



**ENGINEERING SOLUTIONS FOR SUSTAINABILITY:
MATERIALS AND RESOURCES 3**

Toward a Circular Economy

February 18–19, 2017 | Denver, Colorado





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Session # 1: SUSTAINABLE DEVELOPMENT AND THE CIRCULAR ECONOMY

Challenges of a Global Circular Economy

Carol Russell and Deborah Shields



Global Circular Economy – raw materials including energy

A. Context and Risks

B. United Nations

C. World Economic Forum – Organisation for Economic Cooperation and Development (OECD)

D. European Union – European Innovation Partnership on Raw Materials 2016



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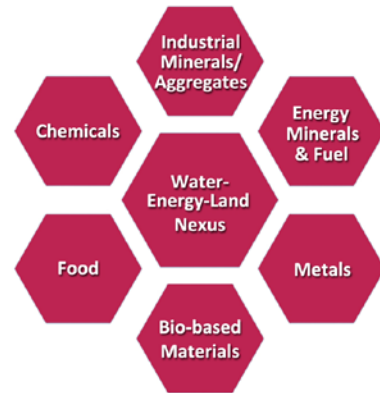


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For more information visit:
www.essmandr3.org



A circular economy requires:

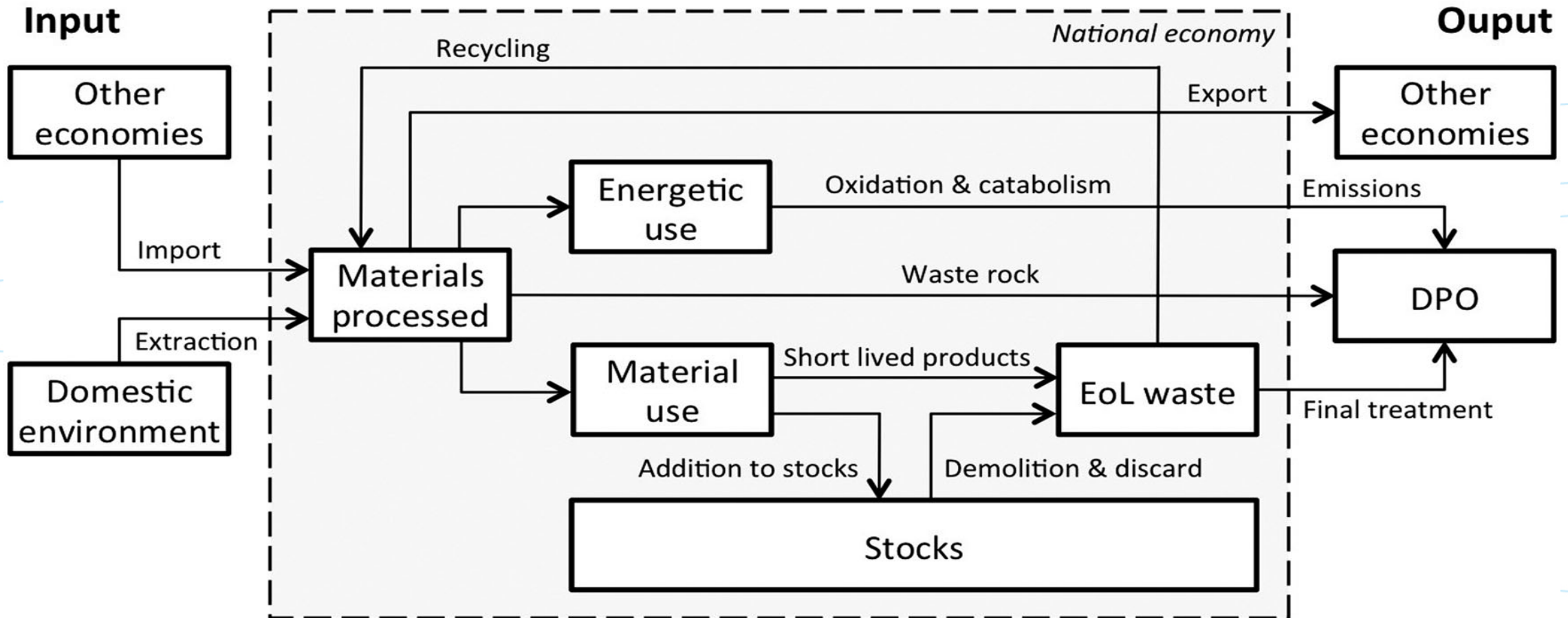
- Raw Material and Energy Inputs
- Feasible Engineering Solutions
- Cross-sectoral flows and linkages
- Effective Policy Measures
- Education and Research

