

Business plan

Proposal to construct biogas installations in rural villages in South Africa to alleviate poverty and improve environmental health

Innovative Development Solutions



Giyani, South Africa

Wageningen, The Netherlands

October, 2007

Contents

- PREFACE 3**
- EXECUTIVE SUMMARY 4**
- 1 INTRODUCTION..... 5**
- 2 BACKGROUND..... 6**
 - 2.1 RURAL AND LOCAL POVERTY ALLEVIATION BY SUSTAINABLE DEVELOPMENT 6
 - 2.2 MEASURES TAKEN BY THE GOVERNMENT 6
 - 2.3 THE FOUNDATION ‘MPFUNeko’ 6
- 3 PLANNED ACTIVITIES 8**
 - 3.1 ORIGIN AND CONTEXT 8
 - 3.2 PROBLEM ANALYSIS 8
 - 3.3 PROJECT MOTIVATION 9
 - 3.4 INTENDED OBJECTIVES AND RESULTS 9
- 4 TIMEFRAME..... 12**
- 5 ACTIVITIES 14**
- 6 INCOME AND EXPENDITURE 16**
- 7 MANAGEMENT AND ORGANISATION..... 20**
- 8 RISKS AND ASSUMPTIONS 20**
- ANNEX A: BUSINESS PLAN MPFUNeko COMMUNITY SUPPORT FOUT! BLADWIJZER NIET GEDEFINIEERD.**
- ANNEX B: PEOPLE INVOLVED IN MPFUNeko..... FOUT! BLADWIJZER NIET GEDEFINIEERD.**
- ANNEX C: SUPPORT LETTER CHIEF GAWULA FOUT! BLADWIJZER NIET GEDEFINIEERD.**
- ANNEX D: SUPPORT LETTERS JABENZI AND AGAMA..... FOUT! BLADWIJZER NIET GEDEFINIEERD.**
- ANNEX E: SUPPORT LETTER KRUGER NATIONAL PARK FOUT! BLADWIJZER NIET GEDEFINIEERD.**
- ANNEX F: BUDGET FOR THE WORK PACKAGES FOUT! BLADWIJZER NIET GEDEFINIEERD.**
- ANNEX G: COSTS AND BENEFITS IN THE OPERATIONAL PHASE FOUT! BLADWIJZER NIET GEDEFINIEERD.**
- BIBLIOGRAPHY FOUT! BLADWIJZER NIET GEDEFINIEERD.**

Preface

This plan aims at alleviating poverty and improving environmental health in South Africa by constructing biogas installations in rural areas. The plan is written by the board of Stichting Innovative Development Solutions (IDS) in close co-operation with Mpfuneko Community Support. The aim of IDS is to support local organisations in offering sustainable solutions for environmental and poverty related problems by providing sustainable financial solutions and participation from local communities. Mpfuneko Community Support is a South African not for profit organisation that aims at stimulating rural development. This plan is based on information provided by AGAMA Energy, a South African supplier of biogas installations. Jabenzi, a South African company that is specialised in environmental and poverty alleviating projects, has expressed its support for this initiative.

We hope that this business plan will attract and convince South African and international funding agencies to provide financial support and make it possible to realise the plans in a joint effort between IDS and Mpfuneko Community Support.

Board of IDS

Charles Gerhardt (chairman)

Rijkelt Beumer (secretary)

Martijn Koster (treasurer)

Davey Groothof

Ekko van Ierland

Wageningen, October 2007

Executive summary

This business plan is written by Stichting Innovative Development Solutions (IDS), in close co-operation with Mpfuneko Community Support, a South African not for profit organisation.

The plan aims at contributing to sustainable development in poor rural areas by means of constructing biogas installations in South Africa in very close co-operation with the local population.

In this plan it is envisaged that in the short-run one biogas installation will be built. The aim is to assess the technical and economic feasibility of this project. The biogas digesters will be fed with cow dung, provided by the cattle of the local population. IDS contributes knowledge and assistance with fundraising and Mpfuneko Community Support leads the project and supervises construction of biogas installations and production of biogas. It is envisaged to provide biogas at a larger scale in the region in a later stage and eventually to extend the activities to other countries in Southern Africa.

