THIRSTY COAL 2: SHENHUA'S WATER GRAB

An Investigation into the Over-extraction of Groundwater and Illegal Discharge of Wastewater by Shenhua Group's Ordos Coal-to-Liquid Demonstration Project

GREENPEACE 绿色和平

Shenhua's water extraction projects have caused many of the poplar trees planted by local herders to die off. ©Greenpeace/Bo Qiu

Report Summary

This investigation report is a follow-up to the 2012 Greenpeace and the China Academy of Sciences joint study: *Thirsty Coal: A Water Crisis Exacerbated By China's New Mega Coal Bases*[1]. In this report, we focus on the most controversial part of China's coal strategy: the proposed scaling up of the coal chemical sector. In particular, Greenpeace investigated the largest of nine coal chemical demonstration projects in operation: Shenhua's Coal-to-Liquid Demonstration Project located in Ordos, Inner Mongolia. Given its size and scope, this massive, controversial project is a classic example of the unchecked expansion of coal-reliant industries that is in growing conflict with China's water resources.

The Shenhua Group is China's largest coal conglomerate, producing 460 million tons of raw coal every year, half of which is located in the Shendong coal field, which is currently the largest integrated coal field in terms of proven reserves and makes up 1/4 of the national total. It is one of the world's eight largest coal fields and contains both the Shendong and Shaanbei coal bases. It is also where the Ordos Coal-to Liquid Demonstration Project has been in operation since December 2008.

Greenpeace investigated two aspects of Shenhua's coal chemical demonstration project: its water demand and extraction, and the quantity of industrial wastewater and its disposal. We have collected evidence of practices that are in clear violations of Chinese laws governing the access to water resources and the control of industrial wastewater discharge.

"Water Grab"

Greenpeace's investigation revealed that Shenhua's Coal-to-Liquid Project went to extraordinary length to secure water supply for its operations, and has found alarming evidence of widespread ecological and social damage, resulting from the short span of eight years of operations. Shenhua's plundering of water at the costs of local population and the baseline needs of the environment is of such a scale that can only be described as a "water grab" in the most ruthless way.

Ignoring the serious deficit of water resources and ongoing of environmental damage already caused by its mining operations, in 2002 the Shenhua Group began construction on a water-intensive, highly polluting coal-to-liquid fuel project in Ulan Moron[2] near

[1] The Institute of Geographic Sciences and Natural Resources Research (IGSNRR), Chinese Academy of Sciences (CAS), Greenpeace East Asia. 2012. Thirsty Coal: A Water Crisis Exacerbated By China's Mega Coal Power Bases, China Environmental Science Press.

[2] In Mongolian, Ulan Moron means Red River

Shenhua's Coal-to-Liquid Project illegally dumps highly concentrated industrial wastewater. ©Greenpeace/Bo Qiu

the city of Ordos. The project requires an average of 10 tons of fresh water to produce just 1 ton of end-product, while at the same time producing 9 tons of carbon dioxide and 4.8 tons of wastewater. [3] This was at a time when local water reserves had already been exhausted and there was no water for the project to use. [4] In 2006, Shenhua turned its focus on the Haolebaoji region, in the heart of the Mu Us desert, 100 kilometers away from its proposed plant, and began extracting water. Shenhua's actions in Haolebaoji have resulted in drastic drops in local groundwater levels and clear environmental damage. The lives of local farmers has also become increasingly difficult. So far, Shenhua has extracted a total of over 50 million tons of groundwater. [5]

From March to July, 2013, Greenpeace visited Haolebaoji eleven times to see exactly how seriously Shenhua's over-extraction of groundwater was damaging the environment. We found the following:

• First, Shenhua has drilled 22 wells, each over 300 meters deep, which extract as much as 14.4 million tons of water per year. This is depleting groundwater and has caused the groundwater levels to drop up to 100 metres. [6] Since 2006, every single artesian well in the region has gone dry and most wells less than 30 meters deep have been abandoned. Now, new wells must be dug at least 100 meters deep to ensure the accessibility of water supplies.

• Second, there has been a clear decrease in the surface area of Subeinaoer Lake, the main lake in the region. Satellite images show that in 2011, the surface area of the lake had decreased by 1.27 square kilometers, or 62%, when compared with images from 2004 before Shenhua began extracting water for its Coal-to-Liquid Project in Ordos.

[3] Lei Shaocheng; Zhang, Jiming. Environmental Impact Analysis of the Coal-to-liquid Industry [J]. Shenhua Science and Technology, 2009, 7(3): 84-88
Wang, Jiming. The Current State and Future of China's Modern Coal Chemical Industry [J]. Modern Oil and Petrochemical, 2012, 212(8): 1-6

[4] Li, Baojun; Guan, Xiaofang. An Economic and Technical Analysis of Water Supply and Reuse in the Shenhua Group Coal-to-liquid Project. Inner Mongolia Environmental Protection, 2003, 15(3): 24-27

[5] Proposal 2011 #49: Recommendation on General Relocation of Farmers and Herders in Water Source Area of the Shenhua Direct Liquefaction Project. Ordos People's Congress Website. http://www.ordosrd.gov.cn/dejwcrdh/yajy4/201103/t20110322_296594.html 2011-3-22
Recommendation (建议) is a special Chinese form of political initiative or motion.

[6] Interviews of Haolebaoji villagers by Greenpeace East Asia, March 2013

• Third, there has been a decline in surface vegetation. Vegetation planted by local residents in the region, such as saltcedar, sagebrush and yang chai (羊柴) are dying off in great numbers. Poplars planted to block wind and sand have also decreased in number with many dying off.

• Fourth, natural and planted vegetation covering sand dunes is also dying off on a massive scale, causing sand dunes to become mobile and making desertification of grasslands worse. Large expanses of mobile sand dunes had formed and are quickly expanding. In the past, low lying areas, riverbanks and lakes were relatively plentiful in water, but later sand settled into rivers and lakes, and sand dunes have become even more common.

• Fifth, it has become very difficult for farmers and herders to obtain water. The water that 2,402 households (5,752 people) depend on to survive has been destroyed, with 80,000 hectares of land affected by severe water scarcity. Water needed for irrigation has become scarce and production per area of land has declined with abandoned fields everywhere. The number of animals that can be supported in grazing areas has also declined with fewer larger animals, especially cows and horses. The number of sheep has also declined sharply. Farmers and herders have submitted countless petitions on water extraction issues.

Illegal discharge of industrial Wastewater.

Greernpeace also investigated the discharge of industrial wastewater by the demonstration project. Based on careful examination of technical details we estimate that the total amount of industrial wastewater produced by the Shenhua coal-to-liquids project could be as much as 4.79 million tons per year per 1 million tons of end-products produced.

As one of the Fortune 500 and a self-proclaimed green corporation, Shenhua has said that in the course of implementing any project, it has made every effort to use mechanical cyclical evaporator technology with membranes, ensuring that wastewater is completely reused. This technology meets the highest international standards[7]

[7] Trial Run of the Model Million-Ton Shenhua Coal-to-liquid Project a Success. January 8, 2008. Chinanet

and can reuse over 95% of wastewater. Shenhua has constantly emphasized that it has zero discharge system and has a sufficient number of evaporation pools. This is in addition to taking strict anti-leaking measures to ensure that the actual number of pollutants that enter the water cycle is zero. So, has this huge volume of wastewater, after being treated and turned into harmless runoff, been no burden to the environment?

During several recent visits Greenpeace made to Shenhua's coal-to-liquid plant in Ordos, we noticed seepage pits no more than 500 metres from the main office building where highly toxic industrial wastewater was being dumped and left to seep naturally into the ground, polluting the groundwater below. Greenpeace had collected a number of samples at the discharge sites. These samples were sent to two independent labs for testing, including the Shanghai branch of SGS Laboratories, a leading inspection, verification, testing and certification company; and the Greenpeace Laboratory at the University of Exeter.

These tests has found high levels of harmful substances: sulfide level was almost twice the national standard, while the benzo(a) pyrene levels in PAHs were 3.3 times the national standard. Furthermore, as many as 99 different types of semi-volatile organic compounds were found in the wastewater and sediment samples, including PAHs and PAH derivatives xylene, styrene, dichloromethane and cresol, many of which are considered to be carcinogenic.

The Shenhua Group's extraction of groundwater from the Haolebaoji region for its coal-to-liquid project in Ordos has infringed on water used for agricultural, ecological and residential purposes. It has also passed the government's "red line", the ecological policy limit, causing serious damage to the local ecosystem. The Shenhua water extraction project did not hear local opinions and it is suspected that construction began before proper licensing was obtained. It is also suspected of breaking the Water Law and the Grasslands Law of the People's Republic of China. This is in direct conflict with the massive investments the government has made over in recent decades to protect the Mu Us desert. Nor is it line with the government's policy on water that requires "the strictest management of water resources". It also goes against industry development requirement of "Limiting coal expansion based on water capacity ".

What's more worrying, while damage to the environment and to the livelihoods of residents continues, the expansion of the coal-to-liquid project was initiated in December 2012, including an Environmental Impact Assessment. There are also plans to build a coal-to-natural gas project neighboring the coal-to-liquid plant capable of producing 2 billion cubic meters per year. After going into operation in 2016, it is expected that total water usage will be as much as three times current levels and is nearly twice the maximum capacity of the Haolebaoji reserves. To make up the difference, Shenhua may increasingly extract water from the Yellow River to support its coal liquefaction operations.

Water is the source of life, the key to production and the foundation of the environment.

As the coal industry continues to take water from the people, the people will have no choice but to leave. When the environment is deprived of the water it needs, rivers will dry up, and the ecosystems will no long be able to support life.

Led by large-scale state-owned enterprises like Shenhua, the coal industry, which includes coal mining, thermal power and coal chemical production have plundered the Yellow River basin and groundwater, worsening the already delicate ecosystem of the middle course of the Yellow River. It has also caused a general exodus of local residents as coal interests expand. This short-sighted development model that only cares about GDP growth concern for the environment must be stopped immediately and reevaluated.

Therefore, Greenpeace calls for the following:

First, the Shenhua Group needs to immediately stop further damage to the environment and water resources in the Haolebaoji region, stop illegal discharge of polluted water. Furthermore, Shenhua Group needs to cease activities that will further damage both water resources and the environment in the remaining production lines of Phase One of the Ordos Coal-to-Liquid Demonstration Project, all of Phase Two, and the coal-to-natural gas project.

Second, in light of the massive water usage requirements and severe pollution inherent to coal chemical projects, the National Development and Reform Commission, the Ministry of Industry and Information Technology, the Ministry of Water Resources and the Ministry of Environmental Protection of the People's Republic of China need to set clear, scientific and applicable rules that truly adhere to the idea of limiting coal expansion based on water capacity. When coal chemical projects are in the application phase, strict reviews of water usage and environmental impact must be carried out and projects that do not meet requirements must be rejected.

Third, with regard to the coal chemical projects that have already been approved, the National Development and Reform Commission, the Ministry of Industry and Information Technology, the Ministry of Water Resources and the Ministry of Environmental Protection of the People's Republic of China need to reevaluate their expected impacts to water resources and make adjustments, and release the results of such reevaluations.

CONTENTS

26 April, 2013, Inner Mongolia, China, the vast plant of the Shenhua Coal to Liquid and Chemical Co.,LTD. ©Greenpeace/Bo Qiu

Introduction

In August 2012, Greenpeace released a joint study with the Institute of Geographical Sciences and Natural Resources under the Chinese Academy of Sciences entitled, Thirsty Coal: A Water Crisis Exacerbated by China's New Mega Coal Bases[8]. The study estimated that water demand created by the 16 large-scale coal power bases outlined in the 12th Five-Year Plan will reach at least 9.975 billion m^3 in 2015 – equivalent to one sixth of the annual total water volume of the Yellow River during a normal year.

This report is a follow-up study on the most controversial part of China's coal strategy: the proposed scaling up of the coal chemical sector. In particular, Greenpeace investigated the largest of nine coal chemical demonstration projects: Shenhua's Coal-to-Liquid Project located in Ordos, Inner Mongolia. Given its size and scope, this massive, controversial project is a classic example of the unchecked expansion of coal-reliant industries that is in growing conflict with China's water resources.

The recent rise of China's coal chemical sector

The past several years have seen an explosion of growth in China's chemical sector. According to a 2011 KPMG report[9], the chemical sector made up of over 33,000 enterprises, with total revenue surging at 20.2 percent CAGR for the period spanning 2006–2010. This compares to 1.4% in Japan and 12.2 percent in India over the same period.[10] Then, the chemical industry was the third largest in China, after textiles and machinery, and accounted for 10 percent of the country's GDP.

Given China's abundant coal reserves and its lack of oil, there has been intense industry interest in chemical sector, where coal is used as feedstock to create petrochemical products such as olefins, ethylene and propylenes.[11] According to IHS Chemical China[12], since the 1970s, coal has been used in China to create an array of basic chemicals such as methanol, ammonia capacity, PVC and benzene. Increasingly so, coal chemical processes have moved further up the value chain with companies such as Shenhua, and China Power Investment Corporation producing more complex coal-derived chemical products. A key driver behind movement has been the lack of rail capacity to transport coal from the northwestern supply areas to the demand centers in the east, giving rise to stranded coal assets, and thus creating an interest by companies to convert coal into other chemical products.

Concerned about the over enthusiasm of the coal industry, in the 11th Five-Year Plan (FYP, 2006-2010) for the Development of Coal Industry, the government set out the vision of "orderly advancement of demonstration projects to develop coal deep processing and transformation industry, and the advancement of coal liquefaction demonstration projects"[13]. In that period, 9 coal chemical demonstration projects were approved to test the technical and commercial viability before further scaling up deployment.[14] Shenhua's Direct Coal Liquefaction Project was amongst the first projects to be approved, and was even included as part of the national energy security strategy.[15] But since then, the rush to coal chemicals is still speeding up at an alarming rate, partly due to the slowdown of coal demand from the domestic power sector, and massive coal production over-capacity. In 2012, the National Development and Reform Commission (NDRC) of the People's Republic of China approved 15 large-scale demonstration projects, and according to an official in the National Energy Bureau, 104 proposed projects have been submitted to NDRC for approval. If all of them would go ahead during the 12th Five-Year period, the scale of investment would reach a staggering 2 trillion yuan.[16]

The NDRC is expected to release the national coal chemical strategy for the 12th FYP shortly. But as this study reveals, in reality, due to its water and energy intensity and serious pollution, the coal chemical industry remains highly controversial and its proposed expansion will face significant environmental and social constraints.

[8] The Institute of Geographic Sciences and Natural Resources Research (IGSNRR), Chinese Academy of Sciences (CAS), Greenpeace East Asia. 2012. Thirsty Coal: A Water Crisis Exacerbated By China's Mega Coal Power Bases, China Environmental Science Press.

[9] KPMG. 2009. China's Chemical Industry: The new forces driving changes. http://www.kpmg.com/CN/en/IssuesAndInsights/ArticlesPublications/Documents/China-Chemical-Industry-201109.pdf

[10] Chemical Manufacturing in China, June 2011, DataMonitor

[11] Alexander. G., Coal emerges as Cinderella at China's energy ball",Financial Times. 1st May 2013. http://www.ft.com/intl/cms/s/2/b3dff99a-b2a0-11e2-a388-00144feabdc0.html#axzz2Z50ixFtx.

[12] Clay, B., 2013. Location is the Key to China's New Generation of Coal Chemical. Chemical Week. 16th May 2013. http://www.downstreamtoday.com/news/article.aspx?a_id=39448

[13] In Chinese:"有序推进煤炭转化示范工程建设，推进煤炭液化示范工程建设"

[14] Liu Fangbing. Unusual rise of coal chemical in the 11th FYP[J]. China Petroleum and Chemical Industries. 2011(2): 31-33

[15] Yin Yao, Ren Huibin. Coal-to-Liquid" becomes a realistic choice for energy security under high oil price, Liao Wang Magazine, 2008. http://lw.xinhuanet.com/htm/content_3410.htm

[16] "From energy security to profit driven: coal-to-Liquid deployment speeds up and intensifies" New Financial Observer, 7 April 2013, http://biz.cn.yahoo.com/ypen/20130407/1693469.html

Nearly Thirty Years of Coal Mining have Caused the Ulan Moron River, a Class-A Tributary of the Yellow River, to Run Dry Several Times This is an image of Shenhua Group's Bulianta Coal Mine in Ulan Moron. ©Greenpeace/Bo Qiu

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The Shenhua Group

Ordos Coal-to-Liquid Demonstration Project

Shenhua Group is China's largest coal conglomerate, a domestically listed company and number 178 on the world's Fortune 500 list. In 2012, it produced 460 million tons of raw coal that generated 344 billion RMB of revenue, of which 76.8 billion RMB was profit. Its main operation is at the Shendong mining zone, which produced 230 million tonnes of coal in 2012, or 6.3% of China's total coal production. This is also where the Shenhua Ordos Coal-To-Liquid Project is located.

