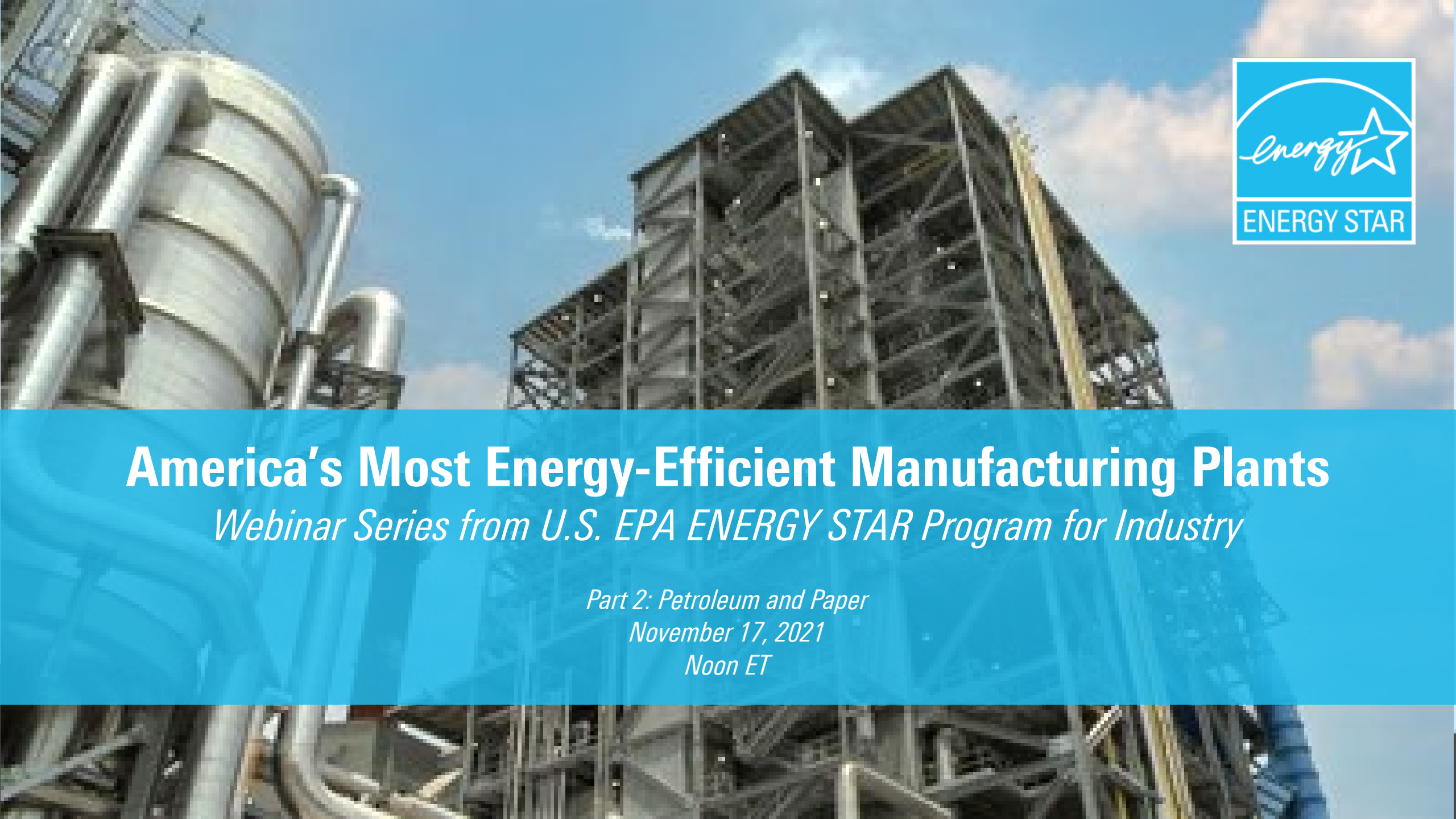


America's Most Energy-Efficient Manufacturing Plants

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

Part 2: Petroleum and Paper
November 17, 2021
Noon ET

We'll get started in a minute. But while you're waiting…

How much energy does it take to:

Refine a barrel of oil?

Manufacture a ton of paper?

(1 BTU is approximately the amount of energy created by burning one blue-tip kitchen match)

EPA | ENERGY STAR. The simple choice for energy efficiency.

How much energy does it take to:

Refine a barrel of oil?
600,000 Btu

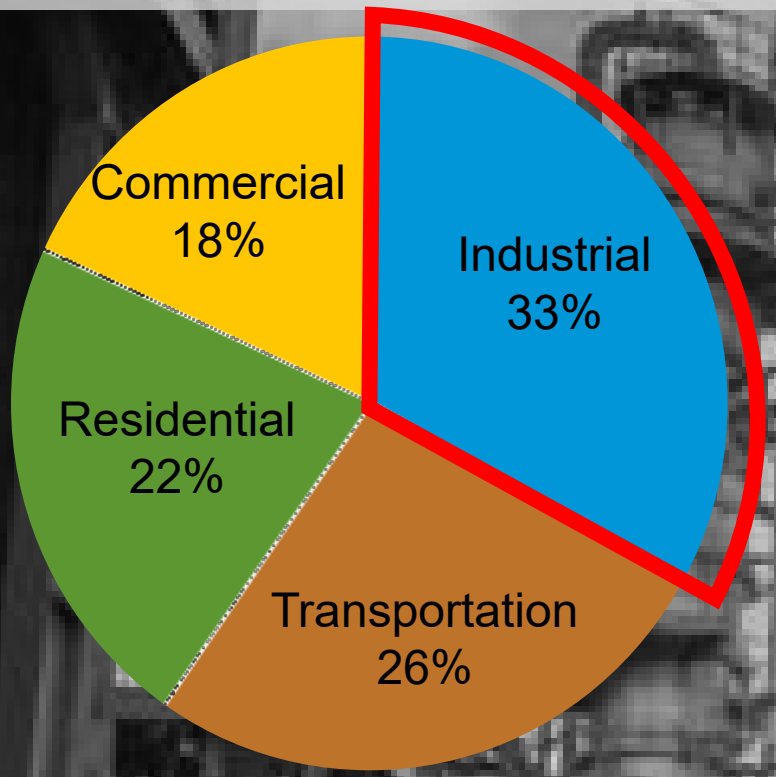
Manufacture a ton of paper?
6-9 million Btu

Bring gallon of 68°F water to boil
1,200 Btu

Sources: Refining a barrel of oil is total energy/total production from Table 1.1 of 2018 MECS and 2018 refinery production. | Energy intensity for manufacturing a ton of paper from Kramer, K. et al. (2009). Energy Efficiency Improvement and Cost Saving Opportunities for the Pulp and Paper Industry at an integrated paper mill.

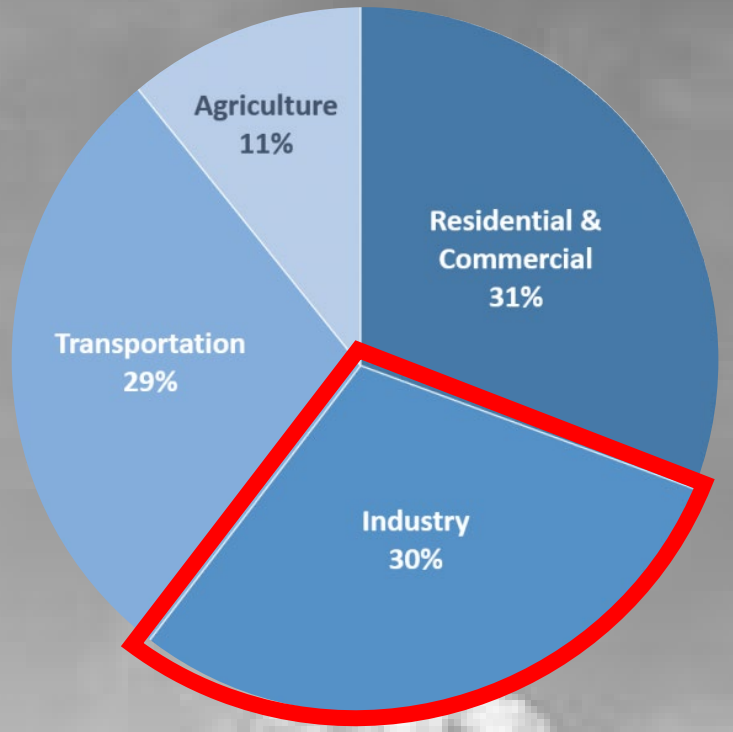
Why focus on plants?

Total U.S. energy consumption by end-use sectors (2020)



Source: U.S. Energy Information Agency, *Monthly Energy Review*, Table 2.1 April 2021

Total U.S. greenhouse gas emissions by end use sectors



Source: U.S. Environmental Protection Agency. https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions#electricity. Accessed November 2021

