Review of Household Clean Energy Technology for Lighting, Charging and Cooking in East Africa – Kenya and Tanzania

Toolkit for Implementing Household Energy Projects in Conservation Areas

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ACRONYMS

AWF	African Wildlife Foundation
CAMARTEC	Centre for Agricultural Mechanisation and Rural Technology
CBO	Community Based Organisation
CO2	Carbon Dioxide
EAC	East African Community
ERC	Energy Regulatory Commission
GVEP	Global Village Energy Partnership
HEDON	Household Energy Development Organisation Network
IAP	Indoor Air Pollution
ICS	Improved Cookstoves
ISAK	Improved Cookstove Association of Kenya
ISO	International Organisation for Standardisation
JGI	Jane Goodall Institute
KEBS	Kenya Bureau of Standards
KENFAP	Kenya National Federation of Agricultural Producers
kW	Kilo Watts
LPG	Liquefied Petroleum Gas
M&E	Monitoring and Evaluation
MFI	Micro Finance Institution
MOU	Memorandum of Understanding
NGO	Non-Government Organisation
PCIA	Partnership for Clean Indoor Air
PV	Photo Voltaic
RE	Renewable Energy
REEEP	Renewable Energy and Energy Efficiency Partnership
SACCO	Savings And Credit Co-operative
SHS	Solar Home System
SNV	Netherlands Development Organisation
TAREA	Tanzania Renewable Energy Association
TOR	Terms of Reference
W	Watts

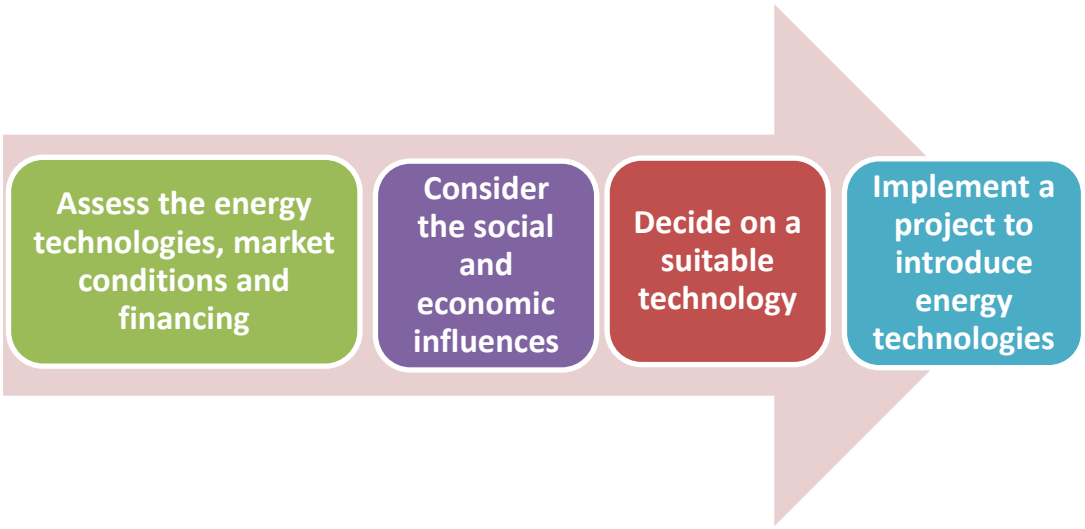
Photo Sources: GVEP International unless otherwise stated

1. INTRODUCTION

1.1. Toolkit

This toolkit has been designed as a resource document for the African Wildlife Foundation (AWF) and Jane Goodall Institute (JGI) to implement clean energy projects at the household level in conservation areas in Kenya and Tanzania. The toolkit will guide the user through the steps of designing and implementing an energy program and provides information on the following topics:

- Prerequisites when considering the suitability of energy technologies
- Necessary steps required to introduce a particular energy technology
- Market and socio economic feasibility of energy technologies
- Potential financing options for energy technologies
- Implementation process for energy projects



This toolkit is a follow on from the learning report documenting the findings from a review of household clean energy technology for lighting, charging and cooking in Kenya and Tanzania conducted by GVEP International on behalf of AWF and JGI. Further information regarding the different types of energy technologies available in Kenya and Tanzania, the main suppliers of energy technologies and challenges and lessons learnt from energy programs can be found in this report.

In addition to AWF & JGI staff, the toolkit can be used to inform the larger conservation community and donors who are considering implementing projects in the household energy sector.

1.2. Energy

Household energy is a crucial issue for organisations such as Africa Wildlife Foundation (AWF) and Jane Goodall Institute (JGI) who are working to conserve local environments that are coming under pressure from increasing human populations and activity. In areas of ecological importance energy services are of significant importance as communities need to rely less on natural resources such as firewood to lower pressure on depleting forest resources. In addition, the use of non-renewable sources such as kerosene to meet their cooking and lighting needs can also be reduced by cleaner energy technology alternatives. Many clean energy products such as improved cookstoves, solar home systems and lanterns, biomass briquettes, biogas and wind turbines are readily available in the East African market. Such products can bring the following benefits to the communities living in conservation areas:

- reduce household's reliance on unsustainable sources of fuel such as firewood and charcoal which can in turn reduce local deforestation;
- improve the social and economic welfare by saving them money on fuel, saving them time on fuel collection which can be spent on other activities and improving living conditions by reducing the use of smoky stoves and inadequate lighting;
- create livelihood generating opportunities, through activities such as solar phone charging, constructing energy efficient stoves and producing biomass briquettes.

2. ENERGY TECHNOLOGY OPTIONS

This section will describe the suitability of key energy technologies and the factors that need to be considered when introducing these technologies to a program. This section will focus on the following key technologies; improved cookstoves (ICS), solar technology, biomass briquettes & eco charcoal, biogas and wind. For more information on the different types of energy technologies available in Kenya and Tanzania and the key suppliers please refer to the learning report.

Technology	*Reduce Deforestation*	*Local Job Creation*	*Improve Living Conditions*	*Save Time*	*Save Money*
Improved Cookstoves	✓	✓	✓	✓	✓
Solar		✓	✓	✓	✓
Briquettes	✓	✓	✓		
Eco Charcoal	✓	✓	✓		
Biogas	✓	✓	✓	✓	✓
Wind			✓	✓	✓

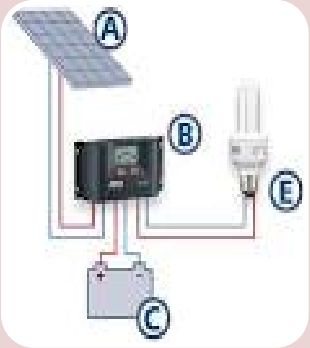
2.1. Technologies

2.1.1. Solar

When is Solar Technology Suitable?

