BENEFICIATION – National and African Mining Vision discourse

PRESENTATION BY

THE SECRETARY FOR MINES AND MINING DEVELOPMENT

PROF. F. P. GUDYANGA

7th ZIMBABWE MINING & INFRASTRUCTURE INDABA 2015
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IMPORTANCE OF MATERIALS IN SOCIETY

• Linked to all industries across the economy
• Minerals underpin downstream sectors
• Improve quality of life
• Future technological progress
• Improved environmental performance
  • Green energy
54 IMPORTANT MINERALS/MATERIALS

Aluminum, Antimony, Barytes, Bauxite, Bentonite, Beryllium, Borates, coking Coal, Chromium, Clays (and kaolin), Cobalt, Copper, Diatomite, Feldspar, Fluorspar, Gallium, Germanium, Gold, Gypsum, Hafnium, Indium, Iron ore, Limestone (high grade), Lithium, Magnesite, Magnesium, Manganese, Molybdenum, Natural Graphite, Natural Rubber, Nickel, Niobium, Perlite, Phosphate Rock, Platinum Group Metals, Potash, Pulpwood, Rare Earth Elements – Heavy, Rare Earth Elements – Light, Rhenium, Sawn Softwood, Scandium, Selenium, Silica Sand, Silicon Metal, Silver, Talc, Tantalum, Tellurium, Tin, Titanium, Tungsten, Vanadium, Zinc.
<table>
<thead>
<tr>
<th>Country</th>
<th>Materials produced</th>
<th>Total % of supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>48</td>
<td>30%</td>
</tr>
<tr>
<td>USA</td>
<td>36</td>
<td>10%</td>
</tr>
<tr>
<td>Russia</td>
<td>42</td>
<td>4.9%</td>
</tr>
<tr>
<td>Brazil</td>
<td>36</td>
<td>4.6%</td>
</tr>
<tr>
<td>Australia</td>
<td>34</td>
<td>4.0%</td>
</tr>
<tr>
<td>South Africa</td>
<td>26</td>
<td>3.9%</td>
</tr>
<tr>
<td>Chile</td>
<td>18</td>
<td>3.4%</td>
</tr>
<tr>
<td>Canada</td>
<td>30</td>
<td>3.2%</td>
</tr>
<tr>
<td>India</td>
<td>30</td>
<td>2.5%</td>
</tr>
<tr>
<td>Turkey</td>
<td>25</td>
<td>2.1%</td>
</tr>
</tbody>
</table>
CRITICALITY OF SOME MINERALS

• Importance of mineral to the economy
• Risk associated with supply
21 CRITICAL MINERALS/MATERIALS

