

CDCC/PO/WP/80/7

29 April 1980

ECONOMIC COMMISSION FOR LATIN AMERICA
Office for the Caribbean

CARIBBEAN DEVELOPMENT AND CO-OPERATION COMMITTEE

LATIN AMERICAN INSTITUTE FOR SOCIAL AND
ECONOMIC PLANNING

Second Meeting of Planning Officials
in the Caribbean
29 May - 2 June 1980
Kingston, Jamaica



PLANNING THE ENERGY SECTOR

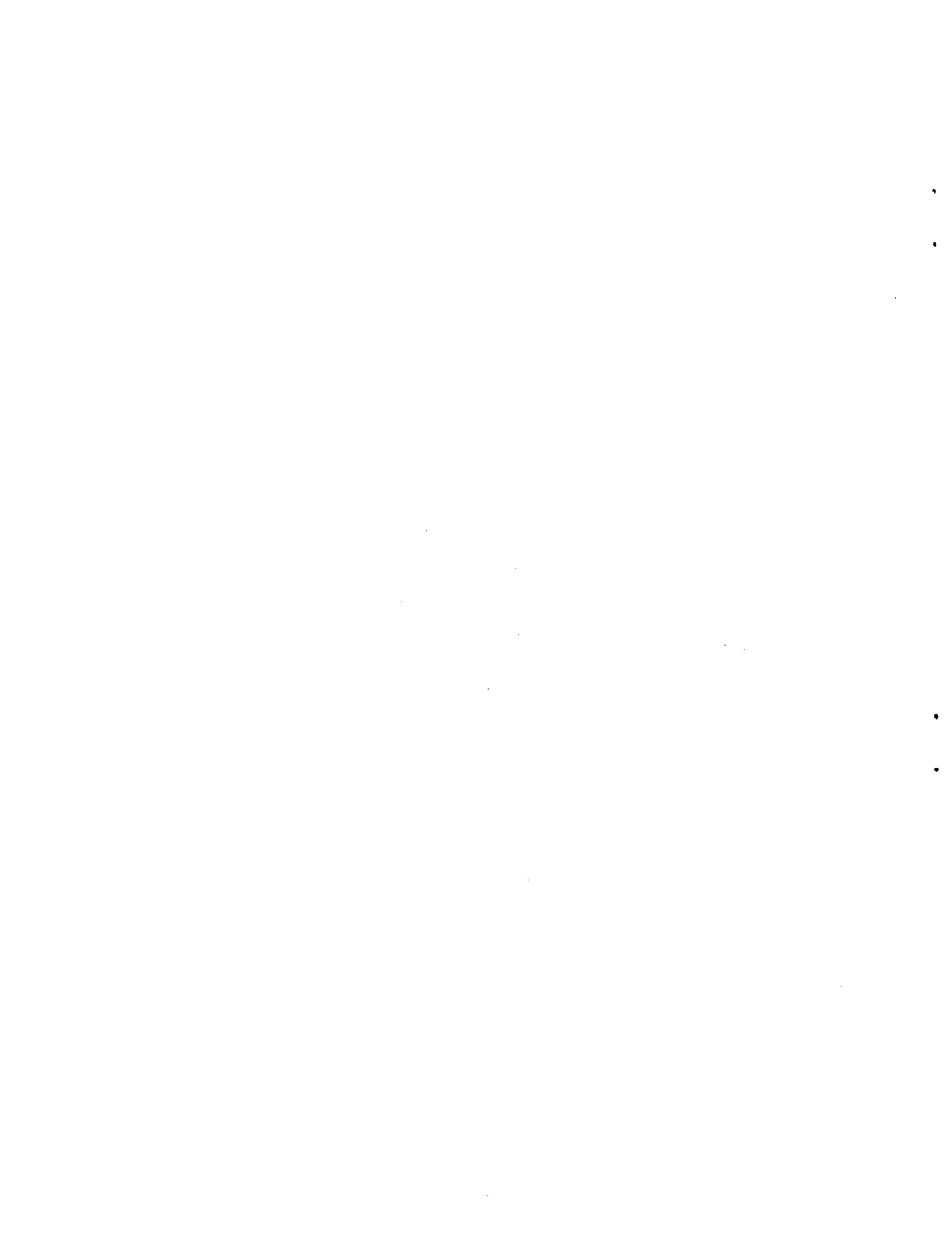
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UNITED NATIONS

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The dramatic increase in oil prices since 1973 has resulted in a massive escalation of the cost of energy for many oil-importing, energy-deficit countries, at the same time that it has meant tremendous windfall gains for the relative handful of oil exporters. In the Caribbean for example, Jamaica has seen its imports of oil, which account, for about 90 percent of its energy consumption climb from 8 percent of total imports of goods and services in 1972 to 16 percent in 1978. While roughly the same amount of oil was imported in 1978 as in 1972 (16.1 million barrels) its value shot up by some 250 percent from \$55.5 mn U.S in 1972 to \$193.9 mn U.S in 1978.

