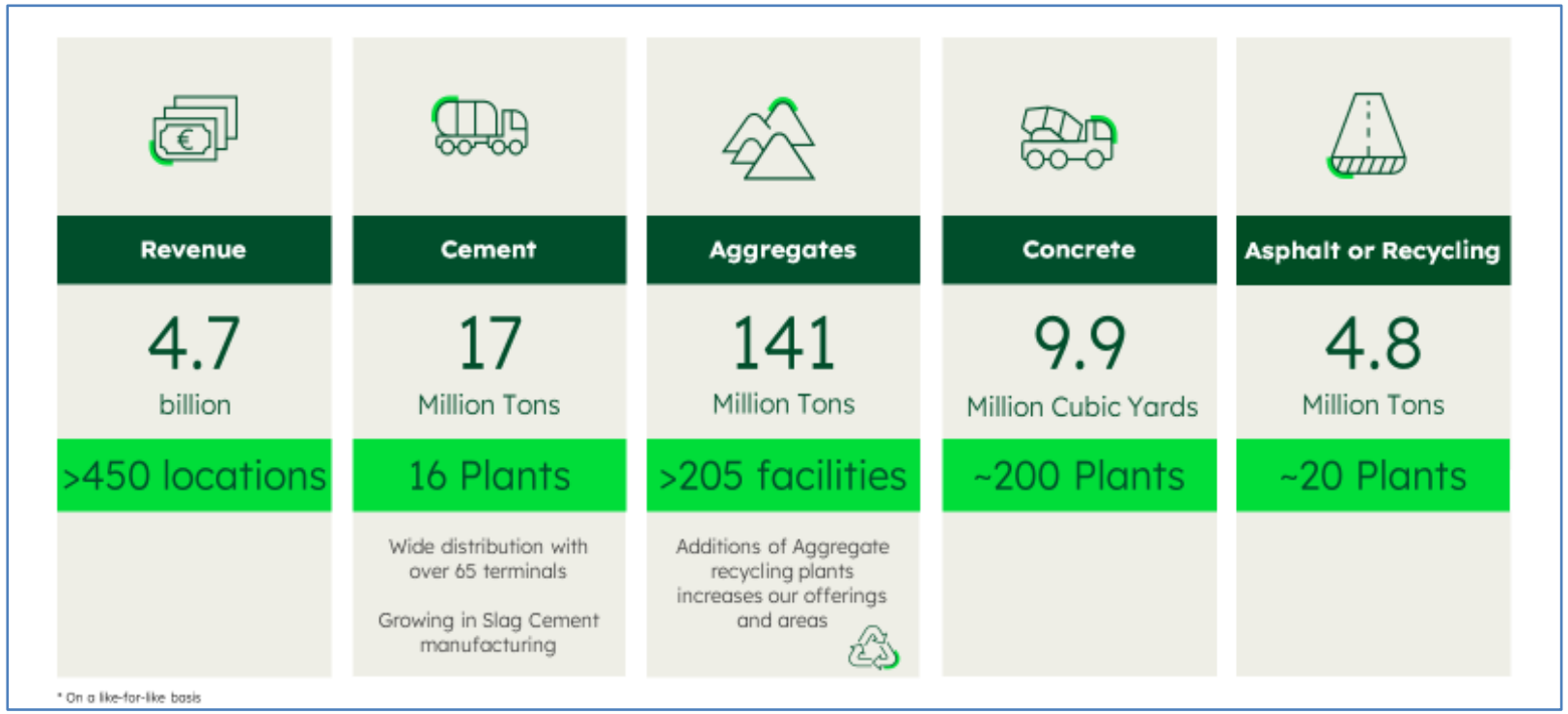
American Concrete Institute

Harvesting of Fly Ash - Sustainable Value and Benefits

Examine current technologies in processing coal ash deposits

Harvesting of Fly Ash - Sustainable Value and Benefits

Heidelberg Materials North American Business

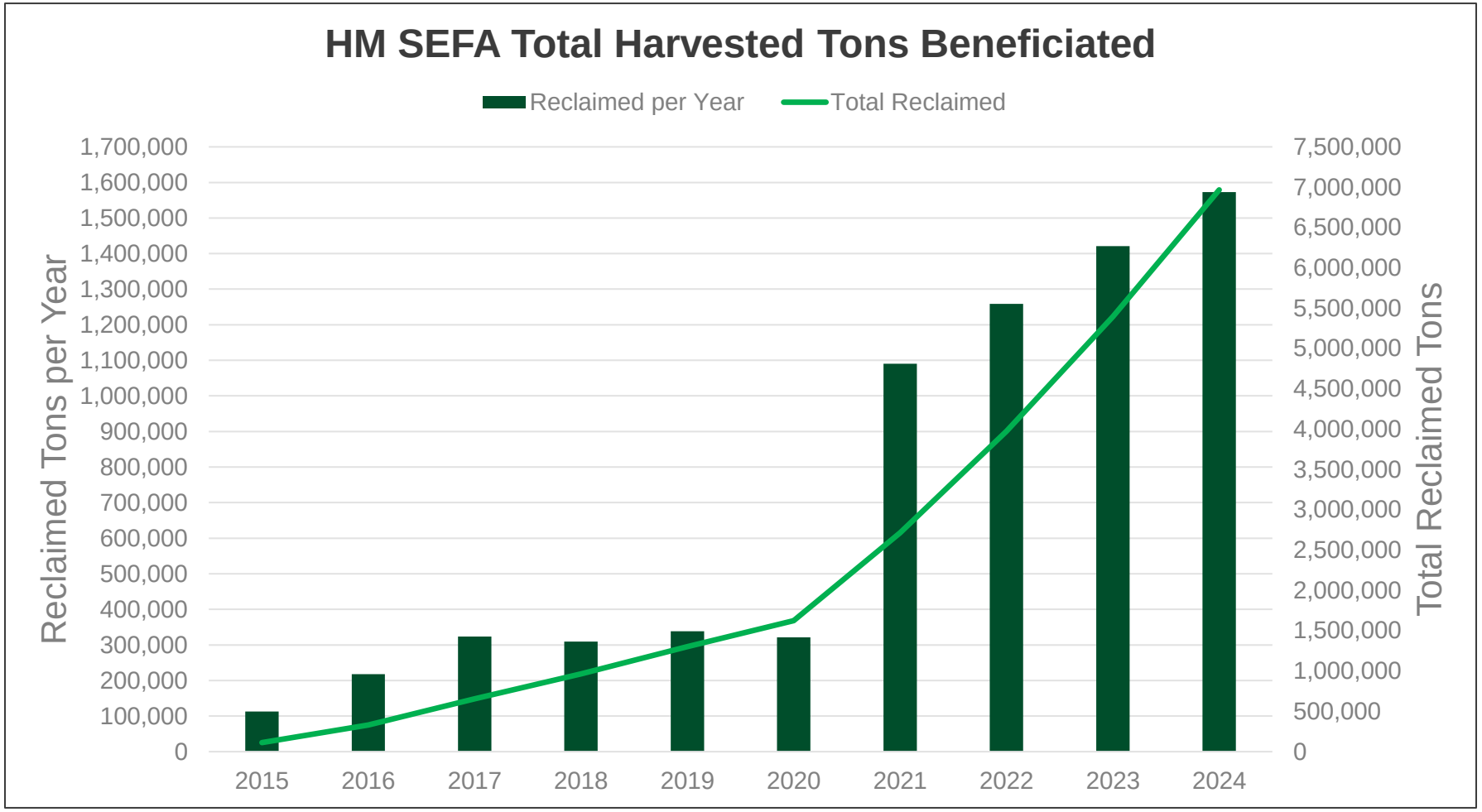


May 2023

Heidelberg Materials announced it has completed the purchase of **The SEFA Group**.

The acquisition further strengthens Heidelberg's cementitious footprint in the key Southeastern U.S. market and provides a solid platform for growth on the path to carbon neutrality.

