CIRCULAR ECONOMY FOR BETTER RESOURCE MANAGEMENT

INSTITUT JOZEF STEFAN

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Janez Potočnik

Co-Chair UNEP International Resource Panel (IRP)
The international resource panel was created in 2007 as a science-policy interface in responding to economic growth, escalating use of natural resources and deteriorating environment and climate change.
MISSION AND STRUCTURE

- INDEPENDENT AND AUTHORITATIVE SCIENTIFIC ASSESSMENTS OF POLICY RELEVANCE ON THE SUSTAINABLE USE OF NATURAL RESOURCES
- BETTER UNDERSTANDING OF HOW TO DECOUPLE ECONOMIC GROWTH FROM RESOURCE USE AND ENVIRONMENTAL DEGRADATION

SCIENTIFIC PANEL
- Internationally recognized experts on sustainable resource management
- Scientific assessments and advice, networks

STEERING COMMITTEE
- Governments
- Other Organizations and Associations
- Strategic guidance, political support, regional synergies

Science-policy interface

UNEP SECRETARIAT
- Direction, procedures, support in development and implementation of assessments, outreach
Assessing biofuels: towards sustainable production and use of resources (2009)
Priority products and materials: assessing the environmental impacts of consumption and production (2010)
Metal stocks in society: a scientific synthesis (2010)
Recycling rates of metals: A status report (2011)
Decoupling natural resource use and environmental impacts from economic growth (2011)
Metal Recycling: Opportunities, Limits, Infrastructure (2013)
Assessing Global Land Use: Balancing consumption with sustainable supply (2014)
Decoupling: Technological Opportunities and Policy Options (2014)
Managing and Conserving the Natural Resource Base for Sustained Economic and Social Development (2014)
Policy Coherence of the SDGs - A Natural Resource Perspective (2015)
10 Key Messages on Climate Change (2015)
Green Energy Choices: The Benefits, Risks and Trade-offs of Low Carbon Technologies for Electricity Production
Options for Decoupling Economic Growth from Water Use and Water Pollution (2016)
Rapid Assessment on Global resource efficiency prospects and economic implications (2016)
Food Systems and natural resources (2016)
Global Material Flows and Resource Productivity (2106)
Unlocking the Sustainable Potential of Land Resources (2016)
IN THE RECENT SIX MONTH ...
WORLD IN WHICH WE LIVE
20th CENTURY
THE GREAT ACCELERATION

• Growth of population by a factor 3.7
• Annual extraction of construction materials grew by a factor of 34, ores and minerals by a factor of 27, fossil fuels by a factor of 12, biomass by a factor of 3.6
• Total material extraction grew by a factor of 8
• GHG emissions grew by a factor of 13
• Globalisation
“PLANETARY BOUNDARIES”

Source: Steffen et al. 2015
21\textsuperscript{th} CENTURY
FACTS WE CAN NOT IGNORE

• Population growth (2050 - 9.7 billion)

• Per capita consumption growth (McKinsey estimates 3 billion consumers moving from low to middle class consumption till 2030)

• Example: China used more cement in the three years 2011-2013 than the USA used in the whole 20\textsuperscript{th} Century
21st CENTURY FACTS WE CAN NOT IGNORE

• **Poverty and social inequality** (Oxfam Report: 62 people own the same as half of the world and the richest 1% is more wealthy than the rest of the world)

• 60% of **ecosystems** already degraded or used unsustainably

• Increasing evidence of the **climate change threat**
INTERNATIONAL DEVELOPMENTS
SDGs offer unique opportunity to move to an integrated, universally relevant and potentially transformative Global Development Agenda.
12 SDGs ARE DIRECTLY DEPENDENT ON NATURAL RESOURCES
Sustainable Consumption and Production is the most efficient strategy to avoid trade-offs and create synergies to resolve the development and environmental challenges articulated in the SDGs.
SDGs DIRECTLY DEPENDENT ON NATURAL RESOURCES
IN THE RECENT SIX MONTH ...
• A coherent account of material use in the global economy and for every nation, complementary to the System of National Accounts
• A large data set covering 40 years (1970-2010) and most countries of the world.
• Presents direct and consumption-based material flow indicators, covering total usage, per capita use and material use per US$.
• Information will help identify opportunities, risks and vulnerabilities related to the global supply of primary materials and show the potential for efficiency gains and reductions in material use in the global economy
• Annual global extraction of materials grew from 22 billion tonnes in 1970 to around 70 billion tonnes in 2010
• Non-metallic minerals used in construction was the fastest growing group of materials

Figure 1. Global material extraction (DE) by four material categories, 1970-2010, million tonnes
Asia and the Pacific had the largest growth, especially China and Southeast Asia.

