Union of Concerned Scientists

Citizens and Scientists for Environmental Solutions

A **Risky** Proposition

The Financial Hazards of New Investments in Coal Plants

EXECUTIVE SUMMARY

Across the United States, the electric power sector is placing new bets on an old technology—coal-fired power plants. Utilities and other electricity producers are poised to invest heavily in retrofitting their old plants or in building new ones. Each major retrofit or new plant represents an enormous long-term financial commitment to coal power. But as discussed in this report, current economic, technological, and policy trends make such commitments exceedingly risky.

Demand for coal power is being steadily eroded by competition from energy efficiency and renewable energy, which are benefiting from rising policy support, growing public investment, advancing technologies, and often-falling prices. Coal power also faces much stronger competition both from new and existing (though underutilized) natural gas plants, which can take advantage of today's relatively low gas prices.

Coal prices, by contrast, are on the rise. Having spiked in 2008 in response to global coal demand, they are climbing again with the global economic recovery. There is growing concern, moreover, that they could be driven much higher by soaring demand from China and India, as well as by falling productivity across all U.S. coalfields and by shrinking reserve estimates. Construction costs for coal plants, which skyrocketed in the years prior to 2008, remain high, and all these risks make the financing of long-term coal investments both harder and costlier. Coal plants, new and old, are losing the cost advantages they once had, and they lack the operational flexibility that will be increasingly valuable as the power grid evolves to integrate more sources of clean but variable renewable power.

In addition to these ongoing structural changes, which are making coal power increasingly costly and less competitive, coal power faces the financial risks posed by its many environmental impacts. The continuing damages that coal power poses to our air, land, and water—and our health—are a major financial liability that remains unresolved. Coal plants emit air pollutants that still kill thousands of people yearly, costing society over

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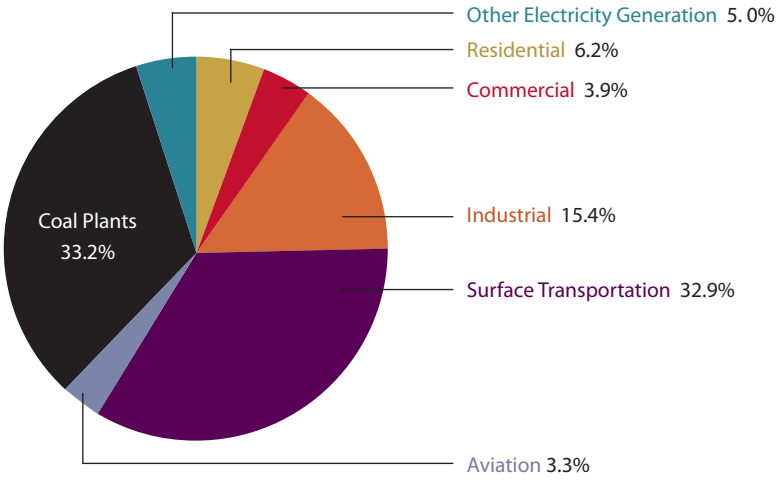
$100 billion per year, by one estimate (CATF 2010). These plants are also a leading source of mercury, which threatens children's brain development; they create vast quantities of toxic ash, which require careful handling in order to prevent leakage; and their huge cooling-water withdrawals strain our increasingly vulnerable water bodies. Expected regulations would reduce many of these costly harms, but as several recent financial analyses point out, much of the nation's coal fleet is

Figure ES.1. U.S. CO_2 EMISSIONS FROM ENERGY USE BY SOURCE, 2009



More CO_2 is emitted from coal plants than from any other technology or sector, including all modes of surface transportation combined (EIA 2011a). (Power plant emissions are presented under coal plants and other electricity generation, rather than under the residential, commercial, and industrial sectors where the power is consumed.)

already old, inefficient, and ripe for retirement. Rather than retrofit them, it makes greater economic sense to close them.

Finally, there is the unavoidable financial risk associated with coal's critical role in destabilizing the global climate. Given the increasingly dire nature of global warming, climate legislation is still widely expected in the years ahead, with inevitable cost implications for coal plants.

