ACP-EU Energy Facility
Project Monitoring Guide for EU Delegations

A guide to monitoring technologies, governance and institutional frameworks

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Contents

1. Introduction

The day-to-day monitoring of EU-funded, energy projects is undertaken by the EU Delegations. Whilst Task Managers have a great deal of sectoral knowledge, it is often not possible for the Task Manager to know the details of specifics technologies and possible pitfalls which can affect implementation based from lessons learned in similar projects. The purpose of this guide is to provide background technical information and the strengths, weaknesses, opportunities and threats of the various types of projects funded under the ACP-EU Energy Facility. This will hopefully enable Task Managers to be aware of typical issues, and to be able to touch upon some key questions when undertaking routine project monitoring visits or when reviewing project progress reports.

The guide is ***not designed to be a study manual which is to be read and absorbed in one sitting***. As first-line monitors, you will come across new projects and may like to have some background knowledge. Each of the 2 page sections is designed to provide a kind of fact sheet summary by technology or topic. You may want to print the relevant couple of pages and take them with you as a reminder.

As stated in the EU Reference Document[1] to strengthen project internal monitoring, monitoring has several objectives, including informing decisions at key stages during the implementation and to provide informed and useful reporting. Task Managers are also expected to engage in dialogue with projects, keeping abreast of project progress, providing capacity building advice and support to implementing partners where necessary.

2. Energy Monitoring

The specific complexities of monitoring energy sector projects are found in the multitude of permutations of energy technologies which are employed and the relative infancy of some of the project technologies, such as for example plastic biogas chambers or farming of Jatropha. This highlights the importance of focusing on lessons learning. In addition, the varied scale of the projects funded means that not only energy-related monitoring is required.

This guide presents key elements for consideration in terms of general design of energy projects, and then looks at the specific technologies and approaches under the ACP-EU Energy Facility's Component 1 (access to energy services) and Component 2 (governance and capacity building). The following section provides some key features of the *design* of energy projects which require attention.

[1] http://ec.europa.eu/europeaid/multimedia/publications/documents/tools/europaid_strengthening_project_internal_monitoring_en.pdf

2.1. Key Features of the Design of Energy Projects

Most Energy Facility projects related to component 1 deal with one of the following:

- Rural Electrification (either through grid extension or decentralised renewable energy technologies),
- Increased efficiency, in particular through efficient cooking stoves,

All Energy Facility projects have a very strong social and often a commercial content. Designers of rural electrification projects are responsible for a range of critical decisions that affect sustainability. These decisions include technology choice, ensuring affordability, financial sustainability including technology replacement, social safeguards and environmental considerations, as well as taking advantage of opportunities to initiate and enhance productive activities and institutional applications. Project designers must also consider ways to use appropriate business models, determine necessary regulatory actions, and explore opportunities for international co-financing.

The conception and implementation of an electrification system project must be consistent with the overall (rural) electrification plan for the region. The project should not be influenced by such ad-hoc factors, such as one-time availability of donated equipment or pressure exerted by local politicians, which can be unsustainable.

The first task to be carried out when monitoring an electricity infrastructure project is to analyze the project feasibility studies, making sure that the existing and foreseeable conditions (mentioned in the paragraphs above) are carefully considered and that assumptions for future evolution of tariffs, market mechanisms, energy policies, etc. are reasonable.

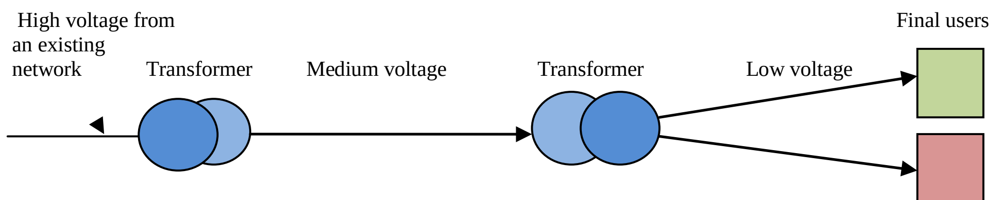
The Scoping or Feasibility Study

A feasibility study must determine the most appropriate technological solution, specifically in relation to rural electrification. This requires data gathering for each specific proposed site. Technical, economic, financial, and socio-cultural considerations must all be included in the decision process to ensure the appropriate choice of technology. Further to the usual considerations financial sustainability, there are specific issues related to energy projects. For instance in the case of a biomass-based energy plan, the feasibility study might assume that the resource will be available for free in the case of waste products (e.g. sugar or maize). However it can happen that once the provider realises that the product is demanded by the power producer, he starts charging for it and make the project financially unfeasible.

2.2. Specific Guidance

Guidance by Type of Technology

<table>
<tr><th colspan="2">Grid Extension</th></tr>
<tr><td>Technology background</td><td>
A typical extension of an electric grid is composed of transformers (or groups of them), to convert the upstream voltage level to the design level of the extension, and lines (aerial or underground in certain cases) connecting the transformers and the final users. In large projects different voltage levels can exist in different parts of the grid, with transformers between each level.



In the extension of isolated grids, supply can come from one or several generating units of different types (hydro, thermal, photovoltaic, wind, etc)
Certain types of users (industrial/commercial) can be supplied directly at high or medium voltage levels.

Switchgears, circuit-breakers and other protection devices must be installed at both sides of each group of transformers to make it possible to electrically isolate different parts of the grid to allow maintenance and to guarantee security.
From the viewpoint of energy efficiency, it is important to guarantee an adequate sizing of wires and capacity of transformers, to avoid a high level of thermal losses. If the project goes beyond a strict extension of a distribution network and contemplates supply of electrical devices, use of highly efficient equipment (modern bulbs (CFLs, LED), efficient and well isolated fridges, etc.) is recommended.
</td></tr>
<tr><td>Types of installations</td><td>

Medium-low voltage distribution lines composed of poles, wires and switchgears and protection devices.

Poles can be made of steel, concrete, fibreglass or wood. In the case of wooden poles, it must be guaranteed that the wood is duly treated to avoid deterioration. The choice of material for the poles can have consequences on costs. For example, in Africa, wooden poles need to be treated in South Africa therefore having transport implications. Concrete poles can be produced locally although they are more expensive to produce. The lifespan of the poles should be factored into calculations.
Wires for aerial distribution lines are normally made of aluminium-steel (to guarantee mechanical resistance). The useful cross sectional area of the wires (gauge) must be sufficient for present peak loads and future increases. The larger the load, the larger the gauge required. Copper should only be used indoors or in underground, isolated cables.
Insufficient gauge of wires can result in high distribution losses (high

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	working temperature of components) or blackouts. o Underground distribution lines are costly and should only be used when legal requirements make them mandatory (normally in urban areas) or when typhoons, hurricanes, etc. are frequent, as it is the case in certain areas. o **Switchgears and protection devices** must comply with the legal requirements of the corresponding country. It is important that disconnection of a line can be detected by sight (besides of circuit breakers), in order to avoid accidents. • **Transformers**: sizes varying from a few kW to hundreds of MW (for high voltage transmission networks). o For low-voltage small transformers it is admissible to have them installed on top of poles. Users must be informed about the dangers derived from manipulation of any part of the transformers (this is especially important for children). o Switchgears must be installed at both sides of the transformers (low and high voltage). o Large transformers (more than a few kW) should be installed in cells not open to the public, to which only authorized personnel is allowed to access. All the equipment must comply with country legal regulations and with connecting rules approved by the country regulatory authority.

Strengths • Diversification of supply from different power plants • Possibility to receive electricity from other countries • Significant experience in distribution in most countries; possibility of extrapolations about most common practices by final users	**Weaknesses** • Dependency on sub-contracting and regulatory approvals which can cause delays to implementation • Lack of adequate level of generating capacity to the electric network • Possible high level of losses if the distribution lines are very long • Necessity of highly qualified personnel to guarantee adequate maintenance of distribution equipment
Opportunities • Development of industrial or semi-industrial activities requiring reliable continuous supply of electricity • Improvements in education, health care, communications and other basic needs	**Threats** • Possible duplications with projects financed by other donors • Possible wrong estimations of the demand level at peak load of potential users • Costs of connection to the grid often exceed buying power of the target community

Key questions	1. Does the project guarantee adequate supply of electricity to all the potential users? 2. Are households connecting at the expected rate? Are connection costs affordable? Are they or can they be subsidised to increase affordability? 3. Are the usage tariffs affordable? Are prepaid meters used to increase income recovery and enable customer management of energy costs? Are the tariffs set so low so as to discourage efficient use of electricity? 4. Are the size and/or capacity of components sufficient to guarantee a reasonable level of losses and to cater for future increases in demand for electricity? 5. Has the public been informed about the security measures to be adopted to avoid accidents? 6. Are the maintenance programs adequately defined? Is the training guaranteed of the personnel in charge of maintenance? 7. Does the installation comply with the applicable technical and legal requirements?

