ECONOMIC RESEARCH INSTITUTE

REPORT

COPPER MARKET STUDY

March 2017

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Contents

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List of Abbreviation

ICA	International Copper Association
ICSG	International Copper Study Group
IMF	International Monetary Fund
WBMS	World Bureau of Metal Statistics
USGS	United States Geological Survey
HS	Harmonized Commodity Description and Coding system "Harmonized System"
NSO	National Statistics Office of Mongolia
OT	Oyu Tolgoi
OTTR	Oyu Tolgoi Technical Report 2016
MoF	Ministry of Finance
MM	Ministry of Mining and Heavy Industry
MEITI	Mongolian Extractive Industries Transparency Initiative
MOU	Memorandum of Understanding
GDP	Gross Domestic Products
ITC	International Trade Centre
MEITI	Mongolian Extractive Industry Transparency Initiative
ISIC	International Standard Industrial Classification
BI	Bloomberg Intelligence
WCO	World Commodity Outlook
WB	World Bank Group
CME	Chicago Mercantile Exchange & Chicago Board of Trade
Cu	Copper
Kt	Thousand tonnes
Mt	Million tonnes
Kt/y (Mt/y)	Thousand tonnes (million tonnes) per year

1. DEMAND SIDE

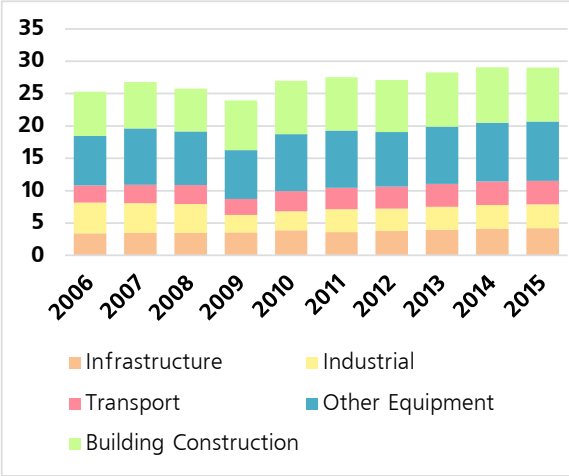
1.1 World copper demand

Copper is a very flexible, durable and recycle metal which resists and conducts electricity and heat very well. It is also mixed with other metals to create different kind of alloys - i.e. brass and bronze.

The world demand for refined copper has more than tripled in the last 50 years due to expanding sectors such as electronic products, building construction, industrial machinery and equipment, consumer and general products. This expansion is mainly due to Chinese industrialization.

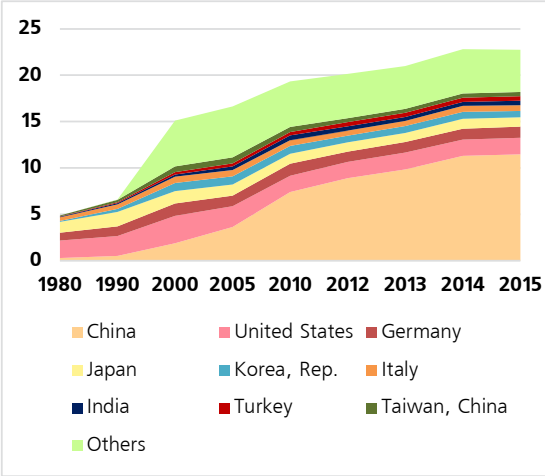
In 2015, equipment (including industrial 13%, transport 13% and other equipment 32%) was the largest copper end-use sector accounting for over 50 percent of total consumption, followed by building construction 29 percent and infrastructure 15 percent (Figure 1).

Figure 1. Usage of copper/end use sector million tons (2006–2015)



Source: ICSG, 2016

Figure 2. World consumption of refined copper by countries million tons (1980–2015)



Source: WBMS, 2015

According to World Bureau of Metal Statistics, world total consumption of refined copper reached to 23 Mt and 80 percent of which is used by 9 countries shown in Figure 2. Accordingly, almost half of it is used by China and the combined share of consumption by other 8 countries is around 30 percent (United States 8%, Germany 5%, Japan 4%, Korea Rep 3%, Italy 3%, India 2%, Turkey 2% and Taiwan 2%).

The below table shows the growth rate of copper demand by countries in given periods. The world demand for copper has increased mostly due to Chinese contribution. The copper demand has increased by 17.6 percent from 2010 to 2015, to which China, USA, German, Japan, India, Turkey and other countries contributed 21%, 0.2%, -0.5%, -0.3%, -0.1%, 0.5% and -3.2% respectively.

Table 1. Growth of World copper demand and countries contribution (percentage)

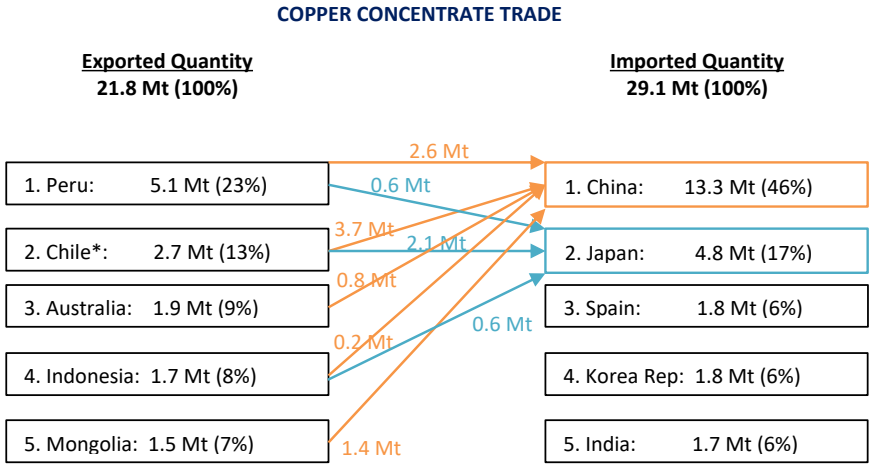
	1990 – 2000	2000 – 2005	2005 – 2010	2010 – 2015
WORLD	40.0	10.3	16.2	17.6
China	12.6	11.6	22.6	21.0
USA	7.7	-4.7	-3.0	0.2
Germany	2.6	-1.3	1.2	-0.5
Japan	-2.1	-0.8	-1.0	-0.3
India	1.0	1.0	0.7	-0.1
Turkey	1.3	0.5	0.3	0.5
Others	16.8	4.0	-4.6	-3.2

Source: WBMS, 2015

1.1.1 Main foreign buyers and distributors

According to ITC, the world total export of copper concentrate is 21.8 Mt and value is 46.5 billion USD in 2015. On the contrary, the world total import is 29.1 Mt and value is 45.9 billion USD. The top five exporters are Peru, Chile, Australia, Indonesia and Mongolia which combined around two thirds of the world total export.

Figure 3. World trade of copper concentrate by top 5 countries (2015)



*Note: *Chilean total export is 2.7 Mt, but imports of China and Japan from Chile are combined to be 5.8 Mt.*
Source: ITC, 2016

As shown in Figure 3, China imported 13.3 Mt of copper concentrate (46% of total import) of which 3.7 Mt from Chile, 2.1 Mt from Peru, 1.4 Mt from Mongolia and 6.1 Mt from other countries in 2015. Mongolia is the 5th ranked exporter and 3rd biggest exporter to China. The second largest importer of copper concentrate is Japan which is, in turn, the biggest exporter of refined copper as being one of the major countries with capacity of smelting production.

Chinese capacity of smelting production has been increasing and its production has increased. However, its production of refined copper is not enough for Chinese demand. As a consequence, one half of Chinese consumption is imported.

The following table shows the major importer/exporter countries of copper market trade.

Table 2. Main partner countries in World copper trade (basis 2015)

Copper concentrate		Refined copper	
Exporter	**Importer**	**Exporter**	**Importer**
Chile	China	Chile	China
Peru	Japan	Japan	Germany
USA	India	Russia	USA
Indonesia	Spain	Australia	Italy
Australia	Korean Rep.	Kazakhstan	Taiwan
Canada	Germany	India	Turkey
Brazil	Bulgaria	Poland	Korean Rep.
Mexico	Brazil	Korean Rep.	Malaysia
Spain	Finland	Peru	Thailand
Mongolia	Sweden	Canada	France

Source: ICSG, 2016

1.1.2 Smelting/Refining

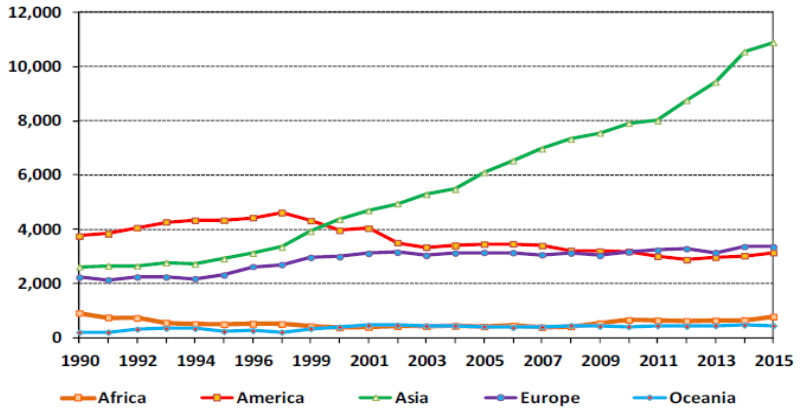
Mines produce copper concentrates that are sold to smelters and refineries for their copper content. Mongolian one of major mineral export commodities is copper concentrate and smelters (and refineries) convert copper concentrate into refined copper.

In this section, we discuss smelters, especially those in China as they purchase most of Mongolian concentrate. In addition, Asia's share of copper smelter production increased from 27% in 1990 to 60% in 2015 as copper smelting industry in China expanded rapidly (Figure 4). Since 2000, Chinese smelters became prominent in the copper market due to their cheaper Treatment/Refined charges (TC/RC). According to ICSG, 30% of total smelter production was in China, followed by Chile 8%, Japan 8% and Russia 5% in 2015.

One may say that the copper market including refined copper and concentrate is under the control of China (and Chinese smelters) as being related to approximately 50% of world copper consumption as well as production.

According to copper industry analysts, global smelting capacity is forecasted to increase through 2030. Asian smelting capacity is dominated by China, Japan, India and Indonesia. China had 49 smelters in operation with a total capacity 7 Mt in 2015. By 2030, Chinese capacity will reach around 10 Mt.

Figure 4. Copper smelter production by region, Kt (1990–2015)



Source: ICSG, 2016

The revenue of smelters based on their TC/RC (main factors for smelters). Mining companies offer their TC/RC to smelters primarily when supplying copper concentrate. This enables smelters to mitigate the effect of sharp variations of revenues due to copper price fluctuations. Typically, after TC/RC smelters pay to the producer 96–97% of the metal value contained in the concentrate (Nussir, 2015).

Table 3 shows the tope smelters in the world and their production capacities.

Table 3. Top 20 copper smelters, by capacity in Kt (2016)

№	SMELTER	COUNTRY	OWNER(S)	PROCESS	CAPACITY
1	Guixi (smelter)	China	Jiangxi Copper Corp.	Outokumpu Flash	900
2	Birla Copper (Dahej)	India	Birla Group	Outokumpu Flash, Ausmelt, Mitsubishi	500
3	Hamburg	Germany	Aurubis	Outokumpu, Contimelt, Electric	450
4	Besshi/Ehime (Toyo)	Japan	Sumitomo Metal Mining Co. Ltd.	Outokumpu Flash	450
5	Saganoseki/Ooita (smelter	Japan	Pan Pacific Copper Co. Ltd	Outokumpu Flash	450
6	El Teniente (Caletones)	Chile	Codelco Chile	Reverberatory/Teniente Conv.	400
7	Jinchuan (smelter)	China	Jinchuan Non-Ferrous Metal Co	Reverberatory/Kaldo Conv.	400
8	Jinchuan (Fangchenggang)	China	Jinchuan Non-Ferrous Metal Co	Flash smelter	400
9	Jinguan (smelter)	China	Tongling Non-Ferrous Metals Group	Flash smelter	400
10	Xiangguang copper (smelter)	China	Yanggu Xiangguang Copper Co	Outokumpu Flash	400
11	Sterlite Smelter (Tuticorin)	India	Vedanta	Isasmelt Process	400

12	Norilsk (Nikelevy, Medny)	Russia	Norilsk Nickel	Reverb, Electric, Vanyukov	400
13	Codelco Norte (smelter)	Chile	Codelco	Outokumpu/Teniente Converter	380
14	Pirdop (smelter	Bulgaria	Aurubis (99.77%)	Outokumpu Flash	360
15	Llo Smelter	Peru	Southem Copper Corp. (Grupo Mexico 75.1%)	Isasmelt Process	360
16	Onahama/Fukushima	Japan	Mitsubishi Materials Corp. (49.3%), Dowa metals & Mining Co. Ltd. (31.15%), Furukawa Metals & Resources Co.Ltd. (12.67%)	Mitsubishi/Reverb	354
17	Jinlong (Tongdu)	China	Tongling Nonferrous Metals Corp. (57.4%), Sumitomo (35%), Pingguo Aluminium Co.	Flash smelter	350
18	Yunnan	China	Yunnan Copper Industry group (Local Government)	Isasmelt Process	350
19	Naoshima/Kagawa (smelter)	Japan	Mitsubishi Materials Corp.	Mitsubishi Continuous	342
20	Isabel/Leyte (PASAR)	Philippines	Glenccore plc 78.2%, Local investors 21.8%	Outokumpu Flash	330

Source: ICSG, 2016

Smelters in some countries such as USA and China are least affected by fluctuations in the exchange rates because TC/RC based on US dollar. For smelters in other countries such as in Chile, on the other hand, the exchange rate is a major issue.

