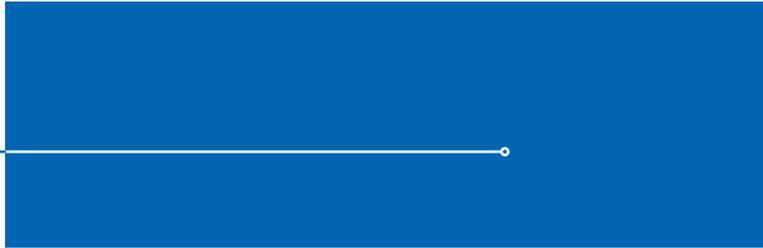


# SOUTHERN MONGOLIA INFRASTRUCTURE STRATEGY



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The workshop proceedings and background studies are available at [www.worldbank.org/southgobi](http://www.worldbank.org/southgobi).

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## EXECUTIVE SUMMARY

The signing on October 6, 2009 of an investment agreement for the development of a copper and gold mine at Oyu Tolgoi marks a turning point in Mongolia's history. As Mongolia begins to emerge from the Global Financial Crisis, the country's decision-makers can turn their attention to the plans, institutions and investments needed to support the country's tremendous growth potential. If the right steps are taken, within a few years, the mines of Southern Mongolia could be generating annual revenues of more than US\$5 billion. But in order to make this a reality, more than US\$5 billion of infrastructure investment will be needed. This will be a huge challenge, in a country with a GDP of around \$5 billion, and with a Government deficit of 8.2 percent of GDP in June 2009.

Beyond the signing of investment agreements for the proposed mines of Southern Mongolia, the Government will need to make plans for the construction of towns, energy and transport facilities, and management of water resources. The social and environmental impacts of the mines, supporting infrastructure, and population influx will need to be managed. Laws and regulations governing infrastructure investment and regulation will need to be developed or amended, to provide a reasonable balance between the interests of private investors and the Government. And institutions will

need to be established that can manage all of these steps, and carry them forward as quickly as possible.

### Mining in Southern Mongolia

The table below sets out preliminary estimates of production volumes from the major mines in Southern Mongolia. Coal production in the region could reach 45 million tonnes per year, of which 14,000 tonnes of steam coal production from Shivee Ovoo is currently intended to be converted into electricity for export to China.

Over the next five to ten years, the Chinese market might absorb about 20 million tonnes of coking coal imports per year, with Mongolia in a good position to dominate China's import market.

The market for steam coal is much more marginal, with China having a lot of cheap domestic production of steam coal. The cost of production of Southern Mongolia's coal will be in the order of \$10-\$30/tonne. The cost of rail freight into China could be in the order of \$10-\$30/tonne. And the price paid by Chinese power plants for thermal coal ranges from \$18-\$55, depending on the thermal value of the coal. The price paid for rail freight will be a key factor in selling thermal coal to China.

### Potential Major Mines in Southern Mongolia

Mine	Mineral	Life (years)	Production ('000 tons/year)	Employment Estimate	Start date Estimate
Tavan Tolgoi	Coal	200+	15,000	1500	2012
Uhaahudag	Coal	40	10,000	1000	2009
Baruun Naran	Coal	20	6,000	500	2012
Tsagaan Tolgoi	Coal	20	2,000	150	2015
Nariin Sukhait	Coal	40	12,000	150	2003
Ovoot Tolgoi	Coal	50	5,000	400	2008
Sumber	Coal	50	5,000	400	2015
Shivee Ovoo	Coal	200+	14,000	600	2015
Oyu Tolgoi*	Copper	50	2,000	4000	2012
Tsagaan Suvraga*	Copper	20	250	1000	2012
Total				7800	

\* Production figure is for copper concentrate (30% copper)

Higher prices may be realized in markets outside China. Gaining access to these markets will require the construction of good rail connections through China or Russia, and will again depend on the rail freight prices.

At current prices, exports of 20 million tonnes of coking coal would generate annual revenue of US\$ 2 billion. Exports of 15 million tonnes of steam coal would generate annual revenue of US\$0.9 billion.

The Chinese market should be able to absorb all of Southern Mongolia's copper production. Combined with the gold that will be produced at Oyu Tolgoi, Southern Mongolia's copper mines would generate annual revenues of around US\$ 2.3 billion at current prices.

## Town Development

In planning towns, the starting point is an estimate of mine employee numbers. The rate of population growth is extremely uncertain, and the Government will need to monitor population changes regularly to ensure that adequate services are provided for new arrivals. This report assumes that the population will increase by around eight times the number of mine employees. On average, Mongolian families have 4.1 members. And international experience of mining towns suggests that for every new person in a mining employee's family, an additional new arrival may be attracted by increased economic opportunities.

Based on preliminary estimates of mine employment, indicative population estimates can be made for the various mining centers of Southern Mongolia. An Excel model is available which can convert the estimated population numbers into an estimate of the capital cost of town development. The costs estimated include housing, other buildings, drinking water, waste water, town electricity and

heating, and solid waste services. By 2015, town development might require investment of US\$ 1.4 billion.

There are several different models for town development, and these will have important implications for the extent of population influx and the region's development. The models include:

- *Fly-in fly-out*: For mines in remote areas or with small deposits which would not justify large set-up costs, mining companies frequently choose "fly-in fly-out", or bus-in bus-out arrangements, with workers staying at the mine for 2-3 weeks, and then spending 1 week at home in a large town. Many workers find these arrangements preferable to living full-time in small and remote location, but it places stresses on family life. FIFO arrangements typically result in relatively low population influx near the mine site, and accordingly require lower total investment.
- *Gated community*: Internationally, some mining companies have chosen to develop gated communities, in which their workers and their families live close to the mine, in a small town which is separate from the existing local community. Reasons for such segregation include security concerns, or because the mine workers require very different standards of accommodation from the rest of the community.
- *Integrated community*: Where such concerns are not relevant, and the mine is located near existing towns, new mines can choose to integrate their housing arrangements into the existing community. Where possible, these sorts of "integrated communities" present a range of social advantages, but they require an existing community with the capacity to house several

## Indicative Capital Costs of Town Development

Population Center	Additional Population	Buildings (\$m)	Infrastructure (\$m)	Total (\$m)
Tavan Tolgoi	16,772	238	42	280
Nariin Sukhait	7,967	112	29	141
Oyu Tolgoi	33,544	490	69	559
Tsagaan Tolgoi	1,258	18	20	38
Shivee Ovoo	5,032	70	23	93
Dalanzadgad	16,772	238	42	280
<b>Total</b>	<b>81,344</b>	<b>1,166</b>	<b>225</b>	<b>1,391</b>

thousand new mine employees and their families.

- *Company town*: Finally, some mining companies have built “company towns”, where the mining company builds all the housing and infrastructure. This sort of arrangement can run into problems of financial sustainability if the level of population influx is large – the mining company may be unwilling or unable to expand services to new arrivals who do not work for the mine.

Investment costs are likely to drive much of the decision-making concerning town development. Mining companies have a desire to see town development proceed rapidly. And with the security of a future revenue stream arising from their proposed mining projects, the mining companies are able to raise large amounts of capital to finance the developments that are necessary in order to undertake the mining projects. Housing their workers in agreeable accommodation is one of the priorities for all of the mining companies. So it is attractive to rely on the mining companies to develop the necessary towns and town services.

But the planning process should not be entirely left to the mining companies. The Government

of Mongolia is interested not just in the success of individual mines, but in the development of a vibrant mining industry. Recognizing that different workers and their families will have different preferences, the Government should work to ensure that a range of township options are provided in the region, including FIFO and integrated communities. Providing a range of regional accommodation choices will help to enlarge the employment pool for the mining industry. In order to bring this about, the Government will need to monitor all of the different proposals being made by mining companies, and might need to suggest changes.

Moreover, mining companies are not necessarily the best entities to plan, build, and operate town services. For example, mining companies may be unwilling or financially unable to provide housing and other services for non-employees. Democratically elected local governments can be expected to be more responsive to the needs of the local community. But national government may have better access to finance and stronger human capacity than local governments. The table below suggests the advantages and disadvantages of allocating planning responsibility to different entities which could possibly plan and organize town services.

### Choosing Who Plans and Controls Infrastructure Assets

	Advantages	Disadvantages
National Government	<ul style="list-style-type: none"> <li>• Highest capacity</li> <li>• Good on national infrastructure like highways, railways, transmission</li> </ul>	<ul style="list-style-type: none"> <li>• Remote from local needs</li> </ul>
Aimag	<ul style="list-style-type: none"> <li>• Can coordinate development of several mines, several towns, and the links between them.</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of capacity</li> <li>• Still somewhat remote from some local needs</li> </ul>
Soum	<ul style="list-style-type: none"> <li>• Knows the local situation</li> <li>• Accountable to local people</li> </ul>	<ul style="list-style-type: none"> <li>• Lacks capacity</li> <li>• Cannot coordinate</li> <li>• No economies of scale</li> </ul>
Mining company	<ul style="list-style-type: none"> <li>• Business interest in having infrastructure to support workers</li> </ul>	<ul style="list-style-type: none"> <li>• Interested in own workers, not the rest of the community</li> <li>• Not specialized in infrastructure</li> </ul>
Specialized private operator	<ul style="list-style-type: none"> <li>• Strong financial incentive to get infrastructure working well</li> </ul>	<ul style="list-style-type: none"> <li>• More complicated to procure and manage</li> <li>• Can be hard to attract a good operator</li> </ul>
Private property developer	<ul style="list-style-type: none"> <li>• Business interest in getting infrastructure working for tenants</li> </ul>	<ul style="list-style-type: none"> <li>• Not specialized in infrastructure other than housing</li> <li>• No obligation to serve populations outside of property gate</li> </ul>

A consultative planning process is suggested in order to govern town development. Suggested activities include:

- conduct a public workshop with mining companies, to determine the mining companies' plans including likely employment numbers and proposed housing strategies;
- issue a public discussion document, indicating the proposed locations of new towns, as well as an indication of possible options for service delivery at each of those locations, and indicative costings for each of those options. Permit a period of public debate before making a government decision on the locations.
- allocation of responsibility (across tiers of government and between ministries) and establishment of a timeline for the preparation of town development plans for each of the proposed locations. Each town development plans should indicate, for each infrastructure service (buildings, water, waste-water, electricity, heating, solid waste):
  - the expected capital and operating costs;
  - who would finance the assets;
  - who would design and build the assets;
  - who would operate the infrastructure service; and the expected level of tariffs and approach to revising tariffs over time.
- publish the town development plans, and seek public comment on them, before formally approving them;
- where the Government seeks mining company finance to support town development, ensure that a written agreement is reached setting out the details, and make this agreement publicly available.

Careful political leadership will be required to explain the tariff implications of new town development. If private sector finance is to be used to build infrastructure services, tariffs will need to cover the costs of service delivery – the private sector will not invest in non-profitable activities. Compared with current tariffs, cost-covering tariffs for new facilities could be 2.3 times higher for drinking water, 3.5 times higher for electricity, and 26 times higher for waste water.

### Railways and Roads

Mongolia faces a trade-off between minimizing the costs of railway investment, and addressing the market power of railway companies. Larger investments in railways will mean higher transportation costs, a smaller profit margin for the mining industry and lower mining revenues for the Government. On the other hand, serving Southern Mongolia with multiple railways owned by different operators would help to reduce the market power of any individual railway. Monopoly railway owners – in China, Russia, or Mongolia – have the potential to charge excessive prices for railway transportation, reducing competition and the profitability of Mongolian mines.

Managing the trade-off between investment cost and market power of railways can best be managed with a phased approach to railway development. In the near-term, the priority should be to develop the least-cost railways that will kick-start the development of mining in Southern Mongolia: the proposed railways from Tavan Tolgoi to Gashuun Sukhait and then to Baotou, and from Nariin Sukhait to Ceke. Once these railways are built, the resulting

### Cost-Covering Tariffs

	Water	Waste-water	Electricity option A	Electricity option B	Electricity option C	Heating option A	Heating option B
Units	\$/m <sup>3</sup>	\$/m <sup>3</sup>	\$/kWh	\$/kWh	\$/kWh	\$/m <sup>2</sup> /month	\$/m <sup>2</sup> /month
Current residential tariff	0.52	0.17	0.05	0.05	0.05	0.17	0.17
Current enterprise tariff	0.61	0.17	0.08	0.08	0.08	0.40	0.40
Tariff covering O&M	0.11	0.06	0.03	0.07	0.45	0.06	
Tariff covering full costs	1.20	4.57	0.19	0.29	0.55	0.41	0.03

Assumes a population of 15,000 people. Option A provides electricity over a high voltage transmission line, with heating from heat only boilers. Option B provides electricity and heat using a 5MW combined heat and power plant. Option C provides electricity from local diesel generators without district heating – for heating residents would use heat only boilers, as in Option A.

boost to national GDP will facilitate financing of additional railways.

Part of the solution to the market power of Chinese railways could be long-term contracts addressing the prices at which coal and other minerals will be transported within China. Prior to making large investments, developers of Mongolian mines and railways may seek such contracts privately in order to enhance certainty over their investment returns. The Mongolian Government could usefully play a role in dealing with the Chinese Government to provide inter-governmental recognition of such long-term arrangements and ensuring effective remedies in the event of breach of such contracts. A secure agreement for the transit of Mongolian minerals across China for overseas export would help to promoting a reliable and competitive mining industry in Mongolia, which would also be in China's interests.

Another part of the solution to railway market power in China may be the construction of alternative railway routes to Russia. These routes are not the lowest cost options for the transport of Mongolian minerals to international markets, but their construction may become necessary in the event that reasonable long-term arrangements cannot be made with Chinese railways. In the near-term, the possibility that a railway to Russia could be built will help to improve Mongolia's bargaining position when dealing with Chinese railway operators.

Within Mongolia, individual railway companies will also have market power in dealing with mining companies. Decisions have already been made to permit Energy Resources and MAK to build railways serving Tavan Tolgoi and Nariin Sukhait. There are economic incentives for these mining companies to use their monopoly control of the railways to set high transport tariffs and extract all of the profit from competing mines, or to completely exclude their

mining competitors from using the railways. Such behavior would not be in the broader interests of Mongolia. The construction of additional competing railway routes over time could help to lessen such potential monopoly power.

The Government could also play a useful role by regulating to ensure that competing mining companies can have access to Mongolian railway services at reasonable prices. Development of a regulatory access regime will be, however, a considerable challenge in terms of both policy development and institutional capacity. In the short-term, operating licenses for these railways could include provisions which ensure which provide a forum and basic pricing principles for arbitration in the event that access disputes cannot be resolved between the parties directly involved.

### Possible Railway Routes for Tavan Tolgoi's Coal

At a cost of around US\$1.8 million per kilometer, new railways in Southern Mongolia will only be financially justified for freight volumes of at least 2-4 million tonnes per annum. New railway construction will be justified for coal mines, but it is unlikely that copper mines or other minerals extraction (eg uranium in northern-eastern Mongolia) would generate the freight volumes to justify new railway construction.

The value of Southern Mongolia's coal mines will depend on the cost of the railways they use, and this in turn is determined by the transport distance. Various potential railway routes were considered for the export of coal from Tavan Tolgoi. The following table summarizes the combined costs of coal production and rail freight, for different potential railway routes, depending on the annual quantity of coal produced at Tavan Tolgoi. The cheapest costs for delivered coal are at Baotou or the Chinese port of Huanghua.

## Cost per Tonne for Coal Exported from Tavan Tolgoi (US\$)

	10 million tonnes/year	20 million tonnes/year	30 million tonnes/year
A. Tavan Tolgoi – Gashuun Sukhait – Baotou	\$33.00	\$26.80	\$24.70
B. Tavan Tolgoi – Gashuun Sukhait – Baotou – Huanghua	\$56.50	\$50.30	\$48.20
C. Tavan Tolgoi – Sainshand – Zamiin Uud – Datong – Qinhuangdao	\$55.50	\$53.15	\$50.10
D. Tavan Tolgoi – Tsagaan Suvraga – Sainshand – Choibalsan – Vladivostok	\$95.22	\$87.72	\$81.62
E. Tavan Tolgoi – Airag – Choibalsan – Vladivostok	\$94.92	\$87.72	\$81.62
F. Tavan Tolgoi – Airag – Ulaanbaatar – Ulan Ude – Vladivostok	\$83.54	\$89.84	\$84.04
G. Tavan Tolgoi – Ulaanbaatar – Ulan Ude – Vladivostok	\$81.64	\$80.84	\$76.24

Assumptions and notes.

(1) Assumes an indicative \$12 cost of coal production. Estimated costs of coal production range from \$10-\$28 per tonne.

(2) It is assumed that a new railway has capital cost of \$1.8 million per kilometer, amortized over 20 years at a 15% discount rate, operating costs of \$0.02 per tonne per kilometer, and a distance of 1.05 times the indicated straight-line distance.

(3) It is assumed that the existing Mongolian network can handle volumes of up to 10 million tonnes per year at an operating cost of \$0.02 per tonne per kilometer. For greater freight volumes, a second track would need to be constructed, with the same assumptions as for note (2).

(4) The estimated cost for the existing Chinese network reflects current Shenhua and China Railways tariffs. Actual prices will be commercially negotiated.

(5) The estimated cost for the Russian network is based on operating costs of \$0.01 per tonne per kilometer. This is likely to be an under-estimate of the true cost and can be compared with current Russian freight rates of around \$85 per tonne for foreign coal from Naushki to Vladivostok.

The costing assumes that Russian railways could provide services at a cost of US\$0.01 per tonne per kilometer. The actual cost is likely to be higher. Under the current regime of rail pricing, Russia charges a higher freight price for foreign coal than for domestic coal. Transport of foreign coal from Naushki to Vostochnaya would cost around \$85/tonne. Including the cost of railway construction in Mongolia, the total cost of transporting coal from Tavan Tolgoi to Vostochnoy would be in the order of \$125/tonne. At this cost it would be impossible to export thermal coal through Russia. Coking coal exports would be very vulnerable to fluctuations in world prices or changes in Russian freight charges.

Even if acceptable Russian rail freight prices can be negotiated, it is not clear that the ports would accept Mongolian coal. Russian ports are largely controlled by Russian coal companies. It is also not clear that Russian ports currently have the capacity to accept additional large freight volumes.

The relationship between the value of Mongolia's coal resources and the costs of rail freight is illustrated in the following table. The table estimates the present value of coal sales from Tavan Tolgoi, net of the costs of production and rail freight, under the assumption that all of the coal is directed along one of the routes discussed above. The table is not intended to be an accurate reflection of the value of Tavan Tolgoi reserves. Rather, it illustrates the importance of considering coal mine and rail development together. For example, under the assumptions in the table, if Tavan Tolgoi produces 20 million tonnes per year, the resulting revenue stream would be worth \$6.2 billion if the coal is exported through Huanghua, but \$1.5 billion if the coal is exported through Vladivostok via Sainshand and Choibalsan.

## Indicative Present Value of Tavan Tolgoi Revenues (\$ million)

Tons per Year	A. Baotou	B. Huanghua	C. Qinhuangdao	D. Sainshand Choibalsan Vladivostok	E. Airag Choibalsan Vladivostok	F. Airag Ulaanbaatar Vladivostok	G. Ulaanbaatar Vladivostok
10m	4,194	2,723	2,785	299	318	1,030	1,149
20m	9,164	6,222	5,865	1,537	1,537	1,272	2,399
30m	14,140	9,727	9,370	3,451	3,451	2,997	4,462

Assumptions: All coal is freighted along the routes indicated. Present value is computed assuming constant annual sales at \$100/tonne, less the cost of production and rail freight as indicated in Table 4.1, during a period of 20 years with a discount rate of 15%. Note that not all values are possible (eg, it is unlikely that 30 million tonnes of coking coal can be sold at Baotou in the foreseeable future).

Similar analysis is performed for potential rail routes to transport coal from Nariin Sukhait. Coal could be transported along the new Chinese railway from Linhe to Ceke, or alternatively a new railway could be built to connect with the Energy Resources Railway at Tavan Tolgoi. The analysis suggests that a railway from Nariin Sukhait to Tavan Tolgoi would not be justified unless freight volumes reach at least 50 million tonnes per year.

### Roads

Mongolia's Road Master Plan, prepared in 2007, calls for the construction of several sealed roads in Southern Mongolia. Their estimated cost is set out in the following table. Where possible, the master plan suggests that mining projects will be encouraged to finance and perform the works for upgrading or new construction. The roads will then be handed back to the Government which would operate them as toll-roads to at least cover their current costs.

would improve access for workers, for emergencies, and for mining supplies. A sealed road along this route would cost in the order of US\$ 85 million.

The Mongolian trucking industry is currently impeded by over-zealous regulation. Individual permits, signed and sealed by relevant individuals, are required for each individual international freight trip. A simplified system is required, in order to promote Mongolia's road freight industry.

The border crossings at Gashuun Sukhait and Ceke also need revised regulatory procedures. For example, the crossing at Gashuun Sukhait is only open for Mongolians and Chinese to cross, on the first 20 days of each quarter. All foreign specialists who work with the mines and their Chinese customers must travel via Ulaanbaatar. This is not conducive to development of an efficient mining industry in Southern Mongolia.

### Road Master Plan Projects in Southern Mongolia

	Timing	Distance (km)	Cost (US\$ million)
Ulaanbaatar – Mandalgovi	2008-10	230	69
Dalanzadgad – Gashuun Sukhait	2008-09	329	99
Nariin Sukhait – Chinese border	2009	40	12
Mandalgovi – Dalanzadgad	2011-15	293	88
<b>Total</b>		<b>892</b>	<b>268</b>

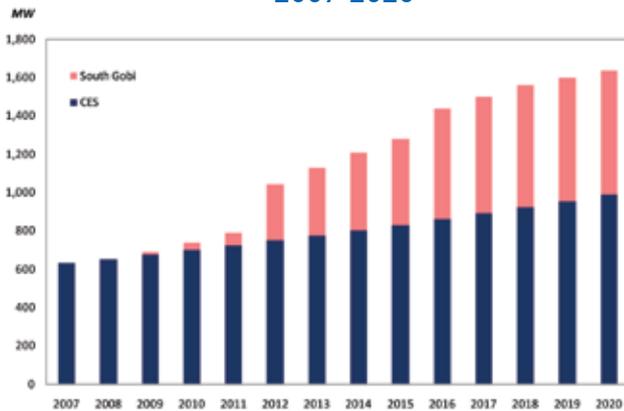
The master plan notably omits any connecting road between Dalanzadgad and Nariin Sukhait. This appears to be an oversight. The mines around Nariin Sukhait would benefit from access to a regional mining service center, which could be located at Dalanzadgad or near Tavan Tolgoi. A sealed road

### Electricity

Without additional generating capacity, there will be an inadequate supply reserve margin from 2011, and electricity demand will exceed supply from 2012. The demand forecast is set out in the

figure below. The forecast assumes 3.5% demand growth on the Central Electricity System (CES) centered on Ulaanbaatar, and takes account of the likely development of Oyu Tolgoi, Uhaahudag and Tavan Tolgoi mines. It is assumed that Nariin Sukhait and Ovoot Tolgoi will be supplied with electricity imported from China. If Chinese imports are not permitted, demand growth will be even greater than shown in the figure.

### Peak Electricity Demand Growth, 2007-2020



In order to meet the expected demand growth, various possible projects have been considered:

- Thermal power plant Number 2 (TPP#2) was initially supposed to be retired in 2005. TPP#3 was to be retired in 2008 and 2011. Darkhan TPP was to be retired in 2013. Some deferral of these plants' retirement is possible, but it is now anticipated that TPP#2 will need to be retired in 2012, and TPP#3 will be retired in 2016.
- The privately financed Newcom 50MW wind farm is expected to be commissioned in 2010, although there are still ongoing negotiations concerning the power purchase agreement. Because the output is dependent on the wind, this plant cannot be considered as a candidate for supplying firm capacity to meet peak demand.
- The Ministry of Mines and Energy is currently in negotiations with a Chinese bidder for construction of a proposed 300 MW Thermal Power Plant #5 (TPP#5) at Ulaanbaatar, to be operated as an independent power plant. Because of the complications of dealing with a single bidder, international experience suggests these negotiations are likely to be protracted, and the report assumes the plant will not be commissioned before 2013.
- The China Exim Bank agreed in 2006 to provide a \$300 million credit for construction of the 220

MW Egiin hydro power plant (HPP). But construction bids ranged were for a minimum of \$400 million. The project was cancelled in mid-2008 and the credit was reallocated to other projects. Subject to financial and environmental feasibility, the Egiin hydro power plant would be a useful addition to the CES, providing the flexibility to respond rapidly to plant outages. If a revised attempt to raise financing for the plant begins now, the plant could be commissioned by 2015.

- The 100 MW Orkhon HPP would serve as an alternative to the Egiin HPP. It is unlikely that both would be developed in the near future. As Egiin is more advanced, this report assumes that Orkhon will not be developed.
- A 50-100 MW pumped water storage plant using treated waste water has been proposed as part of the Tuul Songino water supply and wastewater treatment complex. Current price differentials between night and daytime tariffs are not sufficient to make the project reliable. Moreover, the plant would not make a reliable contribution to baseload capacity. The project is not considered as a reliable means of meeting the expected growth of baseload and peakload demand.
- The Oyu Tolgoi mine developers have reached an advanced stage of preparation for construction of a 450 MW coal-fired power plant. This plant could be commissioned in 2012.
- The Shivee Ovoo thermal power plant is intended to be a 3,600 MW power plant, exporting power to China. The commercial feasibility of the plant is unclear. Government to Government negotiations are also likely to be complex. The plan is unlikely to be ready by 2012-13, although it may be an option in the longer term.
- A mine-mouth power plant at Tavan Tolgoi has been proposed. The Ministry of Fuel and Energy proposed a 600 MW power plant in May 2008. A larger power plant of, say, 2000 MW, could be built, supplied by coal middlings, produced as a waste product in coal washing. There has been little work done on the plant so far, but with a determined effort and an experienced transaction advisor, an IPP could be commissioned at Tavan Tolgoi by 2013-2014.
- There have been proposals to develop a 650 MW Integrated Gasification Combined Cycle Plant at Baganuur. The plant would convert coal to liquids for export of oil to China. It would require around 400 MW for the coal to liquids process, leaving 250 MW available for supply to the CES.

There are considerable technological and commercial uncertainties associated with this project. It is unlikely that the plant will be commissioned in time to meet the growth of demand over the next few years.

- Increased Russian imports provide a safety valve in the system, but only up to a maximum of 255 MW – the capacity of the existing transmission line. Mongolia has a current contract for import of up to 120 MW of electricity. Mongolia does not wish to increase its reliance on imports, for reasons of security of supply.

From among the various options, three plants could provide the necessary security of base-load capacity, in the time-frame required: TPP#5, Oyu

Tolgoi TPP, and Tavan Tolgoi TPP. Because of the need to expand heat supply in Ulaanbaatar, the least-cost option would be to commission TPP#5 first. But there is a high risk that TPP#5 will not be commissioned until 2013.

If the Oyu Tolgoi plant were not developed, reliance on TPP# 5 would pose a high risk of delaying Oyu Tolgoi mine’s start of operations until 2013, depriving the country of US\$ 2 billion of mine revenues, of which perhaps \$670 million would be Government revenues. Moreover, reliance on TPP#5 would pose significant operational risks for the mine at Oyu Tolgoi. Accordingly, the suggested investment plant involves the commissioning of Oyu Tolgoi in 2012.

The following table sets out the suggested investment plan. And the figure below it sets out the implied balance between supply and demand across the CES and Southern Mongolia.

### Suggested Electricity Investment Plan

	Additions (MW) <sup>a</sup>	Retirements (MW) <sup>a</sup>	Available Capacity (MW) <sup>b</sup>	Investment Cost (\$million)
2008			902	
2009			902	
2010	+50 (Newcom)		952	
2011			952	
2012	+416 (Oyu Tolgoi) CES-South Gobi interconnector	-18 (TPP#2)	1350	750 207
2013	+270 (TPP#5 unit 1)		1,620	450
2015	+220 (Egiin HPP) +277 (Tavan Tolgoi TPP unit 1)		2,117	400 450
2016		-107 (TPP#3)	2,009	
2017			2,009	
2018	+270 (TPP#5 unit 2)		2,279	450
2019			2,279	
2020			2,279	

a. Available capacity shown. This differs from installed capacity due to self-consumption by units.

b. Assumes imports of up to 255 MW.

### Supply and demand in the CES and Southern Mongolia combined



These plans suggest the following priorities:

- Ensure timely completion of the CES-South Gobi interconnector transmission line.
- Provide the permits for construction of an Oyu Tolgoi TPP, in conjunction with the investment agreement for Oyu Tolgoi copper and gold mine.
- Develop a power purchase agreement under which the Oyu Tolgoi mine will find it financially attractive to sell power to the CES.
- Complete the bidding process for TPP#5. Hiring an internationally-experienced transaction adviser would facilitate the process.
- Hire an internationally experienced transaction adviser to launch a bidding process for Tavan Tolgoi TPP.
- Relaunch the Egiin hydro power project, seeking alternative donor finance or as a privately financed IPP.

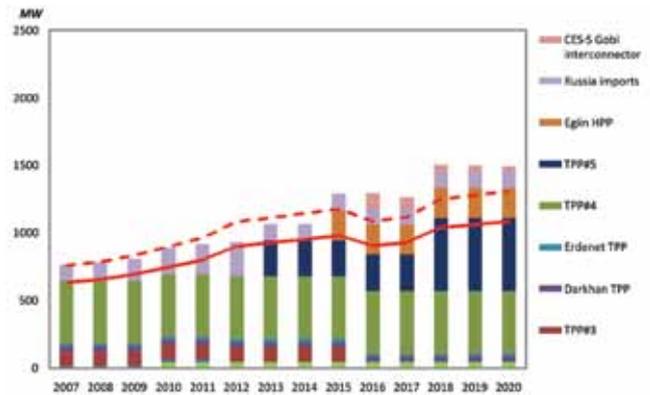
Financing the new investments will require tariff increases. Without taking account of the need for upgrading transmission and distribution facilities, tariffs would need to increase by more than 30% in real terms. Including full-cost recovery for transmission and distribution, tariffs might need to rise by up to 60%.

As an alternative to the investment plan set out above, the report also considers the impact of supplying Oyu Tolgoi with electricity imported from China until 2016. It will still be possible to satisfy demand in the CES, provided that TPP#5 is commissioned in 2013. Increased Russian imports will be necessary, as it will not be possible to supply energy from spare capacity at the Oyu Tolgoi TPP to the CES. However, during 2011-2014 reserve margins will fall to very low levels, increasing the risk of temporary supply interruptions. Frequent interruptions are likely, as no generating unit can operate at 100% availability.

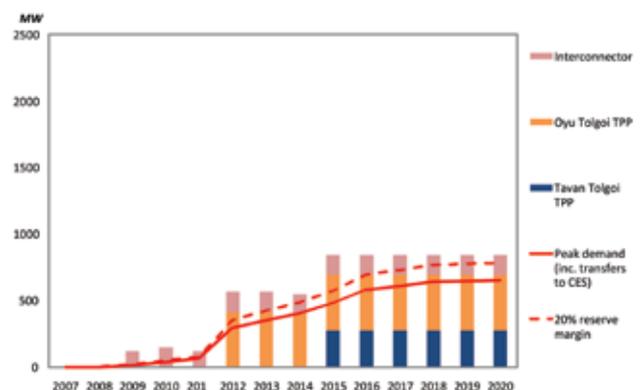
Without the Oyu Tolgoi TPP there will be difficulty in meeting growing demand in Southern Mongolia. In 2013 and 2014, before the commissioning of a power plant at Tavan Tolgoi, capacity would be insufficient to meet electricity demand in Southern Mongolia. This could be addressed through additional imports of Chinese power. But this may imply higher costs of electricity supply than a local power plant, and there may be problems of reliability arising through dependence on a single inter-connector for supply.

The following figures show the projected demand-supply balance in the CES and Southern Mongolia, under the revised plant commissioning schedule.

Supply & demand in Southern Mongolia with delayed Oyu Tolgoi TPP



Supply & demand in Southern Mongolia with delayed Oyu Tolgoi TPP



## Water Resources

The extent of underground water resources in Southern Mongolia is not known with any precision.

It appears that there is sufficient groundwater potential to accommodate demand growth until at least 2020. Based on a fairly high estimate of possible demand growth, the demand for water resources in Southern Mongolia could grow from the current consumption of around 50,000 m<sup>3</sup>/day to around 350,000 m<sup>3</sup>/day in 2020.

A conservative estimate of the extent of water resources in the area suggests there is groundwater potential for 500,000 m<sup>3</sup>/day. This estimate takes account of:

- shallow groundwater (<50 meters deep) is likely to be recharged through infiltration by rainfall. A conservative estimate of the extent of this recharge is 1 mm/year, based on comparable international areas such as the Gobi Desert in China. Spread across the (large) surface area of Southern Mongolia, this represents storage of 950,000 m<sup>3</sup>/year in the shallow aquifers. It is assumed that 30% of this storage could be abstracted, providing 300,000 m<sup>3</sup>/day.
- Studies were made prior to the 1990s at more than 40 sites in the region. These studies were constrained by maximum drilling depths of 170 meters, and assumed that local aquifers would be depleted by 40-60% over a period of 25 years. It is assumed that the groundwater potential is only 50% of that identified in the studies.
- the Gunii Hooloi groundwater aquifer study concluded that 60,000 m<sup>3</sup>/day could be abstracted over a period of 40 years, lowering the groundwater table to the top of the aquifer. The conservative estimate assumes this is the only deep aquifer (> 200 meters) in the region.

Development of a water supply system relying on abstraction of groundwater reserves could cost in the order of US\$ 260 million, of which around US\$ 35 million would be required for investigative studies and drilling to identify reliable wells.

An alternative option would be to supply Southern Mongolia with surface water, piped from either the Kherlen or the Orhon Rivers. The capital cost of these options would be at least US\$ 400 million each. The option of groundwater supply is preferable not only because it is cheaper, but because the capital costs can be spread across time and space, as particular mining and town developments proceed.

There may eventually be a need for the construction of water pipelines from the Kherlen or Orhon Rivers. But over the next decade the priority should be to rely on groundwater resources in the region, and to increase knowledge of the extent of those resources through a program of studies and drilling. It is likely that additional studies will reveal additional resources beyond those assumed in the conservative estimate of groundwater potential of 500,000 m<sup>3</sup>/day.

To support the studies and drilling, a new Southern Mongolia Groundwater Management and Information Center is proposed. This Center would act as a focal point for information and initiation of

new studies, and could develop guidelines for the sustainable allocation and use of groundwater in the region. A program of technical assistance to support the establishment of such an institution might cost around US\$2.5 million over three years.

Two policy issues could also usefully be reviewed:

- large numbers of herder wells are currently abandoned, suggesting current institutional problems in ownership, operation, and maintenance. A review of alternative operating models could help to find solutions.
- Current pricing of water resources does not appear to be based on economic principles for the management of exhaustible resources. A review of Mongolia's water resource pricing principles could be used to set tariffs at a level which encourages appropriate levels of recycling and minimization of water demand.

### Social Issues

It will be difficult to developing a comprehensive strategy to ensure that local residents receive a reasonable share of the benefits of mining, because there are so many different institutions responsible for addressing the diverse social impacts.

A first step towards a comprehensive strategy would be the establishment of a regular consultative forum, involving different tiers of government, mining companies, local communities, and NGOs. The forum could provide opportunities for information-sharing, decision-making, and dispute resolution. Many of the social impacts will need to be addressed by local governments. Investments in capacity-building of local government should begin ahead of population influx.

#### Some of the areas to be addressed include:

*Sharing mining revenues.* On a per capita basis, local residents should receive at least as much of the proceeds of mining revenues as residents in other parts of the country, and there should be transparent reporting on how any reserved part of mining revenue is allocated to local communities.

*Aligning mining company contributions with government policy.* Mining company contributions to the local community should be aligned with a local development strategy, developed by the local government. Capital contributions should only be accepted if there are adequate funds to support ongoing maintenance.

*Improving employment opportunities through education and training.* Education and training facilities need to be developed and improved to address the needs of the mining industry, so that local residents can improve their employment prospects. Entrepreneurs can be supported with business incubation and training services.

*Encouraging women's participation in the labor force.* Mining companies themselves can play an important role in the promotion of women in the workforce. Governments can support with social services addressing child care, sexual harassment and violence against women.

*Improving town and social services.* The capacity of local governments will be severely stretched as local populations grow. There will be a need to ensure adequate accommodation, town infrastructure, education, health, law and order, and town administration.

*Protecting vulnerable groups.* Compensation arrangements for herders who are displaced by new mining developments could be reviewed to ensure that adequate livelihoods are retained following relocation. Environmental and technical training could help to promote awareness of improved mining techniques by artisanal miners. Government vigilance will be needed to ensure that government-determined salaries and pensions keep pace with local inflation in Southern Mongolia, and to ensure registration of new arrivals to permit access to social services.

*Protecting foreign workers.* Large numbers of foreign workers, particularly from China, will be employed by the construction and other industries. Internationally, immigrant workers are often subject to discriminatory practices, exploitation, and racism. Careful political leadership will be required to ensure acceptable working standards and respect for the human rights of all workers, including temporary foreign workers.

*Planning for mine closure.* Particularly for short-lived mines, the Government should begin developing its strategies now for how to handle eventual mine closure. Where possible, diversification of the local economy can reduce dependence on mining and ease the transition when the mine closes. If this is not possible, housing and other strategies should be employed to minimize population influx while the mine is operating.

## Environment

Construction of major roads and railways will have serious and regionally significant impacts on movement of wildlife, including khulan (wild ass) and Mongolian gazelles. At present, not enough is known about what migration routes are used by these animals, and what sorts of facilities they will use to cross major roads and railways. Studies to identify appropriate wildlife crossing arrangements are a high priority. Requirements to construct wildlife crossings should be included in the environmental management plans for approved roads and railways. Where feasible, transport networks should be planned to minimize disruption to major migration routes.

Dewatering of mines will drain ground water from large areas around those mines. Development of bores and springs elsewhere could help to offset the environmental consequences.

Development of Southern Mongolia will involve a host of individual projects, including mines, towns, roads, railways, power facilities, and water abstraction. Each project will need its own environmental impact assessment (EIA) and environmental management plan (EMP). The Ministry of Nature, Environment and Tourism will have an important role in ensuring the quality of EIAs, appropriate responses to EIAs, and appropriate monitoring and enforcement of EMPs. The Ministry's resources may need to be increased, to provide high quality and speedy responses.

Soum and aimag governments could also play an increased role in environmental impact assessment and environmental management, but will need substantial capacity building in order to play this role.

Mongolia can contribute to global goals on climate change by increasing efficiency of new and existing power plants, increasing reliance on zero-emissions fuels, ensuring appropriate pricing of power, and adopting energy efficiency measures to reduce demand growth.

## Financing

Development of the infrastructure to support mining in Southern Mongolia will require investments totaling more than US\$ 5.5 billion by 2015. The Ministry of Finance should develop a financing plan, which indicates who would finance the various investment projects: the budget, donors, or the private sector.

