Introduction

• Extractives: Oil & Gas + Mining (coal, metals, gems) + Quarrying (sand etc).

• Non-Renewable Resources (but importance of the ‘Circular Economy’: Recycling etc.).

• Renewable Resources (soils, forests, fisheries etc.) – avoid damage from extractives industries
Development Challenges
Extractives export dependence in Africa 1996-2014

**Averages**

- **Dependence 2014 = 58.9%**
- **Change since 1996 = 19 % points**

### Export Dependence 2014 (%)

- **Angola**: 84.1%
- **Nigeria**: 62.2%
- **Chad**: 57.6%
- **DRC**: 56.1%
- **Guinea**: 54.3%
- **Congo**: 53.2%
- **Botswana**: 51.0%
- **Sudan**: 50.9%
- **Gabon**: 46.9%
- **Zambia**: 46.9%
- **Mozambique**: 44.4%
- **Mauritania**: 43.1%
- **Niger**: 43.1%
- **Cameroon**: 42.9%
- **Rwanda**: 42.2%
- **Ghana**: 40.6%
- **Mali**: 40.1%
- **Sierr Leone**: 40.1%
- **Liberia**: 40.1%
- **South Africa**: 40.0%
- **Namibia**: 40.0%
- **Lesotho**: 40.0%
- **Erstrea**: 40.0%
- **Madagascar**: 40.0%
- **Senegal**: 40.0%
- **Togo**: 40.0%
- **Tanzania**: 40.0%
- **Zimbabwe**: 39.9%
- **Burkino Faso**: 39.9%
- **Cote d’Ivoire**: 39.9%

### Change in Dependence since 1996 (% points)

- **Angola**: -11.0%
- **Nigeria**: -14.4%
- **Chad**: -14.0%
- **DRC**: -13.9%
- **Guinea**: -13.6%
- **Congo**: -13.4%
- **Botswana**: -13.2%
- **Sudan**: -13.0%
- **Gabon**: -12.9%
- **Zambia**: -12.9%
- **Mozambique**: -12.8%
- **Mauritania**: -12.7%
- **Niger**: -12.7%
- **Cameroon**: -12.6%
- **Rwanda**: -12.4%
- **Ghana**: -12.3%
- **Mali**: -12.2%
- **Sierr Leone**: -12.2%
- **Liberia**: -12.2%
- **South Africa**: -12.2%
- **Namibia**: -12.2%
- **Lesotho**: -12.2%
- **Erstrea**: -12.2%
- **Madagascar**: -12.2%
- **Senegal**: -12.2%
- **Togo**: -12.2%
- **Tanzania**: -12.2%
- **Zimbabwe**: -12.2%
- **Burkino Faso**: -12.2%
- **Cote d’Ivoire**: -12.2%
Many African countries have huge unexploited resources

Example Guinea:
Guinea’s exceptionally high levels of reserves are nowhere near to being matched by its levels of bauxite production. For example, the world’s largest bauxite producer namely Australia has six times the Guinean level of annual production but reserves equal to only 65% of those located in Guinea.
Concentrated contributions of mining argues dilutes the benefit for many

FOREIGN DIRECT INVESTMENT
Mining FDI often dominates the total flow of FDI in less developed economies that have only limited other attractions for international capital

30% – 60%

EXPORTS
Mineral exports can rapidly rise to be a major share of total exports in less developed agrarian economies even when starting from a low base

GOVERNMENT REVENUE
Mineral taxation has become a very significant source of total tax revenues in many less developed economies that have limited tax raising capacity

3% – 20%

NATIONAL INCOME (GDP & GNI)
Modern-day mining is a capital-intensive industry – so it may account for only a small proportion of total national GDP and less for GNI

3% – 10%

EMPLOYMENT
This is also low – typically only 1-2% of total employment

1% – 2%
Policy Challenges: A Few (1)

- Taxation agreements with companies. National Oil Companies?
- Maintain other revenue sources (VAT, Property Taxes etc)

- What % of new revenues should be spent? On consumption v investment? (Candidates: social protection; public infrastructure).
- What % should be saved? & How?
- Volatile prices (so fiscal buffers to smooth public spending). Fiscal Rules (Chile)
- Liquid assets (US treasuries) to manage exchange rate
- Invest in higher return (but less liquid) assets to transfer % of wealth to future generations (Sovereign Wealth Fund)?
- But if investments today have good social returns won’t that make future generations richer? (e.g. educating today’s generation: then more productive)
Policy Challenges: A Few (2)

