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Thirsty Coal:

A Water Crisis Exacerbated

By China's New Mega Coal Power Bases

As China's economy grows, its thirst for energy - nearly 70% of which now comes from coal - worsens. The world's second largest economy will construct 16 large-scale coal power bases, predominantly in western areas of the country over the duration of the 12th Five-Year Plan (2011-15). According to the plan, in 2015, the following bases: Shendong, Mengdong, Jinbei, Jinzhong, Jindong, Ningdong, and Shaanbei, most of which are situated in Inner Mongolia, Shanxi, Shaanxi, and Ningxia, will contribute a total coal output of 2.2 billion tons, contributing to 56% of China's annual coal output for 2015 (3.9 billion tons). And with expansion across the country's arid western areas, these water-intensive projects will inevitably trigger a serious water crisis and exacerbate existing water scarcity problems.

Coal mining is an extremely water-intensive industry, as are coal-fired power plants and coal chemical industries. Through Greenpeace commissioned research, it is estimated that water demand created by this energy strategy will reach at least 9.975 billion m³ in 2015 – equivalent to one sixth of the annual total water volume of the Yellow River during a normal year. The study also estimates that in 2015, the water demand of coal power bases in Inner Mongolia, Shaanxi, Shanxi and Ningxia will either severely challenge or exceed the respective areas' total industrial water supply capacity. Thus, the development of coal-related industries in these areas will take up a significant amount of water currently allocated to non-industrial uses, such as farming, drinking water and ecological conservation.

Poorly planned and unregulated coal mining activities have already resulted in controversy in some provinces. Left unchecked these mining projects will only cause more ecological disaster and social unrest in the foreseeable future. Greenpeace strongly urges China to reconsider the distribution and scale of its coal power expansion strategy, watch over the water supply situation in its mega coal power bases, and make adjustments to these ambitious plans in accordance to availability and sustainability of water resources in western China over the remaining time left in the 12th Five-Year Plan period.

1. An Energy Scheme that Won't Hold Water

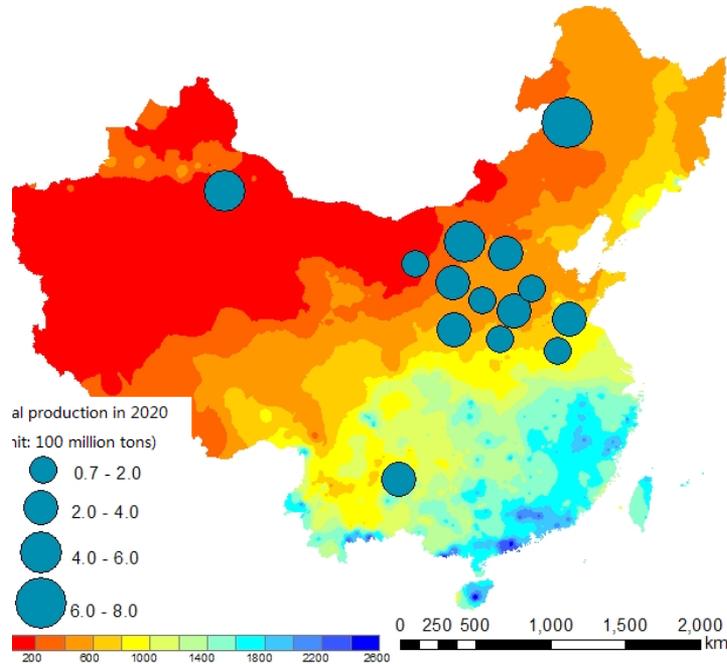
According to its 12th Five-Year Plan (2011-2015), China will develop five key integrated energy bases within the period of the plan to meet the nation's growing energy needs. The predominant energy output of these bases, located in Shanxi, the Ordos Basin, the eastern part of Inner Mongolia, Xinjiang and in southwestern China, will be fired by coal. Within these five energy bases, both China's "Energy Development: Five-Year Plan (draft)" and its "Coal Industry Five-Year Development Plan" clearly state that the country will focus on constructing 14 large-scale coal min-

ing bases¹. The coal coming out of these 14 bases will then fuel 16 coal-power generation bases with a total expected installed capacity exceeding 600 GW. What more, it is not only coal extraction and the coal-fired power generation that is projected to soar within the following few years, but the coal chemical industries too. However, this grand strategy is doomed to meet an unavoidable bottleneck: water scarcity. In fact, water resources per capita and per unit area in these areas are only one tenth of the national average².

