The Republic of The Gambia
Office of the President, Energy Division

Renewable Energy Study for The Gambia

FEASIBILITY STUDY
Solar Home System Program

FINAL

Prepared by:

Lahmeyer International GmbH

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Abbreviations

AC	Alternating Current
AfDB	African Development Bank
CDMA	Code Division Multiple Access
CO_2	Carbon Dioxide
CRD	Central River Division
CSIP	Community Skills Improvement Project
DC	Direct Current
DOE	Division of Energy
GMD	Gambian Dalasi
GBA	Greater Banjul Area
GREC	Gambia Renewable Energy Centre
GTZ	German Agency for Technical Co-operation
HH	Household
IP	Internet Protocol
kWh	Kilowatt-hour
LC	Low Consumption
LGA	Local Government Authorities
LRD	Lower River Division
MCC	Multi-Purpose Community Centres
M&E	Monitoring and Evaluation
MFI	Micro-Finance Institution
MCC	Multipurpose Community Centre
MHC	Medical Health Care
MW	Megawatt
NAWEC	National Water and Electricity Company
NBD	North Bank Division
NGO	Non-Governmental Organisation
PHC	Primary Health Care
PV	Photovoltaic
RE	Renewable Energy
RET	Renewable Energy Technology
SDF	Social Development Fund
SHS	Solar Home System
SMME	Small-Micro-Medium Enterprises
SMU	Study Management Unit
SPACO	Strategy for Poverty Alleviation Coordinating Office
SSS	Senior Secondary School
TBA	Traditional Birth Attendant

tCO_2	Tons of CO_2
UBS	Upper Basic School
UNDP	United Nations Development Programme
URD	Upper River Division
US$	United States Dollar
VCR	Video Cassette Recorder
VDC	Village Development Committee
VHW	Village Health Worker
VISACA	Village-Initiated Savings and Credit Associations
VOIP	Voice Over Internet Protocol
WCE	World Computer Exchange
WD	Western Division
Wp	Watt peak

Measures and Currencies

Currency Equivalents of Gambian Dalasi (D or GMD)

Exchange rate	2000	2001	2002	2003	2004	2005	2006
US dollar (US$)	14.9	16.9	23.4	31.0	29.5	27.5	29.0

Measures and Units

1 kW	=	kilowatt	= 1,000 watts (W)
1 kJ	=	kilo joule	= 1,000 Joules (J)
1 MW	=	Megawatt	= 1,000 kilowatts (kW)
1 kWh	=	kilowatt-hour	= 1,000 watt-hours
			= 3,600 kilojoules

1 EXECUTIVE SUMMARY

Under funding of African Development Bank (AfDB), Lahmeyer International has been contracted by the Government of The Gambia, Office of the President, Energy Division to provide consulting services for the "Renewable Energy Study and Plan for The Gambia". The Plan's purpose is to develop and promote the use of renewable sources of energy in The Gambia, with particular emphasis on rural areas. The Study is further meant to assist The Gambian authorities in preparing projects that will provide sufficient energy to the population and improve their access to social services, such as education, health services and water supply. In consequence, the Plan is supposed to contribute to poverty reduction through the improvement of economic and social conditions of the population particularly in the rural areas. Finally, it is hoped the Plan will help stop the ongoing environmental degradation and lopsided dependency on imported fossil fuels.

In the First Phase of the Study, a wide screening of all renewable sources of energy was performed during 2005-2006. These sources of energy were investigated in terms of potential, technical feasibility and eventual social, economic and environmental benefits for The Gambia. These studies led to the preparation and completion of the Renewable Energy Master Plan.

It was then decided by the government of The Gambia that in the Second Phase further feasibility studies will focus on two main priority projects:

- A small wind farm of around 4 megawatt (MW) along the coast in the district of Kombo North, near the city of Brufut
- A programme dedicated to the development of solar home systems (SHS) for rural households and other photovoltaic systems (PV) for social services (schools, clinics) and productive uses (rural telecommunication centres).

This report focuses on the second priority project and presents the feasibility which elaborated for a PV Technology Dissemination Program.

In particular, this report provides:

1) A so-called demand assessment aiming at sizing an optimum SHS Programme
2) A technical analysis of the possible PV system to be offered and included in the study, including sizing of the systems
3) A cost assessment of the various systems in terms of investment and O&M
4) A discussion of the social-economic-institutional and environmental issues associated with the introduction of the Programme
5) Recommendations for design, implementation, monitoring and evaluation of the SHS Programme
6) A complete financial and economical evaluation of the programme using different scenarios and financing possibilities.

Chapters 3, 4 and 5 provide a complete overview of the proposed Solar Home Systems Programme. The budget for such a programme may approximately be US$ 9 million, a mix of loans and grants provided by AfDB and/or other donors, of which some US$ 7 million are meant for PV equipment and installation and US$ 2 million for technical assistance activities. The SHS Programme plans to install some 10,200 SHS (costing about US$ 6.1 million) and PV systems for rural clinics, school and, in community centres, for telecommunications. The reader should note that these figures are indicative only, as the Programme is still in the process of being defined and designed.

While the technical feasibility of the SHS option for rural electrification has been proven in many places around the world, a number of issues, associated with the implementation of solar energy project for electrification, need a more thorough analysis. One issue is access of the targeted beneficiaries to PV technology (including ability and willingness to pay) and the uses of PV technology (for individual, social or productive uses).

Another issue that the report emphasizes is which business model to follow, e.g. a fee-for-service model, in which the implementing organization retains ownership of the systems and the end-users pay a regular (monthly or seasonal) fee, or a more market-oriented approach, in which end-users purchase the PV system by paying cash or over time under a (micro-)credit scheme. Both models can have a market concession variant, involving competitive bidding in a certain region of The Gambia and awarding a contract to the selected private company or NGO with the exclusive right/obligation to provide electricity services to the customers in that area. Each model has its pros and cons and maybe the choice should depend on the use of existing network already operating in rural areas. For example, various micro-finance organizations operate in The Gambia and have a proven network reaching into the rural villages. Financial institutions, such as the development agency Social Development Fund and micro-finance institutions, would play an important role, not only in providing credit for rural households, but for the solar companies and rural-based solar technicians as well. In taking a market-oriented approach, it will be important to strengthen the supply chain from PV supplier (based in Banjul) to locally based technicians (and small local entrepreneurs, such as sellers of batteries, household goods and hardware) down to the end user.

With respect to the environment, the use of solar PV by rural households and services will have a positive impact in terms of reduced CO_2 emissions by means of the avoided use of kerosene for lighting in households and the avoided use of diesel in generators that would be the alternative in rural institutions (schools, clinics). However, the use of solar PV systems should go hand-in-hand with a recycling system for batteries to avoid that battery chemicals are dumped into the environment.

A number of recommendations for the design and implementation of the SHS Programme are presented in Chapters 6 and 7.

In Chapter 8, the report focuses a complete and thorough economic study in order to assess the financial and economic viability of such a rural electrification project. It is well known that Solar Home Systems schemes are very difficult to insert in any financial model. Indeed, electricity generation costs are really high with SHS but because of the sociology of the receiving population, the benefits provided are priceless. Indeed, it appears that the SHS program is very expensive in terms of generation costs over the project’s lifetime but it was also calculated that the solar options were the more economical ones to provide energy services to the population compared to conventional power generation solutions and grid extension.

At later stage, tender documents will be elaborated for this priority project to be implemented in the medium term.

2 INTRODUCTION

Under funding of African Development Bank (AfDB), Lahmeyer International has been contracted by the Government of The Gambia, Office of the President, Energy Division to provide consulting services for the “Renewable Energy Study for The Gambia”. The study’s purpose is to develop and promote the use of renewable sources of energy in The Gambia, with particular emphasis on rural areas. The Study is further meant to assist The Gambian authorities in preparing projects that will provide sufficient energy to the population and improve their access to social services, such as education, health services and water supply. In consequence, the study is supposed to contribute to poverty reduction through the improvement of economic and social conditions of the population particularly in the rural areas. Finally, it is hoped the project will help stop the ongoing environmental degradation and lopsided dependency on imported fossil fuels.

In the First Phase of the Study, a wide screening of all renewable sources of energy was performed during 2005-2006. These sources of energy were investigated in terms of potential, technical feasibility and eventual social, economic and environmental benefits for The Gambia. These studies led to the preparation and completion of the Renewable Energy Master Plan.

It was agreed with the government of The Gambia that in the Second Phase further feasibility studies will be performed. Two main priority projects were chosen:

- A small wind farm of around 4 megawatt (MW) along the coast in the district of Kombo North, near the city of Brufut
- A Programme dedicated to the development of solar home systems (SHS) for rural households and other photovoltaic systems (PV) for social services (schools, clinics) and productive uses (rural telecommunication centres).

This report focuses on the second priority project by making a first technical, economical and financial feasibility study and an attempt to assess the social and environmental issues and impacts of such a Solar Home System (SHS) Programme. In particular this report provides:

1) A technical feasibility study of the SHS Program,
2) An economical and financial analysis
3) A discussion of the social-economic-institutional and environmental issues associated with the introduction of the Programme
4) And finally a set of Recommendations for further implementation of the SHS Programme.

3 DEMAND ASSESSMENT

3.1 Introduction

Areas beyond the grid can be serviced by a variety of stand-alone systems. These stand-alone systems can consist of combinations of photovoltaic (PV) panels, wind turbines, and generators running on diesel, gasoline, or propane. Stand-alone systems range in size from small solar lighting systems that provide 20–200 watt-hours for lighting at night, to diesel-powered mini-grid systems with peak capacities of more than one megawatt.

Concerning The Gambia, the SMU decided to focus on solar PV systems for households, schools and health centres. The overall goal of the Solar Home System Programme (hereafter referred to as the SHS Programme) is to provide electricity for a large share of the population living in remote areas within the next few years using solar PV technologies. Specific targets for the first stage of the Program are to:

- Provide electricity access to rural and peri-urban households (who do not currently have electricity) and to services (including schools, health centres and communication community centres).
- Propose stable financing and coherent institutional authorities and framework for the implementation of the Program
- Analyse stable financing schemes, markets, technical capacity, and training systems

3.2 Households

3.2.1 Demand

Most households in the rural Gambia have no access to modern energy services. The electrification rate of the GBA and provinces averages below 30% (except for Banjul where the rate stands at 70%). According to a recent household energy survey (DMCI, 2005), 64% of urban users and 11% of rural users is connected to the grid[1]. Outside GBA only 6 provincial centres (Mansakonko, Farafenni, Kerewan, Janjanburegh, Bansang and Basse) have been electrified with a series of diesel-fired isolated systems with a total installed capacity of approximately 1 MW with electricity available for some 12-15 hours a day. In 2000, the total number of customers in rural areas was only about 2,600.

For lighting purposes, kerosene and candles are popular but are of low efficiency, expensive and dangerous.

Therefore, SHS are seen as an excellent alternative to grid extension and existing power supply systems and the population is basically in need of such solutions. Thus, the demand exists but depends on the people’s capacity and willingness of payment and on the possibility of implementation of such a Program.

[1] 2.5% of urban households and 0.7% of rural households have their own generator, while 2% of rural households use solar PV; 1.7% and 2.6% of, mostly peri-urban households use car batteries

3.2.2 Screening

The Solar Home System (SHS) Program shall cover different levels and groups of the population. It is a very ambitious part of the project and is the one aimed at providing the more significant social improvement for the people of The Gambia.

The present Program is mainly dedicated to rural population with no access to electricity as for now and in order to ensure that this Program gets some of its money back and finance some more systems, the targeted population needs to benefit from some minimum income.

Therefore, different assumptions were defined and applied to screen statistical population data in order to determine the plausible population which could be addressed by a Solar Home System Program in The Gambia.

This separation of the whole population in different categories is necessary to size the target populations, determine the particular characteristics of each population in terms of demand and ability of payment and therefore size properly the Program.

Having studied the statistics of The Gambia and thus divided the population in different groups, an analysis of the load for different typical households and community centres will be carried out. On that basis different solar powered systems will be designed.

3.2.2.1 Electrification Factor

As stated before, the Solar Home System Program is largely focused on rural or peri-urban populations that do not (and will not in the medium term and even in the long term) have access to electricity via a power grid.

The official generation and distribution of electricity in The Gambia is the task of the National Water and Electricity Company (NAWEC). NAWEC currently operated a large diesel power station in Kotu, in the Greater Banjul Area, which feeds the western power grid. NAWEC’s production capacity for the time being in this region is limited to about 26-30 MW[2]. The capacity of distribution is also limited and the grid only covers the most important urban centres in the west. Many inhabitants of the covered regions do not have access to the grid, a certain number of households might not be connected to the grid through a meter and power shortages happen every day.

Because of this weakness of the distribution, some households in these urban regions have purchased SHS, either because they are not connected or because they want to be sure to have electricity 24 hours per day, 7 days per week, the SHS being then a back-up system.

In rural regions, detached from the main grid, NAWEC is implementing a large rural electrification project. This project includes the construction of 6 isolated grids powered by medium-size diesel generators, the installed power per station ranging from 180 kW to 1400 kW.

These settlements, towns and villages will be soon connected to the local grids and have access to power. The coverage of the population that NAWEC intends to reach is although unclear. Even if a settlement will be connected this does not mean that all inhabitants will have access to electricity. Therefore, we retrieve the same scheme as before for the peri-urban regions of Western Division.

[2] Number given by the Energy Department (email 28/09/2006)

This brings us to a distribution of the population in three different categories: urban, peri-urban and rural. They are defined as follows:

- urban people having access to the grid : they will be referred to as urban
- urban people not having access to the grid : they will be referred to as peri-urban
- people living in large settlements parts of the 6 isolated grids : they will also be referred to as urban
- people living in the country side, not having access to any grid : they will be referred to as rural

It has to be noted that this is a very conservative simplification as the electrification rate reached by NAWEC in the "electrified" regions is really low. As it can be seen in the table given below, the electrification coverage is low even in the "electrified sectors" such as the parts of the Western Division covered by NAWEC where the coverage reaches a mere 11%.

Table 3-1[3]: Tentative estimation of NAWEC's electrification rate

Region	Population	Estimated number of Households	Official number of domestic meters	Coverage by NAWEC
Banjul + Kanifing	357'796	56'395	22'202	39%
Western Division				
Entire division	389'594	44'781	3'716	8%
Part Covered by NAWEC's grid	294'972	33'905	3'716	11%

Nevertheless, this electrification rate calculated here is considered as an estimation. Indeed, a certain share of the meters installed are said to be by-passed. The number of users connected to the grid is includes a relatively large margin of errors [3]. Taking this fact into account and the fact that the rate of electrification is supposed to grow over the years and as more and more households are to be connected, it was decided to consider as totally electrified the towns and settlements were a grid is available. This also applies to the Greater Banjul Area, which is completely excluded from the present scheme.

This application of electrification factor lead in addition to the exclusion of all the towns and settlements given in appendix in Table 9-1 and Table 9-2.

3.2.2.2 Community factor

The dissemination of a new technology always implies the training of the users and of technical personal, who will be able to maintain the new systems for the years to come.

[3] Source : Documents provided by NAWEC and interview with NAWEC's Billing Director Momodou Jallow.

Such a Program can also require the set up of a repayment collection scheme, of an awareness campaign or similar things. All these actions make only sense in the case of targeted population living in relatively large communities instead of small settlements of few households. Indeed, repayment collection trips or training sessions would then quickly become costly and time consuming.

Therefore, there was a need to fix a lower limit of households (HH) per village or community. The Consultant could access various reports dedicated to social and economical studies in The Gambia[4]. However, the pieces of information and number given in those reports were too coarse to allow any specific targeting. Therefore, it was decided to assume that this lower limit of HH per village would be of 100 households per targeted community. It is believed that this is a reasonable limit for such a Program allowing micro financing institutions or training personal to perform and work efficiently. In fact, this limit still allows us to select a large number of villages. Due to the fact that a large proportion of The Gambian rural population is distributed in smaller villages, a limit lower than 100 would have caused the selection of additional tens of villages. This would have led to an "over selection", which would have thus been absolutely inefficient.

The upper limit was fixed at 450 households, mainly because of electrification consideration. Indeed, it has been verified that all villages and communities having more than 450 HH are already connected to a grid (NAWEC in the West) or will be connected soon (isolated grids in rural areas)

Table 3-2: Distribution of Settlements with respect to size and location

VILLAGES	Brikama	Mansa Konko	Kerewan	Kuntaur	Janjabureh	Basse	TOTAL
100-150	16	17	22	8	11	8	**82**
150-200	5	5	4	2	4	5	**25**
200-300	15	3	7	0	2	6	**33**
300-450	8	0	2	0	2	3	**15**
TOTAL	**44**	**25**	**35**	**10**	**19**	**22**	**155**

A list of the communities in question is given in appendix in Table 9-3.

3.2.2.3 Poverty Factor

In all development Programs, poverty is an important factor. Indeed, while this is what most Programs are fighting against, this is also one of the most determinant factor. In the present case, SHS will improve living conditions by allowing activities to continue at night, for instance children studying or parents continuing productive processes. It also helps reducing households consumption of candles and kerosene, reducing health and hazard risks. But at the same time, it is proven that the persons the most in need of such systems, the poorest, are the ones the least able to maintain them because of very low income.

Income and Expenditure are critical elements of poverty in The Gambia. The main finding in this area of the review shows that regardless of the area of the country, people spend the largest proportion of their income on food. This is a defined sign of extreme poverty as given in the 2004 PPA.

[4] Especially the Population Census 2003 Report

In the Consultant's opinion, this share of the population should not be included in the programme but instead be targeted by more social measures regarding food and health services.

In the end, there are two ways of action to reduce the population under consideration in the Program to its components that can afford some energy goods. The very poor being by definition the share of the population with too little income to buy the set of basic goods, it could be assumed that they do not have any ability to pay for solar home systems. This method would be coherent with the first steps of the screening process (electrification and community factors) for which it was decided to go for a binary approach. The goal of this approach was to give a plausible number of households with NO access to electricity and having a certain ability to pay for their system. The assumption that the very poor people do not have the ability to pay is not necessarily absolutely true but is most likely.

Table 3-3[5]: Distribution of the population depending on poverty

Division	Very poor %	Poor %	Non poor %	Rich %
Brikama	*44*	*21.3*	*26.7*	*8*
Mansa Konko	*28.6*	*44.8*	*21.9*	*4.8*
Kerewan	*52*	*20*	*24.7*	*3.3*
Kuntaur	*34.1*	*31.1*	*27.3*	*7.6*
Janjabureh	*30.8*	*26.3*	*36.3*	*7.5*
Basse	*42.1*	*24.3*	*24.3*	*9.3*

Even if this assumption would allow the study to concentrate more on the desired target population, it has to be said that even the Very Poor are resourceful in the Gambia, no matter what the reports mention. Gambian officials are very sure that even this social category can afford energy services.

In fact, the second option would be not to put the Very Poor away from the programme and propose for them a product inexpensive enough. Therefore, all layers of the Gambian Society can be covered by this study and it was so in the following chapters.

[5] Source : PPA, 2004 ; According to PPA 2004, Poverty Categorization was used to determine the level and prevalence of poverty using the community's perception. The village selected three informants who had very good knowledge of the inhabitants of the village. The inhabitants of the village were divided into four categories namely very poor, poor, non – poor and rich. Categorizations were done based on the characteristics and the indicators of poverty, developed by the community during the focus group discussion

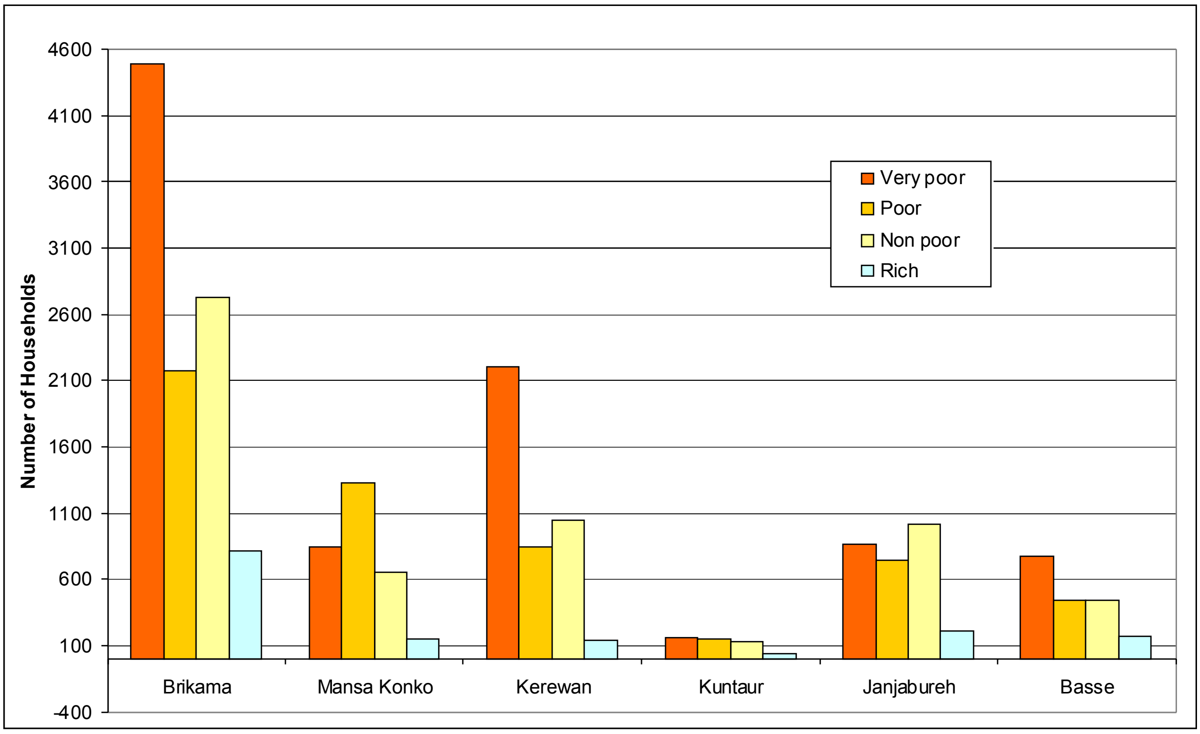

Figure 3-1: Distribution of HH depending on social category and location

3.2.2.4 Summary of the screening factors

The lack of social and economic data and reports about the rural population in The Gambia prevented the screening and selection to be based on the ability and willingness of the people to purchase SHS.

The screening of the population data was performed by using the following parameters. These factors allowed to reduce the population in consideration and to properly and accurately target the most viable communities.

Table 3-4: Summary of screening factors

Factor	
Electrification	The community or settlement should not be electrified or to be electrified. Towns and villages even partially connected to a grid are excluded from the Program
Community	Are considered communities with number of households between 100 and 450
Poverty	No social layer will be excluded from the Project but a specific product for each one will be proposed

3.2.3 Estimation of the overall population to be covered by the Program

According to the parameters given and explained above, the size of the target population was estimated for every LGA, in number of households. The numbers given in the table below correspond to the number of households living in communities of 100-450 households not linked to any power grid.

Table 3-5: Post-screening estimation of number of HH with respect to social category and location

Division		Very poor HH	%	Poor HH	%	Non poor HH	%	Rich HH	%	Totals HH
Brikama		3531	44	1710	21.3	2143	26.7	642	8	4495
Mansa Konko		850	28.6	1332	44.8	651	21.9	143	4.8	2126
Kerewan		2201	52	847	20	1046	24.7	140	3.3	2033
Kuntaur	CRDN	161	34.1	147	31.1	129	27.3	36	7.6	312
Janjanbureh	CRDS	864	30.8	738	26.3	1018	36.3	211	7.5	1967
Basse	URD	771	42.1	445	24.3	445	24.3	171	9.3	1061
	TOTAL	8378	41.1%	5219	25.6%	5432	26.7%	1343	6.6%	20372

The total number of potential target households is of about 20'400.

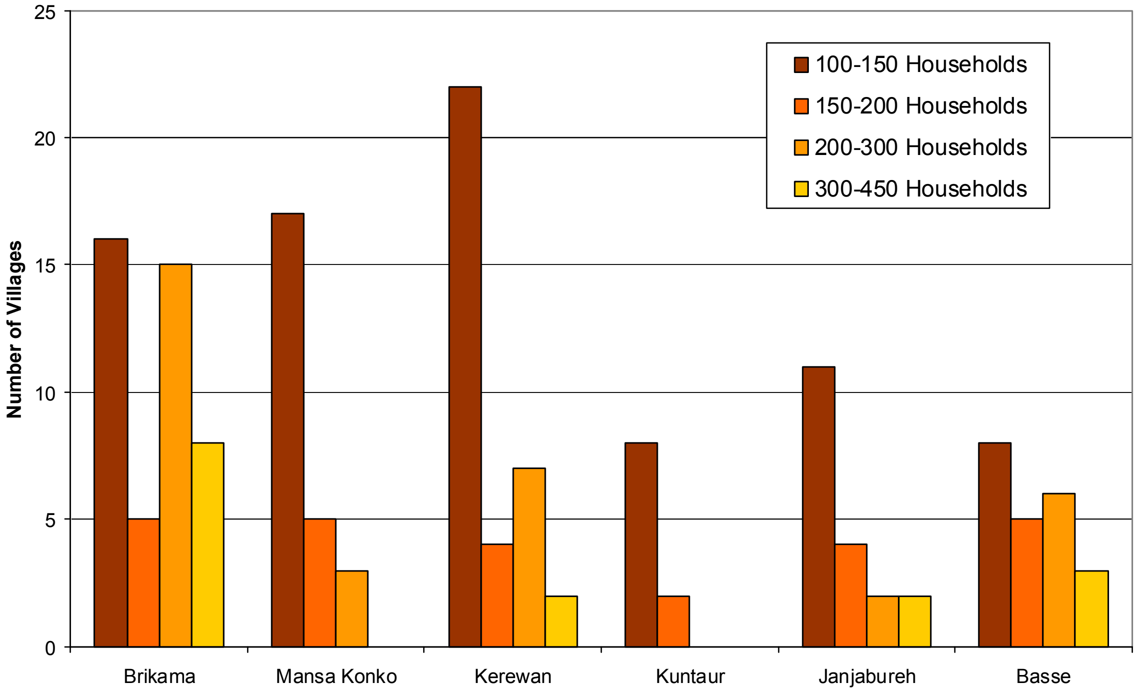

Figure 3-2: Graphical presentation of the distribution of HH after screening; distribution with respect to income level and location

As can be seen in the Figure above, the distribution of these communities is widely spread over the country with some irregularities. It appears that settlements in general are more concentrated and larger in the West of the country, while the eastern divisions have smaller communities (the share of very small settlements, not represented here, is indeed much larger in proportion for those regions). Two particularities can be stressed out: Brikama has the largest number of large villages and communities whereas in Kuntaur's LGA they are inexistent.

Nevertheless, the way the screening was done, does not allow to use this figure as an other screening parameter. Indeed, the communities with between 100 and 450 households are all suitable for this Program as stated before. This brings a total of 155 communities and villages which all could be covered by the Program. Even if most of the activity would be in the western divisions, the eviction of one or several regions would be done for political reasons and not statistical.

3.2.4 Market Assessment

After the different screenings were performed, rural households in The Gambia were divided into different categories distributed as shown in the plot below. The general pattern in terms of population, obviously copies that of the distribution of communities throughout the country with a predominance of the three western divisions. However, in terms of poverty, the same regions have a larger share of Poor and Very Poor people compared to the west of the country.

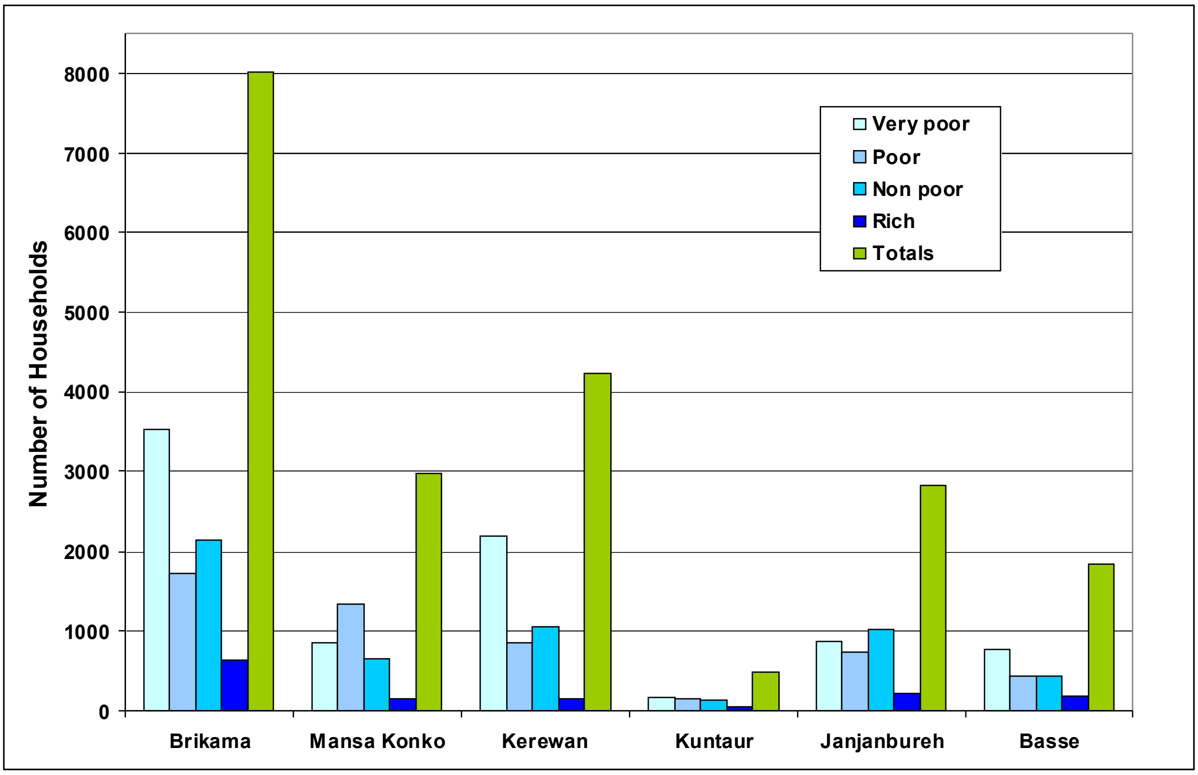

Figure 3-3: Distribution of rural HH with respect to social categorising

As the programme is dedicated to improve standards of living in the Gambia, it was decided that all social categories would be covered by the study.

In order to evaluate the number of SHS to be provided and thus the size of the Program to be developed, it is necessary to define which proportion of the four categories can have the capacity of payment and the willingness to purchase a SHS.

It was impossible to gather reliable and consistent information regarding these two important factors. Actually, no accurate study exists about the people's income in rural areas and about the share of their income that they spend on energy services such as kerosene, candles or battery charging. The only statistics available dealt with general numbers of average income per LGA and could bring nothing viable for the present study.

In consequence of all this, the Consultant proposes a scenario considering a share or coverage factor of the targeted population to be provided with SHS. As the SHS Program will be likely to involve a financing mix regrouping payment by households, micro credit and subsidies, different designs of the financing mechanisms are likely to help reach these objectives if they are defined as such.

In the present case it was estimated that a share or coverage ratio of 50% of the four social categories would represent a plausible proportion of the population that could be supplied by the Program.

The DMCI (2005) household energy survey gives some interesting data on energy use in rural households as well as perception of development problems. Of the rural respondents interviewed, 11.4% reported to have access to electricity, of which connected to a NAWEC grid, 3.6%; connected to a neighbour, 1%; having own generator, 0.7%; having a PV system, 2%; using car batteries, 2.6% and using torch batteries, 2.6%.

Regarding electric appliances 18% of the rural households are reported to have a TV, 84% have a radio, 4% have a VCR and 3% have a refrigerator, while 25% uses cellular phones. Regarding lighting 63% uses a kerosene lamp at an average fuel expenditure of GMD 2 per day.

Excluding the households that live in or near rural towns (and are or may be connected to a NAWEC grid), the above figures imply that some 4% of households (around 3,000) use a generator, a solar system or re-charge car batteries. Given the desire to have a TV or cellular phone, these figures give a confirmative indication that a market niche for the 10'200 SHS (the figure aimed at in the SHS Programme with 50% coverage factor, see the last paragraphs) should indeed exist, at least in the wealthier segments of the rural population.

It is important to note that this investment Program does not take into consideration different coverage rate depending on social distribution, but would consider a specific SHS designed for each social category. In other words, Very Poor households would receive a solar lantern, Poor ones would be equipped with the small SHS, the Non-Poor with a medium sized SHS and Rich households would prefer a larger SHS.

Table 3-6: Total number of HH living in communities targeted by the Program, distributed per social category and LGA

Division		Very poor HH	%	Poor HH	%	Non poor HH	%	Rich HH	%	Totals HH
Brikama		3531	44	1710	21.3	2143	26.7	642	8	8026
Mansa Konko		850	28.6	1332	44.8	651	21.9	143	4.8	2976
Kerewan		2201	52	847	20	1046	24.7	140	3.3	4234
Kuntaur	CRDN	161	34.1	147	31.1	129	27.3	36	7.6	473
Janjanbureh	CRDS	864	30.8	738	26.3	1018	36.3	211	7.5	2831
Basse	URD	771	42.1	445	24.3	445	24.3	171	9.3	1832
	TOTAL	8378	41.1%	5219	25.6%	5432	26.7%	1343	6.6%	20372

With a coverage of 50%, the following numbers of households would be equipped with SHS as given in Table 3-7. The Program would then deal with about 10'200 SHS with about 7'600 systems in the three western regions and 2'600 in the east.

Table 3-7: Number of SHS, which can be installed within the frame of the Program with a coverage ratio of 50%

Division		Very poor HH	%	Poor SHS	%	Non poor SHS	%	Rich SHS	%	Totals SHS
Brikama		1766	44	855	21.3%	1072	26.7%	321	8.0%	4014
Mansa Konko		425	28.6	666	44.7%	326	21.9%	72	4.8%	1489
Kerewan		1101	52	424	20.0%	523	24.7%	70	3.3%	2118
Kuntaur	CRDN	81	34.1	74	31.1%	65	27.3%	18	7.6%	238
Janjanbureh	CRDS	432	30.8	369	26.1%	509	35.9%	106	7.5%	1416
Basse	URD	386	42.1	223	24.3%	223	24.3%	86	9.4%	918
	TOTAL	4191	20.6%	2611	25.6%	2718	26.7%	673	6.6%	10193

3.3 Health Centres

3.3.1 Introduction

Even at provincial centres, electricity is only partially available, not even 12 hours a day. At some of the larger centres, a smaller diesel generator may be available at the local clinic, although in rural Gambia the supply of fuels and electricity supply is highly unreliable. The small health posts have no power source at all and personnel have to use candles and kerosene lamps for performing medical acts at night. Electric lighting greatly improves accessibility and quality of (emergency) care at night. Failing reliable refrigeration, the potency of vaccines is lost. Vaccine refrigeration and ice-pack freezing are common applications of solar energy in rural health clinics. Also radio communication can greatly improve rural health care services, by providing full-time communication with medical back-up staff at the divisional or national health centres. Remote and non-electrified rural communities have notorious difficulty to recruit and keep trained medical staff; a small SHS providing light, music and/or TV can be important incentives for professional staff to stay.

3.3.2 Typical Clinic Services

Despite their poor state and low level of equipment, health facilities in the rural Gambia are in charge of taking care of many pathologies. The most common are listed below :

- Inoculations
- Treatments for:
    - Respiratory infections
    - Venereal diseases
    - Diarrhoea diseases
    - Skin disease
    - Eye disease
    - Malaria
    - Parasitical diseases
- Trauma:
    - Burns
    - Simple fractures
    - Wounds
    - Snake bites
- Prenatal/postnatal care and child birth
- Dental
- Referral to hospitals
- Public health education

This list illustrates the importance of these facilities for rural populations and, thus, let presume about the great impact that would have an improvement of caring conditions thanks to PV installations on all classes of the society.

3.3.3 Typical Applications

Typically, health clinics require electricity for lighting, communication equipment, and refrigeration. Electric lighting is vastly superior to candles and kerosene lamps. Often, when a clinic is electrified, lights are included in the initial installation package. Because of the need to conserve power, most off-grid clinics use compact fluorescent lights that typically draw from 5 to 20 watts each. Even clinics that use day lighting, need electric lights for emergency night care. Emergencies also require reliable communication equipment. Electricity provides radio and satellite communications that enable the clinic staff to consult with specialists as needed and to arrange quick evacuations of seriously ill or injured patients. Health clinics also rely heavily on refrigeration to maintain the viability of medicines and vaccines. In the last 15 years, great progress has been made in the development of vaccine refrigerators. These small, highly efficient, usually DC, refrigerators can be powered by a modest-sized solar array. Typical models draw 80–120 watts and will run for around 10 hours per day. Some super-efficient models use even less energy. Although they are expensive, these refrigerators are becoming increasingly popular and are considered so important that the World Health Organisation has set standards for them. Like lighting, a vaccine refrigerator is often included in the installation package when a clinic is initially electrified. Other applications for electric power in clinics include small water pumps, ceiling fans, small sterilising stoves, vaporisers, computers, centrifuges, and TVs and VCRs. The latter are used not only for entertainment, but also to show instructional and public health videos. Larger facilities such as district hospitals also may have additional laboratory equipment.

