

PROJECT PLAN

OPERATING BIOGAS DIGESTER
CHICKEN CHAIN FARM
DEVON, ZUID AFRIKA



Yonis Le Grand
4081633

-

Steven Roerink
4314751

-

Job Seuren
4289021

-

Eva ten Velden
4275624

INHOUDSOPGAVE

Mission of the project	3	ANNEXES:	
Scope	3	1. Project timeline	16
Portrait of the organization	4	2. Development context and Cultural differences	17
Summary of desk research	5	3. Safety and security	20
Analyses of the problem	6		
Project structure	7		
Project organisation	9		
Presentation and continuation	10		
Management of risk	11		
Business model canvas	12		
Business and finance	13		
Bibliography	15		

“The mission of the project is to introduce sustainable energy, with the use of available resources. To build a biogas plant with generator and create awareness, of this renewable technology, in the local population.”

Before the actual construction of the biogas plant certain actions need to be taken care of. First of all, the team will be writing a businessplan for the situation on the farm of Mr. Mofokeng about the use of the biogas plant. This business plan will show the possibilities about the electrification of biogas and the sale of the electricity to the network of ESKOM.

During the stay at the Chicken Chain Farm, the team will visit an experienced biogas company in the region. After contacting this company the designing of a biogas plant will take place. Because the team is not able to design a biogas plant from scratch, an existing approved design will be adapted to the specific situation of the Chicken Chain Farm. The design will also take into account the possibility of upscaling in the future.

After the design has been finalised contact will be made with a contractor. This company will start constructing the biogas plant. The agreements with the contractor will be made before the team returns to the Netherlands.

Furthermore, the earlier mentioned business plan will be further adapted during the stay at the Chicken Chain Farm. Besides this case specific business plan, a general business plan will also be written. This general business plan could be used by other farmers in Gauteng when they ask Mr. Mofokeng for help.

PORTRAIT OF THE ORGANIZATION

The biogas plant will be built on the Chicken Chain Farm of Mr. Mofokeng (figure 1). This cattle farmer owns around 150 cows and has the ambition to produce something useful out of the manure from his cows. By designing, building and using the installation the cow manure will be converted into biogas which then again will be made into electricity. At the moment, the manure of the cows at the Chicken Chain Farm is estimated to be enough to produce 20 kW. The aim is to produce an amount of 1 MW.

The Chicken Chain Farm is situated near Devon. A little village in the South African province Gauteng. As the manure from the 150 cows on this farm most likely can provide gas for roughly 10 households, and even less in the case of electricity production. Mr. Mofokeng would like to cooperate with as many neighboring farmers as possible through contracts. These farmers could serve as a supplier of biomass, by delivering the manure of their own farm to the farm of Mr. Mofokeng. When also the manure of the animals from other farmers is processed in the biogas plant, a much greater quantity of gas will be produced. In addition it is much more profitable to convert this gas into electricity. Several things have to be taken into account when the contracts between the local farmers and Mr. Mofokeng will be made. Including the potential types of feedstock, feeding of the animals, transport of manure to the Chicken Chain Farm and the minimum amount of manure which is transported. Thereby, the income of the process should also be taken into account and how this income will be distributed among the stakeholders.

Besides the construction of a biogas plant on his land Mr. Mofokeng would also like to raise awareness of the possibilities of biogas by including local farmers and the Tshwane University of Technology in Pretoria. He aspires for this project to serve as an example for other farmers. In the eventuality that these farmers would want to build a biogas plant of their own, they could come to Mr. Mofokeng for advice. It is important that Mr. Mofokeng can easily provide sufficient information. This information will be given through the handing out of a general business plan. The local farmers can use this to write a plan specific to their own situation. Mr. Mofokeng is enthusiastic about the idea of the widespread application of biogas in South Africa. This project aims to achieve this by promoting courses for sustainable energy, with biogas in particular, at the Tshwane University of Technology in Pretoria.

In short, Mr. Mofokeng is the client of this project. His request is a functional biogas plant, potentially supplied with biomass from neighbouring farms, with the higher purpose of raising awareness of the potential of biogas technology among the locals.



Figure 1: Mr. Takatso Mofokeng during a skype meeting with our group.

SUMMARY OF DESK RESEARCH

The farm where the biogas plant will be built is owned by Mr. Mofokeng. Most farmers in South Africa are white. Mr. Mofokeng is one of the few black farmers in the area. It is important to keep the Apartheid history and the fight for racial equality, which were only twenty years ago, in mind throughout the duration of the project. It is sensitive to this project because Mr. Mofokeng wants to improve the situation of black people in the society and the team consists of white students. During the project it is essential that the team has to show respect to the client.

Mr. Mofokeng obtained his doctorate in theology in the Netherlands. After his retirement he started a cattle farm and at the moment he owns 150 cows. With the manure of these cows Mr. Mofokeng has the ambition to produce biogas and electricity. This process would contribute to the green energy supply in South Africa. One year ago a team of two students, also from the TU Delft, made a start with this project by building a biogas digester just big enough to produce biogas from the manure of two cows. The scale of this biogas digester is not big enough to make the production of electricity profitable. Therefore the upscaling of the biogas digester will be addressed in this project plan.

At the moment a new group of students is present at the Chicken Chain Farm and this second group will be followed up by our project team. The second group has made a feasibility study about the future biogas plant of the farm. This included taking into account the potential for various types of biomass, composite products and suppliers. Furthermore, this project group would make a business plan and a design for the biogas plant.

However, it is questionable whether this business plan and design will

be delivered on time. Therefore, it has been decided by our own project group to write a business plan for the situation after the construction of the installation and modify an existing approved design. This design can be owned by a company in South Africa which often produces a biogas plant or this design will be a design of the previous project group.

During our stay in South Africa we still have to keep one major roadblock in mind. Halfway December most institutions will be running a skeleton crew due to the summer holidays. This means that important contacts have to be approached in the first period, before 14th to be precise, of our stay. In addition, the universities can only be approached after the summer. Before then the teachers are busy with the exam period and subsequent summer holidays. Our internship must therefore be well planned in order to prevent that some parties will be missed.

The research we did so far to prepare for our stay in South Africa contains several skype interviews with both Mr. Mofokeng, Mrs. Mofokeng, and the current group. In addition, the mid-term report and other relevant literature is being read in preparation for the design phase, and a first draft of a business plan has been written based on known facts and assumptions.

Besides the fact that this project builds on the project from the previous group, we have to keep in mind the examples of all existing farms with a biogas plant. Near Heidelberg, another city in the province Gauteng, a biogas construction company is active. This company, BOTALA energy solutions, provides farmers in South Africa with biogas plants. To gain experience, there also will be some visits to farms that have worked with BOTALA in the period of our stay.

ANALYSES OF THE PROBLEM

Our mission and project is to provide a small scale improvement to three major global and local problems in South Africa stipulated by Mr. Takatso Mofokeng's business plan:

- The global state of environmental degradation and climate change;
- Rising energy demand in South Africa;
- Economic (racial) inequality in South Africa.

The first major issue is the commonly known negative effect of industrialization throughout the world. South Africa has been heavily reliant on fossil fuels which have a negative impact on its ecosystem. This is why the South African government and various institutions in the private sector are making a push for alternative renewable resources.

This issue is closely coupled to the increasing energy demand. The national energy supplier, ESKOM, is having difficulties expanding at a rate that could satisfy the increasing demand. Rolling blackouts and electricity price escalations are the general experience of the locals. These inevitably lead to commodity price increases and the strangling of emerging agricultural producers.

Which is the third problem that we wish to tackle. Due to the Natives Land act of 1917 most farms are in the hand of the white minority. Black Africans have lost the contact with the land after years of oppression and lack of opportunity under apartheid. Skilled black farmers are still a (growing) minority. This problem is evident across other economic sectors of South Africa. The lack of educated individuals is making one of the most powerful economies of the African continent increasingly difficult to maintain.

The plants eaten by the cow consume CO₂. The same amount of CO₂ is released in the atmosphere after the biogas is burnt. This is why biogas is seen as a carbon neutral energy source. The biogas plant will be consuming two natural resources that are in great abundance, namely the sunlight and cow manure. It can be a solution to the waste problem of farms and cities as well as to the rising energy demand.

Our project also aims to promote sustainable energy solution amongst local farmers and the population. The biogas plant can serve as an example for local farmers. Biogas is a possible tool for emerging farmers, who are generally black, to become self sustaining. Furthermore the maintenance of the biogas plant will be a source of labour. The combination of these factors will be a small contribution to the economic inequalities of the region.

Spread knowledge about biogas plants of the same scale like Takatso Mofokeng's project.

