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Press Release

Contact: C. G. Steiner
Phone: 913.897.2727

For Immediate Release
Date: October 20, 2007

Subject: Overseas Consultants Completes Feasibility Study that includes Self-Biofueled Locomotives, Self-Biofueled Ships, Tidal Generators, and BioWastes-To-Renewable Energy, Biofuels, Organic Foods, & Water Independence for the Islamic Republic of Pakistan.

WaterSmart Environmental, Inc. announces the completion of the wastes-to-renewable energy feasibility study for the Islamic Republic of Pakistan. Pakistan has been enjoying robust growth over the last several years. This growth has substantially increased the need for additional energy. Its Governments has decided to provide the additional energy as renewable energy that prevents additional global warming.

The many agricultural and manufacturing activities that are included are designed to improve per capita income and to reduce the marketplace costs of electricity, food, fuel and water. In the process the named cities will become zero wastes-to-landfill societies using technologies that possess a zero carbon footprint. The associated jobs creation potential could easily eliminate all of the unemployment that now exists throughout the Islamic Republic of Pakistan.

The Biowastes-To-Renewable Energy agricultural activities consist mostly of tilapia fish production and associated processing. Additional agricultural activity includes the farming of Spirulina microalgae that will be used as a whole food product for tilapia fish feed. Excess Spirulina will be converted into biodiesel and compressed natural gas (CNG) biofuels. These several agricultural activities share their routine annual profits 50:50 with the communities they serve. The manufacturing activities include of the construction of self-biofueled trains, self-biofueled ships, and renewable energy tidal generators (see April 10, 2007 Press Release, May 7, 2007 Press Release, and May 10, 2007 Press Release, respectively, at http://www.watersmart.com/Press_Releases.html for additional information). The manufactured products will mostly be exported to worldwide markets.

The entire biowastes-to-renewable energy, food, biofuels, and water independence project consists of the construction of many large buildings that will house both farming and manufacturing activities in full compliance with Kyoto Protocol. The individual buildings will be connected with infrastructure that includes roads, sanitary wastewater collection, potable water distribution, natural gas distribution, and electricity distribution. The biofuels produced consist of biodiesel and compressed natural gas (CNG). The foods production will provide food independence for the referenced Pakistani cities with excess food production exported to distant markets.

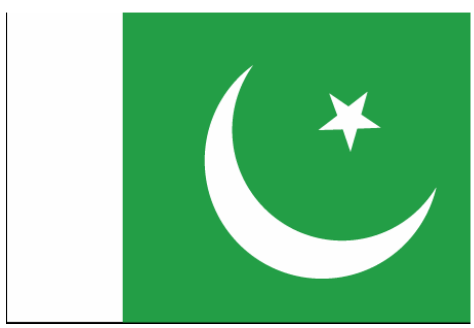
WaterSmart Environmental is marketing its Kyoto Protocol compliant wastes-to-energy technology on an economic development platform to concentrated animal feeding operators and to municipalities. Animal farmers benefit by purchasing biodiesel, electricity, and natural gas (methane) at a 20% discount from retail. Municipalities also benefit by making biodiesel, electricity, natural gas, and potable water available to its citizens and businesses at a 20% discount from existing prices. The technology is marketed on a build-own-operate basis thereby eliminating the necessity for local sales and property tax increases since project financing is entirely secured from the financial marketplace. Municipalities that embrace the waste-to-energy technology automatically become zero waste-to-landfill communities. The waste-to-renewable energy technology has been slowly developed over the last 10 years. It is just now being introduced to the international marketplace. The technology has the clear potential for making every single city throughout the world energy and fuels independent while reducing oil and natural gas imports. The technology will also permit every single city throughout the world to improve water and wastewater treatment infrastructure while creating jobs and investment opportunities. The waste-to-energy technology can also be applied to Sugar Cane Mills as well as Pulp & Paper Mills with equal success. Both types of mills become energy, food, fuels, and water independent while significantly increasing profits from routine operations. In the case of Sugar Cane Mills temporary and seasonal jobs turn into full time better paying jobs. **Widespread use of the technology carries with it the potential for contributing substantially to the reversing of global warming.**

WaterSmart Environmental, Inc. is a provider of waste-to-energy, food independence, water independence, and energy independence technologies and a manufacturer of highly engineered water purification components and systems. The company designs and builds a wide variety of water treatment equipment including packaged water and wastewater treatment plants, UltraPaq™ aerobic package plants, OAT™ Process anaerobic digesters with associated energy production, aerators, filters, PuriSep™ and SmartWater™ oil/water and solids/liquids separators, RainDrain™ perimeter trench sand filters for stormwater runoff, dissolved air flotation separators, air strippers, complete skid assembled aqueous waste treatment plants, FilterFresh™ skid mounted potable water production plants, skid mounted wastewater treatment systems for laundromats, commercial laundries, and car/truck wash facilities with water reclamation and reuse, softeners, demineralizers, activated carbon treatment equipment, and water purifiers for domestic and international markets.

FEASIBILTY STUDY

Islamic Republic of Pakistan

BioWastes-To-Renewable Energy, Food, Biofuels, and Water Independence



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A CHP Partner, an AgSTAR Ally, and Members of ACORE, AWWA, and WEF.

October 19, 2007

Subject: Kyoto Protocol Compliant BioWastes-To-Renewable Energy, Food, Biofuels, and Water Independence Project Description

Technology Provider: _WaterSmart Environmental, Inc._

Project Developer: Overseas Consultants

Dear Investor:

The Alternative Energy Development Board of Pakistan is now promoting the development and use of renewable energy and biofuels throughout the country. Pakistan's economy has been robust over the last several years resulting in a deficiency of affordable energy. It's Government strongly appreciates the potential of alternative energy sources and is now taking steps to achieve its development.

This initiative is to establish renewable energy, food, biofuels, and water independence throughout the entire Islamic Republic of Pakistan. Karachi, Pakistan's largest city (pop. 14 million), generates about 7,500 tons of municipal solid waste (MSW) per day. This MSW is presently handled by several private contractors and is dumped at multiple landfill sites in and around the city. The city's population continues to expand rapidly, and has resulted in an urgent need to address the environmental problems associated with air and water pollution through proper MSW management and disposal, as well as increased demand for electric power. The proposed WTE plant would help address the power needs and the environmental concerns of Karachi, while at the same time generating a source of income for the city.

At the present time electricity is generated from very expensive imported fossil fuels that have become too costly to generate sufficient electricity. Even though Pakistan has abundant coal for power generation its government has refused to consider its use out of respect for the environment. Pakistani coal is very high in sulfur content and thus if used would be a significant contributor of acid rain and aerosol sulfate pollution. Aerosol sulfate pollution is one of the factors associated with global dimming, a phenomenon that exists simultaneous with global warming. Acid rain also has its adverse impact in lowering the pH of soils making them less fertile while lowering the pH of the oceans of the world—again with adverse impact on marine life.

What we are proposing is the construction of a single project building just east of the existing Port of Karachi. This building will engage in the generation of over 100 MW of renewable energy using municipal solid wastes and agricultural wastes as the feedstocks. The building will be producing and processing tilapia fish. The finished tilapia fillets will be sold to local and distant markets. The market for tilapia fish is already quite large worldwide and on the increase.

The project building will also engage in both ship breaking and ship building. Ship breaking is the marketplace activity that reclaims the steel from ships that are no longer serviceable. Pakistan is already a major world player in the shipbreaking business. The industry is extremely dangerous because of less than adequate shipbreaking facilities. The industry is also known to produce substantial pollution since the ships that are sent for breaking must frequently be towed to the site because their propulsion system has quit working. In every instance there will be unused petroleum fuels and other contaminants that will escape to the sea. In short, it is a dangerous and pollution laden industry. With the proposed technology this industry will move indoors where adequate shipbreaking equipment will be installed and where its associated wastes can be converted into renewable energy through anaerobic digestion technology. The wastes will simply be added to the municipal solid wastes and agricultural wastes to become but another components of the total feedstock stream.

The ship building will consist of the construction of SuperGreen Self-BioFueled SuperStrong Concrete Barges & Ships. More information on this subject is contained at our website at http://www.watersmart.com/Press_Releases.html. Please refer to the May 7, 2007 Press Release.

Additional activities within the project building will consist of the construction of Self-BioFueled Trains & Locomotives (see April 10, 2007 Press Release) and Integrated Renewable Energy Tidal Generation Technology (see May 10, 2007 Press Release).

The renewable energy technologies include agricultural farming and processing, the generation and distribution of electricity, the production and distribution of renewable natural gas, the production and distribution of potable water, the treatment of sanitary wastewaters, and the total management of solid wastes all of which in full accord with Kyoto Protocol on climate change.

The waste-to-energy technology has been favorably reviewed by both the Food and Agricultural Organization of the United Nations and the World Bank. The primary features of the technology are:

1. The free distribution of potable water,
2. The free collection and treatment of sanitary wastewater,
3. The free collection and management of municipal solid wastes (MSW),
4. The generation and distribution of renewable energy electricity at US$0.045/kWh regardless of time of day used or amount consumed, and
5. The 50:50 sharing of annual profits with the communities served.

The exportable food products produced by the technology consist of tilapia fish. Additionally, liquefied nitrogen will be exported to the chemical processing industries. The domestic products produced consist of electricity, water, and the biofuels of biodiesel and compressed natural gas (CNG). The tilapia and pork will be produced 100% organic. The tilapia fish will also be certified as mercury free.

The water produced will be of reverse osmosis (RO) quality associated with bottled water. It will be distributed free of charge to end users. The waste-to-energy technology will be treating sanitary wastewaters at no charge. The waste-to-energy technology will be accepting municipal solid wastes (MSW) and other wastes at no cost to the waste generator. The wastes to renewable energy technology will be producing and retail selling electricity at the marketplace discounted price of US$0.045/kWh. The electricity will be sold through the Karachi Electric Supply Co. (KESCO) at a cost that will permit the realization of a reasonable profit. KESCO will independently determine what their resonable profit will be.

Inexpensive electricity is always a basis for strong industrial development. Presently, Pakistan has a deficiency of electricity. That which is available if very expensive when available. As a result, industrial development in Pakistan is now quite impossible. The proposed technology will have a very positive and immediate impact on industrial development.

The project will be implemented in two phases. The first phase consists of the construction of a project building that measures 2 km x 2 km x 200 m high using precast concrete building panels. This building will engage in tilapia fish production and associated processing. This building will also engage in biofuels production and associated processing. The biofuels consist of renewable natural gas and biodiesel. Most of the processed tilapia fish will be sold to export commodity markets. Spirulina microalgae farming will also be accomplished with some of the microalgae converted into biodiesel biofuel and the balance used a fish feed. All of the wastes associated municipal solid waste management and the treatment of food production and processing wastes will be accomplished through anaerobic digestion to produce methane and carbon dioxide gases. Some of the methane will be converted into electricity with the balance sold as CNG biofuels.

This building will employ about 3,500 full time workers in a variety of unskilled, skilled, and managerial jobs. The first jobs will be associated with construction and as building construction is nearing completion the jobs will be replaced with ship breaking, ship building, tidal generator manufacturing, and agricultural based jobs utilizing the same employees.

The second phase of the project will consist of adding stories to the existing building. The added stories will engage in the agricultural activities consisting bananas, beef cattle, black bass, cassava, coffee, cotton, corn, lobster, prawns, rice, sugar cane with white sugar refining, shrimp, sweet potatoes, and trout. The second phase will also include the construction of concrete freeways (not tollways) that will connect the project building to others that will be constructed at Karachi's existing landfills under greenfield construction projects. The freeways will also include a light rail transit system common to the major cities of the world. The second phase of the project will be internally funded from the first phase revenues. Estimated time to complete the entire makeover of Pakistan's Karachi is estimated at only 5 years.

The sharing of profits with the City of Karachi will enable the implementation of community projects that have been postponed due to lack of funding. The inexpensive electricity will be highly appreciated by those interested in starting or further development of their business interests. Inexpensive electricity always supports industrial development. The free processing of sanitary wastewaters and municipal solid wastes also helps industrial development.

The power supply and distribution within Karachi is beset with insufficient supply problems coupled with illegal connections to the distribution grid. Some existing KESCO clients bypass the electric meters. To prevent this practice most of the meters have now been moved to the street. Some industrial clients that are billed on a sanctioned load simply use bigger grips to obtain more power than they are paying for. Other power users use kundas (hooks) on distribution lines to obtain free electricity through simple theft. In order to prevent unauthorized use and full accountability the renewable energy will be distributed underground using meters at the use location with duplicate power usage data recorded at the point of generation. The attached WSE Drawing No. S-9900-20 shows the details.

The photo below shows tens of illegal electricity connections made on a single pole by (kundas) hooks in Lines Area, Karachi. Photo provided courtesy of Daily Jang, Karachi.

News Photo of recent Power Riots in Karachi, June 10, 2007

KESCO was sold to a private firm KES Power and Others who took control of the company on November 29, 2005. The new management employed Siemens Pakistan Engineering Limited as the Operations and Management (O&M) Contractor. This includes generation, transmission, distribution, maintenance, and repair.

The shipbuilding/shipbreaking project building will be constructed in Karachi. This facility will engage in the manufacturing and construction of self-biofueled concrete ships, self-biofueled trains & locomotives, and the construction of tidal generators. Information on all three activities is contained within the feasibility study.

The economic development impact on the named cities of Pakistan will be immediate and immense. In addition to significant economic development the project also fully qualifies as a humanitarian project in that it provides for the health, education, and housing of its employees, provides employment for the unemployed and underemployed, distributes free clean drinking water, provides food for the poor, combats climate change, gives something back to the world, and enhances the lives of others.

In addition to the quite large shipbuilding/shipbreaking facility at Karachi, there will be an additional construction of some 3,300 smaller project buildings throughout the Islamic Republic of Pakistan. These buildings will engage in the same activities as the quite large shipbuilding/shipbreaking facility at Karachi except for the shipbuilding and shipbreaking activities. They will measure 1 km x 1 km x 3 stories high.

The total capital costs of the 2 km x 2 km x 200 m high shipbuilding/shipbreaking facility are estimated at US$3,259,680,000. The total capital costs of the 3,300 smaller 1 km x 1 km x 3 story high project buildings are estimated at US$406,571,000. Each of these several buildings will be project financed one by one until all are financed. As soon as each single building is financed we will commence construction activities. It is expected to take but 5 years to accomplished renewable energy, fuels, food, and water independence for the entire Islamic Republic of Pakistan.

It is hoped that this grand program will focus attention on the necessity to develop the entire Islamic Republic of Pakistan as a modern and developed nation in the world and thereby bring ease in the life of a common man—an extended vision of Karachi's mayor, the honorable Syed Mustafa Kamal.

Your timely investment interest is hereby solicited. With Warm Regards I am

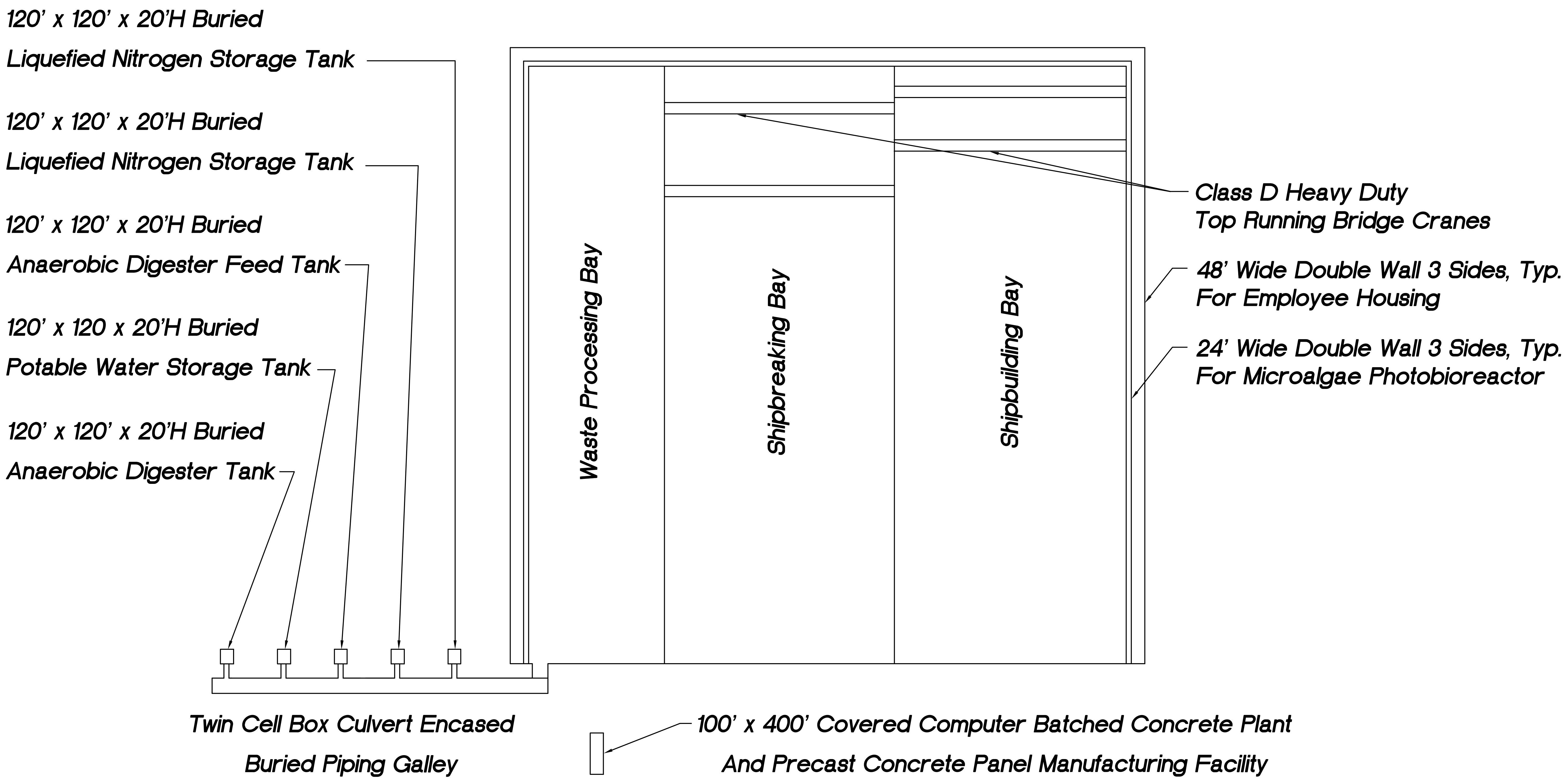
Very truly yours,

WaterSmart Environmental, Inc.

