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THIRSTY COAL 2: SHENHUA'S WATER GRAB

An investigation into the over-extraction of groundwater and illegal discharge of wastewater by Shenhua Group's Coal-to-Liquid Demonstration Project in Ordos, Inner Mongolia

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

Report Summary

This investigative report is a follow-up to a 2012 joint study by Greenpeace and the China Academy of Sciences: *Thirsty Coal: A Water Crisis Exacerbated By China's New Mega Coal Bases*^[1]. This report will focus on the most controversial part of China's coal strategy: the proposed further development of the coal chemical sector. In particular, Greenpeace investigated the largest of the 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 powerfully demonstrates the threat to China's water resources posed by the unchecked expansion of coal-reliant industries.

The Shenhua Group is China's largest coal conglomerate, producing 460 million tons of raw coal every year. Half of this total comes from the largest integrated coal field, Shendong, with proven reserves which provide 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 mines. Shenhua Group's Ordos Coal-to-Liquid Demonstration Project is located in the Shendong coal field.

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

“Water Grab”

Greenpeace's investigation revealed that in the eight years that it has been in operation, Shenhua's Coal-to-Liquid Project has gone to extraordinary lengths to secure the water it requires; and the investigation has found alarming evidence of the resultant widespread ecological and social damage. Shenhua's plundering of water at the expense of the local population and the baseline needs of the environment can only be described as a ruthless “water grab”.

Ignoring the serious deficit of water resources and the ongoing environmental damage already caused by its mining operations, in 2002 the Shenhua Group began construction of 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 waste water.^[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 to the Haolebaoji region, in the heart of the Mu Us desert, 100 kilometres away from its proposed plant, and began extracting water. Shenhua's actions in Haolebaoji have resulted in a drastic drop in local groundwater levels and obvious environmental damage, causing serious difficulties for local farmers. So far, Shenhua has extracted a total of over 50 million tonnes of groundwater.^[5]

From March to July 2013, Greenpeace

visited Haolebaoji eleven times to analyse the impact on the environment of Shenhua's over-extraction of groundwater. We found the following:

- Shenhua has drilled 22 wells, each over 300 metres deep, which extract as much as 14.4 million tonnes of water per year. This depletion has caused the groundwater levels to drop by up to 100 metres^[6]. Since 2006, every single artesian well in the region has run dry and most wells less than 30 metres deep have been abandoned. Now, local people must dig new wells at least 100 metres deep to access water.
- There has been a large decrease in the surface area of Subeinaoer Lake, the main lake in the region. Satellite images show that by 2011, the lake had decreased by 1.27 square kilometres, or 62%, when compared

with images from 2004 (before Shenhua began extracting water for its Coal-to-Liquid Project in Ordos).

- There has been a decline in surface vegetation. A great deal of the vegetation planted by local residents in the region, such as salt cedar, sagebrush and yang chai (羊柴) is dying. Poplar forests, planted to block wind and sand, are failing.
- Natural and planted vegetation covering sand dunes is also dying, causing sand dunes to expand and become mobile, leading to increasing desertification of the grasslands. In the past, low lying areas, riverbanks and lakes were relatively plentiful in water; but now sand has settled into rivers and lakes, and sand dunes have spread.
- It has become very difficult for farmers and herders to obtain water. The water that 2,402 households (5,752 people) depend on for survival has been lost, with 80,000 hectares of land affected by severe water shortage. Water needed for irrigation has become scarce and land productivity has declined with abandoned fields everywhere. The herds that can be supported in grazing areas have declined dramatically, with fewer

large animals, especially cows and horses. The number of sheep has also fallen. Many petitions about water extraction have been submitted by local farmers and herders.

Illegal Discharge of Industrial Wastewater

After detailed technical analysis, Greenpeace's investigation into the discharge of industrial wastewater by the demonstration project shows that the total amount of industrial wastewater produced by the Shenhua Coal-to-Liquids project for each 1 million tons of end-product could be as high as 4.79 million tons per year.

As one of the Fortune 500 and a self-proclaimed green corporation, Shenhua has stressed that in the course of implementing any project, it has made every effort to use mechanical cyclical evaporator technology with membranes, ensuring that waste water is completely re-used. It is claimed that this technology meets the highest international standards^[7] and can re-use over 95% of wastewater. Shenhua has constantly

^[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 Relocation of All 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 EastAsia, March 2013

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

emphasized that it has a zero-discharge system, a sufficient number of evaporation pools, and takes strict anti-leaking measures, to ensure that the actual number of pollutants entering the water cycle is zero. So, has this huge amount of wastewater, after being treated and turned into apparently harmless run-off, had any detrimental effect upon the environment?

During recent visits made by Greenpeace to Shenhua's Coal-to-Liquid plant in Ordos, we noted seepage pits no more than 500 metres from the main office building. There, highly toxic industrial wastewater was being released and left to seep naturally into the ground, polluting the groundwater below. Greenpeace collected a number of samples at the discharge sites, which were sent to two independent labs for testing - 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: the sulfide level was almost twice the national guideline level, while 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 the 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 depleted local water reserves normally 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 Group did not canvass local opinion ahead of the project. It is also thought that construction began before the project was properly licensed, a possible violation of the Water Law and the Grasslands Law of the People's Republic of China. The project is in direct conflict with massive investments made by the Chinese government in recent decades to protect the Mu Us desert. Nor does it comply with the government's water policy that requires "the strictest management of water resources". It also contravenes the requirement for the coal industry to "limit expansion based on water capacity".

In spite of the continuing damage to the environment and to the livelihoods of local residents, a proposal to expand the Coal-to-Liquid project was submitted for an environmental impact assessment in December 2012. This impact assessment is currently under review. Shenhua's plan to expand the scope of the project is now an issue of even greater concern. Shenhua is planning to build a coal-to-natural gas project alongside the Coal-to-Liquid plant, capable of producing 2 billion cubic metres of gas each year. Once operational in 2016, it is expected that total water usage will rise to up to three times the current level, and nearly twice the maximum capacity of the Haolebaoji reserves. To make up the

difference, Shenhua may increasingly look to extract water from the Yellow River to support its operations.

Water is the source of life, the key to production and the foundation of the environment. If the coal industry continues to drain away the local water, it will have no choice but to ultimately leave the area. In an environment deprived of the water it needs, rivers will dry up, and the ecosystems will no longer be able to support life.

Led by large-scale state-owned enterprises like Shenhua, the coal industry, which includes mining, thermal power and chemical production, have plundered the Yellow River basin and groundwater, worsening the already delicate ecosystems along the middle course of the Yellow River. This has caused an exodus of local residents, as coal interests expand. This short-sighted development model that concentrates only on GDP growth, without any apparent concern for the environment, must be stopped immediately and re-evaluated.

Therefore, Greenpeace calls for the following:

First, the Shenhua Group must immediately cease causing damage to the environment and water resources in the Haolebaoji region, and curtail the illegal discharge of polluted water. Furthermore, Shenhua Group must halt operations that will further damage both water resources

and the environment in the course of Phase One of the Ordos Coal-to-Liquid Demonstration Project, as well as all of Phase Two, and the coal-to-natural gas project.

Second, in view 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 must all set clear, scientific and applicable rules that truly adhere to the principle of limiting coal expansion based on water capacity. Coal chemical projects must be subject to strict reviews of water usage and environmental impact at their application stage. Projects that do not meet these strict requirements must be rejected.

Third, 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 must re-evaluate the expected impact of coal-chemical projects that have already been approved, based on water resources. Adjustments must be made, and the results of such re-evaluations must be released.

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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 auspices of the Chinese Academy of Sciences entitled, *Thirsty Coal: A Water Crisis Exacerbated by China's New Mega Coal Bases*^[8]. The study estimated that the annual amount of water needed to run the 16 large-scale coal power bases outlined in the 12th Five-Year Plan will reach at least 9.975 billion m³ by 2015 – equivalent to one sixth of the annual total water volume of the Yellow River in a normal year.

This report is a follow-up study looking into the most controversial part of China's coal strategy: the proposed further development of the coal-chemical sector. In particular, Greenpeace has investigated the largest of nine coal chemical demonstration projects: Shenhua's Coal-to-Liquid Project located in Ordos, Inner Mongolia. This massive and controversial project is a classic example of how unchecked expansion of coal-reliant industries is having a detrimental effect on China's natural water resources.

The recent rise of China's coal-chemical sector

The past few years have seen explosive growth in China's chemical industries. According to a 2011 KPMG report^[9], the chemical sector is made up of over 33,000 enterprises, with total revenue surging to 20.2 percent CAGR for the period spanning 2006–2010. This compares to 1.4% in Japan and 12.2 percent in India in

the same period.^[10] At that time, the chemical industry was the third largest in China, after textiles and machinery, and accounted for 10 percent of the country's GDP.

In view of China's abundant coal reserves and its lack of oil, the chemical sector

has shown intense industry interest in the processing of coal to create petrochemical products such as olefins, ethylene and propylenes.^[11] According to IHS Chemical China^[12], coal has been used since the 1970s in China to create an array of basic chemicals and materials, such as methanol, ammonia, PVC and benzene. Therefore, coal-chemical processing has moved further up the economic value chain, with companies such as Shenhua, and China Power Investment Corporation producing ever more complex coal-derived chemical products. An impetus for such development has been a lack of rail capacity to transport coal from northwestern supply areas to centres of high demand in eastern China. This has created an impetus for companies to convert coal into other chemical products, in areas near to where it is mined.