## Infrastructure Investment Needs (to 2015)

	US\$ million	Observations
<b>Towns</b>	<b>1,454</b>	
Buildings	1,277	} Options include financing and delivery by governments, PUSOs, mining companies, and/or property developers. A complex series of decisions is required.
Drinking water	10	
Waste water	28	
Power and heat	125	
Town roads	4	
Solid waste management	4	
Transaction management	6	
<b>Land Transport</b>	<b>1,150</b>	
Tavan Tolgoi – China	700	Will be financed and operated by Energy Resources Rail
Nariin Sukhait – China	100	Will be financed and operated by MAK
Roads	350	Includes Road Master Plan roads, plus Nariin Sukhait to Dalanzadgad sealed road. Some sections will be privately constructed.
<b>Electricity</b>	<b>2,711</b>	
Oyu Tolgoi 450MW	750	To be financed by Ivanhoe Mining
South Gobi interconnector	207	
TPP #5, Ulaanbaatar, unit 1	450	Although an IPP is planned, at least some risks will be borne by the Government.
Oyu Tolgoi plant	450	Likely to be financed by Ivanhoe Mining
Tavan Tolgoi plant, unit 1	450	This plant could be privately developed. A much larger plant could be built to export power to China.
Egiin HPP	400	Likely to be largely government financed.
Transaction management	4	Transaction advisers for an IPP, including all the necessary studies, can cost over \$1 million per transaction.
<b>Water Resources</b>	<b>262</b>	
Investment	224	Some investigation and investment will be financed by mining companies.
Investigation	35	
Institutional strengthening	3	
<b>TOTAL</b>	<b>5,577</b>	

The financing needs for Southern Mongolia's infrastructure vastly exceed the Government's currently available finances. Many, but not all, of the individual projects could be financed by the private sector. But this will require a major effort to improve the investment climate for private investment in infrastructure.

Donors can assist in providing financing, in various ways. Total disbursements from all donor loans were in the range of US\$ 80 – 130 million per year, during 2002-2008. As Mongolia becomes richer, it will begin to lose its access to donor loans with the lowest rates of interest (eg IDA credits). But lending limits are likely to be higher for loans that offer less concessionality, but that are still cheaper than market borrowing (eg IBRD loans). For example, it is already possible for Mongolia to expand its borrowing from the World Bank for projects that can be linked to the generation of foreign currency (enclave financing). Donors can also assist in the mobilization of private investment,

either by lending directly to private investors (eg IFC investment loans), or through the provision of various sorts of guarantees addressing political or other risks. All of these options should be addressed in a comprehensive financing strategy for Southern Mongolia.

### Institutions

As a basis for discussion various possible new institutions are proposed. These proposals are intended to develop new areas of expertise, or to serve as improved mechanisms for the coordination of multiple activities which will be needed in order to implement an integrated infrastructure strategy. Among the different institutions there should be a single high-level agency which is responsible for taking the lead on development of Southern Mongolia's infrastructure, ensuring that other relevant agencies play their roles and meet deadlines in an integrated development plan.

*Southern Mongolia Infrastructure Council.* This council would include representation from the national government, aimag and soum governments, mining companies, and NGOs. It would provide a forum for public consultation, in which the government and mining companies would regularly exchange information about their plans. One model for the Council would be purely as an advisory body and forum for stakeholder consultation. Another model would give the Council a budget and the authority to make decisions and to finance infrastructure.

*Southern Mongolia Infrastructure Coordination Unit.* Implementation of Southern Mongolia's infrastructure investments will require a lot of exchange of information between government ministries, as well as the coordination of decisions across multiple tiers of government. Strong systems have not yet evolved for the regular sharing of information. A Coordination Unit could take various possible forms:

- it could simply gather information and monitor the activities of line ministries;
- it could be given "step-in" powers, to take over control of activities from line ministries when adequate progress is not being made;
- it could be given powers to manage all stages of policy development and project management for Southern Mongolia's infrastructure.

*PPP Unit.* A wide range of specialist skills are required to manage a successful PPP transaction. Mongolia does not have significant experience in developing PPPs, nor does it have a large number of potential PPP projects. Accordingly, it would make sense to concentrate Mongolia's scarce PPP skills in a single institution. Before deciding on where this unit should be located, it is important to have a good idea of the particular PPP transactions it is intended to manage.

*Risk Management Unit.* Government guarantees will be required to cover various risks

in PPP transactions. There is always at least a small probability that a guarantee will be triggered. The Government needs to make sure it can cover any such events. At a minimum, a Risk Management Unit should report annually on the extent of any contingent liabilities created through guarantees. The RMU could report on the expected liability, having regard to estimated probabilities of guarantees being called. The RMU could also play a role in establishing caps on the overall exposure to contingent liabilities, and in the approval of project-specific requests for government guarantees.

*International Infrastructure Expert Advisory Panel.* At various times the Government and the Parliament may be concerned about whether they are getting the best possible advice, or whether the outcomes of commercial negotiations represent the best possible deal for Mongolia. To assist, the Government might wish to hire a panel of internationally respected infrastructure experts, paid on a retainer, who can be called upon from time to time to review particular matters.

*Economic Regulation Agency.* Special skills, particularly economic, accounting, and legal, are required for effective regulation of infrastructure PPPs, balancing the needs of investors, government, and consumers. These skills are in short supply in all countries. Particularly in small countries, it makes sense to bring these skills together in a single agency, rather than having them fragmented across different sectoral agencies. Consideration could be given to establishment of an economic regulation agency which would assume responsibility for tariff regulation in the railway and electricity sectors, and also for contract monitoring and tariff-setting for the various proposed PPPs in Southern Mongolia.

*Southern Mongolia Groundwater Management and Information Center.* This Center would be used to bring together the information which currently exists spread across multiple government agencies. It could also coordinate a program of drilling and studies to better establish the extent of groundwater potential.



# 1

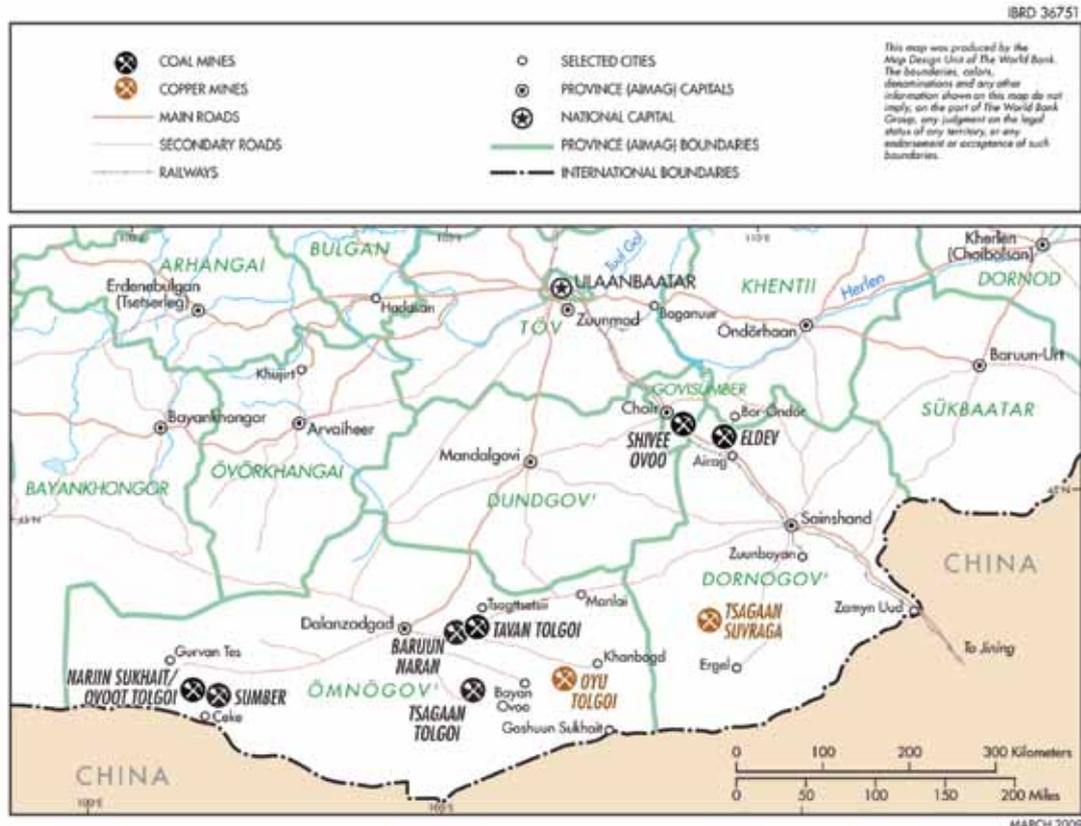
## INTRODUCTION

*“Knowing your destination is half the journey” – Anonymous*

This report is concerned with the development of the infrastructure which is required in order to support proposed mines in Southern Mongolia. In order for the mines to be developed, it will be necessary to provide towns for the new inhabitants, road and rail links to provide supplies and to transport the mines' products to markets, and electricity for the mines' operations. Water resources need to be investigated and supplied to the mines and towns. And as all of the development advances, consideration needs to be given to mitigating any negative environmental and social impacts.

The mines of principal interest are indicated in the map in Figure 1.1. Significant copper deposits are found at Oyu Tolgoi and Tsagaan Suvraga. In addition to copper, there are several existing and proposed coal mines in the region. The coal deposits at Tavan Tolgoi are known to be particularly significant. Mining companies are exploring the extent of additional coal resources, and if their best hopes are realized Southern Mongolia could become one of the world's major coal producing areas.

Figure 1.1 Important Mines in Southern Mongolia



The geographic focus of the report varies according to the particular topic. The mines are all located in a region which this report defines as “Southern Mongolia”, and which includes the aimags of Omnogovi, Dornogovi, Govisumber and Dundgovi. The majority of the important new mines are located in Omnogovi, and the analysis of housing and social impacts is concentrated in areas close to these mines. When attention turns to water resources and environmental issues, all of Southern Mongolia is considered. For issues of electricity, attention broadens further to the interconnected Central Electricity System, which is centered on Ulaanbaatar. And for land transport, attention extends as far as ports in China and Russia.

In terms of time, the report concentrates on the most important priorities for government action up to 2015. Nevertheless, consideration is given to a longer time-horizon when considering the potential environmental and water resource demands likely to arise as a result of the region’s development. The report is not concerned with the longer-term actions required for broader economic development of the region, including the development of value-added industries associated with the mining industry. To get to long-term objectives, it is necessary to start with the short term. This report assumes that the Government will permit development of the mines in the near future, and addresses the question: what else needs to happen in order to make the mines a reality?



# 2

## MINING IN SOUTHERN MONGOLIA

### KEY POINTS

- Southern Mongolia may be able to export around 20 million tonnes of coking coal annually, which at a price of \$100/tonne would generate revenues of US\$ 2 billion.
- Annual exports of 15 million tonnes of thermal coal may also be possible, which at a price of \$60/tonne would generate annual revenues of \$0.9 billion.
- Exports of copper and gold from Oyu Tolgoi and Tsagaan Suvraga may generate annual revenues of around US\$2.3 billion.
- Southern Mongolia's coal exports may be constrained by China's demand.
- Realizing Southern Mongolia's coal potential will depend on the price of rail freight, in order to undercut current domestic Chinese coal, or to export to international markets.
- An alternative way of marketing Southern Mongolia's coal may be as electricity exports to China.
- The Chinese market should be able to absorb Southern Mongolia's copper.

### 2.1 Major mines of Southern Mongolia

Table 1.1 sets out preliminary estimates of the annual volumes of coal and copper that may be produced by Southern Mongolia's major mines, as well as employment at the mines and associated infrastructure, and possible start dates. All of these estimates are subject to changes in government and

mine owner plans. This report bases its estimates on these assumptions. In planning infrastructure for Southern Mongolia, the Government will need to continually update its projections of mine output and employment.

**Table 2.1 Potential Major Mines in Southern Mongolia**

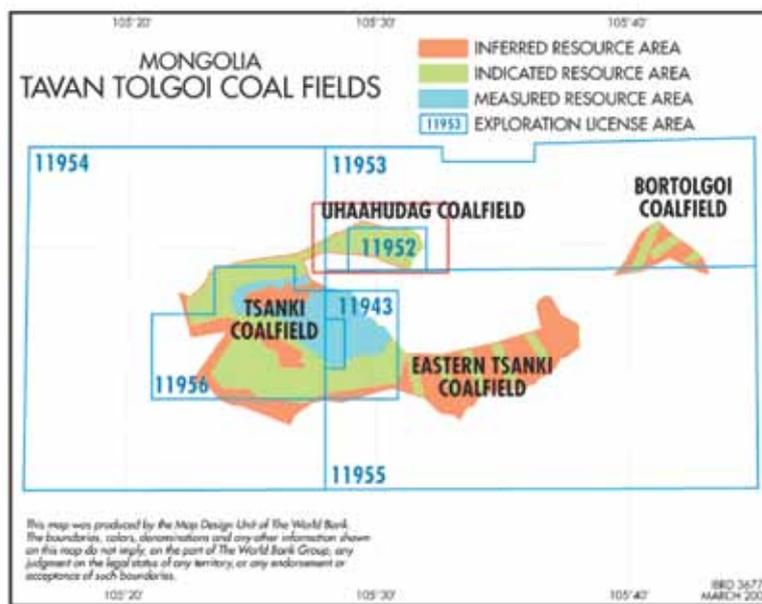
Mine	Mineral	Life (years)	Production ('000 tons/year)	Employment Estimate	Start date Estimate
Tavan Tolgoi	Coal	200+	15,000	1500	2012
Uhaahudag	Coal	40	10,000	1000	2009
Baruun Naran	Coal	20	6,000	500	2012
Tsagaan Tolgoi	Coal	20	2,000	150	2015
Nariin Sukhait	Coal	40	12,000	150	2003
Ovoot Tolgoi	Coal	50	5,000	400	2008
Sumber	Coal	50	5,000	400	2015
Shivee Ovoo	Coal	200+	14,000	600	2015
Oyu Tolgoi*	Copper	50	2,000	4000	2012
Tsagaan Suvraga*	Copper	20	250	1000	2012
Total				7800	

\* Production figure is for copper concentrate (30% copper)

## Tavan Tolgoi and Baruun Naran

Tavan Tolgoi contains over 4.5 billion tons of established resources, of which 1.9 billion tons are coking coal, and the remainder is thermal coal (see Box 1.1 for a discussion of the different types of coal). Additional resources are inferred taking the total resource envelope up to 6.0 billion tons. Tavan Tolgoi includes four fields: Uhaahudag, Tsanki, Eastern Tsanki, and Bortolgoi (Figure 2.1).

Figure 2.1 Coalfields at Tavan Tolgoi



A joint venture between the aimag government and Qinhu currently operates a small mine within the Tsanki coalfield, trucking about 1 million tons of coal per year to the Chinese border (Figure 2.2)

Figure 2.2 Existing Tavan Tolgoi coal mine



The Uhaahudag coal field is owned by Energy Resources. Energy Resources is currently preparing its mine site, and expects to export about 2 million tons in 2009. The Government has given Energy Resources the right to construct a railway, which would permit Energy Resources to expand its production to around 10 million tons per year.

The remaining fields of Tavan Tolgoi are owned by Erdenes MGL LLC, the state-owned holding company. How best to go about developing these fields has been the subject of much debate within Mongolia. It is likely that a major strategic investor will be sought to develop the mine and to market the coal.

## BOX 2.1 TYPES OF COAL

Coal is classified by its carbon content, which determines the amount of heat given off when it is burned. There are three “ranks” of coal, as well as lignite:

- Lignite is a soft brown fuel which has characteristics somewhere between coal and peat. The heat content of lignite ranges from 2,400 to 4,165 kcal/kg. It is used almost exclusively as a fuel for steam for electric power generation. Because of its low energy density, it is not profitable to transport lignite long distances, and it is not traded extensively on the world market compared with higher coal grades. It is often burned in power stations constructed very close to mines.
- Sub-bituminous coal is a brown coal with a heat content of 4,165-5,700 kcal/kg, and is used primarily as fuel for steam electric power generation. Its relatively low density and high water content (20-30% inherent moisture by weight) renders it susceptible to spontaneous combustion if not packed densely during storage in order to exclude free air flow.
- Bituminous coal is a hard coal with a heat content of 5,700-8,480 kcal/kg. Bituminous coal is classified into coking and non-coking grades. Both kinds are widely used in industrial power plants. Bituminous coal must meet a set of criteria for use as coking coal, including moisture content, ash content and fusion temperature, sulfur content, volatile content, tar content and plasticity/fluidity. Coke is produced by baking coal at high temperature (2000 degrees Celsius) in an airless oven, to drive off volatile (vaporizing) material. Coke is the main fuel in blast furnaces used to make iron.
- Anthracite is a hard coal, with a carbon content of between 92 and 98%, and a heat value greater than 6,200 kcal/kg. Its principal use is as a domestic fuel. It burns cleanly with little soot, but its high value typically means it is too expensive to use in power plants.

The “grade” of coal is determined by the amount of ash and trace elements it contains:

- Most commercial coals range from 3% to 9% ash, typically sand and clay that was carried into the swamp which produced the coal. After burning, ash is either removed from the combustion chamber, or it goes up the smokestacks as fly ash.
- Trace elements in coal can either affect the combustion process or cause atmospheric pollution. Sodium causes ash to precipitate on the boilers, reducing the efficiency of the boiler. Sulfur is released as sulfur dioxide upon burning, and if not scrubbed out of the emissions, will produce sulfuric acid and acid rain. Other trace elements commonly found in coal include phosphorous, chlorides, nitrates, sulfates, mercury and arsenic. A number of Mongolian coals also contain uranium.

The Baruun Naran deposit lies about 20km west of Tavan Tolgoi. It has a reported potential production of about 120 million tons of coal of which 70 million is coking coal and 50 million tons is thermal coal. Until 2008, the deposit was owned by QGX Limited, a Canadian listed company. In 2008, MCS Holdings LLC, acquired QGX. MCS Holding also holds a controlling interest in Energy Resources. Prior to the takeover, QGX Limited, a Canadian company, had planned to commence production in 2011 or 2012. Annual production was planned at 6 million tons with a mine life of twenty years.

## Nariin Sukhait and Ovoot Tolgoi

The Nariin Sukhait coal deposit contains two mines, one owned and operated exclusively by the Mongolian Alt Corporation (MAK) and another operated as a joint venture between MAK and the Chinese company Quinhua (Quinhua-MAK). The deposit reportedly contains 134 million tonnes of coal resources. The mines currently truck about 2 million tons of coal per year, to the Chinese border at Ceke.

Figure 2.3 Nariin Sukhait (MAK), Ovoot Tolgoi East and West Fields, and Sumber

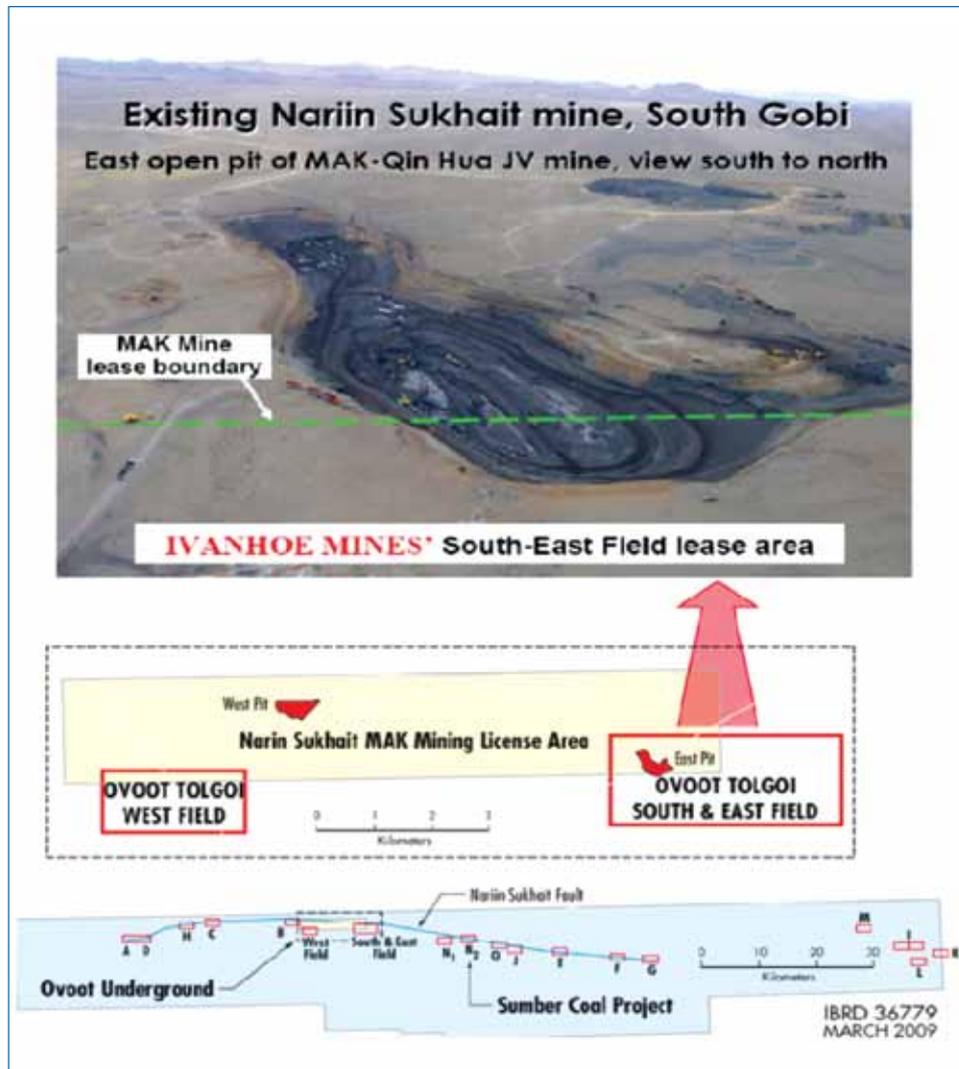


Photo source: SouthGobi Energy Resources website, January 22, 2009

Adjoining the Nariin Sukhait coal deposit, South Gobi Energy Resources (a subsidiary of Ivanhoe) began operations at the Ovoot Tolgoi mine in April 2008. The deposits at the Ovoot Tolgoi West Field and South and East Field contain approximately 259 million tonnes of measured and indicated coal resources, and a further 145 million tonnes of inferred resources. This mine is expected to ship about 2 million tons of coal per year, and perhaps 6 to 8 million tons if a rail connection to China is constructed.

The current operations form part of a single thick seam of low-ash, high-rank, bituminous coal extending from the surface to depths ranging between 120 and 150 meters, with a thickness averaging approximately 60 meters. This seam continues across a major coal basin that stretches 120 km east and west from Nariin Sukhait. South Gobi Energy Resources holds the exploration rights to much of this seam. In addition to the operations at Ovoot Tolgoi, the company is currently examining the potential for operations at Sumber, 16 km east

of Ovoot Tolgoi. Initial results show coal of similar quality to Ovoot Tolgoi, although the seam is not quite as thick.

### Shivee Ovoo and Eldev

Shivee Ovoo is located 250 km south of Ulanbaatar in Govisumber aimag, beside the trans-Mongolia railway line. It has coal resources estimated at more than 2 billion tonnes. It was opened in 1992 for the purpose of meeting domestic demand for coal in Mongolia. Shivee-Ovoo coal is sub-bituminous, with a high moisture content. This causes some problems when it is used in power stations in Mongolia due to poor ignition in the furnace and freezing of stockpiles in winter. There are plans to use the deposit to fuel a large power plant, and to export electricity to China. The proposed power plant would be in the order of 6 x 600 MW, and would be a joint venture between the Mongolian and Chinese governments.

The Eldev coal mine is 20 km north of the Trans-Mongolian Railway, in Dornogovi aimag. The mine is operated by MAK. The mine has resources estimated at 51 million tonnes, and currently exports 500,000 tonnes of coal per year, making it one of the largest existing operations in Southern Mongolia. It is not anticipated that the mine will be expanded to the extent of other existing coal mines in Southern Mongolia, and it is not considered further in this report.

### Oyu Tolgoi

The Oyu Tolgoi copper and gold deposit is about 200 km south-east of Dalanzadgad. The deposit has

measured and indicated resources of 1.387 billion tonnes grading 1.33% Cu and 0.47 g/t Au, and a further inferred resource of 1.397 billion tonnes grading 0.98% Cu and 0.24 g/t Au; ie containing about 32 million tonnes of copper and 987 tonnes of gold. Mineable reserves are likely to be somewhat below these global resource figures, but nevertheless this is a huge orebody with potential to sustain a large scale mining operation for more than 50 years.

The project is owned by Ivanhoe Mines Mongolia Inc, a joint venture between Ivanhoe Mines Inc and Rio Tinto PLC. The cost of mine development has been estimated by Ivanhoe at around US\$ 5 billion, and net of these costs the project has been projected to yield revenues with a present value of around \$3 billion. The Government is encouraging Ivanhoe Mines Mongolia to build a smelter, and to export refined copper.

While extensive exploration and mine site preparation has already occurred, moving into the production stage awaits the conclusion of an investment agreement with the Government. The agreement is necessary to provide certainty to private investors concerning the legal and fiscal arrangements, particularly the stability of royalty and tax rates, and other levies that will be paid to the Government. The current Government has recently indicated that concluding an investment agreement for Oyu Tolgoi is one of its highest priorities.

Figure 2.4 Mineshafts at Oyu Tolgoi



### Tsagaan Tolgoi

Tsagaan Tolgoi is a coal deposit about 100 km west of Oyu Tolgoi, with 36.4 million tonnes of measured and indicated resources, and a further 9 million tonnes of inferred coal. The coal rank is high volatile B and C bituminous (which would usually be used for steam, but could be blended with higher rank coal to make coke). Its owners, South Gobi Sands (which is partially owned by Ivanhoe), have suggested that it could be used as a fuel source for the power plant supplying electricity to Oyu Tolgoi.

### Tsagaan Suvraga

The region surrounding Tsagaan Suvraga, approximately 150 km northeast of Oyu Tolgoi in Dornogovi aimag, contains seven significant copper-molybdenum deposits, of which the most significant is at Surven-Sukhait. This deposit is 164 km southwest of the Zuun-Bayan railway station, which lies at the end of a 50 km branch from the trans-Mongolia railway. Copper resources have been estimated at over 220 million tons at 0.54% copper and 0.019% molybdenum. These grades are similar to those at Erdenet (Mongolia's largest copper mine and third-largest city), although the currently identified resources are substantially smaller. Expected output is about 1 million tonnes of copper concentrate per year (ie about 50 trucks per day). As yet, there are no firm plans for the development of Tsagaan Suvraga.

## 2.2 Markets for Mongolia's coal

Given the extent of coal resources in Southern Mongolia, sales of coal over the next decade or so are likely to be constrained by the extent of demand rather than by the supply of coal. Exports of around 20 million tons of coking coal per year might generate net revenues of around \$1.2 billion per year (assuming production costs of \$30/ton, freight costs of \$20/ton, and a price for coking coal of \$110/ton). Key factors affecting revenues will include the pace at which the mines and associated rail infrastructure can be developed, the strength of Chinese demand for coal, the vagaries of international prices for coal, and the rates negotiated for access to the Chinese rail network.

Mongolia is well-placed to capture the majority of China's growing demand for coking coal imports. Historically, China produced all the coking coal it

required, with very limited imports. In recent years as steel production has rapidly increased, imports of coking coal have also increased, but they remain a small proportion of total Chinese demand. In 2007, estimated Chinese production of metallurgical coal was 365 million tons, with exports of 6 million tons and imports of 3 million tons. In the past, most of China's coking coal imports came from Australia. In recent years Mongolia has rapidly become the most important supplier. In 2008, Mongolia supplied more than 50% of China's coking coal imports, and over 75% in June and July.

Given its geographical proximity, Mongolia could capture the market for all of China's coking coal import requirements, other than a few specialized shipments. Early in 2008, the medium-term forecast for the growth of China's demand for coking coal imports was 8% per annum, with imports growing to around 20 million tons by 2013. The current economic crisis could significantly weaken this demand growth. Southern Mongolia's new coal mines will also compete with existing Mongolian mines, which already account for over 3 million tonnes of coal sales to China.

The market for exports of thermal coal from Mongolia to China is much more marginal, and will depend on the particular grades of coal, the costs of transport, and the prices of coal and electricity in China. In August 2008, the on-grid power tariff for generators in China's Inner Mongolia was around RMB 240 (US\$ 35/MWh). If the Chinese plants cover full costs, this tariff would support coal prices ranging from US\$ 18/tonne to US\$55/tonne, depending on the thermal value of the coal. The cost of freight for coal from Southern Mongolia to Inner Mongolia might be in the range of US\$ 10-30 per tonne. These figures suggest a price range from US\$ -28/tonne to US\$ 45/tonne that Inner Mongolian power plants would pay for Mongolian thermal coal. Coal exports would only be profitable if the cost of production is less than the price received:

the current regulated price of production from Shivee Ovoo is Tg 11,400/tonne (US\$10/tonne).

developers of the Baruun Naran mine have suggested that their operating costs, including overheads would be around US\$ 28/tonne (Table 2.2).

the operators of the Ovoot Tolgoi mine report current operating costs of US\$11.5/tonne (<http://www.southgobi.com/s/OvootTolgoi.asp>).

Against this gloomy outlook, there are three possibilities for creating a market for export of thermal coal from Southern Mongolia: possible increases in the price of electricity in China; possible exports beyond China; and conversion of coal into electricity in Mongolia, to support exports of electricity.

**Table 2.2 Indicative Open-Cut Coal Mining Costs**

Unit Cash Costs per Product Ton	US\$/metric ton
Overburden Removal	\$14.87
Coal mining and product haul	\$1.78
Field support cost	\$2.72
Coal washing and handling	\$3.46
Administration, royalty, and overheads	\$5.46
Total Operating Costs/ton	\$28.29
Coal transport and port costs	\$10.00 – \$32.00

*Source: QGX Ltd. Press release, January 23, 2008*

The market for thermal coal in China reflects government regulation of retail prices for electricity. It appears that Chinese power producers sell power at a price which does not include the full value of the coal they consume. In February 2009, benchmark prices for Chinese coal at Qinhuangdao port were around US\$ 90/tonne. Deducting transport and port costs of around US\$30/tonne, this would give a price for coal at a power plant in Inner Mongolia of US\$60/tonne. There will be commercial pressures in China in coming years to adjust electricity tariffs to reflect the full value of coal inputs. Adjusting for different coal heating content the equivalent price for Southern Mongolian thermal coal might be in the order of \$35/tonne. This would be profitable for at least some Mongolian thermal coal producers, depending on the price of rail freight.

It may be possible to realize higher prices for Mongolian coal by exporting to Japan and Korea, or other international markets. In January 2009, Macquarie Group Ltd forecasts for coking coal prices in 2009 were \$110 per metric ton for coking coal and \$75 for thermal coal FOB in Newcastle (compared with \$300 and \$125 in 2008). Obtaining such prices for Southern Mongolia's coal would depend on the price of rail freight through China or Russia. Chapter 4 discusses the feasibility of potential rail routes by which such exports might occur.

Finally, an alternative to exporting coal to China is to export electricity, using coal fired power plants built in Southern Mongolia. The amount of coal used by a power plant varies, depending on factors such as the efficiency of its burners, the calorific value of the coal used, and the proportion of time it is operational per year. The Mongolian Government is seeking to develop a 3,600 MW power plant at Shivee Ovoo to export electricity to China. The plant would consume around 14 million tonnes of coal per year. It would also be possible to build a large power plant in the area of Tavan Tolgoi, potentially fuelled by coal middlings produced as a byproduct of coal washing for the production of coking coal for export (which would otherwise be dumped as a waste product). It is cheaper to export coal as electricity than by rail freight, but feasibility studies for this option will need to take account of transmission and distribution losses. It will also be necessary to operate efficient power plants that can compete with potential new plants in China.

In sum, within the next five years, Southern Mongolia may be able to export around 20 million tonnes of coking coal per year, and up to 15 million tonnes of thermal coal. At prices of \$100/tonne for coking coal and \$60/tonne for thermal coal, this would generate annual revenues of US\$ 2 billion for coking coal, and US\$ 0.9 billion for thermal coal.

These quantities of coal exports are less than the estimated supply capacity of Southern Mongolia's mines, set out in Table 2.1. Unless exports to world markets are undertaken, it may not be possible to develop all of the coal mines in Southern Mongolia over the next decade. Individual mine developers will bear the risk of ensuring that there is demand for their coal output, before investing in major mine developments. The Government will similarly need to be careful to ensure that it does not over-invest in shared infrastructure.

### 2.3 Markets for Mongolia's copper

China's copper consumption in 2008 was around 5 million tons, while its output of refined copper was about 3.7 million tons. To meet the additional demand for copper, China imports about 4-5 million tonnes of concentrate (ie about 1.5 million tonnes of refined copper). Although China's economic growth will weaken considerably in 2009, its copper consumption is still forecast to grow to around 5.4 million tons in 2009, because of ongoing urbanization and the infrastructure focus

of China's stimulus package. In addition, several large copper mines in China will reach the ends of their productive lives by around 2015. Compared with other countries, Mongolian copper concentrate should have a freight advantage in selling to China. Accordingly, it should be possible to find a market for all of Mongolia's copper production in China.

In January 2009, prices for copper were around \$3,200 per tonne, a third of the level a year earlier. Copper prices have been very volatile over the past five years, experiencing an unprecedented period of high prices from 2003 to mid-2008. Prices are forecast to return to an average price of around \$1.75 per lb (\$3,850/tonne) over the next few years.

With a price of \$3,850/tonne for copper, Oyu Tolgoi's annual output of around 450,000 tonnes of refined copper would generate revenues of around \$1.746 billion per year. Oyu Tolgoi will also produce around 330,000 ounces (10 tonnes) of gold per year, which at a price of \$900/ounce would have a market value of \$297 million per year. Tsagaan Suvraga's output of 60,000-80,000 tonnes of copper would have a value of \$230-300 million per year. Together, the mines at Oyu Tolgoi and Tsagaan Suvraga could generate revenues of around \$2.3 billion per year.



## KEY POINTS

- Over the next five years, the population of Southern Mongolia may expand by around 80,000 people, with one extra immigrant for every member of mine workers' families.
- To plan for infrastructure demand, the Government should regularly keep track of expected mine employment as well as the actual rate of population growth associated with new mines.
- Four possible models of mining settlements are identified: fly-in fly-out; gated community; integrated community; company town.
- A mix of FIFO and integrated community developments may help to widen the potential labor market for mines and other employers in Southern Mongolia.
- Once town locations are decided, decisions need to be made about who will plan, finance, construct and operate urban infrastructure such as buildings, local electricity, drinking water, sanitation, solid waste, and town roads.
- Town development for 80,000 people could cost around \$1.4 billion.
- Cost-covering tariffs for infrastructure services will be needed if private investment is sought.
- Cost recovery implies tariff increases of 230% for drinking water and 350% for electricity, compared with current tariff levels in Southern Mongolia.
- A consultative process is recommended to plan town locations, models of mining settlements, and arrangements for provision of urban infrastructure.
- If it is expected that mining companies should make financial contributions to township development, this should be specified in agreements between the Government and the mines, in connection with Investment Agreements.

### 3.1 Population growth

Employment in Southern Mongolia's mines will stimulate population growth much greater than the direct employment numbers. Miners will bring their families with them to the region, and additional population influx will be induced by commercial and lifestyle opportunities. A plausible estimate is that the population will expand by more than 8 times direct mining employment within 5-10 years. Table 2.1 (page 3) provides preliminary employment estimates of 9,700 in the major mines of Southern Mongolia, suggesting a total population increase of more than 80,000. The majority of these would be located in Omnogovi aimag.

The population multiplier associated with mine workers is determined by several factors. Workers will want to live with their families, and average Mongolian households have 4.1 people. In addition, many people who are not directly employed by the mines will be attracted to the area by increased commercial opportunities, hopes of employment, or because urban service provision is better in the new mining developments than in the surrounding region. A plausible estimate of this "influx" is

## BOX 3.1 PREDICTING POPULATION GROWTH

It is very difficult to predict how many people will be attracted to live in the area of a new mine, beyond those who are not directly employed at the mine. The table below summarizes a range of international experience. The “influx multiplier” is measured over several years according to data availability and is calculated as:

$$\frac{\text{Final population} - \text{base population}}{\text{base population}}$$

where the *base population* includes the existing population at the start of mine operations plus mine employees and their families.

Mine	Settlement Type	Initial population	End population	Years of data	Mining workers	Influx multiplier
Pilbara, Australia	Fly-In Fly-Out	44,798	37,762	5	180	-0.17
Tierra Amarilla, Chile	Integrated community	11,724	12,888	10	860	-0.12
Copiapo, Chile	Integrated community	100,907	129,091	10	860	0.24
Escondida, Chile	Gated community	228,408	296,905	10	2,000	0.26
Grasberg, Papua New Guinea	Company town	1,000	110,522	29	18,000	0.43
Pierina, Peru	Gated community	66,888	100,931	14	540	0.47
Sossego, Brazil	Integrated community	10,000	20,000	3	600	0.63
Yanacocha, Peru	Integrated community	92,447	162,326	14	269	0.74
Zouerate, Mauritania	Company town	1,000	18,000	27	1,900	1.35
Erdenet, Mongolia	Company town	1,000	83,000	35	6,000	2.03
Carajas, Brazil	Gated community	1,000	110,000	24	2,150	11.00

There is wide variation between the different cases. Mines which rely on fly-in fly-out operations (eg some of Rio Tinto’s Pilbara operations in Western Australia) result in minimal or even negative population influx. Company towns, where the mining company provides extensive good quality urban services, typically attract higher levels of population influx.

International experience does not suggest that remoteness plays an important role in determining the level of population influx. Rather, migration is likely to be determined by the relative opportunities offered by mining communities as compared with opportunities elsewhere in the country.

For this report, an influx multiplier of 1.0 is assumed for Southern Mongolia. That is, one new person will move to the area for each additional mine worker or member of his or her family. This is at the high end of the cases surveyed, reflecting Mongolians’ relatively high mobility, past experience at Erdenet, and the relative importance of mining in Mongolia’s economy. But an influx rate equal to that of Erdenet is not expected, in part because modern mining companies are unlikely to build the sort of company town that was built during the Soviet era.

For planning purposes, the Government should regularly keep track of the mines’ employment plans, and update its knowledge of the rate of influx as people start arriving in the region. Regular updating of plans will help to ensure adequate and timely infrastructure services provision.

that for every member of a miner's household, one more person will migrate to the area (Box 3.1). Finally, Mongolia's population growth rate has averaged about 1% over the past 15 years, and Southern Mongolia's population may be expected to grow at this rate (ie a multiplier of about 1.05 every five years).

The level of population influx associated with mine construction is difficult to predict. Employment at individual mines will peak during initial construction and site preparation. Construction workers will typically be housed in temporary construction camps, without their families. The construction workforce at Oyu Tolgoi reached around 3,000 in 2007, although once the mine enters production the workforce is likely to be in the order of 2,000. Although construction workers are typically temporary, housed in camps without their families, considerable population influx has already been observed at nearby Khanbogd during Oyu Tolgoi's site preparation.

Although individual mines are likely to regard construction workers as a temporary phenomenon, Southern Mongolia as a whole is likely to experience a protracted construction period of up to a decade, since the mines will not all enter production at the same time. Additional construction workers will also be required to build the infrastructure associated with the region's development. For example, a planned 450 MW power plant to serve Oyu Tolgoi might employ up to 2,000 workers during an 18 month construction period. Construction workers are likely to move around the region over the next decade, from site to site. It may be desirable to ensure a central location where construction workers and their families can be based between jobs (eg Dalanzadgad).

