COMINTEL
GREEN TECHNOLOGIES

biogen

CGT BIOGEN ADVANCED BIOMASS GASIFICATION SOLUTION

Presented by

LIM KENG HOCK

COMINTEL
GREEN TECHNOLOGIES

biogen

Conventional Energy production from BIOMASS

- Boilers and Steam turbines lead to combustion inefficiencies when implemented for less then 20MW. Lack of modularity.
- Earlier Gasification Technology are expensive, not modular and produce polluted waste water streams.
- High supply chain costs.
- Time to market – very long.

COMINTEL
GREEN TECHNOLOGIES

biogen

Comintel Biogen Advanced Biomass Gasification Solution

•The Comintel Biogen gasification process is unique and superior because we combine unprecedented temperature control in the reactor with our exclusive closed loop tar recovery process.

•We employ specialized systems to clean our synthesis gas virtually tar-free, and the filtered tars are recycled as fuel in the reactor.

•The result is exceptionally clean synthesis gas that will run a wide variety of genset engines, a closed-loop process free of wastewater emissions, and the ability to operate with the widest variety of biomass.

COMINTEL
GREEN TECHNOLOGIES

biogen

Process Flow



PLANTATION RESIDUES





PLANTATION


BIOCHAR


MUNICIPAL SOLID WASTE

$CO_2 + H_2O$


SYNGAS

Electricity Generation

Exhaust heat from engines is used to dry incoming biomass

COMINTEL BIOGEN
ADVANCED BIOMASS GASIFIER






BIOMASS RESOURCES



Chipping / Shredding


Drying


Briquetting / Palletizing

COMINTEL
GREEN TECHNOLOGIES

biogen

Biogen Technology Differentiators

Differentiators	Explanation
Low temperature gasification	prevents slag formation, resulting in an ability to gasify a wider spectrum of biomass including energy crops (sorghum, grasses, corn, sugarcane, bamboo, etc) and Municipal Solid Waste (MSW)
Tar Management System	through the collection and gasification of tars and result in tar free synthetic gas for engine-generator combustion. Increased effeciency.
A closed loop system	produces no smoke, produces no water effluents, recycles engine heat, and produces only synthesis gas, charcoal and solid ash.
Predictable power output	Biomass gasification plants continuously produce 75-85% of rated capacity versus 25-40% wind and solar.
Distributed power generation benefits	including reduced transmission and distribution costs and losses for local utilities.

COMINTEL
GREEN TECHNOLOGIES

biogen

What can be Gasified?

WOOD RESIDUES:
forestry and lumber residues, etc.

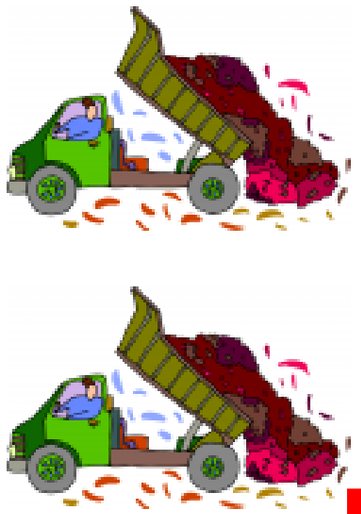
CROPS & RESIDUES:
energy crops, corn, soy, sorghum and any other agricultural or agro-industrial residues .

OTHER RESIDUES:
Refuse Derived Fuel, swine residues, etc.