Thirty years of mining led by Shenhua in the Shendong mining zone has resulted in serious and irreversible environmental damage, including widespread land subsidence, significant flow reduction of Ulan Moron River, a Class-A tributary of the Yellow River, and depletion of groundwater in the region. An increasing number of local residents have been affected leading to repeated protests and migration.

Despite pronounced environmental and social concerns, the local government and Shenhua Group still decided to move forward with the Ordos Coal-to-Liquid Project. But they immediately faced the first hurdle – there was a clear mismatch between the high water demand by the project and the available local water resources, which had been depleted due to long years of extraction and pollution from the mining operations. To tackle that, Shenhua decided to construct a 100-km pipeline to extract groundwater from beneath the grasslands in another region. And in doing so, Shenhua had spread and exacerbated the environmental crisis in the region.

Since 1985, Shenhua has engaged in coal mining along the river in the Ulan Moron area, in the border area between Shaanxi and Inner Mongolia, and this mining contributes to more 50% of the group's production in 2012.

Thirty Years of Coal Mining by Shenhua and the Environmental Consequences

The Shendong Coal Field is currently the largest integrated coal field in terms of proven reserves and makes up 1/4 of the national total. It is one of the world's eight largest coal fields and contains both the Shendong and Shaanbei coal bases. It stretches across Shaanxi, Inner Mongolia and Shanxi in a transitional zone between the Mu Us desert and China's loess plateaus. The climate here is dry and harsh. The field has a total area of 31,200 square kilometers and has proven reserves of 223.6 billion tons.

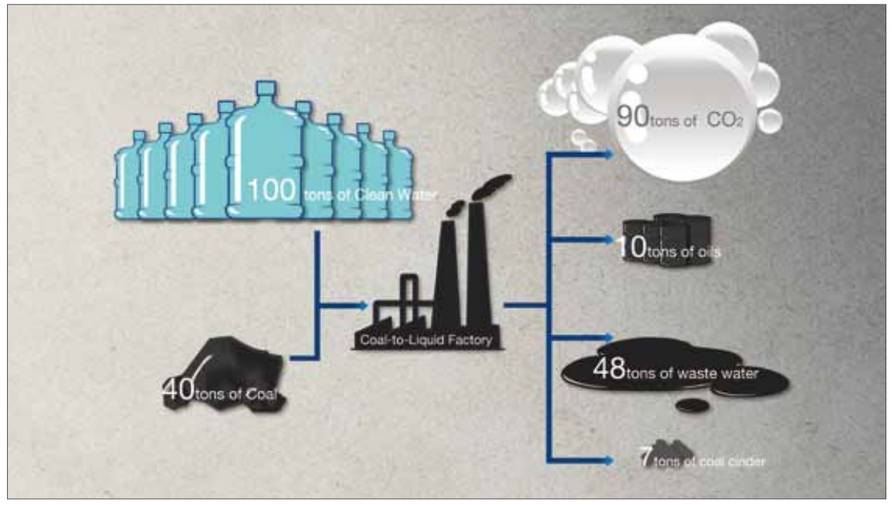
The Shendong mining zone is located in the center of the Shendong coal field and was one of the first discovered as well as the currently most productive. In 1985, the government invested more than 89 billion RMB in the Shenhua Project in order to make up for coal shortages faced by Chinese industry. Large-scale mechanized excavation began in the Ulan Moron and Daliuta regions along with the construction of power plants, railways and ports. In 1995, the Shenhua Group was founded. In 1998, the Shendong mining zone produced 7.13 million tons of coal and by 2004, this amount had increased to 85.75 million tons. In 2012, this number had reached 230 million tons, or 6.3% of China's total coal production. This comprised a full 50% of Shenhua's production. From 1998 to now, the company's coal production has expanded at 28.3% on an annualized basis.

However, the result of this "coal boom" has been that in the short span of 30 years during which the Shendong mining zone was being mined, severe damage was inflicted on the environment and water resources in the region. The Shenhua Remote Sensing Prospecting Co., Ltd. issued a document in 2008 that concluded there was surface damage covering an area of 180 square kilometres of the Shenhua mining zone. Sinkholes, cracking, shifting and deformation of the land due to mining had resulted in damage to vegetation over an area of 17,700 hectares, including 6,267 hectares of key farmland. It also caused damage to underground aquifers and aquacades as well as a decrease in surface runoff, a fall in groundwater levels and the drying up of springs. The large amount of waste earth produced resulted in serious topsoil loss and exacerbated soil erosion to the degree of 45.14 tonnes/year with an additional 20.19 tonnes of loess silt per year. 20,000 hectares of land have experienced desertification.[17]

[17] Meng, Jianghong. Environmental Problems Due to Mining in the Shedong Region and Overall Prevention Measures [J]. Coal Field Geology and Propsecting, 2008. 36(3): 45-51

Between 2001 and 2010, a total of 4,175 households (12,011 people) have been forced to move due to sinkholes resulting from mining operations.[18]

Meanwhile, large-scale uninterrupted development along the Ulan Moron River, a Class-A tributary of the Yellow River, has resulted in a rapid decrease in the runoff of this river. The main branch has run dry several times and many of its tributaries have dried up completely. Research by the Yellow River Conservancy Commission of the Ministry of Water Resources has shown that, coal mining was the main reason for an average decline in the water resources of the Ulan Moron River of 2.9 $\times 10^8$ cubic metres between 1997 and 2006. The research attributed 54.8% of the runoff reduction to coal mining. For 1 tonne of coal mined, 5.27 cubic metres[19] of runoff is affected.



The water consumption, energy consumption and industrial waste discharge levels of direct coal liquefaction

Coal-to-liquid Technology: Highly water-intensive and highly polluting

Coal liquefaction technologies fall into 2 main categories: direct and indirect liquefaction. Due to the amount of water and energy required, as well as the technical challenge of processing resulting wastewater, both processes are hotly debated within and outside the industry.

Studies show that direct coal liquefaction (DCL) requires 3-4 tonnes of coal as feedstock to produce 1 ton of oil, while indirect coal liquefaction (ICL) is even higher. For every tonne of oil produced using direct coal liquefaction, 10 tonnes of water is used along with 9 tonnes of carbon dioxide, 4.8 tonnes of wastewater and 0.7 tonnes of solid waste.[20] Meanwhile, indirect liquefaction requires 14 tonnes of water for each tonne of oil produced and releases 10 tonnes of carbon dioxide into the atmosphere.[21] Another industry source shows that water use can be as high as 17 tons.[22]

Coal to...	Coal consumed (ton of coal/ton of chemical)	Water consumed (ton of water/ton of chemical)	Electricity consumed (KWh/ton of chemical)	Carbon Emissions(ton of CO2/ton of chemical)	Unit cost production (RMB/per ton of chemical)
Methanol to Olefin (MTO)	7 - 8	50 - 60	1500 - 2000	10 - 12	6000 - 7000
Methanol to Propylene (MTP)	8 - 9	36 - 45	2200 - 2500	10 - 12	7000 - 8000
Oil (Indirect Method of Production)	4 - 5	15 - 17	300 - 400	7 - 10	2200 - 3200
Natural Gas	3.5/1000m³	6 - 10/1000m³	200-300/1000m³	>10/1000m³	1000 - 1200/1000m³
Methanol	2 - 3	12 - 15	300 - 400	3 - 4	1300 - 1700
Dimethyl ether	3 - 4	14 - 18	500 - 600	4 - 5	2000-3000

Diagram 3: Comparison of different coal chemical processes. Source: Credit Suisse

[18] Bian, Chaoxia; Wang, Haiyan. Efforts in Harmonious Development by Shenmu County and Shendong Corporations. Shendong County Government Website, http://www.sxsm.gov.cn/news/shenmuxinwen/201305/t20130528_150829.html. 2013-05-28

[19] Jiang, Xiaohui; Gu, Xiaowei; He Hongmou. The Impact of Coal Mining on the Water Cycle of the Kuye River Basin [J]. Natural Resources Journal, 2010, 25(2): 300-306.

[20] Lei, Shaocheng; Zhang, Jiming. Analysis of the Environmental Impact of the Coal-to-liquid Industry. Shenhua Technology, 2009, 7(3): 84-88.

[21] Wang, Jiming. The Present and Future of China's Modern Coal Chemical Industry [J]. Modern Oil and Petrochemical, 2012, 212(8): 1-6.

[22] Zhang Zhihong Credit Suisse, "Update on coal energy and coal energy industry", A power point presentation, May 30, 2013, Shenzhen. In Chinese.

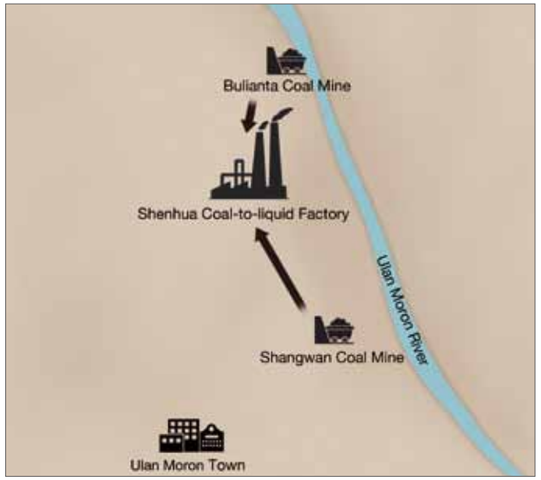
Compared to traditional refining processes, direct coal liquefaction uses 12-16 times the amount of fresh water and produces 14 times the amount of carbon dioxide.[23] What's worse, these calculations only focus on the core techniques used in coal-to-liquid processing and not including water used by associated projects like coal power plants and coal washing /selection plants.

The planning and implementation of industry projects with such a high water intensity and high level of pollution in areas with severe water scarcity and fragile ecosystems is a policy that cannot be sustained.

The Ordos Coal-to-liquid Project: Going to the extreme for water already in Phase 1

In August 2004, construction began on the Shenhua Coal-to-Liquid Project in Ordos. The project is located in the village of Majiata, in the township of Ulan Moron in Elgin Horo county, Inner Mongolia. Ulan Moron shares a border with Daliuta Township in Shaanxi Province and both are on the banks of the Ulan Moron River, a Class-A tributary of the Yellow River. The demonstration project is located literally across the street from its main source of coal, Shenhua's Bulianta mine and only 6 kilometres from the Shangwan mine.

The project has two phases and would ultimately be able to produce 5 million tonnes



Shenhua's Coal-to-Liquid project uses coal from the Shenhua Bulianta Coal Mine and the Shenhua Shangwan Coal Mine

[23] Lei Shaocheng; Zhang, Jiming. Environmental Impact Analysis of the Coal-to-liquid Industry [J]. Shenhua Science and Technology, 2009, 7(3): 84-88
Wang, Jiming. The Current State and Future of China's Modern Coal Chemical Industry [J]. Modern Oil and Petrochemical, 2012, 212(8): 1-6

The Shenhua Ordos Coal-to-liquid Plant ©Greenpeace/Bo Qiu

of petroleum products every year, including diesel, naphtha and liquefied petroleum gas. Supplementary products include industrial crude phenol and industrial sulfur. Phase One planned for three production lines with a total production capacity of 3.2 million tonnes per year. In December 2008, the first production line, with production capacity of 1.08 million tonnes went into operation and became China's only large-scale commercial production using direct coal liquefaction technology. In February of 2010, the Shenhua Coal-to-Liquid Project obtained an operational license to sell refined oil products. In 2012 the total volume of products produced by the Shenhua Coal-to-Liquid Project was 860,000 tonnes.

In addition to the 1.08 million tonne/year direct coal liquefaction production line, the Shenhua Coal-to-Liquid Project also includes an indirect liquefaction facility capable of producing 180,000 tonnes of product per year. Construction began in August 2007 and the project went into operation December of 2009. The project is very capital intensive with costs of 1 billion RMB. Products include liquefied petroleum gas, naphtha and diesel.

ENERGY DEMAND

To power the energy intensive process, additional facilities associated with the coal-to-liquid plant include an internal power generation plant owned by the Shenhua Shendong Electric Company. Plans for the project include eight boilers and five turbines (8×440t/h+5×100MW) as well as 3×6B+1×60MW gas/steam combined cycle units (3×40MW+1×60MW) for power production. Total capacity thus reaches 680MW. The first phase will include three boilers and two turbines (3×440t/h+2×100MW) and three 3×6B combined cycle units (3×40MW). Construction began on October 15, 2005 and the power plant began producing electricity in 2007.

WATER DEMAND

As discussed in the last section, the project requires a massive amount of water for its operation. According to Shenhua's own environmental impact report, the core installation of first production line alone requires at least 6.65 million tons of water per year.[24] However, the Ejin Horo county government claimed that this production line withdraws as much as 10 million tons of water per year[25].

THE WATER EXTRACTION AND 100km PIPELINE PROJECT

Over the past thirty years, the Shenhua Group has carried out uncontrolled large-scale, mechanized mining operations in this area that have resulted in a rapid decline in both surface and ground water resources that now could not have supported a highly water-intensive project like coal-to-liquid production.

To secure the water needed for its liquefaction operations, Shenhua Group started large-scale well drilling operations in the Haolebaoji region of the Mu Us desert basin, 100 kilometres from its project base. Extraction of this precious water source, on which the grasslands and local farmers depend to survive, began in 2006. In 2012, Shenhua extracted 14.4 million tons of water[26], leading to a whole host of serious environmental and social problems. The second section of Chapter 2 will discuss them in more detail.

FUTURE EXPANSION PLAN IN ORDOS, AND EXPECTED WATER DEMAND

Despite the high risk, high capital investment and high environmental damage inherent to coal-to-liquid projects, the Shenhua Group plans to expand current production capacity even further. In December 2011, the Shenhua Coal-to-Liquid Company began construction of a new 2 billion cubic metres/year Coal-to-Synthetic Natural Gas (SNG) project next to the current plant, which would require as much as 13.23 million tonnes of water per year.[27] In December 2012, initial work, including environmental impact assessment, began for the second and third production lines of Phase One of the Shenhua Coal-to-Liquid Project. Production capacity of these new lines is expected to reach 2.12 million tonnes/year by 2016.

Conservative estimates show that by 2016, the water demand of the three production lines of Phase One of the Shenhua Ordos Coal-to-Liquid Project will reach 40.68 million tonnes/year, three times the current levels. This is nearly twice the maximum design capacity of the water extraction project in the Haolebaoji region.[28] It is very likely that water will be extracted from Yellow river to make up for deficiencies.[29]

According to internal plans from Shenhua Group, a second phase with a production capacity of 1.8 million tons/year will be added to the current coal-to-liquid project before 2020. This will also include a 300 megawatt coal-fired power plant. After its completion, water requirements will further increase to 53.63 million tons/year.

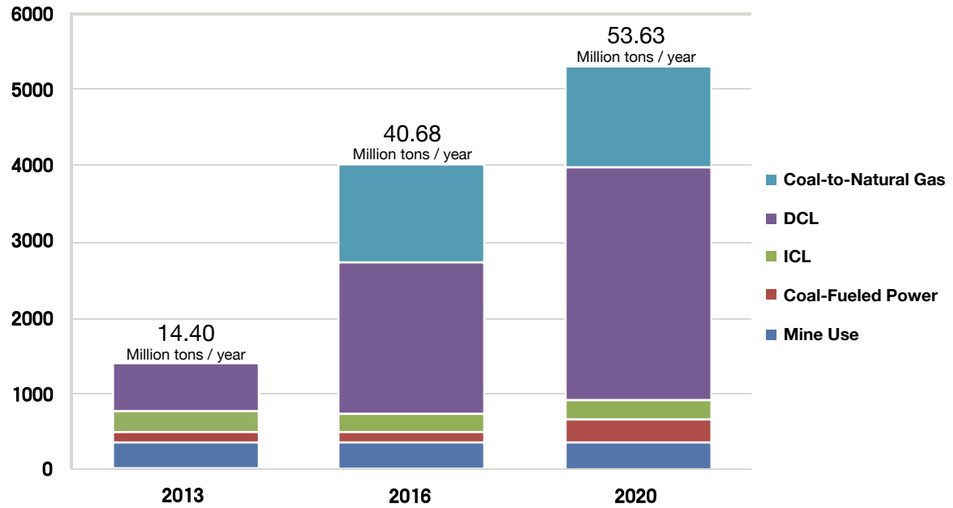


Table: Current and Expected Annual Water Requirements of the Shenhua Ordos Coal-to-Liquid Project

[24] Liu, Baojun; Guan, Xiaofang. Economic and Technical Analysis of Water Supply and Waste Water Recycling at the Shenhua Coal-to-liquid Plant. Inner Mongolia Environmental Protection, 2003, 15(3): 24-27.

