Circular economy

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TIPS Development Dialogue
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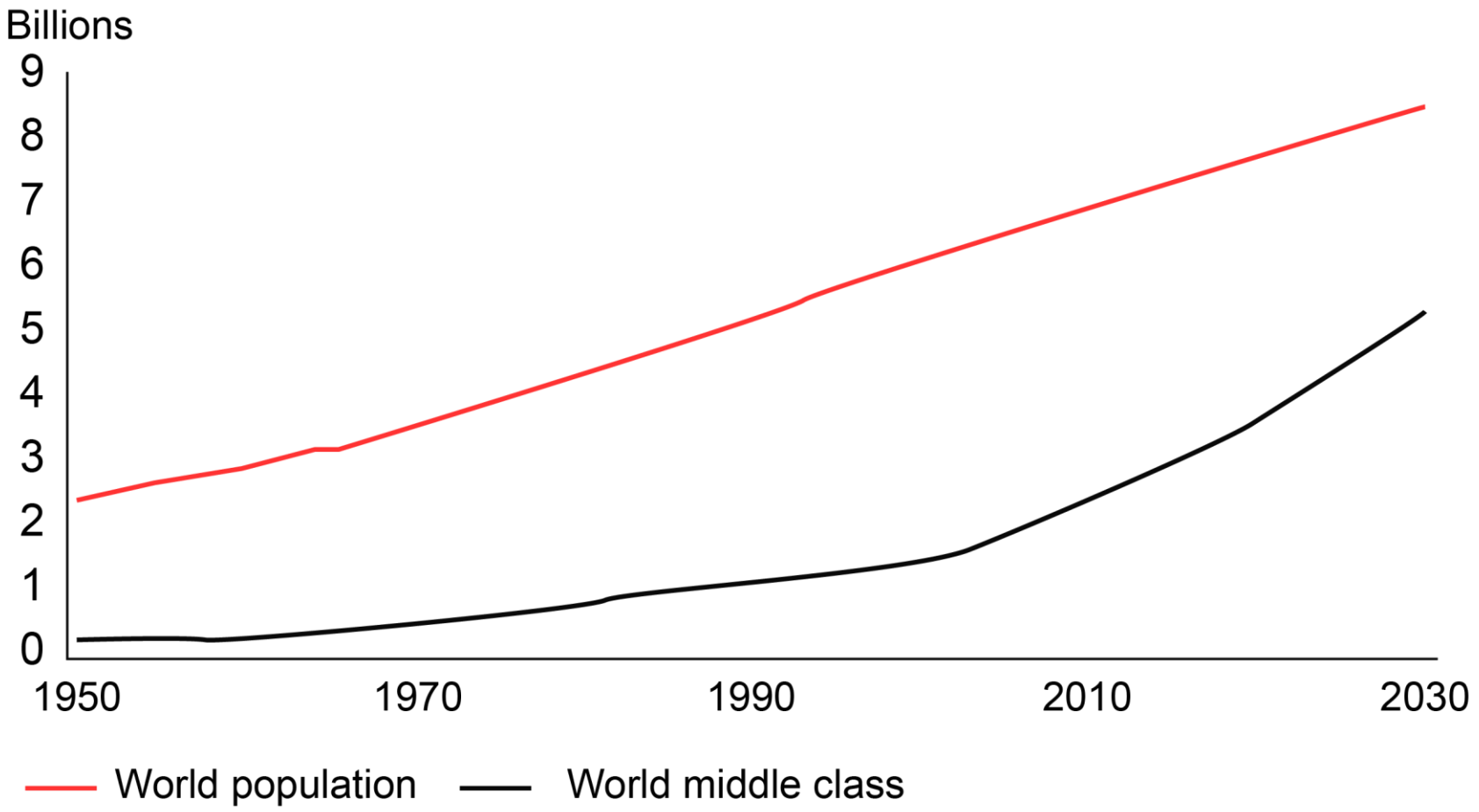
Outline

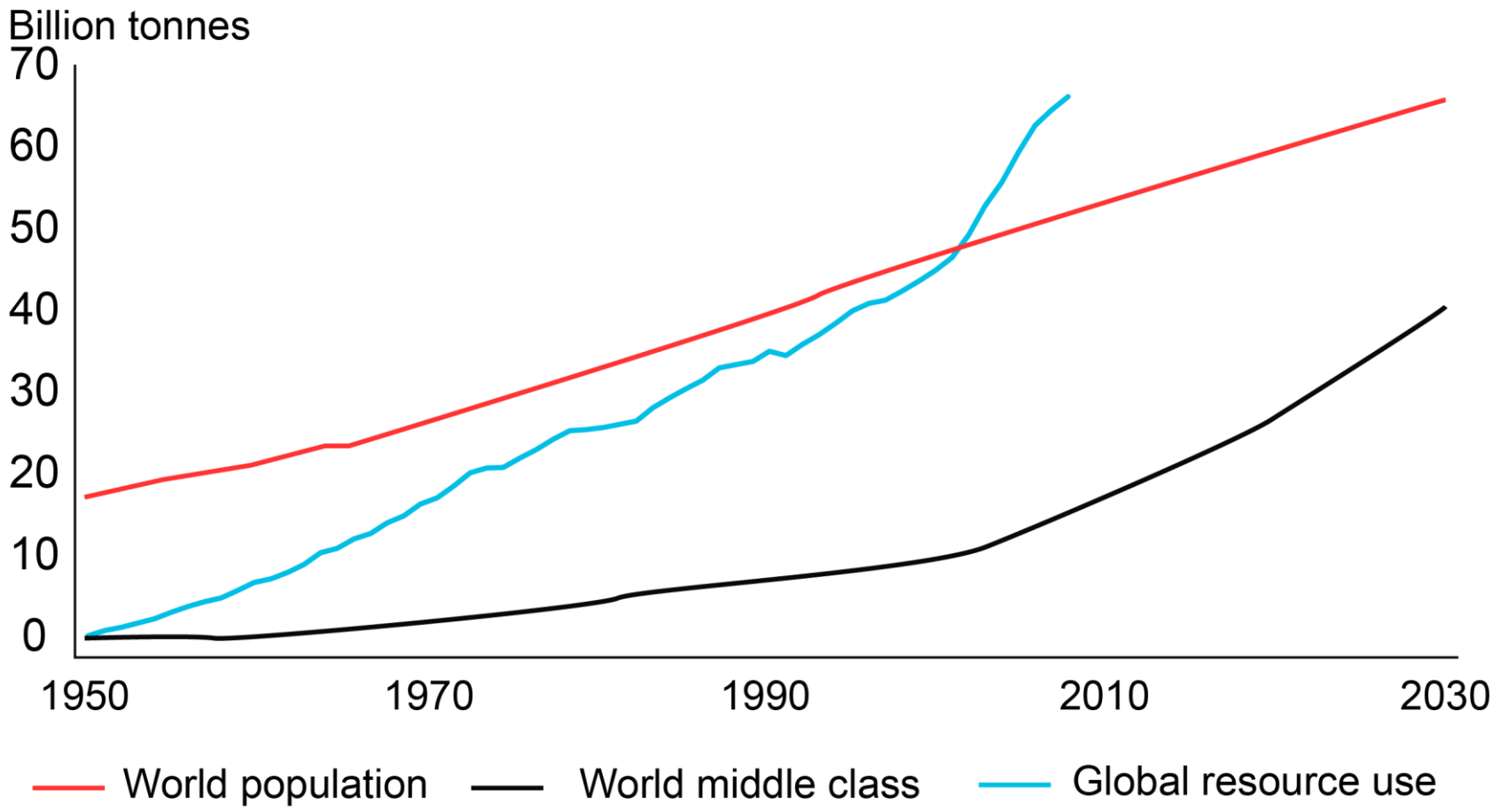
- Global trends in resource supply and demand
- What are we consuming?
- What are governments doing?
- What is new with “circular economy”?
- What are businesses doing?
- Discussion on implications for developing countries

Resource supply and demand

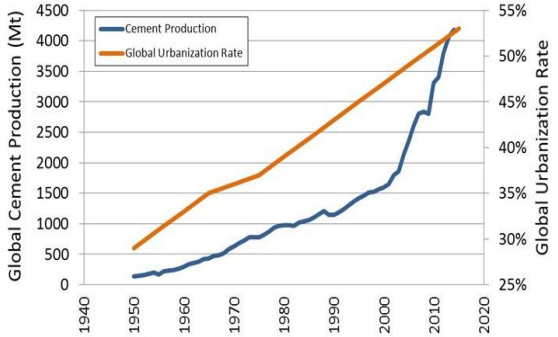
World population

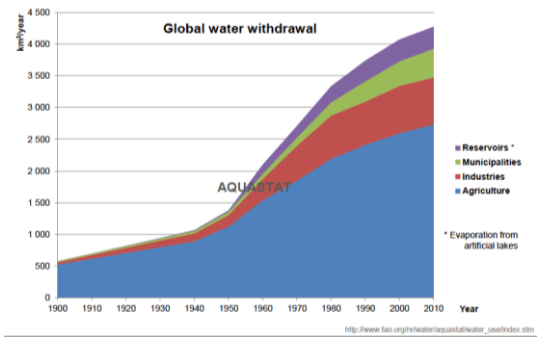


World population and resource use

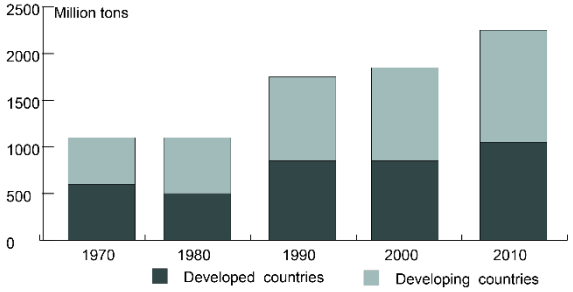


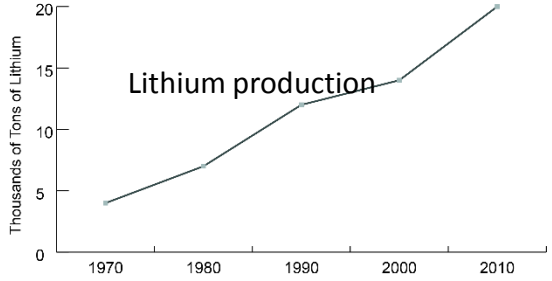
Our consumption is skyrocketing!