Combined, these trends and developments create risks that no one considering a long-term investment in new or existing coal plants can afford to ignore. They also create unique opportunities to invest instead in the cleaner technologies that will be in growing demand as we transition toward a more modern, flexible, diversified, and sustainable energy system.

"The need for urgent action to address climate change is now indisputable." This warning was part of a 2009 joint statement by the U.S. National Academy of Sciences and its counterpart academies from 12 other nations, urging world leaders to take action to slow global warming (NAS 2009). Already, the climate is changing, both faster and in more dangerous ways than computer models had projected, and much worse lies ahead if we fail to make deep cuts in our global warming emissions (NRC 2010a).

Deep emissions cuts are needed from coal plants. Coal power is the nation's largest source of CO_2, emitting more than all of our cars, trucks, and other modes of surface transportation combined (Figure ES.1). As the source of one-third of energy-related CO_2 emissions, coal plants must be a primary source of the reductions we need to protect the climate. Indeed, reducing emissions from coal plants is a particularly cost-effective approach to climate protection (Cleetus, Clemmer, and Friedman 2010).

A future price on carbon still threatens coal investments. The 111th Congress failed to pass a comprehensive climate bill, and the 112th Congress is even more deeply divided on the issue, thereby perpetuating uncertainty over the timing and nature of future climate policies and their impacts on coal plants. However, the growing urgency of global warming means that Congress will face sustained pressure to tackle the problem again, perhaps repeatedly over the years, until the nation is off the dangerous path it is currently traveling (unless other factors, such as a steep decline in coal use driven by the other risks discussed in this report, succeed in slashing our carbon emissions). Because a price on carbon would help to stimulate private-sector innovation, it remains a likely element of such future climate policies; and as the source of power that has the highest carbon emissions, coal would thereby be disadvantaged compared with cleaner technologies.

Carbon-capture retrofits cannot be counted on to cut emissions affordably. While projects to demonstrate the potential of carbon capture and storage (CCS) are important, it would be financially reckless to make coal-plant investments based

on the assumption that CCS retrofits will provide an affordable way for those plants to avoid a future price on CO_2 emissions. There are still no coal-fired power plants using CCS on a commercial scale. Design estimates indicate that CCS could increase the cost of energy from a new pulverized coal plant by 78 percent, and costs would be even greater if CCS were added as a retrofit (ITF CCS 2010). It is always possible that future advances in CCS technology will drive such costs down substantially, but the CCS projects under development today have faced serious cost overruns and delays. Moreover, the fall in natural gas prices, concern over future coal supplies and prices, and the failure of the 111th Congress to pass climate legislation—which would have put a price on carbon and established massive subsidies for CCS—may further delay CCS development.

Many of the nation's coal plants are old, inefficient, and ripe for retirement. Seventy-two percent of present U.S. coal capacity is already older than 30 years—the operating lifetime for which coal plants were typically designed—and 34 percent of the nation's coal capacity is more than 40 years old (Bradley et al. 2010). Older plants become increasingly inefficient and unreliable, and they face high maintenance and capital costs if they are to continue operating economically. And because they were built before modern pollution controls were required and over the decades many have avoided adding those controls, older plants are generally far more polluting than new ones and face significant retrofit costs as a result.

Coal plant operators in various parts of the country—including Colorado, Delaware, Georgia, Illinois, Indiana, Minnesota, North Carolina, Ohio, and Pennsylvania—have already announced the retirement of dozens of their oldest plants (Bradley et al. 2010). By December 2010, 12 gigawatts (GW) of coal plant retirements had already been announced (Salisbury et al. 2010). Financial and industry analysts expect the wave of retirements to grow. In the words of a Credit Suisse analyst, "a large chunk of the U.S. coal fleet is vulnerable to closure simply due to crummy economics" (Eggers et al. 2010). In announcing the closure of three of its older coal units, Exelon Corp. noted, "these aging units are no longer efficient enough to compete with new resources" (Power-Gen Worldwide 2009).