[25] Ejin Horo County Business Bureau, Introduction of Shenhua Coal Liquefaction Project. Xinhua Inner Mongolia http://www.nmg.xinhuanet.com/nmgwq/2009-12/03/content_18402394.htm. 2009-12-03

[26] Xiong, Jing. Inspection of Water Resources in Uxin Banner by Municipal Party Committee Member and Deputy Mayor Gong Bingxiang. http://www.wsq.gov.cn/tpws/201306/t20130608_877738.html. 2013-6-8

[27] Shenhua Group Journal. Editing Committee, Shenhua Group Journal (Chinese) [M]. Beijing: Coal Industry Press. 2012:500

[28] Qu, Jianhua; Hua, Haizhong; Liu, Jianxing; et al. Project Design for External Water Supply, Industrial-Use Water and Waste Water for the Shenhua Direct Coal Liquefaction Project. 2008, 39(5): 50-52.

[29] Achievements of Water Infrastructure Construction in Uxin Banner. Ordos People's Government Website http://wap.ordos.gov.cn/xxgk/zwyw/qqdt/201111/t20111108_514940.html

	Project Name		Per Unit Fresh Water Usage	Annual Water Usage	Total Annual Water Usage
2013	Completed	1.08 million tons/year of direct coal-to-liquid (phase one, first production line)		6.65 million tons	14.4 million tons
		180,000 tons/year of indirect coal-to-liquid	14 tons[30]	2.52 million tons	
		200 megawatt coal-fired power production unit	0.30 $m^3/s \cdot GW$	1.23 million tons	
		Shendong Mining Zone Residential Water Use	1.0 m^3/day[31]	3.6 million tons	
2016	Initiated (environmental impact assessment underway)	2.12 million tonnes/year direct coal-to-liquid (phase one, second/third production lines)		13.05 million tons	26.28 million tons
		2 billion cubic meters/year of coal-to-natural gas		13.23 million tons	
	Total Volume of Water Demand in 2016				**40.68 million tons**
2020	Planned	1.8 million tons/year direct coal-to-liquid (phase two)		11.1 million tons	12.95 million tons
		300 megawatt coal-fired power production unit	0.30 $m^3/s \cdot GW$	1.85 tons	
	Total Volume of Water Demand in 2020				**53.63 million tons**
Haolebaoji	Theoretically Extractable Water Resources (per year)				28.8 million tons
	Maximum Design Capacity of Shenhua's Water Extraction Facility (per year)				20.88 million tons
	Shenhua Water Extraction License[13] (per year)				18 million tons

Table: Current and Expected Water Requirements of the Shenhua Ordos Coal-to-liquid Project
Note: Haolebaoji is located in Uxinzhao Township, 100 kilometres west of the Shenhua Coal-to-Liquid Project. This is currently the only source of fresh water for Shenhua.

[30] Wang, Jiming. The Current State and Future of China's Modern Coal Chemical Industry [J]. Modern Oil and Petrochemical, 2012, 212(8): 1-6

[31] Yan, Ru. Connection of New Water Resources from Haolebaoji to the Mining Zone Completed. Official Website of the Shenhua Shendong Coal Group. http://www.shendong.com.cn/sdhtml/gongsixinwen/shendongxinwen/shendongyaowen/2012/0131/7130.html. 2012-01-31

Shenhua Ordos Coal-to-liquid Facility Image ©Greenpeace/Bo Qiu

Shenhua Group plans for coal-to-liquid projects in Ningxia and Xinjiang

Most of China's coal production is carried out in the arid or semi-arid central and western regions of the country. However, how much and when water resources are used must be examined and irresponsible coal chemical will directly impact local social and economic stability as well as environmental protection.

However, despite this, the Shenhua Group has already obtained permission to start construction on a 4 million tonne/year coal-to-liquid project in the Ningdong region of Ningxia Province. In addition to this, a 3 million tonne/year coal-to-liquid project has already begun construction near Urumqi in the Xinjiang Uighur Autonomous Region. According to internal reports from the Shenhua Group, under the 12th five year plan, by 2015 Shenhua will produce 3 million tonnes of petroleum products, 5 million tonnes of chemical products and 1.8 billion cubic metres of natural gas. By 2020, petroleum, chemical and natural gas products will reach a volume of 11 million tonnes and 10 million tonnes, and 1.83 billion cubic metres respectively. [32]

[32] Shenhua Group Plans under the Twelfth Five-Year Plan, 2010.

2013年4月27日 中国 内蒙古鄂尔多斯 乌审旗 浩勒报吉农牧区 这里原来是湖泊，现在都干涸了。©Greenpeace/邱波

2

Shenhua's Water Grab in Haolebaoji:

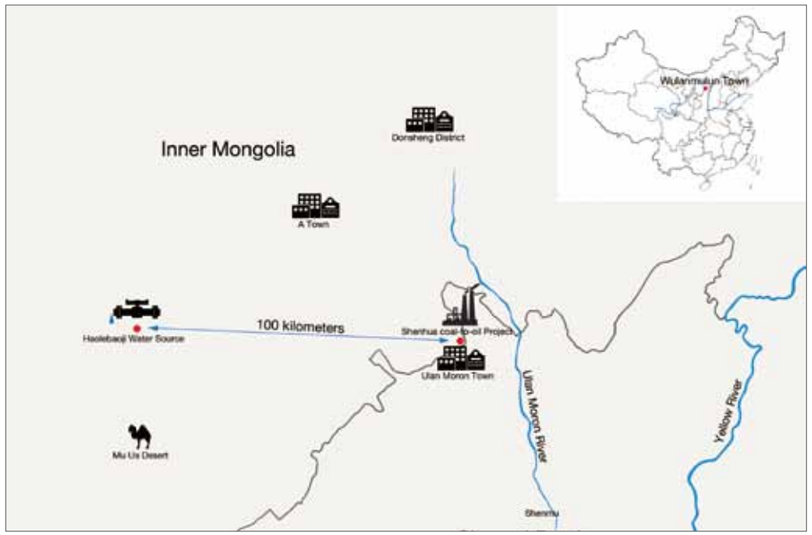
ecological disaster, social unrest

The Haolebaoji agricultural and grazing region 100 kilometres to the west is an important source of water within Inner Mongolia's Mu Us desert region. Water in the area has been relatively abundant. However, since the Shenhua Group chose this place as a water source for its coal-to-liquid project in Ordos and began extracting water on a large-scale in 2006, the local ecosystem has seen rapid decline. Groundwater levels have dropped dramatically and there has been widespread loss of vegetation like salt cedar trees and yang chai. The extent of desertification has also increased, with the area of Subeinaoer Lake in the center of the region shrinking by 62%. Local farmers and herders are powerless to protect their water and have been forced to decrease the amount of land they farm. The number of animals they raise has also declined. Sometimes even drinking water is scarce. The destruction of this basic resource has caused strong objection among local residents and social stability has been seriously affected.

Water Extraction: 22 mechanized wells extract groundwater, used over 100 kilometers away

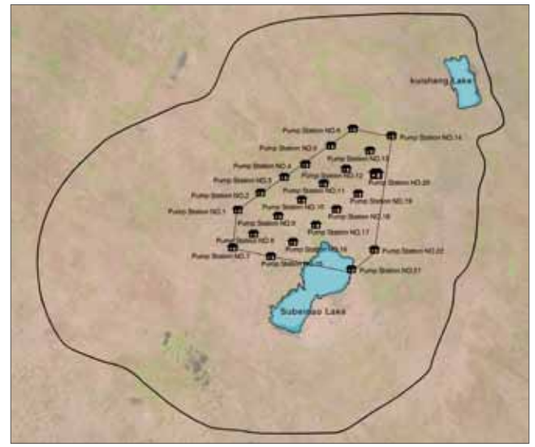
In the area surrounding the Shendong mining zone where the Shenhua coal-to-liquid plant is located, surface and ground water have been completely used up and there is no water to be found.[33] This is why Shenhua decided to implement large scale drilling projects in the Haolebaoji region, taking groundwater from the grasslands of that region, then piping it to their coal-to-liquid facilities.

Haolebaoji is located in the northern part of Uxin county in Inner Mongolia at the intersection of Uxin county, Hanggin county and Ejin Horo county, 100 kilometres from Shenhua's coal-to-liquid plant. The affected region covers are total area of 80,000 hectares, which includes 2,333 hectares of irrigated farmland and 77,300 hectares of grazing lands. This includes five villages: Haolebaoji, Bahannao, Adaohai, Zhongnai and Chahanmiao,[34] which currently contain 2,402 households and a total population of 5,752.



The Haolebaoji area, located in Mu Us desert is 100km from the Shenhua Coal-to-Liquid Project

Haolebaoji is located in the heart of the Mu Us desert. It has a pronounced continental highland climate with an average annual rainfall of only 346.2mm and an evaporation volume of 2,253.8mm. However, in the Mu Us desert region, the groundwater resources contained within Haolebaoji have been relatively plentiful. According to reports from the China Geological Survey, underground water resources cover an area of 50 square kilometres in a relatively closed basin formation. The surrounding land formations are higher on all sides and the groundwater collects in Subeinaoer Lake naturally. This forms a closed drainage basin with extractable water resources estimated at 80,000 cubic metres/day.[35] However, as the geological formation is relatively closed, 76% of groundwater recharge is dependent on rainfall. Lateral recharge is rare and water levels are difficult to restore after they have fallen. This is why the devastation caused by extraction will be difficult to reverse[36].



Shenhua's Coal-to-Liquid project relies on 22 deep wells in the Subeinaoer Lake Basin for its water supplies

[33] Liu, Baojun; Guan, Xiaofang. . Economic and Technical Analysis of Water Supply and Waste Water Recycling at the Shenhua Coal-to-liquid Plant.. Inner Mongolia Environmental Protection,2003 , 15(3): 24-27

[34] The villages of Haolebaoji, Bahannao, Adaohai and Zhongnai were originally part of Haolebaoji Township, but were later incorporated into Uxinzhao Township.

[35] Hou, Guangcai; Zhang, Maosheng; et al. Prospecting Research of Groundwater in Ordos [M]. Beijing: Geological Press. 2008: 234-235

[36] Wang, Wanli; Yang, Guangyuan; Wang, Guiling. Numerical Simulations of Groundwater Flows in Haolebaoji & an Evaluation of the Impact of Mining on the Environment. South-North Water Transfer Science and Technology. 2010. 8(6): 36-41

A Shenhua pump in Haolebaoji. Grass coverage around it has clearly declined due to the drop in groundwater levels. Shallow wells have been abandoned. Animal husbandry has been greatly affected. ©Greenpeace/Bo Qiu

DISPARITY BETWEEN COMPANY, OFFICIAL AND LOCAL REPORTED WATER CONSUMPTION FIGURES

- COMPANY: According to Sinopec Engineering Design Co. Ltd., the designer of the water extraction facility for Shenhua's Coal-to-Liquid Project, 22 wells were designed for the extraction facility with a maximum extraction rate of 58,000 cubic meters/day, with an initial operating rate set at 30,000 cubic metres/day.[37]

- LOCAL GOVERNMENT: According to the Uxin county Government, the current water extraction volume for the Shenhua direct coal liquefaction project is 14.40 million tonnes/year or 40,000 cubic metres/day. (Another document released in 2004 by the NDRC (NDRC Resources 2004-#1734), original plans called for 36 wells with a maximum extraction capacity of 90,000 cubic metres/day.

- LOCALLY REPORTED: A 2011 recommendation issued by the local-level People's Congress reported that Shenhua drilled 21 wells between 2007 and 2010, each over 300 metres deep for a total extraction volume of 22.92 million tonnes.[38]

- Another local People's Congress recommendation jointly signed by ten individuals in 2013 claimed that the Shenhua direct liquefaction project has extracted 50 million tonnes starting from 2007. [39]

[37] Qu, Jianhua; Hua, Haizhong; Liu, Jianxing; et al.. Project Design for External Water Supply, Industrial-Use Water and Waste Water for the Shenhua Direct Coal Liquefaction Project.. 2008. 39(5): 50-52

[38] 2011 Recommendation #49: Recommendation on General Relocation of Farmers and Herders in Water Source Area of the Shenhua Direct Liquefaction Project. Ordos People's Congress Website. http://www.ordosrd.gov.cn/dejwcrdh/yajy4/201103/t20110322_296594.html 2011-3-22

[39] 2013 Recommendation #6: Recommendation on Strengthening Management of Water Resources. Ordos People's Congress Website. http://www.ordosrd.gov.cn/dbyd/dbjy/201305/t20130516_855231.html. 2013-5-16

The difference between these two locally reported figures show that since construction began on the Shenhua Coal-to-Liquid Project, the amount of water required by production lines and its internal power generation facility has been enormous. In 2012, the actual amount of water extracted from Haolebaoji is already starting to approach the total designed capacity of the current project and has far exceeded original water usage estimates, and has already severely exceeded the ecological limits for the Haolebaoji region.

WATER LICENSE WOES

Shenhua's Haolebaoji water extraction project began test drilling between March and September 2003 and in April 2005 built their first pump station and laid piping. In May 2006 they officially began extracting water. However, water sources and the rights to use them were not "approved" until January of 2006.[40] And it wasn't until January 2008 that Shenhua officially obtained the water extraction permit.[41] However, when challenged by local residents in Haolebaoji, not only could the local government produce no water extraction licensing documents, they lied directly to the residents saying that the Shenhua direct liquefaction project had "obtained permission for water extraction from all levels of government,"[42] and "the extraction project must go forward."[43] "It has already obtained the right to develop and use water resources within the Haolebaoji region."[44] Construction of a water extraction project prior to approval is an illegal act clearly prohibited by the Water Law and Regulations on Water Extraction Approval and Water Resource Fees.

In addition, the aforementioned regulations require the applicant to submit stakeholder impacts assessment report should the water extraction project affect the interests of any third parties. Before making a decision on the application, relevant departments should be made aware of the relationship between the applicant and the impacted stakeholders.

[40] Shenhua Group Journal. Editing Committee, Shenhua Group Journal (Chinese) [M]. Beijing: Coal Industry Press. 2012:473

[41] The Water Extraction Permit was received on January 15, 2008. Official Website of Shenhua Group Co., Ltd. http://www.shenhuagroup.com.cn/zjsh/zzry/shzz/mhg/index.shtml

[42] Implementation Proposal on Ensuring the Livelihood and Production of People in Haolebaoji under the Shenhua coal liquefaction project. Uxin Banner Letter[2005] #62.

[43] Uxin Banner People's Government. A Letter to the People within the Water Extraction Zone. June 26, 2005

[44] See the "Introduction Pamphlet of the Shenhua Coal Liquefaction Plant Water Extraction Project" issued by the local government to residents of Haolebaoji.

Should the applicant or the impacted stakeholders require a hearing, the relevant department should hold said hearing. Should there be disagreement or litigation related to the application for water extraction permits, the relevant department should advise the applicant in writing that approval procedures have been suspended and will resume after the disagreement has been resolved or litigation has been concluded.

However, local residents say that they were never consulted, neither before Shenhua began illegal construction of its water extraction project, nor during permit application stage after the construction was completed. Local residents even made two official appeals and coordinated several group protests. However, water extraction permits were still approved. In the eight years that extraction has been going on, the residents of Haolebaoji have been furious and petitioned numerous times. However, in January 2013, Shenhua's water extraction permit was swiftly renewed.[45] (See the supplement "A Decade of Fighting: a story of the Ordos grasslands for transcripts from petitions.)

In the cases of water-intensive projects like this one the local government in Ordos has taken GDP growth performance into consideration more than the environment and the people are left with nothing more than anger and helplessness. Reports show that in 2000, when the Ejin Horo county government found Shenhua to "run" a project, they promised that "we'll help you find the water."[46] The blatant negligence of ecological limits and the environmental carrying capacity by local governments, who make decisions at the drop of a hat, blindly providing business with all the water they need, is one of the root causes of the environmental and human tragedy we see in Haolebaoji.