3.3.4 Typical Electrical Appliance Data

In a health centre the most common appliances are those dedicated for lighting, refrigeration, communication, and sterilisation. A list is given below :

Table 3-8: Typical appliances in a health centre

Item	Power required in Watts	Use in hours per day	Energy Requirement in kWh/day
Lights	5–20	Varies	Varies
2-way radio	75	1	0.075
Refrigerator	60–120	8-15	
Stove	200–500	1	0.2–0.5
Vaporiser	35–70	1	0.035–0.070
Ceiling fan	5–20	Varies	Varies

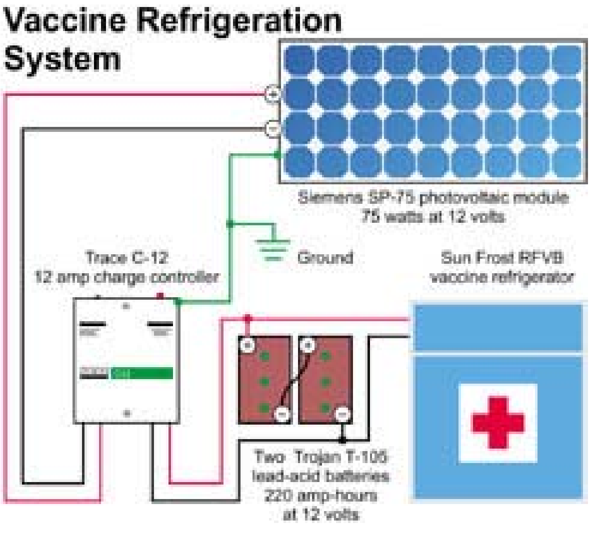

Figure 3-4: Basic PV system for a vaccine refrigerator

3.3.5 Health Centres in The Gambia

In The Gambia, health care deliveries are through, Primary Health Care (PHC), Village Health Worker (VHW), Traditional Birth Attendant (TBA), Medical Health Centre (MHC), Dispensaries and Hospitals. Health care is not very expensive, but long distance plus inaccessible roads, lack of ambulances to name a few prevent a major part of the people to access them in a proper way.

Furthermore, facilities are inadequate and mostly without enough drugs. Distance to health facilities is far for most rural communities. Inadequacy of drug supplies at the health facilities, waiting time, lack of enough physicians and other indirect costs compel villagers to be using traditional medicines. All these issues need to be addressed urgently to restore communities' confidence in the modern health care system.

In addition most health facilities in the rural Gambia do not have energy for most time of the day. The largest ones rely on standby generators, which have high recurrent cost, while the small health posts have no power source at all. In these cases, personal has to use candles and kerosene lamps for performing medical acts at night.

As stated before, the implementation of a Program for this target group is recommended. Indeed, a special focus should be brought on health posts and very remote health centres. A list is given below for the 18 health posts in the Western Division. 12 other health posts are located in the other LGA in rural areas, bringing the total number to 30.

Some of those posts are connected to a grid but this parameter is not here taken into account. Indeed, one goal of the Program would be to make health centres independent in terms of energy supply. The power shortages from NAWEC represent a great inconvenience for those health posts and for their patients. As a consequence, it is believed that the installation of PV systems for them all is a necessity.

Western Division (Health Posts & Key Villages)
Farato H / Post
Pirang H / Post
Tujering H / Post
Mayork H / Post
Kanilai H / Post
Basorie K / Village
Kafuta K / Village
Sibanor K / Village
Sintet K / Village
Besse K / Village
Sangajorr K / Village
Mandinary K / Village
Kartong K / Village
Marakissa K / Village
Jambanjelly K / Village
Brikama K / Village
Brufut K / Village
Banjulinding K / Village

Figure 3-5: List of health posts in Western Division

The goal of the Program shall be to provide all health posts in The Gambia with PV power supply systems. As a feasibility study for all posts is not possible for the time being, it has been assumed that most of them have very same basic needs as they all have very similar number of workforce, in terms of quantity and education.[6]

[6] Source : Report from Health Department, Workforce 2005

3.4 Schools

3.4.1 Target Schools

The Gambia has a large number of schools and not all of them can be electrified or equipped with solar PV installations within the frame of the present Program. In addition, this would not make sense as some of them are already connected to a grid or likely to be connected in the near future.

As for households, schools have been submitted to a screening related to electrification and all schools electrified or located in electrified places where taken out of the present study. A shorter list of pre-selected schools was then elaborated; this list is given in appendix.

The Consultant has selected 51 Upper Basic Schools (UBS) and 3 Senior Secondary Schools (SSS) of interest. While the selected UBS are distributed quite evenly all over the territory of The Gambia, the selected SSS are only located in WD and NBD.

3.4.2 Defined Typical Needs

3.4.2.1 Upper Basic Schools

As stated in the introduction of this section, the most basic need for UBS is lighting. Thanks to lighting, evening classes can be organised and literacy courses for adults can be performed. It was estimated that as a standard product, three classrooms in each UBS should be equipped with lighting installations and that some safety lighting for the outside should be added. In addition, a power source for some radio device for night watchers should complete the equipment.

Requirements:

- Night classes in 3 classrooms
- Plus outdoor light in front of door
- Security light around school
- Possibility to power a transistor radio (max. 10W) during day

The load was calculated according to the following parameters:

- Classroom lighting for 4.5 h/d, 5 days a week
- Outdoor light in front of door for 4.5 h/d, 5 days a week
- Security light around school 12 h a day, 7 days a week
- Transistor radio (max. 10 W) during 12 h at daytime
- 3 days of autonomy

Estimated Energy Requirements:

Table 3-9: Estimated Energy Requirements for a standard UBS

DC Energy Demand	Daily Average	Annual
In kWh	1.45	530

3.4.2.2 Senior Secondary Schools

Similarly to UBS, SSS should be equipped with lighting in three classrooms as a standard product. As the number of SSS in consideration is relatively low, further adaptation could be easily achieved.

In addition to lighting, electrical power should be provided to a computer lab of ten computers each, with internet access and some basic appliances such as a printer.

Requirements:

- Night classes in 3 classrooms
- Plus outdoor light in front of door
- Security light around school
- Possibility to power a transistor radio (max. 10 W) during day
- Possibility to power ten computers and a printer
- Possibility to power additional electronic devices such as router, wireless internet receiver, etc.

The load was calculated according to the following parameters :

- Classroom lighting for 4.5 h per day, 5 days a week
- Outdoor light in front of door for 4.5 h per day, 5 days a week
- Security light around school 12 h a day, 7 days a week
- Transistor radio (max. 10 W) during 12 h at daytime
- Ten computers with specific consumption of 100 W each, 8 hours a day, 5 days a week
- An AC/DC inverter, 1500 W of peak load capacity
- Additional electronic devices (about 500 W), 8 hours a day, 5 days a week
- 3 days of autonomy

Estimated Energy Requirements:

Table 3-10: Summary of the estimated energy need for a standard installation in a SSS

DC Energy Demand	Daily Average	Annual
In kWh	1.37	500
AC Energy Demand	**Daily Average**	**Annual**
In kWh	1.45	530
	8.57	3,130

3.5 ICT Centres

3.5.1 Introduction

The term ICT stands for Information and Communication Technologies. An ICT centre is a community place regrouping communication and information equipment. In this report, it is planned to combine ICT and Multimedia Community Centres (MCC) as a large set of the later have been built across the country in recent years. Indeed, most ICT centres are places with phone services and eventually computers connected to the Internet. These places provide an incredible improvement to the population as they can easily communicate with the family living in another part of the country and to the youth in particular.

Information and communication technologies (ICT) have become indispensable tools in the digital age we live in. Whether it is computers, the Internet (and related technologies), telephony, or the mass media, there is no doubt that ICTs can, and have made significant contributions to national development.

ICTs are especially important as they facilitate work in many sectors, reduce costs, and facilitate communications as well as information dissemination. For this reason, ICTs help increase awareness and, by implication, transparency because people are more informed.

It is perhaps in the civil society sector that ICTs are most important. This is especially so in Africa because of many factors. First, the fact that ICTs reduce communication and information dissemination costs is most welcome in Africa, because most of the African population is resource-poor, and hence, can hardly afford high expenses, even on important issues as outreach. In the same vein, ICTs are important to African population because they facilitate communication. This easier access to information technologies brings them a lot and greatly improves their ability to communicate with the world and their families abroad.

Despite the important role that ICTs play in national development, many Gambians are yet to benefit fully from the information revolution going on daily around them. The reasons for this situation include the fact that most Gambians cannot afford ICT products and services, and/or do not have the required capacity (especially in terms of training) to make of the most of these technologies. A case in point is access to the ubiquitous and global Internet, and related services such as Web site hosting, Internet telephony (sometimes called Voice over IP, or VOIP), and e-commerce, to name a few.

Although efforts are underway to bridge the digital divide faced by Gambians, there still is a lot to be done.

3.5.2 The rural market place

All ICT projects exist in a market place, therefore issues of need and application, demand, affordability, willingness to pay, awareness creation, advertising, competition, regulation, and the growth of all of these must be considered in detail. The factors that together create and sustain a market derive fundamentally from the nature of an area's or country's economy and from its socio-economic, demographic and cultural make-up. Geographical factors – in particular, size, topography and population density - also play an important role in defining how viable a 'market' is as a commercially interesting or sustainable opportunity for ICT projects.

3.5.3 Rural telecommunications fundamentals

Before we describe the methods and tools to estimate demand in rural areas, it is important to describe a few key features of rural telecommunications and ICT as they differ from urban ICT.

3.5.3.1 Public access

In the past rural telecommunications has been often considered unviable, but this was usually based on fixed telecommunications networks and the assumption that telephone lines are provided on an individual household basis. And what the individual household could afford to spend annually was usually well below the costs of installing a line in sparsely populated rural areas. Today it is accepted practice to provide public access telephones, a payphone or phone shop shared and used by a larger community of users, e.g. a village. The advantages are obvious: the revenue is concentrated on a single line or on a single end-user terminal, making the installation more economical for the operator and cost-effective for the users. This is important, as it is not individual demand that needs to be the outcome of the demand study, but the collective demand of a certain defined user community. As a public access telephone should be able to capture the demand of a community, issues of where to locate the phone and how to operate the phone are much more important, in order to achieve the highest accessibility. There have been examples in the past (e.g. in India) where the public telephone was placed in the office of the local administrator. This is not a good choice as it prevents many people from using the phone due to social barriers (especially in a caste society such as India). In addition, an administrative office is only a limited number of hours open to the public.

Many advantages speak for the phone shop model in developing countries, as opposed to an unmanned payphone booth. This includes that the phone shop owner can assist first-time users or illiterate users, less logistical issues with coin collection or phone-card distribution, the owner can perform simple trouble-shooting and provides security for the phone installation, among others. One disadvantage is that the shop is not open 24hours per day.

3.5.3.2 Incoming calls and interconnection revenue

For rural telecommunications, it must be recognised that perhaps more than 50% of the operator's potential revenue could come from incoming (i.e. urban to rural) calls. There is a considerable demand in urban areas to call into rural areas, usually from relatives and friends who moved to the city. Those are typically also the more affluent telephone users. Data in Latin America, for example in Chile, demonstrates that rural operators earn over 60% on their revenue from incoming calls to rural areas[7]. This pattern has also existed in other countries, such as The Gambia where lots of rural families have relatives in urban areas or abroad and could become a general rule in low-income countries and areas. Thus, a demand study, which only looks at the affordability in rural areas and does not estimate the demand for calls into rural areas, will overlook a huge potential for revenue generation by the rural network, as well as overestimate the subsidy required. Most rural people have family members or close associates in the city or overseas and these urban-dwellers have more affordability and also a willingness to call or accept charges.

As a result, there is a major potential for the supplier of rural telecommunications service to secure revenue that actually originates in urban centres. This means that the actual revenue potential for the telecommunications operators could exceed what the rural community is able to spend. If an operator is both the originator and terminator of these calls, it should account for the calls properly and recognise the added benefit received from installing rural networks.

Also, schemes to incentives the retailers/minders of public payphones (e.g. in PCOs, tele-kiosks, phone shops. etc.) to welcome incoming calls – rather than treat them as an annoyance – take messages, set up return calls, etc, could greatly enhance the operator's revenue stream (as well as the kiosk owner's business). This could make the difference between non-viability and viability of rural networks. Experiments with virtual voice-mail, where rural users can subscribe to their own voice-mail for a monthly fee, similar to having a P.O. box, are particularly promising. Operators who serve only the rural areas can also derive huge benefit from incoming calls to their area if they receive payment from urban based operators for terminating the calls. Since there could be more incoming than outgoing calls, their source of revenue from this could be greater than the revenues collected from rural callers. This inter-operator payment is called an interconnection fee or 'access charge'. Few countries in Africa yet recognise the importance of this or enforce fair compensation to rural operators for it in their regulatory regime. However, this is one fundamental area of policy that must change in order to encourage rural networks to proliferate. The rural networks would be much more viable if this simple principle of interconnection payment was implemented. Furthermore, the per-minute access charges justified in the urban-to-rural direction can be higher than in the rural-to-urban direction. If cost based interconnection were implemented, we could see a very different form of project justification and viability scenario for rural telecommunications than hitherto.

3.5.3.3 Rural traffic patterns

Another characteristic related to traffic is that rural people more often make (or receive) long-distance calls, for example to the next district centre or to the capital. Especially in Africa it can be expected that almost all calls are to persons outside of the village based on the assumptions that the majority of rural villagers does not have an individual phone to be

[7] Bjoern Wellenius, "Closing the Rural Communications Access Gap: Chile 1995-2002"

called on, and will use an available public payphone. Also, as the affordability is still low, rural villagers can be expected to walk short distances (e.g. to a neighbouring village) to save spending the money on a call. Only for larger distances the cost-benefit ratio of travel vs. communication reverses and makes the call more cost-efficient.

In general, rural users are thus to gain from tariff rebalancing which reduces long-distance rates and increases local call rates. With the above in mind, there might be some scope of improving the affordability of communications for rural areas by a considered design of local calling areas mindful of demographics and communities of interest rather than to geography alone.

Demand studies start from very cursory or preliminary desk studies to more detailed ones, and then to sample field studies and to full-scale representative base line demand studies. These have several levels of depth and accuracy. The voice telephony market can be profiled roughly in terms of demand for private lines, demand for calls from public phones, total revenue potential, costs, and profitability (or not) of the supply business.

3.5.3.4 Non-voice ICTs

To this point, there is no such clear-cut demand and revenue stream, that can be identified from non-voice communication, even though there could be significant market in the medium term. The fact of the matter is that even urban based Internet Service Providers and applications businesses (information, education, or e-commerce) are finding it difficult to estimate their market and meet targets without risk. The AC Rural ICT Program recognises this fact by noting that the need, demand and application for ICTs in rural areas of Africa can be characterised as follows:

· Basic voice telephony by the majority of the population, and

· Non-voice ICT networks and services at intermediary agencies with active interests, responsibilities and activities in rural areas. These are local government agencies, social infrastructure and health institutions, schools, NGOs and some business entrepreneurs.

With the exception of some of the more ‘advanced’ or ‘vanguard’ rural based agencies or units, the vast majority of the intermediary agency offices with demand for non-voice ICTs today are based in regional or district centres and/or other small towns, but usually not in villages, even though many of their ‘clients’ are villagers and villagers may visit their offices often. Thus the potential user community and ‘demand’ for more advanced ICT has to be identified in a more consultative fashion than for telephony and often involves more than simple identification of demand. It includes consideration of how to catalyse partnerships between development, administrative and private agencies to create sustainable and scalable ICT demand. The process typically includes the following:

a) Through desk research, stakeholder consultation and consensual analysis, identify the type of agencies, institutional units, associations and individual small-micro-medium enterprises (SMME) that are the most likely to become users of ICT, based on current activity and interest, development Programs, state of finances & economy, etc.

b) Identify the distribution and size of these institutions and units (i.e. local government, hospitals and clinics, schools, NGOs, business and/or agricultural associations, micro-finance offices, etc.) and profile potential requirements

c) Carry out a field survey as a 'reality check' to identify what the real potential, ability to absorb investment and use of the technology will be, and what form of partnerships may be required

d) Identify the centres – e.g. district centres, small towns, etc. - where Internet points of presence will best serve the 'demand'

e) Coordinate with specific data for ICT deployment coming from other sector players

f) Harmonize the data into realistic (and not over-optimistic) demand approximations.

3.5.4 Power issues

Powering telecommunications infrastructure and end-user equipment as well as other ICT applications is a challenge in rural and remote areas. The overwhelming majority of rural areas lacking telecommunications also lack electricity supply. Providing ICT to rural areas thus needs to consider how to provide the electricity to power ICT as well. In the present case, the study is only focused on PV power supply. Indeed, photovoltaics is in general most cost-efficient when only modest levels of electricity, up to a few hundred watts, are required.

One power system cost that can be sometimes forgotten is surge protection. This could range from the careful installation of ground wires for radio sites to simple protection devices for computer and telephone end-user equipment in telecentres. Power and telecentres is also a problematic issue. Power requirements of a larger number of PCs are quite high, thus powering a large telecentres off-grid is often not feasible. This adds another reason to the emerging understanding that telecentres should start small.

3.5.5 Low cost end-user terminals & delivery devices

Rural telecentres and Programmes in education, e-commerce and telemedicine use the capabilities of ICT devices to enable a range of functions including data entry, information retrieval, voice communications and messaging services. Personal computers (PCs) are frequently used to support these services, but can be difficult to operate and maintain in rural areas. Therefore, it is helpful to review a range of low cost ICT devices and applications that could be valuable for rural users.

3.5.5.1 Thin Client systems (network computers)

Thin client systems (also known as "network computers") are specialized client/server systems in which most of the processing is done on the server. The terminal has no independent intelligence but can access standard computer applications. Thin client systems could be suitable for use in rural telecentres, schools, etc. as part of a local area network. However, thin client systems are not suitable to provide rural users in developing countries with affordable, networked computing over wider areas because considerable bandwidth is required between the thin client and the server.

The relevance of thin client systems has diminished considerably in the last two years. Recent declines in computer prices have eliminated the cost advantages of thin client systems over standard PCs. For instance, Compaq's lowest priced thin client system, the Evo T20, now sells for US$399. An inexpensive PC running Linux, such as the Microtel Sysmar710 sells for US$199 without a monitor (inexpensive new monitors cost less than US$100). The same system using Microsoft Windows XP costs US$299. For more information on thin client terminal and PC pricing, http://computers.cnet.com/ is a useful source.

3.5.5.2 Linux

The Linux operating system has the potential to reduce the cost of computers. Linux is an open source operating system for use on PCs and servers. Linux is therefore available free for downloading and copying. Though there are not as many software applications available for Linux as there are for Microsoft's Windows, there are a number of low cost applications available, such as Sun's Star Office package (includes word processor, spreadsheet, presentation, drawing and database). Obtaining service and support will likely be more difficult for Linux than for Windows.

Fortunately, the popularity of Linux is increasing rapidly and it is not considered difficult to learn.

Using the Linux Terminal Server Project system could further reduce computer costs in rural schools or telecentres. Trials have been taken place in South Africa for example. The system requires only one server with a hard disk. Other PCs can be networked to run off the server's hard drive and thus even computers without a functioning hard drive can be re-used. To find out more, http://www.linux.org/ offers extensive information and operating system downloads.

3.5.5.3 Refurbished computers

The use of refurbished computers is another way of reducing technology costs for rural users. Organizations such as World Computer Exchange (WCE) can provide inexpensive used, working, Internet-accessible computers. Though used computers might not necessarily be capable of performing all of the functions of a new computer, they are adequate for many users who only require e-mail and word processing functions. The cost of refurbished computers varies depending on the source and the type of computer, but usable refurbished computers can be purchased for under US$100.

3.5.6 Development of an ICT Project in The Gambia

A development Program for such ICT centres can be implemented in The Gambia.

This ICT centre should be installed in multimedia community centres in rural areas. It would regroup a set of computers and their respective equipment (network, printer, internet access, etc.) and other services that still need to be discussed (community television, etc.)

The basic services offered by the centre should be as follows:

- Wireless Internet access (solar-powered where necessary)
- Web site development and hosting
- Web-based e-mail accounts
- Development and hosting of online communities (e.g. online discussions on poverty, education, etc.)
- VOIP-based communication system
- Training on Internet use

ICT centres should be located in large settlements in rural areas. As a matter of fact, such a centre has to cope with different requirements and needs. In order to ensure sustainability of the project, it has to be located in a community large enough to provide enough income to make it financially viable. Also, it would not be located in a settlement or town which is to be connected to a power grid. Such settlements have to be ruled out.

3.5.7 Location

3.5.7.1 Wireless Access[8]

The Gambia has relatively few telecommunication infrastructures compared to western standards. However, an almost-all wireless network is being developed in the country. On the south bank of The Gambia river, an optic fibre has been drawn from the coastal region all the way to Fatoto at the very east of the territory, following the main road between Brikama to Basse. On the north bank, between Barra and Georgetown, wireless communications are ensured by a set of radio E1 stations. These later transfer the information per radio wave and not by optic fibre as on the south bank. The flow of information coming from those stations is therefore much narrower and should be limited to voice transfer.

As for now, internet transfer is only viable using the Code Division Multiple Access (CDMA) stations installed or to be installed on the optic fibre backbone.

Although the implementation of the emitting stations has not been completed, it is believed that the south bank will be entirely covered within the next months. Each CDMA station emits over an area of 30km radius, meaning that large areas are covered and often, large parts of the north bank as well.

As a consequence, the number of places where a wireless access to phone services or internet services is not available is relatively small. Indeed, apart from the extreme east of the country where power supply is problematic (the situation is to be solved by the implementation of the rural electrification Program), most parts of the country are accessible to such services.

3.5.7.2 Multipurpose Community Centres in The Gambia

Within the frame of the Community Skills Improvement Project (CSIP), 21 Multipurpose Community Centres (MCC) were or are being built in The Gambia. These are meant to provide conductive working environment for women and out-of-school youth in running literacy/numeracy sessions, skills training and income generation, micro-finance activities among others.

The list below gives the location of the selected Multipurpose Community Centres in The Gambia. These 18 facilities do not have access to the grid.

[8] Personal conversation with Mr. Abdulie Bass, Technical Manager, Gamtel

Table 3-11: List of all selected Multipurpose Community Centres in The Gambia (CSIP)

Division	Community
North Bank Division	Bereding Juffureh Kerr Jarga Sara Kunda
Central River Division - North	Wassu Gendeh
Central River Division - North	Jah Kunda Kulkule
Upper River Division - South	Hela Kunda Cha Kunda
Central River Division - South	Jareng Bureng
Lower River Division	Koloir Kiang Karantaba Bondali
Western Division	Somita Omorto Brufut

Equipped with multimedia and information equipment they allow communities to organize meetings, presentations, film projection or learning sessions.

These MCC should be used as a base for ICT. Selected MCC can be then modified in ICT by the adjunction of telecommunication equipment and solar energy supply.

3.5.7.3 Selection of one Location for an eventual Pilot Project

The present study is based on the assumption that 18 of the MCCs will be turned into ICT centres. However, such development requires much more attention and work than others. Indeed, it has to be done in an economically viable way and has to target the right populations. In addition, the added value brought by the use of Internet services has to cope with population's ability to use them. Therefore, in a first step, an option might also be to,only focus on one pilot project from which valuable lessons could be learnt before further implementation. In this optic, this short section is dedicated to the selection of one best suitable MCC for the one eventual pilot project in question.

The development and the implementation of a pilot project would allow the collection of important set of information in terms of the call-generating and purchasing power of population clusters above a certain size or within a given geographical radius. The demand for telephone service has been identified at somewhere between 1-3% of a community's total income (i.e. per capita income x population, or household income x no. of households) no matter what level of income a community enjoys. People want and need to communicate and are prepared to pay for it. The benefits they receive for their expenditure are to be in touch for family, business or emergency purposes and to save time and expense (the 'opportunity cost') of alternative means of communications such as travelling to a distant location. Whereas the actual percentage of disposable income they are willing to spend varies from country to country, a good rule of thumb is 2%. However, this will have to be confirmed for Internet services and non-voice services.

A first overview of the available MCC led to the selection of three of them as most suitable for the installation of a pilot project[9].

These three centres are Kaur, Bereding and Kiang Karantaba. Because of the importance of its population (larger community of potential users), the presence of several schools (better education of the population) and economical activities (higher income for the population), Kaur could be a good choice. However, this town will be electrified soon within the frame of the Rural Electrification Program and had to be ruled out. Bereding and Kiang Karantaba have respective populations of 1'440 and 892. Bereding is located close to Barra and Essau and benefit from the local economic activity. Karantaba, in Lower River Division is a very isolated community, about one hour drive from the south bank's main road. This town could represent a good site for a pilot project, demonstrating that a solar powered ICT centre can run in a very remote place. Nevertheless, the lack of economic activity is likely to jeopardize the sustainability of the project.

As a consequence, it is believed that Bereding would be the most suitable place for the implementation of an ICT pilot project if it was decided that the ICT Centre Project would start with such a first step.

3.5.8 Load assessment

It is to be noted that, according to the authorities, the MCC centres will all be equipped with solar supply systems in the near future. These systems were designed to provide power for lighting, video appliances and fridges. Therefore, these applications were not taken into account in this study. The PV installations to be installed by the government are composed of a 800 Wp PV array, a 600 W AC/DC inverter, a 12 V Charge controller (100 Amps max) and a 700Ah battery bank.

A basic ICT centre would be then composed of 5 computers. A network would be installed in order to link all computers together and to the internet access. As this Program is aimed at rural areas, the internet access will be wireless, the centre having its own wireless receiver.

Regarding the power supply, the centre will be equipped with an adequate solar array, an AC/DC inverter and a battery bank. This supply system has to be sized properly in order to allow the centre to run every day for 8 hours even on overcast day.

Table 3-12: Estimated AC energy requirement for the computer equipment of a standard ICT centre and for all 18 of them.

	AC Energy Demand	Daily Average	Annual
For one ICT centre	In kWh	6.0	2'190
For all 18 selected ICT centres	In kWh	108	39'420

[9] Personal interview with Mrs. Maria Dacosta, Project Manager for the Community Skills Improvement Project (CSIP)

As the MMC are to be already equipped with PV systems for other applications such as lighting, the estimation of the energy requirements performed here was only based on the expected consumption of the computers and related electronics and appliances.

4 CONCEPTUAL DESIGN AND TECHNICAL LAYOUT

4.1 Households

Solar home systems (SHS) are used around the world to provide electricity in areas that are not served by electric utility grids. These systems are often designed to provide a minimum amount of electricity to families in rural areas in developing countries.

There are a number of ways to design Solar Home Systems. The most basic design includes only a PV panel, a battery, wiring, and a few electric loads (e.g. fluorescent compact lights, radio and a TV).

Often, but not always, systems also include safety features such as fuses and disconnect switches. Many systems also include a charge controller (to protect the battery from overcharging), low voltage disconnect (to protect the battery from damage by deep discharges), meters to measure current and voltage in the system, and other components.

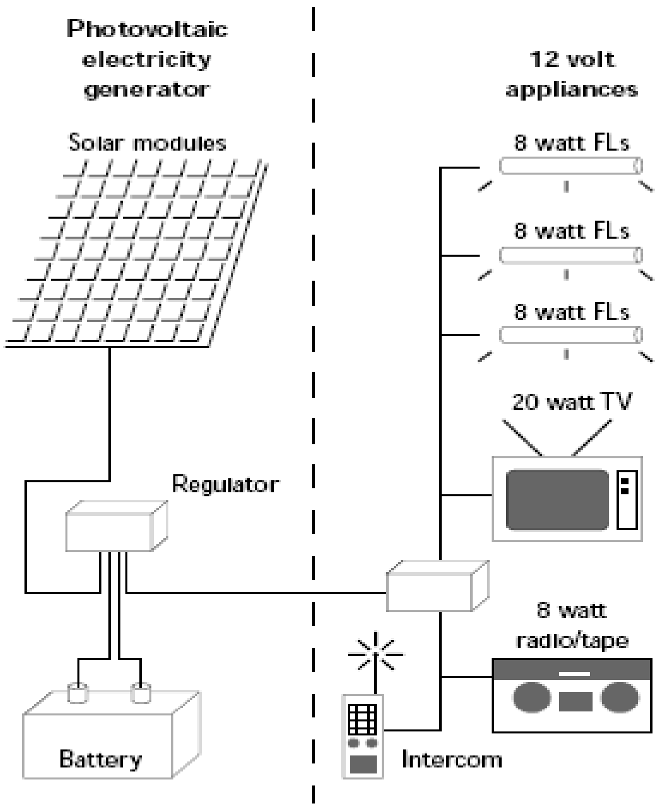

Figure 4-1: Example of a basic lay out for a SHS with power supply, controls and appliances

It was decided to focus the present Program on four SHS systems : a solar lantern for very poor households, a small one able to satisfy basic needs from households, a medium size for households with better income, which can provide power for more appliances and finally a large SHS designed to power an AC colour TV set along with an AC/DC inverter.

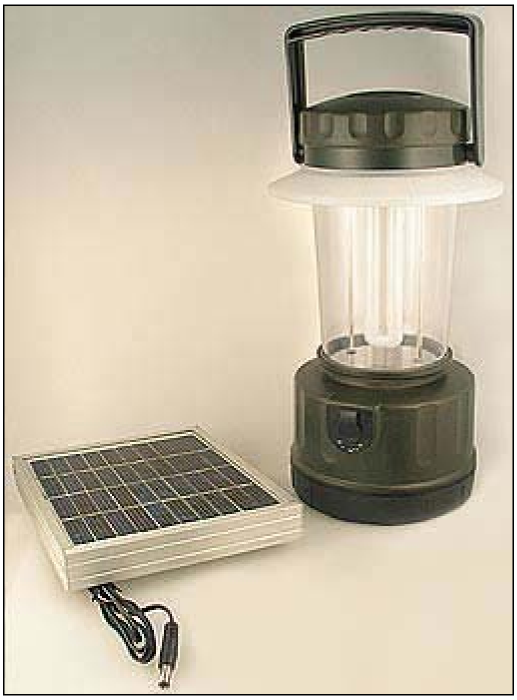

Figure 4-2 : Picture of Solar Lantern and its Solar Panel

The description of the systems is given below:

Table 4-1: Basic characteristics of the Solar Systems for households in the Rural Gambia

	Solar Lantern	Small solar home system	Medium solar home system	Large solar home system
PV array	2,5 W	40 W	70 W	150 W
Battery	4 Ah	35 Ah	60 Ah	120 Ah
Lights	1 U-bulb 7W	3 bulbs 9 W LC	4 bulbs 9 W LC	5 bulbs 9 W LC
Other appliances	None	10 W DC Radio set	20 W DC Black & White TV set	60 W AC Colour TV Set, 60 W AC/DC Inverter
Energy Generated per year	**2.1 kWh**	**33 kWh**	**59 kWh**	**121 kWh**

These four systems are thought to answer most needs of rural communities in The Gambia.

Indeed, each system is believed to be more suitable for a stratum of the population: the solar lantern for the very poor, the smaller system is believed to be more suitable for the Poor category, the medium size SHS for the Non Poor population and the large system is dedicated to the category designated as Rich. The estimation of the overall Program investment will be based on this assumption.

4.2 Health Centres

The basic needs considered are lighting, refrigeration, a radio and a few fans. Sterilization has been taken out of the study because of its very high energy consumption. With these different components, an average package is set up and its sizing and cost estimated.

A basic sizing is provided in the table below:

Table 4-2: List of basic pieces of equipment needed for the selected health posts

Application	Items	Time of use per day	Daily Consumption in Wh
Lighting	5 LC bulbs (15 W each), DC 12V	4 hours	300
Refrigeration	1 solar fridge (about 120 W), DC 24V	12 hours	1’440
Radio	1 radio for information (10 W), DC 12V	12 hours	120
Ceiling fans	2 ceiling fans (15W each)	12 hours	360
	Total Daily Consumption in Wh		**2’220**

The estimated basic requirements mentioned above will consume about 2.22 kWh of electricity per day that will have to be supplied by the PV installation..

Based on the requirements formulated in the Demand Assessment section, it was estimated that the PV supply system would be as follows:

Table 4-3: Basic characteristics of power supply for a standard Health Centre[10]

Components	Characteristics
PV Array	1.0 kW
Battery Bank	400 Ah
Distribution System	24 V

The distribution was chosen to be of the DC type with all appliances in DC.

The energy generated per year by such a system should **be around 810 kWh.**

[10] Calculations based on standard PV and battery products with average efficiency (13% for PV). PV array is south facing with a 15° tilt.

4.3 Schools

4.3.1 Upper Basic Schools

4.3.1.1 Distribution System for lighting

The distribution system would be based on 24V DC with a central switch for the system, a switch per row of lights in each classroom and switch outside for security lights. The lights in each classroom would be of the 12V type as these parts are already available in the rural Gambia. A DC/DC converter will have to be installed in order to transform the current from 24V to 12V.

The following basic layout is given here as an example and provides a good idea of what kind of installation the study is based on.

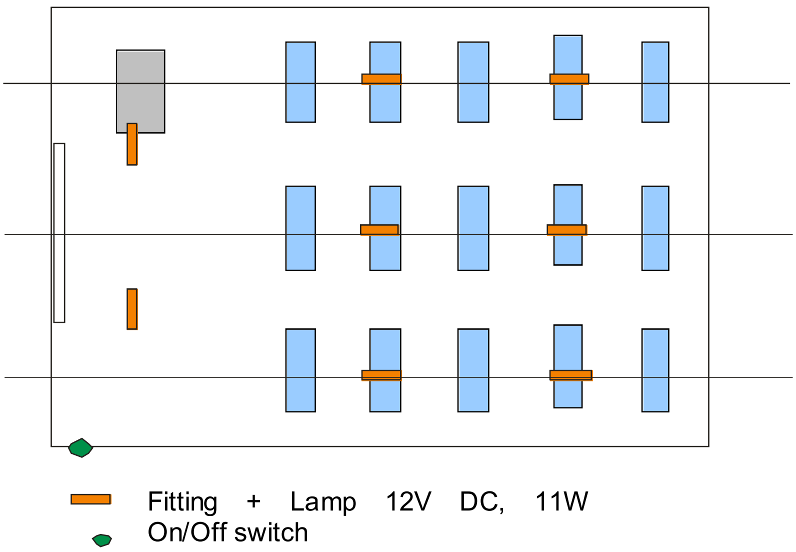

Figure 4-3: Lighting system for one classroom in a UBS

4.3.1.2 Power Supply

In the case of UBS, power would be delivered by PV system with the following characteristics as stated in Table 4-4.

Table 4-4: Basic characteristics of power supply for UBS[11]

[11] Calculations based on standard PV and battery products with average efficiency (13% for PV). PV array is south facing with a 15° tilt.

Components	Characteristics
PV Array	0.60 kW
Battery Bank	250 Ah
Distribution System	24 V

Thanks to this design, most of the energy needs would be covered and **about 485 kWh would be produced per year.**

4.3.2 Senior Secondary Schools

4.3.2.1 Distribution System for lighting

The distribution system would be based on 24V DC with a central switch for the system, a switch per row of lights in each classroom and switch outside for security lights. The lights in each classroom would be of the 12V type as these parts are already available in the rural Gambia. A DC/DC converter will have to be installed in order to transform the current from 24V to 12V.

The following basic layout is given here as an example and provides a good idea of what kind of installation the study is based on.

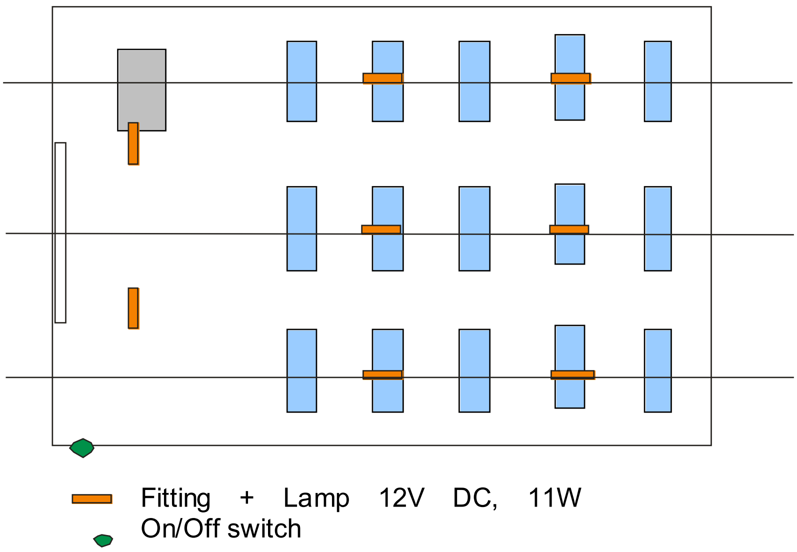

Figure 4-4: Lighting system for one classroom in a SSS

4.3.2.2 General Distribution System

The general distribution system would include a 1500 W inverter because of the connection of the computer lab. The lighting system, as for UBS, remains in DC.