- ✓ The area is off grid and is unlikely to be connected to the grid electricity, at least for 5 years.
- ✓ The area experiences sufficient levels of sunshine throughout the year, an average of 4 to 8 hours per day.
- ✓ A suitable location exists to place the solar technology which receives unobstructed sunshine.
- ✓ Households or businesses exist which have energy needs that can be met by the solar technology (i.e. lighting, battery charging).
- ✓ Capacity or local suppliers exist to supply, install and maintain the solar equipment.
- ✓ In some cases, when local politicians are not promising electricity connection to local population.

Solar Technology Options



Solar Home System

This technology is suitable for households and small business with basic lighting and charging needs. A suitable location to mount the panels is required which will receive sufficient level of unobstructed sunshine throughout the year. A SHS will be able to light a few rooms and depending on size power equipments such as TV, radio and refridgerators.

Solar Lanterns

Solar lanterns are suitable for homes and small business to replace a kerosene light for lighting a room. They can also be used by children to study with at night. They are suitable where household cannot afford a larger solar system. Most lanterns also have phone charging capacity.

Other Solar Technology

Solar water pumps are suitable for agricultural purposes and pumping water.

Solar water heaters (pic above) are suitable where homes and hotels require hot water throughout the day.

Solar dryers are suitable where agricutural produce needs to be dried.

Photo Source: solarpower-nigeria.com, solarthermalmagazine.com

Application of solar technology to conservation areas

Pros and Cons of Solar Technology

+	-
✓ Can provide light and power in off grid areas	× High initial cost can be prohibitive to lower income households
✓ After initial purchase cost there are no fuel expenses	× Requires regular maintenance and replacement of the batteries (depending on technology provided)
✓ Renewable energy that produces no harmful emissions	× Back up may be required for continuous power

2.1.2. Improved Cookstoves

When is an Improved Cookstoves Suitable?

- ✓ Households are highly reliant on biomass (fuel wood and charcoal) for cooking
- ✓ Households are experiencing problems with sourcing biomass for cooking (cost, availability, fire wood collection)
- ✓ Households are currently using traditional cooking methods and technologies such as an open fire or a basic metal stove
- ✓ Household members are exposed to high levels of smoke and other emission from their current cooking methods

(Note: This also applies to institutions such as Schools)

Improved Cookstove Options

Below are some examples of the different types of improved stoves and things to consider when assessing their suitability. Versions exist for both wood and charcoal.

Fixed Improved Cookstoves

This technology is suitable for users who own the house and cook inside consistently in a fixed position. Stoves can be made from locally available raw materials making them relatively cost effective. Versions with chimneys are suitable where high levels of emissions are present.

Local Portable Improved Cookstoves

This technology is suitable where the user needs to move the stove around or does not have a permanent residence. They can be bought directly from local distributors or producers. They are suitable for low income households usually costing less than $10.

Imported Improved Cookstoves

Most imported cookstoves are portable and hence suitable for users that want to move the stove around. They are a more expensive option than locally available stoves. They are also more efficient than local stoves. They can be bought from distributors but are less common than locally made stoves.

Application to conservation areas

Institutions
for cooking in schools reducing firewood use

Households
for cooking in the home

Restaurants
for cooking in restaurants and hotels

Businesses
for other applications that require heating of water etc.

Pros and Cons of Improved Cookstove Technology

+	-
✓ Can reduce fuel consumption and expenditure	× Quality of the stoves can vary and may need regular maintenance or replacement
✓ Can reduce harmful smoke and emissions given off during cooking	× Can be expensive compared to traditional stoves depending on type and quality of stoves
✓ Can offer beneficial cooking characteristics (improved cooking time, cleanliness, heat control)	× May not be able to meet all the end users cooking needs and secondary uses of the stove (heating the house or lighting)
✓ Can reduce the risk of burns and fire	

2.1.3. Briquettes & Eco Charcoal

When are briquettes and eco charcoal suitable?

- ✓ Charcoal is currently produced in an unsustainable manner
- ✓ Households are cooking with charcoal and using charcoal stoves
- ✓ People are buying charcoal at a high price (mainly urban areas)
- ✓ Briquettes & eco charcoal can be produced at a cost which is competitive with the local price of charcoal
- ✓ For briquettes, sufficient and reliable supply of biomass feedstock and binder (such as cassava) exists in the area
- ✓ For eco charcoal, wood lots exist locally or can be established for charcoal production

Briquette & Eco Charcoal Production Options

Eco charcoal is normally produced from wood in a specially designed kiln which has a higher efficiency than traditional methods of charcoal production. It is produced from only the branches of trees or sustainable grown trees. Briquettes are made from recycled biomass waste materials. Below are some examples of the different types of briquettes and some considerations to assess their suitability.

Feedstocks

Briquettes can be made from a variety of different feedstocks depending on what is available in the local area. The most popular is charcoal dust but other feedstocks include sawdust, maize husk, coconut shells and coffee husks. A binder is also required to hold the feedstock together.

Carbonisation

The feedstock needs to be burnt in a kiln to carbonise it. Carbonised briquettes tend to be less smoky hence suitable and preferred for household applications. Non carbonised briquettes are more smoky but can still be suitable for industrial applications. Charcoal dust is a popular feedstock since it is already carbonised but is not sustainable.

Equipment

It is possible to make basic briquettes manually. However, for better quality and higher production levels mechanical extruders should be used. Extruders can be manual or electric and vary in output and price depending on the capacity of the business.

Application to conservation areas

Institutions	Households	Restaurants	Businesses -
fuel for cooking and heating water	fuel for cooking in the home	fuel for cooking in restaurants and hotels	fuel for other applications that require heating of water or space heating

Pros and Cons of Briquette & Eco Charcoal Technology

+	-
✓ Reduces reliance on charcoal made from unsustainable wood resources	× Need to get recipe right to ensure a good quality briquette
✓ Briquettes improve waste management since they are made from recycled materials	× Can be more labour intensive than traditional charcoal production, hence increasing the unit price
✓ Can offer beneficial cooking characteristics – smokeless, steady burning, cleaner	× Feedstock supply may start to run out or competing uses for feedstock may arise.
	× Both fuels will not be feasible in areas with abundant firewood supply

2.1.4. Wind

When is wind technology suitable?

