REINHOLD ENVIRONMENTAL Ltd.

2018 NOx-Combustion Round Table & Expo Presentation

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The Changing Landscapes of Power Generation

From Coal to Gas… Most of the Time?

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DYNEGY

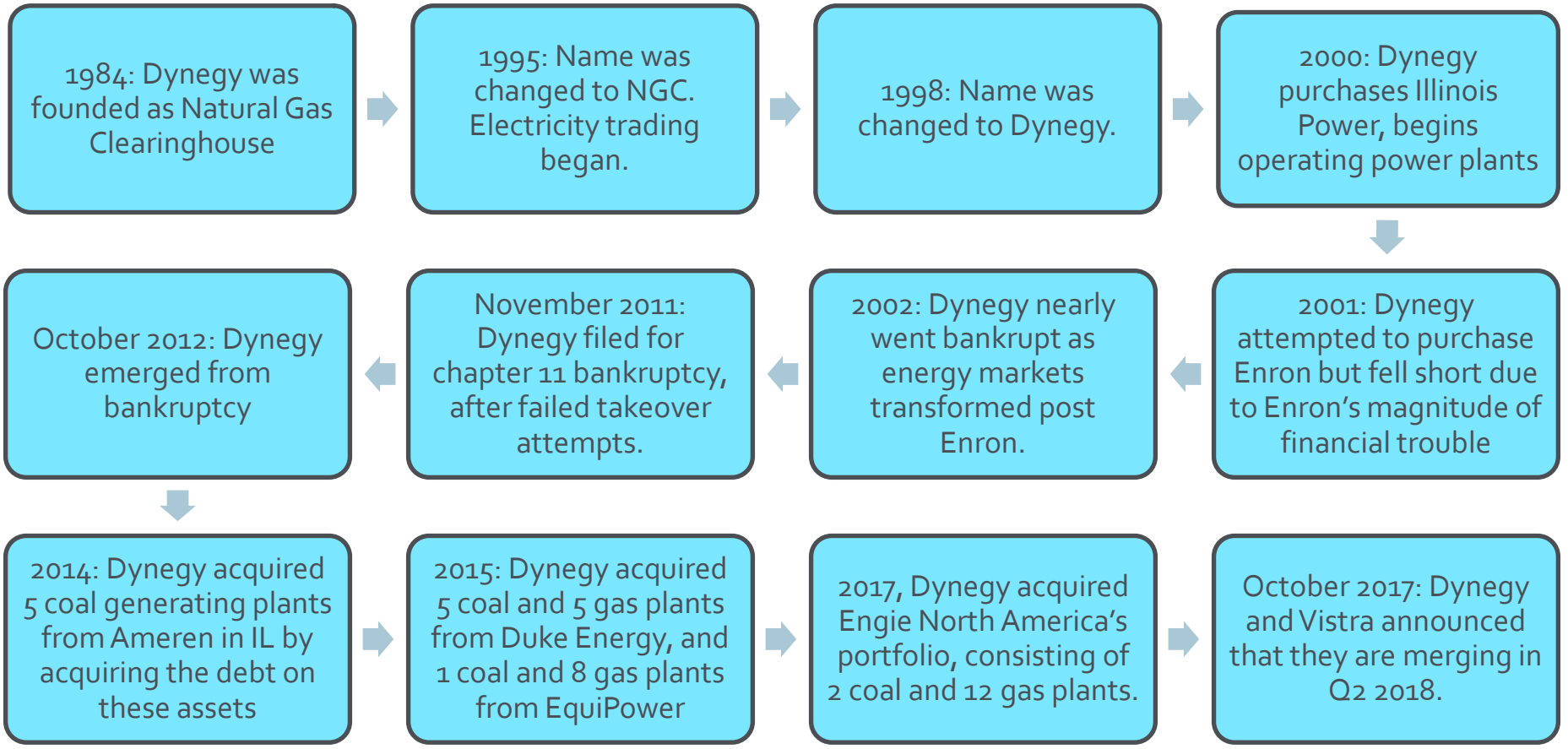
Generation Industry Change Trend - Coal to Gas

