Handbook for Financial and Development Professionals

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Introduction

The purpose of this Handbook is to introduce financial and development professionals to clean energy technologies, enterprises and the issues involved in assisting or evaluating such enterprises.

The major objective of this handbook is to provide information and concepts that may guide finance and development organizations to become involved in project development, implementation and finance.

This Handbook is a companion to *AREED's Toolkit for Energy Entrepreneurs*. Unlike the Toolkit, which is designed in a building block fashion (from fact-finding to feasibility analysis to business planning), this handbook consists of separate chapters on reasonably self-contained topics.

Chapter 1 is an introduction to six clean energy technologies: solar PV, hydroelectricity, biomass, wind, solar hot water heaters and hybrid (combination) systems. The introductions are brief and non-technical; multiple world wide web sites are provided for additional information.

Chapter 2 provides brief descriptions of existing clean energy projects and enterprises. The major goal of this chapter is to show that sustainable, profitable businesses already exist in a variety of technologies and forms.

Chapter 3 describes the variety of business models that exist and tries to distill the lessons that have been learned regarding how these businesses grow, especially from the perspective of needing infusions of seed capital and a variety of business assistance.

Chapter 4 is a “how to” chapter aimed at energy entrepreneurs but useful to finance and development professionals in that it sets forth a format to preparing a project or enterprise business plan and provides two detailed examples of such business plans.

Chapter 5 presents the issues that need to be evaluated in making a decision about investing in or supporting a clean energy project. It includes supplementary checklists concerning market conditions, evaluating a project management team and conducting due diligence.

Chapter 6 presents some of the programs and organizations that provide financial and technical assistance to clean energy projects in developing countries.

Chapter 7 is another “how to” chapter on undertaking financial analysis.

Chapter 8 presents the complex subject of the environmental and social consequences of energy production and use.

Finally, Chapter 9 is a glossary, divided among financial terms, technical terms and energy measurement and conversion factors.

This first version of this Handbook is very rough. There is enormous scope for improvement and it is hoped that most of the suggestions will come from men and women using, rather than just reviewing, its contents. Any and all comments and suggestions are welcomed. Please send these to areed@energyhouse.com.

For the AREED[1] Team: Philip LaRocco
December 27, 2000

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[1] African Rural Energy Enterprise Development initiative of UNEP, E&Co, the UN Foundations and many local partners in Ghana, Mali, Senegal, Zambia and Botswana. This Handbook and its companion Toolkit for Energy Entrepreneurs are available for non-commercial use and distribution at no cost (with attribution to AREED, UNEP and E&Co). Contact areed@energyhouse.com for information.

Handbook for Financial and Development Professionals

Chapter 1

Introduction to Sustainable Energy Technologies

This chapter provides introductory information and sources of additional information concerning four renewable energy technologies

- **Solar PV**

PICTURE AND PAGE NUMBER

- **Hydropower**

PICTURE AND PAGE NUMBER

- **Biomass**

PICTURE AND PAGE NUMBER

- **Wind and Hybrids**

PICTURE AND PAGE NUMBER

- **Solar Hot Water Heaters**

PICTURE AND PAGE NUMBER

SUGGESTION: CREATE A SEPARATE SECTION ON HYBRIDS

Solar PV – Information and General Introduction

- Information on Solar PV can be found at:

  - http://www.shell.com
  - http://www.raps.co.za
  - http://www.fsec.ucf.edu/PVT/index.htm
  - http:// www.eren.doe.gov/pv
  - http://www.pvpower.com
  - http://www.solarpv.com
  - http://www.sunlightpower.com/upvg/pv_what.htm

- General Introduction

Solar panels collect sunlight, generate electricity and are connected to different components to form a solar system suitable for a specific application. The components connected to the solar panel are called balance of system components (BOS).

The most common application are lighting, water pumping, powering small appliances in households (e.g., TV) and powering productive use applications (e.g. sewing machine).

The direct current (DC) electricity generated by the solar panels during the day is generally stored. This allows 24-hour access to electricity. For this reason most solar systems are connected to a battery-bank.

In applications where alternating current (AC) is required to power certain appliances, an inverter is installed to transform the DC current available from the solar panel or the battery-bank to AC current.

The numerous configurations made possible by connecting different balance of system components to solar panels allows their use in many different ways.

<u>Households</u>
Solar Home Systems (SHSs) are used to power lighting, entertainment and information electronics (radio, television, cassette players, etc), and to a lesser extent productive or environment improvement appliances such as fans, sewing machines, soldering irons, hair clippers, etc.

<u>Community</u>
Solar PV Systems may be used for indoor or outdoor lighting such as streetlights or the powering of small hand tools in community centers or workshops.
Solar Water Pumping Systems provide small communities easy access to water.

<u>Health</u>

Solar PV Systems can power vaccine refrigeration, general facility and task lighting, and communication with district hospitals.

Education
The provision of solar power to rural schools allows the lighting of classrooms at night, which could aid programs providing basic adult education. Solar power systems also make the introduction of teaching aids such as computers, television, video and overhead projectors possible.

Manufacturing and Commercial
Numerous possibilities exist where solar power can be used in the manufacture or processing of product and the retailing of goods in rural communities. Examples include, refrigeration, cash registers, small machine tools or appliance powering.

Tourism
Through the installation of solar power, accommodation facilities within nature reserves can be greatly improved.

Telecommunications
Solar power is used to power two-way radios and telephones but also the infrastructure backbone of these services. Service providers use solar power to relay messages through repeater towers instead of establishing direct wire links.

Transport
The high cost of providing grid power in remote sites made the transport sector one of the first to make use of solar power for road signs, railway signals and navigational buoys.

Agriculture
Agriculture in developing countries benefits from solar power through applications such as water pumping and electric fencing.

Solar PV Systems consist of a number of interconnected components. Typically a solar system would consist of a:

Solar Array – The solar array in a typical solar system consists of one or more solar panels. The size of the solar array is determined by the load (duration, quantity and size of appliances) to be powered. A solar home system (SHS) usually consists of one or more solar panels with a combined peak wattage of between 20 and 150 watt. larger arrays, a series of multiple panels, are used to meet the higher energy demands of clinics, schools, water pumps and other greater demands.

Mounting Structure – The solar array is normally mounted on a metal or wooden structure to secure it against wind gusts, at such a height as to allow minimum obstruction of the sun's rays and in such a position as to keep it out of harms way. The mounting structure is erected in such a way that the available daily sunlight on the solar array is maximized. For this reason solar panels face the equator and are tilted at an angle that allows optimal sun during all seasons of the year.

Charge Controller – The charge controller manages the charging process of the battery-bank. Batteries must not be overcharged or discharged too deeply as this can severely affect their life expectancy. The functions of the charge controller include the optimization of the charge current received from the solar array and the protection of the battery-bank from overcharging. Many charge controllers also provide a customer interface as to inform the user of battery-bank's state of charge.

Battery Bank – The energy produced by the solar array is stored in the battery bank for use at any time. The battery-bank typically consists of one or more lead-acid rechargeable batteries similar to that found in motor vehicles. The use of ordinary automotive batteries in solar PV systems is not recommended. Use should rather be made of batteries that are better suited to delivering smaller amounts of power for longer periods of time in order to increase the battery-banks life expectancy. Generally batteries are a costly item in a solar system and need to be selected with care.

Inverter – Solar arrays and battery-banks deliver direct current (DC) electricity. To make this electricity useful for the powering of electrical appliances it needs to be changed to alternating current (AC). The device used for the purpose of transforming low voltage DC current to 110 or 220VAC is called an inverter.

Other Balance of System (BOS) Components – To get the solar system to work, the components need to be interconnected. For this purpose wire and cable of appropriate size, which minimizes resistance and a potential drop in voltage, is used. Other components needed for installation purposes, to make the system operational, include connectors, sockets, power outlets, channeling and tubing, as well as mounting hardware and terminals.

A solar PV system's size is determined by the peak wattage of the solar array. The amount of power (watts) that is available for consumption on a daily basis is however dependent on the average daily insolation (amount of sunlight measured in kWh/day/m^2) that a region receives. For example, the daily average insolation in the arid semi-desert regions of the continent is significantly higher (as much as 33%) than that in the rainforests of the equator.

In practical terms, this means that if the same 50 Watt peak Solar Home System is installed in both regions, the people in the semi-desert would be able to consume 50% more power on a daily basis than their counterparts in the rainforest.

The average daily insolation in Africa per annum varies from around 4kWh/day/m^2 to 6.5 kWh/day/m^2. This is some of the best sunshine in the world and superior to the average of 2 kWh/day/m^2 to 4 kWh/day/m^2 received in northern Europe, Canada and the northern section of the United States of America.

Not all solar panels are of good quality. The best way to distinguish between solar panels is to look at the reputation of the manufacturer, its distributors and the warranty and after sale service that they are willing to attach to their product.

- Solar Photovoltaic System Costs

Giving an indication of the cost of a solar PV system is extremely difficult, as it is dependent on the system's application and whether appliances are part of the system, such as a vaccine refrigerator in a health clinic system.

As a general rule it can be accepted that the smaller the solar PV system the higher the cost per peak watt installed. Larger solar PV systems therefore cost less per peak watt to install than the average Solar Home Systems. The installed cost of a Solar Home System of between 20 and 150 watt is typically in the region of US$10 to US$12 per peak watt. The average price of PV cells declined by one third in the past year, dropping to about $2.00 per peak watt. Module prices also declined from about $4.00 per peak watt in 1998 to approximately $3.60 in 1999.

Photovoltaics are now a proven technology that holds much promise for business. PV has the ability to bring about real change in rural unelectrified communities and create a business base for entrepreneurs in:

- Small-scale usage: Sale (cash or credit) and provision of services to homes for a fee, businesses and communities.

- Large scale uses: Water pumping, clinic and schools electrification and other productive uses.

Advantages:

- In rural markets that have no access to grid-connected electricity, life-cycle costs for photovoltaic systems are often equal to non-renewable alternatives now in use (kerosene, dry-cell batteries).

- Improved quality of life by increasing the number of productive hours, i.e. hours for education, income generation activities, etc.
- Proven technology with low operation and maintenance costs.
- Free abundant resource that is non-polluting.
- Self contained generating and distribution system.
- Modular

Disadvantages:

- Systems have high capital and transaction costs.
- Most rural families cannot afford to purchase for cash.

- Batteries contain hazardous materials and a means for careful recycling or disposal should be included in the long-term project design and funding scenario.
- Photovoltaic modules produce direct current (DC) electricity only; an inverter must be added to the system to run alternating current (AC) devices.
- Many governments have yet to realize the value of solar power and there are disincentives for its use due to high import duties, taxes, and subsidies for competing fuels.
- Information gaps exist. Updated information on the technology and availability is not readily available to all potential customers.

Hydropower – Sources of Information and General Introduction

- Information on Hydropower can be found at:

    - http://www.geocities.com/wim_klunne/hydro/
    - http://www.tamar.com.au/ (click on Hydro turbine section)
    - http://www.domme.ntu.ac.uk/microhydro
    - http://www.powerflow.co.nz/
    - http://www.inel.gov/national/hydropower/hydror%26d/hydror%26d.pdf

- General Introduction

Hydropower uses the energy of flowing water and variations in the altitude of the terrain to generate electricity. Typically, hydro plants include:

Dam: to accumulate water (in the case of small hydro this may be an "intake weir" that would ensure a high enough water level to keep water always entering the penstock).

Reservoir: where water is stored.

Penstock: pipes that carry water to the turbines inside the powerhouse.

Turbines: turned by the force of water in their blades.

Generators: driven by the turbines, they produce electricity. Two types of electricity are produced by generators, alternating current (AC) or Direct Current (DC). The choice between the two usually depends on the size of the system. AC is more common as DC is generally used in very small power systems of a few hundred watts.

Power House: actual building where electricity is generated and transformed to allow transmission to homes and businesses.

Transformer: Equipment that changes the AC voltage produced by the generator to a higher voltage for transmission.

Transmission lines: carry electricity local substations and to final users.

Small hydro plants usually do not require the construction of large dams. Facilities that actually require water storage will usually do little or no damming to the river's flow. This is seen as one of small-hydro's main benefits.

The power potential of water depends on the volume of water in the river (the "flow") and on the difference between the levels at which the water can flow down (the available "head").

The flow of the river is the amount of water (in cubic meters or liters) that passes from one point to another in the river, in a certain amount of time. Flows are normally given in cubic meters per second (m3/s) or in liters per second (l/s). The head can also be measured as the height from the turbines in the power plant to the water surface created by the dam.

The quantity of water available and the flow at different times in the year will produce different amounts of electricity.

Theoretical power equation:
$P = Q * H * e * 9.81$
Where:
P: power at the generator (in kilowatts)
Q: flow (in m3/sec)
H: head (in m)
e: efficiency of the plant considering losses (in decimal points, 85% efficiency level is entered as 0.85)
9.81: constant value (in kilowatts) for converting flow and head into kilowatts.

There are generally two categories of hydro power plants: run-of-river and storage plants.

Run-of-river plants generally use some or most of the flow in a stream to ensure the necessary amount of water to run the turbines. A run-of-river project normally does not have a dam, except for an intake weir. This storage facility keeps the water at a specific altitude and enables the pipes to be filled at all times.

Storage plants are usually larger hydroelectric plants that have a dam where water is stored to offset fluctuations in water flow. These fluctuations are generally caused by seasonal changes (different levels of rainfall). Storage facilities can be designed to provide daily and/or weekly storage needs. This is mainly done to satisfy energy demand in “peak” demand hours, and to conserve the water during low demand hours. “Peak” demand hours are those hours in which homes and businesses need electricity the most.

Kaplan, Francis, Pelton, Turgo Impulse and cross flow turbines are the most common turbines used in small hydroelectric facilities.

All power systems produce less power than is theoretically available because losses in energy take place as a result of changes in flow, when water enters and runs through the penstock, and also because of inefficiencies in the turbines. This is why the “e”, efficiency term is used in the above calculation.

As the head decreases, to achieve the same amount of power output the flow must increase. Generally, the cost of the turbine is determined by its diameter. The lower the head, the higher the flow and the higher the cost of the machinery and powerhouse. This cost may be offset by the cost of the civil works required to build tunnels or high dams. Overall, the technologies involved in the development of small hydro facilities are proven.

Plant capacity factor: this is a commonly used term. It is the ratio of the actual power produced in a year to the power that could be produced in a year if the equipment ran at full capacity for the whole year. Normally, the plant capacity factor is in the range of 30% (for plants that have specifically been built to supply power during “peak” hours) to 75% for stations with either large storage capacity or a very steady water flow throughout the year.

- System Costs

Estimating the average capital cost of small hydro plants is difficult because the type of plants can vary (depending on the flow and head and also depending on environmental considerations). The following average data corresponds to small hydro plants of 125kW and 32.4 MW in size.

Turbine Cost:	$450 - $600/kW	
Total Project Cost:	$1,000 - $2,100/kW	
Cost Breakdown:		
	Civil works	15 - 40%
	Equipment	30 - 60%
	Infrastructure	10 - 15%
	Development Costs	10 - 15%

Average Construction Time: 2-3 years
Operating & Maintenance Cost: $0.01 - 0.02/kWhr

Advantages

The environmental and industrial advantages of small-hydro power generation are often disputed because they are grouped with the problems associated with large-scale hydroelectric plants. However, in favorable sites, small-scale hydroelectric plants remain a very valuable form of energy both in environmental as well as in financial terms when compared to other forms of energy investments.

Some of the advantages commonly linked to small-hydro power generation include:

- The fuel source is essentially “free”, it can be reused (as the fuel is not consumed) and it is non-polluting.
- The system can be integrated with water flows used for irrigation and potable supply.
- Systems can have a 50-year or more useful life and provide continuous power as long as water resources are sufficient.
- Limited maintenance (compared with diesel power) is required.
- The conversion of the potential energy of water into mechanical energy is highly efficient, if compared to thermal power stations.

Disadvantages

- Flows often vary throughout the year, affecting the availability of water in certain seasons or time periods (as in the case of El Niño or Monsoon climates);
- It is a site specific technology, meaning that the necessary conditions for power generation in terms of flow and “head” need to be present for use. Locations where power can be economically exploited are limited;
- Water flow and “head” conditions limit the maximum level of power that can be generated. The level of expansion is therefore bounded.

Biomass – Sources of Information and General Introduction

- Information on Biomass can be found at::

  - http:// www.shell.com
  - http:// www.solstice.crest.org/renewables/re-kiosk/biomass/index.shtml
  - http:// www.nrel.gov/research/industrial_tech/biomass.html
  - http:// www.ott.doe.gov/biofuels/what_is.html
  - http:// www.eren.doe.gov/re/bioenergy.html
  - http:// www.nrel.gov/lab/pao/biomass_energy.html

- General Introduction

Biomass accounts for more than 10 percent of global energy use. In parts of the developing world it accounts for up to 90 percent. Biomass is an indigenous fuel source that is often readily available and inexpensive throughout much of Africa. It can also be effectively converted to electricity and heat due to recent technological developments. It is because of these two factors that biomass will most certainly play a significant role in the development of energy sectors across the world.

The two most common types of biomass resources are p*lant biomass* which includes woody and non-woody biomass and processed waste and fuels; and, a*nimal biomass* which includes animal manure as a feedstock to generate energy using biogas technologies or directly as a cooking fuel.

Each type of biomass has unique characteristics that make it more or less suitable as a fuel source:

- *Moisture content:* This is simply the amount of water found in the resource expressed as a percentage of the total resource weight. The value can range from less than 10 percent, for some straws, up to 70 percent for forest residues. The percentage can be expressed as a portion of the wet, dry, or ash-free matter. Typically, it is measured on a wet basis, however it is important to know and cite the way in which the resource was measured.
- *Ash content:* Again, the ash content can be measured on all three bases - wet, dry or ash-free matter. The type used must be reported. It is most common to see the ash content measured as a percentage of the dry matter. In wood, the ash content is around 0.5 percent, for agricultural residues the percent ranges from 5 to 10, and for husks it can be as high as 40 percent. The amount of ash affects the biomass's behavior when exposed to the high temperatures necessary to convert it to electricity.
- *Volatile matter content:* This is the measurement of the amount of the biomass that escapes when heated up to 400 and 500 degrees Celsius. When exposed to high heat, the biomass decomposes into solid char and volatile gases. The volatile content can be as high as 80 percent.

- *Elemental composition:* The elements contained in biomass are typically carbon, oxygen and hydrogen with a small amount of nitrogen.
- *Heating value:* This property measures the amount of energy that is chemically bound in a standard environment. The heating value is a measurement of the energy (Joules; J) per amount of matter (kilograms; kg). The value cannot be measured directly so it is done according to reference states such as the lower heating value (LHV), measured in a gaseous state and the higher heating value (HHV) measured in its liquid state.
- *Bulk density:* This is the weight of the resource per unit of volume. This measurement can be found when the biomass is in zero (0) moisture content state (MC=0), termed the oven-dry-weight basis, or according to its given moisture content (MC_w). This property also shows extreme variations from as low as 150 to 200 kg/m^3 straws to 600 to 900 kg/m^3 for wood. The last two properties, heating value and moisture content together determine the biomass resource's *energy density*. The energy density is defined as the potential energy per unit volume. The result is typically one-tenth that of fossil fuels.

- Technology Options

The following provides a brief introduction to the various types of biomass technologies that are available for different biomass resources.

Direct Combustion: Biomass such as wood, garbage, manure, straw, and biogas can be burned without processing to produce hot gases for heat or steam. Burning the resource by direct heat is termed direct combustion. Examples of direct combustion range include burning wood in fireplaces, burning garbage in a fluidized bed boiler, producing heat or steam to generate electric power. This is the simplest, most widely used, and often most economical biomass technology especially if the biomass resource is within close proximity.

Pyrolysis: Pyrolysis is the thermal degradation of biomass by heat in the absence of oxygen. Biomass resources, such as wood or garbage, are heated to a temperature between 800 and 1400 degrees Fahrenheit, but no oxygen is introduced to support combustion. Pyrolysis results in three products: gas, fuel oil, and charcoal.

Anaerobic digestion: Anaerobic digestion converts organic matter to a mixture of methane, the major component of natural gas, and carbon dioxide. Biomass, such as wastewater (sewage), manure, or food processing wastes, is mixed with water and fed into a digester tank without air. Use of this type of technology results in biogas.

Gasification: Biomass can be used to produce methane through heating (800 Celsius) or anaerobic digestion. During gasification, about 65% of the energy is captured and converted into combustible gases. The gases are then converted into natural gas, which can be used to fuel vehicles, generate electricity, or again converted into synthetic fuels. This technology is not as commercially viable as direct combustion because it is more costly and more state of the art. The most commonly used types of gasifiers are fixed-bed and fluidized-bed. There are many advantages that gasification technologies have over direct combustion and the other converting technologies. The advantages include increased efficiencies by as much as 50%, variety of suitable biomass resources.

Alcohol Fermentation: Fuel alcohol is produced by converting starch to sugar, fermenting the sugar to alcohol, then separating the alcohol water mixture by distillation. Feedstocks such as wheat, barley, potatoes, waste paper, sawdust, and straw contain sugar, starch, or cellulose and can be converted to alcohol by fermentation with yeast. Ethanol, also called ethyl alcohol or grain alcohol, is the alcohol product of fermentation usable for various industrial purposes including alternative fuel for internal combustion engines.

Landfill Gas: Landfill gas is generated by the decay (anaerobic digestion) of buried trash and garbage in landfills. When the organic waste decomposes, it generates gas consisting of approximately 50 percent methane, the major component of natural gas.

Cogeneration: Cogeneration is the simultaneous production of more than one form of energy using a single fuel and facility. Furnaces, boilers, or engines fueled with biogas can cogenerate electricity for on-site use or sale. Biomass cogeneration has more potential growth than biomass generation alone because cogeneration produces both heat and electricity. Cogeneration results in net fuel use efficiencies of over 60 percent compared to about 37 percent for simple combustion. Electric power generators can become cogenerators by using residual heat from electric generation for process heat, however, waste heat recovery alone is not cogeneration.

Co-firing: Co-firing is only possible if using an existing coal-fired power plant. This process is possible by mixing biomass with coal and then burning them together or in different boiler feeds. Advantages of this technology are that it can be the least-cost option and can displace up to 15% of the coal. The typical biomass resources used in this case are wood products.

Overall, one of biomass's most attractive qualities is its versatility. It can be easily converted to electricity by burning or converted to liquid or gaseous fuel by physical or biological means.

- System Costs

Due to numerous variables, it is not reasonable to provide estimate costs for biomass projects. Issues to consider in determining the cost of using a biomass resource include:

- Crop selection and rotation: Biomass properties will often affect the attractiveness of the resource. For example, the energy density, leaf cover, productivity, water and nutrient requirements, soil erosion susceptibility to disease, effect on biodiversity may increase the cost of converting the resource;

- Cost and seasonal availability of resource;
- Storage: It may be possible that you have to collect and store the resource for a period of time, which may be costly;
- Transport: Costs to get the biomass to the conversion site; and
- Efficiency: The lower the efficiency of the biomass resource the more land is required. This cost may be a substantial percentage of the total project costs or the land may be economically suited for another activity.
- Plantation running costs: labor, fertilizer, and herbicides

Advantages

- Biomass is a renewable source as is receiving a great amount of attention as a possible fuel of the future to combat climate change. This could have a positive impact on the cost, etc.
- Biomass is often available in large supply in developing countries.
- Land requirement is not an issue because there is generally a large amount of land area in Africa that cannot be used for other productive uses, but can sustain biomass.
- A variety of conversion products are available with a wide range of uses.

Disadvantages

Biomass is often left out as a fuel for the future for the following reasons:

- Associated with health related problems in developing countries mainly from particulates released during burning and carbon monoxide. These problems lead to respiratory infections in children and complications during pregnancy;
- Biomass is often bulky and may have a high water content.
- Quantity of fuel is unpredictable and may be difficult to handle. Long-term fuel supply contracts ;
- Low energy density per unit of land, water, or per unit weight of raw product;
- Energy crops and dedicated biomass requires a large amount of dedicated land area. Unfortunately, dedicated areas may reduce the soil fertility, biodiversity, water level, landscape, displace food, and affect the leaching of nutrients.
- In developing country it is expensive as wood fuel costs 2 to 3 times higher than in Europe or the US. (Better example)

Wind and Hybrids – Sources of Information and General Introduction

- Information on Wind and Hybrids can be found at:

  - http://www.bergey.com
  - http://www.energy.ca.gov/earthtext/wind.html
  - http://www.nrel.gov/clean_energy/wind.html
  - http://www.eren.doe.gov/wind/web.html
  - http://www.britishwindenergy.co.uk/frames/index.html

- General Introduction

For many years, humans have used wind to crush grain, pump water and transport goods and people. Most recently wind machines have been developed that produce electricity. Wind is used to drive a rotor (blades) that is connected through a power shaft to an electric generator. Wind speed increases with height above the ground, so wind turbines are mounted on towers. The amount of energy a wind turbine produces depends on the wind speed and the diameter of the rotor.

Electricity produced from the wind represents the fastest growing energy sector in the world. If the 27% average annual growth rates of 1995-1998 can be sustained, wind energy could account for more than one-tenth of world electricity production by the year 2020. Improved technology and larger wind energy machines have combined to make wind energy cost competitive with fossil fuel.

While large, grid-connected systems dominate the statistics of wind energy production, the improvement in smaller wind technologies has been equally dramatic. Wind energy, alone or combined with other means of energy production – such combinations are called "hybrids" – are in position to make significant contributions to rural energy supply.

These contributions can take the form of water pumping for drinking or irrigation, electricity for income producing activities, or household, health and community services. These services can be to individual buildings or groups of buildings or to a "mini-grid" covering a village or town.

The most common wind turbines in operation today have two or three blades that revolve around a horizontal axis. These "horizontal-axis wind turbines" (HAWT) also include a gearbox and generator, a tower, and other supporting mechanical and electrical equipment.

Wind turbines are rated by their maximum power output in kilowatts (kW) or megawatts (1000 kW). For commercial utility-sized projects, the most common turbines sold are in the range of 600 kW-1000 kW (one megawatt) – large enough to supply electricity to 600-1000 homes. The newest commercial turbines are rated at 1.5 megawatts or more.

If the goal is local energy production for local use – as is the case with most rural and smaller projects -- wind machines (turbines) and a tower need to be of a size suited to the prevailing winds and electricity demand in the area. Where larger projects (wind "farms") are involved, the electricity produced is usually for sale to the electricity grid. Project interconnections make these projects far more complicated from a technical perspective. Because of the need to technically integrate two complex systems.

Long-term wind data (wind maps) of an area are *absolutely critical* to ensure the average wind speed that can be expected. Once long-term wind averages are determined site specific data are equally essential and require specific measurement over time using devices known as wind anemometer.

Since the current phase of development began in the 1980's, the price for wind-generated electricity has been reduced by an average of 3 percent per annum. This has been due in part to ever-increasing turbine capacity, increasing from an average 220kW in 1992 to 650 kW in 1998.

- System Costs

Wind Turbine Size ranges:

- Large units – 250kW to 1500 kW each, cost $600/kW
- Medium sized units – 10 kW, cost $1,400/kW
- Small units – less than 500 W, cost $1,600/kW

Total Project Cost: $1,000 - $1,600/kW

Advantages

- Although the wind resource for any site is intermittent, it is predictable and its available power increases dramatically with an increase in available wind speed. Thus the output from a wind plant can be integrated with other energy supplies or into existing electrical grids with a high degree of confidence. A modern wind turbine's "capacity factor" (the percentage of time a wind turbine generates power) is in the range of 20-40 percent.
- Wind turbines require no fuel and operations are simple with low maintenance requirements.
- Wind turbines are rugged and reliable and the modularity of wind machines allows units to be sized to match existing energy needs and expanded as demand grows.
- A small windfarm can generally be constructed within a year.

Disadvantages

- Wind energy is very site specific with minimum wind speed requirements.
- Larger wind farms require land and may be visually unappealing and noisy. Such larger systems can not be sited close to centers of demand.

<u>Wind Hybrid Systems</u>

A hybrid system comprises components that produce, store and deliver electricity utilizing more than one energy generation technology. This could include a wind turbine, PV array and diesel generator. The most common combinations are wind and PV or a generator because wind energy production tends to be highly variable; therefore, wind turbines are often best combined with PV panels or generators to ensure energy production during times of low wind speeds.

Many sites, particularly in northern latitudes have seasonally complementary wind and solar resources (strongest wind in winter, strongest solar in summer). Therefore, establishing a system using both wind and solar PV could address the energy needs year round. In addition, combining wind and PV can shrink the battery bank requirements and further reduce diesel consumption.

Utilizing a wind-hybrid system is very common in telecommunications applications. In addition, establishing a wind/diesel battery charging stations could address the need of carrying batteries to town for charging in developing countries. Offering wind/diesel power battery charging services at the village appears to be very cost effective ($2.50 - $5.00 per month).

Advantages of Hybrid Power Systems:

- Provide dependable, utility grade power 24 hours a day.
- Not dependent on a single source of energy
- Flexible, expandable and able to meet changing loads.
- Simple, quick, low cost installation.
- Low operating costs (O&M and Diesel fuel).
- Simple operation, low maintenance and service requirements.
- Lower life cycle costs of electricity for remote applications.

Disadvantages of Hybrid Power systems:

- High capital cost compared to diesel generators.
- Diesel and Hybrids have very different cost components.
- More Complex than stand-alone power systems; requires battery storage and power conditioning.
- Not yet in full commercial production/few suppliers.

Solar Thermal – Sources of Information and General Introduction

- Information on Solar Thermal can be found at:

  - http://www.eren.doe.gov/solarbuildings/ hotwater.htm
  - http://www.natenergy.org.uk/swh.html
  - http://www.nrel.gov/
  - http://www.eren.doe.gov/
  - http://www.eren.doe.gov/consumerinfo/elecsource.html
  - http://www.epsea.org
  - http://www.eren.doe.gov/erec/factsheets/solrwatr.html
  - http://www.greenbuilder.com/sourcebook/heatcool.html#Define
  - http:// www.seia.org/sf/sfsolth.htm
  - http://infinitepower.com/fs10.html

- General Introduction

Solar thermal technologies enable us to produce hot water from the sun's energy for use in homes, factories, hotels and many other applications. Solar water heating is not only a suitable and economical alternative to water heating with electricity in towns, it can also provide hot water efficiently and reliably in rural off-grid areas.

Solar water heaters typically consist of a collector and an insulated water storage tank that is similar to a conventional electric hot water tank or geyser. The collector is a box with a see-through glass (or acrylic) cover containing a number of black coloured pipes attached to or laid on a black heat absorbing surface. Water or other liquid flows through these pipes and is warmed by the sun, and then stored in the water storage tank. This process is repeated over and over while the sun is shining; every time the fluid passes through the pipes a small amount of heat is added to it. Water typically reaches between 60°C and 80°C in solar water heating systems intended for human use.

Solar water heaters are available in various sizes, designs and for various applications. Small systems, with a hot water storage capacity of less than 500 litres, are called domestic systems. These systems are usually installed in residential homes or facilities such as visitor centres and campground showers. Larger size systems (more than a 500 litres per day) are normally referred to as industrial systems. Examples of the application of large systems are found in the agriculture, industrial, tourism and accommodation sectors of the economy.

Special systems that produce a water temperature of several hundred degrees are sometimes used in industry and for power generation. Another popular application of solar water heating is the heating of swimming pool water in less temperate climates.

Homeowners that install solar water heating systems to replace water heating by electricity could expect electricity cost saves in access of 40%. The use of solar water heating therefore not only makes environmental sense but also economical sense. Generally it is possible to recoup the capital expenditure on a solar water heater within 2 to 5 years out of the savings realised.

Solar water heating is a renewable energy technology that is well proven and reliable. Various types of Solar Water Heaters are produced in different sizes. Changes in design are required depending on the climate where the system is installed, the water quality and on the specific use for the hot water.