The symposium and workshop will explore the interdependent roles each play in bringing about a sustainable future. The outcome of the event will be a vision for and roadmap to a sustainable world where affordable and reliable resources support the social, economic and environmental needs of a growing population.

A **circular economy** is an alternative to a traditional linear economy (make, use, dispose) in which we keep resources in use for as long as possible, extract the maximum value from them whilst in use, then recover and regenerate products and materials at the end of each service life.
Source: www.wrap.org.uk



How Circular is the Global Economy?



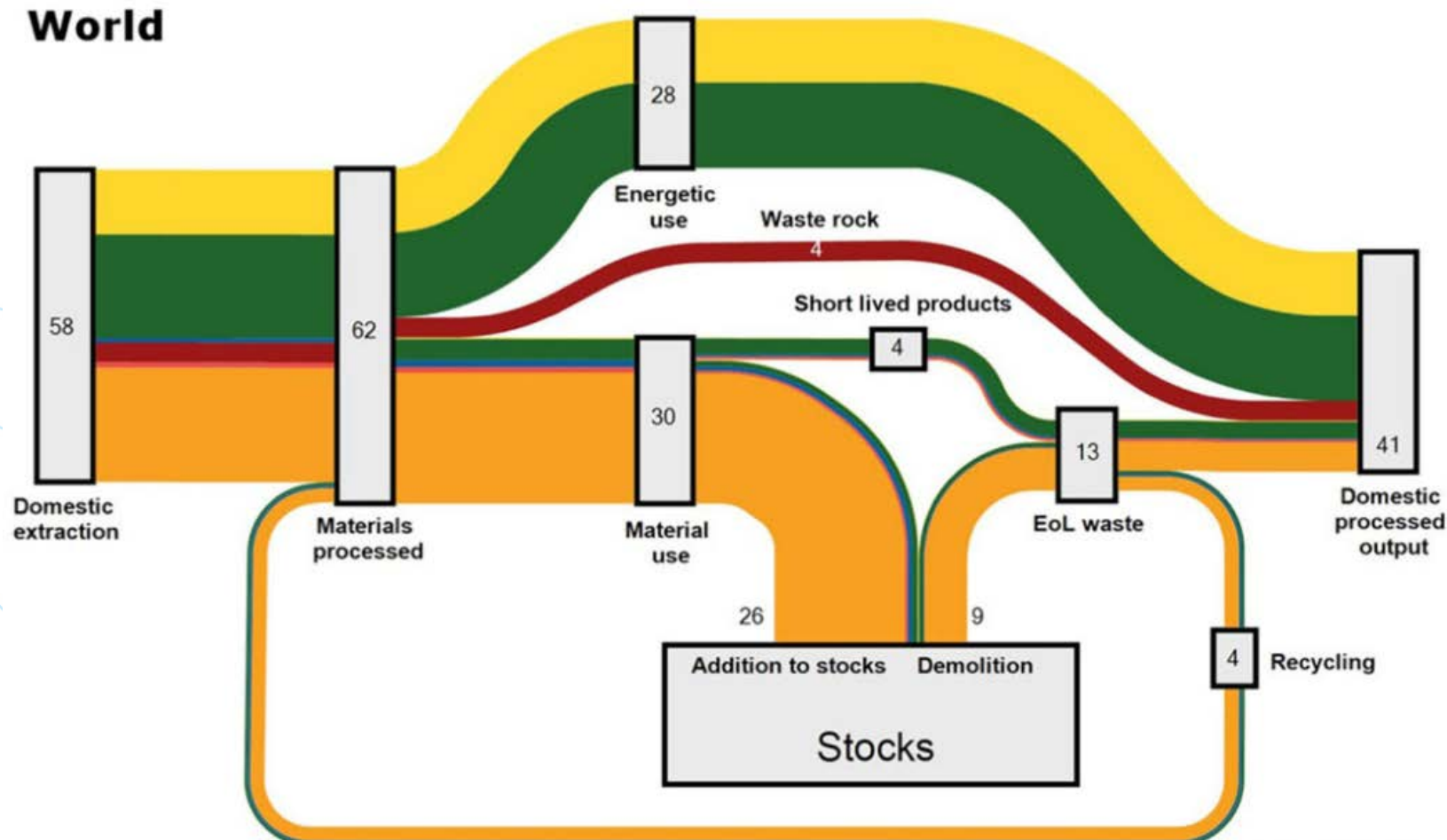
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Haas, W. 2015

