

# Options for PFAS Destruction for WRRF Biosolids

**September 13, 2023 3:00 PM**

- Sean Sweeney



**Tackling Contaminants  
of Emerging Concern**

**2023**  
SPECIALTY  
CONFERENCE  
& WORKSHOP  
SERIES



In the Water Cycle through Advancements in Plant Operations

# Biosolids Disposal

- Ocean Dumping
- Incineration
- Landfilling
- Land Application



# Biosolids Disposal

- Ocean Dumping  
Not Allowed
- Incineration Only  
Few Remain in NYS
- Landfilling 5 or  
10% Rule or  
prohibited
- Land Application  
Emerging  
Contaminates  
Concerns



# Dryer evaporates water, but what about PFAS?



# Draft DEC PFAS Guidelines

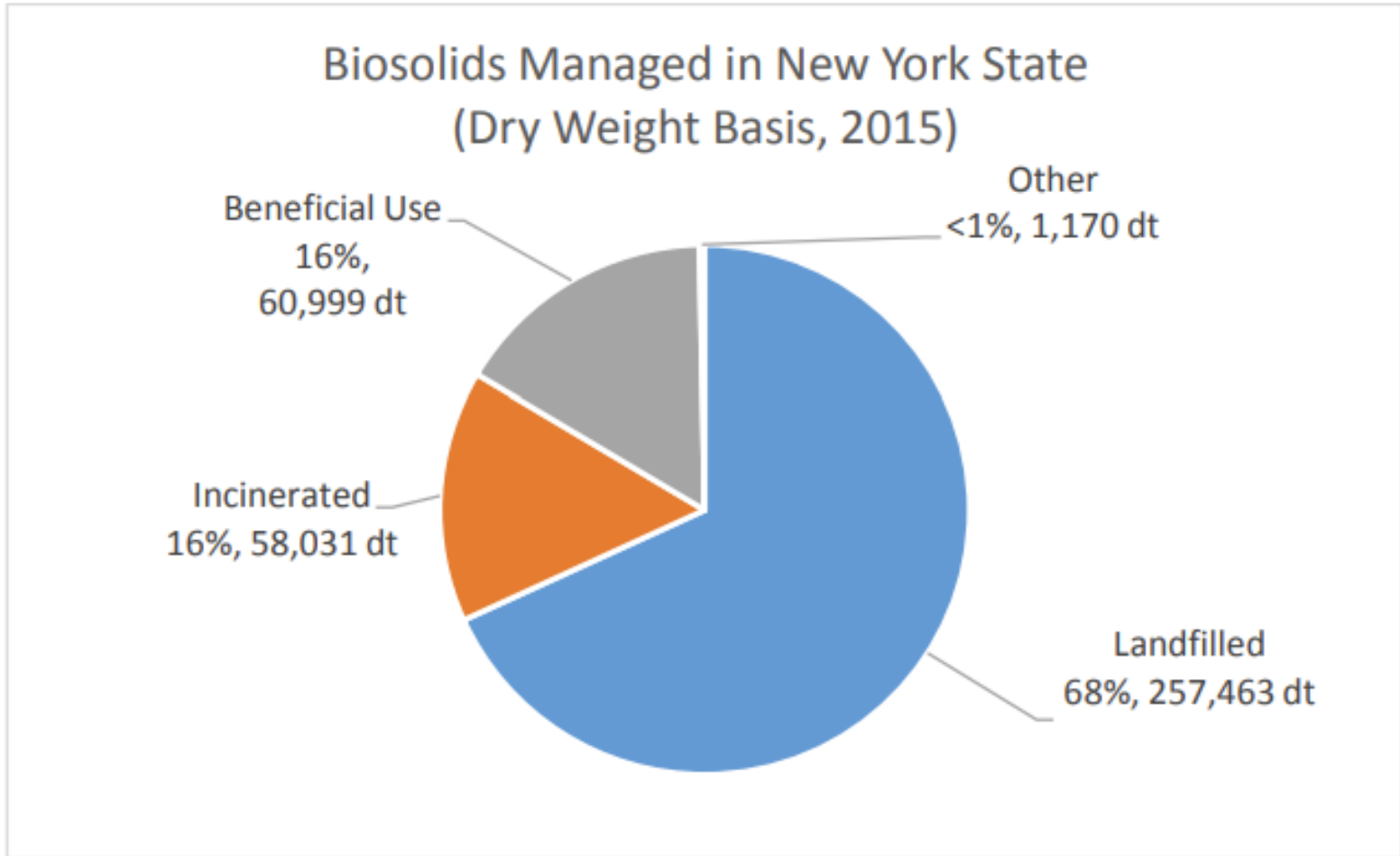
DEC interim guidelines for PFOA and PFOS in biosolids recycled:

PFOA or PFOS in biosolids, dry weight (ug/kg or ppb)*	Action Required for Biosolids that are Recycled
20 or less	No action required
> 20 but <50	Additional sampling required. DEC will take appropriate steps to restrict recycling after one year if the PFOS or PFOA levels are not reduced to below 20 ppb or less.
50 or greater	DEC will take action to prohibit recycling until PFOS or PFOA concentration is below 20 ppb.

- May 11, 2023 from NYSDEC
- Draft limits for PFOA and PFOS in recycled (land applied) biosolids
- Some NYS WWTP biosolids will test at 10 ppb, some 150 ppb
- Maybe lower levels with less industry and leachate customers?
- If your cake is <20 ppb, maybe land application an option?

