



OLD SMOKEY POWER: TRANSFORMING AGING POWER PLANTS

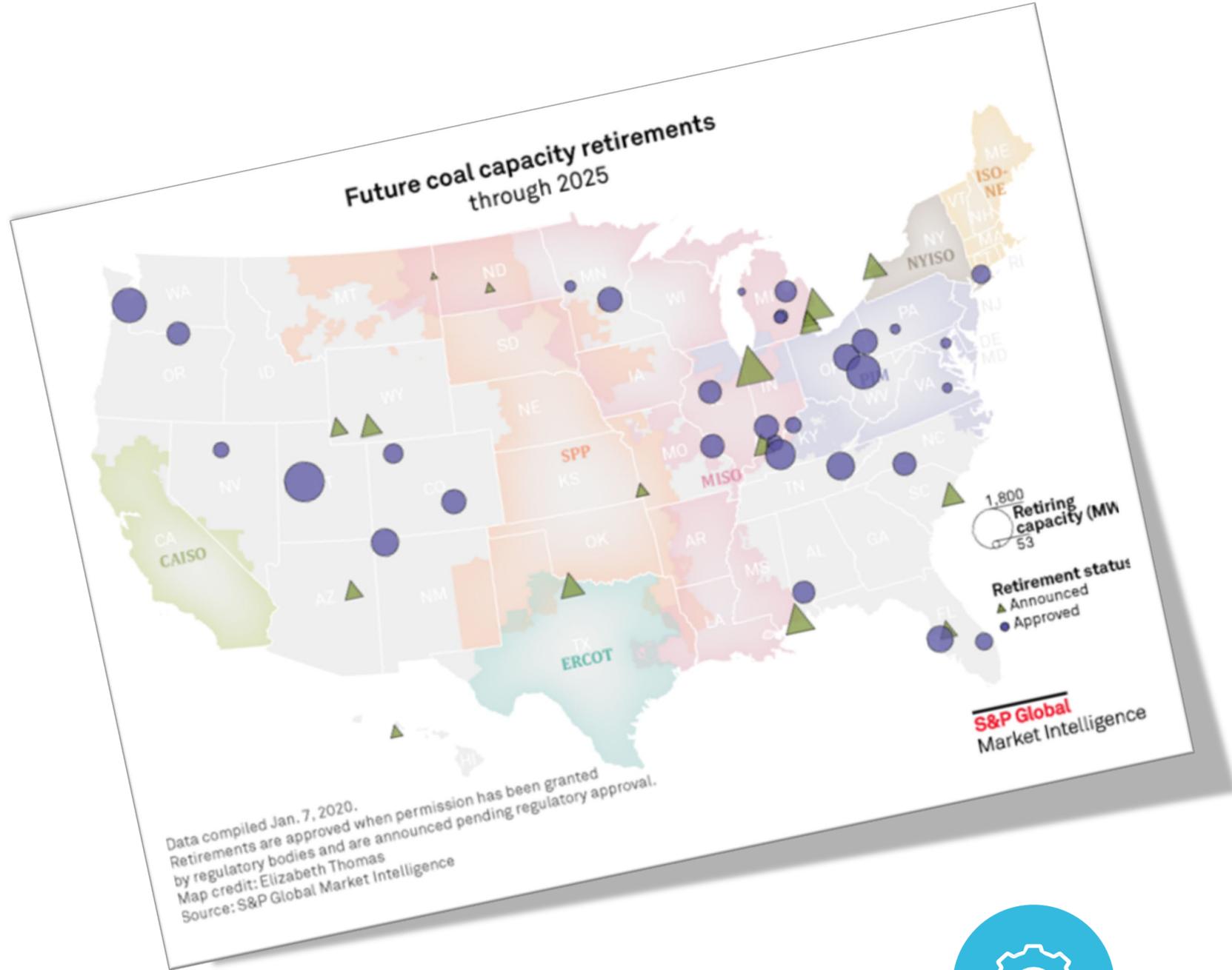
A&WMA MEGA SYMPOSIUM

NOVEMBER 18, 2020



PLANNED COAL CAPACITY RETIREMENTS

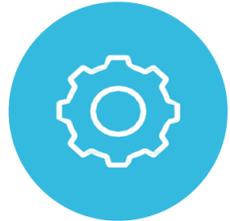
FUTURE RETIREMENTS THROUGH 2025



Largest planned coal retirements through 2025

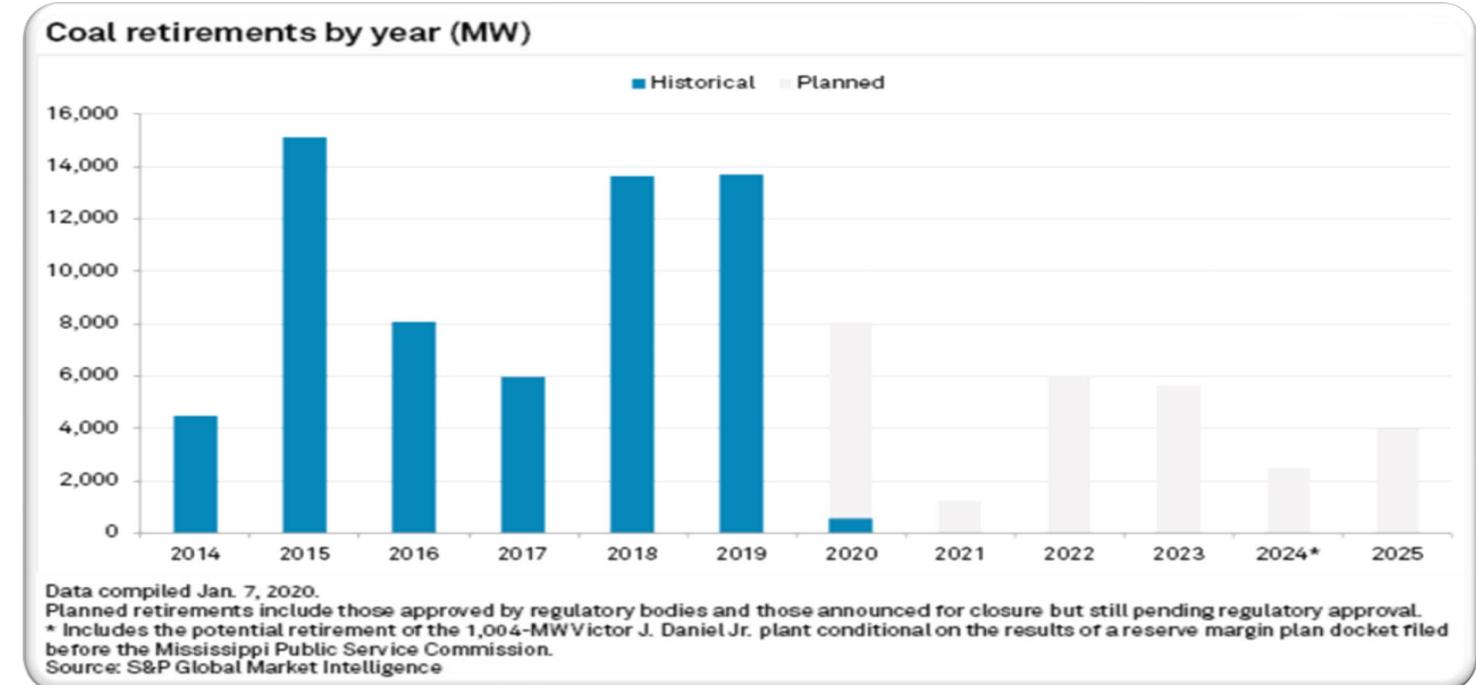
Power plant	Retirement status	ISO/RTO	Retiring capacity (MW)
Intermountain	Approved	ISO/RTO	1,800
R.M. Schahfer	Announced	CAISO	1,625
Centralia	Approved	MISO	1,340
Pleasants	Approved	Outside ISO/RTO	1,300
St Clair	Approved	PJM	1,100
Paradise	Announced	MISO	1,017
Victor J. Daniel Jr.*	Approved	Outside ISO/RTO	1,004
Bull Run	Announced	Outside ISO/RTO	872
San Juan	Approved	Outside ISO/RTO	847
Big Bend	Approved	Outside ISO/RTO	790
Donesville	Approved	Outside ISO/RTO	780
N.H. Sammis	Approved	PJM	720
Somerset ST	Approved	PJM	692
Sherburne County Plant (Sherco)	Announced	NYISO	682
Comanche	Approved	MISO	660
Petersburg	Approved	Outside ISO/RTO	657
Oklahoma	Approved	MISO	650
Meramec	Announced	ERCOT	620
J.G. Allen	Approved	MISO	604

