Brown AND Caldwell

New England Water Environment Association

Drying and Thermal Treatment Technologies for Biosolids Management

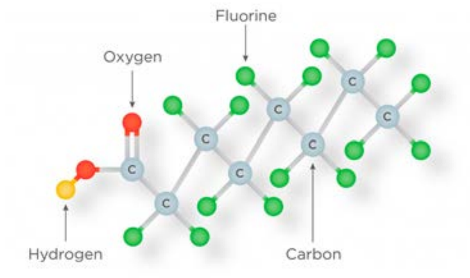
October 7, 2021

Today's Agenda

1. Biosolids Management
2. Dryer Feasibility Case Study: LAWPCA
3. Post-Drying Thermal Technologies
4. Questions

Biosolids Management

PFAS Concerns



Maine DEP Establishes Aggressive Requirement for PFAS Testing in Biosolids

'Forever chemicals' found in 18 private wells near Fairfield dairy farm

Presque Isle to spend $15.6M fixing its wastewater sludge problem

Maine DEP enacts biosolids screenings standards

Concerns grow over tainted sewage sludge spread on croplands

Bulk agriculture land application of biosolids slows to a halt…

Market Overview

- Across the Eastern US, landfill costs are going up 50-200%
- Landfills are getting tired of biosolids
- In the Northeast, land application opportunities are limited
- PFAS concerns exerting additional pressures (PFAS riders in contracts)
- Have observed management costs as high $200/WT in New England

Why Evaluate Thermal Drying

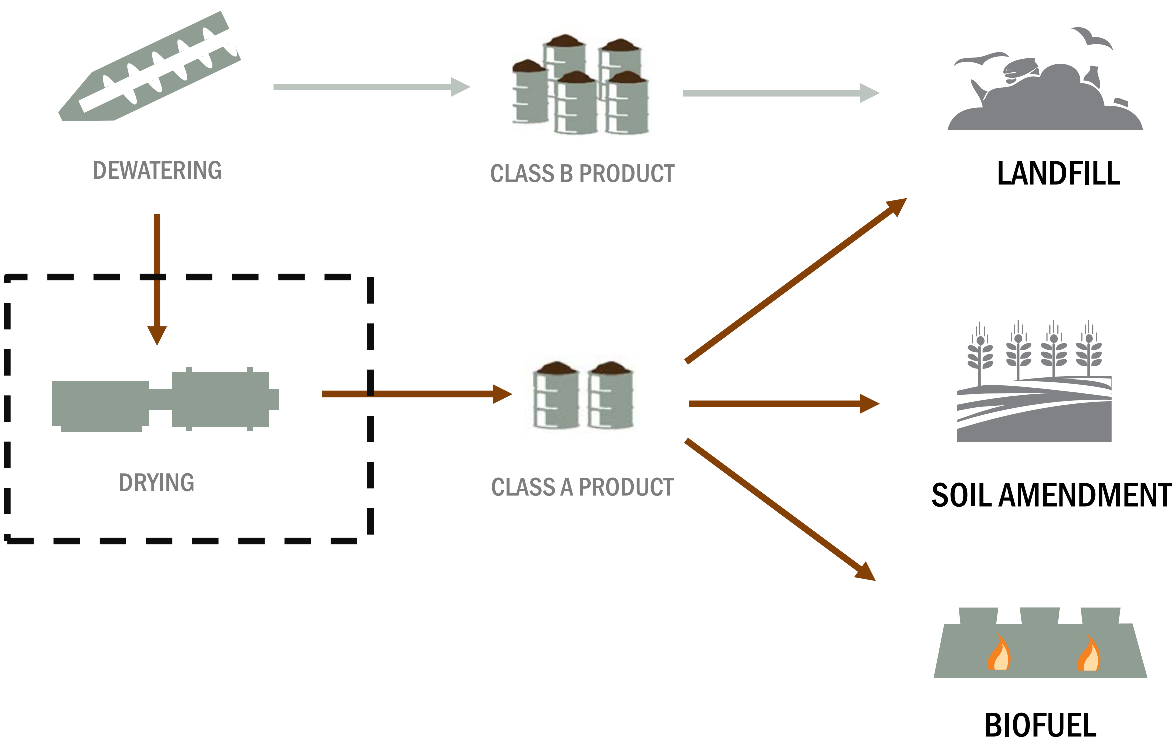
Pros

- Volume Reduction (70%-85%)
- Reduces Truck Traffic and Disposal Fees
- Class A Beneficial Reuse
- Less Odorous Product

