Power Plant Project
Municipal Solid Waste Conversion to Briquette
(300 T/D MSW)
Gasification & 8.8 MW Power

For:

Your country

Client name and address
Introduction:

This is a 8.8 MW Power Plant Project Proposal, which is presented to address the disposal of Municipal Solid Waste (MSW) and converting that into Electricity.

The “Grand Project” could be for any multiple of 4.4 MW power project, if client wants to expand the project by adding 4.4 MW to this plant.

For example, if a community produces approximately 600 Tons of MSW per day. This amount of MSW will be enough to produce 17.6 Mega Watts electricity. To achieve 35.2 MW or 44 MW, eight units or ten units of 4.4 MW will be installed together. In case of future expansion, 4.4 MW unit could be added to the existing plant.

MSW is posing a hazard to the environment and to the people if it is burned in open pits or piled in dumpsites. Furthermore as reported in the media; absence of a proper garbage disposal system has caused a number of health and social problems.

The demand for electricity is always projected to increase due to the social and economical developments happening in the Country.

CHAMCO, Inc. proposes to build facilities that will help to alleviate these problems.

CHAMCO will build facilities that convert MSW into refuse derived fuel Briquette (RDF) and Power Plants using RDF as fuel in Gasification units and generate Electricity.

In this proposal, MSW first will be sorted. The constructional waste, ferrous & nonferrous wastes, glass pieces & other noncombustible ingredients will be separated. Sorting machine with atomized conveyor & magnetic separators will be installed before subjecting the biomass to RDF Briquetting machines.

Two gasification unite coupled with units of 4x3.6 MW generators requires approximately 200 T/D briquette, which is derived from approximately 300 Tons of wet and low calorie MSW.

In some cases we might use 6 units of generator sets with lower capacity, if transportation of bigger generators would have difficulties.

If MSW is dry and rich, then the excess briquettes, with caloric value of 3,000 Calories per Kg. could be sold in the market or increasing the power plants capacity in the future.

We do recommend adding 10% coal or other high calorie biomass to the MSW Briquettes for better operation of the gasification.
**Scope of Work:**

Upon award of the contract, CHAMCO, Inc. will furnish a turnkey job for the MSW processing units, Gasification and Power Plants.

**Project Cost:**

The total cost of the Sorting and Briquette making facilities, Gasification and Power Plants including; survey, feasibility study and planning, engineering, procurement, contracting, test, commission and training is approximately $4,000,000 per Mega Watt (four million USD per 1 MW).

Therefore, cost of this 8.8 MW power plant (with 14.4 MW generators rating) will be: $35,200,000 (thirty five million & two hundred thousand US Dollars).

**Note:**
For this 8.8 MW project, the total generators rating will be 14.4 MW, but the output is around 8.8 MW.
This is due to the fact that synthetic gas (syngas) has less than half the caloric value of the natural gas, and even much less than Biogas. Therefore a natural gas engine, which is rated for 3.6 MW, after modification for syngas will generate 2.2 MW.
This is our unique know-how that we modify natural gas engines to run with syngas.

**Project Timeline:**

Following land acquisition, obtaining all permits, contacting with all local authorities, and award of contract, the following timeline is to be expected:

- Site assessment and engineering 3-4 months (according to the specific conditions encountered)
- Procurement 5-8 months (according to the specific units required)
- Installation of the units 6-9 months (according to conditions on the ground)
- Commissioning 3-5 months (according to the type of units specified)

After synchronization in the commissioning phase, there will be a 3-month operational phase with CHAMCO technicians on location to handle training and operational details that may arise. Total time from award of contract to completed system is 17-26 months depending upon conditions encountered on the ground.
Facility Process Overview:

- MSW will arrive at the MSW processing facility location around the city. This facility can be located either at the generation facility or another location remote from the generation facility.
- Garbage will be dries and sorted. Recycling can be done at this stage.
- Garbage will be sized and processed into RDF.
- The RDF will be used at Gasification units to produce Syngas.
- Syngas directly will be used in to generate electricity.