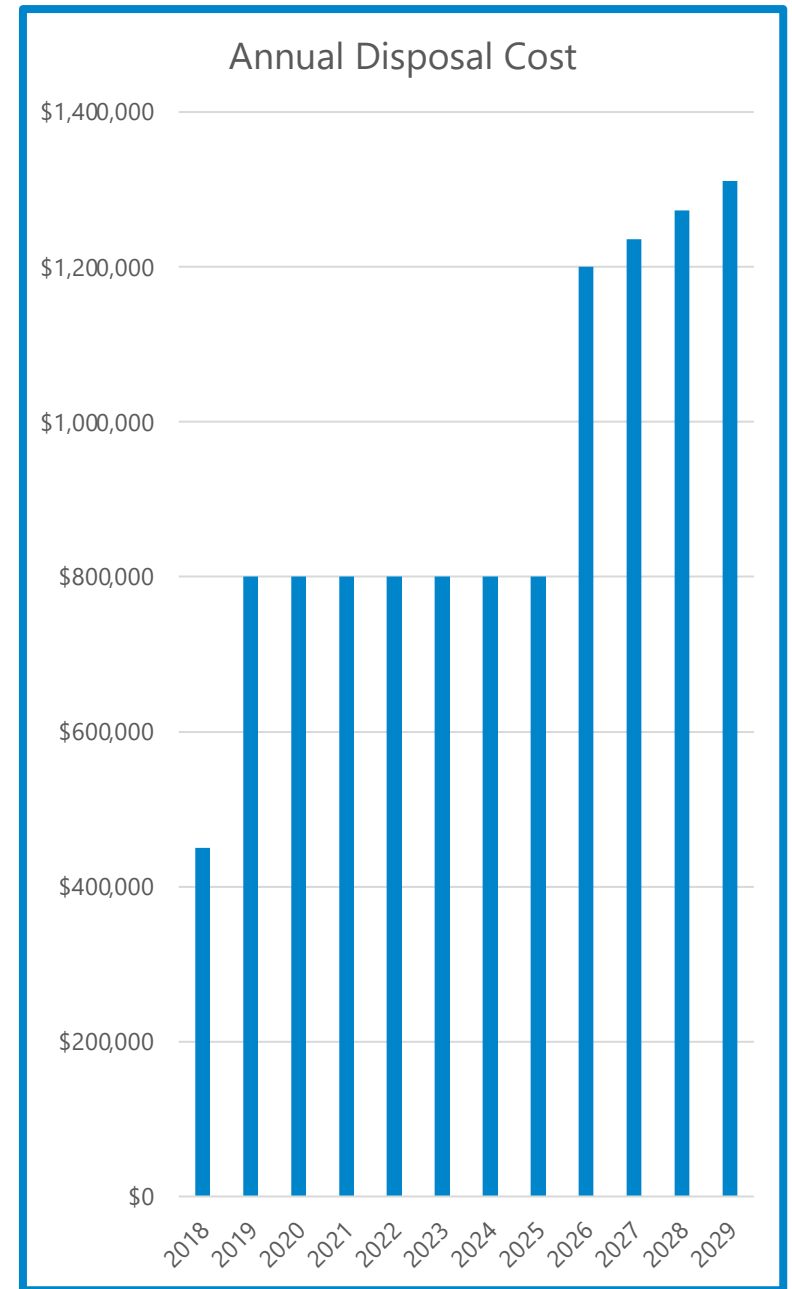
## If Cake >50 ppb PFAS?

- Does the proposed limit inhibit ability to land apply biosolids?
- Not all Beneficial use biosolids at 20 or below 50 ppb
- Will the proposed limit reduce cake recycled percent?
- Not here today to discuss/debate science of biosolids land application



# The Big Question: What do I do with my cake from my WRRRF?

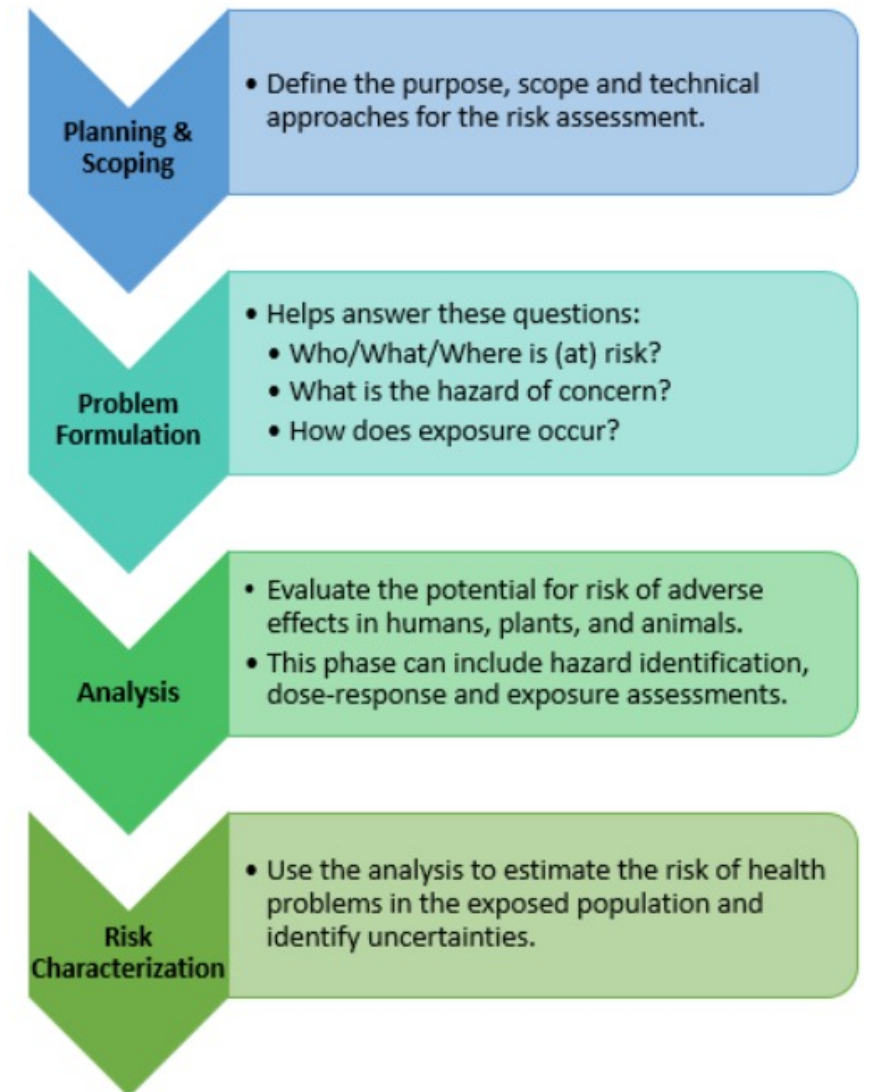
- Landfill disposal fees going up: \$25/ton or \$150/ton or more?
- Landfill restricting deliveries of cake
- Pending biosolids rules limits recycle options if PFAS levels high
- Biosolids incineration air regulations becoming more strict
- Any Other Options?



# The Big Question: What do I do with my cake from my WRRF?

- Various treatment technologies are being discussed:
  - Super critical water oxidation (SCWO)
  - Thermal treatment (pyrolysis/gasification/incineration)
  - Existing incineration regulations getting more strict. (*16% of biosolids are incinerated* (EPA, 2019))
  - Photochemical destruction?
- Any Other Options?

