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1. INTRODUCTION & PURPOSE

The purpose of this Item is to inform the Mayoral Committee and/or Municipal Council of the Municipality of the proposal by Reuse Technologies SA to encourage the Municipality to consider utilizing the suitable regulatory procedure for the implementation of a Waste-to-Energy Process Facility in the Prince Albert Municipality in the format of the introduction of Reuse Technologies SA Waste-to-Energy Project, described below, to be located in the town of Leeu Gamka.

Reuse Technologies SA Waste-to-Energy Technologies produce homegrown Renewable electricity and fuel from waste and provide landfill reduction options, and jobs. All of this while reducing the dependence on current capital-intensive energy production technologies, with the best environmentally acceptable solution and the best outcome economically in terms of cheaper energy products, for optimum economic growth and development for Formal and Informal Settlement areas throughout the Municipal area.

Reuse Technologies SA proprietary methodologies include tried and proven technologies evolved for the 21st century and beyond to provide an opportunity to integrate current modalities for municipal waste management with a sustainable fuel production infrastructure, and distributed energy production opportunities that form the basis for Waste-to-Revenue processing.

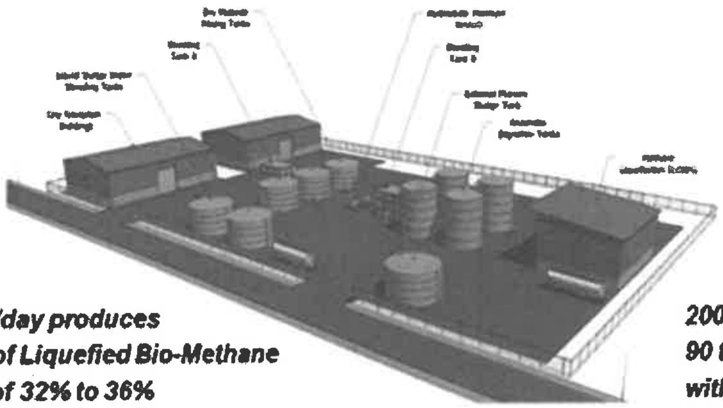
Municipal waste management operators, energy sales and distribution companies, and South African industries that use and export Liquefied Natural Gas (LNG) products, will all benefit immensely from Reuse Technologies SA Solutions.

Reuse Technologies SA as a company delivers value through core business strategies and supports a technical framework that will help to overcome municipal and commercial risks in adopting anaerobic Waste-to-Energy based technologies and introducing Municipalities to a validated business model for applied Waste-to-Energy technology.

The proposed Facility will be modular in design and will comprise a series of equally-sized parallel streams, each being run independently of each other.

An independent application for Carbon Credits for any proposed Facility could attract substantial funds for the development of the municipal area.

Projected impacts of the Reuse Technologies SA demonstration research include the ability to process 230-400,000 dry tons of municipal solid waste per year with outputs of the most valuable biofuel (LBM) at rates of 40,000-70,000 tons + generation of 5MW7.5MW of electricity per year, creation of up to 1000 direct and indirect jobs, potential to divert 100% of waste going into landfills, and a return on investment within 2-3 years of construction.

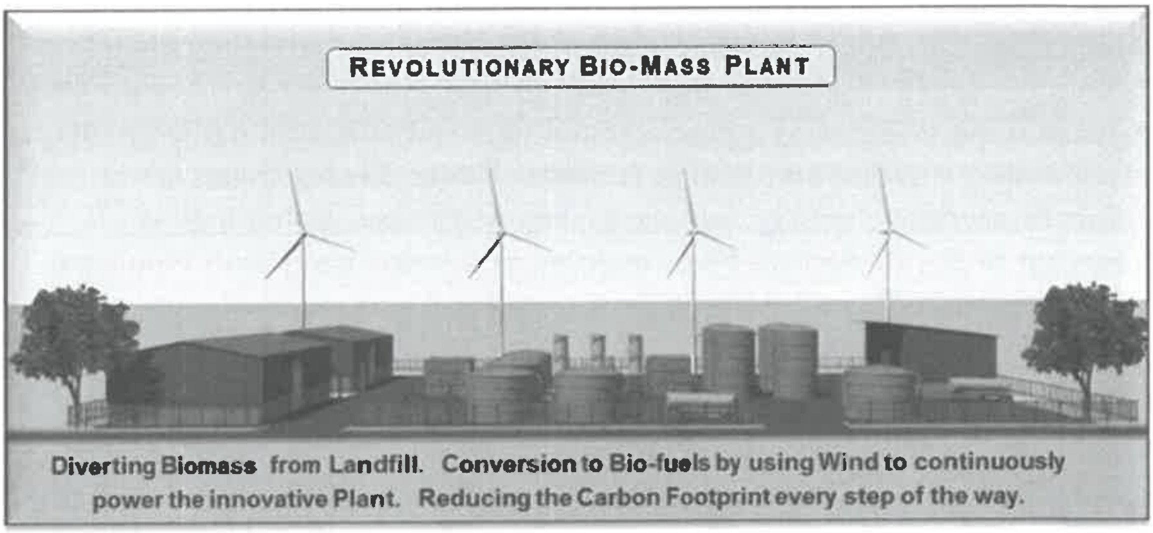


200 dry tons/day produces
30 tons/day of Liquefied Bio-Methane
with an IRR of 32% to 36%

200 dry tons/day produces
90 tons/day of Saccharides
with an IRR of 10% to 20%

Natural gas products, solar, and wind seem to present the best opportunities for growth, but of the three, Waste-to-Energy using Wind presents the best return on investment.

2. TECHNOLOGY CONSIDERATIONS



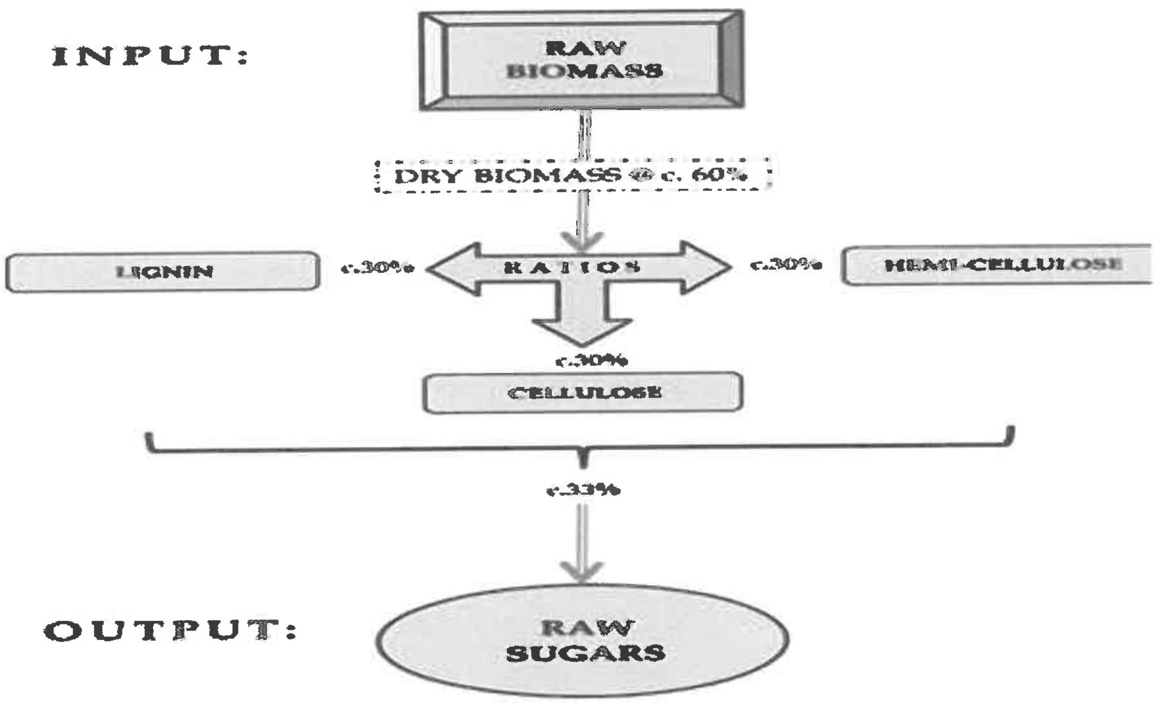
The revolutionary technology is proprietary and changes what were once Liabilities into Assets.

WORKING ACCELERATOR FOR SUSTAINABLE TRASH TO ENERGY

Roughly one million people produce 650,000 tons of waste yearly, which could be processed into 46,000 tons of liquid bio-methane through the Reuse Technologies SA partnership with municipalities to produce sustainable solutions for energy!

Reuse Technologies SA has expended significant efforts researching the challenges South African Municipalities face with regard to the generation, recycling, and management of waste, as well as the transmission, distribution, and retail of energy products in South Africa. The complexity of the problem necessitated the pursuit of the identification of the primary drivers to obtain the most effective solutions.

By dynamically integrating a practical and financial adoption pathway through complementary waste and energy facilities, Reuse Technologies SA revitalizes domestic energy manufacturing, promotes technological leadership of South African Municipalities, and helps transform Municipal Solid Waste (MSW) into a viable driver for local and regional jobs, and National energy independence.



Waste-to-revenue Core Solutions:

Reuse Technologies SA, in partnership with the Prince Albert Municipality, could have a commercially viable demonstration plant built and bringing in revenue in the region of R249 Million within 2-3 years of operation.

It is predicted that by 2050 global energy needs will be about twice current usage making energy one of the most pressing challenges facing humans today. Currently, electricity consumption in SA is 227 terawatts per year and forecast to increase considerably. There is a significant strain on the existing energy infrastructure and if the majority of the country's energy continues to be generated through non-renewable means (coal, nuclear), then this will potentially damage environmental health, through effluent gas emissions and global warming.

3.0 Global Waste

The world generates 2.01 billion tonnes of municipal solid waste annually, with at least 33 percent of that—extremely conservatively—not managed in an environmentally safe manner. Worldwide, waste generated per person per day averages 0.74 kilograms but ranges widely, from 0.11 to 4.54 kilograms. Though they only account for 16 percent of the world's population, high- income countries generate about 34 percent, or 683 million tonnes, of the world's waste.

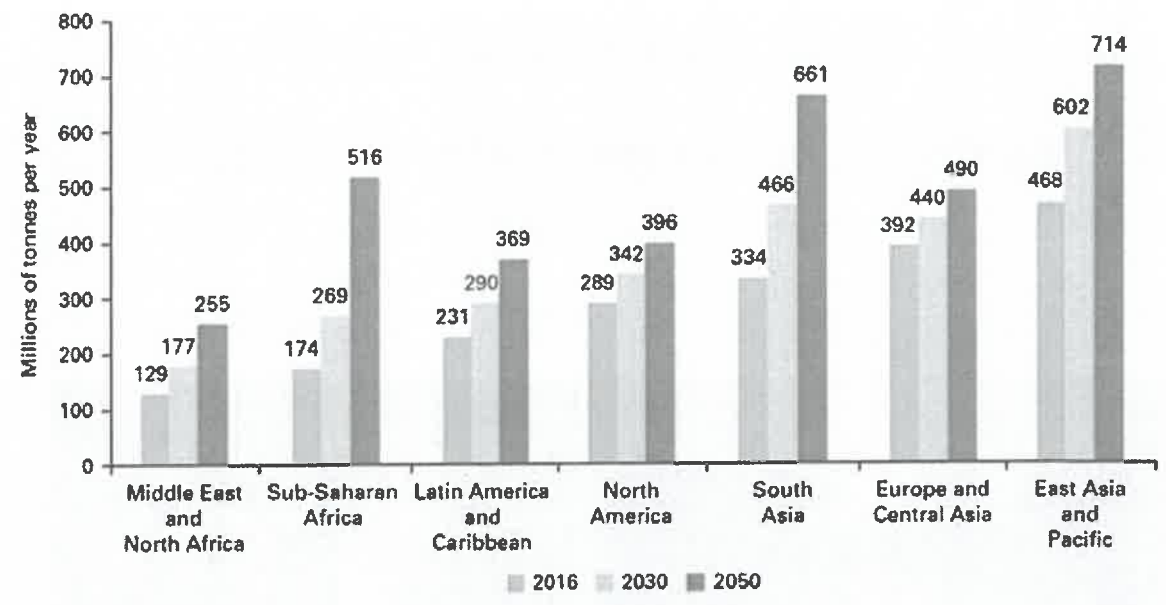
When looking forward, global waste is expected to grow to 3.40 billion tonnes by 2050, more than double population growth over the same period. Overall, there is a positive correlation between waste generation and income level. Daily per capita waste generation in high-income countries is projected to increase by 19 percent by 2050, compared to low- and middle-income countries where it is expected to increase by approximately 40% or

more. Waste generation initially decreases at the lowest income levels and then increases at a faster rate for incremental income changes at low-income levels than at high-income levels. The total quantity of waste generated in low-income countries is expected to increase by more than three times by 2050.