Concerned about the coal industry's over-enthusiasm, the Chinese government set out in its 11th Five-Year Plan (FYP, 2006–2010), a vision of "orderly advancement of demonstration projects to develop deep processing of coal and coal transformation industries, and the advancement of coal liquefaction demonstration projects"^[13]. In that period, 9 coal-chemical demonstration projects were approved, to test technical

and commercial viability ahead of further development.^[14] Shenhua's Direct Coal Liquefaction Project was one of the first projects to be approved, and was even included as part of the national energy security strategy.^[15] But the rush towards coal-chemical processing is today increasing at an alarming rate, due to a slowdown in coal demand from the domestic power sector, alongside massive over-mining. In 2012, the National Development and Reform Commission (NDRC) of the People's Republic of China approved 15 large-scale demonstration projects. According to an official in the National Energy Bureau, an additional 104 proposed projects have since been submitted to the NDRC for approval. If all of them go ahead during the 12th Five-Year plan period, total investment will reach a staggering 2 trillion RMB.^[16]

The NDRC is soon expected to release its national coal-chemical strategy for the 12th Five Year Plan. This study by Greenpeace demonstrates that any proposal to expand the coal-chemical industry remains highly controversial, due to the industry's intensive reliance on water and energy and the resulting serious pollution. Any further development will have significant environmental and social implications.

^[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/yphen/20130407/1693469.html>



Nearly thirty years of coal mining has 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's Coal-to-Liquid Demonstration Project in Ordos

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 intensive coal mining along the river in the Ulan Moron area, which lies near the border between Shaanxi and Inner Mongolia. This mining contributed more than 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 coalfield in terms of proven reserves, which make up 1/4 of the national total. It is one of the world's eight largest coalfields 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 Plateau. The climate is dry and harsh. The field has a total area of 31,200 square kilometres and has proven reserves of 223.6 billion tons.

The Shendong mining zone was one of the first discovered, and is located in the centre of the Shendong coalfield. It is currently the most productive zone. In 1985, the Chinese government invested more than 89 billion RMB in the Shenhua Project in an attempt to address coal shortages faced by Chinese industry. Large-scale mechanized excavation began in the Ulan Moron and Daliuta regions, alongside 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. Just six years later, by 2004, this amount had increased to 85.75 million tons

per year. In 2012, this number had reached 230 million tons per year, 6.3% of China's total coal production. This comprised a full 50% of Shenhua's total production. From 1998 until the present day, the company's coal production has expanded at an average 28.3% annually.

However, the result of this "coal boom" has been that in the short 30 year life-span of the Shendong mining zone, severe damage has been inflicted on the environment and water resources in the region. In 2008, the Shenhua Remote Sensing Prospecting Co., Ltd. issued a document that highlighted ground surface damage over an area of 180 square kilometres of the Shenhua mining zone. Sinkholes, cracking, shifting and deformation of the land had resulted in damage to vegetation over an area of 17,700 hectares, including 6,267 hectares of key farmland. Also damaged were underground aquifers and aquacades, with a decrease in surface runoff, a fall in groundwater levels and a drying up of springs. The large amount of waste earth produced had resulted in serious topsoil loss and exacerbated soil erosion to a degree of 45.14 tons per year, plus 20.19 tons of silt deposits per year. 20,000 hectares of land have experienced desertification.^[17] Between 2001 and 2010, a total of 4,175 homes, housing 12,011 people,

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

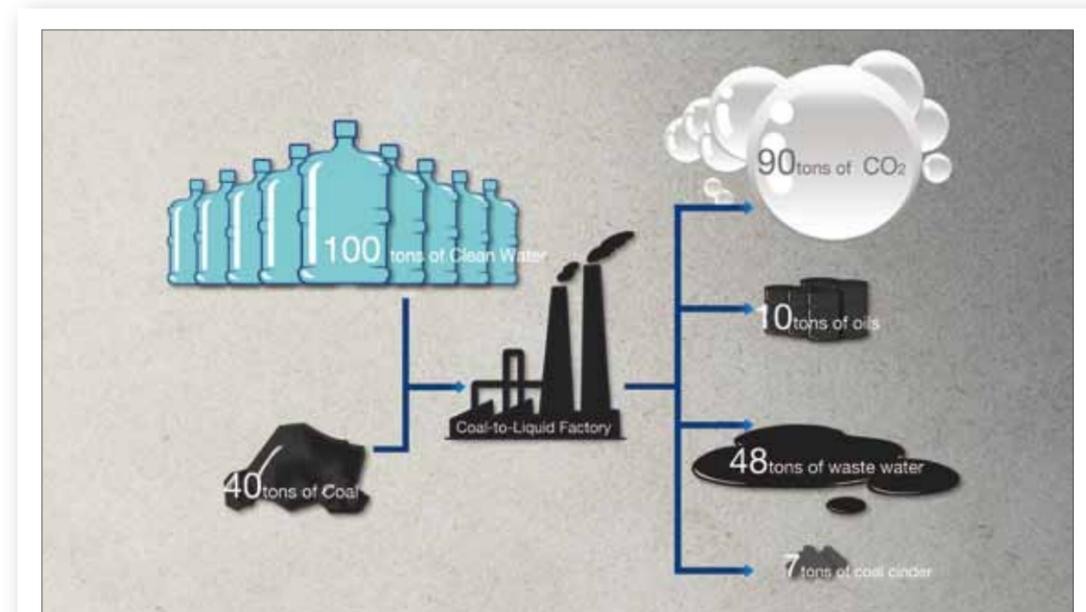
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have been forced to move due to sinkholes caused by mining operations.^[18]

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 water run-off. The river's main branch has run dry several times and many of its tributaries have dried up completely. Research by the Yellow River

Conservancy Commission under the Ministry of Water Resources shows that coal mining was the main reason for an average annual decline in the Ulan Moron River's water resources of 2.9×10^8 cubic metres, between 1997 and 2006. The research attributed 54.8% of the runoff reduction to coal mining - every ton of coal mined has produced a drop in water runoff of 5.27 cubic metres^[19].



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

^[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.

Coal-to-Liquid technology: highly water-intensive and highly polluting

(Water consumption, energy consumption and industrial waste discharge levels of direct coal liquefaction)

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 the resulting wastewater, both processes are controversial, within and

outside the industry.

Studies show that direct coal liquefaction (DCL) requires 3-4 tons of coal as feedstock to produce 1 ton of oil. Indirect coal liquefaction (ICL) requires even more. For every ton of oil produced using direct coal liquefaction, 10 tons of water is needed. 9 tons of carbon dioxide is emitted, along with 4.8 tons of wastewater and 0.7 tons of solid waste.^[20] Indirect liquefaction requires 14 tons of water for each ton of oil produced, and releases 10 tons of carbon dioxide into the atmosphere.^[21] Another industry source

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	3.5/1000m ²	6 - 10/1000m ²	200-300/1000m ²	>10/1000m ²	1000 - 1200/1000m ²
Methanol	2 - 3	12 - 15	300 - 400	3 - 4	1300 - 1700
Dimethyl ether	3 - 4	14 - 18	500 - 600	4 - 5	2000-3000

Comparison of different coal chemical processes. Source: Pucheng Clean Energy Chemical Company

^[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.

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shows that water use can be as high as 17 tons per ton of oil.^[22] Direct coal liquefaction uses 12-16 times the amount of fresh water and produces 14 times the amount of carbon dioxide, compared to traditional refining processes.^[23] Worryingly, these calculations only focus on the core techniques used in Coal-to-Liquid processing. They do not include water used by associated projects like coal power plants and coal washing / selection plants.

The establishment of industrial projects with such high water usage and such serious levels of pollution in areas with severe water scarcity and fragile ecosystems is a policy that cannot be sustained.

The Ordos Coal-to-Liquid Project: extreme water use in Phase 1

Construction began on the Shenhua Coal-to-Liquid Project in Ordos in 2004. 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. It lies just 6 kilometres from the Shangwan mine.



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

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

^[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

The project has two phases and will ultimately be able to produce 5 million tons of petroleum products every year, including diesel, naphtha and liquefied petroleum gas. Supplementary products include industrial crude phenol and industrial sulfur. Phase One involves three production lines with a total production capacity of 3.2 million tons per year. In December 2008, the first production line, with production capacity of 1.08 million tons went into operation, becoming China's only large-scale commercial operation to use direct coal liquefaction technology. In February 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 tons.

In addition to the first production line, the Shenhua Coal-to-Liquid Project also includes an indirect liquefaction facility capable of producing 180,000 tons of product per year.

Products include liquefied petroleum gas, naphtha and diesel. Construction began in August 2007 and the project went into operation in December 2009. The project has been very capital intensive, with costs of 1 billion RMB.

ENERGY DEMAND

In order to power the energy intensive process at the Coal-to-Liquid plant, additional facilities are being constructed, including the continued expansion of internal power generation facilities. The ongoing project will ultimately house 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). Total capacity will thus reach 680MW. The first phase was completed in 2007, and houses three boilers, two turbines (3×440t/h+2×100MW) and three 3×6B combined cycle units (3×40MW).

