MINISTRY OF MINING

BASELINE REPORT: ‘GOLD 2025’ PROGRAM

DECEMBER 2015

TABLE OF CONTENTS

FIGURES

TABLES

INTRODUCTION

The National Gold Program of 1992 - 2004 was successfully implemented, making a significant contribution to the economic growth of Mongolia. According to the National Statistics Office of Mongolia, gold production accounts for 2.6% of the country's GDP, 9.6% of mining production and 9.1% of export revenue. Mongolia's current gold reserves are estimated to exceed 2,000 metric tons ("t" or "tonnes"), both in deposits, in which gold is the principal metal and those in which gold is secondary to other metals.

Recent amendments to gold sector legislation and taxation policy have had a positive impact, resulting in a steady increase in gold sales and export revenue. The nation's total gold production was 5.9 t in 2012, grew to 12 t in 2014, and is expected to have hit 15 t in 2015. Gold sales to the MongolBank (the Mongolian Central Bank) rose from 6 t in 2013 to 12.7 t in 2014. The percentage of gold purchased by the MongolBank from artisanal operators grew markedly from 0.1% in 2013, to 25.5% in 2014 and 45.7% in 2015 (as of end October). From 2013 to 2014, the respective total gold sales revenue of these miners (in Mongolian Tugrik) almost doubled, from an equivalent of US$270.4 million to US$514.5 million.

Share of gold sales revenue contribution to the national total foreign currency reserves was estimated at between 4% and 7% in 2010-2013 and increased to 40% in 2014. Total gold exports were 7.5 metric tonnes in 2013, worth US$308.8 million, grew to 10 metric tonnes in 2014, and, preliminary estimates for 2015 are that exports likely will reach 11 metric tonnes worth US$412.9 million.

Although the potential for a much larger annual production of gold is widely considered to be high, the country has many pressing issues to manage, including:

- increasing gold resources through intensive exploration;
- establishing a consolidated database for gold mining and processing;
- improving the responsibility of gold mining entities and artisanal miners;
- enhancing the recovery rate at placer and hard rock deposits;
- processing for extraction of gold remaining in mine tailings and waste rock;
- improving environmental reclamation of mined areas; and
- optimising the legal framework for artisanal micro-mining.

The Ministry of Mining, jointly with the Mineral Resource Authority, is planning to submit a "National Gold Sector Development Program 2025" to Cabinet for approval. The paper should propose measures to address issues impeding the growth of the sector and include recommendations to manage the development of all types of gold mining (including artisanal), storing, transporting and sales regulations.

The proposed Gold Program aims to ensure long-term sector development, stability of the legal environment, intensified exploration, better efficiency and viability of the gold mining sector through the introduction of environmentally-friendly gold mining and processing technology, improvement of Mongolia's competitiveness, and maximisation of sector

benefits for the national economy. The proposed Program's wide scope encompasses gold exploration, mining, processing, sales and export, processing technology, environmental reclamation and artisanal mining.

Global price predictions from banks and financial institutions of the leading 10 countries are that the global market gold price will likely increase to US$1155.0 per troy ounce ("oz") in 2016, followed by a slight increase in 2017, settling in the US$1210-1230 range in the 2018-2020 period and fluctuating between US$1250 and US$1350 per oz from 2020 to 2025.

During the 10-year period of Gold Program implementation, investment and intensive exploration will increase gold resources and result in production of gold mined as a primary product to the range of 20 to 47.7 t annually, with an estimated total mine output of 353.2 t during the period.

Favorable factors such as policy measures to boost gold mining and sales combined with an increase in global market prices are expected to positively impact the gold sector, with sales revenues predicted to reach US$580.8 million in 2015, US$789.2 million in 2018, US$853.7 in 2020 and US$1167.7 million in 2025. In that 10-year period, gold exports are expected to fluctuate between 15.8 and 40 t per year. Gold exports are predicted to be worth US$1177.9 million in 2020 and US$1564.7 million in 2025. Gold exports in 2020 are predicted to be 26.7% more than in 2015 and 68.4% more in 2025.

With an increase in formal gold sales and export revenues, the country's foreign exchange reserves will grow and contribute to the stabilisation of the national currency exchange rate, further enhancing the other valuable contributions of the gold sector to economic growth. A stable legal environment for gold mining and sales will encourage further investment in exploration and mining.

Program implementation will result in a steady increase of gold and other mineral reserves containing gold, and will encourage the introduction of more advanced mining technology, reduced waste and allow better gold recovery. Opening a national gold refinery will enable direct gold sales to the international market, with more domestic production of end products, development of small and medium enterprises and more jobs.

As much investment is required to discover and develop deposits in the timeframe, there will be a pressing need for effective use of various innovative financing resources and for encouraging both foreign and domestic investment.

The supporting baseline report serves to provide the data and information required to develop an informed strategy for the 'Gold Program 2025'. **The next step is for the Government of Mongolia to develop an action plan to guide implementation based on these strategic recommendations.**

CHAPTER ONE - IMPLEMENTATION AND OUTCOMES OF GOLD PROGRAMS IN 1992 AND 2000

"Gold-1" Program

In the early 1990s, under the guidance and direct supervision of the first democratically-elected President of Mongolia, the Government of Mongolia developed a Gold Program and started implementation under Resolution 304 (1 November 1991).

During 1992-2000, annual gold mining output increased from 0.7 metric tonnes to 11 metric tonnes, with the development of placer gold mines, based on private sector funding. A considerable amount of tax revenue was generated for the state budget by the gold sector.

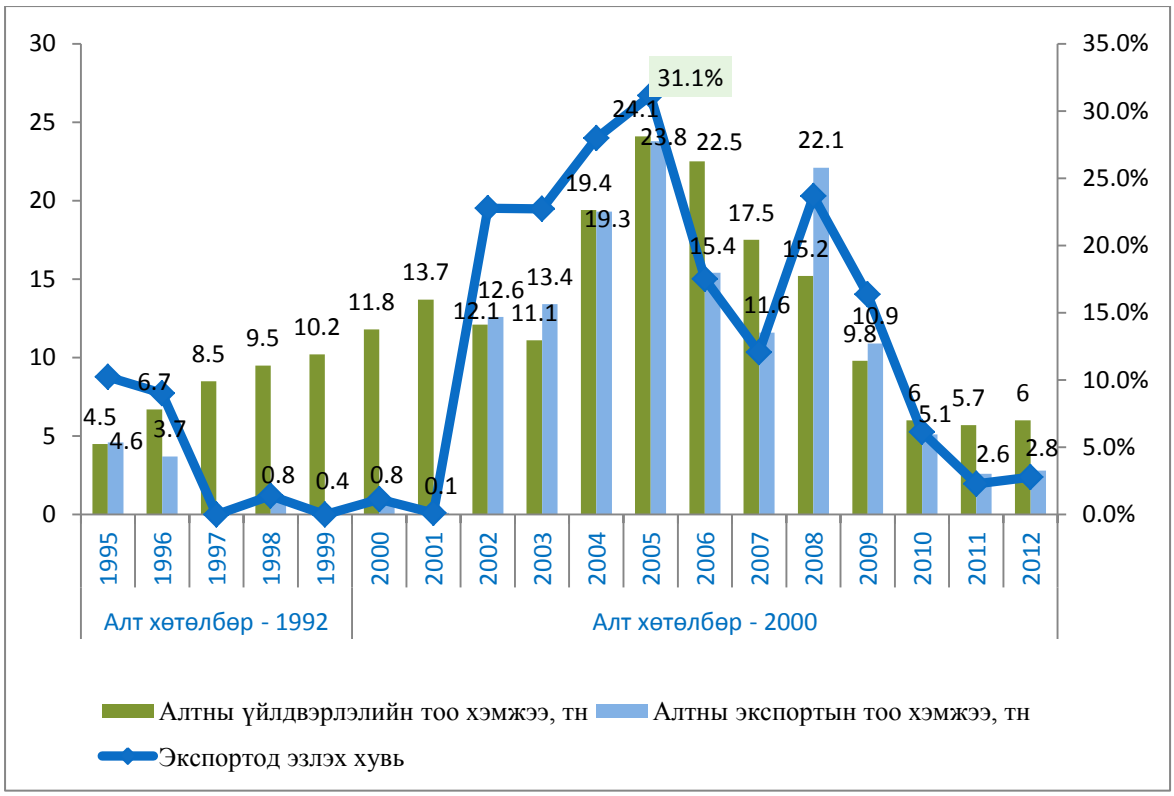
During the initial years, rehabilitation and environmental protection measures were not implemented. However, during 1995-1997, works such as an environmental impact assessment and mine rehabilitation plans were undertaken by gold mining companies. In addition, due to formation of waste damps around various placer gold mines, artisanal miners began to work around Sharyn-Gol, Zaamar and Bayankhongor gold mines.

"Gold-2" Program

A new era for gold production commenced during the decade from 2000-2010, for the first time witnessing national production of 24.1 t in a year, with almost 40 percent deriving from primary or non-placer gold deposits. However, it is understood that the severe decline of production during the last four years was based on the enactment of the "Law on Windfall Tax". There was a dramatic decrease in the amount of gold mined and sold by miners between 2007 and 2012. In 2012, only 6 t was reported by producers in the entire country and 2.8 t exported the lowest since 1996.

Between 1992 and 2012, gold production totalled 218 t and Mongolia exported 153.7 t in that ten year period. Gold production grew steadily between 1992 and 2000, and production between 2000 and 2005 rose from 11.8 to 24.1 t. Likewise, gold exports rose dramatically, accounting for 31.1% of all exports and a record high over the previous two decades.

Figure 1: Gold mining and exports, 1992- 2012 (t)



The results of previous Gold programs are summarised as follows:

1. An independent gold production industry was established.
2. Gold mining multiplied 17 times, from 0.8 t in 1992 to 13.7 t in 2001. The sector made a very significant contribution to recovery from the economic recession and played a key role in stimulating further growth.
3. The total of gold mined between 1992 and 2012 was 218 t and national exports of gold were worth US$2.8 billion in that period.
4. Over 10,000 jobs were created in the gold production sector, with many skilled and educated human resources.
5. Geological and technological studies into gold production have expanded. Gold separation and washing/prospecting technologies were widely introduced, opening up more options for technological choice and enabling a wide and unique combination of gold mining systems and equipment.
6. Gold resource exploration has been carried out simultaneously with extensive gold mining.

CHAPTER TWO – NOTABLE RESOLUTIONS

Minerals Commodity Exchange

The Government's Action Plan for 2012-2016 includes measures to encourage more transparent gold production, storage and gold sales. To implement this plan, a working group was formed at the Ministry of Mining and has carried out a considerable amount of preparation for the establishment the Minerals Commodity Exchange. The Government of Mongolia issued Resolution #211 for the "Establishment of a Minerals Commodity Exchange", to be established based on domestic and foreign partnership and with 100 percent private investment. The Resolution indicated that draft regulations were to be prepared to regulate the commodity exchange.

Measures for Increasing Gold Mining and Stimulating Economy

The Government of Mongolia, during its session of 11th March 2015, made a Resolution #94 on "Some Measures for Increasing Gold Mining and Stimulating Economy". These measures include a clause to "Prepare a proposal to strengthen the Assay Inspection Department of the Mongolian Agency for Standardization and Metrology, and improve the registration systems".

Regulation of Artisanal Mining

"Regulation of Artisanal Mining" was approved by the resolution of Government on 1st of December 2010. For the implementation of this regulation, a model tripartite contract between the local authority, license holder and a partnership has been issued for approval. This model contract includes conditions on mining, sales of minerals mined by the partnership according to the related laws and regulations, and minerals sales to be made to a legal entity with respective rights. But, some provisions regarding gold mining and sales are not being implemented.

Law on Taxation onto Self-Employed Citizens with Indefinite Incomes

The "Law on Taxation onto Self-Employed Citizens with Indefinite Incomes" was adopted on 21st of October 2010 and laid a foundation for creating a legal environment for artisanal mining in conjunction with amendments to "Minerals Law" and "Land Law", on 1st of July 2010.

Civil Code

Gold mining and artisanal mining are regulated by clause 481.1 of the "Civil Code", and clauses in the Code became the legal grounds for activities of citizens, who are organised into unregistered partnership for the purpose of "mineral mining in the areas of mineral occurrences, waste and low grade reserves, and economically not feasible low grade deposits, that are licensed for artisanal mining".

The artisanal gold mining and sales' issue has been addressed in the amendment to the Minerals Law. Meanwhile, the previously existing minimum weight limit of gold sales has been eliminated to support and increase formal gold sales.

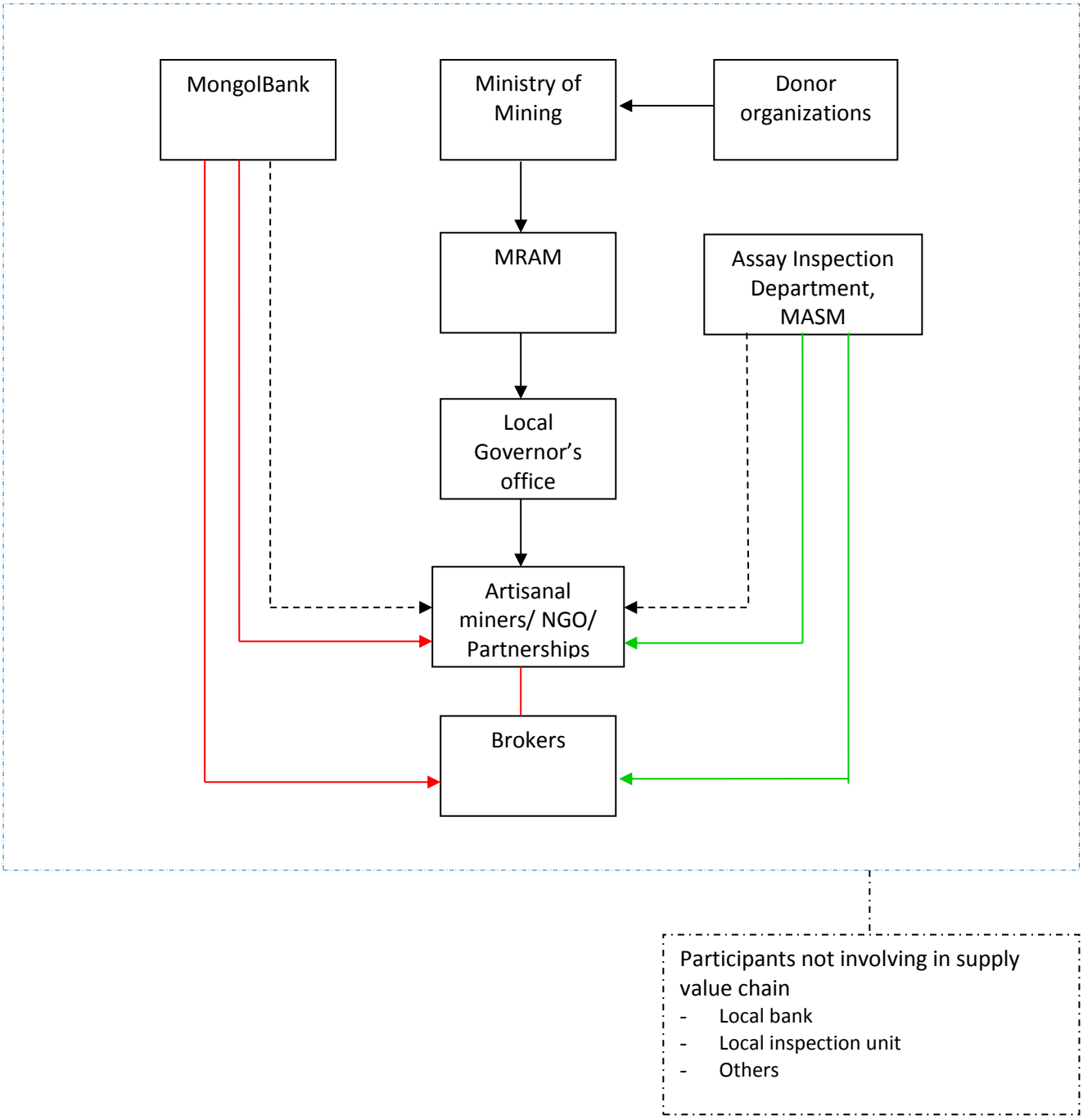
Clause 35 of the Minerals Law

A revision to Clause 35 of the Minerals Law was made on 24th of January 2014. According to this clause, if it's the case that gold mining entities and artisanal miners sell their produced gold to the MongolBank or another commercial bank (formally licensed and permitted by MongolBank) the royalty rate is to be 2.5%, and the royalty for sales in excess of market price does not apply. The reduction of royalty rate from 10% to 2.5% has served as an incentive for artisanal miners. Moreover, gold mining and sales by artisanal miners became more transparent, and their contribution to the state budget has increased considerably.

CHAPTER THREE – MANAGEMENT OF THE SECTOR

The intention of this chapter is to provide details on the organisations and participants, roles and responsibilities of gold miners, in relation to gold mining and the supply chain.

Figure 2: Management and structure of organizations involved in gold supply chain



Red line indicates gold sales route, green indicates assay inspection channels, black refers to management line, while the dotted lines indicate organizations that have the potential but do not yet participate in the gold supply chain.

Ministry of Mining

The Ministry of Mining is the state central administrative organisation defining mining sector policy, as well as monitoring policy implementation. Within this framework, the Ministry aims to achieve the following strategic objectives, including:

- Formation of mining sector laws, policy and medium to long term strategy;
- Organisation and coordination of implementation of laws, policy, programs and projects;
- Monitoring, inspection of laws and regulations, carry out monitoring and analysis during policy implementation, make evaluation in outcome and make conclusions.

The Strategic Policy Planning Department of the Ministry of Mining is responsible for artisanal mining issues and, together with the Policy Implementation Department, offers policy options for implementation in the artisanal mining sector, while the Monitoring, Evaluation and Internal Audit Department reviews the implementation of such policies.

Minerals Resources Authority of Mongolia (MRAM)

The Minerals Resources Authority acts as an implementing Agency under the Ministry of Mining, supporting policy implementation in relation to the geology and mining sector. Specifically, MRAM manages the implementation of the Minerals Law, Law on Land, Law On Procedure for Implementation (Long-Named Law), the Government Action Plan and the Mining Policy. According to the Minerals Law, MRAM is responsible for managing and regulating the approval processes for mining licence holders' feasibility studies, annual mining plans, environmental impact assessments and gold mining activities.

MongolBank and commercial banks

The Bank of Mongolia (MongolBank) is the legally responsible organisation for the implementation of the state monetary policy, with the objective to provide stability of the national currency.

According to the Treasury Law of Mongolia, it is responsible for buying and selling gold, its storage and refining. The Bank carries out gold export activities, but does not exercise its right to sell gold in the domestic market. MongolBank also issues special permission to commercial banks to buy and store gold, but commercial banks do not yet exercise these rights in realising gold sales.

MongolBank subsidiaries operate in 12 aimags (provinces of Mongolia) including Arkhangai, Bayan-Ulgii, Bayankhongor, Khovd, Dornod, Dundgobi, Govi-Altai, Khentii, Khuvsgul, Sukhbaatar, Uvs and Zavkhan, while smaller units operate in 5 aimags including Darkhan-Uul, Orkhon, Uvurkhangai, Dornogobi and Umnugobi. Branches and units act to facilitate inter-bank transactions, but they do not yet provide loans.

MongolBank verifies assay results of smelted and refined gold (assayed by Precious Metal Lab at the Assay Inspection Department), arranges the gold payment, charges 2.5% gold royalty and transfers this amount to the gold sellers' account at the Taxation Department. The gold price is set by MongolBank based on the previous day's London Bullion Market ("LBM") gold price quotation, minus US$3 per oz as the refining charge and converts the amount to Mongolian MNT according to the official US$ vs. MNT exchange rate. Smelted

and unrefined gold is sold at a price 0.2-0.25% lower than world gold price. The above price margin covers storing, transportation and refining cost of the MongolBank.

Standardisation and Metrology Agency

The Assay Inspection Department of the Mongolian Agency for Standardisation and Metrology carries out control of the certification process of precious metals, including jewellery samples and assaying, which are mined, produced and sold in Mongolia. This organisation has the right to conduct the assaying of precious metals at local levels, but this right is not being implemented due to the absence of finance, necessary equipment as well as proper laboratory facilities. The Government of Mongolia issued resolution #33 in 1998 and approved precious metal and stones quality inspection rules.

Local government

In line with the "Procedure on artisanal mining", Governors and Citizens' Representative Khural at soum (county) and district levels are regarded as the primary level state organisations directly engaged in activities related to artisanal mining and trading by miners, and forming agreements and partnerships with artisanal miners. Local Citizen's Khural exercise the right to take part in the activities of artisanal miners through providing assistance in defining mineable locations and their coordinates through sending permission to the Minerals Resources Authority and monitor implementation.

Artisanal miners, partnerships and non-governmental organisations

Since 1990, when artisanal mining first began in Mongolia, artisanal miners were referred to as illegal or informal artisanal miners, individual miners or informal workers. In the absence of formal legal coordination, state support has not been uniform or consistent.

The activities of artisanal mining are now regulated by clause 4.1.2 of the 'Land law' and clause 481.1 of the "Civil Code". Specifically these regulations support the activities of citizens, organized in the form of unregistered partnerships for the purpose of 'mineral mining in the areas of mineral occurrences, waste and cut-off grade reserves, and economically not feasible low grade deposits, that are licensed for artisanal mining'. According to the 'Law on determining income for self-employed' artisanal miners have the obligation to pay MNT 53000 per month.

Gold brokers

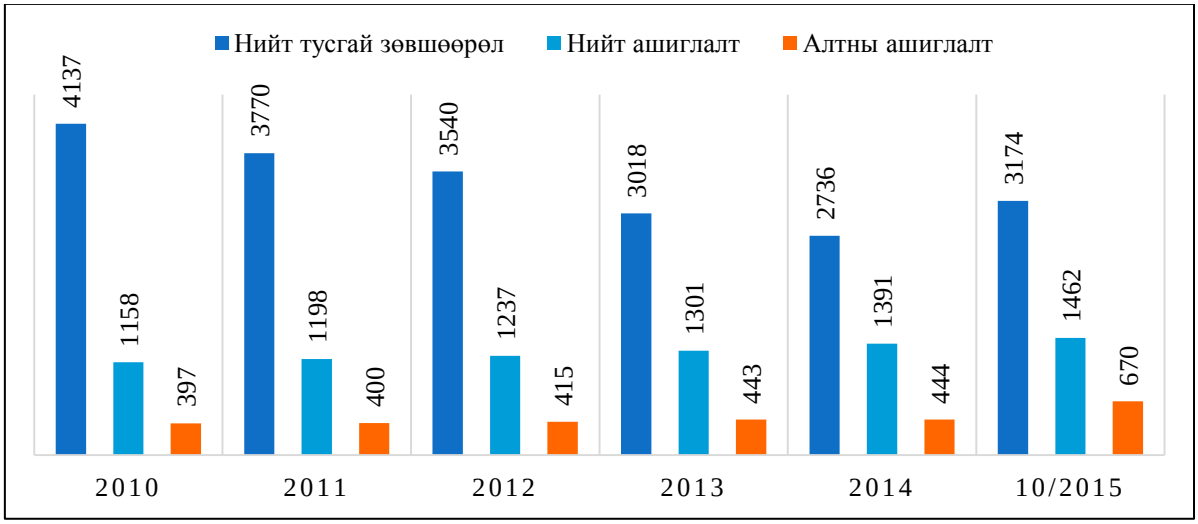
Gold brokers act as 'middle men', buying gold from artisanal miners and selling gold to the MongolBank. They use their own funds to purchase gold and trade for profit. Due to the absence of MongolBank branches and assay inspection services in rural areas - to support the activities of artisanal miners - brokers purchase gold from artisanal miners, then transport to Ulaanbaatar city, store, assay, and then sell to the MongolBank.

CHAPTER FOUR - SITUATIONAL ANALYSES OF THE GOLD SECTOR

1. GOLD EXPLORATION AND MINING LICENSES

Mineral Resources Authority of Mongolia (MRAM) data of October 2015 shows that 3174 licenses (1462 mining licenses and 1712 exploration licenses) are in effect.

Figure 3: Total gold mining licenses



Source: MRAM, 2015

There are 670 gold mining licenses (49.4% of all mining licenses) and 322 gold exploration licenses (23.1% of all exploration licenses). An area of 13.3 million hectares in Mongolia has been allocated for mining licenses, 22.2% of which each cover an area of only 2.9 hectares.

Table 1: Number of gold mining licenses

Years	Gold mining licenses	Share of gold mining licenses in total licenses
2006	513	59.5
2007	492	52.8
2008	437	41.9
2009	416	36.8
2010	397	32.9
2013	443	34.1
2014	444	31.9
2015.10	670	49.4

Source: MRAM, 2015

2. GOLD EXPLORATION

An unfavorable legal and tax environment for the mining sector in the 2008-2012 period slowed national and foreign investment in gold exploration. This slowing also reflected a

recognition that the country appears to be running out of placer gold deposits and there seems little likelihood that larger placer deposits will be discovered. In this period, thousands of exploration licenses were cancelled and many areas covered by exploration and mining licenses were removed from the licensed areas by the Long-Named Law, making it impossible to carry out any mineral exploration and extraction. Unlike earlier, when mineral licenses covered 40% of Mongolia, license coverage areas fell to 9.5%, more than a fourfold decrease.

To bolster foreign currency reserves, there is a need to increase gold resources, to start commercial use of newly discovered deposits and use existing deposits more efficiently. The Government of Mongolia allocated MNT 10 billion (approx. US$5million) for geological mapping and general exploration in 2014.

Recent endorsement of the State Policy for the Mineral Resources Sector and amendments to the Minerals Law have permitted licensing for 19.5% of Mongolia, an important step towards intensifying exploration and increasing domestic and foreign investment.

In 2014-2015, the Mineral Resources Authority issued over 600 licenses to national and foreign entities, either through direct application or by auction.

3. GOLD RESERVES

In 2014, over 1350 t of gold reserves had been officially proven and registered according to the established Mongolian system for classification of reserves in mineral deposits: 27.6 t in placer deposits, 224.2 t in hard rock gold deposits, and 1101.3 t in other minerals deposits containing gold.

Table 2: Proven gold reserves

Type of deposit	1991		1997		2014	
	Number of deposits	Reserve, tonnes	Number of deposits	Reserve, tonnes	Number of deposits	Reserve, tonnes
Alluvial	156	90.3	498	206.25	608	27.6
Hard rock	15	50.2	31	127.8	74	224.2
Deposits of other metals plus some gold	-	-	-	-	17	1101.3
Total	**171**	**140.5**	**529.0**	**334.05**	**699**	**1353.1**

Source: MRAM, 2015

Currently, the Boroo hard rock deposits are being actively mined and are almost exhausted, while deposits held by Altan Dornod Mongol, Shijir Alt (subsidiary of MongolRosTsvetMet) and Monpolimet have run out of reserves. This will mean a drastic decrease in gold mining and production volume.

Alluvial deposits take up a low share in overall reserves, while potential areas for exploration were restricted under the Long-Named Law, so there is little possibility of increasing alluvial deposit reserves. It is predicted that mining operations at alluvial deposits will cease within the next 7-8 years.

A. Alluvial gold deposits

Presently, 608 large and small placer gold deposits have been identified in Mongolia as formal reserves; 169 placer deposits have been mined and are out of reserves, while a few deposits have not been exploited because of difficult geological conditions and high operating costs (AISC).

It is estimated that 27.5 t of gold reserves remain to be mined in operating placer deposits. The percentage of placer deposits in overall reserves has fallen drastically, while there has been a considerable increase of reserves in hard rock deposits, particularly those in which gold is not the principal commercial component. Gold mining has the potential to increase by discovering and developing hard rock deposits containing gold.

