Power Plant Overview & More

Miami Fort Station

October 2022

Sean Behm, Environmental & Chemistry Manager

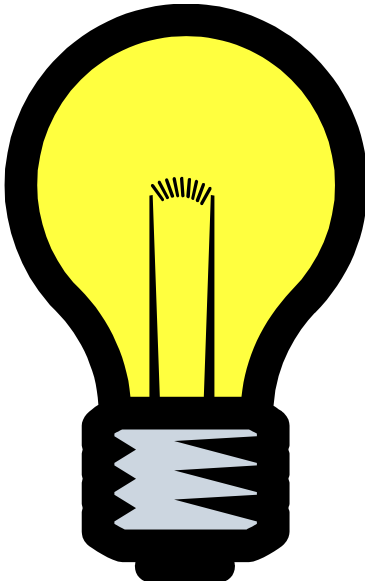
Luminant

Discussion Topics

- Power Plant Operation
  - How Electricity is Made
  - How Steam is Made
  - Environmental Controls
  - Byproducts
- Electrical Grid Overview
  - Robustness & Fragility – Columbus June 2022 event
- Energy & Electricity Trends (EIA)

ELECTRICITY - WATT IS IT?

- **The movement of electrons through a conductor**
- **Measured in Watts= Voltage X Current**
- **Made & Used INSTANTANEOUSLY**



Miami Fort Station

Produces 1,100 Mega Watts

Or

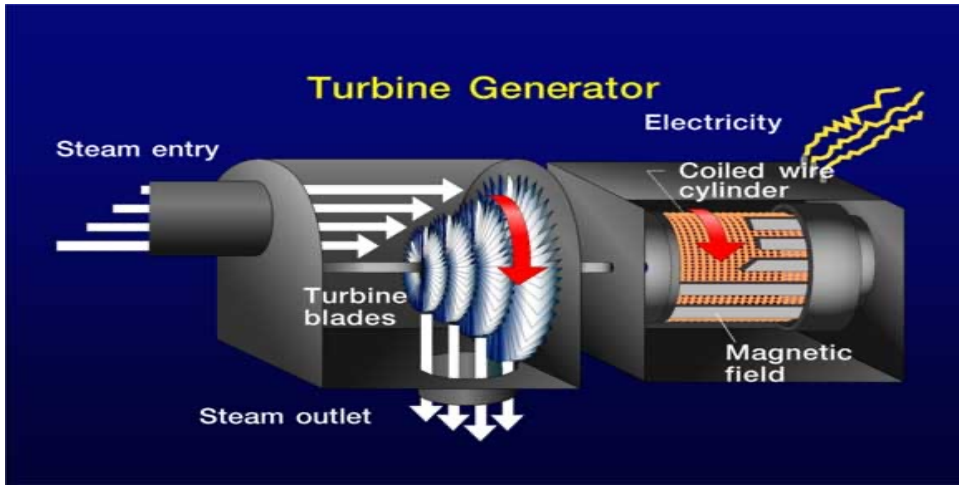
1,100,000,000 Watts

Or

Enough electricity to light 11,000,000 100-watt lights bulbs at once…even more LEDs!

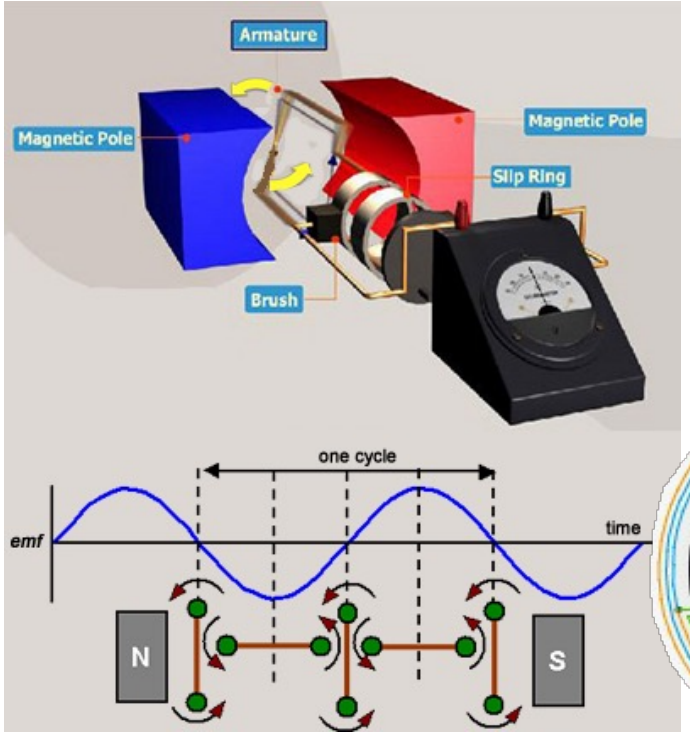
Enough electricity to power nearly 800,000 homes

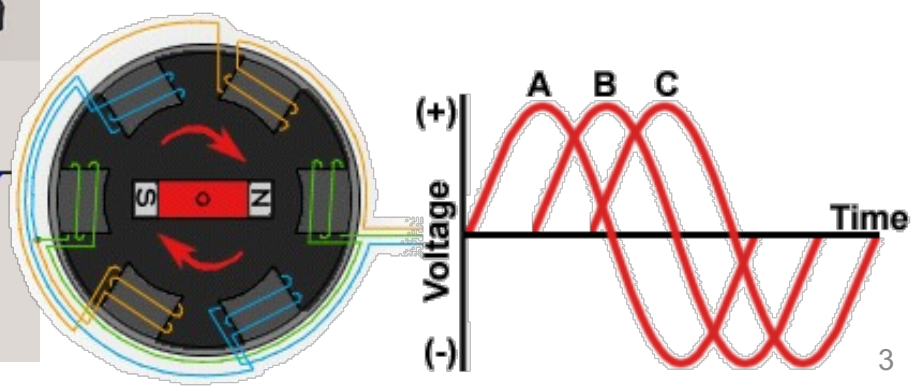
ELECTRICTY - How is it made?



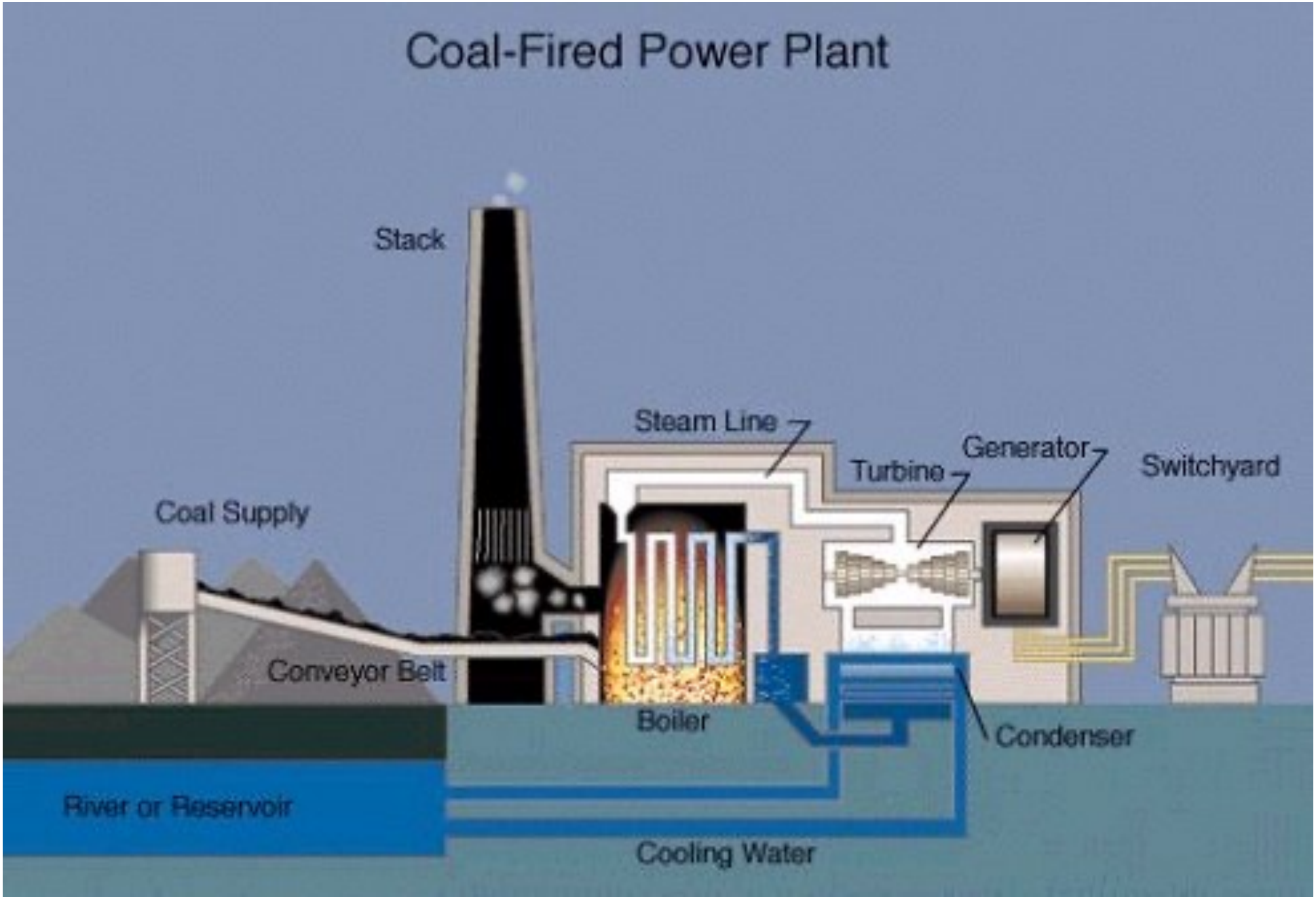
Generator Facts

- Similar to a large electric motor
- The turbine shaft is connected to the shaft of the generator, where magnets spin within wire coils to produce electricity
- Rotor spins at 3600RPMs = 60Hz
  - 60 revolutions per second
- Generator produces 22,000 volts of electricity at 18,000 amps
- Cooled with Hydrogen Gas

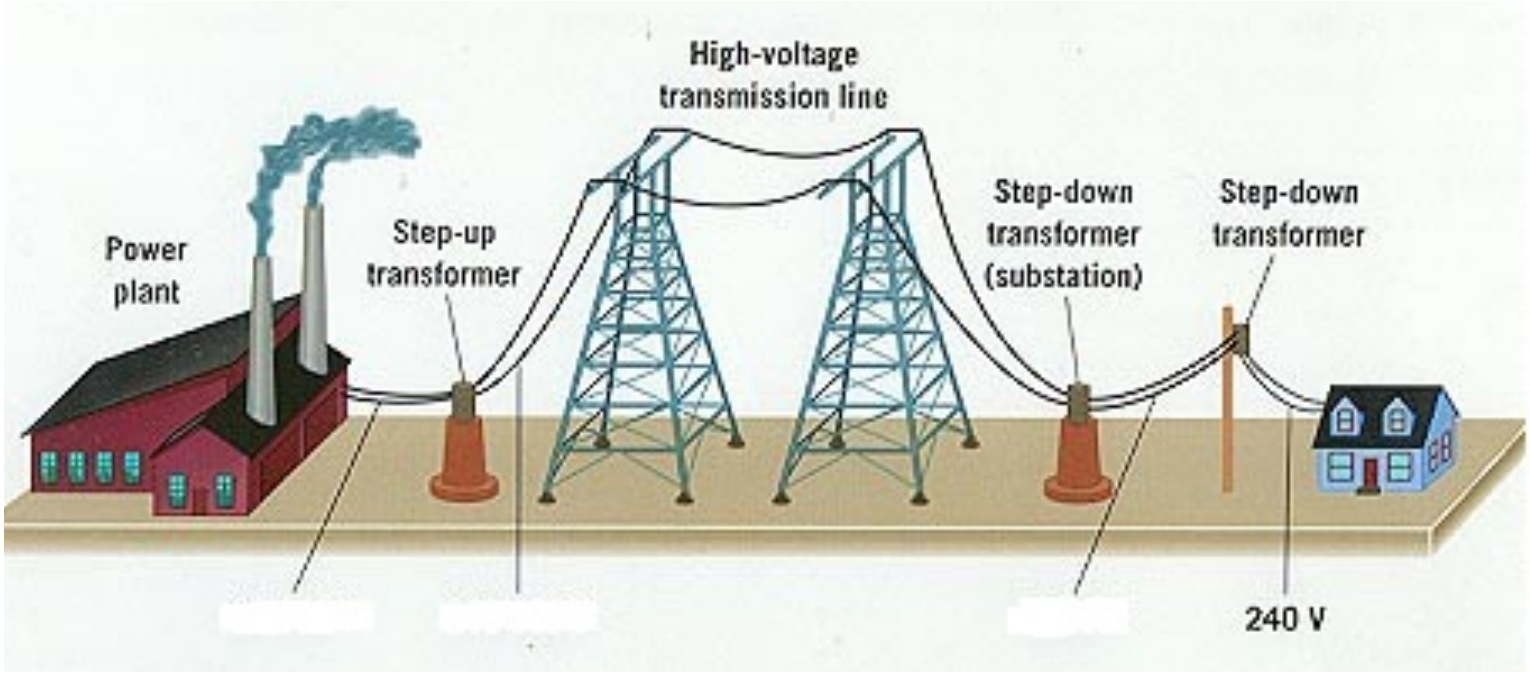




How do coal fired power plants work?



ELECTRICITY - How does it get to your house?