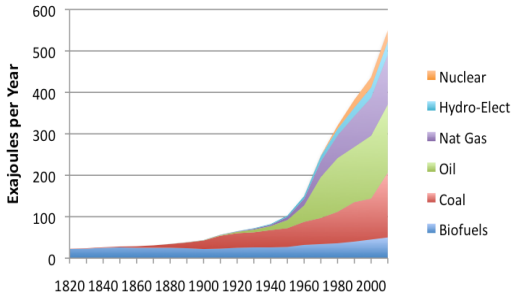


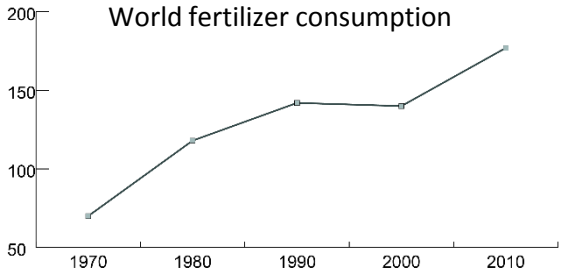
Cereal production

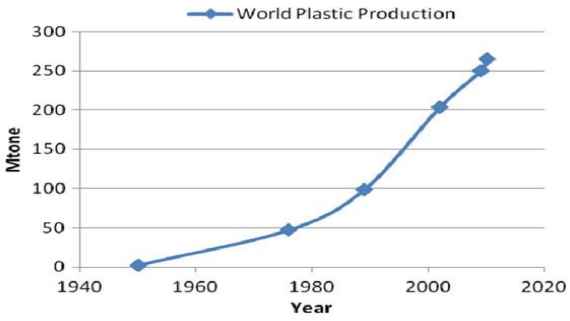


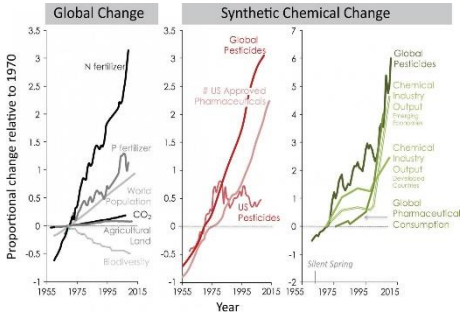


World Energy Consumption





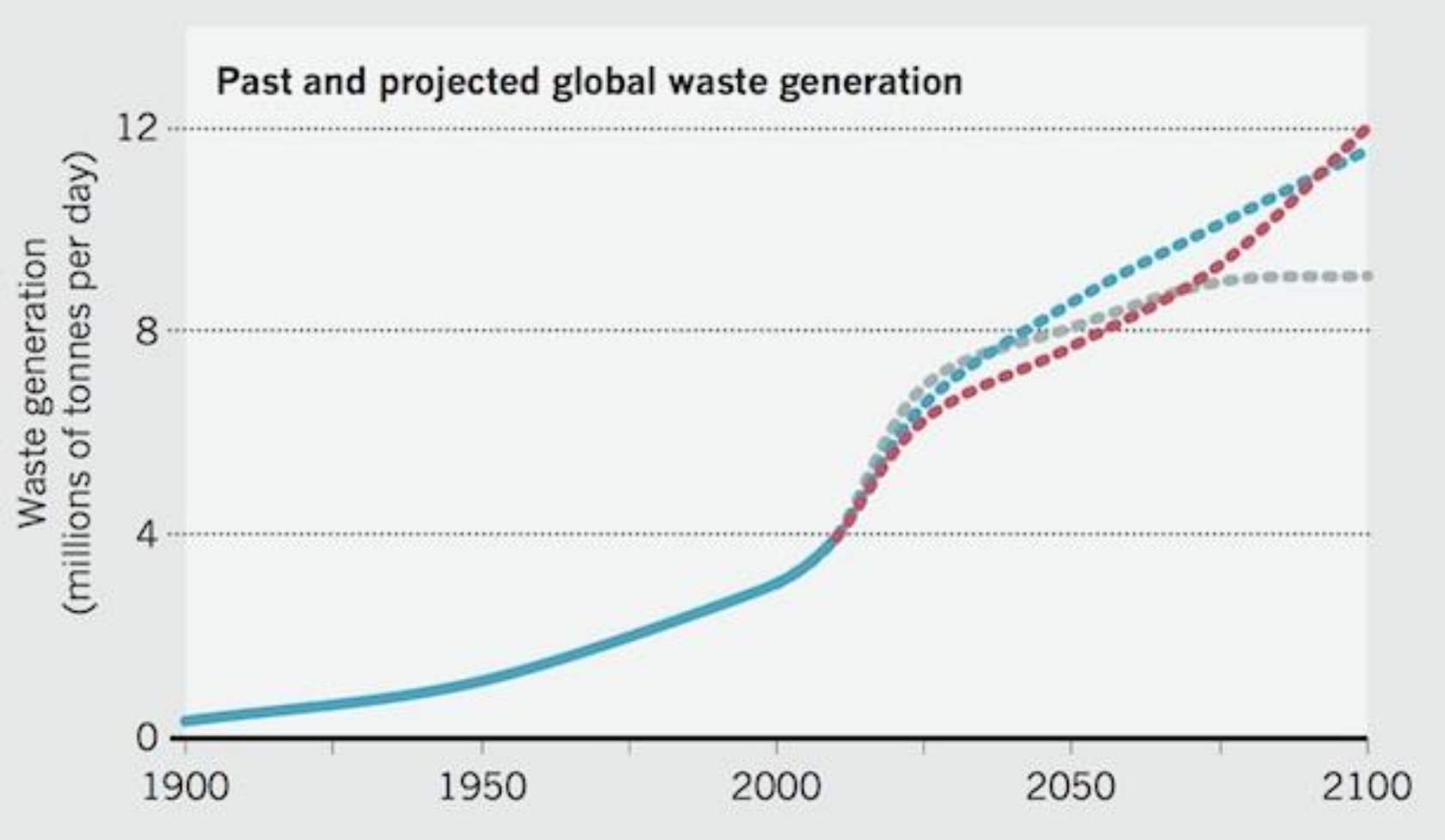




Our cities are almost unlivable!

But, more than 50% of urban fabric expected to exist by 2050 still needs to be constructed

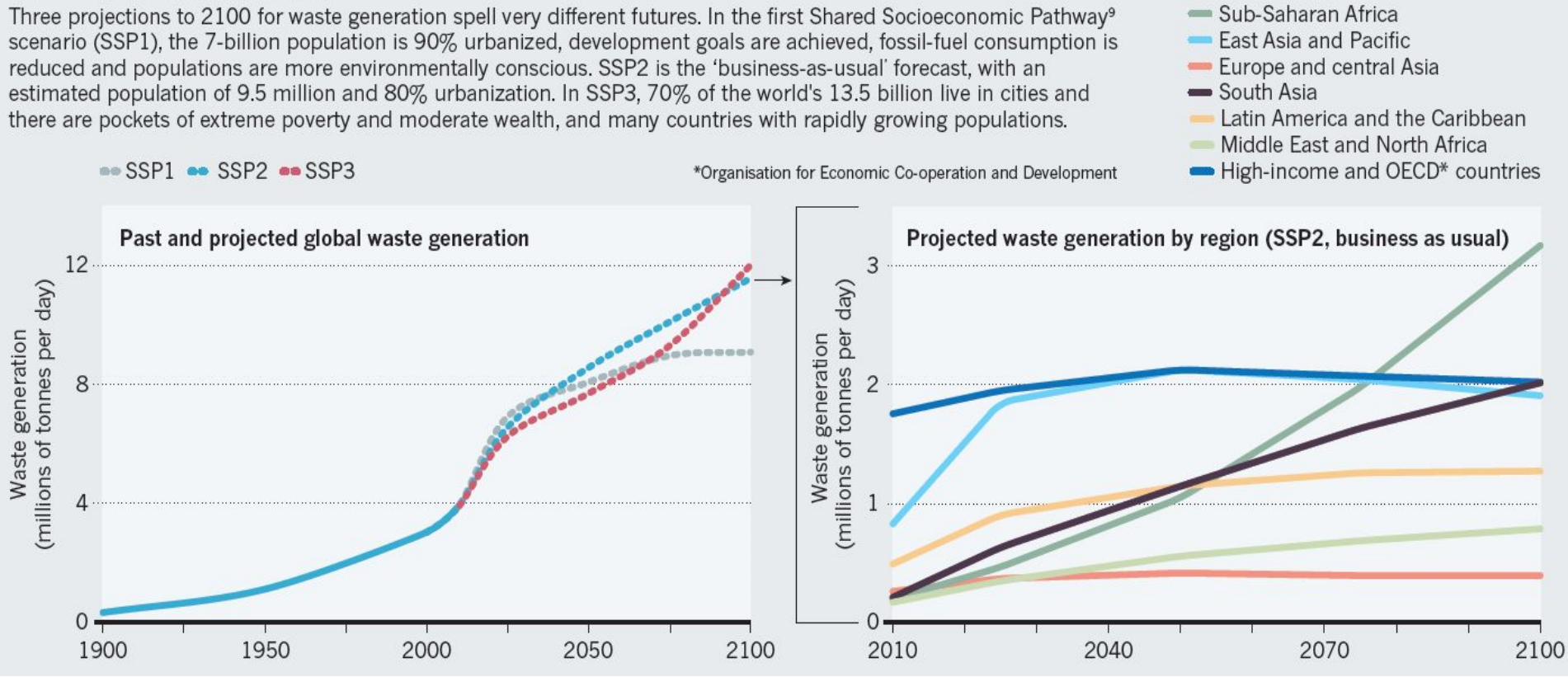
Global waste generation



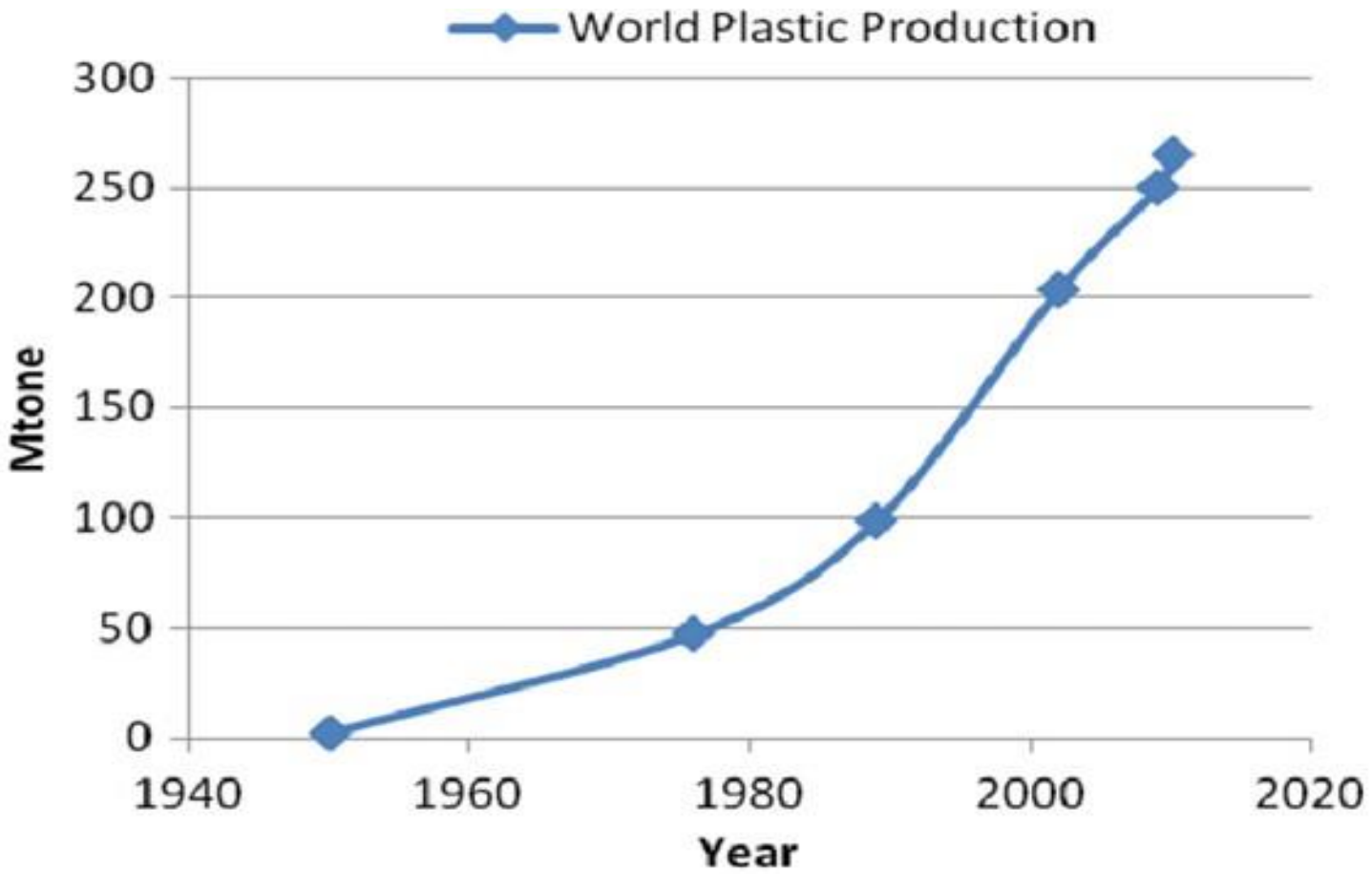
Global waste generation

WHEN WILL WASTE PEAK?

Three projections to 2100 for waste generation spell very different futures. In the first Shared Socioeconomic Pathway[9] scenario (SSP1), the 7-billion population is 90% urbanized, development goals are achieved, fossil-fuel consumption is reduced and populations are more environmentally conscious. SSP2 is the 'business-as-usual' forecast, with an estimated population of 9.5 million and 80% urbanization. In SSP3, 70% of the world's 13.5 billion live in cities and there are pockets of extreme poverty and moderate wealth, and many countries with rapidly growing populations.

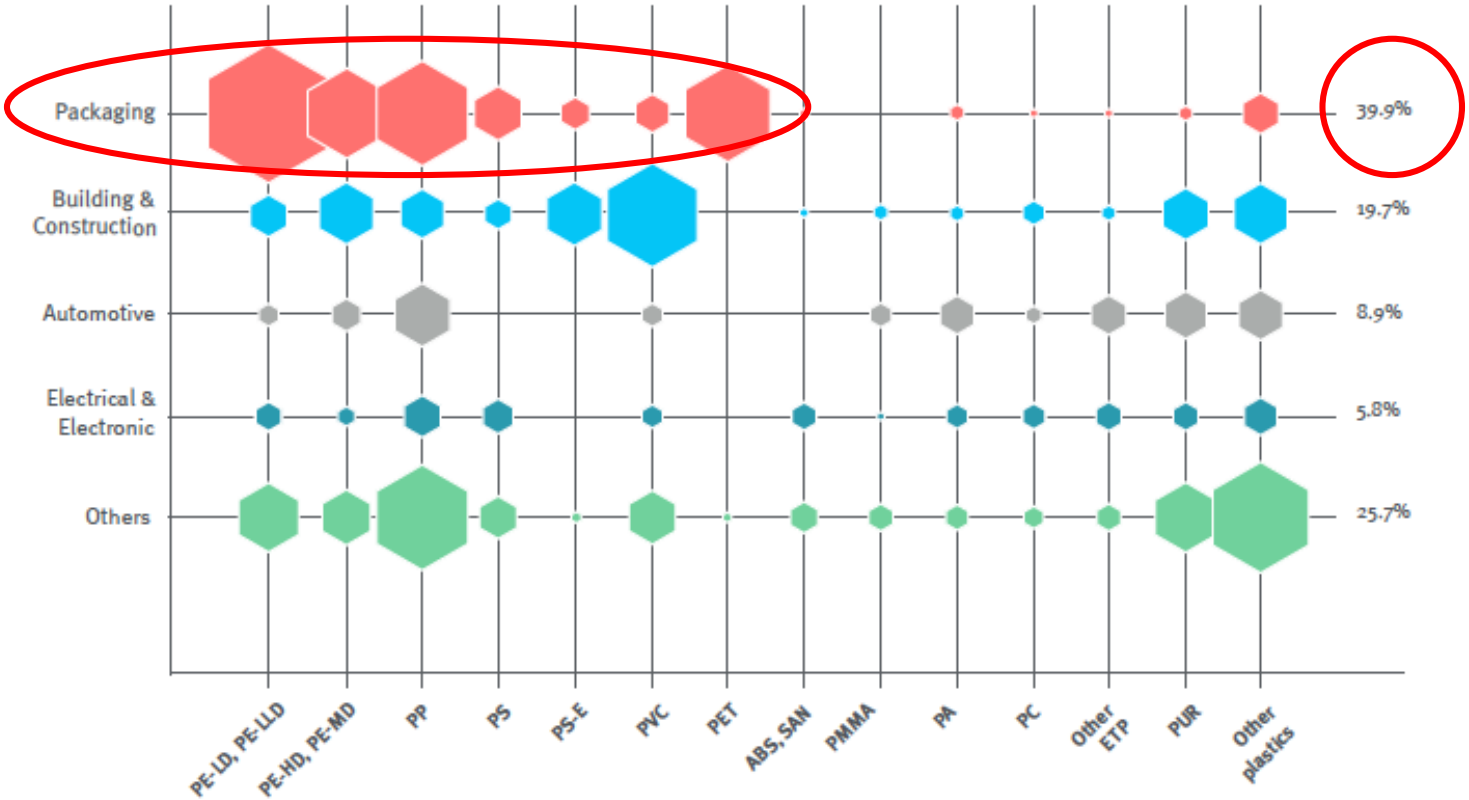


Plastics


World Plastic Production
300
250
200
150
100
50
0
Mtone
1940
1960
1980
2000
2020
Year

Plastics use in Europe

Source: PlasticsEurope (PEMRG) / Consultic / myCeppi



Our waterways and oceans are filled with waste!