FACTBOX Reuters - Scott DiSavino

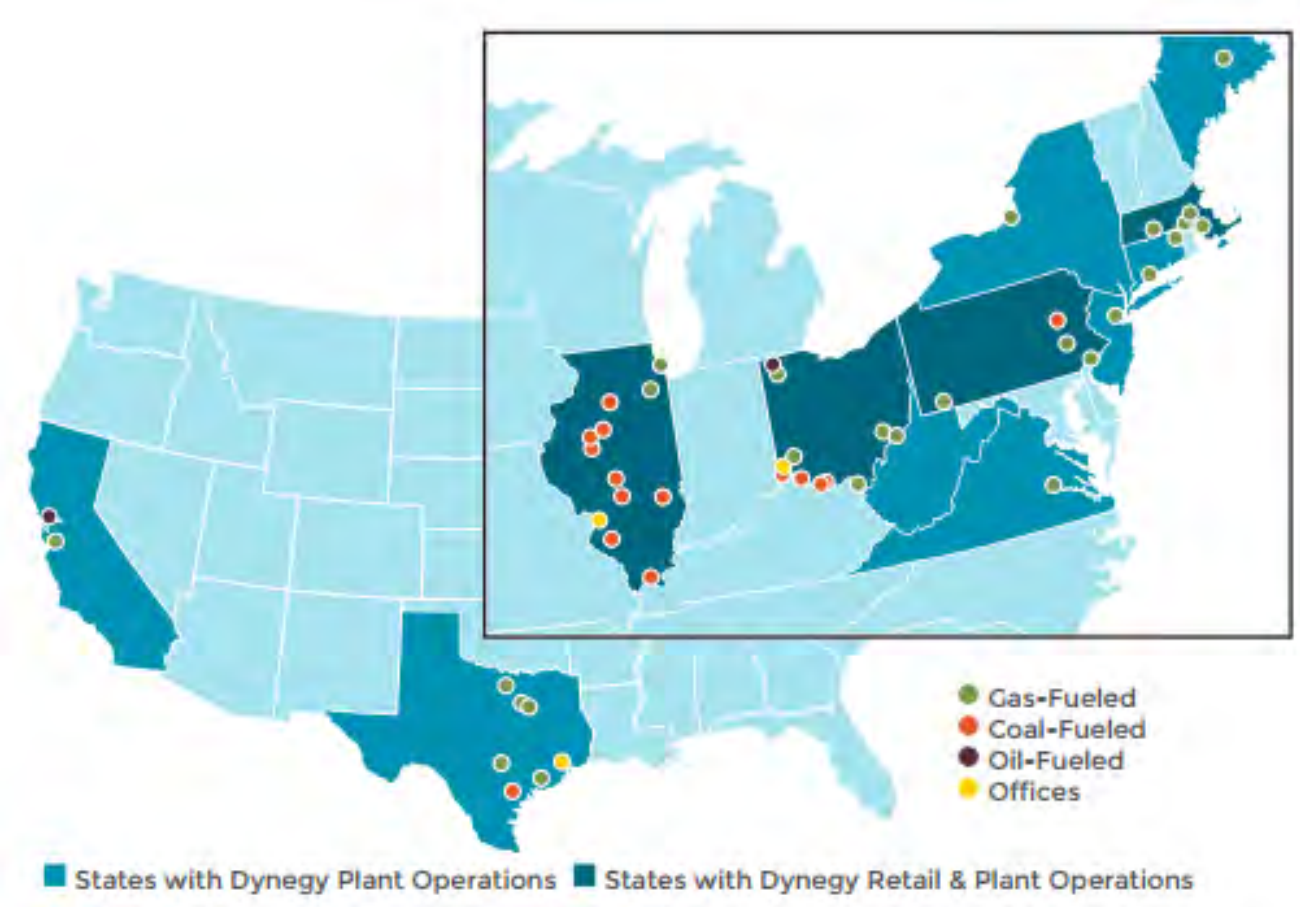
February 15, 2018

- U.S. power companies expect to retire or convert from coal-to-gas about 15,000 megawatts of coal-fired plants in 2018 after shutting almost 8,000 MW in 2017
- In 2015, power companies shut almost 18,000 MW of coal-fired generation, the most in any year.
- U.S. coal power capacity peaked around 318,000 MW in 2011, according to EIA data. It has declined every year since and fell to around 259,000 MW by the end of 2017
- Coal had been the primary fuel source for U.S. power plants for the last century, but its use has been declining since peaking in 2007.
- Gas overtook coal as the leading fuel for U.S. power plants in 2016, according to federal data.