Beneficiation Processes & Methods



Beneficiation Processes & Methods

Benefits of Recycling Fly Ash

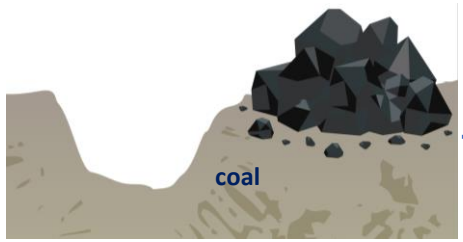
1. Environmental Impact: Recycling fly ash reduces the need for landfill space and prevents harmful substances from leaching into the soil and water. This helps mitigate pollution and conserves natural resources.
2. Energy Efficiency: Using fly ash in construction materials, such as concrete, reduces the energy required for production. Fly ash can replace a portion of Portland cement, which is highly energy-intensive to produce.
3. Cost Savings: Fly ash is often cheaper than traditional materials used in construction. Its use can lower overall project costs while maintaining or improving the quality of the final product.
4. Sustainable Construction: Fly ash can be used to produce eco-friendly building materials like bricks, tiles, and paint, promoting sustainable practices in the construction industry.
5. Improved Material Properties: Fly ash enhances the strength and durability of concrete, making it more resistant to cracking and extreme weather conditions. It also improves workability and reduces the amount of water needed in the mix.

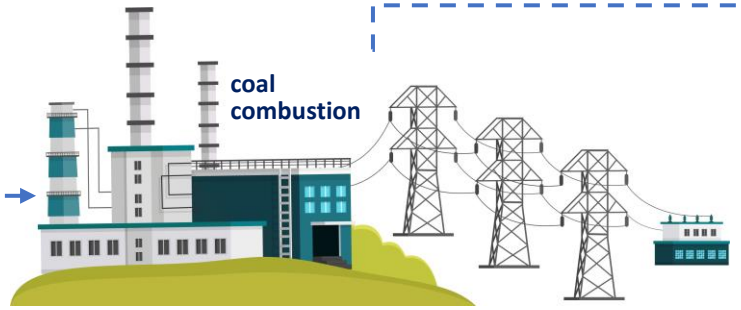
Technical Benefits of Fly Ash in Concrete

Replacing a portion of cement with performance-enhancing fly ash contributes to short-term and long-term benefits in concrete:

1. Increased ultimate strength
2. Greater durability
3. Improved workability
4. Mitigation of Alkali-Silica Reactivity (ASR)
5. Reduced segregation and drying shrinkage
6. Enhanced sulfate resistance
7. Reduced bleeding
8. Improved pumpability
9. Improved watertightness
10. Reduced heat of hydration
11. Reduced efflorescence
12. Improved resistance in marine environments

Beneficiation Processes & Methods



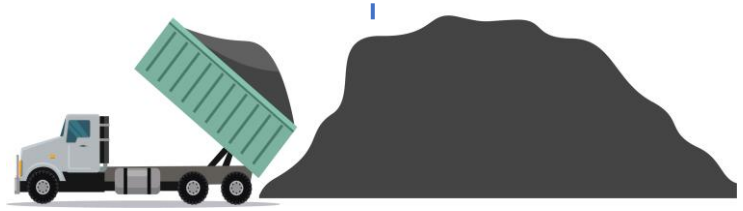


power plant (electrical utility)

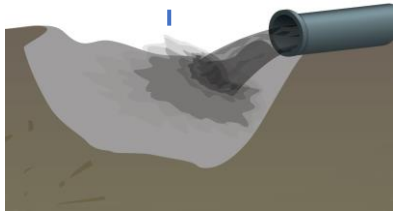
CCP marketer

BENEFICIATION

DISPOSAL



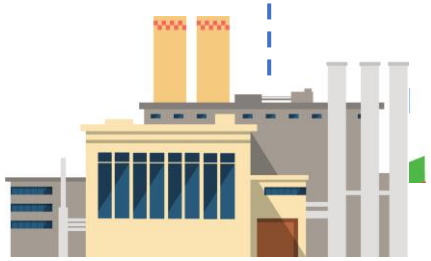
landfill “dry”



pond “wet”

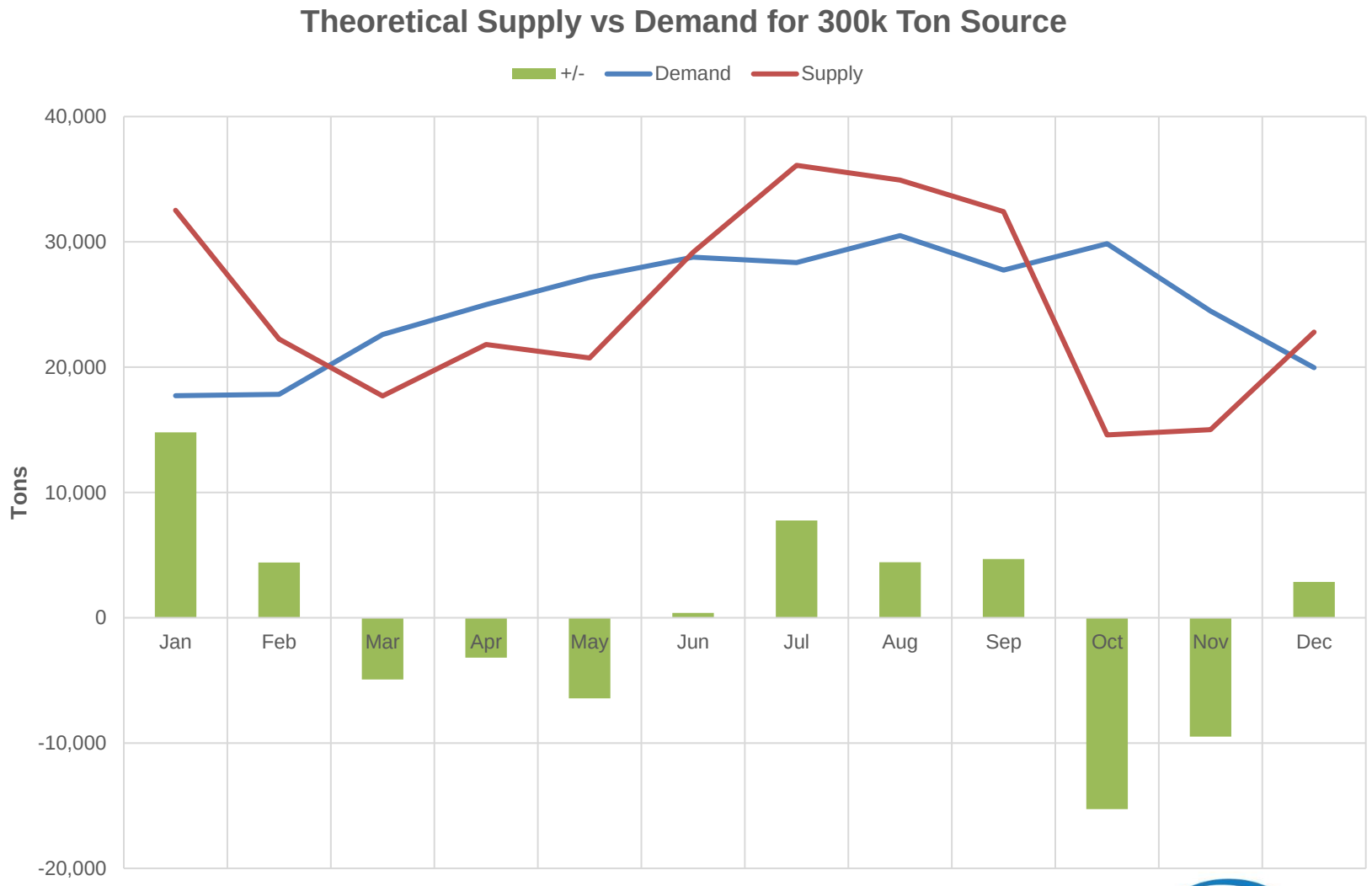
BENEFICIAL USE

Concrete Products



Cement Manufacturing

Beneficiation Processes & Methods



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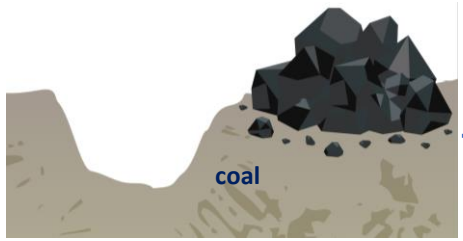

