



Biomass Gasification

We are a great fit because...

- Proven gasifier technology for biomass management
- Meets Engineered Municipal Solid Waste Facility Definitions
- Experienced team
- Reduce GHG emissions
- Renewable Energy
- Flexibility



Outline

- Introductions
- Installations
- Gasification Overview
- Process Flow
- Implementation



Who is Aries Clean Energy?



Originally funded by Thompson Machinery, Aries closed additional corporate financing with Spring Lane Capital solidifying equity financing.

Aries acquired downdraft technology from APA, and fluidized bed technology from MaxWest environmental. Both are commercially proven systems.

Installations



Downdraft gasification system in Lebanon, TN.

Proven Technology:

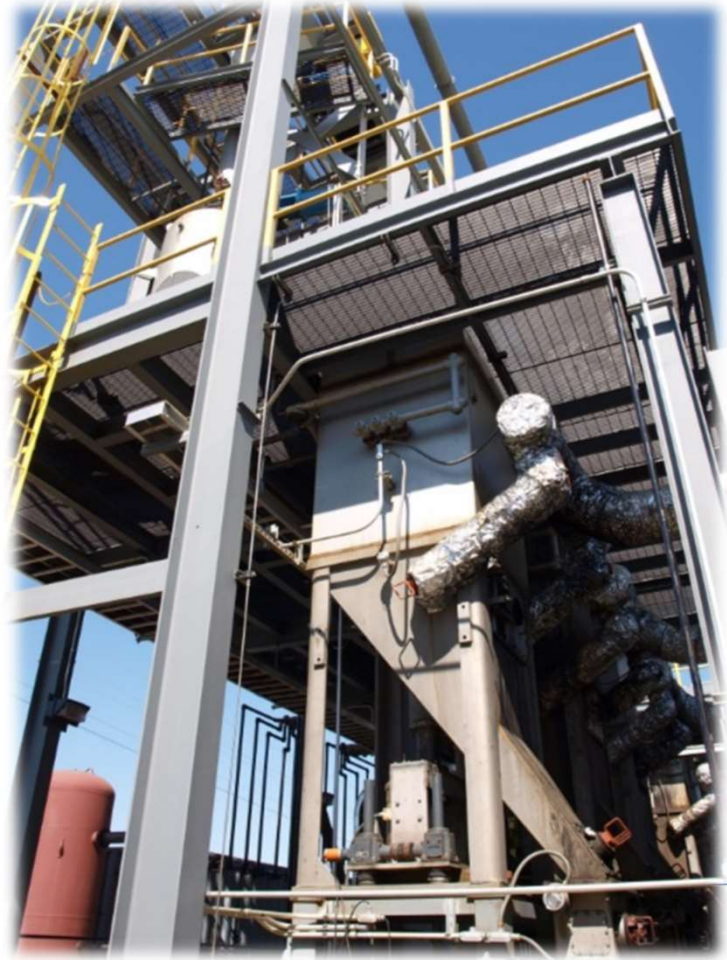
Client/Location	Date	Equipment	Output
Boral Brick - Phenix City, AL	2003	(3) PHG-08 Gasifiers	12 mmbtu/h
Boral Brick - Augusta, GA	2005	(3) PHG-08 Gasifiers	12 mmbtu/hr
Boral Brick - Gleason, TN	2008	(6) PHG-08 Gasifiers	36 mmbtu/hr
Boral Brick - Gleason, TN)			1 MW
PHG Energy - Greenwood, MS			32 mmbtu/hr
City of Covington, TN			125 kW
City of Lebanon, TN		Oxidizer, ORC System	420 kW
City of Sanford, FL	2012	Gen 2 Fluidized Bed- biosolids gasification	NA