Table 3.1 provides a preliminary estimate of the population growth that could be associated with the main mining areas of Southern Mongolia. The table suggests that by 2015, in addition to the people who already live there (and their natural population growth), a further 80,000 people may be living in Southern Mongolia.

## 3.2 Different models for mining settlements

One of the factors affecting the rate of population growth will be choices made in the provision of accommodation and urban infrastructure for the new population.

International experience suggests a range of options for the housing of mine employees and associated population influx. The options chosen in Mongolia will have implications for the cost of town construction and service provision, mine construction and operation costs, the extent of population influx, and the social well-being of the region's inhabitants.

This report groups settlement options into four types: fly-in fly-out; gated communities; integrated communities; and company towns. Each has their advantages and disadvantages.

### Fly-in, Fly-Out

In the fly-in fly-out model (FIFO), workers and their families live in regions, often metropolitan areas, located far away from the site of mining operations. Workers commute to the mine site on a rotation basis, for example 14-days on/7 days off. There is no recruitment from local communities, and no infrastructure development in local communities. The mining company builds a mining camp, inside the mine gate, with enough infrastructure for mine employees only. A variation on the FIFO mode is the bus-in, bus-out model used where commuting distances permit, or airstrips are not available.

FIFO operations are often used in remote locations, where there are few possibilities for local recruitment and housing, particularly for mines with a relatively short operating life. Because accommodation is kept to the minimum necessary for mine operation, the capital cost of mine construction is minimized. But transport costs, as well as the complications of worker scheduling can raise mine operating costs. For mines with short operating lives, FIFO minimizes the social dislocation associated with mine closure.

**Table 3.1 Preliminary Population Projections for Mining Areas in 2015**

	Mine Workers <sup>a</sup>	Families <sup>b</sup>	Influx <sup>c</sup>	Total, with natural population growth <sup>d</sup>
Tavan Tolgoi and Baruun Naran	2,000	6,200	8,200	16,772
Nariin Sukhait, Ovoot Tolgoi, Sumber	950	2,945	3,895	7,967
Oyu Tolgoi <sup>e</sup>	4,000	12,400	16,400	33,544
Tsagaan Tolgoi	150	465	615	1,258
Shivee Ovoo	600	1,860	2,460	5,032
Dalanzadgad <sup>f</sup>	2,000	6,200	8,200	16,772
Total	9,700	30,070	39,770	81,344

a. from Table 2.1. b=a x 3.1. c=a+b. d=a x (1.01)<sup>5</sup> + b x (1.01)<sup>3</sup> + c x 1.01.

e. Ivanhoe Mines intends that it will disperse accommodation and recruitment of its workers around the region. Accordingly the total population indicated here would be dispersed to reflect this pattern, and would not all be located near the mine site.

f The figures here do not include the existing population of Dalanzadgad, merely the additional numbers of potential Dalanzadgad residents attributable to the mining industry

Many mine workers prefer FIFO arrangements, because they and their families can live in large towns with a wide range of urban services, rather than in a small remote mining town. The long periods off work are also attractive to many workers. Being able to recruit such workers enlarges the potential employment pool for mining companies.

Negative social impacts associated with FIFO operations may arise from the transient nature of the workers they attract, who will typically have few ties to any local communities which may be located in the area of the mine. A shortage of recreational opportunities for mine workers can lead to social problems of alcohol and drug use. The long periods away from home mean that workers' wives effectively adopt the role of single mothers, and there is some evidence that the work model may be associated with greater instances of family violence and break-ups, and parenting problems.

### Gated Community

In the gated community model, workers and their families are housed in an area which adjoins existing local communities. The mining company builds the infrastructure needed to support the families within the gated community, for the exclusive use of these families. The mine may take advantage of some of the local community's infrastructure, such as roads or electricity connections. Mines may provide leisure facilities for the families within the gated community, but might also expect workers to use facilities of the local community for leisure.

The model implies greater capital cost to the mining company than FIFO, and probably greater cost than would be incurred under the integrated community model. It typically involves lower capital costs for the mining company than the company town model. Mining companies may be attracted to the gated community model, where the local community is unable to provide the sort of accommodation and services which are necessary to recruit mine workers. Gated communities may be used particularly where there are security concerns. For a relatively short-lived mine, the model may be appropriate to lessen social dislocation associated with mine closure.

Compared to a FIFO model, the gated community model offers social and health benefits associated with workers living full-time with their families. On the other hand, the presence of a gated community can create social discord, because of the presence of relatively wealthy workers within the gated

community, and poorer residents outside the gate – the “haves” and “have-nots”.

### Integrated Community

In the integrated community model, mine workers are housed in an existing community located near the mine. The local community would provide the bulk of the accommodation and infrastructure for these workers. Depending on the local community's resources, mining companies may make some contribution, and would typically permit non-miners to use any facilities they provide.

Depending on the resources of the hosting community, the integrated community model may provide some opportunities for a mining company to reduce its capital costs. The greater involvement of the mining population in the local community can also be positive for the company's local image – which may be important in securing other aspects of the company's activities. On the other hand, where the mine becomes involved in upgrading community services to ensure appropriate standards for its workers, it may find that costs escalate with population growth and pressures on the company to provide services for all town inhabitants.

The social benefits of the integrated community model include workers living with their families, and potentially greater benefits to the existing local communities because of the greater interaction with mine workers. On the other hand, tensions may arise from some of the consequences of mine development. The economic activity generated by the mine may bring with it a higher cost of living, and an influx of migrants that the existing population does not always view as desirable. For example, at the Yanacocha gold and silver mine in Cajamarca, Peru, residents have benefited from improved services, but view the mineworkers as disorderly and rough, and note the deterioration of local customs with the appearance of nightclubs, prostitution, and increased crime.

### Company Town

In the company town model, a mining company builds and operates an entire town including all basic infrastructure necessary to accommodate miners and their families. It may also build and operate recreation and leisure facilities (eg restaurants, retail shops, community centers, hotels, and movie theaters). Mining companies usually plan to accommodate the supplier and contract population, the service population, and possibly some of the existing population.

The substantial capital costs associated with building a company town mean that mining companies would only contemplate it for a very long-lived mine, and where there is little possibility of gaining financial contributions to the expenses from the local government and community (eg. because of remoteness or poverty). If the mine subsidizes town services, it is likely to attract increased population influx. There is a risk that as the population expands the mining company may not be able to operate all of the township services effectively.

Positive social effects of a company town include the health benefits of the family-centered style of accommodation. Negative social effects come from the town's dependence on the mining company for employment and economic activity.

### 3.3 Options for planning and providing urban services

Once plans are made about where a town will be located, and forecasts for the population over the next 3-5 years are made, a variety of decisions need to be made concerning the town's urban services:

- What physical infrastructure is needed, where it should go, how much capacity is needed, and when will capacity be expanded?
- What quality of infrastructure services will be provided, and what prices will consumers pay for those services?
- Who will design, build, operate, and maintain the infrastructure?
- Who will pay for the infrastructure to be built?
- Who will pay for the operating expenses of the infrastructure services?

Potentially, a range of different organizations could make these decisions and/or provide the various infrastructure services. Possible organizations include:

- The national Government;
- The aimag Government;
- The soum Government;
- A mining company;
- A specialized private infrastructure service company;
- A private property development company.

### Planning and Controlling Infrastructure

Mongolia illustrates a range of options for the planning and controlling of infrastructure. National infrastructure has traditionally been planned and controlled by national government ministries and state-owned enterprises. Aimag governments control municipal public urban service organizations (PUSOs) by owning the assets. In Dalanzadgad, the aimag government has delegated operations and maintenance to a private company, but retains control through its majority ownership of the PUSO.

Internationally, many governments take responsibility for planning and controlling infrastructure assets. Even if private companies build, own and operate infrastructure, the Government typically specifies where the infrastructure should be built, and who should receive services from it. For example, many private companies build, own, and operate electricity infrastructure in the United States, Australia, and Japan, but the national and provincial governments in these countries control where generating stations and transmission lines can be built.

In countries with decentralized governance systems, planning for local settlements and communal infrastructure is usually a local government responsibility. Where private firms are making significant new investments, the private firms may also plan settlement and infrastructure, as they do in traditional mining towns.

Table 3.2 compares the advantages and disadvantages of having different entities responsible for planning and controlling infrastructure assets.

Table 3.2 Choosing Who Plans and Controls Infrastructure Assets

	Advantages	Disadvantages
National Government	<ul style="list-style-type: none"> <li>• Highest capacity</li> <li>• Good on national infrastructure like highways, railways, transmission</li> </ul>	<ul style="list-style-type: none"> <li>• Remote from local needs</li> </ul>
Aimag	<ul style="list-style-type: none"> <li>• Can coordinate development of several mines, several towns, and the links between them.</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of capacity</li> <li>• Still somewhat remote from some local needs</li> </ul>
Soum	<ul style="list-style-type: none"> <li>• Knows the local situation</li> <li>• Accountable to local people</li> </ul>	<ul style="list-style-type: none"> <li>• Lacks capacity</li> <li>• Cannot coordinate</li> <li>• No economies of scale</li> </ul>
Mining company	<ul style="list-style-type: none"> <li>• Business interest in having infrastructure to support workers</li> </ul>	<ul style="list-style-type: none"> <li>• Interested in own workers, not the rest of the community</li> <li>• Not specialized in infrastructure</li> </ul>
Specialized private operator	<ul style="list-style-type: none"> <li>• Strong financial incentive to get infrastructure working well</li> </ul>	<ul style="list-style-type: none"> <li>• More complicated to procure and manage</li> <li>• Can be hard to attract a good operator</li> </ul>
Private property developer	<ul style="list-style-type: none"> <li>• Business interest in getting infrastructure working for tenants</li> </ul>	<ul style="list-style-type: none"> <li>• Not specialized in infrastructure other than housing</li> <li>• No obligation to serve populations outside of property gate</li> </ul>

The national government typically has greater expertise than provincial and local governments, and can best coordinate investments across multiple provinces and soums, and across multiple sectors. This is clearly still the case in Mongolia. Aimag capitals (including Dalanzadgad) rely on national government to run their power plants. The PUSOs, which provide water services in many soums often look to Ulaanbaatar's Water Supply and Sewerage Authority (USUG) for technical support.

On the other hand, national governments are not likely to understand or appreciate the needs of provincial and local populations as well as do provincial and local government officials. National governments are often better at planning and controlling large-scale infrastructure investments than smaller-scale infrastructure investments within provinces, towns and cities. We see evidence of this in Mongolia, where, as summarized in Section 2, the national government has a lot of plans for transmission lines, roads, and rail lines, but fewer detailed plans for infrastructure within towns near South Gobi's mines.

Mining companies historically have also played a role in planning and controlling infrastructure. Mining companies, however, may lack the inclination or skills to plan and control infrastructure for towns that include miners as well as non-miners. Mining companies, because of their business interests, may plan infrastructure for their workers and workers'

families, but will be less interested in making that infrastructure available to existing non-mining populations or influx. Mining companies also do not specialize in planning and controlling infrastructure assets. A government entity, whether national, provincial, or national, has incentives for planning infrastructure that are better aligned with those of the non-mining populations, and typically has more experience planning infrastructure for towns, and controlling those infrastructure assets.

Private property developers have expertise in planning housing complexes, and the infrastructure required to serve those complexes. Private property developers also have a strong business interest in getting infrastructure up and running for their future tenants. Private property developers are not, however, necessarily experts in planning large-scale network infrastructure such as water and wastewater treatment facilities, or heating and electricity production, nor are they required to serve populations that cannot afford, or do not want to live in their apartments or homes.

### Paying for Infrastructure

If an additional 80,000 people migrate to Southern Mongolia over the next five years, the cost of buildings and urban infrastructure could be in the order of US\$ 1.4 billion, including US\$1.2 billion for buildings and \$225 million for infrastructure (Table 3.3).

**Table 3.3 Indicative Capital Costs of Town Development**

Population Center	Additional Population	Buildings (\$m)	Infrastructure (\$m)	Total (\$m)
Tavan Tolgoi	16,772	238	42	280
Nariin Sukhait	7,967	112	29	141
Oyu Tolgoi	33,544	490	69	559
Tsagaan Tolgoi	1,258	18	20	38
Shivee Ovoo	5,032	70	23	93
Dalanzadgad	16,772	238	42	280
<b>Total</b>	<b>81,344</b>	<b>1,166</b>	<b>225</b>	<b>1,391</b>

An Excel spreadsheet model is available at [www.worldbank.org/southgobi](http://www.worldbank.org/southgobi), which estimates the cost of urban infrastructure based on assumptions including population size the proportions of the population living in gers and apartments, and the manner in which electricity is provided (Option A – transmission line from a large plant; Option B – CHP plant; Option C – a small diesel plant combined with heat only boilers).

Detailed model costings are illustrated in Table 3.4, for a single town big enough to deal with the projected population influx centered on Oyu Tolgoi. The costing assumes that small 5MW combined heating and power plants are built to supply electricity and heat to the population. In practice, the population associated with Oyu Tolgoi could be served with power from the proposed 450 MW Oyu Tolgoi power plant, and the population could be distributed across several towns.

**Table 3.4 Indicative Capital Cost for New Population Near Oyu Tolgoi**

	Number	Unit	Per Unit	Total
<b>Buildings</b>				
Apartments	4.792	Apartments	\$ 78.867.60	\$ 377.933.539
Gers	3.195	Gers	\$ 500.000	\$ 1.597.333
Schools	8.051	Students	\$ 1.317.00	\$ 10.603.167
Kindergartens	2.013	Children	\$ 2.677.00	\$ 5.388.801
Dormitory	671	Beds	\$ 2.388.00	\$ 1.602.348
Family Hospitals	1.175	Persons/day	\$ 12.944.44	\$ 3.459.721
General Hospitals	302	beds	\$ 13.047.00	\$ 33940.194
Other	-	-	\$ -	\$ 85.626.864
<b>Total</b>				\$ 490.151.968
<b>Portable Water</b>				
Boreholes	24	Boreholes	\$ 8.695.64	\$ 208.695
Main Pipelines	2.876	m	\$ 86.96	\$ 250.087
Water Ring Mains (100-20mm)	12.460	m	\$ 52.17	\$ 650.087
Pumps (250m <sup>3</sup> /day each )	2	Pumps (250m <sup>3</sup> /day each )	\$ 260.869.50	\$ 521.739
Reservoirs	4.500	cubic meters	\$ 144.93	\$ 652.174
Standpipes	15	Standpipes	\$ 18.147.27	\$ 272.209
Connections (incl.meters)	4.792	Connections (incl.meters)	\$ 300.00	\$ 1.437.600
<b>Total</b>				\$ 3.992.592
<b>Waste water</b>				
Pipelines (150-200mm)	7.188	m	\$ 130.43	\$ 937.565
Pump Station	1	Pump Station	\$ 52.174.00	\$ 52.174
Treatment Facility 12.000m <sup>3</sup> /day	1	Treatment Facility 12.000m <sup>3</sup> /day	\$ 5.217.391.00	\$ 5.217.391
Connections	4.792	Connections	\$ 853.00	\$ 4.087.576
<b>Total</b>				\$ 10.294.706

<b>Electricity</b>				
Cool plant (5MW CHP)	1	Plants	\$ 8,000,000.00	\$ 8,000,000
Substation (2.500kva)	2	Substations	\$ 349,694.50	\$ 699,389
Distribution lines (10kV)	76.672	m	\$ 15.60	\$ 1,195,700
Distribution network (0.4 kV)	383.360	m	\$ 9.23	\$ 3,538,413
Connections	7,987	Connections	171.00	\$ 1,365,777
<b>Нийт</b>			\$	<b>14,799,279</b>
<b>Heat Distribution</b>				
Main Pipelines (820 mm)	19.168	m	\$ 345.00	\$ 6,612,960
Distribution Pipelines (100-300mm)	28.752	m	\$ 176.78	\$ 5,082,853
Distribution Stations (50 \Gcall/stations)	6	Stations	\$ 3,000,000.00	\$ 18,000,000
Plate Heat Exchangers	72	Heat Exchangers	\$ 30,000.00	\$ 2,160,000
Connections	4,792	Connections	\$ 930.00	\$ 4,456,560
<b>Total</b>			\$	<b>36,312,373</b>
<b>Road</b>				
	9.067	m	198.00	1,795,369
<b>Total</b>				<b>1,795,369</b>
<b>Solid Waste</b>				
land fill	7,275	Tonnes/year	103.09	750,000
Collections Vehicles	2	Vehicles	28,900	115,600
Bulldozer	76,672	Bulldozers	128,000	128,000
Excavator	383,360	Excavators	140,000	140,000
Truck-Mounted Crane	7,987	Cranes	158,000	158,000
<b>Total</b>				<b>1,291,600</b>
<b>Total</b>				<b>558,637,887</b>

The table illustrates the cost of services for a town of 33,544. It is assumed that the population is housed 60% in apartments, 40% in gers. Apartments receive all utility services; gers receive only electricity, water service through stand-pipes/kiosks; and use of roads. Data for construction costs reflect Mongolian prices in 2008, and the model assumes no inflation. A guide to the model is found in the urban infrastructure background paper.

The capital costs of infrastructure construction are usually provided with some mix of equity and debt. The cost of this capital is usually paid back over time, with the proceeds of consumer tariffs. Table 3.5 considers the various organizations which could arrange the up-front financing for infrastructure construction. The organization which organizes the financing will usually want a strong role in determining how the infrastructure is built and managed. It will be important to allocate responsibility for town development in Southern Mongolia to an entity which has the ability to raise finance, and to act quickly and efficiently in getting the towns and infrastructure services built.

**Table 3.5 Choosing Who Finances Infrastructure Assets**

National Government	<ul style="list-style-type: none"> <li>May have access to the lowest cost of finance</li> </ul>	<ul style="list-style-type: none"> <li>Remote from local needs.</li> <li>May have other spending priorities.</li> <li>Problematic if financing is tied with planning and control.</li> </ul>
Aimag or Soum	<ul style="list-style-type: none"> <li>Knows the local situation</li> <li>Accountable to local people</li> </ul>	<ul style="list-style-type: none"> <li>Cannot easily borrow</li> </ul>
Mining company	<ul style="list-style-type: none"> <li>Can borrow easily</li> <li>Can move quickly</li> <li>Business interest in getting infrastructure working.</li> </ul>	<ul style="list-style-type: none"> <li>Interested in own workers, not the rest of the community</li> <li>Not specialized in infrastructure</li> <li>Lower ability to minimize lifetime costs, ultimately implying greater cost to government.</li> </ul>
Specialized private operator	<ul style="list-style-type: none"> <li>Strong incentive to operate well and minimize lifetime costs.</li> </ul>	<ul style="list-style-type: none"> <li>More complicated to procure and manage</li> <li>Higher financing costs</li> <li>Can be hard to attract a good operator</li> </ul>
Private property developer	<ul style="list-style-type: none"> <li>Strong incentive to finance construction of infrastructure to serve homeowners</li> <li>Can borrow easily</li> <li>Can move quickly.</li> </ul>	<ul style="list-style-type: none"> <li>Less infrastructure operational experience which would allow them to minimize lifetime costs.</li> <li>Less incentive to minimize lifetime costs once property is sold.</li> </ul>

It is good practice to require customers to pay for the capital costs associated with infrastructure construction, in addition to the operating costs. If the tariffs paid by consumers do not cover the capital costs, it is very difficult to raise the finance to replace and renew the assets as they age. It is not possible for the private sector to invest in infrastructure services unless it is clear that the tariffs will cover costs, over the life of the investment.

Table 3.6 illustrates the implications of full cost recovery for each of the different infrastructure services, for an illustrative case of a town of 15,000 people. The full cost recovery tariffs are presented as prices per unit of the service, but it would also be possible to split the tariffs with a monthly fee and unit fee.

**Table 3.6 Cost-Covering Tariffs**

Units	Water \$/m <sup>3</sup>	Waste- water \$/m <sup>3</sup>	Electricity option A \$/kWh	Electricity option B \$/kWh	Electricity option C \$/kWh	Heating option A \$/m <sup>2</sup> /month	Heating option B \$/m <sup>2</sup> /month
Current residential tariff	0.52	0.17	0.05	0.05	0.05	0.17	0.17
Current enterprise tariff	0.61	0.17	0.08	0.08	0.08	0.40	0.40
Tariff covering O&M	0.11	0.06	0.03	0.07	0.45	0.06	
Tariff covering full costs	1.20	4.57	0.19	0.29	0.55	0.41	0.03

Assumes a population of 15,000 people. Option A provides electricity over a high voltage transmission line, with heating from heat only boilers. Option B provides electricity and heat using a 5MW combined heat and power plant. Option C provides electricity from local diesel generators without district heating – for heating residents would used heat only boilers, as in Option A.

The table illustrates that full cost recovery would require large tariff increases compared with the tariffs currently levied for these services in Southern Mongolia. Drinking water tariffs would rise to 2.3 times their current level for residential consumers. The cheapest option for electricity supply, option A, would require electricity tariffs to rise 3.5 times their current level for residential consumers. And wastewater tariffs would need to rise to 26 times their current level.

Internationally, consumer tariffs for infrastructure services are often regulated, in part to protect consumers from the market power of monopoly service providers. In practice this has often meant that consumer tariffs are below the level of cost recovery:

- Where governments have financed infrastructure, they have not always charged consumers tariffs which reflected the full capital costs. In-

adequate finance has in turn frequently been associated with low service quality.

- Internationally, some private mining companies have subsidized infrastructure services for their workers. In such cases, the subsidy expense is met from mining revenues, reducing the net revenue which available to pay government taxes and charges.
- When the private sector invests in infrastructure, it does so with the expectation of receiving the initial capital expenditure, plus a return reflecting the time value of money and a risk premium. In order to induce private investment, tariffs need to be set at a level which will ensure this rate of return.

If Government does decide to regulate the price of infrastructure tariffs to a level below the cost of service, it is important that the service provider should be compensated with an explicit subsidy from the Government. Ultimately, either consumers or taxpayers pay for all infrastructure services, and the service received is determined by the level of those payments.

### Designing, Building, and Operating Infrastructure

Table 3.7 sets out advantages and disadvantages of different entities designing, building and operating urban infrastructure. Mongolia has a tradition of having the national government design and build urban infrastructure; with aimag governments, through PUSOs, providing water, wastewater, solid waste, and in some cases electricity and heating services. Leaving aimags with responsibility for infrastructure service provision would be a familiar

approach, and require few changes in the way in which infrastructure is currently built and operated. Relying on mining companies could ensure fairly rapid roll-out of new services, but they may not be interested in expanding services as population grows significantly. Specialized private infrastructure companies could provide efficient and sustainable services, but their procurement is typically difficult and fraught with delays in countries with little PPP experience.

infrastructure of Omnogovi’s soums. Dalanzadgad has an airport, and some paved roads within the city and to the airport. Electricity is provided by a 6 MW coal-fired combined heat and power (CHP) plant. The CHP provides heating for apartments, public and commercial buildings. The plant suffers frequent outages, but electricity service is more regular than in many other soums. Centralized water and sanitation services also exists for apartments, public and commercial buildings.

**Table 3.7 Choosing Who Designs, Builds and Operates Infrastructure**

	Advantages	Disadvantages
National Government	<ul style="list-style-type: none"> <li>• Has scale and capacity for large infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>• Government may not always be best at running businesses</li> <li>• Remote from local area</li> </ul>
Aimag or Soum	<ul style="list-style-type: none"> <li>• These governments currently provide municipal infrastructure</li> <li>• Simple</li> <li>• Accountable to local people</li> </ul>	<ul style="list-style-type: none"> <li>• Lacks specialized skills</li> <li>• May lack economies of scale</li> </ul>
Mining company	<ul style="list-style-type: none"> <li>• Business interest in getting infrastructure working</li> <li>• Generally well-organized</li> </ul>	<ul style="list-style-type: none"> <li>• Interested in own workers, not the rest of the community</li> <li>• Not specialized in infrastructure</li> </ul>
Specialized private operator	<ul style="list-style-type: none"> <li>• Strong incentive to operate well and minimize lifetime costs.</li> <li>• Can be held accountable under a contract</li> <li>• Removes direct political control, helping to ensure financial viability</li> </ul>	<ul style="list-style-type: none"> <li>• More complicated to procure and manage</li> <li>• Can be hard to attract a good operator</li> <li>• Removes direct political control</li> </ul>
Private property developer	<ul style="list-style-type: none"> <li>• Business interest in getting infrastructure working</li> <li>• Good at designing and building infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>• Less infrastructure operational experience.</li> <li>• No incentive to provide infrastructure to those who don't buy homes.</li> </ul>

### 3.4 Planning towns in Southern Mongolia

#### The Current Situation

Omnogovi aimag is sparsely populated, with only limited infrastructure. Forty-five thousand people occupy more than 165 square kilometers of land. Eighty to ninety percent of the population lives in gers.

Ger households generally heat with stoves burning coal or animal dung, receive water through communal standpipes, and rely on open pit latrines for sanitation. Gers located near soum centers generally receive some electric service from a diesel generator operated by the aimag government. For example, at Tsogttsetsii gers receive service for five to six hours in the evening. Public buildings and the few private buildings that exist may also receive centralized heating, water and sanitation services. Water is generally chlorinated at the source, and typically sold at water kiosks. Waste water is treated in open aeration ponds.

Dalanzadgad, the capital of Omnogovi, has the largest population (17,000) and the most developed

#### Government Plans

In 2001 the Mongolia Parliament approved a Regional Development Concept, defining policy for urban and rural development until 2020. The Regional Development Concept develops separate plans for five economic zones: Western, Khangai, Central, Eastern, and Ulaanbaatar. The Central economic zone includes the aimags of Southern Mongolia (Omnogovi, Dornogovi, Dundgovi and Govisumber) as well as Darkhan-Uul, Selenge, and Tuv. The Ministry of Construction and Urban Development (prior to its merger with Transport in 2008) has projected population growth over the next decades and developed plans for both regional and soum-level communal infrastructure, based on the Regional Development Concept.

The Ministry of Construction and Urban Development has also developed a more detailed plan for the Galbyn Gobi micro-region, which is defined as the area affected by the mines at Tavan Tolgoi, Oyu Tolgi, and Tsagaan Suvraga. The micro-region includes Tsogttsetsii, Manlai, Khanbogd, and Bayan-Ovoo soums in the Omnogovi aimag; and

Khatanbulag and Mandah soums in the Dornogovi aimag.

Two consulting firms working for the Ministry of Construction and Urban Development have outlined possible plans for developing infrastructure in the Galbyn Gobi micro-region. Both firms predict that the population of the Galbyn Gobi micro-region, which is currently 10,500, will grow to roughly 120,000 by 2020. Both firms include projections of the urban infrastructure required to serve this population. The firms differ, however, in how they see the population dispersed around Galbyn Gobi.

One consulting firm envisages development dispersed throughout the five soums in Galbyn Gobi, including specific non-mining industries:

- In Tsogtsetsii – a coking and chemical industry, poultry and pig farming, a construction materials industry, and other small and medium enterprises;
- In Bayan Ovoo – barter trade and service facilities, duty-free, frontier guard, emergency authorities, public epidemic and law and order institutions, livestock farming, and fruit and berry farms;
- In Khanbogd – transport services (air, rail and road), warehousing and packaging, printing, irrigated farming, livestock farming, meat and meat processing, ecological research and monitoring, tree nurseries, and an air navigation authority
- In Manlai – livestock farming and vegetable growing;
- In Mandah – mining enrichment industries, transportation services, tourist camps, fruit and vegetable farming, sewing, and wool knitting factories.

Another consulting firm would create two new towns: one located between Tavan Tolgoi and Oyu Tolgoi; and the other new Tsagaan Suvraga. Under this plan, the new towns would be the center for economic activity in the region and other soums would be mostly involved in agricultural production.

Prior to the 2008 elections other ministries had also prepared various plans for the development of Southern Mongolia. Ministries included Construction and Urban Development; Roads, Transport and Tourism; Fuel and Energy; Industry and Trade; and Finance. These plans were discussed at a workshop

held in May 2008 in Ulaanbaatar, the proceedings of which are available at [www.worldbank.org/southgobi](http://www.worldbank.org/southgobi). It is notable that the various ministries' plans were not all consistent with each other.

### Current Mining Company Plans

The plans being developed by Ivanhoe Mining and Rio Tinto for the Oyu Tolgoi copper and gold mine are evolving, but it is understood that they involve a scheme of dispersed recruitment and housing, with workers living in Khanbogd, Manlai, Bayan Ovoo, and Dalanzadgad. The workers at Khanbogd would commute daily; others would work on a bus-in bus-out basis, with rotations of 10-20 days spent living at the mine site and 7 days at home.

SouthGobi Energy Resources, through its subsidiary SouthGobi Sands, owns two coal mines at Ovoot Tolgoi. SouthGobi Sands currently has a mining camp with ger accommodation for 180 workers. Roughly 40 to 50 workers are bused in and out from the nearby soum of Gurvan Tes every two weeks. All other workers are flown in and out from Ulaanbaatar. SouthGobi Sands is planning a three-storey hotel to replace the gers in 2009. The hotel will accommodate 196 workers.

The MAK-Quinhua joint venture at Nariin Sukhat has 215 workers, with roughly 20% of the workforce recruited locally from the Gurvan Tes soum. Currently all workers are accommodated in camps at the mine sites. In 2009 the companies plan to introduce rotational fly-in, fly-out or bus-in, bus-out schedules. In 2008, the companies invested about 4.5 billion tugruqs in the camps and their facilities. The two camps, located 7-8 km apart consist of block houses with hot water, heating, electricity and indoor sanitary facilities. Each camp also contains a mine office building, laboratory, garage, repair shop, and fuel station. The company also plans to build a 35kV electricity transmission line from Nariin Sukhait to the Chinese border (56 km), and a 25 km line to Gurvan Tes; and a 56 km road to the Chinese border. MAK has a license to construct a 47.8 km railway from Nariin Sukhait to the Chinese border.

### Suggested Planning Approach

Planning decisions need to be made about population projections; town locations; settlement models (eg FIFO, company town etc); extent of financing to be provided directly by mining companies; and operating models for the supply of various urban infrastructure services.

The foundation for planning towns in Southern Mongolia needs to be projections of planned mine employment, and monitoring of the actual population consequences arising from new mining developments. These projections need to be updated regularly to take account of changes in the plans of mines and government.

A useful starting point would be for the Government to hold a workshop with the major mining companies, in which the mining companies would be asked to present their employment and worker accommodation plans. The mining companies should be asked to provide this information in writing, prior to the workshop. For its part, the Government should provide the latest information on populations in the areas of the mines, so that there can be checking over time to see the empirical extent of population growth in response to new mine employment. Such workshops should be held annually, to permit regular updating of the information.

In each of the main mining areas of Southern Mongolia, different accommodation plans will need to be put in place. Where multiple mining companies will operate in proximity to each other, there will be a greater need for government coordination to ensure that individual mining company plans are consistent with each other, and to permit the realization of economies of scale in town construction and operation. Specific plans should be prepared for town development in each of the following areas:

- Dalanzadgad;
- Nariin Sukhait, Ovoot Tolgoi, Sumber, and Gurban Tes;
- Tavan Tolgoi, Baruun Naran, and Tsogttsetsii;
- Oyu Tolgoi and Khanbogd;
- Tsagaan Suvraga;
- Tsagaan Tolgoi;
- Shivee Ovoo and Choir.

A decision may be required about which town should be the main town center for the region, with facilities such as a large hospital, training center, services for the mining industry, and housing for itinerant construction workers. The obvious choices are Dalanzadgad or a new settlement close to Tavan Tolgoi. Expansion of the existing services in Dalanzadgad may be less risky, rather than trying to build entirely new facilities in the area of Tavan Tolgoi.

To assist Mongolia's mining industry to have a large potential labor pool, it would be useful to diversify the accommodation options in Southern Mongolia, to account for different workers' housing preferences.

- If Southern Mongolia relied purely on FIFO, some potentially qualified workers would regard the arrangements as too disruptive to their families and would not be interested in working in the mines.
- If Southern Mongolia relied purely on integrated communities, there may be other workers whose spouses prefer the employment or social opportunities offered in Ulaanbaatar or other major towns, and who would not be interested in living in relatively small and remote mining communities.

A mix of FIFO and integrated community developments, with significant contributions from major mining companies, is recommended for Southern Mongolia.

- Some FIFO or BIBO operations will be appropriate, particularly for relatively small and short-lived mines, distant from other mines.
- Mongolia does not present the security concerns which might justify gated communities for mine workers and their families in some countries; nor are there likely to be great social divides between mine workers and others which might justify segregation.
- Pure company towns, where mining companies plan, finance, build, and operate all aspects of the town, are unlikely to be viable in Mongolia. Modern mining companies have moved away from this model. Relatively high influx of non-worker populations can be expected in Mongolia, and mining companies will be unwilling to finance urban infrastructure services for these people. An unwilling service provider is unlikely to be as responsive to the needs of these people as would a local government.

Where integrated community developments are proposed, it is likely that mining companies will need to be closely involved in the development planning process. The current aimag and soum governments, even if provided with adequate finances from the central government, are unlikely to have sufficient technical capacity to develop townships at the speed which timely mine development will require. Particularly in the current period of global financing constraints, when the national government may find financing difficult, mining companies' balance

sheets may prove to be an attractive source of finance for the initial capital outlays.

If the plans for the development of townships in any particular area call for contributions from one or more mining companies, it will be important to have these plans agreed between the Government and the affected mining companies, and published. Provision for such subsidiary agreements should be included in new Investment Agreements for strategic mines.

Given the financial significance of housing developments for mine workers and their families, as well as the need for timely coordination of this housing and mine development, it would make sense to have mining companies responsible for the financing and construction of housing for workers and their families. Cost sharing arrangements between mining companies and local governments should be established for the development of communal infrastructure which will benefit mine workers, the pre-existing populations, and any additional population influx. However, mining companies should not typically be made responsible for the ongoing operation of communal infrastructure. Local governments or specialized private infrastructure service providers will have stronger incentives to ensure ongoing service provision for the entire community.

### 3.5 Current Priorities

Flowing from the suggested planning approach, immediate priorities for the development of new towns in Southern Mongolia include:

- conduct a public workshop with mining companies, to determine the mining companies' plans including likely employment numbers and proposed housing strategies;
- issue a public discussion document, indicating the proposed locations of new towns, as well as an indication of possible options for service delivery at each of those locations, and indicative costings for each of those options. Permit a period of public debate before making a government decision on the locations.
- allocation of responsibility (across tiers of government and between ministries) and establishment of a timeline for the preparation of town development plans for each of the proposed locations. Each town development plans should indicate, for each infrastructure service (buildings, water, waste-water, electricity, heating, solid waste):
  - the expected capital and operating costs;
  - who would finance the assets;
  - who would design and build the assets;
  - who would operate the infrastructure service; and
  - the expected level of tariffs and approach to revising tariffs over time.
- publish the town development plans, and seek public comment on them, before formally approving them;
- where the Government seeks mining company finance to support town development, ensure that a written agreement is reached setting out the details, and make this agreement publicly available.



# 4

## LAND TRANSPORT

### KEY POINTS

- To maximize the value of Mongolia's coal resources, investment costs in railways need to be kept to a minimum.
- For mines with less than 2-4 million tonnes of output per year, new railways are not justified, and road transport is adequate.
- Key decisions have already been made to award licences to develop private railways:
  - Energy Resources Rail: Tavan Tolgoi to Gashuun Sukhait
  - MAK: Nariin Sukhait to Ceke
- Decisions on railway routes need to consider the impact on the value of coal resources.
  - A railway connecting Southern Mongolia to the Trans-Mongolian Railway is not currently justified.
- Attention is needed for the rail regulatory framework:
  - Need to ensure that other mining companies can gain access to these railways at a reasonable price.
  - Need rules on when railway capacity should be expanded and how this will be paid for.
  - Take time to get this right, because it will drive the region's development – the railways could take all of the profits from Southern Mongolian mines.
- Private railway companies will need Government help to negotiate access to the Chinese rail network.

Realizing Southern Mongolia's development potential will require roads and railways to ensure that minerals can be transported to markets, and that supplies and workers can travel to the region.

### 4.1 The choice between road and rail

Railways are expensive to build, and will only be justified to serve mines for which there is sufficient freight volume. For tonnages up to about 2-4 million tonnes per year, road transport is generally the most economical method of transport. Railways will be justified for most of Southern Mongolia's coal mines. But it will generally be uneconomic to build railways in Southern Mongolia whose major purpose is the transport of copper, gold, other metals, general freight or passengers.

A simple model can be used to compare the costs of different road and railway options:

$$C = \frac{K \cdot r \cdot (1+r)^T}{(1+r)^T - 1} \frac{1}{x} d + v \cdot d$$

where:

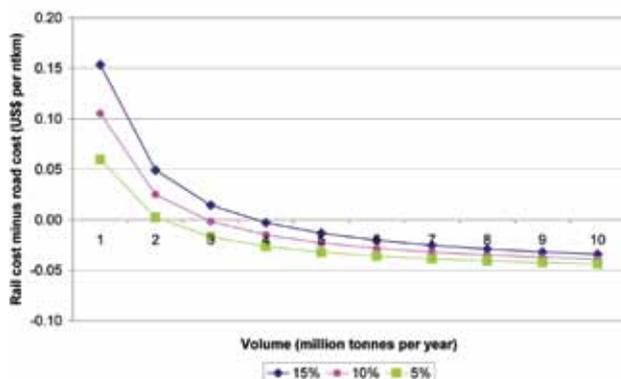
- $C$  is the total cost per ton;
- $K$  is the capital cost of route construction per kilometer (eg \$1.8 million for railway, \$300,000 for a road);
- $T$  is the amortization period (eg 20 years);
- $r$  is the discount rate (15%, or 0.15);
- $x$  is the freight volume per year;
- $v$  is the operating cost per tonne per kilometer (eg \$0.02 for rail; \$0.08 for road);
- $d$  is the distance of the route in kilometers.

Note that in this model, the costs of rolling stock are incorporated into the operating costs. A more complicated model would separate out rolling stock as a separate item, and would also depreciate infrastructure and rolling stock at different rates.

Using the simple model, Figure 4.1 illustrates that for indicative values likely to be realized in Mongolia, rail would yield lower lifetime transport costs than road for volumes greater than 2 million tonnes per year at a 5% discount rate, greater than

3 million tonnes at a 10% discount rate, and greater than 4 million tonnes per year at a 15% discount rate. Private enterprises might use a discount rate of 15%; governments frequently use a discount rate of 10%. For volumes of around 10 million tonnes per year and including capital costs, rail is about 4 cents cheaper per net tonne-kilometer (5.1 cents/ntkm for rail, 9.0 cents/ntkm for road, at a 10% discount rate). For a 400 kilometer haul, this translates to a difference of \$16/tonne.

**Figure 4.1 Difference between rail and road freight costs**



#### Assumptions:

- Rail construction costs \$2 million per kilometer; a similar road costs \$500,000/km.
- Operating costs (excluding infrastructure, but including the capital costs of rolling stock) are 3 cents per tonne-kilometer for rail, and 8.5 cents for road.
- Infrastructure costs are covered with equal nominal charges spread over a 20 year project life, and present value of these charges calculated using discount rates of 5, 10, and 15%.

The choice between road and rail will also be influenced by matters which are not purely financial. The negative environmental impact of road transport in Southern Mongolia is considerable. There are already an average of around 50 loaded coal trucks per day between Tavan Tolgoi and Gashuun Sukhait, and similar volumes between Nariin Sukhait and Ceke, with problems of multi-tracking, dust, erosion, and wildlife and livestock impact.

