



America's Most Energy-Efficient Manufacturing Plants

Webinar Series from U.S. EPA ENERGY STAR Program for Industry

Part 1: Cement and Glass Plants

October 13, 2021

Noon ET

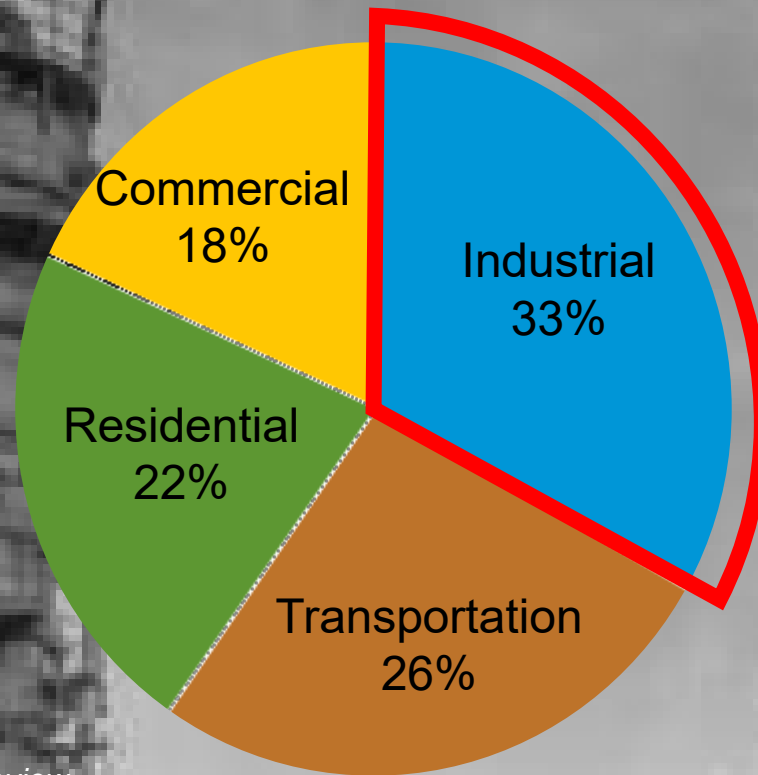
Topics

- Overview
 - Why energy efficiency
 - How to measure energy efficiency
- Energy-efficient glass plant
- Energy-efficient cement plant
- Q&A



Why focus on plants?

Share of total U.S. Energy consumption by end-use sectors (2020)



Why focus on plants?

High process temps = high energy consumption

Highest energy consuming industrial sectors are extremely thermally intensive:

Cement kilns: 2642° – 3600° F

Glass Furnace: 2600 - 3000° F

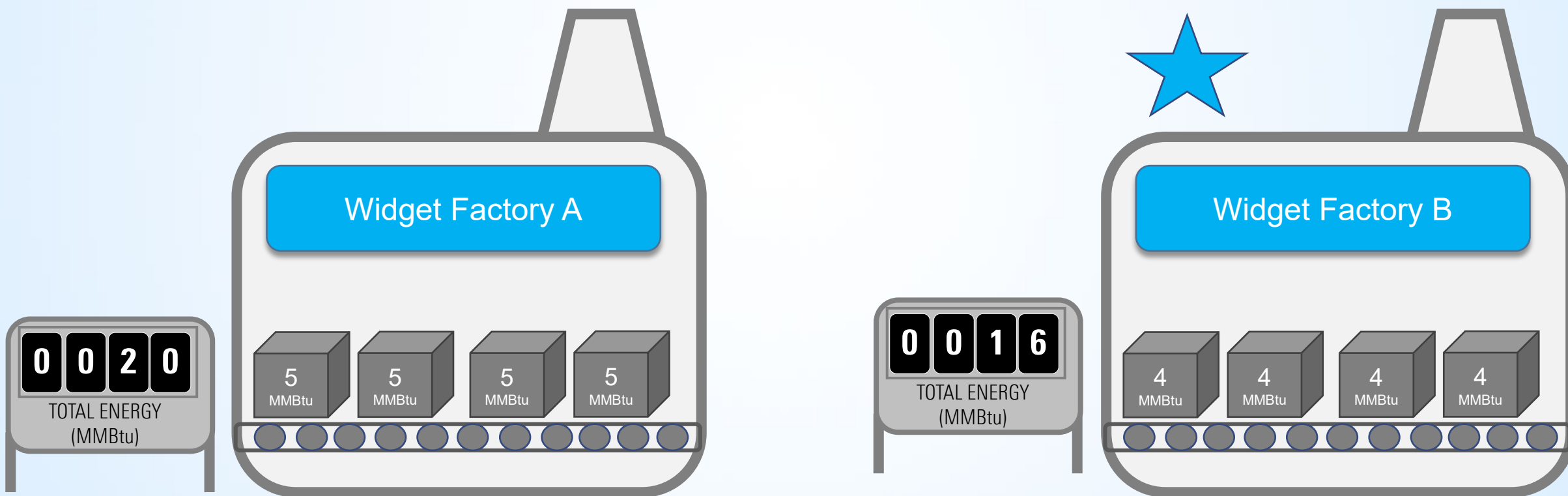
Steel Mill Blast Furnace: 1600° – 2300° F

Using less energy saves money
and reduces GHG emissions

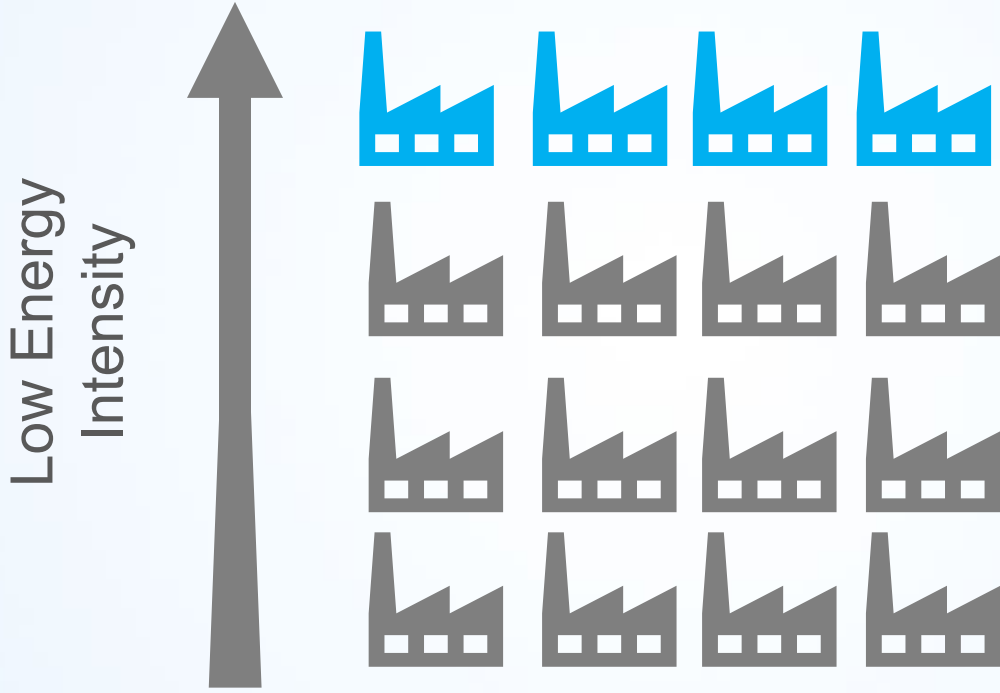


What is energy efficiency?

Using less energy to get the same job done



America's most energy-efficient factories



ENERGY STAR Certified Plants

Most energy efficient plants in the nation

- Plants in top quartile of efficiency
- Plants apply for certification via EPA ENERGY STAR program
- Energy and production data is verified by Professional Engineer
- Facilities recertify annually to demonstrate continued performance



How is plant energy efficiency measured?

ENERGY STAR Energy Performance Indicators

- [Auto Assembly](#)
- [Auto Engine](#)
- [Auto Transmission](#)
- [Cement](#)
- [Commercial Bread & Roll](#)
- [Container Glass](#)
- [Cookie & Cracker](#)
- [Flat Glass](#)
- [Frozen Fried Potato Processing](#)
- [Fluid Milk Processing](#)
- [Integrated Paper Mill](#)
- [Integrated Steel Plant](#)
- [Juice Processing](#)
- [Metal Casting](#)
 - [Aluminum](#)
 - [Iron](#)
- [Nitrogenous Fertilizer](#)
- [Petroleum Refining](#)
- [Pharmaceutical](#)
- [Pulp Mill](#)
- [Wet Corn Milling](#)

www.energystar.gov/plants

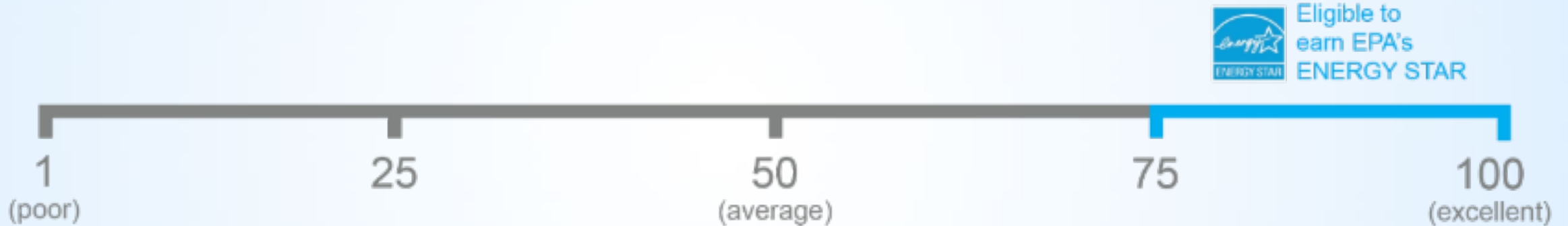
The screenshot shows the ENERGY STAR Plant Energy Performance Indicator form. It is divided into several sections: Plant Characteristics, Energy Consumption, and Results. The Plant Characteristics section includes fields for SIC Code (3537), ZIP Code (27705), Location (Dahon, NC), and various plant types. The Energy Consumption section has a table for Annual Purchases of Electricity, Gas, District Oil, Residual Oil, Coal, and Other. The Results section shows a comparison between the current plant's performance in 2016 and the average plant performance in 2016, along with an Efficient Plant benchmark for 2016. A bar chart at the bottom shows the current plant's performance relative to the average and efficient plant benchmarks.

Year	Electricity	Gas	District Oil	Residual Oil	Coal	Other
2016						
2015						

Category	2016	2015
Electricity	15,000	10,000
Gas	5,000	5,000
District Oil	1,000	1,000
Residual Oil	1,000	1,000
Coal	1,000	1,000
Other	1,000	1,000

Year	Current Plant	Average Plant	Efficient Plant
2016	50	50	75
2015	12,500	7,000	4,000

ENERGY STAR Score from ENERGY STAR Energy Performance Indicator



Based on underlying predictive energy use model from actual
plant energy and production data

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Certified Plant Directory

The screenshot shows the 'ENERGY STAR Certified Building and Plant Locator' search interface. It is divided into two main sections: 'Select Property Type (required):' and 'Refine your search (optional):'. The 'Select Property Type' section features a list of 'Industrial plants' with checkboxes for Aluminum Casting, Auto Assembly, Auto Engine, Auto Transmission, Cement, Commercial bread & roll bakeries, Container Glass, Cookies and Crackers, and Flat Glass. The 'Refine your search' section includes dropdown menus for 'State' (set to 'All States') and 'Certification Year' (set to 'All Years'), and text input fields for 'City', 'Building Name', 'Property Owner/Manager', and 'Service or Product Provider'. A blue 'Search' button is located at the bottom right of the form. On the right side of the image, a vertical sidebar shows a list of search filters, including 'Pharmaceutical manufacturing', 'Commercial bread & roll bakeries', and 'Pharmaceutical manufacturing'.

