Union of Concerned Scientists

EXECUTIVE SUMMARY

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Ripe for Retirement

The Case for Closing America's Costliest Coal Plants

For decades, coal has powered America. Coal mined from Wyoming to West Virginia is burned in hundreds of power plants across the United States to generate electricity. In 2011, approximately 42 percent of our nation's electricity was produced by burning coal (EIA 2012a). But today, more than three-quarters of U.S. coal-fired power plants have outlived their 30-year life span—with 17 percent being older than half a century. Most are inefficient, operating far below both their power generation potential and the most efficient coal units on the power grid.

They lack essential modern pollution controls, so they damage public health. The sulfur they emit causes acid rain. The mercury they release poisons waterways and fish and causes neurological damage in children (EPA 2012). The soot they emit creates smog that causes lung disease, premature death, and triggers asthma attacks (EPA 2010a; NRC 2010). Burning coal demands billions of gallons of cooling water from vulnerable rivers and lakes, and leaves behind vast quantities of toxic ash residuals, while coal mining causes extensive and lasting damage both to human health and the natural environment (Gentner 2010; NRC 2010). Coal-fired power plants are also our nation's largest single source of heat-trapping carbon dioxide (CO_2) emissions, the primary contributor to global warming (EIA 2012b).

These well-documented drawbacks are reason enough to reduce the nation's dependence on coal. Less widely appreciated is that many of these coal plants have reached the end of their useful life—it simply makes no economic sense to keep them running when cheaper, cleaner alternatives are available.

Closing old, inefficient, and uneconomic coal plants is a historic opportunity to accelerate the transition to a cleaner energy future.

As of May 31, 2012, a total of 288 coal-fired generating units (a power plant comprises one or more generating units or generators) totaling 41.2 gigawatts (GW) of coal-fired generating capacity have been scheduled for closure;[1] those power generators supplied 3.8 percent of total U.S. electricity used in 2009 (the most recent year of available data). The owners of these soon-to-be-retired generators have concluded that paying for costly upgrades to keep their outdated coal plants running is a bad investment—particularly now that there are many cleaner, lower-cost alternatives that can replace old coal units while maintaining the reliability of the electric system. Whether natural gas, clean renewable energy from the wind and sun, or cost-effective efficiency measures to reduce electricity use, energy options that are abundant, cheaper, and cleaner are making it harder for dirty coal to compete.

This report examines and evaluates the economic viability of our nation's remaining coal-fired electricity generating units. We find that there are many more uncompetitive coal generators that should be considered for closure. Their retirement would create an opportunity to accelerate our nation's transition to a cleaner energy future by shifting more of the electricity sector's investment dollars away from old coal plants and toward new renewable energy resources, energy-saving technologies, an expanded and modernized

[1] One gigawatt equals 1,000 megawatts (MW) of power generation capacity; typical coal plants range in capacity from 250 to 1,500 MW or more.

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electric grid, and—to a more limited extent—natural gas power plants.

The Economic Test: Can America's Aging Coal Plants Compete?

To evaluate the economic competitiveness of coal generators, we compared the cost of electricity from individual coal-fired electricity generating units with the cost of electricity generated from an average natural gas power plant. Specifically, if a coal-fired generator—after installing any needed pollution controls—would be more expensive to operate than a typical cleaner-burning and more efficient natural gas combined-cycle[2] (NGCC) plant, then we consider that coal generator ripe for retirement. Our analysis is not an evaluation of the coal industry's compliance with federal clean air standards; instead, we estimate the cost of modernizing the coal fleet to protect public health by installing the most effective pollution control technologies available.[3]

Many older NGCC plants have already largely paid off their capital costs, whereas other newer plants are still recovering their initial investment. Thus, we calculated a range for the total capacity of coal generation considered ripe for retirement. The high end of that range was defined by comparing the operating costs of a coal generator—assuming it was upgraded with modern pollution controls—to the operating costs of a typical existing NGCC plant whose capital costs were already largely recovered. This comparison of coal generating units to existing NGCC plants yielded the greatest number of uneconomic coal generators that could be retired; this we call our Ripe for Retirement high estimate.

UCS identified up to 353 coal generators in 31 states—totaling 59 GW of power generation capacity—that are ripe for retirement.

The low end of our range was defined by comparing the operating costs of a coal generator—again, assuming it was upgraded with modern pollution controls—with the operating costs of a typical *new* NGCC plant whose capital costs were not yet recovered. This comparison of coal generating units to *new* NGCC plants yielded the fewest uneconomic coal generators that could be retired; this we call our Ripe for Retirement low estimate.

In both the high and low estimates, the costs of pollution controls were added to the costs of individual coal-fired generators as needed so that the economic analysis included the cost of controlling four major air pollutants: sulfur dioxide (SO_2), nitrogen oxides (NO_x), particulate matter (PM, or soot), and mercury (detailed methodology appears in Appendix A). These costs were then compared with the operating costs of the NGCC plants.