Dynegy's History



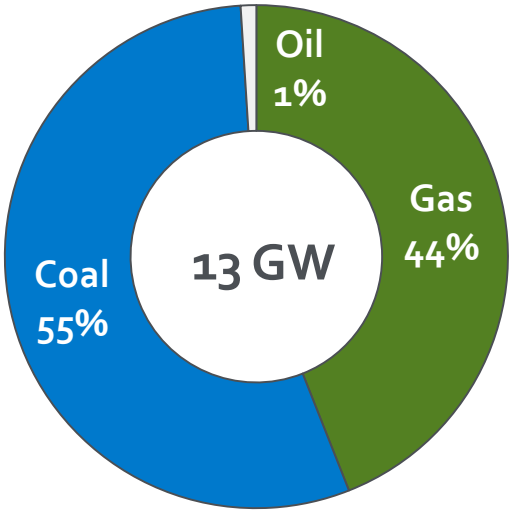
Dynegy Plant & Office Locations



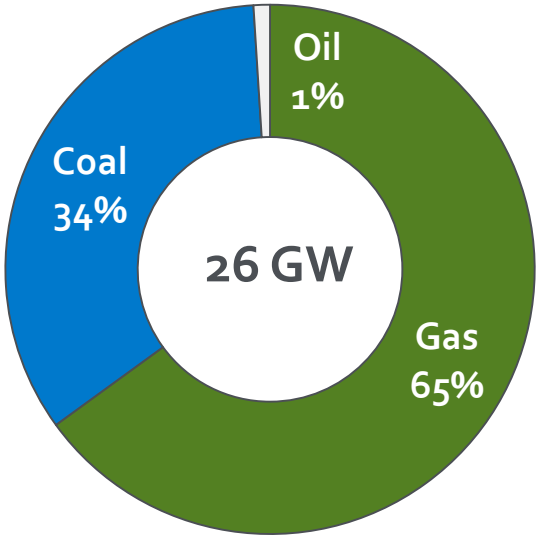
43 facilities – 26 GW – 2500 employees
4 major acquisitions have nearly tripled the size of the fleet since 2012