C. G. (Chuck) Steiner
President and CEO

CGS/mns

enclosures



Dry Dock Project Building Site Plan

2 km x 2 km x 200 m High

Construction Manager:

BioWastePower Constructors

A Division of WaterSmart Environmental, Inc.

WaterSmart Environmental, Inc.
Post Office Box 26346
Shawnee Mission, Kansas 66225-6346

TITLE: Site Plan — Dry Dock Project Building

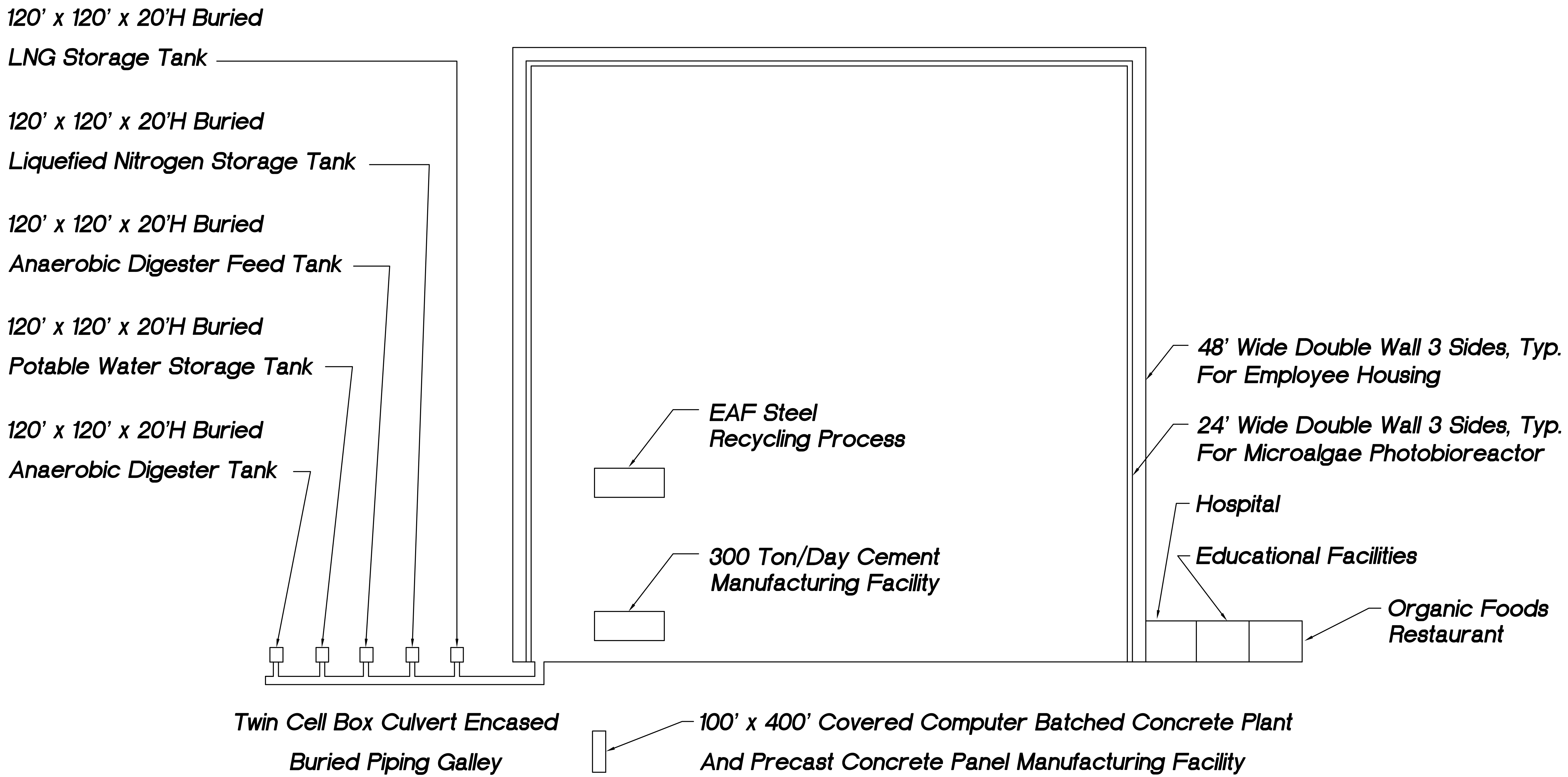
JOB: Shipbuilding & Shipbreaking Wastes-To-Renewable Energy

REV.	DATE	DESCRIPTION	BY	CHK

DO NOT SCALE DRAWING. USE DIMENSIONS ONLY.

SCALE	NONE	DRAWN	B.E.H.	DWG. NO.
DATE	9/7/07	CHECKED	C.G.S.	S-9900-18

Plot Date 9-7-07/1500 Plot Scale 1=24 Produced On AutoCAD Release 2000I



Wastes-To-Renewable Energy Project Building Site Plan

1 km x 1 km x 3 Stories High

Construction Manager:
BioWastePower Constructors
A Division of WaterSmart Environmental, Inc.

WaterSmart Environmental, Inc.
Post Office Box 26346
Shawnee Mission, Kansas 66225-6346

TITLE	Site Plan Project Building
JOB	Islamic Republic of Pakistan
SCALE: NONE	DRAWN: B.E.H.
DATE: 9/8/07	CHECKED: C.G.S.
DWG. NO.	S-9900-19

REV.	DATE	DESCRIPTION	BY	CHK

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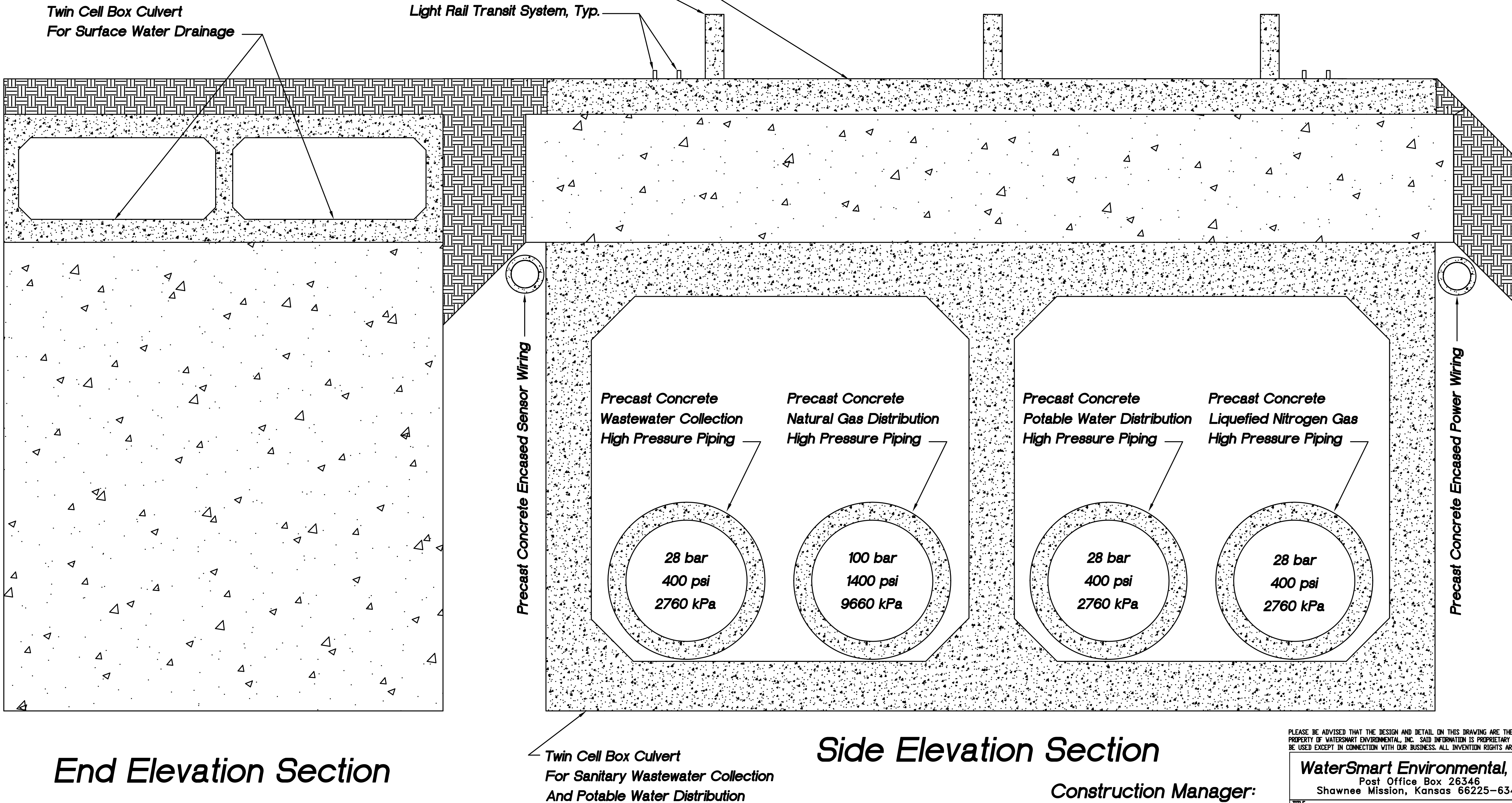
Plot Date 9-8-07/1500 Plot Scale 1=24 Produced On AutoCAD Release 2000I



End Elevation Section

Side Elevation Section

Surface Transportation System

With Buried Utilities Distribution

Construction Manager:
BioWastePower Constructors
A Division of WaterSmart Environmental, Inc.

WaterSmart Environmental, Inc.
Post Office Box 26346
Shawnee Mission, Kansas 66225-6346

TITLE: Surface Transportation System With Buried Utilities Distribution

JOB: Islamic Republic of Pakistan

REV.	DATE	DESCRIPTION	BY	CHK

DO NOT SCALE DRAWING. USE DIMENSIONS ONLY.

SCALE	DRAWN	DWG. NO.
NONE	B.E.H.	S-9900-20
DATE 9/8/07	CHECKED C.G.S.	

Plot Date 9-8-07/1500 Plot Scale 1=24 Produced On AutoCAD Release 2000i

Nonrecourse Project Capital Cost Structure

Islamic Republic of Pakistan

BioWastes-To-Renewable Energy, Biofuels, Organic Foods, and Potable Water Independence

The total estimated capital and development costs of the design-build-own-operate wastes-to-renewable energy project total $453,938,130 for each project building. A total of 3,300 project buildings will be constructed at Karachi, Hyderabad, Sukkur, Multan, Lahore, Gujrat, Faisalabad, Sialkot, Peshawar, Quetta and other smaller cities throughout the Islamic Republic of Pakistan. Additionally, a much larger shipbuilding/shipbreaking project building will be constructed at Karachi. This much larger type facility is the financial equivalent of four (4) project buildings. The major components of capital and other costs for each building are as follows:

Item Description	**Cost in US$**
Anaerobic Digester Feed Tank Constructed Cost[1]	2,000,000
Biodiesel Manufacturing Equipment Constructed Cost[2]	15,000,000
Building Size 1 km x 1 km x 3 stories high Constructed Cost[3]	75,000,000
Cement Kiln Constructed Cost[4]	12,000,000
Concrete Ready Mix Batch Plant Constructed Cost[5]	3,000,000
EAF Steel Recycling Process Equipment Constructed Cost	3,000,000
Fish Processing Equipment Constructed Cost[6]	500,000
LED Lighting Purchase Cost[8]	10,000,000
Liquefied Nitrogen Air Separation Equipment Procurement Capital Cost	15,000,000
Liquefied Nitrogen Delivery Equipment Procurement Capital Cost	500,000
Liquefied Nitrogen Storage Tank Constructed Cost	2,000,000
LNG (Liquefied Natural Gas) Storage Tank Constructed Cost	2,500,000
Methane Gas Compression Equipment Installed Capital Cost	10,000,000
Potable Water Storage Tank Constructed Cost	2,000,000
Photobioreactor Capital Equipment Constructed Cost[7]	100,000,000
Power Generation Equipment Procurement Cost[9]	56,650,000
Reverse Osmosis Equipment Procurement Cost	2,000,000
Fish Procurement Costs	5,000,000
Two-Phase Anaerobic Digester Constructed Cost[1]	37,390,000
Subtotal Project Costs	**353,540,000**
Add 15% Contingencies	53,031,000
Total Capital Costs	**406,571,000**
Finance Charges	8,000,000
Interest During Construction	20,000,000
Administration/Legal	150,000
Permitting	20,000
Technology & Development Cost	316,918,700
Project Development Fee @ 3% of US$406,571,000	12,197,130
Working Capital	7,000,000

Total All Costs	**770,856,830**

Nonrecourse Project Financing Will Be Structured As Follows:

Developer Equity as Technology, 70%[10]	316,918,700
Investor Equity as Cash, 30%	136,181,439
Finance	317,756,691
Loan Term, Years	10
Interest Rate	10%
Developer will contribute 70% equity in the project as the value of the technology.[10]	
Investor will contribute US$136,181,439 cash and the balance will be financed.	

With Following Notes:

1. **The anaerobic digester and its associated feed tank will be constructed of precast concrete panels. The panels will be manufactured by Wieser Concrete Products, Inc. and shipped to the project site. The Wisconsin based precast concrete manufacturer POC is Phil Miller @ phone 800.325.8456 (see http://www.wieserconcrete.com/about.html).**

2. **The biodiesel production equipment will be designed and manufactured by California based R. C. Costello & Associates, Inc. The POC is Rocky Costello, P.E. @ phone 310.792.5870 (see http://www.rccostello.com/).**

3. **The low cost of the project building is made possible by the 100% internal recycling of inorganic wastes that are produced from the anaerobic digestion process. These inorganic wastes are combined with cement and water in the production of precast concrete panels. The special purpose project company will produce its own cement to further minimize construction costs. See attached WSE Engineering Drawing No. S-6099-1 for additional details. The POC at WaterSmart Environmental is Chuck Steiner @ 913.897.2727 (see http://www.watersmart.com/).**

4. **The cement kiln will be sourced through Canada based Cement Process Consulting, Ltd. The POC is Ken Postle @ phone 403.472.4519 (see http://www.cement-process.com/index.htm).**

5. **The concrete ready mix plant will be sourced through Advanced Concrete Technologies. The POC is Stefan Siegels @ phone 603.431.5661 (see http://www.concretebiz.com).**

6. **The fish production and processing equipment will be sourced through Colorado based Fisheries Technology Associates, Inc. The POC is Bill Manci @ phone 970.225.0150 (see http://www.ftai.com/).**

7. **The enclosed photobioreactor consists of 2 miles long 12"Ø clear PVC pipe. A possible supplier is Harvel Plastics, Inc. but other sources will be considered prior to procurement (see http://www.harvel.com/).**

8. **The artificial lighting for the photobioreactor consists of 5 miles of high efficiency long lasting (10 years or more) light emitting diode (LED) lighting that will be wrapped barber pole fashion around the clear PVC pipe. A possible supplier is Light Waves Concept, Inc. but other sources will be considered prior to procurement (see http://www.lightwavesconcept.com/).**

9. **The power generation equipment will be sourced through UK based Combustion, Energy & Steam Specialists, Ltd. The POC is Mike Craigie @ phone +44 (0) 1856 851177 (see http://www.cess.co.uk/).**

10. **The seemingly high percentage of developer equity as technology is justified on the basis that it is the only economic development technology that simultaneously achieves:**

    - **100% compliance with Kyoto Protocol thus helping to reverse global warming,**
    - **Distributed Biofuels (biodiesel and compressed natural gas or CNG) independence,**
    - **Distributed Food independence,**
    - **Distributed Renewable energy independence,**
    - **Distributed Water independence, and**
    - **Complete internal recycling of all byproducts and waste streams thereby producing a useful product—namely precast concrete products that will be used for constructing the project building itself as well as infrastructure roads, light rail transit surface transportation system, precast concrete potable water distribution system, precast concrete wastewater collection system, and precast concrete encased renewable energy power distribution system. In doing so the community initiative project will become the very first zero carbon and zero waste community in the world.**

    Climate Change has now become the most serious worldwide concern as the sustainability of our planet appears to be at rapidly increasing risk. Renewable Energy Technologies that address climate change are therefore in great demand. Technologies that address both climate change and substantial economic development are in even greater demand. The proposed waste-to-energy technology has required over 30,000 hours of research over a 10 year period to develop thus fully justifying the seemingly high percentage of developer equity as technology. It is the very first and only worldwide technology that is technically capable of simultaneous distributed energy independence, distributed food independence, distributed fuels independence, and distributed water independence with all in full compliance with Kyoto Protocol.