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WATER DEMAND

As discussed in the last section, the project requires a massive amount of water to operate. 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 claims that this production line withdraws as much as 10 million tons of water per year.^[25]

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 range of serious environmental and social problems. The second section of Chapter 2 will discuss these in more detail.

FUTURE EXPANSION PLAN IN ORDOS, AND EXPECTED RISE IN 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-per-year Coal-to-Synthetic Natural Gas (SNG) project next to its current plant. This would require as much as 13.23 million tons of water per year.^[27] In December 2012, initial work, including an environmental impact assessment, began for the second and third production lines of Phase One of the Shenhua Coal-to-Liquid Project. Production

WATER EXTRACTION AND 100KM PIPELINE PROJECT

Over the past thirty years, the Shenhua Group's uncontrolled large-scale, mechanized mining operations in this area have resulted in a rapid decline in both surface and ground water resources, rendering a highly water-intensive process such as Coal-to-Liquid production unviable.

To secure the water needed for its liquefaction operations, Shenhua Group initiated large-scale well drilling operations in the Haolebaoji region of the Mu Us desert basin, 100 kilometres from its project base.

capacity of these new lines is expected to reach 2.12 million tons per year by 2016.

Conservative estimates show that by 2016, the water required by the three production lines of Phase One of the Shenhua Ordos Coal-to-Liquid Project will reach 40.68 million tons per year, three times the current levels. This is nearly twice the maximum design capacity of the water extraction project in the Haolebaoji region.^[28] Therefore it must be very likely that Shenhua will be forced to

extract water from the Yellow River to make up the shortfall.^[29]

According to internal plans by Shenhua Group, a second phase with a production capacity of 1.8 million tons per 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 per year.

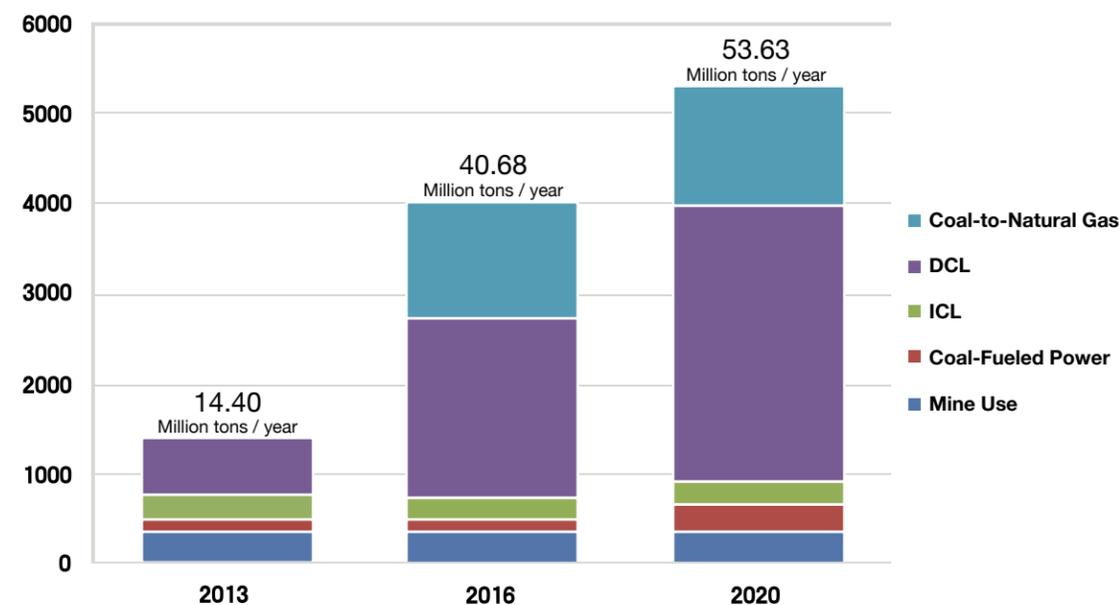


Table: Current and Expected Annual Water Requirements of the Shenhua Ordos Coal-to-Liquid Project

^[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/qgdt/201111/t20111108_514940.html



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

Shenhua Group's plans for Coal-to-Liquid projects in Ningxia and Xinjiang

Most of China's coal production occurs in the arid or semi-arid central and western regions of the country. The proposed amount and timing of the use of water resources must be scrutinized, Irresponsible industrialization will inevitably have a direct impact upon local social and economic stability and the local environment.

However, despite this, the Shenhua Group has already obtained permission to start construction of a 4 million ton per year Coal-

to-Liquid project in the Ningdong region of Ningxia Province. In addition to this, construction has already begun of a 3 million ton per year Coal-to-Liquid project near Urumqi in the Xinjiang Uighur Autonomous Region. According Shenhua Group's internal reports, under the 12th Five Year Plan, by 2015 Shenhua will produce 3 million tons of petroleum products, 5 million tons of chemical products and 1.8 billion cubic metres of natural gas. By 2020, petroleum, chemical and natural gas production will reach volumes of 11 million and 10 million tons, and 1.83 billion cubic metres respectively.^[30]

^[30] Shenhua Group Plans under the Twelfth Five-Year Plan, 2010.

		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 ^[31]	2.52 million tons	
		200 megawatt coal-fired power production unit	0.30 m ³ /s · GW	1.23 million tons	
		Shendong Mining Zone Residential Water Use	1.0 m ³ /day ^[32]	3.6 million tons	
2016	Initiated (environmental impact assessment underway)	2.12 million tons/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 · 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.

^[31] Wang, Jiming. The Current State and Future of China's Modern Coal Chemical Industry [J]. Modern Oil and Petrochemical, 2012, 212(8): 1-6

^[32] 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



2

Shenhua's Water Grab in Haolebaoji:

ecological disaster, social unrest

The Haolebaoji agricultural and grazing region 100 kilometres to the west of Shenhua's Ordos plant is an important source of water within Inner Mongolia's Mu Us desert region. Water in the area has been relatively abundant in the past. However, since the Shenhua Group began extracting water from the area on a large-scale in 2006, the local ecosystem has rapidly declined. Groundwater levels have dropped dramatically and there has been widespread loss of vegetation, including salt cedar trees

and yang chai. The extent of desertification has increased, with the surface 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, as well as the size of their herds. On some occasions, drinking water has become scarce. The destruction of such a basic resource has raised strong public anger among outraged local residents, with serious implications for social stability.

27 April 2013 - Haolebaoji, Inner Mongolia - this used to be a lake, but now it's completely dry. ©Greenpeace/Bo Qiu

THIRSTY COAL 2: SHENHUA'S WATER GRAB

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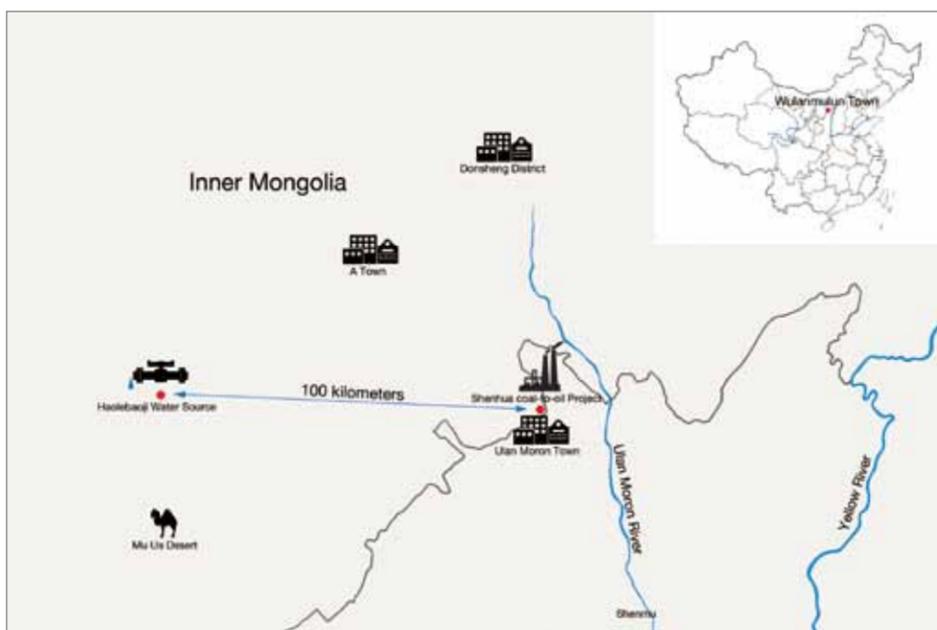
Shenhua's Water Grab in Haolebaoji
ecological disaster, social unrest

Water Extraction: 22 mechanized wells extract groundwater which is then piped over 100 kilometres to Ordos

In the area surrounding the Shendong mining zone where the Shenhua Coal-to-Liquid plant is located, surface and ground water volumes have been completely and irrevocably depleted.^[33] Consequently,

Shenhua has decided to implement large-scale drilling projects in the Haolebaoji region, taking groundwater from its grasslands, and piping it to its Coal-to-Liquid facilities in the Shendong mining zone.

