Analyzing the Consequences of a Shifting Steam Coal Demand to Asia: Insights from the World Steam Coal Market Model COALMOD

Roman Mendelevitch, HU Berlin, roman.mendelevitch@hu-berlin.de
Ivo Valentin Kafemann, DIW Berlin, ikafemann@diw.de
Tim Scherwath, DIW Berlin, tscherwath@diw.de
Franziska Holz, DIW Berlin, fholz@diw.de

Overview

The sustainable development goals (SDG) adopted at the United Nations Sustainable Development Summit in September 2015 include tackling climate change as one of its key targets (UN 2015a). International climate policy has succeeded in achieving global consensus on the urgent need to combat anthropogenic climate change at the Conference of the Parties (COP) 21 in Paris (UN 2015b) and at the COP 22 in Marrakesh. Estimates of fossil fuels that have to remain in the ground to achieve the 2°C target and to prevent irreversible atmospheric changes see the heaviest burden on coal (Meinshausen et al. 2009). 82% to 88% of current coal reserves are considered "unburnable", compared to 33%-35% of oil and 49%-52% of gas reserves (McGlade and Ekins 2015).

Despite some non-believers who claim that the world cannot do without coal (Umbach 2015) the industry is starting to feel the fading perspective for coal. Steam coal production declined by around 20% between 2005 and 2013 (though preliminary data for 2014 shows a very slight increase in production, of around 1%) (IEA 2015b, IV.424). While coal phase-out plans are developed in many European countries (e.g. UK, Denmark and Germany) the future of coal will be decided in the Pacific region. In this paper, we take a particular focus on the two largest producers and consumers of coal: China, and India, that will decide whether a global coal phase-out is about to commence. They both followed the paradigm of western economies where economic growth is built on an industrialization driven by the massive use of coal for electricity and heat generation. But times are beginning to change:

China:

China is seeing a massive deployment of renewables and also has introduced a moratorium on new coal power plants and mines (The State Council of the People's Republic of China 2016). It's future steam coal demand will be shaped by the magnitude and sectoral composition of its economic growth, reductions in energy-intensity and environmental policies. Additional critical factors will be local pollution and water shortage at mining and electricity production sites (Cheng et al. 2016). Burke and Liao (2015) find that China's coal price elasticity of demand is increasing which supports the effectiveness of a national emissions trading scheme as a mechanism for reducing coal consumption and associated emissions. In its New Policies Scenario (NPS), the IEA World Energy Outlook (WEO) predicts that China`s coal demand will stay constant over the next 25 years (IEA 2015a, Table 7.2). However, there are strong indications that the peak of coal use for power generation may already be starting to occur. Preliminary data for 2014 shows that steam coal consumption was 3.5 per cent lower than in 2013 (IEA 2015b, III.21) despite increased power demand, suggesting that its share in the fuel mix has dropped. This view is confirmed by figures published by the Chinese National Bureau of Statistics suggesting a 1.9% drop in energy-related carbon emissions, which mainly originate from a drop in annual coal consumption of 3.7% (Slater 2016; Yeo 2016). While the WEO discusses the possibility of a decline of coal consumption in China, and warn against negative effect on the global coal industry (IEA 2015a, 291), it excludes this trend from its central scenario. Against the background of continued policy interventions further reducing future coal demand and supply are very likely.

India:

The situation in India is different: On the one hand, an ambitious plan to rapidly extend the renewable generation fleet is the central element of the INDC submitted to COP21 by India. On the other hand, the central government's plan also includes a massive extension of domestic coal production. Future coal demand will be shaped by India's economic growth, increased electrification to overcome high levels of energy poverty (IEA 2015a, 448), and to some extent, environmental policies. In its "intended nationally determined contribution" (INDC) India has committed to reduce the carbon-intensity of GDP by 33 to 35% from 2005 levels by 2030 and, conditionally, to increase the share of non-fossil fuels in power generation capacity to 40% by 2030 (Government of India 2015a). Moreover, it targets to increase solar generation capacity to 100 GW and total renewables capacity to 175 GW by 2022 (Government of India 2015c). As an additional policy measure India has introduced a tax on imported coal of 0.8 USD in 2010, and has twice doubled the tax to 3.2 USD for 2015-2016 (Mittal 2014; Ministry of Finance 2015). A key question in relation to India's future steam coal demand is the extent to which it will continue to be met by

