actions as emission controls and reforestation.

(ii) **Those actions which are apparantly desirable and economically sensible but for which there are non-capital barriers to implementation.**

These barriers can be sociological, economic, political, institutional, technological or strategic, and can be more or less difficult to overcome. Some of this category of actions are suitable for aid agency action.

In many cases it will not be necessary or desirable to fund the programme of action itself, but rather to fund the removal of the barriers to implementation. The simplest categories of barriers to overcome are those that result from lack of information and/or technology and skills, risk aversion and trade restrictions. In may often be possible for donor agencies to facilitate information and technology transfer, and with the backing of their own country (in the case of bilateral donor agencies) or the international community, to agree insurance options to counter risk aversion and favourable trade/credit agreements to counter trade barriers.

Where funding is provided to overcome barriers to implementation rather than the CO_2 reduction programme itself, it will very often be necessary to make the aid conditional on implementation, i.e. aid is only given on the condition that the recipient government funds the desired CO_2 reduction programme (eg reducing transmission and distribution losses to save energy in exchange for funding of a rural development scheme designed to reduce theft of electricity.) If the developing country funds the CO_2 reduction programme it will then have a vested interest in its success.

This second category of funding will often require a smaller capital subsidy than the direct funding of CO_2 reduction measures such as those described in (i) above. Thus, although it will be tempting for OECD countries to achieve their target reductions by implementing least cost options in developing countries, funding the removal of barriers to implementation is not suitable for OECD countries seeking off-set mitigation for the following reasons.

- OECD countries seeking offset mitigation would wish to fund the CO_2 reduction action itself in order to clearly demonstrate that the required CO_2 reduction targets had been met. This approach will not help to overcome the root cause of non-implementation and the programme would probably fail in the longer term.

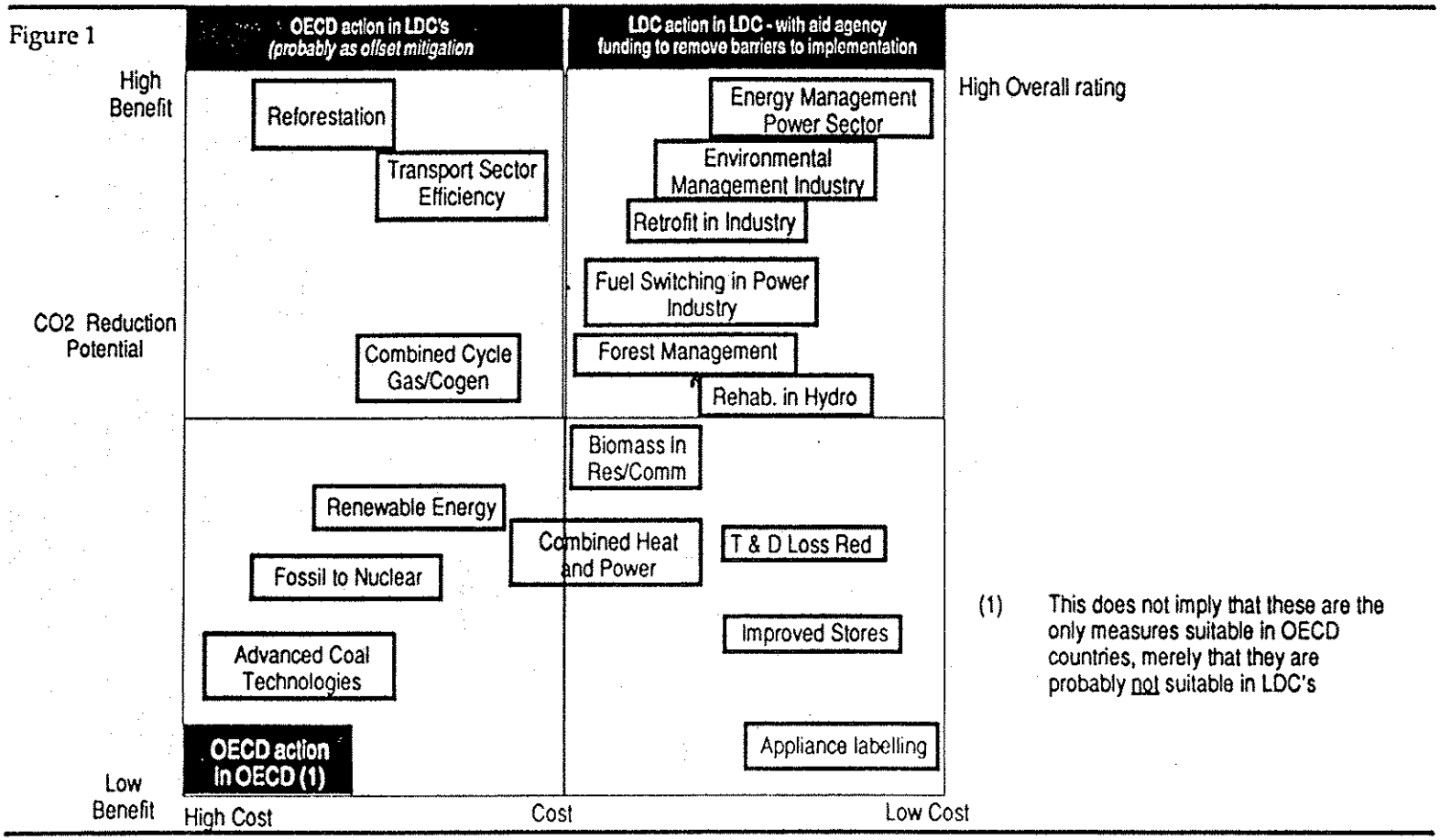
- Some types of action would be of direct benefit to the developing country if the barriers to implementation are removed. LDC's may therefore wish to take action themselves especially if they are to become party to international laws and conventions on environmental protection. There are therefore equity issues to be considered in allowing, (or even encouraging,) OECD countries to exploit all the potentially economically attractive mitigation measures in order to offset their own pollution.

Figure 1 shows a variety of potential CO_2 reduction measures arranged on a quadrant with some unspecified measures of financial cost along the x-axis and a similarly unspecified measure of benefit on the y-axis. The various options then tend to fall into three distinct categories. In the top right corner are the various options which have a high CO_2 reduction potential without incurring excessive costs, or with relatively short pay-back periods after which an economic benefit it likely. These include such measures as energy management in industry and increased use of hydro-potential instead of further fossil fuel use. These are the type of measures that are potentially economically attractive to LDC's but are currently not taken advantage of due to various barriers to implementation. This is where aid agencies can most usefully provide funding for programmes to overcome these social, political or economic barriers.

In the bottom left hand corner fall measures that are only likely to be applicable within OECD countries, these include measures to reduce CO_2 within a system which has already exploited many of the most economically attractive options such as reducing transmission and distribution losses and managing energy efficiency in industry so that the incremental costs of energy efficiency/CO_2 reduction are much greater and measures such as advanced coal technologies begin to look attractive in the face of enforced CO_2 reduction requirements. (Nuclear power falls into this category despite the arguments about its economic viability, as it is nonetheless a potential CO_2 reduction option which is certainly **not** viable in most LDC's.) The options shown in this quadrant do not constitute a complete list of potential options in OECD countries, they merely demonstrate the types of options which are not likely to be implemented in LDC's in the near future.

