



UNFAIR MARKET VALUE II

COAL EXPORTS AND THE VALUE OF FEDERAL COAL

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Executive Summary

Facing increasingly dismal prospects in the US coal market, many coal companies operating in the American West have vigorously pursued plans to sell their wares overseas. When seaborne coal prices were high, these companies found that they could earn far greater profits exporting coal to Asia than selling it domestically.

The coal companies that have most avidly pursued coal exports rely heavily on coal purchased from the American public, sold by the US Bureau of Land Management (BLM) at prices as low as pennies per ton. Yet despite ample evidence that the coal industry has used federal coal leases to develop export-oriented coal mines in the western United States, BLM has largely ignored the economics of coal exports when deciding the “fair market value” at which it will sell federal coal leases.

The agency now has an ideal opportunity to rectify this shortcoming. In January the federal government announced a three-year moratorium on new coal leases, triggered by a public-interest lawsuit calling for a sweeping review of the federal coal leasing program. The US Department of the Interior can now take advantage of this leasing moratorium to review the finances and economics of federal coal exports, and how export dynamics affect the value of federal coal sold to private companies.

This report, an update of [Sightline's 2014 analysis of exports of federal coal](#), offers new data and methods to assist in such an analysis. The key findings of this report include:

- **Overheated Asian coal markets sparked a US export boom.** After a 2009 spike in Chinese coal imports sent Pacific Rim coal prices skyrocketing, coal companies operating in the western United States took advantage of high prices to boost exports, particularly from mines in Montana, Utah, and Colorado.
- **US exporters relied on federal coal.** Major West Coast coal exporters relied heavily—and in some cases almost exclusively—on coal produced from federal coal leases to supply overseas customers.
- **Asian coal markets have collapsed.** Declining coal imports in China and India, coupled with burgeoning coal supplies from Indonesia, Australia, and Russia, flooded seaborne coal markets with inexpensive coal. Starting in 2011, international coal prices fell for five consecutive years, forcing many US exporters to pull out of Asian markets.
- **US coal producers still hope for an export rebound.** Despite the collapse in seaborne coal prices, US coal companies have continued to pour money and resources into export projects—suggesting that coal industry executives were making calculated gambles that export markets could re-inflate.
- **The potential for future exports boosts the value of federal coal.** The possibility that seaborne coal prices might someday rise gives the purchasers of federal coal leases a valuable “option” to profit from future price increases.
- **The federal government should consider coal exports when setting the “fair market value” of federal coal.** As Interior reviews the federal coal program, the agency should consider the unique dynamics of coal exports—including the “option value” of potential future coal exports—when determining the fair market value of federal coal leases.

Introduction

Facing steep declines in domestic coal demand and increasingly fierce competition from natural gas, solar, and wind power, major coal companies operating in the western United States have gambled that their financial future lies not in America but in Asia. Relying on old forecasts of robust growth in coal-fired power in China, India, Japan, Korea, and Southeast Asia, these companies have positioned themselves to reap huge profits if Asian coal demand should rise. Collectively, these firms have spent untold millions of dollars to secure long-term deals to export coal from terminals in California and British Columbia and millions more in attempts to develop new export facilities in Oregon and Washington.

The coal industry's export ambitions rely heavily on federal coal leases that they purchased at prices as low as pennies per ton. (See Table 1.)

Table 1: Selected federal coal leases at export-oriented mines in the Western United States.



PARENT COMPANY	MINE	STATE	YEAR	TONS	PRICE PER TON
Cloud Peak Energy	Spring Creek	Montana	2007	108,600,000	\$0.18
Signal Peak Energy	Signal Peak	Montana	2012	35,500,000	\$0.30
Arch Coal	West Elk	Colorado	2007	12,100,000	\$0.25
Bowie Resource Partners	Bowie #2	Colorado	2014	8,020,000	\$0.36
Bowie Resource Partners	Sufco	Utah	2015	42,000,000	\$0.40
Bowie Resource Partners	Skyline	Utah	1996	24,100,000	\$0.23

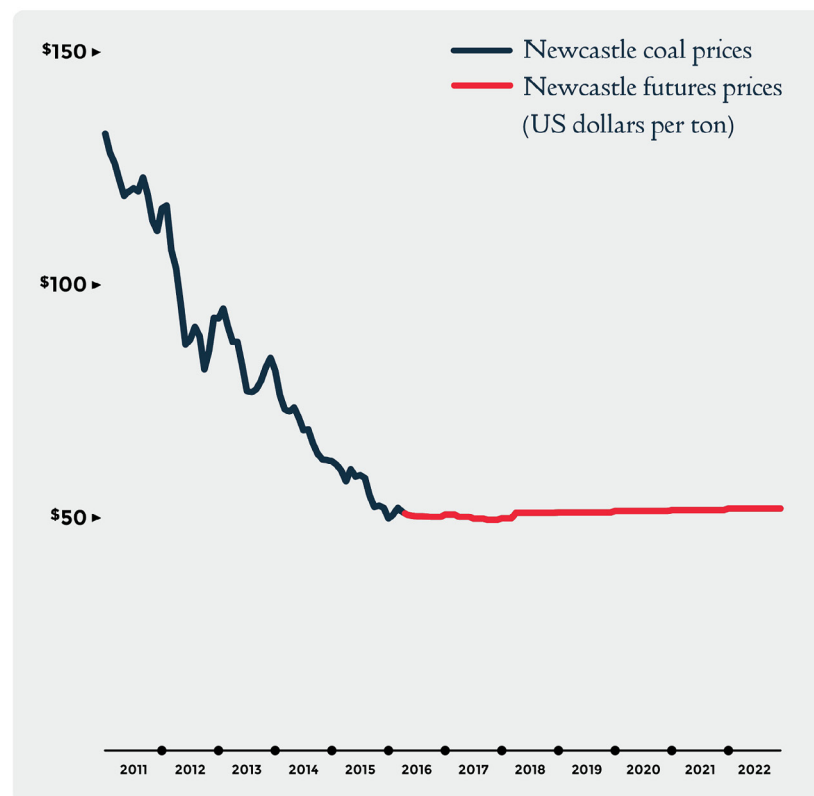
Source: Bureau of Land Management

But the Asian market has not been the economic bonanza on which the coal industry had counted. A sharp rise in seaborne coal prices in 2009 and 2010 had led many industry executives to assume that prices would remain high for years. Yet prices actually peaked in 2011 and fell for five consecutive years, making it impossible for most US exporters to profit from selling coal to Asia. Several US coal exporters have now curtailed exports, in some cases paying steep contractual penalties to avoid even steeper losses selling coal into an oversupplied market.

Yet the worst may be yet to come for the seaborne coal market. China and India, the world's top two coal importers, are slashing their coal imports, even as coal producers continue to flood the seaborne market with abundant supplies of inexpensive coal. With this combination of weak demand and abundant supplies, futures markets now predict that international coal prices will remain at low levels for the foreseeable future. (See Figure 1.)

However, international coal markets have proven both volatile and unpredictable over the past decade, characterized by unexpected spikes and precipitous collapses. As the growing practice of “real options valuation” demonstrates, price volatility can actually add value to undeveloped mineral reserves. The potential for wild price swings holds out the promise of booms as well as busts. By purchasing federal coal mining rights, coal producers can realize substantial profits from federal coal when prices rise, without committing themselves to substantial losses if coal prices should remain low.

Figure 1: Pacific Rim coal prices have fallen dramatically since 2011.



Source: World Bank, eSignal.com

More generally, buying the right to mine federal coal reserves gives coal companies the option to exploit those reserves when it is profitable to do so, without obligating them to develop mines when doing so is unprofitable. A robust and growing body of academic research, as well as real-world practice, demonstrates that well managed firms consider this “option” value when considering the price they’re willing to pay for mineral reserves. Higher volatility in commodity prices entails a higher likelihood of profitable price swings, and hence a higher option value attributable to undeveloped mineral reserves.

Because prices are both higher and more volatile on international coal markets than in domestic ones, the option value of exporting coal typically is higher for exports than for domestic sales. This may help explain why US coal companies so

fervently pursued West Coast coal export projects even after international prices dwindled: expanding export infrastructure would allow the industry to take fuller advantage of any future increase in international coal prices, thereby boosting the option value of domestic coal reserves.

Yet despite the coal industry's clearly expressed plans to export large volumes of federal coal to Asia, the federal government has largely ignored the economics of coal exports when deciding on the price at which to sell the right to mine publicly owned coal to private coal companies. It now has an ideal opportunity to rectify this oversight. On January 15, 2016, the Obama Administration announced a three-year moratorium on all new federal coal leases. This moratorium came on the heels of a public-interest lawsuit against the US Department of the Interior that urged the agency to undertake a sweeping review of its federal coal leasing program. The administration has announced that it will use the leasing moratorium to undertake such a review.

During this pause, the federal government now has both an opportunity and a duty to conduct a thorough and thoughtful examination of how coal export economics affect the value of federal coal and the price that the federal government should accept for any future coal leases. Based on a preliminary analysis, such a review is likely to find that the growth of coal export infrastructure on the US West Coast could significantly increase the price that the American public should expect to receive for selling the right to mine federal coal.

Coal exports: A “Hail-Mary” pass for an embattled industry

The US coal industry finds itself today in the midst of its worst slump since the Great Depression.¹ A combination of low natural gas prices² and stricter health and environmental standards for power plants³ has prompted many utilities to switch away from coal and towards cleaner sources of electricity. All told, the electric power industry has retired at least 263 coal-fired power generators since 2012.⁴ Meanwhile, the plummeting cost of wind and solar power⁵ has eaten into coal’s market share, even as economic shifts and gains in energy efficiency have kept the growth of US electricity demand in check.⁶

These forces have converged to create a perfect storm for the American coal industry. By late last fall, coal’s share of the nation’s electricity market had fallen to its lowest level in 45 years.⁷ But the worst was still to come: plummeting natural gas prices in early 2016 prompted an even sharper shift by utilities away from coal and to natural gas.⁸ By mid-April, US coal production had fallen by nearly one-third from the same period a year earlier, even as coal prices in most major mining basins slumped.⁹

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The combination of waning demand and falling prices has sent US coal producers into a financial tailspin. Since 2012, at least 50 US coal companies—including Peabody Energy, the largest private sector coal company in the world—have declared bankruptcy,¹⁰ even as many others continue to march towards insolvency.¹¹

Given the dismal long-term trends in the domestic coal market, US coal producers have desperately looked beyond America’s borders for any shred of hope.

Several years ago, it appeared as if exporting coal to Asia—and to China in particular—might provide the lifeline for which the industry so desperately yearned. China historically had been a net exporter of coal. But at the turn of the millennium, the Asian giant’s coal consumption skyrocketed, with demand tripling between 2000 and 2013.¹² By 2009, China’s coal demand outpaced its supply: rail lines between coal-producing regions in China’s interior and the industrial coast became increasingly bottlenecked, even as a government crackdown on illegal and unsafe mines kept production growth in check.¹³

The shortage of domestic coal forced China to turn to seaborne coal markets to meet demand, and the nation quickly shifted from being a net exporter of coal to being a substantial net importer.¹⁴ Although coal imports represented only a small share of China's overall coal consumption, China's emergence as a major net importer sent Pacific Rim coal prices skyrocketing for nearly two years, prompting speculation that global coal markets had entered a new "supercycle" of rising demand and high prices.¹⁵

The American coal industry fully bought into the euphoria. Coal industry executives had spent years painting the US as the "Saudi Arabia of coal,"¹⁶ while patiently waiting for an opportunity to reap financial rewards from exports. With international coal prices buoyed by China's seemingly insatiable appetite, they finally saw an opportunity to turn that rhetoric into reality. Almost overnight, a host of North American coal companies and port operators launched ambitious export plans. By 2012, coal companies and terminal operators had proposed seven different coal export projects in Washington, Oregon, and British Columbia alone, with combined export capacity of more than 150 million tons per year—all designed to meet growing Asian demand.

But US coal companies weren't the only ones who felt the euphoria. Indeed, every other participant in the Pacific Rim coal market quickly recognized—and reacted to—the swift rise in Chinese coal demand and the spike in seaborne coal prices. Australia and Indonesia, the largest and best positioned coal exporters in the region, expanded their mining capacity and added new shipping terminals to take advantage of high prices and burgeoning demand. Coal producers in eastern Russia signed agreements with China to develop new mining and rail projects to feed Asian demand.¹⁷ China itself took great strides in modernizing its coal mining sector, boosting output from its most efficient mines while making major investments in rail and electricity transmission infrastructure to move both coal and power from inland provinces to energy-hungry coastal markets.¹⁸ At the same time, China's economy simultaneously slowed and became more energy-efficient, tempering growth in the Asian giant's power demand.¹⁹

As these adjustments took hold, international coal prices stabilized and then plummeted. From early 2011 through mid-2014, Australian benchmark thermal coal prices fell from \$132 per ton to less than \$70 per ton, turning many coal export projects from highly profitable to economically infeasible. As prices fell, the prospect of exports vanished, and the proponents of many coal terminal projects, in the Northwest and beyond, shelved their plans.

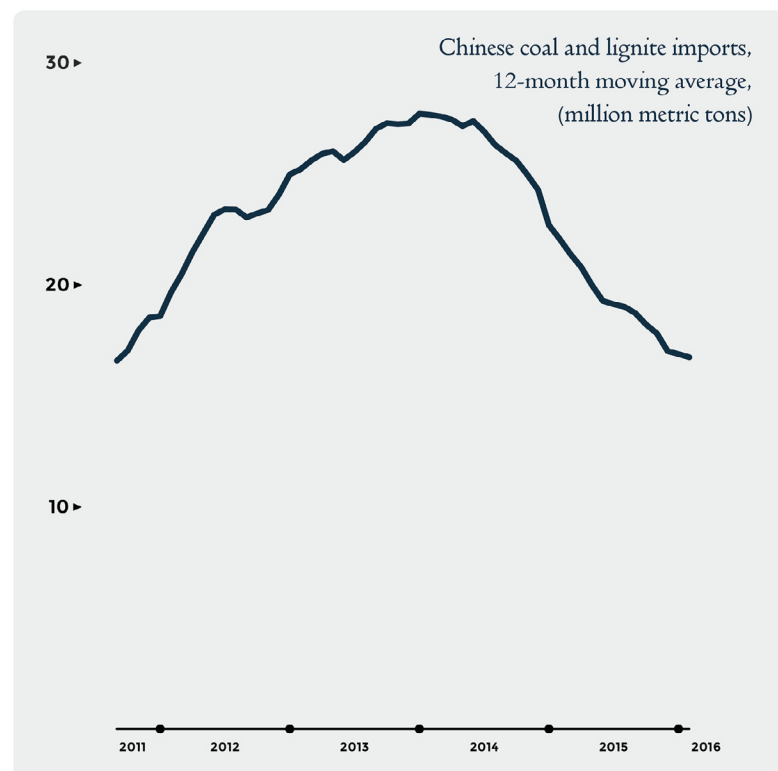
But for Pacific Rim seaborne coal markets, the worst was yet to come. Starting in mid-2014, China's overall demand for coal—both domestic and imported—began to fall. The declines stemmed from complex causes: government policies designed to curtail overproduction in the cement, glass, and steel industries;²⁰ an economic shift towards consumer goods and services and away from heavy industry; further slowdowns in the pace of economic growth;²¹ and aggressive government response to a horrific air quality crisis in smog-choked cities.²²

Together, these moves slashed total Chinese coal consumption by an estimated 2.9 percent in 2014²³ and an additional 3.7 percent in 2015.²⁴ Early figures show that these declines have accelerated, with a 6.8 percent decline in coal production in the first four months of 2016.²⁵ China has announced further steps to shrink its coal industry, including plans to close 1,000 coal mines in 2016 alone,²⁶ while transitioning as many as 1.8 million workers out of the coal and steel industries and into other fields.²⁷

As Chinese coal consumption fell, the central government took steps to protect its domestic coal industry from foreign competition, including strict import quality restrictions²⁸ and a revival of import tariffs.²⁹ These policies led China's coal imports to decline much faster than overall consumption: by January 2016, the 12-month rolling average for Chinese coal imports had fallen by 38 percent since its June 2014 peak.³⁰ (See Figure 2.)