<table>
<tr><th colspan="2">Solar – Photovoltaic</th></tr>
<tr><td>Technology background</td><td>
Photovoltaic (PV) involves the direct generation of electricity from light by using a semi-conductor material which can be adapted to release electrons.
The most important parts of a PV system are the cells which form the basic building blocks, the modules, which bring together large numbers of cells into a unit, and, in some situations, the inverters used to convert the electricity generated into a form suitable for everyday use. PV array (for larger systems) connects modules of same specs in series or parallel. The installation should be fixed at a certain pre-determined angle so as to collect the maximum solar irradiation over a year or during the season of highest demand and may be adjusted seasonally. The battery banks are made up of multiple units of stationary deep-cycle batteries linked together in series. The size is determined by the load capacity and desired storage time. Batteries store the energy and feed the system. The charge controller controls the charging of the battery and is used to protect the battery from over charge or discharge.
A photovoltaic system does not need bright sunlight in order to operate. It also generates electricity on cloudy days, with its energy output inversely proportionate to the density of the clouds.
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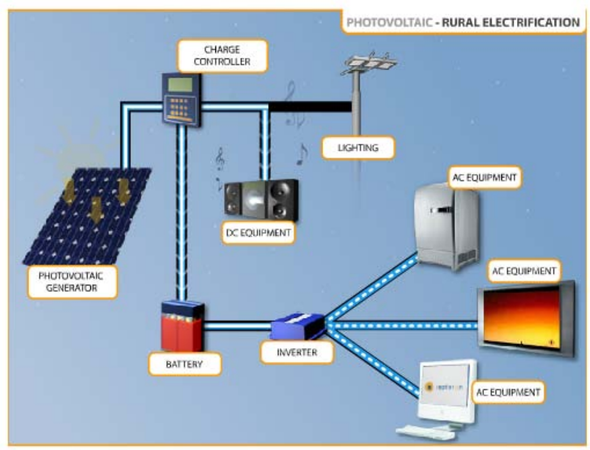
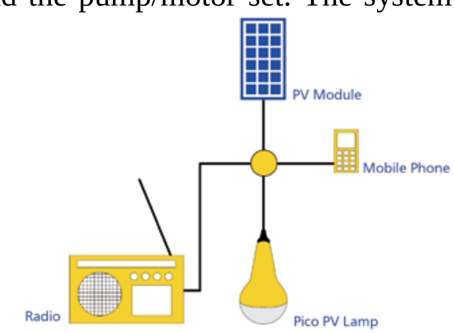
<tr><td>Types of installations</td><td>
A Solar Home System (SHS) includes one or more PV modules, a battery (to store energy for the future), a charge controller, wiring and outlets for other direct current (DC) appliances. A SHS of 50 Wp and a daily average yield of 180 Wh suits the electricity needs of a typical rural household by feeding direct current for two fluorescent tubes, a radio and a small television or electric fan[2].


The PV Water Pump System components include a PV array of modules, its support structure, the system controller and the pump/motor set. The system also includes the water storage and water distribution systems. The function of the controller is to optimize the production of water by adjusting the voltage supplied to the pump motor.


A PicoPV (PPS) system is defined as a small SHS with a power output of 1 to 10W, mainly used for lighting and thus able to replace unhealthy and inefficient sources such as kerosene lamps and candles. The PV panel can be either fixed on
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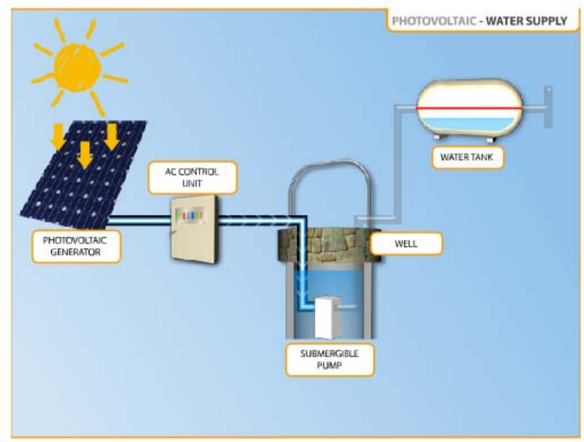
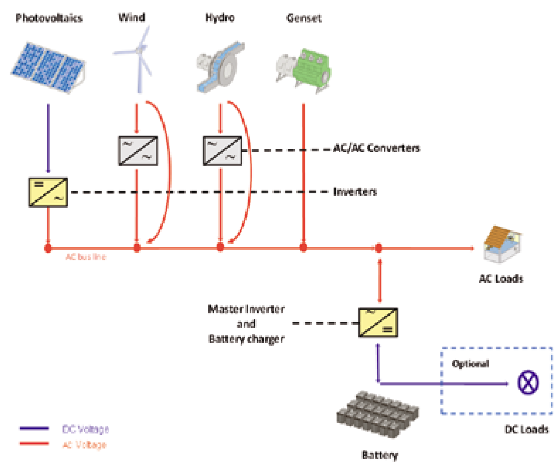
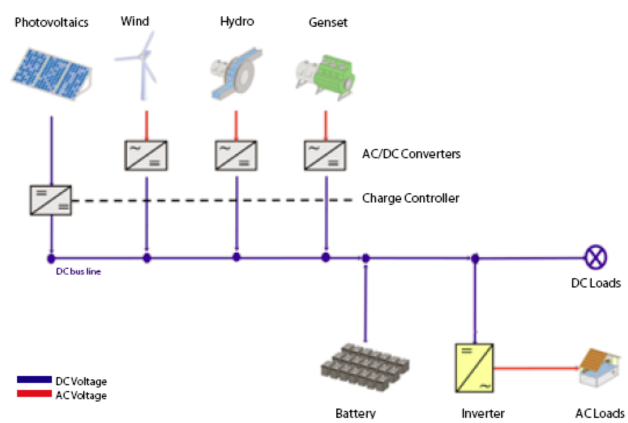
[2] **Diagrams from:** http://www.ruralelec.org/fileadmin/DATA/Documents/06_Publications/ARE_TECHNOLOGICAL_PUBLICATION.pdf

	the product itself (e.g. solar lanterns) or separated from it. PV Systems are also applied to water treatment/purification systems, communication systems, cooling systems, etc.	 Source: www.isofoton.com

Strengths	**Weaknesses**
• Small PV systems are flexible to mount, easy to move and share • User-friendly application, low investment costs, little maintenance required	• Easily reaches its capacity limit, and households may not respect the maximum load that each system can ‘accept’, thus tending to link too many electrical appliances to the system • Maintenance not safeguarded. Risk that parts are being sold • Improved designs for charge regulators are required to extend the lifetime of batteries and thereby reduce the lifetime costs • Poor households may not afford to replace the batteries • Spare parts / small parts to be later purchased by the beneficiaries will most likely not be compliant with rules of origin and often be of poorer quality
Opportunities	**Threats**
• Awareness raising on renewable energy and how to increase energy efficiency • Over the past few years, advances in white Light Emitting Diode (LED) technology have made LED products commercially available for lighting applications, and reliability and quality have gradually improved. Such products might be considered when products cheaper than SHSs are needed to provide basic lighting services	• Equipment availability • There is no local ownership and responsibility • Donated systems face a high risk of not being valued or taken care of • Lack of future appropriate technical and financial support • Almost every problem with any part of a PV system can result in shortened battery life • Lack of appropriate and sustainable solutions for disposal of batteries

Key questions	1. In standalone PV systems, especially the smaller ones, the loads are an integrated part of the systems and have to be carefully chosen because of their impact on the efficiency and the lifetime of the system itself. What is the actual load compared to the design load? 2. Are international quality standards for each component (PV module, inverter, battery etc) in the system followed? 3. The socio-economic and cultural dimension. What level of organization exists within the community? Who are the leaders and are they willing to assume responsibility to ensure that management and maintenance of solar systems are sustainable? Has a maintenance fund been established for social institutions, such as schools and health clinics? 4. Local infrastructure. Have any local technicians in the area been trained and know how to maintain systems, identify problems and replace deficient components in the future? How close are the technicians to the installations (response times)? 5. How are old batteries handled when replacing with new ones? 6. Is the design load comparable to the actual realized load – i.e. does the installation provide as much power as anticipated? 7. Are safeguards against theft necessary? If yes, are they in place?

<table>
<tr><th colspan="2">Solar – Hybrid</th></tr>
<tr><td>Technology background</td><td>A solar hybrid power system uses renewable energy as a primary source and a generator set (most of the time diesel fed but potentially with gasoline and LPG) as a backup resource. This solution is especially interesting for isolated villages/ small towns, away from the national electricity grid and without realistic hope of being connected to it in the near future. Hence, a solar-hybrid system can integrate the advantages of each technology and balance their different limitations. In order to ensure the continuity of supply, maximise the lifetime of components by reducing the stress on the system (especially the battery) and reduce overall costs, diesel/gasoline/LPG generators are commonly added as complementary sources/backup.</td></tr>
<tr><td>Types of installations</td><td>Electricity generation coupled at AC bus line[3]
All electricity generating components are connected to an AC bus line. AC generating components may be directly connected to the AC bus line or may need a DC/AC converter to enable stable coupling of the components. Components operating like a voltage source can be coupled directly e.g diesel generator, wind or small hydro power. In both options, a bidirectional master inverter controls the energy supply for the AC loads and the battery charging. [4]


Electricity generation coupled at DC bus line
All electricity generating components are connected to a DC bus line and charge the battery directly. The battery is controlled and protected from overcharge and discharge by the charge controller and supplies power to the AC load through the DC/AC inverter.

