Torrefaction

The Evolution of the Dark Side

What is Torrefaction?

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- Cooking biomass feed stock in a low oxygen environment
- Vaporizing moisture from the wood
- Capturing and burning the natural gases
- Chemically altering the composition of the material.
- Substantially reducing the mass
- Stopping the process before it becomes Charcoal

How is it made?

Material is processed in one of several ways:

- In a sealed batch
- Using plugged sealed screws
- In a rotating drum
- On a vibrating bed

How is it heated?

- Indirect Natural Gas
- Thermal oil
- Hot gas from Syngas Combustor
- Microwave
- Oxygen is kept at a minimum to retard combustion

What can it be used for?

In Non-Densified Format:

- Soil Amendment (Biochar)
- Replacement for Fuel Oil
- Lump Charcoal
- Low Density Coal Supplement

What can it be used for?

In a Densified Format:

- As a direct replacement for coal
- As a replacement for white pellets with several benefits

What are the benefits?

- Higher Energy Content
- Lower Storage Requirement
- Greater Durability
- Moisture Resistance
- Lower Emissions
- Reduced Corrosion
- Elimination of Facility Conversion Costs

Why should I care?

- While torrefaction technologies have been slow to materialize on a large scale basis, work has continued at a steady pace, and there is clear evidence that it is now only a matter of time before large scale production capacity will be come a reality.
- You should care because as the scale of these facilities increase, their cost of production will decrease.
- As the cost of torrefied pellets becomes more attractive, the benefits will warrant a premium for a product with such distinct advantages.
- Integration of torrefaction in existing and new pellet plants should be considered as the technology emerges.

What are the challenges?

- Explosive Gasses
- Explosive Dust
- Containment/Bulk Storage
- Build-up in Ductwork
- Production Costs
- Mass Balance
- Consistent Densification

Which system is best?

Which system is best?

- Torrefaction is actually quite easy and essentially any biomass or organic material can be torrefied.
- The decision process starts with understanding your raw material
- Having raw material with a consistent moisture content is critical for some of the systems
- Pre-Drying is necessary for some processes
- Some systems require material to be reduced to a particular size
- Fines are a problem for some systems
- Some have a large footprint while others are quite small
- Most require material with a high VOC content
- The challenge is consistency

What's the perfect system?

- The lowest capital cost
- Easy maintenance
- The smallest footprint
- The lowest operating cost
- Ability to consistently densify
- Ability to use low cost feedstocks