Find certified buildings and plants: energystar.gov/buildinglist

America's Most Energy-Efficient Manufacturing Plants

Since 2006



230+ plants
ENERGY STAR certified

\$6 billion+
savings on energy bills

65 million
metric tons GHG
emissions avoided

Find certified buildings and plants: energystar.gov/buildinglist

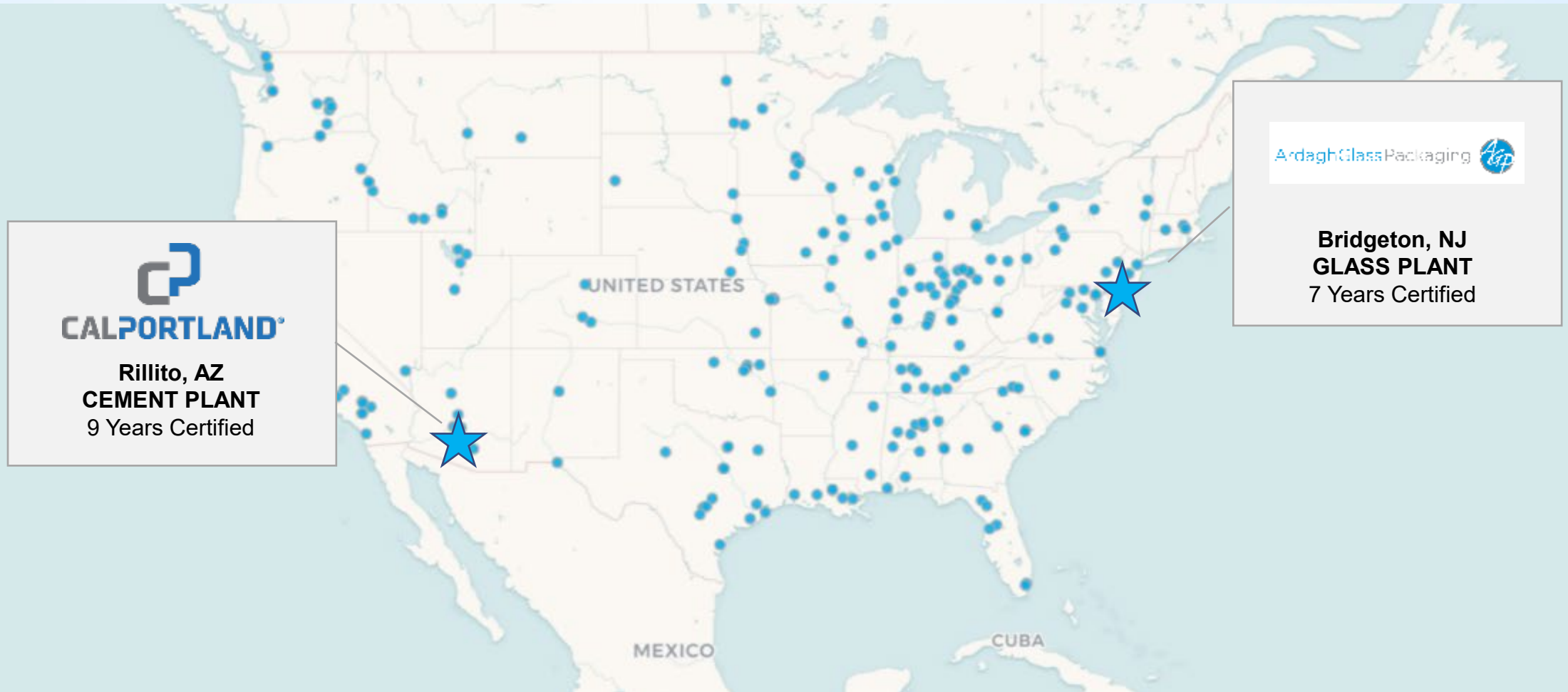


ENERGY STAR. The simple choice for energy efficiency.



America's Most Energy-Efficient Manufacturing Plants

Today's Webinar



America's Most Energy-Efficient Manufacturing Plants

Today's Webinar



Brian Kristofic
Director of Sustainability
Ardagh Glass Packaging-
North America



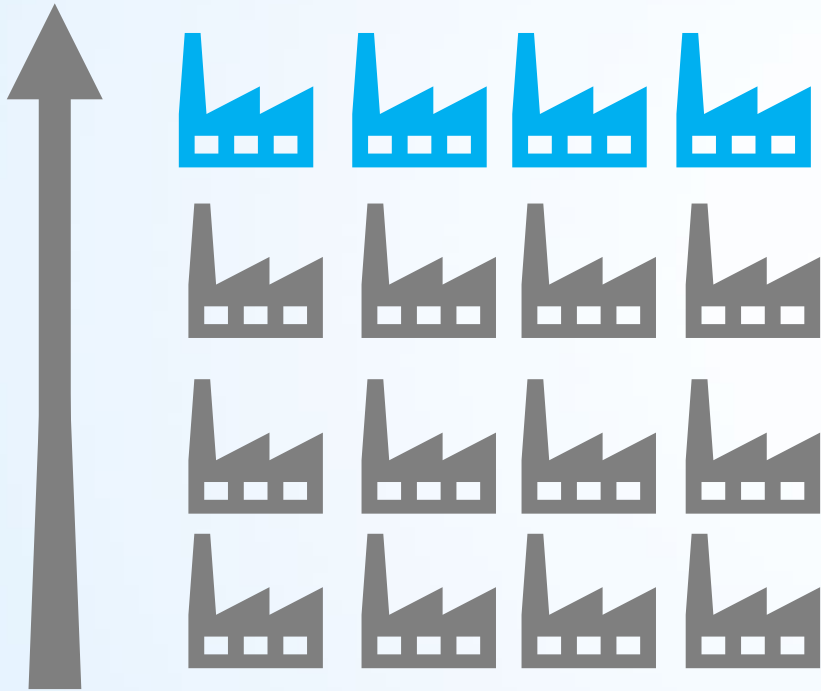
Ted Moser
Energy Manager
Ardagh Glass Packaging-
North America



Bill Jerald
Chief Energy Engineer
CalPortland

Listen for...

Low Energy
Intensity



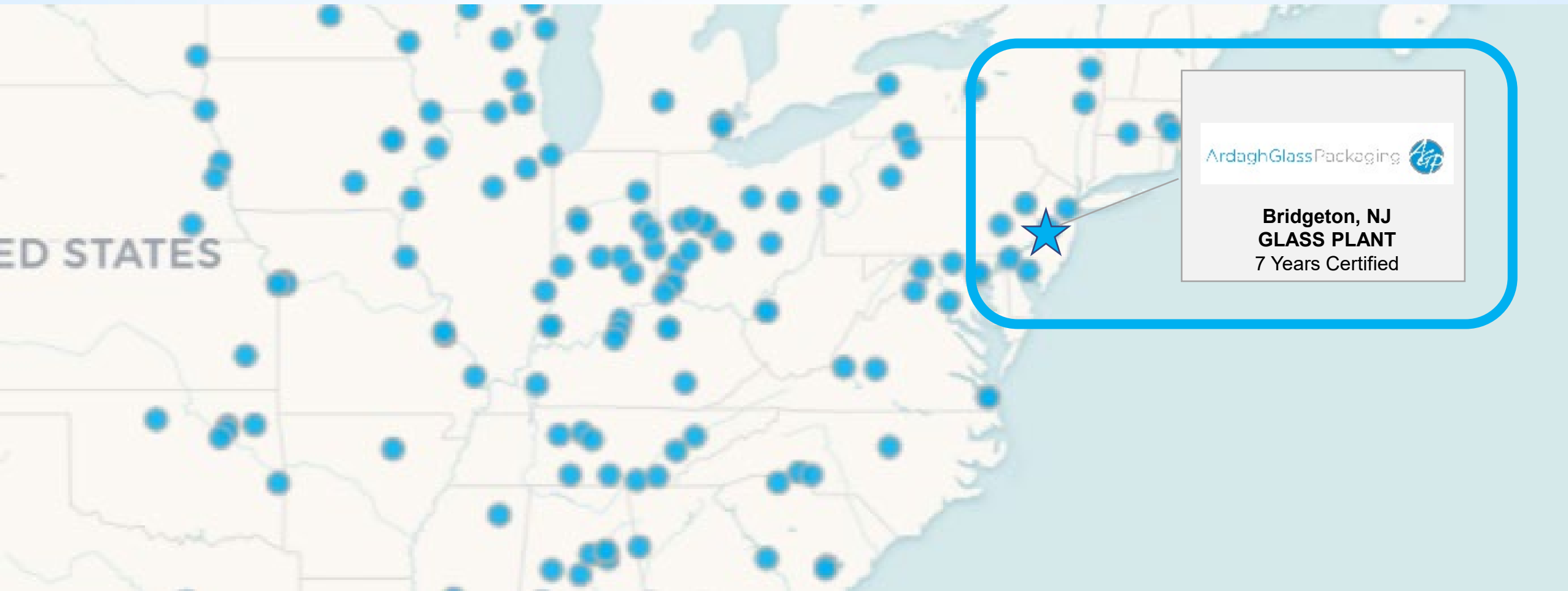
Can something similar be done in my plant or building?

How can I use ENERGY STAR to better manage energy and GHGs?



