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Abbreviations

BOP	Balance Of Project (not a BET deliverable)
Btu	British thermal unit
CO ₂	Carbon Dioxide
EFW	Energy From Waste
e.g.	example
FS	Feedstock
ITT	Invitation To Tender
kW	kiloWatt (electric / hour)
kWt	kW (thermal / hour)
L/m	Liters / minute
MJ	MegaJoules
MBTU	million Btu / hour
MSW	Municipal Solid Waste
N ₂	Nitrogen gas
NO _x	Nitrogen oxides
O ₂	Oxygen
O&M	Operating & Maintenance
ORC	Organic Rankin Cycle
SRM	Specified Risk Materials (including BSE prion)
tpd	tonne / day
USA	United States of America

Symbols

~	proximate
η	BET efficiency above 150C hot gas temperature

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1 Quotation Summary

Baleen International Inc. submits this quotation to Asian Development Bank for the supply of a **BET 21-S** (750,000 BTU \ 220 kWt) organic materials recycling capacity BET system that produces a low particulate hot gas stream and ~157 kilogram per day of dry sterile ash from ~1,750kg/day of MSW [~33% water and 12.34 MJ/kg (5,303 Btu/lb) caloric]. The hot gas stream could be used for any one, or combination of, electric power generation, district/facilities/ventilation air/water heating, water purification, and more; at owner's discretion. BET systems produce no liquid wastes. The BET 21-S system will be built in Missouri, USA. It will then be disassembled into sections suitable for/loaded onto a BOP container(s) thereat. A BET representative will (during 1 consecutive week at site) inspect the BET 21-S system installation, supervise start up/commissioning thereof, and train owner's BET system O&M personnel. BET deliverables include: an emissions compliance warrantee; 12 month operating license for the BET W2E system, 12 month automatic useable energy monitoring/recording, and; 12 month BET system O&M support/troubleshooting. Barring disruptions beyond its control, BET will load its BET 21-S system deliverables onto a BOP container(s) at a site in Missouri, USA within 2 months of the date it receives ADB's Milestone 1 payment. **This USD\$59,700.00 quotation is subject to revision after 26 April 2020 if the first Milestone Payment is not complete.**

2 BET System Technology

The BET Technology is currently being used in over 100 applications across North America. This technology has proven versatile and effective on a wide range of feedstocks with high moisture content. The basis of the BET system has been proven over many decades using pure organic or mixed municipal solid waste feedstock in both off-grid and newer leading-edge technology applications.

The basic operating premise is based on heating the feedstock to the point that flammable gases are driven off of the solid materials. These gases are ignited when heated to the correct ignition temperature and combined with the proper amount of combustion oxygen. Under proper operating parameters, complete combustion of the gases occurs resulting in a clean burn.

The BET System accomplishes this process by a simple and effective manner. First, the shredded (for this B21S System – a feedstock of <5cm) feedstock is gravity fed into the primary combustion chamber through a hopper. The feedstock flows onto a series of inclined step grates and horizontal toe grates. A solid fuel bed of hot embers builds up on the grates. Additional fuel is added, which forms a layer over the hot fuel bed. Primary combustion air enters through the draft doors and passes through the fuel bed. The gases from the fresh layer of fuel are distilled by the primary air stream passing through the fuel bed, creating volatile gases in the combustion chamber. Preheated secondary air entering from the top of the system provides the oxygen and turbulence needed to ignite such gases, providing complete combustion.

The BET System builds on a reputation of being extremely simple to operate, having only three (3) types of adjustments available. Adjustments are made based on the characteristic of the fuel feedstock, and how much air is able to pass through the feedstock. As a rule of thumb, the amount of primary air should be rather limited, having only the amount necessary to maintain the creation of gas.

The BET System utilizes very limited draft in its operation. The unit is designed to create combustible gases with the introduction of primary air, and the combustion of those gases with secondary air. It is best to error on the side of having too little draft than too much draft, particularly primary draft.



Baleen International Inc will ensure proper onsite training is provided to the Owner’s O&M personnel during the commissioning to ensure a clear understanding of the fundamentals.

