



POWER | RESET

OPTIMIZING THE EXISTING COAL FLEET TO
ENSURE A RELIABLE AND RESILIENT GRID

ASSESS | SUPPORT | REFORM | RENEW



Power Reset:

Optimizing the Existing U.S. Coal Fleet to Ensure a Reliable and Resilient Power Grid

The National Coal Council is a Federal Advisory Committee established under the authority of the U.S. Department of Energy. Members from a diverse set of backgrounds and organizations are appointed to serve on the NCC by the Secretary of Energy to provide advice and guidance on general policy matters relating to coal and the coal industry. The findings and recommendations from this report reflect a consensus of the NCC membership, but do not necessarily represent the views of each NCC member individually or their respective organizations.

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Power Reset
**Optimizing the Existing U.S. Coal Fleet
to Ensure a Reliable and Resilient Power Grid**

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NCC Overview - 1984 | 2018

In the fall of 1984, Secretary of Energy Don Hodel announced the establishment of the National Coal Council (NCC). In creating the NCC, Secretary Hodel noted that “The Reagan Administration believes the time has come to give coal – our most abundant fossil fuel – the same voice within the federal government that has existed for petroleum for nearly four decades.”

The Council was tasked to assist government and industry in determining ways to improve cooperation in areas of coal research, production, transportation, marketing and use. On that day in 1984, the Secretary named 23 individuals to serve on the Council, noting that these initial appointments indicate that “the Department intends to have a diverse spectrum of the highest caliber of individuals who are committed to improving the role coal can lay in both our Nation’s and the world’s energy future.”

Throughout its nearly 35-year history, the NCC has maintained its focus on providing guidance to the Secretary of Energy on various aspects of the coal industry. NCC has retained its original charge to represent a diversity of perspectives through its varied membership and continues to welcome members with extensive experience and expertise related to coal.

In 1985, the NCC was incorporated as a 501c6 non-profit organization in the State of Virginia. Serving as an umbrella organization, NCC, Inc. manages the business aspects of running the Council. The leadership of the NCC serves as officers of NCC Inc. and members of the Council serve as NCC Inc. shareholders. The Executive Director of the Council is NCC Inc.’s Executive Vice President and Chief Operating Officer.

Today, the NCC continues to serve as an advisory group to the Secretary of Energy, chartered under the Federal Advisory Committee Act (FACA). The NCC provides advice and recommendations to the Secretary of Energy on general policy matters relating to coal and the coal industry.

The Council activities include providing the Secretary with advice on:

- Federal policy that directly or indirectly affects the production, marketing and use of coal;
- Plans, priorities and strategies to address more effectively the technological, regulatory and social impact of issues relating to coal production and use;
- The appropriate balance between various elements of Federal coal-related programs;
- Scientific and engineering aspects of coal technologies, including emerging coal conversion, utilization or environmental control concepts; and
- The progress of coal research and development.

The principal activity of the NCC is to prepare reports for the Secretary of Energy. The NCC’s Coal Policy Committee develops prospective topics for the Secretary’s consideration as potential subjects for NCC studies. During its nearly 35-year history, the NCC has prepared more than 35 studies for the Secretary, at no cost to the Department of Energy. All NCC studies are publicly available on the NCC website.

The NCC is a totally self-sustaining organization; it receives no funds from the Federal government. The activities and operations of the NCC are funded solely from member contributions, the investment of Council reserves and generous sponsors.



Report Request from Energy Secretary Rick Perry



The Secretary of Energy
Washington, DC 20585

April 07, 2018

Mr. Greg Workman
Chairman, National Coal Council
Dominion Generation
120 Tredegar Street, DC3
Richmond, Virginia 23219

Dear Mr. Workman:

I am writing today to charge the National Coal Council (NCC) to develop a white paper assessing opportunities to optimize the existing U.S. coal-fueled power plant fleet to ensure a reliable and resilient electricity system.

The white paper should focus on drivers governing the evolution of the existing fleet and its attributes; outlooks on the future U.S. generation mix considering regional drivers, anticipated capacity additions, and retirements; characteristics of a reliable and resilient electricity system; and opportunities for the existing coal-fueled fleet to enhance the said characteristics. The white paper should examine policy, market, and technological aspects influencing the ability of coal-fueled plants to uniquely enable a reliable and resilient electricity system. The key questions for this white paper to address are "*What actions can be taken to optimize the U.S. coal-fueled power plant fleet so it can continue to provide reliable, resilient, affordable power as part of a diverse electric generation mix, and what unique benefits does coal provide?*"

I ask that the white paper be completed no later than September 30, 2018.

Upon receiving this request and establishing your internal working groups, please advise me of your schedule for completing the white paper. The Department looks forward to working with you on this effort.

Sincerely,

A handwritten signature in black ink that reads "Rick Perry".

Rick Perry





October 22, 2018

The Honorable Rick Perry
U.S. Secretary of Energy
U.S. Department of Energy
1000 Independence Ave., SW
Washington, DC 20585

Dear Mr. Secretary:

On behalf of the members of the National Coal Council (NCC), I am pleased to submit to you, pursuant to your letter dated April 7th, 2018, the report “Power|Reset: Optimizing the Existing Coal Fleet to Ensure a Reliable and Resilient Grid.” Consistent with your request, the report focuses on assessing policy, market and technological developments affecting the ability of existing coal-based power plants to uniquely enable a reliable and resilient electricity system. The report details coal’s unique attributes as well as the drivers that have resulted in recent plant retirements. Specific actions are identified that can be undertaken to support and optimize the U.S. coal fleet so that it can continue to contribute to our nation’s diverse electric generation mix.

