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Case Study

Energy Service Companies (ESCOs) in Zambia

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Centre for Energy, Environment and Engineering Zambia Lilited
Private Bag E721, Lusaka
Telefax: +260 1 240267
Tel: +260 1 243619
Email: ceeez@coppernet.zm

CEEEZ
Centre for
Energy, Environment and
Engineering Zambia Limited

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ACRONYMS/ABBREVIATIONS

NESCO	Nyimba Energy Service Company
CHESCO	Chipata Energy Service Company
LESCO	Lundazi Energy Service Company
DEA	Development and Energy in Africa
SEI	Stockholm Environmental Institute
PV	Photo Voltaic

1.0 INTRODUCTION

1.1 Overview

1.1.1 Context of the case Study

This case study was undertaken as part of the project "Development and Energy in Africa "(DEA). DEA is funded by the European Commission's Intelligent Energy-Europe programme COOPENER and co-funded by the Danish International Development Agency (DANIDA) through the UNEP Risoe Centre and the Netherlands Government through ECN.

The project commenced in May 2005 and it is expected to last for 30 months to October 2007. The principal aims of the DEA project are (i) to identify and examine the developmental impacts of energy interventions[1] linked to improving energy access and poverty alleviation and (ii) to use the information and insights gained to improve on-going and future energy interventions by energy policymakers and institutions in six Sub-Saharan African countries: Botswana, Ghana, Mali, Senegal, Tanzania and Zambia. The immediate objectives of the DEA project are (i) to establish and apply an Assessment Framework for evaluating development and poverty impacts of energy interventions and (ii) to engage in a dialogue with energy policy makers and other stakeholders on the basis of the framework, with a view to incorporate these issues in energy policy.

DEA has nine work packages. To date the project has accomplished the following.

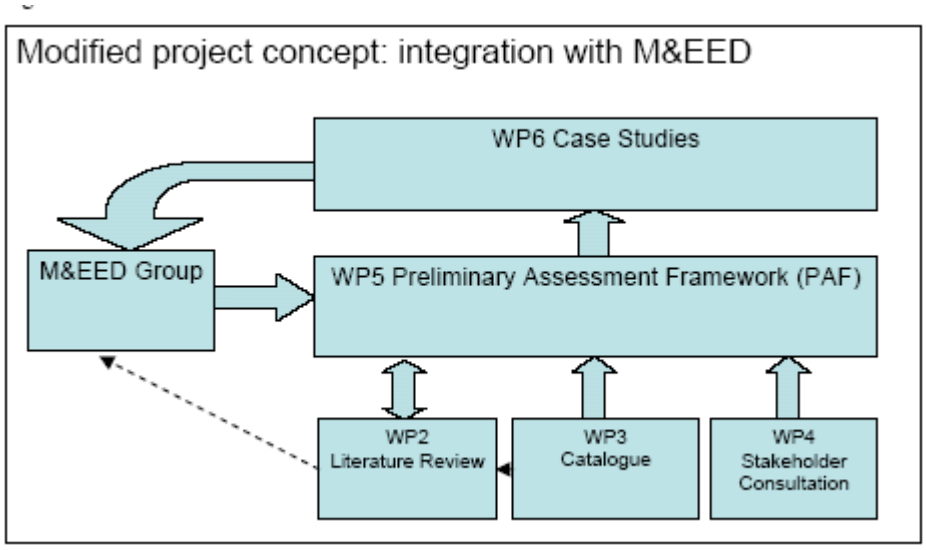
- Literature review that will feed into the development of the Preliminary Assessment Framework (WP2)
- A catalogue of energy interventions from the participating countries (WP3)
- Bilateral consultations conducted by the six African partner centres with key national Stakeholders (WP4)
- First National Workshops, arranged by the six partner centres, to introduce and discuss the DEA project and in particular gather stakeholder opinions on requirements for impact analysis of energy interventions

The case study falls under WP6 as indicated in Fig 1.1, where WP2, WP3, WP4 and WP6 contribute to the development of the Assessment Framework, which is the main objective of the DEA project (WP5). Each participating country is undertaking one case study selected from their catalogue of energy interventions that have been submitted as WP3.

The process leading to the case studies comprised
- Development and agreement on criteria for case study selection
- Selection of case studies for the six countries
- Preparation of causal link diagrams and preliminary tables. These were further elaborated at the second project workshop.

[1] An energy intervention is here defined as an explicit project, policy or innovation – either technological or institutional – that affects energy demand and/or supply in a country.

Fig 1.1 Inter-linkages of Work Packages with the Assessment Framework and other initiatives.



1.1.2 Criteria for Case Study Selection

For the purpose of selecting the case studies, a set of selection criteria, comprising 6 local and 2 global considerations, was developed in collaboration with all project partners in the 6 participating countries. The agreed criteria are presented in Box 1.1

1 Box 1.1 Agreed Selection Criteria for country case studies

Local Criteria – seen from the point of view of the country team and the country L1. National preference/relevance L2. Development impact L3: Availability of development impact data L4. Availability of baseline L5. Achievability L6. Synergy with other development projects
Global Criteria – seen from the point of view of the DEA project as a whole – contributing to the quality and usefulness of the Assessment Framework G1. Representative: The set of interventions in the Case Studies should span a number of different types of interventions or energy technologies in order to "test" or develop the AF. G2. Illustrative value: The intervention may have high value in illustrating energy-development connections to other countries, i.e. intervention types which are common in other African countries.

The selected case studies for each of the participating countries are listed in table 1.1.

Table 1.1 Selected Case Studies for each of the DEA participating Countries

Country	Selected case Study
Botswana	Grid Rural electrification through the Rural Electrification collective scheme
Ghana	Grid-based rural electrification
Mali	Women Renewable Energies Project (focus on one area)
Senegal	PROGEDE (focus on improved stoves)
Tanzania	Small-scale irrigation using solar and wind energy
Zambia	Solar Energy Supply Companies (ESCOs)

The above set of case studies (table 1.1) reflects the local criteria applied by the six participating country energy centres. With regard to the global criteria, the selection is satisfactory in spanning a range of different energy interventions that are also relevant for African countries in general.

2.0 CASE STUDY IN THE CONTEXT OF ZAMBIA

2.1 Overview

Three energy interventions were identified at the start of the DEA project, namely,

- Solar bakeries
- Jatropha Processing and
- Energy Service Company (ESCO)

For the Zambia case, the ESCO project was selected to start based on the following criteria.

- Global criteria
  - Representative
  - Coverage of key sectors and energy project type

- Local criteria
  - National relevance
  - Should be achievable, data available for both the energy intervention and potential impacts
  - Baseline available
  - Availability of assessment tool

This report presents results from a questionnaire study carried out in Nyimba and Chipata between 2nd and 5th October 2006. The aim of the study was to investigate the impacts of use of solar PV on social, economic and other aspects on the lives of the people. The study further sought to assess the impact of energy service provided by ESCOs on different consumers in sectors such as domestic, health, education and business sectors. Furthermore, the study investigated the various uses of solar PV and how users have adapted their lives to introduction of solar PV in the study area. The questionnaires used the study for each category are provided in Annex A1.1 to A1.4

The large scale introduction of solar PV in Zambia was done in the Eastern province of Zambia towards the end of the 1990's when the Energy Service Company (ESCO) project was started by the Department of Energy of the Republic of Zambia. The project received funding from the Swedish Development Cooperation Agency (SIDA). The rural energy services companies project is a SIDA funded phase I pilot project that was initiated in 1998. The focus of the project was to identify the conditions for solar photovoltaic systems in rural areas, to locate prospective entrepreneurs and to help them get started. (SEI, 2005)

The first three ESCOs mentioned above commenced operations by 2000 with at least 100 solar systems. Market and socio economic surveys indicated that the selected towns in eastern province were not well serviced by national grid electricity but had comparatively wealthier communities with strong agricultural base. The ownership and insurance of the Solar Home Systems is still with the government of the Republic of Zambia through the Department of Energy.