COMINTEL
GREEN TECHNOLOGIES

biogen

MSW **current** process



Collection Point

Reduce
Reuse
Recycle

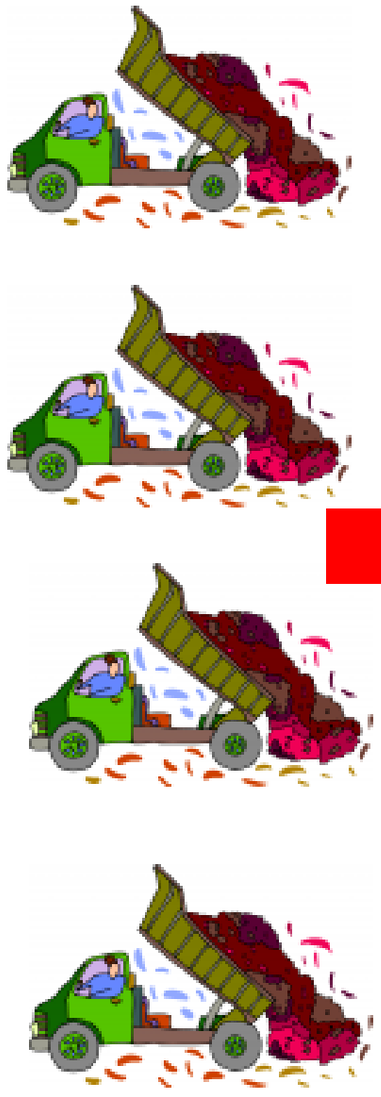
89%

Transport to Landfills
300 + Miles
(increased Carbon Footprint)