Some plants manufacture products more energy efficiently than others

Refine a barrel of oil?
600,000 Btu

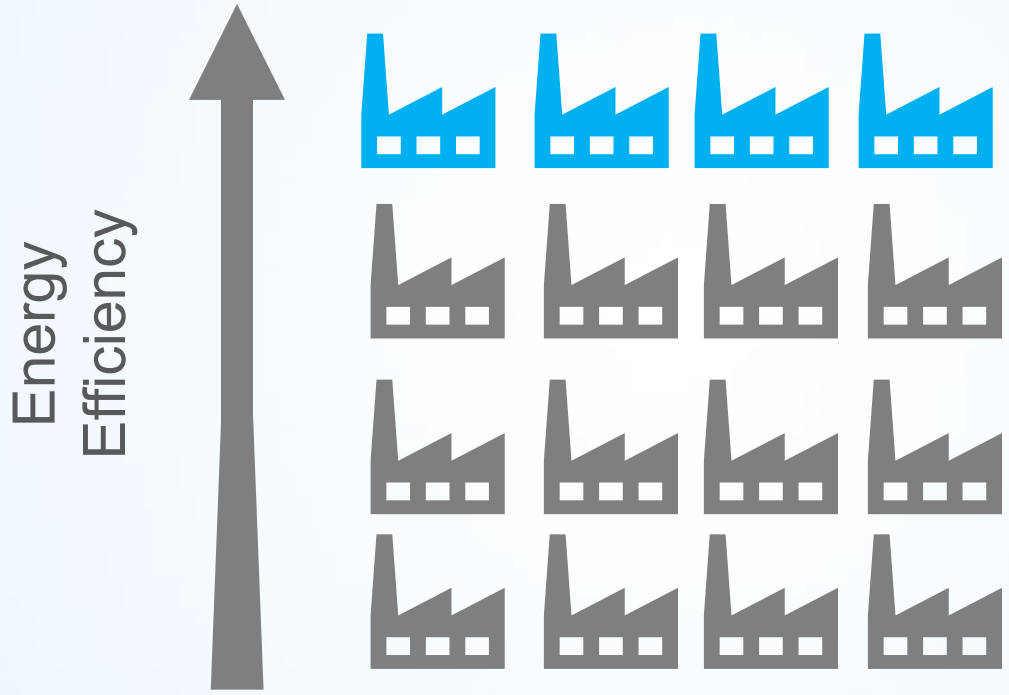
More efficient — Less efficient

Manufacture a ton of paper?
6-9 million Btu

More efficient — Less efficient

America’s most energy-efficient factories

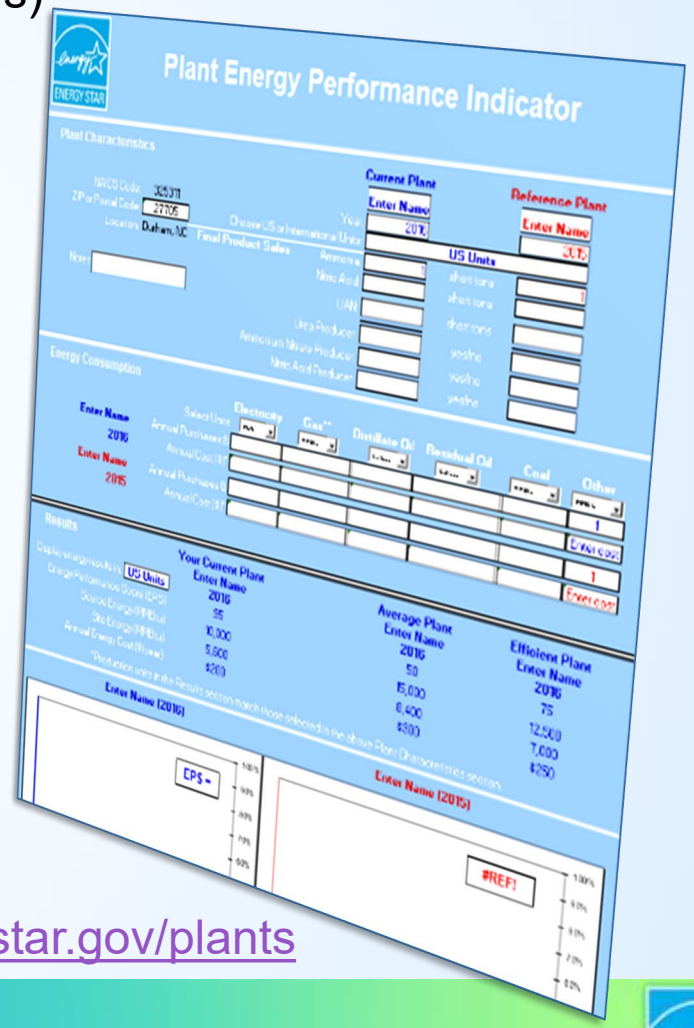
Using less energy to produce the same product



How is plant energy efficiency measured?

ENERGY STAR Energy Performance Indicators (EPIs)

- 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



*ENERGY STAR recognizes third party tool for benchmarking energy performance of Petroleum Refineries.

www.energystar.gov/plants

How an EPI works

- Enter plant and energy data→ Get score (1-100 scale)
- Based on underlying predictive energy use model from actual plant energy and production data

Plant Characteristics

Data shown here is fictitious and is for demonstration purposes.

Location: New York, NY

ZIP Code: 10000

Please note: all product classes

		Current Plant: Test plant	Reference Plant: Test plant	Units
	Year	2020	2019	
Production				
Paper	Uncoated free sheet (<10% mechanical fiber)	550,000		tons
Paperboard	Bleached packaging and industrial converting paperboard			tons

Energy Consumption

		Electricity	Gas	Distillate Oil	Residual Oil	Coal *	Biomass	Other
	Select Units	MWh	MMBtu	Gallons	MMBtu	MMBtu	MMBtu	MMBtu
Test plant 2020	Annual Purchases & Transfers	30,000	1,500,000	10,000,000				
	Annual Cost ($)**							

Results

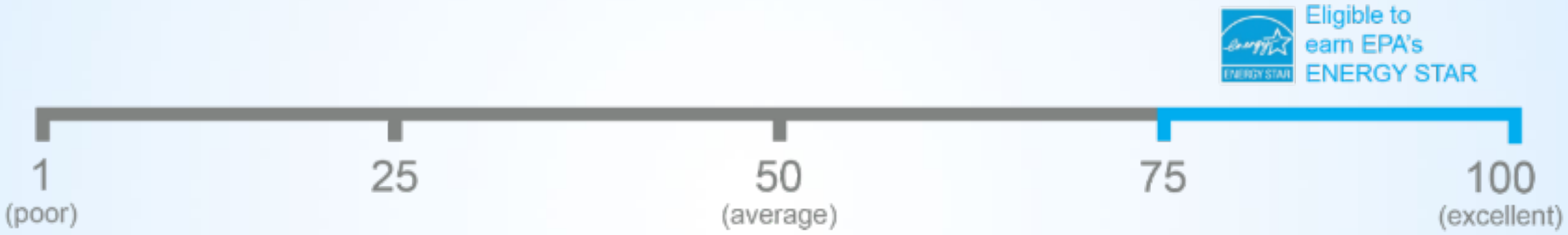
	Your Current Plant: Test plant 2020	Average Plant: Test plant 2020	Efficient Plant: Test plant 2020
Energy Performance Score (EPS)	78	50	75
Purchased Source Energy (MMBtu)	3,228,787	4,138,130	3,332,903
Energy Intensity (MMBtu/Ton of Paper)	5.87	7.52	6.06

Snapshot of key fields from Integrated Paper & Paperboard Mill Energy Performance Indicator.

EPA | ENERGY STAR. The simple choice for energy efficiency.

ENERGY STAR Certified Plants

Most energy efficient plants in the nation

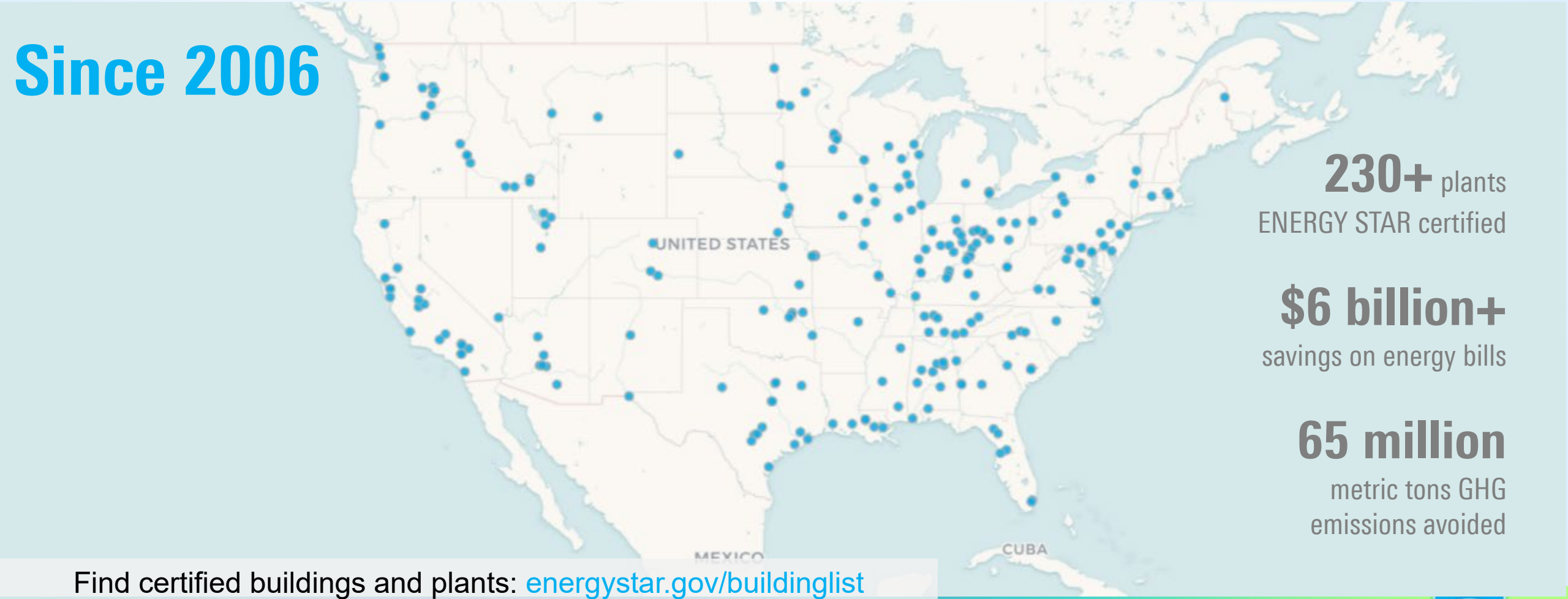


- Top quartile of efficiency
- Energy and production data is verified by Professional Engineer
- Must apply for certification
- Facilities recertify annually to demonstrate continued performance

www.energystar.gov/plants

ENERGY STAR Certified Plants
America's Most Energy-Efficient Manufacturing Plants