Such massive increases in energy costs have forced policy makers in almost all countries to now accord to energy a central place in their policy formulation. In the circumstances, planning the energy sector and devising sensible policies for coping with the problems has become a matter of both urgency and importance. The present paper seeks to outline heuristically how energy planning can (ought to) be approached. It is based on AFROSIBER, which is a nine point planning method suitable for use for comprehensive national planning^{1/} and we take the Caribbean region as our referent point.

The first step in planning the energy sector and devising policies related to energy use involves a systematic evaluation of the particular country's situation. There are four aspects to this. First of all, energy planning, like any other macro-level planning, requires that certain basic pre-conditions be satisfied for it to be "successful"^{2/}

^{1/} Farrell, Trevor. "How to Plan: AFROSIBER - The Nine Point Planning Method and its application to Development Planning", U.W.I., St. Augustine Department of Economics (mimeo).

^{2/} Venezuela, Ministry of Energy and Mines, Governing Document on Venezuelan Energy Policy, Caracas, May 1979.

If these pre-conditions are not satisfied at the start of the planning exercise, then their fulfillment becomes either a proximate or a concomitant objective of the planning process. What then are these pre-conditions?

They are six in number.

(1) Planning for energy, like planning the national economy, or the agricultural sector, or education, requires first of all that an effective organizational apparatus exist or be created, charged with formulating, executing, coordinating, monitoring and reviewing plans, projects, policies and programs with respect to energy. This of course sounds obvious, even trite, once stated. It is enough however to consult actual experience in many countries to see that it is so often ignored in practice that it needs to be stated quite explicitly.

(2) The second precondition, is related to the first. This is that there must exist, or be developed, a cadre of people with the necessary specialist skills and knowledge who can undertake the business of planning and executing policies and programs. A review of the Caribbean situation shows that in several countries, the first precondition - an effective organizational apparatus for energy planning and policy formulation - is not yet met. This is in part due to the failure to satisfy the second precondition - i.e. the finding, recruiting and training of people with the specialist skills in energy and planning that are necessary.

(3) Ultimately, one cannot plan for something over which you have absolutely no control. There is a certain basic minimum degree of control that a country must be able to exercise over its energy sector as over any other sector, for it to be able to plan effectively.

(4) The fourth precondition for successful planning relates to a more subtle and intangible factor. For planning to be carried out properly, there must exist in the system a sophisticated understanding of planning, exactly what it can accomplish, what its real advantages are, where its limitations lie, how it has to be carried out, what are

its organizational and political implications and what its costs are in terms of time, resources, and the frustration that can come from doing nothing at times when action seems desperately needed, because something called "planning" is going on. This is related to the fifth pre-condition that there exists the will to plan on the part of the top policy makers in the system. In the absence of this, technocrats charged with planning are likely to find themselves frustrated and candidates for hypertension unless they develop psychological safety valves.

(5) Sixthly and very importantly, good planning depends utterly on good information. Good, sound policies with respect to energy have to be based on a thorough understanding of what the situation is in the country in question with respect to energy. Information is at the heart of this kind of understanding.

It is quite clear that in many parts of the Caribbean today, these six pre-conditions for good energy planning are remarkable chiefly by their absence or low-level of fulfillment. Thus one of the first tasks of energy planning, as with any other type of planning under Caribbean conditions, is to seek ways of addressing these problems.

The second aspect of evaluating the situation with respect to energy can almost be treated as yet another pre-condition. This relates to the fact that proper and comprehensive energy planning is really infeasible unless it accompanies some planning of other areas of the national economy. At a minimum, if other areas of the national economy are not planned, their future course must at least be seriously considered.