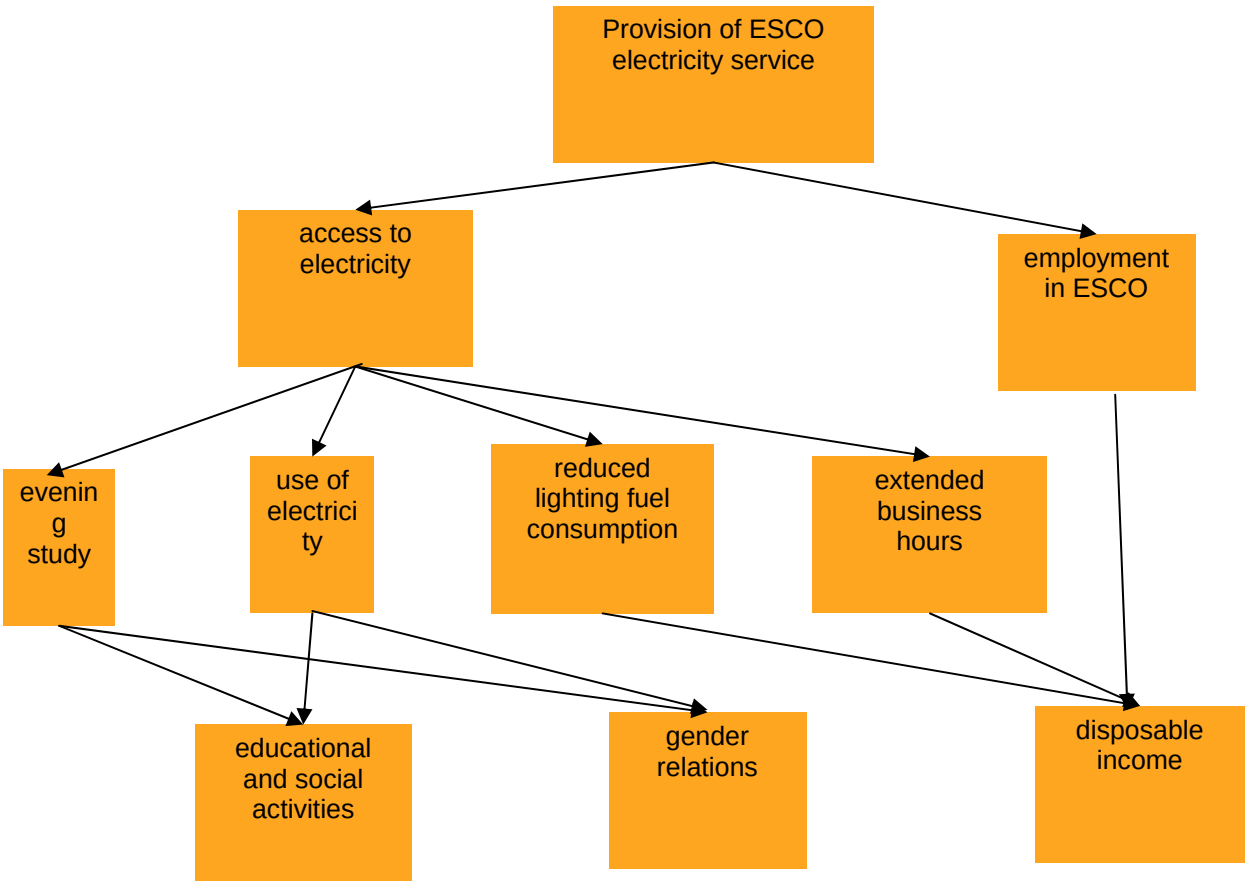
2.2 Elaboration of the project

This report provides an in-depth discussion on the results of the study.

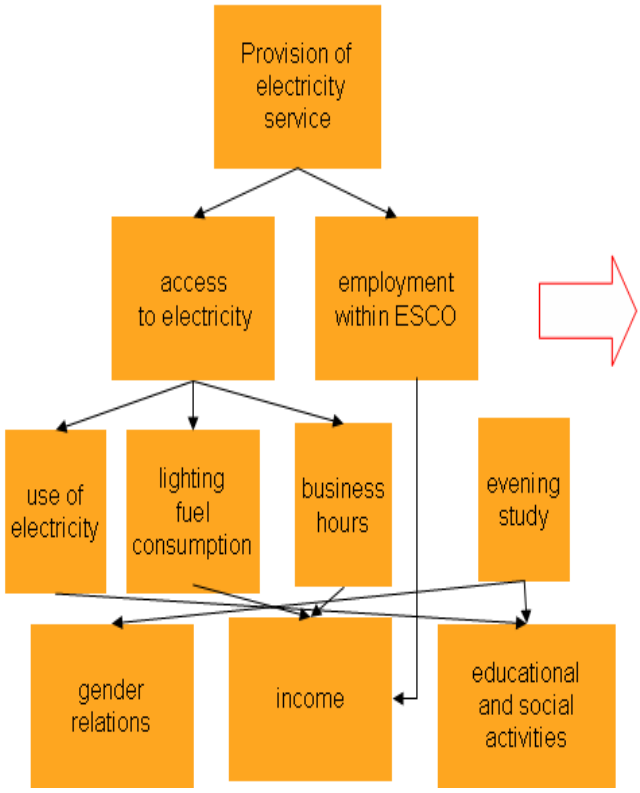
The DEA project (Development and Energy in Africa) aims at developing an operational tool (assessment framework) that facilitates improved design of energy interventions. An energy intervention is any policy measure that affects energy demand and/or supply in a country. This can be a project, a policy or an innovation. An innovation can either be technological or institutional.

An investigation of the benefits from the energy service becomes necessary in this project as a link between the outcome and impact in the causal diagram for the ESCOs case study. This questionnaire study therefore and hence this report is one portion on data collection in the whole DEA project process.

2.3 Causal linkage based on Fringilla Process



2.4 Causal linkage based on the case study



Elements	Indicators	Units	Source	Method
Inputs: •provision of electricity service	established ESCO	ESCOs	ESCOs	desk study
Outputs: •access to electricity •employment	•total SHS installed •jobs	•SHS •no. jobs	•SHS •no. jobs	•interviews •interviews
Outcomes: •use of electricity •lighting fuel •business hours •evening study	•appliances •fuel costs •av. b. hrs •school study/night	•number •$ •hrs •hrs	•number •$ •hrs •hrs	•survey •interview •survey •focus group
Impacts: •income •educational •gender	•income •sch. perf. •decision-making roles	•$ •grades •h/h	•$ •grades •h/h	•interview •interview •focus • group

3.0 METHODOLOGY, RESERCH PLAN AND STUDY AREAS

3.1 Methodology

The first part of the methodology involved desk study aimed at collecting data related to impacts associated with the selected energy intervention. The second part of the methodology involved collection of data through key informant interviews and questionnaires.

Data collected through questionnaires, targeted the total SHS customer group in Nyimba and Chipata and a sample of independent owners of solar PV who do not belong to the ESCOs' clientele but have been helped by ESCO staff to do the installation and servicing. All the questionnaires administered were responded to, since they were all guided.

a) The questionnaires were designed using information from the Fringilla approach for each category of the NESCO and CHESO clientele. Closed questions in combination with open ended ones were appropriate for the task. The questionnaires can be found in appendices.
b) Other methods used for data collection included observations while in the field and desk study from different reports such as the Energy Regulation Board, Department of Energy Private and SEI reports, and Internet.

3.2 Research Plan

The research plan was formulated taking into account preparatory work, followed by desk study focusing on design of the questionnaire, recruitment of respondents and research assistants and elaboration of data collection planning. The second part of the plan involved field work which included data collection interviews, household surveys, institutional surveys, ESCOs survey observations preliminary findings, and analysis and reporting. Given in table 3.2 the details of the research plan

Table 3.2 The adopted research plan

What	When	Who	Remarks
Preparations			
Finish and agree on research plan	6/07/2006	GP. FDY, LZ	
Desk study	22/09/06		
Design questionnaires	22/09/06	GP, LZ	
Recruit respondents	27/09/06	GP, LZ, HW	We will recruit by this date
Recruit research assistants	n/a		We will not
Prepare focus group discussion		GP, LZ,HW	

Elaborate data collection planning	27/09/06	FDY, GP, LZ	
Data collection	01/10/06		
Continuation desk study			To be a continuous process
Interviews	01/10/06	GP, LZ, HW	Activities to be done concurrently.
HH surveys	01/10/06	GP, LZ, HW	
Focus groups	01/10/06	GP, LZ, HW	
Observation	01/10/06	GP, LZ, HW	
Documenting preliminary findings		GP, LZ, HW	
Updating people involved in research on preliminary findings		GP, LZ, HW	
Analysis and Reporting			
Data analysis		LZ, GP,HW	
Report writing		LZ, GP, HW	
Discussion Draft report	18/10/06	FDY, LZ, GP	
Finalizing report		GM, FDY, LZ, GP, Emiel	
Communicating results	02/11/06		During Workshop

3.3 Study Areas

3.3.1 Chipata Energy Service Company

Chipata Energy Services Company (CHESCO) is located in Chipata town at NAPSA building 1st floor eastern wing. The company started operations in the year 2000 with the view of supplying solar home systems. The current workforce of the company is 4 persons, and is as follows:

- One director
- One administrative officer
- Two technicians

Since the establishment of CHESCO, seven persons have been trained. Three of these were trained as accountants while the remaining four were trained as technicians. The technicians have been trained at the University of Zambia in skills such as servicing, sizing, installation, troubleshooting and repairs. Their acquired skills are also evident in their sizing and installation of solar water pumping system at Mkanda clinic in the outskirts of Chipata. This solar pumping

system has been running successfully for some time now and is supplying clean water to the clinic.