Growth in Asia and the Pacific reverberated in Latin America and Africa who supplied materials to Asia.

Figure 2. Domestic extraction (DE) by seven subregions, 1970-2010, million tonnes
• Trade has grown faster than domestic extraction and direct trade in materials has expanded fourfold since 1970
• Per capita global exports of materials doubled from 0.8 tonnes per capita in 1970 to 1.6 tonnes per capita in 2010

Figure 3. Global exports of materials by four material categories, 1970-2010, million tonnes
The new indicators of raw material equivalents of imports and exports show that trade mobilizes much greater amounts of materials than direct traded flows indicate.

In 2010, 30 billion tonnes of materials extracted globally were required to produce 10 billion tonnes of directly traded goods.

Figure 4. Raw material trade balance (RTB) by seven subregions, 1990-2010, million tonnes
- Growth in per capita income and consumption have been the strongest driver of growth in material use, even more important than population growth in recent decades.
Average material footprint of medium HDI countries has grown slowly over past two decades, reaching 5 tonnes per capita, while material footprint in low HDI countries has been stagnant for the past two decades at 2.5 tonnes per capita.

Figure 8. Per capita material footprint (MF) by HDI level, 1990-2010 (the HDI is a compound index on life expectancy, literacy and income)
If current systems of production and provision for major services will not be changed, nine billion people would require about 180 billion tonnes of materials annually by 2050, almost three times today’s amounts.
ECOLOGICAL FOOTPRINT (hectares per person per year)

Source: Global Footprint Network, 2012; UNDP, 2014a
Global economy now needs more materials per unit of GDP than it did at the turn of the century.

This has been caused by large shift of economic activity from very material-efficient economies such as Japan, the Republic of Korea and Europe to the much less material-efficient economies of China, India and Southeast Asia.

Figure 7. Material intensity by development status and global material intensity, 1970-2010
AND ...

SOLUTIONS
Decoupling is the imperative of modern environmental and economic policy.

- Human well-being
- Economic activity (GDP)
- Resource use
- Environmental impact

Resource decoupling
Impact decoupling
• **Developed economies** will need to adopt strategies that bring their resource consumption down to globally sustainable levels (**ABSOLUTE DECOUPLING**)

• **Developing nations** must strive to improve resource efficiencies and cleaner production processes as their net consumption of natural resources increases for a period until they achieve a societally acceptable quality of life (**RELATIVE DECOUPLING**).
IN THE RECENT SIX MONTH ...
“With concerted action, there is significant potential for increasing resource efficiency, which will have numerous benefits for the economy and the environment”
“Improving resource efficiency is indispensable for meeting climate change targets cost effectively”

Total anthropogenic GHG emissions (Gt CO2eq per year) by economic sector
CLIMATE

CARBON MANAGEMENT

LAND
WATER
GHG
MATERIALS

DECOUPLING

RESOURCES

LOW CARBON RESOURCE EFFICIENT ECONOMY
“Resource efficiency can contribute to economic growth and job creation”

Modelling results differ in size, but all of them show that increasing resource efficiency can lead to higher economic growth and employment, often even when environmental benefits are not accounted.
“There are substantial areas of opportunity for greater resource efficiency”

The top 15 categories of resource efficiency potential
“Increased resource efficiency is practically attainable”

Energy consumption and saving potential by equipment type in US mining industry
CIRCULAR ECONOMY
**PRINCIPLE 1**

Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows.

**PRINCIPLE 2**

Optimise resource yields by circulating products, components and materials in use at the highest utility at all times in both technical and biological cycles.

**PRINCIPLE 3**

Foster system effectiveness by revealing and designing out negative externalities.