Certain activities are scheduled to spread knowledge. We will educate farmers with presentations and workshops in community halls. Mr. Mofokeng informed us about a local meeting with government and farmers and we will attend one of these meetings. We will also try to arrange a meeting like this, but also with biogas companies included, in community halls in cooperation with the government, once during our internship.

Secondly we will spread our general business plan to farmers after visiting the farm of Mr. Mofokeng. One of the projects is to organise an event to get farmers in contact with biogas companies. This event will be organised once during our stay at the farm of Mr. Mofokeng. Therefore we have to visit companies and farmers and invite them to join a 'braai' at the farm. We don't know how much time this will cost, but it can be combined with other visits to make it more effective. We need to promote this through the internet (news websites, community websites, social media), advertisements (in newspapers, magazines), flyers/posters/signs on the road and collaborate with churches. This will be done in the first weeks of December. It's scheduled in December, because at that time the government is closed and we can focus on promotion.

Thirdly in January we will collaborate with knowledge institutions and their students. We will visit the university in January as much as possible. We assume that five visits will take place. We will give the professors a presentation on biogas technology and argue for its implementation in the curriculum. This way we can inform the students about green energy.

Finally. The current group is busy writing a feasibility analysis. In collaboration with them we will be writing the business model for Mr. Mofokeng. Therefore, we will do research about the financial aspect (including production) of the business case. Once we arrive we will check if our assumptions, which we have made in the business model canvas about the production and customer (ESKOM) are right and adapt the canvas to the situation. In the next phase we will begin setting up agreements with biogas system design and construction companies.

PROJECT STRUCTURE

Our team will do the following three activities on the farm of Mr. Mofokeng:

- The set up of a functional biogas plant;
- Make the setup of a biogas plant easier for (other) local farmers;
- Spread knowledge about biogas plants with the same scale like Takatso Mofokeng's project.

Set up a functional biogas plant

To set up a functional biogas plant, our team will need to follow certain steps. First we will study biogas technology, its use, implementation, design and biochemistry. To do this will read certain books, reports and articles proposed by Henry Spanjers, a professor at the TU Delft and biogas expert, and the current group. This research is done in October.

The team needs to contact a company (e.g. Botala Energy Solution) with a proven design during our stay South Africa. We will visit five big companies to ask design questions. We assume that there should be two visits per company. As mentioned before, designing a biogas plant of this scale from scratch is beyond the expertise of this team. That's why we need to adapt a proven design to the parameters of the situation on the farm of Mr. Mofokeng. This phase scheduled in November till the beginning of December.

After this activities we will contact a contractor for the construction of the biogas plant. Therefore we will visit around five companies and we assume that we need to visit them twice. After all this visits we can decide together with Mr. Mofokeng and Mrs. Mofokeng with which company we will do business with. Because of the scale of the project, Mr. Mofokeng is not able to build a biogas plant without some professional knowledge. We have to find this constructor and set up a contract about the building of the biogas plant, with this company before we leave South-Africa at the end of January. The contact moments with these relevant stakeholders are scheduled in the period of November until the beginning of December. The signing of the contract will be done in January.

Make the setup of a biogas plant easier for (other) local farmers.

One of our other main activities is to make the setup of a biogas plant easier for other local farmers. We will write two different business plans:

1. First for Mr. Mofokeng's farm
2. Secondly a general business plan with tools for an easier application to governmental grants.

The first part of the business plan for Mr. Mofokeng's farm is made in the Netherlands before we leave to South Africa on the 4th of November. The second part will be done by contacting all kind of suppliers for biogas systems, i.e. SimGas, BOTALA, Bio2Watt and Biogas SA. We are also planning to contact NGO's through Mr. Mofokeng's network, to research their designs. We will visit five big companies for design questions and we assume there should be two visits per company.

We will also contact local farmers that already have a biogas plant at their farm. The first group is busy visiting as many farmers as possible. We have scheduled this activity during our first weeks of stay in November. Before we can visit those farmers, we first need to interview the contacts made by the current group. This will comprise of two interviews about their experiences with them. The knowledge should be transferred between our group and the group who is already busy with research in South Africa on Mr. Mofokeng's farm.

We write the general business plan at the beginning of December. We will use the format we have used for the current business model canvas. We have to check our assumptions during our internship and change them according to our experiences. We will interview Mr. Mofokeng once or twice about the best opportunities to network with other farmers. He already has a big network. Using this network we can visit, inform and invite the farmers for a guided tour at Mr. Mofokeng's farm. The visiting will be combined with visits for the delivery of biomass. During the guided tour there will be information about biogas installations and the general business plan will be handed out. There will be advice on how to make it easier to apply and receive fundings. We will therefore set up a program of information which will be told during the guided tour. These activities are scheduled in November and December and the guided tours will take place once a month.

PROJECT STRUCTURE

Spread knowledge about biogas plants of the same scale like Takatso Mofokeng's project.

Certain activities are scheduled to spread knowledge. We will educate farmers with presentations and workshops in community halls. Mr. Mofokeng informed us about a local meeting with government and farmers and we will attend one of these meetings. We will also try to arrange a meeting like this, but also with biogas companies included, in community halls in cooperation with the government, once during our internship.

Secondly we will spread our general business plan to farmers after visiting the farm of mr. Mofokeng. One of the projects is to organise an event to get farmers in contact with biogas companies. This event will be organised once during our stay at the farm of mr. Mofokeng. Therefore we have to visit companies and farmers and invite them to join a 'braai' at the farm. We don't know how much time this will cost, but it can be combined with other visits to make it more effective. We need to promote this through the internet (news websites, community websites, social media), advertisements (in newspapers, magazines), flyers/posters/signs on the road and collaborate

with churches. This will be done in the first weeks of december. Its scheduled in december, because at that time the government is closed and we can focus on promotion.

Thirdly in January we will collaborate with knowledge institutions and their students. We will visit the university in January as much as possible. We assume that five visits will take place. We will give the professors a presentation on biogas technology and argue for its implementation in the curriculum. This way we can inform the students about green energy.

Finally. The current group is busy writing a feasibility analysis. In collaboration with them we will be writing the business model for mr. Mofokeng. Therefore, we will do research about the financial aspect (including production) of the business case. Once we arrive we will check if our assumptions, which we have made in the business model canvas about the production and customer (ESKOM) are right and adapt the canvas to the situation. In the next phase we will begin setting up agreements with biogas system design and construction companies.

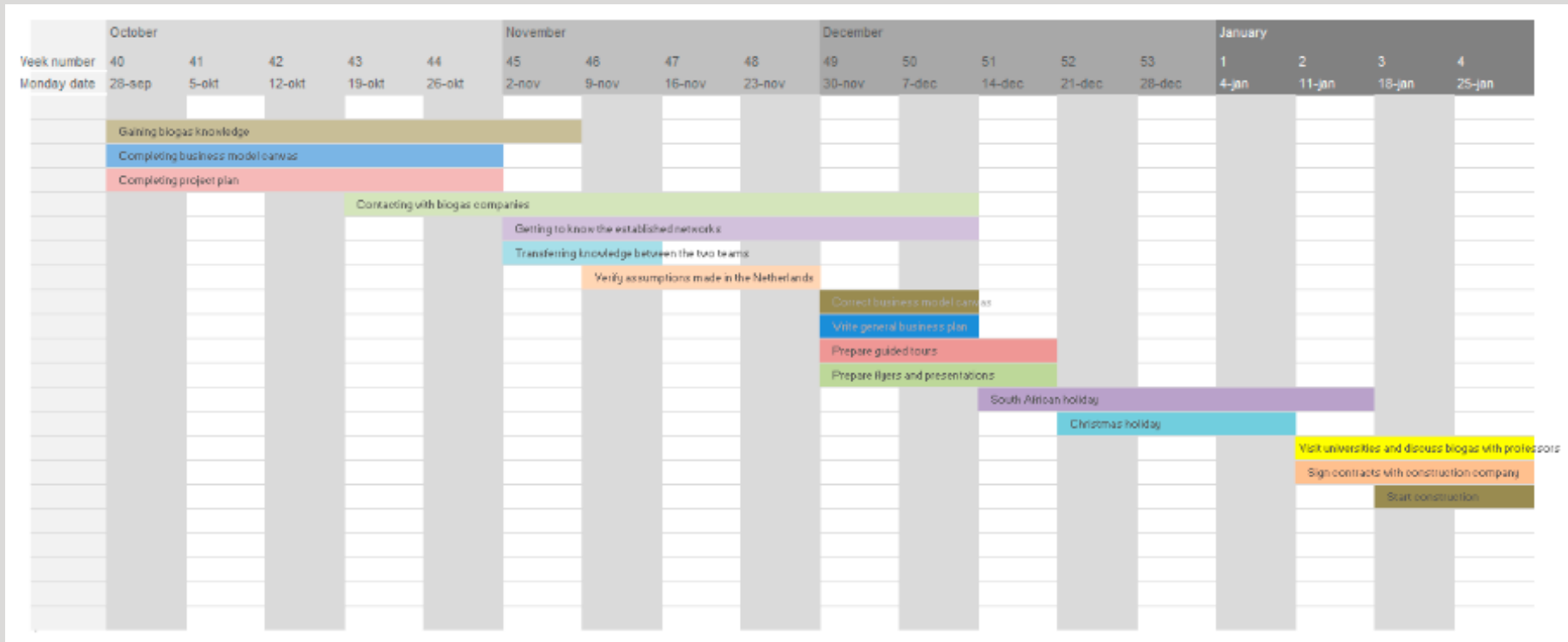


Figure 2: In annex 1 you will find the version of this timetable on full display.