Targeting Actions to Reduce CO_2 Emissions

Figure 1



(1) This does not imply that these are the only measures suitable in OECD countries, merely that they are probably not suitable in LDC's

The third category of options falls on the left hand side of the figure. These are the group of options which due to their cost are unlikely to be attractive to governments of LDC's in the short to medium term but which might attract OECD funding as off-set mitigation measures. In the top left hand quadrant are the set of potentially most effective options. These include re-forestation programmes and major capital investment in energy efficient technologies for industry and power generation. In the bottom right hand quadrant are those options with lower potential CO_2 reduction potential and are therefore likely to be low priority to all interested parties but which are still likely to be more attractive to OECD countries looking for off-set mitigation than they would be to LDC's.

This idea is presented in a different way in Figures 2 and 3. These have been constructed in a similar way to 'production frontiers' except that the frontiers (dotted lines) on the disgrams) represent equal CO_2 reduction. The y-axis on both figures is a measure of the overall CO_2 reduction potential of the option. For example, the total potential for CO_2 reduction from moving from coal and oil in power generation to combined cycle gas turbines, if taken to its extreme, is much greater than the total amount of CO_2 that could be saved by rehabilitating old diesel generating plants. The x-axis is a measure of cost per unit of CO_2 reduction. In general it applies that the same amount of CO_2 can be saved by spending a lot of money on an option where the total potential for CO_2 reduction is relatively small (marginal costs of improvement are high) or a relatively small amount of money on an option where the potential for CO_2 reduction is great (marginal costs are low.)

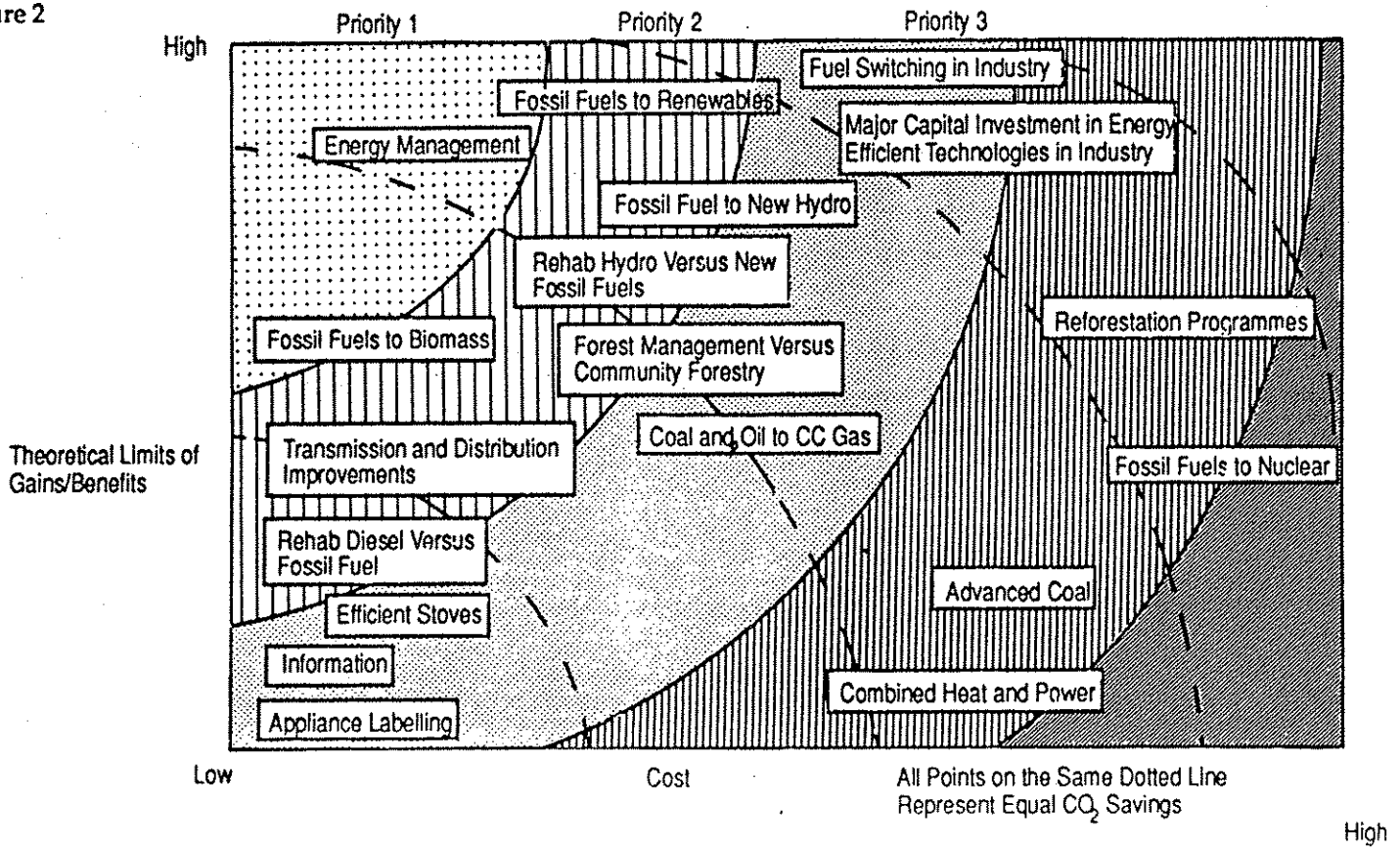
It then follows that the priorities for action fall into bands from the top left hand corner to the bottom right hand corner. These priorities will be different in LDC's and in OECD countries, hence the need for two diagrams. Priorities will in fact vary considerably from one country to another whether in the developing or developed world, so that these diagrams are conceptual only. However, a broad principle is illustrated.

Looking at Figure 2, which shows the priorities for action in LDC's, it can be seen that LDC governments would be inclined to implement options in the top left hand corner of the diagram, though barriers to implementation may exist. This is where the aid agencies can bring about the greatest and most cost effective results. Options falling in the lower right hand side of the diagram are most suitable for OECD off-set mitigation, (subject of course to thorough economic analysis.)

There is a fine line between off-set mitigation actions and bilateral aid, and should a policy such as that described here ever be adopted, it is likely that off-set mitigation would sometimes masquerade as Aid so that less expensive actions can be exploited. Whilst any action to reduce global CO_2 emissions is welcome, there are equity issues to consider and proposals for off-set mitigation or even bilateral aid would require close scrutiny on this basis.