The existing U.S. coal fleet offers unique benefits for the nation that must be valued or it will continue to erode. Accordingly, the NCC advocates a four-step approach summarized by four key words:

ASSESS | SUPPORT | REFORM | RENEW

ASSESS the value of the coal fleet.

Steps must be taken to ensure that the reliable and resilient attributes of U.S. coal generation are acknowledged and that the nation’s existing coal fleet is equitably compensated for the services it provides. Firm, dispatchable power must remain a sustained part of the nation’s fuel mix; targeted minimum levels for key fuel sources should be strongly considered.

SUPPORT efforts to retain continued operation of the existing coal fleet.

Ensuring compensation for all valuable attributes of the existing coal fleet can help put an end to the precipitous retirement of dispatchable coal. Support for sustained operation of U.S. coal plants can provide an opportunity to assess future power demand scenarios and the ability of various energy resources to realistically, reliably and resiliently meet those needs. Economic and regulatory support are needed to stem the tide of plant retirements and ensure the sustainability of a diverse energy portfolio.

REFORM the regulatory environment.

The efficiency, environmental performance and cost-competitiveness of the existing U.S. coal fleet can be enhanced with reforms to various regulatory mandates. Environmentally permitted investments should be afforded the opportunity to recoup value over their useful life and enable the power grid to take full advantage of existing resources. Just compensation is warranted should that opportunity be denied.

RENEW investment in coal generation.

Optimizing existing coal fleet assets requires a targeted Research Development, Demonstration & Deployment (RDD&D) program focused on increasing the efficiency, flexibility and competitiveness of the fleet. Public funding and support mechanisms, complemented by public-private partnerships will ensure grid reliability, dispatch effectiveness and power system resilience.

Specific actionable items recommended to achieve these strategic objectives are detailed in Chapter 4 of the report. Tactical recommendations are framed to specify what must be done and why.

Thank you for the opportunity to prepare this report. The Council stands ready to address any questions you may have regarding its findings and recommendations.

Sincerely,

A handwritten signature in black ink that reads "Deck A. Slone". The signature is written in a cursive, flowing style.

Deck Slone
National Coal Council Chair 2018-2019



Power Reset

Optimizing the Existing U.S. Coal Fleet to Ensure a Reliable and Resilient Power Grid

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Power | Reset

Optimizing the Existing U.S. Coal Fleet to Ensure a Reliable and Resilient Power Grid

Executive Summary

The nation's abundant, affordable and diverse domestic energy resources underpin its economic prosperity. The existing fleet of U.S. coal power plants is a critical component of the nation's energy portfolio, providing a foundation of reliable and resilient electricity in today's dynamic and rapidly evolving energy system.

The historic stability of the nation's energy system is, however, subject to disruptions arising from market distortions, regulation and regulatory uncertainty, which can increase the cost of electricity, threaten the reliability and resilience of the electric grid and hamper economic growth. These factors have most significantly and disproportionately impacted the nation's coal plants. As of August 12, 2018, more than 115,000 MW of coal generating capacity has retired, converted to another fuel or been slated for retirement by 2030. This represents nearly 40% of the U.S. coal fleet that was operating in 2010.

It's time for the U.S. to hit the "Power Reset" button to assess, support, reform and renew the role of the existing coal fleet in the U.S. power sector. **ASSESS** the value of the coal fleet. **SUPPORT** efforts to retain continued operation of the existing coal fleet. **REFORM** the regulatory environment. **RENEW** investment in coal generation.

Coal's Unique Role in the U.S. Energy Portfolio

The U.S. power system benefits from an electric grid that is not only reliable, but resilient. A reliable electric system minimizes the likelihood of disruptive electricity outages, while a resilient system is designed with the understanding that outages will occur, is prepared to deal with them, is able to restore service quickly, and draw lessons from the experience to improve performance in the future.

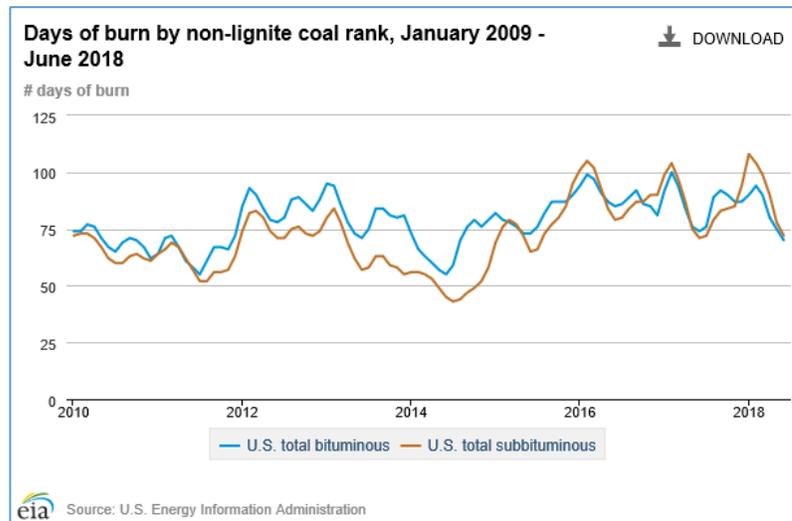
Among the attributes in which coal plants excel are fuel security/assurance, resource availability, on-site fuel supply, price stability and dispatchability.