Source: Ellen MacArthur Foundation; McKinsey Center for Business and Environment; Stiftungsfonds Für Umweltökonomie und Nachhaltigkeit (SUN); Drawing from Braungart & McDonough Cradle to Cradle (C2C)
Remanufacturing is a comprehensive and rigorous industrial process by which a previously sold, worn, or non-functional product or component is returned to a “like-new” or “better-than-new” condition.
BENEFITS OF REMANUFACTURING
CASE STUDY: CYLINDER HEAD

- GHG EMISSIONS: 50% LESS
- WATER USE: 90% LESS
- ENERGY USE: 80% LESS
- MATERIAL USE: 99% LESS
- LANDFILL SPACE: 99% LESS
**MOBILE PHONE ... OUR POCKET PARTNER**

- Wedding ring: 10 tonnes of gold ore
  10 kilos of mobile phones
- Less than 10% recycled
- In EU more than 100 mil each year in the drawers

2.4 tonnes of gold
25 tonnes of silver
1 tonne of palladium
900 tonnes of copper
**END OF LIFE RECYCLING RATE (GLOBAL) FOR 62 METALS**

UNEP EVALUATION JANUARY, 2010

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<thead>
<tr>
<th>Period</th>
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<td>Cs 55</td>
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<td>63</td>
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<td>Ba 62</td>
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<td>K 87</td>
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<td>Rf 104</td>
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</table>

* **Lanthanides**

  - La 57
  - Ce 58
  - Pr 59
  - Nd 60
  - Pm 61
  - Sm 62
  - Eu 63
  - Gd 64
  - Tb 65
  - Dy 66
  - Ho 67
  - Er 68
  - Tm 69
  - Yb 70
  - Lu 71

** **Actinides**

  - Ac 89
  - Th 90
  - Pa 91
  - U 92
  - Np 93
  - Pu 94
  - Am 95
  - Cm 96
  - Bk 97
  - Cf 98
  - Es 99
  - Fm 100
  - Md 101
  - No 102
  - Lr 103

Legend:
- **>50%**
- **>25-50%**
- **>10-25%**
- **1-10%**
- **<1%**
- **??**
STRUCTURAL WASTE IN THE MOBILITY SYSTEM

CAR UTILISATION
- 1% sitting in congestion
- 1.6% looking for parking
- 5% driving
- 92% of time the typical European car is parked
- Average European car has 5 seats but carries 1.5 people/trip

TANK-TO-WHEEL ENERGY FLOW - PETROL
- Engine losses
- Idling
- Rolling resistance
- Auxiliary power
- Transmission losses
- Aerodynamics
- 12:1 dead-weight ratio
- 86% of fuel never reaches wheels

DEATHS AND INJURIES/ YEAR ON ROAD
- 30,000 deaths in accidents
- 4X as many disabling injuries
- >95% of accidents from human error

LAND UTILISATION:
- 5% of land is used for motorways
- 50% of most city land is dedicated to streets and roads, parking, service stations, driveways, signals, and traffic signs
- Road reaches peak throughput only 5% of time and only 10% covered with cars then
A future end-state could look very different from today’s mobility situation

Illustrative vision

The car of tomorrow

- 3D printed
- Driverless
- Electric and silent propulsion
- Durable, upgradable and easily repairable
- Connected
- Long battery duration
- Designed for disassembly
- Remanufactured locally

The mobility system of tomorrow

- Low CO₂ level
- Renewable energy
- Parking spots returned to land
- Fewer lanes needed
- Wireless contents provided to the user
- Zero accidents
- Universal access and higher affordability
- Personalized multimodal route. Car preferred for last mile
- Shared cars is the norm: autonomous cars on demand
- Based on individual preferences (e.g. fast vs. cheap, sharing, etc.)

SOURCE: SUN, ELLEN MACARTHUR FOUNDATION AND MCKINSEY & COMPANY: TEAM ANALYSIS
ACTION PROGRAMME EU

• **ECO-DESIGN** to include reparability, durability, recyclability

• Legislation on **FERTILISERS**, including organic and waste-based fertilisers

• Minimum requirements for the **REUSE OF WASTEWATER**

• Actions on **GREEN PUBLIC PROCUREMENT**

• **FUNDING** of €650 million for ‘industry 2020 in the circular economy’

• Quality standards for **SECONDARY RAW MATERIALS**

• **STRATEGY ON PLASTICS**, including marine litter

• Interface **CHEMICALS, PRODUCTS AND WASTE LEGISLATION**
GROWTH WITHIN: A CIRCULAR ECONOMY VISION FOR A COMPETITIVE EUROPE
## The Resolve Framework

### RE(Generate)
- Reclaim, retain, and restore health of ecosystems
- Return recovered resources

### S(Hare)
- Share assets
- Reuse/secondhand
- Prolong life

### O(ptimise)
- Increase performance/efficiency of product, value chain, consumer
- Leverage big data, internet of things, etc to make product or value chain more intelligent