Tepid demand from the rest of Asia has further dashed the hopes of coal exporters. From mid-2014 to late 2015, China's import collapse vastly outstripped any modest growth in seaborne coal demand from other Asian

Figure 2: China's coal imports peaked in early 2014, and are still falling.



Source: General Administration of Customs, PRC

nations. And over the past several months, India—which had emerged as the world’s second-largest coal importer—has also begun to curb seaborne coal imports.

Last November, India’s coal minister announced his goal to stamp out all virtually all coal imports by 2017, mostly by boosting domestic production.³¹

The country’s coal sector has responded quickly, registering a 49 percent year-over-year decline in imports in November 2015 and a 34 percent drop in December 2015. All told, India’s coal imports fell by 15 percent from April through December 2015.³² With the world’s two largest coal importers curtailing their purchases of coal from seaborne markets, coal exporters in the western US are now struggling with a financially toxic combination of low prices and weak demand.

The US coal industry took full advantage of the brief spike in the seaborne coal market.

However, the fact remains that the US coal industry took full advantage of the brief spike in the seaborne coal market, in many cases earning hefty profits by exporting coal to Asia. Moreover, the industry is continuing its aggressive pursuit of coal exports and hopes to position itself to realize even greater profits should seaborne coal prices rise again.

Coal Exports from the western United States

From 2005 through 2014, the four western states of Colorado, Montana, Utah, and Wyoming moved nearly 137 million tons of coal to overseas destinations. Exports from Colorado, Montana, and Utah all rose particularly sharply from 2010 through 2013—the period during which Chinese coal imports boomed. (See Table 2.) In contrast, exports of Wyoming coal, particularly from the southern Powder River Basin (PRB), lost ground in export markets over the decade, with Wyoming export volumes slipping from 8.2 million tons in 2004 to 1.5 million tons in 2013.

Table 2: Coal exports from four Western states topped 136 million tons from 2005 through 2014.



	<u>COLORADO</u>	<u>MONTANA</u>	<u>UTAH</u>	<u>WYOMING</u>	<u>4-STATE TOTAL</u>
2005	706,000	653,000	351,000	7,365,000	9,075,000
2006	799,000	447,000	55,000	5,622,000	6,923,000
2007	345,000	387,000	541,000	7,626,000	8,899,000
2008	874,000	1,480,000	0	6,094,000	8,448,000
2009	850,000	2,065,000	148,000	3,016,000	6,079,000
2010	2,195,230	6,431,790	634,110	5,237,530	14,498,660
2011	3,000,200	13,198,700	1,080,700	4,471,000	21,750,600
2012	6,507,300	9,084,800	1,080,000	3,128,600	19,800,700
2013	6,281,600	12,121,200	1,452,600	1,507,700	21,363,100
2014	<u>3,818,700</u>	<u>12,408,600</u>	<u>2,869,000</u>	<u>1,009,500</u>	<u>20,105,800</u>
Total	25,377,030	58,277,090	8,211,410	45,077,330	136,942,860

Source: US Energy Information Administration, Annual Coal Distribution Reports

Despite the large and growing volumes of coal exported from the western United States and the increasing importance of coal exports to the Colorado and Montana coal industries, Interior has consistently downplayed the importance of export markets to the US coal industry. For example, in response to a 2013 report by Interior's Inspector General that criticized BLM's leasing practices for failing to account for export profits, BLM responded:

Little Federal coal is currently exported. According to the Energy Information Administration, no more than 1.6 percent of Powder River Basin coal is exported...[T]he general discussion of exports in the text of the report...may create the misleading impression that the opposite is the case.³³

This argument was triply deceiving. First, it ignored the substantial volumes of federal coal exported from *outside* the PRB. Second, it neglected the industry's widely advertised plans to export large volumes of coal, particularly PRB coal, through planned new coal export terminals in Washington, Oregon, and British Columbia. And third, it lumped together the substantial volumes of coal produced in the southern PRB (which is mostly sold on the domestic market) with coal from the northern PRB and from neighboring coal basins (large shares of which are shipped overseas). By 2012, more than one-quarter of all coal produced in Colorado and Montana was shipped overseas, demonstrating incontrovertibly the growing importance of exports to the West's coal industry. (See Table 3.) As the following company- and mine-specific analyses show, the top coal exporters in the western United States rely heavily on coal obtained from Interior's coal leasing program.

Table 3: Exports have accounted for a significant share of total coal sales in Colorado, Montana, and Utah.



	<u>COLORADO</u>	<u>MONTANA</u>	<u>UTAH</u>	<u>WYOMING</u>
2005	2%	2%	2%	2%
2006	2%	1%	0%	1%
2007	1%	1%	2%	2%
2008	3%	4%	0%	1%
2009	3%	5%	1%	1%
2010	9%	15%	3%	1%
2011	12%	34%	6%	1%
2012	25%	25%	7%	1%
2013	27%	30%	8%	<1%
2014	16%	28%	16%	<1%

Source: US Energy Information Administration, Annual Coal Distribution Reports

Cloud Peak Energy: Spring Creek Mine, Montana

Cloud Peak Energy, which bills itself as the only “pure play Powder River Basin (PRB) coal company,”³⁴ has exported nearly 25 million tons of coal to Asia since 2010, mostly through the Westshore coal terminal outside of Vancouver, British Columbia.³⁵

For years, Cloud Peak centered its entire corporate growth strategy on coal exports.³⁶ In the company’s third quarter 2013 investor conference call, for example, the company’s Chief Financial Officer explained the company’s expansion plans: “[W]hat we want to do is to try and build...our exports, which we believe [offer] strong growing demand and potentially good margin through the cycle.”³⁷ And in a 2014 presentation to investors,³⁸ the company outlined its strategy for responding to a sagging domestic market as:

- **Responding to domestic utility demand and low pricing by reducing domestic shipments over time**
- **Focus on growth through exports**

This strategy represented a remarkable turn for a US coal company: an explicit admission that the domestic market for coal was in a long-term decline and that the company’s growth hinged on selling coal to customers in Asia.

One key to Cloud Peak’s export strategy was securing shipping capacity at coal export terminals. By 2013, the company had signed a long-term contract to ship at least four million tons of coal per year through the Westshore terminal just south of Vancouver, British Columbia. In late 2014, Cloud Peak expanded its position at Westshore by purchasing additional shipping capacity from a Canadian coal producer, announcing that the agreement would allow the company to boost exports to 6.5 million tons per year in the short term and to as much as 7.5 million tons per year by 2019.³⁹

Cloud Peak also positioned itself to ship coal through proposed export terminals. In 2013, the company purchased an option for 16 million tons of coal shipping capacity at the Gateway Pacific Terminal outside of Bellingham, Washington (which has since been canceled).⁴⁰ And in August 2015, Cloud Peak took its interest in Gateway one step further by acquiring a 49 percent stake in the project in exchange for a \$2 million up-front payment, plus an agreement to pay up to \$30 million in permitting costs.⁴¹

Likewise, Cloud Peak obtained an option for up to seven million tons of throughput capacity at the proposed Millennium Bulk Terminals coal export project outside Longview, Washington. Cloud Peak secured this capacity by granting full ownership of the Decker coal mine to the Millennium terminal's main proponent, a company then known as Ambre Energy but which since has been reconstituted as Lighthouse Resources.⁴²

Cloud Peak executives have repeatedly told investors, regulators, and the general public that they have centered the company's export strategy on its Spring Creek mine in Montana.⁴³

The company's presentations to investors tout Spring Creek's advantages in the Asian export markets, stating that the coal's high quality and proximity to coastal terminals give Spring Creek coal a competitive edge over rival coals from the southern PRB and that Asian utilities prize Spring Creek coal's consistent quality.⁴⁴

When international prices were robust, Cloud Peak reaped impressive profits from Spring Creek coal exports.

Cloud Peak has planned to solidify these advantages by creating a massive export-oriented mining complex centered on Spring Creek. Much of this expansion would involve expanding the Spring Creek mine into nearby federal coal tracts: the company has applied for a new federal coal lease on land adjacent to the Spring Creek mine,⁴⁵ as well as a modification to expand its existing lease at Spring Creek.⁴⁶ In addition, Cloud Peak hopes to expand its Spring Creek mining complex to projects that rely on non-federal coal, including the Youngs Creek mining project in northern Wyoming, which would mine private coal, and the Big Metal project on lands owned by the Crow Nation.⁴⁷

A focus on export markets was especially critical for the Spring Creek and nearby mines, because the coal's high sodium content⁴⁸ limits the mine's domestic market, as high-sodium ash can corrode power plant boilers and impair generator performance.⁴⁹ But Asian coal consumers who buy in bulk from multiple sources can blend Spring Creek coal with other coals to create a mixture with acceptable performance.⁵⁰

Cloud Peak purchased the majority of its Spring Creek coal from the federal government. Of the 17.3 million tons that the Spring Creek mine produced in 2014, 13.0 million tons, or 75 percent, was federal coal.⁵¹ Cloud Peak obtained the rights to mine this federally owned coal through two successful "lease-by-application" (LBA) bids in coal auctions conducted by the US Bureau of Land Management. BLM

accepted the first bid in 2001 at a price of 11¢ per ton and approved the second bid in 2007 at a price of 18¢ per ton.⁵²

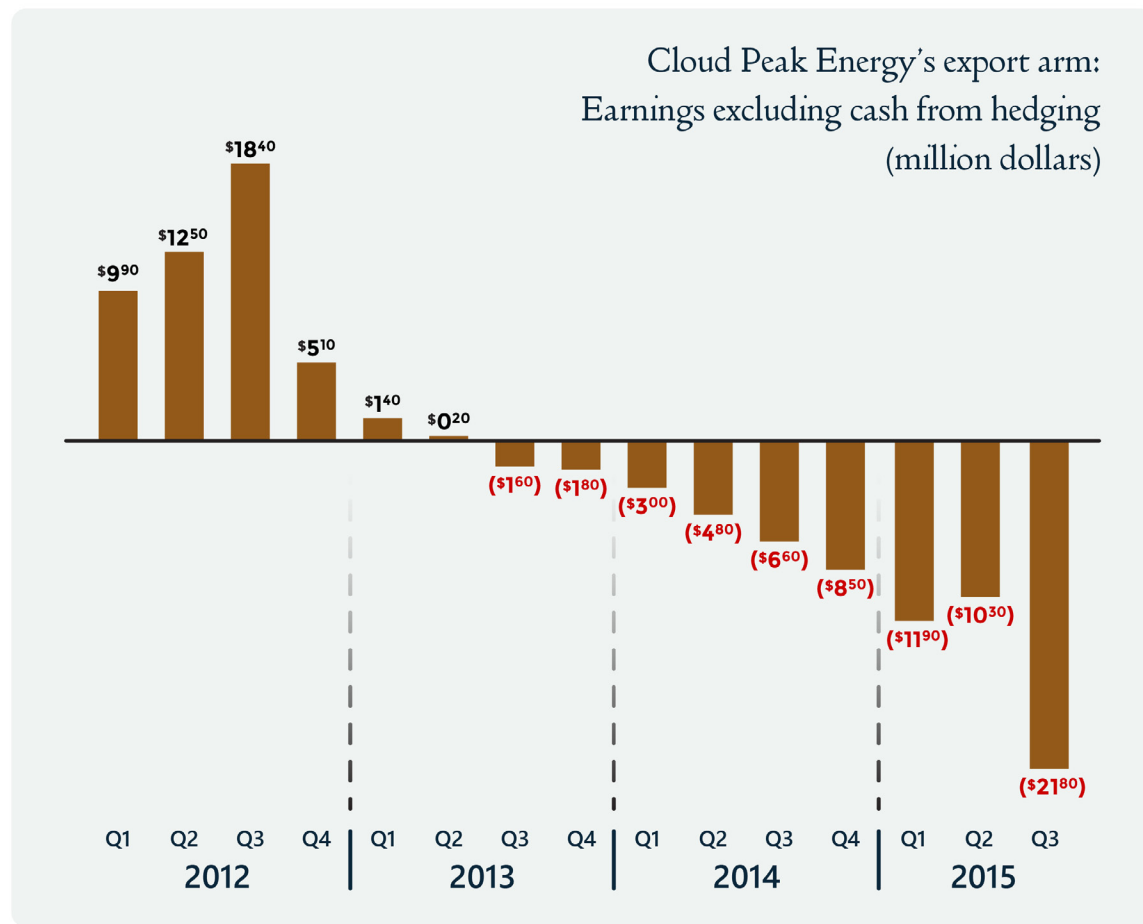
When international prices were robust, Cloud Peak reaped impressive profits from Spring Creek coal exports. The company's export arm earned \$57 million in 2012 alone and a total of \$75 million from 2012 through 2014. In 2012, the peak year for the company's export profitability, Cloud Peak made profits of nearly \$13 per ton of coal exported to Asia—more than four times the profit margin for comparable domestic sales and at least 70 times as much per ton as Cloud Peak originally paid the American public for its Spring Creek coal leases.⁵³

But in late 2014, after more than three consecutive years of declining prices on the seaborne coal market, Cloud Peak's earning statements started to show significant and accelerating export losses. Cloud Peak continued to report export profits from mid-2013 through mid-2014, but the company had used "hedging" contracts on the futures markets to lock in export profits when prices were high. So, excluding those hedging gains, Cloud Peak's actual export sales had started to lose money starting in mid-2013. (See Figure 3.)