- ✓ The area is sufficiently windy with average wind speed above 5 m/s
- ✓ The area is off grid and is unlikely to be connected to the electricity grid at least for five years
- ✓ A suitable and safe location exists to place the wind turbines ideally on high ground free of obstacles
- ✓ Households or businesses exist which have energy needs that can be met by the wind turbines (i.e. lighting, battery charging)
- ✓ Capacity or local suppliers exist to supply, install and maintain the wind turbines

Wind Technology Options

Wind turbines can be either vertical or horizontal mounted with many variations of design and shape existing. Small wind turbine systems ranging from 50W to 40 KW are most suitable for small households and business. The two main applications for wind energy are electrical generation and water pumping.

Electrical Generation

Small wind systems are suitable for battery charging, stand alone applications and small mini grids. At the household level they are suitable for low-energy light bulbs, radios, mobile phone charging and occasional television use. They are also suitable for businesses charging batteries or phones.

Water Pumping

Windpumps are suitable for agricultural applications to pump water for irrigation. They are also suitable for pumping water from boreholes for community water supply and for livestock.

Photosource: Practical Action

Application to conservation areas

Tourism
power and lighting for tourism camps and lodges

Households
power and lighting for the home

Agriculture
for water pumping or food processing activities

Businesses
for electrical devices and charging mobile phones

Pros and Cons of Wind Technology

+	-
✓ Can provide power and water pumping in off grid areas	× Not suitable to all areas
✓ After initial purchase cost there are no fuel expenses	× Can perform badly if not correctly positioned and sized
✓ Renewable energy that produces no harmful emissions	× High initial cost can be prohibitive to lower income households
	× Back up may be required for continuous power

2.1.5. Biogas

When is biogas technology suitable?

- ✓ A source of organic matter exists to feed the biogas plant (cattle dung, human excrement or other organic waste)
- ✓ Biogas plants fed by livestock require a minimum of 2 cows
- ✓ There is a year round reliable water source
- ✓ Animals are housed in a stationary enclosure for a minimum of 12 hours a day (to ensure production of enough dung in a fixed location.)
- ✓ A suitable location to build the biogas plant exists

Biogas Technology Options

Floating drum plants

A dome shaped digester with a large floating inverted drum for gas storage. They are easy to operate but can be relatively expensive and require regular maintenance.

Photos source: azizakenya.com

Fixed dome plants

The most popular type in East Africa. A dome shaped digester, mixing and expansion chamber are constructed underground. This plant is cheaper, but harder to construct requiring a trained technician.

Tubular Plastic Plant

The digester consists of a polyethane bag with a hose to transport the gas.The gas pressure is controlled by a rope around the middle of the storage bag. This plant is cheap to contruct but can easily be damaged and is not widely available in East Africa.

Application to conservation areas

Tourism

provide gas for cooking in tourist camps & lodges

Households

provide gas for cooking

Institutions

provide gas for cooking using human excrement or cattle dung

Pros and Cons of Biogas Technology

+	-
✓ Reduce reliance on wood based fuels	× High initial cost can be prohibitive to lower income households
✓ Reduce time spent on wood collection and money spent on fuel	× Only suitable for a specific household markets where livestock is owned
✓ Provides a clean fuel which can reduce exposure to indoor air pollution (IAP)	× Require regular maintenance to keep in working order
✓ Produces a nutrient rich fertiliser as a by product	× Can perform badly if not constructed by a qualified technician

2.1.6. Other Options

Further energy technologies exist that are outside of the scope of this toolkit which may also be applicable in conservation areas;

- Other improved cooking technologies such as **LPG** and **fireless cookers**. Fireless cookers are insulting baskets that part-cooked food can be placed inside to continue cooking. LPG is a clean burning gas that can be used for cooking. The application of LPG depends highly on the availability of supply. The upfront cost of hardware can also be a barrier to households.
- **Hydropower** (micro and pico) is obtained from natural streams and rivers. The running water is diverted from its source down a steep incline, to run through a turbine system to generate electricity, before being returned to the flow. Conditions for this technology are very specific; therefore it is not suitable to all areas.
- **Geothermal** is generated using heat stored in the earth deep underground. The system requires a high start-up cost, but can produce large amounts of energy.

2.2. Suppliers

For almost all energy projects, equipments will need to be sourced through suppliers, i.e. solar panels, wind turbines or improved cookstoves. A number of suppliers of energy equipment exist in Kenya and Tanzania as detailed in the accompanying learning report. This section will describe ways in which to identify energy technology suppliers and considerations for sourcing products.

How to identify energy technology suppliers:

- Talk to local businesses and other members of the community to assess if suppliers exist in the local area of the site
- Seek advice from local NGOs or community based groups who operate in the area
- Search local company directories, websites and other advertising avenues.
- Attend trade fairs and exhibitions such as Dar es Salaam International Trade Fair
- Connect with energy associations such as Tanzania Renewable Energy Association (TAREA) In Tanzania or Improved Stoves Association of Kenya (ISAK) in Kenya for information on suppliers.
- Explore energy networks such as HEDON (*www.**hedon**.info)*, REEEP (*www.**reeep**.org*) and PCIA (*www.**pcia**online.org*)

Considerations when choosing a technology supplier:

Suppliers may range in size, location, price and experience from small local suppliers to established regional suppliers. The products they supply may be made locally or imported from abroad. It is recommended that a number of suppliers are approached and asked to provide information on their business, product specifications and price so an informed decision can be made. The following are some pointers when considering the technology suppliers you could potentially work with.

Geographical Reach	•Where do they have branches? •Who do they already supply to?
Production	•Where do they source from? •What is their production capacity? •What quality control measures do they have in place? •How much do their products cost? •What are the product specifications? •Do the products have a standard certification? •Is there a guarantee or warranty for at least 6 months?
Maintenance	•Do they provide local maintenance? •What warranty do they offer on products? •What after sales support is available?
Transportation	•How will the products be tranported to site? •How much does transportation cost?
Knowledge	•Do they have experience of the local area and community? •Do they provide marketing and promotional material? •What is their customer profile?