Our gasifiers alone have logged more than 75,000 hours of commercial service

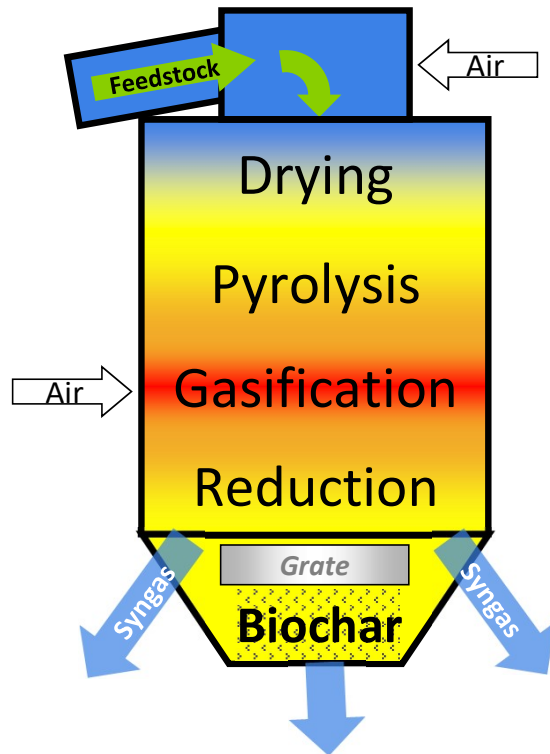
What is Gasification?

The clean, efficient conversion of biomass into a synthetic gas in an oxygen-starved environment

- NOT Incineration.
- More oxygen than Pyrolysis
- Less oxygen than Incineration
- 10% remains as charcoal biochar

