Developments and New Challenges for Base Metals: The Case of Copper, Zinc, Lead and Nickel

by

Mr. Carlos Risopatron
Director of Economics and Environment
International Copper Study Group (*), Lisbon Portugal

*presentation prepared with the assistance of the International Lead and Zinc Study Group and the International Nickel Study Group

The views expressed are those of the author and do not necessarily reflect the views of UNCTAD.
Developments and New Challenges for Base Metals: The Case of Copper, Zinc, Lead and Nickel

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Summary

1. Description of the Study Groups: Membership and Objectives

2. Global Use, Mining and Recycling of Refined Copper

3. Global Use, Mining and Recycling of Refined Lead and Zinc

4. World Mining, Scrap Use and Demand for Nickel

5. Regulatory Trends and Non Ferrous Metals Based Development

6. Role of China in the Use of Copper, Lead, Zinc and Nickel

7. World Metal Balances and Inventories 2013-2014

8. Metals Study Groups Activities 2014 and Publications
ICSG Membership

- Autonomous International Governmental Organization. **Active industry involvement.**
- Main source of **unbiased information** for governments, the public and the industry.
- Membership open to countries involved in copper production, use or international trade.
- **23 member countries and the EU.** 4 recent member states. **Non-members can attend as observers.**

Australia  France  Luxembourg  Serbia
Belgium  Germany  Mexico  Spain
Chile  Greece  Peru  United States
China  India  Poland  Zambia
European Community  Italy  Portugal  Russian Federation
Finland  Japan  Sweden
Autonomous International Governmental Organization.

Membership open to any country involved in lead and/or zinc production, usage, or trade.

30 members (>85% of global lead/zinc industry). **Key role in the industry.**

- Australia
- Belgium
- Brazil
- Bulgaria
- Canada
- China
- Finland
- France
- Germany
- India
- Iran
- Ireland
- Italy
- Japan
- Korea Rep.
- Mexico
- Morocco
- Namibia
- Netherlands
- Norway
- Peru
- Poland
- Portugal
- Russian Fed.
- Serbia
- South Africa
- Sweden
- Thailand
- United States
- European Union
International Nickel Study Group

- Autonomous International Governmental Organization.
- Co-located with ICSG and ILZSG resulting in **significant cost savings**
- Enhancement of market transparency in the nickel market.
- Active industry involvement. Forum for discussions on nickel. **15 members.**

Australia, Brazil, Cuba, European Union, Finland, France, Germany, Greece, Italy, Japan, Norway, Portugal, Russian Federation, Sweden, United Kingdom
2012 Global Copper Flows 25 Mt = 16.5 Mt Mine Refined + 3.6 Mt Scrap Refined + 4.9 Mt Direct Scrap.

Industrial use of copper trend 2007-2012: up just in China and a few oil economies.

