“I Think I Can, I Think I Can”, can US railroads navigate the decline of the domestic coal industry?

(RailPictures, 2007)

An entry for the Cambridge-McKinsey Risk Prize

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Executive Summary: The American coal power industry has been under siege from regulation, partially driven by concerns about climate change, and historically low natural gas prices, which is largely a result of a the US Shale revolution. This paper will utilize scenarios to evaluate how US railroads, who generate a significant portion of their revenue from coal transportation, can best adapt to a changing energy generation and resource production market.

Introduction

Traditional thinking about carbon based fuels has focused on the notion of peak supply, which implies that the global economy's demand for fossil fuels will exceed the planet's finite supply. However, concerns about global warming and the increasing efficacy of renewable sources of energy, which might be both cheaper and cleaner than current energy systems, could dramatically challenge this traditional notion of peak supply. Instead, peak demand, the idea that the global economy's aggregate demand for fossil fuels will be depleted before supplies are, ought to be more seriously evaluated. Peak demand could very well lead to "stranded assets" (Caldecott et al cited in Smith School, 2017) that cannot be profitably extracted and will significantly impact firms and communities involved in fossil fuel production.

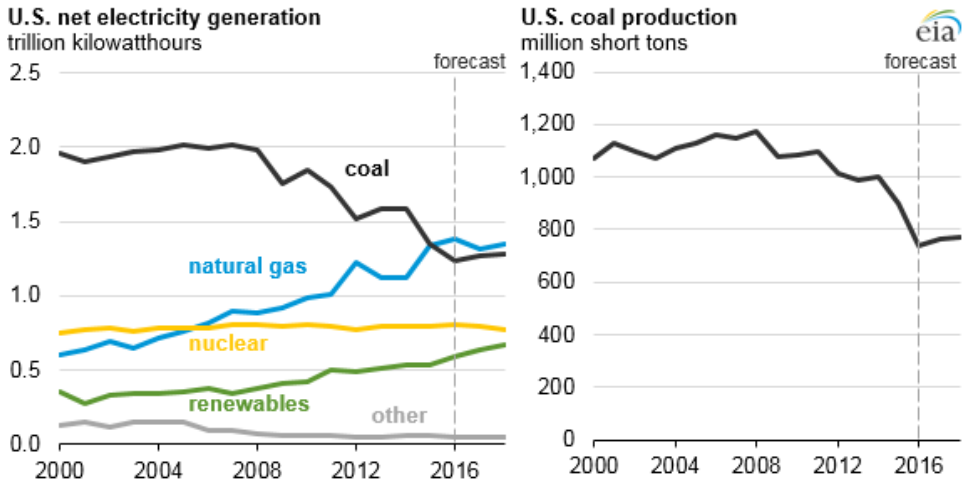
This sea change in the global energy industry will reverberate through the economy. For many firms, the coming disruption will offer an opportunity. For the majority of firms in the energy industry and those industries that support the energy industry, it means managing a transition away from current models of business. In the United States this change will be particularly difficult for US railroads, who have long earned stable profits transporting primary energy products from the mines to power stations.

This paper will examine the how railroads in the United States can manage the risks associated with this global energy transition, specifically the decline of the domestic coal industry. The paper will briefly describe the nature of the relationship between the US electrical production industry, the coal industry and railroads. The key decision for US railroads is if and how they will dispose of their assets that currently support coal transportation. Scenario analysis will evaluate how two prominent risks the industry faces, increases in regulation and the adoption of renewables, will impact demand for thermal coal. This analysis will also suggest additions for the railroads' enterprise risk management framework.

