

# Aspire

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## Waterford Centre of Green Excellence



WATERFORD KAMHLABA  
United World College of Southern Africa

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### COE CARBON NEUTRALITY PROJECT

November, 2015

*It is to be recognized that while the country's innovative technology system has taken important strides forward, **there is a tremendous gap between Swaziland and other countries identified as knowledge driven economies. The grand challenges outlined in this plan address an array of social, economic, political, scientific and technological benefits.** They are designed to stimulate multidisciplinary thinking and to challenge our country to answer existing questions, create new disciplines and develop new technologies to enable municipalities. In parallel with global climate change science, and taking into account Swaziland's geographic position, it enables us to prove Swaziland can play a leading role in climate change science. We wish to focus on Energy, Waste and Water Security – the race is on for safe, clean, affordable and reliable energy supply and Swaziland must meet its medium-term energy and water supply requirements while innovating in clean technologies for the long term.*

***“Too much talk for a long time...too little action for a long time...”***

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## Carbon Neutrality by 2017

### ***PPEP = Public Private Educate Partnership***

#### Objective of the COE

To create an integrated vehicle for economic development and testing in energy, water and waste efficiency and renewable energy technologies with zero waste to landfill and reforestation, all driving carbon reduction proof. ***"A holistic test model for a small town municipality"***

The Centre will work towards the creation of an enabling environment for regional renewable energy and energy efficiency markets by mitigating existing barriers. It will in particular focus on building capacity, manage knowledge and awareness in the region and promote business and investment opportunities.

***"Just as we cannot blame others for destroying the environment, so we cannot look to others to protect the environment. Responsibility for both begins at 'home'..."***

#### Call to Provide a Solution to Swaziland's Green Challenge

As a responsible global citizen with moral as well as legal obligations under the UNFCCC and its Kyoto Protocol, Swaziland should be committed to contributing its fair share to global GHG mitigation efforts. It's said climate change impacts had already been witnessed in Swaziland in the form of erratic rainfall and changing temperatures which have a direct influence on the availability of water, agriculture production, energy sources and supplies, waste management, environmental management and sustainability.

***Aspire and Waterford believe that global greenhouse gas reduction efforts must work in tandem with a pro-poor adaptation agenda. Such an approach will empower the poor and vulnerable and ensure human dignity, whilst endeavouring to attain environmental, social and economic sustainability. This is because the poorest, such as those on the African continent, have contributed least to greenhouse gas concentrations in the atmosphere, but face some of the worst consequences and generally have the least capacity to cope with climate change impacts.***

## Waterford & Carbon Neutrality Dec 2016 – Living Proof Measured and Verified – Step 1

***“He who wishes to prove has to measure...”***

Smart institutions understand the risks posed by climate change and demonstrate leadership in their community and country by setting **science-based greenhouse gas reduction targets**. Institutions that are invested in preventing the adverse consequences of climate change, are seizing opportunities in the new low-carbon economy. The next step in protecting that investment is to ensure that greenhouse gas reduction targets are set at the rate consistent with the pace recommended by climate scientists in order to limit the worst impacts of climate change.

Emissions reductions targets adopted by institutions to reduce GHG emissions are considered “science-based” if they are in line with the level of decarbonisation required to keep global temperature increase below 2°C compared to pre-industrial temperatures, as described in the Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)

**Science Based Targets** is a joint initiative by CDP, the UN Global Compact (UNGC), the World Resources Institute (WRI) and WWF which raises the ambition of corporate mitigation efforts and drives bolder business solutions by identifying and promoting innovative approaches to corporate greenhouse gas (GHG) target setting.

The Science Based Targets initiative is calling on companies to demonstrate their leadership on climate action by publicly committing to science-based GHG reduction targets. We aim to enlist 100 companies in 2015 and 2 500 companies globally by 2020. All participating companies will be recognized internationally with world acclaim. **Waterford has been nominated and accepted to be one of the top 100 in the world for 2015.**

### **Benefits of Science Based Carbon Accounting**

Reducing GHG emissions protects our climate and our communities – and it’s also good for business. Companies that set science-based targets build long-term business value and safeguard their future

**Profitability** in four important ways:

#### **1. Drive innovation**

The transition to a low-carbon economy will catalyse the development of new technologies and operational practices. **The institutions that set ambitious targets now, will lead innovation and transformation tomorrow.**

#### **2. Save money and increase competitiveness**

Setting ambitious targets now ensures a lean, efficient and durable business in a future where resources will become increasingly more expensive – particularly resources derived from fossil fuels.

#### **3. Build credibility and reputation**

Institutions taking a leadership position on climate bolster their credibility and reputation among stakeholders, including investors, students, employees, policy makers and environmental groups. Approximately half of consumers worldwide believe climate change will have a negative effect on their own lives, and 65% of consumers agree that human activity is responsible for climate change.

#### 4. Influence and prepare for shifting Public Policy

Taking ambitious action now assists companies in staying ahead of future policies and regulations in order to limit GHG emissions. Institutions that are seen as leaders are better able to influence policy makers and help shape and develop legislation.

#### Criteria for setting science-based targets

- **Scope:** The target boundary must be company-wide covering of all of the GHG's included in the GHG Protocol and must include **Scope 1** and **Scope 2** emissions as per the GHG Protocol Corporate Standard.
- **Timeframe:** The commitment period must cover a minimum of 2 years from the date of announcement of the target.
- **Level of ambition:** The ambition of the target must lead to a gross GHG reduction rate that is consistent with the level of decarbonisation required to keep global temperature increase well below 2 °Celsius compared to pre-industrial temperatures, as described by the IPCC AR5 report
- **Reporting:** Companies are required to disclose their GHG emissions on an annual basis along with any other data that shows progress against their targets.

**Waterford will follow total compliance to GHG International Protocol reporting and verification - monitored and verified Internationally and made available for Public Viewing.**



#### Background

##### Energy Crisis in Swaziland

South Africa supplies and fulfils most all of Swaziland's Energy Requirements

Experts admit that the South African economy, among the biggest in Africa and a top emerging market, is unable to grow due to a supply crisis by state-owned electricity provider Eskom and calls are being made to reduce supply to Swaziland amongst other looming strategies. Eskom has current and forthcoming price hikes tabled which will filter to the off takers as well as numerous predicted supply shortages in the next 5 years.

Currently, South Africa's energy production is based primarily on fossil fuels. Coal, of which South Africa has comparatively rich reserves, provides some 93% of South Africa's electricity production, but places the country among the world's highest producers of CO<sub>2</sub>e per capita. It exports over 90% of Swaziland's electricity consumption to it and as a result, Swaziland is accountable for the emissions on energy it takes off.

Swaziland's crises could be alleviated if energy generation is structured into diversified generation units. Generation will need to be managed by a smaller number of financially viable outfits feeding municipalities to create enabling environments for municipalities.

**In order to achieve this, the COE Project wishes to act as a platform for building relationships with responsible authorities, provide support in shaping new legislation and comment on amendments, ensure compliance with existing laws, involve the public in energy issues and build human capacity for environmental action.**

## Swaziland Water Crisis

Swaziland faces a far more disruptive threat than Eskom, its energy supplier's power failures, one that is potentially calamitous.

### **Swaziland is currently facing a multi-faceted water crisis**

In addition, given the current and anticipated future growth rates of the population and trends in socio-economic development, it is estimated that Swaziland's freshwater resources will be unable to sustain the current patterns of water use and discharge. *"It is estimated that the country's total requirements for water use will double over the next 30 years."* –WORLD BANK. Major industrial development and urban settlement have taken place in regions where water resources are not readily available and have resulted in substantial potential impacts on the quality of water in the country which is already limited in terms of supply. Waste water needs to be re-deployed back into areas – *"cradle to cradle..."*

*"The rapid increase in urbanisation in Swaziland (3 to 5% per annum) has been fuelled by rural-to-urban migration. Currently, about 25% of the population lives in urban areas or peri-urban areas in the country. If rural-to-urban migration continues at this rate, it is expected that by the year 2030, approximately 70% of the total population will be living in urban or peri-urban areas. This has led to the development of unplanned settlements with low quality housing, poor sanitation and unhealthy living conditions and shortage of job opportunities. This has resulted in a significant decrease in the provision of basic services of housing, water, sanitation, education and health services."* –WORLD BANK. Examples of sources, residuals discharged and effects can be seen in Manzini where the challenge of urbanisation is serious.