Reliability and Resilience Attributes

Qualitative Comparison of Grid Reliability and Resilience Attributes by Fuel Type					
Attribute	Coal	Natural Gas	Wind/Solar	Nuclear	Demand Response
Dispatchability	✓	✓		✓	
Inertia	✓	✓	✓(wind)	✓	
Frequency Response	✓	✓	✓ ³		
Contingency Reserves	✓	✓			✓
Reactive Power	✓	✓		✓	
Ramp Capability	✓	✓			✓
Black Start		✓			
Resource Availability	✓	✓		✓	
On-Site Fuel Supply	✓			✓	✓
Reduced Exposure to Single Point of Disruption	✓		✓	✓	✓
Price Stability	✓		✓	✓	✓

Source: PA Consulting

The ability to store fuel onsite and keep generation online is invaluable, especially during regional storms or other disturbances. It is also valuable in supporting rapid recovery following power outages. As of May 2018, the average coal plant burning subbituminous coal had a stockpile that represented 78 days of burn. Over the last five years, the average subbituminous coal plant had a stockpile of 75 days; the average bituminous plant had a stockpile of 81 days of burn.



Average Days of Stockpiled Coal Burn

Resource availability is a concept that acknowledges the value associated with abundant fuel sources that are widely and readily accessible. Coal is used to generate electricity in 48 states; it provides at least half the electricity in 13 states and at least one quarter of the electricity in 24 states.

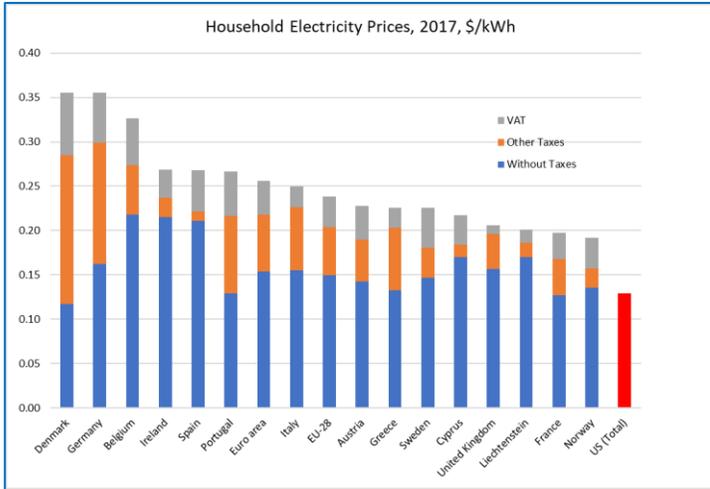
Coal is mined in 25 states and can be shipped via a variety of transportation modes, including rail, truck and barge. Diversity in transportation methods makes coal supply less vulnerable to single points of disruption. Coal's price stability is evident in that it has maintained steady, non-volatile pricing over time and can be secured on a guaranteed basis.

Dispatchability, a key component of a reliable and resilient power system, is provided by baseload plants that can be scheduled in advance to meet predicted load and adjusted to increase or decrease output as required. Unlike dispatchable plants, wind and solar generation are intermittent renewable energy (IREs) sources and require backstop dispatchable generation in order to reliably maintain grid supply-demand balances.

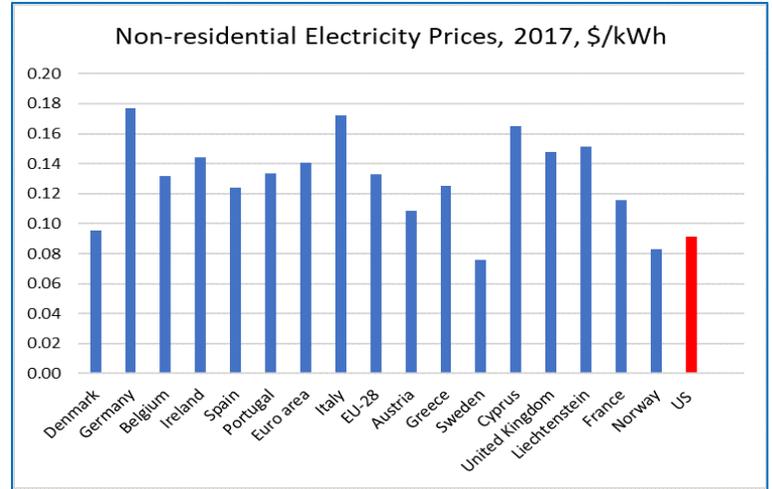
Resource diversity is critical to maintain a reliable and resilient grid, especially in the event of high impact-low frequency (HILF) events. Diversity helps maintain system reliability and the resiliency required to recover from HILF events. The economic impacts of a less diversified energy portfolio were assessed by IHS Markit in its report on "Ensuring Resilient and Efficient Electricity Generation." Their analysis comparing the existing U.S. electric supply portfolio in 2014–2016 with a less diverse supply portfolio concluded:

- The current diversified portfolio lowers the cost of electricity production by about \$114 billion/year and lowers the average retail price of electricity by 27% versus the less diversified portfolio. A 27% increase in retail power prices results in a decline of real U.S. GDP of 0.8%, equal to \$158 billion (2016 chain-weighted dollars).
- The current diversified portfolio reduces the variability of monthly consumer electricity bills by about 22% versus the less diverse portfolio.
- A more diverse portfolio mitigates an additional economic cost of \$75 billion/hour associated with more frequent power supply outages.
- Less efficient diversity involves a reduction of *one million jobs*.
- A less efficient diversity portfolio reduces real disposable income per household by about \$845 (2016 dollars) annually.

Maintaining a diversified, dispatchable energy portfolio allows the U.S. to maintain low electricity rates which, in turn, enhance the nation's competitiveness in international markets and provides lower rates for the residential sector. The average U.S. residential consumer pays about one-half of the rate for the EU-28 countries, while the U.S. commercial and industrial rate is about 30% less than that of the EU-28.