We also examined the effect of several variables that could influence

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Up to 353 coal-fired power generating units (or 59 GW) are ripe for retirement nationally. These units are good candidates for closure because they are economically uncompetitive compared with cleaner, more affordable energy sources. These coal generators represent more than 6 percent of total U.S. electricity used in 2009—equivalent to about 120 average-sized coal plants.

[2] NGCC plants are relatively efficient because they generate electricity not only by burning natural gas to turn a turbine but also by converting the heat from natural gas combustion into steam that powers a second electricity-generating turbine.

[3] For every coal generator that lacks pollution controls for any of four specific pollutants—sulfur dioxide, nitrogen oxides, particulate matter, and mercury—we calculate the cost to install that control technology.

Key Findings

- Using economic criteria, we have identified a range of 153 to 353 coal-fired electric utility generating units (from a national total of 1,169) as ripe for retirement; all are good candidates for closure because they are economically uncompetitive compared with cleaner, more affordable energy sources. These coal units collectively represent 16.4 to 59.0 GW of generation capacity and 1.7 to 6.3 percent of total U.S. electricity used in 2009 (the most recent year of available data).
- The potential closure of these units would be in addition to the 288 units representing 41.2 GW of coal-fired generating capacity already scheduled by their owners for closure, which produced 3.8 percent of U.S. electricity use in 2009. Together, the ripe-for-retirement units plus the already announced closures would constitute a combined 100.2 GW of potential coal plant retirements.
- Like the announced retirements, the coal generators that are ripe for retirement are typically older, less utilized, and dirtier than the rest of the nation's coal fleet.
- The ripe-for-retirement generators can be closed without jeopardizing the reliability of the national electricity system because the United States is projected to have 145 GW of excess capacity by 2014 above and beyond reserve margins required to maintain reliability at the regional power grid level.
- Every region of the country has the potential to replace the generation from the ripe-for-retirement generators by increasing the use of renewable energy, implementing energy efficiency to reduce electricity demand, and ramping up underused natural gas plants.
- The states with the most ripe-for-retirement generators are primarily in the Southeast and Midwest, with the top five (in order) being Georgia, Alabama, Tennessee, Florida, and Michigan.
- The ripe-for-retirement generators are owned by some of the nation's largest power companies, with the top five (in order) being Southern Company, the Tennessee Valley Authority, Duke Energy, American Electric Power Company, and First Energy.
- Replacing a combined 100.2 GW of coal generators could reduce heat-trapping CO_2 emissions and provide other significant public health and environmental benefits. Emissions could be cut by anywhere from 245 million tons to 410 million tons annually, depending on what resource replaces the coal. These reductions account for 9.8 to 16.4 percent of CO_2 emissions from the power sector in 2010.

the economic competitiveness of the remaining operational coal fleet. In these alternative scenarios, we compared the operating costs of a coal generator upgraded with added pollution controls with NGCC plants using a higher and lower natural gas price, and with the cost of new wind projects both with and without federal tax credits. Lastly, we examined how a $15-per-ton price on carbon emissions would affect the economic viability of coal-fired power compared with cleaner alternatives.

Why a comparison with NGCC plants to establish a range to our estimates? In many parts of the country, natural gas is currently the most readily available low-cost power generation option capable of rapidly replacing coal-fired power plants in the near term, and many utilities are already taking steps to make this switch. However, we believe that retiring coal capacity could and should be replaced by a mix of alternatives including renewable energy technologies and reduced demand due to energy efficiency. We did not consider new nuclear or coal with carbon capture and storage (CCS) plants as near-term alternatives because of their long construction lead times, high costs, and limited number of proposed projects. The closure of old, inefficient, and uneconomic coal plants is a historic and important opportunity not only to make smart economic investments, but also to transition to the lowest-carbon energy resources to reduce global warming emissions significantly from the power sector.

The Ripe-for-Retirement Generators

Using our economic criteria, we find that a significant number of additional coal generators nationwide are ripe for retirement, ranging from a low estimate of 153 to a high estimate of 353. Collectively, the units represent 16.4 to 59.0 GW of generating capacity; they thus supplied 1.7 to 6.3 percent of total U.S. electricity used in 2009. Notably, the units we identify are in addition to the 288 coal units previously announced for retirement by utility companies and power generators, which supplied 41.2 GW or 3.8 percent of the nation's electricity.

For all of the ripe-for-retirement generators identified in this report, the power they produce—after being upgraded with modern pollution controls—is more costly than electricity generated from existing natural gas power plants, and many are more expensive than wind power. Our analysis shows that many of these ripe-for-retirement units may already be uneconomic even *before* considering the cost of pollution controls. Indeed, even without considering the cost of needed pollution controls, 23.4 GW are *already* more expensive to operate than existing natural gas plants.

Ripe-for-retirement coal generators are older, less utilized, and dirtier than the rest of the nation's coal fleet.