Data compiled Jan. 7, 2020.
 * Potential retirement of the 1,004-MW Victor J. Daniel Jr. plant is still conditional on the results of a reserve margin plan docket filed before the Mississippi Public Service Commission. Retirements are approved when permission has been granted by regulatory bodies and announced pending regulatory approval.
 Only includes plants with over 600 MW of retiring capacity.
 Source: S&P Global Market Intelligence



YEARLY COAL RETIREMENTS

HISTORICAL AND PLANNED GIGAWATTS AND MEGAWATTS



FUEL MIX ELECTRIC GENERATION

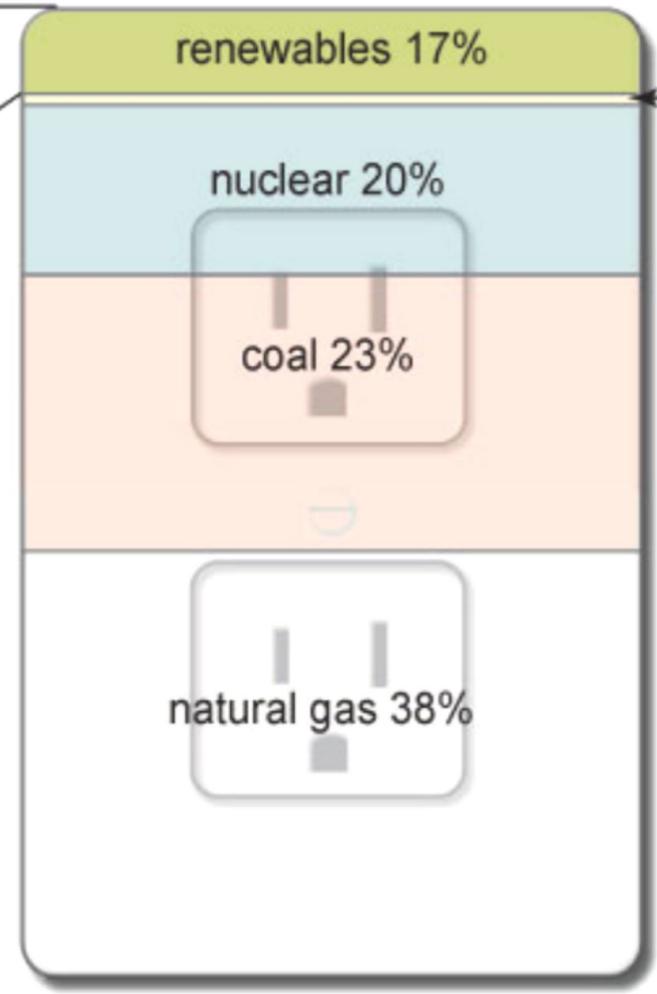
US ELECTRICITY SOURCES



Sources of U.S. electricity generation, 2019

Total = 4.12 trillion kilowatthours

wind	7.3%
hydro	6.6%
solar	1.8%
biomass	1.4%
geothermal	0.4%



Note: Electricity generation from utility-scale facilities. Sum of percentages may not equal 100% because of independent rounding.

Source: U.S. Energy Information Administration, *Electric Power Monthly*, February 2020, preliminary data



Source: U.S. Energy Information Administration, *Electric Power Monthly*, February 2020, preliminary data
Note: Electricity generation from utility-scale facilities. Sum of percentages may not equal 100% because of independent rounding.



GENERATION, DELIVERY AND ENVIRONMENTAL DRIVERS

IN 2017-2020, EXPECT CONTINUED LITIGATION, POLICY SHIFTS, EXECUTIVE ORDERS, ADMINISTRATIVE RECONSIDERATIONS, AND STAKEHOLDER PRESSURES RESULTING IN:

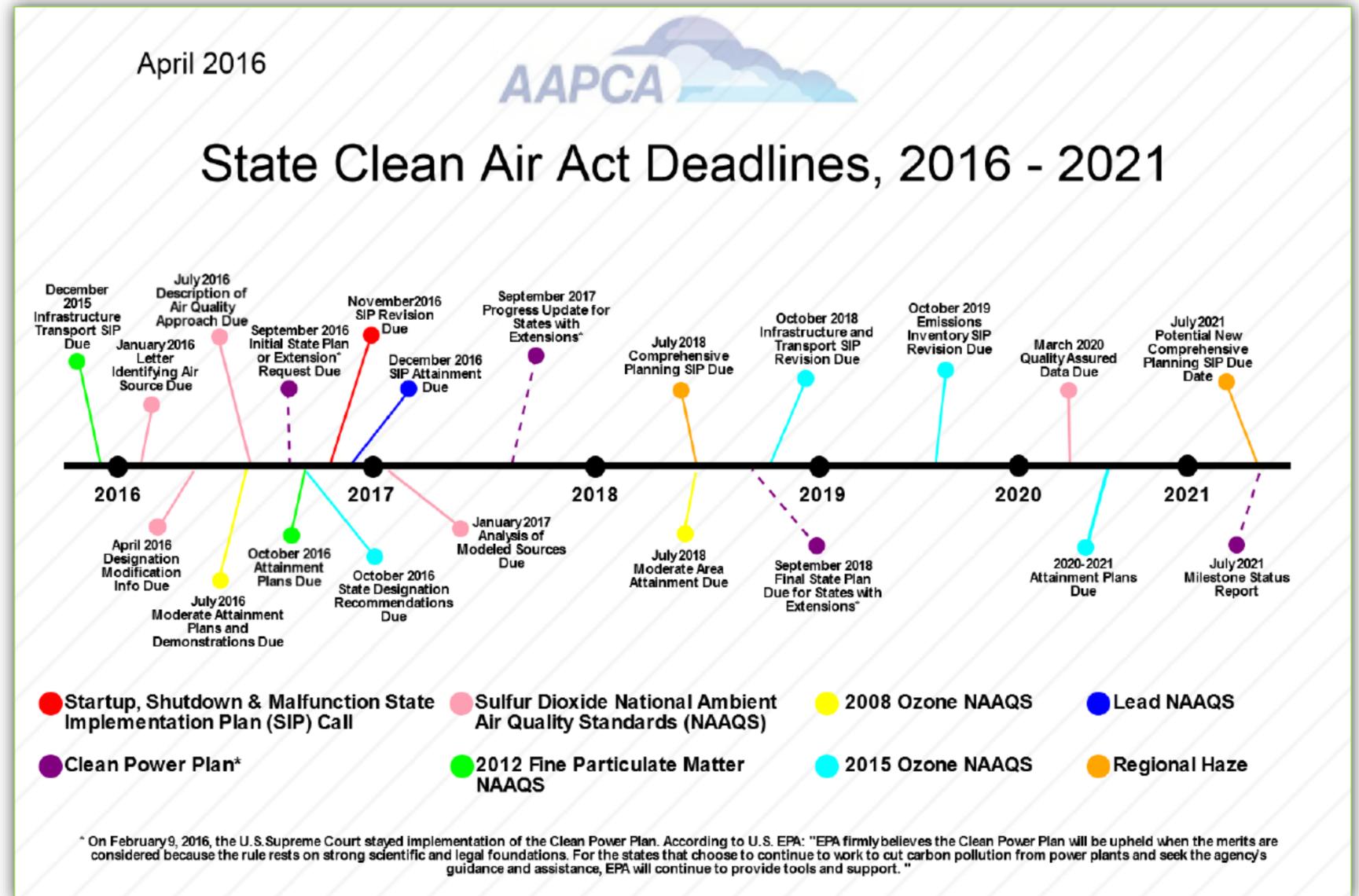
Final rules review and possible revisions