Antimony, Beryllium, Borates, Chromium, Cobalt, Coking coal, Fluorspar, Gallium, Germanium, Indium, Magnesite, Magnesium, Natural Graphite, Niobium, PGMs, Phosphate Rock, Rare Earth Elements (REEs), Silicon Metal, Tantalum, Tungsten.
<table>
<thead>
<tr>
<th>Mineral/Metal</th>
<th>Uses or value added products</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Antimony (Kwekwe)</td>
<td>Flame retardants, alloys for batteries, plain bearings, solders, fiberglass composites</td>
</tr>
<tr>
<td>2 Beryllium (Kamativi)</td>
<td>Military applications, consumer electronics and telecommunications products, Alloys (CuBe), ceramics, aerospace, landing gears, medical devices</td>
</tr>
<tr>
<td>3 Chromium (Great Dyke)</td>
<td>Stainless steel (cutlery, sink etc.), chrome plating, white cast iron, foundry grade chromite.</td>
</tr>
<tr>
<td>4 Coking Coal (Hwange)</td>
<td>Steel production, alumina refineries, paper manufacturing, and the chemical and pharmaceutical industries (e.g. ammonia salts, nitric acid and agriculture fertilisers).</td>
</tr>
<tr>
<td>5 Fluorspar (Kamativi, Dande)</td>
<td>flux for smelting; in the production of glass and enamels; source of hydrogen fluoride; production of AlF$_3$ and cryolite (Na$_3$AlF$_6$), which are the main fluorine compounds used in aluminium smelting.</td>
</tr>
<tr>
<td>6 Magnesite (Kadoma, Zvishavane)</td>
<td>refractory material production for lining in blast furnaces, kilns and incinerators, binder in flooring material, catalyst and filler in the production of synthetic rubber and in the preparation of magnesium chemicals and fertilizers; In fire assay, magnesite</td>
</tr>
<tr>
<td></td>
<td>Natural Graphite (Karoi)</td>
</tr>
<tr>
<td>---</td>
<td>-------------------------</td>
</tr>
<tr>
<td>7</td>
<td>Niobium (Kamativi)</td>
</tr>
<tr>
<td>8</td>
<td>PGMs (Great Dyke)</td>
</tr>
<tr>
<td>9</td>
<td>Phosphate Rock (Dorowa)</td>
</tr>
<tr>
<td>10</td>
<td>Rare Earth Elements (Bikita, Kamativi, Mhangura, Mberengwa, Hwange, Mana Pools)</td>
</tr>
<tr>
<td>11</td>
<td>Silicon Metal (Rivers)</td>
</tr>
<tr>
<td>13</td>
<td>Tantalite (Kamativi, Bikita)</td>
</tr>
<tr>
<td>14</td>
<td>Tungsten (Hwange)</td>
</tr>
<tr>
<td>Nation</td>
<td>Goal</td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
</tr>
</tbody>
</table>
| Japan  | Secure a stable supply of raw materials for Japanese industries | Cobalt, **Nickel**, Manganese, Molybdenum, **REE**, **Tungsten**, Vanadium | • Substitution research  
• Exploration, excavation, refining and safety research |

To promote sustainable management, exploration, mining, processing and marketing of mineral resources for the benefit of all Zimbabweans.
<table>
<thead>
<tr>
<th>Nation</th>
<th>Goal</th>
<th>Key Materials identified for action</th>
<th>R&amp;D Activities</th>
</tr>
</thead>
</table>
| China  | Maintain a stable supply of raw materials for domestic use through industry consolidation, mitigating overproduction & reducing illegal trade | Antimony, Tin, Tungsten, Iron, Mercury, Aluminum, Zinc, Vanadium, Molybdenum, REEs | • Rare earth separation techniques & exploration of new functional materials  
• Rare earths: metallurgy; optical, electrical, magnetic properties; basic chemical sciences |
<table>
<thead>
<tr>
<th>Nation</th>
<th>Goal</th>
<th>Key Materials identified for action</th>
<th>R&amp;D Activities</th>
</tr>
</thead>
</table>
| South Korea  | Ensure a reliable supply of materials critical to Korean mainstay industries | Arsenic, Titanium, Cobalt, Indium, Molybdenum, Manganese, Tantalum, Gallium, Vanadium, Tungsten, Lithium, REEs | • Recycling end-use products  
• Designing for recyclability  
• Substitute materials  
• Production efficiency |
<table>
<thead>
<tr>
<th>Nation</th>
<th>Goal</th>
<th>Key Materials identified for action</th>
<th>R&amp;D Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Maintain investment in the mining industry &amp; fairly taxing the depletion of national resources</td>
<td>Tantalum, Molybdenum, Vanadium, Lithium, REEs</td>
<td>• Promote sustainable development practices in mining</td>
</tr>
<tr>
<td>Nation</td>
<td>Goal</td>
<td>Key Materials identified for action</td>
<td>R&amp;D Activities</td>
</tr>
<tr>
<td>---------</td>
<td>-----------------------------------------------------------------------</td>
<td>------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Canada  | Promote sustainable development & use of resources, protect the environment & public health, ensure attractive investment climate | Aluminum, Silver, Gold, Iron, Nickel, Copper, Lead, Molybdenum. | • Provide comprehensive geosciences information and infrastructure  
• Promote technological innovation in mining processes  
• Value-added mineral & metal products |
<table>
<thead>
<tr>
<th>Country</th>
<th>Stages of supply chain focused</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>Substitution research and exploration</td>
</tr>
<tr>
<td>China</td>
<td>Processing and metallurgy and export restrictions</td>
</tr>
<tr>
<td>South Korea</td>
<td>Recycling</td>
</tr>
<tr>
<td>Australia</td>
<td>Sustainable mining (depletion taxes)</td>
</tr>
<tr>
<td>Canada</td>
<td>Exploration</td>
</tr>
<tr>
<td>Russia</td>
<td>Material Stockpiling and export restriction</td>
</tr>
<tr>
<td>USA</td>
<td>Stockpile for strategic defence materials</td>
</tr>
</tbody>
</table>
AFRICAN MINERALS

• Exported as ores, concentrates or metals

• No downstream processing of value addition.