Cons

- Energy Consumption
- Safety Concerns
- Capital Investment
- Does Not Destroy PFAS

Drying as a Tool to Address Biosolids Management Risks



Reduced volume, moisture, content and odors makes dried product more amenable to landfilling

Opens up non-agricultural and soil or fertilizer blending outlets

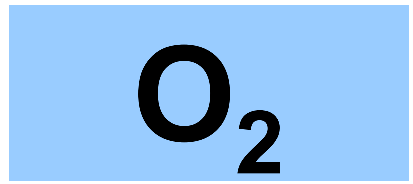
Can be used as alternative fuel for offsite industry or incorporated into future non-incineration destruction process

Energy Content of Solids

~8,000 Btu/lb

Combustion Risk

- Oxygen
- Ignition Source
- Combustible Dust

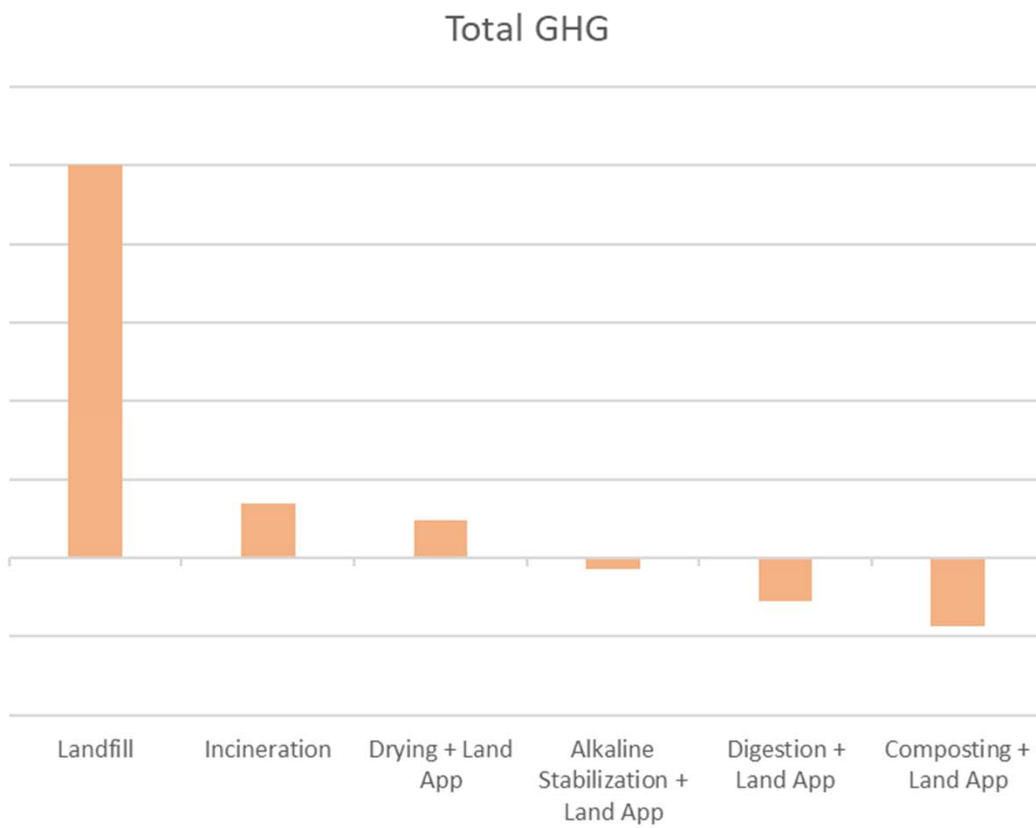


Critical Temperatures	Degrees F
Temperature at which self heating can occur	±122
Minimum dust cloud ignition temperature (NFPA 654)	329

Source: UK HSE

Why Thermal Drying Now?