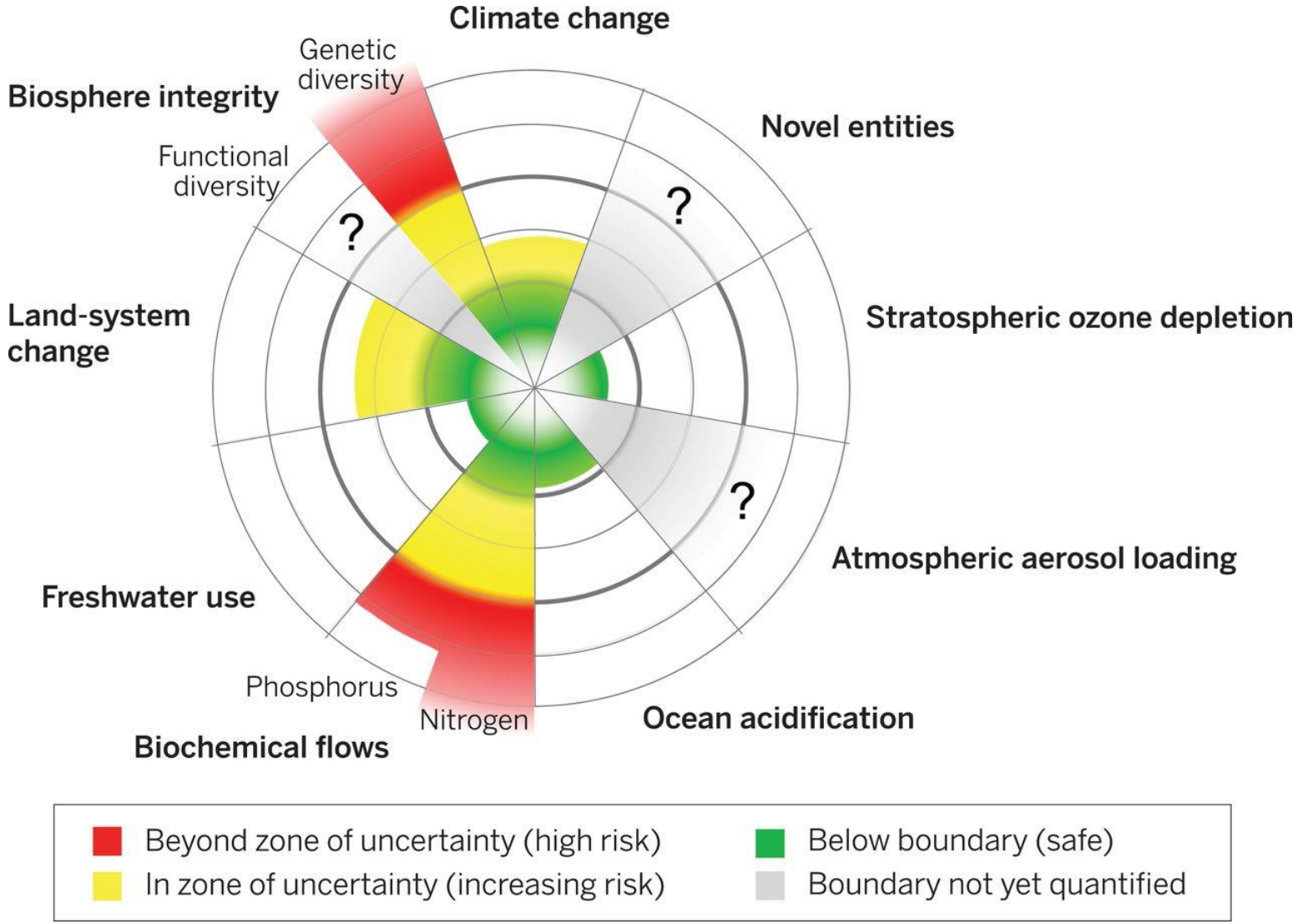
Pollution kills people and damages economies

- **9 million premature deaths per year** (16% of all deaths in the world!)
- $4.3 trillion welfare loss per year (**6% of global economic output**)

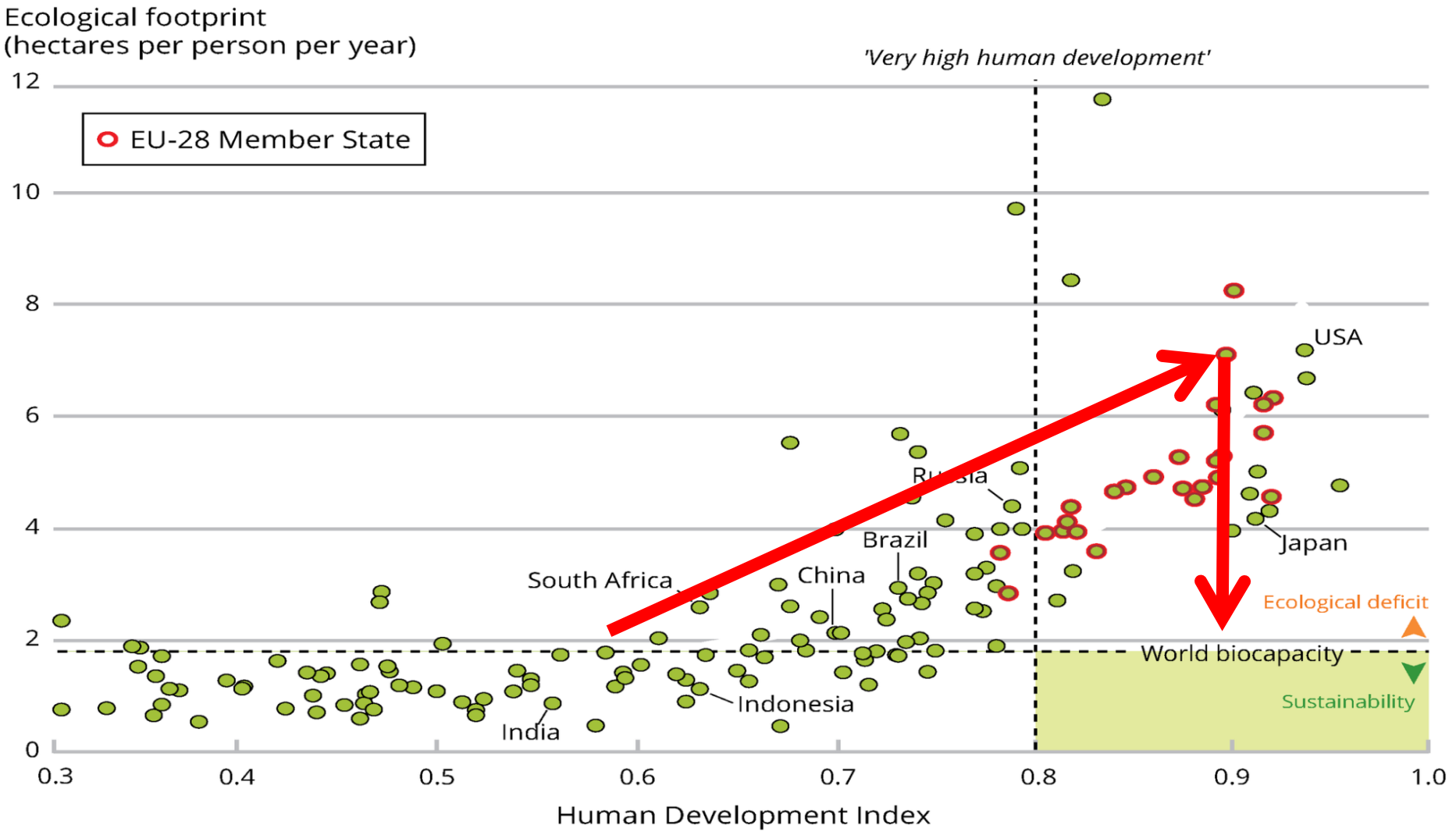
Source: Lancet Report on Health and Pollution, Oct 2017; funded by EC, UNIDO, USAID

In today's economy

- 65 billion tons of raw materials per year (22kg/person/day) are extracted, harvested and used (with total extraction at 90 billion tons per year)
- Only 7% of these materials are reused or recycled
  - About 8 million tons of plastics enter the oceans every year
  - 300 tons of gold is buried in 50 million tons of electronic waste every year
- 40 % of GHG emissions are attributable to materials management
- Waste of
  - Resources
  - Economic value
  - Business opportunities
  - Environment as a resource: Soil / water / air



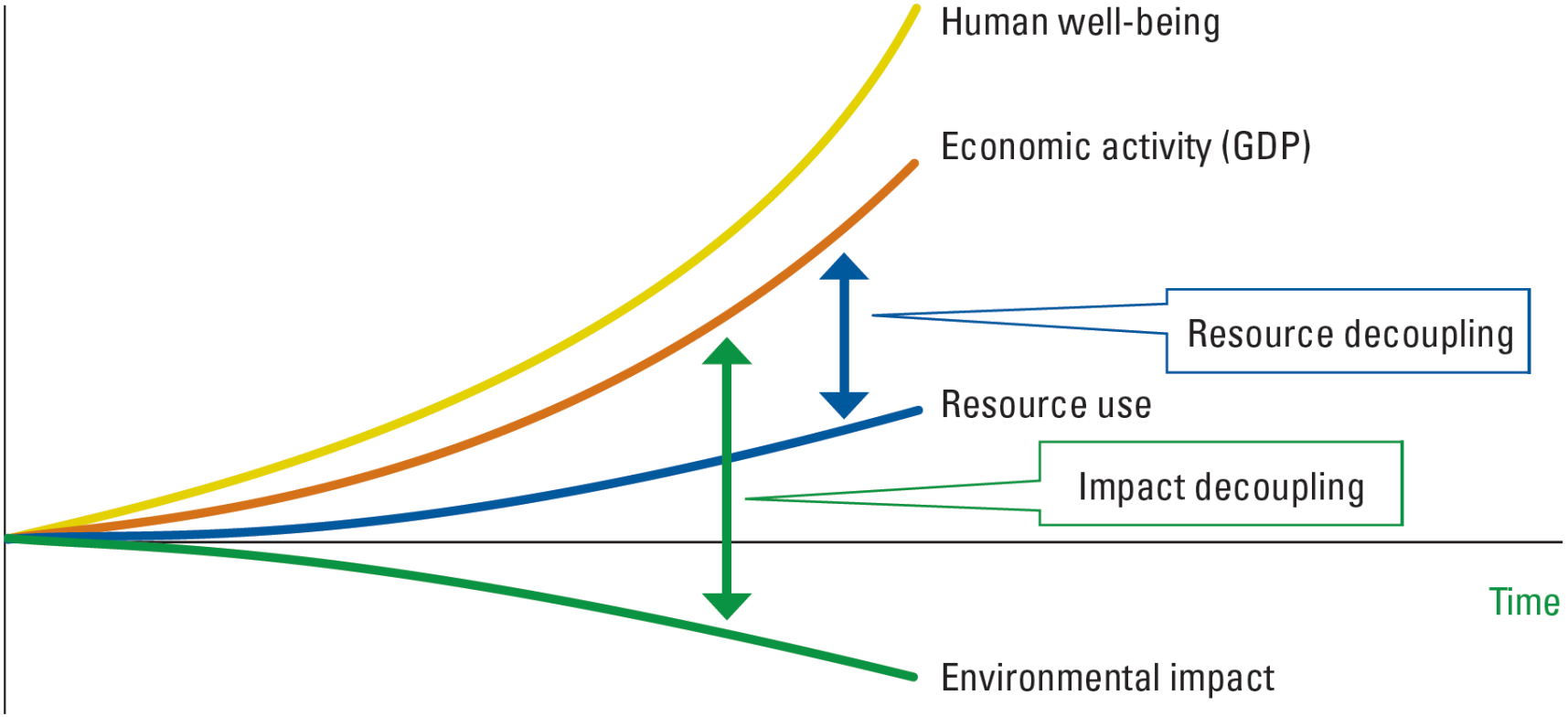
Source: Steffen et al. Science, 2015



Source: Global Footprint Network, 2012; UNDP, 2014a

"Decoupling is the imperative of modern environmental and economic policy"

