MICC

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From Megawatt Projects to Gigawatt Policy: Mongolia's Energy Challenges and Opportunities

Market Research

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Contents:

Executive Summary

Every few months, the Mongolian government announces and signs a power purchasing agreement or license for a new power plant. Despite having approved over 60 power plant projects over the last few years, Mongolia today faces serious energy challenges, namely growing domestic demand — up to 7,100GWh in 2015 — and ageing or, more accurately, obsolete infrastructure. Mongolian foreign energy imports grew to 20% of overall electricity consumption in 2015. Yet there have been no major generators constructed in Mongolia since 1983. So what is preventing the successful development of additional power capacity? Why does Mongolia have so many projects in the pipeline, but so few successes? MICC finds one explanation for Mongolia's lack of new capacity to be, almost paradoxically, the large number of projects currently under development.

The number of projects in the pipeline is unwarranted from both a demand and cost perspective. Each project plans to produce electricity for the domestic market, intending to replace imports from Russia — even though Chinese energy actually accounts for a far larger annual expenditure. However, the current and projected domestic imported energy market is too small to feasibly support more than one or two medium capacity generators. Furthermore, the current price for imported electricity is only marginally higher than the most recent and planned projects. Combined with a price tag of several hundred million dollars, many proposed plants are simply not worth building from a financial standpoint. The amount of projects thus stands as a major overcompensation, one that is misaligned with Mongolia's actual domestic needs.

Like in other developing countries, financing remains the most decisive factor for the development of a new power plant. Following an enthusiastic signing ceremony and announcement, the project sponsors soon encounter a hard reality: financing for a new plant that must recoup investment costs in 15-20 years is difficult in a frontier market like Mongolia. An overcrowded pipeline in a small domestic market, along with volatile domestic politics, add a high risk premium to investments. Among the current pipeline, MICC concludes that only the construction of CHP5 and Tavan Tolgoi may be feasible, logical, and financeable.

Ultimately, Mongolia's overcrowded pipeline has also impeded its ability to take advantage of a major economic opportunity crucial to its future development: energy exports to China and East Asia. The currently planned projects are uncoordinated and almost exclusively focused on the domestic market. Instead of juggling dozens of small-to-medium sized projects (under 600MW), Mongolia should focus on a few GW-scale projects — potentially sourced from renewables — that are competitive in foreign energy markets. Mongolia's energy future is bright, but it must first realign its power projects to fit its existing reality.

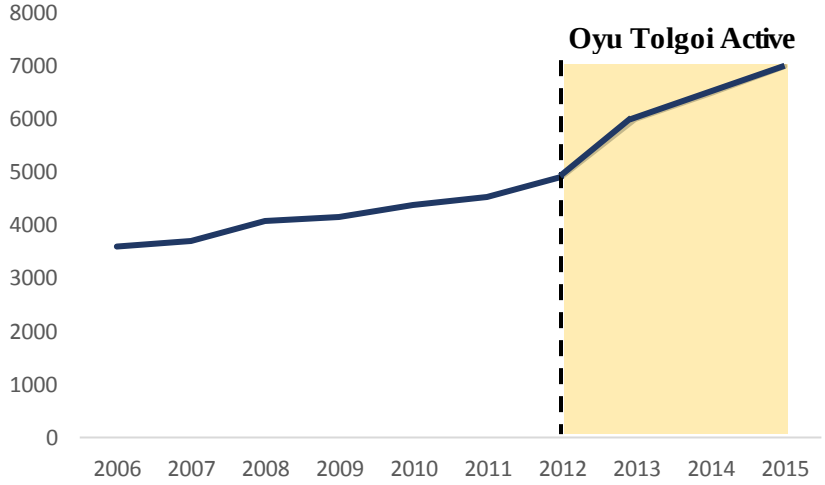
1. Demand

Understanding how the current project pipeline hinders development first requires understanding the state of the energy sector. The following section outlines the current demand, major drivers of energy use, and predictions for the future. The historical and estimated growth of demand would seem, at first glance, to warrant a massive expansion and transformation of the domestic energy market.

Demand for power is, unsurprisingly, concentrated in the population and economic centers of Mongolia. Peak electricity demand in the Central System was estimated by the Ministry of Energy (MoE) to top almost 1115MW in 2015, as compared with a total of 110MW in the other 3 sectors.[1] Energy demand in Mongolia is highly seasonal as well, with the -40℃ winters requiring much higher consumption. According to ADB, demand for heat is on aggregate twice that of electricity. In total, Mongolia consumed 7.1 billion KWh of electricity in 2015.

As in most developing countries, economic growth in Mongolia has driven higher energy usage. The MoE estimated demand to have grown 7-10% annually over the past few years. Per capita consumption nearly doubled from 2000 to 2013, rising to 1,908 KWh. Construction and mining booms, as well as changes in consumer behavior, drove this meteoric growth. The south Gobi, in particular Oyu Tolgoi, is the center of recent increases in demand. Throughout Mongolia though, the power consumption of transportation, agriculture, and residential uses have all increased across the board by 30%. Figure 1 depicts the total electricity consumed annually from 2006 to 2015. As evident from the graph, Oyu Tolgoi's development coincides with a noticeable increase in the rate of growth after 2012.