Table 3: Gold placer deposits, reserves, by aimag

	Aimag	Placer deposits	Number of mines using placer deposits	Total reserves, tonnes
1	Tuv	179	50	12.9
2	Selenge	114	29	4.4
3	Bayankhongor	99	29	4.8
4	Darkhan-Uul	46	15	2.2
5	Bulgan	26	8	2.8
6	Dornod	20	8	1.5
7	Uvurkhangai	26	8	1.3
8	Uvs	24	8	0.4
9	Khentii	22	8	3.6
10	Arkhangai	20	4	1.7
11	Gobi-Altai	8	2	0.3
12	Bayan-Ulgii	4	-	
13	Umnugobi	2	-	
14	Khovsgol	1	-	
15	Sukhbaatar	1	-	
	Total	608	169	34.3

Source: MRAM, 2014

There are 392 placer gold deposits registered in Tuv, Selenge and Bayankhongor aimags; 108 are currently being mined. Gold mining in these three aimags makes up 64.5% of all placer deposits, 63.9% of all deposits currently mined and 64.4% of all gold reserves.

B. Reserves in hard rock deposits

There are 74 known hard rock gold deposits in Mongolia, with 224.2 t of reserves. The Gatsuurt hard rock deposit in Selenge aimag has been exhausted. Names of a number of other such deposits are Tsagaan Chuluut, Olon Ovoot, Narantolgoi, Tavt and Tsagaan Tsakhir.

Table 4: Hard rock gold deposits, by aimag

	Aimags	Number of deposits
1	Selenge	18
2	Tuv	13
3	Umnugobi	10
4	Dornod	6
5	Khovd	5
6	Uburkhangai	3
7	Bayankhongor	3
8	Zavkhan	3
9	Gobi-Altai	2
10	Sukhbaatar	2
11	Dornogobi	2
12	Khentii	2
13	Bayan-Ulgii	2
14	Darkhan-Uul	1
15	Dundgobi	1
	Total	74

Source: MRAM, 2014

Table 5: Hard rock deposits with commercial potential considered to be not fully realised

	Deposits	**Grade, grams/tonne**	**Reserves of gold, kg A+B+C grades combined**
1	Narantolgoi	7.49	4553.6
2	Tsagaan Chuluut	11.6	421.8
3	Sujigtei	31.9	1995.0
4	Yoroo	23	86.9
5	Khargana	23.33	159.1
6	Tsagaan Tolgoi	5.62	80.6
7	Bumbat Sudal-118	5.84	4316.2
8	Boroo	2.64	3646.1
9	Olon Ovoot	2.68	14728.2
10	Tavt	11.8	3865.1
11	Bumbat	20	349.8
12	Malgar Uul	4.51	9.1
13	Tsagaan Tsakhir Uul	23.18	354.8
14	Khan Uul	4.02	624.1
15	Ergen Us	3.1	54.0

16	Modot Uul	18.6	107.8
18	Nariin Gol	7.5	1638.9
19	Tsagaan Sudain	15.32	229.0
20	Baruun Shuvuun Uul	2.81	112.0
21	Bukhtuul	7.1	7600.1
22	Berlh Uul	5.79	452.8
23	Barjin Uul	9.9	325.3
24	Gatsuurt	3.6	59560.0
25	Ulziit	6.2	334.6
26	Yamaat	14.1	2189.0
27	Ereen	1.1	14082.9
28	Baavgait	1.41	538.0
29	Naranbulag	3.84	372.8
30	Burkhan Del	1.09	4776.8
31	Shalrga Ovoo	2.85	367.3
32	Shaazgait	4.32	1005.9
33	Baga Mukhar	4.34	936.4
34	Tsagaan Khyar	1.18	4476.2
35	Alag Shand	1.37	559.4
36	Khorimt Khudag	1.58	357.9
37	Uvur Khooloi	1.19	347.6
38	Shar Tolgoi	1.58	1470.5
39	Saaral Khutul	3.54	38.8
40	Tsagaan Chuluut	7.5	294.1
41	Bayan Undur	2.86	20336.4
42	Urliin Ovoo	2.91	2319.6
43	Bayan Airag	2.05	14986.0
44	Ar Bogol	7.8	117.3
45	Mushguu	2.54	607.3
46	Tsenkher Nuden	6.2	539.2
47	Undur Javkhlan	5.32	3858.4
48	Altan Khundii	1.11	4049.8
49	Sujigtei	12.17	2220.3
50	Tsagaan Gozgor	3.03	994.7
51	Altan Tsagaan Ovoo	1.4	26389.9
52	Tsagaan Chuluut	2.73	148.6
53	Gutain	5.73	3174.2
54	Boholyn Khoshuu	2.85	119.3
55	Uluntyn Khyar	6.54	446.6
56	Nurag Uul	1.08	1135.7
57	Tsagaan Tolgoi	5.11	345.4
58	Ulaan Khyar	1.61	417.4
59	Khar serven	1.64	1879.2
60	Jargalant 1	1.2	2279.7

61	Urt Del	1.1	381.5
	Total		224164.7

Source: MRAM

Table 6: Low grade deposits with potential for increased reserves and commerciality

	Deposits	**Grade, grams/tonne**	**Commercially viable reserve, kg**	
			Ore, thousand tonnes	A+B+C
1	Ulaan Bulag	0.83	3957.3	2940.3
2	Toromkhon	0.65	5715.73	4176.62
3	Kharmagtai	0.444	18031.26	13430
4	Khorimt Khudag	0.96	85.93	417.35
5	Erdenetolgoi	0.68	2690.32	3432.11
6	Ovoot Khyar	0.64	4439.79	2890
7	Oyutuul	0.28	24383.53	6095.12
8	Barlag River	0.51	3748.02	1906.66
9	Ulaan Khajuu	0.06	9757.34	556.19
10	Yembuu Tolgoi	0.85	437.66	369.6
11	Musun Turuu	0.62	3337.49	2511.6
12	Boroo	0.63	235.42	9434
13	Uvur Togtor	0.76	1564.17	1149.04
	Total		78383.96	49,308.59

Source: MRAM

C. Metal deposits in which gold is or has potential to be a co-product or byproduct

Mineral deposits of copper, lead and zinc which contain gold constitute the majority of gold reserves in Mongolia. There are 11 such deposits, 6 of lead and zinc and 11 of copper. They contain 1103.3 metric tonnes of gold; the Oyu Tolgoi copper deposit has 1028.0 metric tonnes of gold, plus over 810 metric tonnes of gold classified as C grade, viable under certain conditions.

Gold is also a constituent of ore mined from the Ulaan polymetallic deposit.

Table 7: Metal deposits with gold content

	Deposits	**Grade, grams/tonne**	**Gold reserves, kg**		**Total, kg**
			Balance reserve (commercially exploitable)	Out of balance reserve	
1	Ulaan	0.24	7,122.00	-	7,122.00
2	Tsav	66	2,219.00	-	2,219.00
3	Bayan Airag	0	27,905.00	-	27,905.00
4	Oyu Tolgoi	0.28	1,028,000.00		1,838,000.07

				810,000.07	
5	Tsagaan Suvarga	0.05	11,127.00	-	11,127.00
6	Nomint	0.27	4,302.50	-	4,302.50
7	Budag Tolgoi	0.2	681.29	-	681.29
8	Saran Uul	0.097	4,575.00	4,585.40	9,160.40
9	Sallkhit	0.005	9.34	10.46	19.80
10	Tsakhir Tolgoi	0.12	1,800.00	-	1,800.00
11	Nariin Khudag	0.07	698.00	753.00	1,451.00
12	Oyut Ulaan	0.38	4,022.00	246.00	4,268.00
13	Mankhan Uul	0.182	1,539.40	-	1,539.40
14	Erdenetolgoi	0.06	862.49	-	862.49
15	Khadat Gun	0.004	3,339.28	-	3,339.28
16	Salkhit East	0.407	1,160.00	-	1,160.00
17	Ulaan Khud	0.04	1,905.22	-	1,905.22
	Total		1,101,268.00	815,594.90	1,916,862.90

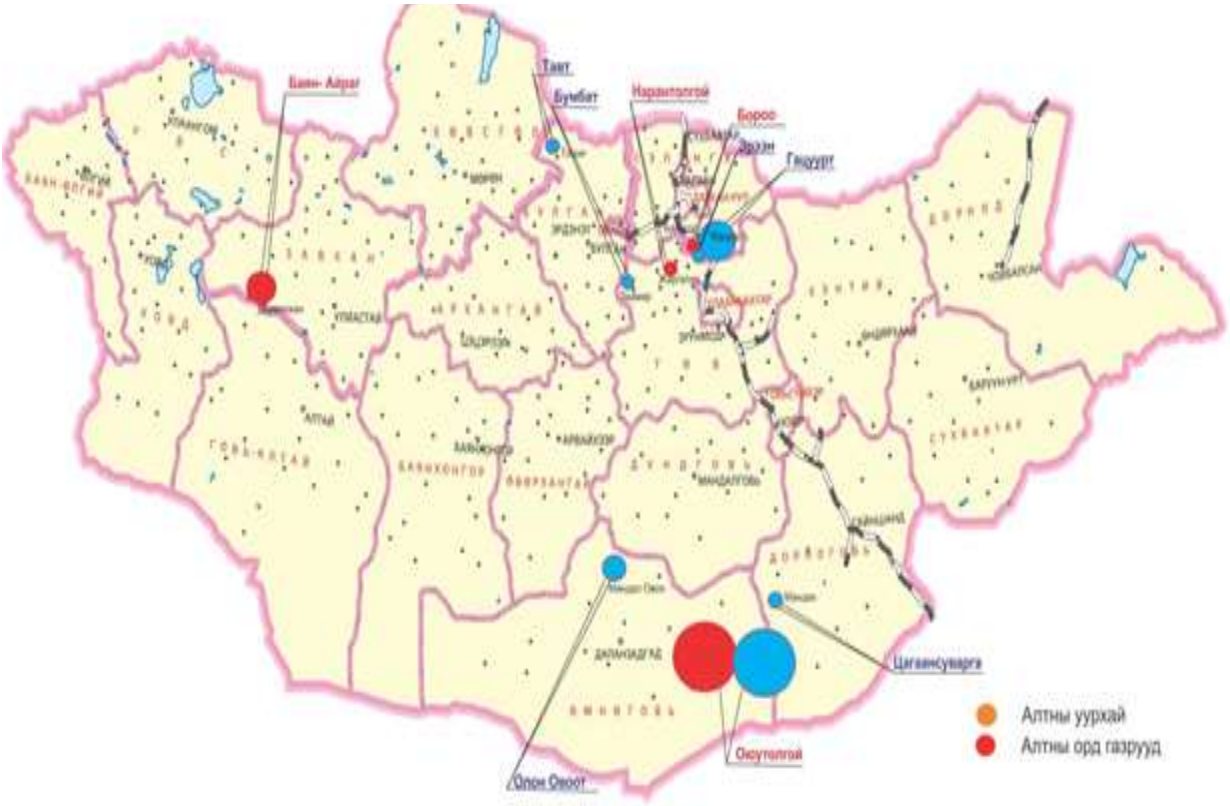
Source: MRAM

4. GOLD MINING

At the end of October 2015, Mongolia's gold sector accounted for 2.6% of the national GDP, 6.5% of all industrial output, 9.6% of mining industry output, 9.1% of export revenue and 40% of national currency reserves.

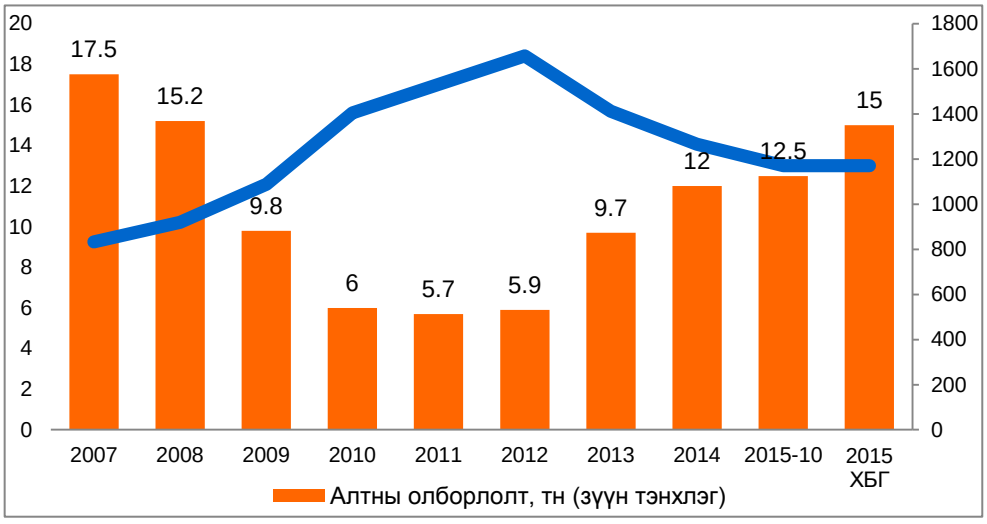
Most gold production is from deposits in Selenge and Tuv aimags while the rest is from deposits in 6 aimags, including Uvurkhangai, Bulgan and Bayankhongor.

Figure 4: Larger gold deposits and mine locations



Mongolia's gold mining peaked between 2007 and 2013, when the global gold market price was high. The nation produced 17.5 t in 2007, which fell drastically by 2012 to 5.7 t, a three-fold decrease. The sector revived again in 2012 and, in 2014, gold production rose 23.7% (2.3 t) over the 2013 figure, with total gold production of 12 t.

Figure 5: Gold mining and market prices



Source: MRAM, 2015

The decline in gold mining was caused directly by the adoption of the Windfall Taxes Law (so-called 68% tax law) and the Law Prohibiting Minerals Exploration and Extraction in the Headwaters of Rivers, Protection Zones of River Basins and Forest Areas (the so-called Long-

Name Law). Because of such legal barriers, gold sales went "underground" and hence are undocumented.

The *Annulling Windfall Tax Law* (2011) and the 2014 Minerals Law amendment reduced royalties on gold sold to the MongolBank to 2.5% whilst keeping the 10% royalty on gold directly exported without being sold to the MongolBank. This made gold sales more transparent and was an important contribution to increased government and export revenue, as well as to MongolBank gold purchases. Gold sales by October 2015 had risen to 12.5 t and are predicted to have reached a total of 15 t by year end.

In Mongolia, 4 or 5 entities (including Boroo Gold LLC, Altan Dornod Mongol LLC, Mon Dulaan LLC, and Monpolimet LLC) produce most of the gold. Of the 9.7 t of gold mined in 2013, 18% came from the Boroo hard rock deposit. The rest came from placer gold deposits. Three other companies (Mondulaan - 1 t, Altan Dornod Mongol - 0.8 t and MonPolimet - 0.48 t) produce approximately 25% of all annually mined gold.

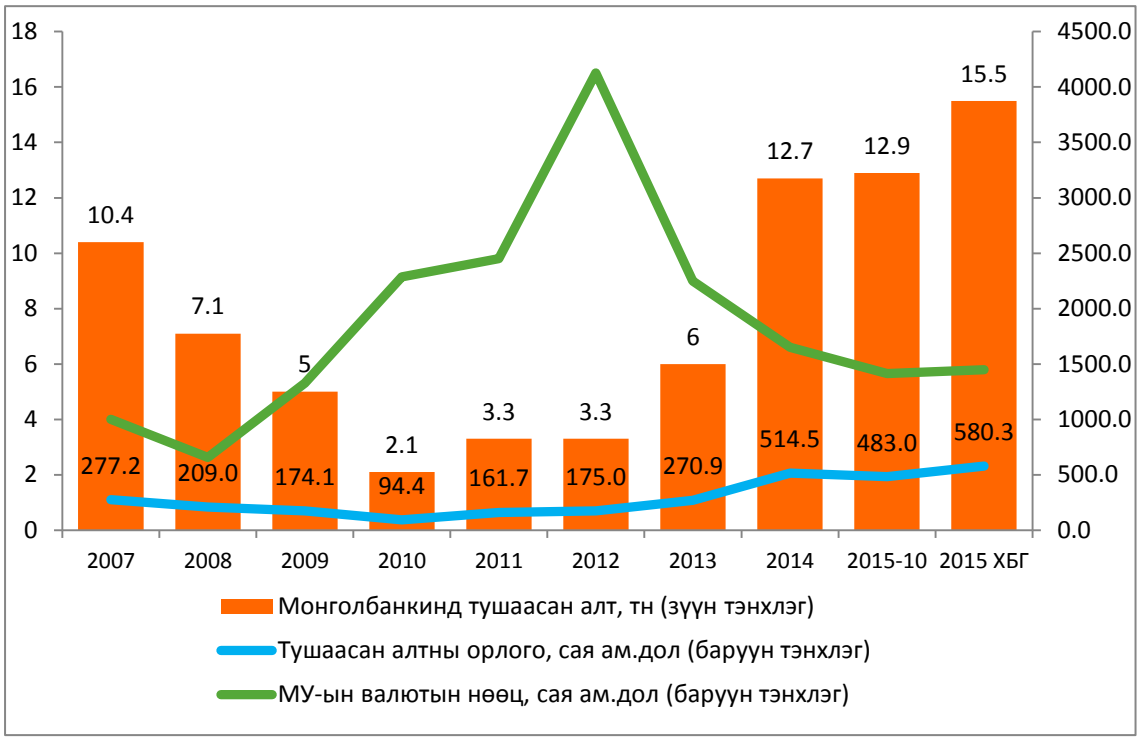
5. GOLD SALES

MongolBank (Bank of Mongolia) reported in 2013 that it purchased 6 t of gold from 71 businesses and 3 individuals. In 2014 the MongolBank bought gold from 1102 suppliers (entities, artisanal miners and individuals). By the end of October 2015, gold sales to the MongolBank had risen to 12.9 t, and there was a significant rise to 86 businesses and 1723 individuals selling gold to the MongolBank.

Table 8: Gold sales by legal entities and artisanal miners to MongolBank

	Indicators	2010	2011	2012	2013	2014	2015-10
1	Number of companies selling	105	114	94	71	79	86
2	Number of artisanal miners and individuals selling	7	179	11	3	1102	1723
3	Total gold sales (tonnes)	2.1	3.3	3.3	6.0	12.7	12.9

Figure 6: Amount of gold sold to MongolBank



Source: BoM

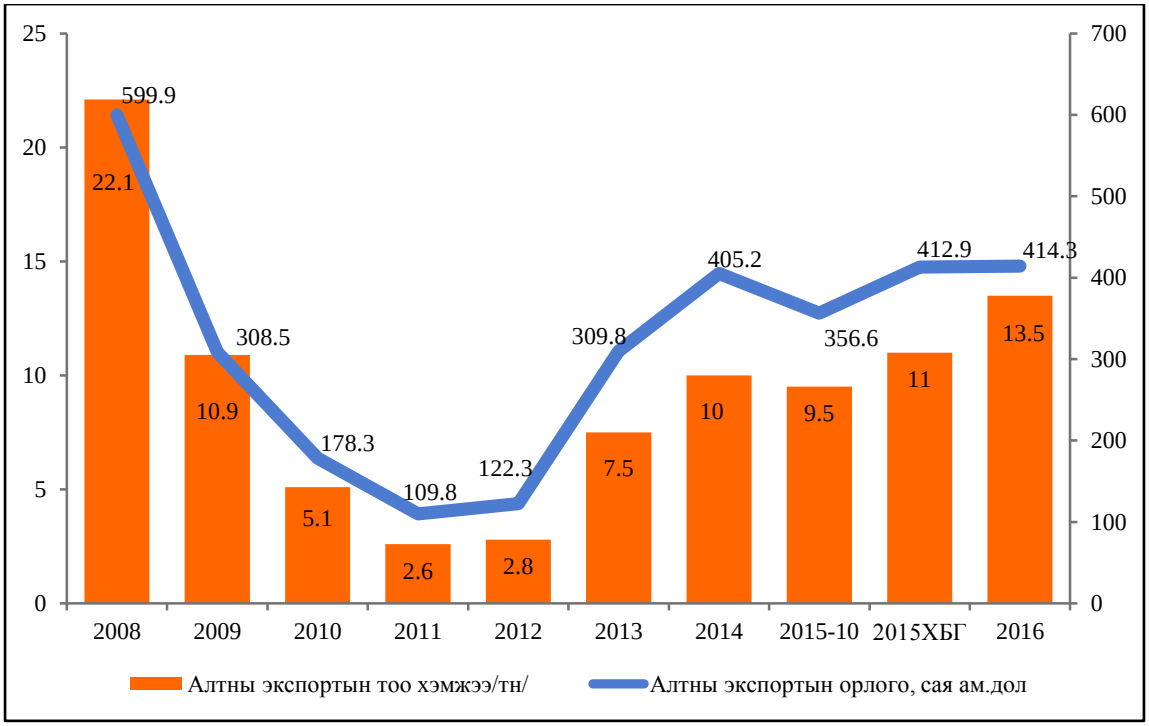
The above graph shows gold sales to the MongolBank, with gold market prices and total gold revenue. The amount of gold sold to MongolBank fell drastically in the 2009-2012 period despite the rise in world gold prices and resulted in a decrease in export revenue.

Compared to 2013, the 2014 gold sales increased 90%, from US$270.4 million to 514.5 million. By October 2015, the MongolBank had bought 12.9 t of gold, the highest purchase since 2007.

6. GOLD EXPORT

It is predicted that by the end of 2015, gold export revenue will have risen to US$412.9 million. From 2008 to 2012, global gold market prices rose by approximately 80%, but Mongolia's gold exports dropped, resulting in decreased export revenue.

Figure 7: Mongolia's gold exports



Source: General Customs Department, 2015

Total gold exported in 2008 was 22.1 t, which fell by 8.7 times to 2.6 t in 2011.

However, gold exports rose to 10 t in 2014 and stood at 9.5 metric tonnes to the end of October in 2015. Most gold went to Canada and the UK. It is predicted that gold exports will reach 11 metric tonnes by the end of 2015, and 13.5 metric tonnes in 2016.

7. GOLD ARTISANAL MINERS

According to data from the Mineral Resources Authority there are approximately 30,000 individuals carrying out artisanal mining. In recent years, artisanal mining partnerships and the number of members in artisanal mining partnerships have steadily increased. In July 2010, amendments to the 'Minerals Law' meant that 'relations in artisanal mining shall be subject to Government approval'. Subsequently, Government Resolution #308 'Procedures for artisanal mining' was adopted in December 2010, and is currently being implemented. According to this, artisanal miners, in respect to Section 477-482 of the Civil Law and the Partnership Law, can organise themselves as partnerships, and these partnerships have the obligation to form cooperation agreements with local governors.

Artisanal miners and their activities have been legally formalised according to the Minerals Law. With the creation of a legal environment to form partnerships, the number of partnerships and their members has increased, thus providing the basis for advancing principles of responsible mining.

Table 9: Partnerships and their members

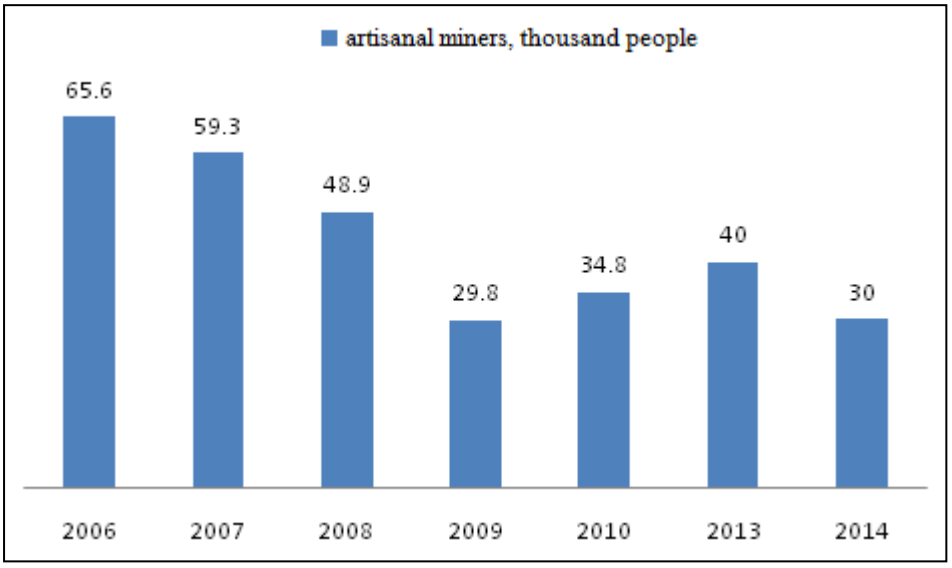
Indicator	2011	2012	2013	2014
Partnerships	20	29	38	41
Members of partnerships	3302	4451	4972	5271

Source: Mineral Resources Authority, 2014

According to the Mineral Resources Authority, there were 20 partnerships with 3,300 members in 2011. The numbers increased to 41 partnerships with 5,300 thousand members in 2014, a two-fold increase in number of partnerships and 1.6-fold increase in the number of members.

According to data from the Sustainable Artisanal Mining project, 70% of artisanal miners are operating in the gold sector. The majority of artisanal miners are producing from primary and placer gold deposits. The number of individuals involved in artisanal mining has increased due to the high global price of gold, the fairly quick rate of achieving sales and convertibility to currency, and, the provision of a legal basis to practice gold mining.

Figure 8: Number of artisanal gold miners



Source: MRAM, Sustainable Artisanal Mining Project

According to Figure 8, the number of artisanal gold miners between 2006 and 2009 declined almost 2.2-fold from 65,600 to 29,800, but the number began to increase from 2010 through 2013. With the adoption of the windfall profits tax, the activities of some entities and artisanal miners decreased while other artisanal miners adopted informal activity forms, resulting in a decline in the numbers of such miners. Government Resolution #308 adopted in 2010, 'Procedures for artisanal mining', triggered an increase through formalization of artisanal activity and positively impacted the numbers involved.

To determine the amount of gold mined by artisanal miners[1]:

- The average amount of gold produced by an artisanal miner is 0.4 grams per day, working for 4 months with approximately 20 days per month.

Based on this it can be estimated that the quantityof gold mined is 2,100 metric tonnes in 2006, 1,900 metric tonnes in 2007, 1,600 metric tonnes in 2008, 900 metric tonnes in 2009, 1,700 metric tonnes in 2010, 1,300 metric tonnes in 2013 and 900 metric tonnes in 2014.

Table 10: Artisanal gold mining, tonnes

Indicator	2006	2007	2008	2009	2010	2013	2014
Total gold mining	22.5	17.5	15.2	9.8	6.0	9.7	12.0
Artisanal gold mining	2.1	1.9	1.6	0.9	1.7	1.3	0.9
Share of artisanal gold mining in the total mining(%)	9.3	10.9	10.5	9.2	28.3	13.4	12.5

Source: Working Group estimates

Table 10 aims to show total gold production in Mongolia during 2006 and 2014, and specifically the share of gold produced by artisanal miners. Similar to the trend experienced in the gold sector, levels of artisanal mining declined between 2006 and 2009 and increased in 2010. The windfall profits tax also had an impact on artisanal miners.

Table 11: Gold sales to MongolBank by traders and artisanal miners

Indicators	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total gold sales to MongolBank, tonnes	8.0	10.4	7.1	5.0	2.1	3.3	3.3	6.0	12.7
Gold sales to MongolBank by traders, tonnes	0.5	0.3	0.675	0.460	0.038	0.215	0.016	0.003	3.2
Share of traders' gold sales to MongolBank, %	6.3	2.9	9.5	9.2	1.8	6.5	0.5	0.1	25.2

Source: Mineral Resources Authority, MongolBank, 2014

Table 11 shows the total amount of gold sold to MongolBank, including the number of tonnes and percentage sold by artisanal miners. While artisanal miners sold 0.675 t (675kg) to the MongolBank in 2008, this number decreased significantly to 0.003 t (3.2kg) in 2013.