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[3] A bus line is the link between components and operate on an Alternating Current (AC) or Direct Current (DC)

[4] **Diagrams from:** http://www.ruralelec.org/fileadmin/DATA/Documents/06_Publications/Position_papers/ARE-WG_Technological_Solutions_-_Brochure_Hybrid_Systems.pdf

	Electricity generation coupled at DC/AC bus lines DC and AC electricity generating components are connected at both sides of a master inverter, which controls the energy supply of the AC loads.

Strengths	**Weaknesses**
• Stable power supply also at night and during unfavorable weather conditions. The diesel kicks in when RE energy supply is low • Ensure continuous and reliable electricity supply • Have a positive social impact by fostering and improving local governance structures through the involvement of the community in the decision-making process linked with the energy system	• Emissions and noise from generator • Setting up Operation and Maintenance (O&M) schemes and local structures/regulation are the greatest barriers
Opportunities	**Threats**
• Can be easily scaled up when the demand grows and they can be potentially connected to the national grid and serve as additional generation capacity	• Functioning depends on availability of fuel • Increased fuel prices for back-up generator

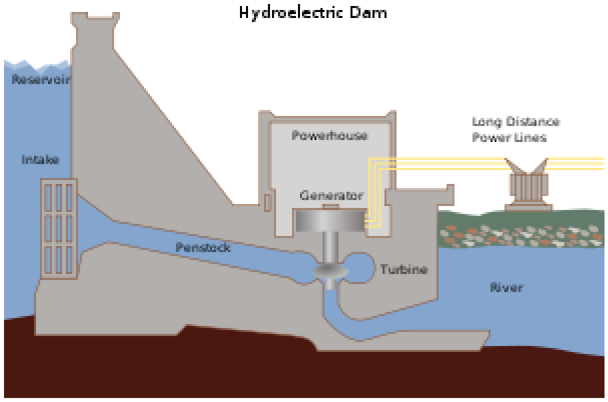
Key questions	1. The socio-economic and cultural dimension: What level of organization exists within the community? Who are the leaders and are they willing to assume responsibility to ensure that management and maintenance of solar systems are sustainable? Has a maintenance fund been established for social institutions, such as schools and health clinics? 2. Local infrastructure: Have any local technicians in the area been trained and know how to maintain systems, identify problems and replace deficient components in the future? How close are the technicians to the installations (response times)? 3. Are international quality standards for each component in the Solar-hybrid system followed (refer to the International Electrotechnical Commission http://www.iec.ch/standardsdev/publications/)? 4. Is the generator sized according to the calculated average daily energy consumption (ADC) and the storage according to the expected working time of the system with the ADC? 5. Solar-hybrid systems have to be monitored in order to supervise the energy flows and to optimise components and energy management control. Such monitoring requires communication among all components to collect the necessary information, so slow communication (frequency from 0.01 up to 1Hz) is often used for remote control of the system. Is such a monitoring system included/installed? 6. Is the design load comparable to the actual realized load – i.e. does the installation provide as much power as anticipated?

Hydropower

Technology background

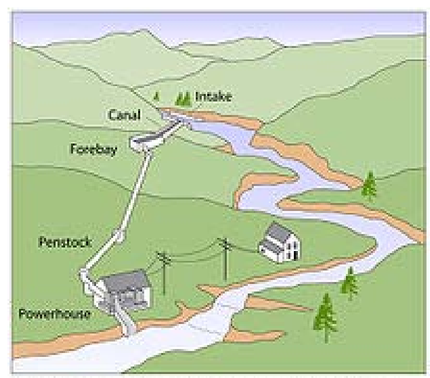
Hydropower is one of the oldest and most well known sources of renewable energy. It is both scalable and relatively reliable, provided the right site is chosen and climate conditions do not alter dramatically. The fundamental basis of hydropower is the conversion of kinetic and potential energy into electrical using gravity and the rate of flow of a river or channel of water to drive turbines which, in turn, generate electricity. This principle is applied according to the needs of the plant and can generate between 100 kW and hundreds of MW of electricity.

There are several key elements of a hydropower installation, no matter the size.[5]



As shown to the left, in larger hydroelectricity schemes, water is collected in a reservoir using a dam. The **head** of the water is difference in the elevation of water at the intake and the elevation of the turbine inlet located in the powerhouse. The **penstock** is the channel which carries the water down through the turbine. The **tail race** is the water which is ejected from the penstock back to the natural stream of water flow.

Smaller capacity installations are often built based on the **run-of-river** design. This is the diversion of *some* water from a weir (a small headpond) towards the penstock. The force of gravity generates the energy to spin the turbine. The water is then redirected back to the river through the tailrace not requiring a reservoir and therefore having less impact on the surrounding ecology.



In this microhydropower system, water is diverted into the penstock. Some generators can be placed directly into the stream.

Each element of the system has an impact on the efficiency of the generation of electricity however there are 3 key factors:

- The *size of the head* – this determines the amount of potential energy which can be converted into mechanical and subsequently electrical energy.
- The *rate of flow* of water – the kinetic energy available through the rate of flow of water has a direct correlation to the power generated.
- The *materials used in the penstock* – this determines how much energy is lost through friction as water flows to the turbine.

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[5] **Diagrams from:** http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Water%20Resource%20Engg/pdf/m5l01.pdf

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- The *type of turbine* – based on the characteristics of the site, specifically the head, rate of flow and volume of water, turbines are specifically designed and take various forms, the most common of which is the Pelton turbine.

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<tr><td>Types of installations</td><td>

Within the Energy Facility, the most common installations are pico or mini hydro, classified as such based on their capacity output, although there are also some larger scale facilities being constructed primarily by government or private sector partners.

Capacity guidelines are as follows[6]:

<table>
<tr><th>Type of installation</th><th>Generating Capacity</th></tr>
<tr><td>Large Hydro</td><td>10 MW +</td></tr>
<tr><td>Small Hydro</td><td>1 to 10 MW</td></tr>
<tr><td>Mini Hydro</td><td>100 KW to 1 MW</td></tr>
<tr><td>Micro Hydro</td><td>5 KW to 100 KW</td></tr>
<tr><td>Pico Hydro</td><td>less than 5 KW</td></tr>
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The key benefits and disadvantages of hydro installations include[7]:

- Hydro power is relatively reliable and sustainable, specifically as it is not susceptible to fluctuations in fuel prices
- Environmental impact: large scale installations have a high environmental and social impact due to the flooding caused once the dam has been built. Both human, animal and water life are often dramatically affected by the creation of a reservoir. However, in the case of run-of-river, there is no need for a dam but the reduction in the quantity of water flow can reduce the quality of water for fish and other water life. Environmental Impact Assessments are usually required before permissions will be granted to undertake large hydro projects. The ecological impact of run-of river small-scale hydro is minimal; however these must be taken into consideration before construction begins, as stream water will be diverted away from a portion of the stream, and proper caution must be exercised to ensure there will be no damaging impact on the local ecology or civil infrastructure.
- The selection of the site is critical to success and is a limiting factor as the rate of flow of the water and the topography (which influences the drop or head, which is the vertical distance the water will fall through the water turbine) are such fundamental requirements
- In many locations stream size will fluctuate seasonally. During the dry months there will likely be less flow and therefore less power output. Advanced planning and research will be needed to ensure adequate energy requirements are met.
- Maintenance and Operating costs are lower than other fuel sources, specifically in the case of run-of-river installations (see below)

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[6] http://www.marketresearch.com/SBI-v775/Hydropower-Energy-Technologies-Worldwide-Large-1926640/
[7] http://www.cleantechinvestor.com/portal/renewable-energy/1777-the-run-of-river-energy-sector.html

Strengths	Weaknesses
• Renewable source of energy • Scalable capacity according to the needs of the target population • Can supply target populations with energy for all types of socio-economic activity • Longevity of the systems	• Can be cost-intensive to build due to construction and turbine costs • Large installations can have significant negative environmental impacts, specifically if a reservoir is being constructed or part of the river flow is being diverted • In the case of mini, micro or pico schemes, the size and flow of small streams may restrict future size expansion as electricity demand increases
Opportunities	**Threats**
• Use of community committees to manage and maintain sustainable schemes • Affordable tariff structures can be established, specifically where connections fees are subsidised • Increased economic activity (even industry) due to availability of a reliable energy source	• Equipment and spare part availability • Lack of technical capacity, although simpler than other technologies • If not run as a commercial enterprise, the feasibility of keeping up the O&M reduces • Poorly executed feasibility studies can result in overly optimistic estimations of output • Climate change, as it can affect the water levels • Poor construction leads to losses of kinetic energy, thereby reducing power output, and high maintenance costs

Key questions	1. What is the actual output compared to the designed output? Are there any system losses which affect the output? 2. Is the rate of flow of water as anticipated and are the peaks and troughs sufficient to meet demand? 3. Is the penstock / canal kept clean? Can heavy rain falls cause landslides above the penstock? Is a rock wall needed to avoid that earth falls into the canal? 4. Has the community been sufficiently involved in the implementation, specifically in the process of the construction of the distribution network? 5. Local infrastructure. Have any local technicians in the area been trained to maintain the systems? 6. Are the tariffs and connection fees affordable whilst enabling the generator/distributor to maintain a (profitable) business? 7. Where the distribution is being managed by a community-based organization, has capacity been built in terms of business/financial management in order to ensure that the business functions effectively? 8. Have sufficient permissions been sought for the use of land for the distribution network? If so, were local leaders as well as government involved?