## Waste Water Crisis in Swaziland

A challenge faced in Swaziland is that about only **10%** of Swaziland's ground water is being accessed while **90%** of its citizens depend on this groundwater - many of which are from rural areas. Currently, there are no direct uses for greywater in Swaziland; either for domestic, agricultural or industrial use. Swaziland has the potential to reuse wastewater on a large scale since the current infrastructure can be modified to support alternative solutions.

There is limited capacity and expertise within the water sector of Swaziland as no need has arisen previously to revise older systems. There are gaps, both in the policies and its implementation, of wastewater management. There is also an absence of a concluded *National Water Development Plan* with particular focus on waste water management. Lack of knowledge has been identified both on the supply as well as demand side. Institutions responsible for allocating water to users do not

prioritise wastewater use. Instead, more emphasis is placed on improving irrigation efficiency since 95% of the water received in Swaziland, is used in the agriculture sector (DWA, 2011a). They do not see the benefits of wastewater recycling and perceive wastewater as unsafe - even after treatment. With the urbanisation growth predicted and the current water shortages, it is now imperative to deliver with 'tested' solutions.

On the wastewater side, energy potential (contained in wastewater and its bio solids) exceeds the energy used to treat it, **tenfold**. Some WWTP's can produce **100% or more** of the energy they require to operate- Collectively, they can potentially meet 10% of the national electricity demand. This represents a tremendous opportunity in the wastewater industry which we wish to prove.

## Reforestation & Natural Biomass Swaziland

Global reforestation is an important environmental issue of growing concern. International programs like the United Nations Initiative for Reducing Emissions from Deforestation and Forest Degradation are key for implementing global programs for reducing deforestation, emissions through reforestation and afforestation projects.

Commercial bamboo plantations can help achieve these goals by serving as an alternative to traditional timber and as a resource to stimulate national and local economies and reduce foreign imports.

Bamboo is a rapidly growing grass that can tolerate poor soils. With over 1,400 species, selection of suitable species can reforest areas, restore degraded lands and provide financial benefits. Planting bamboo is particularly important in locations where a return to pure or mixed forested areas is not realistic. In a landscape mosaic approach, bamboo is planted in areas that combine forests and trees with other land uses.

Bamboo can support restoration efforts through soil protection and slope stabilization, helps regulate water tables, contributing to filtration and watershed protection and protecting against soil erosion and runoff. Shade produced by bamboo moderates the microclimate and increases rainfall while the multilevel ecosystem increases biodiversity. An outstanding element is that it thrives in 'greywater' and effluent water.

## Barriers to Entry - Acceptance of Energy, Water, Waste & CO<sub>2</sub>e Reduction Strategies

- Perceptions about initial capital outlay; may be allayed by greater familiarity with the technology and the savings realized through the use of renewable generation equipment which, in turn, funds secondary initiatives -proof of '*triple bottom line*' returns.
- The use of renewables and waste processing is seen as costly, unfamiliar and lacking in support; vast technological advancement that requires national demonstration pilots.
- Information; especially relating to performance and reliability - required to identify and assess opportunities for using "*greening*" components and its benefits;
- Lack of demonstrations of renewable equipment in remote areas; could be an effective means of disseminating information.
- A reliable system of providing continuous service, maintenance, testing and R & D; hence a "**Centre Of Green Excellence**" (COE).

## Waterford presents it's COE and combined path to Carbon Neutrality

### **Centre of Green Excellence - a trial as a "Micro Municipality"**

***"Every municipality in Swaziland ensuring it undertakes core basic functions as efficiently, effectively and rigorously as is humanly possible..."***

We wish to devise a model conducive to the Swaziland Local Government Act in order to create an enabling environment and remove current perceived barriers to entry - in line with Mbabane's statement - the leader of all municipalities in Swaziland - **Mission - "The City of Mbabane shall strive to deliver high quality services through;**

- Preserving, protecting and enhancing the quality of life
- Harnessing growth, development, good governance, responsive quality services for all Stakeholders
- Sustainable development based on modern technological, environmental, economic and social principles.

**We have concluded with Waterford Estate (a 'mini municipality'), located in Swaziland, to host a "Bouquet of Technologies" supplied by leading innovators, to simulate core disciplines of Energy ,Water, Reforestation and Waste 'hybrid' solutions. This model, once commissioned, and proving the technologies indeed work, together with returns on investments – can then be replicated on a larger scale, into a municipality, confidently.**

***"...PROOF OF THE PUDDING IS IN THE EATING..."***

## Green Centre of Excellence -Why Waterford ?

*"Waterford Kamhlaba UWCSA strives to lay the foundation for its students to become responsible citizens who have the skills, knowledge and sense of purpose to provide leadership in both Africa and the world. We passionately believe that all young people must be given access to education of the highest standard to enable them to realise their potential. Waterford Kamhlaba UWCSA is proud to deliver that opportunity to disadvantaged yet talented African students through its Scholarship Programme. Waterford highly values its socio-economic and cultural diversity. In 1967 His Majesty King Sobhuza II, Ngwenyama of Swaziland, granted Waterford the title "Kamhlaba", eloquently describing Waterford's culturally rich and diverse community thus:"*

***"We are all of the earth, which does not see differences of colour, religion or race. We are 'kamhlaba' – all of one world."***



Tackling climate change requires concerted coordinated government action as well as conscious and informed efforts by individuals. Therefore, it is essential to strengthen both formal and informal education on climate change and viable lifestyles. In addition, sustainable production and consumption patterns must be promoted and youth supported as environmental champions in their local communities. Partnerships should be developed between governments, intergovernmental, non-governmental and youth organizations for joint environmental initiatives aimed at building the capacity of youth as future leaders and driving forces behind a new climate change regime. Considerable efforts are also needed in strengthening the adaptive capability and resilience of youth in rural communities in developing countries.

***“More efforts must be made to ensure that youth are ready to take advantage of new environment oriented employment opportunities. Growing attention to climate change and sustainable development offers a chance for green economic growth around the world. Green jobs not only provide much needed employment opportunities for youth, they also give youth an outlet to contribute directly to the fight against climate change by adopting green behaviours in the school place as well as in their private lives...”***

## Training, Awareness & New Skills Development into the “Green Economy”

Training and education are widely accepted as a necessary facilitator for change to occur. It is therefore imperative that the built environment sector gears up for this change and equips industry with the skills, knowledge and behaviour required to deliver a sustainably built environment. This includes not only skills in the low carbon and environmental goods and services sector, but also those needed to help all businesses use natural resources efficiently and sustainably and to be resilient to climate change. Through a diverse education programme we aim to build the capacity of new skills for new jobs in this environment;

- Encourage leadership on ‘green’ issues
- Enhance knowledge about sustainability
- Facilitate multi-disciplinary collaboration
- Assist organisations to ‘future-proof’ their business’
- Foster a perspective based around systems-thinking
- Ensure environmental workforce development and ‘Green’ Job Training Academy

‘Green’ jobs can be found in sustainability-related career fields that encompass a wide range of skills, educational backgrounds and occupational profiles. The advantages of these green jobs are that they not only alleviate poverty, but they "contribute" directly to preserving or enhancing environmental quality in a sustainable low-carbon economy; protect ecosystems and biodiversity; reduce energy, materials and water consumption through high efficiency strategies; de-carbonise the economy; minimise or altogether avoid the generation of all forms of waste and pollution.

# SCHEMATIC OF THE HOST TO THE CENTRE OF GREEN EXCELLENCE HUB



Our "Mini Municipality"



## Project Developer - Aspire System Concept

This *Aspire Low Carbon Emitting Lifestyle Project* is a 'proof of concept' project that will lead to the establishment of a "Centre of Excellence" for a Sustainable Green Eco System which includes 1 MWp renewable energy power generation, recycling of waste to reduce the adverse impact of modern lifestyles on the environment, reforestation to provide a carbon sink (*and feedstock for biomass energy*), a pilot of 6 x low cost sustainable housing schemes together with skills development the 'green' technologies industry.