The East Asia and Pacific region is generating most of the world's waste, at 23 percent, and the Middle East and North Africa region is producing the least in absolute terms, at 6 percent.

However, the fastest-growing regions are Sub-Saharan Africa, South Asia, and the Middle East, and North Africa, where, by 2050, total waste generation is expected to more than triple, double, and double respectively. In these regions, more than half of waste is currently openly dumped, and the trajectories of waste growth will have vast implications for the environment, health, and prosperity, thus requiring urgent action.

Projected waste generation, by region (millions of tonnes/year)*

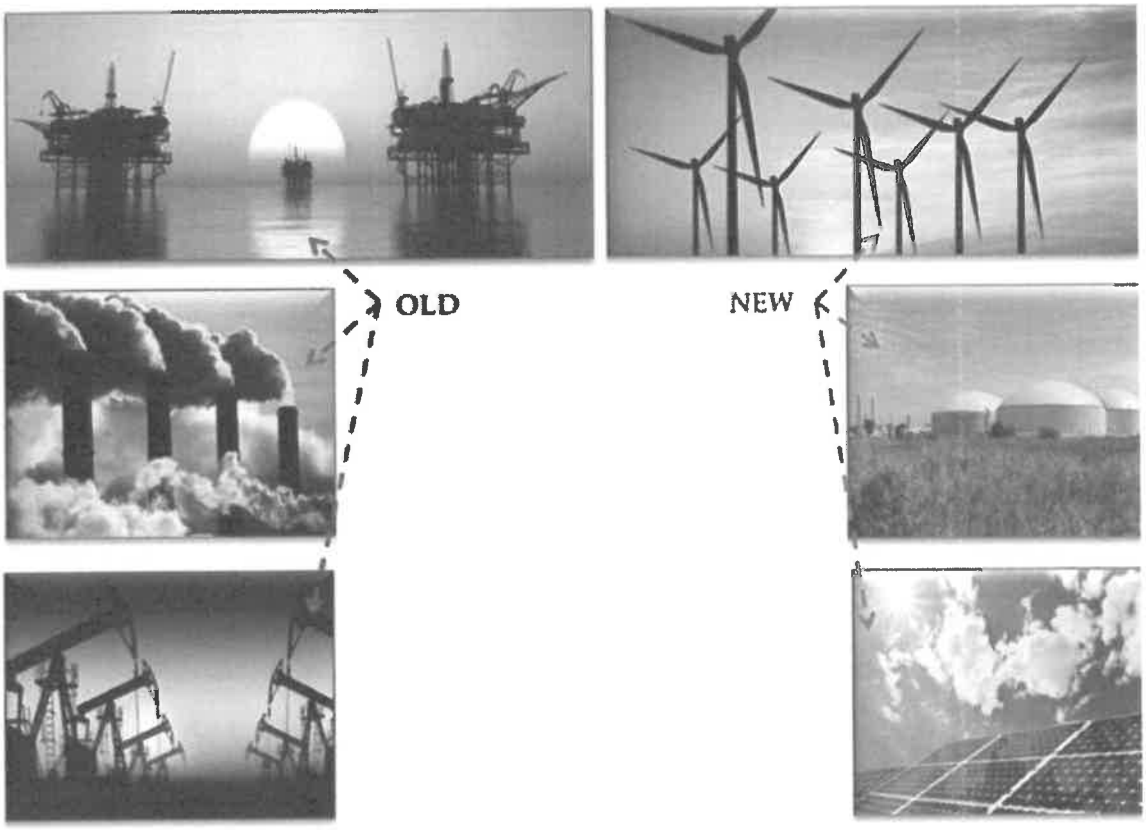


World Bank News Feature

Waste collection is a critical step in managing waste, yet rates vary largely by income levels, with upper-middle- and high- income countries providing nearly universal waste collection. Low-income countries collect about 48 percent of waste in cities, but this proportion drops drastically to 26 percent outside of urban areas. Across regions, Sub-Saharan Africa collects about 44 percent of waste while Europe and Central Asia, and North America collect at least 90 percent of waste.

3.1 THE GLOBAL ENERGY STORY

Mankind has an insatiable appetite for energy.



Currently, it is 18 terawatts per year and forecast to increase to 30 terawatts by 2050. There is a significant strain on the existing energy infrastructure.

If the majority of world energy continues to be generated through non-renewable means, then this will potentially damage world environmental health, through effluent gas emissions and globalwarming

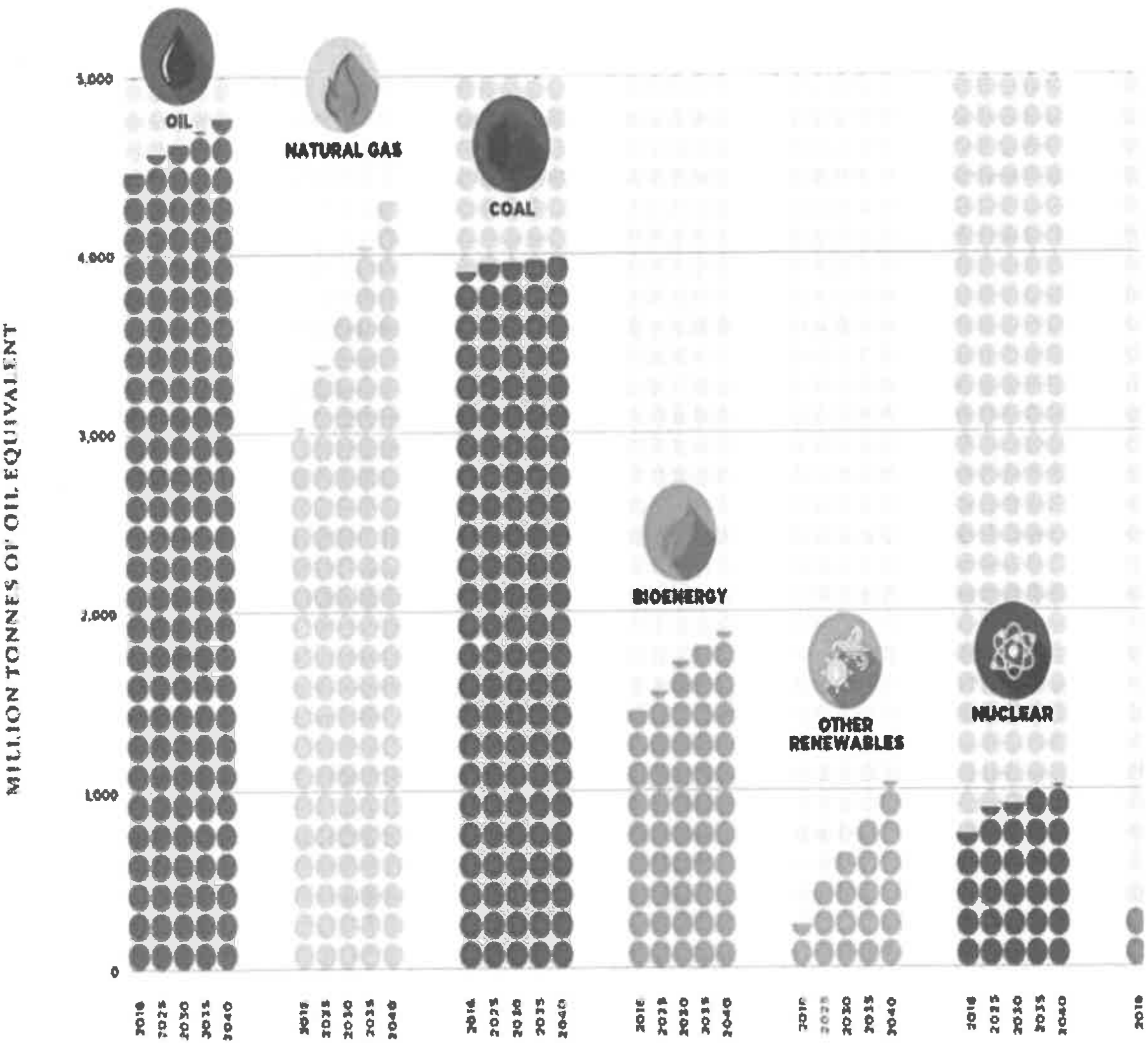
3.2 GLOBAL ENERGY NEEDS:

Regardless of the source of energy, demand is growing. With the global population expected to increase by about two billion over the next two decades, and with improving standards of living, it is estimated the world will need about 47 million more megawatts of electricity than current consumption.

Right now, fossil fuels supply about 80% of the energy we require. The remaining sources include nuclear power, biofuels, hydro, and other renewables such as solar, wind, and geothermal energy.

*The International Energy Agency (IEA) prepares annual projections about potential energy demand using a number of different scenarios. In its 2019 report, the IEA projected global demand for natural gas is expected to increase by 36% by 2040, supplying 25% of total energy consumed worldwide, and global demand for oil will increase by 9%, supplying 28% of total energy consumed.

Growth in the Global Energy Mix from 2016-2040



Source: International Energy Agency (IEA) 2019 Stated Policies Scenario

4.0 MARKET RESEARCH, ANALYSIS, AND PLAN

4.1 Market Overview

South Africa is looking for solutions to power our economy into the future, and Renewable Energy is the answer!

There is no doubt that the current economic outlook in South Africa is bleak and all the factors surrounding energy seem to be significantly worse. Since 2008 we have experienced 400% increases in electricity tariffs alone, chronic power shortages (load shedding), and massive overruns in capital expenditure on power projects. This has led to the recent issuance by the Department of Minerals and Energy to diversify its electricity generation Portfolio to include Independent Power Producers (IIP's) able to produce cleaner-burning fuels such as natural gas and renewable energy to deal with the current generation capacity shortage and financial crises which Eskom is experiencing.

What we at Reuse Technologies SA have not seen calculated as yet, is a measure of the incidental cost caused by the non- dispatch able nature of renewable energy, the sensitivity of the South African Grid, and mitigation measures on power loss. The impact of this, over time, as can also be seen in South Australia, destroys industry and is profoundly negative toward any positive economic outlook.

Following the historic Paris Agreement on climate change signed by the then South African Environmental, the late Minister Edna Malewa in 2016, it's clear that the days are numbered for coal-fired power plants. The agreement, forces countries worldwide to switch to a low-carbon economy to fight the effects of a changing climate. If South Africa persists with the terms of the global pledge it made, Medupi and Kusile will probably be the last coal-fired power stations built in the country.

Just five years ago, the green energy footprint was small in the country, but now more than 2 000MW is coming from 42 projects that have been installed across South Africa and there is more to come. It is noted that currently, only about 4.5% of South Africa's 44 000MW of generating capacity comes from renewable sources.