America's Most Energy-Efficient Manufacturing Plants

Today's Webinar



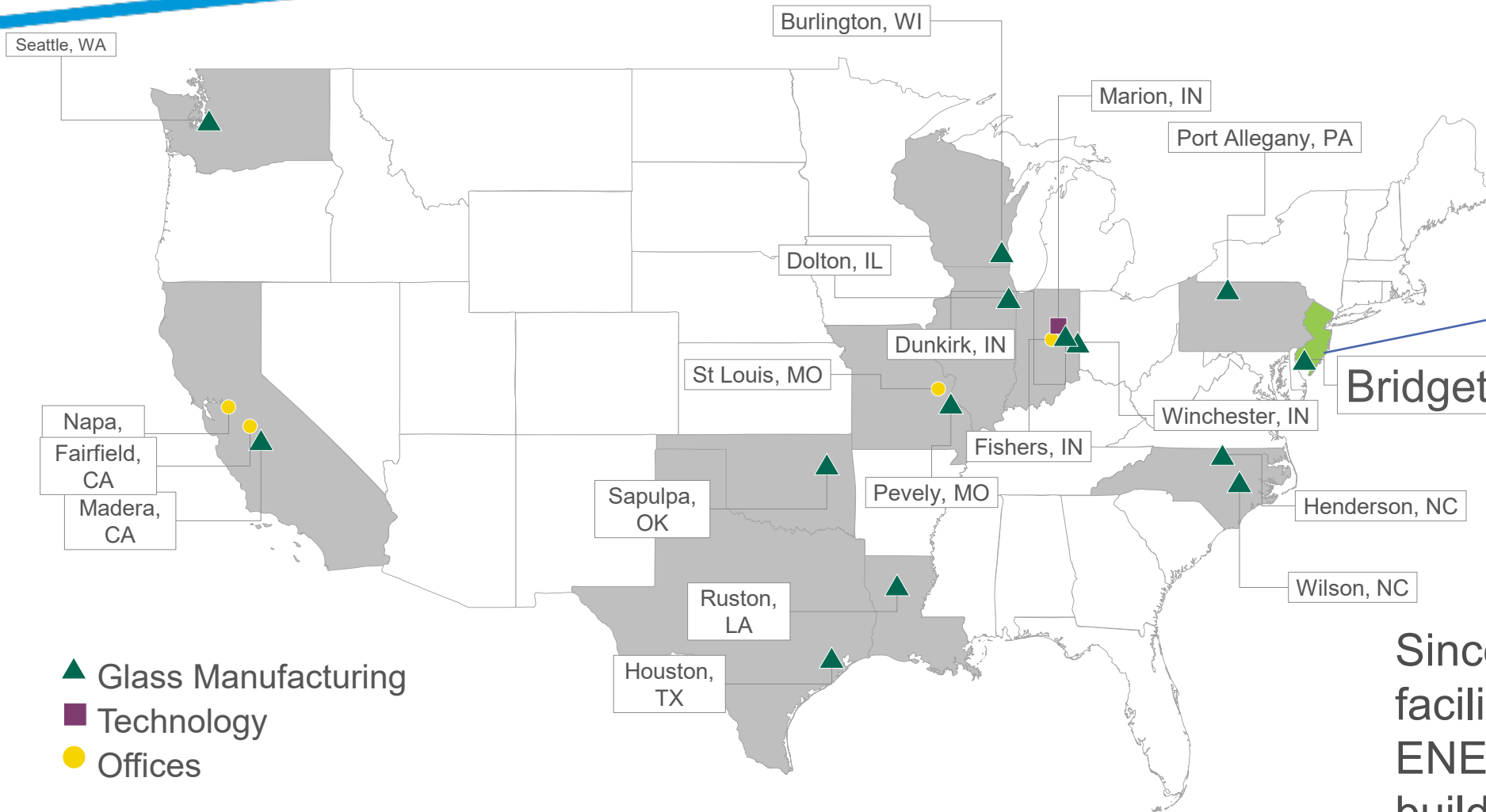
Ardagh Glass Packaging – North America Bridgeton, N.J.



ArdaghGlassPackaging



Ardagh Glass Packaging locations



Bridgeton, N.J.
glass plant
ENERGY
STAR certified
every year,
2015 - 2021

Bridgeton, NJ

Since 2010, ten AGP – NA facilities have received 47 ENERGY STAR plant and building certifications

Our Sustainability strategy

Our sustainability strategy



ENVIRONMENT AND ECOLOGY

Our sustainability levers

Minimise our GHG emissions

- Get to 100% renewable energy
- Hybrid furnace
- Recycled content increase
- Product design
- Energy efficiency projects
- Low carbon transport
- Sustainable sourcing
- Minimize NOx

Minimise our ecological impact

- Maintain excellence on water management
- Support increased recycling and use of recycled content
- Promote circularity narratives on use of infinitely recyclable materials



SOCIAL

Our people & our communities

- Excellence on health and safety
- Increase our retention, promotion and inclusion of diverse profiles
- Engage proactively with our local communities through grassroots 'Giving Back' initiatives

Our direct link with UN's Sustainable Development Goals



Our sustainability filter

Sustainability only has a sustainable impact if it is economically viable both long and short term

Bridgeton plant overview

- 1966 – Built by Leone Industries
- 2012 – Purchased by Ardagh Group
- 146,000 sq. feet – plant space
- 65,000 sq. feet – warehouse space
- 5.5 MW DC 20-acre solar facility installed 2019
- 2 furnaces, 24/7/365 operations
- Manufacture approximately 1.5 million glass containers per day for the food, beverage and spirits markets
- Approximately 360 employees



Inside an Ardagh glass facility

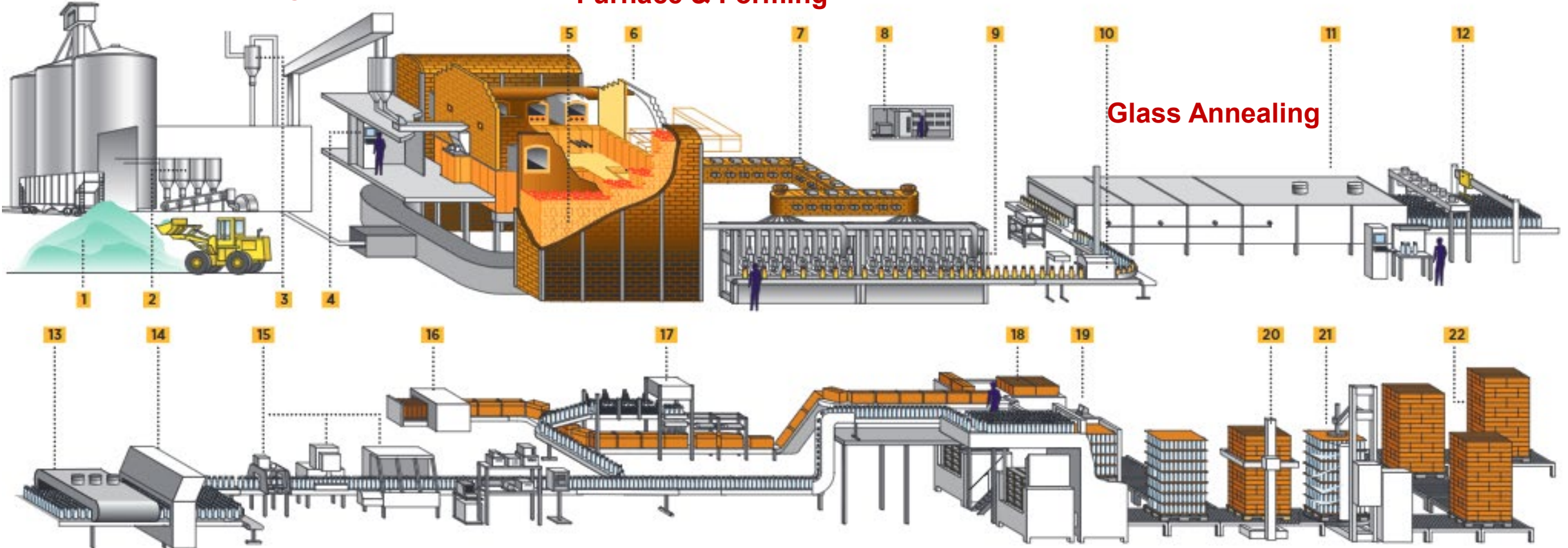
Raw Materials Storage

Furnace & Forming

Glass Annealing

Container Inspection

Container Palletization, Shipping & Warehouse



Glassmaking Process: <https://www.youtube.com/watch?v=p7y7Gtc1mX4>

AGP introduction: https://www.youtube.com/watch?v=c8-6j_V9IkE

Opportunities for energy efficiency

- High use of recycled glass (cullet)
- Preheating of cullet and raw batch materials
- Regular audits to find / repair compressed air leaks
- Regular audits to find / repair natural gas leaks
- Optimize burner settings – regular maintenance of combustion fans
- Installation of energy efficient lighting
- Compressor & vacuum system upgrades under consideration

Don't forget to ask your utility company for financial assistance.

Opportunities for energy efficiency

Use of recycled materials

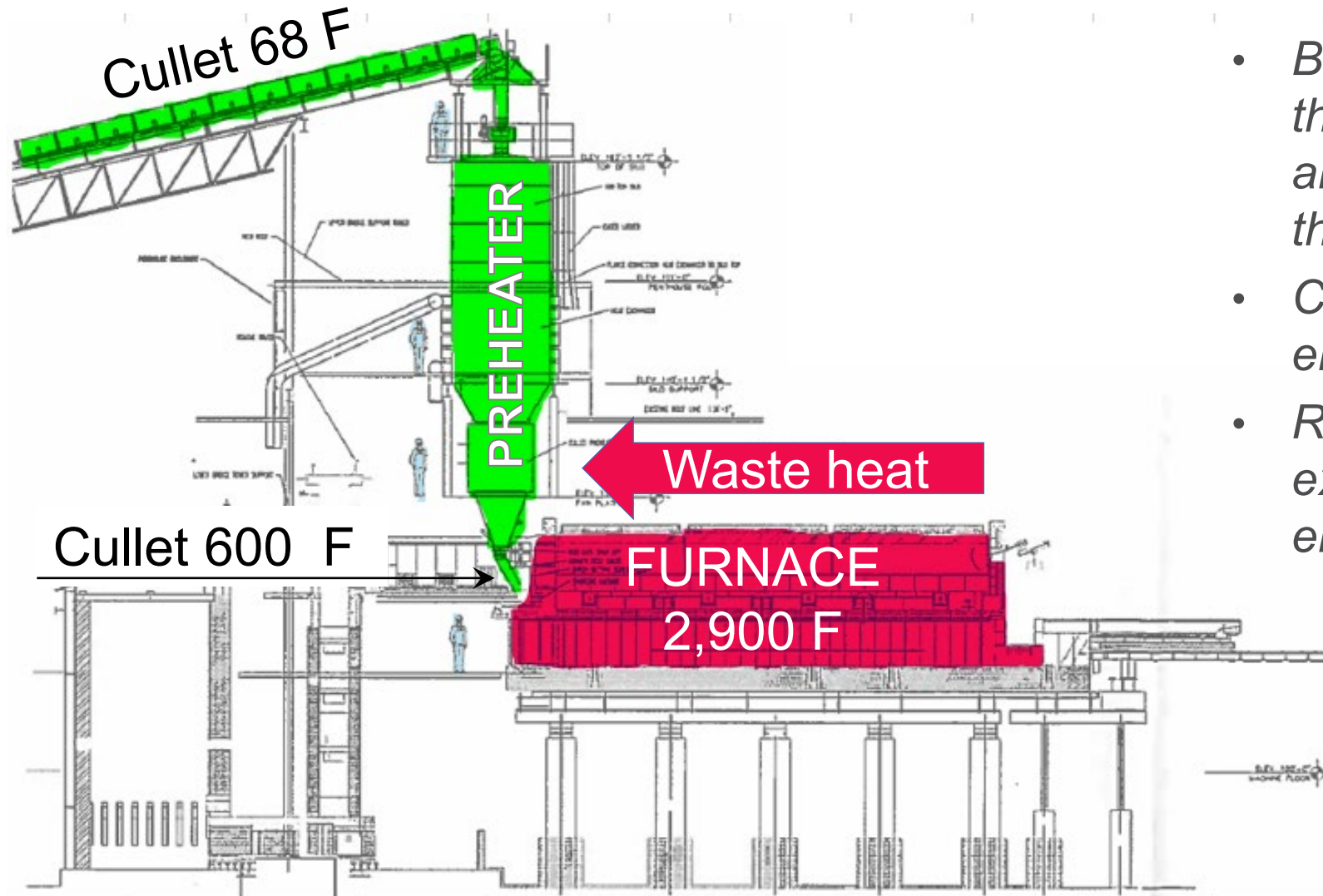


- High use of recycled glass (cullet) reduces energy required. Cullet has lower melting point than raw materials.
- Every 10% increase in cullet content = 3% energy reduction.
- Availability is a constraint
- Recycling rates vary
- Reduces quarrying of virgin raw materials; for every 100 tons of cullet recycled = 120 tons of virgin materials
- Some large furnaces can consume as much as \$2,000,000 per year in natural gas

