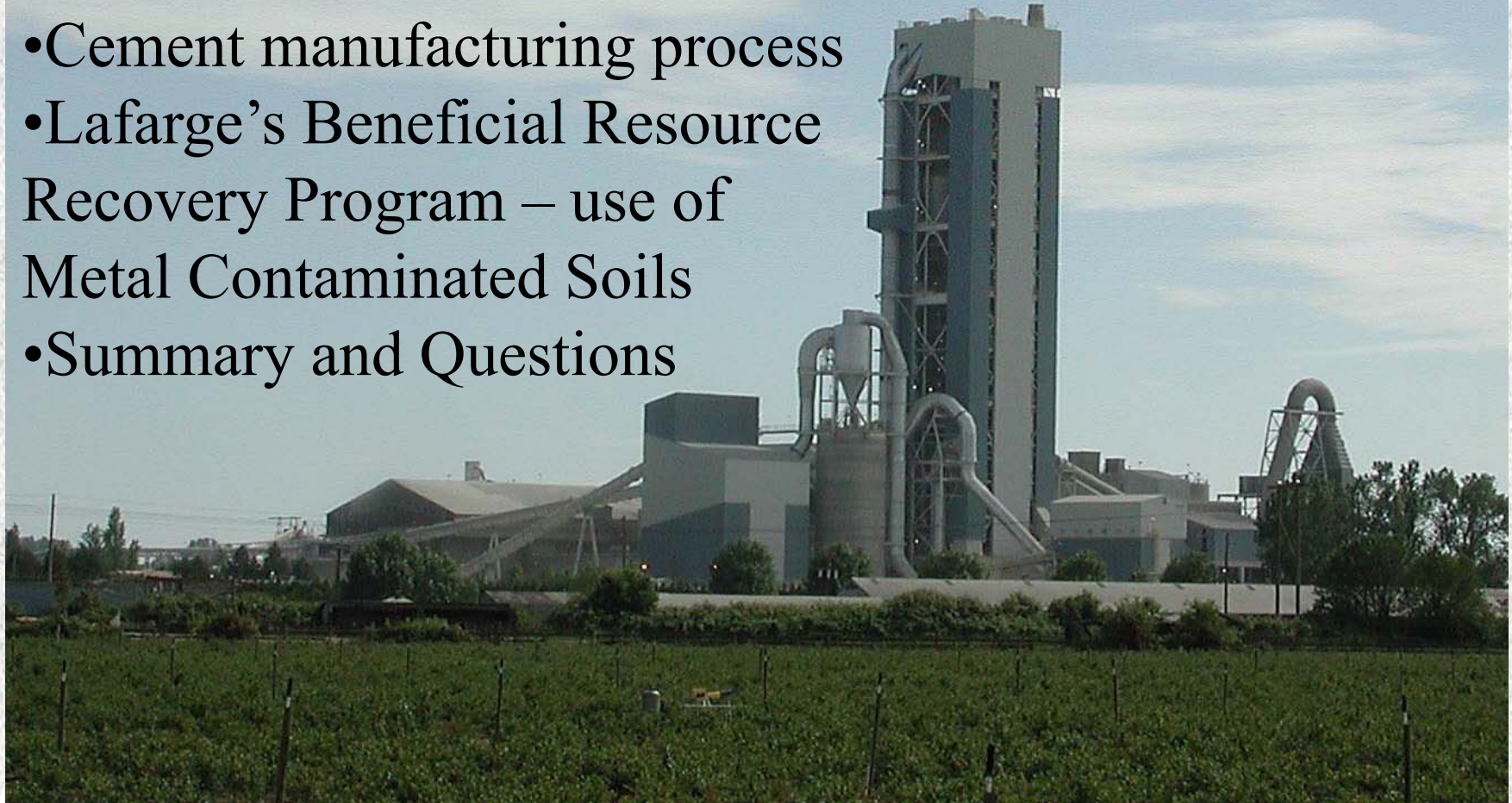




# Beneficial Recovery of Metal Contaminated Soils in a Cement Kiln

- Cement manufacturing process
- Lafarge's Beneficial Resource Recovery Program – use of Metal Contaminated Soils
- Summary and Questions





- Subsidiary of Lafarge (*since 1986*)
- Works with Cementos Argos to continue supplying alternative fuel for two cement plants that were purchased from Lafarge in 2011 - Harleyville, SC and Calera, AL
- Works with Eagle Materials Inc. which purchased the Tulsa, OK and Sugar Creek, MO facilities from Lafarge in 2012.