WORRYING FUTURE

Shenhua is planning a second and third production line for its coal-to-liquid project as well as a 2 billion cubic meter/year coal-to-natural gas project. After completion in 2016, the total amount of water required by the Shenhua coal-to-liquid plant will be three times the current level, far exceeding the 58,000 cubic metres/day designed maximum of the Haolebaoji location. The fragile ecosystem and the lives of local farmers and herdsmen in this region face utter destruction.

[46] Propaganda Department, Ordos City, Inner Mongolia. The Ordos Plateau: home of the clouds. Wenming.cn http://archive.wenming.cn/zt/2010-04/28/content_19645857_9.htm. 2010-04-28

Consequences of Shenhua's Water Grab: desertification of Ordos' grasslands, farmers livelihood on the brink

In the short span of eight years of operations, the over extraction of water, "the water grab" to drive Shenhua's Coal-to-Liquid Project has already caused alarming and widespread ecological and social damage. In response to the environmental issues and difficulties faced by residents in the Haolebaoji area, Greenpeace traveled within the region eleven times between March and July 2013 to carry out in-depth on-site surveys. The results are as follows:

(1) The Water is Gone - groundwater levels on the grasslands fell at dramatic rate

The depth of wells constructed as part of the water extraction project for the Shenhua Ordos Coal-to-Liquid project on average exceeds 300 meters. The 22 wells are capable of extracting 40,000 cubic meters of water per day.

Related research at the time showed that an extraction volume of 8×10^4 cubic meters / day and a recharge volume of 12.20×10^4 cubic meters/day, in the decade after 2009, would cause the groundwater level in the Subeinaoer basin to decline at a rate of 2.8 meters per year and the maximum drop over a 15 year period would be 32 meters.[47] The Inner Mongolia Second Hydrogeology Engineering Geological Prospecting Institute, which designed this extraction project, reviewed their survey findings in 2012, saying that local groundwater levels in the Haolebaoji region had recently seen considerable drops, between 5-10 meters.[48] After multiple visits to the region, Greenpeace found that the actual changes in water levels and the overall impact were both far worse than original estimates released a decade ago.

Eight years after the project went into operation, we observed that within the area surveyed, wells that local residents rely on for their daily needs, which are generally less than 30 metres deep, had mostly been abandoned because of severe drops in groundwater levels. This has affected five villages with a total population of 5,752. Interviews with local residents indicated that groundwater table may have dropped by as much as 100m in some parts: Local farmers and herdsmen say that in the 1970s there

[47] Wang, Wanli; Yang, Guangyuan; Wang, Guiling. Numerical Simulations of Groundwater Flows in Haolebaoji & an Evaluation of the Impact of Mining on the Environment. South-North Water Transfer Science and Technology. 2010. 8(6): 36-41

[48] Wang, Cunliang; et al. Succession Models and Succession Process Evaluation for Vegetation in the Subeinaoer Basin under Groundwater Extraction Conditions. Anhui Agricultural Journal. Vol. 40, No. 11, 2012.

Children from a herder family playing next to an artesian well ten years ago in the water extraction region used by the Shenhua Coal-to-Liquid Project.

Ten years ago this old well would shoot water as high as a man, but after Shenhua began water extraction, it went completely dry and the surrounding land has turned to desert. ©Greenpeace/Bo Qiu

were many artesian wells, but these have all run dry now. New wells need to be at least 100 metres deep to ensure a steady water supply .[49]

(2) The Lakes are Dry: shrinking of surface water

The drop in groundwater level is directly reflected in the change in size of Subeinaoer Lake. Subeinaoer Lake is located at the bottom of the basin and is a discharge area for phreatic aquifers. Changes in the surface of the lake are a direct reflection of the changes in groundwater levels. Estimates show that if water extraction is carried out at 80,000 cubic metres/day for 30 years,

Worry among Haolebaoji Residents about the Water Extraction Project

"36 wells were drilled between March and October 2003. Every time a test drill for a well was conducted, the water levels in artesian wells, irrigation wells and drinking wells used by residents and animals went down. Water used for irrigation and daily life were seriously impacted. When test drillings for these 36 wells were being done, statistics and estimates showed that inflow levels in the area had declined by 20-30 meters. This threatened the existence of some 4,000 residents and 60,000 animals. It also affected the health of irrigated farmland, grazing land and forests in the area. The region in which we live is a semi-arid desert region and while prospecting programs by the government show there to be rich groundwater resources, the close relationship between surface and ground water, and the relatively lack of the former, mean that life in this region is especially dependent on groundwater."

—— Petition by a Resident of Haolebaoji, June 2006.

Note: The number of wells drilled during the prospecting phase was even greater, different from the number of extraction pumps in operation phase.

[49] Based on interviews of local residents during the on-site investigation. They said they used to be able to get water from wells less than 20m deep, but those wells are all dry. Now they need to pay the engineers to drill down 100m before they get water, in some cases the wells even need to be 150m deep to ensure stable water supply.

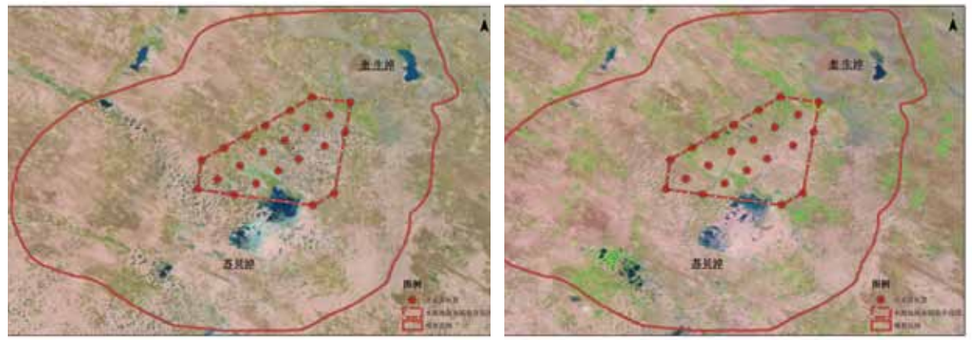
The Shenhua water extraction project has resulted in continued drops in water levels in villages. Existing shallow wells have all run dry. There are seven drilling teams in Uxinzhao that drill over 400 deep wells a year. ©Greenpeace/Bo Qiu

Gradual declines in water levels of Subeinaoer Lake make it necessary for salt farms along its shores to extract groundwater to replenish the lake and keep it from going completely dry. ©Greenpeace/Bo Qiu

the inflow volume of Subeinaoer Lake will drop from an initial estimate of 2,113.61 × 10^4 cubic metres/year to 302.76 × 10^4 cubic metres/year. This will cause the water level of the lake to drop 0-5 metres. From this, we can predict that the area of Subeinaoer Lake will gradually shrink. [50]

During our surveys, Greenpeace found that as early as ten years ago, Subeinaoer Lake had already been used as a salt farm. Now, due to the drop in water levels, the lake has now split in to a northern part and a southern part, making salt making even easier. Now, in order to ensure that the lake can continue producing salt, salt farms extract groundwater from wells to recharge the lake, preserving the water levels to ensure that it doesn't go completely dry. With the exception of the areas where salt is produced, sections that represent an ecologically functional water area are extremely limited.

Despite this, satellite images from 2011 show that compared with water levels in



August 26, 2004 **July 30, 2011**

Between 2004 and 2011, satellite remote sensing maps show that the areas of Subeinaoer Lake and Kuishengnao Lake near the water extraction project (within the circle) have declined rapidly.

2004, before Shenhua began extracting groundwater, the lake had shrunk by 1.27 square kilometres, or 62%. One of the herder families living near the lake said that water levels on the west side of the lake had gone down considerably and low-lying areas that

[50] Wang, Wanli; Yang, Guangyuan; Wang, Guiling. Numerical Simulations of Groundwater Flows in Haolebaoji & an Evaluation of the Impact of Mining on the Environment. South-North Water Transfer Science and Technology. 2010. 8(6): 36-41

had been full of water in the past were now dry and that two thirds of farmland had been abandoned.

At the same time, the number of seasonal rivers and lakes in the region has declined and the famous "Sandy Sea" in the heart of the extraction zone has become a "Dry Sea" according to locals. The wetlands are gradually disappearing.

(3) The Sand is Coming – mobile sand dunes indicates advance stage of desertification of grasslands

The water extraction zone of the Shenhua Coal-to-Liquid Project is part of the Mu Us desert. In modern times, mainly semi-permanent sand dunes and seasonal rivers and lakes have characterized this area. There were generally good soil water level along the lakes and rivers as well as between the sand dunes. Vegetation cover was high and moving sand dunes were rare. It has long been an ideal place for farming and grazing. With the rapid decline of groundwater levels, the natural and planted vegetation that covered the sand dunes has disappeared on a large scale, causing the sand dunes to become mobile. Large stretches of mobile sand dunes have formed and are expanding rapidly.

Our survey shows that water in low-lying areas, the banks of rivers and around lakes was originally plentiful, but in places where wind-blown sand and sediment were greater, mobile sand dunes were more common. These areas were originally also good grazing and farming areas and their desertification has had a direct impact on the farming and herding industries.

The Mu Us desert is one of the major sources of northern China's dust storms and in recent years has been a key focus of controlling this phenomenon through ecological programs. Our survey shows that with the large-scale extraction of groundwater, large expanses of manually planted trees and brush have died and desertification has picked up again.

(4) Surface vegetation die off

The Haolebaoji region is interspersed with semi-brush grass-like vegetation, wetland grasses and trees. In different areas, constructive species include poplars, willow trees, sand willow, sagebrush, ningtiao (*柠条*, caragana microphylla), jijicao (*芨芨草*, achnatherum splendens), Indian aster, bugseed and sedge. Of these, sand willow, jijicao, Indian aster and taicao (*苔草*) are incapable of surviving if groundwater levels fall below 8 metres. Once vegetation in a sandy region is damaged, it takes a long time before it can be restored. As will be explained in the fifth section of this report , the region in which these water resources lie is the site of a number of

Large-scale water extraction has resulted in increasingly mobile sand dunes and expanded desertification. ©Greenpeace/Bo Qiu

The emergence of active sand dunes and mobile sand dunes is encroaching on existing grassland vegetation. ©Greenpeace/Bo Qiu

national and regional sand control projects. This puts the actions of the Shenhua Coal-to-Liquid Project, which lead to the decrease in vegetation, in direct conflict with the aim of these policies.

Between March and June, 2013, we found that:

- In the eastern portion of the extraction zone, large amounts of manually planted poplar trees, sagebrush and yang chai (羊柴) have died off. This eastern section is a classic example of bedrock tableland. Nearly 30% of poplar trees have died off, while the remaining trees are withering. Meanwhile, 60-70% of the yang chai (羊柴) in the woods have died off.
- Most of the poplar forests in the northern agricultural areas that had been planted to stop the spread of sand have died off. Wetlands and marshes have decreased in size considerably and seasonal rivers have disappeared. The aquatic ecosystem has all but wiped out.
- The amount of yang chai (羊柴) and salt cedar in the south and west have also died off. Grazing grasses and production of biomass has dropped off considerably.

(5) The People are Desperate - farmers and herders fall on hard times

In 2005, when the water extraction project began, the government was faced with worry from residents and pledged that a "balance could be achieved between extraction and recharging without any impact on the environment." The government also promised that an entire series of projects would be put in place for drilling, water conservation and reuse, drinking water resources as well as assurances of comprehensive irrigation programs. The government further promised that current irrigation water sources would be guaranteed and that drinking water sources would not be affected. Also, that within 5 years, the amount of irrigated land per capita would increase by 3 mu (equals to 0.2 ha).[51]

However, in the end, Shenhua's plundering of groundwater did cause changes in the environment and considerably affected the productivity of the area and livelihoods of residents in the Haolebaoji region, shaking the foundations of the local community. The decrease in water resources led to limited irrigation capabilities, smaller fields and a decrease in production volume. At the same time, the shrinking of grazing land means that grasslands couldn't support as

[51] Notice on Specific Issues regarding Further Ensuring the Livelihood of Residents in the Extraction Zone Haolebaoji Party Office [2005]#53.
Implementation Proposal for Ensuring the Production and Livelihood of Residents in the Shenhua Coal-to-Liquid Project Water Extraction Zone . Uxin CountyLetter[2005]#62

Many of the poplar trees planted by villagers have died off. Most of these have been cut down for firewood. ©Greenpeace/Bo Qiu

Large numbers of saltcedar planted by herders has died off. ©Greenpeace/Bo Qiu

Many of the saltcedar trees and yang chai planted by villagers has died off. There is an old pond at the persons feet, which has completely dried up. ©Greenpeace/Bo Qiu

many livestock, forcing herders to decrease the number of animals they raised. The number of horses and cows continues to fall and there have been rapid decreases in the number of sheep being raised. Our interviews indicate that among herding families, the number of sheep they raise has fallen sharply by over 1/3 and the number of horses and cows kept has fallen by over half.

During interviews with farmers, Greenpeace found that farmlands have shrunk by varying degrees, including a large number of farmlands that have been completely abandoned or that have changed crops because of limited water supplies. At the home of a family not far from the central pumping station, we could see an abandoned field with corn stalks from a few years ago still lying on the ground. The furrows are still very clear, but the field has been abandoned for some time. The nearby well was completely dry.

In 2011 and 2013, the People's Congress of Ordos put forward two proposals that stated the Shenhua water extraction project had already caused local groundwater levels to drop 15 meters, affecting the water levels in 2,163 wells and making irrigation impossible. 458 households engaged in farming and animal husbandry as well as 80,000 livestock were facing serious difficulty. The livelihoods of farmers and herders as well as the state of the environment were in serious danger. There were frequent petitions made by these individuals and the situation was clearly contributing to social instability. (For more stories, see the supplement "A Decade of Fighting: a story from the Ordos grasslands")

A People's Congress representative named Jigeji and ten other individuals called on the People's Congress to work with national agencies to stop the Shenhua Group's use of groundwater in Haolebaoji and protect valuable underground water resources. [52]

[52] Recommendation 2011 #49: Recommendations on General Relocation of Farmers and Herders in the Shenhua Coal-to-Liquid Project Water Extraction Zone. Ordos People's Congress Website, http://www.ordosrd.gov.cn/dejwcrdh/yajy4/201103/t20110322_296594.html. 2011-3-22
Recommendation 2013 #6: Recommendations on Strengthening Water Resource Management. Ordos People's Congress Website. http://www.ordosrd.gov.cn/dbyd/dbjy/201305/t20130516_855231.html. 2013-5-16

There are increasingly fewer wells and corn shoots that have just sprouted are dying because they can't be irrigated. ©Greenpeace/Bo Qiu

Groundwater levels continue to fall and even though local herders continue to dig deeper wells, they're still not sure what the future will bring. ©Greenpeace/Bo Qiu

"A PLEA FOR HELP TO THE SHENHUA COAL-TO-LIQUID PROJECT OFFICE"

I live in the Subai Livestock Cooperative in the village of Chahanmiao, in the very center of six wells dug for the Shenhua Coal-to-Liquid Project (wells #16, #17, #18, #9, #10 and #11).

Prior to 2006, I had 88mu (equals to 5.87 ha) of irrigated land that came from 3 wells. I also raised over 400 sheep, 50 cows and my annual income could be as much as 100,000 RMB. Life was good. Since 2006, and the start of large-scale extraction of groundwater, this area has become increasingly dry and vegetation is dying off. Water levels in the wells is dropping and production levels from my fields has decreased. Starting this year, the well that we use for drinking water has gone completely dry and the well that I use for irrigation can only cover around 10 mu of land.. With drinking water difficult to come by and the dying off of grazing grasses, we are unable to raise livestock and live has become very difficult. The irrigated land I have spent years cultivating is now wasted and the trees I have planted are dead. The loss to me is enormous. This, even with subsidies from the government, is not enough to resolve this situation. As I am unable to maintain a normal life due to these hardships, I beg the company to decrease the damage you are doing and lighten my burden.