It is no coincidence that the ripe-for-retirement coal generators may be good candidates for closure. As Table ES-1 indicates, the coal units we identified are, on average, similar to the coal generators that utilities have already scheduled for closure according to three important metrics:

They are old. Ripe-for-retirement units average 45 years in age, close to the 50-year-old average of the generators recently announced for retirement. Both figures are well beyond the 30-year expected life span for a typical coal generator. Old coal generators are typically less efficient and have higher operating costs compared with newer plants.

Table ES-1. Older, Underutilized, and Dirtier: Ripe-for-Retirement Coal Generators Are Similar to Those Already Announced for Retirement

	Announced Retirements	Ripe-for-Retirement Generators	
		High Estimate	Low Estimate
Number of coal generators	288	353	153
Total capacity[a] (gigawatts)	41.2	59	16.4
Percent of total U.S. electricity consumption	3.8%	6.3%	1.7%
Average generator age (years)[b]	50	45	45
Average generator capacity factor[c]	44%	47%	47%
Average generator size (megawatts)	143	167	107
Percent of generators lacking three or more pollution control technologies[d]	88%	71%	83%
Avoided annual CO_2 emissions if all identified generators are retired (million tons)[e]	88–150	157–260	52–75

[a] Capacity is the amount of electricity a coal generator (or group of generators) can produce operating at full (100%) power. One gigawatt is equal to 1,000 megawatts.

[b] Age is as of 2012. Results reflect average of the age of the units, weighted by each unit's total potential generation capacity.

[c] Capacity factor is as of 2009 (the most recent year of available complete data), which measures how often and intensively a generator is run over time, calculated as the ratio of actual power output to potential output if the generator had operated at full (100%) capacity over the same period. Results reflect weighted averages based on total generating capacity.

[d] Pollution control technologies evaluated include scrubbers (for sulfur dioxide), selective catalytic reduction (for nitrogen oxides), baghouses (for particulate matter), and activated carbon injection (for mercury).

[e] The low end of the avoided annual CO_2 emissions range reflects replacement of coal with natural gas (existing NGCC units for the high estimate and announced retirements, new NGCC units for the low estimate); the high end of the avoided annual CO_2 emissions range reflects replacement of coal with zero-carbon-emitting resources such as wind, or reduced energy demand due to increased energy efficiency.

Nearly 40 percent of ripe-for-retirement coal units are more expensive to operate than existing natural gas plants—before considering the cost of needed pollution controls.

They are not heavily used. Ripe-for-retirement generators are underutilized because they are not the workhorses of the electricity industry: they operate at an average of just 47 percent of their power generation capacity, compared with an average of 64 percent for the total U.S. coal fleet. The generators already slated for closure have a similarly low average capacity factor of 44 percent. Conversely, a large, recently built coal unit typically operates at approximately 80 to 85 percent of its design capacity.

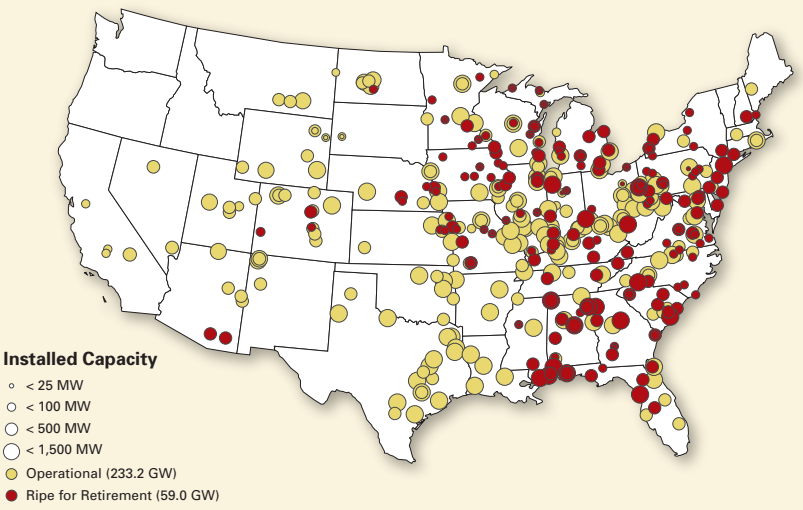
They are dirty. More than 70 percent of the generators identified as ripe for retirement in our analysis lack at least three of the four major pollution control technologies used to reduce the environmental and health effects of coal-fired power generation. The same is true of 88 percent of the units already scheduled to be shut down.

As Figure ES-1 indicates, the nation's coal-fired generators are concentrated in the eastern half of the country, primarily in the Southeast, Midwest, and Mid-Atlantic. Those areas have been dependent on coal for many decades, with many plants built a half-century ago, so it is not surprising that they also host the largest concentration of plants that are ripe for retirement. In general, coal plants in the western United States tend to be younger and more likely to have pollution controls installed.