### L(oop)
- Remanufacture
- Recycle materials
- Repurpose renewable materials to other uses
- Extract biochemicals from organic waste

### V(irtualise)
- Direct dematerialisation, e.g., books, CDs, DVDs, travel, office space
- Indirect dematerialisation, e.g., online shopping, autonomous vehicles

### E(xplore)
- Advanced materials
- Different technologies
- Different product/service
- Renewable energy

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**Examples**

**REGENERATE**
- Nespresso
- Bunge
- Savory Institute

**SHARE**
- Airbnb
- Autolib'
- Nearly New Car by Mercedes-Benz
- Patagonia
- Bla Bla Car

**OPTIMISE**
- Toyota
- CISCO
- Wrap
- SAB Miller
- The Vauban Quartet

**LOOP**
- CAT
- Renault
- Winsun
- Veolia
- Patagonia
- Mazuma
- Dell

**VIRTUALISE**
- Google
- Netflix
- Kindle
- iTunes

**EXPLORE**
- Iberdrola
- SkyTrans
- Novo Nordisk
- Philips

**Source:** S. Heck and M. Rogers, “Resource Revolution: How to Capture the Biggest Business Opportunity in a Century”, 2014; Company interviews; Web search; Sun, Ellen MacArthur Foundation and McKinsey & Company team analyses.
COST REDUCTION POTENTIAL INHERENT IN BROAD CIRCULAR ECONOMY LEVERS

Total annual cash-out costs per household; EU average 2012, Euro, Improvement potential for the year 2050

<table>
<thead>
<tr>
<th>Mobility</th>
<th>Food</th>
<th>Built environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Today’s cost</td>
<td>~5,500</td>
<td>~6,600</td>
</tr>
<tr>
<td><strong>RE</strong>generate</td>
<td>6%</td>
<td>&lt;2%</td>
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<tr>
<td><strong>Share</strong></td>
<td>40%</td>
<td>2%</td>
</tr>
<tr>
<td><strong>Optimise</strong></td>
<td>&lt;5%</td>
<td>35%</td>
</tr>
<tr>
<td><strong>Loop</strong></td>
<td>5%</td>
<td>&lt;2%</td>
</tr>
<tr>
<td><strong>Virtualise</strong></td>
<td>25%</td>
<td>6%</td>
</tr>
<tr>
<td><strong>Exchange</strong></td>
<td>25%</td>
<td>&lt;2%</td>
</tr>
<tr>
<td>Remaining cost</td>
<td>60-80%</td>
<td>25-40%</td>
</tr>
</tbody>
</table>

1 Note that this is not a forecast of how costs will develop. It is an assessment of how costs could develop if Europe aggressively went after this agenda, and if all improvements were captured as cost savings.

SOURCE: SUN, ELLEN MACARTHUR FOUNDATION AND MCKINSEY & COMPANY TEAM ANALYSES REPORT
Achiving ‘Growth Within’
10 CE investment opportunities to accelerate Europe’s circular economy transition