Excess generating capacity in the United States will facilitate coal retirements. The nation currently has ample generating capacity, which can help it accommodate the projected coal plant retirements and still maintain the reliability of the power system (Bradley et al. 2010; Shavel and Gibbs 2010).

Coal is no longer a reliably low-cost fuel, in part because it is increasingly vulnerable to volatile global markets.

One recent analysis found that the power sector "is expected to have over 100 GW of surplus generating capacity in 2013" (Bradley et al. 2010).

New coal plants are not economic, even under current policies. The economic outlook for new coal plants is very different from what it was just a few years ago.[1] When most new plant projects in the pipeline today were announced, the U.S. Energy Information Administration (EIA) computer model predicted a large amount of new coal plant construction in the years ahead (Figure ES.2, p. 4). But now the same model no longer projects any new coal plants without CCS coming online through 2030 (apart from 11.5 GW of new coal plants that the EIA counts as already under construction and assumes will be completed). The EIA's modeling has historically underestimated coal plant costs, but it is starting to reflect the economic realities that have already led to the recent cancellation or rejection of about 150 coal plant proposals nationwide and that threaten the remaining coal plant proposals as well.

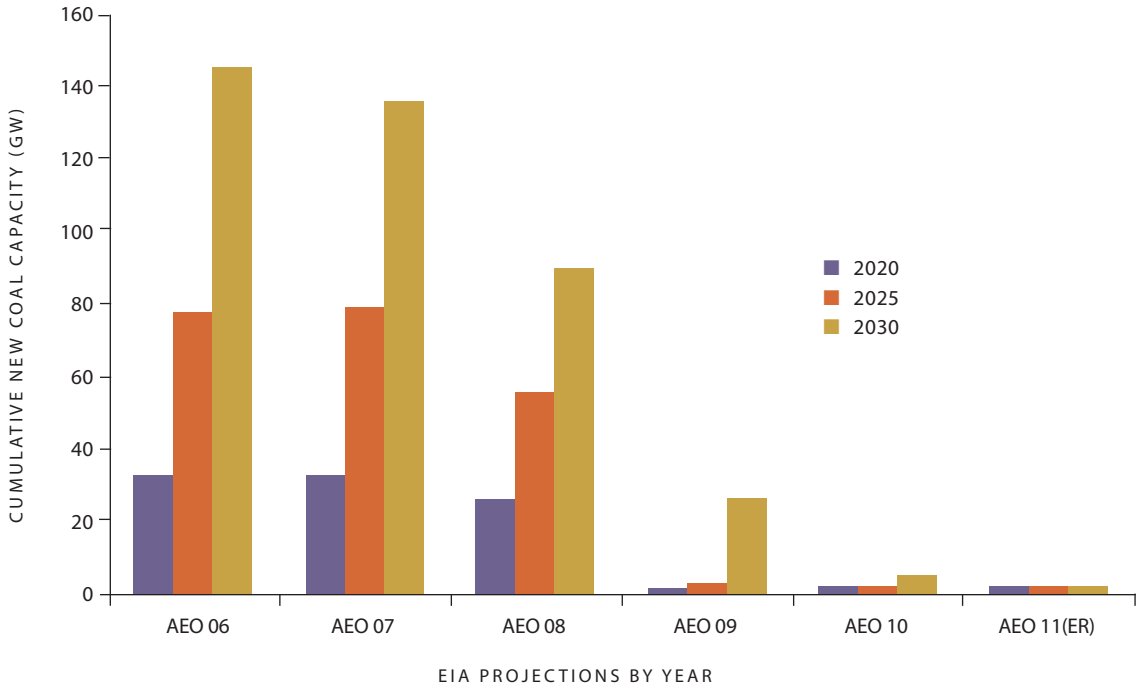
Demand for coal power will continue to fall as the nation turns to cleaner options. Coal provided almost 53 percent of U.S. power demand in 1997, but market share dropped to less than 46 percent in the first half of 2010. Given the strong growth of competing cleaner technologies, this decrease is likely to continue.