Pros and Cons of Local versus Imported Technology

Local		Imported	
+	-	+	-
Creation of jobs in the community	Quality cannot be guaranteed	Well tested and reliable if from reputable producer	Relatively expensive
Sustainable and utilises local materials	Can have crude appearance	Often more efficient and higher quality	Spare parts may not be available locally
Can be repaired locally	May be less efficient	More choice of technologies available	Maintenance will depend on presence of supplier/ distributor in local area
Low transportation costs			

2.3. Quality

The quality of energy technologies available in the market can vary and is an important consideration when deciding on the technology and supplier to use. Below are some pointers that can be used for assessing the quality of energy technologies.

East African Standards

Check if the supplier / product meet quality regulations and standards. These are available mostly only for solar or cookstoves products. These could include the following;

- Energy Regulators Commission (ERC) solar regulations
- Kenya Bureau of Standard (KEBS) certification
- ISO certification
- Lighting Africa certification (for solar lanterns)
- East African Community (EAC) guidelines

Testing Products

Independently verify the performance of the product by taking a sample for testing either in a laboratory or through field trails to check that it meets the given specification. This is possible if an organisation wants to roll out a particular product, but may be too expensive for a household to investigate.

Reputable Suppliers

- Work with an established supplier to minimise risk of getting bad quality products
- Ask for references or visit a customer already using the product to check quality and performance
- Identify supplier through sector associations or programs such as the Domestic Biogas Program which promote quality control
- Assess the methods used in production and skill of labourers

Example: The KEBS Kenya Standard for Household Biomass Stoves (not full criteria)

- ✓ Stove cladding should be made from a mild steel sheet of minimum thickness 0.60mm and maximum thickness 1.20mm
- ✓ Liner made from suitable pottery clay fired at 700- 900 degrees C and should withstand 5 cycles of extreme heating and cooling.
- ✓ Outside surface temperature of the stove should not exceed 45 degrees C
- ✓ Thermal efficiency of more than 30% at power output of 30 kW

Example - Biogas: Both Kenya and Tanzania have National Domestic Biogas Programs which has been supported by SNV and implemented through local implementing agencies. In Kenya, the local implementing agency is the Kenya National Federation of Agricultural Producers (KENFAP), whilst in Tanzania it is the Centre for Agricultural Mechanisation and Rural Technology (CAMARTEC). The National Domestic Biogas Program in each country aims to create a sustainable and commercially viable biogas sector in each country using a private sector strategy. This strategy involves training local masons, involving financial institutes to provide end user loans, providing incentives to investors and ensuring quality manufacturing.

3. MARKET FEASIBILITY

3.1. Assessing the existing market

It is important to consider the current conditions of the target market and the feasibility of the product when deciding on a suitable energy technology. In a conservation context the target market might be the local community in a conservation area who are using local wood resources for cooking and travelling long distances to purchase fuel for lighting. The target market could also be urban areas that are using charcoal that is sourced from wood in conservation areas. Urban and rural markets will have different energy needs and may require different implementation approaches.

Urban	VS	Rural
•More likely to be using charcoal, kerosene and LPG •More likely to pay for their fuel usage •May be connected to grid electricity •Better access to products and services •Often living in rented accommodation with less land available		•More likely to be using firewood •May be collecting firewood for free •May be far from grid electricity •May travel large distances to collect fuel •May have more land available and more likely to own livestock

The following sections give example questions that can be asked to assess the target market and ideas on how this might influence the approach taken in an energy project.

Assess existing energy needs and habits

Questions:

- What fuel does the target population currently cook with?
- What types of cooking device/s are being used?
- What fuel/product do households use for lighting?
- What are the problems with current cooking and lighting methods used?
- What are the factors that influence these cooking and lighting choices?

Options:

Assessing the current cooking and lighting practices will help evaluate the potential market demand for energy products. For example if households are already connected to grid electricity there will be a low demand for solar technology. However, if households travel far distances to purchase kerosene or charge mobile phones, solar technologies may be attractive. It will also enable a choice of technologies that are appropriate to the situation. For example an improved charcoal stove would not be appropriate in an area where most people cook with firewood and charcoal is not available.

Understanding current problems will help to choose technologies which will offer clear benefits to the consumer. For example if smoke from stoves is a problem for end users a stove with a chimney could help overcome this problem. It will also help in developing marketing messages for the product, for example – 'improved cookstove can reduce smoke and relieve sore eyes and coughing'.

Assess current level of consumer awareness of energy technologies

Questions:

- Have consumers heard of the energy products (improved cookstoves, solar lanterns, eco charcoal, biogas etc.)?
- What attributes do people associate with these products (both positive and negative)?
- Do people know where they can buy these energy products?
- What are some of the constraints or barriers that stop people purchasing these energy products?

Options:

Households in the area are unaware of the energy technology	A program needs to have a large element of awareness creation and involve marketing and advertising campaigns, or community mobilisation efforts on the uses and benefits of the energy technology/ies
Consumers have heard of energy products but have negative perceptions	Further marketing/ information may be required to overcome negative perceptions or advertise the full product benefits.
Consumers have a high awareness of energy products but the products are not available	A program needs to increase the availability of the products and contact sources where the products can be bought
Consumers have a high awareness of energy products but think they are expensive	A program would need to explore ways to make the products more affordable and advertise the cost saving benefits of the technology. Programme could consider linking financing for customers.

Assessing willingness to pay

Questions:

- What is the income level/s of the various segments of the target population?
- What is the current household expenditure on different energy needs?
- What cost saving benefits could the various energy technology/ies offer?
- Are there times of the year when households have more money?
- Do households prefer to pay for items upfront or in instalments?
- What is the minimum & maximum payment preferences for energy products?

Options:

- If households display low willingness to pay financing mechanism might be needed to help spread the cost of the energy products such as paying in instalment/s, on credit etc. (see Types of finance available).
- Consider marketing energy products to households at times of the year when they have more money available such as when harvests or livestock have been sold.
- Highlight the cost saving benefits of energy technologies to consumers and how this saving will allow the product to pay for itself.

Assess existing energy businesses and projects

Questions:

- What existing energy businesses are there in the area?
- What skills and resources exist within the local area?
- Are energy programs already operating in the area?
- What local organisations could potentially be partnered with?

Options:

- Existing energy businesses could be used as potential product suppliers and provided with further capacity building to increase the quality of their products or their market reach.
- Even if no energy businesses exist there may be potential to start energy businesses if the necessary raw materials and skills are available in the area.
- If existing energy programs exist these could be leveraged to provided services to the target area or provide technical or marketing assistance.
- Local organisations working closely with the community could be utilised to introduce energy products and mobilise the community. However, energy technology experts may be needed to train these mobilisers first.