Electric Transmission Facts

- From the generating stations, large amounts of electricity are transported on transmission lines.
- Next, substations convert the transmission line voltage to lower levels that are used in local communities. Substations also control the flow of electricity and protect the lines and equipment from damage.
- A transformer converts the distribution level voltage to levels that can be used inside your home or business. That voltage ranges from 120 to 480 volts.

ELECTRICITY – Miami Fort Switchyard Picture

Component- COAL

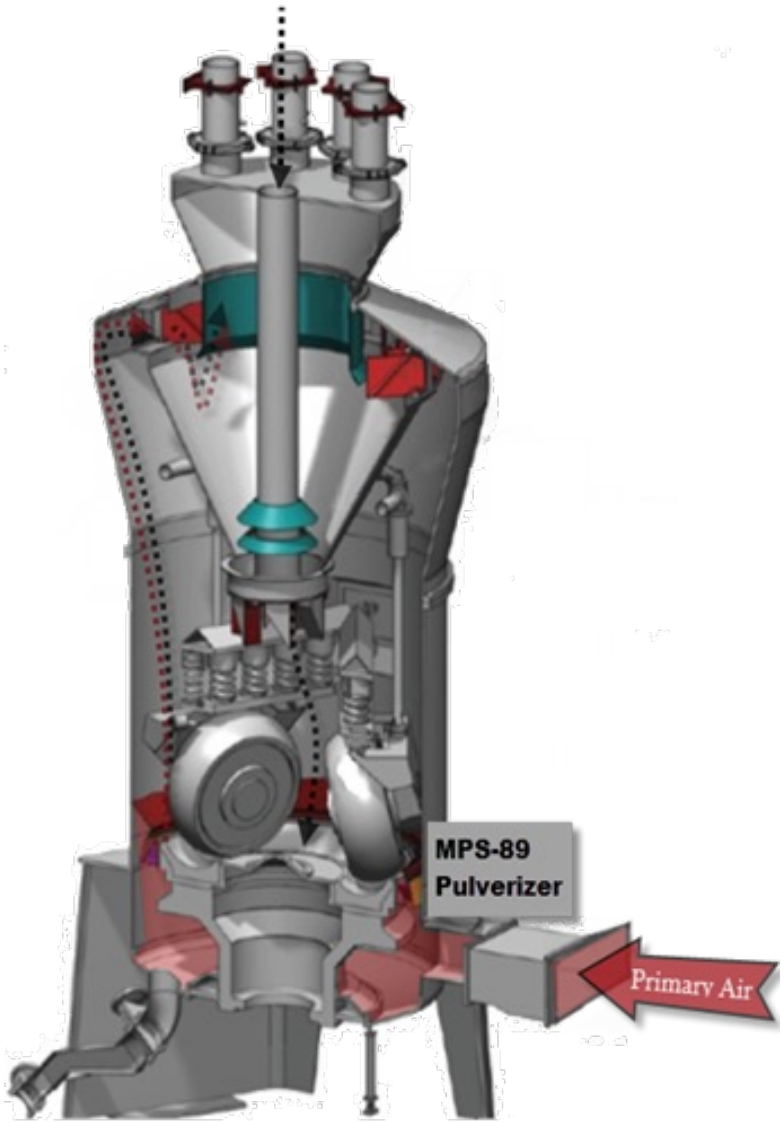
Miami Fort Station Facts

- Receives all its coal on river barges.
- Coal comes from OH, KY, WV, IL.
- Burns approximately 12,500 tons per day or 4.0 million tons per year
- All coal is different

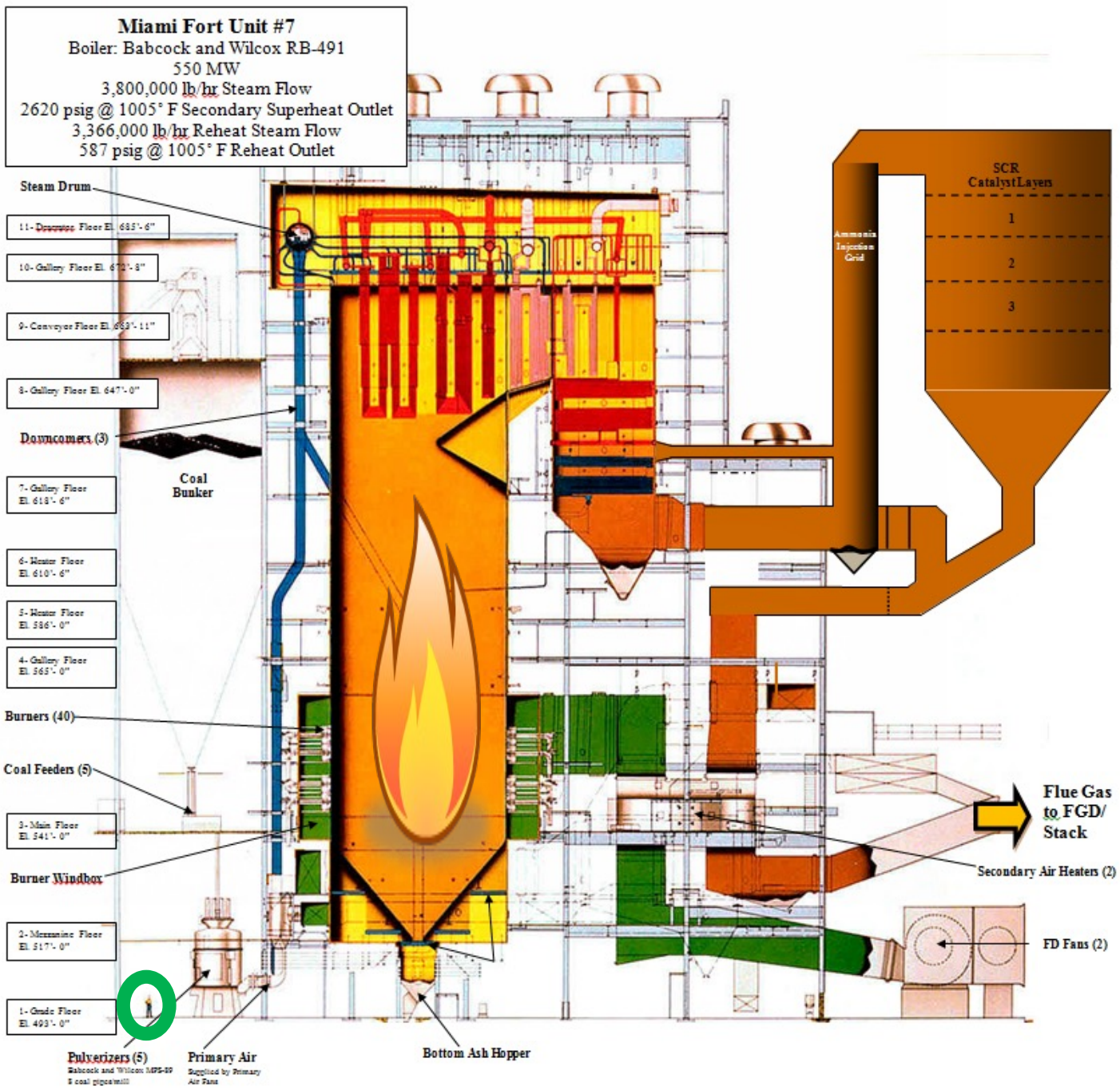
Coal Barge Unloader – Additional Pictures

Component- Bunker and Feeder Pictures

Component- Pulverizer Pictures



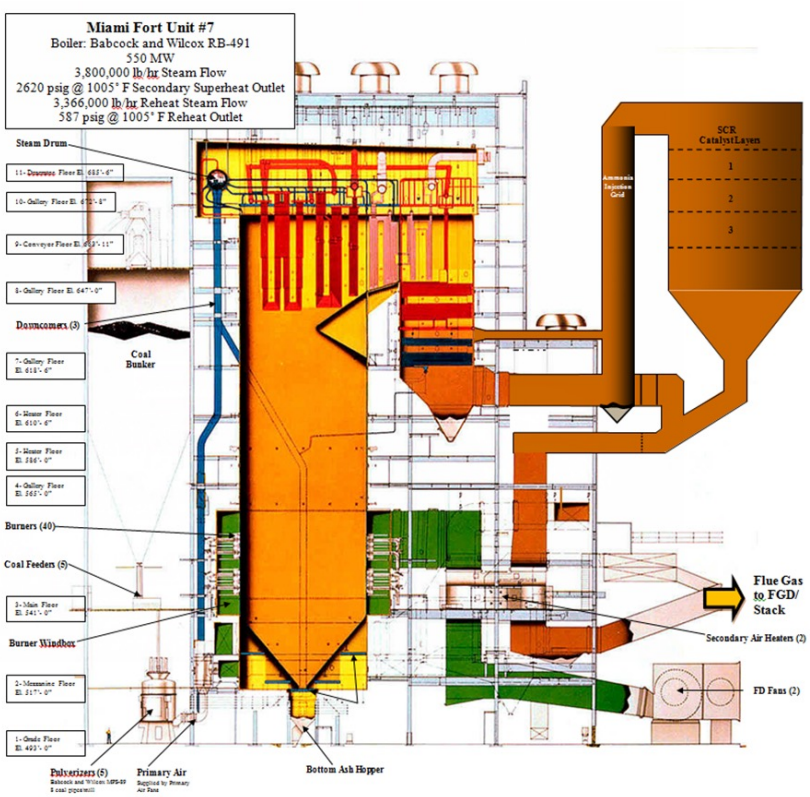
Component- Boiler



- Boilers can produce flame temps of greater than 3,000° F at with steam pressures greater than 2,700 psi

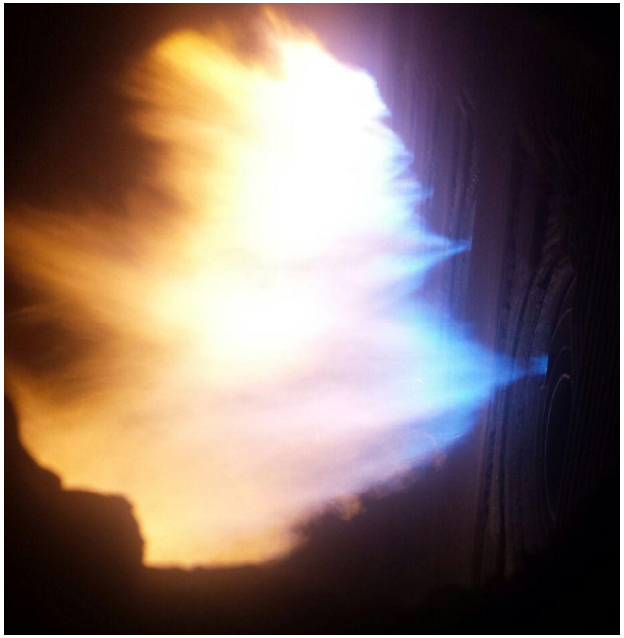
- 1005° F superheated steam is then piped to the turbine