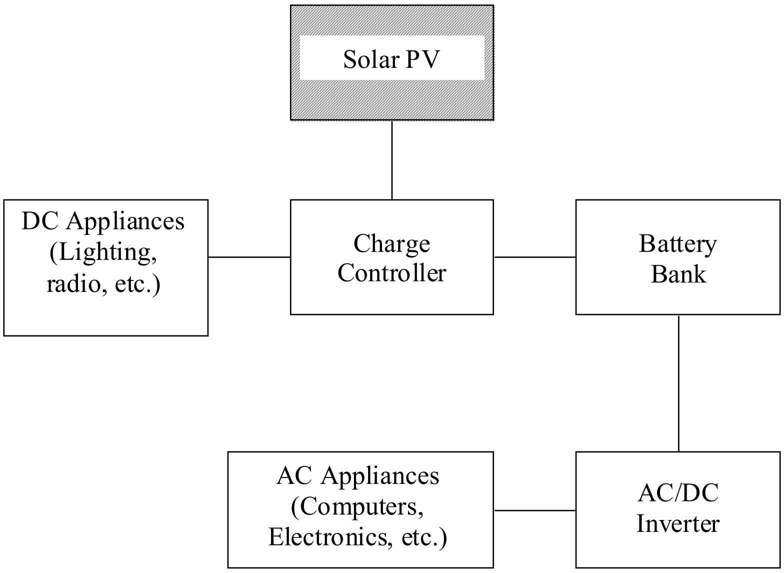

Figure 4-5: Basic wire diagram of the distribution system for SSS

4.3.2.3 Power Supply

In the case of SSS, power would be delivered by PV system with the following characteristics:

Table 4-5: Basic characteristics of power supply for SSS[12]

Components	Characteristics
PV Array	4.8 kW
Battery Bank	2000 Ah
Distribution System	24 V DC and 230 V AC
Inverter	1500 W

Thanks to this design, most of the energy needs would be covered and **about 4000 kWh would be produced per year**.

4.4 ICT Centres

After the assessment given in section 3.5.8, a basic estimation was performed. The system has to be sized in order to provide enough energy to supply the five computers and all electronic auxiliary systems such as internet access, router or even a printer.

4.4.1.1 Distribution system

[12] Calculations based on standard PV and battery products with average efficiency (13% for PV). PV array is south facing with a 15° tilt.

The distribution system would be similar to that of the Senior Secondary Schools apart from the fact that there would not be any DC circuit.

This scheme is, for the time being, tentative. Indeed, as there are already some PV systems to be installed on the community centres, a coupling of both systems is possible and may be desirable. However, the present study prefers to consider a conservative view.

4.4.1.2 Power supply

In the case of MCM, power would be delivered by PV system with the following characteristics:

Table 4-6: Basic characteristics of power supply for MCM[13]

Components	Characteristics
PV Array	2.8 kW
Battery Bank	1200 Ah
Distribution System	24 V
Inverter	800 W

Thanks to this design, most of the energy needs would be covered and **about 2'450 kWh would be produced per year**.

[13] Calculations based on standard PV and battery products with average efficiency (13% for PV). PV array is south facing with a 15° tilt.

5 Costs Assessment

5.1 Households

5.1.1 Investment Costs

5.1.1.1 Prices of SHS

The investment costs for the SHS Program for individual is mainly based on the basic price of the proposed SHS. These prices, given in the table below, include all necessary for power supply, electronics, battery and accessories and installation.

Table 5-1: Basic prices of the Solar Home Systems

	Solar Lantern	Small solar home system	Medium solar home system	Large solar home system
PV array	2.5 W	40 W	70 W	150 W
Unit Price	70 US$	650 US$	1000 US$	2000 US$

5.1.1.2 Costs of SHS Program with 50% coverage factor (about 10'200 SHS)

Table 5-2: Estimated investment for SHS Program with 50% coverage factor (about 10'2000 SHS)

Division		Very poor HH	%	Poor in $	%	Non poor in $	%	Rich in $	%	Totals in $
Brikama		*$123,620*	*5.2%*	$555,750	*23.2%*	$1,072,000	*44.8%*	$642,000	*26.8%*	$2,393,370
Mansa Konko		*$29,750*	*3.2%*	$432,900	*46.4%*	$326,000	*35.0%*	$144,000	*15.4%*	$932,650
Kerewan		*$77,070*	*7.6%*	$275,600	*27.1%*	$523,000	*51.5%*	$140,000	*13.8%*	$1,015,670
Kuntaur	CRDN	*$5,670*	*3.7%*	$48,100	*31.1%*	$65,000	*42.0%*	$36,000	*23.3%*	$154,770
Janjanbureh	CRDS	*$30,240*	*3.1%*	$239,850	*24.2%*	$509,000	*51.4%*	$212,000	*21.4%*	$991,090
Basse	URD	*$27,020*	*4.8%*	$144,950	*25.6%*	$223,000	*39.3%*	$172,000	*30.3%*	$566,970
	TOTAL	***$293,370***	**4.8%**	**$1,697,150**	***28.0%***	**$2,718,000**	***44.9%***	**$1,346,000**	***22.2%***	**$6,054,520**

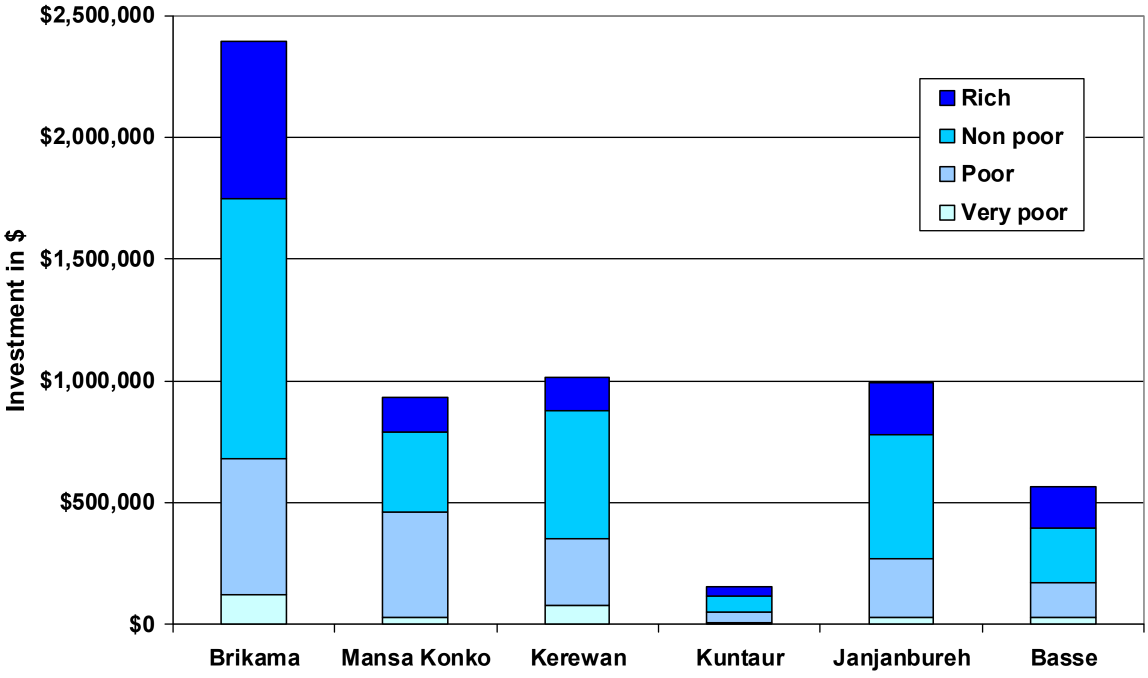

Figure 5-1: Estimated Investment for the SHS Program with geographical and social distribution - 50% coverage factor (about 10’200 SHS)

5.1.1.3 Synthesis

The estimated investment for the Program with a 50% coverage ratio is about 6.1 million US$. Independently of the size, the SHS be all distributed mostly in Brikama’s LGA because of the importance of its population. LRD, NBD and CRD south would receive approximately the same amount of money invested with the difference that the share of small systems is larger in Mansakonko’s LGA. CRD north would represent a very small part of the Program, as expected.

5.1.2 O&M Costs

Unlike other power generating systems such as diesel gensets, SHS do not require any fuel. Although, they require maintenance and spare parts. This part of a SHS Program is very important as it will determine the viability of a Program. If the targeted populations do not have enough income or the willingness to perform adequate maintenance, the installations will fail within a short period of time. This basic maintenance should be performed annually. It mainly concerns the batteries and the electrical parts.

An other important source of spending is the replacement of bulbs and batteries, which is here considered to happen every three years. The maintenance plan is then a combination of these two kinds of maintenance and is illustrated by Table 5-4.

It is important to note that the solar lantern has to be completely replaced after 10 years of operation.

The table below summarises the costs of O&M and replacement for all four systems.

Table 5-3: Summary of O&M and Replacement Costs - SHS

System	Solar Lantern	Small System	Medium Size System	Large System
Investment in US$	70	650	1000	2000
Annual O&M in US$	2	15	30	50
Costs Spare Parts in US$				
Solar Battery	-	160	280	750
Bulbs	*20*	30	40	40
Inverter				130

Table 5-4: Maintenance Plan for one system - SHS

Year	O&M + Replacement Costs in US$				Remarks
	Lantern	Small	Medium	Large	
1	70	650	1000	2000	*Investment*
2	2	15	30	50	*Maintenance*
3	2	15	30	50	*Maintenance*
4	22	205	350	970	*Complete*
5	2	15	30	50	*Maintenance*
6	2	15	30	50	*Maintenance*
7	22	205	350	970	*Complete*
8	2	15	30	50	*Maintenance*
9	2	15	30	50	*Maintenance*
10	70	205	350	970	*Complete*
11	2	15	30	50	*Maintenance*
12	2	15	30	50	*Maintenance*
13	22	205	350	970	*Complete*
14	2	15	30	50	*Maintenance*
15	2	15	30	50	*Maintenance*
16	22	205	350	970	*Complete*
17	2	15	30	50	*Maintenance*
18	2	15	30	50	*Maintenance*
19	22	205	350	970	*Complete*
20	2	15	30	50	*Maintenance*

5.2 Health Centres

5.2.1 Investments Costs

The Program is to cover all health posts in the country and provide them a reliable source of energy for basic needs. All electric appliances are to be included, i.e. fridge, lights, etc.

The systems described in 4.2 have an estimated cost of about 10’000 US$ each, the share for energy supply being by far the largest, as shown below.

Table 5-5: Summary of Investment Costs for PV System - Health Centre

Component	Investment in US$
PV Array	5,800
Battery Bank	1,900
Electrical Equipment	800
Installation	1,500
TOTAL	**10,000**

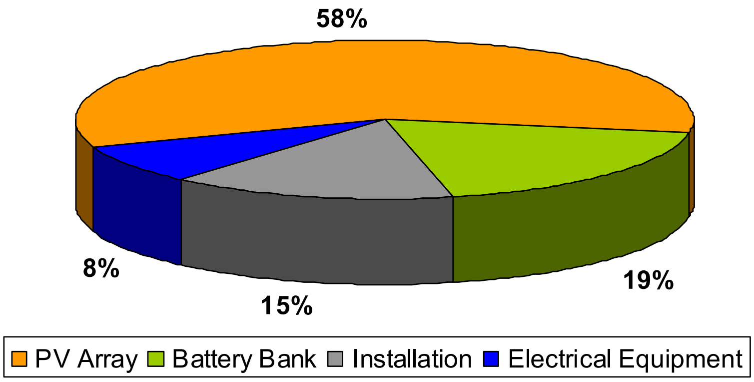

Figure 5-2: Cost Breakdown of the three main components of the PV installation for health posts in The Gambia

By taking into consideration of health posts in The Gambia, a PV investment Program would consist into the installation of PV energy supply systems for all 30 of them. Such a Program would represent a minimum investment of about 300'000 US$, not including any training, spare parts stock, etc.

Table 5-6: Summary of the investment plan dedicated to health posts

Investment Program	
PV systems for Health Posts	US$ 10'000
Health Posts in Urban and Rural Areas (not including GBA)	30
TOTAL	**US$ 300'000**

5.2.2 O&M Costs

As for PV system, these of the health centres will require some maintenance and the regular replacement of parts and devices. Indeed, a regular maintenance is necessary in order to ensure the continuous and satisfactory running of the installation. This regular maintenance will include the replacement of little parts such as fuses.

In addition to this maintenance, some other parts will have to be replaced at given time. This is the case of batteries and bulbs. In the case of health centre, it was estimated that the replacement could happen **every four years** because of the probable presence of a qualified technician.

The estimated costs for maintenance are given below:

Table 5-7: Summary of O&M and Replacement Costs – Health Centre

System	Health Centre
Investment in US$	10000
Annual O&M in US$	250
Costs Spare Parts in US$	
Solar Battery	1900
Bulbs	50

Table 5-8: Maintenance plan - Health Centre

Year	O&M + Replacement Costs in US$ One System	O&M + Replacement Costs in US$ All Systems	Remarks
1	10,000	300,000	*Investment*
2	250	7,500	*Regular maintenance*
3	300	9,000	*Regular maintenance + bulbs*
4	250	7,500	*Regular maintenance*
5	2,150	64,500	*Regular maintenance + batteries*
6	300	9,000	*Regular maintenance + bulbs*
7	250	7,500	*Regular maintenance*
8	250	7,500	*Regular maintenance*
9	300	9,000	*Regular maintenance + bulbs*
10	2,150	64,500	*Regular maintenance + batteries*
11	250	7,500	*Regular maintenance*
12	300	9,000	*Regular maintenance + bulbs*
13	250	7,500	*Regular maintenance*
14	250	7,500	*Regular maintenance*
15	2,200	66,000	*Complete*
16	250	7,500	*Regular maintenance*
17	250	7,500	*Regular maintenance*
18	300	9,000	*Regular maintenance + bulbs*
19	250	7,500	*Regular maintenance*
20	2,150	64,500	*Regular maintenance + batteries*

5.3 Schools

5.3.1 Investments Costs

The breakdown of investments costs for both kinds of education facilities is presented in the Figures below. The capital needed for the equipment of SSS is much higher than that of UBS because of the buy of the computers and because of their high energy consumption requiring larger PV systems. Indeed, the investment required by 3 SSS equals the two thirds of what is necessary for 51 UBS.

For all selected schools, the total investment approaches **580'000 US$**, with about **321'000 US$ for UBS** and **165'300 US$ for the three SSS**.

5.3.1.1 Upper Basic Schools

Table 5-9: Summary of Investment Costs for PV System - Upper Basic School

Component	Investment in US$
PV Array	3,500
Battery Bank	1,200
Electrical Equipment	700
Installation	900
TOTAL	**6,300**

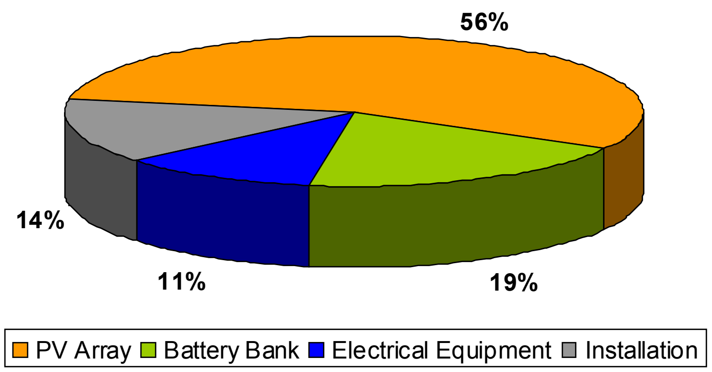

Figure 5-3: Breakdown of investment costs for a PV system – Upper Basic School

5.3.1.2 Senior Secondary Schools

Table 5-10: Summary of Investment Costs for PV System – Senior Secondary School

Component	Investment in US$
PV Array	27,800
Battery Bank	9,600
Electrical Equipment	5,300
Installation	7,400
Computers and accessories	5,000
TOTAL	**55,100**

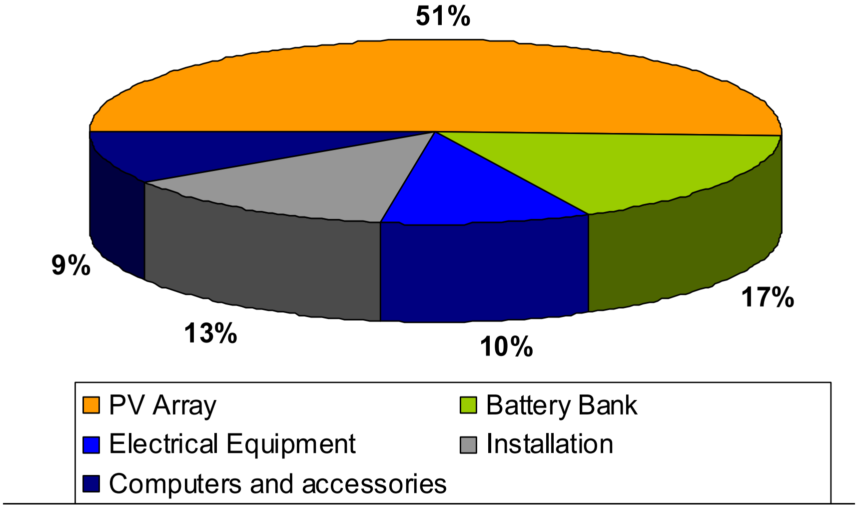

Figure 5-4: Breakdown of investment costs for a PV system - Senior Secondary School

5.3.2 O&M Costs

Table 5-11: Summary of O&M costs for unit systems for education centres

System	UBS	SSS
Investment in US$	6,300	55,100
Annual O&M in US$	150	1,250
Costs Spare Parts in US$		
Solar Battery	1,200	9,600
Bulbs	250	250
Inverter		1,500

Table 5-12: Maintenance plan over 20 years for the selected education facilities

Year	O&M + Replacement Costs in US$				Remarks
	UBS		SSS		
	One System	All	One System	All	
1	6,300	321,300	55,100	165,300	*Investment*
2	150	7,650	1,250	3,750	*Maintenance*
3	150	7,650	1,250	3,750	*Maintenance*
4	1,600	81,600	11,100	33,300	*Complete*
5	150	7,650	1,250	3,750	*Maintenance*
6	150	7,650	1,250	3,750	*Maintenance*
7	1,600	81,600	11,100	33,300	*Complete*
8	150	7,650	1,250	3,750	*Maintenance*
9	150	7,650	1,250	3,750	*Maintenance*
10	1,600	81,600	11,100	33,300	*Complete*
11	150	7,650	1,250	3,750	*Maintenance*
12	150	7,650	1,250	3,750	*Maintenance*
13	1,600	81,600	11,100	33,300	*Complete*
14	150	7,650	1,250	3,750	*Maintenance*
15	150	7,650	1,250	3,750	*Maintenance*
16	1,600	81,600	11,100	33,300	*Complete*
17	150	7,650	1,250	3,750	*Maintenance*
18	150	7,650	1,250	3,750	*Maintenance*
19	1,600	81,600	11,100	33,300	*Complete*
20	150	7,650	1,250	3,750	*Maintenance*

5.4 ICT Centres

5.4.1 Investments Costs

The cost of such a system including installation was estimated at **about 32'500 US$**. The cost breakdown is clearly dominated by the price of the components for power supply, with the PV array accounting for almost half of the total investment and the battery bank for a good quarter. Only 14% represent the cost of installation. The application itself is not expensive but its consumption makes the system expensive. Indeed, the IT equipment such as computers and auxiliaries were not included in the assessment as they should be provided by other parties. This cost could be estimated to be around 2-3'000 US$, about 10% of the complete installation.

Table 5-13: Investment Cost Breakdown for the selected ICT Centres

Component	Investment in US$ For one System	Investment in US$ For all selected Systems
PV Array	16,800	302,400
Battery Bank	5,800	104,400
Electrical Equipment	3,100	55,800
Installation	4,300	77,400
TOTAL	**30,000**	**540,000**

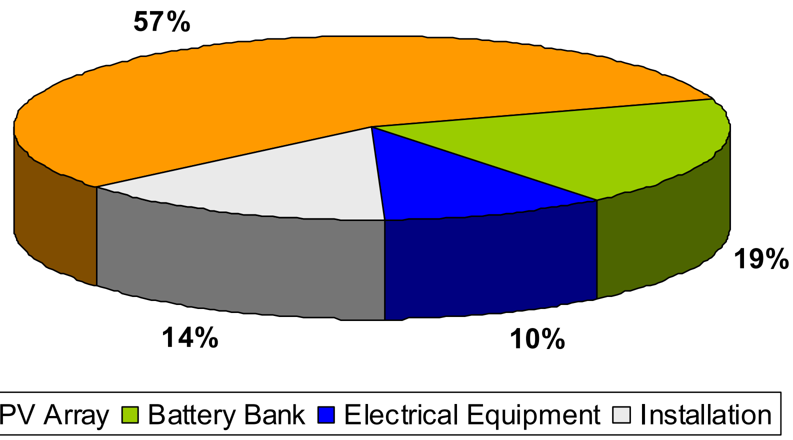

Figure 5-5: Cost Breakdown of the equipment necessary for the implementation of the pilot ICT project

5.4.2 O&M Costs

Table 5-14: Summary of O&M costs for unit systems for the pilot ICT project

System	ICT Centre
Investment in US$	585,000
Annual O&M in US$	13,050
Costs Spare Parts in US$	
Solar Battery	104,400
Inverter	14,400

Table 5-15: Maintenance plan over 20 years for the pilot ICT project

Year	O&M + Replacement Costs in US$	Remarks
1	585,000	*Investment*
2	13,050	*Maintenance*
3	13,050	*Maintenance*
4	131,850	*Complete*
5	13,050	*Maintenance*
6	13,050	*Maintenance*
7	131,850	*Complete*
8	13,050	*Maintenance*
9	13,050	*Maintenance*
10	131,850	*Complete*
11	13,050	*Maintenance*
12	13,050	*Maintenance*
13	131,850	*Complete*
14	13,050	*Maintenance*
15	13,050	*Maintenance*
16	131,850	*Complete*
17	13,050	*Maintenance*
18	13,050	*Maintenance*
19	131,850	*Complete*
20	13,050	*Maintenance*

6 INSTITUTIONAL ARRANGEMENTS, FINANCING MECHANISMS AND MANAGEMENT STRUCTURE

Based on the analysis in the baseline studies undertaken in both Phases of the 'Renewable Energy Study for The Gambia', the Consultant has some suggestions on how to implement a future SHS Programme, in terms of Programme institutional setup, Programme financing, and product delivery modalities.

6.1 Management of SHS Programme

In the management of the SHS Programme the following functions can be distinguished:

- *Supervisory function*, this will be with the Energy Division of the President's Office
- *Programme management*. A powerful enough institution to implement the proposed SHS Programme or with sufficient financial and human resources does not currently exist in The Gambia. This implies that a Project Implementation Unit (PIU) will have to be set up to coordinate the Programme with a substantial degree of operational autonomy. This PIU could be established at the President's Office, or GREC or elsewhere. Here we suggest that the PIU is established at GREC as part of the overall capacity strengthening of GREC. After the project finishes the PIU's facilities and staff would then be absorbed into the 'renewable energy implementation' section of GREC and would continue its activities of implementing new renewable energy projects, which could be one of GREC's functions (alongside its proposed training and information dissemination functions; see paragraph 8.3).
- *Financing function*. The Consultant suggests setting up a 'revolving credit fund' on behalf of the SHS Programme. Being an autonomous government agency and being a financial institution with sufficient track record and with networks into the rural areas, such a function could be assigned to the Social Development Fund (SDF). The 'revolving credit' fund would be set up with the funds from the donor agency supporting the SHS Programme, that is AfDB from the grant (and loan) components destined for the acquisition of solar PV systems (the 'technical assistance activities' are likely to be managed directly by the PIU). The functions of such a 'revolving fund' would be the provision of:
    - Soft loans and bank guarantees for solar companies and micro-finance organization
    - End user finance (if this cannot be done better or done at all by banks or MFIs; in this case there should be no conflict of interest between the MFIs and SDF)

6.2 Financing mechanisms

A key financing issue for private companies and end-users is to overcome the high up-front cost of PV systems. End-users need finance to reduce the initial cost of the PV system. But also the (solar) companies need working capital when business is expanding, while MFIs may want to be backed up with a loan guarantee scheme before going into the new (and risky) solar energy financing business.

The Consultant recommends that a number of 'financing tools' should be considered to be included in the SHS Programme. The applicability of these tools in the context of The Gambia should be further elaborated in conjunction with the 'pilot activities' preceding the implementation of the full SHS Programme.

1) *Finance for end-users.*

With cash purchase out of the question for most rural families will have to resort to some form of financing:

- If being a member of a credit union, rural-based civil servants, such as teacher, can enter into an agreement to have a monthly deduction from the pay slip, or, if being a member of a cooperative organisations, have a loan at lower interest rates (than those normally charged by banks or MFIs)
- In MFI-type of loans, a group of people come together with the expressed purpose of purchasing a PV system. Each of them pays a nominal amount into a savings fund that is used as collateral for the whole group. These loans are normally linked with income generation and not for consumer goods only[14].
- In The Gambia, the solar company Gam-Solar has been experimenting in one project in providing dealer-extended credit. In general, one can say that solar companies are not very keen to act as credit providers; it is not their core business and unlike MFIs they do not maintain a network for credit collection.
- In a fee-for-services scheme, the end user does not own the system, but instead pays a monthly or regular fee for use of the system, while the system is owned by the organization or institution which has installed it.

2) *Finance for solar companies and financing the financiers (MFIs)*

Solar companies have access to bank loans, but may be reluctant to do so, due to the high interest rates charged[15]. The SHS Programme can provide a number of financing tools that reduce the financial cost for solar companies, NGOs or MFIs to get involved in solar energy:

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[14] Most loans, whether from MFIs or commercial banks, are not accessible for many rural dwellers, if the loan is meant only for consumer goods. With little repayment capacity, the only collateral is land which most farmers cannot or will not mortgage. It is important therefore if some income-generating activity can be linked with the purchase of the PV system. Here, it should be noted that farming households cannot repay on a monthly basis; most households are only credit-worthy after harvesting. Experience in The Gambia has shown that mostly it is women who have access to credit facilities, especially when organised in women's groups. Men, as family heads in the traditional culture, often are reluctant to pay back credit as priority is given to urgent family expenditures. Accordingly, one should be cautious of the fungibility of credit to ensure that it is not used for a purpose it was not originally intended for.

[15] Important commercial banks are the Trust Bank, Standard Chartered Bank and the Arab-Gambian Islamic Bank (AGIB). The importance of the banking sector for energy and development is limited. With prime and commercial interest rates of 31% and 36% respectively, most loans are for short-term trading purposes and not for development projects. The AGIB, being an Islamic bank, does not charge interest and is involved in leasing of equipment (in which the bank purchases equipment, e.g. solar equipment, and provides the requesting company with the equipment, after which the company pays AGIB through a deferred-payment scheme). AGIB is also involved in skills development through its Enterprise Development Project. In this EDP craftsmen are trained in elementary management, provided with a start capital (an extra 20% above the cash needed for equipment) to set up their small enterprise.

- Funds from the Program are used to guarantee credit lines of MFIs or to a company to purchase and sell equipment
- In 'subsidized loans' the interest rate is reduced using a subsidy element to cover banking costs.

3) *Grants and subsidy*

Grants basically mean free equipment that is provided without charge. Subsidies enable the consumer to get straight discount on a system. Instead of the consumer, a subsidy can be provided to the solar company to buy equipment at an agreed upon price or to MFIs to on-loan to consumers of small businesses.

Much discussion has revolved around the pros and cons of investment subsidies and grants. Most rural electrification Programs in the world do have an element of subsidy. Also in The Gambia, many rural households will simply not be able to afford a solar home system (even with credit provided or under a fee-for-services scheme). Since the market is small, the small revenue flows do not attract companies to provide solar energy services in the rural areas, so some subsidy support may be needed to stimulate them.

If not properly implemented or targeted, subsidy schemes are known to have negative impacts. Subsidies and grants can seriously distort the commercial market of solar energy. Rather then helping the market, businesses go after subsidies rather than concentrating on developing a sound energy service business and having no incentives to lower costs. Subsidy and grant schemes tend to be difficult to administer to targeted groups and restrictive with respect to end-use technology, depriving the users of choice. Given the fact that in The Gambia 90% of rural households are not connected to any grid, targeting will be difficult indeed. Subsidies can lower the cost of doing business to service rural areas and lower the upfront cost for consumers. Subsidies may be aimed at improving access of the poor, but are likelier to go to the wealthier households in rural areas (those that can more easily afford the energy service as well as buying the electric appliances). Given the budgetary limitations of the SHS Programme, the higher the subsidy, the more the poorer segments will be reached, but also in fewer villages. In the end, it will be hard to justify why some villages would receive high subsidies and why others were not be included in the Programme, making the scheme more prone to corruption practices. It has also happened in other projects in the world, which acquired heavily subsidised SHSs, that villagers just sold the systems afterwards to get quick cash.

Given the fact that, many rural households will not be able to afford the high investment cost of solar home systems, the Consultant suggests that some subsidy on its investment cost should be considered. After all, providing subsidy on PV systems is common also in industrialized countries such as Netherlands, Germany, Japan or U.S.A. To counter the negative effects of subsidy schemes mentioned earlier, 'smart subsidies' should be designed, such as the examples given in the box below.

Examples of 'smart' subsidies:

- Subsidy to consumer on systems: The smaller the system, the larger the subsidy. For example, systems of 40 Wp would get 40%, a 70 Wp system would get 20% (reasoning that the rich can buy larger systems and should receive less subsidy) and larger systems will get 10% but only up to a limit.
- Subsidy to companies on systems: For example, the first 2,000 systems sold get US$ 70 subsidy, the next 2,000 get US$ 55 subsidy and the next 1,000 get US$ 40
- Subsidy according to area: higher subsidy can be provided to villages that are qualified as 'remote' or poor.
- Public institutions (schools, clinics) get 75% (meaning there is no free lunch, even institutions have to show their desire to have a PV by paying something; if they have to pay something they are likely to maintain them better)
- Subsidies diminish over time. At the end of the SHS Programme, the subsidy should be zero, unless the Government has found funds to keep on subsidising them in a financially sustainable way.

6.3 Product delivery mechanisms

Two main implementation models can be identified for the SHS Programme:

- In a fee-for-services model, the governmental/public organisation responsible retains ownership of the PV system but its electricity service is provided to the customer through a service agreement with the customer, who pays a regular fee to the company, while the company pays for the equipment. In another variant, the fee-for-services option can be implemented as a market concession model. This variant involves competitive bidding in a certain region and awarding the concession agreement by the Government to the selected private company or NGO (that is given the exclusive right/obligation to provide electricity services to the customers in that area).
- In the dealer/retailer model, a company (private, NGO) sells PV systems directly to customers, often by completely installing the system at the end-user's home. The customer owns the system and is responsible for maintenance (following whatever warranty/maintenance is provided by the company) and for paying the system back. Again, this model can be implemented as a market concession under the SHS Programme in which the winning bidder (e.g., a solar company or NGO) has the exclusive right/obligation to serve in a defined area, in which companies can sell PV systems on a cash basis or on a credit basis (by providing dealer's credit or by linking up with a micro-finance organisation).

The advantage of the fee-for-services model is that it addresses the consumer affordability barrier by means of small regular payments. In The Gambia, only a few rural households would be able to purchase a PV system by cash, given the very low ability to pay in the rural areas and the high up-front cost of PV systems. However, a disadvantage is that it is quite capital-intensive in terms of administration. There is often a tendency, especially in government or donor-sponsored Programs, to set tariffs too low (under the assumption that end-users are not able or willing to pay more) and thus not generating sufficient income for the concessionaire. In practice, it requires a strong service provider with long-term interest in off-grid electrification, a proven track record and sufficient financial resources. Such a service provider does not currently exist in The Gambia.

The market-oriented model has the advantage of being more responsive to consumer requirements and (in the market concession variant, depending on the contract specifications) can offer a broader array of PV products than a fee-for-service provider usually does. In the SHS Programme, a subsidy amount could be given in combination with credit, by partnering with micro-finance organizations. The disadvantage of such a private/NGO-based marketing and financing infrastructure (that deal with loans for energy equipment) does not really exist yet in The Gambia for solar energy. Quite some capacity building would be needed (as will be discussed in chapter 4).

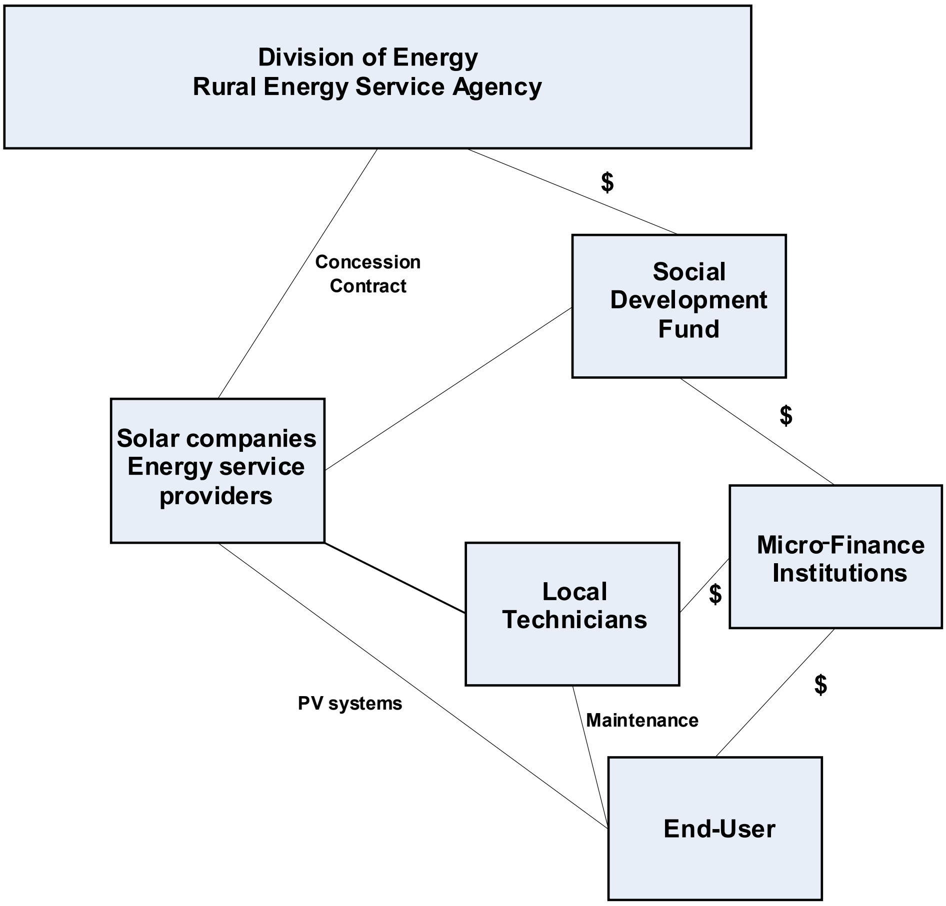


Figure 6-1: Possible PV system delivery scheme

Nonetheless, the Consultant recommends following a business-oriented and competitive approach, given the fact it can build upon the already existing rural networks that many NGOs and MFIs seem to have in rural Gambia. Cultural aspects do also favour private sector involvement, in the sense that Gambian people have tendency not to pay back government agencies, but NGOs seem to have a better record as evidenced by the high repayment rates.

6.4 Financing of the Programme

The Consultant assumes here that the SHS Programme will be financed by a mix of grant and soft loans coming from AfDB (or other donors).

Based on the investment figures for the solar PV systems as estimated in Chapter 3 (to which some 10% is added as miscellaneous cost), a tentative budget for the SHS Programme is given in the table below:

Table 6-1: Estimated budget for SHS Programme in US$

Component	Total	Loan	Grant
PV systems for households (coverage 50%)	6,660,000	4,662,000	1,998,000
PV systems for institutions	1,460,000	438,000	1,022,000
Total investment	*8,120,000*	*5,100,000*	*3,020,000*
Capacity and institution building	500,000		500,000
Strengthening product delivery system	700,000		700,000
Management and monitoring	800,000		800,000
Technical assistance activities	*2,000,000*		*2,000,000*
Total budget	**10,120,000**	**5,100,000**	**5,020,000**

A second scenario assumes that all required budget will come in a grant form from AfDB.

6.5 Staged approach

As a kind of intermediary phase between the 'design' and 'implementation' phases in the project cycle, the Consultant suggests undertaking a 'pilot phase' in which the SHS Programme is started on a small scale, to learn form the experience in a trail-and-error approach and then replicating the successes in the full Programme.

Suggested 'pilot activities' are:

- Primary data gathering to complete Lahmeyer's baseline analysis by means of a dedicated 'solar energy survey' in (some of) the target villages given in Annex C, focussing on capacity of payment and willingness to pay for PV system
- Start a pilot of 500-700 PV systems in the target villages in order to experiment with the various implementation and financing modalities with different target groups and areas
- Capacity building activities (end user awareness campaign, entrepreneurial and technical training, seminars ands workshops for decision makers)
- Re-adjust design of the full Programme according to the results of the before-mentioned activities, by following a participatory approach with stakeholder engagement (interviews, workshops, seminars)

7 SOCIAL AND ENVIRONMENTAL ASSESSMENT

7.1 The role of assessing and evaluating project impacts in the project cycle

7.1.1 Approach to the role of monitoring and evaluation in the project cycle

The cycle of rural electrification projects consist of several stages, (1) preparation, (2) design, (3) implementation and (4) impact assessment. In a conventional approach, a project is formulated in the design and preparation phases by defining outputs and activities; beneficiaries and main stakeholders. Sometimes the project design includes a basic framework for the monitoring of project results and impacts, but usually there is no monitoring until the project reaches implementation. Only once the project has begun a framework of project impacts will be developed in earnest, with the difficulty that results and impacts cannot be compared with the baseline situation, since data on the situation' before the project' were not collected in a way coherent with the framework of monitoring and evaluation of impacts.

