PN-AAR-701

DATA COLLECTION WORKBOOK

for the Assessment of

Renewable Energy Systems Installed

in Selected African Countries

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Bureau for Africa
Washington, DC 20523

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Prepared by:

Associates in Rural Development, Inc.
362 Main Street
Burlington, VT 05401 U.S.A.

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SECTION I

Introduction

This workbook is meant to be both a guide to data collection and to provide the actual format and pages for writing down what you have collected. The methodology for the assessment is contained in a separate document entitled, Assessing Renewable Energy Technologies and Renewable Energy Project Elements in the African Context: A Study Design and Methodology, and provides the rationale for what is on the following pages. This methodology paper should be familiar to the workbook user as it also contains information about data collection.

There are four modules which describe the fieldwork covered by this workbook that are discussed in the methodology paper. (These modules are presented graphically on the next four pages.) These modules should be reviewed and followed as the team progresses through the stages of fieldwork. This is especially true of the selection of non-AID projects.

There are four key questions which guide the data collection, and they arise directly out of the purposes of the assessment and the resulting methodology.

Energy Systems Effectiveness

- What have been the observed economic, technical, institutional and social problems and performance of the renewable energy systems currently installed in selected AID countries in Africa?

End-Use Application

- What has been the comparative economic, technical, social and institutional performance of alternative renewable energy systems in the provision of usable cost-effective energy-specific African end-use applications in the areas of agricultural production, agricultural processing and food preservation, domestic consumption, and small-scale commercial and industrial operations?

Project-Specific Monitoring and Evaluation

- What mechanisms currently exist within ongoing AID and non-AID African development projects that allow for the "real-time" monitoring and evaluation of installed renewable energy systems and for modifications of technologies or project elements to take advantage of the lessons learned from the monitoring and evaluation of economic, technical, institutional and social performance of installed energy systems?

National Energy Profiles

- What is the potential "fit" between the pattern of current and projected end-use energy needs (in the individual African countries and in the whole sub-Saharan region) and the renewable energy systems currently installed in Africa?

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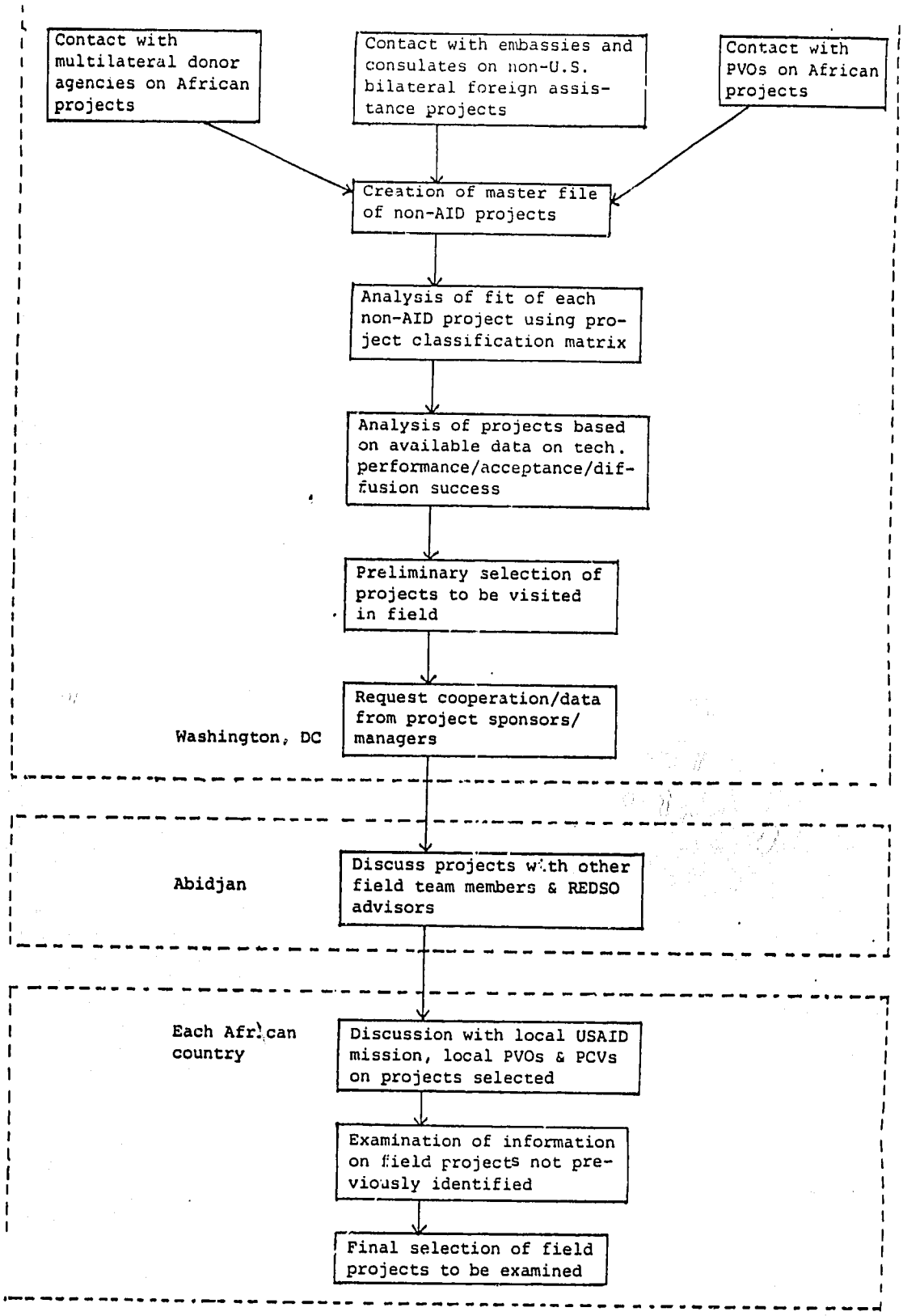
DATA COLLECTION/ANALYSIS MODULE I:

NON-AID PROJECT SELECTION



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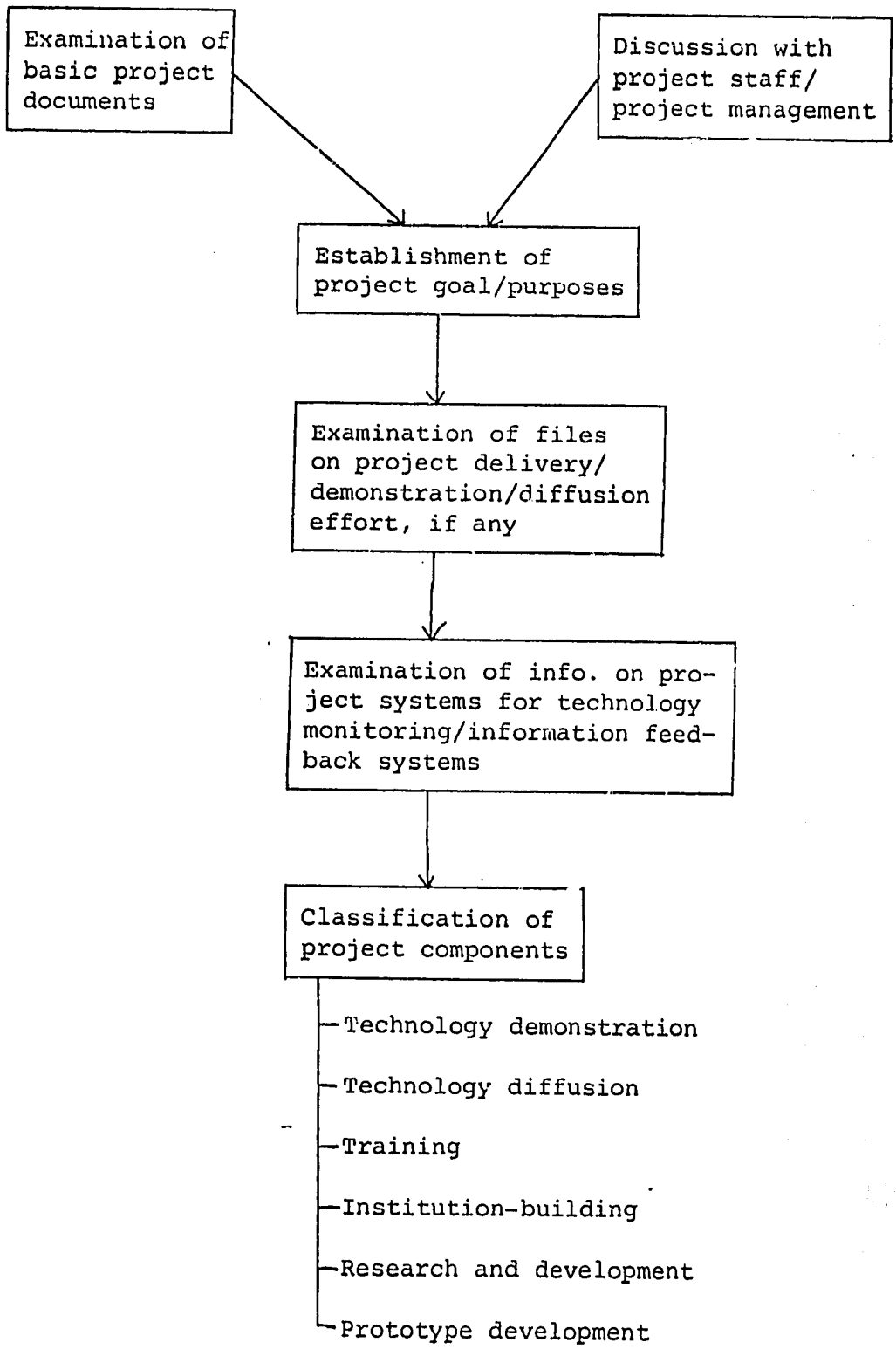
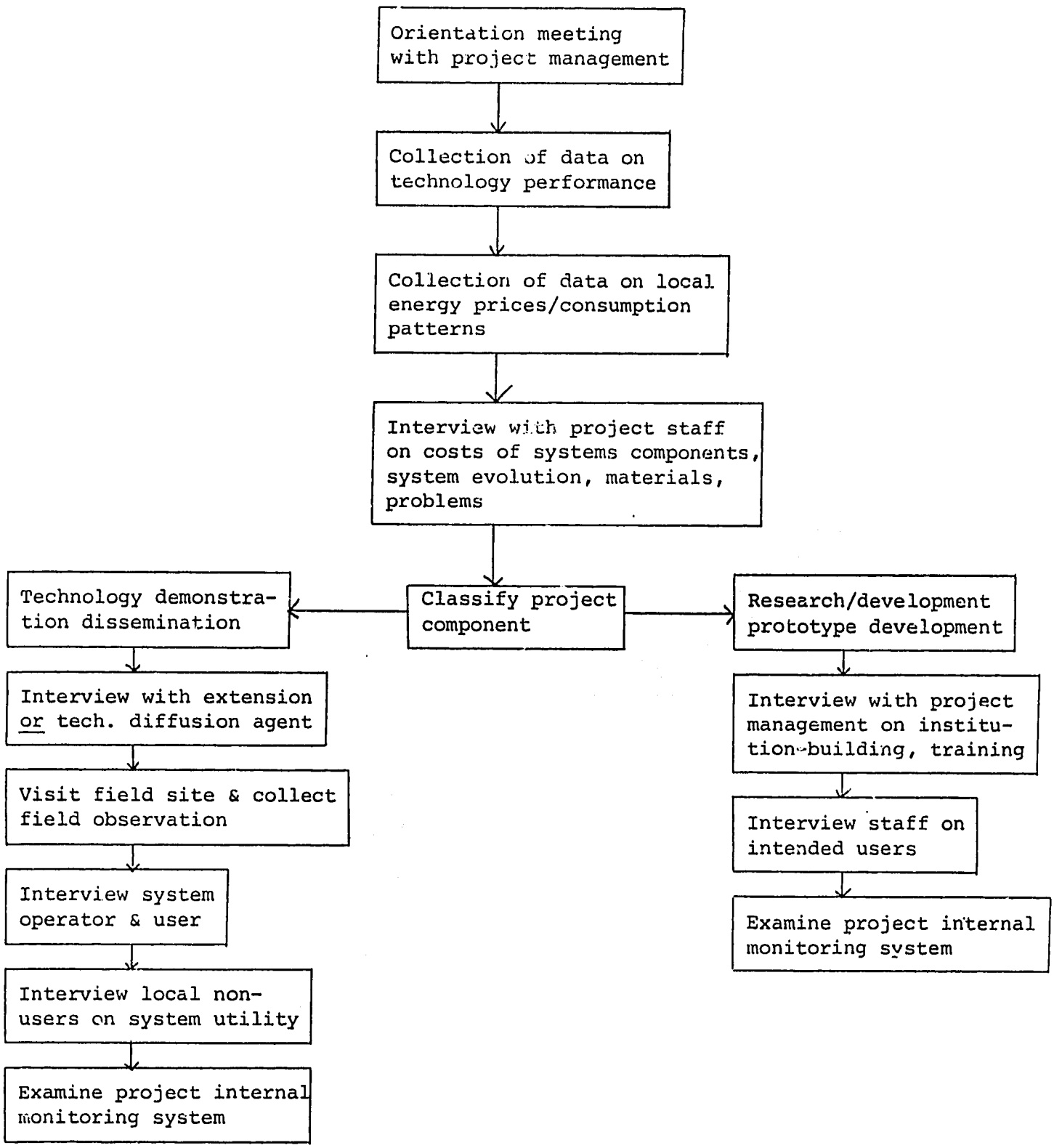
DATA COLLECTION/ANALYSIS MODULE II: PROJECT COMPONENT CLASSIFICATION



DATA COLLECTION/ANALYSIS MODULE III:

FIELD DATA COLLECTION



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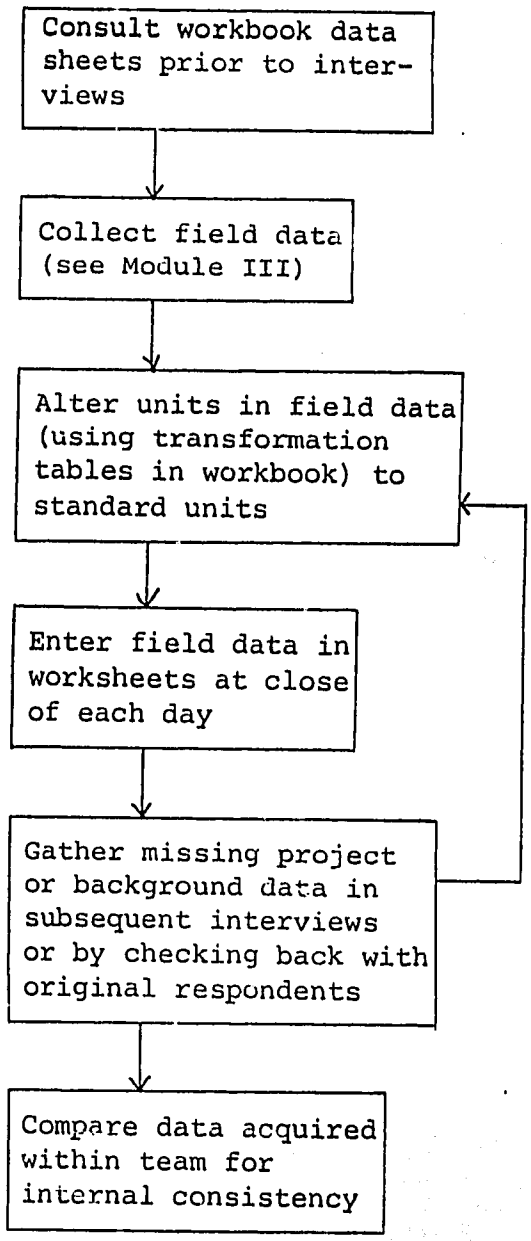
DATA COLLECTION/ANALYSIS MODULE IV: FIELD DATA COLLATION AND PROCESSING



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The following four pages provide a survey of the information or data points that this fieldwork hopes to cover. The data elements section of this workbook (Section VI) contains detailed questions and space for writing up answers on all of these general data points. In general, the workbook follows the order presented in these summary pages. However, there is some variation, such as "general project information," simply because conversation and emphasis of the work make the workbook more useable in a slightly different order by data question.

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CLASS	DATA CATEGORIES	DATA ELEMENTS		
Energy Systems Effectiveness	I. Technical II. Economic III. Institutional IV. Energy Systems Profile V. Social and Cultural	I. ENERGY SYSTEMS PROFILE	II. TECHNICAL	III. ECONOMIC
		A. Energy System Description B. Inputs C. Operating Schedule D. End-Use Applications	A. Technical Performance B. System Reliability C. Durability/ Materials Problems D. Operation/ Maintenance E. Output versus Resource Base	A. Costs B. Benefits
		IV. INSTITUTIONAL	V. SOCIAL AND CULTURAL	
		A. Project Support B. Experience C. Capacity	A. Beneficiaries B. Acceptance Problems/ Solutions	

CLASS	DATA CATEGORIES	DATA ELEMENTS		
End-uses	I. Agricultural Production II. Agricultural Processing & Food Preservation III. Domestic Uses IV. Commercial/ Industrial	I. AGRICULTURAL PRODUCTION	II. AGRICULTURAL PROCESSING/FOOD PRESERVATION	III. DOMESTIC USES
		A. Irrigation Pumping B. Cultivation C. Fertilizer Production D. Space Heating/ Cooling (greenhouses) E. Transportation	A. Grinding/Milling B. Crop Drying C. Threshing D. Cold Storage Regrigeration	A. Cooking B. Water Heating C. Lighting D. Potable Water Pumping E. Space Heating/ Cooling
		IV. COMMERCIAL/ FINANCIAL		
		A. Low-temperature Process Heat B. High-temperature Process Heat C. Space Heating D. Water Heating E. Transportation F. Motor Shaft Power		

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CLASS	DATA CATEGORIES	DATA ELEMENTS		
		I. PROJECT MANAGEMENT	II. TECHNICAL	III. DISSEMINATION
Project Monitoring and Evaluation	I. Project Management II. Technical III. Dissemination	A. Decision-making structure B. Project changes	A. Performance B. Design C. Economic	A. Institutional B. Users C. Barriers and Constraints

CLASS	DATA CATEGORIES	DATA ELEMENTS	
		I. ENERGY RESOURCES	II. ENERGY USE
National Energy Profiles	I. ENERGY RESOURCES II. ENERGY USE	A. Conventional Commercial Sources B. Traditional and Nonconventional Sources	A. Industrial B. Commercial C. Institutional D. Transport E. Household (urban and rural) F. Agricultural

SECTION II

Hints for Using this Workbook

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION _____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

2.1 BEFORE AN INTERVIEW OF SITE VISIT

Before site visit the interviewer should make sure that he/she is clear about the exact purposes of the visit and review the modules for data collection and decision making that are in the introduction. Make sure that everyone going is as clear as possible about individual roles and who will be responsible for which types of data gathering. If it has been decided to divide up certain parts of the workbook to be filled out later, make sure there is no confusion as to which team member will fill out which section of the workbook for the visit.

Before going it will also be important to be as clear as possible about:

- What types of people will you be talking with (project staff, users, private sector entrepreneur, etc.)?
- What technologies will you see and are you familiar with them?
- Where do the technologies and the project fall (with non AID projects) in terms of the technology/end-use match? This is important for gaining a broad project sample and filling out the country matrix in section V.

Try to review your pocket guide to see what key words will keep you on track during the site visit.

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION _____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

2.2 AFTER A SITE VISIT

If possible, at the end of each day the team should meet to discuss the results of the day's interviews and identify important data gaps and other unanticipated problems that may have arisen. Strategies should then be developed to overcome these problems and collect any missing information.

It must be remembered that the workbook is a data collection guide and must be used as such. It should not be considered or used as a constraint to information collection; however, given the vast amount of data to be gathered, the workbook is useful in bounding and clearly identifying the needs of the project.

Site visits should be written up at the end of each day while information is still fresh in people's minds and so that too large a backlog doesn't build up. In many instances only part of the workbook sections will be relevant for a particular site visit. Also, questions where data is available in documents that have been collected often need only be answered by referencing the document and the page number.

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION _____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

2.3 AT THE END OF THE COUNTRY VISIT

Several days before ending the country visit all team members should review site visit workbook data element sheets and verify that all missing data has been collected or, if not, note an explanation if it is not obtainable. Of real importance is a review of the country matrix to see if the assessment is obtaining as broad a sample of technologies and end-use mixer as is possible.

At the end of the visit put all data and information from your visit together. One person on the team will generally have responsibility for transporting all information back to the U.S. Also, provide that person with a list of people and addresses for appropriate letters of 'thank you' to be sent afterward.

