PHOSPHORUS
GLOBAL RESOURCES PERSPECTIVE
ESPP
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WORLD
IN WHICH WE LIVE
• 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)
52% of urban fabric expected to exist by 2050 still needs to be constructed
Between 2000 and 2030 it is estimated that developing countries would have added 400,000 km² of built-up urban area, equal to the world’s built-up area in 2000
In the three year period (2011-2013), China has used more cement than the USA during the entire 20th 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
THE GLOBAL GOALS
For Sustainable Development

1. NO POVERTY
2. ZERO HUNGER
3. GOOD HEALTH AND WELL-BEING
4. QUALITY EDUCATION
5. GENDER EQUALITY
6. CLEAN WATER AND SANITATION
7. AFFORDABLE AND CLEAN ENERGY
8. DECENT WORK AND ECONOMIC GROWTH
9. INDUSTRY, INNOVATION AND INFRASTRUCTURE
10. REDUCED INEQUALITIES
11. SUSTAINABLE CITIES AND COMMUNITIES
12. RESPONSIBLE CONSUMPTION AND PRODUCTION
13. CLIMATE ACTION
14. LIFE BELOW WATER
15. LIFE ON LAND
16. PEACE AND JUSTICE STRONG INSTITUTIONS
17. PARTNERSHIPS FOR THE GOALS
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 FEW MONTH ...

- **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**: Towards the Water-Resource-Limited Scenario
- **Resource Efficiency**: Potential and Economic Implications
- **Unlocking the Sustainable Potential of Land Resources**: Evaluation Systems, Indicators, and Tools
- **Food Systems and Natural Resources**: Regional and Global Impacts
- **Global Material Flows and Resource Productivity**: A Regional Case Study for the Latin American and Caribbean Region
• **Consumption** has been stronger driver of growth in material use than population growth

• **Since 2000 material efficiency has declined** - global economy needs more materials per unit of GDP. Production has shifted from material efficient countries to countries that have lower material efficiency

• **The richest countries** consume on average **10 times more materials** as the poorest

• **The level of well-being achieved in wealthy industrial countries** cannot be generalised globally based on the same system of production and consumption
DEVELOPMENT TRAJECTORY

Ecological footprint (hectares per person per year)

Source: Global Footprint Network, 2012; UNDP, 2014a
AND ... SOLUTIONS
Decoupling is the imperative of modern environmental and economic policy.
“Improving resource efficiency is indispensable for meeting climate change targets cost effectively”
CLIMATE

CARBON MANAGEMENT

LAND
WATER
GHG
MATERIALS

DECOUPLING

RESOURCES

RESILIENT SUSTAINABLE ECONOMY
1. Hunting and fishing

2. Can take both post-harvest and post-consumer waste as an input

Source: Ellen MacArthur Foundation; McKinsey Center for Business and Environment; Stiftungsfonds Für Umweltökonomie und Nachhaltigkeit (SUN); Drawing from Braungart & McDonough Cradle to Cradle (C2C)

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

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

3. **PRINCIPLE**
   
   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)
90-95% of world phosphate rock goes to agriculture, around 85% to fertilisers and 5-10% to animal feed.

Food system is therefore critical for P and P is critical for the food system.

Even if our focus today is on P in industry this fact cannot be ignored since it is influencing on the all P users and overall P availability.
IN THE RECENT FEW MONTH ...
Food systems are at the heart of the 2030 agenda for sustainable development

The food we grow, harvest, process, trade, transport, store sell and consume is the essential connecting thread between people, prosperity, and planet.
FOOD SYSTEMS DIFFER WIDELY GLOBALLY often interconnected - and depending on the same resources

Critical shifts No 8: Reconnect mineral flows between urban areas and rural areas, as well as between crop and livestock production
Concentrations within the Dutch food chain

Sustainable production processes need a new business plan. Production that pays attention to animal welfare, nature and landscape is in line with society's idea of sustainable food production. It does however lead to a higher cost price. Despite the social support for such a production process, it is still hard to turn a profit. Inventing new revenue models and creating new markets is a precondition for earning back the additional costs of production. These changes call for new organisational forms within the food chain, for example, through direct sales from farmers and horticulturalists to consumers. In addition, producers will need to convince consumers to not just look at the price, but consider sustainability as well.
NUTRIENT RECOVERY AND REUSE IN EUROPEAN AGRICULTURE
20 century: feeding the larger, better-fed, longer-living human population

Exponential growth in nutrient use is overwhelming the absorptive capacity of natural nutrient cycles

Nutrient use has relatively low efficiency and high leakage in 4 sectors:
- Fertilizing crops with manure and mineral fertilizers
- Feeding livestock and managing their waste
- Processing food and feeding humans
- Managing human waste