Since 2006



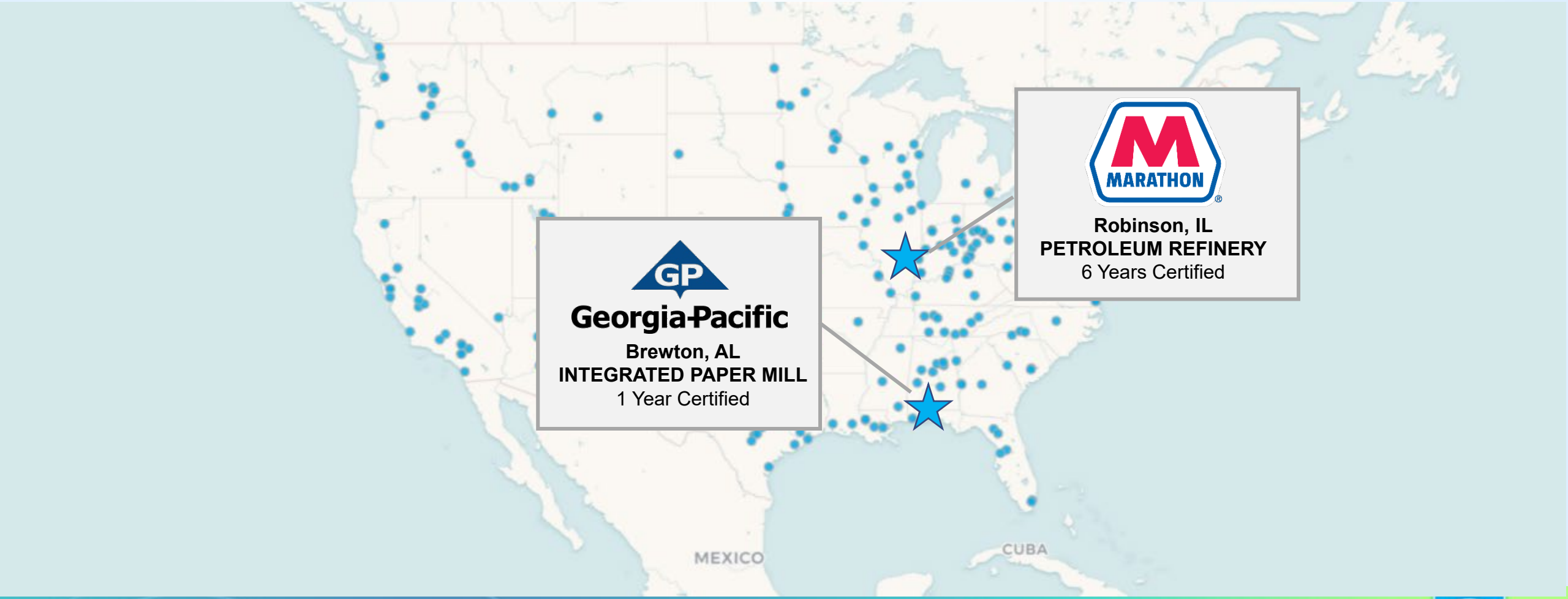
230+ plants
ENERGY STAR certified

$6 billion+
savings on energy bills

65 million
metric tons GHG
emissions avoided

Find certified buildings and plants: energystar.gov/buildinglist

America's Most Energy-Efficient Manufacturing Plants
Today's Webinar



America's Most Energy-Efficient Manufacturing Plants

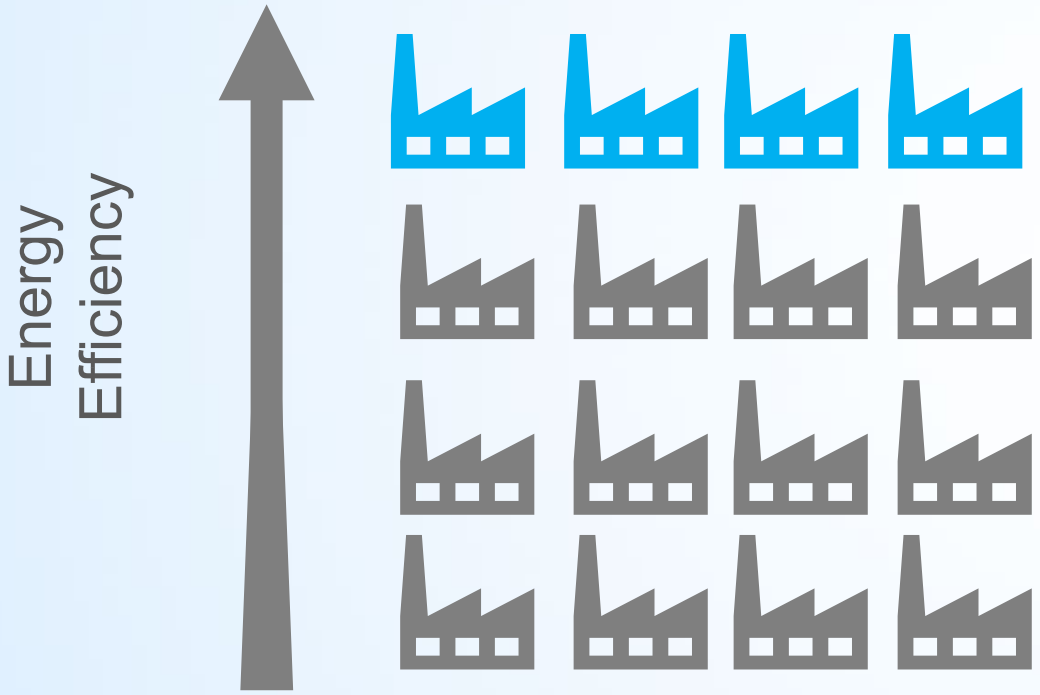
Today's Webinar

Jason Akey
Corporate Energy Technologist
Marathon Petroleum

Barret Von Behren
Energy & Sustainability Coordinator, Robinson Refinery
Marathon Petroleum

Mike Younis
Director of Energy Optimization
Georgia-Pacific

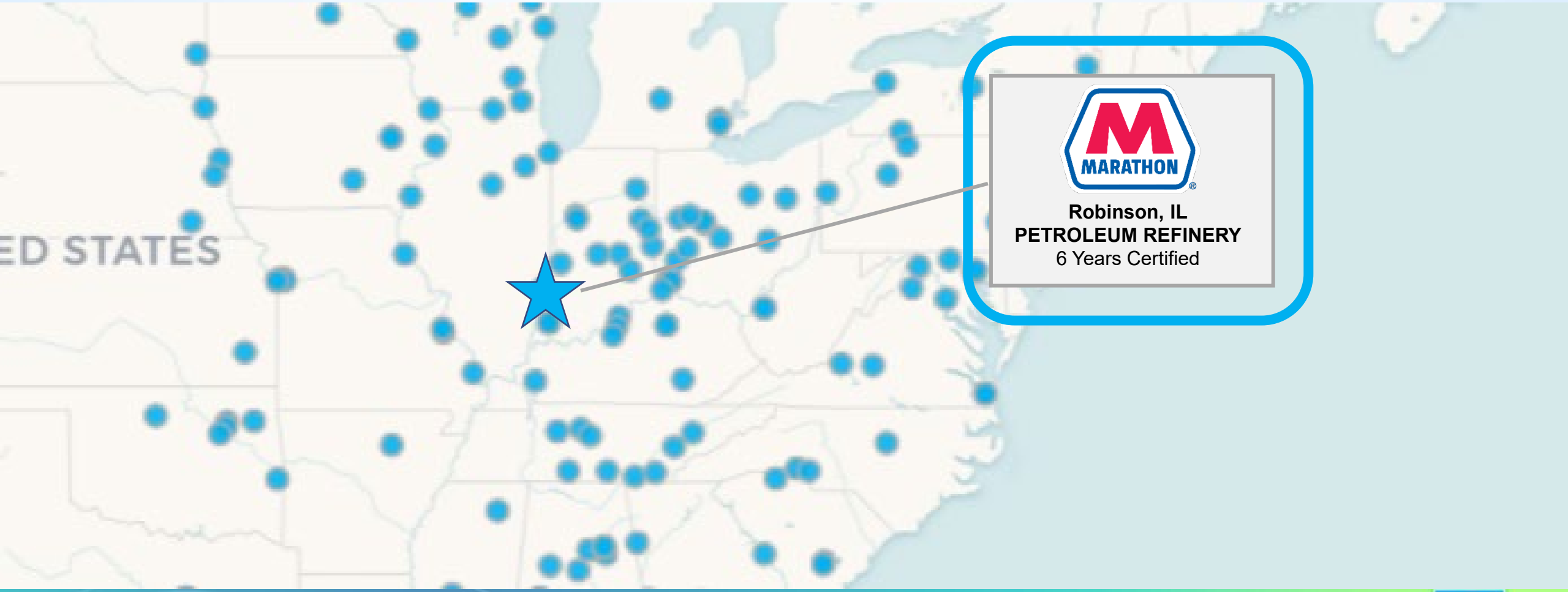
Listen for…



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



ENERGY STAR Webinar Series
“America’s Most Energy Efficient Plants”

Jason Akey & Barret Von Behren

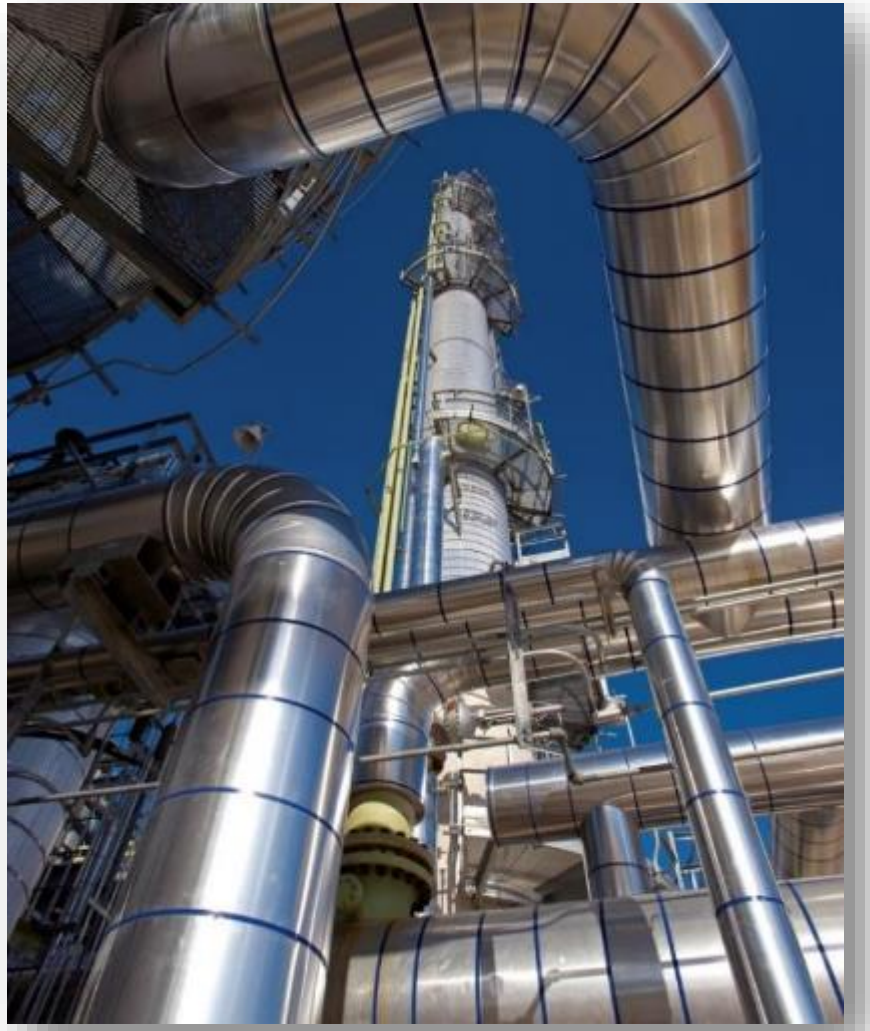
Presenter Bios

- Jason Akey
  - Energy & Special Project Technologist
  - B.S. Chemical Engineering, University of Wisconsin