Aspire has partnered with Waterford Estate – provider of the land required for the "proof of concept" Renewable Energy Innovation showcase. Incorporated stakeholders are Private Sector Partners, Technology/Solution Partners, Specialist Consultant and Implementation Experts and Independent Strategists and Campaigners.

A 'real life' working Innovation Centre will exist, showcasing the following components of Renewable Energy and other technologies utilized:

- Photovoltaic - Grid & Off Grid Energy System Hybrid with Waste-to-Energy plant
- Water Recycling and Sewage Capture
- Reforestation and Feeder Stock for Biomass
- Waste to Landfill Eradication
- Green, Sustainable Building "Village"

## The Envisaged Result

The model and showcase, when commissioned, will prove to interested parties that the technologies and "triple" returns on investment, can be replicated with confidence on a larger scale to different communities throughout Swaziland. The COE will serve as a "mini municipality" within Waterford Estate.

## Aspire Energy System Objectives

1. We believe that Waterford can be successfully grid disconnected and be self-sustainable at the same time. It is to be noted that this environment has excessive peaks and dips 24/7 due to the nature of its business; this would dispel doubts about the capability of 'Hybrid' power generation systems to produce reliable energy from renewable energy sources to support a typical town or city.
2. About 50% of the energy from the Aspire RE Power System will be consumed by Waterford with the balance to be evacuated into the local Municipal Grid, in collaboration with the Municipality thereby proving, that under the MFMA metering, Municipalities can buy 'Green' Energy. We have the support from SEC and SERA in this regard. The remuneration on the energy will ensure sustainability going forward.

3. Waterford is like a small housing suburb with regular energy requirements. The Aspire RE Power System aims to show that a hybrid system can power a town that is not grid connected (such as rural areas in Swaziland with no electrification).
4. Performance Data of each RE Technology will be made available to the public for research and evaluation on an ongoing basis.

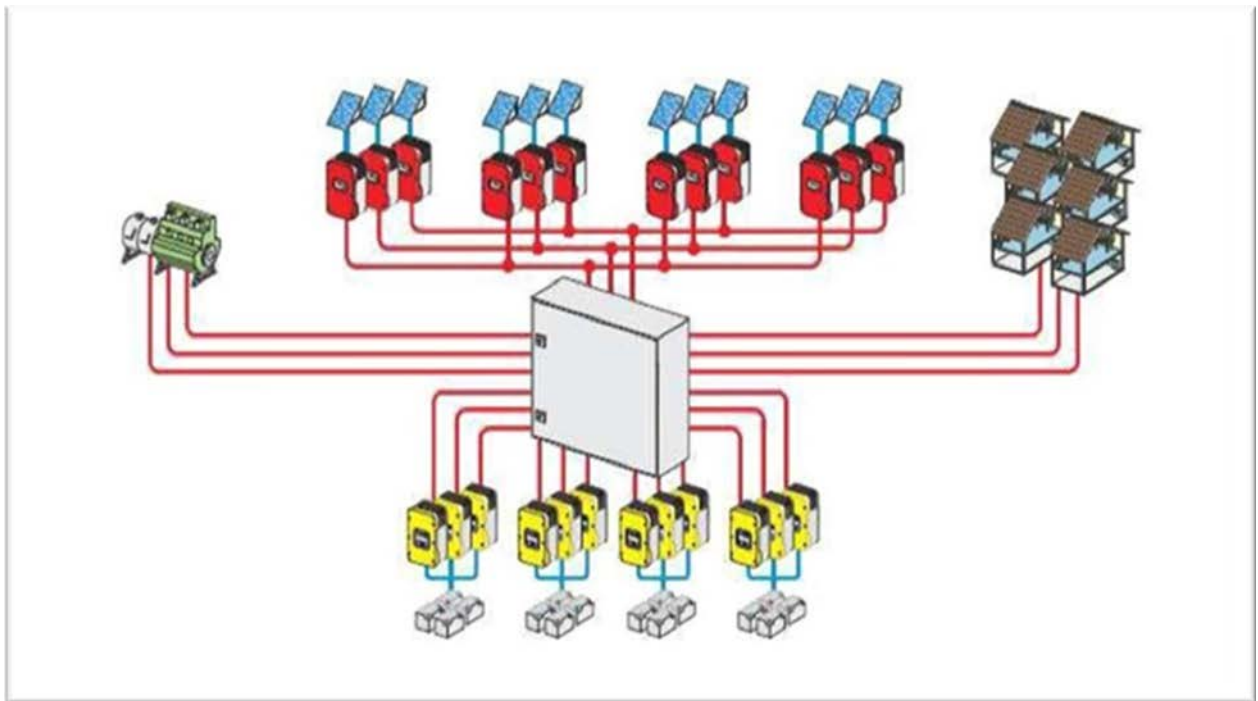
## PV/Battery/Gen-set /Hybrid

Waterford can be compared to a small housing suburb and its energy requirements. We wish to prove a revolutionary hybrid system to support a small town for an application in areas with no grid infrastructure - self sustainability. Waterford currently utilizes 1 400 000 kWh per annum. Historical and ongoing feasibility will be conducted as well as all the restrictions and implications of this solution to ensure confidence prior to roll out into other challenged areas.

Alternative energy support is provided via a stand-alone energy generation plant comprising of about 700 kWp solar ground mounted tracking system interacting with a 250 kW SMA battery inverters. A further 900 kWh Lithium Ion battery system will stabilise and support the load consumption. A Gas Gen-set of 250kVA is directly connected to the cluster box, as the load is.(fed with gas from biomass). A second Gas generator (150 kVA), located 125 m from the new energy house is serving as a back-up generator and provides energy in the case of peak loads in winter season. Under low load conditions, the grid will be formed by the battery inverters. With start of the 250kVA Gas Gen-set, it overtakes forming the grid, the battery inverters and PV is synchronizing itself to it. Note that the system is also suitable to be connected to the grid instead of the Gas aggregates.

The surplus energy generation of this system and the waste energy system will be evacuated into the SEC grid.

*Microgrids are modern, localized, small-scale grids, contrary to the traditional, centralized electricity grid (macro grid). Microgrids can disconnect from the centralized grid and operate autonomously, strengthen grid resilience and help mitigate grid disturbances.*



*Concept of a PV/Battery/Gen-set Microgrid as proposed for Waterford*

## Waste-To-Energy Plant

**The 250 kW an hour waste to energy plant will be connected to the grid**

### Processes & Benefits

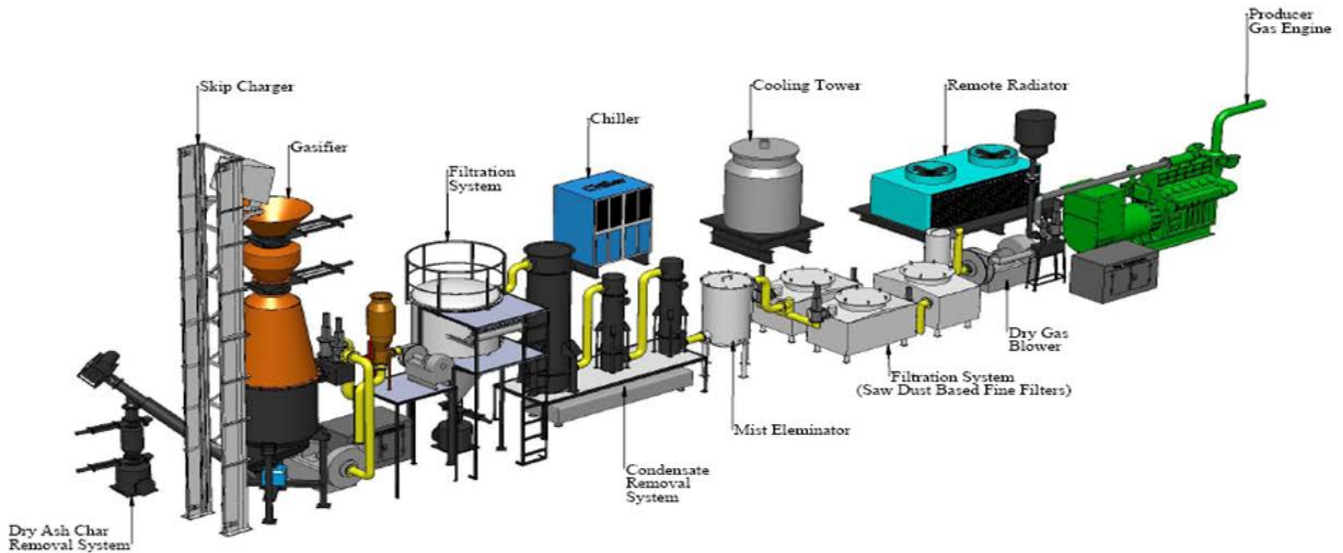
- Reduce 1 ton of MSW or Sewage waste per day currently going to the landfill sites
- Waste will be mixed with biomass products from bamboo reforestation (explained later )
- Generate energy 24/7 and supply SEC with 2 500 000 kWh a year of 'green' energy
- Carbon reduction on waste and energy
- Produces natural by-product of approx. 1 ton of bio-char per day for soil enhancement for sustainable farming projects, up to 80 times better than fertilisers and **reduces water need**
- Solution model can be replicated on a large scale for all municipal sewage works.
- Proof of connection to the grid in a municipal area with compensation - one of the challenges in MFMA currently to define policy on grid feed and tariffs.
- Enabling environment for the **municipality to derive profit from Green Energy**
- Solve threatening Sewage and MSW to landfill challenges.