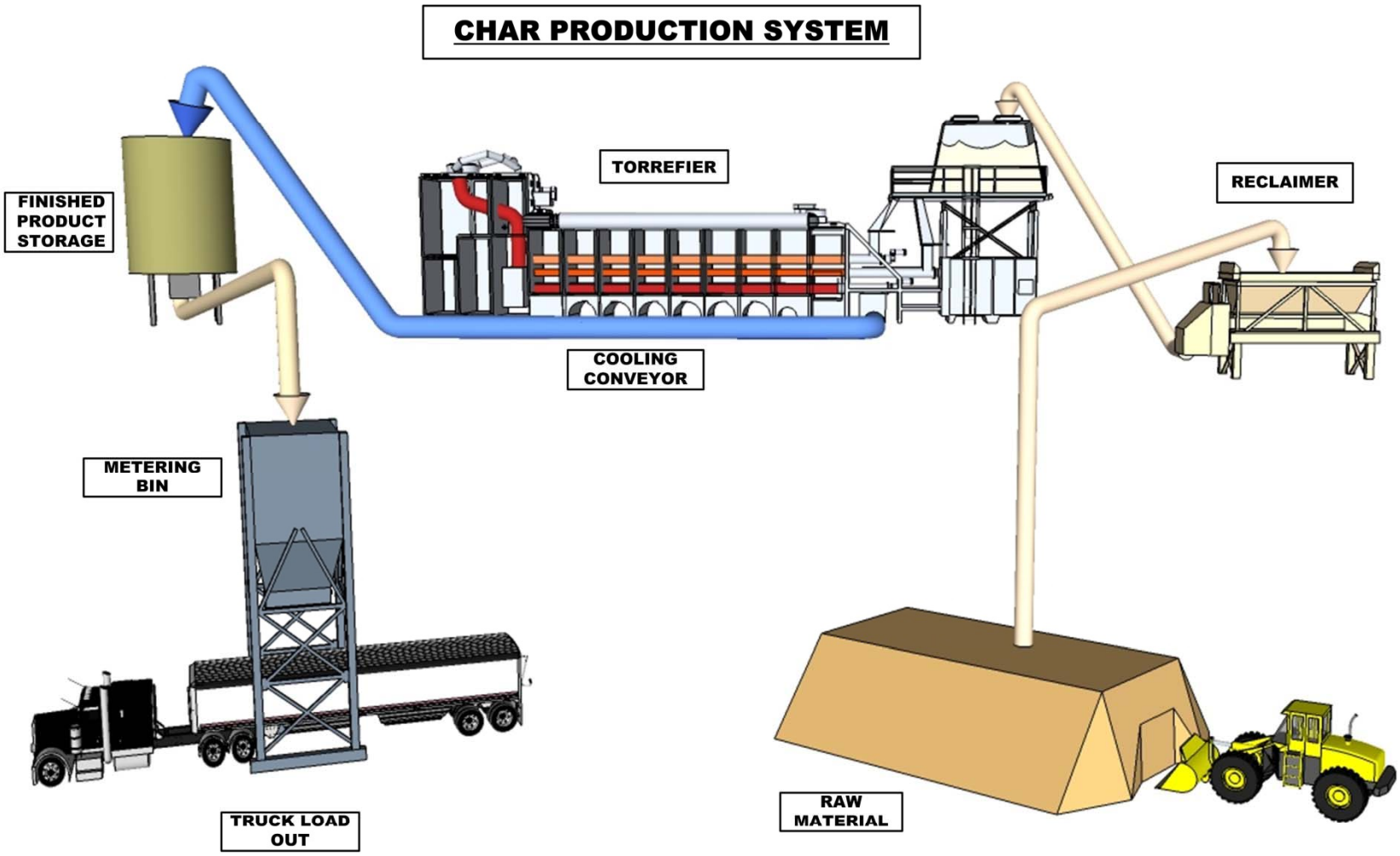
Just feed torrefied carrots to this guy and you have “the best” system.

What's the problem?