This is because energy, like manpower, is an input into other activities. Consequently, the desirable level of energy production for example, cannot be specified independently of the expected levels of activity in other areas of the economy. What will happen, or what is planned to happen in the various sectors of the economy, the new projects slated to come on stream, improvements in the standard of

living, are all likely to impact on the level of energy utilization in the society (ignoring for a moment the impact of technological changes in energy production). Energy planning therefore ideally ought to be detailed with the planning of the other major sectors and areas of activity in the national economy. Ensuring that mechanisms exist, or are created which provide for this linkage is the second aspect of our evaluation of the situation.

The third stage in the process is the formal assessment of the situation with respect to energy specifically. This involves the preparation of a set of studies which provide much of the basic background information necessary for decision-making. Analyses are conducted which permit the following questions to be answered:

(a) How much energy is consumed in the country in question? What has been the pattern with respect to energy consumption historically? What does it imply, if anything?

(b) What are the sources of the energy consumed? By source of supply; Domestic vs. Imported.

(c) What is the cost to the country of the energy consumed? This involves an analysis of the foreign exchange costs of imported energy, the cost of domestic production of energy, if any, and the relationship between energy costs and consumer welfare. Also other aspects of social cost such as the environmental impact of current and past patterns of energy use are taken up here. The costs involved in the pattern of energy usage are of course analyzed over time, and trends etc. identified.

(d) What is the relationship if any, between energy consumption and overall economic performance? How invariant is this relationship in the short, medium and long term?

(e) Next, a breakdown of the national economy into sectors/areas of activity is made and a detailed analysis is conducted of the consumption of energy by sector/area of activity, e.g. transport, bauxite, tourism, household, etc. For each sector, certain fundamental questions are asked,

and answers sought: How much energy is used? How much does it cost? What share of the costs of production of the sector's output is accounted for by energy? How does the sector/area of activity's energy usage compare with other sectors/areas of activity domestically and internationally? How energy intensive is the sector/area of activity? What substitution possibilities exist with respect to energy sources? How efficiently is the energy used? Can the same quantity of energy be used with greater net social benefit elsewhere, in some other more productive sector?

(f) Next comes an analysis of energy consumed by source of supply. Each source of supply, actual and potential, is studied, an analysis is made of the end uses to which it is directed, which end uses are feasible, which desirable. The comparative costs of alternative energy sources is investigated and alternative sources are rigorously compared using systems analysis techniques which enable a comprehensive assessment of each source to be made considering everything from security of supply, to transportation, distribution, storage, technologies involved, costs, prices, etc.

(g) Energy balances are computed which link sources of supply to intermediate and end uses. These balances permit the tracing of energy flows through the economy by use of a complex of matrices.

(h) The analysis of energy by source of supply and by end use permits an overall assessment of energy usage to be made: How much energy is consumed? Where? How justifiable are the sectoral, area, and overall levels of consumption? What conservation possibilities exist within the existing framework? How responsive is energy demand to price changes? How much do different alternative sources of supply of energy cost? (See Table 1).

(i) Special detailed analyses should be conducted of specific supply sources such as oil which may be particularly important to the country in question. Also, it is usually desirable to conduct a special analysis of electricity generation and consumption.

(j) Next comes an assessment of current and past policies with respect to energy and their impact.

(k) Finally, it is necessary to carefully analyze the international situation with respect to oil and energy and its current and future impact on the domestic situation.

It should of course be quite clear that this list of information needs that I have detailed here represents the ideal. No one who has attempted to do actual energy planning and policy formulation for under-developed, Caribbean-type countries will be under any illusion that, at least at the beginning, one will get all the information and answers desired.

Since prior to 1973, few people troubled themselves very much about energy issues, relatively little was done in the way of data collection with respect to energy issues. Consequently when one begins to develop energy planning there are initially enormous data gaps and correspondingly large areas of ignorance.

Over time, the situation improves and our ability to generate and assess the information necessary for properly carrying out this first step in the planning process improves pari-passu.

This means that one of the first objectives in energy planning in Caribbean economies, implicitly or explicitly has to be the improvement of the data base we work with and energy information systems more generally - especially as it relates to the international energy market.

Also, grievously imperfect as the data base may be initially, it does not mean that enough cannot be found or generated fairly quickly (in a few months), to enable some initial plans to be formulated and some policy initiatives to be decided.