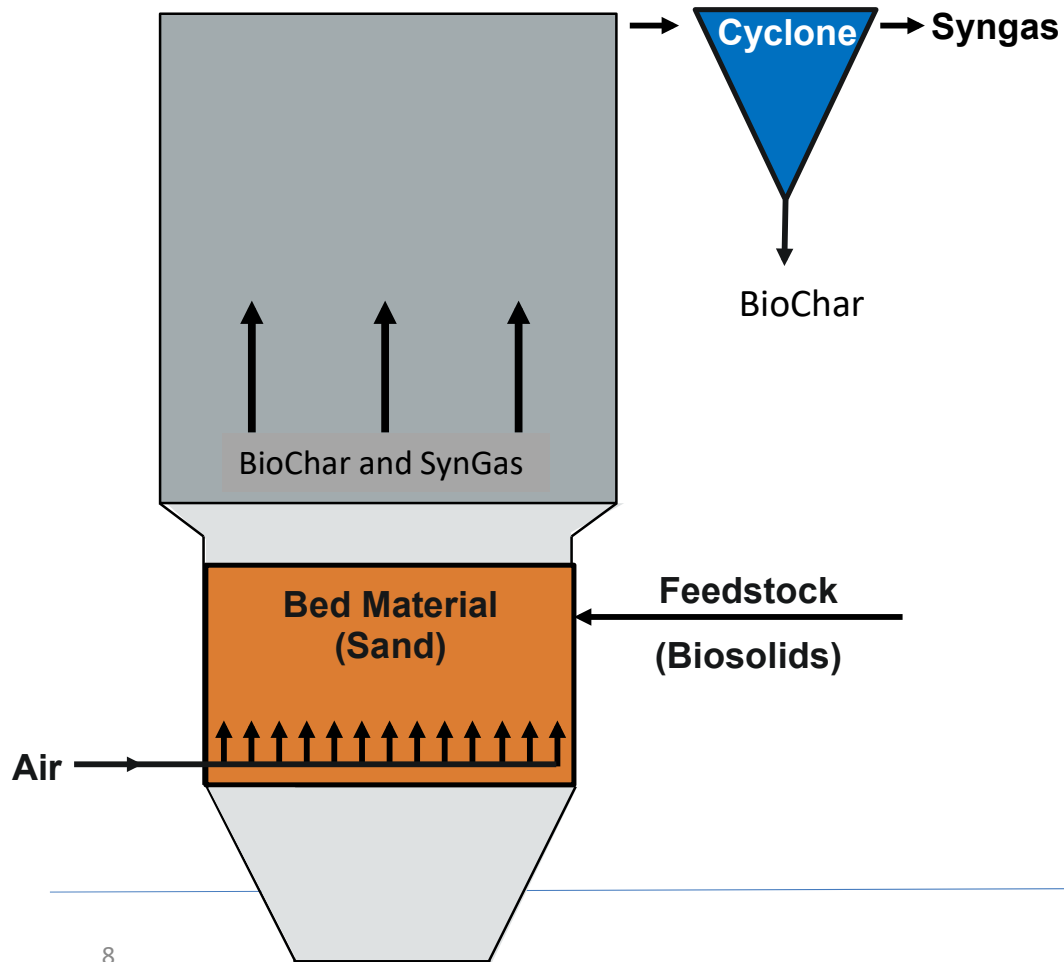


Aries Downdraft Gasifier



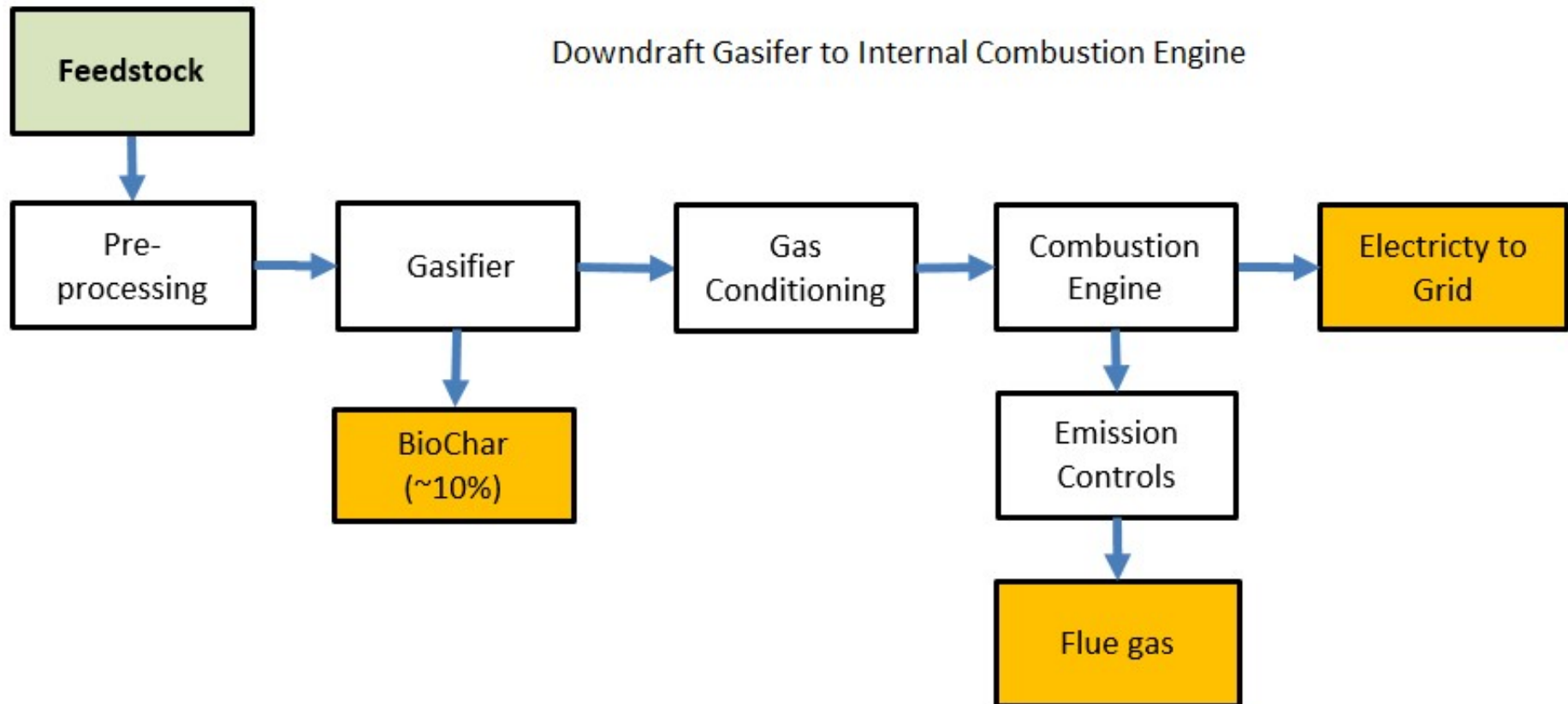
- Feedstocks:
 - Woody biomass
 - Biosolids
- Outputs:
 - **Biochar** (high carbon content)
 - **Syngas** (~100-130Btu/CF, CO + H₂)
- 85-90% mass + volumetric reduction
- 60TPD modules
- CO₂ reduction