Component- Boiler Pictures



W. H. Zimmer Power Plant Steam Generator, largest formerly operating boiler in the world

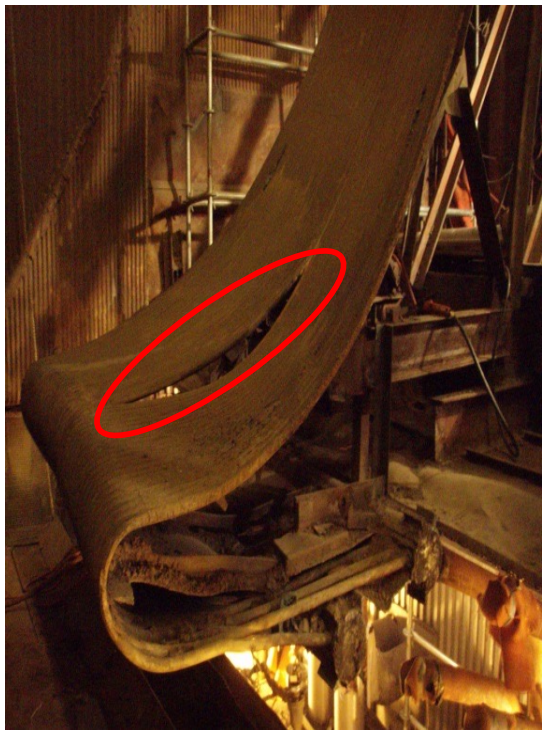
Component- Boiler Pictures



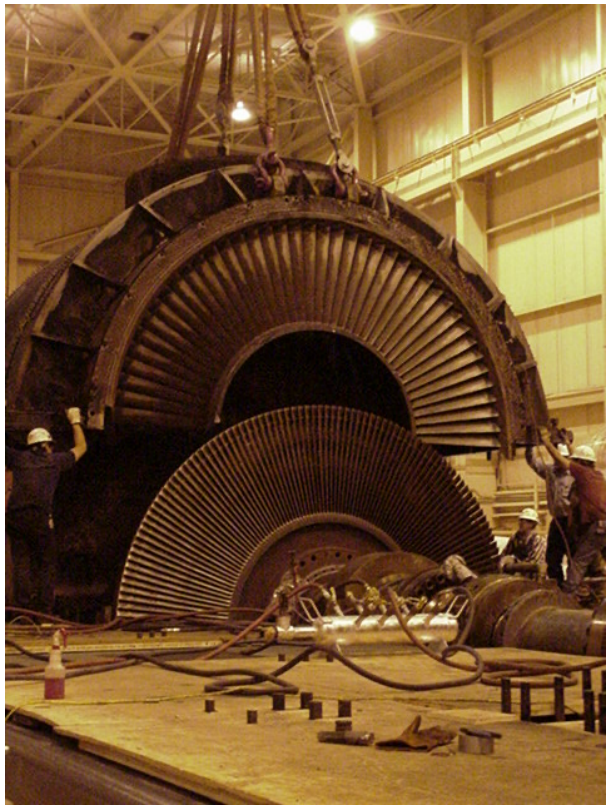
Component- Boiler problems

Boiler Tube Failures - #1 Cause of Forced Outages at plant

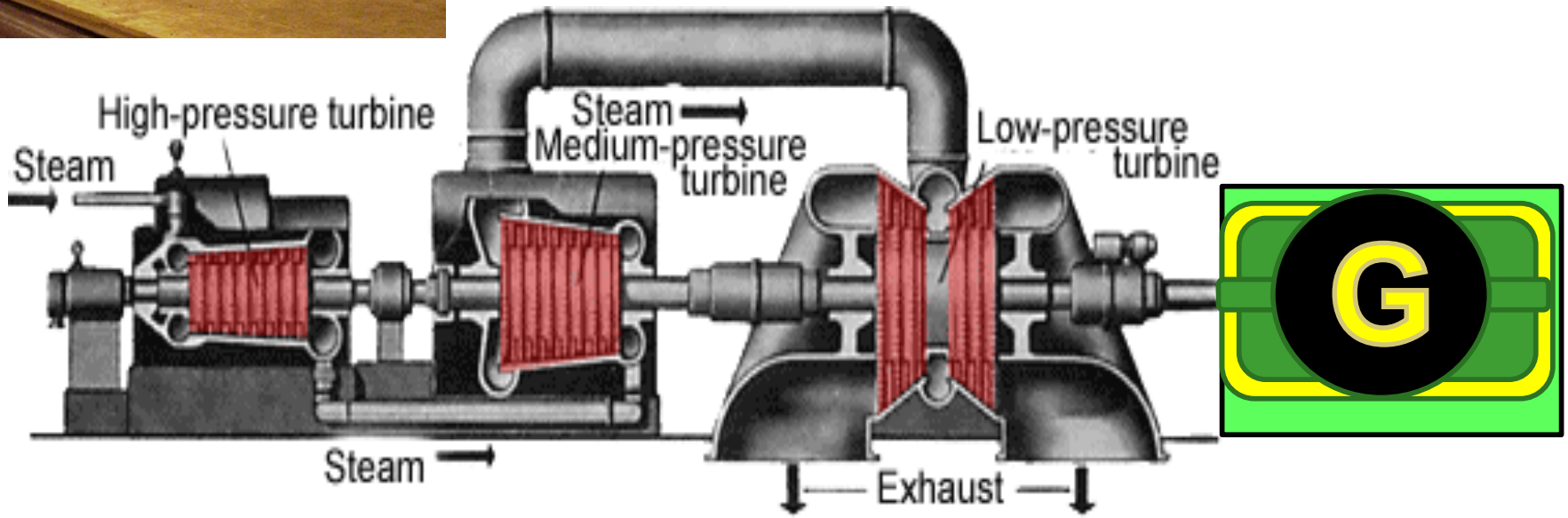
- Poor Combustion / Overheating / Slag
- Corrosion / Erosion
  - Coal Specs
- OUTAGES!!!! LOST $$$$



Component- Steam Turbines



- Mechanical device that extracts thermal energy from pressurized steam and converts it into useful mechanical work.
  - Rotates at 3,600 RPM's
- The high pressure steam (2,400 psi @ 1,005° F) drives the turbine through a series of "blades" which rotates the turbine shaft.
  - The turbine shaft is connected to the shaft of the generator.
  - The exhausted steam is condensed and returned to the boiler to go through the process again.

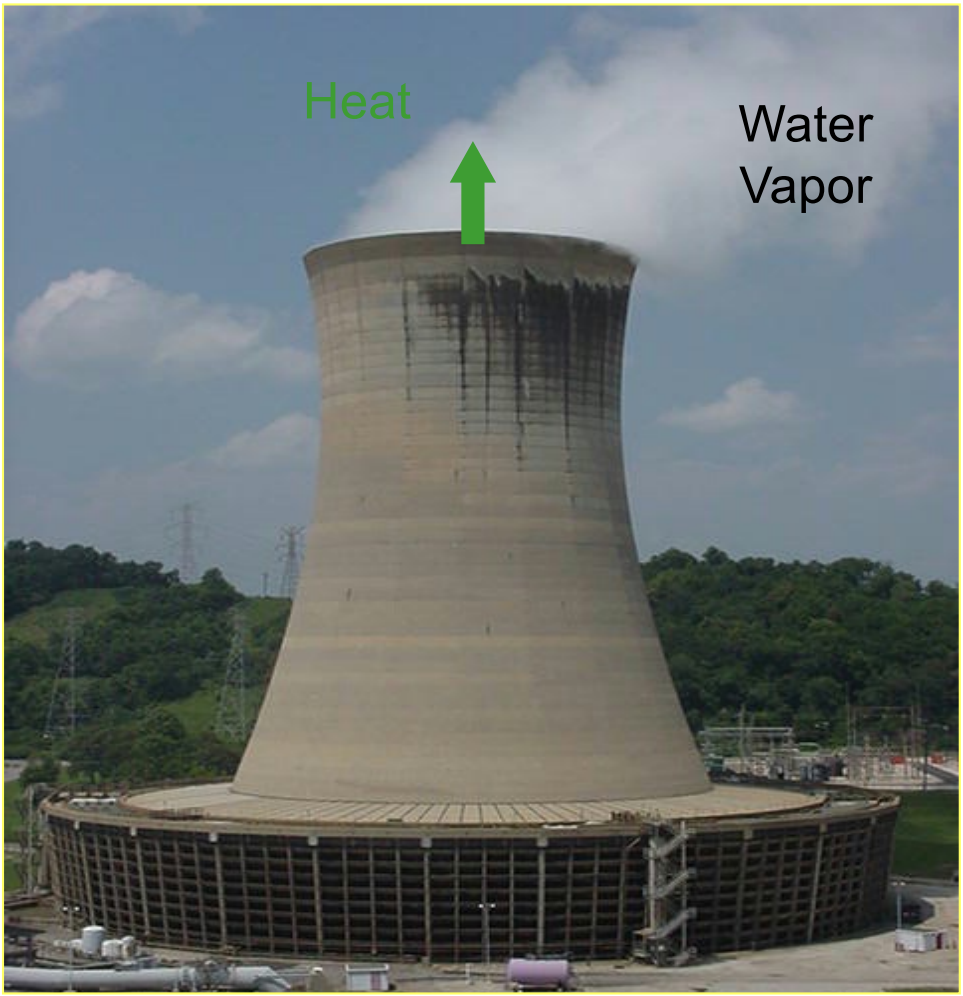


Component- Steam Turbine – Unit 7 Turbine

Component- Steam Turbines – Unit 8 Turbine Deck

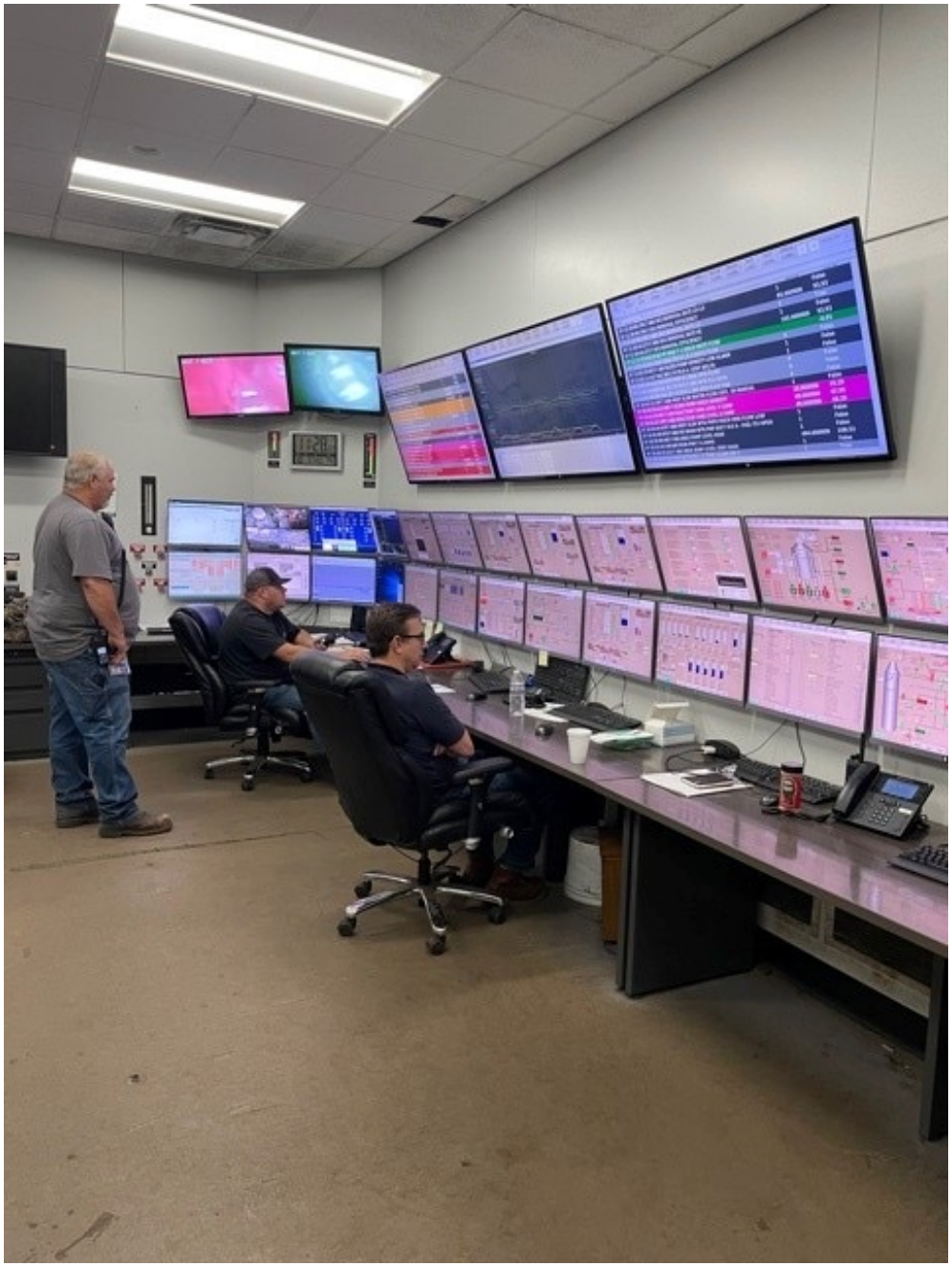
Component- Cooling Tower

Natural Draft Cooling Tower



The circulating cooling water is cycled between these types of towers and the condenser. The heat in the falling water is carried away by the upward air draft in the towers.

Control Room



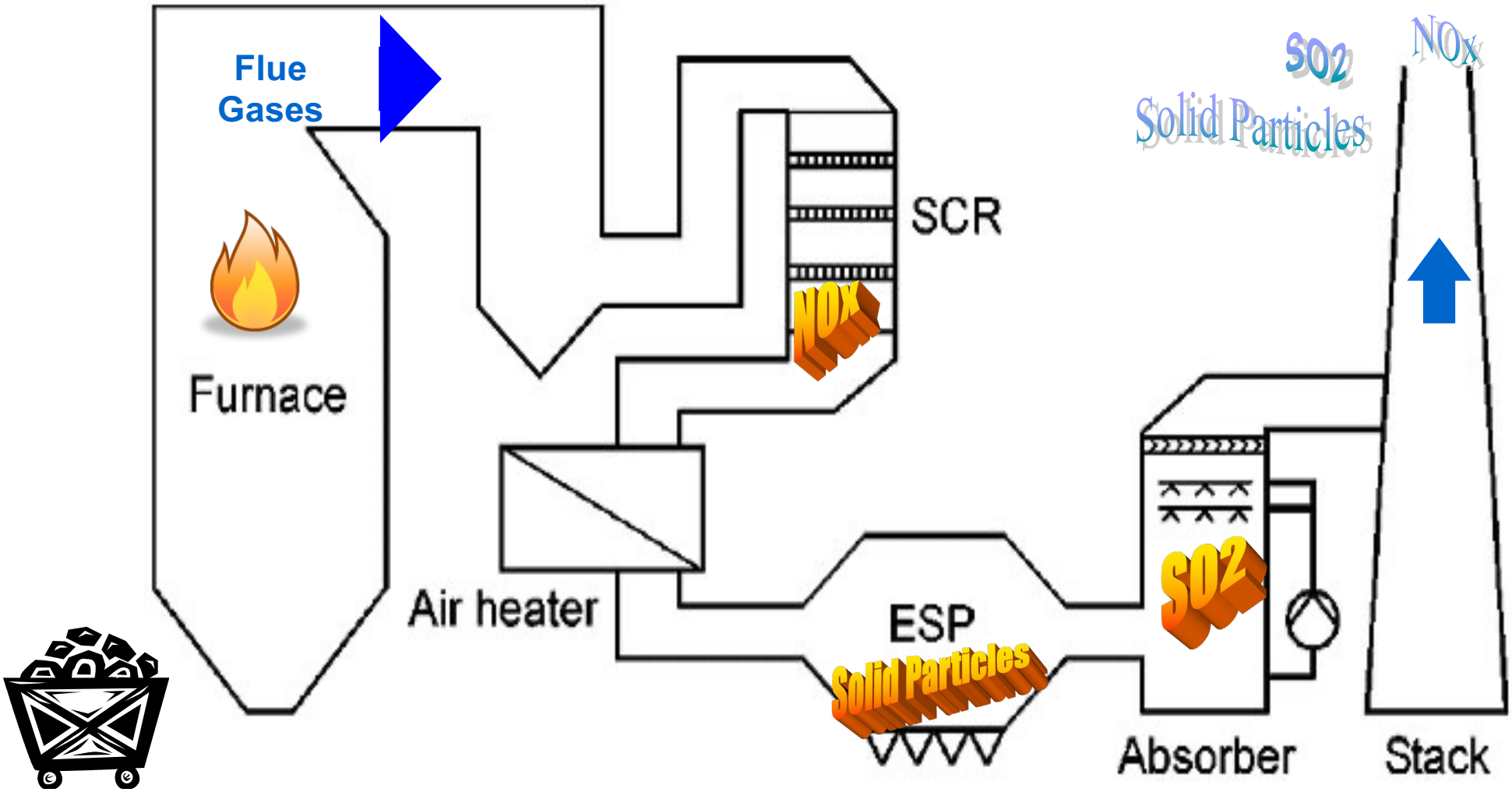
Component- Environmental Control

- Selective Catalytic Reduction- SCR's.
  - Removes reduces 92% Nitrogen Oxide (NOx) emissions.
  - Similar to catalytic converter in a car - ammonia is oxidized, NOx is reduced.