By late 2015, international coal prices had fallen so low that Cloud Peak announced that it would halt all coal exports in 2016 and possibly 2017 and 2018 as well.⁵⁴ In the company's 2015 year-end financial statement, Cloud Peak admitted that deteriorating export economics had forced the company to write off \$58 million in port access and development expenses. Those write-offs covered both the company's Westshore contract and its shipping options at the proposed Millennium and Gateway Pacific terminals (the latter of which was recently shelved by the US Army Corps of Engineers).

Furthermore, the company now faces nearly \$71 million in penalty payments over the next three years to the Westshore terminal and BNSF Railway for failing to meet its contractually obligated export volumes.⁵⁵ Cloud Peak will likely pay these penalties to avoid even steeper losses shipping coal to an oversupplied seaborne market. These financial results show that Cloud Peak's bet on coal exports, which at one point contributed significantly to the company's bottom line, now bleed red ink.

Figure 3: Excluding cash from “hedging,” Cloud Peak’s export arm started losing money in mid-2013.



Source: Cloud Peak Energy regulatory filings

Given this dismal financial news, public enthusiasm for Cloud Peak’s coal exports has dimmed. In its most recent presentation to investors, the company admitted that “exports [are] currently projected to be minimized due to external environment” and that it was “reducing production to better balance market demand.”⁵⁶ A substantial part of that reduction will come from the Spring Creek mine, where the company plans production cutbacks in response to waning exports.⁵⁷

Nonetheless, the company has not abandoned its export ambitions. Cloud Peak’s executives pointed out that the company would retain ownership of port access rights and would “look to restart exports when prices rise sufficiently for them to be profitable.”⁵⁸ Furthermore, as mentioned above, in late 2012 and early 2013, the

company requested that BLM prepare the paperwork for a new federal coal lease, as well as a modification of an existing coal lease, in order to expand its Spring Creek mine. So far, despite the dismal performance of Spring Creek as a platform for a long-term export business, Cloud Peak has done nothing to put those federal coal lease applications on hold. Even amid a crippling decline in the prospects for profitable coal exports, Cloud Peak remains committed to its long-term coal export ambitions.

Lighthouse Resources: Decker Mine, Montana

Lighthouse Resources has become one of the key players in coal exports in the Pacific Northwest, with aspirations to build a vertically integrated coal mining and export business. The company currently operates two coal mines—the Decker Mine in the northern PRB in Montana and the Black Butte Mine in southern Wyoming. It also hopes to develop two major coal export terminals: the 8-million-ton-per-year Morrow Pacific Project in Oregon and the 44-million-ton-per-year Millennium Bulk Terminal in Longview, Washington.

Until April 2015, Lighthouse was known as Ambre Energy North America (AENA). The company changed its name after its former corporate parent, a small Australian coal firm called Ambre Energy, ran into such severe financial difficulty that it was forced to hand over its North American operations to its main creditor. Lighthouse may have changed its name to distance itself from Ambre's financial implosion; yet despite the name change, Lighthouse's business plans, strategy, and management structure remain substantially intact from its days as a subsidiary of Ambre Energy.

Lighthouse's Decker mine lies at the center of the company's ambition to become a vertically integrated coal exporter. Like the nearby Spring Creek mine, the Decker mine has a small domestic customer base because of the coal's high sodium content. But the mine's proximity to West Coast ports and its coal's high energy content make it better suited to export markets than many other PRB coals. In its 2011 annual report, Lighthouse's corporate predecessor, Ambre Energy, spoke of its export ambitions for Decker coal:

Coals such as those at [the] Decker coal mine based in Montana are the best suited coals for the Asian export market. In addition to the state's geographical advantage to the US west coast, the Montana coals have higher energy levels compared to the southern PRB in Wyoming.⁵⁹
[Emphasis added.]

The 2011 annual report went on to add:

*The company also intends ultimately to increase coal production [at Decker] to **take advantage of demand for coal from North Asian customers** via...port infrastructure in the US west coast region. [Emphasis added.]*

Ambre Energy, Lighthouse's corporate predecessor, crystallized its Asian export strategy in 2012 by signing agreements with two South Korean utilities to ship them up to five million metric tons of coal per year for ten years.⁶⁰ This agreement later proved Ambre's undoing: those utilities extended loans to Ambre that the company could not pay back, triggering the financial crisis that forced Ambre to sell its North American assets to creditors.

Ambre's difficulties with its Morrow Pacific coal export terminal project compounded its financial implosion. In August 2014, the Oregon Department of State Lands denied a key permit for the Morrow Pacific project,⁶¹ making it all the more difficult for Ambre Energy to find new financing.

Like the nearby Spring Creek mine, the Decker mine depends heavily on federal coal. Federal data show that Decker produced a total of 3.4 million tons of coal in 2014, including 2.7 million tons of federal coal—meaning that 80 percent of the coal Decker produced in 2014 came from federal coal leases.

Interestingly, BLM hasn't completed a lease sale at Decker since 1982.⁶² But Lighthouse hopes to keep the flow of federal coal coming. In December 2015, the company filed a coal lease application to expand its access to coal tracts adjacent to its existing Decker lease.⁶³ The company hopes to use the lease to boost Decker's total production to 15 million tons per year, significant quantities of which would be sold on export markets.⁶⁴

By all appearances, Lighthouse remains firmly committed to its coal export strategy. The company has maintained unflagging public support for its Millennium Bulk Terminal in Washington, and it hopes to revive its Morrow Pacific Project by appealing the project's permit denial in a hearing scheduled for September 2016.⁶⁵ A fair and comprehensive evaluation of the fair market value of Lighthouse's proposed coal lease at Decker must consider the company's extensive and detailed export plans—and the potential for the company to earn substantial profits from those plans if international coal prices were to rise.

Signal Peak Mine, Montana

Signal Peak Energy is one of the top exporters of thermal coal to Asia operating in the western United States. It is also only one of two US companies (along with Cloud Peak Energy) known to have shipping contracts at the Westshore coal export terminal in southwestern British Columbia. Although Signal Peak has not released statistics on its exports, data from Westshore and Cloud Peak suggest that the firm shipped 6.4 million tons of thermal coal to Asia through Westshore in 2014, up from roughly 5.6 million tons in 2013 and 3.2 million tons in 2012.⁶⁶

Signal Peak Energy is a three-way venture co-owned by utility holding company FirstEnergy Ventures, coal mining firm Boich Companies, and international commodity-trading giant Gunvor. The venture's only mining property is the Signal Peak mine, also called the Bull Mountain mine, near the town of Roundup, Montana. One of the highest-producing longwall operations in the United States,⁶⁷ the Signal Peak mine relies on a mix of federal and non-federal coal, with the amount of federal coal mined in any year varying with the progression of the mining equipment through the coal seam.

In 2014, the company reported that it mined only 51,000 tons of federal coal out of 7.9 million tons produced. However, BLM sold Signal Peak a 35.5-million-ton federal coal lease in 2012, charging the company only 30 cents per ton for mining rights. As the federal lease sale indicates, much of the mine's future production hinges on the availability of federal coal.⁶⁸

For more than half a decade, Signal Peak's leadership has consistently extolled exports as a centerpiece of the company's strategy. As early as 2009, FirstEnergy President and CEO Anthony J. Alexander mentioned their Asian export strategy for Signal Peak in an investor conference call, saying: "We've...secured multiple test cargos that will be shipped into the Asian markets in the fourth quarter."⁶⁹ Then, in a 2010 investor conference call, FirstEnergy CFO Mark Clark asserted:

*Signal Peak is doing quite well...They produced 8 million tons last year, somewhere between 4 million and 5 million was cleaned. About half of that comes east, to us, and **about half of it goes into the international market.***⁷⁰

In 2011, a press release by FirstEnergy and Boich Companies trumpeted Gunvor's acquisition as opening up new possibilities for coal exports.⁷¹ According to Wayne Boich, Jr., President and Chief Executive Officer of Boich Companies:

*One of the key advantages that Gunvor Group brings to this venture **is the ability to utilize their commodity trading relationships in such markets as Japan, China, Korea and Chile to sell more coal.***

In the same press release, Timothy Legge, chairman of Gunvor, one of Signal Peak's co-owners, said that Signal Peak had good export potential:

*Signal Peak represents our first investment in a coal mine located in the U.S. It presents Gunvor with the opportunity to use the existing rail and port operations to market this high quality, low sulfur bituminous coal **to expanding markets around the world, particularly in the Pacific and Asia markets through our arrangements with Westshore Terminals in Vancouver, the prime coal moving terminal on the West Coast.***

The following year, Reuters cited an anonymous senior Gunvor executive as stating that export sales from Signal Peak...

*...were profitable and demand remains strong...**Gunvor ships Signal Peak coal to Europe and Latin America as well as China and other Asian countries. "We've just shipped two vessels to China and both were paid for," he said.***⁷²

Then in 2013, the Associated Press reported that the company was ramping up its exports:

*[D]omestic demand for the fuel has fallen off sharply over the last several years, primarily due to competition from cheap natural gas...To offset those declines, companies including Signal Peak and Cloud Peak have **stepped up sales in Asia, where demand remains strong among developing countries and industrialized nations including Japan and South Korea.***⁷³

Canadian port data suggest that Signal Peak's exports nearly doubled from 2012 to 2014.

But in late 2015, Signal Peak's export affiliate, called Global Coal Sales, announced that the company's export business was in trouble:

[T]here has been a further significant decline in the product pricing for thermal coal in the global export market...With no apparent improvements to such pricing in the near term, Global Coal Sales Group, LLC ("Global"), an exporter of thermal coal, has advised Westshore Terminals LP ("Westshore") that it will be necessary to reduce its sales to the export market.⁷⁴

Signal Peak will likely cut exports by roughly two million tons in 2016 and could cut them further in 2017 and 2018. Since the mine has few prospects to increase domestic sales to offset the export losses, the company announced steep layoffs last December.⁷⁵ And in yet another blow, one of Signal Peak's co-owners, FirstEnergy, admitted in its 2015 annual report that steep losses on exports had forced the company to completely write off its investment in the mine.⁷⁶

Despite this torrent of bad news, Signal Peak's executives have given every indication that they plan to boost their export sales as soon as prices improve enough to make exports profitable once again. And if Signal Peak's export plans succeed, the company will rely heavily on its generous supplies of federal coal to feed overseas demand.

Bowie Resource Partners Mines, Colorado and Utah

In 2013, the Kentucky-based Bowie Resources partnered with private equity firm Galena Private Equity Resource Fund to purchase three bituminous coal mines in Utah from Arch Coal. The two firms created a new company, Bowie Resource Partners (BRP), which now operates those three mines, as well as the Bowie #2 Mine, a bituminous coal mine in Colorado. The firm now advertises itself as "The Nation's Largest Western Bituminous Coal Producer."⁷⁷

All four Bowie mines rely on federal coal leases. Bowie mined 13.1 million tons from its Bowie #2, Sufco, and Skyline mines in 2014. Of that total, 10.8 million tons were obtained through federal coal leases. BLM sold 32 million tons of coal at the Bowie #2 Mine for 32¢ per ton in a 2000 lease sale, and in 2014 sold an additional 8 million tons at the mine for 36¢ per ton.⁷⁸ And BLM's Utah office charged 21¢ and 23¢ per ton for coal leases at the Dugout and Skyline mines, respectively,⁷⁹ as well as 28¢ and 40¢ for two separate leases at the Sufco mine.⁸⁰ The company is now seeking yet another federal coal lease at Sufco.⁸¹

In the announcement of its financing agreement with Galena, BRP specifically mentioned exports as a key element of the company's coal business plan, touting loading agreements with the ports at Stockton and Richmond, California:

Bowie has a long-term agreement with Metropolitan Stevedore Company ("Metro Ports") for the Port of Stockton, which will provide BRP with the opportunity to ship up to 2.3 million tons annually, as the Metro Ports/Stockton agreement will be assigned by Bowie to BRP. Separately, Bowie has been in negotiations with Levin Richmond Terminal Corporation for the port of Richmond, which would provide BRP with annual "topping off" capacity of an additional 1.2 million tons.

As with many of the company's competitors, Bowie's executives foresaw that export markets offered more promising territory than domestic ones:

We think the time is right to introduce the new 'Bowie Brand' into markets where the need and appetite for coal-fired power generation is growing, not abating.⁸²

And despite the long-term decline in seaborne coal prices, Bowie maintained its long-term focus on the export market. In a March 2015 IPO prospectus, Bowie boasted:

We are the only coal producer with contracted U.S. West Coast export capacity, with aggregate throughput capacity of approximately 5.7 million tons through the Port of Stockton, California and the Levin-Richmond Terminal.⁸³

Before Bowie began to ramp up its exports, coal shipments through the San Francisco Customs District (SFCD) had been virtually non-existent for nearly a decade. But Bowie's exports quickly turned the district into a significant coal shipper, with exports spiking to three million tons in 2014. Through the first three quarters of 2015, coal shipments through the SFCD were roughly on pace to match 2014 levels, but coal shipments cratered in the fourth quarter, leaving overall shipments for the year down by nearly a quarter from the previous year. (See Table 4.)

Table 4: Coal Exports from the San Francisco Customs District.

	<u>COAL EXPORTS, SHORT TONS</u>	<u>REVENUE/TON</u>
2012	35,129	\$81.04
2013	1,341,492	\$77.83
2014	3,038,813	\$70.63
2015	2,264,824	\$68.34

Source: US Energy Information Administration

Bowie has exported coal in partnership with the multinational commodity trading firm Trafigura. And Trafigura, in turn, is the corporate parent of Galena Partners, the private equity firm that financed Bowie's original purchase of its three Utah mines. Trafigura's chief customer for Bowie's coal has been Mexico's Comisión Federal de Electricidad (CFE), which purchases coal for its Petacalco power plant near the port of Lázaro Cárdenas in southwest Mexico. Trafigura has won several auctions to deliver coal to supply Petacalco, including:

- Late 2011: 3.8 million tons, for delivery from January 2013-June 2014;⁸⁴
- Late 2013: 3.6 million tons, for delivery through June 2015;⁸⁵
- Mid-2014: 3.5 million tons, for delivery in the second half of 2015, reportedly supplied specifically from Bowie Resource Partners' mines in Colorado and Utah;⁸⁶ and
- Late 2015: 390,000 tons.⁸⁷

All told, 88 percent of all coal exported from the San Francisco area from the beginning of 2013 through late 2015 was shipped to Mexico.⁸⁸ Yet the Mexican market offers limited growth potential: the country supplies most of its coal from domestic sources, importing only 6 to 7 million metric tons of coal per year.⁸⁹

While Bowie's main export customer has limited demand for additional coal, the company has nonetheless worked diligently to secure additional export capacity. In 2013, the company signed a letter of intent to acquire significant terminal space at an undisclosed port in the US Northwest.⁹⁰ More controversially, the company has aggressively pursued a port project in the city of Oakland, California. In February 2014, the Oakland Port Commission unanimously rejected an application to build a terminal that would handle coal, petroleum coke, and other bulk minerals.⁹¹

But Utah state officials took approving note of Bowie's export ambitions,⁹² and in 2015 took the remarkable step of offering to invest \$53 million of state money into an Oakland coal terminal project, sparking an outraged response from the local community,⁹³ city officials, and state legislators.⁹⁴ After legal questions arose about using these funds for a private coal project, the Utah state legislature approved a complex fund-swapping scheme that would use state transportation funds to build the Oakland port and reimburse the transportation budget with money from federal mineral royalties.⁹⁵

Trafigura and Bowie have little reason to hope for any increase in coal exports in the coming years.