Regarding to Mongolia, Erdenet sells its copper concentrate to Chinese smelters through international trading companies such as Trafigure, Ocean Partners, Gerald Metals, Samsung, Milliford, Global Corporation, CWT Commodities Pte Limited (Swedish, South Korean, French, Dutch and HongKong companies). Chinese smelters are Jinchuan copper, Yunnan Copper, Daye Nonferrous Metals, Yanggu Xiangguang Copper, Bayan Nonferrous.

OT is currently exporting its copper concentrate to Chinese smelters as well. However, it considers Japanese and Taiwanese smelters as potential buyers and hence studying possibilities (i.e., logistics). For instance, in Q3 of 2016, it signed a MOU with a Japanese smelter to supply copper concentrate.

1.1.3 Foreign policies

There are many factors such as foreign government policies, company policies, environment issues, trade regulations and substitutions that may affect the world copper market. Particularly, Chinese policies and situations will have major impacts.

Copper substitution

- Copper scrap is expected to increase as a proportion of world copper demand over the next 15 years.
- Aluminum is considered as a competitive alternative to copper because it is used in PVC for plumbing, automotive wiring harnesses and some industrial building wire and

cable applications. Also, aluminum is cheaper than copper while producing a less environmental effect. According to BHP Billiton, there will be 2-6 percent loss in total Chinese copper demand by 2030 because of substituting aluminum for copper. Bloomberg Intelligence analysts report (in their trends in metal market in 2017) that aluminum will substitute for copper in power cable industry.

China

Although the China's economic growth has slowed down and its policy is more toward consumption and service industries, it is estimated that its demand for copper will stay flat in the near future and increase moderately in the long-term because of following factors:

- Growth target for the 13th Five-year plan for period 2016-20 expected to be approximately 6.5 percent per annum;
- A further 240 million people are expected to urbanize by 2030;
- Growing middle class will increase consumption;
- Driving copper demand from all sectors of the economy (e.g. expansion and upgrade of power infrastructure, refurbishment and fit out of new and existing housing etc.)

If Chinese rail operator, Shenhua, extends the rail line into Mongolia, to the vicinity of Tsagaan Khad, this rail line will technically enable Mongolia to export minerals to seaborne markets via Chinese Port Tianjin. This would require exports to originate in and traverse China using the same transport mode (rail gauge) in order to be classified as bonded cargo and therefor exempt from 17% Chinese VAT.

Other countries

Many resource rich countries benefitted from the commodities super cycle. However, metal prices have decreased since 2011. For example, compared with the peaks in 2011, metal prices are 50-70 percent lower in 2016. These have been affecting many commodity exporting countries. As a result, some countries governments may consider delaying new initiatives in the mining sector until the price outlook turns more favorable. Also, tax and political reforms can be influencing copper production decisions.

- Chinalco has reached a deal with the Peruvian government for a major expansion of Toromocho. Indonesia may relax a ban on ore export planned for January 2017 for copper. The objective is to give companies more time to build value-added domestic processing capacity.
- Zambia will cancel the 7.5% import tax that the country had planned to impose on copper concentrate effective from January 1, 2017 (www.wenhua.com). Industry insiders criticized that Congo would sell surplus output to other regions if Zambia levies such tax, which would harm the global copper supply chain.
- Table 1.4 shows some expected policy changes in countries.

Table 4. Announced price-related production cut

Country	Mine	Operator	Process	2014 production (Kt Cu)	Announcement date	Action	Duration
USA	Miami	Freeport	SX-EW	26	End Aug 15	Closure	These plans will continue to be reviewed and additional adjustments may be made as market conditions warrant
USA	Tyrone	Freeport	SX-EW	43	End Aug 15	50% cut mining rates	
Chile	El Abra	Freeport/ Codelco	SX-EW	166	End Aug 15	50% reduction of mining and stacking rates	
Chile	Collahuasi	Anglo American /Glencore	Concs & SX-EW	445 & 25	End Sep 15	Cut in SX-EW production of 30 ktpy	NA
USA	Ray	Asarco	Concs & SX-EW	53 & 29	End Aug 15	40% cut in output (indefinite shutdown of concentrator and reduction in stripping fr leach operation)	Adjustment may be made as market conditions warrant
Congo	Katanga (Kamoto)	Glencore	SX-EW	160	Sep 15	Suspension of operations	18 month
Zambia	Mopani mines	Glencore	Concs & SX-EW	110	Sep 15	Suspension of operations	18 month
Zambia	Mopani refinery	Glencore	Electrolytic /SX-EW	185	Sep 15	Suspension of operations (might continue concs toll smelting and refined production)	18 month
Namibia	Otjihase and Matchless	Weatherly	Concs	6	Sep 15	Closure	To be reviwed when market conditions improve
Botswana	Mowana	African Copper	Concs	10	Mar 15	C&M	NA

Source: ICSG, 2016

Table 5 shows some major mine projects and expansions taking place in 2015-2017.

Table 5. Major mine projects and expansions in 2015–2017

Country	2015	2016	2017
Armenia	Teghout 30 Kt (conc), started Jan 2015		Hillside 35 Kt Cu (conc), Little Eva 39 Kt (conc)
Australia			Carmacks 15 Kt (SXEW)
Canada	Red Chris 40 Kt (conc), production Feb 2015		
Chile	Antucoya 85 Kt (SXEW)		Xietongmen 56 Kt (conc)
China		JiaMa phase II 15 Kt exp in 2016 (conc), Shaxi 16 Kt (conc), Duobaoshan 10 Kt exp (conc), Zijinshang 18 Kt exp (conc)	Kinsenda 20 Kt (conc), Kamoto delayed exp from 165 Kt in 2015 to 285 Kt by 2017 (SXEW)
DRC	Kalumines 40 Kt (conc)	Sicomines 50 Kt (SXEW), Kipoi 25 Kt exp (SXEW), Frontier 20 Kt exp (conc)	Taft 28 Kt (conc)
Iran		Darehzar 26 Kt (conc)	Arava Mines 22 Kt (SXEW)
Israel			Aktogay 90 Kt (conc)
Kazakhstan		Bozshakol 100 Kt (conc), Aktogay 15 Kt (SXEW)	Los Chalchihuites 26 Kt (conc)
Mexico	Boleo 56 Kt (SXEW)	Buenavista new SXEW III plant started 2014 reaching full cap 120 Kt in 1Q 2016 (SXEW), concentrator 188 Kt exp in 4Q 2015 (conc)	
Myanmar	Monywa exp 40 to 50 Kt (SXEW)	Lefpadaung 100 Kt (SXEW)	
Namibia	Tschudi 17 Kt (SXEW)		
Peru	Constancia 120 Kt (conc) started end 2014 with production in 2015	Las Bambas 400 Kt (conc), Cerro Verde II 270 Ktpy exp (conc)	
Romania	Baita Bihor 25 Kt (conc)		
Saudi Arabia		Jabal Sayid 45 Kt (conc)	
Spain		Rio Tinto Mines 37 Kt (conc)	
USA	Morenci 100 Kt exp (conc)		Pumpkin Hollow phase 1, cap 34 Kt (conc)
Zambia	Sentinel 250 Kt (conc)	Chambishi 50 Kt exp (conc)	Kansanshi 60 Kt exp (conc), Kangaluwi Chisawa 35 Kt (SXEW)
Ramp-up mines	Ramp-up of projects that started previous year (inclu Sierra Gorda, Caserones, Toromocho, Salobo)	Ramp-up of projects that started previous year	Ramp-up of projects that started previous year

Source: ICSG, 2016

1.1.4 Outlook of copper demand

All copper industry analysts analyzed that global copper demand may continue to be supported by further, a moderate expansion in China, continued solid growth in other emerging markets, such as India and ASEAN and modest growth in more industrialized regions such as the USA and Europe. For instance, total demand in non-OECD and OECD countries is expected to grow at around 3.6% and to fall around 0.6% per annum to 2030, respectively according to BHP Billiton.

China's supports to copper demand:

- Continued urbanization (a further 240 million people are expected to urbanize by 2030);
- Greater prosperity (growing middle class will increase consumption);
- Driving copper demand from all sectors of the economy (e.g. expansion and upgrade of power infrastructure, increasing penetration of consumer durables and passenger cars etc.)

According to WB's Commodity Outlook 2017, copper demand has been strong in China from the main power-grid, automotive, and construction sectors.

1.2 Mongolian copper demand

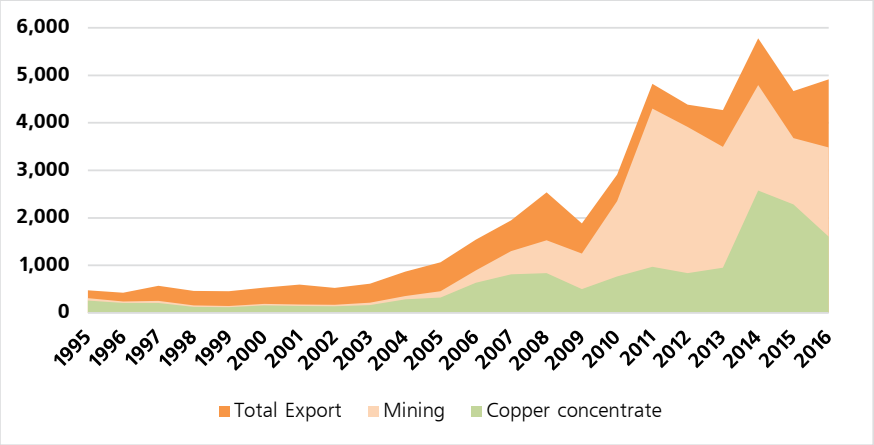
1.2.1 Background of the industry

As an average of last five years, Mongolian mining industry has produced about 18 percent of GDP and it employed around 4 percent of total labor in 2015 (42.6 thousand employees). In addition, mineral products account for around 80 percent of exports and 62 percent of industrial output. Especially, mining of metal ore[1], including copper ore, concentrate, iron ore and so on, is 47 percent of industrial output in 2015. As shown in Figure 5, Mongolian exports increased sharply to 4.8 billion USD in 2011 of which 47 percent and 20 percent were coal and copper ore, concentrate (HS code 2603)[2] respectively due to the increase in the world market prices.

[1] According to Mongolian ISIC, mining of metal ore classifies two sub categories that mining of iron ore (code 071) and mining of non-ferrous metal ore (code 072). For example, mining of gold, silver and copper classify for non-ferrous metal ore.

[2] Based on Mongolian Customs, export/import of copper classify two sub categories which are copper, copper products (HS code 74) which include refined copper and copper ore, concentrate (HS code 2603). In this study, furthermore, we indicate "copper ore, concentrate" to "copper concentrate".

Figure 5. Mongolian total exports million $ (mining and copper concentrate export) (1995–2016)



Source: Mongolian Customs

Since 2014, the export of copper concentrate has accounted for over 40 percent of the total exports because of the OT operation. However, in 2016, the export of copper concentrate decreased to 1.6 billion MNT (by 30 percent from 2015) and accounted for 33 percent of the total exports.

Furthermore, investment in the mining sector constitutes 71 percent of the total FDIs, in comparison to the construction sector (8%), banking and financial sector (3%) and the railway sector (3%) (MEITI, 2015).

According to MEITI, the mining sector made a substantial contribution to the Mongolian state budget: on average over the period of 2010-14, the sector provided 52 percent of its tax revenue and 25 percent of general government revenue. For the years of 2010-14, revenue generated in Mongolian general budget from extractive industry increased from 1.1 trillion MNT to 1.7 trillion MNT, but decreased to 1.4 trillion MNT in 2015.

In addition, OT LLC (hereinafter expressed as OT) and Erdenet Mining Corporation LLC (hereinafter expressed as Erdenet), which represent the industry of copper concentrate in Mongolia, are the highest ranked companies in terms of total payments to the government. For example, the government revenue from OT and Erdenet are 515.2 billion MNT and 353.3 billion MNT respectively in 2015 (MEITI, 2015).

1.2.2 Demand for Mongolian copper: past trends and current states

Mongolia has rich resource of copper and started producing and exporting copper concentrate since 1980s. Copper refining industry, on the other hand, has developed only for past 10 years. There are two companies, Erdmin Co.Ltd (hereinafter expressed as Erdmin) and Achit Ikht Co.Ltd (hereinafter expressed as Achit Ikht), have had combined production capacity of 13 Kt of refined copper per annum since 2014. As a consequence, most of local usage of copper products are imported.

In the next subsections, we will discuss the usage of copper products in Mongolian (local demand) and exports (foreign demand).

LOCAL DEMAND

The local demand for copper is mainly generated by construction and infrastructure industries. But Mongolia is currently producing a few kinds of copper products such as refined copper (cathode copper), rolled copper, copper wire and electric copper wire while the other copper products are imported. Therefore, the local demand for copper is on the products of Erdmin, Achit Ikht and imports.