Our analysis found that 19 states are each home to more than one gigawatt of coal generating capacity whose power costs exceed those of existing NGCC plants (Figure ES-2, p. 6) and are thus ripe for retirement. Four of the top five states are in the Southeast—Georgia, Alabama, Tennessee, and Florida (in order of capacity that is ripe for retirement)—with 79 generating units totaling more than 21.6 GW. Although Michigan ranks fifth in capacity, it has the greatest number of coal generators ripe for retirement: 39 mostly smaller units averaging 94 MW each. Elsewhere in the Midwest, Wisconsin, Indiana, and Ohio are also among the top states, with 7.1 GW of coal capacity spread over 50 generators that are uneconomic when compared with existing natural gas plants.

The ripe-for-retirement generators are owned by dozens of different utilities and independent power

Figure ES-1. Ripe-for-Retirement Generators Located in 31 States (High Estimate by Size of Generators: 353 Generators Totaling 59 GW*)



As many as 353 coal generators in 31 states are ripe for retirement (red dots) according to our high estimate, which compares the cost of operating coal-fired generating units with the cost of operating existing NGCC generating plants. These 353 units total 59 GW of capacity, about 6.3 percent of electricity generated nationwide.

* Includes all utility-scale generating units using coal as a primary fuel source, except those that have already been announced for retirement. Each dot represents an individual generator (some dots represent multiple generators at the same power plant); the size of the dot depicts its generating capacity. Capacity is the amount of power a generator is capable of producing when operating at full (100%) output, typically measured in megawatts or gigawatts (1 gigawatt = 1,000 megawatts). A gigawatt of coal generating capacity is capable of producing enough electricity to power approximately 1 million typical U.S. homes.

producers. Some owners have been less forthcoming than others in scheduling the closure of economically uncompetitive coal units. Southern Company, for instance, has by far the most generation capacity deemed ripe for retirement—15.6 GW—but it has announced less than 1.4 GW of plant closures (Table ES-2). Duke Energy, American Electric Power, and FirstEnergy, by contrast, have fewer plants deemed ripe for retirement, in part because these companies have already announced plans to close a larger portion of their coal fleet.

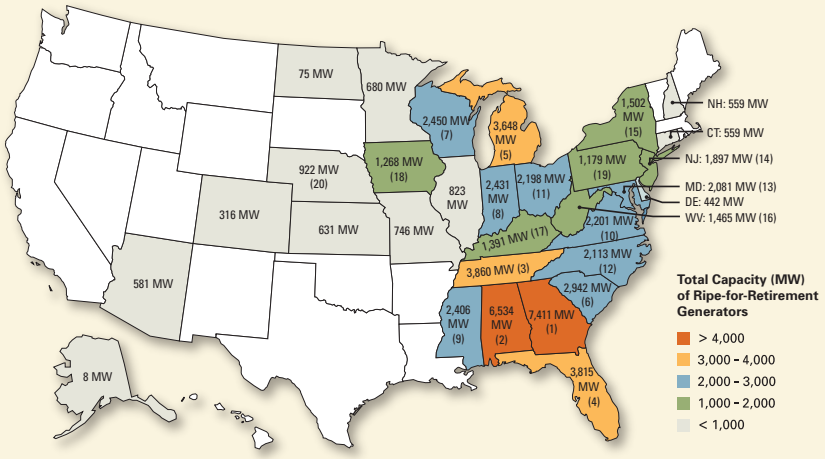
Economic Variables

A variety of factors will determine the future economic viability of the nation's coal fleet relative to other electricity sources. Such factors include the price of coal relative to alternatives such as natural gas and renewable energy, the cost of complying with existing and pending pollution standards, and whether a price is placed on carbon dioxide. As our analysis shows, wind is already cost-competitive with coal and natural gas in some parts of the country. With additional policy support such as tax incentives, considerably more wind and solar energy facilities could compete with existing coal plants, particularly given the environmental and health costs that coal or utility companies do not shoulder but are borne by the public.

More than 70 percent of the ripe-for-retirement coal generators lack at least three of the four major pollution control technologies that reduce mercury, soot, sulfur dioxide, or nitrogen oxides.

To assess how economic variables would alter the number of coal generators deemed ripe for retirement, we repeated our analysis under the following additional potential future scenarios: both a 25 percent increase and a 25 percent decrease in the price of natural gas from our core-case price of $4.88/MMBtu;[4] a $15 per ton price on CO_2 emissions, which is consistent with more conservative price forecasts from several government, industry, and expert analyses (Johnston et al. 2011); and both the extension and expiration of federal tax credits for wind power (Figure ES-3, p. 8). The core-case natural gas price is a national 20-year levelized price delivered to the electricity sector based on the U.S. Energy Information Administration's (EIA's) reference

Figure ES-2. Ripe-for-Retirement Generating Capacity Is Concentrated in Eastern States* (High Estimate: 59 GW)



UCS identified up to 353 coal-fired generators nationwide that are uneconomic compared with cleaner alternatives and are therefore ripe for retirement. These units are in addition to 288 coal generators that utilities have already announced will be retired. Under the high estimate, there are 19 states with more than 1,000 MW of ripe-for-retirement coal-fired generating capacity, all in the eastern half of the United States. Georgia leads all states with more than 7,400 MW of ripe-for-retirement capacity; several other Southeast states also top the list. However, if previously announced retirements were added to the high estimate, the state rankings would shift. For example, several Midwest states would move up in rank as a result of significant recent coal retirement announcements. As a result of nearly 6,800 MW in announced retirements—more than any other state—Ohio tops the rankings in total coal-fired generating capacity both scheduled for retirement and ripe for retirement.

