PD-AAI-547

936-5703

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(3)

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT PAPER FACESHEET

1. TRANSACTION CODE: A (A = ADD, C = CHANGE, D = DELETE)

PP

2. DOCUMENT CODE: 3

3. COUNTRY/ENTITY: Energy - Worldwide

4. DOCUMENT REVISION NUMBER:

5. PROJECT NUMBER (7 digits): 936-5703

6. BUR/ZAU/OFFICE: A. SYMBOL: DS/EY; B. CODE:

7. PROJECT TITLE (Maximum 40 characters): Energy Assessment & Policy Dev

8. ESTIMATED FY OF PROJECT COMPLETION: FY 81

9. ESTIMATED DATE OF OBLIGATION: A. INITIAL FY 79; B. QUARTER 4 (Enter 1, 2, 3, or 4); C. FINAL FY 80

10. ESTIMATED COSTS ($000 OR EQUIVALENT $1 =)

A. FUNDING SOURCE	FIRST FY B. FX	C. L/C	D. TOTAL	LIFE OF PROJECT E. FX	F. L/C	G. TOTAL
AID APPROPRIATED TOTAL						
(GRANT)	(1000)	( )	(1000)	(2000)	( )	(2000)
(LOAN)	( )	( )	( )	( )	( )	( )
OTHER U.S. 1.						
OTHER U.S. 2.						
HOST COUNTRY						
OTHER DONOR(S)						
TOTALS	1000		1000	2000		2000

BEST AVAILABLE DOCUMENT

11. PROPOSED BUDGET APPROPRIATED FUNDS ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE C. GRANT	D. LOAN	E. 1ST FY — F. GRANT	G. LOAN	H. 2ND FY — I. GRANT	J. LOAN	K. 3RD FY — L. GRANT	M. LOAN
(1)				1000		1000		2000	
(2)									
(3)									
(4)									
TOTALS				1000		1000		2000	

A. APPROPRIATION	N. 4TH FY — O. GRANT	P. LOAN	Q. 5TH FY — R. GRANT	S. LOAN	LIFE OF PROJECT T. GRANT	U. LOAN
(1)					2000	
(2)						
(3)						
(4)						
TOTALS					2000	

12. IN-DEPTH EVALUATION SCHEDULE: MM 0 YY 28 1

13. DATA CHANGE INDICATOR. WERE CHANGES MADE IN THE PID FACESHEET DATA, BLOCKS 12, 13, 14, OR 15 OR IN PRP FACESHEET DATA, BLOCK 12? IF YES, ATTACH CHANGED PID FACESHEET.

1 (1 = NO, 2 = YES)

14. ORIGINATING OFFICE CLEARANCE

SIGNATURE

Alan B. Jacobs

TITLE

Director,
Office of Energy

DATE SIGNED: MM 06 DD 13 YY 79

15. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION: MM 06 DD 13 YY 79

AID 1330-4 (3-78)

PROJECT AUTHORIZATION AND REQUEST FOR ALLOCATION OF FUNDS

PART II

ENTITY : Worldwide

PROJECT : Energy Assessment and Policy Development

PROJECT NUMBER: 936-5703

AID grant financing is approved in the amount of $2,000,000 to cover life of project costs.

FY 1979 grant financing of $1,000,000 is authorized to cover initial year project costs.

John I. Bruce
DAA/DS/DT

6/22/79
Date

Clearance:
DS/PO:RSimpson Date 6/22

Simpson

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT AUTHORIZATION AND REQUEST FOR ALLOTMENT OF FUNDS PART I

1. TRANSACTION CODE: A (A - ADD, C - CHANGE, D - DELETE)

PAF

2. DOCUMENT CODE: 5

. COUNTRY/ENTITY

4. DOCUMENT REVISION NUMBER

. PROJECT NUMBER (7 digits): 936-5703

6. BUREAU/OFFICE: A. SYMBOL: DS/EY; B. CODE:

7. PROJECT TITLE (Maximum 40 characters): Energy Assessment and Policy Development

- PROJECT APPROVAL DECISION — ACTION TAKEN: A (A - APPROVED, D - DISAPPROVED, DE - DEAUTHORIZED)

9. EST. PERIOD OF IMPLEMENTATION: YRS. 02 QTRS.

10. APPROVED BUDGET AID APPROPRIATED FUNDS ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE C. GRANT	PRIMARY TECH. CODE D. LOAN	E. 1ST FY 79 F. GRANT	E. 1ST FY 79 G. LOAN	H. 2ND FY 80 I. GRANT	H. 2ND FY 80 J. LOAN	K. 3RD FY L. GRANT	K. 3RD FY M. LOAN
1) SDP				1000		1000			
2)									
3)									
4)									
TOTALS									

A. APPROPRIATION	N. 4TH FY O. GRANT	N. 4TH FY P. LOAN	Q. 5TH FY R. GRANT	Q. 5TH FY S. LOAN	LIFE OF PROJECT T. GRANT	LIFE OF PROJECT U. LOAN
1)					2000	
2)						
3)						
4)						
TOTALS						

11. PROJECT FUNDING AUTHORIZED (ENTER APPROPRIATE CODE(S)) 1 = LIFE OF PROJECT, 2 = INCREMENTAL, LIFE OF PROJECT: A. GRANT 2; B. LOAN

C. PROJECT FUNDING AUTHORIZED THRU FY 79

12. INITIAL PROJECT FUNDING ALLOTMENT REQUESTED ($000)

. APPROPRIATION	B. ALLOTMENT REQUEST NO. C. GRANT	B. ALLOTMENT REQUEST NO. D. LOAN
1) SDP	1000	
2)		
3)		
4)		
TOTALS	1000	

13. FUNDS RESERVED FOR ALLOTMENT

TYPED NAME (Chief, SER/FM/FSD)

SIGNATURE

DATE

4. SOURCE/ORIGIN OF GOODS AND SERVICES: 000 941 LOCAL OTHER

5. FOR AMENDMENTS, NATURE OF CHANGE PROPOSED

FOR PPC/PIAS USE ONLY	16. AUTHORIZING OFFICE SYMBOL	17. ACTION DATE MM DD YY	18. ACTION REFERENCE (Optional)	ACTION REFERENCE DATE MM DD YY

936-5703
ARDEN = AID/RFF Development of Energy

CANDIDATE PROJECT PAPERS

Introduction

The following sections give some information on the candidate project papers and a list of their titles. Copies of the candidate project papers can be found in the appendix.

What Candidate Project Papers Are

The candidate project papers are means of informing the Advisory Committee of some of the thinking that the ARDEN staff has done on these subjects. The format of the papers is designed to give enough background on the projects so that the Advisory Committee may intelligently criticize the scope and methods of the proposed projects, as part of a general discussion of these ideas and other energy-developmental concepts and projects.