The department of energy has committed South Africa to increase renewable energy generation to 13 225MW by 2025 in terms of South Africa's Integrated Resource Plan (IRP 2010 - 2030). Part of this plan is to expand the renewable procurement program to generate 6 000MW by 2020. The IRP document paved the way for the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) that we see today. South Africa's utility-scale Renewable Energy sector is the most mature in the region, and therefore offers a useful platform for investors seeking to venture into the rest-of-Africa market, which is growing at a rapid pace. Various regional, continental and international programs are in place to support the development of requisite infrastructure, technical and financial capacity, and policy environments conducive to increased uptake of Renewable Energy.

The South African market has never been more perfectly primed for the Green Energy Revolution and with the REUSE TECHNOLOGIES SA'S methodology and technology, a partnership with a Municipality in the Karoo will be the ideal place to attract global attention and could position not only the technology but the region in terms of tourism and development and ensuring placement on the frontline of the green revolution.

4.2 Market prices

Table I shows the current Eskom rates for power distributed under 300 km during both high and low demand.

		Active energy charge [c/kWh]											
Transmission zone		High demand season [Jun - Aug]						Low demand season [Sep - May]					
	Voltage	Peak		Standard		Off Peak		Peak		Standard		Off Peak	
			VAT incl		VAT incl		VAT incl		VAT incl		VAT incl		VAT incl
≤ 300km	< 500V	279.71	318.67	85.11	97.03	46.44	52.94	91.58	104.40	63.20	72.05	40.28	45.92
	≥ 500V & < 66kV	275.30	313.84	83.41	95.09	45.29	51.63	89.81	102.38	61.81	70.46	39.22	44.71
	≥ 66kV & ≤ 132kV	266.61	303 94	80.76	92 07	43.86	50 00	86.97	99 15	59.87	68 25	37.97	43.29
	> 132kV*	251.27	286.45	76.12	86.78	41.33	47.12	81.96	93.43	56.41	64.31	35.79	40.80

Table I: Eskom Flex Rates

4.3 The Waste Dilemma

Problems of the waste challenge the transition to a renewable energy economy in South Africa. Moreover, there is an increasing solid waste management problem. Currently, South Africa produces 108 million tons of waste per year. A total of 90 per cent of that waste ends up in landfills and only 10 per cent of waste is currently recycled. Notwithstanding the current landscape for organic waste where the Western Cape government landfill diversion targets have been set at a 50% diversion of organic waste to landfill by 2021 and 100% diversion to landfill by 2026. These include more stringent regulations whereby certain waste streams (e.g. abattoir) will be banned from landfills with revised norms and standards as well as increased costs of disposal to landfills. This diversion plan has placed Municipalities in a position to invest in alternative green waste management technologies, processes, and systems to replace the already overburdened landfill in most Municipalities. New technologies not only provide the waste management solution to Municipalities but also provide an opportunity for development and economic growth.

Reuse Technologies SA believes that the solution is to provide the facilities to dispatch renewable energy intelligently, economically, and environmentally friendly to ensure stability, quality, availability, reliability, and efficiency, resulting in lower tariffs, augmented with green energy, under sophisticated load management and collection systems which at the ground level makes way for zero-waste communities and the phasing out of landfill use in the country. It is our contention that Waste-to-Energy process facilities will benefit both Municipalities and Eskom exponentially and ultimately prove to be the true catalyst for economic transformation and growth of the South African economy. Municipalities can be expected to become profitable in a short space of time and as a result growing and developing entire regions. In addition, it will expose the crucial role the waste economy can play in addressing poverty, unemployment, and opport. for tools of the trade.

The Reuse Technologies SA Waste-to-energy Process technologies make use of integrated technologies in biomass utilization. The technology is 100% compliant with amongst others, the Paris agreement on climate change signed by RSA. All waste is converted to energy. The process is clean and we do not burn or bury (no waste diverted back to landfill).

A collaboration between 16 of Europe's top Engineering specialists on waste culminated in the innovative Intellectual Property combined with a community-based South African business model specifically designed by Reuse Technologies SA's team aimed at addressing current inefficacies in communities in need in SA. As well as incidental costs of funding an alternative waste treatment technology.

Reuse Technologies SA's vision can be best applied in the form of an agreement between the PRIVATE element (Reuse Technologies SA) and the PUBLIC element (Prince Albert Municipality) of the Service Delivery arrangement which is based on the general precepts of an UNSOLICITED BID Process under the auspices of a Service Level Agreement and SOCIETY (Communities), as well as PRIVATE SECTOR funding (Investor) and specialized products and services (Technologies). Within the framework of Waste-to-Energy process facilities we focus on employment and some of its 'derivative' applications such as energy security (capping energy costs) and waste reduction, climate change, green clean energy training, and development (supplying sustainable green energy production).

4.4 What Makes Reuse Technologies SA So Unique?

Reuse Technologies SA technologies provide an improved energy yield and profitability of traditional anaerobic digester systems that will change how waste is managed, processed, and distributed for the foreseeable future. In addition, the process converts waste into a variety of biogas energy products at the speed and efficiency unmatched by other technologies and the technology is unique and disruptive but not new. This is a system of waste management that is needed on the continent and more specifically our public partners and collaborators to drive the waste economy with an environmentally centric waste to an energy plan. We change the landscape for cellulose to energy production that will see the generation of renewable green energy in the form of electricity and/or heat, biofuels, and other energy products.

4.5 Marketing Strategy

Marketing efforts are focused on the communities in and around the Central Karoo District where waste is transferred to the landfill site in Leeu Gamka for use on the processing facility. Any misappropriated focus on areas, where promises are made that cannot be met, constitute a serious risk if there are unmet expectations.

4.5.1 Entrepreneurial Approach

Reuse Technologies SA envisions a Partnership under the auspices of a Service Level Agreement wherein Reuse Technologies SA and Prince

Albert Municipality join together in taking Reuse Technologies SA's market-ready technology and uses private funds to develop a self-sustaining saccharides plant in Leeu Gamka which brings a return on investment while lowering costs associated with managing municipal solid waste in the Central Karoo District. Reuse Technologies SA envisions an ideal partnership with Municipalities.

Demonstration facilities will quantify a city's municipal solid waste and turn it into revenue. Presently, cities/towns are finding it to be financially burdensome to sustain a multi-stream recycling and solid waste program. In many cases, recycling programs are COSTING Municipalities money long after state subsidies are no longer available.

Reuse Technologies SA's approach could turn municipal Waste-to-Energy at the transfer station, thus drastically reducing transportation costs, tipping fees, and the need to pay for landfills. The railway system will be upgraded and utilized to reduce overheads immensely.

Reuse Technologies SA envisions a future where Municipalities across South Africa have turned their waste streams into revenue streams. Plus, the potential to remediate existing Strategic Landfill sites for reuse near to existing Conurbations – making the land available for Housing/Leisure/Parks. These are significant and important goals for Reuse Technologies SA.

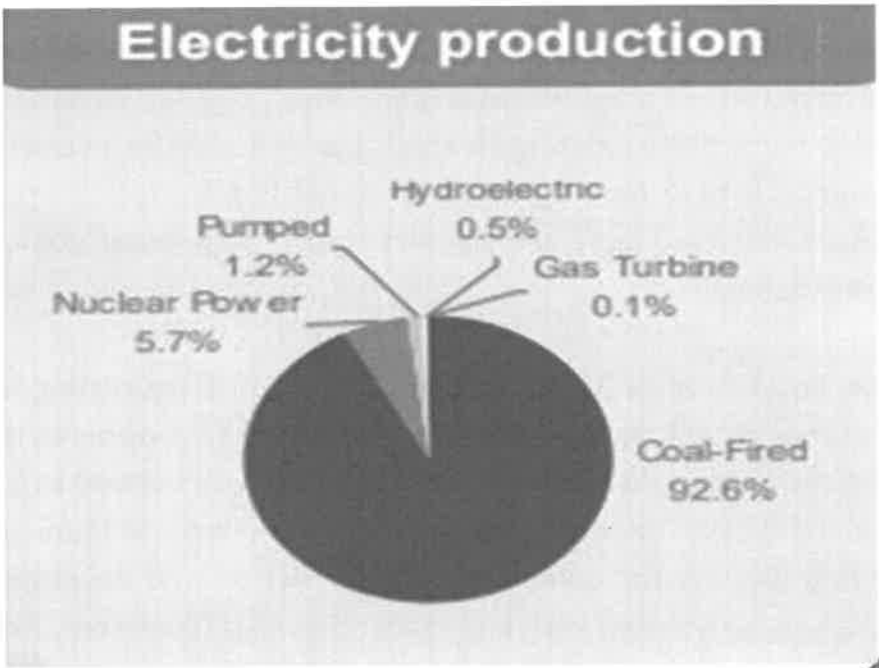
Ideally, Reuse Technologies SA would like to imagine Beta-testing for the Waste-to-Energy technology adoption that would be supported from the provincial and municipal level, and where waste was viewed as a commodity instead of an expense. Initially, the proportion of Municipalities that see the opportunity for economic transformation and development may be modest as is the case with any innovative idea; however, Reuse

Technologies SA proposes to justify the extended development of Waste-to-Energy infrastructure in the focus area, and quickly balance the proportion.

Participation within Reuse Technologies SA gives municipalities an opportunity to commoditize their waste in ways that benefit the communities and the local economy.

South Africa's energy sector is critical to its economy, as the country relies heavily on its large-scale, energy-intensive coal mining industry holding 75% (1 billion short tons at the end of 2016) of Africa's total coal reserves and 70% of the country's total primary energy consumption with the electricity sector accounting for more than half of the coal consumed in South Africa. South Africa has limited proven reserves of oil and natural gas and uses its large coal deposits to meet most of its energy needs, particularly in the electricity sector.

South Africa's total domestic electricity generation capacity is 51,309 megawatts (MW) from all sources. Approximately 91.2%, or 46,776 MW, comes from thermal power stations, while 4,533 MW, or 8.8%,* is generated from renewable energy sources.



Generation capacity:

- Installed Capacity: 51,309 MW
- Thermal: 46,776 MW
- Hydroelectric: 661 MW
- Other Renewables: 3,872 MW

Connections:

- Current Access Rate: 86%
- Rural: 66% Urban: 93%
- Households without Power: 2.2 million

The use of liquid fuel (petrol and diesel) and electricity completely dominate the energy profile of the Central Karoo towns and consumption of petrol and diesel has seen consistent decreases since 2009. This has been brought on by the lack of development in the region forcing residents to seek employment and education opportunities outside of their birth towns.

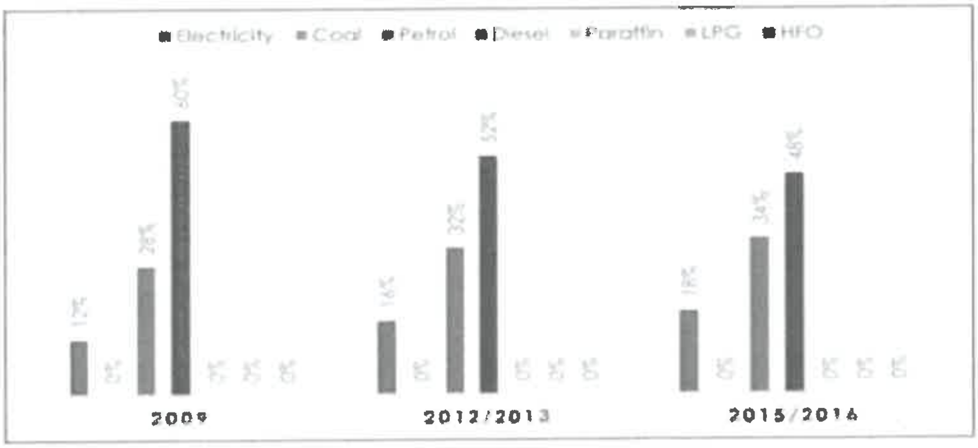


Figure 34 - Energy use by fuel for Central Karoo (GJ) - comparing 2009, 2012/13 and 2015/16

According to a 2015 study by the U.S. Energy Information Administration (EIA), South Africa holds the eighth-largest technically recoverable shale gas resources in the world (390 trillion cubic feet) primarily located in the Karoo basin. The South African government hopes that shale gas will provide the country with a reliable alternative fuel to coal. However, regulatory uncertainty and environmental concerns have delayed exploration. Some progress was recently made when the Petroleum Agency South Africa (PASA) announced that it would start processing existing applications for exploration permits in late 2017.