Material Flows of the Global Economy



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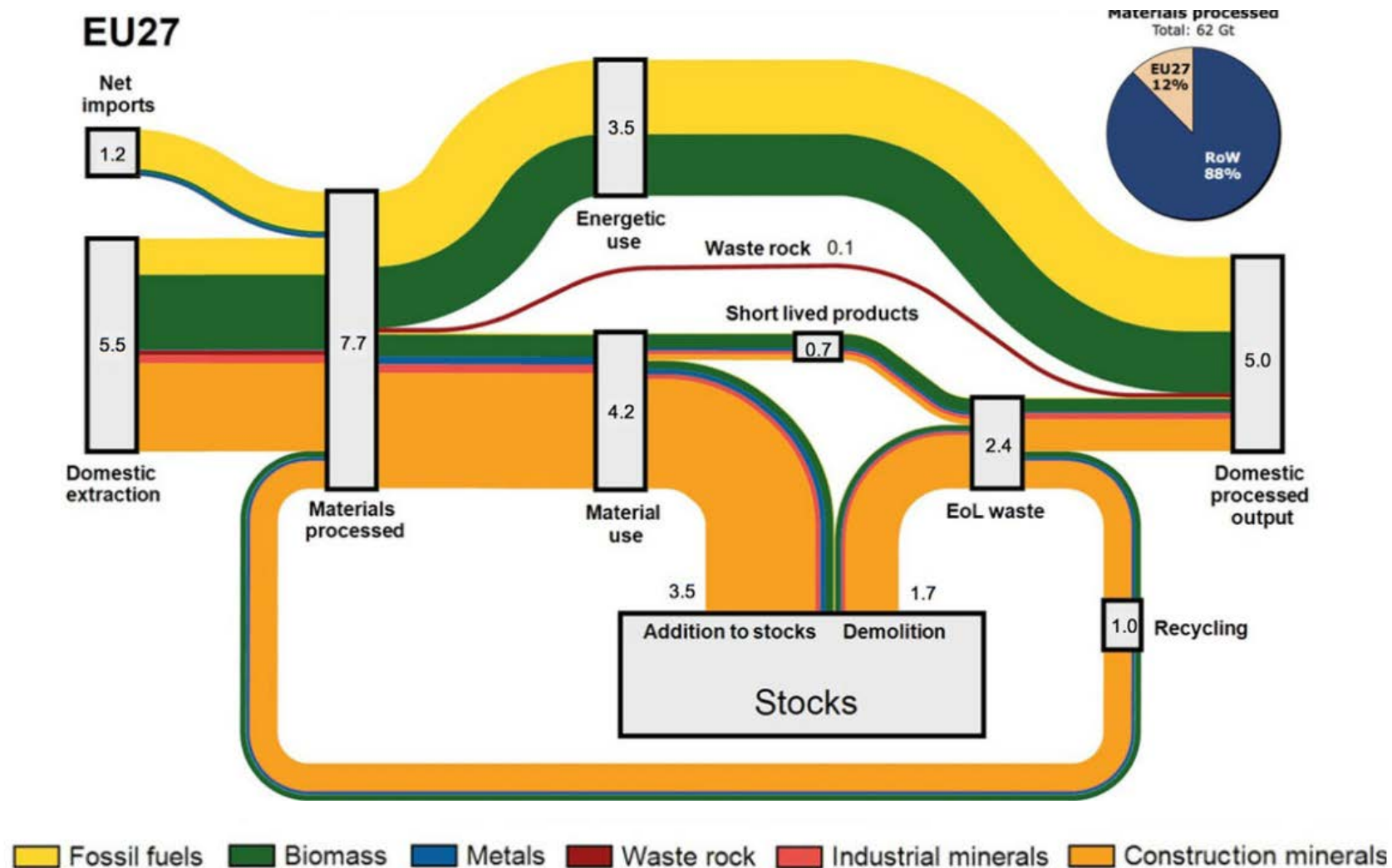
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Fossil fuels Biomass Metals Waste rock Industrial minerals Construction minerals