Compliance timeline delays of final rules

Increased state requirements

Continued pressure to reduce GHG emissions and water use

Broaden sustainability and reliability efforts



ECONOMIC DRIVERS

KEY INFLUENCE FACTORS

- Low Power Prices
- Low Gas Prices
- More Efficient Gas Turbine & Engine Technology
- Renewables
- Lower Fixed Costs
- Capital Avoidance - Fewer Pollution Controls
- “We’re Losing Money Every Day”



UPTHA CREEK

UNIT I

7

300 MW PC

CONSTRUCTED 1973

INTERNALS REBUILT
SEVERAL TIMES

ESP 1980

10-15% CF (PREVIOUSLY 30-40%)

10,900 BTU/KWH

LOCAL, LOW TO MEDIUM S
BITUMINOUS COAL, \$70/TON

UPON COOLING, BARON RIVER

ASH SLUICED TO ON-SITE
SURFACE IMPOUNDMENT

NATURAL GAS 3.5 MILES EAST

2,800 LBS CO₂/MW

EVALUATED ALTERNATIVES

UC-1

CONTROL AND UPGRADE INVESTMENTS TO UC-1

- Aging unit
- High heat rate, low CF

RE-POWER UC-1 – NATURAL GAS COMBINED CYCLE



- Existing power plant, transmission, infrastructure
- Older design STG, well maintained
- Retain once through cooling? Cooling tower BTA?
- Natural gas at \$8.4M (\$2.4M/mile), \$3/MMBtu

DEMO, MOTHBALL UC-1 OR BUILD NEW COMBINED CYCLE (CCGT)

- 1X1 7FA, 7,000 Btu/kwh
- Natural gas at \$8.4M (\$2.4M/mile)
- Wells and cooling towers
- Recips instead of CCGT?

CO-FIRE AND RENEWABLES



- Co-Fire Natural Gas with Coal
- Contract for 300 MW off-site/renewables

UC-1

7,000

1X1 7FA, Btu/kwh

\$8.4M

Natural Gas

300 MW

Offsite/renewables contract

WORST-CASE UTC-1 UPGRADES

REASONABLE OPTIONS

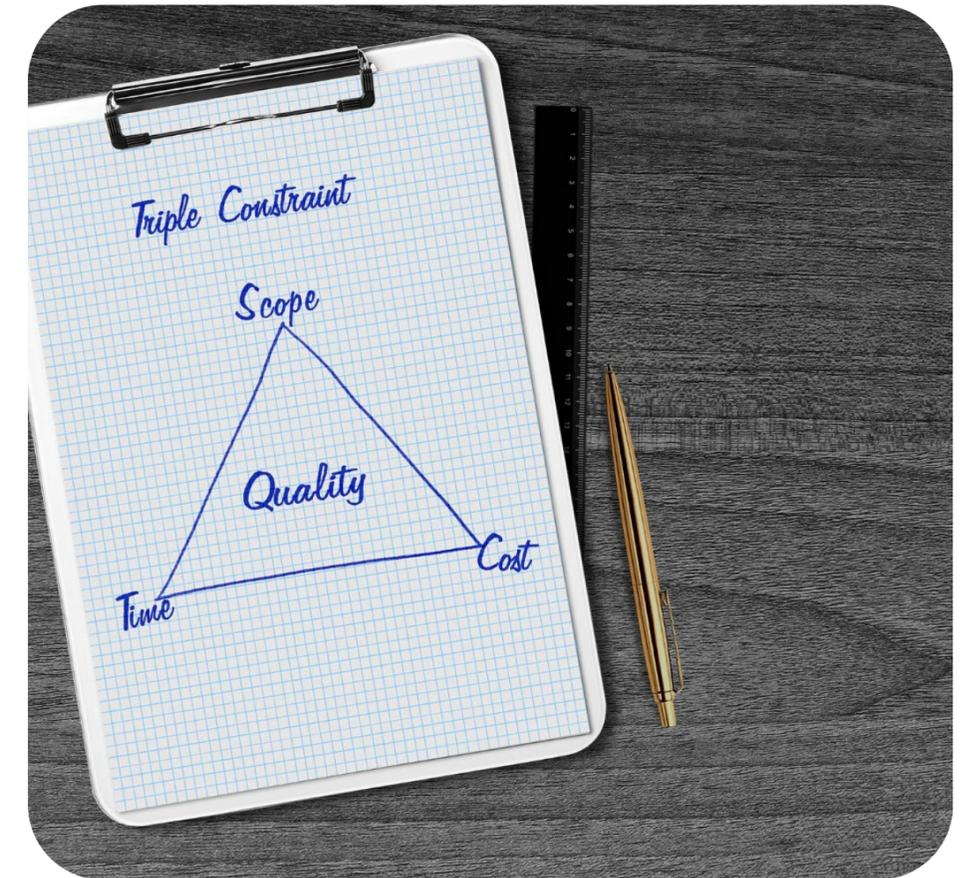


- Cap-ex air \$211 million
 - +/- \$63 million
- Cap-ex 316(b)
 - Ash ponds, etc.
 - ~ \$75 million
- Op-ex
 - Current generation
 - 1,681,920,000 kw-hr/yr
- Fuel cost
 - \$63M/yr at \$3/MMBtu, 12,500 Btu/kW-hr
- Annualized Production Cost
 - Cost Recovery Factor
 - ~ \$33,000,000/yr
 - \$/yr / current kW-hr/yr
 - = \$0.057/kWh