Figure 1: Total Energy Consumption (GWh), 2006 - 2015

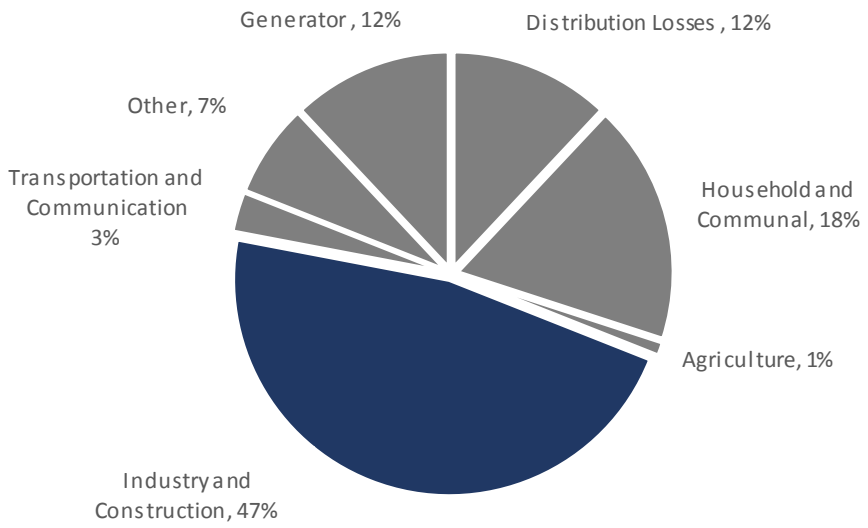


Source: MoE Sustainable Development, 2016

Mining, construction, and industrial manufacturing also constitute the largest consumers of power. Figure 2 depicts the 2015 power usage statistics from the MoE, where these industries consume nearly 50% of the total electricity available. Additionally, note that approximately 12% of power is lost to distribution and transmission, which, according to Parliamentary Resolution 63, is 1.3 to 1.7 times higher than other developed countries.

[1] A quick note on energy terminology. A megawatt (MW) is a measure of power, the possible rate of energy generation. This amount can refer both to the total capacity installed in a country as well as the amount of energy demanded at peak load hours. There is a clear distinction between 'MW' and megawatt hour (MWh), which represents the physical amount of energy. MWh refers to the quantity of electricity consumed or produced in a given year. A 1MW generator operating for 1 hour produces 1 MWh. As with any metric unit, 1,000MWh equals 1 GWh or 1,000,000KWh.

Figure 2: Energy Consumption by Sector and Usage, 2014



Source: MoE GSEP Power Working Group, 2014

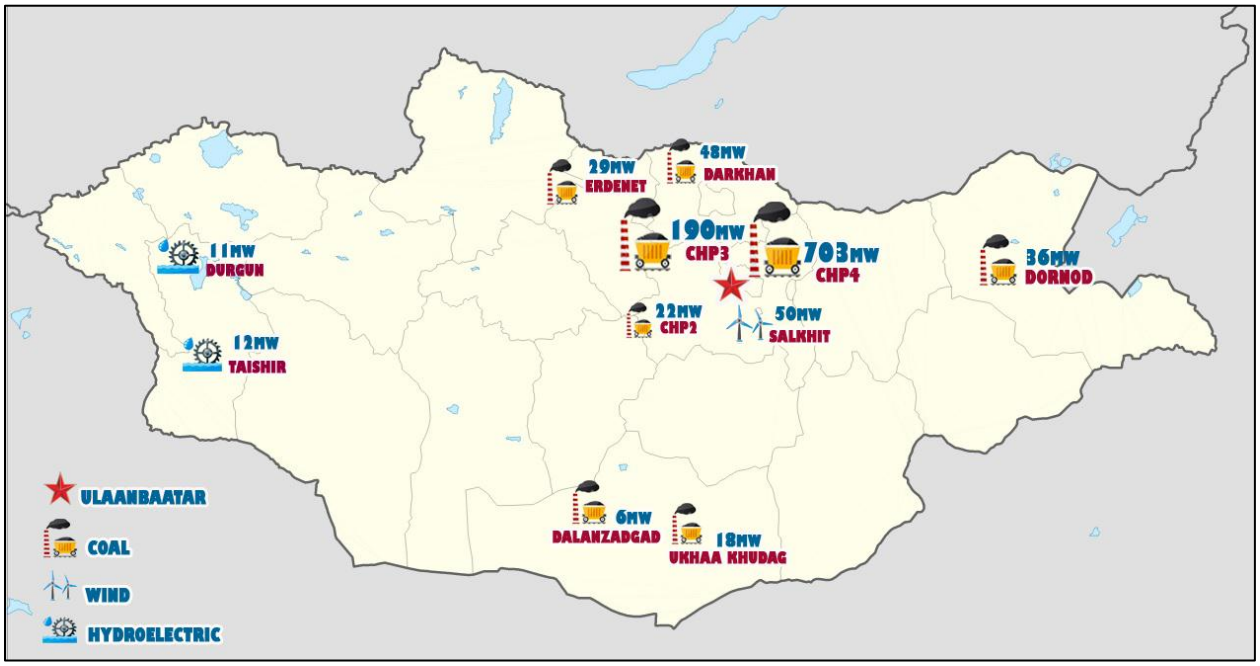
Though the recent economic slowdown has diminished the growth of electricity consumption, demand is still expected to rise in the coming years — driven by manufacturing, mining, and construction projects. The MoE declared that by 2020, peak energy demand would double to approximately 2000MW. Invest Mongolia estimated that by 2030, this demand would then rise to 3501MW. A more credible estimate is given by the ADB's 2013 Proposed Energy Master Plan, which predicted an average annual consumption growth rate of 3.5%. This report uses the ADB growth rate as a baseline assumption for its later analysis.

2. Supply

Mongolia's supply of energy, meanwhile, has failed to keep apace of the rapid demand growth. This section provides an outline of the current generation loads, energy portfolio, plant age, and foreign electricity imports to emphasize the very real need for additional projects.

