

# The End of the Age of Coal

## Why it can happen sooner than people think

26 November 2012

**A fundamental shift away from coal-based electricity production is gathering pace in the US, while hard constraints have emerged that will limit the rise of coal consumption in China and India. The beginning of an energy transition is taking place. Greenpeace examines these factors, and the choices faced by the US, China, India that will shape the climate negotiation in Doha.**

Coal is the biggest driver of climate change, responsible for 43% of world CO<sub>2</sub> emissions from fuels; and CO<sub>2</sub> emissions from coal have grown by 57% since 1990.<sup>1</sup> The growth in coal use has caused over two-thirds of the increase in global CO<sub>2</sub> emissions in the past five years.<sup>2</sup> Despite the recent massive expansion, the devastating local impacts of the coal industry and the rise of renewable energy are starting to push coal out of some markets, and create support for further action by governments.

This briefing outlines the energy sector developments in 2012 and emerging constraints that shape the outlook for coal. At the 18th Conference of the Parties to the UN Framework Convention on Climate Change (UNFCCC) meeting in Doha, Qatar (COP18), it is essential for governments to recognise that every new coal plant or new mine will make it harder to achieve the goals being negotiated in Doha. Whether or not governments are reducing the use of coal is a key test of their commitment to meeting their climate goals.

### Key points:

- A fundamental shift away from coal use is taking place in the US electricity sector.
- The nuclear phase-out decision in Germany has further catalysed the growth of renewable energy (RE) and has significant impact in Europe.
- Carbon Capture and Storage, the industry's "solution" for coal, has largely failed to deliver and is now increasingly being used to boost oil production.
- Water scarcity and health damage from air pollution have emerged as hard constraints that will limit the rise of coal consumption in China and India.
- Aggressive US and Australian coal export plans, aided by government support and subsidies threatens to increase coal use in Asia and Europe, and undermine climate mitigation efforts.
- Renewable energy is starting to overtake coal as the mainstay of new power generation investments globally. But the decisions in the next few years are crucial and will determine whether the "carbon lock-in" phenomenon will persist, which would lead to market and policy failures that can inhibit the diffusion of renewable energy and energy efficiency technologies.
- Curbing the investment and plans for new coal plants and mines needs to be central to international and national climate mitigation efforts. Governments need to recognise that every new coal plant or new coal mine is a threat to the climate.
- The success of COP18 in Doha is crucial for sending the right signals to deter further coal expansion. The adoption of a second commitment of Kyoto Protocol and a roadmap towards a legally binding global agreement by 2015 are crucial for deterring large-scale coal expansion that would forever close the possibility to limit climate change to under a 2°C temperature rise.

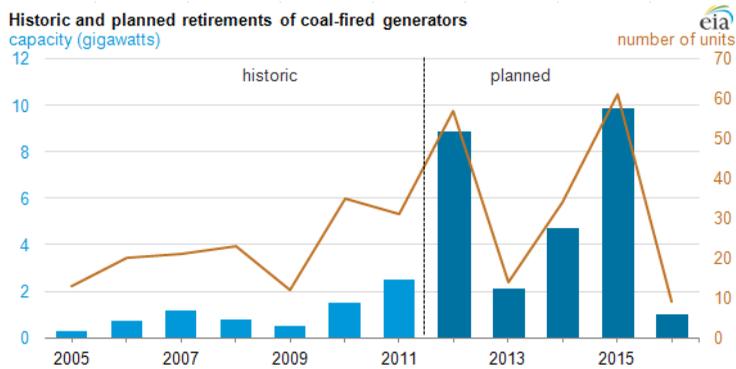
<sup>1</sup> International Energy Agency, World Energy Outlook (2012), p.554

<sup>2</sup> Calculation based on data in BP Statistical Review of World Energy 2012, five-year period 2006-2011