APC COSTS

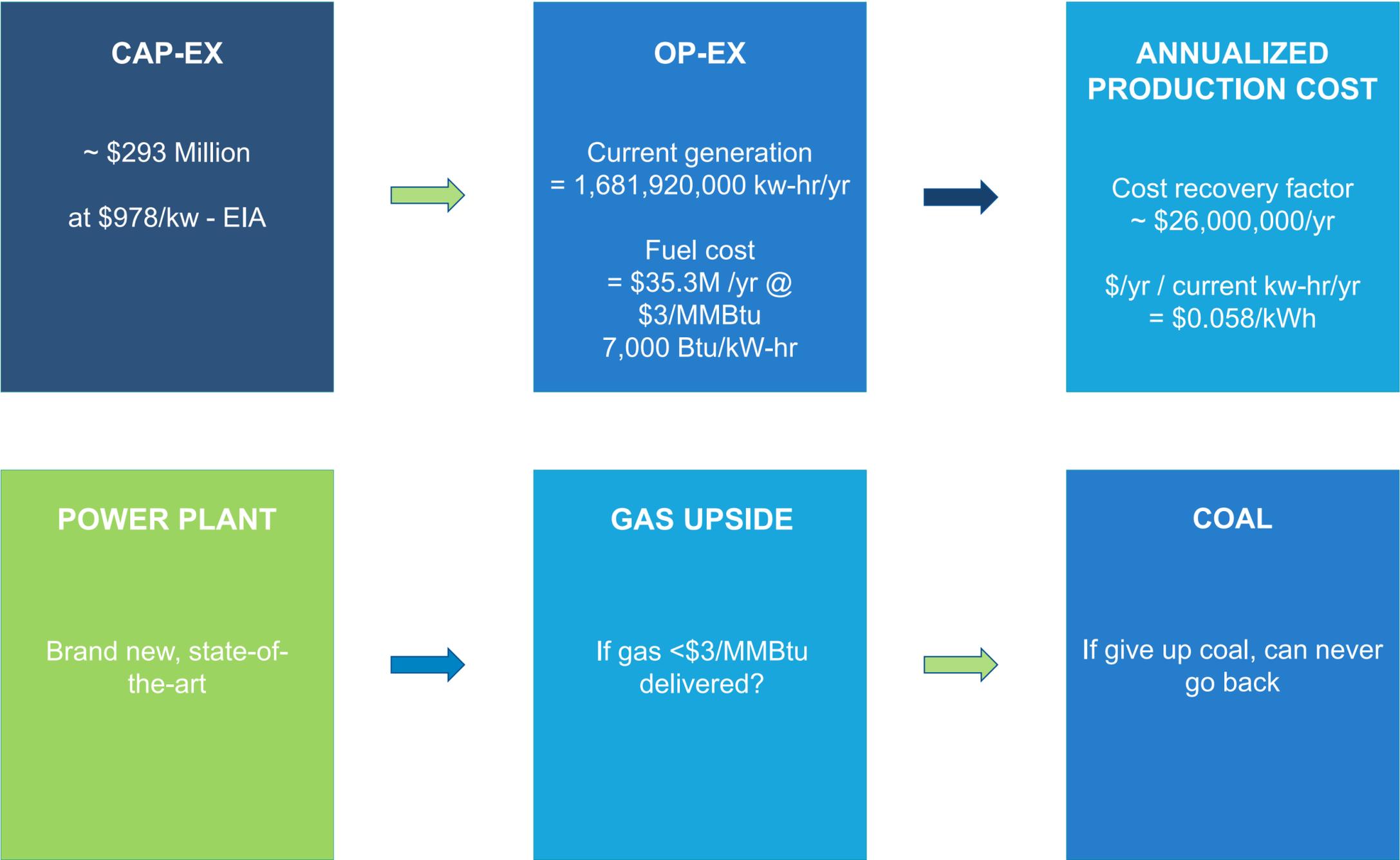
UTC-1 RANGE

CONTROL TECHNOLOGY	BEST BASE	MOST LIKELY	WORST CASE
LNB & Advanced OFA	\$ 4.4	\$ 4.4	\$ 4.4
SNCR or SCR	\$ -	\$ 3.5	\$ 31.9
ESP Upgrade	\$ 10.0	\$ -	\$ -
Existing ESP & Polishing FF	\$ -	\$ 21.9	\$ 36.9
Trona Injection	\$ 2.0	\$ -	\$ -
SDA	\$ -	\$ 65.5	\$ -
ACI	\$ 1.8	\$ 1.8	\$ 1.8
Wet FGD	\$ -	\$ -	\$ 136.1
TOTAL (+/- 30%)	\$ 18.2	\$ 97.1	\$ 211.1



COMBINED CYCLE

NEW CYCLE COMPARISON



CONSIDERED ALTERNATIVES

Base Case - Invest in suite of controls and upgrades to existing coal unit

Replace existing capacity with new combined cycle natural gas

Replace with Recips

Wind or Solar

Fuel switch - Co-fire UTC-1 with gas/PRB

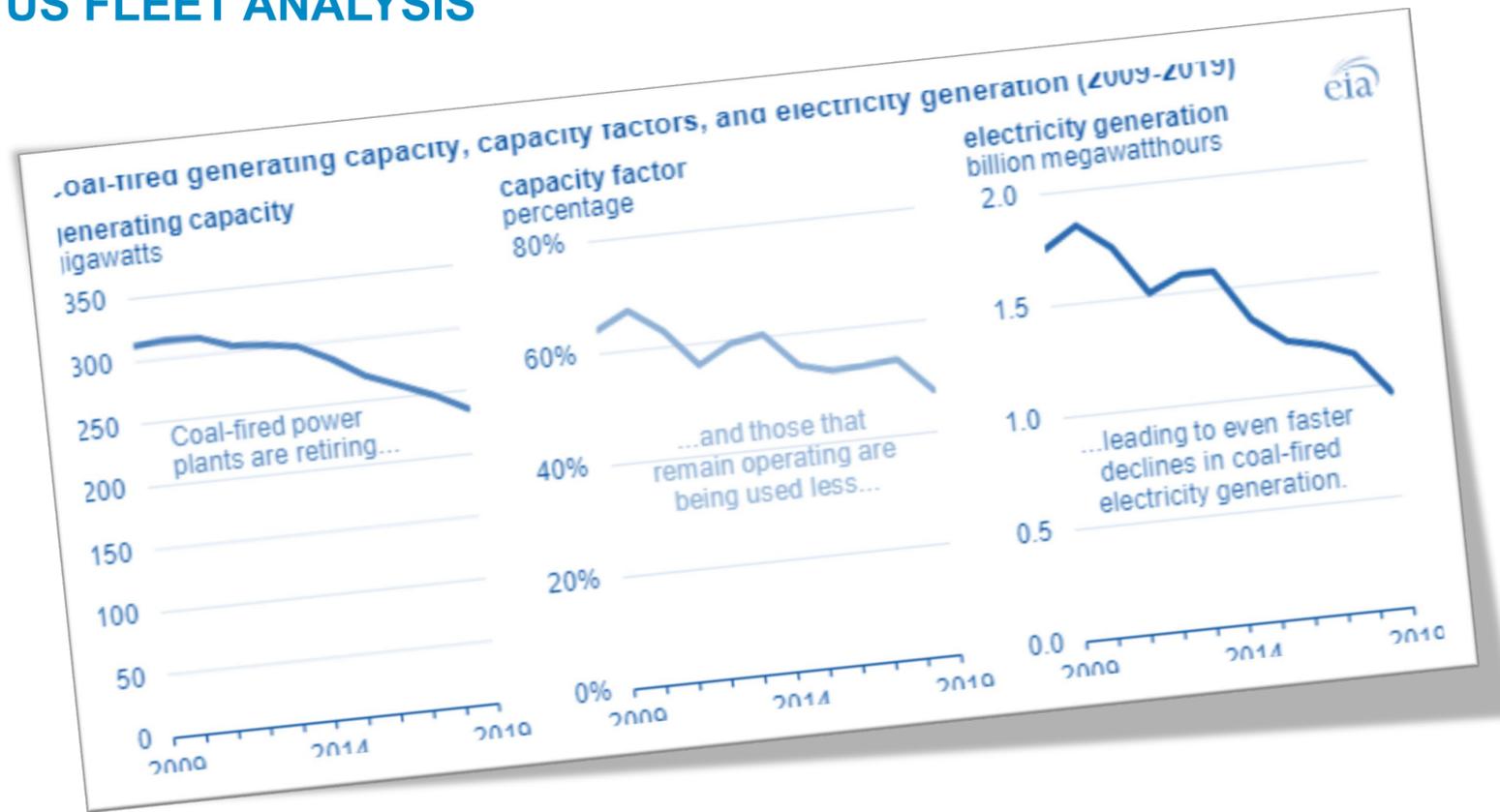
Shut down UTC-1, purchase market power

Future consideration – CCS for EOR?



IS COAL DEAD?