What Candidate Project Papers Are Not

The candidate project papers are not designed to be complete final proposals on the ideas discussed. Before any such proposals can be generated, the ARDEN staff will revise the candidate projects in line with comments by the Advisory Committee, and then select several for a short "mini-study." At the end of this mini-study, the candidate projects may be shelved or abandoned or a final proposal to AID will be made for the project, detailing the work to be done, the developing area institution(s) (DAIs) to be retained, RFF and DAI levels of effort and budget expenditures, and other relevant matters. This final proposal or project design will be submitted to the AID Office of Energy for their approval before any project is begun.

Rationale for the Choice of Candidate Projects

The general rationale for the choice of candidate projects should be considered by the Advisory Committee and the ARDEN staff on an ongoing basis.

For the initial set of candidate projects, the following three factors have been taken into account:

1. Relevance to energy supply and demand either for major or for especially critical end uses.

2. Importance for major economic development decisions.

3. Practical usefulness of findings to policymakers within a reasonable timeframe.

Three other factors will be considered during the course of any mini-study.

4. Feasibility within program resource limits.

5. Consistency with other AID Office of Energy programs.

6. State-of-the-art of relevant research and RFF comparative advantage.

Applying the Rationale to the Choice of the Initial Project Papers

While the rationale for individual projects will be a continuing subject of discussion by the Advisory Committee and for consideration by the ARDEN staff and by AID, certain lines of reasoning can be traced in the choice of the initial candidate projects given below.

First of all, some projects dealing with major overall energy supply and demand difficulties, and the effects of those difficulties on future industrial growth and rural development of a developing nation, should have a high priority. Primary among these is the need for some understanding of policy alternatives in the increasing exploration for fossil fuels (see project 1: "Policy Problems in Expanding Fossil Fuel Exploration and Development"). Specific shortages of fuels for major sectors may be also of great importance, in particular fuels for the generation of electricity (see project 2: "Fuels for Electrical Generation")

nd the replacement of critical supplies of specialized liquid fuels for transport and other uses in the modern sector of the nation (see project 6: "New Sources of Liquid Fuels").

Major reductions can be made in the demand for imported oil by various fuel substitution and conservation options. Substitutions may be possible between electric and non-electric uses (see project 3: "The Energy Supply Mix and the Role of Centrally Generated Electricity") or conservation can be effected by technical changes (see project 9: "Conservation Potential in Developing Countries") or by changing fuel pricing policies that do not reflect correct opportunity costs (see project 8: "Energy Pricing and Demand Management Policies").

The needs of the traditional sector often involve the major source of energy inputs to the economy and must also be considered. Possibilities for improving fuel or charcoal delivery systems can be of great importance (see project 4: "Fuelwood and Charcoal Supply Systems"). In some cases, indeed, the examination of new energy supply possibilities or demand management options encompasses both the modern and traditional sectors. The problem of biomass for fuel versus food and other uses falls into this category (see project 7: "Food, Forests, and Fuel: Competition for Biomass Resources") as does the interfuel substitution problem, which ranges from kerosene substituting for firewood to natural gas substituting for residual oil (see project 5: "Interfuel Substition in Developing Countries").

Given the great emphasis that has been placed on integrated rural development in the past, an examination of the advantages and disadvantages of rural electrification, and what might be needed to improve it, could be of major help in development planning (see project 10: "Rural Electrification: A Comparative Study of Development Efficiency and Income Distribution Problems").

Finally, it seems evident that sooner or later the problem of the interaction between economic development strategy and energy use must be attacked in a rather general way (see project 11: "Energy Implications of Alternative Development Strategies").

Initial Candidate Project Papers

In line with the discussion above, the following lists a group of eleven candidate project papers to be submitted to the Advisory Committee on October 15. It should be stressed that these constitute an initial selection of candidates only. Several of these candidates should turn out to form the basis of the first two or three project mini-studies. However, the list of other projects will probably be extensively revised before the next Advisory Committee meeting.

It is also to be noted that some overlap in the candidate projects may occur. Since one project of a pair containing overlapping sections might be implemented and the other not, no effort has been made to eliminate overlap at this point. If both members of such a pair were to be chosen for further consideration for implementation, such overlap problems would be sorted out during the course of the mini-studies.

The list is as follows:

1. Policy Problems in Expanding Fossil Fuel Exploration and Development

SOK project? 2. Fuels for Electrical Generation

3. The Energy Supply Mix and the Role of Centrally Generated Electricity

4. Fuelwood and Charcoal Supply Systems

5. Interfuel Substitution in Developing Countries

Brazil project? 6. New Sources of Liquid Fuels

7. Food, Forests, and Fuel: Competition for Biomass Resources

8. Energy Pricing and Demand Management Policies

9. Conservation Potential in Developing Countries

10. Rural Electrification: A Comparative Study of Development Efficiency and Income Distribution Problems

11. Energy Implications of Alternative Development Strategies

Format of Candidate Project Papers

The format of the papers gives first some background, then describes the policy relevance of the proposed candidate project, then a description of the tasks that might be performed. Finally, the method of research and the types of countries and cooperating institutions envisaged are given.

No estimate is made here of the level of effort for either RFF or the cooperating DAIs. Such a level of effort will be sorted out during the mini-study phase. However, for purposes of visualization of the total effort, it is anticipated that--for the total program--roughly fifty man months of RFF effort would be available and some 300 man months of effort on the part of the DAIs. The planning of the scope of the individual projects during the mini-study will take these overall resource constraints into account.

POLICY PROBLEMS IN EXPANDING FOSSIL FUEL EXPLORATION AND DEVELOPMENT

Background

For any oil-importing developing country burdened by the foreign exchange costs and supply uncertainties of energy imports, the discovery and development of economically competitive indigenous fossil fuel resources is a consummation devoutly to be wished. The radical increase in world oil (and to a lesser extent in coal) prices since 1973 should in principle have shifted previously known but uneconomic deposits toward profitability and also greatly increased the incentives to governments and private enterprise to search for new sources. Nevertheless, adequate action in this direction appears constrained by a series of "impediments"--summarized by the World Bank as "the scarcity of risk capital for exploration, inadequate analysis of the data derived from exploration, and a shortage of skilled personnel and institutions to deal effectively with international oil companies. Many developing countries find that though they have potentially economic exploitable resources, they cannot attract international oil companies, either because not enough is known about the characteristics of these resources, or because the petroleum deposits are believed to be too small, or because the contract terms offered are inappropriate." (World Development Report, 1979, p. 39.)

There is also a growing recognition in the United States and other industrial countries that they too have a postive interest in increased fossil fuel supplies in developing countries, even if not are exported, since additional supplies help to relieve the upward price pressure on the inter-

national oil market, which is now the residual balancer of all forms of energy supply and demand. Hence the decision by the World Bank to engage in lending for fossil fuel exploration and development and to offer technical assistance to help reduce the "impediments," as well as the Inter-American Development Bank's new program for multilateral guarantees of private investments in this field, the enhanced interest of the U.S. Development Programme, and the potential interest of U.S. and other bilateral aid programs.

