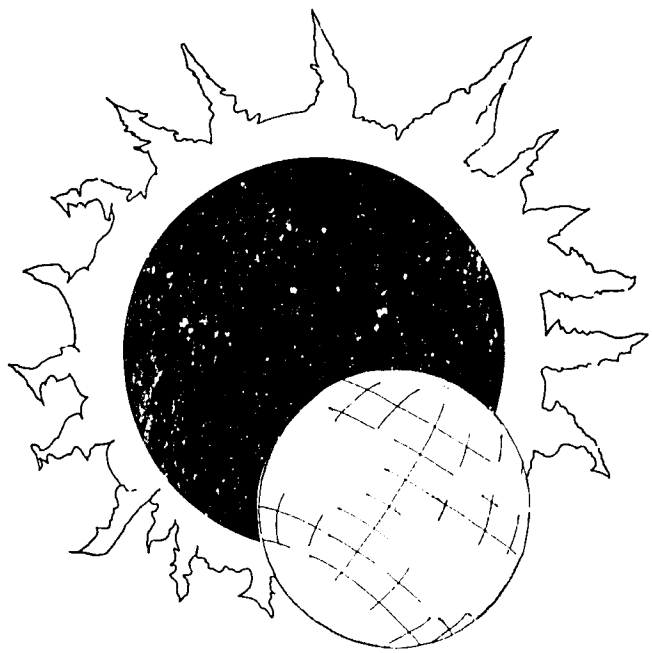

TRAINING IN ALTERNATIVE ENERGY TECHNOLOGIES

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TRAINING IN ALTERNATIVE ENERGY TECHNOLOGIES

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GROUP PROJECT

RESOURCES ASSESSMENT

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"Nevertheless, despite all the uncertainties, we must prepare for the future"

Eduardo Sibaja
Fernando Gonzalez
Joaquin Santaella

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SUMMARY

The purpose of this report is to identify the major needs for improved data on energy consumption, to specify the types of data that should be collected, and to suggest some general methods of collecting and organizing these data for use in designing and evaluating an energy public policy in less developing countries (L.D.C.'s).

INTRODUCTION

Improved energy consumption data are needed for several purposes.

1) Data are needed to describe and monitor energy consumption.

2) Data are needed to model and predict changes in patterns of energy use, both short-term and long-term.

3) Data are needed to assess the effects of policy changes.

All three functions -- monitoring, modeling and assessment -- involve the collection and analysis data. Each function requires different types of data, and those data are further differentiated by the needs of data users -- individuals, firms, or governmental agencies at the local, state, or national level.

DESCRIBING AND MONITORING ENERGY CONSUMPTION

Accurate description of energy consumption patterns is basic to the formulation and implementation of effective policies. Monitoring energy consumption provides information about the total amount of energy consumed, the forms in which energy is consumed, and the end uses served. Moreover, monitoring implies continuous or repeated measurement, so that information is provided about both the rate of consumption from one time to another. Such data can be used to describe what happens to actual rates of energy consumption over time.

The limitations of monitoring for purposes of policy making are inherent in its all-inclusiveness: monitoring data reflect all the factors that influence energy consumption. The changes in energy consumption from one monitored time to another incorporate the effects of old policies as well as recent ones, changes in supplies and prices, public information about energy stocks and future trends, and many other institutional,

social and economic factors that influence energy consumption.

MODELING ENERGY CONSUMPTION

Policy makers must be aware of changes in consumption, but they require a more complex kind of information as well -- information that helps to explain the cause of such changes. The purpose of explanation, in contrast to description, is accomplished by the various analytic procedures called modeling. To model something is to identify its major causes and show how each of them enters into the processes that affect the outcomes.

Models of energy use are devices -- such as statements of statistical relationships, mathematical functions, physical or engineering relationships, and the like -- for explaining the factors that have affected energy consumption in the past and may determine future consumption under various possible circumstances. A model of energy consumption for the household sector, for example, would be based on analyses of how housing characteristics, appliance stocks, income levels, household composition and energy prices affect household consumption of various forms of energy. Such a model could generate estimates of how changes in energy prices or subsidies for the replacement of existing appliance stocks would affect consumption.

Empirical models of energy consumption can provide explanations and even estimates of the effects of public policies, but models are always simplified versions of reality and their estimates are subject to error. Unanticipated events or forces not incorporated into a model may substantially weaken its ability to mimic real processes. Policy outcomes typically remain problematic to some degree, even when a model has apparently

predicted or explained them.

ASSESSMENT OF ENERGY POLICY

Responsible policy assessment requires knowing "not only how and why" patterns of energy consumption change, but also how those changes may affect other economic, social and institutional aspects of national life. Not all assessment activities require the collection of data different from those needed for monitoring and modeling: a good monitoring system can sometimes be used to assess changes resulting from a given policy, using statistical procedures to isolate the effects of the policy from the effects of other factors; and data collected for modeling are often useful for assessing the effects of policies. However, some assessment activities require collecting different kinds of data, both experimental and non-experimental like we do.