- Tipping point for management fees
- Can be compatible with GHG goals if beneficially used
- Emergence of lower-cost belt dryers



Dryer Feasibility Study: LAWPCA

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Lewiston-Auburn Water Pollution Control Authority

- In 2020 Compost Facility closes, PFAS impacts land application
- Current Disposal consists of trucking digested sludge predominantly to offsite landfills
- Offsite disposal increased 70% to $95 a ton (including transport)
- PFAS concerns continue, future impacts are unknown
  - USEPA risk assessment ongoing
  - Maine PFAS surcharge fee being considered

Lewiston-Auburn Wastewater Treatment Plant

Design Capacity

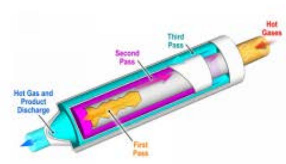
- Average flow: 14 MGD
- Average Solids Production: 17 wtpd anaerobically digested

Former Compost Facility

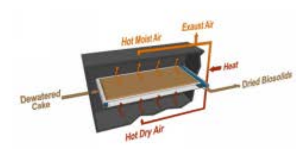
Existing Conditions

High-Level Dryer Overview and Screening

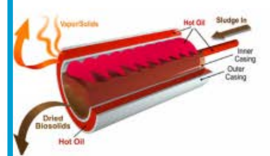
Rotary Drum



Belt



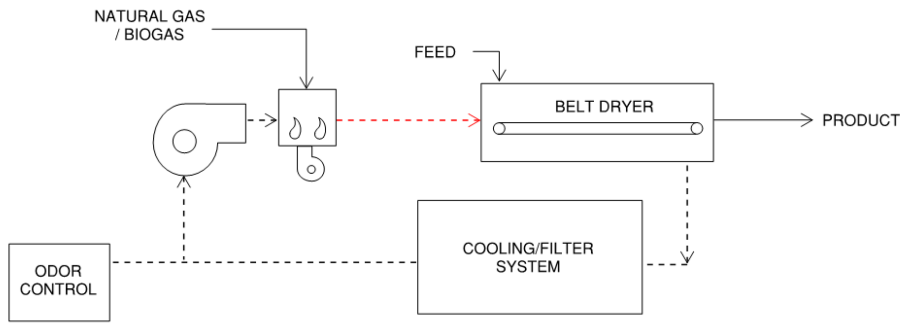
Contact (Paddle)



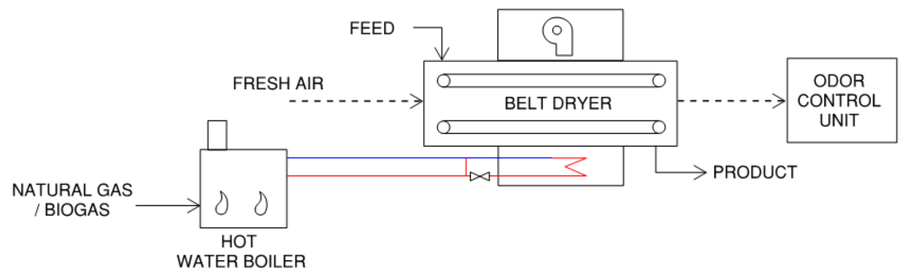
Greenfield Dryer Installation at Small – Medium Sized Facility	Rotary Drum	Belt	Contact (Paddle)
Appropriate to Size	2-3d/wk operation	Can run 24/7	Can run 24/7
Operational Complexity	Highest	Moderate	Lower (8hr shutdown)
Capital Cost	3.0x	1.0x	1.5x
Product Quality	Highest	Moderate	Lowest/Dustiest