PROJECT ORGANISATION

Our project team

Y.S. le Grand	Mechanical engineering
S.J. Roerink	Technology, Policy & Management
J.J. Seuren	Maritime technology
E. ten Velden	Architecture

Job Seuren and Yonis le Grand will be mainly concerned with the technical aspects of the project. Research and design will be their prime responsibility. The designing will be supervised and valorised by Bart Frederiks.

Steven Roerink and Eva ten Velden will focus their attention towards the management- and marketing aspects of the project.

During the course of the project a natural overlap of the assigned tasks will take place. The major steps will be decided as a group. And every member of the group will be a contact person towards the outside world.

The following stakeholders are the clients and supervisors as described in the mid-term report by Goemans et al. 2015

Internal stakeholders

Prof. T.A. Mofokeng

Prof. Takatso Mofokeng is the owner of the Chicken Chain Farm enterprise and the client of this project. Originally obtaining a doctorate in Theology at Kampen University he decided to become a cattle farmer. He chose this career path because of the lack of black farmers in South Africa. He runs a mentorship program for the emerging black farmers in South Africa.

Mvr. N. Mofokeng

Nqobile Mofokeng is Takatso Mofokeng's daughter in law. She has procured a lot of financial experience. Her previous employers include KPMG, SAB and BP. She is now heavily involved with the Chicken Chain farm corporation and is the financial adviser of the project due to her expertise.

Bart Frederiks MSc.

Bart Frederiks received his Master's degree in Development Studies from the Technical University of Eindhoven. Currently, he works as a freelance consultant with some 15 years of experience in the field of biomass and bioenergy. Hence, he is an experienced and capable supervisor who will supervise the team of students during the project mainly in the technical field.

Dr. Otto Kroesen

Otto Kroesen has a background in theology and received his doctorate from the Theological University of Kampen. At present, he is an Assistant Professor in ethics, intercultural communication and development theory at the Technical. He also teaches technology, innovation and development at the Technical University of Eindhoven. He has an affinity for the development of technology in developing countries. In the context of the project he advises the team of students on the business development side with a particular focus on the socio-cultural context.

The previous project team

Our team will be taking over from a group of students that has been working on this project since september this year:

Evan Roberts

Evan Roberts is a student currently enrolled in his Bachelor studies in mechanical engineering at RWTH Aachen University.

Len Rijvers

Len Rijvers is a student who received his Bachelor's degree Mechanical Engineering from the Technical University of Eindhoven. Currently he is enrolled in the Master program Sustainable Energy Technology at the aforementioned university. In the context of an internship he participates in this project.

Roxanne Goemans

Roxanne Goemans is a student who received her Bachelor's degree Molecular Science and Technology from the Technical University of Delft. Currently, she is enrolled in the Master program Management of Technology at the aforementioned university. In the context of her Master thesis project she participates in this project.

This group is currently undertaking a feasibility research and designing a business model. Upon our arrival they will have set the parameters for the design of the biogas installation.

External stakeholders

Biomass Suppliers

At the moment there are several potential biomass suppliers. Especially farmers in the vicinity have been examined.

Mr. Twala, farmer

Rossgro, Farmer

Mr. Abdul, farmer

Devon Meat wholesalers, abattoir

Mr. Mampe, farmer

Sunshine Chicken, abattoir

Chicken Layer Devon, farmer

Sewage treatment installation Devon

Customer

Eskom, electricity producer in ZA

Constructors

BiogasSA, Biogas company that specializes in agricultural solutions

SimGas, Dutch Biogas company active on the African continent

Xergi, International Biogas company

Dresser-Rand, gas turbine and generator company

Botala Energy Solutions, Biogas company that has designed and constructed plants for companies in the region.

PRESENTATION AND CONTINUATION

After our departure from South Africa a functioning electricity producing biogas plant will be constructed and finished. It will not only serve as an energy source, but also as a source of inspiration for local farmers. Students and farmers will be able to get guided tours of the biogas plant. Our own findings will be documented on the ginger website (gingerresearch.tudelft.nl), in video and hopefully in the local news. The generalized business model that we have written will be distributed to other farmers after our departure.

Furthermore we hope that the Thswane University of Technology in Pretoria will implement the teaching of biogas technology in their curriculum. This could be in the form of a practical, an internship or part of a sustainable energy course.

How does your project contribute to development?

Our project contributes to development, in a few points:

Green energy, especially biogas, will contribute to a more sustainable South Africa;

The new biogas plant creates awareness for the local people and we hope that the other local farmers will follow Mr. Mofokeng's example of building a biogas plant;

Financially Mr. Mofokeng will receive money by selling the electricity to the network of ESKOM;

All the development will start in the country itself, there is no foreign support needed, because the farmers and local contractors will build the biogas digester themselves.

The crucial actors and factors for successful entrepreneurship and innovation are Required Functions of Innovation Systems Analysis. For this explanation see annex 2.

Under the conditions of the Required National Innovation System Analysis & Cultural Analysis entrepreneurship and innovation results in development. For this explanation see annex 2.

MANAGEMENT OF RISK

The project depends on many actors and factors. There are certain expectations of the actors and factors. If these expectations will not be lived up, other solutions have to be found.

In the period from november to january the main actors of the project are:

- Project owner Mr. Mofokeng
- Financial consultant Mrs. Mofokeng
- Student team 1
 - Roxanne Goemans
 - Len Rijvers
 - Evan Roberts
- Student team 2
 - Yonis Le Grand
 - Steven Roerink
 - Job Seuren
 - Eva ten Velden
- Government
- Local contractors
- Suppliers of biomass
- Employees
- Tshwane University of Technology

The factors that affect the project from november to january:

- Car
- Money
 - Grants
- Permits

Risk + Description and action plan

Conflict between parties

Conflicts can arise from different causes and can have negative effects on the project. Different culture have different ways of thinking, so it is important the other party has be approached discreetly. For both parties the higher goal is the success of the project, so you have to make some compromises. It is essential that the communication between the parties remain good, so that conflicts can be prevented.

No grants

The funding of the government is very important for the project. The construction of the biogas plant will be partly financed by these fundings. If the farm does not get the grants, it will lead to a stagnation of the project. If this happens, we will try to do as much as we can of that what doesn't depend on the grants. We will have to discuss with Dr. Kroesen about the continuation plan.

No permits (in time)

If the permits will not be given in time, the construction of the biogas plant will be postponed. The only thing that can be done is the preparation work for the construction. This includes writing the business plan, networking, approaching the Tshwane University of Technology, creating renewable energy awareness etc..