The proposed wastes-to-renewable energy technology consists of a suite of individual component technologies. The individual component technologies are:

- **Biodiesel Production With Associated Waste Processing. The National Renewable Energy Laboratory (NREL) pioneered the very first production of biodiesel from microalgae. The research and development was carried out under the "Aquatic Species Program" (ASP) that consisted of the first production of a biofuel called "algal biodiesel" (see http://www1.eere.energy.gov/biomass/pdfs/biodiesel_from_algae.pdf). Under the referenced program Algal Biodiesel was produced through the growing of microalgae for their lipid content. The lipid content was then converted into biodiesel through chemical transesterification in the same manner that soybeans and other vegetable oils are now being converted into biodiesel. The ASP funding totaled $25.05 million over a 20 year period that began in 1978. Continuation funding was ultimately terminated when it was officially determined that algal biodiesel could not be produced economically. The ASP obtained its research data from growing microalgae in warm open ponds (Salton Sea in Southern California) at a pH of 8.2 using atmospheric carbon dioxide. The Salton Sea is the recipient of agricultural runoff nutrients as well as additional nutrients contained in municipal sewage treatment plants discharges. The Middle Cordoba Province Project will produce microalgae within an enclosed photobioreactor that will operate at the optimum growing temperature of 35ºC (95ºF) and at the optimum growing pH of 9.4. Photosynthesis will occur 24/7 rather than just during daylight hours by using long lasting light emitting diode (LED) lighting. The photobioreactor will receive the total carbon dioxide output from both the anaerobic digester as well as the power generation equipment thus substantially increasing production over that obtainable from using carbon dioxide from the atmosphere. Microalgae production will be further increased by adding the micronutrients contained in the reverse osmosis concentrate stream thus substantially improving microalgae production. The total increase of these process modifications over that obtained by the National Renewable Energy Laboratory's ASP is estimated at a factor of at least 1000 to 1. By producing the microalgae within an enclosed photobioreactor the technology becomes totally compliant with Kyoto Protocol since all discharges of greenhouse gases to the environment are eliminated.**

- **Cement manufacturing as a technology has been practiced for many hundreds of years throughout the entire civilized world.**

- **Fish farming was first practiced by the Chinese over 100 years ago. Due to the over fishing of the oceans fish farming is now widespread throughout the entire civilized world.**

- **Precast concrete panels and piping have been manufactured for the last 50 years. The use of precast concrete panels has become quite popular in the building industry during the last 10 years.**

- **Liquefied Nitrogen and Liquefied Oxygen have been produced in the marketplace for the last 50 years. Names of today's largest industrial suppliers consist of Air Liquide, Air Products & Chemicals, Inc., Cryogenic Industries, Inc., Gas Systems Corporation, and Praxair, Inc.**

- **Methane gas-to-methanol alcohol through synthesis gas (syngas) technology represents the standard method of producing methanol throughout the civilized world.**

- **Microalgae production through the use of a photobioreactor (use of artificial light rather than sunlight) is now being done at several research institutions. The technology has yet to be put into full scale commercial operation. The Middle Cordoba Province Waste-To-**

Renewable Energy Community Initiative project will become the first full sized worldwide commercial application of the enclosed photobioreactor technology.

- **The anaerobic digestion of municipal solid wastes (MSW) was first accomplished by two-phase anaerobic digestion in 1996 (see http://lib.kier.re.kr/caddet/retb/no66.pdf). More recently the management of municipal solids wastes is being accomplished using conventional anaerobic digestion by Waste Management, Inc., a waste management company (see http://www.wm.com/WM/environmental/Bioreactor/technologies.asp).**

- **Precast concrete panels and precast concrete pipes have been manufactured for the last 50 years throughout the world.**

- **Renewable energy power generation has been practiced for at least 30 years in the EU and 20 years in the United States.**

- **Reverse osmosis treatment has been around on a commercial basis for over 30 years. During the last 5 years its marketplace costs have been halved and it is now considered very good and very affordable technology.**

11. Each project building will be financed individually rather than grouping two or more buildings together.

Islamic Republic of Pakistan Prefeasibility Study, October 19, 2007	Totals
Location: Pakistan	
Technology Provider: WaterSmart Environmental, Inc.	
Project Developers: Overseas Consultants et al POC: Dr. M. A. Qazi Johnstown, Pennsylvania Phones: 814.270.1422, 814.262.7489 Fax: 814.266.9371 email: drmaqazi@yahoo.com Marvel Energy, Ltd. Karachi, Pakistan POC: Mr. Sheeraz Khan email: sheeraz.khan@gmail.com	
Project Type: Economic Development through Design-Build-Own-Operate BioWastes-To-Renewable Energy, BioFuels, Organic Foods, and Potable Water Independence	
Project Dollar Size: US$460 million for each 1 km x 1 km x 3 story high project building	
Project Dollar Size: US$2,500,000 million for each 2 km x 2 km x 200m high shipbuilding/shipbreaking project building	
Number of project buildings required: 920	
Number of shipbuilding/shipbreaking project buildings required: 1	
Project Building Activities: Extensive Agricultural Production and Processing that additionally includes renewable energy, biofuels, and water production along with 100% recycling of all byproducts into precast concrete panels and precast concrete piping for infrastructure development	
Shipbuilding/Shipbreaking Project Building Activities: 1. Extensive Agricultural Production and Processing that additionally includes renewable energy, biofuels, and water production along with 100% recycling of all byproducts into precast concrete panels and precast concrete piping for infrastructure development, and 2. The construction and sale of self-biofueled concrete ships 3. The breaking of ships with concurrent waste management 4. The construction of self-biofueled trains & locomotives 5. The construction and sale of tidal generators	
Jobs Creations Potential for each 1 km x 1 km x 3 story high project building: 1,500	
Jobs Creations Potential for each 2 km x 2 km x 200 m high shipbuilding/shipbreaking project building: 2,500	
BioWastes Treated: Biodiesel Processing Wastes, Construction & Demolition Wastes, Foods Production & Processing Wastes, Hazardous Wastes, Medical Wastes, Municipal Solid Wastes (MSW), and Petroleum Derived Wastes	
Local Population Served for each 1 km x 1 km x 3 story high project building: 50,000	
Local Population Served for each 2 km x 2 km x 200 m high shipbuilding/shipbreaking project building: 50,000	
Residual Wastes to Landfill: Zero	
Greenhouse Gaseous Emissions to the Environment: Zero	
Climate Change Carbon Footprint: Zero	
Investor Internal Rate of Return: Optimal	
Note on Electricity Distribution: At the completion of the project 100% of the Nova Scotia electricity requirements will be provided thus eliminating the necessity for continued use of electric utility grid supplied electricity. After complete BioWastes-To-Renewable Energy,	

BioFuels, Organic Foods, and Potable Water Independence project implementation all electricity will be distributed at a sustainable US$0.045/kWh to all users regardless of kWh electricity usage amount or time of day when provided. Inexpensive electricity is absolutely necessary in every country to support meaningful industrial development. It is expected that the distribution of inexpensive electricity within Pakistan will strongly support much needed industrial development. Inexpensive electricity distribution is made possible by the extreme profitability of extensive agricultural production and processing in combination with extensive biofuels production.

Detailed Project Description

Extensive Agricultural Production in each project building will consist of a 100 hectare tilapia fish farming operation that is also sized to produce excess local marketplace demand for tilapia fish. The excess processed fish will be exported to distant markets to provide visible cash flow to the project. With a world population approaching 7 billion the fish output of a single project building calculates out to approximately 0.15% of worldwide demand of tilapia fish. A total of 1 ÷ 0.0015 = 666 project buildings would therefore be required to satisfy worldwide demand for tilapia fish. Worldwide consumption of fish data is attached. The marketing idea is to produce 100% of the local demand for fish with the entire excess of each sold to export markets for visible sales revenue.

In addition to agricultural production, each project building will produce Portland cement for the purpose of manufacturing precast concrete panels and piping for direct infrastructure development.

1. **In the production of cement considerable carbon dioxide gas is produced.**
2. **When processing biowastes using anaerobic digestion both methane gas and carbon dioxide gas are produced.**
3. **When generating renewable energy both water vapor and carbon dioxide gas are produced.**

100% of the carbon dioxide gas produced during the production of cement, the processing of biowastes, and the generation of electricity will be routed to an enclosed photobioreactor for the purpose of producing Spirulina microalgae. 75% of the Spirulina microalgae will be used as animal feed in the production of tilapia fish. The remainder 25% will be converted into biodiesel biofuel (B100) and sold locally to produce visible sales revenue.

Spirulina microalgae contain about 6% lipids (fats). The production of biodiesel produces about 6% lipid (fat) conversion into biodiesel biofuel from Spirulina microalgae. The 94% remaining biowastes are returned to the anaerobic digester to produce additional methane gas and carbon dioxide gas. The resulting methane gas produced can be used for power generation or sold as a biofuel. The resulting carbon dioxide gas produced from electricity generation will be automatically routed to the enclosed photobioreactor to enable production of additional Spirulina microalgae.

The economic development objective is to produce 100% of the local demand for electricity, 100% of the local demand for biodiesel biofuel, 100% of the local demand for natural gas (methane gas is a near equivalent to natural gas) biofuel, and 100% of the local demand for compressed natural gas (CNG) automotive biofuel. Biodiesel (B100) can be used as a direct replacement for petroleum diesel without equipment modification. CNG biofuel must be used in vehicles equipped for this fuel. Each project building will engage in the modification of gasoline automotive equipment to enable the use of CNG biofuel. Automobiles that operate on CNG biofuel enjoy extended useful life of the engine by a factor of 4 or more. Trucks that operate on biodiesel biofuel enjoy extended useful life of the engine by a factor of 2 or more. Each economic development project includes the infrastructure for local distribution of renewable natural gas. To the extent that methane gas is used for electricity generation, the production of biodiesel biofuel, and the production of CNG biofuel, each qualifies for renewable energy credits since all such uses

are carbon neutral.

As background information, the production of ethanol from corn and biodiesel from beans has precipitated a massive food or fuel issue throughout the world causing the marketplace price of both corn and soybeans to increase dramatically. These increases have, in turn, caused the marketplace price of ethanol and biodiesel to increase as well the marketplace price of corn and soybean based food products. It is these increases in marketplace prices that have caused the food or fuel issue. With our business model, the production of biodiesel from Spirulina microalgae stays completely clear of the food or fuel issue as does the production of CNG biofuel from biowastes. To achieve total sales of the biofuels production outputs they will be sold at a 20% discount from existing retail. At this attractive pricing 100% of routine production will easily sell in the marketplace.

Because nutrients will be 100% recycled internally, each project building will produce substantial liquid fertilizer concentrate that will be distributed to area farmers in need on a no-charge basis. Excess liquid fertilizer, if any, would be eligible to sell to distant markets or possibly converted into value added products. To the extent that the local market does not make use of the liquid fertilizer concentrate the fertilizer product will be sold to international markets to increase additional visible cash flow to the project.

Because 100% of the water is recycled internally, potable water of the quality of bottled water will be distributed locally on a no-charge basis. Because water is required to process municipal solid wastes each project building will accept both sanitary wastewater and storm water for that purpose on a no-charge basis. Over time, additional stories will be added to each project building to enable additional agricultural activities that could include bananas, beets, black bass, beef cattle, beans, cassava, coffee, corn, cotton, dairies, lobster, onions, poultry, prawns, rice, shrimp, sugar cane, sweet potatoes, trout, and many other crops.

No Charge For Potable Water

No Charge For Wastewater Treatment

Throughout the prefeasibility study extensive efforts are made to provide balanced chemical equations and mathematical calculations, where appropriate, to permit extensive due diligence evaluations of the proposed sciences to be used.

No Charge for Stormwater Treatment

Marketplace BioWastes-To-Energy Feedstocks

A determination of the amount of volatile solids (VS) is necessary in order to calculate the amount of methane gas that can be produced from the anaerobic digestion of biowastes. Eligible feedstocks consist of municipal solid wastes (MSW), medical wastes, and construction & demolition wastes. For the purpose of arriving at conservative waste figure availability, a total of 2 lbs/person/day will be used for the purpose of calculating total feedstock biowaste amounts for developing countries and a total of 5 lbs/person/day will be used for the purpose of calculating total feedstock biowaste amounts for developed countries. For an area population of 50,000 for each project building the available biowastes calculate out to 50,000 x 2 lbs/person/Day = 100,000 lbs/day, or when divided by 2,000 lbs/Ton = 50 Tons/Day for developing countries and 50,000 x 5 lbs/person/day = 250,000 lbs/Day, or when divided by 2,000 lbs/Ton = 125 Tons/Day for developed countries.

For undeveloped countries, the calculation for municipal solid wastes is as follows:

> Assuming 25% moisture content 50 Tons/Day x 75% = 37.5 Dry Tons/Day
> Assuming 80% organic content 37.5 Dry Tons/Day x 80% = 30 Organic Tons/Day
> Assuming 80% volatile solids content 30 Organic Tons/Day x 80% = 24 Tons Volatile Solids/Day or x 2,000 lbs/Ton = 48,000 lbs/Day. This amount of waste translates into 48,000 lbs Volatile Solids/Day x 12 cubic feet of methane/lb Volatile Solids = 576,000 CFD of CH_4. At 24 cubic feet/lb, the methane production translates into 576,000 CFD CH_4/24 = 24,000 lbs/2,000 = 12.0 Tons CH_4/Day for undeveloped countries.

60 Tons VS/Day From MSW Undeveloped Countries

30 Tons CH_4/Day From MSW Undeveloped Countries

For developed countries, the calculation for municipal solid wastes is as follows:

150 Tons VS/Day

Assuming 25% moisture content 125 Tons/Day x 75% = 93.75 Dry Tons/Day Assuming 80% organic content 93.75 Dry Tons/Day x 80% = 75 Organic Tons/Day Assuming 80% volatile solids content 75 Organic Tons/Day x 80% = 60 Tons Volatile Solids/Day or x 2,000 lbs/Ton = 120,000 lbs/Day. This amount of waste translates into 120,000 lbs Volatile Solids/Day x 12 cubic feet of methane/lb Volatile Solids = 1,440,000 CFD of CH_4. At 24 cubic feet/lb, the methane production translates into 1,440,000 CFD CH_4/24 = 60,000 lbs/2,000 = 30.0 Tons CH_4/Day for developed countries. In addition to fresh municipal solid wastes, the project will directly collect an additional 10 lbs/person/Day from existing landfills, rubbish piles, and dumps for the twofold purpose of producing additional methane gas and reclaiming additional ferrous and nonferrous metals while getting rid of existing dump/landfill sites. This activity will increase the methane gas and carbon dioxide gas production from two-phase anaerobic digestion by a factor of 5/2 or 2.5 thus increasing the volatile solids from undeveloped countries from 24 Tons/Day to 60 Tons/Day and from developed countries from 60 Tons to 150 Tons/Day. The associated methane gas is increased from 12 Tons CH_4/Day to 30 Tons CH_4/Day for undeveloped countries and from 30 Tons CH_4/Day to 75 Tons CH_4/Day from developed countries. The 60 Tons Volatile Solids/Day from undeveloped countries can be converted into CO_2 production by multiplying the Volatile Solids by 12 to determine cu. ft. of methane gas produced. Cu. ft. of methane gas produced ÷ 24 cu. ft./lb = lbs methane gas. Lbs. methane gas multiplied by 1.375 = lbs CO_2 produced or 60 Tons VS/Day x 2,000 lbs/Ton x 12 = 1,440,000 cu. ft. CH_4/Day. 1,440,000 cu. ft. ÷ 24 cu. ft./lb = 60,000 lbs CH_4/Day. 60,000 lbs CH_4/Day x 1.375 = 82,500 lbs CO_2/Day. 82,500 lbs CO_2/Day ÷ 2,000 lbs/Ton = 41.3 Tons CO_2/Day. The 150 Tons Volatile Solids/Day from undeveloped countries can be converted into CO_2 production by multiplying the Volatile Solids by 12 to determine cu. ft. of methane gas produced. Cu. ft. of methane gas produced ÷ 24 cu. ft./lb = lbs methane gas. Lbs. methane gas multiplied by 1.375 = lbs CO_2 produced or 150 Tons VS/Day x 2,000 lbs/Ton x 12 = 3,600,000 cu. ft. CH_4/Day. 3,600,000 cu. ft. ÷ 24 cu. ft./lb = 150,000 lbs CH_4/Day. 150,000 lbs CH_4/Day x 1.375 = 206,250 lbs CO_2/Day. 206,250 lbs CO_2/Day ÷ 2,000 lbs/Ton = 103 Tons CO_2/Day. Revenue collected for management of landfill wastes, municipal solid wastes, medical wastes, and construction & demolition wastes: US\$0/Day/Ton. Never a charge, ever. This service always provided as a public service activity only.	From MSW in Developed Countries 75 Tons CH_4/Day From MSW in Developed Countries No charge for MSW disposal US\$0.00/Day From MSW
Agricultural Food Production and Processing Will consist of a 100 hectare Tilapia fish farm at each project building for producing and thereafter processing organically grown Tilapia filets, mostly for the export fish market. Electricity requirements are estimated at 1.0 MW. The estimated raw fish produced per day is 1,340,000 lbs. At a filet yield of 42% a total of 562,000 lbs (281 Tons of Tilapia filets) will be produced/Day along with 778,000 lbs or when divided by 2,000 lbs/Ton = 389 Tons of biowastes/Day. At a commodity sell price of US\$2.18/lb, the daily revenue is estimated at 389 Tons/Day x 2,000 lbs/Ton x US\$2.18/lb = US\$1,225,160/Day It is virtually impossible to obtain a buyer commitment on a current basis in the form of a purchase agreement for a product that is 36 months away from coming into existence. In terms of investor risk assessment, the existence of the very large fish commodity market itself is regarded as ample proof of probable visible cash flow from this specific food product.	0.5 MW Electricity Required For Tilapia Fish Farming US\$1,225,160/Day From Tilapia Fish 389 Tons VS/Day From Fish