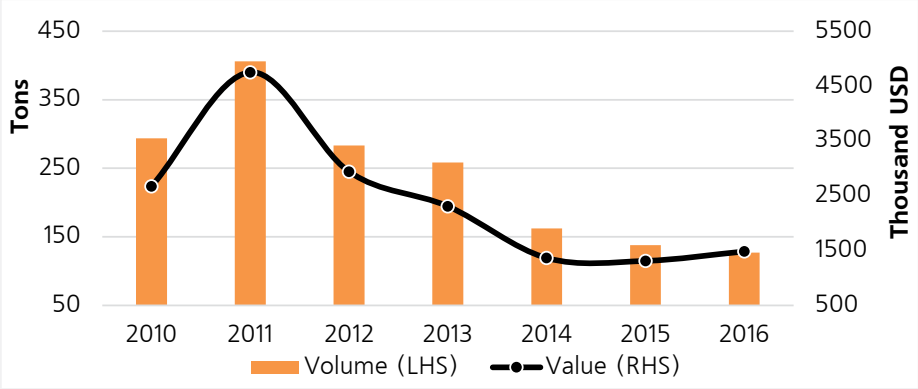
In 2011, Mongolian economic growth was at its peak and 400 tonnes of copper products were used in construction and infrastructure mostly. Since 2011, the economy has slowed down and the construction industry has been affected the most. As a result, the average usage of copper has dropped to around 200 tonnes (Figure 6). During the last 5 years, the volume of copper import decreased at annual rate of 15%.

The decrease was caused by the following factors:

- Economic slowdown;
- Slowdown and delay in the construction industry since 2015;
- Erdmin company started producing copper products which substitute for imported products such as copper wire, tubes for last few years;
- Achit Ikht company also started producing refined copper (HS code 7403) since 2014.

In 2016, Mongolia imported 127 tonnes of copper products, worth of 1484 thousand USD which is 0.04% of its total imports.

Figure 6. Copper import in Mongolia (2010-2016)



Note: that estimated except kitchen tools (HS code 7418)
Source: Mongolian Customs

According to Achit Ikht and the Mongolian Customs, Achit Ikht has exported all of its refined copper. Also, Erdmin has exported small volume of copper tube (HS code 7411), copper tube armature (HS code 7412) (see Figure 7).

Based on the customs data and the capacity of Erdmin and Achit Ikht, it is estimated that Mongolia has consumed over 100 tonnes of copper and copper products, on average in each year, for last 2 years.

From 2010 to 2016, imported copper products are presented in Table A1 in Appendix.

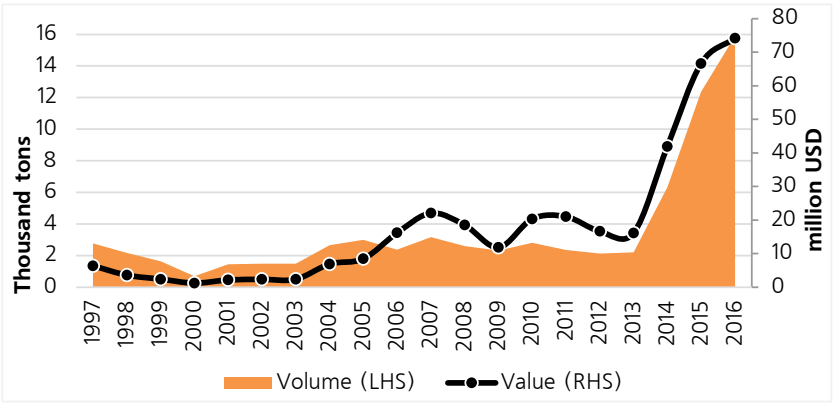
MONGOLIAN EXPORT OF REFINED COPPER AND COPPER CONCENTRATE

Around 80% of Mongolian exports is mining commodities. In particular, the export of copper concentrate has been about 30% of its exports each year for last 10 years and export of refined copper account for 0.8%.

Refined copper

In 1997-2013, approximately 2.2 Kt of refined copper (and copper alloys) was exported by one company, Erdmin. In 2014-2016, export volume increased from 6.3 Kt to 15.9 Kt due to Achit Ikht's operation. Now Mongolia has a potential to export over 10 Kt of refined copper constantly every year.

Figure 7. Refined copper export (1997–2016)



Source: NSO

Refined copper export has reached to 74 million USD in 2016 and increased by 11% compared to 2015, accounting for 1.5% of total exports.

Furthermore, Mongolia exported small amount of copper tubes and copper tube armature to China and Taiwan and earned 171 thousand USD in 2016.

According to Mongolian Customs, Mongolia have exported refined copper to China, Taiwan, Vietnam, Saudi Arabia, Netherlands, Indonesia and the Republic of Korea.

Copper concentrate

Before 2013, Mongolian copper concentrate was exported by Erdenet and the annual average volume was 550 Kt equivalent to 120 Kt copper. Because of OT, the volume of copper concentrate export has more than doubled since 2014. In 2016, Mongolia exported 1562 Kt copper concentrate with copper content around 330 Kt. OT's concentrate export was 829 Kt with 189 Kt copper (Figure 8).

As shown in Figure 9, until 2000, copper concentrate had been exported by Erdenet and its main trading partners were China, Russia, Uzbekistan, Republic of Korea, Japan and Kazakhstan. However, since 2000 China has been the main buyer for the following 2 reasons:

- China is our neighbor – i.e., low transport cost;
- Chinese demand (its economic growth and industrialization).

In recent years, almost 100 percent of copper concentrate is exported to China despite the fact that small amount is exported to other countries. In 2015, Mongolia exported 5808 tonnes to Russia and 4622 tonnes to Japan which are combined to be less than 1% of total exports of copper concentrate.

Figure 8. Export volume of copper concentrate by Oyu Tolgoi and others (Cu, 1995–2016)

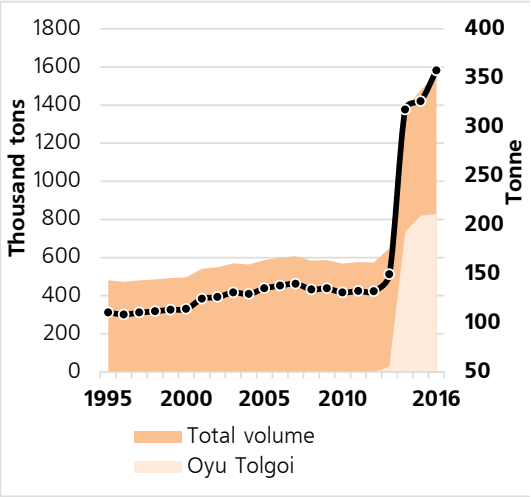
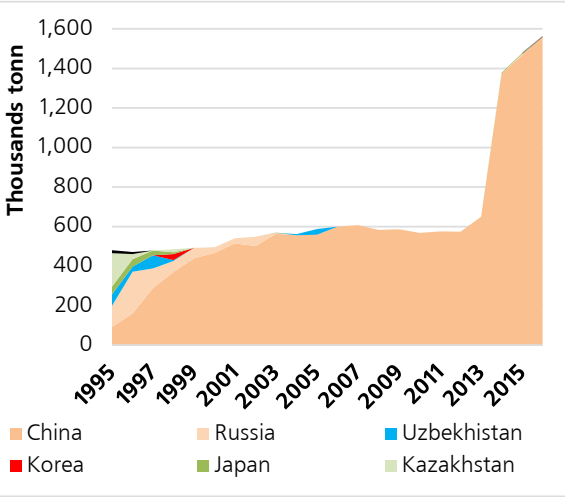


Figure 9. Export volume of copper concentrate by countries (1995–2016)



Source: Mongolian Customs, Turquoise Hill Resource Ltd "Press Release" and prepared by survey team

Although Mongolian export volume of copper concentrate increased, the world copper price has decreased continuously since 2011 (Figure 21-22). As a consequence, Mongolia exported 1.47 Mt of copper concentrate earning 2.28 billion USD in 2015 while 1.56 Mt were exported earning 1.60 billion USD in 2016 (see Figure 5). Because of the decline in the commodity prices and other issues, mining exports decreased by 5 percent and copper concentrate export decreased by 29 percent in 2016. In addition, the share of copper concentrate in total exports decreased from 49 percent in 2015 to 33 percent in 2016.

1.2.3 Mongolian policies

Mongolian Government is determined to create a favorable environment for investments in geological and mining sectors, develop the mining sector steadily and increase the capacity of Mongolian minerals production designated to the international markets in the near and long terms. Under these goals, the following main national policies, development strategies, concepts and plans have been approved by the State Ikh Khural and Government.

Mongolian long-term sustainable development concept (2016-2030)

The Concept aims to support the mining sector, particularly large-scale mineral projects, in countering the decline in mineral prices by setting goals to improve infrastructure – roads, energy supply, water supply and customs streamlining. To achieve sustainable development, the government will carry out an appropriate macroeconomic policy and diversify the economic production structure. In that respect, it gives an importance to many industries including copper-smelters.

It has an objective to complete a railway connecting Erdenet-Ovoot and the Bogd Khaan railway and start other railway projects (see

http://www.legalinfo.mn/annex/details/7105?lawid=11725 for more detailed information).

State minerals policy (2014-2025)

"State Minerals Policy" focuses on providing national primary interests by developing conspicuous and responsible mining relied on private sector, in addition it aims to develop multisector and balanced economic structure in the short and mid-term. Its objective is to establish stable investment environment, to improve quality of mineral exploration, mining and processing by encouraging use of environment friendly and advanced techniques, technologies and innovations, to produce value-added final products and strengthening competitiveness of the country in the international market. It supports actions to construct a smelter and purify copper concentrates (see http://www.legalinfo.mn/law/details/9756 for more information).

The State policy on the Industrial sector (2015-2030)

The policy will be implemented in three 5-year stages, and a different strategy is planned for each stage. The stages and their main concepts are the following:

- First stage 2015-2020: It will protect national industry, process local raw materials within the country, support export by adopting new technologies and implement industrial policies to find substitutes for imports.
- Second stage 2020-2025: It will create an industrial structure where export dominates the other fields, build foundations for high technology, machines and facilities and chemical plant.
- Third stage 2025-2030**:** It will develop knowledge-based industry and begin technology export.

The Ministry plans to list goals once the policy draft is passed by the State Ikh Khural (see detailed information from http://legalinfo.mn/annex/details/6811?lawid=11129)

1.2.4 Outlook of Mongolian copper demand in the near future, long term 10 years

LOCAL DEMAND

As mentioned before, the local demand for copper falls on the products of Erdmin, Achit Ikht and imports.

Because of the slowdown in economic growth and the stagnation of the construction industry, the local demand for copper and copper products has fallen in recent years. Most of the local demand is met by imports. In the near future, the local demand is expected to be over 100 Kt per year. In the long-run, however, the local demand may increase as the economy expands.

EXPORT

Mongolia exports almost all of its copper concentrate produced as well as 100 percent of refined copper produced by Achit Ikht. In that sense, the total export of copper concentrate (and refined copper) may represent the total production. In this subsection, we discuss briefly the future of Mongolian export/supply of copper (see detailed outlook from section 2.3.6).

We estimate that Mongolian export of refined copper will be around 13 Kt per year in the next 4 years which is determined by the full production capacity of Erdmin and Achit Ikht.

If a new project of a copper smelter plant is implemented, it may export around 138 Kt per year in the long-run.

In 2017 and 2018, it is expected that Mongolia will export about 1.3-1.5 Mt of copper concentrate with around 300 Kt of copper content. As the copper grade is falling, Erdenet and OT will be exporting copper concentrate with less copper content. If Tsagaan Suvarga mine project completes in next few years and OT's underground mine starts the shipment from 2021, then starting year of 2022, around 2 Mt of copper concentrate with over 600 Kt/y copper content will be exported annually (see Figure 18).

2. SUPPLY SIDE

2.1 World and Mongolian copper resources

Porphyry copper deposits account for about 60% of the world's copper deposits and Mongolia has rich resource of porphyry copper. According to the USGS, copper reserves[3] currently amount to around 720 Mt and the total resources (including identified and undiscovered)[4] are estimated to be around 5600 Mt (Figure 10). The identified resources are about 2100 Mt of which around 62% and 19% are in America and Asia respectively.[5] Most of the undiscovered resources, estimated around 3500 Mt, are in Asia (45%).[6]

A country with the largest copper reserves is Chile (210 Mt) followed by Australia, Peru, Mexico and USA, based on 2015 reserves. In the period of 2005-2015, due to high demand for copper, reserves have grown by 250 Mt. Current and future exploration opportunities will lead to increase resources.

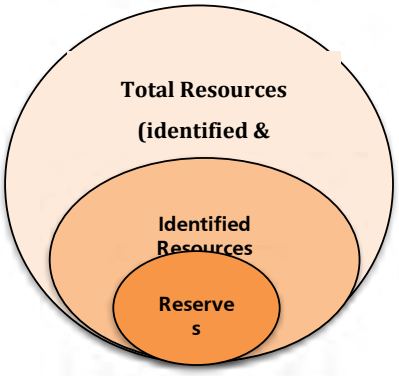
[3] Definition (USGS): That part of the reserve base (part of an identified resource that meets specified minimum physical and chemical criteria related to current mining and production practices, including those for grade, quality, thickness, and depth) which could be economically extracted or produced at the time of determination. The term reserves need not signify that extraction facilities are in place and operative.

[4] Definition (USGS): A concentration of naturally occurring solid, liquid, or gaseous material in or on the Earth's crust in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible.

[5] Definition (USGS): Resources whose location, grade, quality, and quantity are known or estimated from specific geologic evidence. Identified resources include economic, marginally economic, and sub-economic components.

[6] Definition (USGS): Resources, the existence of which are only postulated, comprising deposits that are separate from identified resources. Undiscovered resources may be postulated in deposits of such grade and physical location as to render them economic, marginally, or sub-economic.