Residential Electricity Rates

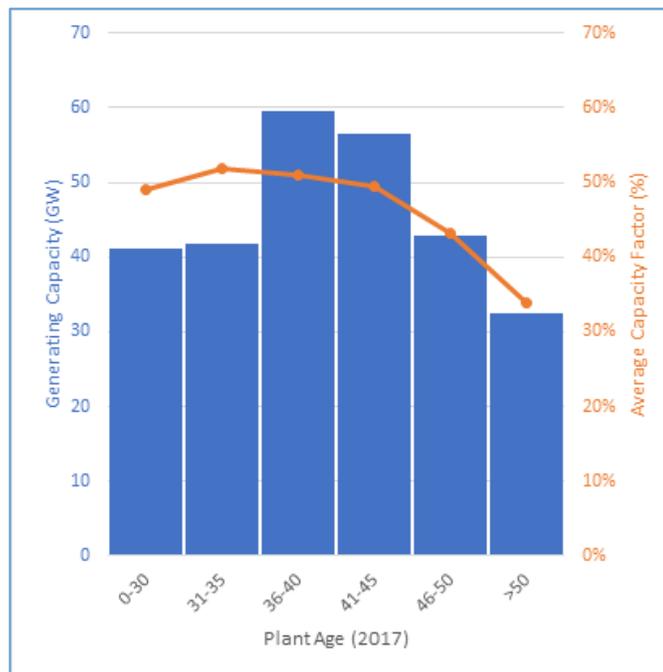


Non-residential Electricity Rates

The U.S. Coal Fleet Today & Tomorrow

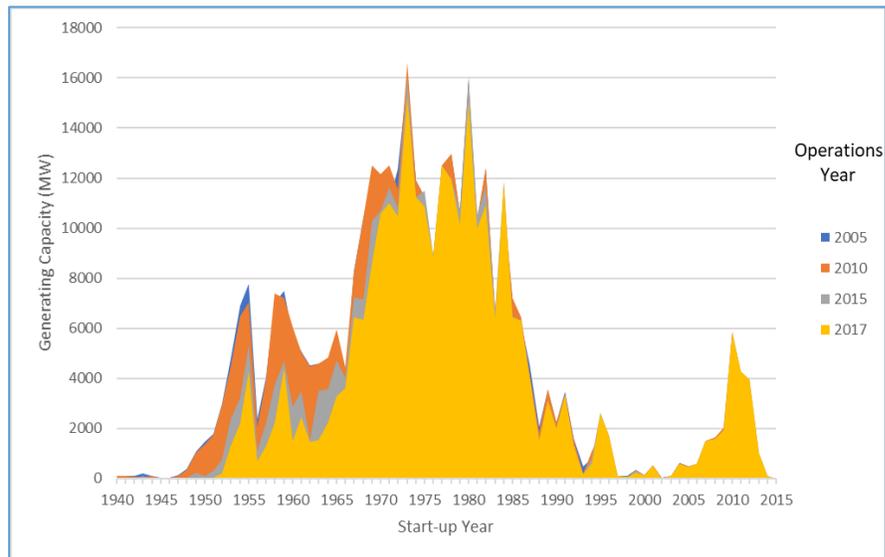
In 2005, approximately 325 GW of coal-based generating capacity was in operation in the U.S.; at the end of 2017, the U.S. existing coal fleet was made up of approximately 253 GW of generating capacity. Based on EIA data, 24% of the 2005 fleet had retired by 2017, representing approximately 79 GW. Since 2005, 27 GW of new coal-based generation has been added – although no additional plants are being built or planned today.

The average age of the existing coal fleet is 40 years. The capacity factor for the newest plants is over 70%, compared to 50% or less for plants more than 46 years old indicating that, in general, newer plants operate more often than older plants.



U.S. Coal Fleet Age in 2017 and Respective Average Generating Capacity Factor

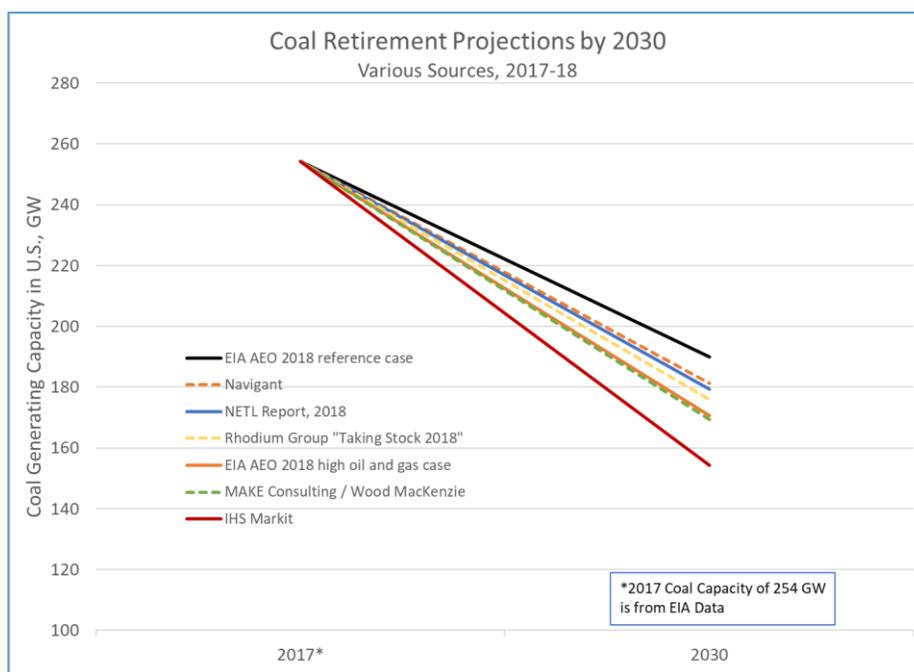
Coal power plant retirements since the turn of the century have been driven by numerous factors, including competitive pricing from other fuel resources, federal and state energy and environmental policies, declining electricity demand, inadequate funding for technology innovation, and societal pressures. From 2005 to 2017, many smaller and older coal plants had retired and been largely replaced by alternatives – mostly gas-fired generation with some intermittent renewables.