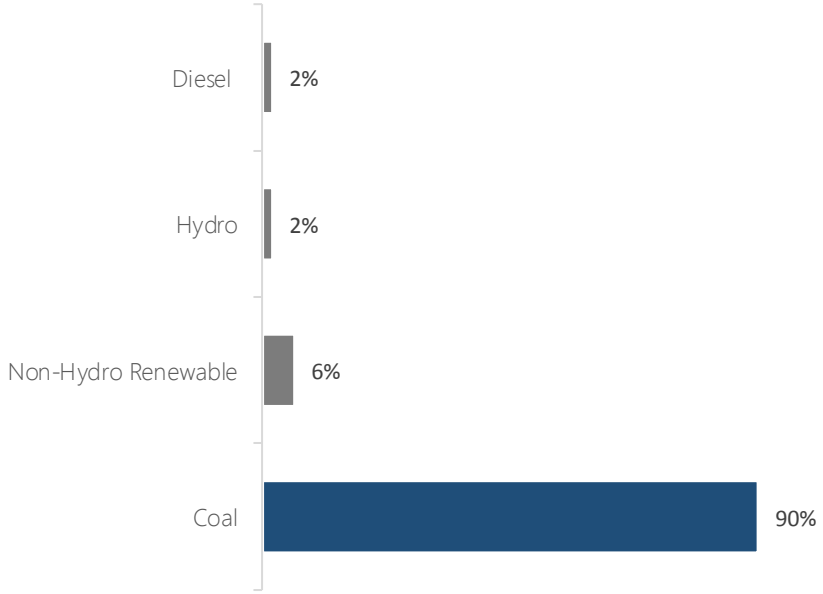
Though no major power projects have been completed since 1983, Mongolia has increased its overall domestic capacity to 1,225MW through a combination of upgrades to existing facilities and small-scale projects. 91% of all power capacity exists within the Central System. Annual electricity generation has increased by approximately 50% since 2006.The unprecedented growth in demand has incentivized previously installed generators to produce more on a yearly basis. Below, Figure 3 depicts the geographic location of a selection of major power plants. Though by no means an exhaustive list, Figure 3 provides a broad visual overview of the location, respective fuel source, and capacity size of Mongolian power generators.

Figure 3: Infographic of Major Mongolian Power Generators



Nationwide, approximately 8 coal-fired combined heat and power plants (CHP), 600 small diesel generators, 13 hydroelectric plants, and a few wind arrays generate the domestic energy. Figure 4 depicts the percentage breakdown of Mongolia's portfolio. The vast majority of energy, 85% of installed power capacity, is sourced from coal-based generation. Responding to environmental concerns, the government hopes to increase the percentage of renewable energy to 30% by 2030.

Figure 4: Energy Source by Percentage of total 1130MW, 2015



Source: Parliament of Mongolia Resolution 63, 2015

Furthermore, ageing power infrastructure has greatly reduced the de facto capacity. The United States Environmental Protection Agency recommends operating a CHP generator for no more than 20 years. The average age of Mongolia's major CHP generators is 36. There have been no major power plants commissioned in

Mongolia since 1983, although existing generators have been upgraded with additional capacity. Figure 5 provides an overview of these plants, which constitute the vast majority of the installed electrical capacity.

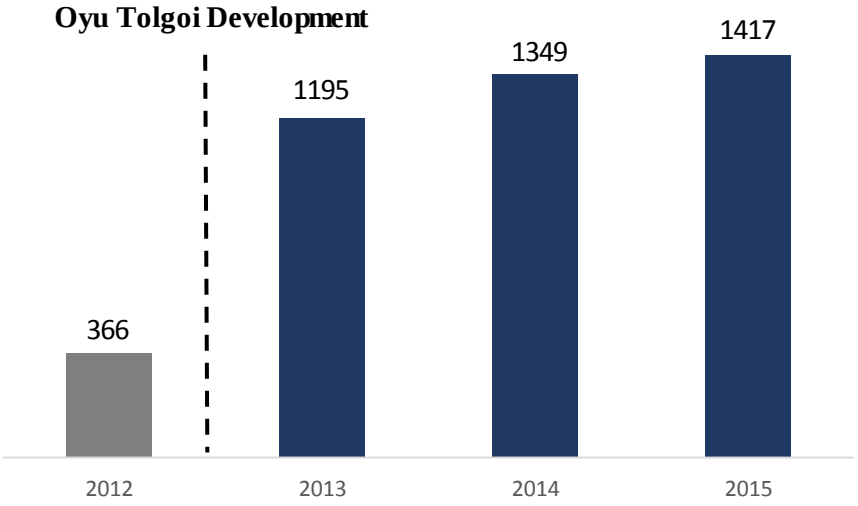
Figure 5: Major CHP Generators

Name	Installed Capacity (MW)	Available Capacity (MW)	Location	Commissioning Date
CHP 2	22	18	Ulaanbaatar	1961
CHP 3	190	155	Ulaanbaatar	1968
CHP 4	703	575	Ulaanbaatar	1983
Erdenet	29	21	Erdenet	1987
Darkhan	48	39	Darkhan	1965
Dornod	36	29	Dornod	1969
Dalanzadgad	6	5	South Gobi	2000
Ukhaa Khudag	18	16	South Gobi	2011
	874	665		

Source: 2016 IRENA Mongolia Report; MICC analysis

Ultimately, domestic supply is unable to satisfy peak domestic demand. Mongolia imported 1,420GWh of electricity in 2015, approximately 20% of its total annual consumption. Russia and China supply energy to the northern and southern parts of the Central System respectively, which will be classified as the Northern and Mining sub-markets respectively. Russia, which supplies Ulaanbaatar with energy at $0.08 per KWh, is often mistaken as the largest supplier of energy to Mongolia. Yet with the development of Oyu Tolgoi in the south Gobi and Tamsag oil field in the east, China has recently begin supplying approximately three-quarters of all Mongolian energy imports at a high $0.10 KWh tariff rate. Figure 6, below, shows the historical rate of imports from 2012 to 2015 — Oyu Tolgoi's 2013 development drove an almost three-fold increase in energy imports.

Figure 6: Historical Electricity Imports (GWh), 2012 – 2015



Source: National Statistics Office, 2015

These imports impose a very real cost on the Mongolian economy, as the annual expenditure on foreign energy was approximately $135 million in 2015 for roughly 1420GWh. Imports from China constitute around $100 million of the total cost and, being driven by the development of Oyu Tolgoi, primarily began after 2012. New projects can potentially supply electricity at a cheaper rate than China or Russia, but per-KWh cost savings are minimal.