The 389 Tons/Day of biowastes x 2,000 lbs/Ton = 778,000 lbs of Volatile Solids/Day. This amount of waste translates into 778,000 lbs Volatile Solids/Day x 12 cubic feet of methane/lb Volatile Solids = 9,336,000 cubic feet/Day (CFD) of CH_4. At 24 cubic foot/lb, the methane production translates into 9,336,000 CFD CH_4/24 = 389,000 lbs/2,000 = 194.5 Tons CH_4/Day.	Processing 194.5 Tons CH_4/Day From Fish Processing
Subtotal Carbon Dioxide Gas Produced From Municipal Solid Wastes Processing:	41.3 Tons CO_2/Day
The 60 Tons Volatile Solids/Day from Municipal Solid Wastes can be converted into CO_2 production by multiplying the Volatile Solids by 12 to determine cu. ft. of methane gas produced. Cu. ft. of methane gas produced ÷ 24 cu. ft./lb = lbs methane gas. Lbs. methane gas multiplied by 1.375 = lbs CO_2 produced or 60 Tons VS/Day x 2,000 lbs/Ton x 12 = 1,440,000 cu. ft. CH_4/Day. 1,440,000 cu. ft. ÷ 24 cu. ft./lb = 60,000 lbs CH_4/Day. 60,000 lbs CH_4/Day x 1.375 = 82,500 lbs CO_2/Day. 82,500 lbs CO_2/Day ÷ 2,000 lbs/Ton = 41.3 Tons CO_2/Day.	
Subtotal Feedstocks Volatile Solids From Tilapia Fish Farming Wastes:	2.8 Tons/Day
The 1.4 Tons Volatile Solids/Day from Tilapia Fish Farming Wastes can be converted into CO_2 production by multiplying the Volatile Solids by 12 to determine cu. ft. of methane gas produced. Cu. ft. of methane gas produced ÷ 24 cu. ft./lb = lbs methane gas. Lbs. methane gas multiplied by 1.375 = lbs CO_2 produced or 2.8 Tons VS/Day x 2,000 lbs/Ton x 12 = 67,200 cu. ft. CH_4/Day. 67,200 cu. ft. ÷ 24 cu. ft./lb = 2,800 lbs CH_4/Day. 2,800 lbs CH_4/Day x 1.375 = 3,850 lbs CO_2/Day. 3,850 lbs CO_2/Day ÷ 2,000 lbs/Ton = 1.92 Tons CO_2/Day.	1.92 Tons CO_2/Day From Tilapia Fish Farming Wastes
Subtotal Feedstocks Volatile Solids From Tilapia Fish Processing Wastes:	389Tons VS/Day
The 389 Tons Volatile Solids/Day from Tilapia Fish Processing Wastes can be converted into CO_2 production by multiplying the Volatile Solids by 12 to determine cu. ft. of methane gas produced. Cu. ft. of methane gas produced ÷ 24 cu. ft./lb = lbs methane gas. Lbs. methane gas multiplied by 1.375 = lbs CO_2 produced or 389 Tons VS/Day x 2,000 lbs/Ton x 12 = 9,336,000 cu. ft. CH_4/Day. 9,336,000 cu. ft. ÷ 24 cu. ft./lb = 389,000 lbs CH_4/Day. 389,000 lbs CH_4/Day x 1.375 = 534,874 lbs CO_2/Day. 534,874 lbs CO_2/Day ÷ 2,000 lbs/Ton = 267 Tons CO_2/Day.	267 Tons CO_2/Day From Tilapia Fish Processing Wastes
Subtotal Carbon Dioxide Gas Produced From Pork Processing Wastes:	15.5 Tons CO_2/Day
Subtotal Carbon Dioxide Gas Produced From Tilapia Fish Farming Wastes:	1.92Tons CO_2/Day
Subtotal Carbon Dioxide Gas Produced From Tilapia Fish Processing Wastes:	389 Tons CO_2/Day
Subtotal Carbon Dioxide Gas Produced From Electricity Generation:	247.0 Tons CO_2/Day
Subtotal Carbon Dioxide Gas Produced From Cement Manufacturing:	67.2 Tons CO_2/Day
Total Carbon Dioxide Gas Produced:	483.0 Tons CO_2/Day
Subtotal Methane Gas Produced From Municipal Solid Wastes:	30.0 Tons CH_4/Day
Subtotal Methane Gas Produced From Tilapia Fish Farming Wastes:	0.7 Tons CH_4/Day
Subtotal Methane Gas Produced From Tilapia Processing Wastes:	97.3 Tons CH_4/Day
Subtotal Methane Gas Produced From Biodiesel Processing Wastes:	97.1 Tons CH_4/Day
Total Methane Gas Produced:	249.9 Tons CH_4/Day

Two-Phase Anaerobic Digestion

All of the wastes associated with agricultural production will be managed through two-phase anaerobic digestion technology. Traditional anaerobic digestion (often referred to as conventional high rate anaerobic digestion) produces a biogas that consists of 1/3 carbon dioxide gas by volume and 2/3 methane gas by volume as a common gas mixture. Two-phase anaerobic digestion, however, produces the same gases as two distinct gases consisting individually of carbon dioxide gas and methane gas. The separation of the two gases permits each to be managed individually.	Products Of Two-Phase Anaerobic Digestion Volatile Solids (VS) x 12 = cu. ft. CH_4
In every anaerobic digester the ratio of carbon dioxide gas produced relative to methane gas is 1:2 on a volumetric basis. The molecular weight of methane gas (CH_4) is 16 (12 for Carbon + 4 for Hydrogen) whereas the molecular weight of carbon dioxide gas (CO_2) is 44 (12 for Carbon and 32 for Oxygen). 1 x 44 = 44 weight units for carbon dioxide gas and 2 x 16 = 32 weight units for methane gas. 44 divided by 32 = 1.375. Carbon dioxide produced relative to methane produced is therefore 137.5% on a mass basis. The actual weight of	cu. ft. CH_4 x 0.0423 = lbs CH_4 lbs CH_4 x 1.375 = lbs CO_2

methane gas produced may be found by multiplying its cubic feet by the factor 0.0423 lbs/cu. ft. to arrive at its actual weight in lbs. This weight may be multiplied by the factor of 1.375 (137.5%) to arrive at the corresponding weight of carbon dioxide produced in lbs. The amount of methane gas generated through two-phase anaerobic digestion may be found by multiplying the volatile solids weight of the biowastes in lbs by 12 to arrive at the cubic feet of methane gas produced in lbs.

Other sometimes handy mathematical relationships are:

1 Ton VS/Day produces 24,000 CH_4/Day from two-phase anaerobic digestion
1 Ton VS/Day produces 0.508 Tons CH_4/Day from two-phase anaerobic digestion
1 Ton VS/Day produces 0.698 Tons CO_2/Day from two-phase anaerobic digestion
1 Ton CH_4/Day used for electricity generation produces 2.75 Tons CO_2/Day
83,780 CH_4/Day produces 1 MW of simple cycle electricity power generation

Enclosed Photobioreactor for Spirulina Microalgae Production

The enclosed photobioreactor consists of a 2,200,000 foot long 12"Ø clear schedule 40 PVC pipe spiral wrapped externally with ultra high efficiency long lasting (10 years +) light emitting diode lighting for continuous photosynthesis. A small portion of the Spirulina microalgae produced will be continuously recycled to the start of the photobioreactor to provide the required seed to enable continuous Spirulina microalgae production. Electricity requirements = 6.0 MW for the lighting and associated recirculation pumping equipment.

The photobioreactor will receive 100% of the carbon dioxide gas output of the two-phase anaerobic digester and 100% of the carbon dioxide gas output from electricity generation. In addition, it will receive 100% of the output of macronutrients from the reverse osmosis treatment equipment deployed downstream from the two-phase anaerobic digester. The Spirulina microalgae require both carbon dioxide and macronutrients to maximize their rate of growth. The photobioreactor will be operated at a temperature of 35ºC (95ºF) and a pH of 9.4 to further optimize Spirulina microalgae rate of growth. Please refer to attached WSE Drawing Nos. S-6099-1 and S-9900-1 for additional information.

Spirulina will be produced using photosynthesis in the same manner that has existed for billions of years in the oceans of the world. The photosynthesis reaction is:

$$6\ H_2O + 6\ CO_2 + \text{photons} \xrightarrow{\text{Chlorophyll}} C_6H_{12}O_6 + 6\ O_2$$

water + carbon dioxide + light energy → glucose carbohydrate + oxygen

The chemical mass balance of the above equation becomes :

$$108\ \text{gm}\ H_2O + 264\ \text{gm}\ CO_2 \rightarrow 180\ \text{gm glucose carbohydrate} + 192\ \text{gm}\ O_2$$

total of 372 gm reactants → total of 372 gm products

For each 264 grams of CO_2 reacted 180 grams of glucose carbohydrate and 192 grams of O_2 will be produced. For each ton of CO_2 reacted, 180/264 or 0.682 tons of glucose carbohydrates and 192/264 or 0.73 tons of O_2 will be produced. Glucose carbohydrates equate to Spirulina microalgae, a plant type material called phytoplankton.

One Ton CO_2/Day Produces 0.682 Tons Of Glucose Carbohydrates/Day (Spirulina Microalgae)

Respiration occurs in the Mitochondria of cells. It is almost the exact opposite reaction to photosynthesis. These two reactions work together to maintain a biological balance on earth. The respiration reaction is:

$$C_6H_{12}O_6 + 6\ O_2 \xrightarrow{\text{Mitochondria}} 6\ H_2O + 6\ CO_2$$

It is generally believed that photosynthesis occurs only during periods of sunlight (or artificial light) and that respiration occurs only during periods of darkness. Horticulture studies have established that several, but not all, species of plants can be grown under continuous lighting. The same studies have established that photosynthesis and respiration can and do occur simultaneously under continuous lighting conditions. Plants are multi-cell and capable of learned behavior whereas Spirulina microalgae are single cell plants and therefore totally incapable of acquiring learned behavior. Spirulina microalgae can therefore be grown under continuous lighting conditions even though they have never been exposed to continuous lighting conditions for billions of years. Continuous lighting therefore approximately doubles total Spirulina growth relative to day/night growth rates. **The glucose produced during photosynthesis contains about 6% lipids (fats). Lipids are efficiently converted into biodiesel through a transesterification process. Each ton of CO_2 will simultaneously produce 0.68 tons glucose carbohydrates x 0.06 = 0.04 tons biodiesel and 1.0 – 0.04 = 0.96 tons of byproduct biowastes. 100% of the byproduct biowastes will consist of volatile solids. One ton CO_2/Day can therefore produce 0.04 tons biodiesel/Day. At a specific gravity of 0.88 this is equivalent to 0.04 tons x 2,000 lbs/ton divided by 0.88 specific gravity = 90.91 gallons/day. The same one ton CO_2/Day will produce 0.96 tons x 2,000 lbs/ton = 1,920 lbs volatile solids/day or 21.12 lbs volatile solids/gallon of biodiesel produced/day.**	**One Ton CO_2/Day Produces 0.04 Tons Biodiesel/Day** **One Ton CO_2/Day Produces 0.96 Tons Volatile Solids/Day** **One Ton CO_2/Day Produces 90.91 Gallons Of Biodiesel/Day** **Each Gallon of Biodiesel Produced Produces 21.12 lbs of Volatile Solids**

Biodiesel Production

All biodiesel produced will fully comply with American Society for Testing and Materials (ASTM) Standard Specification D 6751-03. The referenced specification is attached to the prefeasibility study.

The amount of biodiesel produced is directly dependent on the amount of Spirulina microalgae produced. The amount of Spirulina microalgae produced is directly dependent on the amount of carbon dioxide gas that is added to the photobioreactor. Since carbon dioxide gas is produced by electricity generation, two-phase anaerobic digestion, and cement production, the total amount of CO_2 produced must be determined from each source.

Source No. 1: Electricity Generation:

30 MW of electricity will be produced for the community initiative. Another 21.5 MW of electricity will be used internally for the photobioreactor, air liquefaction, methane gas compression, tilapia fish lighting, pig production, and general building use. The total amount of electricity produced therefore equals 30 MW + 21.5 MW = 51.5 MW.

When generating electricity CO_2 is produced according to the following combustion equation:

$$CH_4 + 2O_2 + 7.52\ N_2 \rightarrow CO_2 + 2H_2O + 7.52\ N_2 + \text{heat}$$

methane + oxygen + nitrogen → carbon dioxide + water + nitrogen

The chemical mass balance of the above equation becomes:

$$16\text{ gm } CH_4 + 64\text{ gm } O_2 + 105\text{ gm } N_2 \rightarrow 44\text{ gm } CO_2 + 36\text{ gm } H_2O + 105\text{ gm } N_2$$

total of 80 gm reactants → total of 80 gm products

Please note that nitrogen is not a reactant as it does not participate in the reaction. For each ton of CH_4 used for electricity generation a total of 44/16 or 2.75 tons of CO_2 will be

1 Ton CH_4 Produces 2.75 Tons CO_2 From Electricity Generation

1 Ton CH_4 Produces 2.25 Tons H_2O From Electricity

produced along with a total of 36/16 or 2.25 tons of H_2O. 2.25 tons of H_2O is, in turn, equivalent to 2.25 tons H2O x 2,000 lbs/ton = 4,500 lbs ÷ 8.34 lbs/gallon = 540 gallons of water. **If 51.5 MW of electricity is produced to provide energy independence within the Community Initiative, a total of 51.5 MW x 83,780 CH_4/Day/MW = 4,314,670 cubic feet of methane gas will have to be used each day. At 24 cubic foot/lb, the methane usage translates into 4,314,670 cu. ft. CH_4/24 = 179,778 lbs/2,000 = 89.89 Tons CH_4/Day. Since each ton of CH_4 produces 2.75 Tons of CO_2 the generation of 51.5 MW of electricity produces 89.89 x 2.75 = 247.0 Tons of CO_2/Day due to the generation of electricity. Since each ton of CH_4 produces 2.25 Tons of H_2O, the generation of 51.5 MW of electricity also produces 89.89 x 2.25 = 202 Tons of H_2O/Day.** **Source No. 2: Two-Phase Anaerobic Digestion:** **To determine the amount of CO_2 produced first requires a determination of the amount of CH_4 produced as CH_4 production directly determines CO_2 production by a factor of 1.375.** **To determine the amount of CH_4 produced first requires the amount of volatile solids that are treated as each lb of volatile solids x 12 = cu. ft. CH_4 produced.** **The volatile solids available from MSW processing are 60.0 Tons/Day as listed above. The volatile solids available from tilapia fish farming are 1.4 Tons/Day as listed above. The volatile solids available from tilapia fish processing are 194.5 Tons/Day as listed above. The total volatile solids available as listed above = 60.0 + 27.0 + 22.6 + 1.4 + 194.5 = 305.5 Tons CH_4/Day. 305.5 Tons CH_4/Day x 1.375 = 420.1 Tons CO_2/Day.** **The project building will engage in the manufacturing of cement. Carbon dioxide is produced in cement making as a result of the production of a process ingredient called 'Clinker'. Clinker is made when limestone is heated to produce lime. Substantial amounts of carbon dioxide are simultaneously formed during this reaction. The final amount of carbon dioxide produced varies depending on the type of cement being made. Each project building will be manufacturing 300 Tons/Day of Portland type cement.** **According to the *Annual Review of Energy and the Environment,* (Vol. 26: pp 303-329, November 2001) average CO_2 emissions/Ton from cement production = 448 lbs. At a cement production rate of 300 Tons/Day the total carbon dioxide emissions = 300 Tons/Day x 448 lbs CO_2/Ton = 134,400 lbs/Day ÷ 2,000 lbs/Ton = 67.2 Tons CO_2/Day. Adding this amount of CO_2 to the above total of 420.1 Tons CO_2/Day = 487.3 Tons CO_2/Day that will be produced from electricity generation, two-phase anaerobic digestion of volatile solids feedstocks, and cement production.** **Since each ton of CO_2 produces 0.682 Tons of Spirulina microalgae 487.3 Tons CO_2/Day produces 487.3 x 0.682 = 332.3 Tons Spirulina microalgae/Day.** **75% or 249.2 Tons Spirulina/Day will be used for feeding tilapia fish and pigs. The remaining 25% or 83.1 Tons Spirulina/Day will be used in the production of biodiesel (B100). 83.1 Tons Spirulina production is the equivalent of 25% of 487.3 Tons CO_2/Day or 121.8 Tons CO_2/Day. 249.2 Tons Spirulina production is the equivalent of 75% of 487.3 Tons CO_2/Day or 365.5 Tons CO_2/Day.** **Since one ton CO_2/Day produces 0.682 Tons of Spirulina microalgae, 108.3 Tons CO_2/Day produces 108.3 x 0.682 = 73.86 additional tons of Spirulina microalgae increasing its production from 295.5 Tons/Day to 369.4 Tons/Day.** **Since one ton CO_2/Day produces 0.04 tons biodiesel/day, 121.8 Tons CO_2/Day produces 121.8 x 0.04 tons = 4.87 tons biodiesel/Day. At a specific gravity of 0.88 this is equivalent to 4.87 tons x 2,000 lbs/ton divided by 0.88 specific gravity = 11,073 gallons/day.**	**Generation** **1 Ton CH_4 Produces 540 Gallons Of Water From Electricity Generation** **51.5 MW Of Electricity Produces 247.5 Tons Of CO_2/Day** **51.5 MW Of Electricity Produces 89.89 Tons Of CH_4/Day** **332.3 Tons Spirulina Microalgae Produced/Day**

Since each gallon of biodiesel produced generates 21.12 lbs of volatile solids, 11,073 gallons x 21.12 = 233,856 lbs. Volatile Solids/Day. 233,856 lbs Volatile Solids/Day ÷ 2,000 lbs/Ton = 116.9 Tons Volatile Solids/Day. The 116.9 Tons Volatile Solids/Day from biodiesel production can be converted into CO_2 production by multiplying the Volatile Solids by 12 to determine cu. ft. of methane gas produced. Cu. ft. of methane gas produced ÷ 24 cu. ft./lb = lbs methane gas. Lbs. methane gas multiplied by 1.375 = lbs CO_2 produced or 116.9 Tons VS/Day x 2,000 lbs/Ton x 12 = 2,806,272 cu. ft. CH_4/Day. 2,806,272 cu. ft. ÷ 24 cu. ft./lb = 116,928 lbs CH_4/Day. 116,928 lbs CH_4/Day x 1.375 = 160,776 lbs CO_2/Day. 160,776 lbs CO_2/Day ÷ 2,000 lbs/Ton = 80.4 Tons CO_2/Day. Since one ton CO_2/Day produces 0.04 tons biodiesel/day, 80.4 Tons CO_2/Day produces 80.4 x 0.04 tons = 3.22 tons biodiesel/Day. At a specific gravity of 0.88 this is equivalent to 3.22 tons x 2,000 lbs/ton divided by 0.88 specific gravity = 7,308 gallons biodiesel/day thus increasing biodiesel production from 11,073 GPD to 18,381 GPD. Since the basic waste-to-energy process fully satisfies electricity demand the excess methane gas will be beneficially used for: 1. The production of methanol through syngas technology that is used as a required feedstock in the production of biodiesel biofuel, 2. The production and sale of compressed natural gas (CNG) biofuel surface transportation fuel, and 3. The production and sale of renewable natural gas biofuel to the marketplace.	18,381 Gallons Of Biodiesel Produced/Day 58.5 Tons CH_4/Day plus 38.6 Tons CH_4/Day = 97.1 Tons CH_4 Produced/Day From Biodiesel Production
Tilapia Fish Feed Requirements: The production of tilapia fish is 670 Tons/Day. It takes about 1.2 lbs of feed to increase the fish weight by 1.0 pound. The 670 Tons of finished fish will require 670 x 1.2 or 804 Tons of feed per Day. Spirulina microalgae production at 332 Tons feed/Day will mostly satisfy tilapia fish feed requirements. As the MSW volume increases the volume of Spirulina microalgae will automatically increases. It won't take much of an increase in MSW volume to fully satisfy total feed requirements. The preferred initiative is to increase collection of MSW biowastes by excavating area landfills and dumps for the purpose of treating their contents with two-phase anaerobic digestion to increase the associated production of Spirulina microalgae.	