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. It lies 100 kilometres from Shenhua's Coal-to-Liquid plant. The



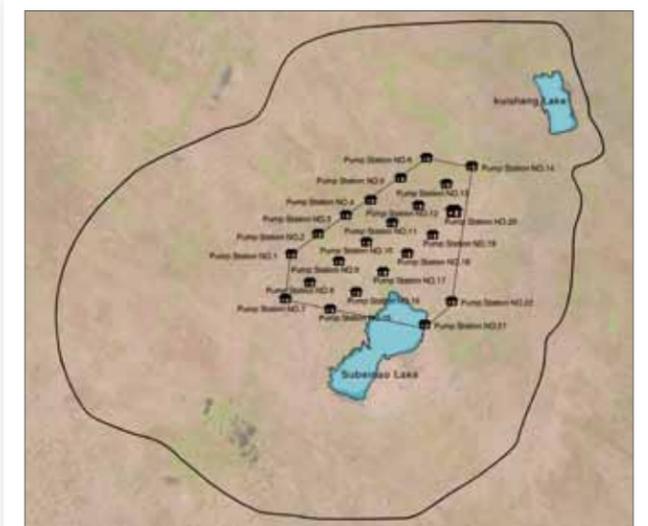
The Haolebaoji area, in the Mu Us desert is 100km from the Shenhua Coal-to-Liquid Project

^[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 年 , 15(3): 24-27

affected region covers a total area of 80,000 hectares, which includes 2,333 hectares of irrigated farmland and 77,300 hectares of grazing land. It includes five villages: Haolebaoji, Bahannao, Adaohai, Zhongnai and Chahanmiao,^[34] which currently consist of 2,402 households, home to 5,752 people.

Haolebaoji is located in the heart of the Mu Us desert. It has a pronounced continental highland climate with an average annual rainfall of just 346.2mm and an evaporation volume of 2,253.8mm. Despite this, groundwater resources within Haolebaoji have been relatively plentiful in the past. 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 naturally in Subeinaoer Lake. This forms a closed drainage basin with

extractable water resources estimated at 80,000 cubic metres per day.^[35] However, as the geological formation is relatively closed, 76% of groundwater recharging is dependent on rainfall. Lateral recharging is rare and water levels are difficult to restore once they have fallen. This means that the devastation caused by over-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

^[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 falling groundwater levels. Shallow wells have been abandoned. Animal husbandry has been badly affected. ©Greenpeace/Bo Qiu

DISPARITIES BETWEEN SHENHUA, GOVERNMENT AND REPORTED WATER CONSUMPTION DATA

- **COMPANY:** According to Sinopec Engineering Design Co. Ltd. (the designer of the water extraction facilities for Shenhua's Coal-to-Liquid Project), 22 wells were designed for the extraction facility with a maximum total extraction rate of 58,000 cubic meters per day. Their initial total operating rate was set at 30,000 cubic metres per 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 tons per year or 40,000 cubic meters per day.

In another document released in 2004 by the NDRC (NDRC Resources 2004-#1734), the original plans called for 36 wells with a maximum extraction capacity of 90,000 cubic metres per 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, with a total annual extraction volume of 22.92 million tons.^[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 tons starting from 2007.^[39] (TOTAL OR PER YEAR?)

^[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 disparities in the data demonstrate 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 increased enormously from the initial projections. By 2012, the actual amount of water extracted from Haolebaoji had already begun to approach the total design capacity of the current project, far exceeding original estimates. It has already severely exceeded the ecological limits for the Haolebaoji region.

ILLEGAL CONSTRUCTION, ABSENCE OF REQUIRED CONSULTATION, IGNORED APPEALS

Shenhua's Haolebaoji water extraction project began test drilling between March and September 2003. In April 2005, the first pump station and pipes were constructed, with water extraction beginning in May 2006. However, the right to exploit the local water sources was not "approved" until January

2006^[40] and the water extraction permit was not issued until January 2008. When challenged by local residents in Haolebaoji, local government officials could produce no water extraction licensing documents. They lied to the residents, saying that the Shenhua direct liquefaction project had "obtained permission for water extraction from all levels of government,"^[42] that "the extraction project must go forward"^[43] and that "it had 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 under the Water Law and under the Regulations on Water Extraction Approval and Water Resource Fees.

In addition, the regulations require the applicant to submit an assessment of the extraction project's potential impact on any third parties. Before deciding on an application, licensing authorities are required to be made aware of any concerns expressed by impacted stakeholders. Should the applicant or the concerned 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.

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require a hearing, the relevant department should hold such a hearing. If the water-extraction permit application is subject to any disagreement or litigation, 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 tell us that they were not consulted at any stage, either before Shenhua began illegal construction of its water extraction plant, or during the permit application stage, once construction was complete. Local residents even made two official appeals and coordinated several group protests; however, the extraction permits were still approved. In the eight years since the extraction started, angry residents of Haolebaoji have petitioned against the project many times. Nonetheless, in January 2013, Shenhua's water extraction permit was swiftly renewed.^[45] (See supplement "A Decade of Fighting: a story of the Ordos grasslands" for petition transcripts.)

In such cases of water-intensive projects, the local government in Ordos has clearly prioritized GDP growth above the

environment. Local people have been left feeling angry and helpless. In 2000, when the Ejin Horo county government allowed Shenhua to "run" a project, it promised residents they would be helped to find alternative water sources.^[46] Ruthless disregard for ecological preservation and environmental sustainability, whereby local government officials make ill-considered decisions, rashly allowing big business to take all the fresh water they need, is one of the root causes of the human and environmental tragedy now playing out in Haolebaoji.

FEARS FOR THE FUTURE

Shenhua is planning a second and third production line for its Coal-to-Liquid project, plus a 2 billion cubic metre-per-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 designated 58,000 cubic metres-per-day maximum that was set for the Haolebaoji region. The fragile ecosystem and the livelihoods of local farmers and herdsmen in this region are facing complete destruction.

^[45] Water Balance Testing Report by Ordos Coal-to-Liquid Approved by Experts. Shenhua Coal-to-Liquid Website. <http://www.cscl.com.cn/xwygg/gsxw/2013-04-15/1186.shtml>. 2013-1-31

^[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

Alarming and widespread ecological and social damage has already been caused by "the water grab", in the eight years since the Coal-to-Liquid Project started operations. In response, Greenpeace visited the Haolebaoji 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 – grassland groundwater levels fall at a dramatic rate

The 22 wells constructed for the water extraction project are more than 300 metres deep on average. They are capable of extracting a total of 40,000 cubic metres of water per day.

Research shows that an extraction volume of 8×10^4 cubic metres per day, coupled with a recharge volume of 12.20×10^4 cubic metres per day, in the decade after 2009, would cause groundwater levels in the Subeinaoer basin to decline at a rate of 2.8 metres per year. The maximum drop over a 15 year

period would be 32 metres.^[47] The Inner Mongolia Second Hydrogeology Engineering Geological Prospecting Institute, which designed the extraction project, reviewed its survey findings in 2012. It said local groundwater levels in the Haolebaoji region had recently dramatically dropped between 5-10 metres.^[48]

Greenpeace has found that the actual changes in water levels and the overall impact of these both far exceed the estimates of a decade ago.

Eight years into the project, wells that local residents rely on for their daily needs, which are generally less than 30 metres deep, have mostly been abandoned. This has affected five villages with a total population of 5,752. Interviews with local residents indicate that the groundwater table may have dropped by as much as 100m in some parts. Local farmers and herdsmen say that in the 1970s there were many artesian wells, but these have all now run dry. New wells have to be dug that go at least 100 metres deep, if residents are to ensure a steady water supply.^[49]

^[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.

^[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.



Children from a herding 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 well would shoot water up to two metres high. Since Shenhua's water extraction began, it has run dry, with the surrounding land turning to desert. ©Greenpeace/Bo Qiu

Haolebaoji Residents' concerns 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 was seriously affected. When test drillings for these 36 wells were being done, statistics and estimates showed that inflow levels in the area 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 and while prospecting programs by the government show that there are rich groundwater resources, the close relationship between surface and ground water, and the relative lack of surface water, 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 the operation phase.

2. Dry lakes and shrinking surface water

The shrinking size of Subeinaoer Lake directly reflects the drop in groundwater levels in the surrounding area. Subeinaoer Lake is located at the bottom of a basin and is a discharge area for phreatic aquifers. Estimates show that if water extraction is carried out at 80,000 cubic metres per day for 30 years, the inflow volume of Subeinaoer

Lake will drop from an initial estimate of $2,113.61 \times 10^4$ cubic metres per year to 302.76×10^4 cubic metres per year. This will cause the water level of the lake to drop 0-5 metres. It is therefore clear that the size of Subeinaoer Lake will continue to reduce over time.^[50]

During its surveys, Greenpeace found 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