3. Power Project Pipeline Overcompensates

This brief overview of supply and demand illuminates the very real need for additional capacity, but does not answer the question of why no major plants have been built in over 30 years when over 60 projects remain in consideration. For starters, MICC's research suggests that the current project pipeline vastly overcompensates for Mongolia's real energy needs. From an electricity market and cost-effectiveness lens, the vast majority of these projects are unwarranted. Appendix C provides a list of almost 30 proposed projects, which together constitute an additional 10.6GW of capacity — nearly 10 times the amount currently installed. The projects range in size from 3MW to 3,600MW, with costs varying from $2.5 million to $4,000 billion. The vast majority of these projects, however, can be classified as medium sized (250MW to 600MW) and therefore intended exclusively for domestic use. Appendix D provides a visual representation of many of the planned projects' locations. While one or two of these projects may be desirable for domestic imperatives, in total there are too many projects in the pipeline.

3.a. Insufficient Domestic Demand for Electricity

Mongolia's domestic electricity market cannot support a massive capacity increase. Currently, Mongolia's domestic capacity services 80% of all electricity consumed. The market for a new power project's electricity is the remaining 20%, or 1,420GWh in 2015, that is unmet by existing capacity. Below, MICC estimates electricity demand through 2020 with two plausible scenarios, assuming ADB's aggregate 3.5% growth rate as the baseline. In the first scenario, domestic and imported consumption equally grow at 3.5%. In the second scenario, domestic capacity remains constant while imports grow at a rate consistent with the total 3.5% rate.

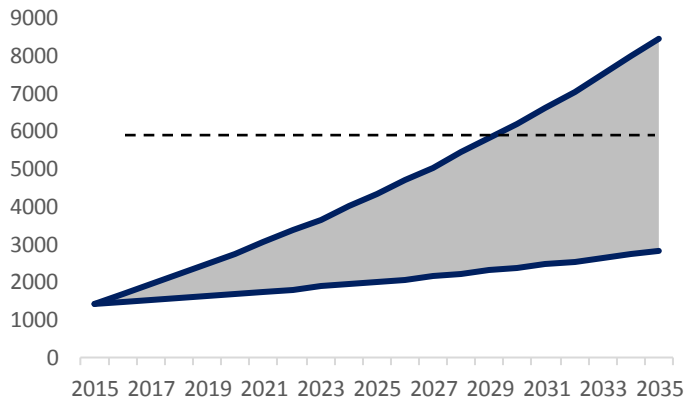
Scenario 1: Total demand for electricity is equally satisfied by imported and domestically produced energy						
Year	2015	2016F	2017F	2018F	2019F	2020F
Import (GWh)	**1,420**	**1,470**	**1,521**	**1,574**	**1,629**	**1,686**
Domestic (GWh)	5,680	5,880	6,085	6,298	6,518	6,746
Total (GWh)	7,100	7,349	7,606	7,872	8,147	8,433
Estimated Import Cost (USDmillion)	135	140	144	150	155	160
Percentage Imports	0.2	0.2	0.2	0.2	0.2	0.2

Scenario 2: Total demand for electricity is exclusively satisfied by imported electricity; domestic capacity remains the same						
Year	2015	2016F	2017F	2018F	2019F	2020F
Import (GWh)	**1,420**	**1,669**	**1,927**	**2,192**	**2,467**	**2,753**
Domestic (GWh)	5,680	5,680	5,680	5,680	5,680	5,680
Total (GWh)	7,100	7,349	7,606	7,872	8,147	8,433
Estimated Import Cost (USDmillion)	135	159	182	208	234	261
Percentage Imports	0.2	0.23	0.25	0.28	0.30	0.33

As is bolded in the above tables, Mongolia's imported electricity is expected to rise to between 1,686 GWh and 2,753 GWh by 2020. Percentagewise, imports will rise to at most 32.6% of total energy consumption. MICC calculated the annual import costs by assuming that Russia will continue to supply one-quarter of energy and China will supply the rest—at the current average import tariff rates. If left unchecked, these imports may cost Mongolia almost a quarter of a billion dollars annually.

Yet while these numbers are alarming, the predicted energy shortage still does not warrant the planned increase in energy capacity. The 1,686GWh to 2,700GWh estimate represents the theoretical maximum that a new power generator could sell into the grid in 2020, assuming all other power sources continue to generate at the same rate and that Mongolia defies its contractual obligations to purchase foreign power. Figure 7 extends this analysis to the year 2035, predicting a future range for the size of the electricity market between 2,000 and 8,000 GWh. However, this upper range assumes that no other power plants are built by 2035— which is highly unlikely. Two medium sized 450MW generators could supply the majority of Mongolia's predicted electricity needs. 900MW of generating capacity, operating for a reasonable 18 hours a day (80% of available time is consistent with several feasibility studies) would provide approximately 6,000 GWh annually. These projections suggest that Mongolia's energy needs can be met with just two of the dozens of projects in development.

Figure 7: Estimated Range of Future Electricity Market (GWh) with Electricity Produced by 900MW depicted with Black Line, 2015 – 2035



Source: MICC analysis

Without adequate demand, larger projects cannot succeed. A generator needs to sell all of its produced electricity at the agreed upon PPA rate to be feasible. In Figure 7, all area below the dotted black line represents excess electricity that cannot be sold. Note that the upper range of this projection is vastly unrealistic; the actual size of the market for electricity is most likely between 3,000 and 5,000GWh. The current market — where in the major Central System is split into a Northern and Mining sub-group —cannot support much more than 900MW and certainly not the vast majority of projects listed in Appendix C and D.