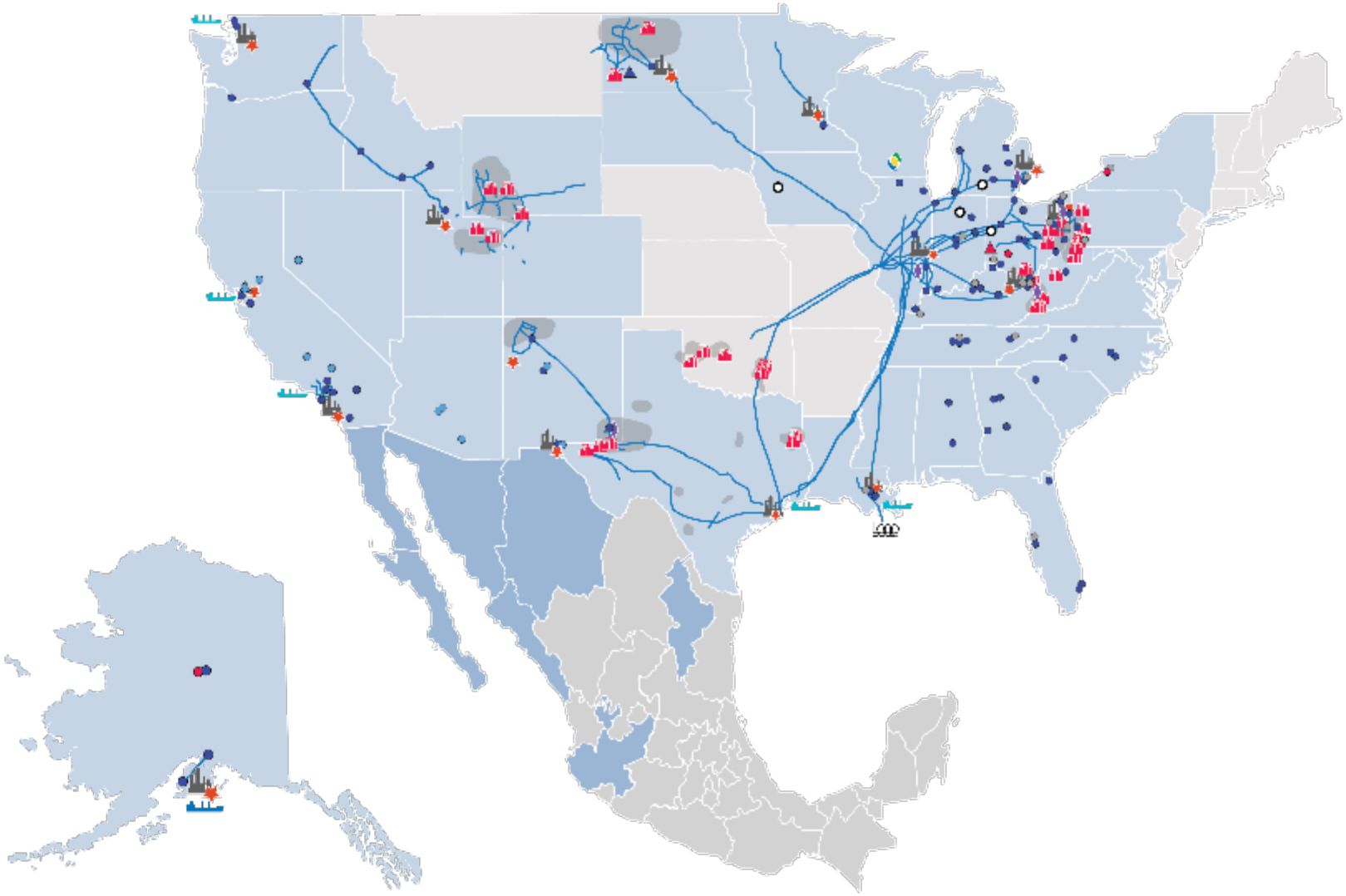
- Barret Von Behren
  - Energy & Sustainability Coordinator, Illinois Refining Division
  - B.S. Chemical Engineering, Missouri University of Science & Technology

Marathon Petroleum at a Glance

- Fortune 50 company
- Established in 1887
- Largest U.S. refiner
  - 2.9 million barrels per day
- Headquartered in Findlay, Ohio
- 13 refineries in 12 states
- 2 renewable diesel plants
- Various refined products including:
  - Gasoline, diesel/jet fuel, asphalt & petrochemicals
- Extensive terminal, pipeline and retail network



Marathon Petroleum Integrated System



MARATHON

- MPC Refinery
- MPC Owned and Part-Owned Light Product Terminal
- MPC Owned Asphalt/ Heavy Oil Terminal
- MPC Owned and Part-Owned Marine Facility
- MPC/MPLX Pipeline[a]
- Cavern
- MPC Domestic Marketing Area
- MPC International Marketing Area
- Ethanol Facility
- MPC Biodiesel Facility
- Virent[c]
- MPC Renewable Diesel Facility
- Martinez Renewable Fuels Project

MPLX

- MPLX Owned and Part-Owned Light Product Terminal
- MPLX Owned Asphalt/ Heavy Oil Terminal
- MPLX Natural Gas Processing Complex[b]
- MPLX Refining Logistics Asset
- MPLX Gathering System
- MPLX Owned Marine Facility

Note: Illustrative representation of asset map

(a) Includes MPC/MPLX owned and operated lines, MPC/MPLX interest lines operated by others and MPC/MPLX operated lines owned by others.

(b) Includes MPLX owned and operated natural gas processing complexes

(c) Wholly owned subsidiary of MPC working to commercialize the conversion of biobased feedstocks into renewable fuels and chemicals.

As of 5/12/21

Sustainability Initiatives

- ENERGY STAR Partner of Year 2018-2021

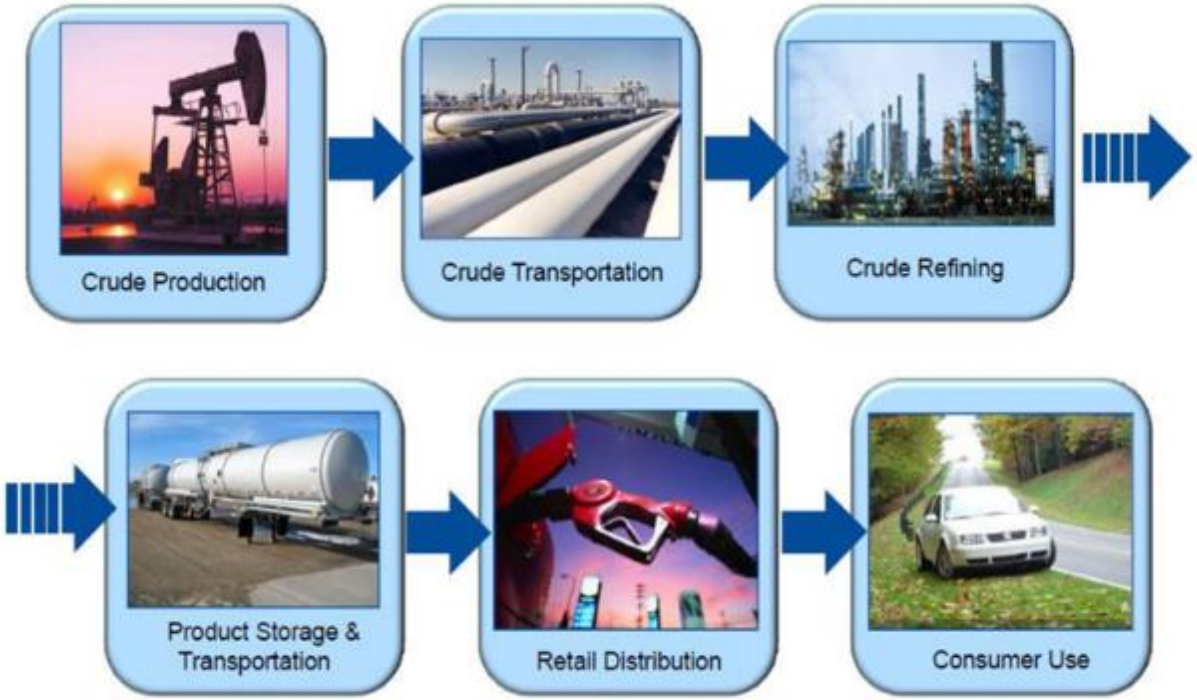
- Multiple ENERGY STAR certified facilities:
  - Anacortes, WA (1 total)
  - St. Paul Park, MN (3 total)
  - Robinson, IL (6 total)
  - Garyville, LA (15 total)
  - Canton, OH (15 total)