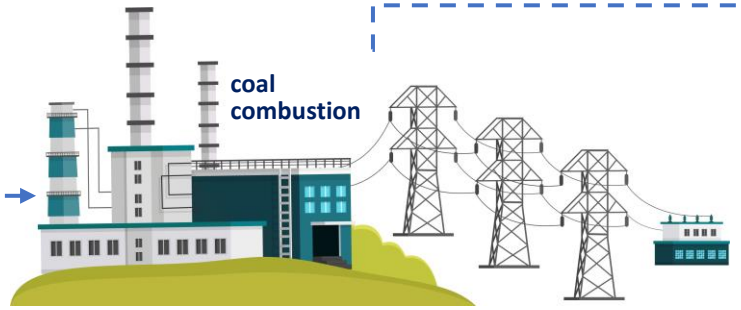

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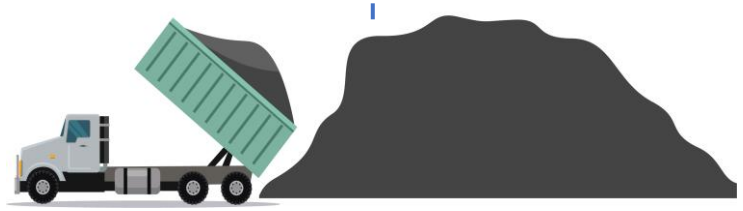

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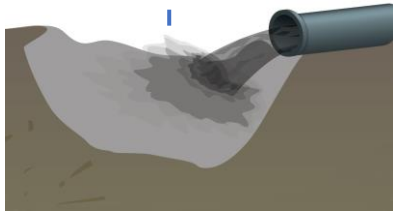

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HARVESTING

CCP marketer

BENEFICIATION

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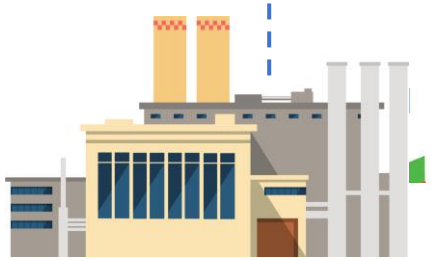

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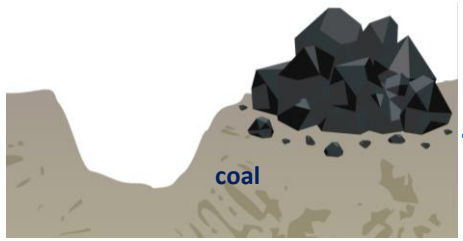
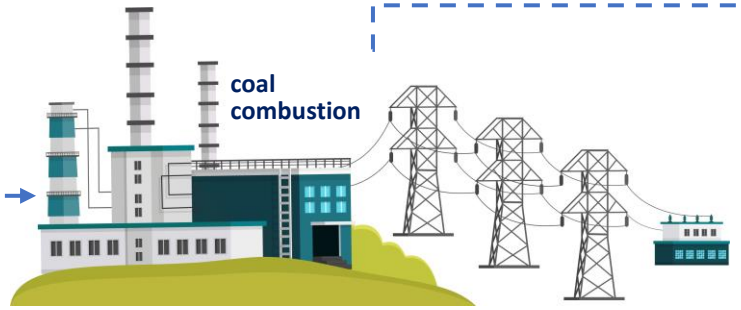
Beneficiation Processes & Methods





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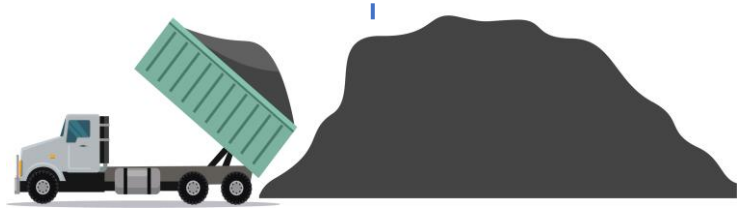

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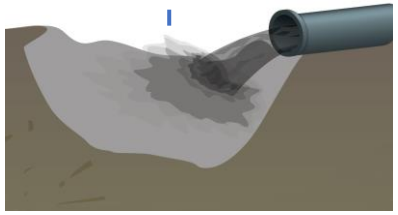

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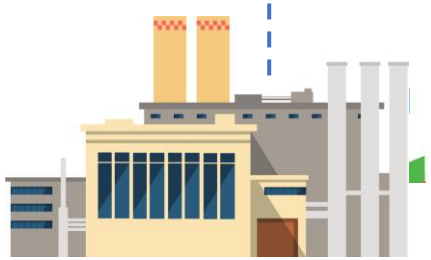

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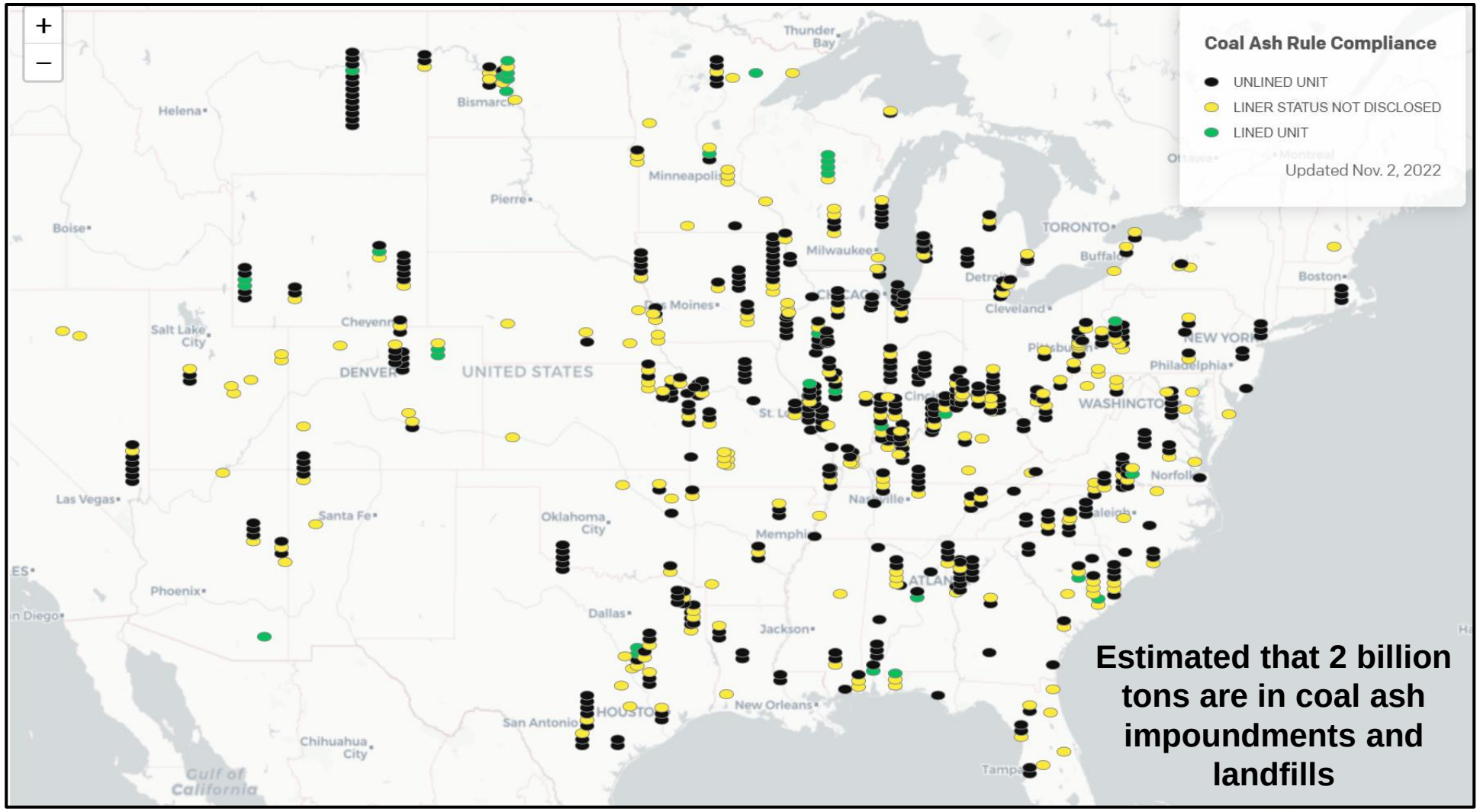
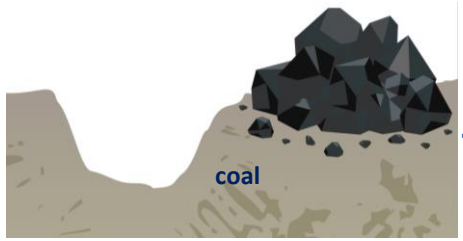
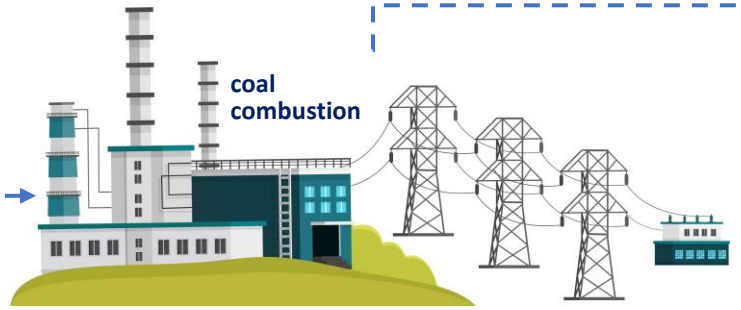