Cost Benefit Analysis:

We provide a system to convert solid waste to electric energy.
The main considerations are:

1. Effective use of the landfill for real estate values
2. Environmentally sound disposal of the waste
3. Employment of local population
4. Production of electricity

The Power Plant will be located where the transmission line and substations are. This location might be different from the MSW dumpsite, where briquettes are produced. In that case transporting briquettes to the power plant is the others responsibility.

Landfill sites can become prime real estate in the long term for commercial, civic, or residential use. This fact alone may generate enough capital to more than pay for power generation, depending on location. The long-term effects of landfill sites are harmful gases that pollute the air, the danger of leakage into the underground water tables, and a potential setting for breeding diseases of all types.
Project Income:

A – “Power Purchase Agreement” (PPA) for electricity, which the national grid pays to the owner of the plant. For calculation purposes we will use 15 cents per kilowatt hour (KWH).

Assume that the PPA for 8.8 MW of electrical power generation at a fixed price is $0.15 per KWH.

Sale of electricity =
8.8 MW (net power generation) x 1000 x 24 (hours) x 365 (days) x $0.15 x 0.85 (Efficiency Factor) = $11,700,856 gross income from power generation annually.

B - Tipping Fee: Municipalities pay the plant operators/owners a tipping fee for each Ton that they receive and handle per day. The average tipping fee is around $40 per Ton in the US. We will assume a tipping fee of $20 per Ton:

Tipping Fee = 300 (T/D) x $20 (per Ton) x 365 Days = $2,190,000 Annually.

D - Real Estate income could be calculated by pricing 80% of the present area of the landfill, after this land is converted to parks and property for residential and industrial developments. This benefit and income is also ignored at this time.

Project Costs:

A - Plant Turnkey Cost includes Engineering, Procurement Contracting, Insurance, Marketing and Commission etc.

Cost of the Project: $35,200,000

For example, a plant in South China, which converts 1000 Tons per day and generates 20 MW, has cost the Chinese more than $86m (Documented from the web). But the last cost estimate at 2005 was $120m. That is around $4.5 Million per MW. Therefore the most conservative cost estimate of a 10 MW power project would be $45,000,000. CHAMCO, Inc. quotes: $35,200,000.

B – Adding coal to the Fuel. Adding 10 to 15% coal to the MSW Briquettes if the price of coal is low, could increase efficiency of the gasification units. This option should be considered in the future.

C - Operation & Labor Cost. For this project of 10 MW power plants and RDF plant, a work force of about 6 technical and 14 non-technical workers are estimated. Assuming $80,000 per technical and $40,000 per non-technical works, the approximate labor costs will be: 6 x $80,000 + 14 x $40,000 = $1,040,000

CHAMCO proposes to build a facility to process 300 Tons of garbage per day and generate 8.8 MW by using RDF. The total estimated cost is $35,200,000.
Summary:
- Assume 4 years Return On Investment (ROI)
- Cost of facilities $35,200,000
- Income from PPA $11,700,856
- Income from tipping fee $2,190,000
- Labor costs $1,040,000
- Maintenance costs $140,000
- ROI = $35,000,000/(11,169,000 + 2,190,000 − 1,040,000 − 140,000) ~ 3 years

Note:
This offer is for a direct sale.

In case of Financing or BOT or BOOT the financing could be arranged and investment costs will be added to this offered price.
Municipal Solid Waste Conversion to RDF

The Municipal Solid Wastes (MSW) should be sorted first into recyclable and combustible components. This is a typical sorting facility and Briquette making plant. The Bioreactor is used if composting or fertilizer unit is added to the system.

Depending to the conditions of the MSW, if the moisture is high, it should be dried. The combustible component of the MSW is turned into RDF (Refused Derived Fuel) pellet by shredding, crushing, electromagnetic separations.

Pictures of few equipments are shown here:
Below is the schematic view of the RDF plant. Adding Solar Greenhouse and Rotary Kiln should be added if MSW is very wet:

To see the animation of this picture visit www.CHAMCO.net

The final product is shown here. These briquettes have a caloric value of 3,000 Calories per Kg, which is the fuel for Gasification unit:
Gasification

Gasification is a flexible, reliable, and clean energy technology that can turn a variety of low-value feedstock’s into high-value products and can provide a clean alternative source of base load electricity.