The costs of implementing some proposed policies, the almost inevitable uncertainties and disagreements about their effectiveness, and the difficulty of identifying their specific effects contribute to the importance of controlled and randomized field experiments as a tool for policy assessment. Such experiments can be considered extensions of modeling; they test models and provide empirical estimates of the parameters of models. More importantly, they permit the testing and evaluation of policies on a relatively small scale -- a scale on which failure or unexpected results can be tolerated and the information gained can be used to improve both models and policies.

SECTION 1

BRIEF REMARKS ABOUT ENERGY RESOURCES ASSESSMENT

1.1 HYDROPOWER

1.1.1 CONVENTIONAL HYDROPOWER

As a renewable source of energy, water is the only one that has been exploited by man on a large scale and that has a well developed technological base to support its continued exploitation (at present, about 23% of the world's electricity supply is from hydro plants).

For the reliable design of hydropower projects there is a necessary basic data, like: river flow measurements, sediment content of streams, geographic location, etc.

Project designs thus far appear to be adequate, although additional attention must be paid to the determination of project generation capacity, giving full attention to the multipurpose (electrical generation, irrigation, flood control, etc.) use of the available water.

It is well recognized that hydropower can be a valuable resource to any country, not only because of its relatively low cost per kilowatt-hour but also because its increased profit does not require increased dependence on external sources of fuel, neither requires excessive imports, it is nonpolluting and it can provide water for irrigation, municipal uses, flood control, recreation and production of fish. In fact, in a well-designed electric power system, hydro facilities provide a reliability and flexibility unmatched by far more expensive power generation systems.

1.1.2 MINI-HYDRO

At present, there are many mini-hydro plants (1 - 10 MW or less) contributing in local energy supply in many parts of the world. Basically, the assessment and use of mini-hydro requires the same basic data as that of conventional hydropower. The large number and different

character of potential new sites make it very difficult to determine which are the most attractive for development: that is, not two plants are exactly the same and their costs vary considerably.

Clearly, mini-hydro plants are more attractive when they have a load center nearby, since the transmission distances are short and existing infrastructures could be used (i.e. rods, power lines, transformers, etc.), but in the case of remote areas the importance of the mini-hydro should be greater because one of these plants can supply energy and power to a human group, which would not get them in other conventional ways. In the case of these remote and non-developed zones, a plant of mini-hydro could occupy a unique position in the development of the region. Many more mini-hydro sites should be certainly identified and a concerted effort to fund and develop such sites would provide satisfaction far beyond that indicated by mere economic analysis.

A mini-hydro plant's site is an asset that could be maintained in service for many decades by simply rewinding the generator and renewing mechanical parts. Many hydro plants have operated for 50 years.

1.2 SOLAR POWER

All countries in the world receive some solar energy. This amount varies from a few hundred hours per year to almost four thousand, depending on the location. Solar energy is the ultimate source of most forms of energy used now and it has many advantages when it is used directly (is clean, safe, free, etc.).

But, the fact that solar energy is free does not mean it will automatically have a low utilizing cost. Several solar devices are now available in the market and their price varies from country to country. Their efficiency also varies. That is why it is difficult to name a fixed price for a solar article. Anyway, a wide line can be drawn out regarding the market for each type of solar equipment available at present.

For the particular application of solar energy a basic data is needed also. It includes the quantity of solar radiation falling in a certain place, the number of sun-hours in the same place, wind velocity, property of materials, costs, etc.

Solar energy research has been confined to the pure researchers since the latter years of the last century. Since then, several solar energy utilizing devices have been designed, studied, built and tested, such as heaters, stoves, stills, dryers, refrigerators, air conditioners, pumps, photovoltaic cells, etc.

However, only one solar technology well enough established to be tapped immediately, based upon extensive experience and promising economics, is the hot water heating system.

It should be noted that if the governments of each country provide investment incentives to stimulate the generalized use of solar water heaters, they could recover most of their investment over a period of

almost ten years, not to mention the savings in oil imports and the stimulation of the domestic economy through solar heater manufacturing and installation.

This is because when considering the cost analysis, generally, the prime consideration is given to the capital investment and, at present, solar energy devices are still more expensive than any fuel device. But due to the rising cost of conventional fuels this could be changing.

Mentioning other possible useful solar energy applications, the solar pond should be able to provide heat and/or electrical power as well in the future. Also, the use of flat plate solar energy collectors for a variety of applications (like dryers, refrigerators, air conditioners, space heaters) is becoming profitable. The use of "passive solar energy", that is, the application of solar energy without any special device should be very useful if a well designed policy is followed. Intermediate and high temperature solar applications (evacuated tubular collectors, linear parabolic troughs, power towers, parabolic and cylindrical concentrators, etc.) show long-term promise.

Other solar technologies like photovoltaics, water pumping, cooking, etc. also show promise for the future and are expected to contribute to the energy supply in the following decades. In the particular case of photovoltaics it could be very useful but only when the prices decrease measurably.

Concluding, one of the major economic advantages of solar energy is that it is available in any place of demand, besides, with the use of solar energy appliances minimum care after construction is needed.

One of the possible ways to improve the profit of solar energy is in the hands of the governments. They can stimulate its usage by educating

the potential consumers and by providing certain investment incentives. A rational program should include incentives also for the manufacturers, repair services, financing, etc. in order to reach a real advantage with the direct use of solar energy.