- *Energy efficiency* has enormous potential to cut power demand—by 23 percent below projected levels by 2020 and by even more if the technology is assumed to advance (Goldstein 2010; Granade et al. 2009). That potential is beginning to be realized, as 27 states at present—double the number in 2006—have adopted or have pending energy efficiency resource standards that over time can

1 While many of the new coal plants announced over the last few years were subsequently cancelled or blocked (largely as a result of the economic and policy trends discussed in this report), dozens of proposals are still on the table. The Sierra Club maintains a database of coal-fired power plant proposals around the country. As of January 2011, it lists 149 coal projects as recently cancelled or rejected, 50 plants as active or upcoming, 26 plants as progressing (some of which have been completed), and 18 plants with uncertain status (Sierra Club 2011).

Figure ES.2. DECLINING FEDERAL PROJECTIONS OF NEW COAL PLANTS THROUGH 2030

In its Annual Energy Outlooks (AEOs), the EIA's projections of unplanned coal capacity coming into service by 2020, 2025, and 2030 have dropped dramatically. In 2006 the EIA projected 145 GW of new coal by 2030 (the equivalent of about 240 new plants of 600 megawatts). But the agency now projects only 2 GW by 2030, consisting entirely of advanced plants with CCS technology that are inputs to the model based on the assumed response to federal subsidies. Planned capacity additions—plants that the EIA understands to be under construction already—are not reflected (EIA 2006, 2007, 2008a, 2009a, 2010a, 2011a).



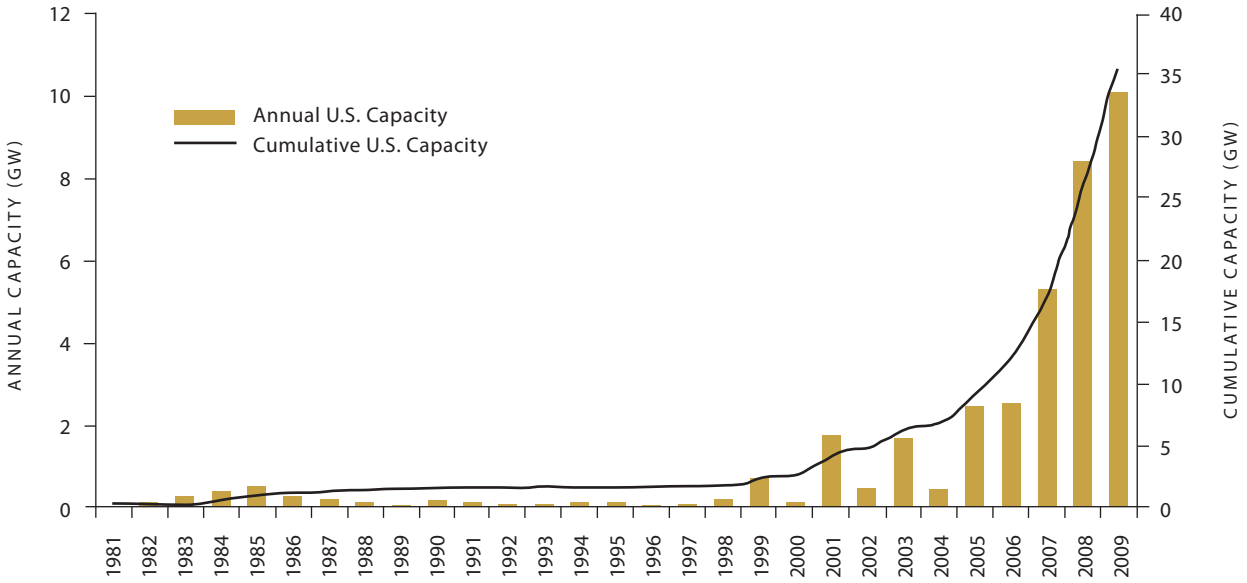
greatly reduce electric demand (ACEEE 2010a). State spending on ratepayer-funded electricity- and gas-efficiency programs nearly doubled between 2007 and 2009, rising from $2.5 billion to $4.3 billion (ACEEE 2010a). And new federal appliance standards for more than 20 consumer products will help reduce consumer demand for years to come.