Additional Considerations

Questions:

- What is the transport infrastructure in the region like?
- What would be the cost of transporting energy products to the region?
- What marketing avenues already exist?

Options:

- Consider how to reduce transport costs for example taking advantage of economies of scale or linking with existing distribution networks.
- Local market days or trade fairs could be used to advertise energy products and create awareness.

3.2. Types of finance available

The high upfront cost of energy technologies is most often a significant barrier to purchase of products. In such cases finance schemes might be necessary which allow the user to pay for energy products in credit or through one or two instalments. Access to capital may also be required by energy businesses to help them scale up or expand their market reach.

Assessing what financial services are available

Questions:

- What financial institutions are operating in the area? These could be banks, micro finance institutions (MFI), and community level savings groups or co-operatives.
- What services do financial institutions offer?
- Do they offer any energy product loans?
- What are their terms and conditions of lending?

Types of Financial Institutions (FI)

Banks
FI directly regulated by the bank

MFIs and SACCOS
not directly regulated by the bank but under various government laws

Informal Lending Schemes
includes community level savings schemes, those set up by CBO's

Consumer Payment Options

Upfront payment:

The consumer pays fully for the item from the supplier or dealer in a single transaction.

Credit from supplier or dealer:

The energy technology supplier may extend credit to the consumer directly and allow for payments for the product in instalments.

Credit through a financial institution:

Financial institutions may offer loans to their members or to groups to purchase energy products.

Pay as you go arrangements:

The consumer can pay as they go to access energy services such as lighting from a solar system in the same way they would buy fuel in small instalments each week.

Due to the small amounts involved and perceived risk of lending many financial institutions prefer to lend through groups, who can then in turn extend credit to their members. These groups could be farming associations, women's groups or other umbrella organisations. Where possible, groups should secure a deposit from their members, to demonstrate commitment to the project and a willingness to pay, with the remaining amount been given as a loan. Energy loans are becoming more common both in Kenya and Tanzania but may be less available in rural areas.

4. SOCIOECONOMICS

Social and cultural factors can have a strong influence on the uptake of energy technologies. Users can attach certain perceptions around cooking methods, fuels and technologies. Many communities have been using the same technologies to meet their household energy needs for generations. Introducing a new energy technology can represent a big shift in behaviour that needs to be accounted for.

EXAMPLE: How social and cultural factors can influence the uptake of energy technology

- Besides from cooking, the three stone fire can also be used to warm the house and the smoke can be used to ward of mosquitoes and dry maize - uses that are not effectively catered for by many improved cookstoves.
- A negative perception around cooking food on gas produced from human waste deters many schools from adopting institutional biogas technology.
- Many people believe that the smoke from the three stone fire or an inefficient cooking stove adds flavour to the food.

Useful questions for analysing social and cultural factors:

- What are your current methods for cooking/lighting/charging? What do you like and dislike about the various methods?
- What secondary uses does the current cooking and lighting technology provide?
- Does your current method for cooking/lighting/charging provide you with any additional social or economic opportunities?
- Would you be willing to change to another method of using fuel or technology? Why or why not?
- Are there local resources that would be impacted with the introduction of an energy technology?

How to overcome cultural and social perceptions

- Provide alternatives to meet secondary uses that an improved energy technology may not meet.

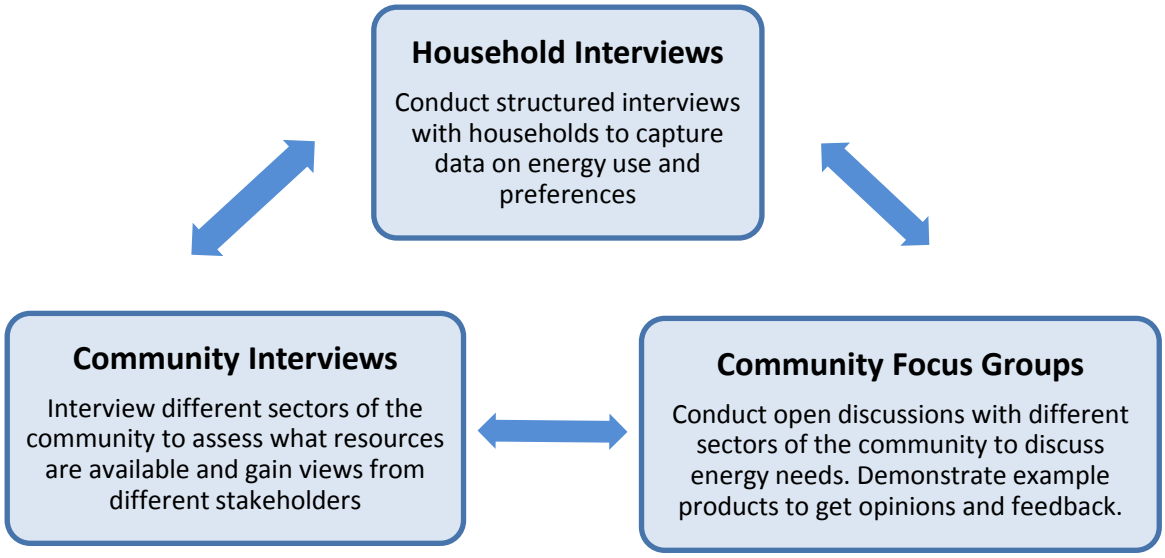
- Highlight the additional benefits that an improved energy technology could meet such as, home improvement aspects, freeing up time and social opportunities created by having electricty or a smoke free kitchen.

- Peer marketing can have a strong effect on technology uptake. Having one household adopt the technology as an energy champion will allow other members of the community to admire the benefits for themselves and hear positive testimony from their peers. The impact is higher if the early adopter is a leader of the community or region. This allows for more visibility.

- Market energy products as an inspirational item so they are seen as a progression rather than a replacement. To do this, quality of products are essential to be promoted.

4.1 Methods for assessing the market

The best methodology for assessing markets as well as the socio cultural aspects is to conduct a participatory series of discussions with the potential user community. Various methods such as household interviews through a survey, and community focus group meetings can be used as below.