Start-up Year and New Generating Capacity for Coal Plants Still in Operation in 2005, 2010, 2015 and 2017

The U.S. power fleet is experiencing a period of rapid changes, making it challenging to forecast the outlook for power generation. Substantial year-over-year differences in projected future coal plant retirements are one indication of the uncertainty of these predictions. Some impacts on the generation fleet are cumulative. Reliability projections tend to underestimate the impact of current operating conditions on coal plants. The result of load cycling may be sharp increases in electric generation costs, much larger than anticipated in current economic projections. A rapid decline in baseload and dispatchable power due to an accelerated aging of the fleet could also severely reduce power supply reliability unless the overall system can be structured to absorb these changes, especially during extreme weather conditions.

Several sources have estimated the future generation mix and the range of predictions is broad. From 65 to 100 GW of coal-based power is predicted to retire by 2030. EIA predicts that coal-based power will remain flat from 2030–2050. At the other end of the spectrum, Bloomberg NEF’s New Energy Outlook 2018 predicts that by 2050 coal and nuclear will have almost disappeared from the electricity mix. Without appropriate mechanisms that value the diversity, reliability and resiliency provided by the existing coal fleet, the downside capacity predictions are much more likely than the EIA flat line projections.



*Coal Generation Retirements Projected through 2030
Source Emissions Strategies, Inc.*

Policy Measures to Optimize Diversity & Resilience

Opportunities exist to streamline, re-evaluate, amend and implement regulatory and legislative measures that will enable the U.S. existing coal fleet to operate more efficiently and effectively. The NCC report highlights reforms possible for New Source Review (NSR), land use policies related to carbon storage and utilization, the Public Utility Regulatory Policies Act of 1978, the Coal Combustion Residuals rule and Effluent Limitation Guidelines.

In its *Policy Parity* report (November 2015), NCC noted that “uncertainties created by NSR rules, their enforcement by EPA, and the prohibitive cost of administering NSR compliance have created strong disincentives to the widespread deployment of efficiency improvements.” Recent regulatory initiatives at EPA and legislative proposals in Congress have the potential to eliminate regulatory uncertainty and reduce litigation risks for utilities seeking to implement energy efficiency measures at their coal plants.

Various tax credits have been proposed or passed that could also provide support for the existing U.S. coal fleet. These include provisions for an Operations & Maintenance tax credit, reforms to the 48A Investment Tax Credit, and synergistic policies to enhance implementation of the recently passed 45Q tax credit revision, such as reforms to enhance eligibility for Private Activity Bonds (PABs) and Master Limited Partnerships (MLPs).

Land use policies supporting storage of CO₂ in saline formations and oil and gas reservoirs could potentially benefit coal facilities. Reform of the 1978 Public Utility Regulatory Policies Act (PURPA) would more realistically reflect today's electricity landscape and ensure utilities are not forced to purchase power they do not need. Additionally, reforms to new rules for coal combustion residuals (CCRs) and effluent limitation guidelines (ELG) would allow for the development of cost-effective means to manage CCR impoundments and wastewater discharge without forcing the premature retirement of existing coal plants.

Wholesale Electricity Market Reforms to Optimize Diversity & Resilience

The nation's seven independent system operators (ISOs) and regional transmission organizations (RTOs) were designed primarily to maintain competitive markets, low electricity prices and transmission reliability. They were not designed to ensure resilience, fuel diversity, or fuel security. Some 164,000 megawatts (MW) of coal-based generation — almost two-thirds of the fleet — are located in ISO/RTO footprints. As a consequence, ISO/RTO market policies affect the competitiveness and economic viability of the coal fleet.

For a number of reasons, including market policies, 45,000 MW of coal-based generating capacity in ISO/RTO regions have retired. An additional 17,000 MW in these regions are slated to retire over the period 2018 through 2020, of which 12,000 MW have been attributed to market conditions.

Various out-of-market subsidies and mandates can put dispatchable sources, such as coal, at a competitive disadvantage. For example, wind and solar benefit from a Federal Production Tax Credit (PTC) which, in the case of wind, allows this resource to bid into markets at a zero or negative cost that suppresses prices for other electricity resources and increases the need for load following and ramping from coal units.

In addition to tax benefits, 29 states have renewable portfolio standards (RPS) requiring that specific percentages of electricity sales come from renewables. These percentages range from 10% in Wisconsin to 100% in Hawaii.

Other out-of-market subsidies disadvantage the coal fleet. Within PJM's 13-state footprint, 4 states — Northern Illinois, Pennsylvania, New Jersey and Ohio — have adopted or considered zero-emissions credit policies to subsidize existing nuclear plants. Subsidies allow renewable and nuclear generators to enter capacity auctions at prices below their operating costs, pushing down overall market prices and sometimes leading to power plant retirements.