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



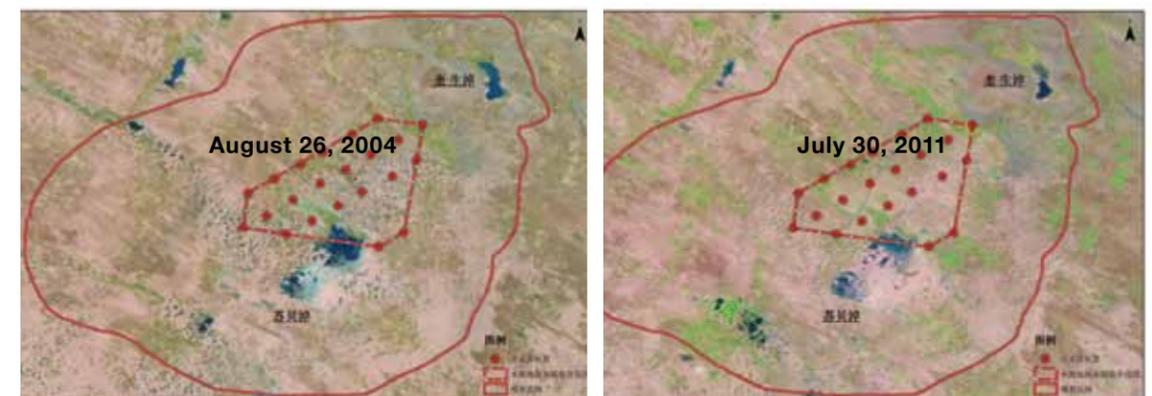
A gradual decline in the water level of Subeinaoer Lake has made it necessary for salt farms along its shores to extract groundwater to replenish the lake, in order to stop it receding further. ©Greenpeace/Bo Qiu

Subeinaoer Lake has long been used for salt production. Now, due to its shrinking size, the lake has split into two parts - a northern and southern lake. This has actually allowed for more salt-production. To preserve the water levels and ensure that the lake continues producing salt, salt farms extract groundwater from wells to recharge the lake. Apart from the areas where salt is produced, areas of ecologically functional water are extremely limited. Satellite images from 2011 show that since 2004 (before Shenhua began extracting groundwater) the lake had shrunk by 1.27 square kilometres, 62% of its former size. One herding family living near the lake said that water levels on the west side of the lake had gone down considerably, with low-lying areas that were previously been full of water now dried up. They said two thirds of local farmland has had to be 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 people living nearby. The wetlands are gradually disappearing.

3. The sand is coming: shifting sand dunes indicate the onset of desertification

The water extraction zone of the Shenhua Coal-to-Liquid Project is part of the Mu Us desert. In modern times, this area has been characterized by mainly semi-permanent sand dunes, seasonal rivers and lakes. Water saturation of the soil around the lakes and rivers and between the sand dunes was generally good. Vegetation cover was high and moving sand dunes were rare, making it an ideal place for farming and grazing. With the rapid decline in groundwater levels, the



Satellite remote sensing maps show how Subeinaoer Lake and Kuishengnao Lake within the water extraction zone (circled) have shrunk rapidly in size between 2004 and 2011.

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natural and planted vegetation that covered the sand dunes has largely disappeared. This has led to the sand dunes starting to shift. Large stretches of mobile sand dunes have formed and these are growing in size and increasing in number.

Surveys by Greenpeace show that water in low-lying areas, such as riverbanks and the shores of lakes was originally plentiful. However, in places where wind-blown sand and sediment were greater, mobile sand dunes are appearing more often. These areas have traditionally been good grazing land and farmland. Their rapid desertification is directly impacting farming and herding industries.

The Mu Us desert is one of the major sources of northern China's dust storms. For decades, a series of scientific programs have attempted to control the impact and encroachment of the desert sand into northern China. Greenpeace's surveys show that with the large-scale extraction of groundwater, great expanses of manually planted trees and brush, which are designed to stem the tide of desertification, and help prevent sand storms, are now dying, actually accelerating the desertification process.

4. Surface vegetation is dying

The Haolebaoji region is interspersed with semi-brush grass-like vegetation,

wetland grasses and trees. Different areas have poplars, willow trees, sand willow, sagebrush, ningtiao (柠条, caragana microphylla), jijicao (芨芨草, achnatherum splendens), Indian aster, bugseed and sedge. Sand willow, jijicao, Indian aster and taicao (苔草) are unable to survive if groundwater levels fall below 8 metres. Once vegetation in a sandy region is damaged, restoration is a lengthy process. As will be explained in the fifth section of this report, the region in which the water extraction is taking place is the site of a number of national and regional sand control projects. Thus the Shenhua Coal-to-Liquid Project is in direct conflict with these projects.

Between March and June 2013, Greenpeace 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. This eastern section is a classic example of bedrock tableland. Nearly 30% of poplar trees have died, while the remaining trees are withering. Meanwhile, 60-70% of the yang chai (羊柴) forests have died.
- Most of the poplar forests in the northern agricultural areas that were 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



Large-scale water extraction has resulted in a greater number of shifting sand dunes and accelerated the process of desertification. ©Greenpeace/Bo Qiu



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

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ecosystem has been almost totally wiped out.

- The amount of yang chai (羊柴) and salt cedar in the south and west have also died off. Coverage of grazing grasses and the production of biomass have both dropped off considerably.

5. On the brink: farmers and herders struggle to survive

In 2005, when the water extraction project began, the local government was informed of residents' concerns. It pledged that a "balance could be achieved between extraction and recharging without any impact on the environment." The local government promised that an entire series of projects would be put in place to safeguard local sources of drinking water, ensuring water conservation and reuse. It also assured residents that comprehensive irrigation programs would be undertaken. A commitment was made that the amount of irrigated land per capita would increase by 3 mu (equal to 0.2 ha) within 5 years.^[51]

However, Shenhua's plundering of groundwater in the Haolebaoji region has 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 cannot support as many livestock, forcing herders to decrease the number of animals they raise. Interviews by Greenpeace indicate that among herding families, the quantities of sheep raised has fallen sharply by over one third, while herds of horses and cows have more than halved in number.

During interviews with farmers, Greenpeace found that farmlands have shown a variable but marked reduction. A large number of farmlands have been completely abandoned. Others have had to switch crops due to limited water supply. At the home of a family not far from Shenhua's central pumping station, we saw 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 that the Shenhua water extraction project

^[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 County Letter[2005]#62



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



Large numbers of salt cedar planted by herders have died. ©Greenpeace/Bo Qiu



Many of the salt cedar trees and yang chai planted by villagers have died. Where this man is standing was once a pond. It has now completely dried up. ©Greenpeace/Bo Qiu

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had already caused local groundwater levels to drop 15 metres, affecting the water levels in 2,163 wells and making irrigation impossible. It was reported that 458 households engaged in farming, including animal husbandry of 80,000 livestock, were facing serious difficulties and that the livelihoods of farmers and herders were in serious danger. Frequent petitions had been made by local residents and the situation was clearly contributing to social instability.

(For transcripts of these petitions, see the supplement "A Decade Of Fighting: A Story From The Ordos Grasslands")

The government of Ordos was urged by some representatives of the local 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



Recently sprouted corn shoots are dying because they can't be irrigated due to the dwindling number of wells. ©Greenpeace/Bo Qiu



Groundwater levels continue to fall forcing local herders to dig deeper wells. ©Greenpeace/Bo Qiu

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Shenhua's Water Grab in Haolebaoji
ecological disaster, social unrest

"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 centre 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 (equal to 5.87 ha) of land irrigated by 3 wells. I also raised over 400 sheep and 50 cows. 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 are dropping and production 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 life has become very difficult. The irrigated land I have spent years cultivating is now wasted and the trees I have planted are dead. The personal loss to me is enormous. Despite subsidies from the government, not enough is being done 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 it is 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 has caused extremely serious water shortages. Five villages in Uxinzhao Township, Uxin Banner, including Haolebaoji, lie in the vicinity of water extraction by 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 per year. 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 has a higher salt content and the quantity is insufficient for the needs of vegetation. Surface vegetation has died off and some regions have experienced total 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 issue. This has caused social instability and disharmony in the region.

Ordos is currently experiencing rapid development of its regional economy and there are a number of industrial projects still to 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 with 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 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 use 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 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. Herders are forced to raise fewer sheep each year.
©Greenpeace/Bo Qiu



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

Conclusion

Field investigations by Greenpeace have shown that, as a result of the plundering of groundwater in Haolebaoji by the Shenhua Coal-to-Liquid Project located 100 kilometres away, the local groundwater has almost completely dried-up and the local environment has been extensively damaged. Groundwater levels have dropped dramatically, lakes have shrunk and vegetation has died. Desertification is on the rise, causing a decline in agriculture and grazing. These environmental and social consequences of the Shenhua project show 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.

Under pressure from local residents and increasingly bound by new environmental regulations, local governments have considered bringing in water from the Wanjiashai Reservoir in Shanxi Province^[53] and the Yellow River in Dengkou County, Inner Mongolia.^[54] However, water resources along the main trunk of the Yellow River are already over-taxed. The balance between supply and demand is increasingly precarious; the amount of water the river needs to move sediment and support the local environment has been ignored, 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. These factors are now threatening the very survival of the Yellow River.

The evident and dramatic ecological and social consequences caused by the Shenhua Coal-to-Liquid demonstration project within just eight years must serve as a warning for government agencies like the Ministry of Water Resources and the Ministry of Environmental Protection against the further expansion of coal-chemical projects. These projects are water and 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

^[54] Achievements of Water Infrastructure Construction in Uxin County, 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 Pollution Discharge in Ulan Moron: industrial wastewater dumped into the ground

Huge quantities of industrial wastewater are produced by complex coal-chemical processes. Based on careful examination of technical materials, of the equipment used and the experiences of other refineries and power production facilities, Greenpeace estimates that the total amount of industrial wastewater produced by the Shenhua Coal-to-Liquids project could be as much as 644 cubic metres per hour. Given that the designed capacity for the equipment is 7,440 hours and an estimated 1 million tons of liquid products per year, the total volume of wastewater would thus be 4.79 million tons per year or 4.79 tons of wastewater for every ton of product produced.