In the Terms of Reference of the Consultant (i.e. Lahmeyer International), the activities referred to as 'First Phase – Master Plan Elaboration' correspond to the 'preparation' phase in the before-mentioned project cycle. This has resulted in the identification of two priority Programme activities, (1) the development of grid-connected wind farms and (2) a Programme of rural electrification with solar home systems, referred to in this report as the 'SHS Programme'. The 'Second Phase – Feasibility Studies' of the two priority Programmes form part of the 'design phase' in the project cycle. For a detailed Terms of Reference of the two Phases of the Renewable Energy Study by the Consultant, the reader is referred to the Inception Report.

The approach advocated in this report sees the monitoring and evaluation process starting at the preparation stage of the project. This has the double advantage that the basic logical framework of results and impacts is designed properly from the beginning so that at the end it can be evaluated whether or not the project has received its targets. On its turn, thinking about the possible results and impacts of the projects helps the project designer in developing and fine-tuning project outputs and objectives.

7.1.2 Indicators for planning and project development

The above-sketched approach to project design, monitoring and evaluation is dependent on obtaining information for a key set of variables. The baseline, monitoring and evaluation studies should provide important information for planners and policy-makers in the areas of energy and development. The purpose is to highlight the social and environmental impacts and effectiveness of the SHS Programme by collecting measurable variables and indicators. The importance of the variables for monitoring and evaluating project progress is that they measure key aspects governing the success or failure of the Programme. Some indicators can be gathered from secondary sources of information or measured easily. Other indicators will need surveys and other methods, in which a balance must be found between budget availability and information needs

The Social and Environmental Review Report from the Consultant ends with presenting a generic list of such indicators for renewable indicators in general. This report will present a list of possible indicators as relevant for the envisaged 'Solar Home System (SHS) Program' and use this list as a guideline for describing the baseline and potential project impacts. A summary of these indicators is given in Table 7-1.

Table 7-1: Key indicators for the baseline analysis, monitoring and evaluation of the SHS Programme

Variable	Indicators
	Project results
Installation and operation of solar home systems	- Electrification rate and cost of alternative fuels (e.g., kerosene, torch batteries) and energy equipment (diesel generators) - Number and type of PV projects being implemented and developed in The Gambia - Number and capacity (in kW) of PV systems installed - Annual electricity production (kWh or MJ) - Cost of PV systems, cost of installation, cost of O&M (including battery replacement); cost of electric appliances - Design, components and installation - Access to PV systems (number and % of households or institutions that use PV) - Number of institutions with PV systems installed (clinic, school, telecommunications, village centres) - Demand responsiveness (user voice in planning end-use priorities and appliances; choice in PV equipment and appliances offered; end-use training co-ordination between end-user(s) and service provider)
Programme implementation	- Existence of working technology delivery and business models PV - Effective management (fee collection, in case of fee-tariff system; capacity to troubleshoot problems; level of service, quality of repair and spare parts timeliness and availability; budgeting and accounting system) - Financial viability of the service provider (fee-for-services, concessionaire) - Quality of design, components and installation - Quality, reliability and predictability of service operation; expected load being met
	Project impacts
Impacts on end-users and degree of change in socio-economic development	*Social uses of solar energy:* - Convenience, comfort and domestic productivity (ability to conduct, time spent and efficiency of domestic activities; leisure time; time spent on watching radio/TV) - Education (ability to attend school, quality of education and presence of teachers, time spent on education) - Health care (access and quality of health care, access to medicines; decline in diseases; presence of health workers) - Access to information and communication (access to news and information on income-generating activities; on health, safety and family planning; communication with distant family members) *Productive uses of solar energy:* - Water supply (number and distribution of wells powered by PV) - Ability to do income-generating activities (number and % of small and micro-enterprises using PV; number of micro-enterprises operating because of access to new energy services; applications

Variable	Indicators
	in agriculture) - Productivity and profitability of income-generating activities (value added generated by productive uses of energy, number of farming households and income generated; number of families out of extreme poverty)
Policy support for RET development	- Existence of a policy on rural energy and off-grid electrification - Government priorities regarding renewable energy and PV (% of fund allocation in the energy sector; capacity (number of staff, budget for RE development; staff trained on renewable energy); official government statements on RETs) - Existence of dedicated institutions with sufficient financial and human resource capacity for (off-)grid rural electrification, (agency; rural energy fund) - Existence of knowledge base for renewable energy application (e.g. wind and solar resource maps; information dissemination)
Expansion of business and supporting services for solar PV	- Number and size of PV companies; annual sales of PV systems - Number of trained technicians in rural areas - Awareness and ability of NGOs and training centres to incorporate (renewable) energy services in their activities (number of activities, staff dedicated)
Increase of financing availability and mechanisms	- Amounts of government, commercial, and bilateral/multilateral financing for PV system (type of financing: loan, grant, guarantee schemes; for investment or non-investment activities). Availability of consumer (micro-)credit for purchase of PV systems, including dealer-supplied credit, microfinance, and credit from development banks (number and % of financial institutions and micro-credit organisations involved in lending for PV; volume of lending for PV systems); characteristics of financing Programmes dedicated to renewable energy technologies - Credit availability for solar PV companies; existence of loan guarantee schemes - Profitability of lending for solar equipment (repayment rates by end-users and financial returns)
Expansion of business and supporting services for solar PV	- Number and size of PV companies; annual sales of PV systems - Number of trained technicians in rural areas - Awareness and ability of NGOs to incorporate (renewable) energy services in their activities (number of activities, staff dedicated)
Improvement of awareness and understanding of PV technologies	- Training Programmes for solar technicians and companies; workshops for government, NGO and financial organisations; dissemination campaigns - Training on PV, incorporated in curricula of universities or vocational centres - End user awareness on PV use and capabilities; awareness of social benefits and productive uses of RETs; - Level of skills created through training of PV companies, NGOs and financial institutions (type and duration of training; number or staff trained) - Level of skills created locally (training of local technicians; end-user awareness of PV system use and capabilities; end-user capacity to troubleshoot problems) - Awareness and built capacity of relevant national and local-level authorities

Variable	Indicators
	- Improved dialogue between government, private sector and NGOs (RE seminars and workshops, etc.) - Informal or formal networks on solar energy are functioning
Environmental impacts	- Impact on global climate (greenhouse gas emission reduction by avoided use of kerosene for lighting in households and use of diesel generators at institutions) - Battery recycling and disposal practices

7.1.3 Monitoring and evaluation

Studies similar to Lahmeyer's baseline studies should be conducted during the project's implementation phase (monitoring) and the end of the project (final evaluation). The monitoring/evaluation studies can help to identify issues and problems occurring during implementation of the SHS Programme and will provide important information on actual energy demand and supply, markets for PV energy services, acceptance and attitudes of people towards the new technology as well as benefits (e.g., productivity, education, health, convenience) and environmental impacts (e.g., greenhouse gases). Data can be gathered by analysing reports, statistics and sales data or interviews with stakeholders. In addition, surveys provide quantitative information needed to measure the socio-economic and environmental impact indicators. Using follow-up participatory assessments at the community-level will help to understand how the beneficiaries of the PV systems perceive and are affected by the Programme.

Following the outline of impacts and indicators as given in Table 7-1, the following paragraphs provide a short narrative to explain what the potential results and impacts of implementation of the Solar Home System Programme can be. Some impacts regarding the credit systems and establishing the product delivery chain were discussed in the chapter 6 and will not be repeated here.

7.2 Impacts on end users and changes in socio-economic environment

7.2.1 Rural households

While reliable information on ability to pay does not really exist, some rough estimates can be made on the income level of the 'average' rural household. The SPACO (2000) survey, for example, estimates the income level of non-groundnut farmers, groundnut farmers, non-farming workers and non-workers at US$ 330, US$ 228-254, US$ 338 and US$ 727 respectively[16], implying an average income of US$ 387 per household annually. With average food expenditure of US$ 234 on food and non-food items this would imply cash savings of the average rural households of around US$ 150 annually, not very much indeed. Although the figures in the above example should be interpreted with care, they give the order of magnitude of earnings in The Gambian rural areas. It becomes clear that only a few rural households would be able to cash purchase a PV system. However, wealthier and non-farming households (or farming households those that have additional sources of income) will be more interested in acquiring a SHS system if credit is offered

[16] The groups present 12%, 41%, 22% and 24% of rural households respectively (including GBA). Converted from Dalasi at US$ 1 = D 11 (1998) exchange rate

under one the schemes mentioned in Chapter 6, by enabling them to pay the initial investment back over a number of years.

The DMCI (2005) household energy survey gives some interesting data on energy use in rural households as well as perception of development problems. Of the rural respondents interviewed, 11.4% reported to have access to electricity, of which connected to a NAWEC grid, 3.6%; connected to a neighbour, 1%; having own generator, 0.7%; having a PV system, 2%; using car batteries, 2.6% and using torch batteries, 2.6%.

Regarding electric appliances, 18% of the rural households are reported to have a TV, 84% have a radio, 4% have a video and 3% have a refrigerator, while 25% uses a cellular phone. Regarding lighting 63% uses a kerosene lamp at an average fuel expenditure of GMD 2 per day.

Table 7-2: Micro business and solar PV

Micro-enterprise: selling fruit juice	
Base data	
Solar system (US$)	375
Battery ($)	25
Blender ($)	100
Depreciation PV (years)	2
Depreciation battery (years)	2
Depreciation blender (years)	2
O&M	2%
Fruits (US$ per drink)	0.2
Selling price (US$ per drink)	0.5
Sales (drinks per day)	20
Purchase of fruit	88
Blender depreciation	4.8
System depreciation	18.0
Blender depreciation	4.8
Battery depreciation	1.2
O&M	0.6
Total expenses (US$ per month)	117
Revenue (sales of drinks; $/month)	220
Profit	103

Excluding the households that live in or near rural towns (and are or may be connected to a NAWEC grid), the above figures imply that some 4% of households (around 3,000) use a generator, a solar system or re-charge car batteries. Given the desire to have a TV or cellular phone, these figures give a confirmative indication that a market niche for the 6,000 SHS (the higher range figure aimed at in the SHS Programme with 50% coverage factor, see the previous chapter) should indeed exist, at least in the wealthier segments of the rural population.

Solar home systems improve the quality of life of households by providing better lighting in evening hours than kerosene lamps do. It also avoids the burning accidents that sometimes happen when handling kerosene lamps.

Despite the relatively high cost of investment, PV can be an attractive option to generate income. An example is given in Table 7-2. A credit of US$ 500 (to be paid back in 2 years), is given to a fruit seller to buy a solar PV system that powers a DC blender to sell fruit juice.

This will allow the beneficiary to sell drinks and make a net monthly profit. While this example is hypothetical, micro businesses are operating well with solar energy in other parts of the world.

Associated with poverty is the availability and stability of food supply. Given the fact that agriculture has to provide food and income to the fast growing Gambian population, there is a need to increase food production to satisfy income sources and adding value by improved processing and storage of agricultural produce. Increasing farm production at competitive prices will require (possibly year-round) energy.

Energy intervention can play a supporting role in increasing productivity of farming, in small farmer extension services and in agricultural commercialisation. This requires access to energy services in various forms, electricity or fuel for pumping, boiling, drying and to drive mechanical and electric equipment. The powering of tools for off-farm activities with small renewable energy systems encounters obvious limits on the power supply side. Solar PV systems are not an option for energy-intensive activities such as in rice mills and most agricultural processing activities.

Solar PV can offer an option in low load applications:

- *Agricultural production:* PV pumping for horticultural and cash crop irrigation of small field sizes (up to 3 ha), characterised by low water use (using water-conserving irrigation methods) and low pumping head (up to 30 metres) in combination with new developments in water-conserving irrigation practices favour irrigation technologies, such as drip- and micro-irrigation;
- *Water supply:* The supply of drinking water is often a top priority of villagers that lack reliable service. The successful introduction of water supply (powered by renewable energy) to rural households should be continued as it will free, above all, the poor from daily drudgery in the fetching of safe water. A typical installation could have, for example, a dynamic head of some 40 m and pumps 180 m^3 per day with a PV Array size of 3,000 Wp. One important lesson learned from previous projects is the importance of organization and financing of system maintenance by means of payment for water by the villagers. In this sense, it can be regarded as an income-generating activity.
- *Agro processing:* Options are, for example, solar thermal ice plants for food and fish preservation and solar drying tunnels (with fans powered by AC or DC sources of electricity, such as PV) for food conservation and fish drying.
- *Micro and small businesses.* The relevance of solar energy systems for productive uses is in income-generating activities that require little power input, e.g. in small retail shops, telecommunications shops (mobile phone and internet shops), repair workshops, handicrafts as well as small restaurants/bars (for light and radio/TV). One common example of productive use in rural businesses is related to the prolonged working hours due to lighting and as well as powering electric equipment, such as small drills or soldering irons. Lights, radios, television sets, and cell phones may be operated using small PV systems (20-200 W) and most of these loads can be operated using DC. For AC loads, such as those for colour TVs and VCRs, a small inverter can be included. Slightly larger PV systems (250-1,000 W) are suitable for slightly greater needs, such as light-use motors for sewing machines, refrigerators, hand power tools and fans, or for small amounts of heat (as such needed for soldering irons).

- *Energy service business:* One simple examples of rural income generation, is the sale and servicing of PV systems (e.g., selling or renting out solar PV lanterns and SHSs) by locally based technicians.

7.2.2 Power for community-based services

Failing reliable refrigeration, the potency of vaccines is lost. Vaccine refrigeration and ice-pack freezing are the best-known and most common applications of solar energy in rural health clinics. Electric lighting greatly improves accessibility and quality of (emergency) care at night. Also radio communication can greatly improve rural health care services, by providing full-time communication with medical back-up staff at the divisional or national health centres.

In remote rural villages, schools and other community centres (such as mosques) are often a focal point for the community, with great potential for the integration of community development and educational goals. Basic lighting in the evening can facilitate after-dark activities like community reunions, adult education, religious activities and festivities.

Remote and non-electrified rural communities have notorious difficulty to recruit and keep trained medical and teaching staff. Small renewable energy systems (i.e. solar PV) providing light, music, TV and communication can be important incentives for professional staff to stay. Also it allows teachers to prepare classes at night and stay informed, through radio and TV, which should have their effect on the quality of classes.

7.3 Strengthening policy and institutional support for solar energy

The human, physical and financial resources available for energy planning, management as well as of research, development and promotion activities on renewable energy in The Gambia are quite limited.

The First Phase of the Renewable Energy Study has already contributed to strengthen the capacity, by:

- Setting up a knowledge base for renewable energy application (such as the wind and solar energy resource assessment and the other baseline studies carried out by institutional issues, financing and credit, socio-economic aspects that have resulted in the 'Renewable Energy Master Plan').
- With funds of Renewable Energy Study, some office infrastructure has been established at GREC including vehicles, office and computer equipment and a small bibliotheca.
- Organization of seminars and workshops
- Organization of overseas and in-country training on renewable energy technologies.

Within the framework of the EU Energy Initiative Partnership Dialog Facility a study was done, which contemplates setting up a Rural Energy Services Agency (RESA). Such a government agency would be responsible for promotion and advocacy of rural energy, training of local technicians and, potentially, the implementation of upcoming projects, or even a regulatory role. The Consultant suggests the re-establishment and strengthening the role of GREC which would act as such a RESA and as a 'one-stop-shop' for investors and project developers. Under this idea, GREC would have a 'Training and Information' section, a 'Renewable Energy Implementation' section and an 'Energy Conservation and Applied Technology' centre.

In addition, the capacity of The Gambia Renewable Energy Centre will have to be re-established in order to ensure the adequate promotion of renewable and appropriate energy technologies. Qualified staff will have to be identified and recruited as soon as possible, so that they will be able to participate in the training measures to be executed in the course of the project. In terms of staff number, composition and qualification, it should be assumed, that a total staff of 10-12 would be sufficient, consisting of one administrative head of the centre, 3-4 RE planners and engineers, two economic and financing experts, one training and curricula development expert, one IT expert and one or two secretaries, 3 people as support staff drivers should be assumed.

The SHS Programme could support GREC in organizing part of the capacity strengthening activities that are detailed below.

7.4 Strengthening the product support system

An important challenge therefore is to connect the demand for PV in rural areas to the suppliers that are concentrated in Banjul. The disperse nature of the PV business provides a profound challenge to build a product delivery infrastructure of sales and after-sales when the level of sales is low, but expenses for transportation, communication, training and after-sales service are high.

The Consultant suggests therefore that the 'technical assistance' component in the proposed SHS Programme focuses, among others, on strengthening the supply chain from PV supplier (based in Banjul) down to the end user, by engaging locally based technicians and small local entrepreneurs (that sell hardware, car batteries, and electric household goods) This implies on one hand capacity building, i.e. providing technical and entrepreneurial training to rural-based technicians so that they are able to provide a system installation and subsequent maintenance service of sufficient quality.

In addition, links need to be promoted between with the Banjul-based PV suppliers so that the local technicians can act as agents in their areas. Also, the local technicians will need some working capital to acquire tools and locally available supplies of spare parts and for transportation to be able to do the after-sales service, an aspect that is often forgotten. This implies linking them as well as with banking and micro-finance organizations. In the longer term, some successful local electrical technicians may even expand their services and grow into a locally based electrical and solar business, selling solar equipment and electrical appliances for a local market they know well.

It is not enough to just have a PV system installed; the end user needs to be educated on how to maintain the system cleaning of solar panels and replacement of batteries and the power capacity delivery limitations of a PV system. In addition, a company or a technician that sells or installs a PV system should also provide after-sales support service as part of its service contract.

7.5 Capacity building and awareness creation

The SHS Programme is likely to be financed by a full grant or mix of loans and grants from AfDB and other donors. A part of the grant should be used for capacity building activities. In general, the introduction of the product delivery modalities (discussed in the previous

Chapter 6) will require new skills within almost all stakeholder organizations involved, for the product suppliers, for the financiers, for the staff of the government organization responsible as well as for NGOs.

Examples of such capacity building activities which could be included in the 'technical assistance' component of the SHS Programme are:

- Public awareness and capacity building
    - Awareness campaign and advocacy workshops (radio/TV, newspaper, demonstrations at trade fairs, village meetings of NGOs and associations, etc.) that target intermediary organizations (NGOs, private sector, financial institutions and government agencies)
    - Outreach and awareness campaign, targeting beneficiaries (farming households, micro/small entrepreneurs, local technicians)
    - Skills development for rural-based local technicians on PV
    - Training on business development and technical aspects for solar companies
- Strengthening of institutional cooperation and networking
    - Supporting the establishment of informal/formal networks of stakeholders on solar energy
        - At the policy-making level, the establishment of a 'rural energy and development committee' could be considered, in which government entities involved in energy and rural development[17] work together with each other and with non-governmental entities[18] on energy supply, rural development and environmental issues in a systematic way
        - At the individual level, a 'renewable or solar energy association' could be formed by individual and institutional members as a lobby and interest group
    - Strengthening links and cooperation between solar companies (based in Banjul) and locally based technicians and with financial institutions and NGOs.

7.6 Environmental impacts

The use of solar PV by rural households and services will lead to reduced CO_2 emissions by means of the avoided use of kerosene for lighting in households and the avoided use of diesel in generators that would be the alternative in rural institutions (schools, clinics).

The targeted institutions in the SHS Programme consume about 71,365 kWh per year[19], as was detailed in Chapter 3. Assuming this energy would otherwise need to be generated using a diesel generator, this implies a greenhouse emission avoidance of 90 tCO_2 annually[20].

17 E.g., Division of Energy, NAWEC, Department of Water Resources, Forestry Department, Department of Community Development, Department of Education, Department of Health, Department of Agricultural Services and government agencies such as SDF

18 For example, NGOs (e.g., GREC, AFET, CRS, TARUD), financial institutions (e.g., banks, such as AGIB, or micro-credit, such as GAWFA)

19 The 51 UBSs consume 24,735 kWh, the 3 SSSs consume 12,000 kWh, the 30 clinics 24,300 kWh and the 18 ICT stations 44,100 kWh per year.

20 Assuming the fuel consumption is 0.35 litres per kWh and CO_2 content is 3.6 kg per litre of diesel

In case of households, the solar home system will replace the use of paraffin lamps. Assuming a paraffin consumption of 118 litres[21] a year per household, this implies a CO_2 reduction of 3,835 tCO_2 annually[22] for the 6,000 targeted in the SHS Programme.

The more widespread use of solar PV systems should go hand-in-hand with a recycling system for batteries to avoid that battery chemicals are dumped into the environment. Current practice in The Gambia with car batteries is just that, discarding them as waste[23].

21 Assuming that a household uses 2 paraffin lamps for 4 hours a day, giving a kerosene consumption of 0.324 litres per day

22 Assuming that 1 litre of kerosene emits 3.18 kg of CO_2.

23 The battery is the most sensitive component of a PV system and requires a certain amount of care. Car batteries are widely available in The Gambia at a relatively very low price (an important aspect if the battery has to be replaced after a couple of years of operation and consumer-paid), but have a very short life and require maintenance (have to be filled with distilled water). Heavy-duty batteries (used in trucks and buses) require medium maintenance and are available at a medium low price. High-quality solar batteries are optimal for PV applications requiring little maintenance, but cost 4-6 more than car batteries. If no good after-sales service exists, replacement of solar batteries may pose a problem and the end-user may be tempted to comprise system quality by replacing the solar battery with a car battery.

8 FINANCIAL AND ECONOMIC ANALYSIS

8.1 Financial Analysis

8.1.1 Introduction

Experience across the developing world confirms the technical reliability of photovoltaic (PV) systems in a variety of settings. Under the right conditions, solar systems, and especially the so-called solar home systems (PV systems designed for home use), can offer lighting and other services to large numbers of households that are poorly served by existing energy sources or have no service at all. This study identifies an important economic niche for such systems within rural electrification programs. PV systems are an effective complement to grid-based power, which is often too costly for sparsely settled and remote areas. For such rural conditions, fuel-independent, modular solar home systems are supposed to offer the most economical means to provide lighting and power for small appliances.

8.1.2 Approach & Methodology

In order to assess the financial feasibility of the different solar-energy products presented in the previous chapters, a financial analysis was carried out based on a complex financial model programmed in MS-EXCEL. Such a financial analysis is typically conducted from the viewpoint of the project owners, and takes into account all relevant costs and revenues, including taxes and financial fees.

In the first part of this financial analysis, the Dynamic Unit Cost – DUC of a kilowatt-hour (kWh) of electricity generated by each of the eight individual products as described above has been assessed considering the outflows of each project, mainly:

- Investment costs;
- Operating & maintenance costs; and
- Debt service payments.

The DUC was calculated based on the discounted yearly project costs and the discounted yearly quantity of energy delivered.

The analysis is carried out considering three different scenarios regarding the investment costs:

- Investment costs are granted by AfDB, or other institutions (Scenario A);
- Investment costs are partially loan financed (70%) and partially granted (30%) (Scenario B);
- Investment costs are 100 % financed by a soft loan (Scenario C).

As it can be assumed that the project will be administered by a Rural Energy Service Agency – RESA, financed and controlled by the government of The Gambia, in the second part of this financial analysis the viability for the whole program is assessed under the viewpoint of such a RESA.

The following indicators were calculated in order to evaluate the financial performance of the projects:

- NPV – Net Present Value; and the
- Benefit / Cost - Ratio;

The corresponding values were derived from the initial investment costs and the cash flow of yearly revenues and expenditures in US$, discounted at a discount rate of 10 %.

Detailed information on the determination of these values is shown in Figure 9-12-Figure 9-33 of the Appendix.

8.1.3 Assumptions

8.1.3.1 Loan conditions

The loan is considered to be available for a duration of up to 20 years, meaning over the whole lifetime of the projects, and at an average interest rate of 4 %, including this rate a lending margin and related fees.

8.1.3.2 Construction Period

It was assumed that the implementation of the individual projects can be realised within a few weeks and will be finished at latest by the end of 2007, commercial operation would thus commence in 2008.

8.1.3.3 Capital Expenditures

Table 8-1: Investment Cost Breakdown

Item	Value [US$]	# of Units	Total
Solar Home System – 2.5 W	70	4,191	293,370
Solar Home System – 40 W	650	2,611	1,697,150
Solar Home System – 70 W	1,000	2,718	2,718,000
Solar Home System – 150 W	2,000	673	1,346,000
Solar Home System – Health Centre	10,000	30	300,000
Solar Home System – Schools (UBS)	6,300	51	321,300
Solar Home System – Senior Secondary School (SSS)	55,100	3	165,300
Solar Home System – ICT Centre	30,000	18	540,000
TOTAL			**7,381,120**

A breakdown of the investment costs for the eight individual project types is provided in the table above. The basic project cost figure is all inclusive, i.e. includes equipment, mounting and commissioning. Whereas the first part of the financial analysis has been accomplished with the investment cost as in Table 8-1, the second part and also the economic analysis were based on the figures of the total investment in Table 6-1. The difference between investment costs and total investment for other miscellaneous costs in the range of approximately 10% as described in line with Table 6-1 has been declared as upfront discount in the second part of this financial analysis. These costs amount to 738,880 US$ (as shown as "Upfront Discount" in Figure 9-29, Figure 9-31 and Figure 9-32) and are expected to be subsidised.

8.1.3.4 Operating Expenditures

Costs incurred for the operation and maintenance of the projects include mainly:

- General maintenance, and
- Solar batteries and bulbs,

as shown with their annual values for the eight products in different tables of chapter 5.

All costs for O&M for the different PV products as introduced in chapter 5 are considered in the first part, whereas the second part of this financial analysis is based on the assumption that the O&M costs of institutional buildings, i.e. Health Centres, Schools and ICTs, will be subsidised.

8.1.3.5 Tariffs

The tariff used in the second part of this financial analysis for the evaluation of the solar program realised by a RESA, according to Table 6-1 of this study, has been calculated as a pondered average of the Dynamic Unit Costs as shown in Table 8-2, in Scenario B (30% grant, 70% loan), where only the owners of SHS are supposed to pay for the electricity received. A summary of the calculations can be found in Table 9-7 given in Appendix.

Based on these calculations, the average tariff was established at 2.09 US$/kWh.

8.1.4 Results

8.1.4.1 Individual Products

The first results of the financial analysis are the Dynamic Unit Costs of the electricity (US$ / kWh) generated in each of the eight project types, according to three different scenarios.

Table 8-2: Dynamic Unit Costs for seven products in three different scenarios (US$ / kWh)

Product		Dynamic Unit Cost [US$/kWh]		
	Annual Electricity Consumption	Scenario A (100% grant)	Scenario B (70% loan, 30% grant)	Scenario C (100% loan)
Solar Lantern	2.1	4.13	5.59	6.44
Small SHS	33	1.81	2.51	2.95
Medium SHS	59	1.77	2.51	2.95
Large SHS	121	2.23	2.96	3.38
School – UBS	485	1.00	1.57	1.90
School – SSS	4,000	0.87	1.48	1.83
Health Centre	810	0.64	1.18	1.49
ICT	2,450	0.92	1.45	1.76

As shown in Table 8-2 the cost per kilowatt-hour is high for all products and scenarios compared with the normal tariffs of the public utility NAWEC, which are right now in the range of 18 – 25 cents of a Dollar. This is due to relatively high investment costs, and yearly costs for maintenance and replacement of parts, such as bulbs and batteries.

Even in Scenario A, where we suppose 100 % granted investment cost, the Dynamic Unit Cost is still relatively high due to those costs for maintenance.

Solar home systems use renewable energy and are self-contained generation and distribution systems. They consequently have low operating and maintenance costs in comparison to fossil fuel alternatives. Thus, the initial capital cost of a solar home system is very high in proportion to its total life-cycle costs.

Nevertheless, one should bear in mind that the plants initial and current costs are divided by relatively small numbers for electricity generated during a year. Thus for example in the case of the small SHS the whole electricity output of a year is hardly 33 kWh, what means not even three (3) kWh per month. Under these conditions, the owner of such a plant would have to face a monthly electricity bill of 5 to 9 US$, according to the percentage of grant.

This monthly burden might be perfectly manageable considering the actual expenditures, which a family might have for batteries, kerosene, or candles, without offering the same quality of service. As it is well-known, especially the cost of small batteries for radios and other electric devices is very high, calculated on the basis of kWh.

The basic problem therefore seems to be the availability of suitable financing instruments for such an investment, and not so much the related costs per unit, month or year. The price of solar home systems is one of the greatest barriers to ownership among rural populations, especially given a virtual absence of credit. Financing costs may increase the life-cycle costs of PV systems but they make the systems more widely affordable.

8.1.4.2 RESA

In this second part of the financial analysis the expected performance of a so-called RESA – Rural Energy Service Agency – is investigated based on the assumptions mentioned here above and the information contained in Table 6-1. Such a RESA could be a solution to the problem of financing the promulgation of solar plants.

The result of the corresponding analysis was a Net Present Value (NPV) 1,090,502.96 US$ and a Benefit / Cost – Ratio of 0.95. These values indicate that the solar program as designed is not feasible over the whole period of twenty years.

Table 8-3: Dynamic Net Present Values and Benefit / Cost Ratio for the three different scenarios (US$ / kWh)

	Scenario 1 (as in Table 6 –1)	**Scenario 2** (grants: + 1,200,000)	**Scenario 3** (Tariff: + 13.9%)
Net Present Value - NPV	-1,090,502.96	ca. 0	0
Benefit / Cost - Ratio	0.95	1.05	1.05

Second scenario calculations showed that an additional grant or subsidy in the range of 1,200,000 US$ would bring these values to satisfying ranges of about zero (0) for NPV and 1.05 for the Benefit / Cost – Ratio.

In a third scenario calculation it has been stated that the same indicator values as before might be obtained by an increase of the electricity tariff from initially 2.09 US$ / kWh to 2.38 US$ / kWh (+ 13.9%).

These calculations indicate that the program needs a broader finance inflow as foreseen to be successful over the complete period of twenty years. As solutions hereto might be considered

a) An increase in the grants foreseen for this program,

b) A higher tariff for the electricity generated and delivered to the customers of the solar home systems, and eventually

c) Charging as well the institutional users of solar plants for the services received. This should be considered at least for the replacement of bulbs and batteries but on the other hand, also user fees for the ICTs could be introduced.

Thus with improved the basic conditions, the program should have good perspectives regarding the expected results.

8.1.5 Conclusions

PV systems are safer and more convenient than kerosene lanterns and dry cell or automotive batteries which are widely used in developing countries for lighting and to power small appliances. Solar home systems are especially attractive to women and children, who rely heavily on household energy services for a range of activities.

Despite these appealing features, solar home systems do not yet have the broad market acceptance they merit. The main obstacle is their relatively high purchase price, which puts them out of the reach of all those households, which do not have enough savings, or do not have access to credit. However, even with further reductions in the system costs, unless adequate financing arrangements, geared to low and middle-income households, are in place, solar home systems cannot play a significant role in rural electrification.

Evidence suggests that consumer willingness and capacity to pay is influenced more by the size of the down payment for solar home systems than by the number or the size of the monthly payments. Besides, flexible payment schemes may be needed for households with irregular income streams.

A judicious use of grants and subsidies can help implement household PV programs. To assure sustainable programs, such assistance should be used to build market infrastructure through planning, promotion, training, feasibility studies, quality assurance, and similar activities, or limited equity to reduce the capital costs of a project. The use of grants or subsidies to cover operating costs is dangerous and could undermine the long-term sustainability of a PV electrification program.

Duty and tax structures should be rationalised, if these discriminate against PV development. Relatively high import duties and other taxes (particularly on PV modules) can severely limit the potential for commercially viable, market-driven solar home system programs. Duties and taxes on PV system components raise the financial costs of solar home systems. At the same time, subsidies for rural grid service or for kerosene often lower the cost of competing energy options to well below their economic value. While subsidies may be justified for social or developmental objectives, they can create serious distortions that hinder household PV use in areas where PV is clearly the least-cost economic option.

8.2 Economic Analysis

8.2.1 General

The purpose of an economic analysis is to encourage investment in projects which promote the most efficient use of a nation's resources. This means that projects deemed as being the economically most feasible will not necessarily always coincide with those which generate the greatest yield on investment. As the evaluation is done from the viewpoint of the national economy, inflation and other factors which distort market prices are not taken into consideration.

Various supply options were elaborated for their application in The Gambia. These options were conceptualised and are referred to as "products". The purpose of the economic analysis is thus to assess the economic feasibility of the solar energy program based on these different products.

8.2.2 Approach & Methodology

The economic analysis of the individual products was carried out in a conventional cost-benefit analysis, where the costs of the project are compared to its benefits. The basic technique for comparing costs and benefits occurring at different times during the project period is to discount both costs and benefits, and to express them in a common value at one point in time. In this way the time related value of money is taken into account. Costs and benefits are set up as annual streams over the study period (cash flows) and then discounted to their present values. The evaluation period covers the construction period and the operating period over the economic lifetime of the project. All costs and benefits of the project are expressed in monetary terms at their economic prices.

To realise the economic analysis, a spreadsheet-based model has been used, which allows for the calculation of the following economic indicators:

- Economic Net Present Value - NPV;
- Economic Benefit / Cost – Ratio.

The term "economic" is used in this study to express that the analysis is done from the country's perspective. All transfers within the country are eliminated, including import duties, sales taxes, income taxes, and other budget transfers to and from government (such as subsidies). Shadow prices are used where market prices do not reflect true opportunity costs.

Generally, the benefits of the products are the savings, achieved by its application to cover the final energy demand, and compared to the use of alternative energy sources, fitting for the specific purpose.

Due to the insuperable difficulties to define and quantify clearly all benefits of those photovoltaic plants, as it would be required for the purpose of an economic analysis, the Consultant decided to define in this study the benefits of the solar plants as the avoided costs for the connection to the grid, powered by diesel generators, which would be the most likely alternative to solar plants.

If all those new consumers would get a grid connection instead of a solar plant, investments would be required for

- The installation of about 530 kW additional generation capacity, with an estimated cost of about 1,000 US$ / kW (as it can be supposed that all the new customers would demand electricity especially also in early evening peak hours, so that a corresponding increase in generation capacity would be inevitable);
- The connection of the new clients to the low-voltage grid at a cost of in-between 230 and 2,100 US$ per customer, and sometimes even more;
- The reinforcement of the middle and high-voltage grid, as far as required. (Nevertheless, as these costs due to the lack of information on this subject cannot even be roughly estimated, they will not be taken into account hereafter).

In additional to these investment costs, and the corresponding operation and maintenance costs, considerable fuel costs for the electricity generation, about 440,000 kWh or 106,000 US$ yearly would arise.

8.2.3 Assumptions

To facilitate the economic analysis, the following general assumptions are used:

Table 8-4: Basic Assumptions

Item	Value
Discount rate	10%
Operational Period	20 years
Pay-back period for loans	20 years
Exchange rate US$ / GMD (August 9th, 2006)	26.83746
Diesel cost	0,80 US$ / Litre (August 2006)
Calorific value of Diesel	10 kWh / litre
Average plant efficiency	26 %
Diesel substituted	132,568Litres / year 106,055 US$ / year

8.2.4 Results

Following the above mentioned methodology, the Economic Net Present Value and the Economic Benefit / Cost – Ratio have been fixed on zero (0) for the NPV and in the range of 1.10 for the Benefit / Cost – Ratio in order to calculate the corresponding individual connection cost break-even value, and thus the whole avoided costs for the alternative connection of all new customers to the diesel-powered public grid.

In a first approach all costs of the solar energy program as also considered too in the financial analysis have been taken into account, with the result that under economic criteria the solar program would be feasible as soon as the cost for the connection of a new customer to the public grid is reaching an average value of 774 US$, or higher. In this case the connection of all new customers would generate an investment cost of nearly 8 million US$.

Table 8-5: Break-even grid connection costs

	Scenario 1 (as in Table 6 –1)	Scenario 2 (without O&M costs)	Scenario 3 (without grant 3,020,000 US$)
Break-even value for Connection Costs to the Public Grid (US$)	774	82	326
Net Present Value - NPV	ca. 0	ca. 0	ca. 0
Benefit / Cost - Ratio	1.05	1.13	1.09

Nevertheless, considering that the cost of the grid connection alternative do not include the cost for operation & maintenance, they include only investment and yearly fuel costs, the elimination of the O&M costs in the solar energy program has been considered in a second scenario. As a consequence, the break-even value for a grid connection dropped down to about 82 US$. This variation shows that this criterion is reacting very hard on changes of the O&M costs especially.

Eliminating in a third scenario the grant of 3,020,000 US$ to be received for the solar energy program (see Table 6-1), the break-even value for a grid connection arrives at about 326 US$.

These results show very clearly that there must be a very interesting market for solar plants, when higher connection costs to the public grid are to be avoided by the installation of solar solutions.

The exact point of break-even has to be determined in each specific case, taking into account on one hand the specific conditions of new customers (e.g. density per square kilometre, consumption patterns, supply conditions, etc.), and on the other hand considering the conditions of the solar energy program to be implemented (funds available, interest rates, grants, etc.).

The sensitivity analysis realised as part of the financial and economic analysis (see appendix : Figure 9-2 to Figure 9-11) shows that especially the investment and O&M costs of solar plants are very important for the successful implementation of such a program.

Additionally the availability of credit funds at low interest rates for a lifetime financing of such projects seems to be essential. The application of grants should be realised in a very careful manner, having in mind that notable market distortions have to be avoided.

8.3 Conclusions

As a renewable energy source, PV systems are also environmentally friendly and reduce reliance on expensive imported fuels.