1.3 BIOMASS

Biomass could be a very important source of fuel, like ethanol and methane gas, that is, high-quality fuel. At present, it is probably unrealistic to contemplate extremely large scale deployment of biomass conversion systems, mostly due to the land requirements and agricultural problems. Significant quantities of agricultural residues are generated during harvesting and also during processing operations. It is not expected that the agricultural residues left in the fields be collected and used for generation of energy in appreciable amounts for several reasons:

1 - In the collection process there are a lot of difficulties.

2 - The agricultural residues provide very important nutrients for the soil.

3 - Many of these residues are used for animal feed.

4 - The residues protect the ground by acting as a cover, until the next crop.

5 - In many cases, the agricultural wastes are not well concentrated.

Other kinds of problems to be considered are: conflicts with food and traditional forest industries, the remoteness of some forests and principally certain types of social problems since the work with biodigesters, for instance, is not so agreeable to do.

But, anyway, the production of liquid and gas fuel by using organic wastes like raw material must be well studied and developed because in the future it will represent a very important source of energy and, maybe, biomass could be assuming the role of petroleum.

1.4 FOSSIL FUELS

It is perfectly known that the world depends in a very large proportion on the fossil fuels, as well as is also known that these fuels are not inexhaustible; the amount of utilizable fossil fuels must be determined as a function of its accessibility and certain environmental considerations.

But this is not the principle problem; in talking about fossil fuels it is necessary to say that their prices are becoming more expensive each day, and their increasing use may lead to potentially climatic and environmental changes. Anyway, each country should have a rational assessment about its specific fossil fuels potential. In order to do this, the following subjects should be considered.

1.4.1 COAL, PEAT AND LIGNITE

In this case, the determination of zones of deposition of these fuels and the projected cost of power distribution are the most important aspects. Here, all the properties, uses, exploitation, prices, etc. of each one of the mentioned fuels should be enclosed.

1.4.2 OIL AND GAS

In the case of oil and gas, the prospection is even more necessary, but is more expensive than in the other case. Since the oil and gas are the most common fossil fuels, their use is more common. That is why, when talking about fossil fuels, the idea of oil and gas (in that order) immediately comes.

The importance of the fossil fuels for the world, at the present time, is very well established. The governments of each country should

adopt as a prudent energy policy a strategy that permits a well organized way to profit from the existent fossil fuels, taking into account all their advantages and disadvantages.

1.5 OTHER RESOURCES

1.5.1 WIND

The basic data for the wind as an energy source includes wind speed duration, frequency and direction.

In certain regions of the world, the wind energy can make significant contributions to the energy consumption (especially in rural areas for water pumping) but, in any case, could become the unique solution to the energy requirements. The particular design of a "wind machine" will depend on the data available (preferably from a network of meteorological stations).

1.5.2 GEOTHERMAL

At the present time we cannot consider geothermal energy as an interesting freak of nature or as a tourist attraction (geysers, fumaroles). Geothermal energy could be one of the most attractive energy sources. Basically, there are three types of geothermal resources: the hydrothermal convection system, the regional conductive environment and the hot igneous system. Under actual conditions only the first type is commercially attractive.

It's possible to find geothermal resources in many types of geologic formations, and generally they are in different stages of maturity for commercialization.

Anyway, the development of geothermal resources requires a major effort, including the improvement of existing exploration and assessment technology, meaning the application of such technology to accelerate the identification of major types to geothermal resources.

SECTION 2

SECTORIAL ENERGY CONSUMPTION

2 SECTORIAL ENERGY CONSUMPTION

2.1 INDUSTRY

In the broadest sense, the industrial sector consists of all non-household activity that involves the production of goods and services that are used throughout the economy. This sector covers the energy consumption of the manufacturing industries. Due to the large size of this sector, we recommend making the energy analyses by sub-sectors, following a scheme like this:

Mining
Cement
Sugar
Food and Beverages
Glass Containers
Paper
Petroleum Refining
Textiles
Chemicals
Iron and Steel

The industries are centers of high energy consumption, especially of electricity, diesel oil, fuel oil (Bunker C), wood, and bagasse. In order to evaluate the energy consumption of this sector, we designed a data gathering table for enterprises (industry and commerce), that is shown in Section 2.1 of this report.

A number of potential options for reducing energy use in these sub-sectors could be developed. These include the following:

a) an energy use reporting system, which by heightening energy awareness reduces energy waste and improves maintenance,

b) improved efficiency through conservation measures,

c) a study of refinery reconstruction to allow use of heavy high sulfur crude oil,

d) use of cogeneration in several industry sectors. Cogeneration and other waste heat applications could be instituted in a number of industries, most importantly the petroleum refinery, textile and chemical industries, sugar mills and paper industry,

e) plant redesign to include more energy efficient processes, notably greater use of the semi-dry process in cement making,

f) fuel switching,

g) solar energy to meet a portion of thermal energy requirements,

h) finally, some financial incentives to conservation could be assumed, such as investment tax credits and low cost loans to accelerate introduction of new energy efficient equipment.