In 2016, 70% of South Africa's total primary energy consumption came from coal, followed by oil (22%), natural gas (4%), nuclear (3%), and renewables (less than 2%), according to *BP Statistical Review of World Energy 2017*. South Africa's dependence on coal has led the country to become the leading carbon dioxide emitter, on a volumetric basis, in Africa (accounting for 35% of emissions in Africa) and the 14th-largest emitter in the world, according to the latest BP Statistical Review estimates.

Reuse Technologies SA's framework for applying Waste-to-Energy technology presents an opportunity for the Central Karoo District to generate more immediately available electricity and stored energy products. Natural gas products, solar, and wind seem to present the best opportunities for growth, but of the three, Waste-to-Energy

presents the best return on investment. In addition to turning municipal solid waste into a commodity, it alone creates storable energy for use at future times, sustainable employment provides various ancillary by-products and business opportunities, and it's easily exportable.
Prince Albert Municipality can lead the rest of the country in showing how to diversify RSA energy production while decreasing landfill use and increasing revenue and employment. The Reuse Technologies SA project, led by the accomplished and capable engineers of Reuse Technologies SA, can create the market transformation model that changes how municipal waste is viewed and handled in the RSA for the foreseeable future.

This demonstration project towards market transformation will be assisted on a Municipal level through partnership agreements. These combined efforts will provide an integrated solution to the projected gaps in technology and training that slow the commercial development and adoption of waste-to-energy technologies. Similarly, we will address public concerns regarding the project if so required. Our demonstration research will test the local and regional market for an integrated system of waste transfer and energy production sites. Distinguishing this system from smart-grid efforts and public use demonstration programs in isolation, Reuse Technologies SA proposes a unique framework that addresses municipal and commercial adoption of high impact Waste-to-Energy technologies as a coordinated technical engineering challenge. Financial barriers are addressed with foreign investment partnerships and Joint Ventures that provide efficiencies of expertise, Coordinate safety, maintenance, and training standards, and provide instant tie-ins to end markets.

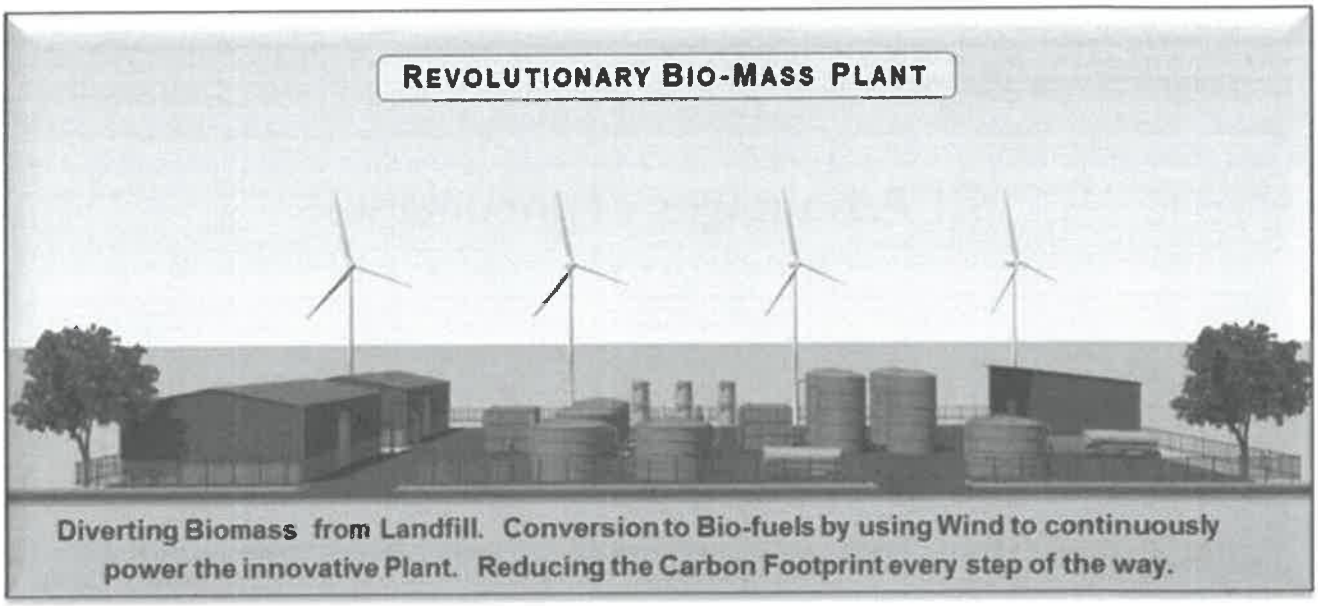
4.5.2 Treatable Wastes

Waste treatable by our Technology includes:

1. Organic Materials derived from:
   - Industrial and Municipal Wastewater Treatment Sludge's.
   - Moorland & Forestry Wastes and Parks & Gardens Trimmings.
   - Farming and Agriculture & Horticultural Wastes.
   - Commerce and Industry Wastes & By-Products.
   - Pharmaceutical & Chemical Industry Wastes.
   - Food Production & Food Processing Wastes.
   - Wood and Paper Wastes & By-Products.
   - Municipal Solid Waste & Food Waste
   - Animal Husbandry Waste and Manures
   - Medicinal (including Red Bag) Wastes
   - Impounded Drug Disposals

2. Inorganic & Inert Materials derived from:
   - Plastics
   - Landfill leachate
   - Hydrocarbon Waste

5.0 Our Solution



The application of our proprietary system using "Wind Turbines" to Generate Compressed Air in Storage Tanks (Compressor) for use Pneumatically – this is Revolutionary!

Pneumatic systems used in industry are commonly powered by compressed air. A centrally located powered compressor powers cylinders, air motors, and other pneumatic devices. A pneumatic system controlled through manual or automatic solenoid valves provides a lower cost, more flexibility, and is a safer alternative to electric motors and actuators.

Pneumatic systems in fixed installations, such as factories, use compressed air because a sustainable supply can be made by compressing atmospheric air.

5.1 Advantages of pneumatics:

The simplicity of design & control: Machines easily designed using standard cylinders and other components, and operated via simple on-off control

Reliability: Pneumatic systems generally have long operating lives and require little maintenance. Because air is compressible, equipment is less subject to shock damage. Air absorbs excessive force, whereas fluid in hydraulics directly transfers force. Compressed air can be stored, so machines still run for a while if electrical power is lost.

Safety: there is a very limited chance of fire and newer machines are usually overloaded safely.

5.2 Thermal Conversion Process Plant Advantages:

- Modular design specification.
- Low visual impact and small footprint.
- The plant process is contained in water.
- The plant is totally enclosed to contain and treat odors.
- Minimal emissions and greenhouse gas production.
- Relatively low capital outlay, when compared with comparable processes.
- Plant components can be easily extended, replaced, maintained, and overhauled.
- Significantly lower emissions than with all thermal and composting processes.
- The flexibility of operation allows for variations in loads.
- The plant can take on additional waste streams from other sources.
- No emissions to the atmosphere, no odors, and no export of waste.
- The design/technology process is recognized by the EU as suitable for waste treatment.
- Biomass from wastewater sludge treatment plants can be used in the process.
- The moisture & nutrient content of the biomass waste complements the process.
- With municipal solid waste, organic materials are diverted from landfill dumps.
- After final extraction, every residue produced is inert and reusable.

- Pre-stored biomass can be blended into the process.
- The processed output is carbon neutral.

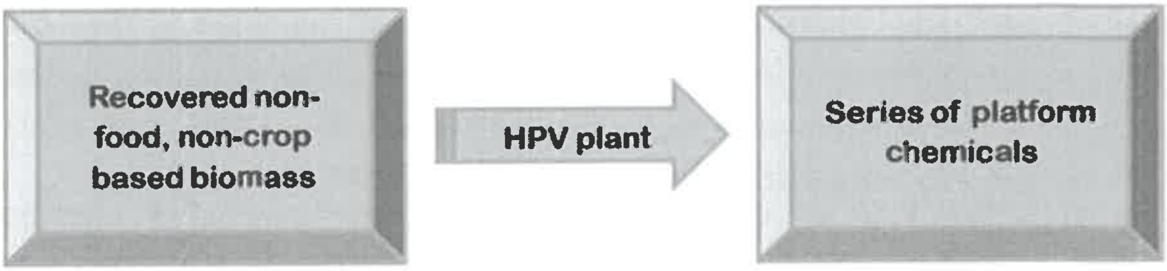
5.3 Partnership Facilities:

- Reuse Technologies SA offers a range of economic solutions to waste and energy requirements - and can be up-scaled on a modular basis.
- The core element is the HPV process and it can include combinations of the front-end waste input and preparations, plus the back-end processing of saccharides and by-products.
- At all stages, elements of our holistic approach can be integrated and provide profitable solutions, and generous payback and IRR returns, all based on the specified facility metrics.

*** A Note on Water: Our process produces excess water that can be treated and made suitable for reuse as irrigation, or any other appropriate standard.**

5.4 Conversion Process

A detailed description of the conversion process to be used in the Leeu-Gamka Waste-to-Energy Plant.



Stage 1: Pre-treatment

The biomass is mixed in water, shredded, and separated from any residual inorganic dense and lightweight materials. The biomass, still in the water, is extracted, and macerated to plate-like fractions of between 3 mm and 6 mm. These solids are then concentrated and cleaned and by using on-line water mixing the result is that the ratio of the solid in water is established at 8-12% content.

This mixture is then transferred to storage tanks or the thickening tanks shown in the schematic.

Within these storage/thickening tanks, the mixture is further modulated by employing the use of the company's Intellectual Property Technologies.

After retaining the mixture of Biomass (the Ligno-Cellulose) in the tanks, in accordance with the Intellectual Property issues, it is then extracted and passed through a macerating pump to be further concentrated and then passed forward to be treated in a pressurized hot water system.

Stage 2: Extracting the Saccharides from the Biomass

The process of extracting the Saccharides from the Ligno-Cellulose uses Pressurised Hot Water and Hydrolysis.

Hydrolysis is a process where the Cellulose and Hemi-Celluloses are converted to the Saccharides by adding external water. This is obtained from the carrying water in the mixture.

This is a simple procedure that frees the pent-up Cellulose and Hemi-Cellulose converting them to the Saccharides releasing them for processing to further products.

The process can work under Concentrated Acid conditions at below the first critical point of water, and under Dilute-Acid conditions where the temperature of the water is raised above the boiling point where it is kept as a liquid under pressure – this is known as Superheated Water – and it can occur both below the critical point of water (Sub-Critical Water) or above the Critical Point of water (Supercritical Water). In both systems, the acid is neutralized with an

Alkali after the Hydrolysis process. In using Concentrated Acids much effort is required to collect the salt so formed and then attempting to reformulate this in order to collect the acid used, around 30% of this acid is wasted as a result. By using a Dilute Acid at high pressure in Superheated Water the spent acid which is also converted to salt can be discarded although in some cases (particularly with organic acids) this can have valuable chemical consequences.

Stage 2.1 The following information relates to Dilute-Acid Hydrolysis

When a Biomass (Ligno-Cellulose) is fractionated down and pre-treated by softening with various front-ended processes the bond connecting the Lignin to Cellulose and Hemi- Celluloses are partially cleaved. This cleavage is of help when using Pressurised Hot Water as the carrying medium in Dilute-Acid Hydrolysis.