While resource surveys and the first phases of exploration may be within the combined means of the LDC governments concerned and the international public lending institutions, more intensive exploration and actual development require enormous volumes of capital, which are generally available only from the private sector on some kind of risk venture basis. But there are indications that potentially rewarding activity is frustrated by mutual suspicions of LDC governments and fossil fuel enterprises (including, but not limited to, the major international oil companies). The former fear the "theft" of precious natural resources by foreign companies, while the latter fear harrassment ranging from unreasonable regulation through creeping expropriation to outright nationalization without adequate compensation. History justifies all these fears on both sides. But their persistence may also reflect a "culture lag" which fails to recognize changing attitudes and changing industrial structures.

The purpose of the project would be to explore in detail the economic, institutional, and policy impediments to expanded fossil fuel exploration and development, with emphasis on the role of the private sector and

alternative modes for its collaboration with LDC governments. In each of the countries selected for case study, the project would seek to identify the missing inputs (technology, capital, organization, capacity to assume risks, etc.), the potential sources of such inputs, and the array of possible arrangements, including appropriate policy measures, to bring them into operation. If successful, a workshop would be set up in the latter phases to compare the country cases and assist in formulating policy conclusions.

Policy Relevance

Since fossil fuel import costs now loom as a major obstacle to continuing development progress for many LDCs, any research aimed at indigenous fuels on an economic basis has a direct bearing on development policy. At the same time, for reasons already indicated, a favorable outcome would assist all countries by improving the global energy balance.

Tasks

The project would:

1. Identify key areas of study that would complement the World Bank program.
2. Assemble evidence on "impediments," including self-limitation of geographical scope of activities by international fossil fuel companies and their reasons for such limitations, political limitations on foreign equity-holding, effects of various tax arrangements (in both host and home countries), effects of other regulatory requirements, and bottlenecks in technology or organization for specific phases of exploration or development.

3. Assembly information of the array of cooperative arrangements used, including conventional equity participations, various forms of unbundling exploration and development, product participation formulas, mixed public-private ventures, unilateral and multilateral insurance against political and commercial risks, etc.
4. Select several countries with contrasting experience in fossil exploration for analysis in depth by cooperating local institutions working to a common research pattern.
5. Compare case materials and develop policy conclusions

Method

The project would build on the work done by Professor Raymond Mikesell (partly under RFF auspices) in reviewing the terms of oil exploration arrangements in several Latin American countries. It would also take advantage of information assembled at the U.S. Commission on Transnational Corporations, the World Bank, the International Chamber of Commerce, and international investment and commercial banks. Research would employ interviews in depth with governmental and industry representatives rather than widely distributed questionnaires or surveys.

Types of Countries and Cooperating Institutions

Countries should be selected from all three of the main LDC continents. Professor Mikesell's work in Latin America should readily identify the best prospects there, and reconnaissance at the U.N. Commission, the International Chamber of Commerce, and the World Bank should rapidly suggest countries in Asia and Africa likely to be interested in collaborating in this project. The institutional base of the local cooperating researchers would be policy-oriented schools of law or of business or policy research institute.

Remarks

The importance of a positive contribution to understanding and policy-making in this field is beyond doubt. We see some possibility that a disinterested private non-profit research institution such as RFF might be able to conduct such inquiries than governmental representatives or the staff of international institutions. On the other hand, the kind of research involved has a much stronger institutional emphasis than has been typical of work at RFF, and we are uncertain whether its selection would meet the test of comparative advantage.

Project 2
Draft
2 October 1979

FUELS FOR ELECTRICAL GENERATION

Background

A key drain on imported oil in many developing nations is as a fuel to generate electricity. Not only do existing oil-fired power plants contribute to existing pressures on oil supplies, but often the expansion of supplies of electricity will be a key feature in carrying out programs of industrialization and agricultural reform. While price or technical conversion measures can help reduce the use of oil for motor fuels, it is often less easy to cut back either on present production or on future expansion of oil-fired generators. Indeed, many countries may come to prohibit the construction of new oil-fired generation.

And yet viable alternatives exist for many countries. Indeed, in many countries hydroelectric power has been the mainstay of electricity in the past, and the possibility of further increases in hydro capacity must be the current preoccupation of many electric utility planners in developing areas. Some countries have been fortunate enough to find local supplies of natural gas, and so an obvious source for power-plant fuel. All too often, however, few other conventional alternatives exist. Nuclear power has been proposed in many places, and has been adopted in some, but problems with international politics of nuclear proliferation and waste disposal, plus more down-to-earth questions like operational reliability and apparent trends toward rapidly increasing generating costs have cast doubt upon the nuclear power option. Meanwhile, possibilities of using imported coal have been little studied, and exploration for new coal fields has been a neglected subject. In addition to conventional sources, there are of course various renewable options, of which biomass conversion is perhaps one of the most promising for many areas--since wood combustion is an established technology.

Project No. 3
Draft
October 2, 1979

THE ENERGY SUPPLY MIX AND THE ROLE OF CENTRALLY GENERATED ELECTRICITY

Background

In the development strategies of most LDCs, large-scale electric power systems have occupied a prominent place. Their technological imperatives have necessitated deliberate planning on a national (or at least large regional) scale. Many systems were initiated by foreign-based multinational utility companies, but during the 1950s and 1960s they were all transferred to national ownership, usually delegated to semi-autonomous government corporations (in Latin America "autarquias"). The combination of large capital and foreign exchange requirements with readily transferable technology and financial autonomy made them ideally suited to international financing by the multilateral and bilateral lending institutions, and they constituted the largest single sector in the early years of World Bank, Regional Bank, and Export-Import Bank financing.

The systems were generally urban-based and designed to meet existing demand (supplied by inefficient decentralized generators) or easily foreseeable increases in demand. A great deal of attention was given (under active World Bank leadership) to engineering soundness, administrative competence, and financial viability. Systematic analyses were made of alternative primary energy sources--expecially of hydropower and oil-fired thermal generation--taking proper account of needs for base load and peaking and other relevant factors. Cadres of planners, operators, and maintenance supervisors were trained and often became a kind of managerial elite.

Notwithstanding all this concentrated attention, it did not become standard practice to assess electrification programs as an integral part of wider development strategies, evaluating the opportunity costs of capital and foreign exchange

or relating electricity networks to policies of industrial decentralization or agriculture development. Since power projects were direct producers of revenue, they could stand on their own feet in securing external financing as long as the country concerned was considered generally "creditworthy." For many countries in the 1950s and 1960s, the bottleneck to external aid was limited "absorptive capacity" and an insufficiency of technically and financially sound projects; electric power therefore enjoyed a kind of inherent priority.

Since the mid-1970s, the context has been changed both by the cumulative secular trend toward more comprehensive analysis of development strategies (including efforts to assess external costs and benefits of projects and dynamic effects of some kind of infrastructure in creating their own demand) and by the sharp increases in primary fuel costs and construction costs for large capital investment projects. Except for hydro, the large losses in conversion to electricity might appear to suggest that, at the margin, electricity should now be less attractive than direct use of primary energy--but that hypothesis implies that there is a substantial amount of potential substitution. The changes in relative costs should also induce more systematic efforts to improve load factors and reduce reserve margins, partly by changes in rate structure and partly by improved maintenance procedures. In addition, where small hydropower or other renewable sources are available, the changed conditions may have shifted the balance toward a larger proportion of small-scale decentralized supply, even if electricity remains the best form of energy use.