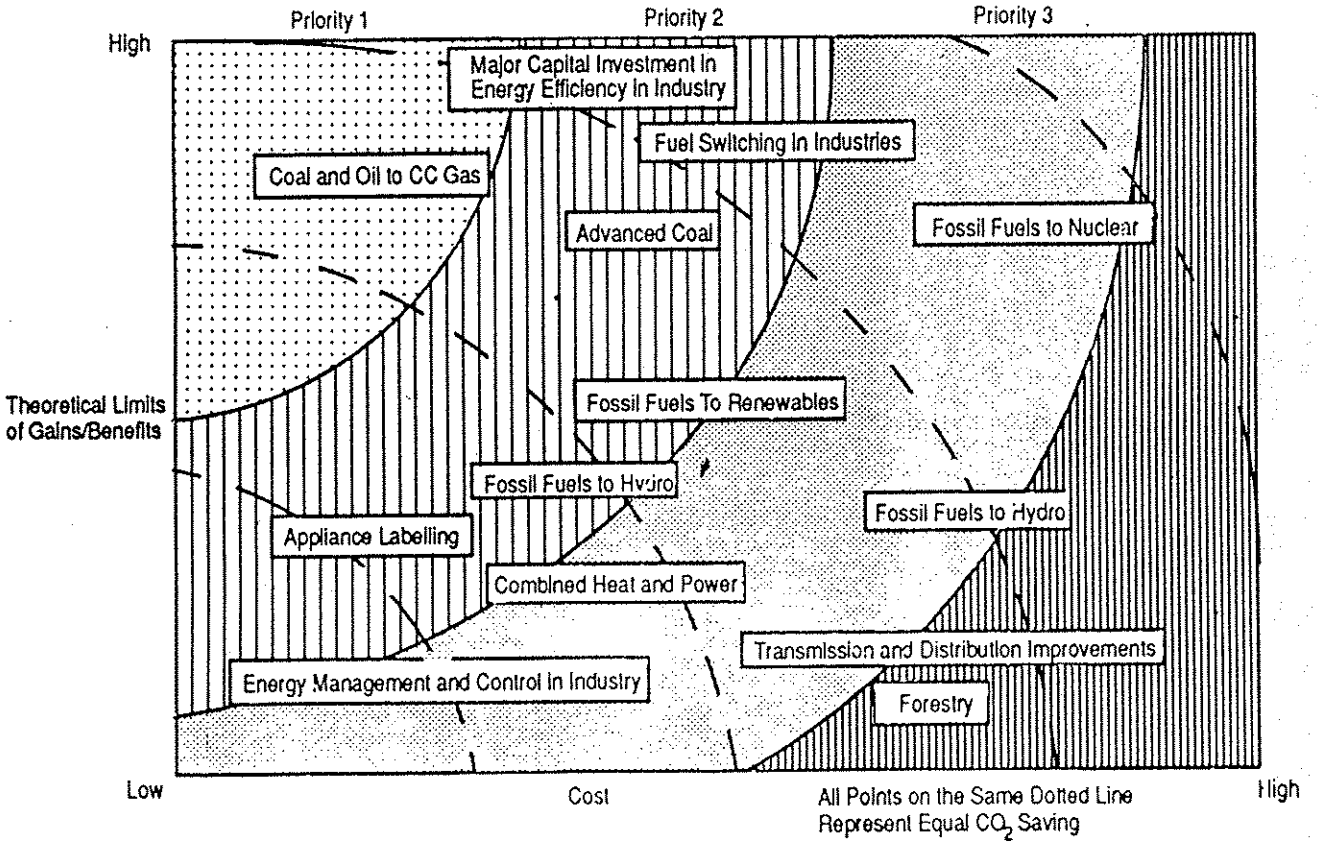
Priorities for Action in LDC's

Figure 2



Priorities for Action in OECD Countries

Figure 3



In summary, on the assumption that off-set mitigation will become an increasingly attractive option to OECD countries as a means of achieving global CO_2 reduction targets, aid agencies should channel their funding in ways in which it can be of maximum benefit in removing barriers to implementation of options that would otherwise be attractive to the LDC's. OECD countries seeking off-set mitigation measures should be restricted to direct, capital intensive, CO_2 reduction measures which are unlikely to ever appear economically attractive to a developing country. These measures are outside the set of actions that developing countries, with the help of aid agencies, could directly benefit from.

TOWARDS A NEW BIOMASS ENERGY STRATEGY FOR SRI LANKA

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THE SECOND ENERGY CRISIS AND SRI LANKA'S FIRST BIOMASS ENERGY STRATEGY

From the mid-1970s, the idea of a "second energy crisis", in the form of generalised shortages of the fuels traditionally used by the poor, predominantly rural, majority of third world households, began to gain increasingly wide acceptance in international development circles[1].

In Sri Lanka, this was to prompt a series of government and donor supported activities, the most important of which were the Community Forestry Project and the National Fuelwood Conservation Programme.

These were planned and executed in almost total isolation from each other; and without any serious investigation having first of all been conducted to determine the precise nature or extent of the crisis within a national context. These shortcomings were subsequently recognised, and proposals advanced for them to addressed through the formulation of a national Biomass Energy Strategy: but this was never actually implemented[2].

This paper summarises the findings of a study designed to go at least some way towards filling the vacuum which arose as a result[3]. It deals mainly with the rural areas, where most of those affected were believed to live, and where interventions were focussed; and is based upon fieldwork conducted in Sri Lanka in 1987, as well upon the re-interpretation of secondary data[4].

Following the structure of the main research report from which it is derived[5], the discussion falls into three major parts. The first identifies the geographical areas and

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1 See Eckholm (1975) and FAO (1981).

2 See Ministry of Power and Energy (1985).

3 The research was funded by the British Overseas Development Administration and conducted under a Visiting Scholar arrangement with the Agrarian Research and Training Institute, Colombo. The author is grateful to both institutions for their valuable support, but the views expressed are his alone.

4 See especially Ministry of Lands and Land Development (1986).

5 See Howes (1990).

major social groups most likely to be affected by biomass energy shortages. The second examines the record of the two major interventions, and outlines the problems which have arisen in relation to each. The third draws upon the earlier analysis to suggest principles for a re-formulated Strategy.

IDENTIFYING BIOMASS SHORTAGES

(i) Biomass supply

The supply of biomass energy is broadly determined by the way in which land is used for agricultural and other purposes.

The majority of rural households throughout the country have home gardens, and almost irrespective of location, members of this group tend to gather a substantial proportion of their requirements from this convenient source. Beyond this, however, there are marked regional variations in the places from which fuel is obtained[6]. In the Wet Zone, which comprises the south-western corner of the island, rubber wood is most widely used in certain districts, and coconut by-products in others. In the tea-growing areas of the central Hill Country, people rely mainly on clippings from tea bushes. In the Dry Zone, which comprises the extensive eastern and northern areas of the country, fuel may be obtained from sparsely cultivated upland areas; or directly from remaining forest land. In the extreme north, palmyra by-products are predominant (see map).

(ii) Biomass Demand

The domestic sector accounts for some 88 per cent of all biomass energy consumption, and with average per capita requirements varying relatively little from one place to another, consumption is heaviest in the most densely populated, and mainly urbanised Wet Zone districts of Colombo and Gampaha. It is also comparatively heavy in the Hill Country, and in the more rural, but still quite densely populated districts which comprise the rest of the Wet Zone.

Industries use the remaining 12 per cent, and are a significant factor in the overall energy picture of the localities in which they are most heavily concentrated. These include the tea and tobacco growing parts of the Hill Country, and the brick making area to the north of Colombo.

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6 See Wijesinghe (1984).