* Rankings for top 20 states are given in parentheses. State totals of ripe-for-retirement coal capacity do not include announced retirements.

[4] One million British thermal units (MMBtu, a unit of measure of the energy content of fuel) is equivalent to 1,000 cubic feet of natural gas.

case projections from its *Annual Energy Outlook 2012* (EIA 2012c). The low-price case, which is a 25 percent decrease in the EIA's reference case projections, leads to a natural gas price of $3.66/MMBtu. The high-price case, which is a 25 percent increase, leads to a natural gas price of $6.10/MMBtu.

In comparing this set of alternative scenarios we find that varying the natural gas price has the most dramatic effect on how many coal units are deemed uncompetitive. Wind power with a continuation of existing federal tax credits has a similar level of impact on the economic viability of coal generators as does the high estimate in our core case of comparing the operating costs of coal generators with the operating costs of existing natural gas plants. Placing a price on carbon dioxide emissions would also have a significant impact on the economics of coal generators. It is important to note, however, that although these comparisons set analytical bounds on our analysis, they do not prescribe which energy resources should in fact replace coal.

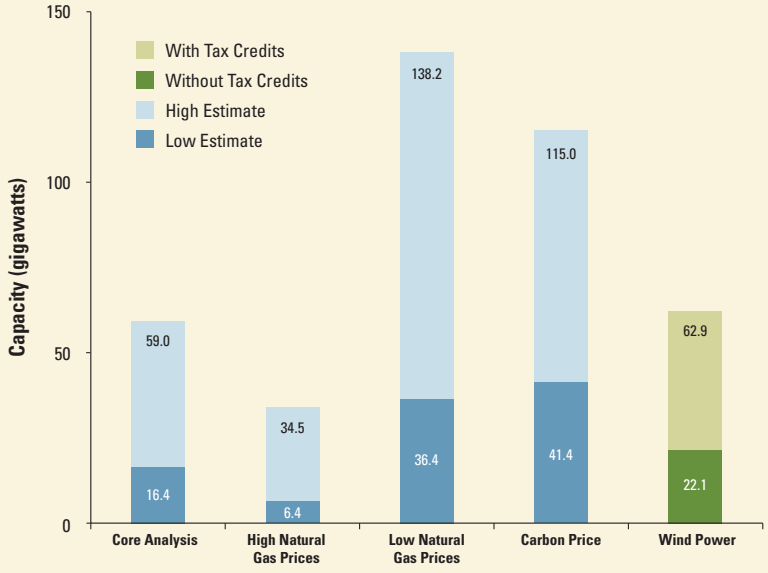
This report attempts to characterize which coal generators are most economically vulnerable under current and possible near-term economic and regulatory conditions in the power market. It can help utilities, state and federal regulators, and banks decide whether it makes more economic sense to retire certain coal-fired generators, and potentially replace them with cleaner energy alternatives, instead of sinking hundreds of millions—and in some cases billions—of dollars in additional capital into retrofitting them with modern pollution controls.

Table ES-2. Top 10 Power Companies with Most Ripe-for-Retirement Generators (High Estimate)

Rank	Power Company	Ripe-for-Retirement Generators			Capacity of Announced Retirements (MW)
		Capacity (MW)	Number of Generators	Location (State)	
1	Southern Company	15,648	48	Alabama, Florida, Georgia, Mississippi	1,350
2	Tennessee Valley Authority	5,385	28	Alabama, Kentucky, Tennessee	969
3	Duke Energy Corp.	2,760	17	Indiana, North Carolina	3,230
4	American Electric Power Company, Inc.	2,355	4	Indiana, Virginia, West Virginia	5,846
5	FirstEnergy Corp.	2,075	7	Ohio, Pennsylvania	3,721
6	Public Service Enterprise Group Inc.	1,713	4	Connecticut, New Jersey	0
7	Progress Energy, Inc.	1,685	3	Florida, South Carolina	2,532
8	Wisconsin Energy Corp.	1,653	10	Michigan, Wisconsin	384
9	SCANA Corp.	1,405	3	South Carolina	883
10	GenOn Energy, Inc.	1,385	6	Maryland, West Virginia	3,882

We recognize that factors other than operating costs can and will influence which coal generators are retired. Such factors include whether the coal units are located in regulated or deregulated electricity markets, which can greatly influence whether power plant owners can pass coal plant upgrade costs on to ratepayers. Other key factors include where the coal units are located on the power grid, what cleaner alternative energy sources are available nearby, and whether power transmission lines are available to deliver those cleaner alternatives to customers. The trend, however, is clear: collectively, these factors are leading to an accelerated retirement of coal generating capacity in the United States.