The standard industrial classification (SIC) provides a systematic framework within which economic activities are defined and organized. This coding and classification system is widely used by both government agencies and private industries to maintain comparability of statistical data. Major industries that are functionally similar are called divisions, designated by the letters A - K. Major groups of industries within divisions that use similar processes or produce similar products or services are designated by a numerical code in which the first two digits correspond to divisions. Additional digits may be used to provide a subclassification of industries within major groups. The major divisions of the SIC system are listed on the following page.

DIVISION	INDUSTRY DESCRIPTION	NUMERICAL CODES (FIRST TWO DIGITS)
A	Agriculture, Forestry and Fishing	01 - 09
B	Mining	10 - 14
C	Construction	15 - 17
D	Manufacturing	20 - 39
E	Transportation, Communications, Electric, Gas and Sanitary Services	40 - 49
F	Wholesale Trade	50 - 51
G	Retail Trade	52 - 59
H	Finance, Insurance and Real Estate	60 - 67
I	Services	70 - 89
J	Public Administration	91 - 97
K	Non-Classifiable Establishments	99

The major groups of the SIC system are listed below:

I. Processes That Change Molecular Structure of Materials

Sic Code	Industry
28	Chemicals and Allied Products
33	Primary Metal Industries
29	Petroleum and Coal Products
26	Paper and Allied Products
13	Oil and Gas Extraction

II. Processes That Change State or Configuration of Materials

Sic Code	Industry
32	Stone, Clay and Glass Products
15 - 17	Construction
20	Food and Kindred Products
01 - 09	Agriculture
35	Machinery Manufacturing
22	Textile Mill Products

Industry's statements of conservation goals may be considered an estimate of the combined effects of changes in processes, prices, regulatory practices, and fuel availability. However, much more detailed data are needed to analyze the energy embodied in finished products.

2.2 TRANSPORTATION

Energy consumption for transportation could be disaggregated into nine categories:

Urban Mass Transit

Interurban Mass Transit

Private Automobiles

Large Trucks

Small Trucks (Pick-Up, Vans)

Private Autobuses

Aircraft

Ships and Boats

Miscellaneous

Most of the less developing countries import all or almost all the petroleum they consume, so we can say that this sector is very important in the current energy balance because it consumes petroleum byproducts in its totality; basically gasoline, diesel oil and jet fuel.

Urban and interurban mass transit and private automobiles are the most important areas of concern, based on the range of energy consumption possible in the future. Urban mass transit can conserve substantial amounts of fuel through successful implementation of systems, such as large-scale minibus systems and trolleybus systems. Substitution of larger capacity vehicles for those with smaller capacity with maintenance of equal or better levels of service is the key to curbing energy consumption.

This same generalization holds for interurban mass transit. It is important to utilize minibuses and large buses to replace retiring automobiles and to accommodate increased ridership. Otherwise, fuel

consumption will rise at an unnecessarily high rate.

Private automobiles also have the potential to rapidly increase fuel usage. For this category it is important to use import tariffs and licensing and registration fees to encourage the purchasing of the most efficient automobiles, and to discourage discretionary driving.

Large cargo carrying trucks have considerable potential to conserve, but the structure of the trucking system makes it highly unlikely that more than a small portion of this potential can be realized by year 1990 or even year 2000.

In order to reduce the petroleum consumption in this sector, we suggest that the less developing countries, according with their government energy policies, analyze the possibility of using a new technology in this field, such as:

a) Electric and Hybrid Vehicles

b) Gasohol

c) Methanol

d) Hydrogen Economy

In the long run, the demand for gasoline is derived from the characteristics of the stock of motor vehicles. In effect, consumers buy an entire set of characteristics when they purchase a vehicle. These characteristics include size, power, comfort, specific features such as air conditioning as well as characteristics such as costs of maintenance, repair, and fuel. The optimal set of characteristics demanded can be expected to change because of changes in family size and geographic location or because the cost associated with the various characteristics changes. In general, higher gasoline prices provide consumers with the incentive to trade size, performance and comfort for more fuel economy.

2.3 COMMERCIAL SECTOR

The commercial sector as defined here consists of the standard commercial enterprises such as shops, offices, etc. and a residual of activities not classified elsewhere, such as construction and public services. This diversity rules out the possibility of characterizing energy use in the commercial sector by a single pattern of end uses. Somewhat greater uniformity emerges by dividing the sector into the following subsectors:

a) Standard Commercial Activities - offices, shops, etc.,

b) Construction - mainly the energy demand of equipment and machinery at construction sites,

c) Government - primarily national and municipal offices,

d) Public Services - water, sewage, garbage, road maintenance, public lighting, etc.

Primary energy demand in the commercial sector is usually almost entirely supplied by electricity, LPG and diesel. In order to evaluate the energy consumption of this sector, we designed a data gathering table for enterprises (industry and commerce), that is shown in Section 2.1 of this report.

The problems of energy consumption measurement for commercial buildings are more difficult than those of the other sectors covered in this report, excluding of course the rural sector. These difficulties stem from several causes:

1) the lack of uniformity in the definition and concept of the various activities that constitute this sector,

2) the wide diversity of activities covered by the sector and the diversity in the types of structures and equipment used, and

3) the lack of basic data necessary to describe energy use even at the aggregate level.

An examination of the data currently available for energy consumption in this sector suggests that data on energy consumption should be collected on a sample survey basis to establish benchmark energy consumption data. The survey design and the sample size should be developed to yield estimates for the many disparate units of the commercial/service sector.