—— Local Haolebaoji Resident, 2006

Recommendations on Strengthening Water Resource Management

Ordos Municipal People's Congress Proposal 2013 #6

Water resources in this municipality are scarce with only 1,300 cubic meters per capita. This is lower than both the national and regional averages. Water deficits in terms of resources, structure and engineering characterize the state of water in the region. In recent years, the rapid economic and social development in this municipality have caused extremely serious water shortages. Five villages in Uxinzhao Township, Uxin Banner, including Haolebaoji, are the location of water resources used for the Shenhua Direct Coal Liquefaction Project. This region currently contains 2,402 households (5,753 people) and has a high concentration of ethnic minorities. The designed extraction capacity of the Shenhua Direct Coal Liquefaction Project is 14.4 million tons/year and since 2007 the project has extracted a total of over 50 million tons. **Due to the scale of water extraction, there have been clear drops in groundwater levels. The quality of groundwater has also changed. The water taste saltier and the quantity is insufficient for fulfilling the needs of vegetation. Surface vegetation has died off and some regions have experienced desertification. Drinking water for people and livestock is also severely threatened, increasingly affecting the productive capability and livelihoods of local farmers and herders, who have made numerous petitions on this issues. This has caused social instability and disharmony in the region.**

Ordos is currently experiencing rapid development of its regional economy and there are still a number of industrial projects that will be implemented under the Twelfth Five Year Plan. The conflict between economic development and limited water resources will continue in the long-term and dealing with this problem effectively will be an unavoidable issue for this generation and generations to come. Strengthening the management of water resources, especially groundwater is urgent and pressing. In this respect, we make the following recommendations:

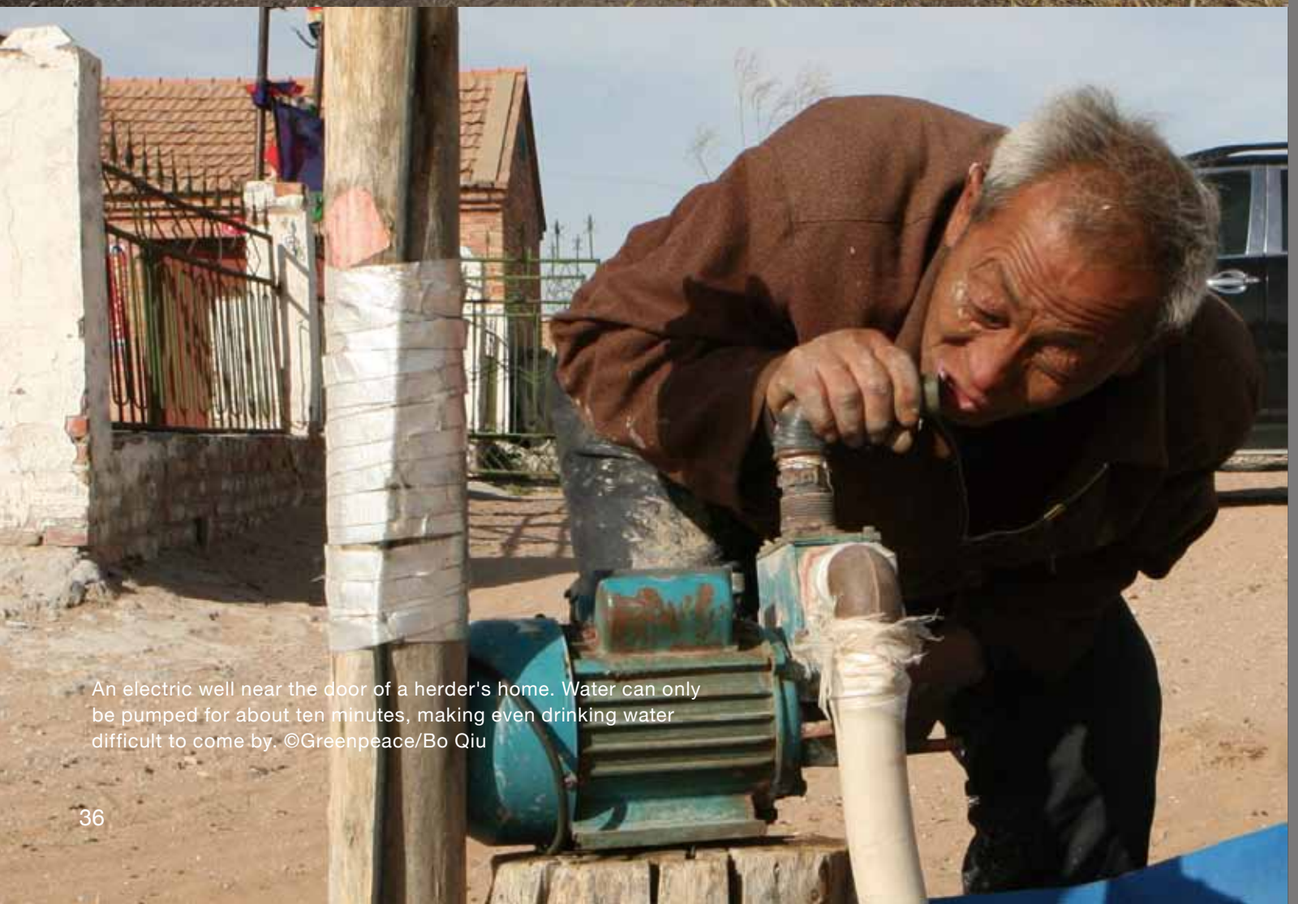
First, based on the current national industrial policies and long-term development needs, reviews of groundwater usage for industrial purposes throughout the municipality must be carried out, in accordance to the "three red lines" of water management policy ("total volume control", "water efficiency control" and "regional limitations on pollution"); higher Yellow River water allocation shall be sought; and water infrastructure projects shall be scaled up. At the same time, **we sincerely request that the municipal government to coordinate with national agencies and the Shenhua Group to work on a solution that would use water from the Yellow River for the Shenhua Direct Coal Liquefaction Project and end the use of groundwater resources in the Haolebaoji region to ensure that valuable water resources are protected.**

Second, we recommend that regions profiting from the use of water resources allocate a portion of those profits to form a water resource compensation mechanism based on ecological compensation mechanisms. This would compensate regions that provide water resources and provide for the relocation of local farmers and herders as well as the conservation of water resources. As the Haolebaoji and Hatoucaidang water sources are of the same drainage system, we sincerely request that the municipal government use the Hatoucaidang relocation policy as a model to ensure the legal rights of the residents living in the surrounding areas are protected, to ensure social stability. We urge the municipal government to include the residents of the Haolebaoji region in the municipal relocation plan for farmers and herders. We also request that the government coordinate with the Shenhua Group to provide relocated farmers and herders with relocation subsidies.

Third, we recommend strengthening the enforcement of water resource regulation, including the collection of fees for water usage, the closing off of groundwater wells and the approval process for new wells.

This proposal is submitted by: Ji'erji, Suyaltu, E'erdeni, Siqingtuya, Saren, Zhao Yongfeng, Mengkedalai, Wulanqiqige, Wang Xiaoqin, Li Ruijiang, Liu Qiang, Liu Zhigang and Yin Yuzhen.

The decrease in groundwater levels has caused the grasslands to retreat. Many herders say the number of sheep they can raise is fewer and fewer. ©Greenpeace/Bo Qiu



An electric well near the door of a herder's home. Water can only be pumped for about ten minutes, making even drinking water difficult to come by. ©Greenpeace/Bo Qiu

Conclusion

Field investigations by Greenpeace have found that the plundering of groundwater in Haolebaoji by the Shenhua Coal-to-Liquid Project 100 kilometers away has resulted in the near drying up of groundwater and extensive damage to the local environment. Groundwater levels have dropped dramatically, surface water area has shrunk, vegetation has started to die off and see regressive succession, welcoming desertification and the decline of agriculture and grazing. The resulting environmental and social impacts of the Shenhua water extraction project prove that not enough consideration was given to the amount of water required by the local environment and by local residents when investigating water resources in the region.

Faced with pressure from local opposition and government policy, local governments have considered bringing in water from the Wanjiazhai Reservoir in Shanxi Province[53] and the Yellow River in Dengkou County, Inner Mongolia,[54] but water resources along the main trunk of the Yellow River is already over-taxed. The balance between supply and demand is increasingly precarious and the amount of water the river needs to move sediment and support the local environment has been pushed to the limit, causing the river to run dry, outflow into the sea to fall dramatically, increased sediment in the river bed and an overall worsening of the environment. All of this is threatening the survival of the Yellow River.

According to a report completed by the Ministry of Environmental Protection between 2009 and 2011 titled "A Strategic Environmental Assessment of Key Industry Development in the Upper & Middle Catchment of the Yellow River", Ningxia, Inner Mongolia, Shaanxi, Shanxi and other regions along the middle reaches of the Yellow River will see water deficits of 5.4-8 billion tons by 2015. Drought and water shortages are issues that will continue to be faced throughout the region, whether groundwater is exploited or water is extracted from the Yellow River. All of these are shortsighted and insufficient models for sustainable development.

The evident and dramatic ecological and social consequences caused by the Shenhua coal-to-liquid demonstration project within just eight years should serve as a warning for government agencies like the Ministry of Water Resources and the Ministry of Environmental Protection against further expansion of coal chemical projects, that are so water-intensive, energy-intensive, and highly polluting.

[53] Initial Investigations on Using the Yellow River to Supply Water to Southern Ordos. Xinhua Net-Inner Mongolia http://www.nmg.xinhuanet.com/nmgwq/2009-08/07/content_17337404.htm. 2009-08-07

[53] Achievements of Water Infrastructure Construction in UxinCounty. Ordos People's Government Website http://wap.ordos.gov.cn/xxgk/zwyw/qqdt/201111/t20111108_514940.html. 2011-11-01

Shenhua transfers waste water to other nearby sandy patches of pit, spreading it everywhere. ©Greenpeace/Bo Qiu

3

Illegal Discharge of Pollution Harms Ulan Moron:

industrial wastewater dumped directly into sand pits

The complex coal chemical processes produce huge quantity of industrial wastewater. For the Shenhua coal-to-liquids project, based on careful examination of technical materials on the equipment used and the experiences of other refineries and power production facilities, we estimate that the total amount of industrial wastewater produced could be as much as 644 cubic metres per hour. Based on a designed capacity for the equipment of 7,440 hours and an estimated 1 million tonnes of liquids products per year, the total volume of wastewater would thus be 4.79 million tonnes per year or 4.79 tonnes of wastewater for every ton of product produced.

As one of the Fortune 500 listed and a self-proclaimed green corporation, Shenhua has claimed that in the course of implementing any project, it has made every effort to use mechanical cyclical evaporator technology with membranes, ensuring that wastewater is completely reused. This technology meets the highest international standards[55] and can reuse over 95% of wastewater. Shenhua has constantly said that it has zero discharge system and has a sufficient number of evaporation pools. This is in addition to taking strict anti-leaking measures to ensure that the actual number of pollutants that enter the water cycle is zero. So, has this huge volume of wastewater, after being treated and turned into harmless runoff, been no burden to the environment?

[55] Trial Run of the Model Million-Ton Shenhua Coal-to-liquid Project a Success. January 8, 2008. Chinanet

The location of Shenhua's Coal-to-Liquid Project's 3 dumping sites and corresponding on-site photos. ©Greenpeace/Bo Qiu

Shenhua insists that it has used the world's most advanced technology in the coal-to-liquids project, that the amount of pollutants produced per ton of product is better than on the same level as the most advanced refineries, and that it has truly realized zero emissions. However, the actual situation that we have observed is the direct discharge of industrial wastewater into open sand pits.

Through field investigation Greenpeace has found that Shenhua Coal To Liquid And Chemical Co. Ltd had illegally discharged industrial wastewater to surrounding areas, and as there were no barriers, the discharge is likely to contaminate underground water. In April and May 2013, Greenpeace had collected a number of samples at the discharge sites. These samples were sent to two independent laboratories for testing, including the Shanghai branch of SGS Laboratories, a leading inspection, verification, testing and certification company; and the Greenpeace Laboratory at the University of Exeter.

These tests found high levels of harmful substances: sulfide level was almost twice the national standard, while the Benzo(a) pyrene levels in PAHs were 3.3 times the national standard. Furthermore, as many as 99 different types of semi-volatile organic compounds were found in the wastewater and sediment samples, including PAHs

Greenpeace sampling a 400 square metre illegal seepage pit, used for the disposal of wastewater, located 500 metres from the Shenhua plant. ©Greenpeace/Bo Qiu

A 400 square metre illegal seepage pit for the disposal of wastewater located 500 metres from the Shenhua plant. ©Greenpeace/Bo Qiu

and PAH derivatives xylene, styrene, dichloromethane and cresol, many of which are considered carcinogenic.

Wastewater Discharge Site 1: industrial wastewater dumped into seepage sand pits

The wastewater discharge site 1 is located at the north corner of the coal-to-liquids plant, only 500 metres from the plant itself and 10 metres from the road that passes in front of the plant. There are no other industrial facilities in the area. The area of the dump site is 400 square metres and is comprised of natural, sandy soil. There are no anti-seepage installations in place. The industrial wastewater in the pool is an inky-black and has a strong petroleum smell. A couple of dozen trees in the center and around the edge of the pool are all dead.

Using seepage pits to dispose of industrial wastewater can threaten groundwater after it seeps into the ground. It is extremely harmful and a number of Chinese laws prohibit this type of action and can be persecuted under Article 338 of the Criminal Law.

On October 30th, 2010, there isyet no sign of the seepage pit.

On May 27th, 2011, a black pit of wastewater has appeared.

On September 30th, 2011, the black pit has clearly expanded.

On June 9th, 2013, the wastewater pit is still visible

Satellite images show that the illegal dump site appeared in early of 2011, nearly two years ago, and it is located a mere 500 metres from the plant's main office building. And the road, which is only ten meters away from the pond, has been blocked at the other end, making this pond difficult to be discovered. The fact that this large-scale illegal discharge site, located so close to Shenhua's plant, has been in use for so long makes one wonder whether the company has been intentionally violating the laws. At the same time, one must also ask whether it's possible that the local enforcement agencies have actually remained ignorant that wastewater has been dumped here for two years. And what action did they take if they knew?

On May 8th, 2013, after representatives from the Shenhua coal-to-liquids plant found out about the research that Greenpeace was conducting, they tried to remove the wastewater using a suction tube and transfer it to another sand pit in the area. However, this only serves to further spread the pollution and accelerate its seepage into groundwater. After they finished extracting the water, the bottom of the seepage pit remained deep black.

Every morning, Shenhua releases milky-white wastewater into the hidden drainage ditch. ©Greenpeace/Bo Qiu

Wastewater Discharge Site 2: "Rivers of Milk" polluting downstream waterways and killing trees

The wastewater discharge site 2 is located outside the southwest corner of the plant. At night, the milky-white wastewater flows through a covered drainage ditch to a nearby patch of sand. As the wastewater seeps into the sand quickly, it creates a band of greyish-white deposits that is several kilometres long. No anti-seepage measures were put in place and the trees close to this river of pollution passes are all dead. The course of the pollution discharge eventually intersects with a waterway.

A nearby aquaculture farmer said that in 2010, wastewater from the Shenhua plant flowed into his fish pond and killed all of the fish in it.

Wastewater Discharge Site 3: polluted water flows freely out of "Zero Discharge" evaporation pools

The wastewater discharge site 3 is the evaporation pool for highly concentrated industrial wastewater that was included in the design of the coal-to-liquids plant. It is located 1,500 metres to the northwest of the plant. In promotional materials about the Shenhua coal-to-liquids plant, it says that thanks to the strict anti-seepage features of evaporation pools, the actual amount of wastewater that escapes into the environment is zero.

However, during our research, Greenpeace representatives found that just next to the evaporation pool there is wastewater flowing freely over the surface and there is a strong smell of rotten eggs. It is very probable that no or insufficient anti-seepage lining was used to line the pool and this should be further investigated by environmental protection authorities.

Sample: testing shows organic pollutants, some carcinogenic

During April and May, 2013, Greenpeace took total nine samples (wastewater and sediment samples) from the three industrial wastewater discharge sites and recorded the sample taking process.

All samples were taken using scientific methods and sent to the SGS laboratory, the world's largest laboratory for inspection, verification, testing and certification, as

Sampling Time and Location:

Sampling Time	Sampling Location	Sampling Type	Sampling Location Description
April 27/29 and May 5, 2013	Discharge Site #1	wastewater/ Sediment	Located in sandy soil to the northeast of the plant, industrial wastewater was discharged into the area and formed a massive pool of industrial wastewater.
May 4/5, 2013	Discharge Site #2	wastewater/ Sediment	Located in a covered ditch outside the southwestern wall of the plant compound. Industrial wastewater flowed through the ditch to a sandy area and because of the high permeability of the soil a band of wastewater several kilometers long was formed.
May 4, 2013	Discharge Site #3	wastewater	An evaporation pool located 1,500 meters to the northwest of the plant.

well as the Greenpeace Laboratory at the University of Exeter in the United Kingdom.