Systems can be very similar to traditional electric water heaters, where water is stored in a tank and then heated. The difference is basically that instead of heating the water with electricity or a gas flame, the water flows through a solar collector panel, where the sun's rays heat it.

The different designs of solar water heaters available on the market allow for their application in many sectors of a developing country's economy. Examples of these applications include:

Households
Water heater by solar is used for bathing, dish washing and laundering in numerous households. Pool heating is another popular application of solar in the houses of the more affluent in less temperate climates.

Health
Clinics and hospitals use solar heated water in ablutions and laundries. Hot water in access of 80°C can also be used for sterilisation purposes.

Education
Many dormitories at schools and universities use Solar Hot Water systems for the communal shower facilities.

Tourism and recreation
Hotels and accommodation in nature reserves use solar heated water in laundries, bathrooms and sometime for swimming pools.

Industry
Apart from the application of Solar Water Heating systems in worker ablutions, hot water is also required in many industrial processes. Solar hot water applications have been particularly popular in abattoirs due to the cost savings that it brings about. The water is used for the cleaning and sterilisation of the abattoir facility.

Agriculture
A wide range of uses is also found in agriculture. These range from heating water on crocodile farms to pasteurisation and sterilisation on dairy farms.

Solar Water Heater Components

Solar Collector: which is usually a flat metal box or frame with pipes. Collectors have:

Transparent covers that let solar energy in are either made of a special glass that resists breaking and scratching or ultra violet radiation resistant acrylics (plastic).

Absorber plates are dark surfaces that trap heat. These are generally metal sheets or containers filled with water, rocks or bricks that are painted black or another dark colour to retain the heat.

Insulation materials prevent heat from escaping to colder places.

Vents, tubes and pumps carry the heated water from the collector to the places where it can be used.

Storage tank: which stores the water to be heated. The storage tank is similar to most gas or electric water heaters. The tank is made of steel and sometimes copper or even plastic.

The amount of hot water that is produced by a solar water heater depends on the size and type of the system and on the amount of sunlight available at the site. There are many types of solar water heaters, but generally, they can be classified as direct or indirect systems that employ either active or passive fluid flows in their design.

Domestic Solar Water Heaters usually have storage tanks with a capacity of 100, 150, 200 and sometime 300 litres. The size of system selected will depend on the expected household consumption and budget available.

- System Costs

The cost of solar water heaters varies depending on their size and type. Direct *passive* solar water heaters of between 100 and 200 litres usually cost between $750 and $1,250 including installation, while indirect passive heaters are usually in the $1,000-$2,000 price range depending on their size and level of sophistication. Active systems for domestic use are usually in the $2000 to $4000 price range.

Advantages

- Lower consumption of conventional energy that would otherwise involve the use of fossil fuels and cause environmental damage.
- Systems that can operate in any climate.
- Short construction and installation times.
- Modularity.
- For households already connected to the grid, substantial savings in electricity bills.

- Solar water heating is the least cost method of heating water if life cycle costs are calculated.
- Water heating by solar energy is highly efficient.
- Long-term benefits for users as the systems isolate them from future fuel shortages and price increases.
- Opportunities for local production and job creation.
- Hot water can make a valuable contribution to personal hygiene.

Disadvantages
- Ultra violet (UV) rays damage most materials after a few years in the sun. Good quality more expensive materials that are capable of withstanding the damaging effect of UV radiation need to be used.
- Systems of appropriate design and quality must be used if a medium to long-term cost saving is to be realised.
- Solar water heaters are more cost-effective than electric water heaters but less so if compared to gas water heaters.
- In places with cold weather, the solar water heater might require a back-up device (usually electric element) to ensure hot water provision at times of low solar energy. Electrically boosted solar water heaters can actually produce more air emissions than high-efficiency gas water heaters, in climates where solar systems are largely reliant on boosting.
- The initial cost of solar water heaters is generally higher than that of conventional water heaters. However, as the fuel is free, the energy costs over the life of the system offset the initial cost.

Handbook for Financial and Development Organizations

Chapter 2

Enterprise and Project Examples

- **Kanata** – Grid Connected Hydroelectric
- **Mae Ya** – Grid Connected Hydroelectric
- **SELCO** – Off-grid solar electricity – cash and credit
- **SOLUZ** – off-grid solar electricity – market-based fee-for-service
- **RAPS** – off-grid solar electricity and other energy carriers –concession-based fee-for-service
- **NOORweb** – off-grid solar electricity combining different approaches
- **Riberalta** – local area grid using biomass combustion
- **Gam-Solar** – off-grid solar electrification and solar hot water heating
- **Rural Industries Innovation Centre** (RIIC) – productive use kits and training
- **SUGGESTED ADDITIONAL EXAMPLES TO ADD: CHINA COASTAL ISLAND HYBRID, PHILIPPINE OR THAI LARGE FARM BIOGAS, RSA PRODUCTIVE USE CENTER, RED CERAMICS…**

Kanata is a 7.4 MW hydro project located in Cochabamba, Bolivia. Its operation allows the production of electricity for the local utility and provides a 30% increase in the potable water available to the city of Cochabamba, a city that suffers regular drought conditions. The project harnesses the outflow from an existing high-altitude dam. Initially, the water passed through an open canal and a gully that were being used to provide drinking water to the city. This conveyance system lost a great deal of water due to the spillage that occurred as the water descended from the reservoir. The project sponsor received a concession for hydropower exploitation from the Bolivian state in 1995. The municipal water supply company retained water consumption rights. The project was designed so that it would rehabilitate the open canal and a penstock would be constructed that would capture 100% of the water flow and lead to a small-turbine power plant. Initial activities included the construction of a forebay, the installation of site facilities, call for bids from equipment suppliers and debt and equity commitments from investors. Kanata's power began to feed the Bolivian grid in May 1999, making it the first Independent Power Production project of its kind in the country and displacing thermal generation. The hydro development has provided a 4km-grid line that will also enable the expansion of the electricity distribution network to the unelectrified rural communities surrounding the project.

The **Mae Ya** small hydro power plant is located in one of Thailand's National Parks on the Mae Ya river in the north west of the country, and is owned and operated by the Provincial Electricity Authority (PEA). The penstock is an exposed steel pipe 900 mm diameter and 370 m long. The turbine house is located 100 m below and adjacent to the river where a 1.15 MW Turgo turbine is located. The generator is connected to the local grid through power transmission lines, mounted on overhead poles. The flow's peak is at 1.37 m3/s but it has a large seasonal variation. To solve one of the most acute problems of small hydro facilities in Thailand – highly abrasive silt - a desalting unit was built at Mae Ya behind the weir. The plant has been in operation since 1991 performing at a 55% load factor

VACVINA, a Vietnamese rural development agency, established a small enterprise distributing and installing household biogas systems. These family-sized bio-digestors are marketed to local farmers and are fueled by household pig or poultry waste. The systems are constructed with locally available plastic sheeting and piping and produces methane gas suitable for cooking. Some 2,500 of these systems have been installed and sales are continuing. Technological development work has continued and Vacvina has designed and installed a more robust unit that can use a brick/plaster construction or reinforced concrete. These units use considerably less ground space than the plastic units and allow their placement under piggeries and/or other farm structures. The VAC Company plans to install some 10,000 household biogas systems by the year 2001. With financing, the company is implementing a project that allows the bulk purchase of materials, the continued promotion of the technology and the training of local technicians in the installation and maintenance of the systems. The financing is being structured on a risk share basis in that its repayment will be based on a "royalty" payment received from each sale of the biogas system.

Solar Electric Light Company, **SELCO,** is a solar energy services company that markets small-scale photovoltaic (PV) power systems in southern India. It also has operating subsidiaries in Vietnam and Sri Lanka. These renewable energy systems offer an affordable and sustainable alternative for lighting and communication in rural households not serviced by the electric grid and provide a stable backup to households on the grid. The current market for residential systems in the off-grid, rural areas of the southern Indian states of Karnataka, Andhra Pradesh, northern Kerala and Tamil Nadu is estimated to be 290,000 households. SELCO has established marketing, sales, installation and service operations in areas of Karnataka and Andhra Pradesh to serve this market through cash and credit sales of household systems. SELCO India also formed partnerships with local suppliers of balance of system components, which resulted in reduced costs. SELCO India's early success in demonstrating the market demand resulted in a number of rural banks offering financing for credit sales. This has allowed SELCO India to further penetrate the rural household market. The successful development of SELCO is demonstrating to both the public and private sectors the commercial viability of rural household PV systems and is seen as a model for replication elsewhere in India and throughout emerging markets.

Soluz is a company that grew from efforts of international and local non-governmental organizations that funded successful demonstrations in Central America that showed a market existed for the credit financing of household PV systems in unelectrified rural villages, specifically in the Dominican Republic and Honduras. However, these projects also demonstrated that cash and credit-based approaches would only reach about 20% of the unelectrified rural population.

This realization spurred Soluz to develop a strategy of providing PV household energy services on an affordable monthly rental basis that would allow the provision of energy services to those who could not afford the services on a cash or credit basis. In 1993, $100,000 was provided to Soluz to implement a prototype demonstration of its SEED model, Solar Electric Energy Delivery, which is the provision of PV solar home systems (SHS) on a monthly-fee for service basis. This economic and technical feasibility work produced a measurable demonstration case and a business plan.

In the Dominican Republic, Soluz Dominicana is following a business strategy to grow the company operations to the next level of 5000 systems by 2002. It has done a successful job of installing systems in the field with a payment collection rate exceeding 95%. Its fee-for-service approach (monthly charges of $10 - $20 per household) is recognized by the industry as highly innovative and ground-breaking. Soluz looks to improve the local benefits of its operations: it has assembled a strong Dominican staff and it maximizes the use of local products and services. Soluz has also established a fee-for-service operation in Honduras.

RAPS is a newly created enterprise with a core business activity to supply electricity and other energy products to the rural community in South Africa. The strategy is to establish privately owned energy stores, called RAP Stores, to oversee the service and maintenance of PV solar systems as well as the supply of complimentary energy products and equipment. The local stores would be established as RAPS' franchises and would receive intensive training by RAPS and standardization of products and services. An innovative feature of RAPS implementation plan is to use a pre-payment system. With this system, the users purchase tokens or cards from the franchises or designated community place. These tokens or cards are then inserted into the solar home system and energy services can be accessed – without the prepaid token, the system won't work. This approach to collection reduces the risk of not receiving regular monthly payments from the users.

RAPS has evolved along with the national government's program to expand the provision of electricity in the rural areas. The RAPS business plan is based on the government concession program. This program establishes rural concessions of 80,0000 households. Following a proposal process, private companies were selected to implement a fee for service PV rural electrification program, receiving a government subsidy of ~3000 Rand per household (~US$450) as part of the program. RAPS was selected as one of the concessionaires. The government regulatory and approval process for the concessions has not advanced as rapidly as originally forecast. While RAPS is still in line to participate, it has had to seek out additional business opportunities while the concession process is delayed.

NOOR Web is a four-year old private company headquartered in Marrakech, Morocco that was established to provide energy services to the large rural unelectrified population in Morocco. NOOR serves this market through two main strategies, first by empowering local entrepreneurs to open and operate their own DAR NOORs, or solar boutiques -- directly in the villages -- to supply their neighbors' needs by recharging batteries and by selling solar home systems and other appropriate items including batteries, electric equipment and low-voltage TV sets; and second by providing, under contract to Moroccan and foreign government agencies, as well as charitable non-governmental organizations, the equipment, installation, maintenance and after-sales service of photovoltaic systems for the rural population. Over time, the company's strategy evolved from a battery - charging station concept to one where numerous distribution approaches will be incorporated, including cash, credit and fee-for-service. This evolution was influenced by numerous changes in the electrification strategy of the National Utility (ONE) to introduce solar power on a widespread basis. While this significantly impacted the ability of NOOR to develop, it did result in a new business opportunity. In 1998, NOOR was awarded a 7,000-unit contract to act on ONE'sr behalf in the installation and maintenance of the rural household PV systems.

Riberalta is a 1 MW biomass power plant in Bolivia that uses 2 tons of Amazonian (Brazil) nut husks/hour and residual scrap wood from local sawmills to produce electricity that feeds an existing distribution system. Prior to the plant operations, the nut husks were dumped in the local rivers, creating significant pollution, and electricity was produced through the use of diesel fuel. Both were significantly altered as a result of this project. The project became operational in 1997. Since that time, it has encountered significant mechanical and institutional barriers that have prevented it from producing at full capacity and easing the power demands of Riberalta. First, the other diesel generators, which combined with the biomass plant produced the full capacity for the Riberalta system, went out of service, putting complete load responsibility on the biomass plant. This prevented needed maintenance and required the biomass plant to be in operation continuously. Additionally, there was a technical complication resulting from excess moisture in the nut husks. Lastly, the operators of the Riberalta system, the Cooperativa Eléctrica de Riberalta (CER), did not execute the necessary institutional and procedural improvements required by the project's main funder, the National Rural Electricity Cooperatives Association (NRECA). As a result, NRECA took over operation of the plant and is now in the process of implementing the require technical upgrades and maintenance.

The response of the Riberalta community has also impacted the project's success. Initially, the community was supportive. However, when all the diesel systems went down, it was blamed on the biomass plant. What the community failed to recognize was that without the biomass plant, when the diesels failed, there would have been no power supply.

Gam-Solar is focusing on (1) household scale solar electrification and water heating in the rural portions of The Gambia and (2) larger scale solar water heating in hotels. Presently Gam-Solar plans to install over 240 rural household hot water or PV electricity systems and undertake one larger hotel conversion to solar hot water. A second stage of activity is planned that would bring the company to financial self-sufficiency by late 2001. Gam-

Solar's strategy is to align itself with well-established in-country entities for rural energy projects and to partner with international energy companies for the larger scale hotel conversions. The company believes these alliances will allow it to establish a presence in both the rural and urban markets without having to build substantial in-house staff and overhead. Limited product and market diversification (large and small, rural and urban, household and hotel, hot water and electrification) is a sound second strategic element. Gam-Solar's products are affordable to large segments of the rural population as a combination of it offering small as well as mid-sized systems and its partnership with an organization offering agricultural-cycle based loans.

The **Rural Industries Innovation Centre** (RIIC), Botswana's national appropriate technology center, designs and manufacturers technologies geared to employment creation and sustainable development, especially in rural areas. RIIC also provides short courses in training for income-generation skills for village people. Through RIIC, the government of Botswana will be making available loans to rural households, payable over 4 years for the installation of PV systems. Customers are required to pay a non-refundable deposit and make monthly payments. Appliances that can be used with PV electricity include: water pumping, lighting systems, TVs, radios, vaccine refrigeration, and sewing machines.

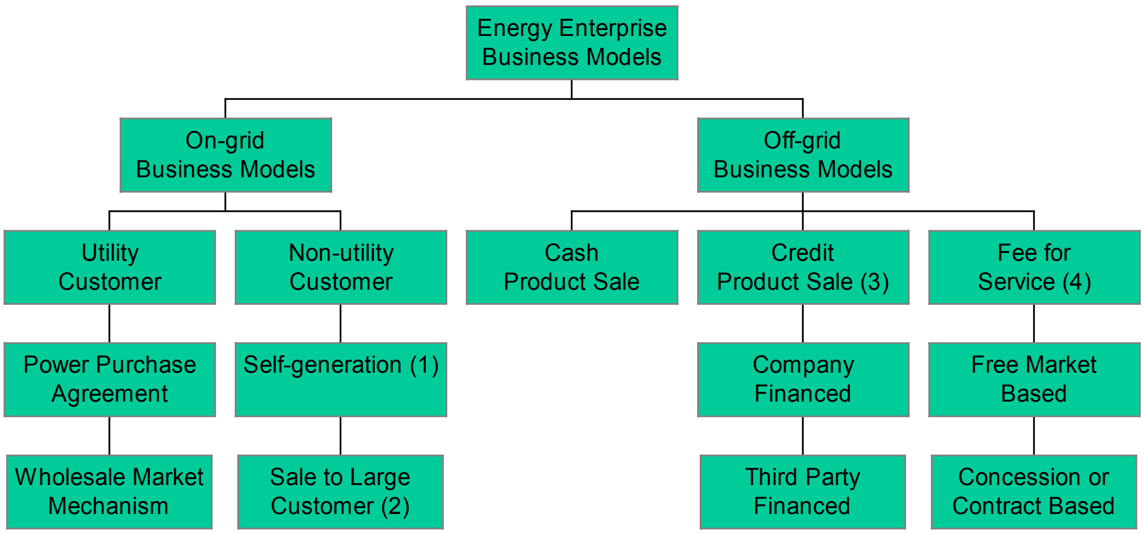
Handbook for Financial and Development Professionals

Chapter 3

Energy Enterprise Business Models

This chapter consists of three parts. In the first part the various types of business models for on-grid and off-grid energy projects are introduced, based essentially on the types of customers served. In the second part this typology is expanded to include other factors that serve to distinguish different ways of doing business. The third part of this chapter reviews some of the lessons learned in developing country energy enterprises and describes three paths that these companies tend to take. This third part also elaborates on why this is a growth sector and the assistance needed for this sector to grow -- a theme that is also found in Chapter 8.

Part 1 – The Basic Business Model Distinctions: Grid Characteristic and Customer Relationship



(1) usually includes purchase of back-up power from and sale of excess electricity to the utility.
(2) usually involves “wheeling”electrcity over the utility’s electricity grid.
(3) Includes installment sales and hire-purchase arrangements.
(4) Includes leasing

The first distinction to be made concerning types of energy projects is between on-grid and off-grid projects: those connected to and selling capacity and energy to a national electricity system versus those off the national grid, which may be individual energy installations (households, businesses, public facilities) or local area grids.

On-grid Projects
Grid connected projects fall into two categories: those connected to public or private sector utility companies (generators or distributors, usually the latter) and those connected to non-utility companies (usually large industries).
**Utility Projects*
Projects involving utilities receive payments in two ways. The first way is a contract called a Power Purchase Agreement, which specifies the amounts to be paid for capacity and energy and the terms and conditions governing the contract.. The second way is called the Wholesale Market, in which case the price to be paid for energy is determined by a market mechanism that determines the price, usually per hour, on the basis of energy offered for sale by projects.
Non-utility Projects
In these projects energy is either consumed by a company producing the energy (these are called " inside the fence" projects but these also tend to be connected to the national grid for either the purchase of power or the sale of power not used within the companies operations. Common examples of these projects include sugar mills that use bagasse to produce steam and electricity for use, with the sale of excess electricity to the power grid. Another type of project involves the production of energy for sale to an industrial user, which usually involves the "wheeling" of electricity through the wires of the national grid.

Off-grid Projects
Off the grid projects involve the sale of products or energy services to customers directly or the production of energy at one location for sale to a group of customers (often through what is called a local "mini-grid"). Products tend to be sold for cash or a combination of cash and credit or hire-purchase, which is a form of installment purchase. Services are usually paid for on a regular basis, in cash (the fee for service model), which is also the way mini-grids tend to operate.

Thus, the first distinction in energy project business models essentially relates to who is paying for the project's output and how they are paying for it:
Utility On-grid Project
- Paid via Power Purchase Agreement
- Paid via Wholesale Market Mechanism

Non-utility On-grid Project
- Paid via Contract for Local Use
- Paid via Contract for Energy Wheeled to Different Location

Off-grid Projects
- Product is Sold for Cash
- Product is Sold for Cash-Credit Combination

Product is Rented (Hired) with Ultimate Purchase
Service is Sold for a Fee.

Part 2 – Other Characteristics Distinguishing Business Models

The second set of distinctions applies to how the project is owned and financed, how it is licensed, how revenues are collected and how tariffs are set.

Ownership Structure
Private Sector Company – share company, partnership or sole ownership.
Public Sector Company – government, village-town or co-operatively owned enterprise.
Joint Venture or Mixed Ownership -- multiple private sector or public sector entities.

Capital Structure
Grant based – where the required capital is donated by a specialized donor program or charitable institution.
Net revenue (customer) based – where the revenues of the project support the borrowing of funds (regardless of the source of funds) and the investment by owners and others.
Government financed – where capital is supplied as a matter of public policy, with no repayment expected.
Mixed Structure, combining elements of customer-based, government financed and grant-based financing.

Revenue Collection Structure
Sales are monitored (metered) and billed.
Fixed payment is made for set hours of service or provision of capacity.
Combination of both.

Customer Tariff Structure
Tariff covers all costs and provides a return on investment.
Tariff covers operating costs.
Tariff covers capital costs.
Tariff based on presumed ability to pay.

Authorization Structure
Project operates in an open market situation.
Project is authorized to service a particular territory based on an awarded concession.
Project operates under a contract from a concessionaire or utility holding a franchise.

Construction and Operation & Maintenance
Private sector managed engineering, procurement and construction (EPC).

Public sector managed EPC.
Mixed EPC.
Private sector operations, maintenance and revenue collection.
Public sector O&M and revenue collection.
Mixed O&M and revenue collection.

Part 3 – Lessons Learned and the Development Path of Energy Enterprises

This part is derived from portions of an October, 2000 essay "Meeting the Unmet Demand for Energy Services" ..

The Demand for Improved Energy

Consensus forecasts (IEA, WEC, etc.) point to the conclusion that the demand for modern energy services by hundreds of millions of unserved households, businesses and communities will continue unabated for the foreseeable future.

The vast majority of these unserved customers are in the developing world. Their demand is for basic energy services -- for cooking and lighting -- and for energy to grind, pump, shell, bake, sew and to perform other productive or income generating activities.

Ten years ago it was still possible to ignore this demand. Entire rooms of experts would explain that the technology to deliver such energy services to the customer's location was immature, that the delivery mechanisms and infrastructure did not exist, that extensions of the electricity grid would solve the problem, that policy and price adjustments would solve the problem, and – most often cited – that people could not afford to pay for the services being demanded.

Although there are still small groups who proclaim parts of these positions, mercifully it is becoming generally accepted that all but the poorest of the poor can pay for energy services; that successful programs of service delivery exist; that electricity grid extensions are prohibitively expensive in most cases; and, that technologies to provide energy to remote areas are proven to be cost competitive and reliable. These technologies include wind, water, biomass, solar and fossil-fueled solutions, alone or in combination.

There is a Demand. Energy Enterprises Represent the Supply

In addition to learning that technologies work, grid extensions have their limit, delivery systems can be put in place and that the poor can and do pay for improved energy, something else has been learned in these ten years. If the driving force is the unmet demand for energy services by the rural people of developing countries then the next gear in this energy machine consists of energy entrepreneurs, those men and women who organize the delivery of energy services.

These entrepreneurs come in many forms. Some are local businesses. Others are larger businesses who work with local people to deliver equipment or services for sale or for a fee. Others are employees of governments who organize programs, which invariably depend on other men and women to deliver. Some of these entrepreneurs are in community organizations and what are called NGO's or non-governmental organizations.

The Third Gear -- Seed Capital and Enterprise Development Services

There is a third gear in this energy machine: the programs and organizations that support energy entrepreneurs. This support can take many forms – advice on policy and technical training being the ones that come most easily to mind and have had the largest focus. But there are two types of support that are proving to be far more important than policy advice and technical training, more important in that without such support the policy advice and technical training will be left floating like debris in orbit.

The types of support needed in this third gear are seed capital and what are bundled together under the heading enterprise development services.

Seed capital is the modest amount of capital needed to convert a good idea and a capable entrepreneur into a specific business transaction that brings customers and improved energy together. If someone is going to simply buy and sell individual energy systems – generators, stoves and fuel, rooftop solar systems, biogas units using waste from animals – this seed capital can be extremely small, as small as the price of a few units and the transport to get them to customers, literally hundreds of U.S. dollars or ten thousands of West African CFAs. To create a business that regularly buys, sells, installs, and services such units requires more seed capital, the proper amount being determined by the number of customers being served. Using US$500 per customer as a metric, a company servicing 1000 households requires $500,000 in capital (and probably 3-5 years to reach them all if the base is today zero). This would qualify, if somewhat arbitrarily, as a small rural energy delivery company, and would probably continue to be so classified until it was operating in the 2500-5000 household level, at which time it would have to be graduated to "mid-sized" as a classification. The distinction is more than number of customers. A mid-sized company has substantially more human and physical infrastructure than a small company. A small, dedicated team close to its customers can service one thousand customers. A mid-sized company needs local and regional offices and a network of employees or contractors. At 5000 customers a company requires capital totaling US$2.5 million but it requires it over a multi-year period, not all at once.

The second type of support these entrepreneurs need are bundled together under the heading enterprise development services. Most of these entrepreneurs are new to business and new to energy technologies. Most approach the business from the perspective of the technology. They need a great deal of orientation to the demands and needs of customers, the understanding of market and marketing, the gathering of information and preparation of feasibility analyses, proposals and business plans, the development of contracts and collection mechanisms, the identification of financial and non-financial resources and the negotiation with credit providers, lenders and investors. Enterprise development services involve the information, tools, consulting and direct assistance provided to entrepreneurs so that they can wisely use seed capital to build a sustainable business entity to supply invaluable energy services to customers.

Lessons Learned

Experience to date teaches a few things regarding seed capital and enterprise development services.

The first is that seed capital will often launch a small enterprise but will not suffice to prepare it for next stage, more commercial type of capital.

The second is that rural energy delivery companies are slow to grow, which reinforces the difficulty of attracting next stage capital.

The third lesson regarding these services is that enterprise development services are absolutely key to creating sustainable businesses. While there is scope for standardization, there is a substantial need for customization and "hand-holding" within new markets. Once one or two companies succeed in these markets it is expected that later market entrants will copy the techniques of the first entrants.

The fourth lesson is that there are different paths that companies follow. Path A involves a company that uses seed capital and enterprise development services to bridge directly to commercial capital. This is the path taken by the Kanata Project, a 7.4 MW first-of-its-kind hydroelectric project in Bolivia and many other projects these last 10 years. Path B involves a company that uses seed capital and enterprise development services, reaches a certain level of activity and can be sustainable with no additional input. This is path taken by companies like Vacvina, a Vietnamese biogas equipment company. Path C, taken by companies such as NOORWEB, a Moroccan solar company, involves a need for additional capital and additional enterprise development services after initial infusions of seed capital and enterprise development services.

Most companies (i.e., a substantial portion of the rural energy delivery universe) are simply not yet ready to access commercial capital immediately. There are many variations on theme within these three paths but this typology captures the major classifications to be recognized[1].

[1] A companion typology has been developed by Eric Martinot. While focused on solar companies it provides a handy classification of all types of rural energy delivery companies that serve many customers. In his paper, "The GEF Solar PV Portfolio" Martinot presents a typology broken down between Sales Models (Model A – Cash, Models B, C and D for various credit schemes) and Service Models E, F, G and H, depending on whether the service is delivered through a

A fifth lesson is that enterprise development services tend to be described as third parties teaching and assisting entrepreneurs. This is often the case, especially as regards accessing capital and preparing business plans. However, there is another kind of enterprise development services to be provided. This involves providing sufficient latitude for the entrepreneur to continue to learn, grow and invent. While in mature industries the maxim is to keep the entrepreneur focused on the implementation of a well defined business plan, in immature industries – and rural energy delivery is clearly an immature industry – it is equally important for seed capital and enterprise development services to include support for entrepreneurs to continue to explore and invent.

Stages and Paths of Development

Energy delivery companies go through various stages of development (see next page).

In Stage 1 the companies are new, involve high risk and pioneering entrepreneurs. Many, perhaps most, will fail. Seed capital and enterprise development services are needed to organize the company so that it can deliver products and services to customers.

In Stage 2 these companies take a variety of paths.

Some, like Kanata (Path A) require no additional capital or services and access commercial capital.

Others, like Vacvina (Path B), may or may not need additional capital or services and then reach a level of self-sustaining business, never in need of nor in position to access commercial capital.

Finally, there is the case of the company like NOORweb (Path C), that is not ready to access commercial capital and is not yet large enough to be self-sustaining. This type of company needs additional capital and services.

Though a percentage distribution among these companies is not possible most rural energy companies delivering products and services to rural customers fall in the Vacvina or NOORweb category. Kanata-like companies tend to deliver bulk power to one or a few energy users, including local grids, rather than serving large numbers of customers directly.

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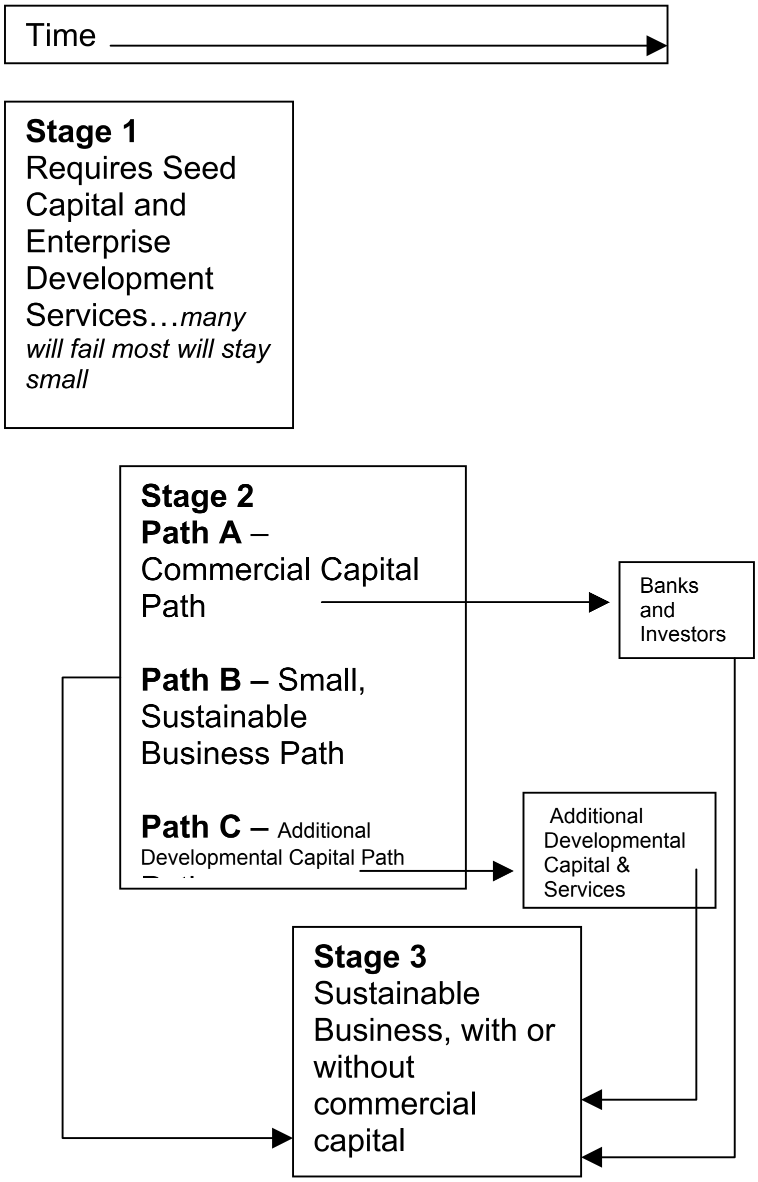
concession operated by a utility (E), by a private company (F) or through an unregulated market provider (G) or community provider (H).