The lack of a consistent definition of the commercial sector seriously interferes with careful acccuating of energy consumption. Energy used in the commercial/service sector is dominated by commercial activities and the public services. So few details are known about energy use and the characteristics of energy-consuming structures and equipment in this sector that the most urgent need is for a benchmark survey of energy consumption patterns.

Greater consistency would be especially useful in defining and reporting in those areas of the commercial/service sector that currently cannot be accurately separated from the household or industrial sectors.

2.4 RURAL AND URBAN SECTOR

Larger energy supplies and greater efficiency of energy use are necessary in the rural area of L.D.C.'s (less developing countries) to meet the basic needs of growing populations. Energy supplies must grow more rapidly than population in order to raise the quality and quantity of human diets, increase incomes and employment and relieve human drudgery. Greater efficiency of energy use, as well as additional sustainable energy supplies, are needed for cooking, and other domestic activities of rural households.

In the tropical or sub-tropical climates of most developing countries, more food can be grown on existing cultivated land by double- or multiple-cropping and by increasing the yield of each crop, that is, the production per unit area. Both double-cropping and higher yields will usually require more water for irrigation and larger doses of chemical fertilizers, as well as use for machinery for seed-bed preparation and other farm work. All three of these inputs depend upon increased energy supplies. In most rural areas, modernization of agriculture also depends upon greatly improved transportation to enable the farmer to receive higher prices for his crops and to lower his costs. Additional energy is needed to fuel the vehicle (other mode) used in transportation.

Traditionally, nearly all energy used in rural areas has been of biological origin, in the form of human and animal labor, and wood and other plant materials. Of these, the greatest untapped potential lies in plant materials, which are usually designated collectively as Biomass.

Throughout history, the major source of energy for most mankind has been the photosynthetic conversion of solar into chemical energy. In absolute terms, biomass net energy production (photosynthetic production minus

plant respiration) is very large. Most of it takes place in the world's forests.

The quantity of biomass energy that can be utilized in the world economy is constrained by several factors:

1) the low efficiency of photosynthetic conversion of solar energy,
2) the fact that the sustainable yields from forests are relatively small fractions of net primary production,
3) the existence of necessary alternative uses for biomass,
4) the necessity of using non-biomass energy to attain an increase in sustainable biomass yields,
5) the requirement for substantial investments, if sustainable yields are to be raised,
6) the great distances between many forested areas and the regions of high energy demand, which require that much energy be used in transportation of harvested wood to the point of use,
7) the necessity to use some energy in harvesting, and
8) the growing demands for forest land for agriculture and other human uses.

Another point of view on analysis of energy alternatives for less developing countries (L.D.C.'s) requires an assessment of present conditions and the availability of resources for future energy alternatives, as well as the identification of socio- techno-economic parameters which have to be satisfied for the successful implementation of desirable energy alternatives.

In fact, the purpose of this report is to identify the major needs for improved data on energy consumption, to "specify the types of data that should be collected", and to suggest some general methods of

collecting and organizing these data for use in designing and evaluating public policy.

Really, L.D.C.'s total energy consumption depends collectively on millions of separate decisions and on the social and institutional structures within which these decisions are made. The use of energy is deeply rooted in practically every aspect of contemporary social and economic behavior. Information about how energy is used is inherently more difficult to collect and organize than information about how energy is produced. There are several reasons for this:

1) Most energy use decisions are decentralized and highly diverse.
2) Detailed records are seldom kept.
3) Energy costs are a small fraction of the total costs of many activities.

Accordingly, no single scheme of data classification is likely to be applicable to the many public policies that may affect how energy is used. Another thing is that we suggest it useful to discuss energy consumption in terms of the end users in different sectors of the economy. We recognize that the data needed to describe energy consumption is <u>essential</u> to the formulation of appropriate public policies. For that reason we designed a data gathering for one of the most important sectors of the economy, the Rural-Sector (see Section 3.3).

A lot of L.D.C.'s energy use in households falls into relatively distinct rural and urban consumption patterns. These patterns are determined, in turn largely by income and the availability of fuels. For example (Spanish speaking Caribbean islands) in rural households, wood and to a lesser extent charcoal are predominant energy sources, as these fuels can be obtained in part at little or no monetary cost.

The household sector (urban) is important in an analysis of L.D.C.'s energy consumption as a direct consumer of energy. In the judgement of our group project, urban household energy consumption can be modified by a variety of energy conservation policies that could be adopted in all levels.

Energy consumption data requirements for this sector can be classified under two general headings: (1) data required to describe and measure the amount of energy consumed and (2) data required to model and explain the amount of energy consumed.

On the other hand, explaining the amount of energy consumed in the household sector requires the data necessary to answer such questions as:

- What would be the effect on the amount of electricity consumed if the use of natural gas were decontrolled?
- How might households change their use of appliances if they knew the actual energy costs of operating them?

Answering such questions requires other information besides the physical amounts of energy consumed. Information is also needed on the factors that determine the amount of energy consumed (e.g. prices of fuels and electricity prices of other goods) (see Section 3.2).