Unable to drive the car

If we are unable to drive the car, there are certain things we can do:

1. Let us drive by a taxi or let us be driven by an acquaintance
2. Try to borrow or buy another car

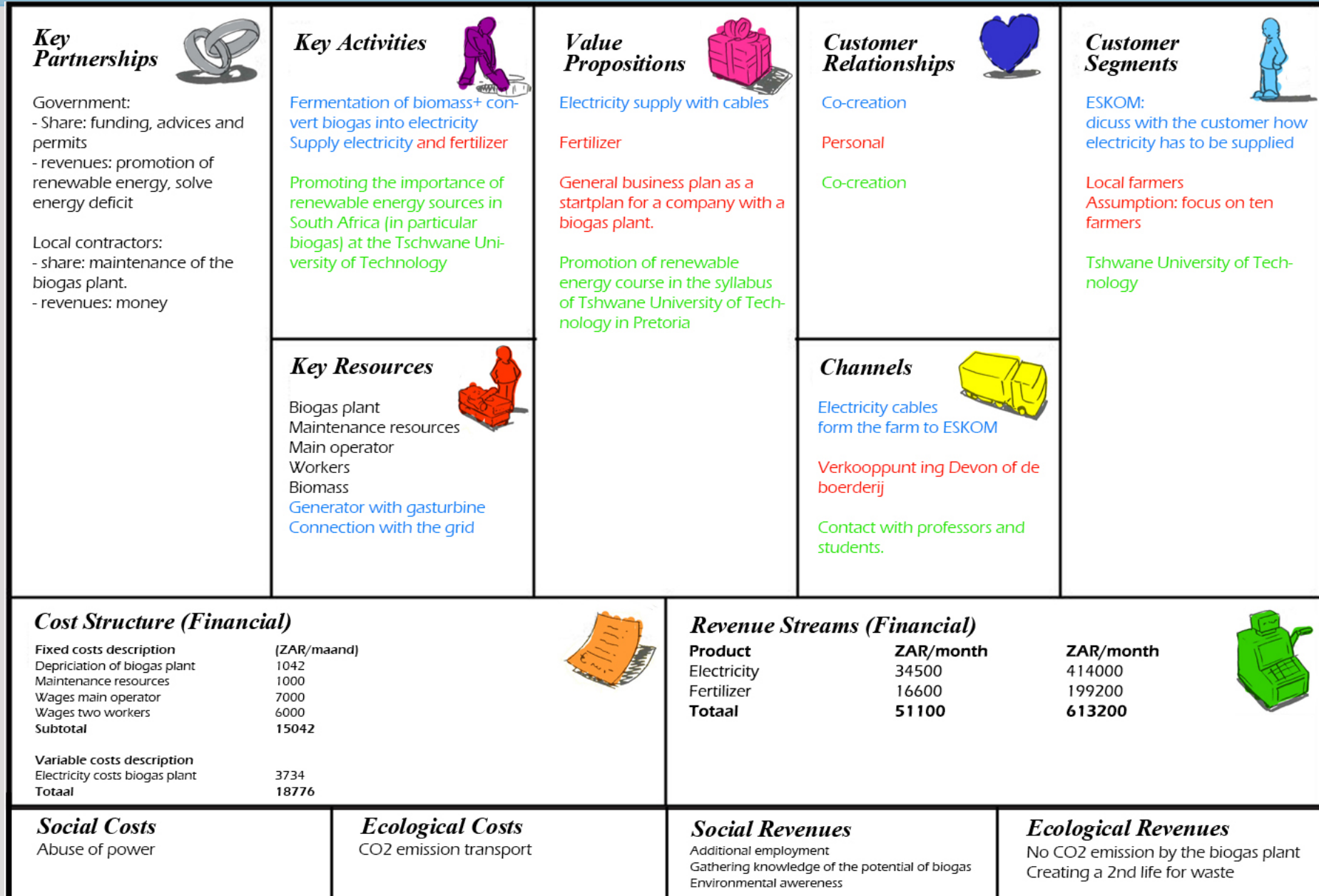
Unable to get in contact with professors

If we can not get in touch with the professors of the Tshwane University of Technology, due to holidays or other causes, we could try to get in touch with the Executive Board or other departments.

The design of the biogas plant is not ready for construction

If the design of the biogas plant is not ready in the period of november to january, the design has to be finished by another party. This could be another follow-up group or a biogas contractor.

BUSINESS MODEL CANVAS



The business model canvas describes the organization in a one-page model that everybody understands and can be used in any discussion, meeting or workshop. The business model canvas is described through thirteen basic building blocks that show the logic of how the company intends to make money. The thirteen blocks cover the four main areas of a business: customers, offer, infrastructure, and financial viability.

BUSINESS AND FINANCE

Organizational

Mr. Mofokeng and the first group arrange the financing of the whole project. Therefore, it is not necessary for us to arrange any further funding from parties in the Netherlands or local parties.

The total costs that are made by the biogas plant when it is functional are discussed in the cost structure of the business plan.

The cost structure describes the most important costs that are made by this business model. There are five segments in the business model that have to be financed. These are value proposition (VP), key resources (KR), key activities (KA), customer relations (CR) and channels (C).

The costs are categorized per segment and divided in fixed costs and variable costs. Fixed costs are not dependent of the production volume. Variable costs, on the other hand, are costs that vary proportional with the production volume.

All amounts will be given in South African Rand (ZAR), the currency rates are given below.

1 euro = 15,06 ZAR

1 dollar = 13,58 ZAR

(October 2015)

All costs are based on assumptions and estimates.

Fixed costs

The fixed costs that are for interest are given in the table below and will be explained further.

Segment	Description	Kosten (ZAR/month)
KR	Depreciation of biogas plant	1042
KR	Maintenance resources	1000
KR, KA	Wages main operator	7000
KR, KA	Wages two workers	6000

Table 1 Fixed costs

The depreciation costs of the biogas plant are very difficult to estimate. These costs depend on various factors, especially the following:

- Construction costs
- Permits cost
- Costs by studentteam September – November
- Costs by studentteam November – January

Part of the biogas plant costs will be financed by grants. Because these costs and grants are difficult to estimate, a rough assumption is made for the depreciation costs of the biogas plant. It is assumed that the total of the four costs described above minus the grants will be 250.000 ZAR. The biogas plants depreciates over 20 years, which will be 1042 ZAR per month.

Among maintenance resources of the biogas plant falls repair tools and materials. The costs of the maintenance resources are assumed to be 1000 ZAR per month.

The main operator of the biogas plant is an high educated employee, which has the responsibility of the monitoring, maintenance and repair of the biogas plant. His wage is assumed to be 7000 ZAR per month. There are two workers employed that are responsible for the loading and unloading of the biogas digester, de regular maintenance, the care of the cattle and other easy and practical tasks. The minimum wage of a landworker is 2606 ZAR per month (Randy Daily Mail, 2015). The wages of the workers on the farm is therefore assumed to be 3000 ZAR per.

In the diagram below the fixed costs distribution is made.

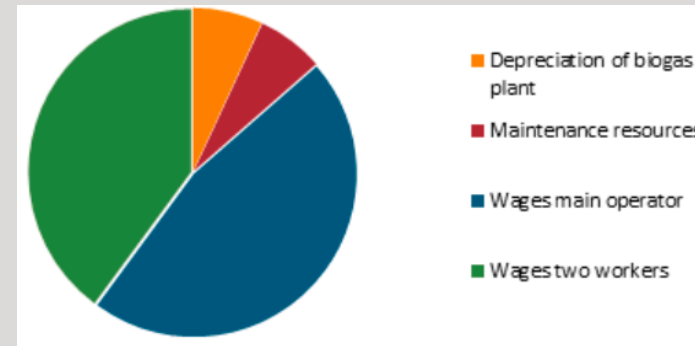


Figure 3: Fixed costs distribution

Variable costs

In the table below assumptions are given, that affect the calculations on the variable costs

Description	Value		
	Min	Max	Unit
Biomass yield	7500	9750	kg/month
Biogas yield	4500	7800	m ³ /month
Electricity output	8100	15210	kWh/month
Elektricity usage	2700	5070	kWh/month

The variable costs are given in the table below and eventually explained.

Segment	Description	Value	Costs per unit	Calculated costs (ZAR/month)
WP	Electricity costs biogas plant	2700 - 5070 kWh	0.96 ZAR/kWh	2592 - 4867

BUSINESS AND FINANCE

The electricity usage is roughly one third of the electricity usage of the biogas plant. (Mehta, 2015) The electricity demand of the biogas plant is mainly built up by the mixing machines in the biogas digester that are needed for the process.

Total costs

In the table below the mean fixed and variable costs are summed.