Lafarge SA had over \$19 billion in sales in 2011 and is:

- a global Fortune 500 company
- the world's largest cement and construction materials manufacturer
- a world-wide user of waste by-products
- on most recent list of: *"Global 100 Most Sustainable Corporations in the World"*



Cementos Argos

- has facilities in Columbia, the U.S. and the Caribbean
- had \$2.0 billion in sales in 2011

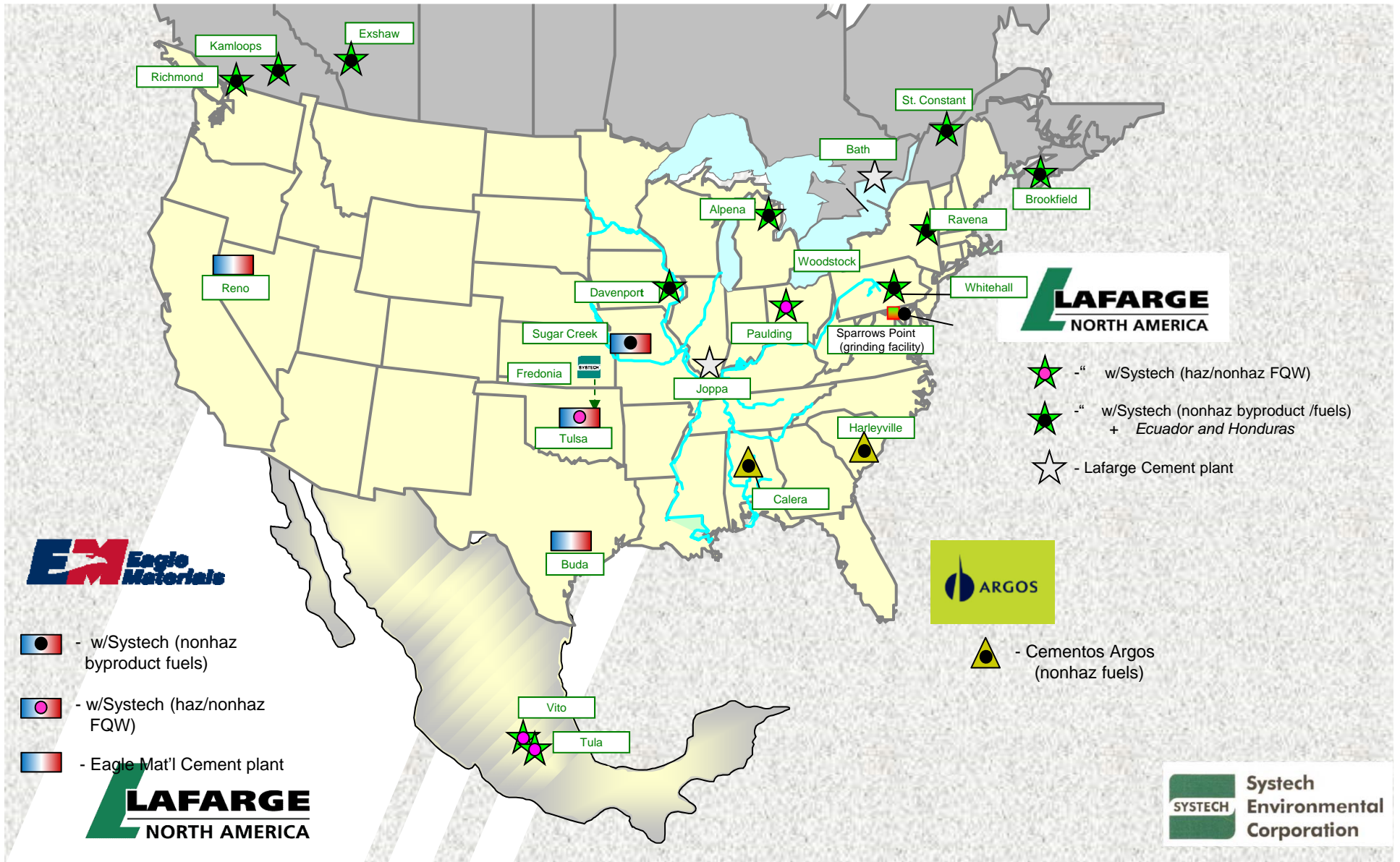


- Eagle Materials, Inc.
  - has six cement plants, all based in the United States (also has other construction materials divisions)
  - had revenue of \$495 million in 2012.