- *Renewable power* is capturing a growing share of the market from coal, and it has the potential to go much further. While non-hydro renewable power provided 3.6 percent of U.S. generation in 2009, the EIA projects that it will increase to 11.7 percent by 2030, primarily because of existing state policies and federal incentives (EIA 2010a). Federal research also concludes that we could meet nearly a quarter of our power needs with renewable power by 2025 with no significant impact on consumer prices at the national level (Sullivan et al. 2009). Wind alone could meet 20 percent of demand by 2030 (EERE 2008), and indeed wind capacity has been added to the grid at a remarkable pace over the last few years (Figure ES.3). Both photovoltaic (PV) and concentrating solar power (CSP) are seeing dramatic growth in their market shares as well, with major new projects moving forward and prices for solar panels falling markedly. New renewable capacity will continue to enter the system, even without further policy changes, as a result of the renewable energy standards already adopted by 30 states and advances in renewable technology.

- *Natural gas* represents another major threat to coal power. The nation has more than 220 GW of efficient natural gas combined-cycle plants, many built in just the last decade. These plants are still greatly underused, operating at 42 percent of capacity in 2007 (Kaplan 2010) and at only 33 percent in 2008 (Bradley et al. 2010). Moreover, gas prices—and price projections—have fallen significantly,

Figure ES.3. WIND POWER GROWING AT RECORD PACE

U.S. wind power capacity expanded by over 50 percent in 2008 alone and continued to expand in 2009 despite the recession (Wiser and Bolinger 2010).



partly as a result of technological breakthroughs in drilling that have the potential to dramatically increase domestic gas production for years (as long as the industry can resolve growing concerns over impacts on water and new questions about methane leakage during production). Ramping up the use of existing gas plants could allow the nation to substantially cut its coal-based electricity generation (Casten 2010; Kaplan 2010). Moreover, new gas plants could be built at a relatively low cost and existing coal plants could be repowered to burn natural gas. While environmental concerns or other factors may drive gas prices back up, would-be coal investors cannot ignore the competitive threat from gas. "Coal is losing its advantage incrementally to gas," a gas analyst with Barclays Capital recently told the *New York Times*, and an energy analyst with Credit Suisse said that the shift from coal to gas "has the potential to reshape energy consumption in the United States significantly and permanently" (Krauss 2010).

U.S. coal prices are rising and could be driven much higher by soaring global demand and shrinking reserves. Coal is no longer a reliably low-cost fuel, in part because it is increasingly vulnerable to volatile global markets. Eastern U.S. coal spot prices spiked in 2008 (Figure ES.4, p. 6), mainly in response to the rising price of coal in international trade, and prices are climbing again as rapidly rising coal demand in China pushes global coal prices higher. Western U.S. coal producers are currently less exposed to global markets, but the price for a one-month contract for Powder River Basin coal still rose 67 percent between October 2009 and October 2010 (Jaffe 2010). Moreover, Powder River Basin coal producers are seeking to build transportation infrastructure to expand their reach to Asian markets, potentially subjecting Western coal to price spikes similar to those experienced in the eastern United States. Chinese officials have announced plans to cap their own coal production, putting even greater upward pressure on global and U.S. coal prices (Reuters 2010a).

New questions are also being raised about just how much economically recoverable coal exists, both in the United States and elsewhere. Official reserve estimates are based on decades-old data and methods. More modern assessments are finding less economically recoverable coal than was commonly thought, including in Wyoming's important Gillette coalfield (Luppens et al. 2008). The fact that productivity at U.S. mines has been dropping for years, not only in the more mature and depleted eastern coalfields but also in the newer mines of the

west, points to likely higher coal production costs ahead—in contrast to the lower production costs expected for natural gas. New studies that project future coal production, including some that make projections by fitting a bell curve to past production levels (an analytic method that remains controversial), predict that we are much nearer to peak coal production than traditional reserve estimates suggest (Heinberg and Fridley 2010; Patzek and Croft 2010; Rutledge 2010; EWG 2007). Coal prices in some markets may also rise in response to efforts to reduce the damage caused by mountaintop-removal mining.