JANEZ POTOČNIK, Co-chair, International Resource Panel



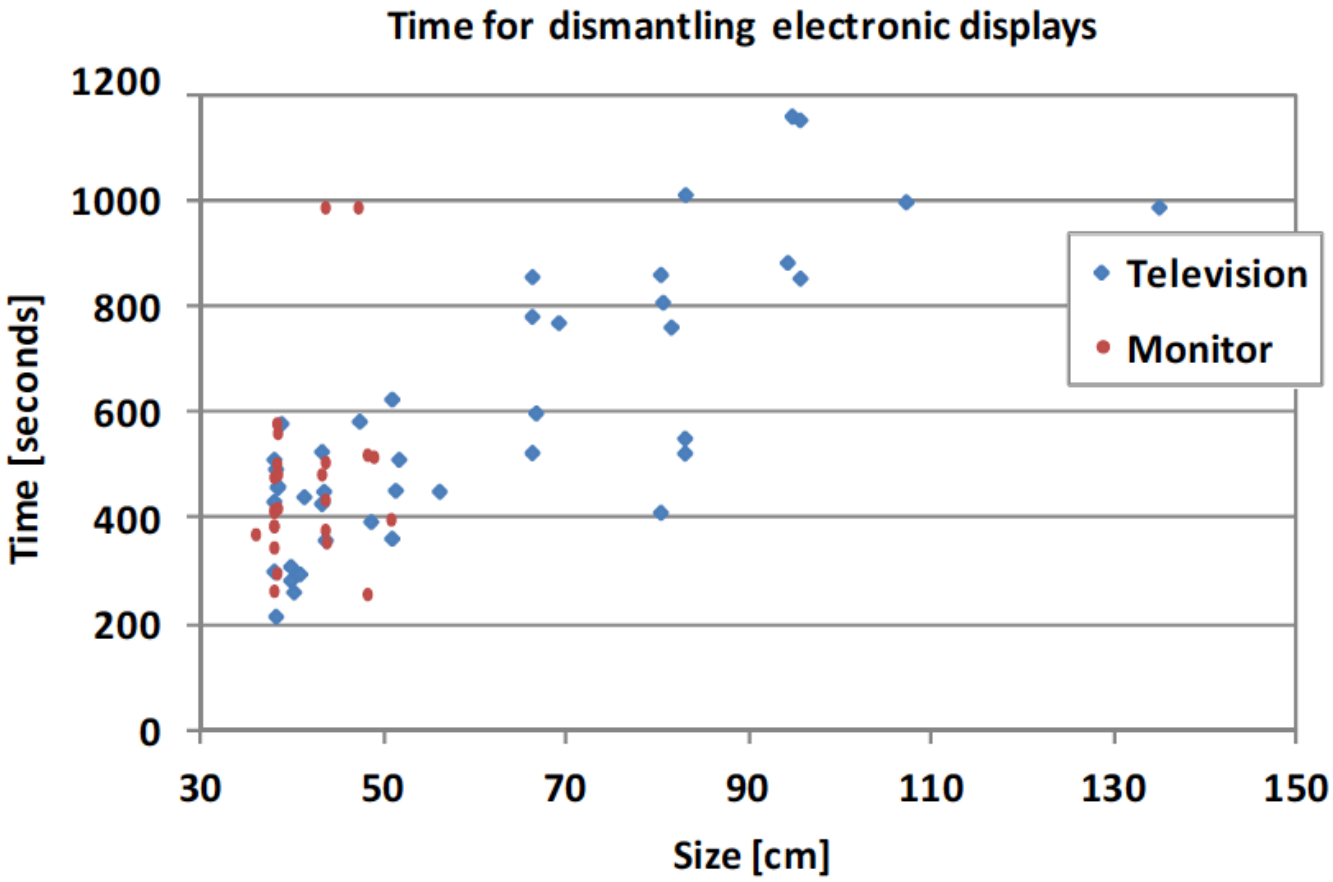
What are we consuming?

A closer look

Products: planned obsolescence!

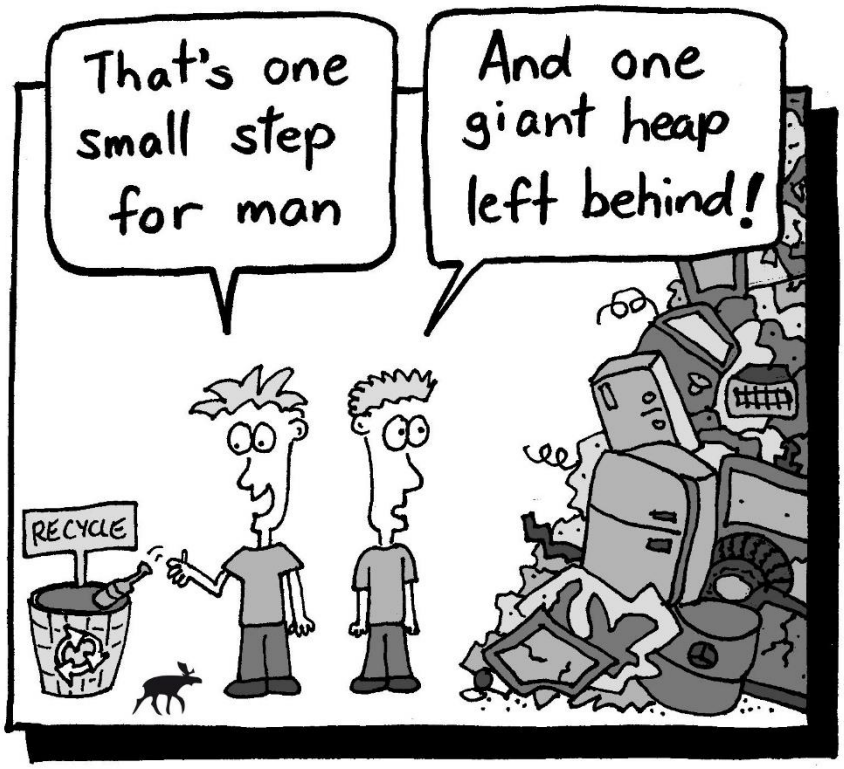
- Frequent cosmetic changes in products
- Non-durability a feature

Products: difficult to disassemble, repair, recycle



Disassembly from 3 to 20 minutes, with special tools

Products: Non-recoverable, non-recyclable waste

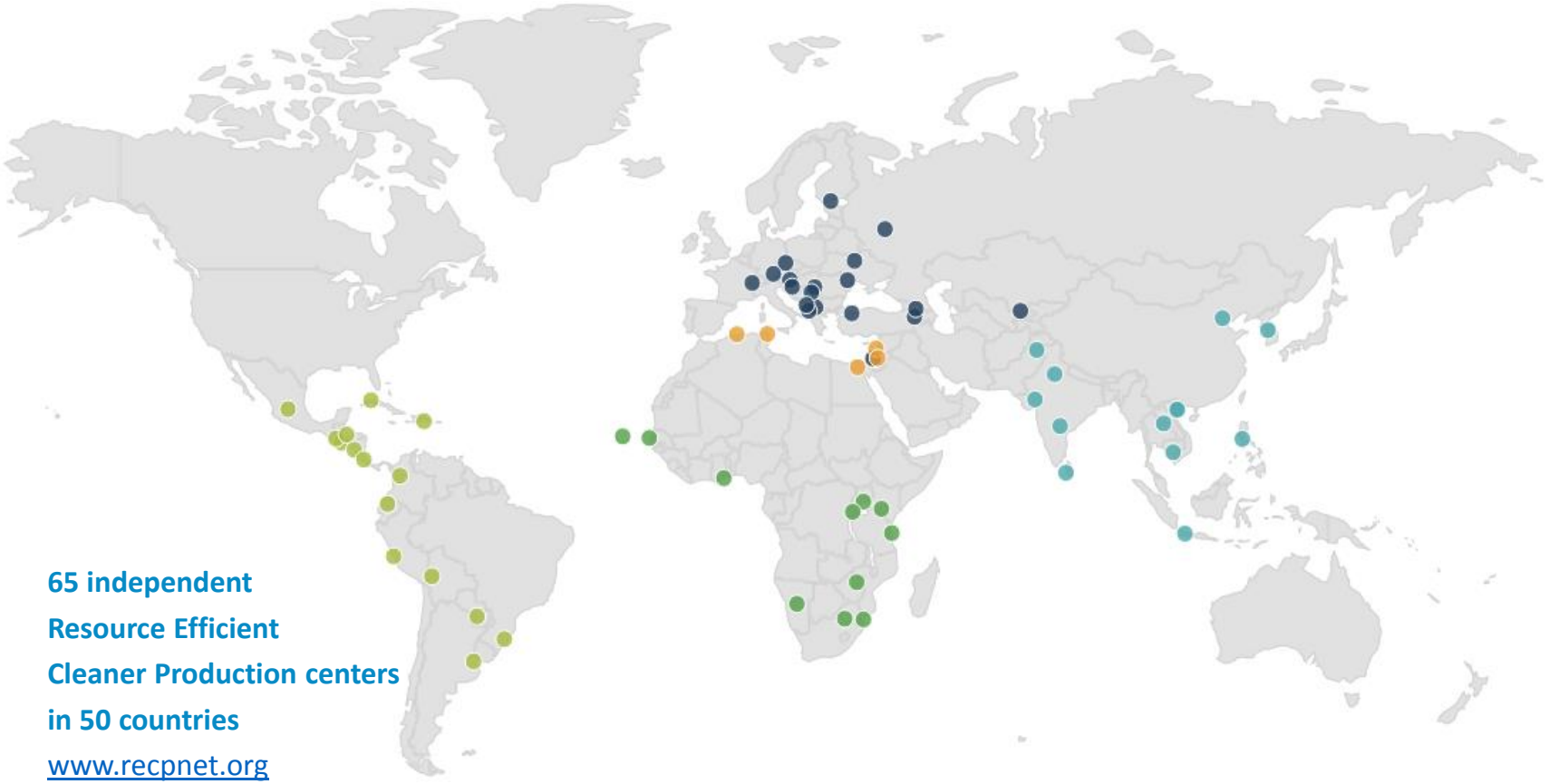


What have governments been doing?

Resource productivity– at the policy level

Country	Resource efficiency/productivity and circular economy initiatives
Argentina	2000's Resource efficiency in the food/feed chain and water use, industrial and solid waste management-federal laws and provincial regulations
Australia	2013 National cleaner environment plan, updated 2016, resource efficiency initiatives at state and territories
Brazil	2007 Product life-cycle approach to resource efficiency, 2010 Solid waste, extended producer responsibility (EPR), resource efficiency in the food/feed chain and water use
Canada	2009 EPR, 2015 Minerals and metals policy
China	2001 **Circular Economy pilot zones**, 2002 Cleaner Production Promotion Law, 2008 Circular Economy Law, 2010 Eco-industrial parks
France	2015 Energy transition for green growth act (circular economy one of 5 pillars; materials)
Germany	Started in early 1970's; more recently, 2002 National sustainability strategy, 2010 Raw materials strategy, 2012 Resource efficiency program (ProgRess) and 2016 ProgRess II
India	2007 11th National Development Plan industrial resource efficiency, waste reuse/recycling
Japan	2001 Fundamental Law of Sound Material-Cycle Society, **3R**-a global initiative since 2008
Turkey	2013 Input supply strategy and plan, 2014 National eco-efficiency/cleaner production program to 2017
EU	2015 **Circular Economy**-Closing the Loop and Action Plan

A UNIDO initiative since 1994[1]



65 independent
Resource Efficient
Cleaner Production centers
in 50 countries
www.recpnet.org

[1] In collaboration with UNEP, in some aspects

Innovation and partnerships at Eco-Industrial Parks (EIP)

Company level

Individual RECP solutions

Resource Efficient Cleaner Production (RECP):

- Materials efficiency
- Water efficiency
- Energy efficiency

Industrial Park level

Collective RECP solutions

Operation & Management of:

- Common Infrastructures
- Resource Supply (Water, Energy, Materials)
- Environmental & Social Services