The indicative cut-off point of 2-4 million tonnes per annum as the choice between road and rail transport can be compared with the expected volumes of output from individual mines in Southern Mongolia, set out in Table 2.1:

- Mines at Tavan Tolgoi, Baruun Narain, Ovoot Tolgoi, and Sumber could probably justify the

construction of a railway on their own.

- Nariin Sukhait's output is probably not sufficient to justify commercially the expense of railway construction, unless the railway can share the output of neighboring mines (ie Ovoot Tolgoi, Sumber, and other deposits of SouthGobi Energy Resources).
- Oyu Tolgoi's output will not be sufficient to justify the construction of a railway, but the most likely route for the Tavan Tolgoi-Gashuun Sukhait railway runs immediately past Oyu Tolgoi. Oyu Tolgoi will be able to take advantage of this railway line to lower its transport costs.
- It is probably not justified to build a railway to Tsagaan Tolgoi or Tsagaan Suvraga. For these mines, it would be cheaper to truck ore to the nearest railway line.
- Shivee Ovoo coal mine is located on the trans-Mongolia railway line.

Passenger and non-mineral freight will not generate sufficient traffic to justify construction of a railway:

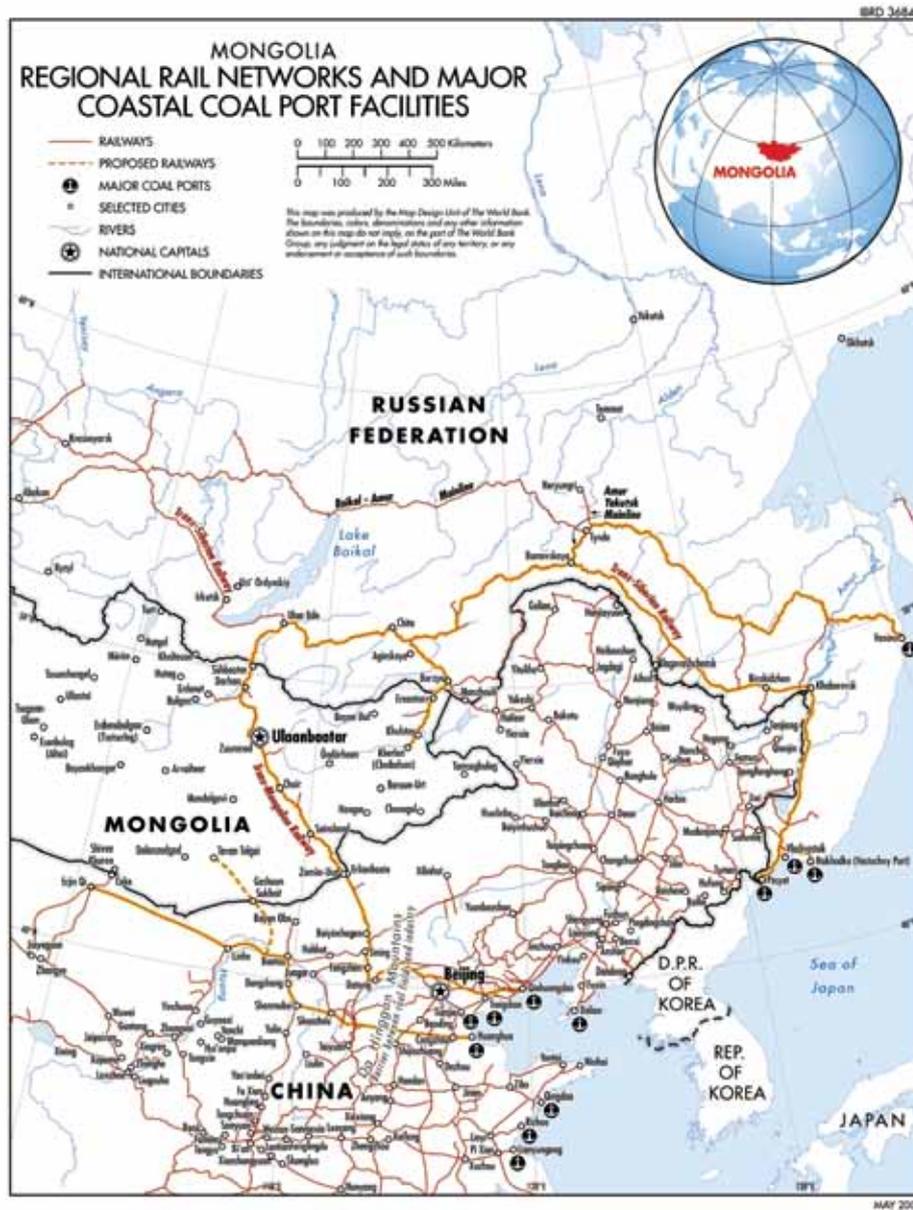
- Mining supplies, other than fuel, are generally transported by road as mixed loads and are typically no more than 5-10% of the output volume.
- Passenger demand for travel by public transport to and from Ulaan Baatar is unlikely to exceed 200,000-300,000 trips p.a. (i.e. 2-3 trips per person living in the aimag); this only requires around ten bus trips daily for the aimag as a whole.
- General freight in such situations is typically about 0.5-1 tonnes/head per year. This can be handled by 10-20 trucks per day (or by a general freight train once or twice a week)

While all these traffics may use a railway to some extent if one is built, none is large enough to justify construction of a line unless there is other traffic.

#### 4.2 Possible railway destinations

The justification for railway construction rests on the needs of the coal and minerals trade for different routes for export. Figure 4.2 provides a map of north-eastern Asia, including the main steel processing areas around Baotou in China, as well as the Chinese and Russian ports. Each of these points is a potential destination for rail freight from Southern Mongolia.

Figure 4.2 Potential Rail Destinations in North-East Asia



### Markets in the Vicinity of Baotou

The closest market for Southern Mongolia’s coal is the area around Baotou in China. Baotou is a major steel production area, providing a ready market for coking coal. In addition, there are several power plants which could consume steam coal from Southern Mongolia, depending on the price at which it is sold.

In mid-2008, the Government decided to give two companies the right to build private railways which would deliver coal and other freight from Southern Mongolia to the area around Baotou. Energy Resources (the owner of the Uhaahudag coal field at Tavan Tolgoi) has the right to build a railway

from Tavan Tolgoi to Gashuun Sukhait. MAK has the right to build a railway from Nariin Sukhait to Ceke. Both railways will be built using standard gauge, which is the gauge used in China.

Energy Resources has established a subsidiary company, Energy Resources Rail, which is responsible for developing the railway. While Oyu Tolgoi’s output would not be sufficient alone to justify construction of a railway, it is conveniently located along the Tavan Tolgoi-Gashuun Sukhait route, and should be able to access the railway once it is built.

China’s Shenhua Group intends to build a rail link from the Gashuun Sukhait border crossing to Baotou, at a cost of 4.7 billion yuan (US\$ 687

million). The railway will be able to transport 60 million tonnes of coal and copper per year, when completed by 2011. In January 2009 Shenhua and Energy Resources Rail signed a memorandum of understanding, agreeing to complete their respective rail lines to the border crossing by mid-2011. There was also a mid-January 2009 meeting in Ulaanbaatar between Chinese and Mongolian officials to discuss the opening of five new land border crossings between China and Mongolia, one of which will be a new Gashuun Sukhait crossing.

China Railways has recently completed construction of a railway connecting Linhe to Ceke, which will provide access to the Baotou market for coal from the Nariin Sukhait area. The Government may wish to consider regulatory arrangements which require the railway to provide rail freight for coal from all three companies in the area (MAK, MAK-Qinhua, and SouthGobi Sands) as well as any potential new entrants in future years.

### Chinese Ports

One option for shipping Mongolian coal to Chinese ports would be to use the Shenhua railway. The Shenhua Group is a state-owned mining and energy company, and is one of 44 major "backbone" companies directly controlled by China's central government. Shenhua Group operates the Shenfu Dongsheng coalfield as well the affiliated railway assets, power plants, port facilities, shipping fleet, and coal liquefaction projects. Its existing railway extends from Baotou to the port of Huanghua. Shenhua's railway is operated independently of China Railways, and so it has the freedom to enter into the sort of long-term agreements that Energy Resources Rail requires in order to raise finance for the Tavan Tolgoi-Gashuun Sukhait portion of the railway. Based on current rates, the cost of shipping coal over the Shenhua network would be Rmb 161/tonne (US\$ 23.50). The actual rates obtained by Mongolian coal producers will be a matter of commercial negotiation with Shenhua.

There are few alternatives to the Shenhua railway for exporting Mongolian coal to Chinese ports on a reliable long-term basis. China's rail network is highly congested, and there is little spare capacity on key routes. Coal occupies about 40% of the traffic carried on China's railways. The major coalfields are all located west of the mountain range which runs north-south up the center of China. Most of China's power plants, and all the coal ports are located to the east of the mountains. Nine railway lines cross the mountains, grouped in three

corridors. The northern corridor carried over 500 million tonnes of coal in 2005, the central corridor carried 75 million tonnes, and the southern corridor carried 110 million tonnes.

The main rail operator in China is China Railways. Currently there is an annual convention at which the available capacity (which is constrained on most of the east-west routes) is allocated to users, and on which the Ministry of Railways' annual transportation plan is then based. If a particular shipper fails to obtain an allocation, it is possible to try for a non-plan allocation by applying to the relevant railway authority. But this is not guaranteed and is subject to changes in circumstances.

There are no arrangements whereby a third party can pay access charges to operate over the main China Railways network. The normal arrangement is that traffic is carried in China Railways wagons. Indicative rates, assuming China Railways wagons, are Rmb 170/tonne (US\$ 24.80) from Gashuun Sukhait to Qinhuangdao; and Rmb 123/tonne (US\$ 18) from Erlian to Qinhuangdao via Jining and the Daqin line. Tariffs in private wagons would need to be negotiated but would probably attract a discount of about 15% for the round trip.

### Russian Ports

It would be useful for Mongolia to have an alternative export route through Russia, if only to gain greater bargaining power in negotiating freight rates for export through China. Exports through Russia will, however, be difficult to achieve unless current practices within Russia can be changed. This would require inter-governmental discussions to address upgrading of Russian rail capacity, changes in rail freight pricing arrangements, and access to Russian port terminals.

Russia applies discriminatory freight charges to foreign coal as opposed to domestic coal. Rail freight for foreign coal from Naushki to Vostochnaya (4,047 km) would cost about \$85/tonne. Russian coal producers in Siberia typically pay about \$25/tonne, for hauls of about 4000 km.

Even if adequate commercial arrangements can be made with Russian railways, Russia's Pacific ports are currently close to capacity. In 2006, the eastern port capacities were: Vostochnoy – over 15 mtpa; Posyet – over 1.9 mtpa; Nakhodka – 0.4 mtpa; and Vanino – 0.6 mtpa. Combined, the ports shipped 18.3 million tons in 2006. Several expansion projects are currently underway.

In addition to questions of physical port capacity, there are likely to be difficulties in gaining access to port terminals, which are largely controlled by Russian coal companies or their marketing arms. In 2004, China attempted to export products, particularly coal, from a region adjacent to the Russian ports of Posyet and Zarubino, where they proposed to construct new terminals. The Russian government advocated the use of existing port facilities by Russian companies, and didn't feel that it was appropriate to rent out port terminals to foreign companies.

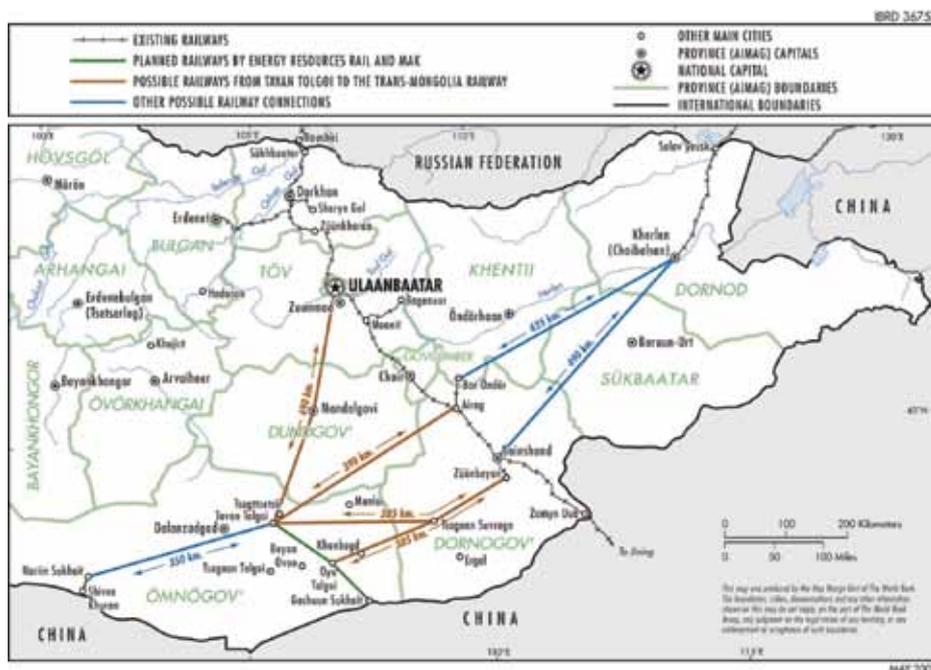
### Possible Railway Routes for Tavan Tolgoi's Coal

Table 4.1 sets out indicative estimates of the cost per tonne of delivering coal from Tavan Tolgoi to Baotou, the Chinese ports of Huanghua and Qinhuangdao, and the Russian port of Vladivostok. The analysis includes different possible routes for new railways within Mongolia, as illustrated in Figure 4.3. The routes considered are:

- the proposed Energy Resources Rail and Shenhua railway line from Tavan Tolgoi to Baotou, passing via Gashuun Sukhait. This route would be used to sell coal to the steel plants around Baotou.
- continuing on from Baotou, Mongolian coal could be shipped over the Shenhua railway network to the Chinese port of Huanghua. Current tariffs along this line are around \$25/tonne for transport from Baotou to Huanghua.

- Alternatively, coal could be shipped along a new railway from Tavan Tolgoi to Sainshand, then to Zamiin Uud and through the Chinese rail network of Jining and Datong to the port of Qinhuangdao.
- a possible new railway line passing from Tavan Tolgoi to Choibalsan, via Tsagaan Suvraga and Sainshand. This route would take advantage of the existing 50 km railway from Sainshand to Zuunbayan, as well as the existing 300 km link from Choibalsan to the trans-Manchurian railway. From here, freight would continue over the trans-Siberian railway to the Russian port of Vladivostok.
- an alternative new railway line serving exports through Russia, which would pass from Tavan Tolgoi to Choibalsan, passing via Airag. This route would take advantage of the existing 60 km railway from Airag to Bor-Ondor. From Choibalsan freight would continue to Vladivostok.
- a possible railway from Tavan Tolgoi to Airag, from where freight would be transported along the existing trans-Mongolian railway to Ulaanbaatar and Ulan Ude, and from there along the trans-Siberian railway to Vladivostok.
- a possible new railway line passing directly from Tavan Tolgoi to Ulaanbaatar, from where freight would be transported along the existing trans-Mongolian railway to Ulan Ude, and from there along the trans-Siberian railway to Vladivostok.

Figure 4.3 Possible Rail Routes in Southern Mongolia



The table indicates the cost advantage gained by targeting markets around Baotou, using the Energy Resources Rail line passing through Gashuun Sukhait. When the demand around Baotou is fully satisfied, the next lowest cost option will be to sell coal to world markets through the port of Huanghua. Once the Energy Resources Rail line is built, any incremental increases in coal export volumes will further lower the unit costs of rail freight along that railway.

The estimates in Table 4.1 of costs for rail freight through China and Russia are not necessarily the prices that Mongolian coal will be charged. Nevertheless, these numbers suggest that there is a highly significant cost advantage in exporting through China. Moreover, the cost estimates for Russian rail are likely to be under-estimates, and the total cost of Russian exports does not leave much profit margin with current coking coal prices.

The relationship between the value of Mongolia's coal resources and the costs of rail freight is illustrated in Table 4.2. The Table estimates the present value of coal sales from Tavan Tolgoi, net of the costs of production and rail freight, under the assumption that all of the coal is directed along one of the routes discussed above. The table is not intended to be an accurate reflection of the value of Tavan Tolgoi reserves. Rather, it illustrates the importance of considering coal mine and rail development together. For example, under the assumptions in the Table, if Tavan Tolgoi produces 20 million tonnes per year, the resulting revenue stream would be worth \$6.2 billion if the coal is exported through Huanghua, but \$1.5 billion if the coal is exported through Vladivostok via Sainshand and Choibalsan.

Table 4.1 Indicative Cost per Tonne for Coal Exported from Tavan Tolgoi (US\$)

	A. Tavan Tolgoi – Gashuun Sukhait – Baotou	B. Tavan Tolgoi – Gashuun Sukhait – Baotou – Huanghua	C. Tavan Tolgoi – Sain- hand – Zamiin Uud – Datong – Qinhuangdao	D. Tavan Tolgoi – Tsagaan Suvraga – Sainshand – Choibal- san – Vladivostok	E. Tavan Tolgoi – Airag – Choibal- san – Vladivostok	F. Tavan Tolgoi – Ulaanbaatar – Airag – Ulaanbaatar – Ulan Ude – Vladivostok	G. Tavan Tolgoi – Ulaanbaatar – Ulan Ude – Vladivostok
Coal production (1)	\$12.00	\$12.00	\$12.00	\$12.00	\$12.00	\$12.00	\$12.00
New railway (2)	(410 km)	(410 km)	(385 km)	(870 km)	(860 km)	(390 km)	(490 km)
• 10 million tonnes	• \$21.00	• \$21.00	• \$19.70	• \$44.50	• \$44.00	• \$20.00	• 25.10\$
• 20 million tonnes	• \$14.80	• \$14.80	• \$13.90	• \$31.40	• \$31.00	• \$14.10	• \$17.70
• 30 million tonnes	• \$12.70	• \$12.70	• 12.00	• \$27.00	• \$26.70	• \$12.10	• \$15.20
Existing Mongolian railway (3)			(240 km)	(350 km)	(360 km)	(760 km)	(410 km)
• 10 million tonnes			• \$4.80	• \$7.00	• \$7.20	• \$15.20	• \$8.20
• 20 million tonnes			• \$8.25	• \$12.60	• \$13.00	• \$27.40	• \$14.80
• 30 million tonnes			• \$7.10	• \$10.90	• \$11.20	• \$23.60	• \$12.70
Change of gauge			\$1.00				
Existing railway (4)		\$23.50	\$18.00				
Existing railway (5)				(3,172 km) \$31.72	(3172 km) \$31.72	(3,634 km) \$36.34	(3,634 km) \$36.34
<b>TOTAL</b>							
• 10 million tonnes	• \$33.00	• \$56.50	• \$55.50	• \$95.22	• 94.92	• \$83.54	• \$81.64
• 20 million tonnes	• \$26.80	• \$50.30	• \$53.15	• \$87.72	• \$87.72	• \$89.84	• \$80.84
• 30 million tonnes	• \$24.70	• \$48.20	• \$50.10	• \$81.62	• \$81.62	• \$84.04	• \$76.24

(1) The \$12 cost of coal production is purely indicative. Estimated costs of coal production range from \$10-\$28 per tonne.

(2) It is assumed that a new railway has capital cost of \$1.8 million per kilometer, amortized over 20 years at a 15% discount rate, operating costs of \$0.02 per tonne per kilometer, and a distance of 1.05 times the indicated straight-line distance.

(3) It is assumed that the existing Mongolian network can handle volumes of up to 10 million tonnes per year at an operating cost of \$0.02 per tonne per kilometer. For greater freight volumes, a second track would need to be constructed, with the same assumptions as for note (2).

(4) The estimated cost for the existing Chinese network reflects current Shenhua and China Railways tariffs. Actual prices will be commercially negotiated.

(5) The estimated cost for the Russian network is based on operating costs of \$0.01 per tonne per kilometer. This is likely to be an under-estimate of the true cost and can be compared with current Russian freight rates of around \$85 per tonne for foreign coal from Naushki to Vladivostok.

**Table 4.2 Indicative Present Value of Tavan Tolgoi Revenues (US\$ million)**

Tons per Year	A. Baotou	B. Huanghua	C. Qinhuangdao	D. Sainshand Choibalsan Vladivostok	E. Airag Choibalsan Vladivostok	F. Airag Ulaanbaatar Vladivostok	G. Ulaanbaatar Vladivostok
10m	4,194	2,723	2,785	299	318	1,030	1,149
20m	9,164	6,222	5,865	1,537	1,537	1,272	2,399
30m	14,140	9,727	9,370	3,451	3,451	2,997	4,462

Assumptions: All coal is freighted along the routes indicated. Present value is computed assuming constant annual sales at \$100/tonne, less the cost of production and rail freight as indicated in Table 4.1, during a period of 20 years with a discount rate of 15%. Note that not all values are possible (eg, it is unlikely that 30 million tonnes of coking coal can be sold at Baotou in the foreseeable future).

### Possible Railway Routes for Nariin Sukhait's Coal

Coal from the mines at Nariin Sukhait/Ovoot Tolgoi could be transported to Baotou along the railway being planned by MAK to Ceke, and from there via Linhe to Baotou. Alternatively, an additional railway line could be built from Nariin Sukhait to Tavan Tolgoi, from where coal could be transported to China via Gashuun Sukhait.

Until high volumes of coal are exported, a railway connecting Nariin Sukhait to Tavan Tolgoi will not be financially feasible. Looking only at the operating costs, Table 4.3 indicates that the route to Baotou via Tavan Tolgoi is shorter and cheaper than the route via Ceke. But the saving in operating costs is small, and would require a volume of around 50 million tonnes in order to justify the capital cost of railway construction. Moreover, because there are mountains between Nariin Sukhait and Dalanzadgad, the operating costs for a railway between these points may be higher than indicated in the table.

There have been proposals to establish two separate railways between Nariin Sukhait and Ceke: the MAK railway to serve the MAK and MAK-Qinhua mines; and a separate railway to serve the SouthGobi Sands mine at Ovoot Tolgoi. A single-track railway with appropriate passing loops could provide the capacity for 30 million tonnes of coal exports per year, and should be capable of serving all three mines in the commercially foreseeable future. Construction of an additional 50 km railway would cost in the order of \$100 million in avoidable capital costs. It is in the interests of all parties – the three mining companies and the Government – to ensure that the costs of railway development are minimized.

### 4.3 Regulation of private railways

The Government has decided that private mining companies should finance, develop, and operate the proposed railways serving Nariin Sukhait and Tavan Tolgoi. Private financing will resolve much of the uncertainty associated with synchronizing

**Table 4.3 Operating Costs of Possible Railways from Nariin Sukhait**

From	To	Distance	Cost/ntkm (Rmb)	Cost/tonne (Rmb)	Cost/tonne (US\$)
<b>Via Tavan Tolgoi</b>					
Nariin Sukhait	Tavan Tolgoi	380	0.10	38.00	
Tavan Tolgoi	Wuyuan	378	0.10	37.80	
Wuyuan	Baotou Xi	177	0.13	22.82	
<b>Total</b>		<b>935</b>		<b>98.62</b>	<b>14.43</b>
<b>Via Ceke</b>					
Nariin Sukhait	Ceke	20	0.10	2.00	
Ceke	Linhe	550	0.15	84.15	
Linhe	Baotou Xi	234	0.10	23.10	
<b>Total</b>		<b>804</b>		<b>109.25</b>	<b>15.99</b>

mine and railway development. Private railways may also be developed more quickly and operated more efficiently than if they were operated by government.

There are, however, some risks associated with the development of these private railways. In particular, there is a need to ensure that the private mining companies which own these railways do not use their control of the railways to inhibit competition from other coal mines. There are international examples where private mining companies have been unwilling to allow competitors to have access to those railways at reasonable prices (see Box 4.1).

In order to maximize coal production in Southern Mongolia, the Government should be concerned to ensure that the regulatory framework permits competing mining companies to use the private railways. The development of the Tsanki, Eastern

Tsanki and Bortolgoi coalfields at Tavan Tolgoi will depend on having access to the Energy Resources railway. The deposits held by SouthGobi Energy Resources in the area of Ovoot Tolgoi could prove to be as significant as the Tavan Tolgoi deposits, but large-scale development will depend on having access to the MAK railway. And in future decades, deposits may be found in proximity to both of the planned railways, to be owned by companies which may not even exist yet, and which may require access to the railways.

The cost of coal production is currently around \$10-30 per tonne from an open cut mine. The price Chinese smelters are willing to pay for coking coal is currently around \$110/tonne. A private railway could thus charge a freight rate of up to \$80/tonne to carry a competitor's coking coal. Excessive freight charges would inhibit the development of competing mines.

#### Box 4.1 Mining Railways in Western Australia

The Pilbara region of Western Australia exports over 40% of the world's sea-borne trade in iron ore. Two companies, BHP Billiton, and Rio Tinto, dominate iron ore production in the region. Starting in the 1960s, each company built its own railway network, extending about 400 km inland. In recent years, a number of "junior" mining companies have discovered additional iron ore deposits in proximity to the railways.

In 2004, one of these juniors, Fortescue Metals Group, sought to use BHP Billiton's Mount Newman railways, in order to develop a new mine. In 2007, additional juniors sought to gain access to Rio Tinto's Robe and Hamersley railways, and BHP Billiton's Goldsworthy railway. BHP Billiton and Rio Tinto have opposed granting access to their competitors.

Following several years of administrative proceedings and court challenges, the Pilbara railways of both BHP Billiton and Rio Tinto were "declared" in 2008. Under special Australian legislation, if the owner of a "declared facility" does not permit others to use it, those seeking access can then ask for an administrative determination governing the terms and conditions by which the owner is legally obliged to provide access. Declaration occurs following a recommendation from the National Competition Council to the Australian Treasurer (Finance Minister), and is only permitted when (among other matters) it would be uneconomical to develop another facility and where permitting access would promote competition.

Fortescue Metals has, in the meantime, built its own railway from Port Hedland to Cloud Break and began to ship iron ore to China in 2008. The result is that there are now two separate single track railways running parallel to each other for about 400 km – a massive avoidable expense. Moreover, joint operation of the two railways (ie double tracking) would provide two to three times the combined capacity of two single track railways.

Australian administrative reviewers and the courts have found that it is economically justified for small mining companies to have access to the railways operated by BHP Billiton and Rio Tinto. The delays in providing such access could have been avoided with more clearly specified access arrangements applying from the time that the railways were built.

The Western Australian State Government is seeking to ensure that this lesson is learnt further south in the state, where an additional railway is planned to serve new iron ore mines. Even before the railway is built, the State Government is specifying the access rules which will govern its operation.

Rail services should be provided at a rate which reflects the cost of service provision, including investment and operating costs, and a reasonable return on investments. This is likely to be in the order of 7-8 cents/ntkm. For a 190 km railway from Tavan Tolgoi to Gashuun Sukhait, this would imply a freight charge of around \$13.30-\$15.20 per tonne.<sup>1</sup>

International approaches to regulation of mining railways to ensure open access typically rely in the first instance on commercial negotiation between companies. Only if agreement cannot be reached would regulatory intervention be required. Where price regulation is exercised, care needs to be taken to ensure that the regulated price is high enough to provide proper incentives to the owner to maintain and expand the facility as required.

Where a private railway owner refuses to provide access to the railway to a mining company to ship significant quantities of resources (say, more than 1 million tonnes per year), consideration could be given to compelling the railway to expand its facilities, or revoking its operating license. If a mine is unable to access an existing railway, it should certainly have the right to construct its own railway (subject to environmental and other land use considerations). A single-track line will be able to support in the

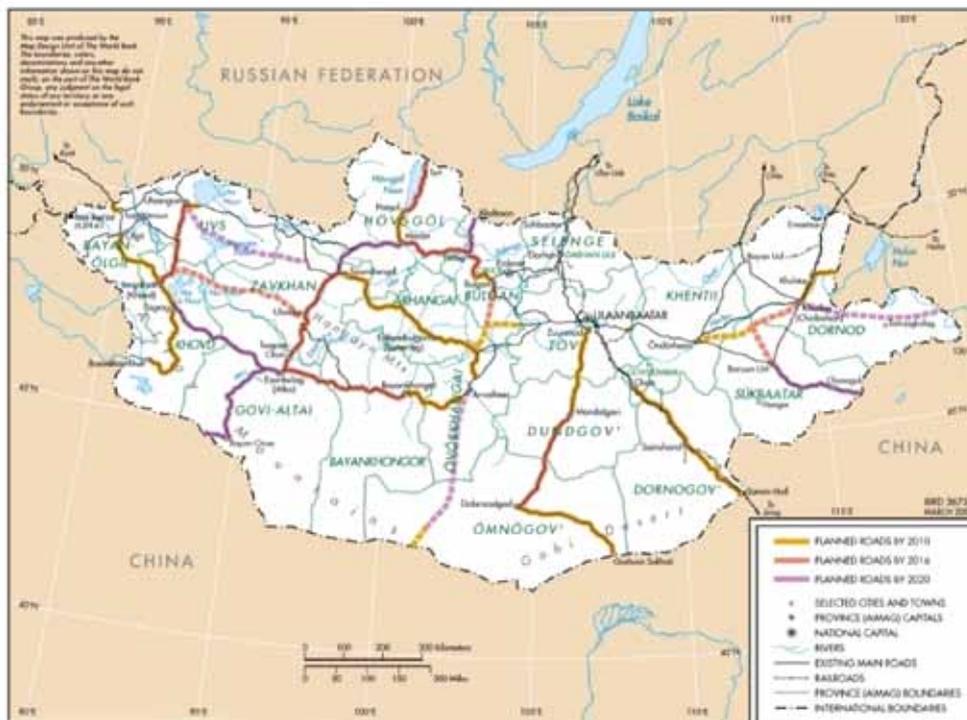
order of 30 million tonnes per year. If at some point production from the Tavan Tolgoi area exceeds this level, a double track line will be needed.

#### 4.4 Roads

In 2005 the Government formulated a National Development Policy for 2006 to 2021. Its objectives for the road sector include the development of a highway network crossing the country from east to west (the “Millenium Road” project) and continuing the periodic maintenance of state highways. These objectives were translated into a set of staged development targets specifying the length of road to be improved and its condition by 2021. The Government intends to improve all unpaved roads directly to asphalt, rather than using the intermediate option of graveling.

A more detailed road master plan was prepared in 2007. Its key feature is a proposal to provide a sealed road between Ulaanbaatar and each aimag center, and to provide full connectivity between the international network and the national roads serving the five economic regions of Mongolia. The proposed routes and their timing are set out in Figure 4.4. The total cost of the program was estimated at US\$1.8 billion.

Figure 4.4 Road Master Plan projects, 2008-2020



Note: dashed lines indicate that the alignment has not been precisely defined.

<sup>1</sup> These prices are only intended as an indication of the rough magnitude of cost-reflective pricing for rail freight, to be contrasted with the potential price of around \$80/tonne. Accurate cost-reflective pricing would require detailed assessment.

The master plan indicates that where possible, mining projects will be encouraged to finance and perform the works for upgrading or new construction. The roads will then be handed back to the Government which would operate them as toll-roads to at least cover their recurrent costs.

The road master plan projects that are relevant for mining development in Southern Mongolia are set out in Table 4.4. The average estimated costs in 2008 prices are \$300,000 per kilometer.

## 4.5 Trucking and Logistics

The current organization of road freight transport in Southern Mongolia is controversial.<sup>2</sup> While Mongolian drivers are permitted to drive only 100 km beyond the border into China (not far enough to reach any of the coal consumers), Chinese trucks drive all 260 km to Tavan Tolgoi to pick up coal. This is in violation of the bilateral transport agreement between Mongolia and China, but there are few

**Table 4.4 Road Master Plan projects relevant for Southern Mongolia**

	Timing	Distance (km)	Cost (US\$ million)
Ulaanbaatar – Mandalgovi	2008-10	230	69
Dalanzadgad – Gashuun Sukhait	2008-09	329	99
Nariin Sukhait – Chinese border	2009	40	12
Mandalgovi – Dalanzadgad	2011-15	293	88
<b>Total</b>		<b>892</b>	<b>268</b>

The road master plan did not include any projects connecting Dalanzadgad towards the Nariin Sukhait. Rather, Nariin Sukhait would be connected to the north, with Arvaiheer in Ovorkhangai aimag. In 2009, the Ministry of Roads, Transport, Construction and Urban Development has proposed that Nariin Sukhait would be connected by a sealed road running north to the town of Bayankhongor, and from there onwards to Russia, with the objective of facilitating the development of western provinces.

The mining industry will need to transport various supplies, as well as people, by road. It would make sense to have a center which supports the mining industry, with specialist supplies and services. This center could be located in Dalanzadgad or near Tavan Tolgoi. Regardless of where the center is precisely located, the various mines of the Nariin Sukhait fault would be better served if they had easy road access to such a center of mine services. It would be useful to revisit the road master plan, to examine the case for a paved road connection from Nariin Sukhait to Dalanzadgad. The straight line distance is 265 km, so a sealed road would cost in the order of US\$ 80 million.

Mongolian trucking companies with the scale to provide the necessary services. An attempt to impose a single concession for trucking coal within Mongolia to a Mongolian company was frustrated when the concession was won by a company that did not have the financial resources to implement its concession.

**Figure 4.5 Coal Being Transported from Tavan Tolgoi to China**



<sup>2</sup> This section draws from a 2008 World Bank report, *Trade and Transport Facilitation Action Plan*.

Development of a Mongolian trucking industry may be impeded by current Mongolian laws and procedures. Regulation of the road trucking industry appears to be excessive, with a large number of laws and responsibilities fragmented across various agencies. Permits are required for each international freight trip. In 2007, 9000 permits were issued for transport to Russia, and 15,000 for transport to China. The permits are issued by the Ministry of Roads, Transport, Construction and Urban Development or its delegated provincial agencies. The permits are required to have seals and signatures of the authorizing officials. A simplified system is required if Mongolia wants an effective domestic road freight industry.

A new border crossing has been opened at Gashuun Sukhait and is open daily for freight but only open for people to cross on the first 20 days of each quarter, and then only for Chinese and Mongolians. The many foreign specialists who need to travel between the South Gobi mines and their Chinese customers must travel via Ulaanbaatar rather than via Gashuun Sukhait. Expanded border facilities and revised procedures to facilitate rapid passage of drivers and other foreigners are required at Gashuun Sukhait.

## 4.6 Current priorities

Immediate priorities for land transport are:

- Prepare licenses for the Energy Resources Rail and MAK railways. These licenses should be drafted in a manner which ensures that coal companies which compete with Energy Resources and MAK can have access to the railways at reasonable prices. The licenses should also provide dispute resolution mechanisms in the event that the ERR and MAK railways reach full capacity and are unable to provide such access.
- Provide a time limit for the development of the MAK railway, before the rights to develop the railway are re-allocated. MAK's freight volume is only barely sufficient to justify construction of a railway. But in conjunction with the output of Ovoot Tolgoi, there is a need for the railway to be built.
- Develop a capacity building program for the Mongolian Railway Authority, to ensure it is able to respond rapidly and effectively to the competing needs of rail license holders, project financiers, and future mine developers.
- Evaluate the feasibility of a sealed road from Nariin Sukhait to Dalanzadgad.
- Review the road freight permit regime, with a view to encouraging the growth of a domestic road freight industry.
- Upgrade the border crossing arrangements at Gashuun Sukhait and Nariin Sukhait, to facilitate driver crossing and the crossing of all nationalities.



## KEY POINTS

- Without additional generating capacity, electricity demand will exceed supply from 2012.
- From among ten potential sources to meet growth of demand, there are just three candidate plants with strong potential to supply firm capacity and be commissioned by 2013-14: TPP#5, Oyu Tolgoi TPP, and Tavan Tolgoi TPP.
- The proposed Oyu Tolgoi 450 MW power plant is probably the only power plant that could be ready to satisfy the increased electricity demand in 2012 arising from the Oyu Tolgoi mine. A delay of one year in supplying power to Oyu Tolgoi would defer mining revenues of \$2 billion and Government revenues of \$670 million.
- The suggested investment plan includes the following sequence:
  - Oyu Tolgoi TPP should be commissioned in 2012, to meet demand from Oyu Tolgoi mine.
  - TPP#5 unit 1 (300MW) should be commissioned as soon as possible, to meet demand growth on the CES.
  - Subsequent demand growth in the CES should be met with CHP units at TPP#5, and demand growth in the South Gobi by development of the Tavan Tolgoi TPP.
- Approximately \$550 million investment will be required each year from 2009 to 2012; and then \$200 million annually until 2017.
- Negotiation of a power purchase agreement with the proposed Oyu Tolgoi power plant is a high priority. Alternatively, there may be a need for imports of power from China, beyond the quantities required to serve Oyu Tolgoi.
- Large increases in tariffs will be required, exceeding 30% in real terms.

### 5.1 Existing electricity and heating systems

The Mongolia energy sector consists of three regional interconnected systems – the Central, Western and Eastern systems – as well as a number of isolated grids. The Central Energy System represents 91% of installed generating capacity and 96% of electricity supplied. In Ulaanbaatar, Erdenet, Baganuur and Darkhan the CES also serves district heating networks and provides steam for industry.

The electricity sector was restructured in 2001 into independent generation, transmission and distribution companies, comprising:

- Five generation companies, arranged around Thermal Power Plants (TPPs) #3, #4 and #5 in Ulaanbaatar, Darkhan TPP and Erdenet TPP.
- Central Regional Electricity Transmission Grid Company (CRETG).

- National Dispatching Center Company (NDC).
- Ulaanbaatar Electricity Distribution Network Company (UBEDN).
- Darkhan-Selenge Electricity Distribution Network Company (DSEDN).
- Erdenet-Bulgan Electricity Distribution Network Company (EBEDN).
- Baganuur and South-Eastern Regional Electricity Distribution Network Company (BSEEDN).
- Ulaanbaatar District Heating Network Company (UBDHN).
- Darkhan District Heating Network Company (DDHN).

CRETG operates a zero balance account mechanism which functions as a “virtual” single buyer. All sales by generators and purchases by distribution companies take place through this

account. All money collected from customers by distribution companies is paid into this account and is then redistributed between energy sector enterprises according to pre-determined formulae, approved by the Energy Regulatory Authority (ERA). The risk of non-collection is thus shared between generators and distribution companies. Revenue collections have greatly improved in recent years, rising from 76.5% in 2001 to 100% in 2007.

At present, generation, transmission, bulk supply, distribution and retail tariffs are all determined by ERA on a cost-of-service basis. There are plans to introduce a competitive market in which generators would supply distribution companies under bilateral contracts with imbalances settled through a spot market mechanism.

2009. The line is subsequently expected to be upgraded to a 22kV double-circuit line as demand in the region increases.

- A second phase will link Mandalgobi to Ulaanbaatar, strengthening the interconnection with the CES, and also extend the line to Tavan Tolgoi. This is expected to be constructed by 2012.

## 5.2 Demand forecasts

Peak demand drives the need for capacity additions. Figure 5.1 illustrates the forecast growth of peak electricity demand in the CES and Southern Mongolia. The derivation of this forecast is set out below. More details are provided in the background electricity study.