Evaluate energy intensity of materials used in production

Opportunities for energy efficiency

Preheating inputs



- *Bridgeton is the only Ardagh plant that currently preheats both cullet and batch with waste heat from the furnace.*
- *Cullet preheating can reduce energy use 10% - 15%*
- *Removing temperature from the exhaust stream may affect emission abatement efficiency*

Opportunities for energy efficiency

Find & repair leaks

Natural gas leak audit

Video clearly shows leak

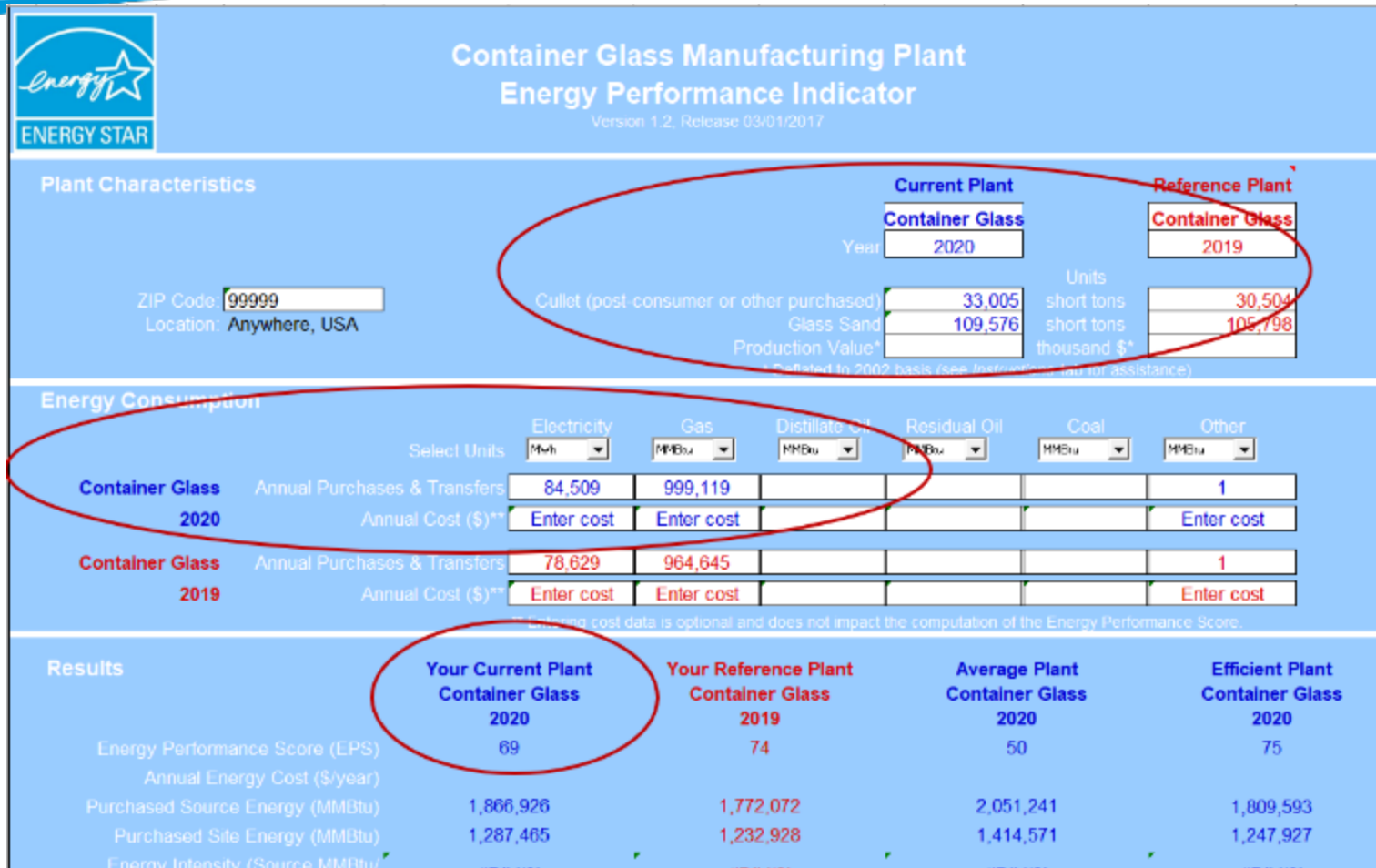


Photograph of leak



Camera Hydrocarbon sensitivity "turned on"

ENERGY STAR – Energy Performance Indicators (EPIs)



Container Glass Manufacturing Plant Energy Performance Indicator
Version 1.2, Release 03/01/2017

Plant Characteristics

	Current Plant	Reference Plant
Year	2020	2019
Cullet (post-consumer or other purchased)	33,005 short tons	30,504 short tons
Glass Sand	109,576 short tons	105,798 short tons
Production Value*		

ZIP Code: 99999
Location: Anywhere, USA

Energy Consumption

	Electricity	Gas	Distillate Oil	Residual Oil	Coal	Other
Container Glass 2020	84,509	999,119				1
Container Glass 2019	78,629	964,645				1

Results

	Your Current Plant Container Glass 2020	Your Reference Plant Container Glass 2019	Average Plant Container Glass 2020	Efficient Plant Container Glass 2020
Energy Performance Score (EPS)	69	74	50	75
Annual Energy Cost (\$/year)				
Purchased Source Energy (MMBtu)	1,866,926	1,772,072	2,051,241	1,809,593
Purchased Site Energy (MMBtu)	1,287,465	1,232,928	1,414,571	1,247,927
Energy Intensity (Source MMBtu/				

Provides plants a score based on production and energy data

- Allows comparison of our portfolio of plants
- Tells us how far a plant is from average or high efficiency
- Clear metric to report to management

ENERGY STAR – one part of our Sustainability measurement program



The Carbon Disclosure Project (CDP) is a global environmental impact non-profit organization that drives companies and governments to reduce their greenhouse gas emissions, safeguard water resources and protect forests.



EcoVadis is a sustainability rating platform which assesses the sustainability policies, actions and reporting of suppliers in the categories of environment, labor practices, fair business practices and sustainable procurement.



Sedex is a networking platform aimed at sharing information on policies, procedures and standards at production facility level. The information is shared with key customers and may be reinforced by external, so-called SMETAs (Sedex Members' Ethical Trade Audits).

Thank you

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Check out our socials!

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<https://www.linkedin.com/company/ardagh-group>

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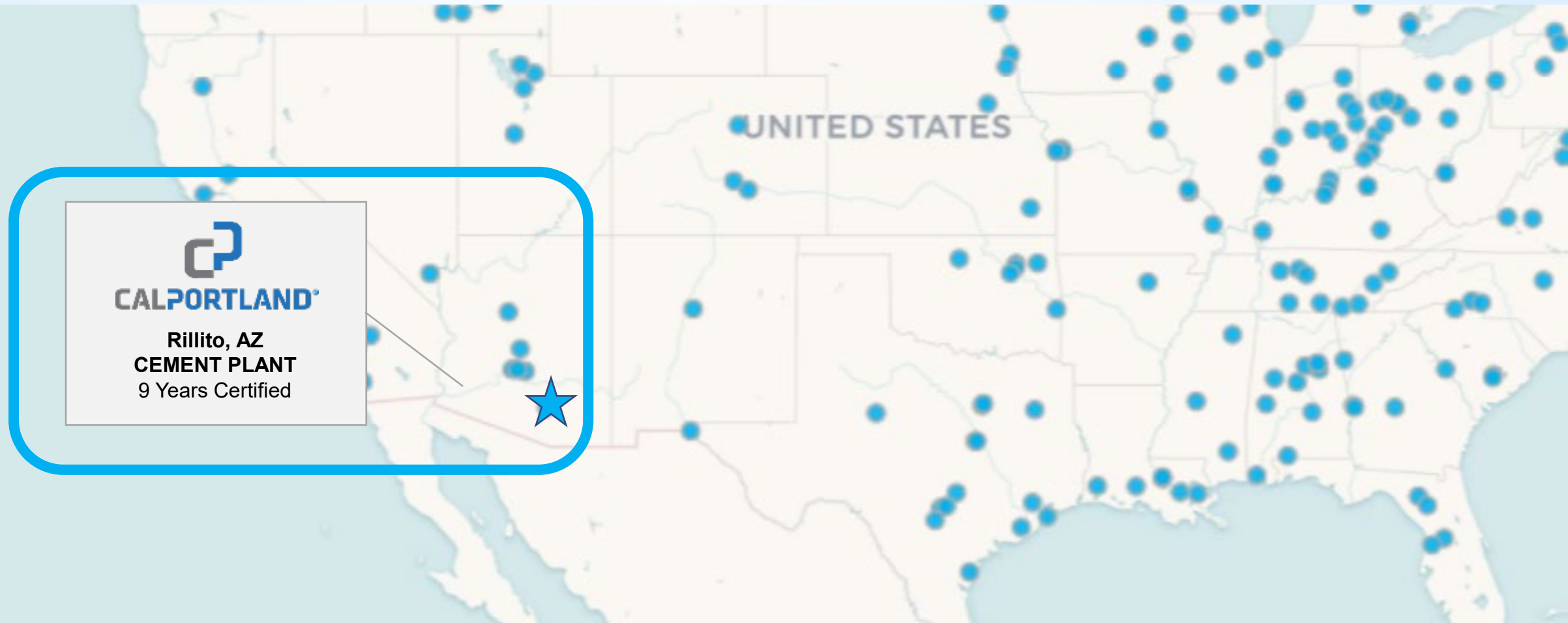
<https://www.facebook.com/ardaghgroup/>

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Thank you

America's Most Energy-Efficient Manufacturing Plants

Today's Webinar





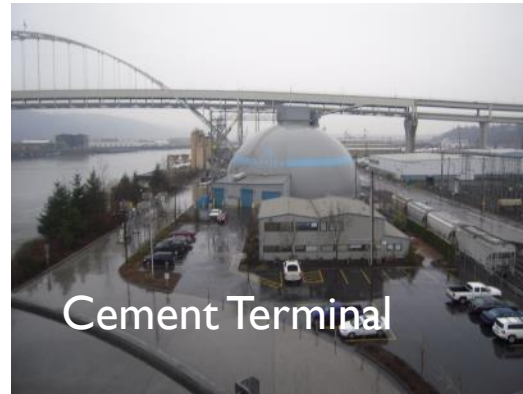
CALPORTLAND AMERICA'S MOST ENERGY EFFICIENT PLANTS