Tips for assessing the market

- ✓ Seek opinions from all sectors of the community
- ✓ Hold discussions with men and women separately
- ✓ Allow for discussions to be held in the local language
- ✓ Discuss the pros and cons of the technology – in relation to resource use, cultural perceptions etc.
- ✓ Interviews should be led by a neutral person to allow open discussion
- ✓ A member of the local community should be involved to introduce the assessment to the local community
- ✓ Consider both the rural and urban market

5. IMPLEMENTATION PROCESSES

So far the toolkit has guided the user on how to choose an appropriate energy technology, how to assess the market for the product or user perceptions in particular considering the cultural and social factors that might influence its uptake. We will now consider some of the options available to implement an energy project to introduce energy technologies to an area and the process that might be taken.

5.1. Implementation Models

Sourcing directly from an established supplier - project based model

- Energy products such as solar home systems, cookstoves and briquettes are sourced from established suppliers, transported to the region and made available for sale.
- The supplier may conduct marketing activities and offer installation and after sales services.
- The project management may front the cost of the equipment and then sell them on in the community or they may secure orders for the products in advance. Alternatively facilities to extend credit could be arranged by the project directly or via suppliers/ financial institutions.

Setting up a dealer network - an enterprise model

- Links are made with established suppliers and a network of distributors in the project area set up. These could be existing business expanding their product range or individuals.
- Distributors source products from the supplier and sell them on in the community.
- The distibutors are trained on marketing , business management and after sales service.
- Financing through the suppliers could be made available so distributors can source products on credit and potential extend this to customers.

Training new energy businesses - an enterprise based model

- New energy businesses are trained and established in the local area
- These businesses could include those producing energy products such as improved cookstoves and eco charcoal or new suppliers and stockists of energy products.
- The entrepreneurs are provided training on technical aspects of production as well as business and marketing skills.
- The entrepreneurs may further be linked to finance to help them purchase additional equipments/products and scale up their business.

Pros and Cons of Implementation Models

Model	+	-
Sourcing directly from an established supplier – project based model	Energy product is immediately available Supplier already has skills and experience Project management can see product and quality before buying	Project may have to meet high transportation costs Consumer may not know how to access after sales service and maintenance Consumer has limited choice
Setting up a dealer network/s - **Enterprise model**	Local job creation Products available at the local level More personal interaction between dealer and consumer	Dealer may not maintain sufficient levels of stock and is dependent on suppliers who may be far away Dealer may not be proactive in marketing the product May have high transportation costs
Training new energy businesses - **Enterprise model**	Local job creation Product available at the local level and utilises local materials Lower transportation costs	Quality of product may not be as high Business may not have necessary business & marketing skills Availability restricted by production levels

Models that consider the complete value chain for the energy product from the supplier to the end user will help address issues of quality, sourcing and distribution throughout the value chain. It will also help the project become sustainable if local business and consumers are not reliant on the project management sourcing the products for them but know where to source them themselves and have a network of dealers to help distribute them.

Working with energy businesses can help to develop a commercial and sustainable market for energy products. An energy program may support such business to improve on their technical and business skills in order to scale up and improve access to their services.

Training Needs of Energy Businesses

Business	Technical
• Developing business plans • Record keeping (sales, profit, loss) • Costing and pricing for energy products • Financial management • How to access finance • How to market energy products • Creating new market linkages	• Sourcing quality products • Correct production methods and quality control (ICS, eco charcoal, biogas) • Product design and testing • Sizing of energy equipment (solar, wind) •Equipment available for production (ICS, eco charcoal)

Ownership and Management:

Appropriate ownership and management are both important determinants of successful projects or businesses. The most common forms of ownership and management are defined below:

Ownership & Management Type	Description	Operational Impact
Individual	- Mainly under an enterprise based model - Individual will own and manage the business / project - If the business is successful and grows significantly, a Manager may be hired - Individual owners normally prefer to manage their business and employ people in various other roles	- Projects could support individual entrepreneurs/businesses to further sell their products or services to community members or to other areas/regions. - Project can build up his/her market by bringing awareness programmes to the respective communities, assisting the entrepreneur to link in to new markets etc.
Community – cooperative model	- Members of a community form a co-operative. - Members of the co-operative can manage a project or set up a mechanism to buy energy products and initiate some lending to group members to purchase it. The co-operative can use internal group funds to finance it amongst themselves.	- Ownership model needs a more time intensive driven approach and a wider mobilisation of community members to take ownership. - Often, an energy committee is formed to manage the day to day activities of the project. - The committee further consults with the community and make decision on their behalf regarding the project. - Issues of leadership, social hierarchies and cohesion need to be discussed before setting it up. - Transparency of information is extremely important to make community projects successful.
Community Model	- Members of the community contribute to the cost and could both own and manage the energy project. - The project could be for a communal service or a service that will be divided between members of the community - Additional funds may be contributed by other stakeholders such as local development funds, investors or local NGOs.	
Group	- Few members within a community may start a project or an enterprise as a formalised group. - It could be gender based - Many women prefer to be under a group ownership model as they do not usually have the financial capital to initiate projects or businesses on their own. Energy projects are products are often cost intensive	- It is important to follow a structured approach and register the group as a legal entity. - The social dynamics of a community needs to be understood well to start a group business or project. - The group can own common resources such as kilns, or workshed/s for business and may sell the products collectively.

	and therefore this model is common particularly in rural areas.	
Investor	- An investor may provide capital to set up an energy product and then charge the end user to access the service - Common with bigger investments such as solar companies setting up small micro grids and charging the community to access the electricity.	- The customer is often not responsible for any maintenance which is the responsibility of the company. - Companies have started to lease products but they are not common in East Africa.
Donor/ development partnership	- A donor or development agency may provide capital to invest in setting up an energy project which can then be accessed by the local community. - For larger installations like solar water pumping or micro hydro plants, donors might provide subsidy for the full project cost.	- It is important to have a good ownership and management model whereby the project will be sustained in the absence or exit of the donors. - The development partner may provide training and capacity building to business or communities and facilitate market linkages. - The organisation could help make decisions about the project i.e suppliers to work with, who to train and conduct monitoring and evaluation of the project.

Additional considerations for community projects:

- All members may not have the same level of understanding and may create misunderstandings
- It is extremely important that appropriate linkages with suppliers, surveyors, financing institutions are well co-ordinated
- Strong leadership is important and any important information should be channelled through the leaders nominated
- Social problems may arise (due to use of common resources etc) and therefore must be monitored and solutions sought
- It is extremely important that a set of rules be developed and maintained for community members to follow
- It is important to bring consent first from the users, and those who might be affected by the project directly. Members must know about the costs and benefits that will be involved.

5.2. Operational Considerations

This section will consider in more detail some of the operational considerations of the project.