Belt Dryer Type Comparison: Heating

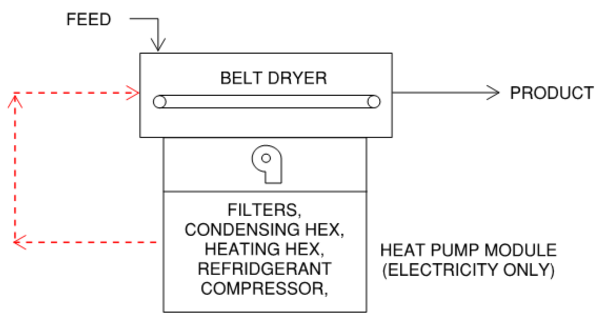
Direct-Fired (Gryphon, Haarslev, Andritz)



Indirect-Fired (Shincci, Huber, Suez, Kruger, Andritz)



Heat Pump (Shincci, Suez)



Belt Dryer Commercial Offerings

Established

Manufacturer	US Installs	Operating Yrs.	Heating	Product Screening
Andritz	5	40	Direct/Indirect/Heat Pump	Y
Huber	5	16	Indirect	N
Kruger	7	62	Indirect	N

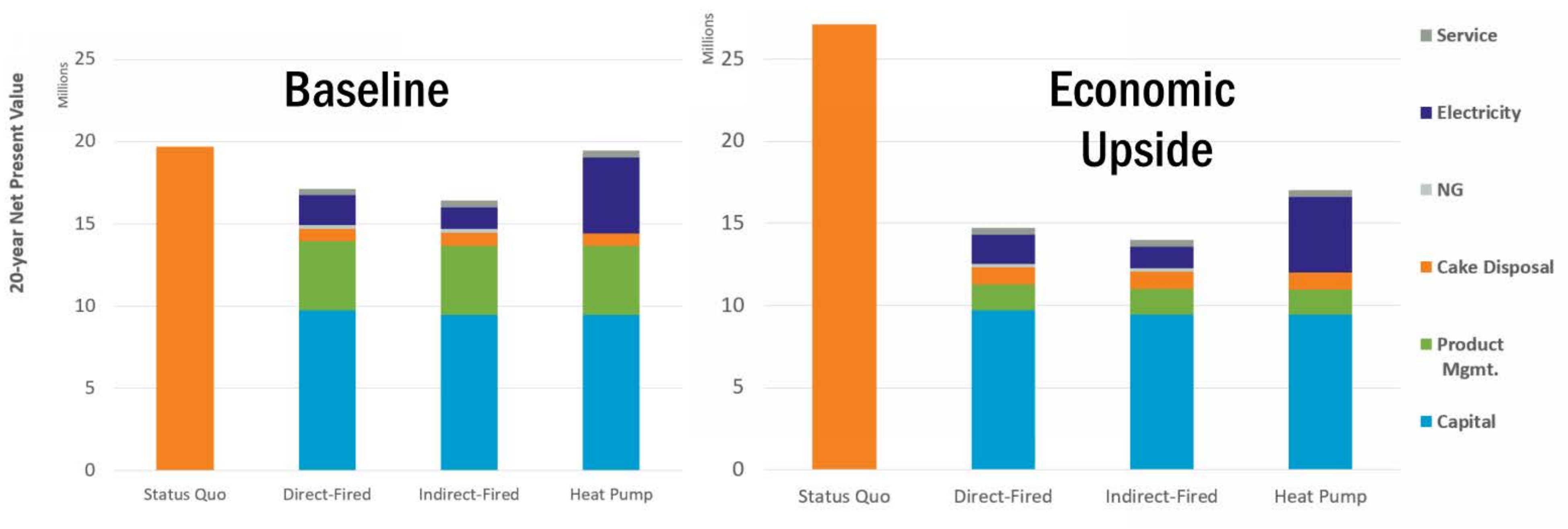
Emerging

Manufacturer	US Installs	Operating Yrs.	Heating	Product Screening
Gryphon	2	2	Direct	N
Haarslev	3	11	Direct	Y
Shincci	2	1	Heat Pump	N
Suez	2	1	Indirect/Heat Pump	N

Dried Solids Market Analysis Findings

- There are limited bulk agricultural outlets for reuse of dried biosolids product with normal PFAS levels
- Application rates for bulk agriculture determined based on
  - PFAS sampling levels
  - Soil loading calculation spreadsheet (application rate and recurrence)
  - Assumed soil background levels (2019 Vermont background study)
- Most potential for reuse in non-agricultural soil or fertilizer blending