WILLIAM JERALD, CHIEF ENERGY ENGINEER, CALPORTLAND

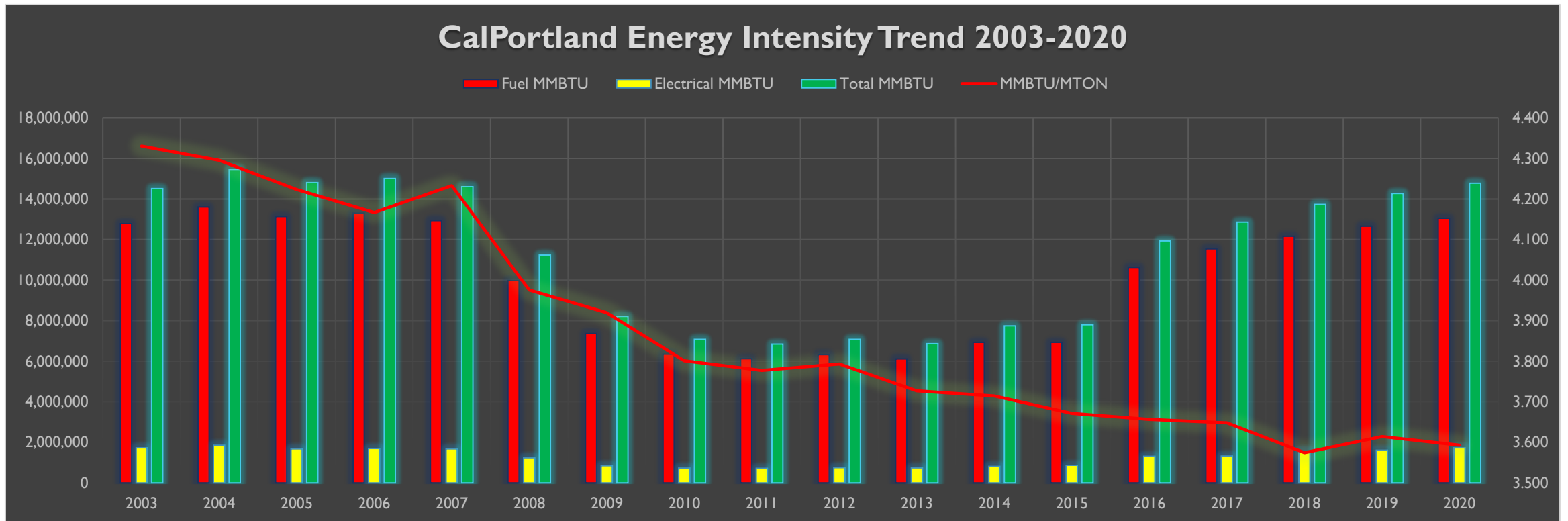
WE ARE CALPORTLAND

- Started operation in Colton, CA in 1891
- Building Material supplier on the West coast of the U.S.
- 3,000 employees
- Over 100 facilities
- Washington, Oregon, Nevada, California and Arizona
- All three cement plants have achieved ENERGY STAR certification at some point
- Over 60 plants have taken the ENERGY STAR Challenge for Industry, over 20 Plants have Achieved the Challenge for Industry

CALPORTLAND OPERATIONS



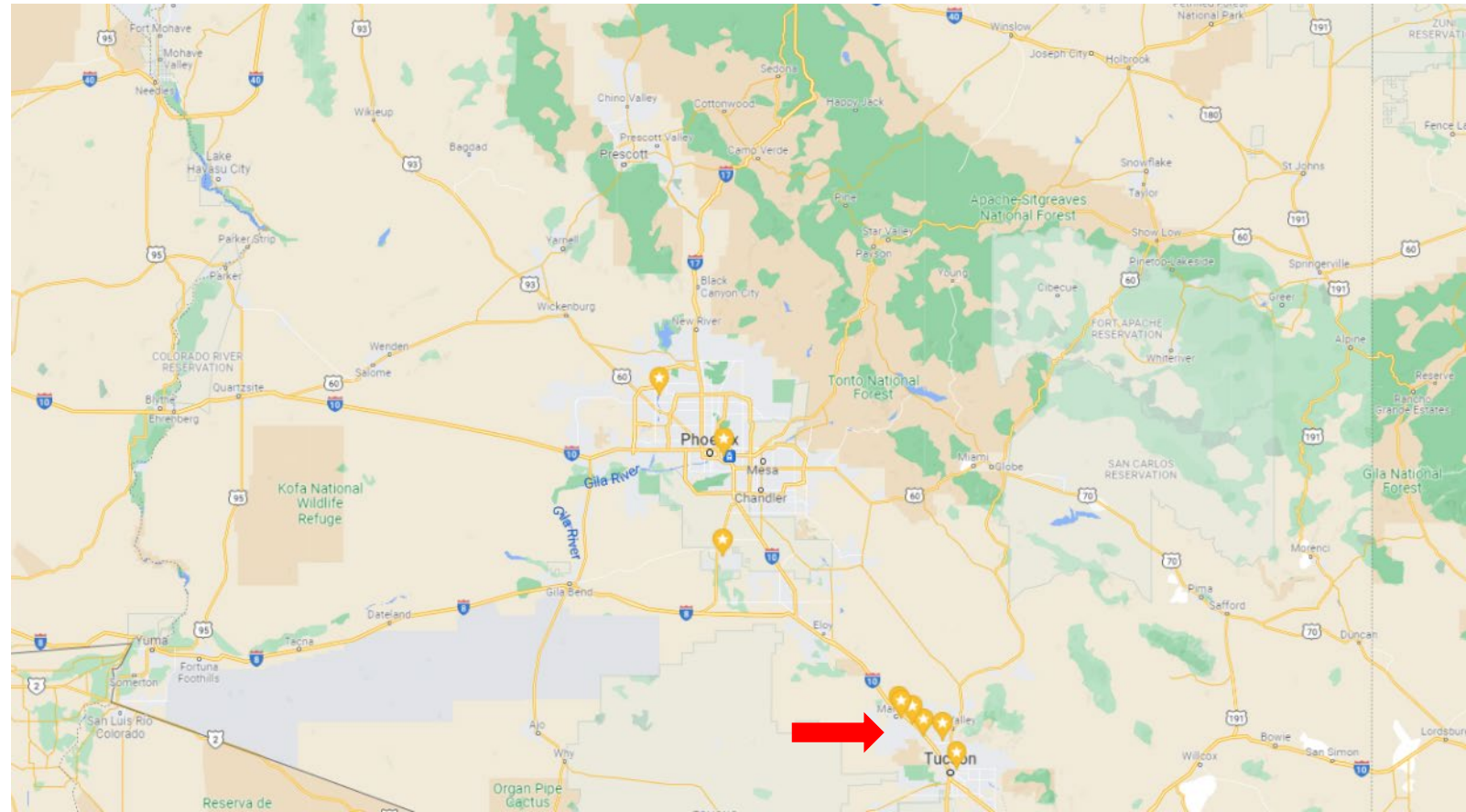
CALPORTLAND ENERGY CONSUMPTION





RILLITO CEMENT PLANT

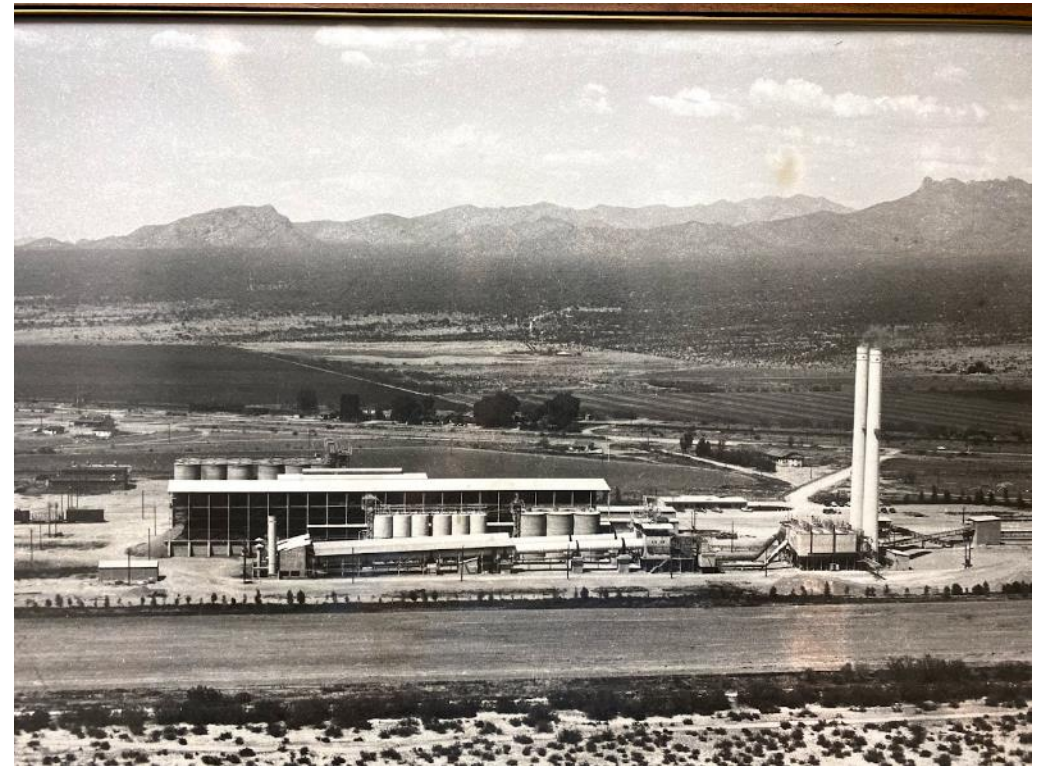
- The Rillito Cement Plant is located just North of Tucson, AZ
- Portland Cement is shipped to Tucson and Phoenix via trucks
- The plant also has the capability to ship via rail
- Over 1 Million Tons of Cement shipped annually