# Systech's Coverage Area

*and other cement partner locations*



# Cement Manufacturing Process

# Cement vs Concrete – There is a difference!



Cement



Concrete

Water + Rocks + Sand

# Cement Manufacturing Process

Step 1. Create a raw mix

Step 2. Burn the raw mix in a kiln to produce  
“clinker”

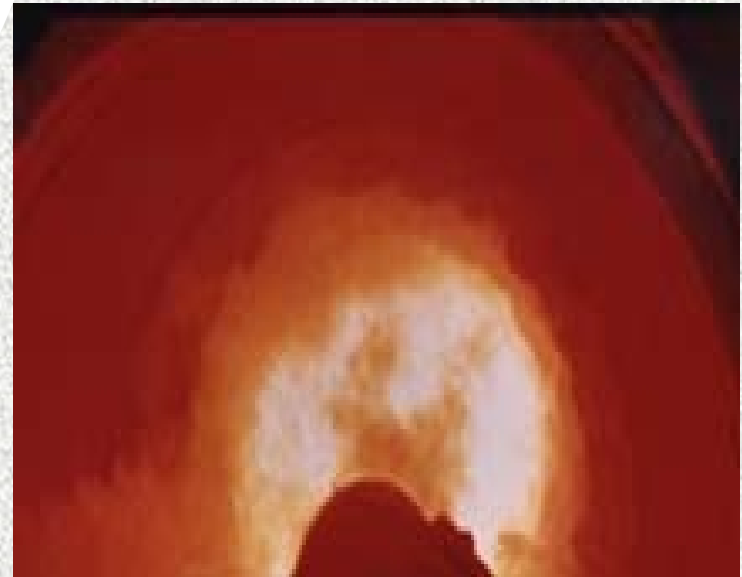
Step 3. Pulverize the clinker to make the powder  
known as cement

# Step 1. Creating a raw mix

- Raw materials are combined in exact proportions to create a chemically correct raw mix
  - Silica (sand, clay, shale)
  - Alumina (clay, shale, low grade bauxite)
  - Iron (mill scale, smelter slag)
  - Lime (limestone)
- Raw mix is pulverized in a mill

## Step 2. Burning the raw mix in a kiln

- Raw mix is burned in a kiln
- Material temperatures  $>1450^{\circ}\text{C}$
- End product is cooled to form pellet size material “Clinker”
- Alternate fuels are introduced here



# Step 3. Pulverizing the Clinker

- Clinker is combined with a small percentage of gypsum and ground in a mill to produce the powder know as cement