Aries Fluidized Bed Gasifier



- Feedstocks:
 - Biosolids
 - Refuse derived fuel
 - Woody biomass
 - Food waste (diversion)
- Outputs:
 - **Biochar** (high carbon content)
 - **Syngas** (~100-130Btu/CF, CO + H₂)
- 90-95% mass + volumetric reduction
- Scaleable
- CO₂ reduction

Process Flow Diagram

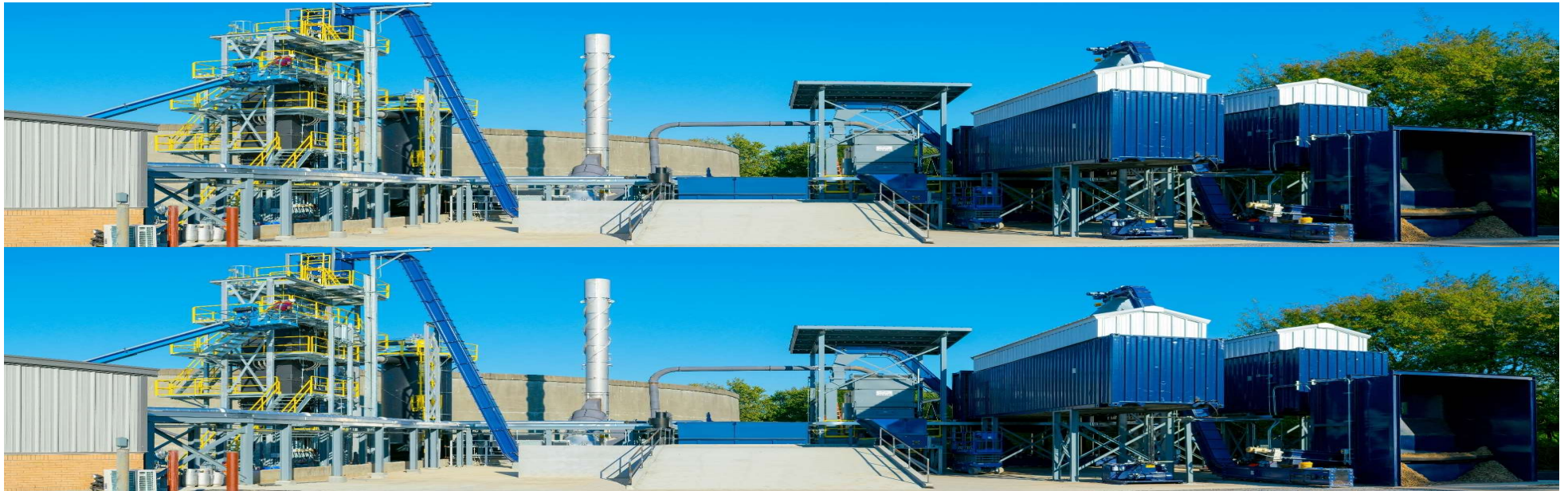




Gasification Plant Tour

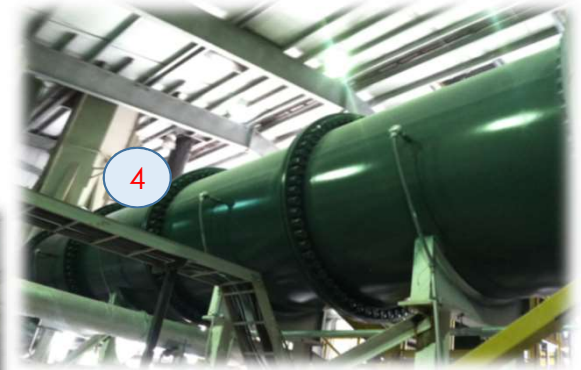
www.ariescleanenergy.com

System Overview – Lebanon Downdraft Gasifier



System Overview – Sanford Fluidized Bed Gasifier

- 1 Feed System
- 2 Gasifier
- 3 Cyclone
- 4 Thermal Oxidizer



Output

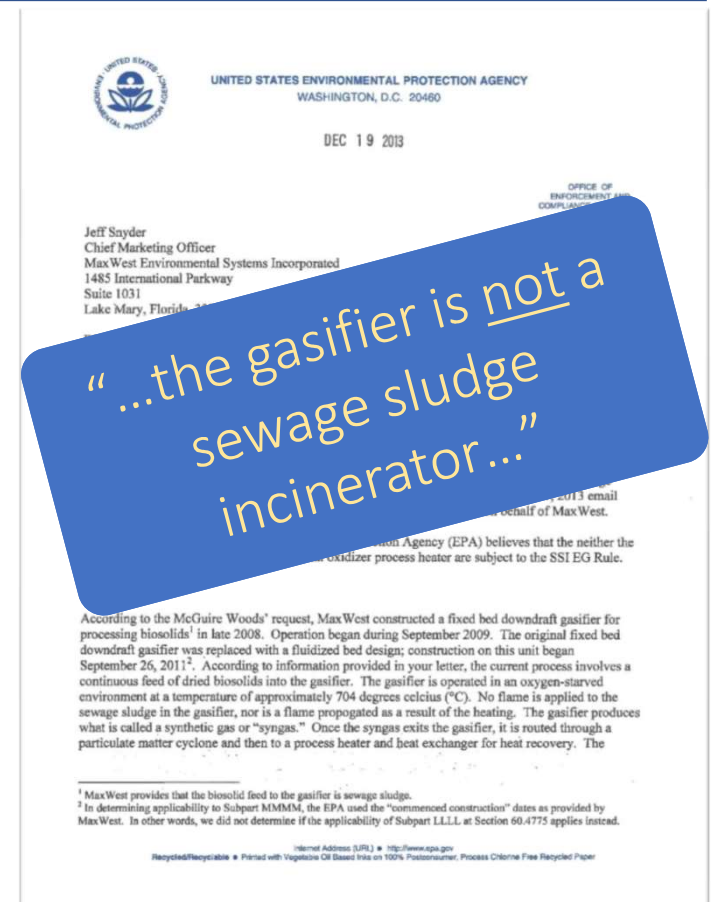
BioChar

- Soil Amendment
 - Increased agronomic activity
 - Less irrigation
 - Less fertilizer
- Carbon Sequestration
- Filter media
- High carbon content
- Aries has two letters of intent in place with W. Coast distributors



Emissions

- Positive Feedback from BAAQMD
 - EPA letter helpful
- Aesthetics – quiet, totally enclosed
- Available 365d/yr (not weather dependent)
- Significantly lower CO2 emissions
- Can reduce traffic



Air Permitting – 3MW woody biomass system

	Gasifier Emissions (Ton/yr)	BAAQMD Threshold ¹ (Ton/yr)
ROG	<1	<10
NOx	<8	<10
PM10	<1	<15