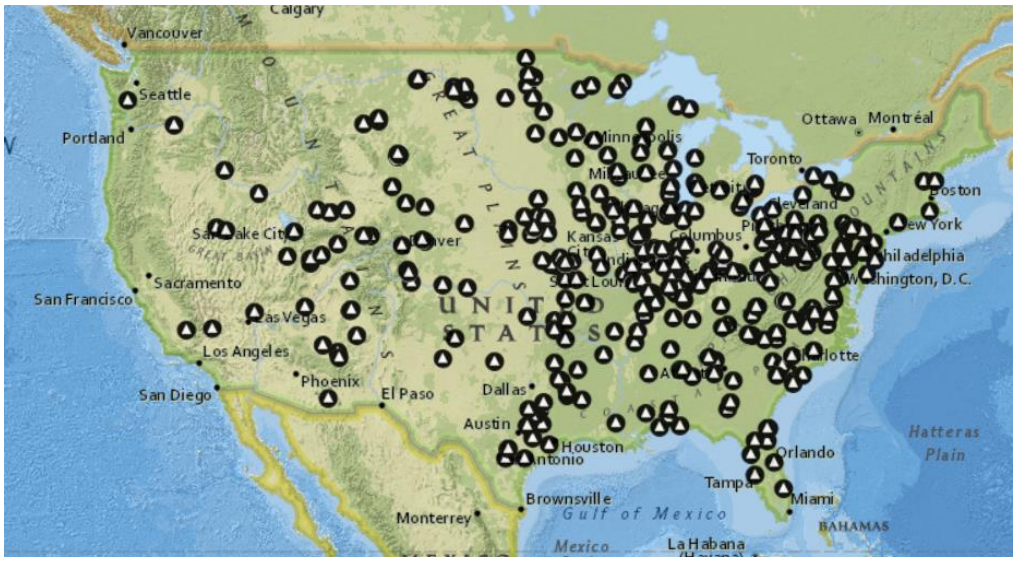
"Going Cold" Coal and Electricity Generation in the US

Electricity generated from coal has declined significantly in the previous decade. The US Department of Energy's (DOE) Energy Information Administration (EIA) calculates that coal based electricity production fell by 46% between 2006 and 2016[1] (2017A). According to the EIA (2016B) this decline has been driven by two independent factors; increased regulation on particulates that are a byproduct of burning coal, which has encouraged utilities to switch to cleaner forms of generation, and a decrease in the price of natural gas, a substitute for coal for power generation (Graph 1) Coal power production is concentrated in the Mississippi River valley and the eastern US (Map 1).

[1]Data is from the EIA, the author calculated the percentages



Graph 1 and 2. Illustrates changes in the US electricity market and the corresponding impact on coal production. (EIA, 2017B)



Map 1. Map of US Coal Powerplants (EIA, 2017C)

The American Coal Industry

92% of coal produced in the US is thermal coal, meaning that it is consumed in the domestic power industry (EIA, 2017B). As a result production decreased from 1.18 billion tonnes in 2007 to 801.6 million tonnes in 2015 (AAR, 2016B, p. 3); this sustained decrease in coal power capacity clearly negatively impacts coal producers. This decline has already impacted the railroads, which transport approximately 70% of the US's coal used for domestic power consumption (AAR, 2015A, p 1). This paper will not address the remaining 8% of the market, the majority of which is metallurgical coal used in the production of steel and would not be directly affected by changes in the energy market.

The American coal mining takes place across the country but it concentrated in three regions. The Powder River basin (PRB) in Wyoming and Montana produces approximately 44% of US coal (EIA, 2016A, p 12) with 10% of the coal mining workforce and is by far the most productive field as measured by production per worker per hour (EIA, 2016A, pp. 34 – 35). The Appalachian field and interior field respectively have a 24% and 19% share of production (EIA, 2016A, p. 12) and a 57% and 22% share of employment (EIA, 2016A, pp.

34 – 35). Given the higher productivity of PRB, further drops in aggregate coal demand will see PRB gain market share. Going forward this paper assumes that thermal coal production will essentially shut down outside of this coalfield when demand drops below 400 Million tonnes.

Map 2. Map of US Coal Mines. (PRB is in the red square, the interior basin is in yellow and the Appalachian field in brown) (EIA, 2017C)

Railroads and the American Economy

When classified by their level of revenue, the US has seven large railroads designated as Class I railroads with at least $476 million in revenue in 2014 US dollars (AAR, 2016A, p. 1). This paper will specifically address the five Class I US railroads involved in coal transportation, Union Pacific (UP), Burlington Northern Santa Fe (BNSF), CSX, Norfolk Southern (NS) and Kansas City Southern (KCS). It is worth noting that UP and BNSF have a duopoly west of the Mississippi, and NS and CSX have a duopoly east of the Mississippi. (Tully, 2015) UP and BNSF handle transportation of coal from the PRB and other coalfields in the western US. NS and CSX service the Appalachian and Interior fields and transport coal from western railroads to eastern power plants. In 2015 these firms generated $68.5 Billion, of which $12.4 Billion is directly attributable to coal transportation. Appendix A breaks down the overall revenue and revenue attributable to coal transportation for each railroad. Coal transportation has long been a revenue staple for American railroads; any weakening in the domestic coal industry, either in coal based power generation or coal mining, will materially impact railroads.