Gasification has been reliably used on a commercial scale worldwide for more than 50 years in the refining, fertilizer, and chemical industries, and for more than 35 years in the electric power industry.

GASIFIERS- (Pyrolyzers) are receiving backing & subsidies from various Governments the world over. They utilize any type of biomass including MSW, coal, waste wood, sawdust, furniture scraps, bagasse, rice husk, coconut shells, poultry litter, plastic, rubber, tires, or any other combustible material.

Ultra clean gas is fed into the engines with the help of a microprocessor based, oil to gas conversion system. When a load is activated the dual-fuel mode of operation of the engine will start automatically at 85% gas and 15% furnace oil, for a short duration then reverts back to 100% gas mode when the load becomes constant.

The exhaust emissions of the engine can be used for a Waste Heat Recovery Boiler. 800 Kg Steam at 7kg. Pressure per hr. can be obtained. This excess heat can be put to use for other thermal applications.

In the updraft gasifier, moist biomass fuel is fed at the top and descends though gases rising through the reactor. In the upper zone a drying process occurs, below which pyrolysis is taking place. Following this, the material passes through a reduction zone (gasification) and in the zone above the grate an oxidation process is carried out (combustion).

In a coal gasification our coal gasifier consumes 418 Kg coal with 6000 Kcal/Kg caloric value to produce 1 MWH. Therefore:
1 MW coal gasification power plant requires 10 Tons of coal / day.
Since the caloric value of MSW Briquettes is about 3000 Kcal/Kg, therefore:
4.4 MW MSW gasification power plant needs about 100 Tons of MSW Briquettes / day.
We assume this 100 Tons of briquettes will be derived from more than 150 Tons MSW in the proposed site.

Gasification Operation:

![Diagram](image)

To supply air for the combustion process and steam for the gasification process, moist hot air is supplied at the bottom of the reactor. Combustible gas at a low temperature (because of the evaporation of moisture in the drying zone) is discharged at the top of the reactor, and inert ash from the heat-generating combustion process is extracted from the reactor bottom through a water lock.

The output of the gasification unit is dry syngas, which directly injected to the natural gas engine, modified by us.
**Breakdown of the price for a 4.4 MW Gasification power plant using MSW as Fuel**

**Part A:**

- Basic and Detailed Engineering
- Shipping to the site
- Storage at site
- Mobilization
- Civil Works
- Mechanical Works (including structure & piping)
- Electrical and Instrumentation
- Tests
- Commissioning
- Training and operation for three months
- Spare Parts

Note: Import Duties, Insurances and Taxes are not included.

**Total Cost for Part A:** $3,500,000

**Part B (Turning Garbage around 150 T/D into Briquettes):**

- 4-man sorting system: 25' long x 36" wide picking table with four 16"x60" chutes with 52" clearance for gaylords or dumpsters. Walkway is 23' long x 33" wide with steps. Powered by 1-hp three-phase electric motor. Equipped with 20' x 36" in feed conveyor.

- Permanent Crossbelt Magnet

  WWR CBS permanent crossbelt magnet powered by a 3/4-hp three-phase 220/480 volts electric motor. Belt is made of heavy-duty rubber with cleats spaced according to application. Maximum belt speed is 155 FPM. 74" long x 18" belt surface, 44" long x 16" wide magnet. Ideal for recycling operations and widely used in the sorting of co-mingle (steel cans, bottle caps, etc).

- 18' Incline Conveyor

  This covered conveyor is 18'-6" long and is powered by a 3-hp, 208-230-460 volt, three-phase electric motor. It is equipped with a 25" belt, with 2" cleats on 24" centers. The enclosure above the belt is 24" high x 28" wide.

- Eidal Model 72 X 41 slow speed-high torque shredder,
Equipped with a KYB 525S hydraulic pack with Dennison pumps and a powered by two (2) 75 hp, 230/460 V 3 phase electric motors. Throat opening is 72" wide X 41" deep with a hopper opening of 92" X 76", 24 3 inch knives and controls.