Industrial Symbiosis

Urban Symbiosis

City level

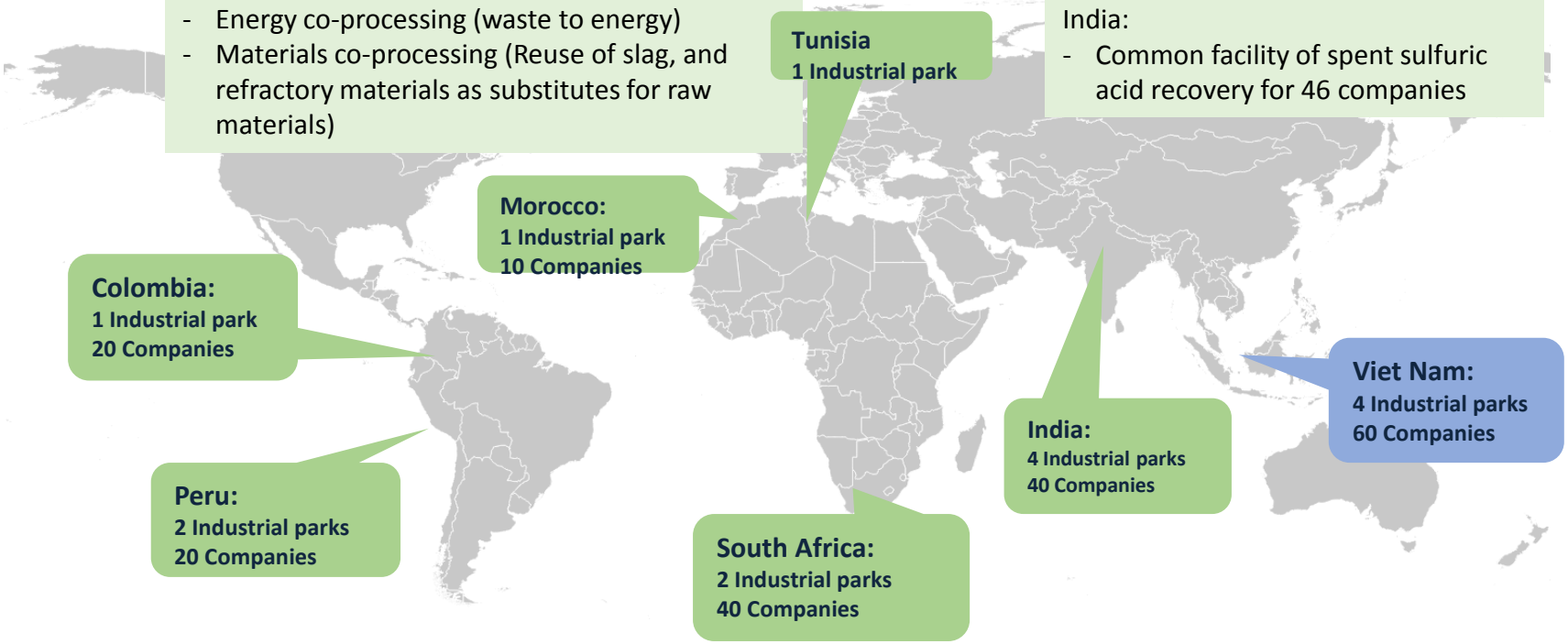
- Waste Management
- Recycling industries
- Corporate Social Responsibility

EIPs instrumental
in promoting sustainable and resilient “business infrastructure”

UNIDO's Eco-Industrial Park Programme

Bir Mcherga industrial park, Tunisia:
Cement industry symbiosis:
- Energy co-processing (waste to energy)
- Materials co-processing (Reuse of slag, and refractory materials as substitutes for raw materials)

Ankelshwar industrial park, Gujarat, India:
- Common facility of spent sulfuric acid recovery for 46 companies



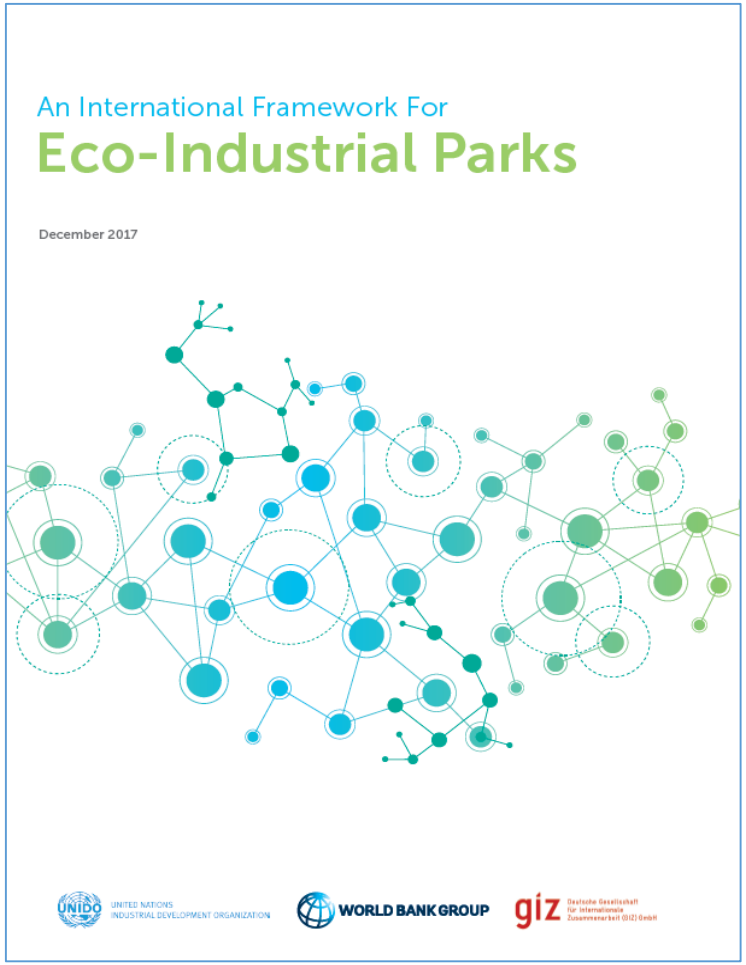
An effective means of scaling up Circular Economy!

Target beneficiaries:
- 15 industrial parks
- Over 200 companies

An international framework for Eco-Industrial Parks

December 2017

UNIDO WORLD BANK GROUP giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH



With support of and inputs from

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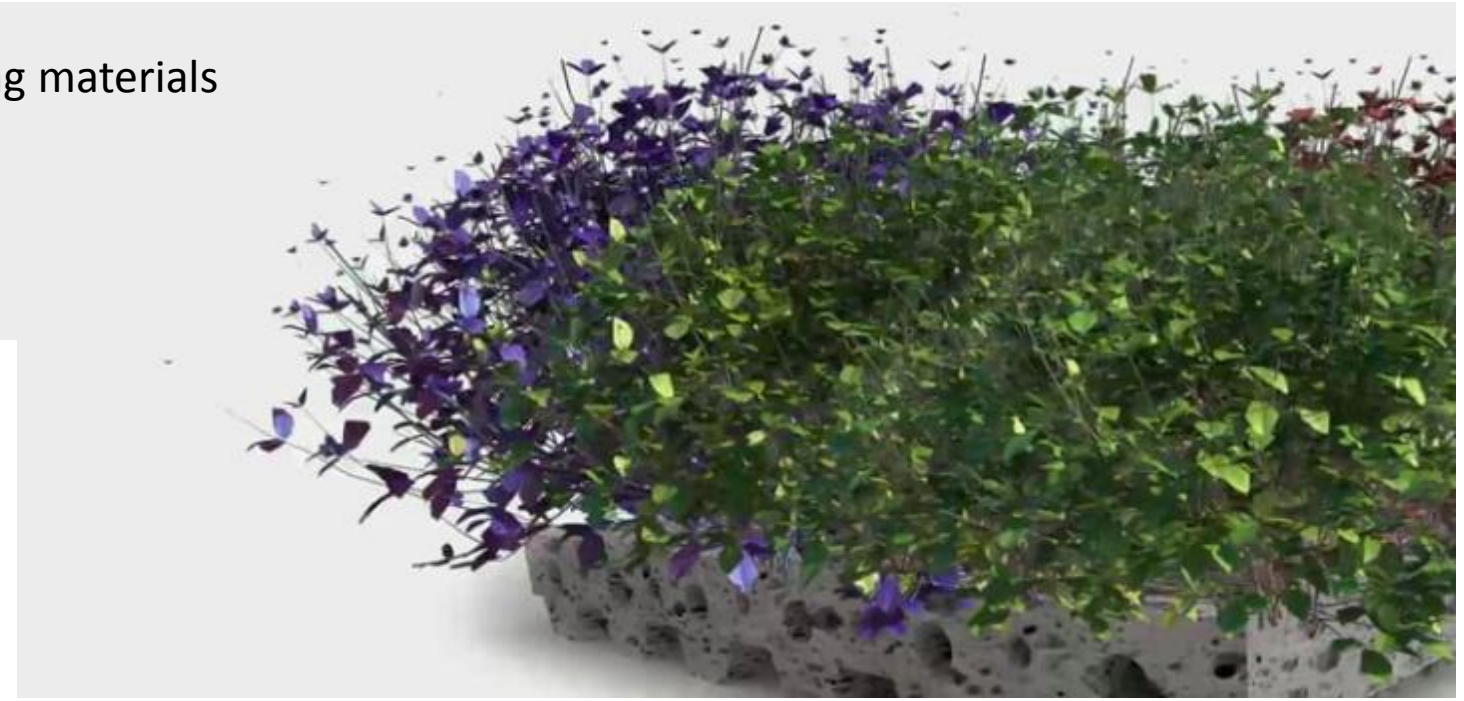
https://openknowledge.worldbank.org/handle/10986/29110

EIP performance assessments

33 IPs

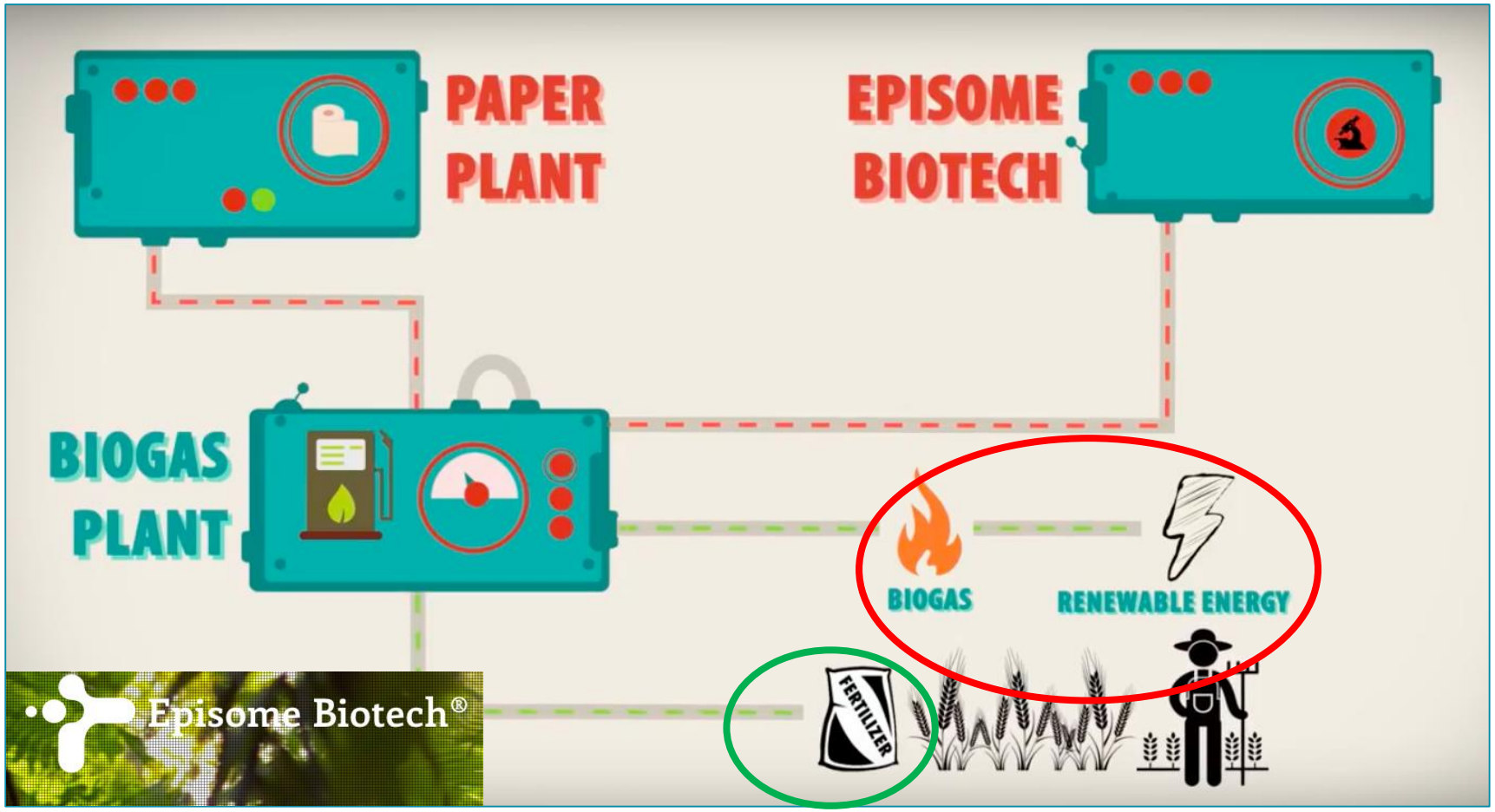
GEF-UNIDO Global Cleantech Innovation Programme