Step # 2 - Forecasting

The second step in the planning exercise is forecasting. It is really intimately related to the first step - the assessment of the situation. In fact they are more two different phases of one step than two very distinct sets of activities. While in Step # 1, we evaluate the present and the past as relevant, in Step # 2, we continue the exercise with an evaluation of the future context or future situation. Planning really involves the interlinking of past, present and future.

In step # 2, then, many of the areas identified in step # 1 for analysis are dealt with again, but this time in terms of the forecasted levels of the particular variables. Now what this really means is that while conceptually, and for purposes of exposition, it is necessary and desirable to identify two distinct steps - assessing the situation, and forecasting, - in practice the two sets of activities are carried out jointly and concurrently and usually by the same set of people.

Thus the likely future demands for energy need to be studied, and not just current patterns of consumption. Projections of future demand for energy are made on both an overall, macro-economic level, and on a sectoral/area of activity level. The macro-level forecasts are generally made using fairly simple econometric techniques and are usually based on the close relationship between energy and output that seems to exist in many economies. Sectoral forecasts are made on the basis of projections of future levels of activity in these sectors. Thus it can clearly be seen here, how energy planning has to be related to other areas of planning.

Forecasts are also prepared of the future supply of energy, by source of supply. These involve considerations of such issues as the possibilities of domestic production of energy, the contribution of new, alternative sources of energy, security of supply problems, technological issues, and expected costs and prices of various energy sources.

Step # 3 - Resource Evaluation

The third step in the planning exercise involves a detailed analysis of the country's resource situation with respect to energy. This is where the country's current or potential energy sources are evaluated - oil, gas, hydro-power, geothermal potential, etc. The kinds of questions asked here relate to estimates of reserves of oil or gas, comparative costs of production of the various alternative sources, what lead times are necessary for the bringing into production of newly discovered resources, exploration programs and their organisation, evaluation of the potential for development of new energy sources - e.g. the use of minidams for hydro, the use of dormant volcanoes for geothermal energy generation etc.

Much of this work in Caribbean countries at this stage has to devolve onto the shoulders of engineers, geologists, geophysicists, etc., since so little is really known about our resource situation with respect to energy. It should also be clear that while the set of activities described here in this step are presented sequentially, in practice the work can be (and probably ought to be), carried out in parallel with the work in Steps 1 and 2.

Step # 4 - Setting Objectives

The first three steps in this planning method are really just about the generation, organization and interpretation of information. Once this work is done, the basis for formulating policies and programs is really laid. At the heart of plan and policy formulation is the setting of a complex of objectives and targets over some time horizon.

From the information derived from the first three steps, it may become clear that possibilities exist in the country for developing more indigenous supplies of energy, but that this will only have an impact in the medium or long-term. This, plus information that there is currently considerable wastage of energy in various sectors/areas of activity may lead to the identification of increased conservation as a short/medium-term objective, and the development of indigenous energy sources as a

medium to long-term objective. Or it may have become clear that the exploitation of certain substitution possibilities e.g. greater use of bagasse instead of oil in the sugar industry may lead to substantial savings. Achieving this then becomes a target of policy.

Some set of objectives then is specified. The list may read:

- (a) Hold down/reduce the foreign exchange cost of energy imports;
- (b) Expand the production and use of indigenous energy supply sources;
- (c) Increase exports to pay for the increased cost of energy imports;
- (d) *Attract increased flows of foreign aid from OPEC countries to help finance oil import costs.*

These broad objectives then have to be broken down into detailed (usually quantified) targets. These targets then become the real specific goals of the planners in the system.

It will be found that a choice has to be made of the fundamental philosophical and operational approach to energy planning. Briefly, there are three fundamental approaches possible. The first approach is essentially: "How can the cost/quantum of energy used in the economy be minimized?" This conceptual notion seems to govern current approaches to short and medium-term energy planning in many countries. It implies that the real concern of the planners is summed up more fully in the question: "Given desired levels of activity, how can the energy required to sustain them be provided most efficiently, at minimum social cost, and how will this cost be best financed?"

A second approach essentially asks: "For a given quantum of energy (defined as affordable given some specific configuration of costs and resources), what is the maximum amount of economic activity that can be obtained?" This involves seeking to vire the available energy to its most productive/most desirable uses and so use it most efficiently.