Grid-based power supply and PV systems are not necessarily mutually exclusive options in delivering electricity services to rural areas. Rural electrification planners should take advantage of multiple options at their disposal. Grid-based power is the least-cost option for large concentrations of household or productive loads. It offers substantial economies of scale, owing to the large fixed-cost investment in distribution lines and generation facilities. However, grid solutions require a minimum threshold level of electricity demand and certain load densities to achieve these economies of scale. The break-even point at which grid-based power supply and PV systems are equally cost-effective in this assessment depends on the size and density of the specific load to be served as well as the distance from low-(LV) and medium- (MV) voltage lines.

Grid-based electricity is more expensive in rural than in urban areas due to lower load densities, lower capacity utilisation rates and often higher energy losses. Rural customers increase the costs of generating electricity disproportionately, since rural areas add to the evening system peak, when power is more expensive. The costs of grid-based rural electrification extensions have ranged from US$230 to US$1,800 and more per connection, with a median cost of about US$600 per connection (excluding the cost of basic generating equipment and high-voltage transmission lines). Since these costs rise considerably in areas with small loads and low load densities (i.e, areas with low population density), alternative approaches are necessary in order to meet rural electricity needs in the least expensive way.

<u>The PV niche within a national rural electrification strategy would comprise those areas where small amounts of electricity are required and load densities will remain modest.</u>

PV projects should be appropriately integrated into the rural electrification planning process as a least-cost electrification option. From the users' perspective, electricity from a reliable distribution grid is preferable, as long as it is affordable. From the country's perspective, rational economic policy dictates a least-cost path to energy service delivery. The rural electricity planner needs to know how to select the least-cost approach of delivering energy services at an acceptable level of reliability and quality from different off-grid options for power supply, including solar home systems, kerosene and batteries, and a grid-based power supply.

While many beneficiaries of rural electrification benefit from subsidies, PV users are generally expected to pay for most of the costs of their systems. But:

- **High capital costs** and lack of access to credit make solar home systems too expensive for many rural households;
- **High transactions costs** arise in the purchase or servicing of solar home systems due to limited supply, sales outlets, technicians and financing infrastructure in rural areas;

- **Market distortions** through
    - import duties, tariffs, and taxes; and
    - subsidies for kerosene and grid-based service to rural consumers

often increase the price of solar home systems relative to alternatives.

Support from government and donor agencies can help build the necessary infrastructure to accelerate development. Such assistance can include:

- Making investment capital available for solar home system programs;
- Encouraging the commercial banking sector and financing agencies to finance PV home systems on reasonable terms by offering support mechanisms refinancing arrangements;
- Supporting promotional campaigns for SHS among rural households;
- Removing regulatory barriers that limit competition among energy service providers; and
- Offering training and technical assistance to help establish retail and service networks.

Consumers are often willing and able to pay more than government programs charge for energy service. Government and bilateral donor-funded PV projects, designed without regard to cost recovery, may also damage private efforts if customers expect to receive subsidised systems. Full recovery of the capital investment, borrowing and operating costs is crucial for financial sustainability.

The affordability of solar home systems can be extended to a greater number of consumers if an Rural Energy Service Agency - RESA, such as the local electric utility or distribution company, offers electricity services using solar home systems, rather than grid extensions. The RESA retains ownership of the equipment and recovers its costs over a long period of time. If an RESA can obtain long-term credit at relatively low interest rates, this option can be an effective way of lowering household monthly payments.

Rural Electrification Service Agency models generally allow for the most affordable payment schemes, and can thus reach a larger customer base than other credit delivery schemes. A local or regional electric utility, a distribution company or a government agency can serve as an RESA. With a large customer base, the RESA can obtain economies of scale in procurement and in the delivery of support services, make product standardisation and quality assurance easier, and facilitate battery recycling. While the RESA model is an attractive concept, its long-term viability requires business management skills and technical capabilities that may be limited in rural areas. The RESA model also carries greater commercial risk due to the longer cost-recovery period.

PV programs should be operated as businesses. They should generate revenues sufficient to recover capital investment, service debt, pay for administrative and support services, cover payment defaults and, in the case of for-profit operations, provide satisfactory returns for investors. Often, the fees charged under many donor- and government-sponsored programs were set at levels comparable to the monthly cost of kerosene for low-income households. This was based on the assumption that rural consumers have a very limited capacity to pay. Such PV programs are intrinsically unsustainable over the long term. Experience shows that consumers are often willing and able to pay more for highly valued services than has previously been assumed.

To ensure sustainability, PV programs should:

a) set prices to allow for full cost recovery;
b) select only consumers with a willingness and ability to pay;
c) ensure that consumer expectations are in line with the energy services to be provided;
d) maintain high product quality and responsive services;
e) establish effective fee collection methods and enforce regulations to “shut off” service for non-payment;
f) adopt simplified administrative procedures; and
g) select and retain quality staff.

9 APPENDIX

Table 9-1: List of electrified settlements in WD

Brikama LGA (Western Division)

District of **Kombo North**

BANJULNDING
BIJILO
BRUFUIT
BRUFUT BEACH
BRUSUBI
BUSUMBALLA
DARANKA
KER SERINGE NGAGA
KOLOLI BEACH
KUNKUJANG KEITA
LAMIN
BRUFUT MADINA
MANDINARI
NEMA KUNKU
NEW YUNDUM
OLD YUNDUM
SUKUTA
SUKUTA SANCHABA
TRANKILL
WELLINGARA

District of **Kombo South**

FARATO
JAMBANJELLY
JAMBURR
SANYANG
TANJEH
TUJERENG

District of **Kombo Central**

BRIKAMA
KEMBUJEH

Kuntaur LGA

District of **Lower Saloum**

KAUR JANNEH KUNDA
KAUR TOURAY KUNDA
KAUR WHARF TOWN

District of **Niani**

KUNTAUR WHARFTOWN
SUKUTA
WASSU

Georgetown LGA

District of **Fulladu West**

BANSANG
DOBANG KUNDA

District of **MacCarthy Island**

JANJANBUREH

Mansa Konko LGA (Lower River)

District of **Jarra West**

KANI KUNDA
KARANTABA
PAKALINDING
SANKWAI
SOMA
TONIATABA

Kerewan LGA (North Bank)

District of **Lower Nuimi**

BARRA
ESSAU
KANUMA
MEDINA SERIGN MASS

District of **Lower Baddibu**

KEREWAN
SAABA
SUWAREH KUNDA

District of **Central Baddibu**

N'JABA KUNDA
SALLIKENE

District of **Upper Baddibu**

FARAFENNI

Basse LGA (Upper River)

District of **Fulladu East**

ALLUNKHARI
BASSE NDING
BASSE SANTO SU
DAMPHA KUNDA
DINGIRI
GAMBISARRA
GIROBA KUNDA
KABA KAMMA
KOBA KUNDA
KULARR
MANNEH KUNDA
MANSAJANG KUNDA
NUMUYEL
SABI

District of **Kantora**

FATOTO
GARAWOLL
KOINA
MISSIRA BA MARIAMA

Table 9-2: List of electrified communities and villages within the PRE

Settlement	District	Division
Basse Santa Su (1400kW)	Fulladu East	Upper River Division
Kaba Kamma		
Mansajang Kunda		
Manneh Kunda		
Koba Kunda		
Giroba Kunda		
Basse Nding		
Alluhari		
Dampha Kunda		
Numuyel		
Sabi		
Gambissara		
Dingiri		
Kulari		
Garrawoll	Kantara	
Fatoto		
Misira		
Koina		
Bansang (600 kW)	Fulladu West	Central River Division South
Dobang Kunda		
Janjanbureh	Mac Carthy Island	
Kuntaur Warf Town	Niani	Central River Division North
Wassu		
Sukuta		
Kaur Touray Kunda (180 kW)	Lower Saloum	Central River Division North
Wharf Town		
Janneh Kunda		
Farafenni (1400 kW)	Upper Baddibu	North Bank Division
Soma	Jarra West	Lower River Division
Pakaliding		
Sankwia		
Karantaba		
Mansakonko		
Toniataba		
Kanikunda		
Kerewan (220 kW)	Lower Baddibu	North Bank Division
Saba		
Suara Kunda		
Salikenni	Central Baddibu	
Njada Kunda		
Essau (460 kW)	Lower Niumi	North Bank Division
Barra		
Medina Serig Mass		
Kanuma		

Table 9-3: List of selected settlements for implementation of SHS Program

LGA	District	LGA	District
Brikama	**Kombo North**	**Mansa Konko**	**Kiang West**
DARANKA	1,054	KARANTABA	892
MAKUMBAYA	1,148	NIORO JATABA	1,004
JABANG	1,171	JIFFARONG	1,112
MARIAMA KUNDA	1,266	JALI	1,137
MADIANA	2,204	KENEBA	1,937
KEREWAN	2,262	KWINELLA SANSAN KONO	730
SINCHU SORIE	2,547	NEMA	1,035
SINCHU BALIA	3,642	KWINELLA NYA KUNDA	1,095
SINCHU ALAGIE	5,073	**Mansa Konko**	**Kiang East**
Brikama	**Kombo Central**	MASSEMBEH	966
BUSURA	1,152	KAIAF	1,473
DASILAMEH	2,021	**Mansa Konko**	**Jarra West**
BRIKAMA WELLINGARA	2,473	JENOI	1,076
Brikama	**Kombo South**	SI KUNDA	1,003
BANIAKANG	1,021	**Mansa Konko**	**Jarra Central**
KARTONG	2,858	JAPINEH MARIKOTO	1,140
NYONFELLEH	1,005	**Mansa Konko**	**Jarra East**
SIFFOE	4,053	BURENG	1,434
KUKUJANG MARIAM	939	BARROW KUNDA	2,314
SOTOKOI DARA	1,342	DONGORO BAH	898
MARA KISSA	1,406	SUTUKUNG	1,205
MANDUAR	1,901	WELLINGARA BAH	1,408
KITTY	2,254		
Brikama	**Kombo East**	**Kerewan**	**Lower Niumi**
BASSORY	2,115	BAKINDICK MANDINKA	953
BERENDING	2,893	AMDALAI	1,425
SOTOKOI	983	BERENDING	1,440
TUBA KUTA	1,186	FASS NJAGA CHOI	2,723
MANDINA BA	1,460	MEDINA DARU	1,262
FARABA MANOKANG	1,703	M'BOLLET BA	1,297
PIRANG	2,080	N'DUNGU KEBBEH	2,808
KULORO	2,085	**Kerewan**	**Upper Niumi**
FARABA BANTA	2,771	ALBREDA	1,100
KAFUTA	3,359	MEDINA SEDIA	1,103
Brikama	**Foni Brefet**	CHILLA	1,213
BULOCK	2,404	FASS CHAHO	2,526
N'DEMBAN CHAPICHON	1,018	TUBAKOLONG	1,127
SUTUSINJANG	1,208	PAKAU N'JOKU	1,179
SOMITA	2,200	**Kerewan**	**Jokadu**
Brikama	**Foni Bintang Karanai**	KERR JARIGA JOBE	1,024
SIBANORR	3,023	DASILAMEH	1,064
Brikama	**Foni Kansala**	KUNTAYA	1,033
BWIAM	2,263	MUNYAGEN	1,353
SANAJOR	1,002	**Kerewan**	**Lower Baddibu**

Table 9-4: List of selected Upper Basic Schools (A = less than 500 students, B = between 500 and 1000, C = more than 1000 students)

UPPER BASIC SCHOOLS			UPPER BASIC SCHOOLS		
Region	**Name**	**Size**	**Region**	**Name**	**Size**
Western Division			**Lower River Division**		
	Darsilami	A		Japenni	B
	Gunjur	C		Kaiaf	B
	Kalagi	B		Kwinella	B
	Kitty	B		Niorro Jataba	A
	Ndemban	B		Pakaliba	A
	Nema Kunku	B	**Central River Division**		
	Nyereka Sonko	A		Brikamaba	C
	Penyem	A		Chamen	A
	Sibanor	A		Chargel	A
	Somita	A		Dankunku	A
	St. Francis	B		Jareng	B
	(Kunkujang Mariama)			Jaromeh Koto	B
North Bank Division				Jimbala	A
	Albreda	B		Karantaba	A
	Berending	B		Kudang	B
	Fass	B		Kuntaur	B
	Illiassa	A		Kunting	B
	Kerewan	B		Madina	A
	Kerr Cherno	B		Njoren	A
	Kerr Pateh	A		Panchang	A
	Kuntaya	B	**Upper River Division**		
	Ndungu Kebbeh	B		Badari	A
	Ngayen Sanjal	A		Bakadaji	B
	Njongon	A		Diabugu	B
	Sincho Njabo	A		Fatoto	B
				Foday Kunda	A
				Julangel	A
				Koro jula Kunda	B
				Nyakoi	B
				Suduwol	B

Table 9-5: List of selected Senior Secondary Schools (A = less than 500 students, B = between 500 and 1000, C = more than 1000 students)

SENIOR SECONDARY SCHOOLS		
Region	**Name**	**Size**
Western Division		
	Fatima (Bwaim)	B
	St. Francis Kunkujang	B
North Bank Division		
	Kuntaya	B

SENSITIVITY

Sens

Investment Costs	+/-	0.00%	70.00
NPV O&M Costs (Maint. Plan)	+/-	0.00%	78.77
Discount Rate	+/-	0.00%	10.00%
Loan Interest Rate	+/-	0.00%	4.00%

NPV **-106.59**

	-10%	-5%	0%	5%	10%
Investment Costs	-106.59	-106.59	-106.59	-106.59	-106.59
NPV O&M Costs (Maint. Plan)	-98.71	-102.65	-106.59	-110.53	-114.46
Discount Rate	-115.42	-110.88	-106.59	-102.52	-98.68
Loan Interest Rate	-105.89	-106.24	-106.59	-106.94	-107.28

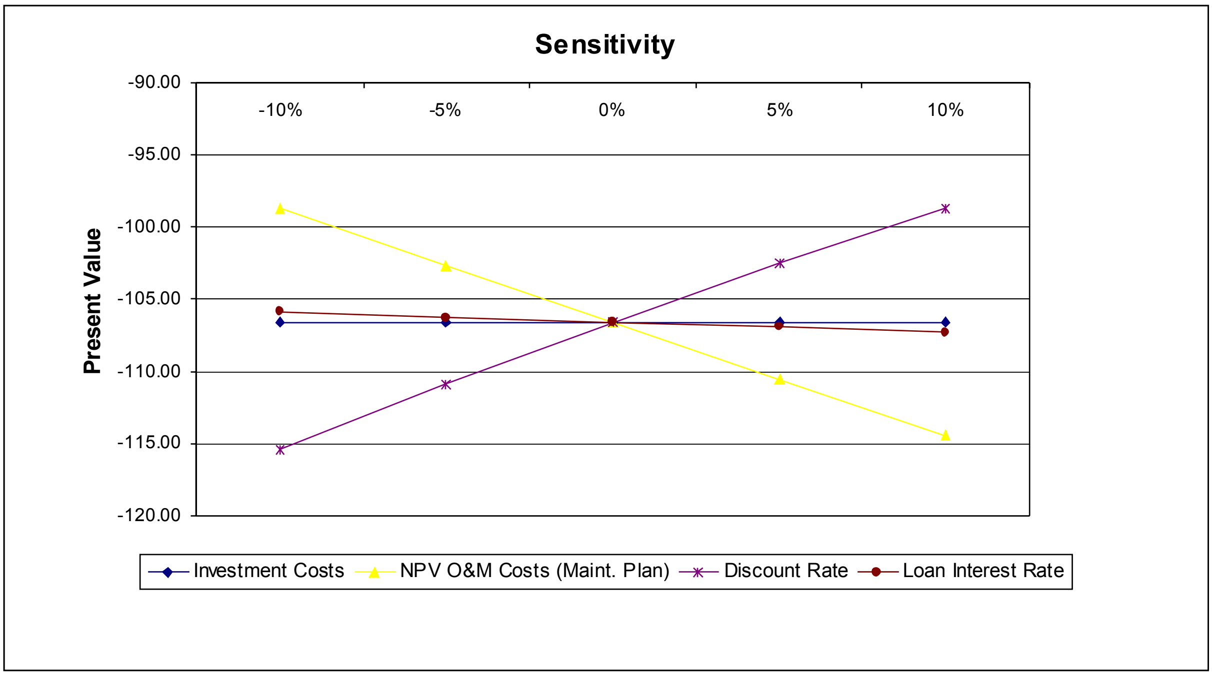


Figure 9-1: Sensitivity Analysis for the case of a Solar Lantern, Scenario B (30% grant, 70% loan)

SENSITIVITY

Sens

Investment Costs	+/-	0.00%	650.00
NPV O&M Costs (Maint. Plan)	+/-	0.00%	542.05
Discount Rate	+/-	0.00%	10.00%
Loan Interest Rate	+/-	0.00%	4.00%

NPV **-800.39**

	-10%	-5%	0%	5%	10%
Investment Costs	-800.39	-800.39	-800.39	-800.39	-800.39
NPV O&M Costs (Maint. Plan)	-746.19	-773.29	-800.39	-827.50	-854.60
Discount Rate	-864.61	-831.59	-800.39	-770.90	-742.98
Loan Interest Rate	-793.93	-797.16	-800.39	-803.63	-806.86

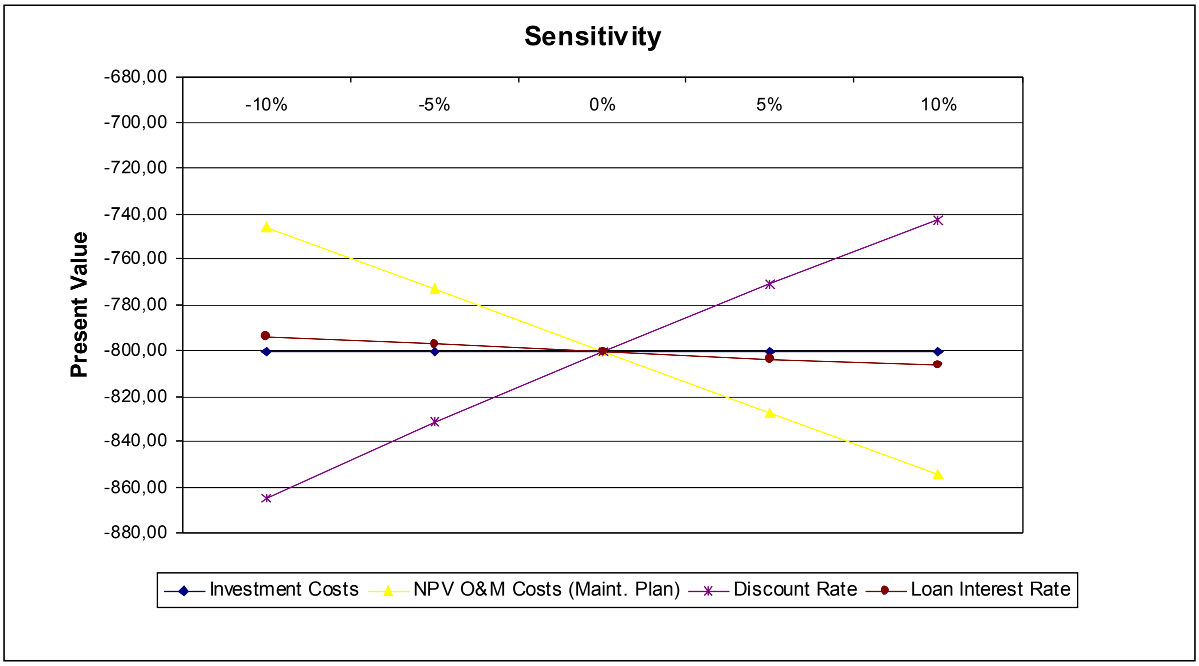


Figure 9-2: Sensitivity Analysis for the case of a Small Household, Scenario B (30% grant, 70% loan)

SENSITIVITY

Sens

Investment Costs	+/-	0,00%	1.000,00
NPV O&M Costs (Maint. Plan)	+/-	0,00%	948,94
Discount Rate	+/-	0,00%	10,00%
Loan Interest Rate	+/-	0,00%	4,00%

NPV **-1.346,40**

	-10%	-5%	0%	5%	10%
Investment Costs	-1.346,40	-1.346,40	-1.346,40	-1.346,40	-1.346,40
NPV O&M Costs (Maint. Plan)	-1.251,51	-1.298,95	-1.346,40	-1.393,85	-1.441,29
Discount Rate	-1.454,88	-1.399,10	-1.346,40	-1.296,58	-1.249,43
Loan Interest Rate	-1.336,45	-1.341,43	-1.346,40	-1.351,37	-1.356,35

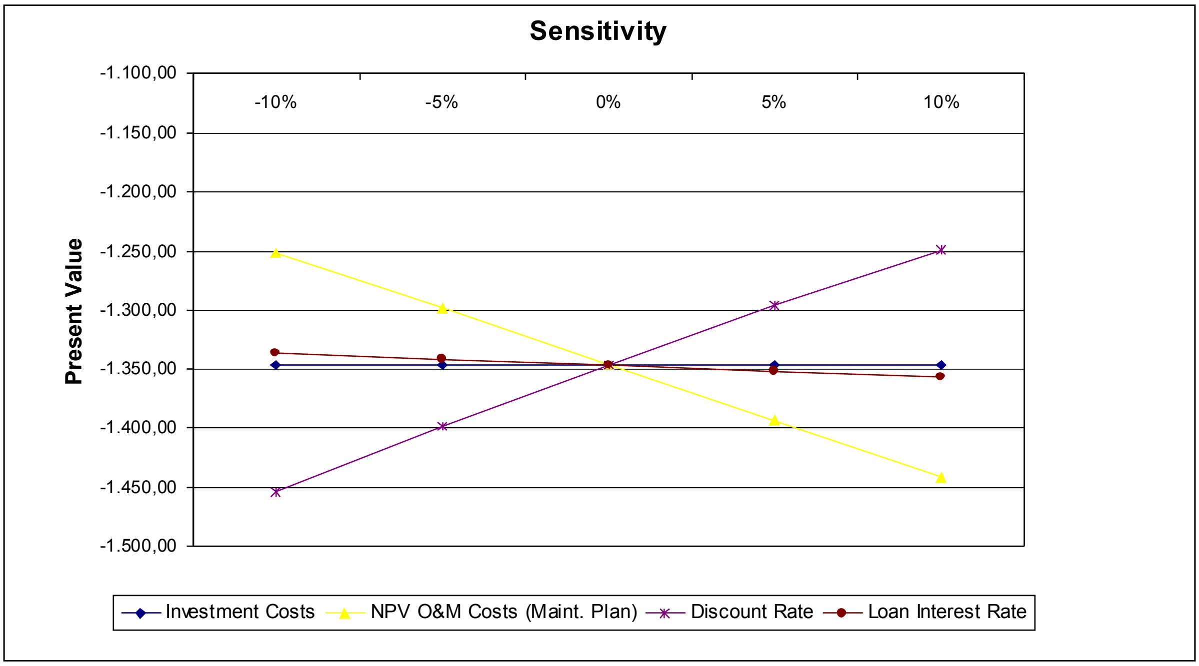


Figure 9-3: Sensitivity Analysis for the case of a Medium Household, Scenario B (30% grant, 70% loan)

SENSITIVITY

Sens

Investment Costs	+/-	0,00%	2.000,00
NPV O&M Costs (Maint. Plan)	+/-	0,00%	2452,54
Discount Rate	+/-	0,00%	10,00%
Loan Interest Rate	+/-	0,00%	4,00%

NPV **-3.247,46**

	-10%	-5%	0%	5%	10%
Investment Costs	-3.167,97	-3.207,71	-3.247,46	-3.287,21	-3.326,95
NPV O&M Costs (Maint. Plan)	-3.002,21	-3.124,83	-3.247,46	-3.370,09	-3.492,71
Discount Rate	-3.513,76	-3.376,81	-3.247,46	-3.125,20	-3.009,54
Loan Interest Rate	-3.227,56	-3.237,51	-3.247,46	-3.257,41	-3.267,36

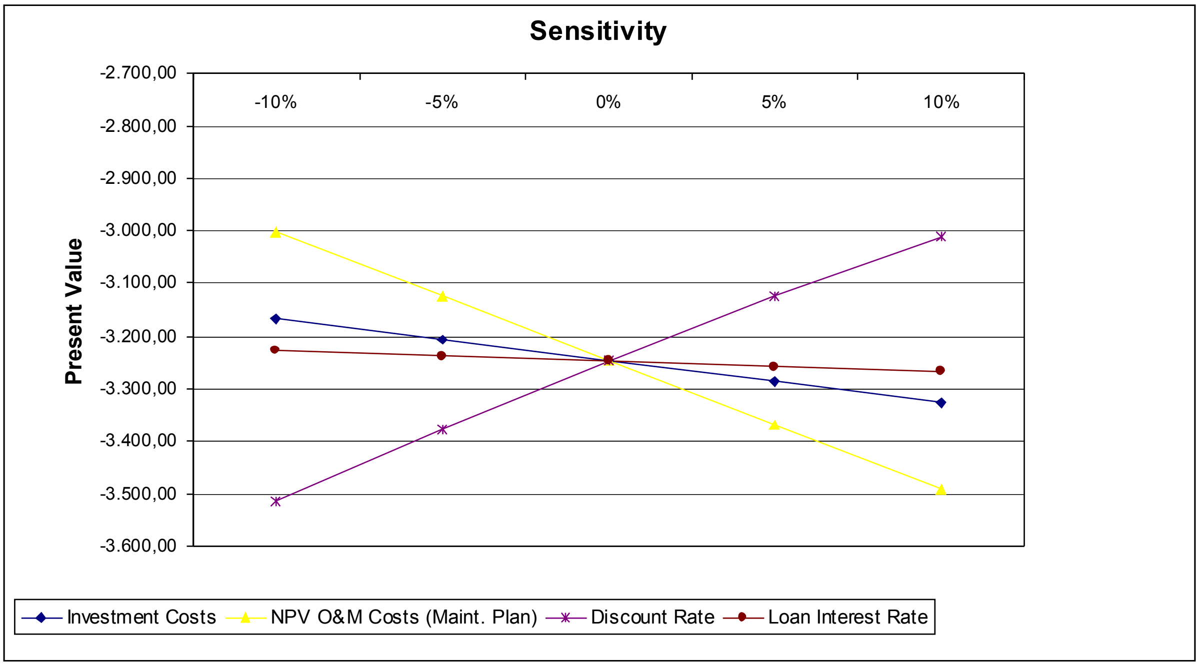


Figure 9-4: Sensitivity Analysis for the case of a Large Household, Scenario B (30% grant, 70% loan)

SENSITIVITY

Sens

Investment Costs	+/-	0,00%	10.000,00
NPV O&M Costs (Maint. Plan)	+/-	0,00%	4674,56
Discount Rate	+/-	0,00%	10,00%
Loan Interest Rate	+/-	0,00%	4,00%

NPV **-8.649,17**

	-10%	-5%	0%	5%	10%
Investment Costs	-8.251,71	-8.450,44	-8.649,17	-8.847,90	-9.046,63
NPV O&M Costs (Maint. Plan)	-8.181,71	-8.415,44	-8.649,17	-8.882,90	-9.116,62
Discount Rate	-9.328,55	-8.979,11	-8.649,17	-8.337,39	-8.042,52
Loan Interest Rate	-8.549,68	-8.599,42	-8.649,17	-8.698,91	-8.748,65

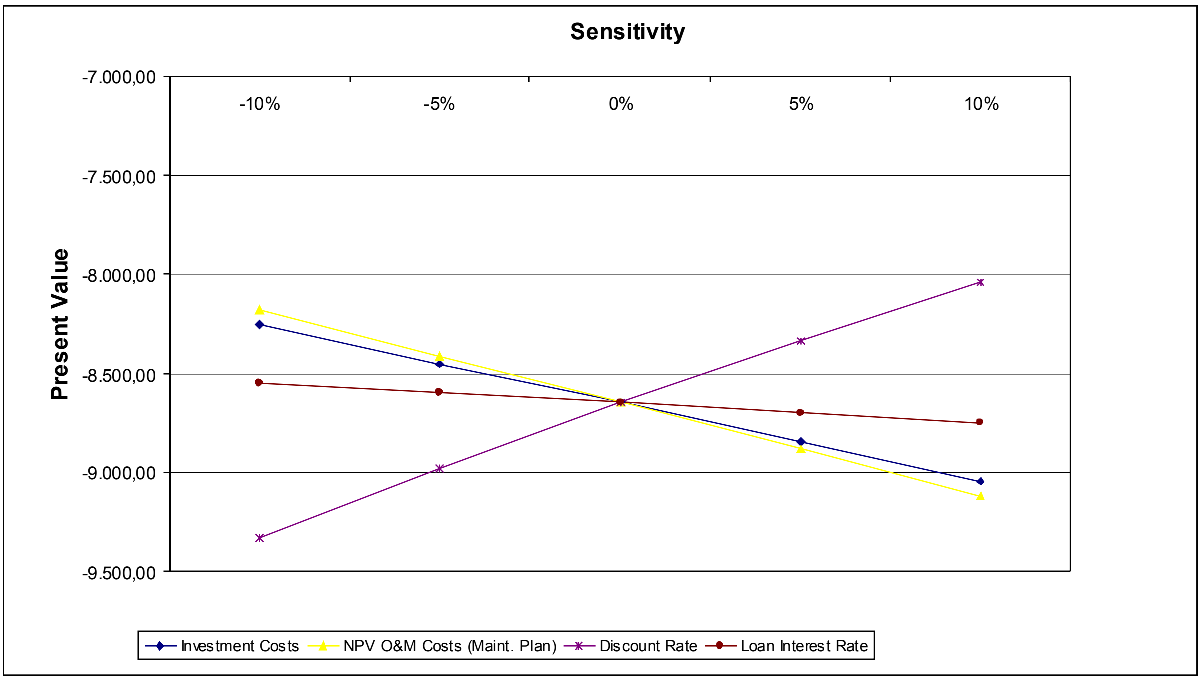


Figure 9-5: Sensitivity Analysis for the case of a Health Centre, Scenario B (30% grant, 70% loan)

SENSITIVITY

Sens

Investment Costs	+/-	0.00%	6,300.00
NPV O&M Costs (Maint. Plan)	+/-	0.00%	4406.82
Discount Rate	+/-	0.00%	10.00%
Loan Interest Rate	+/-	0.00%	4.00%

NPV **-6,910.82**

	-10%	-5%	0%	5%	10%
Investment Costs	-6,660.42	-6,785.62	-6,910.82	-7,036.02	-7,161.22
NPV O&M Costs (Maint. Plan)	-6,470.14	-6,690.48	-6,910.82	-7,131.17	-7,351.51
Discount Rate	-7,458.56	-7,176.95	-6,910.82	-6,659.15	-6,420.94
Loan Interest Rate	-6,848.15	-6,879.49	-6,910.82	-6,942.16	-6,973.50

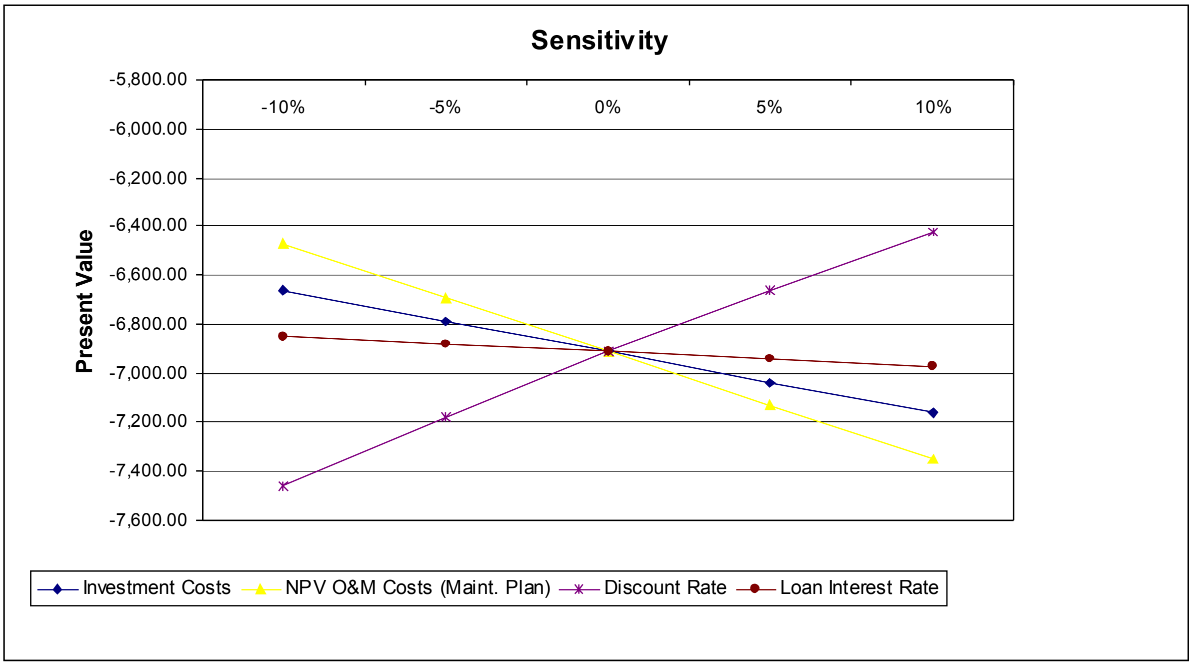


Figure 9-6: Sensitivity Analysis for the case of a UBS, Scenario B (30% grant, 70% loan)

SENSITIVITY

Sens

Investment Costs	+/-	0.00%	55,100.00
NPV O&M Costs (Maint. Plan)	+/-	0.00%	31692.88
Discount Rate	+/-	0.00%	10.00%
Loan Interest Rate	+/-	0.00%	4.00%

NPV **-53,592.98**

	-10%	-5%	0%	5%	10%
Investment Costs	-51,402.97	-52,497.98	-53,592.98	-54,687.99	-55,782.99
NPV O&M Costs (Maint. Plan)	-50,423.69	-52,008.34	-53,592.98	-55,177.63	-56,762.27
Discount Rate	-57,785.59	-55,630.21	-53,592.98	-51,665.94	-49,841.71
Loan Interest Rate	-53,044.81	-53,318.90	-53,592.98	-53,867.07	-54,141.15

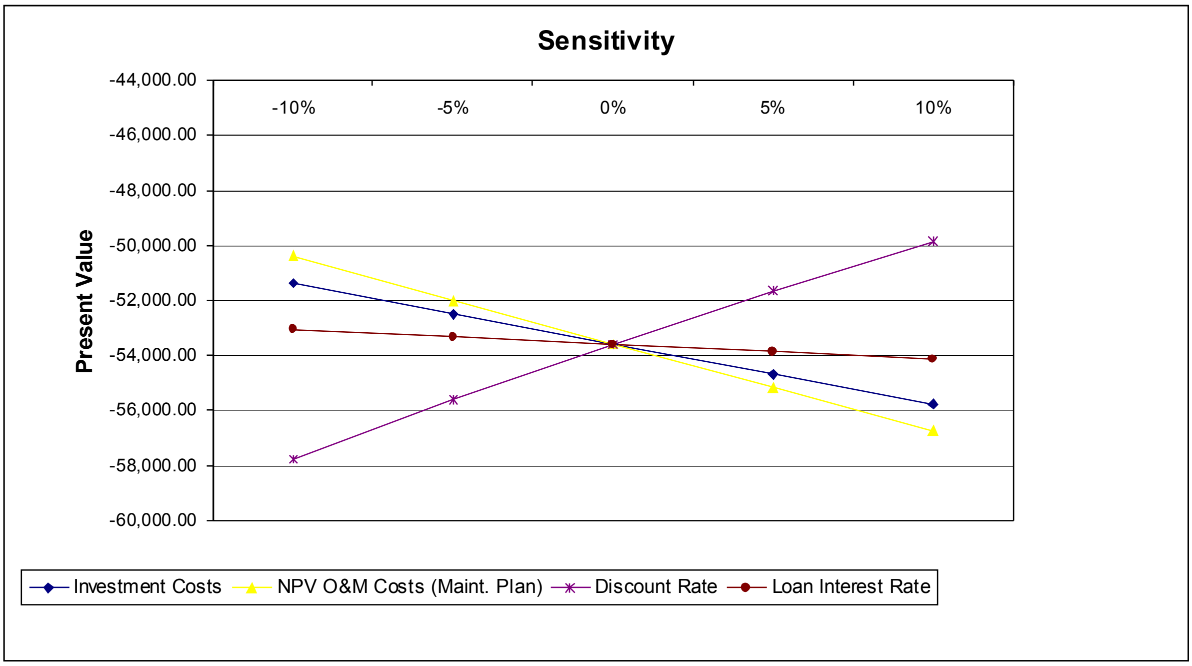


Figure 9-7: Sensitivity Analysis for the case of a SSS, Scenario B (30% grant, 70% loan)

SENSITIVITY

Sens

Investment Costs	+/-	0.00%	30,000.00
NPV O&M Costs (Maint. Plan)	+/-	0.00%	20379.85
Discount Rate	+/-	0.00%	10.00%
Loan Interest Rate	+/-	0.00%	4.00%

NPV **-32,303.68**

	-10%	-5%	0%	5%	10%
Investment Costs	-32,303.68	-32,303.68	-32,303.68	-32,303.68	-32,303.68
NPV O&M Costs (Maint. Plan)	-30,265.70	-31,284.69	-32,303.68	-33,322.68	-34,341.67
Discount Rate	-34,858.15	-33,544.81	-32,303.68	-31,129.88	-30,018.89
Loan Interest Rate	-32,005.22	-32,154.45	-32,303.68	-32,452.91	-32,602.14