Beneficiation Processes & Methods

Benefits of Recycling Harvested Coal Ash

Beneficiation Processes & Methods





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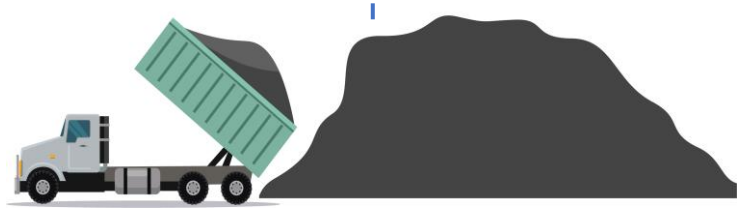

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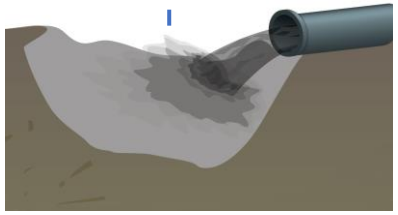

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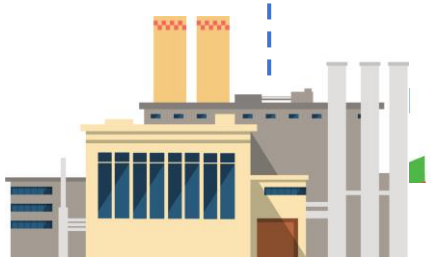

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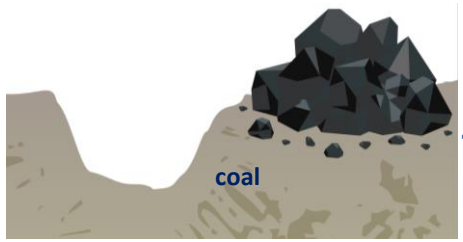

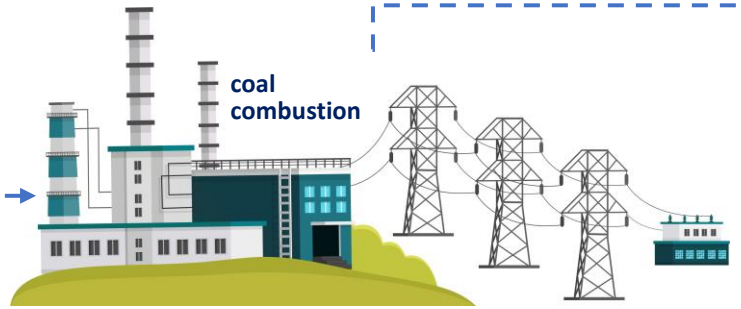

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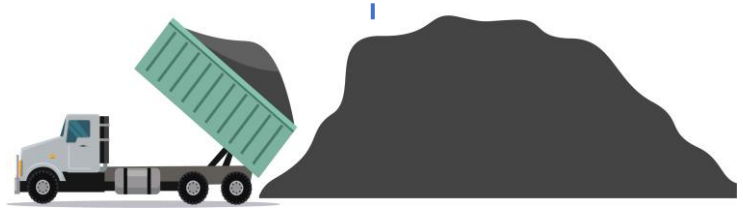

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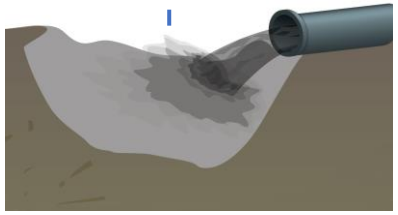

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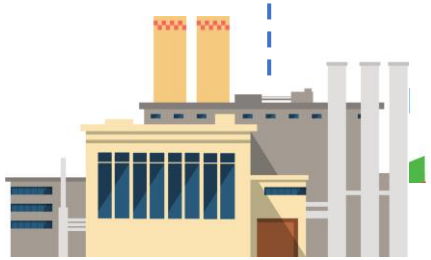

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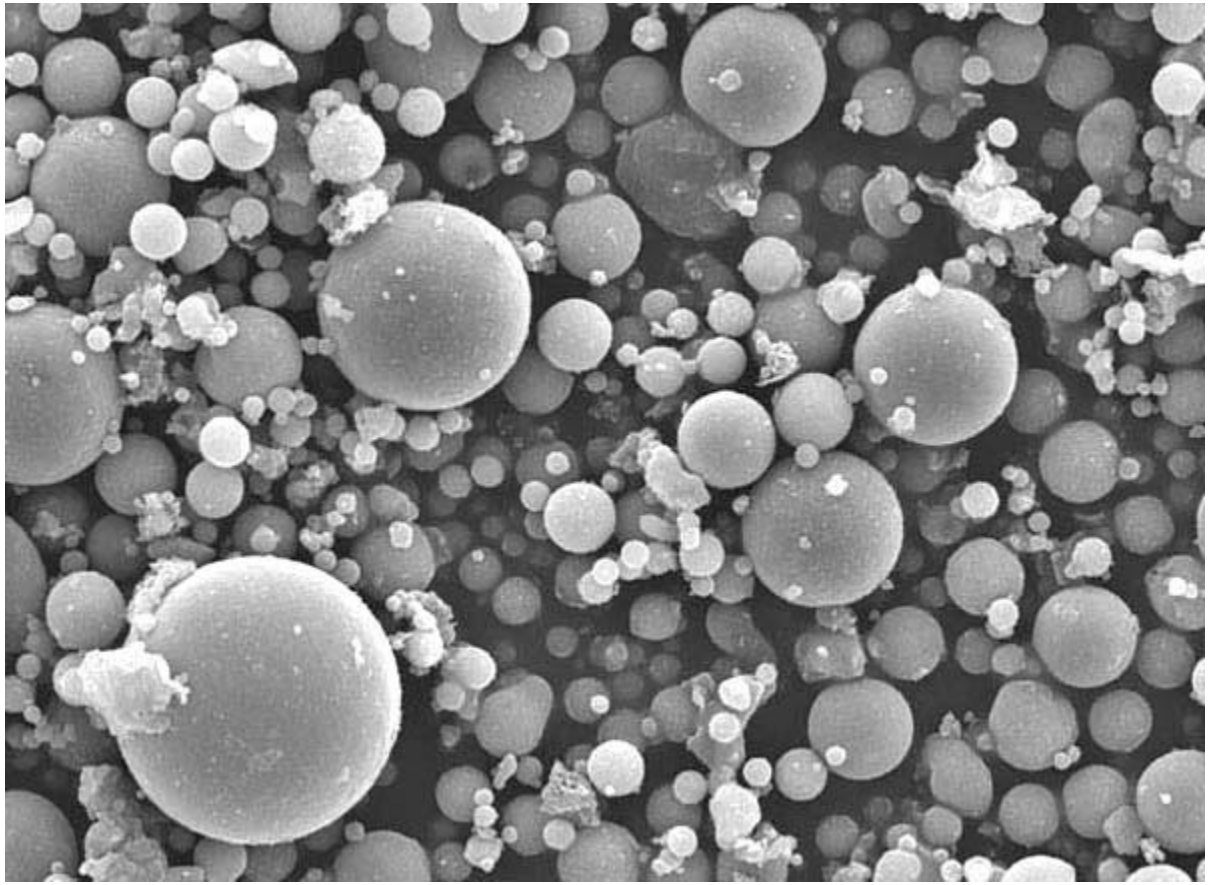
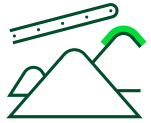