Initially, the firm started with 150 solar PV home systems but at the time of the questionnaire study only 138 were working for reasons outlined below . Out of their current client number 50% are civil servants, 30% farmers and 20 % business people. It must be pointed out that most of the civil servants are also involved in farming activities which help them supplement the monthly cost of solar home systems charged by CHESCO. At the moment less than 10 people have withdrawn their clientele ship from CHESCO due to several reasons which include;

- Acquisition of their own PV systems
- Bereavement of the breadwinner
- Inability to afford
- One of the clients has connected to the grid. The reasons being grid was extended to their catchment, grid is cheaper than CHESCO and ability to use wide range of appliances.

The annual income of CHESCO varies and is so much affected by tobacco and maize yields, and buying. The income of most clients is not steady because it is agriculture based. About 80% of the maintenance costs of solar home systems are born by the clients. CHESCO currently charging its clients an amount of K65,000 monthly. The company's monthly wage bill is 2.5 million Kwacha. CHESCO has devised an incentive scheme for clients who are farmers on the payments of monthly charge. The scheme works in such a way that the farmers are made to use the PVs without paying anything during the farming season and pay later with interest after harvest and selling of farm produce. The interest ranges from 10% to 20% of the amount accrued.

In order to safeguard the PV equipment and lengthen the life of the battery CHESCO has put a directive to its clients not to use invertors on the PV home systems. Any flouting of the directive is met with a penalty of K150 000.

3.3.2 Nyimba Energy Service Company

Nyimba is situated along the Great East Road between Lusaka and Chipata about 200km from Lusaka. The Nyimba town is the district capital in Nyimba district, which is fairly new district. The grid electricity has just been extended to the town. The present set up is that the grid passes through the town of Nyimba where some of the customers have connected to the grid. However in view of the wide spread distribution of the SHS, as far as 30km, most clients will still continue to depend on isolated PV systems.

Most people in the area get their income from farming activities. Crops include maize, groundnuts etc. NESCO is a company that is devoted to delivering energy services to the people through provision of solar PV systems. The company has an office in Nyimba district and this is also the point where most people go and pay their bills and get in contact with the company. NESCO is involved in installation and maintenance of solar PV, and selling of solar light bulbs

The organizational workforce consists of 5 employees, namely, Director, manager, accountant and two technicians. Previously the company had a helper but at the time of the questionnaire study, the helper was not working. The salary of the employees ranges between K250 000 and K550 000.

Currently, NESCO has 96 clients, and are categorized as follows:

- 51 civil servants
- 21 business
- 12 farmers and
- 8 institutions (including schools)

In the recent past NESCO has experienced declining numbers of clients due to several reasons outlined below:

- Transfers of civil servants and left the PV systems (6 clients surrender their PV)
- Grid extension to Nyimba by ZESCO(8 clients surrendered the systems upon connection to ZESCO)
- 3 business clients surrendered due to other reasons

NESCO has 5 technicians trained from the University of Zambia. Two of these were trained initially upon company inception in 2000 and three were trained later in 2005.

Nyimba district has recently experienced three major economic developments; these are, electricity grid extension, Television Signal and extension of network coverage of Cellular communication by CELTEL The Nyimba district has never had TV signals for Zambia National Broadcasting Corporation until recently. This has brought about a rush in the local people to acquire television sets. Since the grid extension by ZESCO has not covered every household, people without electricity are turning to NESCO for supply of PV systems. On the other hand, the extension of network coverage of mobile cellular communication has brought about the desire amongst locals to own cellular phones. People are again turning to NESCO and expressing desire to have solar PV installed for them for charging cell phones. The system for charging batteries is similar for both CHESCO and NESCO, except in the case of former they do not allow charging phones, because such an activity contributes to malfunctioning of the battery.

4.0 RESULTS, OBSERVATIONS AND FINDINGS

4.1 Case study 1

Case study 1 focuses on Chipata Energy Service Company (CHESCO) and its clients.

4.1.1 CHESCO Clients

Clients of CHESCO fall into categories which include; farmers, institutions, civil servants and business. Institutions that are were covered under the questionnaire study as CHESCO clients were schools, clinics and churches. Each of these institutions has a unique benefits/effects resulting from solar PV intervention. Generally, all institutions have a primary benefit of lighting, but the usage of the solar PV lights and its consequential effect differs from institution to institution. The details of the impacts of the energy intervention in each category are provided as follows:

4.1.2 Details of impacts of energy intervention

4.1.2.1 Schools

Under CHESCO institution clients, only one learning institution was considered in this study and it is called Madzimoyo Day High School. The Head of Mathematics was a respondent to the questionnaire. The school is located about 20km from Chipata town and about 1 km off the great east road in a very typical rural setting in Zambia.

The school is fitted with two 55Wp PV modules, regulator, battery and light bulbs. PV in the school is used only for lighting. The school has two classrooms fitted with 8 lights in total.

Even if the school is a day, implying that pupils come to school from home every day, the school has made a provision for weekly boarders for those pupils coming from very far villages. In this weekly boarders arrangement, pupils stay at the school premises from Monday to Friday and return to their villages during weekends. Weekly boarders are allowed to use PV lights between 18:00hrs and 20:00hrs. The teachers sometimes use the classrooms fitted with PV lights to prepare their work and also to help pupils study in the night.

The school is fitted with two 55Wp PV modules, regulator, battery and light bulbs. PV in the school is used only for lighting. The school has two classrooms fitted with 8 lights in total. Madzimoyo school pays K65 000 per system which amounts to K130 000 per month for two systems installed at the school to CHESCO as service charge.

Primary benefit of solar PV lighting in the school

The primary benefits of PV lights to the school are as follows:

- Sufficient lighting
- Longer duration lighting as opposed to candles and kerosene

Secondary benefits of solar PV lighting in the school

- Extended study time for pupils
- Increased motivation to study because sufficient lighting
- Improved academic performance by individual pupils
- Increased pass rate for grades nine and twelve for the school as a whole
- Reduced drop out cases
- Increase ability and chances by pupils to enter into colleges and universities

Wider Implications of solar PV lighting installed in the school

- Increase in literacy levels,
- Increase in academic performance by pupils may earn them places in the universities or colleges or even trade schools. as evidence in one school where the head teacher confirmed that the pass rate fro grade twelve pupils increased from 435 to 55%

4.1.2.2 Clinics

Under this questionnaire study only one clinic called Mukanda was considered. Mukanda, clinic is one clinic that has benefited from solar PV . The clinic admits patients and it is located about 34 km from Chipata town on Lundazi road and about 3.2km from the main road. Mukanda clinic uses four 55WP panels to power a pump in a borehole. The main use of the PV solar therefore is for water pumping for the clinic. The clinic does not subscribe to CHESCO as is the case with other clients considered but the clinic owns the PV system. CHESCO was just used to do the sizing and installation of the PV system and they gave the clinic one year servicing of PV for free. The installation of the solar pumping was carried out in 2001, up to the time of this questionnaire survey the system has run with no major faults or difficulties at all.

The solar PV water pumping system produces 10 000litres of water per day. The water produced is used at the clinic, members of staff houses and the surrounding community.

About 11 million Kwacha – (USD2,500) was used on solar panels, control box and labour. Between 20 (USD5,000) and 30 million Kwacha (USD7,500), in total was spent for the whole project of water pumping including water tanks, reticulation etc.

Conditions before solar water pumping installation

- Patients used to fetch water in buckets from an open contaminated well situated some distance from the clinic thereby worsening their condition. When the well dries out in dry season the patients would walk long distances to fetch water for use in the clinic.
- Members of staff also used to walk distances to fetch water for household use
- Diahorrea cases were rampant due to poor sanitation at the clinic and the surrounding communities
- Fatigue and time wastage in fetching water

Condition after solar water pumping installation

- Patients no longer walk distances to fetch water
- Provision of sufficient, clean piped water to the clinic

- Improved hygiene condition at the clinic as a result of clean piped water
- Reduced cases of cross infection of diahorrea diseases at the clinic

Wider Implications of solar water pumping installed at the clinic

- Since the surrounding community also make use of the clean water , the diahorrea cases have been greatly reduced
- The health staff are motivated to work at the health centre firstly because of improved sanitary conditions at the clinic and secondly because the clinical staff houses also has piped water.
- Enhanced recovery by patients because they are no longer subjected to fatigue inflicting water fetching experiences. Furthermore since clean water is used in the clinical processes such us wound cleaning, maternity etc recovery process is improved as opposed to contaminated water from an open well that used be used before
- Reduced mortality rates

Gender

Solar water pumping system also has an implication on Gender issues.

- Better health care for expecting mothers
- Time saved by wives and girl children of health staff since they no longer walk long distances to fetch for water.
- Elimination of the burden on women and girl children due to carrying water buckets from the open well cooking
- Time saved coupled with less fatigue enable girls to study properly home

HIV/AIDS

Rural communities are said to be hard hit by the HIV/AIDS pandemic. The available clinic at Mkanda provides health care to people suffering from the disease. With solar water pumping the HIV/AIDS patients have indirect benefits such as reduced burden due to carrying water buckets for the use at the clinic when they are admitted. The improved water quality means they are less exposed to opportunistic infections through water borne diseases. The lives of HIV/AIDS patient are thus prolonged.