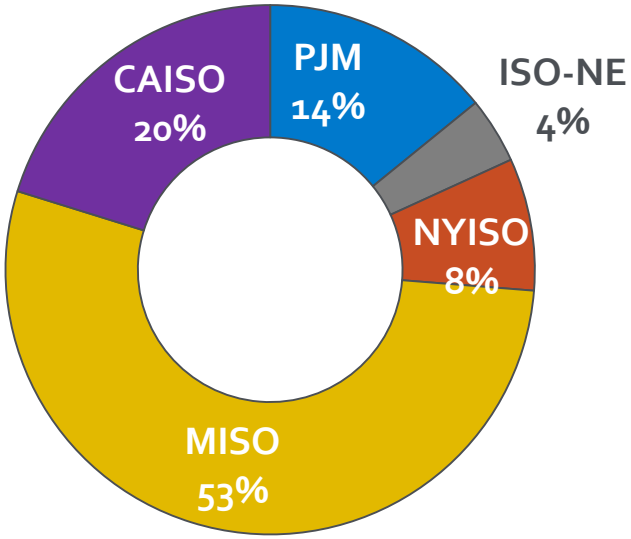
Dynegy Generation Past & Present

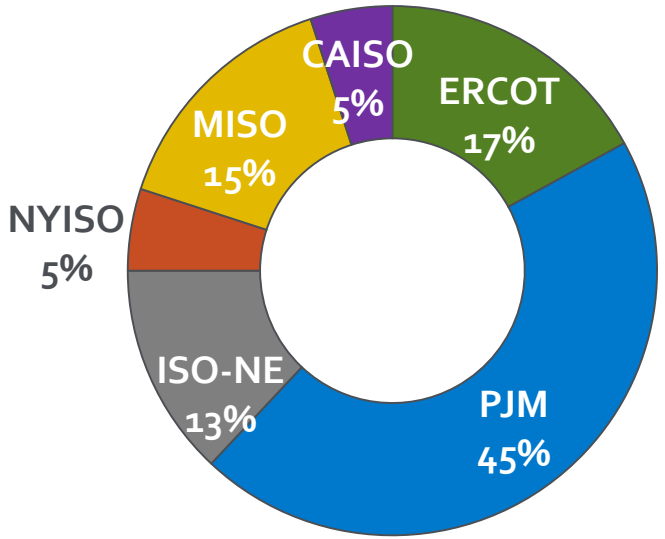
2014 Generation



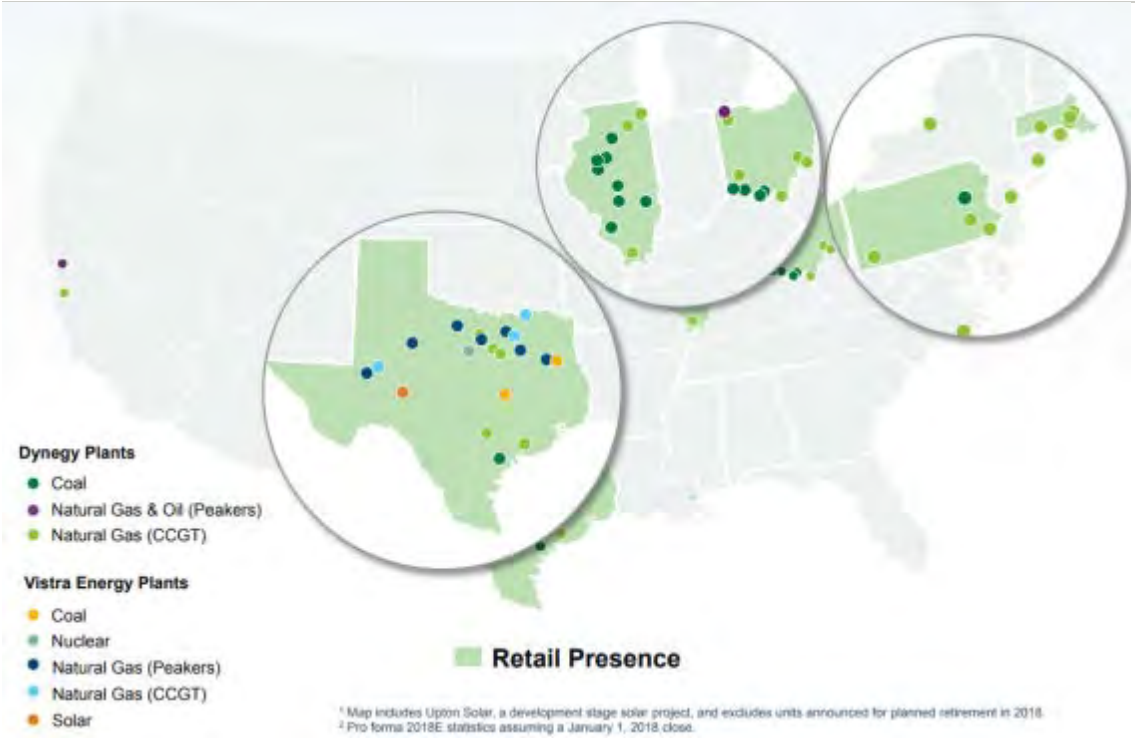
Present Generation

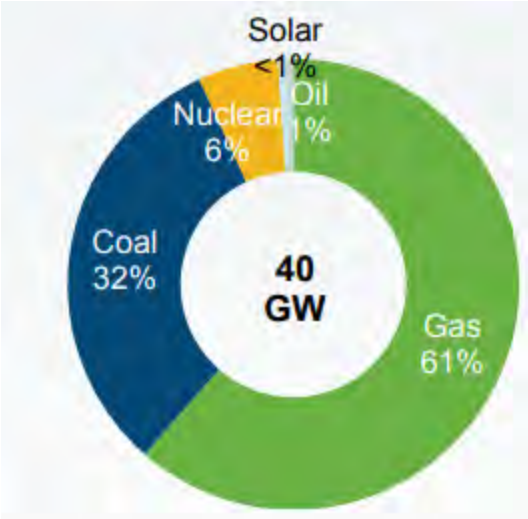


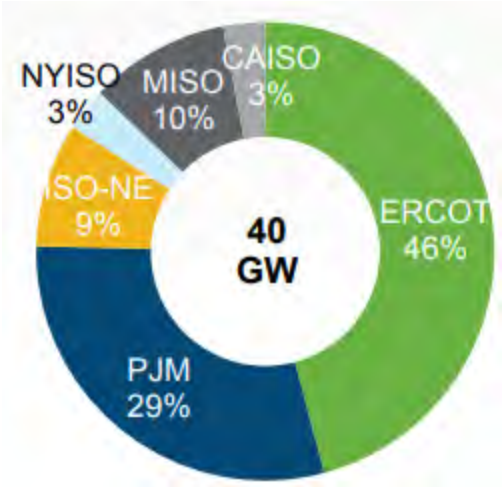




Planned Acquisition by Vistra Energy







56 facilities – 40 GW
Integration processes underway
Close of sale expected in March
Will create largest independent power producer (IPP) in US