The objective of this project is to reexamine the role of centrally generated electricity in the overall energy supply mix of developing countries, establishing

a conceptual framework and a methodology for its assessment, and testing those principles empirically in several representative LDCs.

Policy Relevance

Since expenditures on electric power supply and distribution account for a substantial share of developmental investments and uses of foreign exchange, their rational integration into overall development strategies is of high policy importance. The topic evokes strong emotions and ideological attitudes (both supportive and hostile); it is also subject to bureaucratic and interest-group pressures. For these reasons, it warrants exceptional efforts to place it on an objective footing.

Tasks

This project would:

1. Review the electric power financing projects over the past decade at the World Bank, Regional Banks, and bilateral lending agencies to determine to what extent the projects have been presented as part of a wider developmental strategy.

2. Search for any changes in the assessments since 1974 taking account of altered relative fuel and capital costs.

3. Analyze the pattern of electricity consumption in selected developing countries with extensive data bases to determine where non-electric energy sources might be competitive with electricity and also where centrally supplied electricity might compete with decentralized supply.

4. Develop a methodology for determining the choice between electric and non-electric energy sources and between centralized and decentralized supply, focussed on questions of incremental energy production and use.

5. Within the electric supply system, identify means of significantly increasing load factors and reducing reserve margins without impairing service reliability.

6. Test the applicability of the methodology by empirical research in representative countries conducted by qualified local institutions.

Method

The development of a suitable methodology is one of the main purposes of the project, and cannot be specified in advance. Its outlines should emerge during the "ministudy" phase covering tasks 1 to 3 above--a phase likely to be longer than usual in this project. The boundary conditions for substitution between electric and non-electric energy forms and between centralized and decentralized electric supply are not well understood, and the researchers will have to combine technological and economic knowledge and insights. If interested and qualified counterpart researchers can be identified in a few LDCs with substantial electric power systems and extensive data bases, it would be useful to enlist their collaboration in order to keep the methodological development in touch with real world problems.

Types of Countries and Cooperating Institutions

Countries should involve a diversified pattern of energy usage in industry, agriculture, and transport, with a substantial (but not necessarily all-embracing) electric supply system. Research institutions should be able to mount

small teams combining economists and engineers, and to enlist the cooperation of the electric supply authorities without being controlled by them.

Project 4
Draft
2 October 1979

FUELWOOD AND CHARCOAL SUPPLY SYSTEMS

Background

The importance of the problems of deforestation and its associated fuelwood crises need little emphasis. One answer to the domestic energy supply part of the problem is to increase local supplies of firewood through woodlot schemes. Another possibility is to grow fuelwood (and timber) under centralized management at remote locations and transport them for local use.

If fuelwood is to be grown at a distance from the point of end use, the question of transportation costs looms large. The option of converting fuel wood at the cutting site to charcoal then becomes interesting; this becomes an especially attractive scheme if--as often--the total energy efficiency of charcoal (measured from wood resource to end use in stoves) is as great or greater than that of fuelwood. This possible efficiency gain may depend critically on the state-of-the-art of the charcoal and stove technology used and possible use of by-products.

It is therefore proposed here to carry out a study of the fuelwood/charcoal system, as applied to the energy needs of a typical city or rural area in a developing nation. The investigation should seek to determine the advantages and disadvantages of fuelwood and village charcoal operations as compared to large-scale distribution and charcoal-making options. Consequences for the existing local economic and social environment would be of prime importance in the study.

The study should center on commercial fuelwood systems because of their greater susceptibility to analysis; however, the overwhelming importance of non-priced fuelwood use would suggest that one also calculate the consequences of potential changes in supply strategy for non-commercial fuelwood economics.

Many individual aspects of this type of study are available in the literature or in the form of unpublished studies. However, many other data points are missing, and a total analysis of this kind has not yet been attempted.

Policy Relevance

This study would give guidance to resource and energy planners concerning forestry, woodlot, and charcoal kiln projects. The analysis would be a useful contribution toward planning general strategies for the supply of fuels for domestic use.

Tasks

This study would:

1. Draw up scenarios for prices and other variables in typical fuelwood markets.
2. Investigate the current state of charcoal technology.
3. Review relevant reforestation and village woodlot experience.
4. Model the systems costs for delivered energy for alternative systems: fuelwood, simple charcoal systems, organized charcoal/fuelwood market from a remote forest, and other appropriate options.
5. Investigate health and environmental consequences and constraints, such as deforestation and air pollution.
6. Investigate analogous consequences for non-commercial forestry systems, in particular the role of credit schemes and social acceptability.

7. Sketch out institutional and policy requirements for implementation.

Method

Data on fuelwood and charcoal production, distribution, and use would be collected from the literature, from reports, and from interviews with experts. Further data would be collected as necessary and feasible in case studies carried out by DAIs under this program. Economic analysis will be carried out at RFF and, where feasible, in developing area research institutions.

Types of Countries and Cooperating Institutions

Case studies should be carried out in countries with an active fuelwood and charcoal trade. DAIs used to dealing with market data or with technology feasibility analysis would be appropriate.

Remarks

An independently funded RFF study has been proposed of the fuelwood market in Hyderabad (India). The latter will be carried out at a greater depth of data collection and analysis than envisaged for the ARDEN case studies but would provide invaluable data for this project, especially for tasks 1, 4, and 6.

INTERFUEL SUBSTITUTION IN DEVELOPING COUNTRIES

Background

The radically altered pattern of energy prices and availabilities in the post-1973 period has led to heightened interest in both developed and developing countries in changing the composition of fuel supplies in order to minimize consumption of petroleum and its products. In the near future this may involve the replacement of petroleum by coal, gas, and hydropower, and in the longer term, when resources of fossil fuels are diminished, by essentially inexhaustible solar and nuclear fuel sources. Although there have been major fuel substitution cycles in the past--of wood by coal and coal by oil--the dynamics of this process are still poorly understood. Little has been done to evaluate the lessons of these past experiences with a view to providing guidance to managing fuel transitions in the future.

In developing countries, this problem of a necessary change in the composition of commercial fuel supplies is compounded by simultaneous structural changes in their economic output as income rises. Energy consumption shifts from traditional "noncommercial" fuels, such as wood and dung, into commercial forms of energy as agriculture and industry are mechanized, relative prices and availabilities of traditional fuels change, and urbanization proceeds. The existence of a typical fuel progression from wood to dung to kerosene to electricity and bottled gas as incomes rise in developing countries is fairly well recognized, but the rate at which these changes take place under differing circumstances and the prospects for a progression to

alternative fuels have been little explored. Understanding the nature of interfuel substitution in both the modern sector and the traditional--but rapidly modernizing--sectors of developing countries is therefore critical to the prospects for both the medium- and long-term transition to a post-oil era in these countries.