US FLEET ANALYSIS



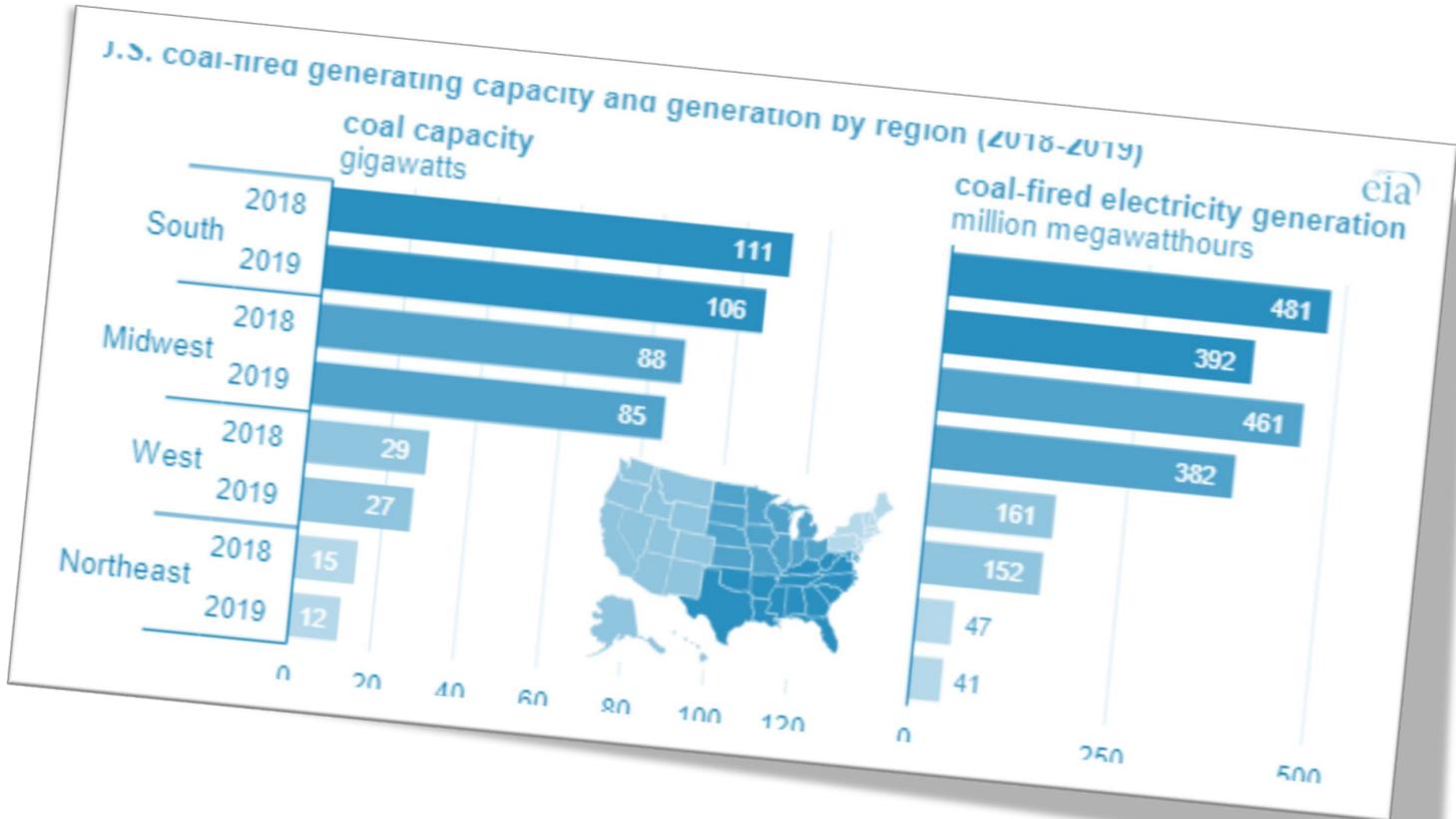
U.S. coal fleet generated as much as 67% in 2010 based upon operating capacity.

Coal's utilization rate since declined fell to 48% in 2019.

Coal-fired generation decreased across United States.

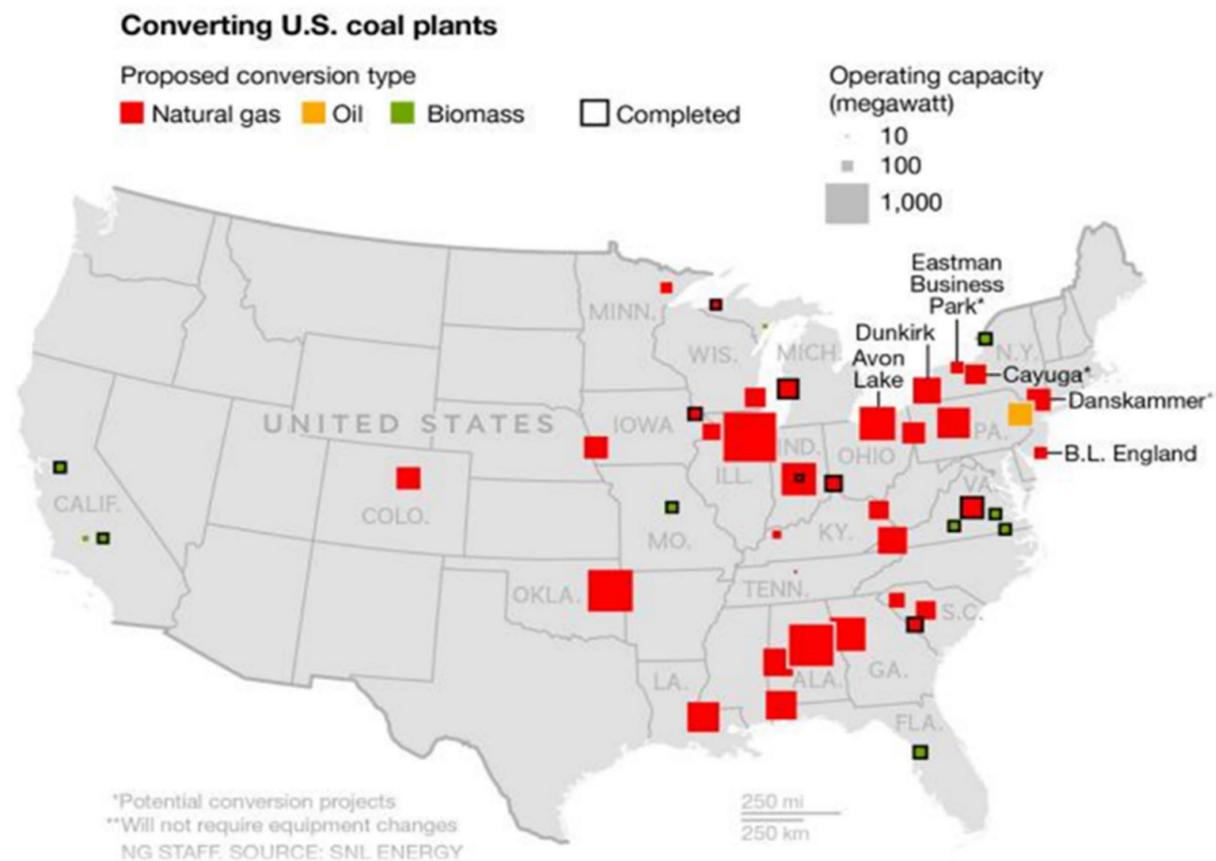
Some Midwest and West areas witnessed fewer coal plant retirements and more stable operation. In 2019, every region recorded substantial generation declines.

Southeast, East North Central, and West South-Central regions with large coal capacities had up to 18% reductions in coal-fired generation.



RETROFIT POWER PLANTS

CONVERTING COAL PLANTS



GAS CAPTURING

- Linear Permitting
- Pipelines and Compressors
- Gas Supply Contracts

BOILER RETROFITTING

- Coal to Gas or Dual Fuel
- Permit Impacts
- Code Requirements
- Boiler Configuration
- Building Improvements
- Burner Management
- Heat Rate Impact



PROJECT REDEVELOPMENT LIFECYCLE

IMPLEMENTATION TO COMPLETION PLANNING STAGES

RETIREMENT

- Announce & cease power production

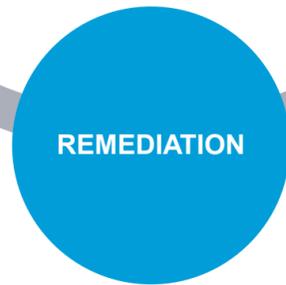
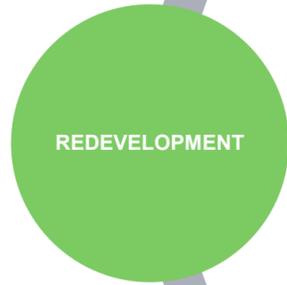