1. These 14 coal bases are Jindong (eastern Shanxi), Jinzhong (central Shanxi), Jinbei (northern Shanxi), Shaanbei (northern Shaanxi), Huanglong, Ningdong (eastern Ningxia), Shendong (Shenfu-Dongsheng), Mengdong (eastern Inner Mongolia), Xinjiang, Jizhong (central Hebei), Luxi (western Shandong), Henan, Lianghuai (Huainan and Huaibei) and Yungui (Yunnan-Guizhou).

2. Zhang Zhiguo, Guan Xinyu, Zhang Ziping, Sun Sai. Brief Analysis on the Methods to Solve the Water Resource Shortage in Coal Chemical Industry. Coal Industry, 2010, (3): 12-14.

Figure 1. Major coal mining bases under the 12th Five-Year Plan
(color indicates annual precipitation, mm/a)



Greenpeace and the Institute of Geographical Sciences and Natural Resources under the Chinese Academy of Sciences worked together to present this study of the estimated water consumption of these coal power bases³. By comparing water demand of these coal bases and the water supply in their respective locations, this study has put a big question mark over the feasibility of China's ambitious coal expansion strategy in relation to the availability of water resources. Case studies in the report suggested that the poorly planned development of the massive coal power bases will not only drain groundwater resources; it will also pollute water resources – which will itself exacerbate drought as there will be less usable water available; pollute and over-consume the water resources of the Yellow River and other key rivers; and cause the widespread destruction of grasslands, forests and other ecosystems. The conclusion: this massive expansion of coal power bases goes against the country's uneven distribution of water resources, and if China insists on going ahead with the plan, the already arid western China will suffer a series of water crises.

3. The main data and science conclusions in this article are sourced from the Thirsty Coal report. Besides, Greenpeace has taken over 10 times of onsite investigation to the main areas in the Thirsty Coal report during 2011-2012.

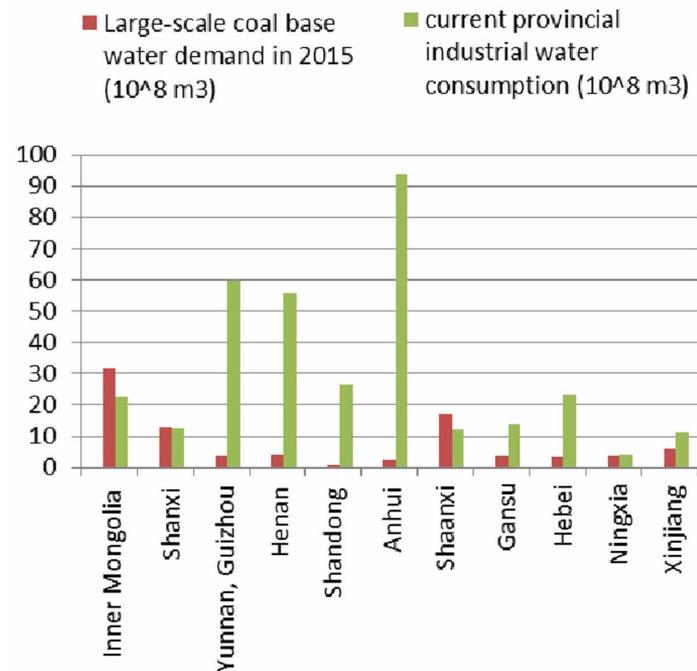
2. A Coal-fired Water Crisis

2.1 The Hard Truth: For Coal, There is Never Enough Water

A fatal dilemma of this energy development plan is negligence of the fact that these mega coal power bases simply don't have the water resource to support their operation. Conservative calculations quoted in this study show that water demand from coal-related industries within the planned large-scale coal bases will reach an estimated yearly 9.975 billion m³ in 2015 – more than one quarter of the water volume of the Yellow River available to allocate in a normal year -- 37 billion m³. Thus, the average daily water demand of all these industries will be 27.33 million m³, which is nine times that of Beijing's daily water supply ability⁴ in 2012 and equals one-fifth of the nation's⁵ average daily consumption in 2009. ⁶

The study also predicts that by the end of the 12th Five Year Plan, the annual water consumption of the coal power bases in Inner Mongolia, Shaanxi, Shanxi and Ningxia will either challenge or exceed the entire area's current total industrial water supply capacity (94.1% to 140.8%). That means these coal power bases, if fully developed, will consume a significant amount of water currently allocated to different uses such as farming, urban residential use or environment conservation; in turn, the fierce competition for water resources between industrial and non-industrial sectors and will very likely cause conflict and unrest in those areas.