- Electrostatic Precipitators- ESP's.
  - Removes approximately 99.9% Fly Ash from the flue gas stream.
  - Fly ash is usable product.

- Flue Gas De-Sulfurization- FGD.
  - Removes 97% Sulfur Dioxide (SO2) emissions.
  - SO2 can cause "acid rain".
  - Sulfur is naturally contained in the coal.
  - Uses lime or limestone (CaCO3) to remove (scrub) the SO2 from the flue gas.
  - Usable by-product is Gypsum for wall board manufacturing.

Component- Environmental Control

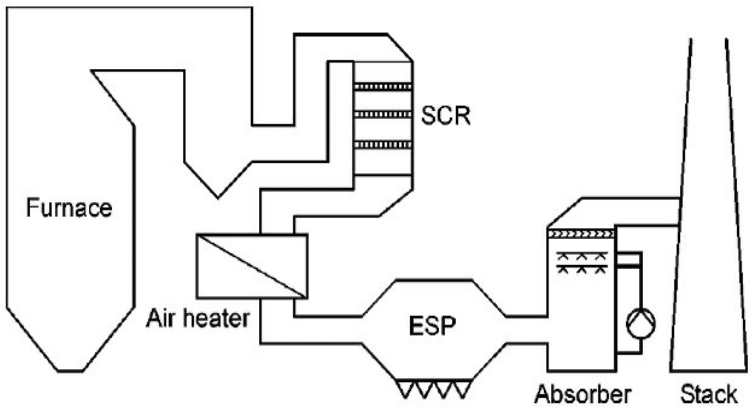


Component- Byproducts

- **Bottom Ash**
  - Used in structural fills for ODOT.
  - Sandblasting media.
  - Miami Fort will produce ~70,000 tons per year.

- **Fly Ash**
  - Used in concrete pavers.
  - Filler for cement.
  - Miami Fort will produce ~ 390,000 tons per year.

- **Gypsum**
  - The FGD Process creates a byproduct called Gypsum.
  - Gypsum is used to make drywall.
  - Miami Fort will produce ~2,000 tons per day.
    - Enough gypsum to make: 95 semi-truck loads of drywall every day or build ~75,000 homes per year.



What is important to us?

Safety

- The safety of our employees, contractors, and guest
- Everyone goes home safe to their family every day

Reliability

- Providing an essential service to the public
- Making Power is how we make money as a business

Environment

- We care about our community and protecting the air we all breath and the water we drink
- Environmental Compliance is critical to our success

Miami Fort Power Station- Over 95 Years of Operation

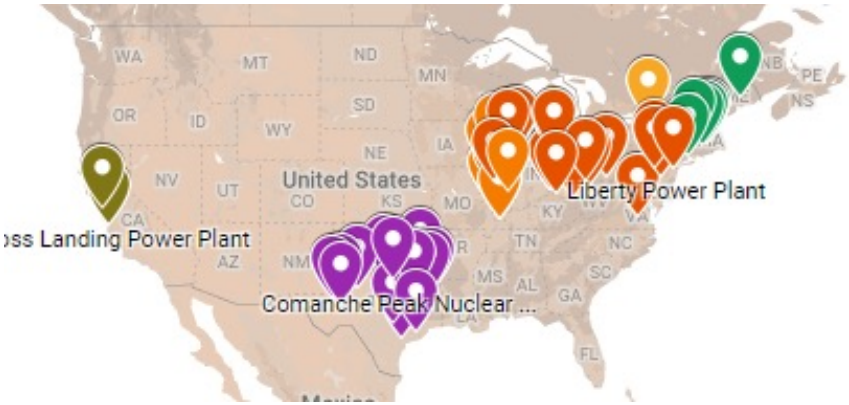
1926

2021

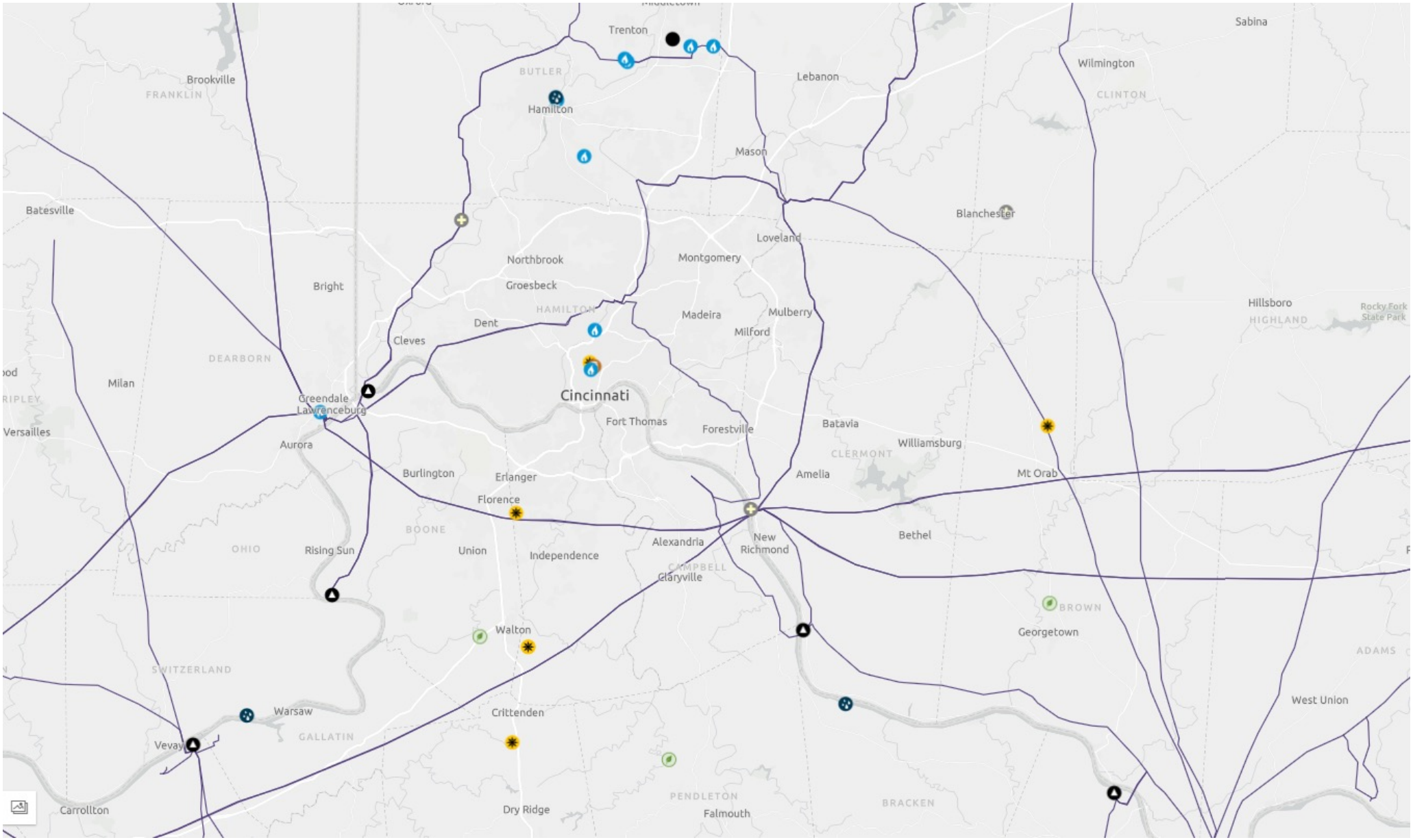
Market Information

- PJM (Pennsylvania, New Jersey, and Maryland)
  - As the primary task, **to ensure the safety, reliability and security of the bulk electric power system**.
  - Create and operate robust, competitive and non-discriminatory electric power markets.
  - Understand customer needs and deliver valued service to meet those needs in a cost-efficient manner.