When Ligno-Cellulose is further pressurized and heated under a balanced regime of pressure and heat using Pressurised Hot Water (in Subcritical Water conditions) this bond breaks altogether. When Pressurised Water o attains a pressure of approximately 900psi and a balanced temperature of around 240 Celsius this bond becomes so weak that it fails. The Lignin breaks away and is then able to be dissolved because the hot water acts as a super-solvent. The two remaining other products, the Cellulose and Hemi-Cellulose - which prior to this time were polymers - lose their stability and identity and they then search for a balanced bonding with another Hydrogen-bond based material which is readily available in the " 'H-OH' compound" we know more familiarly as "'H_2O' or Hydrous Oxide" or water. This instantaneous reforming of bonded materials results in the Cellulose and Hemi-Cellulose being reduced to monomers to which we accord the name Mono-Saccharides. To assist this process the 'pH' of the solid-water mixture is reduced by the addition of a catalyst which is a very Dilute-Acid. As soon as the catalytic reaction has occurred the 'pH' has to be addressed again and neutralised otherwise the reaction would continue and, in particular, the Hemi-Cellulose would start to become dehydrated because its acidity is too strong and the temperature is still too high. If left unattended, over a longer time the reduced Hemi- Cellulose would become dehydrated and becoming firstly Furfural and then Hydoxy-Methyl- Furfural [HMF].

To arrest this latent reaction an equivalent dilute Alkali is added to neutralize the pH returning it to neutral whilst simultaneously returning the temperature below the first critical temperature, 100 Celsius at 100psi as quickly as possible. Under traditional methods adopted in the early part of the 20th Century in closed sequential batch pressure tanks, this took as long as 12 hours although the final embodiments reduced this to 3 hours.

Stage 2.2 By using a Hydrostatic Pressure Vessel the processing time is reduced significantly and made into a continuous procedure

As stated before the pre-treatment of the originating Ligno-Cellulose Biomass is crucial. It has to be cleaned and shredded and mixed in water to present a homogenous mixture. The optimum is around 8 to 12% solids in water. This is then shredded and pumped to storage and its initial temperature is raised to around 70° Celsius and an Alkali is added to pre-soften the Hydrogen bonds in the Ligno-Cellulose: this solution is kept missive for the prescribed time-frame. (This is all set out in the IP).

This consolidated Biomass is then withdrawn by using a progressing cavity pump which simultaneously shreds the bulk biomass and addresses the requirement to neutralise the alkalinity (of the solution). The mixture is pumped into the Hydrostatic Pressure Vessel and the pressure is increased to around 64,000-71,000 kPa whereupon an initial injection of steam is applied to raise the temperature to in excess of 235° Celsius. The steam is now replaced by injecting pressurised Oxygen which then sustains the temperature. The continuing pressure temperature balance in the Hydrostatic Pressure Vessel is maintained in the descending flow of the solution wherein a Dilute-Acid is injected which mixes in the turbulent water and a few second later an equivalent Dilute-Alkali is injected to neutralise the acidity of the solution. The Lignin is thus dissolved in the Pressurised Hot Water whereas the Cellulose and Hemi-

Cellulose are depolymerised to the Monosaccharides. The requirement now is to reduce the temperature of the solution and this is affected by reducing the pressure of the solution to atmospheric and simultaneously dissipating the temperature to below 100° Celsius by the use of a pressure-cooling jacket collection system to optimise the capture of pressure and heat to manufacture renewable energies.

This timing in the reduction of pressure and temperature is crucial in the use of the Hydrostatic Pressure Vessel and is optimized to be less than 10 to 12 minutes and is governed by the tenets of the IP [the Intellectual Property Technologies] held by the company.

In essence, the difference in the ultimate choice results is a balance between capital expenditure and operations and maintenance costs.

Stage 3: Conversion of Saccharides to Renewable Fuels & Renewable Products

After extracting the saccharides, from the Hydrostatic Pressure Vessels they are cleaned and concentrated in water prior to being converted to the chosen products.

The use of saccharides as the intermediate or platform chemical allows the company to make a variety of renewable fuels ranging from Methane to Butanol (and Butadiene as a precursor to making Aviation Fuels,) Di - Methyl Ether, 2,5 DME, and Hydrogen.

In addition, this platform chemical can also be developed to produce "value-added" products such as Bioplastics and Photo-Voltaic Cells.

In most of the processing routes, it will also produce Electricity and Heat.

The process is suitable to convert and treat a wide range of Non-Food based Biomass including that discarded in waste such as Municipal Solid Waste or Sewage Sludge and ABP [Animal By-Products] all in an Environmentally Acceptable and Affordablemanner.

The process is totally contained in water and thus cannot produce odors or any toxic residues.

All of the input materials can be converted into valuable products.

5.5 HPV Process

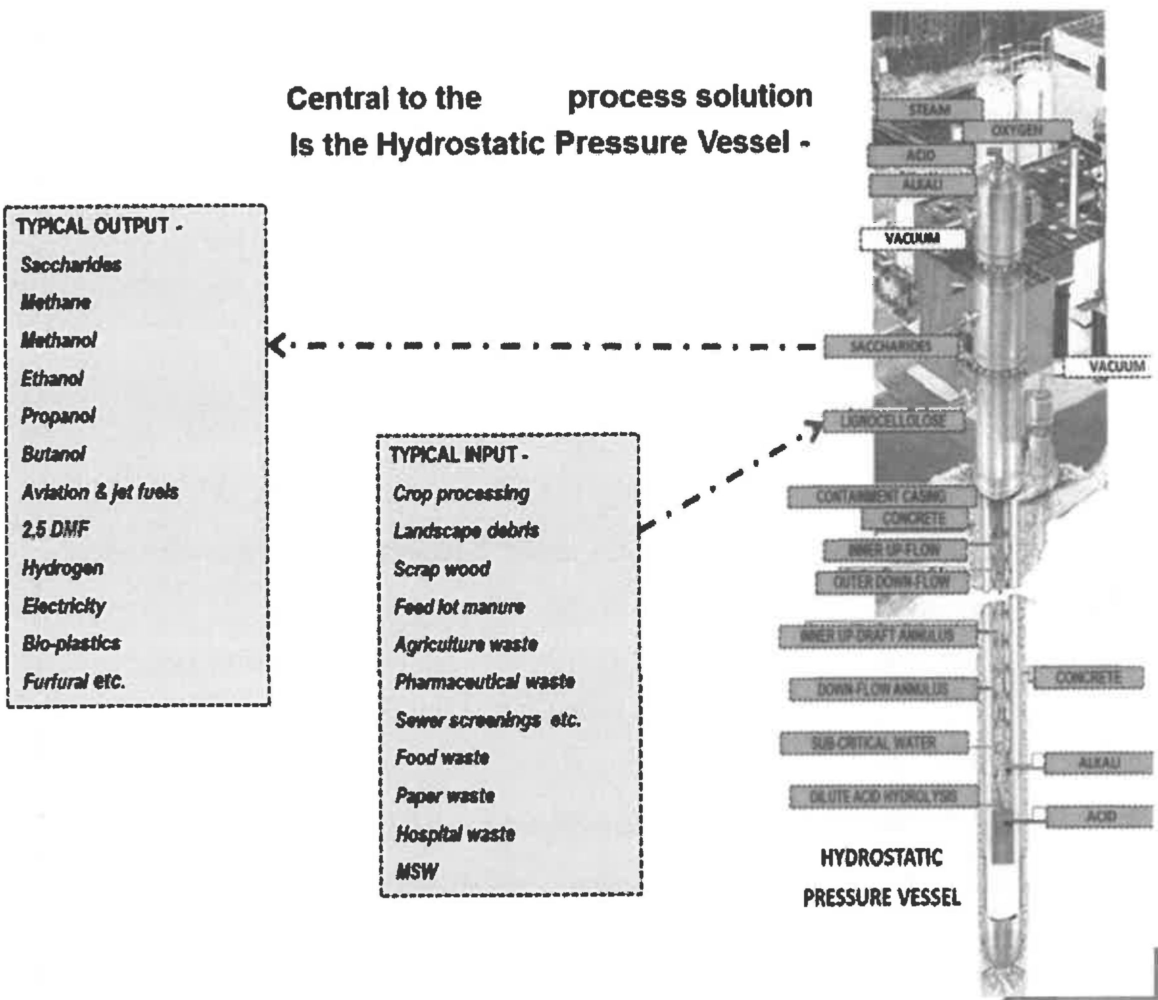
The process of reducing Biomass (Ligno-Cellulose) to the Saccharides by Dilute Acid Hydrolysis has been in use for over 130 years. There are three stages to this process:

Stage 1- Preparation of the Biomass

- Assuming the input material is non-food based biomass, we mix the biomass in water & then the mixture is shredded and separated from any residual materials.

- Biomass is extracted and macerated to 3mm - 6mm plate-like particles and concentrated and cleaned to form a mixture in water with an 8% - 10% solids content.
- This biomass mixture is then extracted and passed through a macerating pump to the down-flowing annulus of the Hydrostatic Pressure Vessel.

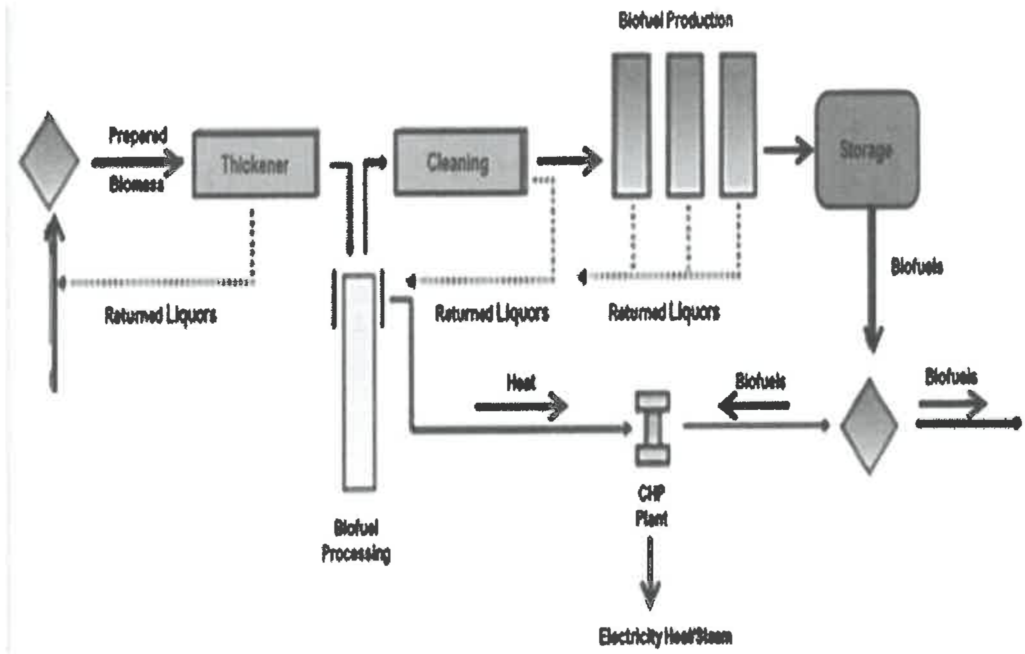
The Core Technology



Stage 2 - Extracting Saccharides

- The process of extracting Saccharides from Biomass uses Dilute Acid Hydrolysis.
- The process extracts the "Pent Up" Saccharides from the Biomass.
- This releases the Saccharides for processing into further proc

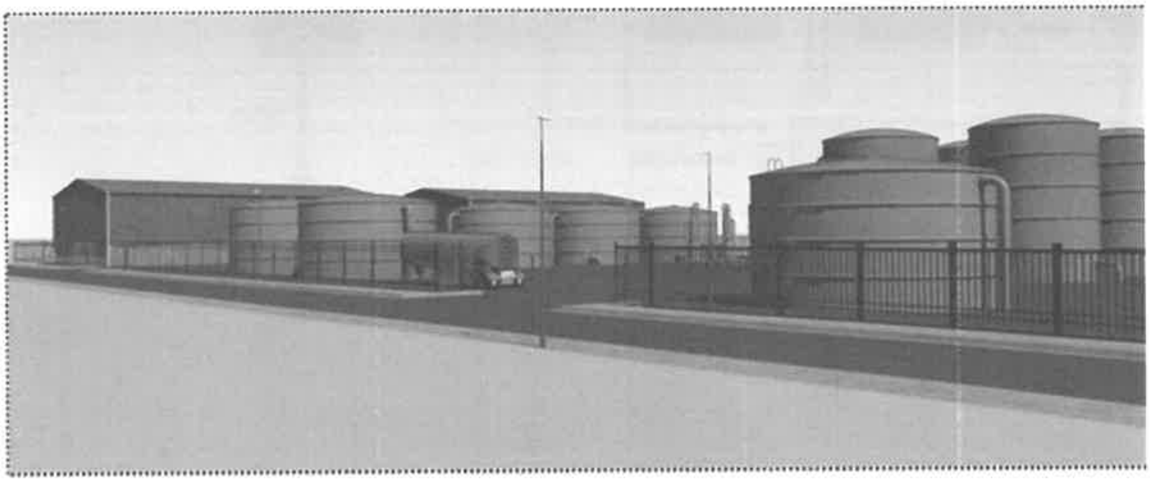
Schematic of the HPV



Stage 3 - Converting of the Saccharides into End Products.