Biomass gasification is basically conversion of solid fuels (wood/wood-waste, agricultural residues, etc.) into a combustible gas mixture normally called Producer Gas. The process is typically used for various biomass materials and it involves partial combustion of such biomass.

Advantages of gasification:

It converts a traditional low quality fuel that is inconvenient to use into high quality, convenient, combustible gaseous fuel. Such conversion is at relatively very high efficiencies and results in total convenience and process control. Almost all environment pollution associated with biomass use can be eliminated. It is environmentally friendly and adds to the efforts to reduce global warming.

Both initial investment and also the cost of energy-power production (LCOE – Levelled Cost of Electricity) are just about the lowest.



## Reforestation - 25 ha Biomass Project

### Proposed Solution - Beema Bamboo

“Beema” is a specially breed variety by Dr. N. Barathi of Growmore Biotech Ltd., which has a potential to grow very fast and yields very high biomass due to the fact that the wall thickness of “Beema” Bamboo is 3 times more than other bamboo. The carbon content of “Beema” Bamboo is between 48 to 52%.

The dry matter production of “Beema” Bamboo under optimum condition reaches 40 to 50 tons per acre or 100 to 125 tons per hectare. The total carbon accumulation every year, after 5 years of growth, is from 18 tons to 23 tons per acre, which is equivalent to 69 tons to 80 tons per acre respectively.

Due to this fact, “Beema” Bamboo acts as a “Carbon Sink”. When “Beema” Bamboo is grown individually in the gardens and parks, it sequester 400 to 500 kg. Of carbon di-oxide every year, thereby reduces the Carbon di-oxide in the surrounding places. “Beema” Bamboo generates 70 to 80 CER per acre / year, which is equivalent to 175 to 200 CER per hectare every year.

## Bamboo for Clean O<sub>2</sub>

- Bamboo absorbs Carbon dioxide and releases oxygen into the atmosphere 3 to 4 times higher than many other trees
- Bamboo sequesters 62 tons of CO<sub>2</sub>/year in 1 hectare
- 1 hectare of young forest sequesters 30 to 40 tons of CO<sub>2</sub>/year
- **NEW "Beema" Bamboo sequesters 200 tons of CO<sub>2</sub>/year in 1 hectare**
- **OXYGEN (O<sub>2</sub>)**
  - Human requirement : 280 – 300 kg/year
  - One bamboo production : 307 kg/year

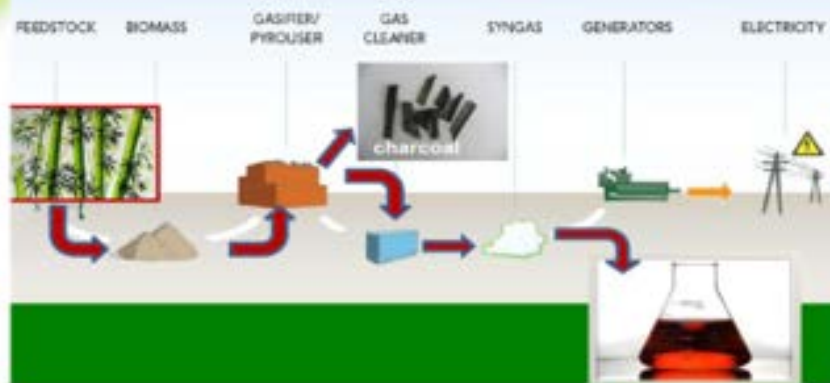


## The Road to Carbon Neutral Swaziland



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## Plantation to Green Energy



USES DEGRADED GREY WATER AND SEWAGE WATER

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fppt.com

### Bamboo - Multiple Benefits & Most Favourable Feedstock

- Indigenous plant species
- Easier to establish than tree species
- High regenerative capacity, even when burned
- High capacity to withstand extreme environmental conditions
- Fast growing and high-biomass yield
- Short maturity period
- Co-products: Bamboo shoots and High quality Bio-Char
- Reduces dependence on fossil fuel
- Establishes land cover
- Reduces GHG emissions
- Creates jobs
- Motivates economic activity in the countryside
- Saves foreign exchange
- Cheaper than fossil fuel



## Grey & Black Water and Rain Harvesting for Drip Irrigation

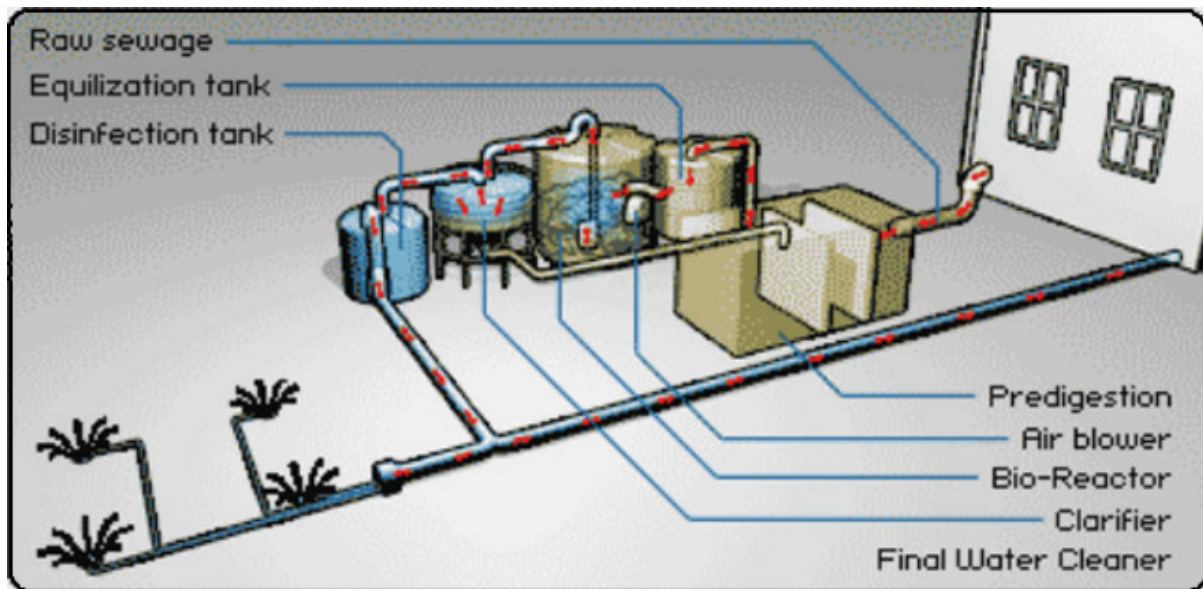
Drinkable water on our planet consists of less than a small percentage of 1% of all the water available. Water will have to be conserved and collected on a local scale, building by building, in the years ahead, to avoid catastrophic consequences. Meanwhile, it's a practical economic benefit for buildings to go "off the pipeline," in terms of water supply, just as many are going "off the grid" to generate their own electricity.