• Factored into economic planning of industrialised countries
SUB-SAHARA AFRICA SITUATION

• Free from conventional colonialism
• Poverty, hunger, diseases, civil wars
• Enormous resources of nature
• Unable to harness its resources of nature
S&T IN SUB-SAHARA AFRICA

• Lack of critical mass of human capital with appropriate knowledge and skills
• Lack of technology, infrastructure for innovation, entrepreneurship and incentives to innovate
• A skills gap prevails in Africa
SCIENCE AND TECHNOLOGY

• Main drivers of economic growth
• Distinguishes NORTH from the SOUTH
• Wide cap in economics is a science gap
• S&T defines the standard of a nation
• Country’s economic well-being corelated to its ranking in S&T
S&T TRAINING IN SUB-SAHARA AFRICA

Brain drain weakens position of S&T

Scientist/engineers per 1 million

• 100 in Sub-Saharan Africa
• 800 scientists/engineers in Asia (excluding Japan)
• 1,100 in industrialised countries
Africa is weak where it matters most – Innovation and Scientific capability for value addition

Vanguards of Country Stability

Primary Grade 1-7

High School Form 1-4

High School Form 5-6

FET Colleges

Univ undergrad

Masters

PhD

Science & Eng

Educated Generic Workforce

Increasing Level of Education

Fraction of population

Population

Specialised workforce

Artisans, etc

Innovators and knowledge-based economy drivers
The Origins of The AISTs

At a meeting in February 2001 the African leaders lamented the knowledge deficit in Africa. They went on to suggest that world class African Institutes of Science & Technology (AISTs) in sub-Saharan Africa were perhaps Africa’s greatest need. The concept was further pursued by some Africans both on the continent and in the diaspora.
OBJECTIVES OF AISTS (1)

• To catalyze the development of world class science and technology in Africa in ways that can stimulate economic growth and generate employment, and turn brain drain into brain gain;

• To provide the best facilities for post-graduate and post-doctoral studies and research;
OBJECTIVES OF AISTS (2)

• To bridge between research and industrial development through strong link with industry for technology transfer
AGREEMENT BY HEADS OF AFRICAN STATES IN JANUARY 2005 AT ABUJA

4 AISTs:

   *Energy and Petroleum Engineering*

2. East Africa: Arusha (Tanzania) 2008
   *Life Sciences (Bio-engineering and Agriculture)*

   *Water and Environmental Engineering*

4 Southern Africa: ????
*Minerals beneficiation and value addition*
BASIS FOR ZIMBABWE’S BID TO HOST PAMUST

• the country’s strength in mineral endowments,
• well-developed mining industry,
• strong commitment education in general by the leadership of Zimbabwe central location in Southern Africa
• easy accessibility and a well-developed infrastructure
ZIMBABWE AT THE CENTRE OF A MINING REGION: CENTRAL AND SOUTHERN AFRICA
ZIMBABWE’S BID TO HOST PAMUST

• COMESA support
• Zimbabwe then won the bid to host the Pan African Minerals University of Science and Technology. The Government of Zimbabwe is going to house PAMUST at the Scientific and Industrial Research and Development Centre (SIRDC), located in Harare, which already boasts a well-developed infrastructure spanning conference facilities, laboratories and communication networks.

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PAMUST: OUTPUT AND DELIVERABLES

• A critical mass of postgraduates is required to meet the mining sector needs in universities, R&D institutions, industry and government departments.