This approach which is implicit in the policy formulations of some countries in the depths of fundamental economic crisis boils down to a maximization under constraints problem in which some quantum of foreign exchange available for energy purchases say is the constraint, and the level of economic activity the objective function to be maximized. The first approach by contrast is akin to a minimization subject to constraint problem in which the maintenance of some desired level of activity acts as the constraint and the costs of the energy required to produce it are what is minimized.

The third approach is the canonical classical method of economics. This approach recognizes that neither the level of economic activity nor the cost of energy ought to be set "arbitrarily". The two interact and ought to be simultaneously determined at some "optimal point". In this approach then, the fundamental philosophical injunction would be to use energy from each source, and in each use, up to the point where the marginal social benefit just equals the marginal social cost.

The differences in the policy objectives from using these different approaches is profound. The second approach leads naturally to a policy which emphasizes conservation, the use of rationing, the cessation of certain activities in favour of others regarded as socially more valuable etc. The third leads to a willingness to import large quantities of expensive energy if it would be used in sectors which are extremely lucrative. It also tends to lead to the use of prices as signalling devices as opposed to state imposed rationing or state controlled deployment of energy to different users using a directive approach.

The third approach is logically, the correct one. The problem, however, is that it is almost impossible to operationalize meaningfully. In practice, the approach to energy planning currently in vogue in many countries, seem to be implicitly or explicitly a mixture of the first and second approaches. One can expect however that as the issue becomes better understood, the more subtle and sophisticated third approach will attract greater attention and greater intellectual effort will be devoted to successfully operationalizing it.

Steps # 5 and 6 - Strategies and their implications

Targets for energy policy having been worked out, the next step is to devise a set of strategies for actually implementing them. For example, a conservation target may require the use of public education techniques, the introduction of some system of taxes, subsidies and a new pricing policy. Increasing the flow of aid may involve the strategy of stimulating a change in oil-importing Third World countries currently acquiescent and supportive policies towards OPEC, and their taking a harder and more demanding line towards the organization.

The strategy having been devised, their implications, the repercussions from employing them etc., have to be worked out. Reactions by other sectors in the situation to the strategies deployed is to be expected, anticipated and allowed for in the strategy set worked up. At this stage, specific projects have to be identified, planned, costed, evaluated and compared. Here then the role of the project analyst is logically to be found.

Step # 7 - Calculation of resource balances

The complex of programs and plans for the energy sector and for the patterns of energy usage require certain resources to carry them out. Decisions to develop more hydro-power or to expand indigenous oil production necessarily involve certain demands on the society's resources of say foreign exchange in order to acquire the capital stock necessary. Similarly the successful carrying out of the proposed programs may require the deployment of various categories of specialized skills of the acquisition and diversion of land from other uses to the development of alternative energy sources. Conservation type programs whether they center on retro-fitting existing plant and equipment, or improving the efficiency of electricity generation may also impose some resource cost on the economy which needs to be calculated.

The costing of all the various programs and plans is undertaken through the computation of certain resource balances. These balances include foreign exchange costs, labour required, high-level technical skills needed etc. The computation of such balances is done as a method

of ensuring that the demands of the various energy projects and programs for resources, whether skilled manpower, foreign exchange or whatever, are harmonized with the quantities of these resources expected to be available.

Usually it will be found that resource demands and resource availabilities do not match up on the first iteration. This means that the set of programs and projects identified needs to be reviewed, pruned, other less costly ways of doing things found, and/or that ways be found to increase the quantum of resources initially thought to be available. The balances are then recomputed again, if necessary, until expected resource demands can be reasonably held to match expected resource availabilities.

A very important, very difficult and very tedious task should now be performed. That is, the time phasing of the various projects and programs. This involves a period-by-period analysis of the various projects to be undertaken, the resource flows necessary in each period, resource availabilities in each period, the implications for the whole system of the scheduling of the various projects etc.

A set of projects with together require a certain amount of foreign exchange or a certain number of engineers may appear quite feasible if assessed over say a five-year plan period and total resource demands compared with expected total resource availabilities of foreign exchange and engineers over the period as a whole.

But differences in the timing of resource needs as compared to the timing of the resources becoming available could throw the entire program into chaos and confusion. Thus if 80 percent of the foreign exchange is required in the first two years during the period of heaviest construction activity but 80 percent of the foreign exchange expected to become available will be received in the fourth year, serious dislocations and waste can occur if the problem is not anticipated and expedients devised to cope with it.