## Fundamental shifts in key energy markets boost clean-energy transition

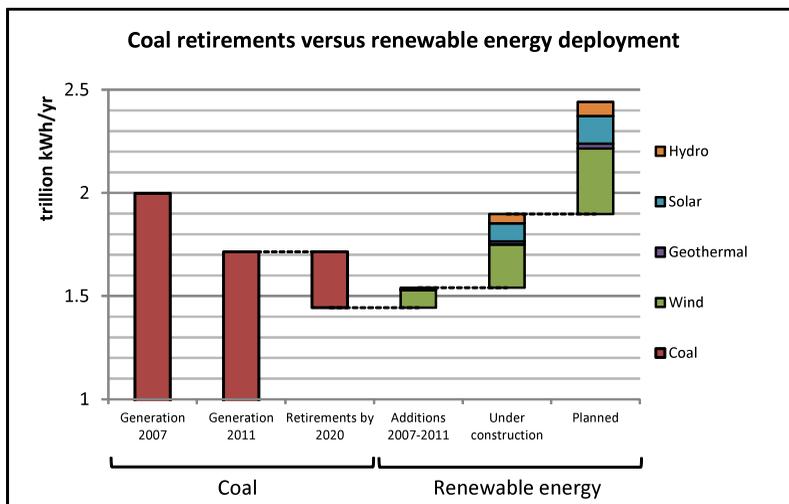
### US

Coal's share of total electricity generation in the US dropped from 49% in 2007 to just 37% in September 2012.<sup>3</sup> More than 10 gigawatts (GW) of coal capacity was retired between 2007 and April 2012. Another 267 units with 47 GW of capacity will retire before 2020.<sup>4</sup> The EIA has attributed the increase in the retirement of coal plants to only modest growth in energy demand, to the costs of natural gas being lower than those of coal with the boom in shale gas production, to increases in environmental compliance costs, and to state-level renewable portfolio standards.<sup>5</sup>



Source: US Energy Information Administration, Form EIA-860, "Annual Electric Generator Report"

It's not all good news: the shale gas boom threatens higher methane leakage and energy-intensive LNG exports. However, clean renewable energy is increasing its share of electricity production. Wind and solar projects that have already been permitted or started construction will offset all the coal capacity set to retire between 2012 and 2020 (see graph below). If renewable energy projects currently in the planning stage remain on track, coal and gas will experience a significant further squeeze.<sup>6</sup>



Source: Ventyx Velocity Suite, 2012

<sup>3</sup> EIA Electric Power Monthly, Sept 2012.  
[http://www.eia.gov/electricity/monthly/epm\\_table\\_grapher.cfm?t=epmt\\_1\\_01](http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_1_01)

<sup>4</sup> Ventyx Velocity Suite, 2012

<sup>5</sup> EIA Today in Energy, 27 gigawatts of coal-fired capacity to retire over next five years, 27 July 2012  
<http://www.eia.gov/todayinenergy/detail.cfm?id=7290>

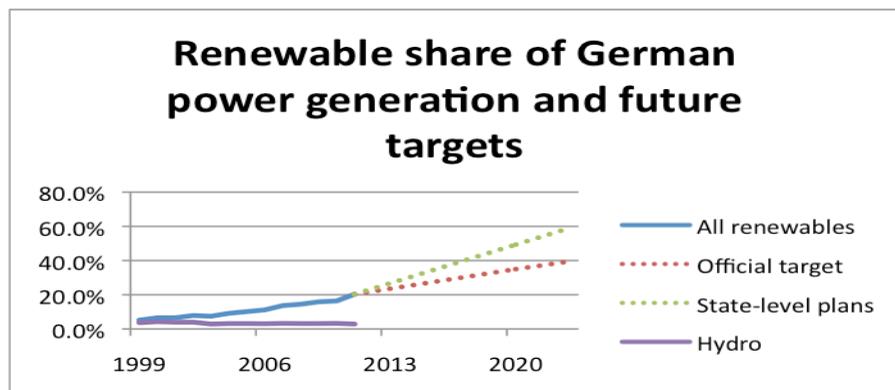
<sup>6</sup> Ventyx Velocity Suite, 2012;  
<http://205.254.135.7/electricity/annual/html/table1.1a.cfm>  
[http://www.eia.gov/totalenergy/data/monthly/pdf/sec7\\_6.pdf](http://www.eia.gov/totalenergy/data/monthly/pdf/sec7_6.pdf)

Changes in capacity converted to annual output using average load factor for coal for 2009-2010, and Ventyx estimates for load factor of new renewable energy projects.