• (1200 Masters and 300 PhD will be enrolled annually when PAMUST is fully developed); This is still inadequate to serve the needs of the whole continent!
A Holistic National Framework for Value-Addition

Key value-addition focus areas

Industry
- Optimum Extraction
- Sustainable Extraction
- Value-addition

HEIs
- Human Capital Development
  - Research Chairs
  - Centres of Excellence
  - International collaborations

Government
- Strategic Support on key technologies
- Policy formulation

R&D Centres
- R&D
  - Multiplier effect on value addition
  - State-of-the-art infrastructure
  - International collaborations
5 AREAS OF PAMUST’s FOCUS

• Mineral Exploration
• Mining Engineering
• Advanced extractive processes
• Advanced mineral-based materials value addition
• Minerals Business Studies
PAMUST PILLARS

ECONOMIC GROWTH

DEVELOPMENT

MINERAL BENEFICIATION
AND VALUE ADDITION

GEOSCIENCES
MINING ENGINEERING
EXTRACTIVE METALLURGY
MATERIALS S.E.T.
MINERAL BUSINESS

Mineral Resources and Human Resources

NATIONAL SECURITY

JOBS
PAMUST FEATURES

• Postgraduate research programmes (Masters, PhD and post-doctoral.)
• Pan-African in its student, staff, Council composition
• World Class institution with the most advanced facilities
• Large numbers of postgraduate output
STEPS BY GOVERNMENT

• The Government approved the provision of adequate land for PAMUST at SIRDC, in Harare.

• The Cabinet approved the Principles for the PAMUST Bill which will evolve into the PAMUST ACT.

• The Attorney General’s Office is drafting the PAMUST Bill which will be debated and passed by Parliament eventually.

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His Excellency, President R.G. Mugabe, has approved the appointment of a 13-Member Foundation Committee to steer the establishment of this University.

The Minister of Mines and Mining Development inaugurated the Foundation Committee and announced its membership on Monday 27 July 2015 which is as follows:
Foundation Committee Membership

1. Professor Robson Mafoti Chairman
   • (CEO of SIRDC)

2. Professor Francis P. Gudyanga Co-Vice Chairman
   • (Secretary for Mines and Mining Development)

3. Ambassador Dr. M. Mapuranga Co-Vice Chairman
   • (Secretary for Higher and Tertiary Education, Science and Technology Development)

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Foundation Committee Membership

4. Professor Godfrey Dzinomwa Member
   • (Consulting Metallurgist)

5. Mr. Spencer G T Kahwai Member
   • (Research Fellow, Institute of Mining Research, UZ)

6. Professor Phinias M Makhurane Member
   • (Founding and Emeritus Vice Chancellor, NUST)

7. Mr. Herbert S Mashanyare Member
   • (Formerly Executive Director, Mimosa Mining Company)

8. Ambassador Dr. Mary M Muchada Member
   • (Deputy Chairman, Public Service Commission)

To promote sustainable management, exploration, mining, processing and marketing of mineral resources for the benefit of all Zimbabweans
Foundation Committee Membership

9. Professor Levi M Nyagura Member
   • (Vice Chancellor, University of Zimbabwe)

10. Professor Samson Sibanda Member
    • (Pro-Vice Chancellor, NUST)

11. Professor David J Simbi Member
    • (Vice Chancellor, Chinhoyi University of Technology)

12. Dr. Eng. Michael J Tumbare Member
    • (Chairman, Research Council of Zimbabwe and Chairman of the Department of Civil Engineering, University of Zimbabwe)

13. Air Vice Marshal T.M. Moyo
    (Commandant, National Defence College)

To promote sustainable management, exploration, mining, processing and marketing of mineral resources for the benefit of all Zimbabweans.
• Materials/ minerals play an irreplaceable role in society
• Some minerals are more critical than others
• Africa has enormous minerals resources
• Exported as raw material
• Zimbabwe hosts 14 of the 21 minerals considered critical to global economies
• Africa’s inability to harness its natural resources
• African Institutes of Science and Technology
• Zimbabwe is to host PAMUST
• The establishment of PAMUST this year coincides with the Chairmanship of His Excellency, President R.G. Mugabe, of the SADC and African Union.
It is morally unacceptable, geo-politically dangerous, environmentally unsustainable and economically unjustifiable for developing countries, like Zimbabwe, to continue to fuel the development of richer countries at the cost of their own present and future.
I THANK YOU!