Description	Mean calculated costs (ZAR/month)
Depreciation of biogas plant	1042
Maintenance resources	1000
Wages main operator	7000
Wages two workers	6000
Electricity costs biogas plant	3734
Total	18776

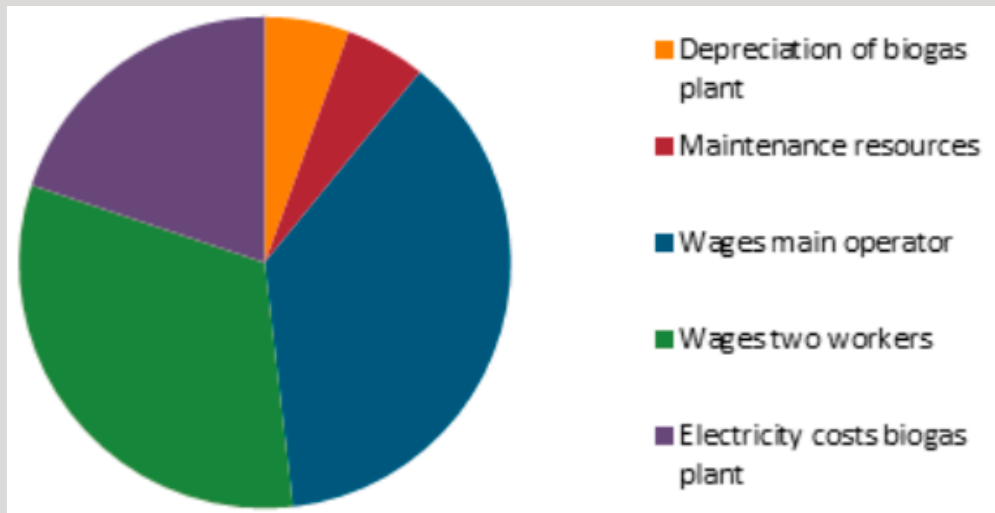


Figure 4: Total cost distribution

Reflection

In the cost structure the assumption is made that biogas will be produced from the 150 cattle on the farm of Mr. Mofokeng. However, it is known that biomass suppliers in the region are willing to supply biomass for the biogas plant. This brings scalability possibilities with it. In this paragraph this scalability will be discussed.

The extra biomass which can be supplied is given in the following table.

Biomassa soort	Gewicht per maand [kg]	Biogasproductie per maand [m3]
Cattle manure	15000	9000
Condemned matter (abattoir)	9000 - 20400	2700 - 6120
Stomach content (abattoir)	18000 - 22500	5400 - 6750
Chicken droppings	411000	123300
Totaal	442350	133830

This is 21 times as much as the current scale of 150 cattle. Since this scale is many times greater than the current situation, there will not be made an extensive cost analysis. The costs that will be created or increased are the following:

- Electricity usage of the biogas
- Rent or depreciation of trucks
- Fuel costs
- Wages of workers
- Biomass costs

Personal finance

On the farm is a car we can use for our own use and accommodation is free. The fuel is for our own costs if we use the car for our own use. If the car is used for visits regarding the project, it is uncertain if the fuel costs will be reimbursed. Mr. Mofokeng told us in a skype-meeting that the accommodation outside the farm will be reimbursed if they are made with regard to the project.

From what we are told by the first group, we expect to spend 10 euro's per day on basic needs, such as food, drinks, fuel costs, and accommodation when in Johannesburg.

BIBLIOGRAPHY

(2015). Retrieved October 29, 2015, from South African Biogas Industry Association: <http://www.biogasassociation.co.za/>

(2015). Retrieved from Tshwane University of Technology: <http://www.tut.ac.za/>

Goemans, R. R. (2015). *Mid - Term Report Biogas Business*.

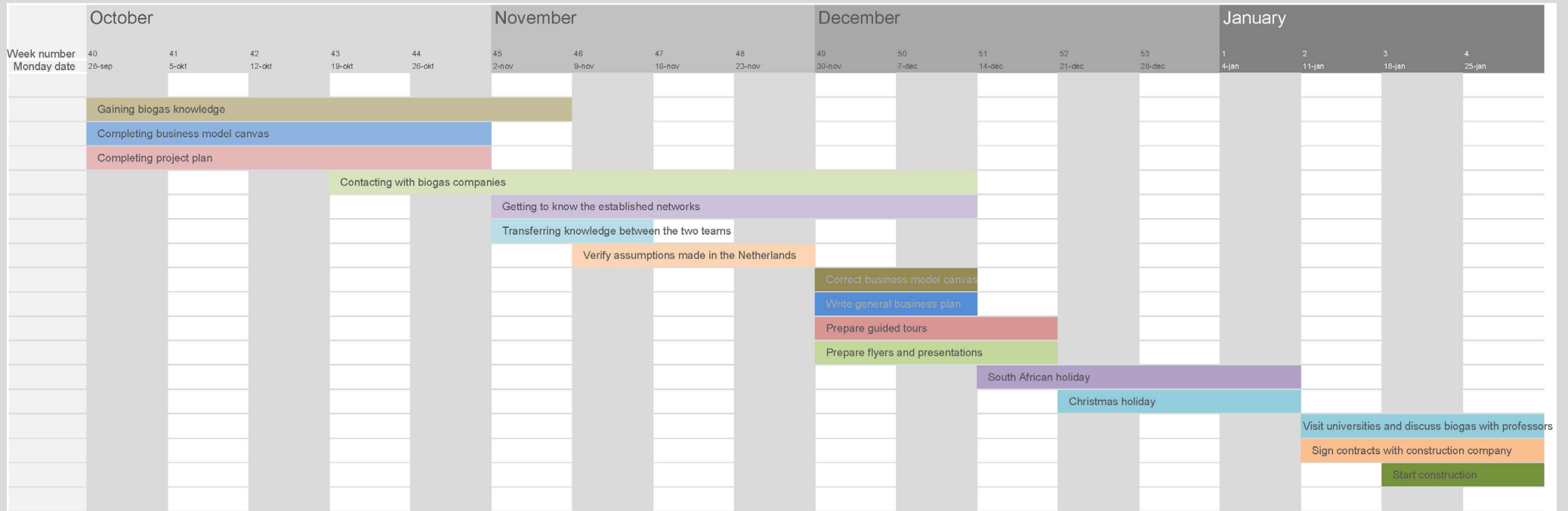
Malaria risk map for South Africa 2014. (2015, March). Retrieved October 29, 2015, from SaNTHNet: <http://www.santhnet.co.za/index.php/malaria-advice-for-travellers/item/330-malaria-risk-map-for-south-africa-2013.html>

NERS. (2011). Review of Energy Feed-in Energy Tariffs (REFIT). *National Energy Regulator of South Africa Consultation Paper*.

Reisadviezen. (2015, October). Retrieved October 29, 2015, from Rijksoverheid: <https://www.rijksoverheid.nl/onderwerpen/reisadviezen>

ANNEX I.

PROJECT TIMELINE



ANNEX 2. DEVELOPMENT CONTEXT & CULTURAL DIFFERENCES

How will culture, and differences in cultures, influence your project and results (List of 11)

1. Power distance – egalitarianism

In the case of Mr. Mofokeng there is power distance. Mr. Mofokeng is not living at the farm, because his wife doesn't like it. We have to respect the project owner and we are in a position to discuss the possibilities of biogas with him, but the arguments should be well constructed. Finally, the project owner is always right, so there is definitely power distance. In whole South-Africa since the Apartheid there is more egalitarianism in the society, but still in companies you can see a larger power distance between employer and employee.

2. Individualism – collectivism

At the farm of Mr. Mofokeng we can see signs of a collectivist culture. The people on the farm are working together on one big project as a team. The priority of the group serves a higher goal than of an individual. Mr. Mofokeng's mentorship of black farmers is a sign of collectivism, because his interest of the group is bigger than that of him as an individual.

3. Masculine – feminine

The culture on the farm is feminine. Mr. Mofokeng's daughter in law plays an important role as a financial advisor processes to his firm. This can be seen as a sign of equal gender roles. Mr. Mofokeng himself wants to help other farmers. This can be seen as the nurturing. A man taking a nurturing role is another aspect of a feminine culture.

4. Uncertainty avoidance – traditionalism

In our case it is difficult to say if there is uncertainty avoidance. We think that there is a non-uncertainty avoidance situation, because Mr. Mofokeng is introducing something new on the farm and is definitely taking risks. On the other side we can also describe this situation as uncertainty avoidance, because of producing electricity. There are a few other farmers in the neighbourhood who also produce electricity with a biogas plant. So uncertainty avoidance or not, it depends on the way you look at it.

5. Universalism – particularism

In our situation you can see the particularism, because relations have more importance than rules. Knowing people, especially people with power, is important to get things done.

6. Specific – diffuse

In our case there is a diffuse culture. In the culture work relationships are closely connected to social relationships. If the social relationship is bad on the farm, the work relationship will go bad as a result.

7. Neutral – affective.

We think that in this situation there is a neutral way of connecting with each other. South Africa is different from other countries in Africa. The society is very tough compared with other African nations. For example, in Malawi the people refer to South Africa as 'the Europe of Africa', because of the corporate atmosphere and of the prosperity. It's not easy to see on their faces if they really have affections, it's more focused on avoiding tension. This analysis is based on what we have and heard experienced from people.

8. Status by achievement and labor or position.

Mr. Mofokeng himself is an example of status by achievement. All the people in the neighbourhood call him by his title, Professor Mofokeng. He was promoted to professor in the Netherlands. Generally in South Africa people obtain their status by position. There are several government officials who either have not completed formal education or are friends of old ministers. This is an example of status by position.