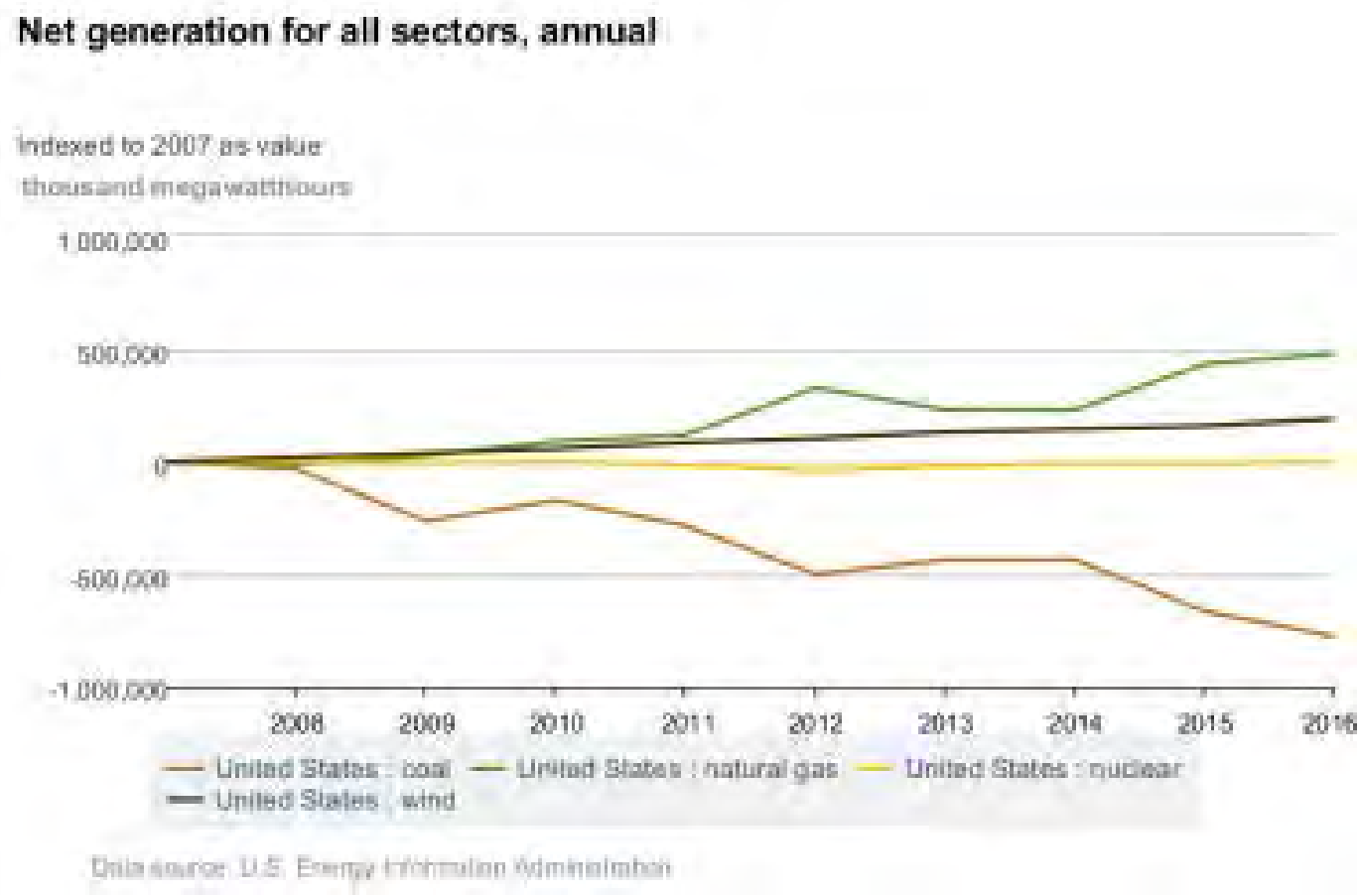
Major Transition Points from Coal Focus to Gas Focus