Particularly in 2010, with the adoption of the long-named law, the amount of gold sold by artisanal miners declined drastically. This means that gold sales by artisanal miners shifted towards the informal and undocumented market. According to MongolBank, in 2013, two individuals sold 3.2 kg of gold while in 2014, 896 individuals sold 3200.0 kg. In 2014, the number of individuals selling to MongolBank was 448 and the amount of gold increased by

[1] "Society, economy and livelihoods of artisanal miners" paper by "Social policy and development research institute" with the support from the "Sustainable Artisanal Mining" project in 2013.

1000 times. With amendments to the 'Minerals Law' in January 2014, the royalty reduction resulted in more transparent gold trading and a significant increase in gold purchased by MongolBank.

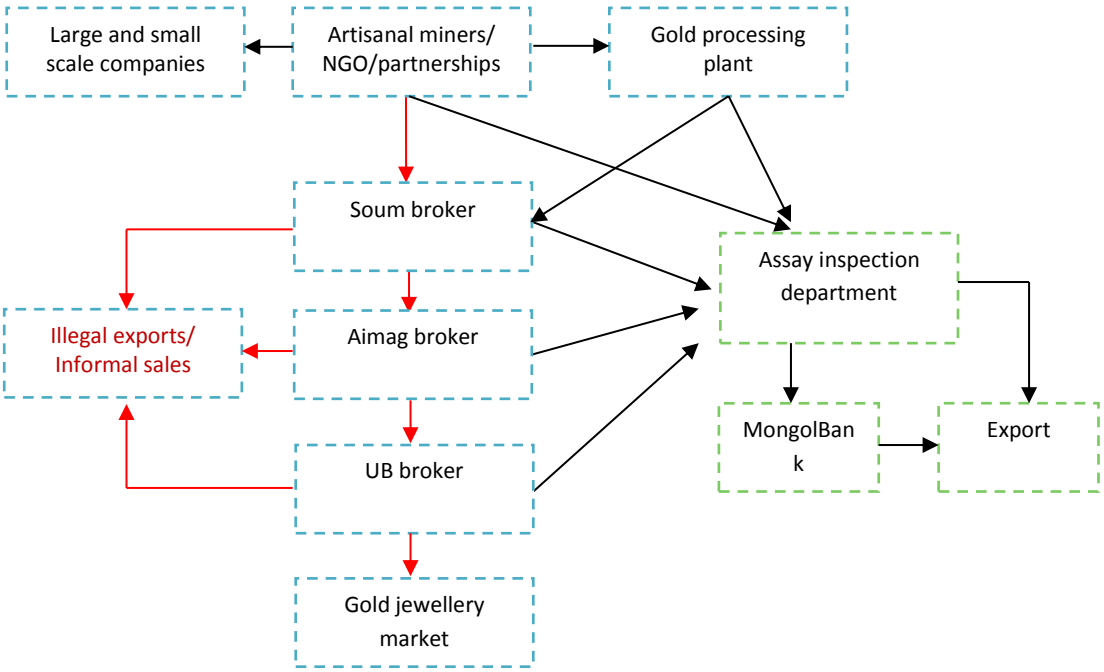
As per Table 11, share of gold produced by artisanal miners and sold to MongolBank decreased from 9.5 percent in 2008 to 0.1 percent in 2013. In 2014, traders and individuals sold 3.2 t to MongolBank or 25.1 percent of the 12.7 t total. This increase in the share from artisanal miners indicates that the informal sector has started to become more formal.

While the amount of gold sold to MongolBank among artisanal miners was 1.5 t, brokers and artisanal miners sold 3.2 t, indicating that in order for entities to avoid paying taxes on income, they tend to sell through individuals.

8. ARTISINAL GOLD SUPPLY CHAIN

The gold supply chain is dictated by artisanal miners and brokers operating at various levels. Gold supply and distribution channels can be seen on Figure 9 below:

Figure 9: Current state of gold mining and supply chain



Source: Working group

The participants in the artisanal gold supply chain are follows:

- Artisanal miners,
- Gold traders of soum, province and Ulaanbaatar,
- Assay inspection department of the Mongolian Agency for Standardization and Metrology,
- MongolBank.

In accordance with the 'Regulation on artisanal mining', artisanal miners and partnerships have the responsibility to sell mined gold to those who have the legal right to purchase. These include the MongolBank and license holders. Artisanal companies with special licenses for gold mining exploration should send the gold to the state administrative department responsible for assay inspection to determine its quality and subsequently sell the gold to the MongolBank. For those artisanal miners who do not hold special licenses, there is no legal basis to regulate the sale of gold.

Only those entities and artisanal miners that hold special exploration licenses register through the MongolBank and the Assay Inspection Department for export. In this case, they are obliged to pay a gold basic royalty rate of 5%, and an additional excess royalty of 5 percent.

The gold price is set by the MongolBank based on the previous day's LBM gold price quotation, less US$ 3 per ounce as the refining charge and converted to Mongolian MNT according to the US$/MNT exchange rate, announced by MongolBank.

According to Civil Law, gold broking is a legal activity in Mongolia. Three tiers of broker exist, at soum, aimag and Ulaanbaatar levels. Selling to brokers is increasingly common due to a lack of storage resources, high transport costs and safety concerns. Artisanal miners will often sell to soum brokers, who then sell to aimag brokers, with aimag brokers selling to city brokers who have the quality of gold determined through the Assay Inspection Agency, before selling to the MongolBank or directly to jewellers. Note, that the local traders buy gold at a price 10-15% lower than the price settled by the MongolBank.

It is suspected that traders operating at mine sites at provincial levels sell gold illegally thorough local Chinese traders and at border points with China. They sell gold to Chinese traders, so as to avoid tax and imposed fees, and shorten the end-sale turnaround time. Currently, artisanal miners do not have direct access to services offered by the MongolBank and Assay Inspection Department, which provides further encouragement for selling gold on the informal market.

According to the 'Regulation on artisanal miners', the location of artisinal gold ore production must be defined through consultation with the Ministry of Mining, local government Citizen's Khural and the Specialised Inspection Agency. These parties are obliged to provide joint support. Currently, there are gold ore processing sites located in the Tuv and Bayankhongor aimags. These facilities aim to support the fair trading of gold through the purchase of gold mined by artisanal miners, concentration of their ore products and a market place.

9. POSSIBILITIES TO OPEN A GOLD REFINERY

Although gold mined in Mongolia is approximately 90% pure (i.e. 900.0 parts per thousand gold), the international market for the most part follows the "Good Delivery" fineness specification for a minimum of 995.0 parts per thousand fine gold as issued by the London Bullion Market Association ("LBMA") which also puts forth requirements for listing on the LBMA Good Delivery List of approved refineries.

Traditionally, Mongolia has refined its gold in refineries in Russia, the UK and Japan. Mongolia is now mining over 10 t of gold per annum, which may well increase 1.5 to 2 times in the future because of more extensive mining of hard rock deposits of gold as well as other deposits in which gold is not the principal constituent.

This makes it feasible for Mongolia to consider establishing its own refinery; it is proposed that this facility will be established in 2017-2018. Such a refinery should utilise technology that would readily allow it to be expanded and adapted for refining the gold-bearing product from copper smelters as well as to produce end products such as mint gold, coins and gold items for export to the world market. Refining gold outside Mongolia is considered by many to be cost prohibitive, due to difficulties in and complexity of transport, insurance, security, time and other arrangements.

The MongolBank says that Mongolia first sent its mined gold to Russia (then the Soviet Union) in 1976 and paid US$4936 for transport, US$5954 for refining and US$11,155 for insurance, a total of US$22,045. One third of all costs involved insurance and transport. In 1984, refining 1 metric tonne of gold cost US$ 97,521, including US$56,298 for refining, US$11,346 for transport (excluding return costs) and US$37,965 for insurance; 41% of all refining costs involved transport and insurance.

The refining process involves a loss of 2% of the gold, while recovering other precious minerals like silver and platinum is troublesome. So, Mongolia has come to an important crossroads, whether to establish its own gold refinery to intensify domestic processing, separate by-products, and save on costs (transport, storage and insurance) or continue to export unrefined gold.

Gold-refining technology varies from country to country. The major methodologies to increase the gold purity to 99.99% are chemical, electrical, hydro and pyro-metallurgical, alone or combined. The pyro-metallurgical method uses a thermal process to remove impurities, while the hydrometallurgical process uses electrical methods. For gold refining and purification, the USA, Japan, the UK, Germany, Switzerland and RSA are considered world leaders.

Comparing available refining and processing technologies, some use aqueous chemistry for minerals recovery and achieving as much as 98%, followed by extraction with chemicals for 99.99% purity. Some methods use an electrolytic process to reach 95% purity then leach in solutions for extraction to reach 99.99% purity. Some gold refineries use very sophisticated technology and equipment and apply fewer technological stages, while some use lower grade technology which cost less.

Comparing widely-used gold refinery technologies, the Minataur process as developed and applied in South Africa is considered to be the most advanced and efficient. This process employs fewer staff to refine up to 24 metric tonnes of gold per year and is considered an environmentally friendly and low-waste technology. This technology was successfully applied in Harmony Gold in 1996.

Gold from refineries that do not meet global standards for gold purity (or are not certified by the London Bullion Market Association) cannot be exported, sold or pledged as collateral.

A new refinery must meet the following requirements:

- LBMA good delivery certification so that gold refined and purified in Mongolia meets standard requirements for guaranteed sales on the global market.
- Certified for no negative environmental impact.
- Refining costs must be competitive and able to pay tax from profits.

The following principles and conditions must also be taken into account in deciding whether to establish a gold refinery.

- Use technology and equipment fully guaranteed on the global gold market and meeting international benchmark standards.
- Manufacturers of the facility and providers of "know-how" must train staff to operate key stages of refining technology and the laboratories.
- Supplier of the refinery technology and equipment should provide a turnkey service when installing all equipment and guarantee product quality.
- The estimated investment for the refinery must include not only equipment, tools and primary materials, but also technology and "know-how."
- The refining process should not be harmful to the environment or human health, and must employ the most up-to-date technology to neutralize and detoxify harmful substances.
- It must include a complete and comprehensive laboratory for gold refining, assaying, study and testing.

CHAPTER FIVE - GOLD SUPPLY, DEMAND AND COMPETITIVENESS

1. Exploration contribution and role in providing world supply

The gold price began to rise in 2003 after almost 5 years below US$ 300/troy ounce (tr oz), but gold mine production fell from a high of approximately 2,600 t in that year to 2,260 t in 2008 even though the price increased to more than US$ 800/tr oz in the same period. Nevertheless, the price increase led to more supply from recycled gold (Figure 15), an increase in exploration spending (Figures 13) and accelerated development of previously discovered gold deposits (Figure 10) while mines which had been selectively mining higher grade portions of ore deposits to remain profitable resumed mining ore of reserve grade (Figure 11). The gold price peaked in the $1,600/tr oz range during 2011 and 2012 (Figures 10 & 12). Spending on exploration for gold and other nonferrous metals peaked in 2012 (Figure 13).

A high level of exploration spending is extremely important in facilitating new mine supply 10 years or so after discovery of deposits has peaked. Two peak discovery periods have occurred since 1990 (Figure 10), one centered on 1995 and the most recent on 2007. Some of the discoveries during the second peak may have become mines, but the majority will await development in the 2017-2025 intervals as the production decline forecast for the post-2015 period inevitably will result in a rising price trend. Interest rates, wars, the environmental impact assessment approval process, public sentiment and central bank policies will play a role in determining the timing, rate and level to which the price increases.

The number of metal deposit discoveries in Central Asia and Europe over the decades since 1950 is low compared to Latin America and the High Income OECD countries (Figure 14), particularly when considered in the context of the potential inferred from geology and known gold and other metal mines. Government policy and political stability thus have the potential to stimulate exploration and mine development investment with assurance of realizing increased gold supply in Mongolia.

The other main component of supply is recycled gold from scrap, mostly jewelry. The onset of the western economic recession in 2009 induced many to sell their gold-bearing jewellery and coins ('recycled gold' from 'scrap') that then contributed about 40% of supply while mined gold contributed 60% (Figure 15). By 2014, recycled gold accounted for only 26.5% (1,169 t), and, as reported on the World Gold Council web site, mines produced 3,139 t of the supply.

Figure 10: Gold discovered 1990-2013, mine production 2003-14 & forecast to 2022

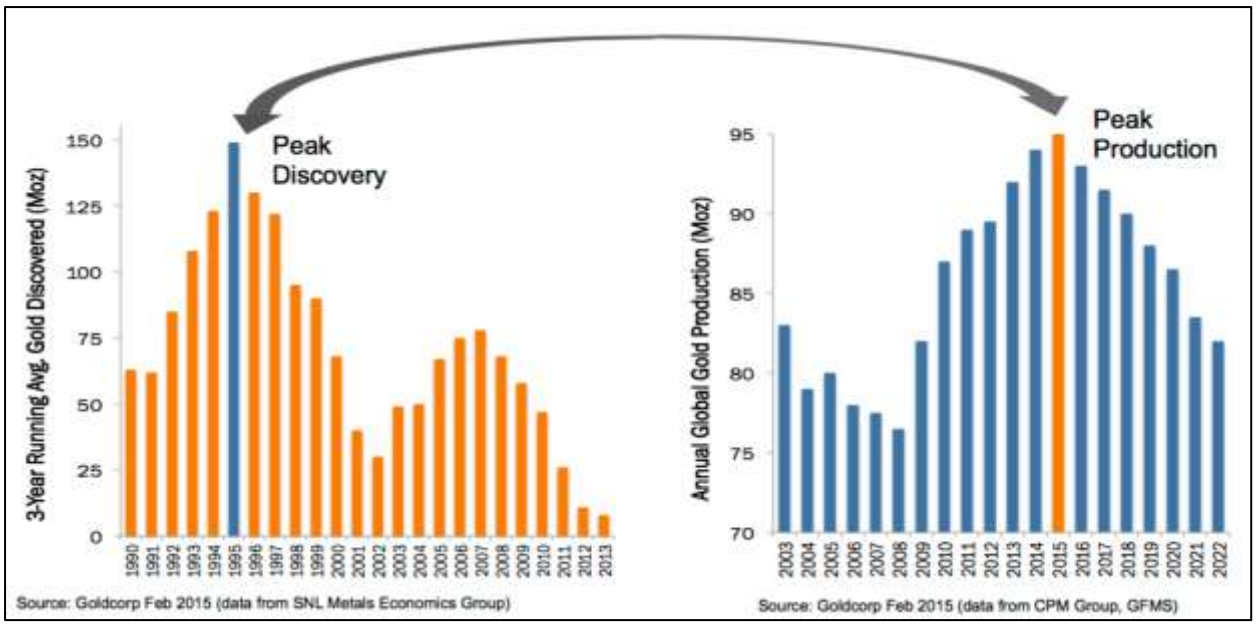


Figure 11: Gold content of ore processed compared with reserve grade, 1990-2014

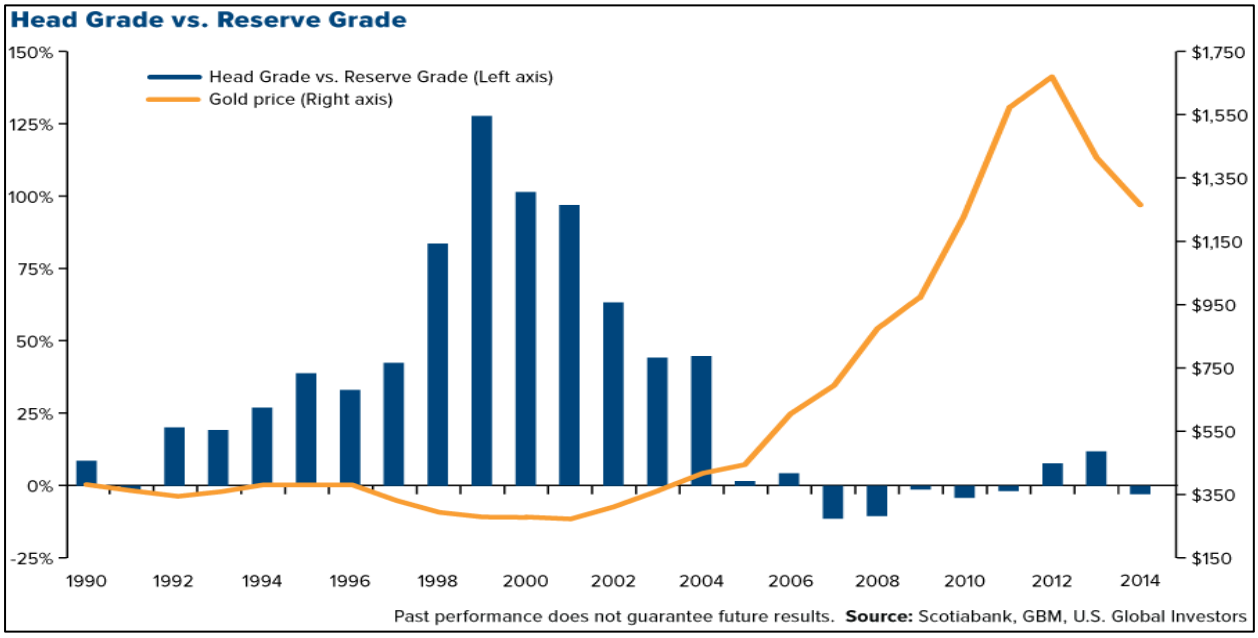


Figure 12: Cash costs for gold mines in top producing areas & gold price, 2010-2015

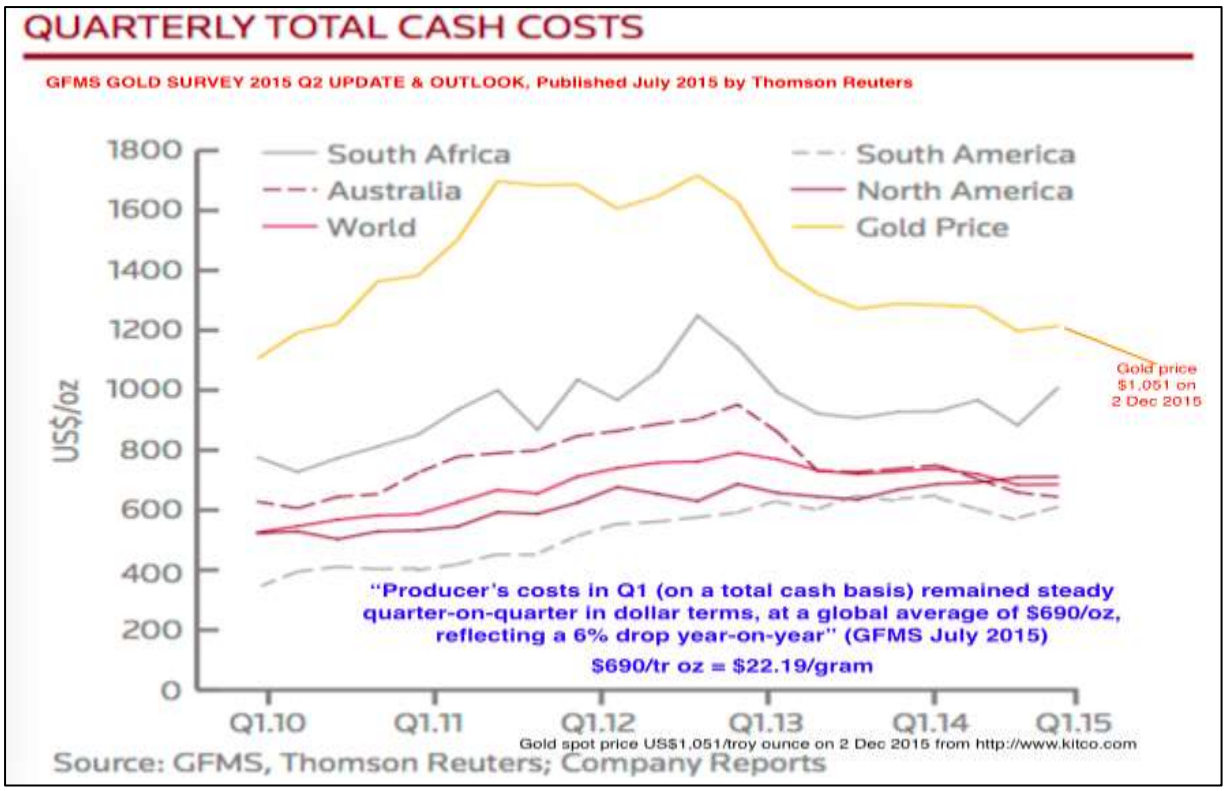


Figure 13: Exploration budgets - world totals for nonferrous metals, 1993-2015

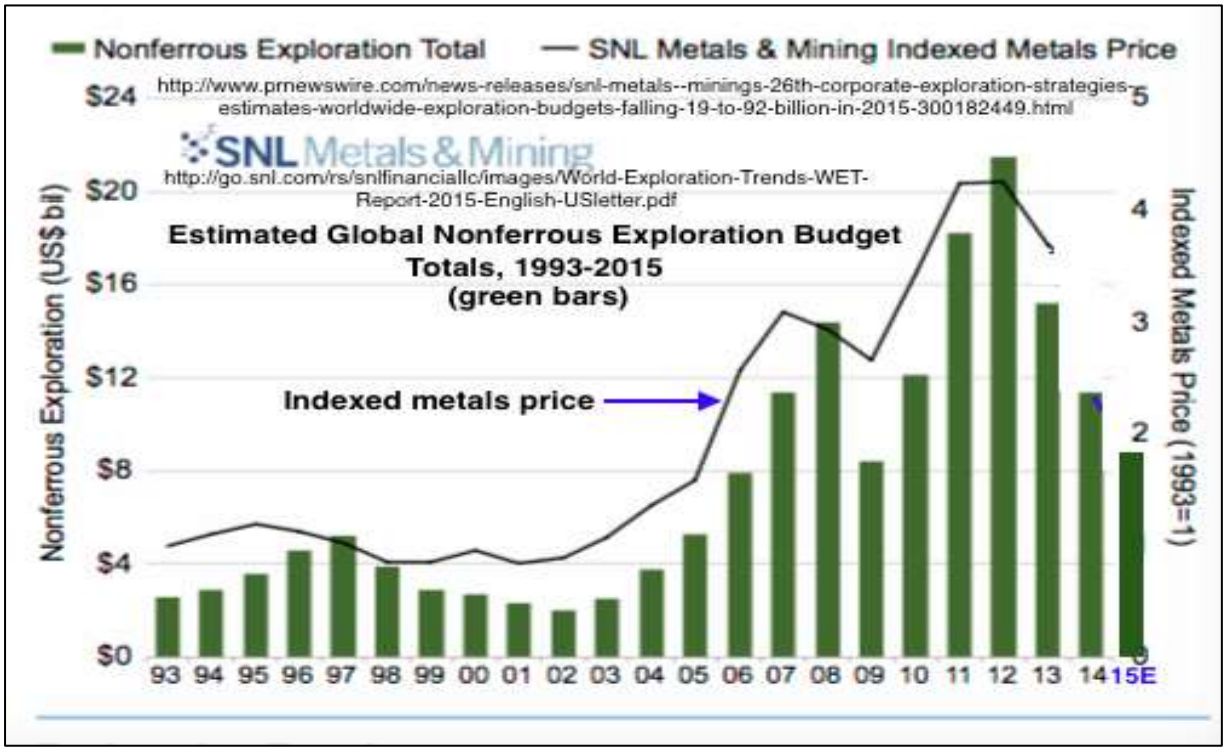


Figure 14: Metal deposit discoveries by region and decade, 1950 to 2009

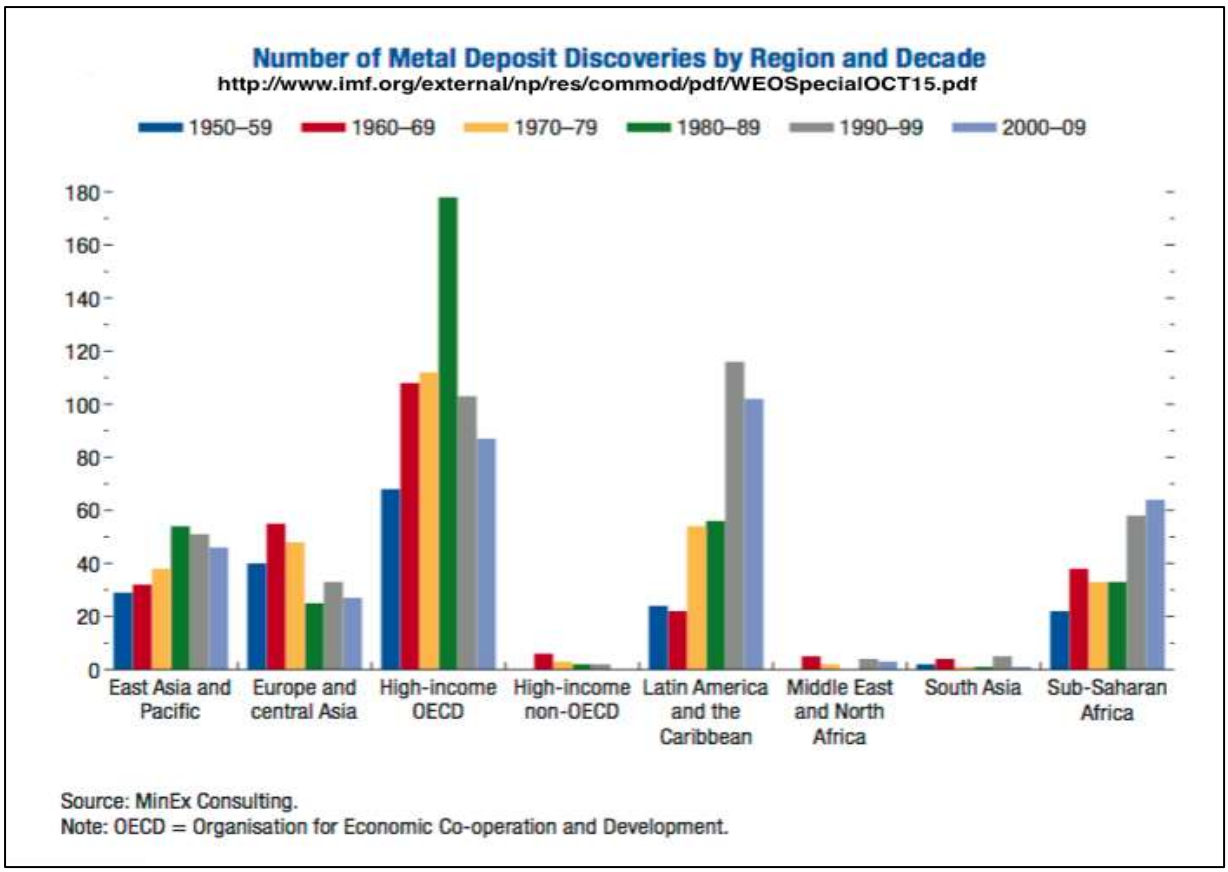
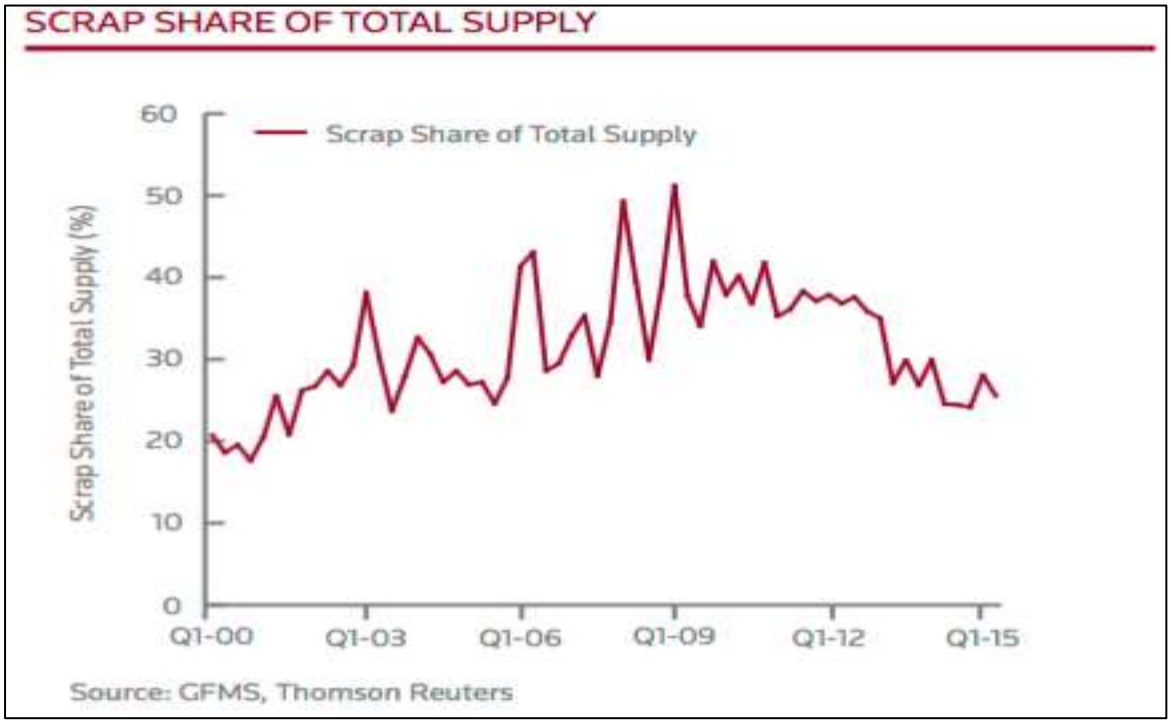


Figure 15: Recycled gold share of world gold supply



2. Gold reserves and resources discovered and/or in production

The term "reserve" in the Americas and Australia refers to the estimated amount of material that is economically viable to mine at the prevailing commodity price while the term "resource" refers to deposits or portions of deposits that have been identified, but not yet confirmed to be viable. The tables and graphs below show combined estimates of reserves and resources, unless the heading specifies one or the other.