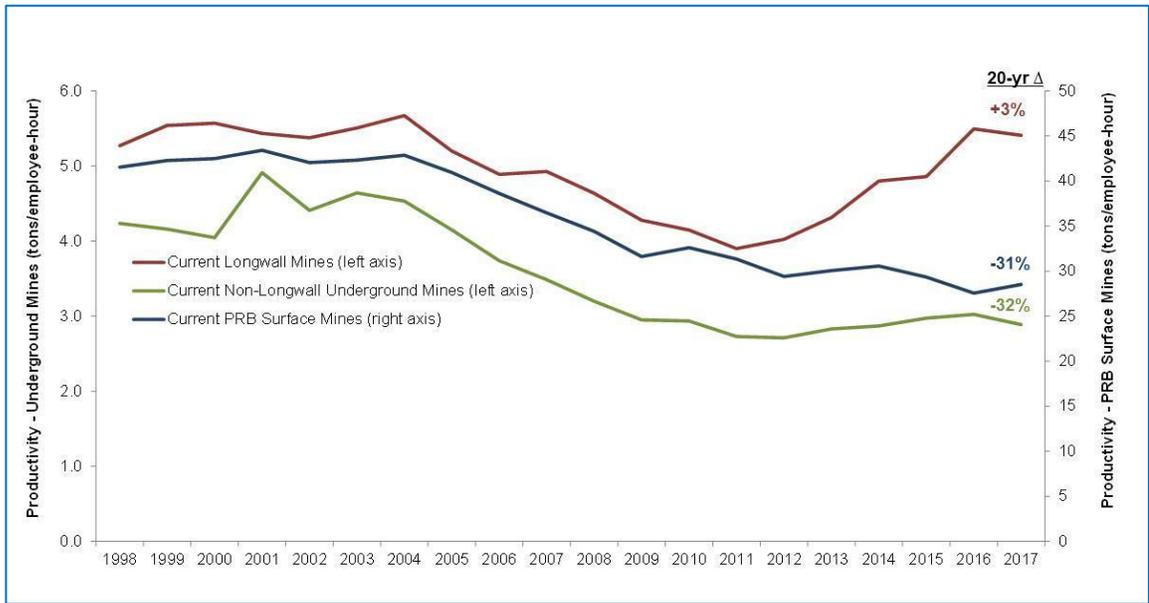
There are many actions that could be undertaken by the Federal Energy Regulatory Commission (FERC) to ensure that the services provided by the U.S. fleet of coal-based power plants are appropriately valued. These include price formation reform, just and reasonable compensation for Essential Reliability Services (ERS), capacity market reforms, implementation of a forward resiliency market and demand response compensation reform.

While coal generation receives the same compensation as other generators for ERS, coal units are not compensated for the increased costs associated with being dispatched to provide load following and ramping services for IREs. Markets do not incent investments in fuel-secure infrastructure.

Technology Options to Optimize Diversity & Resilience

Maintaining the U.S. coal fleet is essential to ensure that the country can continue to provide reliable, resilient, affordable power through a diverse electric mix. To improve the competitiveness of the existing fleet there are many technology options available.

Upstream technologies that improve the efficiency and reduce the cost of mining, processing or transporting coal could play an important role in improving coal’s competitiveness by reducing delivered fuel costs which account for a majority of a power plant’s O&M cost. Opportunities for new technology implementation in coal mining and processing include automation and robotics, big data and advanced computing to improve mining productivity and efficiencies, fully remote mining technologies and advanced coal recovery and upgrading technologies.



Productivity Trends for U.S. Longwall Mines, Non-longwall Underground Mines and PRB Surface Mines in Operation as of 2017

There are material opportunities to further develop coal washing, beneficiating and upgrading. These technologies have the potential to reduce delivered fuel costs, reduce emissions, improve efficiency and reduce variable O&M costs at the power plant.

New technologies, such as high efficiency, low emissions (HELE) plants, offer dramatically improved efficiency and lower CO₂ emissions versus subcritical coal plants. For existing plants, regulatory uncertainties, especially around New Source Review, have limited the ability of owners to aggressively pursue energy efficiency improvement opportunities.

Project Name	Capital Cost	B/C Ratio	B/C Ratio Rank
Circulating Water Pump Refurbishment	Low	High	1
Sootblowing Steam Source	Low	High	2
Coal Mill Inerting Source	Low	High	3
Add Condensate Polishing	Medium	High	4
HP/IP/LP Turbine Upgrade	High	High	5
Coal Mills Replacement	High	High	6
Boiler Feed Pump Refurbishment	Low	Moderate	7
Helper Cooling Tower Replacement & Pumps	Medium	Moderate	8
Replace Flame Scanners	Low	Moderate	9
VFD's for Forced Draft Fans	Medium	Low	11
Air Heater Overhaul	Medium	Low	10
Replace Air Preheat Coils	Low	Low	12
VFD's for Induced Draft Fans	Medium	Low	13
Alternate Air Heater Overhaul	Medium	Low	14
Alternate Air Preheat Coils Modification	Medium	Low	15

Coal Power Plant Efficiency Audit Results

With the rapid increase in IRE generation, there is significant pressure on existing dispatchable coal resources to meet load and balance intermittency. While the existing coal fleet is presently able to deliver variable output to stabilize the grid, this comes at a cost in terms of lower plant efficiency, higher maintenance expenses and shorter life expectancy. There are some changes that can be made to power plants to improve their ability to cycle, but with the rapid growth of wind and solar installations, more aggressive measures are needed to ensure the stability of the grid.

Today's coal-based electric generating units have successfully controlled emissions such as SO₂, NO_x, PM, mercury and other air toxics to meet regulatory requirements. There may be opportunities in the areas of air emissions and water effluent to reduce the technology cost associated with meeting environmental standards. There is a role for the Department of Energy to reduce the cost of new technologies and to promote innovative financing opportunities so that aging plants can adopt the new technologies that are being developed in the U.S. and around the world.

Finally, the development of alternative uses for coal may provide additional revenue streams and uses for existing coal plants that would enable the continued operation of these valuable assets. Rare earth elements (REE) are necessary materials in an incredible array of consumer goods, energy system components and military defense applications. However, the global production and entire value chain for rare earth elements is dominated by China; the U.S. is currently completely reliant on imports of these critical materials. Coal and coal by-products may provide an alternative source of REEs and a secondary source of revenue for coal mines and coal power plants.

Additionally, new markets for coal are being pursued worldwide for various applications such as coal conversion to synthetic oil, transportation fuels, hydrogen and industrial chemicals, as well as conversion of coal into advanced materials, such as carbon fibers. There may be potential opportunities to co-locate new technologies for processing coal at existing power plants and to enhance the use of U.S. coal in markets beyond those for power generation. In all instances, the coal conversion process itself requires electricity, providing the existing plant with a new dedicated customer.