DECOMMISSION

- Remove equipment, materials & demolish buildings



COAL POWER PLANT DECOMMISSIONING PHASES



REMEDIATION

- Clean-up contamination to support new use

REDEVELOPMENT

- Repurpose new site or repower for new gen technology

EXECUTIVE MANAGEMENT

- Strategic Planning
- Decision Making
- Communications
- Approvals

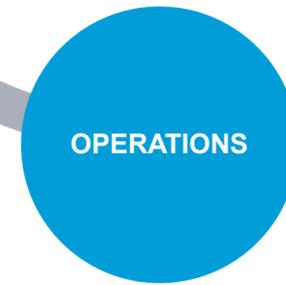


FINANCE

- Cash Flow
- Asset Retirement Obligations
- Book Value
- Taxes



TEAM CREATION



OPERATIONS

- Plant Ops
- Asset Management
- Engineering
- Environmental

SALES PROCESS

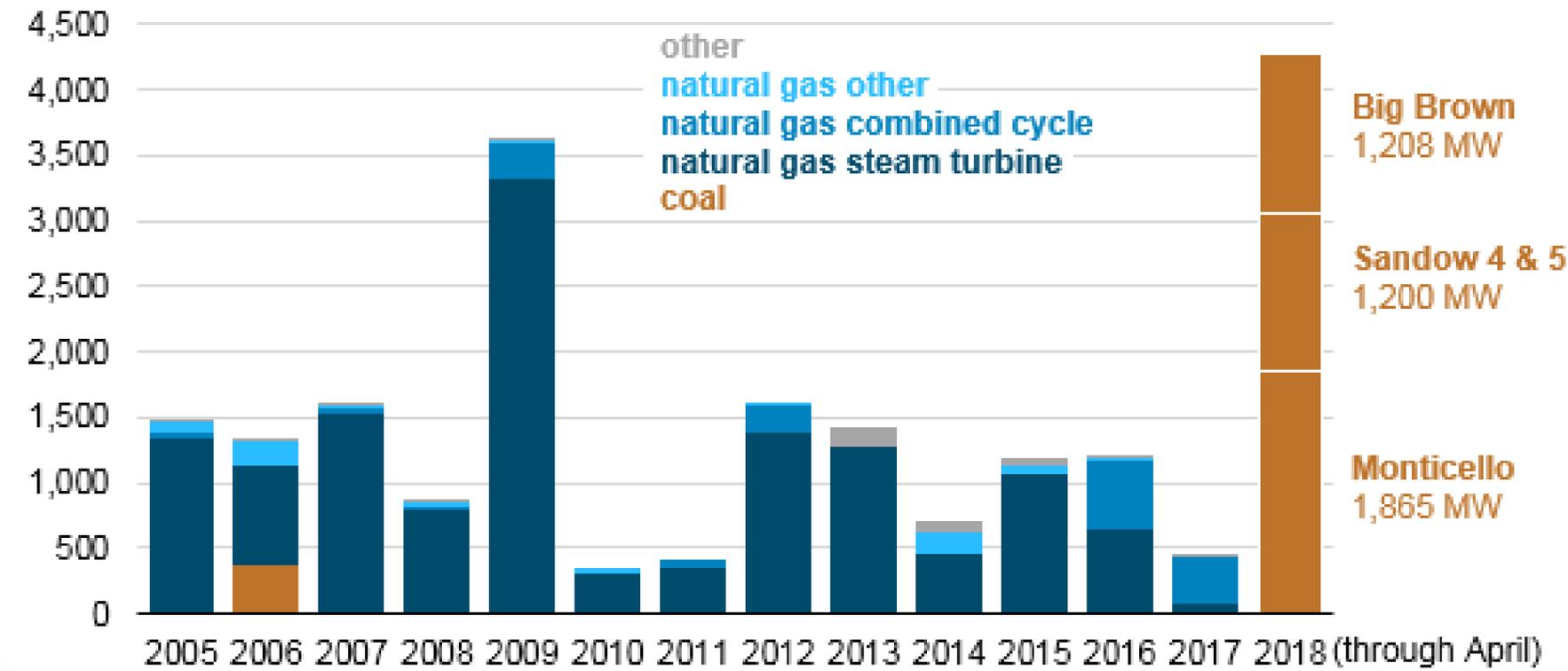
- CIM Preparation Contribution
- Management Presentation Participation
- Lead Site Visits