The development of the Salkhit Wind Farm illustrates why Mongolia's low demand poses a major problem. After signing a PPA that set the tariff rate at $0.095 per KWh, the government refused to purchase the entirety of Salkhit's produced

electricity. Not only did breaching this contract imperil the continued viability of the wind farm, but it also set a dangerous precedent for future projects. Investors no longer trust the Mongolian government to comply with signed agreements. Several additional layers of legal guarantees are now required to assuage investors' doubts. Long-term, the government's actions increased the perceived risks of doing business and will impede future project development.

Likewise, as suggested by Figure 7, the maximum predicted domestic demand is limited. The Mongolian market in 2035 can support no more than 900MW of additional capacity — 2GW total. The vast majority of generators under consideration will be unable to find reliable customers and will not be financially viable. Barring some unforeseen natural resource discovery, the 20 year forecast reveals a market too small to support more than a few medium-sized generators.

3.b. Questionable Cost-Effectiveness

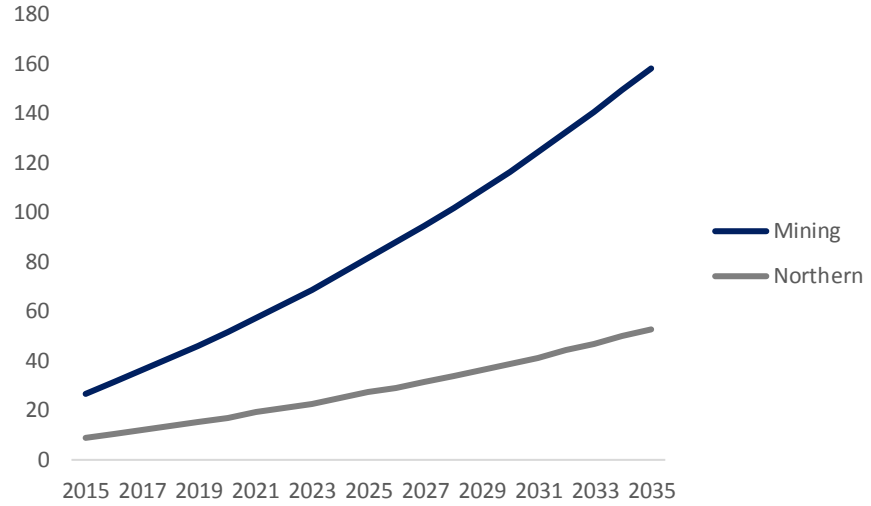
Second, besides the limited domestic market, the proposed generators may not be cost-effective. Instead of building dozens of new projects, MICC estimates that it may be more financially sound to continue importing energy from Russia and China — and building one or two of the most cost-effective plants. Figure 8 shows a simple model projecting the continued costs of importing (the weighted average tariff multiplied by the supply of electricity) against domestically supplied energy. The hypothetical domestic supply would be generated by new power projects producing at a tariff rate of $0.07 per KWh, which is on average the rate allegedly supplied by new projects. As such, these savings represent a theoretical maximum. The ultimate savings in the Central System's two sub-markets are bolded for emphasis.

Figure 8: Estimated Savings From Investment in Domestic Capacity

Year	2015	2016F	2017F	2018F	2019F	2020F
Imports (GWh)	**1,420**	**1,669**	**1,927**	**2,192**	**2,467**	**2,753**
Domestic (GWh)	5,680	5,680	5,680	5,680	5,680	5,680
Total (GWh)	7,100	7,349	7,606	7,872	8,147	8,433
Import Cost Minumum (USD Millions)	135	158	183	208	234	261
Hypothetical Domestic Supply (USD Millions)	99	117	135	153	173	193
Mining Sub-Market Savings (USD Millions)	**26.7**	**31.3**	**36.1**	**41.1**	**46.3**	**51.6**
Northern Sub-Market Savings (USD Millions)	**8.9**	**10.4**	**12.0**	**13.7**	**15.4**	**17.2**

In order for a project to be economically cost-effective, the savings accrued over time must be equal to the useful life of the plant, in this case 20 years. In Figure 8, MICC projects these savings forward by 5 years. However, Figure 9 extends this analysis graphically, assuming a 3.5% growth rate, to predict the annual savings until 2035 in both the Mining and Northern sub-markets. Especially in the southern mining sub-market, savings grow tremendously over a 20 year period.

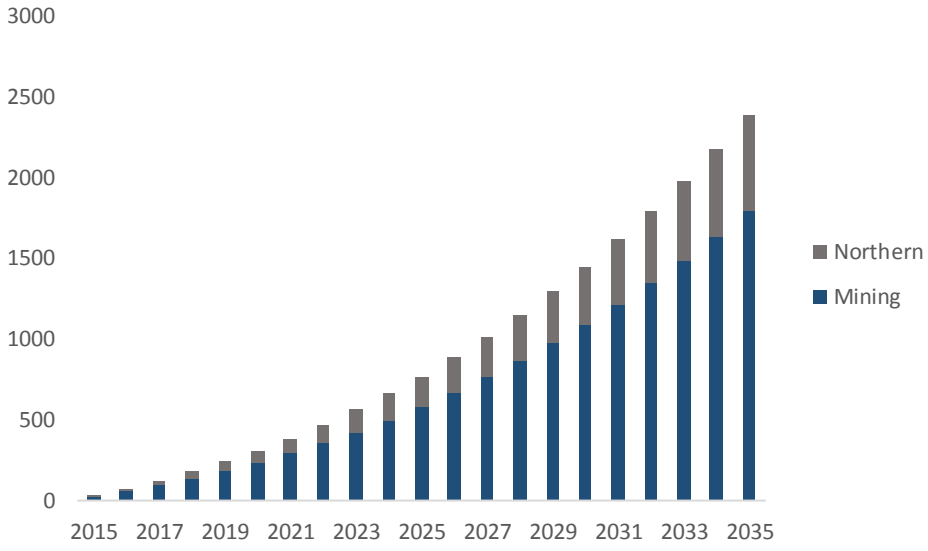
Figure 9: Annual Savings in Mining and Northern Sub-Markets (USD Million)



Source: MICC analysis

The annual savings from supplying domestic energy at an average $0.07 per KWh tariff to the Northern and Mining sub-markets could exceed $60 and $150 million respectively. Figure 10 depicts the aggregate savings across a 20 year period in the Central System, broken into the two sub-market regions. In total, the theoretical maximum amount of savings could be as high as $2.4 billion, with approximately three-quarters of this reduction coming from substituting Chinese energy in the Mining sub-market region.