The Management Decision: A significant amount of railroad infrastructure, from trackage to train maintenance facilities, is oriented to supporting coal transportation. If the coal industry continues to decline or collapses, divesting these assets in a timely manner would be financially prudent and prevent the firms from having to be burdened with unproductive assets. However if railroads divest too soon it would result in a loss of quality revenue that would likely be quickly picked up by a competitor. Given the magnitude of these firms, the assets in question will certainly be measured in the billions of dollars per firm.

Scenarios

Next, this paper will utilize the scenario methodology to analyse the impact of two major risks facing railroads and the coal industry out to 2027. The first risk considers the possibility of increased environmental regulation and the impact this would have on demand for thermal coal. The second risk involves increasing adoption of renewable power in the US, which could replace coal power plants and reduce the demand for thermal coal. The benefit of using scenarios to inform risk management is that it allows for the evaluation of alternative outcomes and the impact they would have on the industry. Lessons learned from conducting this analysis will be incorporated into suggestions for enterprise risk management systems. It is worthwhile to address several assumptions in the model before conducting a detailed analysis of the identified risks.

1) Natural gas prices remain stable – Since 2011 US natural gas prices have been approximately 50% of the price in Europe[2] and 33% of the price in Japan. (BP, 2017) US exports are limited by a lack of Liquefied Natural Gas (LNG) export facilities. If US LNG exports significantly increased this would increase US natural gas prices and reduce the economic incentive for US power producers to switch from coal to natural gas.
2) Coal power plant closing are proportionally distributed across the current network. If coal power plants in the eastern US closed at a higher rate than those in the Mississippi valley it would have different impacts on railroads.
3) There will be no intervention by state or federal government. This paper assumes that government will allow mines to shut and railroads to close infrastructure as coal demand decreases.
4) Railroad coal revenue is closely correlated with coal demand.

This paper estimates that in period of analysis there is a 60% chance that US environmental regulations will increase, which will cause a decrease in demand for thermal coal. The politics of both coal and climate change in the US are complex; President Trump has vowed to remove Obama era regulations on coal power (Clemente, 2016), however, the regulatory direction of travel in the US is very uncertain. According to Gallup (2016) 64% of Americans are concerned about climate change so it is likely that any short term loosening of restrictions could be reversed at a later date. Alternatively, given that power generators can last 50 years or more, electricity generators might choose not to build coal power plants, regardless of short term changes in regulation, to mitigate longer term regulatory risk.

The second risk is the increasing adoption of renewable energy for power generation, which would reduce demand for coal and other fossil fuels. This paper assumes that there is an 80% chance renewables will increase their role in the US energy portfolio over the next 10 years. The driving factor is the relatively low base that the US is starting from, in 2015 the US only generated 13% of its electricity from renewables including hydropower (EIA, 2016C). In the European Union in 2014 25.4% of power was produced from renewable sources (Eurostat, 2016). If the US levels of renewable energy production

[2] Specifically the UK and Germany

were to converge with European levels, this would have significant impacts on US energy producers and negatively affect coal demand.

	Regulations Increase (60%)	Regulations Decrease (40%)
Adoption of Renewables Increases (80%)	***"I can see clearly now... (the acid rain is gone)"*** Probability: 48% Thermal Coal Demand: 300M tonnes Narrative: Coal power is dealt a crippling blow by higher CO2 emission standards and increasing adaptation of renewables	***"America's Great Wall of Solar"*** Probability: 32% Thermal Coal Demand: 600M tonnes Narrative: Despite fewer regulatory restrictions, persistently low natural gas prices and more renewables shrink the coal power requirement
Adoption of Renewables Stalls (20%)	***"Dark Skies for Clean Power"*** Probability: 12% Thermal Coal Demand: 600M tonnes Narrative: Renewables fail to live up to their promise, but CO2 regulations and low natural gas prices continue coal's slide	***"Hoax Revealed, Appalachia Rejoices!"*** Probability: 8% Thermal Coal Demand: 1000M tonnes Narrative: Relaxed regulation and fewer renewables result in an increase of coal production and consumption

In the "I can see clearly now…" scenario, coal demand drops significantly and dramatically alters the shape of the US coal industry. This scenario would likely result in the vast majority of thermal coal production moving to the PRB, shutting down production in other coalfields. Assuming that the decrease in coal power generation is spread evenly throughout the country, this means coal would increasingly flow from Wyoming across the Mississippi to the eastern US where the majority of coal power capacity is located (EIA, 2016, pp. 43 – 44)

These changes in the coal industry would impact individual railroads differently, but would likely disrupt the railroad industry and possibly encouraging consolidation. In this scenario, NS and CSX, who transport coal coming from the Appalachian and Interior fields, should aggressively divest their assets supporting coal production. For UP and BNSF, who generate approximately 70% of railroad coal revenue and move coal from the PRB, a merger with either NS or CSX to create a single integrated network linking suppliers with

customers[3]. In this scenario additional information about the long term viability of exporting coal, especially from west coast ports served by UP and BNSF would inform the analysis.