Table 12: World gold reserves/resources by 10 leading counties and mines (tonnes)

		2013 tonnes estimated	Share in the world gold reserves/resources
Leading countries			
1	United States	14,732	14.7%, 59 deposits
2	Canada	14,666	14.7%, 99 deposits
3	South Africa	14,514	14.5%, 33 deposits
4	Russia	10,210	10.2%, 33 deposits
5	Australia	8,044	8.0%, 56 deposits
6	Chile	4,589	4.6%, 15 deposits
7	Mexico	4,249	4.3%, 33 deposits
8	Ghana	3,796	3.8%, 16 deposits
9	Papua New Guinea	3,388	3.4%, 8 deposits
10	Indonesia	3,286	3.3%, 8 deposits
Leading mines, largest annual production in 2014		**Share of world total**	
1	Muruntau, Uzbekistan	80.9	2.6%
2	Grasberg, Indonesia	35.2	1.1%
3	Pueblo Viejo, Dominican Republic	34.5	1.1%
4	Yanacocha, Peru	30.2	1.0%
5	Carlin Trend, United States	28.2	0.9%
6	Cortez, United States	28.1	0.9%
7	Goldstrike, United States	28.1	0.9%
8	Olimpiada, Russia	22.6	0.7%
9	Veladero, Argentina	22.5	0.7%
10	Boddington, Australia	21.6	0.7%

Sources: http://www.hyperinflation-us.com/world_gold_supply_mining.html http://www.goldval.com/global-reserves-resources/ http://www.visualcapitalist.com/global-gold-mine-and-deposit-rankings-2013/http://www.mining.com/the-worlds-top-10-gold-mines/

Although China was the leading producer of gold in 2014 (Table 13) with 462 t or 15% of the world total, it is noteworthy that most mines are small and that only one mine is reported to have produced more than 9 t in 2014. China's largest deposits include: (Source: http://erdene.com/assets/pdf/Erdene%20 %20Altan%20Nar%20Resource%20Estimate%20-%2001-Apr-15.pdf)

- Zijinshan in SE China, which reportedly has a 134 t reserve/resource at a grade of 0.4 grams/tonne ("g/t") and is operated by Zijin Mining, a state-owned company and China's largest gold producer.
- Hengxing Gold, an emerging Hong Kong-listed company mining the Gold Mountain Deposit in Northern China has a reported 99.5 t reserve/resource averaging 0.7 g/t.
- China Gold International, a company listed on the Toronto Stock Exchange ("TSX" with trading symbol "CGG") operates the CSH gold mine in Northern China, one of the largest gold mines in the country with 155.5 t averaging 0.6 g/t.
- Zijin Mining reports that it has reserved US$1.3 billion for gold acquisitions in 2014/2015; in March 2015 Zijin made a US$81M strategic investment in Pretium Resources (British Columbia, Canada; 214.6 t @ 15.7 g/t Au)
- State-owned China National Gold recently reported it is actively on the hunt for global acquisitions and partnerships in gold

3. World leading gold producing countries, mines and mining companies

Since 1990, China has moved from forth ranking gold producer at 100 t in that year to 300 t and first place by 2009. In the same period, South Africa's production fell from top ranked 600 t to 200 t and third place. By 2010, it was in forth place and, in 2014, sixth place at 167 t, having been surpassed by both Russia and Peru.

Although China is the world's top producer, as noted in the above section, all the Chinese mines are smaller than those in the top ten grouping of producing mines. Estimated gold production in 2014 by the top public gold mining companies whose shares trade on stock exchanges amounted to 933 t (Figure 17), in line with the 2013 total. The 933 t produced by this group of companies is almost equal to combined production in the top three producing countries. The gold content per tonne of ore processed by the top four companies declined by 26% to 47% from 2002 to 2011 (Figure 18). Newmont processed the lowest grade throughout the period starting at 1.18 g/t in 2002 and declining to 0.87 g/t in 2011. Goldfields' South African mines had the highest mill head grade which declined from 5.03 g/t in 2002 to 3.5 g/t in 2011.

Table 13: World gold production, leading 10 countries and mines (tonnes)

	Countries, mines	2014 metric tonnes	Share in the world gold production
Gold production by leading countries			
1	China	462.0	15.0%
2	Australia	272.4	8.8%
3	Russia	266.2	8.6%
4	United States	210.8	6.8%
5	Peru	171.0	5.5%
6	South Africa	167.9	5.4%
7	Canada	151.3	4.9%
8	Mexico	110.4	3.6%
9	Ghana	104.1	3.4%

10	Brazil	90.5	2.9%
Gold production by leading mines by resource/reserve tonnage			
1	Grasberg,Indonesia, 3,304 metric tonnes	35.2	1.1%
2	South Deep, South Africa, 2,532 t	23.3	0.8% (targeted)
3	Lihir, Papua New Guinea, 1,994 t	21.4	0.7%
4	Muruntau, Uzbekistan, 1,555 t	80.9	2.6%
5	Olympiada, Russia, 1,477 t	22.9	0.7%
6	Oyu Tolgoi, Mongolia, 1,441 t	18.3	0.6%
7	Pueblo Viejo,Dominican Rep,1,247 t	34.3	1.1%
8	Mponeng, South Africa, 1,230 t	9.7	0.3%
9	Cadia East, Australia, 1,170 t	7.0	0.2%
10	Obuasi, Ghana, 928 t	7.6	0.2%

Sources: http://www.gold.org/gold-mining/interactive-gold-mining-map
http://www.mining.com/web/worlds-top-10-gold-deposits and company annual report

Table 14: Gold production by top 10 countries, 1960 to 2012

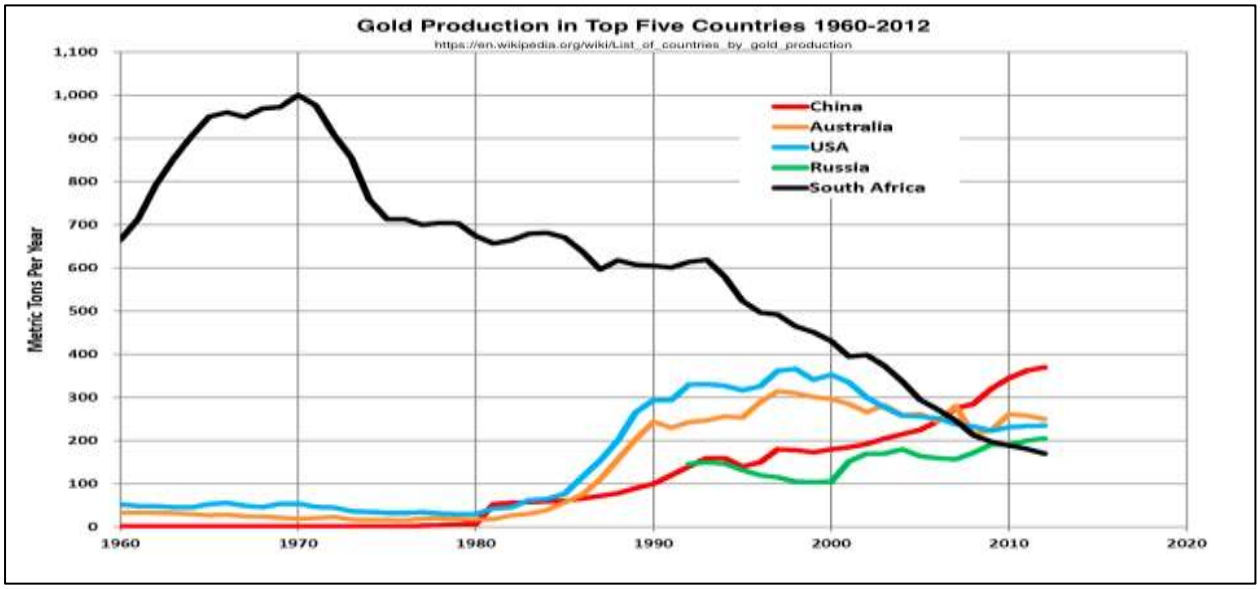


Figure 16: Gold production - top 10 stock exchange-listed companies, 2013-4

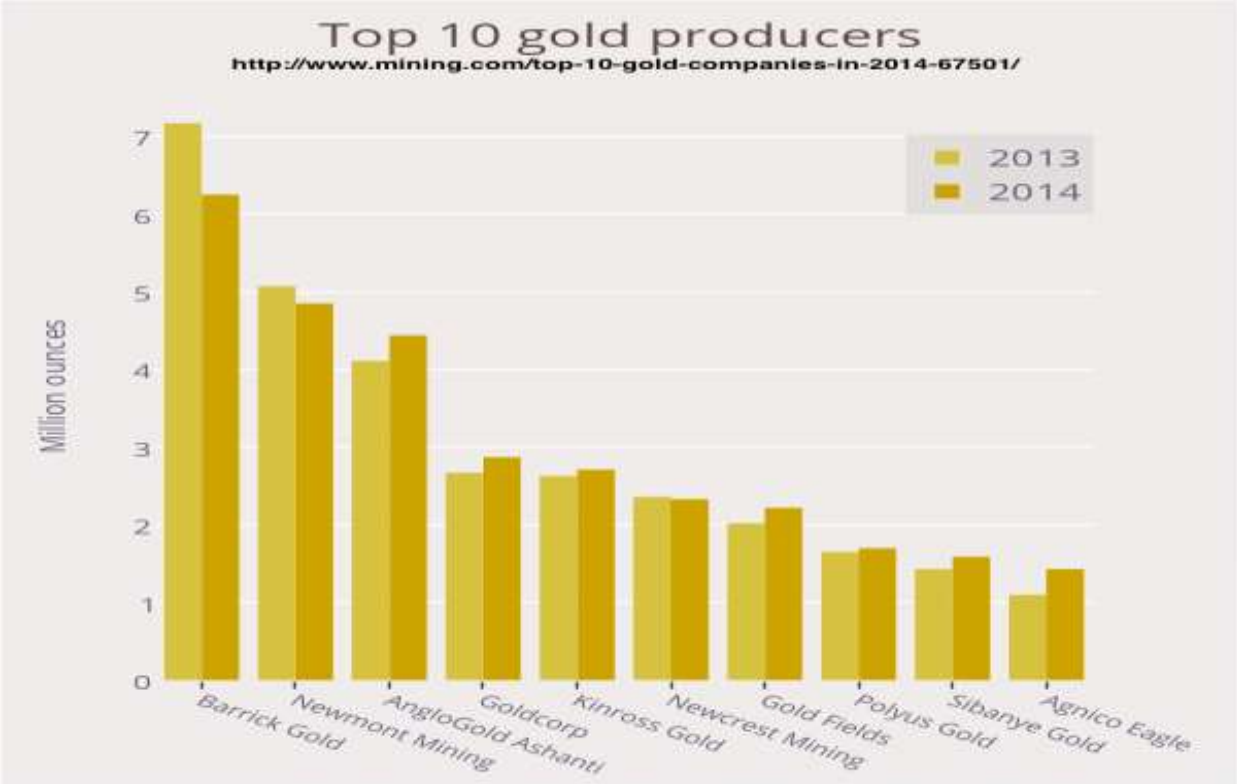


Figure 17: Gold content per tonne ore milled by top 4 companies, 2002-11

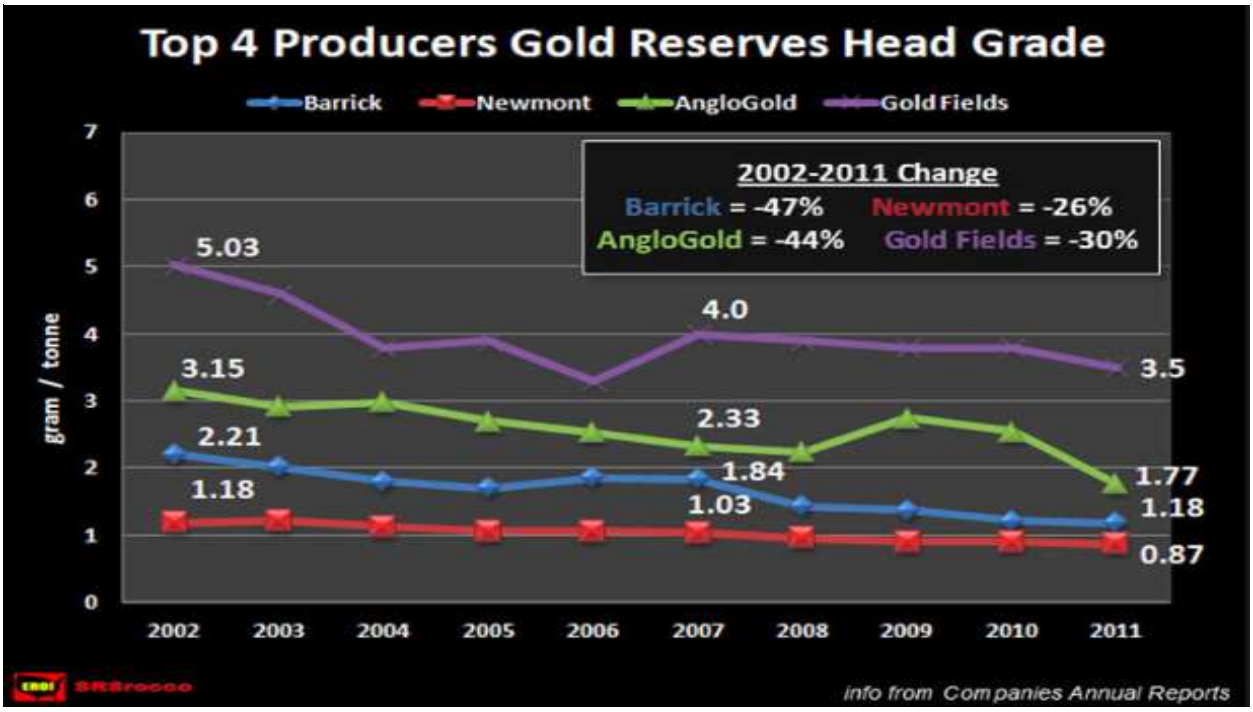


Figure 18: Top 5 producers consumption of diesel fuel per ounce of gold

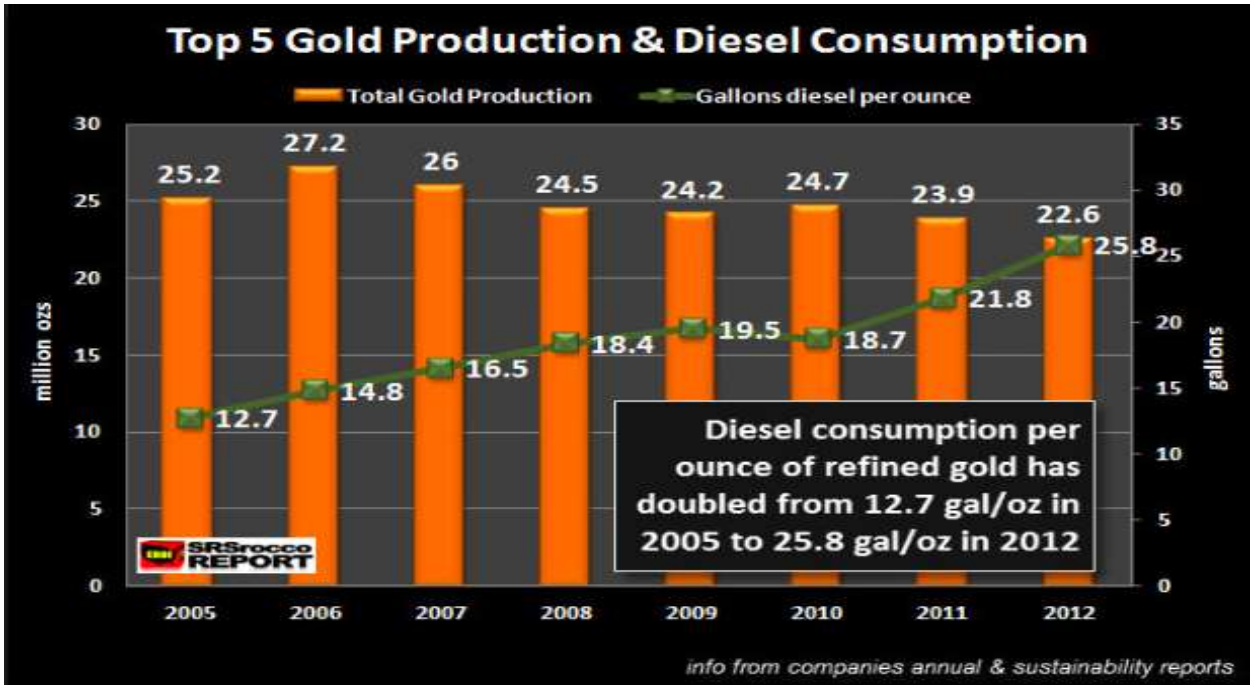
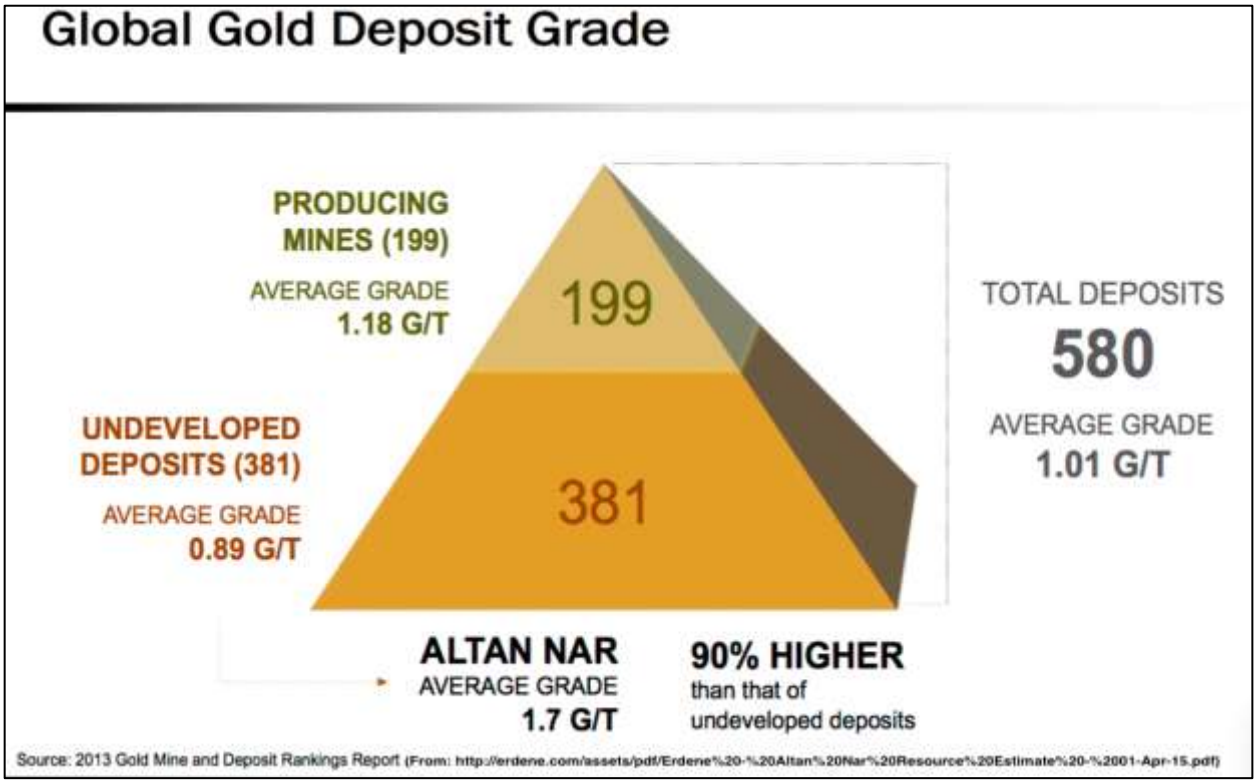


Figure 19: Average gold per tonne at world mines and undeveloped deposits



4. World gold consumption by sector and 10 leading countries

According to the World Gold Council, global gold consumption grew from 3,281 t in the year 2000 to 3,812 t (or 4,108 t including OTC investment and stock flows) in 2010 and 3,924 t (or 4,278 including OTC investment and stock flows) in 2014. Jewelry consumption decreased from 2,902 t in year 2000 to 2,060 t in 2010 and recovered only slightly to 2,152.9 t in 2014. Although other sources of demand listed in Table 15 experienced overall growth, central bank net purchases and exchange traded funds (ETFs) were variable.

Table 15: World gold consumption (consumer demand) by 10 leading counties

	Gold consumption by countries as jewelry, bars and coins	2014 (metric tonnes)	Share in the world gold consumption
1	China, incl. Hong Kong & Taiwan	867.5	27.0%
2	India	842.7	26.2%
3	Europe, excluding CIS	266.4	8.3%
4	Middle East (Saudi, Egypt, UAE)	215.7	6.7%
5	United States	179.2	5.6%
6	Turkey	123.0	3.8%
7	Thailand	83.6	2.6%
8	Russia	70.6	2.2%
9	Vietnam	69.1	2.1%
10	Indonesia	51.8	1.6%

*Source: Gold Demand Trends - Full Year 2014 - World Gold Council, Table 11, www.**gold**.org/download/file/3691/GDT_Q4_**2014**.pdf*

Table 16: World gold consumption (overall demand) by sector (tonnes)

	Structure of gold consumption by sector	2014 tonnes	Share of gold sector in total gold consumption
1	Jewellery	2,152.9	50.3%
2	Physical bar demand	807.8	18.9%
3	Official coin	178.5	4.2%
4	Medals and imitation coins	77.4	1.8%
5	Exchange traded funds (ETFs)	-159.1	-3.7%
6	Technology	389.0	9.1%
7	Central bank net purchases	477.2	11.2%
8	OTC investment and stock flows	354.6	8.3%
	TOTAL	4,278.3	

*Source: Gold Demand Trends - Full Year 2014 - World Gold Council, Tables 4, 6 & 13, www.**gold**.org/download/file/3691/GDT_Q4_**2014**.pdf*

5. World gold total export and import by leading counties

The source web site for Table 17 reports that:

In 2014, gold exports by country totaled US$303.9 billion up by an overall 108.4% for all gold shippers over the five-year period starting in 2010. However, the value of global gold exports dipped 9.9% from 2013 to 2014.

Among continents, European countries accounted for the highest dollar value worth of gold exports during 2014 with shipments amounting to US$132 billion or 43.4% of the worldwide total. Asian exporters were responsible for 27.7% worth of gold exports, while 13.4% was shipped from North America.

Among the above countries, the fastest-growing gold exporters since 2010 were: South Africa (up 956,761%), Switzerland (up 7,010%), United Kingdom (up 3,932%) and Hong Kong (up 395%).

Those countries that posted declines in their exported gold sales were led by: Russia (down 39.2%), Peru (down 27.2%), Japan (down 26.4%) and Germany (down 21.7%).

The listed 15 countries shipped 84.8% of all gold exports in 2014.

Table 17: Top 10 gold importers in 2013, with % of global imports

1. India:	US$37.7 billion (20% of world imports)
2. Hong Kong:	US$25.9 billion (13.8%)
3. United Kingdom:	US$15.2 billion (8.1%)
4. Turkey:	US$15.1 billion (8.0%)
5. Thailand:	US$15.0 billion (8.0%)
6. United States:	US$14.7 billion (4.9%)
7. United Arab Emirates (UAE):	US$13.9 billion (7.4%)
8. Canada:	US$9.3 billion (4.9%)
9. Germany:	US$6.4 billion (3.4%)
10. Italy:	US$5.6 billion (3.0%)

(Source: http://www.worldsrichestcountries.com/top_gold_importers.html)

Table 18: Top 15 gold exporters in 2014, with % of global exports

1. Switzerland:	US$74.1 billion (24.4% of total gold exports)
2. Hong Kong:	US$50 billion (16.4%)
3. United Kingdom:	US$37.6 billion (12.4%)
4. United States:	US$21 billion (6.9%)
5. Canada:	US$15 billion (4.9%)
6. United Arab Emirates:	US$13.1 billion (4.3%)
7. Australia:	US$12 billion (4%)
8. Peru:	US$5.6 billion (1.9%)

9.	Germany:	US$5.5 billion (1.8%)
10.	South Africa:	US$4.7 billion (1.6%)
11.	Mexico:	US$4.7 billion (1.5%)
12.	Japan:	US$4.4 billion (1.4%)
13.	Italy:	US$3.8 billion (1.2%)
14.	Turkey:	US$3.2 billion (1.1%)
15.	Russia:	US$3 billion (1%)

(Source http://www.worldstopexports.com/gold-exports-country/3212)

6. Gold price projections of the World Bank and other institutions

Gold is unlike most mineral commodities because only a small portion of annual mine production is used by industry to fabricate products that are actually needed by society. Instead, gold demand is primarily a function of its value and future stability relative to currencies as perceived at any particular time, whether the perceived value is sought to be secured through the owning of gold jewelry, coins, bars or paper backed by a store of gold. The price of gold at any future time is thus difficult to predict as it is dependent not only on mine supply but also to a great degree on ability to forecast the timing of wars, interest rate changes, recessions and changes in public sentiment.

It is with the above considerations in mind that the forecasts in Figure 21 are to be interpreted. Nevertheless, there is a high degree of certainty that gold supply from mines will not grow in the several years beyond 2015, and, in fact, mine output is predicted to fall, because investment in development of new mines has slowed with the gold price decline over the past few years to the point where depletion of existing mines is not being offset. If interest rates in the United States increase in 2016 and 2017 as predicted and this causes the United States dollar to increase in value relative to most other currencies, investors and speculators would be expected to prefer to hold dollars rather than gold as a source of stability. This could keep the gold price from increasing, but within a number of years the decreasing mine supply is expected to become sufficiently offsetting to cause the price to rise.

Before relying on the gold price forecasts of the World Bank and other research organizations, governments reviewing gold (and copper) mine development strategies should consider the latest (11 November 2015) International Monetary Fund (IMF) graphical depiction of the outlook and risk or confidence levels for both gold and copper prices (Figure 20).