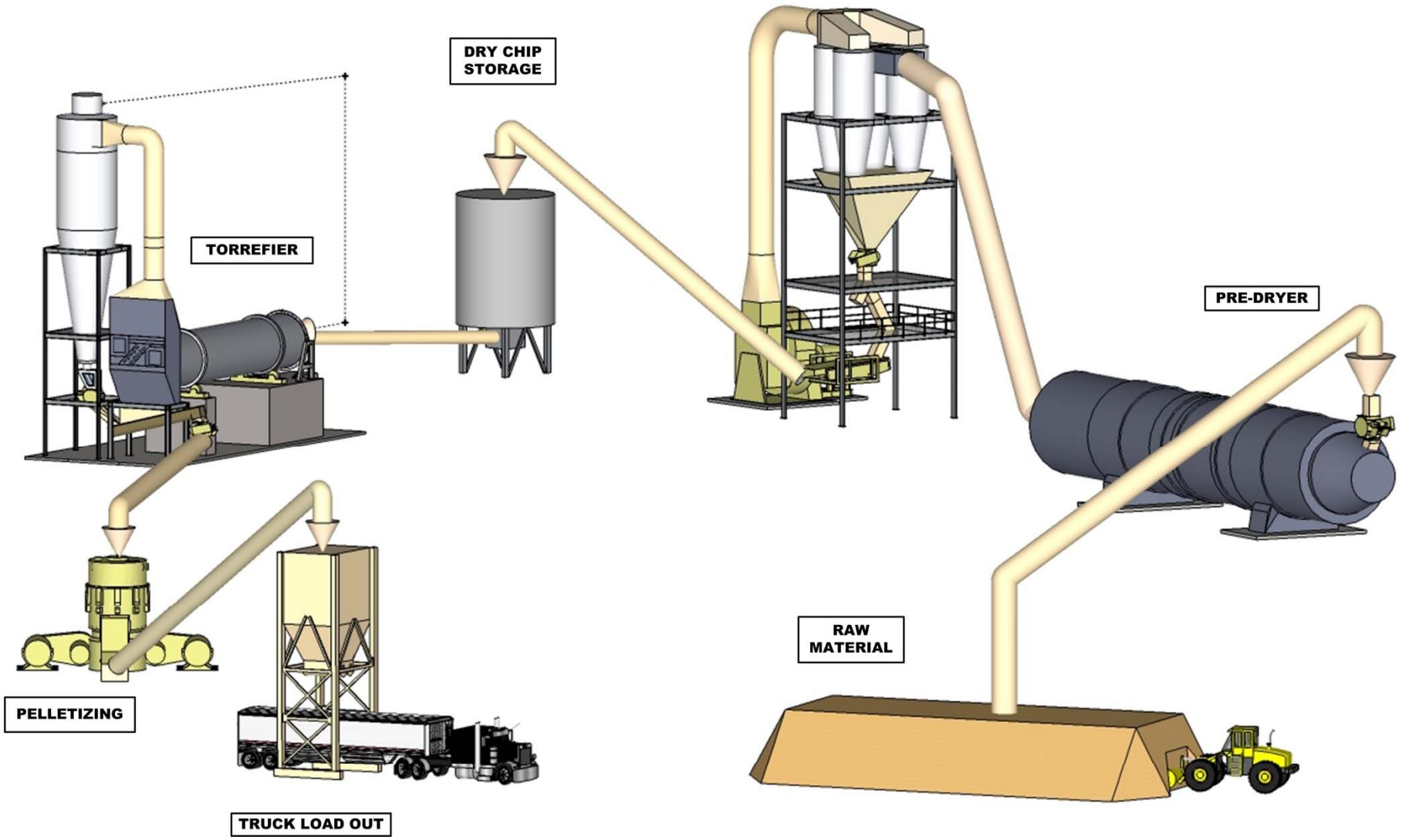
What's the problem?

- The problem is that pellets need to meet a specification.
- While our little friend can definitely densify, the problem is, as many have learned maintaining:
  - Durability,
  - Moisture Resistance,
  - Energy Density,
  - and Low ash content,
- Is quite a challenge.