## Generalized Risk Assessment Framework





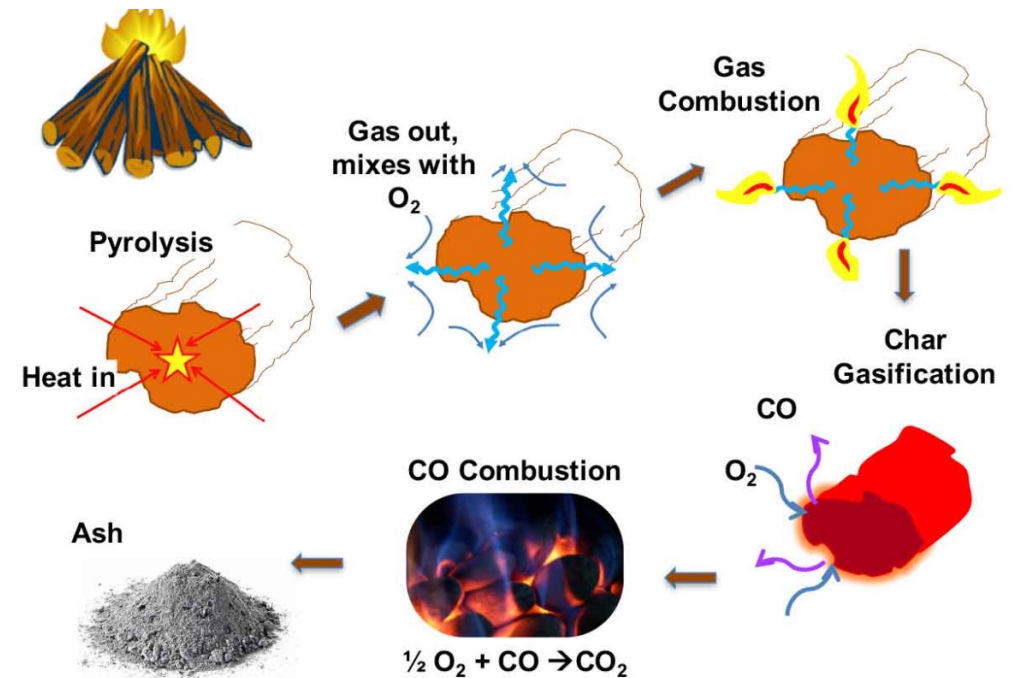
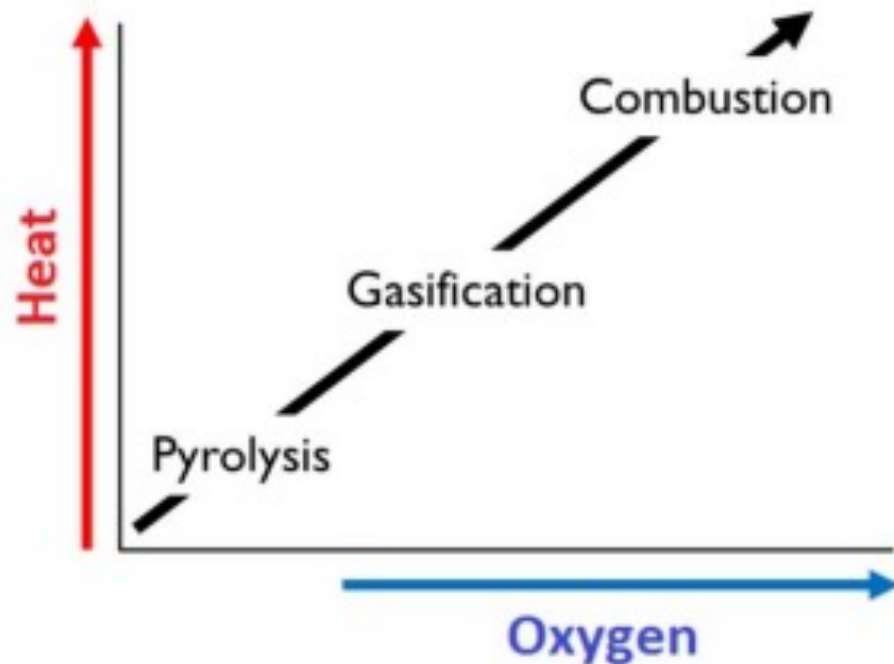
# Pyrolysis/Gasification is a Viable Treatment Option?

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- Various studies have shown 95-99%+ reduction of PFAS compounds from solid char at 500-700°C.
  - Greater temperature & time = greater reduction in residual PFAS
- What happens to it?
- Studies have shown PFAS compounds and precursors report to the syngas/pyro gas in pyrolysis and gasification processes at > 500°C.
- Thermal oxidizers on the back end of the reactor generally operate  $\geq 1,800^{\circ}\text{F}/980^{\circ}\text{C}$ . EPA reported  $900^{\circ}\text{C}$  for 2 seconds was sufficient to destroy most PFAS compounds. Study showed 99.99% destruction @  $1,050^{\circ}\text{C}/1,922^{\circ}\text{F}$

# Biochar Solution

- **ONE SOLUTION – Thermal Processing**
  - **NOT COMBUSTION!**
  - **Organics management through pyrolysis/gasification (thermal processing) and biochar production is one way to manage organics with additional benefits.**



# Biochar Solution

## Materials to be Accepted

- Municipal sludge/biosolids
- Ag & forest product materials
- Food waste and other organics



## Multiple Biochar End Product Uses

- Biochar - USBiochar Initiative, IBI
  - Biochar product quality standards
  - Carbon credits –
    - biochar is considered “durable” carbon removal when land applied
    - Quickly growing in carbon economy
    - Carbon may be the driving factor in next 2 yrs



# Biochar Solution

## End product uses (cont.)

- Agronomic amendment – soil health, moisture & nutrient retention
  - <https://www.ecochar.org>

**Soil Amendment:** Ecochar deposits the carbon and nutrients from the source material back into the ground. This not only enriches the soil, but does so in a form that isn't susceptible to nutrient leeching/run-off, due to the absorbent nature of the char.

**Vital Force:** Our proprietary blend of ingredients includes everything plants need to succeed.

**Animal Bedding:** Ecochar is highly effective at moisture and ammonia reduction, leading to a more pleasant environment and healthier animals. In poultry houses, weight gain consistently increased due to reduced ammonia and moisture content. An ammonia reduction of 30% was observed when using char in horse stalls.