(iii) District energy balances

When total biomass demand is compared with potential supply[7], only five of Sri Lanka's 24 districts[8] are found to be in overall deficit (see table). The shortfall is greatest in Colombo; followed in descending order by Kandy, Gampaha, Nuwara Eliya and Badulla. Deficits are made good by "importing" fuel from other districts. Rubber wood from re-planting schemes, and forest wood from land clearances in the Dry Zone, provide the primary sources of traded biomass. Both are presently in abundant supply, but this is unlikely to remain the case for very much longer.

(iv) Groups affected by shortage

Most urban consumers in the five districts, who together comprise some 250,000 households, or nine per cent of the national total, have little alternative but to purchase their fuel requirements. Although prices are currently low, this group will be especially vulnerable to any future shortages.

The other category who appear potentially most likely to be affected are the 200,000 rural landless households in the deficit districts, who between them account for a further seven per cent of the national figure. An investigation conducted among members of this group in the Hill Country Districts of Kandy and Badulla, whilst revealing considerable variations in individual circumstances and fuel collection strategies; suggested, however, that shortages were not yet a serious problem.

This was because many landless households were able to utilise surpluses from their neighbours' gardens, and thus experienced no real difficulty. Others, were obliged to gather further afield; but still suffered relatively little inconvenience, since this could be done at slack times of the year, when the opportunity cost of their labour was low.

Only a small minority - made up primarily of those who lived on the peripheries of tea estates, and used these and adjoining crown land as their primary sources - faced situations where the times when fuel was available coincided with periods of high labour

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7 Potential supply is a measure of total annual biomass production from currently utilised fuel sources, once present consumption for other more valued uses (eg timber) has been deducted. Potential supply is greater than actual supply since it includes some materials which it would not be economically feasible to extract. Potential supply would be approximately equal to sustainable supply in relation to the 55 per cent of the present figure which is accounted for by non-forest sources, but much greater than sustainable supply in the case of the 45 per cent accounted for by forest wood. For a more detailed explanation see Howes (1989) or Howes (1990).

8 An additional district has been created since the primary date, upon which the analysis is based, were collected.

demand. An even smaller minority, living predominantly in peri-urban areas, were already purchasing fuel like their urban counterparts.

(v) The future

There is thus little evidence of a second energy crisis affecting rural Sri Lankan households at present; even in those districts which are in overall biomass deficit. There are, however, some grounds for supposing that what is presently a rather small problem could, in future, become more significant. Poorer people, in a number of locations, reported that restrictions have, for the first time, recently begun to be imposed on the access which they enjoy to their customary fuel sources, and it seems likely that such tendencies will become more pronounced with the passage of time.

The following sections describe the two major interventions promoted by Government and aid donors, and ask to what extent they would be able to address this eventuality.

THE PROMOTION OF FARMERS' WOODLOTS UNDER THE COMMUNITY FORESTRY PROJECT

(i) Activities

The Community Forestry Project is administered by the Forest Department. It began in 1982, and was originally scheduled for completion in seven years. The overall budget was $13.7mn, $10mn of which was provided as a loan by the Asian Development Bank (ADB).

The Project was designed by teams of consultants provided for the ADB by the UN Food and Agriculture Organisation, and consisted of a number of components. By far the largest of these involved the establishment of extensive, centrally managed fuelwood plantations. These had nothing to do with communities per se, but were justified on the grounds that additional production capacity was urgently required, and could best be provided by conventional means, whilst the Department developed the more innovative solutions which would be required to deal with shortages in the longer term.

The discussion here will focus on the Farmers' Woodlots, which although only allocated a small proportion of the total budget, most closely reflected the long term objectives towards which the project as a whole was directed. The intention of this component was that farmers should be encouraged to cultivate fast growing species of eucalyptus for fuelwood, following a broadly uniform system which had been determined in advance.

For this purpose, households were to be granted extended leases on plots of State land, which would vary from between a half and one hectare in size, according to availability and location. Participants would also be offered free seedlings and technical

advice, but would be obliged to provide any other inputs themselves, together with the labour required to prepare and tend the land.

(ii) Location of woodlots and biomass shortages

Activities were to be confined to the Hill Country Districts of Badulla, Kandy, Nuwara Eliya and Matale; and to Batticaloa in the Dry Zone[9]. Three of the five fell within the biomass deficit category identified earlier, but as the table indicates, the geographical match with concentrations of demand was still not very good.

Badulla, where the Project had its headquarters, and where the largest amount of activity took place, was only marginally in deficit, and nothing at all was planned or implemented within striking distance of the primary deficit district of Colombo. These shortcomings could, to some extent, be attributed to deficiencies in the data available at the time key decisions were made, but were also a function of the simple requirement that woodlots could only be established in places where there was land available to accommodate them.

(iii) Problems encountered

In addition to these locational problems, the woodlots were to encounter a number of other difficulties. These included abnormally low rainfall at the times when seedlings were planted, and competition for scarce resources from other more favourably endowed parts of the project. But even when allowance is made for these "external" constraints, it remains clear that the design and execution of the component itself were, in key respects, defective. Three particular limitations stand out.

Firstly, although the sites utilised were all on Crown Land, and thus formally available for the government to allocate at will, the situation, in practice, was invariably complicated by pre-existing claims and uses, which served in various ways to undermine project objectives. This initial obstacle was often then compounded by serious inadequacies in the way in which land surveys were conducted.

Secondly, no provision was made to compensate farmers for income foregone in the course of land preparation. This served as a powerful disincentive to whole-hearted participation; especially in view of the long period of time which would have had to elapse before harvesting. It also discriminated against people who were allocated land in more difficult locations, where the amount of work entailed could be much greater than elsewhere.

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9 In the event, civil disturbances in the eastern part of Sri Lanka during the mid-1980s made it impossible for any work to go ahead in Batticaloa, and activities were therefore confined to the four Hill Country districts.

Thirdly, most participants were not clearly informed that the central purpose of the woodlots was for fuelwood production. Since this objective did not figure prominently among their own priorities, a vacuum was thus created. This, in turn, was then filled in a range of ways, which reflected the diverse needs and preferences of individual farmers. In extreme cases, people were actually found to be pursuing strategies designed to prevent any tree growth at all from taking place on the land in question.

(iv) Assessment

As a consequence of these problems, only three per cent of the land initially targetted for woodlots had actually been planted successfully by the end of the fifth year of the project[10]. Equally significantly, the procedures followed had ensured that none of that area was under the control of poor households which would previously have fallen into the fuel deficit category. This part of the project had, in other words, almost entirely failed to address any present, or likely future, biomass energy shortages.

THE PROMOTION OF FUELWOOD EFFICIENT STOVES UNDER THE NATIONAL FUELWOOD CONSERVATION PROGRAMME

(i) The development of the Sarvodaya stove

Government and donor supported attempts to promote the widescale dissemination of more efficient stoves did not begin in earnest until 1984, but the design which was selected at that time was the outcome of a sequence of events first set in motion in 1979. At that point, Sarvodaya, Sri Lanka's largest NGO, had begun to explore the possibility of designing a new stove, which might help, in various ways, to improve the conditions of the rural women with whom it was already working.

With this purpose in mind, Sarvodaya enlisted the support of the Intermediate Technology Group (ITDG). Operating from the regional headquarters in the Hill Country District of Kandy, the two organisations then embarked on a process of design and testing, in which local potters and intended users were both closely involved.