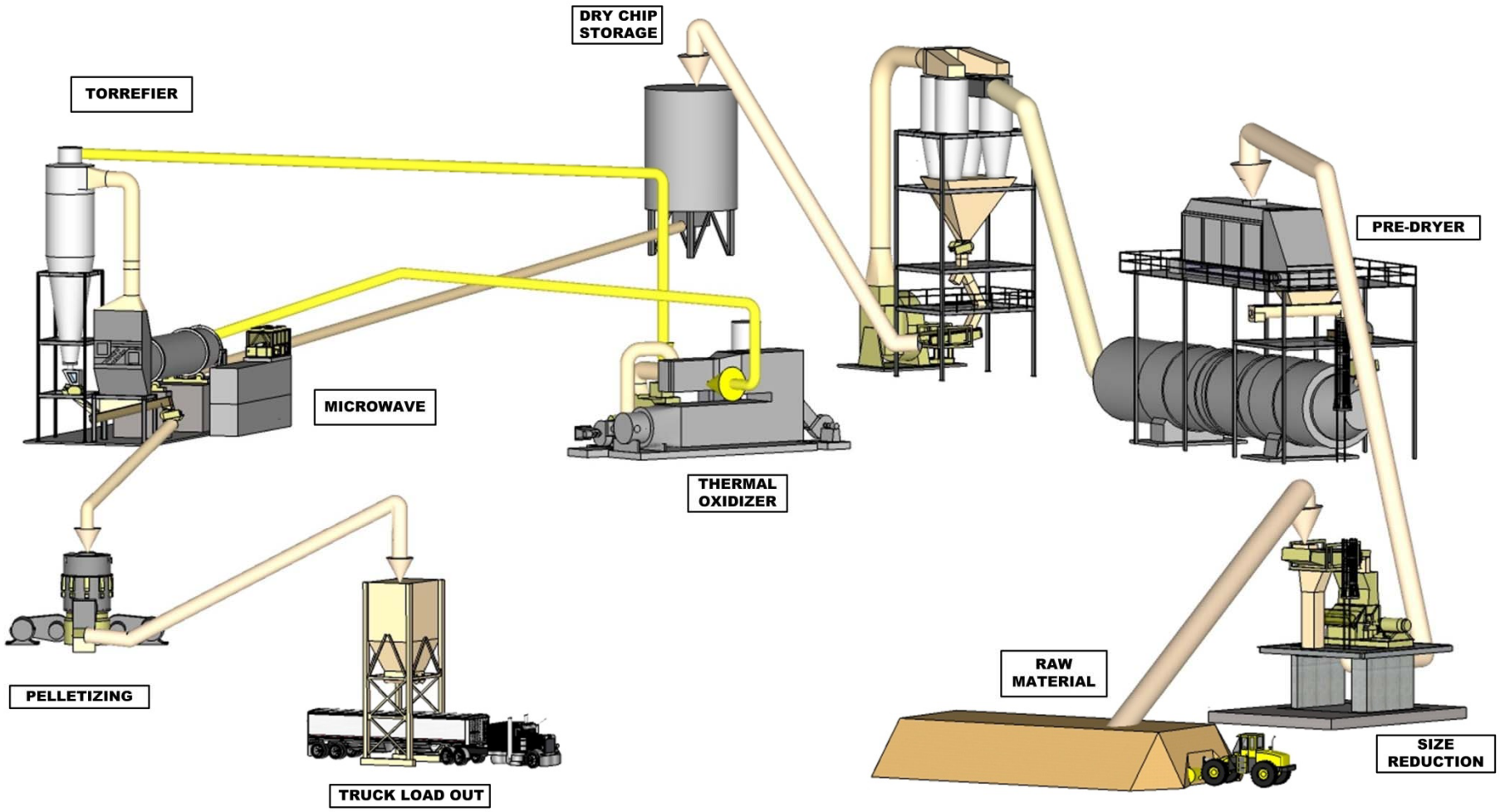
What does a system look like?



TWO-STAGE SYSTEM



MICROWAVE SYSTEM



How much does a system cost?

- The system you choose
- The output capacity needed
- Raw Material Sizing Requirements
- Whether pre-drying is required
- The infrastructure required
- Whether densification is needed
- The method of load-out to be used

Can it be integrated?

Yes……But:

- Integration varies depending on the type of torrefaction system selected.
- In general, torrefaction systems complement traditional white pellet processes but the physical layout will always present unique challenges.
- Size reduction of torrefied material requires significantly less energy that wood
- Most torrefaction systems can tolerate raw material with moisture contents higher than traditional white wood pellet processes.

What raw material works best?






What raw material works best?

- Almost any biomass can be torrefied. The question is whether the raw material will produce enough volatile gasses for the process to work without additional energy.
- Wood is the most common raw material being considered in the larger scale processes currently under development.
- Unlike white wood pellets, the species of wood does not make much difference in the torrefaction process.
- Tests have shown that white wood pellets can be torrefied reliably while maintaining their durability. The problem here is the resulting low bulk density.