RILLITO CEMENT PLANT HISTORY



Rillito Cement Plant First Kiln installed 1949



Rillito Cement Plant Second Kiln installed 1953

RILLITO CEMENT PLANT HISTORY



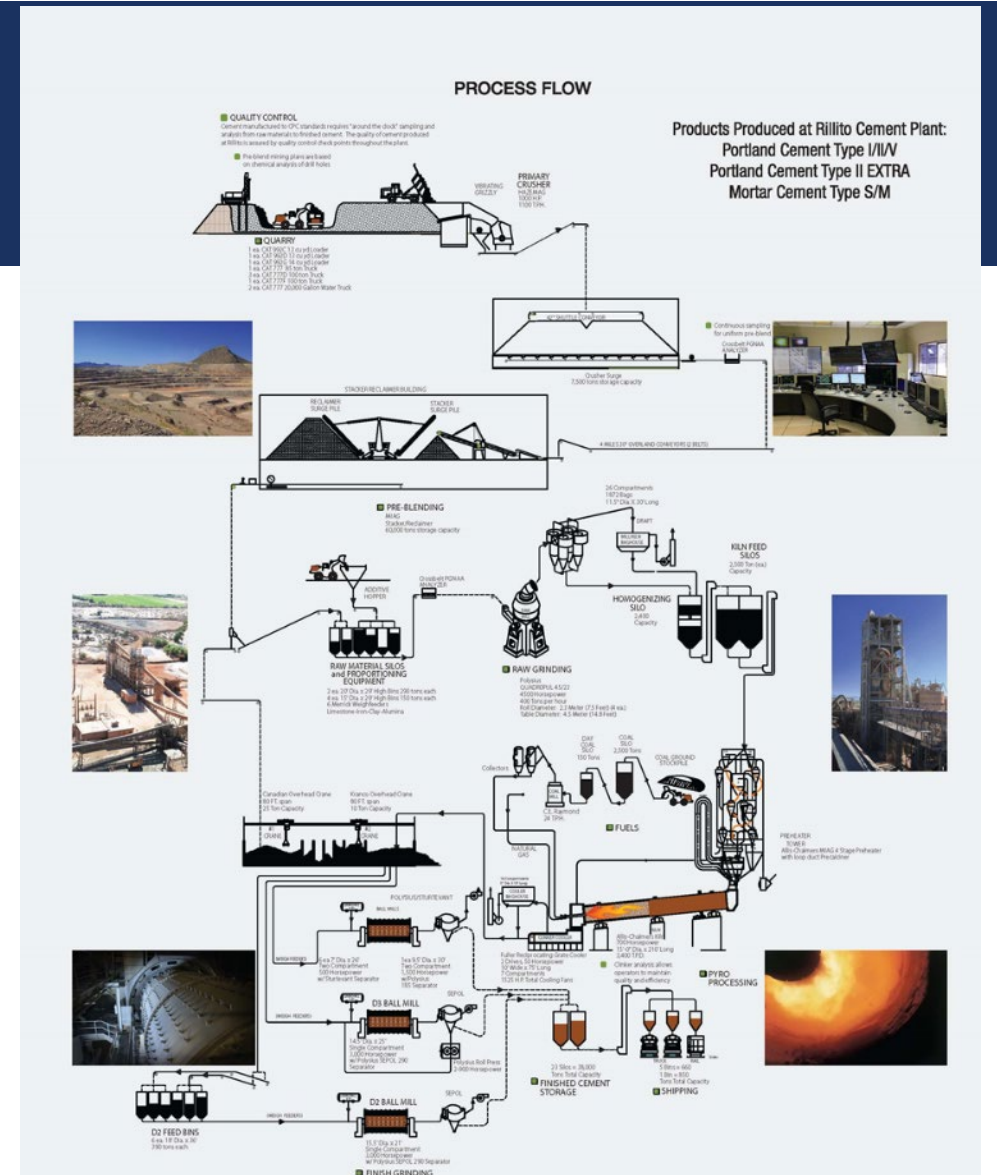
Rillito Cement Plant Third Kiln installed 1955



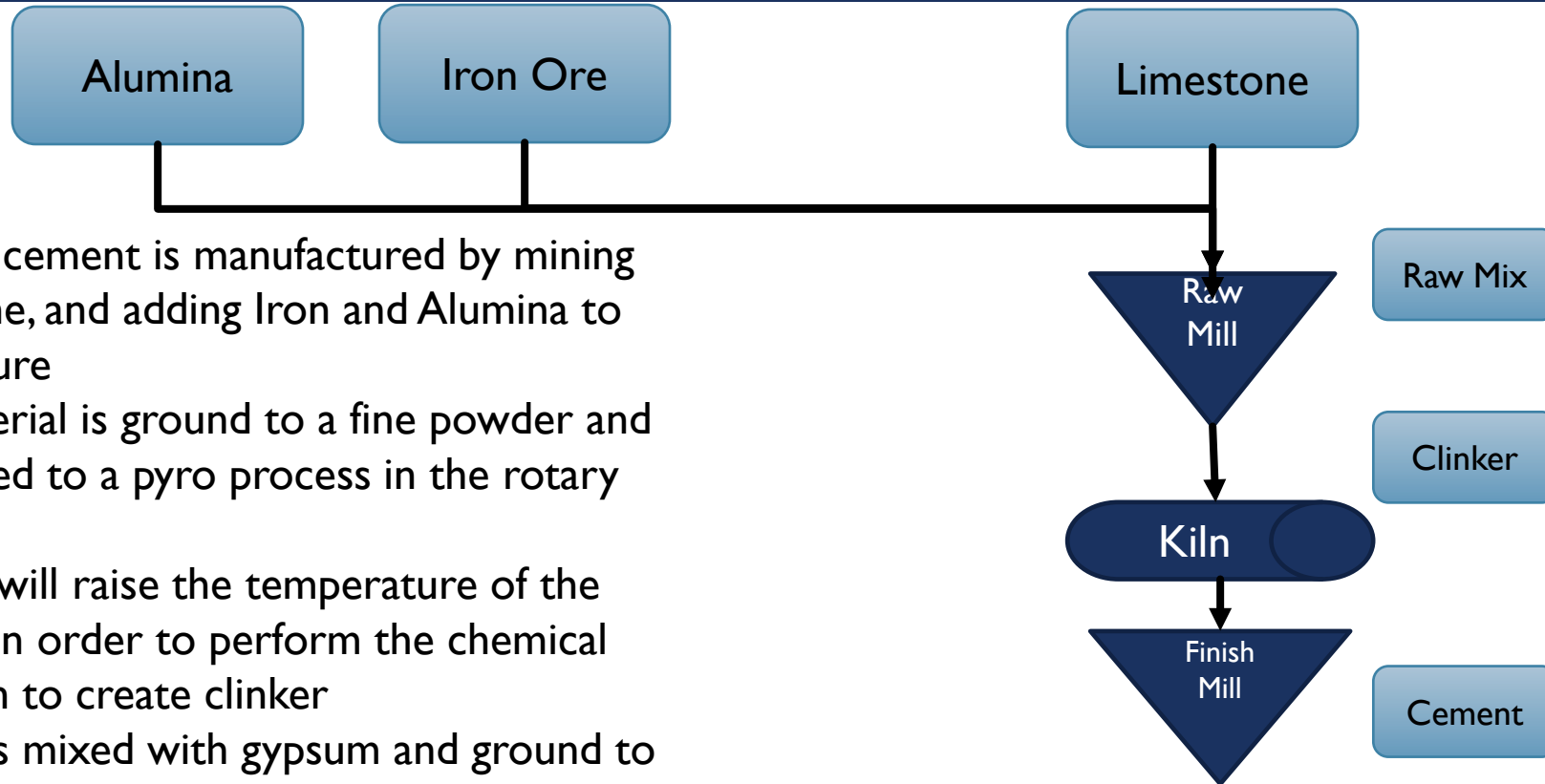
Rillito Cement Plant 4th Kiln with Preheater Tower installed 1955

CEMENT PLANT PROCESS

- Quarry Mines Limestone and delivers to the plant
- Limestone is crushed and Iron and Alumina is added
- The mixture is introduced to kiln process and heated to 2500F
- Kiln discharges the processed product (called clinker)
- Clinker is pulverized into the powdered Portland cement and shipped out to customers

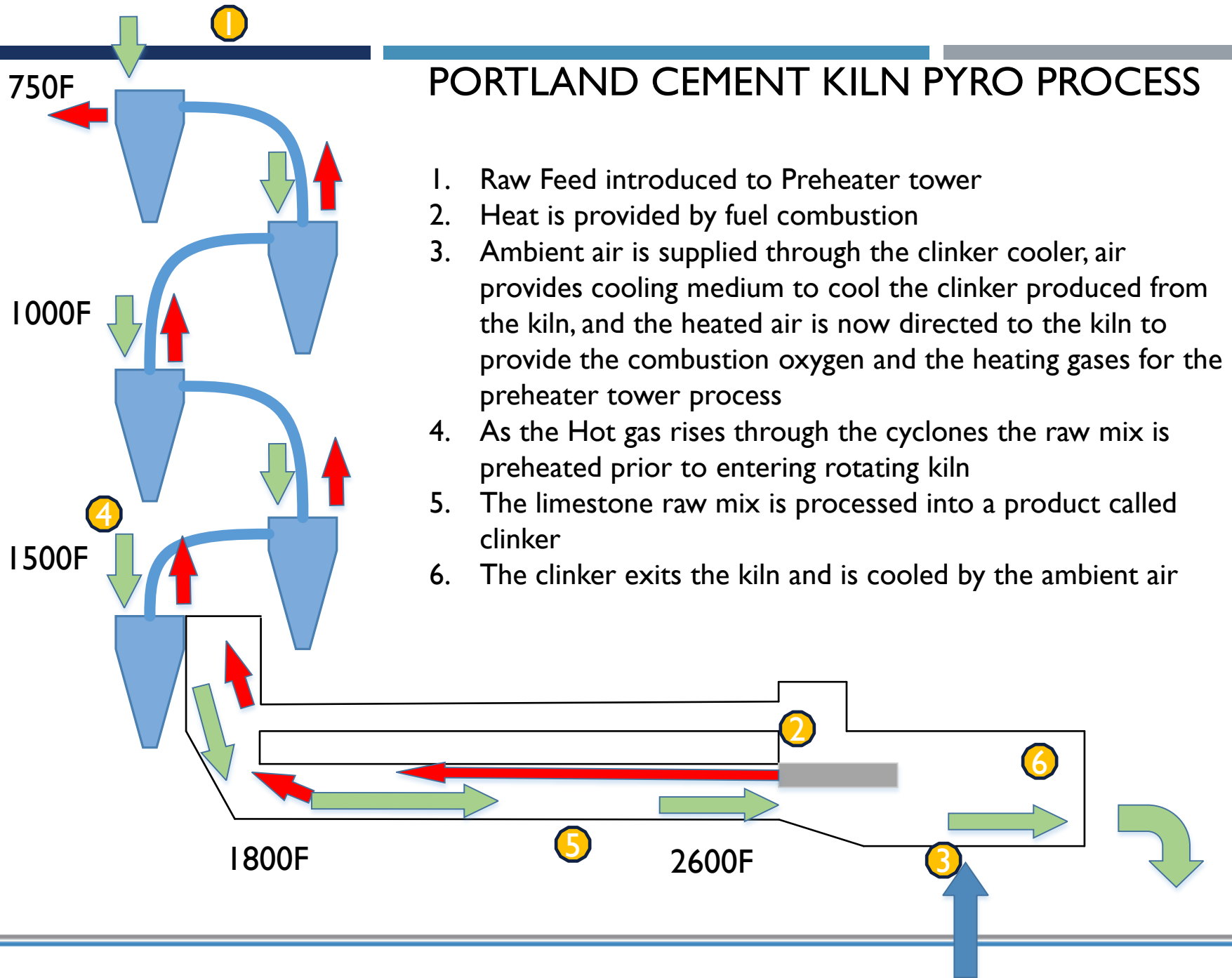


BASIC PORTLAND CEMENT MANUFACTURING PROCESS



- Portland cement is manufactured by mining Limestone, and adding Iron and Alumina to the mixture
- The material is ground to a fine powder and introduced to a pyro process in the rotary kiln
- The kiln will raise the temperature of the mixture in order to perform the chemical transition to create clinker
- Clinker is mixed with gypsum and ground to a fine product that becomes the final product of Portland Cement

PORTLAND CEMENT KILN PYRO PROCESS



1. Raw Feed introduced to Preheater tower
2. Heat is provided by fuel combustion
3. Ambient air is supplied through the clinker cooler, air provides cooling medium to cool the clinker produced from the kiln, and the heated air is now directed to the kiln to provide the combustion oxygen and the heating gases for the preheater tower process
4. As the Hot gas rises through the cyclones the raw mix is preheated prior to entering rotating kiln
5. The limestone raw mix is processed into a product called clinker
6. The clinker exits the kiln and is cooled by the ambient air