Figure 10: Aggregate Savings in Central System (USD Millions), 2015 – 2035



Source: MICC analysis

$2.4 billion stands as a valuable benchmark for evaluating all projects currently in the pipeline. The total projects listed in Appendix C will cost a combined $15.3 billion. Of course, not all of these projects will be built. Yet given the current costs to the Mongolian economy and the 20 year lifetime of a power plant, $2.4 billion is the upper limit for cost-effective energy investments. The solutions under consideration for the energy crisis should not exceed the costs of the problem itself.

4. Blocking up Investments that Matter

Returning to the fact that no major power plants have been built in 33 years, MICC finds the overcrowded pipeline to be directly responsible. There are certainly clear financial and economic reasons for constructing new plants. Outdated infrastructure is inefficient, damaging to the environment, and expensive. Furthermore, the heat generated by CHPs are critical to the survival of much of Mongolia's population. Mongolia's energy dependence is also a geopolitical weakness, one that weighs against immediate financial concerns. Ultimately though, the large pipeline actively hampers the development of strategically vital projects.

4.a. Explanations for Development Delays

Of course, there are countless, oft-cited factors impeding major projects in the pipeline. Mongolia's private-public partnership development system, for instance, requires multiple steps for financing and concessions agreements — it is highly politicized and subject to frequent slowdowns. International financing as well, due to the erosion of investor confidence, also proves to be a major source of delays. And finally, because the process is relatively new in Mongolia, best practices have yet to be implemented for effective development.

Yet considering a large number of projects simultaneously increases the development process's susceptibility to politicization. Already, each individual project involves several stakeholders in construction, finance, and government. Appendix C showcases the range of investors, from private partners to Chinese banks to international conglomerates. State political actors also push their own agenda, potentially leading to conflict. Bringing in additional projects multiples the number of interested parties, all of whom exert influence through the political process. This problem is further compounded by having multiple viable alternatives, which, in total, reduces the urgency and ease of signing individual agreements.

Furthermore, having dozens of projects competing for one small domestic market greatly increases investor uncertainty and hinders future project development. As discussed earlier, only one or two of the proposed projects can successfully and feasibly operate in Mongolia. The pipeline now resembles a disorganized race to the finish line. Developers are proposing projects to investors that cannot all be supported by the domestic market. This uncertainty — whether there will be a sufficient market to support electricity output — adds to the overall risk of individual generators. Long term, this dynamic harms Mongolia's ability to secure financing and complete projects.

4.b. Strategic Projects

MICC has identified two strategically important projects that would benefit from a less crowded development pipeline. Together, these projects are estimated to cost slightly more than $2 billion and provide sufficient domestic electricity for the foreseeable future. In Appendix C, these two projects are bolded for emphasis.

The first, the $1 billion 450MW Tavan Tolgoi generator, will supply electricity to Oyu Tolgoi in the Mining sub-group of the Central System. As Oyu Tolgoi is the

primary consumer of Chinese energy, the Tavan Tolgoi generator will replace these expensive imports with domestically produced energy. The project now has a signed PPA and feasibility study, as well as a recent financing agreement with the Japanese Marubeni Corporation. Planned for operation in 2023, this project was first proposed in 2009. Political disagreements delayed the project extensively, adding to the uncertainty surrounding the Oyu Tolgoi mine development. Barring continued disruptions, the Tavan Tolgoi generator will be one of the nation's first independent power producers. Critically, the size and cost of this project satisfy the above market size and cost-effective criterion.

The long-awaited CHP5, on the other hand, is the second generator that will benefit directly from a project pipeline reorganization. The plant will cost an estimated $1.3 billion and have a capacity of 450MW. Critically, CHP5 also provides heat to the residents of Ulaanbaatar. According to the Mongolian Statistical Information Services, CHPs produce 80% of all heat in Mongolia — yet these plants are outdated, inefficient, and unreliable. CHP5's completion would provide much greater heat security. The Northern sub-market can also feasibly support CHP5's produced electricity. Once completed, Mongolia will be able to substitute out Russian energy imports. The project is currently stuck in a political limbo, having to renegotiate several of its agreements with the new government. Reducing the number of power plants past the initial development stages would accelerate this process and allow the CHP5 to proceed.

5. Gigawatt Export Plan

The Mongolian government should reduce the number of projects under consideration, thereby clearing a path for domestic energy stability — and preparing for future energy exports. Specifically, the appropriate regulatory bodies should enact transparent and binding restrictions on permitting and financing for current and future project proposals. MICC has identified CHP5 and Tavan Tolgoi as promising candidates for strategic development because of their capacity, cost and strategic position. CHP5 will provide valuable heat, whereas Tavan Tolgoi will replace expensive Chinese imports. The Mongolian government needs to pare down the overcrowded pipeline so that it can begin planning in earnest for larger, GW-scale, energy exports.

Though the domestic market is not large enough to support a major increase in capacity, foreign markets offer highly lucrative opportunities for the Mongolian energy sector. These markets are actually identified in the official government energy platform. As it stands though, the current projects in the pipeline are designed for domestic consumption — with the exception of the long discussed Shivee-Ovoo generator. The total 8GW of capacity in the pipeline may be valuable for foreign markets, but there are too many projects to coordinate a large scale shift towards energy exports. Developing dozens of medium sized projects, as demonstrated by Mongolia's recent track record, is difficult. Furthermore, GW-size projects, because of economies of scale, can be much more cost-competitive per KWh. In total then, the government needs to plan fewer, GW-scale projects that utilize Mongolia's natural resource endowments, providing electricity to China and the rest of East Asia.