SECTION III

Standard Data Notation to Use in Workbook Entries

Weight (mass):		kilogram (kg)
	or	metric ton (1,000 kg)
Volume:		cubic metre (m^3)
	or	litre (l)
Density:		kg/m^3
Length:		metre (m) (or decimals thereof)
	or	kilometre (km)
Area:		hectare (ha)
	or	1 square metre (m^2)
Power:		kilowatt (kW) ($=10^3$ W)
	or	megawatt (MW) ($=10^6$ W)
Energy:		kilowatt-hour (kWh)
	or	megajoules (MJ) per m^2 per day (solar radiation)
Heat:		kilocalorie (kcal = 10^3 cal)
Pressure:		atmosphere
Temperature:		degrees Celsius

SECTION IV

Tables for Converting Field Data to Standard Notation Formats

Weight:

1 kg = 2.2 lb
1 metric ton = 1.1 short tons = 0.98 long tons
1 lb = 0.453 kg
1 oz = 0.028 kg (= 28 grams)

Volume:

1 m^3 = 35.31 ft^3 (=1.3 cu. yards)
1 l. = 0.264 gallons (U.S.) = 1.056 quarts (U.S.)
= 0.220 gallons (Imp.)
1 gallon (U.S.) = 3.79 liters (l.)
1 gallon (Imp.) = 4.55 liters (l.)
1 barrell, oil (U.S.) = 159.81 (=42 U.S.G.)
1 ft^3 = 0.028 m^3
1 stève (1 m^3 of stacked wood) = 0.65 m^3 (of solid wood)
1 cubic yard = 0.76 m^3
1 l/minute = 0.0353 ft^3/min. = 0.2642 U.S.G./min.

Length:

1 metre = 3.28 feet
1 kilometre = 0.62 miles (stat.)
1 foot = 0.30 metre
1 mile = 1.61 km

Area:

1 hectare = 2.47 acres
1 acre = 0.40 hectare
1 km^2 = 100 hectares
1 sq. mile = 640 acres = 259 ha

Power:

1 kW = 10^3 joules (KJ) per second
1 H.P.= 745.7 W = 0.746 kW = 2,546.14 BTUs/min.
1 kW = 1.34 H.P.

Energy:

1 kWh = 3.6 MJ (=3.6 x 10^6 J)
1 kWh = 860 kcal
1 kWh = 3,413 BTUs
1 BTU = 0.000293 kWh
1 BTU/ft^2/hr = 3.15 x 10^{-7} kW/m^2
1 MJ = 0.27778 kWh = 238.92 kcal = 947.82 BTUs

Heat:

1 kcal = 3.9671 BTUs
1 kcal = 4,190 J
1 BTU = 0.252 kcal

Pressure:

1 atmosphere = 14.7 lb/in^2
1 lb/in^2 = 0.068 atmospheres
1 atmosphere = 10.13 Pa or N/cm^2 = 101.3 kPa/m^2

Temperature:

degrees C = 5/9 (degrees F - 32) (or °F -32 x .555)
degrees F = 9/5 (degrees C + 32) (or (°C x 1.8)+32)

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SECTION V

Country Interview/Site Visit Log

The purpose of this log is to ensure that all data gathered at a single site or from each organization is clearly labeled. This will minimize confusion if country-level data-sets are separated for technology specific or end-use applications analysis, and will aid in the development of individual project case studies.

Instructions:

1. Enter each site visited or each organization contacted in the chart on the following page.

2. Number each site or organization consecutively.

3. ENTER THIS LOG NUMBER ON EACH DATA SHEET FILLED OUT FROM THIS SITE VISIT/ORGANIZATION CONTACT.

4. Important: Each site visit receives a new number. If you visit 3 different sites for the Botswana Technology Centre, for example, assign 3 separate consecutive numbers. If you talk to 3 individuals about 3 different technologies at the same site, use only one number.

5. Put all entries for a single country on a single log sheet.

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COUNTRY INTERVIEW/SITE LOG

Country: _____

Date month/day	Participating Team Members (last names)	Site/ Organization Visited	Individuals Contacted	Log Number Assigned

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SECTION VI

Data Elements

DATA ELEMENTS

The data elements, in the sections that follow, have been divided into two major categories. These constitute a hierarchy of data collection: i.e., the first set should be sought before the second. However, the more data for categories 2 and 3 that can be collected, the greater the depth of the analysis that can be undertaken.

1. Basic and Necessary

   These are the "must-get" data. Without them, little comparative analysis can be done. These data elements should be requested at each site, and should be collected by interview if they have not been recorded already or if they are not readily available in printed form.

2. Secondary but Important

   These are data which will greatly assist in the analysis. They have been put in this secondary category primarily because they are difficult and time-consuming to collect, rather than because of lack of importance. Whenever these data exist already, they should be gathered and included in the analysis. During interviews, respondents should be queried about these elements and where they can be obtained.

3. Optional (under "Notes")

   These are data items which will enrich the analysis. They are either additional details on the technologies and end-uses or data derived from direct observation of projects, institutions, and implementation procedures. All should be gathered whenever they are readily available, but the integrity of the analysis will not be impaired if these data are only partially obtained.

During field visits in each country, field team members should try to get a copy of a recent government or other relevant publication (1980-82) which discusses:

- energy consumption,
- energy demand, and
- energy production.

This will provide general country-specific energy information relevant to the assessment.

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The section which covers monitoring and evaluation is to be used for summarizing general data about what has been learned as well as specific information about evaluation and monitoring systems and project decision-making. However, as the team is collecting information on specific technologies or dissemination strategies, etc., always ask if there are key items that have been learned. Also, are their observable changes in design or approach that were rationally and consciously carried out? All these responses and observations should be recorded in the "notes" sections of each data element. We have chosen to do this rather than include repetitive questions on "learning" throughout the workbook.

If the site visit is a project, or a user within a project, fill out 6.1 General Project Information, or refer to the project by name, if a sheet has already been filled out. Project papers or similar documents should be collected and attached or referred to so they can be used by the analysis team at a later date.

If the site visit is an individual not connected to any project, or one who is in the private sector, skip 6.1 and start with 6.2. In this instance, indicate in the notes the nature of the visit. It should still have a log number.

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION _____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

6.1 GENERAL PROJECT INFORMATION

Project name: _____

Implementing agency: _____

Project goal: _____

_____

Project purpose: _____

_____

_____

Project outputs: (quantify where possible, e.g. # of units in place, # of trained technicians) _____

_____

Major project components: (e.g. training, small business component, nutrition, fuelwood) _____

_____

Private sector involvement: _____

_____

Delivery mechanism at village level: _____

_____

_____

_____

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COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

6.2 ENERGY SYSTEM EFFECTIVENESS

I. SYSTEM PROFILE

A. ENERGY SYSTEM DESCRIPTION

Basic and Necessary Data Elements

1. Energy System (type and sub-type; make and model: e.g., water pump, reciprocating cylinder, Ajax Mk. II):

Secondary but Important Data Elements

1. Dimensions and type of installation (e.g., 1.5 x 1.5 x 0.7 m; raised platform; crane-mounted):

2. Date of installation:_____

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

B. INPUTS

Basic and Necessary Data Elements

1. Nature and origin of principal components (e.g., cast iron housing; stainless steel main valve; copper tubing; etc.):

Component (describe)	Imported (check)	Fabricated from imported materials (describe)	Fabricated from local materials (describe)	Mixed origin (describe)

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

Secondary but Important Data Elements

1. Nature and origin of principal routine replacement parts (e.g., spark plugs, imported; fan belt, leather, local):

2. Nature and origin of principal operating materials (e.g., 80-octane gasoline, imported; lubricating oil, mineral, imported):

Notes:

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COUNTRY_____ PROJECT LOG_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

C. OPERATING SCHEDULE

Basic and Necessary Data Elements

1. Basic planned operation:
(e.g., daily during harvest season from May to October; on-demand during workdays the rest of the year)
(NOTE: for details of scheduled vs. actual operation, see Section 6.2, II.D.)