Following combustion, all remaining feedstock will be returned as a sterile dry ash product which, depending on its properties has proven to be useable and marketable in a number of applications. It should be noted that minerals (dirt, rock, etc) will not burn in the BET System and will flow through into the dry ash by-product. Excessive amounts of minerals will reduce the quality of combustion and may cause other operational issues; for this reason efforts should be made to reduce the mineral content in the feedstock.

The BET System will be completed with a full PLC Touch Screen integrated control package. This control package will include both Ethernet and Wi-Fi connection capabilities, although it should be noted that Ethernet is the preferred option for stable connectivity and remote support. In addition, remote monitoring will be made possible by fully integrated smart phone application.

3 Basis of Quotation

1. While a comprehensive waste audit and analysis of the MSW feedstock has not been completed, BET system feedstocks will look for a typical MSW blend shredded to 50 mm or less, containing a minimum moisture content of 25%, with the composition generally as follows:

BROAD CATEGORY	MATERIALS	RESIDENTIAL (%)
Wet Putrescible	Food Waste	22.6
	Yard Waste	16.9
	Textile/Leather/Rubber	2.1
	TOTAL	41.6
Dry Combustible	Newsprint	6.8
	Cardboard	3.3
	Mixed Paper	21.5
	Wood	0.7
	TOTAL	32.3
Plastic	Plastic	11.4
	TOTAL	11.4
Inert	Metal	4.5
	Glass	2.9
	Ceramic/Ashes/Fines	2.1
	TOTAL	9.5
Other	Other	5.2
	TOTAL	5.2
TOTAL		100

2. Feedstock for the BET System has no high hazard contents (e.g. radioactive materials, mercury-fluorescent light bulbs/tubes, arsenic, lead, sulphur, batteries, chlorine-other halogens, and like materials requiring special consideration) that may cause BET emissions to exceed governing authority emissions limits.
3. BET system feedstocks being sheared (by BOP equipment) as may be required/coarse shredded (by BOP equipment) down to an equivalent 50mm cube volume (maximum) lump size before loading (by BOP equipment) into feedstock hopper. The BOP estimated shredder electrical load is based on shredding the entire ~1750 kilogram per day of MSW in a 10 hour shift with shredded materials accumulated as required for continuous BET operation (at design capacity) for day shift plus remaining 14 hours each day.
4. BOP work includes:
 - a compacted surface or foundation engineered to carry skid mounted BET system weight (~1.80 tonne plus contents) within specified tolerances (final BET system weights, deflection limits and supports' footprint provided during detailed design), at elevations designed to minimize potential for BET system water damage under worst anticipated flooding conditions;
 - heated (minimum temperature 5C) weather enclosure for BET system feedstock hopper, delivered feedstock containment/handling,
 - a 9.3 m², heated/ventilated/mechanically cooled (12C minimum, 27C maximum room temperature) electrical and control room for the BET 21-S control system;
 - feedstock shear and coarse shredder with a 50 mm screen;
 - ladders, platforms, stairs, handrails if/as desired-required for BET system operation, testing, and maintenance access;
 - supply/installation of scales/other methods of measuring feedstock weights delivered to site and personnel to document dates received, predominant type (category, e.g. MSW, construction wastes, plastics, tires, tree cuttings/other vegetation, etc.) of feedstock, and; delivered weights.
 - a single or three phase, 250W / 220 volt (optimized during BET system detailed design) electric power supply for BET deliverables, and;
5. BET will have unrestricted access for remotely/randomly observing real time BET automation system status 24/7/365 (and operating data history). BOP work includes providing remote (internet connection or like acceptable to BET) 24/7/365 access thereto.
6. BOP/owner supplies propane (or like gaseous fuel) for preheat torch (~15 kg of propane required for each BET system start up).
7. BOP will perform testing if/as required to attain/maintain BET system operating license.
8. Pilot project site, being an owner designated location, that does not unduly complicate/encumber BET system licensing (e.g. in/near a residential area).
9. BOP providing insurance for all work done on project site; naming Baleen International Inc and its employees/contractors/representatives as coinsured.