Mongolia's natural endowment uniquely positions it to construct large quantities of renewable and non-renewable capacity for export. It has an estimated 160 billion tons of coal reserves, approximately 1,100 GW of wind potential, hydroelectric resources estimated to provide up to 6417MW a year, and an average 300-330 sunny days annually. Mongolia has first-in-class potential for massive-scale energy generation — with resource endowments in the southern and eastern regions, close to the Chinese border. The major challenge is transforming potential into power and, ultimately, finding a market. Securing a consistent supply of thermal coal from the independently owned mines stands as another noteworthy obstacle. Ultimately though, the domestic market is not sufficient to warrant much further development of Mongolia's potential.

The growing energy needs of China and East Asia will create an energy market gold rush — which, with the right policies in place, may provide a major economic boon to Mongolia. The electricity needs of Mongolia's neighbors, like China, Japan, and Korea, will double over the coming decades. China's demand is expected to grow 48% by 2035, exceeding 10,000TWh annually by 2040. Yet beyond increased demand, pollution and global warming concerns will incentivize foreign countries to find clean energy suppliers. Mongolia, with its massive renewable energy potential, will be a prime candidate for energy outsourcing. The often discussed Asia Super Grid project captures this vision of Mongolia as a clean energy exporter, building GW-scale projects for GW-scale foreign markets.

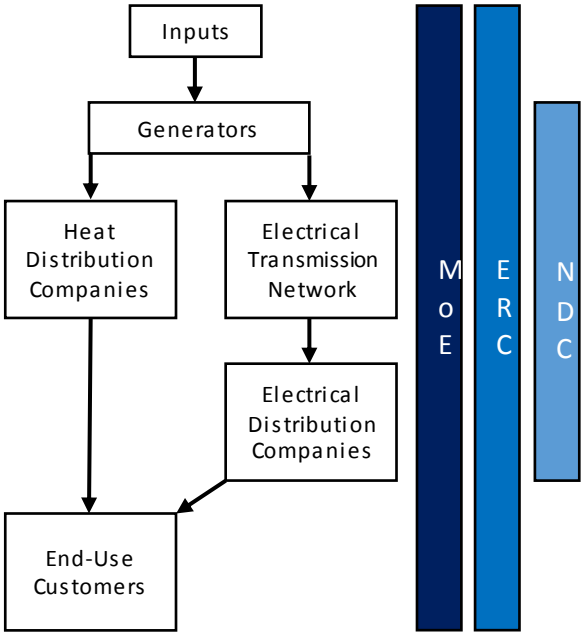
East Asian markets represent the future for Mongolia's energy industry. Yet the current project pipeline misrepresents Mongolia's priorities, overcompensating for the existing domestic capacity shortage. More specifically, the pipeline focuses too heavily on medium-sized projects. MICC recommends that the government of Mongolia reduce the number of projects in consideration, strategically focusing instead on a smaller number of high capacity GW-scale projects like Shivee-Ovoo. Doing so will allow Mongolia to fully articulate a successful export-oriented policy plan. Mongolia has a bright future as an energy exporter, but it needs to unclog its overcrowded development pipeline.

Appendix A: History and Regulatory Structure

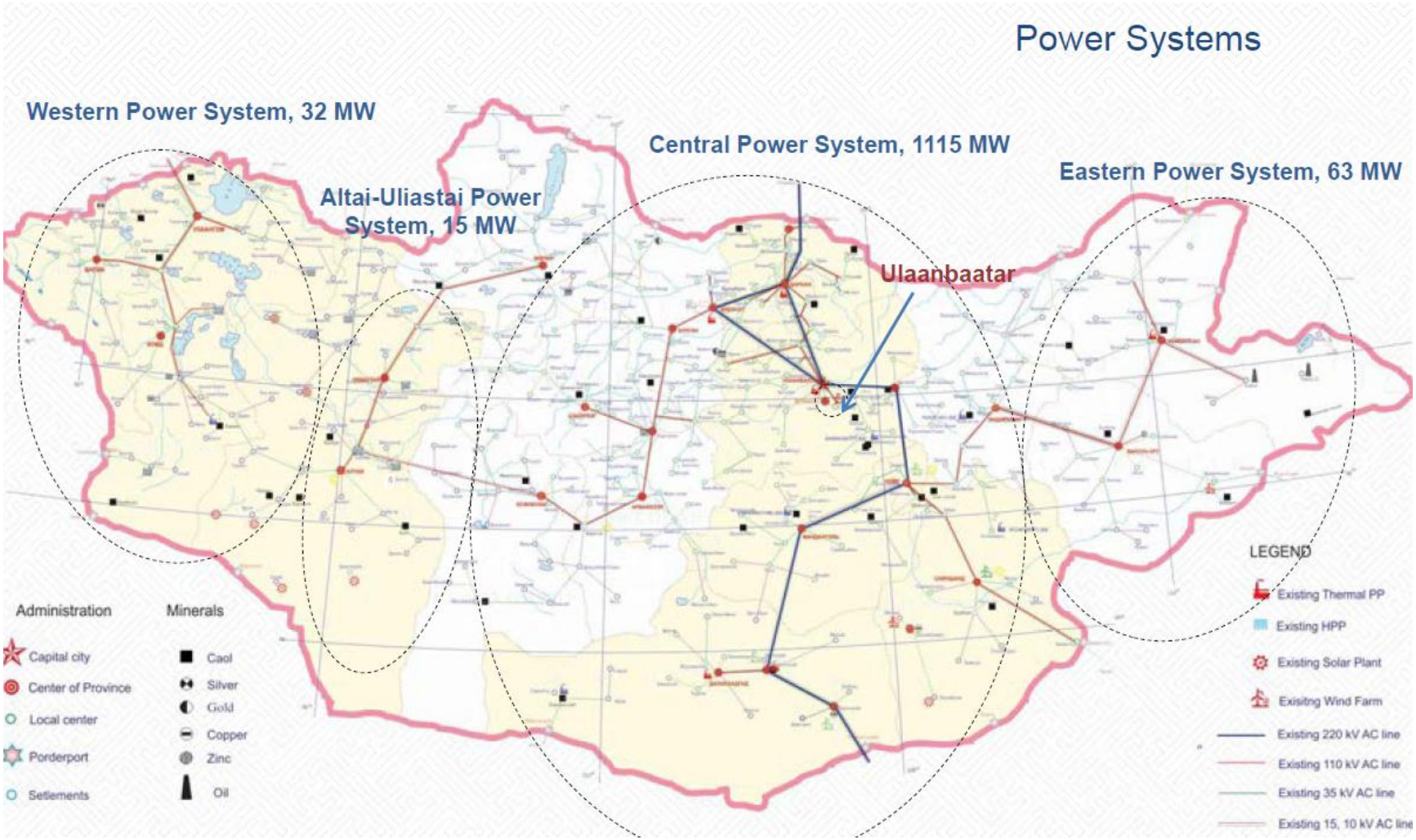
Understanding the current state of Mongolia's energy sector first requires an overview of the current energy landscape. The 2001 Energy Law created the basic framework for the current energy sector — unbundling the power sector and creating a state-owned transmission grid operator and 10 distribution companies, all but one are still state-owned. The legislature has repeatedly amended the Energy Law, clarifying the complex system of generation, transmission, distribution, dispatching, and licensing. The national grid has also been divided into 4 independent power systems: Central, West, Altai, and East. See Appendix A for a visual depiction of the sectors and power grids. Though several organizations regulate and manage the Mongolian power sector, the Ministry of Energy (MoE), the Energy Regulatory Committee (ERC), and the National Dispatch Center (NDC) are central to the grid's operation.