Figure 20: Gold and copper price outlook and confidence levels, November 2015

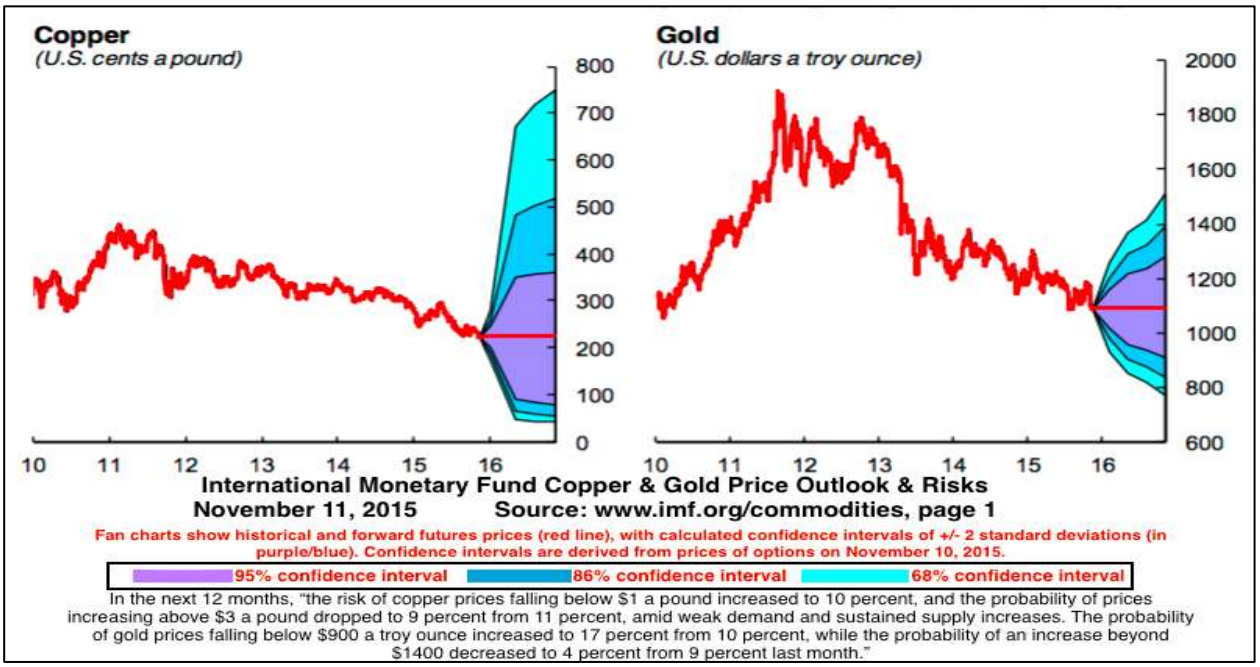


Figure 21: Gold price forecasts and dates when announced, 2015-various years

Gold price forecasts in current (nominal) US dollars and actual gold price average in 2013 and 2014												
Forecaster	**Date**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
World Bank[1]	20-Oct-15	1,175	1,156	1,138	1,120	1,102	1,084	1,067	1,050	1,033	1,016	1,000
Scotiabank[2]	24-Nov-15	1,162	1,090	1,200								
JP Morgan[3]	11-Sep-15		1,090									
BNP Paribas[4]	10-Sep-15	1,145	975	900								
Economist Intellig'ce Unit[5]	18-Nov-15	1,164	1,130	1,213	1,300	1,350	1,330					
Economy Forecast Agency[6]	17-Oct-15		1,068	1,005	854	814	909					
HSBC[7]	27-Jul-15	1,160	1,205	1,300	1,325	1,325	1,325					
Deutschbank[8]	29-Jul-15		785	$785/ tr oz long term 'fair value' according to Deutschbank model								
ABN Amro[9]	01-Sep-15	1,000	800									
UBS[10]	09-Oct-15	1,170	1,250	1,250	1,300	1,300						
Natixis[11] (French bank)	03-Dec-15	1,100	970	1,020	higher prices from 2017 onward in response to decreasing mine supply							
Thomson Reuters GFMS[12]	Jul-15	1,180	1,250									
Standard and Poor[13]	31-Aug-15	1,150	1,150	1,150								
Moody's[14]	08-Jan-14	1,100	1,100									
Average of forecasts		**1,137**	**1,073**	**1,096**	**1,180**	**1,178**	**1,162**	**1,067**	**1,050**	**1,033**	**1,016**	**1,000**

[1]http://www.worldbank.org/en/research/commodity-markets
[2]Scotiabank, Patricia Mohr presentation on 24 Nov 2015
[3]http://www.bulliondesk.com/gold-news/focus-jp-morgan-lowers-15-16-gold-price-forecast-stronger-dollar-to-weigh-100414/
[4]http://www.kitco.com/news/2015-09-10/Expect-Gold-s-Downtrend-To-Continue-Through-2017-Averaging-900-BNP-Paribas.html
[5]http://gfs.eiu.com/Article.aspx?articleType=cf&articleId=1363689520&secId=5
[6]http://longforecast.com/gold/
[7]http://www.bulliondesk.com/gold-news/focus-hsbc-downgrades-2015-gold-price-forecast-six-percent-98492/
[8]http://www.mining.com/deutsche-gold-price-has-another-30-to-fall-and-soon/
[9]http://gulfnews.com/business/sectors/markets/gold-forecast-to-drop-to-800-an-ounce-in-2016-1.1576662
[10]http://www.bulliondesk.com/gold-news/focus-ubs-sees-limited-downside-for-gold-lowers-silver-forecast-102403/
[11]http://www.kitco.com/news/2015-12-03/No-Reason-To-Hold-Gold-In-2016-Prices-To-Drop-Below-1-000-Natixis.html
[12]http://ibja.co/Upload/IBJANewssmallImage/GFMS%20Gold%20Survey%20Q2%202015%20Review%20and%20Outlook%20.pdf
[13]http://www.reuters.com/article/2015/08/31/us-s-p-metals-idUSKCN0R007I20150831#dBhhtch3AZyf6JRr.97
[14]http://www.bulliondesk.com/gold-news/focus-sp-cuts-gold-price-forecasts-weaker-sentiment-possible-us-rate-hike-100223/

7. Production cost of gold at primary and alluvial mines, US$/troy ounce

Relative to gold production from primary bedrock deposits, including deposits mined primarily for other metals, the production of gold from alluvial and placer mines has declined in the majority of countries. This is particularly true in the case of countries with a high per capita gross domestic product. The United States is a typical example where placer

production once accounted for 35 percent of mine output, but declined to only two to three percent in the 1980's and to less than one percent now.

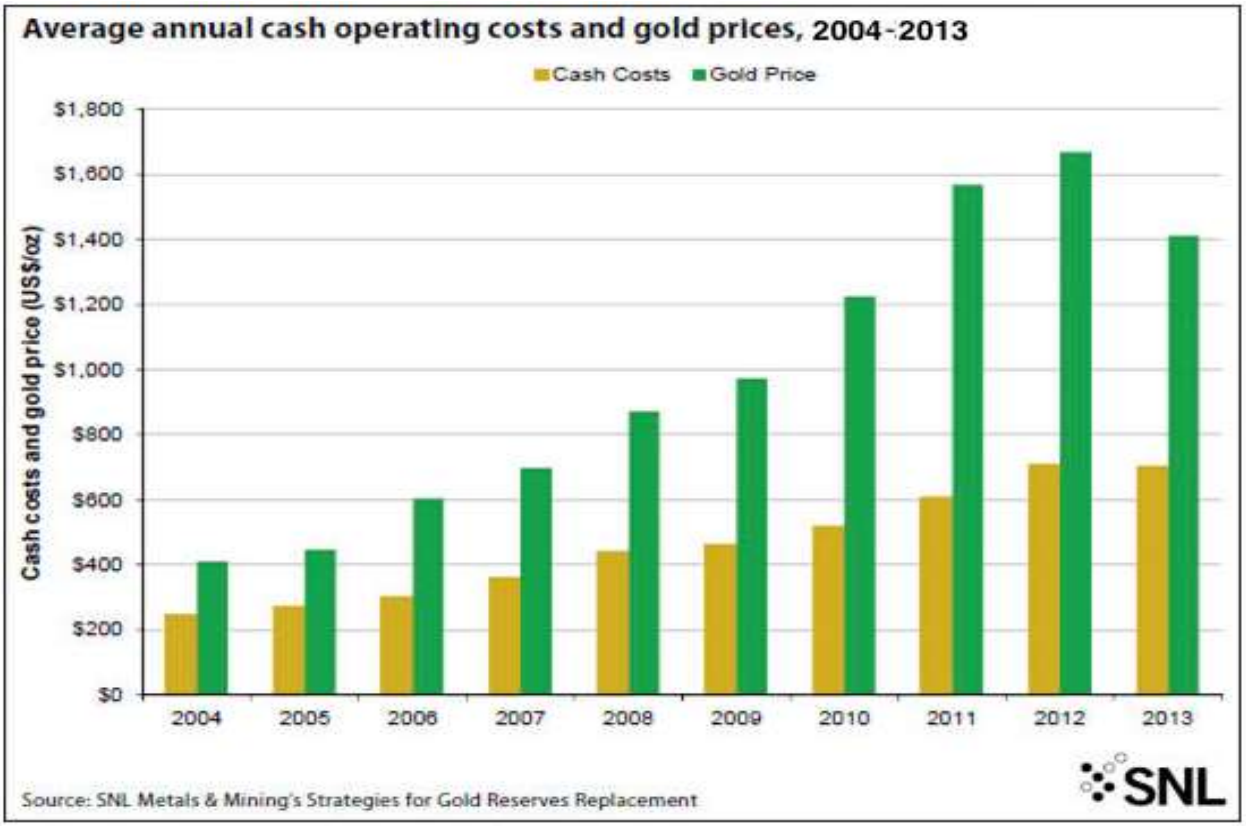
Because the production of alluvial gold is almost exclusively by individuals or companies whose shares do not trade on stock exchanges in jurisdictions requiring public disclosure of costs and audited financial data, the average cash cost of producing an ounce of gold is difficult to determine. A 1994 report by the United States Environmental Protection Agency stated that[2]: *The economics involved in mining a deposit is dependent on factors including the cost of fuel, interest rates, and the market price of gold. These factors are variable in terms of location and time. Under 1991 conditions, gold placer mines could economically beneficiate gravels containing as little as 0.49 grams per cubic meter (0.01 oz/cubic yard). However, average recoverable gold content of precious metals from placer gravels was 0.82 gm/m (0.02 oz/yd) of material washed (US DOI Bureau of Mines, 1992a).*

In the early 1990's gold was approximately US$400/tr oz (31.1 grams/tr oz) and 0.82 grams would have been worth 0.82 X 400/31.1 = US$10.55/cubic meter or US$12.87/gram of gold recovered. Assuming that a miner would need at least US$3.20/gram as a return on investment in machinery and pre-production site preparation, the cash operating cost would have been approximately US$9.67/gram or US$300/tr oz. At the current gold price (US$1,050 to US$1075/tr oz range) and using the same proportion of cash cost to gold price, the alluvial cash cost would be in the US$788 to US$806/tr oz range or US$25.34 to US$25.92/gram of gold produced.

As the price of gold increased in the 2004-2012 period, the cash cost for primary gold mines rose (Figure 22), although at a slower rate than the rate of price increase, even though miners took advantage of the much higher price to access portions of new reserves which had been classified as resources (uneconomic) during the preceding decade.

[2] Excerpt from: GOLD PLACERS, U.S. Environmental Protection Agency Office of Solid Waste, October 1994, http://www3.epa.gov/epawaste/nonhaz/industrial/special/mining/techdocs/placer/placer1.pdf

Figure 22: Annual average gold prices and cash costs, 2004-2013



Following the price decline over the 2013-2015 period, miners have reduced cash costs (Figure 12). All-in-sustaining-costs (AISC) also have been reduced and continue to be reduced if the gold AISC cost curve for 2013 (Figure 23) is compared with the AISC bar graphs for first quarter of 2014 and 2015 (Figure 24) and the 2014 AISC for additional companies (Figure 25).

Because the average gold content of reserves and ore processed fell during the 2002-2011 period (Figure 9), mining companies needed to transport and handle more tonnage in processing plants in order to maintain the same output of gold. This resulted in diesel fuel consumption doubling from 12.7 gallons/tr oz in 2005 to 25.8 gallons/tr oz in 2012 (Figure 10). Fortunately for the mining companies, the price of diesel fuel is now almost half of the price in 2012.

Figure 23: All-in-sustaining-cost curve (AISC) & cost definitions for gold mining companies in 2013

Definition of Different Costs Used by Gold Companies

http://marketrealist.com/2014/09/must-know-deciphering-gold-companies-cost-reporting/

Costs	Definition
Cash Costs	Includes COGS(Labor+Energy+Consumables)+Royalties
Total Cash Costs	Cash cost+Off site costs+Head office costs
All-in Sustaining Costs	Cash cost+ Sustaining capital+Exploration expense+General & Admin expenses
All-in Cash Costs	Cash cost+ Exploration expense+Head office costs+Sustaining capital
Total Costs	Total cost+ Depreciation+Interest+Taxes+Project Capex

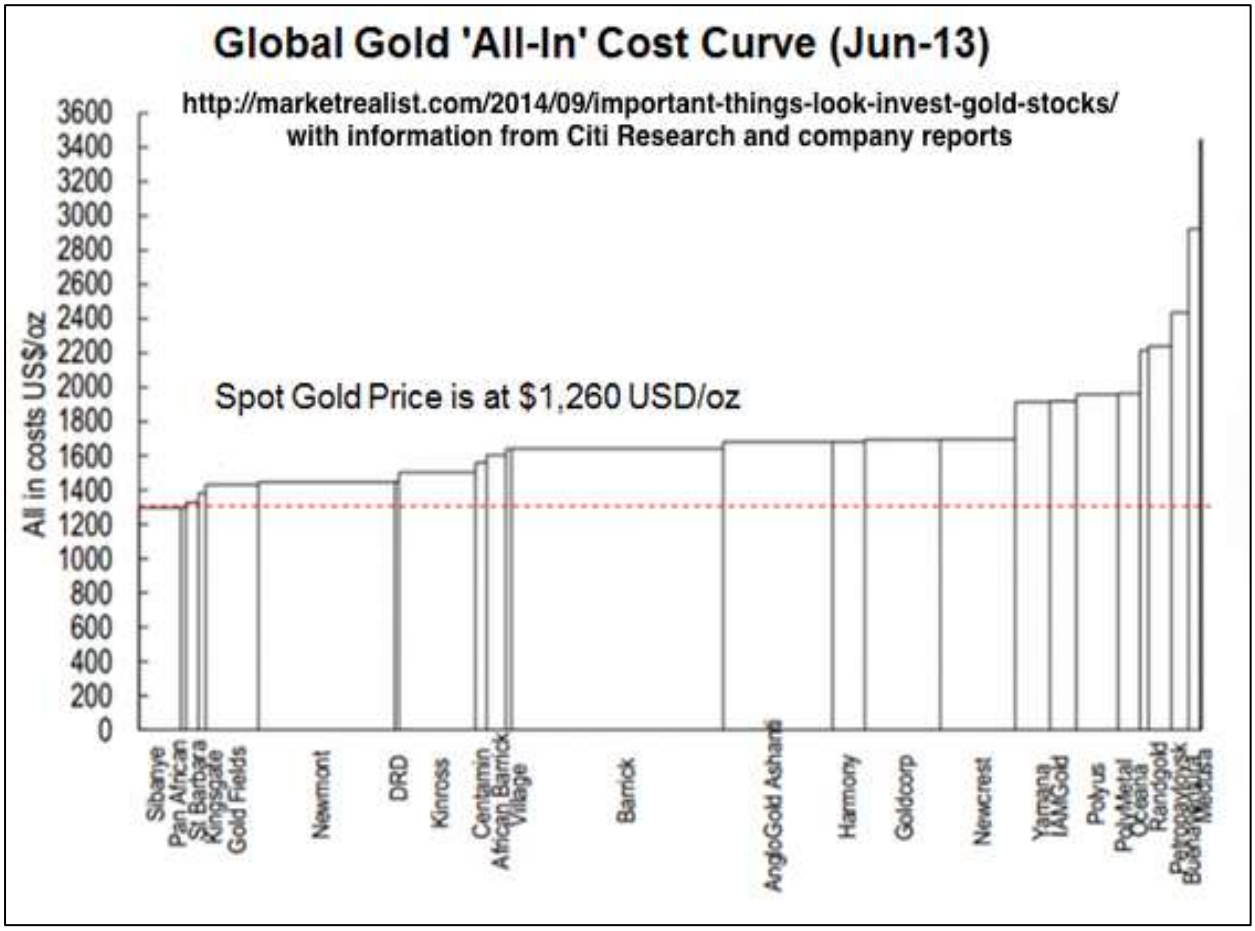


Figure 24: All-in-sustaining costs for gold mining companies, Q1 2014 vs Q1 2015

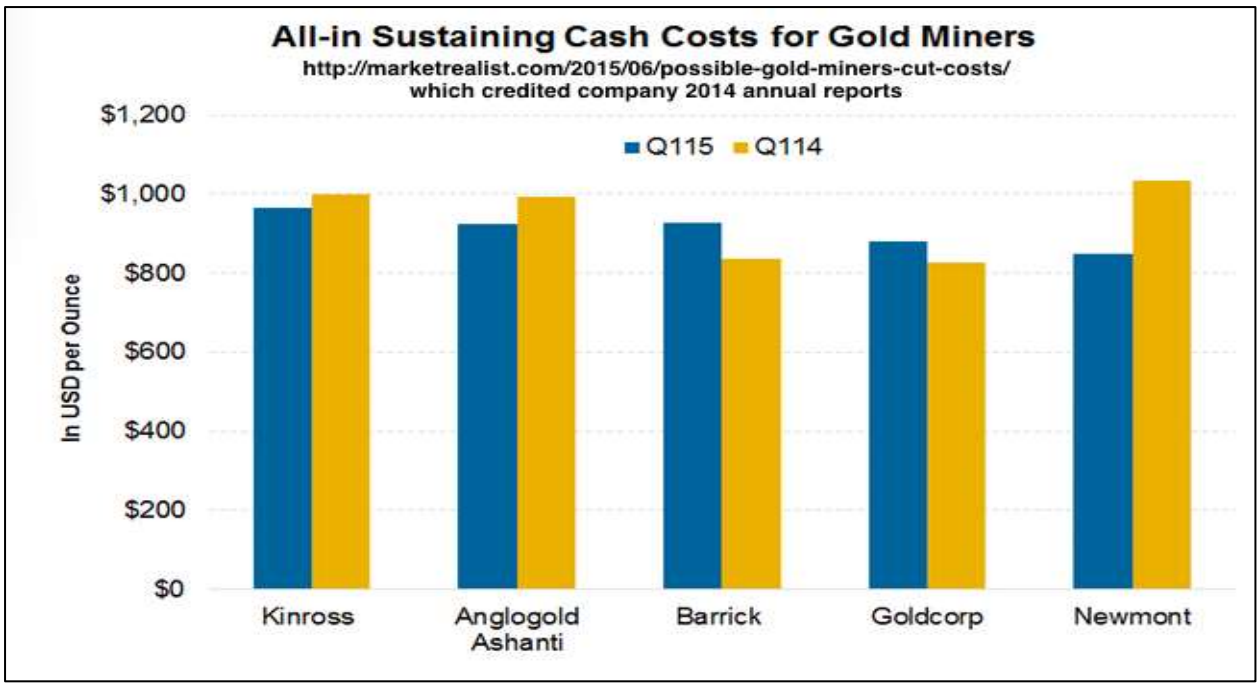
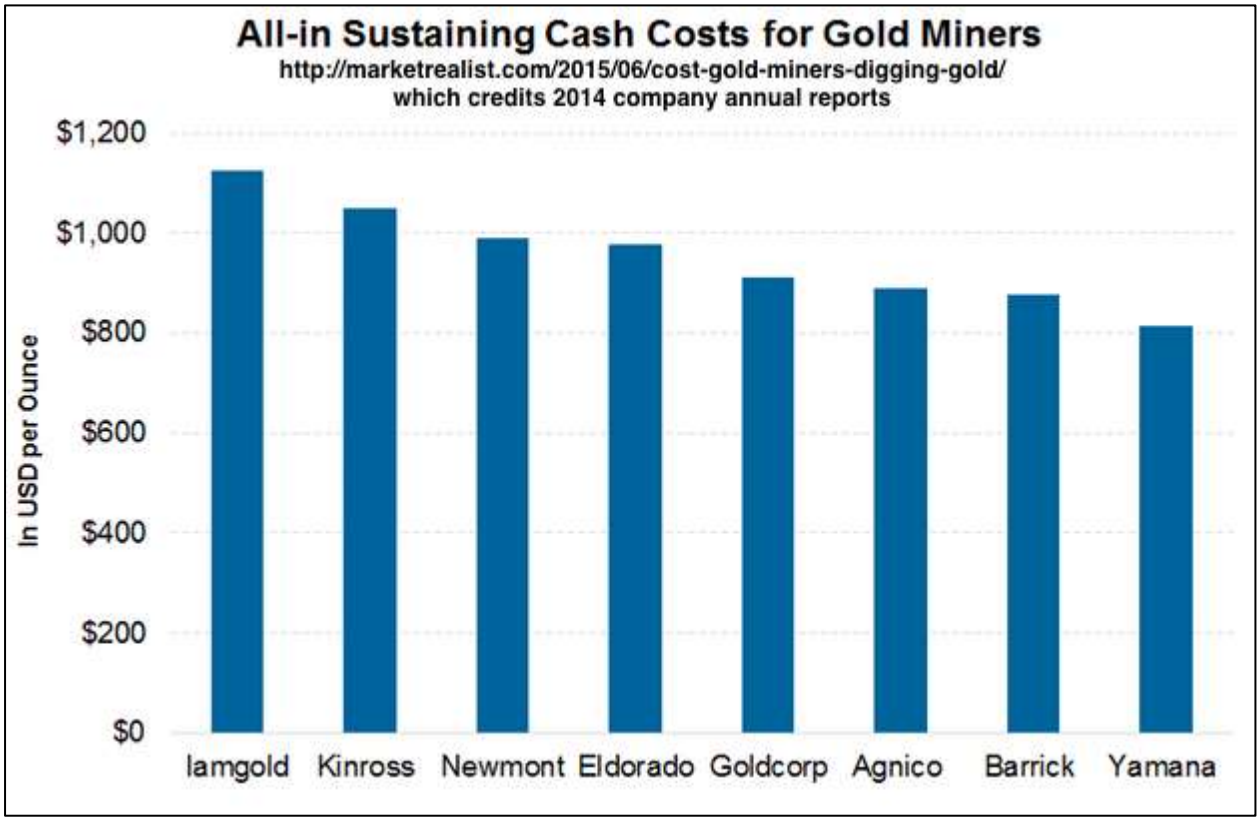


Figure 25: All-in-sustaining costs, including additional gold mining companies, 2014



The Market Realist (http://marketrealist.com/2015/06/possible-gold-miners-cut-costs/) has concluded that:

Gold miners have already slashed costs that are under their control. Most controllable cost-cutting isn't coming from process or efficiency improvements, which are stickier. Miners have made major cost cuts in capital expenditures and exploration budgets.

Some miners have been a bit too hard on costs and have cut exploration costs, which could dent their growth prospects going forward. Some of the cost cutting is from high-grading of mines, or mining the higher grade portion of a mine first. This could be detrimental to mine life in the long run.

Non-controllable costs, including local currency depreciation and cheaper oil prices, also helped miners lower costs considerably last year. According to a 2015 survey by Gold Fields Mineral Services Ltd. (or GFMS), most of the decline in cash costs for 2014 compared to 2013 was due to weaker local currencies and fuel, while the cost of labor and power increased.

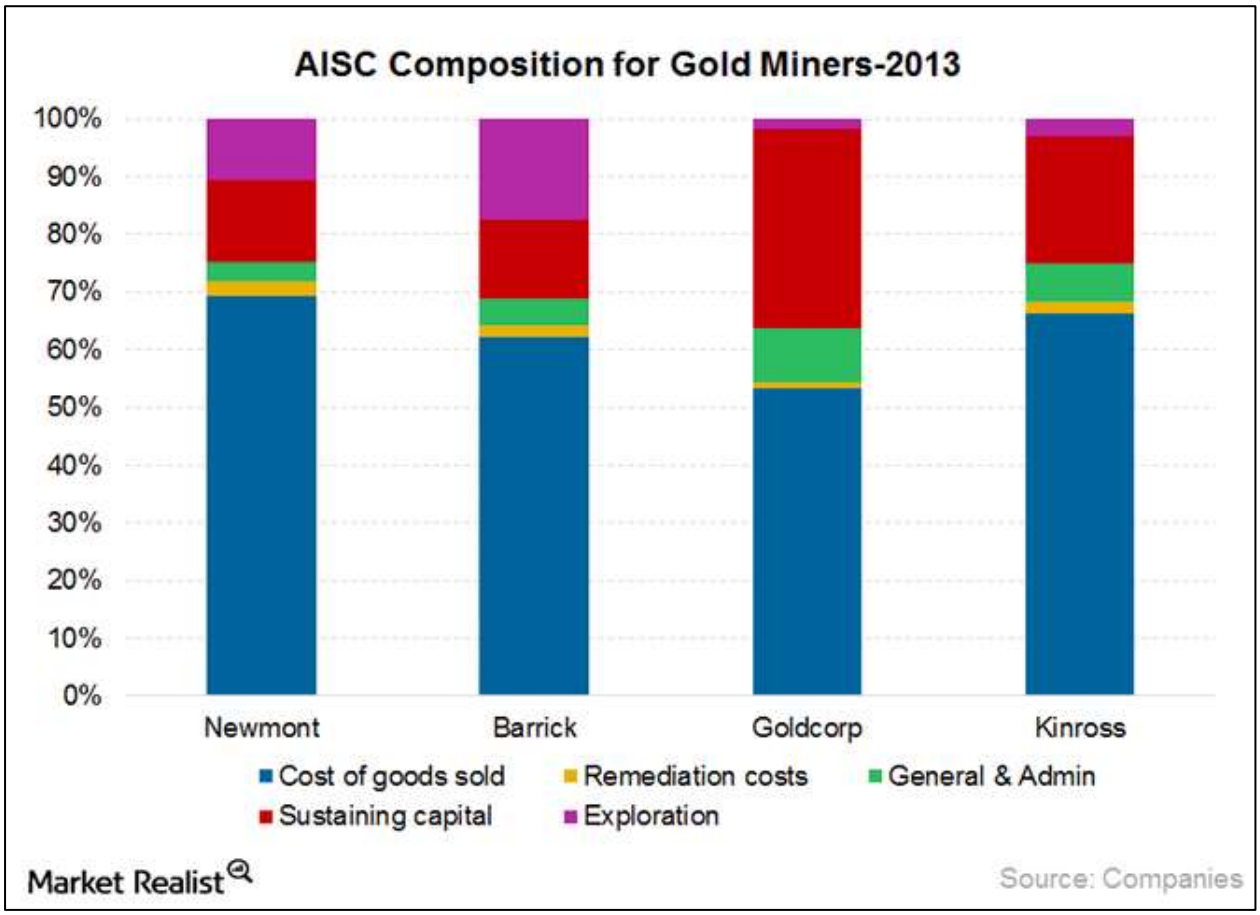
Newmont Mining (NEM) reported an 18% year-over-year decline in all-in sustaining costs (or AISC) in 1Q15. Costs declined from US$1,035 per ounce to US$849 per ounce. However, 30% of the cost improvements were due to lower oil prices and a favorable Australian dollar exchange rate. Another 15% savings was due to capex cuts because of the timing of the projects.