<table>
<thead>
<tr>
<th>Description of next wave Circular Economy investment themes</th>
</tr>
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<tbody>
<tr>
<td><strong>Mobility</strong></td>
</tr>
<tr>
<td>Integrating mobility systems</td>
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<tr>
<td>• Fully integrate the public transport system with shared vehicles both digitally as well as through the upgrading of transport infrastructure</td>
</tr>
<tr>
<td>Case examples</td>
</tr>
<tr>
<td>DriveNow, MiMo, CLEVER</td>
</tr>
<tr>
<td><strong>Designing and producing circular cars</strong></td>
</tr>
<tr>
<td>• Design and produce cars made for looping with durable materials tracked E2E, that would also be made for sharing and/or using clean technologies</td>
</tr>
<tr>
<td>Case examples</td>
</tr>
<tr>
<td>BMW, ZF, Daimler, Ligier, Liabilities</td>
</tr>
<tr>
<td><strong>Ramping up car remanufacturing</strong></td>
</tr>
<tr>
<td>• Rollout remanufacturing of car components at scale</td>
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<tr>
<td><strong>Food</strong></td>
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<tr>
<td>Scaling regenerative agriculture</td>
</tr>
<tr>
<td>• Shifting towards an EU agricultural system that regenerates the soil and revitalizes ecosystems</td>
</tr>
<tr>
<td>Case examples</td>
</tr>
<tr>
<td>Syngenta, MilkFlex, SLM, Harvest, CSS, Forever</td>
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<tr>
<td>Closing nutrient loops</td>
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<tr>
<td>• Scaling nutrient and energy recovery from various waste streams, using anaerobic digestion, bioenergy and other technologies</td>
</tr>
<tr>
<td>Case examples</td>
</tr>
<tr>
<td>Aera, Bioenergy, Agri, CSS, Forever</td>
</tr>
<tr>
<td>Scaling urban farms</td>
</tr>
<tr>
<td>• Scaling hydroponic, aquaponic and aeroponic farms in urban areas</td>
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<tr>
<td>Case examples</td>
</tr>
<tr>
<td>Agricool, LF, Evergreen</td>
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<tr>
<td>Next-wave protein sources</td>
</tr>
<tr>
<td>• Provide options allowing for a dietary shift to more vegetable-based proteins, and to more efficient higher quality animal-based proteins</td>
</tr>
<tr>
<td>Case examples</td>
</tr>
<tr>
<td>Innova, Park2020, Novo Nordisk</td>
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<tr>
<td><strong>Built Environment</strong></td>
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<tr>
<td>Designing and producing circular buildings</td>
</tr>
<tr>
<td>• Design and produce multi-usage, highly modular and energy positive buildings made of durable non-toxic materials</td>
</tr>
<tr>
<td>Case examples</td>
</tr>
<tr>
<td>Syngenta, Novo Nordisk, Park2020</td>
</tr>
<tr>
<td>Looping buildings</td>
</tr>
<tr>
<td>• Ramp up recycling and remanufacturing of building materials</td>
</tr>
<tr>
<td>Case examples</td>
</tr>
<tr>
<td>Eneco, ReelDistricts, Energia</td>
</tr>
<tr>
<td>Scaling circular urban built environment</td>
</tr>
<tr>
<td>• Scale circular management of energy, waste, water and the open space using urban planning, information sharing and innovative technologies</td>
</tr>
<tr>
<td>Case examples</td>
</tr>
<tr>
<td>3M, Eneco, ReelDistricts</td>
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Source: SystemIQ
TO CONCLUDE ...
SUSTAINABLE, LOW-CARBON, CIRCULAR, GREEN, RESOURCE EFFICIENT, ENERGY EFFICIENT, DECOUPLING, 3Rs, C2C, ECOLOGICAL CIVILISATION, BIOECONOMY, ECO-ECONOMY, BLUE ...

• What we actually talk about
NEW ECONOMIC MODEL BASED ON SCP INTEGRATING ALL THREE PILLARS OF SUSTAINABILITY IS NECESSARY AND UNAVOIDABLE

WE HAVE TO FIX A BROKEN COMPASS (PAVAN SUKHDEV)
If prices do not reflect the true value and costs of resources,
If rewards to capital are disproportionate to other inputs,
If managers on annual contracts are induced to make short term investment decisions overly influenced by bonuses based on short term share price,
MARKETS AND REGULATION

• INNOVATION *(Incentives)*
• PRODUCTS *(Design)*
• CONSUMERS *(Behaviour)*
• BUSINESS MODELS *(Sharing - Products to services)*
1. **SCP SHOULD BE PRIORITY OF THE GOVERNMENT (NOT ONLY ENV):** Defined in the strategic documents, supported by indicators, monitoring, reporting and linked to the core economic policy decisions.

2. **ALL POLICIES SHOULD BE SYSTEMATICALLY ADJUSTED:** Beyond GDP, natural capital accounting, corporate sustainability reporting, tax policy, state aid, public procurement, product design, use of banking potential, R and D and innovation, investments in infrastructure, education, consumers awareness, new business models, support to SMS, etc.

3. **ACTIVE DIALOGUE WITH ALL STAKEHOLDERS IS NECESSARY:** Transition is only possible if we actively involve those loosing in the process of transition.
WE CAN NOT SOLVE OUR PROBLEMS WITH THE SAME THINKING WE USED WHEN WE HAVE CREATED THEM

INSANITY - DOING THE SAME THINGS OVER AND OVER AGAIN AND EXPECTING DIFFERENT RESULTS

ALBERT EINSTEIN

ABOUT OUR TIME ...

GIUSEPPE TOMASI DI LAMPEDEUSA

SDGs

EVERYTHING HAS TO CHANGE TO REMAIN THE SAME
THANK YOU

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