But as the seaborne coal market has declined, it has become increasingly unlikely that Bowie will be able to utilize the additional export capacity it seeks. In 2014, Trafigura lost a key supply contract for the Petacalco plant for July 2015 through mid-2016.⁹⁶ Shortly after the company's 2015 contract with Mexico expired, Bowie's West Coast coal shipments collapsed, and the company announced that it would temporarily halt production at its Bowie #2 mine in Colorado, laying off nearly half of its workforce and warning that those layoffs could be permanent.⁹⁷ Then, in February 2016, the company announced that "as a result of continued market deterioration," it would indefinitely idle its Bowie #2 mine pending a re-evaluation of the mine's market prospects.⁹⁸

Even if Trafigura had won the Petacalco contract, there's little reason to believe that the company would need additional port capacity in the greater San Francisco area. As discussed above, Bowie stated in its 2015 IPO prospectus that it already has roughly 5.7 million tons per year of shipping capacity through the Stockton and Richmond terminals. If that claim is true, then Trafigura and Bowie already have enough existing terminal capacity in the SFCD to nearly double exports from their 2014 peak.

But at this point, Trafigura and Bowie have little reason to hope for *any* increase in coal exports in the coming years. Sharp declines in Chinese and Indian coal imports, coupled with limited export cutbacks from competing coal suppliers, have left the Pacific Rim market glutted with inexpensive coal.⁹⁹ Leaving aside local environmental and health concerns that will arise from coal port development, Oakland port officials should be concerned that new coal export capacity would become an expensive, unnecessary, and unused stranded asset supporting an export sector with very little chance of financial success.

Still, despite the dismal state of the international coal market, to all outward appearances Bowie Resource Partners remains steadfastly committed to its export plans. And, like many of its export competitors, Bowie remains deeply dependent on federal coal, having purchased rights to mine this coal for a few dimes per ton. As BLM considers Bowie's pending federal coal lease application at its Sufco mine, the agency should evaluate the economics of Bowie's export plans and the potential for Bowie to realize a substantial windfall should export demand reemerge.

Arch Coal's West Elk Mine, Colorado

Arch Coal has seen better days. Laden with crippling debts and suffering accelerating losses, the company declared bankruptcy in January 2016. But the company once seemed to have a bright future, anchored by coal exports. In 2011, the company paid \$3.4 billion to acquire International Coal Group.¹⁰⁰ With that purchase, Arch hoped to:

[L]everage its dedicated throughput capacity, logistics capabilities and strategic relationships to expand export shipments via the East Coast, West Coast and Gulf of Mexico to further penetrate and participate in the global growth markets.

For a short while, Arch's export strategy paid some dividends. The company's export revenues totaled \$1.2 billion for 2012 and \$0.8 billion in 2013, with overseas shipments totaling 11.5 million tons in 2013.¹⁰¹ Most of Arch's export revenue came from metallurgical coal produced in Appalachia. But the company also exported a significant volume of coal from its West Elk Mine in Colorado, which produces a bituminous thermal coal. As John Eaves, Arch Coal's president and CEO, reported in an investor conference call in early 2014:

As you know our West Elk mine in Colorado is heavily focused on the export market. As 50% of the mine's output[s] were sold in the Europe, Latin America and Asia in 2013. That penetration has been helpful as it has helped to offset a soft demand for Colorado coal domestically.¹⁰²

This was not the first time that Arch has mentioned its significant export position at West Elk and the fact that Colorado bituminous coal has a modest domestic market. In Arch's conference call for the third quarter of 2011, Mr. Eaves stated:

As we look at Western Bit [bituminous], I will tell you that we're not seeing a lot of improvement in the domestic demand there. We are encouraged by what we're seeing in terms of the international market in Western Bit. We're

going to see somewhere around 1.5 million tons there of exports this year and hope to grow that to over 2 million tons next year.

Arch Coal executives have said that the firm has shipped West Elk coal to Japan,¹⁰³ that it had shipped West Elk coal both through West Coast and Gulf Coast ports,¹⁰⁴ and that it expected to ship additional thermal coal overseas as port capacity expands.¹⁰⁵

Although Arch's coal export strategy showed some early successes, that strategy sagged along with international coal prices. In the company's 2014 annual report, Arch reported that declining seaborne coal market conditions from 2012 to 2014 had slashed the company's export revenues by half.¹⁰⁶ By April of 2015, Arch announced that it would pare back production at West Elk: it had managed to lock in only meagre sales contracts for 2015 and 2016, and the company would export only about 20 percent of the coal produced at the mine. In contrast with their former exuberance about exports, Arch's management struck a much grimmer tone in early 2015:

I guess bottom line is West Elk is always going to be a concern. It plays into the export market well, but the export market isn't very strong right now. Its customer base is hit pretty hard by low natural gas prices.

But while coal prices were high, Arch succeeded in exporting significant volumes of West Elk coal. Most of that coal came from federal coal leases. BLM granted the most recent lease application in 2007, under which Arch paid 25 cents per ton for the privilege of mining 12.1 million tons of federal coal. BLM expanded Arch's access to federal coal through a lease modification in December 2012 that gave Arch access to an additional 1,721 acres of federal coal at West Elk.¹⁰⁷ Of the 6.2 million tons of coal mined at West Elk in 2014, 6.1 million, or nearly 99 percent, was federal coal.

Arch hopes to expand its West Elk reserves with an additional 10.1-million-ton federal coal lease. In 2014, however, a US district court put that lease application on hold, arguing that the federal government had failed to consider the cost of greenhouse gases when reviewing the lease.¹⁰⁸

But even though the Obama administration has placed a three-year moratorium on federal coal leasing, the pause won't apply to the West Elk Mine expansion.¹⁰⁹ During the leasing moratorium, however, the federal government will have the opportunity to review how Arch's export ambitions might affect the price that the American public should expect to receive for coal leases at the West Elk mine.

Southern Powder River Basin Mines, WY

The southern PRB is home to the nation's nine largest and highest-producing coal mines. Yet domestic demand for southern PRB coal has been on the decline in recent years, leading to a 20 percent fall in Wyoming coal production between 2008 and 2015.¹¹⁰ This steep drop has prompted companies operating in the southern PRB to seek overseas customers for their coal and to promote exports as a way to revitalize the region's coal industry.

Take, for example, Arch Coal. Even in bankruptcy, the company continues to own and operate two mines in the southern PRB, including Black Thunder, which in 2010 produced more coal than any other mine in the nation.¹¹¹ Arch mines Black Thunder through several coal leases granted by BLM's Wyoming office.¹¹²

Repeated public statements by Arch show that the company has been keen to export its southern PRB coal to overseas customers. In 2010, Arch advertised its success in coal from its Black Thunder Mine "to the West Coast for export to China and the Asia-Pacific market."¹¹³ And in an investor conference call, the company reported that it had shipped thermal coal from the PRB to customers in Korea.¹¹⁴

Until recently, the company also owned a 38 percent stake in the proposed Millennium Bulk Terminal project in Longview, Washington, which would export 44 million metric tons of coal per year. Arch still retains an option to use up to 10 percent of Millennium's capacity, if the terminal is ever completed. Arch's involvement in the Millennium project suggests that the company hopes to ship significant quantities of coal from the southern PRB to customers in Asia.

Peabody Energy also operates three mines in the southern PRB, including the 89-square-mile North Antelope/Rochelle Mine.¹¹⁵ Like its competitors, Peabody had outsized export ambitions during the peak of the international coal bubble. In 2010, the company reported that it had shipped PRB coal to Great Britain.¹¹⁶ And in February 2011, it inked a long-term deal with port operator SSA Marine to ship up to 24 million tons of coal per year, principally to Asia, through the proposed Gateway Pacific coal terminal outside of Bellingham, Washington. Peabody argued that "Powder River Basin coal offers a competitive and reliable alternative for customers in China, South Korea, Japan, India and other Asian nations."¹¹⁷ Then in mid-2012, as progress on Northwest terminal projects stalled, the company announced plans to export PRB coal through terminals in Houston and New Orleans.¹¹⁸

In 2012, Peabody added 1.2 billion in coal reserves to its North Antelope mining complex, through two successful LBA bids: one for the North Porcupine LBA, at \$1.10 per ton, and another for the South Porcupine LBA, at \$1.11 per ton.¹¹⁹ The company had hoped to add an additional billion tons of coal to North Antelope through a lease at Antelope Ridge, though the company chose to withdraw that lease application last November.¹²⁰

Peabody's plans for a substantial increase in exports of PRB coal raise serious questions about the financial underpinnings of these bids. By ignoring the economics of coal exports, BLM likely underestimated the "fair market value" of coal at North and South Porcupine, and the agency now risks doing the same at Antelope Ridge.

In 2013, BLM proposed to amend its management plan for the southern PRB to acknowledge that a key goal of its coal leasing program is to ensure that "leasable coal resources are available to support...export needs."¹²¹ If the agency continues to neglect the economics of coal exports when putting a price on federal coal in the southern PRB, it risks not only shortchanging the American public, but also ignoring the agency's own statements about the core goals of its coal leasing program.

Carbon Resources: Kinney Mine, Utah

Up until early 2015, Australian firm New Horizon Coal was attempting to develop the so-called Kinney coal mine, located in a "mature coal mining district" about 100 miles from Salt Lake City, Utah. In developing the mine, New Horizon hoped to combine two separate coal leases: one for coal controlled by Carbon County, Utah, and a second for federal coal controlled by BLM.¹²² The Kinney mine's proponents aimed for export markets. In a presentation to investors, New Horizon Coal repeatedly spotlighted the Kinney Mine's export potential. Examples include:

- **Rail and road access:** The presentation emphasized nearby "rail and road infrastructure" that would allow Kinney coal "to reach domestic *and export markets*." (Emphasis added.)
- **Port allocation:** New Horizon Coal touts its "Secure Port Allocation and Export Logistics," including an agreement for a "port allocation" at the Texas Deepwater Industrial Port starting at 1.5 million tons per year, and expandable to 3 million tons per year.
- **Premium export prices, high export profits:** The presentation cites industry analysts who forecast "premium pricing on domestic *and export markets*" for Kinney coal. The presentation includes a chart that highlights

coal prices in the Gulf of Mexico, from which New Horizon hopes to export, showing export profit margins starting at \$20 per ton in the short term and rising to \$80 per ton in 2029. A separate presentation states that “the project is expected to realize strong cash flows utilizing a mixture of domestic and export sales.”¹²³

- **Suitability for export:** The presentation explicitly states that Kinney’s high-calorie, low-sulfur coal is “suitable to” export markets, including Europe, Latin America, and Asia.
- **Marketing and Logistics:** The presentation highlights the “significant blending opportunities” for Kinney coal to be mixed with other fast-growing export coals with lower energy content or higher sulfur levels. New Horizon points to its Texas port allocation as a “one stop shop” to blend and export” its coal.

In early January of 2015, however, depressed international coal markets forced New Horizon to abandon the Kinney Mine project and sell all coal rights back to the project’s prior owners. Within a month the BLM announced that the project proponents had withdrawn their application for a federal coal lease.¹²⁴ After millions of dollars in investments by New Horizon, the Kinney mine has become yet another victim of the collapse of the global coal markets.

Coal Exports and the “Option Value” of Federal Coal

The vision of a robust and profitable Asian export market that once captivated the imagination of the US coal industry has proven to be a mirage. The brief period of high international demand and rising seaborne coal prices has given way to an extended slump, leading to massive financial losses for companies that invested heavily in coal exports. To make things even grimmer for the coal industry's export ambitions, international futures markets now predict that coal prices will remain at low levels for the foreseeable future.¹²⁵

But despite this price collapse, major US coal companies continued to sink money into export projects long after Pacific Rim markets became inhospitable to US exports. Last August, for example, Cloud Peak Energy agreed to pay permitting costs for the proposed Gateway Pacific terminal in northwestern Washington, even though the company had started to

The vision of a robust and profitable Asian export market that once captivated the imagination of the US coal industry has proven to be a mirage.

lose money on export sales more than two years earlier.¹²⁶ Although the US Army Corps of Engineers has now denied a key permit for the Gateway terminal, Cloud Peak maintains a shipping option at the proposed Millennium Bulk Terminals facility in Longview, Washington, even as it continues to pursue new federal coal leases adjacent to its export-oriented Spring Creek mine.

Likewise, Bowie Resource Partners has maintained its quest for a coal terminal at the port of Oakland. Lighthouse Resources still seeks an expansion of its export-oriented Decker mine, and continues to support the Millennium terminal project. And until recently, Arch Coal also supported Millennium financially, until the company's bankruptcy administrators forced the company to conserve capital by halting payments to the project.

The fact that coal companies continued to spend money on export projects long after exports had become unprofitable begs for an explanation. Many possibilities suggest themselves, ranging from institutional inertia¹²⁷ to contractual obligations to the reluctance of highly paid executives to admit their own fallibility.¹²⁸ But perhaps the most straightforward explanation is that coal industry executives were making rational, calculated gambles that seaborne coal prices might rebound—and that money spent on export projects ultimately might yield profits.

The fact that coal companies paid large sums just to keep their export options open raises a key question: ***how much is the option to export coal to Asia really worth?***

The answer to this question has profound implications for how the federal government determines the “fair market value” of federal coal. Clearly, owning a federal coal lease would allow the leaseholder to realize substantial gains from exports, provided that international prices gain ground. So at a minimum, BLM ought to consider the economic value of these potential future profits when deciding the price at which it will sell federal coal leases.

Financial economists have developed tools for estimating the value of owning the rights to an undeveloped mineral reserve. These tools rely on the clear parallels between ownership of mineral rights and financial instruments known as “options contracts,” or more simply, as options. (See below.)

