Assessing Thermal Coal Production Subsidies: Policy Makers' Briefing

There has been much discussion of fossil fuel subsidies as both an inefficient use of public tax dollars and a barrier to the scaling up of low- and no-carbon energy sources. As "green" incentives are reduced, the phase-out of fossil fuel subsidies becomes even more urgent in order to reduce market distortions and ensure a level playing field in energy markets.

Developing-world subsidies to fossil fuel *consumption* have attracted the most attention to date. However, fossil fuels also benefit from *production* subsidies in both developed and developing countries. These production subsidies are significant in our view, and an initial framework developed here to evaluate their impact demonstrates the importance of addressing them.

Focusing on thermal coal production that receives important subsidies around the world,[1] we assess whether some coal reserves are entering production only due to government subsidies; and whether without the subsidies, this coal would instead remain in the ground. The question is an important one because coal is one of the most carbon-intensive energy resources in terms of greenhouse gas emissions per kWh of electricity produced. Coal production and combustion also have

Key Findings

Production subsidies summing up to:

- Nearly US$8 per tonne in the US Powder River Basin ($2.9b/year); and
- Nearly US$4 per tonne ($1.3b/year) in Australia.

The removal of these subsidies would result in:

- A 8%-29 % reduction in demand for US PRB coal, with associated cumulative reductions of 0.7 to 2.5 $GtCO_2$ to 2035, equivalent to 9 to 32 coal plants.
- A 3%-7% reduction in demand for Australian Seaborne coal, though with unknown carbon reductions due to substitution of coal from other (often also-subsidized) producers.

Removing subsidies to coal extraction should be a central plank of any country's fiscal and environmental plan. Particularly as subsidies to renewable energy come under increasing pressure, subsidies to the mature coal sector should not be ignored. A broader geographic range for coal subsidy elimination will boost the carbon benefits, as the ability for coal supplies to move in from other subsidized markets will be constrained.

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[1] Unless otherwise noted within the text, weights are expressed in metric tons. Values can be converted into short tons (common in the United States) by multiplying by 1.1.

significant human health and environmental impacts beyond their carbon impact, though we do not examine them here.

While the extraction of some existing reserves may already be "locked in" due to long-term take-or-pay contracts with power plants and leasing subsidies, subsidy reform can play an important role in the direction of future investment. Particularly with regards to federally-owned coal in the US, even purely administrative changes could make a positive difference. Modifications include enforcing royalties on all lease terms; ensuring competitive auctions; and requiring real funding of mine closure liabilities, with contributions held outside of the company. An industry review by Carbon Tracker earlier this year, for example, found that at least 26 US coal companies had gone bankrupt, including once major producers; proper funding of long-term liabilities should not be ignored.

To evaluate the amount of excess demand and resulting carbon emitted due to coal subsidies, we focus on two major coal supply regions of the world: 1) Australia as a major exporter and 2) the Powder River Basin (PRB) as the major domestic supplier in the United States. The Australian example highlights the impacts removing coal subsidies can have for export-oriented markets, underscoring the leverage that can be achieved via global rather than unilateral subsidy removal. The PRB case demonstrates the impacts subsidies can have on domestic coal markets.

The analysis proceeded in two steps: First, we tabulated the major government subsidies to coal producers in these regions, and converted them into subsidies per annual tonne of production in order to ensure that we properly pro-rated national subsidies to the region analyzed. We relied on the most visible data, and recognize that we did not capture all subsidy policies. Those we did include are summarized in a table at the end of this policy brief, and described in detail within the paper. We distinguished between subsidies for rehabilitation after at the cessation of mining activity, and those to ongoing operations. Further, we did not include unpriced externalities such as health costs associated with coal production as a subsidy in our modelling. Both factors suggest our results are conservative. Per tonne subsidy estimates were added as additional costs to the break-even prices on detailed supply curves estimated developed last year by Carbon Tracker.[2]

Second, to gauge the impact of production subsidies on the quantity of coal demanded in that market, we estimated different elasticities of demand (Ed) for coal in the relevant electricity markets where it is used, going out to 2035. The Eds represent the long-term demand response, allowing for the electricity generation capacity mix to change. We based our estimates of Ed on assessments by other researchers and an analysis of future trends. The Ed was used in a partial equilibrium assessment in order to estimate the supply impacts of subsidy elimination. Although we did not use a more detailed energy optimization model with cross-price elasticities, our approach provides an initial first order estimate of the impacts of subsidy reform. By delineating the key assumptions and drivers behind our estimates, , the paper provides a road map for a more comprehensive modeling approach that can refine our first-order estimates.

[2] Carbon Tracker, *Carbon Supply Cost Curves: Evaluating Financial Risk to Coal Capital Expenditures*, September 2014.