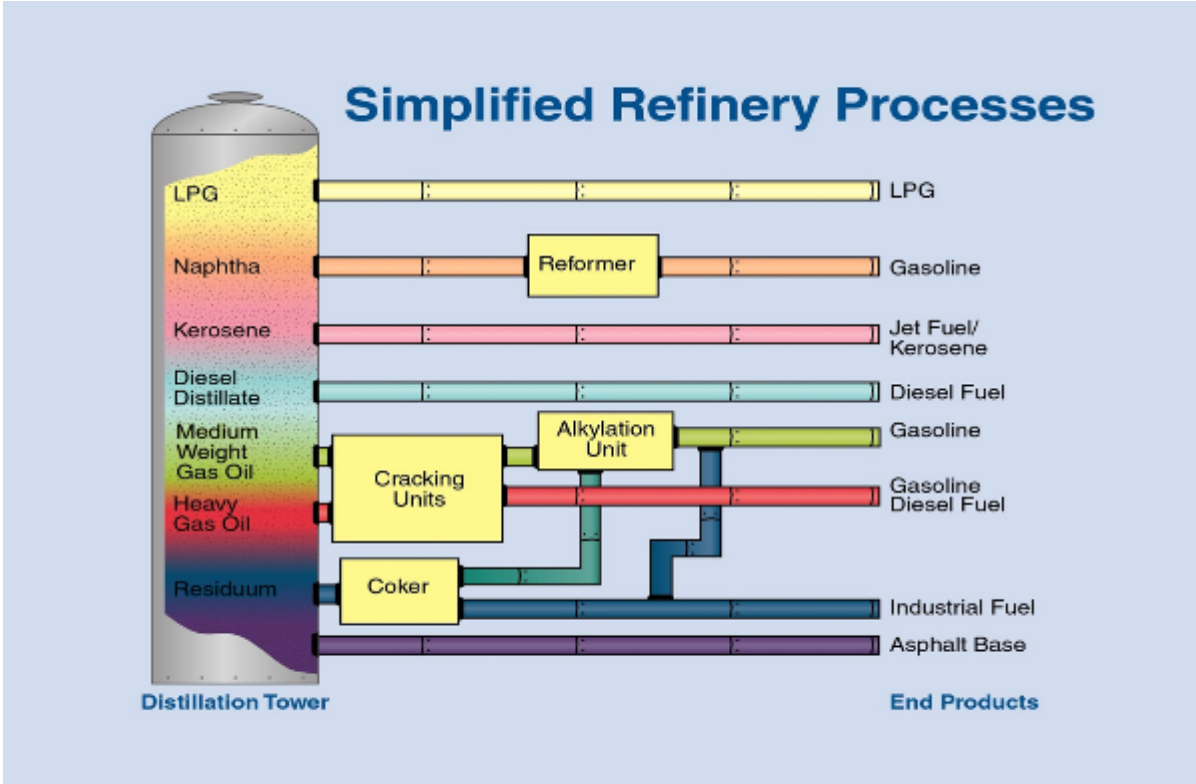
- Goal → 30% reduction in GHG intensity by 2030

Illinois Refining Division

- Located in Robinson, IL
  - 4 hours south of Chicago, 2 hours west of Indianapolis
  - Home of the Heath Bar!
- Plant constructed in 1906
  - Covers nearly 1,000 acres
- Approximately 700 employees
- Processes 265,000 barrels per day of crude oil
  - 24/7 365 operation
- Six-time Energy Star certified

“How it’s Made”


Crude Production
Crude Transportation
Crude Refining
Product Storage & Transportation
Retail Distribution
Consumer Use


Simplified Refinery Processes
LPG
Naphtha
Kerosene
Diesel Distillate
Medium Weight Gas Oil
Heavy Gas Oil
Residuum
Reformer
Cracking Units
Alkylation Unit
Coker
LPG
Gasoline
Jet Fuel/ Kerosene
Diesel Fuel
Gasoline
Gasoline Diesel Fuel
Industrial Fuel
Asphalt Base
Distillation Tower
End Products

Energy in Refining

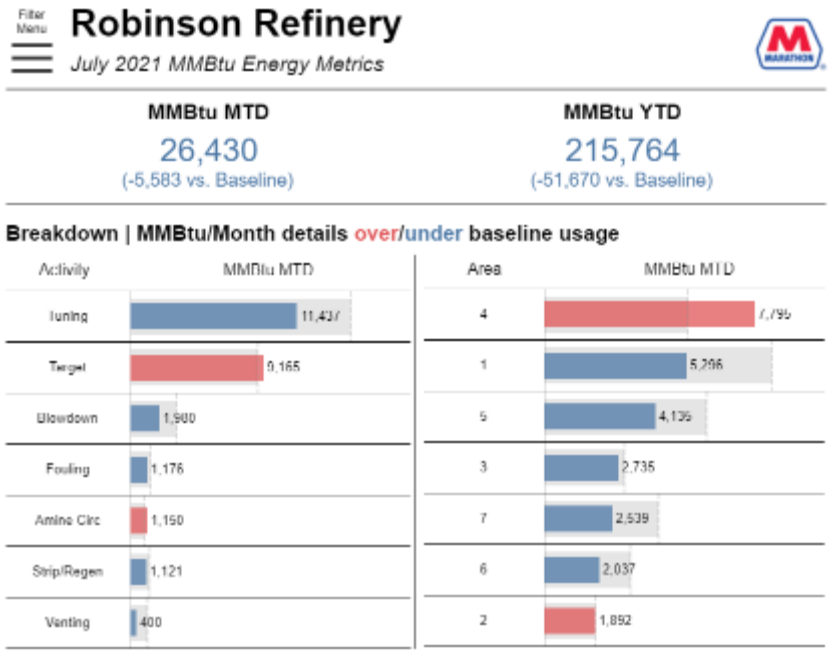
- Refining is energy intensive process
  - Typical refinery consumes ~400,000 BTUs per barrel of oil
- Crude oil heated from ambient conditions to over 700F
  - Utilize furnaces (natural gas) and heat recovery
- Distillation requires vaporization & condensation
  - Natural gas (heaters & boilers)
  - Electricity (cooling fans)
- Various chemical reactions
  - Some endothermic, requiring heat
  - Others exothermic, requiring cooling
- Thousands of pumps to transport commodities

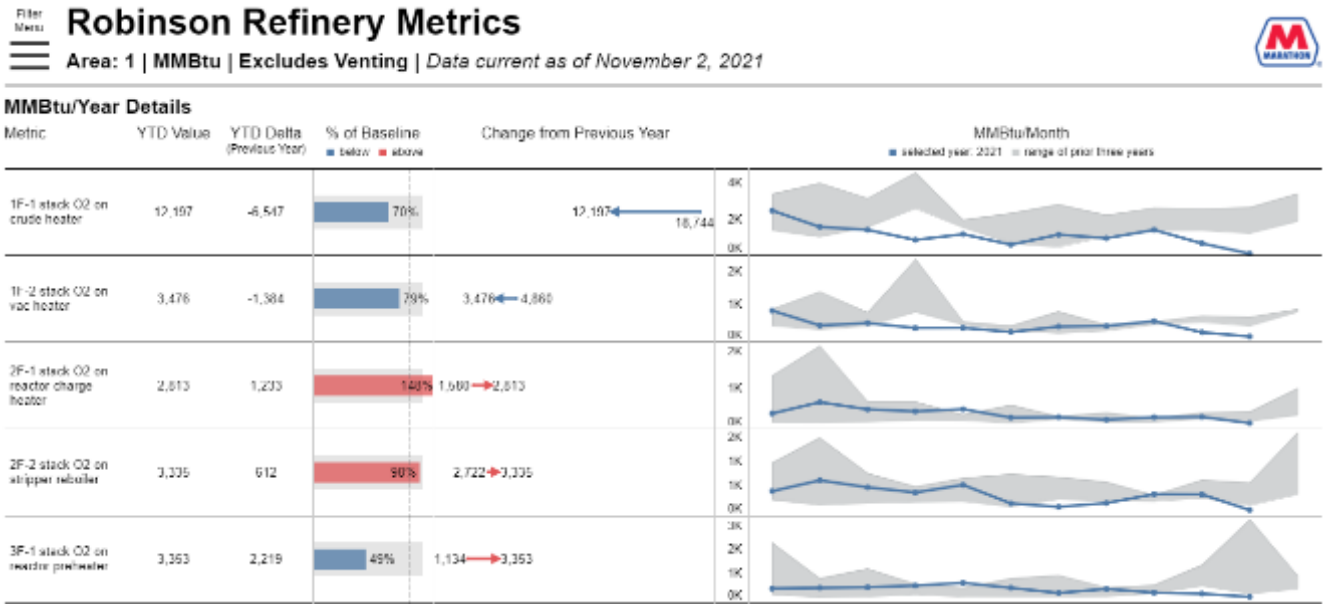
Pillars of MPC's Energy Culture

- Communication! → KPI monitoring/reporting
- Annual energy reduction initiatives/inspections
- Capital project brainstorming & implementation
- Communication!

Communication & KPI Tracking

- Routine reporting to site leadership
- Front line operators access to real time data , “Show me the money!”
- Robust KPI program → “Focus on Energy”
  - Over 70 variables tracked daily: furnace optimization, steam venting, etc.





Energy Reduction Initiatives

- **Compressed Gas Audit**
  - Utilized ultrasonic leak detection equipment to survey air, nitrogen, and fuel gas networks
  - Majority of leaks (94%) compressed air service, up to 1,000 CFM
  - Eliminate entire portable compressor: 100 MGAL/Yr diesel fuel → 1,200 MTCO2e/YR

- **Steam Trap Survey**
  - Conduct annual evaluation of ALL traps (~7,000 total)
  - Outstanding steam system health, <5% of traps failed/cold
  - Failure rate reduce by 40% from prior survey, credit operator performed maintenance
  - Estimated savings: 15 MMBTU/HR → 8,100 MTCO2e/YR

- **Insulation Program**
  - Repairs included annual maintenance budget
  - Routine field surveys conducted to identify missing/damage insulation
  - Common themes: removed & not replaced, inspection ports not plugged
  - Estimated savings: 11 MMBTU/HR → 6,000 MTCO2e/YR