A brief explanation of options

Options contracts, or simply “options,” are carefully constructed agreements that give the option-holder the right, but not the obligation, to buy or sell a specific amount of a good or commodity at a specific price at some time in the future. The option-holder is free to exercise the option—that is, to buy or sell the good—when it is profitable to do so, but is under no compulsion to sustain losses when the trade is unprofitable. In short, options have value because they allow the option-holder to realize a profit without risking a loss.

As a simple example, consider a trader who purchases an option to buy coal at \$20 per ton at some time in the future. If prices happen to rise to \$30 per ton by the time the option expires, the trader could exercise the option to buy coal at \$20 per ton and then resell the coal at the market price of \$30 per ton—earning \$10 for every ton of coal covered by the options contract. However, if the price of coal were below \$20 when the option expired, the trader would simply allow the option to expire, losing nothing but the purchase price of the option.

Interestingly, options contracts can have a significant economic value even if they are currently “out of the money,” i.e., can’t be exercised at a profit at today’s prices. In the example above, a trader might be willing purchase an option to buy coal for \$20 ton in 5 years, even if prices today are only \$15 per ton. In this case, the options buyer is gambling that prices will rise above \$20 and that the option ultimately will prove profitable. Out-of-the-money options don’t cost as much as in-the-money options, but they still have an economic value.

Over the past half-century, economists have carefully studied the pricing dynamics of options, finding that four factors strongly influence their price:

- the market price of the commodity being traded;
- the “exercise” price, which is the specified price at which the option-holder can buy or sell the commodity;
- the time until the option expires; and
- the expected price volatility of the commodity.

Seminal work by economists Fischer Black, Myron Scholes, and Robert Merton established a mathematical model that uses these four factors, along with expected interest rates and dividends, to estimate the fair market value of an options contract.¹²⁹ Roughly speaking, the Black-Scholes-Merton model assumes that prices will move randomly in the future, with the size of those movements set by the forecasted price volatility. The model then calculates both the odds that future price movements might allow the option contract to be exercised at a profit, and also the potential profits if exercised. When multiplied together, the odds of a profit and the total profit if exercised yield a good estimate of what market participants would be willing to pay for an option contract.¹

Under this model, the price of an option depends on **how far prices have to move** for the option to be profitable, **how quickly prices move**, and **how long the option remains open**. The model finds that **high price volatility makes options more valuable**: the faster prices move, the greater the odds that an out-of-the-money option will wind up in the money. Similarly, **high prices make options more valuable**: a 10% price movement is worth more when a good is expensive than when it's inexpensive.

1. This simplified description of options valuation is a common description of the Black-Scholes valuation method. See, e.g., Wikipedia, “Black-Scholes Model: Interpretation,” https://en.wikipedia.org/wiki/Black%E2%80%93Scholes_model#Interpretation. Also note that the Black-Scholes model calculates “volatility” as the standard deviation of annualized percentage price changes.

Options Prices, “Real Options,” and Federal Coal Leases

Borrowing heavily from options pricing theory, financial economists have developed techniques to estimate the value of having the “real option” to develop speculative projects such as new mines.¹³⁰ These techniques establish very tight parallels between the pricing of “call” option contracts—that is, an option to buy minerals at a specified price—and owning the “real option” to bring a previously unexploited mineral reserve into production.¹³¹ The parallels are clear and numerous. For a call option, the option contract sets the “strike price,” i.e., the price at which the optioned commodity can be purchased. For a federal coal lease the “strike price” represents the comprehensive cost per ton to develop and operate the coal mine. In effect, the “strike price” represents the cost at which a leaseholder can “buy” coal by mining the leased reserve. And just as a call option expires after a fixed time, a federal coal lease expires after 10 years if the leaseholder doesn’t take steps to develop the mine.¹³² Similarly, the profitability of both a call option and a coal lease depends on prices: as prices increase, both call options and coal leases become more profitable.

To illuminate the parallels between call options and federal coal leases, consider a 10-year option to buy Powder River Basin coal at \$12, versus a 10-year lease on coal that can be mined for \$12 per ton. In the case of the option, if market prices were to rise to \$15 per ton at some point over that 10-year period, the trader could exercise the option, purchase the coal at \$12 per ton, and resell it at the market price, making \$3 per ton in profit. The owner of the mineral lease could do something very similar: the leaseholder could choose to develop the mine and sell the coal at \$15 per ton, also making \$3 per ton in profit.

Federal coal leases confer what is often called a “real option”: the right, but not the obligation, to undertake a project if it looks profitable to do so. As with financial options, a coal lease bestows the leaseholder a choice that has a clear economic value, namely, the ability to profitably develop a mine when coal prices are favorable, without committing the leaseholder to sink capital into the venture if it appears unprofitable.

But the parallels between financial options and mineral rates go even deeper. Just as price volatility boosts the value of a financial option, volatility also boosts the value of the “real option” to develop or expand a mine. As described by researchers from the Massachusetts Institute of Technology:

*An undeveloped reserve gives the owner an option to develop the reserve, the exercise price for which is the cost of development. **If there is considerable uncertainty over future...prices, the option value will be high.** [Emphasis added.]¹³³*

In the same vein, just as out-of-the-money options have economic value, federal coal leases have optionality value *even if prices don't currently support a project*. As described by Dr. Aswath Damodaran, professor of corporate finance and valuation at the Stern School of Business at New York University:

Having the exclusive rights to a product or project is valuable, even if the product or project is not viable today. The value of these rights increases with the volatility of the underlying business.¹³⁴

The idea that a real option can have economic value even if a project currently doesn't pencil out helps explain why coal companies continued to sink money into coal export projects and export-oriented mines even after international coal prices collapsed. In effect, supporting coal export projects was like buying out-of-the-money options that could be profitably "exercised" if coal prices were to rise.

Of course, the parallels between options contracts and federal coal leases are imperfect.¹³⁵ For financial options, the exercise price—the price at which the option owner can buy or sell a commodity—is fixed by contract. But the "exercise price" for mining rights—namely, the comprehensive cost of developing and producing coal at the mine—faces uncertainties in the costs of capital, equipment, fuel, labor, and other expenses.

Similarly, coal markets can change dramatically in the time it takes to complete a mine, and they can change even more over the mine's lifespan. As a result, financial professionals change their valuation practices once a decision to mine is finalized: the mine is valued no longer as a reversible option, but instead based on the expected future profitability of the mine.

Although they're not identical, options contracts and coal mining rights are so similar that financial economists believe that options pricing methods provide a useful tool for estimating the economic value of undeveloped mineral reserves. As described by Dr. Damodaran,¹³⁶ financial options valuation techniques are best suited for estimating the value of real options when:

- The underlying asset is traded;
- There is an active marketplace for financial options; and
- The cost of exercising the real option is relatively well known.

Federal coal mining rights easily meet all of the above criteria. Coal is obviously widely traded in both domestic and international markets. There is a viable market for coal options, with options prices for coal contracts regularly calculated and reported for a variety of coals.² And the costs of mining federal coal depend largely on the geology of the coal reserves and the technology available to extract them, both of which are exhaustively studied during the leasing process. Clearly, the strong congruence between financial options and coal mining rights suggest that BLM should consider optionality values when establishing the fair market value of federal coal.

Estimating the Option Value of Federal Coal Leases

Below we present preliminary estimates of the potential option value of federal coal leases, based on calculations of similarly structured financial options. We do not suggest that this analysis is definitive. Quite the opposite: a full and thorough exploration of the option value of federal coal remains beyond the scope of this report. We offer our estimates primarily to stimulate discussion and to spur others, particularly BLM, to conduct a more detailed and thorough exploration of the option value of federal coal leases. Such a review seems particularly salient given our tentative findings that BLM has consistently sold federal coal leases at prices substantially lower than the value of comparably structured options contracts.

Our analysis relies on publicly available information, including coal industry financial statements, public statements by coal industry executives, and futures and options pricing data. We estimate the market value of a variety of coal options

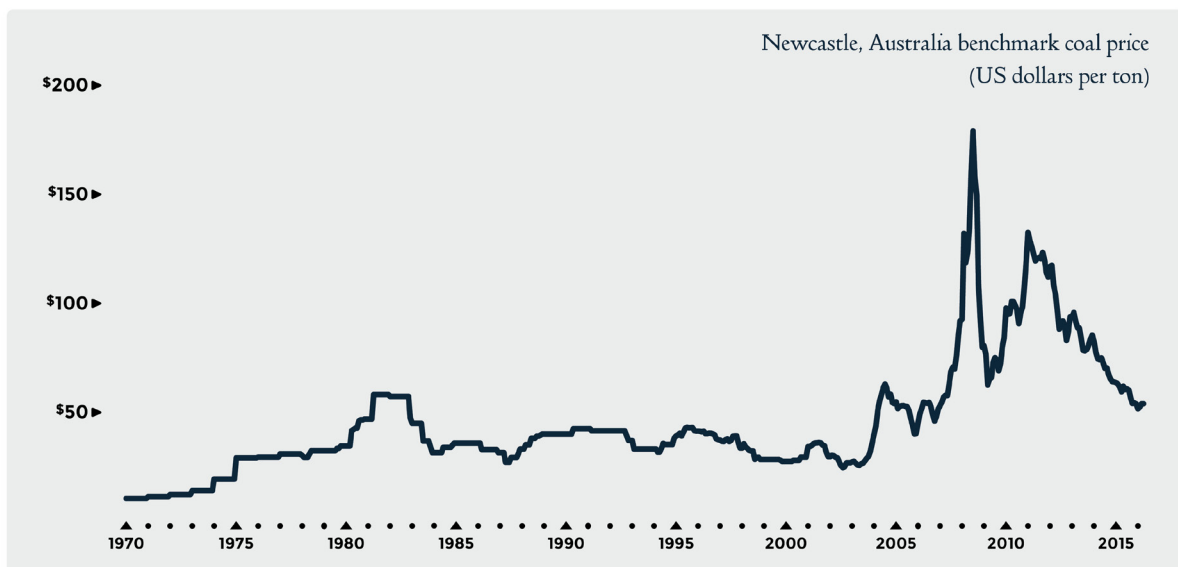
2. See, inter alia, <http://www.eia.gov/coal/data.cfm#prices>, <http://www.eia.gov/coal/markets/>, <http://quotes.esignal.com/esignalprod/quote.action?symbol=NCF-ICE>, <http://quotes.esignal.com/esignalprod/quote.action?s=mcc>, <http://www.cmegroup.com/trading/energy/coal/western-rail-powder-river-basin-coal-swap-futures.html>, <http://www.coalspot.com/indonesian-coal-price-reference/>. Barchart.com, "Futures>>Futures Markets>>Energies," http://barchart.com/commodityfutures/ICE_NewCastle_Coal_Futures/options/LO, accessed May 16, 2015; CME Group, "Powder River Basin Coal (Platts OTC Broker Index) Options Quotes," http://www.cmegroup.com/trading/energy/coal/western-rail-powder-river-basin-coal-swap-futures_quotes_globex_options.html, accessed May 16, 2015.

contracts in both export and domestic markets, structured in parallel to the real options that a federal coal leaseholder would face in choosing whether to develop a mine either for export or domestic consumption. (See Appendix 2 for more details on methods and assumptions.)

The key unknown in any options pricing analysis is the future price volatility of the commodity being assessed. Price volatility, defined as the standard deviation of annualized returns, has a substantial influence on options prices, and that influence grows as the duration of the option increases. While other factors—the current price, the strike price, the risk-free rate, and the expiration date of the option—are either fixed or can be reliably estimated from public data sources, future price volatility is simply unknowable.

Historically, coal prices have varied over time, and from market to market, sometimes abruptly switching from a regime of relative stability to a period of instability. Seaborne thermal coal markets, for example, remained relatively calm from 1970 through 2004, but then entered a period of high volatility characterized by price spikes that far exceeded anything seen on domestic coal markets. (See Figure 4.) Over the decade spanning 2006 through 2015, a period that included two boom-and-bust cycles in international coal markets, Newcastle coal prices (as reported by the World Bank) exhibited an annualized volatility of approximately 27 percent.

Figure 4: Pacific Rim coal markets have grown more volatile over the last decade.



Source: World Bank

Given the “volatility of volatility” in coal prices, we believe that estimates of future price volatility remain inherently speculative. Accordingly, we analyze options values for range of potential coal price volatilities, without assuming that any particular value for volatility will hold true.

Table 5 presents Sightline’s estimates of the potential option value of a hypothetical Powder River Basin coal lease, under current market conditions and a range of future price volatilities. We present details of the calculations in Appendix 2.

Table 5: The estimated “option value” of 10-year federal coal leases for supplying domestic vs. international markets.



PRICE VOLATILITY	OPTION VALUE ON PACIFIC RIM COAL MARKETS	OPTION VALUE ON US COAL MARKETS
10%	\$0.99	\$0.64
15%	\$3.27	\$1.26
20%	\$6.16	\$1.90
25%	\$9.27	\$2.53

See Appendix 2 for methods and assumptions.

These estimates are intended to be illustrative rather than definitive. The valuations that emerge from any translation between financial options and real options will be necessarily imprecise. Nonetheless, four clear conclusions arise from this assessment of the option value of federal coal leases.

1. Even in today’s dismal coal market, the “option” to export federal coal may exceed \$9 per ton.

The estimates in Table 5 are based on recent market conditions, at a time when international coal prices are too low to support most US coal exports. Yet *even in today’s dismal coal market*, a new lease for federal coal at an export-oriented mine could have an option value exceeding \$9 per ton, provided that international coal prices remain as volatile over the next decade as they were over the last decade.

2. Federal coal has a far higher option value if it can be exported than if it only can be sold domestically.

Even with today’s unfavorable export market outlook, the option to export federal coal remains more valuable than the option to sell it domestically, assuming similar levels of price volatility in domestic and overseas markets. This is in part

because exported coal is sold at higher prices, meaning that a small percentage improvement in prices can yield higher absolute profits. And if international coal markets remain more volatile than domestic markets, this volatility would further enhance the option value of export sales over domestic sales.

3. The development of export infrastructure on the US coast would boost the option value of federal coal.

The coal industry has the “real option” to export coal to Asia only to the extent that it can physically access those markets. But West Coast coal export infrastructure currently is limited; even at the height of the Pacific Rim coal export boom, US exporters were able to utilize only a modest amount of capacity at coal terminals in British Columbia and California. However, a major expansion of coal export infrastructure on the West coast would vastly expand the value of the industry’s “real option” to export coal. Expanded export infrastructure, in turn, would significantly enhance the economic value of many federal coal leases, as well as the price that the US public should expect to receive for selling the right to mine federal coal.

4. When many existing coal leases were signed, particularly at export-oriented mines, BLM sold federal coal for less than the “option” value.