SECTION 3

TABLES FOR DATA GATHERING

3.1 DATA GATHERING FOR INDUSTRIAL SECTOR

Person who will answer _____ Position _____

1. a) How many people work here during the year?

   b) How many enterprises, businesses or industries have you worked for during this year?

   c) Has your enterprise been inactive during the past 12 months? How many months?

2. a) What kind of enterprise(s), business(es) or industry(ies) is THIS?

List the commercial name, code (according to the International Industries Uniform Classification CIIU) and the main final products.

Name	CIIU (3 Digits)	Final Products

3. How many people normally work in this enterprise? _____

4. a) During the past year, how many months did this enterprise work?

b) During this period of work, people worked in this enterprise like the following detail:

with salary _____

payment by job _____

total _____

c) During this same period, how many persons worked overtime?

d) What's the mean salary?

5. a) What is your capital worth? _____

b) What is your equipment cost? _____

c) Floor area of your company _____

d) Distance between your neighboring buildings _____

6. a) Total value of the net sales during the past 12 months

_____

b) Cost of raw material and additional equipment _____

c) Cost of salaries _____

d) Others _____

e) Other raw material input and their quality _____

USE OF GASOLINE AND FUEL OIL

7. What fuels did your enterprise use during the past 12 months?
(If the answer is none, go to Question 9.)

	Total* consumed (gallons)	Price per gallon	Total value* consumed $	Amount of Used Fuels Per Equipment					
				Engines Prand Code	No. CF Amount	Engines Brand Code	No. No. Amount	Engines Brand Code	No. No. Amount
Gasoline			$ .00						
Gas Oil			$ .00						

8. How far is your fuel supplier from your enterprise?

a) Gasoline _____ km

b) Gas Oil _____ km

NOTE: Interviewer: Use the following code for the way of use of fuels:

1 - pump
2 - to produce electricity
3 - to transport products
4 - people's transportation
5 - fabrication of equipment

USE OF ELECTRIC ENERGY

9. How much electric energy (non produced in the enterprise) did your enterprise use last month? (If the answer is none, go to Question 10.)

	Number of kwh	Total cost	Type of Equip. Code No. hr/day	Code No. hr/day	Code No. hr/day	Code No. hr/day	Code No. hr/day	Code No. hr/day
			Number of Each Type and Time Used By the Equip. (Per Day)					

NOTE: Interviewer: Use the following code for the electric energy use:

1 - bulb (60 w)
2 - bulb (100 w)
3 - tape & record player
4 - refrigerator
5 - fans
6 - mixer
7 - water pump
8 - 8,000 BTU (120 u)
9 - 10,000 BTU (120 u)
10 - 12,000 BTU (200 u)
11 - 15,000 BTU (200 u)
12 - 21,000 BTU (200 u)
13 - 24,000 BTU (200 u)

Air conditioned
14 - electric equip* used in your industrial process

KEROSENE AND LPG USES

10. How much kerosene and LPG did your enterprise use? What about the prices? (If the answer is none, go to Question 12.)

	Purchased quantity	Time of use (dys)	Total cost	Appliance and Consumption			
				Code Amount	Code Amount	Code Amount	Code Amount
Kerosene	bot	dys	$ .00				
LPG	kg or lb	dys	$ .00				

11. How far is your enterprise from your kerosene supplier? _____ km

NOTE: Interviewer: Use the following code for the appliances:

1 - stove 3 -
2 - water heater 4 -

OILS AND GREASES USES

12. How many oils and greases did your enterprise use the last 12 months? (If the answer is zero, go to Question 14.)

	Total purchased amount	Unit	Cost per unit $	Used Quantity Per Apparatus					
					Amount		Amount		Amount
				Code	Number	Code	Number	Code	Number
Oils									
Greases									

13. How far from your enterprise is a) the oil supplier? _____ km

b) the grease supplier? _____ km

NOTE: Interviewer: Use the following code to indicate the way of consumption:

1 - tractor
2 - pump
3 - truck
4 - electric energy generator
5 - other vehicles
6 - process equipment
7 -

USES OF OTHER TYPES OF FUELS

14. Did your enterprise use another type of fuel during the past 12 months? (If the answer is zero, go to Question 29.)

	Purchased			Non Purchased			Amount of Used Energy Per Apparatus*					
	Amount	Unit	Cost per Unit	Inside* Your Place	Outside* Your Place	Unit	Code	Amount	Code	Amount	Code	Amount
Woodfire												
Charcoal												
Others												

15. How far from your enterprise is your a) woodfire supplier _____ km

b) charcoal supplier _____ km

NOTE: Interviewer: Use the following code to indicate the way of consumption*:

1 - stove 3 - hearth
2 - furnace 4 - process equipment

If this enterprise is not in the transport business, go to Question 19.

If it is, continue with Question 16.

16. What kind of products do you transport? a) _____

b) _____

c) _____

d) _____

e) _____

f) _____

17. What kind of vehicle(s) do you use to transport your products?

a) _____

b) _____

c) _____

18. a) How long do your vehicles run per day?*

b) What is the average distance of a round trip?*

c) What is the average distance with the discharged vehicles?*

d) How many miles per gallon do your charged vehicles run?*

e) How many miles per gallon do your discharged vehicles run?*

(If this enterprise does not store nourishing products more than a week, the interview is over.)