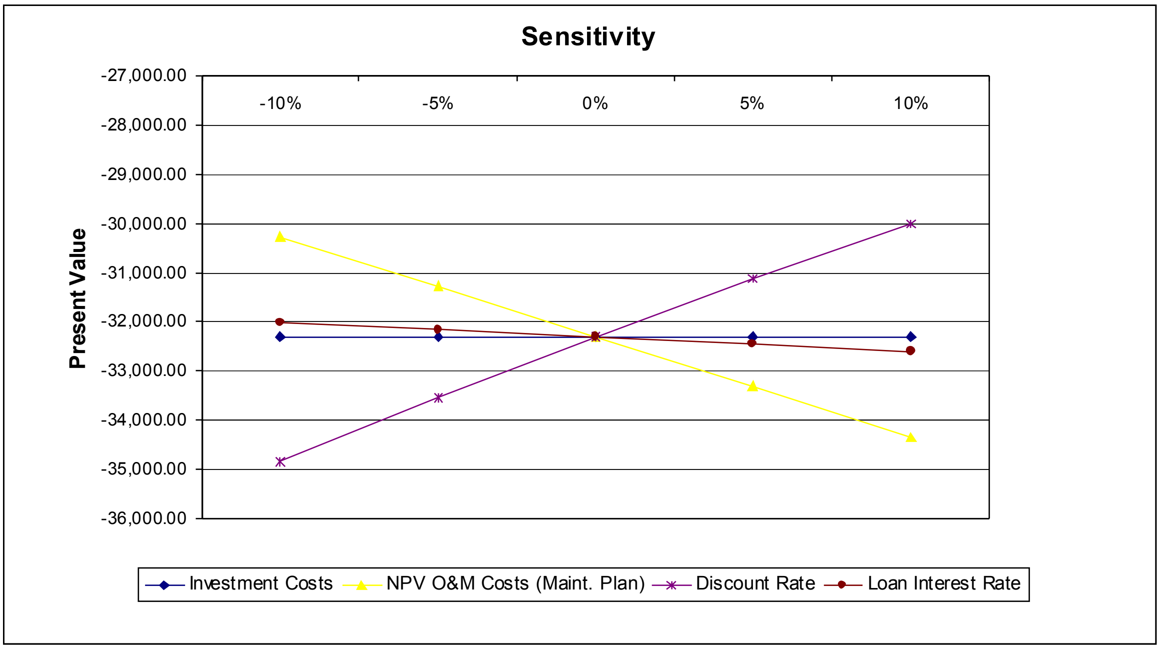


Figure 9-8: Sensitivity Analysis for the case of an ICT, Scenario B (30% grant, 70% loan)

Table 9-6: Real Investment Costs for the overall RESA Programme (compared to investment in Table 6-1)

Item	Units (#)	%	Capacity (per Unit) [W]	Investment Value [US$]	Investment Total [US]
Solar Home System – 2.5 W	4,191	40.71%	2.1	70	293,370
Solar Home System – 40 W	2,611	25.36%	33	650	1,697,150
Solar Home System – 70 W	2,718	26.40%	59	1,000	2,718,000
Solar Home System – 150 W	673	6.54%	121	2,000	1,346,000
Solar Home System – Health Centre	30	0.29%	810	10,000	300,000
Solar Home System – Schools (UBS)	51	0.50%	485	6,300	321,300
Solar Home System – Senior Secondary School (SSS)	3	0.03%	4,000	55,100	165,300
Solar Home System – ICT Centre	18	0.17%	2,450	30,000	540,000
TOTAL	**10,295**	**100.00%**			**7,381,120**

Table 9-7: Determination of average tariff according to DUC of the 4 types of households

Product	Annual Electricity Generation [kWh/a]	Units (#)	Total Annual Electricity Generation [kWh/a]	Proportion of Total Annual Electricity Consumption [kWh/a]	Average Tariff
Solar Lantern	2.1	4,191	8,801.10	1.99%	5.59
SHS (Small)	33	2,611	86,163.00	19.50%	2.67
SHS (Medium)	59	2,718	160,362.00	36.29%	2.51
SHS (Large)	121	673	81,433.00	18.43%	2.96
Health Centre	810	30	24,300.00	5.50%	0.00
Schools - UBS	485	51	24,735.00	5.60%	0.00
Schools - SSS	4,000	3	12,000.00	2.72%	0.00
ICT- Centre	2,450	18	44,100.00	9.98%	0.00
		10,295	441,894	100.00%	**2.09**

Table 9-8: Determination of various parameters for the economic analysis of grid-connection scenario

Pos.	Product	Units (#)	Capacity (per unit in W)	Capacity (Total in kW)	Electricity generation (kWh/year) (per unit)	Electricity generation (kWh/year) (Total)	Diesel substituted (Ltrs./year)	Diesel substituted (US$/year)
1	Solar Lantern	4,191	2.5	10.48	2.1	8,801	2,640	2,112
2	SHS (Small)	2,611	40	104.44	33	86,163	25,849	20,679
3	SHS (Medium)	2,718	70	190.26	59	160,362	48,109	38,487
4	SHS (Large)	673	150	100.95	121	81,433	24,430	19,544
5	Health Centre	30	1,000	30.00	810	24,300	7,290	5,832
6	Schools - UBS	51	600	30.60	485	24,735	7,421	5,936
7	Schools - SSS	3	4,800	14.40	4,000	12,000	3,600	2,880
8	ICT- Centre	18	2,800	50.40	2,450	44,100	13,230	10,584
		10,295		531.53		441,894	132,568	106,055

RESULTS

	Values Actual Case
Net Present Value Project	-1,090,502.96
Benefit-Cost-Ratio	0.95

SENSITIVITY

Sens

Investment Costs	+/-	0.00%	8,120,000.00
NPV O&M Costs (Maint. Plan)	+/-	0.00%	6802061.97
Discount Rate	+/-	0.00%	10.00%
Loan Interest Rate	+/-	0.00%	4.00%

NPV **-1,090,502.96**

	-10%	-5%	0%	5%	10%
Investment Costs	-808,371.41	-949,437.19	-1,090,502.96	-1,231,568.74	-1,372,634.52
NPV O&M Costs (Maint. Plan)	-410,296.77	-750,399.87	-1,090,502.96	-1,430,606.06	-1,770,709.16
Discount Rate	-1,295,452.34	-1,189,926.23	-1,090,502.96	-996,773.48	-908,359.79
Loan Interest Rate	-1,025,467.28	-1,057,985.12	-1,090,502.96	-1,123,020.81	-1,155,538.65

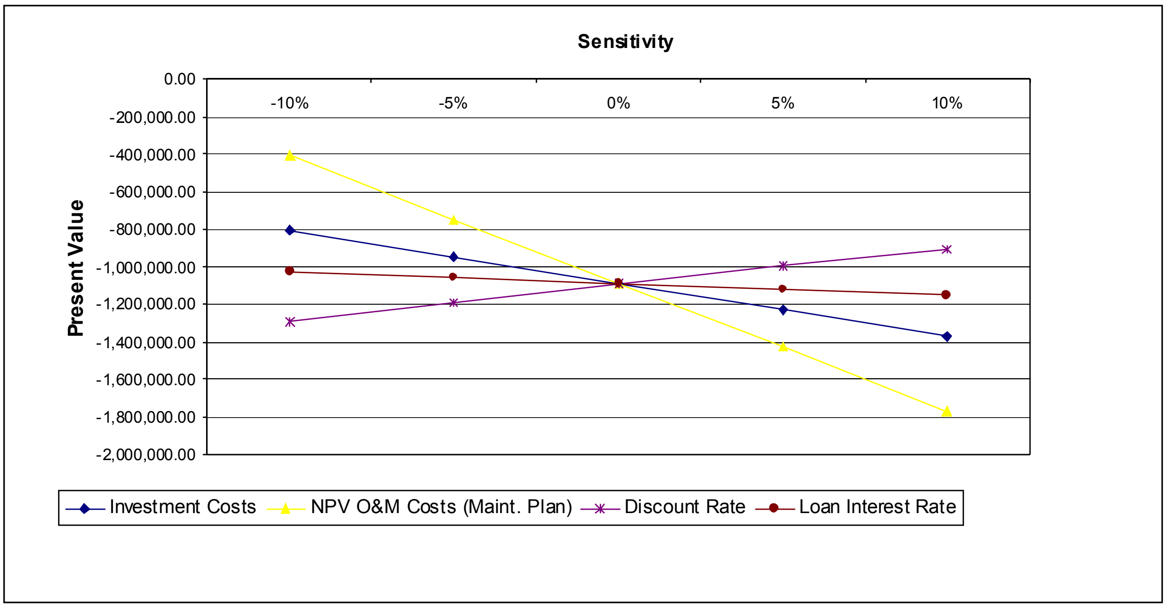


Figure 9-9: Results and Sensitivities for the overall RESA Programme according to conditions in Table 6-1

RESULTS

	Values Actual Case
Net Present Value Project	406.13
Benefit-Cost-Ratio	1.05

SENSITIVITY

Sens

Investment Costs	+/-	0.00%	8,120,000.00
NPV O&M Costs (Maint. Plan)	+/-	0.00%	6802061.97
Discount Rate	+/-	0.00%	10.00%
Loan Interest Rate	+/-	0.00%	4.00%
NPV		**406.13**	

	-10%	-5%	0%	5%	10%
Investment Costs	282,537.68	141,471.90	406.13	-140,659.65	-281,725.43
NPV O&M Costs (Maint. Plan)	680,612.32	340,509.22	406.13	-339,696.97	-679,800.07
Discount Rate	-194,534.91	-94,035.82	406.13	89,199.37	172,721.29
Loan Interest Rate	65,441.81	32,923.97	406.13	-32,111.71	-64,629.55

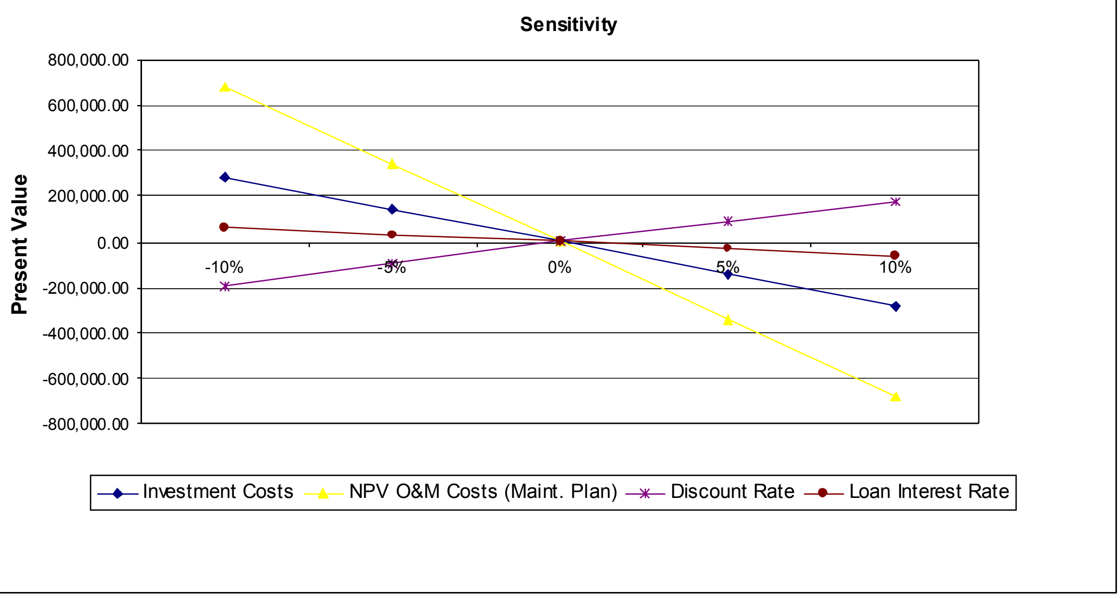


Figure 9-10: Results and Sensitivities for the overall RESA Programme according to conditions in Table 6-1, Adjustment of NPV towards 0 by additional subsidies of 1,200,000 US$

RESULTS

	Values Actual Case
Net Present Value Project	2,199.04
Benefit-Cost-Ratio	1.05

SENSITIVITY

Sens

Investment Costs	+/-	0.00%	8,120,000.00
NPV O&M Costs (Maint. Plan)	+/-	0.00%	6802061.97
Discount Rate	+/-	0.00%	10.00%
Loan Interest Rate	+/-	0.00%	4.00%

NPV **2,199.04**

	-10%	-5%	0%	5%	10%
Investment Costs	284,330.59	143,264.81	2,199.04	-138,866.74	-279,932.52
NPV O&M Costs (Maint. Plan)	682,405.23	342,302.13	2,199.04	-337,904.06	-678,007.16
Discount Rate	-123,818.41	-58,871.37	2,199.04	59,650.24	113,720.37
Loan Interest Rate	67,234.72	34,716.88	2,199.04	-30,318.81	-62,836.65

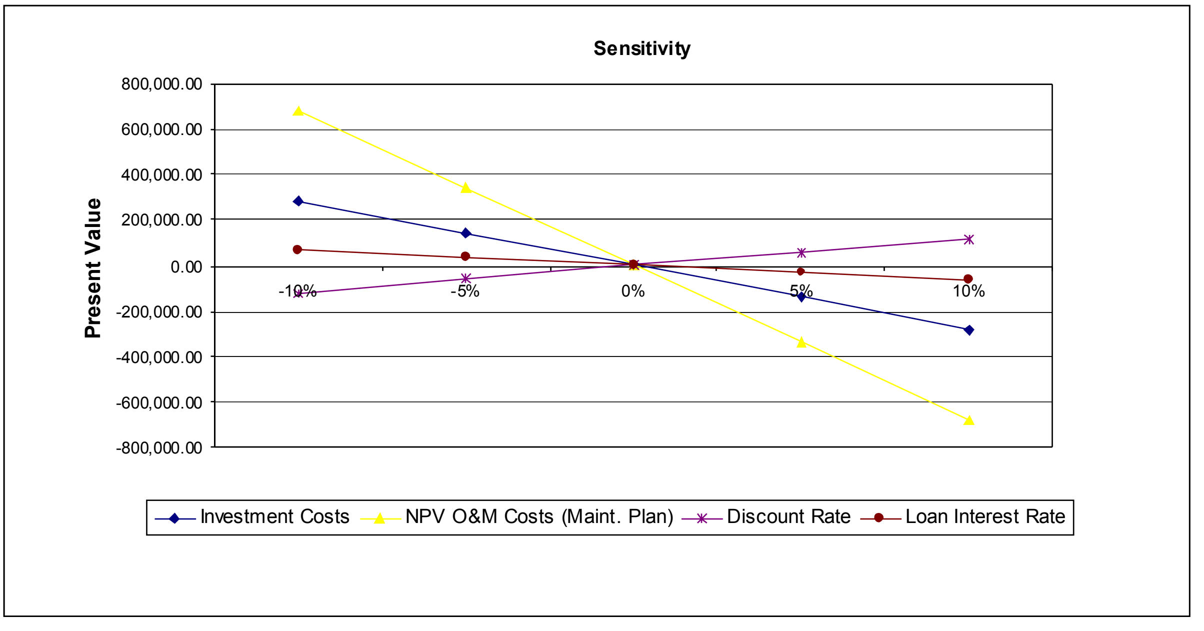


Figure 9-11: Results and Sensitivities for the overall RESA Programme according to conditions in Table 6-1, Adjustment of NPV towards 0 by increase of average tariff by 13.9%

Table 9-9: Grid Connection – Scenario 1 - Results of the Economic Analysis, incl. O&M Costs at a connection charge of 774 US$/customer

RESULTS

	Values Actual Case
Net Present Value Project	8,482.79
Benefit-Cost-Ratio	1.05

Table 9-10: Grid Connection – Scenario 2 - Results of the Economic Analysis, excl. O&M Costs at a connection charge of 82 US$/customer

RESULTS

	Values Actual Case
Net Present Value Project	3,948.27
Benefit-Cost-Ratio	1.13

Table 9-11: Grid Connection – Scenario 3 - Results of the Economic Analysis, excl. O&M Costs and grant on investment (i.e. investment subsidies) at a connection charge of 326 US$/customer

RESULTS

	Values Actual Case
Net Present Value Project	3,744.38
Benefit-Cost-Ratio	1.08

The Gambia

Project: ***Solar Lantern***

ASSUMPTIONS

Currency Unit:	US$
Country:	THE GAMBIA
Date:	08.07.2006
Others:	

TIMETABLE

Start of building work:	Year	2006	
Business Start Up:	Year	2006	

INFLATION

General	0.0%	p.a.
Energy	0.0%	p.a.

DEPRECIATION / DIVIDENDS

Depreciable Life (straight-line depreciation)	20	Years
Amortisation Period	20	Years
Profit Taxes (%)		p.a.
Dividends (%)		

TARIFF

Tariff		$/ kWh

TECHNICAL DATA

Capacity	2.5	W
Availability (%)	9.6%	
Annual Generated Energy	2.1	kWh

CAPITAL COSTS

Proportion of loan capital:	70.00%	
Proportion of grant capital:	30.00%	
Period of redemption:	0	Years
Loan Interest Rate	4.00%	p.a.
Discount Rate	10.00%	

O & M

Fixed O & M Costs	0	$/a
Variable O & M Costs	0	$/kWh

INSURANCE

Insurance	0.00	T $/a
Others	0.00	T $/a

TAXES & LEVIES

Taxes and levies not dependent on profits	0.00	T $/a
Other expenditures	0.00	T $/a

Figure 9-12: Assumption Sheet of the model for the financial analysis; Scenario B (70% loan, 30% grant), Solar Lantern

The Gambia **Solar Lantern**

Table 2: **Profit & Loss**

In: US$

Position		Unit	Period	1	2	3	4	5	6	7	8	9	10
			Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
0.1	Discount rate		10.00%										
0.12	Interest Rate Loan		4.00%										
0.2	Inflation rate (general)		0.00%										
0.3	Inflation rate (energy)		0.00%										
0.4	Lifetime of the project		20										
0.5	Amortisation period		20										
II.2.a	Fixed O&M costs (without staff)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.2.b	O&M Costs (According to Maintenance Plan)			0.0	2.0	2.0	22.0	2.0	2.0	22.0	2.0	2.0	70.0
II.4	Insurance			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.5	Others			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.1	Taxes and levies not dependent on profits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.2	Other expenditures			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.3	Total operating costs (II.1 - III.2)			0.0	2.0	2.0	22.0	2.0	2.0	22.0	2.0	2.0	70.0
IV.1a	Annual Generated Energy	kWh		2	2	2	2	2	2	2	2	2	2
	Selling price / unit	$/ kWh		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Revenues from energy sales			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.4	Total revenues and incomes (IV.1 + IV.2 + IV.3)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
V.1	Returns (IV.4 - III.3)			0.0	-2.0	-2.0	-22.0	-2.0	-2.0	-22.0	-2.0	-2.0	-70.0
V.2	Loan Interest			-0.7	-1.3	-1.2	-1.1	-1.1	-1.0	-0.9	-0.9	-0.8	-0.7
V.3	Depreciation			-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7
V.4	Amortisation			-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7
V.5	**Profit (V.1 - V.2 - V.3 - V.4)**			**-3.1**	**-5.7**	**-5.7**	**-25.6**	**-5.5**	**-5.4**	**-25.4**	**-5.3**	**-5.2**	**-73.2**
	Present Value Factor			0.9091	0.8264	0.7513	0.6830	0.6209	0.5645	0.5132	0.4665	0.4241	0.3855
	Present Value Profit			-2.8	-4.7	-4.2	-17.5	-3.4	-3.1	-13.0	-2.5	-2.2	-28.2
	Project Present Value			**-106.6**									
	Present Value Revenues			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Project Present Value Revenues			**0.0**									
	Present Value Costs			2.8	4.7	4.2	17.5	3.4	3.1	13.0	2.5	2.2	28.2
	Project Present Value Costs			**106.6**									
	Present Value Energy	kWh		1.9	1.7	1.6	1.4	1.3	1.2	1.1	1.0	0.9	0.8
	Sent-Out Energy Present Value			**19.1**									
	Dynamic Unit Cost			**5.592**									
	Benefit-Cost-Ratio			**0.00**									

Position		Period	11	12	13	14	15	16	17	18	19	20
		Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
II.2.a	Fixed O&M costs (without staff)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.2.b	O&M Costs (According to Maintenance Plan)		2.0	2.0	22.0	2.0	2.0	22.0	2.0	2.0	22.0	2.0
II.4	Insurance		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.5	Others		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.1	Taxes and levies not dependent on profits		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.2	Other expenditures		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.3	Total operating costs (II.1 - III.2)		2.0	2.0	22.0	2.0	2.0	22.0	2.0	2.0	22.0	2.0
IV.1a	Annual Generated Energy		2	2	2	2	2	2	2	2	2	2
	Selling price / unit		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Revenues from energy sales		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.4	Total revenues and incomes (IV.1 + IV.2 + IV.3)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
V.1	Returns (IV.4 - III.3)		-2.0	-2.0	-22.0	-2.0	-2.0	-22.0	-2.0	-2.0	-22.0	-2.0
V.2	Loan Interest		-0.7	-0.6	-0.5	-0.4	-0.4	-0.3	-0.2	-0.2	-0.1	0.0
V.3	Depreciation		-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7
V.4	Amortisation		-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7
V.5	**Profit (V.1 - V.2 - V.3 - V.4)**		**-5.1**	**-5.0**	**-25.0**	**-4.9**	**-4.8**	**-24.8**	**-4.7**	**-4.6**	**-24.6**	**-4.5**
	Present Value Factor		0.3505	0.3186	0.2897	0.2633	0.2394	0.2176	0.1978	0.1799	0.1635	0.1486
	Present Value Profit		-1.8	-1.6	-7.2	-1.3	-1.2	-5.4	-0.9	-0.8	-4.0	-0.7
	Present Value Revenues		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Present Value Costs		1.8	1.6	7.2	1.3	1.2	5.4	0.9	0.8	4.0	0.7
	Present Value Energy		0.7	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.3	0.3

Figure 9-13: Profit & Loss Statement of the model for the financial analysis; Scenario B (70% loan, 30% grant), Solar Lantern

The Gambia

Project: ***Small SHS (Household)***

ASSUMPTIONS

Currency Unit:	US$
Country:	THE GAMBIA
Date:	08.07.2006
Others:	

TIMETABLE

Start of building work:	Year	2006	
Business Start Up:	Year	2006	

INFLATION

General	0.0%	p.a.
Energy	0.0%	p.a.

DEPRECIATION / DIVIDENDS

Depreciable Life (straight-line depreciation)	20	Years
Amortisation Period	20	Years
Profit Taxes (%)		p.a.
Dividends (%)		

TARIFF

Tariff		$/ kWh

TECHNICAL DATA

Capacity	40	W
Availability (%)	9.4%	
Annual Generated Energy	33	kWh

CAPITAL COSTS

Proportion of loan capital:	70.00%	
Proportion of grant capital:	30.00%	
Period of redemption:	0	Years
Loan Interest Rate	4.00%	p.a.
Discount Rate	10.00%	

O & M

Fixed O & M Costs	0	$/a
Variable O & M Costs	0	$/kWh

INSURANCE

Insurance	0.00	T $/a
Others	0.00	T $/a

TAXES & LEVIES

Taxes and levies not dependent on profits	0.00	T $/a
Other expenditures	0.00	T $/a

Figure 9-14: Assumption Sheet of the model for the financial analysis; Scenario B (70% loan, 30% grant), SHS Small Households

The Gambia **Small SHS (Household)**

Table 2: Profit & Loss

In: US$

Position		Period / Year	1 2006	2 2007	3 2008	4 2009	5 2010	6 2011	7 2012	8 2013	9 2014	10 2015	11 2016	12 2017	13 2018	14 2019	15 2020	16 2021	17 2022	18 2023	19 2024	20 2025
0.1	Discount rate	10.00%																				
0.12	Interest Rate Loan	4.00%																				
0.2	Inflation rate (general)	0.00%																				
0.3	Inflation rate (energy)	0.00%																				
0.4	Lifetime of the project	20																				
0.5	Amortisation period	20																				
II.2.a	Fixed O&M costs (without staff)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.2.b	O&M Costs (According to Maintenance Plan)		0.0	15.0	15.0	205.0	15.0	15.0	205.0	15.0	15.0	205.0	15.0	15.0	205.0	15.0	15.0	205.0	15.0	15.0	205.0	15.0
II.4	Insurance		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.5	Others		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.1	Taxes and levies not dependent on profits		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.2	Other expenditures		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.3	Total operating costs (II.1 - III.2)		0.0	15.0	15.0	205.0	15.0	15.0	205.0	15.0	15.0	205.0	15.0	15.0	205.0	15.0	15.0	205.0	15.0	15.0	205.0	15.0
IV.1a	Annual Generated Energy	kWh	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
	Selling price / unit	$/ kWh	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Revenues from energy sales		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.4	Total revenues and incomes (IV.1 + IV.2 + IV.3)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
V.1	Returns (IV.4 - III.3)		0.0	-15.0	-15.0	-205.0	-15.0	-15.0	-205.0	-15.0	-15.0	-205.0	-15.0	-15.0	-205.0	-15.0	-15.0	-205.0	-15.0	-15.0	-205.0	-15.0
V.2	Loan Interest		-6.1	-11.8	-11.1	-10.5	-9.9	-9.2	-8.6	-8.0	-7.3	-6.7	-6.1	-5.4	-4.8	-4.1	-3.5	-2.9	-2.2	-1.6	-1.0	-0.3
V.3	Depreciation		-6.8	-6.8	-6.8	-6.8	-6.8	-6.8	-6.8	-6.8	-6.8	-6.8	-6.8	-6.8	-6.8	-6.8	-6.8	-6.8	-6.8	-6.8	-6.8	-6.8
V.4	Amortisation		-15.9	-15.9	-15.9	-15.9	-15.9	-15.9	-15.9	-15.9	-15.9	-15.9	-15.9	-15.9	-15.9	-15.9	-15.9	-15.9	-15.9	-15.9	-15.9	-15.9
V.5	**Profit (V.1 - V.2 - V.3 - V.4)**		**-28.8**	**-49.5**	**-48.9**	**-238.3**	**-47.6**	**-47.0**	**-236.3**	**-45.7**	**-45.1**	**-234.4**	**-43.8**	**-43.2**	**-232.5**	**-41.9**	**-41.3**	**-230.6**	**-40.0**	**-39.3**	**-228.7**	**-38.1**
	Present Value Factor		0.9091	0.8264	0.7513	0.6830	0.6209	0.5645	0.5132	0.4665	0.4241	0.3855	0.3505	0.3186	0.2897	0.2633	0.2394	0.2176	0.1978	0.1799	0.1635	0.1486
	Present Value Profit		-26.2	-40.9	-36.7	-162.7	-29.6	-26.5	-121.3	-21.3	-19.1	-90.4	-15.4	-13.8	-67.4	-11.0	-9.9	-50.2	-7.9	-7.1	-37.4	-5.7
	Project Present Value		**-800.4**																			
	Present Value Revenues		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Project Present Value Revenues		**0.0**																			
	Present Value Costs		26.2	40.9	36.7	162.7	29.6	26.5	121.3	21.3	19.1	90.4	15.4	13.8	67.4	11.0	9.9	50.2	7.9	7.1	37.4	5.7
	Project Present Value Costs		**800.4**																			
	Present Value Energy	kWh	30.0	27.3	24.8	22.5	20.5	18.6	16.9	15.4	14.0	12.7	11.6	10.5	9.6	8.7	7.9	7.2	6.5	5.9	5.4	4.9
	Sent-Out Energy Present Value		**299.5**																			
	Dynamic Unit Cost		**2.672**																			
	Benefit-Cost-Ratio		**0.00**																			

Figure 9-15: Profit & Loss Statement of the model for the financial analysis; Scenario B (70% loan, 30% grant), SHS Small Households

The Gambia

Project: ***Medium SHS (Household)***

ASSUMPTIONS

Currency Unit:	US$
Country:	THE GAMBIA
Date:	08.07.2006
Others:	

TIMETABLE

Start of building work:	Year	2006	
Business Start Up:	Year	2006	

INFLATION

General	0.0%	p.a.
Energy	0.0%	p.a.

DEPRECIATION / DIVIDENDS

Depreciable Life (straight-line depreciation)	20	Years
Amortisation Period	20	Years
Profit Taxes (%)		p.a.
Dividends (%)		

TARIFF

Tariff		$/ kWh

TECHNICAL DATA

Capacity	70	W
Availability (%)	9.6%	
Annual Generated Energy	59	kWh

CAPITAL COSTS

Proportion of loan capital:	70.00%	
Proportion of grant capital:	30.00%	
Period of redemption:	0	Years
Loan Interest Rate	4.00%	p.a.
Discount Rate	10.00%	

O & M

Fixed O & M Costs	0	$/a
Variable O & M Costs	0	$/kWh

INSURANCE

Insurance	0.00	T $/a
Others	0.00	T $/a

TAXES & LEVIES

Taxes and levies not dependent on profits	0.00	T $/a
Other expenditures	0.00	T $/a

Figure 9-16: Assumption Sheet of the model for the financial analysis; Scenario B (70% loan, 30% grant), SHS Medium Households

The Gambia **Medium SHS (Household)**

Table 2: **Profit & Loss**

In: US$

Position			Period Year	1 2006	2 2007	3 2008	4 2009	5 2010	6 2011	7 2012	8 2013	9 2014	10 2015	11 2016	12 2017	13 2018	14 2019	15 2020	16 2021	17 2022	18 2023	19 2024	20 2025
0.1	Discount rate		10.00%																				
0.12	Interest Rate Loan		4.00%																				
0.2	Inflation rate (general)		0.00%																				
0.3	Inflation rate (energy)		0.00%																				
0.4	Lifetime of the project		20																				
0.5	Amortisation period		20																				
II.2.a	Fixed O&M costs (without staff)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.2.b	O&M Costs (According to Maintenance Plan)			0.0	30.0	30.0	350.0	30.0	30.0	350.0	30.0	30.0	350.0	30.0	30.0	350.0	30.0	30.0	350.0	30.0	30.0	350.0	30.0
II.4	Insurance			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.5	Others			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.1	Taxes and levies not dependent on profits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.2	Other expenditures			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.3	Total operating costs (II.1 - III.2)			0.0	30.0	30.0	350.0	30.0	30.0	350.0	30.0	30.0	350.0	30.0	30.0	350.0	30.0	30.0	350.0	30.0	30.0	350.0	30.0
IV.1a	Annual Generated Energy	kWh		59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59
	Selling price / unit	$/ kWh		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Revenues from energy sales			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.1b	Energy substituted	(unit)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Purchasing price / unit	(price / unit)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Savings on energy costs			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.3	Subsidies			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.4	Total revenues and incomes (IV.1 + IV.2 + IV.3)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
V.1	Returns (IV.4 - III.3)			0.0	-30.0	-30.0	-350.0	-30.0	-30.0	-350.0	-30.0	-30.0	-350.0	-30.0	-30.0	-350.0	-30.0	-30.0	-350.0	-30.0	-30.0	-350.0	-30.0
V.2	Loan Interest			-9.3	-18.1	-17.2	-16.2	-15.2	-14.2	-13.2	-12.3	-11.3	-10.3	-9.3	-8.3	-7.4	-6.4	-5.4	-4.4	-3.4	-2.5	-1.5	-0.5
V.3	Depreciation			-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5	-10.5
V.4	Amortisation			-24.5	-24.5	-24.5	-24.5	-24.5	-24.5	-24.5	-24.5	-24.5	-24.5	-24.5	-24.5	-24.5	-24.5	-24.5	-24.5	-24.5	-24.5	-24.5	-24.5
V.5	**Profit (V.1 - V.2 - V.3 - V.4)**			**-44.3**	**-83.1**	**-82.2**	**-401.2**	**-80.2**	**-79.2**	**-398.2**	**-77.3**	**-76.3**	**-395.3**	**-74.3**	**-73.3**	**-392.4**	**-71.4**	**-70.4**	**-389.4**	**-68.4**	**-67.5**	**-386.5**	**-65.5**
	Present Value Factor			0.9091	0.8264	0.7513	0.6830	0.6209	0.5645	0.5132	0.4665	0.4241	0.3855	0.3505	0.3186	0.2897	0.2633	0.2394	0.2176	0.1978	0.1799	0.1635	0.1486
	Present Value Profit			-40.3	-68.7	-61.7	-274.0	-49.8	-44.7	-204.4	-36.0	-32.3	-152.4	-26.0	-23.4	-113.6	-18.8	-16.9	-84.7	-13.5	-12.1	-63.2	-9.7
	Project Present Value			**-1,346.4**																			
	Present Value Revenues			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Project Present Value Revenues			**0.0**																			
	Present Value Costs			40.3	68.7	61.7	274.0	49.8	44.7	204.4	36.0	32.3	152.4	26.0	23.4	113.6	18.8	16.9	84.7	13.5	12.1	63.2	9.7
	Project Present Value Costs			**1,346.4**																			
	Present Value Energy	kWh		53.6	48.8	44.3	40.3	36.6	33.3	30.3	27.5	25.0	22.7	20.7	18.8	17.1	15.5	14.1	12.8	11.7	10.6	9.6	8.8
	Sent-Out Energy Present Value			**535.5**																			
	Dynamic Unit Cost			**2.514**																			
	Benefit-Cost-Ratio			**0.00**																			

Figure 9-17: Profit & Loss Statement of the model for the financial analysis; Scenario B (70% loan, 30% grant), SHS Medium Households

The Gambia

Project: ***Large SHS (Household)***

ASSUMPTIONS

Currency Unit:	US$
Country:	THE GAMBIA
Date:	08.07.2006
Others:	

TIMETABLE

Start of building work:	Year	2006	
Business Start Up:	Year	2006	

INFLATION

General	0.0%	p.a.
Energy	0.0%	p.a.

DEPRECIATION / DIVIDENDS

Depreciable Life (straight-line depreciation)	20	Years
Amortisation Period	20	Years
Profit Taxes (%)		p.a.
Dividends (%)		

TARIFF

Tariff		$/ kWh

TECHNICAL DATA

Capacity	150	W
Availability (%)	9.2%	
Annual Generated Energy	121	kWh

CAPITAL COSTS

Proportion of loan capital:	70.00%	
Proportion of grant capital:	30.00%	
Period of redemption:	0	Years
Loan Interest Rate	4.00%	p.a.
Discount Rate	10.00%	

O & M

Fixed O & M Costs	0	$/a
Variable O & M Costs	0	$/kWh

INSURANCE

Insurance	0.00	T $/a
Others	0.00	T $/a

TAXES & LEVIES

Taxes and levies not dependent on profits	0.00	T $/a
Other expenditures	0.00	T $/a

Figure 9-18: Assumption Sheet of the model for the financial analysis; Scenario B (70% loan, 30% grant), SHS Large Households

The Gambia **Large SHS (Household)**

Table 2: **Profit & Loss**

In: US$

Position		Period / Year	1 2006	2 2007	3 2008	4 2009	5 2010	6 2011	7 2012	8 2013	9 2014	10 2015	11 2016	12 2017	13 2018	14 2019	15 2020	16 2021	17 2022	18 2023	19 2024	20 2025
0.1	Discount rate	10.00%																				
0.12	Interest Rate Loan	4.00%																				
0.2	Inflation rate (general)	0.00%																				
0.3	Inflation rate (energy)	0.00%																				
0.4	Lifetime of the project	20																				
0.5	Amortisation period	20																				
II.2.a	Fixed O&M costs (without staff)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.2.b	O&M Costs (According to Maintenance Plan)		0.0	50.0	50.0	970.0	50.0	50.0	970.0	50.0	50.0	970.0	50.0	50.0	970.0	50.0	50.0	970.0	50.0	50.0	970.0	50.0
II.4	Insurance		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.5	Others		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.1	Taxes and levies not dependent on profits		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.2	Other expenditures		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.3	Total operating costs (II.1 - III.2)		0.0	50.0	50.0	970.0	50.0	50.0	970.0	50.0	50.0	970.0	50.0	50.0	970.0	50.0	50.0	970.0	50.0	50.0	970.0	50.0
IV.1a	Annual Generated Energy	kWh	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121	121
	Selling price / unit	$/ kWh	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Revenues from energy sales		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.4	Total revenues and incomes (IV.1 + IV.2 + IV.3)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
V.1	Returns (IV.4 - III.3)		0.0	-50.0	-50.0	-970.0	-50.0	-50.0	-970.0	-50.0	-50.0	-970.0	-50.0	-50.0	-970.0	-50.0	-50.0	-970.0	-50.0	-50.0	-970.0	-50.0
V.2	Loan Interest		-18.6	-36.3	-34.3	-32.3	-30.4	-28.4	-26.5	-24.5	-22.5	-20.6	-18.6	-16.7	-14.7	-12.7	-10.8	-8.8	-6.9	-4.9	-2.9	-1.0
V.3	Depreciation		-21.0	-21.0	-21.0	-21.0	-21.0	-21.0	-21.0	-21.0	-21.0	-21.0	-21.0	-21.0	-21.0	-21.0	-21.0	-21.0	-21.0	-21.0	-21.0	-21.0
V.4	Amortisation		-49.0	-49.0	-49.0	-49.0	-49.0	-49.0	-49.0	-49.0	-49.0	-49.0	-49.0	-49.0	-49.0	-49.0	-49.0	-49.0	-49.0	-49.0	-49.0	-49.0
V.5	**Profit (V.1 - V.2 - V.3 - V.4)**		**-88.6**	**-156.3**	**-154.3**	**-1,072.3**	**-150.4**	**-148.4**	**-1,066.5**	**-144.5**	**-142.5**	**-1,060.6**	**-138.6**	**-136.7**	**-1,054.7**	**-132.7**	**-130.8**	**-1,048.8**	**-126.9**	**-124.9**	**-1,042.9**	**-121.0**
	Present Value Factor		0.9091	0.8264	0.7513	0.6830	0.6209	0.5645	0.5132	0.4665	0.4241	0.3855	0.3505	0.3186	0.2897	0.2633	0.2394	0.2176	0.1978	0.1799	0.1635	0.1486
	Present Value Profit		-80.6	-129.1	-115.9	-732.4	-93.4	-83.8	-547.3	-67.4	-60.5	-408.9	-48.6	-43.5	-305.5	-35.0	-31.3	-228.3	-25.1	-22.5	-170.5	-18.0
	Present Value Operating Cost		0.0	41.3	37.6	662.5	31.0	28.2	497.8	23.3	21.2	374.0	17.5	15.9	281.0	13.2	12.0	211.1	9.9	9.0	158.6	7.4
	Project Present Value OperatingCost		**2,452.5**																			
	Present Value Revenue		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Project Present Value Revenue		**0.0**																			
	Present Value O&M (Maintenance Plan)		0.0	41.3	37.6	662.5	31.0	28.2	497.8	23.3	21.2	374.0	17.5	15.9	281.0	13.2	12.0	211.1	9.9	9.0	158.6	7.4
	Project Present Value O&M (Maintenance Plan)		**2,452.5**																			
	Project Present Value		**-3,247.5**																			
	Present Value Revenues		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Project Present Value Revenues		**0.0**																			
	Present Value Costs		80.6	129.1	115.9	732.4	93.4	83.8	547.3	67.4	60.5	408.9	48.6	43.5	305.5	35.0	31.3	228.3	25.1	22.5	170.5	18.0
	Project Present Value Costs		**3,247.5**																			
	Present Value Energy	kWh	110.0	100.0	90.9	82.6	75.1	68.3	62.1	56.4	51.3	46.7	42.4	38.6	35.0	31.9	29.0	26.3	23.9	21.8	19.8	18.0
	Sent-Out Energy Present Value		**1,098.3**																			
	Dynamic Unit Cost		**2.957**																			
	Benefit-Cost-Ratio		**0.00**																			

Figure 9-19: Profit & Loss Statement of the model for the financial analysis; Scenario B (70% loan, 30% grant), SHS Large Households

The Gambia

Project: ***Health Center***

ASSUMPTIONS

Currency Unit:	US$
Country:	THE GAMBIA
Date:	08.07.2006
Others:	

TIMETABLE

Start of building work:	Year	2008	
Business Start Up:	Year	2008	

INFLATION

General	0.0%	p.a.
Energy	0.0%	p.a.

