

INVEST-IN-PENANG BERHAD

**STUDY ON THE  
GOLD & JEWELLERY INDUSTRY**

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**PART ONE: INTRODUCTION TO GOLD & JEWELLERY**

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Part One of the “Study on the Gold & Jewellery Industry” is an introduction to the Gold & Jewellery Industry. This report, though not comprehensive, attempts to give an explanation on what the industry entails.

## 1. INTRODUCTION

- 1.1 The earliest known gold & jewellery was believed to have dated back to the Sumer Civilization<sup>1</sup> in around 3000 BC – 4000 BC. The art of goldsmithing first began at the Black Sea or Bulgaria.
- 1.2 People wear gold to enhance strong emotional feeling of the wearer, to complete the wearer's appearance<sup>2</sup> as well as to be respected, admired and to make a good impression.

## 2. GOLD & OTHER PRECIOUS METALS

- 2.1 There are three (3) main variants of gold, i.e. yellow, white and rose (red). Pure gold is yellow in colour. However, when gold is alloyed with other metals, which usually comprise a mixture of silver, copper, and zinc, the amount of each of the metal that can be varied will affect the final colour, normally white or rose (red).
- 2.2 White gold is a mixture of gold with platinum, silver, zinc and / nickel. Rose / red gold is created in varying tones by adding copper to gold.
- 2.3 New technologies also allow gold in different colours such as black<sup>3</sup> gold, green<sup>4</sup> gold, purple<sup>5</sup> gold and blue<sup>6</sup> gold.
- 2.4 Gold is measured in Karat<sup>7</sup> or Millesimal Fineness<sup>8</sup>. Please refer to the table below for the measurement.

Karat	Millesimal Fineness
24K	999 gold
22K	916 gold
20K	833 gold
18K	750 gold
10K	417 gold

- 2.5 Other precious metals<sup>9</sup> include palladium, platinum, silver, rhodium, ruthenium, osmium and iridium. Platinum is also more expensive than pure gold because platinum is worth more than gold.

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<sup>1</sup> In Mesopotamia or the current day Iraq. It is the first fully developed civilization on the Western hemisphere.

<sup>2</sup> To be stylish, beautiful and look nice.

<sup>3</sup> Black Gold is made via a few techniques using black rhodium or ruthenium, amorphous carbon, and oxidation of gold containing chromium or cobalt

<sup>4</sup> Green gold is made by combining gold and silver with copper.

<sup>5</sup> Alloying gold and aluminium makes purple gold.

<sup>6</sup> Combining gold and indium makes blue gold.

<sup>7</sup> Karat is the standard of measure of the purity of gold in its alloys. The formula used to measure the purity rating is  $X = 24 (Mg/Mm)$ . X is the karat value of the material, Mg is the mass of pure gold in the material and Mm is the total mass of the material.

<sup>8</sup> Millesimal fineness is increasingly becoming popular and slowly complementing the karat system. Gold purity is marked as parts per thousand of the pure gold in the alloy. So 999 gold means 24 karat and 916 gold means 22 karat pure gold.

- 2.6 A Hallmark is an official mark or series of marks on precious metals. Hallmarks are guarantee of certain purity or fineness of precious metals. Hallmarks were determined by assaying or formal testing of the metal. Nevertheless, Hallmarks used to be applied by a trusted party or the guardians of the craft.
- 2.7 Some countries require compulsory control and hallmarking of every article while some have voluntary hallmarking system. Malaysia does not require hallmarking.
- 2.8 Hallmarking has been introduced in the late middle ages<sup>10</sup> - France : 1260, England : 1300, Switzerland : 1424.
- 2.9 Modern Hallmarks were introduced in 1973 to standardize the legislation on the inspection of precious metals and to facilitate international trade. A core group of European nations signed the Vienna Convention on the control of the fineness and the hallmarking of precious metal objects. Articles that have been assayed and found to be in conformity by the qualifying office of a signatory country will receive a mark, known as the Common Control Mark (CCM), attesting to the material's fineness.