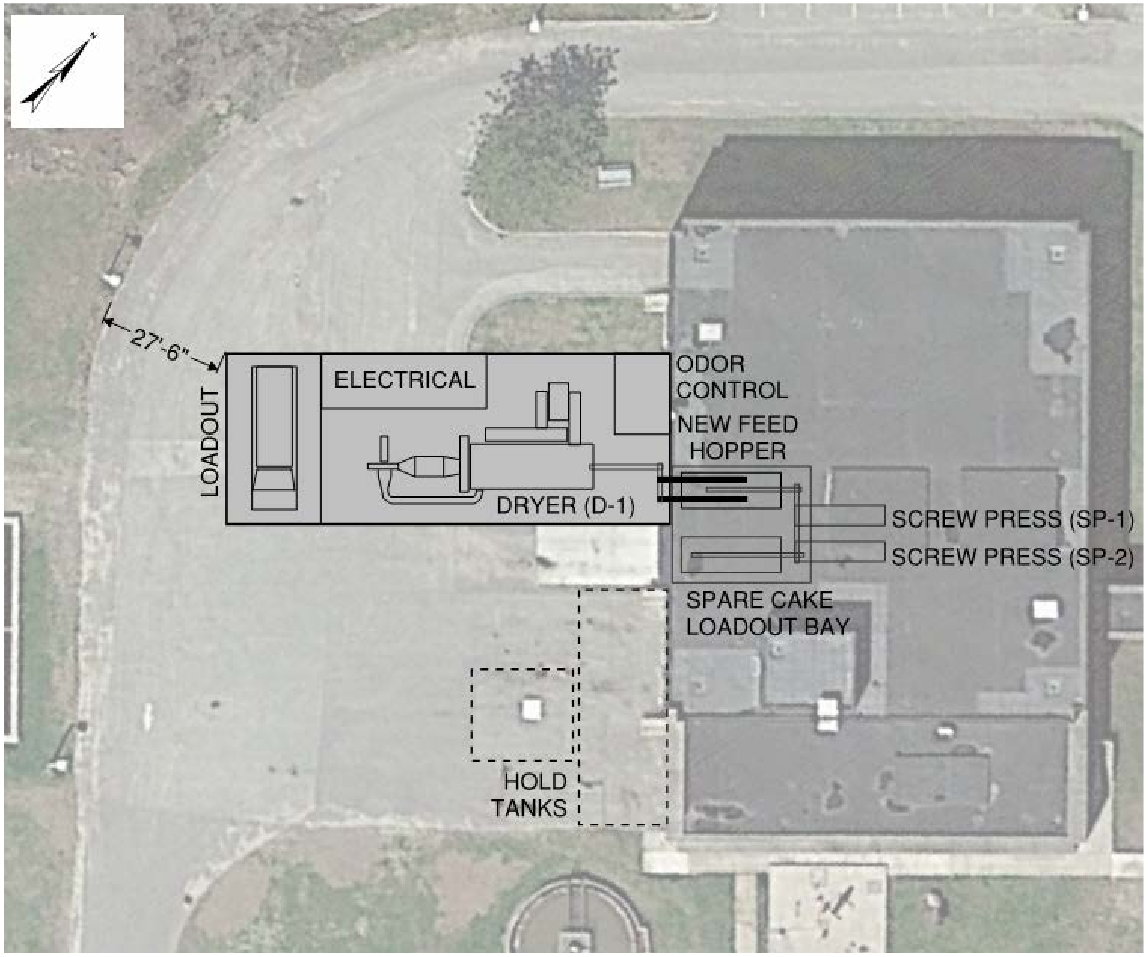
Report Review: Cost Comparison



Recommended Alternative: Indirect-Fired Belt Dryer with Building Addition

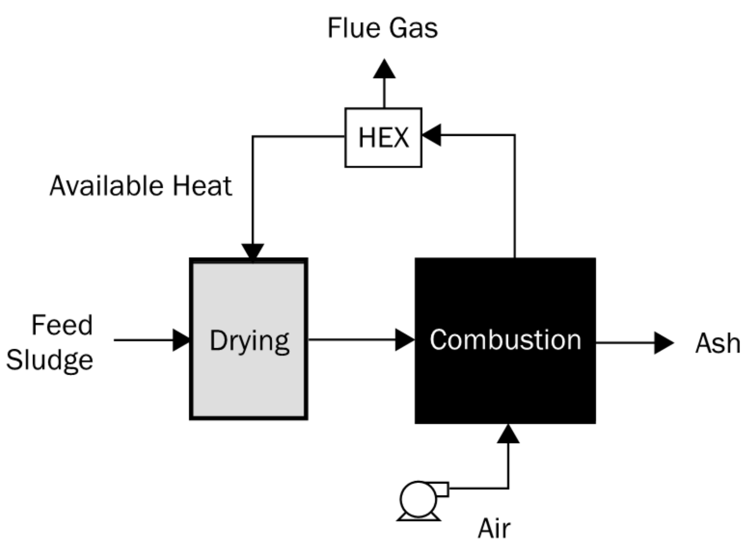
Key Advantages

- Class A product
- Utilizes Waste Heat from Biogas Cogeneration
- Lower Operating Temps for Safety in Operation



Post-Dryer Thermal Processes