The outcome was a model which was inexpensive, but offered significant fuel and time savings; whilst reducing smoke emissions and retaining the more desirable features of the traditional stove it was intended to replace. This proved popular with local women, but Sarvodaya lacked the independent infrastructure which would be required for dissemination upon a more extensive scale[11].

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10 The figures are from project records. Success is defined as 80 per cent survival at the end of the first year.

11 See Howes et al (1983).

It was at this point that the Ministry of Power and Energy stepped in. Arriving on the scene at a time of growing concern in Government circles with deforestation and potential biomass energy shortages, the new stove appeared to be exactly what was required, and was rapidly installed as the central element in a National Fuelwood Conservation Programme (NFCP).

(ii) Mass dissemination under the National Fuelwood Conservation Programme

In its earlier versions, the NFCP envisaged saturation coverage of the country within a period of five years[12]. This was to be achieved through providing training for potters to produce the liners around which the stove was constructed; through cash incentives for the local level government officials who would promote it; and through substantial subsidies to encourage adoption.

The Government, however, lacked the resources to put its' ambitious ideas into effect, and was obliged to look elsewhere for most of the funding which was required. Several donors, including the Dutch, the Swedes, the Norwegians and the World Bank, proved sympathetic; but rather than being channelled through the Ministry of Power and Energy, funds were made available through the various district level Integrated Rural Development Projects (IRDP) which the donors were already supporting.

(iii) Problems

The Programme has proved to be partially successful. By 1987, more than 100,000 stoves had been installed, and although this fell a long way short of earlier targets, it still compared very favourably with what has generally been achieved by attempts to promote stoves elsewhere. This, however, tells only part of the story, and on closer inspection, at least two important limitations become apparent.

Firstly, the de-centralised system of funding created a situation where it was the enthusiasm felt by individual donors and IRDP↔Directors, rather than relative biomass energy scarcity, which became the primary determinant of where stoves would be promoted. The table, which enables distribution to be compared, district by district, with need, indicates that this was to lead to some quite glaring anomalies. At one extreme, Colombo, which had no IRDP programme, got no stoves at all. At the other, Kurunegala, which with the exception of only four sparsely populated Dry Zone Districts, has the greatest biomass energy surpluses found in the country, ended up with the largest concentration of all.

Secondly, most users attached much greater importance to the saving in cooking

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12 See Munasinghe (1986).

time which the new stove made possible than to the fuel savings which were also achieved. This would seem partly to be a function of many stoves being located in places where biomass remains in relatively abundant supply, but also reflected the fact that disproportionately few adopters were drawn from the poorer households who were most likely to be affected by shortage.

In the light of these two factors, it appears that, whilst certain other benefits may be attributed to the NFCP, it has been only slightly more effective than the woodlots in addressing present, or potential future, needs for energy conservation.

TOWARDS A NEW BIOMASS ENERGY STRATEGY

(i) The common limitations of current approaches

The failure of either intervention to have a significant impact upon fuel shortages may be traced back to common underlying limitations.

In the first place, both took, as their point of departure, the unfounded assumption that fuel shortages were serious, widely distributed, and most pervasive in their effects in the rural areas, where the majority of the population lived. From this, it then appeared to follow that "command style" solutions, based on uniform technical packages, and ambitious, centrally determined dissemination targets, represented the only appropriate way forward.

It has been argued here, by contrast, that shortages are, as yet, neither very serious, nor general in their impact. It has also been suggested that, in so far as there is a problem at all, it is confined mainly to urban households, and to the landless in fuel deficit districts: groups which have largely been excluded from participation in the interventions which have been reviewed. Finally, it has also been suggested that even if these other difficulties had been dealt with, problems would still have remained as the result of trying to promote uniform solutions to populations with widely diverging circumstances and needs.

The measure of success achieved in the case of stoves actually reinforces the point, since this may be attributed to the fact that the new design, whilst subsequently promoted in an inappropriate "blueprint" fashion, was first arrived at through a process of experimentation, which ensured that the needs and preferences of at least some rural people were taken into account.

(ii) New priorities and reversals

In so far as future action needs to be directed towards the rural areas at all, it is clear that the initial requirement should be for subsequent interventions to be more purposefully targetted towards the locations and groups most affected by shortage. Beyond that, there

is a need for reversals in the way in which officials and donors presently think about biomass energy.

Two principles, in particular, should be recognised. The first - as a comparison of the performance of the two interventions which have been reviewed demonstrates - is that conservation measures are easier to implement, and should generally enjoy priority over supply enhancing options. The second, in the light of the degree to which decisions about fuel production and use are embedded in a wider range of highly location specific considerations about resource allocation, is that rural people themselves should play a far more central role in any future search for new solutions.

Their potential for innovation has already been demonstrated[13], and their own ideas about conservation and new stove design could now be reviewed and documented; and then, where appropriate, made more widely available. The same would apply to the possibilities of producing fuel from home gardens, or other land already under cultivation; although this would have no direct pay-offs for the poorest, unless they could be allowed access to fuel under new types of labour hiring arrangement.

Proceeding in this fashion, a portfolio of options could be constructed which would provide the means for government to respond with sensitivity to more extensive rural biomass energy shortages, as and when these might arise. Only where such wholly "internal" possibilities proved unequal to the demands of new situations, would more active forms of intervention have to be considered. Even then, there would be no automatic need to revert to a blueprint approach, since there would still remain the "intermediate" option of collaboration between outsiders and rural people along the lines of the original stove programme described earlier.

Such a relatively low key, but flexible, approach would accord far better with present and likely future rural biomass energy needs than current strategies. At the same time, it would release resources which could then be re-deployed to strengthen the search for solutions to more immediately pressing urban problems[14].

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13 In the Hatton area, for example, where local conditions make fuel conservation unusually important, villagers have designed and constructed a number of different types of stove to reflect their particular needs. Enquiries in Kandy and Badulla indicated that farmers are interested in the possibilities of re-designing their home gardens, and that whilst some of the suggestions which they make may be unfeasible, others are potentially promising.

14 This would build upon the urban stoves programme launched in 1987 by the Ministry of Power and Energy, with assistance from ITDG and financial support from the ODA.