- After Saccharides are extracted, they are cleaned & concentrated in water.
- The output is then converted into the chosen revenue products.
- The company can consider a variety of end products, ranging from Methane to Butanol; Aviation fuels to Hydrogen, Electricity, and Heat.

The processing is contained in water and thus cannot produce odors or any toxic residues, and all of the input materials are converted to valuable products.



The HPV process facility can be adopted to different Waste-to-Energy problems, and Reuse Technologies SA offers a range of Metro Solutions to Municipalities.

5.6 Advantages of Plant Facilities

- Relatively low capital outlay
- Modular design specification
- Low visual impact and small core plant footprint
- Plants can be easily extended, replaced, maintained and overhauled
- Enclosed plant contains & treats odors
- Minimal emissions and greenhouse gas production
- Significantly lower emissions than with all thermal and composting processes
- Flexibility of operation allows for variations in loads
- Plant can take on additional waste streams from other sources
- Design/Technology process is recognized by EU
- The processed output is carbon neutral

- Biomass from waste water sludge etc., can be used in the process
- The biomass moisture & nutrient content complements the process
- With municipal solid waste, the organic materials are diverted from landfill
- After final extraction, all residue produced is inert & reusable
- Pre-stored biomass can be blended into the process

5.7 HPV Process Facility

PROCESS INPUT PLANT: Organic Waste Materials → **HYDROSTATIC PRESSURE VESSEL PROCESS PLANT:** → **PROCESS OUTPUT PLANT:** Green Revenue Solutions

TYPICAL ORGANIC WASTE INPUT -

- *Crop processing*
- *Landscape debris*
- *Scrap wood*
- *Feed lot manure*
- *Agriculture waste*
- *Pharmaceutical waste*
- *Sewer screenings etc.*
- *Food waste*
- *Paper waste*
- *Hospital waste*
- *MSW etc.*

THERMAL CONVERSION PROCESS -

The Hydrostatic Pressure Vessel Process Plant converts Organic Waste to Saccharides.

This is achieved by an innovative technology application based on Weak Acid Hydrolysis. The plant process is continuous and economic.

TYPICAL GREEN OUTPUT -

- *Methane*
- *Methanol*
- *Ethanol*
- *Propanol*
- *Butanol*
- *Aviation & jet fuels*
- *2,5 DMF*
- *Hydrogen*
- *Electricity*
- *Bio-plastics*
- *Furfural etc.*

6.0 Process Outline

Reuse Technologies SA Tasked with:

1. Delivering a solution for the growing problem of municipal solid waste in the Central Karoo District in the Province of the Western Cape.
2. Providing the best Environmentally Acceptable and Economically Affordable Solution to divert the Organic Fraction of the Municipal Solid Waste [MSW] collected in the general catchment area through the manufacture of Renewable Fuels and Energy.
3. Base Information regarding the Quantity of MSW generated in the area.

- The area produces over 230,000 tonnes per year of MSW discarded by Society in the area:
- The organic fraction – or Biomass – discarded in the MSW is estimated to be 107,000+ tonnes.

4. Design and Construction, Commissioning, and Setting to work and

the Operations and Maintenance of the following:

- Local collection of the MSW:
- Transfer of the MSW to the appropriate treatment centre:

- Separation of the Biomass from the MSW using a Materials Recovery Facility [MRF] releasing these products for onward classification or sale and/or conversion to other products:
- Treatment of the Biomass to make the Renewable Fuels and Energy.

6.1 The project will be designed to affect the following:

- The facility is targeted to produce an initial (name-plate) 54.99 tonnes per day of the Renewable Fuel Bio-Methane over a 340 day operational year.
- The Methane is proposed to be compressed and liquefied for storage. The output of Methane will be enhanced within a few years of setting to work.
- Additional products made in the process includes Carbon Dioxide (which will be compressed and liquefied and then dry ice for storage,) Furfural (a solvent,) and Struvite (a fertilizer.)

- The facility will produce a surplus of Renewable Electricity and Renewable Heat which will be available for sale / local use. This will be generated via a Combined Heat and Power Plant [CHP.]
- There will be a small quantity/residues resulting from the process which will be made available for reuse.
- Training of All Staff needs as well as for Full Health and Safety issues. The Training system proposed will be using agreed Training

- Courses suitably tailored to the local and International needs.
- It is proposed therefore to incorporate the use of Local RSA Colleges and centres of Higher Learning to train staff both within a learning environment as well as on the site of the proposed facility (facilities.) This intent is to ensure that all staff – regardless of their roles – have full knowledge of these as well as a buy-in of personal acumen to work within the confines of a working site. This training system will continue throughout the tenure of the Operations and Maintenance time frame for the facility.

6.2 The Facility

The Proposed Facility (Plant) is to be located at the agreed site compliant with the approvals by the Prince Albert Municipality. The site will include new buildings and construction plants. Access will be made to the site by a newly-completed surfaced road to be funded by the Department of Trade and Industry in the amount of up to R50 million.

6.2.1 Separation of the Biomass from the MSW using a Materials Recovery Facility [MRF] releasing these products for onward classification or sale and/or conversion to other products.

6.2.1.1 As part of the process the Facility includes a Materials Recovery Facility to separate the Biomass from the MSW.

This will be carried out within an enclosed building which will be

working under a relatively low negative pressure. The MSW will be deposited within the building after each vehicle has been separately weighed within the building and only after the entrance is closed.

The Buildings here will be protected against any vermin entry, and supported by appropriate systems to prevent bird infestations.

The MRF will be a traditional dry and wet system, whereby the initial separation will follow the typical systems seen elsewhere in the waste industry. The recovered materials - except for plastics - will then be made available for reuse and/or for sale.

6.2.1.2 When separated the Biomass will then be further processed under water within the same group of structures and buildings used for the MRF.

The Biomass will be completely covered by water and then an application ofa dilute hydroxide will be mixed so as to neutralize any miscreant products.

6.2.1.3 The Biomass in solution will then be passed forward for further treatment.

The building complex here will be fitted with an air ventilation extraction plant wherein the extracted gases will be diverted through a biologically active gas treatment system.

This will be continuously monitored so as to eliminate and eradicate all odours that may arise from within the MRF facility.

6.2.1.4 All and every access to the buildings here will be controlled by Operations and Maintenance procedures. Personnel will be logged in and out and regularly checked during their time of working.

6.2.2 Treatment of the Biomass to make the Renewable Fuels and Energy.

6.2.2.1 At this point the Biomass which is in solution will be macerated and concentrated to form a dilute solution which will have been rendered neutral with a pH of 7.0 prior to onward processing.

6.2.2.2 This solution will then be processed again and by using hydrolysis the anticipated chemical transformation to produce the intermediate products prior to further treatment to Methane will have been affected.

6.2.2.3 This solution will then be transferred by pumping and sent through the anaerobic digesters for the production of Methane. Methane is produced as a gas here and is accompanied by a near equivalent volume of Carbon Dioxide and a few other gases – including some nitrogen, ethane, hydrogen and minute sulphides of hydrogen and mercaptans, lactols, indols, skatols and others. Methane is produced with a marginally elevated pressure of 1146.57 hPa and a temperature between 35 degrees and 41 degrees Celsius.

6.2.2.4 Methane and Carbon Dioxide will be cleaned by chemically-based absorption so as to release these two gases and separate them from each other by a gaseous membrane refining. After separation of the Methane and Carbon Dioxide from the anaerobic digesters the gases will be collected and passed through a biologically active and chemically absorbent treatment system. This will be continuously monitored so as to eliminate and eradicate all odours that may arise from within the gas train and the facility.

The Carbon Dioxide will then be cryogenically refined to a liquid and then a solid through which the Methane will be passed through for final polishing to be produced at the correct consistency.

6.2.2.5 The building complex here will be fitted with an air ventilation extraction plant wherein the extracted gases will be diverted through a biologically active gas treatment system.

6.2.2.6 This building will be classified as an enclosed building which will be working under a relatively low negative pressure.

6.2.2.7 All access to the buildings here will be controlled by Operations and Maintenance procedures.

6.2.2.8 All Personnel working or visiting the buildings will be logged in and out and regularly checked during the time they are either working or visiting.

6.2.2.9 There will be no noxious gases arising from the facility.

6.2.2.10 The Buildings here will be protected against any vermin entry, and supported by appropriate systems to prevent bird infestations as well.

6.2.3 The facility will produce a surplus of Renewable Electricity and

Renewable Heat which will be available for local use.

6.2.3.1 The facility will have a full Combined Heat and Power Plant [CHP] which will be used to generate electricity and heat for use within the plant as well as for onward sales.

6.2.4 Residues from the Facility

There will be a residual quantity of water and a small quantity of inert chemicals arising from the facility.

6.2.4.1 The residual water will be treated in a specific facility with an aerobic/anaerobic SBR treatment plant dedicated to that purpose which will be housed on site inside its own structure. It will have its own air extraction and ventilation plant to deal with odours and to comply with the purposes of discharging to local water courses and for irrigation.

6.2.4.2 There will be no Toxic Airborne Emissions to the ground or to the Air: this means that the facility will complement the Stockholm Conventions.

6.2.4.3 The inert chemicals will be non-toxic, classified neutral, and made available for inclusion in road fill.

6.2.4.4 The inert chemicals arising from the production plant will fully comply with being non-toxic and meet compliance standards of the Stockholm Conventions for the full elimination of indirect emissions by run off to the land or surface or subsurface waters and aquifers.

6.3 Adjunct Environmental Issues

The facility will be designed and constructed to all Applicable Regulations applicable to Noise, Odour, Chemical Storage and Use, Fuel Storage and Use, as well as any reasonable environmental practices. The general tenets of the design procedures and the Design and Construction of the Facility is that the plant shall be designed to be modular in design with repetitive modules (or streams) working side by side employing matched plant that can be switched in from one to the other in the event of any downsides or interruption of a stream or until one stream has been brought back into usage. In this regard the facility will be fitted with a dual power supply system fully complimenting the electrical needs of the facility using energy produced from within the facility as its main source of supply. Surplus energy will (as reported) be made available for meeting local service needs in the area. The facility will be designed in accordance with South African Design codes supported with that attendant from within the European Union.

The Facility will be designed with Health and Safety issues dominant and encoded within the construction and in operations and maintenance. Under current legislation, therefore, any programme of work shall adhere to the full rigours of the Construction Design and Management Regulations [C D and M Regulations] and further adhere to the fullest Health and Safety rigours followed across the European Union. As an example therefore during Operations and Maintenance and attendant Servicing each work-station will have a minimum of two personnel working at any work-station as agreed in all Chemical and Waste Water Plants World-Wide. No deviations will be permitted, and this will be reinforced from the outset when design has been commenced.