RILLITO ENERGY MANAGEMENT TEAM

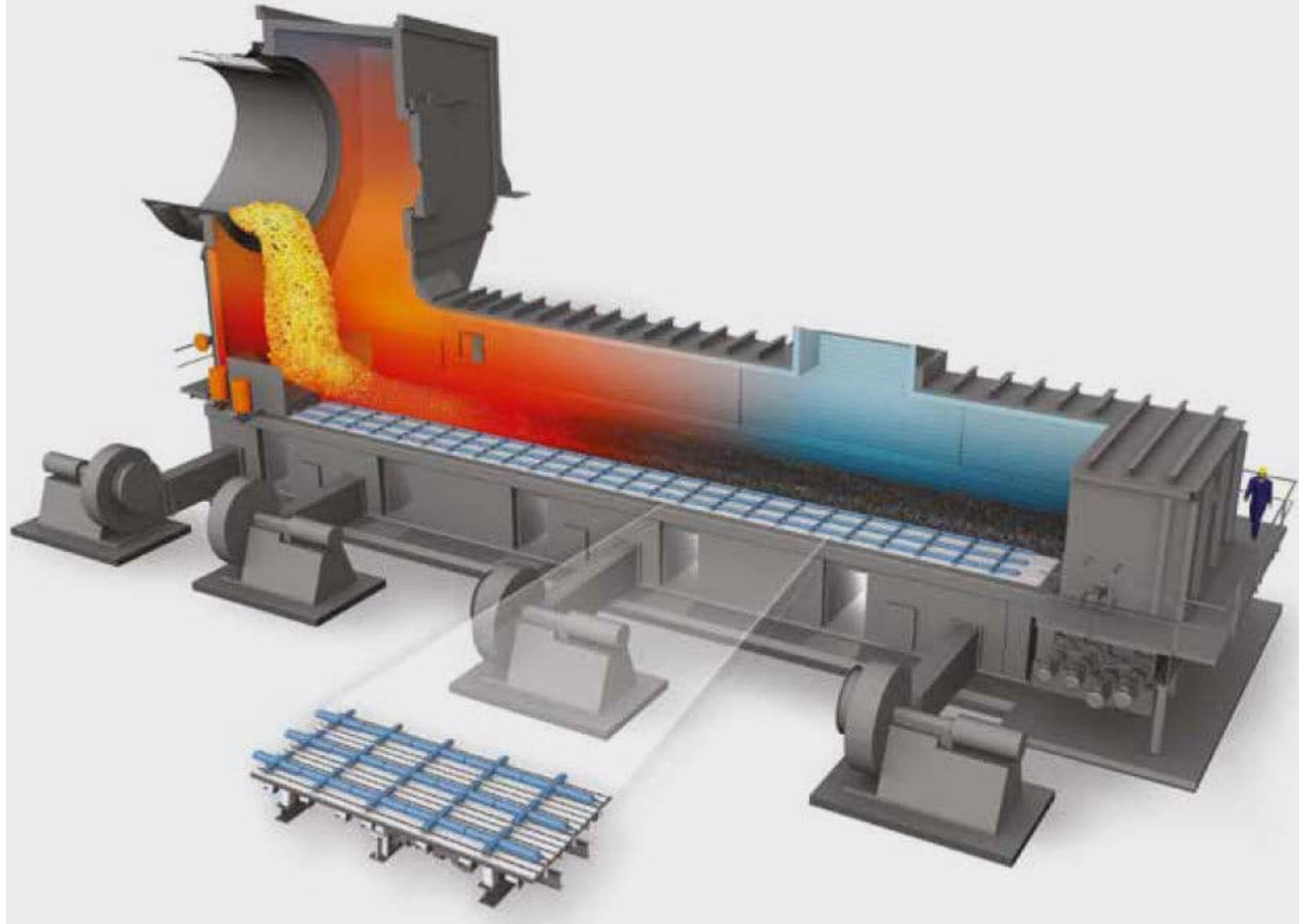
- Plant Engineer is designated Energy Manager
- Weekly meetings to discuss energy efficiency projects
- Quarterly process energy meetings to report energy intensity data across corporate meeting
- Focus on energy data keeps energy topics visible and a high priority





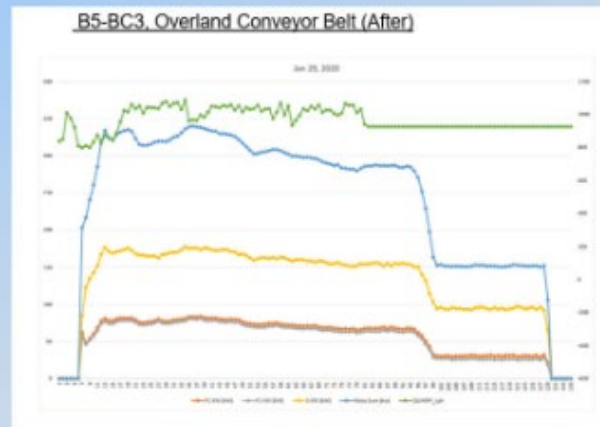
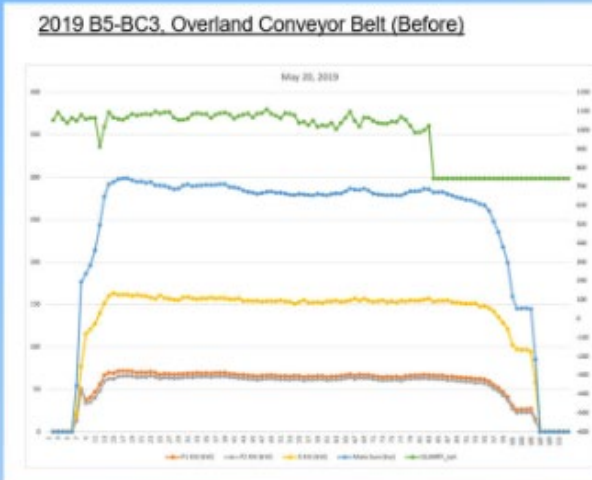
RILLITO CLINKER COOLER MODIFICATION

- Improved heat exchange allows more heat sent back to the process (energy intensity reduction)
- Cooler clinker leaving cooler
- Exit crusher improved allowing less downtime
- 7% kiln fuel efficiency improvement





The 3.5 mile long belt conveyor was due for replacement. Belt product was picked based on promise of reduced energy consumption due to the composition of the belt rubber. Metering installed and performing long term energy intensity analysis



OVERLAND CONVEYOR BELT REPLACEMENT

1-2 % energy efficiency improvement

Fuel System air leakage modifications



Double Tipping Valve

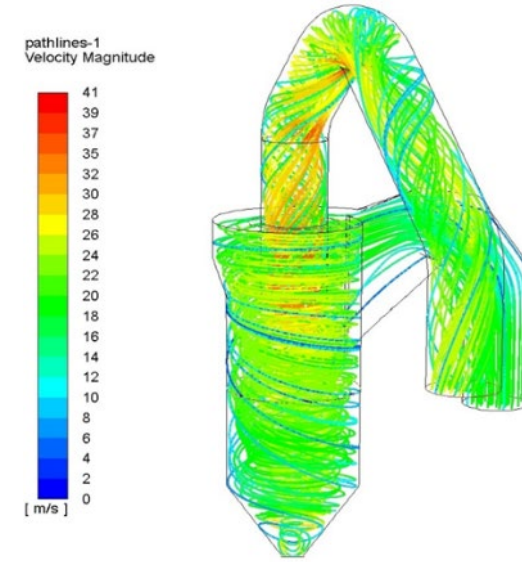


The Rillito Cement plant kiln takes alternative fuels into the upper level of the preheating tower. The original system allowed significant cold air into the process forcing higher fuel consumption, installing new double tipping valve significantly improved performance and allowed the plant to consistently burn alternative fuels efficiently, 1-2% efficiency improvement

RILLITO PROCESS FAN IMPROVEMENTS

- The plant has performed multiple fan assessments
- Various projects have included complete fan wheel replacements, or fan wheel repair and restoration to factory specifications
- Thousands of HP of process fans on the property



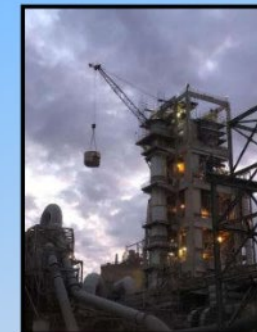


RILLITO PREHEATER TOWER CYCLONE REPLACEMENT

- Cyclone is where the raw mix is introduced to the hot air process, maximizing heat transfer is important to efficiency
- Computational Fluid Dynamic (CFD) modeling used to find the optimum design for maximizing efficiency of new cyclone
- 3-4% kiln fuel efficiency improvement



Completed the project to install new cyclones, rainbow duct and riser with a CalPortland design saving an estimated \$819 K/yr.



RILLITO COMPRESSED AIR SYSTEM UPGRADES

- Plant performs regular leak checks with ultrasonic detector
- Performed DOE in plant training for compressed air systems in 2012, Identified multiple compressed air system modification
- A 2020 vendor performed assessment identified more potential savings projects
- 5% system efficiency improvement

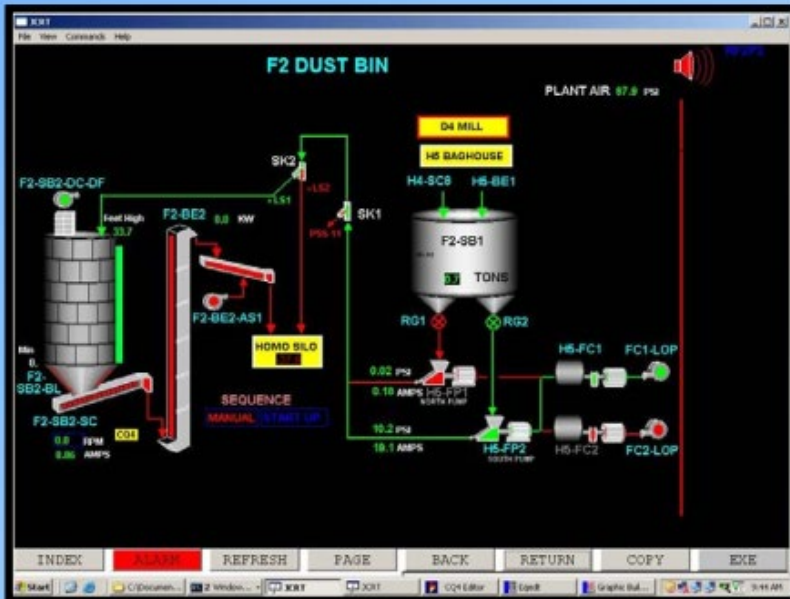




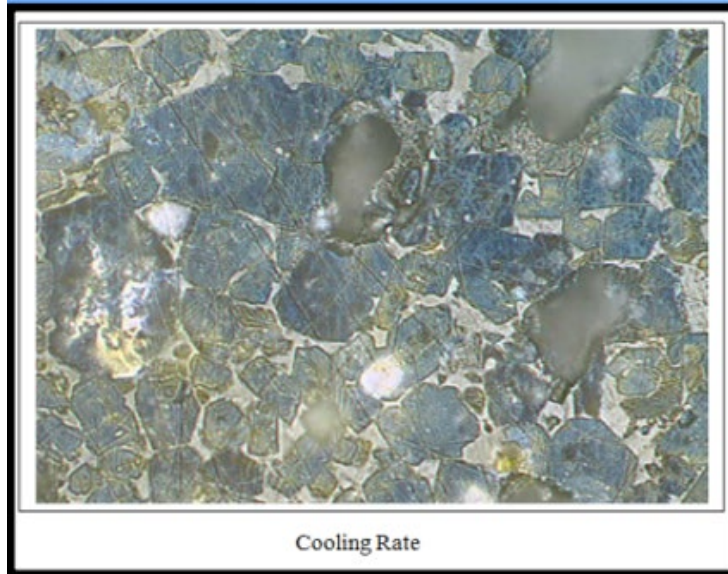
- \$1 Million Project Cost
- 1-2% Estimated Fuel Savings
- Improved std. deviation of kiln feed