Assessing the activities involved in the project

When planning how the project will be executed think about what activities will need to be done. The following list provides examples of some of the activities that your project is likely to involve for an enterprise based approach. An example timeline based on a three year enterprise development project following these activities is given in Annex A: Example timeline for a three year enterprise based energy project.

Activity	Description	Time Required
Project Planning	➢ Conduct market and technical feasibility study and deciding on the implementation model. Could include household surveys focus group discussions and community interviews as outlined in previous sections. ➢ Set project targets - develop indicators for the project and targets that need to be achieved. i.e number of new business started, number of solar systems installed, number of beneficiaries etc. ➢ Financial budget and planning must be outlined in detail to ensure that the targets will be met within a particular timeline ➢ Project staff must be trained on energy if an expert is not in the team.	3 months
Setting up an M&E system	➢ Put your M&E system in place to monitor the progress of the project. Decide on how indicators will be tracked and how data will be collected.	1 month M&E continuous
Recruiting Partners	➢ Create awareness of the project and introduce it to the local community, explain how the project will work and introduce the energy technologies. It is preferable that an energy expert is involved at this stage. Get initial feedback from the community. ➢ Engage suitable businesses identified in feasibility assessment in more in depth discussions of how they could participate in the project. Sign memorandum of understanding between interested partners & project management outlining their responsibility in the project and those of the management. These could also include financial institutions or savings groups to work with on financing mechanisms. ➢ Identify local businesses or individuals that could be start-up energy businesses. They could be identified through initial assessments, through partners or additional mobilisation activities.	Initial partner recruitment 3 months. Continuous activity as more partners are identified and recruited
Training of partners and	➢ This could be training on production techniques for eco charcoal or improved cookstoves so local business can start	Initial training 3 months

energy businesses	producing. It could also be business training for existing businesses. This training should be tailored to the needs of the individual business. It may cover several topics over a series of days or be split into different modules delivered at staged time intervals. Refresher trainings may also be held later on in the project.	Ongoing as more businesses recruited
Conduct marketing events	➢ Events aimed at creating awareness of the energy products may be conducted to try and stimulate demand in the market and advertise where the energy products can be bought. They could also advertise financing mechanism available to purchase the products. These could be held regularly throughout the project.	Held at regular intervals
Business Follow-ups	➢ Follow ups should be carried out with businesses to check that they are implementing the training provide and to offer additional support and advice. A system needs to be put in place to facilitate these follow ups, they could be one to one visits by project staff or monthly group meetings held with participating partners etc. ➢ Skilled staff members that have expertise in enterprise management is required for this type of support	Continuous
Developing business plans	➢ Businesses may be supported to develop business plans and a plan of action put in place to help them realise their business goals.	Continuous
Linking business to finance	➢ Once businesses have been operational in the program for a year and have displayed commitment to the project, business acumen and have a well-developed business plan they may be supported to access a loans to help them expand their operations.	Continuous after first year
Project Evaluations	➢ The project should be evaluated continuously and the strategy refined where necessary. It is recommended that a formal mid project evaluation and final evaluation are conducted to assess the progress against targets set.	Evaluation - 1 month

Identifying Local Partners

Whatever management and ownership model you choose it is likely that you will need to work with local partners in one of the following facilitating roles;

- Leverage their relationship with the local community to create links and introduce the energy project
- Provide day to day management of the project at the local level
- Facilitate specific activities such as trainings or awareness creation

In Tanzania especially, it is also important to work closely with the local government offices and keep them informed of project activities.

How to identify local partners

- Identify NGOs , community based organisations and energy businesses operating in the area (see ***Error! Reference source not found. Error! Reference source not found.***)
- Find out how these potential partners work with the community or what their outreach is, what activities they do and their views on energy issues
- Talk to the local community to see what organisations they are aware of and get their insight into their activities and effectiveness
- Decide on the activities that the local partners would implement based on their skills and experience and discuss with them further. It is best to know their strengths and limitations as not all partners will be experts in all energy technologies.
- For suppliers of energy products, it is best to choose partners that sell quality products, are flexible in reaching to rural areas or a wider area, and most importantly those that provide maintenance services locally.

How to engage the local community

Whether a community or business approach is chosen, it is important to engage the local community in the energy project. Your project should also consider the different needs of both men and women in the community and may take different approaches when seeking their opinions.

Tips for community engagement:

- ✓ Hold a meeting with local community leaders early on in the planning process to discuss the project. Support from local community leaders will help the project run more smoothly.
- ✓ Use local community events and gatherings such as church meetings, market days and fundraisers to promote the project to the community.
- ✓ Have members of the community especially local leaders and those with influence to act as energy champions.
- ✓ Include community members - both men and women - in any project steering committee and keep them consulted on project activities.
- ✓ Work closely with organisations and groups that have strong community links.

Gender Considerations in Energy Projects

Men	Women
• Men are often in charge of expenses in the household and make the ultimate decision on buying. • Men are most likely to be the leaders of the community and should be engaged to introduce the project to other members. •Men often travel large distances to purchase kerosene or charge their mobile phone and find appeal in solar products. •Men tend to dominate in businesses utilising metalwork and electronic skills i.e stove cladding and solar technicians.	• Women are incharge of the cooking in the household and collecting firewood. They will be a direct benificarary of an improved cookstove. •Some savings groups and loan products are targeted at women only. •Womens groups are potential partners for producing and selling energy products. •Women are often less willing to take out large loans and favour businesess requiring less capital start up such as briquettes or improved cookstoves.