https://www.luminant.com/about/

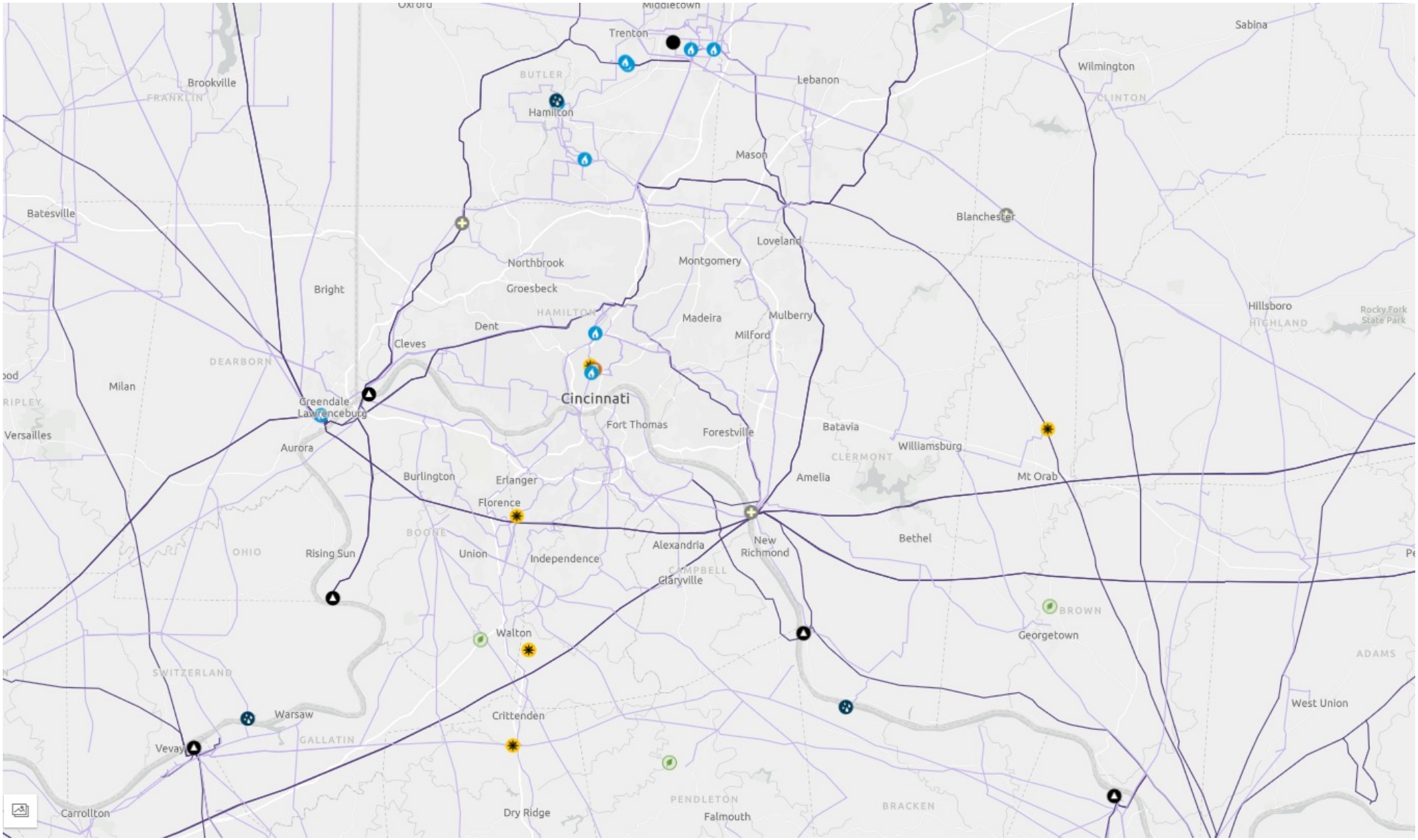


Electric Grid & Generation – Cincinnati - 345 kV



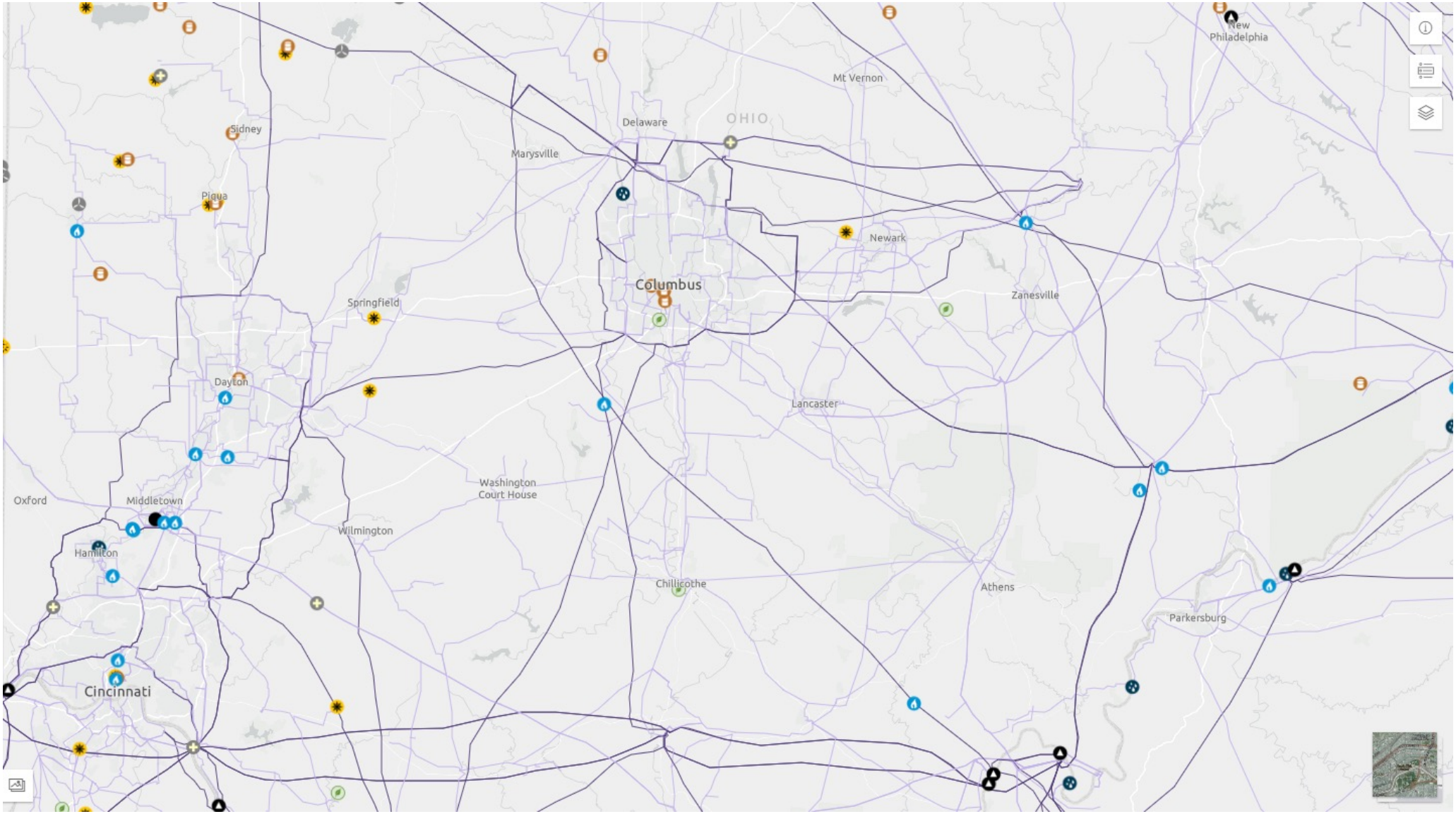
Source: atlas.eia.gov

Electric Grid & Generation – Cincinnati – 69 kV+



Source: atlas.eia.gov

Electric Grid & Generation – Columbus – 69 kV+



Source: atlas.eia.gov

June 13-16th Event – PJM - AEP Load Zone - Columbus

pjm | Emergency Procedures

Postings

Postings | Message Definitions | Message Priorities | Postings Report | PAI Guidance | Regions | Emergency Bid Form

History	Msg ID	Priority	Message Type	Effective Start Time	Regions	Emergency Message	Effective End Time
		All					
	103528	Action	Load Shed Directive	06.14.2022 14:02	AEP	A Load Shed Directive has been issued to mitigate thermal overloads at Kenny-Roberts 138 KV in AEP .	06.15.2022 02:58
	103529	Action	Load Shed Directive	06.14.2022 14:06	AEP	A Load Shed Directive has been issued to mitigate thermal overloads at Clinton - Karl 138 KV in AEP .	06.15.2022 02:58
	103530	Action	Load Shed Directive	06.14.2022 14:35	AEP	A Load Shed Directive has been issued to mitigate thermal overloads at Marion - Obetz 138 KV in AEP .	06.15.2022 02:58
	103540	Action	Emergency Load Mgmt Reduction Action	06.14.2022 15:50	AEP	An Emergency Load Mgmt Reduction Action and a NERC level EEA2 have been issued. Load reduction start times can be found by clicking on the hyperlink(s) in the Regions column. Load reductions should continue until released by PJM. Reductions are mandatory based on product requirements. CSPs should review DR Hub for specific registration details. Lead Time(s) dispatched: Long_120,Short_60,Quick_30 . Product(s) dispatched: Capacity_Performance_DR Additional Comments: This is for the AEP_MARION subzone of AEP only.	06.14.2022 22:00
	103539	Action	Pre-Emergency Load Mgmt Reduction Action	06.14.2022 15:50	AEP	A Pre-Emergency Load Mgmt Reduction Action has been issued. Load reduction start times can be found by clicking on the hyperlink(s) in the Regions column. Load reductions should continue until released by PJM. Reductions are mandatory based on product requirements. CSPs should review DR Hub for specific registration details. Lead Time(s) dispatched: Long_120,Short_60,Quick_30 . Product(s) dispatched: Capacity_Performance_DR Additional Comments: This is for the AEP_MARION subzone of AEP only.	06.14.2022 22:00
	103555	Action	Load Shed Directive	06.14.2022 19:21	AEP	A Load Shed Directive has been issued to mitigate an N-5 cascade analysis at Beatty-Bolton 138kV in AEP . Additional Comments: Pre-contingency load shed of 115% load dump rating.	06.15.2022 02:58
	103564	Action	Load Shed Directive	06.15.2022 10:41	AEP	A Load Shed Directive has been issued to mitigate thermal overloads at Hap Cremean Gahanna 138 KV in AEP .	06.15.2022 13:55
	103562	Action	Pre-Emergency Load Mgmt Reduction Action	06.15.2022 10:50	AEP_MARION	A Pre-Emergency Load Mgmt Reduction Action has been issued. Load reduction start times can be found by clicking on the hyperlink(s) in the Regions column. Load reductions should continue until released by PJM. Reductions are mandatory based on product requirements. CSPs should review DR Hub for specific registration details. Lead Time(s) dispatched: Quick_30,Short_60,Long_120 . Product(s) dispatched: Capacity Performance DR Additional Comments: SZ_AEP_MARION_1269364670	06.15.2022 22:00
	103563	Action	Emergency Load Mgmt Reduction Action	06.15.2022 10:50	AEP_MARION	An Emergency Load Mgmt Reduction Action and a NERC level EEA2 have been issued. Load reduction start times can be found by clicking on the hyperlink(s) in the Regions column. Load reductions should continue until released by PJM. Reductions are mandatory based on product requirements. CSPs should review DR Hub for specific registration details. Lead Time(s) dispatched: Quick_30,Long_120 . Product(s) dispatched: Capacity Performance DR Additional Comments: SZ_AEP_MARION_1269364670	06.15.2022 22:00
	103566	Action	Load Shed Directive	06.15.2022 11:40	AEP	A Load Shed Directive has been issued to mitigate an N-5 cascade analysis at Kenney-Roberts 138kV in AEP . Additional Comments: Additional Comments: Pre-contingency load shed of 115% load dump rating.	06.15.2022 22:25
	103579	Action	Pre-Emergency Load Mgmt Reduction Action	06.16.2022 12:30	AEP_MARION	A Pre-Emergency Load Mgmt Reduction Action has been issued. Load reduction start times can be found by clicking on the hyperlink(s) in the Regions column. Load reductions should continue until released by PJM. Reductions are mandatory based on product requirements. CSPs should review DR Hub for specific registration details. Lead Time(s) dispatched: Short_60,Quick_30,Long_120 . Product(s) dispatched: Capacity Performance DR Additional Comments: SZ_AEP_MARION_1269364670	06.16.2022 17:00
	103580	Action	Emergency Load Mgmt Reduction Action	06.16.2022 12:30	AEP_MARION	An Emergency Load Mgmt Reduction Action and a NERC level EEA2 have been issued. Load reduction start times can be found by clicking on the hyperlink(s) in the Regions column. Load reductions should continue until released by PJM. Reductions are mandatory based on product requirements. CSPs should review DR Hub for specific registration details. Lead Time(s) dispatched: Quick_30,Long_120 . Product(s) dispatched: Capacity Performance DR Additional Comments: SZ_AEP_MARION_1269364670	06.16.2022 17:00

Source: emergencyprocedures.pjm.com

News Articles regarding Columbus June Outages

The Columbus Dispatch

NEWS

Power to be restored Thursday after intentional AEP outage for nearly 170,000 in Columbus

Cole Behrens The Columbus Dispatch
Published 2:47 p.m. ET June 14, 2022 | Updated 10:36 a.m. ET June 15, 2022

View Comments

Statehouse NEWS BUREAU

WKSU
1A

NEXT UP: 12:00 PM Here and Now

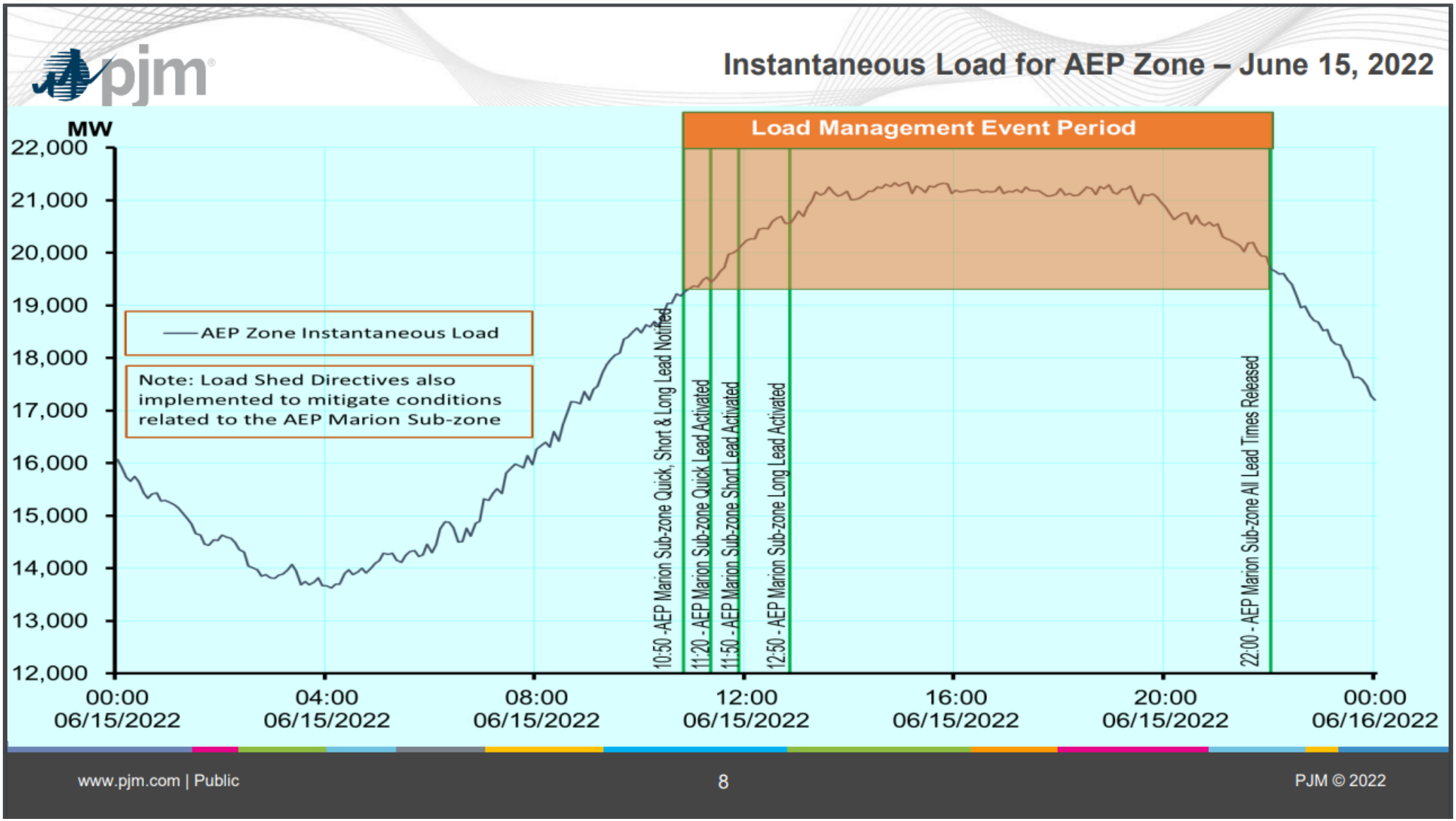
All Streams

WHO WE ARE 'THE STATE OF OHIO' CORONAVIRUS 2021 YEAR IN REVIEW THE OHIO NEWSROOM

Government/Politics

Grid operators gave AEP five minutes to shut off power to thousands of homes in June

The Statehouse News Bureau | By Andy Chow
Published July 13, 2022 at 6:50 PM EDT



https://www.pjm.com/-/media/markets-ops/demand-response/estimated-demand-response-june-14-15-16-2022.ashx

Tuesday, June 14

- Tornadoes/severe storms moved through the western part of the RTO beginning Monday, June 13, impacting dozens of bulk electric system facilities
- Hot Weather Alert for western area of PJM