19. What products do you store and what is the storage time?*

Product	Time

20. What is your storage capacity?*

a) refrigeration*

b) non refrigerated*

c) other*

3.2 DATA GATHERING FOR URBAN HOUSEHOLD

Date: _____ Hour: _____

Address: _____

Name of Head of Household: _____

Interview No: _____ Interviewer's Name: _____

City: _____ Region: _____

FAMILY SIZE

1. a) How many persons actually live in your house, including your own family, relatives and friends. Total _____

   b) How many are over 64 years old? _____

   c) How many are men between 15 and 64? _____

   d) How many are women between 15 and 64? _____

   e) How many are under 15 years old? _____

OCCUPATIONS OF THE FAMILY

2. a) How many have been working for a salary during the last 12 months? _____

NOTE: The interviewer should fill in the following table, asking: Name, Type of Work, Salary Earned and Time Worked.

Use the following code to show the salary period:

1. Daily 2. Weekly 3. Monthly 4. Semi-monthly

5. Payment by Job

Name	Occupation	Days or Months Worked in the Last 12 Months	Salary (Daily, Weekly, Monthly, Semi-Monthly, By Job)	Total Earned in the Year
		___ Mo ___ Days	Code: By _____	
		___ Mo ___ Days	Code: By _____	
		___ Mo ___ Days	Code: By _____	
		___ Mo ___ Days	Code: By _____	
		___ Mo ___ Days	Code: By _____	
		___ Mo ___ Days	Code: By _____	

b) How much money have you received from other jobs, such as rent, pension, etc. _____

WOOD UTILIZATION

3. a) During the last 7 days, how many wood sticks or logs did you use for domestic purposes in your home? _____

(If the answer is zero, go to Question 4.)

b) What was the cost of the wood used in the last 7 days? _____

c) Who bought the wood? _____

d) How much of the wood was free? _____

e) How do you obtain the wood? _____

f) In what way was the wood used?

1. _____ Quantity _____

2. _____ Quantity _____

3. _____ Quantity _____

g) What type of stove do you use? _____

Interviewer: Sketch the stove:

h) What type (specie) of wood is used?

Type or specie _____

Type or specie _____

Type or specie _____

i) What is the distance (in km) between your house and the place you obtain the wood? _____

j) What is the average diameter of the wood that you use? _____

KEROSENE UTILIZATION

4. a) How many bottles of kerosene did you use in the last 7 days in your house for domestic purposes? _____

(If the answer is zero, go to Question 5.)

b) What was the cost of the kerosene used? _____

c) In what way was the kerosene used?

1. _____ Bottles _____

2. _____ Bottles _____

d) What is the distance (in km) between your house and the place you obtain the kerosene? _____

e) What is the size of the container you use to buy the kerosene? _____ liters

f) How long does the kerosene in the container last? _____ days

COAL UTILIZATION

5. a) How much coal did you use the last 7 days in your house for domestic purposes? _____ cans _____ sacks

b) What was the cost of the coal used? _____

c) How much of the coal was free? _____

d) In what way was the coal used?

1. _____ cans _____ sacks _____

2. _____ cans _____ sacks _____

e) What is the distance (in km) between your house and the place you obtain the coal? _____

f) How many containers of coal do you buy each time? _____

g) How long does each container last? _____ days

GASOLINE UTILIZATION

6. a) How many gallons of gasoline did you use in the last 7 days in your house for domestic purposes? _____

(If the answer is zero, go to Question 7.)

b) What was the cost of the gasoline? _____

c) How many gallons of gasoline did you buy each time? _____

d) How frequently do you buy gasoline? _____

e) In what way did you use the gasoline?

1. _____ Gallons _____

2. _____ Gallons _____

f) How far is your gasoline supplier from your house? _____ km

ELECTRICAL ENERGY UTILIZATION

7. a) How much electricity did you use in your house last month? _____ kwh

(If the answer is zero, go to Question 8.)

b) How much was your electricity bill last month? _____

c) In what way did you use the electricity?

Equipment	Quantity	Hours/Week
Lights		
Refrigerator		
T.V.		
Radio		
Iron		
Stove		
Water Heater		
Fan		

LPG UTILIZATION

8. a) Do you use LPG in your house for domestic purposes?

_____ yes _____ no

(If answer is no, go to Question 9.)

b) What kind of container do you use for LPG?

_____ 25 lb. _____ 50 lb. _____ 100 lb.

c) How long did you have to wait to get LPG? _____

d) In what way did you use the LPG?

1. _____

2. _____

e) How long does the LPG container last? _____ days

UTILIZATION OF OTHER FUELS

9. a) During the last 7 days did you use other types of fuels for domestic purposes? _____ yes _____ no

(If the answer is no, go to Question 10.)

b) Which fuel was used and what was the amount?

Fuel _____ Quantity _____

Fuel _____ Quantity _____

10. During the last week, how many persons in your house

had breakfast? _____

had lunch? _____

had dinner? _____

11. What was your food cost? _____

12. Last month, how many days were spent by your family cutting and gathering wood? _____

13. Comparing the amount of fuels you used last year, do you believe you are presently using more, less or equal quantities this year?