### **3. GEMSTONES**

- 3.1 Gemstones or gems are precious or semi-precious piece of mineral, when in cut and polished form, is used to make jewellery.
- 3.2 The precious stones are diamond, ruby, sapphire and emerald. Other gemstones are considered semi-precious. (Please see Appendix 1 for list of semi-precious stones)
- 3.3 Gemstones are generally categorized based on their crystal structure<sup>11</sup>, specific gravity<sup>12</sup>, refractive index<sup>13</sup>, and other optical properties, such as pleochroism<sup>14</sup>.
- 3.4 Gemstones are also identified by gemologists who describe gems and their characteristics using technical terminology specific to the field of gemology, using chemical composition. For example, diamonds are made of carbon (C), rubies are made of aluminium oxide (Al<sub>2</sub>O<sub>3</sub>).

### **4. GOLD SUPPLY CHAIN**

- 4.1 The gold supply chain is non-linear as gold can be owned and supplied by multiple participants in the supply chain.

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<sup>9</sup> Precious metals are chemically less reactive than most elements. They have high lustre, are softer or more ductile (ability to deform under tension), and have higher melting points than other metals. Of the precious metals listed here, silver and platinum are more widely traded.

<sup>10</sup> Middle ages: 5<sup>th</sup> century to 15<sup>th</sup> century.

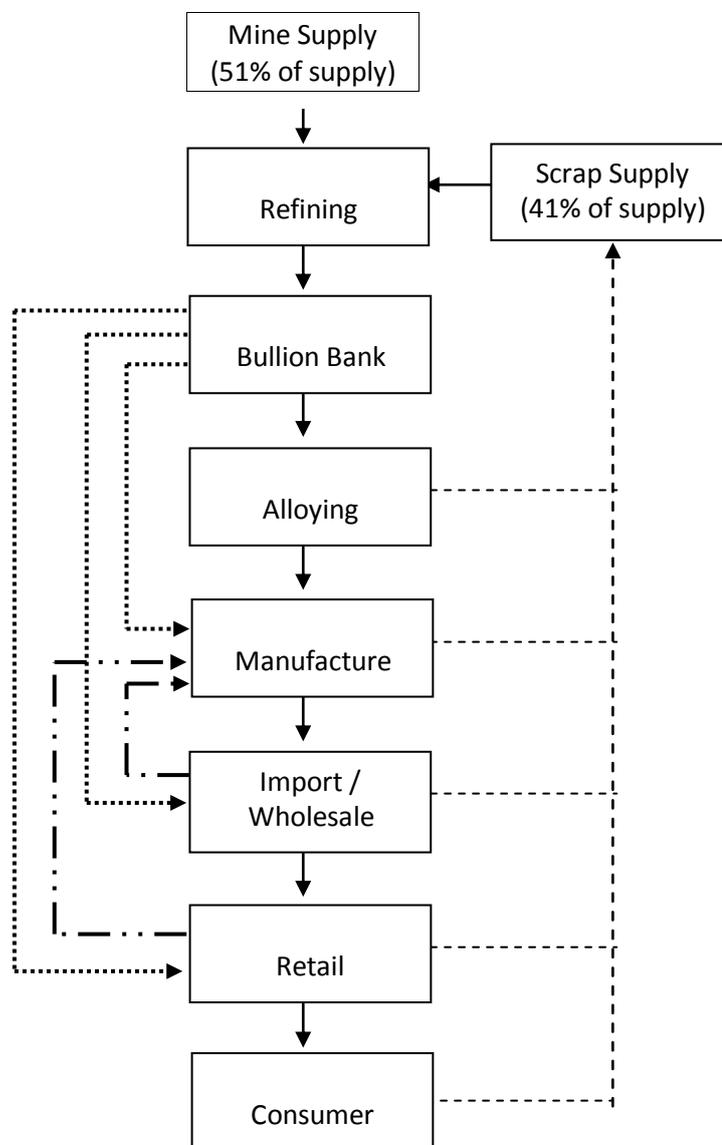
<sup>11</sup> Crystal structure is a unique arrangement of atoms or molecules in a crystalline liquid or solid. A crystal structure is composed of a pattern, a set of atoms arranged in a particular way, exhibiting long-range order and symmetry.