Table 5.1 CES basic statistics

	GWh unless stated
CES generation gross output	3,594
CES generation self-consumption	16.5%
CES generation net output	3,000
Imports	130
CES net supply	3,132
Transmission and distribution losses	17.4%
CES final supply	2,587

Source: 2007 Licensee statistics, ERA

Table 5.2 Current CES power plants

Plant	Installed electricity capacity (MW)	Self-consumption	Available electricity capacity MW	Heat capacity Gcal/h	Plant load factor	Thermal efficiency
TPP#2	21.5	16.4%	18.0	31	62.2%	23.3%
TPP#3	136	21.0%	107.4	518	49.3%	34.2%
TPP#4	540	14.8%	460.1	1045	52.6%	39.3%
Darkhan TPP	48	18.5%	39.1	181	62.0	28.1%
Erdenet TPP	28.8	22.8%	22.2	120	56.5%	43.8%

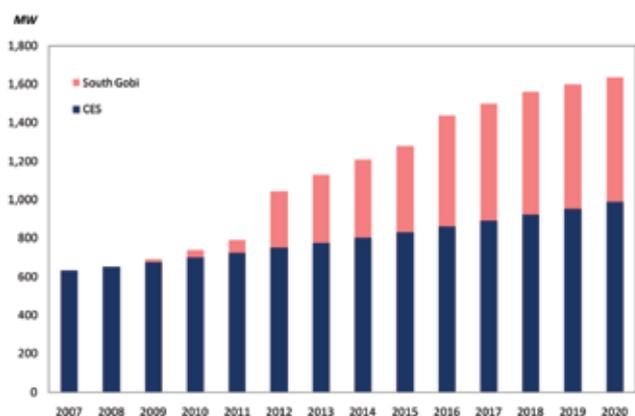
The mines of Southern Mongolia that are already operating are all self-supplied with electricity, with the exception of Shivee Ovoo which is supplied from the CES.

MAK plans to construct a 35kV interconnection from Nariin Sukhait to the Chinese grid to meet growing electricity demand.

Plans are also well-developed for the interconnection of Omnogovi to the CES:

- The Government recently concluded a bidding round for the construction of a 110 kV single-circuit transmission line linking Mandalgobi (which is already connected to the CES) with Oyu Tolgoi. The line is due for completion in

Figure 5.1 Peak electricity demand forecast, 2007-20



## CES electricity demand

During 2007, CES electricity demand peaked in December 2007 at 631 MW. This is used as the base for CES demand forecasts. For purposes of this report, demand in the areas currently served by the CES is forecast to grow by 3.5% annually.

The assumed CES growth rate is lower than the actual growth rate in recent years (ie 4.0% during 2000-07). Future growth of electricity demand will be affected by Mongolia's rate of GDP growth, possibly offset by the impacts of required large tariff increases. Tariff increases in recent years have failed to keep up with inflation, implying significant rises are required. Part of the demand growth could also be met by reducing current distribution losses, which are at 23% in Ulaanbaatar – well above international standards.

In projecting future CES demand growth it is important not to double count. A large part of economic growth in coming years will be created by new mining developments, which will be concentrated in Omnogovi, without increasing electricity demand directly in the areas currently served by the CES.

## Electricity demand in Southern Mongolia

Demand in Southern Mongolia is projected to reach 294 MW in 2012, and 650 MW by 2020, based on the following assumptions:

- the first phase of Oyu Tolgoi will commence production in 2012 (with electricity demand of 200 MW), with the second phase following in 2016 (with demand rising to 300 MW).
- production by Energy Resources will commence at Uhaahudag in 2009 and ramp up to 10 million tons per year by 2014, at which stage demand for electricity will be 100 MW.
- production from the other Tavan Tolgoi deposits and from Baruun Naran mine will begin in 2012 and increase gradually to 20 million tons per year by 2018 (ie demand for around 200 MW of electricity).
- Nariin Sukhait and Ovoot Tolgoi will be supplied by imported electricity from China.
- The expansion of the Shivee Ovoo mine is dependent on whether the proposed exporting power plant for the site is developed. If the mine is expanded, its electricity would be supplied from the new export plant.
- The development of Tsagaan Tolgoi is dependent on whether its output is used to supply power plants in the region, given that the quality of its coal is not sufficient to export.

- New towns in the region with a population of an additional 80,000 people will require provision of around 10 MW of CHP capacity to meet electricity and heating demand. Alternatively, electricity could be supplied from new large power plants established in the region, with heating needs met from heat only boilers (HOBs). In this case, meeting the demand of a population of around 120,000 would require approximately 20 MW of electricity generating capacity.
- Demand from the various non-mining industries that might develop in the region is difficult to predict, but could reach around 30 MW by 2020.

## CES heat demand

Expansions to the CES must be able to meet both electricity and heat demand growth in Ulaanbaatar, Darkhan and Erdenet. This report assumes that heat demand grows at 3.0%. In practice, this growth rate may not be achievable because of supply constraints in district heating networks.

## 5.3 Supply options

Few projects are likely to be ready, even under optimistic assumptions, by 2012-13 to meet expected growth of demand for base-load power. Of the various supply options considered below, the Oyu Tolgoi thermal power plant, Thermal Power Plant #5 at Ulaanbaatar, and Tavan Tolgoi thermal power plant appear to be those generators that are most likely to proceed and that are suitable to meet base load demand. The Newcom wind farm has a reasonable prospect of being commissioned by 2012, but by its nature will not provide firm capacity. With sufficient commitment, it would be possible to commission a thermal power plant at Tavan Tolgoi by 2013-14.

## Existing generation capacity

The current CES generating capacity is 647 MW, which was only just sufficient to meet peak demand of 631 MW in 2007, without an adequate reserve margin. A reserve margin of 20% would be appropriate in Mongolia. This would be sufficient to cover the loss of one of TPP#4's units (each of which represent around 13% of available capacity) as well as an outage of one smaller unit.

The 2002 master plan assumed that TPP#2 would be retired in 2005, TPP#3 in two stages in 2008 and 2011 and Darkhan TPP in 2013, as each plant reaches the end of its operating life. Noting that these plants continue to be necessary to meet demand, the 2006 NDC forecast expects retirement

of TPP#2 to be postponed to 2012, TPP# 3 to 2016 and Darkhan indefinitely. Retirement of TPP#4 is not expected to take place before 2020. Applying the NDC forecasts, available generating capacity will fall to 629 MW in 2012 and 521 MW in 2016.

Mongolia does have the ability to increase imports from Russia. The capacity of the interconnector with Russia is up to 255 MW. Assuming this full capacity is used, demand could be met until 2011. From 2012, without additional generating capacity or imports being added to the system, demand will exceed supply.

### Thermal Power Plant #5

The proposed thermal power plant #5 would be a new combined heat and power plant, located at Ulaanbaatar and fuelled by lignite (probably from Shivee Ovoo). In July 2008, the Government issued a request for proposals for TPP#5 as an urgent requirement, due to the need to meet heat demand growth in Ulaanbaatar.

The request for proposals specifies a 300 MW CHP with a heating capacity of 700Gcal/hour. For this size plant, the estimated investment cost was approximately US\$ 650 million. The expected commissioning date of the plant is 2013.

Bids closed on January 15, 2009. Only one bid was received, from the Datang International Power Generation Co Ltd of China. The bid is now under evaluation. Because of the difficulties of negotiating with a single bidder, international experience suggests that there is a high risk of delay in the commissioning of TPP#5.

### Newcom wind farm

The proposed Newcom wind farm is being developed at Saalkhit uul, 70 km southeast of Ulaanbaatar. Its installed capacity is 50 MW and expected annual output is around 116 GWh. Negotiations are ongoing on provisions of the power purchase agreement with CRETG, concerning scheduling and dispatch. Once a final PPA is agreed, construction should take around one year.

Given its advanced status, the Newcom wind farm is likely to commission in 2010. But given the unpredictable nature of its output (ie dependent on changing winds) it will not be a reliable provider of capacity. Accordingly, it is not considered as a candidate option for meeting demand growth.

### Egiin hydro power plant

The Egiin hydro power plant has a planned capacity of 220 MW and projected annual output of 484 GWh. The project has been delayed because of difficulties in financing.

In 2006, China Exim Bank agreed to a \$300 million credit to finance the project. At the time, the estimated investment cost was US\$ 312 million. But the bids subsequently received from EPC contractors ranged from US\$400 million upwards. The Mongolian Government was unable to finance the difference. The project was cancelled in mid-2008 and the Chinese loan was redirected to investments in apartments and the rail network.

Operationally, the Egiin HPP would be an important addition to the CES, providing flexible capacity to respond to unexpected outages or increased volatility associated with wind and renewable energy generation. This report assumes that the project will be restarted, once new financing becomes available. This assumption would need to be tested with a detailed feasibility study, as well as appropriate environmental impact assessment. The project is unlikely to enter operation before 2015.

### Orkhon hydro power plant

Orkhon HPP is an alternative to Egiin HPP. The plant would have an installed capacity of 100 MW with annual projected output of 219 GWh. The estimated investment cost, based on a 2000 study, would be US\$160 million (US\$1,600/kW). It is unlikely that both Egiin and Orkhon will be developed in the near future, and as Egiin is more advanced, this report assumes that Orkhon will not be developed.

### Tuul Songino pumped storage plant

As part of the development of the Tuul Songino water supply and wastewater treatment complex in Ulaanbaatar, the construction of a 50-100 MW pumped storage plant using treated waste water has been proposed. Total costs were estimated at US\$55-60 million in 2005.

4A price differential of 5:1 is required between daytime sales and night-time pumping tariffs for the project to be viable. The current price differentials are not sufficient to make the project viable. Although the project would contribute to operational flexibility in the CES, it would not make a reliable contribution to baseload capacity. This report does not take the project into account when considering future contributions to baseload and peakload capacity.

### Oyu Tolgoi thermal power plant

The Oyu Tolgoi mine developers have reached an

advanced stage of preparation for construction of a coal power plant, including selecting suppliers and obtaining most of the required permits. The plant would have 3 x 150 MW air-cooled coal-fired units, supplied from China. The developers' plans are for two units to be in operation at any one time to meet the mine's demand, with the third being available as a reserve.

The estimated cost of the plant is US\$650-750 million (approx. US\$ 1500/kW). Expected completion time is 30 months after an order is placed. In the interim, it might be possible to supply the mine through imports from China.

Coal for the plant would be supplied from Tavan Tolgoi, or possibly from Tsagaan Tolgoi. If running at full capacity, the plant would require around 1.8 million tons of coal per year, or almost the entire potential output from the Tsagaan Tolgoi mine.

A delay in development of the Oyu Tolgoi mine would imply lower demand growth than set out in Figure 5.1. The need for new generating capacity could be deferred to 2013, although with a negligible reserve margin.

### Shivee Ovoo thermal power plant

The Shivee Ovoo TPP is intended to be a 3,600 MW (6 x 600 MW) mine-mouth coal power plant, for electricity export to China. A Memorandum of Understanding for the Shivee Ovoo TPP was signed between Mongolia and China in 2005. A feasibility study is expected to be commissioned shortly. The feasibility will be dependent on the prices that can be negotiated for electricity in China.

In 2008, the Ministry of Fuel and Energy indicated the following proposed details for the plant:

- The total investment cost is estimated at US\$ 2,976 million (US\$ 827/kW).
- Of the installed capacity, 300 MW would be available to meet mining demand in Southern Mongolia.
- Annual coal consumption is 13.6 million tonnes. The heating value of Shivee Ovoo coal is estimated at 3,150 kcal/kg, implying a plant thermal efficiency of 40%.
- Commercial operation would begin 2 years after construction begins, with the complex being completed 7 years after construction begins.
- A 1,300 km, 500 kV DC transmission line to China would be constructed. A 200 kV DC connection to the CES would also be built.
- Over time, it is envisaged that total installed capacity of the complex would rise to 10,800 MW.

As discussed in section 2.2, the feasibility of electricity exports into China is subject to various commercial uncertainties concerning current Chinese coal prices and on-grid electricity tariffs. There are also signs that the current economic downturn and increased focus on environmental concerns in China may reduce interest in major new coal-fired projects.

Because of the commercial uncertainties, this report considers that it is unlikely that Shivee Ovoo will be ready for commissioning by 2012-13, although it may become an option in the longer term.

### Tavan Tolgoi thermal power plant

A mine-mouth plant at Tavan Tolgoi has been proposed for development to meet electricity demand in Southern Mongolia as well as, potentially, supply electricity to the CES. The plant would be fuelled by thermal coal removed to allow access to the coking coal deposits at Tavan Tolgoi. The plant could also be used to burn coal from Tsagaan Tolgoi.

In 2008 the Ministry of Fuel and Energy gave a presentation proposing the following plant details:

- 600 MW plant with annual output of 4,144 GWh (79% plant load factor);
- Self-consumption would be 8%
- Investment cost of US\$350 million, or US\$ 580/kW.

The estimated investment cost appears unrealistically low, even allowing for Chinese technology. The proposed Oyu Tolgoi plant is also sourced from China, and has involved more detailed cost appraisal. It is costed at US\$1,500/kW.

The quality of coal at Tavan Tolgoi is higher than that of Shivee Ovoo. Adjusting for heating content, current Chinese coal prices would be equivalent to a coal price of US\$ 55/tonne. This suggests that the proposed Tavan Tolgoi plant is more likely to be viable than the proposed Shivee Ovoo development as an export-oriented project.

There has been little work on the development of this project to date. Allowing for the time necessary for completion of the necessary feasibility studies and construction, it seems unlikely that the plant could be in service before 2013-14 at the very earliest. Because the plant could be largely dedicated to meeting domestic demand, once a decision is made to develop it, the risks of delay are lower than for the almost wholly export-oriented Shivee Ovoo plant.

### Baganuur Integrated Gasification Combined Cycle Plant

Two proposals have been made for the

development of a coal to liquids (CTL) plant at Baganuur – one by a Korean developer and the other by a joint venture including Petroerch, Petrovis (the major Mongolian fuel retailer) and Siemens as a technology partner. The second of these is considered here.

The proposed CTL plant would produce around 2 million tonnes per annum of diesel and gasoline. Of this, approximately 0.8 million tonnes per annum would be used to meet Mongolian demand, with the remainder being exported to oil retailers in China. The CTL plant would include a 650 MW integrated gasification combined cycle (IGCC) power plant, which would be fuelled by the synthetic gas produced as part of the CTL process. Around 400 MW of the plant's capacity would be required for the CTL process, with the remaining 250 MW being available for sale to the CES.

A feasibility study is expected to be undertaken during 2009, and the project's sponsors are targeting 2014 for commissioning. Estimated costs of the CTL plant would be around US\$3.5 billion. The IGC plant would cost around US\$ 390 million (US\$ 600/kW). The project sponsors project oil prices at US\$35/barrel are required for the project to be viable. In contrast, a 2007 US department of Energy study found that a CTL project would be viable with oil prices above US\$45/barrel. Current oil prices thus threaten the viability of CTL projects.

With current oil prices and the limited commercial experience with CTL technology, it is likely to be difficult to raise financing for the project. Internationally, there is currently just one CTL plant operating – in South Africa. Accordingly, this report considers that there is a high risk that this plant will be delayed, and will not be commissioned within the period needed to meet expected demand growth.

### Increased Russian Imports

Currently, Mongolia has a contract for the import of up to 120MW of electricity from Russia, at a cost of US\$ 204,000 per MW per month of contracted capacity, and US\$18/MWh of energy imported. In 2007, imports totaled 130 GWh, giving an average price (capacity and energy) of US\$38.4/MWh before duties and taxes.

For several reasons, increased imports are not considered as an option to meet Mongolian demand growth:

- The Mongolian government is concerned about supply security risks attached to reliance on Russian imports.

- It is not clear that Russia would supply larger volumes at the same price.
- There are operational difficulties in relying on Russian imports, since the contract requires that the import volume be nominated two days in advance, and there are penalties for deviating from the nominated quantities.

However, imports could provide an important means of meeting demand growth on a short-term basis, and to provide system reserves.

### 5.4 Assessment of supply options

A summary of the likelihood of various supply options is provided in Table 5.3, based on the discussion above. This summary does not assess the relative economic and financial attractiveness of different options. Rather it is focused on the state of commercial preparation of the projects, and their ability to be prepared in time for the expected supply shortfall in 2012-13.

In assessing commercial preparedness of projects, it is assumed that at least one year is required to complete feasibility studies and up to a further year for financing arrangements and power purchase contracts to be put in place. Expected construction times are three years for standard commercial plants, four years for more complex plants, and four to five years for large hydro plants. The risks concerning financial viability and markets for major export-oriented projects such as Shivee Ovoo TPP and Baganuur CTL mean that these projects are high risk, and should not be relied on to meet Mongolia's future electricity demand.

It appears that only the Newcom wind farm, TPP#5, and Oyu Tolgoi TPP could be ready by 2012-13. The Tavan Tolgoi TPP could, if the Government begins preparations now, be ready by 2014. The Newcom wind farm will not supply reliable base load. In the short to medium-term, the most realistic prospects of providing baseload reliable generating capacity to meet electricity demand growth in Mongolia are TPP#5, Oyu Tolgoi TPP, and Tavan Tolgoi TPP.

Of the three plants, the Oyu Tolgoi TPP is the most likely to be commissioned first and is probably the only plant that could be commissioned by 2012, when new capacity will be required if the Oyu Tolgoi mine is developed on schedule. The risks of delay to this plant are also lower than for other plants, provided an investment agreement is concluded for the mine in 2009.

Table 5.3 Summary of generation expansion options

Plant	Installed capacity (MW)	Cost (from project proposals)	Earliest date	Risk of delay
TPP#5	300	\$1300-1400/kW	2013	<b>Low to moderate.</b> Bids received in January 2009 and under evaluation. High amount of bidder discretion and single bidder imply extended negotiation period.
Newcom wind farm	50	\$95,000/kWh	2010	<b>Low.</b> Power purchase agreement is in place, but some aspects are being renegotiated.
Egiin HPP	220	\$1420/kW	2015	<b>Moderate to high.</b> EPC bids were obtained, but the project was cancelled due to costs and environmental concerns. This or a replacement project should be re-started.
Orkhon HPP	100	\$1600/kW	2015	<b>Moderate to high.</b> Alternative to Egiin HPP.
Tuul Songino PSP	50-100	\$1600/kW	2012	<b>High.</b> No power purchase agreement is in place and current electricity prices would seem to make the plant non-viable.
Oyu Tolgoi	450	\$1450-1550/kW	2012	<b>Low.</b> Development of plant is tied to development of Oyu Tolgoi mine. Developer commitment appears high. Advanced state of preparation.
Shivee Ovoo TPP	3600-10800	\$827/kW	2013-2014	<b>High.</b> Development of plant is tied to exports of electricity to China. Viability at current prices is unclear, as is the current level of Chinese demand.
Tavan Tolgoi TPP	600	\$580/kW	2014	<b>Moderate to high.</b> Little preparatory work has been undertaken. But the plant is less export-dependent than Shivee Ovoo TPP.
Baganuur IGCC	250 (net available)	\$600/kW	2014-2015	<b>High.</b> Development of plant is tied to coal to liquids plant exporting to China. Technology risk is high compared with other options. Viability at current oil prices is unclear.
Increased Russian imports	Up to 255 MW	\$204,000/MW/ month; \$18/MWh	n/a	<b>N/A.</b> Not considered as long-term supply option, due to security of supply concerns.

These three projects are not mutually exclusive, but there is some potential for choosing the order in which they are developed. In particular, once heat demand in Ulaanbaatar is adequately supplied, it would be possible to meet part of the incremental electricity demand growth with additional generating units located in the CES or in Omnogovi. Within Omnogovi, it may be possible to meet demand from either a plant located at Oyu Tolgoi or at Tavan Tolgoi.

The background paper has compared the costs of these three alternatives. Table 5.4 sets out a summary of this least cost analysis. The summary uses the levelised cost of each plant over its lifetime. Comparison of costs is complicated by the different values that can be placed on coal supplies.

- It is likely that Oyu Tolgoi TPP and TPP#5 will be supplied with coal from sources that are not suitable for export (Tsagaan Tolgoi and Shivee

Ovoo respectively). In these cases the market prices of coal for these generators would be the same as the costs of production and transport.

- It is reasonable to assume that generating capacity at Tavan Tolgoi can be supplied using middlings mixed with thermal coal, which would give a cost somewhere between the cost of coal as a waste product and its market price. That is the price of coal would be approximately the same as its cost of production.

If these coal sources are used, the least-cost generating option would be TPP#5, followed by Tavan Tolgoi TPP and then Oyu Tolgoi TPP. Although TPP#5 is the theoretical least cost option, for several reasons it is preferable to commission the Oyu Tolgoi plant first, in order to meet the expected demand growth arising from the Oyu Tolgoi mine:

- There are concerns over the reliability of supplies for the Oyu Tolgoi mine, particularly when supply is interrupted and choices have to be made about which customers will be served.
- Unless it is possible to speed up the commissioning of TPP#5 from the expected date of 2013, this implies a delay in the start of full production from Oyu Tolgoi mine (currently expected to be around 2012). The lost revenue from a one year delay in commissioning Oyu Tolgoi mine would be around US\$ 2 billion, of which the lost income to the Government would be around US\$ 670 million (assuming a 35% share). The lifetime savings to Mongolia from replacing the Oyu Tolgoi plant with additional output from TPP#5 would be around US\$310 million. The lost mining revenues greatly exceed the expected cost savings in power investment and operating costs.
- The risk of delay to TPP#5 is higher than for Oyu Tolgoi TPP.

**Table 5.4 Candidate power plants**

	Unit size	Life	Capital cost	Annualised cost	O&M cost	Thermal efficiency	Fuel cost	Fuel heating value	Self-consumption	Levelised cost
	Installed capacity (MW)	years	US\$/kW	US\$/kW/year	US\$/kW/year		US\$/tonne	kcal/kg		US\$/MWh
<b>TPP#5</b>										
Regulated coal price/ coal production cost	300	40	1,240	127	38.0	36.0%	12.0	3,150	5%	32.9
Market coal price	300	40	1,240	127	38.0	36.0%	37.0	3,150	5.0%	52.8
<b>Tavan Tolgoi TPP</b>										
Coal production cost	300	40	1,110	114	33.0	33.0%	30.0	5,100	7.6%	37.9
Market coal price	300	40	1,110	114	33.0	33.0%	55.0	5,100	7.6%	51.7
Waste product coal	300	40	1,110	114	33.0	33.0%	0.0	5,100	7.6%	21.3
<b>Oyu Tolgoi TPP</b>										
Coal production cost/ market coal price	150	40	1,500	153	33.0	32.0%	35.0	5,100	7.6%	47.1
Waste product coal	150	40	1,500	153	33.0	32.0%	5.0	5,100	7.6%	29.9

### 5.5 Investment plan and costs

The suggested investment plan arising from the least-cost analysis of new generation capacity combined with consideration of likely commissioning dates is set out in Table 5.5. The implications of this investment plan for the balance between supply and demand in the CES and in Southern Mongolia are shown in Figures 5.2-5.4.

Investment amounts for new plants will typically be disbursed across three years leading up to plant commissioning. Approximately US\$ 550 million annually will be required in investment between 2009 and 2012. From 2013 to 2017 annual investments of around US\$ 200 million will be required.

**Table 5.5 Suggested Investment Plan**

	Additions (MW) <sup>a</sup>	Retirements (MW) <sup>a</sup>	Available Capacity (MW) <sup>b</sup>	Investment Cost (\$million)
2008			902	
2009			902	
2010	+50 (Newcom)		952	
2011			952	
2012	+416 (Oyu Tolgoi) CES-South Gobi interconnector	-18 (TPP#2)	1350	750 207
2013	+270 (TPP#5 unit 1)		1,620	450
2015	+220 (Egiin HPP) <sup>c</sup> +277 (Tavan Tolgoi TPP unit 1)		2,117	450
2016		-107 (TPP#3)	2,009	
2017			2,009	
2018	+270 (TPP#5 unit 2)		2,279	450
2019			2,279	
2020			2,279	

*a. Available capacity shown. This differs from installed capacity due to self-consumption by units.  
b. Assumes imports of up to 255 MW.  
c. Subject to feasibility study and environmental impact of a new dam.*

The investment plan assumes a target reserve margin of 20%. Supply from Newcom or import are assumed not to be firm capacity, and are not taken into account in calculating reserve margins. No account is taken of electricity projects intended purely for export.

The investment plan assumes that the full 642 km double-circuit 220 kV transmission line from Ulaanbaatar to Mandalgobi and on to Tavan Tolgoi and Oyu Tolgoi is commissioned by 2012, with a reliable transfer capacity of 150 MW. The cost of this interconnector is estimated at US\$ 207 million including lines and substations. Transmitting 150 MW along a 220 kV double circuit over 640 km using 375 mm<sup>2</sup> aluminum conductors would result in losses of around 7%. These losses were taken into account in developing the suggested investment plan.

**Figure 5.2 Supply & demand in the CES**

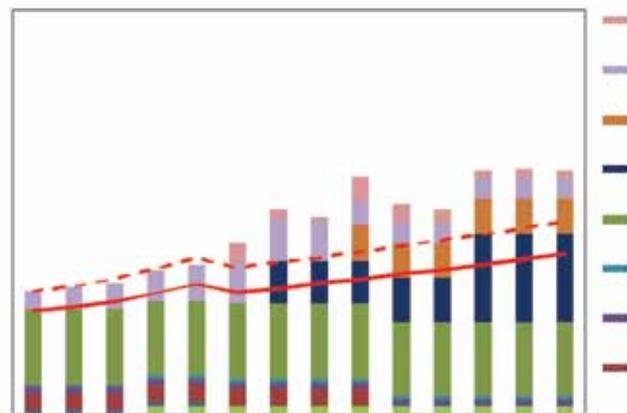


Figure 5.3 Supply & demand in Southern Mongolia

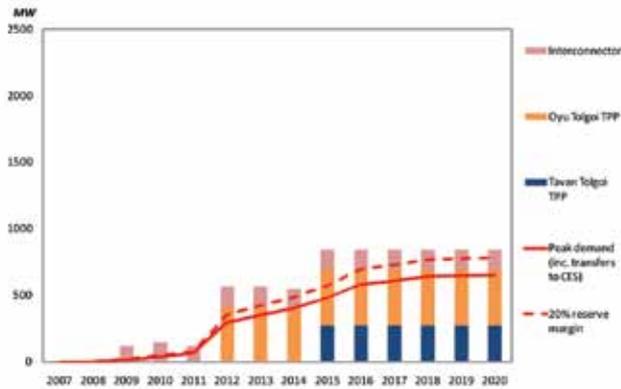
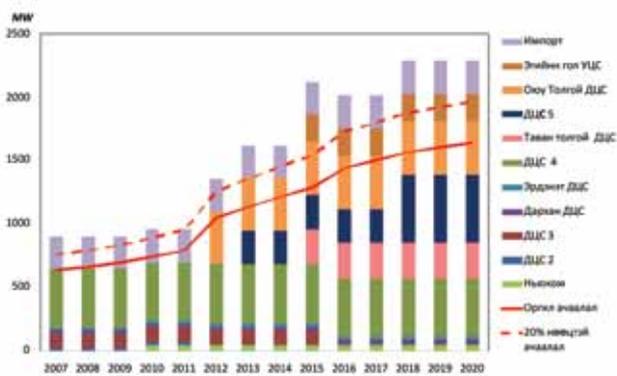


Figure 5.4 Supply & demand in the CES and Southern Mongolia combined



## 5.6 Tariffs

To ensure the financial viability of all market participants it is important that tariffs cover the full costs of production, including generation, transmission and distribution.

### Retail Tariffs

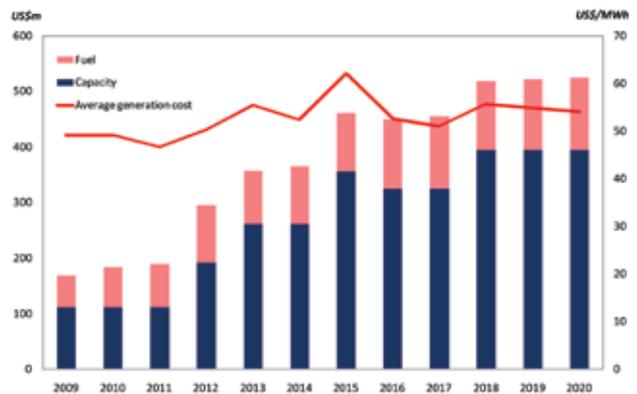
Figure 5.1 sets out the projected evolution of the cost of generating electricity, assuming the investment plan set out in section 5.5. The costs are broken into fuel costs and capacity costs. Capacity costs include the amounts that are charged each year to cover fixed investment costs (including amortization and a return on investments) as well as operating and maintenance costs.

The projected average cost of generation (per hour of generation) will rise to US\$ 62/MWh in 2015, but as demand increases and capacity is better utilized, the average cost will fall to around US\$ 50/MWh by 2020.

Assuming that the projected average cost of generation is passed on to consumers, that all

other regulated tariffs and existing transmission and distribution charges remain unchanged in real terms, and that transmission and distribution losses are unchanged, tariffs will need to increase by more than 30% in real terms. Separate work by USAID has suggested that transmission and distribution prices may also need to be increased, and that tariffs may need to increase by up to 60%.

Figure 5.1 Projected generation costs



### Pricing of Oyu Tolgoi power

Developers of the Oyu Tolgoi plant have indicated that it would be dedicated to the supply of the Oyu Tolgoi mine. For the Government, it would be attractive if the reserve capacity of Oyu Tolgoi could be made available to supply other customers in Southern Mongolia. The investment plan set out above assumes that such supply occurs.

In order for the Oyu Tolgoi plant's owners to agree to such an agreement, the price offered for the power must exceed the cost of providing it. As a minimum, this should include the variable operating and fuel costs (likely to be in the order of US\$ 20/MWh). The owners would also expect a contribution to the fixed costs of the plant in order to offer capacity.

For the Government, the maximum price that should be paid for power from Oyu Tolgoi is the resulting savings from delaying other power plants. In the absence of supplies from Oyu Tolgoi, it would be necessary to advance the Tavan Tolgoi plant by one year, to 2014, and to use more expensive generating units in earlier years. The present value of the savings to the public system from purchasing power from Oyu Tolgoi rather than advancing Tavan Tolgoi would be around US\$ 68 million. The implied value of power purchases from Oyu Tolgoi TPP is around \$34/MWh.

These preliminary calculations suggest that the price for power purchases from Oyu Tolgoi should be set somewhere between US\$ 20/MWh and US\$ 34/MWh (with provision for escalation as fuel and other variable costs increase).

### 5.7 Impact of Chinese Imports for Oyu Tolgoi

The analysis above has been prepared on the assumption that Mongolia would not import electricity from China for the purpose of supplying Oyu Tolgoi. This section reviews how the suggested investment plan above would change, if the Oyu Tolgoi mine is supplied with electricity imports from China during the first four years of its operation.

In this section, it is assumed that all demand from the Oyu Tolgoi mine will be met until 2016 through an inter-connector with a reliable capacity of 200 MW, supplying electricity from China. The Oyu Tolgoi thermal power plant would be delayed until 2016. All other plant commissioning dates are assumed unchanged.

It will still be possible to satisfy demand in the CES, provided that TPP#5 is commissioned in 2013. Increased Russian imports will be necessary, as it will not be possible to supply energy from spare capacity at the Oyu Tolgoi TPP to the CES. However, during 2011-2014 reserve margins will fall to very low levels, increasing the risk of temporary supply interruptions. Frequent interruptions are likely, as no generating unit can operate at 100% availability.

Without the Oyu Tolgoi TPP there would be difficulty in meeting growing demand in Southern Mongolia. In 2013 and 2014, before the commissioning of a power plant at Tavan Tolgoi, capacity including potential transfers from the CES would be insufficient to meet electricity demand in Southern Mongolia. This could be addressed through additional imports of Chinese power. But this may imply higher costs of electricity supply than a local power plant, and there may be problems of reliability arising through dependence on a single inter-connector for supply.

The following figures show the projected demand-supply balance in the CES and Southern Mongolia, under the revised plant commissioning schedule.

Figure 1.2 Supply & demand in the CES with delayed Oyu Tolgoi TPP

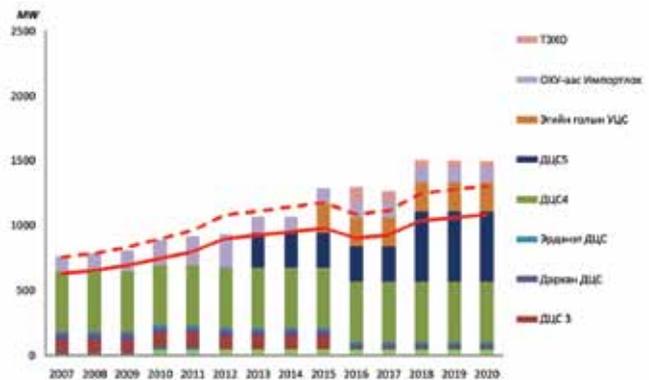
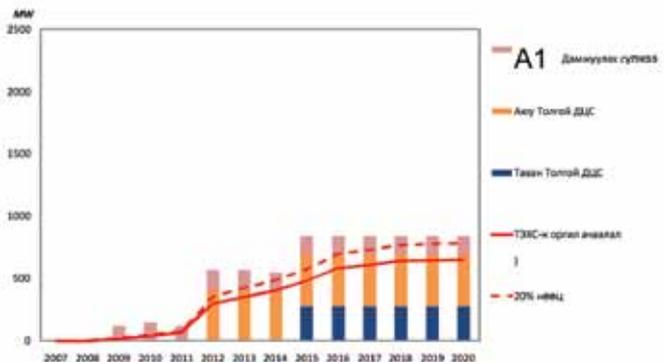


Figure 1.3 Supply & demand in Southern Mongolia with delayed Oyu Tolgoi TPP



### 5.8 Current Priorities

The immediate priorities for electricity are:

- Ensure timely completion of the CES-South Gobi interconnector.
- Develop a power purchase agreement under which the proposed Oyu Tolgoi thermal power plant will find it financially attractive to sell power to the CES, OR, alternatively make arrangements for increased Chinese imports beyond those required to serve Oyu Tolgoi.
- Complete the bidding process for Thermal Power Plant #5. Hiring an internationally experienced transaction adviser would greatly facilitate the process.
- Hire an internationally experienced transaction adviser to launch a bidding process for Tavan Tolgoi thermal power plant.
- Re-examine the financial and environmental feasibility of the Egiin Hydro power project, or identify an alternative project for commissioning in 2015.

# 6

## WATER RESOURCES

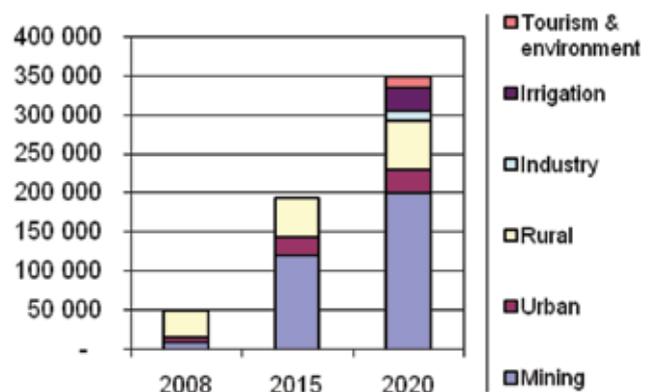
### KEY POINTS

- Initial development of the region should rely on abstraction of groundwater reserves.
- There is sufficient groundwater potential in Southern Mongolia to accommodate demand growth at least until 2020.
  - Demand could reach 350,000 m<sup>3</sup>/day by 2020.
  - Estimated groundwater potential is 500,000 m<sup>3</sup>/day under conservative assumptions, including: 300,000 m<sup>3</sup>/day of rainfall recharge; and depletion of only those local aquifers which have been studied, by 40-60% over at least 25 years.
- Decentralized groundwater supply would have investigation and capital costs in the order of \$260 million, compared with over \$500 million for a pipeline from the Orhon River.
- Over the next decade, more detailed studies are required to determine the extent of groundwater potential:
  - such studies are likely to reveal additional exploitable water resources.
  - studies will also determine if at some stage the conveyance of surface water from the Orhon or Kherlen rivers is economically justified.
- Resources (at least \$2.5 million for a three year startup phase) should be allocated to a groundwater management authority:
  - To conduct detailed studies of water availability in areas of expected demand
  - To monitor the impact of aquifer abstraction on surface water and the local environment
  - To manage and enforce rights to water abstraction.

### 6.1 Demand for water resources

Figure 6.1 illustrates the potential growth of water demand in Southern Mongolia over the next decade, from current consumption of around 50,000 m<sup>3</sup>/day to 350,000 m<sup>3</sup>/day in 2020. Derivation of these estimates is discussed below. The underlying assumptions have been made with the intention of over-estimating the growth of demand, including optimistic levels of mine production, and an annual growth rate of 5% for rural population and livestock water demand.

Figure 6.1 Possible Growth of Water Demand (m<sup>3</sup>/day)



### Urban Water Consumption

The towns of Dalanzadgad, Mandalgobi, and Sainshand currently have a combined population of 55,000, and together consume 6,200 m<sup>3</sup>/day of water. Their supply is from well fields, with treatment where necessary to reach drinking water standards. The figures in Table 6.1 indicate consumption of 100-130 liters per capita per day. This reflects a mix of household connections and sales to gers through water kiosks.

Growth of urban water consumption in Southern Mongolia will be determined by population growth. Over the next five years, the population might grow by around 80,000 people. The Ministry of Construction and Urban Development has forecast (MCUD, 2008) a population increase of 110,000 by 2020. Water consumption could grow to around 150-180 liters/day, as a greater proportion of the population lives in apartments rather than gers.

Combined with the existing population of around 55,000 people, the total population of Southern Mongolia may increase to around 125,000 people by 2015, and 165,000 people by 2020. This would give rise to urban water demand of 24,300 m<sup>3</sup> of water per day by 2015, and 30,000 m<sup>3</sup> of water per day by 2020.

### Rural Water Consumption

Rural water supply in Southern Mongolia is mainly from individual herder wells and from deep wells with pipelines which supply the soums. Water supply in the soums is mainly through kiosks. The total rural water supply is estimated at 1,000-3000 m<sup>3</sup>/day, assuming a daily consumption of 10-30 liters per day for a rural population of 95,000.

Assuming a very rapid annual growth rate of 5% for water demand by the rural population (because of increased population growth or increased water consumption), rural water demand for humans could grow to 4,200 m<sup>3</sup>/day by 2015, and 5,400 m<sup>3</sup>/day by 2020.

Livestock watering is calculated using the estimated number of livestock and daily water consumption figures. Currently, total water use for livestock water supply is around 32,000 m<sup>3</sup>/day (Table 6.2).

**Table 6.1 Current Water Use in the Aimag Capitals**

	Number of wells	Yield liters/sec	Abstraction capacity m <sup>3</sup> /day	Abstraction m <sup>3</sup> /day	Population	Consumption liters/cap/day
Dalanzadgad	10	1-15	4,000	2,000	15,000	133
Sainshand	18	0.4-27	5,000	3,200	29,000	110
Mandalgovi	15	1-10	3,500	1,000	10,000	100

**Table 6.2 Current Livestock Water Use**

	Daily water consumption (l/day)	Number of animals (2003)	Water demand (m <sup>3</sup> /day)
Sheep & goats	4	3,400,000	13,600
Cattle	35	100,000	3,500
Horses	35	260,000	9,100
Camels	45	120,000	5,400
<b>Total</b>		<b>3,880,000</b>	<b>31,600</b>

Demand growth is also estimated at the high annual annual growth rate of 5%, suggesting livestock demand for water of 45,000 m<sup>3</sup>/day by 2015, and 58,000 m<sup>3</sup>/day by 2020.