Eidal Model 400 Vertical Grinder

This grinder is powered by two (2) 200-hp, 460 volts, three-phase electric motors and is 6' in diameter. Hopper opening is 82" tall x 70" wide. Can process 12-25 TPH of wet or dry solid waste, wood & damage material, pallets, and electronics, scrap metal clips up to 3/16" thickness, tin cans, and non-ferrous metal. Reduction size can be varied to suit material or end user without screens or grates through progressive grinding.

Surge Bins

Heavy 10 gauge steel construction, Sight Glasses, Drain Tube, and Hinged Top Access Door, with openings for High and Low Level sensors, High Legs for Discharge, single or tube outlets, slide gates, level sensors, safety ladders & top perimeter hand rails and more.

Andritz Sprout Bauer Pellet mill

The pellet mill includes: Stainless steel pelleting chamber door 2 roll roller assembly 1 used pelleting die 400 HP Motor, Heavy duty pellet chamber on motorized frame for easy access Separate inlet screws achieving effective distribution of product to the press rolls, Safety stop Taper fit die Renewable wear rings Note: All the equipments of Briquette Plant are assembled and made in USA.

Total Cost for Part B: $4,000,000

Part C (Gasification Unit)

Air Blower with a 12.5 KW motor Ash Pan with manual / automatic circular movement by hydraulic Pump with 3.5KW motor Gasified Reactor w. refractory w. an over pressure release valve Refractory & a double wall for Water & steam Jacket, Steam safety release valve. Fresh water circulation by a 3.5 KW mono-block pump set. Hopper for charging of fuel at the top Motorized Conveyor Bucket with channels for upward & downward motion for charging of fuel. 2.25KW motor. Staircase with Platform for inspection. Venturi type Cyclone Filters with 3.5 KW. Mono-block Pump set for water circulation
Four Pipe filters with showers for cooling of Gas & washing of Particulate impurities of Producer Gas. With 3.5 KW mono-block Pump set for water circulation.
Four Stage Dust & Tar Separators- outlet pipe & a valve fitted in bottom for Tar removal. Over pressure release valve fitted in each D & T separator
Water Tank- Common for all filters & Dust & Tar separators. Solid impurities removed as sediments. Water is re-circulated in cooling tower
Cooling Tower fitted with 3.5 KW mono block Pump set for water circulation
De-moisturizer for Producer Gas with a 3.5 KW Pump set for water circulation over condenser
Humidity Analyzer to check moisture content
Gas temperature meter
Gas flow meter with totalizer
Gas Controller
Note: The Gasification equipments are mainly from India and could be assembled in the US if needed.

Total Cost for Part C:      $5,000,000

Part D (Generating Unit)

Engine, modified & converted for Producer Gas mode of operation with microprocessor controlled actuator type Governors
Mounting frame for Alternator & Engine
On-line Gas Analyzer with sampling system