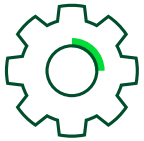
ASTM C618: Standard Specification for Coal Ash for Use in Concrete

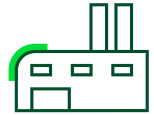
- Chemical Composition
- Moisture
- Fineness
- Loss on Ignition (Carbon)

Beneficiation Processes & Methods

Any harvesting program will need several processing steps to beneficiate the material for concrete use. These steps will include screening in the basin to remove trash and debris, drying, classifying, grinding and possibly **carbon treatment** to ensure compliance with relevant specifications and market acceptance.







Drying	Classifying	Grinding	Carbon Treatment
Moisture < 3%	Fineness Specifications	Fineness Specifications	LOI < 6% for Class F
Material is de-watered in the landfill or basin to less than 25% moisture. Final drying can be accomplished with flash dryers, rotary dryers or fluid bed dryers among others	Max 34% Retained on #325	34% Retained on #325	Passivation/Separation/Removal
	Max 10% Retained on #100	10% Retained on #100	Thermal Beneficiation allows for recovery of waste heat to be used for drying step
	This step separates any co-mingled bottom ash, slag, etc. from fly ash	Any oversized material can be disposed of or ground to meet fineness specifications (ball mill, roller mill, jet mill, etc.)	

Beneficiation Processes & Methods

Drying Methods

Flash Dryer

Rotary Dryer

Beneficiation Processes & Methods

Screening / Classifying

Air Classifier

Vibratory Screen

Beneficiation Processes & Methods

Grinding / Milling

Vertical Roller Mill

Cage Mill

Ball Mill

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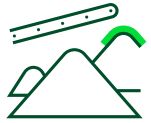

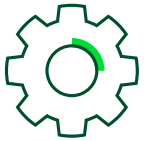

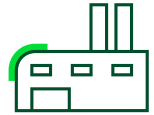

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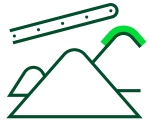

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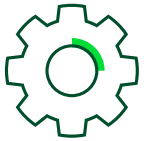

Grinding

Fineness Specifications

34% Retained on #325

10% Retained on #100

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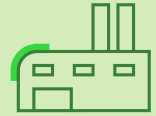


Carbon Treatment

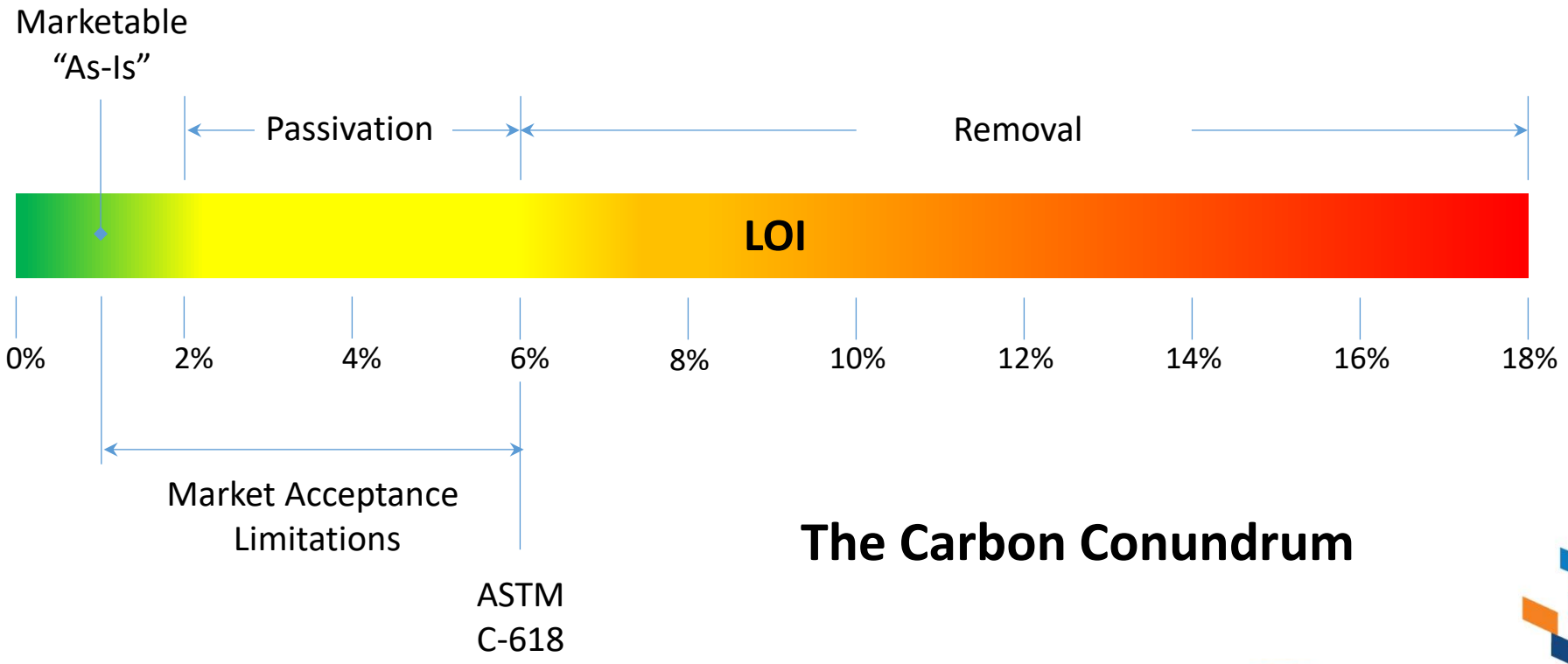
LOI < 6% for Class F

Passivation/Separation/Removal

Thermal Beneficiation allows for recovery of waste heat to be used for drying step

Beneficiation Processes & Methods

Loss on ignition (LOI) is a measurement of unburned carbon remaining in the ash. Specifications of the American Society for Testing and Materials (ASTM C 618) for fly ash used in concrete limit the LOI to 6 percent. Values greater than 2 to 3 percent, however, will probably require you to significantly increase the air entraining agent dosage or possibly require **carbon treatment** to ensure compliance with relevant specifications and market acceptance.