It is planned to have built a fully operational biogas installation in September 2008 and to extend the project with support of local people to several more villages during 2009. The pace of these developments is partly set by the resources provided to the project.

A detailed budget for all the phases of this project is included in this proposal.

Financial support to the phases of this project can be provided in different forms and amounts. Support can be given through Stichting IDS in the Netherlands or through the South African not for profit organisation Mpfuneko Community Support.

1 Introduction

Innovative Development Solutions (IDS) is a Dutch foundation that has committed itself to social-economic development in rural Africa. Through co-operation with local organisations we provide the local population the opportunity to improve their economic independency and to protect their livelihoods.

In South Africa IDS, together with its local partner organisation 'Mpfuneko Community Support', has initiated the 'Greater Giyani Biogas Project'. This project aims at producing biogas, which will be provided to households as a sustainable energy source. This biogas should be used to cook on. It is also envisaged to generate electricity by means of a generator in villages that are not connected to the electricity grid. Furthermore, IDS would like to contribute to the development of a bottling technique for biogas, enabling future sales of biogas to third parties. Profits that will be realised through selling bottled biogas will be re-invested in initiatives on education, health care, and livelihood improvement in general in the Greater Giyani Municipality in South Africa.

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2 Background

2.1 Rural and local poverty alleviation by sustainable development

South Africa is a so-called '*middle-income country*'. There are many poor and disadvantaged people as a result of a highly skewed income distribution. The detrimental effects of the Apartheid-regime are, fifteen years after abolishment of Apartheid, still visible. Only a small portion of the black population has significantly benefited from the political changes. The vicinity of affluent people and well developed markets is a considerable advantage for development processes in less developed areas. It gives poor people the opportunity to sell their products for a good price and necessary materials and machines can be produced or purchased in South Africa. This makes that the chances for successful poverty alleviation are more favourable in South Africa compared to other countries. This gives IDS the opportunity to test and develop its methods before applying them in other countries in Southern Africa.

The Greater Giyani Municipality in the Limpopo Province (South Africa) is an under-developed area. It was part of a so-called '*homeland*' during the Apartheid-era. It was imposed by the government to function as a more or less autonomous area for black people. The result is that there has been no investment in economic development in the past.

2.2 Measures taken by the government

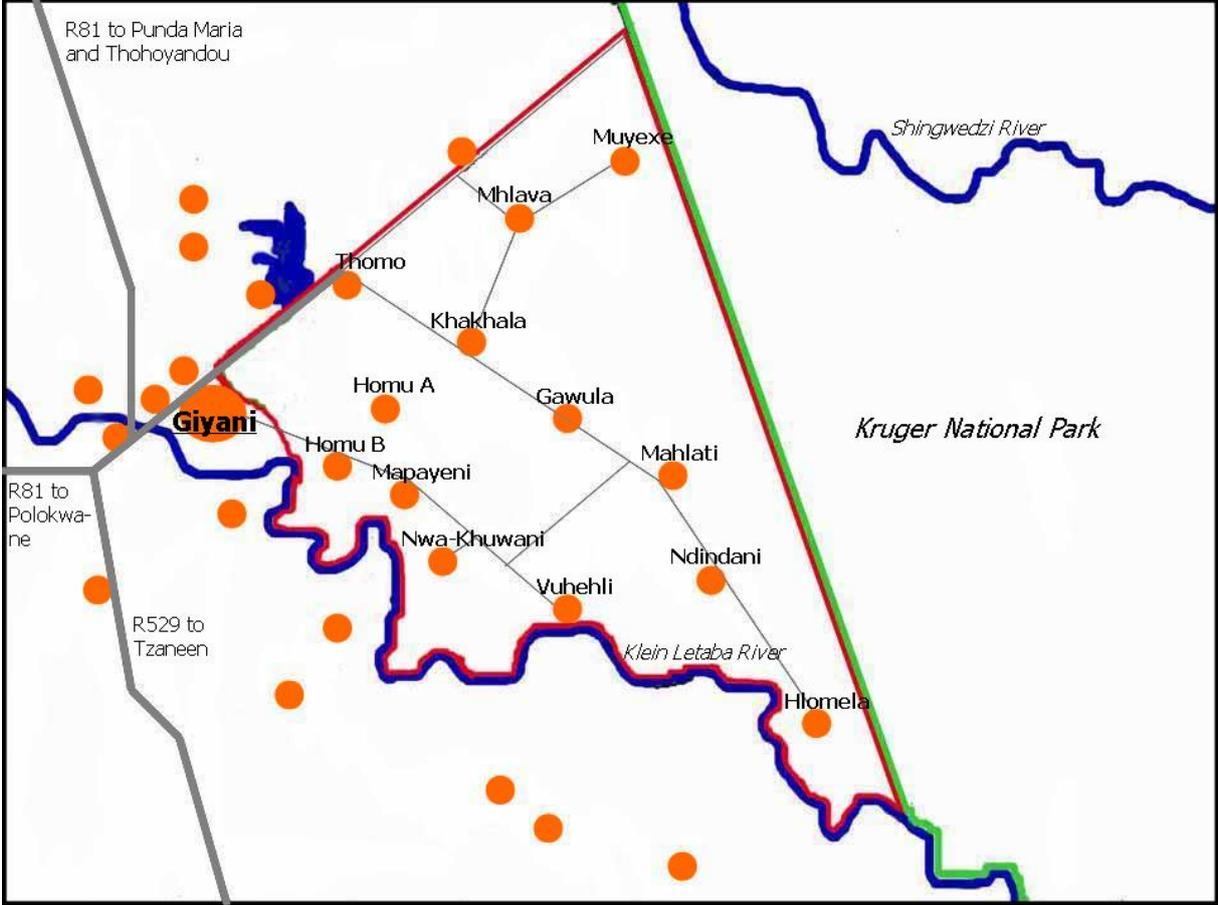
The Greater Giyani Municipality is adjacent to Kruger National Park in the Limpopo Province of South Africa (see Figure 2.1). The South African government acknowledges that poverty is a severe problem and stimulates initiatives aimed at economic development of the area. Unfortunately, the government lacks the means and drive to change the situation. This is further hampered by the isolated setting of the villages.