<sup>12</sup> Specific gravity is the ratio of the density (mass of a unit volume) of a substance to the density (mass of the same unit volume) of a reference substance.

<sup>13</sup> The refractive index or index of refraction of a substance or medium is a measure of the speed of light in that medium. It is expressed as a ratio of the speed of light in vacuum relative to that in the considered medium.

<sup>14</sup> Pleochroism is an optical phenomenon in which a substance appears to be different colors when observed at different angles with polarized light.

- 4.2 About 59% of the supply of gold for jewellery is from the mine supply. The remaining 41% of the supply is from 'scrap' or through refining process. Scrap supply of gold is actually a major component which makes the supply chain cyclical. Scrap gold refers to recycled, preowned or laundered gold.
- 4.3 There are also bullion banks which act as the conduit for central bank gold being loaned into the market. According to the World Gold Council bullion banks are investment banks that function as wholesale suppliers dealing in large quantities of gold. All bullion banks are members of the London Bullion Market Association (LBMA). Currently, there are only six (6) clearing banks on the LBMA handling gold loan transactions. These 6 clearing houses<sup>15</sup> comprise Barclays Bank PLC, ScotiaMocatta, Deutsche Bank AG, HSBC Bank, JPMorgan Chase Bank & UBS AG.
- 4.4 Gold Supply Chain<sup>16</sup>



<sup>15</sup> Source: Blanchard Economic Research Unit.

<sup>16</sup> Source: Philip Olden, "Gold & Jewellery Supply Chain: A Context", 18 May 2010, Responsible Jewellery Council

- 4.5 The top 10 gold mines in the world are<sup>17</sup>:
- 4.5.1 Grasberg Gold Mine in the Indonesian province of Papua, produced 2.025 million ounces of gold and is majority owned by Freeport-McMoRan Copper & Gold Inc. It also produces silver and copper.
  - 4.5.2 Muruntau Gold Mine, about 250 miles west of the capital in Uzbekistan, produced approximately 1.8 million ounces of gold in 2010 and is run by state-owned Navoi Mining and Metallurgical Combinat.
  - 4.5.3 Carlin-Nevada Complex in Nevada, USA, produced 1.735 million ounces in 2010. It is owned by Newmont Mining Corp.
  - 4.5.4 Yanacocha Gold Mine in northern Peru, is the largest gold mine in Latin America, produced 1.46 million ounces in 2010 and is run by Newmont Mining and owned by Newmont Mining and Buenaventurda, a Peruvian company.
  - 4.5.5 Goldstrike (Betze Post) Gold Mine in northwest of Elko, Nevada, produced 1.24 million ounces of gold in 2010 and is owned by Barrick Gold Corp.
  - 4.5.6 Cortez Gold Mine in southwest of Elko, Nevada, produced 1.14 million ounces of gold in 2010 and is owned by Barrick Gold Corp.
  - 4.5.7 Veladero Gold Mine in Argentina, produced 1.12 million ounces of gold in 2010 and is owned by Barrick Gold Corp.
  - 4.5.8 Lagunas Norte Gold Mine in north-central Peru, produced 808,000 ounces of gold in 2010 and is owned by Barrick Gold Corp.
  - 4.5.9 Lihir Gold Mine in Papua New Guinea, produced 790,974 ounces of gold in the 12 months ended June 30, 2010 and is owned by Newcrest Mining Ltd., Australia's largest gold producer.
  - 4.5.10 Super Pit/Kalgoorlie in Western Australia, produced 788,000 ounces in 2010 and is 50:50 owned by Barrick Gold Corp. and Newmont Mining.
- 4.6 The world's largest gold mining companies are:<sup>18</sup>
- 4.6.1 Barrick Gold (NYSE: ABX) – Canadian company headquartered in Toronto. Operates 27 mines worldwide. Market Cap: \$34.5Billion. Yield: 1.01%
  - 4.6.2 GoldCorp Inc. (NYSE: GG) – Canadian company headquartered in Vancouver. Market Cap: \$31.0Billion. Yield: 0.43%
  - 4.6.3 Newmont Mining (NYSE: NEW) – Headquartered in Denver, Colorado (USA). Market Cap: \$22.8Billion Yield: 0.85%
  - 4.6.4 Kinross Gold Corp. (NYSE: KGC) – Canadian company headquartered in Toronto. Market Cap: \$16Billion. Yield: 0.44%

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<sup>17</sup> Source: IB Times World, based on available 2010 production data.