Figure ES-3. Coal Generating Capacity Deemed Ripe for Retirement under Alternative Scenarios



Our analysis reveals that low natural gas prices and a price on carbon dioxide have the greatest impact in expanding the pool of coal-fired generators deemed ripe for retirement, and that extending the federal tax credits for wind power is also significant. Alternative scenarios explore three external economic factors that could influence the coal-fired generating capacity deemed ripe for retirement. In the core analysis (far left), the low estimate (dark blue alone) compares the operating cost of coal generators with the operating cost of a new NGCC plant; the high estimate (combined dark blue and light blue) compares the operating cost of coal generators with the operating cost of existing NGCC plants. The middle three bars repeat the analysis for hypothetical scenarios where natural gas prices might be 25 percent higher or 25 percent lower, or where a $15/ton price might be put on carbon dioxide emissions. For the wind power scenario (far right), the analysis illustrates the capacity of coal-fired generators deemed ripe for retirement if federal tax credits for wind power are allowed to expire (dark green) or are extended (combined dark green and light green).

A Boon for Public Health

Retiring many or all of the coal units identified as ripe for retirement within this decade would improve public health by cutting the amount of dangerous pollution that coal-fired power plants emit into the air we breathe and water we drink, including sulfur dioxide, nitrogen oxides, particulate matter, mercury, and other toxic substances. Such pollutants have been linked to numerous health problems including aggravated asthma attacks, breathing problems, neurological damage, heart attacks, and cancer. Moreover, closing those plants would cut emissions of carbon dioxide, the principal contributor to global warming, and reduce the risks of heat stress and ozone pollution, which are both linked to higher temperatures, among other health-related concerns (EPA 2012; CATF 2010; EPA 2010a; Gentner 2010; NRC 2010; Trasande, Landrigan, and Schechter 2005).

Basing our assessment on the 2009 emissions profiles for all 353 coal generators in our high estimate, shutting down all the ripe-for-retirement coal generators could annually avoid approximately 1.3 million tons of SO_2 and 300,000 tons of NO_x emissions, as well as significant amounts of mercury, particulates, and other toxic emissions—depending on the emissions profile of the power resources that replace them. Replacing 100.2 GW of coal generators (the total sum of the 41.2 GW of announced retirements plus the additional 59 GW of ripe-for-retirement

A wholesale switch to natural gas is not a long-term solution to the climate problem: natural gas is cleaner-burning than coal but still leads to significant carbon dioxide emissions.

generators) by ramping up existing natural gas facilities (many of which are underutilized) would reduce annual carbon dioxide emissions from power generation by approximately 245 million tons—equivalent to 9.8 percent of U.S. power sector CO_2 emissions in 2010. Carbon dioxide emissions at the plant level would be substantially reduced because new natural gas power plants emit about 40 percent of the carbon dioxide that existing coal-fired plants do per unit of electricity produced (EIA 2012c; EIA 2011a). Even bigger reductions could be realized if all 100.2 GW of coal generators were replaced entirely with wind power and other zero-emissions sources, and energy demand were reduced due to greater energy efficiency. In that case, CO_2 emissions could be cut by 410 million tons annually—equal to a 16.4 percent reduction in 2010 U.S. power sector global warming emissions.

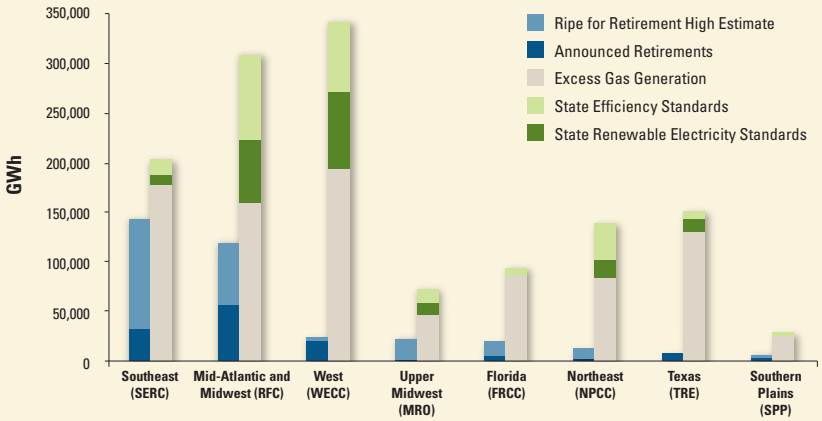
A Reliable Transition

While we rely on the economics of natural gas facilities for comparison with coal in our analysis, we are not suggesting that retiring coal generators should simply be replaced with natural gas—they should be replaced by a mix of cleaner energy resources (including wind, solar, geothermal, and biomass) in addition to natural gas. Moreover, some of the reduction in coal generation would not need to be replaced at all if states put in place measures that reduce electricity demand (through energy efficiency, for example). Investments in new transmission lines could be targeted to bring renewable energy to market. Investments in advanced energy technologies that better balance supply and demand, and integrate large amounts of variable resources into the electricity grid, could also help enable a smooth transition to a low-carbon energy future in the long run.