Figure 10. World copper resource, Mt (basis 2015)

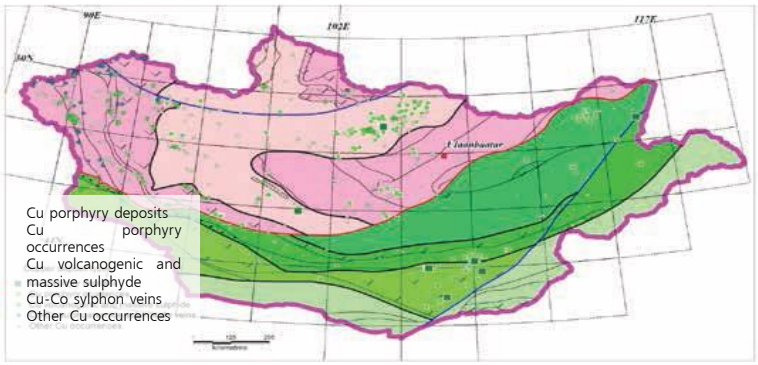


210	Chile
33	United States
88	Australia
11	Canada
30	China
20	Congo (Kinshasa)
46	Mexico
82	Peru
30	Russia
20	Zambia
150	Other countries
720 Mt	**World total**

Note: Undiscovered resources not including deep sea nodules and land-based and submarine massive sulfides.
Source: ICSC (2016) and USGS (2016)

In 2014, Mongolian Ministry of Mining estimated in Mining report that there were 57 copper deposits and about 1180 occurrences with combined 85.7 Mt of copper resources and predicted resource of 93.3 Mt (Figure 11).[7]

Figure 11. Distribution of copper deposits and occurrences



Source: Department of Geology and Exploration, MRAM (2014)

Mongolian mineral resources are registered and reported by the Mineral Resources Authority of Mongolia (MRAM). In monthly bulletin of MRAM, the total registered copper reserve is 53.6 Mt during 2010 and October 2016.

2.2 World copper supply

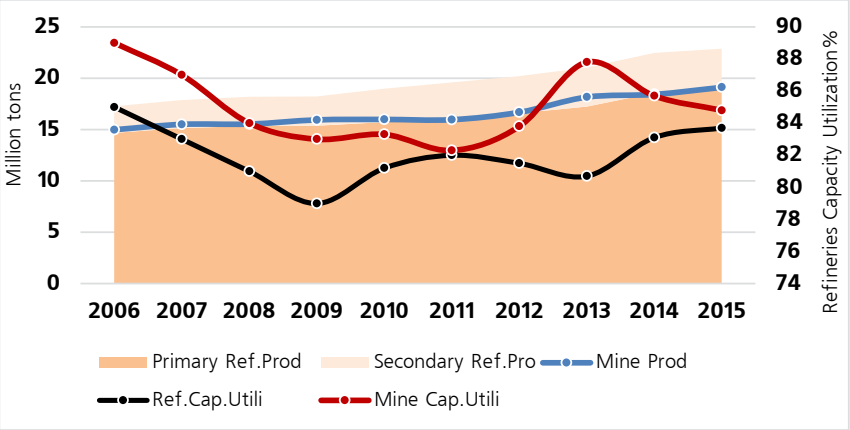
Global copper production increased by around 40 percent from 2000 to 2014 (WBMS & WD, 2016). The world refined copper production was 22.9 Mt in 2015, up 1.7% compared with

[7] According to MEITI annual report 2014, there is 60.7 Mt of reserves in A+B+C categories. (A-confirmed mineral resources, B-expected mineral resources, C-possible mineral resources; needs further survey to confirm)

the previous year. It was originated from mine production[8] (19.1 Mt) and secondary refined production[9] (3.9 Mt). Secondary refined production had been producing 15-17% of total refined copper production in last decade.

According ICSG, the actual copper production (both mine and refined) is more than 80% of world production capacity (Figure 12).

Figure 12. World refined copper production and capacity utilization (2006–2015)



Source: ISCG (2016)

From 1980 to 2015 world copper mine production increased by annual growth rate 2.6%. In 2015, world copper mine production was 19.1 Mt, up 3.8% compared with 2014 (Figure 13).

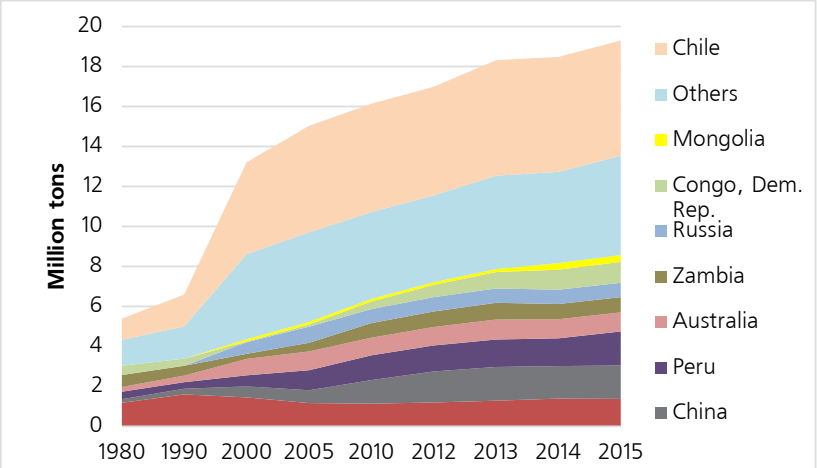
The top three producer countries of mine production are Chile, China and Peru. Chile, world's largest copper producer, produced 5.7 Mt of copper which was 30% of world mine production in 2015. Other largest copper producers, Peru, China and United States produced 1.7 Mt, 1.7 Mt, and 1.4 Mt respectively.

Mongolia produced around 350 Kt of copper in concentrate and reached 1.8% of global copper production in 2015 (before 2013 average percentage was 0.8%). As a result, Mongolia was ranked at 15th of the top 20 countries in 2015.

[8] It is "primary copper production" that as obtainable from a primary raw material source. And also, mine production is generating two types that from metallurgical treatment of concentrate and electrowinning (SX-EW process).

[9] It represents scrap that has been fire-refined, or that has been converted to anode at the smelter level and then electrolytically refined.

Figure 13. World copper mine production (1980–2015)



Source: ISCG, 2016

The world top 20 mines of mine production information about owner, country and capacity shown in following Table 6. BHP Billiton, Rio Tinto, Codelco, Freeport-McMoRan, Glencore, Anglo American (indicated by red in Table 2.8) and Jiangxi Copper are the world's largest copper producers, and are most exposed to copper market dynamics (BI, 2016).

Table 6. Top 20 Copper mines by capacity (basis 2015)

№	Mine	Country	Owner(s)	Process	Capacity, Kt
1	Escondida	Chile	BHP Billiton (57.5%), Rio Tinto Corp. (30%), Japan Escondida (12.5%)	Concs & SX-EW	1200
2	Grasberg	Indonesia	P.T. Freeport Indonesia Co. (PT-FI), Rio Tinto	Concentrates	780
3	Morenci	US	Freeport-McMoRan Inc 72%, 28% affiliates of Sumitomo Corporation	Concs & SX-EW	520
4	Buenavista del Cobre (former Cananea)	Mexico	Grupo Mexico	Concs & SX-EW	510
5	Collahuasi	Chile	Anglo American (44%), Glencore plc (44%), Mitsui (8.4%), JX Holdings (3.6%)	Concs & SX-EW	500
6	El Teniente	Chile	Codelco	Concs & SX-EW	452
7	Antamina	Peru	BHP Billiton (33.75%), Teck (22.5%), Glencore plc (33.75%), Mitsubishi Corp. (10%)	Concentrates	450
8	Los Bronces	Chile	Anglo Amercan 50.1%, Mitsubishi Corp. 20.4%, Codelco 20%, Mitsui 9.5%	Concs & SX-EW	435
9	Polar Division (Norilsk/Talnakh Mills)	Russia	Norilsk Nickel	Concentrates	430

10	Los Pelambres	Chile	Antofagasta Plc (60%), Nippon Mining (25%), Mitsubishi Materials (15%)	Concentrates	420
11	Radomiro Tomic	Chile	Codelco	Concs & SX-EW	370
12	Cerro Verde II (Sulphide)	Peru	Freeport-McMoRan Copper & Gold Inc. 54%, Compacia de Minas Buenaventura 19.58%, Sumitomo 21%	Concentrates	340
13	Chuquicamata	Chile	Codelco	Concs & SX-EW	325
14	Kansanshi	Zambia	First Quantum Minerals Ltd (80%), ZCCM (20%)	Concs & SX-EW	285
15	Bingham Canyon	United States	Kennecott	Concentrates	280
16	Andina	Chile	Codelco	Concentrates	260
17	Batu Hijau	Indonesia	Pt Newmont Nusa Tenggara (PT Pukuafu 20%, Newmont 41.5%, Sumitomo Corp., Sumitomo Metal Mining & Mitsubishi Materials 31.5%, PT Multi Daerah Bersaing 7%)	Concentrates	250
18	Toromocho	Peru	Chinalco	Concentrates	250
19	Olympic Dam	Australia	BHP Billiton	Concs & SX-EW	225
20	Cuajone	Peru	Grupo Mexico (54.1%), Marmon Corp. (15%), Freeport-McMoRan Copper & Gold Inc. (13.9%)	Concentrates	212

Source: ISCG (2016)

2.2.1 Outlook of copper supply

BI analyzed, in 2017, 62,000 fewer tonnes will come to market than previously expected. According to ICSG, in 2017 and 2018 world mine production is expected to remain around 21 Mt. For 2017, world mine production and refined production are expected to maintain growth of around 2 percent. On contrary, world refined usage in 2017 may increase by around 1 percent led by China's usage. BHP Billiton, Rio Tinto and Wood Mackenzie are expected to face supply deficit in the medium to long-term (see Figure 23). Based on analysis by some analysts, copper supply deficit starting in approximately 2019 due to following issues and near-term oversupply.

Supply factors in short term:

- Declining grades at existing operations;
- Tax and political reforms are influencing production decisions;
- Delays in project construction and price-related production cut.

Supply factors in long term:

- Grade decline continues globally (average world copper grade in processed ore from 0.65% (2015) to 0.53% (2025));
- Availability of power and water is a serious issue for the industry;
- Availability of project finance is expected to limit greenfield projects and brownfield expansions;

- Capital and operating cost inflation will impact future investment decisions.

2.3 Mongolian copper supply

2.3.1 Supply of Mongolian copper: past trends and current states

Refined copper

Refined copper had been produced by Erdmin until 2013. In 2014, Achit Ikht company started its production which has a capacity of 3-4 times higher than that of Erdmin. As a result, the industry output increased from 2,344 tonnes to 6,992 tonnes between 2013 and 2014. 14,990 tonnes of refined copper was produced in 2015. Table 8 shows the industry output and exports in 2010-2016.

Table 7. Total production and export of refined copper, tonnes (2012–2016)

	2012	2013	2014	2015	2016
Total Production	2,282	2,344	6,992	14,990	15,010
Total Export	2,120	2,201	6,327	12,371	15,891
Balance (end of year)[1]	**(610)**	**(467)**	**198**	**2,817**	**1,936**

Note: [1] estimated from 1997 based on available data of NSO.
Source: NSO and Mongolian Custom

Copper concentrate

Until 2012, only Erdenet had produced copper concentrate. Since 2013, however, OT and Erdenet have produced and exported copper concentrate. For the last 5 years, the production has grown at an average annual of 15 percent. For instance, 1.3 Mt of copper concentrate was produced in 2015 of which 59% was produced by OT. Due to the OT operation, the Mongolian share of global mine production increased from 0.8 percent in 2013 to 1.8 percent in 2015. As a result, Mongolia was ranked at the 15th place of the top 20 production countries in 2015.

The following table shows the details of annual production and exports including OT's contribution.

Table 8. Total production and export of copper concentrate, Kt (inc. OT)

	2012	2013	2014	2015	2016
Total Production (by metal content)	**788**	**803**	**1,080**	**1,335**	**1310***
Hereof:					
1. OT mine	-	290	564	789	847
OT-Average concentrate grade (% Cu)	-	26.4	26.3	25.6	23.8
OT-(Cu)	-	77	149	202	201
2. Others[2]	788	513	517	546	
(Cu)[2]	181	119	119	125	
Total Export	**574**	**650**	**1,379**	**1,478**	**1,562**

Hereof:					
1. OT mine	-	26	734	820	829
OT-(Cu)	-	6	186	201	189
2. Others[2]	574	624	645	658	
(Cu)[2]	132	143	148	151	
Balance of concentrate[1]	**214**	**153**	**-299**	**-143**	

*Note: * end of November 2016, [1]estimated from 1995 based on available data of NSO, [2] Survey team estimated concentrate (and Cu) of "Others". Therefore, Other's "Cu" isn't actual. Source: NSO, Mongolian Custom, MRAM, Turquoise Hill Resource Ltd "Press Release" and prepared by survey team.*

Based on the NSO's report on the production and exports, we calculate the balance as the difference between the production and exports.

2.3.2 Mongolian main supply centers

In Mongolia, as of 2014, there were 105 manufactures refining minerals other than coal of which 4 were Copper-Molybdenum and 2 copper-refineries. As of 2016, there are over 20 special license holders of exploration and exploitations in terms of copper (MEITI 2015).

Mongolian State Ikh Khural registered and defined "Strategically Important Mineral Deposits[10]" in 2007. Currently, 16 deposits have registered by strategically important mineral deposits including 3 copper deposits, Erdenet, OT and Tsagaan suvarga.

