Alaska Resources Development Council
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Alaska's Natural Resource Commodities: A 10-Year Outlook

David R. Hammond, Ph.D.
Principal Mineral Economist
Hammond International Group

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Commodities are the Fundamental Source of Economic Wealth!

Dave's Axiom of Wealth:

"Real Societal Wealth is Created Only by Growing It, Digging It out of the Ground, or Building It as a Tangible Product with Your Hands; All Other Forms of Commercial Activity are Just Transfers of Wealth Between Parties!"

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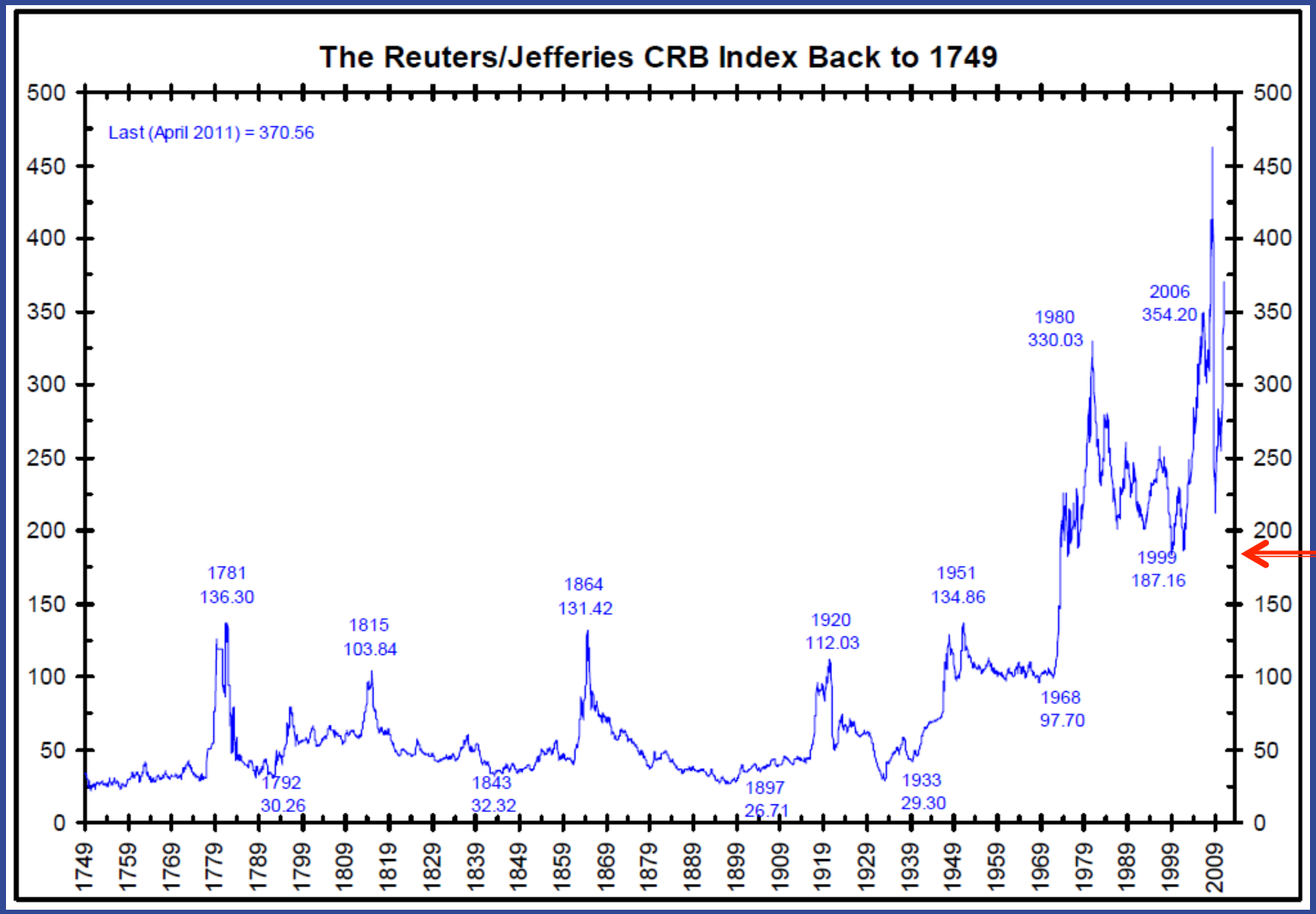
Commodity Prices Over Time:



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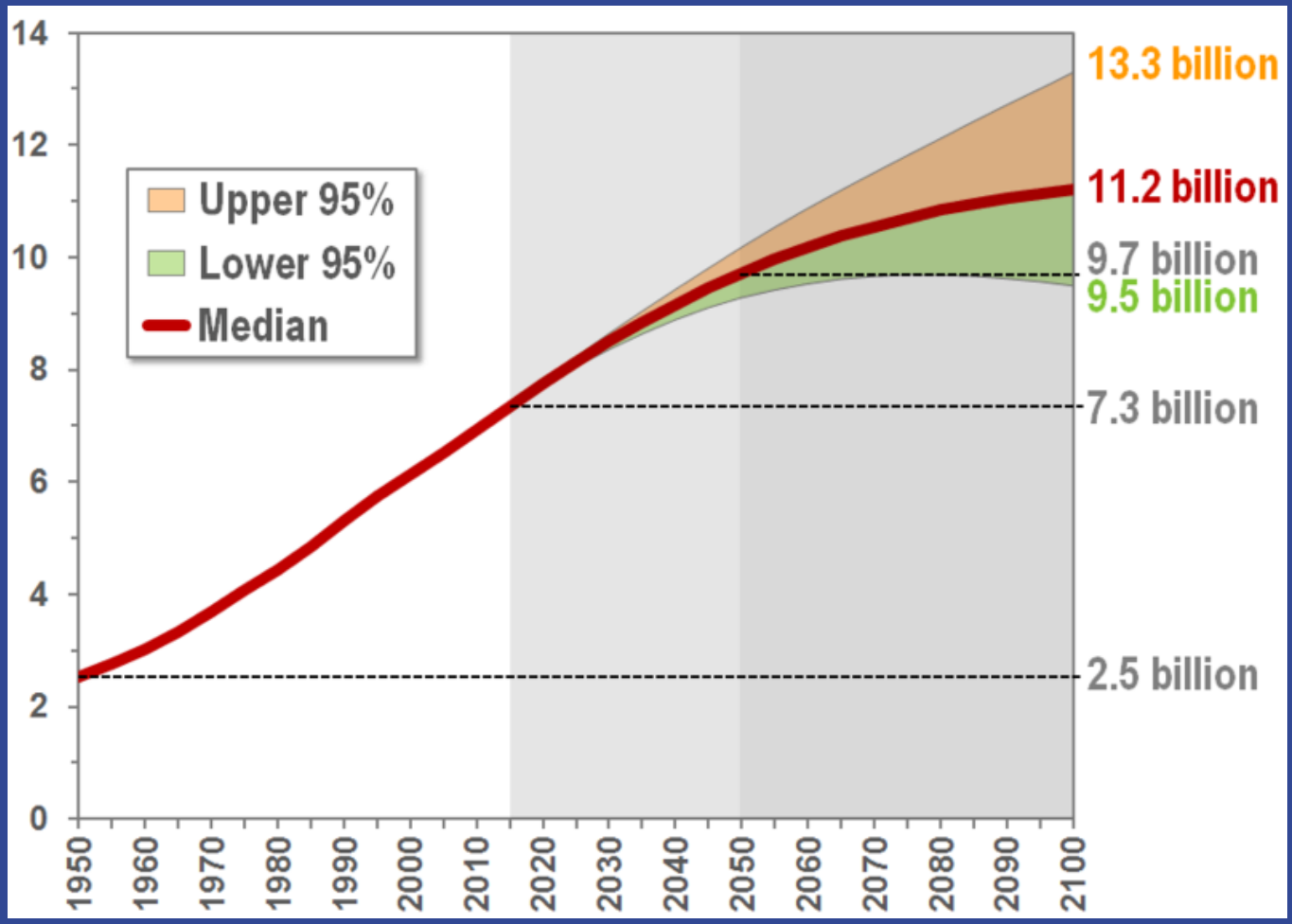
Drivers of Mineral Demand:

- World Population Growth
- Intensity of Use

Drivers of Mineral Price:

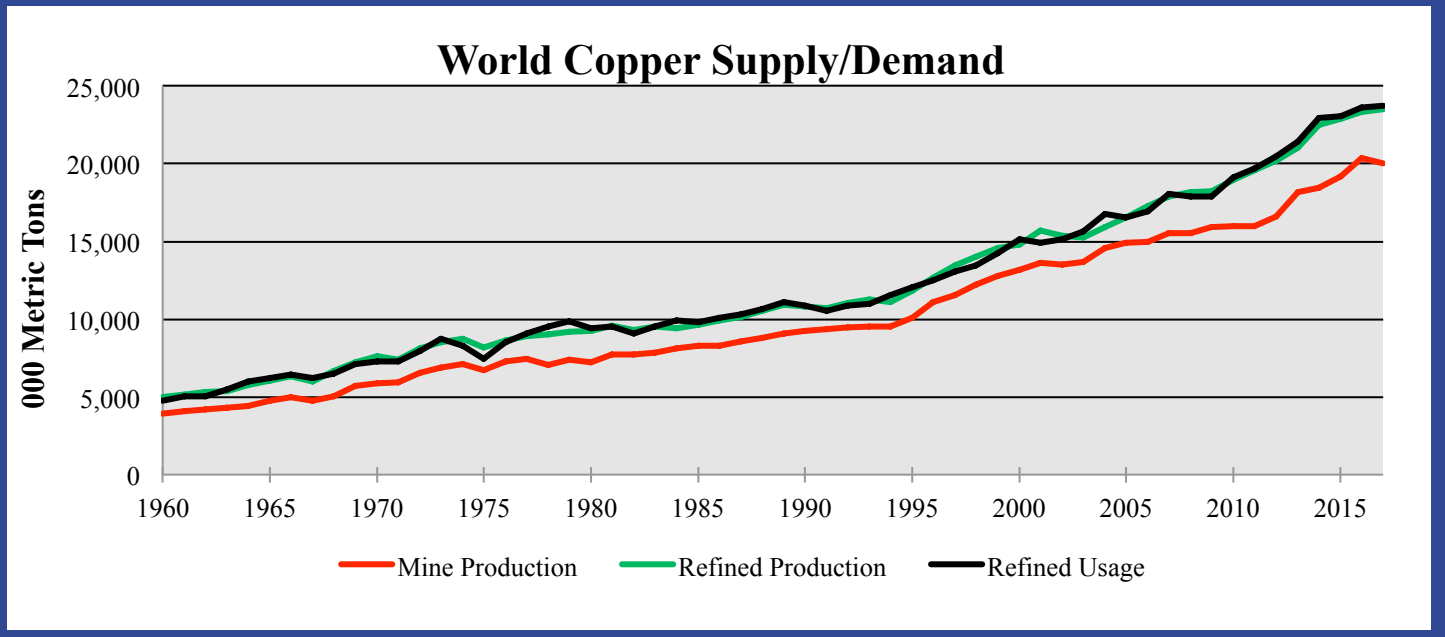
- Short-term Demand
- Short-term Supply

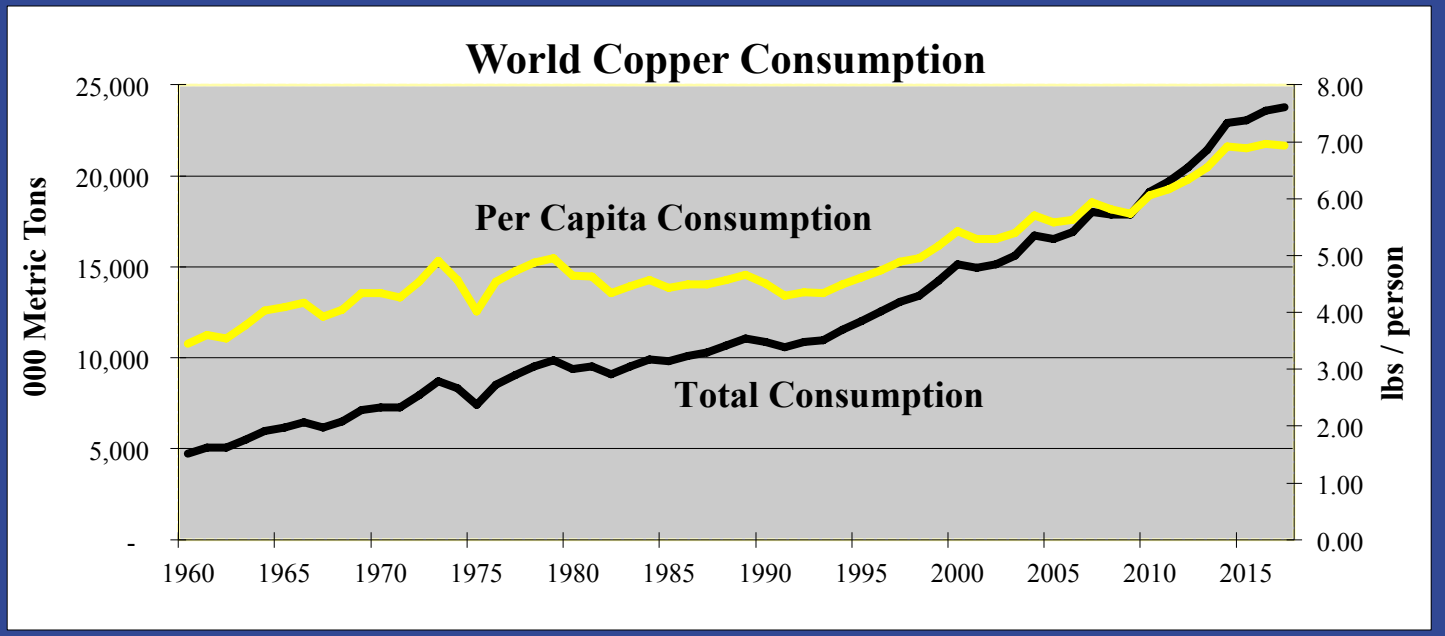
World Population Growth Projections:



Source: *Heilig, Gerhard K. (2016), United Nations, Department of Economic and Social Affairs, Population Division, World Population Prospects: The 2015 Revision, Volume I.*

Copper:





Source: *ICSG*

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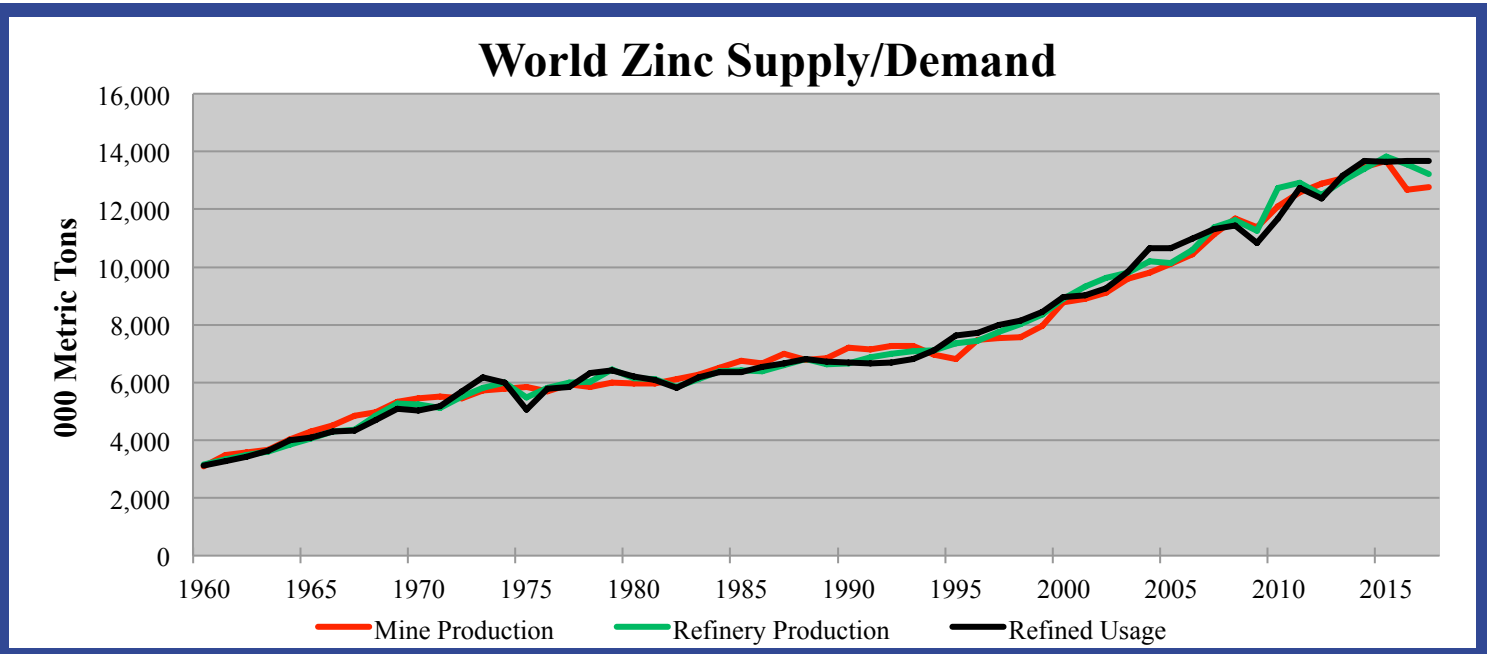
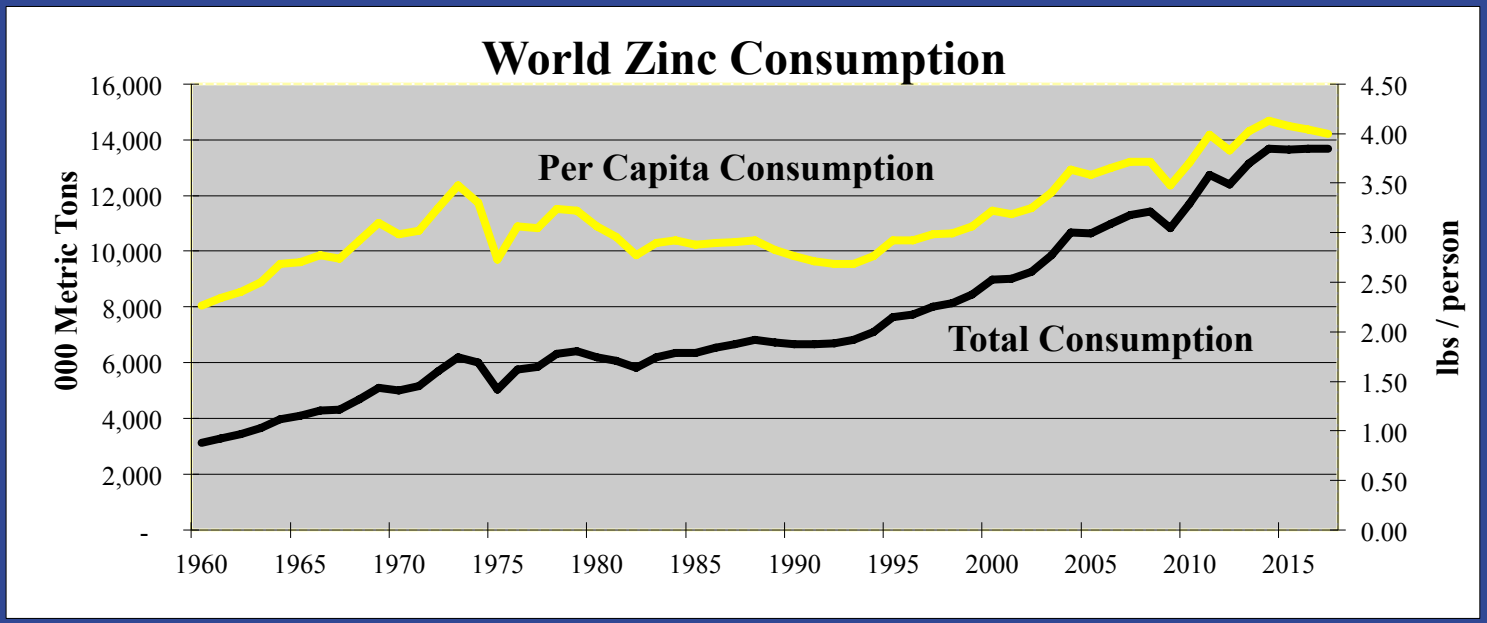
Zinc:





Source: *ILZSG, USGS*

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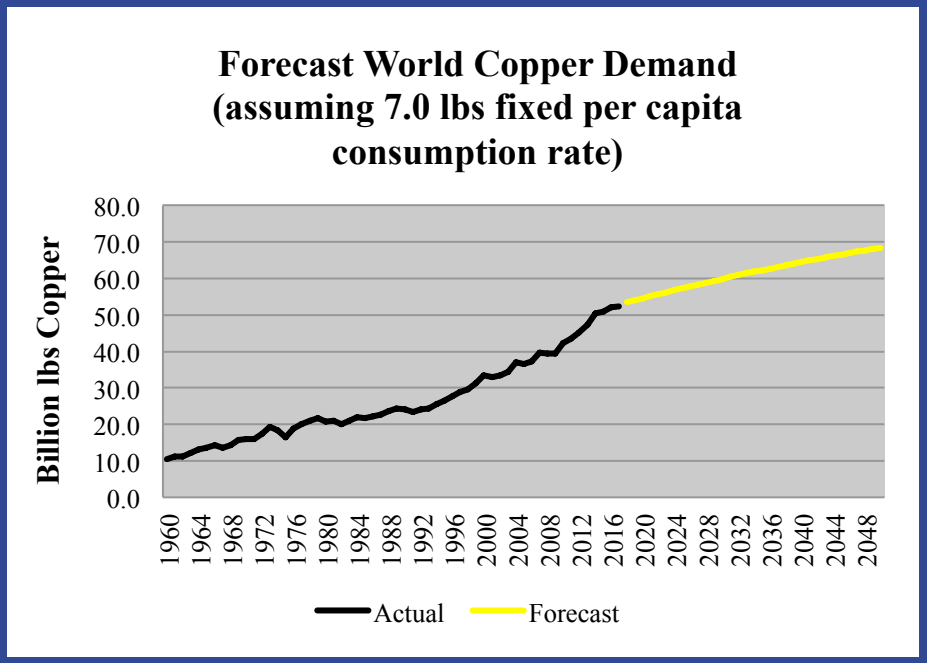
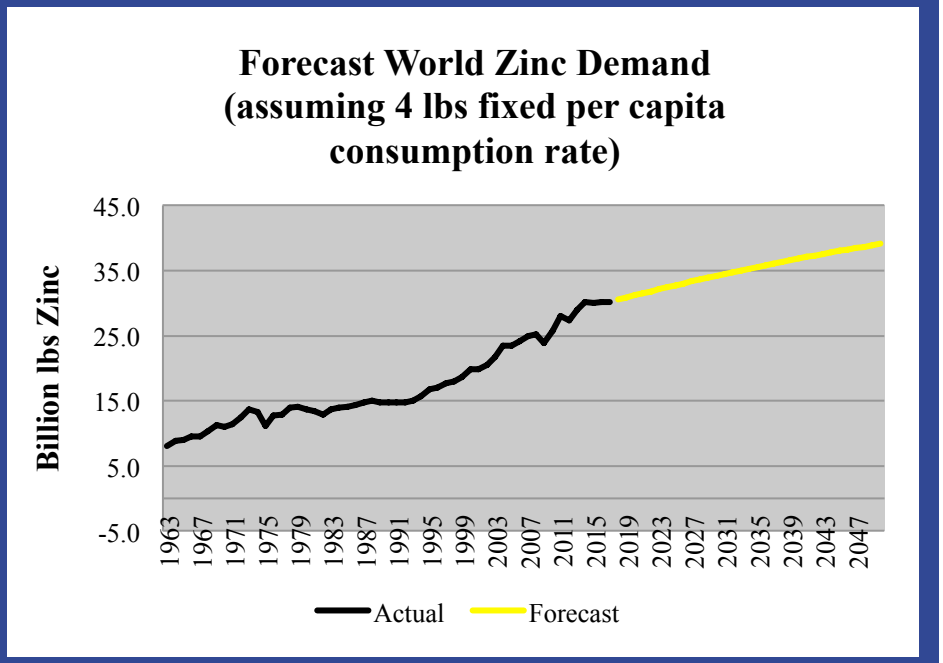
Copper & Zinc – Future Demand





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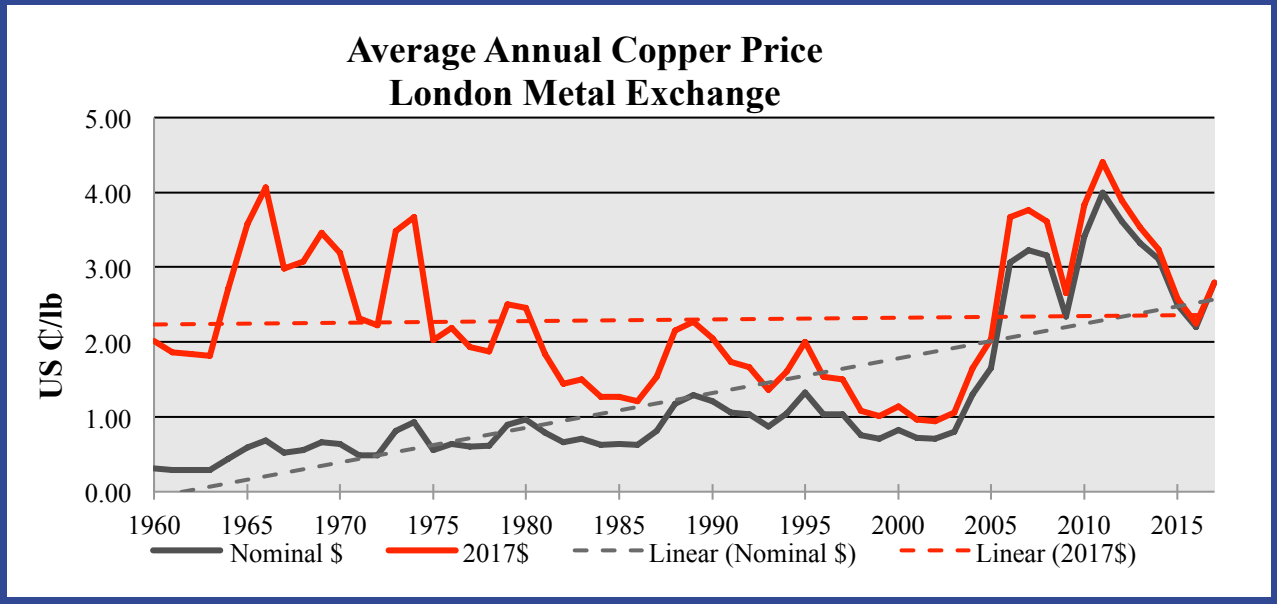
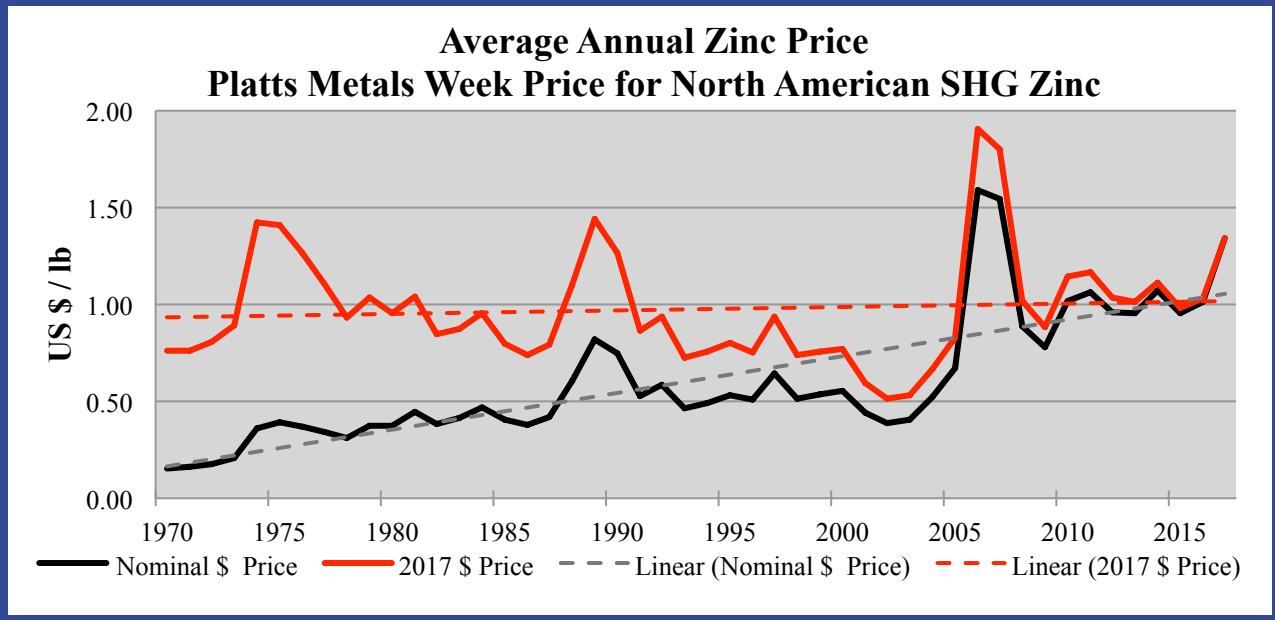
Nominal & Real 2017$ Prices:





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Future Issues for Copper:

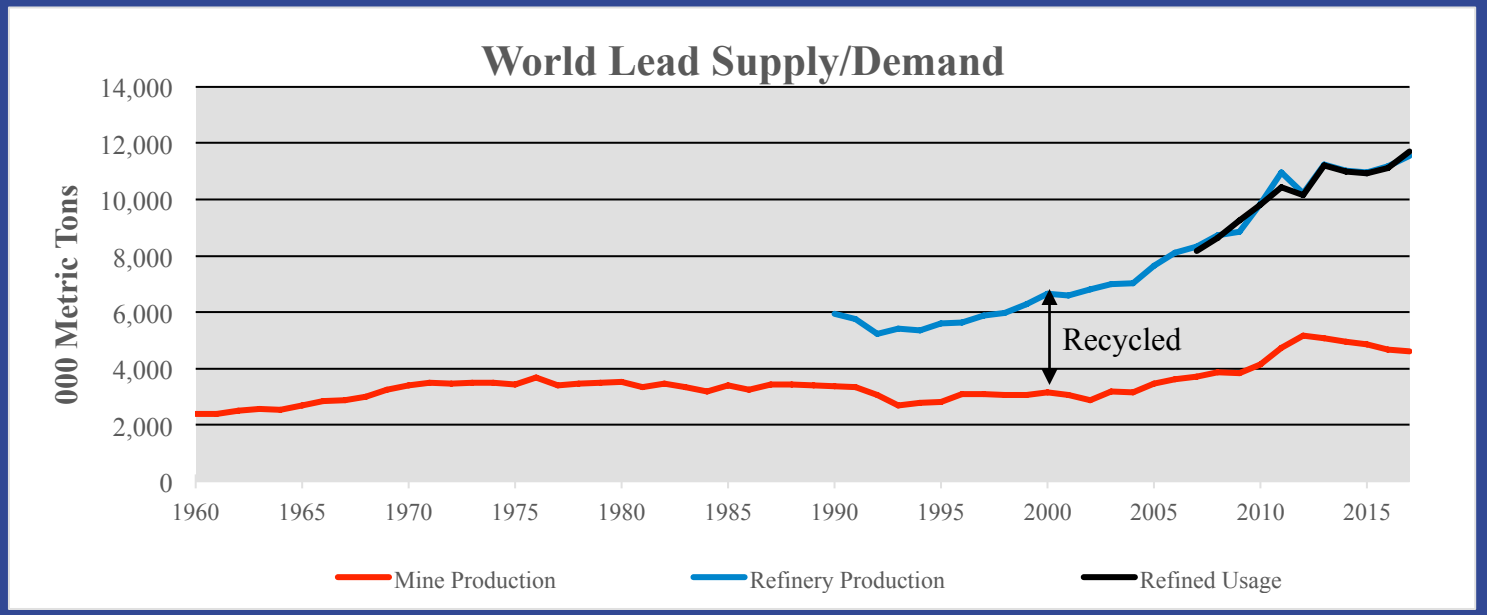
Demand:

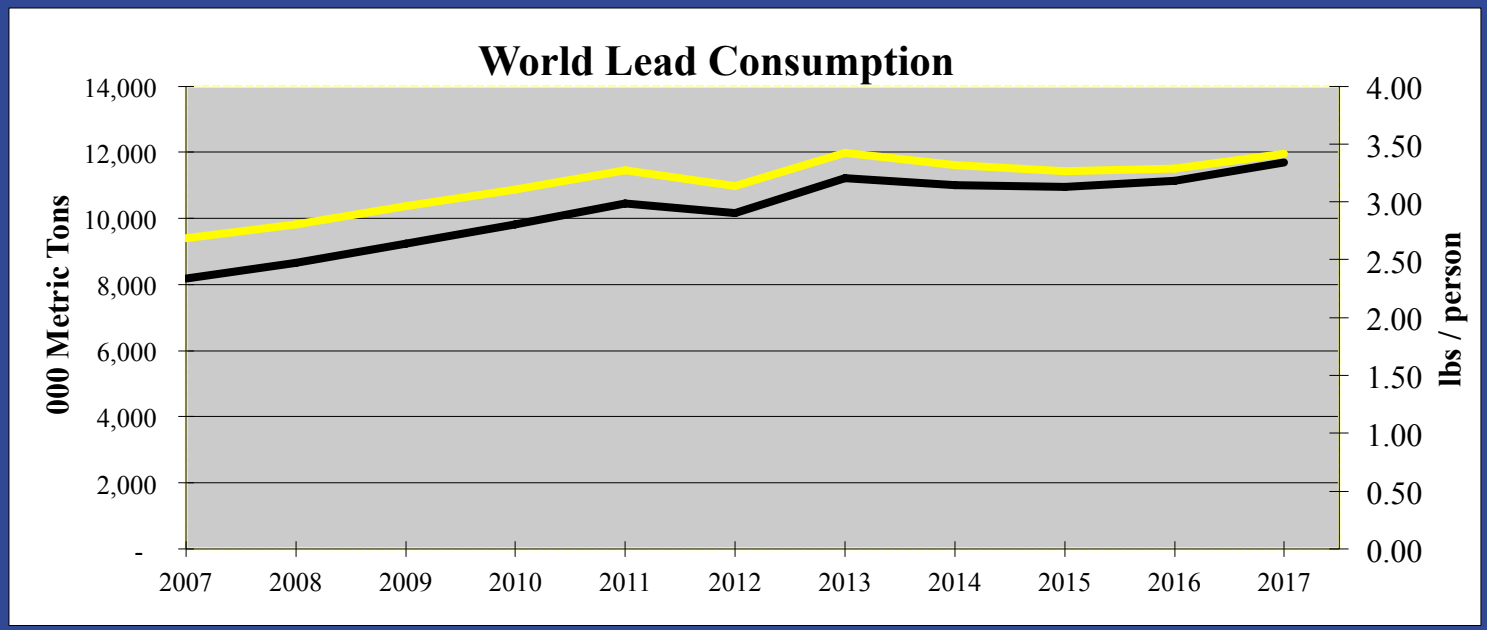
- Driver continues to be economic growth in key consuming economies.
- Uncertainties induced by tariff and other trade disputes.
- Currency exchange volatility

Supply:

- Need to replace 50 billion pounds produced each year.
- Declining ore grades at major existing deposits.
- Discovering of new giant near-surface deposits

Lead:





Source: *ILZSG, USGS*

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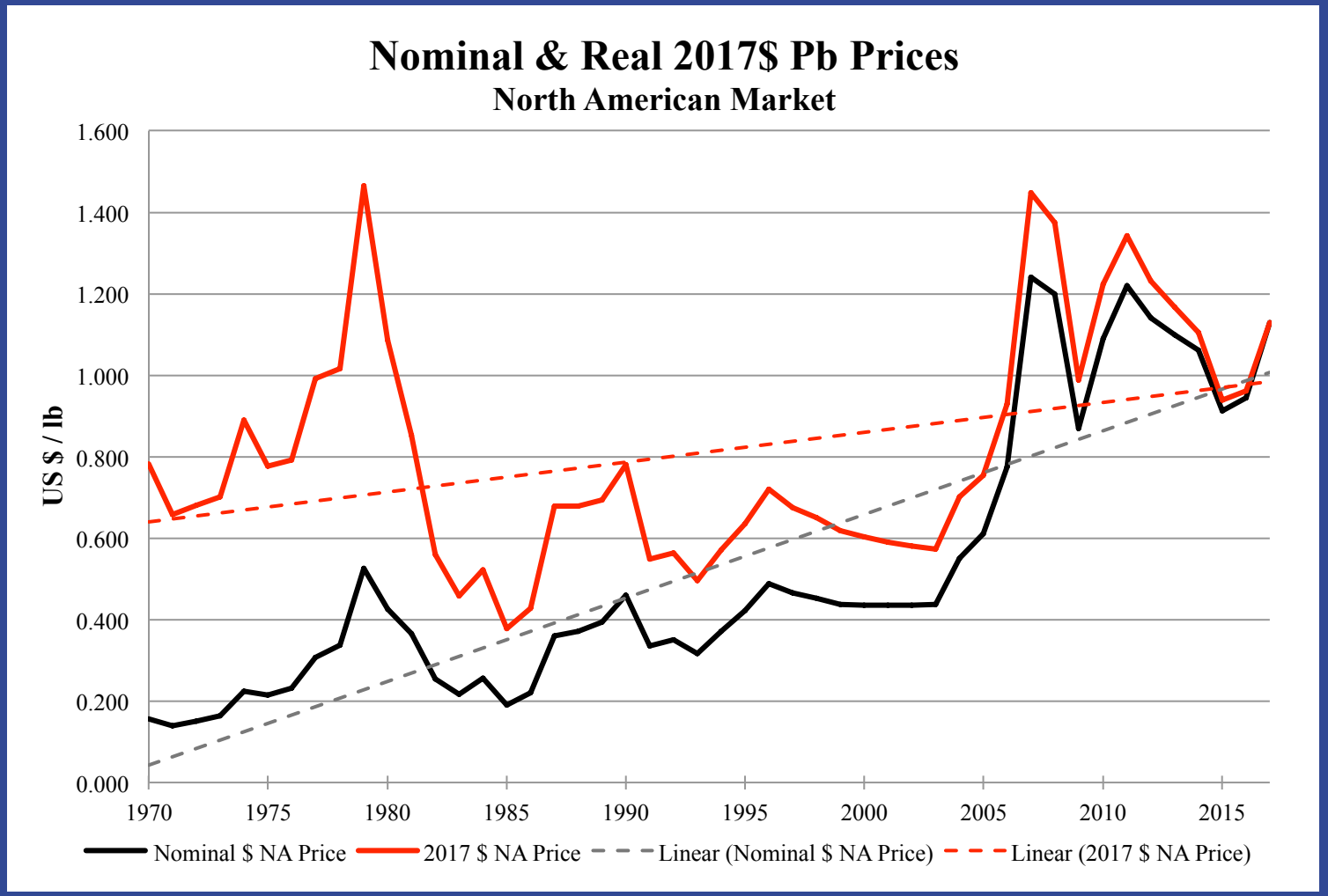
Nominal & Real 2017$ Pb Prices:



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Future Issues for Zinc & Lead:

Demand:

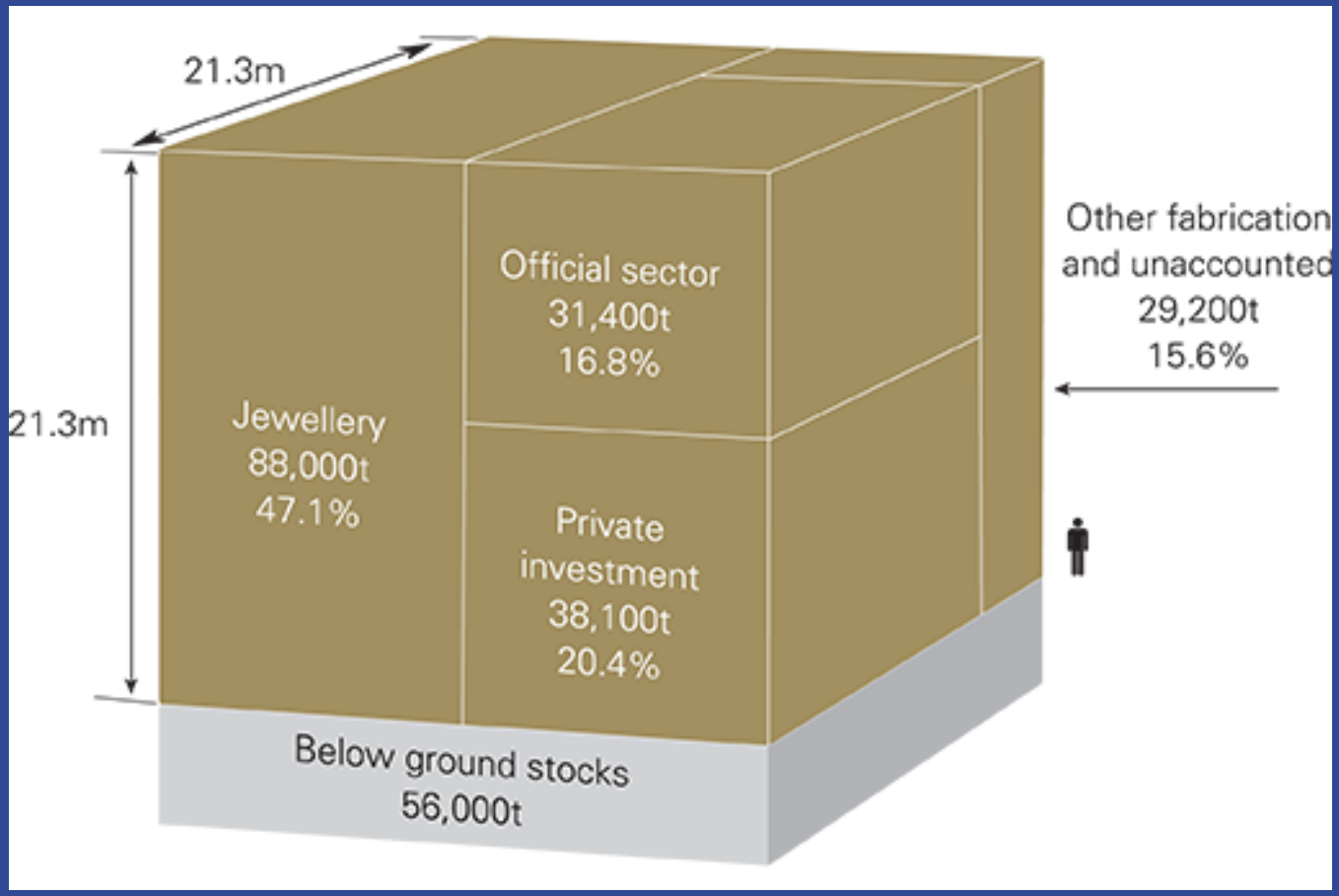
- Zinc is critical for societal development
- A lot more galvanization of steel products will occur
- More uses evolving, such as in health and agriculture

Supply:

- Existing high quality deposits are being mined out
- Lack of new discoveries
- More underground deposits in future, with higher costs