<sup>18</sup> Source: Money Energy, based on size – market capitalization.

- 4.6.5 AngloGold Ashanti Ltd. (NYSE: AU) – Headquartered in Johannesburg, South Africa. Operates mines in Australia, South Africa, West Africa and South America. Market Cap: \$16Billion. Yield: 0.34%
- 4.6.6 Agnico-Eagle Mines Ltd. (NYSE: AEM) – Canadian company headquartered in Toronto. Market Cap: \$11.5Billion.
- 4.6.7 Gold Fields Inc. (NYSE: GFI) – Headquartered in Johannesburg, South Africa. Has operations in South Africa, Ghana, Australia and Peru. Market Cap: \$10.3Billion. Yield: 1.37%
- 4.6.8 Compania de Minas Buenaventura (NYSE: BVN) – Headquartered in Peru and is Peru’s largest publicly-traded gold mining company, with significant domestic operations. Has seven domestic mines. Market Cap: \$9.8Billion. Yield: 0.1%
- 4.6.9 Yamana Gold Inc. (NYSE: AUU) – Canadian company headquartered in Toronto. Begun operations only in 2003. Market Cap: \$8.8Billion. Yield: 0.33%
- 4.6.10 Lihir Gold (NASDAQ: LIHR) – Headquartered in Papua New Guinea with operations in Papua New Guinea, Australia and West Africa. Market Cap: \$7.1Billion.
- 4.7 Please refer to Appendix 2 for list of gold producing countries.
- 4.8 Malaysia also produces gold, in Pahang, i.e. in Penjom, Raub and Selinsing.

## 5. GEMSTONE CUTTING

- 5.1 Gemcutting or lapidary is the process of cutting and polishing gems.
- 5.2 A person who cuts and polishes gems is called a gemcutter or a lapidary or lapidarist.
- 5.3 Common techniques in lapidary include:
  - 5.3.1 Sawing: in most gem sawing, a thin blade usually made of steel, copper or phosphor bronze allow impregnated along the outer edge with diamond grit, rotates at several thousand surface feet per minute accurately scratches its way through the gemstone. A liquid of either oil or water is used to wash away the cutting debris and keep the stone and saw blade from overheating.
  - 5.3.2 Grinding: silicon carbide wheels or diamond-impregnated wheels are used to shape gemstones to desired rough form, called preform. A liquid of either oil or water is used to wash away the cutting debris and keep the stone and saw blade from overheating.
  - 5.3.3 Sanding: is similar to grinding but uses finer abrasives. Its purpose is to remove deep scratches left by coarser abrasives during grinding. Allows more delicate control over final shaping of the stone prior to polishing.
  - 5.3.4 Lapping : is very similar to grinding and sanding. However this is performed on one side of the rotating or vibrating flat disk known as a lap. It is used

especially to create flat surfaces on a stone. Lap is often made of cast iron, steel or copper bronze allow.