This section focuses extensively on Erdenet, OT, Tsagan Suvarga, Erdmin, Achit Ikht and a newly projected copper smelter plant.

The following two tables have brief information about Erdenet, OT and Tsagaan suvarga mines.

Table 9. Main supply centers (2015-2016)

	Oyu Tolgoi mine	Erdenet mine	Tsagaan Suvarga mine
Operator	Oyu Tolgoi corporation Joint venture by Turquoise Hill Resources (66%) and Mongolian Government (34%)	Mongolian government	Mongolian Alt corporation (MAK)
Location	Khanbogd, Omnogobi	Bayan-Undur, Orkhon	Mandakh, Dornogobi
Type	Porphury copper	Porphury copper	Porphury copper
Mineral	Copper, gold and silver	Copper &molybdenum	Copper & molybdenum
Mine Development	2013	1978	Under construction (2018 forecast)
Ore reserves	3.5 Bt	1.5 Bt	Oxide ore: 10 Mt Sulfide ore: 240 Mt

[10] Any deposit which might have an impact upon national security, national economy and social growth of the country and region, or deposits which are capable to supply or supply more than 5 percent of GDP of that year.

Ore grade	Open pit: 0.51% Cu Underground mining: <1.68% Cu	0.51% Cu	Oxide ore: 0.42% Cu Sulfide ore: 0.53% Cu
Copper grade	Open pit: 23-25% Cu Underground mining: 23-35% Cu	23-25% Cu	25.6% Cu
Copper reserves	25.1 Mt	4-6 Mt	1.6 Mt
Method of mining	Open pit Underground mining	Open pit	Open pit
Life	98 year	32-42 year	18 year (forecast)

Source: Official websites of Erdenet, OT and MAK

As of 2015-2016, the combined copper ore reserves of Erdenet, OT and Tsagaan Suvarga are around 5.2 Bt which can be translated into around 124 Mt of copper concentrate with 32 Mt of copper content.

Table 10. Total reserves of main supply centers (basis 2015–2016)

Deposit/Mine	Ore (Mt)	Cu %	Concentrate (Mt)	Copper grade %	Copper (Mt)
1. Oyu Tolgoi mine	**3,423**	**0.83**	**93.3**	**27**	**25.1**
Open pit: Oyut deposit	**951**	**0.45**			**3.3**
Proven	353	0.54		**23–25**	1.5
Probable	598	0.39			1.8
Underground pit:	**2,474**	**0.98**			**21.9**
Hugo North	1,477	1.23			16.5
Probable	499	1.66			7.6
Inferred	978			**23–35**	8.9
Hugo South - inferred	298	1.07			2.9
Heruga - inferred	699	0.42			2.5
2. Erdenet mine – Open pit	**1,500**	**0.44**	**24.6**	**23**	**5.6**
3. Tsagaan Suvarga mine – Open pit	**250**	**0.64**	**6.3**	**25.6**	**1.6**
TOTAL (Mt)	**5,173**		**124**		**32**

Source: Official websites of Erdenet, OTTR, MAK and prepared by survey team (Erdenet and Tsagaan suvarga are estimated)

Oyu Tolgoi mine

OT LLC was a joint venture by Erdenes Oyu Tolgoi LLC (34%), owned by the Mongolian Government, and Turquoise Hill Resource (66%), a Canadian-based international mining company focused on copper-gold and coal mines in Mongolia.

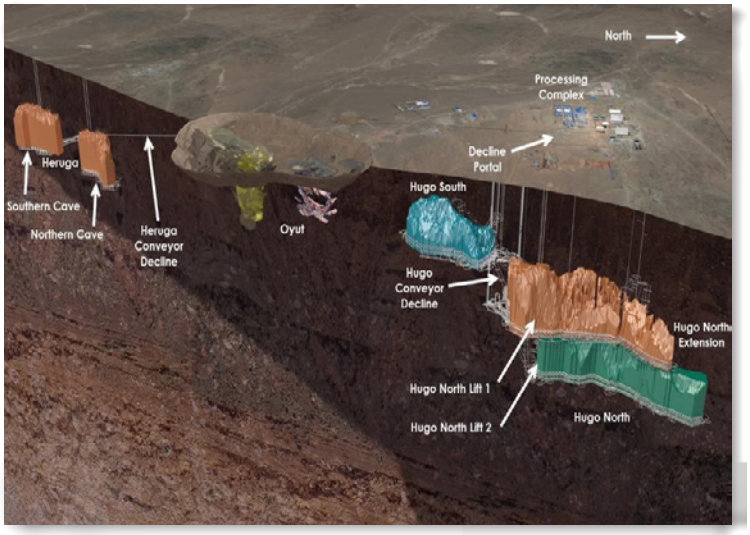
Rio Tinto (a leading international mining group and a London listed public company) indirectly owns around a 50.8 percent interest in Turquoise Hill Resource and Rio Tinto became the manager of OT.

At the end of December 2015, over 95 percent of OT's workforce was Mongolian and approximately over 5825 employees are working for it (MEITI, 2015).

It holds one of the largest undeveloped high grade copper deposits in the world and scale of deposits is larger than Erdenet mine. Approximately 80% of OT's value resides in the underground because the copper grades are roughly three and a half times higher that of the open pit.

As shown in Figure 14, OT deposits are divided into four different deposits: Hugo South, Hugo North, Oyut and Herruga. Hugo North Dummett's block extraction mining method will make OT one of the major players in the global copper market. OT will become a stable and long-term producer of copper concentrate in the global arena. Researchers concluded that upon completion of the OT's underground mine, OT will become one of the biggest 5 copper producers in the world.

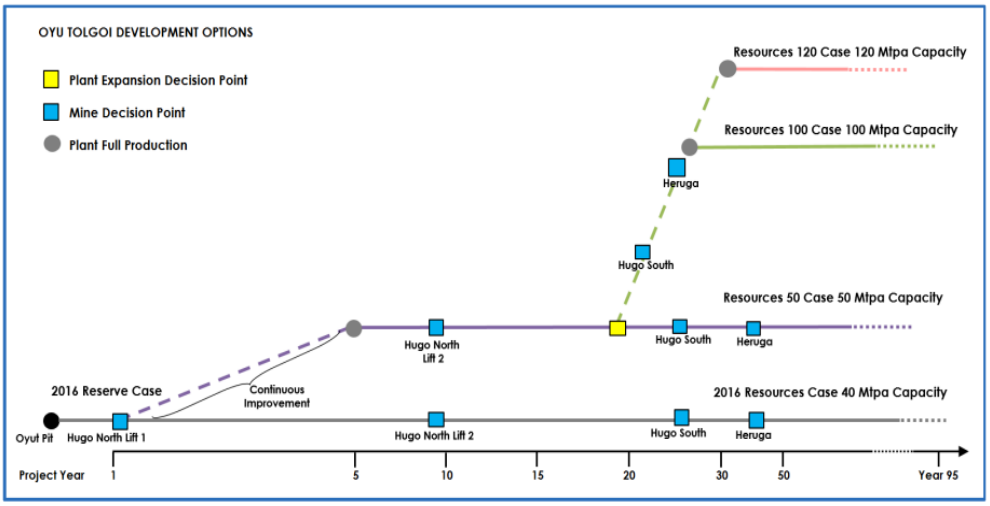
Figure 14. Mine and deposit layout



Source: OTTR

Figure 15 shows an example of the decision tree for the possible development options at OT. It assumes that the project year starts in January 2017, starts the underground mine in 2021 and reach its full capacity in 2027. At that time, the plant capacity of ore production will be 40 Mt per year. Ore processing capacity is 100,000 tonnes per day.

Figure 15. OT Development Options



Source: OTTR

OT's foreign direct investment:

- In 2009-2013, 6.2 billion USD was invested in the 1st phase of construction (FDI) and it has operated the Ouyt, an open pit mine, since 2012.
- The investment decision on the 2nd phase of construction (in the underground mine) was reached in December 2015 and it would spend 4.6 billion USD.
- According to "2016 Oyu Tolgoi Feasibility Study", the construction has 5 phases and it plans to spend 9.7 billion USD on the underground mine construction.

OT's underground tonnages, grades and mining production statistics are shown in Table A3-4 (Appendix).

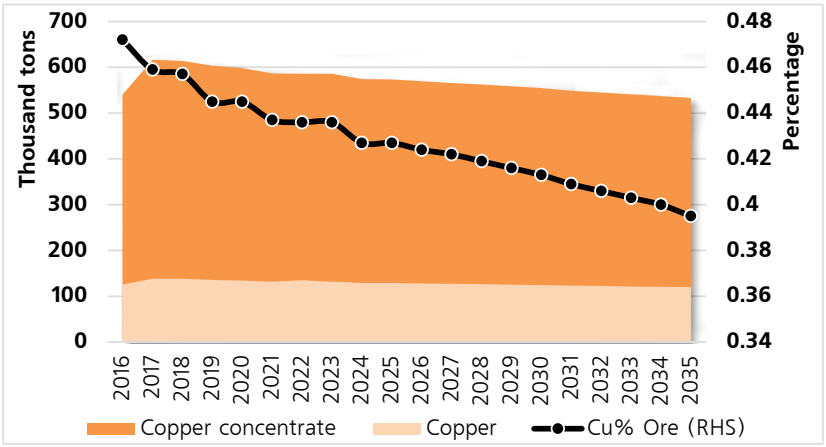
Erdenet mine

Erdenet Mining Corporation (Erdenet) is owned by Mongolian government since late 2016. Before then, Erdenet was established in accordance with an agreement between the governments of Mongolia and Russia. It started its operation in 1978 and one of the biggest ore mining and ore processing factories in Asia.

Erdenet had been the sole producer of copper concentrate in Mongolia until 2013. It employed 5841 employees of which Mongolian employees account for over 95 percent (MEITI, 2015). Until 2015, Erdenet had dressed ore of 722 Mt and produced copper concentrate of 15.4 Mt. Annually, the company processes 26 Mt of ore and produces about 550 Kt of copper concentrate and around 4.5 Kt of molybdenum concentrate in recent years.

Erdenet's copper grade is decreasing and it has resulted negatively in the company's revenue and so on. Consequently, the company has decided to increase the production of ore to maintain the volume of copper concentrate.

Figure 16. Strategic plan of copper concentrate, and Cu grade of ore (2016–2035)



Source: Prepared by survey team (www.erdenetnews.mn)

The company's strategic plan indicates that it will increase its annual ore production from 27 Mt to 35 Mt by 2020, reduce the average cost and produce final goods by adding more value (Figure 16).

Tsagaan Suvarga mine

Tsagaan Suvarga mine is located in Mandakh soum, Dornogove aimag, 560 km away from Ulaanbaatar city, 220 km from Sainshand town (Trans-Mongolian railway station). It is owned by Mongolian Alt Corporation (MAK). It is included in "Strategically important mines" by the government resolution in 2007. In 2014, Mongolian State Ikh Khural approved resolution 54 according to which the government does not hold any share of the company. Last year, MAK signed a long-run sustainable investment contract with the minister of Mining about the Tsagaan Suvarga project.

The total proven reserves is 250 Mt of primary sulphide ores equivalent to 1.6 Mt of copper and 66 Kt of molybdenum. The property has also 16 Mt of oxide ores sitting as a cap over the sulphide ores.

According to its pre-plan, the operation of the mine requires 680 million USD which is to be supported by the German government, and copper (and molybdenum) concentrate will be exported to Germany from 2018. Its capacity is to produce 14.5 Mt of ore or 316 Kt of copper concentrate per year.

Erdmin, Achit Ikht and New copper smelting plant

In Mongolia, refined copper produced by Erdmin (started its production in 1997) and Achit Ikht (started its production in 2014). In addition, within the sustainable development strategy, it is in a decision stage to establish a copper smelter (ministries of Mining and Food, Agriculture and Light Industry). If this new smelter operates with full capacity, the copper production will increase by 125 Kt per year.

Both Erdmin and Achit Ikht located near Erdenet mine and they use waste and low-grade ore piles of Erdenet mine in their productions. The following table exhibits brief information about these 3 main centers of refined copper in Mongolia.

Table 11. Main suppliers of refined copper

	Erdmin Co.Ltd	Achit Ikht Co.Ltd	New Copper smelter plant (Feasibility Study)
Operator	Erdenet Concern LLC, RMC of USA	Achit Ikht (66%) Erdenet Mining Corporation (34%)	Mongolia 10% (Total investment 700 mill US$
Location	Bayan-Undur, Orkhon (area around Erdenet mine)	Bayan-Undur, Orkhon (area around Erdenet mine)	Bor-Undur, Khenti (06.2016)
Source	Low-grade ore	Low-grade ore	Erdenet, OT, Tsagaan suvarga
Process type	Hydrometallurgic smelting (SX-EW)	Hydrometallurgic smelting (SX-EW)	SX-EW
Life (Contract with Erdenet)	40 year	20 year	NA
Manufacture Development	1997	10.2014	2018-2019 (forecast)
Current products, capacity	Cathode copper (LME A grade) 2750 t/y Rolled copper 2000 t/y Copper wire 3800 m/y Electric copper wire 3800 m/y	Cathode copper (LME A grade) 10,000 t/y	Cathode copper 125,000 t/y

Source: Official websites of Erdenet, Achit Ikht, Ministry of Food, Agriculture and Light Industry

2.3.3 Transportation and logistic

Mongolia is a landlocked country situated between Russia to the north and China to the south. Table 12 shows the transportation types and ports for the Mongolian copper exports.