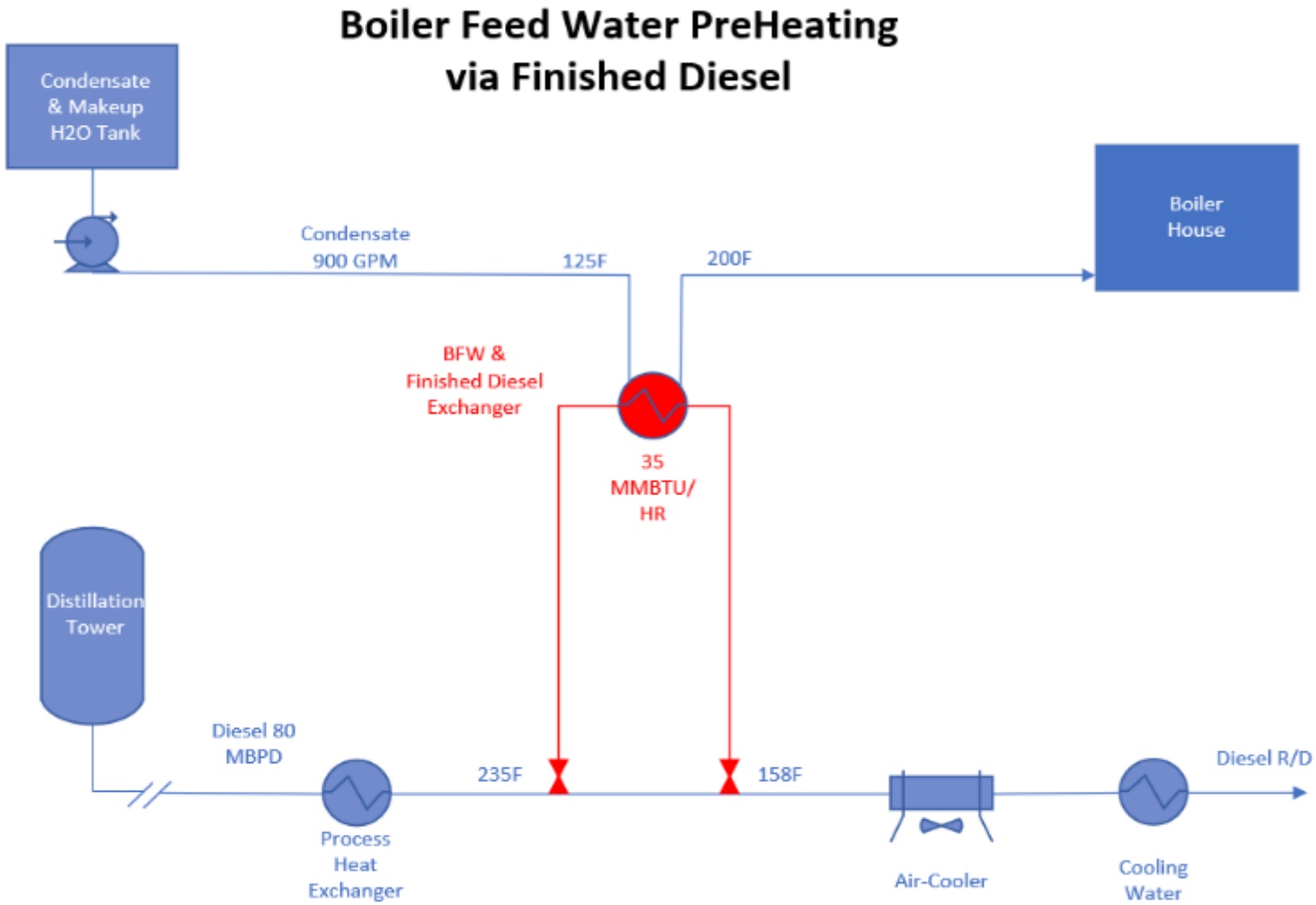
Energy Reduction Capital Projects

- Routine brainstorming exercises by engineering staff
  - Corporate goal → each site develop two projects annually
- Require lower hurdle rate/IRR than other projects
- Major projects require energy efficiency review
- Examples:
  - Waste heat recovery & optimization
  - Eliminate redundant/excessive cooling
  - Technology upgrades → furnace efficiency, heat transfer, etc.

Boiler Feedwater Pre-Heating via Waste Heat

- Refinery has 3 power boilers → 500 MLB/HR 600PSIG generation
- Utilized low-pressure steam to de-oxygenate feed water
- Finished distillate is cooled via air-coolers & cooling water
  - Waste heat simply is rejected to atmosphere
- Project initiated to install 35 MMBTU/HR exchanger
  - Cross exchanger finished distillate with boiler feed water
- Reduce natural gas consumption → **<u>17,000 MTCO2e/YR</u>**
  - *Equivalent to ~90 rail cars of coal burned*

Boiler Feedwater Pre-Heating via Waste Heat



Path to Success

- Develop an energy efficiency culture
  - Slow & steady, don't "burn" out
- Communication is KEY!
  - Get data to decision makers
- Must have leadership support:
  - Corporate → site → front line
- Maintain annual programs & project development

Good Luck!

Thank You,

Questions?

Recognition along the energy management journey

Challenge for Industry

Reduce plant energy intensity by 10% or more within 5 years

- Comparison to self
- Any manufacturing sector
- Any level of performance

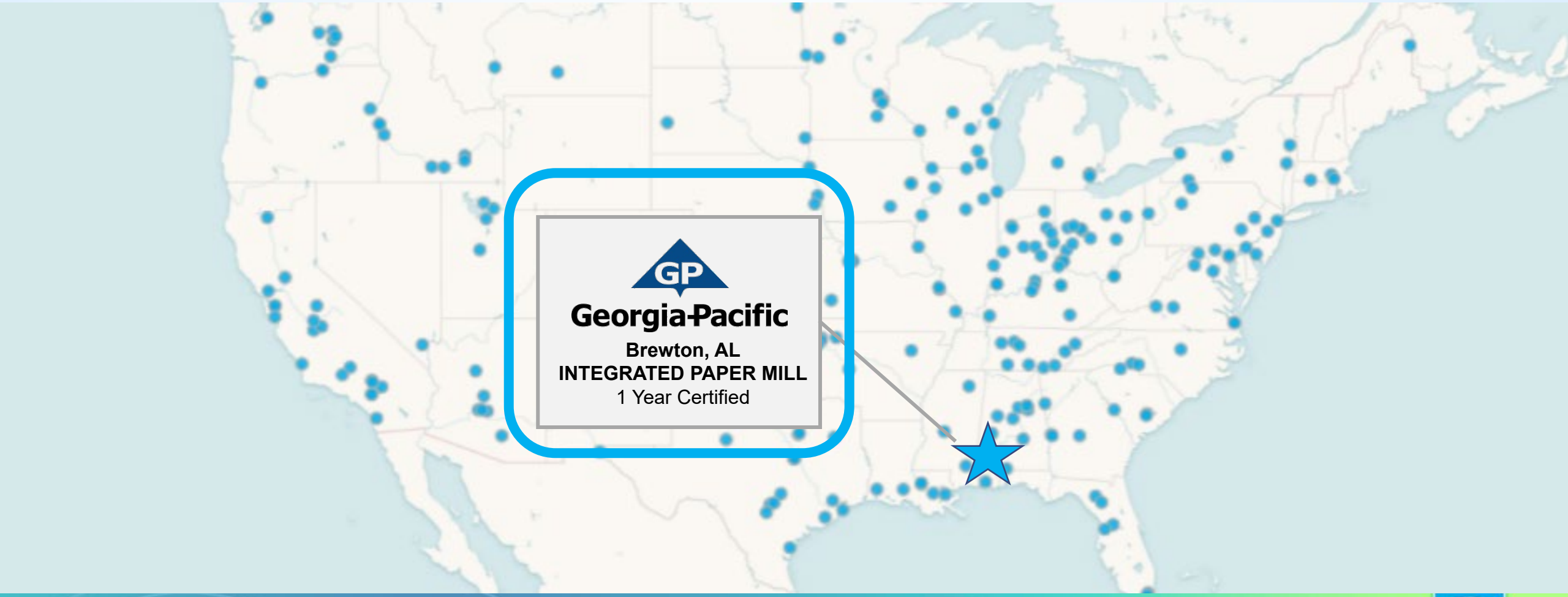
ENERGY STAR Plant Certification

Plant is in top 25% for energy efficiency in sector

- Comparison to sector
- Available for 20 manufacturing sectors
- Top performers

2021 ENERGY STAR CERTIFIED FACILITY
www.energystar.gov

America's Most Energy-Efficient Manufacturing Plants
Today's Webinar



Brewton and Leaf River

ENERGY STAR® Plant Certification

Georgia-Pacific

About Georgia-Pacific

- 30,000 Employees
- 180 Locations
- Forest Products
  - Pulp
  - Paper
  - Building Products
  - Chemicals
- Recycling – Paper, Plastic, Metals