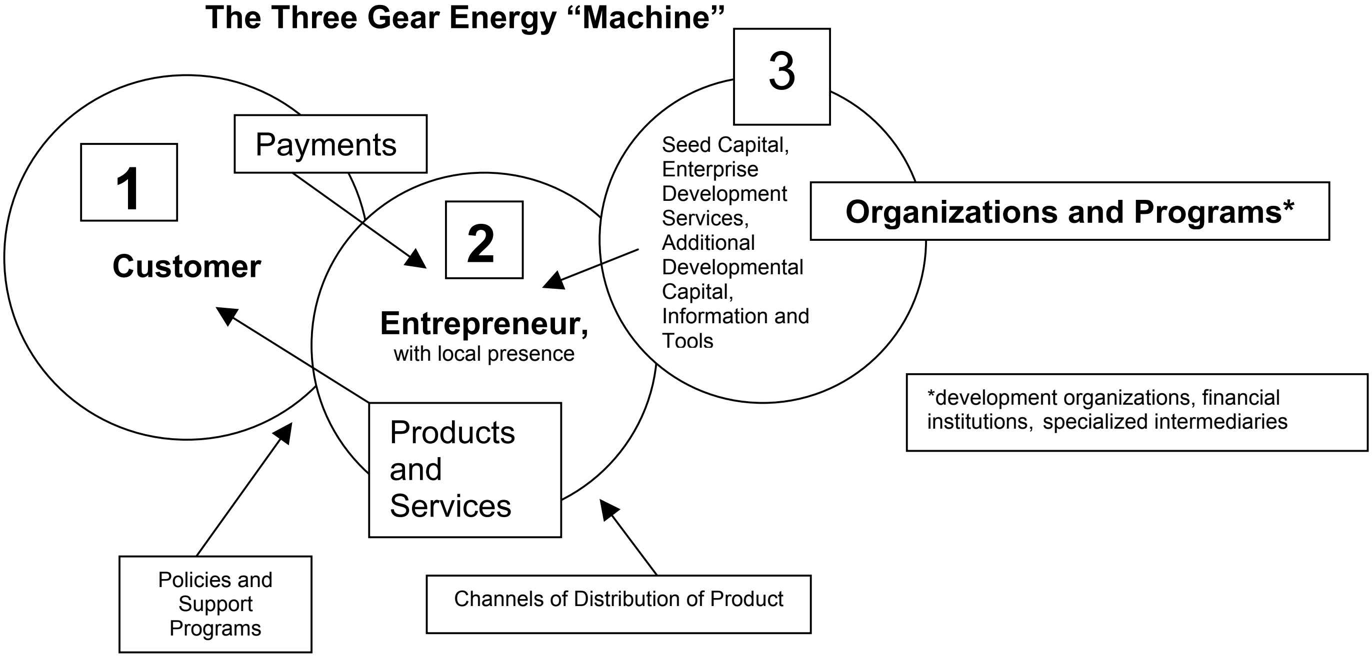
Rural Energy Delivery
Businesses Developmental Stages



What Programs and Organization Need To Do At Each Stage

The third gear of the energy machine – organizations and programs that support companies dedicated to providing energy to unserved households, businesses and communities – needs to provide seed capital and enterprise development services at Stage 1 to virtually all companies entering this market. In addition, these organizations and programs need to recognize that (1) certain entrepreneurs -- those along the NOORweb path, Path C -- require additional capital and services to reach sustainability and, if needed, attract commercial investment capital; (2) other entrepreneurs – along the Kanata path, Path A – often require additional enterprise development services to successfully access commercial capital; (3) all entrepreneurs need to be provided sufficient “breathing room” to pay attention to market developments and required innovations.

The Three Gear Energy “Machine”



Handbook for Financial and Development Professionals

Chapter 4

Project Evaluation and Risk Management Issues

What are the characteristics that indicate that a renewable energy project is feasible?

A general answer goes something like this: **When land, fuel, technology, team, customers and permits are available and when putting these ingredients together makes financial, social and environmental sense, then a project is feasible.** It doesn't guarantee that a project will be funded or implemented – too many other things outside the project's control can go wrong -- but it does set the stage for a project to succeed.

This chapter introduces the main issues that must be evaluated and managed by finance and development professionals. It consists of:

1. Key Feasibility Questions
2. Natural Resources
3. Technology
4. Contracts for Fuel
5. Land
6. Permits
7. Customers
8. Local and National Energy Plans
9. Macroeconomic, Political and Social Setting
10. Project Team
11. Contractors and Suppliers

It also includes a section (#12) on preparing estimates of revenue, capital cost, operating costs and preparing preliminary financial analyses (#13). It also includes checklists to be used to evaluate general market conditions, evaluate the requirements of a project team and conduct due diligence.

1. Key Feasibility Questions

A renewable energy project makes sense and is feasible when:

1. Natural Resources – wind, water, biomass, and sunlight – are available in predictable and sufficient quantity.

2. The available natural resources can be converted to energy using available proven technology.

3. Contractual rights to use these natural resources (water and biomass) as fuel can be obtained.

4. Land needed for the project can be secured and access to the site assured.

5. All the permits needed to design, build and operate the project can be obtained in a timely manner.

6. The energy produced can be transmitted and sold to one or more credit-worthy customers.

7. The project is compatible with local and country energy plans for energy service delivery.

8. The commercial, political and social setting of the project will instill confidence in suppliers, contractors, investors, lenders and insurers.

9. The project team has sufficient experience and skills to design, build and operate the project or has access to qualified full service (Engineering, Procurement and Construction, EPC) contractors.

10. Qualified suppliers, contractors and consultants are available and have expressed interest in the project.

11. Reasonable estimates have been made of all revenue, capital and operating costs, including contingency allowances and taxes.

12. Project revenues are sufficient to pay operating costs, repay loans and provide adequate returns to investors.

13. There is local or international interest in providing loans and investment capital.

2. Natural Resources

Renewable energy projects deal with four types of natural resources – wind, water, biomass and sunlight. The simple question to be asked is "Do these natural resources exist in sufficient quantities to fuel the proposed project?"

- **Wind** – What wind speed measurements have been made? What data exist? Are the measurements site specific, using reliable equipment and accepted techniques? Have the results of these measurements been examined by a qualified and independent professional? What documentation exists to prove that sufficient wind resources exist?
- **Water** – What data exists regarding the flow of water and the "head" (proposed elevation drop)? For how long has this data been collected? By whom? How has it been documented? Has the water data been independently evaluated? Have seasonal and year-to-year variations been estimated? Have the site conditions been studied and integrated with the water data? What documentation exists to prove that sufficient water resources exist?
- **Biomass** – What is the proposed biomass source? Has the biomass source been evaluated for its energy (BTU/joule) content, moisture levels, collection, transport and storage characteristics? What quantities of this biomass source are available? Are there seasonal variations? How have the energy characteristics and quantities been documented? Has this biomass source been used before in this region in the manner proposed?
- **Sunlight** – What solar insolation data exist for the proposed project area? Have solar panels and balance of systems been operated in the project area? Is there any documentation of performance? Are there seasonal variations or extended periods of sub-optimal performance? How is the information documented?

3. Technology

Having established that natural resources exist in sufficient quantities, the next test of feasibility is to determine that the wind, water, biomass or sunlight can be converted into energy at the proposed project site at the scale envisioned.

- What technology will be used?
- Is it available at the project location?
- Have suppliers of the basic conversion technology – wind turbine manufacturers, hydro turbine manufacturers, biomass conversion equipment manufacturers and PV systems

integrators -- reviewed the wind, water, biomass and sunlight data and confirmed that their equipment can produce the desired energy output?

- What warranties do they offer?
- At what price and terms (do they offer supplier credit)?
- What other components are needed to assure energy output?
- Have suppliers of these been identified and price and terms determined?

4. Contracts for Fuel (water and biomass)

It is not enough that sufficient natural resources exist. In the case of water and biomass the right to use these resources must be assured generally through a contract[1], either with fuel suppliers or with the government through a concession for water rights.

- **Water** – What agreements are needed to secure the use of water at the proposed project site? Will a payment be required? What are the conditions of such a contract? For example, what percent of water flow is allowed to be diverted? What is the term of contract? Which lenders and investors will want to exceed their loan or investment term? What is the expiration date if project is not operational within the term? What other related contracts are required, such as an electricity generation contract, and permits, such as an environmental permit?
- **Biomass** – What is the length and terms of the proposed contract(s)? What percent of the project's biomass requirement will be met by this contract(s)? What assurances exist that the biomass supply will be continuous? What is the financial condition of the supplier and the underlying soundness of the industry[2]? What penalties exist for the buyer and seller for non-performance? What backup and supplementary supplies are available?

5. Land

Land is needed for the construction and operation of the project. Land can be secured by ownership, by lease (rental) arrangements or by royalty arrangements. Land is needed not only for the project's physical features themselves but to secure fuel supply (a watershed, for example) and to permit site access.

- What land is needed for the project's construction and operation?
- Has a land map, showing ownership, been prepared and presented?
- Has the ownership of each parcel been established, documented and verified?
- How will land control be secured and for what period of time?
- What access is needed for project construction and operation? How is it secured?
- Are any public lands involved? What approvals are needed?
- Is there sufficient land for storage of equipment and construction supplies during construction? What about worker quarters and site offices?

6. Permits

Every project setting has its own characteristics. It is important to determine, at the earliest possible point, the <u>complete</u> list of permits required and conditions to be met in obtaining approvals.

- Must the project and the project's company be registered? With what entity or entities? Must share capital be at a certain level?
- What are the requirements to obtain environmental permits and approvals? Must the consent of local communities and neighbors be obtained? Must a formal environmental impact assessment be prepared? Is there a public hearing or consultation process?
- What permits and approvals are needed to use natural resources, undertake construction, operate a project, interconnect with the electric grid or build a local grid and sell energy?

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[1] It is possible to buy biomass on an open market at the then current of "spot" price but most lenders and investors are uncomfortable with the uncertainty this implies.

[2] For example, a sugar mill may be able to supply all the bagasse needed for a co-generation project, but the mill may not be competitive due to factors linked to the world market for sugar rather than productivity within the mill itself.

- ❑ What licenses, permits or authorizations are needed to import equipment? What tariffs apply?
- ❑ Are there health and safety procedures to be followed? Must these be documented?
- ❑ Must the owners and managers register and report activities concerning their participation in the project?
- ❑ Must permission or a concession be obtained to provide energy services "off the grid?"
- ❑ Has the opinion of an independent qualified advisor been obtained to document that the list of permits and their requirements is complete?

7. Customers

There are basically two types of customers for energy projects. In the first category are electricity utility companies and large industrial firms with a significant demand for electricity or steam. The most common type of agreement between projects and these types of customers is a power purchase agreement, referred to as a PPA. Most PPA agreements pay for the purchase of capacity and energy separately. "Capacity" is the assured supply of the project (measured in kilowatts or megawatts) being sold to the utility or industrial firm. "Energy" is the actual output of the project, measured in kilowatt-hours or megawatt-hours actually produced and delivered. As electric utility companies become more competitive through the elimination of monopolies, long-term power purchase agreements are being replaced with Wholesale Market Mechanisms, which buy the energy output from projects based on its price when compared to other energy projects supplying the same electricity system (or grid) at the same time. Regardless of the size of the utility or industrial customer, it must be determined that this customer can and will pay for the capacity and energy provided. Many utility companies are technically bankrupt and depend on government subsidies to meet their obligations. These companies (and others) tend to be very poor payers. It is essential to determine that the buyer of energy and capacity can and will pay for the service provided over the life of the contract. The basic message here is this: just because the buyer is a large company do not assume that it will be a good payer. Some of the things to check:

- ❑ What is their net worth (the excess of their assets over their liabilities)?
- ❑ How much money do they owe (compared to their gross revenues and their total assets) and how has this changed in the last 5 years?
- ❑ How much have they been able to borrow in the last five years? In the case of a utility owned by the government has this debt been guaranteed by the government or is the credit of the utility itself good enough?
- ❑ Contact local banks or the local World Bank or IFC office. Contact local offices of well-respected international accounting firms or the bilateral Chambers of Commerce.
- ❑ If you are dealing with a private company that does not publish information, ask the company to supply information and ask them to let you speak with their bank.

The second category of energy customers consists of individual households, businesses and public facilities. The basis for the sale of energy to these types of customers is usually a contract to sell either hardware (a household PV system, a wind-PV combination, a very small hydropower turbine or a small biomass combustion, gasifier or digester unit) or an agreement to sell energy services, usually electricity, for a regular fee. In either case the essential quality of the customer that must be determined is the customers willingness and ability to pay. If the sale is for the full price based on cash then the risk of non-payment is low. However, if the sale is supported by a loan arrangement (credit model) or if the project is depending on a steady stream of monthly payments from the household or business (fee-for-service model), greater comfort is needed that payments will be forthcoming. Down payments by customers are important, as are procedures for the collection of payments from customers and the removal of hardware in the event of customer default. The energy entrepreneurs needs to plan (and perhaps test) these mechanisms.

8. Energy Plans

The proposed energy project must be aware of, and take account of, energy planning underway in the project area and in the country.

- Are there plans to extend the grid into the project area? What impact will this have?
- Are there plans for other decentralized energy projects in the project area? Are there bilateral or government supported programs underway? What impact will these have on the project's ability to sell its energy output?
- Are there plans to change the current energy sale and purchase policy (perhaps switching from a PPA arrangement to a wholesale market)?
- Is the government or the utility planning a major rural electrification initiative? Grid based? Off-grid? Both? How would this initiative impact the proposed project.

9. General Market Conditions

A project's feasibility is determined not just by factors under the project team's control. It is important that general market conditions – economic, commercial, political, social – instill confidence in the people needed to implement a project (for example, lenders, investors, suppliers, contractors, insurers). The most important of the general market conditions that need to be favorable are the following:

- **Macro-economy** - inflation, general economic stability and growth, currency stability, employment growth. While these conditions need not be perfect the general trend of the economy (improving versus declining) and the general perception of the regional and world economic community is important to assess. Sometimes – and this is very frustrating for an energy entrepreneur to hear – it is just better to put a project idea aside and wait until conditions improve.
- **Commercial -** are the rules for doing business, establishing a project company, making investments, recovering investments and importing goods and services clear? What are the appropriate banking, investing and trading laws and regulations? Is there a history of projects, such as the proposed one, being successfully implemented from a commercial perspective? Are in-country banks and investors involved in such projects? Is there a "commercial discipline" based on the general principles of socially responsible entrepreneurship and return on investment (versus top-down planning and state implementation)?
- **Politics** - this category includes the broadest possible definition of politics. Are laws and regulations transparent and enforceable in a reasonable manner? Is power transferred between political parties or factions in an orderly and predictable manner? Are policies transferred from one political appointee to another or does every appointment of a minister or election mean that a project is back to the beginning of the development process? Is corruption – payoffs, favors, conflicts of interest -- part of the process of project approval? Is there political support for the proposed project? Is it needed and will it be helpful (sometimes it is not)? What evidence exists of this political support, if needed and helpful, at the national or local level?
- **Social -** Will the project area benefit from the proposed project? What are the needs in the project area? Is the project compatible with local conditions and plans? Is there social support for the project? How is this support demonstrated?

10. Project Team

Whether proposing a large project producing electricity and selling to a national grid, or a smaller project providing energy services to individual households and businesses, the quality of the project team will be *THE* deciding point for many lenders and investors. For some of these lenders and investors it will be absolutely essential that the team include someone with very direct experience – successful experience – in a closely related project. For others it will be absolutely essential that the project team have substantial money at risk in the project from the very beginning. For others, these requirements may not be as crucial, but these will tend to be early stage lenders and investors who will provide small amounts of money on the basis of "one step at a time". The message here is clear: the energy entrepreneur must assemble the best possible team to plan and implement the best possible project.

- **Technical** - Are there specific engineering challenges that require specific skills on the team on a permanent basis? What are these challenges and what are these skills? Can this need be met through a contract relationship or must one of the core team be an expert?
- **Financial** - What are the financial aspects of the project? Will there be ongoing financial requirements over the life of the project? Can a chief financial officer be hired later or should the team include a financial expert from the outset?
- **Negotiations and Sales** - Are there ongoing business relationships, with suppliers and customers that require regular updating terms and conditions? Will the project always be seeking new customers and relationships or will this be a one-time event?
- **Legal** - Will the regulations and contractual relationships governing the project be fixed or will they change over time, requiring regular attention?
- **Political** - Will regulations and policies affecting the project's performance be evolving and require attention and lobbying?
- **Project Team Funding** - What is the minimum amount of funding needed to complete work underway and make the project attractive to lenders and investors? How much has the project team spent already (time and money) and on what? What will be realistically needed to complete all of the tasks identified? Even then, how much cash equity is needed to assure that the team retains a substantial portion of ownership and control? How much cash equity does the project team have?
- **Entrepreneur Skill, Experience and Resources** - Of the qualifications needed for the team, what skills do the team possess? Are there partners who round out this skill set? Are there advisors who can be hired to assure that all the skills needed are represented? Does the team have an experience base that will "impress" lenders and investors? If not, is there an addition to the team that could solve this problem? Is it possible to contract with an experienced party as part of the team? If not, how does the energy entrepreneur propose to convince lenders and investors that all the skills and experience needed are at hand? Does the team have the time and money needed to complete the work identified? What about the cash equity to be credible in negotiating with lenders and investors? Is there an early stage financial source available to supply these funds? What will the team be giving up and gaining by taking a financial partner?

11. Contractors and Suppliers

Suppliers and contractors, especially good suppliers and contractors, have choices as to the markets they serve. It is important to line up sources of equipment and services, and the terms and conditions that will accompany these contracts, as soon as practical. Suppliers will provide quotes for credible projects, thus getting as much fact-finding and feasibility analysis work documented as possible, and presenting it well, will get the attention of suppliers and contractors.

On larger projects, lenders and investors are going to be concerned that there be no "Completion Risk" that accrues to them. That is, once a project has commenced construction, the lenders and investors want assurances that the project will be completed and will commence operation. Contracts known as EPC, EPC-lump sum, Fixed Price or Turn-key are attractive to lenders and investors. "EPC" stands for engineering, procurement and construction, which is a type of contractor that pulls together all the tasks needed to design and build a project according to a set, pre-quoted, price to deliver the project fully operational. In these cases, the completion risk belongs to the EPC contractor and is secured by something called a Performance Bond. The EPC Contractor, in turn, contracts with sub-contractors and co-ordinates all the tasks involved. As an alternative to this, the project team itself can act as the prime contractor (the role of the EPC), hiring all the engineering, procurement and construction contractors. However, it needs to demonstrate conclusively that the project will be completed and that funds exist to handle cost overruns. A third choice is for the project team to hire a Project Management firm to co-ordinate the project; again, overruns need to be funded and completion assured.

On a larger project it is often a requirement that an operating and maintenance company be employed to run the project once its construction is completed.

On both large and small projects the availability and reliability of suppliers is crucial. Whether a company needs to buy 50 PV panels a month, twenty water pumps a year, 300 batteries every six months, ceramic liners for gasifiers and stoves, or a 25 MW hydroelectric turbine generator set, sources of supply are crucial. A components inventory and supplier network needs to be established as soon as practical and back-up sources identified. The inability to get replacement or spare parts on a timely basis can destroy a company trying to establish itself in the marketplace.

(Manufacture or Buy? There is a natural attractiveness to the idea of designing and assembling small components. Unless there is a decided (and permanent) cost advantage this can and has been a diversion for start-up rural energy companies.)

12. Preparing Revenue and Cost Estimates

Revenue:

The simplest revenue estimate is the one where a product is sold for cash. All that is required is the price per unit to be sold, which needs to include the cost of the unit, the cost of the time and money that goes into making the sale, a portion of the cost of running the company (called general and administrative expense or simply overhead) and the profit desired. Provided that the resulting price is attractive to the buyer, a revenue estimate can be prepared easily.

If the product is not being sold for cash, but will be repaid over time (an installment purchase), then it is necessary to factor in the time value of money by adding an interest component. The cost of administering such an arrangement must also be added.

If the product is not being sold as hardware, but its energy output is being sold to customers, estimates must be made of these revenues based on customer willingness and ability to pay. For the sale of energy services directly to households and businesses, this revenue estimate is based on the market price expected to be paid. There must be evidence to this effect either through test marketing, signed contracts or through a solid analysis that demonstrates that customers are willing to use a product that will substitute for expenses already being incurred (for example, through the purchase of candles, dry cell batteries or battery charging).

For the sale of energy to large customers, the terms of the power purchase arrangement must be converted to revenue estimates, including changes over time. For example, if the price fluctuates on the basis of the cost of fuel oil or inflation, data needs to be obtained as to the generally acceptable expectations of these factors. Central banks and utilities have and use such forecasts; World Wide Web sources, such as the Energy Information Administration have greatly improved the access to information for energy entrepreneurs.

For a feasibility analysis this information need not be perfect. What is needed are reasonable estimates covering a reasonable period of time:

The following are examples of sufficient information for this stage:

<u>Revenue from Sale of Household and Business Energy Systems</u>

# Units	1000
Cost per unit	390
Price per unit	550
Revenue	$550,000

<u>Revenues from Sale of Energy to Households and Businesses</u>

# Units Installed	1000
Cumulative	1000

Price per Unit	450
Revenue per Unit per month	15
Revenue/12 months	$180,000

Revenues from Sales of Electricity to the National Utility

# kW	2,600	
Capacity to be Contracted/kW	1,820	
Payment per month per kW	$10.50	
Energy to be Contracted	18,220,800	7008 hrs
Payment per kWh	0.038	
Revenue	$921,710	

Capital Cost or Cost of Goods Sold:

Whether selling a household energy system that costs $500, or building a 30MW hydroelectric peaking facility that costs $60 million, the same basic elements need to be considered in estimating the initial capital cost of what is being bought or built:

- **Design and engineering cost** – what is the cost of figuring out what to build or buy?
- **Land cost** – what land is needed to build what is proposed (for products being sold to households, this item is zero).
- **Purchase of equipment –**
- **Purchase of services** to assemble or construct the project (for large projects this includes all the civil construction – preparation of land – as well as putting the structured, mechanical and electrical pieces together).
- **Purchase of other services** – lawyers, financial advisors, accountants needed to get approvals, obtain funding or draw up contracts.
- **Insurance** – what is the cost of insuring the risks of people being injured, equipment being accidentally destroyed or not performing?
- **Interest During Construction** - if funds are borrowed to construct a project, part of the cost is the cost of the interest paid (or to be paid) for this period.
- **Payment to Project Team** – on large projects it is not uncommon for the project team to include its costs up to that date (and perhaps a fee on top of that) as part of the project cost and thus get reimbursed or rewarded for the effort to date. If, of course, investors and lenders are willing to include such a reimbursement or fee; otherwise the amounts will simply be counted as equity. In either event, these costs should be accounted for as part of the capital cost of a project.
- **Contingency Allowances** – these are the "what if" allowances in case any of the preceding estimates are wrong. Typically there are two types of contingency allowances. The first is called a construction contingency and is a percentage added to the amounts budgeted for engineering, procurement and construction (the first, third and fourth items, above) since an error in one of these items increases the overall cost to construct the project. The second type of contingency is called a project contingency and it is applied to all costs. This is an allowance for anything going wrong or being forgotten and usually reflects the confidence the entrepreneur has in the quality of each of the estimates received. Very often you will see a 15% construction contingency allowance, reflecting that the detailed engineering is not yet complete, on a large project as well as a 5-10% project contingency. On equipment purchase (rather than construction projects) construction (installation) contingency allowances may be lower but project contingencies may be higher because of the difficulty of estimating the "What ifs" of going to many customer locations rather than one construction site.

An example of a detailed estimate:

	US $	
Land	275,000	8.0%
EPC (includes contingency)	2,125,000	61.6%

Taxes (VAT)	71,600	3.5%
Legal and Financing	85,000	2.5%
Pre-construction	215,000	6.2%
Sponsor's fee	200,000	7.2%
Working capital	65,000	1.9%
Insurance	77,800	2.3%
IDC (interest during construction)	207,000	6.0%
Contingency	128,600	3.7%
Total	$3,450,000	100.0%

What about subsidy programs or government contributions?

Payments from governments or others that make a product more affordable to customers and a project more feasible should be treated in one of two ways:

- As a source of revenue; or
- As a reduction of the initial cost of a project.

The objective of a feasibility analysis is to determine the financial and non-financial factors influencing a project. If a subsidy program exists and can be attracted to the project it should be factored in. However, if no specific program exists to support the type of project being examined it is probably a waste of time to finish a feasibility analysis that the entrepreneur knows from the outset will result in a need for a subsidy that presently doesn’t exist.

The inherent problem of many types of subsidies is that while they create specifically feasible projects, these types of projects and the companies that undertake them are not sustainable without continuous subsidies, which governments tend not to be able to afford.

From the business perspective two kinds of subsidies are attractive:

- Lifeline subsidies that target the poor and open up market segments otherwise out of reach.
- Start-up cost subsidies that get an operation up and running but do not become necessary once the operation has taken off.

Operating Costs

Operating costs include O&M, or Operating and Maintenance Costs, as well as other costs of running the project. Operating costs involve keeping equipment in good operating condition, providing regular maintenance and replacements and in some cases, providing periodic major maintenance (replacement of batteries at solar powered homes, replacement of boiler tubes in large bagasse-fired boilers). These also include the cost of revenue collection and the general management of the company. Typically, operating costs are easiest to estimate and present by separating the costs of labor from the cost of materials and supplies and the cost of third party contracts. For a feasibility analysis, a work paper should show all of the proposed employees and contract personnel, their salaries and benefits and their functions. The cost of supplies needed, rent due, communications expenses and so on should be itemized. Major maintenance items (batteries, boiler tubes) should be itemized separately. Where vehicles or capital equipment are needed for operating purposes these need to be included on a pro-rated basis (if a vehicle will last 5 years, one fifth of its initial cost should be included; its operating expenses – fuel etc – should be listed with supplies). Operating insurance costs should be shown and, finally, a healthy contingency allowance included to account for low estimates or completely forgotten items.

Depreciation and Taxes

Depreciation is the amount of the capital cost of a project to be allocated to each year of a project's life. For solar powered water pumps this could be 10-20 years. For a co-generation project it could be 15-30 years. For each year of a project's life a portion of this cost can be credited against Net Operating Income, thus reducing the amount that the project has to pay for income taxes. A project is also allowed to deduct the amount it pays for interest. At the feasibility analysis stage this interest allowance is a very rough estimate (because no financial plan yet exists).

At the feasibility analysis level it is therefore only important to provide an "allowance" for income taxes from the project on a simplified basis. Usually it is enough to take Net Operating Income (Gross Revenues less Operating Costs) minus a depreciation allowance and minus a rough estimate of interest cost for a typical year and then apply the prevailing tax rate to the result. It is sometimes easiest to compare this result to Revenue Estimate and use the resulting percentage as a substitute for a detailed calculation.

Step 1	Revenue Estimate = $900,000
Step 2	Operating Cost Estimate = $300,000
	Equals Net Operating Income
Step 3	Determine Annual Depreciation Allowance Percentage, Apply to Capital Cost = 10% * $2,250,000 or $225,000
Step 4	Deduct Depreciation Allowance from Net Operating Income = $375,000
Step 5	Guess at what percent of capital costs will be financed and at what interest rate = 70% of $2,250,000 at 12% = $189,000
Step 6	Deduct Interest Estimate = $186,000
Step 7	Determine appropriate income tax rate = 20%
Step 8	Determine Tax = $37,200
Step 9	Determine Tax as a Percent of Revenue = $37,200 / $900,000 = 4.1%
	For feasibility analysis use 4.1% of Revenues as an estimate of taxes in any year where Revenue less operating expenses is a positive number.

13. Preliminary Financial Analysis

The project entrepreneur now has all the information needed to prepare a preliminary financial analysis on a "Checkbook" basis; that is by comparing cash flows to and from the project and estimating the overall project's internal rate of return or IRR (see Chapter 6 for instructions on IRR). Later this IRR calculation will become more sophisticated, taking into account not just the Project IRR, but estimating what the return to equity investors will be after a financing plan is put in place (Investor IRR or Return on Equity). The major difference between a feasibility analysis and a business plan is that a business plan proposes a specific financing plan whereas a feasibility analysis is trying to determine if the overall project "works" before determining how much debt (loans) a project can carry versus how much equity is needed.

Cash Flow Out-Cash Flow In

Just as in a checkbook, cash spent is shown as a negative figure and cash received is shown as a positive. Setting up a work paper in one of the three following ways is usually the easiest way to proceed.

#1 - For a project where most of the capital is spent at the beginning:

Year/Period	0	1	2	3	4	5	6	7	8	9	10
Capital Cost											
Revenue											
Operating Cost											
Net Revenue											
Allowance for Taxes											
Net Cash Flow											

Year or Period 0 represents when the construction or installation of a project is completed, and Year or Period 1 represents when revenue commences.

#2 - For a project selling product to a large number of customers for cash or on credit:

Year/Period	1	2	3	4	5	6	7	8	9	10
Revenue										
Cost of Goods Sold										
Operating Margin										
Operating Cost										
Start-up Costs										
Net Revenue										
Allowance for Taxes										
Net Cash Flow										

#3 - For a project installing product to a large number of customers and receiving fees for delivering services:

Year/Period	1	2	3	4	5	6	7	8	9	10
Capital Invested										
Capital Borrowed										
Revenue										
Operating Cost										
Start-up Costs										
Allowance for Taxes										
Net Cash Flow										

The minor differences among these work paper types actually demonstrate significant differences among the three different business models that tend to dominate energy projects:

- **Capital intensive model** of building and financing a project at the beginning and receiving revenues over time, usually from one or a few customers (e.g., Kanata – see Chapter 6).
- **Cash/Credit model** of obtaining and installing product and being paid in a relatively short period of time through a combination of customer payments and financing of the customer by some third party (e.g., Selco, see Chapter 6).
- **Fee for Service Utility model** of obtaining, financing and installing product (which the project continues to own) and receiving payment in the form of a fee for services provided (e.g., Soluz, see Chapter 6).

The job of the energy entrepreneur at this point is to complete this work paper for his or her project idea and evolve a reasonable estimate of the cash flow for the project. Three samples follow:

- Example # 1 is a company that proposes to install 5,000 solar home systems in a region. The raw data of this analysis consists of the following: 1000 systems per year to be installed at an average cost of $450 per system. Customers will pay an average of $15 per month for the service provided by these systems. Estimates have been made of operating expenses and a tax calculation was made for one year and it was determined that taxes (based on 20% of taxable income) will equate to about 4% of gross revenues, which was used for the analysis. It will cost about $150,000 to start this project, including the cost of setting up sales and service points, vehicles and marketing. The following basic analysis yields a PROJECT IRR of over ~16%. As the company believes it can arrange for financing of about 70% of the capital cost of the equipment at an interest rate of between 12% and 13%, the return on the balance of the required capital (the 30% not financed by loans and the cost of start-up) will be over 25% and therefore be attractive to investors.

Year		1	2	3	4	5	6	7	8	9	10
# Units Installed		1000	1000	1000	1000	1000	0	0	0	0	0
Cumulative		1000	2000	3000	4000	5000	5000	5000	5000	5000	5000
Price per Unit		450	450	450	450	450	500	500	500	500	500
Revenue per Unit per month		15	15	15	15	15	15	15	15	15	15
Capital Invested		450000	450000	450000	450000	450000	0	0	0	0	0
Revenue		180000	360000	540000	720000	900000	900000	900000	900000	900000	900000
Operating Cost		150000	175000	200000	300000	300000	300000	300000	300000	300000	300000
Startup Costs		150000	0	0	0	0	0	0	0	0	0
Allowance for Taxes(as % Revenue)	4%	7200	14400	21600	28800	36000	36000	36000	36000	36000	36000
Net		-577200	-279400	-131600	-58800	114000	564000	564000	564000	564000	564000
Project IRR		16%									

- Example # 2 is a hydroelectric project to produce electricity for sale to the national grid. The project team has assembled a few pieces of key data. From their analysis of hydrological data they have estimated the flow of water and been able to size a 2.6-3.0 MW project. They have decided to use the smaller size for their feasibility analysis and the higher cost estimate they have gotten from their own work (with a local engineer), as well as the budget quotes they have gotten from two suppliers, adjusted to include all related work (quotes range from $1300 per kW to $1500). The project will sell electricity to the national grid and the national utility has a "standard offer" for projects. The project team has made a low estimate of the capacity the project could sell (because there are penalties for failure to deliver on contracted capacity amounts) and used a mid-range estimate for both the quantity of energy (kWh) to be produced and the price. Because the net revenue of the project changes very little, (there are only minor adjustments to revenue and expenses) the analysis is only for six years. But, to this cash flow an estimate of the value of the cash flow for years 7-20 using a net present value estimate (See Chapter 6) is added. Using such an estimate instead of extending the analysis is relatively accurate. The NPV in this case ($4.7 million) is referred to as the project's TERMINAL or RESIDUAL value. The result is a PROJECT IRR of 17.8%. As it is likely that the project will be able to finance at least one-half the cost at ~12% there is sufficient return to pay debt and attract equity (which should earn returns between 20 and 25%. Again, the project team chose to use a "shorthand" method to estimate taxes as a percent of gross revenues. In this case, however, it would be a relatively easy matter to immediately proceed with a 20-year financial analysis beginning with a 50-50 debt to equity assumption and then testing the projects debt service coverage results (see Chapter 6) to propose a specific financing plan and prepare a more precise tax calculation.

