China’s Mineral and Metals Industry:
On the Path towards Sustainable Development?

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Abstract: China’s enormous demand for natural resources is vividly discussed among researchers and politicians. The investments of state companies in foreign oil and gas fields and mines, the government’s resource diplomacy, and increasing prices are mostly associated with the Chinese policy. A concern which received much less attention is the exploration and exploitation of resources within China. This research note presents the empirical basis of a PhD-project on sustainability in China’s mining and metals industry. It examines the recent development path and challenges of sustainability in this industry. The Chinese resource culture has been traditionally struggling with inefficient extraction and wastage of resources, severe environmental impacts, high resource-intensity and illegal mining. The question is whether it is heading towards a more sustainable path and which factors determine this possible transformation. It will be concluded that in spite of some progress and political efforts in resource and environmental protection, China so far did not realize a sustainable mining and metals industry. The production is planned to further increase with demand, inefficiency and environmental pollution remain a problem, and environmental policies face series of challenges.

Keywords: China; Mining and metals industry; rare earth; steel industry; sustainable development

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China’s economic development is driving up demand for natural resources, in particular minerals. The construction and manufacturing sectors have an insatiable hunger for steel and cement. Steel production in turn requires more coking coal, iron ore and other alloy metals. Geologists searched the national territory in the quest for mineral deposits. Today, China is the world’s largest producer and consumer of dozens of minerals and exports many of them. Others, such as iron, copper, and nickel have to be imported in masses. The tremendous mobilization of minerals is paid at a high price for the environment and also the economy. The mining and metals industry is haunted with low efficiency, wastage of resources, high energy intensity and concentration on low-value products. Moreover, the economy is very resource intensive. To what extent has China been able to uncouple from this “unhealthy” resource culture? To what extend did China successfully increase efficiency and produce more high-value products? Is the mining and metals industry on track of the official goal of a sustainable economy? The answers to these questions serve as an empirical basis for a dissertation project on sustainability in China’s mining and metals industry. Preliminary results show that China did not leave the resource-intensive path and the industry is still struggling with old problems. However, a general trend towards more efficiency is visible and the government launched some promising policies but also meets several challenges.