As detailed in Appendix 1, the federal government has sold coal mining rights at export-oriented mines at prices as low as 18 cents per ton—a price well below the “option value” on today’s market and almost certainly below the option value at the time of the lease. As BLM reviews its coal leasing practices, the agency would be wise to consider the economics of coal exports when establishing the fair market value of federal coal. If it doesn’t, BLM runs the risk of shortchanging the American public by selling coal for less than its true value.

Conclusion

This report reaches four fundamental conclusions.

First, it finds that coal export projects in the US West, which once seemed to hold the promise of healthy and sustainable profits for the US coal industry, have become financial albatrosses. From 2009 through 2013, Asia's demand for coal seemed robust and nearly inexhaustible. But a combination of market forces and policy decisions in Asian nations has tempered Asia's appetite for coal, leading to collapsing prices in Pacific Rim coal markets. Export projects that once were sources of significant profits are now merely deepening the financial crisis facing the US coal industry. With the decline in seaborne coal prices, several US coal exporters have reduced shipments; others have halted export projects entirely; and at least two publicly traded coal companies have completely written off their investments in coal export projects as worthless.

Second, the report finds that despite deep losses on exports, the major players in the US coal industry remain publicly committed to their export strategy. When prices were high, these exporters made robust profits on the seaborne coal market. Many of these companies still express confidence that, over the long term, coal prices will rebound once again, making exports profitable once more.

Third, the report finds that all of the major companies involved in exports from the US West Coast are heavily reliant on federal coal. In recent years, these corporations have paid the American public pennies per ton for the right to mine the coal that they have shipped overseas. Many of these companies hope to continue to purchase additional leases to expand their access to federal coal at their export-oriented mines.

And last, the report describes a method for estimating the value of federal coal in light of the coal industry's continuing commitment to exports. This method, based on the financial theory of options valuation, helps explain why coal companies remain so keen to access additional federal coal at their export-oriented mines. Purchasing the right to mine federal coal gives these companies the option of developing federal coal reserves if pricing becomes favorable, without obligating them to accept huge losses if prices remain depressed. And preliminary analysis based on options valuation methods suggests that the federal government has sold the rights to federal coal for just a fraction of the real option value of the coal.

The federal government recently put federal coal leasing on hold for three years while it conducts a comprehensive review of its leasing policies and practices. This

pause will give federal agencies the opportunity to ensure that federal coal leasing policy truly represents the public interest.

In addition to the many other vital issues that such a review should cover—including the external costs of the climate impacts, air and water pollution, and habitat destruction created by the US coal industry—the government should also ensure that the American public is truly getting the money it deserves for selling access to federal coal. It is the responsibility of the federal government to ensure that its coal leasing policy doesn't shortchange the public.

To fulfill this obligation, and in light of the US coal industry's widely advertised plans to ship enormous volumes of federal coal to international markets, federal agencies must thoroughly examine the economics of coal exports. As part of that evaluation, they should also take into account the growing theory and practice of real options valuation, recognizing that federal mining leases give private companies a unique right to extract low-risk profits from a publicly owned resource.

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Sightline Institute is a think tank that provides leading original analysis of energy, economic, and environmental policy in the Pacific Northwest.

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Appendix 1. Recent coal leasing and production at export-oriented mines in the western United States.



	MINE	STATE	Federal Coal Leasing			2014 Production	
			DATE APPROVED	TONS LEASED	PRICE/TON	TOTAL	FEDERAL
Cloud Peak Energy	Spring Creek	Montana	4/1/2001 12/1/2007	15,400,000 108,600,000	\$0.11 \$0.18	17,388,424	12,960,738
Lighthouse Resources	Decker	Montana	Lease application pending			3,411,609	2,743,043
Signal Peak Energy	Signal Peak	Montana	6/1/2012	35,500,000	\$0.30	7,901,784	51,370
Arch Coal	West Elk	Colorado	9/1/2004 3/1/2007	2,400,000 12,100,000	\$0.08 \$0.25	6,192,656	6,102,235
Bowie Resource Partners	Bowie #2	Colorado	3/1/1993 10/1/2014	1,290,000 8,020,000	\$0.11 \$0.36	2,407,598	2,416,634
Bowie Resource Partners	Sufco	Utah	10/1/1999 7/1/2015	60,000,000 42,000,000	\$0.28 \$0.40	6,539,322	5,383,901
Bowie Resource Partners	Skyline	Utah	9/1/1996	24,100,000	\$0.23	4,170,162	2,979,292
Peabody Energy	North Antelope / Rochelle	Wyoming	6/13/2012 10/1/2012	401,830,508 721,154,828	\$1.11 \$1.10	117,965,515	102,545,913
Arch Coal	Black Thunder**	Wyoming	5/1/2012	222,676,000	\$1.35	110,431,343	104,029,820

****Production figures include Arch Coal's Coal Creek mine**

Appendix 2. The Option Value of Federal Coal Leases: Methods and Discussion

As a guidepost for estimating the option value of federal coal leases, we develop price estimates for commodity option contracts that parallel the real options facing the owner of a federal coal lease. Our analysis of the option value of federal coal leases looked specifically at the potential for a federal coal leaseholder to develop a proven, undeveloped coal reserve in the Powder River Basin, calculating possible options values for PRB coal sold domestically and in international markets for a range of different future price volatilities.

To calculate option values, we employ the methods outlined by Dr. Fischer Black in his paper “The Pricing of Commodity Contracts,”¹³⁶ using the following inputs.

Export Coal Options Contract

Model input	Input Value	Details and explanation
Proxy Option:	Newcastle benchmark	The Newcastle, Australia price benchmark, which is the most commonly used price reference for Pacific Rim seaborne coal markets
Commodity price:	\$60	Sightline’s estimated 2026 coal price, based on the Newcastle futures curve as of early June 2016
Strike price:	\$75	Cloud Peak Energy executives have said that they can break even on exports once Newcastle prices hit \$75. This price is inflated at the risk-free rate to 2026 dollars.
Volatility range:	10% to 25%	The wide range of potential future volatility for Newcastle coal prices reflects both a history of high price volatility over the last decade, and uncertainty about whether that volatility will persist.

Domestic Coal Options Contract

Model input	Input Value	Details and explanation
Proxy Option:	PRB coal futures	The benchmark contract for coal produced in the Powder River Basin in Wyoming
Commodity price:	\$12	Sightline's estimated 2026 coal price, based on the PRB futures curve as of early June 2016. This price is inflated at the risk-free rate to 2026 dollars.
Strike price:	\$12	Cloud Peak Energy has reported an average cost of \$10 to produce coal in recent years. We assume that capital markets would require a \$2 per ton additional margin to justify developing a new mine.
Volatility range:	10% to 25%	Although PRB coal prices have been less volatile than international prices over the last decade, for the sake of comparison we examine the same range of price volatilities for both domestic and international options.

We discount the futures price of Newcastle coal to 2016 dollars using the risk-free rate. Similarly, we inflate the strike price, or presumed breakeven price for coal mine development, to 2026 dollars using the risk-free rate. We assume a risk-free rate of 1.72%, which was the 10-year treasury yield in early June 2016.

Historic coal price volatility, defined as the standard deviation of annualized returns, has itself proven quite volatile, with coal prices changing at different rates in different markets at different times. Over the decade spanning 2006 through 2015, a period that included two boom-and-bust cycles in international coal markets, Newcastle coal prices, as reported by the World Bank, exhibited an

annualized volatility of approximately 27 percent. And from 1985 through 2015, calculations of coal price volatility over 5 years ranged from as low as 7 percent to as high as 36 percent.

The uncertainty in future price volatility has also created uncertainty in options prices. Over the past six months, long-term future implied volatility calculated from Newcastle coal options has ranged from as high as 20 percent to as low as 8 percent. Given the “volatility of volatility” in coal prices, we believe that estimates of future price volatility remain largely speculative. Accordingly, we analyze options values for range of potential coal price volatilities, without assuming that any particular value for volatility will hold true.

Endnotes

1. Dr. Ronald Lewis, "West Virginia: Documents in the History of a Rural-Industrial State," June 1991, <http://www.as.wvu.edu/WVHistory/documents/090.pdf>.
2. US Energy Information Administration, "Natural Gas Prices," http://www.eia.gov/dnav/ng/ng_pri_sum_dcu_nus_m.htm.
3. Institute for Energy Research, "Power Plant Closures," <http://instituteeforenergyresearch.org/topics/policy/power-plant-closures/>, accessed May 15, 2016.
4. US Energy Information Administration, "Preliminary Monthly Electric Generator Inventory," <http://www.eia.gov/electricity/data/eia860m/>.
5. Katie Fehrenbacher, "Wind now competes with fossil fuels. Solar almost does," *Fortune Magazine*, October 6, 2015, <http://fortune.com/2015/10/06/wind-cheap-coal-gas/>.
6. US Energy Information Administration, "Electricity Data Browser," accessed May 10, 2016, <http://www.eia.gov/electricity/data/browser/#/topic/2?agg=2,0.1&fuel=vtv&geo=g&sec=g&freq=M&start=200101&end=201511&ctype=linechart<ype=pin&rtype=s&maptype=0&rse=0&pin=>.
7. Bobby Magill, "Coal for Electricity Hits a 45-Year Low," *Scientific American*, January 29, 2016, <http://www.scientificamerican.com/article/coal-for-electricity-hits-a-45-year-low/>.
8. Robert Walton, "Moody's: Cheap gas could pressure coal, nuclear plants into retirement," *Utility Dive*, April 10, 2016, <http://www.utilitydive.com/news/moodys-cheap-gas-could-pressure-coal-nuclear-plants-into-retirement/417138/>.
9. Holly Stewart and Alonso Guerra Garcia, "Coal Weekly: Week Ending April 19, 2016," accessed May 10, 2016, <http://www.howardweil.com/docs/Reports/WEEKLY%20REPORTS/CoalWeekly.pdf>.
10. Taylor Kuykendall, "UPDATE: 'End of an Era': Arch joins list of nearly 50 coal bankruptcies since 2012," *S&P Global Market Intelligence*, January 11, 2016, <https://www.snl.com/InteractiveX/Article.aspx?cid=A-35032322-14387>.
11. Taylor Kuykendall, "My name is Bob: Faith, purpose drive Robert Murray in fight for coal's future," *S&P Global Market Intelligence*, February 2, 2016, <https://www.snl.com/InteractiveX/Article.aspx?cid=A-35226848-12329>.
12. Qi Ye and Tong Wu, "Putting China's coal consumption into Context," *Brookings Institution*, November 30, 2015, <http://www.brookings.edu/blogs/up-front/posts/2015/11/30-china-coal-consumption-context>.
13. Rowena Mason, "Old King Coal will stay on the commodities throne for years," *The Telegraph*, December 29, 2009, <http://www.telegraph.co.uk/finance/newsbysector/energy/6896140/Old-King-Coal-will-stay-on-the-commodities-throne-for-years.html>.
14. Yu Hongyan, "China becomes a net coal importer in 2009," *China Daily*, February 23, 2009, http://www.chinadaily.com.cn/business/2010-02/23/content_9490004.htm.
15. Mario Parker and Noah Buhayar, "Peabody Says Coal in Early Phase of 'Super Cycle'," *Bloomberg*, June 24, 2010, <http://www.bloomberg.com/news/articles/2010-06-24/peabody-energy-sees-global-coal-demand-at-the-beginning-of-a-super-cycle->.
16. See, e.g., Tom Tobin, "U.S. is Saudi Arabia of coal," *PolitiFact*, January 25, 2008, <http://www.politifact.com/truth-o-meter/statements/2008/jan/25/rudy-giuliani/us-is-saudi-arabia-of-coal/>; and *Fortune Magazine*, "The U.S. is the Saudi Arabia of coal," November, 9, 2011, <http://fortune.com/video/2011/11/09/the-u-s-is-the-saudi-arabia-of-coal/>.

17. Luke Burgess, "Russia Inks \$6 Billion Deal with China to Supply 475 Million Tonnes of Coal," *Energy and Capital*, September 10, 2010, <http://www.energyandcapital.com/articles/russia-china-agree-to-6-billion-deal-for-475-million-tonnes-of-coal/1265>.
18. Richard Martin, "China's Great Coal Migration," *Fortune Magazine*, July 11, 2014, <http://fortune.com/2014/07/11/coal-china/>; Reuters, "China to boost annual railway coal capacity to 3 bln T by 2020," January 14, 2014, <http://www.reuters.com/article/china-coal-rail-idUSL3N0KO27W20140114>.
19. *China Economic Review*, "Electricity use trends point to major gains in China's energy efficiency," August 24, 2015, <http://www.chinaeconomicreview.com/electricity-use-trends-point-major-gains-chinas-energy-efficiency>.
20. *Bloomberg News*, "China Cuts Capacity in Some Industries to Reshape Economy," July 25, 2013, <http://www.bloomberg.com/news/articles/2013-07-25/china-cuts-capacity-in-some-industries-to-reshape-economy>.
21. Wenran Jiang, "China isn't hurting oil prices — it's as hungry for oil as ever," *Financial Post*, February 23, 2016, <http://business.financialpost.com/fp-comment/china-isnt-hurting-oil-prices-its-using-more-oil-than-ever>.
22. Li Shuo and Lauri Myllyvirta, "The End of China's Coal Boom: 6 Facts You Should Know," Greenpeace East Asia, April 11, 2014, <http://www.greenpeace.org/international/Global/international/briefings/climate/2014/The-End-of-Chinas-Coal-Boom.pdf>; Conor Gafey, "Beijing Shuts Down Coal Power Plants As Air Pollution Costs Economy," *Newsweek*, March 26, 2016, <http://www.newsweek.com/beijing-shuts-down-coal-power-plants-air-pollution-costs-economy-316829>; Benjamin Kang Lim et al., "China to lay off five to six million workers, earmarks at least \$23 billion," *Reuters*, March 3, 2016, <http://www.reuters.com/article/us-china-economy-layoffs-exclusive-idUSKCN0W33DS>.
23. Lauri Myllyvirta, "Factcheck: What's actually happening with China's coal use," *Greenpeace Energy Desk*, November 23, 2015, <http://energydesk.greenpeace.org/2015/11/23/whats-happening-china-coal/>.
24. Tim Buckley, "New China Data Shows an 'Entirely Beleaguered' Seaborne Market," Institute for Energy Economics and Financial Analysis, January 2016, <http://ieefa.org/chinas-love-for-coal-and-coal-imports-and-longstanding-affair-with-heavy-emissions-rapidly-coming-off-the-boil/>. Edward Wong, "Statistics From China Say Coal Consumption Continues to Drop," *The New York Times*, March 2, 2016, <http://www.nytimes.com/2016/03/03/world/asia/china-coal-consumption-down.html>.
25. National Bureau of Statistics of China, http://www.stats.gov.cn/tjsj/zxfb/201605/t20160514_1356331.html, translation by Google Translate.
26. *Reuters*, "China to close more than 1,000 coal mines in 2016: energy bureau," February 22, 2016, <http://www.reuters.com/article/us-china-energy-coal-idUSKCN0VV0U5>.
27. Sophia Yan, "China plans to cut 1.8 million coal and steel jobs," *CNN Money*, February 29, 2016, <http://money.cnn.com/2016/02/29/news/economy/china-steel-coal-jobs/>.
28. Angela Macdonald-Smith, "China may further toughen restrictions on coal imports, Wood Mackenzie says," *Sydney Morning Herald*, July 29, 2015, <http://www.smh.com.au/business/energy/china-may-further-toughen-restrictions-on-coal-imports-wood-mackenzie-says-20150727-giltfv.html>.