Year	0	1	2	3	4	5	6	Yrs 7-20
Capital Cost	3,900,000							
Revenue		921,710	935,536	949,569	963,813	978,270	992,944	NPV
Operating Cost		191,318	196,101	201,004	206,029	211,180	216,459	12%
Allowance for Taxes		63,648	64,603	65,572	66,555	67,554	68,567	14 years
Net	-3,900,000	666,744	674,832	682,993	691,228	699,536	707,918	4,692,198
IRR	17.8%							
Revenue Escalation per Year	1.50%							
Operating Cost Escalation per Year	2.50%							
Capital Cost per kW	1500							
# kw	2600							
Capacity to be Contracted	1820							
Payment per month per kW	$10.50							
Energy to be Contracted	18,220,800	7008 hrs						
Payment per kWh	0.038							
Revenue	$921,710							
Operating Cost	$0.0105							

- Example # 3 is a company selling any product for cash. It doesn't matter if the product is a treadle pump, electric motors for milling equipment (or the milling equipment itself) or solar home systems or household biogas units. The analysis is very simple and basically the same regardless of product. Three kinds of costs need to be determined: the cost of the product itself, the cost of setting up and maintaining the company's operation (start-up plus fixed costs) and, finally the variable costs attached to each unit sold (it might be the cost of installation or sales or anything). All that remains at that point is to estimate selling price, revenue and provide an allowance for taxes. Only if the project plans to borrow capital for an extended period does such an analysis become much more complicated. Short-term borrowings to finance the cost of buying product, which is then repaid when the product is sold is called a WORKING CAPITAL LOAN and does not change this type of business analysis a great deal. The essence of this type of business and feasibility analysis is quite clear: the entrepreneur must be able to get the margins (or mark up) on the product and the entrepreneur must be able to get paid as soon as possible.

Year	0	1	2	3	4	5	6	7	8	9	10
Revenue		550000	687500	825000	962500	1E+06	1100000	1100000	1100000	1100000	1100000
Cost of Goods Sold		390000	475000	555000	630000	700000	700000	700000	700000	700000	700000
Margin		160000	212500	270000	332500	400000	400000	400000	400000	400000	400000
Margin (as % of Sales)		29%	31%	33%	35%	36%	36%	36%	36%	36%	36%
Operating Cost		120000	122500	127000	131500	132000	132000	132000	132000	132000	132000
Start-up Costs	165000	75000	75000	75000	75000	75000					
Allowance for Taxes		8000	18000	28600	40200	53600	53600	53600	53600	53600	53600
Net	-165000	-43000	-3000	39400	85800	139400	214400	214400	214400	214400	214400
	33%										
# Units		1000	1250	1500	1750	2000	2000	2000	2000	2000	2000
Cost per unit		390	380	370	360	350	350	350	350	350	350
Price per unit		550	550	550	550	550	550	550	550	550	550
Fixed Cost of Operation		100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000
Variable Cost per unit		20	18	18	18	16	16	16	16	16	16

Project Rate of Return

Based on cash flow projections it is relatively easy – with the aid of a financial calculator or spreadsheet software – to determine the project's internal rate of return. Combined with a few pieces of additional information it will be possible to conclude if a project is generally feasible from a financial perspective (all the other factors discussed in this chapter will combine with financial feasibility to determine if a project is fully feasible).

Combined with the project internal rate of return the energy entrepreneur needs to know:

- What is the current interest rate charged for loans in the local market?
- What is the current or projected interest rate for loans from outside the current market?
- What are investors demanding as a rate of return to make their funds available to projects as equity?

If a project's IRR is 16% and the cost of borrowing in the local market is 20% then there is little reason to borrow in the local market unless a large portion of the project capital will come from the energy entrepreneur or others who are willing to receive a low rate of return. The reason as follows, if half the project is financed with 20% debt then the other half must be financed by people willing to receive a return of 12% (50% financed at 20% combined with 50% financed at 12% equals 100% financed at an average 16%). Why would investors make risk capital (equity) available at a rate of return lower than a bank loan and take more risk in the process? There are reasons to organize such a project, but clearly these reasons must be clear at the outset. The most significant reason is the expectation by equity providers that the project is going to increase in value beyond the projections shown in the cash flow (which raises the question: why aren't these values being shown?[3]). Projects where the IRR is below the cost of borrowing are generally only feasible as projects with all or substantially all of the capital coming from equity.

[3] Where projects may increase in value for reasons other than basic cash flow AND where a project is going to be able to capture this value through, for example, a sale to someone, it is possible to show this value increase by inserting a "terminal" value in the year of the sale. However, there must be a reasonable expectation that this increase in value will be turned into a cash-producing event.

There are cases where lower interest loans are available. The situation where a loan from outside a market is willing to accept a lower interest rate than the rate demanded by the local market usually implies one or more of the following:

- Concessionary finance program by a government.
- Equipment or market opening financing by a company with or without the support of the exporting country's government.

Such financing can serve to lower the hurdle rate – the IRR a project needs to meet to be feasible, but usually comes with significant requirements to be met.

When then is a project not feasible from a financial perspective?

- First, if a project has a negative IRR.
- Second, if a project's IRR is too low for even the energy entrepreneur to invest his or her available cash.
- Third, (assuming the energy entrepreneur does not have all the capital required) if the project IRR is too low to attract other equity investors to supply their cash at risk.
- Fourth, (assuming an all equity transaction isn't feasible) if the project IRR cannot support the borrowing of funds through loans the project could rarely be feasible.

The Hardest Task

This is the stage of analysis where very often well-intentioned entrepreneurs refuse to see the reality staring across to them from the numbers THEY prepared. There is hope in "financial engineering", higher revenues than estimated, lower costs, eliminated contingencies, subsidy programs, lower loan costs, value increases and so on. It is OK (and normal) to refine estimates, but there is a point when only the entrepreneur can determine if he or she is fooling himself or herself. It is easy to change assumptions and improve the IRR. There is an old saying that statistics do not lie; only statisticians do. Notwithstanding the ability to manipulate data – and with the help of spreadsheets it is as easy as point and click -- the entrepreneur needs to decide if the project can truly be implemented and if refining the estimates and financial plan makes sense. At this point in the project's analysis **there should be a great deal of room for error**. If the project is just barely financially feasible, if the project absolutely depends on convincing others to make loans and equity investments, if the project estimates have been gone over and over mostly to make the result better, if the entrepreneur has gotten the opinion of others and it is still a very close call then continuing with the project is probably **a bad use of the most valuable commodity an energy entrepreneur has: time.**

General Market Condition Checklist

A project's feasibility is determined not just by factors under the project team's control. It is important that general market conditions – economic, commercial, political, and social, be documented and understood early in the project development process. These factors must instill confidence in the people needed to implement a project (for example, lenders, investors, suppliers, contractors, and insurers).

Macroeconomic conditions:

- ❑ Inflation, last 5 years___________________
- ❑ Growth, measured as % GDP change, last 5 years__________
- ❑ Currency performance (to foreign exchange, German Mark, US $, etc) __________
- ❑ Unemployment percentage, last 5 years ________.

While these conditions need not be perfect the general trend of the economy (improving versus declining) and the general perception of the regional and world economic community is important to assess.

Commercial conditions:

- ❑ What are the requirements for establishing a project company?

  ____

- ❑ What are the regulations governing the making of investments by foreigners and their recovering of investments?

  ____

- ❑ Are any special requirements for importing goods and services clear?

  ____

__

- ❑ What are the appropriate banking, investing and trading laws and regulations?

  ____

  _

- ❑ Is there a history of projects, such as the proposed one being successfully implemented from a commercial perspective?

  ____

- ❑ Are in-country banks and investors involved in projects?

  ____

- What are the most active NGOs involved in energy-environment-economic and social development?

  ____

–

Political conditions:

- Are laws and regulations transparent and enforceable in a reasonable manner?
- Is power transferred between political parties or factions in an orderly and predictable manner?
- Are policies transferred from one political appointee to another or does every appointment of a minister or election mean that a project is back to the beginning of the development process?
- Is corruption – payoffs, favors, conflict of interest -- part of the process of project approval?
- Is there political support for the proposed project? Is it needed and will it be helpful (sometimes it is not)? What evidence exists of this political support, if needed and helpful, at the national or local level?

Social conditions:

- Will the project area benefit from the proposed project?
- What are the needs in the project area?
- Is the project compatible with local conditions and plans?
- Is there social support for the project? How is this support demonstrated?

Project Team Checklist

Technical: Are there specific engineering challenges that require specific skills on the team on a permanent basis? What are these challenges and what are these skills? Can these needs be met through a contract relationship or must one of the core team be an expert?

Technical Skill Needed	Team Member or Advisor with Appropriate Skill and Experience

Financial: What are the financial aspects of the project? Will there be ongoing financial requirements over the life of the project? Can a chief financial officer be hired later or should the team include a financial expert from the outset?

Financial Skill Needed (When?)	Team Member or Advisor with Appropriate Skill and Experience

Negotiations and Sales: Are there ongoing business relationships, with suppliers and customers that require regular updating terms and conditions? Will the project always be seeking new customers and relationships or will this be a one-time event?

Negotiator	Contracts and Issues to be negotiated

Legal: Will the regulations and contractual relationships governing the project be fixed or will they change over time, requiring regular attention.

Legal Expert(s)	Their Credentials and Experience

Political: Will regulations and policies affecting the project's performance be evolving and require attention and lobbying?

Issues	Who Will Handle?

Project Team Funding: What is the minimum amount of funding needed to complete work underway and make the project attractive to lenders and investors? How much has the project team spent already (time and money) and on what? What will be realistically needed to complete all of the tasks identified? Even then, how much cash equity is needed to assure that the team retains a substantial portion of ownership and control? How much cash equity does the project team have?

Amounts Spent to Date	
Amounts to be Spent	

Entrepreneur Skill, Experience and Resources: Of the qualifications needed for the team what skills does the project entrepreneur possess? Are there partners who round out this skill set? Are there advisors who can be hired to assure that all the skills needed are represented? Does the team have an experience base that will "impress" lenders and investors? If not, is there an addition to the team that could solve this problem? Is it possible to contract with an experienced party as part of the team? If not, how does the energy entrepreneur propose to convince lenders and investors that all the skills and experience needed are at hand? Does the team have the time and money needed to complete the work identified? What about the cash equity to be credible in negotiating with lenders and investors? Is there an early stage financial source available to supply these funds? What will the team be giving up and gaining by taking a financial partner?

Skills and Experience Needed	Team and Advisors	Strength or Weakness?
Technical		
Financial		
Negotiating		
Legal		
Other		
Near-term $$$ Needs		

Due Diligence and Risk Analysis Checklist

In preparing an investment proposal for funding consideration, an entrepreneur needs to address numerous project issues to demonstrate the sustainability of the project and ways to mitigate any risks. The following checklist outlines the required information.

When a financial institution reviews a renewable energy investment package, the following project components need to be answered to gain a full understanding of the viability of the project and assess the risks.

I. Market

- Would this technology be cost-competitive with existing sources of electricity (kerosene, candles, diesel generators, etc.)?
- How would the product or services be marketed?
- What is the market potential?
- Do customers have the ability and willingness to pay for the products or services?
- What is the country's energy regulatory policy?

II. Technical

- <u>Fuel Resources:</u>
- What fuel resource (eg: water, sun, bagasse) is being used?
- What fuel supply contracts are needed and which have been secured? Even waste to energy projects need to enter into fuel supply contracts. "Waste" can become an economic value in the future; assumptions that today's waste will be tomorrow's free fuel are not viable.
- What fuel resource data is available? How long has it been analyzed?
- Is historic data available? Site specific and long term data is needed especially for wind and water projects.
- <u>Licensing/permits:</u>
- What licenses or permits are required to complete this project?
- What is the status and schedule for each of these?
- What contracts are needed?
- <u>Energy Purchase Agreements</u>:
- Who will buy the energy produced? Creditworthiness of buyer needs to be verified. Sale of energy needs to be assured through customer contracts, distribution company purchases or regulatory regime. In each case the ability to pay of the purchasing entity needs to be assured, a back-up plan needs to exist and the long-term viability of the purchasing entity needs to be examined.
- What is the status of energy purchase agreements? Is there a PPA or, is this a wholesale market? If so, what is the structure of the market and what are the tariffs? Is it a newly established market or is it already operational? Are there any special considerations for Renewable Energy?
- What risks are there?
- Is there a back-up purchaser for the energy?
- When selling renewable energy equipment directly to customers, revenue collection plans and devices must be in place to assure repossession of non-performing energy assets sold on credit, leased or provided in fee-for-service arrangements. Re-marketing plans must also exist.
- <u>Wheeling:</u>
- If the energy is being sold to other than the local utility, are there expenses to "wheel" the energy to the purchaser? Are they included in the economics?
- <u>Interconnection issues:</u>
- Have the interconnection costs been considered in the investment costs? If not, will the purchaser of the energy pay for this?
- <u>Land ownership issues.</u>
- What is the risk that a developer may lose access to the site in which the project would be implemented? Costs of the land? Relocation of human population? Concessions?
- <u>EPC contracting.</u>
- Will an EPC contractor be retained?
- What is the status of identifying and securing a commitment from an EPC contractor?

- What are the EPC contractors qualifications?
- Is financing available through the EPC contractor?
- Quality of equipment/guarantees.
- What type of equipment is being used (new vs refurbished)? Who is the manufacturer?
- Who will supply the equipment?
- What guarantees will be provided?
- Is financing available through the supplier?
- Is there a local representative for the supplier? If so, what is his experience?
- Concessions/Permits:
- What permits, licenses or concessions are needed?
- What is the schedule for obtaining the necessary items?
- Technical Capability:
- Who will provide technical capability?
- If outside technical assistance is needed, how will this be funded?
- Time Schedule:
- How realistic is the workplan and schedule?
- What financial resources are available if there is slippage in the schedule?
- Operations and Maintenance:
- How will O&M be handled and by whom?
- What is their experience and level of commitment?

III. Sponsors

- Sponsor Credentials:
- What is the overall structure of the company?
- Who are the owners?
- Are there any conflicts of interest?
- Legal Standing:
- Has the Project Company been incorporated?
- Experience of the Company:
- How many years have the entrepreneurs been in business?
- Have they been successful?
- Managerial Strengthen/Depth of company:
- Describe the technical and managerial experience of the team and what is required to ensure that the venture is profitable and sustainable?
- Has the project/energy enterprise secured collaboration with applicable third parties such as equipment suppliers, engineers, site owners, etc.?
- Development of Operations:
- How will the project operate on a day-to-day basis?
- Does the project developer live near the project site? If not, how will the project steadily advance?

IV. Financial

- Financial viability:
- What financial information is available: audited company financial statements, project cashflows?
- What is the company's current financial situation?
- What is the total project cost? A working capital plan must be defined.
- Structure:
- What is the financial structure of the project?
- Have revenues losses from theft or non-payment been estimated?
- Component and operating cost escalations must be estiamted and back-up supplies identified.
- What are the financing and refinancing plans?
- How much has the developer invested to bring the project to this point?
- What percentage of equity will the developer's investment equal?
- How has this been valued?
- Are other organizations investing? Debt or equity? Under what terms?

- Does the developer have financial resources to handle unexpected delays?
- Terms:
- What are the proposed terms?
- Is this a loan, equity, or quasi-equity?
- What type of guarantees can be provided?
- Will this be a dollar denominated investment?
- Can funds be repatriated?
- What is the exit mechanism?

V. Risks

- What risks are associated with this project?
- Country, Political
- Currency, Inflation and Interest Rate
- Managerial Capacity
- Access to balance of project funding/other investors (bankability of project)
- Ability of customers to pay
- Construction Risk
- Environmental Risk
- Contractual Liability Risk (energy purchase/sale agreements, fuel supply contracts), Contract Enforceability
- Competition
- What is the level of risk-sharing with the developer and other partners?

VI. Impact

- Social:
- How does the energy enterprise or project improve the quality of life through the provision of energy services (lighting, cooking, water)?
- Are there productive uses involved with this project? If so, what are they?
- How many people will benefit from this project?
- If the project is grid-connected, who will benefit from increased supply to the grid? Will there be long-term benefits (permanent jobs, access to water, grid extension) or will there be short-term (temporary jobs during construction)?

- Environment:

A thorough analysis of environmental assessment and permitting requirements needs to be undertaken independently and linked back to fuel, energy generation, site access, construction mobilization and other issues in the public domain.

- What are guidelines and record-keeping requirements for:
- ❑ Effluent Discharges
- ❑ Air
- ❑ Hazardous materials
- ❑ Solid waste
- ❑ Noise
- ❑ Relocation
- ❑ End-use Efficiency
- ❑ Greenhouse gases
- ❑ Other _________
- ❑ Resource studies (wind, hydrology, etc.).

- Will the project improve or protect the local, national, and global environment?
- What other energy sources such as diesel, kerosene, candles or firewood will be displaced?
- If displacing carbon, can this be quantified now?
- Does the project have any negative environmental effects?
- Has an environmental impact assessment been done?

Handbook for Financial and Development Professionals

Chapter 5

Business Planning for Energy Entrepreneurs

This chapter is directed primarily at energy entrepreneurs and development professionals. It is meant to serve as a training tool through which entrepreneurs and organizations providing assistance to entrepreneurs become familiar with the business plan preparation process. It may prove helpful to financial organizations that wish to provide guidance to entrepreneurs. It consists of the following content:

1. Introduction (why a good business plan is important and the essential ingredients of a business plan)
2. Lender and Investor Points of View
3. Documentation, Analysis, Testing
4. Detailed Outline of a Business Plan
   - Cover
   - Location and Technology
   - Agreements
   - Participants
   - Market
   - Implementation
   - Finance
   - Risks
   - Impact
   - Closing
   - Executive Summary
   - Attachments

- (Page 13) Grid Connected Business Plan Sample – Rio One Hydroelectric Project
- (Page 28) Rural Energy Delivery Company Business Plan Sample – Sunspot Inc.
- (Page 41) Three Investment Case Studies – Group Exercises

1. Introduction

A good business plan:

- Shows that a proposed energy project is a serious initiative, undertaken by capable entrepreneurs who understand and have control of the essential elements that will assure success.
- Increases the chances that an entrepreneur will be able to attract investors, lenders, partners, strategic allies, suppliers and key staff.
- Forces the entrepreneur to collect, in one place, all of the thinking and research that has gone into the development of a proposed project.

A good business plan is built on solid information. That information can be organized in many different ways but the essential ingredients remain the same:

- **LOCATION AND TECHNOLOGY**
- **AGREEMENTS**
- **SPONSORS AND ADVISORS**

- **MARKET**
- **IMPLEMENTATION**
- **FINANCE**
- **IMPACTS**
- **RISKS**

- LOCATION AND TECHNOLOGY

In this section of a business plan the project is introduced by its location and the proposed technology to be employed. This description includes the inputs (fuels, labor, etc.), the process (equipment configuration) and the outputs (steam, electricity, etc.) of the project.

- AGREEMENTS

This section of the business plan describes all of the legal agreements, including permits, required to construct and operate the proposed project.

- SPONSORS AND ADVISORS

This section describes the project's sponsors, their commitment to the project, the form of the proposed Project Company and the advisors assisting in the project's planning and implementation.

- MARKET

This section describes the country, its legal and regulatory structure and the customers to whom the output of the project will be sold, including their capacity and willingness to pay.

- IMPLEMENTATION

This section describes the specific steps and schedule to progress the project from its present status to completion and operation.

- FINANCE

In this section all of the financial features of the project are presented. The most important financial assumptions of the project are shown, the proposed financial plan is described and an analysis is made of the impact of various changes to the basic financial assumptions.

- IMPACTS

Social and environmental benefits, and any other special features regarding the project are presented here.

- RISKS

This section describes the risks that the project faces and how the project plans to deal with these risks.

In addition to these elements, a business plan contains:

- CLOSING, which describes the project's proposed capitalization plan and what is being requested from lenders and investors;

- COVER, which provides simple but crucial information to help readers understand the document and locate the entrepreneur;
- An executive SUMMARY, which tries to tell the project's " story" in one or two pages;
- A set of ATTACHMENTS, which provide details concerning some of the points made in the business plan.

While certain projects may require additional content most, if not all, project information can fit within this structure.

This toolkit chapter provides a more detailed outline of a business plan as well as sample business plans for a:

- Grid-connected hydroelectric project;
- Solar enterprise selling both product and services to rural communities; and,
- Company providing income generating equipment dependent on energy supplies and efficiency.

However, before proceeding with the presentation of a more detailed business plan outline and sample business plans, three other topics are covered:

- Understanding the views and interests of investors and lenders.
- Understanding the requirements of documenting information and preparing financial data.
- Understanding what a business plan is expected to accomplish and how to prepare a business plan that is targeted to a specific audience.

2. Lender and Investor Points of Views

First, it is important to differentiate between lenders and investors.

Lenders (usually bankers) make loans (debt) in the expectation of a very specific set of payments over time. Their requirements are usually well defined as to what conditions must be met in advance and over the course of the loan. *Lenders do not want to bear risks* and they do not generally enjoy any benefits of a project being profitable. Lenders want to be repaid and if the project cannot make that repayment they want to know that others will make the payment or that assets of equivalent value are available to reimburse them.

Investors make equity investments in projects. They expect a higher return than lenders and are willing to take more risk, but this should not be confused with being risk-takers. They are equally clear about what they are willing to do or not do. Their interests are in seeing a project succeed and in earning a return on their investment. When they are a significant participant in a project, they tend to establish very specific (and stringent) rules and targets to make sure that things are going well. When things are not going well investors often have the ability to make significant changes in a project, including replacement of the project team.

It may sound as though the interests of lenders and investors are aligned: to get paid. Sometimes this is true, especially when things are going well and especially in the early stages of a project. However, very few projects go exactly as planned and "course corrections" are needed. Depending on the seriousness of these corrections the interests of lenders and investors may become very different.

Why do Investors Invest? Investors provide equity to a project for a variety of reasons. It is important that entrepreneurs understand the goals and objectives of investors before going too far in discussions. Investors provide equity to:

- Produce income in the form of cash dividends (often in a particular pattern as in the case of an investment fund that has promised returns to its investors over a specific time period).
- Achieve capital growth (with or without specific time constraints; a traditional equity investor-partner is involved over the life of a project whereas a fund investor, as noted above may have a contractual obligation to liquidate its investment in 6, 8 or 10 years).
- Enter a market (and thereby avoid the start-up and market research costs and problems of entering a market alone, preferring instead to join forces with a project already developed).
- Sell a product (especially equipment).
- Form a partnership and thereby grow quickly (similar in appearance but substantively different than making an investment to enter a market).

In contrast, why do lenders make loans? The list of reasons tends to be shorter, but it is equally important, especially in a new field such as renewable energy, to understand the motives of a lender. Taking it for granted that all lenders make loans because that is an important part of their business and a source of profits, there are other reasons to consider. Lenders make loans (provide debt) to:

- Build relationships with clients who will be a source of future business.
- Enter new business areas that can expand their loan portfolio profitably and provide a competitive advantage to the bank.
- Contribute to economic and social growth and thereby stimulate greater lending activity.

It is important to note that many banks simply do not lend for projects (bankers separate project finance – which is secured by the project proposal – from corporate finance – where all of the activities and assets of a company guarantee a loan – and many do not lend for groups without substantial experience and assets). Learning the interests of banks in advance can save a great amount of time.

What do lenders and investor look for? There are different degrees of emphasis placed on the following factors but both lenders and investors look for:

- Strong sponsor (experience, credibility, skills, commitment of time and money).
- Solid project fundamentals (raw materials, process, outputs).
- Risk assumption by others (completion of project both from the standpoint of time and money, insurance for accidents, guarantees of performance of equipment).

- Clear legal and regulatory framework (energy sector, banking and investment sectors, tariffs, taxes, and incentives).
- Country stability (political, economic and disasters, especially climate driven).
- Exit mechanisms (for bankers: repayment backed up by security and guarantees; for investors: sale of assets or shares to 3rd parties, buy-back by project, re-financing, dividends).

How do lenders and investors analyze projects? The answer to this question is contained throughout this chapter but in summary lenders and investors look at:

- Technology (Will it work? Can it be built? Has it worked and been built here? Is it competitive; that is, will it be replaced by something far better before the loan or investment is repaid?)
- Agreements (for land, fuel, construction, operation and permits).
- Participants (Who are the sponsors? Who are their advisors? What contractors are involved?)
- Implementation (What will it take to get from this point in time to the commencement of construction? From construction to operation? What is the management plan? The insurance plan?)
- Finances (capital cost, revenues, operating costs, depreciation, taxes, debt service plan, cash flow, assets, liabilities and OPM [Other People's Money]).
- Risks (completion, currency, economic, environmental, finance, force majeure, labor, political, raw material and technology).

3. Documentation, Analysis and Testing

Convincing someone that an entrepreneur can create a rural energy project in a developing country is more difficult than convincing someone that Coca-Cola or dry cell batteries can be sold in the countryside. Coca-Cola and dry cell batteries have been sold for generations, worldwide. What an energy entrepreneur proposes tends to be very new.

As a result of this newness the entrepreneur needs to convince people that there are factors that support the idea and that it is likely that the project will succeed.

Where to Begin

In proposing a rural wind, water, biomass or solar project supplying electricity to a house, a business, a community or a national electric grid, a very good beginning would be to show that one or two similar projects have been approved, financed, built, are operating and collecting revenues. **Investors are not pioneers if they can avoid it**. And most choose to avoid it. Lenders are almost never pioneers. So a good place to begin your documentation process is to answer the question, "Have others done this before?"

This is easiest, of course, if one or two very similar rural projects *have* been built. The entrepreneur needs to do a little research and document what happened and when. While everyone wants to think their project is unique, uniqueness is definitely not an asset when trying to convince others to make loans or an investment.

If nothing like the proposed project has been built – and all too often this is the case – then the entrepreneur needs to build as many arguments as possible to reduce the perception of “pioneering risk”.

For example, similar projects may have been constructed and operated, albeit by the government. This helps reduce any perception that there aren’t qualified contractors or workers; that canals, tunnels or other infrastructure cannot be built; that equipment is unknown and so on. What the entrepreneur does by citing such examples is to confine the “newness” of the transaction to the fact that a business is going to build this project (instead of the government) or that new contracts for the sale of electricity must be put in place or some other narrower issue than “it has never been done before”.

If, separately, another private power project (say diesel-fired in the capital city) has sold electricity to the utility and been paid, then the entrepreneur can use that project to reduce the perception that utility power sales and interconnections are new territory.

There are cases however, where the entrepreneur will be the pioneer (the authors have been involved in a few). In these it must be proved that even though no such project presently exists, the country has passed laws and implemented regulations promoting new projects of the size proposed. The entrepreneur must show that a power purchase arrangement has been put in place by the national utility to purchase the output of such projects even if no such contract has yet been signed. The entrepreneur must demonstrate that there is a market operating outside government programs. Is this easy to argue from this starting point? No. Can it be done? Yes, through thorough documentation, step-by-step market research and cross-checking of what you are told. Does the vice-minister say the same thing as the head of the utility? Are both of them citing published regulations and laws or telling the entrepreneur, “Don’t worry, I know the law is a problem but I will make it happen for you”?

Obviously, some situations give more comfort to certain kinds of investors than others. However, the important point here is for the entrepreneur to demonstrate that he or she **has the important facts clearly established and are poised to work through all the problems that will be encountered**. A business plan is not a statement of dreams that may be realized. It is a roadmap to a specific destination.

What needs to be documented?

All of the information gathered throughout the fact-finding and feasibility analysis process needs to, first, be reduced to straightforward paragraphs that describe the situation. Second, all of the “ back-up” documentation (the letters, records, calculations that support the brief paragraph or two) need to be organized in files that are available for inspection by investors or lenders. Third, the most important documents need to be summarized and attached to the business plan itself.

If the entrepreneur has examined the public records that pertain to already authorized projects he or she needs to copy the most important documents, summarize the content of the documents reviewed (contracts, laws, regulations, opinions of counsel) and the conversations had as an attachment to the business plan and prepare a brief paragraph for inclusion in the appropriate place in the business plan (under market or agreements or wherever it is most convincing.)

This is especially important with first of a kind projects that need to explain (with the support of experts, if possible) why the existing laws, regulations etc. are going to support bringing the project to success.

What About High Level Political Support?

The business plan should be clear and objective about the political support a project has and needs. If every project with "top-level" support could be implemented there would be no energy crisis in the developing world. Unfortunately, while having access to the minister, vice-minister and head of the national utility may be required to succeed, it is no guarantee that an entrepreneur will. **Solid regulations, uniform contracts and consistent policies work far better and more sustainably than political connections**. What needs to be documented is the political support the project enjoys *within* the context of a generally understandable "system" of rules and policies that will provide comfort to investors.

Documentation: Start Writing!

Much of your information has been developed in the fact-finding and feasibility analysis phase of planning and implementation. Now the entrepreneur needs to identify the key points and express those points **clearly and succinctly**. Giving a reader all the information you have gathered may demonstrate how thorough you are but you may also bore them to death, causing them to set aside your document in favor of one that is easier to understand. Over-analyzing a project creates a similar problem ("Paralysis through Analysis").

Project Documentation Example

One dimension of a project that must be documented is the laws and regulations that govern its construction and operation. The entrepreneur needs to show a comprehensive grasp of **all** the issues that must be addressed, **all** the rules that apply and **all** the relationships needed to achieve approvals. If fifteen approvals are needed from local, regional and national government the project will succeed once all fifteen are obtained. **There is no second-place prize** for obtaining fourteen and "forgetting" one.

The business plan needs to demonstrate that these issues covered: For example, what laws and regulations govern the use of water? The generation, transmission and sale of electricity? The construction of the project? The registration of the project company? The use or crossing of public property for construction? Environmental permits and requirements? Public meetings?

Having done that, it is not enough to just have a well-organized project. Business Plan readers need to know the larger picture concerning the country, the energy sector and any other sector that might influence the probable success of the proposed business. Is the country stable? What is the state of the economy? What are the prospects for the future? Is it a good place to do business? According to whom? What is the state of its key industries? What is the state of the energy sector? How does it operate now? Are there changes expected? What are the forecasts concerning the demand for and supply of energy?

Detailed Outline Of An Energy Business Plan

Cover and Table of Contents

- Project Title, Location, Technology, Size
- Contact Information
- Contents by Section and Page Number
- Disclaimer and Confidentiality Statement

Executive Summary

Section 1 – Location and Technology

In this section of the business plan the site of the project is described, as is the proposed technology. This description includes the inputs (fuels, labor, etc.), the process (equipment configuration) and the outputs (steam, electricity, etc.) of the project.

- Project location and Setting
- Inputs (Fuel or natural resources)
- Process
- Outputs

Section 2 – Agreements

In this section of the business plan all of the legal agreements, including permits, required to construct and operate the proposed project.

- Site Control
- Pre-construction
- Construction
- Operations and Maintenance
- Sale of Output
- Permits

Section 3 – Sponsors and Advisors

This section describes the project's sponsors, their commitment to the project, the form of the proposed Project Company and the advisors assisting in the project's planning and implementation.

- Sponsors (the development team)
- Advisors

Section 4 – Market

In this section, the country, its legal and regulatory structure and the customers to whom the output of the project will be sold are described.