**Odor Control:** Activated carbon is an essential part of most odor filtration devices. Ecochar has been proven to be effective in odor reduction, and is viable as a filter medium. An example of its effectiveness comes from a customer, who stated they were cleaning out their guinea pig and rabbit cages every two days, and were able to reduce the frequency to every two weeks after the addition of char to their litter.

**Water Filtration:** The ability of Ecochar to filter and absorb fine particulate also makes it great for use in removing unwanted contaminants from water sources.

**Moisture Retention:** Ecochar is able to absorb 2-5 times its weight in water, depending on the source material of the char. When used agriculturally, this allows for a significant reduction of water usage due to avoidance of runoff.

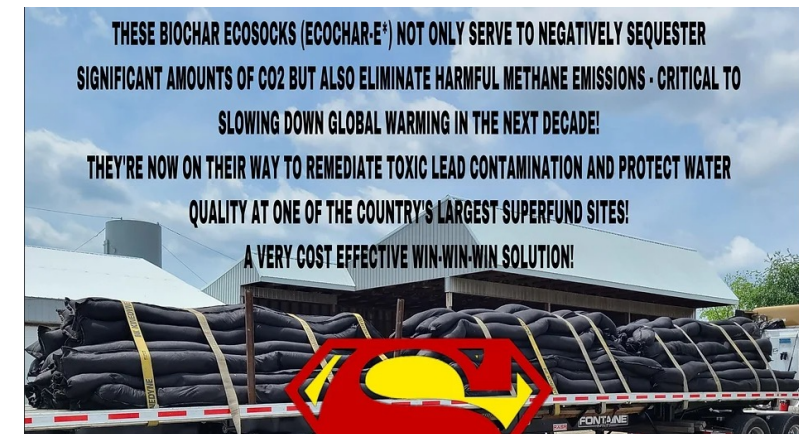
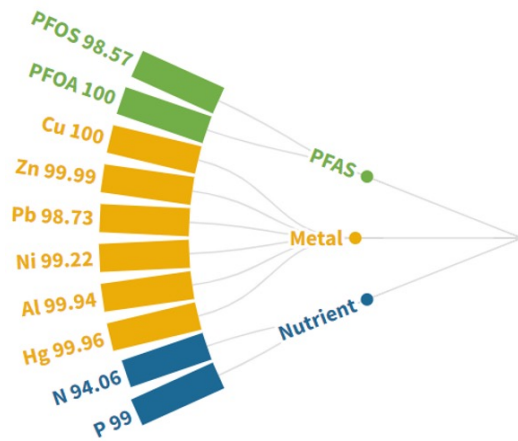
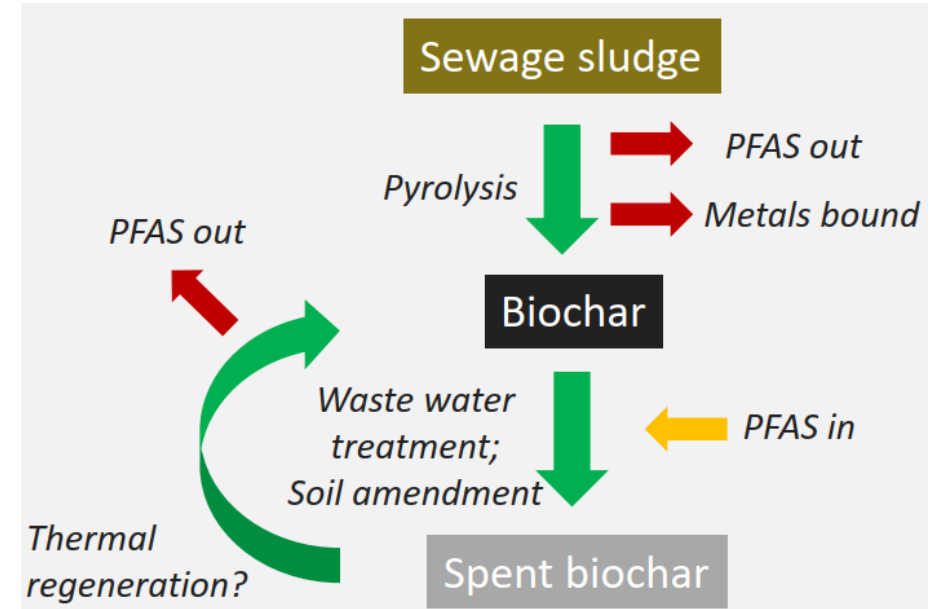
**Mushroom Substrate:** It is an effective replacement for peat moss as a casing layer when growing mushrooms.



# Biochar Solution

## End product uses (cont.)

- Filtration media –
  - Metals & VOC capture/filtration
  - PFAS capture (evolving) – allows for circular treatment system as thermal process breaks significantly reduces PFAS in the solid material
  - Brownfields site remediation – sequester metals
  - <https://www.ecocharenvironmentalsolutions.net>