The project proposed here addresses both aspects of this problem. The purpose would be to evaluate past patterns and assess future prospects for interfuel substitutions in developing countries. The dynamics and relative importance of price, income, convenience, domestic availability, local production problems, rapid economic growth, and government policies in earlier changes in the composition and rate of growth of commercial fuel supplies--for example, from reliance on coal to oil--would be evaluated in several developing countries. Similarly, the rate and nature of the shift from traditional to commercial fuels at different income levels would be investigated. The past and potential future effects of switching fuels on economic and social activities would also be assessed from a sociological point of view. Finally, the most promising possibilities and most serious constraints on future fuel substitutions would be addressed.

Policy Relevance

This project addresses the key policy questions of alternatives and constraints for developing countries in the transition to the post-oil era. Of particular relevance would be the identification of the role, if any, government policy has had or could have in interfuel substitution.

Tasks

This study would:

1. Gather data on interfuel substitutions historically for both commercial and "noncommercial" fuels in selected countries.
2. For the modern sector, identify the relative importance of price, convenience, domestic availability, government policy, and other factors in past changes in the composition of fuel supplies.
3. For the traditional sector, investigate the magnitude and determinants of the shift from noncommercial to commercial fuels.
4. Assess the effects of switching fuels on economic and social activities as a function of sociological variables.
5. Outline the present constraints, prospects, and possible government policies for future interfuel substitutions, given likely prices, incomes, and economic structure.

Method

The collection of data and much of the information would be done by LDC institutions in the selected countries, with RFF handling the definition of the data required and the cross-country analytical work. A good deal of data is presently available in family expenditure surveys.

Types of Countries and Cooperative Institutions

Several countries with different income levels, energy resource endowments, government policies, and fuel mixes would be desirable. It might be possible to analyze a larger number of countries at some

level if data from other program projects could be utilized. Four suggestions for countries are:

- India--some domestic energy resources, heavy coal user, low income, both modern and traditional sectors large.
- Brazil--large oil importer, "newly industrializing country," active government policy in energy.
- Nigeria--oil producer.
- Indonesia--oil producer, severe deforestation problems.

Project 6
Draft
2 October 1979

NEW SOURCES OF LIQUID FUELS

Background

The problem of developing alternative liquid fuels to replace gasoline, diesel oil, and other petroleum liquids is of high priority for any oil-importing country in the process of development. While liquid fuels have many uses, they are particularly irreplaceable in many transport sector end uses--at least with present conventional alternatives. The place of petroleum can be taken over, however, by synthetic fuels from coal or--more to the point for most countries--from biomass stocks such as wood. The production of synthetic gasoline from coal or carbohydrates, for example, still appears to be expensive but has been thoroughly tested on at least a small scale. Alcohols (methanol and ethanol) form alternative fuels that may be of even more promise for developing areas. While the alcohols are not perfect substitutes for gasoline, they have both advantages (higher engine performance) as well as disadvantages (e.g., reduced flexibility of engine operation at different temperatures) compared to petroleum products for motor fuel operation. Some environmental effects, such as methanol toxicity, will also have to be considered.

The production of methanol from wood or other cellulosic products promises to be cheap, at least relative to many alternatives; however, the production of methanol from wood through modern processes on a large scale is not yet fully established. In contrast, the production of ethanol from sugar or starches, while it is an expensive process because of the high cost of the

sugar feedstock, is a very well-established technology that can be easily implemented in many developing areas. Furthermore, the pattern of economic benefits and costs can be rather complicated, because of the interaction of sugar for fuel with markets for sugar for food, and because of uncertainties as to opportunity costs of land, labor, and foreign exchange. A similarly complex cost-benefit relationship, in fact, may hold for some biomass resources useful for purposes of methanol production.

It is proposed to carry out here an analysis of alternative liquid fuels, and especially alcohols, in the context of problems and possibilities in developing areas. Both financial costs and other social costs and indirect effects will be considered as affecting LDC decisions to implement fuel alcohol industries.

Policy Relevance

This project should help LDC planners in planning energy supplies to supply future transport sector operations and other liquid fuels end uses.

Tasks

This study will carry out the following tasks:

1. Literature on the subject will be reviewed.
2. An independent cost analysis for favorable processes will be carried out.
3. Resource possibilities for feedstocks will be estimated in typical developing areas.
4. Local cost corrections to standard cost analyses will be carried out for typical developing areas.
5. Other economic constraints on an LDC liquid fuels industry will be traced.

6. Capital and other costs of needed vehicle modifications and other end-use charges will be investigated.

7. Macroeconomic, environmental, and socieological implications of a liquid fuels LDC industry will be examined.

8. Policy recommendations will be developed.

Method

An analytic review of literature will be carried out in the U.S. In addition, interviews and independent checking of supplier costs will be used to create independent cost estimates, where indicated, for the overall analysis. Local research institutions will carry out estimates of biomass supply possibilities and investigate local production cost corrections and other constraints.

Types of Countries and Cooperating Institutions

Countries with an established forestry or sugar industry would be most suitable. Institutions should be able to handle agricultural problems and/or economic aspects of cost-benefit analyses.

Remarks

Some preliminary analysis of this problem has already been done as part of the Ford-LDC Study at RFF.

Project 7
Draft
3 October 1979

FOOD, FORESTS AND FUEL: COMPETITION FOR BIOMASS RESOURCES

Background

At the World Food Conference in Rome in 1976 there was a genuine consensus that the highest priority should be assigned to expanded food production in developing countries, especially those with dense populations or high rates of population growth. This conclusion followed from the dramatic shift of all three LDC continents (Africa, Asia, and Latin America) from net export of basic food grains before World War II to a large and growing volume of net imports. That growth had been slowed but not stopped by the Green Revolution. Continued population growth, combined with even modest improvements in living standards, would imply further growth of food imports to unmanageable levels (unmanageable for both exporting and importing countries) unless resolute efforts were devoted to increasing production in the LDCs.

The Rome Conference gave some attention to the then recent jump in world oil prices and to the cyclical shortages of fertilizers, but it did not analyze the possible direct and indirect effects of higher energy costs on food production, the possible competition between food and fuel imports for allocations of limited foreign exchange earnings (and borrowings), or the possible competition for land and capital between expanded domestic production of food or of fuel.

Now, with increasing pressures in oil-importing LDCs for "energy independence" as well as food self-sufficiency, these potential conflicts may become major issues for developmental strategy and for relating energy policy planning to other aspects of development. The conflict between food and fuel production may in some cases be unrecognized or sequential, as in the classic sequence of deforestation as a result of fuelwood gathering resulting in soil erosion leading to

reduced agricultural productivity. Our project concept here emphasizes the direct competition of food, fiber, and forest crops with energy crops and fuelwood for scarce resources of land, capital, and foreign exchange, focussed on the resource demand of biomass as an energy source through direct combustion as a traditional fuel or under industrial boilers or conversion to charcoal or alcohols for use in both the traditional and modern sectors.