Energy Efficient Stoves	
Technology background	As the primary use of wood fuel in the developing world is for cooking, it seems natural to establish mechanisms to make the combustion and transferral of heat from woodfuel and charcoal more efficient, thereby reducing the consumption of the fuel and demand for wood. Almost 3 billion people use inefficient, polluting modes of cooking[8]. In an attempt to improve the energy efficiency of more traditional cooking methods, such as the three-stone fire, emphasis has been placed on the development of suitable, energy efficient or "improved" cooking stoves. Refer to the **Thematic Fiche on "Improved Stoves as a Means to Increase Efficient Use of Energy"[9]** for additional information.
Types of installations	The models of energy efficient stoves differ in source of fuel, design, materials, capacity and most suitable application. Many stove designs cater for biomass (wood or charcoal) as the fuel source due to the recognition that this is the most easily accessible and affordable fuels in many rural and peri-urban areas. The small-scale, portable stoves are generally made of clay or metal, or a combination of both. The design concentrates the heat up to the bottom of the pot whilst reducing ambient heat loss by using insulating materials. The medium-scale static household stoves combine brick, mud, and metal, usually including a chimney such that they can be installed inside and incorporating more than one pot stand. On a large scale, energy efficient stoves are constructed for use in schools, hospitals or for small enterprises, such as a bakery. These stoves are built usually from brick although they use the same principles as the medium-scale models.  One good example of a simple portable stove the Jiko stove. The ***Chitetezo Mbaula*** ("protective stove")/ ***Ceramic Jiko*** portable clay stove is practical as it is versatile for indoor or outdoor cooking, dependent on weather conditions. It does not require cooking facilities to be built. It is made using a simple mould and measuring tools to cut out the air inlet and place the handles and pot rests. The basis of the design is to protect the fire, reduce smoke and direct the flames and hot air up to the pot. The more advanced stoves employ metal, bricks and cement and are generally used for fixed stoves. The most popular type of fixed stove is the "rocket stove". It is scalable and comes in a multitude of forms, all using the same principle and adapting it to the capacity requirements and purpose of the stove.

[8] http://cleancookstoves.org/

[9] http://energyfacilitymonitoring.eu/images/stories/publications/thematic_fiche_4.0_stoves.pdf

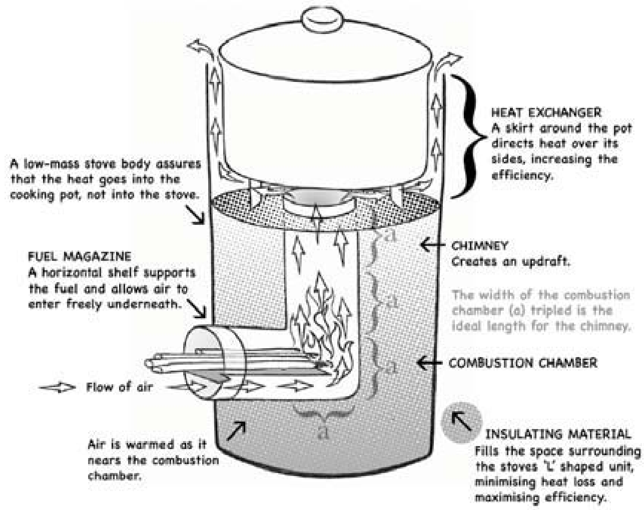


Figure 1 – Rocket Stove (Source: Accessing Carbon Markets for Improved Stoves, GIZ)

The principle of the rocket stove is a narrow combustion chamber in the form of an elbow which sucks in air at the bottom, heats it, and as it is heated, it rises up out of the top of the chamber directly onto the pot. If a "pot skirt" is used, the heat can be made to also go up the sides of the pot, further increasing the rate of heat transferral. The woodfuel is placed on a shelf at the base of the stove, using only the ends of the wood making fuel consumption more economical. This principle is applied in various different models.

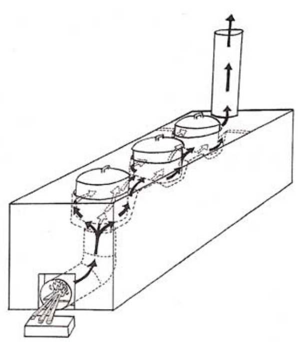


Figure 2 - Rocket Lorena Stove

The ***Rocket Lorena*** is a domestic clay-based, wood-fired stove which can be made to take more than one pot (Figure 5). The benefits of the model are that all smoke is expelled out of the indoor area through the chimney. The Rocket Lorena can also be fuelled using briquettes made from animal dung. Naturally, the investment costs increase the greater the complexity of the rocket stove but, the payback period for the certain designs can be as short as a few weeks due to the dramatic reduction in woodfuel consumption.[10] In larger institutions (hospitals, schools, military camps, etc) the savings are significant and allow institutions to invest in more nutritious foods and/ or other essential activities.

Solar stoves are also produced and whilst applicable to sub-Saharan settings, they are limited in their ability to produce outside of daylight hours, when they are often most needed, or if it is overcast. In addition, cooking times are generally slow and attaining optimum cooking temperatures require skills in positioning. However, the most significant benefit is that the stove is effectively free once the investment cost is overcome.

[10] http://www.rocketstove.org/

Strengths	Weaknesses
• Scalable according to need – i.e. stoves can be built for institutional or domestic use • Various materials can be employed based on availability and capacity to construct • Builds on cultural norms to establish an income-generating opportunity, as well as introducing a more effective technical solution • Sustainability of the solutions with the development of profitable markets initiating viable businesses	• Does not take away the need for use of biomass altogether • Availability of raw materials is often assumed although they are not always available in close proximity, thereby increasing production costs
Opportunities	**Threats**
• Continued improvement of technologies means that there is scope to use the right solution for the local context – be sure to look at the experiences in the field, there is no need to reinvent the wheel • Can be combined with reforestation activities and awareness raising to enhance local awareness of environmental issues • Funding under the CDM or the voluntary carbon trading market • Important positive benefits for health, gender equality, productivity and the environment	• Selected technology is sometimes complex making sufficient turnover for a profitable business difficult • Lack of business management skills and marketing can mean that the business is not viable • The technology is sometimes too complex for local capacity or requires too much time to construct • Maintenance is needed • Lack of policies at the national level and need for standards and quality

Key questions	1. Are the raw materials available locally at suitably low cost? 2. Is quality consistent and is it monitored? 3. Are adequate facilities available to support production, such as drying, firing and storage facilities? 4. Is the business viable and sustainable without support from the project? 5. Is the selling price affordable for the target population? 6. Are there any cultural limitations to the roles of the various stakeholders in the process, e.g. women as stove producers or as marketers? 7. Apart from the technical capacity to produce stoves, has business management capacity been built to ensure sustainability? 8. Have the local authorities, specifically traditional authorities, been involved in the establishment of the production and can they add their support to encourage local populations to adopt the technology? 9. Is maintenance of the institutional and household stoves provided for?