Coal plants also face costs associated with reducing their non-climate environmental impacts. Because coal plants, especially older ones, cause grave harm to the environment and public health, the U.S. Environmental Protection Agency (EPA) is developing more protective regulations (largely in response to court orders requiring it to implement existing statutory standards). Plants face costs associated with:

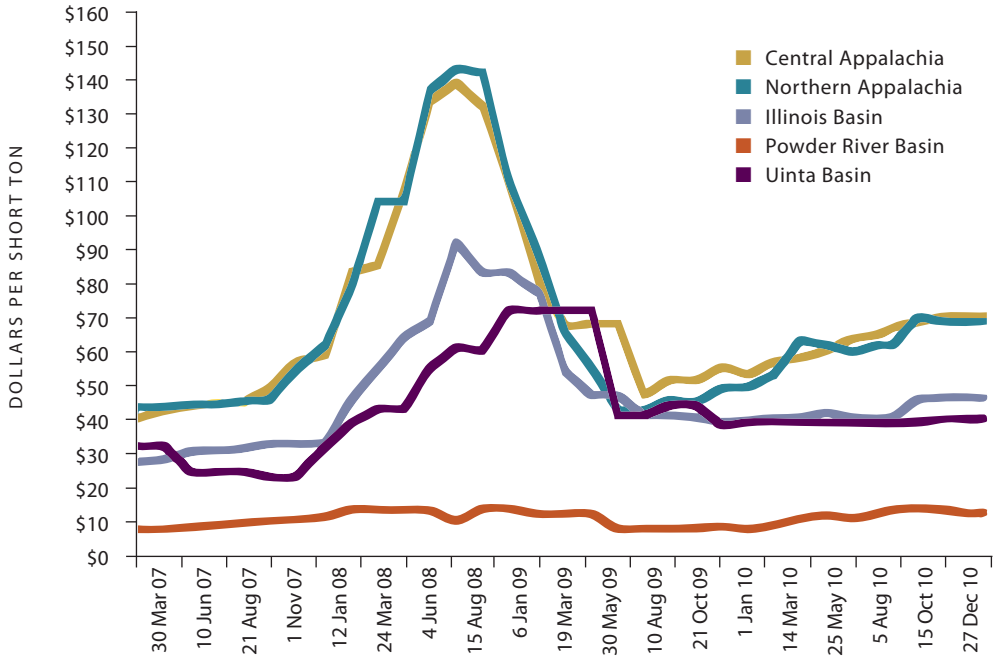
- *Preventing thousands of deaths from heart and lung disease.* Coal power is a major source of sulfur dioxide (SO_2) and nitrogen oxide (NO_X) emissions, which are transported downwind and cause ozone and particulate pollution that shorten the lives of thousands of Americans yearly; these emissions have been estimated to impose annual costs on society of more than $100 billion (CATF 2010). The EPA's proposed Clean Air Transport Rule would prevent many of these premature deaths, as old and uncontrolled plants would finally be required to install controls on SO_2 and NO_X.

- *Protecting children's brains from impairment.* Coal power is the source of at least half of U.S. emissions of mercury, a potent neurotoxin that threatens fetal and infant brain development. The EPA's forthcoming Air Toxics Rule, limiting mercury and other toxic emissions, would require uncontrolled plants to install controls on these pollutants.

- *Keeping toxic coal ash from contaminating the water.* Coal ash contains many toxic components and is currently stored in ways that can result both in catastrophic releases (such as the Kingston, TN, ash spill of 2008) and in slow leakage into ground and surface waters. Proposed EPA rules would

Figure ES.4. AVERAGE WEEKLY COAL SPOT PRICES

Coal prices spiked dramatically in 2008, largely in response to the influence of global coal demand on U.S. coal markets, particularly in Appalachia (EIA 2010e). Prices in most basins are rising again with the economic recovery.



require safer ash handling and potentially oblige many plants to convert from "wet" handling in surface impoundments to "dry" handling in lined landfills; plants could also be required to add new water treatment systems in order to keep toxins out of our water supplies and ecosystems.