- Industry-Wide Generation & Pricing
- Key Differences Between Unit Types
- Environmental Regulations
- Cash Flow Scrutiny
- Outage Coordination
- Support Challenges

Electricity Generation

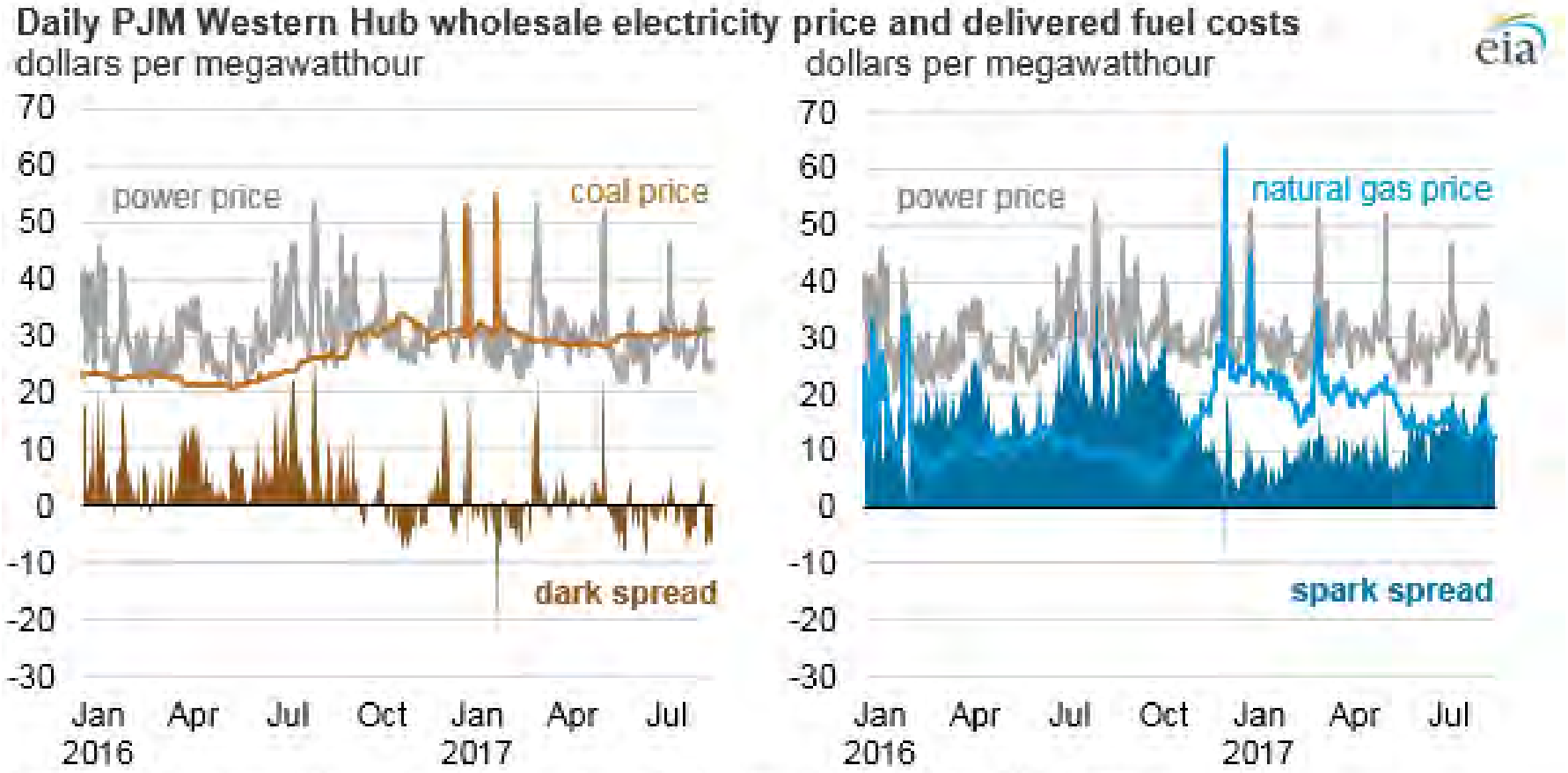
Electricity production from coal has decreased 30%, offset by natural gas generation and renewables. Lower heat rates and gas prices primarily explain this phenomenon.