## Germany's astonishing renewable energy transition

The Fukushima nuclear disaster triggered nuclear phase-out decisions in Japan, Germany and Switzerland this year, creating the space and necessity for new policies to speed up the transition to clean, renewable energy.

Germany's success in rolling out wind and solar power has been a key driver in commercialising these technologies globally, resulting in rapid deployment all over the world. The country has increased its production of electricity from renewable technologies to 20.3% from 6.6% in a decade. The nuclear phase-out decision has enhanced ambition, with the federal states setting a combined target of 53% of electricity from renewables, substantially higher than the national target of 40%. Implementing the development plans of German states would enable the country to cut coal use by half.



Source: AGEB and Bundesnetzagentur: Szenariorahmen für den Netzentwicklungsplan Strom 2013<sup>7</sup>

The transition in Germany has had a significant impact on the rest of Europe. Since 2006, almost 100 gigawatts (GW) of renewable generation have been added to the electricity networks of western European countries, particularly in Germany, Spain and Italy. This means that renewable generation now accounts for almost 35% of the total installed capacity base in Europe. Moody's Investors Service pointed out recently that the rapid deployment of renewable energy is lowering peak power prices and disrupting the business model for European thermal generators, and is having a profound impact on the competitiveness of thermal generation in Europe.<sup>8</sup>

The transformation of European electricity is not yet complete. The European Network of Transmission System Operators for Electricity (ENTSO-E) forecasts that a further 150 GW of renewables will be added by 2020, accounting for almost half of the total capacity base. A report commissioned by Greenpeace and the European Renewable Energy Council (EREC) points out that a green energy revolution would make EU energy almost totally carbon-free by 2050, and would generate €3 trillion in fuel savings between 2011 and 2050.<sup>9</sup>

Globally, investments grew six-fold from 2004, with wind and solar leading the charge.<sup>10</sup> At this rate of growth, the majority of new additions to global electricity output capacity will come from clean and safe renewable energy by the end of this decade.

## Globalising US pollution: Negating emission cuts through fossil exports

In the last few years, the US has slashed use of coal for electricity generation. The coal industry is therefore planning to replace domestic demand with exports.

<sup>7</sup> AGEB: Tabelle zur Stromerzeugung nach Energieträgern 1990–2011.

<http://www.ag-energiebilanzen.de/viewpage.php?idpage=1> and

Bundesnetzagentur: Szenariorahmen für den Netzentwicklungsplan Strom 2013.

[http://www.netzausbau.de/cln\\_1931/DE/Bedarfsermittlung/Szenariorahmen%20zum%20NEP%202013/szenarios\\_nep2013\\_node.html](http://www.netzausbau.de/cln_1931/DE/Bedarfsermittlung/Szenariorahmen%20zum%20NEP%202013/szenarios_nep2013_node.html)

jsessionid=D4730BEF253B8049B18C005F79289112

Assuming that capacity factors for all renewables are on 2011 levels, and 35% for offshore wind.

<sup>8</sup> Moody's Investors Service: Wind and Solar Power Will Continue to Erode Thermal Generators' Credit Quality, 6 November 2012

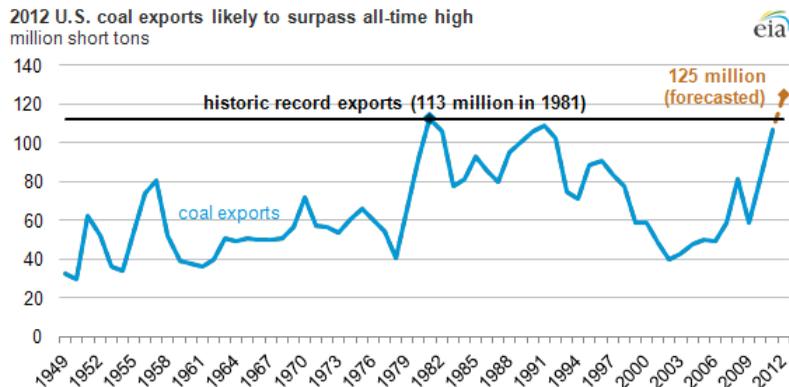
[http://www.moody.com/research/Moodys-Wind-and-solar-power-will-continue-to-erode-thermal--PR\\_259122](http://www.moody.com/research/Moodys-Wind-and-solar-power-will-continue-to-erode-thermal--PR_259122)

<sup>9</sup> Greenpeace International and EREC, 2012 Energy [R]evolution Report for EU, October 2012

<sup>10</sup> UNEP, Bloomberg New Energy Finance and Frankfurt School of Finance and Management 2012: Global Trends in Renewable Energy Investment.