Georgia-Pacific

ENERGY STAR

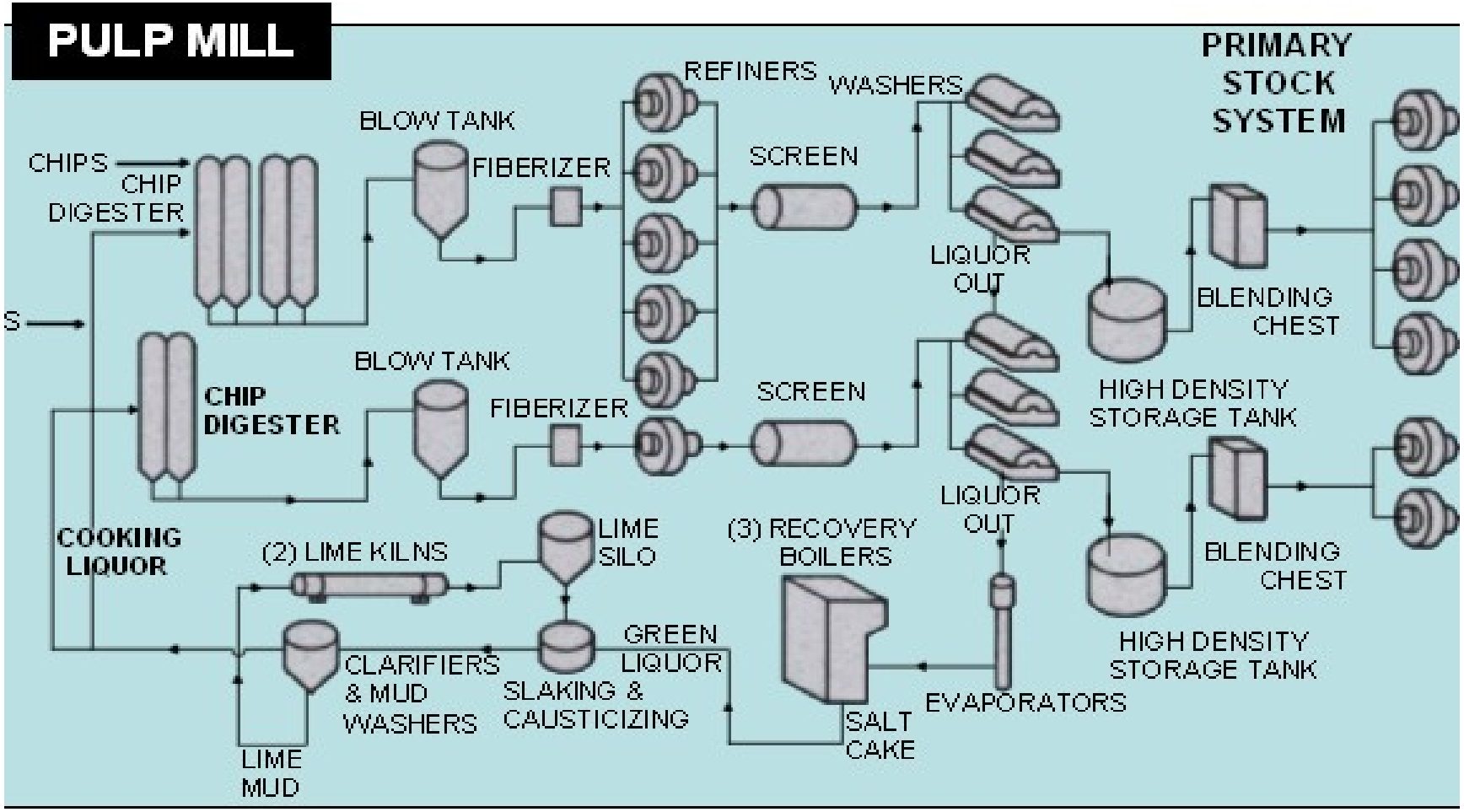
Plant Certification Firsts

- First Pulp Mill – Leaf River
  - Relatively new plant
  - Single Line Design
  - Disciplined operations
- First Paper Mill – Brewton
  - 65-Year-Old Plant
  - Capital Investment
  - Mill employee optimization

Georgia-Pacific

ENERGY STAR

Pulp Mill Process



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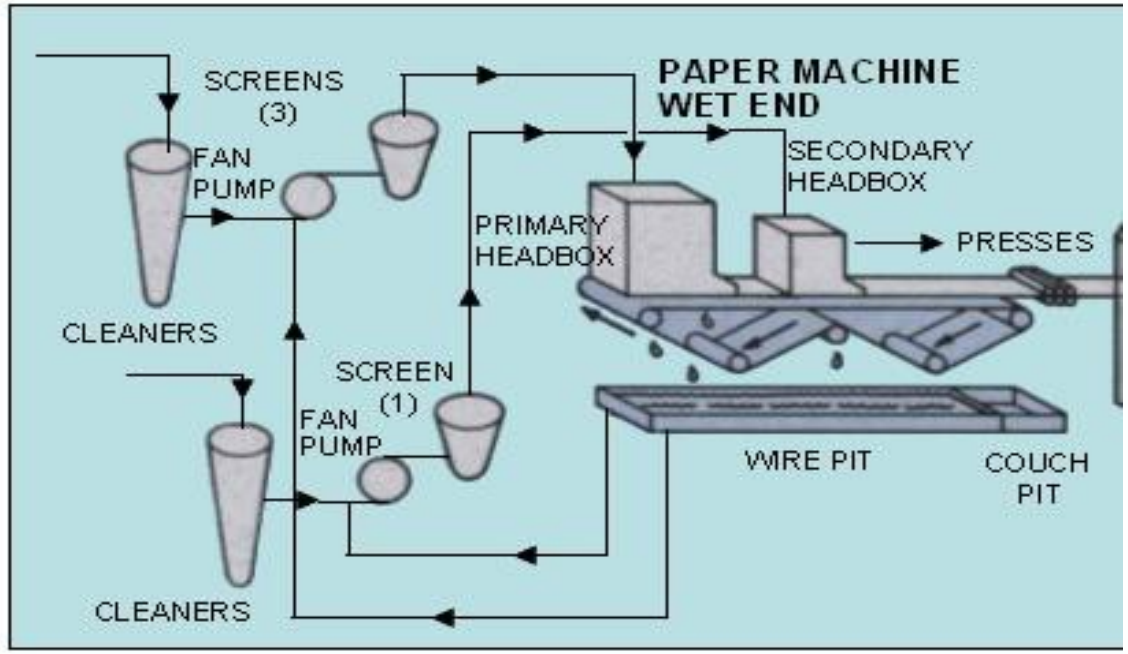
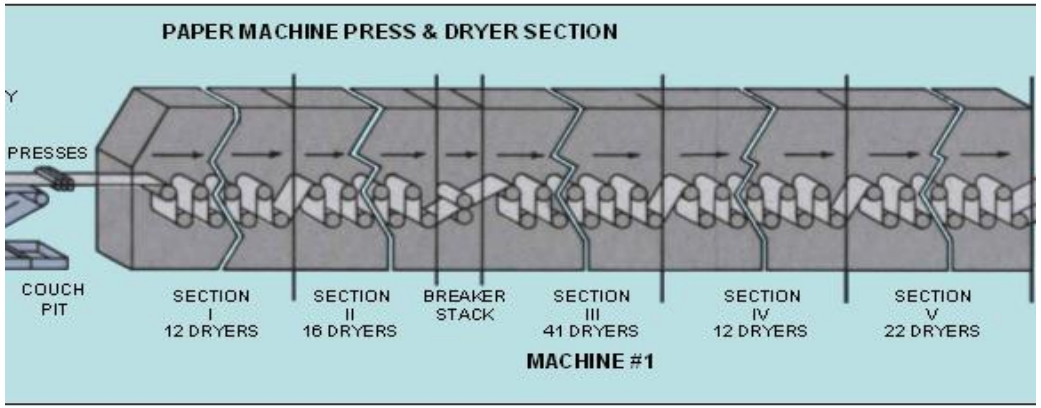
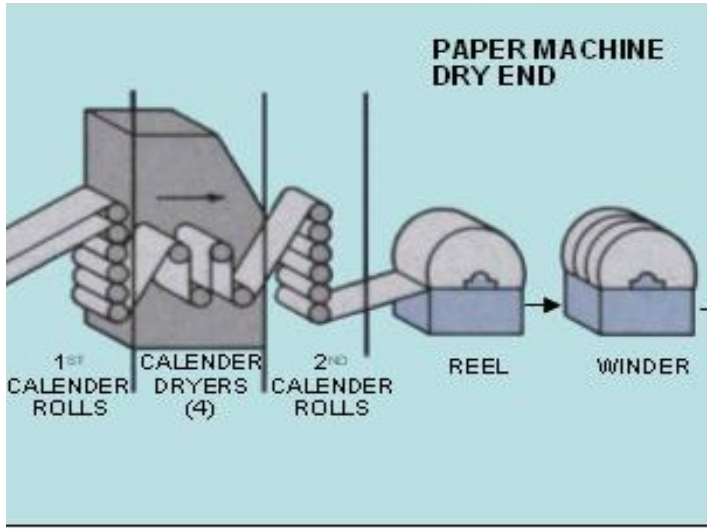
ENERGY STAR

Paper Making Process







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ENERGY STAR

History of the Brewton paper mill

- 1955 Construction began
- 1957 Operations began
- Brewton manufactures paper used in:
  - high-end packaging
  - board used to make Dixie® paper plates.
- 2014 $400M Capital Investment
- 2020 Challenge for Industry
- 2021 Plant Certification

Georgia-Pacific

ENERGY STAR

Project Phoenix – Recovery Boiler

- Large recovery boiler replaced three smaller units.
- Demineralized water system to supply feedwater to the new recovery boiler.

Georgia-Pacific

ENERGY STAR

Project Phoenix – Turbine Generator

- Combined heat and power
- Replaced three steam driven turbine electrical power generators with one high efficiency turbine.

Georgia-Pacific

ENERGY STAR

Project Phoenix - Evaporators

- Replaced three low solids evaporators with a single more efficient evaporator

Georgia-Pacific

ENERGY STAR

Project Phoenix – Compressed Air

- Upgraded the compressed air system
  - (4) Centrifugal Compressors
  - (4) Heat of Compression Dryers

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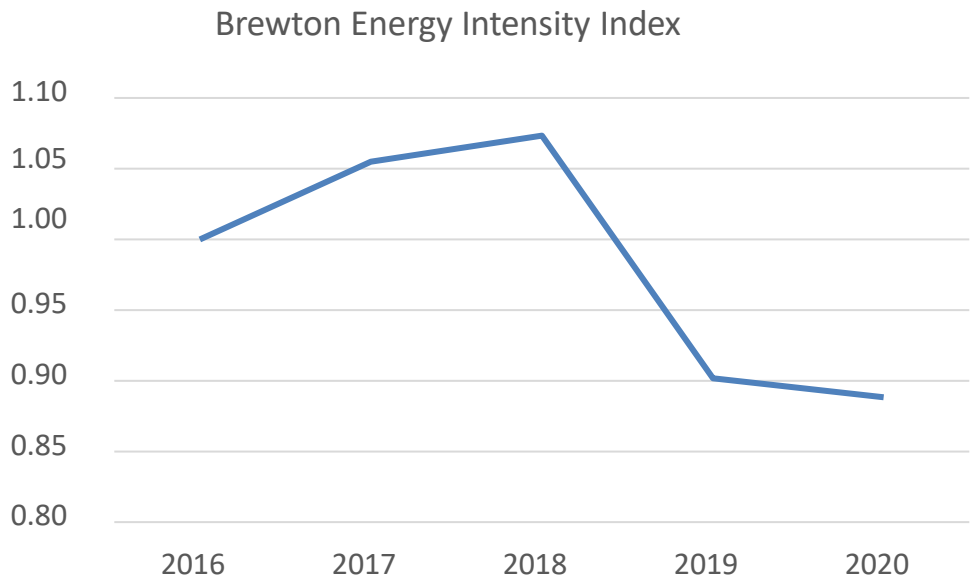
ENERGY STAR

Challenge for Industry

- 2016 Base year
- Project Phoenix complete
- 4th quartile to 2nd
- Process improvement team