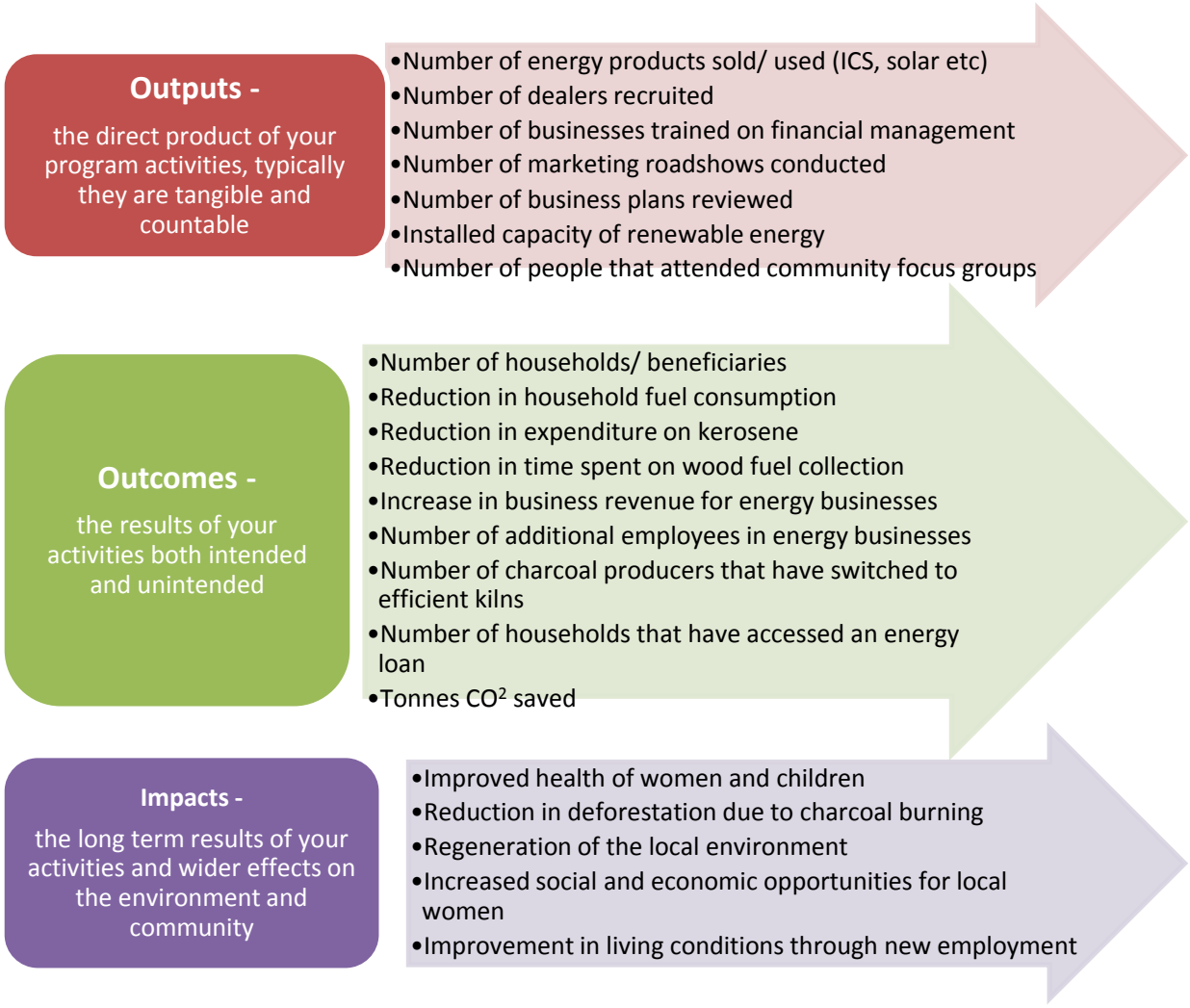
5.3 Monitoring and Evaluation

Once you have decided on how you will implement your energy project you will need to find ways to measure the changes resulting from your project's activities. This will help you to monitor the progress of the project and evaluate its success.

Identifying indicators

Indicators can be used to identify the parameters you want to measure in your project. To identify suitable indicators for your project think about the things you are trying to achieve and the effects of the program activities. Indicators can be both quantitative and qualitative. In some cases, multi-media data - such as pictures, videos and voice recordings - may be used to verify the indicators for your project. In other cases behaviour change or attitude may be an indicator.

Example Indicators



Establishing a baseline

To understand the changes and impacts resulting from your project you will need to know what the current situation is for the indicators that you choose. Below are some pointers on how to establish the baseline for your energy project;

- ✓ **Baseline of energy consumption:** household surveys can be conducted in the target area to ascertain the current energy consumption and determine needs.
- ✓ **Assess the local environmental conditions:** what is the current state of the local environment, amount of forest cover and level of deforestation. Picture data will be useful to capture this information.
- ✓ **Assess existing capacity of partners and businesses:** This can be done through a questionnaire when partners and business are recruited into the program. Consider current sales, turnover and number of employees as well as their current skill level in areas such as marketing, record keeping and financial management.

How to collect the data?

Once you have decided on the indicators to monitor your program and established a baseline, you need to decide how you will monitor these indicators through the course of the project. It is best to collect information at regular intervals to enable the progress of the project and also to learn from the emerging issues and change direction if needed. It is likely that your project will have a monitoring and evaluation officer who will be responsible for this task. However, it is upto the project managers and officers to understand whether the activities they carry out on a daily basis are acquiring the desired impacts in the community or the entrepreneurs they are working with. It is important to note that data collected should be disaggregated by gender, as men and women often have different needs, constraints and aspirations.

What would success look like?

Think about what a successful energy project might look like so you know what you are aiming for. Below is an example of what a successful project - introducing energy products through setting up local business - may look like.

Example: A successful energy project

A range of energy businesses exist in the local area. These businesses source quality products from a reliable supplier/ producer and have developed several channels to sell their products through market days, local women's groups and sales people. Due to training received they keep accurate records and are proactive in marketing activities. They have well developed business plans and high potential businesses have accessed financing and used this to expand their energy businesses. These energy businesses have created employment in the local community.

Households in the area are aware of the energy business; they understand the benefits of the energy products and know where to buy them. The products are affordable in the local market due to financing mechanism set up with local financial institutions and suppliers. As a result uptake of the energy products is high with many households switching from traditional methods to improved lighting, cooking and charging methods.

As a result of the uptake of these energy products, households are using less firewood, charcoal and kerosene and hence saving money which they can spend on other items. Women and children are exposed to less harmful emissions whilst cooking and hence their health has improved. There is a notable reduction in the cutting of trees in the local forest for fuel and as a result the area has started to regenerate.

6. CONCLUSION

This toolkit has guided the user through some of the stages necessary for implementing an energy project, including how to choose a suitable technology, assess the market feasibility of the project and understand some of the steps that may be required in a project. Further information regarding

energy technology suppliers in Kenya and Tanzania and the application of energy technologies in the AWF and JGI sites surveyed during this assessment are given in the learning report.

Different technologies and approaches exist for introducing energy technologies, some of which have been described in this toolkit. This toolkit has provided a general overview and further in depth analysis would be required given the specific project site and implementation model.

7. ANNEX

7.1 Annex A: Example timeline for a three year enterprise based energy project