The same logic can be applied to Kinross Gold (KGC), which reduced its AISC by 3.7% year-over-year, from US$1,001 per ounce in 1Q14 to US$964 per ounce in 1Q15. The majority of its mine production comes from Russia. The depreciation of the Russia ruble against the US dollar led to the majority of the cost gains.

Goldcorp's (GG) 1Q15 AISC increased by 6.3% year-over-year, from US$828 per ounce to US$880 per ounce. The increase would have been more pronounced had the company reported costs on ounces of gold produced rather than ounces sold.

So it seems that most of the low-hanging fruit has already been taken as far as cost cutting is concerned. To realize any upside from here, gold miners will have to explore stronger, stickier options.

Figure 26: Composition of all-in-sustaining costs of largest mining companies, 2013



8. Perception of mining companies about investing in Mongolia

The perception of prospective investors is a factor that has considerable influence on the amount of gold which will be produced in the future in any country or jurisdiction. In order to compare this perception by mining company management about the various jurisdictions of the world, the Fraser Institute conducts a comprehensive survey each year.

The 2014 Fraser survey received 485 responses of which 57% were from either company presidents or vice-presidents and 27% from managers or senior managers. The responding companies reported collective exploration spending of US$2.7 billion in 2014, US$3.2 billion in 2013 and US$4.6 billion in 2012 (https://www.fraserinstitute.org/sites/default/files/survey-of-mining-companies-2014.pdf).

The survey responses for Mongolia and five other jurisdictions are presented in Table 19. If Mongolia were to adopt best practices it would be more favoured by mining investors than Ghana, approximately equal to Namibia and would have gained considerably relative to other jurisdictions as evidenced by percentages recorded in column 1.

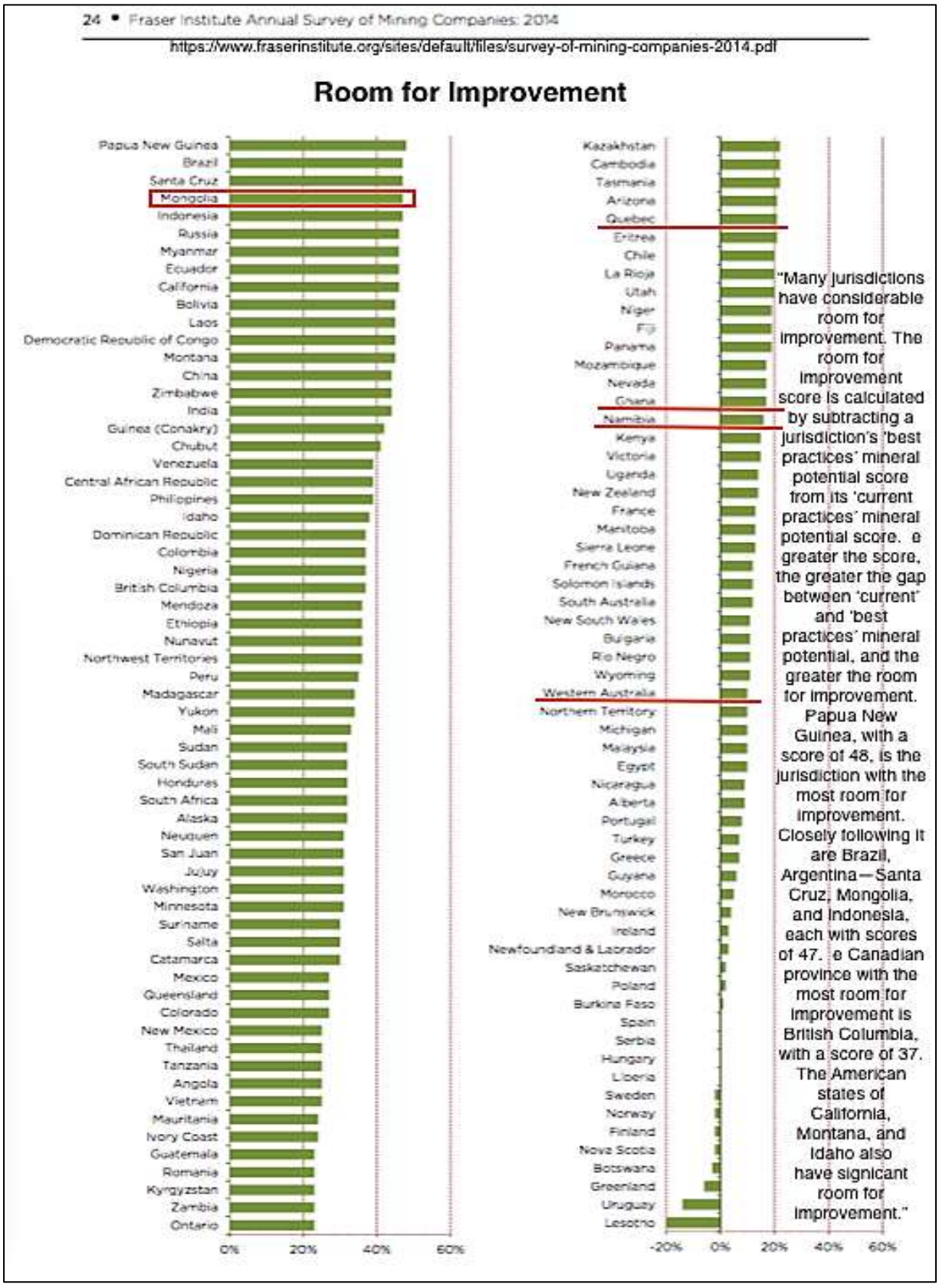
Figure 27 is a graphical depiction of degree of room for improvement in all jurisdictions for which the Fraser Institute surveyed the degree of favourableness for investment in the opinion of mining company management.

Table 19: Government policy factors rated in Fraser Institute survey of 2014, including responses if jurisdictions adopted 'best practice' policies (last rows)

Factor to which percentage of company management response, adjacent columns	**1: Encourages investment 2: Not a deterrent to investment 3: Mild deterrent to investment 4: Strong deterrent to investment 5: Would not pursue investment due to this factor**					
	Response	**1**	**2**	**3**	**4**	**5**
Quality of Geological Database, includes quality and scale of maps, ease of access to information, etc.	Mongolia	6%	25%	38%	31%	0%
	W Australia	58%	42%	0%	0%	0%
	Quebec	71%	24%	4%	1%	1%
	Ghana	18%	39%	43%	0%	0%
	Namibia	41%	41%	19%	0%	0%
Labor Regulations/ Employment Agreements And Labour Militancy/Work Disruptions	Mongolia	6%	29%	53%	0%	12%
	W Australia	20%	56%	19%	5%	0%
	Quebec	19%	60%	16%	6%	0%
	Ghana	17%	53%	27%	3%	0%
	Namibia	21%	55%	21%	3%	0%
Political Stability	Mongolia	0%	12%	29%	35%	24%
	W Australia	56%	40%	5%	0%	0%
	Quebec	46%	26%	21%	6%	1%
	Ghana	30%	37%	20%	13%	0%
	Namibia	50%	39%	11%	0%	0%
Trade Barriers—tariff and . non-tariff barriers; restrictions on profit repatriation, currency, etc	Mongolia	0%	6%	47%	24%	24%
	W Australia	47%	50%	3%	0%	0%
	Quebec	38%	56%	3%	3%	0%
	Ghana	13%	60%	23%	3%	0%
	Namibia	24%	62%	10%	3%	0%
Taxation Regime (includes personal, corporate, payroll, capital, and other taxes, and complexity of tax compliance)	Mongolia	5%	5%	21%	42%	26%
	W Australia	16%	45%	33%	6%	0%
	Quebec	23%	33%	32%	12%	0%
	Ghana	7%	55%	32%	7%	0%
	Namibia	14%	59%	28%	0%	0%
Legal System (legal processes that are fair, transparent, non-corrupt, timely, efficiently administered, etc.)	Mongolia	0%	6%	18%	41%	35%
	W Australia	35%	58%	7%	0%	0%
	Quebec	32%	44%	20%	3%	1%
	Ghana	15%	30%	39%	15%	0%
	Ghana	15%	30%	39%	15%	0%
Regulatory Duplication and Inconsistencies (includes	Mongolia	0%	16%	16%	42%	26%
	W Australia	27%	42%	31%	0%	0%

federal/provincial, federal /state, inter-departmental overlap, etc)	Quebec	20%	39%	22%	18%	2%
	Ghana	18%	42%	24%	12%	3%
	Namibia	27%	40%	27%	7%	0%
Uncertainty Regarding the administration, interpretation, and enforcement of existing Regulations	Mongolia	5%	11%	11%	37%	37%
	W Australia	44%	49%	7%	0%	0%
	Quebec	36%	29%	21%	13%	1%
	Ghana	36%	33%	27%	3%	0%
	Namibia	27%	40%	20%	13%	0%
Mineral Potential, Assuming Current Regulation / Land Use Restrictions	Mongolia	13%	6%	19%	50%	13%
	W Australia	49%	41%	10%	0%	0%
	Quebec	44%	30%	18%	6%	2%
	Ghana	18%	54%	29%	0%	0%
	Namibia	33%	44%	22%	0%	0%
Mineral Potential, Assuming Policies Based on Best Practices (i.e. world class regulatory environment, highly competitive taxation, no political risk or uncertainty, and a fully stable mining regime)	Mongolia	50%	25%	6%	13%	6%
	W Australia	66%	28%	5%	2%	0%
	Quebec	69%	22%	8%	2%	0%
	Ghana	46%	32%	21%	0%	0%
	Namibia	52%	37%	11%	0%	0%

Figure 27: Room for mining policy improvement by jurisdictions - the perspective of mining executives surveyed in August-November of 2014 by the Fraser Institute



CHAPTER SIX - GOLD MINING AND PROCESSING TECHNOLOGY, ENVIRONMENTAL RECLAMATION

During the initial years of the previous Gold program, the main gold mines operated 2 dredges (250 liter capacity, Russian made), 11 gold-washing facilities (able to wash 50-75 cubic meters of ore per hour), 4 excavators (with buckets of 5-10 cubic meters) and 18 bulldozers. Four more Russian dredges, 115 washing facilities (52 domestically made), 8 excavators and over 340 bulldozers were added in 2000.

At mining properties in Mongolia, characterised by fine (very small) particles of gold, the Gold-2000 program planned to encourage the use of advanced equipment to increase the recovery rate in 1997-2000, but no tangible action was taken in this regard. In the Zaamar region, a Canadian-made Nelson concentrator and RR-700 washing sluices were tested in 1996-1997 for a higher recovery rate. There were positive results, but the equipment was not used widely because of its high cost. The current gold separation technology involves a 10-16% waste/loss, excluding mine waste rock (with gold), and a total loss of 15-20%. It is estimated that in 2000, 1.7-2.3 metric tonnes of gold were unrecovered due to technological drawbacks and this gold was left as tailings or waste rock.

The soil stripping technology currently in use at gold deposits varies. The larger mines use a high soil strip ratio technology (10-15 cubic meters) while some use excavators for entire mine transport (Shijir Alt, Tolgoit, Khailaast) to reduce operating costs. Small and medium sized mines use mine transport (excavator and truck, alone or in combination with scrapper); they have no dedicated transport system but use bulldozers. Technologies at gold deposits are basically of two main methods: dredging and separation. The latter transports ore and gold-bearing sand by truck or excavator.

In hard rock gold mines, there were almost no mining operations during the previous Gold program, but there were mine plans outlining open cast mining and mine transport as priority for mining potential deposits at that time. A feasibility study for the Bumbat gold mine planned to use this technology, but the probable reserve was unproved. As with the Boroo hard rock mine, attracting investment took a long time; construction finally started in 2000, and operations in 2003 used cyanide leaching. Boroo has now exhausted its main reserves and is working tailings and poor grade ores with heap leaching. A concentrator was established at Bumbat in 1997, but it ceased due to poor grade ores and incorrect choice of mining technology.

Heap leaching technology was tested at the Olon Ovoot mine (Umnugobi province) in 1997 and 10-17 kgs of gold have been mined per year since then. Olon Ovoot is an open cast mine and a huge factory able to treat 1.5-2 million metric tonnes of ore per year with cyanide leaching technology. This mine produced 3 metric tonnes of gold between 2006 and 2013.

The Gold program included establishment of a gold refinery, but this was not implemented. In 1999 the Ministry of Agriculture and Industry (former name) announced a bid process for establishing a gold refinery, but procurement had to cease as the Treasury Law stated that gold refining is under the power of the Central Bank. The law was amended in 2001, and the legal environment for the refinery was enabled, but no action has taken place.

Placer and hard rock mining technology

In Mongolia, most placer gold deposits use open cut mining; a few (Tsagaan Tsakhir Uul, Sujigtei, Barchin Uul and Tsagaan Chuluut) are underground mines, but their annual production volume is quite low (100-150 kg). Some new deposits were mined in Bayankhongor province with underground mining and the mine produced 80 kg of gold last year. The gold mining technology study focuses mainly on open cast mining.

Copper mines such as Oyu Tolgoi produce ore from both open cast and underground, and currently produce a large amount of gold as a co-product contained in copper concentrate which is exported for smelting and refining to produce both copper and gold.

Presently the following technology flows and equipment are widely used at placer and hard rock gold mines.

Table 20: Mining and concentration equipment

Mining equipment	Transportation	Overburden and tailings management	Separation/concentration
No mine transport system (no hauling)			
Scraper	Scraper	Scraper	Sluice, scraper
Bulldozer	Bulldozer	Bulldozer	Sluice, scraper
Dredge	Dredge	Dredge	Dredge
Mine transportation (hauling)			
Excavators	Off highway and other trucks	Bulldozer	Sluice, scraper
Dredge	-	-	Sluice, scraper

Commonly used mining equipment at placer and hard rock mines are shown below.

Table 21: Open cast mine process

#	Mechanized system		Rock preparation	Rock			Hauling	Pile up	Mine work	Rock type
	Versions	Index		Dig and load	Dig and swing	Dig and remove				
1.	Excavator	Э	-		+	-	-	-	Soil stripping	Soft, dense,
		БЭ	+	-	+	-	-	-		Hard and stone
2.	Excavator–haul*	ЭО	-		+	-	-	+	Soil stripping	Soft, dense
		БЭО	+	-	+	-	-	+		Gard, stone
3.	Excavator–haul*	ЭТ	-	+	-	-	+	-	Mining	Soft, dense
		БЭТ	+	+	-	-	+	-		Rocky and stone
4.	Excavator- haul-	ЭТО	-	+	-	-	+	+	Soil stripping	Soft dense

	pile *	БЭТО	+	+	-	-	+	+		Rocky, stone
5.	Scraper	С	-	-	-	+	-	-	Soil stripping, mining	Soft, dense
		БС	+	-	-	+	-	-		Dense and rocky
6.	Grader	Г	-	-	-	+	-	-	Soil stripping, mining	Soft, dense
		БГ	+	-	-	+	-	-		Dense, rocky
7.	Bulldozer	Б	-	-	-	+	-	-	Soil stripping, mining	Soft, dense
		ББ	+	-	-	+	-	-		Dense, rocky, stone
8.	Hydromechanics	ГМ	-	-	-	+	-	-	Soil stripping, mining	Soft
		БГ	+			+	-	-		Dense

Advantages of mining at placer gold deposits

- Easy to mine with open cast as the ore depth is relatively low.
- Wide choice of options, from the simplest to dredging and conveyor systems.
- Low cost.
- Quick recovery of investment.
- Easily established infrastructure and production facilities, easy to strip soil and reach seams, possibility of quick change of mining system and process.

Disadvantages of placer gold deposits

- Most placer deposits have small reserves, strata or seam ore necessitating work over a wide area with huge negative environmental impact.
- Summer operations; short operating season because of the extreme continental climate.
- Because of low reserves, mine life is short; facilities must be moved frequently; road and water supply facilities are not always effective.

There are various haulage system versions for mining and transport; no hauling system is also used with dredge, scraper, grader or bulldozer. Mine transport systems at placer deposits do not differ much from technology at hard rock deposits. However, depending on the physical rock properties, drilling and blasting may continue during winter and in condition with perma-frost. In some cases drilling and blasting are used for rock preparation and thawing frozen rock, and bulldozers are used for the same purpose.

A gravity method is mainly used at placer gold mines, from manual gravity equipment to scraper, sluice and dredge. All equipment may be based on a gravity method. Bulldozers, scrapers, excavators are used for soil stripping and a wide variety of washing equipment.

For concentration/separation of gold from ore, water cannon and dry methods can be applied in Mongolia (but water is scarce), the key indicator being the recovery rate.

For this baseline study, the team classified major deposits by their reserves, mining conditions, production amount and capacity, and information provided on technology used at these mines.

Mining at larger gold deposits

At the Boroo hard rock mines, there is a wide variety of equipment in use: Drill Tech D25K and Drill Tech D245S drilling machines, CAT5110B and CAT345B excavators, Liebherr R984, Liebherr R974B, CAT 773E and CAT769D off-highway trucks, TR60, CAT D8R and CAT D9R, bulldozers, Liebherr PR764 explosives transporter, ACT 14H motor grader, CAT 988G, CAT980G and CAT990H wheel loaders, CAT 824 wheel bulldozer, all highly efficient equipment from western manufacturers. The mine is working on reclamation and on low grade ores using heap leaching technology.

The geology of the Boroo deposit is not especially difficult. The rock is broken by blasting and ore is loaded into trucks by excavator and transported to the plant for gravity concentration of the gold-bearing material followed by smelting and the production of a doré bar before delivery to the processing plant. A conveyor was considered an option from the open cast mine to the concentrator plant in the expectation that it would save cost, but the investors decided in favour of the trucking option.

The mine uses crushers and mills and carbon-in-pulp leach with cyanide followed by desorb and electrowinning from the active carbon followed by smelting and the production of doré bar. Boroo Gold complies with international standards on its safety. Environmental monitoring and reclamation and managed to minimize the impact on environment at relatively lower level.

The Olon Ovoot deposit (Mandal-Ovoo soum, Umnugobi aimag) has been operated for some time using blasting, excavation, transport, crushing, grinding and cyanide leaching flow. The deposits required a huge amount of soil stripping because of the physical and mechanical properties of the ore, so production costs have been quite high, but the plant also uses very inefficient technology. In general, the Olon Ovoot technology for mining and concentration is similar to that used at the Boroo mine. Olon Ovoot needs to take into account the possibility of the dry tailings being wind-dispersed, so must comply with a special regime for tailings management.

More effort is needed to backfill (technical reclamation during operations), transport and storage of chemicals, and prevention from evaporation is vital. Mining operations did not comply with findings of a geological study at the deposit, so the mine is now in a position that it cannot mine all its proven reserves. Because of failure to opt for the best platform for open cast mining, the company is incurring higher operating costs and has a shortage of ore because of a lack of a proper geological study.

Small scale hard rock mines

The Naran Tolgoi hard rock deposit (Jargalant soum, Tuv aimag) currently works underground, with four inclined shafts. Gold-bearing ore seams have a 60-70 degree fall from the mountain top down the slopes. The deposit is being mined by a Chinese-invested company using both manual and mechanical methods. This is cost prohibitive and not the recommended mining option. The company need not have incurred costs for manual operations if the mine had been properly planned and better technological options adopted. The mine uses a cyanide and ionization process to separate gold from the ore, and needs to pay attention to using chemicals without harmful environmental impact.

The Tsagaan Chuluut hard rock deposit is 4 kms from the Boroo hard rock deposit (Selenge aimag's Bayangol soum), and is one of the few deposits using underground methods. Shafts were sunk by blasting, and the ore is taken by underground rail to the concentrator, where cyanide leaching is used to separate the gold.

Future trends of technology at hard rock gold mines

Mining hard rock deposits is cash intensive because of the geological conditions and the need to build more complex ore processing plants. Hard rock deposits are exploited in two main ways: open cast and underground mining, and 25.5% of all gold produced in Mongolia in 1991-2012 was from hard rock deposits. During this time, hard rock deposits mined were Boroo, Narantolgoi, Olon Ovoot and TSagaan Chuluut; the Boroo mine produced 95% of all gold from these hard rock deposits.

The amount of gold from hard rock deposits will increase as mining at Oyu Tolgoi increases and other gold-bearing hard rock deposits are discovered and developed for mining. Most deposits with good geological and technical conditions have been extensively exploited, so future production will be mostly from hard rock deposits. The mining flow from many open cast mines is quite similar: drilling, blasting, excavation, transport of overburden, concentration and processing.

Hard rock deposits cost more and require a special mining technology as opposed to placer deposits. The Oyu Tolgoi underground mine plans to use a block caving method, new to Mongolia.

Gold extraction/concentration technology

Mongolian gold mines use a wide variety of methods/technology for gold separation: sluices, gravity shaking tables, scrapers, hydro-screening, centrifuges, air separation and cyanide leaching; mercury mining is commonly used by artisanal miners.

During the implementation of the previous Gold program, the simplest method (gravity) was largely used, but the recovery rate is low and it has low efficiency. Because of such wide use of the gravity method, tailings containing gold and technogenic deposits remained. Since 2000, gravity methods have been used in combination with other methods; some equipment has been upgraded and recovery rates have improved.

Boroo gold ore processing technology:

The following processes are used for the Boroo Gold hard rock ore processing plant:

ROM ore is crushed by a single stage jaw crusher. SAG mill is used for grinding and ball mill for regrinding. Any excess ore is transferred to the emergency stockpile which will be used as a source of mill feed when the crushing plant is not operating.

Ground ore is classified by cyclones and cyclone underflow (coarse particles) goes to the gravity circuit were the Knelson Concentrator centrifuges and concentrates the gold. Gold is leached from the gravity concentrate in the Acacia Reactor with a heated solution of Cyanide and leach accelerant.

The cyclone overflow passes to Pre-leach thickener were slurry density is increased from 40% up to 55%. Overflow from the Pre Leach thickener is recycled to the Process. Thickened slurry is pumped to the Leach Circuit.

Leaching of gold takes place in two-stage cyanide leach and six stage Carbon-In-Leach (CIL). Gold is dissolved in cyanide solution in presence of oxygen to form aurum cyanide complex.

The loaded carbon from CIL/CIP process is washed with Hydrochloric Acid and inorganic salts and then goes to elution column with Sodium Cyanide. The gold rich solution, known as Pregnant Eluate, is sent for electrowinning of gold with Acacia Reactor gold solution.

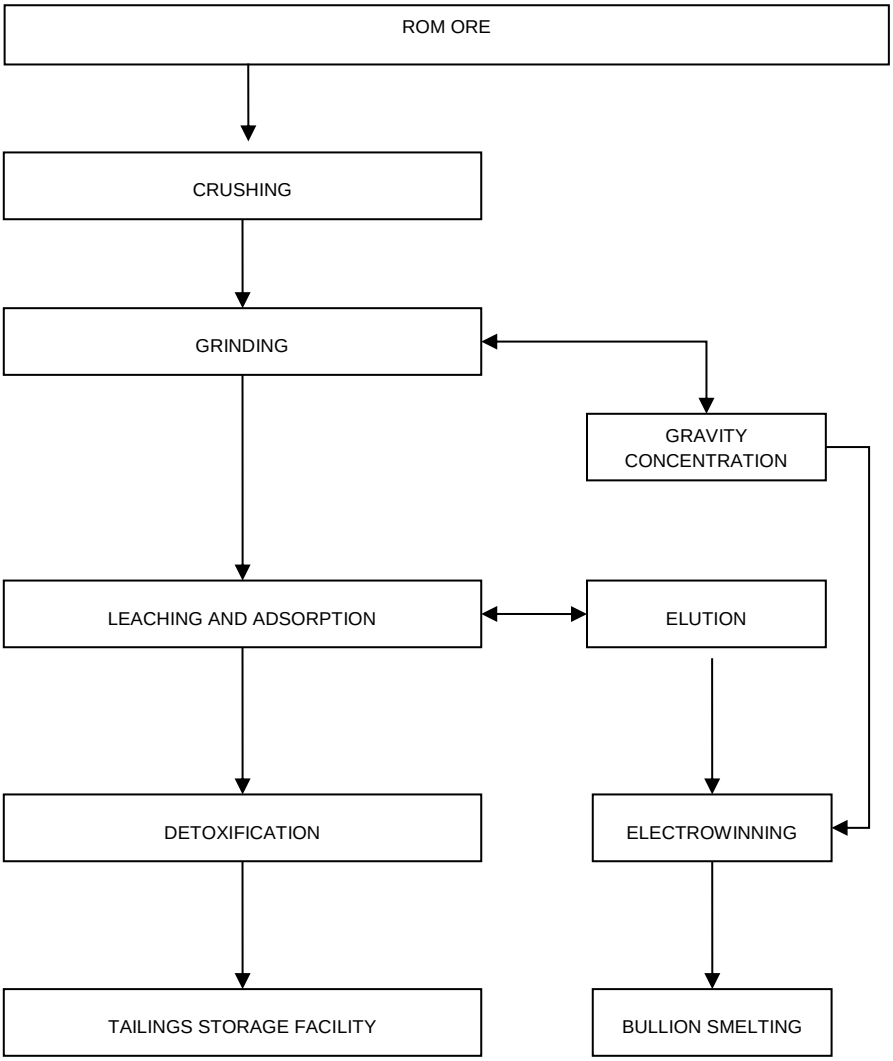
The pregnant eluate recovered from the carbon elution circuit is re-circulated through the electrowinning cells and gold is electroplated onto the steel wool cathodes. At regular intervals the gold loaded steel wool is recovered and calcined in an electric oven before smelting with required fluxes. The Gold bullion is produced through the Smelting in a furnace.

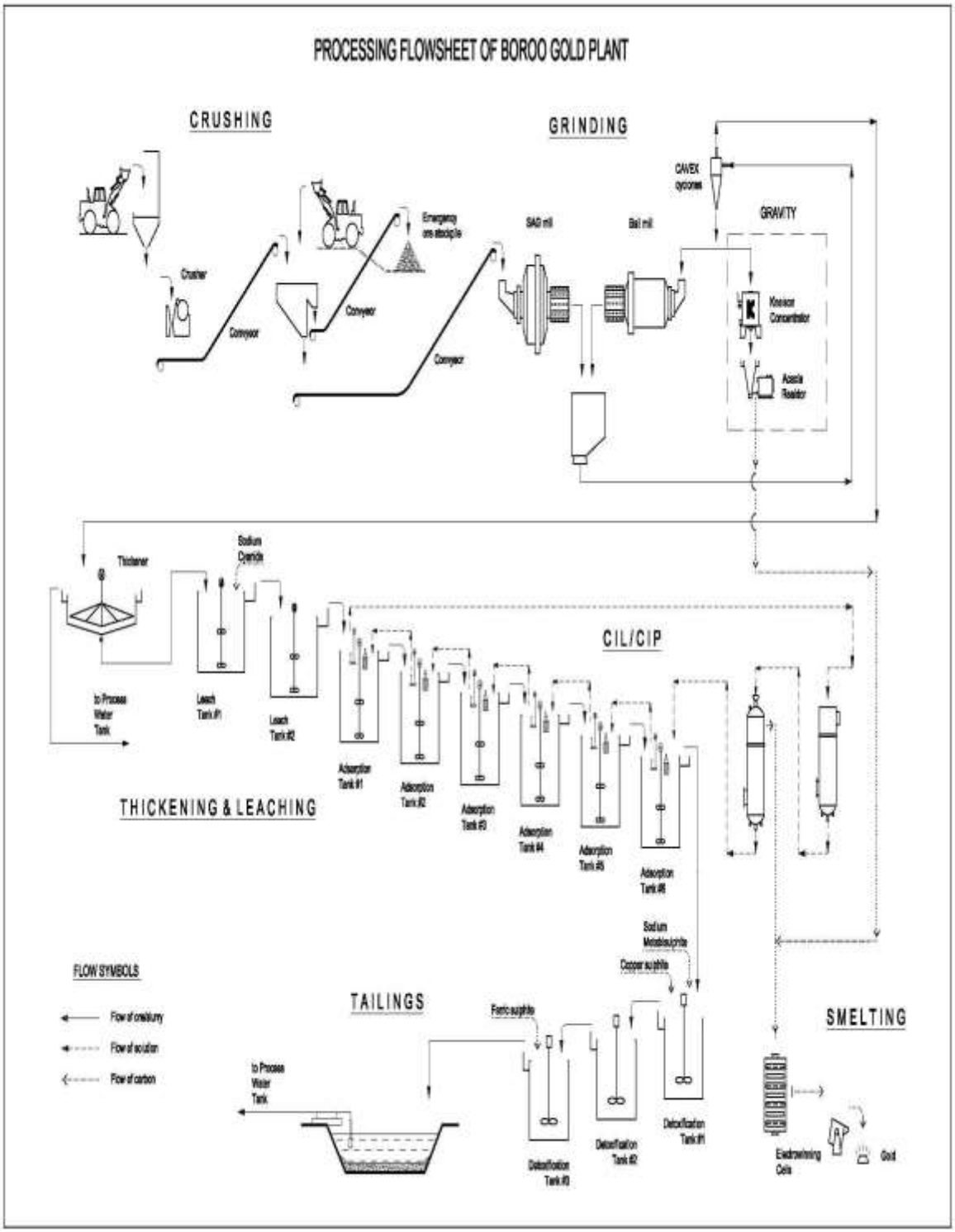
All cyanide remaining unused in the mill process is treated in the detoxification treatment plant before being released to the tailings storage pond. Treatment is done using the Air/SO_2 cyanide removal process. Sodium metabisulphite, oxygen is provided from ambient air, copper sulphate and hydrated lime are used in this process. This is followed by an Arsenic precipitation using Ferric Sulphate.