- Country
- Local
- Legal and Regulatory
- Customers

Section 5 – Implementation

This section describes the specific steps and schedule to progress the project from its present status to completion and operation.

- Plan (management, insurance, construction, operation, permitting, other)
- Schedule
- Resources Required

Section 6 – Finance

In this section all of the financial features of the project are presented. The most important financial assumptions of the project are shown, the proposed financial plan is described and an analysis is made of the impact of various changes to the basic financial assumptions.

- Capital Cost
- Revenue
- Cost of Goods Sold
- Operating Costs
- Overhead (Sales, General and Administrative Costs)
- Indicative Financing Plan
- Interest on Debt
- Depreciation
- Taxes
- Principal Payments
- Basic Assumptions Summary
- Pro Forma Financial Projections - Summary
- Financial Indicators
- Sensitivity Analysis
- Pro Forma Financial Projections – Detailed
- Balance Sheet

Section 7 – Impacts

Social and environmental benefits of the project's implementation, and any other special features of the project, are described in this section.

- Local employment
- Economic activity stimulated
- Improvements to physical assets
- Social benefits
- Protection of environmental quality
- Pollution avoidance or elimination
- Greenhouse gas (carbon) benefits

Section 8 – Risk Factors

This section describes the risks that the project faces and how the project plans to deal with these risks.

- Country
- Project
- Change in Law
- Force Majeure

Closing

The Closing section of this business plan summarizes the projects' proposed capitalization plan and what is being requested from lenders and investors.

Attachments

- Complete financial statements
- Summary of technical and market studies
- Copies of authorization letters and permit approvals
- Detailed background and financial information about the sponsor

*

Next this chapter of the Toolkit will present two typical business plans for a clean energy project. However, BEFORE beginning that presentation it is important that we remind ourselves what are the key elements that determine whether or not a project makes sense.

*

When land, fuel, technology, team, customers and permits are available and when putting these ingredients together makes financial, social and environmental sense, then a project is feasible.

It doesn't guarantee that a project will be funded or implemented – too many other things outside the project's control can go wrong -- but it does set the stage for presenting the project to reasonable people for technical and financial participation. And that is the goal of work prepared BEFORE writing a business plan: for the entrepreneur to know that the pieces of the project can be put together well enough to present the project to others. Generally speaking, a renewable energy project makes sense and is feasible when:

1. Natural Resources – wind, biomass and sunlight -- are available in sufficient quantity.
2. Contractual rights to use these natural resources as fuel have been obtained
3. Land needed for the project has been secured and access to the site assured.
4. The permits needed to design, build and operate the project have been approved or will be obtained in a timely manner.
5. The available natural resources can be converted to energy using available proven technology that qualified contractors are prepared to supply, install and operate.
6. The energy to be produced can be transmitted and sold to one or more credit worthy customers.
7. The project is compatible with the local and country energy plans for energy service delivery.

8. The commercial, political and social setting of the project will instill confidence in suppliers, contractors, investors, lenders and insurers.

9. The project team has sufficient experience and skills to design, build and operate the project.

10. Qualified suppliers, contractors, insurers and consultants are available and have expressed commitments to the project.

11. Reasonable estimates have been made of all revenue, capital and operating costs, including contingency allowances.

12. Project revenues are sufficient to pay operating costs, repay proposed loans and provide adequate returns to investors.

13. There is local or international interest in providing loans and investment capital.

It is the job of the entrepreneur to have all of these issues clearly within his or her control BEFORE beginning to write a business plan for 3rd party review.

- ❑ **Sample Business Plan – Grid Connected**
- ❑ **Sample Business Plan – Off-grid**

Business Plan

River Number One
2.6 MW Hydroelectric Project

Date: June 2000

Project Sponsor Contact Information:
Philip LaRocco, River One Development Group
383 Franklin Street, Cordoba City, Cordoba 07003
Email: phil@energyhouse.com
TEL: 1.973.680.9100, FAX: 1.973.680.8066

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Attachments

Executive Summary

The Project is a proposed 2.65 MW run-of-river hydroelectric project in the __________ Province of the Republic of __________. The Project will provide 1.55 kW of guaranteed capacity and 18.1 million kWh per year for sale to the national utility under a 5 year power purchase agreement.

The Project will be constructed in an area that has ample, documented hydrological resources. The Project will provide peaking capacity and energy through an efficient high-head hydroelectric installation comprised of a reservoir, an open canal and a tunnel connected to a penstock and a powerhouse. The Project will connect to the tail of the national interconnected system through a 3-km transmission line. The project would use three Pelton style hydroelectric units.

The River One Project involves four parcels of land, which are owned or under the control of the project sponsor. The project will be built under an EPC contract. The EPC contract and bid documents have been completed. Two qualified companies have expressed interest and are in the process of bidding. Construction will be supervised by Smith and Jones, Consulting Engineers, on behalf of the Project Company. Operations and maintenance will be provided by a subsidiary of the successful EPC contractor or by a subsidiary of the national utility, which is operating a similar project for a private sector generator.

Three national permits are required to build and operate the Project: Water Use Permit, Energy Generation Permit and Environmental Permit. All three permits have been obtained. One local permit, to improve a public road used in site access, is pending.

The Project Company, Rio One Hydroelectric Project is owned by River One Development Group comprised of S&C Consultants, a fifteen year old civil engineering firm, Thomas Higgins, Esq., and E&Co (USA).

The implementation plan for the Project contains the following key milestones and dates:

- Complete the negotiation and enter a final contract with the EPC contractor (4 months).
- Complete term sheet, due diligence and document preparation for construction and permanent debt (7 months).
- Complete equity agreement and closing with shareholders (7 months)
- Execute power purchase agreement with the national utility (3 months).
- Final land payment on Parcel #3 of the project site.(1 month).

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Construction can commence immediately after the completion of these events; operations can commence 12 months later.

The following data summarize the financial aspects of this business plan:

Capital Cost - $3,450,000
Indicative Financial Plan – 50% Debt at 12% interest, 1 year capitalized interest and seven year repayment with equal principal payments yearly.
Sponsor's equity - $415,000
Equity to be obtained - $1,310,000
10 Year Equity IRR – 19.16%
Lowest Year Debt Service Coverage Ratio – 1.7 times
Seven year Average DSCR - 2.1 times

At the present time the sponsors are seeking $1,310,000 in equity financing for the project and $ 1,725,000 in debt.

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RIVER ONE 2.65 MW HYDROELECTRIC PROJECT
Business Plan

Section 1 - LOCATION AND TECHNOLOGY

The project's 2.65 MW of capacity would be located in the _________ Province of the Republic of __________, 190 km from the capital, at the confluence of River

One and River Two (see map). Water data for the province and the River One and River Two have been accurately collected for more than twenty years. These data were reviewed and tested by an independent hydrology engineer as part of the feasibility study of this project.

The Project is located in a forested and largely uninhabited area, near a protected area. Access to the area is presently on an unpaved road that contributes to local erosion. The Project's construction will improve the road quality and access in the area.

Independent engineering, environmental and social analyses have verified site and surrounding conditions as acceptable and estimated the costs, benefits and consequences of the project. These results are recorded in the document "Feasibility Analysis-River One Hydroelectric Project" prepared by Smith and Jones, consulting engineers.

The Project will provide peaking capacity and energy through an efficient high-head hydroelectric installation comprised of a reservoir, an open canal and a tunnel connected to a penstock and a powerhouse. The design of the installation is consistent with a similar installation in a nearby valley with similar geo-technical conditions.

A powerhouse would be built near the town of __________ with an intake in the River One. Firm capacity of 1.55kW and 18.1 million kWh of energy will be sold to the national utility through a fifteen-year power purchase agreement. The project would connect to the tail of the national interconnected system through a 3-km transmission line. The project would utilize three Pelton turbines manufactured by ___________.

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Section 2 – AGREEMENTS

- Site Control

Four parcels of land are required for the project, as well as a site access through a poorly maintained public road. Three of the required parcels of land are owned by the Project Company. A final installment payment of $100,000 is to be made on these parcels. The fourth parcel of land has granted an irrevocable use permit for 40 years, which can be renewed for an additional twenty years. The fee for this permit has been included in the project's annual operating expenses.

- Pre-construction

Pre-construction work has been undertaken by the project sponsors and a team of technical, legal and financial advisors. With one exception all of these contracts have been completed. The exception is an engineering services contract with Smith and Jones, Consulting Engineers. Under this contract S&J is supervising the preparation and negotiation of the EPC contracts. It is anticipated that Smith and Jones will serve as the owner's engineer during the construction process. Funds for this contract are included in the project's capital cost estimate.

- Construction (EPC)

The project will be constructed under a lump-sum, turnkey engineering, procurement and construction contract. Preliminary estimates have been received from two credit-worthy and experienced firms, who have each agreed to provide appropriate performance bond and insurance policy coverage.

- Operations and Maintenance

The project will enter a 10-year operating contract with either the successful EPC or with the national utility. All are experienced operators of hydroelectric projects of the size of this project. The initial construction (EPC) contract will provide for equipment spare parts and the financial plan provides ample funds for major maintenance.

- Sale of Output

Capacity and energy will be sold to the national utility, which provides a general letter of credit guaranteeing its financial obligations under the power purchase agreement. The national utility has six similar power purchase arrangements, all indexed to foreign currency, and the utility has met all of its obligations under these agreements. Although the utility is yet to achieve sustainable financial performance it is able to regularly borrow at commercial rates, both domestically and internationally, and has steadily improved its operating performance during the last three years. The utility is being prepared for partial or total privatization; thus the pressure to improve operating performance and the need for guarantees, first, that the contract will be honored by any successor company and, second, letter of credit support for payments. All of the essential terms and conditions of the power purchase agreement are completed.

PAGE 6

- Permits

Required permits and government approvals have been obtained; only the approval of the detailed design of a road access cutting across public property remains in process. Following is a list of the pertinent permits and approvals:

- Final permit to draw and use water from River One – Approved December 7, 1999 by The Ministry of Natural Resources and Environment. Approved by Congress under the Small Energy Projects Regulation, which also provided approval for the generation and environmental permits.
- Permit to produce, transmit and sell electricity. – Approved May 15, 2000.
- Environmental approval and national permit to construct project – Environmental Impact Assessment on May 1, 2000 and construction permit approved May 10, 2000.
- Temporary road access permit and permission to improve a public road– Submitted May 15, 2000; approval pending.

The Project has obtained an opinion from its legal advisor that these constitute all of the permits required to commence construction.

Section 3 – SPONSORS AND ADVISORS

The sponsors of the project are an experienced civil engineering firm, an experienced business manager and two investors with prior experience in similar projects.

The Project Company, Rio One Hydroelectric Project is owned by River One Development Group comprised of S&C Consultants, a fifteen year old civil engineering firm, Thomas Higgins, Esq., and E&Co (USA).

- S&C Consultants is a fifteen year old civil engineering firm with 16 full-time employees. It has been involved in more than ten projects of a similar nature. The firm presently owns 51% of the Project Company.
- Thomas Higgins, Esq. has been managing businesses for twenty years directly and through a management company (TH Investments, Inc.). Mr. Higgins and THI own 20% of the project company and provide legal and general management expertise.
- E&Co (USA) is an investor in the Project Company. E&Co. brings substantial experience in hydro investing, forestry, biomass and greenhouse gas related issues. E&Co owns 29% of the project company.

Clark and Hjerthen are the project's legal advisors. Energy House Capital Corporation is the project's financial advisor. Merill, Coopers, Waterhouse, PC are the sponsor's public accountants and auditors.

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Section 4 – MARKET

- Country

The Republic of _________ is a stable democracy. Orderly transitions in government have taken place for more than thirty years. One party dominates national politics in the executive branch but three major parties shared power successfully in the legislative branch of government. The currency of _________ is the __________, which has traded in the 10:1 to 11.5: 1 range with the US$ for the last five years. The population of __________ is 11.2 million, growing at a rate of 2.3% per year. GDP per capita is $1175 nominal and $4800 in comparative purchasing power. The EIU Country Risk Service gives __________ an overall B- rating (A being the highest and D the lowest). This service rated political risk an A, economic policy and economic structure risk at B- and C- respectively (the latter being the result of substantial restructuring underway in the transport and telecommunications area) and Liquidity risk as a C (an improvement from the previous rating). Real GDP has grown by 3.5%-4.3% these last three years and inflation (consumer prices) has averaged 3.5%. The electricity system has 534 MW of installed capacity and last year generated 2,921 GWh of energy. Those figures are projected to be 1,400 MW and 7,700 GWh in 10-12 years.

- Legal and Regulatory Framework

The Energy Law of 1997 which mandated the creation of a private sector generation of electricity for sale to the national utility under long term power purchase contracts, governs the energy sector. The key features of this law and its implementing regulations and bylaws are the following:

- Separation of energy generation, energy transmission and energy distribution within the national utility. Eventual sale of distribution assets is forecasted in the law. More than one distribution company will be formed from the assets spun off in this manner.
- Transmission will be governed by a state-owned company, which will have no other function. Transmission costs will be recovered through a surcharge to energy purchases and sales.
- Distribution companies must contract for firm capacity from the national utility generation company, which in turn will contract with independent power producers (IPPs) such as the Project. These contracts (both between IPPs and the national generation company and between the generation company and the national distribution company) must be entered in a transparent manner and cover at least five years of the projected capacity needs of the distribution company. There will be penalties for capacity not delivered by generators or not covered by the Distribution Company.
- A National Energy Commission will oversee the operation of the Market.

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- Generators using renewable sources of energy --- wind, hydro, biomass, solar --- will receive up to a 10% price premium on top of the standard offer included in the power purchase agreements available to all generators of electricity.
- Renewable energy projects will receive a 5-year income tax holiday and will be exempt from import duties on equipment.
- Rural electrification will be supported through a per household investment by the government, regardless of the mode of electricity service. In other words,

the government will support an investment of $200 per household (subject to adjustment by the National Energy Commission) to promote rural electrification. On-grid extensions will be the responsibility of the nation distribution company serving a particular area. Off-grid hook-ups will be on the basis of applications by energy service companies to provide services to a defined area (between 1000-5000 households). Upon approval of a 5-year off-grid service territory concession companies are responsible for direct marketing to households within the area. Companies are required to provide performance bonds or other security and will be paid the $200 hook-up fee upon installation and verification of the provision of service.

- Customer

Firm capacity is being sold to the national utility, which provides a general letter of credit guaranteeing its financial obligations to purchase firm capacity and energy from generators such as the Project. Payments are guaranteed within 15 days of a month-end statement being delivered to the national utility.

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Section 5 – IMPLEMENTATION

The project will require 12 months to complete from the issuance of a Notice to Proceed to the designated EPC (engineering, procurement and construction) contractor by the Sponsors. The following events, estimated to require seven months from the date of this business plan, must be completed in order to issue such a Notice to Proceed.

- Complete the negotiation and enter a final contract with the EPC contractor (4 months).
- Complete term sheet, due diligence and document preparation for construction and permanent debt (7 months).
- Completion of equity agreement and closing (7 months)
- Execution of final power purchase contract (3 months).
- Final land payment on Parcel #3 of the project site.(1 month).

Section 6 – FINANCE

- Basic Assumptions

Required Investment

The total capital cost of the Project is expected to be under $3.45 million, which is $1,337 per kW. This estimate includes all costs up to the date project operations commence, including interest capitalized during the construction period. This estimate is the result of an independent assessment prepared for the feasibility analysis, confirmed by preliminary quotes from two qualified turnkey contractors.

The estimated capital cost is comprised of the following:

		US $	
Land		275,000	8.0%
EPC		2,125,000	61.6%
Taxes (VAT)		71,600	3.5%
Legal and Financing		85,000	2.5%
Pre-construction		215,000	6.2%
Sponsor's fee		200,000	7.2%
Working capital		65,000	1.9%
Insurance		77,800	2.3%
IDC (interest during construction)		207,000	6.0%
Contingency		128,600	3.7%
	Total	$3,450,000	100.0%

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Capacity and Energy Output

The Project will provide 2,580 kW of "nameplate" capacity. At an 80% plant factor this equates to 2,064 kW of firm capacity. Because of significant penalties for failure to deliver firm capacity the project sponsors have chosen to only contract for 75% of this amount in the early years of the project. Thus, all the financial projections are based on selling only 1,548 kW of firm capacity to the nation utility's distribution company. Based on twenty years of water data the project will comfortably produce 18.1 million units of energy (kWh) per year.

Revenue

The Project has negotiated a 15-year contract to sell its 1,548 MW of capacity at $10.76 per kW per month. This contract can be extended for an additional five years. Energy sales are based on the newly established national utility rate of $37.70 per MWh. Forecasts by the National Energy Commission for the next five years all show average rates of $40 per MWh or more. In combination these energy and capacity revenues are estimated to produce first full year operating revenues of $881,000, after the deduction of appropriate value-added taxes and transmission taxes. This equates to total revenue (capacity and energy) of $.049 per kilowatt-hour. Revenues are denominated in US dollars although paid in equivalent local currency, which can be freely exchanged.

Operating Costs

Operating and maintenance costs, including the provision of a fund for major replacements and the payments to transmit energy to the national grid will cost $130,000 per year, which equates to $.007 per kilowatt-hour. Operating costs include:

O&M Costs, including land rent	60,000
Maintenance	5,000
Transmission Costs	11,000
Insurance	12,000
Administration	36,000
Other Costs	6,000
Total Costs	130,000

Useful Life and Depreciation

With scheduled maintenance and replacements, the Project will have a useful life

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in excess of thirty years. For tax purposes the asset will be depreciated over 20 years, reflecting a combination of the rates for civil works, equipment and infrastructure such as the powerhouse building. Under Government of __________ regulations governing projects such as River One, 80% of the full cost of the project, including interest during construction, can be depreciated.

Taxes

Separate from Income Taxes and Import Duties, Value-added taxes (VAT) will be paid on construction materials and equipment. These payments will be offset against net VAT collected (and passed through to the Government of __________) on the sale on energy in the early years. VAT and transmission taxes combine to total 16% of revenues. Because of the offset and pass-through nature of these costs, these amounts are not shown on the pro forma financial statements.

Income taxes will be paid on Net Income After Depreciation and Interest. A five-year tax holiday is provided under the energy law for renewable energy projects such as River One. The marginal tax rate is 25%.

- Indicative Financing Plan

This business plan has been organized on a 50%-50% split between debt and equity. Debt is assumed to be at 12% annual interest over a period of 7 years, with interest accrued for the construction year. Equal principal payments will be made each year. Debt service coverage ratios will not be less than 1.5 times in any given year and will average 2.0 times over the seven years. Equity is assumed to be all common shares, with annual distributions made to shareholders once all debt service requirements have been met.

- Pro Forma Financial Projections (first 4 operating years)

Project Year	0	1	2	3	4
Fiscal Year	2001	2002	2003	2004	2005
Capital Expenditure	(3,450,000)	0	0	0	0
Revenues	0	881,446	891,669	902,046	912,578
Operating and Maintenance	0	130,000	136,500	143,325	150,491
Net from operations	0	751,446	755,169	758,721	762,087
Overhead	0	0	0	0	0
Net before Interest, Depreciation and Taxes	0	751,446	755,169	758,721	762,087
Interest	0	192,214	162,643	133,071	103,500
Net before Depreciation and Taxes	0	559,231	592,526	625,650	658,587
Depreciation	0	138,000	138,000	138,000	138,000
Net before Taxes	0	421,231	454,526	487,650	520,587
Taxes	0	0	0	0	0
Net Income	0	421,231	454,526	487,650	520,587
Add back: Depreciation	0	138,000	138,000	138,000	138,000
Less: Principal	0	246,429	246,429	246,429	246,429
Net Cash Flow	(3,450,000)	312,803	346,098	379,221	412,159

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- Financial Indicators

10 Year Internal Rate of Return on Equity = 19.16%
Debt Service Coverage Ratio – lowest year (Year 1) = 1.7 times
Debt Service Coverage Ratio – average for seven years = 2.1 times

- Sensitivity Analysis

If no debt available (all equity deal) 15.90% IRR

If 60% debt is available	20.42% IRR 1.7 DSCR average
If no tax holiday	14.00% IRR 1.8 DSCR average
If 10% higher capital cost	15.02% IRR 1.9 DSCR average
If 10% lower capital cost	24.15% IRR 2.3 DSCR average

- Pro Forma Financial Projections and Basic Assumptions – Detailed – are presented on ATTACHMENT A.

Section 7 – IMPACTS

The social and environmental benefits of this project include the following:

- The project replaces the need for additional fossil fuel capacity additions to the national electric grid.
- The siting and dam construction for the project meets national and international standards.
- No displacement of people would occur as a result of the project.
- While trees would be cut during the construction phase of the project a reforestation program would replace these by a factor of ten.
- The project will employ no fewer than 45 local workers during the construction period.
- The project will permanently improve access to the area and reduce erosion through the upgrade of presently unpaved roads.
- Through the use of water as fuel, combined with tree planting the project will avoid over 6250 tons of carbon dioxide emissions per year. This number will be slightly offset during the construction period because of the concrete and transportation impacts of construction.

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Section 8 – RISKS

This business plan poses the following risks to lenders and investors:

- Hydrology and weather

Based on 20 years of data this risk is mitigated by conservative estimates of water flow but weather patterns, especially increases in violent storms and hurricanes, are noteworthy.

- Construction

Utilizing a turn-key EPC approach with a qualified and insured contractor mitigates the risk that construction will not be completed or that substantial cost over-runs will occur.

- Operation

Utilizing a local, experienced and well-established contractor mitigates the risk that operating interruptions will occur.

- Technology failure

Strong manufacturer warranties, substantial experience with this proven technology and excellent operator credentials mitigates the risk that the turbines or generators, controls or interconnection equipment will fail.

- Accidents and business interruption

The project's insurance program covers loss of revenue during interruptions and replacement due to major accidents.

- Failure to achieve capacity and energy output

Careful and conservative estimates have mitigated the risk that basic capacity and energy forecasts will not be met.

- Creditworthiness of capacity and energy buyers

Capacity payments will be guaranteed by a letter of credit from a reputable bank..

- Changes in law, policy, regulation (including taxes)

The present energy law was in design for four years, debated and approved by three different sessions of the Congress, is endorsed by all major political parties and represents a pattern in the region. The prior energy law was in force for 15 years with all of the obligations under that law met, including tax and import duty incentives.

- Sponsor or management change

The present implementation plan for the project is self-managing once the conditions set forth in Section 7 are met. The sponsors will maintain an equity position in the project and will enter agreements with shareholders and lenders to provide for replacement management under appropriate circumstances.

- Foreign exchange conversion of dollar-denominated contract

The Republic of __________ has had the free conversion of currency at transparent rates, without limitation, and the transfer of amounts off-shore for more than 10 years.

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- Expropriation of assets

Though considered unnecessary by the sponsors, risk insurance is available to cover this eventuality.

CLOSING

The sponsors of the Project are proposing a 50-50 debt-equity capitalization of this project, which is supported by the projections included in this business plan. At the present time the sponsors are seeking expressions of interest and direct negotiations with lenders and investors for:

- $1,310,000 in equity, which will secure a significant majority ownership in the project and its resulting cash flow, with exit mechanisms to be discussed.
- $1,725,000 in loans for a seven-year period, dollar denominated at an effective interest rate of 12%, with a one-year capitalized interest period and equal principal payments.

ATTACHMENTS

Pro forma financial projections.
Sponsor information and financial reports.
Executive summary of the Smith and Jones Feasibility Study and other technical studies.
EIU Report (1st Q 2000) on the Republic of __________.
Summaries and approval letters on all permits.
Term sheet of the proposed power purchase contract.

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Business Plan

SunSpot Inc
Household, Business and Productive Use Solar (PV) Project

Date: April 2000

Project Sponsor Contact Information:
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Executive Summary

Sunspot proposes a 5000 household and business solar electrification project in the five northern provinces of the Republic of __________. The Project will provide household and business electricity through the installation of 10-60 watt systems and the collection of monthly fees for the service provided. The Project will also provide a line of income generation equipment tied to solar energy sources through a joint venture with an established small enterprise creation organization.

The Project will be implemented in areas that have ample, documented solar insolation and will build on demonstration and pilot projects that have established consumer acceptance, willingness and ability to pay. The Project will provide households and businesses with a cost-effective substitute for current energy sources (batteries, candles, paraffin). The Project will be implemented through a network of sales and service points (affiliated with and located at existing businesses) combined with a network of technicians for installation and routine maintenance. The Project will be managed from ___________, which is located in Province #1 and central to all the provinces being serviced.

The Project Company, Sunspot, is owned by three local entrepreneurs (each with 18.3% for a total of 55%) and E&Co (USA).

The implementation plan for the Project contains the following key milestones and dates:

- Complete the identification and contracting with the last 2 of the seven local entrepreneurs (2 months).
- Complete documentation on a $1.592 million debt package to be drawn down in $315,000 to $332,000 increments to support the purchase an installation of systems over the next five years (3 months).
- Identify and close on $200,000 worth of equity (5 months).

Implementation can commence immediately after the completion of these events.

The following data summarize the financial aspects of this business plan:

- Capital Cost - $2,600,00 over 5 years.
- Indicative Financial Plan – Five yearly debt tranches of between $315,000 and $332,000, which will finance 70% of the installed cost per customer. An eight year debt schedule is proposed with a one year moratorium on principal and interest and a 13.44% interest rate for seven equal annual payments.
- Sponsor's equity - $150,000
- Equity to be obtained - $200,000
- 10 Year IRR on net cash flow after debt service 27%

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- Lowest Year Debt Service Coverage Ratio – 1.46 times. 12-year average DSCR – 2.0 times
- At the present time the sponsors are seeking $200,000 in equity financing for the project and offering either a 35% common share interest in the project company or a 15% common share ownership combined with a preferred dividend of 15% for year 4-12.

- At the present time the sponsors are seeking a $1,592,000 debt arrangement with drawdowns as follows:
  - Year 1 = $332,000
  - Years 2-5 = $315,000
  - Secured by the household installation and pledges of the shares of the present owners and agreements to debt service covenants before cash distributions.

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Sun Spot
Business Plan

Section 1 - LOCATION AND TECHNOLOGY

The project will be located in three of _________ 21 provinces. The sponsors have been operating in all three of these provinces for more than 5 years. Headquarters is located in Province #1. Sales and Distribution Centers are located in Provinces #2 and #3. These are located within 60 km of headquarters on year-round traveled roads. Each province contains more than 15,000 unelectrified homes in areas not expected to be grid electrified in the next 20 years. Headquarters and each provincial sales and distribution point can each service 2000-4000 customers (this business plan is built of 5000 in total). Through a network of nine local entrepreneurs, seven of whom are trained and operating (contracts with the final two are being completed now and training will commence shortly).

The project will use polycrystalline photovoltaic panels and balance of system components (battery, inverter, controller, wiring, brackets and power points) field tested by Sunspot through its previous activities: the sale and installation of 325 systems for cash and the installation of 75 pilot fee-for-service households. Sunspot will offer three major products of 30, 40 and 50 watts but will also offer smaller packages and a deluxe 60-watt package. Each is profiled in an attachment to this business plan.

The Republic of _________ enjoys year-round solar insolation levels more than adequate to guarantee peak performance of the PV systems purchased by Sunspot for the world's leading manufacturers, including _________ and ________, with whom Sunspot has been dealing for more than 3 years.

Section 2 – AGREEMENTS and KEY BUSINESS ARRANGEMENTS

- Site Control – headquarters, sales and service locations are controlled through ownership or lease arrangements. The major space requirement for the project is a location to assemble components (in headquarters). Individual local entrepreneurs (at the village level) house their Sunspot operation within existing stores or locations under their control and agree not to house competing products.
- Pre-implementation – these activities have been undertaken by the sponsors under a shareholders agreement prescribing contribution of cash and time by Sunspot's owners. These activities, which have cost in excess of $75,000 include the development of standard customer contracts and marketing materials; the identification and training of local (multi-village level)

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entrepreneurs; and, the configuration and pilot installing of 75 fee-for-service systems and associated installation, maintenance and collection systems. Under the existing shareholder agreement the sponsors have committed to an additional $75,000 of time and cash.

- Marketing -- The sponsors with the support of the NGO __________ have undertaken marketing. Sunspot has sold, for cash 375 systems over the last five years, which led to the development and testing of the fee for service approach (See Customers). The primary marketing and sales tools consist of village presentations, household demonstrations of various products and follow-up visits on market day to secure customer sign-up.

  In a related activity – and potential growth sector – Sunspot has entered a three-year agreement with ___________, an NGO specializing in small enterprise development through the provision of training, equipment and financing. Under this agreement Sunspot will modify certain equipment to be solar powered. These will include equipment presently powered with small gasoline-petrol engines, with batteries charged at remote locations and manually powered devices. Equipment for shelling, de-husking and sewing are the first line of products being modified and tested. Under this agreement Sunspot will provide the energy component and limit its price to a 20% mark-up.
- Customers enter a three-year standard contract and pay the initial installation fee.
- Installation – is undertaken by Sunspot technicians who are paid on the basis of installations made. The full cost of installation is paid by the new customers up front ($20 to $30) as a statement of their commitment to the product and service.
- Operations and Maintenance – is performed by Sunspot technicians in concert with training of customers on appropriate use of the product installed. Battery replacements are the responsibility of customers, thus assuring a motivation to protect their investment well.
- Collection – takes place at the seven (soon to be nine) central points and at key locations in the province. Household collections are not part of the collection process or agreement.
- Permits -- Required permits and government approvals have been obtained. These include: (1) general license to do business; (2) permit to enter financial agreements extending more than one year; (3) registration as a company including or contemplating foreign ownership; and, (4) permit to import goods and services in excess of AMOUNT per year. The Project has obtained an opinion from its legal advisor that these constitute all of the permits required to commence construction.

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Section 3 – SPONSORS AND ADVISORS

The sponsors of the project are three sole proprietors who have joined together to form Sunspot:
___________, an electrical contractor with 20 years experience.
___________, a distributor of hardware and appliances in the countryside.
___________, a consultant and professor of business management.
A fourth shareholder is E&Co (USA) an early stage investor in such companies. Sunspot is presently constituted as a stock corporation. Each of the indivuals holds 18.3 % of the shares and E&Co holds 45% of the shares. Each of the four has a seat on the board of directors. __________ is the general manager and expects to be involved in the company full-time for at least the next five years. The articles of incorporation, bylaws and shareholder agreement are summarized in attachments to this business plan.

Section 4 – MARKET

- Country

The Republic of _________ is stable. Orderly transitions in government have taken place for more than ten years. One party dominates national politics in the executive branch but three major parties share power successfully in the legislative branch of government. The currency of _________ is the __________, which has traded in the 10:1 to 11.5: 1 range with the US$ for the last five years. The population of __________ is 11.2 million, growing at a rate of 2.3% per year. GDP per capita is $675 nominal and $1900 in comparative purchasing power. The EIU Country Risk Service gives __________ an overall C rating (A being the highest and D the lowest). This service rated political risk an A, economic policy and economic structure risk at B- and C- respectively (the latter being the result of a need for substantial restructuring underway in the transport and telecommunications area) and Liquidity risk as a C-. Real GDP has grown by 2.5%-3% these last three years and inflation (consumer prices) has averaged 8.5%. The electricity system has 534 MW of installed capacity and last year generated 2,921 GWh of energy. Those figures are projected to be 1,400 MW and 7,700 GWh in 10-12 years but there is significant uncertainty about the government and the national utility to finance such an expansion and very significant skepticism about the national utility's ability to undertaker any griid expansions whatsoever. There are estimated to be 350,000 unelectrified homes in the country.

- Legal and Regulatory Framework

The Energy Law of 1997 which mandated the creation of a private sector generation of electricity for sale to the national utility under long term power purchase contracts, governs the energy sector. The key features of this law have NOT been implemented. They are:

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- Separation of energy generation, energy transmission and energy distribution within the national utility. Eventual sale of distribution assets is forecasted in the law. More than one distribution company will be formed from the assets spun off in this manner.