4.1.2.3 Churches

Churches have also been beneficiaries of the solar PV provided by CHESCO. Particularly one such church that has benefited is Roman Catholic Church Khokwe Parish which is situated about 45 km from Chipata town on Lundazi road and about 3.2 km from the main road.

The PV systems are installed at the ‘Fathers’ house as well as at the Theresian Sister’s Convent. The Fathers house is fitted with two 55WP panels while the convent of sisters is fitted with one 55WP panel supplied by and with subscription to CHESCO. In addition to the PV systems the Theresian Sister’s Convent is fitted with extra panels owned by the church. The church uses the PVs only for lighting.

The total monthly bill paid to CHESCO is K195 000 for the three solar home systems. For each solar home system the church pays a charge of K65 000 per month.

Prior to CHESCO solar home system installation, the church was using the solar panels provided by the diocese. Before the diocese provided the PVs the church was using candles. The cost of candles was proving to be costly at the time for the church, although no figures were available on their cost.

The current capacity of 55WP solar panels is felt to be very inadequate by the church as they desire bigger solar PV installations that are able to power appliances such as DC refrigerators, which typically cost in the range between USD5,000 to USD8,000 per unit. The church also expressed displeasure at the inability to use the solar home systems for cellular phone charging as CHESCO has put a directive never to use invertors on their systems. Further more there is a penalty of K150 000 that attracted as result of going against CHESCO's directive.

Primary benefit of solar PV lighting to the church

- Sufficient lighting
- Improved security at the church premises in the night
- It helps in cleaning dishes in the night because of sufficient light

Secondary benefits of solar PV lighting to the church

- Longer chatting and fellowship by the sister's at the Theresian Convent
- Sisters are able to allow visitors in the evening which was not the case in the past.
- Time of prayers was extended in the evening
- Occasionally, in big meetings the lighting is used when cooking and serving food to church members in the night.
- The Father's uses the light to prepare sermons in the evenings sometimes
- The devotion time of Father's has improved
- At one point a student visited and stayed at the father's house and was able to study up to 20:00hrs

4.1.2.4 Business

The business clients of CHESCO who were considered under the questionnaire study are the following:

- K S boutique a shop which deal in clothing in within Chipata town at the main Chipata Bus stop Market
- A.M general dealers, a small shop in a village located about 45 km from Chipata town on Lundazi road.

Each of these shops uses 55WP solar home system.

K.S boutique has three lighting points (3 light bulbs). Though the market and most shops are electrified through the National grid, the boutique owner has opted for Solar PV due to erratic

power supply from ZESCO. Before solar PV the shop used to close around 17:00hrs but with the solar PV installation by CHESCO the shop has extended closing time to 20:00Hrs. The shop owner pays a monthly charge of K65 000 to CHESCO and has been on CHESCO subscription for three years.

On the other hand A.M dealers a family shop located in a village sells assorted goods from groceries to pots, bicycle parts etc. The shop is adjacent to a house which makes it easier for family members to utilize the lighting for other purposes as well. Before solar PV the shop was lit on kerosene up to 20:00hrs. The shop owner used to spend K2000 per day on kerosene. The shop still closes at 20:00 hrs even with the introduction of CHESCO solar PV.

Benefits of solar PV to each of the two shops

(i) K.S Boutique

- Extended business hours(Use to close shop at 17:00Hrs before solar installation , but now with PV lighting the shop closes at 20:00Hrs
- Improved revenue due to increased sales brought about by extended hours especially after tobacco harvest by farmers
- Improved security at the shop
- Continues to sell when other shops have black out due to power failure and hence giving him a business advantage in the night

(ii) A.M Dealers

- More customers come because of lighting
- No more fire risk due to kerosene
- Able to see clearly the merchandise in the shop and able to sell properly
- Able to extend business hours during the festive season and hence have more revenue
- Improved performance of pupils who take advantage of the lighting for studying

4.1.2.5 Households

A large percentage of about CHESCO clients are households, scattered in and around Chipata town others stretching as far as 45km from Chipata town. Households are further categorized as either civil servants or peasant farmers. It must be mentioned that most of the civil servants also carry out some farming activities as Chipata is a rural town.

4.1.2.6 Civil servants

Civil servants category constitutes among others, teachers, municipal workers, agricultural officers, etc. In almost all the households covered under the questionnaire study, the installed PV size was 55WP in each house. Monthly charge paid to CHESCO for each solar home system was K65 000.

The appliances for solar home systems amongst civil servants included, Black/white television set, indoor and outdoor lighting, radios.

Before solar home system installation families used to use the following:

- candles, matches and kerosene for lighting,
- Dry cell batteries for radios
- In some cases car batteries for a black and white television set

The monthly cost of the above listed energy sources used to range from family to family and most families do not have records of how much it used to cost them. However one family was able to provided details of their monthly cost of kerosene, matches, candles and dry cell batteries which ranged between K80 000 to K100 000 per month. Currently the family is only paying K65000 per month to CHESCO for a solar home system. In terms of quality and other benefits solar home systems offer more than what kerosene, dry cell batteries, matches and candles would provide in a month. Besides, this family now makes a saving of between K15000 to K35 000.

Primary benefits of solar home systems to civil servants

- Civil servants such as Agricultural officers are able to read and write reports in the night for their field work.
- Entertainment through TV
- No more fires due to Kerosene and candles
- Ability by the family to cook and was dishes in the night because they are able to see clearly
- Improved reading and concentration in school work for children as they are able to read in the night
- Children no longer go to the neighbour to watch TV
- No more difficulties in searching for matches to light candles when going outside in the night
- Improved security in the night due to outdoor lighting
- Improved academic performance of the children
- Reduced cost of lighting
- The headmaster was helped in the studies when he pursued a diploma with PV lighting before that he used candles
- A number of teachers were encouraged to pursue their diploma with improved lighting due to solar PV. It has helped further education of teachers
- Surrounding communities have been encouraged to acquire solar PV
- Family enjoys good lighting
- School children have sufficient time to study which has led to improved performance
- It has contributed to a happy home
- Reliable system for TV powering
- The teachers do not feel so remote evidenced by remarks from the Head teacher that teachers do not want to be transferred to other
- Improved life
- It helps the teachers prepare materials adequately for teaching the following day

- Improvement in general security at home
- Sufficient lighting for studying g
- School going children are able to read and write home work at night.
- Children are able to duties at home such as washing dishes clothes at night to keep the morning free so that they can prepare for school early and arrive in good time at school

Gender

School going girl children are able to wash dishes in the night so that they keep the morning free so that they prepare adequately for school.

Good governance

Family members are able to watch TV and listen to the radio powered by solar home system. Interviewees in the households noted that they were able to watch the television debate by presidents of political parties during the tripartite general elections that held in September 2006. The household members were able to make decisions on who to vote for based on the live television debates

HIV/AIDS

Information disseminated on local TV and radio on the dangers of HIV/AIDS and safe sex empowers the people to make informed decisions on matters pertaining to sexuality.

4.1.2.7 Peasant farmers

Farmers equally have similar usage of solar home systems to their civil servant counterparts and pay equally as much in monthly charge to CHESCO. Most of the farmers are located quite far from Chipata town. CHESCO has transferred the cost of transport to its clients, in one incident a farmer said he spends K40 000 on transport cost to take the K65000 CHESCO monthly charge to the designated CHESCO pay point in Chipata town. This implies the total monthly cost comes to K105 000.

Farmers use the solar home systems for appliances such as Black and white Television sets, lighting and radios.

One of the most important benefits of solar PV to the farming activities is the fact that farmers have extended shelling time of maize and groundnuts for as late as 23:00hrs. This enables them to shell in good time to deliver the produce to Food Reserve Agency. If produce delivery is late it has profound negative consequences on the farmers.

Further details on the questionnaire study on CHESCO clients are provided in Annex A2.1

4.2 Case study 2

Case study 2 focused on Nyimba Energy Service Company (NESCO) and its customer base.

4.2.1 Impacts solar home systems on clients as observed by NESCO

Farmers

- use lighting to sort out harvest at night
- use of light in the grinding mill to extend business hours in the night

Business

- Groceries extend business up to 20:00hrs
- Shops selling audio tapes are able to test the tapes using radio cassettes using solar PV , previously they used to use a lot of dry cell batteries which was costly
- Use of solar power for the barber shops and extends in night
- The restaurant is able to open in the night due to sufficient lighting

Households

- Lighting
- Radio
- TV (colour or black and white)
- Cellular phone charging (NESCO)
- Watching of video and DVDs

4.2.2 Impacts observed from field survey

4.2.2.1 Institutions

Only one institution was covered under the questionnaire study in Nyimba district involving a school called Kalambakuwa Day High School. This school is located in a typical village setting about 30km from Nyimba central district. It has a total number 370 pupils. Currently the school has a solar home system whose size is 55WP.