ERCOT SITUATION

POWER PLANT RETIREMENTS

Power plant retirements in Texas ERCOT region through April 2018
megawatts



Big Brown
1,208 MW

Sandow 4 & 5
1,200 MW

Monticello
1,865 MW

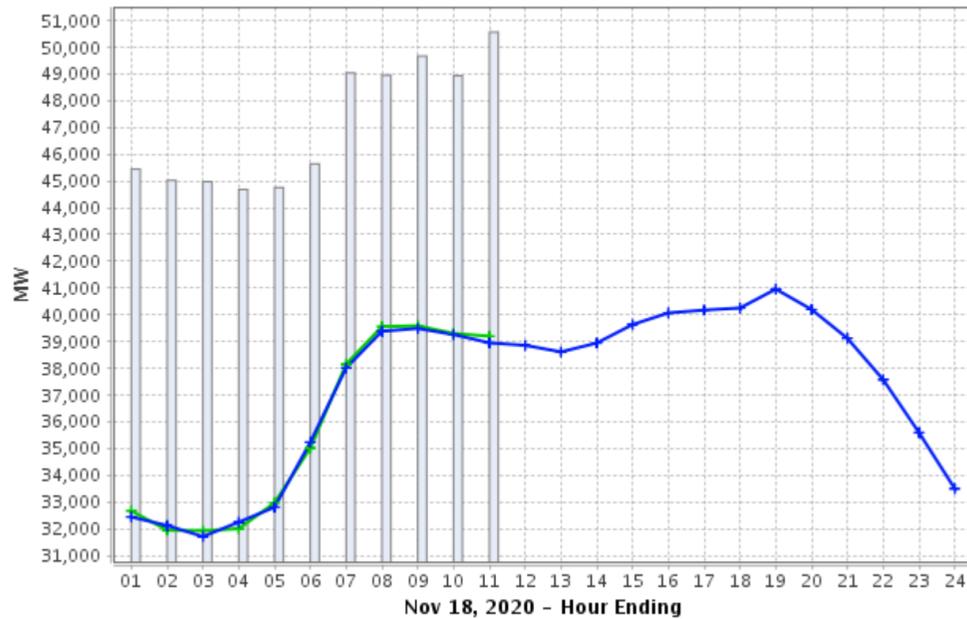


CURRENT ERCOT LOAD COMPARISON

FORECAST VS. ACTUAL

Load Forecast vs Actual

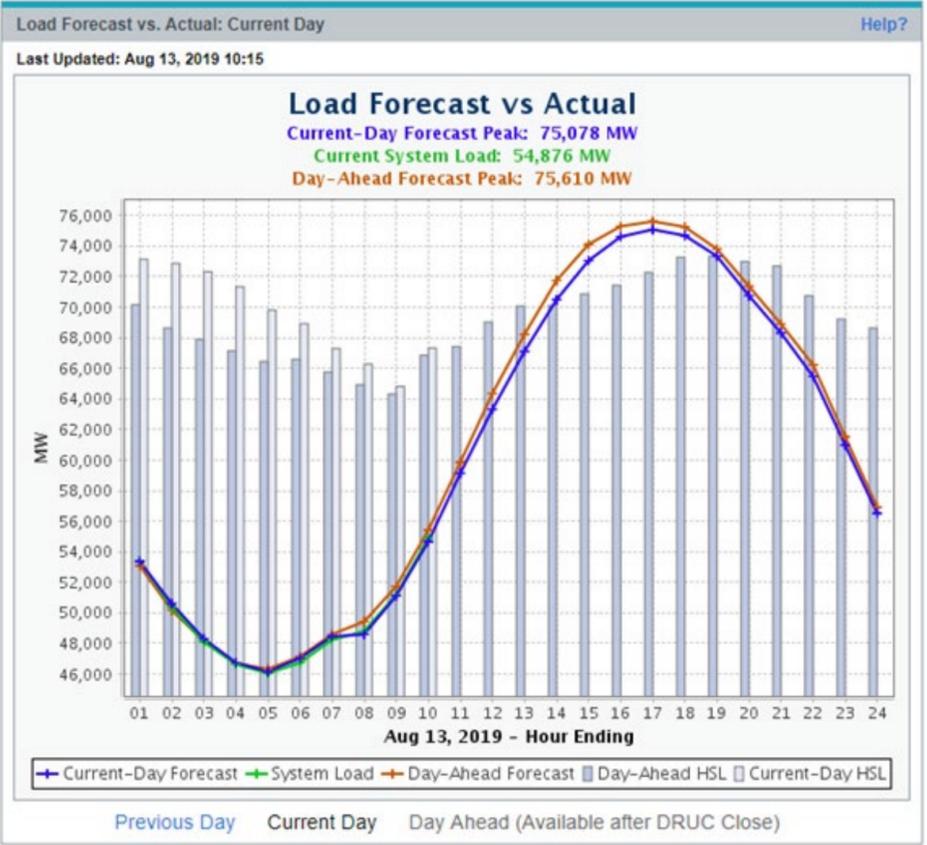
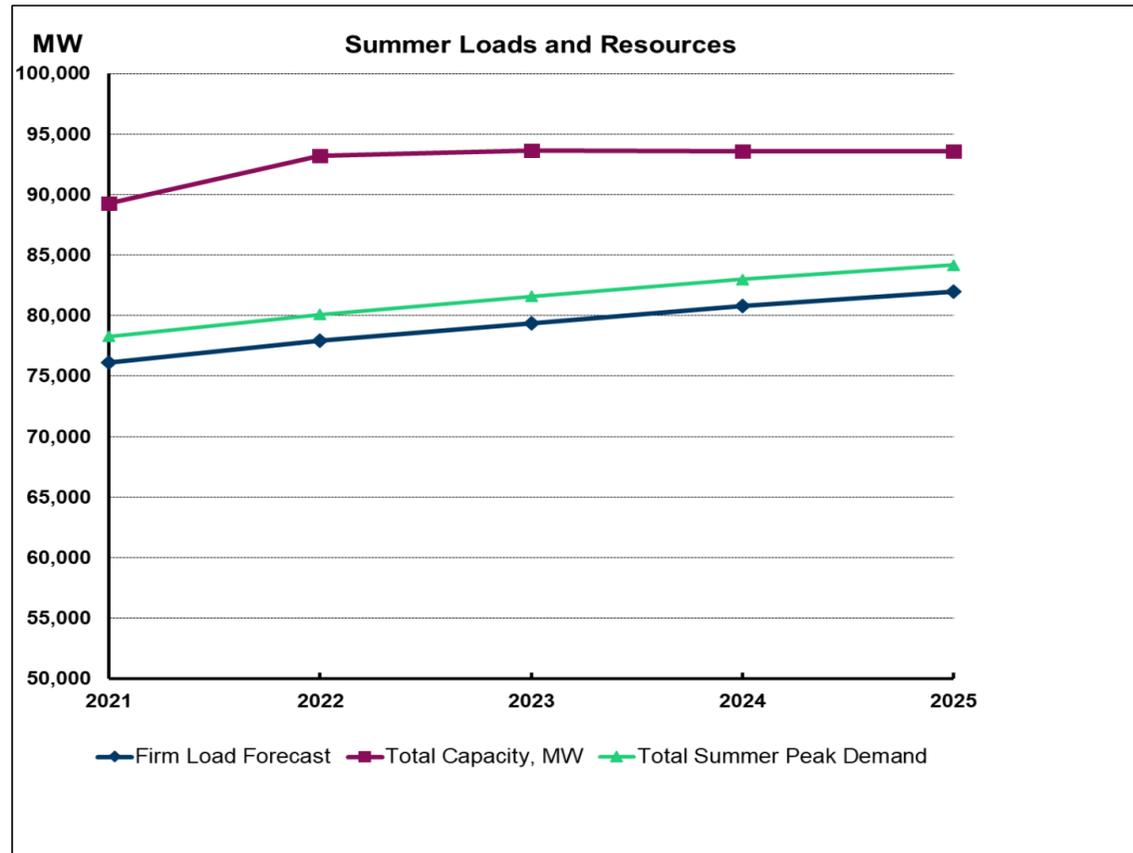
Current-Day Forecast Peak: 40,956 MW
 Current System Load: 39,195 MW
 Day-Ahead Forecast Peak: 0 MW



Nov 18, 2020 - Hour Ending

LOAD FORECAST VS. ACTUAL Today, 11/18/2020

SUMMER LOADS & RESOURCES 2021-2025



LOAD FORECAST VS. ACTUAL August 13, 2019

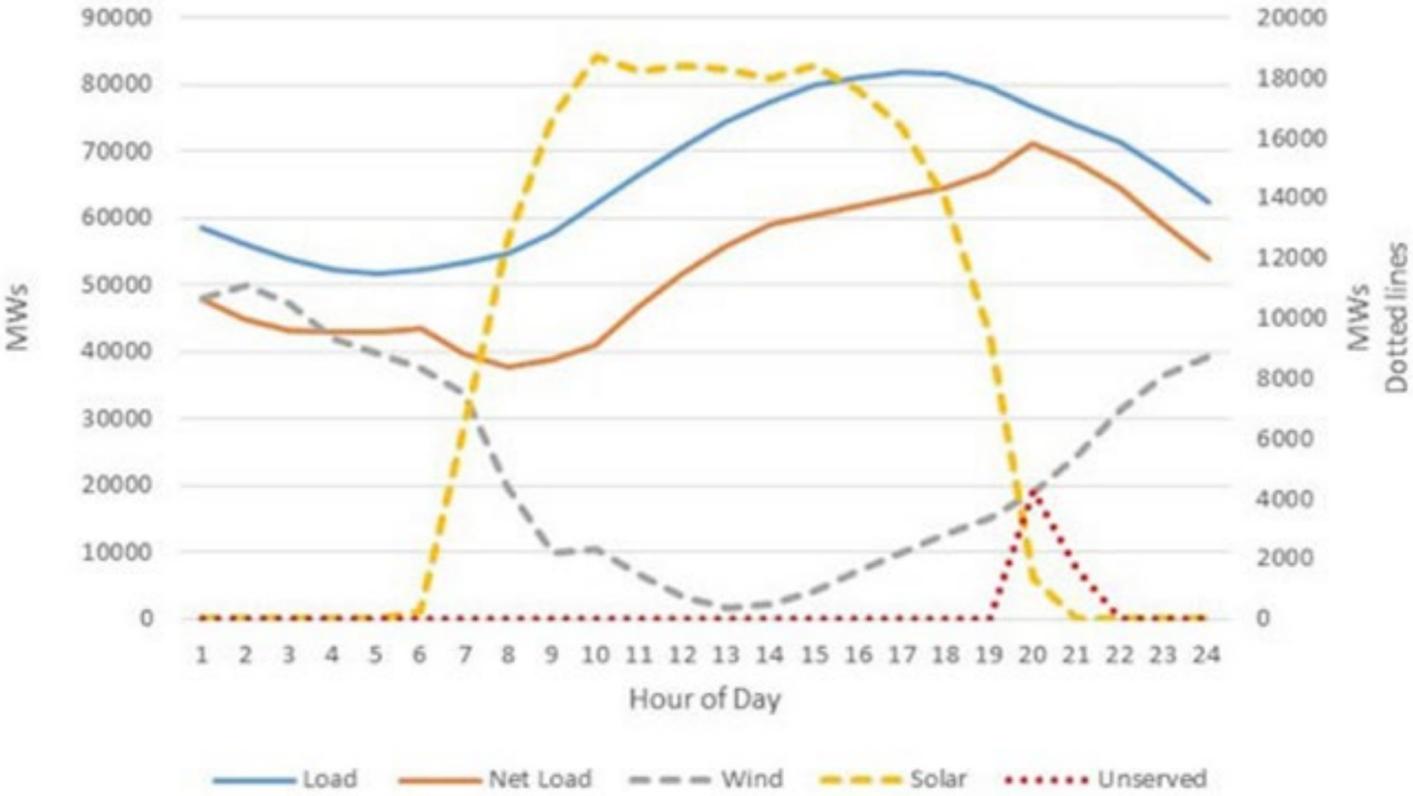
RENEWABLE ENERGY INTEGRATION

ERCOT FORECAST



2031 Evening Solar Issue

All scenarios show roughly the same shortage of capacity in the evening hours because of the large amounts of additional installed solar