- Transmission will be governed by a state-owned company, which will have no other function. Transmission costs will be recovered through a surcharge to energy purchases and sales.
- Distribution companies must contract for firm capacity from the national utility generation company. which in turn will contract with independent power producers (IPPs)
- A National Energy Commission would oversee the operation of the Market.
- Generators using renewable sources of energy --- wind, hydro, biomass, solar --- will receive up to a 10% price premium on top of the standard offer included in the power purchase agreements available to all generators of electricity.
- Renewable energy projects would receive a 5-year income tax holiday and will be exempt from import duties on equipment. Significant for the proposed project this has not been enacted and would substantially improve financial results.
- Rural electrification will be supported through a per-household investment by the government, regardless of the mode of electricity service. In other words, the government will support an investment of $200 per household (subject to adjustment by the National Energy Commission) to promote rural electrification. On-grid extensions will be the responsibility of the nation distribution company serving a particular area. Off-grid hook-ups will be on the basis of applications by energy service companies to provide services to a defined area (between 1000-5000 households). Upon approval of a 5-year off-grid service territory concession companies are responsible for direct marketing to households within the area. Companies are required to provide performance bonds or other security and will be paid the $200 hook-up fee upon installation and verification of the provision of service. Significant for the proposed project this has not been enacted and would substantially improve financial results.

- Customers

Five years experience by Sunspot as well as market research demonstrates that between 7.5% and 10% of households can afford to by Sunspot products for cash and another 10% to 12.5% can afford to by Sunspot products if 18 to 36 month financing is offered. Thus, no more than 20% of the market (350,000 homes nationwide, 50,000 in the three large provinces that are Sunspot’s target market) could afford a cash or credit scheme. By offering monthly service at various prices (from as low as $5 per month to $20 per month) Sunspot can reach 55% of the market, a figure that would grow to 75% if and when the government household entitlement plus concession program is implemented.

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Section 5 – IMPLEMENTATION

Seven of the needed nine sales and service centers are implemented; two are nearing completion of contracts and the commencement of training. The purpose of this document is to secure the financing needed to implement Sunspot’s plan.

If financing (debt and equity) existed today Sunspot could be operational in all seven sales and service points within weeks and fully operational in nine locations within 2-4 months.

Section 6 – FINANCE

- Basic Assumptions
  - Sunspot will install 5000 systems over five years. Sunspot has the capacity to contract for and install 1000 systems in the first year as a result of its previous pilot program.
  - Systems will range from 10-60 watts but the dominant share of product offerings will average 40 watts.
  - Average cost for fully installed systems, excluding installation cost paid directly by customers, is $450 for the first year and $425 thereafter.
  - Average revenue will be $14 per month ($168 per year).
  - Operating costs, comprised of both fixed and variable costs, will begin at $150,000 per year and grow to $300,000 per year, including contingency allowances.
  - Sunspot's agreement with ________ to provide solar energy sources for productive use equipment has been estimated conservatively for this business plan, at 600 watts per year growing to 4000 watts per year, with a 20% mark-up.

<u>Required Investment</u>

The estimated capital cost is comprised of the following:
- PV systems to be installed: $1,592,500 as follows
  - Year 1 = 1000 systems at $475 or $475,000, financed 70% with debt ($332,500).
  - Year 2-5 = 1000 systems per year at $450 or $450,000 per year or $1.8 million over 4 years (70% debt).
  - $150,000 sponsors start-up equity contribution
  - $200,000 in additional start-up equity
  - Total project = $2.6 million

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Useful Life and Depreciation
Sunspot's installations, excluding batteries, have a useful life of 15-20 years, backed by component warranties. For tax purposes installations wqill be depreciated at 10% per year. Customers will replace batteries.

Taxes
Separate from Income Taxes and Import Duties, Value-added taxes (VAT) will be paid on construction materials and equipment. These payments will be offset against net VAT collected (and passed through to the Government of __________) on the sale on energy in the early years. VAT and transmission taxes combine to total 16% of revenues. Because of the offset and pass-through

nature of these costs, these amounts are not shown on the pro forma financial statements.

Income taxes will be paid on Net Income After Depreciation and Interest. A five-year tax holiday is provided under the energy law for renewable energy projects but has yet to be implemented. The marginal tax rate is 20%.

- Indicative Financing Plan

Debt—Sunspot's business plan is built on the financing of 70% of the cost of customer installations through debt. This indicative financing plan is supported by debt service coverage projections. The terms proposed for each of five tranches of loans are the following

- 8 year term
- Amounts per tranche $315,000 to $332,500
- No principal or interest in Year 1 after borrowing
- Equal annual payment in Years 2-8 after borrowing
- Interest at 13.44% based on a 12% nominal rate, adjusted upward to account for interest and principal grace period.

Equity – Sunspot requires a minimum of $200,000 in start-up equity to implement this business plan in addition to the sponsor's commitment. Sunspot is offering two options for investors:
(1) a 35% common shareholding
(2) a 15% common shareholding combined with a fixed 15% preferred dividend for years 4-12.

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Pro Forma Financial Results –

Year	0	1	2	3	4	5	6
Income Statement							
Revenue		175,560	353,600	531,000	708,000	882,000	882,000
Operating Cost		150,000	200,000	250,000	300,000	300,000	300,000
Net from Operations		*25,560*	*153,600*	*281,000*	*408,000*	*582,000*	*582,000*
Interest		0	44,688	82,787	116,302	144,618	167,035
Depreciation		47,500	92,500	137,500	182,500	227,500	227,500
Taxable Income		*-21,940*	*16,412*	*60,713*	*109,198*	*209,882*	*187,465*
Taxes (at 20%)		0	3,282	12,143	21,840	41,976	37,493
Net Income		*-21,940*	*13,130*	*48,571*	*87,358*	*167,906*	*149,972*
Cash Flow							
Add back depreciation		47,500	92,500	137,500	182,500	227,500	227,500
Less principal		0	31,526	65,630	104,318	148,206	197,991

payments							
Capital Investment	150,000	475,000	450,000	425,000	425,000	425,000	0
Amounts Borrowed	0	332,500	315,000	315,000	315,000	315,000	0
Net Cash Flow	-150,000	-116,940	-60,897	10,440	55,540	137,200	179,481
IRR on net cash flow	26.7%						

Debt Service	-	76,214	148,417	220,620	292,823	365,026
Available to Pay Debt Service	25,560	150,318	268,857	386,160	540,024	544,507
Coverage	NA	1.97	1.81	1.75	1.84	1.49

Debt Service-12 years	2,555,184
Available	5,063,477
DSCR, # Times	1.98

Equity Investor Options

35%	*19.0%*	*(150,000)*	*(50,000)*	*3,654*	*19,439*	*48,020*	*62,818*
15%	*15.0%*	*(150,000)*	*(50,000)*	*1,566*	*8,331*	*50,580*	*56,922*

# units		1000	1000	1000	1000	1000	0
Cumulative		1000	2000	3000	4000	5000	5000
Average cost per unit	100%	475	450	450	450	450	0
Amount Borrowed (%)	70%	70%	70%	70%	70%	70%	70%
Average revenue per unit/month	$14.50	$14.50	$14.50	$14.50	$14.50	$14.50	$14.50
Loan Term/years/equal annual		7					
Loan Interest Rate(12% + 1 year grace)		13.44%					
		150000	200000	250000	300000	300000	300000

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Operating Cost

Other Revenue/ watts	600	2000	3000	4000	4000	4000
Average Sales Price/watt	13	14	15	15	15	15
Margin	20%	20%	20%	20%	20%	20%
Revenue:	175,560	353,600	531,000	708,000	882,000	882,000
Fee for Service	174,000	348,000	522,000	696,000	870,000	870,000
Other	1,560	5,600	9,000	12,000	12,000	12,000
Amounts Borrowed	332,500	315,000	315,000	315,000	315,000	
Cumulative Borrowings	332,500	647,500	962,500	1,277,500	1,592,500	1,592,500
Outstanding Debt	332,500	615,974	865,343	1,076,025	1,242,820	1,044,828

- Financial Indicators

12 Year Internal Rate of Return on net cash flow = 26.7%
Debt Service Coverage Ratio – lowest year = 1.46 times
Debt Service Coverage Ratio – average for twelve years = 1.98

- Sensitivity Analysis
  Revenue decrease of 10% = IRR to 16.5%
  Revenue increase of 10% = IRR to 36.8%
  60% of investment financed = 24.4%

- Pro Forma Financial Projections and Basic Assumptions – Detailed – are presented on ATTACHMENT A.

Section 7 – IMPACTS

The social and environmental benefits of this project include the following.

- The project replaces the need for additional fossil fuel capacity additions to the national electric grid and the extension of the grid.
- The project will employ no fewer than 30 local workers.
- The project will avoid carbon dioxide emissions (to be measured, verified and perhaps converted to revenue).
- The project will replace kerosene, dry cell and remotely charged batteries.
- The project will improve quality of life in 5000 households and afford income and education opportunities while avoiding the health consequences of kerosene.

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Section 8 – RISKS

This business plan poses the following risks to lenders and investors:

- Customer Non-payment – will be addressed through a proven collection notice (2 times), re-possession and re-marketing program.
- Technology failure – will be addressed through regular O&M and customer training.
- Grid Extensions – are highly unlikely during the project period if at all, although procedures exist to remove and re-market systems in the event a grid extension occurs.
- Competition – is unlikely in the immediate market area on a direct basis, as there are 300,000 unelectrified households outside out three-province territory and no Sunspot-like firms operating. Other competition from petrol sets and mini-grids, as well as wind-PV hybrids are uneconomic (in the case of petrol and mini-grids) and unlikely in the case of hybrids (as Sunspot may consider such a combination also). The major competitive risk would be give-away programs direct to our customer base, which is extremely unlikely.

CLOSING

The sponsors are seeking to identify interested banks and investors for a multi-year, multi-tranche loan program. Cash flow and existing owner shares as well as covenants to prohibit cash flow distributions until coverage requirements are met would secure bank loans. The sponsors are seeking what would evolve to be a long-term and highly profitable relationship.

The sponsors are also seeking an early stage equity investors and offering a significant position in a growing company.

ATTACHMENTS

Pro forma financial projections.
Sponsor information and financial reports.
Executive summary of pilot program results.
EIU Report (1st Q 2000) on the Country.
Summaries of bylaws, articles of incorporation and shareholder agreements.

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Group Exercise #1

Project – River One - a $3.45 million HYDROELECTRIC project to build a 2.65 MW run-of-river project to generate over 18 million kWh of electricity per year.

Proposal Under Consideration – to invest $250,000 to make payments on behalf of the project prior to the commitment of all the capital needed from others. See project update, below.

Please identify:

- Three to five of the strengths and weaknesses of this project.
- Major risks to be understood by an investor providing this early stage funding of $250,000.
- Your recommendation on proceeding or not proceeding.

UPDATE

Your group has received the River One Business Plan plus the following update on the project:

1. Of the capital cost of US$ 3,450,000, only 60% of the debt and 30% of the equity has been committed. None of this equity is available at this time.
2. US$250,000 must be paid in the next 30 days for:
   (a) engineering services: US$ 50,000
   (b) a security deposit on the energy and capacity sale contracts: US$ 100,000
   (c) final land payments: US$ 100,000
3. In return for US$ 250,000 the Project Company is offering your group:
   (a) an equity interest equal to US$250,000
   (b) a 25% additional cash flow

Group Exercise #2

Project - the conversion of an operating SUGAR MILL to include a high efficiency energy component (approximate total project cost - $50 million).

Proposal Under consideration - to invest $250,000 to complete detailed engineering and various contracts.

Please identify:

- Three to five strengths and weaknesses of this project.
- The major risks to be understood by an investor providing this early stage $250,000.
- The conditions under which such a project might be attractive to a later stage investor or lender.

- Legal and Regulatory Context

The Energy Law of 2000, which mandated the creation of a Wholesale Market for the production, distribution and sale of electricity, governs the energy sector in Cordoba. The key features of this law and its implementing regulations and bylaws are the following.

- Separation of energy generator from energy distribution companies. Common ownership is not permitted.
- Transmission will be governed by a state-owned company, which will have no other function. Transmission costs will be recovered through a surcharge to energy purchases and sales.
- Distribution companies must contract for firm capacity from generation companies. These contracts must be bid in a transparent manner and cover at least five years of the projected capacity needs of the distribution companies. There will be penalties for capacity not delivered by generators or not covered by distribution companies.
- Energy will be dispatched by an independent Wholesale Market Administrator (WMA), an independent, non-profit body governed by a board composed of generators (independent power producers), distribution companies, brokers and the transmission company. Government and citizen observers will participate in a non-voting capacity.
- A National Energy Commission will oversee the operation of the Wholesale Market.
- Direct, negotiated contracts for the sale of energy are permitted. For projects under 5 MW it is also permitted to sell energy to the local Distribution Company at a rate equal to the average energy price paid during the prior year.
- The WMA will dispatch energy on an hourly basis. Generators will bid to the WMA the energy it wants to sell at a price equal to the cost of fuel and

operations. Energy will be dispatched in the order from the least to the most expensive. All energy sold in a given hour will be paid the price of the most expensive unit of energy sold in that hour. All prices will be denominated in US dollars but paid in local currency equivalent funds.

- Generators using renewable sources of energy --- wind, hydro, biomass, solar --- will receive up to a 10% price dispatch preference. In other words if a renewable project bids (based on cost) $.040 per kWh it will be dispatched before a thermal plant with a bid of $.037 and be paid the rate of the most expensive unit of energy dispatched during that hour.
- Renewable energy projects will receive a 5-year income tax holiday and be exempt from import duties on equipment.
- Rural electrification will be supported through a per household investment by the government, regardless of the mode of electricity service. In other words, the government will support an investment of $400 per household (subject to adjustment by the National Energy Commission). On-grid extensions will be the responsibility of the Distribution Company serving a particular area. Off-grid hook-ups will be on the basis of applications by energy service companies to provide services to a defined area (between 1000-5000 households). Upon approval of a 5-year off-grid service territory concession companies are responsible for direct marketing to households within the area. Companies are required to provide performance bonds or other security and will be paid the $400 hook-up fee upon installation and verification of the provision of service.

For the last two years the Jones Engineering Company has been organizing a project to convert the Dulce Sugar Mill from low pressure boilers that supply steam for sugar processing to high pressure boilers that will supply process steam and produce electricity for sale to the local utility. Jones Engineering has completed the following tasks:

- Prepared a feasibility study based on preliminary engineering from a local consultant.
- Entered contracts with the host sugar mill (to supply bagasse and purchase steam and electricity) and the local electricity Distribution Company.
- Entered a memorandum of understanding and begun negotiations with the proposed EPC (engineering, procurement, and construction) contractor.
- Created and registered a project company.

In order to complete the negotiations of the EPC contract and meet its timing commitments to the sugar mill, Jones Engineering must spend $250,000 to complete the following tasks.

- Prepare an environmental assessment and complete the permitting process.
- Have the prior engineering estimates and the EPC estimates examined and verified as reasonable by an independent engineer.
- Prepare an offering memorandum and negotiate terms for both debt and equity.

While Jones is not prepared to bring in a development partner or sell the project to an experienced development company, he is prepared to offer a sizeable equity share in the project company and a share of development fees to an entity providing a $250,000 investment at the present time.

A financial analysis of the project concludes that if the $250,000 in tasks are successfully completed, the Jones Company can reasonably expect to earn a development fee of $2 million for the project and retain a carried interest of $3 million. Jones has spent $1 million of its own funds (and in-kind services) to reach this point but cannot afford additional expenditures.

The feasibility analysis of the project, prepared by Jones, noted the following facts and issues:

- The sugar mill has been successfully competing in this industry for over 20 years, has long established relationships with sugar growers and has above average performance in terms of quantity of sugar processed and profitability.
- The sugar industry has been surviving on thinner profit margins as demand for the product has slowed worldwide and the domestic market has been stagnant.
- The sugar mill completed a modernization five years ago and sees this project as another step in that process. Although it is willing to supply fuel (bagasse) to the project it is not willing to become involved in the construction and operation of a sophisticated power plant. An arrangement based on the sugar mill supplying the bagasse and receiving process steam and a royalty has been reached.
- Excess capacity and energy will be substantial and will be sold to the local electricity Distribution Company utility via a 3-year capacity purchase contract. The utility has a need for additional supplies and an expressed interest in using biomass such as bagasse rather than relying on imported fossil fuels.
- The local electricity utility has entered and honored similar capacity contracts. The utility has not sold any assets or issued any debt in the last three years.
- Energy will be sold into the Cordoba Wholesale Market. Energy sales are denominated in US dollars but paid in local currency equivalent.
- The proposed technology has been implemented in a dozen similar projects worldwide but only one such project has been implemented in this country.

Jones Engineering has negotiated an EPC (engineering, procurement, construction) contract with a well-established international firm, experienced in constructing three similar facilities but none in this country. The contract provides for a fixed price, “turn-key” project (delivered completed and fully operational to an operating company) with the EPC providing six months supervision and training for the operating company, which Jones Engineering is considering to organize and staff. As an alternative, Jones Engineering is considering requesting proposals from experienced operating companies.

The national development bank has tentatively offered a debt package to cover 60% of project cost (over a 12-year period at a commercially attractive local currency interest rate). One of the equipment suppliers has offered a package that would cover an additional 15% of project cost, but on a shorter term (five year) and expensive (16%) dollar/euro denominated basis. Returns on equity (15 years) are 18%, taking into account the carried interest and development fees of Jones Engineering. The facility will have a useful economic life of 25-30 years provided regular maintenance is well performed and capital replacements occur every 5 years. The financial analysis includes allowances for both these costs.

Revenues	Days	MW Sold						
	173.0	21	85946.4					
	96.0	45	103104	2	3	4	5	6
	59.0	45	63295.2	2004				
	328.0	MWh	252345.	252345.6	252345.6	252345.6	252345.6	252345.6
		Rev	844784.	903855.8	962473	1019096	1071734	1117845
		Rev/C$	3.34772	3.582	3.814	4.038	4.247	4.430
		Rev/$	0.06722					

	1	1 in $	2	3	4	5	6	7
	C$ 000	US$,000						
Energy Sales	844,785	16,964	903,856	962,473	1,019,096	1,071,734	1,117,845	1,154,217
O&M Costs	323,275	6,491	365,499	413,570	468,322	514,763	583,678	662,257
Payment to Host Mill	39,691	797	42,467	45,221	47,881	50,354	52,521	54,230
Net from Operations	*481,818*	*9,675*	*495,890*	*503,682*	*502,893*	*506,617*	*481,646*	*437,730*
Other Income	96,438	1,937	110,412	126,243	144,590	165,200	190,081	215,828
Gross Profit	*578,256*	*11,612*	*606,302*	*629,925*	*647,482*	*671,817*	*671,727*	*653,558*
Depreciation	95,613	1,920	95,613	95,613	95,613	95,613	95,613	95,613
Net/ebit	*482,643*	*9,692*	*510,689*	*534,312*	*551,869*	*576,204*	*576,113*	*557,945*
Interest	240,001	4,819	227,554	215,736	200,375	182,209	165,231	144,213
Net	*242,642*	*4,872*	*283,135*	*318,576*	*351,494*	*393,995*	*410,882*	*413,731*
Taxes (after 5 year holiday)	0	0	0	0	0	0	100,666	101,364
Net	*242,642*	*4,872*	*283,135*	*318,576*	*351,494*	*393,995*	*310,216*	*312,367*
Depreciation	95,613	1,920	95,613	95,613	95,613	95,613	95,613	95,613
Principal	107,831	2,165	131,337	155,144	173,194	164,602	192,551	225,465
Cash Flow	***230,423***	***4,627***	***247,411***	***259,045***	***273,912***	***325,007***	***213,278***	***182,516***

debt service coverage	1.66	1.66	1.69	1.70	1.73	1.94	1.88	1.77
ebit/$	9,692		9,458	9,127	8,695	8,374	7,722	6,898
C$ Rate	49.8		54.0	58.5	63.5	68.8	74.6	80.9
equity in and cash flow/$	**-10000**	**4,627**	**4,582**	**4,425**	**4,316**	**4,723**	**2,859**	**2,256**
		irr	-5.3%	17.4%	28.8%	35.5%	37.9%	39.2%
			2 year	*3 Year*	*4 Year*	*5 Year*	*6 Year*	*7 Year*

				$ & C$	$	C$
Capital Cost		Debt 1/C$	14%,10Years	25.1	0	25.1
EPC	35.0	Debt 2/$	12%,10 Years	10.7	10.7	0
M&E,finance consultant,legal, admin	1.2	Subdebt/$	18%,4 Years	2.0	2	0
Finance Fees	0.7	Equity		10.2	5.4	4.8
Development Fee	1.5			48.0	18.1	29.9
Contingency	3.0					
	41.4				Deprecia-tion	Formula Based

IDC	9.9%	4.1			$Cost	95613.2
Sunk Development Costs		2.5	$	C$	@80% X	
		48.0	18.1	29.9		

	$C =	Cordoba Dollars						

Group Exercise #3

Project - a $25 million RURAL ELECTRIFICATION project to serve 50,000 or more households.

Proposal Under Consideration – to spend $250,000 to scale up and test a comprehensive marketing scheme that would serve as Phase 1 of the $25 million project.

Please identify:

- Three to five of the strengths and weaknesses of this project.
- Major risks to be understood by an investor providing this "Phase 1" funding of $250,000.
- Conditions under which such a project might be packaged to be made attractive to a later stage investor or lender.\

- Legal and Regulatory Context

The Energy Law of 2000, which mandated the creation of a Wholesale Market for the production, distribution and sale of electricity, governs the energy sector in Cordoba. The key features of this law and its implementing regulations and bylaws are the following.

- Separation of energy generator from energy distribution companies. Common ownership is not permitted.
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- A National Energy Commission will oversee the operation of the Wholesale Market.
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- Generators using renewable sources of energy --- wind, hydro, biomass, solar --- will receive up to a 10% price dispatch preference. In other words if a renewable project bids (based on cost) $.040 per kWh it will be dispatched before a thermal plant with a bid of $.037 and be paid the rate of the most expensive unit of energy dispatched during that hour.
- Renewable energy projects will receive a 5-year income tax holiday and be exempt from import duties on equipment.

Rural electrification will be supported through a per household investment by the government, regardless of the mode of electricity service. In other words, the government will support an investment of $400 per household (subject to adjustment by the National Energy Commission). On-grid extensions will be the responsibility of the Distribution Company serving a particular area. Off-grid hook-ups will be on the basis of applications by energy service companies to provide services to a defined area (between 1000-5000 households). Upon approval of a 5-year off-grid service territory concession companies are responsible for direct marketing to households within the area. Companies are required to provide performance bonds or other security and will be paid the $400 hook-up fee upon installation and verification of the provision of service.

For the last four years Solelectric SA has been providing solar home systems (photovoltaics or PV) to villages in various locations throughout Rural District #1 (which is very large and contains 80,000 unelectrified homes).

Solelectric has been selling systems for cash and has developed a relationship with a micro-credit NGO so that it now has experience in selling systems on installment credit. Solelectric obtains these products from different suppliers (domestic and international) in the market and thereby has been able to keep its prices competitive. Solelectric's experience on both cash and credit transactions has been good. Solelectric's success has been aided by an approach that involves a partnership with local businesses so problems (involving maintenance, revenue collection, faulty components) are handled quickly.

Most recently Solelectric SA has installed systems in a village using a different approach. In this village Solelectric provides the system and support services and the households pay a monthly fee, just as you would to a local electricity distribution company, if one existed in Rural District #1. Thus far the experience has been satisfactory and Solelectric's local partner has been able to collect fees, provide service and, where payment has not been made, repossess and re-market the equipment.

The national government and the state-owned utility have been under intense pressure to electrify Rural District #1 but the cost of extending the electricity grid is prohibitive. What they have proposed instead is a two-phase project of decentralized electrification using solar panels.

In Phase 1 Solelectric would electrify 400 homes in three villages. Solelectric would offer a range of products, from small and inexpensive PV portable lanterns to large household PV systems. These products would be offered on the basis of (1) an all cash price, (2) a price including pre-arranged credit or (3) a fee-for-service price (in which case Solelectric continues to own the system). In addition, the government would contract with Solelectric to install public lighting and community electricity services (with TV-VCR combinations and small, WHO-quality vaccine refrigerators).

The government would pay Solelectric for its start-up costs in this Phase 1 and would provide a cash subsidy of $400 per household --- much less than the cost of grid extension -- to allow a substantial portion of the population to afford the products. Solelectric would be responsible for procuring, installing and servicing equipment.

In Phase 2 the government would offer a concession for all of Rural District #1 <u>on a competitive bid basis</u> but with substantial credit to any bidders who have direct experience in the region and experience with the comprehensive cash-credit-fee for service approach.

Solelectric's CEO is concerned about the following issues:

- Whether combining cash, credit and fee-for-service in the same market will confuse and disorganize the buyers.
- Whether the bidding process for Rural District #1 will be as described by the government (with credit for experience by Solelectric). If not, a better-financed or influential bidder might push Solelectric aside.
- Whether Solelectric will be able to establish channels of product supply and service in a way that will allow a smooth transition from the Phase 1 scale to a 50,000 household scale.

One idea under consideration is to form a partnership with a major international supplier of PV systems. The advantages are that Solelectric would not need to source most of the $250,000 for Phase 1 capital and it would be positioned with a strong partner to bid on Phase 2. The disadvantages are that an international supplier will demand great amounts of control to become involved in Phase 1, whereas if Solelectric completes Phase 1 without such a supplier partnership it will (1) significantly increase its value and its ability to maintain control and (2) eliminate the potential problem of being tied to a single supplier (which may or may not be competitive in the future).

As an alternative to taking an industry partner Solelectric is seeking a $250,000 financial investor to allow Solelectric to implement Phase 1 without being “tied” to one supplier.

The return on investment (Phase 1, all equity) is over 20% as a result of Solelectric receiving the start-up funding through the government contract. In Phase 2, which will be sufficiently robust to warrant in-country lending and leasing relationships, returns on equity exceed 35%.

SUMMARY

Phase 1 (in US$)

400 Household Pilot	0	1	2	3	4	5
Capital Out	**$ (200,000)**					
Set=up Costs	**$ (50,000)**					
Unit Cost (400 Households)	$ (625.00)					
Cas and Credit		*156250*				
Customers		$ 76,250				
Government (at $400 per household)		**$ 80,000**				
Fee for Service						
Customers		24000	24000	24000	24000	24000
$71,774.69	NPV	$ 71,775				
Government (At $400 per household)		**$ 80,000**				
CASH FLOW	**$-250,000**	**$308,025**				
IRR	**23%**					

Phase 2 Summary (in Local Currency)

Total Sales Revenue		**5,752,495**	**13,321,775**	**24,442,509**	**37,081,841**	**63,939,030**
Total Cost of Sales		**4,355,732**	**9,721,332**	**16,932,962**	**24,888,248**	**42,130,727**
Total Gross Margin		**1,396,763**	**3,600,442**	**7,509,547**	**12,193,593**	**21,808,303**
% of Sales		24%	27%	31%	33%	34%
Total Operating Cost		**6,146,526**	**5,452,303**	**6,564,839**	**7,706,990**	**8,986,241**
Net Income Before Taxes		**-4,749,763**	**-1,851,860**	**944,708**	**4,486,602**	**12,822,062**
Net Income After Taxes		-3,087,346	458,708	2,924,628	4,896,212	8,743,950
Revenues include Government Contribution						
Cashflow (nominal)		(4,533,643)	(127,205)	2,472,190	4,554,363	8,377,620
Net CF ADJUSTED DOWNWARD BY 30%		(4,533,643)	(89,044)	1,730,533	3,188,054	5,864,334
NPV @20%	1,055.787					
5 Year IRR (adjusted Cash flow)	40.8%					

Handbook for Financial and Development Professionals

Chapter 6

Sources of Technical Assistance and Finance

- UNEP Investment Advisory Facility
- AREED
- E&Co
- Renewable Energy and Energy Efficiency Fund
- EEAF
- Prototype Carbon Fund

- **UNEP RET/EE Investment Advisory Facility**

The *RET and EE Investment Advisory Facility* (IAF) is a pilot initiative launched in mid-1999 as the core element of the Global Environment Facility MSP 'Redirecting commercial investment decisions to cleaner technologies'. It provides targeted expertise to banks and financiers to help them evaluate proposals in the renewable energy or energy efficiency sectors.

To date the IAF has worked with the development banks IFC, IADB, ADB, FMO and DEG; with a European commercial bank; and with a few private investors (see summary table). The first two investments, whose evaluations were supported by the IAF, have now gone forward. One is a $36 million small hydro peaking plant in Guatemala, and the other is a $4 million biomass plantation in Tanzania. The IAF provided $25,000 in technical support for the first investment and $26,000 to the second, allowing both to overcome problems encountered in the due diligence process.

The banks are not used to coming to a UN institution for technical support, therefore much of the work in setting up the IAF has been building credibility with banking sector clients. This has included setting up of rapid administrative procedures which can operate within a bank's short proposal evaluation cycle. This effort has been successful, based on an October 2000 completed review of the facility.

The experience gained so far has been that the IAF can be an effective tool for helping banks over some of the hurdles they encounter in evaluating sustainable energy projects. The IAF, in its existing or some modified form, should become one element of the Sustainable Business Alternatives Network (SBAN) under development within the UNEP-GEF Strategic Partnership.

Bank / Financier	Investment Description	GHG Offsets 20 year cumul. (tons CO_2)	UNEP/GEF Contribution	Investment Size
Inter-American Investment Corporation (part of IADB)	20MW Small hydro peaking plant in Guatemala.	561,000	$25,000	$36,700,000
Dutch and German Dev. Banks (FMO, DEG)	Sustainable forestry plantation in Tanzania	n.a.	$26,000	$1,200,000
European commercial bank	Biomass coffee waste utilisation in Central America	508,000	$34,000	$1,000,000
European commercial bank	District heating co-generation plant in Eastern Europe	n.a.	$38,000	$1,000,000
RES Ltd.	20MW Wind farm in Jamaica	1,107,000	$38,115	$28,000,000
International Finance Corporation, Pacific Hydro	5 MW Geothermal power plant on Vanuatu	324,000	$37,000	$14,700,000
			$198,115	**$93,600,000**

2. Background

Many RET and EE technologies are no longer considered experimental; they have proven to work well in commercial settings throughout the world. However, even though such RET and EE investments are 'bankable', these technologies have not found wide-spread acceptance in the financial community.

Financiers undertake a well defined appraisal process for loan and investment proposals which consists of defining a risk/return profile that considers both the various project and sponsor risks involved, and the financial returns expected. When a proposal involves a new technology or business activity, the risk assessment needed is more rigorous and the information scarce. The up-front *transaction costs* of evaluating such proposals are greater than for more conventional investments.

In the sustainable energy sector, the cautious attitude of financial institutions combined with their difficulty in correctly assessing the risks often lead to decisions against extending financing for otherwise sound projects. In the end, projects that might really be good investments and yield a global environmental benefit fail to go forward.

These up-front issues (or barriers) are the key targets of the *RET/EE Investment Advisory Facility*. If a financier is willing to invest his/her time and resources in considering a RET or EE project for investment, the IAF is able to *buy down* some of their incremental transaction costs. For example, preparing a financial risk analysis for an energy crop is more complex than for a more conventional business activity, such as thermal power generation, thus the additional incremental[1] effort can be IAF supported.

By supporting such efforts the IAF helps investment officers prepare financing proposals for consideration by their internal investment committees (Figure 1 shows a typical investment evaluation process). To secure approvals, besides being financially viable, sustainable energy investments must be as well

[1] Incremental costs are those that are over and above the baseline, which for the IAF are those costs normally involved in evaluating the least cost technology option.

documented as the conventional (and better understood) power sector investments. This is challenging for any new type of investment, let alone RETs or EE which often have complicated risk/return profiles. After investing in 10 coal fired power plants, it is far easier to invest in an 11th than to consider a wind farm investment instead. The IAF aims to level this information planning field.