## Mining Industry Water Requirements

Current water demand of the mining industry in Southern Mongolia is around 9,000 m<sup>3</sup>/day (see the background paper for details of this estimate). Combining estimates of water demand for coal, copper, and other minerals, the mining industry could require around 120,000 m<sup>3</sup> of water per day by 2015, and 200,000 m<sup>3</sup> of water per day by 2020.

Water use in coal mining varies according to the method of mining. Underground coal mining requires water, but open pit mines do not. For processing, water can be used for coal washing, dust suppression, plant operation and personnel, and power supply. Water could also potentially be used to transport coal by pipeline, but planned railway construction means this option is unlikely in Southern Mongolia.

Most of the planned coal mines will be open pits, with dust control and small uses being the main water needs. This will result in water demand of around 100-200 liters of water per ton of coal. Coal washing would add 400-600 liters of water per ton of coal, depending on the process used and the level of re-use. Assuming that half the mines export unwashed coal, while the other half exports washed coal, the coal mines would use on average around 400 liters of water per ton of coal.

With assumed annual production of around 20 million tons of coal by 2015, Southern Mongolia's coal industry might consume 22,000 m<sup>3</sup> of water per day. By 2020, with production potentially in the order of 50 million tons of coal, the coal industry's water consumption might reach 55,000 m<sup>3</sup>/day.

For the copper industry, Oyu Tolgoi's plans suggest it will require 67,000 m<sup>3</sup> of water to process 110,000 tonnes of ore per day. This equates to 30 m<sup>3</sup> of water per ton of concentrate. If production reaches 1 million tons of concentrate per year, Oyu Tolgoi's water consumption will be around 82,000 m<sup>3</sup>/day.

Copper production at Tsagaan Suvraga might reach 500,000 tons of concentrate per year by 2020.

Applying Oyu Tolgoi's water demand estimates, Tsagaan Suvraga might consume around 41,000 m<sup>3</sup>/day.

In addition to the coal and copper mines, other small mines in the area might consume an additional 10,000 m<sup>3</sup>/day by 2015 and 20,000 m<sup>3</sup>/day by 2020.

## Other Sources of Water Demand

Industry, commerce and irrigated agriculture currently have low levels of water demand, but it is possible that as towns are established by 2015, these activities could develop in surrounding areas. For indicative planning purposes, it is supposed that industry and commerce require around 12,500 m<sup>3</sup> of water per day by 2020. Irrigated vegetable production around urban centers might occupy 1,000 hectares and consume 10,000 m<sup>3</sup> of water per day by 2020.

Tourism activities currently require negligible amounts of water. And no special reservation of water is currently required for environmental purposes. This may change as the region develops. It is assumed that tourism and the environment will together require 15,000 m<sup>3</sup>/day by 2020.

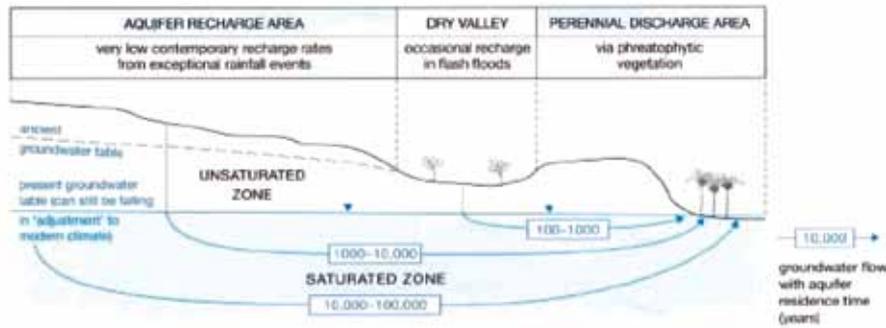
## 6.2 Groundwater potential supply

### Groundwater Concepts

Aquifers are layers of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt, or clay) through which groundwater can flow and from which groundwater can be usefully extracted using a water well.

The occurrence, quality and movement of groundwater in aquifers depend on the type of formation and the recharge mechanisms. The source of recharge is usually rainfall, but it can also be seepage from rivers, canals or lakes. Infiltrating water percolates to the water table and flows from the points of recharge to the points of discharge. Groundwater systems are dynamic, with groundwater in continuous slow motion from zones of recharge to zones of discharge. Tens, hundreds or even thousands of years may elapse, especially in arid and semi-arid areas.

Figure 6.2 Typical groundwater cycle in an arid region underlain by major aquifers



Aquifers can be characterized by their capacity for groundwater storage (productivity) and their capacity for groundwater flow (continuity). A distinction is usually made between aquifers with high, moderate, and low productivity. Continuous aquifers (as in Figure 6.2) extend regionally and are known as major aquifers. In contrast, Southern Mongolia's aquifers are smaller, and are known as minor or local aquifers. The more permeable and productive formations in Southern Mongolia generally have a limited extension and are surrounded by rocks with low permeability. For example, the Gunii Hooloi aquifer, which may be used to supply water to Oyu Tolgoi, is surrounded by granite.

In some cases, aquifers are cut off from their source of recharge, due to geological events or climatic changes. These are called "fossil aquifers". Fossil groundwater needs special care as it is a one-time reserve, which is not replenished.

"Groundwater reserve" is the total amount of water stored in an area. "Groundwater potential" is the amount of water that can be abstracted. Since most of Southern Mongolia's groundwater is fossil, the abstraction potential depends on the extent of lowering of the groundwater table during a certain period of time.

### Southern Mongolia's groundwater

Southern Mongolia has aquifers at various depths. Recharge in the region comes from rainwater which percolates in the upper (shallow) aquifers and is discharged to springs; feeds vegetation, wadis or temporary lakes; or is abstracted by shallow wells. A small portion percolates to the deeper aquifers, but the amount is largely unknown.

The deep aquifers are the permeable rock sections from which groundwater can be abstracted. Pumping from these aquifers will lower the groundwater table in the layers above the aquifer (and its vicinity), and will eventually dewater the aquifer itself. This lowering may affect the wells in the upper aquifers and the environmental functions of the shallow groundwater (feeding vegetation, springs, wetlands etc). The rate of abstraction from the deep aquifers is defined by the number of years of pumping and the acceptable lowering of the water table.

Estimates of the groundwater potential of the region have been made using three different methodologies:

- A plausible estimate, which assumes up to 1-2% of Southern Mongolia's surface area is underlain by aquifers between 50 and 100 meters below the surface, suggests a total groundwater potential of 680,000-1,370,000 m<sup>3</sup>/day.
- A conservative estimate, which takes into account the rate of recharge from rainwater based on comparable international studies as well as the results of the existing studies of aquifers in the region, suggests groundwater potential of 580,000 m<sup>3</sup>/day. A large number of the existing studies were conducted in the 1980s and 1990s by Russian and Mongolian experts are a source of much information concerning what is currently known about Southern Mongolia's water reserves. These studies assume 40-60% depletion of the groundwater reserve in an aquifer over a period of pumping of 25-27 years.
- Dr Jadambaa, a Mongolian water resource expert, estimates groundwater potential is 1.3 million m<sup>3</sup>/day.

The estimates are discussed in more detail below.

### Extensive estimate of groundwater potential

Figure 6.3 is a hydrogeological map of Omnogovi aimag. Similar maps are available for the other aimags of Southern Mongolia. A simplified interpretation of the map is that the brown and red areas have no or limited groundwater, solid blue areas are likely to contain highly productive local aquifers, and all other areas include moderately productive local aquifers. There is vast potential for exploitable aquifers across the whole of the aimag. But so far, only a limited number of studies have been conducted to test the actual groundwater potential of the geological formations.

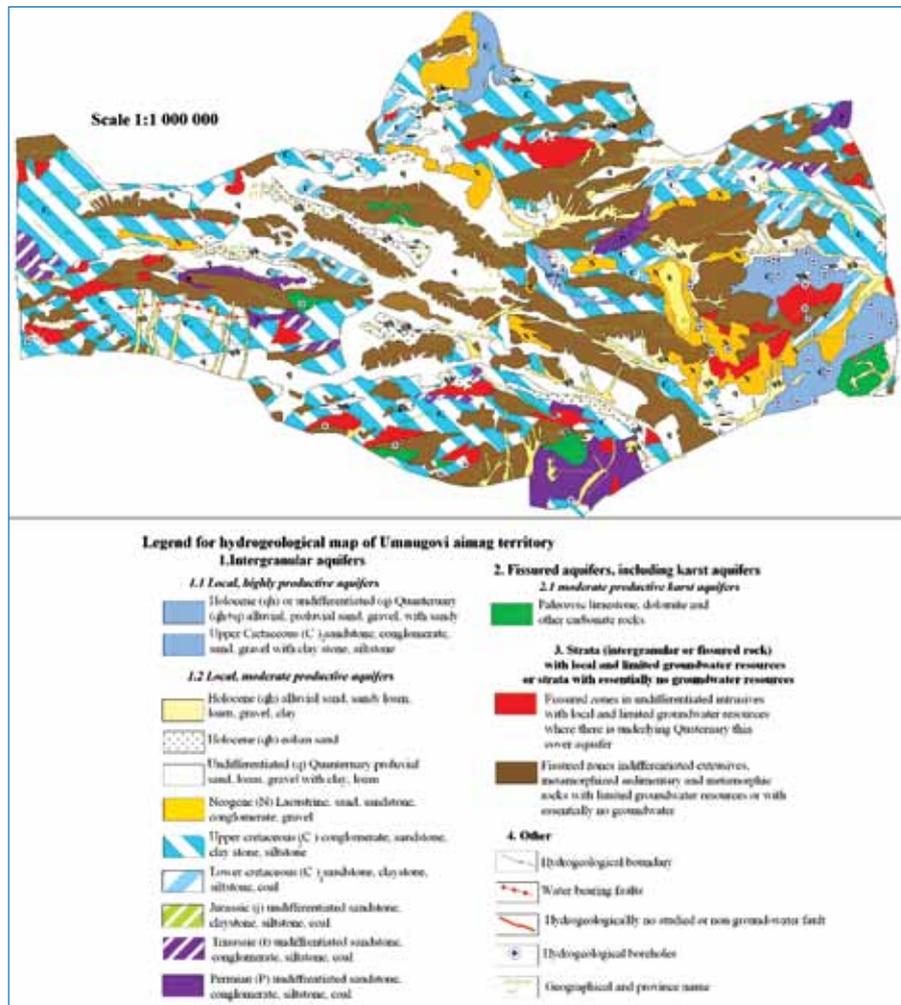
The underground area of Southern Mongolia (350,000 km<sup>2</sup>) consists of a complex variety of different rocks. Below the groundwater table (50 meters below the surface), all these rocks are saturated with groundwater. Assuming a porosity of 0.1, the volume of this water is 35 billion m<sup>3</sup> per

meter thickness, or 3,500 billion m<sup>3</sup> over a depth of 100 meters (from 50 to 100 meters below ground).

If all this water could be abstracted, lowering the water table over the entire area by 1 meter per year would produce 35 billion m<sup>3</sup> per year (or 96 million m<sup>3</sup> per day). But abstraction is only possible from rocks with sufficient permeability (aquifers). The abstraction rate of aquifers is related to the accepted lowering in a certain period of time. For the Gunii Hooloi aquifer (550 km<sup>2</sup>), the abstraction rate was calculated as 42 million m<sup>3</sup>/year, for a lowering of the water table by 100 meters during 40 years.

The aquifers of Southern Mongolia are known to occupy at least 4,000 km<sup>2</sup>, based on existing groundwater studies. Assuming that 1-2% of the region is underlain by aquifers (7,000 km<sup>2</sup>), the figures of the Gunii Hooloi study suggest a total groundwater potential of 250-500 million m<sup>3</sup>/year (680,000-1,370,000 m<sup>3</sup>/day).

Figure 6.3 Hydrogeological Map of Omnogovi Aimag



Conservative estimate of groundwater potential

Table 6.3 estimates the groundwater potential in the region as 580,000 m<sup>3</sup>/day. The estimate is based on conservative estimates of the probable recharge rate as well as the results of around 40 local studies. Further studies may confirm the presence of additional groundwater potential.

**Table 6.3 Groundwater potential (m<sup>3</sup>/day)**

	Omnogovi	Dundgovi	Dornogovi
Shallow groundwater	135,616	61,233	89,589
Aquifers 50 – 200 m	60,000	8,500	111,000
Aquifers > 200 m	115,000		
<b>Total</b>	<b>310,616</b>	<b>69,733</b>	<b>199,589</b>

Shallow groundwater (<50 meters deep) consists mainly of granular aquifers in river beds and depressions and recharged from infiltration by rainfall. These aquifers are the main source of water for rural purposes. Low annual rainfall (100-150 mm) limits recharge from rainfall, but spread across the large area of Southern Mongolia still amounts to a substantial amount of renewable water. Recharge of 1 mm per year is assumed across the region, of which a usable fraction of 30% is assumed.

- Studies in the Gobi Desert in China under comparable conditions showed a recharge of 1-2 mm per year. A study in the Mandalgobi area also found the presence of recharge, at a higher rate. A recharge of 1 mm/year is consistent with research in other semi-arid desert areas, but is likely to be a conservative estimate.

- The surface area of Omnogovi aimag is 165,000 km<sup>2</sup>; Dundgovi is 74,500 km<sup>2</sup>; and Dornogovi is 109,000 km<sup>2</sup>. A recharge of 1 mm/year represents 950,000 m<sup>3</sup>/year storage over the total area. Assuming that 30% of this is effectively available for use, it represents 300,000 m<sup>3</sup>/day.
- It is unclear how much of this water reaches deeper aquifers, and which part is abstracted by herder wells or discharged locally to springs, rivers and local depressions.

Deep aquifers (50-170 meters) were studied at more than 40 sites in the latter decades of the 20<sup>th</sup> century. A number of them are now exploited for urban and mining water supply, including mines at Tavan Tolgoi, Tsagaan Suvraga and Shivee Ovoo. The studies were constrained by the maximum depth of drilling rigs at the time (up to 170 meters). For purposes of Table 6.3, it is assumed that the groundwater potential of the aquifers amounts to 50% of the water identified in these studies.

The Gunii Hooloi groundwater area, studied for the Oyu Tolgoi mine, is the first deeper aquifer to be investigated. The study concluded that 60,000 m<sup>3</sup>/day can be pumped during a 40 year period, assuming that the groundwater table will not be lowered further than the top of the aquifer. That is, the water would be mined from the layers overlaying the aquifer from which the water is pumped. For purposes of Table 6.3 it is assumed that the Gunii Hooloi area is the only deeper aquifer in the region, but future investigations could reveal the presence of other deeper aquifers.

#### Groundwater estimates by Dr. Jadambaa

Dr. Jadambaa (2007) prepared a recent estimate of the groundwater potential based on his experience in the region, presented in a classification of the different aquifer productive types. The total figure is about 480 million m<sup>3</sup>/year, or 1.3 million m<sup>3</sup>/day.

**Table 6.4 Groundwater potential estimated by Jadambaa (2007)**

Aquifer classification	Productivity (liters/sec/km <sup>2</sup> )	Groundwater resources (million m <sup>3</sup> /year)		
		Omnogovi	Dundgovi	Dornogovi
Highly productive	>1	31	25	19
Moderate to locally highly productive	0.1-1.0	138	77	71
Low to moderately productive	0.03-0.1	89	2	19
Low productive	0.003-0.03	3	3	4
Essentially no groundwater	<0.003	0	0	0
<b>Total</b>		<b>261</b>	<b>107</b>	<b>113</b>

## Cost of groundwater supply

Table 6.5 presents an estimate of the cost of developing groundwater supply in Southern Mongolia, based on a hypothetical scenario of supplying 8 rural centers, 2 towns, 10 irrigation projects and 2 mines with a total of 1500 liters/second (130,000 m<sup>3</sup>/day) of water. Unit costs are derived from Mongolian prices in 2008, supplemented with international unit costs and information from Ivanhoe Mines about the cost of investigations and development of the groundwater in the Gunii Hooloi aquifer. Groundwater feasibility studies typically cost 10-15% of the investment cost. The total cost for the scenario is around US\$ 260 million.

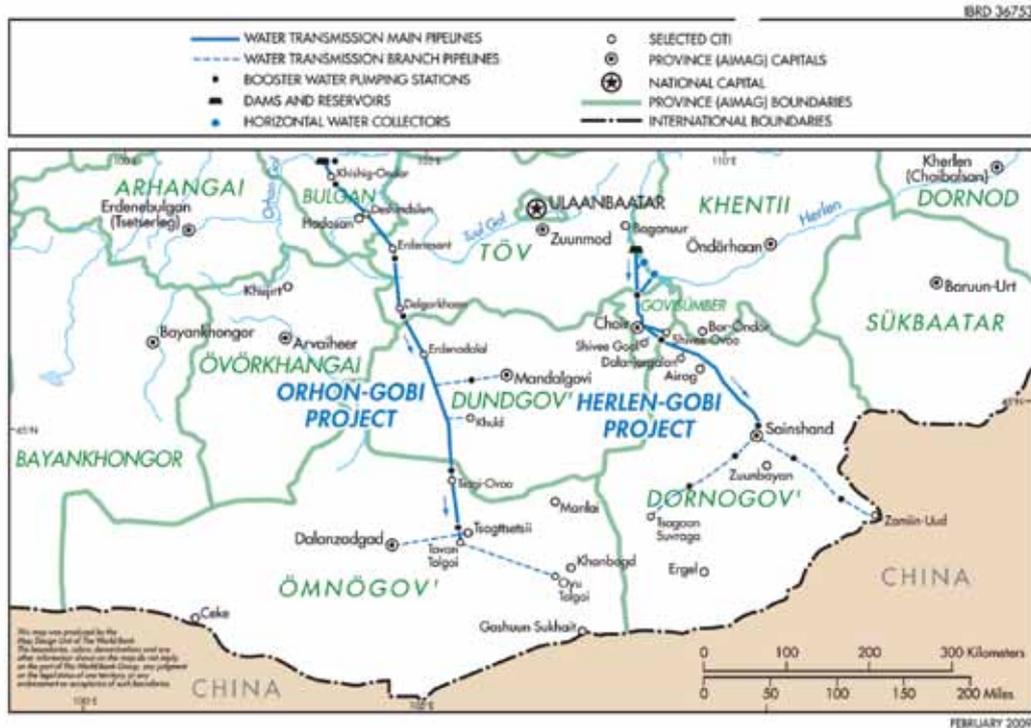
**Table 6.5 Costs of groundwater supply**

	Parameter	Rural water	Town water	Agriculture	Mines	Total
<b>Demand</b>						
demand	l/sec	6	50	50	425	
number of locations		8	2	10	2	
total supply	l/sec	50	100	100	850	1500
	Million gallons/day	0.96	1.92	9.6	16.32	
<b>Production wells</b>						
well capacity	l/sec	5	10	15	35	
pumping hours		12	12	12	12	
wells	Number	20	20	67	49	
<b>Conveyance</b>						
distance	km	10	25	10	75	
pipe diameter	inch	4	12	12	30	
<b>Storage/treatment</b>						
storage	hours supply	4	6	2	6	
	m <sup>3</sup> /location	86	1,080	360	9,180	
treatment		chlorination	conventional	chlorination	reverse osmosis	
<b>Unit prices</b>						
cost per well	US\$	200,000	250,000	250,000	300,000	
cost of pipeline	US\$/m <sup>3</sup>	200	250	250	600	
power supply	US\$/unit	200,000	300,000	400,000	1,000,000	
storage cost	US\$/m <sup>3</sup>	1,000	1,000	1,000	1,000	
treatment cost	US\$/unit	50,000	3,000,000	500,000	1,000,000	
<b>Investment cost</b>	US\$ million	21	26	51	126	224
<b>Investigation cost</b>	US\$ million	2	3	5	25	35
<b>Total cost</b>	US\$ million	23	29	56	151	259
<b>Cost per m<sup>3</sup> installed capacity</b>	US\$	5,421	3,305	1,290	2,058	

### 6.3 Long distance surface water pipelines

There is no perennial surface water available in Southern Mongolia. Use of surface water from rivers and lakes would require long-distance transportation from perennial rivers in the center of the country. The Mongolian National Water Programme Support Center has proposed two possible pipelines: the Kherlen-Gobi Project and the Orhon-Gobi Project (Error! Reference source not found.)

Figure 6.4: Possible Water Pipelines for Southern Mongolia



The Orhon-Gobi Project would pump 2,500 liters/second (216,000 m<sup>3</sup>/day) from the Orhon River through a 740 km pipeline to Tavan Tolgoi and Oyu Tolgoi, with side branches to Mandalgovi and Dalanzadgad. The system would include a 20 MW hydro-electric power plant. A substantial portion of the water would be used for irrigation, close to the river intake and would not be transported deep into the Gobi area. The Kherlen-Gobi pipeline would convey 1,500 liters/second (130,000 m<sup>3</sup>/day) from the Kherlen River through a 540 km pipeline to Shivee Ovoo, Sainshand and Zamin-Udd with a side branch to Tsagaan Suvraga.

In 2005 the estimated cost of the Kherlen-Gobi pipeline was US\$ 400 million. A cost estimate is not available for the Orhon-Gobi pipeline, but a longer pipeline would cost proportionately more to install (ie around \$500 million).

### 6.4 Comparison of groundwater versus surface water pipeline

Based on a conservative assessment it appears there is sufficient groundwater potential in Southern Mongolia to meet demand over the next decade, and quite likely for a significant period beyond. Nevertheless, as the groundwater is abstracted over time, monitoring will be required to determine whether negative environmental consequences are likely. Improved understanding of the extent and nature of Southern Mongolia's groundwater reserves will permit an assessment of whether and when it might be financially and environmentally justified to develop a long-distance pipeline to transport surface water.

For several reasons, the transportation of surface water by long distance pipelines is not a current priority, at least for the purpose of supporting mine development in Southern Mongolia:

- Long distance pipelines would have slightly lower operating and maintenance costs than would decentralized groundwater supply, but the difference in capital costs, more than \$200 million, provides strong financial reasons to favor the development of groundwater.
- Decentralized groundwater supply can be developed in stages, and so it can be more easily matched to the development of individual towns and mines over time.
- Developing a large water pipeline project would pose significant financing and technical capacity challenges within Mongolia. Development of several smaller decentralized groundwater projects would be easier to manage.
- The environmental consequences of water extraction from the Orhon or Kherlen rivers still need to be determined.

There may be an economic justification for building one or more shorter pipelines in order to develop agriculture close to the surface water intakes, but this would not require a pipeline extending to Southern Mongolia. The development of agriculture in areas closer to the river intakes has not been considered for purposes of this report.

## 6.5 Groundwater management

The groundwater potential estimates give a range of 550,000-1,370,000 m<sup>3</sup>/day (200-500 million m<sup>3</sup>/year). This wide range is caused by the uncertainty in the available data and information. Water demand is currently around 80,000 m<sup>3</sup>/day, and could increase to 350,000 m<sup>3</sup>/day by 2020. These figures lead to the conclusion that the groundwater potential is sufficient to cover water demands at least until 2020, and probably for a longer period.

More detailed studies are required in order to spatially match water demands with water resources, and to determine the longer-term water resource arrangements for the region. Water quality also needs to be assessed, since different qualities of water can be used for different mining activities, as well as for supplying humans and livestock.

### Information Gathering

An integrated hydrogeological assessment of Southern Mongolia is required, integrating all existing information and complemented by additional surveys

and investigations. The information thus obtained should form the basis of a Southern Mongolia groundwater development and management plan. This plan should indicate the possible gaps between groundwater availability and water demands, and indicate how these would be addressed over time. The new studies should be concentrated in the areas of new mining developments and Dalanzadgad.

Studies could also be initiated in the coming years to better determine the feasibility of the proposed surface water pipelines. Issues to be addressed include the economic feasibility of large scale irrigation, the social and economic feasibility of the rural water supply delivery points along the pipeline, and the environmental impacts on the Orhon and Kherlen rivers of the projects.

### Institutional Strengthening

A single institution is needed to conduct the studies, integrate existing information, and manage the development plan. There is currently a wealth of information about the groundwater in the region, but it is spread across different institutions (Geological Information Center, Institute of Environment, Ministry of Nature and Environment, private sector, and individual experts.

One possibility would be the establishment of a Southern Mongolia Groundwater Management and Information Center, under the Water Authority. This SMG-MIC would act as a focal point for information and initiation of new studies, and could develop guidelines for its sustainable allocation and use. This would help to ensure that groundwater is presented as a single resource.

The World Bank Groundwater Management Advisory Team (GWMATE) could possibly give guidance in the development of a groundwater management plan, including the technical, regulatory and institutional aspects, and provide information about international experiences.

### Policy issues

In addition to the development of new institutions for development and implementation of an overall groundwater management plan, there are two policy issues of national importance which may warrant review: institutional arrangements for the maintenance of herders' wells; and the allocation and pricing of groundwater resources.

The large number of herder wells that are currently abandoned suggest current institutional problems in ownership, operation, and maintenance. A review of alternative operating models could help to find solutions.

Setting prices at economically appropriate levels would provide the right incentives for mines and other users to use water carefully. Pricing of water resources is set out under two laws: the law on water and mineral water use fees (2004) and the Law on the amount of expenditure for measures to protect the environment and to restore natural resources out of the fund". Water resource use in the energy sector, for crop production, for livestock and herder water supply, and for domestic water consumption are excepted from the water use fees.

groundwater quantity and quality (maps) and identification of the main information gaps;  
Formulation of the capacity building and training needs of the SMG-MIC;  
Definition of the short term water demands (in terms of quantity and quality) and its spatial distribution, based on confirmed economic development plans and mining development;  
A detailed study of the recharge from rainfall to the streambed aquifers and the potential to increase its use through water conservation and ground-

**Table 6.6 Water use fees in 2006**

Purpose of water use	tugrugs/m <sup>3</sup> water use	
	surface water	groundwater
Heavy manufacturing	20	30
Manufacturing	10	30
Mining		
Gold and pewter extraction	100	120
Natural oil, zinc, lead	100	120
Copper concentration, fluorspar	80	120
Food and beverage industry	10	30
Other commercial use	10	30
Water use for hydropower stations, navigation, fauna breeding and horticulture, water sports	1% of market revenue	

Development of mining in Southern Mongolia will greatly increase the abstraction of fossil groundwater. This is a non-renewable resource, which should be managed with great care. An economic analysis, having regard to pricing principles for non-renewable resource extraction, would help to ensure that Mongolia's precious groundwater reserves are allocated to the highest value uses. Allocation to the highest value use implies that the same price is paid for particular classes of water, regardless of the purpose for which that water is used.

### 6.6 Current priorities

Immediate priorities for development of a water resource management plan in Southern Mongolia include:

- Establishment of a Southern Mongolia Groundwater Management and Information Center (SMG-MIC), and collection of all existing information on groundwater resource mapping;
- Review of available information and data, storage of all data in a systematic spatial database, preparation of a spatial and lateral overview of

- water storage systems;
- A detailed analysis of the groundwater studies conducted in the last decades, including the recent studies for the mining industry;
- Formulation and implementation of additional surveys and investigations to complement the overall understanding and potential of the groundwater system, such as recharge studies using chloride tracers, a regional isotope study or airborne geophysical surveys;
- Identification of aquifers with promising potential, suitable for further investigations;
- Coordination of detailed groundwater investigations in these aquifers, in collaboration with, and co-financed by, potential users in the mining sector;
- Preparation of a plan for water supply to herders, rural settlements and livestock. These are expected to be served from streambed and shallow groundwater, and locally from deeper production wells.
- Preparation of a groundwater management and monitoring plan for the areas near new major mines and Dalanzadgad, including guidelines

for the abstraction of fossil groundwater based on an analysis of the environmental impacts of groundwater table lowering.

This work would take two to three years, provided that the institutional structures are in place, and sufficient human and financial resources are available. A preliminary costing of \$2.4 million is set out in Table 6.7. This amount does not include detailed groundwater assessment studies for specific aquifers, which should be co-financed by beneficiaries such as coal mine developers.

Upon completion of the initial phase of activities, the results could be evaluated and reviewed for expansion to cover the whole of Southern Mongolia, and to contribute to the decision-making process for investments for conveyance of surface water by long-distance pipelines.

Two additional reviews, which could be conducted by experienced international experts, could help to improve water resource management in Mongolia:

- a review of institutional arrangements for the management of herders' wells; and
- a review of pricing for fossil groundwater abstraction based on economic principles of pricing for non-renewable resources.

**Table 6.7 Cost estimate for priority groundwater assessment**

Item (for 3 years)	unit	unit cost (US\$)	number	cost (US\$)
Staff (5 staff members)	month	3,000	180	540,000
Support staff & drivers	month	1,000	180	180,000
Office costs	month	1,000	36	36,000
Transportation	month	2,000	36	72,000
Database development				100,000
Hydrochemical survey and analysis				100,000
Isotope study				200,000
Monitoring wells & equipment	pcs	20,000	20	400,000
International consultancies	month	40,000	12	480,000
Maps, publications etc	month	2,000	36	72,000
Meetings, seminars	pcs	5,000	10	50,000
Training (invited lectures, short courses)				200,000
<b>TOTAL</b>				<b>2,430,000</b>

## KEY POINTS

- New mining development promises new opportunities for many in Southern Mongolia, but the transition may impose costs on some residents.
- Transparent arrangements should be established for sharing the benefits of mining development with the local community.
- Training institutions can help local residents to take advantage of new employment and entrepreneurial opportunities;
- Local governments will play an important role in ensuring that adequate social services (including health, education, and law and order) are provided at the levels required to cope with rapid population influx.
- Methodologies for compensating herders who are displaced or lose access to pastures from mining could be reformed to ensure maintenance of livelihoods.
- Some degree of conflict between different stakeholders is inevitable – a forum for regular exchange of information and views between multiple stakeholders could help to resolve disputes.

The potential social impacts of mining development are wide-ranging, and do not fall neatly into the responsibilities of individual line ministries at central government level. And local governments do not have responsibilities for addressing all potential social impacts, even though local communities will be the most directly affected.

A consultative forum could help to ensure a wide-ranging and coherent response to the social issues. The forum should include local communities, mining companies, and the different tiers of government. An early stage might be development of a strategy to assist transition of different vulnerable groups within the community, as well as comprehensive local development strategies designed to ensure strong local participation in the benefits of mining.

### 7.1 Sharing the Benefits of Mining Development

Residents of Southern Mongolia are excited about the development of mining, but they are also deeply concerned that they may be left out of the opportunities, losing out to urbanites from

Ulaanbaatar or foreigners. One of the international lessons of mining development is that if large revenues are generated and local communities do not benefit, the ensuing social unrest can threaten the sustainability of the mines. Benefits can be shared through direct financial transfers of a share of the mining revenues, and through improved employment and livelihood opportunities.

### Sharing Mining Revenues

Mongolia's national Government retains a share of mining revenues, through mining royalties and other fees, and as an equity holder in some mines. By law, 20% of mining royalties is supposed to be allocated to aimag budgets, and 10% to soum budgets. In practice, there is little clarity on the relationship between mining royalties and sub-national government budget allocations, nor on the mechanisms for transferring and utilizing revenues for local development

Mongolia currently has a centralized financial management system, with local tax revenues channeled back to the center before being

redistributed to provinces and then soums. Under this system local authorities have little or no discretionary funds for local development, and virtually no retained revenue. Other than under projects such as the World Bank and European Union financed Sustainable Livelihoods Program, there are very few funds available at the local level for capital investment. The influx of mining revenue will likely require a new system to be developed to reallocate these funds to the local level. The Government is currently considering reforms to introduce new mechanisms for inter-government transfers to enable the sharing of mining revenues in a transparent manner.

Several principles should guide Mongolia as it develops its system for channeling resource revenues into improved services in local communities. Resources assigned to different levels of government should be linked to the scope of functions devolved to them. Thus, a first design step is clearly specifying the functions to be performed by sub-national governments, and ensuring that adequate funds are allocated for the performance of these functions. And there should be transparent reporting on how any reserved part of mining revenue is allocated to local communities.

The IMF advises against providing a guaranteed share of natural resource revenues to sub-national governments, because they are volatile (sub-national governments need stable revenue sources) and tend to be geographically concentrated (creating inequality between regions).

Permitting citizens to examine the benefits (and revenues) that are channeled from mining to the government and communities can reduce and prevent corruption, as well as improving public satisfaction with the uses of revenues. Legal tools and institutions available for monitoring, transparency and accountability include:

- Article 42.3 of the Minerals Law, which allows citizens to elect a representative to provide public monitoring of the license holder's activities;
- Chapter 9 of the Minerals Law, which permits access to minerals-related information and reports;
- The Extractive Industries Transparency Initiative, which seeks to increase knowledge of the transactions between mining companies and governments;
- License Watch (Open Society Forum) which provides statistical analysis on the numbers of licenses and the procedure to obtain licenses, information on contracts, and hosts discussions on the uses of mining revenue.

### Aligning Mining Company Contributions with Government Policy

Mining companies may contribute directly to local communities by, for example, donating supplies, donating funds for the construction of facilities, or providing bonuses for service providers to work in remote areas. There are many examples of foundations established by mining companies to

#### Box 7.1 IMF Advice on Sharing Natural Resource Revenues with Sub-National Governments

The IMF has recently published a paper on fiscal decentralization, providing the following observations. "Even though the availability of large natural resource revenue typically exacerbates demands for decentralization (with producing jurisdictions claiming control of such revenue), sharing of such revenue should be avoided. Assignment of natural resource revenues to subnational entities has many disadvantages, especially in small countries.

- Attribution of volatile resource revenues to local governments can complicate fiscal management and macroeconomic policy: during price booms, large resource revenue tends to induce unsustainable expenditure levels; while during price downturns, basic expenditures assigned to subnational governments might come under pressure. This is now acutely felt in Nigeria, where the states (which receive a fixed share of the oil revenue) built in unsustainable levels of spending during the recent oil boom.
- Geology or geography differences should not determine the distribution of revenues from national resources; when shared on the basis of origin, significant horizontal imbalances would arise.
- Resource revenues bring with them little accountability: this problem exists at the national level, but is probably exacerbated in local government.
- The size of resource revenues, relative to the size of the jurisdiction, may bring risks not only of absorptive capacity, but also of corruption.

The central government is often in a better position to smooth fluctuations in natural resource revenues, provided that these resources are transparently managed.

Source: IMF (2009). "Macro Policy Lessons for a Sound Design of Fiscal Decentralization."

assist in local community development (eg. Box 7.2). In countries where governments are well organized, such contributions can act as a useful supplement to the government's own activities. Mining companies are not, however, a substitute for good government.

Some soums in rural Mongolia have already established Soum Development Funds, into which mining companies active in those areas contribute. While these funds are welcome, the mechanisms for the utilization of funds are not transparent and they are generally off budget. Clear procedures are needed to identify, prioritize and implement local sub-projects under Soum Development Funds.

For sustainable community development, it is desirable that mining company contributions be aligned with a local development strategy, prepared by the local government with input from local citizens. Desirably also, communities should have a clearly defined role for selecting sub-projects and monitoring implementation. Donations that include physical investments and equipment should be made in close consultation with relevant line ministries to ensure that funds are set aside for recurrent expenses.

Current education levels in rural areas, and outdated vocational training, are likely to place many of the direct mining jobs out of reach of local residents in the short to medium term. Current skill weaknesses have led to increasing use of workers from Russia and China in the construction and mining sectors. The idleness rate of vocational school graduates is 26 percent. Improved training will be fundamental to ensuring that local and national residents are well-placed for employment.

The Ministry of Social Welfare and Labor, in collaboration with the Ministry of Mineral Resources and Energy, could encourage mining companies to implement training and apprenticeship programs. Existing programs could be evaluated, improved, and scaled-up where possible.

This could be supplemented with a medium to long-term training strategy to increase the capacity of the national labor force. Potential delivery options could include job training programs delivered by trainers from mining companies, improved Vocational Training Centers, and potential new regional technical training or higher education

### Box 7.2 The Yanacocha Association and Yanacocha Women's Association

The Yanacocha Mining Company in Cajamarca Peru established two associations to help with regional economic development. The Yanacocha Association and Yanacocha Women's Association assist in areas of health, nutrition, and education. As the associations' regional development focus expanded, they began to work with third party mediators and development agencies, including CARE, the Inter-American Foundation, and others.

A rural development office was created to coordinate the actions of all parties in order to create a belt of development around the mine instead of taking on scattered projects. The development office has succeeded in providing expanded drinking water systems, education, and health services, and rural highway renovations.

The two associations also established the Yanacocha Food Security Project (Prosay), with a budget of over US\$ 1 million. The project's aims were agricultural development, income generation, health and nutrition, hygiene and potable water, and school breakfast programs. The project benefited roughly 36% of families in the area.

Source: Pasco-Font, Alberto et. al., "Peru: Learning by Doing". In Eds. Gary McMahon and Felix Remy, *Large Mines and the Community: Socioeconomic and Environmental Effects in Latin America, Canada, and Spain*. IDRC/World Bank 2001.

### Improving Employment Opportunities

Mining development offers the potential for new jobs. Around 8,000 people may be employed directly in the mining industry in Southern Mongolia, and there will be additional jobs involved in the provision of goods and services for the mining companies. Ensuring that the local community benefits to the greatest extent from these opportunities will require improved vocational training, as well as measures to support local entrepreneurs.

centers with mining-related curricula. Expenditure on higher education needs to be supplemented with investment at the secondary level.

### Box 7.3 Building a Base of Mining Professionals in Namibia

Namibia is facing shortages of skilled professional and technical personnel in mining related fields, in all categories and at all levels. Of note are shortages of mining engineers and geologists in government and both professionals and artisans in the private sector. Across the sector core skills are needed in the following fields: geology, mining engineering, mineral processing, metallurgy, mineral economics, mine surveying, chemistry, environmental science and mineral policy and investment analysis. Additionally, technician-level skills, such as mining and mineral processing technicians, geo-technicians, laboratory technicians and mine surveyors are required.

In 1996 a report noted that most of the professionals in the private sector were expatriates and that the Namibian mining sector needed to develop a skills base within the country to meet both its short- and long-term needs.

In response:

- A consultative process was established involving the Ministry of Mines and Energy, the academic institutions, and industry to determine requirements and improve the quality of training programs.
- The Government also examined means of sharing the costs of training with various stakeholders.

The Government:

- established a geology department at the University of Namibia.
- established Vocational Training Centers, which were designed to provide hands-on training and develop artisans.
- encouraged the employment of regional and international experts to train local personnel.
- relaxed the work permit regime to bring in specialized instructors and trainers.

The mining companies:

- provide in-house training programs on mines
- provide general information and guidance on career opportunities and educational paths in mining to enhance knowledge of training opportunities.
- co-operate with other mining companies in the use of in-house multi-skilling programs.

Beyond direct participation in the mining industry, new job opportunities can be created through the development of broader industries. The Government has been considering various proposals for industry development in the region. These plans are beyond the scope of the current report, but they will be an important part of ensuring that the local residents benefit from regional development.

#### Supporting Entrepreneurs

Local entrepreneurs will be able to profit from the outsourcing of goods and services by mining companies and the provision of inputs for infrastructure services (eg building roads, running restaurants and hotels). For example, at Borro gold

mine, small and medium enterprises are supplying maintenance, haulage, catering, lime, and transportation services. Local herders may also be able to tap new markets for animal products.