- 5.3.5 Polishing : is done after the gemstone is sawed and ground to the desired shape and sanded to remove rough marks left by coarser grits. Polishing aid light reflection from the surface of the stone (or refraction through the stone, in the case of transparent materials). Very fine grades of diamond (50,000 – 100,000 mesh) can be used to polish a wide variety of materials. Other polishing agents include metal oxides such as aluminium oxide, cerium oxide, tin oxide, chromium oxide, ferric oxide or silicon dioxide.
  - 5.3.6 Drilling: is to make a hole in or through a gemstone (e.g., a bead). A small rotating rod or tube with a diamond tip, or a slurry of silicon carbide and coolant, is used to drill through the stone. Ultrasonic, or vibrating, drills are also very effective, but they tend to be costly and thus reserved for high-volume commercial drilling.
  - 5.3.7 Tumbling: is the process where large quantities of roughly shaped stones are turned at a slow speed in a rotating barrel with abrasives and water for extended periods – of days or even weeks. Tumbling with progressively finer grades of abrasive, usually comprising silicon carbide and washing carefully between grades, the gemstones are smoothed and polished to favourable and attractive shapes. An alternative to rotator tumbler is a vibratory machine or a vibratory tumbler. Tumbling is often used to polish large quantities of metal jewellery.
- 5.4 Gemstones are normally fashioned into following forms using lapidatory techniques:
- 5.4.1 Cabochons: is a stone that is smoothly rounded and polished on top, relatively flattish and either flat or slightly rounded on the bottom. Often used in opaque or translucent stones. Cabochon cutting or cabling is often performed by holding the stone in the finger but it is more commonly done by dopping (attaching adhesive wax or glue) the stone to a wooden or metal dipstick. This facilitates twirling the stone to form smooth curves and avoid flat areas during grinding, sanding and polishing.
  - 5.4.2 Faceted stones: Faceting is mostly done on transparent stones. Flat facets are cut and polished over the entire surface of the stone, usually in symmetrical pattern. The stone is dopped, then inserted in a handpiece that allows precise control of positioning. The cutting angle is adjusted vertically via a protractor and rotationally via an index gear. The facets are then ground, sanded and polished on a rotating lap.
  - 5.4.3 Beads & spheres: Spheres are initially sawed into cubes and then ground to shape between two pipes or rotating concave cutter, allowing the stone to rotate freely in any direction to form a perfect spherical shape. Finer grade of abrasive are used to grind, sand and polish the tones. Beads are more

commonly cut and polished as small spheres and then drilled to allow stringing.

- 5.4.4 Inlays<sup>19</sup>: A gemstone is cut to fit and glued into a hollow recess in another material which could be other gemstones, wood or even metal. The top is then ground and polished flush with the surrounding material. Most common gemstones for inlay are strongly coloured opaque stones such as black onyx, lapis lazuli<sup>20</sup>, turquoise and tigereye<sup>21</sup>.
- 5.4.5 Intarsias and Mosaics : Small bits of different coloured stones are fit together and the top cut and polished to present a picture or other interesting pattern. A mosaic is constructed on top of a flat base of another material, which is usually stone. An intarsia is set flush into the surface of the base material. The finest intarsias and mosaics were traditionally of Italian origin.
- 5.4.6 Cameos and Intaglios: are carved portraits in stone or seashells. Cameos are raised portraits. Intaglios are carved down into the surface of the material. Both take advantage of the different coloured layers of material. The finest cameos and intaglios have traditionally come from Italy (shell) and Germany (agate).
- 5.4.7 Sculpture: Gemstones can be carved into any other form, though limited to the talents of the sculptor.

## 6. GLOBAL GOLD DEMAND AND SUPPLY

- 6.1 Demand for gold in 2011 reached 4,067.1 tonnes, an increase of 29% above the 2010 value.<sup>22</sup> This is equivalent to US\$205.5 billion in value terms.
- 6.2 Demand for gold bars and coins remains healthy. Growth in gold coins in particular was responsible for much of the increase. Gold bar and coin demand surged 24% to 1,486.7 tonnes in 2011 over the 2010 figure, largely due to growth in demand for gold bars.
- 6.3 Demand for gold used in technology declined modestly by 0.6% to 463.5 tonnes in 2011 compared with 2010. However the value of annual demand increased 28% to a record US\$23.4 billion. Demand from the electronics segment was broadly steady, while gold in the dentistry and other industrial sectors declined.
- 6.4 Jewellery accounts for around 50% of the total gold demand. Other demands for gold are for investments<sup>23</sup> and technology<sup>24</sup>. The table below shows the demand for gold in value terms.

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<sup>19</sup> Ornament or object by embedding pieces of a different material in it, flush with its surface or contrasting material set into a surface in pieces to form a design.

<sup>20</sup> Deep blue with golden inclusions.

<sup>21</sup> Golden to red brown in colour.

<sup>22</sup> World Gold Council.

<sup>23</sup> Investments in gold include physical bar, official coin, medals / imitation coins as well as exchange traded products (ETF)

6.5 Annual supply of gold decline slightly although mine production saw additional supply. Lower levels of gold recycling contributed to the slowdown in supply.