The Carbon Conundrum

Beneficiation Processes & Methods

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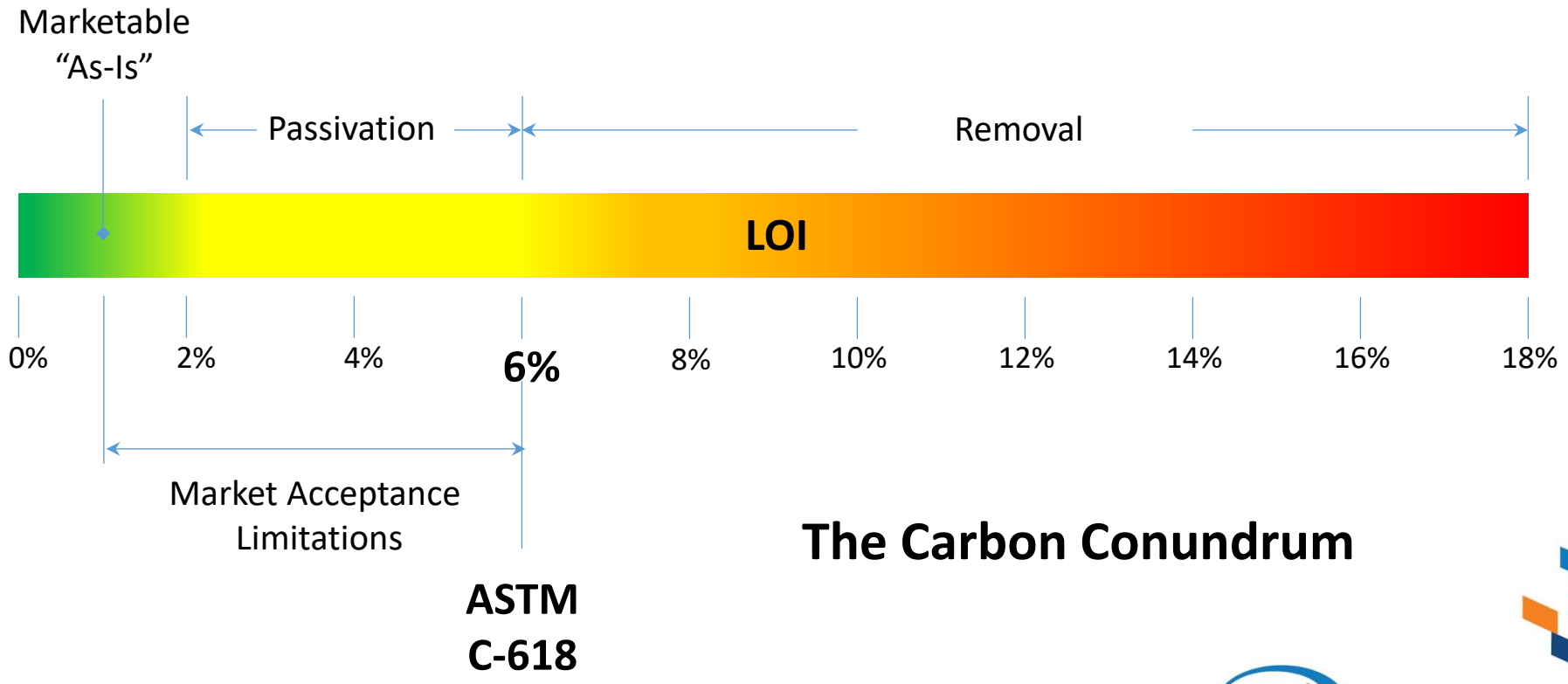

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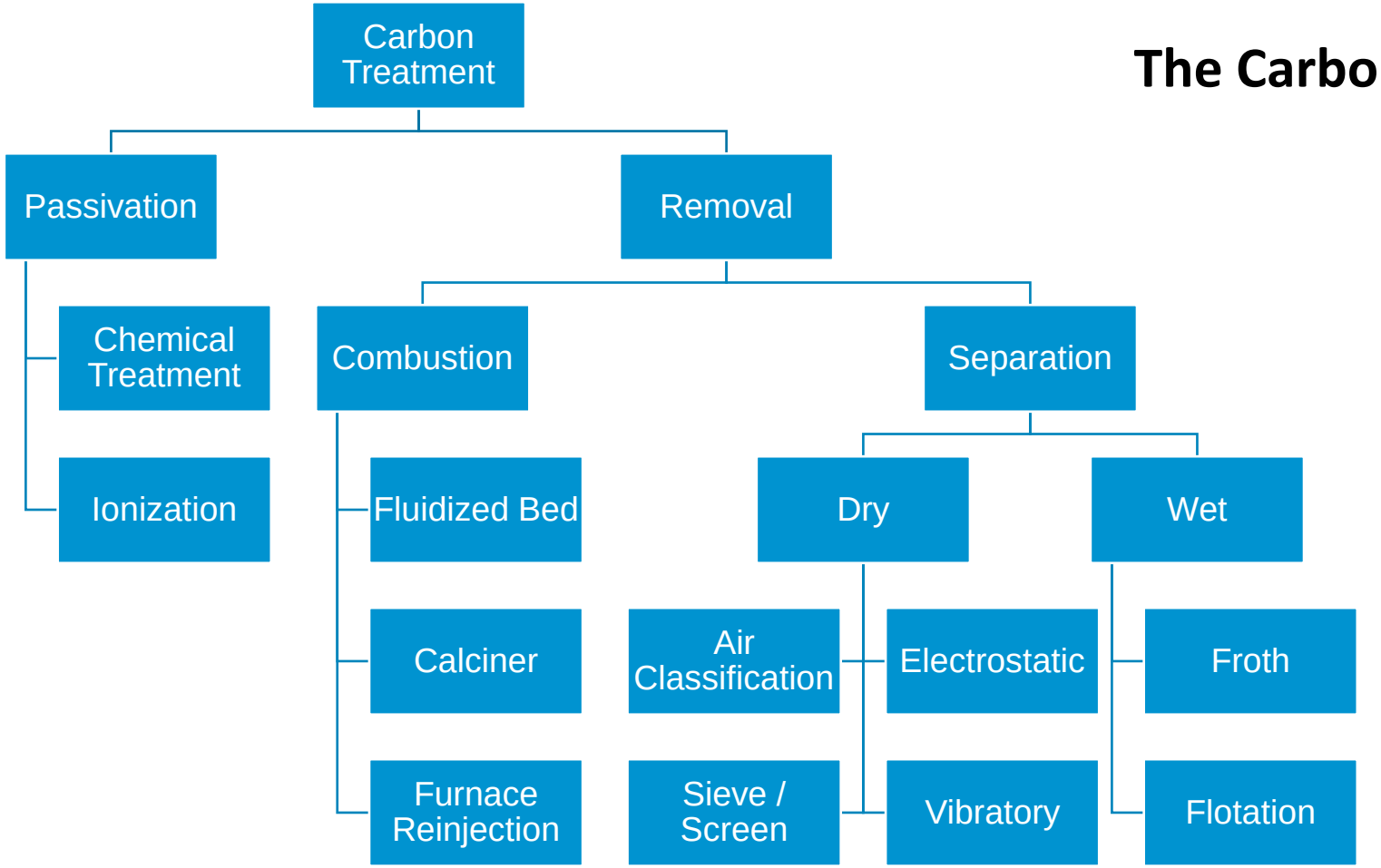
Beneficiation Processes & Methods