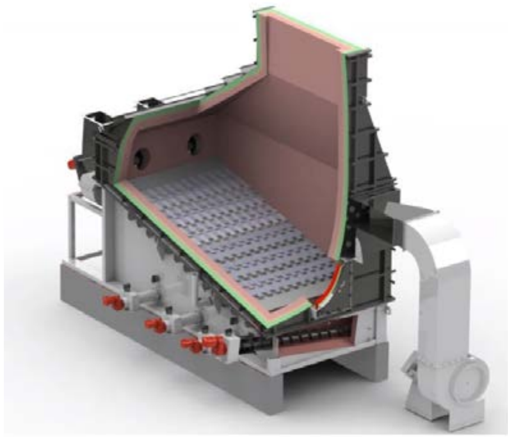
Pellet Furnace (Incineration)



Overview	
Process Air	>stoichiometric
Reactor Temp	800 - 980°C (<1,150°C)
Residuals	Mineral Ash

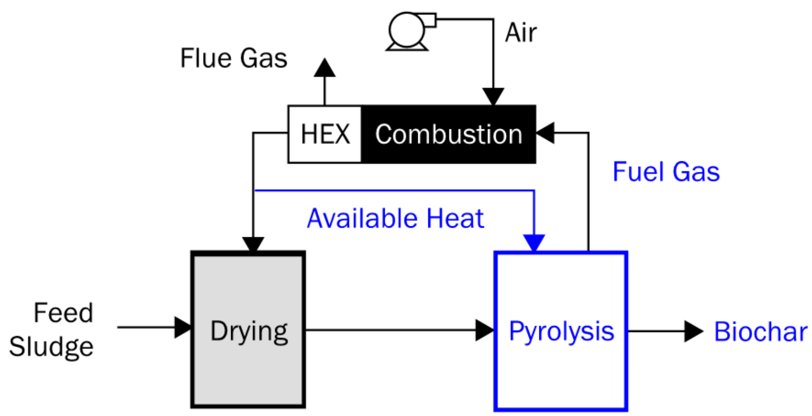
Buffalo, MN (2009)

- 15 wet tons per day
- Reported to save 70% - 80% of fuel costs with 95% mass reduction