As one of the Fortune 500 companies and a self-proclaimed green corporation, Shenhua claims 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 involve the reuse of over 95% of wastewater. Shenhua has consistently claimed it has a zero discharge system, involving a sufficient number of evaporation pools. This is in addition to strict anti-leakage measures. The company says that these methods ensure that zero pollutants enter the water cycle. So has there been any impact on the environment from this huge volume of wastewater?

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

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The location of the Shenhua Coal-to-Liquid Project's three discharge dumpsites
©Greenpeace/Bo Qiu

Shenhua insists it employs state-of-the-art technology in its Coal-to-Liquid project, claiming that the amount of pollutants produced per ton of product is lower than most advanced refineries. Shenhua says it has truly achieved zero emissions. However, the truth uncovered by Greenpeace is that industrial wastewater is being directly discharged into open sand pits.

Greenpeace has found that Shenhua has illegally discharged industrial wastewater into surrounding areas and that the discharge is likely to have contaminated underground water. In April and May 2013, Greenpeace 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 to Greenpeace's Laboratory at the University of Exeter.

These tests have found high levels of harmful substances: sulfide levels were almost twice the national standard, while 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 carcinogenic.



A 400 square metre illegal seepage pit 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

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

Shenhua's first wastewater discharge site (dumpsite 1) is situated at the north corner of the Coal-to-Liquid plant, just 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 dumpsite covers an area of 400 square metres and is comprised of natural, sandy soil. Nothing has been done to prevent seepage. The industrial wastewater in the pool is inky-black and smells strongly of petroleum. Some trees in the center and around the edge of the pool are dead.

Using seepage pits to dispose of industrial wastewater can threaten groundwater once

the wastewater seeps into the ground. It is extremely harmful and a number of Chinese laws prohibit this type of action. The offence can be prosecuted under Article 338 of China's Criminal Law.

Satellite images show that the illegal dumpsite appeared in early 2011, nearly two years ago. The nearby road has been blocked, making the pond hard to find. The fact that this large-scale illegal discharge site, located so close to Shenhua's plant, has been in use for so long would suggest that the company is intentionally breaking the law. At the same time, Greenpeace asks how it is possible that local enforcement



October 30, 2010: No trace of the seepage pit.



May 27, 2011: A black wastewater pit has appeared.



September 30, 2011: The black pit has expanded.

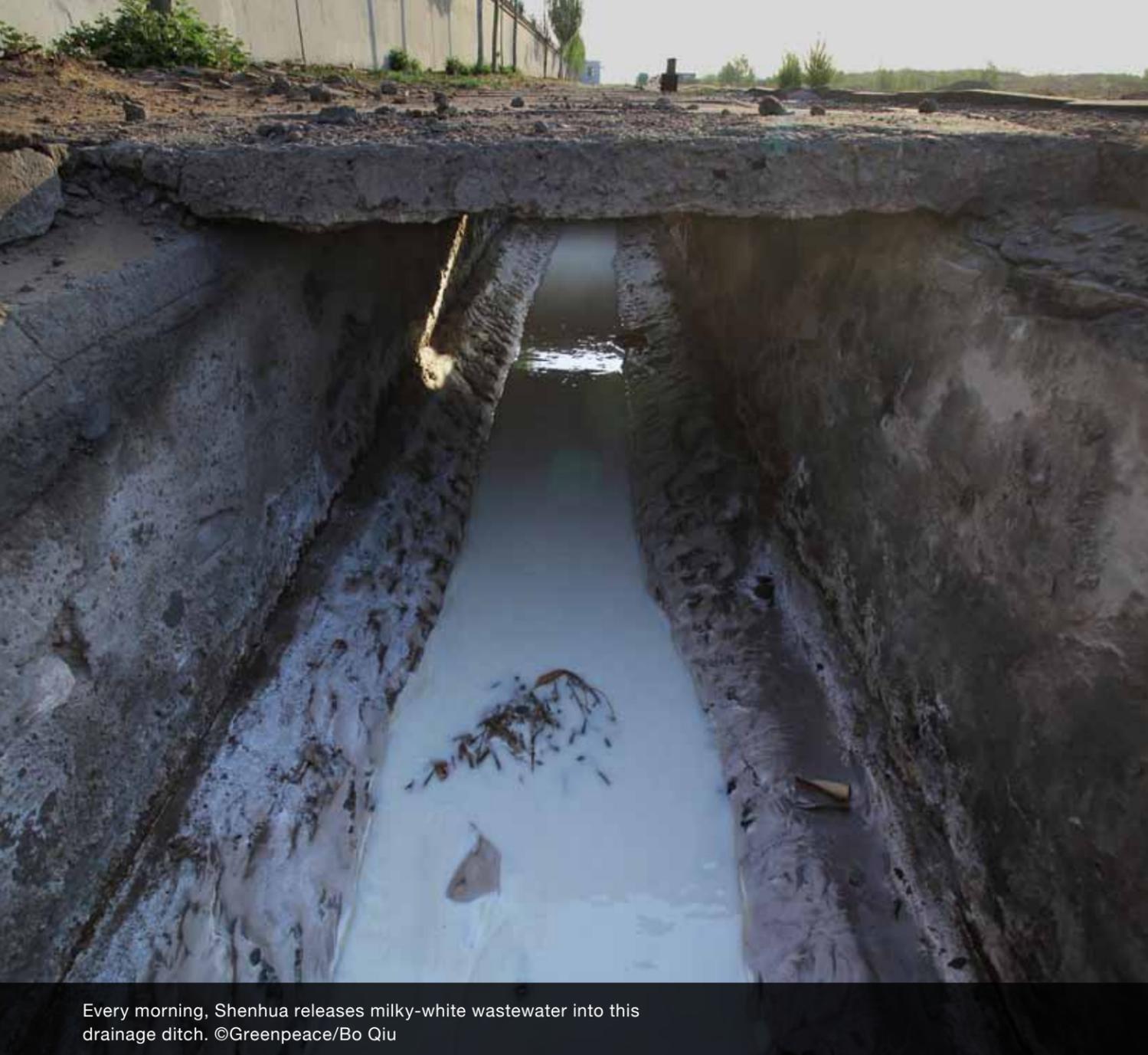


June 9, 2013: Black colour remains despite draining

agencies did not know about the wastewater dumpsites. And if they did know, what action did they take?

On May the 8th, 2013, after Shenhua learnt about investigations by Greenpeace, they tried to drain the wastewater using a suction

tube and transfer it to another pit in the area. This only served to spread the pollution and accelerate the wastewater's seepage into groundwater. After the water was extracted, the bottom of the seepage pit remained deep black.



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

Wastewater Discharge Site 2: "Rivers of Milk" pollute downstream waterways and kill trees

The second wastewater discharge (site 2) is located just outside the southwest corner of the plant. At night, milky-white wastewater flows through a covered drainage ditch to a nearby patch of sand. As the wastewater

quickly seeps into the sand, it creates a band of greyish-white deposit several kilometres long. No anti-seepage measures have been put in place and all nearby trees are dead. This pollution discharge eventually reaches a nearby river.

A nearby fish farmer says that in 2010, wastewater from the Shenhua plant flowed into his fishpond, killing all his fish.

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

The third wastewater discharge site (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 its promotional materials, Shenhua says that this evaporation pool is how it achieves its zero discharge claim.

However, during its surveys, Greenpeace has found that next to the evaporation pool, wastewater has collected freely on the ground, producing a strong smell of rotten eggs. It is highly likely that insufficient or no anti-seepage lining was used in building the

pool. This failure must be investigated by environmental protection authorities.

Sample testing shows organic pollutants, some carcinogenic

During April and May, 2013, Greenpeace took nine wastewater and sediment samples from the three industrial wastewater discharge sites, scientifically recording the sample collection process.

All samples were sent to both the SGS laboratories in Shanghai, the world's largest laboratory for inspection, verification, testing and certification, and the Greenpeace Laboratory at the University of Exeter in the United Kingdom.

Wastewater samples were subjected to three

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 flows 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.

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different pollution tests, for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) and heavy metals. Sediment samples were tested for two pollutants - semi-volatile organic compounds (SVOCs) and heavy metals.

Summary of Greenpeace's sample test results:

In samples from discharge Site #1, SGS laboratories found sulfide levels twice the national standard and Benzo(a)pyrene levels 3.3 times the national standard.

In addition, large amounts of toxic and harmful organic compounds were found at each of the dumpsites. As many as 99 different kinds semi-volatile organic compounds were found, including polycyclic aromatic hydrocarbons (PAHs) and PAH derivatives xylene, styrene, dichloromethane and cresol. Many of these have been determined to be carcinogenic. There are, however, no specific standards set to control the discharge of coal-chemical industrial pollutants at a 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 using new technologies, produces

complex arrays of pollutants, making the safe treatment of wastewater difficult and expensive. With a large number of coal-chemical demonstration projects now 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 standards" (GB8978-1996), sulfides were 2 times the national level, while benzo(a)pyrene levels were 3.3 times the national standard.