Secondary but Important Data Elements

1. Planned life of energy system (months or years)_____

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

D. END-USE APPLICATIONS

Basic and Necessary Data Elements

1. Direct and indirect end-uses of energy system: (e.g., water pumping, irrigation; photovoltaic power for irrigation water pumping and intermittent use of telecommunications)

2. Occasional or unplanned end-uses: (e.g., power used to operate educational TV 1-2 times/mo.; windmill used for water pumping convertible for occasional grain-grinding)

Notes:

COUNTRY_____ PROJECT SITE_____ LOG # _____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

II. TECHNICAL

A. TECHNICAL PERFORMANCE

Basic and Necessary Data Elements

1. Type of energy produced:_____

(e.g., electricity, shaft power, low-temperature heat)

2. System output of final product:

(e.g., liters of irrigation water, kilograms of dried produce, quantity of food cooked)

average output _____/day

and/or

single observation _____ on _____
date

3. Hours of operation necessary to produce the system output in question # 2 (above):

_____/day

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

Secondary but Important

1. Amount of energy produced per day:

   average _____/day
   kWh or kcal or BTUs

   and/or

   single observation _____ on_____
   kWh or kcal or BTUs date

2. Quality of energy produced:

   (e.g., high/low-temperature range for heat output; maximum recorded output in kW or shaft horsepower)

   _____

3. Daily/seasonal variation in output:

   maximum_____ at _____
   time/season

   minimum_____ at _____
   time/season

4. What other alternative technologies were considered?

   _____

   _____

   (What are the perceived efficiencies for those technologies as per the above questions 1-3?)

Notes:

COUNTRY_____ PROJECT SITE_____ LOG # _____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

B. SYSTEM RELIABILITY

Basic and Necessary Data Elements (monthly averages)

1. No. of hours of scheduled vs. actual operation:

scheduled operation _____/month
hours

actual operation _____/month
hours

2. Longest period of unscheduled downtime:

system out of operation_____
hours

Notes:

Secondary but Important (monthly averages)

1. Number of hours of scheduled maintenance:

_____/month
hours

2. Number of hours of unscheduled maintenance:

_____/month
hours

Notes:

COUNTRY_____ PROJECT SITE_____ LOG#_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

C. DURABILITY/MATERIAL PROBLEMS

Basic and Necessary Data Elements

1. Materials substitutions that had to be made due to premature degradation, breakage, or design changes:

   (e.g., fiberglass for glass glazing; metal for wooden towers)

   _____

   _____

2. Reason for above materials substitution:

   _____

   _____

3. Component substitutions that were made due to premature degradation, breakage, or design changes:

   (e.g., hammer mill for ball mill; deep-cycle battery for regular battery; jack pump for centrifugal pump)

   _____

   _____

4. Reason for above component substitution:

   _____

   _____

Notes:

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COUNTRY_____ PROJECT SITE _____ LOG #_____

END-USE APPLICATION _____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

Secondary but Important Data Elements

1. Design changes made to limit or eliminate durability and materials problems:

   (e.g., change mud/sand mixture in Lorena stoves to lower stove cracking; lowering of cut-out speed on wind turbine to eliminate blade fatigue)

   _____

   _____

2. Results of above design change(s):

   _____

   _____

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

D. OPERATION AND MAINTENANCE

Basic and Necessary Data Elements

1. Number of hours operator is in attendance:

_____/month
hours

2. Frequency of fueling of system (if appropriate):

_____/week
number of refuelings

3. Frequency of cleaning (if appropriate):

_____/year
number of cleanings

4. Frequency and duration of major scheduled overhauls:

_____/year
frequency of overhauls

_____/overhaul
duration in hours

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

Secondary but Important

1. Frequency and duration of scheduled lubrication/maintenance:

_____/year
number of lubrications

_____/lubribation
time in hours

2. Frequency and duration of spare parts replacement:

_____/year
number of times

_____/year
time in hours

parts replaced: _____
specify parts

Notes:

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COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

E. OUTPUT VS. RESOURCE BASE

Basic and Necessary (specific for each energy system)

- wind electric: _____ (kWe output) at _____ (wind speed) (m/sec)
- wind mechanical: _____ (shaft horsepower) at _____ (wind speed) (m/sec)

  all wind systems: _____ (anemometer height) (meters)

- photovoltaic systems: _____ (output--$watts_e$) for _____ (insolation) (watts/meter^2)
- solar thermal-liquid:

  _____ (ΔT(°C.) inlet/outlet) at _____ (flow rate(liter/min)) for _____ (insolation) (watts/meter^2)

- solar thermal-air:

  _____ (T(°C.) inlet/outlet) at _____ (flow rate(meter^3/min)) for _____ (insolation) (watts/meter^2)

- mini-hydroelectric systems:

  _____ (kWe output) for _____ (head) (meters)

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

III. ECONOMICS

A. COSTS: Operation and Maintenance

Basic and Necessary Data Elements

- currency conversion rate: _____/dollar
  local currency

- price of raw feedstock (if purchased):

  (e.g., wood for gasifier, dung for anaerobic digester, charcoal for cookstove)

  _____/month
  local currency

- amount of feedstock used:

  (note: record the units that the respondent is comfortable with: headloads of wood, buckets of manure, etc. We will try to make conversions to standard units later.)

  _____/month
  units

- cost of fuel for back-up system (if any):

  (kerosene for stove; diesel for back-up pump)

  _____/month
  local currency

- total wages paid to operators:

  _____/month
  local currency

- price of routinely scheduled spare parts and lubrication:

  _____/month
  local currency

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

- total wages paid to maintenance staff (if different from operators; if included in operator wages, write N/A in blank below):

_____/month
local currency

Notes:

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COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

COSTS: Capital Expenses

Basic and Necessary Data Elements

(IMPORTANT NOTE: THIS SECTION APPLIES FOR ENERGY SYSTEMS INSTALLED IN THE FIELD OR SYSTEMS ASSEMBLED FROM COMMERCIALLY AVAILABLE COMPONENTS ONLY: SKIP THIS SECTION FOR LABORATORY PROTOTYPES)

- Renewable energy system only delivered to or fabricated at the site:

  (i.e., the wind turbine with its tower, a micro-hydro station complete with its impoundments and pen-stocks but not including any energy-using equipment driven by the station;
  NOTE: if the energy system comes as a complete unit with power conditioning, and auxiliary equipment, write complete unit next to the price in the blank below)

  _____
  local currency or $U.S.

  Note: was energy sytem (check one):

  locally produced _____locally assembled _____imported

- Renewable energy sytem power conditioning equipment delivered to site:

  (i.e., electrical inverter; internal combustion engine for biomass gasifier or anaerobic digester, etc.)