- **AREED (African Rural Energy Enterprise Development) Program**

AREED provides early-stage funding and enterprise development services to **entrepreneurs** interested in building successful businesses that will supply clean energy technologies and services to rural African customers. Development services include training, hands-on business development services as well as early-stage investment and assistance securing financing.

AREED builds capacity in **African NGOs** to introduce and work with clean energy enterprises. This is accomplished through workshops and resource tools, focused on business planning, management structuring, and financial planning for the rural energy sector. Training for NGOs will help them identify potential rural energy projects and develop their ability to guide entrepreneurs on starting projects, as well as preparing NGOs to provide follow-up business support services to entrepreneurs both in partnership with AREED and, eventually, on their own.

AREED will also work with **financial institutions** to assess the sector and integrate it into their portfolios. This will be accomplished through workshops and specific hands-on tools focusing on rural energy markets and RET enterprises, appropriate project finance models, financial analysis and risk management issues. Opportunities for co-financing will be explored.

For more information, please contact AREED at areed@energyhouse.com or consult our web site at www.areed.org.

- **E&Co**

E&Co was created in 1994 as an independent non-profit organization to provide enterprise development services and modest loans or equity investments ($25,000 to $250,000) to promote economically, socially and environmentally sustainable energy enterprises in developing countries. These services and catalytic funds enable entrepreneurs to take their early stage ideas and experiences and prepare them for later stage investors, implementation and growth. E&Co's strategy is to demonstrate to public and private sector investors that the establishment of sound, indigenous energy enterprises represents a win-win solution to the twin problems of the unmet demand for energy services in developing countries and climate change. By establishing a credible portfolio of such projects, E&Co's goal is to influence the transfer of capital flows from investment in fossil fuel technologies to renewable and efficient sources of energy production and use.

E&Co's work strengthens in-country human capacity, nurtures local enterprises and accelerates project implementation by providing concrete support through the pre-investment stage. This phase of E&Co involvement provides a critical link between enterprise development and project finance.

E&Co's goal is to have a direct influence on the implementation of clean, economically sound energy projects that reach rural as well as urban populations in developing countries. E&Co will consider providing energy enterprises with support *if* the following conditions are met:

- ***New Money for New Energy***

E&Co's objective is to influence the transfer of capital from fossil fuel based energy production to renewable energy and energy efficiency enterprises. First by demonstrating the commercial viability of the enterprise and then building a pipeline of projects for future investments by others. Will the project/energy enterprise utilize renewable energy or energy efficiency technologies in a commercial fashion and attract new sources of investment?

- ***Social and Environmental Elements***

Does the energy enterprise or project improve the quality of life through the provision of energy services? For example, will it target under-served communities to create employment opportunities? Will the project improve or protect the local, national, and global environment? Will it displace harmful energy sources such as diesel, kerosene, candles or firewood?

- ***Technology***

Does the energy enterprise utilize an *appropriate technology* when compared on the basis of cost, affordability and environmental impact?

- ***Businesslike***

Does the energy enterprise/project have the technical and managerial experience required to ensure that the venture is profitable and sustainable? Has the project/energy enterprise secured collaboration with applicable third parties such as equipment suppliers, engineers, site owners, etc.? Does a second stage of the project or potential for replicability exist?

- ***Reasonable Risk***

Has the project/energy enterprise considered the market in which it will operate? Has a clear assessment been completed on the national risks – inflation, devaluation, taxation, and political uncertainity – as well as at the project level – competition, energy purchase/sale agreements, environmental and land regulations, and permitting. Are the risks reasonable and consistent with the charitable purpose of E&Co?

- ***"But For"***

Is the intervention by an entity such as E&Co necessary to advance the enterprise? "But for" the participation of E&Co, would the project succeed?

- ***Policy Framework***

Does the energy enterprise/project influence policy makers and decision makers to support renewable energy and energy efficiency initiatives?

- ***Human Capability***

Does the energy enterprise/project improve national or local capacity to promote renewable energy and energy efficiency initiatives?

For more information visit E&Co's website at www.energyhouse.com.

- **Renewable Energy and Energy Efficiency Fund**

The Renewable Energy and Energy Efficiency Fund for Emerging Markets, Ltd. (REEF) is a private equity investment fund with an initial capitalization of $65 million. REEF, launched in February 2000, is the first global fund organized to tap the sizable opportunities to invest in emerging markets renewable energy and efficiency. REEF actively seeks to make minority equity and quasi-equity investments in profitable, commercially viable private companies and projects in sectors that include: electricity generation primarily fueled by renewable energy sources, energy efficiency and conservation, and renewable energy/efficiency product manufacturing and financing. These projects can be on or off-grid.

INVESTMENT CRITERIA

Sectors:

- Low-impact Hydro
- Solar/PV
- Geothermal
- Wind
- Biomass
- Energy Conservation and Efficiency

Geographic Focus: Emerging market countries eligible for IFC financing. This includes all of Africa; all but two countries in South and Central America; Mexico; most of the Caribbean; all but two countries in Asia; the former Soviet Union and Eastern Europe.

Investment size: The REEF will consider investment in projects with total capitalization requirements of between $1,000,000 and $100,000,000.

Instruments*:* REEF's investments may take a variety of forms including common and preferred stock, partnership and limited liability company interests, and convertible or subordinated debt with equity warrants/options. REEF may also make loans to projects or project sponsors on a bridge or permanent basis. Equity transactions are typically structured so that the entrepreneur retains the majority of shares and/or management of the company.

Contact Information

To be considered for an investment, submit a brief introductory letter describing your firm, the investment proposal and the anticipated financial plan to the REEF management team. For projects of interest, business plans and other materials will be requested at a later stage.

Projects over 7MW	*Commercial projects < 7MW*	*Off-grid projects and Developmental projects < 7MW*
EIF Group	Environmental Enterprises Assistance Fund	Energy House Capital Corp.
727 15th St., NW – 11th floor	1655 N. Fort Myer Drive, Suite 520	383 Franklin Street
Washington, DC 20005	Arlington, VA 22209, USA	Bloomfield, NJ USA 07003
Tel: (202) 783-4419 Fax: (202) 371-5116 e-mail: klocklin@eifgroup.com	Tel: (703) 522-5928 Fax: (703) 522-6450 e-mail: brooks@eeaf.org	Tel: (973) 680-9100 Fax: (973) 680-8066 e-mail: capital@energyhouse.com

- **Environmental Enterprises Assistance Fund**

Environmental Enterprises Assistance Fund is a non-profit organization that operates as a venture capital fund, providing long-term risk capital to environmental businesses in developing countries. EEAF has made over 20 direct investments and manages for-profit funds for Latin America. Through the mobilization and distribution of capital, EEAF has become a leading implementor of sustainable development.

EEAF invests in businesses engaged in agriculture, forestry, aquaculture, tourism, renewable energy, energy efficiency, pollution abatement and recycling. The financing offered by EEAF *is* $100,000 to $2 million in either debt, equity or a combination. EEAF will syndicate for investments in excess of these amounts.

EEAF is active in Latin America, Indonesia and the Philippines. For more information, visit EEAF's website at www.eeaf.org.

- **Prototype Carbon Fund (PCF)**

The PCF is a $145 million fund supported by 6 governments and 17 private sector firms. Its main objective is to create a market for carbon offsets within the framework of the Kyoto Protocol. It has completed an agreement with the government of Latvia and has 20 other projects presently under consideration. It presently has a request for proposals pending on the purchase of emission reductions from Central America, with a particular focus on projects in the 100-1000 kW range, involving purchases in the $1-$3 million range. The PCF seeks projects that can produce emission reductions at a *cost* of $10 per ton of carbon (~$3 per ton of CO_2) and appears to be motivated to purchase emission reductions at a price of $20 per ton of carbon (~$5 per ton of CO_2)

See www.prototypecarbonfund.org

Recognizing that global warming will have the greatest impact on its borrowing client countries, on July 20th, 1999 the Executive Directors of the World Bank approved the establishment of the Prototype Carbon Fund (PCF). The PCF, with the operational objective of mitigating climate change, aspires to promote the Bank's tenet of sustainable development, to demonstrate the possibilities of public-private partnerships, and to offer a "learning-by-doing" opportunity to its stakeholders.

Objectives: What Will The PCF Produce?

1. **High-Quality Emission Reductions**
   The PCF funds projects that produce high quality greenhouse gas emission reductions which could be registered with the United Nations Framework Convention on Climate Change (UNFCCC) for the purposes of the Kyoto Protocol. To increase the likelihood that the reductions will be recognized by the Parties to the UNFCCC, independent experts will provide baseline validation and verification/certification procedures for emissions reductions that respond to UNFCCC rules as they develop.
2. **Knowledge**
   By transacting the business of reducing greenhouse gas emissions, the PCF is developing a knowledge base of business processes and practice to facilitate climate-friendly investment and inform the ongoing UNFCCC negotiations. PCF is pioneering approaches to achieving environmentally credible emissions reductions beginning with defining baselines for more climate-friendly activities to verification, certification, and transfer of emissions reductions achieved. The analyses, independent opinions, and contracts which underpin this process will be made public, along with lessons learned.
3. **Public-Private Partnership** Finally, PCF resources are provided by both the public and private sectors. The PCF demonstrates how insights and experience from both sectors can be pooled to mobilize additional resources for sustainable development and address global environmental concerns. The active participation of both sectors ensures that the PCF operates efficiently and in accordance with the Kyoto Protocol while serving the interests of World Bank client countries.

Operations: How Will The PCF Work?

Companies and Governments have contributed to the PCF which will use Fund resources to support projects designed to produce emission reductions fully consistent with the Kyoto Protocol and the emerging framework for Joint Implementation (JI) and the Clean Development Mechanism (CDM). Contributors, or "Participants," in the PCF will receive a pro rata share of the emission reductions, verified and certified in accordance with carbon purchase agreements reached with the respective countries "hosting" the projects.

A Consultative Process

From its inception, the PCF has strived to engage constructively all interested parties in its development and operations. In this regard, strategic guidance will be sought, through the life of the PCF, from representatives of host countries, participating entities, and NGOs, while being sensitive to the UNFCCC process.

Operational Processes

The PCF Team developed an **Operations Handbook** for PCF project managers and others interested in learning from the PCF's experience in producing emisions reductions consistent with the Kyoto Protocol. This handbook is available in the "Projects" and the "Document Library" sections of the PCF website.

Project Pipeline: What Kind of Projects Will The PCF Fund?

The PCF is endeavoring to achieve a balanced portfolio both geographically and technologically. Approximately half of the investments will be made in Economies-in-Transition demonstrating JI, and half will be made in developing countries facilitating the CDM. The major emphasis will be placed on renewable energy and energy efficiency projects, which havea great potential for replication and for reducing climate change at a reasonable cost. Normally, the PCF will purchase emission reductions from projects directly, and not through intermediaries. However, PCF will also work through established intermediaries, such as local or regional energy investment funds, energy service companies, commercial banks, and others to aggregate smaller projects efficiently and build capacity for smaller economies to supply high quality, attractively priced emission reductions.

Participants: Who Contributes to the Prototype Carbon Fund?

To demonstrate convincingly to developing country governments that there is significant private sector interest in the emerging market for emission reductions under JI and the CDM, contributors to the PCF include both companies and governments ("PCF Participants") . Participation by private companies is essential to this effort, since private sector investment must dominate trade under the Kyoto Mechanisms in order reach the scale necessary to address climate change effectively. Governments are involved to assure companies that the PCF will operate within the regulatory framework being developed by the Parties to the UNFCCC, and to guide and learn from the PCF's experience in supporting sustainable development.

Handbook for Financial and Development Professionals

Chapter 7

Introduction to Finance for Non-financial Professionals

Basic Concepts of Financial Analysis
- Interest and Interest Rates
- Types of Loans
- Net Present Value
- Internal Rate of Return
- Debt Service Coverage

Interest and Interest Rates

Interest is the cost or value of money. An interest rate is the amount, usually stated as a percentage, demanded by a lender or an investor to make an amount of money available to a borrower.

- $1,000 borrowed for 1 year at 12% interest requires the repayment of $1,120, of which $1,000 is the principal (abbreviated capital or lower case P) and $120 is interest (I or i). Together they are called Principal and Interest (abbreviated P & I or p + i).

- $1,000 borrowed for 1 year at <u>1% per month, compounded</u> (meaning paying interest on interest as well as principal) requires a payment of $1,127 at the end of the year. P= $1,000; I = $127.

- $1,000 borrowed for <u>2 years at 12% per year, compounded</u>, requires a payment of $1,254 at the end of 2 years.

Interest is always compounded unless clearly specified to be Simple Interest (which means interest on principal only with no interest charged on interest).

An interest calculation based on borrowing $1,000 for 5 years at 12% interest per year follows:

Year 0 [1]*	$1000.00
Add: 12% for Year 1	120.00
End of Year 1	$1,120.00
Add 12% for Year 2	134.40
EOY[2] 2	$1,254.40
Add 12% for Year 3	150.53

[1] * Year 0 is the point in time when a loan is made.

[2] EOY = end of year

EOY 3	$1,404.93
Add 12% for Year 4	168.59
EOY 4	$1,573.52
Add 12% for Year 5	188.82
EOY 5	$1,762.34

P = $1,000.00
I = $ 762.00

On a calculator:
PV = 1000;
I (i)= 12%
N (n) = 5
Solve for FV (future value)

On Excel or other spreadsheets:
Open *f** (function)
Choose Financial Functions
Choose FV
Rate = 12%
Nper = 5 (number of periods)
PMT = 0
PV = 1000
"OK"

Three Types of Loan Calculations (based on $1,000 at 12% for 5 years)

- Interest Only
- Equal Payment *(on Excel, choose Financial functions, PMT)*
- Equal Principal Payment *(principal amounts are the same, interest amount declines over time)*

Year→	1	2	3	4	5	Total
Interest Only	$ 120.00	$ 120.00	$ 120.00	$ 120.00	$1,120.00	$ 1,600
Equal Payment	$ 277.41	$ 277.41	$ 277.41	$ 277.41	$ 277.41	$ 1,387
Equal Principal	$ 320.00	$ 296.00	$ 272.00	$ 248.00	$ 224.00	$ 1,360

Net Present Value

An interest rate looks forward in time. It represents what someone expects to earn in the future.

A discount rate serves the same function, except that it works backwards in time, taking a future cash flow and giving it a value today.

Present Value (called Net Present Value or NPV) of three different future cash flows today (year 0), discounted at 12% follow.

0	1	2	3	4	5	Total
$1,000	$ 120.00	$ 120.00	$ 120.00	$ 120.00	$1,120.00	$ 1,600
$1,000	$ 277.41	$ 277.41	$ 277.41	$ 277.41	$ 277.41	$ 1,387
$1,000	$ 320.00	$ 296.00	$ 272.00	$ 248.00	$ 224.00	$ 1,360

On a Calculator:

I = 12%, enter PMTS in order, solve for PV

On Excel:

for each line, enter each value for year 1, 2, 3, 4, 5…*f**…financial…NPV…rate = 12%…values as entered…"OK"

Excel Spreadsheet:

12% Discount Rate

1	2	3	4	5	Total	NPV
120.00	120.00	120.00	120.00	1120.00	1600.00	1000.00
277.41	277.41	277.41	277.41	277.41	1387.05	1000.00
320.00	296.00	272.00	248.00	224.00	1360.00	1000.00

This small exercise demonstrates that from a mathematics perspective all three payment plans are the same. However, they are not the same when factors other than mathematics are considered.

For example, perhaps the lender expects inflation to occur. The first payment plan (interest only) "back end loads" the stream of revenue. During inflation periods money value declines; thus money earlier is better than money later. The opposite would be true for the borrower.

Another example might involve the needs of the lender to have cash available at certain points in the future (say Year 3) because of another opportunity or an obligation. Payment Plan #1 (Interest only) gets the lender only $360 in the first three years, while the other plans get the lender $832 and $888. While the mathematics are the same from an NPV perspective the cash flow is not if the lender needs $800 in 3 years.

Looked at from the borrower's perspective it is important that payment plans match ability to pay, on the one hand, and ability to borrow in the future, on the other. Thus, the back-end loaded payment plan might appear attractive (by pushing off large payment obligations); however, it will inhibit the borrower from making a second (perhaps larger and more important) loan more than would the other payment plans.

While an NPV calculation can demonstrate that these three payment plans are mathematically the same the reality is that from an entrepreneur's perspective "all loan payments are not created equal" even if the NPV is the same.

The real purpose of NPV analysis is to compare the present value of future investment opportunities. Theoretically, the present value of a future stream of cash (outgoing and incoming) must be positive to justify an investment. In other words, if a project is worth more than it costs its NPV will be positive. Three examples follow of similar cash flows, all adding to the same total cash flow over 5 years. A net present value analysis – also called discounted cash flow analysis – allows the entrepreneur to compare among these three choices.

Year	0	1	2	3	4	5	Year 0-5 Total	NPV at 12%
Case A	$ (1,000)	$ 300	$ 240	$ 240	$ 270	$ 350	$ 400	$0.18
Case B	$ (1,000)	$ 350	$ 280	$ 350	$ 280	$ 140	$ 400	$37.70
Case C	$ (1,000)	$ 350	$ 350	$ 300	$ 200	$ 200	$ 400	$40.75

Note: outgoing cash (in Year zero) is always shown as a negative, as it would in a checkbook.

Looking at these three choices, only two have a positive NPV at a 12% discount rate (the third is actually slightly positive, a $0.18). Observe what happens if the discount rate changes.

First, if it is <u>lowered from 12% to 8%:</u>

0	1	2	3	4	5	Year 0-5 Total	NPV at 8%
$(1,000)	$ 300	$ 240	$ 240	$ 270	$ 350	$ 400	$102.52
$(1,000)	$ 350	$ 280	$ 350	$ 280	$ 140	$ 400	$132.46
$(1,000)	$ 350	$ 350	$ 300	$ 200	$ 200	$ 400	$134.64

All of the choices have positive net present values.

Observe what happens, however, when our discount rate – the interest rate we need to recover in order to be profitable – rises to 16%:

0	1	2	3	4	5	Year 0-5 Total	NPV at 16%
$ (1,000)	$ 300	$ 240	$ 240	$ 270	$ 350	$ 400	($80.61)
$ (1,000)	$ 350	$ 280	$ 350	$ 280	$ 140	$ 400	($38.50)
$ (1,000)	$ 350	$ 350	$ 300	$ 200	$ 200	$ 400	($34.73)

In this case all of the choices fail the test of having a positive net present value.

What does this short exercise demonstrate?

It demonstrates that in financial analysis, in general, and in net present value analysis in particular, the choice of discount rate is crucial.

What are the factors to be considered in selecting a discount rate to apply to a project? Though oversimplified, the following information needs to be estimated.

- For the project being evaluated what portion of the project will be financed with loans? Even the best of projects rarely finance more than 70% of the cost with debt. 50%-60% is more likely.
- What will the expected interest rate be on this loan? This can usually be determined by taking the current rate offered to good credit projects and companies and adding a few percentage points (2-6) for the additional risk of this project. Or, similar projects can be researched and an interest rate inferred. An interest rate typically includes the following components:
  - Base cost of money
  - Allowance for inflation
  - Allowance for profit
  - Allowance for cost to administer the loan
  - Factor for the risk of the project.
- Expected return requirements of investors providing equity.

These three pieces of information can help determine a discount rate.
- Assume debt from lenders will be 60% of the financing.
- Conversely, equity will be 40%.
- If loans for excellent projects are being made at 7% per year in dollar terms and this project is moderately more risky than other projects (because those projects may have more creditworthy sponsors or contracts) then add 3% for additional risk.
- If investors demand 18% to provide equity (a reasonable estimate in a market where debt would cost 10-12%), then a discount rate can be estimated:
  - 60% * 10% = 6.0%
  - 40% * 18% = 7.2%
  - Combined = 13.2%

Applying this result to our previous three choices provides us with the following result.

0	1	2	3	4	5	Year 0-5 Total	NPV at 13%
$ (1,000)	$ 300	$ 240	$ 240	$ 270	$ 350	$ 400	($26.07)
$ (1,000)	$ 350	$ 280	$ 350	$ 280	$ 140	$ 400	$13.09
$ (1,000)	$ 350	$ 350	$ 300	$ 200	$ 200	$ 400	$16.37

Two of the proposals produce a positive net present value.

Must you calculate a discount rate to analyze a project or set of project alternatives? The answer is no. A companion technique – internal rate of return – allows for project analysis or the comparison of project alternatives without having a specific discount rate.

Internal Rate of Return

An internal rate of return calculation allows you to determine the interest rate that a project will earn on the original amount of capital invested. In other words it provides the discount rate that a project produces rather than applying a discount rate determined from outside the project. Unfortunately, internal rate of return – IRR – requires a calculator or a computer, whereas NPV can be prepared, if needed, with a pencil and either a formula or an interest and discount rate table.

Calculator:
- Enter Cfo (first year cash flow, which must be negative)
- Enter Cf1, Cf2 etc
- Solve for IRR

Excel:
- Enter cash flows in cells
- Open *f**
- Choose Financial
- Choose IRR
- "OK"
- Highlight values from Year 0 to Year 5
- "OK"

Year	0	1	2	3	4	5	Year 0-5 Total
Case A	$ (1,000)	$ 300	$ 240	$ 240	$ 270	$ 350	$ 400
Case B	$ (1,000)	$ 350	$ 280	$ 350	$ 280	$ 140	$ 400
Case C	$ (1,000)	$ 350	$ 350	$ 300	$ 200	$ 200	$ 400

IRR for A	12.0%
IRR for B	13.9%
IRR for C	14.1%

Debt Service Coverage

Debt Service is the amount a project pays (or proposes to pay) each year for principal and interest. An important measure of a project's ability to pay is its Debt Service Coverage; that is, the amount of debt service to be paid when compared with the funds available to pay that debt service.

If a project's income is $1,000,000 and its operating expenses are $475,000 it has $525,000 available to pay principal and interest on loans (debt service). If the project borrows $2,200,000 for 12 years at 12% interest with equal payments every year, its obligation is $355,000. When compared to the $525,000 available for debt service the project has what is called a 1.5 times debt service coverage or debt service coverage ratio or DSCR (arrived at by dividing $525,000 by $355,000).

Rarely do projects have such uniform debt service coverage calculations. For this reason analysts look at what is called Average Debt Service Coverage (the sum of all the year's available amounts divided by the sum of all the debt service payments) and examine the coverage ratios of each year. Usually, analysts will then focus on the lowest debt service coverage years as well as the average.

Year	1	2	3	4	5	6
Income	$1,000	$1,000	$1,000	$1,000	$1,000	$1,100
Operating	475	475	475	475	575	475
Avail for D/S	$525	$525	$525	$525	$425	$625
Debt Service	$355	$355	$355	$355	$355	$355
DSCR	1.5	1.5	1.5	1.5	1.2	1.8

Year	7	8	9	10	11	12	Total
Income	$1,100	$1,100	$1,100	$1,100	$1,100	$1,100	$6,100
Operating	475	475	475	575	475	475	$2,950
Avail for D/S	$625	$625	$625	$525	$625	$625	$3,150
Debt Service	$355	$355	$355	$355	$355	$355	$2,131
DSCR	1.8	1.8	1.8	1.5	1.8	1.8	1.5

Why are debt service coverage ratios important and how are they used? DSCRs are important because they tell a lender what excess exists in the event revenues or expenses are less or greater than estimated. Most lenders have a specific coverage "test" that must be met for both average and lowest year debt service coverage. If a project cannot meet these tests then a number of options exist, including:

- Lowering the amount to be borrowed (thereby increasing the amount of equity that needs to be put in a project).
- Setting up reserves or credit agreements to pay the shortfall amount in the specific year (for example, setting aside $100,000 for this purpose to cover the shortfall in year 5 in the above example).

Essentially Debt Service Coverage calculations determine how much debt a project can afford. Combined with IRR, these two tools assist the entrepreneur to determine what is practical to propose to lenders and investors.

Handbook for Financial and Development Professionals

Chapter 8

Social and Environmental Dimensions of Developing Country Energy Production and Use

This chapter explores:

- Why Energy Matters
- The Connection between Energy and Poverty, Health and Equity
- The Connection between Energy and Environment
- The Connection between Energy and Population
- Towards a Solution – the role of NGOs and other intermediaries

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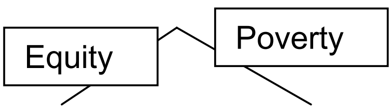
Why Energy Matters

If this woman spends four hours every day hauling water her chances of escaping poverty are very low.

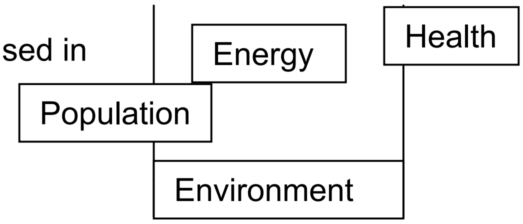
If this boy collects firewood instead of attending school his child will probably do the same thing.

Why energy matters I: the face



of energy is that of a woman or child.

How energy is produced and used in developing countries has enormous impact on poverty, health, environment population and equity.



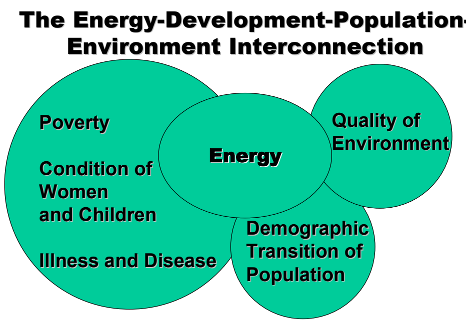
Why energy matters II: conventional approaches to energy production and use – central station fossil fuel facilities and electricity grids – have severe limitations. Fossil-fueled energy production is a leading cause of local and global pollution, including climate changing greenhouse gas build-up.

Electricity grid extensions are prohibitively expensive in many rural energy applications. For lesser sums energy can be provided that is as efficient and clean.

Why energy matters III: economic and social development require increases in energy. The history of humanity is essentially the history of the ever more productive application of energy resources. Without energy increases economic and social development is not possible.

Why energy matters IV: people are already spending large sums for inefficient energy carriers (dry cell batteries, kerosene). This expenditure represents a substantial business opportunity. Small and medium sized entrepreneurs are already capitalizing on this opportunity.

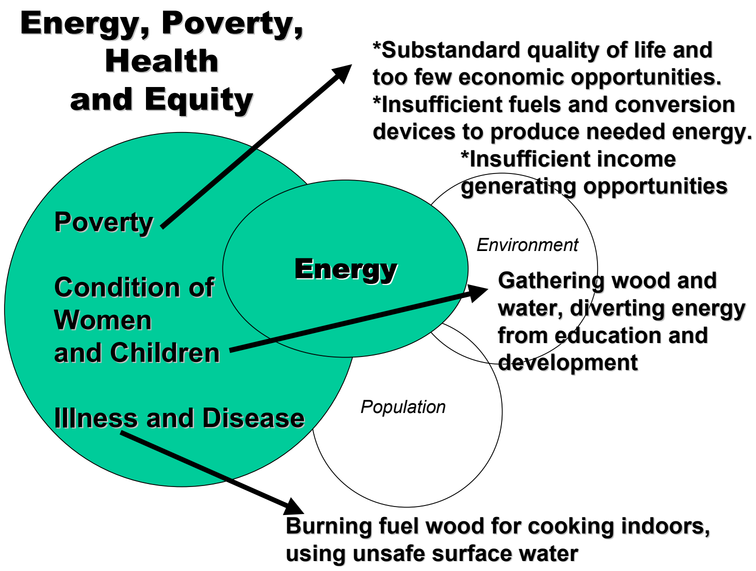
The activities of these entrepreneurs can have enormous impacts in three of the most pressing issues facing the world:
1. Poverty alleviation, health and the status of women and children.
2. Environmental quality and sustainability.
3. Demographic transition to more sustainable population growth.



Poverty alleviation, health and the status of women and children.

If a woman or child spends extraordinary amounts of time gathering fuel wood and water then the opportunity for that woman or child to engage in income generation, education or other quality of life activities is severely limited. Energy improvements attack this problem from two sides: labor saving, which creates the opportunity for income generation; and, energy inputs with which to generate income.

Issues



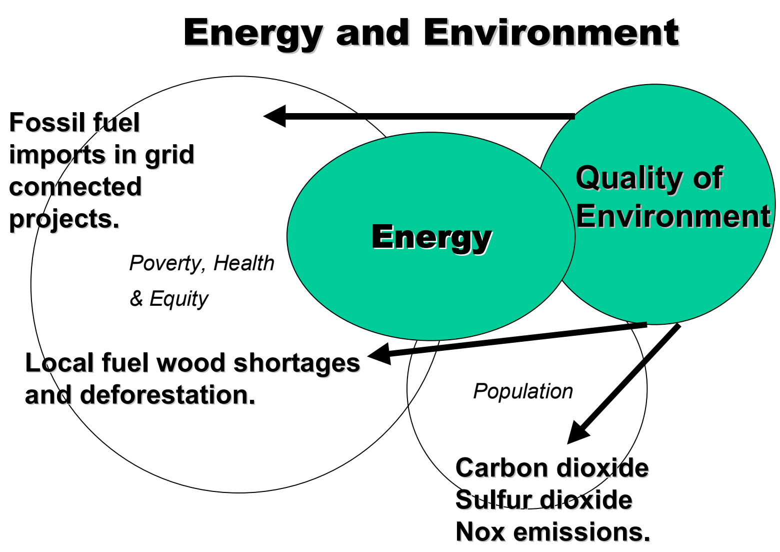
Solutions

- Small and medium sized enterprises -- private sector, NGO or community based – using local resources (e.g. biomass, running water, wind and sunlight) as fuel.
- Decentralized and efficient energy conversion devices, including improved cook stoves.
- Water pumping or filtration systems.
- Productive use and income generation "kits" combined with training.
- Community lighting and power points for education.
- Local enterprises installing and servicing.

An income generating "kit" consists of an energy supply system combined with the equipment needed to produce a product (building blocks, fencing, bread) or provide a service (sewing, chilling, hair cutting)

Environmental quality and sustainability.

Whether the issue is fossil fuel use in large energy projects or fuel wood, coal or charcoal being burned in households the environmental consequences are severe. These mostly pertain to air pollution and climate changing greenhouse gases, although there are consequences to local soil and wood conditions also.



Solutions

- Energy production using water, wind, sunlight and biomass.
- Policies encouraging clean energy resources and eliminating subsidies for polluting technologies and fuels.
- Policies supporting independent energy production and capital market interest in renewable energy projects..
- Energy entrepreneurs developing clean energy resources and establishing commercially viable businesses.

Energy, Health, Income

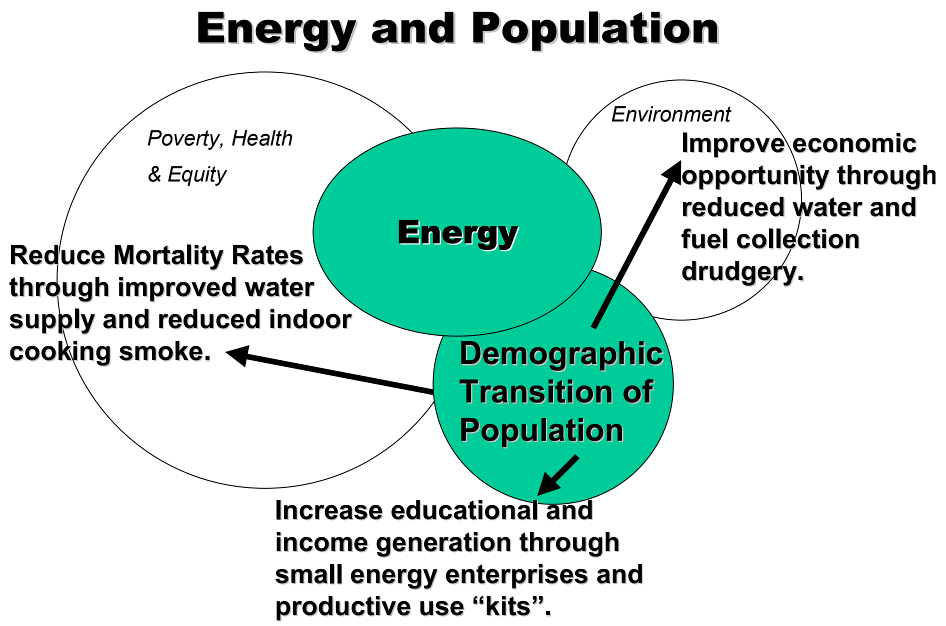
Country and Income *(purchasing power)*	*Energy* *Kg of oil equivalent*	*Under 5 Mortality Rate (per 1000)*	*Population w/ Safe Water*
Ghana **$1,581**	313	107	52%
Bolivia **$2,881**	766	96	32%
Vietnam **$1,641**	570	43	42%
Netherlands **$21,104**	4182	6	100%

Demographic transition to more sustainable population growth.