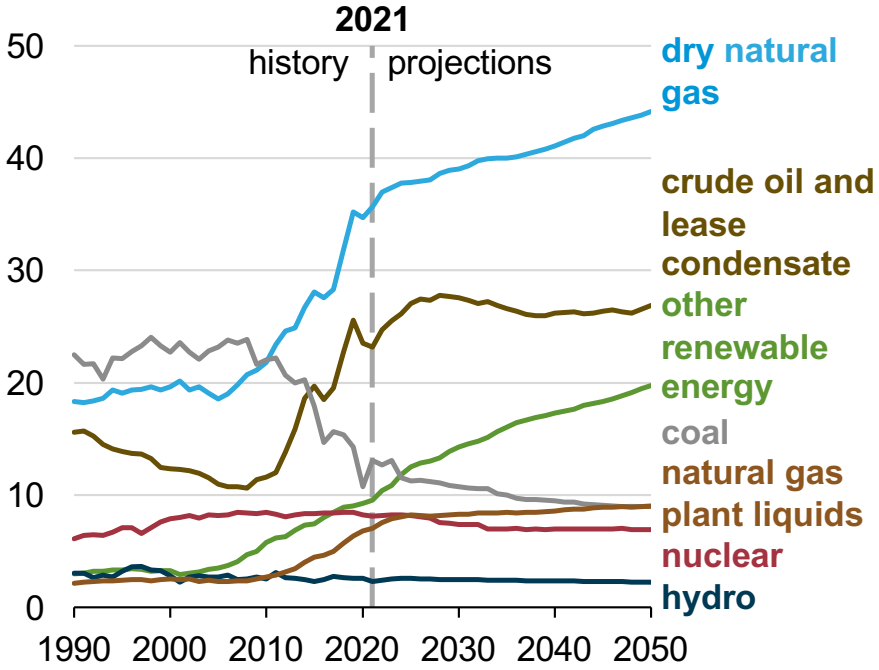
Time	Event
13:00 – 14:00	Seven 138 kV facilities in the AEP zone tripped
	Actual load on several facilities **above** load dump rating
14:02 – 14:35	PJM issued several load shed directives to AEP to alleviate local thermal overloads created by the additional outages
	This action initiated the Performance Assessment Interval (PAI)
	Contingency switching was used where possible to manage thermal loading
15:50	Pre-Emergency and Emergency Load Management Reduction Action for the Marion area of AEP
	Multiple N-5 potential cascade overloads
19:21	PJM issued an additional load shed directive to mitigate a potential N-5 cascading outage for the Beatty – Bolton 138 kV line

Energy Trends

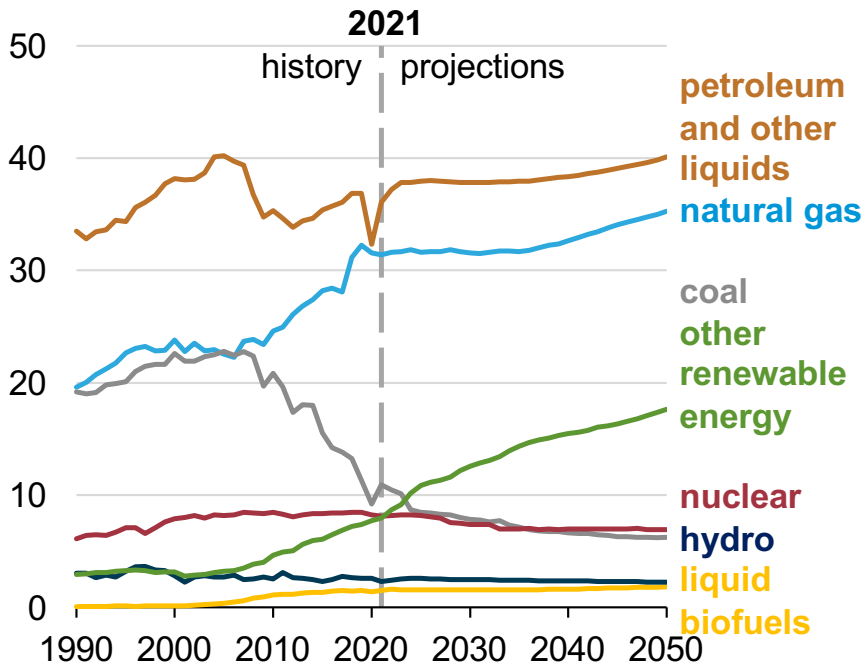
Sourced from EIA (Energy Information Administration) – 2022 Annual Energy Outlook

Energy production and consumption

Energy production by source
AEO2022 Reference case
quadrillion British thermal units



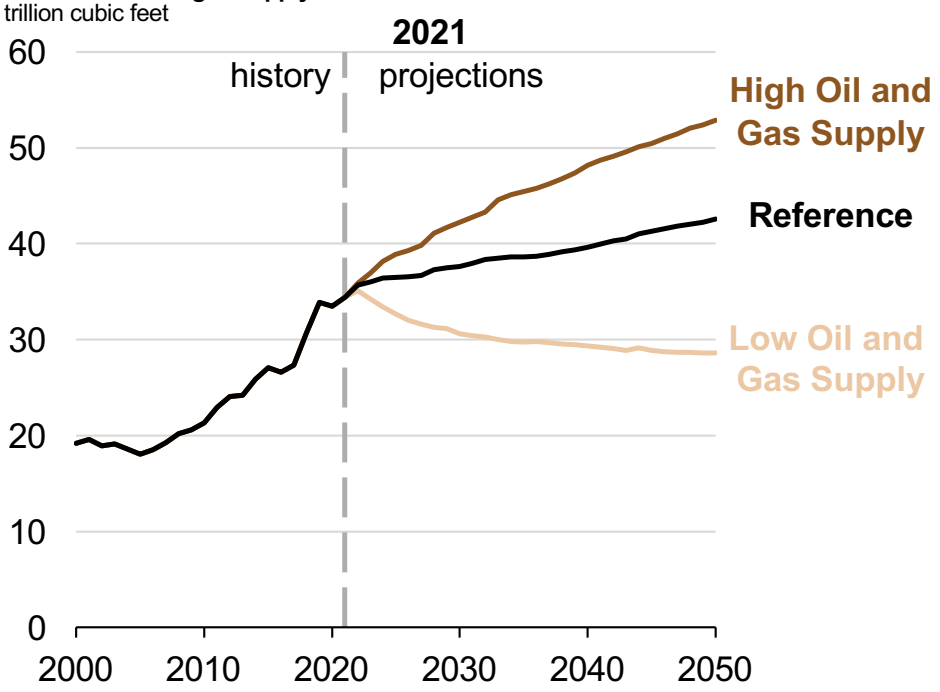
Energy consumption by fuel
AEO2022 Reference case
quadrillion British thermal units



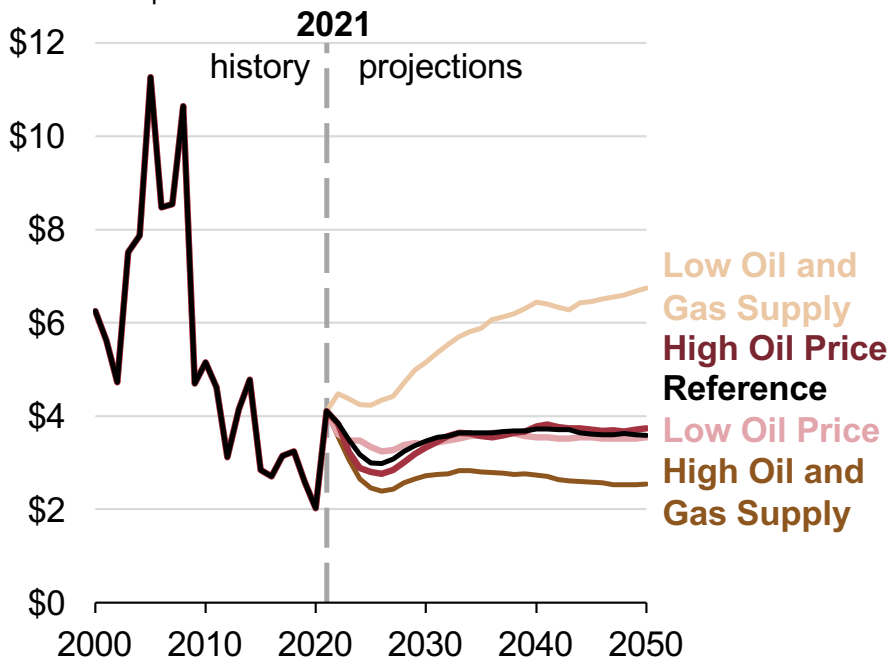
Note: Biofuels are shown separately and included in petroleum and other liquids.

U.S. natural gas production and prices

U.S. dry natural gas production
AEO2022 oil and gas supply cases
trillion cubic feet

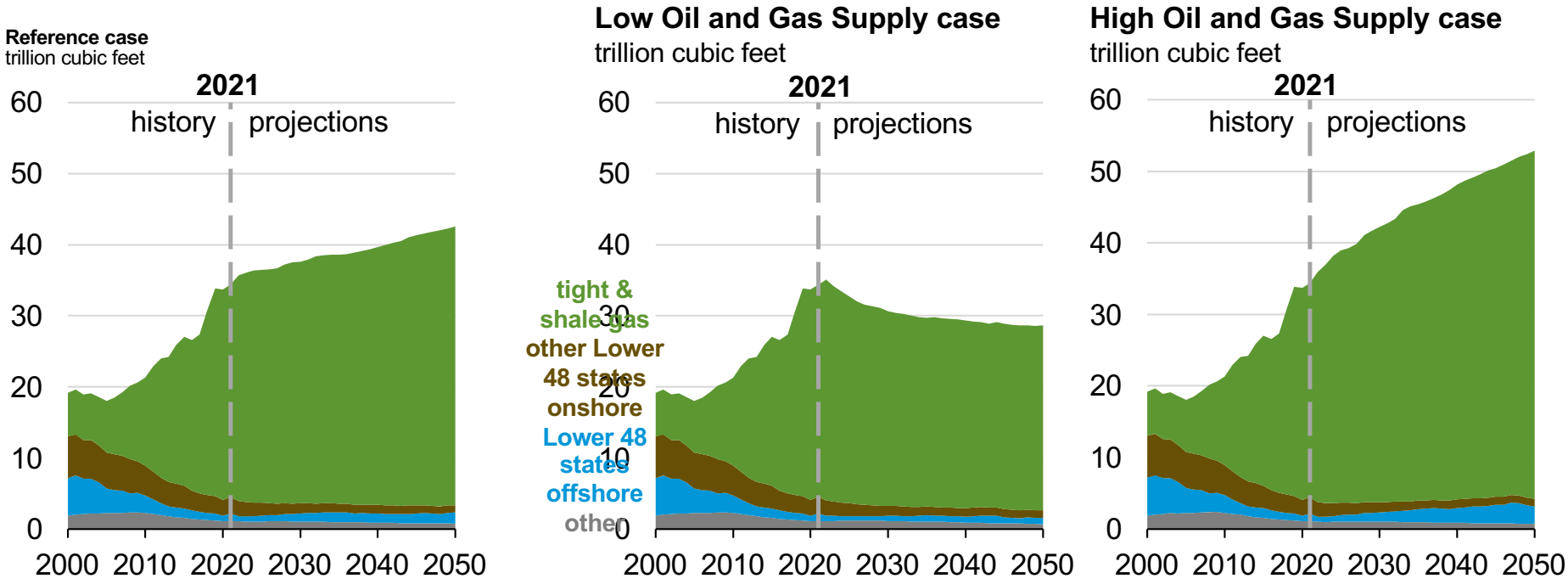


Natural gas spot price at Henry Hub
AEO2022 side cases
2021 dollars per million British thermal unit



U.S. dry natural gas production

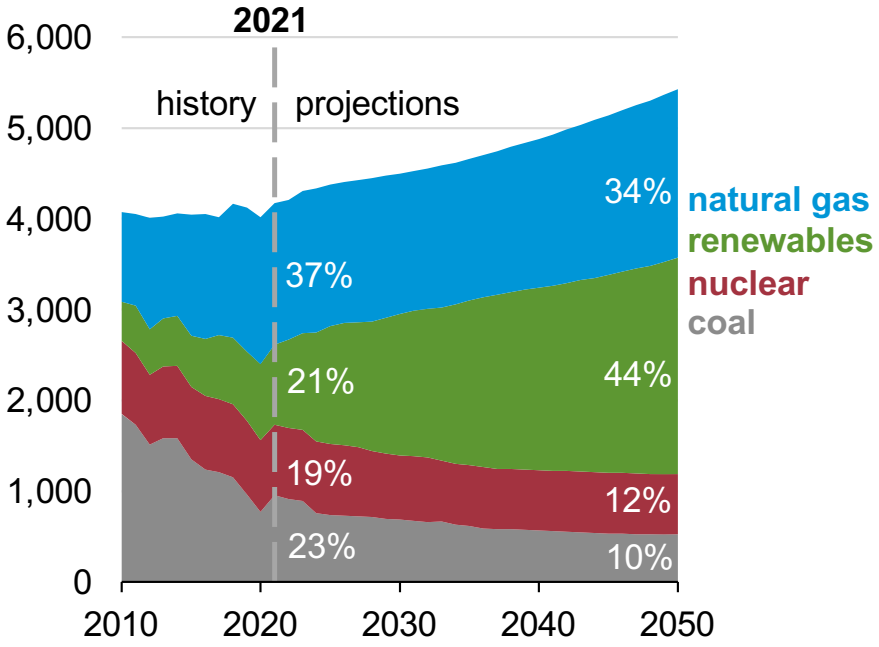
Dry natural gas production, AEO2022 oil and natural gas supply cases