Biomass	
Technology background	Biomass relates to wood, charcoal, wood waste or crop residues such as straw, husk or empty fruit bunches in most cases. The non-fossil part of industrial and municipal waste may count as biomass as well. Biomass is carbon-based and any carbon based naturally grown material will go as biomass. If biomass degrades in an oxygen free environment, so called anaerobic environment, the bacteria will be anaerobic bacteria and will produce methane (CH_4) which is the main component of natural gas, and may be utilised as a fuel if the process is controlled and the gas is captured. Biomass is considered a renewable source of energy under the Kyoto Protocol[11] provided that the biomass is woody biomass from forests, woody and non-woody biomass from cropland and grassland, a biomass residue (for example bagasse from sugar plantations) or the non-fossil fraction of industrial or municipal waste.
Types of installations	The most common ways of utilising biomass energy is in **thermal installations** using combustion, gasification and pyrolysis. **Combustion**: - in open fires (70% of sub-Saharan Africans rely on firewood for cooking and lighting), - in boilers producing steam or power or both (combined heat and power, CHP). The heat may be used in an industrial process or used in turbines to produce electrical power. **Gasification** (originally used for production of town gas) is a partial oxidation process leading to formation of CO (carbon monoxide and CH_4). The technology may be used for heating and/or power generation in small or medium sized power plants. **Pyrolysis** is thermal decomposition of the biomass in the absence of oxygen. The products will be charcoal, gas and liquids and may be used for densification of biomass for transport (charcoal), co-firing for heat and power or feedstock for gasification. The installations will be facilities or kilns controlling the process temperature and methane emissions. **Biomass Integrated Gasification Combined Cycle**: the co-production of energy using a combination of power, steam, hydrogen, biomass fuels, and/ or chemicals. The deployment of both IGCC and synthesis gas conversion technologies, increases capacity and reliability. This technology is not widely used for small-scale production at present as it requires high capital investment. Biomass is a natural material and several natural**, bacterial processes** have been developed in nature to facilitate the fundamental life cycles in the global ecosystems, especially the carbon cycle where carbon alternates between being bound in organic matter and being part of the atmosphere as CO_2. These processes may be controlled in industrial facilities and the energy bound in the

[11] Please consult http://cdm.unfccc.int/EB/023/eb23_repan18.pdf for a full definition if needed.

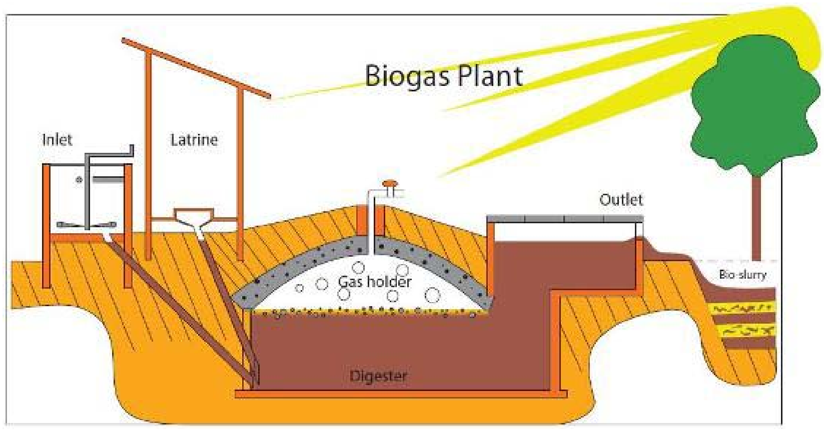
	biomass may be tapped as heat or combustible gases, or the end result may be compost obtained in an aerobic process not utilizing the generated heat. The main processes are anaerobic digestion, fermentation and composting. **Anaerobic digestion** will lead to the formation of biogas (CH_4), which can be used as a fuel in a boiler or bottled and sold in the market. **Fermentation** may lead to the formation of biofuels based on biomass from for example starch and sugar components sugar beet or sugar cane. **Composting** is aerobic degradation of biomass undertaken in facilities aiming at either reducing the amount of for example municipal waste or aiming at producing a saleable compost suitable for farming. The heat generated during the composting process may be exploited using a heat pump.

Strengths	**Weaknesses**
• Reduce the use of fossil fuels and thereby reduce the contribution to global warming. • Probably locally available making the economy more self-supplying. • Use of waste-based biomass will lead to more recycling, especially if combined with reuse of sorted waste products such as plastic, metal etc.	• Lack of a sustained technical basis in the area. Some skilled labour will be needed both for implementation and for the operation and management • The availability or assessment of availability of project resources may change from allocation of funding to time of implementation. • The fuel collection is often a major constraint (poor roads, unreliable suppliers) • Seasonal and variable availability of suitable biomass (such as straw)
Opportunities	**Threats**
• Biomass is widely available • A number of relevant technologies are already developed that makes utilisation of the biomass an attractive alternative to energy systems based on fossil fuels	• Biomass projects may be organised in smaller economic units without the necessary technical, financial and administrative experience leading to loss of funds. Project organisation should include the whole supply chain from availability of biomass to selling of end product. • Land ownership is often a major obstacle for project implementation. • The supplier with the best funding opportunities may win over a technically and financially better supplier.

Key questions	1. Is there a feasibility study showing availability of all materials and other resources (including long term biomass delivery contracts from documented land owners, staff, financing, permissions) necessary for the implementation and operation of the project? 2. Has all necessary land been successfully acquired? 3. Has the technology supplier sufficient experience in project implementation in the country or region? 4. If the biomass is Municipal Solid Waste (MSW) or industrial waste, is it free of toxic and medical substances? 5. Will there be any social, economic or environmental influence of the project on local citizens? 6. Is the type of biomass suitable as fuel for the specific technology?

<table>
<tr><th colspan="2">Biogas</th></tr>
<tr><td>Technology background</td><td>Biogas technologies cover all technologies that include biological degradation of biomass in an oxygen free environment – normally including a tank, or biogas stemming from a thermal process (pyrolysis or gasification).

In the anaerobic processes the lack of oxygen makes so-called anaerobic bacteria take over the degradation process. The exhaust from the bacteria is methane (CH_4), which is also the main content of natural gas.



[12]</td></tr>
<tr><td>Types of installations</td><td>Biogas installations may be established at a factory, landfill or domestic facility where a large amount of organic waste (e.g. human or animal dung) or waste water with a high organic content is available for energy purposes. Biogas production may be included as a solution to a waste water problem or a solid bio waste problem.

The installation itself will include a closed tank or similar where biomass may be stored under anaerobic conditions. The tank will need piping to tap the produced gas. The design of the tank or storage will depend on the type of biomass. If the organic matter is solid, then the tank will need to be accessible for removal of the digestate, which can be used for fertiliser.

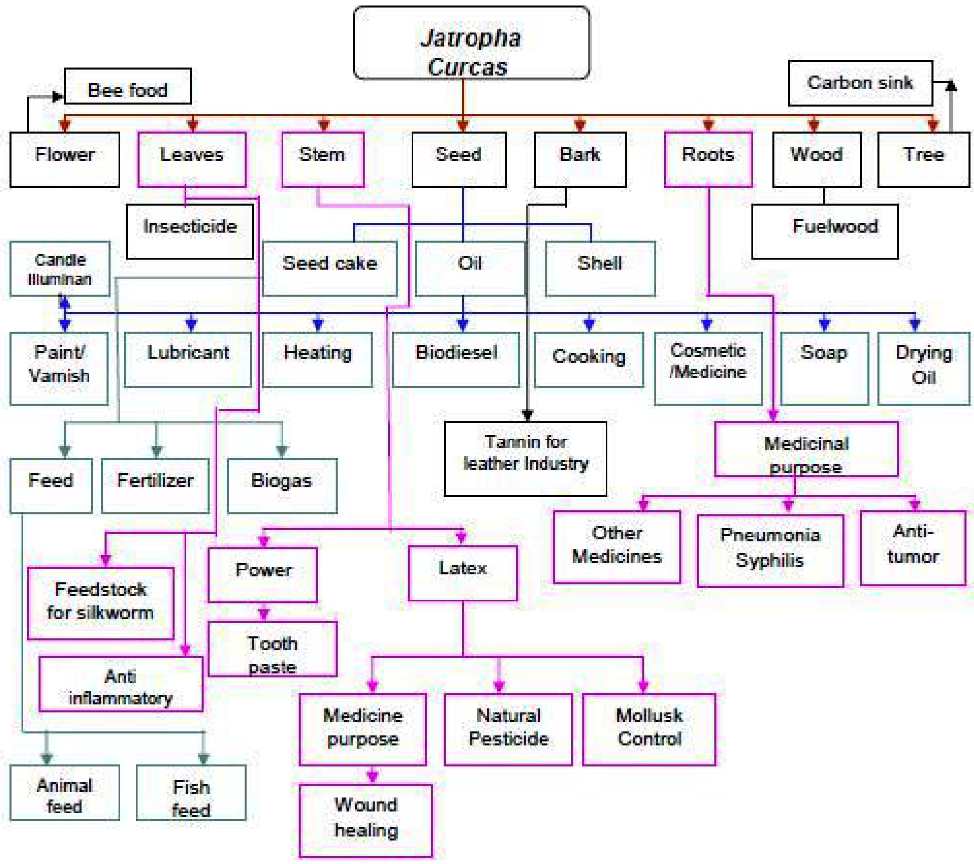
Biogas consists of approximately 40 % methane (natural gas) and 60 % CO_2. It can either be used as it is or cleaned for use in natural gas networks. Biogas may be use for:
• Heat production (combustion in a boiler/ cooking)
• Lighting
• Combined heat and power (combustion in a boiler)
• Transport fuel (liquefied under pressure)
• Power production (combustion in a gas generator)
• Injection in the gas grid (after purification)</td></tr>
</table>