Water wastage is prolific. In the world, monies are poured into automatic sprinkler systems that merrily encourage *driveways, pavements and other inanimate to grow*. This method is very cost ineffective. Another factor is that, especially when the sun is shining, much of the irrigated water is lost to evaporation. Most plants are solar sensitive and internally (metabolically) active very early in the mornings.

Drip irrigation is water wise. It allows the delivery of a limited volume of water to the soil just above the root zone of each individual plant, or clump of small varieties, ensuring that wastage is at an absolute minimum. For most, two litres per plant per day is adequate. Every drop goes to the roots, avoiding the wasteful 'feast and famine' caused by irregular soakings.

### **Black Water**

The efficient, clean and cost effective way of processing Dangerous Human Waste Water is the Lilliput Treatment System- simple to install and even simpler to run. They exceed the limits for discharge to the environment and are biologically processed. Lilliput Systems comply with responsible disposal requirements and save you water by re-using it for irrigation. The Lilliput operation is both odourless and virtually silent.



The Lilliput system has the following advantages:

- Environmentally friendly
- Very simple and cost effective to maintain
- Quick and simple to install and operate
- Very small footprint.

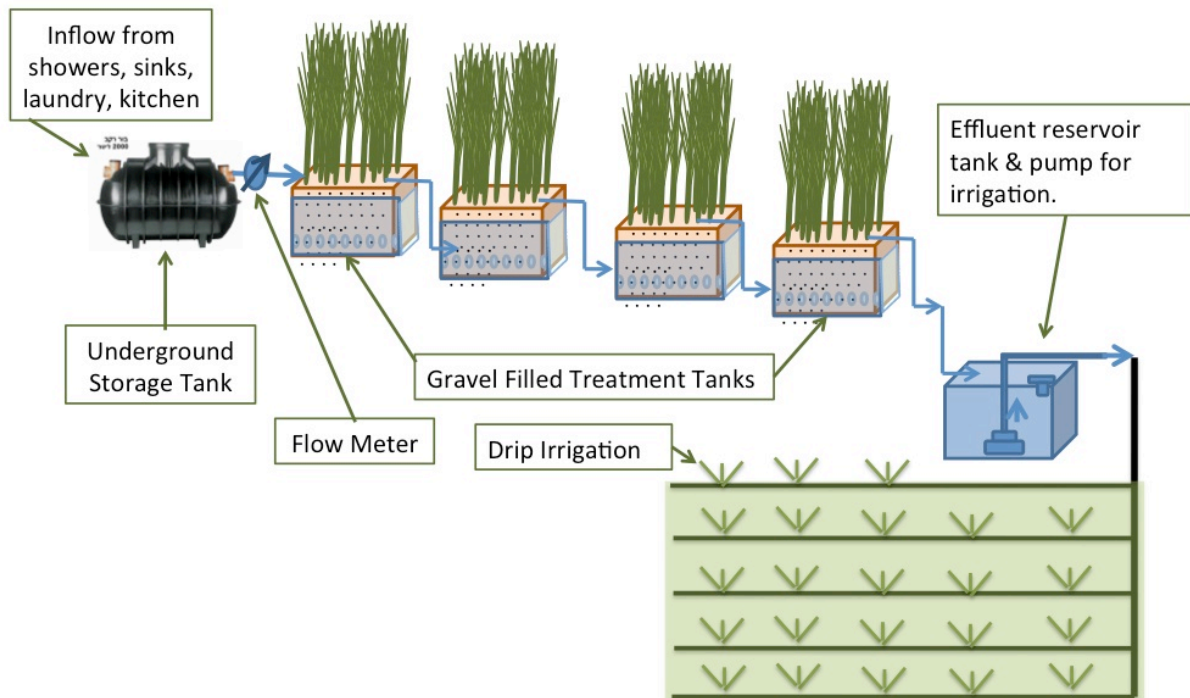
Urbanization and population growth have taken their toll on the crumbling sewer systems in many municipalities and **many sewer systems are forced to release untreated sewage - a serious health issue and waste of valuable water and fertiliser.**

One human is the cause of up to 200l of waste per day- and 500g of dry sludge, both products a useful resource..!

### Grey Water and Rain harvesting

What is greywater? Greywater includes all wastewater generated in the residences, except toilet water (which is considered “black water” and is covered above).

Aspire has developed a natural greywater treatment and reuse system. As illustrated in Figure below, these systems are designed to collect greywater (reclaimed water from sinks, showers, kitchens, or laundry) and, through a series of gravel-filled treatment tanks, treat water to a quality suitable for reuse in irrigation for agriculture.



Rain Water harvesting tanks must also be deployed to the main reservoir tank on the grey water system.

The above will be utilised for testing and R&D at the COE to monitor and prove the viability of balancing grey and black water for re-use , with larger scale replication in clusters into the communities. This would be huge avoided capital on reticulation infrastructure for sewage system.

## Landfill Waste Reduction with Zero Emissions

The Thermal Garbage Processor is without a doubt the most viable solution for any municipality when one considers the issues surrounding landfill sites, be it the commissioning of a new one or the rehabilitation of a filled one. This in line with Government's encouragement of municipalities to review alternative means of solid waste management. They are encouraged to explore alternative methodologies to manage solid waste, including recycling and incineration in plants that use the heat energy to generate electricity.

We will prove a solution to the below National Strategy by operating a mini system on Waterford Estate

**This National Solid Waste Management Strategy (NSWMS) for Swaziland sets out the following vision for the Kingdom:**

*"to develop, implement and maintain an integrated waste management system that will reduce the adverse impact of all forms of solid waste, so that social and economic development in Swaziland, the health of it's people and the quality of it's environment and it's resources benefit."*

## Advantages

- This product can dispose refuse without use of oil, electricity or any fuel.
- The high temperature treatment of waste, affords the product to kill harmful bacteria.
- Utilise environ-waste friendly gas treatment equipment, gas emission in-line with air quality standards.
- No unpleasant odours and no impact to the surrounding environment.
- Significant reduction in refuse quantity. Residue after treatment is only 3% of the original volume.
- Can continuously operate 24 hours after first ignition as long as there is waste in the machine chamber – the critical temperature has to be maintained.
- This machine has no complex drive part in its system, easy to operate and has a proven stable performance.
- This product is equipped with good thermal conductivity materials and will not form local high temperature when working.