Four signs of this over-extended system:
- Eutrophication of waters (N and P)
- Pollution of air - nitrogen oxides, particulates, ammonia
- Greenhouse gases - nitrous oxide and methane
- Damage to terrestrial and aquatic/marine biodiversity
Large volumes, of highly dilute, heterogeneous, material
Continuous daily flows, multiple sources, spatially dispersed, but use of fertilizers is highly seasonal
Multiple decentralized, relatively small production units for recovery
Compared to fertilizers: relatively heterogeneous inputs and products
Safety concerns: presence of: heavy metals, pathogens, pharmaceuticals, smell, in products destined to be added to soil
Number of stakeholders involved
No presumption that the products of NRR are perfect substitutes for mineral fertilizers: price, consistency, nutrient content and availability
Workable business models not yet widely known
FIVE GOALS AND CONCERNS FOR NUTRIENTS

- Food Production
- Farm Viability
- Reduction and Recycling of Food Chain Waste
- Pollution of Water, Air, Soil and Impact on the Climate
- Dependence on Finite, Insecure, Non-Renewable Resources
NUTRIENT USE - MINERAL FERTILISERS, 1930 - 2015

Fertilizers Europe
PHOSPHORUS FLOWS IN THE EU27

ONLY 30% OF INPUT P REACHES HUMAN CONSUMPTION
THREE LARGEST SUBSTRATE FLOWS FOR NRR IDENTIFIED

• Animal manure
  o Improve handling, storage and application of manure
  o Process manure to more concentrated product
• Waste water and sewage sludge
  o Increase recovered amounts and recovery rates
  o Increase knowledge and specification of nutrient content
  o Address concerns about soil, plant and human health
• Food chain waste (e.g. Slaughterhouse waste)
  o Increase recovered amounts and recovery rates
  o Increase knowledge and specification of nutrient content
  o Address concerns about soil, plant and human health
1. Better data (2)
2. Regulatory coherence (1)
3. Appropriate policies to find optimal NRR contribution (5)
4. Back the circular economy action plan (3)
5. Consumer acceptance and land manager mobilization (4)
6. Optimal level of livestock production and consumption (1)
1. Waste and the growing leakage of nutrients into the environment are more important challenges of nutrients management and a more urgent threat to food sustainability/security than resource finiteness

2. Security/reliability of EU supply of P and natural gas may be a serious challenge
Phosphate rock is however **essential for a whole range of industries**

- Electronics - production of microchips
- Fire safety - replacing halogenated flame retardants
- Pharmaceuticals, Medical applications, Agrochemicals
- Food additives, for example non toxic food preservatives
- Catalyst and Chemicals
- Other new innovative applications with high potential for society, such as new compounds for batteries, safer than lithium ion
- ...
ESPP ROLE

ESPP is active in addressing phosphorous sustainability and phosphorous recycling in both:

- The *agri-food system*, in particular at present with the revision of the EU Fertiliser Regulation, phosphorous recycling from sewage, manure, and food industry by-product streams, and addressing improved phosphorous use in agriculture and livestock production
- *Industrial applications* of phosphorous
- It also *makes the link between the two worlds* of phosphorus (agricultural fertilisers, manure, sewage - and industrial):
  - technologies developing to recover P as high-quality industrial form;
  - links between agronomy, bio-chemistry, medicine, industrial chemistry
TO CONCLUDE ...
SUSTAINABLE, LOW-CARBON, CIRCULAR, GREEN, RESOURCE EFFICIENT, ENERGY EFFICIENT, DECOUPLING, 3Rs, ECOLOGICAL CIVILISATION, C2C, 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)
21st CENTURY

FROM FRAGILITY TO SUSTAINABILITY
INCREASED RESPONSIBILITY
MARKETS CANNOT ENSURE EFFICIENCY IN THE ALLOCATION AND USE OF RESOURCES ...

• If prices do not reflect the true value and costs of resources,
• If rewards to capital are disproportionate to other inputs (financial capital is overvalued, human capital is undervalued and natural capital in many cases not valued at all)
• If managers on annual contracts are induced to make short term investment decisions overly influenced by bonuses based on short term share price,
• If ...
Better regulation is not about less regulation, it is about creating the conditions for confidence to invest in technologies for the markets of the future, coupled with appropriate incentives to make the markets viable.
• KNOWLEDGE (Creation)
• INNOVATION (Incentives)
• PRODUCTS (Design)
• CONSUMERS (Behaviour)
• BUSINESS MODELS (Sharing Products to services)
Any global transition is a major new opportunity for the innovation, new development opportunities, new jobs.

And alternative …

I would rather not think and talk about it!
THANK YOU

www.unep.org/resourcepanel