[12] **Diagrams from:** africa-toolkit.reeep.org/**modules**/**Module7**.pdf

Strengths	**Weaknesses**
• Biogas is a renewable source of energy, and the production of biogas reduces global emissions both because natural formation of the potent GHG methane (global warming potential 21 times that of CO_2) is avoided and because biogas may substitute the fossil fuel natural gas • Depending on the source of organic matter for production of biogas the use of biogas will reduce dependency on imported natural gas and other fossil fuels, help reduce waste amounts, create jobs and reduce odours from open air degradation of organic waste (landfills, waste water) • Sustainability of the projects if implemented in a market oriented approach.	• Lack of a sustained technical basis in the area. Some skilled labour will be needed both for implementation of the project and for the operation and management. • Existing data may prove inadequate for undertaking a sound due diligence. • The availability or assessment of availability of project resources may change from allocation of funding to time of implementation. • Availability of manure is not always guaranteed • The beneficiaries are often amongst the richest (owners of cattle) • Important need for water • Important upfront costs implying that it is necessary to work with microfinance institutions.
Opportunities	**Threats**
• Most communities and especially farms and agro-based industries have an abundance of bio waste and waste water creating environmental problems and contributing to global warming. • This resource may serve as feedstock for biogas facilities, which are affordable and available for biogas production. • The technologies involved are simple. • The by-product is a clean fertiliser • It often solves the problem of waste water and latrines • Carbon funds under the CDM or the voluntary market can be obtained	• A sound safety system needs to be in place since biogas is highly combustible. Pressure is normally low, but the plant needs qualified staff for maintenance. • The complete technical system needs to be designed, so that each component is suitable for the overall plant design, with emphasis on protecting the plant from unnecessary wear and tear for example from corrosion due to insufficient cleanup of the gas before use. • Lack of business management skills and marketing can mean that the business is not viable • The technology is sometimes too complex for local capacity or requires too much time to construct

Key questions	1. Is there a feasibility study showing availability of all materials and other resources (such as adequate water and dung or waste to maintain required output levels) necessary? 2. Has the supplier sufficient experience in project implementation in the country or region? 3. Will there be any social, cultural (due to use of human/ animal waste), economic or environmental influence of the project on local citizens? 4. Is the biogas cleanup system adequate for the need (engine, micro turbine, fuel cell, or cooking needs)? 5. Has the project been checked for the possibility of including carbon financing? 6. Is there a system in place for maintenance? Does local capacity exist perhaps in the form of local companies/cooperatives with trained people?

Biofuels	
Technology background	**Biofuel** is fuel derived from plants and plant-derived materials (biomass) and mainly used to power vehicles and heat homes. Biofuels mainly refer to liquid biofuels, but the term also covers biomass and biogas. Biofuels can be divided into first, second, third and fourth generations, based on their time of invention. First generation includes bio-alcohols, such as bio-ethanol produced by fermentation of sugar, starch or corn etc. First generation biodiesel is produced in a transesterification process based on food crops like rapeseed and sunflower. Second generation biofuels includes bio-hydrogen diesel and are based on non-food biomass (cellulose). Third generation bio-fuels are based on algae that has a higher energy content than other biomass used for fuel purposes and can be used to produce jet fuel, gasoline as well as diesel through bio-catalytic cracking and fractional distillation. Fourth generation of biofuels is in the making and will most likely concentrate on microorganisms. Many of the ACP-EU Energy Facility projects use Jatropha oil to produce a biofuel. The Jatropha plant is sturdy and does not require large amounts of water, therefore does not require irrigation. The residue can be used for burning or as a fertilizer, or as the basis of other products, such as soaps and candles. The growing of Jatropha plants also serves to reduce soil erosion and acts as a fence around subsistence crops preventing livestock from eating the harvest.
Types of installations	Production facilities to produce biofuels are industrial process plants which can be small or large depending on the size of production required. Apart from the biofuel produced, there are often many by-products which can be used for income-generating activities. One of the most common sources of biofuel under the Energy Facility projects is the Jatropha plant. The seed is processed fundamentally using a very large-scale juicer which extracts the oil and releases the cake residue. The uses of Jatropha are illustrated in the diagram below which illustrate the extent to which the plant can be used for the purposes of not only biofuel production but also supplementary activities:



[13]

Under the Energy Facility, the Jatropha plants are interspersed with existing crops or planted as a fence to protect food crops. There is some controversy regarding large-scale Jatropha plantations for fear that they displace land devoted to food crops and deteriorate food security.

There are certain considerations before site selection is made for the growing of biofuel crops (specifically Jatropha):

- Type of soil and climate: Jatropha can grow in marginal areas with low quality soil and in frequent rains as it is a hardy crop, however yield is affected
- Availability of data for assessment of suitable climate and topography
- The possibility of establishing a nursery for seedlings, which gives the highest rate of successful planting and fruiting
- Proximity to possible processing sites
- Rights to use land for processing sites
- Capacity exists for local farmers to learn how to plant and maintain Jatropha as the way in which it is planted is crucial

[13] http://www.lged-rein.org/archive_file/Jatropha%20Cultivation%20-presentation.pdf

Strengths	Weaknesses
• Biofuels are based on renewable sources of energy, and the production of biofuels reduces global emissions both because natural formation of the potent GHG methane (global warming potential 21 times that of CO_2) is avoided and because biofuels substitute fossil fuels. • Depending on the source of organic matter for production of biofuels the use will reduce dependency on imported fossil fuels. • Biofuels are expected to be of major importance in the future transport sector	• Biofuel projects involve medium level technical expertise and are highly depending on the availability of skilled labour. • Especially the first generation of biofuels has been criticised for leading to increased food prices. This criticism is likely to be applied to all energy crops that do not rely solely on utilisation of crop residues such as cellulose in for example straw, where the nutrient part of the crop has been utilised. • Existing data (climate and topography) may prove inadequate for undertaking a sound due diligence. • The availability or assessment of availability of project resources may change from allocation of funding to time of implementation. • Crops are vulnerable to weather changes (e.g. droughts)
Opportunities	**Threats**
• Residues from food crops are a resource not in widespread use. • Production of biofuels is an opportunity to find raw materials for production of non-fossil fuels. • The use of biofuel sources such as Jatropha serve multiple purposes, such as fertilisation, reduction of soil erosion and protection of crops	• Large scale biofuel projects may face local resistance due to lack of farmland and other resources and due to fear of increased food prices • The technological development in the biofuel industry has been rapid and long lead times in project preparation may lead to the agreed project being outdated by more recent productive technologies being marketed in the meantime

Key questions	1. Is there a feasibility study showing availability of all materials and other resources (including long term biomass delivery contracts from documented land owners, staff, financing, permissions) necessary for the implementation and operation of the project? 2. Has the technology supplier sufficient experience in project implementation in the country or region? 3. Will there be any social, economic or environmental influence of the project on local citizens, for example availability of farm land and cheap food? 4. Is the biofuel technology involved up to date? 5. Has the project been checked for the possibility of including carbon financing 6. Is the biofuel produced for local market?

Investment in the Energy Sector	
Background	Financing of an investment in the energy sector can be obtained from different sources: • Entirely private, from domestic and/or foreign sources. • Entirely public. • From international donors. • Any combination of the above. Apart from this, an investment can refer to either: • An activity which is a natural monopoly (for instance, electricity transmission or distribution networks). These activities are regulated; hence their foreseeable level of income depends on decisions taken by the corresponding regulatory authority. • An activity in which competition is possible (generation of electricity through any type of power plant, supply of electricity to final consumers (either industrial/commercial or domestic)). If this is the case, the level of income depends either on tariffs or on conditions and evolution of the corresponding market, which can easily fluctuate. • Creation of a complete chain of supply (from generation to final supply) to a certain area, with or without connection to an existing network (electrification or supply of natural gas to a certain area). National regulations should be considered, and a previous complete analysis of financial viability is necessary. Responsibilities related to adequate future maintenance of installations must be defined.
Key issues in financial arrangements	• Stakeholders must have an adequate level of reliability and solvency. References are important. • Tariffs to be applied (if any) and methodologies for tariff updating should be adequately defined to guarantee viability. Technical and legal requirements from the regulatory authority affecting the financial viability of the project must be carefully analyzed, as well as mechanisms for revision and/or updating of these requirements. • Conditions of participation and responsibilities of each stakeholder should be clearly defined in the financial arrangement to be duly signed by all stakeholders in due time. • In case of investments whose profitability depends on market conditions (see above), an analysis of financial viability must be carried out, based on reasonable hypotheses and guesses about future developments. Structure, degree of development and possible future evolution of the energy market must be carefully analyzed. • Public-private partnerships (PPP) have the advantage of getting some compromise from public bodies: guarantee of compatibility with public energy policies, good knowledge of tariff methodologies, support mechanisms for renewable energy sources, etc.