Determining a representative Ed is not a simple task. Available studies on coal's Ed may be time-period dependent, derived using different methodologies, or contain estimates that vary widely across geographic areas. In particular, the existence of other sources of coal to compete if prices rise in our focus supply markets, as well as the potential for other lower carbon alternatives to become more competitive, all play a key role in the likely level of the demand response that the Ed tries to capture. These factors also affect the net impact of subsidy removal on carbon emissions.

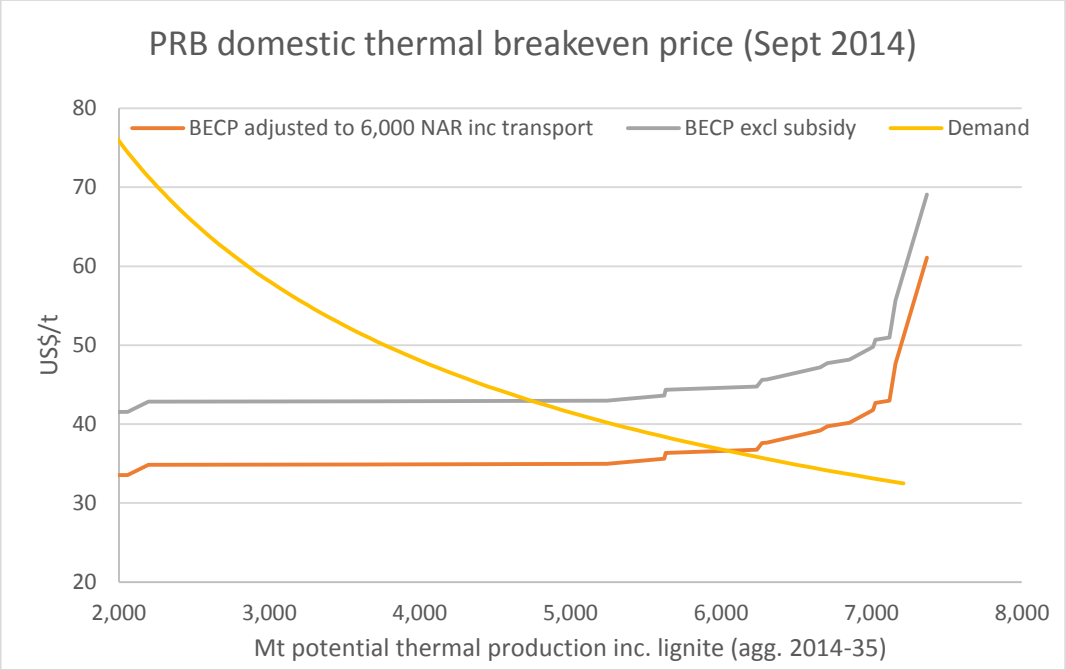
Importantly, these interactions underscore the degree to which the impacts fromf removing production subsidies will depend on the national and international energy market contexts. For example, unilateral subsidy reform in Australia may have a significant impact on coal exports, but a much smaller effect on carbon emissions as other sources of coal move in to take the market share. Despite this limitation, even unilateral subsidy removal can have important economic, social and environmental benefits. For example, where large new projects in environmentally sensitive areas are prevented once subsidies are removed -- such as the Great Barrier Reef in Australia -- there can be significant benefits even if coal from other existing locations moves in. However, in markets easily accessible to globally traded coal, the broadest benefits of emissions' reductions will only be realized via more globally-coordinated, systematic removal of coal subsidies.

Subsidy reform in the US offers different opportunities, as it is a more isolated supply market. If the U.S. alone removes all subsidies to domestic coal (not just those flowing to the PRB basin), we expect a substantial and positive reduction both in quantity of coal consumed and the resulting carbon emissions. Indeed, although focusing on PRB subsidies alone would generate some switching to coal from other basins, the increasing competitiveness of gas, as well as renewables and energy efficiency, suggest strong CO_2 reductions.

As shown in the figure below, subsidy removal will drive up the breakeven price of PRB coal, with resultant declines in production. The red line shows the energy-adjusted price of coal needed for a mine to break even, if subsidies are in effect. If production subsidies are removed, the costs of the mine (and hence the required price of coal) are increased; the price of coal needed for a mine to break even without the cost benefit given to it by subsidies is shown by the grey line.

US PRB Subsidies Case Study

PRB domestic thermal breakeven price (Sept 2014)- 1.5x Ed, US$8 subsidy



Note – based on September 2014 data. The break-even coal price (BECP) is based on a standardized energy content exported from Newcastle Australia. The supply curve has been adjusted for transport costs based on EIA estimates compared to the curve derived in September 2014. This is needed in a subsidy price effect analysis to derive a delivered price.

Carbon benefits remain evident under wide variety of input assumptions

To address key areas of uncertainty in our data, we present a set of sensitivity tables that illustrate the impact on demand of different subsidy levels and different Ed levels. These tables illustrate that under a wide range of assumptions, subsidy removal will reduce the US reliance on coal, and its coal-related emissions. This conclusion applies even if only subsidies within the PRB are addressed.