4 Added Value

- 4.1 Provided additional fuel feedstock maintains a stable consistency less than 50mm to allow continuous gravity flow with <65% moisture content, BET System additional feedstocks capability includes (as delivered, without modifications):
- coarse shredded, metal entrained MSW including whole mattresses/sofas/reclining chairs/steel toe footwear/and like
 - medical waste, past date pharmaceuticals, petrochemical industry wastes, and like
 - industrial wastes [tires, spent lubricants, PCBs, benzenes, plastics/composites (including films/bags/drinking straws/wind farm end-of-life turbine blades/old boat hulls), chemicals, and like]
 - raw sewage (e.g. Baleen Filter) screenings, dilute sewage plant sludges, septic tank-holding tank-portable toilet contents, landfill leachate, and like
 - refuse derived wastes (demolition, construction, disaster, auto shredder residue, and like)
 - utility poles and rail ties
 - forestry/agricultural industry wastes [bark, sawdust, diseased trees/vegetation (Dutch Elm/ Emerald Ash Borer culls, vegetation containing urushiol {e.g. destroys poison ivy, etc. without risk of inhaling smoke https://www.sciencedaily.com/terms/poison_ivy.htm}), contaminated grains, grain bags, herbicides/pesticides (including plastic containers), and like]
 - agri-food industries waste (fishery/slaughterhouse offal, deadstock, meat & bone meal, diseased animal carcasses, manures, SRM, culls, off-spec product, and like)
 - contraband/mined landfill materials
- 4.2 Converting conventionally recycled organics directly into energy where BET recycling cost/carbon footprint are less than existing community recycling programs [offsets include additional (beyond BET systems) carbon footprints, site size, parasitic loads, requisite equipment-vehicle-infrastructure acquisition/build/maintenance/licensing/insurance, associated management/payrolls/ burdens/cascading feedstock conversion efficiency losses/product fuels consuming equipment emissions, etc.]

5 BET Feedstock Comparisons Table

The BET can process any planet organic up to ~65% water content. It has a 15 year economic life when operated and maintained compliant with BET' and component/materials suppliers' manuals/instructions.

BET systems automatically adjust to rapid/random variations in feedstock caloric/water contents within following table extremes. Examples of BET 91-S system performance with various feedstocks (**proximate values**):

Feedstock (FS)	FS lb/h	FS H2O	FS MJ/kg	WW L/m	ash (dry tpd)	outlet temp.	Avg. annual η^*
ALL plastic	226	5%	30.9	3.9	0.0	1,285	62%
MSW (per ITT)	566	33%	12.3	2.1	0.63	1,285	63%
ITT MSW, max. H2O	1,024	63%	6.8	0.0	0.35	1,028	54%
ITT MSW, 40% (minimum feed rate)	222	33%	12.3	0.0	0.25	1,285	63%



* Portion of 3,000,000 Btu/hour (879 kWt) feedstock energy output as useable energy.

6 Baleen International Inc Inputs

1. Invite ADB representatives to observe manufacture of BET 21-S module and loading components/subassemblies onto BOP's containers at manufacturing site.
2. Instruct ADB representative(s) in BET system re-assembly on site.
3. Provide a Baleen representative on site for approx. 1 consecutive weeks (pending if refractory is installed at site)(plus remote support / consultation for duration) to inspect assembled BET 21-S system, supervise start up/commissioning, and train owner's BET system O&M personnel.
4. Make refinements as may become necessary for optimizing BET performance to owner's feedstocks.
5. Supply equipment/personnel/materials required for commissioning to demonstrate quoted performance and facilitate Baleen acceptance.
6. BET O&M support/troubleshooting during 1 month project commissioning period.

7 Asian Development Bank, (ADB) Inputs

1. Milestone payments to Baleen per clause 9.2.
2. Insure and transport BET system deliverables, on BOP's container(s), from manufacturer site in MO to **Philippine** site.
3. Perform the function as Project Manager to coordinate between Baleen International Inc and BET System owner, to ensure completion of BOP requirements.