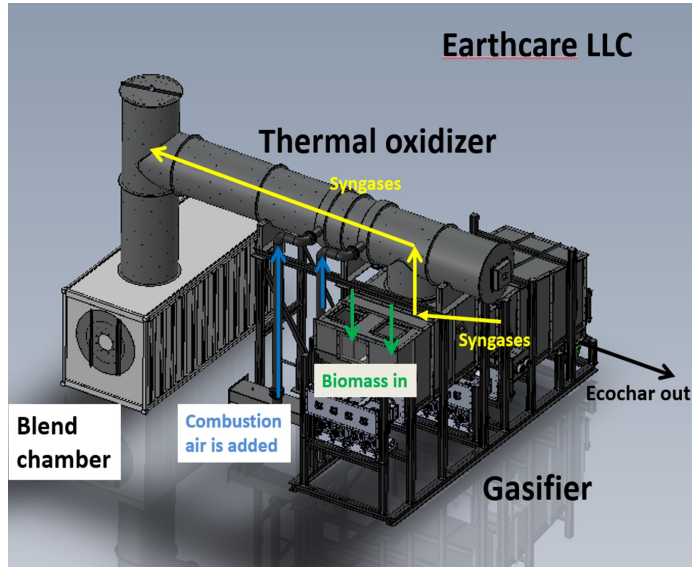


# Biochar Case Study

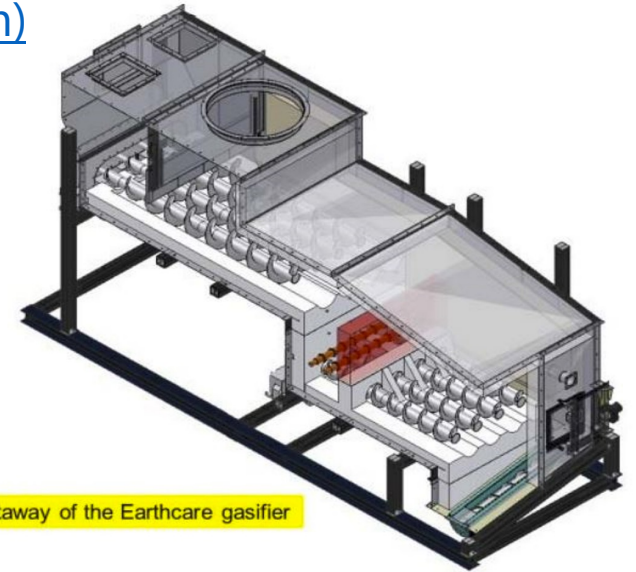
- Teaming with Earthcare, LLC a organics solutions provider in the organics management space on Bethel Twp. PA site
  - Leader in biochar production technology related to non-wood feedstocks (ex. ag manure, etc)
  - (3) facilities in the US; (10) operational units (at scale 30,000 -70,000 wet TPY) world wide
  - Sister companies to market end product (Ecochar<sub>TM</sub>)
    - Ecochar Environmental Solutions
    - Vital Force
    - Ecochar



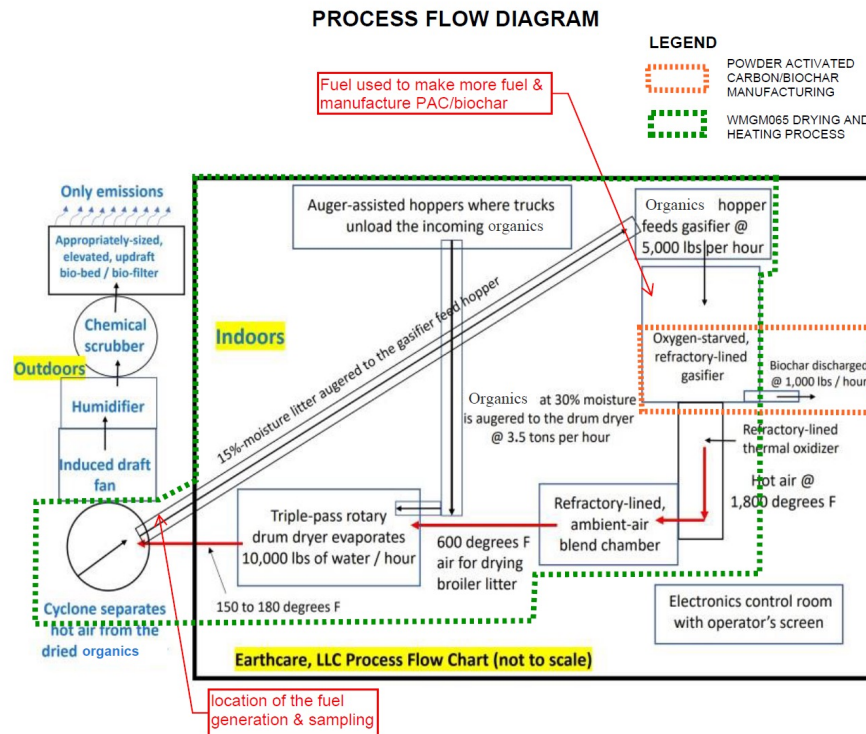
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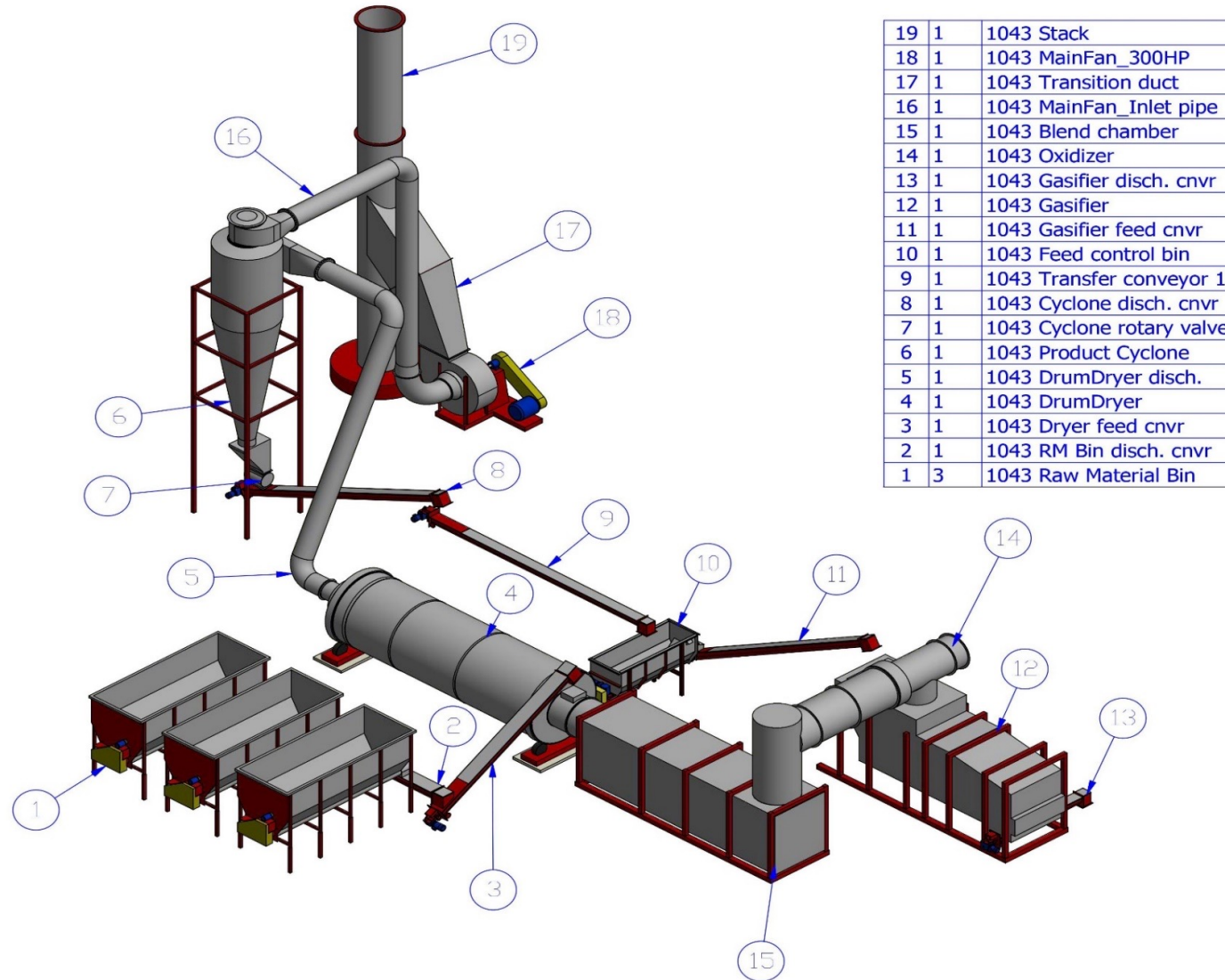
[Walkthroughs | Earthcare \(earthcarellc.com\)](http://earthcarellc.com)