The main uses of the PV energy supply at the school are lighting of the headmaster's office and two classrooms. The school also has diesel generator which is used to power computers. Due to increasing cost of diesel, the school is unable to cope and desires to power computers using solar PV. An appeal was raised by the headmaster during the questionnaire study to the NESCO staff who was accompanying the team conducting the questionnaire study the possibility of increasing the capacity of the PVs so as to power computers, since the school was willing to pay for the extra cost of the expansion. .

Before installation of solar home systems, the pupils were using kerosene whose monthly expenses could not be quantified owing to lack of records. At the moment the school spends K 50 000 as monthly charge which it pays to NESCO.

Benefits of solar PV to the school.

- Sufficient lighting for pupils
- Teachers come in the evenings to help pupils read in class

Implications

- Increased motivation to study as pupils are able to read from evening up to 04:00Hhrs
- Improved performance of pupils
- Improved pass rate for grade 12 pupils from 43% before solar PV lighting to 55% after PV installation

4.2.2.2 Business

Solar home systems are also utilized in small scale business ventures in Nyimba. Because of limitation of time as well as unavailability of shop owners the questionnaire study under business category only managed to cover a small shop locally commonly known as "Ntemba". Interesting results were brought out on how the lighting has brought some changes to the business.

The current capacity for the "Ntemba" is a 50WP panel and it powers the following appliances:

- Radio cassette player for testing cassettes during sales
- Lighting in the evenings

The shop pay a monthly subscription of K50 000 to NESCO. Before solar PV installation the shop used to close before the sun sets so that the shop owner can utilize the sunlight for packing when knocking off. Furthermore, the shop owner used to utilize dry cell batteries to power radio cassette player and it proved to have been very costly for them. The radio cassette player was necessary in the sales of music/audio tapes as the buyer would like to hear how it plays before buying.

Benefits/impacts

- Lighting in the evenings helps in packing when knocking off. Every day merchandise has to be brought and taken from the shop at the market place. Now since knocking off is in the evening packing the merchandise is not a big problem with sufficient lighting
- Entertainment
- Reduced cost of powering the radio cassette player as cost of dry cell batteries is eliminated

Implications

- Business hours have been extended to evenings
- The shop owner has also introduced TV sales because of solar PV

4.2.2.3 Households

NESCO household clients generally use solar home systems for the following:

- Indoor lighting

- Outdoor lighting for security in the night
- Watching of television sets and videos
- Cellular phone charging

Further details on the questionnaire study on NESCO and clients are provided in Annex A2.2

5.0 FINANCIAL SUSTAINABILITY OF ESCOS

The ESCOs offer a service of supplying solar electricity to the community. The main sources of income are:

1. Application fees – Application fees are one-off fees to cover administrative expenses for assessing the application.
2. Sale of accessories – This comprises sale of accessories like light bulbs.
3. Service fees – This is a fixed monthly charge and the main source of income paid by customers for using the solar system.
4. Installation fees – This is a one-off fee paid at the beginning for installing the system.
5. Other income – Bank interest, reconnection fees, transfer of system fees, and battery charging contribute to other income.

The total investment costs at the start of the project was equivalent to US$1,000 per system.
As at December 2005 different ESCOs owed the following amounts to Government of Zambia through the Department of Energy.

- NESCO K467.8 million
- CHESCO K800 million
- LESCO K694.7 million

According to the ERB "report on the performance and Economic viability of Energy Supply Companies" The ESCOs have been making losses since their inception. The companies are charging about $10 per month as service fees. The loan amounts for the standard 100 units cost K4,678,200 each bringing total loan amount to K467,820,000. At the time of acquisition, this amount was equivalent to $100 000. The companies are expected to pay back the loan in 15 years, at a recovery rate of $6 per month per system. At the current charge of $10, the companies are making losses. This means either the service charge is low or the companies are operating inefficiently. The charge of $10 per month is not cost reflective as the losses have continued. This will worsen when the companies start liquidating the loans they owe as the interest have to be factored in the income and expenditure statement leading to a constraint in the cash flow.

As figure 5 below shows, none of the ESCOs recorded a profit during the period under review. This shows serious problems with the way the ESCO system is working. The companies can not sustain themselves at the current operational levels.

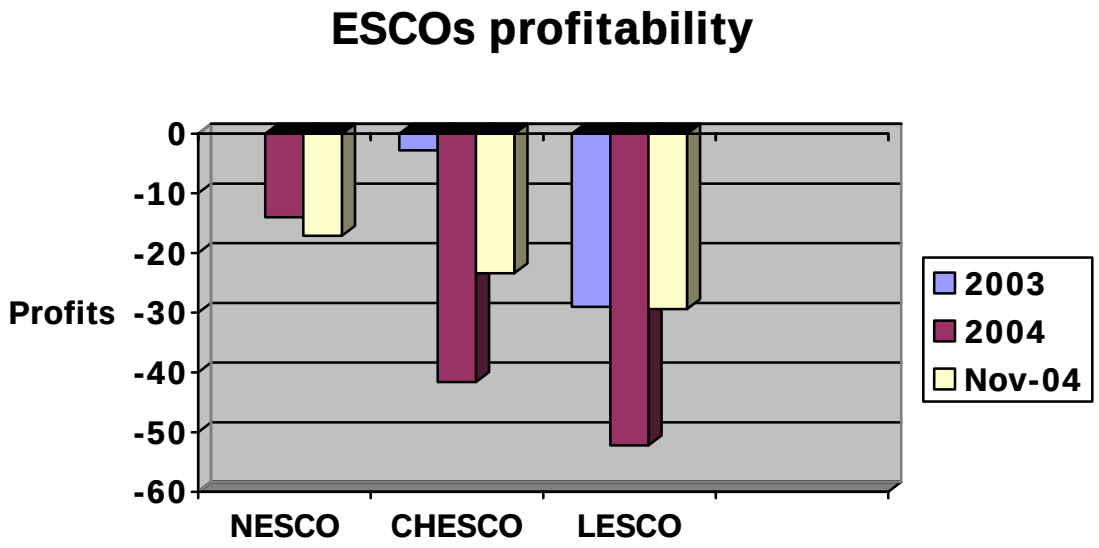


Figure 5. ESCOs profitability

The idea of charging service fees is only sustainable when there are economies of scale. According to the World Bank, a solar company would be able to make profits if it has at least 5,000 solar units. The maximum an ESCO has is 150 units which is far less than the breakeven point of 5,000 units.

In terms of sustainability, without government support in terms of subsidies at either capital investment level or operation level the ESCOs have no capacity to sustain their operations. This has so far been evident in failure to replace run down system batteries.

As regards financial returns, i.e. the extent to which the project will generate revenue to fully meet its financial obligations, the Companies have been making losses since their inception. Furthermore, the companies have no financial reserves with which to use in the purchase of run down system batteries. This means the project is not sustainable as it has no capacity to reinvest and therefore continue to offer the service.