Table 12. Transportation and ports of main suppliers

	Type of transport	Ports
OT	Road	Gants mod, Gashuun Sukhait
Erdenet	Ralway (road)	Zamiin Uud
Erdmin	Ralway (road)	Zamiin Uud (and Tianjin port)
Achit Ikht	Ralway (road)	Zamiin Uud

Source: Companies websites and other sources

Erdenet, Erdmin and Achit Ikht use the Trans-Mongolian Railway which is 1110 km between Sukhbaatar and Zamiin Uud. OT mine is 110 km away from Gashun Sukhait (Gants mod) port and uses road to transport its product (which is packed in two-tonne bags) to its

bonded warehouse (Ganqimaodao) that is in China and 7 km away from Gashuun Sukhait port.

The current logistics of Erdenet, Erdmin and Achit Ikht:

1. Road transport from mines to railway in Orkhon aimag;
2. Transport to Zamiin Uud port by the Trans-Mongolian railway;
3. A mix of road, railway and sea to customers (customers are responsible for this logistics).

The current logistics of OT:

1. Road transport from the mine to the bonded warehouse (Ganqimaodao);
2. Stored at the warehouse for 14-21 days for the Chinese customs clearance. Mongolian customs clearance occurs at the marshalling yard at the OT site;
3. A mix of road and railway from Ganqimaodao to customers (customers are responsible for this logistics).

"Ulaanbaatar Railway" and the department of Policy and Planning at the Ministry of Road and Transport provided MEITI the following information about the mineral transportation by railway.

- The total number of wagons (by pieces) decreased to 205 in 2015 compared with 230 in 2014. It is because of the drop of total railway freight from 15 Mt to 13 Mt. However, the freights of copper concentrate and ferrous metal increased while others decreased. In particular, copper concentrate freight went up from 584 to 612 Kt (mostly generated by Erdenet) and ferrous metal from 11 to 17 Kt in 2015.
- In 2015, the total freight turnover is 1,191 Mt km and total income reached to 154 billion MNT[11]. OT's freight turnover to Gants mod port is 92 Mt km accounted for 20 billion MNT.

The terms of trade of Erdenet and OT follow the international standards. The following 4 principles are agreed in the terms of trade.

- Cost of treatment and refining copper concentrate;
- Loss during smelting;
- Payment before or after shipping;
- In calculating the price of copper concentrate, choose the price of the month before or after shipping given the month to be shipped.

According to unofficial source, Erdenet has a 3-year contract and agrees on the price every year while OT has a 5-8 year contract. Incoterm of OT is 'Delivered at Place' (DAP) basis at the bonded warehouse facility (Gangimaodao).

[11] It's conducted by main eight routes: Route 1 - Tavan Tolgoi in Tsogttsetsii soum of Omnogobi aimag (Ukhaa Khudag mine-Gants mod port), Route 2 – Oyu Tolgoi at Khanbogd soum of Omnogobi aimag (Gants mod port in Gashuun Sukhait soum), Route 3 – Ovoot Tolgoi MAK in Gurvan Tes soum (Sekhee port in Shivee khuren soum), Route 4 – Ailbayan mining in Khuvsgul soum of Dornogobi aimag (Khangi-Mandal port), Route 5 – Tamsagiin Sav Gazar Dornod aimag (Bichigt port in Erdenetsagaan soum), Route 6 – Tamsagiin Sav Gazar in Dornod aimag (Bayankhoshuu port in Khalkh soum), Route 7 – Khushuut mining in Khovd aimag (Yarant Takeshikin port in Bulgan soum), Route 8 – Tayannuur mining in Gobi-Altai aimag (Burgastai Laoemo port in Bugat soum).

2.3.4 Supply cost structure and main factors

Supply infrastructure

OT: Most of the infrastructure facilities required for the OT project were completed during Phase 1. Certain infrastructure buildings and services will be expanded or added during Phase 2. OT is currently focusing on maintaining two long-term power supply options: Tavan Tolgoi (TT) with an IPP (Power Plant), and OT Build Own Operate (OT BOO). A final decision on the TTPP's (Tavan Tolgoi Power Plant) construction is expected in 2017 (see Figure A1 in Appendix).

Energy Resource started constructing a single-track heavy-haul rail from its Ukhaa Khudag coal mine (approximately 120 km to the north-west of Oyu Tolgoi) to Gashuun Sukhait, ultimately to be interconnected with the Chinese rail network at Ganqimaodao on the Chinese side of the border. Once constructed, the South Gobi Rail alignment would pass within 10 km of the OT project area and therefore represents an opportunity for eventual connection of the mine to the rail network.

Erdenet: According to the strategic plan of development of Erdenet Mine for the years 2010-2020, Erdenet Mining Corporation has the tasks to improve the equipment of the plant, to extend the ore processing capacity up to 35 Mt per year, to reduce unit cost, to produce a final product with added value by introducing new techniques and technologies, which are environmentally-friendly and energy saving.

Erdmin and Achit Ikht: Erdmin and Achit Ikht run their activities with around 110 and 200 Mongolian workers, respectively. Erdmin has been conducting research to manufacture copper plates, new products with added value from copper. Also, it has developed a project of factory with manufacturing capacity of 25 tonnes cathode copper per day in collaboration with Erdenet Mining Corporation.

Technology of companies, SX-EW plants has the following 3 main production stages:

1. Dump leaching
2. Solvent Extraction workshop (SX)
3. Electrowinning workshop (EW).

Supply cost structure

The main cost factors of a mine are financing costs, operating costs, administration cost, license costs (royalties) to the country of the mine and depreciation and amortization. To compare the cost of different copper mines, mainly the cash costs are compared. In the cash cost model of a copper mine the total costs are considered from ore to copper cathode. If a mine does not produce cathodes, then also the treatment and refining charges (TC/RCs) given to the smelter and refinery are considered as cash costs. The cash costs include mining costs, milling costs, royalties and administration costs of the mining site, but no costs of the headquarter. Cash costs do not include financing costs and depreciation and amortization. Sometimes cash costs are also termed "direct costs" abbreviated as C1 (www.understanding-copper.com).

There is a lack of official information on Erdenet, Achit Ikht and Erdmin's supply costs. Only OT's financial information is in Table 13.

OT's C1[12] costs in Q3 of 2016 were 1896 $/t, compared with 1257 $/t in 2015. The increase was mainly due to lower gold sales, combined with lower production reflecting lower grades from reduced mining. All-in sustaining costs[13] in Q3 of 2016 were 2998 $/t, approximate with last year.

Table 13. OT Key financial metric

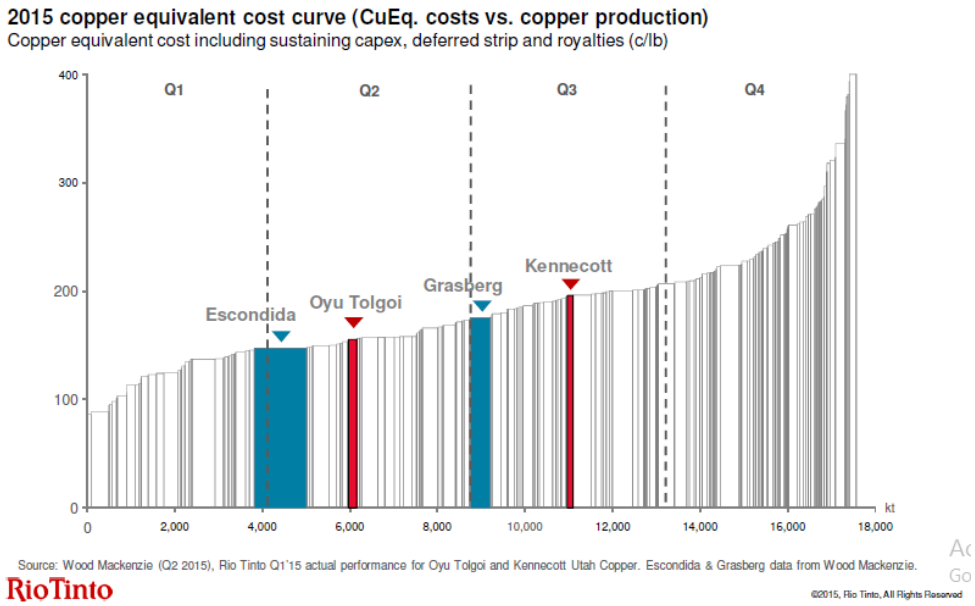
	2013	2014	2015	Q3 2016
Revenue ($ in millions of dollars)	52	1644	1635	979
Concentrates sold ('000 tonnes)	26	734	820	647
Revenue by metals in concentrates ($ in millions of dollars)				
Copper	38	1011	830	584
Gold	13	616	789	377
Silver	1	17	16	18
Cost of sales ($ in millions of dollars)	**49**	**1272**	**975**	**678**
Production and delivery costs	37	888	630	401
Depreciation and depletion	13	382	345	266
Capital expenditure on cash basis ($ in millions of dollars)		159	116	184
Royalties		92	121	55
Operating cash costs ($ in millions of dollars)		906	963	600
Unit costs ($ per pound of copper)				
C1		1.14	0.57	0.86
All-in sustaining		1.95	1.37	1.36
Unit costs ($ tonne of copper)				
C1		2513	1257	1896
All-in sustaining		4299	3020	2998

Source: OTTR and Turquoise Hill Resource Ltd "Press Release"

[12] C1 cash costs is a metric representing the cash cost per unit of extracting and processing the Company's principal metal product to a condition in which it may be delivered to customers, net of gold and silver credits from concentrates sold. C1 cash costs are relevant to understanding the Company's operating profitability and ability to generate cash flow. When calculating, costs associated with producing a pound of copper, the Company includes gold and silver revenue credits as the production cost is reduced as a result of selling these products.

[13] All-in sustaining costs (AISC) is an extended cash based cost metric, providing further information on the aggregate cash, capital and overhead outlay per unit, and is intended to reflect the costs of producing the Company's principal metal product in both the short term and over the life-cycle of its operations; as a result, sustaining capital expenditure on a cash basis is included rather than depreciation. As the measure seeks to present a full cost of copper production associated with sustaining current operations, development project capital is not included.

Figure 17. Copper mine's 2015 copper equivalent cost curve (CuEq, costs vs, copper production)



Source: Rio Tinto (2015)

2.3.5 Supply competitiveness and FDI in the industry

Supply Competitiveness

The copper industry has, over the past ten years, become increasingly competitive. The success of any future operation will depend on its ability to survive in periods of low copper prices. For companies operating on copper concentrate, the competitiveness is the main indicator. The main competitiveness for companies is costs and other factors such as unit cash cost, technologies, operation, region and to a lesser extent to exchange rates.

- OT's long-term C1 cash cost (net of by-product credit) is planned to be 1.15 US$/lb which is close to the world's №1 mine Escondida's plan, 1.08 US$/lb.
- It plans to make TC-RC costs to be 85 US$/t-0.085 US$/lb which is close to the expected world averages of 87 US$/t-0.087 US$/lb. This indicates that OT's concentrate has competitive advantages to smelters.
- The Mongolian government policies mentioned in the previous chapters such as the national development strategy, industry and tax policies will have direct and indirect effects on the costs.
- Mongolian copper concentrate and some refined copper sales are settled in USD, and a portion of its expense are incurred in local currency MNT. In the short-term, foreign exchange fluctuations could have an effect on companies' operation margins (OTTR, 2016).
- Location has a major impact on processing. For instance, it is less costly to ship concentrate from Chile's copper mines due to their proximity to the sea, than, say

from Central Africa where because of infrastructure impediments, it is more profitable to smelt and refine the ore locally in order to reduce the volumes transported to ports (Crowson 2011 & "Special focus" WB).

- Being close to China which consumes 50% of world refined copper and produces 30% of copper smelting production may be an advantage for Mongolia.

Foreign direct investment (FDI)

Mongolia attracted 4.7 billion USD by FDI that equal to 45 percent of GDP in 2011. Since then FDI has been decreasing and reached to 122 million USD in 2015 because of decreasing world prices of commodities and political instability in Mongolia. However, due to investment decision of OT's "2nd Phase – in the underground mine" and Mongolian policies which to create a favorable environment for investments of mining sector, Mongolia is expected to attract more FDIs in the near future. There are the following facts in Mongolia relating to copper mines:

- OT's investment decision on the 2nd phase of construction was reached in December 2015 and it would spend 4.6 billion USD. According to "2016 Oyu Tolgoi Feasibility Study", the construction has 5 phases and it plans to spend 9.7 billion USD on the underground mine construction. It was planned to invest 200 million USD in 2016. By Q3 of 2016, it invested 105.8 million USD. According to the investment agreement in Q4 of 2016, 750 million USD investment will be started in 2017.
- MAK plans to invest 680 million USD with the support of Germany government in Tsagaan Suvarga mine.
- Under the Mongolian government support, Ministry of Mining and Food, Agriculture and Light Industry and others explored about New Copper smelter plant. A feasibility study indicates that it will require 700 million USD.

2.3.6 Outlook of Mongolian copper supply in near future, long term 10 years

As mentioned before, at present, Mongolian refined copper capacity is around 13 Kt/y and most of it is exported. If the new copper smelter is approved by the government and resolves an investment and other environment issues, the refined copper will increase by 125 Kt per year.