Cutaway of the Earthcare gasifier

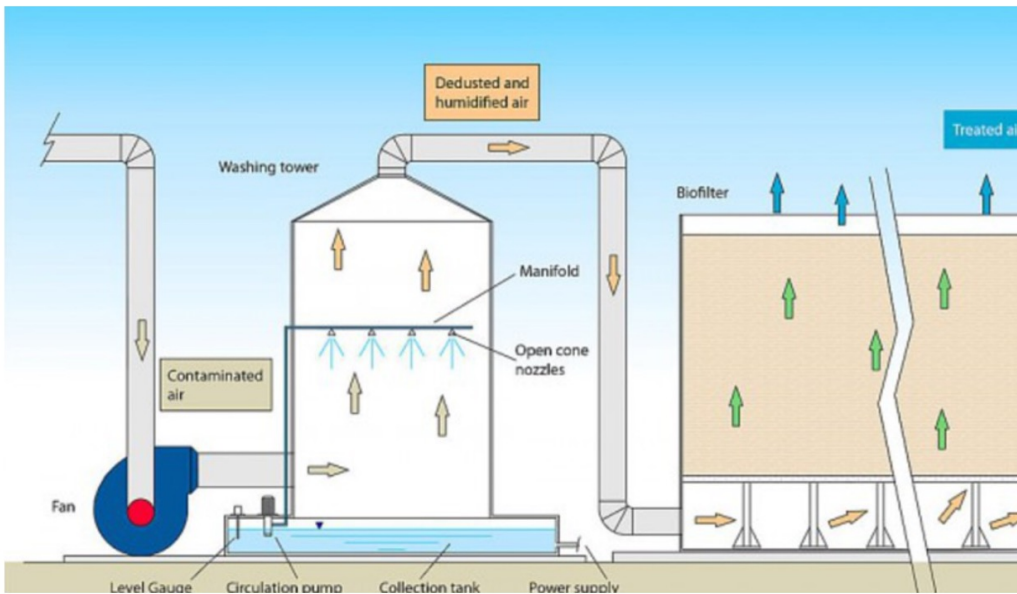
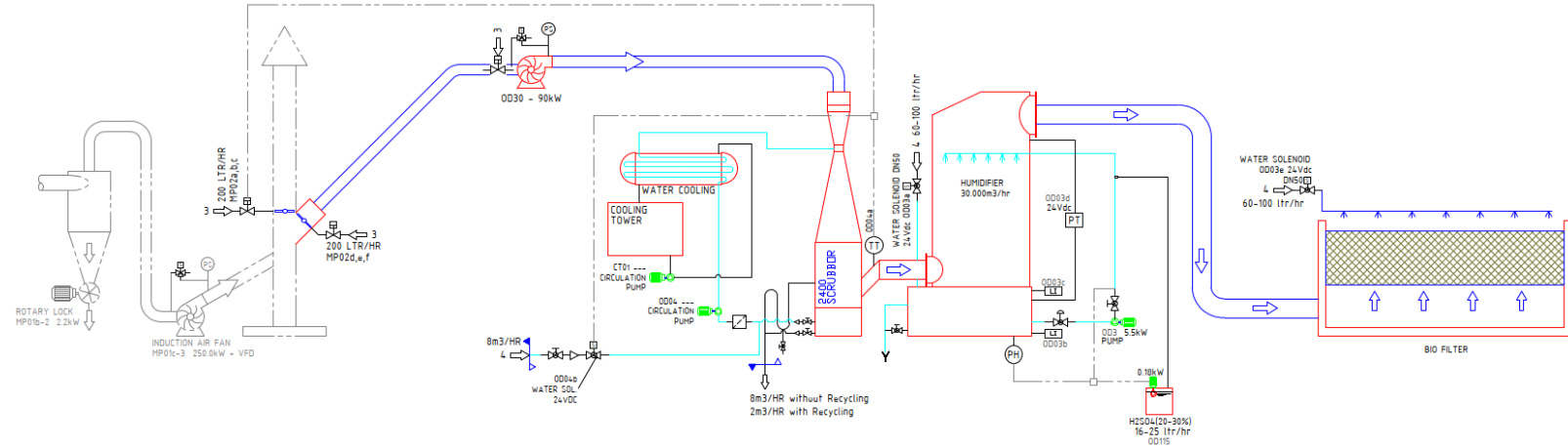