The Facility will be treated in part as a Fuels Production plant wherein the produced Bio-Methane will be classified as a fuel under the relevant statutes with the RSA. This section of the Facility will thus have a separate entrance and exit point away from the main treatment facility with its own security access included.

Within the tenets of the Design – and prior to that in the Feasibility arena – a full accountancy of the Greenhouse Gases emitted during the time frame for the Operations and Maintenance of the Facility will be accredited.

6.4 Local Collection of the MSW

6.4.1 It is proposed that the contracting entity here will arrange for the provision of a fleet of new standard fixed wheelbase MSW

6.4.2 collection vehicles for the area. Each vehicle will be a dual-fuelled meaning that they will be able to use compressed Biomethane as a direct replacement for oil-based Diesel and electrical energy. It is proposed that both of these sources of energy will be provided from the treatment site/facility.

6.4.3 It is proposed that all staff proffered for use working with these vehicles will attend the appropriate training centres for driving and working with such vehicles and be regularly tested against all and necessary Health and Safety and Environmental Standards as well as Hazards at Work recorded in internationally-acclaimed standards.

6.5 Transfer of the MSW to the appropriate treatment centre

6.5.1 It is proposed that after collection of the MSW, the collection vehicles will be embarked on a Rail Transfer system to take the MSW to the appropriate treatment centre. Under this guise of using a Rail Transfer system to take the MSW to the separation facility where the MRF is situated significant fuel savings and environmental nuisance can be avoided.

6.5.2 For this consideration of using a rail transfer system – such as this – all the fuel as Diesel would be countenanced against the train taking the loads and using that train engine to bear the transfer costs. In the calculation of this therefore there are known for which the expression of costs is fairly substantial, and these can be off-set quite substantially by the rail haulage system. The equivalent European Union comparison of haulage rates per Diesel engine driven lorry are given in this extract from Spain in these reported information extracts

6.6 Waste-to-Energy Plant Transportation Process

Reuse Technologies SA commissioned a concept level study to investigate the provision of a rail link between the towns inside the Central Karoo District and the Reuse Technologies SA Waste-to-Energy process plant. A suitable location is along the existing N1 National Highway railway network. This concept will unlock a new potential for a multi provincial strategic rail corridor, while at the same time relieving pressures from the long distant, dangerous, high emissions and time consuming journey to the landfills.

The railway link is a result of Reuse Technologies SA commitment to ensuring environmental protection through safe handling and disposal of waste. This concept is referred to as RailRoad transportation. Reuse Technologies SA will use this concept to change the way that waste is transported and how it is processed from the source to the Waste-to-Energy Process Plant.

Reuse Technologies SA has redesigned how garbage will be collected from the source. This may be from homes, offices or even farms. The process of getting the garbage from the source to the process plant will make use of the RailRoad.

The RailRoad Highway will make use of existing railway tracks which are running through South Africa. Minor upgrades will be made to the rails in order to support the Reuse Technologies SA RailRoad Trains. This RailRoad is the future of transportation for the Waste and Commercial sectors.

6.6.1 Benefits of the RailRoad

6.6.1.1 Rail transport can be cost effective: Shippers who convert long-haul freight from road to rail, can save 10-40%. Rail has lower fuel costs compared to road transport, especially when shipping a high volume of freight. Rail also has fewer costs associated with drivers.

6.6.1.2 Shipping via train is more environmentally friendly: Trains burn less fuel per ton mile than trucks. Using rail transport over road transport can lower greenhouse gas emissions by 75%.

6.6.1.3 Trains are capable of hauling large loads: Trains can handle high volumes of freight. In fact, one double-stacked train can hold approximately the same amount as 280 trucks. This can be very beneficial for shippers with large loads.

6.6.1.4 Railways are reliable: Railways have standardized transit schedules and don't share their tracks with the public like trucks do with the road. For that reason, trains aren't hindered by traffic and weather the same way trucks are.

6.6.1.5 Rail freight can be efficient: For many types of loads, the average transit time is comparable to that of road transport. While rail shouldn't be used for time-sensitive shipments, it can provide very similar transit times for longer hauls.

The RailRoad Highway saves fuel, tolls and cuts time by avoiding traffic jams, and drivers can comply with legally required rest times without interrupting transport. A major demand for this type of service appears when road costs (fuel, tolls) increase significantly. Making use of the RailRoad Highway, the travel time is easier to estimate and known by the user, but it depends, however, on different aspects (speed, load, type of rails, locomotive), time departure factors and bottlenecks.

7.0 Intellectual Property Rights & Technologies

7.1 Intellectual Property Rights & Technologies to be used on all Process facilities:

The Company can select from various proprietary technology and Intellectual Property that is available for use and are contained within its portfolio. All of the Intellectual Property Rights are executable through Bio-Rights BV and others to Waste E3 Solutions and transferred to REUSE TECHNOLOGIES SA.

The following items are a relevant selection:

IP No 1. Assessment of Free Water Content and the Assay of the content of Lignin, Cellulose and Hemi-Celluloses and Ash Content in the Biomass.

As part of the basic data required by the company for determining the use is the most appropriate option for conversion of the Biomass (Ligno-Cellulose) to Renewable Products. The company has agreed to analyse this in accordance with European Standards using affiliated assessment laboratories at Premier European Union Universities and Colleges of Higher Learning to determine these important parameters.

These determinants will be carried out in two simultaneous and neutrally confirmed bases supervised by the providers of the Intellectual Property Rights, through the use of its Preferred and Contracted Companies of European Consulting Engineers, who have signed a non- compete agreement to work on its Intellectual Properties and the Processes across the World.

IP No 2. Thickening of Prepared Biomass in Water using a Proprietary adjustment of Alkalinity, and then the use of Polyelectrolytes and Catalytic Chemicals - which can be reclaimed after use.

An approach to consolidate and thicken Biomass in Water employing a development already carried out and proven confidentially at scale in an internationally renowned University

– Boras in Sweden - Research Programme, and a scale plant of 20 tonnes per day dry solids content of various mixed sources of Biomass from Non-Food based sources - including some from Municipal Solid Waste including Food Waste, Agricultural and Horticultural Waste, Food Preparation Waste and from Phytoplankton harvested at Sea and in Land Locations.

All using a series of general Alkaline conditions supported with the use of Polyelectrolytes and Catalysts in order to stimulate de-lignification and to increase the solids to water ratios. The determinations have resulted in producing a Biomass in Solution that retains its laminar flow conditions making it suitable as a solution

IP No 3. Pressurised Hot Water solution of Biomass developed during Positive Displacement Pumping and the subsequent Catalytic Acidification and De-Acidification of the Biomass and Cooling and Depressurisation of the solution and capturing of Pressure and Heat Energy.

The Hydrolysis of Biomass in a continuous system using heat and pressure pumping technology, via a positive displacement pumping plant, and the controlled rapid cooling and depressurisation of the solution - with the capturing of Heat and Pressure Energy for power generation - to prevent the dehydration of the resultant saccharides to furfural and other toxic chemicals that are counterproductive to the production of same for use in the production of Renewable Fuels and Products.

IP No 4. Using Pressurised Hot Water in a Pressure Vessel to break down Biomass and dissolve the Lignin, and then employing Dilute-Acid Hydrolysis to Reduce the Cellulose and Hemi-Cellulose polymers into the Saccharides by using a Hydrostatic Pressure Vessel.

The Hydrolysis of Biomass in a Pressure Vessel at the regions of Sub-Critical and Super-Critical Water conditions using very dilute acid catalysts already developed in Confidence during a research programme at scale in the Internationally

Renowned University Boras in Sweden Research Programme, of 20 tonnes per day in a continuous employing a sustained pumping pressure at entry into the pressure vessel, and the subsequent rapid cooling and de-pressurisation of the solution (with the

capturing of Heat and Pressure Energy for power generation) to prevent the dehydration of the resultant saccharides to furfural and other toxic chemicals that are counter-productive to the production of same for use in the production of Renewable Fuels and Products.

IP No 5. Using Pressurised Hot Water in a Pressure Vessel to break down Biomass and dissolving the Lignin, and then employing Alkali Hydrolysis to Reduce the Cellulose and Hemi-Cellulose polymers into the Saccharides by using a Hydrostatic Pressure Vessel.

Alkali Hydrolysis is an already stabilised procedure to rupture Ligno-Cellulose Biomass, so enabling the extraction of Cellulose and Hemi-Cellulose for further Processing for Treating these to make Renewable Fuels. This embodiment of the process uses this procedure as it allows the processing rules to be employed without using costly enzymes.

The process continues on from the prior pre-treatment procedures developed in IP No 2 and is maintained in a continuous application in an enclosed pipe at ground level.

IP No 6. Using Microwave Technology in Pressurised Hot Water in a Pressurised Vessel to break down Biomass and relieve the Lignin from Cellulose and Hemi-

Cellulose in Ligno- Cellulose Biomass by using a Hydrostatic Pressure in a pipe vessel.

Microwave depolymerisation of Ligno-Cellulose Biomass is a well-known and effective system for extracting and breaking down the Lignin from the Cellulose and Hemi-Cellulose fractions of Biomass. Hitherto this needed a large container and a lengthy time of treatment until the containment system was converted to a pipe where laminar hydraulic flow was used. This embodiment short-cuts the retention time and is enabled by building banks of pipes together, to contain the process and keep the system on a modular basis as plant sizes increase.

IP No 7. Using Hydrogen in the Anaerobic Digestion of pre-separated Cellulose and Hemi- Cellulose in a Pressure.

This process is used in combination with the pre-treatment systems in prior IP No's 3, 4, 5 & 6 developments stated previously.

IP No 8. A Catalytic Polymeric system for reducing Biomass and dissolving the Lignin to Reduce the Cellulose and Hemi-Cellulose polymers into the Saccharides at room temperature for subsequent uses in the production of Renewable Fuels at low temperatures.

This development spurred on by a traditional review of an existing system has been re-evaluated to extract the three principal components in Biomass - Lignin Cellulose and Hemi-Cellulose - so that each can be collected separately for onward processing.

IP No 9. Using Super-Heated Hot Water in a modified Tube-Pipe - with a catalytic inner wall - as a Continuous Flow Pressure Vessel to break down Biomass to dissolve relieving the Cellulose and Hemi-Cellulose polymers for the manufacture of Saccharides for the production of sensitive Pharmaceutical products.

High Temperature Cleansing of raw Biomass from farming and Agriculture free from toxins incumbent in Municipal Solid Waste and Industrial Wastes precludes such use in the production of sensitive Pharmaceutical products. Removing these by destruction is an issue that also destroys the Cellulose and Hemi-Celluloses. This embodiment uses a Catalyst inside the reaction area to accelerate the destruction of these minor fractional components in Biomass, so that they play no further part in the subsequent process. The Cellulose and Hemi-cellulose fractions are then devoid of impurities, and can then be used for further use in Pharmaceutical Product development.