SRI LANKA: ZONES AND ADMINISTRATIVE DISTRICTS

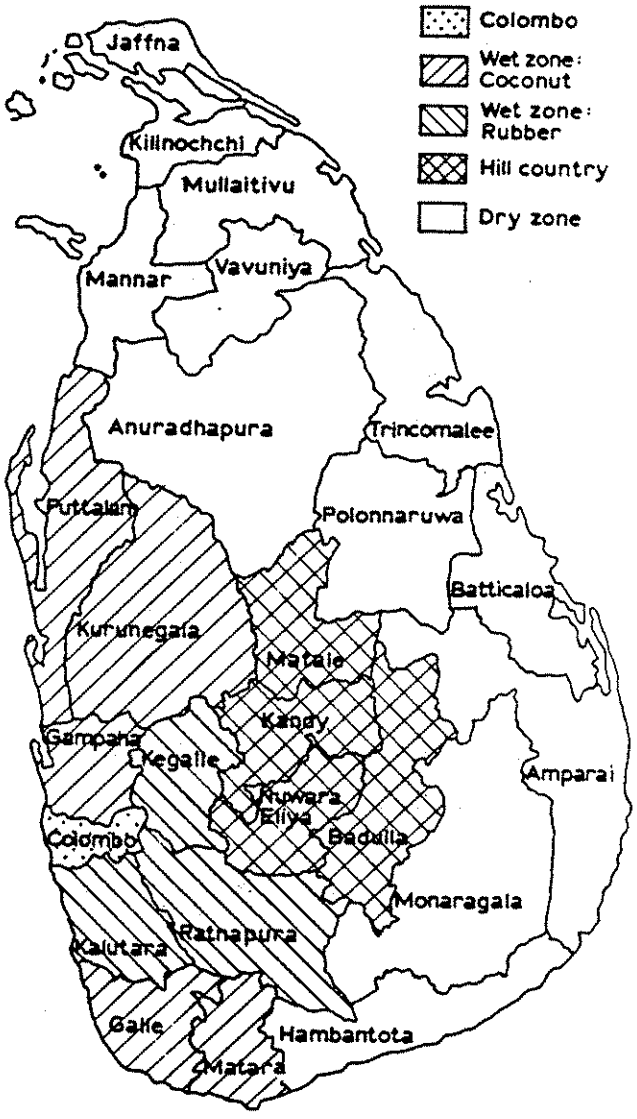

TABLE - DISTRICT FUEL BALANCES AND INTERVENTION PRIORITIES

District	Fuel Balance '000 tonnes[1]	Stove Programme Priority Ranking[2]	Forestry Programme Priority Ranking[3]
Colombo	-373		
Kandy	-333	4	3
Gampaha	-228	7	
Nuwara Eliya	-176	8	3
Badulla	-90		1
Matale	4	9	3
Matara	71	6	
Galle	77		
Jaffna	81		
Hambantota	111	3	
Batticaloa	123		2
Kalutara	178	10	
Ratnapura	270	2	
Kegalle	403	5	
Trincomalee	513		
Mannar	570		
Vavuniya	578		
Amparai	591		
Puttalam	640		
Kurunegala	774	1	
Polonnaruwa	808		
Anuradhapura	809		
Mullaitivu	853		
Moneragala	1110		

1 See footnote (7) for an explanation of how this figure is derived. Districts are listed with the one in largest deficit at the top and the largest surplus at the bottom.

2 This refers to the situation at the end of 1987. The district with the largest number of stoves installed under the programme is given the number '1', the second largest '2', and so forth. A blank indicates no stoves. The urban programme, focussed initially on Colombo and Gampaha did not start until 1987, and is therefore not included.

3 Priority is based upon the total areas earmarked for planting in the initial project document, and includes block fuelwood plantations, as well as farmers' woodlots.

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ENERGY AID AND THE GULF CRISIS

Gerald Foley, Nordic Consulting Group

The Gulf crisis is about oil, its price on world markets and access to resources. As one American realist, or cynic, put it: "There would have been none of this talk about international morality, freedom and justice if Kuwait's main export had been carrots."

The immediate effect of the crisis on world oil prices has been dramatic. Crude oil prices have exceeded $40 per barrel, more than double what they were before the Iraqi invasion at the beginning of August. The World Bank has been considering a scenario in which the price of crude oil reaches $65 per barrel in the event of war; others have suggested it might reach $100 per barrel.

Energy aid, for most donor agencies, is, however, primarily concerned with the medium term rather than measures to alleviate the immediate impact of a events in the Gulf. The question for policy-makers in the aid area is whether, as a result of the Gulf crisis, there is a need for a significant reorientation of present energy aid policies. In particular, many will want to know whether the balance should be shifted towards renewable energy sources and away from oil.

At present, as the military build-up continues, it is impossible to say what exactly is going to happen. Any number of scenarios, from a climb-down by Iraq through to a major war affecting Saudi Arabia and other oil producers in the Gulf area, can be envisaged. The best approach is therefore to look at a range of such scenarios and examine what their effect on energy aid policy would be.

THE GLOBAL ENERGY PICTURE

The world's total consumption of conventional fuels in 1989 was just over 8000 million tones of oil equivalent (toe)[1]. Apart from a couple of years stagnation in the mid 1970s and mid 1980s, this total has been growing at an average rate of about 2.3% over the past twenty years.

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[1] The majority of energy statistics used in this paper have been taken from BP's Statistical Review of World Energy.

This, incidentally, does not include firewood and other traditional fuels which are used by perhaps 2000 million people as their sole or main fuel. There are no reliable statistics on the global consumption of these biomass fuels, but assuming it averages 750 kg per head per year, the total is about 500 million toe, or about 6% of the world's total energy consumption.

In absolute terms, oil consumption has remained practically constant over the decade of the 1980s. The figure for 1989 was 3098 million tonnes, about 1.4% less than it was in 1979.

The share of oil in the world's energy consumption has, however, changed significantly in the past decade. In 1979, it supplied 46% of the world's total energy consumption. The share in 1989 was 39% of the total, with coal next at 28%, natural gas at 21%, hydro at 6.5% and nuclear at 5.5%.

Oil resources and prices

The 1970s and early 1980s were a period of considerable shock and anxiety in world oil markets. The price of Arabian light crude oil, for example, rose in current prices from $1.9 per barrel in 1972 to about $36 per barrel in 1980. In real terms, this was roughly a quadrupling of prices.

There was also widespread misapprehension about the resource position. Geologists like Hubbert and Warman forecast a peak in oil production around the turn of the century; this was widely misconstrued to mean that oil resources would be completely depleted by that time.

It was a period when OPEC control over world oil markets was at its greatest. Its ability to force prices up was clearly demonstrated after the 1973 Middle East War and again after the Iranian revolution in 1979. OPEC, at that stage, accounted for 48% of the world's total oil production and three quarters of the world's reserves and many observers believed its hold on the market was permanent. There were forecasts of the oil price reaching $100 per barrel by the turn of the century.

Certain voices, like Professor Peter Odell, however, proclaimed to general scepticism that there was a great deal more oil available than people thought. Sheik Yamani warned producers that high prices would cause consumers to economise and shift away from oil and would also undermine the cartel position of OPEC by encouraging exploration in a variety of other non-OPEC areas.

The 1980s saw the vindication of these views. The market share of oil, in an expanding global energy market, fell. New production capacity was brought on stream both

inside and outside OPEC. Far from heading into depletion, the figure for published proved reserves increased by a massive 56%, from 88 billion tonnes in 1979 to 138 billion tonnes in 1989. When the price of Arabian light crude oil dipped to $13 per tonne in 1988, it was back, in real terms, to what it was before the 1973 Middle East war.

Analysts speculated about where the medium term equilibrium price might be. Few expected it to be seriously above $20, in present terms, before the turn of the century. Sheik Yamani, for example, suggested that at about $18 per barrel, there would be a medium term equilibrium between supply and demand.

The Middle East and world oil supplies

The Middle East has about 65% of the world's published proved reserves. Of this total, Saudi Arabia has about 40% and Iran, Iraq, Kuwait and Abu Dhabi have about 15% each.

The Middle East is therefore in a key position as far as reserves and the world's long term supply of oil are concerned. But its contribution to present world consumption is rather less dominant.