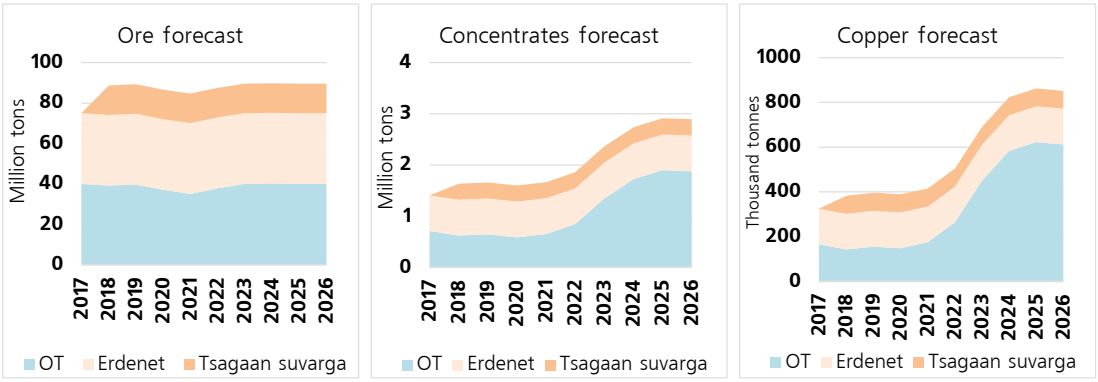
According to Turquoise Hill company's plan in 2016, OT will produce 600 Kt of copper concentrate in 2017-2021 and 1.5 Mt 2022-2027, on average. OT is expected to produce 130 to 160 Kt of copper in concentrates and 100,000 to 140,000 ounces of gold in concentrates for 2017.

Erdenet is producing, on average, around 130 Kt of copper in concentrate that over 500 Kt of copper concentrate each year until 2015. From 2016, Erdenet has expanded and update equipment of production and as a result, they are expected to increase producing, on average, over 600 Kt copper concentrate with around 160 Kt of copper in the near future. It is expected to maintain this level in the future. But, due to decreasing copper grade in ore body, Erdenet will have to increase the ore production so as to maintain its copper output level.

If Tsagaan Suvarga starts its production in 2018 as planned, the country's supply of copper concentrate will increase by around 310 Kt each year.

As a consequence, we estimate following production forecast of ore, copper concentrate and copper content in concentrate in Mongolia.

Figure 18. Supply forecast, 2017–2027 (processing ore, copper concentrate and copper content)



Note: First year begin from 2017.
Source: OTTR, MAK, Erdenet and prepared by survey team

In 2017, the production of copper concentrate will be around 1.4 Mt similar to that in 2016. But its copper content is expected to be lower. From 2023, the production of copper concentrate might reach 2 Mt if OT's high copper content mine and Tsagaan Suvarga operate. If so, the copper content will reach over 600 Kt which is twice as much as the current amount.

As you can see following brief forecast of copper concentrate and copper:

- **2017:** around 1300-1400 Kt concentrate with 300-350 Kt copper (period of low grade copper);
- **2018–2021:** annual average 1600 Kt, except Tsagaan suvarga it will be around 1300 Kt concentrate with around 350-400 Kt copper (period of low grade copper);
- **2022–2027:** annual average 2500 Kt (period of high grade in OT mine).

3. COPPER PRICE

3.1 Analysis of price

The income of companies producing copper concentrate is a function of mainly the final copper (cathode) price and the quality of their concentrate. The price of base metal such as copper, tin, zinc and so on is decided in international metal exchange, most importantly at the London Metal Exchange (LME), but also the Shanghai Futures Exchange (SHFE) and the Commodity Exchange Inc (COMEX) (Aikaterini and Jose, 2016). The final price paid for the finished product consists of the price determined on the metals exchange plus a regional cathode premium (ECORYS, 2011).

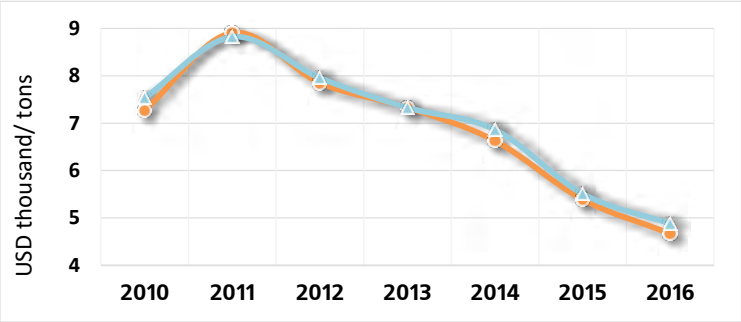
Copper price is set in the global market and Mongolia is a price taker so that the price of copper concentrate follows the world copper price. Next subsection discusses Mongolian export price trends of copper concentrate (and copper in concentrate) and refined copper.

3.2 Prices for Mongolian: past trends and current state

Price of refined copper

Following figure shows that the price of the Mongolia exported copper is approximately same as LME price[14]. Mongolian refined copper is "grade A cathode" which registered by LME and Mongolia has exported refined copper at 4669 USD/t that is 210 USD/t less than the world price in 2016 (Figure 19).

Figure 19. Mongolian refined copper price and LME price, per tonnes (2010–2016)



Source: Mongolian Customs and IMF (Dec 2016)

Price of copper concentrate

Using the Mongolian Customs data, we estimate the unit price of copper concentrate by countries from exportation data. It is calculated that the price of copper concentrate increased from 1460 USD/t in 2013 to 1867 USD/t in 2014. This increase was due to high content of copper and gold in OT's copper concentrate (Table 14).

Table 14. Unit price of copper concentrate by countries, USD/t (1995–2016)

Year	Average (HS code 2603)	By countries						
		China	Russia	Uzbekistan	South Korea	Japan	Kazakhstan	Others
1995	541	538	506	578	660	626	526	610
1996	438	408	440	482	329	453	560	408
1997	441	437	439	458		449	-	454
1998	257	257	259	281	252	263	258	226
1999	242	240	262	-	201		-	-
2000	323	324	314	-	400		-	-
2001	273	276	232	-	-		-	-
2002	256	256	255	-	-	360	-	1919
2003	288	288	272	-	10000	288	-	473

[14] Definition (IMF): Its yearly average price - LME, grade A cathodes, spot price, CIF European ports.

2004	505	504	719	580	-	-	-	549
2005	556	558	604	517	-	-	-	1655
2006	1060	1060	1139	-	-	-	-	1709
2007	1335	1335	1277	-	-	146	-	778
2008	1434	1434	1047	-	1321	-	-	1460
2009	855	855	893	-	-	-	-	1908
2010	1355	1355	1480	-	-	-	-	2354
2011	1682	1682	167	-	-	-	-	806
2012	1460	1460	-	-	-	-	-	-
2013	1460	1460	-	-	1434	-	-	-
2014	1867	1864	-	-	-	2757	-	-
2015	1543	1539	2470	-	-	1668	-	-
2016	1029	1029	-	-	-	-	-	-

Source: Mongolian Customs and prepared by the authors

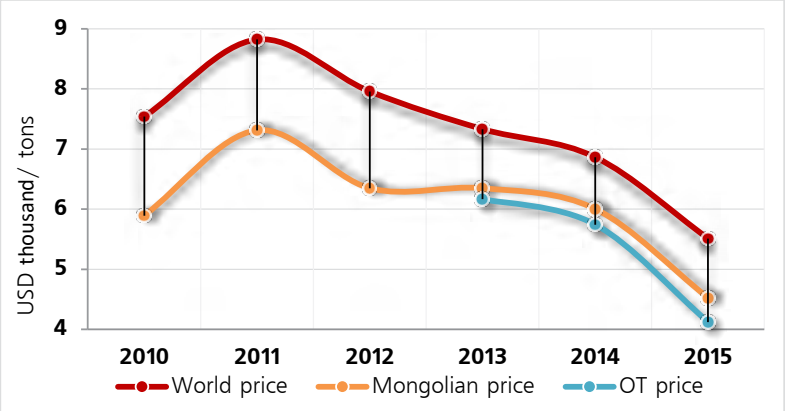
The annual average price of copper concentrate declined to 1543 USD/t in 2015 and 1029 USD/t in 2016. This is because of the decline in the world copper price and the decrease in the gold and copper content of OT's concentrate.

According to ITC, the world average price of copper concentrate for importers is 1579 USD/t and exporters is 2130 USD/t in 2015. For instance, Chinese imported price was 1458 USD/t that to consider by top countries, Chile 1521 USD/t, Peru 1416 USD/t, and Mongolia 1605 USD/t in 2015. On the contrary, main exporter price such as Chile's exportation price is 5053 USD/t, Peru is 1299 USD/t, Indonesia is 1915 USD/t and Australia is 1909 USD/t.

Price of copper content contained in concentrate

The price of the copper content in Mongolian copper concentrate is about 65-87% of the world copper price. Figure 20 shows the difference. For example, in 2015, the price of exported copper in concentrate was 4522 USD/t which is less than that of copper by 989 USD/t. But this gap has declined. Because during 2010-2012, difference was more than 1500 USD/t.

Figure 20. Price of copper in concentrate (2010–2015)



Source: Mongolian Customs, OT, IMF and prepared by authors

This difference can be explained by smelting cost, refining cost, transportation costs and profit of smelting. On average, the price difference had been around 1000 USD/t since 2013, the difference between the world copper price and that of OT's concentrate is bigger compared with the Mongolian average price (Figure 20).

To conclude, the price of Mongolian copper in concentrate was less than the world market price by 13-22 percent in last few years.

3.2.1 Copper price forecast for Mongolian Budget plan

The Mongolian government has aimed to support mega project in mining and proposed the following factors against metal prices drop:

- to improve infrastructure and road;
- to improve energy supply;
- to improve water supply;
- to reduce burden of border by pass activities.

In article 47 of Mineral law, it states that royalty is "0" percent when the copper price is less than 5000 USD/t.

Copper producers Erdenet and OT were the largest generators of government revenue in 2015. According to MEITI, mining (extractive) sector's revenues to paid government budget is 1004 Billion MNT in 2017 which 638 billion MNT (63%) consist with dependence on copper concentrate.

In table 3.2, 2017 State budget plan of Mongolia, the equilibrium price of copper taken into account of copper royalty in 2017-2019 forecast.

In 2015, Mongolian government forecasted copper price into the State budget of 2016 and it was higher than actual price.

Table 15. Government forecast of copper price and export in Budget plan

	2016	2017	2018	2019
Export of Copper concentrate (Mt)	1.392	1.400	1.282	1.462
Price (USD/t)				
World price (at budget plan)	4676.9	4693.1	4693.5	4701.5
Equilibrated price	5137.7	4599.4	4658.9	4725.5

Source: 2017 State budget plan of Mongolia, MoF

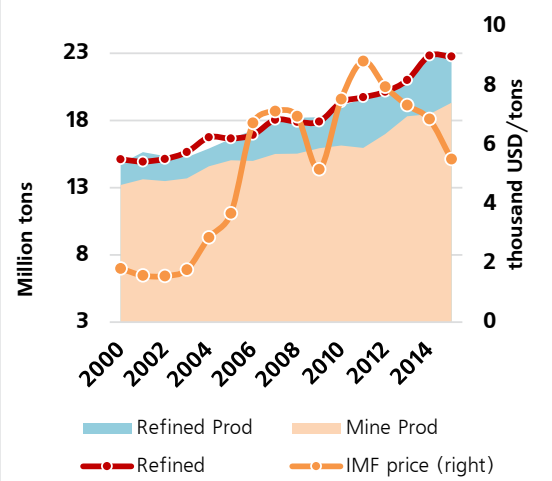
As a result, copper performance in the revenue of royalty will be lower than expected. In 2017, the equilibrated price of copper is forecasted at 4599 US$/t and the copper royalty is calculated at that price. If the copper price reaches more than 5000 US$/t in 2017 as forecasted by IMF and WB, it will affect positively on the revenue of copper royalty and exports of Mongolia.

3.3 World copper price

The surge in copper price during the 2000s has at times been attributed to rising demand from China and India (WB, 2015). In 2000-2014, it was led by Chinese industries that accounted for almost half of China's growth. Especially, China's demand for copper created a shortage in 2003-2005, leading to a sharp upward trend in the price (Figure 21-22). Because of the excess demand, the price reached its highest level of 9881 USD/t (monthly price of IMF – LME price) in 2011. Since 2011, the difference between the supply and demand decreased and averaged around 150 Kt of an excess supply per year (ICSG). Then, the copper price has been decreasing and to an annual average of 4879 USD/t in 2016. The following factors may have affected the decrease in the price of copper:

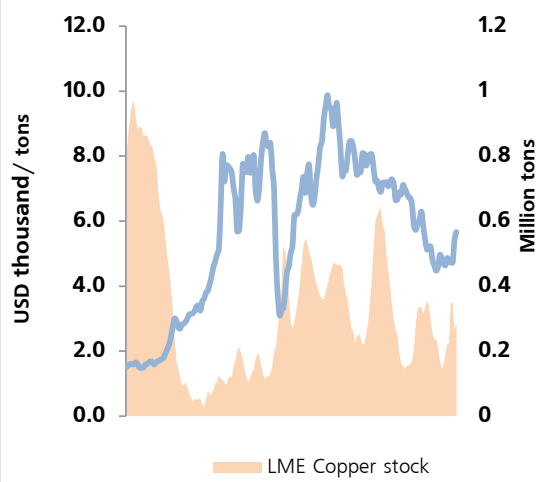
- China's economic growth slowdown;
- Surplus of supply;
- Stronger USD (Fed increased its rate by 25 percentage points);
- The price of oil and energy have declined etc.