2.3 The Foundation 'Mpfuneko'

'Mpfuneko Community Support' is a local not for profit organisation based in South Africa that is involved in development aid. Its aim is to alleviate poverty and to promote sustainable development of rural communities. Mpfuneko envisages building a reputation as reliable and committed partner in 'development activities'. On the one hand reliable means that Mpfuneko will be responsible for its activities and realisation of the projects in which it participates, as well as the use of funds. On the other hand Mpfuneko also has the ambition to be a reliable partner for the communities in the sense that it sticks to its arrangements with communities, acts in agreement with the communities and does not appropriate the scarce resources of the local population for its own profit. The main activities are implementation of a development plan for

the region based on production and distribution of biogas and promotion of agricultural activities. Refer to Annex A for the business plan of Mpfuneko Community Support.

Figure 2.1: Map of Giyani and its surrounding villages



3 Planned activities

3.1 Origin and context

Previous research in the region showed that the availability and degradation of natural resources is a severe problem (Millennium Ecosystems Report, 2005). Fuelwood is harvested and used for cooking. As a result, extensive damage is caused to the natural vegetation. The high population density causes a high degree of deforestation. We aim at avoiding deforestation and offering a suitable alternative at the same time. Several studies showed that biogas in South Africa has great potential. Similar initiatives in, among others, Nepal and Vietnam have already proven to be successful. We are convinced that biogas can be a success in South Africa too!

We will start our activities in the Greater Giyani Municipality. It is our intention to introduce biogas installations at a larger scale in the region. Limiting conditions are the availability of cattle and water. We are well known with the region and have a good relationship with Mpfuneko Community Support, our partner organisation. We also have permission of the Greater Giyani Municipality, as well as local and traditional authorities (chiefs) of the villages to implement this project (see Annex B and Annex C). The presence of Mpfuneko Community Support is one of the reasons why the Greater Giyani Municipality is mentioned in the national feasibility study for biogas in South Africa as one of the areas from which a national roll-out of a biogas programme could commence (Agama, 2007).

3.2 Problem analysis

IDS is committed to improve the social-economic situation of rural communities. Biogas has the potential to resolve several problems that are related to poverty in these communities. In addition, biogas installations are relatively cheap and the gas is produced from biological waste, in particular cow dung. Cow dung is used for construction and as fertiliser at the moment. Only a small part of total cow dung available is used for these purposes. Furthermore, 85% of the nutrients can still be used for agricultural purposes after producing biogas. As a result, there are hardly any opportunity costs when producing energy from cow dung, while considerable advantages will result from avoided deforestation and reduced greenhouse gas emissions, emitted when fuelwood is subtracted from ecosystems in an unsustainable way.