### Fabrication of Copper and Copper Alloyed Products: 2012 Versus 2007

**million tonnes gross weight, other alloyed metals included**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>6.3</td>
<td>11.31</td>
<td>79.5%</td>
<td>ICSG</td>
</tr>
<tr>
<td>United States</td>
<td>2.94</td>
<td>2.17</td>
<td>-26.0%</td>
<td>ICSG</td>
</tr>
<tr>
<td>Germany</td>
<td>1.85</td>
<td>1.52</td>
<td>-17.7%</td>
<td>ICSG</td>
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<td>Japan</td>
<td>1.75</td>
<td>1.33</td>
<td>-23.9%</td>
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<td>Korean Republic</td>
<td>1.33</td>
<td>1.06</td>
<td>-20.2%</td>
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<td>Italy</td>
<td>1.75</td>
<td>1.03</td>
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<tr>
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<td>0.85</td>
<td>0.71</td>
<td>-16.4%</td>
<td>ICSG</td>
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<tr>
<td>Spain</td>
<td>0.34</td>
<td>0.32</td>
<td>-4.7%</td>
<td>ICSG</td>
</tr>
<tr>
<td>Poland</td>
<td>0.34</td>
<td>0.23</td>
<td>-31.4%</td>
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<td>France</td>
<td>0.54</td>
<td>0.19</td>
<td>-64.5%</td>
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<tr>
<td>India</td>
<td>0.71</td>
<td>0.64</td>
<td>-9.6%</td>
<td>Estimate</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>0.80</td>
<td>0.56</td>
<td>-30.2%</td>
<td>Estimate</td>
</tr>
<tr>
<td>Turkey</td>
<td>0.41</td>
<td>0.27</td>
<td>-34.0%</td>
<td>Estimate</td>
</tr>
<tr>
<td>Thailand</td>
<td>0.29</td>
<td>0.27</td>
<td>-5.6%</td>
<td>Estimate</td>
</tr>
<tr>
<td>Brazil</td>
<td>0.37</td>
<td>0.23</td>
<td>-38.4%</td>
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<tr>
<td>Indonesia</td>
<td>0.20</td>
<td>0.22</td>
<td>8.5%</td>
<td>Estimate</td>
</tr>
<tr>
<td>United Arab Emirates</td>
<td>0.00</td>
<td>0.21</td>
<td>100%</td>
<td>Estimate</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>0.19</td>
<td>0.21</td>
<td>8.4%</td>
<td>Estimate</td>
</tr>
<tr>
<td>Iran</td>
<td>0.19</td>
<td>0.20</td>
<td>7.5%</td>
<td>Estimate</td>
</tr>
</tbody>
</table>

**Sample of Countries** 21.1 22.7 7.4%

* 12 months before November 2012

In 2012 the industrial use of copper fell 2% worldwide: falling end uses, mainly in Europe.
In 2012-2013 more mine production caused copper oversupply and reduced prices. But ~840 Kt of these concentrates to stock. China reported +630 Kt of concentrate imported in 2013.

It might be not enough stock: 2015-2017 new copper mine capacity plans down 1.5 Mt-Cu on 2013 CAPEX cuts!
Observed industrial copper use up ~7.6% in 2013, up just ~2% out of China, partly led by lower prices. So in 2013 the industrial use of refined copper and copper scrap was not far than 27 Mt-Cu worldwide.