**A 2 Ton pilot plant to be setup and operated at Waterford Centre for replication on large scale landfill sites**

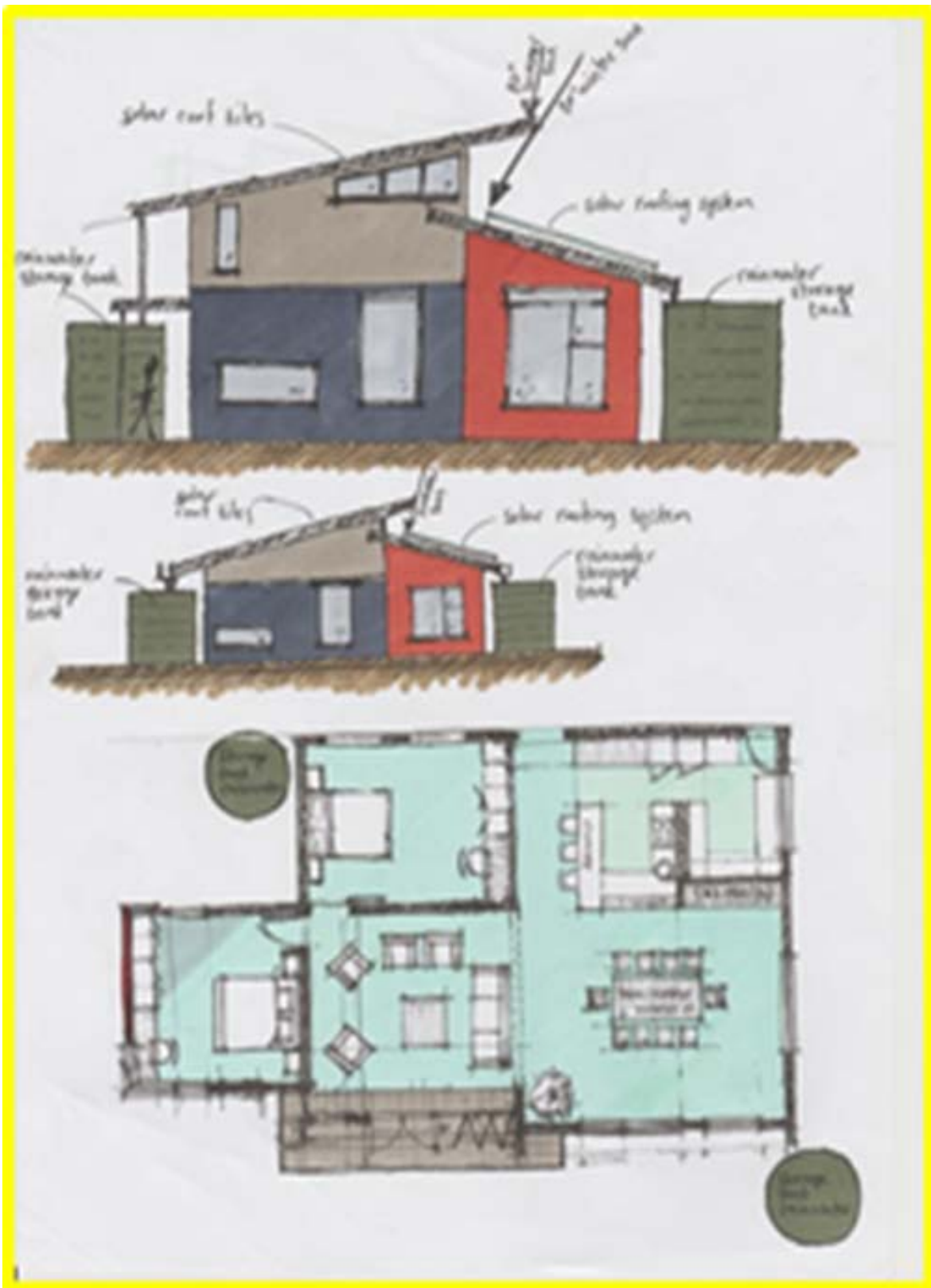
## Alternative Housing Solution

*“Given the enormous housing backlog in Swaziland and the need for quality houses to be built, we have developed a solution using green alternative technology that is affordable, is adequate and one which would restore the dignity of our people”*

The construction of the buildings will be done in such a way that the buildings will not be using any Municipal Electricity. The roofs will be harvesting solar power and all lighting and energy efficient electrical fittings will be running from the power generated on the roofs. Both rainwater as well as grey water harvesting will be implemented for re-use in toilets and watering of the vegetable gardens. Water saving fittings will also be installed at all water points. Black water will also be recycled on site using the ‘Lilly pit’ system and bamboo for runoff water to purify water for use in the gardens. Aerated Autoclaved Concrete products from the AAC Production Plant are ideal for the construction of the COE, which are bricks with a very High R Rating, cheaper than bricks currently used for low cost housing and green in production – ‘Passive’ green building.

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*The insulation properties of the AAC products are such that there is no need for heating or cooling in the buildings.*



There is no need for sewage, water or electricity connection - Moving away from biomass burning  
It can be constructed in 8 weeks - Self-Sustainable house ready for occupation  
In 8 weeks, with all the finishes of a "middle class" Home, but in 40 to 80 msq sizes.

The construction of the houses will be evaluated and used as proof for “Green Star Rating”.

All R&D specialists will be able to engage at the COE to fit houses with ongoing innovative designs.

The houses will then form the “Green Village” in which visitors to the centre will stay in to review the centre’s “Bouquet” of Technologies.

## The Green Hub of the COE

The project will house a ‘hub’ where all R&D can be displayed contributing significantly to the development and demonstration of new technologies that will lead to emissions reductions and the feasibility for implementation within small municipalities across Swaziland and help them achieve their climate change obligations as well as service supply challenges in water, waste and energy services. The COE will also support small and medium sized businesses in developing additional innovative low carbon products continuously.

### ***A “Green”, State of the Art, Research Centre for Municipalities***

Researchers, engineers, project managers, Government representatives, SEC , SERA and members from academia as well as industry, will be invited to work and explore, side-by-side, in the centre, which will be based in a new environmentally-friendly “green building village” - the COE. Waterford, host of the COE, already has conferencing and event facilities, exhibition space, which can be grown in order to host larger groups, etc. To underpin the sustainability and low-carbon credentials of the research undertaken here, Waterford , in itself, will already be a ‘Green’ site that strives for Carbon Neutrality.

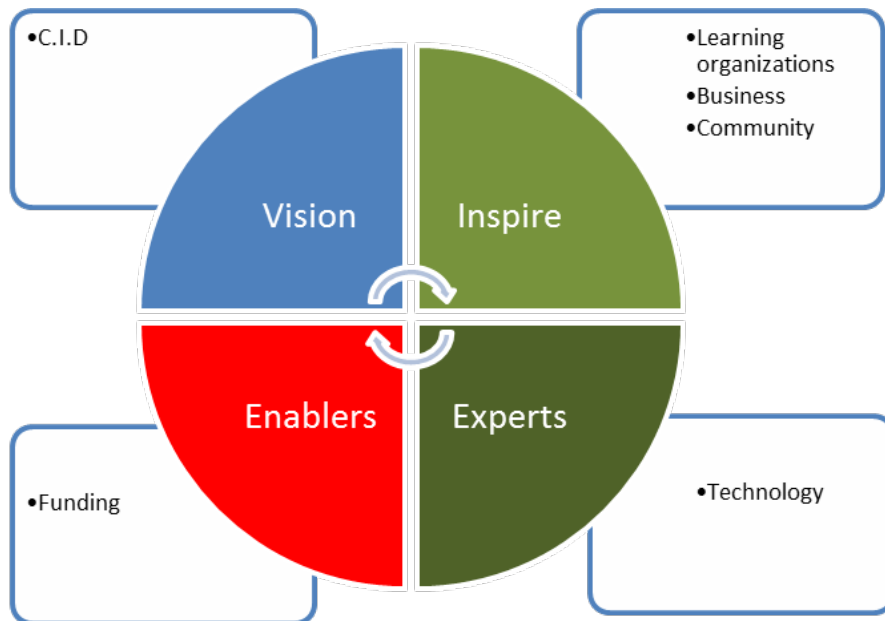
### **Show case, Testing, Training & Development - The Bigger Picture**

- To do continual testing and evaluation on the equipment performance
- Recording all data ,stats and results in collaboration with the design specialists
- To showcase the technology where local and national stakeholders, can “touch and feel” and question the technologies
- To develop from the show case centre, a training centre in green technology, that can be expanded as the need arises, complete with accommodation and Lecturing facilities.
- Training courses in new skills to be developed from the core dynamics of the technology.
- To provide Municipalities confidence in “new” technology for replication on a larger scale.
- The Centre is in Central Swaziland and accessible to all the neighbours equally
- Two Year Vision is to grow into full established Green Academy.

## Sustainability & Resilience Education

Sustainability Education empowers the youth of this generation and future generations to leading society to a low carbon and climate resilient future - **The birth of "PIRE"**

**Concept Initiator & Developer - Mike Doyle**



### **PIRE GROUP - Partners in Renewable Energy Group**

#### **Vision**

Research shows that there is disconnect between the understanding of Sustainability Education and the implementation thereof. Concept Initiator Developer (CID), Michael Doyle, has a vision that for Sustainability to become the new 'collective will' requires learning organizations to not only adopt it as an embedded part of education, but to also demonstrate the theory in action. The vision of the PIRE GROUP is to bridge this disconnect and inspire future generations to a new way of thinking and co-operation.

#### **Inspire**

Essential to the vision is the inspiration that learning organization can bring to not only learners, but also to other stakeholders such as parents, their supply chain, and community. In order to do so, learning organizations will embed Sustainability in their curriculum, and equally importantly, demonstrate the practice of Sustainability. Furthermore, the learning organization has the



opportunity to develop its renewable energy program with partnerships with their stakeholders in order to expand the network of sustainable practice.

