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Integrated Energy-Water Resources Management for Green Industries

The Case of Mongolia

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Summary

By 2050 global industrial output will quadruple in value. In industrialising countries this figure is likely to be higher. Typical industrial activity consumes approximately 40% of an industrialising nation's energy and water and creates similar proportions of waste water and solid waste. It is clear that rapid industrialisation can quickly exceed the supply system for many nations and for Mongolia this situation is made more likely by the challenging climate, and by the rapidly urbanising citizens. Together with the common challenge that early stage industrialisation is often energy intensive while adding little value, we conclude that Mongolia is close to entering the 'brown growth trap'.

The 'brown growth trap' commonly entails a slow rise up the value chain, with early and significant demands on infrastructure and significant pollution, while delivering low return in economic value. The Mongolian government has shown insight and leadership in setting its ambition for 'green growth' and this report is intended to offer knowledge on how industry could play a key role in delivering green growth, especially in Ulaanbaatar.

The report is based on decades of research and direct work with many industries. Taking these global lessons about green growth we learn that:

1. Best Available Technology must be combined with Most Efficient Practice
2. Working together, best technology and practice can deliver up to 75% reduction in energy and water usage in a single factory
3. Most Efficient Practice can only work when staff have the right skill and knowledge
4. Best Available Technology also requires excellent skills to maximise the return on investment
5. Most Efficient Practice also delivers improvement in process control and so improves product quality and increases added value in the market

The research team spent time in Ulaanbaatar studying the energy-water system and its relationship to industry. We learnt that:

1. There is insufficient data on the true water capacity
2. Industry energy and water demand is also poorly understood due to lack of reliable data
3. While the re-locating of specific industries away from the centre of Ulaanbaatar will reduce local pollution it is not clear that it will reduce overall energy and water demand
4. There is strong government recognition of the need for co-ordination of policy across departments

Bringing global knowledge into the very specific Ulaanbaatar context we can conclude that Mongolia is at a crossroads in industrial development, and that the 'brown growth trap' of slowly increasing added value while rapidly increasing environmental loads would be a major problem for Ulaanbaatar but may happen through lack of decisive action. We also conclude that 'green growth' is still possible for Ulaanbaatar (and, through building those capacities, also true for wider Mongolia).

Significant investment and development of industrial and utility infrastructure is already happening in Ulaanbaatar. There is little room for delay if those investments are to support a green growth pathway.

Based on the need to quickly move onto a green growth pathway, we have focused our recommendations on actions that can be implemented quickly, that provide a very quick return on any investment while also developing the institutional capacity to deliver in the long term. In particular we propose that the government focus its efforts on two industrial sectors that have the greatest potential for moving quickly down the brown growth or green growth pathways. The wool, textile and leather industry has very significant water usage with poor water waste. The industry is under-going a physical change and investment and there is a rare opportunity to shape its future economic, environmental and social performance. The construction industry is undergoing rapid growth and change, and its products will largely fix the future energy and water performance of Ulaanbaatar for the next 40 years. The most successful rapidly industrialised countries (such as Taiwan or South Korea) specifically supported their construction industries early in their economic development due to their contribution to national capacity.

By improving the quality of engineering in both industries it is possible to rapidly increase added value while reducing energy and water inputs. There is currently much waste of energy and water and improving the skills of engineers and staff can deliver quick returns, especially if these industries can learn from the best in the world.

Even with an increasingly efficient industry Ulaanbaatar faces a challenge in managing energy and water supply and demand. We agree with many local experts on the need for integrated resource management, where resources are considered as a system and managed as a whole. This includes the detail interactions between water and energy for example, where more energy supply also increases water demand. Integrated resource management must include a deep understanding of the challenges and opportunities that industry place on resources. Integrated resource management cannot happen without data to make better decisions, and many of our detail recommendations are concerned with improving data on energy and water supply and demand as part of a planning tool.

Our broad recommendations for these two sectors and the government are therefore:

1. To collect data on current and predicted water and energy usage of the two sectors
2. To identify global best companies in each sector and establish relationships for rapid training of Mongolian staff on reducing energy and water usage
3. For government to work across each sector in supporting industrial symbiosis (where resources are shared or used twice among multiple companies in a cluster, and waste is used as a collective resource)
4. For government to set ambitious goals for energy and water performance of all buildings based on global knowledge of what is possible and local plans for building sector technical capacity to highest quality levels

There is good evidence that these recommendations can work, but they need active government effort and strong co-ordination across government and with industry itself. Mongolia, and Ulaanbaatar, have shown great leadership in setting out its ambitions for green growth; the government knows why it must do so and what it wants to achieve. The next challenge is learning how to achieve it in practical detail.