The MoE is a central state administrative body that coordinates its policy agenda with the Finance Ministry and sets the energy sector planning agenda. The MoE approves transmission - distribution plans and audits past energy projects. The ERC, meanwhile, is the primary energy sector regulatory body, which approves generation licenses, sets tariffs, resolves disputes between license holders, and endorses Power Purchasing Agreements (PPA). Transmission lines are owned by the state and require a PPA for use, which establishes an agreed-upon rate for electricity pricing for a given time frame. Finally, the NDC is the organization that specifically enters into these PPAs with independent power producers, which are then approved by the MoE and endorsed by the ERC.

In total, the current power market in Mongolia follows a single-buyer model. After obtaining a PPA and other regulatory licenses, power generators sell to the NDC and supply electricity to the transmission network (or heat distribution company, if heat), which then sell power to a distribution network, who then finally sell to end-use customers. Along each step, the MoE and ERC undertake various regulatory roles. Below, a simplified schematic that provides a big-picture overview of the energy sector is presented.



Appendix B: National Grid



Appendix C: Planned Projects

№	Name	Capacity (MW)	Estimated Cost (USD MLN)	Sponsor/ Developer	Selling price (USD per KWH)
1	Shivee-Ovoo	3600	4,000	N/A	N/A
2	Baganuur	700	1,340	CNI22	0.07
3	Booroljuut	600	1,100	Bodi International	0.07
4	Chandgana	600	750	Prophecy Coal	0.055
5	Tevshin Gobi	600	824	SEPCO III, Firebird Management	0.073
6	**CHP5**	**450**	**1,250**	**Engie. Sojitz, Posco, Newcom**	**N/A**
7	**Tavan Tolgoi**	**450**	**1,000**	**Marubeni Corporation MCS**	**N/A**
8	Egin-Gol	315	825	Exim Bank	N/A
9	Aduuchulun	300	487	MAK	0.065
10	Khanbogd	250	170	Cleanergy, Softbank	0.095
11	Ulaanbaatar HPP	100	726	Ulaanbaatar Hydro Power Station LLC (Morit Impex LLC)	0.04
12	Sainshand Wind Farm	52	75	Sainshand Wind Farm LLC	0.95
13	Dalanzadgad CHP extension	3	2	Dal CHP SOE	N/A
14	Wind farm	100	172	AB Solar Wind LLC	0.095
15	Wind farm	50	82	Aydiner Global LLC (NREC)	0.095
16	Telmen CHP	100	98	New Asia Group LLC	0.055
17	Tsaidam Nuur CHP	600	468	Tsaidam Energy LLC	N/A

18	Erdenetsogt CHP	600	496	Erdenetsogt Energy LLC	N/A
19	Oyutolgoi CHP	450	431	Oyu Tolgoi LLC	0.096
20	Maikhan HPP	15	10	Usny Erchim LLC	N/A
21	Sainshand SPP	30	76	Desert Solar Vaughn Germany	0.15
22	Ovoot tolgoi	12	N/A	South Gobi Sands LLC	N/A
23	Nariinsukhait CHP	195	221	Mongolyn Alt LLC	0.10
24	Erdenetsagaan CHP	21	18	Bayan-Erch LLC (Energy International LLC)	0.099
25	Western CHP	60	107	Energy Developmet Center	N/A
26	Taishir Wind Farm	9	N/A	Salkhiny Erch LLC	N/A
27	Khankhonkhor CHP	300	500	(Mon-Energy Consult LLC)	N/A
28	Sümber SPP	10	23	Feasibility National Processed Renewable Energy Center	N/A
29	Bayanteeg SPP	10	27	Mon Altai LLC, WOOIL engineering LLC	N/A
TOTAL (Estimated)		**10,582**	**15,278**		

Appendix D: Planned Projects Map