9. Sequential – synchronous

On the farm of Mr. Mofokeng the work is done in a sequential way. Mr. Mofokeng and the current group are working on one thing at the a time. They made a schedule at the beginning and have tried to reach those milestones. The plans, that have been made in the first stadium of the project, are still the same.

10. Internalism – externalism

In this business case there is a shortage of electricity. There are signs of internalism in this situation. Mr. Mofokeng will produce electricity while is not fully dependent on the market. He can affect the market more than it can affect him, because of the electricity shortage and his own electricity production. Beside this fact, this case is driven by technology push and not by market pull. One of the only externalist processes is the funding by the government. Mr. Mofokeng can turn this external into an internal factor by the delivery of a realistic and fully described proposal.

11. Civil Society

In South Africa everyone has the possibilities to develop themselves, for example at the universities. It is easy to start your own company. The society is not a strong one, because of all the corruption in the government. South Africa is a universalistic state, while there is an good functioning law, equality and financially they are in good conditions. Finally there is a responsible state, because every inhabitant has the rights to give their own opinions. Also in the media people are allowed to say what they want, but there is an boundary, like it is the Netherlands too.

ANNEX 2. DEVELOPMENT CONTEXT & CULTURAL DIFFERENCES

Function of Innovation Systems

How can this project become successful? Which actors and factors are crucial for the successful entrepreneurship and innovation? These questions are answered with the functions of Innovation Systems. There are two sets of functions of innovation systems. Van Alphen describes the functions that are more suitable for underdeveloped countries, while Hekkert describes the functions of innovation systems of developed countries. A choice has to be made for which functions to use. For our project we took the system of van Alphen, because South Africa is still an underdeveloped country.

1. Entrepreneurial activities

Mr. Mofokeng is trying to use the opportunities of biogas technology at the moment. At the farm of Mr. Mofokeng there is a spirit of culture of enterprise. Two years ago a group of two students went to the farm and built a small biogas plant. Nowadays, Mr. Mofokeng wants to expand the small installation into an installation for at least 150 cows.

2. Creation of adaptive capacity

We think that the people are definitely ready for the innovations of Mr. Mofokeng. In the neighbourhood there are already a few farmers with a biogas installation and nearby a biogas power plant. The people are ready and by the given tours Mr. Mofokeng will show all the possibilities of biogas to make them ready for innovations. We assume that the universities need to teach about green energy in the future. So we can collaborate on a designing new course with them as means of innovation. Conditions that should be made are by example a collaboration with teachers from the TU Delft for professional expertise.

3. Knowledge diffusion through networks

The word will be spread by us. In collaboration with Mr. and Mrs. Mofokeng we will make a promotion campaign. This is already explained in the section 'Project Structure'. We will promote using the internet (news websites, community websites, social media), advertisements (in newspapers, magazines), flyers/posters/signs, collaborate with churches. The sources of information are given by Mr. Spanjers, a professor from Holland, the current project team and from Mr. Mofokeng himself.

4. Demand Articulation.

Consumers are not aware of this need at the moment. We will spread knowledge about biogas in collaboration with the government, local biogas companies and Mr. Mofokeng. A few local farmers are aware of the advantages from making gas from your own waste. This project is not fully focused on the consumer society, but the consumers are in big need of electricity. This is a win-win situation, even though Mr. Mofokeng is not focused on consumer society. The consumers will still be pleased by the production of electricity and a hopeful price drop in the long term.

5. Market formation

In this business case electricity will be produced. In Devon, and in South Africa in general, there is an electricity shortage. This means that there is not enough electricity to use every electronic device in the house and at certain hours there is no electricity at all. Therefore, there is a market to sell this new produced electricity from the manure of cows. The only electricity supplier in South Africa, and Devon, is ESKOM. This is the reason why the electricity produced at the Chicken Chain Farm will be sold to ESKOM. The extra electricity makes that there will be less power cuts.

6. Resources mobilization

The most important resource will be the biogas digester. This digester has to be designed, constructed and maintained. The design will be an adapted proven already existing design and made by us. The construction and maintenance will be done by a local constructor. The already existing proven design is not that easy to get. We will need to visit some farms where there is already a processing biogas plant, so this can be our example. The next phase will be the application for permits.

Then the manure will be needed to make biogas and electricity out of it. The manure of the cows of Mr. Mofokeng is already on the farm. The manure of the animals which are from the biomass suppliers has to be picked up at the other local farms.

7. Creation of legitimacy / counteract resistance to change

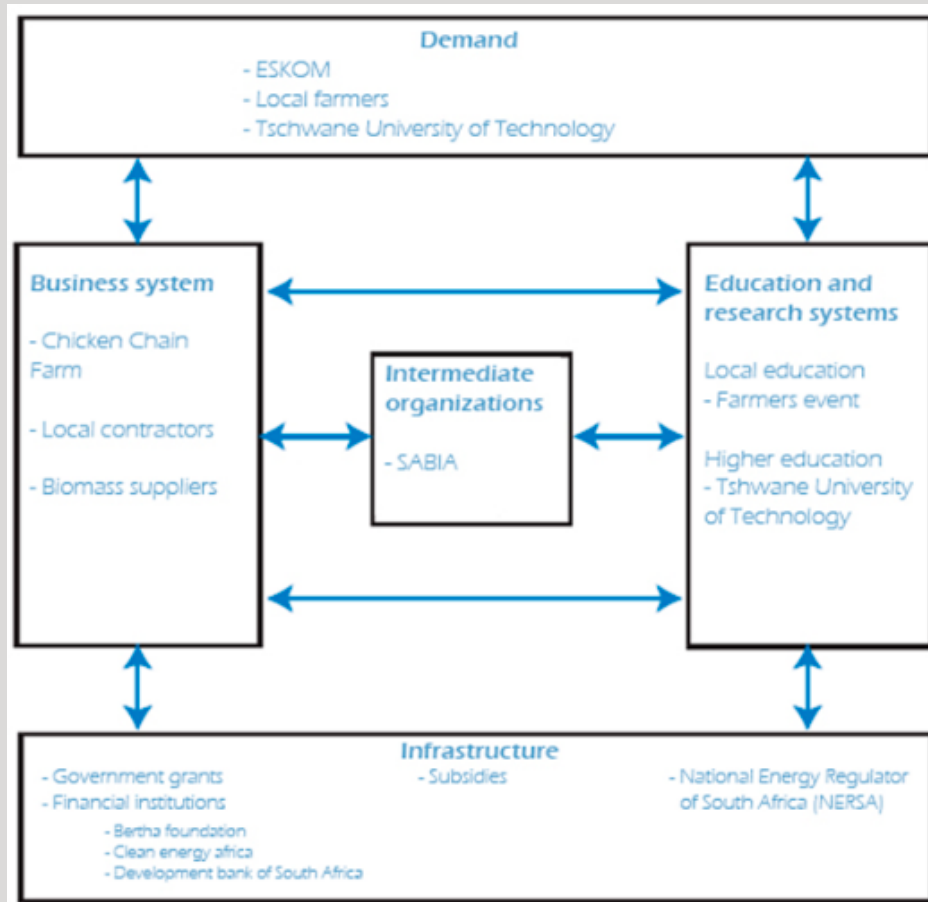
The people in Devon have a need for electricity so the extra production of this product is very welcome. Where or how the electricity is produced is probably not that important to the consumers as long as it will be there.

8. Infrastructure networks

The necessary infrastructure is not yet fully available. First of all the manure of cattle from other farms need to be picked up. Therefore Mr. Mofokeng needs to have a pick-up to get the manure. This pick-up is already available. Next there need to be some electric cables to transport the electricity from the Chicken Chain Farm to ESKOM. These cables are not yet available but will be when the contract with ESKOM is signed.

ANNEX 2. DEVELOPMENT CONTEXT & CULTURAL DIFFERENCES

Cultural analysis



The scheme of the national innovation system regarding the project is given in the figure above. The situation of the influence of the project is explained. The components that need further explanation are Intermediate organizations and Infrastructure.

In the intermediate systems the organizations are put which form a link between business systems and education and research systems. The most important intermediate system is SABIA, South African Biogas Industry Association. This is a network that represents the interest of the members of the biogas industry in South Africa. Over thirty parties from the biogas industry are member of SABIA.

In the infrastructure component the financing of the project plays a big role. NERSA is a regulatory authority whose mandate is to regulate the electricity, piped-gas and petroleum pipelines industries. And financial institutions and the government play a big role in funding the project.

The important potential barriers and/or enablers are NERSA, financial institutions, the government and local contractors.

NERSA can be a barrier. NERSA plays a role in issuing the licenses and setting pertinent conditions with regard to the generation and trading of energy products, including electricity and biogas.