Wastewater samples were subjected to three different pollutants test for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) and heavy metals. Sediment samples were subject to test for two pollutants - semi-volatile organic compounds (SVOCs) and heavy metals.

A summary of the results:

At discharge Site #1, SGS laboratory found sulfides that are 2 times the national standards and amounts of benzo(a)pyrene that were 3.3 times the national standard. In addition to this, large amounts of toxic and harmful organic compounds were found at each of the dump sites. As many as 99 different kinds semi-volatile organic compounds were found and included polycyclic aromatic hydrocarbons (PAHs) and PAH derivatives xylene, styrene, dichloromethane and cresol. Many of these have been determined to be carcinogenic, but there are no specific standards set to control the discharge of coal chemical industrial pollutants at the national level. Detailed results are included in Appendix 1 and a list of toxic and harmful substances can be found in Appendix 2.

Coal chemical processing, especially that which uses new technology, produces complex arrays of pollutants, making treatment process difficult and expensive. With a large number of coal chemical demonstration projects currently being approved, new processes will increase the technical challenges for regulators.

Discharge Site #1:

SGS laboratories found that the sulfide content was at 1.96mg/L, while the benzo(a) pyrene levels in PAHs were 0.1μg/L. Based on national "Integrated wastewater discharge standard" (GB8978-1996) , sulfides were 2 times the national level, while benzo(a)pyrene levels were 3.3 times the national standard.
Exeter laboratories found that samples taken at this location showed an even broader range of complex organic contaminants, with characteristics that could clearly be linked to coal liquefaction chemistry. The samples collected at this location on two occasions. Samples from the first collection on 27 April 2013 contained of a total of 99 compounds resolved by the analysis, only 25 could be reliably identified (greater than 90% match quality following expert interpretation) which including pyrene, fluoranthene and various derivatives of PAHs. Quantitative analysis of this sample by an independent laboratory in UK showed the sample to contain 55 ug/l (55 ppb) of PAHs (16 types), dominated by pyrene at 47 ug/l. However, the broader qualitative screening analysis conducted in Exeter laboratory revealed the presence of a diverse range of substituted PAHs. Although the total concentrations of such PAH derivatives in this wastewater cannot be determined from the analyses conducted in this study, it is clear that the routine analysis of the sample alone could lead to a substantial underestimate of total PAHs and related compounds. This is important both in terms of regulatory oversight and control, and in relation to any assessment of the likely impacts of the release of such wastes to the open environment.

When such wastes are discharged to the surface of the soil, the potential for persistent contamination of soils and any underlying groundwater is significant. Indeed, a sediment/soil sample collected from the same location showed the presence of a similar array of PAHs and substituted PAHs, among other compounds. The PAHs identified included acenaphthene, fluorine, phenanthrene, fluoranthene, pyrene, benzo[b]fluoranthene, benzo[a]pyrene and benz[ghi]perylene, though unfortunately it has not so far been possible to conduct a quantitative analysis of these compounds in this sample. Alongside these parent PAHs, a number of hydroxylated derivatives of naphthalene, acenaphthylene, anthracene, pyrene, fluorene and phenanthrene were also reliably identified, as well as other similar compounds among those more tentatively identified. These data suggest that, even if the surface accumulation of wastewater itself were to be recovered for treatment, a substantial quantity of surface soil contamination with toxic organic chemicals would remain.

A further sample of wastewater from the same pool but collected one week later, on 4 May 2013 (CW13001), contained similar types of compounds, though fewer altogether. It is not known if this results from variation in the quality of the wastewater that had been discharged to this location over time or results from some degree of adsorption to underlying soils/sediments (thereby removing them from the water) or from some further breakdown of the contaminants.

DischargeSite #2:

The industrial wastewater contained a complex mix of organic chemical contaminants (a total of 76 individual sVOC compounds) of which only a small fraction (8 sVOC compounds) could be identified to a high degree of reliability...

A sediment sample collected from the same channel also contained a range of organic contaminants, though in this case medium- to long-chain linear hydrocarbons (C14-C26) were particularly common, as well as the PAHs naphthalene and pyrene and closely related chemicals. A number of other PAH

derivatives were identified more tentatively in this sediment sample.

Unless properly contained and further treated, this wastewater discharge could be acting as a significant point source of hydrocarbons, organosulphur compounds and other contaminants to the receiving environment, with the possibility of long-term contamination of soils and the potential for impacts on groundwater should the contaminants persist for sufficient time to percolate through the soils.

Discharge Site #3:

The samples also contained a diverse and complex mix of organic contaminants, including many which were typical for wastes arising from coal liquefaction chemistry. In this case, however, the most prominent contaminants were phenols, methylphenols (cresols) and dimethylphenols (xylenols) and closely related derivative compounds, as well as benzene, xylenes, substituted benzenes and (non-chlorinated) biphenyls. The PAH pyrene was also found, as well as a number of its methylated derivatives being tentatively identified. Only a relatively small proportion of the chemicals present could be reliably identified (28 of a total of 90 sVOC compounds isolated), with implications for full assessment and control of the hazards presented by these wastes.

The ultimate fate of contaminated wastes in this and other evaporation ponds is not known. It may be expected that the liquid component would evaporate over time, and that the more volatile contaminants would be similarly lost to the atmosphere or through breakdown during this process. Partial or complete breakdown would also be expected to reduce the content of heavier organic contaminants found over time if there were no fresh discharges to the pond. However, a proportion of the compounds found would be expected to persist in the sediments and sludges which accumulate at the bottom of the evaporation pond, materials which were not possible to sample on this occasion. If such materials were subsequently to remain in the environment, they could act as a long-term source of contamination to the surrounding environment and, depending on the integrity of any lining of the ponds, potentially also to underlying soils and groundwater.

The plant has been discharging large amounts of complex organic compounds in the three discharge sites, most of which are dangerous and poisonous. However, currently government wastewater disposal regulations have no provisions in place for many of these pollutants. In our analysis of all samples taken from each of the 3 discharge sites showed some chemical compounds listed as "priority substances" in the EU Water Framework Directive.[56] These are believed to present a significant risk to or via the aquatic environment. The presence of phthalates in the samples is not clear and needs further study.

- The highest concentration of harmful substances in each of the samples taken was in polycyclic aromatic hydrocarbons (PAHs), some of which are known to cause cancer. PAHs are a type of persistent organic pollutant and because of their persistence, toxicity and ability to move over long distances have been defined as complete carcinogens. Extended exposure to high-concentrations of PAHs over long periods of time, can cause skin, lung, stomach and liver cancer.
- Syrene is also carcinogenic. Breathing in styrene can cause lymphoma, hematopoietic malignancies or non-tumorigenic illnesses, especially in the central nervous system.
- Dichloromethane is a toxic substance that can cause damage to the liver and kidneys as well as the brain. It may also cause dermatitis that could lead to cancer.
- Cresol has also been proven to cause cancer in humans. Limited exposure can result in abnormalities in the digestive system or the nervous system.
- Xylene can cause irritation to the skin, eyes, nose and throat. It can also damage the lungs and make breathing difficult. It has also been known to cause a decrease in memory, upset stomach and changes in the liver and kidneys. Both short- and long-term exposure to xylene may also affect the nervous system.
- Phthalates, also known as "plasticizers", have the same function as estrogen or antiandrogens, and have been called environmental hormones. They can cause testicular disease and a drop in sperm counts among men. Many phthalates are typical environmental hormones and their use in children's products has been strictly limited in the EU and United States.

To date, research targeted on pollutants produced by Modern Coal Chemical Industrial technologies is very rare. The results presented above do not, of course, represent a complete overview of waste discharges and environmental contamination

[56] Establishing the List of Priority Substances in the Field of Water Policy and Amending Directive , EEA Decision No 2455/2001.
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2001:331:0001:0005:EN:PDF

Clean groundwater from Haolebaoji (right), is extracted and sent 100 kilometers to the Shenhua coal-to-liquids plant. By the time it goes through the Shenhua plant and is illegally dumped, it has already become heavily polluted (left). ©Greenpeace/Bo Qiu

relating to the coal liquefaction plant. Rather they are a snapshot, which provides an illustration of the complex and hazardous nature of the wastes generated by the facility of Shenhua and discharged to the environment either through formal or informal disposal operations. Likewise, it is not possible to draw from the analyses conducted on a limited number of samples firm conclusions about the extent and severity of environmental contamination arising from such waste discharges (including potential contamination of groundwater resources), or the potential exposure of nearby communities to the hazardous chemicals identified.

Our research findings show that industrial wastewater released by the Shenhua Ordos coal-to-liquids plant contains a complex mix of a wide array of pollutants of high environmental risks. Despite Shenhua's claims that it has a "zero discharge" record in terms of pollution, what we have found shows just the opposite. Furthermore, the long-term buildup of chemicals and organic compounds in the sediment of these illegal dump sites may turn local river basins or groundwater supplies into "storage facilities" for persistent, toxic pollutants. When there are heavy rains or rivers flow stronger, these sediments may become disturbed and enter into surface or groundwater and ultimately flow into the Yellow River basin.

Because of the difficulty in obtaining these samples, Greenpeace has yet to carry out full analysis on them, making it difficult to judge the seriousness and extent of the pollution resulting from the illegal discharge by the Shenhua coal-to-liquids project. It is also difficult to say what potential risks these toxic pollutants pose for local villages and the environment. We are also unable to determine how wastewater discharge compares to atmospheric discharge in their overall impact on the environment. Furthermore, limitations and environmental standards are founded on treating pollutants as one, monolithic category, but the fact is that chemical pollutants may react with each other to grow and form new compounds. This is why, from the initial results of this round of research, we can see that a complete and comprehensive evaluation is urgently needed. The Ministry of Environmental Protection and other related agencies should clamp down on Shenhua's industrial pollution to prevent further damage to the local environment and ensure the health of local residents.

Conclusion

Not only has Shenhua plundered precious, irreplaceable water resources from over 100 kilometres away, it has also been eroding the quality of the remaining water resources in the region through large scale discharge of industrial wastewater. In arid regions, water is something incredibly precious and the illegal practices of the Shenhua coal-to-liquids project is an act of environmental crime and a failure to fulfill even its most basic social responsibilities.

As a major corporation under China's central government, Shenhua has hidden behind environmentally friendly claims of high-tech and high investment, but it has clearly failed to deliver.

10 June 2013. Zhang Dadi prays for rain in the middle of his corn field that he cannot irrigate in the Adaohai Number 1 Commune. Haolebaoji, Uxin County, Inner Mongolia, China.©Greenpeace/Bo Qiu

4

Knowingly Breaking the Law:

Shenhua's actions go against multiple environmental protection policies

The Shenhua Group's extraction of groundwater from the Haolebaoji region for its coal-to-liquid project in Ordos has infringed on water used for agricultural, ecological and residential purposes. It has also breached the government set ecological policy limits, "red lines", causing serious damage to the local ecosystem and threatening the livelihoods of local farmers and herders.

Shenhua's actions, including stealing water from the people and depriving the environment of necessary water resources, are against the principles set out in the Water Law and the Grasslands Law of the People's Republic of China. They are also contrary to national-level ecological management and water protection policies. They also go against clear directives from government agencies on the development of the coal chemical industry.

Conflicts with National Ecosystem Management and Zoning Policies

Haolebaoji is located in the center of the Mu Us desert, which sees little rain and has a very fragile ecosystem. Of the 42,200 square kilometres that made up the Mu Us desert, 13,800 are comprised of active sand formations that have continually expanded over the millennia.

Faced with an increased environmental degradation, modern China has invested a great deal into keeping sand formations in check and preserving arable land. Starting in 1987, Uxin county was listed as one of three

forest protection sites. In the fourth phase of this program (2001-2010), a total of 37.55 million RMB was allocated to create 17,066 hectares of forest. In 2000, Uxin county was named a test site for returning farmland to forest and in 2001 loans in the amount of 36.08 million RMB was taken out in Japanese Yen to fund a program to prevent sand expansion over the course of ten years to create 10,647 hectares of forest. In the same year, 116 million RMB was spent on a program to preserve natural forests and plant 90,000 hectares of new forests using flyover planting techniques. Since 2001 through the present day, Uxin county has been a key location in managing the source of sands that contribute to sand storms in the Beijing/ Tianjin region.

National Ecological Zoning places the northern part of Uxin county including Haolebaoji, within the "Ordos plateau grassland desertification control zone". Faced with serious topsoil loss, desertification and loss over vegetation, this is a very sensitive region and this designation requires protection of water and soil, prevention of erosion and the encouraging of animal husbandry.[57] Southern Uxin county is part of the "Mu Us desert sand control vegetation band zone". This area is seriously desertification and requires human action and restoration of natural environments to restore the ecosystem. National regulations clearly prohibit the promotion of water-intensive industries in arid or semi-arid regions. In basins of rivers that have stopped flowing, it is also prohibited to build new water extraction or storage facilities and requires individuals and companies to use water resources reasonably, ensure that the local environment has the water it needs and to protect wetlands. All activities that lead to continued destruction of the environment must be stopped.[58]

In the Inner Mongolia Functional Zoning regulations that were released in July 2012, the Mu Us desert was designated as a sand control zone and was included on the list of limited development regions. The report states that the Mu Us desert is "extremely sensitive to desertification, which could endanger energy producing centers in Shanxi, Shaanxi and Inner Mongolia; there is serious degradation of grassland ecosystems and desertification is becoming increasingly severe."

National ecosystem zoning also requires that "in regions where there is a severe shortage of water resources, environmental capacity is

[57] Database for Ecosystems and Ecosystem Services Zoning in China, http://www.ecosystem.csdb.cn/ecoass/ecoplanningzone_detail.jsp?id=68F20FE18ACCB5BBEDB0600CA4E44C78

[58] National Functional Zoning. Ministry of Environmental Protection, 2008.

The drying up of groundwater has made it impossible to keep the pine trees just outside Shenhua's coal-to-liquid plant alive. Most of them have already died.
©Greenpeace/Bo Qiu

low, ecosystems are weak or that are subject to frequent earthquakes or geological natural disasters, energy and mineral resource extraction must be strictly controlled."

Shenhua's coal-to-liquid project in Ordos all but destroyed the ecosystem of the Majiata region and then turned to the heart of the arid, ecologically delicate Mu Us desert region to extract large amounts of groundwater, going against national directives on ecological preservation and seriously threatening advances made in ecological management over the previous decades. Extracting groundwater from a limited development zone not only contributes to further desertification and exacerbation of topsoil loss, it also puts the survival of planted forests at risk, wasting the billions of RMB spent by the government to manage this and putting the rest of the country at risk.

Activities Contrary to Local and National Policies Demanding "Strictest Water Resource Management"

Ordos is a very arid region and it is said that out of every decade, nine years are plagued with drought. The environment is harsh and over half of the region's water comes from underground. Rapid industrial development centered on the coal industry has resulted in soaring demand on groundwater resources. The need to protect groundwater resources has been recognized by all levels of government, from the national to the provincial, to the local.

In December 2010, the State Council issued National Functional Zoning Regulations, requiring "strict management systems for water resource management" to be put in place and that "management and protection of groundwater be strengthened, while over-extraction of groundwater be dealt with severely, ensuring overall strengthening of soil retention efforts." The central government also required that energy base development in the Ordos Basin implement strict water resource management measures. Water resources must be developed in an orderly, limited and compensatory manner and be used efficiently and sustainably. Management of water demand and water use must also be strengthened based on capacity of water resources and the environment." The Regulations also clearly states that "in areas where water resources have been over-extracted, resulting in damage to the local ecosystem, the ecological water removed must be replaced through reasonable allocation of other resources to the end that ecological systems in the region can be restored and that rivers and groundwater are able to serve their basic functions."

In 2011, the central government issued its Decision on Speeding Up Reform and Development of Water Resources, requiring "strict management and protection groundwater and immediate issuing of prohibitions and limitations on extraction, gradually lowering over-extraction of groundwater and establish a balance between extraction and recharge." In 2012, the State Council released its Opinions on Applying the Strictest Water Resources Control System, further clarifying that "in areas where over-extraction has occurred, agricultural and industrial activities are prohibited and new service industry projects may use groundwater resources. Over-extraction must also be gradually lowered and a balance between and extraction and recharge must be established."