PM2.5	<1	<10

1. BAAQMD CEQA Air quality guidelines 5/2017 Table 2-2 “Threshold of Significance”

Schedule

Approximately 2 years from start to close-out

- 9 month development
- 12 month construction
- 6 month close-out

Task Name	Duration	Start	Finish	Half 1, 2018				Half 2, 2018				Half 1, 2019				Half 2, 2019								
				D	J	F	M	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J
▷ Aries Development	158 days	Tue 1/2/18	Thu 8/9/18																					
▷ Development Agreements	40 days	Thu 2/8/18	Wed 3/29/18																					
▷ Definitive Agreements	80 days	Thu 5/3/18	Thu 7/12/18																					
▷ Finance - Private activity bond	26 days	Thu 5/3/18	Thu 6/7/18																					
▷ Development Permits	70 days	Thu 5/3/18	Thu 6/14/18																					
▷ Electric Interconnection	45 days	Thu 5/3/18	Thu 6/14/18																					
▷ Power Purchase Agreement (PPA)	45 days	Thu 5/3/18	Thu 6/14/18																					
▷ Engineering	141 days	Thu 5/3/18	Thu 8/23/18																					
▷ Major Equipment Purchase	160 days	Thu 5/3/18	Thu 9/21/19																					
▷ Construction	240 days	Thu 5/3/18	Thu 7/11/19																					
▷ Close-Out	165 days	Fri 7/12/19	Thu 2/27/20																					