Haas, W. 2015

Material Flows in the European Union



Global Context and Risks

- “Done wisely, globalization could lead to unparalleled peace and prosperity. Done poorly, to disaster”. IMF



Research is Essential

Future Earth, an international science program seeking to generate knowledge and data for a sustainable world, has expressed concern that “a backlash against globalization and a rise in nationalist populism across the globe, along with anti-immigrant sentiment, are making it more difficult for scientists to conduct collaborative, international research”.

<http://www.futureearth.org/news/statement-research-integrity>.

Accessed Feb 2, 2017.

United Nations



1 NO POVERTY



2 NO HUNGER



3 GOOD HEALTH



4 QUALITY EDUCATION



5 GENDER EQUALITY



6 CLEAN WATER AND SANITATION



7 RENEWABLE ENERGY



8 GOOD JOBS AND ECONOMIC GROWTH



9 INNOVATION AND INFRASTRUCTURE



10 REDUCED INEQUALITIES



11 SUSTAINABLE CITIES AND COMMUNITIES



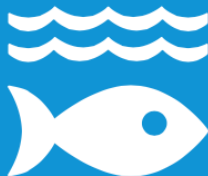
12 RESPONSIBLE CONSUMPTION



13 CLIMATE ACTION



14 LIFE BELOW WATER



15 LIFE ON LAND



16 PEACE AND JUSTICE



17 PARTNERSHIPS FOR THE GOALS



THE GLOBAL GOALS
For Sustainable Development



United Nations

Sustainable Development Goals

- 17 goals agreed by all 193 member nations in 2015
- Each relevant to the extractive industries





United Nations

Mining impacts six Sustainable Development goals most directly:

- SDG9 (Infrastructure, Innovation, and Industrialization)
- SDG8 (Employment and Economic Growth)
- SDG7 (Energy Access and Sustainability)
- SDG6 (Clean Water and Sanitation)
- SDG15 (Ecosystem and Biodiversity Protection)