imports. In the short term, it is likely that imports will continue to increase. In the longer term, the Indian government is aiming to reduce import dependency – possibly to the extent of becoming self-sufficient in steam coal (*Reuters India* 2015). A strong domestic production targets of 1500 Mt/a for 2020 is in place, but its success will depend on whether present constraints on production can be overcome (EIA 2015a). Coal quality is a further consideration. A majority of 85% of the young Indian coal-fired generation fleet is designed for Indian coal and cannot easily take other coal types (IEA 2015a, 440). Only new generation of power plants is suitable for imported coal (Carl 2015, 129). At the same time the Indian government has announced that the Thirteenth Five Year Plan (which commences in 2017) will require all new coal-fired generation capacity to use supercritical technology (Government of India 2015b). However these would induce an ongoing need to import coal (Commonwealth of Australia 2015a, 82–83).
For the two countries, we perform a thorough scenario analysis of various policies that might further shape the countries' coal demand and its implications for the world market.

Methods

For the scenario analysis we use the COALMOD-World model which is designed to replicate global patterns of coal supply, demand and international trade. It features a detailed representation of both domestic and international steam coal supply with possible substitution, based on endogenously calculated Cost, Insurance, Fright (CIF) costs, and prices that take into account additional rents. It features endogenous investment in a multi-period framework into production, land transport, and export capacity, as well as an endogenous mechanism assessing production cost increase due to resource depletion.
We perform thorough policy analysis for the international coal market as a whole, and for the two focal countries in particular. Based on this, we set up various demand-side and supply-side policy scenarios and investigate their effect. The policies will have a direct effect on the local production and consumption patterns but also on the international market, both in the short and in the long-term. We evaluate these effects with respect to their distributional implications but also contrast it against a coal consumption path that is compatible with a 2°C target.
Policy scenarios include i) a cap on coal consumption, ii) import tax on coal, iii) production subsidy reform, vi) less coal consumption in the power sector due to increasing cost advantages of renewables, and v) an increase in quality standards for imported or all coal vi) lower reserves due to natural reserves conservation, difficulties in acquiring property rights.

Results

Our numerical results suggest that a strong reduction in domestic consumption of China or India entails a rebound effect and induces consumption by other large consumers. By contrast, limiting global coal supplies to those in existing reserves to reach the climate targets results in an emission reduction of on average 6.9 Gt per year for the period 2020-2050 or 5.2 Gt per year for 2010-2050 (see figure 1). Such a joint supply-side policy leads adds a scarcity rent of on average 50 USD/t (production-weighted) to the price of coal. The policy leads to an average global price increase of 93% for the period 2020 to 2050. Seaborne trade sees an even stronger concentration on China and India, while both domestic supply and imports to other countries is reduced by over 90%. Japan, Korea, Malaysia and Taiwan, are the only countries that have significant imports in 2040, besides China and India.

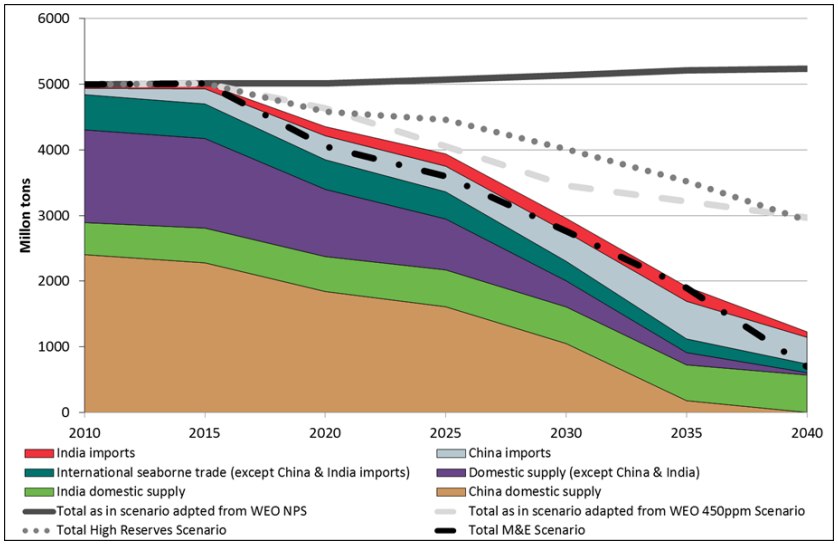

Figure 1: Global coal consumption in a supply side scenario

Conclusions

While a coal phase-out has begun in some European countries, China and India will decide where a global coal-phase out will be successful. Supply-side measures can be an effective climate policy as they come with the additional benefit of raising prices due to scarcity rents which induce additional demand reductions. However, such policies should not be considered as an isolated measure but as part of an integrated climate policy package. Otherwise, there is a risk that it will be deemed a temporal industry support policy that protects current incumbents without any long-term effect on reducing CO_2 emissions.