Conclusions

Although there are many challenges facing the existing U.S. coal fleet, it continues to play an important role in the current diverse energy mix. A wide range of policy mechanisms, market changes and technology solutions exist or could be developed that could enable this fleet to continue to play an important role in the U.S. electricity system well into the future. DOE has the ability to take action and/or influence many of the key areas addressed in the NCC report that would benefit the nation's coal fleet.

National Coal Council Recommendations

The existing U.S. coal fleet offers unique benefits for the nation that must be valued or it will continue to erode. Accordingly, the NCC advocates a four-step approach:

ASSESS | SUPPORT | REFORM | RENEW

ASSESS the value of the coal fleet.

Steps must be taken to ensure that the reliable and resilient attributes of U.S. coal generation are acknowledged and that the nation's existing coal fleet is equitably compensated for services it provides. Firm, dispatchable power must remain a sustained part of the nation's fuel mix; targeted minimum levels for key fuel sources should be strongly considered.

SUPPORT efforts to retain continued operation of the existing coal fleet.

Ensuring compensation for all valuable attributes of the existing coal fleet can help put an end to the precipitous retirement of dispatchable coal. Support for sustained operation of U.S. coal plants can provide an opportunity to assess future power demand scenarios and the ability of various energy resources to realistically, reliably and resiliently meet those needs. Economic and regulatory support are needed to stem the tide of plant retirements and ensure the sustainability of a diverse energy portfolio.

REFORM the regulatory environment.

The efficiency, environmental performance and cost-competitiveness of the existing U.S. coal fleet can be enhanced with reforms to various regulatory mandates. Environmentally permitted investments should be afforded the opportunity to recoup value over their useful life and enable the power grid to take full advantage of existing resources. Just compensation is warranted should that opportunity be denied.

RENEW investment in coal generation.

Optimizing existing coal fleet assets requires a targeted Research Development, Demonstration & Deployment (RDD&D) program focused on increasing the efficiency, flexibility and competitiveness of the fleet. Public funding and support mechanisms, complemented by public-private partnerships will ensure grid reliability, dispatch effectiveness and power system resilience.

Specific actionable items recommended to achieve these strategic objectives are as follows:

ASSESS the value of the coal fleet.

- Establish a uniform definition of grid resilience.
A standardized definition of resilience is needed in order to assess and compensate the value of various energy resources and the range of grid services they supply.
- Assess the fuel security of ISOs/RTOs.
Fuel security is critical to grid resilience as it enables the grid to absorb and recover quickly from manmade or natural disruptions in the power system.
- Establish quantitative metrics against which to evaluate grid resilience.
Resilience metrics can be used to assess and equitably compensate electricity generators for services provided.
- Evaluate the experience of other nations regarding the value of firm, dispatchable power and challenges associated with intermittent renewable energy deployment.
Lessons learned from other nations are instructive in defining pathways to a stable and sustainable energy future for the U.S.

SUPPORT efforts to retain continued operation of the existing coal fleet.

- Provide appropriate economic and regulatory incentives to stem the tide of plant retirements.
Acknowledge the significant and disproportionate impact on the existing U.S. coal fleet of market distortions, regulation and regulatory uncertainty.
- Establish an environment that values and compensates diversity.
Resource diversity is critical to maintain a reliable and resilient grid, especially in the event of manmade and natural high impact-low frequency events.
- Support mechanisms to immediately compensate the U.S. coal fleet for the essential services it provides.
Acknowledge the explicit economic, dispatchable and grid-resilient value provided by the existing U.S. coal fleet.

REFORM the regulatory environment.

Policy Reforms

- Reform New Source Review rules.
Eliminate regulatory uncertainty and reduce litigation risks for utilities seeking to implement energy efficiency measures and enhance operational flexibility solutions at coal plants.
- Reform the Public Utilities Regulatory Policies Act of 1978.
Reforms will more realistically reflect today's electricity landscape and ensure utilities are not forced to purchase power they do not need.
- Revise the 2015 Coal Combustion Residuals ruling.
Reforms could provide states and utilities with flexibility in how CCR is managed.
- Support changes to Effluent Limitation Guidelines establishing wastewater treatment standards.
Changes would support standards that could be more realistically and cost-effectively met with technologies commensurate with the resultant health and welfare benefits realized.
- Advance CO₂ storage laws and regulations on Federal and tribal lands.
Regulations could facilitate deployment of CCUS technologies by existing coal plants located near Federal and tribal lands.
- Engage EPA as it progresses the Affordable Clean Energy plan.
Provide technical guidance to EPA on the potential technologies and the role of efficiency gains and flexibility improvements that could reduce emissions from the existing fleet.

Market Reforms

- Support FERC capacity market reform initiatives.
Provides opportunities to ensure that resilience, fuel diversity and/or fuel security are valued along with low electricity prices and transmission reliability.
- Support FERC initiatives to refine ISO/RTO price formation.
Allows fuel-secure resources to set locational marginal prices, eliminate negative pricing, establish a price floor for fuel-secure resources and require the value of tax and other subsidies to be imputed into market bids of subsidized resources.
- Support FERC efforts to establish and enforce standards for essential reliability services.
Allows for a more realistic assessment of attributes, such as fuel security, that support a reliable and resilient grid.
- Support efforts by ISOs/RTOs to conduct assessments evaluating fuel security and resilience of the bulk power system.
Assessments provide critical data on the resilience of wholesale electricity markets.