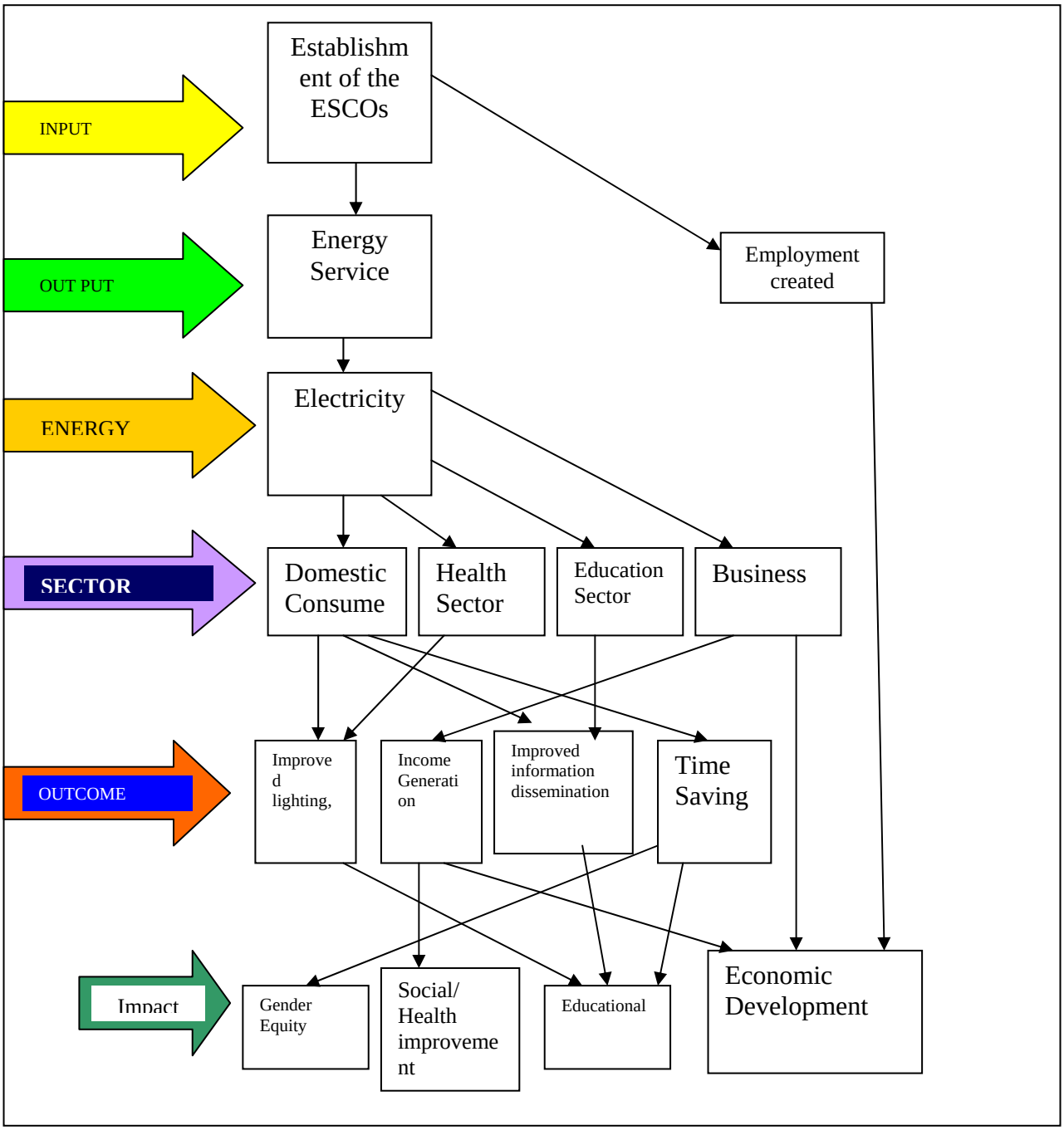
Another parameter looked at was the projects' capacity to cope with an uncertain future. Without government/ donors' support it appears that the companies would have difficulty obtaining the systems on commercial terms.

Generally, the project cash flow has not been impressive resulting from system breakdowns and failure to replace batteries

Under the current set-up, the ESCOs financial and operational performance has not been satisfactory and is not sustainable. Due to uncertainty about the system ownership and repayment arrangements the project has lacked innovation.

6.0 LINK BETWEEN ENERGY INTERVENTION AND DEVELOPMENT

The link between ESCOs intervention in Eastern province (Chipata and Nyimba) and development has been drawn by referring to the elaborated Causal Chain in figure 6.



7.0 CONCLUSIONS

The introduction of solar home systems in some village towns in the Easter province of Zambia has brought about quite a number of positive changes to the lives of people. Solar home systems provides a non-polluting form of energy as compared to candles, matches, kerosene and some times diesel which people used to use before. Solar home systems not only provide sufficient light but also entertainment to people through use of television sets, DVD players, videos and radios. According to the beneficiaries of solar home systems, the introduction solar home systems is a form of civilization. People in the rural areas are able to follow current affairs in the country and beyond and make informed decisions in matters pertaining to HIV/AIDS, rainfall predictions by meteorological department, politics(especially in times of general elections), etc.

The largest cellular phone network provider in Zambia CELTEL has just extended the network to most parts of eastern province; this has necessitated acquisition of cellular phones by local people. Since most of the households are not connected to the national electricity grid they therefore depend on solar energy for cell phone charging. This aspect of cellular phone charging is being promoted so much by NESCO as opposed to CHESCO. NESCO has permitted clients to use inverters on their systems and thereby making it possible to have cell phones charged. On the other hand CHESCO has banned any use of inverters; as a result clients are unable to charge cellular phones on CHESCO solar home systems. NESCO has had an increase in inquiries to subscribe to them and are anticipating a boom in its client numbers because of introduction of National Television signal to Nyimba as well as Cellular phone network. A number of people in the town and villages are now buying TV sets which can either be powered by car battery or solar home systems. Solar home systems have benefited different categories of people in a unique way.

Farmers use the solar lighting to extend the shelling time of maize and groundnuts, and in some cases the farmers go as late as 23:00hrs in night doing shelling. This implies that farmers finish shelling quick enough to deliver their harvest to Food Reserve Agency (FRA) to enable them to be paid in good time for them to begin adequate preparation for the next farming season. If delivery of harvested crop is delayed, it results in protracted payments which create huge problems for the farmers as they are unable to prepare for the following farming season adequately. In a way solar PV lighting provides a means of speeding up the crop harvesting process and ensures quicker payments thereby increasing efficiency in the agricultural production process and contributes to poverty reduction.

Institutions such as schools, churches clinics also benefit greatly from the solar PVs provided by ESCOs. The schools experience improved pupil performance and it leads to increase in pass rates for grades nine and twelve examinations. The improved school performance is owing to increased motivation to study in the school because of provision of sufficient light. In some cases some pupils are able to read through the night up to about 04:00hrs in the morning. Teachers also take advantage of lighting in the class rooms to help pupils study at night.

In churches, the church leaders use the light to prepare sermons and also for reading. The lighting at the church also helps worshipers during large meetings to prepare and serve meals in the night.

There is a special case where CHESCO was used to size and install solar water pumping at Mukanda clinic. The clinic owns the system and the water is used in the clinic, by clinical staff houses, and surrounding communities. Before that the water for use in the clinics was drawn by patients from some distance at an open contaminated well. The sanitary condition at the clinic then was very poor and there were a lot of diahorrea cases. Currently, the clinic is enjoying piped clean water supply through solar water pumping.

In households, solar home systems have benefited the people with sufficient lighting, improved security in the night, entertainment. Those households who have school going children have benefited greatly in that the children use the sufficient lighting to study in the night. This has brought about improved performance in school work.

Civil servants such as teachers and agricultural officers are also beneficiaries of the solar home system. Agricultural officers are able to read and write reports in the night about their field work. Teachers are able to prepare their material for teaching in the night. There was a case where a head teacher use the lighting to enable him successfully complete his correspondence studies. He later inspired other teachers in the same school to acquire solar home systems and pursue their diploma by correspondence.

From the foregone analysis it can be observed that energy intervention has an impact on the lives of the people and it contributes to development and progress in general.

It is clear that solar home systems have immense benefits in terms of impacts on the communities involved, but the biggest barrier is that of financial sustainability of the business model adopted, and also relatively low income levels from the various stake holders. In view of this status quo, it is important that an innovative financing mechanism is put in place which will involve provision of smart subsidy on capital investment to enable the entrepreneurs attain financial sustainability during the operation period of the business. This was a pilot project, which was initiated to ascertain an appropriate business model to suit the circumstances of the region under consideration. It is clear from the results that if sustainable development was to be attained in rural areas of Zambia, and taking account of the level of poverty prevailing, it is a conclusion of this case study that the principle of awarding smart subsidy to capital cost only is essential. As regards the level of subsidy, CEEEZ financial assessment is that for the business to be viable, the capital subsidy should be in the range between 50% to 70%.

Based on the experience gained so far from the ESCO project, the Government of Zambia in conjunction with SIDA have agreed to implement phase two. Under this phase, SIDA has pledged an amount of SEK2 140 000 inform of loans to be used for purchasing the new solar home system for the three ESCOs. This loan agreement shall be part of the mechanism to provide expansion possibilities the ESCOs providing energy services with PV equipment in the eastern province of Zambia. In order to strike a balance between the ESCOs, this allocation shall be distributed according to 42% of available resources to NESCO, and 29% each to CHESCO and LESCO. The payback period for the loan has been pegged at 10 years.

In terms of payment of this loan, a subsidy amounting to 25% of the initial value of the capital shall be granted. This means that the total value of the loan shall be reduced by 25% as a subsidy and the remaining to be paid in the ten-year period. Upon each payment, certificate of ownership for a number of solar PV systems shall be given to the ESCOS, corresponding to the value provided. Additionally, the personal guarantee of the payment of the loan shall be given by the Director in order to cover the debt in case of ESCOS defaulting. A charge of 2% of the payment shall be added to the repayment in order to cover the cost for administration of the credit mechanism. Under this arrangement ESCOs shall be at liberty to pay part of, or the whole remaining debt by paying the remaining capital any time. Finally it has been agreed that should a Solar Fund of Zambia be established in future, with more lenient conditions for capital payback, this agreement shall be negotiated to reflect the most favourable terms.

Upon signing of the loan agreement, and accepting the conditions to pay for the systems, ownership of the purchased systems will immediately be granted to ESCOs. These certificates of ownership shall be used as collateral for the systems. A solar PV system for which such a certificate cannot be produced, shall not be sold or offered as security for any business. In order to provide security for the repayment according to the schedule, ESCO shall have to give up custody of the certificates of ownership, for the systems on the date of purchase. These certificates shall be kept by the MEWD until payment is effected.