3.3 Project motivation

Biogas has a number of positive features:

1. It contributes to preservation of local environmental health. The gas will replace fuelwood for cooking purposes. Fuelwood is scarce in this region and the biogas project will reduce further deforestation. The reduction of CO₂ emission is another important environmental objective.
2. Emancipation of women. Women are committed workers in this region and are, among others, responsible for cooking and taking care of the kids. The time that is saved when cooking on gas is estimated at 2 to 3 hours a day. This time may be used for education or other social activities.
3. Health. In particular women and children have health problems as a result of inhaling smoke. It may be romantic, but cooking with fuelwood in scarcely ventilated huts is very detrimental to their health.
4. Employment. Constructing and operating biogas installations creates jobs for local people.
5. Fertiliser. The residual can be used to fertilise agricultural land and reduces the need to use expensive artificial fertilisers. Nutrients are concentrated in the residual of the biogas production process which, if used in an appropriate manner, can increase agricultural production with 25%.
6. Possibility to generate electricity. The electricity that is generated may be used for lighting and all kinds of spin-off activities such as a back-up generator for a local hospital or a cold storage facility for a local butchery.

3.4 Intended objectives and results

The broader mission of IDS:

'To create an opportunity for African communities to become economically independent by sharing knowledge and capital, and to support these communities in poverty alleviation and improvement of their livelihood'

These objectives serve improvements in health, socio-economic development, and the environment. In the beginning the focus will be on the Greater Giyani Municipality in South Africa.

General objectives:

- Development and introduction of biogas installations and the distribution of biogas for cooking and, if possible, for generation of electricity.
- Improvement of the environment. In addition to a reduction in CO₂ emissions, deforestation in the area will be actively prevented by offering a viable alternative.
- Improvement of health of women and children since these groups will be exposed most to smoke while cooking on wood fires.
- Contribution to emancipation of women. On average it takes women 2 to 3 hours a day to collect fuelwood. This time could be spent on education, work, or other social activities.
- Employment for local people, e.g. in the construction and installation of digesters, collecting cow dung and provisioning and maintenance of digesters.
- Use of the residual from the digesters as fertiliser. If used in an appropriate manner, this fertiliser can increase agricultural production by about 25 %.

Short term objectives:

1) Construction of one complete biogas installation for 30 households to assess the technical and economic feasibility of the project. A complete biogas installation embraces the following: a digester, a pipeline system to households, gas stoves, and possibly a generator to generate electricity. When the results of the test are positive the number of digesters can be increased to 20 so that a long-lasting and financially feasible management structure can be implemented (see paragraph 6). Jabenzi is a South African company that has implemented all kinds of development projects in Southern Africa. Jabenzi is convinced that biogas projects in Giyani have the potential to be successful and is eager to co-operate with Mpfuneko Community Support (see Annex D).

2) Biogas for domestic consumption is only feasible at a large scale, due to the low ability-to-pay. Selling biogas could increase the potential of biogas in the long-run. To be able to sell biogas at high prices it must be bottled. When bottled, it can be sold to large buyers like chain stores and hotels. Kruger National Park supports the initiative of Jabenzi, AGAMA Energy and Mpfuneko to develop a small-scale bottling technology for biogas (see Annex E). Technology to bottle biogas safely in rural areas is currently not available. Therefore, contributing to the development of a bottling technology for biogas is the second short-term objective of IDS.

These two objectives are related in the following way: When biogas can be bottled and sold commercially, the resulting profits can be used to supply households with biogas. In addition, temporary excess supply of biogas can be bottled and sold. This

excess supply is the result of fluctuations in the supply and demand of biogas that will be produced for households.