COMINTEL
GREEN TECHNOLOGIES

MSW **proposed** process

biogen



Collection Point

Reduce
Reuse
Recycle

89%

biogen

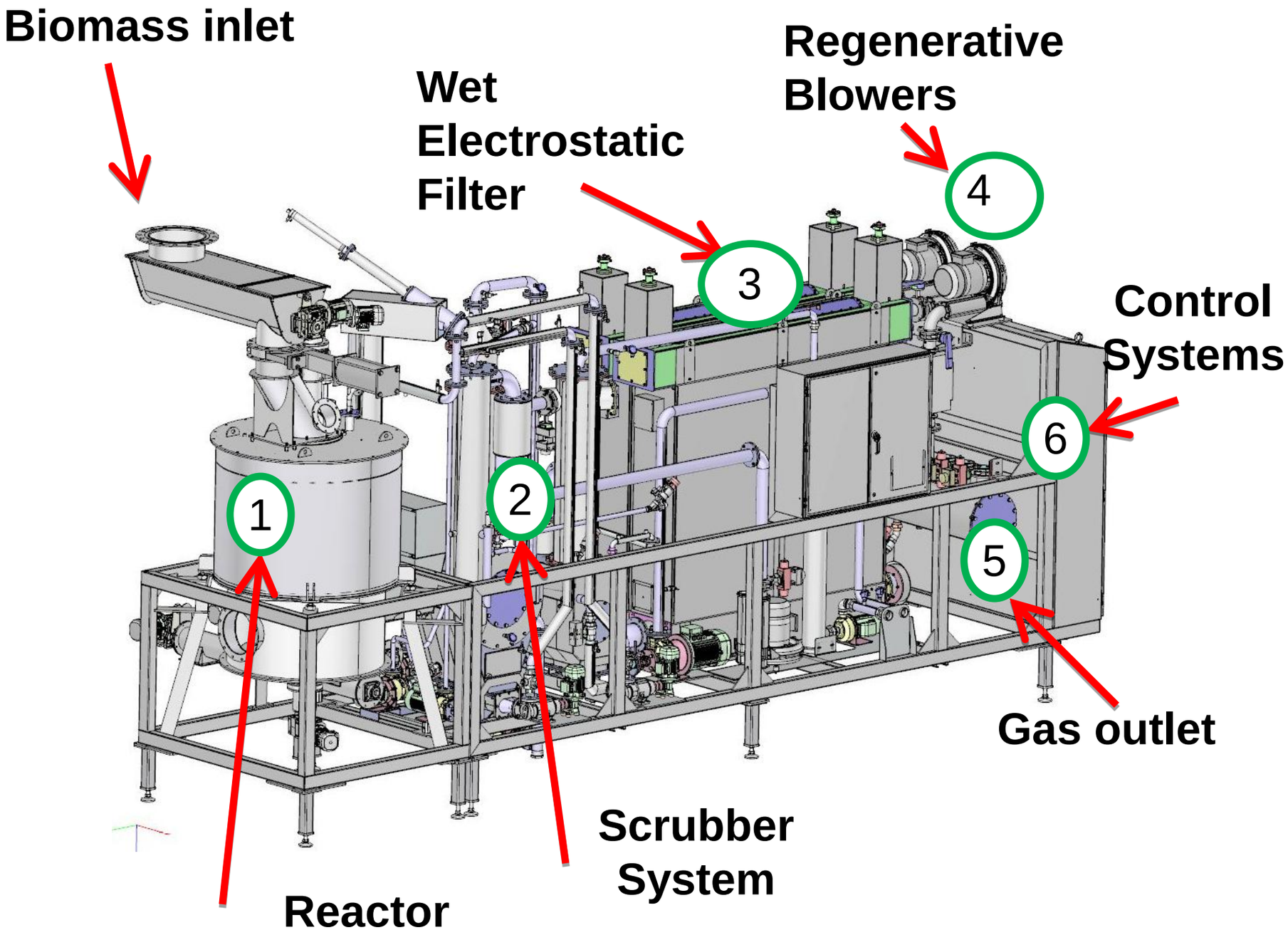
Volume Reduction >75%

Green Energy

COMINTEL
GREEN TECHNOLOGIES

biogen

The Biogen Gasification Solution



1.Biomass transformed into syngas

2.Cleans the syngas. Cools down the syngas.

3.Final syngas cleaning stage - tar free

4.Pressurizes the syngas up to 300 mbar.

5.Distributes gas under pressure up to 3 consumption points.

6.Process fully automated.

COMINTEL
GREEN TECHNOLOGIES

biogen

Gasification Basic

•The gasification process starts with a high temperature reactor, where dried biomass (<15% moisture content) is converted into synthesis gas. Gasification reactors resemble tube furnaces, with a fuel inlet at the top and a grating at the bottom. A primary difference between a furnace and a gasifier is the stratification of different layers, or zones inside the reactor. With a furnace, the combustion is at the bottom; near the grating; fuel is added to the top, with gases and smoke exhausting out the top.

•With a gasifier, there is also a combustion, or oxidation zone, however it is positioned higher up in the tube, and there is another zone below, called the reduction zone, where the synthesis gas is produced. Basically, in the oxidation zone the fuel is initially burned same as in a furnace, with the hydrocarbons in the fuel converting to carbon dioxide (CO_2) and water vapor (H_2O). This reaction is exothermic and produces a large amount of energy as heat; but in the reduction zone below, the CO_2 and H_2O convert to carbon monoxide gas (CO) and hydrogen gas (H_2).

•These reactions are endothermic and need a lot of energy to take place; the oxidation zone directly above supplies the necessary energy to form these gases. These two gases are the main combustible ingredients of the synthesis gas. Other combustible hydrocarbon gases like methane (CH_4) and others are also present from incomplete combustion. These are called pyrolysis gases, and they increase the caloric value of the synthesis gas. There are typically small amounts of other more complex hydrocarbons (tars) also present in the gas due to incomplete combustion, along with the incombustible components; Nitrogen gas (N_2), and typically some unreacted CO_2 and H_2O. So in a nutshell, a gasifier is a type of furnace arranged so that there is a reduction zone underneath the traditional oxidation zone. Another major difference between a furnace and a gasifier is that there is no exhaust of gases and smoke; all the volatiles emitted become synthesis gas, with no other exhaust emitted.