### Copper and Copper Alloy Products Semifabrication
Kt-Cu Copper Content, Surveys and Estimates

<table>
<thead>
<tr>
<th></th>
<th>2012</th>
<th>2013</th>
<th>Vol Change</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>9,408</td>
<td>10,600</td>
<td>1,192.0</td>
<td>12.7% Jan-Dec</td>
</tr>
<tr>
<td>United States</td>
<td>1,748</td>
<td>1,755</td>
<td>7</td>
<td>0.4% Forecast</td>
</tr>
<tr>
<td>Germany</td>
<td>1,209</td>
<td>1,235</td>
<td>26</td>
<td>2.2% Jan-Dec</td>
</tr>
<tr>
<td>Japan</td>
<td>1,073</td>
<td>1,084</td>
<td>11</td>
<td>1.1% Forecast</td>
</tr>
<tr>
<td>Korean Rep.</td>
<td>938</td>
<td>975</td>
<td>37</td>
<td>3.9% Forecast</td>
</tr>
<tr>
<td>Italy</td>
<td>834</td>
<td>845</td>
<td>11</td>
<td>1.3% Jan-Dec</td>
</tr>
<tr>
<td>Taiwan (China)</td>
<td>494</td>
<td>493</td>
<td>(1)</td>
<td>-0.2% Jan-Dec</td>
</tr>
<tr>
<td>Turkey</td>
<td>457</td>
<td>485</td>
<td>28</td>
<td>6.2% Jan-Dec</td>
</tr>
<tr>
<td>United Arab Emirates</td>
<td>285</td>
<td>375</td>
<td>90</td>
<td>31.4% Jan-Dec</td>
</tr>
<tr>
<td>Spain</td>
<td>258</td>
<td>250</td>
<td>(8)</td>
<td>-3.0% Forecast</td>
</tr>
<tr>
<td>India Wire Rod</td>
<td>330</td>
<td>306</td>
<td>(25)</td>
<td>-7.5% Forecast</td>
</tr>
<tr>
<td>Poland</td>
<td>263</td>
<td>251</td>
<td>(11)</td>
<td>-4.3% Jan-Dec</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>204</td>
<td>205</td>
<td>1</td>
<td>0.5% Jan-Dec</td>
</tr>
<tr>
<td>France</td>
<td>166</td>
<td>155</td>
<td>(10)</td>
<td>-6.2% Jan-Dec</td>
</tr>
<tr>
<td>Egypt</td>
<td>145</td>
<td>155</td>
<td>10</td>
<td>6.9% Jan-Dec</td>
</tr>
<tr>
<td>Iran</td>
<td>95</td>
<td>100</td>
<td>6</td>
<td>5.9% Jan-Dec</td>
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<tr>
<td>Oman</td>
<td>14</td>
<td>14</td>
<td>0</td>
<td>0.0% Jan-Dec</td>
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<tr>
<td>Kuwait</td>
<td>9</td>
<td>9</td>
<td>0</td>
<td>0.0% Jan-Dec</td>
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<tr>
<td>Morocco</td>
<td>1</td>
<td>-</td>
<td>(1)</td>
<td>Jan-Dec</td>
</tr>
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**Reported Ex-China**

<table>
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<tr>
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<th>2013</th>
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</thead>
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<tr>
<td></td>
<td>8,521</td>
<td>8,692</td>
<td>170.8</td>
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**All Reporting**

<table>
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<th>2012</th>
<th>2013</th>
<th>Vol Change</th>
</tr>
</thead>
<tbody>
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<td></td>
<td>17,929</td>
<td>19,292</td>
<td>1,362.8</td>
</tr>
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</table>
Recycled copper use <8.5 Mt-Cu in 2013. The global copper scrap shortage deepening in 2014. Why?

If the economic value of the metal is high enough, no much recycling regulation/enforcement needed.

Scrap Directly Melted by Fabricators 2013: 4.7 Mt-Cu

Copper Cathode Refined from Scrap 2013 = 3.8 Mt-Cu
The global demand for lead critically depends on recycling, mainly lead-acid battery scrap. America still #1 lead recycler. In China, vehicles, e-bikes, and 4G telcos are driving lead use up fast.

**World Refined Lead Demand 2012**

- **Asia Ex China**: 2,035, 20%
- **Europe**: 1,622, 16%
- **Americas**: 2,127, 20%
- **Africa/Oceania**: 119, 1%
- **China**: 4,479, 43%

**World Lead Mine Production (2012)**

- **China**: 53.9%
- **USA**: 6.9%
- **Mexico**: 4.5%
- **Peru**: 4.7%
- **Canada**: 4.5%
- **Australia**: 10.9%
- **Other**: 11.0%
- **Europe**: 7.1%

Lead supply constraints: slow lead mine capacity expansion, grades down. China remains #1 lead mine producer.
Zinc Demand Growth
China vs Rest of the World 2002-2013

Source: ILZSG

World Zinc Mine and Recycled Supply
Kt of Metal Content in 2012

- Zinc Scrap
  Direct Melt, 2500, 17%
- Recycled Zinc
  Refined Production, 822, 6%
- Zinc Mine Production, 11478, 77%

World Zinc Mine Supply 2012

- Europe 7.7%
- Canada 4.5%
- India 5.7%
- Peru 9.4%
- Other 25.6%
- Australia 11.1%
- China 36.0%

New Zinc Mine Capacity 2012

- Lady Loretta, Australia (new)
- Cerro Lindo, Peru (40kt expansion)
- Colquijirca, Peru (35kt expansion)
- Halfmile Lake, Canada (new)
- Langlois, Canada (reopening)
- Tizapa, Mexico (26kt expansion)
- Neves Corvo, Portugal (reopening)

12 New Zinc Mines and Expansions 2013-2014
World Refined Nickel Metal Flows 2013 = 1.8 Million Tonnes
68% of world nickel supply from 4 countries. 53% of demand from China
Just 22 Kt of refined nickel coming from scrap. Most recycled nickel from stainless steel scrap.