Green building materials



greencoat™

GEF-UNIDO Global Cleantech Innovation Programme

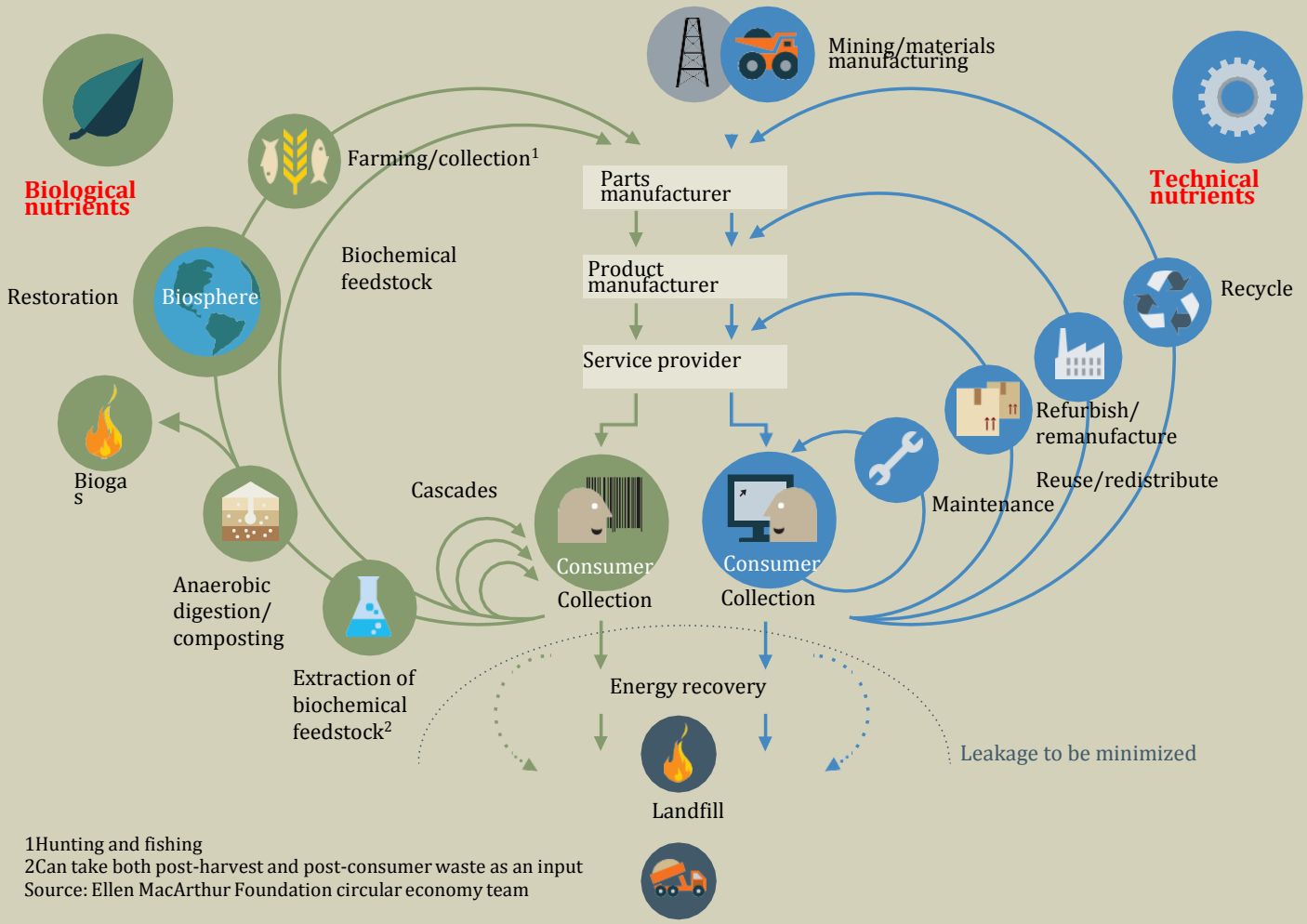


What is new in “circular economy”?

Circular economy principles and concepts

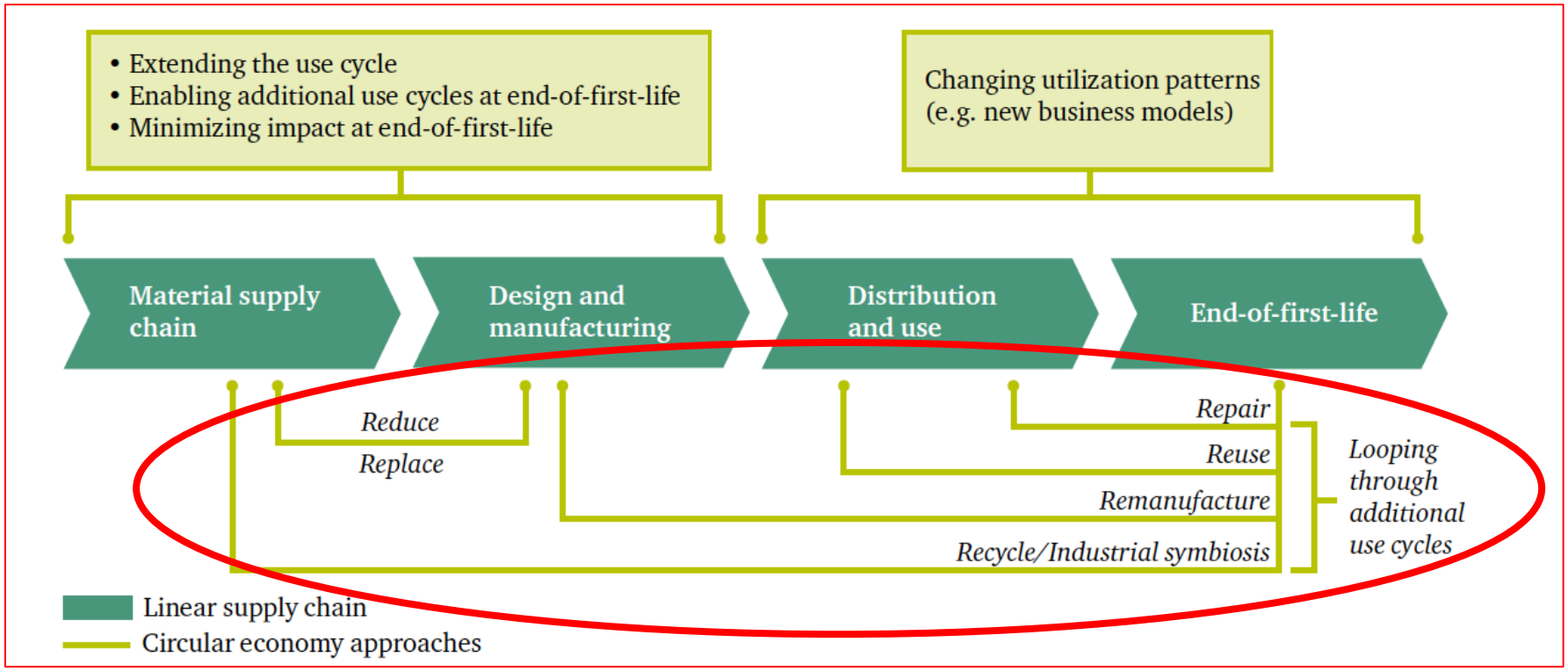
- Circular economy is an industrial economy that is
  - Restorative by intention
  - Designs out waste
  - Minimizes, tracks and eliminates use of toxic chemicals
  - Systemic innovation is at its core
  - Aims to rely on renewable energy
- Raw and recycled materials are nutrients
  - Biological (agriculture, animal husbandry, fisheries, forest resources)
  - Technical (extracted by mining; minerals, petroleum, chemicals and other synthetic materials not based on biological nutrients)

The circular economy—an industrial system that is restorative by design



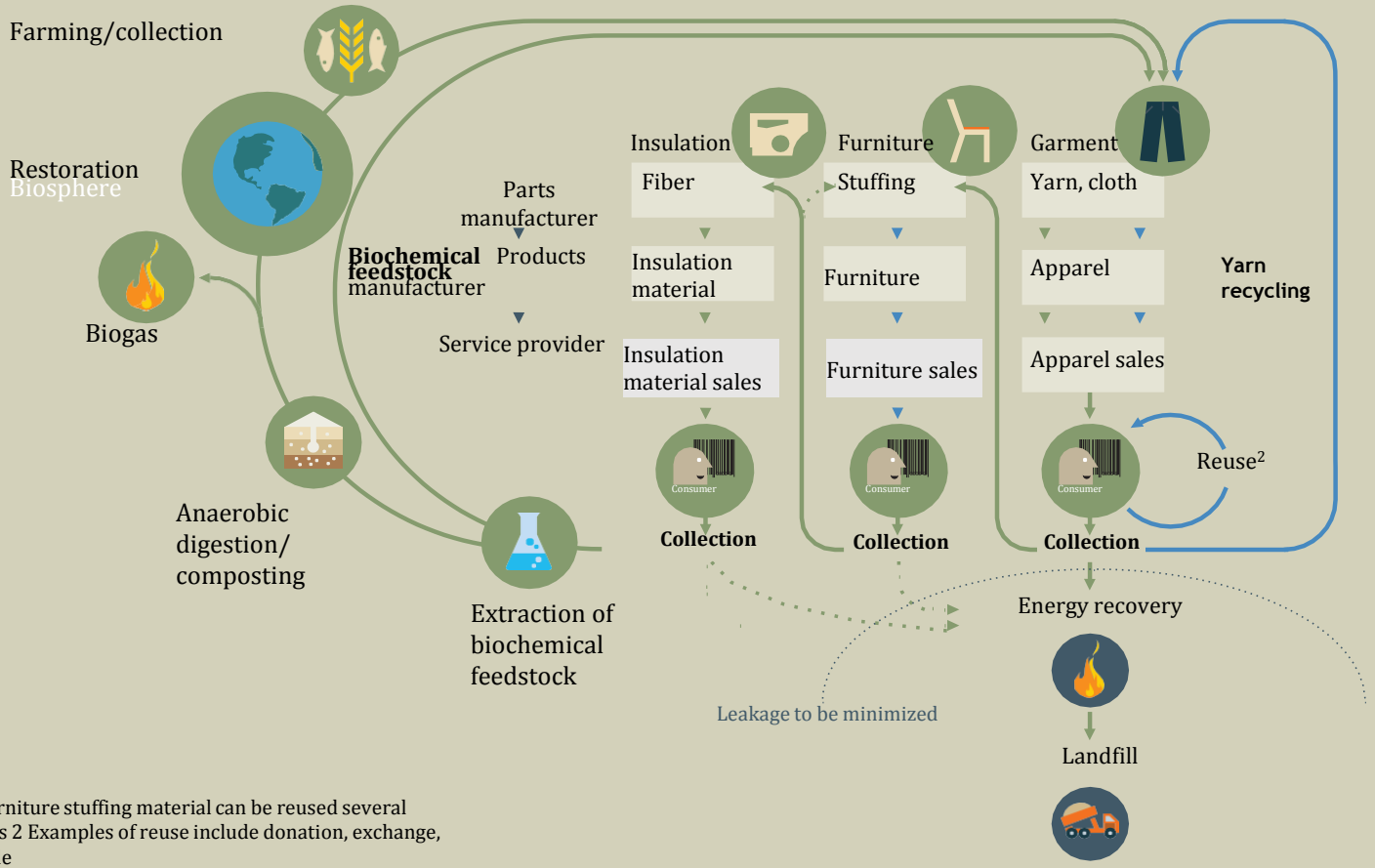
1Hunting and fishing
2Can take both post-harvest and post-consumer waste as an input
Source: Ellen MacArthur Foundation circular economy team

Circular economy activities



Source: Felix Preston and Johanna Lehne, *A wider circle? The Circular Economy in Developing Countries, Chatham House, Dec. 2017*

Cascading keeps materials in circulation for longer—textile example



1 Furniture stuffing material can be reused several times 2 Examples of reuse include donation, exchange, resale

Source: Ellen MacArthur Foundation circular economy team

REPURPOSE

What are businesses doing?

Business models I

Business models	Brief description	Illustrative examples	Illustrative circular economy benefits/advantages
ON DEMAND			
Produce on demand (made to order)	Producing a product or providing a service only when consumer demand has been quantified and confirmed.	Aeroplanes, often furniture and designer clothes/footwear are only manufactured once ordered. Other items are produced based on user/customer votes (e.g. most popular t-shirt designs are made available for sale), where a mechanism is required to guarantee an informed response.	Minimizes raw material demand and avoids over-stocking. Can enhance "personalization" via delivery of a better fit to customers' requirements, leading to less product redundancy.
DEMATERIALIZATION			
Digitization	Replacing physical infrastructure and assets with digital/virtual services.	Move from physical video/DVD stores to online film and music services, etc., digital as opposed to camera film or vinyl records.	Offers dematerialization advantages over tangible products, but without reducing the perceived value to the customer.
PRODUCT LIFE CYCLE EXTENSION/REUSE			
Product life-extension	New products are designed to be durable for a long lifetime (durability). Design improvements might be needed to also facilitate easier repair, particularly by third parties.	Leading high-grade washing machines. An infrastructure and buildings specification with an extended design-life (e.g. 120 instead of 100 years).	Increased product life.
Facilitated reuse	Reuse with or without repair/upgrade and supplied either free of charge (FOC) or resold.	FOC: furniture reuse networks. Resold: online auction and for-sale websites.	Reduces the demand for new products.
Product modular design	Products designed to be modular so that parts can be replaced to update/upgrade a product, but not replace the whole item.	Modular construction (e.g. mobile phones).	Replacement at part(s) rather than product level (e.g. new screen as opposed to new mobile phone). Can also encourage cost-effective product repairs and reduce need for replacement of integrated components, thereby reducing resource consumption.