IP No 10. Using a Controlled Two-Stage Super-Heated Hot Water, which is then cooled and Reheated Super-Heated Hot Water system in Tube-Pipe - with a catalytic inner wall - as a Continuous Flow Pressure Vessel to break down Biomass to:-

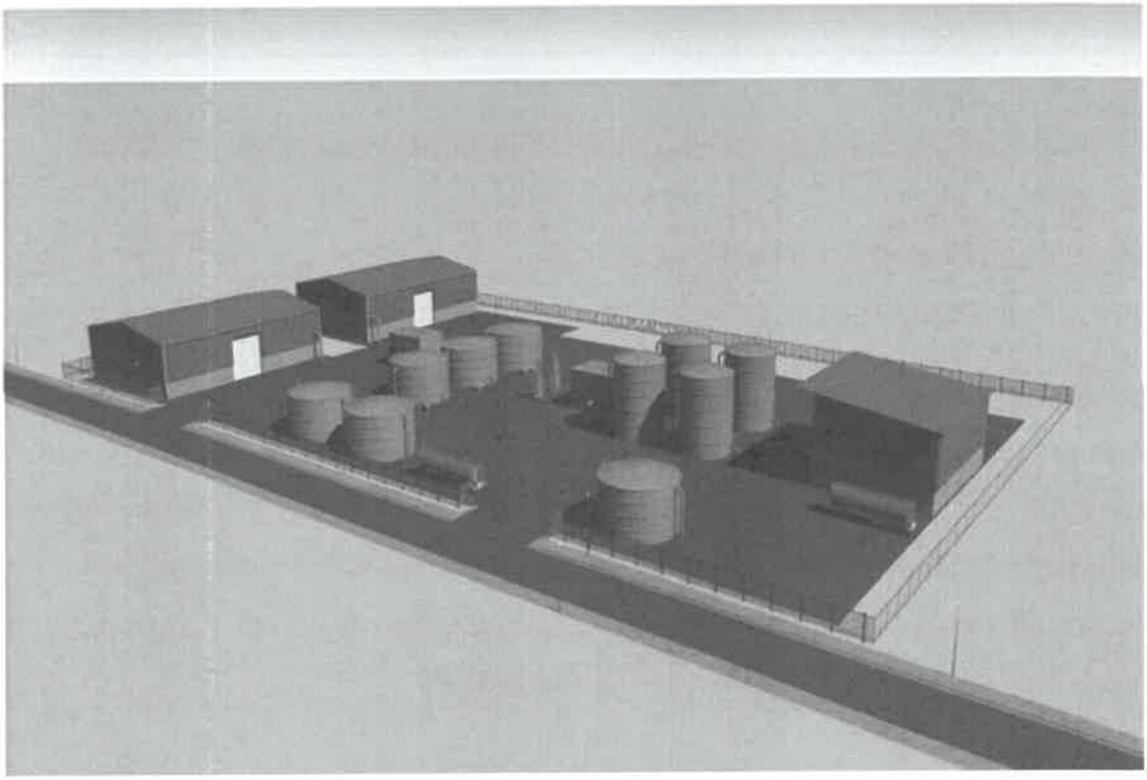
dissolve the Lignin – which is then extracted to manufacture Renewable Fuels,

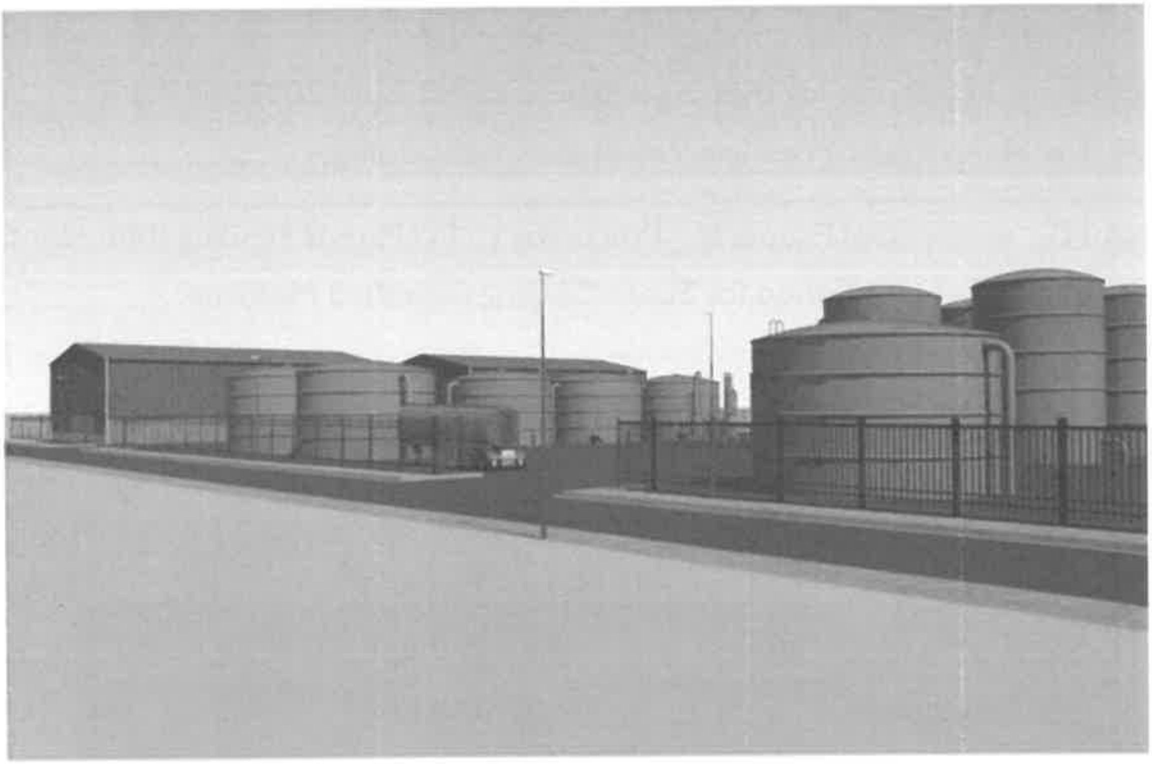
And to extract the Cellulose and Hemi-Cellulose polymers for the manufacture of Saccharides for the production of individual Cellulosic components for manufacturing Bio- Plastics.

Method and Apparatus for treating waste streams: April 2002 and April 2004. The Hydrostatic Pressure Vessel and Methodology.

IP No 11. Intellectual Property – Precursor to EU Patent Pending (Not identified under WIPO Rules) Method for Super-Chilling Liquefied Methane.

7.2 General Plant Drawings





Pressure Vessel Injection Nozzle Drawings

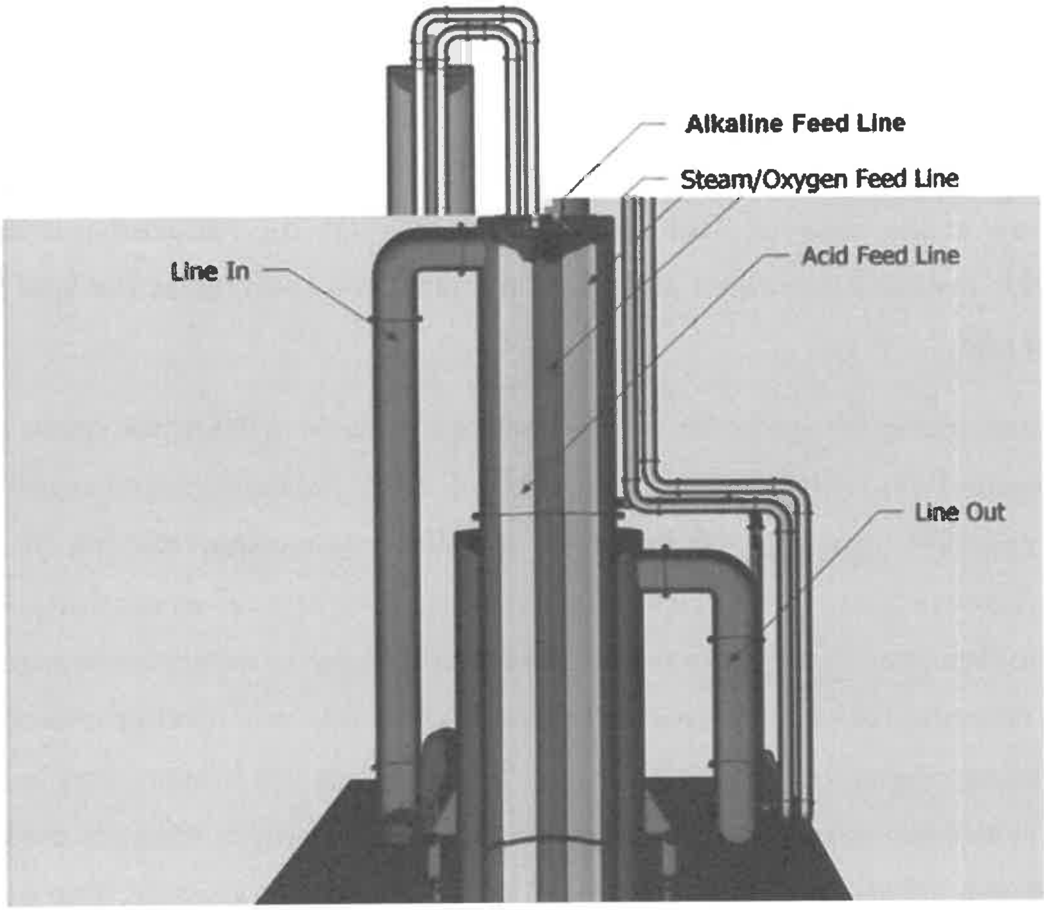
The pressure vessel is a kind of pump that can process hundreds, or even thousands, of gallons per minute with no moving parts. Water carrying tonnes of preselected and processed suspended organic solids per day are drawn down into the central shaft of the closed system gaining pressure naturally hydrostatically and pneumatically as the organic solids descend. It is heated by the fluids coming up from the bottom of the vessel.

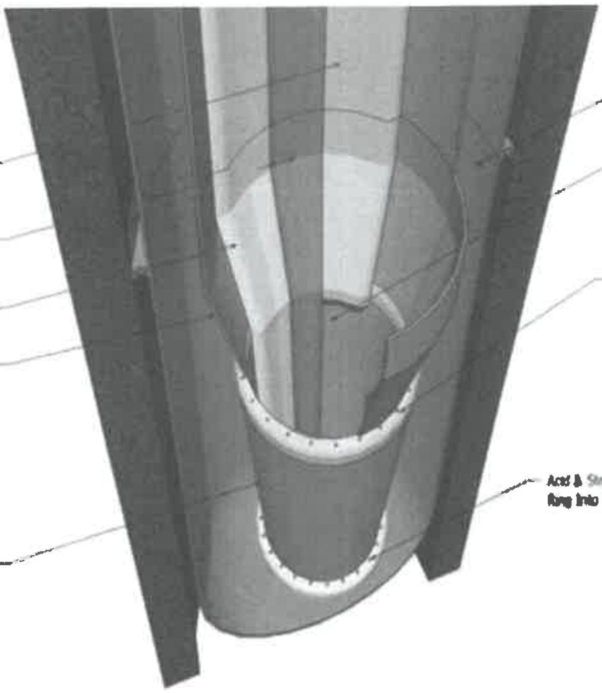
When the organic solids reach the Injection Nozzle it is under full pressure and has been pre- heated. Once the material reaches the optimum depth (Lowest Point) it flows into the return up pipe and at this point, the pressure, and heat is at its greatest. Steam is added at the bottom to raise the core temperature and then oxygen is added to purge the organic solids providing heat. Next the acid is injected into the material under high pressure. At the point the acid is injected, the shape of the chamber resembles that of a jet engine whereby a tapered conical

Shape exists. This allows the high flowing acid jet to naturally increase the dynamic flow of the material itself which travels through the reduced aperture. The dynamic pressure increases and the static pressure reduces as the aperture reduces in size.

The reaction increases because of the reduced volume within the space at a higher dynamic flow, which will also reduce the critical reaction temperature. The chemical reaction between the cellulose and water is exothermic, i.e., it generates intense heat, which is more than sufficient to keep the reaction going. Carbon dioxide provides the weak acid that breaks down the fibres into sugars. Once the reaction takes place an alkaline is added to stop any further chemical reaction occurring which fixes the sugar. The sugar in the water rises in the pressure vessel and is cooled by the descending organic solids. Most of the heat remains in the pressure vessel which can be converted to power. The outlet chamber separates the lime and metal oxides from leftover gasses from the water and sugar solution.

Injection Nozzle Drawings





Pressure Vessel Spiral Ring Drawings

A "Spiral Ring" has been added at the bottom after the Injection Nozzle similar to that required for a jet engine to accelerate the process and reduce the depth. When the reaction starts with the steam/acid/oxygen on the organic solids the nozzle causes a vacuum, and the material with the Heat accelerates and spirals up the tube gaining speed and pressure causing a vortex. This helps the conversion process needing less heat but gaining pressure which reduces the depth of the HPV.

Spiral Ring Drawings