  _____
  local currency or $U.S.

  Note: was power conditioning equipment (check one):

  locally produced _____locally assembled _____imported

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

- End-use auxiliary equipment delivered to site:

  (i.e., irrigation pumps; ball mills or hammer mills for grinding; gas cook stoves for anaerobic digesters)

  _____
  local currency or $U.S.

  Note: was end-use auxiliary equipment (check one):

  _____locally produced _____locally assembled _____imported

- Energy storage devices delivered to site:

  (i.e., electrical batteries, hot water storage tanks, rock bin storage for sensible heat, etc.)

  Specify type of storage device_____

  _____
  local currency or $U.S.

  Note: was energy storage device (check one):

  _____locally produced _____locally assembled _____imported

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

COSTS: Other

- Extraordinary one-time costs:
  (site preparation, temporary buildings, custom engineering, prototype development)

  _____
  local currency

- Training costs for end-users:

  _____/annum
  local currency

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

- Affordability to user

  _____% of user income to buy technology

  _____% of user income to maintain and operate

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COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

Basic/necessary

- local prices for fossil fuels; delivered to site:
  - gasoline (regular) _____/liter
    local currency
  - kerosene _____/liter
    local currency
  - diesel fuel _____/liter
    local currency
- local prices for biomass fuels:
  - dry fuelwood _____/unit
    local currency
  - charcoal _____/unit
    local currency
- grid electricity: _____ /kWh
  local currency
- diesel electric generating set, initial price:

  5 kWe _____/unit
  local currency

  25 kWe _____/unit
  local currency
- diesel electric generating set, fuel consumption:

  5 kWe unit _____/month
  liters

  25 kWe unit _____/month
  liters

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

- training cost for operation, maintenance and repair personnel:

_____/annum
local currency

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

B. ECONOMIC BENEFITS

Basic and Necessary

Increase output:

- Increased output of final product due to additional energy or value added to existing output:

  (e.g., increased agricultural yield/hectare due to irrigation; increased value for crop due to drying)

  _____

  or _____

- Value of output per unit of time

  _____(value) per _____(time)

Notes:

COUNTRY _____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

ECONOMIC BENEFITS: Fossil Fuel Displacement

- amount of fossil fuel displaced at site by renewable energy system/month:

  (e.g., liters of diesel or kgs. of coal)

  _____/month
  liters or kgs.

- cost of fossil fuel delivered to site:

  _____/liter or kg.
  local currency

- amount of fossil fuel-fired electricity displaced by renewable energy system:

  _____/month
  kWh or Whrs.

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

ECONOMIC BENEFITS: Employment

- Types of employment created (list and indicate full or part time, and provide wage scale if possible):

- Number of full-time equivalant jobs per month or year for number of units produced:

  _____ jobs per _____ units per _____(year/month)

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION _____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

Secondary

- Secondary stimulation of the economy (list and describe to the extent possible new services or businesses, the establishment of which have been stimulated by the introduction of new energy systems: e.g., expansion of metal fabrication, fuel and lubricant dealers, other services or businesses attracted by higher incomes in agriculture, including new civil-service positions associated with higher level of economic activity; higher tax revenues traceable to higher outputs):

Notes:

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COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION _____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

IV. INSTITUTIONAL

A. PROJECT SUPPORT

Basic and Necessary Data Elements

	Adequate	Inadequate
1. Support of central government:		
Support via policies:		
Support via legal or institutional revisions:		
Manpower support:		
Financial support (direct or indirect, such as subsidies or new rates)		
Practical support (elimination or redtape; facilitation or customs clearance; help with transport; storage, housing; other_____)		

	Adequate		Inadequate	
	Reg.	Local	Reg.	Local
2. Support of regional/local government:				
Manpower support:				
Legal/institutional revisions:				
Practical support (financial; facilities; redtape; favourable publicity, etc.)				

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION _____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

B. EXPERIENCE

Basic and Necessary Data Elements

1. Experience of personnel connected with energy system:	Adequate	Inadequate
Owner/operator	_____	_____
Manager	_____	_____
Maintenance	_____	_____
Government Tech.	_____	_____
Support	_____	_____

Notes:

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COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION _____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

C. CAPABILITY

Basic and Necessary Data Elements:

		Adequate	Inadequate
1.	Capability of central government to support energy system:		
	Technical competence:	_____	_____
	Manpower vs. workload:	_____	_____
2.	Training and manpower needs of central government (describe briefly)		

		Adequate	Inadequate
3.	Capability of regional government to support energy system:		
	Technical competence:	_____	_____
	Manpower vs. workload	_____	_____
4.	Capability of local government to support energy system:		
	Technical competence:	_____	_____
	Manpower vs. workload:	_____	_____
5.	Training and manpower needs of regional/local government (describe briefly)		

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION _____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

6. Capability of owner/operator and training needs (describe briefly):

7. Capability of maintenance personnel and training needs (describe briefly)

Notes:

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COUNTRY_____ PROJECT SITE_____ LOG #_____

END USE APPLICATION _____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

V. SOCIAL AND CULTURAL

A. BENEFICIARIES

Basic and Necessary Data Elements

1. Profile of beneficiaries (check off as pertinent: categories are by local standards; define in absolute terms if possible):

- small landowner(s)_____
- medium landowner(s)_____
- large landowner(s)
- entrepreneur prior to introduction of energy system_____
- became entrepreneur with new energy system_____
- current local income: low_____; medium_____; high_____
- history of innovation_____
- holder of traditional office_____
- holder of government office_____
- long settled in area _____
- recent arrival_____
- formal education_____
- other special training (describe)_____
- other special experience (describe)_____

  _____

- holds more than one job (e.g., farmer and dealer)_____

  _____

- male head of family_____
- female head of family_____

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION _____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

- other male_____
- other female_____
- age (by decade)
- beneficiary other than individual (describe) _____
- other characteristic(s) (describe)_____

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION _____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

B. ACCEPTANCE: Problems and Solutions

Basic and Necessary Data Elements

1. Problems:

- type of energy output does not match need_____
- quantity of energy output does not match need_____
- type of energy system differs from the one preferred

  _____
- excessive complexity of energy system_____
- replacement parts too difficult to obtain_____
- technical support overwhelms government services____

  _____
- energy system violates cultural norms (describe briefly; e.g., offends religious beliefs, changes sex roles, etc.)