The slurry then flows by gravity to the tailings dam. Decant water from tailings dam is recycled.

A simplified process flowsheet diagram of the Boroo Gold Processing Plant is showed on following figure.

Figure 28: Simplified Flowsheet Diagrams for Boroo Gold Processing Plant





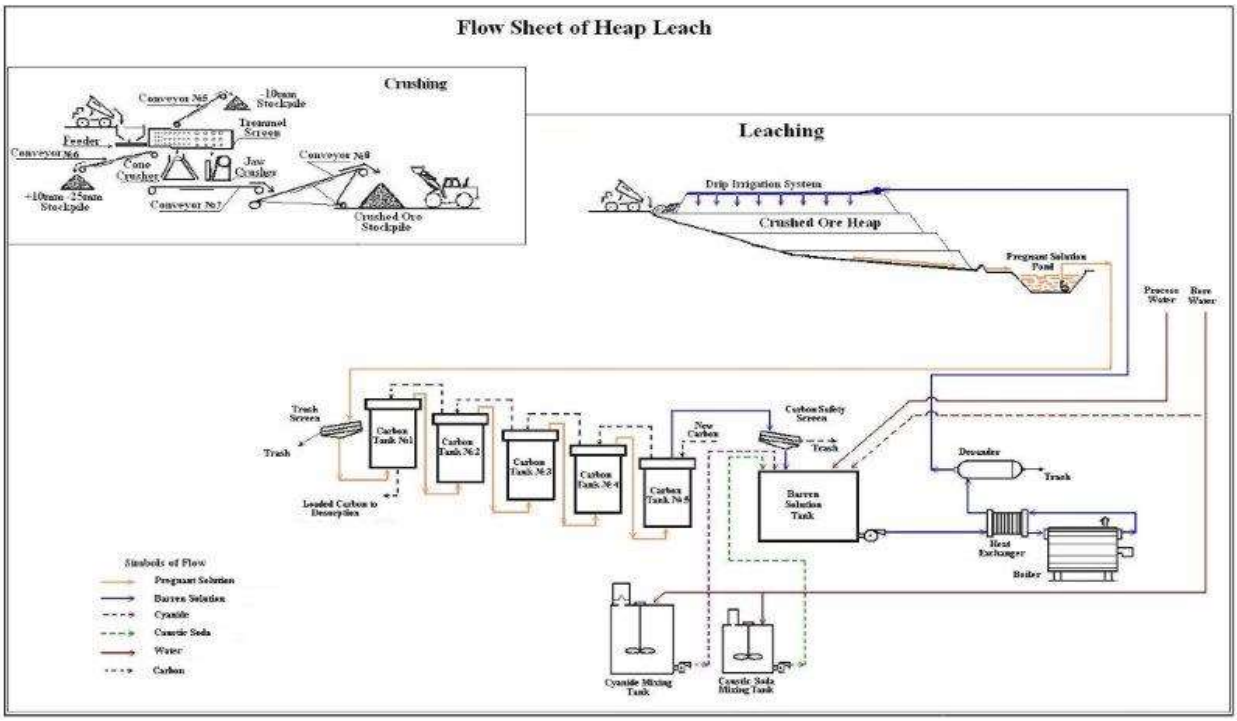
The Heap Leach Project designed to treat over 16Mt of ore at an average grade of 0.7 gAu/t. Total recovery expected to be 60%. Heap Leach will process 3 Million metric tonnes ore per year. What was once considered "waste rock" (0.2 – 0.8g/t) can now be economically processed by Heap Leach.

The ore is hauled from the mine to a stockpile near the heap leach pad then crushed to -100mm and stacked on the prepared Leach Pad.
The Leach Pad is lined with (from the bottom to the top):

- 300 millimeter layer of liner bedding compacted clay
- 1.5 millimeter thick linear low density polyethylene (LLDPE) geomembrane liner
- 600 millimeter layer of crushed (+10-25mm) liner over drain material

Heap Leach is the process of dissolving gold from low grade stacked ore by a cyanide solution. A Leach Solution is applied to the ore stacked on the pad utilising "drip emitters". As the Leach Solution passes through the ore it dissolves the gold then it is collected in a piping system at the bottom of the pad and delivered to the Pregnant Leach Solution (PLS) pond. The Pregnant Leach Solution is pumped through Carbon Columns (CIC) and the gold is attached to the carbon. The Barren Solution is then returned to the Heap Leach. When the "carbon" is loaded with gold it is removed from the columns and the gold is stripped from the carbon in the Mill.

Figure 29: Heap leach flowsheet for Boroo mine



The BiOX® Bio-Oxidation Process for the Treatment of Gatsuurt Gold Concentrate

Processing

The Gatsuurt oxide cap which is 15% of total ore to be processed at the Boroo facility is to have gold extracted by direct cyanidation. The remaining ore is fresh or sulphide and refractory. This type of ore will be treated by Flotation and BIOX® process.

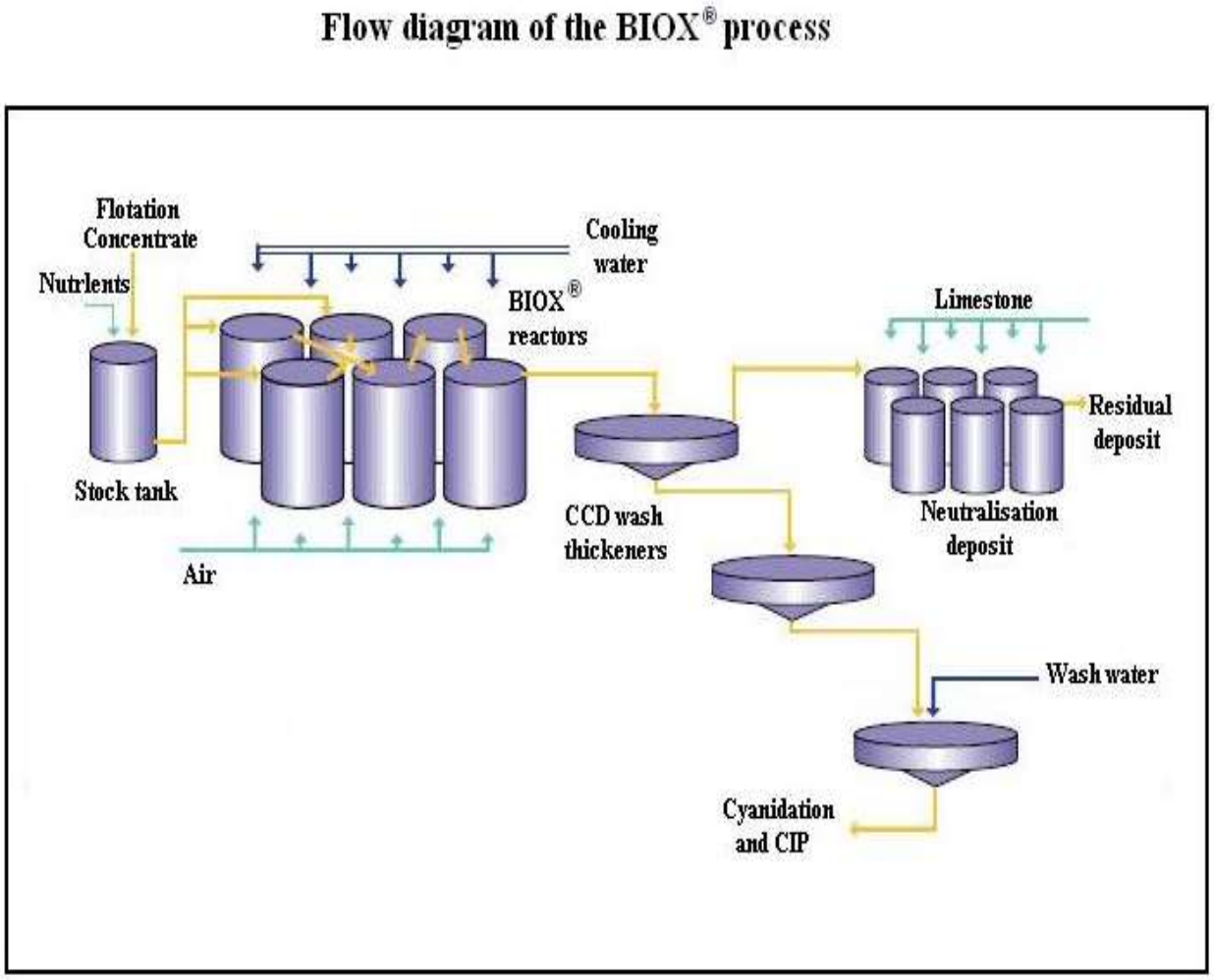
The BIOX® Process

BIOX® Process utilises naturally occurring bacteria to oxidise the sulphide minerals, liberating contained gold for leaching with cyanide. The process utilises a mixed population of *Acidithiobacillus ferrooxidans*, *Acidithiobacillus thiooxidans* and *Leptospirillum ferrooxidans*. The bacteria attach themselves to the metal sulphide surfaces in the ore where they cause accelerated oxidation of the sulphides. The composition of the population is influenced by factors such as temperature and pH. It is important to control the pH and temperature within narrow ranges (40°C to 45°C) to maintain the right balance of bacterial species to optimise the rate of oxidation. The typical operating pH range in the BIOX® process is acidic 1.2 to 1.8.

The BIOX® process involves the continuous feeding of the flotation concentrate slurry to a series of stirred reactors. Furthermore, sufficient carbon dioxide is required for the bacteria to maintain cellular growth. This is obtained from the injected air as well as carbonate minerals. Since direct sulphide oxidation requires high levels of oxygen, large volumes of air have to be injected and dispersed in the slurry. The reactors are aerated and the slurry temperature is maintained at the optimum level. As the oxidation reactions of sulphide minerals are exothermic, it is necessary to cool the tanks. Maintaining the slurry temperature within the optimum range is done by circulating cooling water and removing the excess heat via a cooling tower. The bacteria also require nutrients to sustain growth. Nitrogen, phosphorous and potassium are added to the primary reactors. Solids from BIOX® process are washed and sent to cyanide leaching. Effluent from washing is treated with limestone and lime to neutralize acidity and precipitate dissolved arsenic with dissolved iron to create stable compound for long term storage.

Technology is licensed by Biomin Technologies, South Africa.

Figure 30: Flow Diagram of the BIOX Process

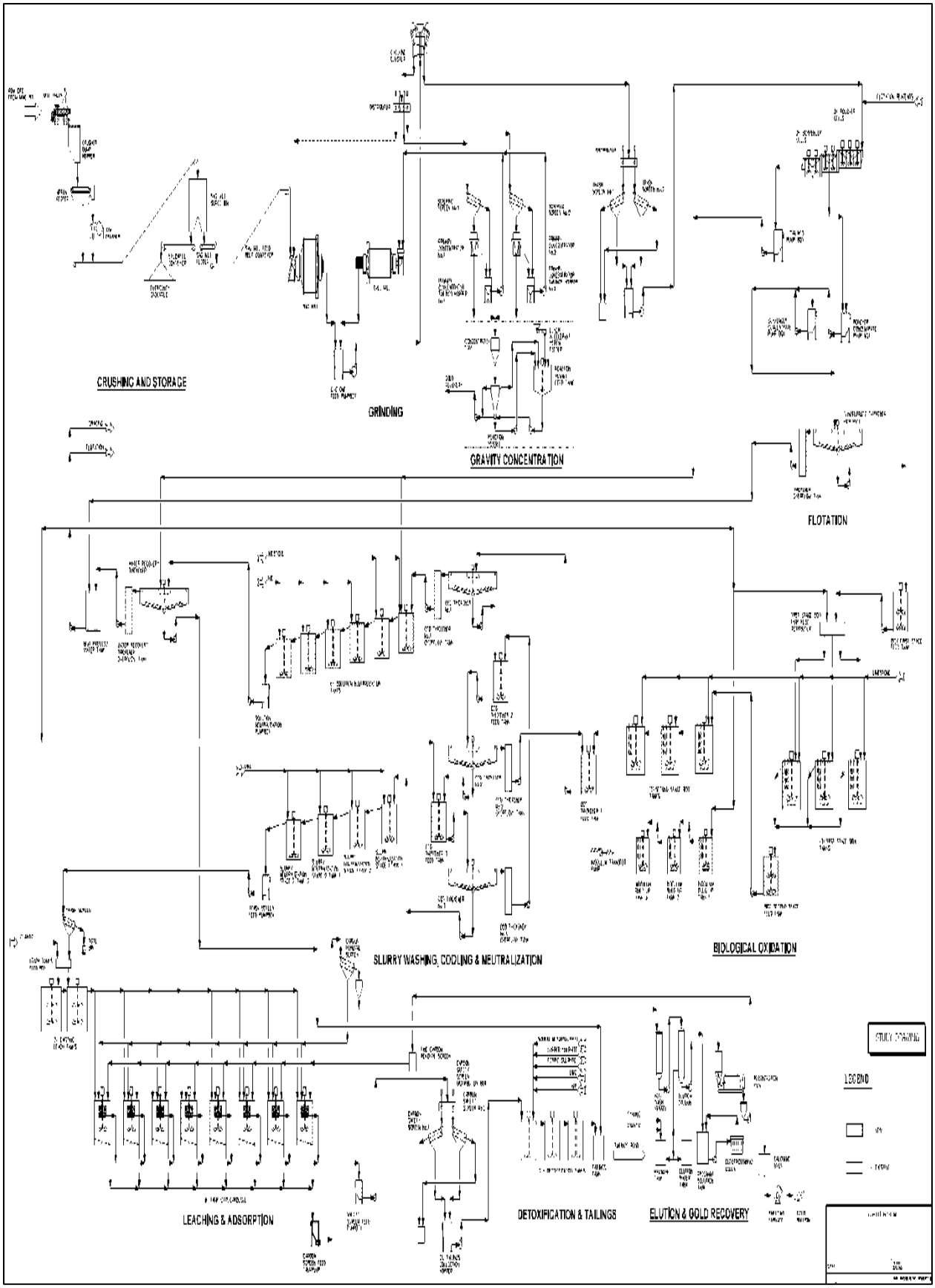


Gatsuurt Project - Boroo Mill Modification

Modification of Boroo Mill will include the following for processing Gatsuurt refractory ore:

- Gatsuurt Project - Boroo Mill Modification
- BIOX® effluent neutralization circuit.
- BIOX® product cyanide leaching and carbon in pulp circuit.
- BIOX® utilities (limestone preparation, cooling system, water recovery, reagent systems).

Figure 31: Gatsuurt Project - Process Flowsheet



International experiences of gold mining, extraction and processing

For the development of the Gold Program, we studied international gold mining trends and recent technological advances. Mongolia has an immediate need for internationally applied technology, and we studied technology used at leading gold mines worldwide.

During operations at hard rock deposits, miners often find it difficult to follow gold seams as they branch out. There is trial technology on offer to overcome this by thermal fragmentation methods, under development by the Canadian Rockmech company. This method is offered to Mongolia as appropriate to Mongolian conditions.

Newmont Boddington Gold, Australia

In 2011, the formal Boddington reserve was registered as having 606.5 metric tonnes of gold and 1.04 metric tonnes of copper. The deposit covers a vast area of 3,650 hectares, the open cast mine area is 4x1 km, to a depth of 700 meters. The on-ground conveyor runs for 2.2 kms and the total length of conveyors is 5.3 kms.

Figure 32: Conveyor facility at Boddington Mine

At Boddington, ore mining concentration and impurity removal takes place as follows.

- Drilling and blasting.
- Loading rocks after blasting.
- Ore transport.
- Ore crushing, grinding and milling.
- Floatation.
- Cyanide leaching and CIP separation.
- Applying active carbon to separate gold (active carbon re-used).

- Electroextraction.
- Smelting at high temperature to mold into bars.
- Refining.

Yanakocha gold mine (Peru)

Yanakocha is South America's largest gold mine, 800 kms north-east of Lima, Peru's capital, in the Cajamarca region. It officially started operations in 1992 and is owned by the following shareholders.

- Newmont mining corporation (51.35%), Denver, USA.
- Cia. de Minas Buenaventura (43.65%).
- IFC (5%).

Figure 33: Yanakocha gold mine

The rock is blasted and ore then transported to a cyanide leaching overburden by 250-tonne capacity truck. Loading and transport is computer-controlled and tracked by satellite.

Cyanide is applied to pyramid-shaped ore at 50 mg/ litre and gold separated through a filtration system under the overburden/heap. To prevent chemical spill and ground water pollution, high density polyethylene is used. Depending on the ore properties, heap leaching is not always possible, so unsuitable ore is processed in a concentrator. The leaching process takes 60 days for gold separation, but the concentrator, able to deal with 5 million metric tonnes per year, separates gold in 24 hours.

Figure 34: Heap leaching at Yanakocha mine

Carbon in pulp (CIP): a two-part extraction technique for recovery of gold which has been liberated into a cyanide solution as part of the gold cyanidation process and passes on to the Merril-Crowe process. The first process liberates gold from the cyanidation process through active carbon; the second process de-absorbs the gold by active carbon filtration through a wire mesh.

Merril-Crowe process: *t*he solution with gold or silver is separated from the ore by methods such as filtration and counter-current decantation. Then a very clear solution is arrived at by use of pre-coated filters to apply diatomaceous earth. Oxygen is then removed by passing the solution through a vacuum de-aeration column. Zinc dust is added, then the gold is precipitated. Poor grade gold precipitate (barren) is then filtered out of the solution, and the zinc dust and gold are mixed with sulfuric acid to dissolve the zinc. The solution is filtered, and the remaining solids are separated.

Refining: through the Merril-Crowe process, gold is heated to 650 degrees for condensation, and then the product is fed into a smelter at 1200 degrees and led into gold bars.

Hemlo Gold Mine (Canada)

The Hemlo series of deposits are 350 kms east of Thunder Bay, Ontario, Canada. The proven average ore grade in Hemlo is 2.35 gr/tonne; the deposit comprises 15 million metric tonnes of ore. The deposit was discovered in 1869, and mining operations started in the 1940s. The Hemlo mine includes the Williams underground mine and the David Bell open cast mine; these share the same mills, processing factories and waste rock tailings. Ores from the two mines are fed into the standard mill, followed by floatation and leach circuit where the gold is dissolved and then recovered in a carbon-in-pulp circuit.

Figure 35: Hemlo Gold Mine

The underground mine uses long-hole mining. For processing, the mine uses a variety of processes: crushing, grinding, milling, dissolving and carbon circuit. For transport, Hemlo uses dump trucks, excavators and drilling machines at the open cast mine and crusher, and uses cyanide leaching and carbon pulp for processing.

Environmental reclamation of the gold sector

The following table shows the data from Mineral Resources Authority on environmental reclamation carried out over the last 8-year period.

Table 22: Environmental reclamation status of gold mining sector, 2006-2014

Indicators	2008	2009	2010	2011	2012	2013	2014
Total mined area, hectares	365.31	447.4	429.99	408.77	458.9	405.54	306.9
Total reclaimed area, hectares	816.69	652.29	825.21	1279.15	1270.95	572.24	370.9
Number of companies carrying out reclamation	75	82	75	86	72	74	69
Number of artisanal miners carrying out reclamation			410	317	680	787	871
Total reclaimed			2	5	56.54	29	85.21

area by artisanal miners, hectares								

Source: MRAM

Table 23: Environmental reclamation by gold mining companies, 2006-2014

Indicators		2006	2007	2008	2009	2010	2011	2012	2013	2014
1	Total mined area, hectare	838.284	535.4	365.31	447.4	429.99	408.77	458.9	405.54	306.9
	Oyu Tolgoi	-	-	-	-	4.4	127	193.75	87.67	
	Boroo Gold	-	-	-	-	56.3	-	-	-	-
	Mon dulaan	-	5.07	11	10.7	33.9	44.7	-	-	-
	Altan Dornod Mongol	120.8	-	31.6	-	-	-	27.7	30.7	56.9
	Shijir Alt	65	-	-	41.4	-	-	-	-	-
	Monpolimet	-	53.08	52.5	69	43.85	53.69	32.33	32.3	10
	Gazar Holding	-	-	-	-	-	-	-	-	-
	Zeregtsee	-	-	-	-	-	-	7.5	4.1	-
	Other	652.48	477.25	270.21	326.3	291.54	183.38	197.62	250.77	240
2	Total reclaimed area, hectare	1114.33	1260.86	816.69	652.29	825.21	1279.15	1270.95	572.24	370.9
	Oyu Tolgoi	-	-		-	-	802	511.25	-	
	Boroo Gold	48.5	21	44.6	52.1	56.3	55.2	-	-	-
	Mondulaan	-	-	20	8	19.15	22.3	-	-	-
	Altan Dornod Mongol	208.7	338.4	283.7	-	-	-	54.6	86.3	99.7
	Shijir Alt	90	63	57	41.4	40	65	120	-	-
	Monpolimet	-	93.3	51	59.3	117.3	83	113.8	36.5	20.8
	Gazar holding	-	-		-	-	-	-	-	-
	Zeregtsee	28.4	12	37.7	-	-	-	33.4	13.1	-
	Other	738.73	733.16	360.39	545.49	592.46	251.65	437.9	436.34	250.4
3	Costs for reclamation, MNT million	4416.95	8582.04	7358.1	9216.41	7480.22	4643.55	8659.9	5437.09	5358.03
	Oyu Tolgoi	-	-	-	-	-	-	-	-	870.7
	Boroo Gold	35	359.56	1070	1569.86	2206.32	2281	-	-	-
	Mondulaan	-	-	9.51	1.8	170	1.54	-	-	-
	Altan Dornod Mongol	406.33	4884.23	2881.52	-	-	-	3135.4	443.36	2834.3
	Shijir Alt	1074.3	890.1	729.7	1126.06	413.8	298	840	-	-
	Monpolimet	-	216	422.2	574.68	100.5	362.6	1193.92	516.93	276.6
	Gazar holding	-	-	-	-	-	-	-		
	Zeregtsee	254.7	83	212.92	-	-	-	655.8	361.4	-
	Other	2646.62	2149.15	2032.25	5944.01	458.96	1700.41	2834.78	4115.4	1376.43
4	Technically reclaimed area, hectare	854.12	909.92	758.58	558.28	667.08	359.35	1075.2	421.93	355.69
	Oyu Tolgoi	-	-	-	-	-	-	-	-	10.89
	Boroo Gold	48.5	21	44.6	50	56.3	55.2	-	-	-
	Mondulaan	-	-	12	8	16.15	22.3	-	-	-
	Altan Dornod Mongol	180.2	250.5	283.4	-	-	-	39.3	80.48	100.5
	Shijir Alt	90	63	57	41.4	40	65	120	-	-
	Monpolimet	-	54	51	53	41.3	28.7	113.8	36.5	20.8
	Gazar holding	-	-	-	-	-	-	-	-	-
	Zeregtsee	-	12	37.7	-	-	-	33.4	13.1	-
	Other	535.42	509.42	272.88	405.88	513.33	188.15	768.7	291.85	223.5
5	Biologically reclaimed area, hectare	555.18	978.98	615.44	257.67	421.1	455.45	303.34	252	201.37
	Oyu Tolgoi	-	-	-	-	-	150	70	-	
	Boroo Gold	30.4	21	4	37.1	52.2	55.2	-	-	-
	Mondulaan	-	-	11	2.6	21.6	9.7	-	-	-
	Altan Dornod	253.85	528.5	217.3	-	-	-	1.1	75.1	56

	Mongol									
	Shijir Alt	-	-	100	100	55	20	76	-	-
	Monpolimet	-	39.3	15.3	6.3	76	45	54.6	42	-
	Gazar holding	-	-	-	-	-	-	-	-	-
	Zeregtsee	-	3	43	-	-	-	18.6	5.65	-
	Other	270.93	387.18	224.84	111.67	216.3	175.55	83.04	129.25	145.37
6	Environmental protection cost, MNT million	2238.51	2772.27	2751.69	2767.76	6740.23	1014.25	1778.4	533.26	1217.79
	Oyu Tolgoi	-	-	-	-	202.1	135.06	790	227.26	253.03
	Boroo Gold	240.26	50	4.27	1569.86	2206.32	811.7	-	-	-
	Mondulaan	-	-	14.51	35.8	208.35	1.5	-	-	-
	Altan Dornod Mongol	1.36	704.92	675.07	-	-	-	11.28	3.97	72.78
	Shijir Alt	1074.3	0.5	729.7	32.5	413.8	9.6	0.4	-	-
	Monpolimet	-	216	60.7	574.68	100.5	3.4	7.58	41.07	20.65
	Gazar holding	-	-	-	-	-	-	-	-	-
	Zeregtsee		4.6	212.92	-	-	-	10.7	-	-
	Other	922.59	1796.25	1054.52	554.92	3609.16	52.99	958.44	260.96	871.33

Source: MRAM

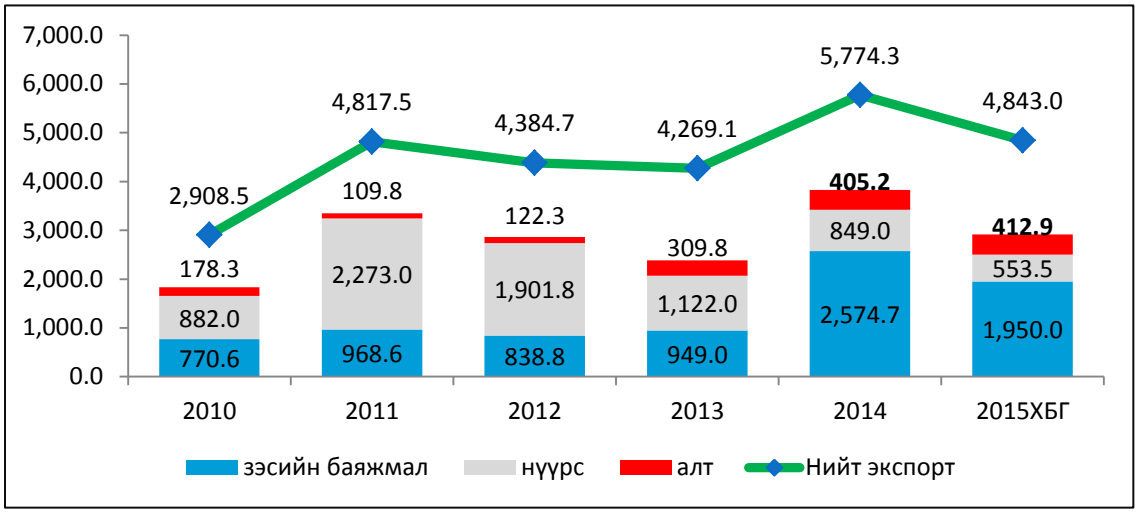
CHAPTER SEVEN - ECONOMIC IMPACT OF THE GOLD SECTOR

To demonstrate the impact of the gold production sector on the overall economy, this baseline study looked at a wide range of indicators: gold exports; royalties paid to central and local governments; personal income taxes; Mongolia's currency reserves and import trade reserves; and, the gold sector's contribution to local development and total job creation.