This problem of food versus fuel has been attacked in partial ways, emphasizing the tradeoffs for particular areas or types of crops. However, considering the importance of the potential biomass resource, a wider survey of different possibilities seems in order. The opportunity costs of land not now being used for forest or fuel crops might be investigated by comparison with land now under cultivation, in order to see if the same factors of transportation cost, soil and climate conditions, and so on apply to alternative uses for energy or for food. Since a wide variety of types of fuels and end uses--as well as in general a number of food crops--can be envisaged for given regions, one of the goals of the study would be to trace the key elements for cost analysis in decision-making. These elements would include of course not only local costs, but also job creation, foreign exchange, and other important economic problems.

Policy Relevance

The project should be especially helpful in providing rational criteria for judging the competing claims of Ministries of Agriculture, of Forests, and of Energy and the proposals of special interest groups for subsidized investments of guaranteed markets.

Tasks

This study would:

1. Develop a cost-benefit model for the food/fuel comparison.
2. Identify candidate regions in developing countries for further analysis.
3. Investigate local costs of production, transport, and other pertinent factors.
4. Examine the wider economic dimensions of the problem, such as foreign exchange limitations.
5. Examine possible socioeconomic changes in local communities.
6. Report the findings in a form useful to LDC policy-makers and to development-promoting institutions engaged in decision-making on the energy and food sectors as parts of a comprehensive developmental strategy.

Method

The initial methodological development would enlist the collaboration of agricultural economists already showing interest in this subject. The empirical work would be done in LDC institutions in countries with an active interest in biomass energy potential. The definition of data needs would be worked out jointly by RFF staff and LDC institutions. Data collection and preliminary analysis would be the primary responsibility of the DAIs, while RFF would supervise the final analysis.

Types of Countries and Cooperating Institutions

Its unique pioneering role makes Brazil a highly desirable case. Others should be selected from regions with greater pressures on land, such as a Caribbean or Central American sugar-growing country, a Southeast Asian rice-growing country, India or Pakistan, and an East African mixed agriculture country.

Institutions should be sought with some established background in land use technology and economics.

But all unconventional sources raise questions about long-term costs and reliability.

Analyses of electricity options exist for the U.S. and for some of the other OECD countries. However, cost figures and other relevant factors may differ markedly in developing areas from typical OECD estimates. Costs can be complicated by, among other things, the presence of set prices for fuels produced by nationalized energy industries. To elucidate these issues, one has few electricity cost analyses of any sort for LDCs, and no detailed comparative cost assessment has appeared in the literature. Therefore, energy planners in LDCs often must accept cost estimates from local or national utilities or make rough analogies to OECD-type cost comparisons to assess these alternatives. It is proposed here that an objective study be made to help clarify these issues.

Policy Relevance

This project should help energy planners in developing areas design new generating capacity for future national needs.

Tasks

The study will accomplish the following tasks:

1. Existing U.S. and other OECD analyses will be reviewed.
2. A special technology assessment of large-scale and small-scale hydro power will be carried out.
3. A technological assessment of biomass combustion will be done.
4. Patterns of cost differentials for LDC operation versus OECD operation will be examined.
5. Economic constraints on fuel switching will be considered.
6. Macroeconomic and sociological consequences of fuel switching will be analyzed.

7. Potential local consequences of the International Nuclear Fuel Cycle Evaluation study and other international nuclear policy issues will be investigated.
8. Systems costs for typical LDCs will be examined, both for transmission and distribution as they might be affected by the location of generating plant alternatives.
9. Consequences of the analysis for load management will be sketched.
10. Policy instruments and planning considerations will be suggested.

Method

Existing literature on electrical generation will be reviewed and analyzed. Special analyses will be carried out of hydro power, by means of a critical local review of existing national assessments of hydro potential. The potentialities for direct biomass combustion will be traced on the basis of existing data, and the practical possibilities for specific developing area(s) will be implemented by a local study, using land records and survey techniques where feasible.

LDC costs of construction will be examined for a sample case by the review of local construction costs through documents and interviews. The cooperation of a local utility will be sought for a study of systems problems.

Types of Countries and Cooperating Institutions

The country should have a sizable electric grid already in place, with some variety in present capacity and the possibilities for new capacity. The DAIs involved should include groups used to dealing with the electrical generation problem and with analysis of costs in the building trades and in heavy equipment, plus entities familiar with the general type of social and economic analyses required.

Remarks

RFF should have an unusually strong relative advantage in this area. because of our participation in the Mellon study, as documented in our recent books Energy in America's Future: The Choices Before Us and Unpaid Costs of Electrical Energy.

ENERGY PRICING AND DEMAND MANAGEMENT POLICIES

Background

A characteristic of energy policy in both developing and industrialized countries, at least up to 1973-74, was its piecemeal nature. Energy policy was typically supply oriented and done on a fuel by fuel basis. There was, for example, a policy towards electricity, towards coal if there was indigenous production, and perhaps towards oil imports. There was little attention to demand apart from the levying of often quite high taxes on petroleum products for fiscal rather than conservation purposes.

To some extent things have changed. There is more awareness of the need to take a coherent rather than a piecemeal view of energy policy, and there is greater commitment in theory at least to the importance of demand conservation. While some increasing attention has been paid to the need for energy conservation, little has been done to assess conservation potential in a realistic way (a separate project is devoted to this topic) or how to achieve energy savings.

The present project is addressed to this last aspect--energy demand management policies, especially as they affect petroleum consumption. The purpose of this project would be to draw up a catalog or inventory of energy policies in selected countries, particularly policy changes which have been made since 1973-74. This inventory would include subsidy policy (it is known, for example, that kerosene is frequently subsidized, but not the significance or consequences of such subsidization), the

structure of electricity tariffs and applicability of marginal cost pricing, taxes, price controls, and physical controls including rationing of foreign exchange.

The gathering of such data would in itself be an important contribution to information for policy-making. In addition, it could form the basis of assessments of the effectiveness of existing policies in relation to energy conservation aims (by analogy with the International Energy Agency's review of member countries' energy policies and programs).

Given the objective of expanding the energy data base systematically, this project could be extended to the collection of price data on a consistent basis for a number of countries. Economic analysis of energy consumption in developing countries has been hampered by a lack of price data, either comparative or historical. This project might offer a useful opportunity to collect price data which could be used in econometric and other studies of energy consumption.

Policy Relevance

Demand management may be critical to the efficient solution of energy problems and it is also a very timely topic as countries may be all the more interested in energy demand policies after the recent round of petroleum price increases. It is hoped that his catalog of energy policies and their assessment will act as a consciousness raiser to policy makers in developing (and industrialized) countries. It is sometimes not clear how far de facto policies diverge from stated aims. Furthermore, the inter-country comparisons may provide data for new approaches to other key questions.