<http://fs-unep-centre.org/sites/default/files/publications/globaltrendsreport2012final.pdf>

According to EIA, US coal exports, supported by rising steam coal exports, are expected to reach 114 million metric tonnes (125 short tons) in 2012, breaking their previous record level of 113 million tonnes, set in 1981.<sup>11</sup>



Source: US Energy Information Administration, Short-Term Energy Outlook, US Census data.

This is partly because the coal industry has access to taxpayer-owned lands for extremely low costs, due to favourable land leasing process. In a recent auction, Peabody Energy – the largest private coal company in the world – was reported to have secured taxpayer-owned coal in the Powder River Basin for \$1.11 US dollars per short ton (\$1.21 per tonne)<sup>12</sup>, which it is likely to sell for \$100 in the international market.<sup>13</sup> According to a report from energy analyst Tom Sanzillo, this leasing process has amounted to a \$28.9bn subsidy to the coal industry over the last three decades.<sup>14</sup>

Because of the slump of US domestic coal consumption, the coal industry is ramping up export plans. Several proposals for infrastructure expansion including ports and railway lines have been tabled, that would enable coal from the Powder River Basin to be shipped to the Pacific with trains and barges, initially for around 131 million tonnes (145 million short tons) per year<sup>15</sup>, and could open the door to much higher volumes. Another 60 million tonnes of coal export capacity is planned on the US East Coast and Gulf Coast by 2016<sup>16</sup>. According to compilation by Sierra Club, total proposed facilities in the US, Canada and Mexico to be used for exporting US coal amount to 492 million tons (446 million tonnes) of annual coal export capacity<sup>17</sup>.

Aggressive US coal export expansion planned by the industry, aided by government support and subsidies, would dump under-priced coal on the world market, which would cancel out US mitigation progress and undermine climate mitigation efforts in Asia and Europe.

### Carbon capture and storage: boosting carbon emissions

In the 2012 World Energy Outlook, the International Energy Agency (IEA) recognised that “no more than one-third of proven reserves of fossil fuels can be consumed prior to 2050 if the world is to achieve the 2°C goal”, but added a caveat: “unless carbon capture and storage (CCS) technology is widely deployed.”

Statements like this give false hope to the fossil fuel industry. Despite substantial public funding (\$52bn according to *Bloomberg New Energy Finance*), CCS technology has largely failed to deliver as a climate solution due to technical and economic reasons. With numerous project cancellations and only eight demonstration projects in operation globally, CCS falls far short of the IEA’s CCS roadmap of 100 plants by 2020 and 3,000 plants by 2050.

<sup>11</sup> EIA: Today in Energy: US coal exports on record pace in 2012, fueled by steam coal growth, 23 October 2012.

<sup>12</sup> Bureau of Land Management Wyoming State Office, North Porcupine Coal Lease Sale Winning Bid Over \$793 Million, 28 June 2012 [http://www.blm.gov/wy/st/en/info/news\\_room/2012/june/28-coalsale.html](http://www.blm.gov/wy/st/en/info/news_room/2012/june/28-coalsale.html)

<sup>13</sup> Peabody Coal buys coal from U.S. taxpayers for cheap, sells it abroad for huge profit, 18 May 2012. <http://grist.org/coal/peabody-coal-pays-u-s-taxpayers-1-11-per-ton-of-coal-sells-it-to-china-for-123/>

<sup>14</sup> Declaration in District Court of Columbia, January 2012 <http://climatemwest.files.wordpress.com/2012/01/tom-affidavitfin.pdf>

<sup>15</sup> Sightline Daily: Coal Exports and Carbon Consequences II, 23 May 2012 <http://daily.sightline.org/2012/05/23/coal-exports-and-carbon-consequences-ii/>

<sup>16</sup> IEA World Energy Outlook 2011

<sup>17</sup> Sierra Club, “Proposed Coal Export Terminals or Expansion”, as at May 2012.

