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)*
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)**
- Industrial: 33%
- Transportation: 26%
- Commercial: 18%
- Residential: 22%

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

**Total U.S. greenhouse gas emissions by end use sectors**
- Residential & Commercial: 31%
- Industry: 30%
- Transportation: 29%
- Agriculture: 11%

Some plants manufacture products more energy efficiently than others.

Refine a barrel of oil?
600,000 Btu

Manufacture a ton of paper?
6-9 million Btu
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

Data shown here is fictitious and is for demonstration purposes.

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

Robinson, IL
PETROLEUM REFINERY
6 Years Certified

Brewton, AL
INTEGRATED PAPER MILL
1 Year Certified
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

Robinson, IL
PETROLEUM REFINERY
6 Years Certified
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

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 bio-based 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”
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.

Robinson Refinery Metrics

Area: 1 | MMBtu | Excludes Venting | Date current as of November 2, 2021

| MMBtu MTD | 26,430 | (-5,583 vs. Baseline) |
| MMBtu YTD | 215,764 | (-51,670 vs. Baseline) |

Breakdown | MMBtu/Month details | Over/Under baseline usage

Activity | MMBtu | Over/Under

- Furnace: 4,239
- Turbine: 1,561
- Boiler: 3,161
- Feeding: 1,178
- Condensate: 1,150
- Slurry: -121
- Yarding: 610

Robinson Refinery Energy Metrics

Key KPIs:
- Over 70 variables tracked daily: furnace optimization, steam venting, etc.
- "Show me the money!"
- "Focus on Energy"
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 $\rightarrow$ 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 $\rightarrow$ 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 $\rightarrow$ 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 → **17,000 MTCO2e/YR**
  - Equivalent to ~90 rail cars of coal burned
Boiler Feedwater Pre-Heating via Waste Heat

Boiler Feed Water PreHeating via Finished Diesel

Condensate & Makeup H2O Tank

Boiler House

Distillation Tower

Diesel R/D

Process Heat Exchanger

Air-Cooler

Cooling Water

Diesel 80 MBDP

235F

158F

200F

125F

Condensate 900 GPM

BFW & Finished Diesel Exchanger

35 MMBTU/HR
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?

ENERGY STAR
AWARD 2021
PARTNER OF THE YEAR
Sustained Excellence
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
America’s Most Energy-Efficient Manufacturing Plants

Today’s Webinar

Brewton, AL
INTEGRATED PAPER MILL
1 Year Certified
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
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
Pulp Mill Process
Paper Making Process
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
Project Phoenix – Recovery Boiler

- Large recovery boiler replaced three smaller units.
- Demineralized water system to supply feedwater to the new recovery boiler.
Project Phoenix – Turbine Generator

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

- Replaced three low solids evaporators with a single more efficient evaporator
Project Phoenix – Compressed Air

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

- 2016 Base year
- Project Phoenix complete
- 4th quartile to 2nd
- Process improvement team
Plant Certification – Turbine Optimization

Automating Turbine Generator to optimize overall generating efficiency.
Plant Certification – Hot Water Collection

Hot water tank automated to maximize collection of waste heat
Evaporator production automatic process control implemented with automated wash sequencing designed to improve efficiency and heat recovery.
Plant Certification

• 2021 Certification
• 2nd quartile to 1st
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