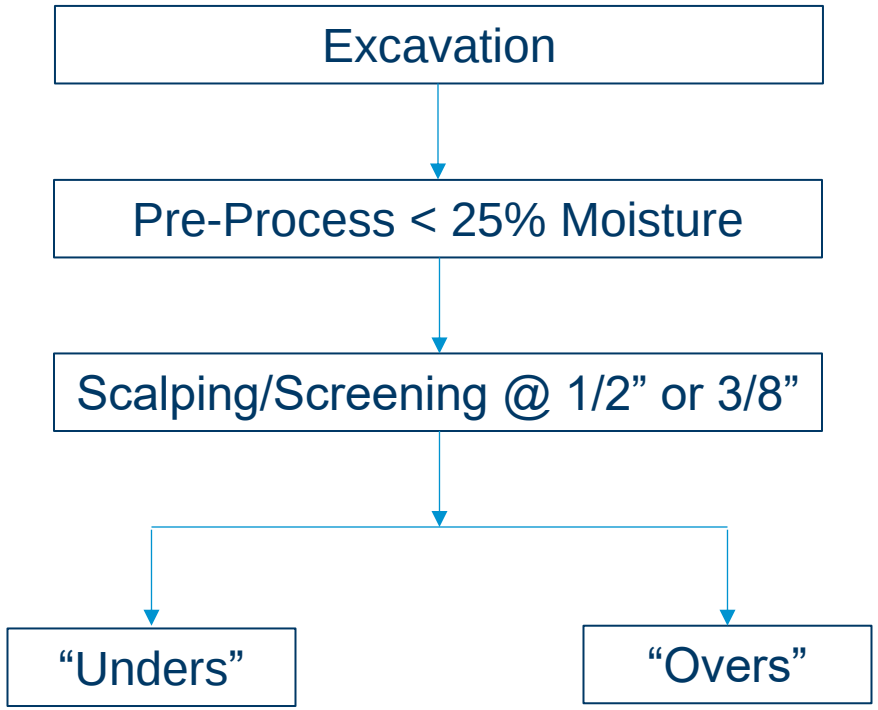
The Carbon Conundrum

Beneficiation Processes & Methods

Pre-Process

Civil Scope

- Basin / Landfill Characterization
- Identification of comingled wastes
- Excavation Plan
- Blending for Homogeneity
- Water Treatment / Handling
- Closure Plans



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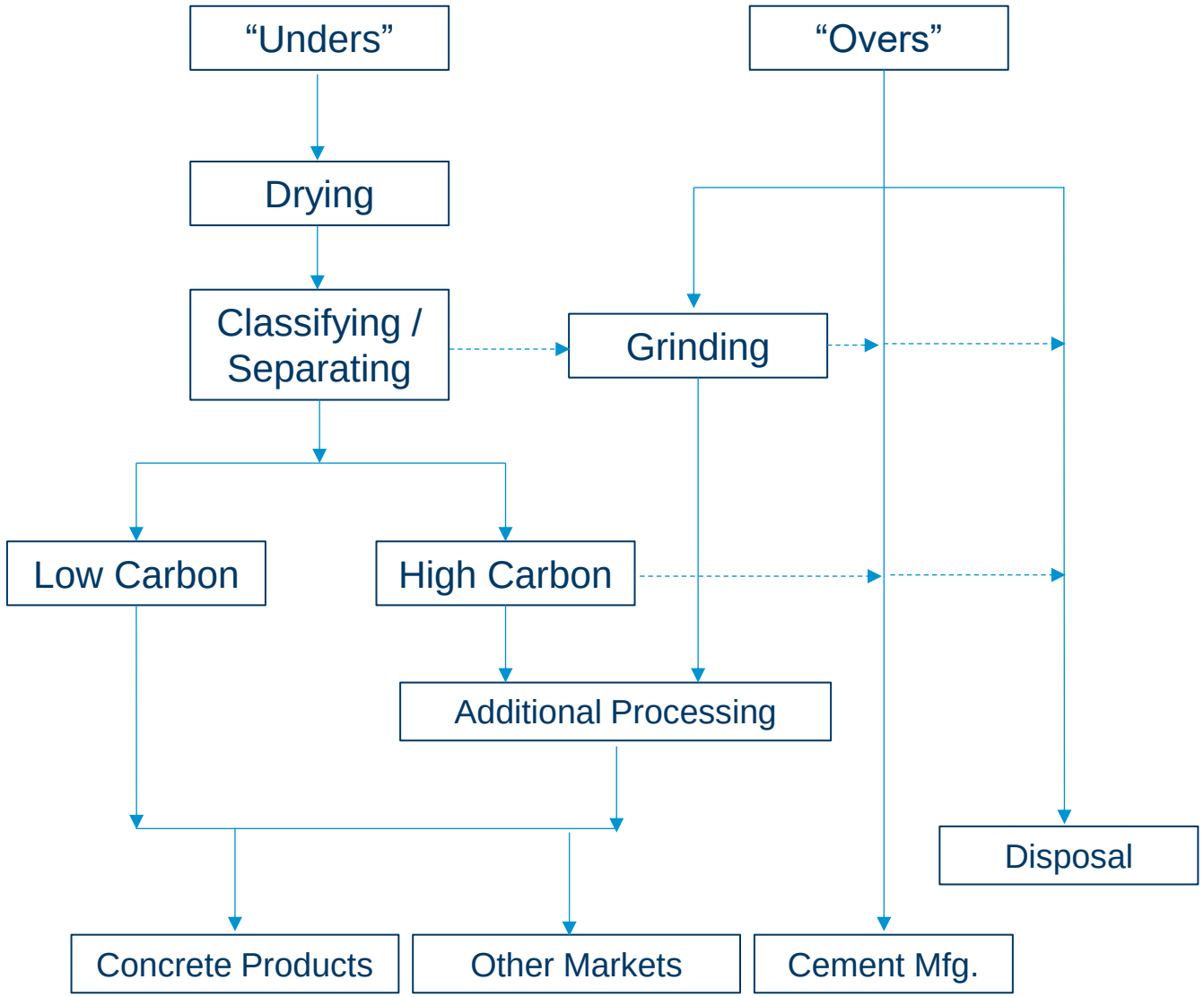
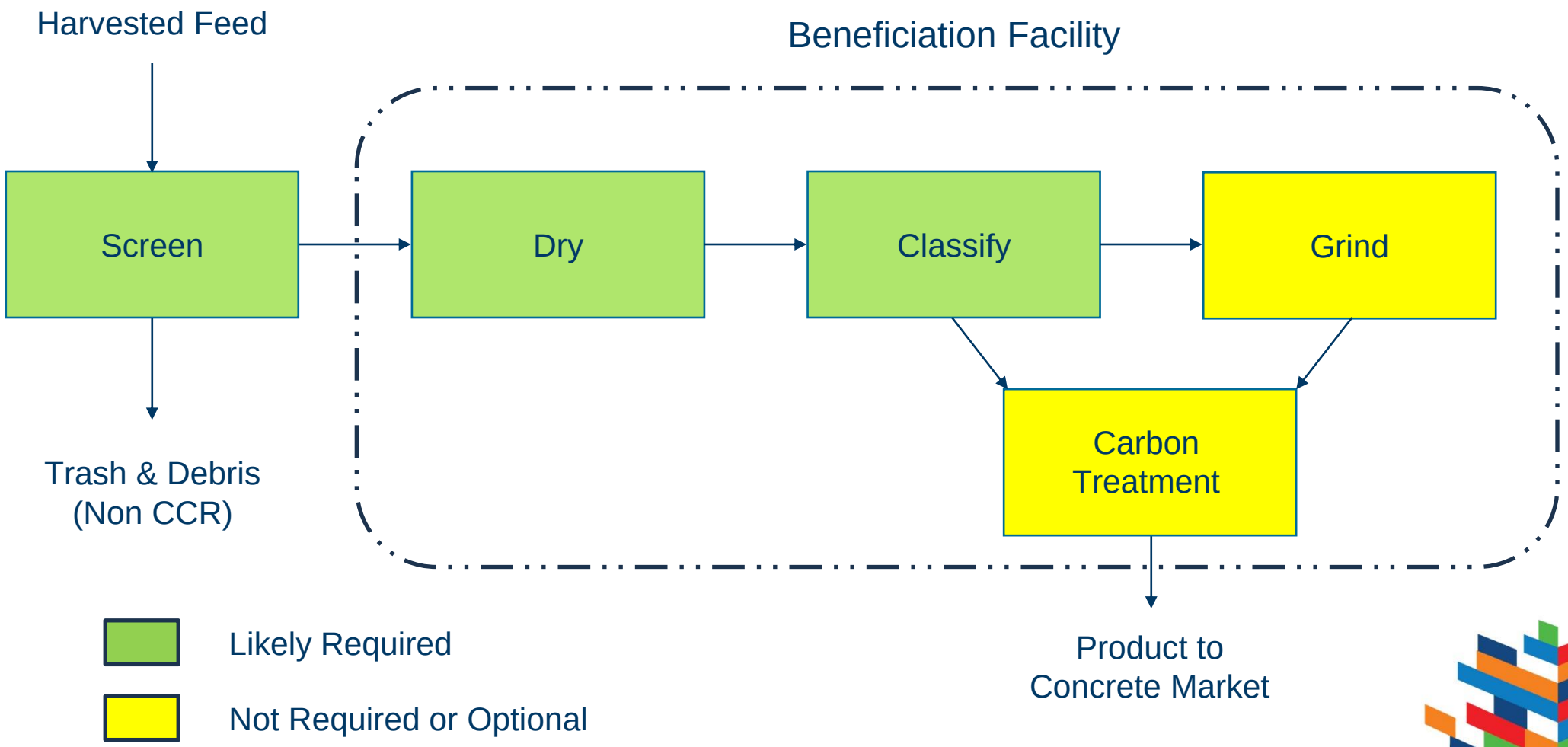