FIRMS

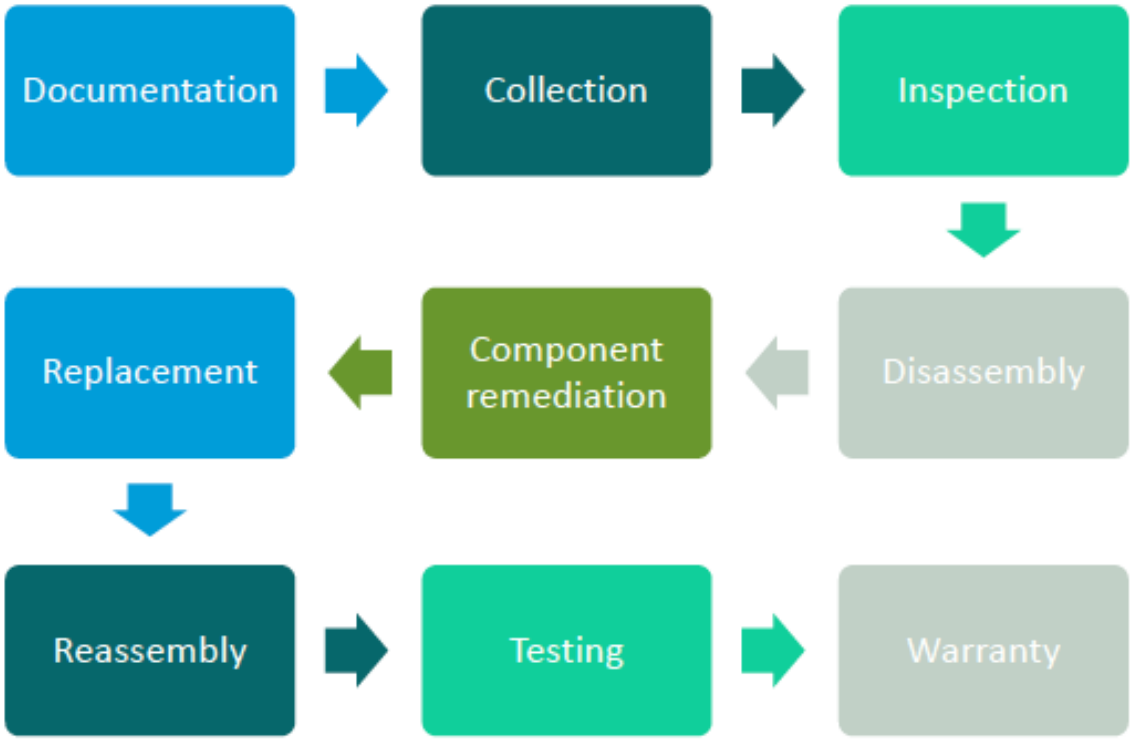
Source: BSI 8001/2017

Shooz: modular shoe

skin + sole = Shooz

Remanufacturing

Returning a product to at least its original performance with a warranty that is equivalent to that of the new product



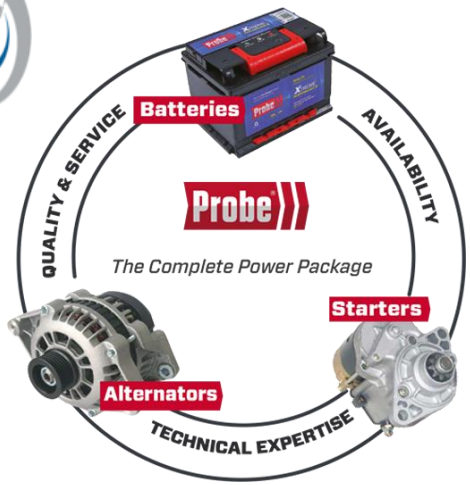
Remanufacturing in South Africa

- Automotive industry in the country
  - produces over 600,000 vehicles per year;
  - supplier employment in 2014 was 80,000,
  - parts and components exports to EU, Africa, US, Brazil, Japan, Australia, South Korea, India and China
- Engines for major brands such as Toyota, Ford, VW, GM, Audi, Chevrolet, Isuzu, Opel, Mazda, Nissan and Land Rover
- Alternators, invertors, starters, compressors, etc.

REMTEC
PREMIUM ENGINE SOLUTIONS

We remanufacture engines for:

TOYOTA, mazda, OPEL, NISSAN, LAND-ROVER, Audi, Ford, ISUZU



Probe re-manufactured, approved replacement parts and the highest quality approved repair facility

REMTEC & PROBE
(Business Models working in SA)

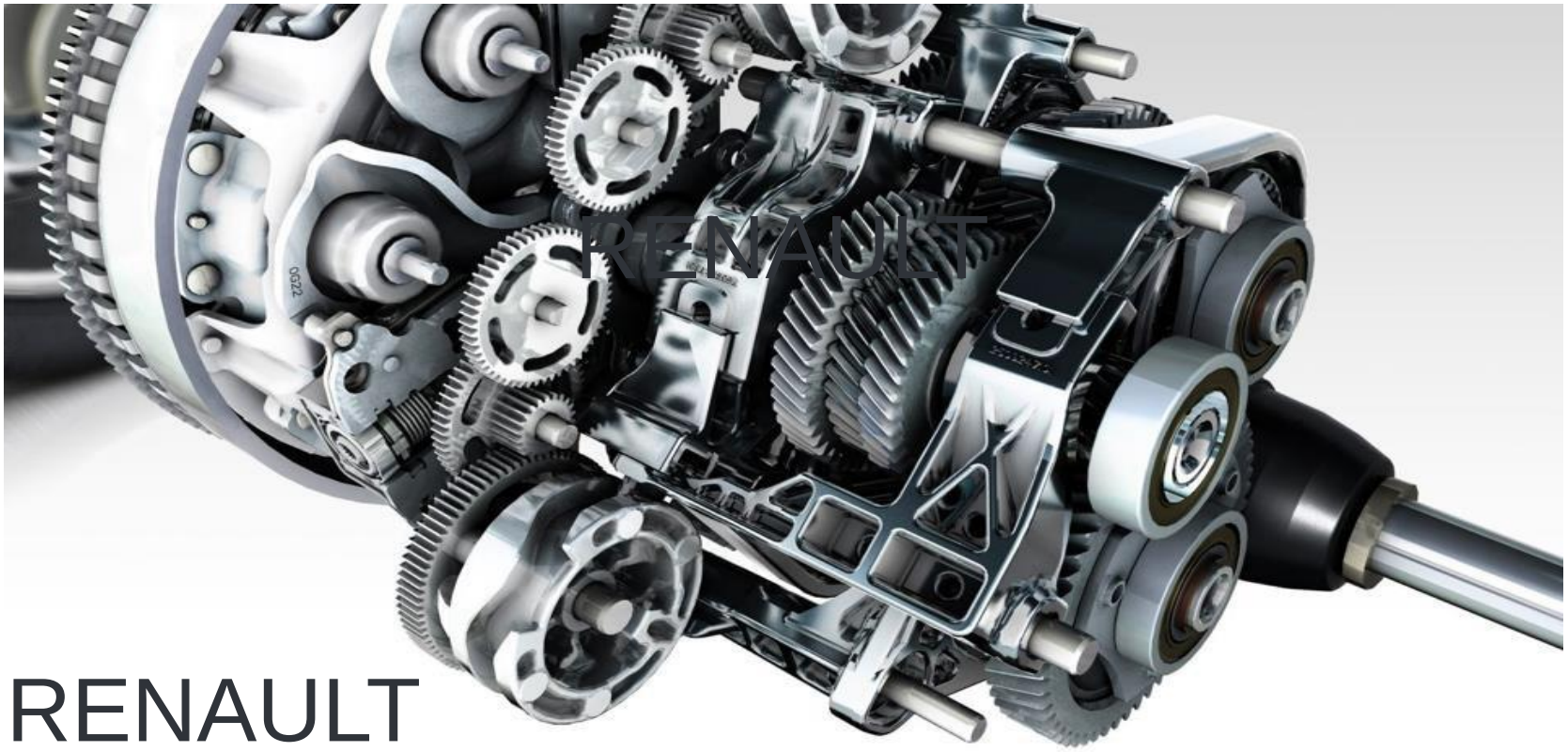
TRI MED
PROMISES INTO REALITY
APPROVED & LICENSED BY AERB

Caterpillar remanufactured equipment

Remanufacturing in Argentina

- SKF Argentina SA
  - Remanufacturing and maintenance services for life time extension

Recover, reuse, remanufacture, recycle



RENAULT

https://youtu.be/7UVCCevwMfE

Business models II

Business models	Brief description	Illustrative examples	Illustrative circular economy benefits/advantages
Refurbish, repair, remanufacture and recondition	Product gets a next life (e.g. after remanufacture – the process of restoring the product or part functionality to "as-new" quality; facilitated by design for disassembly). Enables the producer to put the product back into the market to earn a second or subsequent income, from a second or subsequent user.	Remanufactured products, parts and components provided with "as-new" performance and reliability at a reduced cost compared with new. Major car manufacturer offering genuine exchange parts remanufactured from returned used parts which are inspected and rebuilt to meet the same quality standards and performance as new, and carry the same warranty.	Reduces demand for new products/raw materials.
RECOVERY OF SECONDARY RAW MATERIALS/BY-PRODUCTS			
Recovery of secondary materials/by-products (including recycling)	Value optimization by creating products from secondary raw materials/by-products and recycling (e.g. polyethylene depolymerization, steel, bio-based materials), whether open or closed loop.	Closed loop: • glass/plastics bottles back into glass/plastics bottles; • aluminium car body components back into auto-industry; • recycled asphalt planings in new roads. Open loop: • plastic bottles recycled into fleece jackets and fibres for shoe lining; • nylon fishing nets used in carpet and skateboard manufacture; • reclaimed timber to make garden furniture; • car tyres into shoe sole outers; • marine plastic to manufacture training shoes; • clean wood-fibre to beer bottles; • bio-based materials/packaging to quality compost or digestate; • recycled aggregate to offset primary aggregate (e.g. block manufacture).	Reduces natural capital demand and minimizes waste.

Source: BSI 8001/2017

FIRMS

Interface: Fishing nets into carpet tiles

Recycling machine tools for raw materials

Industry 4.0!

> Desechos transformados en grandes ahorros
>
> Crónica

Sandvik Coromant Argentina recycles tungsten carbide inserts. Since 2012 the company has recycled 70% by weight of all the hard tools sold globally

Extended Producer Responsibility (EPR)

- EPR is an "*environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle*" (OECD, 2001)
- EPR
  - Obliges the producer to **take back its product at end-of-life**
  - Shifts responsibility (financially or operationally) **the treatment and disposal of the end-of-life product to the producer**
  - Partially or fully **relieves municipalities of waste management** for the said product (there could be mixed models; hence, partial or full relief of municipalities
  - Provides **incentives to producers** to integrate environmental considerations in the **design** of their products.
  - Seeks to **integrate signals** related to environmental characteristics of products and production processes **throughout the product chain**.

Car dismantling company

De-registration

Draining fluids

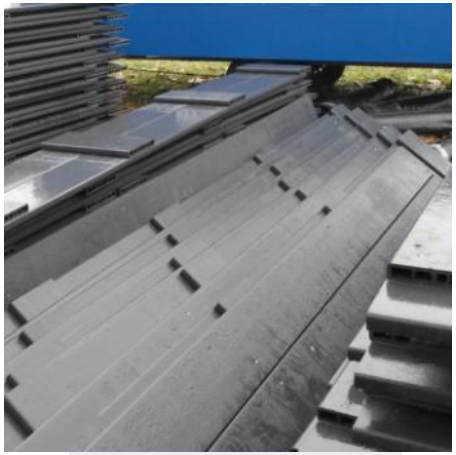
Used parts

Metal separation

Post Shredder Technology (PST)