### Experts

Central to the development of PIRE success is the research and development component. This requires expert knowledge for the development of the correct renewable energy and efficiency technologies. Furthermore, expert knowledge is required to illustrate the benefits of the energy switch to the learning organization, and its stakeholders, as well as the associated impacts on the natural environment. Carbon Project Developer, Jo Dean, is one of the few experts in South Africa capable of doing so.

### Enablers

Actioning a vision requires not only a collective will and expertise, but also the core component of funding. Low Carbon Financing, a company of like-minded financial sustainability experts, are the enablers of the PIRE GROUP vision, and with their funding model are the key to the unlocking the learning organization's sustainability goals.

## Timing of Basis Structures of the Project

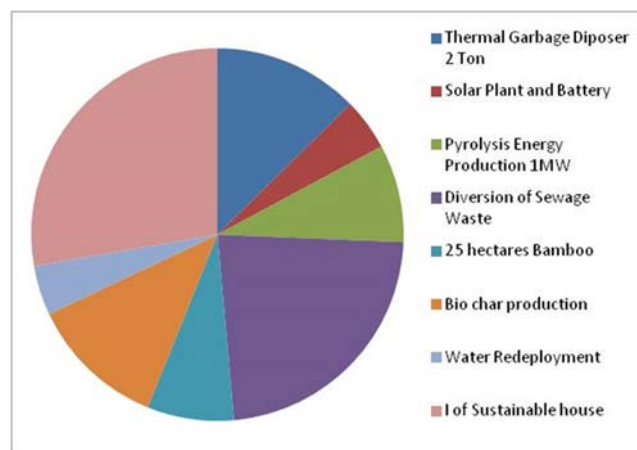
Alternative House Village	10 weeks
Solar Farm and Battery Back Up	16 weeks
Bamboo Plantation++++	18 weeks
Thermal Garbage disposer 2 ton	10 weeks
Pyrolysis 250 KWp plant	20 weeks
Training Academy	Ongoing
++++ The bamboo requires 18 months to reach maturity and in the interim other Feed stocks will be utilised (alien vegetation- agri- waste)	

Ongoing testing and monitoring and development will be executed by a full professional design engineering team.

The centre will be open to all members of the public for viewing and investigation  
A Dashboard Hub will be created where all data reviews and stats can be viewed and questioned in collaboration with top engineers.

## Carbon Reduction of Waterford project

Technology	GHG and CO2e Reduction on Microcosm of Emoya
Thermal Garbage Diposer 2 Ton	3358 CO2e
Solar Plant and Battery	1200 CO2e
Pyrolysis Energy Production 1MW	2255 CO2e
Diversion of Sewage Waste	6096 CO2e
25 hectares Bamboo	2000 CO2e
Bio char production	3153 CO2e
Water Redeployment	1146 CO2e
1 of Sustainable house	7360 CO2e
<b>TOTAL</b>	<b>26 568 CO2e</b>



### If scaled and replicated to a Municipality of 26 000 houses - Manzini

Technology	GHG and CO2e Reduction on Municipality of 26 000 houses - Manzini Population 110 000
Thermal Garbage Diposer 50 Ton/day	73000
Solar Hybrid 20MW Only For Houses	87600
Pyrolysis Energy Production 10MW at seawgae farm	78600
Diversion of Sewage Waste	102765
800 hectares Bamboo	64000
Bio char production	32716
Water Redeployment	60800
10 000 of Sustainable house new build and retrofit	184000
<b>TOTAL TONS CO2E</b>	<b>683481</b>
Rand Value equity for investment	R 82 017 720,00

### COST AND FEASIBILITY OF FINANCIALS FOR WATERFORD PROVE TRIPLE BOTTOM LINE RETURNS

The project is financed internationally through a Low Carbon Financing Consortium

The Debt servicing will be through derived monetised savings from technologies and any excess will be re-invested into establishing the same roll out at other Learning Institutions.

## Conclusion & Closing Arguments

Important changes are taking place in the global climate, but there is still great uncertainty about how earth systems operate. Our COE is positioned to serve as a unique “laboratory”. **Mitigating climate change also provides an economic opportunity for the battling countries with their smaller towns; therefore we need to develop a strategy to take advantage of the so called “Green Economy”**

In today’s world, behaviour, science and technology are deeply intertwined, and advancing one without considering the others yields limited results. The socioeconomic challenges that we face require focused work by teams of cross disciplinary experts. And while the grand challenges presented in this plan stress technological innovation, we recognize that technologies cannot be developed without giving thought to how they will affect and be received by human beings

As Swaziland strives to become an innovative society, **it is essential to support the public and government understanding of and engagement with new innovative paths.** The COE is to demonstrate the technologies and applications **including systems and policy development**, so that the members of public and government are not merely passive recipients of innovative technology, but are important players in processes that shape the focus and patterns of science, technology and development.

**Our current “innovation chasm” in this country is a major weakness in our economy and the dual need for reduction of climate change factors.**

We also want to overturn the major obstacle to commercialization of technological innovations due to lack of financing, due to the high risk and complexity of R&D investments.

Above all, the plan requires political leadership, policy direction and careful attention by the Stakeholders and other departments to ensure that Swaziland succeeds to implement the grand challenges.

There are great expectations for the development of technologies that emit low (or no) amounts of greenhouse gases (GHG). While appropriate innovation policies are required in order to incubate such advancement, innovation is not a singular process but rather a mixture of different practices — including fundamental research and development (R&D), commercial R&D and commercial applications., policy innovation that assists technology diffusion into the market is, key.

**Many GHG-mitigating projects are in the category of “waiting-list projects” in Swaziland and require new mechanisms and market systems that incorporate externalities.**

The threat in Swaziland is that the institutions wish to maintain their current technology status and we know that **policy innovation takes place only when a rare opportunity for change demands it such as the devastating energy and water crisis that we, as Swazis, are currently experiencing.**

The main reason behind this is political judgement and biases. Sustainability requires a normative approach in which a specific political system adapts to changes and implements this approach. Thus, **sustainable transition** is, in essence, a political project.

The rationale used by some policymakers may come from economic considerations and industrial pressures and the ‘sustainability’ argument may not be viewed as a firm basis for their policy formulation.

What policymakers care about most is not necessarily sustainable energy transition, but has more to do with economic rationale and the interests of relevant stakeholders and/or organisations.

In other words, for some policymakers, policy design matters less than political drivers and/or agendas. Because technology is not their core business.

Only after an empirical understanding of political motives is gained, can the 'politics of sustainability' transition be argued. This is what we endeavour to prove with COE.

This political transition is key in creating an environment wherein policies are innovated in such a way that it is conducive to ensuring sustainability.

It is important to understand how a new policy is conceived, disseminated, diffused and takes off as an embedded notion to a political agenda, quite similar to the technology transition process itself. Political transition holds the key to ensuring policy innovation is enabled in reality, and political transition to sustainable development therefore needs to be analysed and investigated much further.