Contemplated short term results:

- To show local people that biogas technology works and that it has many advantages. This will have considerable exemplary value and will motivate communities to start similar projects independently.
- Mpfuneko Community Support will be able to construct biogas installations and implement biogas projects independently.
- 600 households will be supplied with biogas that can be used for cooking and, when desired, for lighting. As a result, an estimated 3000 people will benefit from related health improvements.
- 4 villages with an estimated total of 10,000 inhabitants will benefit from environmental improvements.
- A yearly CO₂ emission reduction of 1250 tons will be realised.
- A minimum of 8000 man-days of temporary labour for the least advantaged people in the communities will be created.
- A minimum of 21 permanent jobs will be created.
- Additional jobs will be created in related activities such as selling bioslurry (fertiliser).
- A foundation for more commercial finance methods of additional digesters will be created, for example through selling carbon credits.

4 Timeframe

The contemplated timeframe is shown in Table 4.1.

Table 4.1: Contemplated timeframe for the biogas projects of IDS

Timeframe												
Activity	Period											
	2008				2009				2010			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Household biogas supply												
Work package 1												
Setup of project administration and organisation	■	■										
Construction of pipeline system	■	■										
Construction of first biogas digester	■	■										
Informational campaign	■											
Start-up of first biogas digester			■									
Testing of the installation			■									
Operational phase of the first digester				■	■	■	■	■	■	■	■	■
Work package 2												
Construction of pipeline systems for 9 additional digesters					■	■						
Construction of 9 additional digesters					■	■						
Informational campaign					■	■						
Start-up of 9 additional biogas digesters							■					
Testing of 9 additional biogas digesters							■					
Operational phase of 9 additional digesters								■	■	■	■	■

(Continuation of Table 4.1)													
Work package 3													
Construction of pipeline systems for 10 additional digesters													
Construction of 10 additional digesters													
Informational campaign													
Start-up of 10 additional biogas digesters													
Testing of 10 additional biogas digesters													
Operational phase of 10 additional digesters													
Project evaluation phase 1													
Project evaluation phase 2													
Project evaluation phase 3													
Project evaluation of the total project													
Bottling of biogas													
Work package 4													
Development of bottling technology													
Producing biogas cylinders													
Building and testing bottling installation													
Filling the first biogas bottle													
Application for permits and licences													
Preparations for large-scale production													
Work package 5													
Construction of commercial biogas digesters													
Filling and selling biogas cylinders													

5 Activities

IDS will contribute knowledge and capital for the construction of biogas installations. We will start with the construction of one biogas installation. To facilitate this, Mpfuneko Community Support will have to employ and / or train people. In addition, construction material has to be purchased. Other costs include, among others, transport and sub-contracting a construction supervisor and technical expertise.

The type of digester that will be built is an underground *fixed dome continuous flow* digester. Picture 5.1 shows how such a digester is built and Figure 5.1 shows the cross-section of a fixed dome digester.