# Richmond Cement Kiln



# Richmond Cement Kiln



# How Cement is Manufactured – 3 Step Process



**Lime:** Limestone



**Alumina:**  
Ash, Shale

## 1. Creating a raw mix



**Silica:** Sand, soil



**Iron:** Steel  
slag



## 2. Burning the raw mix

**Clinker**

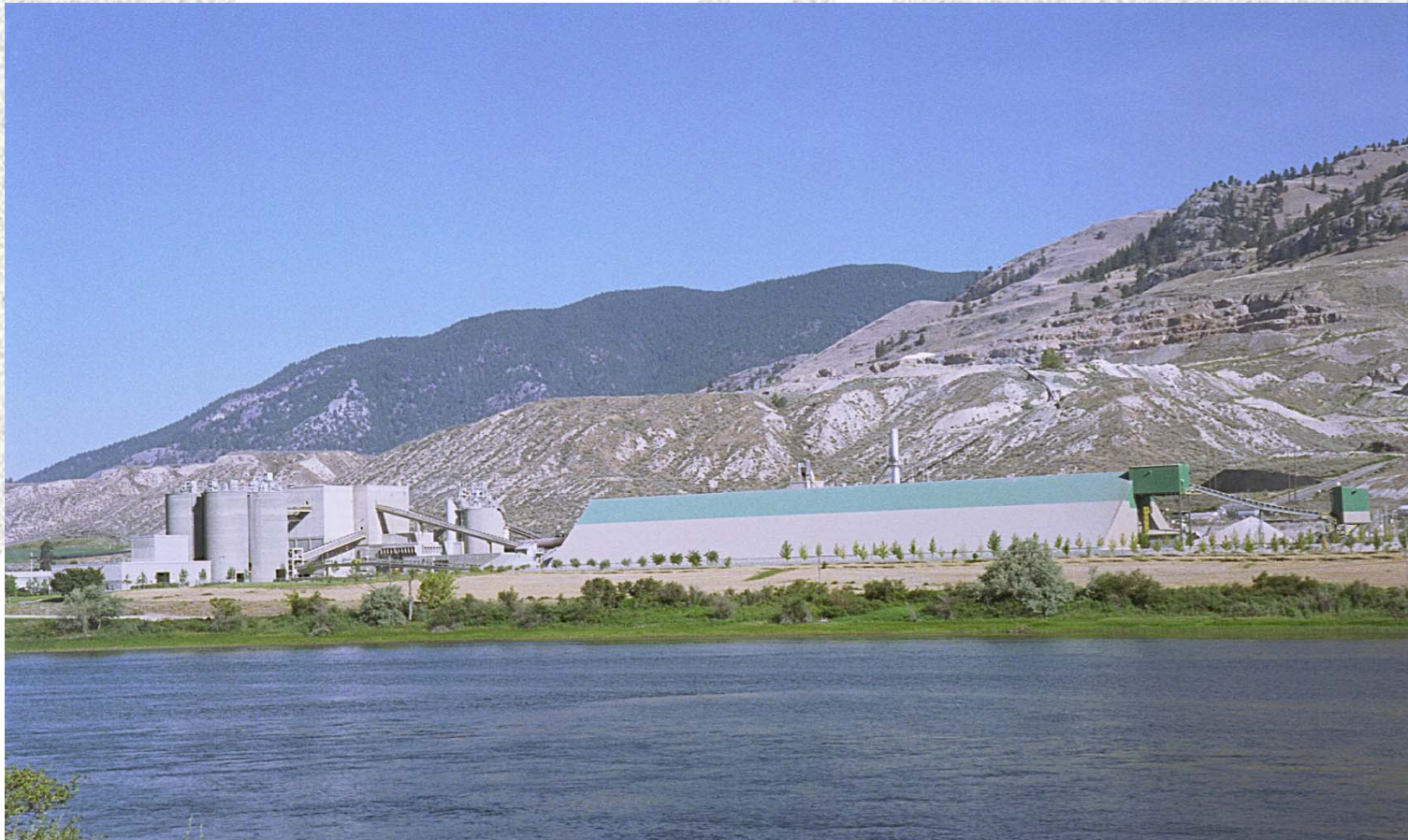


## 3. Final Grind

**Cement**



# Lafarge's Beneficial Resource Recovery Program



# Resource Recovery Opportunities at Cement Plants

- 1) Replacement of conventional raw materials with byproduct streams originating primarily from industrial and commercial sources.
- 2) Replacement of conventional fuels with by-product streams originating from industrial, commercial, institutional and residential sources.

# Beneficial Recovery of Metal Contaminated Soil Materials

- Cement plants consume large quantities of conventional raw materials such as sand, shale and limestone.
- Industrial by-products can off-set usage of natural raw materials
- A large number of cement kilns around the world consume a wide variety of by-products containing silica, alumina, iron and/or lime.

# Contaminated Soil Utilization Criteria

- Non hazardous soils only
- Chemically compatibility
- Physical characteristics, handling and process introduction
- Environmental considerations and impact on emissions
- Health and safety factors
- Financial considerations

# Typical Alternative Raw Materials

- Aluminum catalysts
- Fluid cracking catalysts
- Boiler ash
- Silica Desiccant
- **Metal impacted soils**
- Spent abrasives
- Spent foundry sands
- Flyash
- Lime Sludge
- Alumina Sludges

# Lafarge Cement Kiln Beneficial Recovery

- Lafarge cement kilns can provide complete and safe destruction for a variety of byproducts including contaminated soil while recovering their inherent value.
- Beneficial recovery is aligned with the concept of sustainable development through the replacement of fossil fuels and conventional materials with byproducts.
- Proven use of byproducts at many of Lafarge's plants worldwide.

# Cement Kiln Beneficial Recovery Differs from Incineration

- Conventional raw materials are replaced by the by-products
- Conventional fuels are replaced by the by-products for energy use
- **No residual materials to landfill – NO ASH**
  - **Ash is incorporated into final product**