COMINTEL
GREEN TECHNOLOGIES

biogen

Reactor Cross Section

DRY BIOMASS ENTERS REACTOR

PYROLYSIS ZONE –THERMAL DECOMPOSITION

OXIDATION ZONE—COMBUSTION OF HYDROCARBON INTO CO2 + H2O

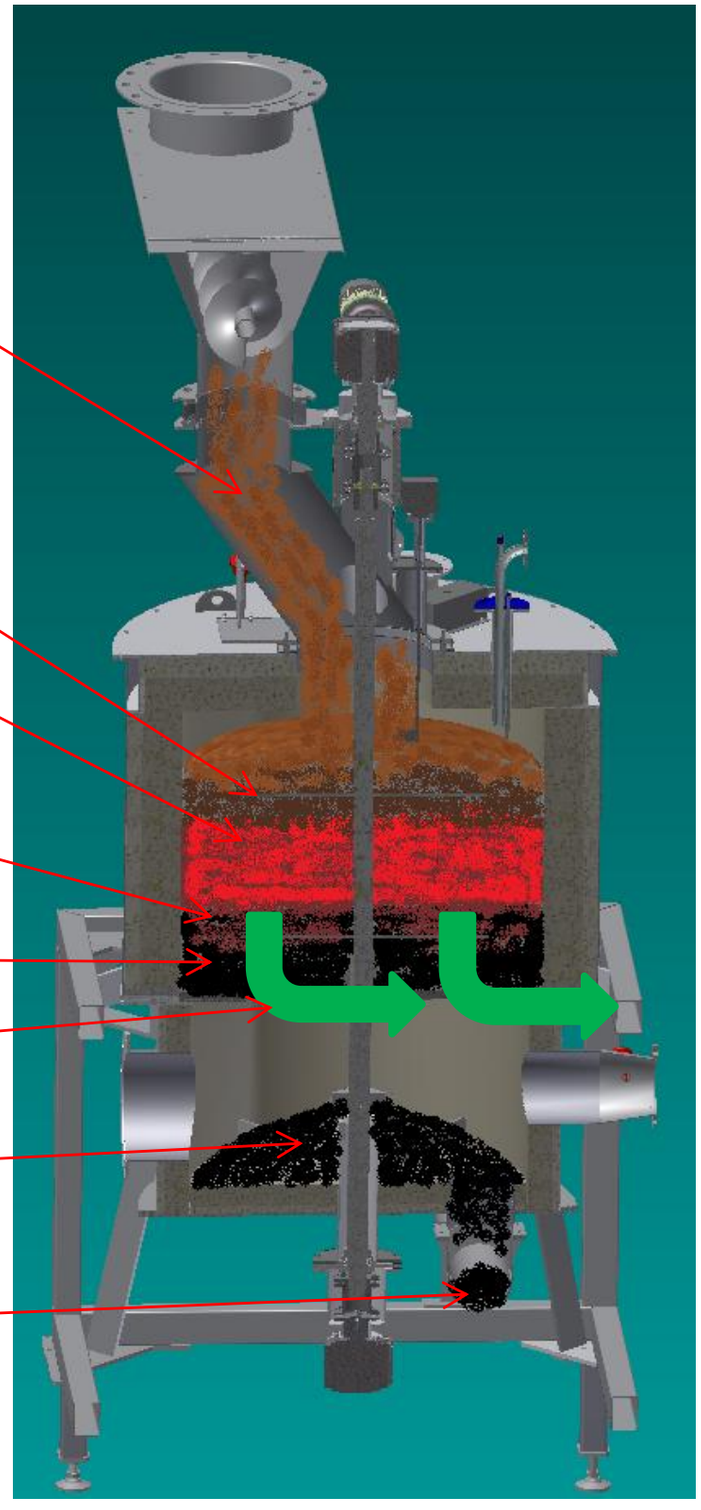
REDUCTION ZONE—SYNGAS FORMATION

GRATING

SYNGAS OUT TO CLEANING

CHARCOAL COLLECTION

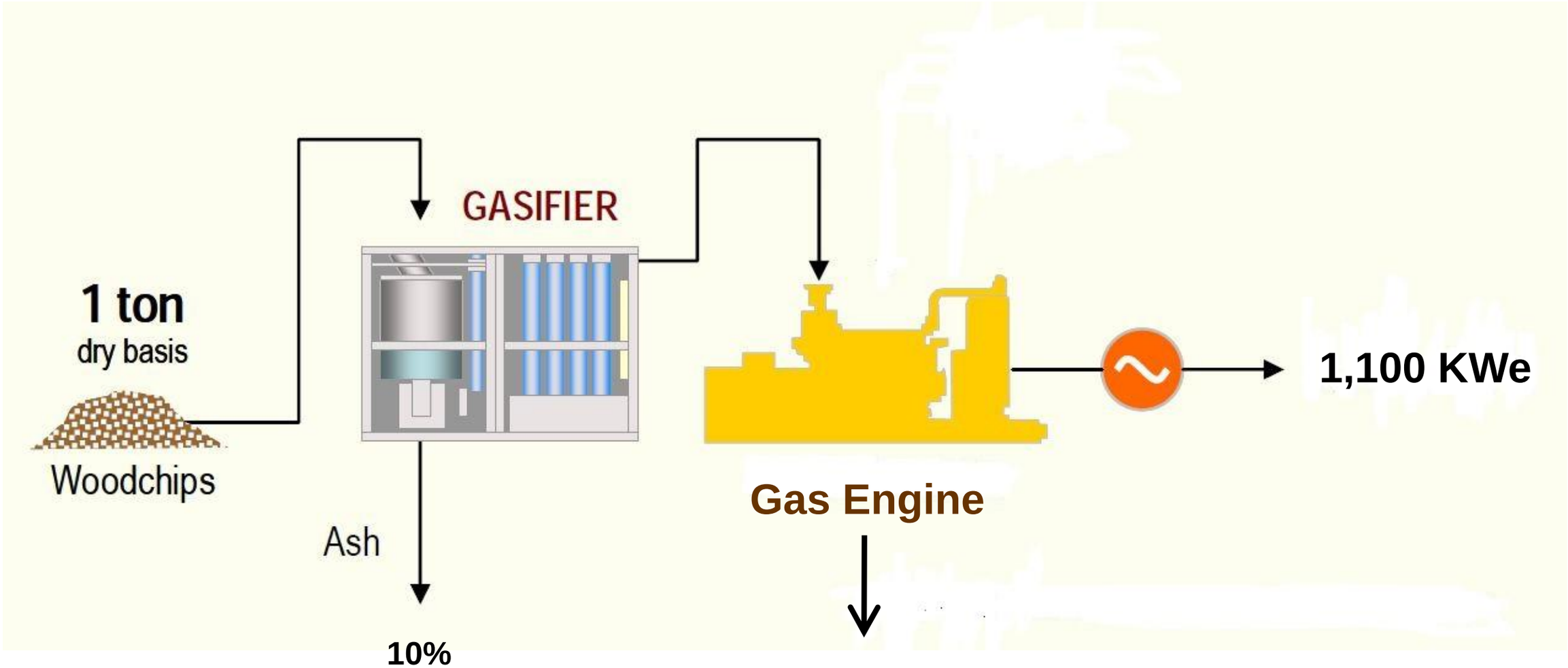