Increased electricity supply from natural gas could come from two sources: greater use of the nation's abundant and underutilized existing natural gas generation capacity, and the development of a limited number of new natural gas power plants. The nation's natural gas power plant fleet operated at only 39 percent of its design capacity in 2010. The amount of additional electricity that could be generated by running these plants at 85 percent capacity would exceed the amount (100.2 GW) of electricity generated by all coal generators already announced for retirement plus all 353 additional generators we deem ripe for retirement in our high estimate. Indeed, the power supply would be adequate in every region of the country (Figure ES-4, p. 10), although a more detailed analysis of the electricity grid would be needed to identify potential supply and demand imbalances that could result from coal-unit retirement. In addition, analysis of natural gas pipeline capacity would be needed to determine the adequacy of pipeline infrastructure to support increased natural gas generation. But the abundance of underutilized *already existing* natural gas generating capacity across the country suggests that any need for replacement generating capacity would not be a barrier to retiring coal units in most areas.

Retiring coal generators would cut many harmful pollutants that damage public health and contribute to global warming. Closing all 353 ripe-for-retirement coal generators would annually avoid as much as 410 million tons of CO_2, 1.3 million tons of SO_2, and 300,000 tons of NO_x emissions.

Figure ES-4. Renewable Energy, Energy Efficiency, and Existing Excess Natural Gas Can Readily Replace Retiring Coal Generation by 2020*



Old, inefficient coal-fired generators deemed ripe for retirement can be shut down with minimal impact on the reliability of the nation's electricity grid. Every region of the country has the potential to replace the generation from both announced retirements (dark blue) plus units we identify as being ripe for retirement (medium blue). They can do so through a combination of ramping up underused natural gas plants (gray), and making use of new renewable energy generation (dark green) and energy efficiency savings (light green) that are projected to be developed over the next eight years as a result of existing policy requirements, including existing state-level renewable electricity standards and energy efficiency resource standards.

* The North American Electric Reliability Corporation (NERC) oversees reliability for a bulk power system that includes the United States and Canada. In this effort, NERC coordinates with eight regional entities to maintain and improve the reliability of the power system. These entities are composed of utilities, federal power agencies, rural cooperatives, independent power marketers, and end-use customers. Excess gas generation was estimated by determining the amount of generation that would be produced if existing gas facilities increased electricity production to 85 percent of their capacity. State efficiency standards and renewable electricity standards are the GWh of savings or generation that would occur if state policy goals are met through 2020.

Over the next eight years (that is, by 2020), we project that existing state policies requiring the use of renewable electricity and energy-saving technologies will generate or save more electricity than would be lost (100 GW) through the closure of retired coal generators (UCS 2012). Such clean energy gains would exceed the amount of power generated in 2009 by these coal units in most regions of the country, as shown in Figure ES-4.

Our Clean Energy Future

Apart from the uneconomic coal-fired generating capacity that is already planned for shutdown or ripe for retirement based on current economic considerations, we need to consider the long-term implications of continuing to operate the remaining 229 GW of coal-fired generation capacity that still appears economically viable in the short term. The stark reality is that avoiding the worst effects of climate change requires profound and aggressive action to decarbonize our power sector, and rapidly. Many studies have demonstrated that a smooth transition to low-carbon or carbon-free sources of energy is technically feasible and can be affordable, given stable and supportive long-term clean energy and climate policies (e.g., Specker 2010; UCS 2009).

While the current policy landscape is challenging, the risks of unchecked climate change are becoming ever clearer. Policy makers should consider the significant health and economic risks of unchecked climate change and take broad action to cut carbon dioxide emissions, which could include putting a price on carbon dioxide pollution. With this future cost in mind, making expensive investments to upgrade the remaining coal fleet with needed pollution controls is financially risky, as it may simply be postponing the inevitable: these newer coal plants will also eventually need to be shut down (or retrofitted with very expensive, and as yet untested, carbon dioxide capture and sequestration technology) to meet climate policy goals. Cleaner, low- or no-carbon energy sources are far better long-term investments.

A wholesale switch to natural gas is not a sustainable solution to the climate crisis. Although cleaner-burning than coal and with less than half the carbon content, natural gas is still a fossil fuel; burning it still leads to significant emissions of carbon dioxide. Moreover, natural gas itself (mainly

composed of methane) is a far more powerful global warming gas than carbon dioxide, and methane leakage associated with drilling, processing, and transporting natural gas raises its life-cycle global warming emissions. Drilling practices such as hydraulic fracturing also lead to significant environmental and health concerns, such as the potential contamination of drinking water supplies.

Thus, investments in renewable energy and reducing electricity demand through greater efficiency, supported by sustained federal and state policies, will be critical to transitioning to a low-carbon electric system over time.