Greenpeace's 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. Samples were collected at this location twice. The first samples, taken on 27th April 2013, contained a total of 99 compounds, of which only 25 could be reliably identified (reliable identification requires greater than 90% match quality after expert interpretation). These include pyrene, fluoranthene and various derivatives of PAHs. Quantitative analysis of this sample by an independent laboratory in the 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 at Greenpeace's 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 impact of the release of such waste 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 May 4th 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 in this location over time, or from some degree of absorption into underlying soils/sediments (thereby removing them from the water) or from some further breakdown of the contaminants.

Discharge Site #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

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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 impact on groundwater should the contaminants persist for sufficient time to percolate through the soils.

Discharge Site #3:

These 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. Possibly the liquid component will evaporate over time, and the more volatile contaminants will 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 it was 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 Greenpeace's analysis of all samples taken from each of the 3 discharge sites, some chemical

compounds were found that are 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.
- Styrene 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, an 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 oestrogen 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, there has been little research into pollutants produced by modern coal-chemical industrial technologies. The results presented above do not represent a complete overview of waste discharges and environmental contamination relating

^[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 kilometres to the Shenhua Coal-to-Liquids plant. By the time it goes through the Shenhua plant and is illegally dumped, it has become heavily polluted (left). ©Greenpeace/Bo Qiu

to Shenhua's coal liquefaction plant. They are snapshots, which provide an illustration of the complex and hazardous nature of the wastes generated by the facility and discharged to the surrounding environment, either through formal or informal disposal operations. Likewise, it is not possible to draw firm conclusions from the analyses conducted on a limited number of samples 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.

Greenpeace's 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 risk. 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 dumpsites may turn local river basins and groundwater supplies into "storage facilities" for persistent, toxic pollutants. When there is heavy rain or rivers flow stronger, these sediments may become

disturbed and enter surface or groundwater and ultimately flow into the Yellow River system.

Because of the difficulty in obtaining these samples, Greenpeace has yet to carry out a full analysis of them, making it difficult to judge the seriousness and extent of the pollution resulting from the illegal discharge. 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. China's Ministry of Environmental Protection and other related agencies should investigate and restrict 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 from its processing plant, it has also been eroding the quality of the remaining water resources in the region through the large-scale discharge of polluted industrial wastewater. In arid regions, water is an extremely precious resource. Shenhua's illegal practices are environmental crimes. They represent a complete failure by the company to fulfill its most basic social responsibilities.

As a major corporation under China's central government, Shenhua hides 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 directly contravene multiple environmental protection policies and laws

Shenhua Group's extraction of groundwater from the Haolebaoji region for its Coal-to-Liquid project in Ordos has depleted water used for agricultural, ecological and residential purposes. It has also breached legislative ecological limits – so called “red lines” - causing serious damage to the local ecosystem and threatening the livelihoods of local farmers and herders.

Shenhua's actions, depriving the population and 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 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 make up the Mu Us desert, 13,800 are comprised of active sand formations that have continually expanded over the millennia.

Faced with increasing environmental degradation, modern China has invested a lot in projects to keep sand formations in check and preserve 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

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17,066 hectares of new forest. In 2000, Uxin county was named as a test site for returning farmland to forest. In 2001, loans amounting to 36.08 million RMB were taken out in Japanese Yen, to fund a program to prevent sand expansion over the course of the coming decade, by creating 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. From 2001 to the present, Uxin county has been a key location in efforts to manage 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". This designation requires the protection of water and soil, prevention of erosion and the encouragement of animal husbandry.^[57] Southern Uxin county is part of the "Mu Us desert sand control vegetation band zone". National regulations clearly prohibit the promotion of water-intensive industries in arid or semi-arid regions. In basins of rivers that have stopped flowing, the building of new water extraction or storage facilities is also prohibited and individuals and companies are required to

use water resources reasonably, to 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] Where desertification is getting worse, companies are required to try to restore the natural environment and ecosystems, using artificial methods.

In the Inner Mongolia Functional Zoning regulations, released in July 2012, the Mu Us Desert was designated as a sand control zone and included on a list of regions where development must be limited. 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 regulations also state that "in regions where there is a severe shortage of water resources, environmental capacity is low, ecosystems are weak or subject to frequent earthquakes or geological natural disasters, energy and mineral resource extraction must be strictly controlled."

^[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 depletion of groundwater has made it impossible to keep pine trees just outside Shenhua's Coal-to-Liquid plant alive. Most have already died.
©Greenpeace/Bo Qiu

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

Knowingly Breaking the Law
Shenhua's actions go against multiple environmental protection policies

Shenhua's Coal-to-Liquid project in Ordos has all but destroyed the ecosystem of the Majiata region. It has then turned to the heart of the arid, ecologically delicate Mu Us desert region to extract large amounts of groundwater. This practice goes against national directives on ecological preservation and seriously threatens to undermine advances made in ecological management over recent 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 in trying to prevent desertification, and putting the rest of the country at risk.

Shenhua's activities contravene local and national policies demanding "Strictest Water Resource Management"

Ordos is a very arid region, which suffers from drought nine years in every ten. The environment is harsh and over half of the region's water comes from underground reserves. Rapid industrial development centered on the coal industry has resulted in soaring demand for groundwater resources. The need to protect groundwater resources has been recognized at all levels of government, including national, provincial, and local.

In December 2010, the State Council issued National Functional Zoning Regulations, requiring "strict systems for water resource management". The regulations said the "*management and protection of groundwater must be strengthened, while over-extraction of groundwater must be dealt with severely, ensuring an overall improvement in soil retention efforts.*" The central government also requires that "*the development of the energy sector in the Ordos Basin is regulated using strict water resource management. 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 state 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 so 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 the "*strict management and protection of groundwater and the immediate issuing of prohibitions and limitations on extraction,*

gradually lowering the extraction of groundwater and establishing 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 must be prohibited and new service industry projects may not use groundwater resources. Over-extraction must also be gradually lowered and a balance between 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, saying that "*strict limitations must be placed on water intensive industrial projects in regions with water shortages.*"

Inner Mongolia's Groundwater Protection Plan was initiated in June 2011. It used the case of the falling groundwater levels caused by Shenhua's Coal-to-Liquid water extraction project in Haolebaoji 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 is occurring and that existing extraction for industrial purposes be replaced with alternative techniques that

use surface water. The Saihan District water supply zone in Huhhot and the Haolebaoji region of Ordos were included as key protection and management zones. In these areas, complete protection is required of groundwater sources with a supply volume of over 10,000 cubic metres per day, through the use of project-based planning and non-project measures, in order to form a comprehensive protection, management and detection system for groundwater extraction zones.

Article 24 of the Inner Mongolia Autonomous Region's Regulations on Saving Water in Agriculture, implemented on December 1st, 2012, requires that governments at county level and above organize industrial development structures based on the state of local water resources and environmental capacities within their respective administrative regions. New constructions, as well as refitting or expansions of water-intensive industrial projects, are prohibited from using groundwater without permission. Established water-intensive projects that use groundwater must take steps to minimize water consumption and gradually reduce the amount of groundwater they extract. They must switch to non-conventional water sources and surface water, if these other sources are locally available. Article 46 states that those who break these rules will be given a time limit by the county

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government's water administration agencies to conform to the regulations and fined a minimum of 50,000 RMB and a maximum of 100,000 RMB.

Article 28 of the Inner Mongolia Autonomous Region's Administrative Measures for Groundwater Management (Pending), released on January 4th, 2013, stipulates 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.

The Communist Party of China's party secretary for Inner Mongolia, Bate'er, has emphasized the importance of protecting groundwater on numerous occasions. On December 28th, 2011, Bate'er spoke at a regional economic work meeting, saying, "Work on replacement water source projects for water-intensive industries must be accelerated, transitioning them away from using groundwater." On February 15th, 2012, Bate'er once again emphasized this in a report to the autonomous region's

People's Government, calling the scientific development and the reasonable use of water resources "imperative". The report also states "in implementing the strictest measures for the 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 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, saying that "Firstly, the use of groundwater is high, around 68%. The development of groundwater in the irrigation zones of Galutu, Haolebaoji and Wudinghe is 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 seasonal rivers run dry or disappear completely. Lakes and wetlands have also seen varying degrees of decline."^[59] In terms of response measures, the Uxin county government proposed to "actively fight for Yellow River water allocation, with the goal

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

of sourcing 100 million cubic metres of water from outside the region by 2017" and to "find alternative water sources for industrial projects as soon as possible to replace the use of groundwater from the Haolebaoji region, in order to stop local ecological degradation."

Policy infringements and duplicity 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 affected parties (in this case, the villagers of Haolebaoji).

Application documents for an extraction license must include a "stakeholder impact 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 the preservation of water resources and 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 public hearing on the application. In cases where there are conflicts of interest between the applicant and other involved individuals, 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 time, the approval process will be resumed.

In reality, during Shenhua's application to build and run its Coal-to-Liquid water extraction project, villagers in Haolebaoji were **never** consulted, despite launching numerous objections. Nonetheless, Shenhua was given a water extraction license. Greenpeace, along with the Haolebaoji villagers, highly suspect that the Inner Mongolia Water Resources Department did not follow the requirements of the State Council regulations.

Furthermore, construction of the Shenhua Coal-to-Liquid water extraction project began in April 2005. However, it wasn't until January 2006 that the location for the

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project and water allocation was permitted.^[60] Shenhua did not officially receive its water extraction license until January 2008.^[61] Construction of 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 regulations over the past two 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 wastewater containing toxic pollutants, polluted water containing pathogens or other waste material into seepage wells, seepage pits or caves. Article 42 of the same law states that in areas that are not naturally isolated, enterprises and public units are prohibited from using ditches and 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 water 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 4th, 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 the prevention of seepage, in order 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.