In 2011, Inner Mongolia released its Opinions on Speeding Up the Reform and Development of Water Resources with similar requirements that "strict limitations be placed on water intensive industrial projects in regions with water shortages."

The Inner Mongolia Groundwater Protection Plan was initiated in June 2011 and used the case of Shenhua's coal-to-liquid plant water extraction project in Haolebaoji causing drops in groundwater levels as an example of what can happen when large- and medium-scale water supplies are overused. The Protection Plan required that new industrial projects be prohibited from using groundwater in areas where over-extraction was occurring and that existing extraction for industrial purposes be replaced with surface water alternatives. The Saihan District water supply zone in Huhhot and the Haolebaoji region of Ordos were included as key protection and management zones, requiring complete protection of groundwater sources with a supply volume of over 10,000 cubic meters/day through the use of project-based planning and non-project measures to form a comprehensive protection, management and detection system for groundwater extraction zones.

Article 24 of the Inner Mongolia Autonomous Region Regulations on Saving Water in Agriculture, implemented on December 1, 2012, require that governments at the county level and above organize industrial development industry structures based on the state of water resources and the environmental capacity within their respective administrative regions. New constructions, refitting or expansions of water-intensive industrial projects are prohibited from using groundwater without permission. Completed water-intensive projects that use groundwater must take steps to minimize water consumption and gradually reduce the amount of groundwater they extract. Those capable must replace

groundwater sources with non-conventional water sources or surface water. Article 46 states that violators will be given a time limit by the water administration agencies of county government to conform to regulations and fined between a minimum more than 50,000 RMB and a maximum of less than 100,000 RMB.

Article 28 of the Inner Mongolia Autonomous Region Administrative Measures for Groundwater Management (Pending), released on January 4, 2013, stipulate that food, beverage and pharmaceutical projects that receive permission from water administration agencies may use groundwater. In regions where water resources are scarce, industrial projects that do not affect the regional ecology are permitted to use brackish or salt groundwater. Other industrial projects are prohibited from using groundwater.

Bate'er, the party secretary for Inner Mongolia, has emphasized the importance of protecting groundwater on numerous occasions. On December 28, 2011, Bate'er spoke at a meeting on regional economic work, saying, "Work on replacement water source projects for water-intensive industries must be accelerated, transitioning them away from using groundwater." On February 15, 2012, Bate'er once again emphasized this in a report to the Autonomous Region People's Government, saying that "scientific development and the reasonable use of water resources" is imperative and that "in implementing the strictest measures for management of groundwater resources, **the use of groundwater for water-intensive industrial projects must be prohibited.**"

The local Uxin county government clearly also has a firm grasp on current existing ecological problems in the region. In December 2012, the local water management and soil preservation bureau issued an article that summed up the challenges facing water resources like this, "Firstly, the use of groundwater is high, around 68%. The development of groundwater in the irrigation zones of Galutu, Haolebaoji and Wudinghe are relatively high and water levels in these areas have declined. Long-term over-extraction of groundwater is a definite threat to local ecological work. Secondly, the risk that groundwater has been polluted is also high. Thirdly, long-term droughts mean that season rivers run dry or disappear completely. Lakes and wetlands have also seen varying degrees of decline."[59] In terms of response measures,

[59] The Role of Water in Building an Ecological County. Uxin Banner Bureau of Water Management and Soil Preservation Website. http://wsqswj.gov.cn/xxgk/ghjh/201301/t20130104_782582.html. December 9, 2012

the government proposed "actively fight for Yellow River water allocation, with the goal of sourcing 100 million cubic metres of water from outside the region by 2017, as well as **"finding alternative water sources for industrial projects as soon as possible to replace that of the groundwater from the Haolebaoji region, in order to stop local ecological degradation. "**

Policy Infringements and Underhandedness in Obtaining Water Extraction Licenses

According to Article 28 of the Water Law of the People's Republic of China, no unit or individual may divert, block (store) or drain water in such a way that harms the public interest or the legal rights of others. Administrative Regulations on Water Extraction Licensing and Water Resource Fees issued by the State Council state that reviews of applications for extraction licenses must take into consideration the impacted party (which here, are the villagers of Haolebaoji).

Application materials for an extraction license must include a "stakeholder impacts assessment report". After the relevant agency has received the application, it must carry out a full review of the application materials and take into full consideration the possible impact on preservation of water resources as well as the local community when deciding to approve or deny the application. In cases where the reviewing department feels that the public interest is at stake, it must call a hearing that should be open to the public and hear the case. In cases where there are differences of interest between the applicant and other individuals involved, the reviewing department must first inform both the applicant and other stakeholders of their decision. The applicant and the stakeholder may demand a hearing, which the reviewing department must arrange. In cases where there is disagreement or litigation related to the application, the reviewing department must inform the applicant in writing that the approval process will be stopped until the disagreement is resolved or the litigation is completed, after which the approval process will be resumed.

However, in reality, the Shenhua coal-to-liquid water extraction project never consulted the villagers in Haolebaoji (third-party), who in fact objected strongly on numerous occasions. Nonetheless, Shenhua was given the water extraction license. We have every reason to believe that the Inner Mongolia Water Resources Department did not follow the requirements of the State Council regulations.

Furthermore, the Shenhua coal-to-liquid

water extraction project began construction in April 2005 and finished in May 2006. But it wasn't until January 2006 that the location for the project and water allocation was permitted.[60] And it wasn't until January 2008 that Shenhua officially received its water extraction license.[61] Construction on a water extraction project prior to approval is an illegal act prohibited by Article 69 of the Water Law and Article 49 of the Administrative Regulations on Water Extraction Licensing and Water Resource Fees.

Violations of "Water Pollution Prevention and Control Law" and other Industrial Wastewater Management Regulations

All levels of government nationwide have passed clear regulation over the past couple decades regarding the discharge of industrial wastewater. Article 41 of the Water Pollution Prevention and Control Law of the People's Republic of China, passed in 1984 and revised in 1996, prohibits enterprises and public units from discharging or discharge wastewater containing toxic pollutants, polluted water containing pathogens or other waste material into seepage wells, seepage pits or caves. Article 42 states that in areas with strata that are not well isolated, enterprises and public units are prohibited from using ditches, pools without proper anti-seepage features to transport or store toxic pollutants, polluted water containing pathogens or other waste materials.

Article 28 of the 2002 revised Inner Mongolia Autonomous Region Environmental Protection Regulations states that clean and wastewater being discharged from industrial processes must be separated, processed independently and reused. Ditches or pools used to transport or store wastewater containing toxic pollutants, polluted water containing pathogens or other waste materials must be treated with anti-seepage techniques.

Article 31 of the Inner Mongolia Autonomous Region Administrative Measures for Groundwater Management (Pending) implemented on January 4, 2013 states that the storage or transport of wastewater containing toxic pollutants, polluted water containing pathogens or other waste materials that may pollute groundwater must meet national regulations for anti-seepage to protect the quality of groundwater. Anti-seepage projects must include groundwater monitoring facilities that are inspected and approved by water administration agencies before being used. Article 32 states that it is prohibited to use seepage wells, seepage pits or crevices to discharge or dump industrial wastewater, residential wastewater, toxic wastewater and other waste materials that may pollute groundwater; it is also prohibited to use aquifer pores, crevices or abandoned mining pits to store oil, radioactive materials, toxic chemicals or fertilizers.

[60] Shenhua Group Journal. Editing Committee, Shenhua Group Journal (Chinese) [M]. Beijing: Coal Industry Press. 2012:473

[61] Water Extraction License received January 15,2008 ..Official Website of Shenhua Group Co., Ltd. http://www.shenhuagroup.com.cn/zjsh/zzry/shzz/mhg/index.shtml

Rapid deterioration of vegetation in Haolebaoji. The land continues to turn to sand and objections from local residents are strong. ©Greenpeace/Bo Qiu

On June 17, 2013, the Supreme People's Court and the Supreme People's Procuratorate issued a joint Interpretation of Several Issues Related to Laws Applicable to Criminal Cases of Environmental Pollution that acts of "independently constructing hidden pipelines or using seepage wells, seepage pits, crevices or caves to discharge, dump or dispose of radioactive waste, contagious pathogenic waste or toxic materials," shall be considered "serious pollution of the environment." Article 38 of the Criminal Law states that the punishment for this crime may be a prison sentence or detention of three years or less, or by fine alone; more serious cases may be a prison sentence of more than three years or less than seven years in addition to a fine.

At Odds with National Policy on the Coal Chemical Industry

In response to the water-intensive, energy-intensive and highly pollution nature of

A well cover belonging to Shenhua Coal-to-Liquid and Chemical Project's water supply pipeline. Shenhua pumps water from here to its coal chemical plant in Ulan Moron, nearly 100 kilometers away. Wushen Township, Inner Mongolia. ©Greenpeace/Bo Qiu

the coal chemical industry, national-level administrative agencies implemented clear requirements for the coal chemical industry as early as 2006. In July 2007, the National Development and Reform Commission issued a Notice on Strengthening Management of Coal Chemical Project Construction and Promoting Healthy Industry Development, which clearly states:

"Water resources are an important limiting factor in the development of the coal chemical industry. They are also a limiting factor to China's economic development. China's water resources are far below the world average. In major coal production areas, the amount of water resources per capita and water reserves per unit of area are only 1/10 the national average. Water usage in large-scale coal chemical projects is often many million cubic meters higher than this and water usage is often ten tons per ton of product. This is equivalent to water resources for a region with over 100,000 people or an area over 100 square kilometers in area. Some regions are investing more heavily now in coal chemical projects than ever before. This may be partly due to production surpluses, but it may also damage the delicate balance of water resources in a region, directly affecting the social and economic stability as well as the ecology of the region. At the same time, hastily constructed large-scale industrial coal-to-liquid and alkene projects are not only highly risky, the also leave concealed dangers that may affect the healthy development of the industry."

The National Development and Reform Commission has also required that coal chemical development remain mindful of

the "balance of water resources". With the exception of Yunnan and Guizhou, China's coal resources and water resources are distributed contrary to their respective locations. Most coal chemical products are extremely water-intensive. **Development of the coal chemical industry should be based on available water resources and should be prohibited from infringing on residential or agricultural water use to support development.** The construction of coal-to-natural gas and coal-to-liquid projects must be strictly controlled in areas where water is scarce. Limiting the use of water-intensive techniques and equipment while encouraging those that save water, as well as promoting the reuse of waste water, reclaimed water and mine shaft water are key measures. "

From 2009 to 2011, the Ministry of Environmental Protection conducted a strategic evaluation of the environment in this region and published a report titled "Evaluation of Carrying Capacity for Key Energy and Chemical Industrial Zones in Upper and Middle Reaches of the Yellow River" that examined coal chemical projects. [62] The Evaluation proposed a water control measure whereby industry production was based on water resources available, clearly requiring development plans for water-intensive heavy or chemical projects to be based on the carrying capacity of regional water resources. Only after regional environmental, residential and agricultural water resource needs were met could "appropriate amounts" of development be carried out.

Conclusion

One of many projects, the Shenhua Coal-to-Liquid Project has caused extreme damage to local water resources and ecosystems. It has also come in conflict with and violated the national environmental protection policies, the protection of water resources, environmental protection and even macro industry development. One must ask, how was the Shenhua project assessed, what was the basis for the decision and which government agencies should be held accountable?

This demonstration project seems to have demonstrated nothing but a huge environmental mistake.

[62] Zhou, Nengfu. ed. Evaluation of Carrying Capacity for Key Energy and Chemical Industrial Zones in Upper and Middle Reaches of the Yellow River. Beijing: China Environmental Press. 2013: 200

10 June 2013 – Haolebaoji, Inner Mongolia – Zhang Dadi of the Adaohai #1 Commune has a 150-meter deep well that he uses to irrigate his corn. Last year he planted 20 mu of land, but could only irrigate 15. This year he planted 1 hectare, but could only irrigate 8 and the remaining 7 mu didn't get irrigated. The water table drops every year and it doesn't rain. Corn planted over a month ago still hasn't started to sprout. ©Greenpeace/Bo Qiu

5

Conclusions and Recommendations

By conducting on-site surveys and research, Greenpeace has recorded evidence of environmental damage and disruption of the livelihood of local residents in Haolebaoji by the Shenhua Ordos Coal-to-Liquid Demonstration Project.

Our research shows that the extraction of groundwater in Haolebaoji for the Shenhua Coal-to-Liquid Project has directly caused water levels to drop by as much as 100 metres over an area of 1.2 million mu of grassland, leading to the depletion of local groundwater resources, the severe shrinking of Subeinaoer Lake, the die off or retreat of much of the region's surface vegetation as well as desertification. It has also made it difficult for 2,402 households engaged in farming and herding to even find drinking water, raise their livestock or farm their fields. It has destroyed the foundations of the local community and threatens the residents' survival. These actions have violated several laws including the Grasslands Law and the Law on Prevention and Control of Desertification. It has also gone against the spirit of the "system for the strictest management of water resources, three forestry projects and sand control measures for the Beijing/Tianjin region."

In addition to damaging the environment and the livelihoods of people over 100 kilometres away, the Ordos Coal-to-Liquid Project has also discharged industrial wastewater in the area near the plant itself with dangerous, toxic substances. Tests of collected samples has found the benzo(a)pyrene levels in PAHs were 3.3 times the national standard, and as many as 99 different types of semi-volatile organic compounds including polycyclic aromatic hydrocarbons, xylene, styrene and dichloromethane have been found. It has polluted the environment and further threatens the safety of groundwater. Not only is this contrary to the "zero output" claim of the Ordos Coal-to-Liquid Project, it also violates the Water Law and Water Pollution Prevention and Control Law of the People's Republic of China.

As a "demonstration project", the reprehensible actions of the Ordos Coal-to-Liquid Project, including the pillaging and destruction of the environment and water resources, direct negative impacts on the livelihoods of farmers and herders as well as its direct violation of the law, should be seen as yet another alarm to national energy and environmental agencies. The water-intensive, energy-intensive, highly polluting and high risk nature of coal chemical projects is difficult to mitigate and the rapid development of the coal chemical industry will naturally spur the growth of coal mining and coal-fired thermal power, further exacerbating the damage and pollution caused by the entire industry chain. Meanwhile, the blind race by local governments to bring in coal chemical projects means that from initial environmental impact assessment to supervision, local governments acquiesce to the demands of investors. From the position of the environment and the legal rights of local residents, the result has been a host of environmental issues and harming the stable social development.

Being socially responsible is not only the mission and responsibility of the central government. It is also the expectation that the public has for the companies under control of the central government.[63] However, despite being one of 53 directly managed large-scale state owned enterprises, Shenhua Group's actions have been completely contrary from what they tell the media. Continued for years, the record of damage to the environment from pollution is extensive. On national and provincial level environmental protection agency websites alone, nearly fifty examples

[63] Guidelines to the State-owned Enterprises Directly under the Central Government on Fulfilling Corporate Social Responsibilities, State-owned Assets Supervision and Administration Commission of the State Council, December 29, 2007

of violations of laws and regulations can be found.[64] In January 2013 when the media exposed discharge of polluted water from a coal-to-olefin plant in Baotou, also part of the Shenhua Coal-to-liquid Co., Ltd., the Ministry of Environmental Protection issued an order to stop production. In June 2013, the Ministry of Environmental Protection issued another order for an second phase of an expansion project of Shenhua's Anqing power plant to cease construction and reorganize building plans because of illegal construction that went forward without having an approved environmental impact assessment. Shenhua's Ordos Coal-to-Liquid Project, which Greenpeace investigated, was also ordered to stop construction in 2009 by the Ministry of Environmental Protection because of unauthorized construction.

Faced with criticism and investigation by the public and the government, Shenhua Group has still continued its damage to the environment and we must question where Shenhua's social responsibility lies as a massive state-owned enterprise. Are the advanced technologies that it boasts about or commitments to the environment nothing more than empty words?

Greenpeace calls on the Shenhua Group to immediately stop further damage to the environment and water resources in the Haolebaoji region, and commit to eliminating similar kinds of damage during construction of remaining production lines of Phase One, Phase Two of the project, as well as the coal-to-natural gas project.