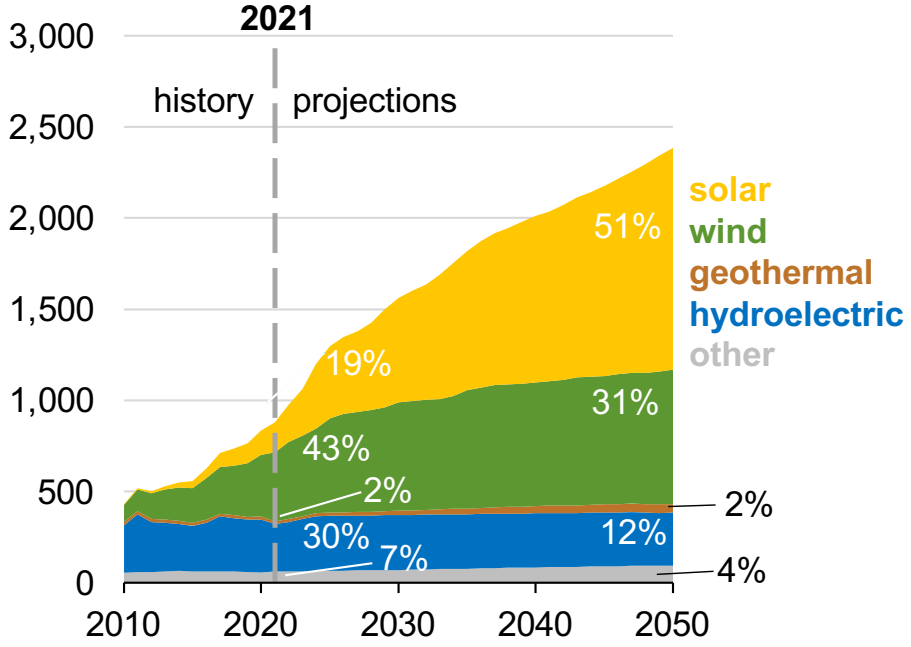
Note: *Tight and shale* gas includes tight gas, shale gas, and natural gas from tight oil formations.

U.S. electricity generation and shares from selected fuels and renewable sources

U.S. electricity generation from selected fuels
AEO2022 Reference case
billion kilowatthours

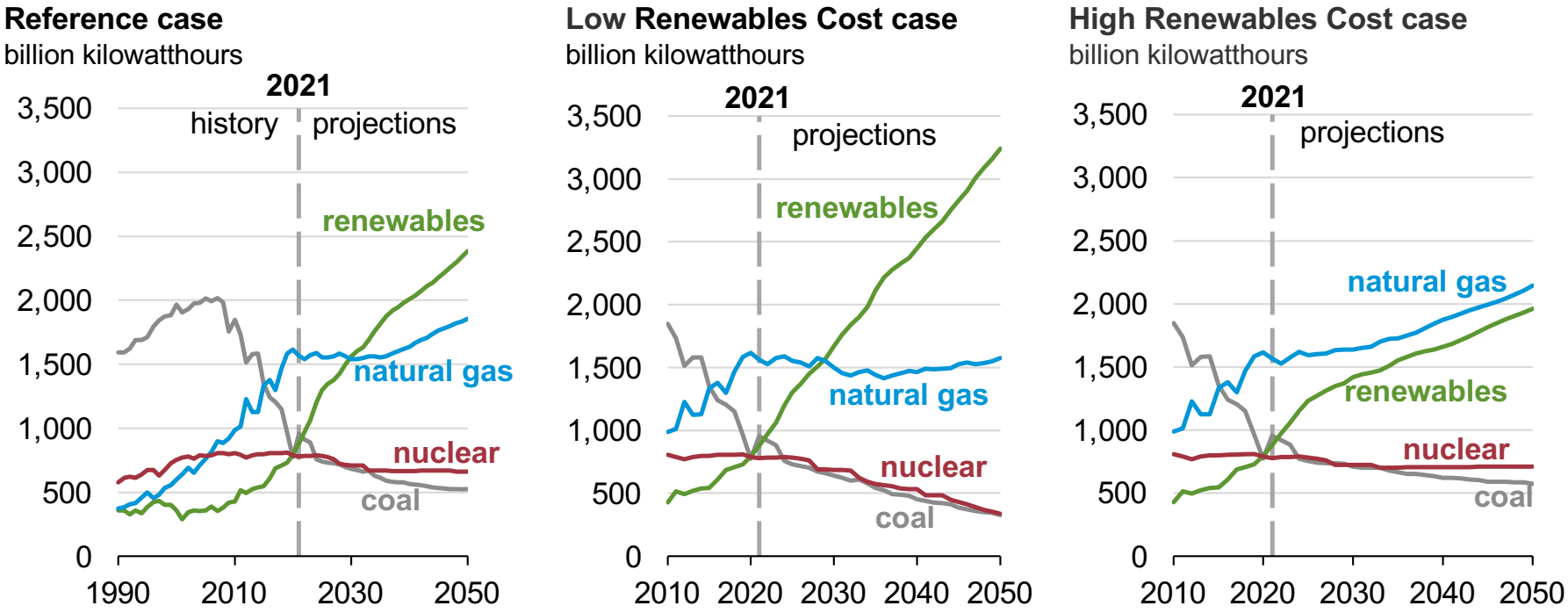


U.S. renewable electricity generation, including end use
AEO2022 Reference case
billion kilowatthours



U.S. electricity generation levels from selected fuels and renewable sources

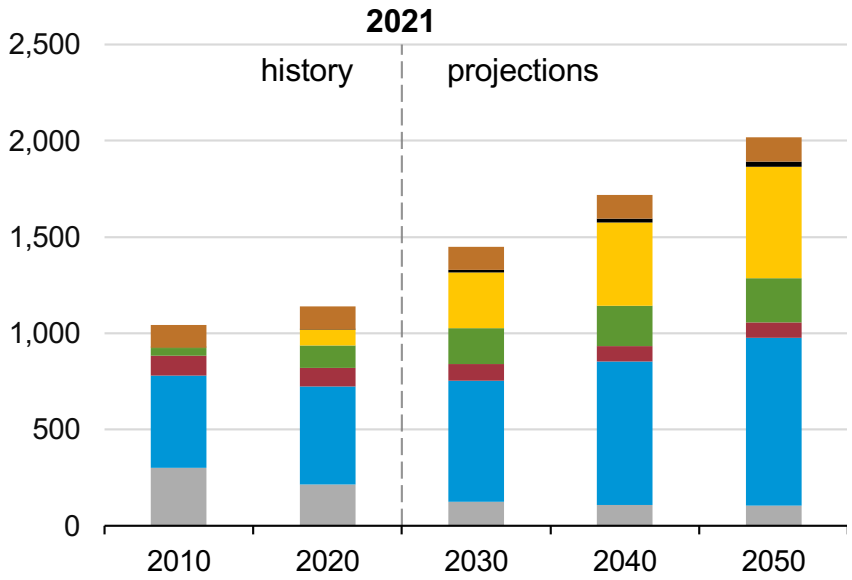
U.S. electricity generation, AEO2022 renewables cost cases



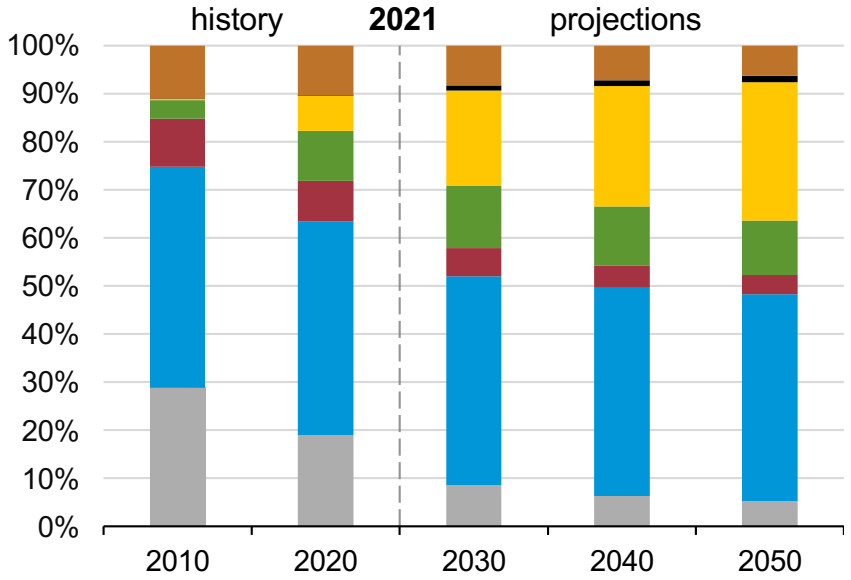
Note: Renewables category includes electricity generation from wind, solar, hydroelectric, geothermal, wood, and other biomass sources.

Installed electric generating capacity by source

Installed electric generating capacity by source
AEO2022 Reference case
gigawatts



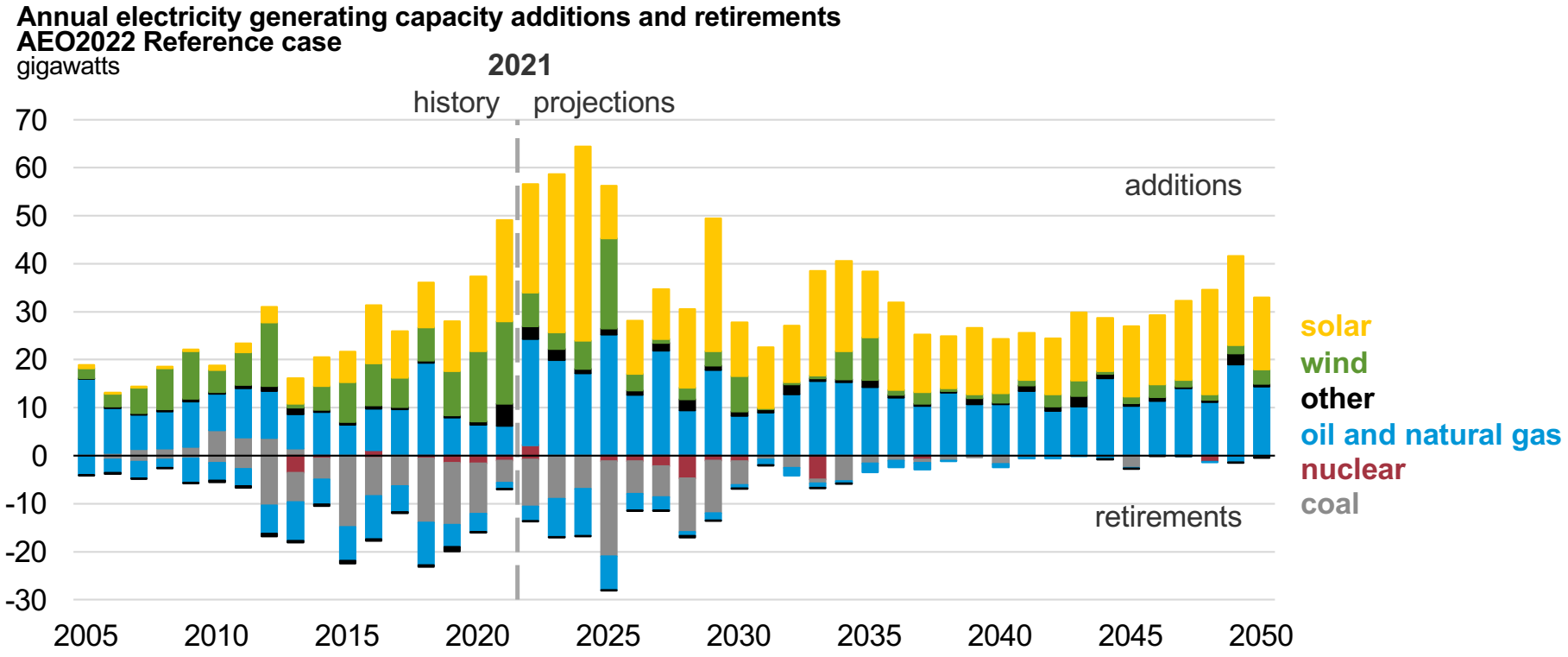
Share of installed electric generating capacity
AEO2022 Reference case
percentage



other | diurnal storage | solar | wind | nuclear | oil and natural gas | coal

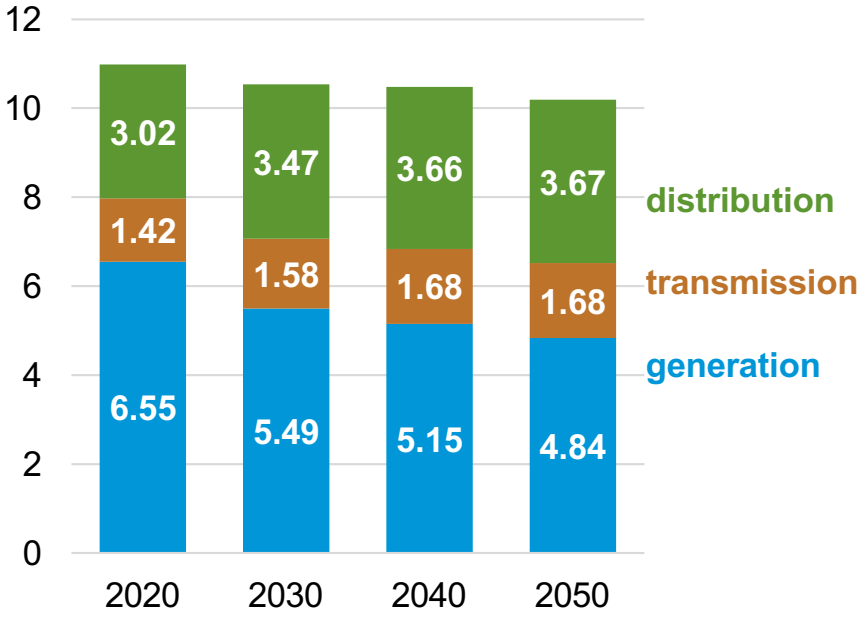
U.S. retiring and new generating capacity