^[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/zry/shzz/mhg/index.shtml>



Rapid deterioration of vegetation in Haolebaoji. The land continues to turn to sand causing anger among local residents. ©Greenpeace/Bo Qiu

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.

On June 17th, 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". In this, it was stated 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 of three years or less, or a fine; more serious cases may be punished by a prison sentence of between three and seven years, in addition to a fine.

Shenhua at odds with national policy on the coal-chemical industry

In response to the water-intensive, energy-intensive and highly polluting nature of the coal-chemical industry, national-level administrative agencies implemented clear requirements for the coal-chemical industry



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

as early as 2006. In July 2007, the National Development and Reform Commission issued a notice on strengthening the management of coal-chemical project construction and promoting healthy industrial 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 in China's economic development. China's water resources are far below the world average. Moreover, in China's major coal production areas, the amount of water resources per capita and water reserves per unit of area are only 1/10th the national average. Water usage in large-scale coal-chemical projects often amounts to ten times the amount of end product. Some regions are investing more heavily now in coal-chemical projects than ever before.

This will create production surpluses and will ultimately damage the delicate balance of water resources, directly affecting social and economic stability as well as the ecology. At the same time, hastily constructed large-scale industrial Coal-to-Liquid and alkene projects are not only highly risky, they also leave concealed dangers that may affect the healthy development of the industry."

The National Development and Reform Commission has also required that those responsible for 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 re-use of wastewater, 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 entitled "Evaluation of Carrying Capacity for Key Energy and Chemical Industrial Zones in the Upper and Middle Reaches of the Yellow River". This report examined coal chemical projects in the region.^[62] The evaluation proposed a water control measure whereby industrial production is based on water resources available, clearly requiring development plans for water-intensive or chemical projects to be based on the carrying capacity of regional water resources. Only once regional environmental, residential and agricultural water resource needs are met can "appropriate amounts" of development be carried out.

^[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

As in many similar projects, the Shenhua Coal-to-Liquid Project has caused extreme damage to local water resources and ecosystems. It has also come into conflict with and violated national environmental protection policies, policies governing the protection of water resources, environmental protection policies and policies governing macro industrial development. Greenpeace is asking how the Shenhua project was assessed, what was the basis for the decision to allow the project to go ahead, and which government agencies should be

held accountable?

It is Greenpeace's view that this demonstration project has demonstrated nothing other than a huge environmental catastrophe.

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

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Greenpeace's 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 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 contravened 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 proximity, containing dangerous, toxic substances. Tests of collected samples have found Benzo(a)pyrene levels in PAHs to be 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. The Ordos Coal-to-Liquid Project has polluted the environment and further threatens the safety of groundwater. Not only is this contrary to Shenhua's "zero output" claim, 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 and criminal actions of Shenhua at its Ordos Coal-to-Liquid Project must be seen as yet another warning 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 a continued growth in 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 suggests that from initial environmental impact assessment to supervision, local governments acquiesce to the demands of investors. The consequence has been massive environmental damage and irreparable harm to the stable social conditions of residents.

Being socially responsible is not only a mission and responsibility of central government. It

is also a public expectation of companies under central government control.^[63] However, despite being one of 53 directly managed large-scale state owned enterprises, Shenhua Group's actions have completely contradicted its media declarations. Over years, the group's record of pollution damage to the environment has been extensive. On national and provincial level environmental protection agency websites alone, nearly fifty examples 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 cease production. In June 2013, the Ministry of Environmental Protection issued another order for the second phase of an expansion project of Shenhua's Anqing power plant to cease construction and for the group to reorganize its building plans. This was an illegal construction that had gone forward without having an approved environmental impact assessment. In 2009, Shenhua was also ordered by the Ministry of Environmental Protection to cease the construction of an additional experimental facility at the Ordos Coal-to-Liquid Project,

because it didn't pass its environmental impact assessment.

Faced with criticism and investigation by the public and the government, Shenhua Group has still continued its activities causing damage to the environment. **Greenpeace questions where Shenhua's social responsibilities lie as a massive state-owned enterprise. Are the advanced technologies it boasts about and its environmental commitment merely empty words?**

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

In order to prevent any repeat of this huge environmental tragedy, the National Development and Reform Commission, the Ministry of Industry and Information Technology, the Ministry of Water Resources, the Ministry of Environmental

^[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

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

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Protection 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 ensuring 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. Projects that do not meet the requirements must be rejected.

For 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 must re-evaluate the expected impact on water resources by these projects, make relevant adjustments, and release the results of such re-evaluations.

Environmental degradation caused by the Ordos Coal-to-Liquid Project is not an isolated case. Jinjie, Qingshui, Yuheng and Nalin River are large-scale coal base industrial zones similar to the Shenhua Coal-to-Liquid Project in Ordos. These are being built and expanded

in large swathes 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. They face a difficult task in keeping expanding sands at bay. Due to the impact of the coal industry, the Yellow River and its tributaries have already been damaged and polluted and the over-extraction of groundwater has also had a very serious impact. The unchecked expansion of the coal industry is not sustainable and is certain to cause ever more environmental and social problems. **A change in direction is urgently needed.**

The threat of coal development to water resources has attracted widespread public attention and debate over the extent of the expansion of China's 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.

The following appendices provide further data to support this report.

Appendix I:

Timeline of Shenhua's 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 gets 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 million tonnes / year DCL expansion project went into production	
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	<p>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.</p> <p>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-.</p> <p>Volatile Organic Compounds: 2 types of volatile organic compounds were detected. Sample (CW13026) was found to include methane and trichlorofluoro-carbons.</p> <p>Heavy Metals: No high concentrations of heavy metals were found in this sample.</p>
	Sediment	<p>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.</p> <p>Heavy Metals: No high concentrations of heavy metals were found in this sample.</p>
Discharge Site #2	Wastewater	<p>Semi-volatile Organic Compounds: Sample CW139024 was found to contain extremely complex organic compounds (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, diethyl phthalate, and dis(2-ethylhexyl) phthalate. Pollutants also included a series of organo-sulfer compounds and some carboic acid compounds (including 4-methyl and 4-propylphenol) as well as toluene, phthalate, and low molecular mass volatile chlorinated compounds (1,2-dichloroethane, dichloromethane and carbon tetrachloride).</p> <p>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-, Ethane, trichloro-, Methane, dichloro-, Methane, tetrochloro- and toluene.</p>

Sample Location	Sample Type	Main Pollutants Found
		<p>Sample CW13015 was found to contain 9 volatile organic compounds, 7 of which could be reliably identified, including: Chloroform, ethane, 1,2-dichloro-, ethane, trichloro-, methane, dichloro-, Methane, tetrachloro-, Methane, trichlorofluoro- and toluene.</p> <p>Heavy Metals: No high concentrations of heavy metals were found in the sample.</p>
	Sediment	<p>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 hydrocarbons. 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.</p> <p>Tetradecane, Phenol, 2-methyl- and Phenol, 3-methyl.</p> <p>Heavy Metals: No high concentrations of heavy metals were found in the sample.</p>
Discharge Site #3	Wastewater	<p>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</p> <p>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, nenzene, 1,1'-(1,2-ethynediyl)bis-, nenzene, 1,3,5-triethyl-, benzene, 1-methoxy-4-(1-methyl-2-propenyl)-, Benzene acetaldehyde, 2-methoxy-, Benzene methanol, 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 substitute compounds. There was also benzene, xylene, substituted benzenes and (non-chlorinated) biphenyls and benzofurans. PAH-pyrene was also found and some methylated derivatives.</p> <p>Heavy Metals: No high concentrations of heavy metals were found in the sample.</p>

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, a clear dose effect relationship exists between the concentration of PAHs and the rate of lung cancer or death. Separate research results confer. (Armstrong et al., 2004)

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

• Phthalates

Phthalates are dialkyl or alkaryl ester benzene (aka 1,2- benzenedicarboxylic acid). The name phthalate comes from a combination of phthalate acid and its original word naphthalene. Phthalates are a general term for (SEMI?) organic 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 PVC, 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.^[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]

Phthalates have similar functions as oestrogen 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, phthalates 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, 6 phthalates 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 of 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 in paint thinners 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. Industrial accidents can lead to large amounts of xylene entering into soil, water and air.^[72]

Xylene has a mild toxicity level and is somewhat carcinogenic.^[73] Scientists have found that all 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,

^[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>

with symptoms such as headaches, lack of muscle coordination, dizziness and confusion. It can also affect balance.^[74] Xylene mainly enters the body through the respiratory tract.

• Styrenes

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

Styrene has a sharp smell and as concentrations increase, so does the strength of the odour. 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 World Health Organisation's International Agency for Research on Cancer concluded that styrene is carcinogenic. Inhaling styrene in its gaseous form can cause 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 is often mixed with most organic solvents to produce industrial and commercial solvents.^[76]

The toxic materials in dichloromethane can cause headache, nausea, a loss of consciousness and 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: 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. It can also lead to cancer-causing dermatitis. Three research reports have shown that workers subjected to long-term exposure did not show increased potential for cancer. However, 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>