The financial institutions and government are enablers, because the project will be funded by financial institutions and the government.

The local contractors are mostly enablers. The local contractors will construct the designed biogas plant, however they can be barriers when they do not meet up the agreements.

All enablers and barriers are summed in the following table.

Enablers

- ESKOM
- Tshwane University of Technology
- Local contractors
- Biomass suppliers
- Government
- Financial institutions

Barriers

- Local contractors
- Government
- NERSA

Cultural dimensions

- Collectivism
- Feminine
- Non-uncertainty avoidance
- Particularism
- Neutral
- Status by achievement
- Sequential
- Internalism
- Civil Society

- Power distance
- Diffuse

ANNEX 3.

SAFETY AND SECURITY

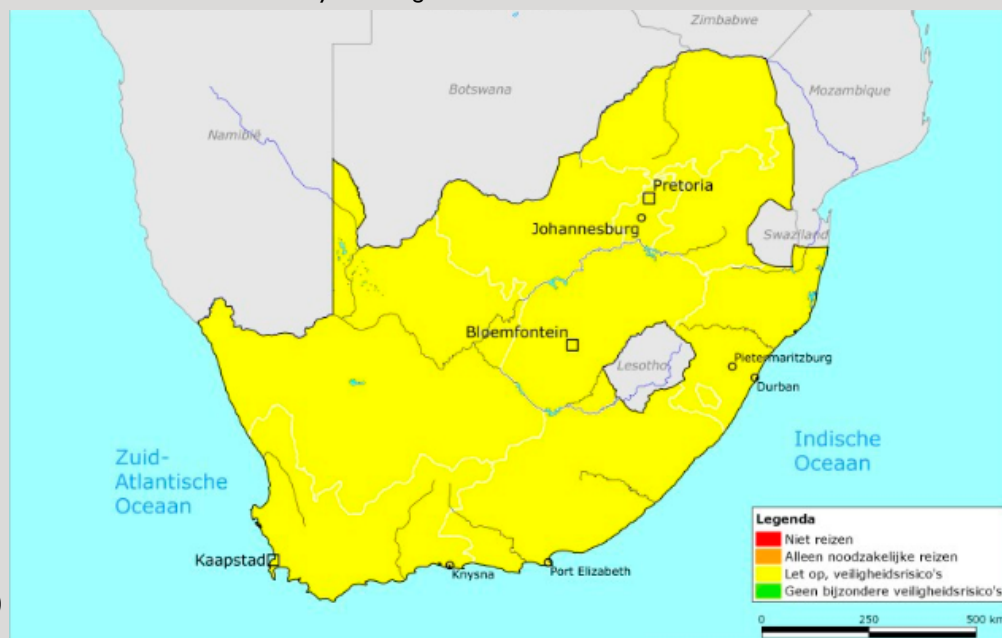
Context analysis

South Africa was originally a Dutch Colony which was overtaken by the British in 1806. Since 1961 it has been a republic. South Africa's modern history has been marred by the policy of apartheid (instituted in 1948 by the National Party). Under apartheid the nation was racially segregated into whites, blacks, Asians and coloureds. Control of the government, land and economy was in the hands of the white minority elite. After a long and violent struggle with the African National Congress, the first fully democratic elections were held in 1994. Nowadays South Africa has 11 official languages. Although South Africa has overcome minority oppression, it faces many challenges as most of the economy is still in the hands of elite, rising xenophobia, emigration of educated whites, high unemployment and poverty rate and a high crime rate. The current president Jacob Zuma has faced corruption and fraud charges.

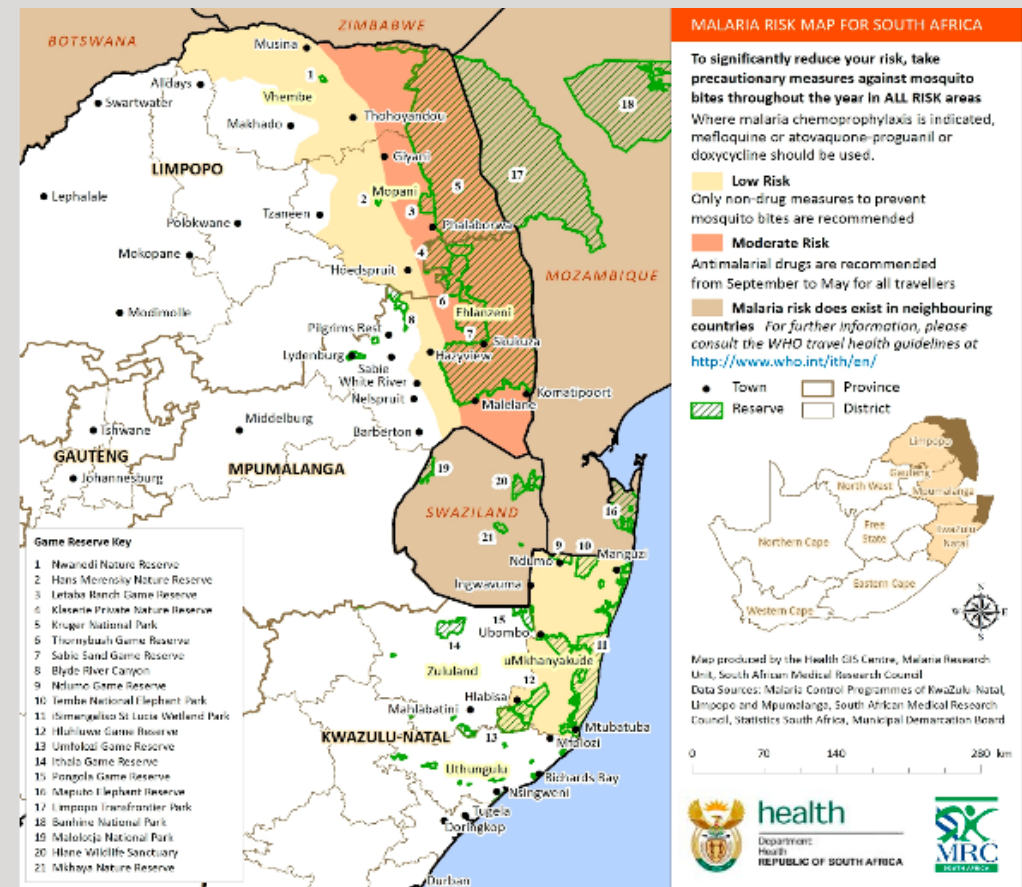
We will be working for one of the few black farmers in South Africa. Our project concerns the design and construction of a medium scale biogas plant. By finding a use for the large amount of waste in the region and providing to South Africa's rapidly increasing energy demand he aims to hit two birds with the same stone.

We will be staying at a farm in Devon, Gauteng. Gauteng is the most diverse and populous region of the nation. Housing one of the capitals, Pretoria, and the largest city, Johannesburg. The name is devised from the Dutch word "Goud" and the Xhosa suffix "-eng". This is symbolic for the prominence of the mining industry in the region.

The farm is located at 1 hour driving from Johannesburg and fifteen minutes from the nearest township. The area is incredibly vast and empty. The climate is comparable to the Mediterranean and quite agreeable. Chance of malaria is very low, as the rainfall is low. In the image below the travel advice of South Africa from the Ministry of Foreign Affairs of the Netherlands.



The malaria risks map as released by the Department of Health. Map produced by the Health GIS Centre, Malaria Research Unit and South African Medical Research Council. Since there is no malaria risk in Devon, we will only take enough malaria pills with us for the safari trip in the National Kruger Park.



ANNEX 3.

SAFETY AND SECURITY

Risk analysis

Impact	Catastrophic					
	High					
	Medium					
	Low					
	Very Low					
		Very Low	Low	Medium	High	Very High
		Probability				

Threat	Likelihood	Estimated Impact	Consolidated Risk	Measures and mitigating actions
Earthquake	Low (2)	Low (2)	4	Go outside
Traffic accident	High (4)	High (4)	16	Wear a seatbelt, ride on safe roads, drive as less as possible. Read the rules what to do in case of accidents and make sure you have a excellent insurance for the car.
Corruption	High (4)	High (4)	16	Follow the rules, don't stand out of the crowd. Negotiate, CARE. Prepare beforehand what to say and to do.
Robbery	High (4)	Medium (3)	12	Give a small amount of money, avoid bad neighborhoods. Look after each other. Do not wear valuables at least not visible.
Infection by rabies	Very low (1)	Very high (5)	5	Avoid contact with dogs, cats, monkeys, bats etc.
No clean water	High (4)	Low (2)	8	Buy bottled water. Use a bobble bottle. Or cook it and filter it, in case of no clean water in the neighborhood
Rape	Low (2)	Very high (5)	10	Never walk alone. Avoid <u>night life</u> . Be at home before dark. Avoid certain neighborhoods. Have a cellphone circle between the four of you initiated.
Armed farm robbery	Low (2)	High (4)	8	Don't tell people where you are staying. Don't be predictable when travelling towards the farm.
Armed vehicle robbery	Low (2)	High (4)	8	Do not drive; only if really necessary. Don't drive in certain neighborhoods. Do not be predictable. Do not carry valuables. Surrender the vehicle immediately
HIV/AIDS	Medium(3)	Very High (5)	15	Avoid sex, avoid unclean needles and avoid bleeding people.