**The COE is, in essence, a "micro municipality" that can be with ease - then replicated across all smaller / rural municipalities.**

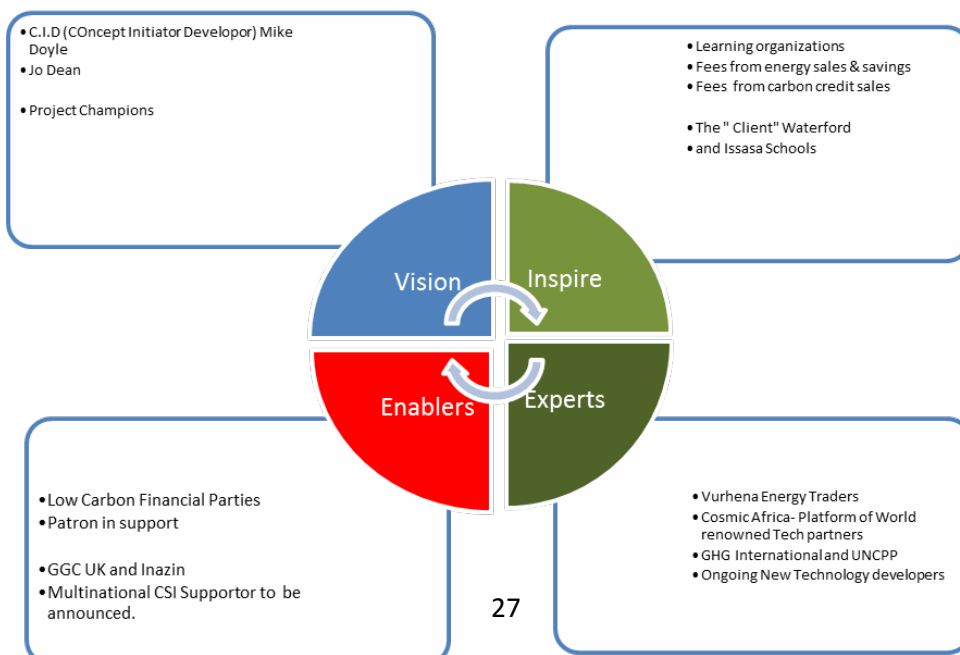
**Whilst the larger African Countries are moving 'ahead', the smaller seemingly inconsequential countries are left behind in 'island mode'.**

## The Burning Question    How will this be done?



A

### Social Partnership in Carbon Reduction



## Meet the Team

### CID – Mike Doyle

Michael is a Member and Accredited Presenter for the Climate Reality Leadership Corps as well as the Eco Estate Manager, Waterford Kamhlaba United World College, Swaziland

In order to further his ability to educate on Sustainability, Michael has studied:

Sustainability in Practice: University of Pennsylvania,  
Climate Change in Four Dimensions: University of California,  
The Science of Climate Change: University of Chicago.

Michael's passion for life-long learning is reflected in his current registration for:

The Post Graduate Diploma in Futures Studies  
Business School, Stellenbosch  
(Completion: October 2015)

These courses will ensure that a well- rounded approach to climate change and sustainability is presented under Michael's guidance.

### CID – Jo Dean B.Eng. (Mech.) (Env & SUS) CPD & S

Ms. Dean is an Independent Carbon Reduction Advisor & Project Developer working across all industries on environmental, climate change and energy challenges. She is qualified to develop and design Carbon Projects. (Carbon Master Class).

Main Areas of Expertise include:

- Renewable Energy and Energy Efficiency Investments & Project Design,
- Energy Management & Control Systems,
- Water and Waste Management.

Previous Experience:

18 years Murray & Roberts Heavy Engineering division executing R&D on Plant, Flow and Process Control Technologies for the Mining Sector in N. Cape, F.S., Lesotho and North West Province with her portfolio in excess of R2 Billion.

Ms. Dean's current main areas of expertise are:

Current Service offerings on "Green" Project Development:

Carbon Foot Printing

- Greenhouse gas (GHG) inventory development reporting and management,
- GHG data verification,
- Energy Efficiency,
- Sustainability Valuation Approach,
- Life Cycle Assessment (LCA),
- Carbon Disclosure Project (CDP) and Water Disclosure Project (WDP),
- Carbon Neutral and Offsetting,
- Climate change risks and opportunities,
- G4 Reporting,
- Carbon Tax,
- Clean Development Mechanism (CDM) process from inception to project registration,
- Voluntary Emission Reduction (VER) projects – "GOLD" Standard



Vurhena Energy is an innovative company that develops strategies that are aimed at improving and facilitating the integration of sustainability into businesses, built on a solid foundation of non-financial data management and reporting that translates into triple bottom line returns.

Through years of experience in this sector, and drawing on our unrivalled international networks of professionals, Vurhena Energy has developed an algorithm for Sustainable Development that is practical, embeddable and translates into measurable action.

Vurhena Energy forges partnerships that drive innovation and business optimisation in a measured way resulting in business and brand becoming more profitable, valuable and sustainable services include:

- Clean energy trading for offsetting & mitigation
- Carbon benchmarking
- Optimisation of energy / water / waste reduction
- Life cycle assessments (LCA)
- Energy management services (EMS)
- Strategy formulation & implementation of cleaner production and sustainability projects

We have a deep understanding of the African financing / funding and policy challenge and we pride ourselves on our specialist skills in unlocking opportunity within the African emerging Green Economy.

## Cosmic Energy Africa – Platform of Technology Leaders



Cosmic Energy is a company formed to respond to the increasing demand of the Alternate Renewable Energy Sector, focused on bio-energy, solar, wind, waste to energy, projects both as developers and consultants. Cosmic Energy prides itself efficient and effective rollout of large scale projects. The mission of Cosmic Energy is bring together a group of highly skilled individuals into a team that is inspired by the very bold step our country has taken to embrace the range of international protocols to reduce our carbon footprint and in a very decisive manner allocate some two hundred billion in the implementation of alternate renewable solutions to deal with the energy demand and shortage in our country.

Cosmic Energy brings together a team that has immense experience in the project management of large scale projects, under the Directorship of Derek Naidoo. The project team comprises qualified Civil, Electrical, Chemical and Mechanical Engineers, Planners, Financial and Legal Advisors and Quality managers.

The team is committed to the service delivery objectives of local municipalities and has expertise in IDP formulation, SDBIP, Budget Preparation and Monitoring, Implementation of Systems and Processes to ensure Clean Audit, Implementation of Infrastructure Projects, advice on technology providers, Waste Management and recycling.

The cosmic energy team provides a high class, end-to-end service for clients seeking services within the renewable/clean technology markets. Our services extend throughout the value chain from origination to disposal of projects. Our team is involved promotes alternate renewable energy generation through sustainable processes, either with existing or new green/clean technologies.

Our vision is to successfully promote renewable energy on the continent, working with companies, investors and developers to make the process sustainable, commercially viable, promote job creation and create a better life for all. Our aim is to create a more sustainable energy environment for local communities, reduce the carbon footprint and attract investment through industry and commerce. We endeavour with countries in Africa to promote renewable energy through incentives and work within the 'feed in tariffs'. Our mission is to be the leading specialist agency in the renewable energy space in Africa.

## GGC and Low Carbon Investors UK



Ms. Debbie Webb Lead Funding Intermediary - Director of Greentec Global Consultancy Ltd

Ms. Webb is qualified to degree level in international business, specializing in New business development with a wealth of experience developing International projects, with direct funders across the renewable industry as well as the Water & Waste Water field. Particularly focused on Africa/EMEA & India, Emerging Markets, Energy and Renewable Energy.

Areas of Expertise include

Renewable Energy Solar PV Plants

Water & Waste Water; Petro Chemicals; investments; SPV

Previous Experience:

Strategic development in licensee proposition, partnerships, JVs and international business, 15 years' experience throughout the Middle East having successfully secured contract value of 11.5m USD for the rehabilitation of the largest desalination plant in Saudi Arabia. Secured World Bank funding of 17m USD to establish a manufacturing plant in India under JV, working with consultants and contractors such as Bechtel and Samsung.

Over recent years Ms. Webb has dedicated her expertise to renewable energy, Solar PV plants with extensive experience as both an EPC and a developer with Blue-chip UK companies. Now developing and delivering projects directly to investors with appetite for Global projects. To date Ms Webb has been involved with delivering plants up to 200 MW and is now the founder & Director of Greentec Global Consultancy with select investor client base of Fund Managers looking for high quality investment opportunities with partners specializing in Carbon Reduction Projects.

## To be unveiled..... Multinational Patron and Benefactor

We are finalising negotiations for our "sponsor/patron" will be like minded to the carbon reduction as well as vision of sustainability education. And will be proudly announced within the next month.

The reasoning for a Patron

In accordance to the Kyoto Protocol, apart from reducing their emissions, Annex I countries must also provide financial and technological resources to help enable what needs to happen in non-Annex I countries – development with low emissions. Amongst Annex 1 Corporates a price is applied to each metric ton of CO<sub>2</sub> — is used as a planning tool by businesses across all industries and geographies, with the majority in Europe and strong representation from North America.

Corporations chose to use the prices applied (ranging from \$1 per metric ton to \$357 per metric ton) as part of their efforts to mitigate risk from current or potential regulation and via "climate justice" and the Kyoto Protocol, assist non annex countries.