Picture 5.1: Construction of a biogas digester

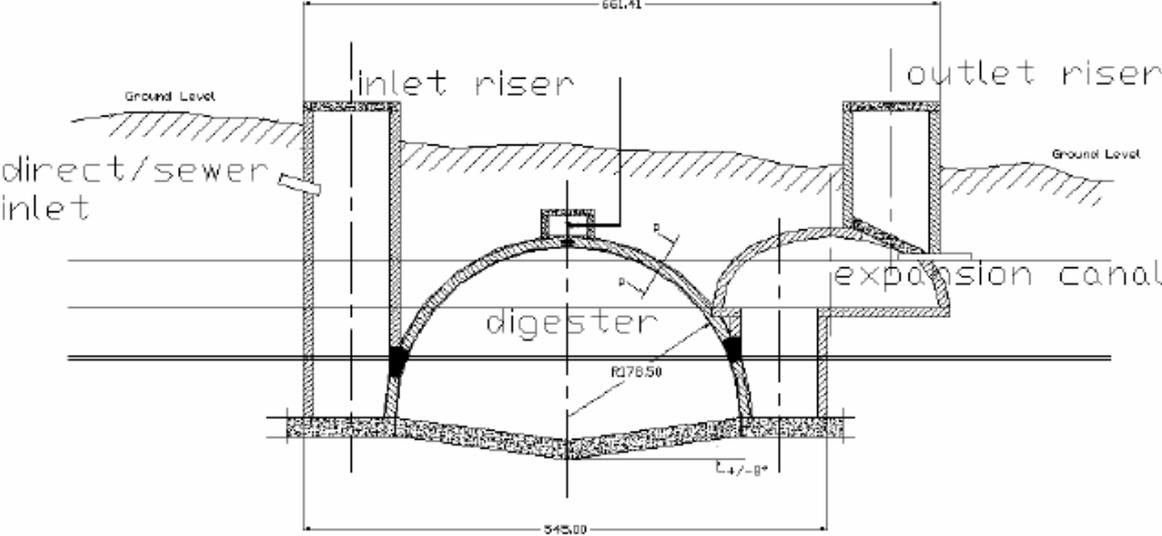


Source: Biogas for a better life, an African initiative

A mixture of water and cow dung (possibly complemented with other organic waste) enters the underground digester through the inlet. During the digestion of cow dung gas is produced that concentrates at the top of the digester. After a while the gas pressure rises, pressing the remaining cow dung, named bioslurry, through the outlet. When enough gas is built up, the gas can be transported to households

through a pipeline system. The digester will be fed with fresh dung every day in order to guarantee a continuous gas production and supply to households.

Figure 5.1: Cross-section of a biogas digester



Source: *Biogas Technology: Delivering Ecological Sanitation and Renewable Energy*

6 Income and expenditure

This business plan covers a period of approximately three years. The activities that IDS has planned in this period to realise its objectives are divided in five Work Packages. Table 6.1 provides an overview of budgeted costs per Work Package. Table 6.2 indicates the nature of these costs. Labour, materials, and other costs account for respectively 63%, 29%, and 9% of total costs. The activities and budgets for the Work Packages are further described and elaborated below.

Table 6.1: Budgeted costs per Work Package (in Euro)

Work Package		Budgeted costs (Euro)
1	Construction of the first digester	52,022
2	Construction of 9 additional digesters	313,723
3	Construction of 10 additional digesters	346,599
4	Contribute to development of bottling technology	6,800
5	Bottling and selling biogas	PM
Total		719,144

Table 6.2: Overview of costs per cost category (in Euro and as %)

	WP 1	WP 2	WP 3	WP 4	WP 5	Total	Total %
Labour:							
- Expert	5,500	10,312	10,312	4,125	PM	30,249	4%
- Local (skilled)	16,872	118,548	131,424	0	PM	266,844	37%
- Local (unskilled)	9,657	58,830	65,379	0	PM	133,866	19%
Materials	11,642	100,331	111,417	0	PM	223,390	31%
Transport	660	1,980	1,980	2,200	PM	6,820	1%
Training	1,111	2,222	2,222	0	PM	5,555	1%
Overhead	6,580	21,500	23,865	475	PM	52,420	7%
Total	52,022	313,723	346,599	6,800	PM	719,144	100%

We aim at constructing one biogas installation in one of the villages in the Greater Giyani Municipality (possibilities exist in Gawula, Mahlati, or Ndindani) in the period from January until September 2008. It is planned to build a biogas installation with a digester volume of 150 m³. From there the gas can be distributed to a minimum of 30 households making use of pipeline system. Constructing this first biogas installation (Work Package 1) costs Euro 52,022 (see Tables 6.3 and 6.4).

Table 6.3: Features and price of a 150 m³ digester

Features	150 m³ digester
# Cattle (overnight kraaling)	150
Biogas production (m ³ /day)	30
Biogas consumption (m ³ /HH/day)	1
# Households	30
Connection distance (m)	50
Total length of pipelines (m)	1500
Price excl VAT (Euro)	€ 25,000
VAT 14% (Euro)	€ 3,500
Price incl VAT (Euro)	€ 28,500
Price/HH incl VAT (Euro)	€ 950

Source: Quotation AGAMA Energy (Pty) Ltd, South Africa

Table 6.4: Budgeted expenditures for implementation of the first digester during nine months (in Euro)

Category of expenditure	Unit	Number of units	Costs per unit (Euro)	Total costs (Euro)
Labour				
- expert	Month	4	1,375	5,500
- local (skilled)	Month	38	444	16,872
- local (unskilled)	Month	87	111	9,657
Materials				
- construction materials for digester				10,042
- information materials	Brochures	500	2.20	1,100
- other				500
Transport	Kilometre	3,000	0.22	660
Training				1,111
Overhead (office, telephone, and other costs)				6,580
Total				52,022