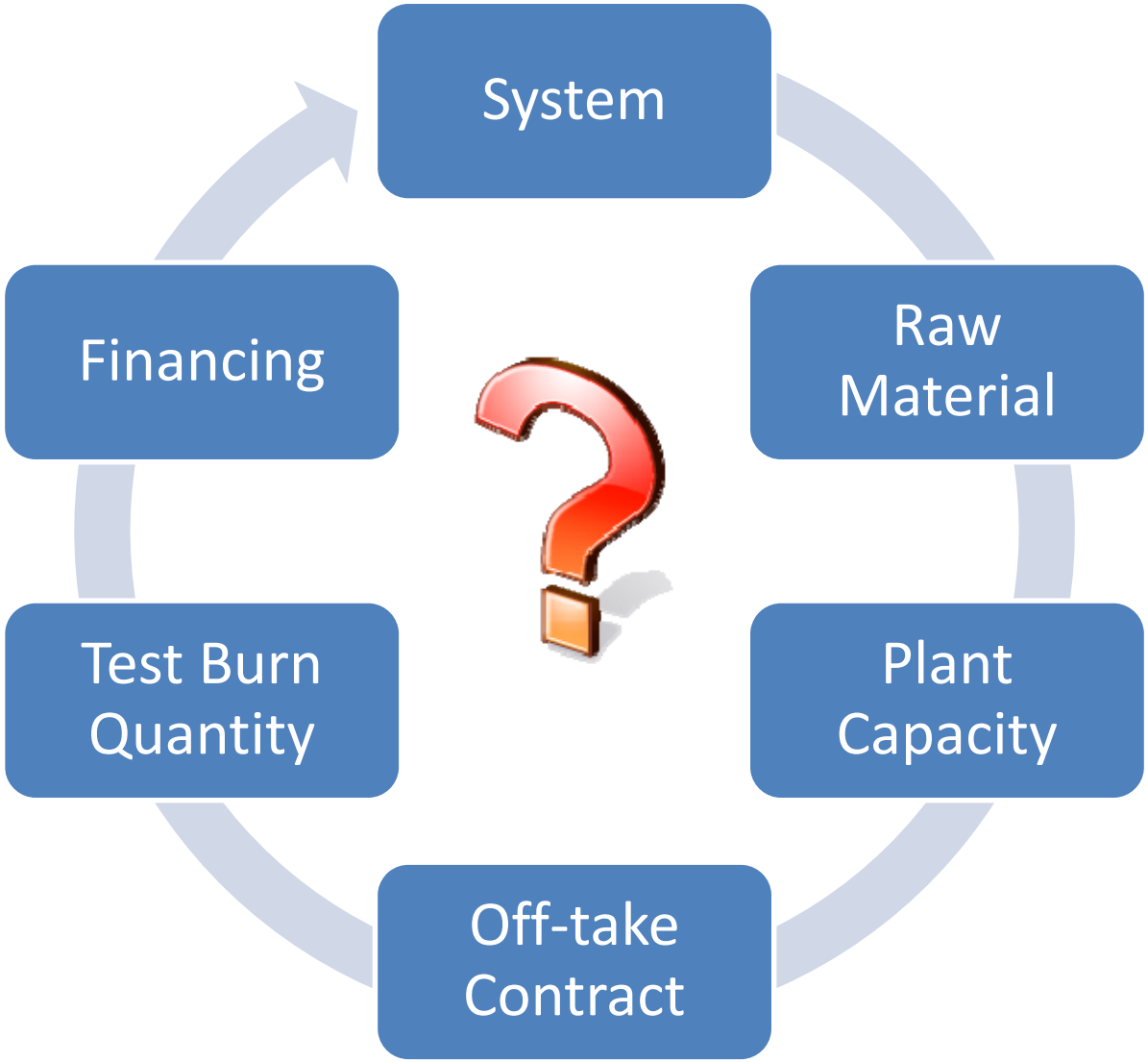
Where is the demand?

	Total electricity generation 2030 (TWh)	% coal-fired electricity supplied by torrefied biomass	Consumption of torrefied biomass as substitute for coal (million tonnes)
Germany	189	20%	16.9
UK	79	30%	10.6
Poland	137	20%	12.2
Netherlands	18	30%	2.4
Other Europe	311	10%	13.9
USA	1705	5%	38.1
Canada	81	10%	3.6
South Korea	291	10%	13
Japan	247	10%	11
Total	3048	8.90%	122

Where is the demand?

- While the “projected” demand appears high, the current demand is invisible due to the lack of production.
- The US has the “potential” to be the largest consumer
- The lack of production is due in part to the challenge of financing
- Long-term contracts would help with the financing but large customers want large test-burn quantities of high quality consistent material that meets their specification
- Without adequate confirmation, large customers are unlikely to offer long-term contracts

What's the bottom line?



What's the bottom line?

- There are several questions that need to be addressed that are unique to each project.
- Torrefaction process continue to be developed and refined.
- Large test burn quantities of consistent product are required to lure potential customers
- The process to produce densified torrefied biomass is not as "easy" as many have claimed.
- Issues remain to be solved but progress is being made in several areas by those with the resources and initiative to be first in the market.

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