Behaviour and measures

Personal behavior and measures

Do not stand out as tourist and try to blend in with the local people.

Don't wear watches, jewelry, designer clothes, don't have full wallets.

As a women dress deservedly, wear clothes to cover shoulders, knees, etc.

Do not try to be a hero when you are in a unexpected and possibly dangerous situation.

Wear money on different spots on your body.

Know where the hospitals are, how to reach the hospital, which doctors are acting and know the English names of diseases.

Follow the local rules, but be alert.

Drive at least as possible and when driving, drive carefully, don't drink alcohol, don't take too much package and do not take unknown passengers with you.

Always travel with a cell phone. The emergency number to call for the Police is 10111. A functioning cell phone is essential to carry with you at ALL times with full battery and enough credit. Find out before leaving home if your phone will work in South Africa. If not, hire a cell phone when you arrive. Make sure that in case of switching to a local number that you change the number in Osiris and in Kompas.

Avoid contact with animals.

Do not swim in stagnant water.

Do not drink unsafe water and eat only cooked meat/vegetables and salad washed with clean water.

Group rules of engagement

Do not walk alone, always stick in teams of at least two people.

Do what is best for the group, do not be selfish.

Keep in contact with each other, to know where everyone is and where everyone is going.

Know what everyone is up to.

Be home before dark

Watch out with using the Dutch language (they speak Afrikaans).

Contingency plan

CARE

- Calm dignified attitude
- Accept this is happening to you
- Release your valuables
- Eyes: look for things to identify later

Consider

What can you do to make the situation safer?

Is anybody missing or wounded?

Should you involve the police?

After the incident

Write up the details

Help TU Delft to evaluate the incident

Accept help

In case of crisis:

Inform the insurance crisis center

Inform your embassy

Address	210 Florence Ribeiro / Queen Wilhelmina Avenue, Cnr Muckleneuk Street 0181 New Muckleneuk Pretoria South Africa
---------	---

Phone	+27 (0)12-425 4500 24 hours a day, 7 days a week
-------	---

Inform the TU Delft crisis control room; (crisis plan starts)

+31 15 278 1226

Inform Eileen Focke-Bakker

+31 6 388 29 149 (When kidnapped and asked for number call her)

Inform other contacts (parents)

Inform local contacts

Accident	Action plan	Incident reporting
Earthquake	Go outside and stay calm, the earthquakes in this area are not that dangerous.	Takatso Mofokeng
Traffic accident	Always carry a phone number of a taxi company and the nearest hospital. In case others are involved, write immediately the information down. In case of an injury visit the hospital and inform the crisis service of the insurance	Hospital Johannesburg and TU crisis procedure
Corruption	Use prepared sentences like "I will visit the police office with you." and avoid giving money. Don't give your passport or driver's license.	Takatso Mofokeng
Robbery	Stay calm and give your money.	Insurance
Rabies infection	1. Wash the wound thoroughly with soap and water for at least 15 minutes. 2. Apply ethanol or a similar antiseptic to prevent secondary infection. 3. Seek urgent medical attention. You need to start post-exposure prophylaxis as soon as possible.	Hospital Johannesburg
Sickness due unclean water	Get checked by a doctor.	Hospital Johannesburg
Rape	Try to resist. If that doesn't help, give in and don't look at his face. In that case you will be less likely to be killed and get traumatized	Call the TU Delft crisis control room. Call the crisis service of the insurance, alarm the embassy and call Eileen Focke-Bakker
Armed farm robbery	Always hand over any property demanded by armed assailants. Move slowly, carefully, not unexpected Do not try to escape, do not be funny or aggressive. Carefully initiate conversation. Negotiate if possible. Be carefully when trying to alarm the police.	Call the TU Delft crisis control room. Call the crisis service of the insurance, alarm the embassy and call Eileen Focke-Bakker
Armed vehicle robbery	Stay calm, try to negotiate, follow their rules. Don't negotiate if they have a gun.	Call the TU Delft crisis control room. Call the crisis service of the insurance, alarm the embassy and call Eileen Focke-Bakker
Infected with HIV/AIDS	Immediately visit a hospital.	Hospital Johannesburg

Organization details

Accommodation and transport

We are staying at a farm in eastern Gauteng a 15-minutes drive from the nearest village, a 45-minutes drive to a bigger village. And a 1-hour drive to Johannesburg. If we are in Johannesburg we will stay in hostels or hotels. Mr. Mofokeng owns several guard dogs.

There is a car from the farmer for own use, but we will try to avoid driving when it's not necessary. In Johannesburg we will use taxi's (find a trustworthy taxi driver) or public transport.

When staying in Johannesburg we will keep our hotel room locked at all times and only open the door if you are certain who is on the other side. We will hide our personable valuable stuff on a safe spot and not in sight.

Since construction of the biogas plant will not be our job. Personal protective equipment and insurances regarding the construction will not be necessary.

Travel details and local address details

We will travel on the 4th of November with British Airways and arrive on the 5th of November. Yonis, Steven and Job will take the same plane, Eva will take another plane at the flight to South Africa. We will travel back together on the 27th of January (arrival 28th of January), again with British Airways. On our flights we will transfer at London Heathrow.

UW VLUCHTGEGEVENS		details	Standard economy class	BRITISH AIRWAYS	British Airways
✈	wo 04/11 11:45u	Amsterdam (AMS) Schiphol	wo 04/11 12:05u	Londen (LHR) Heathrow	BA 431 (1u20m)
✈	wo 04/11 20:50u	Londen (LHR) Heathrow	do 05/11 09:40u	Johannesburg (JNB) OR Tambo	BA 57 (11u50m)
✈	wo 27/01 20:20u	Johannesburg (JNB) OR Tambo	do 28/01 05:25u	Londen (LHR) Heathrow	BA 56 (10u05m)
✈	do 28/01 06:50u	Londen (LHR) Heathrow	do 28/01 09:15u	Amsterdam (AMS) Schiphol	BA 428 (1u25m)

Figure 5: Flight information Job, Steven and Yonis.

Vluchtboeking		Order number KAXRYE	
Van	Tot	Datum	Tijd
✈ Amsterdam	London Heathrow Apt	Wed 04 Nov 2015	16:10 - 16:30
✈ London Heathrow Apt	Johannesburg O.R. Tambo International	Wed 04 Nov 2015	18:00 - 07:05
✈ Johannesburg O.R. Tambo International	London Heathrow Apt	Wed 27 Jan 2016	20:20 - 05:25
✈ London Heathrow Apt	Amsterdam	Thu 28 Jan 2016	06:50 - 09:15
Passagiers		e-Ticket number(s)	Book no./air ref.
EVA TEN VELDEN		1259772491361	WYEFCL / BA/3GU6GA

Figure 6: Flight information Eva

Main residence

Chicken Chain Enterprise, owned by Takatso Mofokeng
Palmietkuil IR 322 Devon
Gauteng
South Africa

Personal contact details and relevant medical details

Eva ten Velden

Dutch mobile phone: 0031630955070

Parents: 0031623179066 or 0118-601940

Mail: eva_tenvelden@hotmail.com

Allergies: None

Diseases: Colitis Ulcerosa

Blood type: Unknown

Health insurance: Amersfoortse

Steven Roerink

Dutch mobile phone: 0031647950392

Parents: 0031618605858

Mail: stevenroerink@hotmail.com

Allergies: Hay Fever

Blood type: Unknown

Health insurance: OHRA

Job Seuren

Dutch mobile phone: 0031636333869

Parents: 003164630027

Mail: job.seuren@gmail.com

Allergies: None

Blood type: Unknown

Health insurance: IAK

Yonis Le Grand

Dutch mobile phone: 0031681396777

Parents: 0032494259863

Mail: yslegrand1@gmail.com

Allergies: None

Blood type: Unknown

Health insurance: OHRA, Vanbreda (Brussel)

NOTE: If you change your phone number to a local number, do not forget to change that in Osiris and in Kompas.