CHARCOAL EXTRACTION



COMINTEL
GREEN TECHNOLOGIES

biogen

Biomass Energy Output using Woodchips



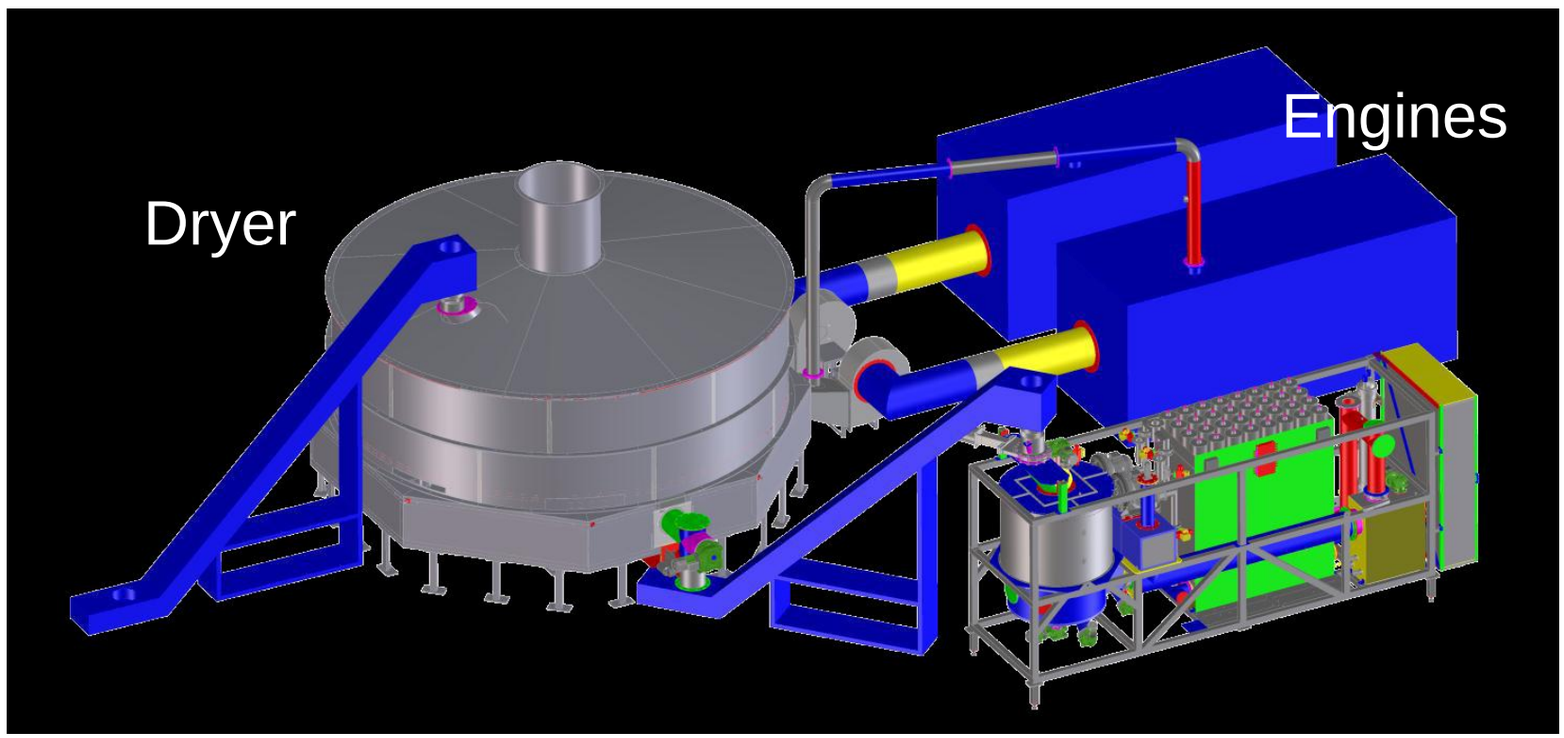
Bio-charcoal from woodchips has value for agricultural applications.

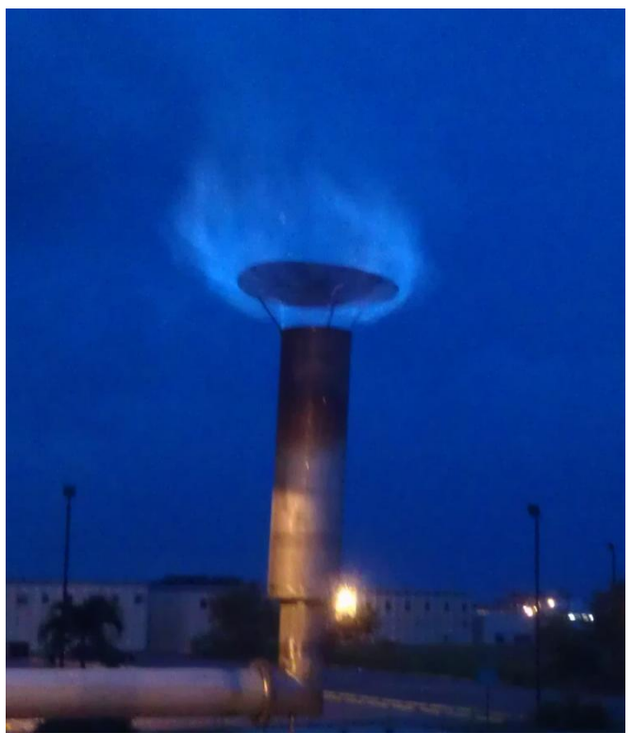
COMINTEL
GREEN TECHNOLOGIES

biogen

Technology

- “Wet” biomass enters the dryer.
- Dried biomass exits dryer and enter gasifier.
- Syngas (H2, CO, CH4) is cleaned and provided to “off-the –shelf” engine-generators.
- Engines generators combust fuel and generate electricity
- Alternately Syngas can be combusted for thermal process applications.
- Exhaust heat from engines is used to dry incoming biomass
- Process is continuous, not batch