	More	Equal	Less	Don't Use
a) Wood				
b) Kerosene				
c) Coal				
d) Gasoline				
e) Electric Energy				
f) LPG				
g) Fuel Oil				
h) Other				

14. End of Interview

3.3 DATA GATHERING FOR THE RURAL SECTOR

1. IDENTIFICATION OF THE PRODUCER

a) Who is the person responsible for planting and harvesting, or for the raising of cattle on this farm?

b) Who is giving this information?

_____ Producer

_____ Administrator

_____ Wife

_____ Other

2. LAND USE

2.1 a) How much land do you own?

b) How many cattle do you own?

c) What type?

d) How many people work in the land?

e) How many of them are family members?

f) How much irrigation?

g) When (day or night)?

h) Do you own a mechanized farm?

2.2 LAND USE

a) What part of your farm is dedicated to:

1. Temporary Cultivation (such as corn, rice, etc.) including all that was harvested during the last 12 months?

2. Permanent Cultivation (such as coffee, banana, cacao)?

3. Cultivated Pasture Lands

4. Natural Pasture Lands

5. Forest

6. Land Not Under Cultivation (to increase productivity)

7. Other Uses (such as irrigation)

8. TOTAL

MULTIPLE CULTIVATION

b) What part of your land is planted more than once every 12 months?

2.3 TEMPORARY CULTIVATION CODE

11	Chili	21	Paltroon
12	Garlic	22	Yam
13	Rice	23	Potatoe
14	Sweet Potatoe	24	Sorghum
15	Onion	25	Soybean
16	Young Onion	26	Tobacco
17	Leguminous Plant	27	Tomatoe
18	Red or Black Bean	28	Cassava or Yucca
19	Corn	29	Other
20	Peanut	30	Other

PERMANENT CULTIVATION CODE

Cacao	Banana
Coffee	Papaya
Sugar Cane	Orange
Coconut	Pineapple

3. Cultivation of land during the last 12 months
Area, production and value of the sales of the harvest during the last 12 months

Name of the Cultivation	Total of the Production			Sales Values
	Quantity	Units	Weight Per Unit	

FUELS UTILIZATION

4.1 DOMESTIC USE

a) How much fuel (what type) do you use for lighting?

b) What type of lighting device?

c) How much fuel (what type) do you use for cooking?

d) What type of cooking stove?

4.2 a) What kind of fuels did you use on your land during the last 12 months (without including your domestic use)?

	Volume of Container	Time of Use	Total Used	Price Per Gallon	Fuels Used For Equipment
Gasoline					
Diesel Fuel Oil					
Oil					
Grease					
Kerosene					

b) How far is your fuel supplier from your farm?

Gasoline ____, Fuel Oil ____, Oil ____, Grease ____,

Kerosene ____

c) Mode of transportation

Bicycle ____, Animal ____, Motor Cycle ____, Walk ____

4.3 Types of Equipments

a) Tractor c) Truck e) Van Truck

b) Pumps d) Lamp f) Electric Generator

4.4 How much electrical energy do you use in your farm? (without including your domestic use)

	Kwh	Total Cost	Equipment That Uses Electrical Energy Per Week
Electrical Energy			

5.1 OTHER FUEL UTILIZATION

a) What other fuels did you use on your farm? (without your domestic use)

	Purchased	Free	Energy Used Per Equipment
Wood			
Coal			
Animal			
Waste			

b) How far is your fuel supplier from your farm?

wood ____

coal ____

other ____

---

c) Equipment: a) Stove b) Oven c) Other

Please Make Drawing of Equipment

6. How far is your actual wood supplier from your farm compared to 10 years ago?

____ farther than 10 years ago

____ closer than 10 years ago

____ same

SECTION 4

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS AND RECOMMENDATIONS

Much of our work concentrates on the data needed to understand the present and future patterns of energy consumption. Many of our recommendations deal with data needed to specify the effects of energy public policy on future energy consumption rather than with descriptive data on current or historical energy consumption patterns. It would be possible, although expensive, to accumulate enormous masses of data on actual energy consumption, classified by every conceivable type of user, fuel and function.

1) The economic, social and energy consequences of demographic changes can be very large within the time periods of interest to energy policy decisions.

   We recommend careful use of demographic data in energy policy analysis, especially data that describe fertility rates, household formation, labor force participation and effective length of the work week.

2) We recommend that benchmark surveys be undertaken to measure detailed uses of energy in households by end uses. These data could be obtained by a listing of household appliances and appliance use rates.

3) We recommend that a special study be undertaken to explain present variation in the energy intensity of personal transportation. This study would aim at determining the factors that induce the purchase of more energy-efficient vehicles and use of alternative modes of transportation, such as carpools, bicycles, and public transportation.

4) For energy-intensive industries, data are needed on both total energy consumption and energy consumption per unit of specific product output. These data should be in both physical and ($) dollar or peso units and should be classified by fuel type. In general, annual or biennial data would be sufficient for these industries, since major process changes take place gradually. Moreover, for some industries, studies should be made to determine the amounts of energy used for alternative processes that are in active use for the same basic product but that are significantly different in energy use.

5) We recommend that a benchmark survey of energy use in commercial buildings be undertaken. This survey should obtain information on energy used, with appropriate specification of sub-categories.

SECTION 5

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