Figure 21. Past trends of World copper market (2000–2015)



Source: IMF, WBMS and ICSG

Figure 22. LME copper stocks and prices (Jan 2002 – Dec 2016)



Source: West metal and LME

As mentioned before, the final price of copper is decided in international metal exchanges. On the LME copper is quoted in US dollar per tonne, on COMEX quoted in US cents per pound and on the SHFE quoted in Renminbi per tonne. In these exchanges, prices are settled by bid and offer, reflecting the market's perception of supply and demand of a commodity on a particular day. Also copper is a settlement price for the present day (spot price) or for future days.

The relationship between monthly LME copper stock and IMF price (based on LME price) is given in Figure 3.4. Accordingly, the copper price increased in the last few months of 2016. The 2016 high and low copper prices were 5666 USD/t (Dec) and 4471 USD/t (Jan), respectively and the annual average was 4879 USD/t (11.5% less than that in 2015). BI reported that this monthly spike was due with higher Chinese demand than expected and muted supply growth. Some researchers add, there are another driver of this shift that is Donald Trump's promise to rebuild infrastructure in the US.

Hence, as of the end of December, copper stocks held at the major metal exchanges (LME, COMEX, SHFE) was total 539 Kt increased by 57 Kt (12%) from stocks held at the end of December 2015. Compared with December 2015 levels, stocks were down at SHFE and up at the LME and COMEX (ICSG, Jan 2017).

There are lots of literatures exploring the factors responsible for the changes in the copper price. Namely,

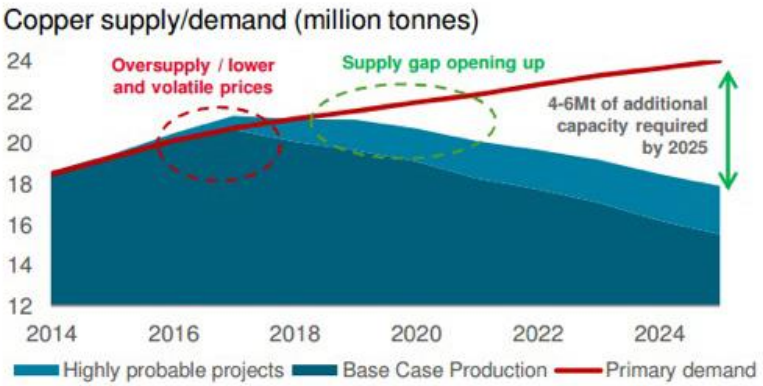
- "A 1 percentage point decline in China's growth has been estimated to reduce metals prices by 1.3-1.5 percent" (Inoue, Kaya and Ohshige 2015; Ahuja and Nabar 2012).
- "A 1 percentage point decline in Chinese industrial production has been associated with a decline of 2.3 percent in copper price" (Roache, 2012).
- US Fed has increased its interest rate, this resulted in the appreciation of US dollar. The experts believe the situation also affected copper price.

- According to CME Group, 42% of the copper price changes is explained by the following factors WTI-oil, RMBUSD, EURUSD, FTSE, China A50, S&P 500 and Fed Funds Rate.
    1. Oil price 10% rise (fall) correlated 2.9% rise (fall) copper price;
    2. S&P 500 10% rise copper price 3.9%;
    3. Chinese stock has a weak effect;
    4. A weak US$ tends to mean higher copper prices and vice versa;
    5. Finally, copper exhibits a fairly modest, and, by most measures, not a statistically significant negative response to Fed rate hikes.

3.3.1 Outlook of copper balance

Overall, we mentioned before, global copper demand will increase due to moderate expansion in China. Moreover, copper supply deficit starting in approximately 2019 (Figure23).

Figure 23. Copper supply–demand balance



Source: Wood Mackenzie, Q1 2015 & Rio Tinto, 2015

As a result, the combination of ongoing amortization at existing mines and further demand growth means the industry will need to find significant new capacity in the medium to long term.

On the other hand, BI forecasts that the surplus of refined copper starting in 2017 and peak in 2019 at about 900 Kt (Kenneth and Zhuo, 2016). Because of development of new mines and assuming announced copper projects are completed and ramp up (and idled copper mine capacity may return if price sustain recovery).

And also, WB reported that although significant supply growth is expected in a number of countries in 2017-2018, declines elsewhere and potential disruptions from upcoming wage negotiations in Chile may minimize the expected surplus.

3.3.2 Outlook of world prices for Mongolian copper in near future, long term

Based on global outlook of copper supply/demand and other factors, IMF, WB and OT has made their copper price forecasts (Figure 24).

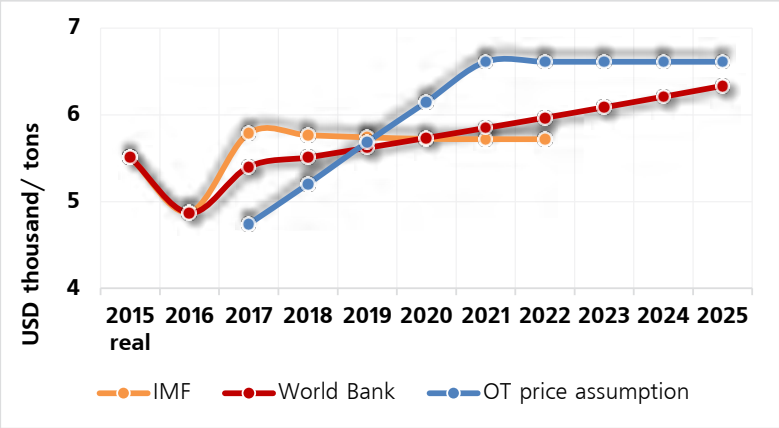
Copper prices are projected to decline approximately by 13 percent in 2016 due to surplus in copper market.

IMF, WB and OT has assumed copper price will start to increase from 2017.

- In next 2-3 years, the price will increase modestly due to copper market rebalance.
- In the long term, the price will start to increase more due to shortage of supply.

For instance, price will be reached over 5400 USD/t according to IMF and WB.

Figure 24. Copper price forecast (2015–2025)



Source: IMF (Dec 2016), WB (Jan 2017) and OTTR (Oct 2016)

In world market, metals prices are projected to increase by 11% in 2017 due to tightening markets for most metals, especially those facing imminent resource constraints. Double-digit gains are expected for copper price (WCO, 2017). Hence, WB reported in WCO that upside risks to prices include stronger global demand, slower ramp-up of new capacity, tighter environmental constraints, and policy action that limits supply. Downside risks include slower demand in China and higher-than-expected production, including the restarting of idled capacity.

Main conclusions

- All copper industry analysts expect that global copper demand may continue to be supported further by a moderate expansion in China, continued solid growth in other emerging markets, such as India and ASEAN, and modest growth in more industrialized regions such as the USA and Europe. For instance, the total demand in non-OECD and OECD countries is expected to grow at around 3.6% and to fall around 0.6% per annum to 2030, respectively. In 2017 and 2018, the total demand of copper will be same level with 2016 and further annual average growth will reach around 1-3%.
- China is one of the main players in the copper market and consumes about 50% of total copper production. It is anticipated that it will remain the main player in the future. Although Chinese economy has slowed down in the recent years and it supports the shift towards service and consumption from manufacturing in the 13th 5-year plan, the fundamental factors for the demand for copper are still in effect, according to analysists. In particular, it is expected that the demand for copper will be strong because increasing population and urbanization will be lead to more demand for electronics, equipment, infrastructure, electricity, maintenance, construction and automobiles.
- The top three producer countries of mine production are Chile, China and Peru. Chile, world's largest copper producer, produced around 30% of world mine production. Mongolia was one of the top 20 producer countries of copper in 2015 and the third largest supplier of copper concentrate to China after Chile and Peru. If the underground mine of Oyu Tolgoi starts its production in 2022 as in the plan, Mongolia will be exporting 2.4-2.6 million tonnes of copper concentrate with 600-800 thousand tonnes of copper content per year, on average. In relation to the underground mine of Oyu Tolgoi, 4.6 billion USD is expected as FDI.
- The copper price has declined since 2012 and the average price in 2016 is 4879 USD per ton. Because of the price decline, some mines reduced their production, some stopped their production temporarily and some delayed their planned extensions which has had a negative effect on the supply. Analysts expect that there will be a shortage in the market from 2019 because of the worldwide decline in copper content and changes in some government policies. In the near future, specifically in 2017 and 2018, the stock of copper will run down and hence the demand and supply of copper will be in balance.
- Based on global outlook of copper supply/demand and other factors, IMF, WB and OT has made their copper price forecasts. IMF, WB and OT has assumed copper price will start to increase from 2017.

APPENDIX

Table A1. Copper Import in Mongolia, 2010-2016, thousand USD (by copper products)

HS Code	Code description	Unit	2010		2011		2015		2016	
			Volume	Value	Volume	Value	Volume	Value	Volume	Value
2603	Copper ore and concentrate	kg	7	6.6	60	5.3	71	2.4	18	0.3
74	Copper and copper products									
7401	Stream-copper, copper	kg	-	-	-	-	-		0.6	0.3
7403	Refined copper and copper alloys	kg	36,194	285.4	24,639	248.8	2	0.1	-	-
7404	Copper waste and scrap	kg	-	-	-	-	-	-	-	-
7406	Copper powders and flakes	kg	-	-	21	2.2	3	0.1	-	-
7407	Copper bars, rods and profiles	kg	3,236	24.4	3,144	17.8	13,538	91.3	4,489	36.1
7408	Copper wire	kg	37,322	342	149,592	1722.4	5,759	36.4	11,493	51.1
7409	Copper plates, over 0.15 mm thick	kg	12,615	93	7,881	90.9	20,390	92.2	3,053	30.7
7410	Copper foil, 0.15 less thick	kg	-	-	4	0.5	2,230	33.3	-	-
7411	Copper tubes	kg	19,648	168	48,209	369.9	62,770	481.7	49,971	376.5
7412	Copper tube armatures	kg	12,835	216.6	20,020	263.4	21,195	276.5	29,679	427.7
7413	Plaited bands, copper wire (not electrical cover)	kg	128,384	1193.7	69,947	1373.2	228	2.8	10,605	280.3
7415	Nails and laces make with copper	kg	35,500	104.6	59,592	152.9	5,509	51.3	4,059	51.7
7418	Kitchen tools with copper	-	31,657	147.1	2,225	36.3	-	73.5	-	63.8
7418 2000	Plumbing equipment, parts	kg	243	5.3	823	23.2	2,008	66.4	1,379	50.2

7419	Other copper products	kg	7,702	80.2	21,843	436.6	4,422	102.5	12,140	179.2
	Total	**kg**	**293,686**	**2666.7**	**405,774**	**4743.4**	**138,125**	**1312.7**	**126,905**	**1548.1**

Source: Mongolian Customs

A2: Copper production: How is copper produced? (ICSG)

Table A3. Underground tonnage and grades

Deposit	**Mines (Mt)**	**Copper feed grade (%)**	**Copper (Mt)**
Hugo North	1,477	1.23	16.5
Hugo South	298	1.07	2.9
Heruga	699	0.42	2.5
Total	**2,474**	**0.98**	**21.8**

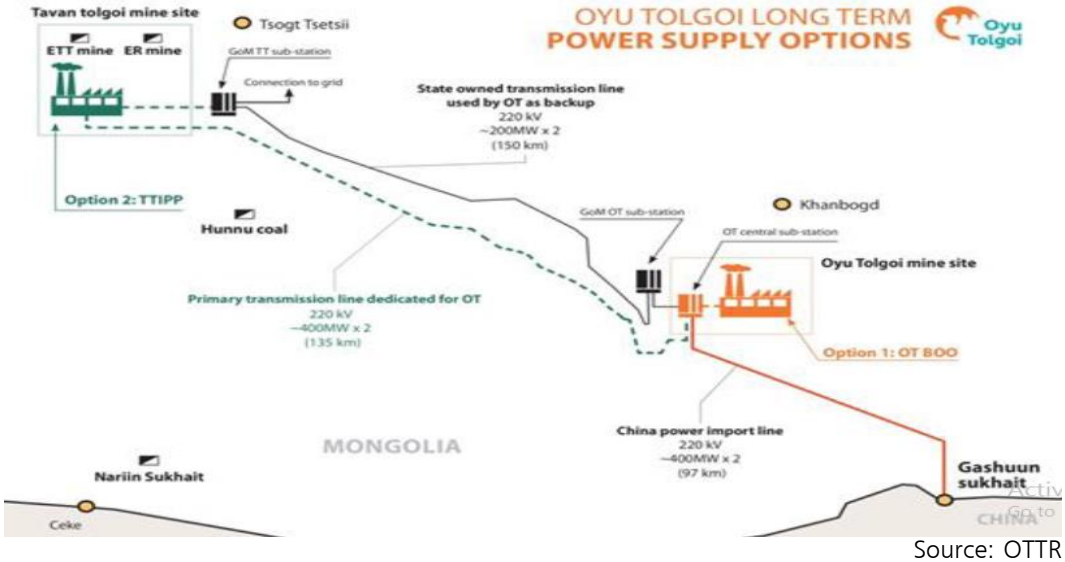
Source: OTTR

Table A4. Mining production statistics - 2016 (reserves case and resources case)

		5-Year average	**10-Year average**	**2016 Reserves case**	**2016 Resources case**
Quantity ore treated	Mt	38.2	38.9	1,448	3,423
Copper feed grade	%	0.51	0.97	0.86	0.83
Copper recoveries	%	81	88	87	88
Concentrate	Mt	0.6	1.1	38.6	93.3
Copper concentrate grade	%	25	30	28	27
Contained metal in concentrate					
Cu	Mt	0.2	0.3	10.8	25.1

Source: OTTR

Figure A1. Power supply options – OT



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