In the “Dark Skies” and “Great Wall” scenarios, coal demand falls from its current level of 800 million tonnes to 600 million tonnes. In these scenarios the railroads need to more fully incorporate the enterprise risk planning tools recommended later to mitigate the fallout; however this drop in demand would not likely reshape any of the associated industries. Eastern coalfields would likely produce a smaller portion of national coal output, but this level of demand would not put an entire field out of production.

“Hoax Revealed” would see an increase in coal power generation and coal production. This would be a boon for all the railways and requires no additional analysis.

Implications for Strategic Planning and Enterprise Risk Management

Rail firms need to more actively consider the future of the coal industry in their enterprise risk management systems and make investment and disinvestment decisions accordingly. First, they need to analyse the cost of production for the coal mines they service and estimate the level of production at various price levels. In particular they ought to assess their dependency on particular mining firms and estimate the price at that these mines are no longer economically viable. Second they need to evaluate the likelihood that individual power generators, both their customers and the wider generation market, are likely to switch from coal to alternative source of power or shut down. The latter is more straightforward than the former, as the permitting process for power plants generally requires public consultation, which should allow firms to anticipate changes in aggregate demand.

By combining those two analyses the firms will be able to understand how a drop in coal demand would impact their current clients, both producers and consumers. This will allow individual firms to assess the viability of their current footprint and develop contingency plans for different levels of coal demand. It will also identify opportunities for mergers and acquisitions and partnerships, as changes in the competitive landscape will present opportunities as well as risks.

Conclusion

Climate change and the growing efficiency of renewables will change the nature of the US power industry, impacting coal miners and the railroads. It is clear that there is a significant possibility for disruption to the railroads if the coal powered electricity generation continues to diminish. Incorporating risk management approaches, even in less extreme scenarios, by developing a better understanding of how the power industry is changing and how coal miners are adapting will allow railroads to better position their individual firm in the changing environment.

[3] This would have significant benefits for other portions of the business outside of coal transportation, but would likely face significant regulatory hurdles.

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Annex A: Railroad Revenue Data and Railroad Revenue from Coal Transportation

Table 1: 2015 Total Revenue in Million USD for selected Class I US railroads

	UP	BNSF	CSX	NS	KCS	Total
2015	21813	21967	11811	10511	2418	68520

Source: Railroad Annual Reports (UP, 2016; BNSF, 2016; CSX, 2016; NS, 2016; KCS, 2016)

Table 2: 2015 Revenue from Coal in Million USD for selected Class I US railroads

	UP	BNSF	CSX	NS	KCS	Total
2015	3490.08	4613.07	2291.334	1786.87	181.35	12362.704

Source: Railroad Annual Reports (UP, 2016; BNSF, 2016; CSX, 2016; NS, 2016; KCS, 2016)

2017 Cambridge - McKinsey Risk Prize Bio-sketch and Photo Page

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Title of Submission: "I Think I Can, I think I Can", can US railroads navigated the decline of the domestic coal industry?

I am a candidate for the degree:

Executive MBA

Bio-sketch

I am currently in my final year as an Executive MBA student at the Judge Business School. When not attending Cambridge I am a serving military officer in the United States Marine Corps. For the past nine years I have served in a variety of leadership, intelligence and project management roles at several locations in the United States, Afghanistan and the United Kingdom. Before joining the US military I attended the University of Virginia, graduating with a double Bachelor Degree in Economics and History.

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2017 Cambridge - McKinsey Risk Prize Declaration Form

Student Name: ___Steven Cooney_____

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Title of Submission: ___"I Think I Can, I think I Can", can US railroads navigated the decline of the domestic coal industry?_____

Number of words of submission: __2909 including references_____

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I confirm that this piece of work is my own and does not violate the University of Cambridge Judge Business School's guidelines on Plagiarism.

I agree that my submission will be available as an internal document for members of both Cambridge Judge Business School and McKinsey & Co's Global Risk Practice.

If my submission either wins or receives an honourable mention for the Risk Prize, then I agree that (a) I will be present at the award

presentation ceremony 23 June 2017, (b) my submission can be made public on a Cambridge Judge Business School and/or McKinsey & Co websites.

This submission on risk management does not exceed 10 pages.

S. D. Cooney
(Signed Digitally)