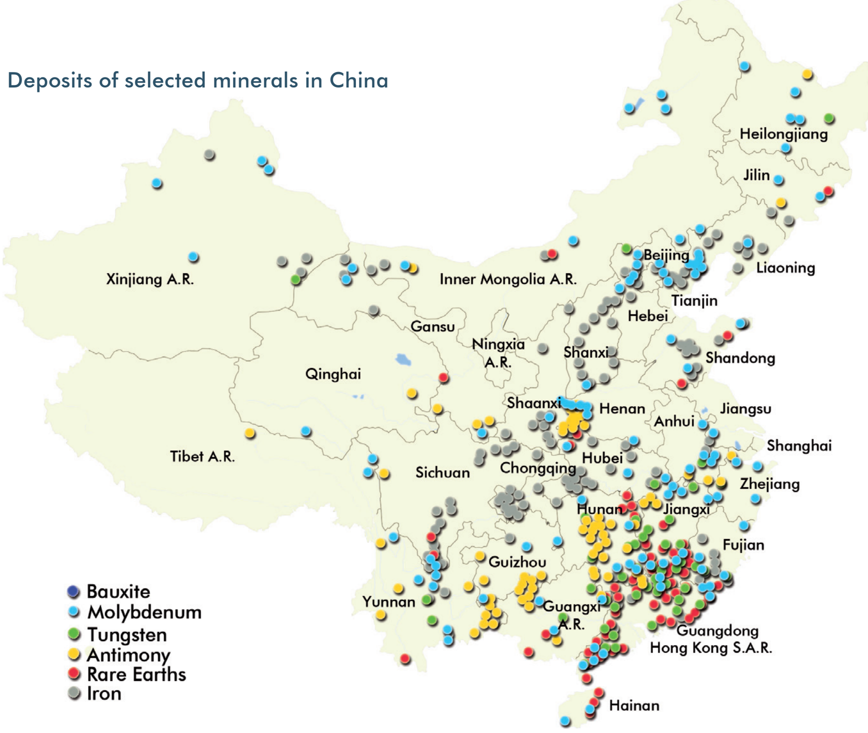
Baiyun'ebo Mine © Bert van Dijk 2011

Rise of a resource giant

The resource culture of early Qing Dynasty (1644-ca.1750) was quite different from today. The mining industry was in a difficult position: The authorities forbid mining in many cases because they considered it to harm local fengshui, the harmony of man with his environment, and the "dragon life lines," which ran throughout the country. But at the end of the dynasty, reformers believed that the insufficient use of minerals has contributed to China's backwardness (Wu & Shen, 2001). China stepped up its efforts to explore the country's geological richness in the 1930s. The largest deposits have been discovered until the late 1970s, such as the iron mine of Bayan Obo in Inner Mongolei, the copper mine of Dexing in Jiangxi, the iron mine of Panzhihua in Sichuan, and the lead-zinc deposits of Lanping in Yunnan (Zhu, 2006). That China today holds the largest reserves of many minerals is due to the geological mobilization around that time (Xibu Ziyuan, 2011). However, China remained a dwarf in production, with the exception of tungsten (also known as wolfram) and antimony. This changed in the reform era, when domestic demand revitalized the mining and metals industry, especially since the 1990s. Economic reforms allowed state-owned enterprises (SOE) more leverage and town-and-village enterprises (TVE) became an important pillar of the resource economy. Regarding steel and coal, around half of production was provided by TVEs and local SOEs in the mid-90s. As of 2007, the mining and metals industry accounted for 5.5% of GDP (Lin et al., 2011). Chinese think that their country has "a large total amount of minerals, but little per capita, and a poor natural endowment" (总量大、人均少、禀赋差). Although China is rich of natural resources, the amount is small regarding the huge population. The low ore grade of Chinese minerals makes extraction more difficult, more expensive, and more resource-intensive (Lin et al., 2011).

China is today the greatest producer of magnesium (54% of world production), fluorite (54%), baryte (57%), silicon (65%), germanium (67%), graphite (73%), tungsten (85%), antimony (91%), rare earths elements (95%), and other minerals. Many of these have important application in industry. Rare earths are relevant to the wind-power sector, electronics (e.g. mobile phones), electric vehicles and other appliances of highly efficient generators. Tungsten is primarily used in cemented carbides in construction, metalworking, mining and the oil industry (USGS, 2012). Most of produced minerals are consumed domestically, but China also became a major exporter. The share of exports in total production is decreasing, however. 27% of antimony metal output was exported in 1995, but today it is only 2.7%. A similar tendency can be observed for tin, zinc, and other metals. But as of 2009, China was the largest supplier of many resources for the European Union, including rare earths, antimony, indium, tungsten and tin (Raw Materials Supply Group, 2010).

Deposits of selected minerals in China



Source: Jost Wübbeke; Design J. Wübbeke/Tino Kaiser.

Resource use at high costs

The extraction of domestic resources puts particular strain on national reserves. China's production-to-reserve ratio is generally lower than the global average. Current reserves of antimony could be used up within eight years, zinc in ten years, baryte in 13 years, and manganese in 18 years. Although these reserves are going to increase due to economic demand and technological change, this points to an appalling overuse of national deposits. Whereas the investments in geological exploration are growing, discovery of new reserves is declining (Gu & Cheng, 2010).

The wastage and inefficient production of resources is a persistent problem. Compared to foreign mines, the percentage of recovered minerals in China is much lower. Associated ores have an average benefication recovery rate of 50 to 60%, which is 20% lower than the average in industrialized countries. Many associated minerals are often not processed and end up unused in the tailing dams (Xu et al., 2010). Although Bayan Obo is China's largest niobium deposit and contains large reserves of thorium, these two associated minerals are not recovered. In the last four decades, rare earths at Bayan Obo had only an average recovery rate of 10% (Xu & Shi, 2005). Moreover, the use of scrap for the production of metals is much lower in China than in industrialized countries, although it is increasing (Xu et al., 2010).