- *Reducing fish kills and protecting water bodies.* Coal plants use vast quantities of water from adjacent rivers, lakes, and bays, taking a heavy toll on aquatic life as a result. The EPA is considering new rules that would require more coal (and other thermal power) plants to install cooling towers that would greatly reduce the amount of water they withdraw and the thermal pollution they discharge.

Retrofitting coal plants with pollution controls and other technologies could greatly reduce these environmental and health damages, and the retrofits would cost much less than what the damages currently cost society. However, the retrofit costs would be substantial for many plants, particularly the oldest and dirtiest. The limited remaining useful life of many older coal plants would make such investments difficult, if not impossible, to recover, making retirement the better financial option.

Major coal projects face high and unpredictable construction costs. Coal plant construction costs rose at a rapid rate in the years leading up to 2008, contributing to the cancellation of many proposed facilities. Despite the subsequent recession, construction costs have remained high (IHS CERA 2010), and some coal plant projects were still announcing substantial cost increases in 2010. Much of the construction-cost increase was driven by rising global commodity costs. While these commodity prices went back down with the global economic crisis, they rebounded quickly, and experts project that they will remain high by historical standards (IMF 2010).

Coal project financing may be harder to obtain and may cost more. The trends discussed above increase the risk that coal investment projects will fail to obtain the financing they need or that they will have to pay more for it than planned. The financial community is becoming increasingly wary of the risks associated with new investments in coal. A series of utilities and other power producers have seen their credit ratings and outlooks downgraded, in part because of the ratings agencies' concerns about coal construction or retrofit costs.

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New coal plants cost more than cleaner options. The traditional cost advantage that coal power enjoyed over cleaner energy has largely disappeared with respect to new plants. Figure ES.5 (p. 8) compares the levelized costs of electricity[2] from new coal plants to those of other new sources of power, both with and without incentives and using a range of assumptions described in Part 8 (and in Appendix A, which is available online). Power from new coal plants clearly costs more than power from new gas plants, wind facilities, and the best geothermal sites, and much more than investing in energy efficiency. When either carbon prices or incentives are factored in, power from new coal plants (with or without CCS) becomes even less competitive, costing more than power from biomass facilities or from the best solar thermal and solar photovoltaic sites. These comparisons reflect a range of coal prices (but do not fully represent the risk that coal prices could rise steeply due to volatile global markets and other causes) and they incorporate conservative assumptions about falling prices of renewable technology.