Organization for Economic Cooperation and Development

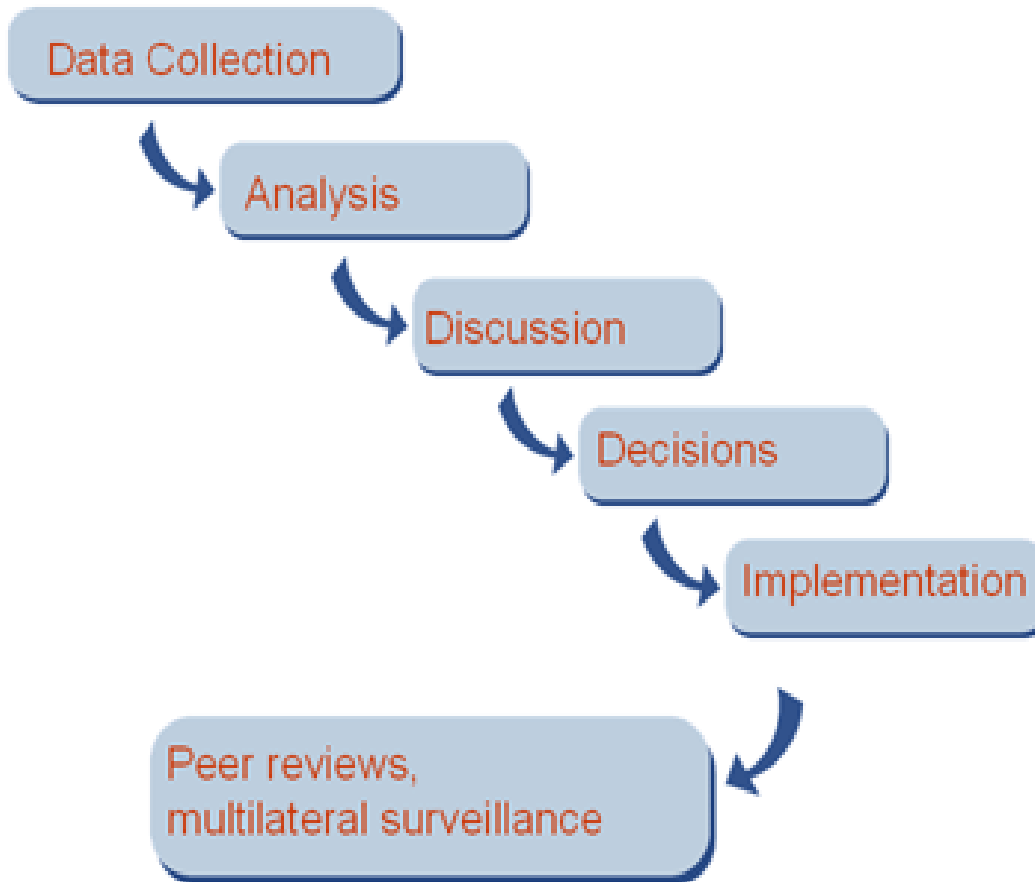
“Improving resource efficiency is among the top priorities in today’s world, as governments, businesses and civil society are increasingly concerned about natural resource use, environmental impacts, material prices and supply security”.



<http://www.oecd.org/env/indicators-modelling-outlooks/resourceefficiency.htm>

World Economic Forum – Organisation for Economic Cooperation and Development (OECD)

OECD's way of working



OECD - Exports of mineral commodities: Contributing to economy-wide growth?

- Almost all consumer goods contain products from the mining ... but no country is self-sufficient in these materials.
- Some minerals-exporting countries are highly dependent on these exports... but mining does not create many jobs.
- Some countries restrict exports of unprocessed minerals in an attempt to support or create a downstream processing industry that will create jobs, or simply to collect revenue for the government
- Some countries, such as Chile and Botswana, have leveraged their mineral resources for wider economic growth without resorting to trade restricting policies.
- Chile has implemented a transparent, stable, balanced regulatory framework that applies to all firms, in particular as regards tax, investment and trade policies.
- How revenue from the mining sector is spent is as important as how much is collected. Botswana has invested the entirety of the revenue collected from its large diamond reserves on the health and education of its people and on its physical infrastructure.
- Universal notification of the use of such trade policies would be a first step to reducing unpredictability in minerals markets.



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One requirement for successful circular approach is an understanding of what resources are available, where they are located and in what form, and how they flow through the economic system.