Mining and refining is a very resource-intensive industry. The steel industry is the largest industrial energy consumer, currently accounting for about 20% of national energy consumption. Energy intensity of the industry has been decreasing fivefold since 1994 but is still high compared to international levels and has not yet reached the level Germany had already achieved in the 1960s (Li & Qin, 2011; Stahlinstitut VDEh, 2010). Until now, the consumption of coking coal for the steel industry is still two to three times higher than in the US and Japan. This is due to the significantly lower share of scrap steel used for production. Moreover, the steel companies work inefficiently in terms of output per employee. The ten largest Chinese steelmakers produce 350 tons per employee, but the leading international companies produce about 2,550 tons per employee (Yu & Yang, 2010).

Environmental impacts of mining and refining are severe in China. Because many mining companies use old technologies and have inappropriate environmental equipment, their mines and factories emit untreated waste waters, waste airs and solid waste. They often do not meet national emission standards. In early 2012, a spill of huge amounts of cadmium at a local mining company polluted the Longjiang River in Guangxi causing threat to human health and the local eco-system (Xinhua, 2012). Tailing dams contain hazardous chemicals or even radioactive substances in some cases and are prone to collapse. If the dams are not appropriately secured, waste is scattered in the surroundings by wind and rain and trickles down through the soil.

The mining and metals industry struggles with a range of other problems which have not been solved yet. Producers still concentrate on low-value products. The steel industry mainly produces long products (bars, wires, tubes and sections) which are used in the construction sector and for home-appliances and less high-value flat products (steel strips and sheets) for the manufacturing sector. However, the share of the latter is increasing (Haloway et al., 2010). Moreover, mining disasters are a frequent occurrence, mostly resulting from gas explosions and intrusion of water. Because most coal deposits are located in deeper layers, Chinese coal has to be mined underground. This more dangerous method leads to the high number of mining deaths in China. In recent years, this number is decreasing, though: Whereas in 1980, eight people died per 1 million tons of coal produced, it was only three in 2005 (compared to 0.3 in the U.S.) (Lin et al., 2011; Wright, 2012). The growth of the Chinese economy is still very resource-intensive. The consumption of minerals is growing at a faster rate than the GDP. China consumes about 40% of global cement, one third of global iron ore, steel and tin, one fourth of aluminum, and one fifth of copper. The immense demand is rising further and a change of this pattern is not really in sight (Yao, 2006; Li & Liu, 2011). One exception might be the recent slowing down of steel consumption growth. Commonly, iron consumption is believed to peak at a per capita income of US$ 14,000. Thus, the recent trend might also be only a short-term phenomenon due to the global economic downturn. Aluminum and copper are likely to peak at higher incomes due to their different use in basic appliances (Lin et al., 2011).

Government policies

This short overview demonstrates that the Chinese resource culture is still awaiting the transformation towards a more efficient and environmentally friendly pattern. But still, China has become active in various fields to tackle the notorious problems of the mining and metals industry. The greatest concern of the Chinese government is to satisfy increasing future demand. The government predicts that resource demand will grow for at least another decade. Thus, while pursuing resource and environmental protection, the government is continuing to increase the exploitation of minerals. According to the National Minerals Plan promulgated in 2007, China strives to extend the geological exploration of the national territory. Until now, only one third of the resource potential has been fully explored, in particular the Western provinces Tibet and Xinjiang have many blank spots. The plan foresees to raise production of iron ore (by 17%), tin (7%), tungsten (4%), and other minerals and to reduce reliance on imports (MLR, 2007).

At the same time, resource protection is a major concern of the government. The government policy aims at avoiding overproduction beyond production plans and oversupply beyond demand. The main goal is the conservation of scarce resources. Measures are manifold, including production quotas (for rare earths, tungsten and antimonium), national stockpiles (for rare coal types, copper, chromium, manganese, tungsten and rare earths), export restrictions, resource taxes and other measures (MLR, 2007). The government tries to control oversupply in order to prevent falling prices. Oversupply has become a particular problem since the financial and economic crisis when foreign demand went down. These policies are only partly successful. Production quotas are often surpassed and illegal mining and smuggling are hard to control (Lian et al., 2011). Moreover, Chinese export restrictions on raw materials were subject to two WTO dispute settlement cases. China lost the first case on nine raw materials. After the Chinese Ministry of Commerce decided to decrease the export quota for rare earths by 40% in 2010, a major row erupted between China and major buyers. China still restricts exports through quotas, taxes (between 15 and 25%), licensing and minimum export prices. In March 2012, Japan, EU, and U.S. filed a new WTO case against China's export policy on rare earths.