COMINTEL
GREEN TECHNOLOGIES

biogen

PRIVATE & CONFIDENTIAL

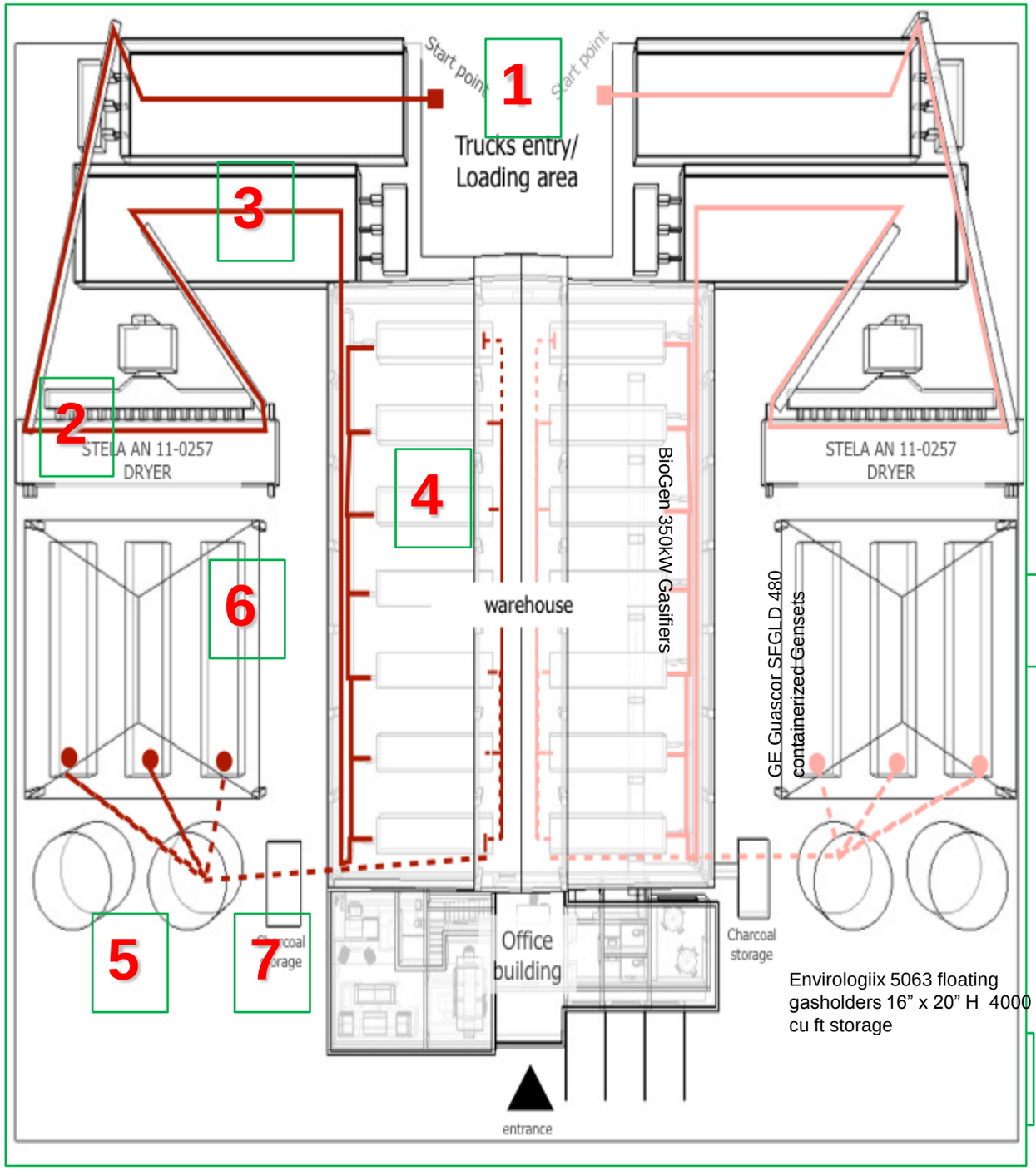
COMINTEL
GREEN TECHNOLOGIES

biogen

PRIVATE & CONFIDENTIAL

COMINTEL
GREEN TECHNOLOGIES

Flowchart example, 5 MW site.