- China still relies on imports of refined nickel.
- Asia ex-China use more refined nickel than all Europe.
With high prices pre-2009, recycled nickel scrap provided 33% of world nickel uses.

**Source:** Nickel Institute 2008

Chinese imports of nickel ore from Indonesia and Philippines ended the shortage in 2009-2012. More nickel in the pipeline, but when? Massive CAPEX requirements and major technical difficulties.
Changes In Trade Regulations Cause Price Volatility And Can Reduce Global Non Ferrous Metals Mine/Scrap Supply

Indonesia - Local Content for Mineral Exports *
January - 2014

- nickel pig iron 4%
- ferro-nickel 10%
- Copper concentrate 15%
- manganese concentrate 49%
- lateritic iron 51%
- zinc concentrate 52%
- lead concentrate 57%
- ferro-manganese 60%
- manganese silica 60%
- chromium alloy 60%
- alumina; iron ore concentrate 62%
- nickel matte 70%
- sponge iron 75%
- bauxite - 90% chemical
- pig iron 90%
- alumina, 98% smelter
- gold 99%
- silver 99%
- chromium 99%
- tin metal 99.9%

* A progressive export tax will be implemented

Is China stainless steel production vulnerable in 2014? Or enough stocks?

Many opportunities to develop the Russian market for copper products in different sectors. Source: Metal Bulletin Copper Conference - Elkat

February 2014 Kazakhstan extended ban on export of scrap and ferrous metals waste to prevent a critical domestic shortage.
IMO: some metal ores cargo can be harmful to marine environment now.

Air quality and lead recycling:
- Mexico: 15 ug/dL
- US EPA: 1.5 ug/dL

USA → Mexico scrap battery exports: +500%

**Some Environmental Regulations Can Reduce World Metal Supply More than Others**

**Chile: New Emission Standard for Copper Smelters And Sources of Arsenic Emissions (H2SO4 Plants).**

**Law Published: 12/December/2013**

**Maximum Emission Limits**

- On Existing Sources
- At the End of the Transition Period*

<table>
<thead>
<tr>
<th>Plant</th>
<th>SO2</th>
<th>As</th>
<th>PM</th>
<th>Hg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chuquicamata</td>
<td>49,700</td>
<td>476</td>
<td>400 ppm</td>
<td>1 Mg/Nm3</td>
</tr>
<tr>
<td>Potrerillos</td>
<td>24,400</td>
<td>157</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caletones</td>
<td>47,680</td>
<td>130</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Altonorte</td>
<td>24,000</td>
<td>126</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ventanas</td>
<td>14,650</td>
<td>48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chagres</td>
<td>14,400</td>
<td>35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hernan Videla Lira</td>
<td>12,880</td>
<td>17</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Total          | 187,710 | 989 | 320,950 |

**Maximum Emission Levels**

- On Existing Sources
- Effective 12/December/2013

<table>
<thead>
<tr>
<th>Plant</th>
<th>SO2</th>
<th>As</th>
<th>PM</th>
<th>Hg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chuquicamata</td>
<td>96,500</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Potrerillos</td>
<td>89,500</td>
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<tr>
<td>Caletones</td>
<td>80,000</td>
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<tr>
<td>Altonorte</td>
<td>Regional Authority Law 193</td>
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<tr>
<td>Ventanas</td>
<td>16,500</td>
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<td>Chagres</td>
<td>13,950</td>
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<td>Hernan Videla Lira</td>
<td>24,500</td>
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</tr>
</tbody>
</table>