Manufacturing Activities

Self-Biofueled Trains & Locomotives	The shipbuilding/shipbreaking project building will be designed to accommodate the manufacture of 100 self-biofueled trains & locomotives per year at an estimated marketplace price of US$3,500,000/unit. Visible revenue produced = US$3,500,000 x 100 = US$350,000,000/year or ÷ 365 = US$958,900/Day.	US$958,900/Day
Self-Biofueled Ships	The shipbuilding/shipbreaking project building will be designed to accommodate the manufacture of 10 self-biofueled ships per year at an estimated price of US$250,000,000/unit. Visible revenue produced = US$250,000,000 x 10 = US$2,500,000/year or ÷ 365 = US$6,849,315/Day. Maximum size of manufactured ship = 1,200 ft long x 120 ft wide.	US$6,849,315/Day
Tidal Generators	The project building will be designed to accommodate the manufacture of 20 tidal generators per year at an estimated price of US$500,000,000/unit. Visible revenue produced = US$500,000,000 x 20 = US$10,000,000,000/year or ÷ 365 = US$27,397,260/Day. Tidal generators will be sold on a fully	

installed basis.	US$27,397,260/Day
Subtotal Methane (CH_4) Gas Production From Municipal Solid Wastes (MSW):	
60 Tons/Day Total Volatile Solids x 2,000 lb/Ton x 12 Cubic Feet (CF)/lb = 1,440,000 cu. ft./Day. 1,440,000 cu. ft. CH_4/Day ÷ 24 lbs/cu. ft. = 60,000 lbs. 60,000 lbs ÷ 2,000 lbs/Ton = 30 Tons CH_4/Day	1,440,000 cu. ft. CH_4/Day = 30 Tons CH_4/Day From MSW
Subtotal Methane (CH_4) Gas Production From Biodiesel Processing Wastes:	
4,659,366 cu. ft. CH_4/Day ÷ 24 cu. ft./lb = 194,140 lbs. 194,140 lbs ÷ 2,000 lbs/Ton = 97.1 Tons CH_4/Day	97.1 Tons CH_4/Day From Biodiesel Wastes
Subtotal Methane (CH_4) Gas Production From Tilapia Fish Farming Wastes:	
2.8 Tons/Day Total Volatile Solids x 2,000 lb/Ton x 12 Cubic Feet (CF)/lb = 67,200 cu. ft./Day. 67,200 cu. ft. CH_4/Day ÷ 24 lbs/cu. ft. = 2,800 lbs. 2,800 lbs ÷ 2,000 lbs/Ton = 1.4 Tons CH_4/Day	67,200 cu. ft. CH_4/Day =1.4 Tons CH_4/Day From Tilapia Fish Farming Wastes
Subtotal Methane (CH_4) Gas Production From Tilapia Fish Processing Wastes:	
389 Tons/Day Total Volatile Solids x 2,000 lb/Ton x 12 Cubic Feet (CF)/lb = 9,336,000 cu. ft./Day. 9,336,000 cu. ft. CH_4/Day ÷ 24 lbs/cu. ft. = 389,000 lbs. 389,200 lbs ÷ 2,000 lbs/Ton = 194.6 Tons CH_4/Day	9,336,000 cu. ft. CH_4/Day = 194.6 Tons CH_4/Day From Tilapia Fish Processing Wastes
Total Methane (CH_4) Gas Generation from all sources:	249.9 Tons CH_4/Day
OAT Process Power Generation Potential:	
249.9 Tons CH_4/Day x 2,000 lbs/Ton = 499,800 lbs/Day. 499,800 lbs/Day x 24 cu. ft./lb = 11,995,200 cu. ft./Day. 11,995,200 cu. ft./Day ÷ 83,780 cu. ft./MW = 143 MW. 143 MW less 15% parasitic digester plant use = 122 MW Net	122 MW Net
Two-Phase Anaerobic Digester Size Calculations:	
Volatile Solids = 249.9 Tons/Day x 2,000 lbs/Ton = 499,800 lbs/Day	
VS:COD = 1:2, COD = 999,600 lbs/Day	
Organic Loading lbs COD/Day/Cubic Foot = 6	
Digester Size = 999,600/6 = 166,600 Cubic Feet	
Digester Size In Gallons = 1,246,335 Gallons	
Safety Factor = 1.5	
Digester Size = 1,869,502 Gallons (120' x 120' x 20'H)	
Estimated Constructed Cost At US$20/Gallon = $37,390,000	
Building Size: 1 km (3,280') x 1 km (3,280') x 3 - 50' stories high w/3 side double wall construction to accommodate photobioreactor and employee housing = 50,000,000 total sq. ft. of precast concrete construction estimated @ US$1.50/sq. ft. = US$75,000,000. Project building will manufacture its own cement and will purchase a ready mix plant (3 concrete delivery/mixer trucks) to minimize precast concrete panel construction costs.	
Remanufactured 300Tons/Day Cement Kiln Purchase Cost = US$12,000,000	
Remanufactured Ready Mix Batch Plant Purchase Cost = US$3,000,000	
Photobioreactor: 2,200,000 foot long 12"Ø Clear PVC schedule 40 pipe = US$100,000,000 to includes ultra high efficiency long lasting (10 years +) light	

	emitting diode (LED) lighting for photosynthesis @ US$10,000,000 Electricity requirements = 6.0 MW	
	10 MGY Biodiesel Manufacturing Equipment Cost Estimate: US$15,000,000. Electricity Requirements = 0.5 MW	
	Two (2) 110 GPM 4:2:1 Array Reverse Osmosis Equipment Cost Estimate: US$2,000,000	
	Digester Equalization Feed Tank Cost Estimate: $2,000,000 w/Equalization Tank Size = 120' x 120' x 20' H, 2,000,000 Gallon Capacity	
	Potable Water Tank Cost Estimate: $2,000,000 w/Equalization Tank Size = 120' x 120' x 20' H, 2,000,000 Gallon Capacity	
	Anaerobic Digester Feed Tank Cost Estimate: $2,000,000 w/Equalization Tank Size = 120' x 120' x 20' H, 2,000,000 Gallon Capacity	
	Liquefied Nitrogen Storage Tank Cost Estimate: $2,000,000 w/Equalization Tank Size = 120' x 120' x 20' H, 2,000,000 Gallon Capacity	
	Liquefied Natural Gas (LNG) Storage Tank Cost Estimate: $2,500,000 w/Equalization Tank Size = 120' x 120' x 20' H, 2,000,000 Gallon Capacity	
	EAF Steel Recycling Process Equipment Cost: US$3,000,000	
	12,000,000 CFD Compressed Methane Gas (CNG) Equipment Cost Estimate = US$10,000,000. Electricity Requirements = 2 MW	
	221 Ton/Day Liquefied Nitrogen Air Separation Equipment Cost Estimate: $20,000,000. Electricity Requirements = 10 MW	
	Liquefied Nitrogen Delivery Equipment: US$500,000	
	Fish Procurement Cost Estimate = US$5,000,000	
	51.5 MW Natural Gas Fueled Combined Cycle Power Generation Equipment @ US$1,260/kW = 51,500 kW x US$1,100 = US$65,000,000	
	Total Electricity Generation Requirements:	
	For each project building: 51.5 MW (includes projected demand for the next 20 years	
	For Photobiorector = 6.0 MW	
	For Compressed Natural Gas (CNG) = 2 MW	
	For Liquefied Nitrogen (LN2)(LIN) = 10 MW	
	For Liquefied Oxygen = Included with Liquefied Nitrogen	
	For Tilapia Farming = 0.5 MW	
	For General Building use = 2 MW	
	Total Electricity Installed Capacity Requirements = 51.5 MW	
	122 MW potential less 51.5 MW used = 70.5 MW remaining. At 83,779 cu. ft./MW, 83,779 cu. ft. x 70.5 MW = 5,906,420 cu. ft./Day available to marketplace at US$0.70/126.67 cu. ft. or US$32,640/Day as CNG automotive fuel. If sold to a natural gas pipeline the revenue would be slightly less by about 10%.	

Schedule of Project Construction Costs:		
	Anaerobic Digester Feed Tank: US$2,000,000	
	Biodiesel Manufacturing Equipment: US$15,000,000	
	Building Size: 1 km x 1 km x 3 Stories High Constructed Cost: US$75,000,000	
	Cement Kiln Constructed Cost: US$12,000,000	
	Concrete Ready Mix Plant Constructed Cost = US$3,000,000	
	EAF Steel Recycling Process Equipment Constructed Cost: US$3,000,000	
	LED Lighting Purchase Cost: US$10,000,000	
	Liquefied Natural Gas (LNG) Storage Tank: US$2,500,000	
	Liquefied Nitrogen Air Separation Equipment: US$15,000,000	
	Liquefied Nitrogen Delivery Equipment: US$500,000	
	Liquefied Nitrogen Storage Tank: US$2,000,000	
	Methane Compression Equipment: US$10,000,000	
	Photobioreactor: US$100,000,000	
	Potable Water Storage Tank Constructed Cost: US$2,000,000	
	Power Generation Equipment: US$56,650,000	
	Reverse Osmosis Equipment: US$2,000,000	
	Fish Procurement Costs: US$5,000,000 **Electricity Requirements = 2.0 MW**	
	Tilapia Fish Farming Acreage: 50 hectares x 24' H **Tilapia Fish Farming Production: lbs/day = 281,400 of tilapia filets** **Tilapia Fish Farming Electricity Requirements = 0.5 MW** **Fish Processing Equipment: US$500,000**	
	Two-Phase Anaerobic Digester: US$37,390,000	
	Subtotal Project Construction Costs: US$353,540,000	
	Add 15% Contingencies @ 53,031,000 = US$406,571,000	
	Total Project Construction Costs:	**US$406,571,000**
Project Visible Cash Flow Revenue Streams:		
	From Sanitary Wastewater – US$0.00	
	From Municipal Solid Wastes – US$0.00	
	From Agro Wastes – US$0.00	
	From Animal Wastes – US0.00	
	From Electricity: 44 MW x 24 = 720 MWh/Day @ US$45.00/MWh = US$47,520/Day. This amount of electricity generation will provide the average demand load of the participating communities for the next 20 years.	**US$47,520/Day**
	From Biodiesel: 18,381 GPD always priced at 80% of existing marketplace retail. Current retail is US$1.67/gallon. US$1.67 x 80% = US$1.34. 18,381 x US$1.34 = US$24,630/Day.	**US$24,630/Day**
	From Liquefied Nitrogen (LN2)(LIN): 244,003 GPD priced at US$0.50/gallon = US$122,000.00/Day.	**US$122,000/Day**
	From Compressed Natural Gas (CNG) Fuel:	**US$32,640/Day**
	From Fresh Tilapia Filet Exports: US$1,226,900 at a sell price of US$2.18/lb	**US$1,226,900/Day**
	From Self-Biofueled Trains & Locomotives:	**US$958,900/Day**
	From Self-Biofueled Ships:	**US$6,849,315/Day**
	From Tidal Generators:	**US$27,397,260/Day**
	Renewable Energy and other Credits based on estimated 36 MW Project Power Generation:	
	One Certified Emission Reduction Credit = 1 Tonne CO_2 Reduction. 51.5 MW Project Power Production x 24 hour/Day = 1,236 MWh/Day.	

		1,236 MWh/Day x 1,100 lbs CO_2 Reduction (using natural gas)/MWh ÷ 2,000 lbs/Ton = 680 Tons/Day = 248,000 T/Year x 2,000/2,204 = 225,226 Tonnes/Year @ US$20 (range of US$20-US$40) = US$4,504,000/Year ÷ 365 = US$12,341/Day for years 2008-2012 delivery.	US$12,341/Day
Total Project Revenue Streams:			**US$962,583/Day**
To the extent that electricity is generated, the combustion off gases (CO_2, NOx, N_2, and H2O) will be entirely used for Spirulina microalgae production. After Spirulina microalgae production has occurred the remaining Nitrogen gas (N_2) will be liquefied and sold to the marketplace. The remaining N_2 gas stream will also contain Oxygen gas (O_2) due to the respiration of microalgae during their production in the same manner that trees and plants give off oxygen. This oxygen will be simultaneously liquefied during the liquefaction of N_2 and subsequently distilled off, compressed, and subsequently used internally as a welding gas, to enhance cement manufacturing, to enhance fish farming, and for smelting iron into steel. Some of the Nitrogen Gas will be used as a protective blanket gas in the production of methanol through syngas technology. The methanol is produced as a required feedstock in the production of biodiesel.			

Additional Notes:

1. Land Requirements: Estimate 300 hectare for Project Building and/or 1,200 hectare for Shipbuilding/Shipbreaking Project Building.

2. Time to design-build-install-operate either above option is estimated at 36 months.

3. Lighting for tilapia must be a daily cycle of:
   7.5 hours of total darkness
   0.5 hours of sunrise (begins at 6 a.m. w/3 ft-candles)
   15.5 hours of daylight (max 10 ft-candles)
   0.5 hours of sunset (begins at 10 p.m. w/3 ft-candles)

4. Sufficient project building room remains to add a 10,000 beef cattle operation, a 10,000 milker dairy farm, and significant poultry operations along with all of the associated processing equipment to produce value added products consisting of dressed beef, milk and other dairy products, broilers, and eggs. All of these activities represent future economic development activities.

5. WSE Engineering Drawing Nos. S-9900-18, S-9900-19, and S-9900-20 are attached.

Nonrecourse Project Capital Cost Structure

City of Karachi, Pakistan
BioWastes-To-Renewable Energy, Biofuels, Organic Foods, and Potable Water Independence

The total estimated capital and development costs of the design-build-own-operate wastes-to-renewable energy, organic foods, biofuels, and water independence project building totals US$6,207,640,400 utilizing both new and remanufactured process equipment. The major components of capital and other costs for the project building are as follows:

Item Description	Cost in US$
Anaerobic Digester Feed Tank Constructed Cost[1]	2,000,000
Biodiesel Manufacturing Equipment Constructed Cost[2]	15,000,000
Building Size 2 km x 2 km x 3 stories high Constructed Cost[3]	2,400,000,000
Cement Kiln Constructed Cost[4]	50,000,000
Concrete Ready Mix Batch Plant Constructed Cost[5]	15,000,000
EAF Steel Recycling Process Equipment Constructed Cost	3,000,000
Fish Processing Equipment Constructed Cost[6]	500,000
LED Lighting Purchase Cost[8]	10,000,000
Liquefied Nitrogen Air Separation Equipment Procurement Capital Cost	15,000,000
Liquefied Nitrogen Delivery Equipment Procurement Capital Cost	500,000
Liquefied Nitrogen Storage Tank Constructed Cost	2,000,000
LNG (Liquefied Natural Gas) Storage Tank Constructed Cost	2,500,000
Methane Gas Compression Equipment Installed Capital Cost	10,000,000
Potable Water Storage Tank Constructed Cost	2,000,000
Photobioreactor Capital Equipment Constructed Cost[7]	100,000,000
Power Generation Equipment Procurement Cost[9]	200,000,000
Reverse Osmosis Equipment Procurement Cost	2,000,000
Fish Procurement Costs	5,000,000
Two-Phase Anaerobic Digester Constructed Cost[1]	37,390,000
Subtotal Project Costs	**2,834,500,000**
Add 15% Contingencies	425,180,000
Total Capital Costs	**3,259,680,000**
Finance Charges	80,000,000
Interest During Construction	200,000,000
Administration/Legal	150,000
Permitting	20,000
Technology & Development Cost	2,500,000,000
Project Development Fee @ 3% of US$3,259,680,000 =	97,790,400
Working Capital	70,000,000
Total All Costs	**6,207,640,400**

Nonrecourse Project Financing Will Be Structured As Follows:

Developer Equity as Technology, 70%[10]	2,500,000,000
Investor Equity as Cash, 30%	1,112,292,120

Finance	2,595,348,280
Loan Term, Years	10
Interest Rate	10%
Developer will contribute 70% equity in the project as the value of the technology.[10]	
Investor will contribute US$1,112,292,120 cash and the balance will be financed.	

With Following Notes:

1. **The anaerobic digester and its associated feed tank will be constructed of precast concrete panels. The panels will be manufactured by Wieser Concrete Products, Inc. and shipped to the project site. The Wisconsin based precast concrete manufacturer POC is Phil Miller @ phone 800.325.8456 (see http://www.wieserconcrete.com/about.html).**

2. **The biodiesel production equipment will be designed and manufactured by California based R. C. Costello & Associates, Inc. The POC is Rocky Costello, P.E. @ phone 310.792.5870 (see http://www.rccostello.com/).**

3. **The low cost of the project building is made possible by the 100% internal recycling of inorganic wastes that are produced from the anaerobic digestion process. These inorganic wastes are combined with cement and water in the production of precast concrete panels. The special purpose project company will produce its own cement to further minimize construction costs. See attached WSE Engineering Drawing No. S-6099-1 for additional details. The POC at WaterSmart Environmental is Chuck Steiner @ 913.897.2727 (see http://www.watersmart.com/).**

4. **The cement kiln will be sourced through Canada based Cement Process Consulting, Ltd. The POC is Ken Postle @ phone 403.472.4519 (see http://www.cement-process.com/index.htm).**

5. **The concrete ready mix plant will be sourced through Advanced Concrete Technologies. The POC is Stefan Siegels @ phone 603.431.5661 (see http://www.concretebiz.com).**

6. **The fish production and processing equipment will be sourced through Colorado based Fisheries Technology Associates, Inc. The POC is Bill Manci @ phone 970.225.0150 (see http://www.ftai.com/).**

7. **The enclosed photobioreactor consists of 2 miles long 12”Ø clear PVC pipe. A possible supplier is Harvel Plastics, Inc. but other sources will be considered prior to procurement (see http://www.harvel.com/).**

8. The artificial lighting for the photobioreactor consists of 5 miles of high efficiency long lasting (10 years or more) light emitting diode (LED) lighting that will be wrapped barber pole fashion around the clear PVC pipe. A possible supplier is Light Waves Concept, Inc. but other sources will be considered prior to procurement (see http://www.lightwavesconcept.com/).

