

Zero Waste

Fly Ash - Gallery Walk Presentation



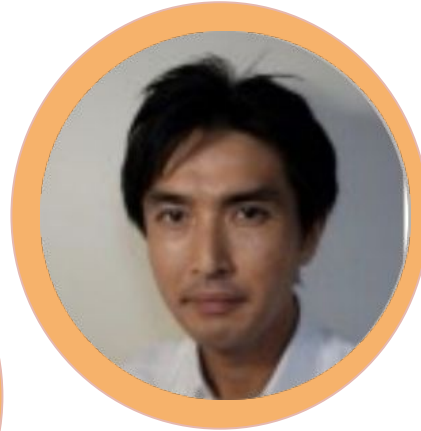
Team Members



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Our Project

This project aims to research the capturing and monetization of three waste streams from the biorefinery and biomass power plants: fly ash, CO₂, and biochar. Using the life principle of recycling all materials this team will work towards creating a net zero system with all reusable organic materials from the different New England sites.



What is Fly-Ash?

- Biomass fly ash is a residue that results from the combustion of biomass and is transported by flu gasses (stack exhaust).
- Traditionally viewed as waste from the pyrolysis process, fly ash can be repurposed across many industries and areas with one of the largest being the building materials sector.



Background



→ University of Maine Fly Ash Study

- ◆ Partial replacement of cement
- ◆ Controlled low strength materials (CLSM)
- ◆ Manufacturing of Portland cement

→ Stantec Engineering Study

- ◆ ASTM C618 and C311 are used to test fly ash and other natural pozzolans for use in Portland cement
- ◆ Echoed UMaine feasibility study showing 20-30% fly ash volume is optimal for cement mixture
- ◆ ASTM C618 does not allow for the usage of biomass fly ash in Portland cement manufacturing

Potential Wood Fly Ash Utilization

Construction Sector

- Cement and concrete mix
- Substitute for hydraulic lime

Road Construction & Pavement Sector

- Soil layer stabilization
- Base layer stabilization
- Asphalt filler material

Agricultural Sector

- Incorporated with Sewage Sludge
 - ◆ Fertilizer
- Mix with Biochar

Benefits

- Mitigates the landfilling of ash
- Provides value & revenue for the reuse of waste
- Reduces costs of construction across different industries
- Decreases ecological footprint

Industry Policies Surrounding Fly Ash

- No standard for biomass fly ash usage in portland cement
 - ◆ ASTM C618 applies to coal-ash usage

- Standard submission process
 - ◆ Submit request to ASTM technical committee
 - ◆ *Exploratory level*
 - Committee explores subject area
 - ◆ *Planning level*
 - Meet key stakeholders in the given area
 - ◆ *Organizational level*
 - ASTM meeting with key stakeholders to initiate formal motions

- Process can average about 18 months to complete



Market

Global Market:

- Growth Estimates:
 - ◆ From USD 3.4 bn in 2018 to USD 4.5 bn in 2023; 6% CAGR ¹
 - ◆ From USD 8.54 bn in 2019 to USD 13.3 bn in 2027; 5.83% CAGR ²

US Market:

- Estimated growth from USD 525.9 million in 2020 to USD 729.18 million in 2025.
- Road construction was the largest use in 2020.
- Geopolymer use expected to show largest CAGR through 2025. ³

Drivers of Growth & Demand:

- Increase in infrastructure and road construction projects.
 - ◆ Policies such as “Buy Clean”
 - ◆ Biden’s \$2T Infrastructure deal
- Construction industry growth, along with increased demand for sustainable materials.
- Issues with landfilling of fly ash
- Promotion by governments to find more sustainable uses.
- Fly Ash market prices tend to trend along with cement market prices. ⁴

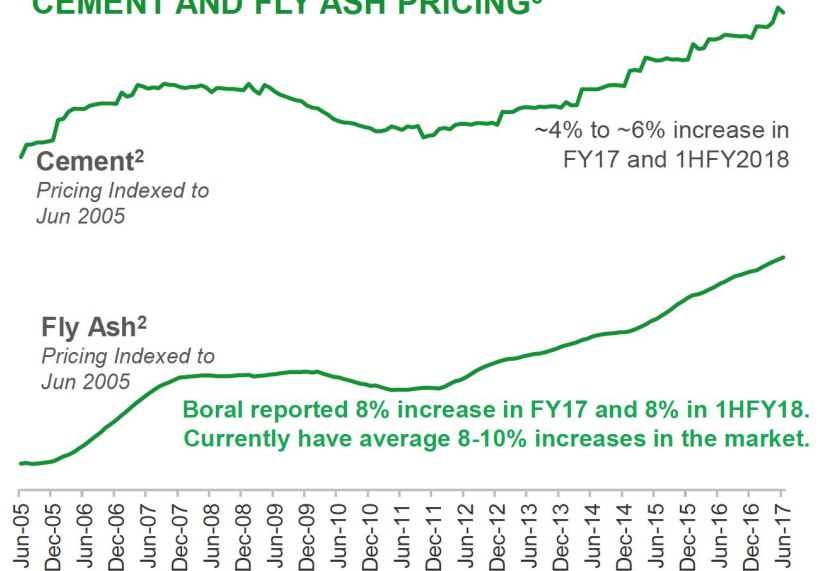
1. MarketsandMarkets Fly Ash Market Report
2. Fortune Business Insights Fly Ash Market Report
3. Business Wire Fly Ash Market Report
4. Boral Investor Slides, Fly Ash

Market Continued...

US market given proper ASTM standards

- values based on the market for the use of coal ash in cement, assuming they are direct substitutes
- fly ash saw EBITDA margins to be between 22% and 25% of its North American construction materials market.
- trend with the price of cement in the Ready Mix market, which was between USD 90 to 150 per ton

CEMENT AND FLY ASH PRICING³



Carbon Credits

- carbon credit offset market has the potential to be worth upwards of US\$50 billion in 2030
- voluntary carbon credits can be purchased regardless of where they are produced, and the purchase of these credits is not restricted to certain industries, but are open to any entity seeking to offset their carbon emissions
 - ◆ It supports the investment in projects that can lead to the innovation needed to develop lower-cost versions of climate technologies
- Voluntary carbon credits are classified into one of three categories
 - ◆ Avoidance
 - ◆ Reduction
 - ◆ Removal

Future - Zero Waste Innovations

Zero Waste Team

- Team focused on creating innovative solutions that combine waste streams from both the biomass power plant and biorefinery
- **Building Materials**
 - ◆ use of both Fly ash & Biochar in cement
 - ◆ Partner with local cianbro for local applications
- **Road Applications**
 - ◆ Use of Fly ash & biochar in lower strength materials such as asphalt Partner with cianbro
 - ◆ Other global partners include Syncraft and Snohetta

Thank You