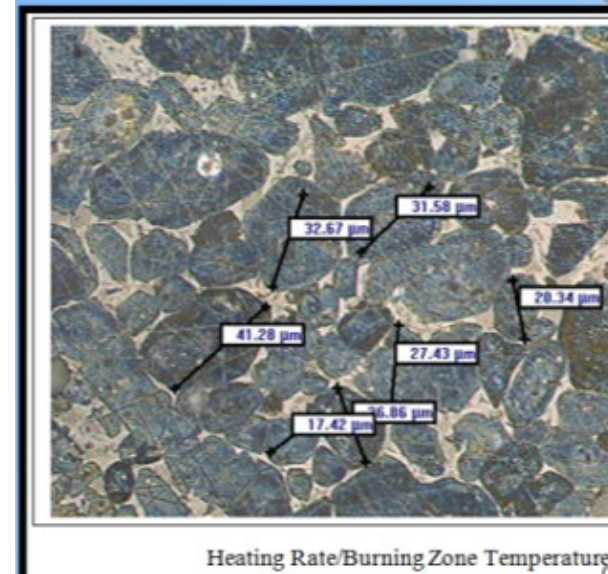
KILN FEED DUST BIN INSTALLATION



Dust Bin takes baghouse dust and reintroduces it to the raw mix in a metered process to reduce raw feed transient quality, improves kiln energy intensity due to stability improvements



Cooling Rate



Heating Rate/Burning Zone Temperature

MICROSCOPY OF CLINKER

- Clinker samples analyzed for crystal structure formation
- Analysis helps determine kiln performance and advises necessary kiln operational and chemistry adjustments to improve performance and efficiency

Primary Air Temp	2,171 F	O2 inlet	5.2 %	C4AF (%)	11.3	
Secondary Air Temp	1,565 F	NOx inlet	929 ppm	LSF	94	
Preheater Inlet Temp	130 F	Low CO inlet	0 ppm	MgO (%)	4.6	
Preheater Outlet Temp	10 rpm	O2 tower	3.2 %	Liter Weight (g/l)	1,241	
Preheater Inlet Pressure	21.6 in WG	NOx tower	454 ppm	F CaO (%)	0.5	
Preheater Outlet Pressure	389 Amps	Low CO tower	1,763 ppm	Burn Factor	106	
Preheater Inlet Rate	219 tph	Kiln Pfister	192 MMBTU	Liquid (%)	26.0	
Preheater Outlet Rate	141 rph	Calciner Pfister	205 MMBTU	SR	2.7	
Preheater Inlet/Feed	0.64 rev/ton	Alternate Fuel Rate	0 sT/hr	SO3 (%)	0.2	
Preheater Air damper	80 %	Stage 4 Gas Temp	1,602 F	S / Alk	0.3	
		Kiln Fuel Rate	48 %			
		Fuel Consumption	3.0 mmBtu/t			
		Coal 200 Mesh	72.1	100 Mesh	96	
				200 Mesh	80	
				Calcination (%)	88	Score
Rate	Average; Alite size 30-40 µm					4
Zone Temp	<input type="checkbox"/> Very Hot <input type="checkbox"/> Hot <input checked="" type="checkbox"/> Warm <input type="checkbox"/> Cool					4
Zone Time	Medium/Short; Belite size 15-20 µm					4
Rate	<input type="checkbox"/> Quick <input type="checkbox"/> Medium Fast <input checked="" type="checkbox"/> Medium Slow <input type="checkbox"/> Slow					4
Observations						

ENERGY STAR EPI POSTER

- Rillito ENERGY STAR EPI score poster
- Placed throughout the plant
- Employee engagement is critical



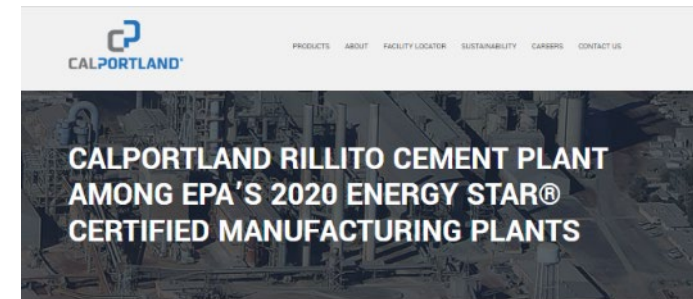
EMPLOYEE SHIRTS CELEBRATING CERTIFICATION

- Rewarding and Acknowledging employees is vital to maintaining energy efficiency gains



CERTIFICATION ANNOUNCEMENT

- CalPortland proudly shares and announces our plant certification to the community
- Sharing with our neighbors
- Sharing with our customers to make them aware of our commitment to energy efficiency and sustainability



Home | About | Media Center | CALPORTLAND RILLITO CEMENT PLANT AMONG EPA'S 2020 ENERGY STAR® CERTIFIED MANUFACTURING PLANTS

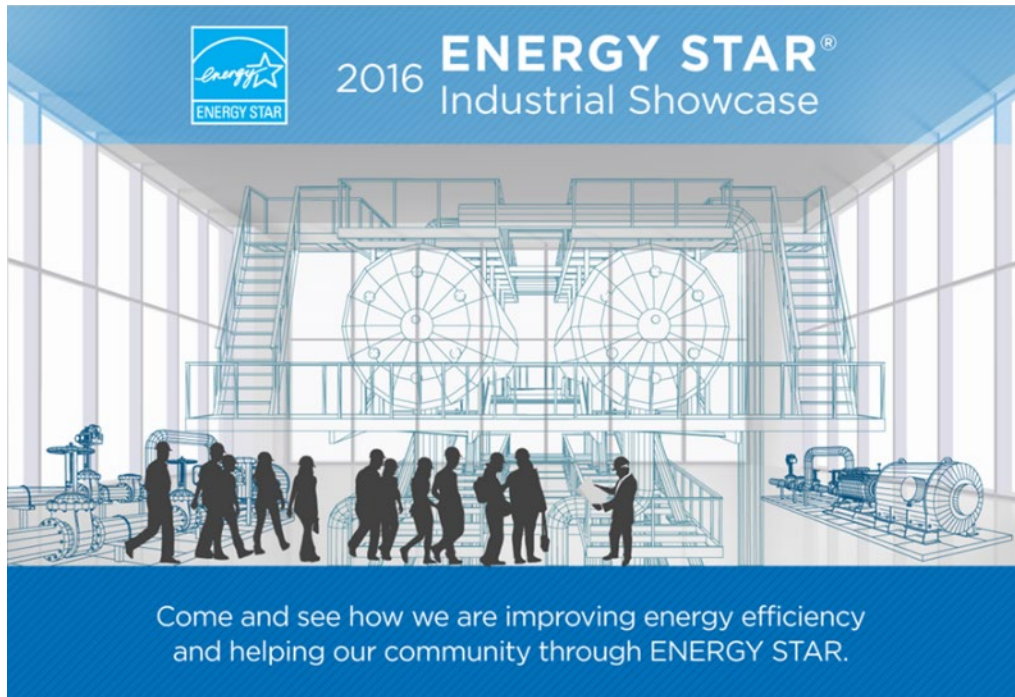


CALPORTLAND RILLITO CEMENT PLANT AMONG EPA'S 2020 ENERGY STAR® CERTIFIED MANUFACTURING PLANTS

March 16, 2021, Glendora, CA. The U.S. Environmental Protection Agency (EPA) announced yesterday that 90 U.S. manufacturing plants earned ENERGY STAR® certification in 2020 for being among the most energy efficient in their industries. CalPortland is proud to announce that the company's Millis, AZ cement plant, was one of 13 cement plants and 65 U.S. manufacturing plants to earn this certification. Facility Certification signifies that the industrial plant performs in the top 25 percent of similar facilities nationwide for energy efficiency and meets strict energy efficiency performance levels set by the EPA. Since the first industrial facilities received certification 15 years ago, ENERGY STAR® certified plants have significantly helped the U.S. economy and the environment, resulting in more \$6 billion in savings on energy bills and cleaner air by preventing over 45 million metric tons in greenhouse gas emissions compared to average performing facilities. This is the ninth consecutive (2012 - 2020) year that the Millis, AZ cement plant has earned the ENERGY STAR, reflecting a legacy of continued energy savings.

"CalPortland is pleased to accept EPA's ENERGY STAR 2020 certification in recognition of our energy efficiency efforts at the Millis plant," said Allen Hamblin, President/CEO CalPortland. "We continue to demonstrate our commitment to environmental stewardship and ENERGY STAR while also reducing our energy costs through the hard work of our employees and our corporate energy management culture."

RILLITO CEMENT PLANT ENERGY STAR INDUSTRIAL SHOWCASE



2016 **ENERGY STAR**[®] Industrial Showcase

Come and see how we are improving energy efficiency and helping our community through ENERGY STAR.



RILLITO CEMENT PLANT, ENERGY STAR CERTIFIED

- Rillito Cement Plant
- ENERGY STAR certified since 2012
- Continual improvements over the years
- Was able to maintain certification with the new EPI baseline





THANK YOU

WILLIAM JERALD

CHIEF ENERGY ENGINEER

CALPORTLAND

WJERALD@CALPORTLAND.COM

Sectors eligible for ENERGY STAR certification

- [Auto Assembly](#)
- [Auto Engine](#)
- [Auto Transmission](#)
- [Cement](#)
- [Commercial Bread & Roll](#)
- [Container Glass](#)
- [Cookie & Cracker](#)
- [Flat Glass](#)
- [Frozen Fried Potato Processing](#)
- [Fluid Milk Processing](#)
- [Integrated Paper Mill](#)
- [Integrated Steel Plant](#)
- [Juice Processing](#)
- Metal Casting
 - [Aluminum](#)
 - [Iron](#)
- [Nitrogenous Fertilizer](#)
- Petroleum Refining
- [Pharmaceutical](#)
- [Pulp Mill](#)
- [Wet Corn Milling](#)



2021 ENERGY STAR
Certified Plant
application deadline
November 30, 2021

www.energystar.gov/plants

Next webinars

Part 2: Paper and Petroleum

Wednesday, November 17, 2021; 12 PM ET

- Georgia Pacific's Brewton, Alabama containerboard mill
- Marathon Petroleum Corporation's Robinson, Illinois Refinery

Part 3: Bakeries

February 9, 2022; 12 PM ET

- Weston Foods' ACE Gaffney, South Carolina (2 years ENERGY STAR certified) and Winnipeg, Canada commercial bakeries



[www.energystar.gov/industrial_plants/America's
_most_energy_efficient_plants](http://www.energystar.gov/industrial_plants/America's_most_energy_efficient_plants)