9. The power generation equipment will be sourced through UK based Combustion, Energy & Steam Specialists, Ltd. The POC is Mike Craigie @ phone +44 (0) 1856 851177 (see http://www.cess.co.uk/).

10. The seemingly high percentage of developer equity as technology is justified on the basis that it is the only economic development technology that simultaneously achieves:

- **100% compliance with Kyoto Protocol thus helping to reverse global warming,**
- **Distributed Biofuels (biodiesel and compressed natural gas or CNG) independence,**
- **Distributed Food independence,**
- **Distributed Renewable energy independence,**
- **Distributed Water independence, and**
- **Complete internal recycling of all byproducts and waste streams thereby producing a useful product—namely precast concrete products that will be used for constructing the project building itself as well as infrastructure roads, light rail transit surface transportation system, precast concrete potable water distribution system, precast concrete wastewater collection system, and precast concrete encased renewable energy power distribution system. In doing so the community initiative project will become the very first zero carbon and zero waste community in the world.**

Climate Change has now become the most serious worldwide concern as the sustainability of our planet appears to be at rapidly increasing risk. Renewable Energy Technologies that address climate change are therefore in great demand. Technologies that address both climate change and substantial economic development are in even greater demand. The proposed waste-to-energy technology has required over 30,000 hours of research over a 10 year period to develop thus fully justifying the seemingly high percentage of developer equity as technology. It is the very first and only worldwide technology that is technically capable of simultaneous distributed energy independence, distributed food independence, distributed fuels independence, and distributed water independence with all in full compliance with Kyoto Protocol.

The proposed wastes-to-renewable energy technology consists of a suite of individual component technologies. The individual component technologies are:

- **Biodiesel Production With Associated Waste Processing. The National Renewable Energy Laboratory (NREL) pioneered the very first production of biodiesel from microalgae. The research and development was carried out under the "Aquatic Species Program" (ASP) that consisted of the first production of a biofuel called "algal biodiesel" (see http://www1.eere.energy.gov/biomass/pdfs/biodiesel_from_algae.pdf). Under the**

referenced program Algal Biodiesel was produced through the growing of microalgae for their lipid content. The lipid content was then converted into biodiesel through chemical transesterification in the same manner that soybeans and other vegetable oils are now being converted into biodiesel. The ASP funding totaled $25.05 million over a 20 year period that began in 1978. Continuation funding was ultimately terminated when it was officially determined that algal biodiesel could not be produced economically. The ASP obtained its research data from growing microalgae in warm open ponds (Salton Sea in Southern California) at a pH of 8.2 using atmospheric carbon dioxide. The Salton Sea is the recipient of agricultural runoff nutrients as well as additional nutrients contained in municipal sewage treatment plants discharges. The Middle Cordoba Province Project will produce microalgae within an enclosed photobioreactor that will operate at the optimum growing temperature of 35ºC (95ºF) and at the optimum growing pH of 9.4. Photosynthesis will occur 24/7 rather than just during daylight hours by using long lasting light emitting diode (LED) lighting. The photobioreactor will receive the total carbon dioxide output from both the anaerobic digester as well as the power generation equipment thus substantially increasing production over that obtainable from using carbon dioxide from the atmosphere. Microalgae production will be further increased by adding the micronutrients contained in the reverse osmosis concentrate stream thus substantially improving microalgae production. The total increase of these process modifications over that obtained by the National Renewable Energy Laboratory's ASP is estimated at a factor of at least 1000 to 1. By producing the microalgae within an enclosed photobioreactor the technology becomes totally compliant with Kyoto Protocol since all discharges of greenhouse gases to the environment are eliminated.

- **Cement manufacturing as a technology has been practiced for many hundreds of years throughout the entire civilized world.**

- **Fish farming was first practiced by the Chinese over 100 years ago. Due to the over fishing of the oceans fish farming is now widespread throughout the entire civilized world.**

- **Precast concrete panels and piping have been manufactured for the last 50 years. The use of precast concrete panels has become quite popular in the building industry during the last 10 years.**

- **Liquefied Nitrogen and Liquefied Oxygen have been produced in the marketplace for the last 50 years. Names of today's largest industrial suppliers consist of Air Liquide, Air Products & Chemicals, Inc., Cryogenic Industries, Inc., Gas Systems Corporation, and Praxair, Inc.**

- **Methane gas-to-methanol alcohol through synthesis gas (syngas) technology represents the standard method of producing methanol throughout the civilized world.**

- **Microalgae production through the use of a photobioreactor (use of artificial light rather than sunlight) is now being done at several research institutions. The technology has yet to be put into full scale commercial operation. The Middle Cordoba Province Waste-To-Renewable Energy Community Initiative project will become the first full sized worldwide commercial application of the enclosed photobioreactor technology.**

- **The anaerobic digestion of municipal solid wastes (MSW) was first accomplished by two-phase anaerobic digestion in 1996 (see http://lib.kier.re.kr/caddet/retb/no66.pdf). More recently the management of municipal solids wastes is being accomplished using**

conventional anaerobic digestion by Waste Management, Inc., a waste management company (see http://www.wm.com/WM/environmental/Bioreactor/technologies.asp).

- **Precast concrete panels and precast concrete pipes have been manufactured for the last 50 years throughout the world.**

- **Renewable energy power generation has been practiced for at least 30 years in the EU and 20 years in the United States.**

- **Reverse osmosis treatment has been around on a commercial basis for over 30 years. During the last 5 years its marketplace costs have been halved and it is now considered very good and very affordable technology.**

Islamic Republic of Pakistan Prefeasibility Study, October 19, 2007	Totals
Location: Pakistan	
Technology Provider: WaterSmart Environmental, Inc.	
Project Developers: Overseas Consultants et al POC: Dr. M. A. Qazi Johnstown, Pennsylvania Phones: 814.270.1422, 814.262.7489 Fax: 814.266.9371 email: drmaqazi@yahoo.com Marvel Energy, Ltd. Karachi, Pakistan POC: Mr. Sheeraz Khan email: sheeraz.khan@gmail.com	
Project Type: Economic Development through Design-Build-Own-Operate BioWastes-To-Renewable Energy, BioFuels, Organic Foods, and Potable Water Independence	
Project Dollar Size: US$460 million for each 1 km x 1 km x 3 story high project building	
Project Dollar Size: US$2,500,000 million for each 2 km x 2 km x 200m high shipbuilding/shipbreaking project building	
Number of project buildings required: 920	
Number of shipbuilding/shipbreaking project buildings required: 1	
Project Building Activities: Extensive Agricultural Production and Processing that additionally includes renewable energy, biofuels, and water production along with 100% recycling of all byproducts into precast concrete panels and precast concrete piping for infrastructure development	
Shipbuilding/Shipbreaking Project Building Activities: 1. Extensive Agricultural Production and Processing that additionally includes renewable energy, biofuels, and water production along with 100% recycling of all byproducts into precast concrete panels and precast concrete piping for infrastructure development, and 2. The construction and sale of self-biofueled concrete ships 3. The breaking of ships with concurrent waste management 4. The construction of self-biofueled trains & locomotives 5. The construction and sale of tidal generators	
Jobs Creations Potential for each 1 km x 1 km x 3 story high project building: 1,500	
Jobs Creations Potential for each 2 km x 2 km x 200 m high shipbuilding/shipbreaking project building: 2,500	
BioWastes Treated: Biodiesel Processing Wastes, Construction & Demolition Wastes, Foods Production & Processing Wastes, Hazardous Wastes, Medical Wastes, Municipal Solid Wastes (MSW), and Petroleum Derived Wastes	
Local Population Served for each 1 km x 1 km x 3 story high project building: 50,000	
Local Population Served for each 2 km x 2 km x 200 m high shipbuilding/shipbreaking project building: 50,000	
Residual Wastes to Landfill: Zero	
Greenhouse Gaseous Emissions to the Environment: Zero	
Climate Change Carbon Footprint: Zero	
Investor Internal Rate of Return: Optimal	
Note on Electricity Distribution: At the completion of the project 100% of the Nova Scotia electricity requirements will be provided thus eliminating the necessity for continued use of electric utility grid supplied electricity. After complete BioWastes-To-Renewable Energy,	

BioFuels, Organic Foods, and Potable Water Independence project implementation all electricity will be distributed at a sustainable US$0.045/kWh to all users regardless of kWh electricity usage amount or time of day when provided. Inexpensive electricity is absolutely necessary in every country to support meaningful industrial development. It is expected that the distribution of inexpensive electricity within Pakistan will strongly support much needed industrial development. Inexpensive electricity distribution is made possible by the extreme profitability of extensive agricultural production and processing in combination with extensive biofuels production.

Detailed Project Description

Extensive Agricultural Production in each project building will consist of a 100 hectare tilapia fish farming operation that is also sized to produce excess local marketplace demand for tilapia fish. The excess processed fish will be exported to distant markets to provide visible cash flow to the project. With a world population approaching 7 billion the fish output of a single project building calculates out to approximately 0.15% of worldwide demand of tilapia fish. A total of 1 ÷ 0.0015 = 666 project buildings would therefore be required to satisfy worldwide demand for tilapia fish. Worldwide consumption of fish data is attached. The marketing idea is to produce 100% of the local demand for fish with the entire excess of each sold to export markets for visible sales revenue.

In addition to agricultural production, each project building will produce Portland cement for the purpose of manufacturing precast concrete panels and piping for direct infrastructure development.

1. **In the production of cement considerable carbon dioxide gas is produced.**
2. **When processing biowastes using anaerobic digestion both methane gas and carbon dioxide gas are produced.**
3. **When generating renewable energy both water vapor and carbon dioxide gas are produced.**

100% of the carbon dioxide gas produced during the production of cement, the processing of biowastes, and the generation of electricity will be routed to an enclosed photobioreactor for the purpose of producing Spirulina microalgae. 75% of the Spirulina microalgae will be used as animal feed in the production of tilapia fish. The remainder 25% will be converted into biodiesel biofuel (B100) and sold locally to produce visible sales revenue.

Spirulina microalgae contain about 6% lipids (fats). The production of biodiesel produces about 6% lipid (fat) conversion into biodiesel biofuel from Spirulina microalgae. The 94% remaining biowastes are returned to the anaerobic digester to produce additional methane gas and carbon dioxide gas. The resulting methane gas produced can be used for power generation or sold as a biofuel. The resulting carbon dioxide gas produced from electricity generation will be automatically routed to the enclosed photobioreactor to enable production of additional Spirulina microalgae.

The economic development objective is to produce 100% of the local demand for electricity, 100% of the local demand for biodiesel biofuel, 100% of the local demand for natural gas (methane gas is a near equivalent to natural gas) biofuel, and 100% of the local demand for compressed natural gas (CNG) automotive biofuel. Biodiesel (B100) can be used as a direct replacement for petroleum diesel without equipment modification. CNG biofuel must be used in vehicles equipped for this fuel. Each project building will engage in the modification of gasoline automotive equipment to enable the use of CNG biofuel. Automobiles that operate on CNG biofuel enjoy extended useful life of the engine by a factor of 4 or more. Trucks that operate on biodiesel biofuel enjoy extended useful life of the engine by a factor of 2 or more. Each economic development project includes the infrastructure for local distribution of renewable natural gas. To the extent that methane gas is used for electricity generation, the production of biodiesel biofuel, and the production of CNG biofuel, each qualifies for renewable energy credits since all such uses

are carbon neutral.

As background information, the production of ethanol from corn and biodiesel from beans has precipitated a massive food or fuel issue throughout the world causing the marketplace price of both corn and soybeans to increase dramatically. These increases have, in turn, caused the marketplace price of ethanol and biodiesel to increase as well the marketplace price of corn and soybean based food products. It is these increases in marketplace prices that have caused the food or fuel issue. With our business model, the production of biodiesel from Spirulina microalgae stays completely clear of the food or fuel issue as does the production of CNG biofuel from biowastes. To achieve total sales of the biofuels production outputs they will be sold at a 20% discount from existing retail. At this attractive pricing 100% of routine production will easily sell in the marketplace.

Because nutrients will be 100% recycled internally, each project building will produce substantial liquid fertilizer concentrate that will be distributed to area farmers in need on a no-charge basis. Excess liquid fertilizer, if any, would be eligible to sell to distant markets or possibly converted into value added products. To the extent that the local market does not make use of the liquid fertilizer concentrate the fertilizer product will be sold to international markets to increase additional visible cash flow to the project.

Because 100% of the water is recycled internally, potable water of the quality of bottled water will be distributed locally on a no-charge basis. Because water is required to process municipal solid wastes each project building will accept both sanitary wastewater and storm water for that purpose on a no-charge basis. Over time, additional stories will be added to each project building to enable additional agricultural activities that could include bananas, beets, black bass, beef cattle, beans, cassava, coffee, corn, cotton, dairies, lobster, onions, poultry, prawns, rice, shrimp, sugar cane, sweet potatoes, trout, and many other crops.

No Charge For Potable Water

No Charge For Wastewater Treatment

Throughout the prefeasibility study extensive efforts are made to provide balanced chemical equations and mathematical calculations, where appropriate, to permit extensive due diligence evaluations of the proposed sciences to be used.

No Charge for Stormwater Treatment

Marketplace BioWastes-To-Energy Feedstocks

A determination of the amount of volatile solids (VS) is necessary in order to calculate the amount of methane gas that can be produced from the anaerobic digestion of biowastes. Eligible feedstocks consist of municipal solid wastes (MSW), medical wastes, and construction & demolition wastes. For the purpose of arriving at conservative waste figure availability, a total of 2 lbs/person/day will be used for the purpose of calculating total feedstock biowaste amounts for developing countries and a total of 5 lbs/person/day will be used for the purpose of calculating total feedstock biowaste amounts for developed countries. For an area population of 50,000 for each project building the available biowastes calculate out to 50,000 x 2 lbs/person/Day = 100,000 lbs/day, or when divided by 2,000 lbs/Ton = 50 Tons/Day for developing countries and 50,000 x 5 lbs/person/day = 250,000 lbs/Day, or when divided by 2,000 lbs/Ton = 125 Tons/Day for developed countries.

For undeveloped countries, the calculation for municipal solid wastes is as follows:

60 Tons VS/Day From MSW Undeveloped Countries

> Assuming 25% moisture content 50 Tons/Day x 75% = 37.5 Dry Tons/Day
> Assuming 80% organic content 37.5 Dry Tons/Day x 80% = 30 Organic Tons/Day
> Assuming 80% volatile solids content 30 Organic Tons/Day x 80% = 24 Tons Volatile Solids/Day or x 2,000 lbs/Ton = 48,000 lbs/Day. This amount of waste translates into 48,000 lbs Volatile Solids/Day x 12 cubic feet of methane/lb Volatile Solids = 576,000 CFD of CH_4. At 24 cubic feet/lb, the methane production translates into 576,000 CFD CH_4/24 = 24,000 lbs/2,000 = 12.0 Tons CH_4/Day for undeveloped countries.