  _____
- local energy-equipment dealer and/or government agent is not trusted_____
- operation of energy system interferes with social/community life_____
- operation of energy system is poorly matched with rythm of agricultural or other operations_____

  _____
- type of energy system fits in poorly with local climatic or other environmental conditions_____

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COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION _____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

- energy system is perceived as making rich richer, and poor poorer (or generally incites social jealousies):

  _____

  _____

- energy system is perceived as having been imposed by government _____

  _____

- energy system is (or is perceived as being) too expensive:

  _____

  _____

- energy system is too unwieldy, heavy or inflexible:____

  _____

  _____

- energy system is seen as displacing local labor:_____

  _____

  _____

- worry about durability and maintenance:_____

  _____

  _____

- traditional energy system is perceived (rightly or wrongly) as being superior (or equal) in performance:_____

  _____

  _____

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COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION _____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

- water pumping is seen as interfering with traditional water rights_____

_____

2. Solutions:

- users need more training _____

_____

- users need subdidies/tax breaks_____

_____

- potential users need more demonstrations_____

_____

- extension service needs to be strengthened_____

_____

- energy system needs redesign_____

_____

_____

- operation of energy system needs to be revised_____

_____

_____

- after-sales service needs to be improved_____

_____

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COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION _____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

- greater local participation in the planning of new energy systems_____

  _____

- greater local control over the management of collective energy systems_____

  _____

- greater local input in the design of energy system(s)____

  _____

  _____

- local entrepreneur is a less intimidating diffusion agent than the government (or vice-versa)_____

  _____

- users need to be shown alternative uses of the same energy

  _____

  _____

- ownership of energy system needs to be clarified_____

  _____

  _____

- management of energy system needs to be clarified or re-organized_____

  _____

- other solutions_____

  _____

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

6.3 END-USE APPLICATIONS

The overall question being addressed in the evaluation is:

- What has been the comparative economic, technical, social and institutional performance of alternative renewable energy systems in the provision of usable cost-effective energy-specific African end-use applications in the areas of agricultural production, agricultural processing and food preservation, domestic consumption, and small-scale commercial and industrial operations?

In order to assist in answering the larger question, a series of narrower questions are provided below. First, there are questions which apply to every end-use application. These are followed by a series of questions concerning specific end-uses, which provide greater insight into the conditions that the end-use application requires of any technology (or conditions necessary for "fitting" technology to end-use).

Questions for All End-Uses:

1. Type of output required: _____
(e.g., drinking water, dried product, etc.)

2. Production level sought/needed: _____ per day/month

3. Currently used technology which meets end-use requirements and price/unit: _____

_____

4. Limitations of currently used technology: _____

_____

_____

5. Advantages of currently used technology: _____

_____

_____

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

Questions for All End-Uses (continued):

6. Commercially available technologies which meet end-use: _____

_____

7. Advantages/disadvantages of commercially available systems: _____

_____

_____

_____

8. Key use considerations for technology design: _____

_____

_____

_____

_____

9. Key fuel considerations for technology design: _____

_____

_____

_____

_____

10. Key production materials considerations for technology design, (e.g., scarcity, availability): _____

_____

_____

_____

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

End-Use Specific Questions:

I. Agricultural Production

A. IRRIGATION PUMPING

Basic/necessary:

- crops being irrigated,
- number of hectares irrigated/day,
- water output/use/day (peak and average),
- pumping lift,
- type of pumps installed, and
- current conventional pumping units installed locally.

Notes:

Secondary:

- number of days output/year above normal use, and
- seasonal fluctuations in water demand.

Notes:

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COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

B. CULTIVATION

Basic/necessary:

- crop being tilled, and
- number of hectares being tilled.

Notes:

Secondary:

- general soil and terrain types,
- type and depth of cultivation, and
- form of energy used.

Notes:

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COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

C. FERTILIZER USE

Basic/necessary:

- crops being fertilized, and
- amounts (kg) required/season.

Notes:

Secondary:

- nutrients required (including proportions),
- seasonal fluctuation in fertilizer demand, and
- how fertilizer is applied to field (e.g., type of equipment/tools used).

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

D. SPACE HEATING/COOLING

Basic/necessary:

- heating/cooling requirements by month (°C temperature change),
- seedlings to be produced each year (type and number),
- temperature and solar insolation fluctuations by season in °C, and
- m^3 and dimensions (m) to be heated or cooled.

Notes:

10

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

E. TRANSPORTATION

Basic/necessary:

- engine to be run (size in hp or cc),
- type of fuel needed,
- distance to be travelled (in kilometers),
- amount of fuel necessary per kilometer, and
- load to be carried, size (m^3) and weight in kilograms.

Notes:

Secondary:

- topography to be covered, steepness (percent of slope), roughness of terrain, and
- frequency of trips.

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

II. Agricultural Processing

A. HARVESTING

Basic/necessary:

- tonnes/ha/day, on average,
- person(s) used per ha, and
- equipment used.

Notes:

Secondary:

- mobility of equipment desired, and
- duration of peak harvesting period(s).

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

B. THRESHING

Basic/necessary:

- person(s) doing threshing,
- crop to be threshed, and
- number of kilograms of crop to be threshed per day.

Notes:

Secondary:

- moisture content (in percentage) of crop, and
- portability requirements.

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

C. CROP-DRYING

Basic/necessary:

- type and volume (in kilograms) of crop to be dried per day,
- percentage of residual moisture of crop desired,
- temperature (°C), rainfall (mm), and insolation (watts/m^2) fluctuations by season or month, and
- seasonal or monthly demand pattern for drying.

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

D. COLD STORAGE/REFRIGERATION

Basic/necessary:

- m^3 of space required for storage and product to be stored/refrigerated, and
- ^oC change necessary, and seasonal, day/night or monthly fluctuations.

Notes:

Secondary:

- seasonal fluctuations in need for storage or refrigeration,
- available back-up units for refrigeration, and
- access requirements (ease and times/day).

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

III. Domestic Uses

A. COOKING

Basic/necessary:

- foods to be cooked (types, cooking times),
- maximum number of pots used simultaneously, size of pots (in liters), and fluctuations in use,
- available fuel and costs thereof (in $$),
- indoor or outdoor use, and
- hours per day of use.

Notes:

Secondary:

- portability requirements,
- rapid heating-up (firing) necessity, and
- cooking used for simultaneous space heating

Notes:

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COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

B. WATER HEATING

Basic/necessary:

- °C change needed and baseline temperature,
- liters per day required, and
- demand pattern during typical day.

Secondary:

- maximum and minimum annual temperatures.

Notes:

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COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

C. LIGHTING

Basic/necessary:

- number of bulbs and wattage to be powered,
- hours per day required, and
- maximum distance from present (potential) power source.

Notes:

Secondary:

- portability

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

D. POTABLE WATER PUMPING

Basic/necessary:

- liters/day required,
- size of group using water,
- distance (m) and head (m) being transported, and
- storage necessity.

Secondary:

- water source

Notes:

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COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

E. SPACE HEATING/COOLING

Basic/necessary:

- seasonal variation in heating/cooling requirements,
- temperature change in °C required,
- size of room/building (m^3), and
- exposure of building/room to be heated.

Notes:

Secondary:

- dimension (m) of building/room.

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

IV. Commercial/Industrial

A. LOW-TEMPERATURE PROCESS HEAT

Basic/necessary: • °C and amount of energy available in BTUs or kcal.

Notes:

B. HIGH-TEMPERATURE PROCESS HEAT

Basic/necessary: • °C and amount of energy available in BTUs or kcal.

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

C. SPACE HEATING/COOLING

Basic/necessary:

- building or room to be heated, materials made from,
- area (m^3), dimensions (m),
- seasonal variation in heating/cooling requirements, and
- change in temperature (°C) required.