Figure 2. Comparison of coal bases water demand in 2015 with current provincial industrial water consumption



4. 3 million m³, Beijing water group water supply capacity in 2012 http://www.bjwatergroup.com.cn/264/2012_6_7/264_5700_1339050233109.html

5. 136.09 million m³, China Statistics Year Book 2010

6. Of the almost 10 billion m³ of water, coal mining would make up 66.6% of the total water demand. The coal-fired power sector would make up 22.2%, and the coal chemical industry would comprise of 11.13%.

2.2 Mother River: Sucked and Trashed

One of the most visible crises caused by these new coal power bases is an ever drier Yellow River, a river considered by the Chinese people as a totem of their culture. The Yellow River, already challenged by water grabbing and pollution, will be further drained by five coal bases⁷. These five coal bases, proven to contain 41% of the country's total coal reserves, are all located on the upper stream of the river. These "big five" are all also heavy consumers of water, sucking the Yellow River's tributaries up and causing them to run dry more frequently, and cutting off water that would otherwise feed into the Yellow River.

Take the coal-rich Ningxia Hui Autonomous Region as an example. Statistics have shown that in the area between 2001 and 2005, coal mines over-consumed almost 800 million m³ of water from the Yellow River each year⁸, about 25% over the approved quota; and between 2003 and 2006 a total of 16 pre-warnings were issued, predicting that the Yellow River would run dry within Ningxia and Inner Mongolia's territory.

If these five coal power bases are constructed as stipulated by the 12th Five-Year Plan, the residents living on the arid Yellow River basin will be deprived of even more of their water rights. Even their drinking water

supply will be put to risk, as the Yellow River runs dry with increased frequency.

Coal bases along the Yellow River Basin also dump significant amounts of waste into the river's tributary system. Every year, the five main coal-power bases located on the upper and middle reaches of the Yellow River discharge more than 80 million tons of waste, which ultimately flows into the Yellow River. This causes direct economic losses every year of between RMB11.5 billion and RMB15.6 billion⁹. Furthermore, it poses a threat to drinking water safety for millions of people living along the Yellow River – water cutoffs have already happened in several cities due to serious pollution incidents.

In fact, coal mining, transport, processing, and use of coal all produce large amounts of waste water and industrial waste, which in China is often directly dumped into rivers, causing serious surface water pollution and leaving little or no clean water for local people to use for agriculture or daily use.

7. Including: Shenfu & Dongsheng coal base, Shanxi coal base, coal base along Shanxi & Shaanxi & Inner Mongolia valley by the northern side of Yellow River, coal base along Shanxi & Shaanxi & Inner Mongolia borders, and Ningxia Yinchuan & Shizuishan coal base.

8. <http://finance.sina.com.cn/chanjing/b/20060814/1108857622.shtml>

9. Wang Zhihua, 2005, Prevention and Treatment for Water Pollution in Yellow River.

3. China's Biggest Power Bases: Thriving on the Corpse of Grasslands

The construction and operation of coal-power bases in such ecologically vulnerable areas such as China's west is a nightmare unfolding for the people living on the grasslands. Not only will they lose their grazing land to coal mines, they will also witness and suffer the destruction of forests, wetlands and other ecosystems, vegetation degradation, soil erosion, and – ultimately – exacerbated desertification.

To support hydraulic projects in the coal-power bases artificial reservoirs are constructed, cutting off natural rivers that are supposed to feed into grasslands, forests, wetlands and other ecosystems downstream. Gradually, grasslands and wetlands will turn into deserts, no longer able to support crop and animal farming.

The consequences of these disruptions to the ecology are most clearly demonstrated at Inner Mongolia's Xilin Gol and Hulun Buir coal bases, where the environmental nightmare is quickly climaxing in a tragic catastrophe.

3.1 Eastern Inner Mongolia: Where the Green Gives in to the Black

Inner Mongolia is a key region for the expansion of the coal-power bases as outlined in the 12th Five-Year Plan. But the region faces a harsh reality: while it is blessed with 26% of China's coal reserves, it only has 1.6% of the country's water resources. Thirsty Coal estimates that in 2015, the major coal-power bases in the region will demand a water volume 139.5% of its industrial water consumption in 2010. And let's remember the expansion of coal-power bases in Inner Mongolia has already brought about irreversible destruction of water resources, grasslands and forests, and affected the lives of local residents.