Beneficiation

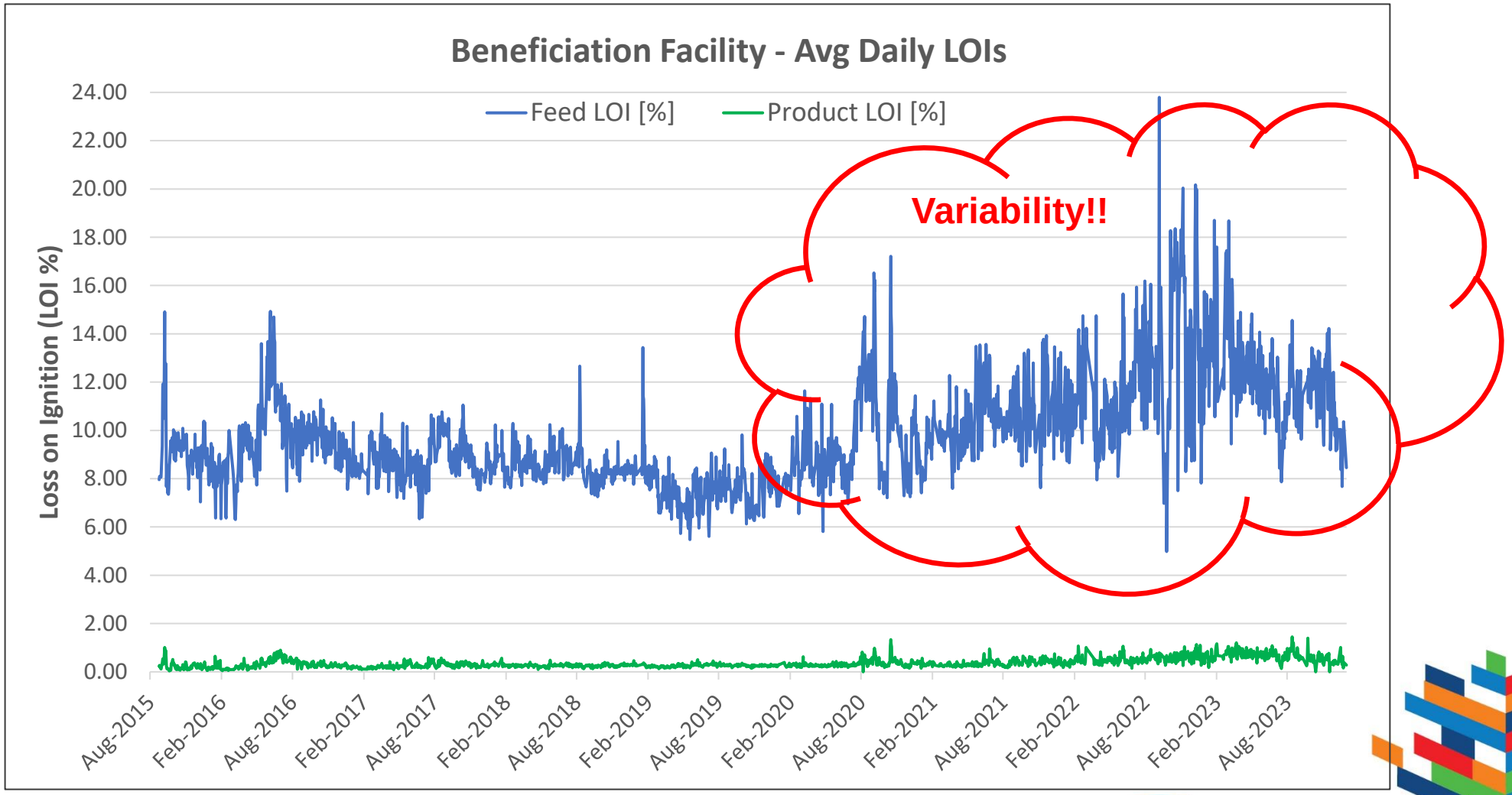
Product Specifications / Requirements:

- LOI (Carbon)
- Particle Size
- Carbon Reactivity
- Air Entrainment
- Fly Ash Reactivity with Cement
- Color
- Trace Constituents (Hg, etc.)

Beneficiation Processes & Methods



Beneficiation Processes & Methods



Beneficiation Processes & Methods

Manufactured Product => Consistent Quality

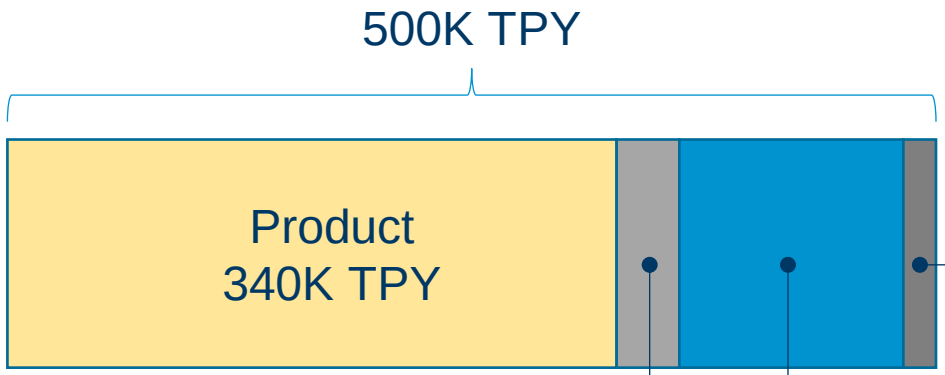
Harvested Feed => Consistent Supply

Harvested Coal Ash Beneficiation Facility
500,000 Tons Processed Annually

Raw Feed Storage

Product Storage

Beneficiation Processes & Methods



Assumptions:

- Rejects (+ 3/8”) < 2%
- Moisture < 25%
- Carbon < 10%

100% of Bottom Ash ground to meet fineness specifications

Beneficiation Processes & Methods

Non-CCR and Reject / Waste Streams

Stream	Description	Rejects (mass %)
Trash & Debris (Non-CCR)	Overburden, underburden, biomass, etc.	3% to 10%
Comingled Wastes / Contaminates	Gypsum, scrubber wastes, spoils, etc.	0% to 100%
Beneficiation Non-Spec Streams	Oversized, High LOI, etc.	0% to 50%
Beneficiation Waste Streams / Rejects	Chemical Treatment	15% to 50%
	Electrostatic Separation	10% to 50%
	Thermal Treatment	0% to 10%

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Summary and Conclusions

1. Utilizing coal ash in concrete provides economic and technical benefits
2. Displacing cement with ash lowers global CO2 improving sustainability
3. Production Coal Ash supply faces logistic challenges, and its supply continues to decrease
4. Harvesting and beneficiating coal ash can fill the gap between supply and demand
5. There is no one size fits all when it comes to coal ash beneficiation

Thank you

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