The total oil production of the Middle East in 1989 was 814 million tonnes, about 26% of the world total. About 140 million tonnes was for the producing countries own consumption. Total exports from the Middle East were 663 million tonnes, about 22% of the world's total consumption. In 1979, it supplied about 31% and in 1974 it supplied 37%. The share of the Middle East in the world's total energy production has fallen from 18% in 1974 to 10% in 1989.

Production by Saudi Arabia in 1989 was 256 million tonnes, by Iraq was 139 million tonnes and by Kuwait 79 million tonnes. Exports from Iraq and Kuwait, allowing for their own consumption, were around 200 million tonnes, about 6.5% of world total consumption.

THE RECENT GULF EVENTS

At the beginning of August 1990, Iraq annexed Kuwait. The Iraqis were in dire economic straits after the war with Iran. The oil price was so low that they could not obtain the revenues they needed for reconstruction. They were among the producing nations who favoured restraints on OPEC production to drive prices up, whereas Kuwait was resisting such measures.

There were undoubtedly many factors in the decision to invade Kuwait. But controlling its oil resources and through them influencing the price of oil upwards was a undoubtedly a major consideration. Iraq's prime aim, it has been suggested, was to drive the

price of oil up to about $25 per barrel. If that could not be achieved, the invasion of Kuwait would at least provide it with additional export capacity which could be used to increase its income.

The industrial world, led by the USA, rushed to arms to protect its cheap oil sources. One of the biggest fears was that, if Saddam Hussein were allowed to annex Kuwait with impunity, in the longer term he would try to take over other nearby oil-producers, particularly Saudi Arabia. He would then be in a much stronger position to control world oil prices to the advantage of Iraq and other OPEC producers.

For oil producers not directly involved in the Gulf, the crisis has provided a completely unforeseen financial bonus. Otherwise it has been pretty disastrous for all concerned. The Iraqis see the price of oil far higher than they would have dared dream, but have major problems selling any of their own or Kuwait's. The industrial world is not only paying $40 per barrel but has in addition the cost of the military expeditionary forces; the cost of its military build-up is reputed to be costing the US an additional $10 per barrel for its oil from the Gulf. The dangers of economic recession have become greater and inflation has been increased. The long term social and political stability of the Gulf has been seriously undermined. The Third World has received a massive financial blow.

The question is what does this mean in the longer term and what implications does it have for energy aid policy.

A range of possible scenarios

This question can only be answered by looking at the range of possible outcomes in the Gulf crisis and their likely impact on oil prices. The most optimistic scenario is a negotiated settlement; the most pessimistic is a major war with heavy destruction of oil production and port facilities. By looking at these two extremes, it is possible to bracket the range of policy the range of responses likely to be evoked in energy aid policies.

A peaceful compromise would basically involve an Iraqi withdrawal from Kuwait. Although any such agreement might include a degree of Iraqi control over some of Kuwait's oil resources or production levels, it is difficult to see how this could prevent world oil markets returning to their condition before the invasion.

At the other extreme, is the possibility of a major war. This would almost certainly bring about large scale destruction of production facilities in Iraq and Kuwait. It could also involve long distance rocket attacks on production wells, refineries and export terminals in other neighbouring states. A worst-case scenario might involve the destruction of 500 million tonnes of export capacity in the Gulf. This would cover the whole production of Saudi

Arabia, Iraq, Kuwait and one of the smaller producers.

The total loss would be about 16% of the world's total present oil consumption.

Future prices

In the case of the peaceful compromise scenario, the likely outcome would be a fall in oil prices to the $15-20 per barrel range in which they have been in recent years. The fact that the crisis has clearly weakened the already shaky cohesion of OPEC means that future control of production will be even more difficult than it has been in the past five or six years. It is therefore possible to envisage an even greater collapse in oil prices.

In the major war scenario, virtually anything is possible as far as short term prices are concerned. Oil is bought on the spot market, whatever the price, because oil companies know the short-term price elasticity of oil is extremely low. People have to pay what is asked for petrol, for example, if the alternative is not getting to work. Moreover, oil companies would prefer to have oil, at virtually any price, which they can sell to their customers rather than find themselves without stocks if supplies are seriously disrupted.

But in the medium term, as the history of the past two decades has shown, fuel substitution and conservation are waiting to be deployed. Moreover, the effect can be quite rapid. Under the pressure of the price rises in the late 1970s, world oil consumption fell by 344 million tonnes between 1979 and 1983 and then gradually crept back up again as prices eased. In North America, the fall in consumption between 1979 and 1983 was 19%; while in the decade between 1979 and 1989, oil consumption in Europe fell by 17%. The potential of these regions for further fuel switching and conservation is by no means exhausted.

Many of the other oil producers are under severe economic pressure and would welcome an opportunity to increase production. The scope for doing so exists even in the short term. The unused production capacity among the world's oil producers is variously reckoned to be in the range 5-12 million barrels per day (250-600 million tonnes per year). In the slightly longer term there are numerous opportunities for increased exploration and enhanced recovery techniques.

Nor are there major constraints on the continued expansion of substitutes for oil. Production of natural gas, for example, continues to increase; production grew by about 500 million toe or 30% during the 1980s and an increase in oil prices or worried about security of supplies would undoubtedly provide a further stimulus. Coal production also increased by 23% or 410 million toe during the 1980s and has large amounts of unused production capacity. Even nuclear power is likely to continue to increase its output as the stations under construction come on stream; its output grew by about 230 million toe during the 1980s.

The outlook is therefore that a combination of conservation, fuel switching and increased oil production from other sources can, over a period of 5-10 years, readily make up for even a catastrophic loss of production facilities in the Middle East. The medium term outlook for oil prices, even in the worst case scenario, is therefore that they will fall to the range $20-25 per barrel.

No major change in renewables position

The first sight, the Gulf crisis appears to be a potentially cataclysmic event on the world energy scene. The most natural reaction, from the point of view of energy aid policy, is that it greatly improves the competitive position of renewable energy technologies and they should, therefore, be given a higher priority. The above discussion suggests that nothing has significantly changed.

The prices of petrol, diesel and fuel oil are obviously going to be considerably higher in the short term future. But this does not provide a basis for the evaluation of decisions which will only come to fruition in the medium term future. The results of an aid agency decision on a power station or rural electrification programme made in the next year will not be realised in the field for another couple of years. By that time, the price of petroleum fuels should be well on its way down to its medium term equilibrium level.

The rules for the evaluation of renewables therefore remain more or less as they are at present. Renewables should be assessed on exactly the same technical criteria as conventional alternatives and should be able to perform the task for which they intended reliably and effectively. Financially they should be evaluated against petroleum fuel prices based on a crude oil price of around $20 per barrel, plus or minus $5. If they are found superior to petroleum-fuelled equipment under these criteria, they should be used. If not, the petroleum fuelled equipment should be used.

THE SAME OLD PROBLEM FOR THIRD WORLD COUNTRIES

The fact that the competitive position of renewables is not likely to be significantly altered by the Gulf crisis does not mean that petroleum fuels are cheap for the Third World. Obtaining their petroleum fuel requirements remains the same old problem for a large number of Third World countries.