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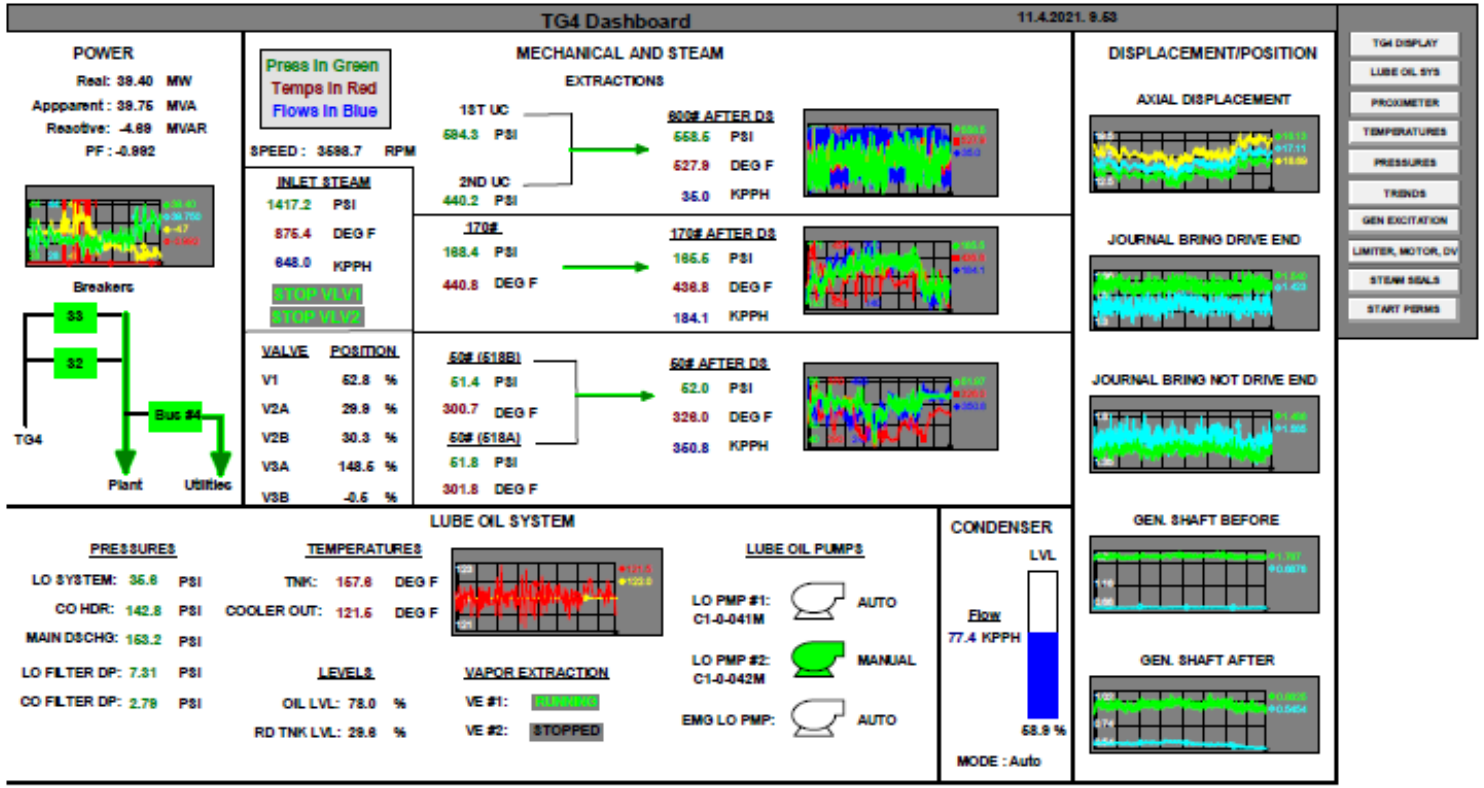
ENERGY STAR

Plant Certification – Turbine Optimization

Automating Turbine Generator to optimize overall generating efficiency.



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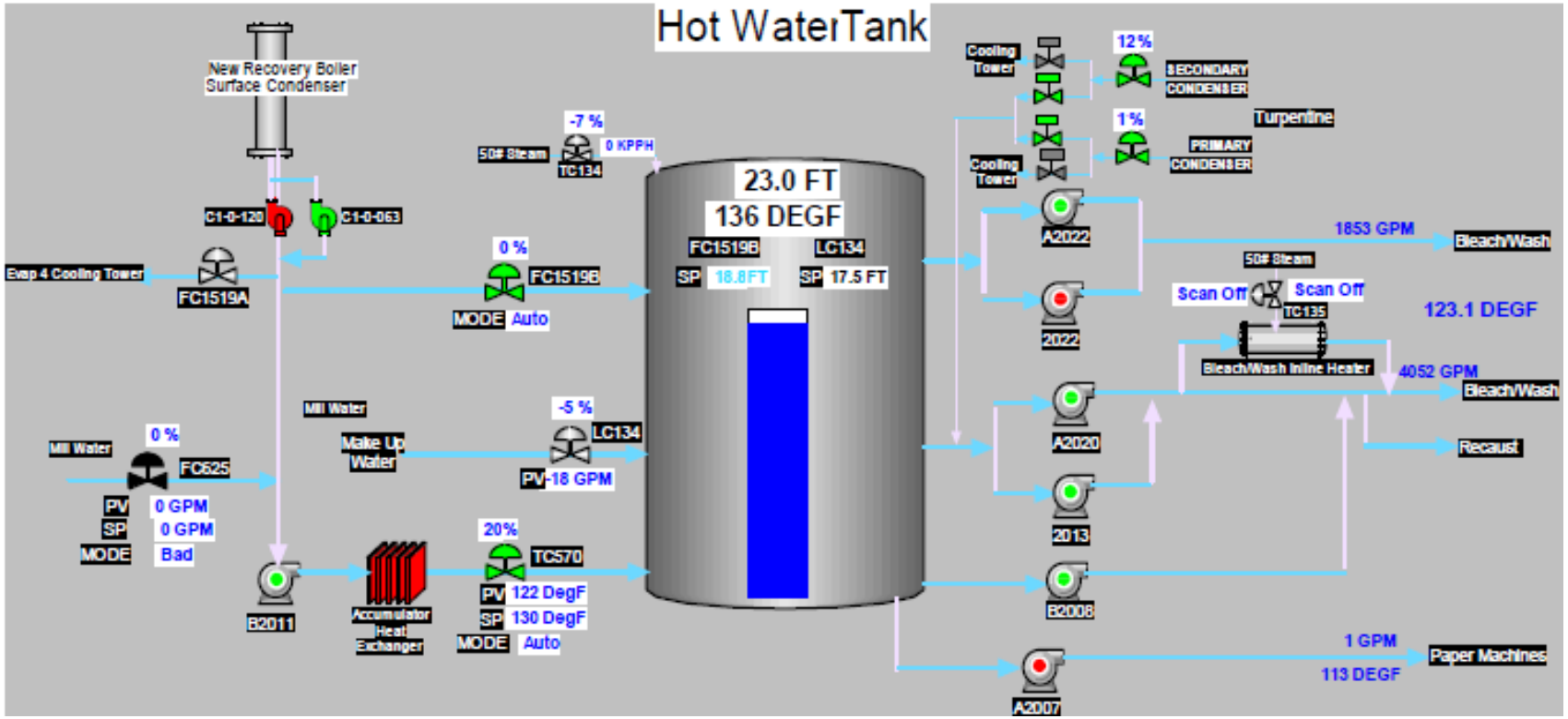
ENERGY STAR

Plant Certification – Hot Water Collection

Hot water tank automated to maximize collection of waste heat



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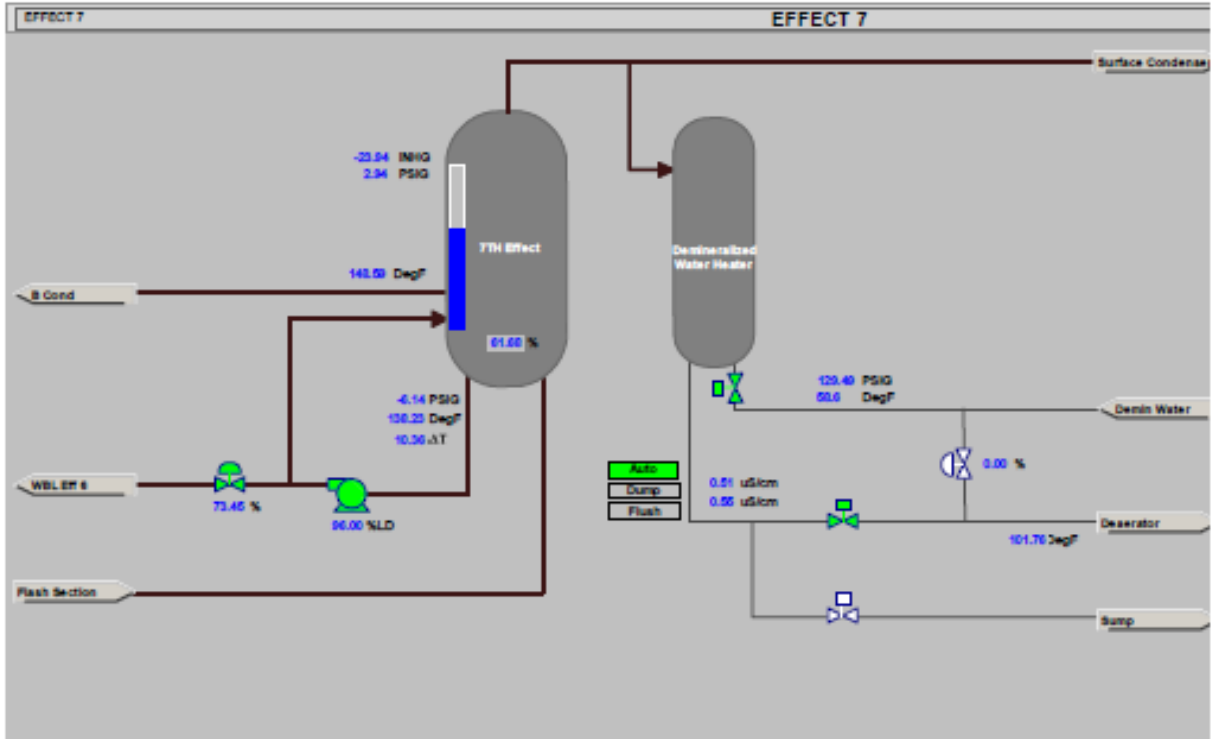
Plant Certification - Evaporator

Evaporator production automatic process control implemented with automated wash sequencing designed to improve efficiency and heat recovery.



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ENERGY STAR

Plant Certification

- 2021 Certification
- 2nd quartile to 1st

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ENERGY STAR

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 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