8 Baleen International Inc Deliverables

- a. Design BET System for outdoor operation (except electrical and control panels- contents/computer/operator interfaces, feedstock hopper, and feedstock lift/injection screw) over outdoor temperature range of -35C thru +35C.
- b. Steel beam skid mounted BET module (Baleen deliverable) for installation (by BOP) on (by BOP) compacted surface or engineered structural foundations.
- c. BET system components/features:
 - 1,350°C continuous operation rated ceramic refractory-insulation envelope with self weathering steel shell from organics vaporizer inlet thru retention chamber outlet;
 - feedstock screw back burn protection;
 - feedstock organics vaporization chamber;
 - ash air lock and discharge control assembly;
 - secondary, high temperature, organic vapour combustion chamber;
 - chamber combustion air inlets/dampers;
 - emergency thermal vent off organics vaporizer, and;
 - retention chamber to contain 1,000°C equivalent combustion gasses for ~5 seconds wherein heat is neither added to nor extracted from the hot gas stream.
- d. Electric actuators.
- e. Prewired electrical and control systems equipment, panels, and interconnections.
- f. Remote accessible (SCADA), computer-based control system with operator interface and software for continuous, unattended, auto-modulating 24/7 down to ~40% of design.



- g. A moving “recent past 12 months” date/time correlated record of useable energy output and BET system operating/alarm parameters/signals/operator adjustments/setpoints (at 10-minute maximum intervals) for historical reference and correlation with feedstock consumption.
- h. BET system shop drawings, O&M manual and recommended spare parts list (in electronic format).
- i. 12-month operating license for BET EFW system.
- j. Warrantee of emissions compliance with governing authority regulations while BET 21-S is being properly used as an EFW system. Does not apply during emergency exhaust situations, or if being used solely as an incinerator.

9 Financial

9.1 Cost

Total BET quotation cost: USD\$59,700.00 plus taxes, duties, and like as may apply.

9.2 Payments Schedule

This quotation is based on ADB electronically transferring milestone payments into the Baleen account as follows.

Milestone	Description	Payment (USD\$)
1	Coincident with authorization to proceed (50%)	\$29,850
2	BET high temperature envelope complete and ready for refractory cure or at 2 weeks prior to shipping (40%)	\$23,880
3	After Commissioning (10%)	\$5,970
	Total	\$59,700.00

10 Warrantee

12-month BET system parts replacement from date Baleen deliverables are commissioned on site. Warrantee applies to mechanical, electrical and control components (breakers, sensors, motors, actuators, and like). Wear materials (e.g. high temperature envelope linings) are excluded.

Baleen replaces failed parts, except where part supplier provides evidence that failure occurred due to noncompliance with BET system/component Operating & Maintenance manuals/ guidelines.

Owner pays cost of removing and forwarding failed components to supplier’s location (provided by Baleen), arranges/pays for transport of replacement parts from supplier’s address to Baleen project site, and installs replacement parts.



11 Ongoing BET Operating & Maintenance Support

The BET system, excepting automation system software, can be maintained by appropriately qualified contractors; utilizing remote guidance from/consultation with BET representatives where required.

BET system operators should make a “trouble call” to Baleen whenever they cannot achieve BET system operation consistent with contracted performance.

Owner will allow unrestricted internet access 24/7/365 to its BET automation system so Baleen representatives can, at any time, access the BET system computer and remotely view the same real time information displayed on the site BET automation system monitor. BET will advise Project BET system operators when BET detects a system irregularity.

A Baleen representative(s) will travel to site if/as required for troubleshooting/supporting BET system service personnel.