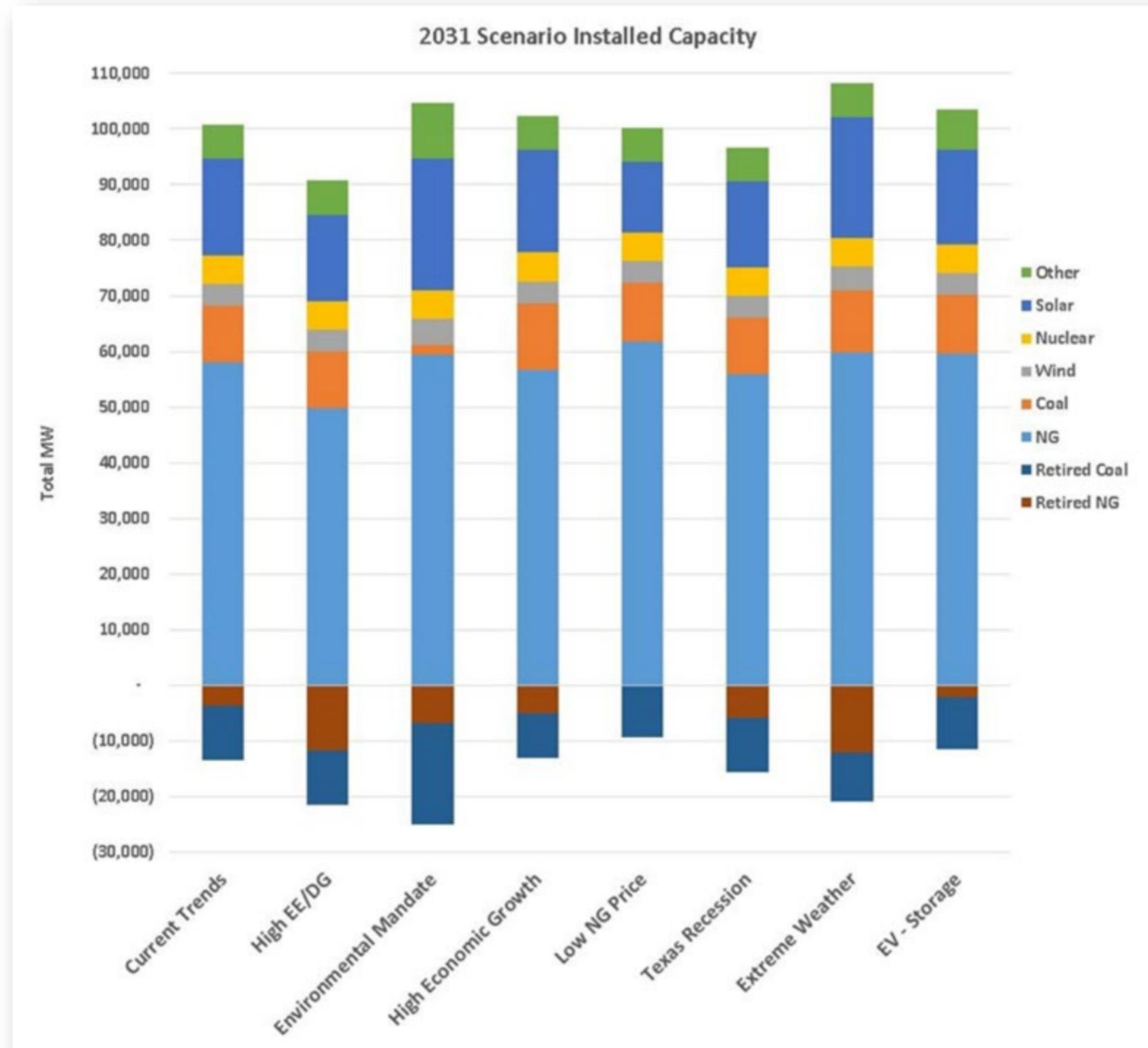


RENEWABLE ENERGY INTEGRATION

ERCOT FORECAST

ERCOT FORECAST

2031 SCENARIO INSTALLED CAPACITY



TOTAL MEGAWATTS

GENERATION TECHNOLOGIES

PLANT'S FUTURE

BEST PLAN DETERMINATION



PLANS

Retirement, Replacement, Retrofit or Sale for Redevelopment



COSTS

Carry and Decommissioning Costs and Scrap Valuation Determined
Which Has Highest Net Present Value or Lowest Cost?



REAL ESTATE

Real Estate Valuation May Require Highest and Best Use or Marketability Studies to
Determine Sale Value



REPLACEMENT

Replacing Coal Steamers with Gas Fired Gen can be Very Powerful But Carries Market Risk.

ENGAGEMENT

Engage Decommissioning and Industrial Real Estate Experts

BEST PRACTICE RECOGNITIONS

UPPER MANAGEMENT BUY-IN

STRATEGIC OPTIONS

- Sell
- Decommission & sell
- Decommission & hold
- Redevelop



BEST TO HAVE A PLAYBOOK

- Scope of Work
- Asbestos and Regulated Materials
- Regulatory Requirements
- Stakeholder Engagement
- Cost Estimate
- Asset Valuation
- Real Estate
- Schedule

ESTIMATED LCOE

NEW GENERATION RESOURCES

TECHNOLOGY	CAPACITY FACTOR %	VARIABLE COSTS INC. FUEL	FIXED O&M	LEVELIZED CAPITAL COST	LEVELIZED TAX CREDIT	TOTAL COST RANGE
Coal Fired Steam Turbine	85	\$22.27	\$5.43	\$47.57	0	\$91.27
Gas Fired Steam Turbine	85	\$37.50	\$5.00	\$50.00	0	\$92.00
Combustion Turbine	30	\$44.33	\$2.65	\$16.17	0	\$81.37
Combined Cycle	87	\$26.88	\$1.59	\$8.40	0	\$45.31
Nuclear	90	\$9.06	\$15.36	\$56.12	(\$6.76)	\$97.50
Wind – Onshore	40	0	\$7.52	\$29.63	NA	\$67.72
Solar PV	29	0	\$6.00	\$26.14	(\$2.61)	\$44.50

Source: U.S. Energy Information Administration | AEO 2020 Levelized Costs

COST ESTIMATES

REFINED



	Base Reasonable Worst-Case Controls & Upgrades	Combined Cycle	Recips	Co-Fire Gas & PRB	Wind	Solar or w/Battery Storage	Battery Storage	Shut Down & Purchase Market Power
CAPEX	\$349M	\$293M	\$96M	\$8.4M	\$152M	\$157M - \$211M	\$167M	\$13M
OPEX	\$96M	\$97M	\$10.2M	\$94.5M	\$3.2M	\$2M - \$4M	\$3M	\$100M

- **CAPEX**
 - EIA; Levelized Cost and Levelized Avoided Cost of New Generation Resources in 2020 Annual Energy Outlook
- **OPEX**
 - Capital Cost Estimates for Utility Scale Electricity Generating Plants, Feb 2020
 - Recips - EIA \$1810/kw however Wartsila non-union ~\$800/kw
 - Wind - \$1265/kw
 - Solar w/Battery Storage - \$1755/kw
 - Solar - \$1313/kw

QUESTIONS?

Peter T. Belmonte, PE
713.380.4790
pbelmonte@camstex.com

THANK YOU!