29. Chuin-Wei Yap, "China Reviving Tariffs on Coal Imports," *The Wall Street Journal*, October 9, 2014, <http://www.wsj.com/articles/china-reviving-tariffs-on-coal-imports-1412867896>.
30. General Administration of Customs of the People's Republic of China, "Customs Statistics," accessed May 10, 2016, <http://www.customs.gov.cn/tabid/49666/Default.aspx>.
31. *The Economic Times*, "India won't need coal imports by 2017: Piyush Goyal," November 16, 2015, http://articles.economictimes.indiatimes.com/2015-11-16/news/68326226_1_coal-washeries-coal-imports-coal-shortages; Tim Loh, "India's Energy Minister Wants to Cut Coal Imports to Nothing," *Bloomberg*, April 25, 2016, <http://www.bloomberg.com/news/articles/2016-04-25/india-s-energy-minister-wants-to-cut-coal-imports-to-nothing>.
32. Tim Buckley and Jai Sharda, "34% Drop in Indian Coal Imports Snuffing Out Thermal Coal Export Market," Institute for Energy Economics and Financial Analysis, January 7, 2016, <http://ieefa.org/34-drop-in-indian-coal-imports-snuffing-out-thermal-coal-export-market/>.
33. Office of Inspector General, US Department of the Interior, Coal Management Program, US Department of Interior, Report No: CR-EV-BLM-0001-2012, June 2013, <https://www.doioig.gov/sites/doioig.gov/files/CR-EV-BLM-0001-2012Public.pdf>.
34. Cloud Peak Energy, "Home Page," accessed May 23, 2016, <http://cloudpeakenergy.com/>.
35. Derived from Cloud Peak 10-K and 8-K forms. Cloud Peak Energy, "SEC Filings – Cloud Peak Energy, Inc.," <http://investor.cloudpeakenergy.com/sec-filings>.
36. See, *inter alia*, Cloud Peak Energy, "Form 8-K, Cloud Peak Energy Inc., May 21, 2014," <http://api40.10kwizard.com/cgi/convert/pdf/CLD-20140521-8K-20140521.pdf?ipage=9611719&xml=1&quest=1&rid=23§ion=1&sequence=-1&pdf=1&dn=1>; and Ross Macfarlane, "Cloud Peak Energy: 'All in' for coal exports from the West Coast," *Climate Solutions*, February 19, 2013, <http://climatesolutions.org/cs-journal/cloud-peak-energy-201call-in201d-for-coal-exports-from-the-west-coast>.
37. Seeking Alpha Transcripts, "Cloud Peak Energy's CEO Discusses Q3 2013 Results – Earnings Call Transcript," October 29, 2013, <http://seekingalpha.com/article/1785532-cloud-peak-energys-ceo-discusses-q3-2013-results-earnings-call-transcript?part=single>.
38. Cloud Peak Energy, "Investor Presentation, May 2014," http://investor.cloudpeakenergy.com/sites/cldpk.investorhq.businesswire.com/files/doc_library/file/Q114_Investor_Presentation_FINAL.pdf.
39. Cloud Peak Energy, "Cloud Peak Energy Amends Throughput Agreement with Westshore Terminals to Increase Committed Export Capacity and Extend Term," August 8, 2014, <http://investor.cloudpeakenergy.com/press-release/business-development/cloud-peak-energy-amends-throughput-agreement-westshore-terminals>.
40. Cloud Peak Energy, "Cloud Peak Energy Announces Option Agreement with SSA Marine for Capacity at Future Cape Size Export Terminal in Pacific Northwest," February 13, 2013, <http://investor.cloudpeakenergy.com/press-release/business-development/cloud-peak-energy-announces-option-agreement-ssa-marine-capacity>.
41. Cloud Peak Energy, "SSA Marine Welcomes the Crow Tribe and Cloud Peak Energy as Partners in the Gateway Pacific Terminal," August 13, 2015, <http://investor.cloudpeakenergy.com/press-release/announcements/ssa-marine-welcomes-crow-tribe-and-cloud-peak-energy-partners-gateway-pa>.

42. Cloud Peak Energy, "Cloud Peak Energy and Ambre Energy Announce Signing of Deal for Ambre Energy's Purchase of Decker Mine Interest from Cloud Peak Energy," September 4, 2014, <http://investor.cloudpeakenergy.com/press-release/business-development/cloud-peak-energy-and-ambre-energy-announce-signing-deal-ambre-en>.
43. Seeking Alpha Transcripts, "Cloud Peak Energy's CEO Discusses Q4 2013 Results – Earnings Call Transcript," February 13, 2014, <http://seekingalpha.com/article/2021131-cloud-peak-energys-ceo-discusses-q4-2013-results-earnings-call-transcript?part=single>.
44. Cloud Peak Energy, "Investor Presentation, February 2016," February 22, 2016, <http://hsprod.investis.com/bwdoc/download.jsp?ipage=10760518>.
45. US Bureau of Land Management, "Montana: Coal by Lease Applications," accessed May 5, 2016, http://www.blm.gov/mt/st/en/prog/energy/coal/montana_s_coals_lease.html.
46. Cloud Peak Energy, "Lease By Modification For Federal Coal Lease MTM-094378," December 18, 2012, http://www.blm.gov/style/medialib/blm/mt/blm_programs/energy/coal.Par.43088.File.dat/SCM%20LMA%20II%20Application%20-modified%205_9_2015.pdf.
47. Cloud Peak Energy, "Investor Presentation, February 2016," February 22, 2016, <http://hsprod.investis.com/bwdoc/download.jsp?ipage=10760518>.
48. John T. Boyd Company, Mining and Geological Consultants, "Powder River Basin coal resource and cost study," September 2011, <http://www.xcelenergy.com/staticfiles/xs/Regulatory/Regulatory%20PDFs/PSCo-ERP-2011/8-Roberts-Exhibit-No-MWR-1.pdf>, p. 68.
49. R. W. Borio and A. A. Levasseur, "Overview of Coal Ash Deposition in Boilers," Argonne National Laboratory, https://web.anl.gov/PCS/acsfuel/preprint%20archive/Files/29_4_PHILADELPHIA_08-84_0193.pdf.
50. John T. Boyd Company, Mining and Geological Consultants, "Powder River Basin coal resource and cost study," September 2011, <http://www.xcelenergy.com/staticfiles/xs/Regulatory/Regulatory%20PDFs/PSCo-ERP-2011/8-Roberts-Exhibit-No-MWR-1.pdf>, p. 68.
51. Joe Smyth, "Corporate Welfare for Coal," Greenpeace, March 2016, <http://www.greenpeace.org/usa/wp-content/uploads/2016/03/corporate-welfare-for-coal.pdf>.
52. U.S. Department of the Interior, "Successful Competitive Lease Sales Since 1990, Montana," <http://www.blm.gov/mt/st/en/prog/energy/coal/tables.html>.
53. Derived from Cloud Peak Energy, Form 10-K Annual Reports for 2011 through 2015, available via <http://investor.cloudpeakenergy.com/annual-reports>.
54. Cloud Peak Energy, "Cloud Peak Energy Enters Amendment to Throughput Agreement with Westshore Terminals to Address Depressed International Conditions," October 28, 2015, <http://investor.cloudpeakenergy.com/press-release/announcements/cloud-peak-energy-enters-amendment-throughput-agreement-westshore-termin>.
55. Cloud Peak Energy, "Form 10-K: Annual report with a comprehensive overview of the company," February 18, 2016, <http://api40.10kwizard.com/download.php?ipage=10754057&subsid=41&pdf=1>.
56. Cloud Peak Energy, "Investor Presentation, February 2016," February 22, 2016, <http://hsprod.investis.com/bwdoc/download.jsp?ipage=10760518>.
57. Seeking Alpha Transcripts, "Cloud Peak Energy's (CLD) CEO Collin Marshall on Q4 2015 Results – Earnings Call Transcript," February 17, 2016, <http://seekingalpha.com/article/3904926-cloud-peak-energys-cld-ceo-collin-marshall-q4-2015-results-earnings-call-transcript?part=single>.

58. Seeking Alpha Transcripts, "Cloud Peak Energy's (CLD) CEO Collin Marshall on Q4 2015 Results – Earnings Call Transcript," February 17, 2016, <http://seekingalpha.com/article/3904926-cloud-peak-energys-cld-ceo-collin-marshall-q4-2015-results-earnings-call-transcript?part=single>.
59. Ibid.
60. Ambre Energy Limited, "Annual Report: financial year ended 30 June 2012," December 12, 2012, <http://documents.mx/documents/ambre-energy-limited-annual-report-30-june-2012-lr.html>.
61. Rob Davis, "Oregon Department of State Lands rejects Ambre Energy coal export permit, dealing major blow," *The Oregonian*, August 18, 2014, http://www.oregonlive.com/environment/index.ssf/2014/08/oregon_department_of_state_land_1.html.
62. Headwaters Economics, "Outcomes of Higher Federal Coal and Natural Gas Royalty Rates," data and analysis supplement, December 2015, available at <http://headwaterseconomics.org/energy/coal/outcomes-higher-coal-naturalgas-royalties>.
63. Lighthouse Resources, Inc. "Lease By Application," December 3, 2015, http://www.blm.gov/style/medialib/blm/mt/blm_programs/energy/coal.Par.41716.File.dat/Decker%20South%20Extension_LBA_BLM.pdf.
64. Matthew Brown, "Coal projects advance but won't be final under moratorium," *Casper Star Tribune*, January 27, 2016, http://trib.com/business/energy/coal-projects-advance-but-won-t-be-final-under-moratorium/article_9b14278e-f26c-5e60-b773-ccb666cb2a87.html.
65. Oregon Department of State Lands, "Fact Sheet Coyote Island Terminal Project (Port of Morrow)," November 23, 2015, http://www.oregon.gov/dsl/permits/docs/fact_sheet_coyote_island_terminal.pdf.
66. Compiled from annual reports for Westshore Terminals, available at <http://www.westshore.com/#/financereports>; and Cloud Peak Energy, available at <http://investor.cloudpeakenergy.com/sec-filings>.
67. Steve Fiscor, "The landscape for U.S. longwalls changes," *Coal Age*, February 2014, pp. 26-32, <http://coal.epubxp.com/i/260368/27>.
68. U.S. Department of the Interior, "Successful Competitive Lease Sales Since 1990, Montana," <http://www.blm.gov/mt/st/en/prog/energy/coal/tables.html>.
69. Seeking Alpha Transcripts, "FirstEnergy Q2 2009 Earnings Call Transcript," August 3, 2009, <http://seekingalpha.com/article/153427-firstenergy-q2-2009-earnings-call-transcript?part=single>.
70. Seeking Alpha Transcripts, "FirstEnergy's CEO Discusses Q4 2010 Results – Earnings Call Transcript," February 16, 2011, <http://seekingalpha.com/article/253325-firstenergys-ceo-discusses-q4-2010-results-earnings-call-transcript>.
71. FirstEnergy Corp., "FirstEnergy and Boich Companies sell partial interest in Signal Peak coal mine to Gunvor Group," October 18, 2011, <http://www.prnewswire.com/news-releases/firstenergy-and-boich-companies-sell-partial-interest-in-signal-peak-coal-mine-to-gunvor-group-132043123.html>.
72. Jacqueline Cowhig, "Gunvor open to Asian stakes in U.S. coal mine," *Reuters*, August 8, 2012, <http://in.reuters.com/article/2012/08/08/gunvor-coal-idINL6E8J84DL20120808>.
73. Associated Press, "Signal Peak Energy eyes coal on Crow Reservation," *Helena Independent Record*, March 18, 2013, http://helenair.com/news/state-and-regional/signal-peak-energy-eyes-coal-on-crow-reservation/article_959e7cfe-8ff5-11e2-8828-001a4bcf887a.html.

74. CNW Group, "Westshore Terminals announces further dividend reduction and update on capital project," December 9, 2015, <http://www.newswire.ca/news-releases/westshore-terminals-announces-further-dividend-reduction-and-update-on-capital-project-561351371.html>.
75. Tom Lutey, "Mine layoffs preceded by cut in coal shipments, reports show," *The Missoulian*, December 31, 2015, http://missoulian.com/news/state-and-regional/mine-layoffs-preceded-by-cut-in-coal-shipments-reports-show/article_136bd8d9-4d9a-5c99-85de-b258e2a0e735.html.
76. FirstEnergy Corporation, "Consolidated Report to the Financial Community, Fourth Quarter 2015," February 16, 2016, <http://investors.firstenergycorp.com/Cache/1001207212.PDF?O=PDF&T=&Y=&D=&FID=1001207212&iid=4056944>.
77. Bowie Resource Partners LLC, "Home Page," <http://bowieresources.com/>.
78. U.S. Department of the Interior, "Successful Competitive Lease Sales Since 1990, Colorado," http://www.blm.gov/wo/st/en/prog/energy/coal_and_non-energy/coal_lease_table/Colorado_Coal_Table.html.
79. United States Government Accountability Office, "Report to Congressional requesters. Coal Leasing: BLM could enhance appraisal process, more explicitly consider coal exports, and provide more public information," December 2013, <http://www.gao.gov/assets/660/659801.pdf>.
80. US Bureau of Land Management, "Successful Competitive Lease Sales Since 1990, Utah," http://www.blm.gov/wo/st/en/prog/energy/coal_and_non-energy/coal_lease_table/utah_coal_table.html.
81. US Bureau of Land Management, "Greens Hollow EIS," accessed May 23, 2016, <http://www.blm.gov/ut/st/en/fo/price/energy/coal.html>.
82. Bowie Resources, "Bowie Resources, LLC announces co-investment with Galena Private Equity Resource Fund to acquire Bowie and Canyon Fuel Mines," June 28, 2013, <http://online.wsj.com/article/PR-CO-20130628-907389.html>.
83. Bowie Resource Partners, "Form S-1 Registration Statement," June 19, 2015, http://www.sec.gov/Archives/edgar/data/1631790/000104746915005595/a2225124zs-1.htm#cu13101_selected_historical_an_cu102315.
84. IHS McCloskey Coal Report, Issue 276, "CFE awards 8.06mt tender to three suppliers," January 13, 2012, p. 24.
85. IHS McCloskey Coal Report, Issue 327, "CFE awards 6.11mt tender," January 24, 2014, p. 8.
86. IHS McCloskey Coal Report, Issue 344, "Mexico's CFE tenders for 5.33mt," September 19, 2014, p. 25.
87. Sentido Común, "Trafigura gana subasta electrónica CFE para proveer 390,000 toneladas carbon," October 19, 2015, <http://www.sentidocomun.com.mx/breves.phtml?id=24390>, translation by Google Translate, <https://translate.google.com/>.
88. US Energy Information Administration, "Coal Data Browser," accessed May 24, 2016, <http://www.eia.gov/beta/coal/data/browser/>.
89. McCloskey Coal Report, Issue 357, "Mexican electricity reforms could increase coal demand," April 2, 2015, p 23.