Courtesy of Veolia

Pyrolysis



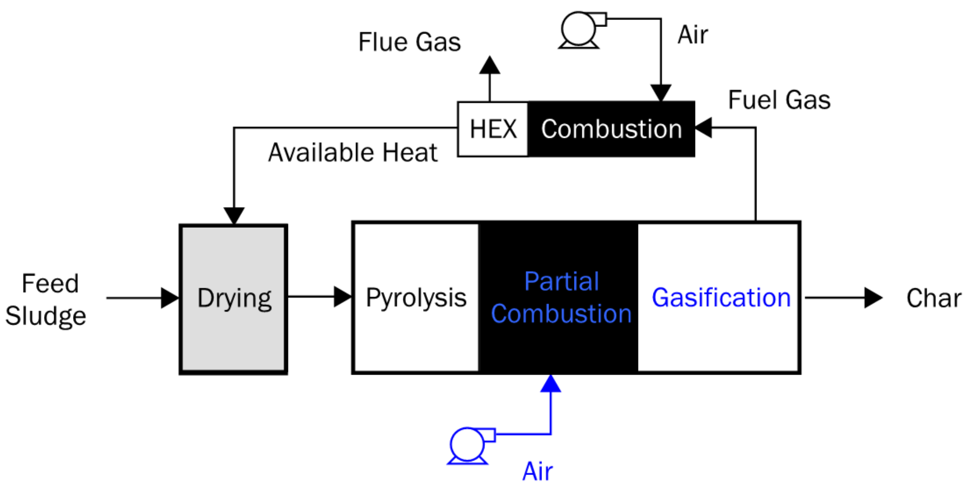
Overview	
Process Air	None
Reactor Temp	300 - 850 °C
Fuel Gas Oxidizer	850 - 980 °C (<1,150 °C)
Residuals	Char (~40% - 50% Carbon)

Silicon Valley CWA, CA (2018)

- 15 wet tons per day
- Inclined Screw Reactor

Courtesy of BioForceTech

Gasification



Overview	
Process Air	<stoichiometric
Reactor Temp	800 -1,000°C
Fuel Gas Oxidizer	850 - 980°C (<1,150°C)
Residuals	Char (~15% - 25% Carbon)

Morrisville, PA (2019)

- 35 wet ton/d
- Fluid Lift Reactor

Courtesy of Ecoremedy

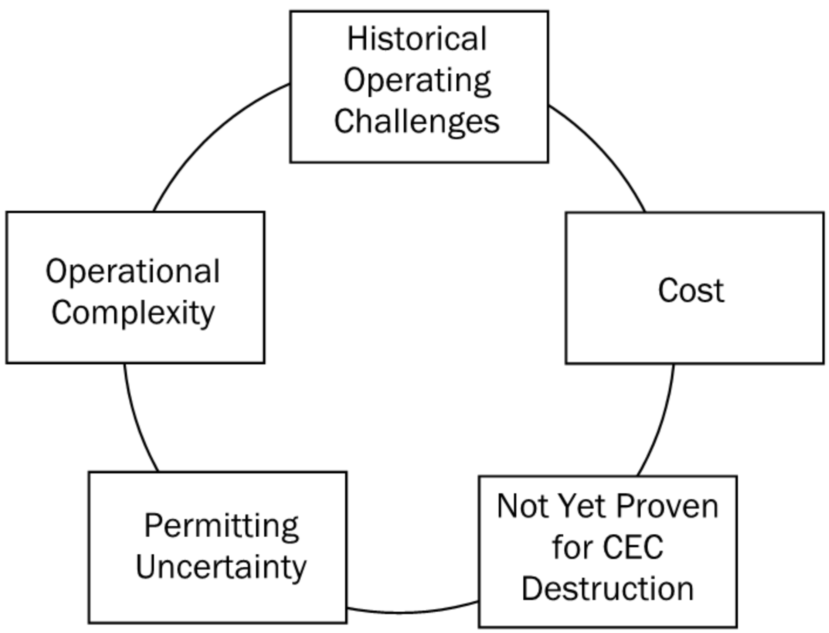
Lebanon, TN (2016)

- 32 wet ton/d (wood, tires and biosolids (10%)