List of Auxiliaries with the Engine in power plant

<table>
<thead>
<tr>
<th>S.n</th>
<th>Part Name</th>
<th>Qty</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Heat Exchanger tube type</td>
<td>1</td>
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<tr>
<td></td>
<td>Lube Oil Cooler- tube type</td>
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</tr>
<tr>
<td></td>
<td>Lube Oil 4-way Motorized filter</td>
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<tr>
<td></td>
<td>Lube Oil Line Filter</td>
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<td></td>
<td>Lube Oil Magnet Filter</td>
<td>1</td>
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<tr>
<td></td>
<td>Lube oil Separator MAPX205 Clarifier, MAB-103 Centrifugal Purifier</td>
<td>1</td>
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<td></td>
<td>Lube oil drain pump 2.5”x2.5”, 3HP gear type</td>
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<tr>
<td></td>
<td>Lube Oil Priming Pump 4”x4” 29 HO (Gear Type) 7.5 H.p.</td>
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<td></td>
<td>Lube oil Main pump either inbuilt or separate.</td>
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<tr>
<td></td>
<td>Rocker lube oil tank with gauge glass- 100 Ltr. Capacity</td>
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<tr>
<td></td>
<td>Rocker Arm lube oil motorized, gear type pump 2.5”x2.5”, 5 H.P</td>
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<td>Raw water Pumpset- 6”x6”(150KL/hr) with 10 H.P. motor</td>
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<tr>
<td></td>
<td>Jacket water pump set- 6”x6”(150 KL/hr) with 10 H.P. motor</td>
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<td>Make-up Water filling pump- Drain to Main Tank: 2.5”x2.5”, 5 H.P Mono-block pump set</td>
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<td>Cooling Tower- 150 KL capacity</td>
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<td></td>
<td>Air Starting valve</td>
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<tr>
<td>S.no</td>
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</tr>
<tr>
<td>a.</td>
<td>Turbo Charger</td>
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<tr>
<td>b.</td>
<td>Head Complete with Rocker Arm</td>
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<tr>
<td>c.</td>
<td>Piston</td>
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<tr>
<td>d.</td>
<td>Liner</td>
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<tr>
<td>e.</td>
<td>Ring Set</td>
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<td>f.</td>
<td>Main Bearing</td>
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<td>g.</td>
<td>C.R. Bearing</td>
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<td>h.</td>
<td>Thrust Bearing</td>
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<td>i.</td>
<td>Main Bearing Housing + Cap</td>
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<td>k.</td>
<td>Fuel Pump</td>
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<td>l.</td>
<td>Connecting Rod</td>
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<td>m.</td>
<td>High Pressure Pipe</td>
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<tr>
<td>n.</td>
<td>Safety Valve</td>
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</tbody>
</table>

Consumables:- ‘O’ Rings, Iron Packing, Iron Channels

**Total Cost for Part D:**  $5,000,000

**Total Cost of the equipments (B+C+D):**  $14,000,000

**Grand Total Cost 4.4 MW Power Plant using garbage as fuel (Turnkey):**
$17,500,000 (seventeen and half million US Dollars)

For 8.8 MW the total cost is $35,200,000
Attachment Drawings:

The clean producer gas thus produced is directly fed into the Engine through the Gas Conversion Kit innovated by us.

FEATURES & ADVANTAGES

- The producer gas generated in the Pyro-Gasifier has higher Calorific Value in the range of 1000-1400 K.Cal/NM3 which is suitable for getting high flame temperature in the range of 1200-1400°C as required by most of the thermal processes.

- Tar Content in the gas by pyro-gasification is minimal as the gas temperature is @150°C, thus delivering gas of higher calorific value to result in higher gasification efficiency and lower coal consumption rate.

- There is no effluent output in the process. The washing of gas is done with hot (70-80°C) recirculated water which separates out the solid impurities & Tar to some extent in liquid form like FO which can be burnt in the furnace for giving extra energy to combustion.

- The In-line ESP's or Electro Static Precipitators innovated by us, totally remove Tar from the gas produced during the process of pyrolysis, and the tar thus separated from the Producer gas can be sold in the market or can be used in the Furnace for heating.

- Due to cleaner gas, the occurrence of choking of the burner filter and duct pipes is negligible, resulting in increase in productivity and minimal cleaning interruptions in the process.

- Extremely Low Particulates and smoke emission, even lesser than Pollution Control board norms, due to the complete direct firing of Producer Gas.

- Worldwide accepted, subsidized, environment friendly Renewable Energy technology.

- Very early payback period.
Pyrolyzer Process Flow

Diagram

TITLE:

SCALE: Not to scale

DATE: 27/4/Aug/2009

TOLERANCE ±

1. Gas Analyzer
2. Blower
3. Water Valve
4. Water Tank
5. Four Pipe Filter
6. Cyclone Filter
7. Power Distribution
8. Pyrolyzer Gas Producer
9. CHD
10. Gas Controller
11. Fuel Ford
12. Gas Power Gen Set 2
13. Conveyor Bucket
14. Ash Pan
15. Oil Tank
16. Test Line
17. Molarizer
18. Hot Steam Line
19. Hot Water Line
20. Joint

DESCRIPTION:

1. Hot Vapour/Gases
2. Biogas/Biomass
3. Water
4. Safety/Manual Valves
5. Pipe Lines

S.NO. DESCRIPTION