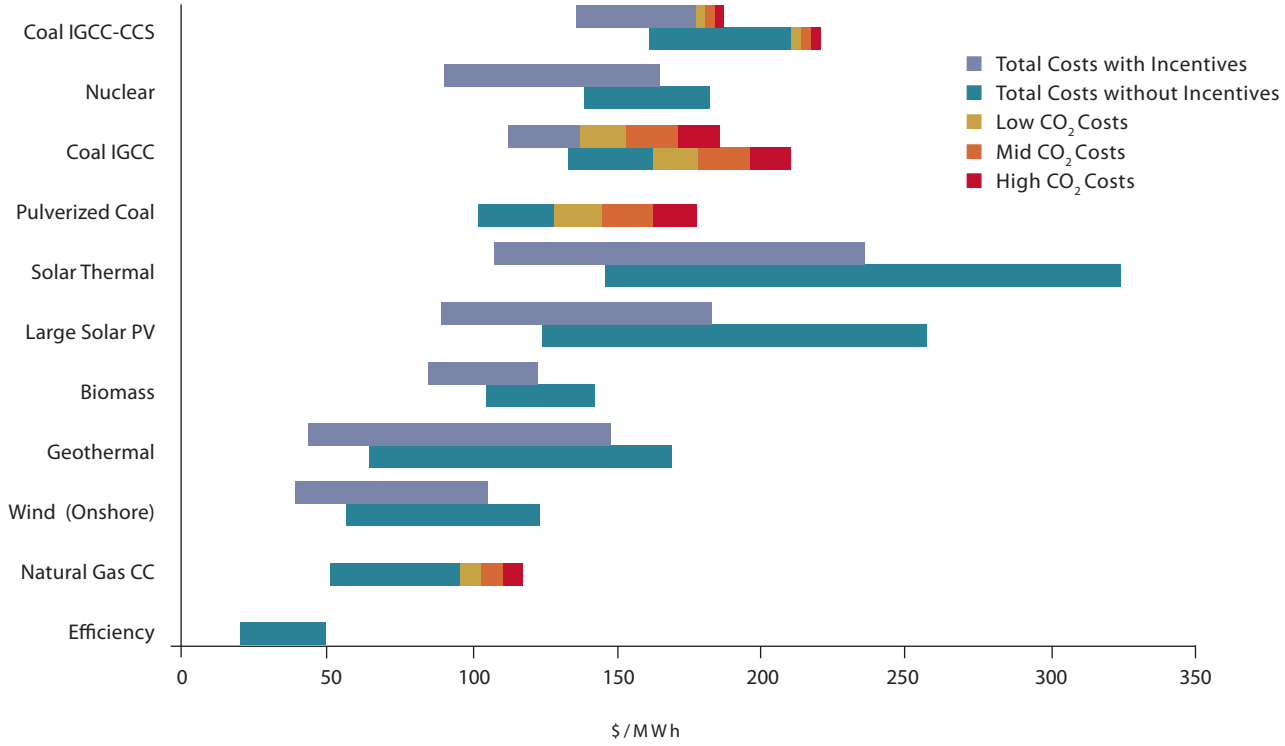
In addition to losing their cost advantage, coal plants' relative lack of operational flexibility makes them poorly suited for the grid of tomorrow, which will surely include greater quantities of variable sources—wind and solar power, for example—and place a premium on other power sources, such as natural gas, that can ramp up or down quickly as needed.

We can dramatically reduce our dependence on coal power. Long-term investments in coal would be less risky if the nation had no choice but to continue with its current level of coal use,

2 Levelized cost of electricity (LCOE) is an economic assessment of the cost of energy generation of a particular system. LCOE includes all of the costs over the system's lifetime, such as capital expenditures, operations and maintenance, fuel cost, and cost of capital, discounted to a net present value. The LCOE is the price at which energy must be sold for the project to break even.

Figure ES.5. LEVELIZED COST OF ELECTRICITY FOR VARIOUS TECHNOLOGIES

All projections assume newly built installations coming online in 2015 and represent levelized costs over a 20-year period. A range of capital costs is assumed for all technologies; a range of fuel costs is assumed for coal, natural gas, and biomass; and a range of capacity factors is assumed for wind, solar, natural gas, and nuclear power. A range of CO_2 prices is taken from Synapse projections (see Part 4 of the full report). Current tax incentives for wind and biomass are assumed to be extended to 2015.



no matter how high the costs. But that is not the case. Studies by the Union of Concerned Scientists and others show that we could in fact replace most of our coal power using renewable energy, demand reduction, and natural gas within the next 15 to 20 years, with additional reductions in coal power afterward (Keith et al. 2010; Specker 2010; Cleetus, Clemmer, and Friedman 2009). And the overall benefits of transitioning to a cleaner energy system—saving lives, protecting air and water, and helping us avoid severe climate changes while stimulating technological innovation and building new clean-energy industries—would be tremendous.

A costly history threatens to repeat itself. When considering long-term investments in coal today, it is helpful to remember an earlier era of power-sector investments that did not end well. In the 1970s, utilities invested massively in both coal and nuclear plants while ignoring the sweeping changes that were increasing the costs of, and decreasing the demand for, such plants. The result was staggering financial losses around the country as scores of plants were cancelled after years of spending. We can avoid repeating that costly history by recognizing that changes under way today are making long-term investments in coal power an unacceptably risky proposition.

This report is available on the UCS website at *www.ucsusa.org/clean_energy*.

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