Tax Reforms

- Support legislative initiatives to provide temporary tax credits to cover a portion of O&M expenses for existing coal plants.
Offsetting a small portion of O&M expenses for the existing coal fleet is estimated to prevent the retirement of as much as 24,000 MW of coal-based generation.
- Support legislative initiatives that would complement and further incentivize utilization of the 45Q tax credit for existing coal plants, including Master Limited Partnerships and Private Activity Bonds.
The recent 45Q tax credit reform provides an important Federal incentive encouraging private investment in the deployment of carbon capture technologies. Additional Federal incentives would complement 45Q and enable more capture projects to become commercially feasible.
- Support changes to the 48A tax credit, such as removing the efficiency increase requirement that would facilitate retrofits of CCUS technology to the existing coal fleet.
In its current form, the tax credit does not incentivize CCUS on new or existing coal plants.

RENEW investment in coal generation.

- Support the development and deployment of the following technologies.
Government and public-private partnership support for advanced coal technologies enhances the competitiveness, efficiency and environmental performance of the existing coal fleet.
 - Advanced coal mining and processing technologies.
Renewed R&D initiatives would enhance productivity and cost-competitiveness of coal supply. Working in concert with MSHA would help expedite the review and approval of these technologies.
 - Coal beneficiation technologies, including coal washing and upgrading.
Advanced R&D initiatives would improve power plant performance and reduce operating costs.
 - Retrofitting and repowering technologies.
Various technologies and processes could be deployed at existing plants to improve energy efficiency and coal plant cost competitiveness.
 - Energy storage technologies.
Various storage technologies – notably Thermal Energy Storage – could potentially allow coal-based power plants to continuously operate at maximum efficiency while reducing the damaging impacts of cycling.
 - Advanced air emissions control system technologies.
Enhancements to existing technologies could improve efficiency and reduce costs associated with controlling SO₂, NO_x, PM and Hg.

- Water effluent technologies.
R&D initiatives are needed to reduce technology costs associated with meeting environmental standards.
 - Carbon capture technologies/projects, including demonstrations at commercial scale retrofitted to existing coal-based units.
Only one CCUS retrofit project is operational in the U.S. today. More projects would reduce costs associated with CO₂ capture, improve project financing opportunities and advance technical knowledge.
 - Rare earth element extraction from coal and coal byproducts.
R&D initiatives could advance the development of and reduce the costs associated with REE extraction, providing a secondary source of revenue for coal producers/consumers and enhancing the cost-competitiveness of the existing fleet.
 - New advanced markets for coal technologies such as coal conversion, carbon engineered products and other coal-derived value-added products.
Co-locating coal-to-X projects at existing coal plants could support the economics of both facilities.
 - Technologies identified in the CURC-EPRI Roadmap that enhance the efficiency and cost-competitiveness of the existing coal fleet.
Provides a focused and comprehensive R&D program to address the many and varied coal generation system components in concert.
- Promote education and awareness about the water-energy nexus.
Education enhances national water planning processes and facilitates a more reasoned approach to decision and policy making.
- Promote initiatives to enhance transparency about the inherent costs and benefits associated with all U.S. energy resources.
Provides a more reasoned approach to energy decision and policy making.

Retirement of Coal Generating Units as of August 12, 2018

	MW RETIRING	UNITS RETIRING
1. Ohio	12,131 ¹ / 6,421 ²	59 / 40
2. Indiana	6,569 / 6,129	39 / 34
3. Pennsylvania	5,847 / 5,548	34 / 30
4. Texas	5,672 / 1,399	10 / 3
5. Illinois	5,663 / 3,076	21 / 14
6. Alabama	5,166 / 5,166	26 / 26
7. Michigan	4,911 / 4,075	44 / 31
8. Florida	4,752 / 1,568	14 / 7
9. North Carolina	4,615 / 2,783	37 / 20
10. Kentucky	4,168 / 3,743	20 / 18
11. West Virginia	4,040 / 2,740	20 / 18
12. Georgia	3,752 / 3,249	17 / 15
13. Arizona	3,482 / 3,482	8 / 8
14. Virginia	3,258 / 2,354	29 / 16
15. Wisconsin	2,928 / 1,287	27 / 16
16. Nevada	2,689 / 0	8 / 0
17. Tennessee	2,659 / 2,659	17 / 17
18. Oklahoma	2,414 / 2,414	5 / 5
19. Colorado	2,405 / 1,776	19 / 16
20. Missouri	2,372 / 2,355	24 / 23
21. Minnesota	2,288 / 2,150	17 / 15
22. Montana	2,248 / 154	5 / 1
23. New Mexico	2,222 / 2,222	7 / 7
24. Utah	2,072 / 272	7 / 5
25. Iowa	1,847 / 1,579	33 / 29
26. South Carolina	1,768 / 1,768	14 / 14
27. New York	1,708 / 475	14 / 3
28. Massachusetts	1,663 / 1,408	8 / 6
29. Arkansas	1,659 / 1,659	2 / 2
30. New Jersey	1,543 / 268	6 / 2
31. Washington	1,376 / 0	2 / 0
32. Nebraska	757 / 637	6 / 5
33. Mississippi	706 / 706	2 / 2
34. Maryland	635 / 115	5 / 2
35. Oregon	585 / 585	1 / 1
36. Louisiana	575 / 575	1 / 1
37. Connecticut	566 / 0	2 / 0
38. Kansas	550 / 478	7 / 6
39. Delaware	360 / 0	4 / 0
40. North Dakota	189 / 0	1 / 0
41. California	129 / 0	3 / 0
42. Wyoming	49 / 49	4 / 4
43. South Dakota	22 / 22	1 / 1
43 / 37 States	115,010 / 77,346 MW	630 / 463 Units

Source: American Coalition for Clean Coal Electricity

¹ Total coal retirements.

² Coal retirements attributed to EPA regulations and policies.