Recommendations

In states with a large number of economically vulnerable coal generators, the closure of ripe-for-retirement units presents a historic opportunity to accelerate a transition to a clean energy economy that will improve environmental quality, reduce carbon dioxide emissions, protect public health, and create new jobs.

National and state policies and regulations have a crucial role in promoting and supporting a transition to a clean energy economy.

Clean air standards. The Environmental Protection Agency (EPA) has already finalized strong standards for several harmful pollutants from coal-fired plants, including NO_x, SO_2, mercury, and other toxic pollutants. It is also expected to finalize, for both new and existing power plants, standards for carbon dioxide emissions, coal ash disposal, and wastewater and cooling-water intake structures—and should implement them without delay to level the playing field for cleaner generation sources and reduce investment uncertainty. These standards will require plant owners to install pollution control technologies at many conventional coal plants that will significantly reduce their harmful impacts to the environment and public health. Plants where upgrades are not economic may then be shut down. Power plant owners may also choose to shift generation to cleaner sources that are able to comply with the standards. The EPA has already signaled that it will use existing flexibilities in the Clean Air Act to ensure that power plant operators have reasonable time to comply with the EPA's standards, and that it will coordinate closely with the Federal Energy Regulatory Commission (FERC) and regional reliability authorities to ensure that the implementation of the standards has minimal effect on the reliability of the electric system.

Stronger state and federal policies such as renewable electricity standards and energy efficiency resource standards are needed to accelerate the transition to a low-carbon energy future.

By 2020, existing state policies requiring the use of renewable electricity and energy-saving technologies will generate or save more electricity than would be lost by closing ripe-for-retirement coal plants.

Energy efficiency and renewable electricity standards. Twenty-nine states have already adopted renewable electricity standards requiring utilities to gradually increase their use of renewable energy, and 27 states have established targets for energy savings achieved through investments in energy efficiency (UCS 2012; ACEEE 2011). Those states can accelerate the transition from coal by strengthening such standards. Other states that have not yet implemented such policies should take the lead from the forward-thinking majority of the nation and enact similar provisions. Even more effective would be a strong federal standard that sets minimum national targets

for renewable energy and energy savings—although states should not wait for the federal government to act. In addition, Congress should extend by at least four years federal incentives for renewable energy and energy efficiency, including the federal production tax credit (PTC) for wind power and other renewable sources. Congress should also reduce federal incentives for fossil fuels and nuclear power, as these mature technologies have already received enormous subsidies for decades that continue to give these unsustainable resources an unfair market advantage.

Electric system planning. Transmission planning entities such as regional transmission organizations (RTOs) and independent system operators (ISOs) that operate large sections of the nation's power grid are uniquely positioned to help shape our clean energy future, assuming they function in an inclusive and transparent manner. Utilities and transmission planning authorities should make public their analyses about what transmission system improvements or additions to the energy resource mix may be needed when coal-fired power plants shut down. In addition, transmission planning authorities must fully comply with FERC Order 1000, which requires all transmission planning entities to consider all relevant state and federal clean energy policies and pollution standards when determining what mix of infrastructure investments will be needed to meet projected customer demand while maintaining reliability. Likewise, regulators in traditionally regulated cost-of-service states should require the utilities they regulate to conduct system-wide planning that evaluates all available alternatives to meet electricity needs in their state, including energy efficiency and clean energy technologies. State regulators should allow a utility to recover the cost of pollution controls from ratepayers only if the utility has demonstrated that the public interest could not be better served by retiring the coal plant and replacing it with more affordable clean energy alternatives. In deregulated states, merchant power producers, who may not be able to recoup an investment in expensive pollution controls in competitive wholesale power markets, are already finding that the bankers who finance investments to retrofit old coal plants are increasingly skeptical about whether such capital investments are financially prudent.

State regulators should not allow a utility to recover the cost of pollution controls from ratepayers if a coal plant can instead be retired and replaced with more affordable clean energy alternatives.

Renewable energy and efficiency as the primary replacement for coal. Historically low natural gas prices and a lack of steady federal policy support for renewable energy and energy efficiency could result in natural gas replacing much of the retiring coal capacity. Simply shifting our reliance on coal to a new reliance on natural gas would be a huge missed opportunity to transition the electric system to truly low- or no-carbon resources that have less impact on the environment and public health. Deliberate policy support at the federal, state, and regional levels is needed to ensure that renewable energy and energy efficiency are not crowded out by a hasty, risky, uncontained rush to natural gas.

Near-term policies are only the beginning of the journey toward achieving a clean, sustainable energy system that will protect public health and achieve the reductions in carbon dioxide necessary to avoid global warming's worst consequences. The nation can and must expand these and other policies to ensure that we achieve these emissions reductions at the lowest possible cost and with the greatest benefits to society. Closing coal plants that are ripe for retirement and replacing them with cleaner, low-cost alternatives, particularly with renewable energy and reduced energy demand through energy efficiency, is a good start.

The fully referenced report and technical appendices are available online (in PDF format) at *www.ucsusa.org/ripeforretirement*.

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