Courtesy of Aries Clean Tech

Innovation Curve

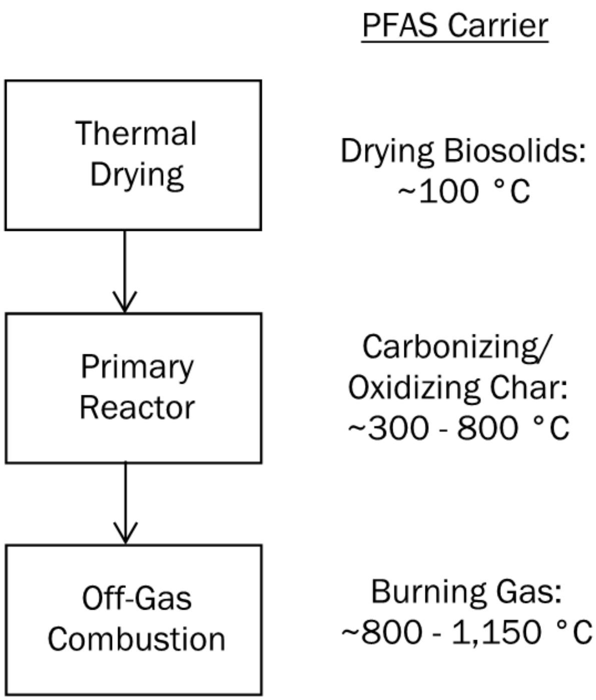
Barriers



Advancements

- Technology modifications to improve resiliency
- Multiple projects in development (with various implementation models)
- USEPA regulation development under way (advance notice released)
- CEC (PFAS) fate studies underway

PFAS Emissions Studies Update



PFAS Fate Data (ASTDR 2015; EFSA 2008; EPA 2016, 2017)		
	PFOA	**PFOS**
Boiling Point (°C)	192	260
Vapor Pressure (mm Hg)	0.525	.002

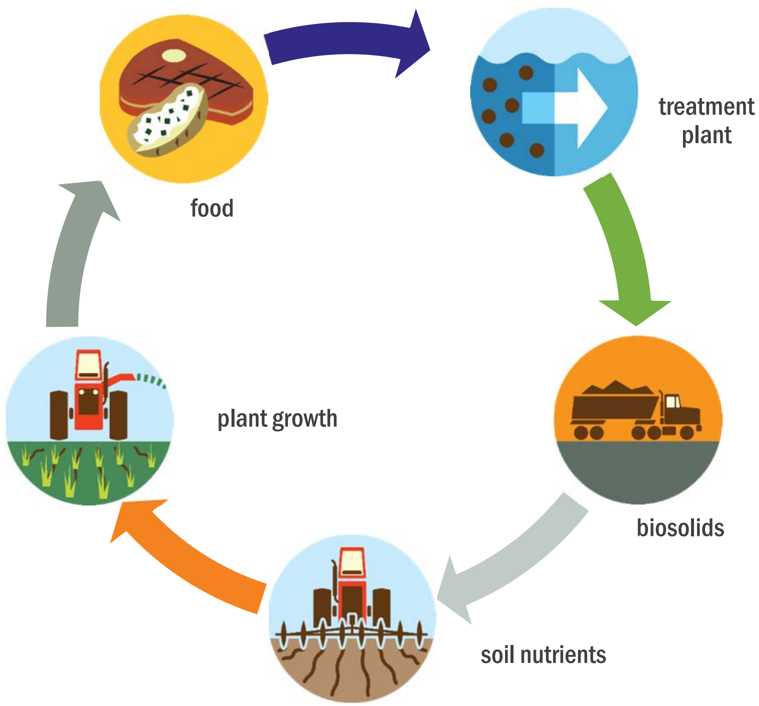
- What we know (USEPA, 2021):
  - PFAS functional groups easy to remove/oxidize
  - Small chain, decomposition products are not
- What we don't know
  - What products of incomplete combustion remain?
  - WRF Project #5111 underway to perform emissions testing for polar, non-polar, volatile, semi-volatile, and non-volatile PFAS and transformation products in SSI stack

https://cfpub.epa.gov/si/si_public_file_download.cfm?p_download_id=539933;
Studying the Fate of PFAS through Sewage Sludge Incinerators | The Water Research Foundation (waterrf.org)

Conclusions

Conclusions

- Recent trends in solids management have made thermal drying a favorable solution to reduce programmatic risk
- In NE, chief benefit is volume reduction with potential diversification of outlets
- Appropriate technology selection and site-specific considerations critical to successful operation
- Drying can provide first step of PFAS treatment process



Thank you.
Questions?

Don Song, P.E.
dsong@brwncald.com

John Ross, P.E.
jross@brwncald.com

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