90. Bowie Resources, LLC, "Bowie Resources, LLC Announces Co-Investment With Galena Private Equity Resource Fund To Acquire Bowie And Canyon Fuel Mines," June 28, 2013, <http://www.prnewswire.com/news-releases/bowie-resources-llc-announces-co-investment-with-galena-private-equity-resource-fund-to-acquire-bowie-and-canyon-fuel-mines-213504911.html>.
91. Steven Tavares, "Port of Oakland rejects coal shipping and opens the door for an A's ballpark on the waterfront," *East Bay Express: Seven Days (East Bay News Blog)*, February 28, 2014, <http://www.eastbayexpress.com/SevenDays/archives/2014/02/28/port-of-oakland-rejects-coal-shipping-and-opens-the-door-for-an-as-ballpark-on-the-waterfront>.
92. Gary R. Herbert, "Energy Initiatives & Imperatives: Utah's 10-year strategic energy plan 2.0 (Updated Plan)," February 2014, http://energy.utah.gov/download/reports/10%20Year%20Strategy_2.0_03042014.pdf.
93. Doug Oakley, "Unlikely partners: Utah investing \$53 million to export coal through Oakland port," *San Jose Mercury News*, April 24, 2015, http://www.mercurynews.com/my-town/ci_27981682/unlikely-partners-utah-investing-53-million-export-coal.
94. David DeBolt, "Oakland: Sen. Hancock introduces four bills to restrict coal exports," *East Bay Times*, February 19, 2016, http://www.contracostatimes.com/breaking-news/ci_29538634/oakland-sen-hancock-introduces-four-bills-restrict-coal.
95. Lee Davidson, "Utah Legislature OK's \$53 million cash swap to fund Oakland coal port," *The Salt Lake Tribune*, March 10, 2016, <http://www.sltrib.com/home/3641085-155/utah-legislature-oks-53-million-cash>.
96. *Argus Media*, "Coal firm Bowie proposed public offering," February 9, 2015, <http://www.argusmedia.com/pages/NewsBody.aspx?id=989911&menu=yes>.
97. Dennis Webb, "More layoffs hit Bowie coal mine," *Grand Junction Daily Sentinel*, September 29, 2015, <http://www.gjsentinel.com/news/articles/more-layoffs-hit-bowie-coal-mine/>.
98. PR Newswire, "Bowie Resource Partners Announces Idling of the Bowie #2 Mine," February 26, 2016, <http://www.prnewswire.com/news-releases/bowie-resource-partners-announces-idling-of-the-bowie-2-mine-300227029.html>.
99. Mario Parker, "Global Coal Market Seen in 'Bad Shape' as Supply Glut Expands," *Bloomberg*, January 21, 2015, <http://www.bloomberg.com/news/articles/2015-01-21/global-coal-market-seen-in-bad-shape-as-supply-glut-expands>.
100. Arch Coal, "Arch Coal Completes Acquisition of International Coal Group," June 15, 2011, <http://news.archcoal.com/phoenix.zhtml?c=107109&p=irol-newsArticle&ID=1574054>.
101. Seeking Alpha Transcripts, "Arch Coal's CEO Discusses Q4 2013 Results – Earnings Call Transcript," February 4, 2014, <http://seekingalpha.com/article/1993391-arch-coals-ceo-discusses-q4-2013-results-earnings-call-transcript?part=single>.
102. Seeking Alpha Transcripts, "Arch Coal's CEO Discusses Q4 2013 Results – Earnings Call Transcript," February 4, 2014, <http://seekingalpha.com/article/1993391-arch-coals-ceo-discusses-q4-2013-results-earnings-call-transcript?part=single>.
103. Seeking Alpha Transcripts, "Arch Coal's CEO Discusses Q3 2013 Results – Earnings Call Transcript," October 29, 2013, <http://seekingalpha.com/article/1782622-arch-coals-ceo-discusses-q3-2013-results-earnings-call-transcript?part=single>.
104. Seeking Alpha Transcripts, "Arch Coal Management Discusses Q2 2013 Results – Earnings Call Transcript," July 30, 2013, <http://seekingalpha.com/article/1585522-arch-coal-management-discusses-q2-2013-results-earnings-call-transcript?part=single>.

105. Seeking Alpha Transcripts, "Arch Coal's CEO Discusses Q4 2012 Results – Earnings Call Transcript," February 5, 2013, <http://seekingalpha.com/article/1157721-arch-coals-ceo-discusses-q4-2012-results-earnings-call-transcript?part=single>.
106. Arch Coal, "Annual Report...For the fiscal year ended December 31, 2014," February 27, 2015, available via Arch Coal, "SEC Filings," <http://investor.archcoal.com/phoenix.zhtml?c=107109&p=irol-sec>.
107. Bureau of Land Management, "Record of Decision: Final Environmental Impact Statement (FEIS), Federal Coal Lease Modifications COC-1362 & COC-67232," December 2012, http://www.blm.gov/pgdata/etc/medialib/blm/co/information/nepa/uncompahgre_field/ufo_nepa_documents0.Par.3646.File.dat/West%20Elk%20Final%20ROD%20SIGNED.pdf.
108. Associated Press, "Judge halts West Elk Mine expansion," June 28, 2014, http://www.denverpost.com/business/ci_26050828/judge-halts-west-elk-mine-expansion.
109. Jason Blevins, "Federal coal lease pause doesn't apply to West Elk Mine expansion," *The Denver Post*, January 16, 2016, http://www.denverpost.com/business/ci_29391583/federal-coal-lease-pause-doesnt-apply-west-elk.
110. US Department of Labor, Mine Safety and Health Administration, "Mining Industry Accident, Injuries, Employment, and Production Data Address / Employment Self-Extracting Files," accessed March 20, 2016, <http://www.msha.gov/STATS/PART50/P50Y2K/AETABLE.HTM>; U.S. Energy Information Administration, "Coal," accessed March 20, 2016, <http://www.eia.gov/coal/data.cfm#production>.
111. Wikipedia contributors, "List of coal mines in the United States," *Wikipedia, The Free Encyclopedia*, http://en.wikipedia.org/wiki/List_of_coal_mines_in_the_United_States.
112. US Department of the Interior, Bureau of Land Management, "Successful Competitive Lease Sales Since 1990, Wyoming," September 23, 2013, http://www.blm.gov/wo/st/en/prog/energy/coal_and_non-energy/coal_lease_table/Wyoming_Coal_Table.html.
113. Ken Cochran, "2010 Arch Coal Analyst Day: Black Thunder Mine," Arch Coal, September 2010, <http://phx.corporate-ir.net/External.File?item=UGFyZW50SUQ9MzM4MjgwNnxDaGlsZEIEPTM5Njc0MXxUeXBIPtI=&t=1>.
114. Seeking Alpha Transcripts, "Arch Coal's CEO Discusses Q4 2012 Results – Earnings Call Transcript," February 5, 2013, <http://seekingalpha.com/article/1157721-arch-coals-ceo-discusses-q4-2012-results-earnings-call-transcript?part=single>.
115. Powder River Basin Resource Council, "Citizen Groups Ask for Better Compliance with Coal Mine Reclamation Standards," May 13, 2014, http://www.worc.org/userfiles/file/News%20Release/2014/Groups_Appeal_Mine_Plan_Approval.pdf.
116. Bruce Nichols, "1-Peabody says shipping US PRB coal to Britain," Reuters, October 15, 2010, <http://www.reuters.com/article/2010/10/15/coal-prb-britain-idUSN1521712320101015>.
117. PR Newswire, "Peabody Energy and SSA Marine enter into long-term agreement for Powder River Basin coal exports," February 28, 2011, <http://www.reuters.com/article/2011/02/28/idUS266539+28-Feb-2011+PRN20110228>.
118. Daniel Cusick, "COAL: Peabody to boost exports from Gulf Coast as Pacific Northwest terminal plans stall," July 18, 2012, <http://www.eenews.net/stories/1059967454>.

119. Bureau of Land Management, Wyoming, "South Porcupine LBA," August 3, 2012, http://www.blm.gov/wy/st/en/programs/energy/Coal_Resources/PRB_Coal/lba/porcupine-south.html;
Bureau of Land Management, Wyoming, "North Porcupine LBA," September 25, 2012, http://www.blm.gov/wy/st/en/programs/energy/Coal_Resources/PRB_Coal/lba/porcupine.html.
120. Bureau of Land Management, Wyoming, "Antelope Ridge LBA," http://www.blm.gov/wy/st/en/programs/energy/Coal_Resources/PRB_Coal/lba/Antelope_Ridge.html
121. Bureau of Land Management, "Draft Resource Management Plan and Environmental Impact Statement for the Buffalo Field Office Planning Area," June 2013, https://www.blm.gov/epl-front-office/projects/lup/36597/43453/46530/Bufalo_Draft_RMP_-_June_2013.pdf.
122. New Horizon Coal Ltd., "Investor Update," April 2013, available via <http://www.newhorizoncoal.com.au/investors/presentations/>.
123. New Horizon Coal Ltd., "Positive Pre-Feasibility Study for Kinney Coal Project," November 29, 2012, <http://www.infomine.com/index/pr/PB260184.PDF>.
124. The Coal Fields, "Wasatch Natural Resources Llc, Lease #UTU----088953," <http://thecoalfields.com/claims/utu----088953>.
125. ESignal.com, "Quote Board: Newcastle Coal Futures," accessed May16, 2016, <http://quotes.esignal.com/esignalprod/quote.action?symbol=NCF-ICE>.
126. Cloud Peak Energy, "SSA Marine Welcomes the Crow Tribe and Cloud Peak Energy as Partners in the Gateway Pacific Terminal," August 13, 2015, <http://investor.cloudpeakenergy.com/press-release/announcements/ssa-marine-welcomes-crow-tribe-and-cloud-peak-energy-partners-gateway-pa>.
127. Paul L. Robertson and Richard N. Langlois, "Institutions, Inertia and Changing Industrial Leadership," *Industrial and Corporate Change*, Volume 3, Issue 2, pp. 359-378, <http://icc.oxfordjournals.org/content/3/2/359.short>.
128. O'Reilly, C.A., et al., "Narcissistic CEOs and executive compensation," *The Leadership Quarterly* (2013), <http://dx.doi.org/10.1016/j.leaqua.2013.08.002>; Leslie Gaines-Ross, *Corporate Reputation: 12 Steps to Safeguarding and Recovering Reputation*, John Wiley and Sons, 2008, p. 51, [web link](#).
129. Wikipedia authors, "Black-Scholes model," accessed May 20, 2016, https://en.wikipedia.org/wiki/Black%E2%80%93Scholes_model.
130. See *inter alia*: James L. Paddock; Daniel R. Siegel; James L. Smith, "Options Valuation of Claims on Real Assets: The case of Offshore Petroleum Leases." *The Quarterly Journal of Economics*, Vol 103, No. 3 (Aug., 1988), 479-508; Jason Hall and Shannon Nicholls, "Valuation of mining projects using option pricing techniques," *The Finsia Journal of Applied Finance*, Issue 4 2007, https://www.finsia.com/docs/default-source/jassa-new/jassa-2007/4_2007_valuation_mining.pdf?sfvrsn=6; Ryan Kellogg, "The Effect of Uncertainty on Investment: Evidence from Texas Oil Drilling," *American Economic Review* 2014, 104(6): 1698–1734, http://www-personal.umich.edu/~kellogg/KelloggUncertainty_AERFinal_withAppx.pdf; [http://pages.cs.wisc.edu/~goadl/classWork/Paddock-Siegel-Smith\(1988\).pdf](http://pages.cs.wisc.edu/~goadl/classWork/Paddock-Siegel-Smith(1988).pdf); Michael A. Livermore, "Patience is an Economic Virtue: Real Options, Natural Resources, and Offshore Oil," 84 *University of Colorado Law Review* pp. 581-650 (2013), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2137806.

131. Jonathan Mun, *Real Options Analysis: Tools and Techniques for Valuing Strategic Investments and Decisions*, 2002, John Wiley and Sons, New York, pp. 77-78; Aswath Damodaran, *Strategic Risk Taking: A Framework for Risk Management*, "Chapter 8: Real Options," 2008, Pearson Education, available at <http://people.stern.nyu.edu/adamodar/pdfiles/valrisk/ch8.pdf>; Aswath Damodaran: "Ups and Downs: Valuing Cyclical and Commodity Companies," Stern School of Business, September 2009, <http://people.stern.nyu.edu/adamodar/pdfiles/papers/commodity.pdf>.
132. Christopher R. Knittel and Robert S. Pindyck, "The Simple Economics of Commodity Price Speculation," MIT Center for Energy and Environmental Policy Research, April 2013, <http://web.mit.edu/ceepr/www/publications/workingpapers/2013-006.pdf>.
133. Aswath Damodaran, "Real Options: Fact and Fantasy," undated, <http://people.stern.nyu.edu/adamodar/pdfiles/execval/optval.pdf>.
134. Tero Haahtela, "Differences between financial options and real options," Lecture Notes in *Management Science* (2012) Vol. 4: 169–178, <http://orlabanalytics.ca/lnms/archive/v4/lnmsv4p169.pdf>; Constance Lütolf-Carroll, Antti Pirnes and Withers LLP, *From Innovation to Cash Flows: Value Creation by Structuring High Technology Alliances*, 2009, <http://onlinelibrary.wiley.com/doi/10.1002/9781118273166.app5/pdf>.
135. Aswath Damodaran, "Real Options: Fact and Fantasy," undated, <http://people.stern.nyu.edu/adamodar/pdfiles/execval/optval.pdf>.
136. Fischer Black, "The Pricing of Commodity Contracts," *Journal of Financial Economics* 3 (1976), pp. 167-179.