Strengths	**Weaknesses**
• Supply of energy and/or electricity is a basic requirement for industrial development and welfare improvement of any country or area. • Consciousness of local authorities and regulatory bodies about the importance of an adequate supply of energy is generally high. • International agencies and donors consider very relevant to guarantee an adequate supply of energy to developing areas, as a pre-requisite for further development.	• Procedures for authorizations for energy plants, lines, etc. can be lengthy, not adequately defined and/or unclear. • Many different bodies can be involved in the process of authorizations, perhaps with a low degree of coordination among them. • Growing concern about negative environmental impact of energy technologies, including renewable energy in certain cases. • Maintenance of energy installations requires skilled manpower, which is not always available. • Periods of maturation are generally quite long.
Opportunities • Many areas in the world have very limited or no access to electricity. • Improvements of welfare of any society are always tied to increases in consumption of energy. • Use of renewable energy sources is encouraged everywhere. • Increasing consciousness about the negative environmental impact of conventional energy technologies.	**Threats** • Possible future modification of legal and/or technical requirements from the regulatory bodies affecting the financial viability of the project. • Possible limitations of increases in tariffs due to political reasons can put in jeopardy the financial viability of the project. • Possible socio-political turmoil in certain countries/areas. • Possible future negative variations in schemes of support for use of renewable energy sources.

Key questions	1. Are the energy project feasibility studies carried out adequately and with the necessary degree of accuracy? 2. Is the regulatory environment in the area adequately developed? Are the possible future variations adequately evaluated? Have the regulatory authorities been contacted? 3. In case of use of renewable energy sources, are the support mechanisms (feed-in tariffs, etc.) reasonably defined by the corresponding authorities? Are they realistic? Can they be considered sustainable in the long term as to guarantee an adequate level of profitability of the project? 4. Is the stakeholders financing agreement adequately designed? Are the contributions of each stakeholder approved by their directive bodies? Are all the responsibilities clear? Are possible future increases in the project budget considered? 5. Is the project sustainable in the long term? Can the project be replicated in the future?

<table>
<tr><th colspan="2">Attracting Private Financing</th></tr>
<tr><td>Background</td><td>With a trend leaning towards stronger private sector participation, as a means to filling the gaps created by inadequate resources within the public sector, more and more capital needs to be raised from the private sector and by foreign sources. Private financing is a challenge to the energy sector, even more so in the ACP region, with many remote areas with low population density and low income.
This leaves an important job for the energy facility in stimulating private sector investments via the pooling mechanism. Attracting private investors is challenging and supporting innovative and flexible funding mechanisms is required. To this end, the energy facility can:

o directly provide the leverage to make energy projects in the ACP region bankable
o support regulatory reform and capacity building to facilitate an investment friendly framework.

The above flashback to the objectives of the Energy Facility can function as the framework for monitoring the financial operation of the projects under the Energy Facility:

Status and changes to the bankability and risk profile of the project during the course of the implementation

So even if the first evaluation of the Energy Fund shows that less than 10% of total project costs has private sector involvement, it is important to monitor how the projects perform from a financial project feasibility perspective to facilitate larger private sector participation in the future.</td></tr>
<tr><td>Key issues in financial arrangements</td><td>The necessary tools are:
a. Financial proposal
b. Current budget
c. Financial statements
d. Ideally, original cash flow analysis together with an updated version.

Armed with these, comparisons can be made – Where are the deviations from the financial proposal to the current budget? And how do these fit with the financial statements? Looking at the financial proposal, it could be an idea to also look back at the design phase questions as stated above, to find the weaknesses in the financial setup, to monitor if these are being dealt with.

A natural way forward is to ask questions on the deviations from the original financial proposal and the current budget – why were changes made? Are new changes needed and why? Looking at the financial statements will also tell you how detailed and up-to-date the accounting is and if good accounting and reporting standards are maintained.
• The pooling mechanism: As several sources of finance are involved, monitor if the project is sufficiently coordinating and managing their financial partners.
• Financial partners: Sometimes, financial arrangements change in the course of the project. This could be related to the identity of the partner and/or the terms on which the partner is participating. Such changes can significantly</td></tr>
</table>

	change the project´s chances of success. • *Other contractual arrangements*: It can also have a significant impact on project financial viability if any of the key contracts change, e.g. the power purchase agreement, feed-in tariff etc. • *Cash flow projections*: Most likely, assumptions did not stick. Monitor how changes to the cash flow projects affect the projects ability to service their debt and provide a return on investment. • *Post Energy Fund finance period*: Intimately connected to cash flow projections, also focus singularly on the commercial viability of the project after the Energy Facility fund support ends. If not commercially viable, other sources of financial support should be in the pipeline. • *Delays*: Energy projects are more often than not delayed. This has a cost; monitor if the effect of delays on the financial viability of the project is properly taken into account by the project.

Strengths • If lending is involved for the remaining finance, financial monitoring is most likely stronger	**Weaknesses** • Lack of resources to service financial partners and ensure longer term commercial viability of project • Lack of resources to map and understand key risks to financial sustainability • Lack of resources to document project to facilitate replicability and private sector finance
Opportunities • Successful projects with good project replicability can facilitate implementation of other energy projects with more private sector finance	**Threats** • Delays in project implementation • Climate change; changes in weather • Interest rate goes up • Oil price goes down

Key questions	1. How does the project coordinate and manage the different financial partners? 2. Have any contracts changed and how does this affect the debt service coverage ratio and the feasibility of the project? 3. Have cash flow projections changed and how does this affect the debt service coverage ratio and the feasibility of the project? 4. How will the project make up for the cash flow from the Energy Fund when funding runs out? 5. Is the project delayed and how does this affect the terms of the loans and project cash flow?

Microcredit	
Background	According to its basic definition, microcredit involves provision of small loans and other financial services (such as savings accounts, cash advance, insurance) to poor people, who do not qualify for formal credit as they have no credit history or collateral. Microcredit allows them to pursue income generating activities that can generate extra income and thereby help them to better provide for themselves and their families. **The key objectives for microcredit are to:** 1) provide small loans and thereby improve loan conditions for poor people, who have traditionally borrowed from informal lending services such as money lenders, pawn shops, friends and relatives; 2) reach those who cannot borrow through traditional banks because they do not have credit history or collateral; 3) improve employment opportunities through income-generating activities; and 4) reduce poverty and improve living condition in a sustainable manner. The types of microcredit offered vary from traditional informal lending to organized village savings schemes to loans provided by financial institutions. All schemes have the following basic principles: • offer flexible financial services targeted on poor people (e.g. repayment • intervals and payback period); • align operations and reduce costs (decentralize loan approval, use • inexpensive offices and staff from local communities, simplify loan appraisal • and approval process); • operate on a market basis charging market interest rates and fees; and • aim at recovering the costs of the loan. For microfinance, repayment often depends on generating income by providing access to electricity. This means that the project must be "more" than establishing a grid or generating electricity – more than "just" credit for technology. For additional information, refer to the thematic fiche "Microcredit – a tool to improve access to modern energy" (http://energyfacilitymonitoring.eu/images/stories/publications/thematic_fiche_3.0.pdf)
Key issues in financial arrangements	Whilst most of the same considerations as for larger loans are applicable, there are some specific concerns that should be addressed when monitoring micro credit schemes for energy. The customers willingness and ability to pay, e.g. typically, the tariff for poorest the end user should not be higher than their current spending on alternative fuel sources, as they will not be able to pay. Another key area is ensuring that sufficient is set aside for equipment and replacement purposes and that this is not expected out of the operating cash flow.

Strengths	**Weaknesses**
• Appropriately designed microcredit loans facilitates livelihood improvements, not "just" credit for modern energy technology • Targets the poorest segments, often with no access to grid electricity	• Limited experience with providing microcredit loans for energy services and technologies • Process of developing suitable credit schemes for modern energy technologies is necessary
Opportunities	**Threats**
• Improve opportunities for initiating income generating activities for poor people • Expand service scope for local banks • Motivate local energy companies to branch out into rural areas	• Limited tradition for taking up loans and pay back capacity • Loans offered without ensuring pay back capacity, either through income generating activities or savings on energy expenses

Key questions	1. How is the loan part of an income generating scheme that will support loan payback? 2. To what extent does the loan scheme meet the objectives of microfinancing as a flexible scheme accessible by the marginalised communities? 3. Is there a need for guarantees? If so, of what kind and how does this affect the uptake of the scheme? 4. How has the project cash flow changed during the project lifetime and why? 5. How does the project expect to finance the ongoing maintenance and replacement costs longer term?