In order to keep the same tragedy from happening again, the National Development and Reform Commission, the Ministry of Industry and Information Technology, the Ministry of Water Resources, the Ministry of Industry and Information Technology and other government agencies must develop clear, scientific and applicable regulations that truly adhere to the principle of limiting coal expansion based on water capacity and ensure ecological limits are not exceeded. When coal chemical projects are in the application phase, strict reviews of water usage and environmental impact must be carried out and projects that do not meet requirements must be rejected.

For coal chemical projects that have already been approved, the National Development and Reform Commission, the Ministry

[64] Enterprise Supervision Records Database, Institute of Public and Environmental Affairs Website. http://www.ipe.org.cn/pollution/index.aspx.

of Industry and Information Technology, the Ministry of Water Resources and the Ministry of Environmental Protection must re-evaluate their expected impacts to water resources and make adjustments, and release the results of such re-evaluations.

Finally, it must be pointed out that the serious problems like those with the Ordos Coal-to-Liquid Project are not an isolated incident. Jinjie, Qingshui, Yuheng and Nalin River are large-scale coal base industrial zones similar to the Shenhua Coal-to-Liquid Project that are being built and expanded in large swaths along the middle stretches of the Yellow River.

Most of the areas along this stretch of the Yellow River are arid with limited ecological carrying capacity and the difficult task of keeping expanding sands at bay. Feeling the pressure of the coal industry, the Yellow River and its tributaries have been damaged and polluted. Over-extraction of groundwater is also very serious. The expansion of the coal industry, which proceeds without care for the environment or public welfare is not sustainable and will definitely cause even more environmental and social problems. Change is urgently needed..

The threat of coal development to water resources has attracted wide public attention and discussion on what plans are reasonable for the development of national coal bases. Research institutes and commercial organizations like the Chinese Academy of Sciences, HSBC and China Water Risk have also been researching these issues from a variety of perspectives, making their own analyses and recommendations. In the following sections, Greenpeace will provide further insight into its analysis of the specific crisis that water resources in the middle stretches of the Yellow River are facing.

Appendix I:

Timeline of Shenhua Ordos Coal-to-Liquid Project Development and Water Licensing Battle

Date	Shenhua project development	Water licensing and local protest
2001		Water extraction project initiation
2003.3 ~ 10		Drilled 36 wells in prospecting phase
2004.8	1.08 million tonnes / year DCL Project started construction	
2005.1	200 MW Coal-power Plant started construction	
2005.4.20		Villager's first petition
2005.6.2		Started pipe lining by force
2005.6.4		Villager's second petition
2005.6.17		Villager's local protest
2006.1		Shenhua "got approval"
2006.3		Shenhua started extraction from Haolebaoji
2007.7	Power Plant Units Into Operation	
2007.8	180,000 tonnes / year ICL Project started construction	
2008.1		Shenhua got water extraction license
2008.12	DCL production line started operation	
2009.12	ICL production line started operation	
2011.12	2 billion cubic metre / year coal-to-gas project started construction	
2012.12	2.12 m/a DCL expansion project started construction	
2013.1		Shenhua' s water extraction license renewed

Appendix II:

Wastewater Discharge Site Test Results

Sample Location	Sample Type	Main Pollutants Found
Discharge Site #1	Wastewater	**Semi-volatile Organic Compounds:** Sample (CW13026) was found to include large amounts of organic compounds. There were a total of 99 organic compounds, 25 of which could be reliably identified. Quantitative analysis of Sample (CW13026-2) revealed: Total (of 16) PAHs, 55 μg/l, including pyrene as high as 47 μg/l, 4.3 μg/l of fluoranthene and 3.2 μg/l of acenaphthene. Sample (CW13001) was found to contain nearly 33 types of organic compounds, of which 8 could be reliably identified. These were: 10-Methylnonadecane, Benzene, 1,2-dimethyl-, Benzoxazole, 2-methyl-, Dimethyl sulphoxide, Fluoranthene, Quinazoline, 2-methyl-, Phenol, 2-methyl-, Phenol,4-methyl-. **Volatile Organic Compounds:** 2 types of volatile organic compounds were detected. Sample (CW13026) was found to include methane and trichlorofluoro- **Heavy Metals:** No high concentrations of heavy metals were found in this sample.
	Sediment	**Semi-volatile Organic Compounds:** Sample (CW13018) was found to include a series of PAHs as well as a large number of other substituted PAHs and other compounds. Of these, PAHs that were found included acenaphthene, fluorene, phenanthrene, fluoranthene, pyrene, benzo [b] fluoranthene, benzo [α] pyrene and benzo [ghi] perylene. Some substituted PAHs found included naphthalene, acenaphthylene, anthracene, pyrene, fluorene, phenanthrene. **Heavy Metals:** No high concentrations of heavy metals were found in this sample.
Discharge Site #2	Wastewater	**Semi-volatile Organic Compounds:** Sample CW139024 was found to contain extremely complex organic compound (a total of 76 compounds), of which 8 could be reliably identified. Cyclohexanol, 5-methyl-2-(1-methylethyl)-, di-n-butyl phthalate, diisobutyl phthalate, naphthalene and sulfur, mol.(s8). Benzene, 1,4-dicloro-, Diethyl phthalate, Bis(2-ethylhexyl) phthalate. Pollutants also included a series of organosulfer compounds and some carbolic acid compounds (including 4-methyl and 4-propylphenol as well as toulene, phthalate, and low molecular mass volatile chlorinated compounds (1,2-Dichloroethane, dichloromethane and carbon tetrachloride). **Volatile Organic Compounds:** Sample CW13013 was found to contain 6 volatile organic compounds, 5 of which could be reliably identified. Including: Ethane, 1,2-dichloro-, Ethene, trichloro-, Methane, dichloro-, Methane, tetrochloro- and Toluene.

Sample Location	Sample Type	Main Pollutants Found
		Sample CW13015 was found to contain 9 volatile organic compounds, 7 of which could be reliably identified. Including: Chloroform, Ethane, 1,2-dichloro-, Ethene, trichloro-, Methane, dichloro-, Methane, tetrachloro-, Methane,trichlorofluoro- and Toluene. **Heavy Metals:** No high concentrations of heavy metals were found in the sample.
	Sediment	**Semi-volatile Organic Compounds:** Sample CW13007 was found to contain a large number of organic compounds (47), 18 of which could be reliably identified. Of these, the most common were medium- and long-chain hyrdocarbons. In addition to this, there were PAHs like naphthalene and pyrene as well as some substitutes thereof. Including: 1,2,3,4-tetralin, 1,2,3,3a,4,5-hexahydropyrene, etc. In addition, there were also a relatively large number of substituted PAHs that were initially identified. Including: Benzene,dimethyl-, Docosane, Eicosane, Heptadecane, Hexacosane, Hexadecane, Naphthalene, Naphthalene, 1,2,3,4-tetrahydro-, 6-methyl-Naphthalene, 1,2,3,4-tetrahydro-6-methyl-, Nonadecane, Octadecane, Pentadecane, Pyrene, Pyrene, 1,2,3,3a,4,5-hexahydro-, Tetracosane. Tetradecane, Phenol, 2-methyl- and Phenol, 3-methyl. **Heavy Metals:** No high concentrations of heavy metals were found in the sample.
Discharge Site #3	Wastewater	**Volatile Organic Compounds:** Sample CW13012 was found to include 11 volatile organic compounds, 8 of which were reliably identified. Including: Benzene, Benzene, 1,2,4-trimethyl-, Benzene, 1,3,5-trimethyl-, Methane, trichlorofluoro-, Naphthalene and o-Xylene **Semi-volatile Organic Compounds:** Sample (CW13023) was found to include 90 organic compounds, including 29 that could be reliably identified. Including: 1,3-Benzenediol, 2-methyl-, 2-Methylcarbazole, 3,5-Dihydroxytoluene, 5H-indeno[1,2-b]pyridine, Aniline, Benzene, 1,1'-(1,2-ethynediyl)bis-, Benzene, 1,3,5-triethyl-, Benzene, 1-methoxy-4-(1-methyl-2-propenyl)-, Benzeneacetaldehyde, 2-methoxy- , Benzenemethanol, 4-ethyl- , Carbazole, Hydroxybiphenyl, Phenol, Phenol, 2,4,6-trimethyl-, Phenol, 2,4-dimethyl-, Phenol, 2-ethyl-, Phenol, 2-ethyl-5-methyl-, Phenol, 2-methyl-, Phenol, 3,5-dimethyl-)-) Phenol, 3-(1-methylethyl)-), Phenol, 3-ethyl-, Phenol, 3-ethyl-5-methyl-, Phenol, 3-propyl-), Phenol, 4-methyl-, Pyrene, Tetradecane, 1,1'-Biphenyl]-2,2'-diol, 1,1'-Biphenyl]-2-ol), Phenol, 3-methyl-. Of these, the most prevalent pollutants were, phenols, methylphenols (cresols), dimethylphenols (xylenols) and related subsitute compounds. There was also benzene, xylene, substituted benzenes and (non-chlorinated) biphenyls and benzofurans. PAH-pyrene was also found and some methylated derivatives. **Heavy Metals:** No high concentrations of heavy metals were found in the sample.

Appendix III:
Toxicity of Pollutants Found

• Polycyclic Aromatic Hydrocarbons (PAHs)

This is the most common harmful, toxic compound found in all the samples tested. PAHs are hydrocarbon molecules that have two or more benzene rings that are connected by fused rings. There are many types of PAHs with over 200 having been discovered so far. PAHs are a type of persistent organic pollutant, because of its persistence, toxicity and ability to travel. Research in recent years has caught the attention of government decision makers and academics alike. (UNECE, web; UNEP, 2003)

PAHs that have primacy and enhancement effects are thought to be complete carcinogens and participate in many stages of cancer development. (Bostrom et al., 2002) Results show that under professional exposure, it is shown that a clear dose effect relationship exists between concentration of PAHs and the rate of lung cancer or death. Different research results confer. (Armstrong et al., 2004)

Environmental research often looks at the 16maternal PAHs, because of their relatively common presence in the environment and their listing as primary controlled pollutants by the Environmental Protection Agency in the United States. (USEPA, 1999)

• Phthalates

Phthalates are dialkyl or alkaryl ester benzene (aka 1,2- benzenedicarboxylic acid); the name phthalate comes from a combination of phthalate acide and its original word napthalene. Phthalates are a general term for sorganic compounds and are mainly used as plasticizers. It greatly increases the plasticity and pliability of macromolecular material like plastic, making it easy to work into shapes and make into soft plastic products. For instance, when making PFC, if more phthalate is added, the result will be soft PVC that can be used to produce toys, children's pools, medical equipment, bags for blood, cosmetics, lubricants and rugs.[65]

Because of the large scale use of phthalates in PVC and other plastics, they have become one of the most common man made materials in the environment and are just about everywhere.[66] These phthalates have started to build up in water, air and soil to varying degrees. Industrial wastewater and residential garbage are some of the main sources of phthalates.[67]

Phthalate have similar functions as estrogen and antiandrogens, and are thought of as environmental hormones. In lab animals, it has been found that in certain doses, phthalates can cause testicular disease and a lowering of the sperm count. Observations of infant boys have also indicated that there are links between abnormalities in the development of the genitals and phthalates.[68] Another study on infants shows that there is a relationship between a drop in reproductive hormones in male infants and the level of phthalates in their urine (from urine tests). A drop in these hormones indicates that the testes are not functioning properly.[69] In addition, phthalate can also cause other health problems, including liver and kidney damage as well as asthma.[70]

As common environmental hormones, the use of many phthalates in children's products has come under strict control in the EU and the United States. Of these, 6phthalates have been explicitly forbidden for use in children's products. In addition, In February 2011, the EU placed the phthalates DEHP, DBP and BBP on a list of chemicals to be phased out.

• Xylene

Xylenes are a type synthetic chemical. The three main forms of xylene are m-xylene, o-xylene and p-xylene. These compounds, which are obtained after two methyl substituents are substituted on the benzene ring are often used as solvents and are used in the printing, rubber and leather industries. In addition to other solvents, xylene has also been used widely as a cleaning agent and for thinner paints and varnishes. It is a colorless, flammable liquid with a sweet scent. Xylene is one of the top thirty chemical products made in the United States.[71]

As a liquid, xylene can seep into soil, surface water (streams, rivers, etc.) and groundwater. Most xylene accidents occur when it is released into the air, but there have also been cases of it escaping into rivers or lakes. If an accident should occur, large amounts of xylene will enter into soils, water and air.[72]

Xylene has a mild toxicity level and is somewhat carcinogenic.[73] Scientists have found that the three forms of xylene have very similar effects on human health. Short-term exposure to high levels of xylene will cause irritation of the skin, eyes, nose, throat and lungs, making it difficult to breathe. It has also been shown to cause a decrease in memory, stomach discomfort and changes in the liver and kidneys. Short- or long-term exposure to high concentrations of xylene can also affect the nervous system and be expressed as headaches, a lack of muscle coordination, dizziness and confusion. It

[65] GIAM, C. S., WONG, M. K. 1987. Plasticizer in food. Journal of Food Protection, 50, pp. 769-782.

[66] GIAM, C. S., WONG, M. K. 1987. Plasticizer in food. Journal of Food Protection, 50, pp. 769-782

[67] Howard, P.H. 1989. Handbook of environmental fate and exposure data for organic chemicals. Lewis Publishers, Chelsea

[68] Swan, S.H., et al. 2005. Decrease in anogenital distance among male infants with prenatal phthalate exposure. Environmental Health Perspectives, 113(8), pp. 1056-1061.

[69] Main, K.M. 2006. Human breast milk contamination with phthalates and alterations of endogenous reproductive

[70] ASTDR (Agency for Toxic Substances and Disease Registry). 2002. Toxicological Profile for Di (2-ethylhexyl) phthalate (DEHP). April 2011. http://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=684&tid=65(Interviewed on May 32011)

[71] http://www.atsdr.cdc.gov/ToxProfiles/tp71.pdf

[72] http://www.atsdr.cdc.gov/ToxProfiles/tp71.pdf

[73] http://cht.a-hospital.com/w/%E4%BA%8C%E7%94%B2%E8%8B%AF#.UdPaz9WS3Dc

can also affect balance. [74] In professional contexts, xylene mainly enters through the respiratory tract.

• Styrenes

Styrenes are a type of highly reactive aromatic alkene. There are many uses for styrenes and they are widely used to create many important raw materials such as general polystyrene, polystyrene foam, styrene butadiene latex, ion exchange resin and medicines. It is also the most commonly used linking agents for unsaturated polyester resin and the cheapest hard monomer for acrylic emulsion polymers.

Styrene has a sharp stink and as the concentration increases, so does the strength of the smell. Inhalation of large amounts can cause dizziness and headache, loss of appetite, weakness and an effect on red blood cells and platelets. In 1996, research by the International Agency for Research on Cancer at the World Health Organization concluded that styrene was indeed carcinogenic. People who breathed in styrene in gas form developed lymphoma, hematopoietic malignancies and non-tumorigenic diseases. The latter has latent potential especially in diseases of the central nervous system. [75]

• Dichloromethane

Dichloromethane is a colorless, highly volatile liquid with a light fragrance. It has been widely used as a solvent because it can be mixed with most organic solvents and is non-toxic.[76]

The toxic materials in dichloromethane can cause headache, nausea, loss of consciousness or even death. It can irritate the skin and eyes and has been listed as a potential carcinogen. Under most situations, dichloromethane is not flammable, but it will burn when heated. Under high temperatures, it produces toxic gases like hydrogen chloride and phosgene. Exposure at extremely high concentrations can lead to loss of consciousness and death. Chronic Toxicity of Dichloromethane: 1. extremely high concentrations can cause damage to the liver and kidneys. Reports have also shown that concentrations of 500 ~3,600 ppm can cause brain damage. 2. It can also lead to cancer causing dermatitis. Three research reports show that workers subjected to long-term exposure did not show increased potential for cancer, but the International Agency for Research on Cancer (IARC) has listed it as a carcinogen.

[74] http://www.atsdr.cdc.gov/ToxProfiles/tp71.pdf

[75] Evaluation of the Toxicity of Styrene Shenyang Chemical Li, Zidong Vol.28 No 4 Dec. 1999 http://wenku.baidu.com/view/3d61881cc281e53a5802ff37.html

[76] http://case.ntu.edu.tw/hs/wordpress/?p=4651

GREENPEACE 绿色和平

3/F, Julong Office Building, Block 7, Julong Garden, 68
Xinzhong Street, Dongcheng District, Beijing, China.
Postal Code: 100027
Tel : +86 10 6554 6931
Fax : +86 10 6554 6932
www.greenpeace.cn