**Figure 2-10. Airborne Pb (TSP) concentrations, averaged across continuously operating monitoring sites: 1980-2002.**
Top Global Mining Companies
2012 Tax Payments as % Of Operational Revenues

Codelco
BHP Billiton Group
Newmont Mining Corp
Freeport-McMoRan
Norilsk Nickel
Barrick Gold Corp
Anglo American Plc
Rio Tinto Group
Vale SA

In 2002 China was still an exporter of refined lead and zinc. In 2014 it is the main importer of refined, ore and scrap copper, nickel, lead and zinc.
Instead of a rent from mineral exports, China invest in value added products using refined metal. Export taxes to raw materials and VAT tax rebates support valuable exports or inputs in short supply. Chinese export measures along the copper value chain: 2010

China Average Import Price Paid in USD per Tonne: Reported, January-June 2013.

China Copper and Alloy Semis Capacity ex Wire Mills 2012-2016 Kt

China March 2014: refined copper cheaper than scrap: 40% rebate on 17% VAT to China scrap processors (MOF)
Rapid urbanization and industrialization in China: key driver of non ferrous metal use growth globally in the past 10 years...

2002-2012 Joint Copper, Lead, Zinc and Nickel Demand Growth: China and Rest of the World. %

<table>
<thead>
<tr>
<th>China: Cu+Ni+Pb+Zn</th>
<th>World ex-China: Cu+Ni+Pb+Zn</th>
<th>Global Demand: Cu+Ni+Pb+Zn</th>
</tr>
</thead>
<tbody>
<tr>
<td>276%</td>
<td>-7%</td>
<td>33%</td>
</tr>
</tbody>
</table>

...and reason behind 4 base metals use up >12 million tonnes in 2002-2012

World Non Ferrous Metal Usage 2002-2012. Thousand Tonnes of Metal Kt

- **Copper Usage**: 25,356 Kt (2012), 20,260 Kt (2002)
- **Zinc Usage**: 12,300 Kt (2012), 9,381 Kt (2002)
- **Lead Usage**: 10,382 Kt (2012), 6,829 Kt (2002)
- **Nickel Usage**: 1,659 Kt (2012), 1,175 Kt (2002)
Global non ferrous use expansion is driven by copper, lead, zinc, and less by nickel.

Global mine supply response to higher Chinese demand: >10 million tonnes in 10 years.
The world uses more of the 4 metals, but less copper and nickel use outside China.

2002-2012: the growth of lead and zinc used outside of China was really marginal.
More stocks in metal exchanges now, but copper and nickel stocks very volatile. In 2013 copper left LME-COMEX and moved from Chinese refiners to Shanghai ports, sold-off in 2014.

Visible Refined Copper Inventories Kt-Cu.

February 2014: just 126 Kt on warrant in LME.
888 Kt-Cu in Shanghai warehouses

Nickel Exchange Stocks (LME)

Feb 2014: >126 Kt of nickel on warrant in LME

Zinc Exchange Stocks

Feb 2014: >582 Kt of Zinc on warrant in LME

Lead Exchange Stocks

Feb 2014: >171 Kt of lead on warrant in LME

Source: LME, SHFE, Comex. Citi @ Joint ICSG/INSG/ILSG
Refined Stocks On Warrant in LME in January 2014 as a % of Output:

- Copper 0.6%
- Lead 1.6%
- Zinc 4.5%
- Nickel 7.0%

* preliminary

Refined Stocks On Warrant in LME in January 2014 as a % of Output:

- Copper 0.6%
- Lead 1.6%
- Zinc 4.5%
- Nickel 7.0%

* preliminary

Refined Cu Stock Change June 2013 - February 2014

Refined Copper Exports Reported from China in 2012. Kt-Cu

Refined Copper Exports Reported from China in 2012. Kt-Cu

Official export data not always matching import data.