1. Impact on exports

Mongolia exported 9.5 metric tonnes of gold from January to October 2015, as much as 1.5 metric tonnes more than forecasted. This lifted gold export revenue by US$32.6 million, making total export revenue US$ 356.6 million.

Figure 36: Gold export revenue, US$ million



Source: General Department of Taxation, 2015

Gold sales revenue hit US$405.2 million in 2014 and is predicted to reach US$412.9 million by the end of 2015. Copper concentrate made up 48.1% of export revenue, coal 11.9%. Gold made up 11.6% of minerals export revenue and 9.1% of all export revenue.

Between January and October 2015, Mongolia exported copper concentrate worth US$ 1,950.0 million, coal worth US$468.5 million and gold worth US$356.6 million, so gold is in the top three export products.

2. Royalties on gold

Between January and September 2015, total government royalty revenues from mining totalled MNT 665.8 billion: MNT 488.3 billion from copper concentrates, MNT 91.8 billion from coal and MNT 23.6 billion from gold. This is MNT 432 billion less than in 2014.

Table 24: Mining sector budget revenues, MNT billion

	2012	2013	2014	2015-09	2015ХБГ
Government revenues from mining sector, from which:	863.1	1,096.5	1,097.8	665.8	797.0
1. Copper concentrate	435.3	573.3	661.5	448.3	584.4
2. Coal	223.8	295.2	284.1	91.8	109.9
3. Gold	118.1	151.2	52.7	38.7	32.2

Source: General Department of Taxation, Working Group, 2015

The Government generated 13.8% of its revenue from the gold sector in 2013, which fell to 4.8% in 2014. Government revenue from the gold sector in 2013 was MNT 151.2 billion: MNT 102.5 billion for royalties (67.8%); MNT 32.2 billion for corporate income taxes (21.3%); and MNT 10.6 billion for social insurance and other payment and fees (7%).

September 2015 statistics show that total tax revenue from the gold sector was MNT 23.6 billion: MNT 7.2 billion from corporate income taxes; MNT 8.4 billion from royalties; MNT 3.7 billion from personal income taxes; and MNT 4.3 billion from social insurance/other fees.

Royalties collected from the gold production sector reached MNT 102.5 billion in 2013; but only MNT 21.7 billion in 2014.

Table 25: Revenue from gold royalties

Years	2011	2012	2013	2014	2015-09	2015ХБГ
Gold sold to MongolBank, metric ton	3.3	3.3	6.0	12.7	12.5	15.5
Total royalties from gold sales, MNT billion	34.9	65.2	102.5	21.7	23.1	28.0

Source: General Department of Taxation, Working Group

At the end of September 2015, MNT 23.1 billion gold sector royalties had been paid; total 2015 royalties are predicted to reach MNT 24 billion. The royalty rate on gold was reduced from 10% in 2014 to 2.5% in 2015; so government tax revenue from the gold sector decreased, but the policy supported the gold sector and was a significant contribution to the creation of currency reserves and ensuring transparency in gold mining and sales.

3. Mongolia's foreign exchange reserves

Mongolia's foreign currency reserves were US$1.4 billion in 2014, a fall of US$0.8 billion over 2013 (35%), and 2.6 times lower than in 2012, when the total reserves were US$3.6 billion.

Table 26: Gold sales and currency reserves

	2008	2009	2010	2011	2012	2013	2014
Gold sales revenue, US$ million	209.0	174.1	94.4	161.7	175.0	270.9	514.5
MongolBank currency reserve, US$ million	637.2	1145.2	2091.2	2273.9	3629.2	2389.2	1398.1
Percentage of gold sales to MongolBank in total currency reserves	32.8 %	15.2%	4.5%	7.1%	4.8%	11.3 %	36.8 %

Source: MongolBank, 2014

The above table shows that gold sales revenue kept falling from 2008 to 2010, from US$209 million to US$94.4 billion. They then rose suddenly to US$514.5 million in 2014. The table also shows the percentage of gold sales revenue in total currency reserves was 32.8% in 2009, falling to 4.5-11.3% in 2010-2013, then reviving to 36.8% in 2014. The increase resulted from a government decision to reduce royalties on gold from 10% to 2.5% in 2014, a significant decision to increase the currency reserves of the MongolBank.

4. Import trade reserves

One important indicator for a country's economic capacity in international trade and finance is the total foreign exchange reserves in weeks of imports.

Table 27: Gold sales by artisanal miners, foreign exchange reserve for imports

	2008	2009	2010	2011	2012	2013	2014
Total import, US$ million	**3244.5**	**2100.5**	**2137.7**	**3200**	**6598.3**	**6357.8**	**5236.7**
Gold revenues, US$ million	209.0	174.1	94.4	161.7	175.0	270.9	514.5
Share of gold in total imports, %	6.4%	8.3%	4.4%	5.1%	2.7%	4.3%	9.8%
Foreign exchange reserve in weeks of imports	3.3	4.3	2.3	2.6	1.4	2.2	5.1

Source: MongolBank, General Department of Customs, 2014

Table 27 shows the share of gold in total imports between 2.7% and 8.3% between 2008 and 2013, then 9.8% in 2014. From 2009 imports kept increasing; however, gold revenue kept falling, resulting in the gold share of imports plummeting.

By October 2015, the share of all gold sold to the MongolBank against total imports was adequate to cover for 6.4 weeks of imports. Therefore, gold sales to the central bank are having a positive impact on foreign trade, particularly on imports.

Presently, foreign direct investment has declined drastically and the national currency exchange rate has constantly depreciated; increased gold mining and sales to the MongolBank significantly contribute to an increase in foreign exchange reserves and help stabilise the national currency exchange rate.

5. Jobs

Operations of gold mining companies and artisanal miners create new jobs. With high unemployment in rural areas, many locals work in the gold sector: 51.6% of previously employed people in the gold sector were unable to find any other job; 32.4% wanted an extra income; 12.0% had no other income source as they had no livestock; and 4% work in the gold sector for other reasons. Most people working in the gold sector spend their income on their household, creating other work opportunities and paying their children's tuition fees.

6. Local social development

Gold mining companies and artisanal miners often focus on local procurement, creating jobs, supporting local businesses, donating to local development and investing in the local economy; the local economy generates revenue from gold mining through increased procurement and taxes.

CHAPTER EIGHT - POLICY CONSIDERATIONS AND ACTIONS

The following issues are identified as key considerations for the Gold Sector Program 2025

Stabilise the legal, tax and investment environments for the gold sector

To boost gold exploration and increase gold mining, the current legal and tax environments for gold businesses should be kept stable.

Intensify the mining of hard rock gold and gold bearing metal deposits over exhausted alluvial gold deposits reserves

Gold-bearing metal deposits account for 90% of Mongolia's total discovered reserves. There is a need to take efficient measures to develop these deposits in the coming 10 years

Consideration of a national gold refinery, smelter and refinery to process gold bearing metal deposits.

Annually, Mongolia produces over 20 metric tonnes of gold which is justification for the consideration of national gold refinery establishment.

Develop a consolidated database for gold mining, production and sales.

There is a need to improve activity coordination of government stakeholders engaged in gold mining and sales and to develop a consolidated database to guarantee increased transparency.

Increase the recovery rate for placer gold deposits and reduce wastes and tailing damps

Carry out technical audits of companies using gold washing and processing technology, with the objective of increasing in gold recovery.

Re-process gold wastes and gold tailings

There is need to study and apply advanced technology to re-process gold damps and tailings from the mining operations of placer and hard rock gold deposits.

Improve the legal environment of artisanal gold mining and gold sales

Despite efforts to formalise the artisanal sector and to build the capacity of cooperatives of artisanal miners, there is much more work to be done in this area.

CHAPTER NINE - GOLD SECTOR DEVELOPMENT SCENARIOS FOR 2015-2025 AND OUTCOMES

In this baseline study, scenarios were established and analyses carried out to determine gold mining, sales and exports throughout a three-phase implementation of Gold-2025.

- Phase One: 2015 -2018.
- Phase Two: 2018-2021.
- Phase Three: 2021-2025.

1. OPPORTUNITIES FOR INTENSIFYING GOLD EXPLORATION AND INCREASING RESERVES

To increase gold mining, priority policy issues must focus on a steady increase of gold reserves and a boosting of domestic and foreign investment in this field.

Some identified deposits still cannot begin commercial operations because of a lack of infrastructure and are awaiting relevant environmental impact assessments.

Registered reserves found by exploration must be verified and proven during the mining process. Mining operations can be expanded as such reserves become proven through the mining stages. The ratio of gold mines to growth of reserves during implementation phases of the Gold-2025 program is shown below.

Table 28: Ratio of gold mines to growth of reserves

Years	2015-2018	2018-2021	2021-2025	Total
Increase of gold reserves, tonnes	109.2	153.1	307.7	570.0
Gold mining, tonnes	72.8	95.7	184.7	353.2
Percentage of increase of reserves to supplement the mining	1.5	1.6	1.7	-

Source: Working Group, 2015

With effective implementation of policy objectives to boost gold exploration, the total gold reserves will likely increase by 570 t during program implementation: by 109.2 t in 2015-2018; by 153.1 t in 2018-2021; and by 307.7 t in 2021-2025. Most of the increase will come from hard rock deposits or other mineral deposits containing gold.

The gold mining reserve growth ratio is predicted to be 1:5 in 2015-2018; 1:6 in 2019-2021; and 1:7 in 2021-2025. Proven gold reserves will probably increase 1.6 times over the gold mining volume in the coming decade. In the next 10-year period, proven gold reserves will increase, so making it possible to increase the annual amount of gold sold to the MongolBank.

2. GOLD MINING FORECASTS

In implementing the proposed Gold Program, it is estimated that 353.2 t of gold will be produced in 2015-2025, including Oyu Tolgoi mining (234.6 t excluding Oyu Tolgoi).

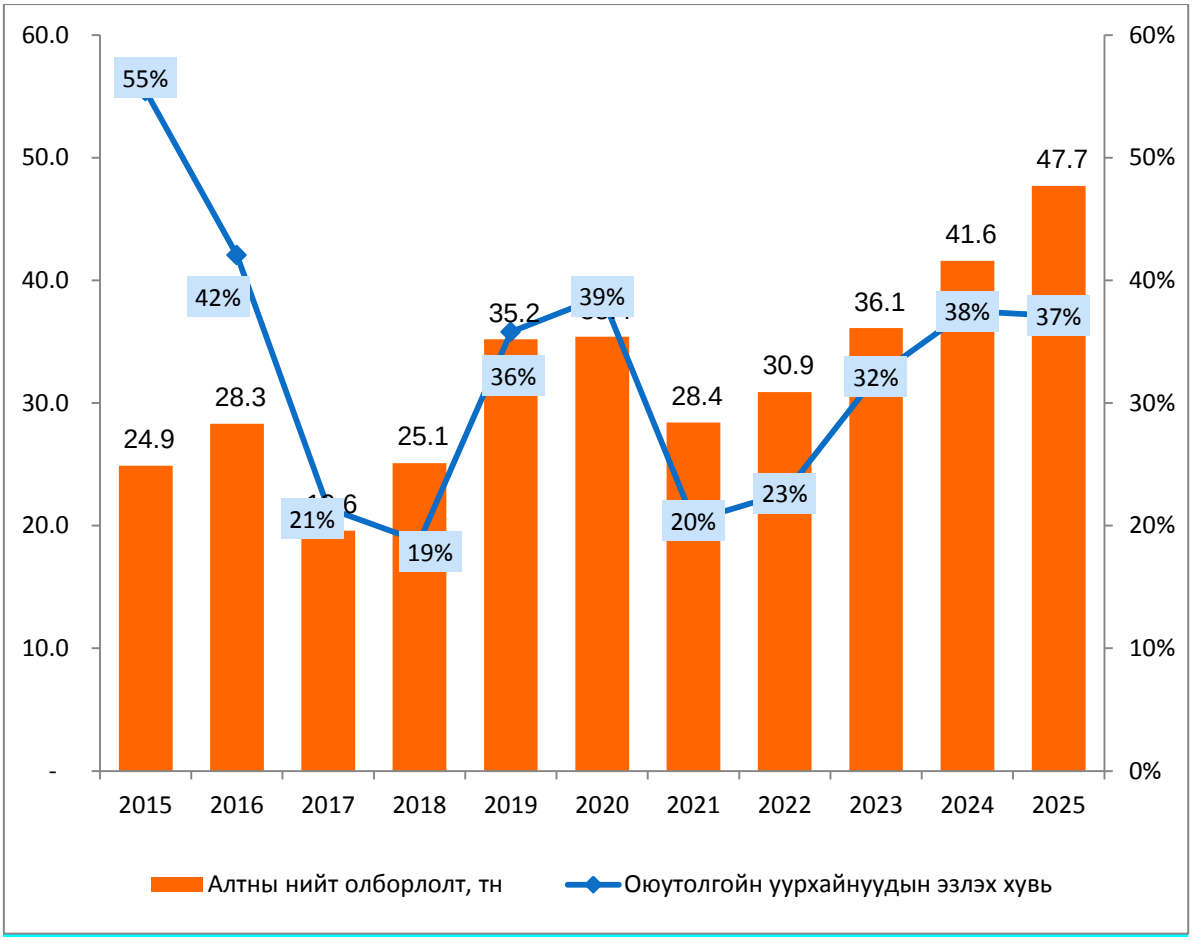
Table 29: Estimates of Mongolia's gold production in 2015- 2025 (tonnes)

	Years	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Amount
1	Oyu Tolgoi (open cast and underground mines)	13.8	11.9	4.2	4.7	12.6	13.7	5.8	7.0	11.6	15.6	17.7	118.6
2	Bayan-Airag	1.5	1.5	1.5	1.5	1.5	1.5	1.2					10.2
3	Gatsuurt		4.3	3.5	4.1	5.2	5.1	5.4	4.9	4.0	2.9	2.9	42.3
4	Placer deposits (deposits by tailings)	5.0	4.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	1.0	28.0
5	Hard rock deposits and other metal deposits containing gold	0.6	3.1	3.9	8.3	10.4	10.1	9.0	11.0	10.5	10.1	11.6	88.6
6	Production by artisanal miners and partnerships	2.5	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	22.5
7	New deposits to be developed resulting from increase in proven reserves							2.0	3.0	5.0	8.0	12.0	30.0
8	Reserves of gold deposits to be used under the long-named law regulations	1.5	1.5	1.5	1.5	1.5	1.0	1.0	1.0	1.0	1.0	0.5	13.0
9	Total gold mining	24.9	28.3	19.6	25.1	35.2	35.4	28.4	30.9	36.1	41.6	47.7	353.2
10	Total gold mining excluding Oyu Tolgoi	11.1	16.4	15.4	20.4	22.6	21.7	22.6	23.9	24.5	26.0	30.0	234.6
11	Oyu Tolgoi's share in total gold mining	55.0	42.0	21.0	19.0	36.0	39.0	20.0	23.0	32.0	38.0	37.0	-

Source: Working Group

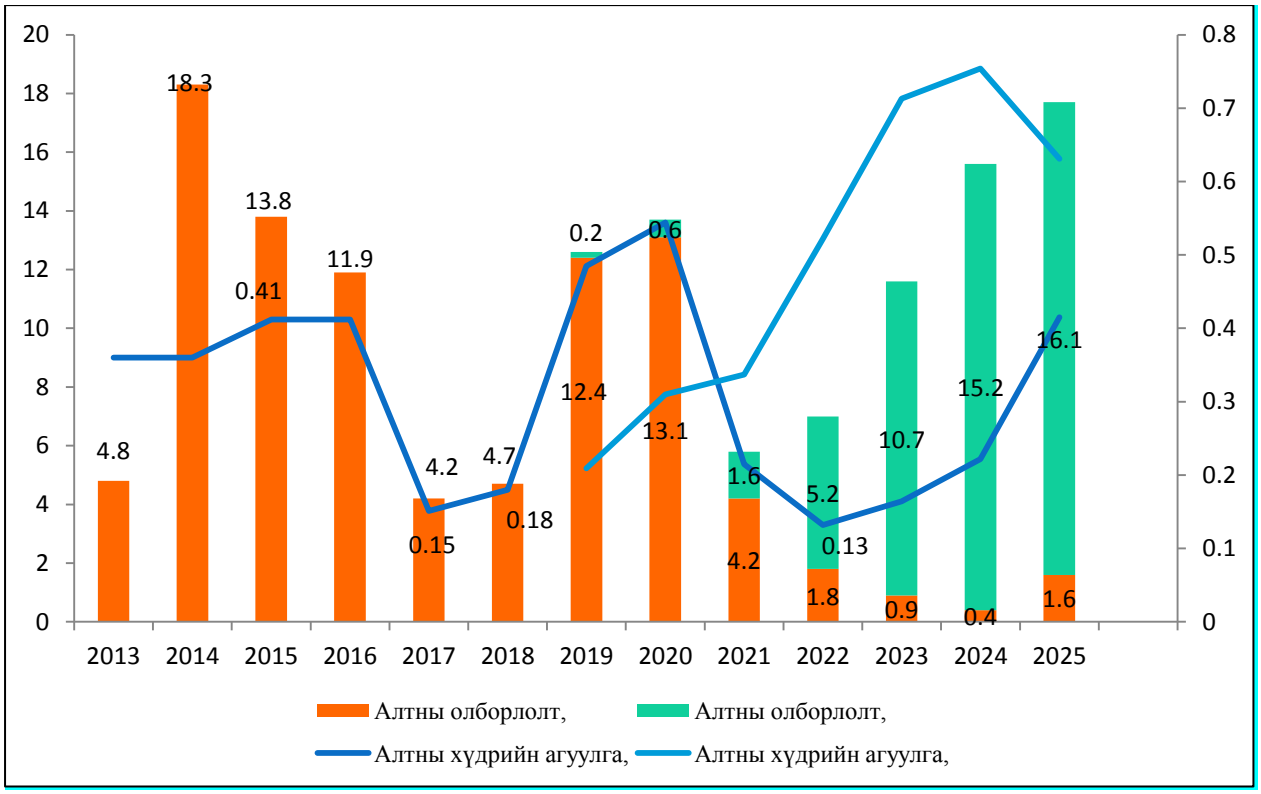
In 2017-2018 and in 2021-2023, the total gold mining volume will probably decline in relation to the gold mining operations of Oyu Tolgoi LLC. Oyu Tolgoi's share of the nation's total gold output will tend to fall from 55% in 2015 to 19% in 2018, then revive from 2019 to 36-39%. This fluctuation is linked to the fact that Oyu Tolgoi's ore grade at the open cast and underground mines will decrease.

Table 30: Oyu Tolgoi's share in total gold mining



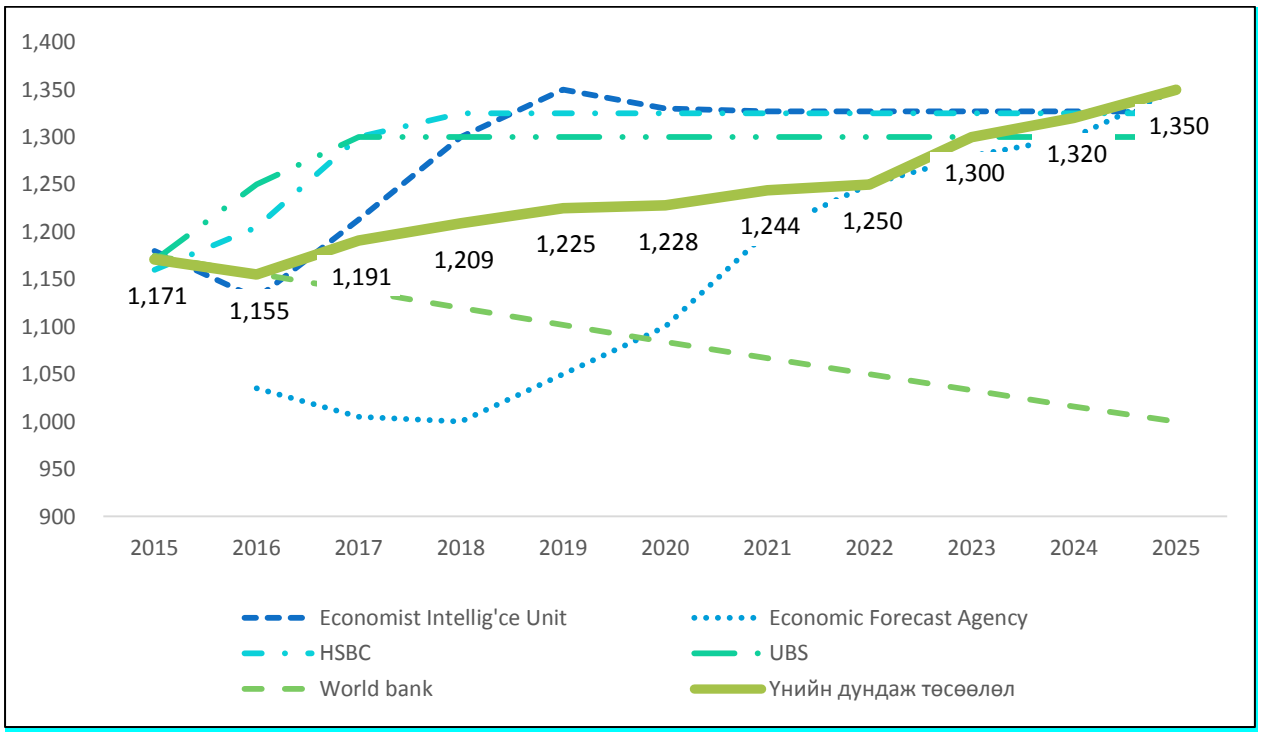
Oyu Tolgoi's open cast and underground mines will have lower grade ore in 2017-2018 and 2021-2022, with a consequent fall in its share of overall gold mining, but gold from Oyu Tolgoi's underground mine will increase from 2019. Oyu Tolgoi's gold production from the open cast mine was 13.8 metric tonnes in 2015 and is estimated to decrease to 4.2-4.7 metric tonnes in 2017-2018 and to 0.4-4.2 metric tonnes in 2021-2022.

Table 31: Gold production of Oyu Tolgoi's open cast and underground mines



Prognosis for gold prices for 2015-2025 based on reports and studies by 10 leading international banks and financial institutions predicting global gold market prices.

Table 32: Medium term gold price estimations, US$/oz (2015- 2025)

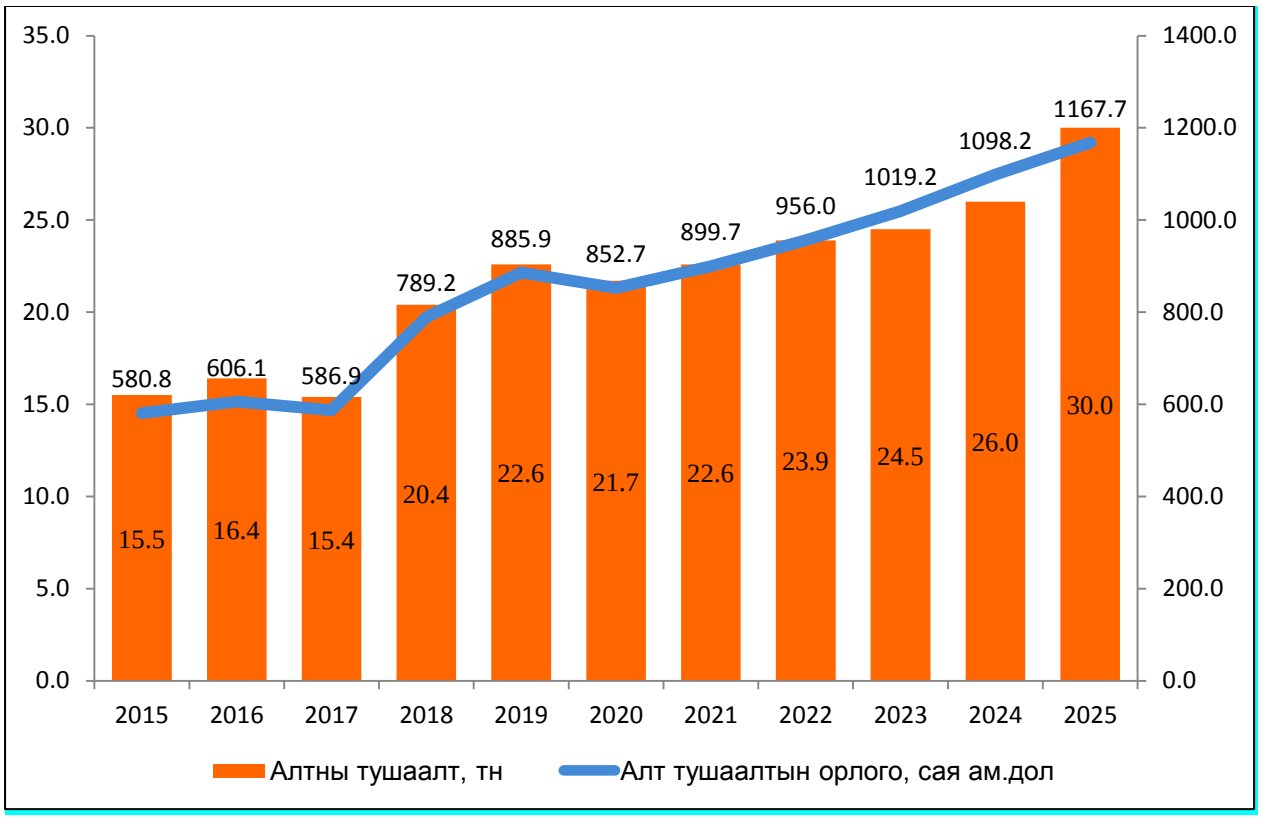


The global market gold price remained at US$1171 per oz in 2015, with a predicted decline to US$1155 per oz in 2016, then a rise from 2017. The predicted price is between US$1191 and US$1350 per oz in 2017-2015.

The table below shows predicted global market gold prices for the coming decade. The predicted total gold production in program implementation is 15.3-30 metric tonnes.

With increased gold production, sales to the central bank and the steady increase of global market prices, gold sales income is estimated at US$580.8 million in 2015; US$789.2 million in 2018; US$852.7 million in 2020; and US$1167.7 million in 2025. Compared to 2015, gold revenue will increase 35.9% in 2018, 46.8% in 2020 and 101.1% in 2025.

Table 33: Predictions for gold sales revenues, 2015- 2025



Through the coming decade, total gold exports will range between 15.8-40 metric tonnes. Gold exports are expected to decline in 2017-2018 and 2021-2022 due to a fall in production at the Oyu Tolgoi mine.

Gold from Oyu Tolgoi accounts for 19-55% of all gold exports. Total gold export revenue was US$929.3 million in 2015; it is expected to fall to US$773.8 million in 2018, then increase to US$1177.9 million in 2020 and US$1564.7 million in 2025.

The predicted decline of gold exports is connected to a decrease in ore grades of Oyu Tolgoi's open cast mine, but the start of underground mining at Oyu Tolgoi from 2019 will probably increase gold export revenue. Compared to 2015, gold export revenue is expected to increase by 26.7% in 2020 and 68.4% in 2025.

Table 34: Predictions on gold export revenues, 2015- 2025