The fact that oil prices have fallen so heavily in the past five or six years has tended to divert attention from this. But many Third World countries have found that much of the benefit of lower oil prices has been eroded by a reduction in the volume and unit price of their exports. For a country which is nearly bankrupt, paying $20 a barrel for oil is better

than paying $35 a barrel, but is still a major problem.

Moreover, there is no avoiding the dependency of Third World economies on petroleum fuels in anything except the extremely long term. Apart from India and China with their substantial use of coal, petroleum fuels typically account for more than 90% of the conventional energy used in the developing world.

There is no point in trying to relieve the burden of oil imports by substituting economically more expensive alternatives. But that does not mean that nothing can be done. It simply puts the focus back where it should be, on energy conservation in the petroleum fuel sector. It is plainly evident that energy use in the developing world is often appallingly inefficient. Probably the best service that energy aid can provide is to help increase the efficiency with which petroleum fuels are used.

ENERGY CONSERVATION IN THE DEVELOPING WORLD

Energy conservation in the developing world has tended to have a low priority in technical assistance programmes to date. Partly this has been because conservation projects tend to be difficult to define and monitor; moreover, their output is less visible than a power station or extension to the transmission system. They also tend to have a low equipment content which makes them less popular with donor country manufacturing companies.

Perhaps most important is the widespread unpopularity of conservation with aid recipient countries. Because of its associations with frugality, conservation is often taken to imply restrictions, whereas it should mean getting the same from less, or more from the same. Third World countries may also resent being told to use less by countries which are clearly much more profligate in their energy use.

Overcoming such resistance and making conservation attractive to aid recipient countries is therefore a major and a high priority task. In many cases, it offers the most cost-effective and potential for enduring benefit in the whole energy aid area.

The Transport Sector

Typically, 60-70% of the petroleum fuels used in a developing country go into the transport sector. It is quite obvious that a great deal of this energy use is far less efficient than it might be. The difficulty, because this is such a diffuse and anarchic sector, is to identify where the opportunities for effective action lie in particular countries.

One area which would certainly repay study inmost countries is the potential offered by fiscal measures. Fuel pricing and vehicle taxation policies, for example, are potentially powerful ways of influencing the mix of vehicles and their use. Many Third World countries

also have controls over vehicle imports; ensuring that energy efficiency was one of the criteria taken into account in issuing import licences could also be a useful step.

Rail systems exist in many Third World countries but are often in extremely poor condition. Their potential for saving road transport fuels deserves to be investigated.

Public transport fleets are often very badly maintained. Upgrading maintenance routines could improve fuel consumption significantly. Similar benefits could be obtained from the improved maintenance of government fleets. Publicity on ways to achieve better performance and improved training for mechanics could also play a role.

Aid agencies could fund, and provide expertise, for a range of practically-oriented studies of the potential for energy conservation in these and other aspects of the transport sector. Promising initiatives identified in the studies could then be funded for implementation.

The Power Sector

Electricity generating plant tends to be old and poorly maintained in many Third World countries. Transmission and distribution systems tend to be heavily overloaded.

The gains from energy conservation in the power sector can be very large. Take the arbitrary, but not at all untypical, situation of a power station with an energy efficiency of 18% and a 25% losses in the transmission and distribution system: the consumer receives 13.5 kWh per 100 kWh burned in the station. Compare this with a system which has an energy efficiency of 30% and 10% losses: the consumer receives 27 kWh per 100 kWh burned in the station. In this case, rehabilitating the existing electricity system doubles the output per unit of fuel.

Electricity is often sold at a small fraction of its production cost. The result is excessive consumption, overloaded systems, and bankrupt utilities unable to maintain their plant and equipment. In a large number of cases, the price paid bears no relationship to the benefits obtained by consumers from the use of electricity. Socio-economic studies of tariff systems could help countries arrive at tariff systems which met their social and developmental objectives while at the same time enabling their utilities to operate in an effective and efficient manner.

Industry

Industry and commercial buildings similarly offer a wide range of possibilities for energy conservation.

In the smaller developing countries, it is often easy to identify the significant industrial energy users on an individual basis. Funding for an energy audit of such major users and for supporting follow-up conservation measures would be a useful activity for aid agencies.

THE USSR AND EASTERN EUROPE

This area uses about 23% of the world's energy and around 17% of the world's oil. By all accounts, it is extremely inefficient in its use of these resources. In addition, there are vast reserves of natural gas, almost 40% of the world's published proved reserves, the development of which is hampered by lack of financial and technical resources. As well as bringing new oil wells into production there also appear to be major opportunities for increasing the rate of recovery from existing wells.

From the viewpoint of the enlightened self-interest of the industrial world, energy aid to the Soviet Union and Eastern Europe in cash, equipment or technical expertise would appear to have a great deal to recommend it. Increasing the efficiency of energy use in these countries would release petroleum resources for export, thus helping reduce and stabilise oil prices. New oil wells, higher petroleum recovery ratios and increased availability of natural gas would have the same effect.

Greater energy efficiency in the Soviet Union and Eastern Europe, by permitting a switch away from brown coal, would also help reduce the acid pollution afflicting western Europe. It has been said that the most cost-effective way for countries like Sweden and West Germany to reduce the present levels of pollution in their own countries is to spend the money in Eastern Europe.

Energy conservation and the availability of additional natural gas could also contribute to a reduction in the rate at which greenhouse gases are being added to the atmosphere - or at least slow the rate of growth below what it would otherwise be. This is another area which calls for enlightened self interest on the part of the industrial world.

CONCLUSION

The initial reaction of most people concerned with energy aid is that it must have a significant impact on policy. In particular, it would appear to improve the competitive position of renewable energy sources.

This has certainly been the reaction in a number of quarters. The Brazilians have apparently decided to accelerate rather than run down their alcohol programme with its costs

of $40-50 per barrel. Shares in the South African chemical company Sasol, which makes a synthetic crude oil from coal, have also been rising.

But the history of the last twenty years shows how difficult it is for producers to sustain oil prices at high levels. Analysis of the potentially worst case scenario for the Middle East shows that the amount of oil which would be withdrawn from production, around 16% of the total, is within the capacity of the world system to accommodate over a period of 5-10 years and probably a lot more quickly. Thus, even in the case of a major war, a mid-1990s oil price in the range $20-25 per barrel seems likely.

In less severe scenarios, the adjustment is likely to be quicker and the mid-1990s price of oil is likely to be lower. In the event of a peaceful settlement, a fall to $15 per barrel or lower is possible, indeed probable.

Such prices would, however, still represent a serious burden for many developing countries. Major opportunities exist for effective energy aid in the area of petroleum fuel conservation. By reducing the amount of energy needed for power generation and distribution, by cutting down on wasteful uses in transport and industry, by reforming prices and tariffs to reflect their costs, substantial increases in economic output per unit energy can be achieved. The task is to develop and implement such programmes in conjunction with Third World countries.

Finally, there are the opportunities and challenges offered by collaboration with the USSR and the countries of Eastern Europe. These provide openings for energy assistance which will help secure alternative sources of supply and hence stabilise the world energy scene. They provide probably the greatest opportunities for reduction in the pollution and greenhouse gas emissions which are putting everyone's future at risk.