It is our intention to extend the project in the following period (Work Packages 2 and 3) so that in three years a minimum of 20 digesters may be installed in 4 villages (see Table 4.1). This number of digesters is sufficient to reach the break-even point for the operational phase and to allow for depreciation of the digesters over a 20-year period so that they can be replaced without requiring additional funds at the end of the 20-year expected lifetime of the digester (see Table 6.5). This requires initial funds of Euro 660,322 (see Annex F for a budget for all Work Packages). The number of

installations that can be realised and the pace at which this can be done is dependent on the amount of money available. The optimal size of a project is 25 digesters in 5 villages that are located close to each other (see Annex G). Such a project can be managed by one local manager, making use of one office and thereby limiting transportation expenses.

An expert will supervise the financial administration and progress of the project on site. Obviously, this information will also be communicated by means of a newsletter and our website.

Table 6.5: Yearly financial costs and benefits in the operational phase for 20 digesters in 4 villages (5 in each village) (in Euro)

Cost categories	Unit	Number of units	Costs per unit (Euro)	Total costs (Euro)
Labour				
- local (skilled)	Month	12	444	5,328
- local (unskilled)	Month	240	111	26,640
Maintenance	Digester	20	550	11,000
Transport	Kilometre	7,000	0.22	1,540
Depreciation (linear over 20 years)	Digester	20	1,425	28,500
Overhead (offices, telephone, etc.)				5,341
TOTAL EXPENDITURES				78,349
Revenue categories				
Contributions of households based on monthly payments	Fees	7,200 (600 households during 12 months)	11	79,200
BALANCE				851

Explanation by Table 6.5: In the operational phase no external expert is needed so that only costs for local skilled and unskilled labour are incurred.

To contribute to the development of bottling technology (Work Packages 4 and 5) IDS needs approximately Euro 6,800. This technology will be developed by a South African company that has already developed and constructed installations to bottle large amounts of biogas in the past. It is envisaged that this technology will be affordable, robust and safe. It will be based on bottling systems for small quantities that are used in Asia and on previous experiences with bottling of biogas in South

Africa. The contribution of IDS will be research into the optimal features of such a system given the conditions and requirements for the area in which Mpfuneko CS is active.

7 Management and Organisation

The Stichting Innovative Development Solutions supports Mpfuneko CS in the development of its activities. Instructions for activities will be given to Mpfuneko CS who has the overall responsibility for commissioning the construction of digesters and its supervision. It is envisaged that the first digester will be installed by AGAMA. Once the digesters have been built and tested, and a local management for the digesters is in place, Mpfuneko CS will be responsible for the operation of the digesters. Mpfuneko CS will be intensively involved in the implementation of the project and will keep as much of the work as possible in-house. After transferring the digesters to Mpfuneko CS the operation will be their responsibility. IDS will continue to follow Mpfuneko CS and, if necessary, support them with maintenance to guarantee the sustainability of the project.

8 Risks and assumptions

The number of installations that can be realised is dependent on the possibilities to obtain funds for the project. We consider the risks of the project to be small. Research done in the area in 2006 and 2007 indicate that there is widespread support for this project and that the available amount of water and cow dung is sufficient to operate the digesters. Lack of water may be a problem in case of long lasting draughts, but even in this case enough ground water will be available to operate the digesters. To further reduce this risk water saving measures will be taken and gray-water will be used wherever possible.

Extensive research has been done to the availability of cow dung and there is no reason to expect any problems. When a village has, as is proposed, 5 biogas installations with a digester volume of 150m³ each, only 50 – 67% of the cow dung that will be left behind in the kraal during an overnight stay will be used in the production of biogas.

A situation could occur in which the local population is not able or willing to pay the monthly user fee of Euro 11. Involvement of as many local people as possible is an important tool to prevent this from happening. The amount of the user fee is based on research to the willingness and ability to pay. Only households that indicate to be willing to pay the user fee will be connected. It will be possible to disconnect

households that do not pay the user fee. During implementation of the first digester it will be tested whether the willingness-to-pay is in accordance with previous research to reduce the risk.

The institutional risks have been reduced as much as possible through consultation and arrangements with local authorities (see annexed support letters). We don't expect any problems and the construction of the first digester offers many opportunities to experience this. So far, the construction of biogas installations in South Africa by AGAMA has always led to good results.