30 Tons CH_4/Day From MSW Undeveloped Countries

For developed countries, the calculation for municipal solid wastes is as follows:

150 Tons VS/Day

Assuming 25% moisture content 125 Tons/Day x 75% = 93.75 Dry Tons/Day Assuming 80% organic content 93.75 Dry Tons/Day x 80% = 75 Organic Tons/Day Assuming 80% volatile solids content 75 Organic Tons/Day x 80% = 60 Tons Volatile Solids/Day or x 2,000 lbs/Ton = 120,000 lbs/Day. This amount of waste translates into 120,000 lbs Volatile Solids/Day x 12 cubic feet of methane/lb Volatile Solids = 1,440,000 CFD of CH_4. At 24 cubic feet/lb, the methane production translates into 1,440,000 CFD CH_4/24 = 60,000 lbs/2,000 = 30.0 Tons CH_4/Day for developed countries. In addition to fresh municipal solid wastes, the project will directly collect an additional 10 lbs/person/Day from existing landfills, rubbish piles, and dumps for the twofold purpose of producing additional methane gas and reclaiming additional ferrous and nonferrous metals while getting rid of existing dump/landfill sites. This activity will increase the methane gas and carbon dioxide gas production from two-phase anaerobic digestion by a factor of 5/2 or 2.5 thus increasing the volatile solids from undeveloped countries from 24 Tons/Day to 60 Tons/Day and from developed countries from 60 Tons to 150 Tons/Day. The associated methane gas is increased from 12 Tons CH_4/Day to 30 Tons CH_4/Day for undeveloped countries and from 30 Tons CH_4/Day to 75 Tons CH_4/Day from developed countries. The 60 Tons Volatile Solids/Day from undeveloped countries can be converted into CO_2 production by multiplying the Volatile Solids by 12 to determine cu. ft. of methane gas produced. Cu. ft. of methane gas produced ÷ 24 cu. ft./lb = lbs methane gas. Lbs. methane gas multiplied by 1.375 = lbs CO_2 produced or 60 Tons VS/Day x 2,000 lbs/Ton x 12 = 1,440,000 cu. ft. CH_4/Day. 1,440,000 cu. ft. ÷ 24 cu. ft./lb = 60,000 lbs CH_4/Day. 60,000 lbs CH_4/Day x 1.375 = 82,500 lbs CO_2/Day. 82,500 lbs CO_2/Day ÷ 2,000 lbs/Ton = 41.3 Tons CO_2/Day. The 150 Tons Volatile Solids/Day from undeveloped countries can be converted into CO_2 production by multiplying the Volatile Solids by 12 to determine cu. ft. of methane gas produced. Cu. ft. of methane gas produced ÷ 24 cu. ft./lb = lbs methane gas. Lbs. methane gas multiplied by 1.375 = lbs CO_2 produced or 150 Tons VS/Day x 2,000 lbs/Ton x 12 = 3,600,000 cu. ft. CH_4/Day. 3,600,000 cu. ft. ÷ 24 cu. ft./lb = 150,000 lbs CH_4/Day. 150,000 lbs CH_4/Day x 1.375 = 206,250 lbs CO_2/Day. 206,250 lbs CO_2/Day ÷ 2,000 lbs/Ton = 103 Tons CO_2/Day. Revenue collected for management of landfill wastes, municipal solid wastes, medical wastes, and construction & demolition wastes: US$0/Day/Ton. Never a charge, ever. This service always provided as a public service activity only.	From MSW in Developed Countries 75 Tons CH_4/Day From MSW in Developed Countries No charge for MSW disposal US$0.00/Day From MSW
Agricultural Food Production and Processing Will consist of a 100 hectare Tilapia fish farm at each project building for producing and thereafter processing organically grown Tilapia filets, mostly for the export fish market. Electricity requirements are estimated at 1.0 MW. The estimated raw fish produced per day is 1,340,000 lbs. At a filet yield of 42% a total of 562,000 lbs (281 Tons of Tilapia filets) will be produced/Day along with 778,000 lbs or when divided by 2,000 lbs/Ton = 389 Tons of biowastes/Day. At a commodity sell price of US$2.18/lb, the daily revenue is estimated at 389 Tons/Day x 2,000 lbs/Ton x US$2.18/lb = US$1,225,160/Day It is virtually impossible to obtain a buyer commitment on a current basis in the form of a purchase agreement for a product that is 36 months away from coming into existence. In terms of investor risk assessment, the existence of the very large fish commodity market itself is regarded as ample proof of probable visible cash flow from this specific food product.	0.5 MW Electricity Required For Tilapia Fish Farming US$1,225,160/Day From Tilapia Fish 389 Tons VS/Day From Fish

The 389 Tons/Day of biowastes x 2,000 lbs/Ton = 778,000 lbs of Volatile Solids/Day. This amount of waste translates into 778,000 lbs Volatile Solids/Day x 12 cubic feet of methane/lb Volatile Solids = 9,336,000 cubic feet/Day (CFD) of CH_4. At 24 cubic foot/lb, the methane production translates into 9,336,000 CFD CH_4/24 = 389,000 lbs/2,000 = 194.5 Tons CH_4/Day.	Processing 194.5 Tons CH_4/Day From Fish Processing
Subtotal Carbon Dioxide Gas Produced From Municipal Solid Wastes Processing:	41.3 Tons CO_2/Day
The 60 Tons Volatile Solids/Day from Municipal Solid Wastes can be converted into CO_2 production by multiplying the Volatile Solids by 12 to determine cu. ft. of methane gas produced. Cu. ft. of methane gas produced ÷ 24 cu. ft./lb = lbs methane gas. Lbs. methane gas multiplied by 1.375 = lbs CO_2 produced or 60 Tons VS/Day x 2,000 lbs/Ton x 12 = 1,440,000 cu. ft. CH_4/Day. 1,440,000 cu. ft. ÷ 24 cu. ft./lb = 60,000 lbs CH_4/Day. 60,000 lbs CH_4/Day x 1.375 = 82,500 lbs CO_2/Day. 82,500 lbs CO_2/Day ÷ 2,000 lbs/Ton = 41.3 Tons CO_2/Day.	
Subtotal Feedstocks Volatile Solids From Tilapia Fish Farming Wastes:	2.8 Tons/Day
The 1.4 Tons Volatile Solids/Day from Tilapia Fish Farming Wastes can be converted into CO_2 production by multiplying the Volatile Solids by 12 to determine cu. ft. of methane gas produced. Cu. ft. of methane gas produced ÷ 24 cu. ft./lb = lbs methane gas. Lbs. methane gas multiplied by 1.375 = lbs CO_2 produced or 2.8 Tons VS/Day x 2,000 lbs/Ton x 12 = 67,200 cu. ft. CH_4/Day. 67,200 cu. ft. ÷ 24 cu. ft./lb = 2,800 lbs CH_4/Day. 2,800 lbs CH_4/Day x 1.375 = 3,850 lbs CO_2/Day. 3,850 lbs CO_2/Day ÷ 2,000 lbs/Ton = 1.92 Tons CO_2/Day.	1.92 Tons CO_2/Day From Tilapia Fish Farming Wastes
Subtotal Feedstocks Volatile Solids From Tilapia Fish Processing Wastes:	389Tons VS/Day
The 389 Tons Volatile Solids/Day from Tilapia Fish Processing Wastes can be converted into CO_2 production by multiplying the Volatile Solids by 12 to determine cu. ft. of methane gas produced. Cu. ft. of methane gas produced ÷ 24 cu. ft./lb = lbs methane gas. Lbs. methane gas multiplied by 1.375 = lbs CO_2 produced or 389 Tons VS/Day x 2,000 lbs/Ton x 12 = 9,336,000 cu. ft. CH_4/Day. 9,336,000 cu. ft. ÷ 24 cu. ft./lb = 389,000 lbs CH_4/Day. 389,000 lbs CH_4/Day x 1.375 = 534,874 lbs CO_2/Day. 534,874 lbs CO_2/Day ÷ 2,000 lbs/Ton = 267 Tons CO_2/Day.	267 Tons CO_2/Day From Tilapia Fish Processing Wastes
Subtotal Carbon Dioxide Gas Produced From Pork Processing Wastes:	15.5 Tons CO_2/Day
Subtotal Carbon Dioxide Gas Produced From Tilapia Fish Farming Wastes:	1.92Tons CO_2/Day
Subtotal Carbon Dioxide Gas Produced From Tilapia Fish Processing Wastes:	389 Tons CO_2/Day
Subtotal Carbon Dioxide Gas Produced From Electricity Generation:	247.0 Tons CO_2/Day
Subtotal Carbon Dioxide Gas Produced From Cement Manufacturing:	67.2 Tons CO_2/Day
Total Carbon Dioxide Gas Produced:	483.0 Tons CO_2/Day
Subtotal Methane Gas Produced From Municipal Solid Wastes:	30.0 Tons CH_4/Day
Subtotal Methane Gas Produced From Tilapia Fish Farming Wastes:	0.7 Tons CH_4/Day
Subtotal Methane Gas Produced From Tilapia Processing Wastes:	97.3 Tons CH_4/Day
Subtotal Methane Gas Produced From Biodiesel Processing Wastes:	97.1 Tons CH_4/Day
Total Methane Gas Produced:	249.9 Tons CH_4/Day
Two-Phase Anaerobic Digestion All of the wastes associated with agricultural production will be managed through two-phase anaerobic digestion technology. Traditional anaerobic digestion (often referred to as conventional high rate anaerobic digestion) produces a biogas that consists of 1/3 carbon dioxide gas by volume and 2/3 methane gas by volume as a common gas mixture. Two-phase anaerobic digestion, however, produces the same gases as two distinct gases consisting individually of carbon dioxide gas and methane gas. The separation of the two gases permits each to be managed individually. In every anaerobic digester the ratio of carbon dioxide gas produced relative to methane gas is 1:2 on a volumetric basis. The molecular weight of methane gas (CH_4) is 16 (12 for Carbon + 4 for Hydrogen) whereas the molecular weight of carbon dioxide gas (CO_2) is 44 (12 for Carbon and 32 for Oxygen). 1 x 44 = 44 weight units for carbon dioxide gas and 2 x 16 = 32 weight units for methane gas. 44 divided by 32 = 1.375. Carbon dioxide produced relative to methane produced is therefore 137.5% on a mass basis. The actual weight of	Products Of Two-Phase Anaerobic Digestion Volatile Solids (VS) x 12 = cu. ft. CH_4 cu. ft. CH_4 x 0.0423 = lbs CH_4 lbs CH_4 x 1.375 = lbs CO_2

methane gas produced may be found by multiplying its cubic feet by the factor 0.0423 lbs/cu. ft. to arrive at its actual weight in lbs. This weight may be multiplied by the factor of 1.375 (137.5%) to arrive at the corresponding weight of carbon dioxide produced in lbs. The amount of methane gas generated through two-phase anaerobic digestion may be found by multiplying the volatile solids weight of the biowastes in lbs by 12 to arrive at the cubic feet of methane gas produced in lbs.

Other sometimes handy mathematical relationships are:

1 Ton VS/Day produces 24,000 CH_4/Day from two-phase anaerobic digestion
1 Ton VS/Day produces 0.508 Tons CH_4/Day from two-phase anaerobic digestion
1 Ton VS/Day produces 0.698 Tons CO_2/Day from two-phase anaerobic digestion
1 Ton CH_4/Day used for electricity generation produces 2.75 Tons CO_2/Day
83,780 CH_4/Day produces 1 MW of simple cycle electricity power generation

Enclosed Photobioreactor for Spirulina Microalgae Production

The enclosed photobioreactor consists of a 2,200,000 foot long 12”Ø clear schedule 40 PVC pipe spiral wrapped externally with ultra high efficiency long lasting (10 years +) light emitting diode lighting for continuous photosynthesis. A small portion of the Spirulina microalgae produced will be continuously recycled to the start of the photobioreactor to provide the required seed to enable continuous Spirulina microalgae production. Electricity requirements = 6.0 MW for the lighting and associated recirculation pumping equipment.

The photobioreactor will receive 100% of the carbon dioxide gas output of the two-phase anaerobic digester and 100% of the carbon dioxide gas output from electricity generation. In addition, it will receive 100% of the output of macronutrients from the reverse osmosis treatment equipment deployed downstream from the two-phase anaerobic digester. The Spirulina microalgae require both carbon dioxide and macronutrients to maximize their rate of growth. The photobioreactor will be operated at a temperature of 35ºC (95ºF) and a pH of 9.4 to further optimize Spirulina microalgae rate of growth. Please refer to attached WSE Drawing Nos. S-6099-1 and S-9900-1 for additional information.

Spirulina will be produced using photosynthesis in the same manner that has existed for billions of years in the oceans of the world. The photosynthesis reaction is:

$$6\,H_2O + 6\,CO_2 + \text{photons} \xrightarrow{\text{Chlorophyll}} C_6H_{12}O_6 + 6\,O_2$$

water + carbon dioxide + light energy → glucose carbohydrate + oxygen

The chemical mass balance of the above equation becomes :

$$108\text{ gm } H_2O + 264\text{ gm } CO_2 \rightarrow 180\text{ gm glucose carbohydrate} + 192\text{ gm } O_2$$

total of 372 gm reactants → total of 372 gm products

For each 264 grams of CO_2 reacted 180 grams of glucose carbohydrate and 192 grams of O_2 will be produced. For each ton of CO_2 reacted, 180/264 or 0.682 tons of glucose carbohydrates and 192/264 or 0.73 tons of O_2 will be produced. Glucose carbohydrates equate to Spirulina microalgae, a plant type material called phytoplankton.

One Ton CO_2/Day Produces 0.682 Tons Of Glucose Carbohydrates/Day (Spirulina Microalgae)

Respiration occurs in the Mitochondria of cells. It is almost the exact opposite reaction to photosynthesis. These two reactions work together to maintain a biological balance on earth. The respiration reaction is:

$$C_6H_{12}O_6 + 6\,O_2 \xrightarrow{\text{Mitochondria}} 6\,H_2O + 6\,CO_2$$

It is generally believed that photosynthesis occurs only during periods of sunlight (or artificial light) and that respiration occurs only during periods of darkness. Horticulture studies have established that several, but not all, species of plants can be grown under continuous lighting. The same studies have established that photosynthesis and respiration can and do occur simultaneously under continuous lighting conditions. Plants are multi-cell and capable of learned behavior whereas Spirulina microalgae are single cell plants and therefore totally incapable of acquiring learned behavior. Spirulina microalgae can therefore be grown under continuous lighting conditions even though they have never been exposed to continuous lighting conditions for billions of years. Continuous lighting therefore approximately doubles total Spirulina growth relative to day/night growth rates. **The glucose produced during photosynthesis contains about 6% lipids (fats). Lipids are efficiently converted into biodiesel through a transesterification process. Each ton of CO_2 will simultaneously produce 0.68 tons glucose carbohydrates x 0.06 = 0.04 tons biodiesel and 1.0 – 0.04 = 0.96 tons of byproduct biowastes. 100% of the byproduct biowastes will consist of volatile solids. One ton CO_2/Day can therefore produce 0.04 tons biodiesel/Day. At a specific gravity of 0.88 this is equivalent to 0.04 tons x 2,000 lbs/ton divided by 0.88 specific gravity = 90.91 gallons/day. The same one ton CO_2/Day will produce 0.96 tons x 2,000 lbs/ton = 1,920 lbs volatile solids/day or 21.12 lbs volatile solids/gallon of biodiesel produced/day.**	**One Ton CO_2/Day Produces 0.04 Tons Biodiesel/Day** **One Ton CO_2/Day Produces 0.96 Tons Volatile Solids/Day** **One Ton CO_2/Day Produces 90.91 Gallons Of Biodiesel/Day** **Each Gallon of Biodiesel Produced Produces 21.12 lbs of Volatile Solids**

Biodiesel Production

All biodiesel produced will fully comply with American Society for Testing and Materials (ASTM) Standard Specification D 6751-03. The referenced specification is attached to the prefeasibility study.

The amount of biodiesel produced is directly dependent on the amount of Spirulina microalgae produced. The amount of Spirulina microalgae produced is directly dependent on the amount of carbon dioxide gas that is added to the photobioreactor. Since carbon dioxide gas is produced by electricity generation, two-phase anaerobic digestion, and cement production, the total amount of CO_2 produced must be determined from each source.

Source No. 1: Electricity Generation:

30 MW of electricity will be produced for the community initiative. Another 21.5 MW of electricity will be used internally for the photobioreactor, air liquefaction, methane gas compression, tilapia fish lighting, pig production, and general building use. The total amount of electricity produced therefore equals 30 MW + 21.5 MW = 51.5 MW.

When generating electricity CO_2 is produced according to the following combustion equation:

$$CH_4 + 2O_2 + 7.52\,N_2 \rightarrow CO_2 + 2H_2O + 7.52\,N_2 + \text{heat}$$

methane + oxygen + nitrogen → carbon dioxide + water + nitrogen

The chemical mass balance of the above equation becomes:

$$16\text{ gm } CH_4 + 64\text{ gm } O_2 + 105\text{ gm } N_2 \rightarrow 44\text{ gm } CO_2 + 36\text{ gm } H_2O + 105\text{ gm } N_2$$

total of 80 gm reactants → total of 80 gm products

Please note that nitrogen is not a reactant as it does not participate in the reaction. For each ton of CH_4 used for electricity generation a total of 44/16 or 2.75 tons of CO_2 will be

1 Ton CH_4 Produces 2.75 Tons CO_2 From Electricity Generation

1 Ton CH_4 Produces 2.25 Tons H_2O From Electricity

produced along with a total of 36/16 or 2.25 tons of H_2O. 2.25 tons of H_2O is, in turn, equivalent to 2.25 tons H2O x 2,000 lbs/ton = 4,500 lbs ÷ 8.34 lbs/gallon = 540 gallons of water. If 51.5 MW of electricity is produced to provide energy independence within the Community Initiative, a total of 51.5 MW x 83,780 CH_4/Day/MW = 4,314,670 cubic feet of methane gas will have to be used each day. At 24 cubic foot/lb, the methane usage translates into 4,314,670 cu. ft. CH_4/24 = 179,778 lbs/2,000 = 89.89 Tons CH_4/Day. Since each ton of CH_4 produces 2.75 Tons of CO_2 the generation of 51.5 MW of electricity produces 89.89 x 2.75 = 247.0 Tons of CO_2/Day due to the generation of electricity. Since each ton of CH_4 produces 2.25 Tons of H_2O, the generation of 51.5 MW of electricity also produces 89.89 x 2.25 = 202 Tons of H_2O/Day. Source No. 2: Two-Phase Anaerobic Digestion: To determine the amount of CO_2 produced first requires a determination of the amount of CH_4 produced as CH_4 production directly determines CO_2 production by a factor of 1.375. To determine the amount of CH_4 produced first requires the amount of volatile solids that are treated as each lb of volatile solids x 12 = cu. ft. CH_4 produced. The volatile solids available from MSW processing are 60.0 Tons/Day as listed above. The volatile solids available from tilapia fish farming are 1.4 Tons/Day as listed above. The volatile solids available from tilapia fish processing are 194.5 Tons/Day as listed above. The total volatile solids available as listed above = 60.0 + 27.0 + 22.6 + 1.4 + 194.5 = 305.5 Tons CH_4/Day. 305.5 Tons CH_4/Day x 1.375 = 420.1 Tons CO_2/Day. The project building will engage in the manufacturing of cement. Carbon dioxide is produced in cement making as a result of the production of a process ingredient called 'Clinker'. Clinker is made when limestone is heated to produce lime. Substantial amounts of carbon dioxide are simultaneously formed during this reaction. The final amount of carbon dioxide produced varies depending on the type of cement being made. Each project building will be manufacturing 300 Tons/Day of Portland type cement. According to the *Annual Review of Energy and the Environment,* (Vol. 26: pp 303-329, November 2001) average CO_2 emissions/Ton from cement production = 448 lbs. At a cement production rate of 300 Tons/Day the total carbon dioxide emissions = 300 Tons/Day x 448 lbs CO_2/Ton = 134,400 lbs/Day ÷ 2,000 lbs/Ton = 67.2 Tons CO_2/Day. Adding this amount of CO_2 to the above total of 420.1 Tons CO_2/Day = 487.3 Tons CO_2/Day that will be produced from electricity generation, two-phase anaerobic digestion of volatile solids feedstocks, and cement production. Since each ton of CO_2 produces 0.682 Tons of Spirulina microalgae 487.3 Tons CO_2/Day produces 487.3 x 0.682 = 332.3 Tons Spirulina microalgae/Day. 75% or 249.2 Tons Spirulina/Day will be used for feeding tilapia fish and pigs. The remaining 25% or 83.1 Tons Spirulina/Day will be used in the production of biodiesel (B100). 83.1 Tons Spirulina production is the equivalent of 25% of 487.3 Tons CO_2/Day or 121.8 Tons CO_2/Day. 249.2 Tons Spirulina production is the equivalent of 75% of 487.3 Tons CO_2/Day or 365.5 Tons CO_2/Day. Since one ton CO_2/Day produces 0.682 Tons of Spirulina microalgae, 108.3 Tons CO_2/Day produces 108.3 x 0.682 = 73.86 additional tons of Spirulina microalgae increasing its production from 295.5 Tons/Day to 369.4 Tons/Day. Since one ton CO_2/Day produces 0.04 tons biodiesel/day, 121.8 Tons CO_2/Day produces 121.8 x 0.04 tons = 4.87 tons biodiesel/Day. At a specific gravity of 0.88 this is equivalent to 4.87 tons x 2,000 lbs/ton divided by 0.88 specific gravity = 11,073 gallons/day.	Generation 1 Ton CH_4 Produces 540 Gallons Of Water From Electricity Generation 51.5 MW Of Electricity Produces 247.5 Tons Of CO_2/Day 51.5 MW Of Electricity Produces 89.89 Tons Of CH_4/Day 332.3 Tons Spirulina Microalgae Produced/Day