What's more, there is a sharp increase in collaboration between the CCS industry and the oil industry to use CCS to help boost oil production. This is bad news for the climate, as Enhanced Oil Recovery (EOR) operations will likely result in a net increase in emissions. For example, the Weyburn-Midale CCS storage project in Saskatchewan, Canada is expected to inject a net amount of 34 million tonnes of carbon dioxide in order to recover an additional 222 million barrels of oil, (equivalent to 95 million tonnes<sup>18</sup> of CO<sub>2</sub>) and prolong the productive life of the oilfield by 25 years<sup>19</sup>.

In UNFCCC climate negotiations, CCS is allowed as a project activity in the Clean Development Mechanism (CDM). It is important that EOR projects are excluded from the CDM to avoid carbon credits being used to aid oil production. There is plenty of evidence showing CCS is being used by the industry as a smokescreen to divert public funding to justify construction of new coal plants and to boost oil production and profits. Governments need to make fundamental changes and stop buying into the CCS rhetoric, and instead invest in real action to curb fossil-fuel consumption.

## Water scarcity and air pollution: hard constraints on coal expansion

### Coal's threat to water resources exposed in China, India, South Africa

This year, Greenpeace released three reports investigating the conflict between proposed new coal-fired power stations and the increasingly scarce water resources in China, India and South Africa:

In China, the demand in 2015 for water for new coal power bases will either challenge or exceed 100% of several provinces' 2010 capacity for industrial water supply (Shaanxi: 141%, Inner Mongolia: 140%, Shanxi: 103%, Ningxia: 94%). This concern is expected to drive an increased focus on water and energy efficiency in the power, industry and mining sectors in China. HSBC has identified water scarcity as an investment risk<sup>20</sup>.

In India, the availability of water in the Wardha River, in the central Indian region of Vidarbha, will be significantly challenged and reduced by as much as 40% through a cluster of proposed coal-fired power plants. Seventy-one coal-fired thermal power projects with a capacity of 55,000 MW have been proposed for the parched Vidarbha region in Maharashtra. If these plants go ahead, the state government would have to allocate 2,049 million cubic metres of water a year, or the equivalent irrigation water for approximately 409,800 hectares of arable land. This will create an agrarian crisis in addition to significant risk of plant shutdowns. It is against the state water policy to prioritise industry water needs over irrigation. Lack of irrigation facilities have been linked to suicides and agricultural distress by many independent studies and by the Indian Planning Commission. 8,200 farmers have committed suicide in the region since 2002.<sup>21</sup>

In South Africa, over 98% of water has already been allocated. It is not clear where Eskom, the national electricity utility, will get the water needed for planned new coal-fired power stations. Eskom uses just over 10,000 litres of water a second, the amount one person uses in a year. Eskom expects its water costs to more than double in five years. This would force South Africa to become a net importer of water, creating huge social risk as well as investment risks.<sup>22</sup>

### Air pollution concerns curb coal in the US, China

In the US, the Environmental Protection Agency's (EPA) 2012 rule on Mercury and Air Toxics Standards will finally put in place regulations that will protect Americans from mercury and other toxic pollutants. It is estimated this rule will save up to 11,000 lives a year.<sup>23</sup> The EPA's Cross-State Air Pollution Rule will save up to 34,000 lives by reducing far-reaching smokestack pollution. New EPA rules on greenhouse gas emissions from new power stations will further squeeze plans for new coal-fired generation. These environmental regulations have huge implications for coal plant operators: in the PJM Interconnection alone (which manages electricity for 13 states as well as

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<sup>18</sup> PTRC: What are the statistics for oil production and CO<sub>2</sub> stored in both the Weyburn and Midale oil fields?