Legal and Regulatory Frameworks	
Background	Encouraging investment to increase access to energy services in rural and peri-urban areas requires, above all, the existence of a stable legal framework providing a **clear set of rules** and a level playing field between incumbent utilities and private operators. Political stability is a precondition for success. A coherent legal framework is composed of a number of documents. For example, (from upper to lower levels): • Energy Policy • Energy Strategy, Energy Efficiency Strategy, Renewable Energy Strategy and respective Action Plans • Energy Law sets the general framework for the functioning of the Energy market and its rules (e.g. degree of separation of generation, transmission, distribution and supply, rules for third party access, concessions, role of institutions, etc) • Eventually, there can be separate Laws for Energy Efficiency or for Renewable Energy, which would contain incentives to encourage investment in these technologies. Sometimes this is incorporated into secondary legislation • Secondary legislation provides detailed regulations relating to specific issues contemplated in the Law, for instance rules for tariff setting, technical requirements for grid connection, etc. The energy legal framework cannot operate in isolation. It needs to be coherent with other sector legislation: for instance, the general investment conditions in the country, import tariffs, labour legislation, etc. Regardless the quality of the energy legal framework, the governance level and independence of the judicial in the country is a key factor for its success. For instance, it will be very difficult to attract investors if they have no certainty that they can defend their contracts in court if it became necessary.
Key issues	In order to have a coherent framework, the government must have a clear idea of the aims and objectives it wants to reach. This should be followed by an analysis of the barriers. Once we know the objectives and the barriers, we can define the instruments to tackle them. Some commonly mentioned barriers are lengthy administrative requirements, too strict technical requirements or high tariffs for grid connection, high tariffs for back-up supplies in case of self-generation plants connected to the grid, lack of access to credit, low rate of return, etc. More difficult to tackle and specific to many Energy Facility projects are low population densities and low affordability. Some of these barriers can be tackled within the legal regulatory framework. Others need additional instruments such as capacity building or awareness raising. For instance, improved access to credit will need capacity building and awareness raising of the eventual credit holder and often credit institutions, in addition to an appropriate legal framework. The framework needs to be wide enough to encourage the adoption of the most cost effective sustainable solution. For instance, in peri-urban areas, grid extension may be the most adequate solution, while in rural isolated areas financially sustainable decentralized solutions may be more feasible. This involves allowing for the

	adoption of different business models. Common types of agreements between the stakeholders are Public-Private Partnerships (PPP) or concession agreements: • **PPP;** While there is no universal definition of Public-Private Partnerships (PPP), it can be defined as *a contract between a public sector institution and a private party, in which the design, financing, building, operation and ownership of the project is shared between the partners*. • **Concessions:** Can be defined as *contracts where the consideration for the works or services to be carried out consists either solely in the right to exploit the work or service, or in this right to exploit together with payment.* A concessionaire generally accepts, for example, the operational and/or financial risk of providing a public service or public work in return for the opportunity to generate income through the exploitation of that service or work. The incentives to invest need to be adapted to the local context, and aim at promoting the technologies with the best potential. For instance, feed-in tariffs (FITs) may be a good option if we want to encourage industrial self-generation of energy in areas connected to the grid, but it will not be effective for isolated rural villages not connected to the grid. If we want to encourage solar technologies, eliminating import tariffs on solar equipment could be an example of an adequate instrument. The process of definition of barriers and choice of instruments requires intensive dialogue and consultation with all the stakeholders, including the private companies, as well as with stakeholders from other sectors, such as health, water, industry, services, SMEs, etc. In most cases the new legal/ regulatory framework will need to be accompanied by capacity and institutional building. A very good legal framework will not be useful if the country does not have the institutional capacity to implement and enforce it.

Strengths	Weaknesses
• Rural electrification recognized as a priority sector => high on the political agenda • Contributes to the sustainability of energy supply to the poor • Give them access to quality control/ redress, if need be • Perceived high political returns by local politicians and law makers • Increase legal local/ national expertise • Contributes to economic growth	• Limited "absorption" capacity of the beneficiary staff in particular at the local level. If the institutional set-up is not ready it will not be possible to implement and enforce the legal framework • Lack of national resources needed for core capacity development actions such as regulatory analysis, civil service training, etc • Lack of government capacity to provide financial support to measures in the project's areas • Insufficient infrastructure/ tools at the institutions allowing the staff to make informed planning decisions • In federal/ decentralised states, differences in policies and in priorities at state/ region/ municipality levels making a consensus on legal and institutional issues difficult to reach
Opportunities	**Threats**
• Harmonise all national energy-related legislations into a coherent whole • Sound legal and institutional frameworks to attract foreign direct investments, which can be replicated in neighbouring countries to allow for future regional integration/ harmonisation of energy policies/ laws • Capacity building of local civil servants and legal practitioners • Improved governance: opportunity to consult and involve all the stakeholders, including the private sector.	• Lack of political support for the project/ failure to attract sufficient political interest/ failure to maintain sufficient political interest • Lack of political stability and predictability during the life time of the project • At best, minimum level of corruption to be factored at all levels of the beneficiary chain • Political hesitations hindering or halting the cooperation between the consultant and the beneficiary and hampering the exchange of information • In countries already suffering from internal conflicts, the situation could further deteriorate to the point when Parliament is unable to pass laws • Failure to achieve multi-party consensus

Key questions	1. What is the degree of government involvement in the project? What is the political will to reform the system? 2. Is the country part of a regional organisation? If so, how is energy handled at regional/ country level? Are there legal commitments that the country has made towards the regional organisation? 3. Is the country's energy strategy voted and in force? If yes, what are the energy laws also in force and what are those still in draft? If not, what is the progress in Parliament? Does the project need to address this first? 4. Of the laws which are in force, is there a need to amend/ add secondary legislation? 5. Of the laws which need to be drafted, what is the priority? 6. Is there a need for an "umbrella" energy law and should the project deliver? 7. How does the Law link with other general/ sectoral Laws? For instance, for a Law/ regulation encouraging private sector investment in the energy sector in rural areas, is there a coherent link to the general conditions for investment in the country (availability of foreign exchange, possibility to defend contracts in Court, political stability, governance level, legal stability)? 8. Is the project's time-line realistic to achieve the legal deliverables? Is there any room to accommodate the delays inherent to the political/ legislative processes? 9. Considering the importance of continued political engagement, is EUD prepared to monitor, engage with and encourage the local political decision-makers, if need be? 10. Is the institutional level ready for the implementation of the new legal or regulatory framework

Institution and Capacity Building	
Background	Several institutions are involved. Without aiming at being exhaustive, the following are key: • Ministry of Energy (at national level) • Regional and local authorities in the energy sector, • Energy Regulatory Authority, • Rural Energy Agency, • Energy utilities. The capacity building needs will be different depending on the function of the institution. A project targeting the ministry will deal with issues of policy and strategy, a project targeting the Rural Energy Agency will cover planning and a project targeting an energy utility may cover technical, managerial or commercial aspects. Projects in isolated areas not connected to the grid will also need to build the capacity of the users on both technical and managerial aspects (e.g cooperatives). In any case, a previous analysis on the needs and gaps is needed. Apart from strengthening institutions' capacities and building expertise, there are other elements involved. For instance, whether the institutions have the necessary tools to make informed decisions. One example is planning tools to make investment decisions. Existing institutions in the energy sector will have to work/ liaise with institutions in other sectors, for instance, the rural Energy Agency will depend on statistical information from other institutions to elaborate the rural electrification plan. Communication and cooperation with these institutions can be a very influential factor to the successful achievement of goals and therefore capacity building to address this can be wise based on the status quo.

Strengths	Weaknesses
• Improved skills • Awareness raising among users and inhabitants • Energy conscious behaviour	• Lack of sufficient project resources allocated • Lack of staff • Lack of proper tools at the institutions • Insufficient coordination with other institutions • Lack of community awareness and involvement in the early project assessment phase

Opportunities	Threats
• Implementation and introduction in schools and universities • Training and capacity building among civil servants • Instigation of institutional energy strategies	• Lack of trainers and skills • Brain drain: staff in institutions may leave for better paid jobs in the private sector or abroad after being trained

Key questions	1. Is the institutional framework in place? How does it work in practice? How does the project intend to address the capacity gaps? 2. Is the target institution sufficiently staffed? Are their skills adequate? Have the skill gaps been identified? Is the institution equipped with suitable tools to undertake its task? If not, is the project addressing this? 3. What is the level of other institutions upon which the concerned institutions depend and what is the quality of the data they can provide? 4. If the institutional framework is not in place, how does the government want to proceed? Should there be an overall energy agency or several energy sector specific agencies? How should the agency/ies be financed? Should there be a dedicated fund/s? Who should contribute to the fund? 5. Is the legal framework allowing the institutions to operate effectively in place? If not, are there plans to develop it? 6. Are sustainable awareness strategies and capacity building plans developed, and how/ who is responsible for the continuous implementation of activities? 7. The understanding and knowledge of maintenance requirements depends very much on attention paid to user awareness and user instruction by a supplier or within a project. Are there special folders, booklets or posters especially for the users in commonly written language and illustrated with pictures? 8. Is the right training being provided to the right persons at user-level? For instance, training is very often provided for the men, while the women are often the main users of the appliances such as PV- system. Are the women familiar with the basics of the functioning of their PV-system?