# Biochar Case Study





# Biochar Case Study



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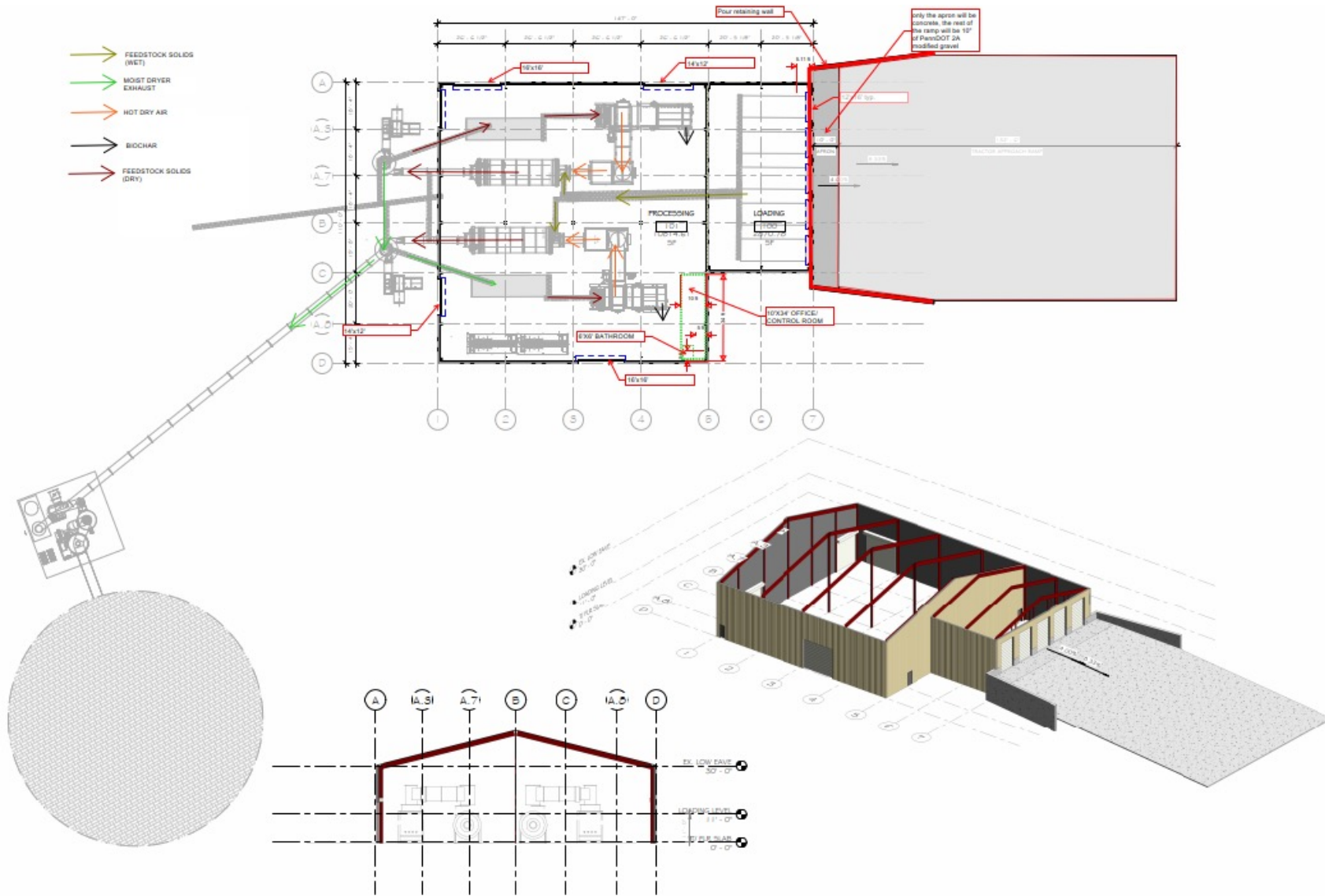
- Location: Bethel Twp., Berks Co., PA
- Capacity: Up to 100,000 TPY of mixed organics
- Feedstocks: 60,000 TPY of biosolids (under contract), remaining chicken manure, spent hens, dewatered dairy manure, saw dust, etc
- Products: 7,000 TPY of biochar, hot air for feedstock drying, condensed/recycled water for biochar quench
- Financing: \$15M state processed taxed and non taxed bonds to private investors
- Permitting:
  - Local zoning & land development permits, building permits
  - State PADEP air permit/air plan approval, modification to solid general permit WMGM065

# Biochar Case Study

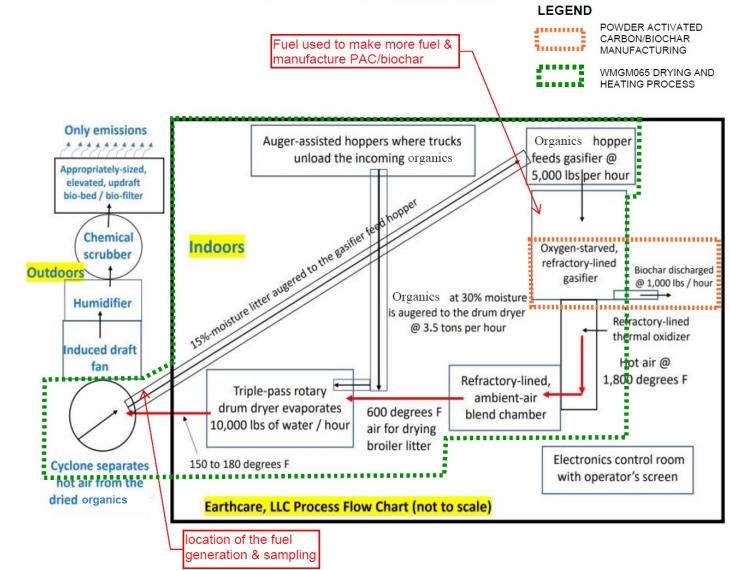
## Bethel Construction schedule:

- Site development & foundations - Feb - April
- Major equipment install - May-July
- Building install - June
- Electrical & controls - June - Sept
- Odor control equipment - Sept
- Start up & commissioning - Sept - Oct
- Operational - Oct - Dec