Additionally the government through the MEWD recognizes the need for increasing the rural and peri-urban access to electricity and information and communication technologies (ICT) as a strategy to reduce poverty in these areas. As part of the implementation strategy, the government embarked on the Increased Access to Energy and Information and Communication Technology Services (IAES) Project supported by the World Bank, the GEF, other donors, and the Prototype Carbon Fund.

The objective of the project is to provide for investment and technical assistance/ capacity building activities to enable scale up of access to electricity and ICT services in rural and peri-urban areas to maximize development impact: (a) income generation by SMEs through productive uses (farm and non-farm), and (b) improved quality of life emphasizing effectiveness of social services (such as health, education) and administrative service.

The underlying approach of the IAES project is to expand access via public-private partnerships in a commercially oriented manner, i.e., with focus on cost recovery. It is recognized that there is a need for “smart’ subsidies that address the up-front capital cost investment requirements and initial transaction costs to encourage entrepreneurial activity while maintaining efficiency of operations and promoting output. The level and terms of capital subsidy may differ according to project characteristics including underlying prospects for economic growth and investment risks. Under this project, both projects for extension from national grid and isolated grids will be supported. The range of technologies for the isolated grids will include micro hydro, wind, biomass, PV, etc. The total project funding under this project is USD16million (USD12 Million from World Bank and USD 4 Million from GEF)

IAES project will provide an initial funding to REF to support promising projects which meet the criteria for selection.

9.0 REFERENCES

1. Stockholm Environmental Institute, 2005: Private Energy Services Delivery in Rural Areas-Experiences From the Zambia PV ESCOs Project, www.sei.se
2. DoE – 2001:Rural Energy Service companies- experiences from Zambia
3. ERB – 2005 Report on the performance and economic viability of ESCOs

ANNEXURE

ANNEX A.1 QUESTIONNAIRES

A.1.1 Questionnaire on Households

1. Name of Interviewee:……

3.3.2.1.1 Size of Family:…….

3.3.2.1.2 Size of PVs……

3.3.2.1.3 Type of appliances……..

3.3.2.1.4 Other uses of solar home systems……

3.3.2.1.5 What benefits would you say are there in having solar home systems?.....….

3.3.2.1.6 Are there any problems you have faced with the solar home systems?……

3.3.2.1.7 What were your energy expenses before acquiring solar home system?.....

3.3.2.1.8 What things were you spending on?.....

3.3.2.1.9 What is you current energy expenditure?.....

3.3.2.1.10 Have you had difficulties in handling the solar home systems?.....

3.3.2.1.11 What impacts has solar PV home system had on your family?.....

A.1.2 Questionnaire on Business

1 Name of Interviewee:……

2 Position in the firm……..…

3 Brief description of type of business……..

4 Do you have competitors?……

5 If the answer to 4 is yes how many?.....

6 How many people are employed in you business?.....

7 What is your management structure?.....

8 How much do your employees earn?.....

9 Has solar PV brought any improvements to your business? ……

10 If the answer to 9 is yes. What improvements?.....

11 Has the number of customers improved since you started using solar PV?…

12 Have you introduced new products for sale due to solar PV?……

13 Did you need to employ more people after solar PVs?.....

14 What form of energy were you using before solar PV?.....

15 How much were you spending on the forms of energy mentioned in 14?.....

16 Do you still use some at the moment?.....

17 What is you current energy expenditure to ESCOs?.....

18 Have you managed to extend business hours because of solar PV?....

19 If the answer to 18 is yes. How many hours?,……

20 What social impacts have solar PV had on your business/community around?.....

21 Do you feel you can use something else apart from solar PV?……..

A.1.3 Questionnaire on Institutions

1 Names of respondents…….

2 Name of school…….

3 Number of pupils at the school……

4 Number of buildings with solar PV……..

5 Number of classrooms and other rooms with solar PV lighting…….

6 Number of lighting points……..

7 Any uses of solar PV apart from lighting?.....

8 What are the benefits of solar PV to the school, pupils and teacher?.....

9 Has the introduction of solar PV led to extended time of study for pupils?.....

10 Has it impacted in any way on pupils performance in class?.....

11 What effect has solar PV on pass rates for grades nine and twelve?.....

12 Has there been any social implications in your school as a result of introduction of solar PV?.....

A.1.4 Questionnaire on ESCOs

1. Name of interviewee:…….
2. Position in the company……..
3. Brief description on service provided by the company……
4. Do you have competitors?.....
5. How many people are employed by this company?.....
6. What is the management structure like?.....
7. Could you provide a salary range for your employees?.....
8. What is the monthly wage bill for the company?.....
9. How many clients do you have?.....
10. Into what categories do your clients fall?.....
11. Did any client withdraw from your clientele?.....
12. If the answer to 11 is yes. How many and why?.....
13. Have you trained any of your staff?..... In what areas?.....
14. Did you do some baseline survey to access market potential?.....
15. **For NESCO only**. Has grid extension to Nyimba affected your business?....
16. What major complaints do your customers have?.....
17. Any negative impacts of in the provision of your services?.....
18. How often do you do maintenance/ repairs ?.....
19. Have people found easy to use the PV systems?.....
20. What observable impact has your services had to clients?.....
21. Are there any dangers technicians face when doing installations? ...

ANNEX A2 DETAILS OF THE RESULTS OF THE QUESTIONNIRE STUDY

A2.1 CHESCO and Clients

Table A2.1.1 Households

	Name of Interviewee	Category	Location	Family size	PV size	Appliances /uses	Energy expense before PV	Energy Expense after PV	Benefits	Comment/appeal
1	Mr Tembo	farmer	45km from Chipata town on Lundazi Rd	4	55 Wp	Black/White TV, lighting (3 lights)	No records	Charge -K65 000 per month Transport-K40 000	• Spend less than before PV, • Stay awake up to 22:00hrs and have more time to read books • Ability to watch current on TV • Children have more time to study • Increased motivation to study for school going children	Desire to own the system and just hire CHESCO for serving
2	Mr T.Mwila Agriculture assistant	Civil Servant/ farmer	45km from Chipata town on Lundazi Rd	5	55 Wp	B/W TV, lighting inside and outside the house	Used kerosene K15000/2.5litres for 2 months	Charge-K65 000 per moth Transport-K40000	• Mr Mwila is able to read and write reports for work in the night • Entertainment through TV • No more fires due to Kerosene and candles • Ability by the family to cook and was dishes in the night • Improved reading and concentration in school work for children as they are able to read in the night • Children no longer go to the neighbour to watch TV • No more difficulties in searching for matches to light candles when going outside in the night • Improved security in the night due to outdoor lighting • Improved academic	Need for expansion of PV to cater for big appliances Desire to have the charge deducted from the salary instead of taking it physically which is costly Desire to own system

									performance of the children	
3	Mr K.T Banda	Civil Servant and small scale farmer	5 km from Chipata town centre	10	55WP Installed in 2001	lighting (4 lighting) , TV and radio	Used candles for lighting before PV and car battery for TV . There are no records for cost	K65 000 per month	• Children able to attend to home work in the night they go up to 20:00hrs • Improved academic performance for children • Family is able to cook and wash dishes in the night unlike before • It helps in quicker shelling of maize and ground nuts since shelling can now be done in the night. This enables quick delivery to markets • Improved security at night and able to see snakes easily and kill them. Hence the danger of snake bites is reduced	The monthly charge is becoming unaffordable Initially he wanted to have electricity from ZESCO but cost forced him to opt for solar PV offered by CHESCO, Desire to have bigger PV systems to carter for bigger appliances such as refrigerators
4	Mr Tembo Headmaster Chakanga Basic School Represented the entire teaching staff since all have solar PV	Civil servant	25km from Chipata town on Great East road		55WP installed at 8 teachers houses	TV- B/W, radio, lighting 4 bulbs in the head teacher's house	Used candles in the past (between K80 000 and 100000 per month	K65000 per month	• Reduced cost of lighting • The headmaster was helped in the studies when he pursued a diploma with PV lighting before that he used candles • A number of teachers were encourage to pursue their diploma with improved lighting due to solar PV. It has helped further education of teachers • Surrounding communities have been encouraged to acquire solar PV • Family enjoys good lighting • School children have sufficient time to study which has led to improved performance • It has contributed to a happy home • Reliable system for TV powering • The teachers do not feel so remote now with PV • Improved life • It helps the teachers prepare materials adequately for teaching the following day • Improvement in general security	The head teacher instituted PV system for every teachers house. There are plans to extend the lighting to classrooms Desire to have bigger PV systems to carter for bigger appliances such as refrigerators

									at home •	
5	Mr Musokeni	Teacher at Madzi moyo school	20 km from Chipata town on Great east road	10	55 WP	TV-B/W, radio, 2 bulbs		K65000 per month	• Sufficient lighting • Able to red at night and prepare teaching material at night • School going children are able to read and write home work at night. • Children are able to duties at home such as washing dishes clothes at night to keep the morning free so that they can prepare for school early and arrive in good time at school • Improved security at home	
6	Mr Chulu' Small holding	farmer	27km from Chipata on Lundazi road	8	60WP Own PV system. Used CHESCO technicians to install the system	TV, Cell phone charging, lighting. 1 bulb outside, 4 bulbs inside the house	Used kerosene, matches and candles for lighting before PV. Monthly expense follows: (K10000-K15000 for kerosene) (K5000 matches). (2 dozens dry cells for radio for K17000)	K65 000 per month	• School going children are able to study at night which has led to improved performance in class • Able to do shelling of maize and ground nuts up to 23:00Hrs in the night(previously the shelling used to go up to 17:00hrs . shelling takes a shorter time and it enables them to take to FRA in good time for quicker payments otherwise payments are delayed • Assist in washing and cooking late in the night	Desire to have bigger PV systems to cater for bigger appliances such as refrigerators