Electricity production from gas is expected to gradually increase over the next 30 years (depending on future pricing)



Energy Pricing - Spark & Dark Spreads

Gas fired units are generally less expensive to operate than coal units, as seen in dark & spark spreads.



Key Differences

Coal Units

- Heavily staffed (> 100 people)
- Fuel handling complexities
- Sulfur scrubbing often required
- Ash handling requirements
- Heat Rate: 9500 – 12000 btu/kWh
- Startup times of 12+ hours
- Auxiliary startup fuels required
- Ramp rates normally < 5 MW/min
- Fuel price & availability firm
- 30+ day fuel storage available
- Unit age generally 25 – 60 years

Combined Cycle Gas Units

- Lightly staffed (< 30 people)
- Pipeline gas – no fuel handling
- Low sulfur fuel – no scrubbing
- No ash or solid byproducts
- Heat Rate: 6500 – 8000 btu/kWh
- Startup times of 2-3 hours or less
- Startup on primary fuel
- Ramp rates often > 10 MW/min
- Fuel price & availability variable
- Fuel storage uncommon
- Unit age generally 0 – 25 years

Plant Staffing – A Dynegy Case Study

1300 MW Coal Plant (Wet Scrubbed)	1400 MW Combined Cycle Gas Plant
6 Managers	3 Managers
8 Plant Engineers	1 Plant Engineer
10 Environmental & Lab Staff	1 Environmental Professional
80 Production Team Members	17 Production Team Members
58 Maintenance Team Members	4 Maintenance Team Members
176 Total Employees	28 Total Employees

Environmental Regulations & Ramifications

- Future environmental regulations on coal-fired units are often unclear or the implementation timing isn't firm

- Forecast cash flows for many coal units are not sufficient to 'proactively' implement environmental controls

- Ultimate decisions will likely be to retire units or install additional controls, similar to experience with MATS

- Lower capital cost strategies may be preferred for units that are expected to retire in the next few years (standard rates of return may not apply)

- Knowledge sharing, particularly from those able to conduct pilot or full scale testing, will be paramount to the effective implementation of these systems on cash-strapped units (where experimentation isn't an option)

Coal Unit Challenges from Tighter Cash Flows

- As forecast cash flow diminishes, scrutiny on dollars spent increases
- Auxiliary labor and capital allocations (labor, equipment and reagents on FGD, material handling, ash handling, etc) drive O&M and capital spend higher than on gas units
- Limited flexibility in turndown can create negative energy margins in off-peak periods
- Forced outage rates tend to be greater on coal units (due to their age and additional complexity), which reduce earnings and increase costs
- In some regions, lower capacity revenues have also reduced cash flows
- Occasional extended outage durations (30+ days) can seriously impact cash flows

Cash Flows & Outage Planning

- Outage spend and lost revenue can significantly impact a unit's profitability
- There's often value in delaying outages, especially to future years when energy revenues are expected to be lower (due to forecast power prices)
- For projects with environmental ramifications, such as SCR catalyst replacement, determining whether an outage delay will potentially cause compliance issues can be a challenge
- Coordinating work with vendors and contractors, especially when outage plans are frequently changed (or changed at the last minute) can also stress engineering & support resources
- Other economic factors often come into play, such as restricted coal sourcing and operation can be weighed against the gains from delaying an outage
- Evaluating the risk vs. benefits of this work can require long-term support resources, especially if scenarios change frequently

Gas Unit Challenges

- Gas Market & Gas Supply
  - No onsite storage of gas – fuel is nominated daily and committed amount must be burned to avoid penalties
  - Gas can only be purchased on week days, so weekend forced outages or opportunity outages are difficult to schedule Gas supply and pricing can be volatile especially in the winter months.
  - Gas compressor stations (usually offsite) are required for fuel delivery.

- Gas Turbine Technology
  - New materials and alloys continue being developed - capacity end efficiency continue to improve. Firing temperature increases 10 deg C every 10 years.
  - Relatively new technology, not enough experience on life expectancy of plant components. HRSGs, GT/ST rotors and casings, Generators, etc.
  - Plants being built with long term service agreements in place. This limits flexibility on maintenance and options for Combustion turbines, unless companies own a large fleet of turbines with LTSAs

Gas Unit Challenges (continued)

- Maintenance
  - Little flexibility on timing of major Inspections - turbine majors need to be performed within a specific number of operating hours and starts. Parts would not last longer intervals and it is expensive to perform maintenance prematurely.