Tasks

This study would:

1. Specify the kind of policy and price data which would be needed.
2. Catalogue the energy demand management policies employed in the countries concerned.
3. Gather energy price data largely at the consumer level but also including information on taxes and subsidies.
4. Analyse the equity and other sociological effects of pricing policies.
5. Assess energy demand policies at present in place in the light of conservation objectives.
6. Compare and contrast energy policies in selected countries.
7. Derive recommendations for planners.

Method

This project would have a high LDC institution content. The approach would be for RFF to define the policy areas of relevance, and to give guidance to DAIs on the collection of price and policy data in such a way as to make inter-country comparisons possible. The collection of data and preliminary analysis would be in the hands of the local institutions, while the final analysis would be done at RFF.

Types of Countries and Cooperating Institutions

Ideally we should seek a range of countries with different types of energy policies. These would include countries which widely subsidize some items of mass consumption, such as kerosene, and countries that allocate supplies through the market mechanisms. Suggestions

might include two Asian countries, two African countries, two Latin American countries and one Central American country, but it might be better to have more. Given the data collection aspect of this project, there is interest in having a larger number of countries than in the average projects.

CONSERVATION POTENTIAL IN DEVELOPING COUNTRIES

Background

Rising energy prices and particularly rising prices of imported oil have increased interest in energy conservation throughout the world. In both industrialized and developing countries higher oil prices have contributed to inflation and to lowered growth rates. In particular, developing countries, even before the latest round of oil price increases, were saddled with current deficits over 100 percent higher than they were in the early 1970s. Furthermore, economic growth and development in the LDCs will in the normal course of events be accompanied by rapid increases in consumption of commercial energy of all kinds, particularly oil. Present concerns and future interests therefore dictate considerable attention to energy conservation.

In many countries, of course, non-commercial fuels (woodfuel, charcoal, animal and crop wastes) account for well over one-half of total energy consumption. Various investigations have dealt with the fact that these fuels are used with great inefficiency and therefore also offer considerable potential for conservation. But the focus of the present study, while recognizing the linkage between commercial and non-commercial fuels, will be on the less studied area (in the LDC context) of commercial fuels and especially oil.

We propose here a project to investigate ~~for~~ in selected countries ~~to what~~ to what extent conservation can realistically be counted upon to contribute to the solution of energy-related problems. Major end uses

cial energy--transport, energy-intensive industry, certain

types of urban living patterns--will be identified and possibilities of moderating future energy growth rates by improving energy efficiencies or by reordering the structure of economic activity will be examined. This represents the application of a relatively developed methodology, appplied so far to industrialized countries, to the special needs of LDCs. It is recognized that conservation is not a costless option, and every attempt will be made to include economic as well as technical feasibility of conservation possibilities, especially given expected LDC capital constraints.

Policy Relevance

This topic directly addresses developing countries' concerns about paying for oil imports. Conservation offers a quicker and probably cheaper means of meeting energy demands than many of the alternatives. This is also a subject of obvious policy concern to AID, which though recognizing the importance of energy conservation has made few loans in this area.

Tasks

1. Analyze patterns of energy consumption by main end use for a group of selected countries (see Types of Countries and Co-operating Institutions below).
2. Having identified main end uses of energy, examine the energy intensity of these energy uses.
3. Estimate potential energy saving in each of the end uses in relation to cost and technology parameters.
4. Estimate potential energy savings to be derived from changes in patterns of economic activity and consumption.

5. Assess the societal impact of possible conservation measures.

6. Based on above, assess potential for energy consumption in a series of different scenarios for the selected countries.

7. Validate the above by inter-country comparisons and by historical evidence.

8. Generate recommendations for policy.

Method

The basic analytical and quantitative framework will be done at RFF. Even at the minimum level, the study should yield some usefule conclusions. To extend the analysis--which is particularly desirable--will require close cooperation with institutions in developing areas. They could provide data on major end use activities such as passenger and freight transport, energy consumption by energy intensive industries which would not otherwise be available. There seems every indication to believe that institutions in developing areas would be willing to cooperate in this exercise, as many analysts in LDCs have expressed an interest in this sort of analysis but lack the means to carry it out.

Types of Countries and Cooperating Institutions

In order to leave open the possibility of inter-country comparison, a selection of countries should be made including relatively rich and poor, with different types of economic activity. For example, the following countries present certain advantages:

- India--a low income country with a large industrial sector.
- Kenya--a low income country with a small industrial sector.
- Brazil--a rapidly growing country with a large, well-established industrial sector.
- South Korea--a rapidly growing country with a new industrial base. Institutions not yet identified.

Remarks

The approach in this study will initially resemble that taken in How Industrial Societies Use Energy by Joel Darmstadter, Joy Dunkerley, and Jack Alterman. Less emphasis, however, will be put on inter-country comparisons and much more on detailed end use analysis, and conservation potential.

2 October 1979

RURAL ELECTRIFICATION: A COMPARATIVE STUDY OF DEVELOPMENT EFFICIENCY AND INCOME DISTRIBUTION PROBLEMS

Background

Substantial resources are being devoted by developing countries to rural electrification, for both economic and social reasons. The provision of electricity in rural areas is widely believed to be a stimulus to increased agricultural productivity and output through irrigation and mechanization, to the growth of rural industries, and to raising the living standards of rural people. It is considered important enough to subsidize extensively in most developing countries. Nevertheless, the direction of causation in the relationship between expenditures on rural electrification and the achievement of rural economic development has not been well established.

Two main problems have become evident: The first of these is that provision of electricity by itself may not be sufficient to promote improved agricultural or industrial productivity without the availability of other factor inputs such as marketing, credit, training, fertilizers, improved seeds and adequate equipment and transport, or without generally increasing incomes in an area which will provide demand for local agricultural and industrial products. The second is that the small or marginal farmer or businessman in particular is often unable to benefit from electricity for productive purposes due to the lack of these inputs, and that the poor in general are commonly unable to utilize electricity to improve their conditions of existence.

The project proposed here would therefore be designed as a comparative study of developmental efficiency and income distribution problems of rural electrification. A survey and analytical methodology for evaluating the developmental benefits and costs of rural electrification at the project level would be developed. This methodology could then be applied experimentally in several regions of one country or in several countries, using control areas in the same region in either case in an attempt to separate out the effects of electrification per se from other factors in development. Potential benefits to be measured include household consumption for lighting and appliances, and increased output and employment in agriculture, commerce and industry through the use of electricity for irrigation and motive power and other productive purposes. Sociological influences and changes and indirect public, environmental, and other benefits would be of special interest. The impacts of subsidies and cost comparisons of alternative sources of energy would also be investigated. Equity factors would be important here as well. Using these results the methodology would be modified for future use.

Where possible, implications for macro planning and policy issues would also be examined on the basis of the comparative analysis. System-wide patterns of utilization, general technical and institutional problems, subsidies and pricing policies, alternatives to electrification, decentralized generation prospects, and financial consequences would be investigated. The role of rural electrification in influencing the achievement of broader development goals, such as decentralization of industrial production and population and integrated rural development, would also be an important topic for analysis in the macro approach.