*Demand for Gold*

\$Million	2009	2010	2011
Jewellery	56,695	79,399	99,175
Technology	12,811	18,363	23,419
Investment	43,555	61,710	82,897
Total	113,061	159,472	205,491

Source: World Gold Council

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<sup>24</sup> Electronics, other industrial and dentistry.

## **Appendix 1:**

This list of gemstones includes the mineral names (in parentheses) of the gemstones

Agate (Chalcedony). Red-banded agate is also known as sard or sardonyx

Alexandrite (Chrysoberyl)

Amber (Amber)

Amethyst (Quartz)

Ametrine (Quartz)

Apatite (Apatite)

Aquamarine (Beryl)

Aventurine (Chalcedony)

Azurite

Benitoite (Benitoite)

Beryl (Beryl)

Bloodstone (Chalcedony)

Carnelian (Chalcedony)

Chrome Diopside (Diopside)

Chrysoberyl (Chrysoberyl)

Chrysoprase (Chalcedony)

Chrysocolla

Citrine (Quartz)

Diamond (Diamond) (precious stone)

Emerald (Beryl) (precious stone)

Fluorite

Garnet (Almandine, Andradite, Grossularite, Pyrope, Spessartine, Uvarovite)

Heliodore (Beryl)

Heliotrope (Chalcedony)

Hematite

Hessonite (Grossularite)

Hiddenite (Spodumene)

Iolite (Cordierite)

Jade (Jadeite or Nephrite)

Jasper (Chalcedony)

Kunzite (Spodumene)

Kyanite

Labradorite

Lapis Lazuli (Lazurite)  
Malachite (Malachite)  
Moonstone (Albite, Microcline Feldspar, Orthoclase, Plagioclase)  
Morganite (Beryl)  
Onyx (Chalcedony)  
Opal (Opal)  
Pearl  
Peridot (Olivine)  
Quartz (Quartz)  
Rhodochrosite (Rhodochrosite)  
Rhodolite (Almandine-Pyropes Garnet)  
Rock Crystal (Quartz)  
Rose Quartz (Quartz)  
Ruby (Corundum) (precious stone)  
Sapphire (Corundum) (precious stone)  
Sard (Chalcedony)  
Sardonyx  
Sinhelite (Sinhelite)  
Sodalite (Sodalite)  
Spinel (Spinel)  
Sugilite (Sugilite)  
Sunstone (Oligoclase Feldspar)  
Tanzanite (Zoisite)  
Titanite (Sphene)  
Topaz (Topaz)  
Tourmaline (Tourmaline)  
Tsavorite (Grossularite)  
Turquoise (Turquoise)  
Zircon (Zircon)

## Appendix 2

### Gold Producing Countries<sup>25</sup>

Afghanistan	Argentina	Armenia
Australia	Bolivia	Botswana
Brazil	Bulgaria	Bulkina Faso
Canada	Central Africa Republic	Chile
China	Columbia	Congo
Costa Rica	Cote d'Ivoire	Dominican Republic
Ecuador	Eqypt	El Savador
Eritrea	Ethipia	Fiji
Finland	France	Georgia
Ghana	Greece	Guatemala
Guinea	Guyana	Honduras
Hungary	India	Indonesia
Japan	Kazakhstan	North Korea
South Korea	Kyrgyzstan	Laos
Malaysia	Mali	Mauritania
Mexico	Mongolia	Mozambique
Namibia	New Zealand	Nicaragua
Niger	Panama	Papua Guinea
Peru	Philippines	Portugal
Romania	Russia	Saudi Arabia
Senegal	Serbia	Slovak Republic
Solomon Islands	South Africa	Spain
Sudan	Suriname	Sweden
Tajikistan	Tanzania	Thailand
Turkey	Ukraine	Uruguay
USA	Uzbekistan	Venezuela
Zambia	Zimbabwe	

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<sup>25</sup> Source: AME Group

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**Note:** Part Two of the Study on the Gold & Jewellery Industry will attempt discuss the local scenario in Penang.