DEPRECIATION / DIVIDENDS

Depreciable Life (straight-line depreciation)	20	Years
Amortisation Period	20	Years
Profit Taxes (%)		p.a.
Dividends (%)		

TARIFF

Tariff		$/ kWh

TECHNICAL DATA

Capacity	1000	W
Annual Generated Energy	810	kWh

CAPITAL COSTS

Proportion of loan	70.00%	
Proportion of grant/equity	30.00%	
Loan Interest Rate	4.00%	p.a.
Discount Rate	10.00%	

O & M

Fixed O & M Costs		$/a
Variable O & M Costs		$/kWh

INSURANCE

Insurance		$/a
Others		$/a

TAXES & LEVIES

Taxes and levies not dependent on profits		$/a
Other expenditures		$/a

Figure 9-20: Assumption Sheet of the model for the financial analysis; Scenario B (70% loan, 30% grant), Health Center

The Gambia **Health Center**

Table 2: **Profit & Loss**

In: US$

Position	Period / Year	Unit		1 / 2008	2 / 2009	3 / 2010	4 / 2011	5 / 2012	6 / 2013	7 / 2014	8 / 2015	9 / 2016	10 / 2017	11 / 2018	12 / 2019	13 / 2020	14 / 2021	15 / 2022	16 / 2023	17 / 2024	18 / 2025	19 / 2026	20 / 2027
0.1	Discount rate		10.00%																				
0.12	Interest Rate Loan		4.00%																				
0.2	Inflation rate (general)		0.00%																				
0.3	Inflation rate (energy)		0.00%																				
0.4	Lifetime of the project		20																				
0.5	Amortisation period		20																				
II.2.a	Fixed O&M costs (without staff)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.2.b	O&M Costs (According to Maintenance Plan)			0.0	250.0	300.0	250.0	2,150.0	300.0	250.0	250.0	300.0	2,150.0	250.0	300.0	250.0	250.0	2,200.0	250.0	250.0	300.0	250.0	2,150.0
II.4	Insurance			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.5	Others			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.1	Taxes and levies not dependent on profits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.2	Other expenditures			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.3	Total operating costs (II.1 - III.2)			0.0	250.0	300.0	250.0	2,150.0	300.0	250.0	250.0	300.0	2,150.0	250.0	300.0	250.0	250.0	2,200.0	250.0	250.0	300.0	250.0	2,150.0
IV.1a	Annual Generated Energy	kWh		810	810	810	810	810	810	810	810	810	810	810	810	810	810	810	810	810	810	810	810
	Selling price / unit	$/ kWh		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Revenues from energy sales			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.4	Total revenues and incomes (IV.1 + IV.2 + IV.3)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
V.1	Returns (IV.4 - III.3)			0.0	-250.0	-300.0	-250.0	-2,150.0	-300.0	-250.0	-250.0	-300.0	-2,150.0	-250.0	-300.0	-250.0	-250.0	-2,200.0	-250.0	-250.0	-300.0	-250.0	-2,150.0
V.2	Loan Interest			-93.1	-181.3	-171.5	-161.7	-151.9	-142.1	-132.3	-122.5	-112.7	-102.9	-93.1	-83.3	-73.5	-63.7	-53.9	-44.1	-34.3	-24.5	-14.7	-4.9
V.3	Depreciation			-105.0	-105.0	-105.0	-105.0	-105.0	-105.0	-105.0	-105.0	-105.0	-105.0	-105.0	-105.0	-105.0	-105.0	-105.0	-105.0	-105.0	-105.0	-105.0	-105.0
V.4	Amortisation			-245.0	-245.0	-245.0	-245.0	-245.0	-245.0	-245.0	-245.0	-245.0	-245.0	-245.0	-245.0	-245.0	-245.0	-245.0	-245.0	-245.0	-245.0	-245.0	-245.0
V.5	**Profit (V.1 - V.2 - V.3 - V.4)**			**-443.1**	**-781.3**	**-821.5**	**-761.7**	**-2,651.9**	**-792.1**	**-732.3**	**-722.5**	**-762.7**	**-2,602.9**	**-693.1**	**-733.3**	**-673.5**	**-663.7**	**-2,603.9**	**-644.1**	**-634.3**	**-674.5**	**-614.7**	**-2,504.9**
	Present Value Factor			0.9091	0.8264	0.7513	0.6830	0.6209	0.5645	0.5132	0.4665	0.4241	0.3855	0.3505	0.3186	0.2897	0.2633	0.2394	0.2176	0.1978	0.1799	0.1635	0.1486
	Present Value Profit			-402.8	-645.7	-617.2	-520.3	-1,646.6	-447.1	-375.8	-337.1	-323.5	-1,003.5	-242.9	-233.7	-195.1	-174.8	-623.4	-140.2	-125.5	-121.3	-100.5	-372.3
	Present Value Operating Cost			0.0	206.6	225.4	170.8	1,335.0	169.3	128.3	116.6	127.2	828.9	87.6	95.6	72.4	65.8	526.7	54.4	49.5	54.0	40.9	319.6
	Project Present Value OperatingCost			**4,674.6**																			
	Present Value Revenue			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Project Present Value Revenue			**0.0**																			
	Present Value O&M (Maintenance Plan)			0.0	206.6	225.4	170.8	1,335.0	169.3	128.3	116.6	127.2	828.9	87.6	95.6	72.4	65.8	526.7	54.4	49.5	54.0	40.9	319.6
	Project Present Value O&M (Maintenance Plan)			**4,674.6**																			
	Project Present Value			**-8,649.2**																			
	Present Value Revenues			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Project Present Value Revenues			**0.0**																			
	Present Value Costs			402.8	645.7	617.2	520.3	1,646.6	447.1	375.8	337.1	323.5	1,003.5	242.9	233.7	195.1	174.8	623.4	140.2	125.5	121.3	100.5	372.3
	Project Present Value Costs			**8,649.2**																			
	Present Value Energy	kWh		736.4	669.4	608.6	553.2	502.9	457.2	415.7	377.9	343.5	312.3	283.9	258.1	234.6	213.3	193.9	176.3	160.3	145.7	132.4	120.4
	Sent-Out Energy Present Value			**7,352.4**																			
	Dynamic Unit Cost			**1.176**																			
	Benefit-Cost-Ratio			**0.00**																			

Figure 9-21: Profit & Loss Statement of the model for the financial analysis; Scenario B (70% loan, 30% grant), Health Center

The Gambia

Project: UBS

ASSUMPTIONS

Currency Unit:	US$
Country:	THE GAMBIA
Date:	08.07.2006
Others:	

TIMETABLE

Start of building work:	Year	2006	
Business Start Up:	Year	2006	

INFLATION

General	0.0%	p.a.
Energy	0.0%	p.a.

DEPRECIATION / DIVIDENDS

Depreciable Life (straight-line depreciation)	20	Years
Amortisation Period	20	Years
Profit Taxes (%)		p.a.
Dividends (%)		

TARIFF

Tariff		$/ kWh

TECHNICAL DATA

Capacity	600	W
Availability (%)	9.2%	
Annual Generated Energy	485	kWh

CAPITAL COSTS

Proportion of loan capital:	70.00%	
Proportion of grant capital:	30.00%	
Period of redemption:	0	Years
Loan Interest Rate	4.00%	p.a.
Discount Rate	10.00%	

O & M

Fixed O & M Costs	0	$/a
Variable O & M Costs	0	$/kWh

INSURANCE

Insurance	0.00	T $/a
Others	0.00	T $/a

TAXES & LEVIES

Taxes and levies not dependent on profits	0.00	T $/a
Other expenditures	0.00	T $/a

Figure 9-22: Assumption Sheet of the model for the financial analysis; Scenario B (70% loan, 30% grant), UBS

The Gambia **UBS**

Table 2: **Profit & Loss**

In: US$

Position			Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
			Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
0.1	Discount rate		10.00%																				
0.12	Interest Rate Loan		4.00%																				
0.2	Inflation rate (general)		0.00%																				
0.3	Inflation rate (energy)		0.00%																				
0.4	Lifetime of the project		20																				
0.5	Amortisation period		20																				
II.2.a	Fixed O&M costs (without staff)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.2.b	O&M Costs (According to Maintenance Plan)			0.0	150.0	150.0	1,600.0	150.0	150.0	1,600.0	150.0	150.0	1,600.0	150.0	150.0	1,600.0	150.0	150.0	1,600.0	150.0	150.0	1,600.0	150.0
II.4	Insurance			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.5	Others			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.1	Taxes and levies not dependent on profits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.2	Other expenditures			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.3	Total operating costs (II.1 - III.2)			0.0	150.0	150.0	1,600.0	150.0	150.0	1,600.0	150.0	150.0	1,600.0	150.0	150.0	1,600.0	150.0	150.0	1,600.0	150.0	150.0	1,600.0	150.0
IV.1a	Annual Generated Energy	kWh		485	485	485	485	485	485	485	485	485	485	485	485	485	485	485	485	485	485	485	485
	Selling price / unit	$/ kWh		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Revenues from energy sales			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.4	Total revenues and incomes (IV.1 + IV.2 + IV.3)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
V.1	Returns (IV.4 - III.3)			0.0	-150.0	-150.0	-1,600.0	-150.0	-150.0	-1,600.0	-150.0	-150.0	-1,600.0	-150.0	-150.0	-1,600.0	-150.0	-150.0	-1,600.0	-150.0	-150.0	-1,600.0	-150.0
V.2	Loan Interest			-58.7	-114.2	-108.0	-101.9	-95.7	-89.5	-83.3	-77.2	-71.0	-64.8	-58.7	-52.5	-46.3	-40.1	-34.0	-27.8	-21.6	-15.4	-9.3	-3.1
V.3	Depreciation			-66.2	-66.2	-66.2	-66.2	-66.2	-66.2	-66.2	-66.2	-66.2	-66.2	-66.2	-66.2	-66.2	-66.2	-66.2	-66.2	-66.2	-66.2	-66.2	-66.2
V.4	Amortisation			-154.4	-154.4	-154.4	-154.4	-154.4	-154.4	-154.4	-154.4	-154.4	-154.4	-154.4	-154.4	-154.4	-154.4	-154.4	-154.4	-154.4	-154.4	-154.4	-154.4
V.5	**Profit (V.1 - V.2 - V.3 - V.4)**			**-279.2**	**-484.7**	**-478.5**	**-1,922.4**	**-466.2**	**-460.0**	**-1,903.8**	**-447.7**	**-441.5**	**-1,885.3**	**-429.2**	**-423.0**	**-1,866.8**	**-410.6**	**-404.5**	**-1,848.3**	**-392.1**	**-385.9**	**-1,829.8**	**-373.6**
	Present Value Factor			0.9091	0.8264	0.7513	0.6830	0.6209	0.5645	0.5132	0.4665	0.4241	0.3855	0.3505	0.3186	0.2897	0.2633	0.2394	0.2176	0.1978	0.1799	0.1635	0.1486
	Present Value Profit			-253.8	-400.6	-359.5	-1,313.0	-289.5	-259.7	-977.0	-208.8	-187.2	-726.9	-150.4	-134.8	-540.7	-108.1	-96.8	-402.2	-77.6	-69.4	-299.2	-55.5
	Project Present Value			**-6,910.8**																			
	Present Value Revenues			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Project Present Value Revenues			**0.0**																			
	Present Value Costs			253.8	400.6	359.5	1,313.0	289.5	259.7	977.0	208.8	187.2	726.9	150.4	134.8	540.7	108.1	96.8	402.2	77.6	69.4	299.2	55.5
	Project Present Value Costs			**6,910.8**																			
	Present Value Energy	kWh		440.9	400.8	364.4	331.3	301.1	273.8	248.9	226.3	205.7	187.0	170.0	154.5	140.5	127.7	116.1	105.6	96.0	87.2	79.3	72.1
	Sent-Out Energy Present Value			**4,402.4**																			
	Dynamic Unit Cost			**1.570**																			
	Benefit-Cost-Ratio			**0.00**																			

Figure 9-23: Profit & Loss Statement of the model for the financial analysis; Scenario B (70% loan, 30% grant), UBS

The Gambia

Project: ***SSS***

ASSUMPTIONS

Currency Unit:	US$
Country:	THE GAMBIA
Date:	08.07.2006
Others:	

TIMETABLE

Start of building work:	Year	2006	
Business Start Up:	Year	2006	

INFLATION

General	0.0%	p.a.
Energy	0.0%	p.a.

DEPRECIATION / DIVIDENDS

Depreciable Life (straight-line depreciation)	20	Years
Amortisation Period	20	Years
Profit Taxes (%)		p.a.
Dividends (%)		

TARIFF

Tariff		$/ kWh

TECHNICAL DATA

Capacity	4800	W
Availability (%)	9.5%	
Annual Generated Energy	4000	kWh

CAPITAL COSTS

Proportion of loan capital:	70.00%	
Proportion of grant capital:	30.00%	
Period of redemption:	0	Years
Loan Interest Rate	4.00%	p.a.
Discount Rate	10.00%	

O & M

Fixed O & M Costs	0	$/a
Variable O & M Costs	0	$/kWh

INSURANCE

Insurance	0.00	T $/a
Others	0.00	T $/a

TAXES & LEVIES

Taxes and levies not dependent on profits	0.00	T $/a
Other expenditures	0.00	T $/a

Figure 9-24: Assumption Sheet of the model for the financial analysis; Scenario B (70% loan, 30% grant), SSS

The Gambia **sss**

Table 2: **Profit & Loss**

In: US$

Position			Period / Year	1 / 2006	2 / 2007	3 / 2008	4 / 2009	5 / 2010	6 / 2011	7 / 2012	8 / 2013	9 / 2014	10 / 2015	11 / 2016	12 / 2017	13 / 2018	14 / 2019	15 / 2020	16 / 2021	17 / 2022	18 / 2023	19 / 2024	20 / 2025
0.1	Discount rate		10.00%																				
0.12	Interest Rate Loan		4.00%																				
0.2	Inflation rate (general)		0.00%																				
0.3	Inflation rate (energy)		0.00%																				
0.4	Lifetime of the project		20																				
0.5	Amortisation period		20																				
II.2.a	Fixed O&M costs (without staff)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.2.b	O&M Costs (According to Maintenance Plan)			0.0	1,250.0	1,250.0	11,100.0	1,250.0	1,250.0	11,100.0	1,250.0	1,250.0	11,100.0	1,250.0	1,250.0	11,100.0	1,250.0	1,250.0	11,100.0	1,250.0	1,250.0	11,100.0	1,250.0
II.4	Insurance			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.5	Others			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.1	Taxes and levies not dependent on profits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.2	Other expenditures			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.3	Total operating costs (II.1 - III.2)			0.0	1,250.0	1,250.0	11,100.0	1,250.0	1,250.0	11,100.0	1,250.0	1,250.0	11,100.0	1,250.0	1,250.0	11,100.0	1,250.0	1,250.0	11,100.0	1,250.0	1,250.0	11,100.0	1,250.0
IV.1a	Annual Generated Energy	kWh		4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
	Selling price / unit	$/ kWh		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Revenues from energy sales			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.4	Total revenues and incomes (IV.1 + IV.2 + IV.3)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
V.1	Returns (IV.4 - III.3)			0.0	-1,250.0	-1,250.0	-11,100.0	-1,250.0	-1,250.0	-11,100.0	-1,250.0	-1,250.0	-11,100.0	-1,250.0	-1,250.0	-11,100.0	-1,250.0	-1,250.0	-11,100.0	-1,250.0	-1,250.0	-11,100.0	-1,250.0
V.2	Loan Interest			-513.0	-999.0	-945.0	-891.0	-837.0	-783.0	-729.0	-675.0	-621.0	-567.0	-513.0	-459.0	-405.0	-351.0	-297.0	-243.0	-189.0	-135.0	-81.0	-27.0
V.3	Depreciation			-578.6	-578.6	-578.6	-578.6	-578.6	-578.6	-578.6	-578.6	-578.6	-578.6	-578.6	-578.6	-578.6	-578.6	-578.6	-578.6	-578.6	-578.6	-578.6	-578.6
V.4	Amortisation			-1,350.0	-1,350.0	-1,350.0	-1,350.0	-1,350.0	-1,350.0	-1,350.0	-1,350.0	-1,350.0	-1,350.0	-1,350.0	-1,350.0	-1,350.0	-1,350.0	-1,350.0	-1,350.0	-1,350.0	-1,350.0	-1,350.0	-1,350.0
V.5	**Profit (V.1 - V.2 - V.3 - V.4)**			**-2,441.5**	**-4,177.5**	**-4,123.5**	**-13,919.5**	**-4,015.5**	**-3,961.5**	**-13,757.5**	**-3,853.5**	**-3,799.5**	**-13,595.5**	**-3,691.5**	**-3,637.5**	**-13,433.5**	**-3,529.5**	**-3,475.5**	**-13,271.5**	**-3,367.5**	**-3,313.5**	**-13,109.5**	**-3,205.5**
	Present Value Factor			0.9091	0.8264	0.7513	0.6830	0.6209	0.5645	0.5132	0.4665	0.4241	0.3855	0.3505	0.3186	0.2897	0.2633	0.2394	0.2176	0.1978	0.1799	0.1635	0.1486
	Present Value Profit			-2,219.5	-3,452.4	-3,098.0	-9,507.2	-2,493.3	-2,236.1	-7,059.8	-1,797.7	-1,611.3	-5,241.6	-1,293.8	-1,159.0	-3,891.2	-929.4	-832.0	-2,888.3	-666.2	-596.0	-2,143.5	-476.5
	Project Present Value			**-53,593.0**																			
	Present Value Revenues			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Project Present Value Revenues			**0.0**																			
	Present Value Costs			2,219.5	3,452.4	3,098.0	9,507.2	2,493.3	2,236.1	7,059.8	1,797.7	1,611.3	5,241.6	1,293.8	1,159.0	3,891.2	929.4	832.0	2,888.3	666.2	596.0	2,143.5	476.5
	Project Present Value Costs			**53,593.0**																			
	Present Value Energy	kWh		3,636.4	3,305.8	3,005.3	2,732.1	2,483.7	2,257.9	2,052.6	1,866.0	1,696.4	1,542.2	1,402.0	1,274.5	1,158.7	1,053.3	957.6	870.5	791.4	719.4	654.0	594.6
	Sent-Out Energy Present Value			**36,308.2**																			
	Dynamic Unit Cost			**1.476**																			
	Benefit-Cost-Ratio			**0.00**																			

Figure 9-25: Profit & Loss Statement of the model for the financial analysis; Scenario B (70% loan, 30% grant), SSS

Feasibility Study SHS

Project: ***ICT***

ASSUMPTIONS

Currency Unit:	US$
Country:	THE GAMBIA
Date:	08.07.2006
Others:	

TIMETABLE

Start of building work:	Year	2006	
Business Start Up:	Year	2006	

INFLATION

General	0.0%	p.a.
Energy	0.0%	p.a.

DEPRECIATION / DIVIDENDS

Depreciable Life (straight-line depreciation)	20	Years
Amortisation Period	20	Years
Profit Taxes (%)		p.a.
Dividends (%)		

TARIFF

Tariff		$/ kWh

TECHNICAL DATA

Capacity	2800	W
Availability (%)	10.0%	
Annual Generated Energy	2450	kWh

CAPITAL COSTS

Proportion of loan capital:	70.00%	
Proportion of grant capital:	30.00%	
Period of redemption:	0	Years
Loan Interest Rate	4.00%	p.a.
Discount Rate	10.00%	

O & M

Fixed O & M Costs	0	$/a
Variable O & M Costs	0	$/kWh

INSURANCE

Insurance	0.00	T $/a
Others	0.00	T $/a

TAXES & LEVIES

Taxes and levies not dependent on profits	0.00	T $/a
Other expenditures	0.00	T $/a

Figure 9-26: Assumption Sheet of the model for the financial analysis; Scenario B (70% loan, 30% grant), ICT

Feasibility Study SHS **ICT**

Table 2: **Profit & Loss**

In: US$

Position			Period / Year	1 2006	2 2007	3 2008	4 2009	5 2010	6 2011	7 2012	8 2013	9 2014	10 2015	11 2016	12 2017	13 2018	14 2019	15 2020	16 2021	17 2022	18 2023	19 2024	20 2025
0.1	Discount rate		10.00%																				
0.12	Interest Rate Loan		4.00%																				
0.2	Inflation rate (general)		0.00%																				
0.3	Inflation rate (energy)		0.00%																				
0.4	Lifetime of the project		20																				
0.5	Amortisation period		20																				
II.2.a	Fixed O&M costs (without staff)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.2.b	O&M Costs (According to Maintenance Plan)			0.0	725.0	725.0	7,325.0	725.0	725.0	7,325.0	725.0	725.0	7,325.0	725.0	725.0	7,325.0	725.0	725.0	7,325.0	725.0	725.0	7,325.0	725.0
II.4	Insurance			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.5	Others			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.1	Taxes and levies not dependent on profits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.2	Other expenditures			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.3	Total operating costs (II.1 - III.2)			0.0	725.0	725.0	7,325.0	725.0	725.0	7,325.0	725.0	725.0	7,325.0	725.0	725.0	7,325.0	725.0	725.0	7,325.0	725.0	725.0	7,325.0	725.0
IV.1a	Annual Generated Energy	kWh		2,450	2,450	2,450	2,450	2,450	2,450	2,450	2,450	2,450	2,450	2,450	2,450	2,450	2,450	2,450	2,450	2,450	2,450	2,450	2,450
	Selling price / unit	$/ kWh		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Revenues from energy sales			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.4	Total revenues and incomes (IV.1 + IV.2 + IV.3)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
V.1	Returns (IV.4 - III.3)			0.0	-725.0	-725.0	-7,325.0	-725.0	-725.0	-7,325.0	-725.0	-725.0	-7,325.0	-725.0	-725.0	-7,325.0	-725.0	-725.0	-7,325.0	-725.0	-725.0	-7,325.0	-725.0
V.2	Loan Interest			-279.3	-543.9	-514.5	-485.1	-455.7	-426.3	-396.9	-367.5	-338.1	-308.7	-279.3	-249.9	-220.5	-191.1	-161.7	-132.3	-102.9	-73.5	-44.1	-14.7
V.3	Depreciation			-315.0	-315.0	-315.0	-315.0	-315.0	-315.0	-315.0	-315.0	-315.0	-315.0	-315.0	-315.0	-315.0	-315.0	-315.0	-315.0	-315.0	-315.0	-315.0	-315.0
V.4	Amortisation			-735.0	-735.0	-735.0	-735.0	-735.0	-735.0	-735.0	-735.0	-735.0	-735.0	-735.0	-735.0	-735.0	-735.0	-735.0	-735.0	-735.0	-735.0	-735.0	-735.0
V.5	**Profit (V.1 - V.2 - V.3 - V.4)**			**-1,329.3**	**-2,318.9**	**-2,289.5**	**-8,860.1**	**-2,230.7**	**-2,201.3**	**-8,771.9**	**-2,142.5**	**-2,113.1**	**-8,683.7**	**-2,054.3**	**-2,024.9**	**-8,595.5**	**-1,966.1**	**-1,936.7**	**-8,507.3**	**-1,877.9**	**-1,848.5**	**-8,419.1**	**-1,789.7**
	Present Value Factor			0.9091	0.8264	0.7513	0.6830	0.6209	0.5645	0.5132	0.4665	0.4241	0.3855	0.3505	0.3186	0.2897	0.2633	0.2394	0.2176	0.1978	0.1799	0.1635	0.1486
	Present Value Profit			-1,208.5	-1,916.4	-1,720.1	-6,051.6	-1,385.1	-1,242.6	-4,501.4	-999.5	-896.2	-3,347.9	-720.0	-645.2	-2,489.8	-517.7	-463.6	-1,851.4	-371.5	-332.5	-1,376.6	-266.0
	Project Present Value			**-32,303.7**																			
	Present Value Revenues			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Project Present Value Revenues			**0.0**																			
	Present Value Costs			1,208.5	1,916.4	1,720.1	6,051.6	1,385.1	1,242.6	4,501.4	999.5	896.2	3,347.9	720.0	645.2	2,489.8	517.7	463.6	1,851.4	371.5	332.5	1,376.6	266.0
	Project Present Value Costs			**32,303.7**																			
	Present Value Energy	kWh		2,227.3	2,024.8	1,840.7	1,673.4	1,521.3	1,383.0	1,257.2	1,142.9	1,039.0	944.6	858.7	780.6	709.7	645.2	586.5	533.2	484.7	440.7	400.6	364.2
	Sent-Out Energy Present Value			**22,238.7**																			
	Dynamic Unit Cost			**1.453**																			
	Benefit-Cost-Ratio			**0.00**																			

Figure 9-27: Profit & Loss Statement of the model for the financial analysis; Scenario B (70% loan, 30% grant), ICT

The Gambia

Project: ***SHS Programme***

ASSUMPTIONS

Currency Unit: US$
Country: THE GAMBIA
Date: 08.07.2006
Others:

TIMETABLE

Start of building work:	Year	2008	
Business Start Up:	Year	2008	

INFLATION

General	0.0%	p.a.
Energy	0.0%	p.a.

DEPRECIATION / DIVIDENDS

Depreciable Life (straight-line depreciation)	20	Years
Amortisation Period	20	Years
Profit Taxes (%)		p.a.
Dividends (%)		

TARIFF

Tariff	2.09	$/ kWh

TECHNICAL DATA

Capacity	531,528	W
Annual Generated Energy	441,894	kWh

CAPITAL COSTS

Proportion of loan	62.81%	
Proportion of grant/equity	37.19%	
Loan Interest Rate	4.00%	p.a.
Discount Rate	10.00%	

O & M

Fixed O & M Costs		$/a
Variable O & M Costs		$/kWh

INSURANCE

Insurance		$/a
Others		$/a

TAXES & LEVIES

Taxes and levies not dependent on profits		$/a
Other expenditures		$/a

Figure 9-28: Assumptions Sheet of the model for the financial analysis of the overall RESA Programme according to Table 6-1 (Scenario 1)

The Gambia **SHS Programme**

Table 2: **Profit & Loss**

In: US$

Position		Period / Year	1 / 2008	2 / 2009	3 / 2010	4 / 2011	5 / 2012	6 / 2013	7 / 2014	8 / 2015	9 / 2016	10 / 2017	11 / 2018	12 / 2019	13 / 2020	14 / 2021	15 / 2022	16 / 2023	17 / 2024	18 / 2025	19 / 2026	20 / 2027
0.1	Discount rate	10.00%																				
0.12	Interest Rate Loan	4.00%																				
0.2	Inflation rate (general)	0.00%																				
0.3	Inflation rate (energy)	0.00%																				
0.4	Lifetime of the project	20																				
0.5	Amortisation period	20																				
II.2 a	Fixed O&M costs (without staff)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.2 b	O&M Costs (According to Maintenance Plan)		0.0	194,687.0	196,187.0	2,485,817.0	251,687.0	196,187.0	2,485,817.0	194,687.0	196,187.0	2,743,985.0	194,687.0	196,187.0	2,485,817.0	194,687.0	253,187.0	2,485,817.0	194,687.0	196,187.0	2,485,817.0	251,687.0
II.4	Insurance		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.5	Others		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.1	Taxes and levies not dependent on profits		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.2	Other expenditures		2,000,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.3	Total costs (II.1 - III.2)		2,000,000.0	194,687.0	196,187.0	2,485,817.0	251,687.0	196,187.0	2,485,817.0	194,687.0	196,187.0	2,743,985.0	194,687.0	196,187.0	2,485,817.0	194,687.0	253,187.0	2,485,817.0	194,687.0	196,187.0	2,485,817.0	251,687.0
IV.1a	Annual Generated Energy	kWh	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894
	Selling price / unit	$/ kWh	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090
	Revenues from energy sales		923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5
IV.1b	Energy substituted	(unit)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Purchasing price / unit	(price / unit)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Savings on energy costs		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.1c	Energy related production																					
	e.g. drinking water (units)	(unit)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Price / unit	(price / unit)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Revenues from other production		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.2	Capacity charge (....... MW yearly average)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.3	Subsidies		2,000,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Upfront Discount (Investment Cost)		738,880.0																			
	Subsidies (Adjustment B/C Ratio 1.1)																					
	Subsidies O&M Institutions		0.0	31,950.0	33,450.0	254,250.0	88,950.0	33,450.0	254,250.0	31,950.0	33,450.0	311,250.0	31,950.0	33,450.0	254,250.0	31,950.0	90,450.0	254,250.0	31,950.0	33,450.0	254,250.0	88,950.0
IV.4	Total revenues and incomes (IV.1 + IV.2 + IV.3)		3,662,249.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5
V.1	Returns (IV.4 - III.3)		1,662,249.5	728,682.5	727,182.5	-1,562,447.5	671,682.5	727,182.5	-1,562,447.5	728,682.5	727,182.5	-1,820,615.5	728,682.5	727,182.5	-1,562,447.5	728,682.5	670,182.5	-1,562,447.5	728,682.5	727,182.5	-1,562,447.5	671,682.5
V.2	Loan Interest		-60,860.8	-118,518.5	-112,112.1	-105,705.7	-99,299.3	-92,892.9	-86,486.5	-80,080.0	-73,673.6	-67,267.2	-60,860.8	-54,454.4	-48,048.0	-41,641.6	-35,235.2	-28,828.8	-22,422.4	-16,016.0	-9,609.6	-3,203.2
V.3	Depreciation		-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9
V.4	Amortisation		-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1
V.5	**Profit (V.1 - V.2 - V.3 - V.4)**		**1,346,388.7**	**355,164.1**	**360,070.5**	**-1,923,153.1**	**317,383.3**	**379,289.7**	**-1,903,933.9**	**393,682.5**	**398,508.9**	**-2,142,882.7**	**412,821.7**	**417,728.1**	**-1,865,495.5**	**432,040.9**	**379,947.3**	**-1,846,276.3**	**451,260.1**	**456,166.5**	**-1,827,057.1**	**413,479.3**
	Present Value Factor		0.9091	0.8264	0.7513	0.6830	0.6209	0.5645	0.5132	0.4665	0.4241	0.3855	0.3505	0.3186	0.2897	0.2633	0.2394	0.2176	0.1978	0.1799	0.1635	0.1486
	Present Value Profit		1,223,989.7	293,524.0	270,526.3	-1,313,539.5	197,070.0	214,099.1	-977,019.1	183,618.5	169,006.7	-826,174.0	144,691.5	133,101.1	-540,367.6	113,769.9	90,956.4	-401,803.5	89,279.4	82,045.6	-298,738.4	61,461.1
	Project Present Value		**-1,090,503.0**																			
	Present Value Revenues		3,329,317.8	763,115.3	693,741.2	630,673.8	573,339.8	521,218.0	473,834.6	430,758.7	391,598.8	355,998.9	323,635.4	294,214.0	267,467.3	243,152.1	221,047.3	200,952.1	182,683.7	166,076.1	150,978.3	137,253.0
	Project Present Value Revenues		**10,871,353.2**																			
	Present Value Costs		2,105,328.0	469,591.3	423,214.9	1,944,213.3	376,269.8	307,118.9	1,450,863.7	247,140.2	222,592.1	1,182,173.0	178,943.9	161,112.9	807,834.9	129,382.2	130,091.0	602,755.6	93,404.3	84,030.6	449,716.7	75,791.9
	Project Present Value Costs		**11,441,559.3**																			
	Present Value Energy	kWh	401,721.9	366,201.7	332,001.6	301,819.6	274,381.5	249,437.7	226,761.5	206,146.9	187,406.2	170,369.3	154,881.2	140,801.1	128,001.0	116,364.5	105,785.9	96,169.0	87,426.4	79,478.5	72,253.2	65,684.7
	Sent-Out Energy Present Value		**4,011,090.4**																			
	Benefit-Cost-Ratio		**0.95**																			
	IRR		**18.95%**																			

Figure 9-29: Profit & Loss Statement of the model for the financial analysis of the overall RESA Programme according to Table 6-1 (Scenario 1)

The Gambia

Project: ***SHS Programme***

ASSUMPTIONS

Currency Unit:	US$
Country:	THE GAMBIA
Date:	08.07.2006
Others:	

TIMETABLE

Start of building work:	Year	2008	
Business Start Up:	Year	2008	

INFLATION

General	0.0%	p.a.
Energy	0.0%	p.a.