Issues

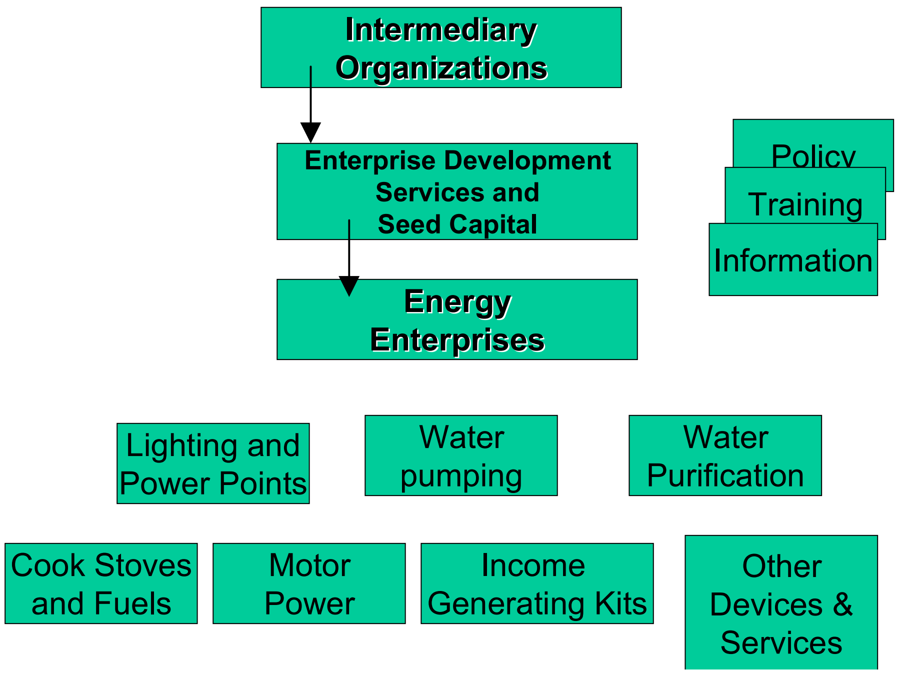
- Higher "under 5" mortality rates, significantly caused by unsafe water and indoor smoke from cooking with wood and coal.
- High demand for women and child labor in water and fuel wood tasks, eliminating opportunity for education and income production.
- Lack of energy, energy conversion devices and productive use equipment.

Some of the Solutions



TOWARD A SOLUTION – Role for NGOs and Other Intermediaries

- NGOs can support, with enterprise development services and seed capital, energy entrepreneurs developing clean energy grid connected projects or rural energy delivery companies.
- International organizations and donors can support NGOs and other intermediary organizations supplying enterprise development services and seed capital to energy entrepreneurs.
- Enterprises should include within their rural energy delivery product lines: productive use kits; water pumping and purification; and, efficient cook stoves and fuels.



Handbook for Financial and Development Professionals
Chapter 9
Glossary

This section contains the following:

- Technical Terms
- Financial Terms
- Abbreviations
- Conversions

TECHNICAL TERMS

Absorber: The part of the solar collector that receives radiant energy and transforms it into heat energy.

Absorptive Coating: Covers the absorber plate and improves its ability to absorb energy without reflecting it away.

Active Solar System: A system that traps the sun's energy and utilizes a mechanical subsystem to move that energy to its point of intended use for water heating, space heating and possibly space cooling.

Alternating Current (AC): An electric current that reverses direction in a circuit at regular intervals. Electrical energy usually obtained from utility grids or generators.

Ampere (Amp): Measure of electric current.

Amp-Hours: Battery storage capacity. A 100 amp-hour battery will supply a 10-amp load for 10 hrs.

Array: A group of photovoltaic modules wired together to produce a specific amount of power. Array size can range from one to hundreds of modules, depending on how much power will be needed.

Bagasse: The fibrous material remaining after the extraction of juice from sugarcane; often burned by sugar mills as a source of energy.

Balance of System (BOS): Parts of a photovoltaic system other than the photovoltaic array, such as: connectors, sockets, wires, cables, power outlets and mounting hardware.

Batch: Black tank that serves as both collector and storage tank. Can be enclosed, with one side glazed.

Battery: An energy storage device.

Bioenergy: Energy derived from plant matter, or biomass. Green plants capture solar energy and store it as chemical energy in the form of cell walls in the plants' stalks, stems and leaves and as oils or starch in the seed, fruits or roots. Both plants and the waste materials derived from them (such as sawdust, wood wastes, and agricultural wastes) are referred to as biomass. Biomass can be used directly as a solid fuel to produce heat, or it can be converted to other bioenergy carriers such as liquid and gaseous fuels.

Borehole: Synonym for water well.

Btu (British thermal unit): A unit of heat. The quantity of heat required to raise the temperature of one pound of water by one degree Fahrenheit.

Carbon Dioxide (CO_2): The gas formed in the ordinary combustion of carbon, given out in the breathing of animals.

Casing: Plastic or steel tube that is permanently inserted in the well after drilling. Its size is specified according to its inside diameter.

Cell (photovoltaic): A semi-conductor device that converts light directly into DC electricity.

Centrifugal Pump: A pumping mechanism that spins water by means of an "impeller". Water is pushed out by centrifugal force. See also multi-stage. Centrifugal pumps have high flow rates with low suction.

Check Valve: A valve that allows water to flow one way but not the other. A foot valve is one example.

Chlorofluorocarbons: Compounds containing chlorine, fluorine, and carbon - they generally are used as propellants, refrigerants, blowing agents (for producing foam), and solvents. They are identified with numbered suffixes (e.g., CFC-11, CFC-12) which identify the ratio of these elements in each compound. They are known to deplete stratospheric ozone and also are "greenhouse" gases in that they effectively absorb certain types of radiation in the atmosphere.

Closed Loop System: System of which no part is vented to the atmosphere or fed with fresh liquid. The system liquid is re-circulated.

Cogeneration: The simultaneous generation of both electric power and heat. The heat, instead of being discharged without further use, is used in some fashion (e.g., in district heating system, steam, etc).

Collector Loop: The part of the solar system that has solar collectors. The collector loop may be piped and include other components.

Collector Tilt: The angle between the horizontal plane and the solar collector plane.

Concentrator: A photovoltaic module, which includes optical components, such as lenses, to direct and concentrate sunlight onto a solar cell of smaller areas. Most concentrator arrays must directly face or track the sun.

Controller/Regulator: A device to protect the batteries from being overcharged.

Dam: A structure for impeding and controlling the flow of water, which increases the water elevation to create the hydraulic head. The reservoir creates, in effect, stored energy.

Deforestation: The permanent clearing of forest land and its conversion to non-forest uses such as clearing land for agriculture, cutting down trees for lumber and gathering fuelwood. These activities are having devastating effects of acid rain, nuclear radiation and other pollutants.

Demand-side management: The planning, implementation and monitoring of utility activities designed to encourage customers to modify their pattern of electricity usage.

Diaphragm Pump: A type of pump in which water is drawn in and forced out of one or more chambers, by a flexible diaphragm. Check valves let water into and out of each chamber.

Differential Controller: Control, which measures the difference between the collector and the tank temperatures.

Diffuse Radiation: Solar radiation received after its direction has been changed by reflection and scattering in the atmosphere.

Diode: An electronic semiconductor device that allows current flow in only one direction. Also called a rectifier. The electrical equivalent of a check valve in water.

Direct Current (DC): A type of electricity transmission and distribution by which electricity flows in one direction through the conductor; usually relatively low voltage and high current.

Efficiency (of a solar cell or module): The ratio of electric energy produced to the amount of solar energy incident on the cell or module. Typical crystalline solar modules are about 10% efficient -- they convert about 10% of the light energy they receive into electricity.

Emissions: Flows of gases, liquid droplets, or solid particles into the atmosphere. Gross emissions from a specific source are the total quantity released. Net emissions are gross emissions *minus* flows back to the original source. Plants, for example, take carbon from the atmosphere and store it as biomass during photosynthesis, and they release it during respiration, when they decompose, or when they are burned.

Energy: The capacity for doing work.

Energy audit: A survey that shows how much energy is being used and shows ways to reduce energy usage.

Energy intensity: The amount of energy required per unit of a particular product or activity. Often used interchangeably with “energy per dollar of GNP.”

Flat-plat module or array: A photovoltaic module or array in which the incident solar radiation strikes a flat surface and no concentration of sunlight is involved.

Flat Plate Collector: Converts the sun's radiation into heat on a flat surface within a simple box. Does not use reflecting surfaces, lens arrangements to concentrate the sun's energy.

Foot Valve: A check valve placed in the water source below a surface pump. It prevents water from flowing back down the pipe and "losing prime". See check valve and priming.

Fossil fuel: Coal, petroleum or natural gas. Any fuel derived from them.

Friction Loss: The loss of pressure due to flow of water in pipe. This is determined by 3 factors: pipe size (inside diameter), flow rate, and length of pipe. It is determined by consulting a friction loss chart available in an engineering reference book or from a pipe supplier. It is expressed in PSI or Feet (equivalent additional feet of pumping).

Gasifiers: Tank for anaerobic fermentation of biomass residues from sugar cane, pulp and paper, etc., to produce biogas.

Generating capacity: The capacity of a power plant to generate electricity - typically expressed in watts-electric (e.g., kWe or Mwe).

Geothermal: Natural heat extracted from the earth’s crust using its vertical thermal gradient, most readily available where there is a discontinuity in the earth’s crust (e.g. where there is separation or erosion of tectonic plates).

Greenhouse effect: A popular term used to describe the heating effect due to the trapping of long wave radiation by greenhouse gases produced from natural and human sources.

Greenhouse gases: The gases such as water, vapor, carbon dioxide, methane and low level ozone that are transparent to solar radiation, but opaque to long wave radiation, and which contribute to the greenhouse effect.

Grid-connected: A photovoltaic system that is connected to a centralized electrical power network.

Gross domestic product (GDP): total value of goods and services produced by a country (residents and non-residents) per annum.

Gross national product (GNP): GDP + income residents receive from abroad for labor and investments, less similar payments made to non-residents who contributed to the domestic economy.

Head: A unit of pressure for a fluid, commonly used in water pumping and hydro power to express the height a pump must lift water or the distance water falls. Head losses are important for determining flow rates and pump sizes.

Headers: Main passages through which the heat transfer medium enters into or exits from the collector. Also called manifolds.

Heat Exchanger: A device that is used to transfer heat between fluids and gasses through an intervening metal surface.

Heat Transfer Medium: Air or liquid that is heated and used to transmit energy to its point of use.

Hybrid system: A power system consisting of two or more power generating subsystems (e.g., the combination of a wind turbine or diesel generator and a photovoltaic system).

Indirect System: A solar heating or cooling system in which the solar heat is collected outside the building and transferred inside using ducts or piping, and usually, fans or pumps.

Insolation: The amount of energy in sunlight reaching an area. Usually expressed in watts per square meter (W/m2), but also expressed on a daily basis as watts per square meter per day (W/m2/day).

Inverter: An appliance used to convert DC (battery) power into standard household (utility) AC electricity.

Jet Pump: A surface-mounted centrifugal pump that uses an "ejector" (venturi) device to augment its suction capacity. In a "deep well jet pump", the ejector is down in the well, to assist the pump in overcoming the limitations of suction. (Some water is diverted back down the well, causing an increase in energy use.)

Kilowatt (kW): 1000 watts

Kilowatt-hour (kWh): 1000 watt-hours. A typical residence in the United States consumes about 1000 kilowatt-hours each month at a price in the range of $.06 to .15 per kilowatt-hour.

Least-cost planning: In energy planning, the practice of basing investment decisions on the least costly option for providing *energy services.* It is distinguished from the more traditional approach which focuses on the least costly way to provide specific types of energy, with little or no consideration of less costly alternatives that provide the same energy service at lower costs.

Life cycle cost (LCC) analysis: A form of economic analysis to calculate the total expected costs of ownership over the life span of the system. LCC analysis allows a direct comparison of the costs of alternative energy systems, such as photovoltaics, fossil fuel generators, or extending utility power lines.

Load: The demand on an energy producing system. The energy consumption or requirement of a piece or group of equipment.

Maintenance costs: Any costs incurred in the upkeep of a system. These costs may include replacement and repair of components.

Maximum power point tracker: An electronic device that acts as a "transmission" between the PV panels and the pump. Provides the maximum power possible out of the solar array. While an **array** tracker that follows the sun provides higher efficiency and power in the summer, a MPPT provides the highest gains in winter and/or cold weather, due to the higher PV outputs at colder cell temperatures. Where maximum efficiency is needed, both may be used.

Megawatt: One thousand kilowatts, or 1 million watts. Standard measure of electric power plant generating capacity.

Megawatt hours: One thousand-kilowatt hours or 1 million-watt hours.

Methane: A compound consisting of one carbon atom and four hydrogen atoms; it occurs naturally, often in association with coal and petroleum (see Natural gas below) and as a byproduct of the metabolic activities of some microorganisms; it also can be synthesized artificially.

Module: A number of solar electric cells wired together to form a unit, usually in a sealed frame of convenient size for handling and assembling into arrays. Also called a "panel."

Montreal Protocol: The principal international agreement under which ozone-depleting compounds are regulated. Its formal name is the "Montreal Protocol on Substances that Deplete the Ozone Layer" and was adopted in September 1987.

Multi-Stage Centrifugal: A centrifugal pump with more than one impeller and chamber stacked in a sequence to produce higher pressure. Conventional AC deep well submersible pumps and higher power solar submersibles work this way.

Natural gas: A naturally occurring mixture of hydrocarbons (principally methane) and small quantities of other gases found in porous geological formations, often in association with petroleum.

OECD: Organization for Economic Cooperation and Development, an organization that includes most of the world's industrialized, market economies. Members include: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, and United States.

Off-peak: The period of low energy demand, as opposed to peak demand.

Open Loop System: Some part of the system is vented to the atmosphere, or the system contains fresh or changeable water.

Operating costs: The costs of using a system. For fuel-based systems these costs include all fuel costs over the system's lifetime.

Ozone: A molecule consisting of three oxygen atoms in the atmosphere, it is found in both the stratosphere and troposphere. Ozone effectively absorbs certain forms of solar ultraviolet radiation known to damage living organisms. It also absorbs certain wavelengths of infrared radiation and therefore is a "greenhouse" gas.

Panel: A device containing solar cells encapsulated under glass and installed in an aluminum frame. Typically rated at approximately 50 watts for 12-volt DC applications.

Passive Solar Heating: Solar heating of a building accomplished by architectural design without the aid of mechanical equipment.

Peak sun hours: The equivalent number of hours per day when solar insolation averages 1000 watts per square meter. For example, six peak sun hours means that the energy received during total daylight hours equals the energy that would have been received had the insolation for six hours been 1000 watts per square meter.

Peak Watts (Wp): The maximum power (in watts) a solar array will produce on a clear, sunny day while the array is in full sunlight and operating at 25 C. Actual wattage at higher temperatures is usually somewhat lower.

Photovoltaics (PV): The direct conversion of light into electricity. "Photo" means light and "voltaic" means electric. More commonly referred to as solar electricity.

Polycrystal Silicon Cells: Pure silicon is melted and cast into bricks, then sliced into thin wafers and coated with electrical contacts. Typically 36 cells are soldered together to produce a 12 volt DC solar module.

Positive Displacement Pump: Any mechanism that seals water in a chamber then forces it out by reducing the volume of the chamber. Examples: piston (including jack), diaphragm, rotary vane. Used for low volume and high lift. Contrast with "centrifugal". Synonyms: volumetric pump, force pump.

Power: The rate at which energy is consumed or generated. Power is measured in watts or horsepower.

Pressure: The amount of force applied by water that is either forced by a pump, or by the gravity. Measured in pounds per square inch (PSI). PSI = vertical lift (or drop) in Feet / 2.31, or .43 PSI per foot.

Pressure Switch: An electrical switch actuated by the pressure in a pressure tank. When the pressure drops to a low set point (cut-in) it turns a pump on. At a high point (cutout) it turns the pump off.

Pump Controller: An electronic device, which varies the voltage and current of a PV array to match the needs of an array-direct pump. It allows the pump to start and to run under low sun conditions without stalling. Electrical analogy: variable transformer. Mechanical analogy: automatic transmission. See Linear Current Booster and Maximum Power Point Tracker.

Pump Jack: A deep well piston pump. The piston and cylinder is submerged in the well water and actuated by a rod inside the drop pipe, powered by a motor at the surface. This is an old-fashioned system still used for extremely deep wells, including solar pumps as deep as 1000 feet. In solar powered systems, a DC motor replaces the windmill.

Pump Staging: A method of placing two or more pumps together to increase flow or overcome head losses. Series-staged pumps are placed in the same line and increase the head. Parallel-staged pumps are placed in two separate lines, feeding a common line and increase the flow rate.

Renewable energy: Flows of energy that are regenerative or virtually inexhaustible. Most commonly includes solar (electricity and thermal), biomass, geothermal, wind, tidal, wave, and hydropower sources.

Retrofit: To update an existing structure or technology by modifying it, as opposed to creating something entirely new from scratch. For example, an old house can be retrofitted with advanced windows to slow the flow of energy into or from the house.

Risers: Flow passages (pipes or channels) that distribute heat transfer fluid across the absorber panel in a collector.

Sealed Piston Pump: A type of pump in which water is drawn in and forced out of a chamber by a piston mechanism. The pistons have a very short stroke, allowing the use of flexible gaskets to seal water out of the piston mechanism. Check valves let water into and out of the chamber.

Sensor: Sensing device that changes its electrical resistance according to temperature. Used in the control system to generate input data on collector and storage tank temperatures.

Silicon: A non-metallic element that, when specially treated, is sensitive to light and capable of transforming light into electricity. Silicon is the basic material of beach sand, and is the raw material used to manufacture most photovoltaic cells.

Solar Collectors: A solar collector is a device designed to absorb incident solar radiation and to transfer the energy to a fluid passing through it.

Solar Radiation: The sun’s energy that comes to earth in the form of direct, diffuse and reflected rays.

Solar Storage: A water tank or rock bed that absorbs collected solar energy and holds it until needed.

Solar Thermal: Solar thermal energy systems capture the sun's free energy and convert it into heat. The most common applications in developing countries are heating water, food processing, crop drying and space heating in colder climates.

Stand-alone Photovoltaic System: A solar electric system commonly used in remote locations that are not connected to the main electric grid. Most stand-alone systems include some type of energy storage, such as batteries or pumped water.

Static Water Level: Depth to the water surface in a well under static conditions (not being pumped). May be subject to seasonal changes or lowering due to depletion.

Submergence: Applied to submersible pumps: Distance beneath the static water level, at which a pump is set. Synonym: immersion level. Total Dynamic Head - vertical lift + friction loss in piping (see friction loss).

Submersible Pump: A motor/pump combination designed to be placed entirely below the water surface.

Suction Lift: Applied to surface pumps: Vertical distance from the surface of the water in the source, to a pump located above surface pump located above. This distance is limited by physics to around 20 feet at sea level (subtract 1 ft. per 1000 ft. altitude) and should be minimized for best results.

Surface Pump: A pump that is not submersible. It must be placed no more than about 20-ft. above the surface of the water in the well.

Sustainable: A term used to characterize activities that can be undertaken in such a manner as to not adversely affect the environmental conditions (e.g., soil, water quality, climate) necessary to support those same activities in the future.

Thermostat: Temperature sensing device which is used to switch mechanical equipment on and off.

Thermosyphon: Passive solar systems that rely on the natural convection of liquids to collect energy. Designed with the tank above the collection surface.

Transfer Fluid, Heat: The heat transfer fluid is the medium, such as air, water or other fluid, which passes through the solar collector and carries the absorbed thermal energy away from the collector.

Unglazed Collector: A collector with no transparent cover plate.

Vane Pump: (Rotary Vane) A positive displacement mechanism used in low volume high lift surface pumps and booster pumps. Durable and efficient, but requires cleanly filtered water due to its mechanical precision.

Vertical Lift: The vertical distance that water is pumped. This determines the pressure that the pump pushes against. Total vertical lift = vertical lift from surface of water source up to the discharge in the tank + (in a pressure system) discharge pressure. Synonym: static head. Note: Horizontal distance does NOT add to the vertical lift, except in terms of pipe friction loss. NOR does the volume (weight) of water contained in pipe or tank. Submergence of the pump does NOT add to the vertical lift in the case of a centrifugal type pump. In the case of a positive displacement pump, it may add to the lift somewhat.

Voltage/Volts: The amount of electricity pressure, which causes the flow of electricity through the circuit. Typically 12 volt DC for panels/batteries or 120/220 volts AC for appliances.

Watts: The measure of electrical power. Volts x amps = watts.

Watt-Hour: The quantity of electrical energy used or produced when one watt is used for one hour.

FINANCIAL TERMS

Accounting: Is the process of recording, classifying, summarizing, communicating and interpreting the economic events of a business or organization to interested users.

Accounts payable: Amounts of money owed to others. These are current liabilities incurred by a company during the normal course of business.

Accounts receivable: Amounts of money owed to a business by customers who purchase goods or services on credit. On the balance sheet, these are current assets.

Accrual basis accounting: An accounting method that recognizes expenses when incurred and revenue when earned rather than when payment is made or received.

Asset: Something of monetary value owned by a business or individual.

Balance sheet: An accounting report that summarizes a firm's financial position at a specific date by listing assets, liabilities and owner's equity.

Bonds: Long-term promissory note or debt instrument issued by public and private institutions.

Break-even: The point where the level-of-sales is such that, total revenues equal total costs. Break-even analysis serves as a guideline to determine how changes in the volume of sales affect earnings.

Budget: An estimated amount of expected income and expense for a specified future period of time. It is a formal financial summary of management plans that allows the communication of previously agreed upon objectives and once approved it is used for evaluating performance.

Budget-forecast-actual: A comparison between actual results with planned objectives.

Business cycle: The regular but recurring periods of change in economic activity over time. It is characterized by periods of expansion, abundance, contraction and recessions.

Business plan: A formal written strategy that specifies the steps to be undertaken in order to carry out a specific activity and reach the planned objectives of the organization. It is a document that details the past, present and future of a company usually designed to attract capital investment.

Cash basis accounting: An accounting method that records revenue when is received and expenses when they are paid.

Cash flow: The amount of net cash available in a firm as a result of its operations. It is calculated by adding non-cash expenses such as depreciation to net income after taxes and it helps determine a firm's level of liquidity.

Contribution (margin, percentage): The contribution margin is the amount of revenue remaining after deducting variable costs from total sales. This margin is the amount available to cover fixed costs and to contribute to profit. If you divide the contribution margin by total sales you can obtain the contribution margin ratio. This ratio helps you determine the effect of changes in sales on income.

Controller, Comptroller: An organizations chief accounting officer responsible for the establishment and maintenance of the firm's accounting system.

Corporation: A business organized as a legal entity separate from its owners, distinguished by having limited liability, easy transfer of ownership and unlimited life.

Cost of goods sold: The total cost of products sold during a specific period. It is equal to beginning inventory plus cost of goods purchased minus ending inventory.

Credit: An accounting entry that records a decrease to assets and an increase to liabilities and owner's equity. It is also the ability to borrow or purchase goods and services without having to pay on delivery.

Current ratio: A liquidity measure that helps determine a company's short-term debt paying ability. It is obtained by dividing current assets by current liabilities.

DBA, doing business as: Used to signify that a company is operating using a name other than its legally incorporated name.

Debentures: A long-term unsecured debt instrument. It usually applies to unsecured bonds of a corporation.

Debt (senior, junior): Words used to prioritize the order in which debt is going to be repaid or claimed in the event of liquidation.

Debt to equity ratio: It is computed by dividing owner's equity into long term debt and it shows the relationship between long term funds provided by creditors and funds provided by owners.

Due diligence: Pertains to the process leading up to an investment. Including among other things a review of financial statements, market assessment, economic conditions and management background.

Equity: In accounting terms is the funds contributed to the firm by stockholders through direct payment or retained earnings. Also known as owner's equity.

Exit strategy: Is a component of an investment plan that sets forth one or more mechanisms for an investor to liquidate their original investment plus earn a return. Examples of exit strategies include among others, initial public offerings and buyback agreements from other shareholders.

Financial plan: The process of determining the financing needs of a firm including a strategy for obtaining those funds.

Financial Reporting: Reports that provide financial statistics relative to an organization's operations and financial condition.

Grants: An amount of money that doesn't need to be repaid.

Gross domestic product (GDP): Total value of goods and services produced by a country (residents and non-residents) per annum.

Gross national product (GNP): GDP + income residents receive from abroad for labor and investments, less similar payments made to non-residents who contributed to the domestic economy.

Gross profit: Total sales revenue minus cost of goods sold. Gross profit does not take into account selling and administrative expenses.

Income statement: A financial statement that reports revenue and expenses and resulting net income or net loss for a specified period of time.

Insolvency: The inability to meet debt obligations.

Inventory: The amount of raw materials, work in process and finished goods owned by a company and ready for sale during the course of business.

Investor: An institution or individual who provides funds to others through risk capital (equity) by purchasing income-producing assets. (eg. shares). Someone that puts money into a project or other assets in exchange for income returns or interest.

Lenders: Institutions or individuals that provide funds (eg. Loans) with a specified interest rate and repayment period.

Limited liability companies: A business form that makes its owners responsible for no more capital than they have personally invested in the business. Thus, stockholders only lose the amount paid for the shares of ownership regardless of the firm's financial obligations.

Limited partner: A member of a limited partnership that enjoys limited liability. He or she is not liable for the debts of the partnership.

Management: The individuals directing, handling and controlling the affairs of a business.

Market analysis: A study of the economic environment including among others market structure, size, competition, barriers and, growth potential.

Market penetration: The portion of a particular market that a company has been able to acquire.

Mezzanine debt: After initial capital is raised for a company there exists a period of time when combinations of debt convertible to equity is a viable tool to finance a company. These debt instruments, which sometimes are accompanied with warrants (an option to purchase stock) and are often convertible to equity, are grouped together under the heading of mezzanine debt, meaning it is between start-up capital and conventional debt. It is also sometimes referred to as quasi equity.

Net income: The income that remains after all expenses including taxes have been deducted from revenues. Also called net profit.

Non-compete agreement: An agreement between parties under which one party promises not to engage in certain business activities in a particular region.

Non-disclosure agreement: A confidentiality agreement.

Operating costs: Expenses incurred during the normal course of business with the exception of interest expense, taxes and cost of goods sold.

Partnership: A business form owned by two or more people who agree to share both, profits and losses.

Payback strategy: The mechanism to be followed in order to fulfill a firm's corresponding debt obligations.

Per capita GNP: GNP divided by the country's population total.

Personal guarantee: A personal pledge, tangible object or formal assurance given as security for a debt obligation.

Preferred shares: A type of security that shows ownership of a company and has preference over common shares in the payment of dividends and claims of assets.

Projections: The calculation of future costs, revenues, rates of growth and the like.

Prospectus: A formal document that discloses information relating to a new securities offering including, information about the issuing company, financial data, proposed business plan, list of its officers, description of its operations and, any pending litigation.

Quick ratio: A liquidity measure computed by dividing current liabilities into all current assets with the exception of inventory. It helps determine a company's ability to meet its immediate short -term debt obligations.

Ratios (financial): A relationship between two or more sets of financial data points with the purpose of tracking the performance of a company.

Return on equity: It is calculated by dividing owner's equity into net income after taxes and it's a measure of the net income that a firm is able to earn as a percent of the stockholder's investment.

Return on investment: It is calculated by dividing total assets into net income after taxes and it measures the firm's effectiveness to generate income from available assets.

Sales: It represents revenue exclusively from the sale of goods and services.

Soft loans: A loan with below market rate and terms and even possible forgiveness.

Sole proprietor: The one and only owner of a business who is, personally liable for all the financial obligations incurred by his or her company.

Stock offering: A new issue of securities.

Stock, shares (common, preferred): Securities that show ownership in a corporation and if preferred give the holder a claim prior to the claim of common stockholders on earnings and in the event of liquidation also on assets.

Strategy, tactics: A plan, method or procedures used to obtain a specific goal or result.

Vision and mission: The goals and objectives of an organization.

Working capital: Is computed by subtracting current liabilities from current assets and it represents the amount of funds a firm needs to cover its current obligations. Thus, it also serves as a measure of liquidity.

ABBREVIATIONS

Bbl:	Barrel (of oil), 159 litres
Bcm:	Billion cubic meters (10^9 m^3)
Btu:	British thermal unit (1 Btu = 1055.06 J)
CNG:	Compressed Natural Gas
GJ:	Gigajoule
GtC:	Gigatonnes (elemented) carbon (10^9 tonnes C)
Gtoe:	Gigatonnes oil equivalent (10^9 tonnes oil equivalent)
GW:	Gigawatt (10^9 watts)
KW:	kilowatt
LPG:	Liquefied Petroleum Gas
Mtoe:	Million tonnes oil equivalent
MWh:	Megawatt hour
toe:	Tonnes oil equivalent
TWh:	Tera watt hours (10^{12} watt hours)

ENERGY EQUIVALENTS

1 million metric tonnes of oil is equivalent (toe) to:
- 1.5 million tons of coal
- 1.2 billion cubic meters of natural gas
- 2.5 million tons of fuelwood
- 4 terawatt hours of electricity
- 2 metric tons of uranium (fast reactors)

1 barrel of oil = 159 liters
= 42 gallons (US)
= 35 gallons (UK)

CONVERSIONS

Electrical power is measured in watts

1,000 watts (W)	= 1 kilowatt (kW)
1,000 kilowatts	= 1 megawatt (MW)
1,000 megawatts	= 1 gigawatt (GW)
1,000 gigawatts	= 1 terawatt (TW)

The kilowatt-hour (kWh) measures the amount of electrical energy supplied or consumed.

1,000 kWh = 1 megawatt hour (mWh)
1,000 mWh = 1 gigawatt hour (GWh)
1,000 GWh = 1 terawatt hour (TWh)

1 calorie (cal) =
4.196 Joule (J)

1 quad (quadrillion Btu) =
1.05×10^{18} Joules (J)
1.05 exajoules (EJ)
3.60×10^{5} metric tons, coal
1.72×10^{6} barrels, oil
2.36×10^{5} metric tons, oil
2.83×10^{10} cubic meters, gas
1.07×10^{12} cubic feet, gas
2.93×10^{2} terawatthours

1 kilowatt-hour =
3.41×10^{3} British thermal units (Btu)
3.6×10^{6} Joules (J)

Joule =
9.48×10^{-4} British thermal units (Btu)
2.78×10^{-7} kilowatt-hours (kWh)
0.239 Calorie (cal)
(generally thought of as the energy content of a match tip)

1 British thermal unit (Btu) =
2.93×10^{-4} kilowatt-hours (kWh)
1.05×10^{3} Joules (J)

1 barrel of oil =
Approx. 0.136 tones