2 Years from Concept to Completion

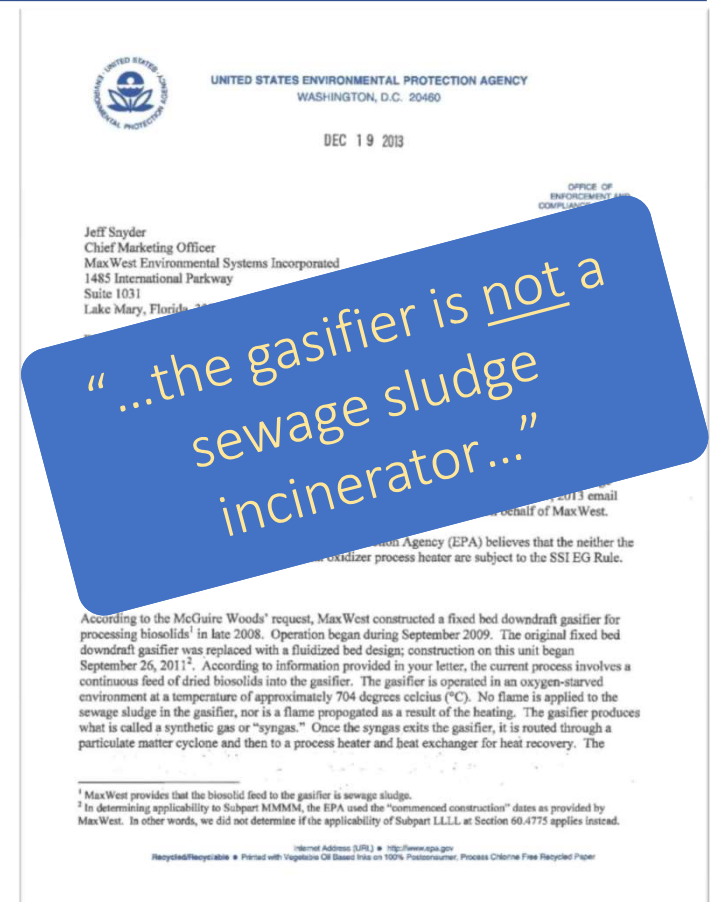
Air Permitting

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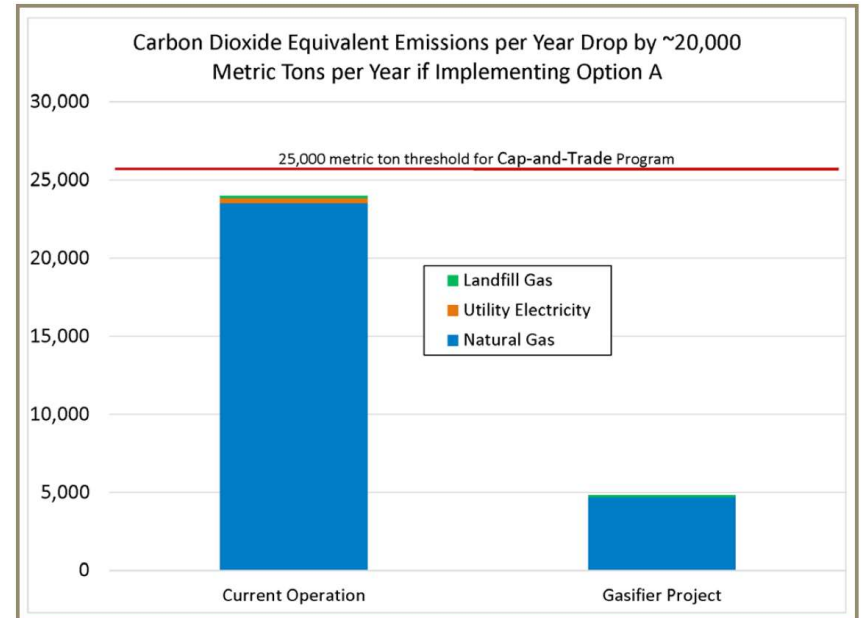
BAAQMD Feedback to Date