• Avoid ‘Dutch Disease’ (destruction of agriculture & non-extractive sectors)
• Avoid currency overvaluation; invest in agriculture & other non-extractive sectors (to diversify economy & exports).
• Local Content, Industrial Policy
• Borrow? (delay in arrival of revenues). Maybe (if good projects available)
• But contain expectations about spending (Hard Politics).
• Transparency in sovereign borrowing (& watch borrowing by corporate sector & national oil companies etc.)

• Fundamental: Build local capacity for analysis & project evaluation.
• Invest in good quality data collection to understand how the economy is changing & who gains (& loses).
Global Context

Opportunities & Risks
Low Carbon future will raise demand for metals & minerals

• Electric vehicles, batteries, grid storage, public transport
• Lithium, Cobalt, Nickel, Copper, graphite
• Recycling in richer countries, but limited stocks to recycle in developing countries
• Mining requires power (‘Green Mining’)
Battery Storage/Smart Grids
Internal Combustion Engine to Electric Vehicles
Cobalt requirements

Amount of cobalt in different devices

- **SMARTPHONE**: 5 to 10 grams (as heavy as 2 to 4 pennies)
- **LAPTOP**: 1 ounce (a slice of bread)
- **TYPICAL ELECTRIC CAR**: 10 to 20 pounds (2 to 3 gallons of milk)
# Cobalt – World Reserves

<table>
<thead>
<tr>
<th></th>
<th>Mine production</th>
<th>Reserves(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2015</td>
<td>2016(^b)</td>
</tr>
<tr>
<td>United States</td>
<td>760</td>
<td>690</td>
</tr>
<tr>
<td>Australia</td>
<td>6,000</td>
<td>5,100</td>
</tr>
<tr>
<td>Canada</td>
<td>6,900</td>
<td>7,300</td>
</tr>
<tr>
<td>China</td>
<td>7,700</td>
<td>7,700</td>
</tr>
<tr>
<td>Congo (Kinshasa)</td>
<td>63,000</td>
<td>66,000</td>
</tr>
<tr>
<td>Cuba</td>
<td>4,300</td>
<td>4,200</td>
</tr>
<tr>
<td>Madagascar</td>
<td>3,700</td>
<td>3,300</td>
</tr>
<tr>
<td>New Caledonia(^c)</td>
<td>3,680</td>
<td>3,300</td>
</tr>
<tr>
<td>Philippines</td>
<td>4,300</td>
<td>3,500</td>
</tr>
<tr>
<td>Russia</td>
<td>6,200</td>
<td>6,200</td>
</tr>
<tr>
<td>South Africa</td>
<td>3,000</td>
<td>3,000</td>
</tr>
<tr>
<td>Zambia</td>
<td>4,600</td>
<td>4,600</td>
</tr>
<tr>
<td>Other countries</td>
<td>11,600</td>
<td>8,300</td>
</tr>
<tr>
<td><strong>World total (rounded)</strong></td>
<td><strong>126,000</strong></td>
<td><strong>123,000</strong></td>
</tr>
</tbody>
</table>
Fossil Fuel Age to Renewables Age (Gas as an ‘energy bridge’)
Asia – LNG Market

Global liquefied natural gas imports
billion cubic feet per day

- Japan
- South Korea
- India
- China
- Taiwan
- other Asia
- rest of world

2015
Coal Retains Steady Share

Fuel shares in power generation

- Non-fossil
- Coal
- Oil and gas
Summing Up

- Coal to gas substitution in power generation. How fast?
- ‘Stranding’ (unburnable carbon) eventually. How Fast?
- In oil & gas: cut GHG emissions inc. methane, reduce environmental footprint.
- Recycling (circular economy) highly desirable – but only takes us so far
- Metals – transition to low-carbon economies (renewables etc) adds to demand
- Lags in mining investments. Environmental & Social Impact Assessment
- Clean Supply-Chains – minimum environmental impact. No child labour etc
Want to Know More?

- Open Access
- https://www.wider.unu.edu/publication/extractive-industries
- https://global.oup.com
www.wider.unu.edu

Helsinki, Finland