The Mengdong coal-power base¹⁰ is China's largest coal-producing area and the fastest growing region in terms of coal yield. Its coal output is predicted to reach 520 million tons by 2015 and 693 million tons by 2020, if it develops as planned. However, it also happens to spread over Inner

Mongolia's – and arguably China's – most beautiful and fragile grasslands: the Xilin Gol grasslands, Hulun Buir grasslands and the Horqin grasslands. These grasslands are located in arid and semi-arid areas, and their very survival relies on groundwater. Taking groundwater out of their soil means guaranteed desertification for these areas. It is estimated that some 73.5% of Inner Mongolia's grasslands are already degraded¹¹. The Hulun Buir Grassland Supervision Station and the Inner Mongolia Grassland Survey and Design Institute found that the area suffering from grassland degradation, desertification and salinization was 3.982 million hectares at the beginning of this century, increasing two-fold from the 1980s when the number was 2.097 million hectares.

This report predicts that by 2015 the annual water demand from Inner Mongolia's coal mining industry will reach 2.218 billion m³. Another 606 million m³ of water will be consumed for coal-fired power generation within the region, and 329 million m³ for its coal chemical industry. That means a total of 3.153 billion m³ of water demand for all

10. The Mengdong Coal Power Base includes the Shengli coalfield, the Baiyinhua coalfield, the Baorixile coalfield, and the Huolinhe coalfield.

11. <http://nmgshkxy.nmgnews.com.cn/system/2009/07/03/010246352.shtml>

three coal-related sectors, which is close to the total volume of water resources of the Xilin Gol grasslands. The development of coal power bases has caused a fundamental change to the distribution of the grasslands' water resources: groundwater is pulled out, and reservoirs are built to trap surface water.

Pumping out groundwater is a prelude to coal extraction. In fact, it is estimated that for every ton of coal extracted, 2.54 m³ of groundwater is destroyed¹². For example, the Shendong and Mengdong coal bases in Inner Mongolia destroy 2.64 billion m³ of groundwater every year. In open-cast coal mining areas in Inner Mongolia, aquifers have dried up and groundwater levels have fallen, leaving the regions' main water resources depleted. Further long-term effects of this include degradation of topsoil into sand, lowered soil fertility and decrease in crop yields.

3.2 Inner Mongolia's Desertification: A State-Owned Tragedy

Greenpeace investigations also found that some of China's biggest power companies have direct investments in dam projects that grab river water meant to feed entire grasslands. For example, China Huaneng Group has built the Honghuaerji Reservoir which dams the Yimin River. China Power Investment has built the Gaolehan Reservoir which dams the Gaolehan River. The Wulagai Reservoir has also been rebuilt for the development of coal mines, coal power plants and coal chemical plants, damming the Wulagai River.

According to the HulunBuir Hydrological Survey Bureau, in recent years, most of the grasslands' rivers have seen water levels drop or simply dried up. The Yimin River, which provides water for the southeastern part of the HulunBuir grassland

but is now cut off and dammed by Huaneng, has tragically dried up - even in flood season. Weak surface and ground water supply will result in degradation of forests and wetlands. In 2006, two years after the Wulagai Reservoir began damming the Wulagai River to meet the water demand of a RMB 20 billion coal chemical plant, the Wulagai Wetland completely dried up. The "wetlands", once a green haven for hygrophytes, are now major contributors to the North's infamous winter & spring sandstorms.

12. Liu Shuiquan, 2009, Consideration on Sustainable Use of Water Resources in Shanxi Province. Water Resource Management, (5): 44-45.

4. Greenpeace Recommendations

"Water is the source of life; it is essential for production; and is the foundation of all ecosystems. China suffers from an uneven distribution of water resources both in terms of location and of time. Parts of the country battle with severe water shortages, water pollution, and environmental degradation. This situation has become increasingly serious and has caused a major bottleneck in constraining sustainable socio-economic development." --- State Council Notes on the Implementation of a Strict Water Resources Management System (State Council Document No.3 in 2012)

While the Central Government has urged local authorities to focus on protecting water resources in its top priority policy papers, as seen in Document No. 1 in 2011 and the State Council Document No.3 in 2012, we predict that the rapid expansion of coal-related industries in arid western China during the 12th Five-Year Plan will likely cause a series of water crises and, consequently, many environmental problems.