- Positive Feedback from BAAQMD
 - EPA Letter helpful
- Reduces Bay Area traffic impacts on busy roads
- Available 365d/yr (not weather dependent)
- Significantly lowers CO2 emissions
 - Could be used for food waste conversion to energy



CO₂ Impact – Ex Central San

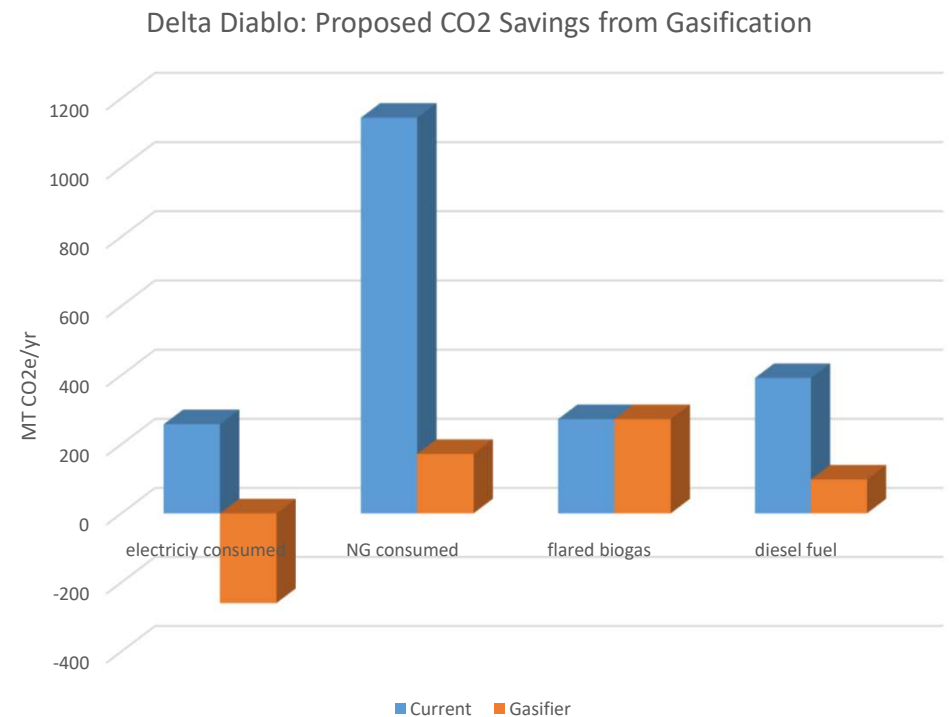
- Ex facility: Central San could reduce operational CO₂ by 70%+ by gasifying biosolids and generating power
- Additional savings by reducing vehicle trips



CO₂ Impact – Ex Delta Diablo

Project: Gasify imported wood waste + Delta Diablo biosolids to generate electricity

- Benefits include:
 - 467kW renewable electricity
 - Reduce transportation emissions
 - Reduce Delta Diablo overall CO₂ emissions 85%
 - Take Delta Diablo 'off grid'



Source: CH2M Technical Memorandum: "Assessment of Conceptual Gasification-to-Power Facility for Delta Diablo Wastewater Treatment Plant" April 26, 2016

Diversion Discussion

"The bill [AB1126] would additionally exclude EMSW conversion from the definition of transformation"

Definition:

Waste Diversion--As defined in California statute, the combined efforts of waste prevention, reuse, and recycling practices

Transformation--Transformation refers to incineration, pyrolysis, distillation, or biological conversion other than composting. The statutory definition of transformation does not include composting, gasification, or biomass conversion.

Questions?



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