1. Biomass enters the facility.
2. Biomass driers use waste heat from engines to dry the biomass.
3. Dry biomass is staged.
4. Gasifiers produce clean gas.
5. Gas is staged in the gasholders.
6. Internal combustion engines produced electricity powered by green syngas.
7. Biochar is extracted, ready for soil applications.
8. Size is approximate - 300 ft X 400 ft

COMINTEL
GREEN TECHNOLOGIES

Biochar is Better

biogen

- Soil has to be viewed as a complex living environment, and the influence of ground vegetation, biomass return, pesticide and fertilizer use - its health must be further researched
- EFB used as mulch is inefficient - Increase of the biomass - needs decomposition by micro-fauna.
- Nitrogen is lost (immobilized by bacteria) during anaerobic digestion to decompose the fresh biomass, causing intolerable smell pollution, breed flies or induce soil anaerobic condition
- Fertilizer reduction is not fully realized - fertilizer - release of ammonia from Nitrogen fertilization contributing to atmospheric nitric acid (component of acid rain)
- Biomass gasification and reintegration of Biochar in the soil is a better agricultural practice than using mulch, as the Biochar is:
  - **Soil enhancer**: increases the physical properties of the soil.
  - **Carbon storage**. Is stable, last for hundreds or thousands of years, fixing CO2 in the soil and reducing the emission of CO2 due to biomass decomposition.
  - **Reduces the use of fertilizer** and less pollution of underground waters.
  - **Ease the availability of nutrients** to the plant.

COMINTEL
GREEN TECHNOLOGIES

biogen

BioChar Result UiTM Analysis

Elemental composition:
C-79.62%; H-0.79%; N-4.83%; Sulphur -00%, O-14.74%

Calorific value: 7955 kcal/kg
Ash : 3.77%
Moisture : 4.5%

Comment: The ash content is very low (3.77%) compare to coal (12-15%) which is very good for fuel application.

Guess this charcoal is from woody biomass. For EFB charcoal it is around 10-14%, PKS charcoal 6%.

The heating value is very high, carbon content is very high, moisture content reasonably low.

Most importantly, the Nitrogen content is so high and it is very good for fertilizer application.

COMINTEL
GREEN TECHNOLOGIES

biogen

Sarawak Palm Biomass Potential

- Sarawak matured palm plantation on year 2011 is 805,955 hectare with average production of 20.08 tonne of FFB per hectare per year

- Available dried solid palm biomass at mill (EFB, PKS, mesocarp fiber) in year 2011 has about 3,313,281 tonne; which is potential to produce 445MW of electricity

- Available dried palm fronds due to pruning in year 2011 is about 8,381,932 tonne; which has potential to produce 1,125MW of electricity

- Available dried Oil Palm Trunk and Palm Fronds due to replanting is about 3,584,485 tonne; which has potential to produce 481MW of electricity

- Total gross potential to generate electricity via Comintel Biogen Gasification Technology using palm residues in Sarawak is about 2,051MW

*Source of Biomass Quantity Data: MPOB

COMINTEL
GREEN TECHNOLOGIES

biogen

Unique benefits from The Biogen Green Energy Solution

- **Biogen is eco-friendly, producing 100% predictable green energy.**
- **High modularity (0.5 to 15 MW) ease the learning process, biomass logistics and minimize risk.**
- **Easy to install, operate and maintain.**
- **The Biogen solution only uses biomass to produce syngas and charcoal.**
- **Resulting biochar is excellent soil enhancer increasing crop yields.**
- **The Biogen energy solution does not generate waste water streams or produce gaseous pollutants or harmful residues.**

COMINTEL
GREEN TECHNOLOGIES

biogen

Bottom line results from Biogen Green Energy Solution: Economic, Social and Environmental Benefits.

- **Promotion of <u>eco-friendly</u> destinations and <u>sustainable local economies</u>.**
- **<u>Predictable power output</u>. Biomass gasification plants continuously produce 75-85% of rated capacity versus 25-40% wind and solar.**
- **<u>Creation of long-term jobs</u>.**
- **<u>Smaller footprint per MWh of capacity</u> ~1 acre.**
- **<u>Distributed generation</u> benefits, reduces transmission and potential of distribution costs for local utilities.**

COMINTEL
GREEN TECHNOLOGIES

biogen

Thank You