Greenpeace believe that to achieve the most stringent water resource management target outlined by national leaders, the water problems coal-power base development must not be ignored, and to that end, we've made the following policy recommendations:

- We propose that a strict and robust water demand assessment should be made on China's coal-power bases. We have found that existing evaluations of water consumption for coal-power bases on the western region are limited in both scope and depth. We suggest new evaluations are conducted on the water demand of all coal power development plans as soon as possible.
- The National Development and Reform Commission should take the lead in adjusting the energy bases and project development plans of the arid western coal provinces, in accordance with the *"State Council Notes on the Implementation of a Strict Water Resources Management System (2012)"*, based on objective EIAs, and water resource assessments. These adjustments should take into account water capacity and production scale, and re-evaluate the feasibility of the coal-power bases in the western region. We advise that those projects which threaten the environment or the area's water security be urgently revised so as not to impact the region's sustainable socio-economic development.
- The Ministry of Environmental Protection should stress the importance of how water consumption and pollution from coal-related industries will impact the region in the Strategic Environmental Impact Assessment (EIA) on the Western Region Development.

Table 1. Key industries of each coal power base under the 12th Five-Year Plan

No.	Coal base	Coal mining capacity (100 million tons)	Coal-fired power plant capacity (MW)	Coal chemical capacity (model projects)
1	Shendong(Shaanxi and Inner Mongolia)	5.2	48,000	50.9 billion m ³ of coal gas; 800,000 tons of dimethyl ether; 500,000 tons of coal tar hydrogenation
2	Mengdong (eastern Inner Mongolia)	5.2	83,170	400,000 tons of glycol; 10 billion m ³ of coal gas; 1.2 million tons of methanol; 460,000 tons of propylene
3	Jinbei, Jinzhong, Jindong(Shanxi)	7.35	80,000	3 million tons of methanol; 600,000 tons of olefin; 300,000 tons of dimethyl ether; 160,000 tons of coal oil; 100,000 tons of maleic anhydride
4	Yungui(Yunnan and Guizhou)	2.6	--	200 million m ³ of Coal-derived natural gas; 500,000 tons of methanol; 600,000 tons of polyolefin
5	Henan	2.15	--	750,000 tons of methanol; 400,000 tons of ethylene glycol; 1.8 million tons of olefin
6	Luxi(western Shandong)	1.4	--	400,000 tons of hydroxy acetate synthesis
7	Lianghuai (Anhui)	1.5	--	1.7 million tons of methanol; 600 000 tons of olefin
8	Huanglong (Huating)(Shaanxi, Gansu)	1.45	50,000	800,000 tons of methanol
9	Jizhong(Hebei)	0.8	--	--
10	Ningdong(Ningxia)	0.9	30,000	4 million tons of coal indirect liquefaction
11	Shaanbei(northern Shaanxi)	3	52,500	1 million tons of coal indirect liquefaction; 7 million tons of olefin; 400,000 tons of methanol
12	Xinjiang	4	7,960	46.4 billion m ³ of coal-derived natural gas; 800,000 tons of dimethyl ether; 500,000 tons of coal tar hydrogenation
Total		35.55	351,630	--

Table 2. Water demand of coal-related industries

No.	Base name	Coal mining water demand (billion m ³)	Coal-fired power generation water demand (billion m ³)	Coal chemical water demand (billion m ³)	Total water demand (billion m ³)
1	Shendong(Shaanxi and Inner Mongolia)	1.768	0.303	0.224	2.295
2	Mengdong(eastern Inner Mongolia)	1.768	0.525	0.105	2.398
3	Jinbei, Jinzhong, Jindong(Shanxi)	0.684	0.505	0.066	1.255
4	Yungui(Yunnan and Guizhou)	0.312	--	0.054	0.366
5	Henan	0.366	--	0.055	0.421
6	Luxi(western Shandong)	0.069	--	0.0022	0.071
7	Lianghuai(Anhui)	0.21	--	0.039	0.249
8	Huanglong (Huating)(Shaanxi, Gansu)	0.261	0.315	0.012	0.588
9	Jizhong(Hebei)	0.32	--	--	0.32
10	Ningdong(Ningxia)	0.153	0.189	0.044	0.386
11	Shaanbei(northern Shaanxi)	0.54	0.331	0.171	1.042
12	Xinjiang	0.196	0.05	0.338	0.584
Total		6.647	2.218	1.110	9.975



Piles of clay and drainage pipes at Baorishearer opencast coal mine in Hulun Buir of Inner Mongolia, taken in May 2012 © Lu Guang / Greenpeace

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