<table>
<tr>
<td colspan="2">Since each gallon of biodiesel produced generates 21.12 lbs of volatile solids, 11,073 gallons x 21.12 = 233,856 lbs. Volatile Solids/Day. 233,856 lbs Volatile Solids/Day ÷ 2,000 lbs/Ton = 116.9 Tons Volatile Solids/Day. The 116.9 Tons Volatile Solids/Day from biodiesel production can be converted into CO_2 production by multiplying the Volatile Solids by 12 to determine cu. ft. of methane gas produced. Cu. ft. of methane gas produced ÷ 24 cu. ft./lb = lbs methane gas. Lbs. methane gas multiplied by 1.375 = lbs CO_2 produced or 116.9 Tons VS/Day x 2,000 lbs/Ton x 12 = 2,806,272 cu. ft. CH_4/Day. 2,806,272 cu. ft. ÷ 24 cu. ft./lb = 116,928 lbs CH_4/Day. 116,928 lbs CH_4/Day x 1.375 = 160,776 lbs CO_2/Day. 160,776 lbs CO_2/Day ÷ 2,000 lbs/Ton = 80.4 Tons CO_2/Day.

Since one ton CO_2/Day produces 0.04 tons biodiesel/day, 80.4 Tons CO_2/Day produces 80.4 x 0.04 tons = 3.22 tons biodiesel/Day. At a specific gravity of 0.88 this is equivalent to 3.22 tons x 2,000 lbs/ton divided by 0.88 specific gravity = 7,308 gallons biodiesel/day thus increasing biodiesel production from 11,073 GPD to 18,381 GPD.

Since the basic waste-to-energy process fully satisfies electricity demand the excess methane gas will be beneficially used for:

1. The production of methanol through syngas technology that is used as a required feedstock in the production of biodiesel biofuel,
2. The production and sale of compressed natural gas (CNG) biofuel surface transportation fuel, and
3. The production and sale of renewable natural gas biofuel to the marketplace.</td>
<td>18,381 Gallons Of Biodiesel Produced/Day

58.5 Tons CH_4/Day

plus

38.6 Tons CH_4/Day

= 97.1 Tons CH_4 Produced/Day From Biodiesel Production</td>
</tr>
<tr>
<td colspan="2"><h2>Tilapia Fish Feed Requirements:</h2>The production of tilapia fish is 670 Tons/Day. It takes about 1.2 lbs of feed to increase the fish weight by 1.0 pound. The 670 Tons of finished fish will require 670 x 1.2 or 804 Tons of feed per Day. Spirulina microalgae production at 332 Tons feed/Day will mostly satisfy tilapia fish feed requirements. As the MSW volume increases the volume of Spirulina microalgae will automatically increases. It won’t take much of an increase in MSW volume to fully satisfy total feed requirements.

The preferred initiative is to increase collection of MSW biowastes by excavating area landfills and dumps for the purpose of treating their contents with two-phase anaerobic digestion to increase the associated production of Spirulina microalgae.</td>
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<tr><td colspan="2"></td><td></td></tr>
<tr>
<td colspan="2"><h2>Manufacturing Activities</h2></td>
<td></td>
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<tr>
<td>Self-Biofueled Trains & Locomotives</td>
<td>The shipbuilding/shipbreaking project building will be designed to accommodate the manufacture of 100 self-biofueled trains & locomotives per year at an estimated marketplace price of US$3,500,000/unit. Visible revenue produced = US$3,500,000 x 100 = US$350,000,000/year or ÷ 365 = US$958,900/Day.</td>
<td>US$958,900/Day</td>
</tr>
<tr>
<td>Self-Biofueled Ships</td>
<td>The shipbuilding/shipbreaking project building will be designed to accommodate the manufacture of 10 self-biofueled ships per year at an estimated price of US$250,000,000/unit. Visible revenue produced = US$250,000,000 x 10 = US$2,500,000/year or ÷ 365 = US$6,849,315/Day. Maximum size of manufactured ship = 1,200 ft long x 120 ft wide.</td>
<td>US$6,849,315/Day</td>
</tr>
<tr>
<td>Tidal Generators</td>
<td>The project building will be designed to accommodate the manufacture of 20 tidal generators per year at an estimated price of US$500,000,000/unit. Visible revenue produced = US$500,000,000 x 20 = US$10,000,000,000/year or ÷ 365 = US$27,397,260/Day. Tidal generators will be sold on a fully</td>
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	installed basis.	US$27,397,260/Day
Subtotal Methane (CH_4) Gas Production From Municipal Solid Wastes (MSW):		
	60 Tons/Day Total Volatile Solids x 2,000 lb/Ton x 12 Cubic Feet (CF)/lb = 1,440,000 cu. ft./Day. 1,440,000 cu. ft. CH_4/Day ÷ 24 lbs/cu. ft. = 60,000 lbs. 60,000 lbs ÷ 2,000 lbs/Ton = 30 Tons CH_4/Day	1,440,000 cu. ft. CH_4/Day = 30 Tons CH_4/Day From MSW
Subtotal Methane (CH_4) Gas Production From Biodiesel Processing Wastes:		
	4,659,366 cu. ft. CH_4/Day ÷ 24 cu. ft./lb = 194,140 lbs. 194,140 lbs ÷ 2,000 lbs/Ton = 97.1 Tons CH_4/Day	97.1 Tons CH_4/Day From Biodiesel Wastes
Subtotal Methane (CH_4) Gas Production From Tilapia Fish Farming Wastes:		
	2.8 Tons/Day Total Volatile Solids x 2,000 lb/Ton x 12 Cubic Feet (CF)/lb = 67,200 cu. ft./Day. 67,200 cu. ft. CH_4/Day ÷ 24 lbs/cu. ft. = 2,800 lbs. 2,800 lbs ÷ 2,000 lbs/Ton = 1.4 Tons CH_4/Day	67,200 cu. ft. CH_4/Day =1.4 Tons CH_4/Day From Tilapia Fish Farming Wastes
Subtotal Methane (CH_4) Gas Production From Tilapia Fish Processing Wastes:		
	389 Tons/Day Total Volatile Solids x 2,000 lb/Ton x 12 Cubic Feet (CF)/lb = 9,336,000 cu. ft./Day. 9,336,000 cu. ft. CH_4/Day ÷ 24 lbs/cu. ft. = 389,000 lbs. 389,200 lbs ÷ 2,000 lbs/Ton = 194.6 Tons CH_4/Day	9,336,000 cu. ft. CH_4/Day = 194.6 Tons CH_4/Day From Tilapia Fish Processing Wastes
Total Methane (CH_4) Gas Generation from all sources:		249.9 Tons CH_4/Day
OAT Process Power Generation Potential:		
	249.9 Tons CH_4/Day x 2,000 lbs/Ton = 499,800 lbs/Day. 499,800 lbs/Day x 24 cu. ft./lb = 11,995,200 cu. ft./Day. 11,995,200 cu. ft./Day ÷ 83,780 cu. ft./MW = 143 MW. 143 MW less 15% parasitic digester plant use = 122 MW Net	122 MW Net
	Two-Phase Anaerobic Digester Size Calculations:	
	Volatile Solids = 249.9 Tons/Day x 2,000 lbs/Ton = 499,800 lbs/Day	
	VS:COD = 1:2, COD = 999,600 lbs/Day	
	Organic Loading lbs COD/Day/Cubic Foot = 6	
	Digester Size = 999,600/6 = 166,600 Cubic Feet	
	Digester Size In Gallons = 1,246,335 Gallons	
	Safety Factor = 1.5	
	Digester Size = 1,869,502 Gallons (120' x 120' x 20'H)	
	Estimated Constructed Cost At US$20/Gallon = $37,390,000	
	Building Size: 1 km (3,280') x 1 km (3,280') x 3 - 50' stories high w/3 side double wall construction to accommodate photobioreactor and employee housing = 50,000,000 total sq. ft. of precast concrete construction estimated @ US$1.50/sq. ft. = US$75,000,000. Project building will manufacture its own cement and will purchase a ready mix plant (3 concrete delivery/mixer trucks) to minimize precast concrete panel construction costs.	
	Remanufactured 300Tons/Day Cement Kiln Purchase Cost = US$12,000,000	
	Remanufactured Ready Mix Batch Plant Purchase Cost = US$3,000,000	
	Photobioreactor: 2,200,000 foot long 12"Ø Clear PVC schedule 40 pipe = US$100,000,000 to includes ultra high efficiency long lasting (10 years +) light	

	emitting diode (LED) lighting for photosynthesis @ US$10,000,000 Electricity requirements = 6.0 MW	
	10 MGY Biodiesel Manufacturing Equipment Cost Estimate: US$15,000,000. Electricity Requirements = 0.5 MW	
	Two (2) 110 GPM 4:2:1 Array Reverse Osmosis Equipment Cost Estimate: US$2,000,000	
	Digester Equalization Feed Tank Cost Estimate: $2,000,000 w/Equalization Tank Size = 120' x 120' x 20' H, 2,000,000 Gallon Capacity	
	Potable Water Tank Cost Estimate: $2,000,000 w/Equalization Tank Size = 120' x 120' x 20' H, 2,000,000 Gallon Capacity	
	Anaerobic Digester Feed Tank Cost Estimate: $2,000,000 w/Equalization Tank Size = 120' x 120' x 20' H, 2,000,000 Gallon Capacity	
	Liquefied Nitrogen Storage Tank Cost Estimate: $2,000,000 w/Equalization Tank Size = 120' x 120' x 20' H, 2,000,000 Gallon Capacity	
	Liquefied Natural Gas (LNG) Storage Tank Cost Estimate: $2,500,000 w/Equalization Tank Size = 120' x 120' x 20' H, 2,000,000 Gallon Capacity	
	EAF Steel Recycling Process Equipment Cost: US$3,000,000	
	12,000,000 CFD Compressed Methane Gas (CNG) Equipment Cost Estimate = US$10,000,000. Electricity Requirements = 2 MW	
	221 Ton/Day Liquefied Nitrogen Air Separation Equipment Cost Estimate: $20,000,000. Electricity Requirements = 10 MW	
	Liquefied Nitrogen Delivery Equipment: US$500,000	
	Fish Procurement Cost Estimate = US$5,000,000	
	51.5 MW Natural Gas Fueled Combined Cycle Power Generation Equipment @ US$1,260/kW = 51,500 kW x US$1,100 = US$65,000,000	
	Total Electricity Generation Requirements:	
	For each project building: 51.5 MW (includes projected demand for the next 20 years	
	For Photobiorector = 6.0 MW	
	For Compressed Natural Gas (CNG) = 2 MW	
	For Liquefied Nitrogen (LN2)(LIN) = 10 MW	
	For Liquefied Oxygen = Included with Liquefied Nitrogen	
	For Tilapia Farming = 0.5 MW	
	For General Building use = 2 MW	
	Total Electricity Installed Capacity Requirements = 51.5 MW	
	122 MW potential less 51.5 MW used = 70.5 MW remaining. At 83,779 cu. ft./MW, 83,779 cu. ft. x 70.5 MW = 5,906,420 cu. ft./Day available to marketplace at US$0.70/126.67 cu. ft. or US$32,640/Day as CNG automotive fuel. If sold to a natural gas pipeline the revenue would be slightly less by about 10%.	

Schedule of Project Construction Costs:	
Anaerobic Digester Feed Tank: US$2,000,000	
Biodiesel Manufacturing Equipment: US$15,000,000	
Building Size: 1 km x 1 km x 3 Stories High Constructed Cost: US$75,000,000	
Cement Kiln Constructed Cost: US$12,000,000	
Concrete Ready Mix Plant Constructed Cost = US$3,000,000	
EAF Steel Recycling Process Equipment Constructed Cost: US$3,000,000	
LED Lighting Purchase Cost: US$10,000,000	
Liquefied Natural Gas (LNG) Storage Tank: US$2,500,000	
Liquefied Nitrogen Air Separation Equipment: US$15,000,000	
Liquefied Nitrogen Delivery Equipment: US$500,000	
Liquefied Nitrogen Storage Tank: US$2,000,000	
Methane Compression Equipment: US$10,000,000	
Photobioreactor: US$100,000,000	
Potable Water Storage Tank Constructed Cost: US$2,000,000	
Power Generation Equipment: US$56,650,000	
Reverse Osmosis Equipment: US$2,000,000	
Fish Procurement Costs: US$5,000,000 Electricity Requirements = 2.0 MW	
Tilapia Fish Farming Acreage: 50 hectares x 24' H Tilapia Fish Farming Production: lbs/day = 281,400 of tilapia filets Tilapia Fish Farming Electricity Requirements = 0.5 MW Fish Processing Equipment: US$500,000	
Two-Phase Anaerobic Digester: US$37,390,000	
Subtotal Project Construction Costs: US$353,540,000	
Add 15% Contingencies @ 53,031,000 = US$406,571,000	
Total Project Construction Costs:	US$406,571,000
Project Visible Cash Flow Revenue Streams:	
From Sanitary Wastewater – US$0.00	
From Municipal Solid Wastes – US$0.00	
From Agro Wastes – US$0.00	
From Animal Wastes – US0.00	
From Electricity: 44 MW x 24 = 720 MWh/Day @ US$45.00/MWh = US$47,520/Day. This amount of electricity generation will provide the average demand load of the participating communities for the next 20 years.	US$47,520/Day
From Biodiesel: 18,381 GPD always priced at 80% of existing marketplace retail. Current retail is US$1.67/gallon. US$1.67 x 80% = US$1.34. 18,381 x US$1.34 = US$24,630/Day.	US$24,630/Day
From Liquefied Nitrogen (LN2)(LIN): 244,003 GPD priced at US$0.50/gallon = US$122,000.00/Day.	US$122,000/Day
From Compressed Natural Gas (CNG) Fuel:	US$32,640/Day
From Fresh Tilapia Filet Exports: US$1,226,900 at a sell price of US$2.18/lb	US$1,226,900/Day
From Self-Biofueled Trains & Locomotives:	US$958,900/Day
From Self-Biofueled Ships:	US$6,849,315/Day
From Tidal Generators:	US$27,397,260/Day
Renewable Energy and other Credits based on estimated 36 MW Project Power Generation:	
One Certified Emission Reduction Credit = 1 Tonne CO_2 Reduction. 51.5 MW Project Power Production x 24 hour/Day = 1,236 MWh/Day.	

		1,236 MWh/Day x 1,100 lbs CO_2 Reduction (using natural gas)/MWh ÷ 2,000 lbs/Ton = 680 Tons/Day = 248,000 T/Year x 2,000/2,204 = 225,226 Tonnes/Year @ US$20 (range of US$20-US$40) = US$4,504,000/Year ÷ 365 = US$12,341/Day for years 2008-2012 delivery.	US$12,341/Day
Total Project Revenue Streams:			**US$34,258,916/Day**
To the extent that electricity is generated, the combustion off gases (CO_2, NOx, N_2, and H2O) will be entirely used for Spirulina microalgae production. After Spirulina microalgae production has occurred the remaining Nitrogen gas (N_2) will be liquefied and sold to the marketplace. The remaining N_2 gas stream will also contain Oxygen gas (O_2) due to the respiration of microalgae during their production in the same manner that trees and plants give off oxygen. This oxygen will be simultaneously liquefied during the liquefaction of N_2 and subsequently distilled off, compressed, and subsequently used internally as a welding gas, to enhance cement manufacturing, to enhance fish farming, and for smelting iron into steel. Some of the Nitrogen Gas will be used as a protective blanket gas in the production of methanol through syngas technology. The methanol is produced as a required feedstock in the production of biodiesel.			

Additional Notes:

1. Land Requirements: Estimate 300 hectare for Project Building and/or 1,200 hectare for Shipbuilding/Shipbreaking Project Building.

2. Time to design-build-install-operate either above option is estimated at 36 months.

3. Lighting for tilapia must be a daily cycle of:
   7.5 hours of total darkness
   0.5 hours of sunrise (begins at 6 a.m. w/3 ft-candles)
   15.5 hours of daylight (max 10 ft-candles)
   0.5 hours of sunset (begins at 10 p.m. w/3 ft-candles)

4. Sufficient project building room remains to add a 10,000 beef cattle operation, a 10,000 milker dairy farm, and significant poultry operations along with all of the associated processing equipment to produce value added products consisting of dressed beef, milk and other dairy products, broilers, and eggs. All of these activities represent future economic development activities.

5. WSE Engineering Drawing Nos. S-9900-18, S-9900-19, and S-9900-20 are attached.