Step # 8 - Execution

Plans mean nothing unless they are executed. The purpose of planning is to inform action, not to act as a substitute for it. After plans are worked out and policies articulated and announced we face the task of implementation. This raises a different set of problems centered on politics, communication, organization, law, international relations etc.

This is not the place to elaborate on the problems of execution. However it may be useful to say a few words on what is often the most critical aspect of execution - organization.

Successful execution of energy plans like any plans involves certain basic organizational imperatives which are as fundamental to success as they are ignored. It is no use, first of all, to have plans concocted in a central planning office with minimal or no participation from the people who will be affected by the plan or who will have to execute it. Such plans are very likely to remain stillborn.

It is necessary to involve in the planning process, the line organizations who the issues affect and especially the people on the ground and on the line who know the particular problems and issues, who have to deal with them on a day to day basis, and who have crucial knowledge and expertise indispensable to proper planning. It is also important to involve people from a motivational point of view. It has been demonstrated over and over that people react negatively to decisions made which affect them but where they were ignored in the decision making process. And in the same way people are usually more highly motivated to carry out a task if they have been consulted and their participation sought, even if their specific advice is not accepted.

It is also necessary to have a system in operation whereby once decisions are arrived at they can in fact reach down into the line organizations and affect what they do. Naturally this implies certain things about authority, the ability to deploy power etc. It makes little sense for a central planning office to come up with an approved

energy plan which has certain implications for the generation of electricity, if it is unable to get the electricity company to carry out agreed on decisions.

Finally, we may mention another major organizational problem, and one which nullifies one of the most important advantages that planning has to offer - that is, ensuring effective coordination between the activities of different organizations.

Step # 9 - Review

At the end of the plan period, it is necessary to have a review. This is by now well-known to be sound managerial practice and should need in consequence no elaboration.

Some Specific Problems of Caribbean Energy Planning

Before concluding we outline briefly some specific problems that arise in trying to develop energy planning in the Caribbean region.

(1) First of all, outside of Cuba, planning is a poorly developed function in the Caribbean. Despite all the paraphernalia of several development plans and appropriately titled ministries and department, there is little experience with real planning in the region, and even less understanding of what planning is all about, how it should really proceed, what are its true advantages and limitations, and little grasp of the various subtleties that come with a sophisticated understanding of planning.

Consequently, energy planning is hamstrung by the weakness of planning as a whole, and the need to integrate energy planning with the forward planning for other sectors/areas of activity in the economy is vitiated by the absence or the anaemic nature of such sectoral activity - area planning.

(2) A second problem that arises centres around the difficulties associated with inducing effective cooperation in the region. It turns out that in several areas associated with energy policy - e.g. information acquisition and sharing, training of personnel, the purchasing and marketing of petroleum products - Caribbean cooperation would be desirable if not absolutely necessary. But bringing the territories together in meaningful joint ventures has proven hitherto to be a herculean task with few real lasting successes.

(3) It is very important that in assessing the situation, a careful study be done of the international oil and energy markets, and a careful, reasoned judgement about the likely future course of oil prices be made. Whether many of the alternative energy technologies currently being mooted, prove to be economic successes or economic disasters depends in large part on whether the relative price of oil continues to escalate or whether it falls.

If oil prices fall in real terms, many of the alternative energy technologies that governments hastily invested large capital outlays in, would be effectively bankrupted. Current conventional wisdom in the shape of forecasts providing each other as usual with mutual reinforcement, choruses with near unanimity that oil prices will continue to rise and energy costs go up. (The Age of Cheap Energy is over, etc. etc. etc.).

However conventional wisdom on the future of oil prices has proven in the past to be disastrously wrong - e.g. pre 1973 predictions of a falling real price for oil in the long-term. It may well be wrong again. One's guess as to what will happen here has the most important implications for the kind of energy policies a country adopts.

(4) The Caribbean region is characterized, inter alia, by its condition of technological dependence on the metropole and the underdevelopment of indigenous technological capabilities. This

general situation coupled with the region's considerable inexpertise with respect to energy matters is fostering a reliance on metropolitan analyses and interpretations of the region's energy problems, as well as a near total dependence on metropolitan technologies and solutions for dealing with these problems.

There is a not inconsiderable danger that in the area of energy like in other areas previously, the region will once again fail to develop the technological capability that would enable it to identify, analyse and find solutions for its problems with full cognizance of the peculiarities and special characteristics of the particular environment that we are dealing with in the Caribbean.