DEPRECIATION / DIVIDENDS

Depreciable Life (straight-line depreciation)	20	Years
Amortisation Period	20	Years
Profit Taxes (%)		p.a.
Dividends (%)		

TARIFF

Tariff	2.09	$/ kWh

TECHNICAL DATA

Capacity	531,528	W
Annual Generated Energy	441,894	kWh

CAPITAL COSTS

Proportion of loan	62.81%	
Proportion of grant/equity	37.19%	
Loan Interest Rate	4.00%	p.a.
Discount Rate	10.00%	

O & M

Fixed O & M Costs		$/a
Variable O & M Costs		$/kWh

INSURANCE

Insurance		$/a
Others		$/a

TAXES & LEVIES

Taxes and levies not dependent on profits		$/a
Other expenditures		$/a

Figure 9-30: Assumptions Sheet of the model for the financial analysis of the overall RESA Programme according to Table 6-1, considering 1,170,000 US$ subsidies in addition (Scenario 2)

The Gambia **SHS Programme**

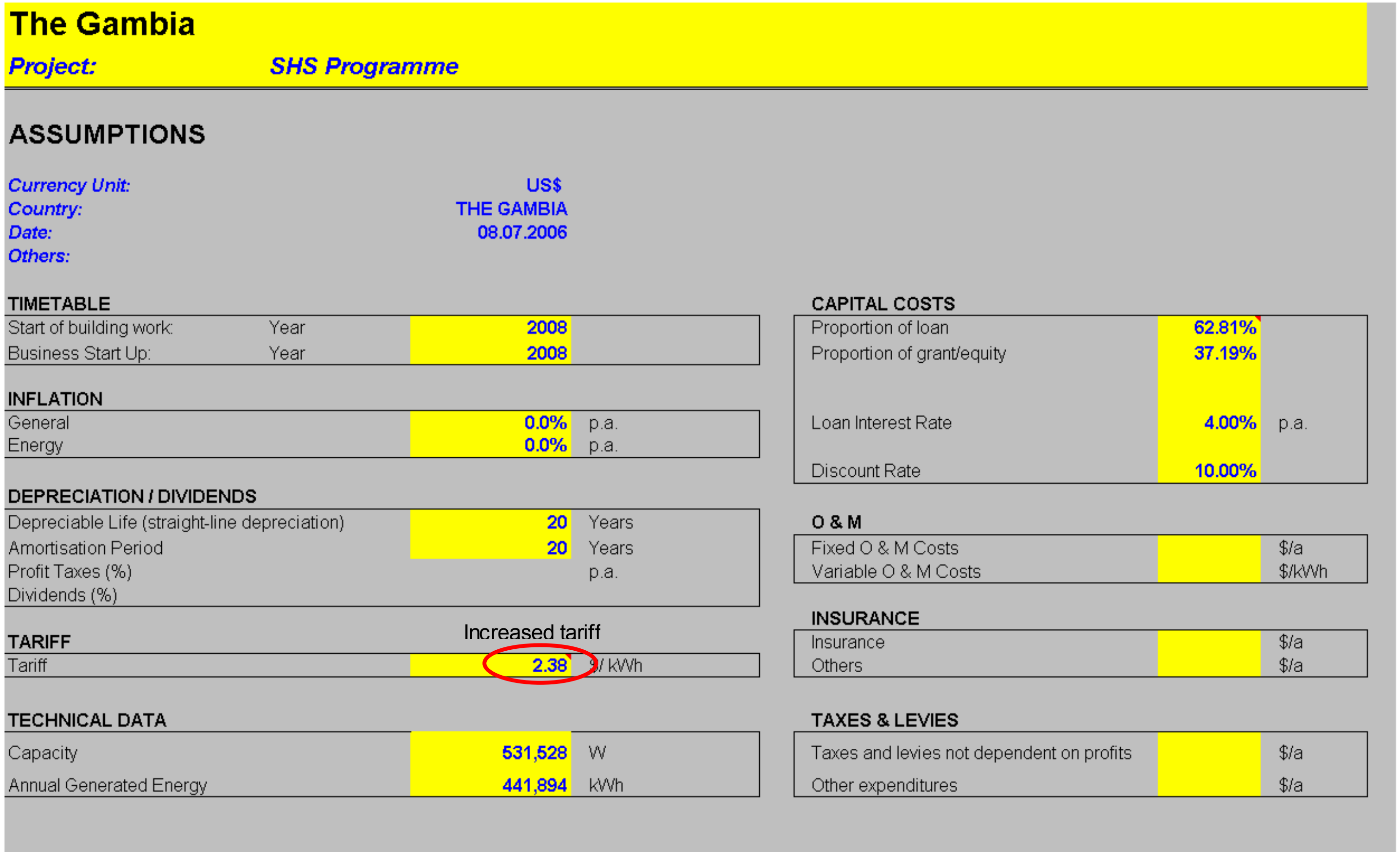
Table 2: **Profit & Loss**

In: US$

Position	Item	Unit / Value	1 2008	2 2009	3 2010	4 2011	5 2012	6 2013	7 2014	8 2015	9 2016	10 2017	11 2018	12 2019	13 2020	14 2021	15 2022	16 2023	17 2024	18 2025	19 2026	20 2027
0.1	Discount rate	10.00%																				
0.12	Interest Rate Loan	4.00%																				
0.2	Inflation rate (general)	0.00%																				
0.3	Inflation rate (energy)	0.00%																				
0.4	Lifetime of the project	20																				
0.5	Amortisation period	20																				
II.2.a	Fixed O&M costs (without staff)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.2.b	O&M Costs (According to Maintenance Plan)		0.0	194,687.0	196,187.0	2,485,817.0	251,687.0	196,187.0	2,485,817.0	194,687.0	196,187.0	2,743,985.0	194,687.0	196,187.0	2,485,817.0	194,687.0	253,187.0	2,485,817.0	194,687.0	196,187.0	2,485,817.0	251,687.0
II.4	Insurance		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.5	Others		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.1	Taxes and levies not dependent on profits		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.2	Other expenditures		2,000,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.3	Total costs (II.1 - III.2)		2,000,000.0	194,687.0	196,187.0	2,485,817.0	251,687.0	196,187.0	2,485,817.0	194,687.0	196,187.0	2,743,985.0	194,687.0	196,187.0	2,485,817.0	194,687.0	253,187.0	2,485,817.0	194,687.0	196,187.0	2,485,817.0	251,687.0
IV.1a	Annual Generated Energy	kWh	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894
	Selling price / unit	$/ kWh	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090
	Revenues from energy sales		923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5
IV.1b	Energy substituted	(unit)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Purchasing price / unit	(price / unit)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Savings on energy costs		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.1c	Energy related production																					
	e.g. drinking water (units)	(unit)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Price / unit	(price / unit)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Revenues from other production		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.2	Capacity charge (...... MW yearly average)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.3	Subsidies		2,000,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Upfront Discount (Investment Cost)		738,880.0																			
	Subsidies (Adjustment B/C Ratio 1.1)		1,200,000.0																			
	Subsidies O&M Institutions		0.0	31,950.0	33,450.0	254,250.0	88,950.0	33,450.0	254,250.0	31,950.0	33,450.0	311,250.0	31,950.0	33,450.0	254,250.0	31,950.0	90,450.0	254,250.0	31,950.0	33,450.0	254,250.0	88,950.0
IV.4	Total revenues and incomes (IV.1 + IV.2 + IV.3)		4,862,249.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5
V.1	Returns (IV.4 - III.3)		2,862,249.5	728,682.5	727,182.5	-1,562,447.5	671,682.5	727,182.5	-1,562,447.5	728,682.5	727,182.5	-1,820,615.5	728,682.5	727,182.5	-1,562,447.5	728,682.5	670,182.5	-1,562,447.5	728,682.5	727,182.5	-1,562,447.5	671,682.5
V.2	Loan Interest		-60,860.8	-118,518.5	-112,112.1	-105,705.7	-99,299.3	-92,892.9	-86,486.5	-80,080.0	-73,673.6	-67,267.2	-60,860.8	-54,454.4	-48,048.0	-41,641.6	-35,235.2	-28,828.8	-22,422.4	-16,016.0	-9,609.6	-3,203.2
V.3	Depreciation		-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9
V.4	Amortisation		-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1
V.5	Profit (V.1 - V.2 - V.3 - V.4)		2,546,388.7	355,164.1	360,070.5	-1,923,153.1	317,383.3	379,289.7	-1,903,933.9	393,602.5	398,508.9	-2,142,882.7	412,821.7	417,728.1	-1,865,495.5	432,040.9	379,947.3	-1,846,276.3	451,260.1	456,166.5	-1,827,057.1	413,479.3
	Present Value Factor		0.9091	0.8264	0.7513	0.6830	0.6209	0.5645	0.5132	0.4665	0.4241	0.3855	0.3505	0.3186	0.2897	0.2633	0.2394	0.2176	0.1978	0.1799	0.1635	0.1486
	Present Value Profit		2,314,898.8	293,524.0	270,526.3	-1,313,539.5	197,070.0	214,099.1	-977,019.1	183,618.5	169,006.7	-826,174.0	144,691.5	133,101.1	-540,367.6	113,769.9	90,956.4	-401,803.5	89,279.4	82,045.6	-298,738.4	61,461.1
	Project Present Value		**406.1**																			
	Present Value Revenues		4,420,226.9	763,115.3	693,741.2	630,673.8	573,339.8	521,218.0	473,834.6	430,758.7	391,598.8	355,998.9	323,635.4	294,214.0	267,467.3	243,152.1	221,047.3	200,952.1	182,683.7	166,076.1	150,978.3	137,253.0
	Project Present Value Revenues		**11,962,262.3**																			
	Present Value Costs		2,105,328.0	469,691.3	423,214.9	1,944,213.3	376,269.8	307,118.9	1,450,853.7	247,140.2	222,592.1	1,182,173.0	178,943.9	161,112.9	807,834.9	129,382.2	130,091.0	602,755.6	93,404.3	84,030.6	449,716.7	75,791.9
	Project Present Value Costs		**11,441,559.3**																			
	Present Value Energy	kWh	401,721.9	365,201.7	332,001.6	301,819.6	274,381.5	249,437.7	226,761.5	206,146.9	187,406.2	170,369.3	154,881.2	140,801.1	128,001.0	116,364.5	105,785.9	96,169.0	87,426.4	79,478.5	72,253.2	65,684.7
	Sent-Out Energy Present Value		**4,011,890.4**																			
	Benefit-Cost Ratio		**1.05**																			
	IRR		**10.00%**																			

Additional subsidies

Figure 9-31: Profit & Loss Statement of the model for the financial analysis of the overall RESA Programme according to Table 6-1, considering 1,200,000 US$ subsidies in addition (Scenario 2)



The Gambia

Project: ***SHS Programme***

ASSUMPTIONS

Currency Unit:	US$
Country:	THE GAMBIA
Date:	08.07.2006
Others:	

TIMETABLE

Start of building work:	Year	2008	
Business Start Up:	Year	2008	

INFLATION

General	0.0%	p.a.
Energy	0.0%	p.a.

DEPRECIATION / DIVIDENDS

Depreciable Life (straight-line depreciation)	20	Years
Amortisation Period	20	Years
Profit Taxes (%)		p.a.
Dividends (%)		

TARIFF

	Increased tariff	
Tariff	2.38	$/ kWh

TECHNICAL DATA

Capacity	531,528	W
Annual Generated Energy	441,894	kWh

CAPITAL COSTS

Proportion of loan	62.81%	
Proportion of grant/equity	37.19%	
Loan Interest Rate	4.00%	p.a.
Discount Rate	10.00%	

O & M

Fixed O & M Costs		$/a
Variable O & M Costs		$/kWh

INSURANCE

Insurance		$/a
Others		$/a

TAXES & LEVIES

Taxes and levies not dependent on profits		$/a
Other expenditures		$/a

Figure 9-32: Assumptions Sheet of the model for the financial analysis of the overall RESA Programme according to Table 6-1, considering a tariff increased by 13.9% (Scenario 3)

The Gambia **SHS Programme**

Table 2: Profit & Loss

In: US$

Position		Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
		Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
0.1	Discount rate	10.00%																				
0.12	Interest Rate Loan	4.00%																				
0.2	Inflation rate (general)	0.00%																				
0.3	Inflation rate (energy)	0.00%																				
0.4	Lifetime of the project	20																				
0.5	Amortisation period	20																				
II.2 a	Fixed O&M costs (without staff)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.2 b	O&M Costs (According to Maintenance Plan)		0.0	194,687.0	196,187.0	2,485,817.0	251,687.0	196,187.0	2,485,817.0	194,687.0	196,187.0	2,743,985.0	194,687.0	196,187.0	2,485,817.0	194,687.0	253,187.0	2,485,817.0	194,687.0	196,187.0	2,485,817.0	251,687.0
II.4	Insurance		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.5	Others		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.1	Taxes and levies not dependent on profits		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.2	Other expenditures		2,000,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.3	Total costs (II.1 - III.2)		2,000,000.0	194,687.0	196,187.0	2,485,817.0	251,687.0	196,187.0	2,485,817.0	194,687.0	196,187.0	2,743,985.0	194,687.0	196,187.0	2,485,817.0	194,687.0	253,187.0	2,485,817.0	194,687.0	196,187.0	2,485,817.0	251,687.0
IV.1a	Annual Generated Energy	kWh	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894
	Selling price / unit	$/ kWh	2.380	2.380	2.380	2.380	2.380	2.380	2.380	2.380	2.380	2.380	2.380	2.380	2.380	2.380	2.380	2.380	2.380	2.380	2.380	2.380
	Revenues from energy sales		1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9
IV.1b	Energy substituted	(unit)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Purchasing price / unit	(price / unit)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Savings on energy costs		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.1c	Energy related production																					
	e.g. drinking water (units)	(unit)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Price / unit	(price / unit)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Revenues from other production		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.2	Capacity charge (....... MW yearly average)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.3	Subsidies		2,000,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Upfront Discount (Investment Cost)		738,000.0																			
	Subsidies (Adjustment B/C Ratio 1.1)																					
	Subsidies O&M Institutions		0.0	31,950.0	33,450.0	254,250.0	88,950.0	33,450.0	254,250.0	31,950.0	33,450.0	311,250.0	31,950.0	33,450.0	254,250.0	31,950.0	90,450.0	254,250.0	31,950.0	33,450.0	254,250.0	88,950.0
IV.4	Total revenues and incomes (IV.1 + IV.2 + IV.3)		3,790,597.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9	1,051,717.9
V.1	Returns (IV.4 - III.3)		1,790,597.9	857,030.9	855,530.9	-1,434,099.1	800,030.9	855,530.9	-1,434,099.1	857,030.9	855,530.9	-1,692,267.1	857,030.9	855,530.9	-1,434,099.1	857,030.9	798,530.9	-1,434,099.1	857,030.9	855,530.9	-1,434,099.1	800,030.9
V.2	Loan Interest		-60,860.8	-118,518.5	-112,112.1	-105,705.7	-99,299.3	-92,892.9	-86,486.5	-80,080.0	-73,673.6	-67,267.2	-60,860.8	-54,454.4	-48,048.0	-41,641.6	-35,235.2	-28,828.8	-22,422.4	-16,016.0	-9,609.6	-3,203.2
V.3	Depreciation		-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9
V.4	Amortisation		-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1
V.5	**Profit (V.1 - V.2 - V.3 - V.4)**		**1,474,737.1**	**483,512.4**	**488,418.8**	**-1,794,804.8**	**445,731.7**	**507,638.1**	**-1,775,585.5**	**521,950.9**	**526,857.3**	**-2,014,534.3**	**541,170.1**	**546,076.5**	**-1,737,147.1**	**560,389.3**	**508,295.7**	**-1,717,927.9**	**579,608.5**	**584,514.9**	**-1,698,708.7**	**541,827.7**
	Present Value Factor		0.9091	0.8264	0.7513	0.6830	0.6209	0.5645	0.5132	0.4665	0.4241	0.3855	0.3505	0.3186	0.2897	0.2633	0.2394	0.2176	0.1978	0.1799	0.1635	0.1486
	Present Value Profit		1,340,670.1	399,597.1	366,956.3	-1,225,875.8	276,764.3	286,548.4	-911,156.1	243,493.9	223,438.9	-776,690.2	189,676.8	173,996.8	-503,189.6	147,568.0	121,681.9	-373,871.2	114,672.5	105,130.1	-277,752.4	80,539.2
	Project Present Value		**2,199.0**																			
	Present Value Revenues		3,445,998.1	869,188.4	790,171.2	718,337.5	653,034.1	593,667.3	539,697.6	490,634.2	446,031.1	405,482.8	368,620.7	335,109.7	304,645.2	276,950.2	251,772.9	228,884.5	208,076.8	189,160.7	171,964.3	156,331.2
	Project Present Value Revenues		**12,836,376.5**																			
	Present Value Costs		2,105,328.0	469,591.3	423,214.9	1,944,213.3	376,269.8	307,118.9	1,450,853.7	247,140.2	222,592.1	1,182,173.0	178,943.9	161,112.9	807,834.9	129,382.2	130,091.0	602,755.6	93,404.3	84,030.6	449,716.7	75,791.9
	Project Present Value Costs		**11,441,559.3**																			
	Present Value Energy	kWh	401,721.9	365,201.7	332,001.6	301,819.6	274,381.5	249,437.7	226,761.5	206,146.9	187,406.2	170,369.3	154,881.2	140,801.1	128,001.0	116,364.5	105,785.9	96,169.0	87,426.4	79,478.5	72,253.2	65,684.7
	Sent-Out Energy Present Value		**4,011,090.4**																			
	Benefit-Cost Ratio		**1.05**																			
	IRR		**9.98%**																			

Figure 9-33: Profit & Loss Statement of the model for the financial analysis of the overall RESA Programme according to Table 6-1, considering a tariff increased by 13.9% (Scenario 3)

The Gambia

Project: ***SHS Programme***

ASSUMPTIONS

Currency Unit:	US$
Country:	THE GAMBIA
Date:	08.07.2006
Others:	

TIMETABLE

Start of building work:	Year	2008	
Business Start Up:	Year	2008	

INFLATION

General	0.0%	p.a.
Energy	0.0%	p.a.

DEPRECIATION / DIVIDENDS

Depreciable Life (straight-line depreciation)	20	Years
Amortisation Period	20	Years
Profit Taxes (%)		p.a.
Dividends (%)		

TARIFF

Tariff	2.09	$/ kWh

TECHNICAL DATA

Capacity	531,528	W
Annual Generated Energy	441,894	kWh

CAPITAL COSTS

Proportion of loan	62.81%	
Proportion of grant/equity	37.19%	
Loan Interest Rate	4.00%	p.a.
Discount Rate	10.00%	

O & M

Fixed O & M Costs		$/a
Variable O & M Costs		$/kWh

INSURANCE

Insurance		$/a
Others		$/a

TAXES & LEVIES

Taxes and levies not dependent on profits		$/a
Other expenditures		$/a

Figure 9-34: Assumptions Sheet of the model for the economical analysis; Scenario 1

The Gambia **SHS Programme**

Table 2: **Profit & Loss**

In: US$

Position		Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
		Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
0.1	Discount rate	10.00%																				
0.12	Interest Rate Loan	4.00%																				
0.2	Inflation rate (general)	0.00%																				
0.3	Inflation rate (energy)	0.00%																				
0.4	Lifetime of the project	20																				
0.5	Amortisation period	20																				
II.2.a	Fixed O&M costs (without staff)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.2.b	O&M Costs (According to Maintenance Plan)		0.0	186,305.0	187,805.0	2,393,615.0	243,305.0	187,805.0	2,393,615.0	186,305.0	187,805.0	2,450,615.0	186,305.0	187,805.0	2,393,615.0	186,305.0	244,805.0	2,393,615.0	186,305.0	187,805.0	2,393,615.0	243,305.0
II.4	Insurance		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.5	Others		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.1	Taxes and levies not dependent on profits		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.2	Other expenditures		2,000,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.3	Total costs (II.1 - III.2)		2,000,000.0	186,305.0	187,805.0	2,393,615.0	243,305.0	187,805.0	2,393,615.0	186,305.0	187,805.0	2,450,615.0	186,305.0	187,805.0	2,393,615.0	186,305.0	244,805.0	2,393,615.0	186,305.0	187,805.0	2,393,615.0	243,305.0
IV.1a	Annual Generated Energy	kWh	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894
	Selling price / unit	$/ kWh	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090
	Revenues from energy sales		923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5
IV.1b	Diesel substituted	(Litres/a)	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2
	Purchasing price / unit	(US$/litre)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
	Savings on energy costs		106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6
IV.1c	Energy related production																					
	e.g. drinking water (units)	(unit)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Price / unit	(price / unit)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Revenues from other production		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.2a	Connection costs (saved)	US$	7,968,330.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.2b	Additional capacity (saved)	US$	631,527.6																			
IV.3	Subsidies		2,000,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Upfront Discount (Investment Cost)		738,880.0																			
	Subsidies (Adjustment B/C Ratio 1.1)																					
	Subsidies O&M Institutions		0.0	31,950.0	33,450.0	254,250.0	88,950.0	33,450.0	254,250.0	31,950.0	33,450.0	311,250.0	31,950.0	33,450.0	254,250.0	31,950.0	90,450.0	254,250.0	31,950.0	33,450.0	254,250.0	88,950.0
IV.4	Total revenues and incomes (IV.1 + IV.2 + IV.3)		11,344,792.1	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6
V.1	Returns (IV.4 - III.3)		9,344,792.1	-80,250.4	-81,750.4	-2,287,560.4	-137,250.4	-81,750.4	-2,287,560.4	-80,250.4	-81,750.4	-2,344,560.4	-80,250.4	-81,750.4	-2,287,560.4	-80,250.4	-138,750.4	-2,287,560.4	-80,250.4	-81,750.4	-2,287,560.4	-137,250.4
V.2	Loan Interest		-60,860.8	-118,518.5	-112,112.1	-105,705.7	-99,299.3	-92,892.9	-86,486.5	-80,080.0	-73,673.6	-67,267.2	-60,860.8	-54,454.4	-48,048.0	-41,641.6	-35,235.2	-28,828.8	-22,422.4	-16,016.0	-9,609.6	-3,203.2
V.3	Depreciation		-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9
V.4	Amortisation		-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1
V.5	**Profit (V.1 - V.2 - V.3 - V.4)**		**9,028,931.2**	**-453,768.9**	**-448,862.5**	**-2,648,266.1**	**-491,549.7**	**-429,643.3**	**-2,629,846.9**	**-415,330.5**	**-410,424.1**	**-2,666,827.7**	**-396,111.3**	**-391,204.8**	**-2,590,688.4**	**-376,892.0**	**-428,985.6**	**-2,571,389.2**	**-357,672.8**	**-352,766.4**	**-2,552,170.0**	**-395,453.6**
	Present Value Factor		0.9091	0.8264	0.7513	0.6830	0.6209	0.5645	0.5132	0.4665	0.4241	0.3855	0.3505	0.3186	0.2897	0.2633	0.2394	0.2176	0.1978	0.1799	0.1635	0.1486
	Present Value Profit		8,208,119.3	-375,015.6	-337,237.0	-1,808,801.4	-305,213.7	-242,522.4	-1,349,116.7	-193,754.7	-174,059.9	-1,028,177.5	-138,834.6	-124,649.9	-750,407.0	-99,247.5	-102,695.8	-559,609.2	-70,763.7	-63,448.1	-417,300.2	-58,781.7
	Project Present Value		**8,482.8**																			
	Present Value Revenues		10,313,447.3	87,648.4	79,680.4	72,436.7	65,851.6	59,865.0	54,422.8	49,475.2	44,977.5	40,888.6	37,171.5	33,792.3	30,720.2	27,927.5	25,388.6	23,080.6	20,982.3	19,074.8	17,340.8	15,764.3
	Project Present Value Revenues		**11,699,992.6**																			
	Present Value Costs		2,105,328.0	462,664.0	416,917.4	1,881,238.1	371,065.2	302,387.5	1,403,539.5	243,230.0	219,037.4	1,069,066.1	176,006.1	158,442.2	781,127.2	127,174.9	128,084.4	582,689.8	91,746.0	82,523.0	434,641.0	74,546.0
	Project Present Value Costs		**11,111,453.8**																			
	Present Value Energy	kWh	401,721.9	365,201.7	332,001.6	301,819.6	274,381.5	249,437.7	226,761.5	206,146.9	187,406.2	170,369.3	154,881.2	140,801.1	128,001.0	116,364.5	105,785.9	96,169.0	87,426.4	79,478.5	72,253.2	65,684.7
	Sent-Out Energy Present Value		**4,011,090.4**																			
	Benefit-Cost-Ratio		**1.05**																			
	IRR		**9.99%**																			

Figure 9-35: Profit & Loss Statement of the model for the economical analysis; Scenario 1

The Gambia

Project: ***SHS Programme***

ASSUMPTIONS

Currency Unit:	US$
Country:	THE GAMBIA
Date:	08.07.2006
Others:	

TIMETABLE

Start of building work:	Year	2008	
Business Start Up:	Year	2008	

INFLATION

General	0.0%	p.a.
Energy	0.0%	p.a.

DEPRECIATION / DIVIDENDS

Depreciable Life (straight-line depreciation)	20	Years
Amortisation Period	20	Years
Profit Taxes (%)		p.a.
Dividends (%)		

TARIFF

Tariff	2.09	$/ kWh

TECHNICAL DATA

Capacity	531,528	W
Annual Generated Energy	441,894	kWh

CAPITAL COSTS

Proportion of loan	62.81%	
Proportion of grant/equity	37.19%	
Loan Interest Rate	4.00%	p.a.
Discount Rate	10.00%	

O & M

Fixed O & M Costs		$/a
Variable O & M Costs		$/kWh

INSURANCE

Insurance		$/a
Others		$/a

TAXES & LEVIES

Taxes and levies not dependent on profits		$/a
Other expenditures		$/a

Figure 9-36: Assumptions Sheet of the model for the economical analysis; Scenario 2

The Gambia **SHS Programme**

Table 2: Profit & Loss

In: US$

Position		
0.1	Discount rate	10.00%
0.12	Interest Rate Loan	4.00%
0.2	Inflation rate (general)	0.00%
0.3	Inflation rate (energy)	0.00%
0.4	Lifetime of the project	20
0.5	Amortisation period	20

Position			Period 1 / Year 2008	2 / 2009	3 / 2010	4 / 2011	5 / 2012	6 / 2013	7 / 2014	8 / 2015	9 / 2016	10 / 2017
II.2.a	Fixed O&M costs (without staff)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.2.b	O&M Costs (According to Maintenance Plan)		0.0	186,305.0	187,805.0	2,393,615.0	243,305.0	187,805.0	2,393,615.0	186,305.0	187,805.0	2,450,615.0
II.4	Insurance		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.5	Others		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.1	Taxes and levies not dependent on profits		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.2	Other expenditures		2,000,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.3	Total costs (II.1 - III.2)		2,000,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.1a	Annual Generated Energy	kWh	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894
	Selling price / unit	$/ kWh	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090
	Revenues from energy sales		923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5
IV.1b	Diesel substituted	(Litres/a)	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2
	Purchasing price / unit	(US$/litre)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
	Savings on energy costs		106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6
IV.1c	Energy related production											
	e.g. drinking water (units)	(unit)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Price / unit	(price / unit)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Revenues from other production		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.2a	Connection costs (saved)	US$	844,190.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.2b	Additional capacity (saved)	US$	531,527.5									
IV.3	Subsidies		2,000,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Upfront Discount (Investment Cost)		738,000.0									
	Subsidies (Adjustment B/C Ratio 1.1)											
	Subsidies O&M Institutions		0.0	31,950.0	33,450.0	254,250.0	88,950.0	33,450.0	254,250.0	31,950.0	33,450.0	311,250.0
IV.4	Total revenues and incomes (IV.1 + IV.2 + IV.3)		4,220,652.1	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6
V.1	Returns (IV.4 - III.3)		2,220,652.1	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6
V.2	Loan Interest		-60,860.8	-118,518.5	-112,112.1	-105,705.7	-99,299.3	-92,892.9	-86,486.5	-80,080.0	-73,673.6	-67,267.2
V.3	Depreciation		-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9
V.4	Amortisation		-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1
V.5	**Profit (V.1 - V.2 - V.3 - V.4)**		**1,984,791.2**	**-267,463.9**	**-261,057.5**	**-254,651.1**	**-248,244.7**	**-241,838.3**	**-235,431.9**	**-229,025.5**	**-222,619.1**	**-216,212.7**
	Present Value Factor		0.9091	0.8264	0.7513	0.6830	0.6209	0.5645	0.5132	0.4665	0.4241	0.3855
	Present Value Profit		1,731,628.4	-221,044.5	-196,136.4	-173,930.1	-154,140.4	-136,511.4	-120,813.8	-106,842.1	-94,412.2	-83,369.3
	Project Present Value		**3,948.3**									
	Present Value Revenues		3,836,956.4	87,648.4	79,680.4	72,436.7	65,851.6	59,865.0	54,422.8	49,475.2	44,977.5	40,888.6
	Project Present Value Revenues		**5,273,501.7**									
	Present Value Costs		2,105,328.0	308,693.0	275,816.7	246,366.8	219,992.0	196,376.4	175,236.5	156,317.3	139,389.7	124,248.0
	Project Present Value Costs		**4,639,497.4**									
	Present Value Energy	kWh	401,721.9	365,201.7	332,001.6	301,819.6	274,381.5	249,437.7	226,761.5	206,146.9	187,406.2	170,369.3
	Sent-Out Energy Present Value		**4,011,090.4**									
	Benefit-Cost-Ratio		**1.13**									
	IRR		**9.96%**									

Position			Period 11 / Year 2018	12 / 2019	13 / 2020	14 / 2021	15 / 2022	16 / 2023	17 / 2024	18 / 2025	19 / 2026	20 / 2027
II.2.a	Fixed O&M costs (without staff)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.2.b	O&M Costs (According to Maintenance Plan)		186,305.0	187,805.0	2,393,615.0	186,305.0	244,805.0	2,393,615.0	186,305.0	187,805.0	2,393,615.0	243,305.0
II.4	Insurance		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.5	Others		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.1	Taxes and levies not dependent on profits		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.2	Other expenditures		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.3	Total costs (II.1 - III.2)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.1a	Annual Generated Energy	kWh	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894	441,894
	Selling price / unit	$/ kWh	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090	2.090
	Revenues from energy sales		923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5	923,369.5
IV.1b	Diesel substituted	(Litres/a)	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2	132,568.2
	Purchasing price / unit	(US$/litre)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
	Savings on energy costs		106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6
IV.1c	Energy related production											
	e.g. drinking water (units)	(unit)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Price / unit	(price / unit)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Revenues from other production		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.2a	Connection costs (saved)	US$	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.2b	Additional capacity (saved)	US$										
IV.3	Subsidies		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Upfront Discount (Investment Cost)											
	Subsidies (Adjustment B/C Ratio 1.1)											
	Subsidies O&M Institutions		31,950.0	33,450.0	254,250.0	31,950.0	90,450.0	254,250.0	31,950.0	33,450.0	254,250.0	88,950.0
IV.4	Total revenues and incomes (IV.1 + IV.2 + IV.3)		106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6
V.1	Returns (IV.4 - III.3)		106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6	106,054.6
V.2	Loan Interest		-60,860.8	-54,454.4	-48,048.0	-41,641.6	-35,235.2	-28,828.8	-22,422.4	-16,016.0	-9,609.6	-3,203.2
V.3	Depreciation		-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9	-94,839.9
V.4	Amortisation		-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1	-160,160.1
V.5	**Profit (V.1 - V.2 - V.3 - V.4)**		**-209,806.3**	**-203,399.8**	**-196,993.4**	**-190,587.0**	**-184,180.6**	**-177,774.2**	**-171,367.8**	**-164,961.4**	**-158,555.0**	**-152,148.6**
	Present Value Factor		0.3505	0.3186	0.2897	0.2633	0.2394	0.2176	0.1978	0.1799	0.1635	0.1486
	Present Value Profit		-73,535.8	-64,809.5	-57,062.0	-50,187.5	-44,091.4	-38,688.9	-33,904.2	-29,669.8	-25,925.0	-22,615.9
	Present Value Revenues		37,171.5	33,792.3	30,720.2	27,927.5	25,388.6	23,080.6	20,982.3	19,074.8	17,340.8	15,764.3
	Present Value Costs		110,707.3	98,601.7	87,782.2	78,115.0	69,480.0	61,769.4	54,886.5	48,744.6	43,265.8	38,380.3
	Present Value Energy	kWh	154,881.2	140,801.1	128,001.0	116,364.5	105,785.9	96,169.0	87,426.4	79,478.5	72,253.2	65,684.7

Figure 9-37: Profit & Loss Statement of the model for the economical analysis; Scenario 2

The Gambia

Project: ***SHS Programme***

ASSUMPTIONS

Currency Unit:	US$
Country:	THE GAMBIA
Date:	08.07.2006
Others:	

TIMETABLE

Start of building work:	Year	2008	
Business Start Up:	Year	2008	

INFLATION

General	0.0%	p.a.
Energy	0.0%	p.a.

DEPRECIATION / DIVIDENDS

Depreciable Life (straight-line depreciation)	20	Years
Amortisation Period	20	Years
Profit Taxes (%)		p.a.
Dividends (%)		

TARIFF

Tariff	2.09	$/ kWh

TECHNICAL DATA

Capacity	531,528	W
Annual Generated Energy	441,894	kWh

CAPITAL COSTS

Proportion of loan	100.00%	
Proportion of grant/equity	0.00%	
Loan Interest Rate	4.00%	p.a.
Discount Rate	10.00%	

O & M

Fixed O & M Costs		$/a
Variable O & M Costs		$/kWh

INSURANCE

Insurance		$/a
Others		$/a

TAXES & LEVIES

Taxes and levies not dependent on profits		$/a
Other expenditures		$/a

Figure 9-38: Assumptions Sheet of the model for the economical analysis; Scenario 3

The Gambia **SHS Programme**

Table 2: **Profit & Loss**

In: US$

Position			Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
			Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
0.1	Discount rate		10.00%																				
0.12	Interest Rate Loan		4.00%																				
0.2	Inflation rate (general)		0.00%																				
0.3	Inflation rate (energy)		0.00%																				
0.4	Lifetime of the project		20																				
0.5	Amortisation period		20																				
II.2.a	Fixed O&M costs (without staff)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.2.b	O&M Costs (According to Maintenance Plan)			0.0	186,305.0	187,805.0	2,393,615.0	243,305.0	187,805.0	2,393,615.0	186,305.0	187,805.0	2,450,615.0	186,305.0	187,805.0	2,393,615.0	186,305.0	244,805.0	2,393,615.0	186,305.0	187,805.0	2,393,615.0	243,305.0
II.4	Insurance			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
II.5	Others			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.1	Taxes and levies not dependent on profits			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.2	Other expenditures			2,000,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
III.3	Total costs (II.1 - III.2)			2,000,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.1a	Annual Generated Energy	kWh		433,093	433,093	433,093	433,093	433,093	433,093	433,093	433,093	433,093	433,093	433,093	433,093	433,093	433,093	433,093	433,093	433,093	433,093	433,093	433,093
	Selling price / unit	$/ kWh		2.018	2.018	2.018	2.018	2.018	2.018	2.018	2.018	2.018	2.018	2.018	2.018	2.018	2.018	2.018	2.018	2.018	2.018	2.018	2.018
	Revenues from energy sales			874,171.4	874,171.4	874,171.4	874,171.4	874,171.4	874,171.4	874,171.4	874,171.4	874,171.4	874,171.4	874,171.4	874,171.4	874,171.4	874,171.4	874,171.4	874,171.4	874,171.4	874,171.4	874,171.4	874,171.4
IV.1b	Diesel substituted	(Litres/a)		129,927.9	129,927.9	129,927.9	129,927.9	129,927.9	129,927.9	129,927.9	129,927.9	129,927.9	129,927.9	129,927.9	129,927.9	129,927.9	129,927.9	129,927.9	129,927.9	129,927.9	129,927.9	129,927.9	129,927.9
	Purchasing price / unit	(US$/litre)		0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
	Savings on energy costs			103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3
IV.1c	Energy related production																						
	e.g. drinking water (units)	(unit)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Price / unit	(price / unit)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Revenues from other production			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.2a	Connection costs (saved)	US$		3,219,860.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IV.2b	Additional capacity (saved)	US$		521,060.0																			
IV.3	Subsidies			2,000,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Upfront Discount (Investment Cost)			717,250.0																			
	Subsidies (Adjustment B/C Ratio 1.1)																						
	Subsidies O&M Institutions			0.0	31,950.0	33,450.0	254,250.0	88,950.0	33,450.0	254,250.0	31,950.0	33,450.0	311,250.0	31,950.0	33,450.0	254,250.0	31,950.0	90,450.0	254,250.0	31,950.0	33,450.0	254,250.0	88,950.0
IV.4	Total revenues and incomes (IV.1 + IV.2 + IV.3)			6,562,102.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3
V.1	Returns (IV.4 - III.3)			4,562,102.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3	103,942.3
V.2	Loan Interest			-149,150.0	-290,450.0	-274,750.0	-259,050.0	-243,350.0	-227,650.0	-211,950.0	-196,250.0	-180,550.0	-164,850.0	-149,150.0	-133,450.0	-117,750.0	-102,050.0	-86,350.0	-70,650.0	-54,950.0	-39,250.0	-23,550.0	-7,850.0
V.3	Depreciation			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
V.4	Amortisation			-392,500.0	-392,500.0	-392,500.0	-392,500.0	-392,500.0	-392,500.0	-392,500.0	-392,500.0	-392,500.0	-392,500.0	-392,500.0	-392,500.0	-392,500.0	-392,500.0	-392,500.0	-392,500.0	-392,500.0	-392,500.0	-392,500.0	-392,500.0
V.5	**Profit (V.1 - V.2 - V.3 - V.4)**			**4,020,452.3**	**579,007.7**	**563,307.7**	**547,607.7**	**531,907.7**	**516,207.7**	**500,507.7**	**484,807.7**	**469,107.7**	**453,407.7**	**437,707.7**	**422,007.7**	**406,307.7**	**390,607.7**	**374,907.7**	**359,207.7**	**343,507.7**	**327,807.7**	**312,107.7**	**296,407.7**
	Present Value Factor			0.9091	0.8264	0.7513	0.6830	0.6209	0.5645	0.5132	0.4665	0.4241	0.3855	0.3505	0.3186	0.2897	0.2633	0.2394	0.2176	0.1978	0.1799	0.1635	0.1486
	Present Value Profit			3,654,956.7	-478,518.7	-423,221.4	-374,023.4	-330,272.8	-291,385.8	-256,839.6	-226,166.4	-198,947.4	-174,808.3	-153,413.9	-134,464.7	-117,692.9	-102,859.2	-89,749.9	-78,174.1	-67,961.2	-58,959.1	-51,032.1	-44,059.1
	Project Present Value			**2,406.8**																			
	Present Value Revenues			5,965,547.6	85,902.7	78,093.4	70,994.0	64,540.0	58,672.7	53,338.8	48,489.9	44,081.7	40,074.3	36,431.1	33,119.2	30,108.4	27,371.3	24,883.0	22,620.9	20,564.4	18,694.9	16,995.4	15,450.4
	Project Present Value Revenues			**7,307,118.0**																			
	Present Value Costs			2,310,590.9	564,421.5	501,314.8	445,017.4	394,812.8	350,058.5	310,178.4	274,656.2	243,029.1	214,882.6	189,845.0	167,583.9	147,801.2	130,230.5	114,632.9	100,794.9	88,525.6	77,654.0	68,027.5	59,509.5
	Project Present Value Costs			**6,753,567.3**																			
	Present Value Energy	kWh		393,720.9	357,928.1	325,389.2	295,808.3	268,916.7	244,469.7	222,245.2	202,041.1	183,673.7	166,976.1	151,796.5	137,996.8	125,451.6	114,046.9	103,679.0	94,253.7	85,685.1	77,895.6	70,814.2	64,376.5
	Sent-Out Energy Present Value			**3,931,202.5**																			
	Benefit-Cost Ratio			**1.08**																			
	IRR			**9.99%**																			

Figure 9-39: Profit & Loss Statement of the model for the economical analysis; Scenario 3