  - Maintenance on BOP, ST and Generators are performed around Maintenance of Combustion turbines.

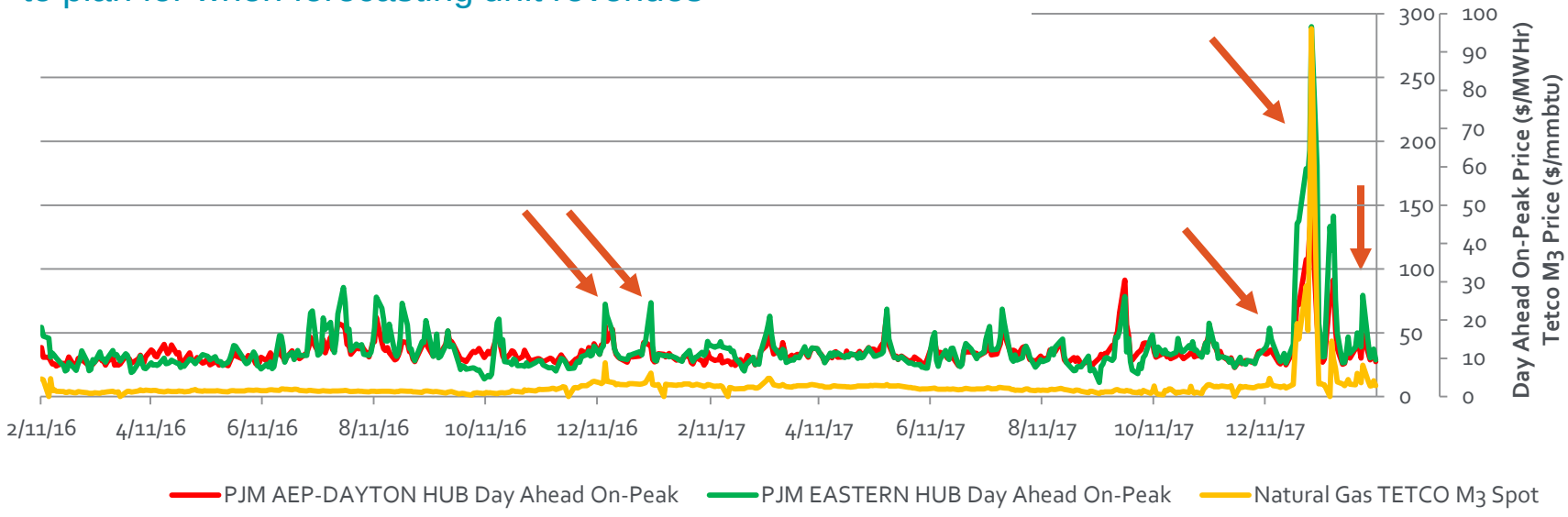
Challenges Transforming Support Teams to a Gas Focus

- Support staff often sit in closer proximity to coal units
- Plants are spread out geographically, making routine travel more difficult
- For some of the plants, they have had little external support during the majority of their operating life, and are unaware or hesitant to request it
- Minimal staff onsite can make communication more difficult, the dedicated ‘point person’ is often a busy production or maintenance manager
- As capacity factors have significantly increased some units are experiencing new challenges due to change from design peak cycling operation to base loaded operation
- Will shared resources availability and contractor labor become an issue?

Market Opportunities for Coal Units

- Cold spells can challenge natural gas distribution networks, sharply increasing prices
- Power prices often trend with gas prices in the winter months, especially in areas without significant coal and nuclear alternatives (such as eastern PA and New England)
- Ensuring coal units are reliable is tantamount to take advantage of these opportunities, where units can pull in millions of dollars per day

- These events are difficult to predict in advance, thus difficult to plan for when forecasting unit revenues



Going Forward

- Operations support personnel & plant staff will need to be even more flexible going forward. Be ready to change direction if any of the fundamental market drivers change
- Continuing support for viable coal plants with their range of challenges
- Tailor support for Units that have shorter known lifespans by prioritizing resources and spend.
  - Safety must drive all decisions
  - Compliance and generation risks identified and assessed.
- Support staff need to develop expertise in environmental controls for gas units to address challenges that will arise going forward, especially as maintenance demands increase as these units age
- Using experience gathered from coal unit support (troubleshooting failures, maintenance practices, etc) could improve future support efforts on gas units
- Sharing knowledge with next generation of staff must be an ongoing priority