Rural electrification policies of the selected regions or countries would be analyzed and recommendations made.

Policy Relevance

Large sums of money are currently being spent on rural electrification in many developing countries, both by developing country governments and by donor organizations, with a clear idea of the benefits derived from this investment. At the same time alternatives to electrification are being widely discussed. The more precise definition of the relationship between rural electrification and economic development would greatly aid developing country governments and international aid agencies in making policy decisions about future directions for energy investment.

Tasks

1. Review existing retrospective and prospective studies of rural electrification.
2. Develop methodology to evaluate impact of rural electrification projects on economic growth and income distribution at micro level.
3. Select regions or countries, control areas, and institutions to implement methodology.
4. Survey selected areas and control groups to assess developmental costs and benefits of selected rural electrification projects.
5. Analyze and compare data from survey areas and control groups to evaluate household and productive uses, sociological influences and effects, indirect benefits and costs, subsidies, and costs of alternatives, and equity impacts.

6. Compare results from the different project case studies and existing retrospective studies in order to generalize findings.
7. Modify methodology based on project case study findings and experience.
8. Recommend appropriate institutional and policy changes at the project level.
9. Examine implications for macro planning and policy electrification systems, especially the role of rural electrification in influencing the achievement of broader developmental goals.
10. Report policy findings in form useful to developing country decision makers.

Method

The survey and evaluation methodology would be developed at RFF, and regions or countries, control groups, and LDC institutions selected. Implementation of the survey and preliminary data analysis would be carried out by LDC institutions. Comparative analysis and policy recommendations would be accomplished at RFF.

Types of Countries and Cooperating Institutions

Several regions within one country could be selected, or several countries could be used. Countries or regions with rural electrification programs at different phases of development, and with different objectives within their programs would be desirable. In either case, similar control groups within the same region or country would be necessary. Some possibilities for countries are:

-- India is an obvious choice because of its considerable experience with analysis of impacts of electrification and its emphasis on the productive uses of electricity. RFF also has excellent contacts with a number of Indian researchers and institutions knowledgeable about rural electrification.

-- Taiwan or Korea, countries with virtually complete rural electrification and relative decentralization of industry, would also be of great interest.

-- Costa Rica or Colombia, countries where AID has had electrification projects in Latin America.

-- In Africa, a country where deforestation has been a problem.

Remarks

An analytical literature survey paper on rural electrification and development, indicating the need for more definitive research, has already been prepared by RFF in connection with the Ford project. The project described here is potentially large, and may have to be divided into sections or phases.

Draft
3 October 1979

ENERGY IMPLICATIONS OF ALTERNATIVE DEVELOPMENT STRATEGIES

Background

In a broad sense, the entire ARDEN program is concerned with the interaction between the energy sector and broader developmental patterns and policies. Since low-cost oil is no longer available in virtually unlimited quantities on world markets, development planners everywhere must be concerned (a) to minimize the impact of higher energy costs (domestic or foreign) and higher import costs on their ongoing developmental strategies, (b) to develop their own energy strategies for supply, conservation and use of various possible energy sources, and (c) to modify their broader development strategies if necessary to accommodate constraints of changing costs, availabilities, and technologies in the energy sector.

There is not available a well-defined taxonomy of alternative development strategies into which countries can be neatly fit. Even if there were, the variety among LDCs in size, resource base, skills, infrastructure, income levels, and external economic relationships would make unlikely any simple relationship between a given development strategy and a particular pattern of energy supply and use. Perhaps the best demarcated classification - between import-substitution industrialization and exported-oriented industrialization - does not have a systematic relationship to energy demand. On the other hand energy patterns and policies appear highly relevant to strategies emphasizing primary resource development and to strategies emphasizing balance in regional development, industrial decentralization, and avoidance of excessive metropolitan concentrations.

In view of its popularity in the "development community" and some donor countries, the "basic human needs" strategy would seem to be an especially

rewarding object of systematic study - contrasting its energy implications with those of more conventional growth strategies. But spokesmen for the organized group of LDCs (the "G-77" in the United Nations) have been hostile to what they claim is a disproportionate preoccupation with basic human needs at the expense of other legitimate developmental goals. It is questionable whether any empirical case exists of a "pure" basic human needs strategy.

Two potentially fruitful lines of research are suggested by these reflections. The first is to explore the feasibility of systematic comparisons of energy-development relationships in matched pairs (or groups) of countries with contrasting characteristics in the broad thrust of their developmental policies. The second is to focus on a narrow but important subset of "alternative development strategies" consisting of contrasting approaches to technology for industrialization: capital-intensive on the one hand, with heavy reliance on imports of both capital goods and technology, contrasted with labor-intensive "appropriate" technologies maximizing use of indigenous resources and established skills. Improved understanding of the energy dimension of alternative industrial technologies might contribute significantly to the formation of sound industrial policies.

Policy Relevance

If the data are available and the analyses are feasible, the studies should indicate whether and to what extent energy considerations should influence choices among broad development strategies or among alternative industrial technologies. If they are found to be neutral in relation to energy, that conclusion would be useful in avoiding irrelevant distractions to sound policy-making. If not neutral, they should point to possible energy constraints or to ways of relieving such constraints.

Tasks

These studies would require a longer period of preliminary investigation than most of the others under consideration. The special country comparisons would require the following:

1. Identification of matched country groups. (Possibilities that come readily to mind include (a) Kenya and Tanzania; (b) Taiwan and Sri Lanka; (c) Colombia, Peru, and Argentina; (d) India and China; and (e) India and Brazil.)
2. Selection of variables for intensive study, and ascertainment of availability covering a substantial time period.
3. Statistical testing of various hypothesized relationships.
4. Formulation of tentative findings on energy supply and use patterns associated with contrasting development strategies, with possible implications for policy.

The study of energy and alternative industrialization technologies would require the following:

5. Identification of industrial sectors of substantial importance in numbers of developing countries and displaying considerable variation in capital or labor intensity.
6. Analysis of forms and amounts of energy use related to variations in technology.
7. Formulation of findings on energy supply and use patterns associated with contrasting industrial technologies, with possible implications for policy.

Method

As already indicated, both sets of studies would require extensive preliminary investigation. The country studies would start with a review of national statistical materials and studies by the World Bank, Regional Banks,

and AID, aided by consultation with country specialists (indispensable in the case of China). The bulk of the first phase would be done in Washington, leaving the possibility of a second field phase for later determination. The industrial studies, on the other hand, would require intensive field work by LDC institutions in a number of relatively industrialized LDCs, all following a common design of data collection and analysis.

Types of Countries and Cooperating Institutions

Suggested candidates for country studies have been listed above. Industrial studies would be most useful in the NICs ("newly industrializing countries") and near-NICs, but also including some sectors such as textiles, furniture, shoes, farm implements, and food processing found in large numbers of developing countries. The institutions would require competence in industrial economics with some strength also in engineering.

Remarks

This project may more logically be done at a later time in the program, when it can benefit from the results of other projects.