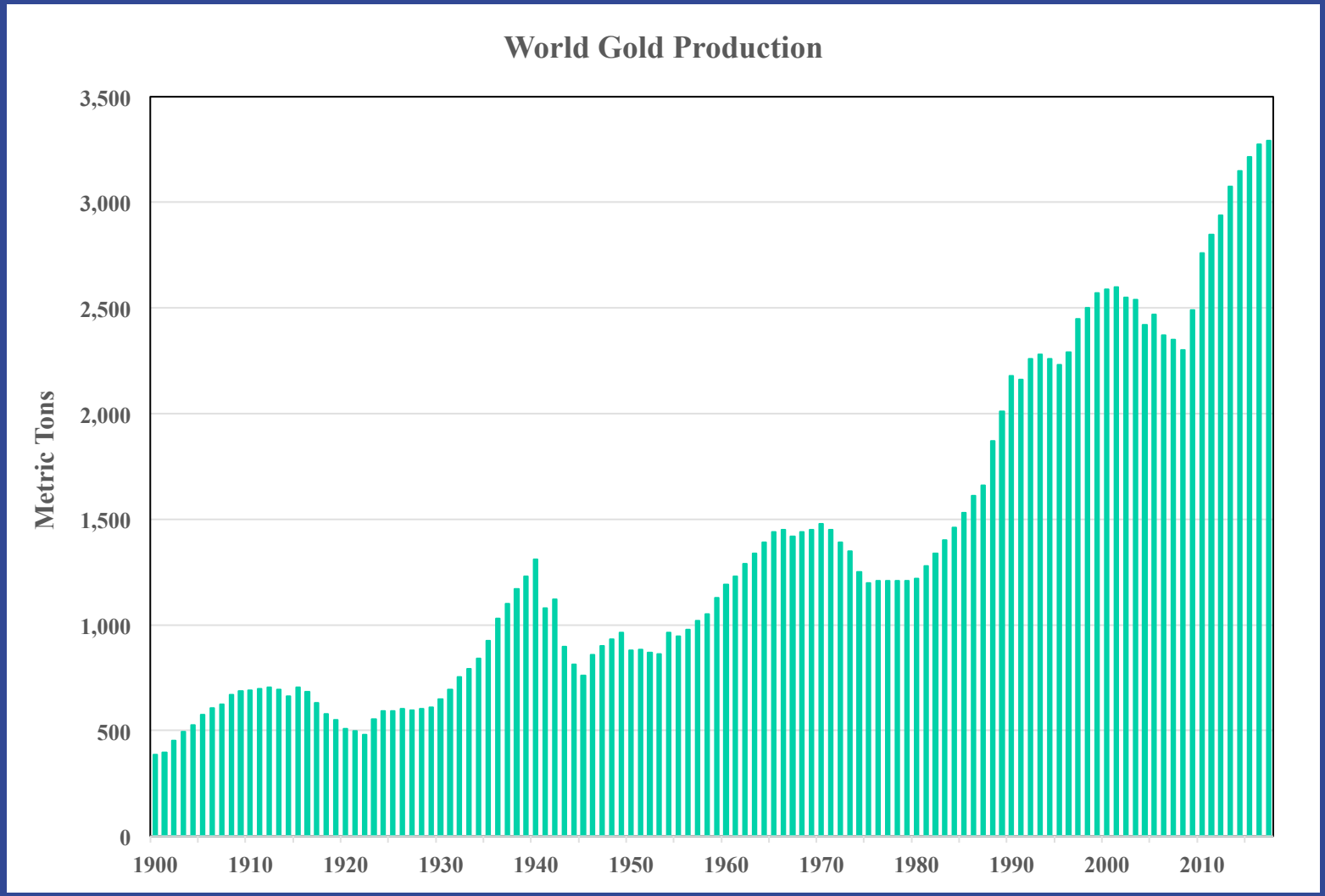
The World Gold Inventory:

Total above-ground stocks = ~187,000 tonnes (6 billion ounces)



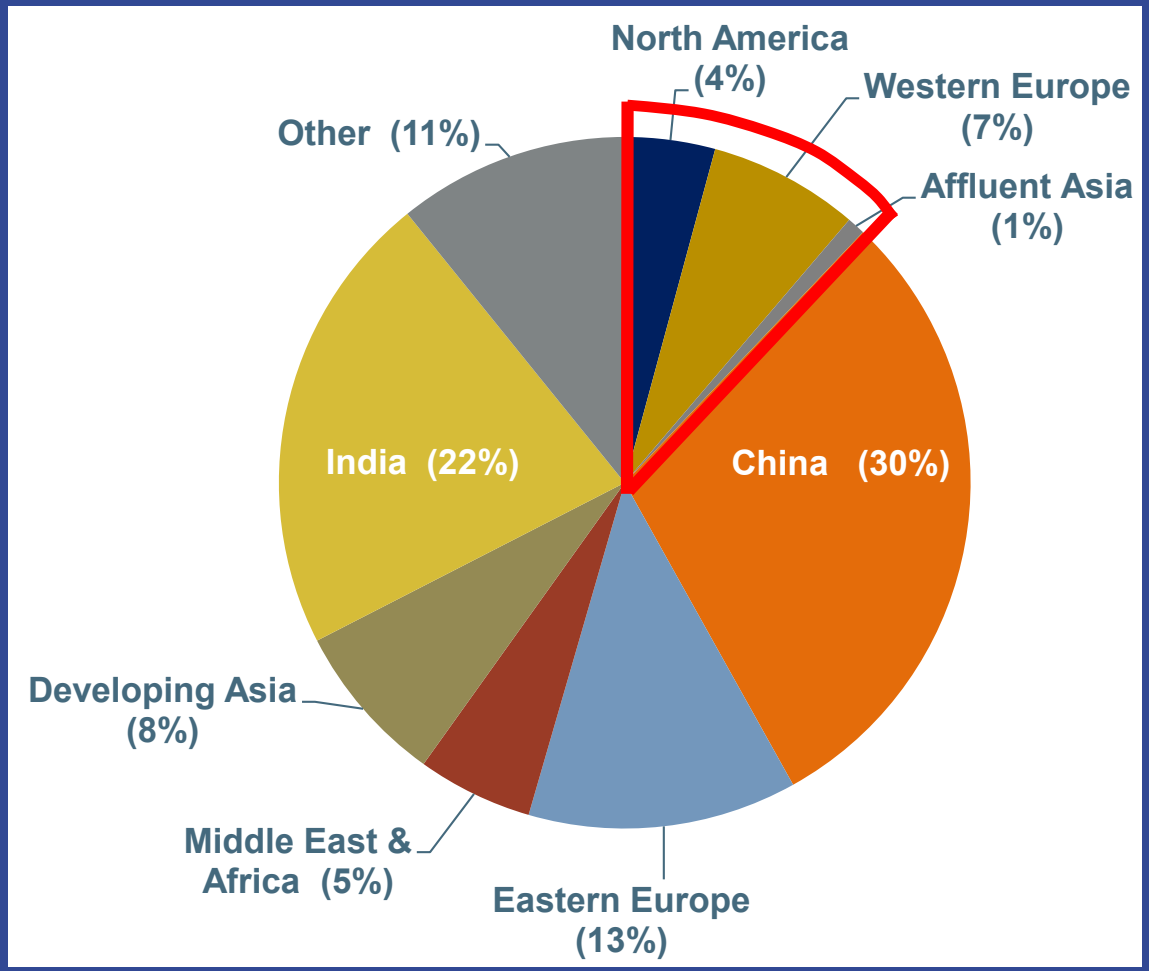
Source: *World Gold Council; Sep 2016*

World Gold Production:



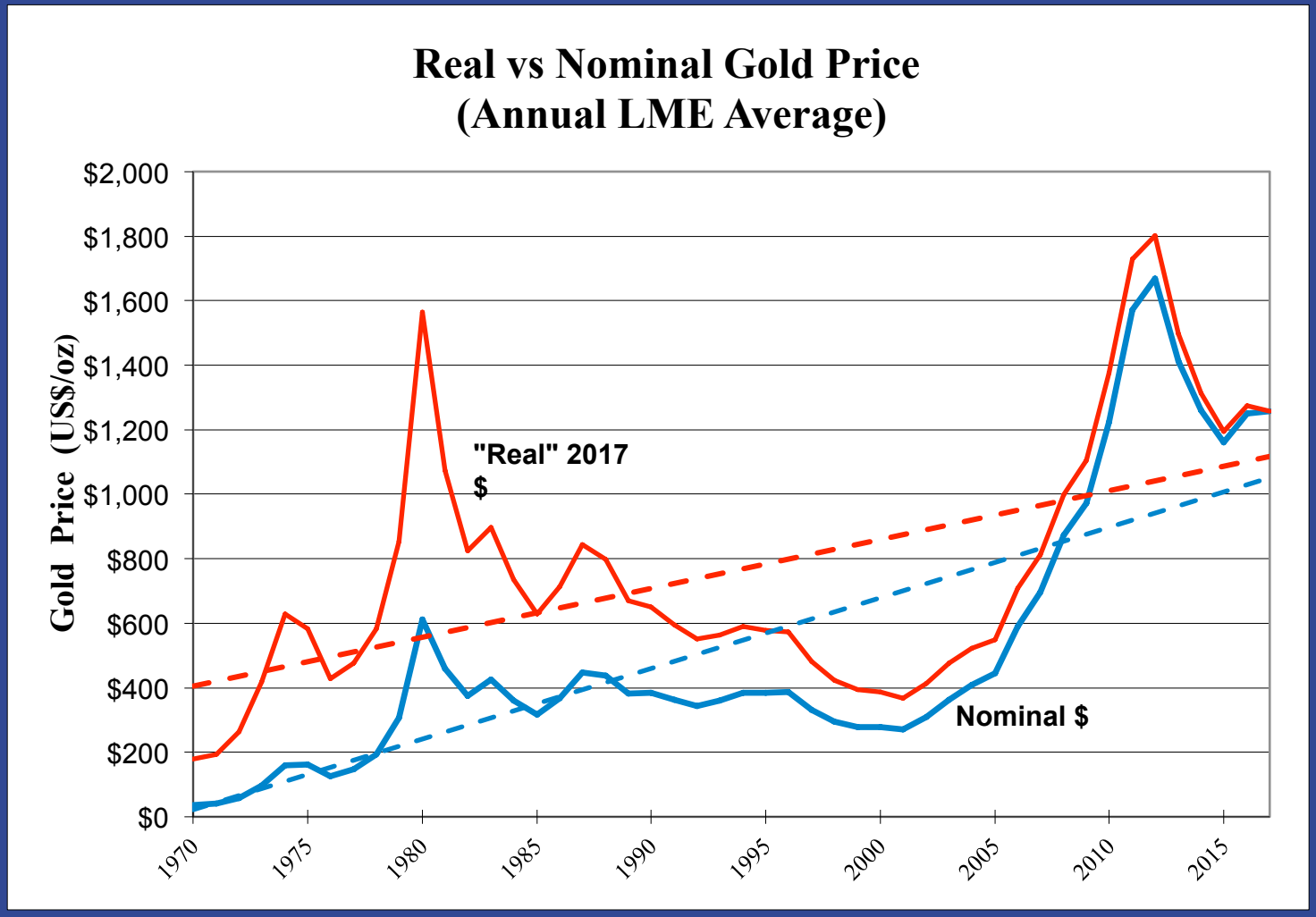
Source: *USGS, World Gold Council*

Gold Demand:



Source: *World Gold Council; Sep 2016*

Nominal & Real (2017$) Gold Prices:



Source: *Nominal Price Data from KITCO*

Future Issues for Gold:

Demand:

- Millennial generation lack of interest in gold.
- ETF effect on price volatility.
- Fall-off in China and India demand:
  - Establishment of formal and trustworthy banking systems.
  - Cryptocurrencies

Supply:

- Declining ore grades at existing mines.
- New "giant" discoveries are increasingly rare.
- Underground deposits require higher grade to be economic.

Economic Fundamentals for Gold are substantially different from other metals!

Critical Materials:

Critical Materials Institute
AN ENERGY INNOVATION HUB

The Periodic Table of the Elements

1 H Hydrogen 1.00794																	2 He Helium 4.003
3 Li Lithium 6.941	4 Be Beryllium 9.012182											5 B Boron 10.811	6 C Carbon 12.0107	7 N Nitrogen 14.00674	8 O Oxygen 15.9994	9 F Fluorine 18.9984032	10 Ne Neon 20.1797
11 Na Sodium 22.989770	12 Mg Magnesium 24.3050											13 Al Aluminum 26.981538	14 Si Silicon 28.0855	15 P Phosphorus 30.973761	16 S Sulfur 32.066	17 Cl Chlorine 35.4527	18 Ar Argon 39.948
19 K Potassium 39.0983	20 Ca Calcium 40.078	21 Sc Scandium 44.955910	22 Ti Titanium 47.867	23 V Vanadium 50.9415	24 Cr Chromium 51.9961	25 Mn Manganese 54.938049	26 Fe Iron 55.845	27 Co Cobalt 58.933200	28 Ni Nickel 58.6934	29 Cu Copper 63.546	30 Zn Zinc 65.39	31 Ga Gallium 69.723	32 Ge Germanium 72.61	33 As Arsenic 74.92160	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.80
37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.90585	40 Zr Zirconium 91.224	41 Nb Niobium 92.90638	42 Mo Molybdenum 95.94	43 Tc Technetium (98)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.90550	46 Pd Palladium 106.42	47 Ag Silver 107.8682	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.760	52 Te Tellurium 127.60	53 I Iodine 126.90447	54 Xe Xenon 131.29
55 Cs Cesium 132.90545	56 Ba Barium 137.327	57 La Lanthanum 138.9055	72 Hf Hafnium 178.49	73 Ta Tantalum 180.9479	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217	78 Pt Platinum 195.078	79 Au Gold 196.96655	80 Hg Mercury 200.59	81 Tl Thallium 204.3833	82 Pb Lead 207.2	83 Bi Bismuth 208.98038	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (263)	107 Bh Bohrium (262)	108 Hs Hassium (265)	109 Mt Meitnerium (266)	110 (269)	111 (272)	112 (277)	113	114				

58 Ce Cerium 140.116	59 Pr Praseodymium 140.90765	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.92534	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93032	68 Er Erbium 167.26	69 Tm Thulium 168.93421	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967
90 Th Thorium 232.0381	91 Pa Protactinium 231.03588	92 U Uranium 238.0289	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)

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Future Issues for Critical Materials:

Demand:

- Demand is complex and evolving; aggressive research on new apps.
- Consumption currently involves relatively small tonnages.
- US imports are large but are we really serious about security of supply?

Supply:

- Separation technologies are technically challenging and expensive.
- Economic production of end products requires integrated process.
- Lots of "prospects" but can they be turned into economic mines?

Alaska Continues to be Ranked High for Mineral Investment:

Source: *Fraser Institute Annual Survey of Mining Companies 2017*

Alaska's Position:

- Alaska: 10/92 overall (was ranked 5th in 2013)
- For mineral potential: 5/91
- For uncertainty of existing regulations: 41/91

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Conclusions:

- Global demand for base metals will grow.
- New mine discovery will require much higher exploration investment.
- Alaska will remain a highly attractive region for mineral investment, from both resource potential and political favorability perspectives.
- Problematic governmental jurisdictions of today will be just as risky in 10 years.

Metal Price Outlook:

	Current LME	Long-Run Price Bank Consensus	2030 Price* HIG	Price Volatility** HIG
Copper:	$2.76/lb	$ 3.10/lb	$ 4.25/lb	35%
Zinc:	$ 1.16/lb	$ 1.10/lb	$ 1.30/lb	25%
Lead:	$ .87/lb	$ .95/lb	$ 1.00/lb	20%
Gold:	$1,203.30/oz	$ 1,335.00/oz	1,200.00/oz	15%

* In 2018 Constant Dollars ** Annual

Future Issues for Oil & Gas:

- **Global oil demand will continue to grow and is unlikely to peak before the 2040s-50s; wide-spread adoption of EVs not going to happen as fast as advocates claim.**
- **Oil demand will shift significantly from transport fuel to petrochemical manufacture.**
- **LNG export direct from North Slope to Europe and Asia with climate change.**
- **Possible/Probable breakup of OPEC.**

Fact: 100 million bbls/day = 35 billion bbls/yr.!