Source: Form EIA-860M, *Monthly Update to the Annual Electric Generator Report*, August 2021

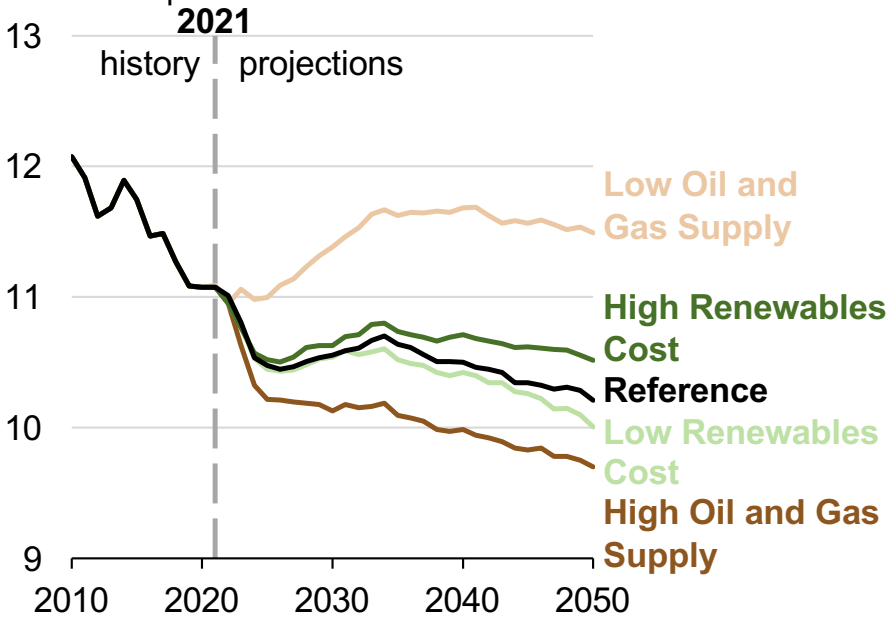


Electricity prices by components and long-term average electricity prices

Components of U.S. Electricity Prices
AEO2022 Reference case
2021 cents per kilowatthour



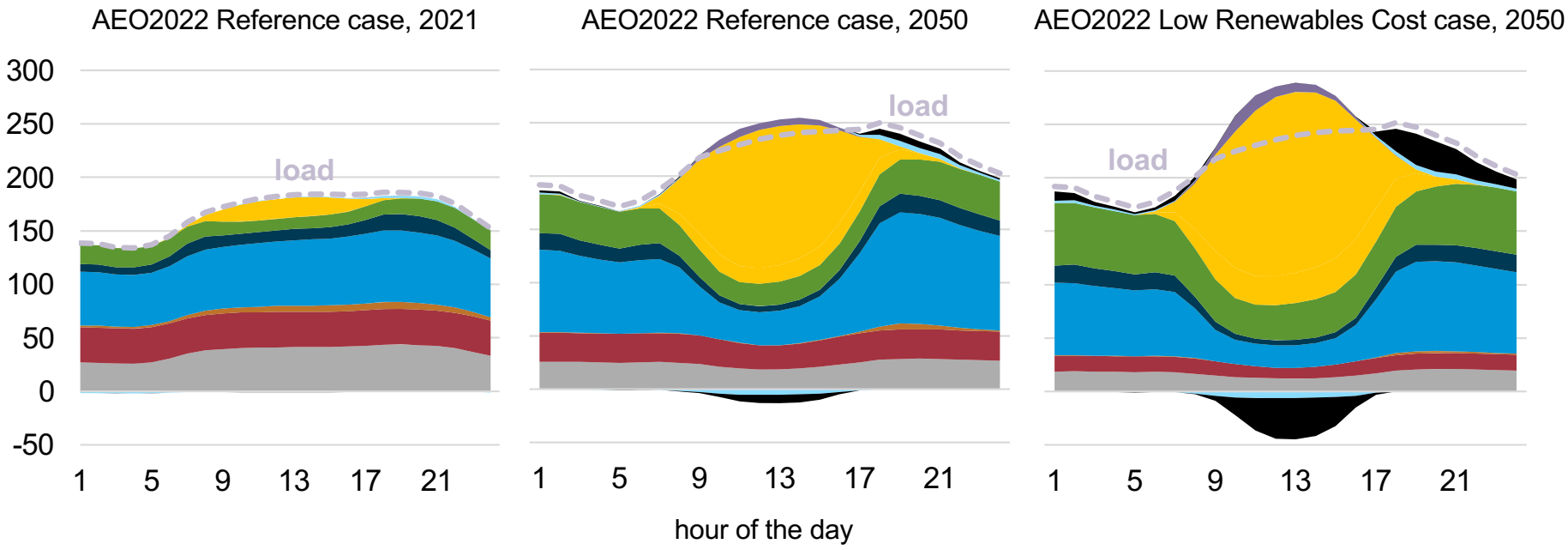
U.S. average electricity price
AEO2022 selected cases
2021 cents per kilowatthour



U.S. electricity generation by source

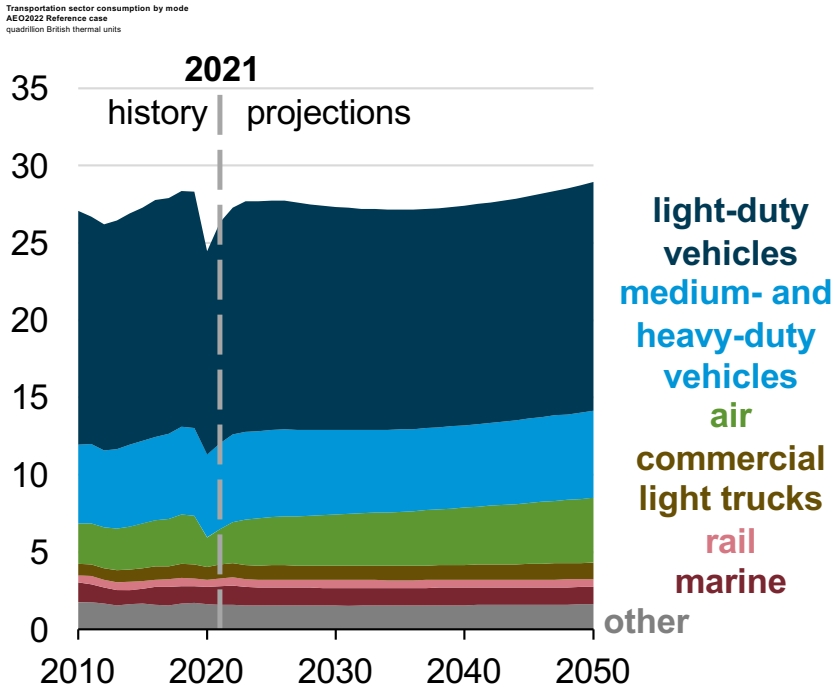
Hourly U.S. electricity generation and load by fuel for selected cases and representative years

billion kilowatthours

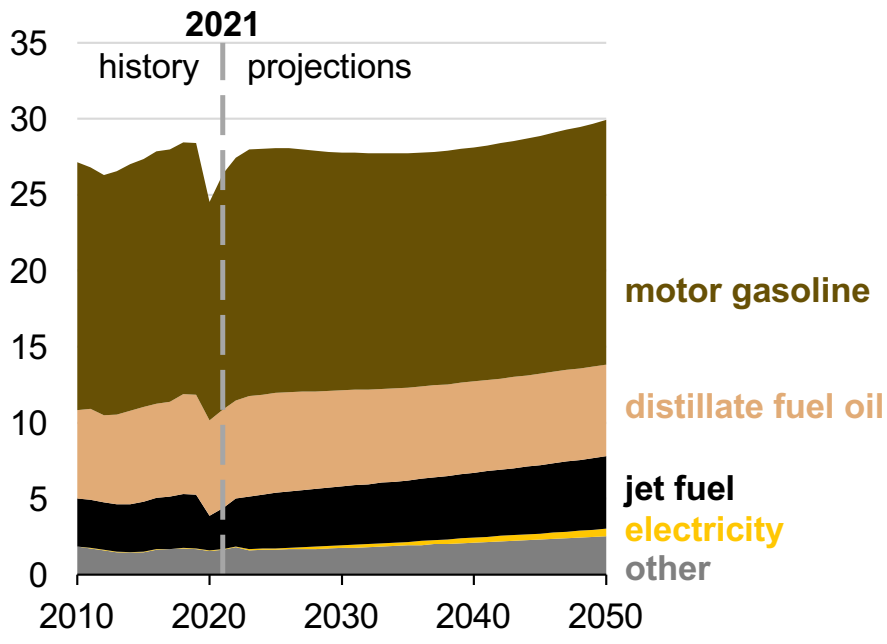


Note: Negative generation represents charging of energy storage technologies such as pumped hydro and battery storage. Hourly dispatch estimates are illustrative and are developed to determine curtailment and storage operations; final dispatch estimates are developed separately and may differ from total utilization as this figure shows. Solar includes both utility-scale and end-use photovoltaic electricity generation

Transportation sector energy consumption

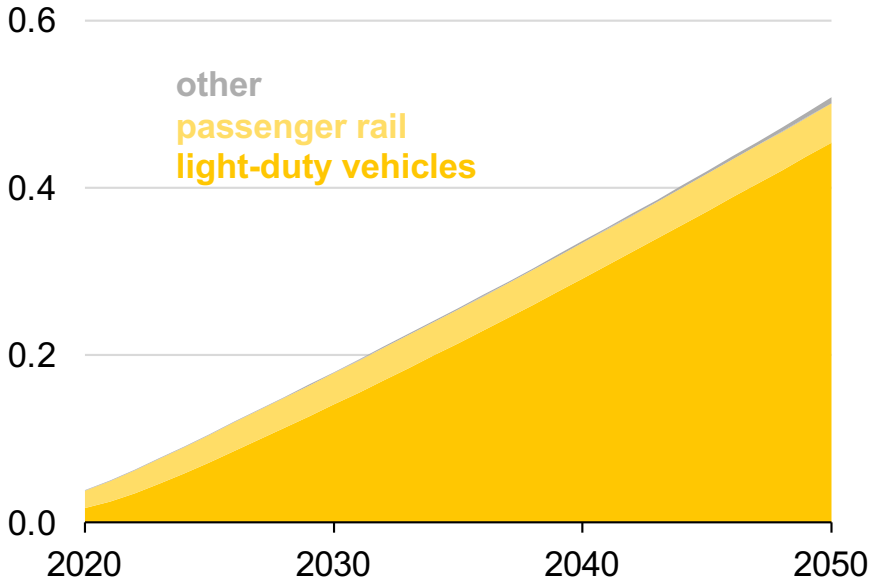


Transportation sector consumption by fuel
AEO2022 Reference case
quadrillion British thermal units

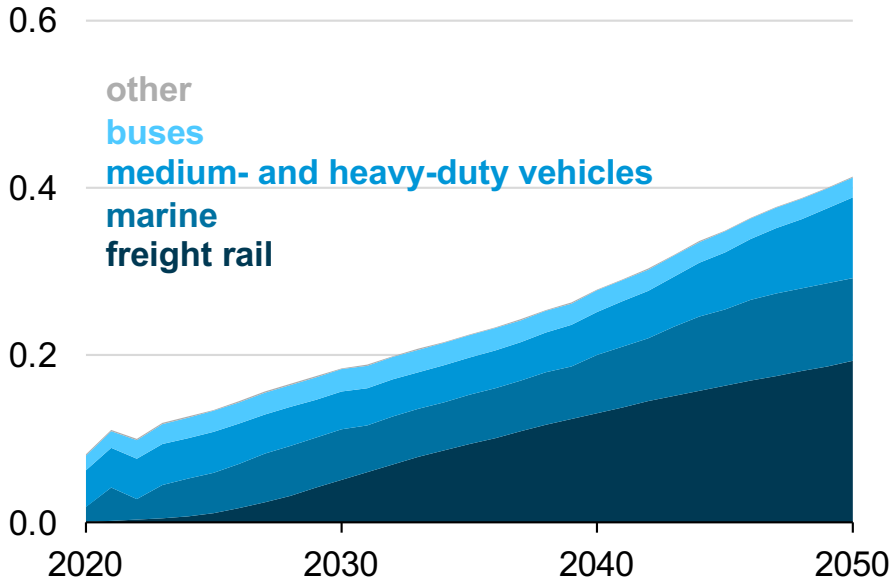


Transportation sector delivered electricity and natural gas

Delivered electricity by mode
AEO2022 Reference case
quadrillion British thermal units



Delivered compressed and liquefied natural gas by mode
AEO2022 Reference case
quadrillion British thermal units



Miami Fort Tour 10/6/22

- Address: 11021 Brower Road, North Bend, Ohio 45052
  - Should be 35-40 minute drive from UC
- Please wear closed-toed shoes and long pants
  - Hard hats, safety glasses, and ear plugs will be provided, feel free to bring your own if you wish
  - There are numerous hazards in the plant, we will discuss safety and any unique risks from operation at the beginning of the tour
  - Please bring a photo ID to be used at check-in
  - Call my cell if you get lost/have trouble – 937-750-3182

Site Map/Entry