Secondary:

- daily habits of people related to comfort needs inside.

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

D. WATER HEATING

Basic/necessary:

- purpose of heated water,
- °C change needed and baseline temperature,
- liters/day requirement of hot water, and
- demand pattern on a daily basis (liters/hour).

Notes:

E. MOTOR SHAFT POWER

Basic/necessary:

- type of motor to be run,
- size of motor (cc or hp),
- duration of demand on a daily basis (hours/day) and at what load level, and
- fuel available (type, amount in kg. or liters).

Notes:

SKIP THIS SECTION IF VISIT IS NOT A FORMAL PROJECT OR IS IN PRIVATE SECTOR.

6.4 Project-Specific Monitoring and Evaluation

An important component of this evaluation is to determine whether or not project staff are attempting to learn from project activities. Many of the technologies and projects are in a pilot or developmental phase. Therefore, this evaluation assumes that there should be a systematic attempt by the project to learn about what is happening so as to improve performance. That is, what mechanisms currently exist within ongoing AID and non-AID African development projects that allow for the "real-time" monitoring and evaluation of installed renewable energy systems and for modifications of technologies or project elements to take advantage of the lessons learned from the monitoring and evaluation of economic, technical, institutional and social performance of installed energy systems.

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

Questions for all projects in general:

1. Is there a formal monitoring and evaluation system? _____

   Describe: _____

   _____

   _____

   _____

2. Is there an informal system, e.g., staff meetings and periodic reports, not formally monitoring the project but providing assessment and direction? _____

   Describe: _____

   _____

   _____

   _____

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION _____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

I. PROJECT MANAGEMENT

A. DECISION MAKING STRUCTURE

Basic and Necessary

1. Is there a formalized process for integrating opinion and information from all involved institutions/groups into the decision making process?

_____

_____

_____

_____

2. Who makes decisions?_____

_____

_____

3. How are decisions made? Describe._____

_____

_____

_____

_____

Notes:

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COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION _____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

B. PROJECT CHANGES

Basic and Necessary

1. Have key management decisions been made which have changed an element or direction of the project?

- project purpose_____

  _____

- project outputs_____

  _____

- staffing pattern_____

  _____

- funding level_____

  _____

- work priorities_____

  _____

2. Where these the result of formal or informal monitoring and evaluation?

   _____

   _____

3. Are there periodic formal reviews and discussions of the project purpose, strategies, etc. (i.e., logframe?)

   _____

   _____

Notes:

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COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION _____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

II. TECHNICAL

(If information is already recorded under technology effectiveness section, so indicate).

A. PERFORMANCE

Basic and Necessary

1. Does the project have a performance monitoring procedure that is used or will be used for each set of technologies? Describe.

_____

_____

_____

_____

_____

2. Has the use of these procedures resulted in observable technology development? Describe.

_____

_____

_____

_____

Notes:

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COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION _____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

B. DESIGN

Basic and Necessary

1. Have there been changes in baseline design of the technologies? Describe or get graphic/written project design changes.

_____

_____

_____

_____

_____

2. Were these changes due to:

- performance evaluation_____,
- user opinion_____ _____,
- laboratory testing_____,
- other_____?

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION _____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

C. ECONOMIC

Basic and Necessary

1. Have financial and economic assessments been carried out for each technology?

_____

_____

_____

2. What were the results? (Obtain analysis or ask project staff opinions).

_____

_____

_____

3. Were actions taken based on these analyses? Describe.

_____

_____

_____

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

III. Dissemination

A. INSTITUTIONAL

Basic/necessary:

1. For each technology, what institutions are deeply involved in dissemination and what is the basic strategy/delivery mechanism? _____

_____

_____

_____

2. Have any of these strategies changed? How? _____

_____

_____

_____

Secondary:

1. Are some institutions doing better than others? Why?

_____

_____

2. What new dissemination strategies have been developed?

_____

_____

Notes:

COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

B. USERS

Basic/necessary:

1. How are user needs determined by the project? _____

_____

_____

_____.

2. What major changes in perception of user needs have occurred since the beginning of the project? _____

_____

_____

_____

3. How are users integrated into:

- design phase? _____

  _____;

- testing phase? _____

  _____;

- demonstration phase? _____

  _____;

- dissemination phase? _____

  _____.

Notes:

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COUNTRY_____ PROJECT SITE_____ LOG #_____

END-USE APPLICATION_____ ENERGY SYSTEM USED_____ DATA COLLECTOR_____

C. BARRIERS AND CONSTRAINTS

Basic/necessary:

1. For each technology or in general, if appropriate, are there barriers and constraints which have become apparent that were not recognized during project design? Describe: _____

_____

_____

2. How were they discovered? _____

_____

_____

3. Are there strategies to address those barriers and constraints? How arrived at? _____

_____

_____

Secondary:

1. What evidence is there that these barriers and constraints will be overcome via present project strategies?

_____

_____

_____

Notes:

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6.5 National Energy Profiles

A national energy profile consists of examining domestic energy resources of a country, its current energy use patterns, and the types and amounts of energy produced in-country and imported. A complete profile also takes into account the trends in each of these areas along with energy pricing information and other country-specific economic and potential factors. Most information necessary for analysis in this subject area of the evaluation will be collected in the United States. However, any studies or reports of the national energy or regional energy situation should be gathered whenever possible. Teams should look for information on:

A. Energy Resources:

1. Conventional Commercial Sources: 10^6 MJ

   a. Petroleum reserves (in million or billion barrels of proved reserves 1 barrel = 5,200 MJ)or annual production

   b. Hydroelectricity(either total potential or annual production; 1 MWh = 3,600 MJ)

   c. Thermoelectric energy, annual production

   d. Other conventional sources (eg., 1 m^3 natural gas = 38 MJ
      1 metric ton coal = 29,700 MJ
      1 metric ton peat = 14,000 MJ)

2. Traditional and Nonconventional Sources:

   a. Firewood (usually projected from standing crop or annual increment in typical stands x total forested area; 1 m^3 = 7,200-12,000 MJ)

   b. Charcoal (annual production; 1 metric ton = 29,300 MJ)

   c. Solar (W/m^2/day; 1 W=1 J/sec)

   d. Wind (mean monthly velocity in meters per second)

   e. Non-wood biomass (crop residues; 1 metric ton= 6,000-8,000 MJ)

B. Energy Use:

1. Industrial (convert kWh, and tons of fuel to MJ: 1 metric ton of diesel fuel= 46,000 MJ; gasolene, 41,900 MJ; fuel oil, 43,900 MJ)

2. Commercial (Large retail business, hotels, banks, printers, etc.) (convert kWh and tons of fuel to MJ)

3. Institutional (hospitals, government, schools and universities, museums, old people's homes etc.; convert kWh and tons of fuel to MJ)

4. Transport (convert kWh and tons of fuel to MJ)

5. Household (convert m^3 of wood and kg of charcoal to MJ; also liters of kerosene and kWh to MJ; 1 liter kerosene = ca. 42 MJ)

6. Agricultural (annual energy consumption per ha in West African countries, including manual labor has been estimated at 8,000-12,000 MJ)