Small % of copper inventories in metal exchanges now.

Refined Exports Reported by China and Importers: Refined from China

- Korean Republic
- Malaysia
- Singapore
- Saudi Arabia
- Taiwan
- UAE
- Others
- Hong Kong
- Vietnam
- Thailand
- Belgium
- Netherlands
- Japan
- Egypt
- Brazil
- India
- Turkey
- Indonesia
- United Kingdom
- China
- South Africa
- United States

28
If we account changes in Shanghai port inventories: global copper deficit 2011-2013
No more global surplus of lead and zinc. Small nickel surplus ...to end in 2014?

- World refined copper balance
- World refined lead balance
- World refined zinc balance
- World refined nickel balance
With a growing world economy in 2013, recyclers and miners struggled to supply metal at low prices, so copper, zinc and lead markets in deficit.

ICSG, INSG, ILZSG 2013 World Balance and 2014 Refined Metals Forecast

<table>
<thead>
<tr>
<th>Million Tonnes of Refined Metal</th>
<th>2013</th>
<th>2013</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper*</td>
<td>21</td>
<td>21.3</td>
<td>-0.536</td>
</tr>
<tr>
<td>Zinc</td>
<td>12.9</td>
<td>13</td>
<td>-0.100</td>
</tr>
<tr>
<td>Lead</td>
<td>11.2</td>
<td>11.2</td>
<td>-0.040</td>
</tr>
<tr>
<td>Nickel</td>
<td>2</td>
<td>1.8</td>
<td>0.200</td>
</tr>
<tr>
<td>4 NFM 2013</td>
<td>47.1</td>
<td>47.3</td>
<td>-0.476</td>
</tr>
</tbody>
</table>

* Change in Shanghai bonded cathode stocks included

<table>
<thead>
<tr>
<th>Million Tonnes of Refined Metal</th>
<th>2014 F</th>
<th>2014 F</th>
<th>2014 F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td>22.3</td>
<td>21.9</td>
<td>0.435</td>
</tr>
<tr>
<td>Zinc</td>
<td>13.5</td>
<td>13.6</td>
<td>-0.040</td>
</tr>
<tr>
<td>Lead</td>
<td>11.7</td>
<td>11.7</td>
<td>-0.050</td>
</tr>
<tr>
<td>Nickel</td>
<td>1.93</td>
<td>1.89</td>
<td>0.047</td>
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<tr>
<td>4 NFM Forecast</td>
<td>49.43</td>
<td>49.09</td>
<td>0.392</td>
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</tbody>
</table>

• Will copper mine oversupply deepen in 2014?
• Will the global copper scrap shortage end in 2014?
• Will Indonesia ore ban allow a refined nickel surplus in 2014?
• Or ore stocks in Chinese ports, users and exchanges are enough?
• Will lead recycling flows allow a perfect global balance again?
• Will the expected zinc mine closures restrict supply? Or be delayed?
China urbanization rate >70% just in 4 regions. Below 50% in Central and West China. The plan: urbanize ~100 million people 2014-2020 = high metal end uses to continue.


2012 Data: 55% of Population in Rural Areas in 2010 (TWB)

China Future Power Grid

Urbanized population % by country as of 2006.

Copper and nickel cheaper now than 100 years ago: in “constant US dollars” and in gold.

Opportunity
Sovereign Funds Investments in Metals Can Reduce Price Super-Cycle Volatility:
Buying the Oversupply and Selling the Shortages.

1966-1973 > one kg of gold per tonne of copper. 1974-2014, < 200 grams of gold per tonne of copper.
Next Sessions
Copper and Nickel: 13-14 October 2014
Lead and Zinc: 16-17 October 2014
Join Metals Recycling Seminar: 15 October 2014
in Lisbon, Portugal

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