Government may be able to assist in the incubation of newly formed enterprises with training in skills such as information technology, accounting, marketing, promotion, finance, and general management. The focus should be on the development of skills that are applicable across a range of businesses. Mining companies could be encouraged to publicize their input requirements, and to tender locally for services that can be provided within the region.

### Box 7.4 Supporting Entrepreneurs in Kazakhstan

A business development center has been established in Kazakhstan, supported by Chevron Texaco and Citigroup Kazakhstan, and implemented by the United Nations Development Program.

The center provides drop-in services, seminars, training and workshops for local entrepreneurs. Small businesses can access secretarial support, workspace, legal help and office supplies. The UNDP hired a technical advisor to train local consultants on sound business practices. A pilot micro-credit scheme was established for graduates of the entrepreneurial training seminar offered by the center.

The center has advised hundreds of local firms, created 230 business plans, more than \$2 million in loans have been disbursed, and 530 new jobs have been created. New businesses have included a private ambulance service, bowling alley, and the city's first supermarket.

*Source: Partnerships for Small Enterprise Development.*

### Encouraging Women's Participation in the Labor Force

Increasing women's incomes contributes directly to improved household well-being and security. From an economic point of view, it makes simple sense to harness the productive capabilities of all potential workers. Inadequate attention to gender issues in mining communities can result in greater income inequality, high levels of prostitution, HIV/AIDS and other social ills that impose significant costs on the local community. To address these risks, mining companies can employ more women and use inclusive strategies to bring benefits to all members of their communities.

The Government of Mongolia's 2007 report to the Committee on the Elimination of Discrimination Against Women points to significant gender gaps in

employment and salaries. Strategies to encourage women's participation in the labor force could include: training women to move into employment sectors that are currently dominated by men; providing incentives to employers to make women managers or administrators; and providing child care facilities for women with young children.

Efforts to increase the number of women in the labor force should be reinforced with measures to protect women from sexual harassment and violence once they are in the labor force. Such measures could include: establishment of guidelines defining harassment and procedures for complaints and disciplinary action; adopting a zero tolerance policy for sexual harassment in the workplace; enforcing existing labor laws; and challenging employment stereotypes in public awareness campaigns.

### Box 7.5 The South African Mining Charter

The Mining Charter adopted by the South African mining industry in 2002 recognizes that "blacks, mining communities and women" have historically been excluded from the mainstream of the economy. The industry states its intention to adopt a proactive strategy of change at the levels of "ownership, management, skills development, employment equity, procurement and rural development."

The Charter states that companies shall establish targets for employment equity and take steps towards "ensuring higher levels of inclusiveness and advancement of women ... (with a) baseline of 10 percent of women participation in the mining industry within 5 years." The industry agrees to setting and publishing of targets in all areas of transformation.

*Source: IFC (2007), "Integrating Women into Mining Operations"*

## 7.2 Providing Adequate Social Services

The increase in Southern Mongolia's population will stretch the capacity of local government facilities and staff. In addition to the physical investments discussed in Chapter 3, additional government expenditures will be required to ensure adequate provision of health, education, law and order, and general administration.

### Accommodation and Town Services

Provision of accommodation and adequate town services for all residents of Southern Mongolia is part of the general sharing of benefits of mining development. Failure to provide such services can cause social discord. In the worst international cases inequality in access to services has threatened mine operations and the basis of regional prosperity.

operations because they permit spouses to remain in a major urban center (eg Ulaanbaatar), where they have access to better employment opportunities and their children may have better schooling and social services. But there is some evidence that suggests FIFO operations are associated with higher levels of divorce and domestic violence, because mine workers' long periods of absence from the family home means they do not fully share in the daily responsibilities of raising a family.

Accommodation options where workers are housed with their families close to mine sites may be better for family life, but may result in lower services for spouses and children. Promotion of local family life will also help to integrate new mine workers into local communities, and ensure that they have an incentive to see the local community develop.

### Box 7.6 Mining Provides No Guarantee of Prosperity for All

Jobs and improved services need to be provided not only for the existing residents, but also for those who move to the area. Examples of what can go wrong can be seen in many countries around the world.

For example, in the early 1980s CVRD established an iron ore mine on a mountain range inside a national park in Brazil's Amazon forest. It built a gated community to house around 5,500 workers and their families at a cost of over US\$ 150 million. To house additional influx, it provided US\$3 million for infrastructure in the nearby Vila de Parauapebas, with no promises of annual upkeep. Parauapebas lacks paved roads and most houses lack running water and sewerage. Notwithstanding the low level of town services, the possibility of employment and the absence of services elsewhere attracted extensive squatter settlements. By 2006, the population of Parauapebas had reached 110,000 with a population consisting primarily of uneducated and unskilled migrants drawn from Brazil's poorest regions.

South Africa provides another example. The Anglo Platinum mining company provided 55% of its workers at Limpopo with a "living out allowance" intended to provide workers with flexibility in choosing their living arrangements. In practice, many workers ended up in informal dwellings because of severe housing shortages. In 2003, roughly 41% of the mine employees who lived away from the mine itself lived in backyard shacks, backyard brick buildings, or free-standing informal shacks. The informal settlements lack water, electricity, and sewerage. Only half of those with living-out allowances had kitchens.

*Source: Castalia background paper.*

To some extent, Mongolian traditions of ger settlements will help mitigate any planning failure to provide accommodation. But Mongolia should aim to provide new arrivals with services (eg water and sanitation, heating, schools, hospitals, etc) that are at least as good as alternatives elsewhere in the country. Although this risks accelerating the rate of population influx, it is a necessary part of ensuring that the local community benefits from mining development. The issues associated with developing town infrastructure are discussed in Chapter 3.

The choice of model for development of townships will have important implications for families. Some families prefer fly-in fly-out mining

Provision of a mix of mine worker housing options in Southern Mongolia will provide individual families with choices, permitting them to decide which sort of arrangements best suit their families.

### Health and Education

There are already significant weaknesses in the delivery of health and education services in Mongolia's rural areas. The addition of a large influx of new population presents a risk of overstretching government capacity. On the other hand, the economies of scale available from increased population may actually provide opportunities for improved services.

Access to health services is constrained by large

distances and poor transport links. Omnogovi aimag has in recent times conducted health campaigns, and monthly visits to Bagh by medical staff. The Ministry of Health has made efforts to provide mobile workers with identity cards to ensure access to health services, and is also promoting the use of mobile health services. But there are still significant gaps in health services.

Inadequate facilities, equipment, desks and books all combine to lower education levels in rural areas. And there are few incentives for teachers to work in rural areas, as pay is lower than in urban areas. The government is investing in improving rural education through its own and donor financed projects, including improving facilities (for instance under the Fast Track Initiative for Education and the Sustainable Livelihoods Program) and improving teacher skills are resources (under the World Bank financed Rural Education Access and Development (READ) project).

Addressing weaknesses in health, education, and general government administration will require increased government expenditures in Southern Mongolia. Attention will need to be given to pay levels for public employees, as educated workers will be attractive to mining companies.

## HIV/AIDS

Mining is likely to bring with it an increase in mobile and migrant workers, and with this will come increased risks of widespread HIV/AIDS infection. The costs of HIV/AIDS are tragic for family and communities, and more generally can impose significant economic costs. Impacts range from reduced productivity among workers, increased demands for health care, and increased burden on women who are often primary care-givers, and higher school drop-out rates as children work in order to replace parents' incomes.

### Box 7.7 Social Impacts of Western Australia's Iron Ore Boom

During 2001-2008, the remote Pilbara region in Western Australia benefited from a boom in iron ore exports. The mines struggled to attract sufficient workers, pushing up wages to around three times those offered elsewhere in the country.

The mines' demand for labor, and ability to pay high wages, made it difficult for small local employers (eg bakeries, cleaning companies, etc) to retain workers. Local schools found it difficult to retain teachers, who were offered relatively low state-fixed salaries, and who could be attracted by higher salaries working for mining companies. In turn, this meant potentially lower standards of education for local children.

Inappropriate regulations that restricted the release of land limited the development of new housing, and cost inflation pushed up the price of even demountable housing to previously unknown levels. Despite these price and wage increases, the supply of housing did not keep pace with the demand, and many local workers were housed in low quality accommodation with minimal facilities. Some long-time residents who did not own their own housing found their rents increased, and were forced to downgrade their accommodation.

Many of the new workers in the area considered themselves temporary residents, and did not develop strong ties to the local community. The boom attracted lots of single men. With lots of cash to spend and away from family or other recreational opportunities, their entertainment choices included consumption of alcohol, illegal drugs and prostitutes. For some long-time residents, the new arrivals could seem undesirable.

While mining companies made an effort to employ local indigenous Aborigines, there were others who were excluded from the new developments. While the rest of the community got rich from the mining boom, these local residents saw no change in their living standards.

Source: ABC Television, Four Corners, *The Money Pit*, broadcast on 18 August, 2008. The video can be seen at: [http://www.abc.net.au/4corners/content/2008/20080818\\_boom/interviews.htm](http://www.abc.net.au/4corners/content/2008/20080818_boom/interviews.htm)

### Box 7.8 The AIDS Epidemic and Mobility in Mongolia

Around 500-1800 adults are reported to be living with HIV/AIDS in Mongolia, and there have been fewer than 100 deaths from the disease. A rise in mobility of the labor force is likely to increase the incidence of HIV/AIDS:

- Nearly 50% of foreign workers in Mongolia work in the mining sector.
- Construction and mining accounted for 10% of the labor force in 2006, and this proportion is likely to grow over the next few years.
- 51% of mobile men had sex with casual partners in 2005.
- Mobile men are the least likely group to be tested for HIV and to know the results.
- Mobile men may be particularly likely to use the services of female sex workers.
- 36% of sex workers were diagnosed as having a sexually transmitted infection (16 times higher incidence than for low-risk women).

*Source: Ministry of Health (2006).*

The Ministry of Health can take a lead in setting policies for prevention, management and care of the disease. The Ministry already has experience in raising awareness of healthy behavior. A more structured and coordinated strategy should be a priority as mining development accelerates.

Mining companies can play also key roles in promoting healthy behavior and reducing infection rates. For example, in South Africa BHP Billiton has adopted measures including raising awareness, offering voluntary counseling and testing services, promoting care and support, and investing in research for a vaccine. BHP has also redesigned accommodation arrangements, so that workers could live with their families rather than in all-male hotels. As a result, BHP's employees HIV prevalence rate is 7.7%, compared with the general working-age population's rate of 18.8%.

#### Law and Order

A rapid increase in population and settlements may threaten social cohesion, and may increase criminality and anti-social behavior. Contributing factors could include unemployment, income inequality, price inflation of basic goods, perceptions of skewed benefit sharing, and alcohol consumption compounded by inadequate recreation facilities.

Law and order concerns could range from petty to serious crime, domestic violence, fraud, and vandalism. Victims of crime and violence could

include migrant workers who may be perceived as taking opportunities from local residents, as well as women who are susceptible to gender-based violence (particularly where there is high alcohol consumption). Perpetrators could include labor speculators, camp followers, disenfranchised local residents, and unemployed youth.

Of particular note is the potential for violence against Chinese migrant workers. The United States State Department noted in its 2008 Human Rights Report on Mongolia that "A small number of nationalist and xenophobic groups threatened Chinese residents' personal safety and businesses, as well as the safety of any Mongolian women who associated with Chinese men. During the year there were several credible reports of violence against Chinese residents. ... Chinese construction workers, when away from their work sites, were sometimes subjected to hostility and suspicion from host-country citizens."

Careful leadership at the local and national level will be required to ensure protection from violence for all residents, including temporary foreign workers. The provision of adequately resourced police and other legal services will be a central element of the response. This could be supplemented with information campaigns to encourage tolerance and raise awareness of the economic contribution made by immigrant workers.

### Box 7.9 Backlash Against Migrants in South Africa

High migration rates can lead to tensions between resident and migrant populations. In 2007, violence against foreigners in South Africa led to the deaths of approximately fifty people and the displacement of tens of thousands others. Target populations included African migrants, Chinese speakers, Pakistani migrants and South Africans from minority language groups. The episodes of violence that led to these deaths were a culmination of years of discrimination, prejudice, and latent conflict between South Africans and outsiders.

A rapid response survey carried out in an effort to understand the violence uncovered the following themes as critical to the emergence of tensions:

#### 1. Role of government

- Frustration over the insufficient pace of service delivery and consultation in general, and over housing provision and administration in particular.
- Ineffective communication and/or engagement with local citizenry around the violence and its underlying causes.
- Perceived corruption and impropriety of government officials, especially in the police service and Department of Home Affairs.

#### 2. The scale of the influx of 'migrants' and migration policy

- Poor management of cross-border migration.
- Unease about the threat posed by undocumented migrants of access to resources such as housing, business opportunities, formal employment and local women.
- Perception that foreign nationals arrive in the country with cash, skills and tolerant of low wages and hard work.

#### 3. The impact of migrants on gender dynamics

- Perception among locals that menial or ill-paid work undermines the hard-won fruits of democracy ('entitlement') and undermines dignity.
- Anger that foreign arrivals are 'showing up' local men by earning more, working harder and take whatever work they can get. This diminishes the locals in the eyes of local women.

#### 4. The pace of housing policy and the administration of housing

- Corrupt housing practices.
- Locals rent out their homes to migrants to secure regular cash income.
- The slow provision of housing.

#### 5. The politics of economic livelihoods and the competition for resources

- Competition for resources such as water, sanitation and health services together with employment and business opportunities is also a key dimension to the recent spate of conflict.
- Further conflict was exacerbated by the local practice of preferring non-South African employees, particularly in the domestic, gardening and construction sectors.
- The lack of a minimum wage in the casual labor sector also means locals are undercut by migrants, triggering unhappiness.

Source: Hadland, A. (2008) *Citizenship, Violence and Xenophobia in South Africa: Perceptions from South African Communities*. (Paper presented to the Department of Home Affairs Imbizo on Xenophobia, Pretoria, 19 August). This paper can be accessed at [http://www.hsrc.ac.za/Research\\_Publication-7627.phtml](http://www.hsrc.ac.za/Research_Publication-7627.phtml)

## 7.3 Protecting Vulnerable Groups

Not all residents of Southern Mongolia will gain from mining development, and some will need to make painful transitions. To ease such transitions and to ensure well targeted assistance measures, the Government could start with a consultative process aimed at identifying the groups most at risk.

### Livelihood Transitions for Herders

As mining and towns develop in Southern Mongolia, the land available for grazing livestock

will diminish. All pastureland is state-owned and managed under an open access system. Herders are the dominant users of land, relying on their herds of goat, sheep, cattle, horses, and camels for income, food, housing, and clothing. Mining activities are likely to affect directly only a small proportion of the total land area of Southern Mongolia. Nevertheless, for those herders directly affected by loss of access to pastures, the impact of new mining development may be substantial.

While almost all of Southern Mongolia is subject to exploration licenses (with relatively small land impact), a much smaller proportion of exploration activities will ultimately give rise to production activities (which have much greater impacts). Production licenses currently occupy around 0.7% of the land area of Southern Mongolia. It should be noted, however, that in some parts of Mongolia mineral resources are often in the same river basin locations as herders' winter (and most valuable) pasture resources

Internationally, land acquisition strategies often include individual compensation, asset replacement, livelihood restoration, and transitional assistance. The aim is to ensure that individuals who suffer losses as a result of government actions should be restored to a position where they are at least as well off as before the land acquisition.

Mongolia's current framework for compensation and relocation under the Minerals Law does not address all aspects of international best practice in

**Table 7.1 Mining Licenses Exploration and Production, January 2009 (hectares)**

	Exploration	Production
Dornogovi	6,407,038	43,957
Dundgovi	2,996,077	5,945
Govisumber	206,084	4,470
Total	39,448,676	234,694

*Source: Open Society Forum*

When land is occupied for mine production, impacts on herder livelihoods may include (i) migration of herders; (ii) a decrease in income or loss of livelihood for herders unable to move to new grazing areas or access new income-generating opportunities; and (iii) competition for natural resources including water and grazing land. Chapter 6 stressed the importance of better information in respect of the impact on mining on water resources.

land acquisition and relocation. Mining companies must provide compensation for assets and relocation costs, but no provision is made for any transitional assistance or livelihood restoration. All grazing land is state-owned, with herders having only informal access rights, and so no compensation is paid for the land. There are no guidelines for the calculation of asset values or relocation costs, or time-frame

**Table 7.2 Potential Effects of Mining on Herders**

Effects	Positive	Negative
<b>Short term:</b>	Increase in demand for animal products from mining companies and new settlements opens up new supply paths for herders	Migration from historically used areas forces herders and herds to adapt to new grazing sites. This may result in lower production of animal products
		Relocation of herders and their herds may permanently reduce production and increase vulnerability leading to impoverishment of herders
<b>Medium-term impacts</b>	Expanded transport network leads to an increase in access to markets which can be tapped by herders	Expanded allocation of mining licenses and town development results in lower availability of pasture for grazing
	Mining development will provide jobs that are directly and in-directly related to mining and jobs in the formal and informal sectors	Increased use of water and pressure on available grazing land will contribute to land degradation which in turn will reduce incomes as productivity drops.
	The expansion of the rural economy may lure the younger generation away from herding and into work in the mines or related business resulting in increased and diversified incomes for individuals and families.	The expansion of the rural economy may lure the younger generation away from herding and into work in the mines or related business resulting in the loss of culture surrounding traditional herding

for their payment. Households unable to negotiate effectively may be exploited and underpaid. No formal mechanism is specified in the Minerals Law for grievance channeling or forum for consultation.

### Artisanal and Small-Scale Miners

It is not clear whether the number of artisanal and small-scale miners will increase or decrease as a result of increased large-scale mining. Higher productivity in formal mining may permit higher salaries, inducing a shift of labor away from artisanal and small-scale mining. Production licenses granted to large-scale formal miners may reduce the areas available for smaller and informal miners. On the other hand, increased areas of tailings or areas abandoned by large mining companies may increase the number of artisanal miners.

Although almost entirely illegal, informal mining has provided a major and effective stimulus to rural livelihoods and rural economies. Informal mining in Southern Mongolia expanded significantly with the severe winter (*dzud*) in 2001-02. Informal mining provides seasonal or regular employment and additional cash income for rural people, reducing migration to urban centers. The World Bank (2006) reports that informal miners have the cash and commitment to ensure their children attend school.

The negative sides of informal mining are health and environmental risks. Illegal mercury usage is wide-spread among artisanal gold miners, posing direct health risks to workers, as well as the wider community when mercury escapes into water supplies. Respiratory risks are posed by dust generated by placer mining, and smoke from tires used to melt permafrost.

Government measures could help to mitigate the negative consequences of informal mining. Whatever the net effect of regional development on their numbers, informal miners are likely to remain a significant element of Southern Mongolia's local economy in the short to medium term. Potential measures include increased environmental and technical training, to promote awareness of improved mining techniques; livelihood compensation for informal miners displaced by large-scale mines; and enhanced public participation in decision-making relating to the development of mining operations.

### Price Effects of a Mining Boom

In countries where mining booms have occurred, difficulties have arisen in coping with sudden changes in relative prices. Labor, goods, and accommodation can all be in short supply, pushing up wages and prices rapidly. While those directly employed by the

mining industry will typically benefit, others who do not see their incomes rise by the same amount may suffer. In particular, the elderly or disabled who rely on social security payments or family support, or those on government-fixed salaries may find themselves worse off as prices rise but their incomes remain the same (Box 7.7).

The Government currently adjusts teachers' salaries downwards in rural economies, to take account of the lower cost of living. In future, government fixed salaries and other government benefits may need to be adjusted upwards to take account of costs of living that are higher in Southern Mongolia than elsewhere in the country.

### Unregistered Residents

As the population of Southern Mongolia grows it is possible that there will be a significant increase in unregistered residents, including Mongolians from other parts of the country as well as foreign workers. Migrant workers may not have the documents required for registration, they may choose not to register in a new soum, or they may not be able to afford registration.

Soums receive financing based on the numbers of registered residents. If the registration process is inefficient, slow, or does not include certain residents, inadequate services will be provided for local residents. Unregistered residents may be forced to pay for their own health care, or go untreated. International experience suggests that undocumented workers may be vulnerable to mistreatment by some employers.

Soum governments need mechanisms to detect new arrivals and to ensure their registration, and the registration system should be simple, cheap, and fast. Providing such services may require increased resources in soum administration.

### Mine Closure

Particularly for short-lived mines, the Government should begin developing its strategies now for how to handle eventual mine closure. In Southern Mongolia, different mines are expected to last from 20 years to over 200 years. Even a mine with an expected life of 50 years will have an impact on the children of today's decision-makers. If there are not alternative economic activities, the local community can be left with little or no economic support.

The closure of a mine can mean the loss of thousands of jobs, the exodus of skilled residents, the deterioration of service delivery, and the hollowing

out of once vibrant communities. The impact on service delivery is likely to be particularly severe where the mining company itself is responsible for those services. For example, when Gecamines, a Congolese state-owned mining company, reduced its operations in the late 1990s, the company shut down all the infrastructure services it provided to the surrounding community, including schools, hospitals, clinics and worker housing.

### Box 7.10 Watching the Pits Disappear

In 1984, the year of the miner's strike, there were 170 working collieries in Britain. Today there are only eight working pits left in the country. The impact of the devastation of an industry that once employed over 100,000 workers has been especially severe for the communities concerned because in many villages the Coal Board was the sole employer.

David Parry, spokesperson for the Coalfields Communities Campaign, comments, "You get 50 jobs created in a place where 2,000 men used to work and this means older men in particular are parked outside the labour market." Hidden unemployment is a large problem with many former miners existing on sickness benefit, while regionally there are some very real blackspots where not very much has moved in the past 10 years.

The fabric of the housing stock has deteriorated and many villages in the former coalfields have become like inner city sink estates except they are in semi-rural isolation. The government has also acknowledged the particular problems faced by ex-mining and coastal communities. An employment report by HM Treasury noted that within regions, though, there remain pockets of high unemployment. A tail of around 15-20 local authority districts have not enjoyed the fruits of recovery seen throughout the rest of Britain. The majority of these areas are in inner cities, but seaside towns and former coal mining areas also feature.

Often people from ethnic minorities, lone parents and people with disabilities are disproportionately concentrated within these small areas. They may suffer from poor housing, inadequate transport links and high crime rates, leading to social exclusion. Low employment rates are often both the cause and effect of these areas' problems.

*Source: HM Treasury (2000), BBC News Online (April 2009).*

These impacts can be mitigated if early on in mine development governments focus on diversifying local economies and reducing dependency on extractive industries. Efforts to prepare for mine closure will require the engagement of multiple stakeholders.

### Box 7.11 Preparing for Mine Closure

#### Mining companies

- Begin planning for closure at feasibility
- Work in partnership with local governments and communities, building capacity and social capital
- Ensure availability of financial resources for closure
- Implement closure in line with laws, regulations and agreement with local communities

#### Local Government

- Prepare for post-closure
- Develop sustainable service delivery
- Support economic diversification

#### Central Government

- Provide an adequate legal and regulatory framework for closure as well as monitoring and enforcement institutions
- Responsibly invest and distribute fiscal revenues from mining
- Promote sound local and regional planning

#### Local Communities and Civil Society

- Participate in closure planning
- Use income to prepare for the future
- Support communities in reducing dependency on the mine
- Engage in service delivery where appropriate
- Monitor mining and closure activity

#### Donors and IFIs

- Support governments as necessary to:
- Establish a modern legal framework for mine closure
- Finance closure costs and social support for workers leaving state-owned mining operations
- Facilitate regional planning
- Encourage economic diversification
- Disseminate good practices

## 7.4 Current Priorities

It will be difficult to ensure a coherent and comprehensive approach to maximizing the social benefits of mining in Southern Mongolia. Without being exhaustive, some of the institutions responsible for addressing the topics identified above include:

- Share the benefits of mining revenues, and increase the transparency with which they are allocated
- Ministry of Mineral Resources and Energy;
  - Ministry of Finance;
  - Mining companies;
  - NGOs
- Align mining company contributions with government policy
  - Local governments to develop local development strategies
  - mining companies to support local priorities;
- Provide training programs and institutions to expand skills of local labor
  - Ministry of Social Welfare and Labor
  - Ministry of Education
- Foster local entrepreneurs
  - Ministry of Foreign Affairs
  - Mining companies to adopt policies of local sourcing of goods
- Encourage women into the labor force
  - Ministry of Labor and Social Welfare
  - Mining companies to adopt pro-female employment policies
- Provide adequate accommodation, health, and education services
  - Local governments
  - Ministry of Roads, Transport, Construction and Urban Development
  - Ministry of Health
  - Ministry of Education
- Ensure law and order
  - Ministry of Interior to ensure adequate policing
  - Political leaders to encourage tolerance of foreigners
- Ensure livelihood compensation for displaced herders
  - Ministry of Mineral Resources and Energy
  - Mining companies
- Provide information and training on alternative techniques for artisanal mining
  - Ministry of Mineral Resources and Energy
- Maintain real levels of government-fixed salaries in Southern Mongolia
  - Ministry of Finance
- Prepare for mine closure
  - Ministry of Mineral Resources and Energy
  - Local Governments

A first step towards a coherent strategy would be the establishment of a regular consultative forum, involving different tiers of government, mining companies, local communities, and NGOs. The forum could provide opportunities for information sharing, decision-making, and dispute resolution.

### Box 7.12 International Good Practice on Stakeholder Consultation

- Develop project-specific policies and guidelines for community engagement and engagement with non-commercial stakeholders (community groups, NGOs, non-shareholding government authorities, universities etc) pursuant to the framework of domestic laws and regulations and international obligations, and including company management and employee training, an effective monitoring system and communication of performance to external stakeholders.
- Disclose information about project operations and potentially adverse environmental and social impacts sufficiently early in planning of each stage of new operations (conceptual design, feasibility studies, construction, operations and decommissioning) to allow engagement with stakeholders on weighing the trade-offs and contributing to design and impact mitigation.
- Communicate meaningful information for stakeholders to make informed choices, i.e. information in readily understandable formats tailored to the needs of different stakeholder groups.
- Communicate information that is accessible to those stakeholder most affected by business operations.
- Identify and inform all relevant stakeholders, with sufficient time (and where necessary facilitation) the interpretation of the information.
- Continually engage with and 'track' stakeholder engagement, with emphasis on measuring company performance (i.e. stakeholder satisfaction) and 'bundling' of different activities that stakeholder would wish to address collectively, e.g. compensation negotiations, employment opportunities and mitigation of adverse socio-economic impacts.
- Maintain oversight of the outcomes of stakeholder engagement undertaken in the name of the company by others, e.g. cases where engagement is undertaken by government (e.g. for asset loss compensation) or contractors (e.g. during Environmental Impact Assessment studies).
- Involve government agencies and legitimate community groups, NGOs etc. in consultation and other engagement activities to build trust and mutual understanding.
- Communicate accessible and safe mechanisms for stakeholders to raise and resolve grievances with the company.
- Recognize the need to secure informed consent on decisions affecting indigenous peoples and their domain areas.
- Involve community, local government and NGOs in environmental and social monitoring, e.g. of ESIA-related management plans and on-going social management systems.

Sources: *Source of Good Practices International Finance Corporation - Doing Better Business through Effective Public Consultation and Disclosure*; *Dow Jones Sustainability Indexes – Guide*; *AccountAbility - AA1000 Series*.

## KEY POINTS

- Construction of major roads and railways will have serious and regionally significant impacts on movement of wildlife, including khulan and Mongolian gazelles. Studies to identify appropriate wildlife crossing arrangements are a high priority.
- Dewatering of mines will drain ground water from large areas around those mines. Development of bores and springs elsewhere could help to offset the environmental consequences.
- Soum and aimag governments could play an important role in environmental impact assessment and environmental management, but will need substantial capacity building to do so.
- Mongolia can contribute to global goals on climate change by increasing efficiency of new and existing power plants, increasing reliance on zero-emissions fuels, ensuring appropriate pricing of power, and adopting energy efficiency measures to reduce demand growth.

### 8.1 Land conversion and mine sites

The most obvious and immediate impact on natural systems is conversion of land, for the mines, ancillary facilities, and regional infrastructure, resulting in loss of vegetation, wildlife habitat, and pasture. A lower bound estimate of the area that will be directly affected within Omnogovi aimag is 16,500 hectares, or 0.1% of the aimag's surface area.

Mitigation strategies for these impacts are related to the environmental impact assessments and environmental management plans required for each development. Mining companies will need to have reclamation plans, and the Government will need to inspect and enforce these plans. Mine sites also present accident hazards to the public, livestock, and wildlife, mitigation of which requires maintenance of site security.

### 8.2 Transport infrastructure

Roads and railways are a potential barrier to movement of livestock and wildlife. Development plans for transport infrastructure need to take account of wildlife migration and movement patterns.

New roads and railways may be highly disruptive to the regional migratory movements of the khulan (wild ass) and Mongolian gazelle, and these impacts will be irreversible. Even though no improved road or railroad yet exists, coal transport between Small Gobi Special Protected Areas "A" and "B" has already ended periodic migration of khulan between the two parts of the protected area. With their habitat thus restricted, they have been moving eastward onto unprotected land where they are vulnerable to illegal hunters. The width of the informal roadway (close to 100 m in places) the size and number of coal trucks, dust and noise are the factors that prevent the khulan (and, to a lesser extent, black-tailed gazelle) from crossing.

### Box 8.1 Threats to wildlife

Threats to wildlife include: degradation or fragmentation of habitat; physical disturbance; competition with domestic livestock; and illegal hunting and trade. Examples include:

- Southern Mongolia is the principal habitat of the regionally-endangered Asiatic wild ass, or khulan, which migrates long distances in search of water and forage. Khulan movements have been disrupted and their habitat fragmented by the fences along the Trans-Mongolian Railway, and recently constructed fences along the China-Mongolia border.
- Mongolian gazelles are the most numerous of any large mammal in Asia, but their future is uncertain with threats from habitat loss, blockages to historic migratory patterns, and poaching. Mongolia's gazelle herds are the last significant populations of these animals in Asia. Sub-populations of Mongolian gazelle have been isolated from the main population in eastern Mongolia by the Trans-Mongolian Railway, the highway that parallels it, and the fences along them. Satellite tracking has shown that gazelle move along the railway but do not cross it, despite better habitat on the other side.
- An estimated 1500 Great Bustards remain in Mongolia. They will desert otherwise appropriate habitat if powerlines are constructed, because they perceive the towers as perches for raptors.
- In the steppe areas of Mongolia, there was a dramatic decrease in the number of saker falcons, a species that is valuable in the world market and can be legally exported from Mongolia under license. Dundgobi and Dornogobi experienced close to 100 percent population loss. In 2006 the government issued a decree establishing a quota of 300 birds per year and high fees for falcon export.
- Snow leopards' main prey are ibex, wild sheep, ungulates and marmots. Decreases in the populations of these food sources have directly affected leopard populations and have also led to increases in attacks on domestic herds, which in turn have provoked killings by herders.
- Permanent human settlements, mining development and fences degrade wildlife habitat by restricting access to water.
- Ecotourist encampments are often established near watering places to increase the probability of animal sightings. Their presence disturbs wildlife and, if continued for several days, deprives them of water.
- Illegal hunting is related to declining numbers of snow leopard, khulan and Mongolian gazelle (hunted for meat), and wild sheep (hunted for horns). Excessively liberal quotas for legal hunting of wild sheep have also contributed to their decline.
- There is a substantial illegal wildlife trade in Mongolia, both internal and for export. Body parts and small numbers of living animals can be found in markets in Ulaanbaatar. Traffic peaks in January, when temporary border crossings are open to facilitate shopping in China. Shipments move inside tires or in containers under other loads, including coal.



Mitigation of this threat will require detailed assessment of wildlife migration patterns, determination of crossing locations, and appropriate design of wildlife crossing facilities. This has the potential to significantly raise the costs of railway construction.

Construction of railways and roads will also involve land degradation at quarries, borrow pits, asphalt plants, construction camps and storage yards. Local environmental authorities must set and enforce appropriate construction standards. Contractors should be required to implement waste management plans, and to rehabilitate areas used for camps and yards.

### 8.3 Road traffic

Over the next few years, the coal mines at Tavan Tolgoi and Nariin Sukhait/Ovoot Tolgoi will generate large volumes of road traffic. In 2009 there could be around 600 truck movements per day, increasing to 1,300 truck movements per day or nearly one every minute. At Nariin Sukhait, the volume will likely be 350 movements per day, or one every four minutes, in 2009. These mines will eventually switch to railways, but smaller mines in the area will continue to use trucks to transport ore to the nearest railways. Effects of large volumes of road freight include:

- Without improved roads, the trucks spread across the landscape, resulting in multi-tracking and huge expanses of degraded land.
- During summer, dust from unimproved roads causes human and animal health problems.
- The presence of large traffic volumes disturbs and repels wildlife.
- Higher traffic volumes increase the risk of accidents with humans, livestock and wildlife.

Mitigation of these problems involves improving roads and requiring trucks to use the improved roads, enforcing loading and speed limits, and prohibiting road haulage during hours of the day when wildlife movements are most likely. In the medium term, shifting ore freight to railways will significantly reduce the impact of road freight.

**Figure 8.1 Dust generated by a coal truck**



Higher volumes of truck traffic will also produce greater emissions of carbon dioxide, nitrogen oxide and carbon monoxide. One truck making a roundtrip from Oyu Tolgoi to Gashuun Sukhait will produce an estimated 2,020 g CO<sub>2</sub>, 320 g NO<sub>x</sub>, and 220 g CO. Across the region and until railways are built, trucks from Tavan Tolgoi, Oyu Tolgoi, Nariin Sukhait and Ovoot Tolgoi may produce around 3 tons of carbon dioxide per day, contributing to global warming.

## 8.4 Energy

As a signatory to the United Nations Framework Convention on Climate Change, Mongolia has an obligation to contribute to the mitigation of climate change effects. While Mongolia's growth is likely to be highly dependent on extractive industries, including coal mining and the export of coal-based electricity, there are various measures that can be taken to reduce Mongolia's own carbon emissions:

- Ensure appropriate pricing for energy, which as a minimum means that prices should cover the full costs of production;

- Ensure fuel efficient technologies in the construction of new coal-fired power plants;
- Expand Mongolia's use of zero-emissions energy production, which currently includes wind and hydro-electric generation;
- Establish policies which encourage reduction of energy demand.

Southern Mongolia's coal-fired power plants could exceed 2000 MW capacity. Such power plants could produce 50-100 tons of ash per hour, containing large quantities of trace elements such as phosphorous, chlorides, nitrates, sulfates, and arsenic. It is possible to use ash as an input into cement, but typically the quantities of ash exceed commercial uses, and the remainder must be disposed in an environmentally sensitive fashion.

Transmission lines may cause disruption for endangered bustards, which perceive the towers as perches for raptors.

## 8.5 Water abstraction

As discussed in Chapter 5, demand for water resources in Southern Mongolia could reach 350,000 m<sup>3</sup> per day by 2020. Some of this demand will be satisfied drawing on natural recharge of aquifers, but there will also be considerable extraction of non-renewable fossil aquifers. This water extraction will result in a lowering of the water table in deep aquifers, potentially affecting the condition of shallow aquifers. This could pose some of the most serious threats to the region's ecology if it is not carefully monitored. If negative effects of water abstraction are observed in a particular location, alternative sources of water supply will need to be considered.

As mine excavation proceeds, water seeps into the mine from neighboring rocks. This water needs to be pumped out in order to prevent the mine from flooding. The process of mine "dewatering" drains water from the surrounding area, potentially affecting springs and vegetation in a radius of 3-7 kilometers around a mine. For the mines of Tavan Tolgoi, Oyu Tolgoi, Nariin Sukhait, and Ovoot Tolgoi combined, the affected area could total around 31,000 hectares. Mitigation measures for mine dewatering need to be put in place as part of each mine's environmental management plan. Possible measures include planting and protecting replacement vegetation to offset unavoidable vegetation loss.

## 8.6 Urban development

Chapter 2 suggests that an additional 80,000 people may need to be housed in areas close to the mines, within the next five years. The new towns will have a direct effect on the environment through the land that they occupy, and will also contribute to demands for water and electricity.

Towns also produce large quantities of waste water and solid waste. Mongolians consume about 120 liters per person per day, and produce almost as much waste water. Mongolians produce about 0.6 kg of solid waste per person per day. For an additional population of 70,000, this implies production of around 8,400 m<sup>3</sup> of waste water per day, and 46 tons of solid waste per day.

As populations increase it will become increasingly important to treat waste water, because of the increased risks of contamination of groundwater supplies. Current solid waste management in the area is inadequate (Figure 8.2), and additional population will only aggravate the situation. Proper solid waste management needs to be implemented, including covering solid waste rather than allowing it to be blown across the countryside.

**Figure 8.2 Solid waste dump outside Dalanzadgad**



## 8.7 Induced development

Induced development is development that takes place because of the mining but not as part of the mine and ancillary facilities or supporting infrastructure. It is, in effect, unplanned, but some of it is a logical result of the growth in mining, and much of that fulfills needs for essential commodities or services, such as markets, specialty shops, workshops, petrol stations, hotels and restaurants. There are also unplanned developments that are predictable but undesirable; this may include prostitution, drug dealing, and illegal trade in plants and animals. Some of the induced development will

occur in soum centers, but much of it will locate along the haul routes from the mines to their markets. Adverse environmental and social impacts can be significant if induced development is allowed to occur without any controls.

## 8.8 Cultural and natural heritage

Local residents are concerned to ensure the protection of cultural and historically important heritage sites, both for their inherent cultural importance and for their potential tourism value. Examples of vulnerable sites and artifacts include Palaeolithic and Bronze Age artifacts, ancient copper mines, petroglyphs, dinosaur eggs, "ovoo" (rock piles with traditional cultural significance), and natural sites with sacred significance.

**Figure 8.3 Ovoo in Ulzit Soum, Dundgovi**



In some cases, obliteration will be an unavoidable impact of mining, and will need to be considered as part mining environmental impact assessment. The ancient copper mines that are in the future open pit area of Oyu Tolgoi are an example.

In other cases, protection and preservation may be possible. The Mongolian Protection of Cultural Heritage Law requires a developer to see the advice of MASIA in the case of projects that could disturb archaeological sites and to obtain its approval before undertaking activities that could damage or destroy them. It may also be possible to relocate small shrines, with the consent of local traditional leaders.

Developers may also be enlisted in the effort to protect such cultural and natural heritage. For example, Ivanhoe Mines is protecting petroglyphs in its project area, and has contributed funds for restoration of the main stupa that had been destroyed at the Demchig Monastery ruins, or "World Energy Center".

**Figure 8.4 Restored Main Stupa at Demchig Monastery Ruins, Khanbogd Soum**



## 8.9 Current Priorities

Perhaps the most significant immediate impact of Southern Mongolia's infrastructure development will be the construction of major land transport links, and increases in traffic along these routes. This has the potential to be highly disruptive to the migration of khulan and Mongolian gazelles. Priority actions to deal with this threat include:

- adapt plans for road and railway construction to ensure they provide ample opportunity for

animal crossings, taking account of the animals' preferences and migration routes.

- study the migration paths of the herds before completion of new links, to ensure that any changes can be monitored.

Table 8.1 summarizes measures that can be taken to address the likely environmental consequences of Southern Mongolia's development. A significant burden will fall on the soum and aimag governments.