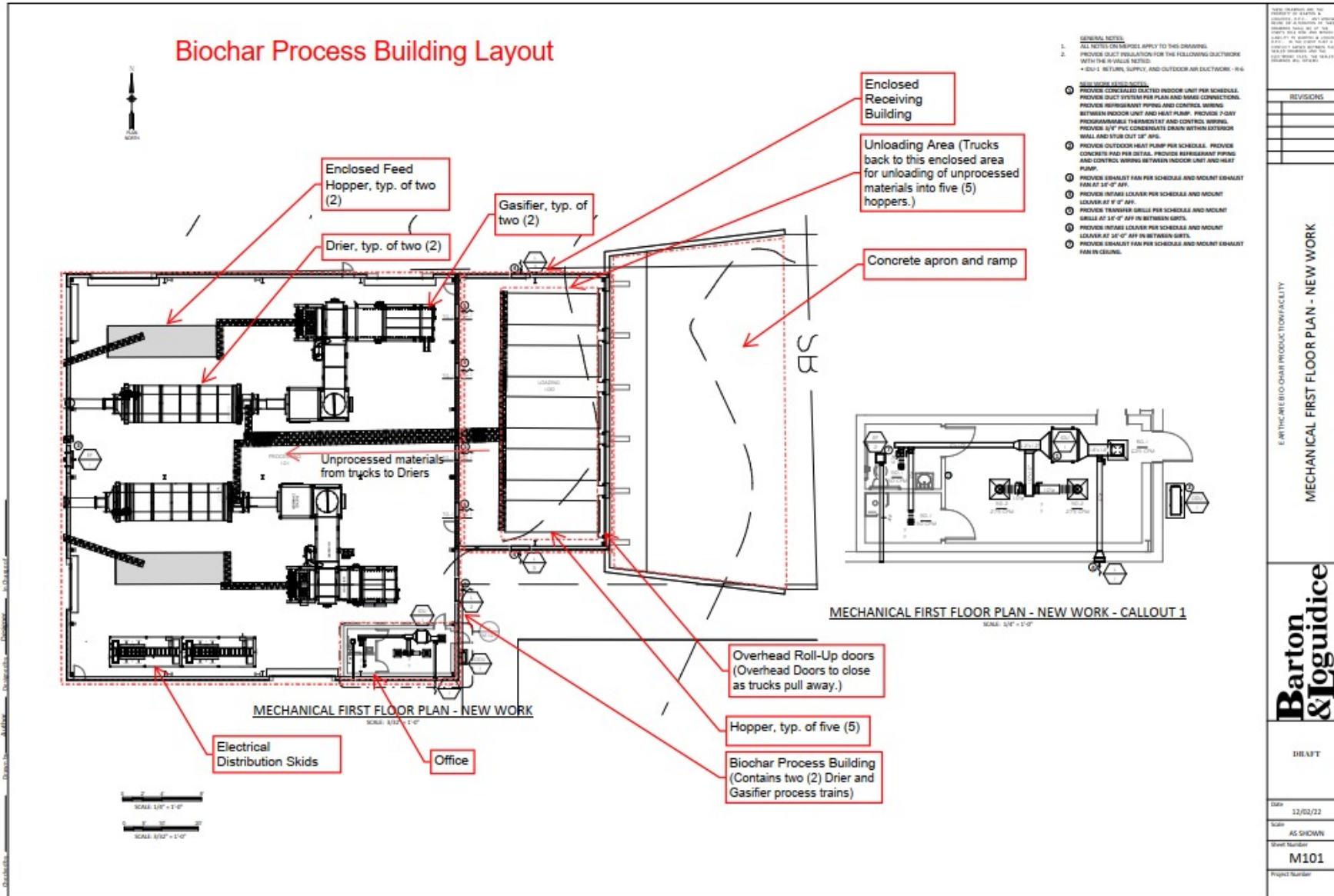
# Biochar Case Study



## PROCESS FLOW DIAGRAM



# Biochar Case Study



# Biochar Case Study



# Biochar Case Study



# Biochar Case Study





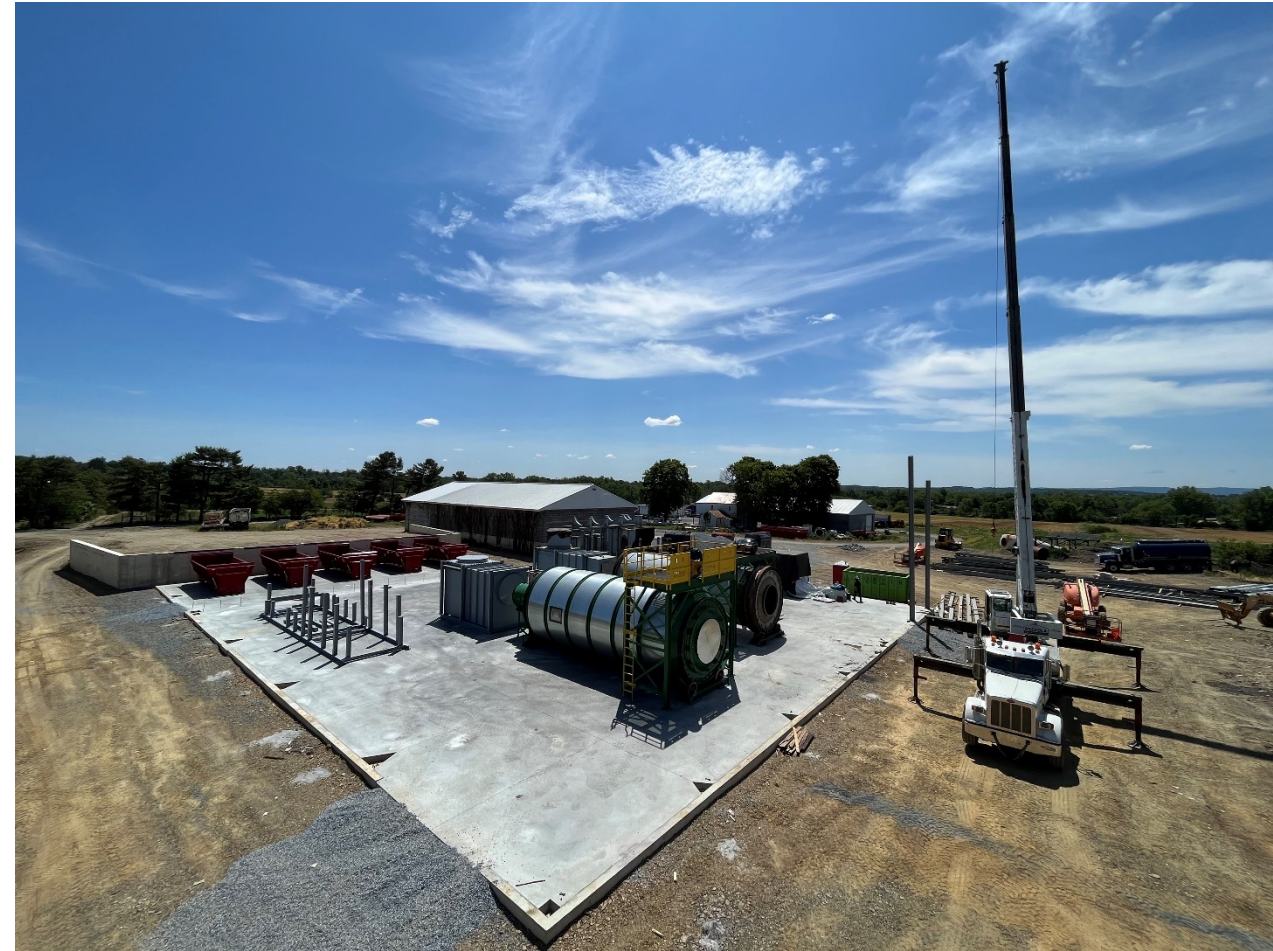
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# Discussion/Questions