Table A2.1.2 Business

	Name of	Category	Type of	Location	PV	Appliances	Problems	Energy	Energy	Benefits	Comment/appeal

	Intervewee		Business		size	/uses		expense before PV	Expense after PV		
1	Mr K. Silungwe Shop owner	Business-Shop	K S Boutique	In Chipata town at the main market	55 WP	Lighting(3 light bulbs) Though the market and most shops are electrified through the National grid, the boutique owner has opted for Solar PV due to erratic power supply from ZESCO	-	-	K65 000 per month	• Extended business hours(Use to close shop at 17:00Hrs before solar installation , but now with PV lighting the shop closes at 20:00Hrs • Improved revenue due to increased sales brought about by extended hours especially after tobacco harvest by farmers • Improved security at the shop • Continues to sell when other shops have black out and hence giving him a business advantage in the night	Has been using the CHESCO PV for 3 years Desire to own system
2	Mrs Sofia Sakala	A.M General dealers	Grocery shop adjacent to a house	45 km from Chipata on Lundazi road slightly more than 3Km of the main road	55WP	lighting		Used kerosene which cost K2000/day	K65000	• More customers come because of lighting • No more fire risk due to kerosene • Able to see clearly the merchandise in the shop and able to sell	The shop has no employees. It is a family business

										properly • Able to extend business hours during the festive season and hence have more revenue • • Improved performance of pupils who tae advantage of the lighting for studing	

Table A2 1.3 Institutions

	Name of Interviewee	Name of Institution	Location	PV size	Appliances /uses	Problems	Energy expense before PV	Energy Expense after PV	Benefits	Comment/appeal
1	Sisters Magrete Zulu and Ruth Tembo (Theresian sisters convent)	Roman Catholic church Khokwe Parish	45km from Chipata town on Lundazi Rd and 3.2 km off the main road	55WP	Lighting only (4 lights)	Inability to use system for phone charging	Used to use Candles monthly whose cost could not be quantified	K65000	• Improved security • Longer chatting and fellowship • It helps in cleaning dishes in the night • Able to allow visitors in the evening which was not the case before • Extended time of prayers. • Occasionally in big meetings the lighting is used for cooking and serving food to church members in the night	Appeal for the reduction of monthly charge. Appeal for increased capacity of PVs to cater for appliances such as refrigerators etc
2	Father Dominic Phiri (Fathers House)	Roman Catholic church Khokwe Parish	45km from Chipata town on Lundazi Rd and 3.2 km off the main road	2 X 55 WP	Lighting only (8 lighting points)	Lack of knowledge of full utilization Experience thieves	Before CHESCO systems they were using PVs provided by the Diocese but prior to	K130 000	• Used sometimes to prepare sermons in the night • Improved devotion time • At one point they had a student who used to	Need for system expansion to cater for bigger appliances such

						who desire to steal the PV systems	that they used to use candles		use the lighting up to 20:00Hrs	refrigeration
3	Mr Musokeni Head of Mathematics Department	Madzimoyo Day High Scool	20km from Chipata town on Great East Road	2 X 55WP	Lighting (8 lighting points) 2 classrooms are fitted with lights		-	K 130 000	• Weekly boarders read able to at night (between 18:00-20:00Hrs) • Improved results of pupils • Increase in pass rate • Teachers sometimes use the classroom lighting to help pupils study in the night • During festivals at school pupils are able to practice drama and choir sessions	Appeal for more classrooms to be fitted with lights
4	Mr Mumba, Senior Clinical officer In charge	Mukanda Clinic	34 km from Chipata town town on Lundazi Road, and 3.2 km from the main Road	4 X 55WP, The clinic owns the PV system and used CHESCO technicians to install. The clinic was given 1 year service free by CHESCO after installation in 2001	Water pumping unit in a borehole- About 10 000 litres/day is pumped The water is used at the clinic and members of staff	-	Patients used to fetch water from a well for their use in the clinic. Members of staff also used to fetch water for their use at home	11 million kwacha was used on solar panels, Control box and lablour, Between 20 to 30 million in total was spent including water tanks, PV etc	• Since the clinic has admissions, patient s no longer walk distances to fetch for water in buckets, • Provision of sufficient clean piped water in the clinic • Improved hyihene as a result of piped water • The community around also draws the water. • Reduced diahorrhea diseases because the community, members of staff and patients are no longer using open well water	The community and clinic are happy with the solar pumping

A2.2 NESCO and Clients

Table A2.2.1 Households

	Name of Interviewee	Category	Location	Family size	PV size	Appliances /uses	Energy expense before PV	Energy Expense after PV	Benefits	Comment/appeal
1	Mr M.A Maponda	Households in a village called Nyansali Chief Ndake's area	Less than 4km from the Town centre	-	50WP	Lighting , TV black and white,		K50000	• Reduced cost of lighting • Keeps children indoors and around the village for entertainment. Before children used to scatter and parents did not have sufficient time with children • Used for cellular phone charging • Reduced on inconvenience of dipping in the pocket daily for such things as candles, matches and kerosene • Reduced fire risks arising form candle usage • Reduced chest problems arising from use of kerosene, sometimes diesel is used when kerosene is scarce.. Villages resort to diesel as cheaper and available source as opposed to kerosene. •	It has slow charging during cloud seasons. Need to esxpant capacity of PVs to cater for bigger appliances PV is good even with the grid electricity as it can be used as back up during load shedding
2	Mr Ndlovu	Household	\within Nymba town		50WP	Radio, TV cellular phone charging and fan		K50 000	• Reduced cost of lighting • Cost effective • School going children able to read in the night • Reduced fire hazards due usage of candles	
3	Prison officer' residence	Household	Within Nyimba town		50WP	Lighting, TV, Radio,		K 50 000	• Cellular phone charging • School going children have sufficient time to study in the night	Bulb s are scarce and replacement is costly The PV lights do not last the

										whole night
4	Teahcer at KalambaKuwa Day High School	Household /Civil servant	Less than 30 km from Nyimba		50WP	TV, video, lighting	Kerosine-K12000, 2-3 dozens of of dry cell batteries per month costing K10000 per dozen.	K50 000	• entertainment	Desire to own system,
5	Teahcer at KalambaKuwa Day High School	Household /Civil servant	Less than 30 km from Nyimba		50WP	lighting, TV, radio, video		K50 000	• sufficient lighting for reading • Entertainment • School going children have the time to do home work in the night • It is a form of civilization • Reduced fire risks, and hazards due to kerosene and candles	Expensive bulb replacement K50000/bulb Delays in servicing

Table A2.2.2 Business

	Name of Intervewee	Category	Type of Business	Location	PV size	Appliances /uses	Problems	Energy expense before PV	Energy Expense after PV	Benefits	Comment/appeal
1	Son to the Shop owner	Business-Shop(Ntemba)	Ntemba	Nyimba town	50 WP	Radio cassette for cassette testing when selling. Lighting	-	-	K50 000	• Radio cassette for cassette testing when selling. • Entertainment, • Lighting when packing in the evening as the merchandise are displayed outside the shop when selling • Reduced cost of powering the radio cassette	

										player as cost of dry cell batteries is eliminated • Extended business hours • Helps packing merchandise after business hours in the evening • Introduced TV sales because of solar PV	

Table A2.2.3 Institutions

	Name of Interviewee	Name of Institution	Location	PV size	Appliances /uses	Problems	Energy expense before PV	Energy Expense after PV	Benefits	Comment/appeal
1	The head teacher , Deputy head and two teachers	KalambaKuwa Day High School with 370 pupils	Less than 30 km from Nyimba town	50WP	Lighting of headmasters office and 2 classrooms)	Inability to use PV system to power computers	Before pupils used to use kerosene	K50000	• lighting pupils are able to read from evening upto 04:00Hhrs • improved performance of pupils • Improved pass rate for grade 12 pupils from 43% before solar PV lighting to 55% after PV installation • Teachers come in the evenings to help pupils read in class	Appeal to expand the capacity of PV so that the school can use computers which are currently running on diesel genset Monthly Cost to NESCO is proving too much for the school