Soum governments will have to prepare their towns for rapid increases in population, and deal with the associated environmental consequences. Existing soum government staff are small, and do not possess all of the skills that will be required, including planners, building inspectors, and health officers. Capacity building and enhanced budgets will be required for the soums to deal with their new responsibilities.

Aimag governments will face the same sorts of challenges as soums in terms of capacity and budgets. They should also be given increased roles in approvals processes for environmental impact assessment.

**Table 8.1 Responsibilities for Impact Management**

Activity	Management Measures	Implementation Responsibility	Oversight Responsibility
Development of mines and on-site facilities	<ul style="list-style-type: none"> <li>• Implement reclamation plan</li> <li>• Maintain site security</li> <li>• Implement environmental impact assessment and environmental management plan.</li> </ul>	<ul style="list-style-type: none"> <li>• Mining company</li> </ul>	<ul style="list-style-type: none"> <li>• MNET and SSIA officers in aimags</li> </ul>
Development of roads and railways	<ul style="list-style-type: none"> <li>• Design and construct facilities for livestock passage</li> <li>• Investigate wildlife migration and movement patterns. Determine appropriate locations and designs of wildlife crossings, and construct them.</li> <li>• Use quarries and borrow pits approved by local environmental authorities, and comply with standards for operation and reclamation</li> <li>• Prepare and implement waste management plans and restore construction areas.</li> </ul>	<ul style="list-style-type: none"> <li>• Ministry of Food and Agriculture to design crossings for livestock; roads contractor or mining company to construct.</li> <li>• Academy of Science and MNET to design wildlife crossings in collaboration with conservation NGOs and other experts.</li> <li>• Contractor or mining company.</li> </ul>	<ul style="list-style-type: none"> <li>• MRTCUD to ensure highway and railway designs include crossings as recommended.</li> <li>• MNET and SSIA officers in aimags.</li> </ul>
Development of electric power infrastructure.	<ul style="list-style-type: none"> <li>• Offset bustard habitat degradation with improved habitat elsewhere</li> <li>• Comply with best available technology to control emissions.</li> <li>• Recycle fly ash. Construct and operate ash disposal facility.</li> <li>• Use low-sulfur coal.</li> </ul>	<ul style="list-style-type: none"> <li>• Power plant developer.</li> <li>• Power plant developer.</li> <li>• Power plant operator.</li> <li>• Power plant operator.</li> </ul>	<ul style="list-style-type: none"> <li>• MNET</li> <li>• MNET and MME</li> <li>• MNET and SSIA officers in aimags.</li> <li>• MNET and SSIA officers in aimags.</li> </ul>
Mine dewatering.	<ul style="list-style-type: none"> <li>• Offset loss of shallow water in the area of mines through restoration, enhancement and protection of other springs and wells.</li> <li>• Monitor condition of trees, irrigate to avoid loss if possible. Plant and protect replacement trees in other locations to offset unavoidable losses.</li> </ul>	<ul style="list-style-type: none"> <li>• Mining company</li> </ul>	<ul style="list-style-type: none"> <li>• MNET officers in aimags.</li> </ul>

Water for coal washing and mineral processing	<ul style="list-style-type: none"> <li>Obtain more complete data on water resources.</li> <li>Limit development in SGR to that which water resources can accommodate, or construct pipelines from rivers to the north.</li> <li>Insist on state of the art water conserving facilities and equipment for all new industrial or commercial development</li> </ul>	<ul style="list-style-type: none"> <li>Establish a new Ground-water Management and Information Center (GMIC) – new institution</li> <li>Aimag governors; new regional development coordinating body; MRTCUD</li> <li>Line ministries; aimag government</li> </ul>	<ul style="list-style-type: none"> <li>MNET-Water Authority</li> <li>GMIC; MNET-Water Authority</li> </ul>
Transport of mine products by road	<ul style="list-style-type: none"> <li>Improve road surfaces and thereafter restrict trucks to the improved road lanes, enforce loading and speed limits, prohibit off-road driving by truckers;</li> <li>assist residents in relocating homes and herds if dust cannot be mitigated.</li> <li>Long-term fix is to shift most hauling to rail.</li> <li>Enforce dust control measures in EIAs for mines and coal depots.</li> <li>Eliminate transshipment operation at border (to minimize coal dust)</li> <li>set and enforce hauling schedule that provides for no traffic during hours in which wildlife are most likely to cross the road.</li> <li>set and enforce regulations against drinking and driving</li> <li>make accidents including those involving wildlife reportable safety incidents under mining company rules with disciplinary action as appropriate, including termination for alcohol-related incidents.</li> <li>Require mining and trucking companies to inspect trucks annually and test for compliance with air emission standards</li> </ul>	<ul style="list-style-type: none"> <li>Mining companies; MRTCUD</li> <li>Mining companies; police</li> <li>Soum governments; mining companies</li> <li>Mining companies; MRTCUD</li> <li>SSIA officers in aimag centers</li> <li>Government of Mongolia</li> <li>Mining companies; trucking companies; aimag governments; MNET</li> <li>Police at aimag level</li> <li>Mining companies</li> <li>SSIA in aimag centers</li> </ul>	<ul style="list-style-type: none"> <li>MNET</li> <li>MNET</li> <li>MRTCUD; MNET and SSIA officers in aimags</li> <li>MNET officers in aimags</li> <li>MRTCUD</li> <li>SSIA</li> <li>MNET</li> <li>MRTCUD</li> <li>SSIA</li> <li>SSIA</li> </ul>
Population influx and development of towns	<ul style="list-style-type: none"> <li>Local government to enforce basic good practice in constructing new housing, shops, etc.</li> <li>Develop new boreholes and provide treatment systems for public supply</li> <li>Construct treatment works for entire soum population, as on-site systems will not accommodate the larger populations and there are no collection and treatment systems in place now</li> <li>Poor solid waste management already is having adverse impacts. Construct solid waste collection and recycling/disposal facilities to serve the entire soum populations.</li> <li>Design and operate power and heating plants according to national standards. Coordinate ash disposal with solid waste management.</li> <li>Provide proper storage and treatment/disposal facilities for medical waste and train medical personnel in approved methods</li> </ul>	<ul style="list-style-type: none"> <li>Soum government</li> <li>Soum government</li> <li>Soum governments</li> <li>Soum governments</li> <li>Soum governments</li> <li>Soum or aimag governments</li> </ul>	<ul style="list-style-type: none"> <li>Aimag government</li> <li>Aimag government</li> <li>Aimag government</li> <li>Aimag government</li> <li>MNET and SSIA officers in aimags</li> <li>Ministry of Health; SSIA</li> </ul>
Induced development follows mining and related infrastructure development.	<ul style="list-style-type: none"> <li>Update land use plans and enforce compliance.</li> <li>HIV/AIDS awareness and prevention programs. Enforce prohibitions on illegal activity.</li> </ul>	<ul style="list-style-type: none"> <li>Aimag and soum governors</li> <li>Aimag and soum governors, Ministry of Health officers in aimags, SSIA</li> </ul>	<ul style="list-style-type: none"> <li>MRTCUD.</li> </ul>

MNET – Ministry of Nature, Environment and Tourism

MME – Ministry of Minerals and Energy

SSIA – State Specialized Inspections Agency

MRTCUD – Ministry of Roads, Transport, Construction and Urban Development



## KEY POINTS

As a basis for discussion, some possible new institutions are proposed:

- Southern Mongolia Infrastructure Council, with stakeholder representation, to provide regular feedback on the Government's plans.
- Southern Mongolia Infrastructure Coordination Unit, to manage and coordinate all tasks associated with developing infrastructure in the region.
- PPP Unit, to develop PPP transactions
- Risk Management Unit, to manage the government's exposure to contingent liabilities in infrastructure PPPs.
- International Infrastructure Expert Advisory Panel, who can provide high level advice to the Government from time to time.
- Multi-sectoral infrastructure regulatory agency, combining the functions of existing economic regulation agencies.
- Southern Mongolia Groundwater Management and Information Center to gather information about the extent of water resources, and propose management guidelines.

There is a need for single high level agency which is responsible for taking the lead on development of Southern Mongolia's infrastructure, and ensuring that other agencies meet timetables.

Developing and implementing a detailed infrastructure strategy for Southern Mongolia will require an assessment of the tasks to be performed, identification of the skills required to perform those tasks, and the establishment of institutions that mobilize skills in an effective fashion for the performance of the tasks.

### 9.1 Tasks to be performed

The preceding chapters have suggested a number of high priority actions required in order to permit the major mines of Southern Mongolia to be developed in a timely fashion. Additional actions may eventually be required for the longer-term development of the region, such as decisions about how to develop more value-added industries in the region, or the development of additional railways. But simply achieving the immediate infrastructure priorities will represent a huge organizational challenge. High priority actions identified in previous chapters include:

#### Towns

- For each of the main mining areas, develop a separate town development plan:
- Make projections about the likely mine worker populations and additional influx over the next 5 years.
- Decide what sort of township development will be used (eg FIFO, integrated community, etc).
- Decide who will be responsible for developing specific town development plans.
- Consider all of the plans together, and consider whether there will be adequate facilities for construction workers who may move from mine to mine.
- Decide whether financial contributions to township development will be sought from the associated mining companies, and on what basis.
- Develop financing, construction and operational plans for the provision of town services (ie what will be the roles of mining companies, different tiers of government, and specialist private infrastructure service companies?)

- Implement the particular infrastructure service model decided for each particular form of infrastructure (eg a PUSO might provide water, a private firm might supply town electricity, a mining company might build housing for its own workers, and private property developers might be given the right to develop housing for other new arrivals).

#### Electricity:

- Procure a private investor for power plant number 5 – hiring of an internationally experienced transaction adviser is recommended;
- Complete negotiations with China concerning the development of a power plant at Shivee Ovoo – again, an internationally experienced adviser is recommended.
- Investigate plans for the development of export power plants located in Omnogovi (for example, a 2000 MW power plant, using coal middlings at Tavan Tolgoi).
- Launch the process of development of a power plant to serve the Tavan Tolgoi area (either require a mining company to build an appropriately dimensioned plant, or procure an independent operator);

#### Land transport:

- Prepare licenses for private railways, ensuring that the operating licenses facilitate the development of a competitive mining industry.
- Build up regulatory capacity within the Mongolian Railways Authority.

#### Water resources:

- Collect and compile all existing information on groundwater resources;
- Conduct new studies and investigations to better determine the availability of water resources in areas close to the main demand centers;
- Produce and regularly update a water resource management plan for the region;
- Monitor the abstraction of water from deep aquifers.

#### Social Impacts:

- Establish training and education institutions to address the labor skills needed by mining and associated industries;
- Provide business incubation and support facilities to assist local entrepreneurs;

- Ensure transparent and equitable sharing of mining revenues;
- Provide adequate town services, including accommodation, urban infrastructure, health, education, law and order, and general administration;
- Identify vulnerable groups, and develop strategies to assist their transition.

#### Environment:

- Identify appropriate arrangements for wildlife to cross road and rail facilities;
- Provide environmental offsets (ie watering points and trees) to compensate for areas affected by mine de-watering;
- Expand involvement and capacity of soum and aimag environmental staff to improve environmental impact assessment and management.

### 9.2 Functions and required skills

Implementing a detailed infrastructure strategy will require several stages of decision-making, each with its own specialist skills. Stakeholder consultation is required to build a national consensus around what needs to be done, and who will be responsible for what. As a consensus about the main options emerges, decision-makers need sufficient information to choose between options, and sufficient authority to commit to particular options. Resources need to be mobilized to permit the implementation of the chosen strategy. Different strategy choices will imply different sorts of required skills for the implementing agency. For example, a decision to enter into PPPs would require skills which are currently in very short supply within the Mongolian Government.

#### Stakeholder Consultation and Consensus Building

The quality of policy decisions can be improved through information about the concerns of various stakeholders. Seeking the inputs of stakeholders can alert decision-makers about issues and concerns they may have overlooked. It also helps to build up acceptance of the final decisions by the broad community. Stakeholder consultation does not mean that the stakeholders views need to be accepted, and it may not be possible to reach complete agreement.

Having identified a particular topic on which stakeholder input is sought, affected stakeholders should be identified. Depending on the issue,

relevant stakeholders could include:

- members of Parliament;
- the different tiers of Government (ministries, aimags, soums);
- mining companies;
- local communities;
- the general Mongolian public;
- private infrastructure investors;
- infrastructure financing institutions;
- non-government organizations focused on specific issues;
- neighboring countries affected by particular decisions;
- the international donor community.

For stakeholder groups with many individual members, such as local communities, decisions need to be made about whether all members should be consulted or whether it is possible to identify individuals who can represent the views of the whole group.

A communications strategy is needed to ensure that the stakeholders are aware of the issues that are being debated, and informed about the choices which are under consideration. For example, will stakeholders be informed by email, advertisements in the media, letters, etc? Should detailed information

be conveyed to the stakeholders in writing, or in a special public event? The communications strategy should include a means of reporting the views of those consulted, and stakeholders should be informed about how the information they have provided will be used, and when decisions are expected.

Where public events are organized, special skills can be required to gather people's views and ensure that all views are fairly represented. Where a lot of time is required from stakeholders, it may be desirable to pay for the time of individuals who can represent their groups.

### Financial Planning and Risk Management

Financial planning is required to ensure that adequate resources are available for implementation of strategy. Indicative financial estimates should be prepared to permit decision-makers to understand the cost of different policy options.

Table 9.1 suggests that over US\$ 5 billion of infrastructure investment will be required by 2015. The estimate draws from the previous chapters, and is focused only on the highest priorities required to commence major new mines and house the associated population. It does not include, for example the cost of a power plant at Shivee Owoo, or the cost of railways other than the proposed ERR and MAK railways.

**Table 9.1 Infrastructure Investment Needs (to 2015)**

	US\$ million	Observations
<b>Towns</b>	<b>1,454</b>	
Buildings	1,277	} Options include financing and delivery by governments, PUSOs, mining companies, and/or property developers. A complex series of decisions is required.
Drinking water	10	
Waste water	28	
Power and heat	125	
Town roads	4	
Solid waste management	4	
Transaction management	6	
<b>Land Transport</b>	<b>800</b>	
Tavan Tolgoi – China	700	Will be financed and operated by Energy Resources Rail
Nariin Sukhait – China	100	Will be financed and operated by MAK
Roads	350	Includes Road Master Plan roads, plus Nariin Sukhait to Dalanzadgad sealed road. Some sections will be privately constructed.
<b>Electricity</b>	<b>2,711</b>	
Oyu Tolgoi 450MW	750	Will be financed by Ivanhoe Mining
South Gobi interconnector	207	
TPP #5, Ulaanbaatar, unit 1	450	Although an IPP is planned, at least some risks will be borne by the Government.
Oyu Tolgoi plant	450	Likely to be financed by Ivanhoe Mining
Tavan Tolgoi plant, unit 1	450	This plant could be privately developed. A much larger plant could be built to export power to China.
Egiin HPP	400	Likely to be largely government financed.
Transaction management	4	Transaction advisers for an IPP, including all the necessary studies, can cost over \$1 million per transaction.
<b>Water Resources</b>	<b>262</b>	
Investment	224	Some investigation and investment will be financed by mining companies.
Investigation	35	
Institutional strengthening	3	
<b>TOTAL</b>	<b>5,177</b>	

The starting point in developing a financing plan for Southern Mongolia's infrastructure is an estimate of how much money the Government is able to commit from its own revenues. Mongolia can also consider the mobilization of donor resources. Donors typically provide funds at varying degrees of concessionality, ranging from grants through to rates somewhat below market interest rates. As Mongolia's economic development proceeds, donors will reduce the availability of the most concessional forms of financing. However, for projects linked to mining developments, it should still be possible to obtain loans from donors at attractive interest rates. In addition, donors will be able to help Mongolia to leverage private funds by providing guarantees to cover particular risks.

In allocating resources, including Mongolian fiscal revenues, donor funds and private financing, trade-offs need to be made between Southern Mongolia's infrastructure versus and other possible government activities elsewhere in the country. Medium-term expenditure planning would help to identify the availability of fiscal and donor resources that can be devoted to Southern Mongolia's infrastructure.

Almost all of the infrastructure required for Southern Mongolia's development could be built, financed and operated by the private sector – either mining companies or specialist infrastructure companies. Given Mongolia's current fiscal deficit, private financing of infrastructure is likely to be attractive. But private investment in infrastructure can only be secured if private investors are confident they will earn a reasonable return on their investments, implying that tariffs should cover costs. Particularly where infrastructure services will be provided to retail consumers (eg drinking water), the implied tariff levels may cause political difficulties in gaining acceptance for private investment. Decisions about whether or not to rely on private finance for infrastructure must balance the fiscal pressures facing the government against a candid appraisal of whether the political system can provide a sufficiently attractive environment for private investment.

Reliance on private investment will bring with it demand for new skills in the Ministry of Finance related to the evaluation of contingent liabilities. Particularly for the initial PPP transactions, private infrastructure investors will require government guarantees in respect of certain classes of risks. Because guarantees come due only if particular

events occur and involve no immediate cost to the government, they can seem attractive to political decision-makers, and they rarely appear in the government accounts or have funds budgeted to cover them.

But guarantees do come due. If there is a 5% probability of an event occurring which triggers payment by the Government of a \$50 million guarantee, and the probability is spread evenly across 5 years, then in any individual year the expected payment is \$500,000. But if the event actually occurs, the Government's liability is \$50 million.

When the Government makes guarantees it should ensure that it has the financial capacity to honor them. The amount that should be set aside is a subject of debate, and relates to the Government's willingness to take risks, as well as an assessment of the probabilities involved. At a minimum, the Ministry of Finance should report publicly on the guarantees that are given and the maximum liability of the Government. The Ministry could also be involved in assessing the probabilities of guarantees coming due, and setting limits on the extent of risks undertaken.

### Policy Formulation

For new policies to be adopted, someone must have authority to make decisions, and that person or agency must be given the information needed to make a well-informed decision.

The issue of who has authority to make decisions can become difficult when decisions cut across institutional boundaries, either because they involve multiple sectors or because they involve multiple tiers of government. For example, decisions about where towns should be located in Southern Mongolia will involve multiple government agencies as well as all tiers of government. Even if it is clear who should make the relevant decision, ensuring the decision is well-informed will require inputs from all of these different stakeholders. It will be a complex process to gather the necessary information to make decisions, and to build consensus about those decisions.

Policy development is more effective if decision-makers are given a range of options to choose from, with the advantages and disadvantages of each option clearly explained. In most countries, the skills to present policy options can usually be found within ministry staff.

Where ministry staff can sometimes be weak, however, is in their consultation and project management skills. As discussed above, most governments could improve their policy-making through the use of stakeholder consultation. The process of policy development and coordination should be regarded as a task of project management, recognizing that a whole series of inter-related decisions and actions need to be undertaken. For example, reliable information about expected mining company employment is required in order to make sensible decisions about town locations and the services that will be provided there. Activities that are on the critical path need to be regarded as high priorities, and an individual with sufficient authority should be responsible for ensuring that all of the necessary pre-conditions are achieved in order to meet critical deadlines.

### Development of PPP transactions

Particularly where private investment is sought, the Government will need to develop new skills in transaction preparation and management. Where a particular infrastructure project is to be implemented by the public sector, the Government of Mongolia can call on the traditional skills of line ministries and state-owned enterprises. But different approaches will be required to introduce PPPs.

The quality of project preparation is key to a successful PPP transaction. Before potential bidders are invited, the Government should have a very clear idea of the services it wants performed by the private sector, and should provide potential bidders with detailed information about the parameters of the project.

The main skills required include:

- *Overall transaction management*: project management skills are required to bring all of the different pieces of work and advisers together in timely fashion, and with adequate quality.
- *Economic*: knowledge of economics (and especially regulation, pricing and the incentives created by difference market and industry structures). Any one reform is likely to have a number of inter-linked elements to it – establishing a market and industry structure, deciding on an appropriate form of ownership and setting a legal and regulatory framework. Economic expertise should be fed into all these areas.
- *Financial*: knowledge of the process of introducing the private sector, the sale or lease of infrastructure assets and the impact of reform decisions on the ability to attract private finance.

- *Legal*: knowledge of both the local legal framework and best international practice in the drafting of legislation and contracts.
- *Technical*: knowledge of the engineering and operational aspects, including investment requirements.
- *Other specialist services*: for example, public relations, human resources, environmental and social analysis.

One of the first steps in developing a proposed PPP is to determine the nature of private sector involvement (investment, ownership, operation), contractual form (full ownership, concession, lease, management contract), duration, and potential regulatory oversight. Advice on these issues is usually given by economists experienced in PPP design.

It is possible that project-specific legislation or licenses will be required to permit a private firm to invest in or operate an infrastructure service. Development of these legal instruments requires specialist technical and economic expertise to advise on their content, and legal skills to ensure they effectively implement the desired choices.

Internationally experienced financial advisers are typically required to ensure the success of a PPP bidding process. They will be closely involved in the design of the proposed contract prior to the bidding process, as well as the terms and conditions of the bidding itself. Public relations advisors will be involved when the government is in a position to alert potential investors of a specific project.

Lawyers will draft the bidding documents, and will have primary responsibility for ensuring that the final commercial agreement is properly reflected in the binding PPP contracts, including possible supplier, construction and maintenance contracts. Lawyers may also be involved in reaching financial close. Contracts will often involve a set of conditions that must be met before the contract is fully effective. These may relate to finalizing, for example, the finance or concluding subsidiary contracts. The legal advisor will verify that these conditions are met.

The ultimate success of a PPP project depends on the government. But governments embarking on introducing PPPs need not, and should not tackle the reforms unaided. Specialist advisers can provide the requisite expertise and experience to ensure the success of the reform process. Key factors in the use of specialist advisers include:

- *setting a realistic timetable*; A consultancy project undertaken over too short a time runs the risk of generating inappropriate advice. Equally

important, rushing to implement correct advice can cause problems (e.g., potential investors are not sufficiently informed about the opportunity and thus do not bid; or stakeholders feel they were not consulted and so resist the reform initiative).

- *setting a realistic budget for advisers.* A well-prepared project will have little difficulty in finding finance. A poorly prepared project is unlikely to be financed by the private sector, and may languish for years. When procuring hundreds of millions of dollars of infrastructure investment, it is worthwhile spending a million dollars to get good quality advice. Table 9.1 includes a rough estimate of the funding that could be needed to prepare various PPP transactions.
- *providing the right incentives for advisers.* Attention is needed to the process of procuring advisers, to ensure that good quality advisers are obtained, and to ensure that their contract provides them with incentives to assist the Government reach financial closure on the best possible terms for the Government.

advance, and bids are made on who will provide the best price, there should be little requirement for commercial negotiation, and the Government can assure itself of a good deal.

But there will be cases where negotiation skills are required in the development of Southern Mongolia's infrastructure. In such cases care should be taken to entrust the authority to undertake and conclude negotiations to individuals with the right skills. In some cases, the importance of the matter will require that the outcome of these negotiations should be ratified by the Parliament. Where Parliament seeks reassurance about the negotiated terms, reference should be had to the advice of outside experts. If Parliament does not ratify the negotiations, the matter should be returned to a specialist negotiator with revised terms of reference.

### Regulation

Economic regulation of infrastructure services has three main aims: to protect consumers from abuse by firms with substantial market power, to

### Box 9.1 IFC Advisory Services in Infrastructure

IFC's Advisory Services in Infrastructure, part of the World Bank Group, provides assistance to national and municipal governments for structuring and implementing sustainable private-sector participation in infrastructure and social infrastructure. Established in 1989, IFC's Advisory Services in Infrastructure has completed over 165 transactions in more than 60 countries and is the only multi-lateral institution to offer direct advisory services to governments on implementing private-sector participation transactions.

IFC's reputation for competence, transparency, and fairness, allows it to play the role of neutral partner to balance each party's interest in a transaction, reassuring foreign investors, local partners, other creditors, and government authorities. IFC promotes good corporate governance principles and high environmental and social standards in every transaction it undertakes.

Some examples of transactions led by IFC Advisory Services include:

- When the state of Cear6 in Brazil sought private sector investment in its power sector, IFC privatized the state power utility, structured and bid out a 240MW independent power project, and set up a regulatory agency to ensure transparency in the sector. Cear6 reaped \$880 million for the utility, 27% above the minimum price.
- When the city of Bucharest's municipal water company had poor performance investment needs of more than \$1 billion, IFC designed a 25 year concession with strict obligations for improving coverage, water quality and customer service. IFC generated strong interest in the tender from well-qualified bidders, and the winning bidder was selected based on the lowest average tariff bid for the life of the concession. The tender resulted in reduced rates and a strong institutional partner.
- When Air Tanzania was in financial difficulties, IFC advised the Government of Tanzania on its privatization. South African Airways was the winning bidder, paying \$20 million for a 49% stake. SAA shares the Government's objective of building Dar-es-Salaam into a hub for regional and intercontinental traffic.

### Commercial Negotiations

Commercial negotiations require special skills, and those with the strongest commercial skills are unlikely to work in government or in Parliament. Carefully managed bidding processes can minimize requirements for commercial negotiation. If the government pre-selects a group of suitable quality bidders, specifies all terms and conditions in

support investment by protecting investors from arbitrary action by government, and to promote economic efficiency.<sup>3</sup>

Regulating infrastructure is complicated by three related considerations. First, prices for infrastructure services are usually political. There are no votes in raising prices of electricity or water.

3 This section draws from Warrick Smith (1997), "Utility Regulators – Roles and Responsibilities".

Second, investors are aware of these pressures and of the vulnerability of their usually large, long-term, and immobile investments. Unless a government has made a credible commitment to rules that ensure an opportunity to earn reasonable returns, private investment will not flow. Weak credibility will be reflected in higher capital costs for new projects, and thus higher tariffs.

Third, the long-term nature of most infrastructure investments makes creating credible commitments difficult. Highly specific rules, if considered sustainable, can provide assurance to investors and lower the cost of capital. But they make it difficult to adjust regulation to unforeseen developments, including changes in technology and market conditions. They also make it difficult to tailor responses to situations and to provide incentives for efficiency. There is thus an important tradeoff between reducing the risk of expropriation, and with it the cost of capital, and retaining the flexibility to pursue efficiency and other objectives.

In designing regulatory agencies, most countries opt to retain some degree of flexibility in setting prices by entrusting a degree of discretion to a decision-maker. Many countries, including Mongolia, have entrusted this discretion to regulatory agencies that are intended to be independent from political influence. To guard against misuse of this discretion, regulators are typically required to make their decisions having regard to various technical factors, such as complicated calculations about the costs of service delivery, the amount of capital invested, and reasonable rates of return. Performing these functions require specialist economic, accounting and legal skills.

### 9.3 Possible new institutions

The following are some suggestions for new institutions which could help to perform the functions identified above. The proposals are for discussion purposes, and are not intended as World Bank recommendations. In many cases, the functions of these proposed institutions could be performed by existing ministries. But establishment of new institutions may be desirable in order to:

- perform new functions which are not currently performed (eg systematically consult affected stakeholders; manage exposure to contingent liabilities in PPPs);
- better coordinate between functions that are currently performed across multiple government agencies (eg bringing together all of the infor-

mation required to decide the nature of services that will be provided in new towns);

- provide a focal point for the development of new skills, and ensure that limited capacity is concentrated in one institution with the scope to be applied widely (eg PPP transaction preparation; economic regulation of infrastructure).  
Southern Mongolia Infrastructure Council

In order to ensure systematic and regular consultation with stakeholders, a Southern Mongolia Infrastructure Council could be established, with representation from the national government, aimag and soum governments, mining companies, and NGOs. The council would hold regular meetings in which the stakeholders discuss their plans.

One model for the Council would be purely as an advisory body, and forum for stakeholder consultation. For example, in Western Australia, the Pilbara Development Commission, a state Government agency, established the Pilbara Dialogue. The Dialogue consists of roundtable discussions between senior representatives from the resource sector, State and Federal Government agencies, Local Government and other relevant stakeholders. The discussions are intended to promote coordinated strategies and actions between stakeholders involved in the development of the region.

An alternative model would give the Council the authority to make decisions and to finance infrastructure. If the Government seeks large financial contributions from mining companies to the development of the region, it may be desirable to give mining companies more than an advisory role in the development of plans for how the money will be spent. The development of Subic Bay in the Philippines presents an example of how private companies can play a decision-making role in infrastructure development and financing.

#### Southern Mongolia Infrastructure Coordination Unit

Existing planning for Southern Mongolia has tended to focus on long-term visions for the region's development. In order to get to the long-term, there is a need to focus on the short-term, with plans that identify what needs to be done this year, next year, and the next three to five years. A possible way of achieving this would be to establish a coordination unit with project-management skills, the ability to bring together information from a variety of government agencies and other sources, and the authority to compel other agencies to act.

### Box 9.2 Subic Bay Metropolitan Authority

When the US Government's lease on Subic Bay expired in 1992 the Government of the Philippines created the Subic Bay Freeport Zone (SBFZ) to fill the void left by the US Military's departure. Together with the neighboring Clark Air force Base, Subic Bay Naval Base was, after the Philippines Government, the largest employer in the country. The Clark and Subic Bases directly employed more than 68,000 Filipinos and injected \$28 million a day to the local economy.

Control of the SBFZ was given to the Subic Bay Metropolitan Authority (SBMA), a 15 person board appointed by the President of the Philippines with the mandate of developing SBFZ into a self-sustaining industrial, commercial, financial, and investment and academic center. The board includes two representatives from national government, five from the private sector, and eight from local government units.

The Privatization and Commercialization Office (PCO) was established as a subsidiary of SBMA. The PCO was established to aid SBMA in privatization of four primary sectors. In 1997, the PCO oversaw the first public private partnership in the Philippines water sector with the privatization of SBFZ's water supply and sewerage system. The Subic Water and Sewerage company serves as the treatment and service provider to the SBFZ as well as the nearby city of Olongapo. SBMA is the regulator of water service provision. The electricity distribution system has also since been privatized, and a number of private generating stations have been planned for the SBFZ.

A similar arrangement was implemented at the former Clark Air force Base. Control of the new Clark Special Economic Zone was handed to the Clark Development Corporation (CDC).

Sources: see the background paper on urban development for references.

Existing planning is fragmented across multiple government agencies, with little effort to ensure consistency. In a workshop organized in May 2008 to discuss the Southern Mongolia Infrastructure Strategy, it was notable that the various line ministries had very different assumptions about what infrastructure the various mines would need, and different visions for how that infrastructure would be provided. Systems have not yet evolved for the regular sharing of information between government agencies, or for coordinated decision-making.

- A Coordination Unit could take various possible forms:
- it could simply gather information and monitor the activities of line ministries, which would remain responsible for the delivery of infrastructure projects.
- it could be given "step-in" powers to take over control of activities for which other line ministries are responsible, when adequate progress is not being made.

it could be given powers to manage all stages of policy development and project management for Southern Mongolia's infrastructure.

Mere monitoring and reporting may not be sufficient to ensure timely project delivery. Without decision-making authority, line ministries may tend to ignore a weak coordination unit. "Step-in" powers might act as an incentive for line ministries to improve their performance, but it is likely that

actual exercise of such a power would be highly disruptive to timely project delivery. To be effective in the Mongolian context, it is suggested that a coordination unit could be given responsibilities for a specific set of tasks, with a requirement that line ministries report to the coordination unit with any necessary information. Such an institution would require strong backing from the Prime Minister, and the support of other ministers.

Possible locations for the coordinating unit might include the Ministry of Mines and Energy; the Ministry of Finance; the new National Development and Innovation Committee; or as a separate institution reporting directly to the Prime Minister.

If a coordination unit is given powers to manage policy and project development and is located in a large central ministry, it will be important to limit the responsibilities to specific tasks associated with development of Southern Mongolia's infrastructure. If there are not some limits around the powers, the Unit would leave little role for other ministries, and would be too large and cumbersome to be effective.

Rather than establishing a large planning department, it may be more effective to establish a small coordination unit with a small team with world class skills, direct access to the top level of government, and a large budget. A recent review of the most successful reforming countries (only 15 countries graduated from low income status to middle income status between 1965 and 2006)

found that many have relied on such small reform teams.

### PPP Unit

A specialist unit could be established to assist in developing PPPs for the provision of infrastructure services. Internationally, there is a range of models of PPP Units, with functions ranging from the provision of advice to line ministries, through to leading transaction development and approving the final deal (Box 9.3)

Mongolia does not have significant experience in development of PPPs, nor does it have a large number of potential PPPs. As discussed above, a wide range of specialist skills are required to manage a successful PPP transaction. Accordingly, it makes sense to concentrate Mongolia's scarce PPP skills in a single institution.

In Mongolia, the main PPPs to be developed currently fall within the responsibility of the Ministry of Mines and Energy, and the Ministry of Roads, Transport, Construction and Urban Development. Some possible PPPs may also lie within the responsibility of sub-national governments. If a single PPP unit is established, it could be located in either of the two national ministries, or in a central agency, such as the Prime Minister's Office, Ministry of Finance, or the proposed Planning Department.

In many countries line ministries have resisted the transfer of responsibility for PPP development to a central unit. If Mongolia wishes to establish a central PPP Unit it will require strong decision-making from Government leadership, and/or good agreement between the main line ministries affected.

Box 9.3 International Experience with PPP Units

Around the world, Governments are turning to the private sector to provide a range of infrastructure services through public-private partnerships (PPPs). When well prepared, PPP transactions can lower lifetime costs of service delivery, improve service quality, and lower government financing requirements. But good preparation of transactions requires project management, careful background studies, consideration of a range of possible long-term consequences, and careful contract specification and bidding.

The skills required to manage PPP preparation typically differ from traditional public sector skills. Many countries have had poor results from PPP programs, because they did not mobilize the right skills to manage PPP transactions. An increasingly common way to mobilize the right skills is to establish PPP units, as new agencies or as special cells within a cross-sectoral ministry such as finance or planning.

Different governments have established PPP units to perform a wide variety of roles:

- In some cases PPP units play a leading role in organizing and managing PPP transactions, with responsibility for taking the deal all the way to financial closure.
- In other cases PPP units play a role in the approval of PPP transactions developed by line ministries. For example, in South Africa the Treasury relies on the PPP Unit to assess whether line agencies and provinces can meet the costs of proposed PPPs within their future budgets.
- Many PPP units provide advisory support and funding to line ministries developing PPPs. This usually involves PPP unit staff acting as resources who can work with line ministries, but it can include additional funding to pay the costs of transaction advisors.
- Most PPP units provide information and guidance on PPPs to other government agencies. This can include general resources on PPPs, such as international experience and customized guidance such as standard contracts or detailed procedures for procuring PPPs.

	Re- source center	PPP guidance material	Project- specific advice	Fund- ing for PPP preparation	Project developer	Contract monitoring	Ap- proval
Andhra Pradesh, India	b	b	b				b
British Columbia, Canada	b	b	b		b	b	
Gujarat, India	b	b	b	b	b	b	b
Ireland			b				
Italy	b	b	b				
Netherlands	b	b	b			b	
Philippines	b	b	b	b		b	b
South Africa	b	b	b	b		b	b
United Kingdom	b	b	b	b	b	b	b
Victoria, Australia	b	b	b			b	

If a line ministry has many PPP transactions to develop, it may make sense for the ministry to develop its own PPP capacity. But if a country has only a limited number of infrastructure PPPs to develop, it makes sense to gather the scarce transaction skills together in a single central unit.

Source: Dutz, Harris, Dhingra, and Shugart (2006)

### Risk Management Unit

The Ministry of Finance could consider the establishment of a Risk Management Unit (RMU), in connection with its debt management functions. As a minimum, the RMU should report annually on the extent of any contingent liabilities created through guarantees for infrastructure PPP projects. The RMU could also report on the expected liability, having regard to estimated probabilities of guarantees being called. The RMU might also play a role in the establishment of caps on the overall exposure to contingent liabilities, and in the approval of project-specific requests for government guarantees.

Requests for guarantees to cover specific risks in proposed infrastructure PPPs could be handled using the following schema:

1. Implementing agency notifies RMU of intention to apply for a guarantee.
2. RMU participates in the preparation of the project
3. Implementing agency files a formal request for a guarantee
4. RMU:
  - verifies that required documentation is complete
  - verifies compliance with criteria
  - calculates contingent liability
  - calculates project exposure
5. Cabinet reviews and decides whether to issue the guarantee
6. Guarantee contract is drafted by the RMU and executed by the Ministry of Finance
7. Implementing agency competitively tenders the project
8. Private firm is selected
9. Guarantee contract becomes effective.

### International Infrastructure Expert Advisory Panel

At various times the Government and the Parliament may be concerned about whether they are getting the best possible advice, or whether the outcomes of commercial negotiations represent a good deal for Mongolia. To assist in such circumstances, the Government may wish to hire a panel of internationally respected infrastructure experts, paid on a retainer, who can be called upon from time to time to review particular matters.

### Multi-Sectoral Infrastructure Regulatory Agency

As the role of the private sector increases in Mongolia's infrastructure, the role of economic regulation of infrastructure services will become increasingly important. Mongolia already has an Energy Regulator and a Railways Authority, both of which are intended to perform functions of economic regulation. As Southern Mongolia develops there may be a growing requirement for contract monitoring and economic regulation of additional infrastructure services.

Consideration could be given to consolidating the various regulatory functions into a single infrastructure regulation agency. Many countries have established multi-sectoral regulatory agencies for infrastructure services, such as state-level regulators in the United States, Australia, and Brazil, and national regulators in Jamaica and Costa Rica. Potential advantages of having a single agency include:

- *Sharing resources.* Economists, financial analysts, and other professionals can work across industries, and administrative staff and facilities can be shared. This is particularly important in countries where regulatory expertise is scarce.
- *Facilitating learning across industries.* All utility industries have unique features, but the main issues in their economic regulation are substantially the same: administering tariff adjustment rules, managing the introduction of competition into traditionally monopolistic industries, and managing relationships with stakeholders. Having a single agency aids the transfer of insights and experience between industries.
- *Reducing the risk of industry capture.* A key challenge in utility regulation is to guard against the agency's capture by the regulated industry. If the industry and the regulator develop too close a relationship, the industry may be able to divert regulatory effort to promote its own interests rather than the public's. The broader responsibilities of a multi-industry agency help to reduce this risk.

### Southern Mongolia Groundwater Management and Information Center

The case for a groundwater management and information center was laid out in Chapter 6. Current information about water resources is spread

across multiple institutions. It needs to be brought together to determine what is already known about the extent of groundwater potential. A program of drilling, investigation, and studies is needed to give a complete picture of groundwater potential, and to make longer-term decisions. This program will be expensive, costing more than \$200 million over several years. A suitable agency is required to manage the program.

The Groundwater Management and Information Center could be established under the Water Authority. It would act as a focal point for information and initiation of new studies, and could develop guidelines for its sustainable allocation and use. This would help to ensure that groundwater is presented as a single resource.

## 9.4 Current Priorities

Priorities for overall planning and institutional design include:

- Develop a financing plan for the various elements of the Southern Mongolia Infrastructure Strategy: what financial resources are available to the Government? which works will be funded from the budget? what will be donor-financed? what will be privately financed?
- Develop a preliminary Government action plan for tasks to be performed in support of the Southern Mongolia Infrastructure Strategy.
- Identify the tasks to be performed under this action plan, and the skills required.
- Establish new institutions which pool together the available skills in order to support the Government's action plan. Ensure clear allocation of decision-making responsibility between Parliament and Government ministries, and between ministries.
- Develop staffing and capacity building programs for each of the new institutions.