1. Introduction

Mongolia's recent history has been dominated by the phenomenon of rapid urbanization. By the end of 2013, 2 million people of the country's 2.8 million population (around 70%) were living in urban areas. The majority of the urban population is located in Ulaanbaatar, the population of which is estimated at 1.28 million people (45% of total population and 64.2% of the urban population). These figures are expected to grow so that urban population and population in Ulaanbaatar will rise to 2.72 million (80% of total population) and 1.85 million (54.6 % of total population and 68% of urban population) by 2030 (UNDESA, 2014) each. The urban growth rate in Mongolia has, in recent years, exceeded the Asia-Pacific's overall rate of urban growth.

While most of the urban population live in Ulaanbaatar, the remaining urban population is growing in relative proportion, and resides in small to medium sized provincial towns known as Aimag centres.[1] Distances between the 21 Aimag centres are vast, yet the centres themselves have only small populations, usually less than 20,000. These factors in combination limit their ability to attract and sustain business.

Recent urbanization has resulted in heightened demand from both domestic and commercial users for urban services like energy and water supply, water sanitation, employment and public health. Energy and water are prerequisite resources for both residential and economic activity. However, over recent decades, population density in Ulaanbaatar has been increasing, and along with it demand, and the mining industry, a recent driver of national economic growth, is highly energy and water-intensive. As a result, energy and water consumption in Mongolia, including its urban areas, has been rapidly increasing.

From 2000 to 2010, final energy consumption in industry and residential use increased from 31% to 34%, and 28% to 30% respectively. In the case of water use, although water withdrawal for domestic use reduced from 19.9% to 12.9%, its use in industry jumped from 27.1% to 43.2%, in between 1993 and 2009 (UNESCAP, 2013).

Moreover, the energy and water infrastructure in Mongolia is old and faces problems of efficiency. About 80% of all Mongolian electricity is generated by the Central Electricity System (CES), which consists of five coal-burning thermal power plants. However, all operating power plants were built between 1960s and 1980s, and the energy losses from transmission and distribution are significant (Ministry of Mineral Resources and Energy of Mongolia, 2011). Centralized systems for water supply in Ulaanbaatar and other Aimags were also constructed in the 1980s, and have not been retrofitted (Batimaa, 2011).

All water resources in Mongolia are derived from surface water (63.5%) and ground water (36.5%) (Hiroshi, 2011). However, because of extreme weather conditions caused by climate change and other environmental problems, the number of dried up streams, lakes and springs since 2003 have risen by 30% (UN WATER, 2013). While water may be abundant in certain areas of the country, the infrastructure to capture, store and distribute it is limited. Where water is in most demand, natural sources are less accessible. Increasingly it is becoming more urgent to manage water effectively, including its re-use.

Given the trends in the Mongolian economy and the urban energy and water systems, it is important to take a holistic perspective for integrating green growth and green urban development in energy and water, and in their interaction. Mongolia needs to simultaneously meet the increasing demands on energy and water services in urban areas, whilst Mongolian industry addresses adjustment to more efficient system, in order to enhance its international competitiveness.

To address both needs of securing sustainable energy and water supply, and enhancing international competitiveness of its industries, Mongolia now faces significant challenges for: (1) enhancing extensive knowledge and expertise in energy-water resources; (2) developing holistic strategies for integrated energy-

[1] The word "Aimag" refers to a first-level administrative province and there are 22 Aimag including Ulaanbaatar.

energy resources management; and finally (3) facilitating sustainable urban industries with improved energy-water efficiency.

2. Research Aim and Scope

2.1 Research Aim

This report has two main research goals: (1) to develop a conceptual framework on integrated resource management (energy-water) for green industries in Mongolia and (2) to propose integrated strategies on how to change the paradigm of integrated energy-water resource management to facilitate the development of green business and industries in Mongolia.

In order to achieve the research aims at:

1) identifying the current situation of energy-water resources under the current situation of rapid urbanization in Mongolia;
2) examining the current and especially future consumption trend of energy-water resources in urban industry in Mongolia; and
3) formulating and proposing policy options for decision-makers' considerations to manage projected future demand versus scarcity, in order to strengthen the desire for the country to move closer to a green development model.

2.2 Research Scope in the Aspects of Demand and Supply

In order to bring about effective and efficient energy-water resources management, comprehensive demand and supply analysis is important. However, since the Mongolian government has already set up the supply plan for energy (Fueg et al., 2011) and water, this report focuses on demand. In addition, this report partly includes suggestions for the supply of energy and the supply of water. In particular, the energy supply sides concern the alternative energy supply in an urban environment, and the water supply side deals with water sanitation. See the Diagram 1.1 for a visual representation of the scope of the research.

Diagram 1.1: Scope of the research

1) Research scope for energy