This is a challenging task not least because the world's economy has become increasingly globalized; it has fundamentally transformed technologically, economically, socially and politically. Supply chains may now run from mines in Brazil to manufacturing plants in China to consumer markets in the United States, and in some cases, to recycling facilities in yet another country.



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OECD - Measuring Material Flows and Resource Productivity

- The guidance provides an accessible guide to the measurement of material flows (MF) and resource productivity (RP) for those involved in constructing and interpreting such measures, including national statistical offices, relevant government agencies, policy analysts and researchers;
- and facilitate the dissemination and uptake of existing experience and guidance.
- Improve international harmonisation and convergence : although the documents are not prescriptive, they point out those areas in which harmonisation of methods is recommended so that results are coherent and can be used in international work.



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OECD – MFA Inventory

Teconomy-wide indicator development (21 countries)

Linking environmental and economic information (19 countries)

Supporting modelling and outlook activities (11 countries)

Informing decision making (10 countries) and as a basis for policy analysis (6 countries)

Informing the public and policy makers (12 countries) about key issues and trends

Monitoring the efficiency of material resource use (19 countries) and its sustainability at various levels (14 countries), often with a link to waste management policies (4 countries)

European Union

EU's raw materials diplomacy event, *European Innovation Partnership (EIP) on Raw Materials* June 28-29, 2016, in Brussels

- Raw Materials Initiative
 - Fair and sustainable supply of raw materials from global markets;
 - Sustainable supply of raw materials within the EU;
 - Resource efficiency and supply of "secondary raw materials" through recycling.
- Key actions include:
 - promoting sustainable production and sourcing;
 - promoting best practices for waste management and resource efficiency in industrial sectors and mining; facilitating industrial symbiosis; and
 - promoting durability, reparability and recyclability in eco-design.

European Innovation Partnership on Raw Materials June 28-29, 2016

Australia - Mining growing due to investment boom and industrialization in Asia.

Brazil – Innovation in hydrometallurgy to float all metals of interest (including REEs) rather than disposal in tailings (CETEM) and use of solvent extraction mini-plants.

Canada – TSM (Toward Sustainable Mining 2004) mandatory facility-based monitoring by external community of interest. Tailings failures huge issue.

Chili – Reduced mining (predominately copper) from 2006-2015 resulted in lower tax revenues, rising unemployment, and civil unrest.

Finland – Self regulated network for sustainable mining established in May 2014 based on Canada's TSM with sustainability standards.



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www.criticalrawmaterials.org/wp-content/uploads/2016/09/Conference-Report-on-Exchange-of-Best-Practices-on-Mining-Policies-and-Technologies-2016

Accessed 2/3/17 Page 8

European Innovation Partnership on Raw Materials cont.

Mexico – 80% of the tax resources from mining are spent on social, environmental and development projects in impacted areas 65% of the time.

Peru – Community roundtables draw up development plans to address investment in local communities.

South Africa – The country has been impacted by a drop in export earnings and a substantial decline in royalties. The African Mining Union endorses SD goals.

Sweden – EU funded project (ProSUM) systematic data collection on wastes: electronics, batteries, used cars and mining waste.

United States – USGS research into reprocessing sewage sludge for gold, silver and copper; -
-- Sulfide precipitation technologies for selective metal recovery by BioTec;
-- In situ leaching (ISL) in-situ uranium recovery;
-- Kennecott dewatering project provides treated water to a nearby city as drinking water.



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Conference Exchange of best Practices on mining policies and technologies:
challenges in the current status of the global economy – 28-29 June 2016



Conclusions

- **We live in ‘interesting’ times.**
- **The widely recognized need to shift to a circular economy may be made more challenging by the backlash against globalization.**
- **No one country can supply all their mineral needs and so we must trade, share information, and collaborate. Otherwise resource efficiency cannot be achieved.**
- **This includes the need for scientific and technical cooperation that will be essential to ensure that needed emerging technologies come to fruition.**