BET WtE DATA SHEET

Model No:	Output BTUs (,000s)	Output kWth	Screen Size (cm)	Estimated Fuel Consumption Range kg/hr	External Dimensions* (cm)	Power Requirements	Budget \$USD	\$ USD per BTU
BET 10	225	66	4	6 - 22	91x165	150W, 120V	\$38,530	\$0.17
BET 111	270	79	4	7 - 26	91x177	150W, 120V	\$41,590	\$0.15
BET 12	312	91	4	8 - 30	91x213	150W, 120V	\$44,300	\$0.14
BET 14	510	149	4	12 - 49	121x254	200W, 220V	\$50,150	\$0.09
BET 21-S	750	220	5	18 - 72	121x305	250W, 220V	\$59,700	\$0.08
BET 24-S	1,400	410	5	33 - 135	138x366	300W, 220V	\$95,450	\$0.07
BET 31-S	2,187	641	5	52 - 210	148x420	300W, 220V	\$165,550	\$0.07
BET 41-S	2,625	769	6	63 - 253	148x427	300W, 220V	\$185,510	\$0.07
BET 49-S	3,500	1026	6	84 - 338	163x488	300W, 220V	\$248,610	\$0.07
BET 51-S	6,000	1758	8	144 - 580	204x549	300W, 220V	\$573,200	\$0.09
BET 61-S	8,400	2462	10	203 - 810	244x732	300W, 220V	\$735,600	\$0.09
BET 71-S	12,600	3693	12	304 - 1216	315x732	300W, 220V	\$1,330,000	\$0.10
BET 81-S	16,800	4924	14	405 - 1621	387x732	300W, 220V	\$1,580,000	\$0.09
BET 91-S	22,000	6155	15	506- 2026	458x732	300W, 220V	\$2,580,000	\$0.11

MODELS:

BET 10 – BET 14 models are firebox systems designed for private use facilities.
BET 21-S to BET 49-S are appropriate for commercial applications.
BET 51-S and higher are manufactured to industrial specifications.

SCREEN SIZE:

Feedstock should be screen to this size prior to being fed into the BET System.

FUEL CONSUMPTION:

Average range is shown. Actual consumption will be based on fuel type, moisture content, and other factors.

EXTERNAL DIMENSIONS:

This is an approximate dimension, which will vary depending on system design, boiler size, and other factors.

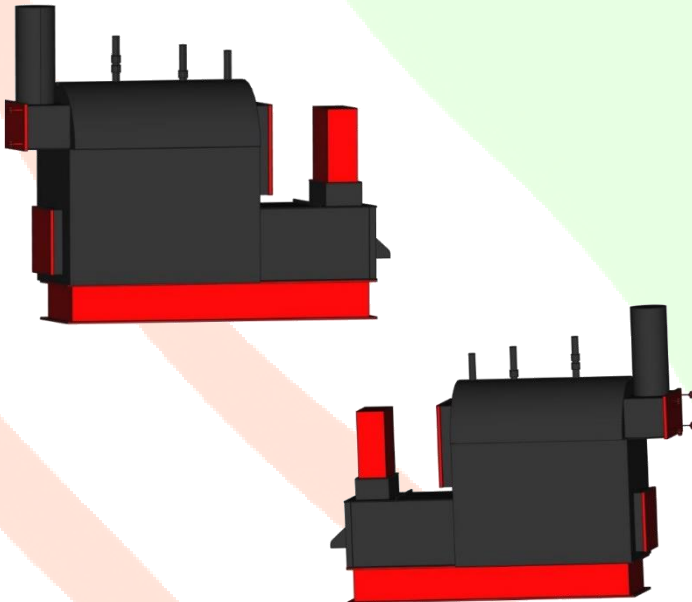
POWER REQUIREMENTS:

Power requirements are based on feed system design. All models are available as non-electric models.

BET 21-S | Commercial

The Commercial Classification units are the medium duty units in our product line. Used in a variety of applications, this units are rugged and extremely reliable.

MODEL BET 21-S



TECHNICAL SPECIFICATIONS:

BTU Output (btu/hr)	750,000
Thermal Energy (kW)	220
Maximum Consumption (kg/hr)	72
Maximum Screening Size (cm)	5
Base Footprint Width (cm)	122
Base Footprint Length (cm)	305
Application Classification	Commercial
Operating Temperature (C)	1250°
Gas Retention (seconds)	~3

The BET Technology is currently being used in over 100 applications across North America. This technology has proven versatile and effective on a wide range of feedstocks with high moisture content. The basis of the BET system has been proven over many decades using pure organic or mixed municipal solid waste feedstock in both off-grid and newer leading edge technology applications.

OPTIONAL UPGRADES:

BioChar TakeOut Module with Airlocks	Stainless Steel Package
Touchscreen PLC Controls	Non-Electric Controls
Smart Phone Connectivity	Solar Island Power Source
Remote Monitoring (WiFi/Ethernet)	MicroGen Power Module



The New Dimension In Renewable Energy