1. We consider the impact of pre-closure subsidies alone and then the impact of both pre- and post-remediation/closure subsidies. This acknowledges uncertainties around the manner and degree to which different types of subsidies will stimulate supply. In particular, investment decision-makers may attribute greater significance to subsidies coming at the project development stage (tax deductions and the like) relative to those at the end of the project life cycle (such as rehabilitation subsidies).
2. In the PRB, a number of subsidies are already phasing down, highlighting the importance to investors exposed to companies that might be affected in understanding the impacts set out in this work.
3. We consider a range of Eds reflecting the differing assumption on cross-coal substitution. Available fuel substitutes, as well as the scope of subsidy removal (specific policy, national, or

global) affect relevant elasticities and the competiveness of lower carbon options. These different estimates might reflect differences in market context, for example:

a. An Ed of 0.5 is more related to short-term effects from price rises in electricity markets. An Ed range of 1-2 would describe market responses to coal subsidy removal across a broader geographic market area, or globally where all subsidies are lifted at once. The upper end of this range would be more likely associated with increased low carbon fuel source penetration based on regulatory support and declining cost curves of substitutes. We see the higher Ed scenario as most relevant to the US PRB, as national removal of US coal subsidies, while not politically easy, is also not impossible to envision. In this market, we see regulation and costs as increasingly making coal less attractive and with gas being an important potential driver on the upside to the Ed.

b. An Ed of 2-3 (ranging up to 4) would incorporate regions where other sources of coal can substitute more easily, allowing consuming industries to shift fuel suppliers while continuing to operate their existing capital. It is possible gas in the PRB could lift the Ed to this level even with other sources of coal constrained, as aging coal plants need replacing. This range would apply at the higher end to Australian coal in isolation, and at the lower end if subsidies were tackled in world seaborne markets and India and China.

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Effect on demand of removing subsidy US$, % (based on supply - demand framework)

Market	Category	Subsidy ($/t)	Elasticity					
			0.5x	1.0x	1.5x	2.0x	2.5x	3.0x
US PRB	Ongoing tax and lease	$4.00	-5%	-8%	-11%	-13%	-16%	-20%
	Phasing out	$3.00	-4%	-7%	-8%	-11%	-12%	-13%
	Remediation	$1.00	-2%	-3%	-4%	-6%	-7%	-7%
	Total	$8.00	-8%	-16%	-22%	-29%	-34%	-39%
Australian Export	Tax and fuel excise	$2.50	-1%	-3%	-3%	-3%	-4%	-4%
	Remediation	$1.50	0%	-1%	-1%	-3%	-3%	-3%
	Total	$4.00	-1%	-3%	-4%	-6%	-6%	-7%

Note:

Australian export and PRB domestic demand impact rounded to nearest 50 mt coal

"Total" based on actual impact of total level of subsidy - sum of consituent parts may be different due to the shape of the supply curve

In terms of carbon impacts, without a detailed dispatch model to assess the penetration of particular substitutes, our analysis should be viewed as indicative. If we assume that it is at the lower Eds that less carbon-intensive substitutes make their biggest impact, then it seems best to focus on the 1-2 Ed. However, this still leaves open the role of gas, particularly in the US PRB. For illustration we have assumed half of the substitution in the US is gas at a 40% saving of carbon (conservative) relative to coal.

CO_2 reductions from removing subsidy US$, $mtCO_2$ (based on supply - demand framework)

Market	Category	Subsidy ($/t)	Elasticity			
			0.5x	1.0x	1.5x	2.0x
US PRB	Ongoing tax and lease	$4.00	432	720	936	1,152
	Phasing out	$3.00	360	648	720	936
	Remediation	$1.00	144	288	360	504
	Total	$8.00	720	1,368	1,944	2,520

Notes:

PRB domestic demand impact rounded to nearest 50 mt coal

CO_2 calculated at 1.8 $mtCO_2$ per mt coal

50% of PRB impact on coal demand assumed to be into gas at 40% less carbon than coal

"Total" based on actual impact of total level of subsidy - sum of consituent parts may be different due to the shape of the supply curve

Subsidies by Category

Australian Coal Industry		
	Total Subsidy	**Per tonne**
Rehabilitation (2015)	A$18bn capital subsidy	A$2.05/US$1.50
Tax deductions and direct spending (2005-2011)	A$414m/US$300m	A$1.25/US$0.91
Fuel excise exemption (2012-2013)	A$767m/US$560m	A$1.92/US$1.40
Total		**A$5.22/US$3.81**
Power River Basin, US		
	Total Subsidy	**Per tonne**
Tax subsidies ongoing	US$1.3bn pa	US$1.56
Tax subsidies phasing down	US$2.4bn pa	US$2.61
Rehabilitation and Self-bonding	A US$2-4bn capital subsidy; US$1bn pa	US$0.78
PRB coal lease subsidy	A US$30bn capital subsidy	US$2.59
Total US		**US$7.54**

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