<http://ptrc.ca/projects/veyburn-midale/faqs>

<sup>19</sup> Calculated using EPA's average conversion factor of 430kg / barrel of oil

<http://www.epa.gov/cleanenergy/energy-resources/refs.html>

<sup>20</sup> China Dialogue, Does China have enough water to keep building three power stations a week? September 2012

<http://www.chinadialogue.net/article/show/single/en/5198-Does-China-have-enough-water-to-keep-building-three-power-stations-a-week>

<sup>21</sup> Greenpeace India, Endangered Waters: Impacts of coal fired power plants on water supply in India, August 2012

<sup>22</sup> Greenpeace Africa, Water hungry coal: Burning South Africa's water to produce electricity, October 2012

<sup>23</sup> EPA, Benefits and Costs of Cleaning Up Toxic Air Pollution from Power Plants

<http://www.epa.gov/mats/pdfs/20111221MATSimactsfs.pdf>

Washington DC), 32% of the organisation's coal capacity is at "high risk" or "some risk" of shutting down due to failing to meet pollution controls.<sup>24</sup>

In China, it is estimated that industrial air pollution kills almost 500,000 people annually, with coal-fired power generation by far the largest sector contributing to damages.<sup>25</sup> Eastern China's coastal areas are the most affected by fine particle (PM2.5) pollution in the world. Research has shown that the biggest source of PM2.5 is coal. According to statistics from China's Ministry of Environmental Protection, in recent years, cities in the three most densely populated regions – the Yangtze River Delta, the Pearl River Delta, and the Beijing-Tianjin-Hebei region – have seen over 100 smoggy days each year, with fine particle concentration two to four times the level recommended by WHO Air Quality Guidelines. This comes as a result of a continuous increase in coal burning. Recognising the serious impacts of air pollution on human health and the quality of life, municipal governments are now taking actions to curb coal burning. Beijing has recently announced a coal-consumption reduction target of 15 million tonnes in the coming five years, 12 million tonnes lower than its 2010 consumption level. Guangzhou, the third largest city in China and the leading city in southern China – the region where coal imports are increasing – recently announced a zero increase target as its key measure to clean up air pollution. Guangzhou will limit its coal consumption to its 2010 level of 29 million tonnes a year by 2015. Other eastern cities, such as Tianjin, Shanghai, Wuxi, Changzhou and Ningbo, have also put forth absolute targets to limit the increase of coal consumption.<sup>26</sup>

### To prevent further coal expansion, Doha must send the right signals

While there are several factors which create constraints for the expansion of coal (both generation and mining) into the future, ranging from resource availability, tightening pollution standards and the transition of energy markets to RE, much is left to politicians to determine. If the politicians fail, it is evident that coal will continue to be the biggest driver of CO<sub>2</sub> emissions. On the other hand, relatively small political signals could reinforce the trends already growing in energy markets.

The wide range of outcomes in politicians' hands is shown in the International Energy Agency's World Energy Outlook 2012. The IEA's current policies scenario sees coal production growing by 54% from 2010 to 2035. However, in the IEA's new policies scenario, where countries implement existing and announced policies, coal production grows by only 18%. If policies were brought in that are consistent with a 50% chance of meeting the 2°C target adopted at COP16 in Cancun in 2011, coal production would shrink by 35%.

Conversely, it is evident that governments need to recognise that every new coal plant or new mine will make it much harder to achieve the goals being negotiated in Doha. Whether or not governments are reducing the use of coal is a key test of their commitment to meeting their climate goals.

The success of COP18 in Doha is crucial for sending the right signals to deter further coal expansion. The second commitment period of the Kyoto Protocol, and a roadmap towards a new legally binding global agreement by 2015 are crucial for deterring further coal expansion that would forever close the door to limiting the rise in global temperatures to 2°C in this century.

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<sup>24</sup> PJM Interconnection, Aug 2011, <http://pjm.com/~media/documents/reports/20110826-coal-capacity-at-risk-for-retirement.ashx>

<sup>25</sup> Based on data in Fang, B. 2012: The assessment of health impact caused by energy use in urban areas of China: an intake fraction-based analysis. *Natural Hazards* 62(1): 101-114.  
<http://dx.doi.org/10.1007/s11069-011-9936-z>

<sup>26</sup> Greenpeace East Asia, Ranking Eastern Chinese Cities by their "Clean Air" Actions, May 2012