The Ministry of Industry and Information Technology, responsible for the mining industry, promotes the consolidation of many mining and metals industries. The goal is to reduce the number of miners and refiners and to build few national champions. This is due to the fact that the government identified the fragmentation of the industry as a major cause for high pollution and inefficiency as well as low prices. For example, some 7,000 companies are operating in the steel industry alone. Although China is the world's largest steel producer by far, only some companies are among the world's largest producers (KPMG, 2011). The "12th Steel Industry Development Plan" published in November 2011 plans to increase the market share of the 10 largest producers from 34.7% (2005) to 60% (2015) (MIIT, 2011). However, the policy meets with much resistance from local authorities which try to protect their own local champions.

Minimizing the environmental impacts of mining and processing is an important goal of the government. In the rare earth industry, the Ministry of Environmental Protection decided on much stricter emission standards in 2011. But these take effect for existing market participants only from 2014 on (MEP, 2011). In the steel industry, small blast furnaces (less than 400 cubic meters), converters, and electric arc furnaces (less than 30 tons) are going to be eliminated until 2015 (MIIT, 2011). The recovery rate and the use of associated minerals as well as the reuse of by-products and tailings is to be increased under the label of the circular economy. In 2009, the government created the "Circular Economy Promotion Law" with the purpose to incite reuse and recycling. About 50% of raw materials could be supplied from the use of tailings, comprehensive utilization and recycling by 2020 (Xu et al., 2010; Wang, 2011).

Because domestic supply cannot satisfy demand, about half of iron ore consumption has to be supplied by foreign sources, 93% of chrome, and 75% of copper ores (Gu & Cheng, 2010). Endowed with huge foreign currency reserves, investment in foreign mines and mining companies is becoming more important. In 2009, about 16% of Chinese foreign direct investment were directed into the mining industry (mainly oil and gas) compared to 40% in 2009. The Chinese "going out" policy has not only spurred much criticism from the West, but has shown limited success. Only 25% of imported iron ore comes from Chinese-owned mines, whereas Japan imports 60% from own mines (Gu & Cheng, 2010). Chinese mining companies failed to increase their share in Australia's Rio Tinto and to overtake other miners. Within China, the Ministry of Land Resources strives

Small mine near Weizigou © Tarboat 2004, Flickr.

to increase international participation in exploration projects in order to improve the technological level.

The whole bunch of policy measures meets with several other challenges. Laws are often not detailed and precise enough. The "Mineral Resources Law" is very vague about environmental protection and does not provide operational provisions in this regard. Its revision is in discussion, but no decision has been made yet (Li, 2007). More generally, bureaucratic power struggles inhibit policy effectiveness. The large number of involved ministries makes coordination difficult. Moreover, implementation remains weak. Although the Ministry of Industry and Information Technology is currently conducting a campaign against illegal rare earth mining and violations of environmental regulations, those measures are often not effective in the long run.

Methodology & further steps

The sustainable transformation of the Chinese resource culture might still take some more time to become more apparent. Regarding industry efficiency, comprehensive use of minerals, recovery rate, and environmental protection some progress is visible. But compared to international levels, these are still poor records and the mining and metals industry is still facing notorious problems. Based on the insights gained here, the dissertation strives to understand the growing but difficult role of sustainability in the mining and metals industry and relevant policies. It examines the challenges and opportunities which sustainable practices face in more detail. The conceptual foundation is Actor-Network Theory which helps to track the interaction of humans and materiality in the process of constituting the network of sustainability and changing its relationships. The task is to inquire into the network of actors that shapes the resource culture and the factors that inhibit or promote the transformation towards sustainability. Data is produced through expert interviews with bureaucrats, industry represents, non-governmental organizations and industry analysts as well as a documentary analysis of official documents, academic articles, and industry publications.

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