Shredder waste treatment

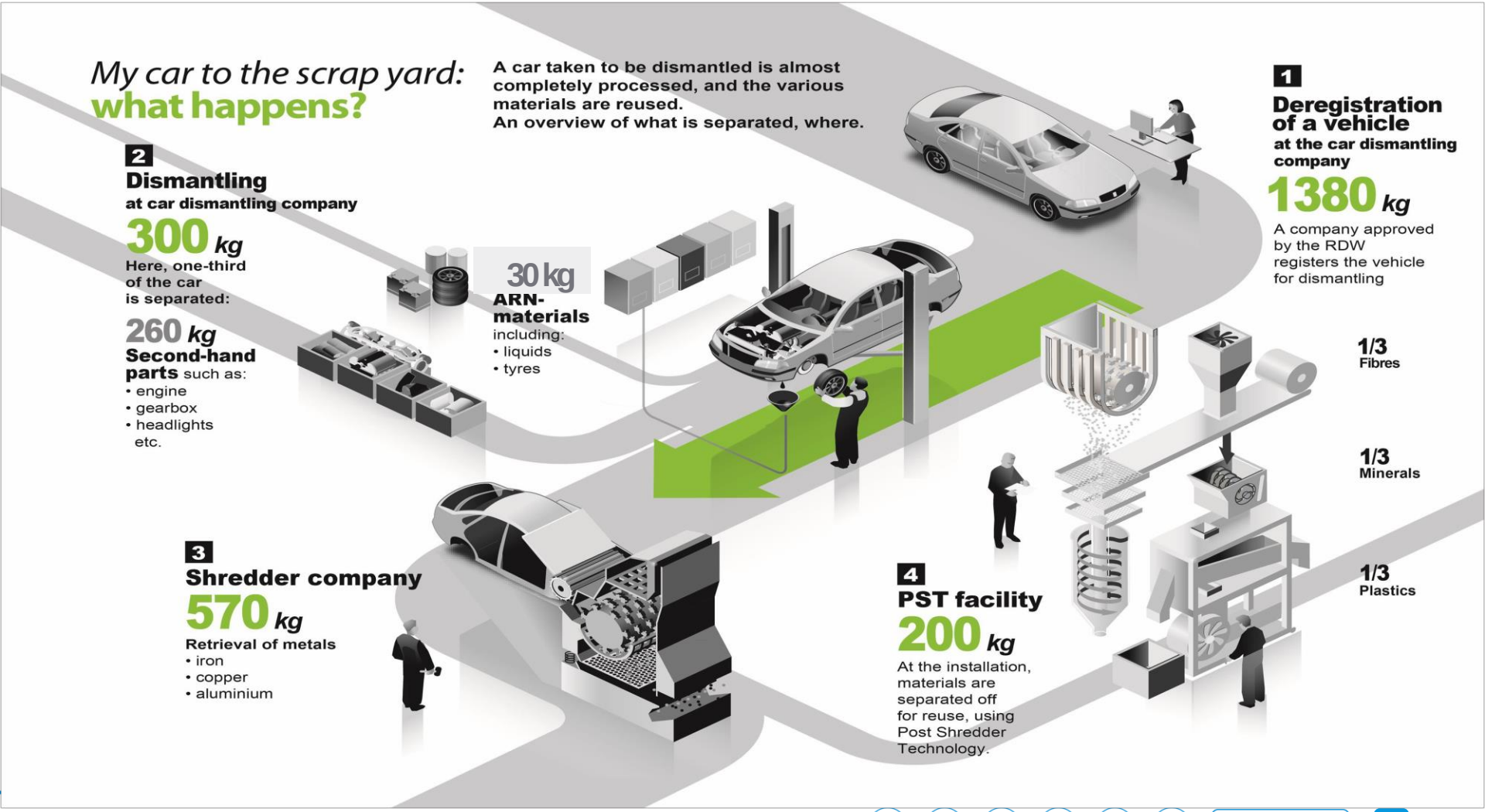
Industry



New products

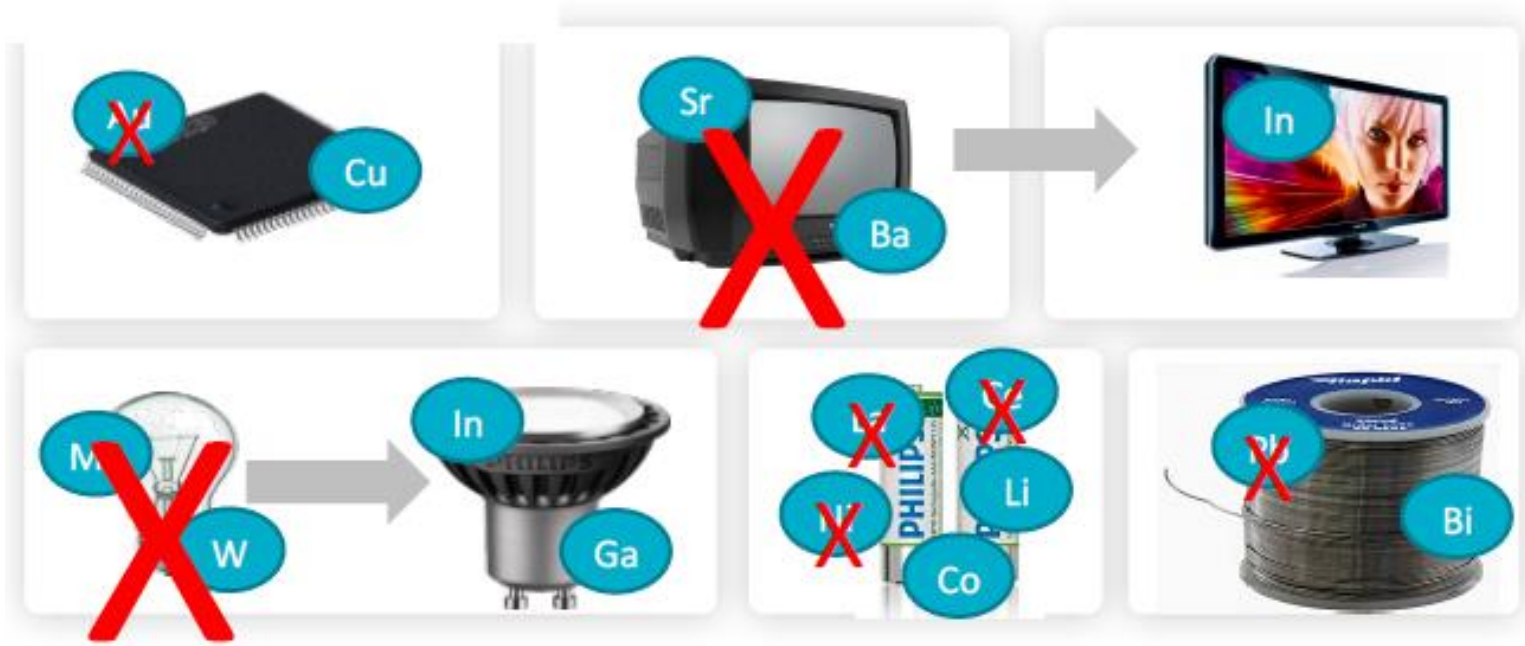
Source: ARN, UNIDO presentation, 12 October 2017

Auto Recycling Netherlands (ARN)



Source: ARN, UNIDO presentation, 12 October 2017

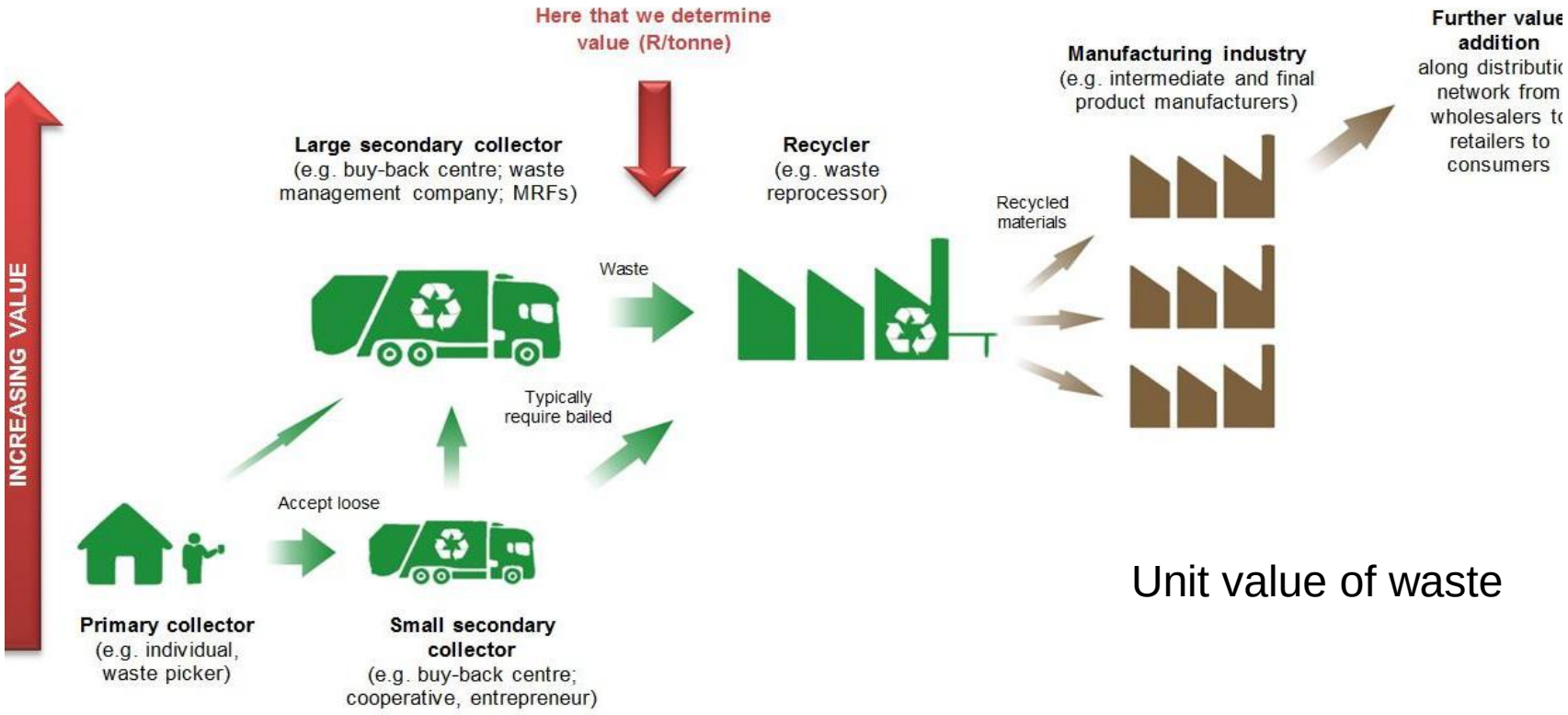
Substitute critical materials and detoxify



Design for disassembly (DfD)

Less than 10 seconds by hand

South Africa: estimating value of waste (2014)



Unit value of waste

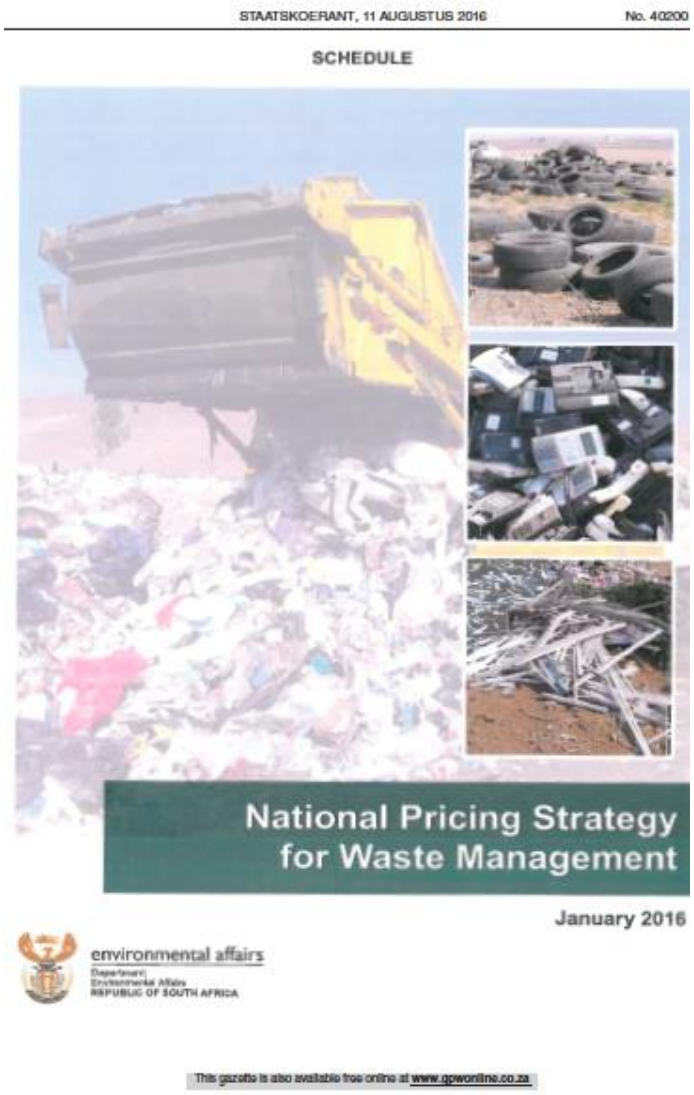
Dr. Linda Godfrey, “Economic value of South Africa’s waste”, CSIR, 2014

Stream	SCENARIO 1 Baseline (2011)			SCENARIO 2		SCENARIO 3 (DST Goal)		SCENARIO 4 (100% recovered)	
	Generated (t/yr)	Recycled (t/yr)	Recycled (%)	Recycled / recovered (t/yr)	Recycled / recovered (%)	Recycled / recovered (t/yr)	Recycled / recovered (%)	Recycled / recovered (t/yr)	Recycled / recovered (%)
Municipal waste (non-recyclable portion)	8 062 934	0	0	2 015 734	25	4 031 467	50	8 062 934	100
Organic component of municipal waste	3 023 600	1 058 260	35	1 587 390	53	2 116 520	70	3 023 600	100
Biomass waste from industry	36 171 127	0	0	10 851 338	30	21 702 676	60	36 171 127	100
Construction and demolition waste	4 725 542	756 087	16	1 559 429	33	2 362 771	50	4 725 542	100
Paper	1 734 411	988 614	57	1 087 476	63	1 387 529	80	1 734 411	100
Plastic	1 308 637	235 555	18	537 850	41	785 182	60	1 308 637	100
Glass	959 816	307 141	32	417 520	44	575 890	60	959 816	100
Metals	3 121 203	2 496 962	80	2 653 022	85	2 809 083	90	3 121 203	100
Tyres	246 631	9 865	4	103 585	42	197 305	80	246 631	100
WEEE	64 045	6 884	11	19 453	30	32 023	50	64 045	100
Slag (from mineral processing)	5 370 968	2 685 484	50	3 356 855	63	4 028 226	75	5 370 968	100
Ash (from power generation)	36 220 000	2 289 104	6	4 766 552	13	7 244 000	20	36 220 000	100
Waste oils	120 000	52 800	44	69 600	58	86 400	72	120 000	100
TOTAL	**101 128 914**	**10 886 756**	**11**	**29 025 804**	**29**	**47 359 071**	**47**	**101 128 914**	**100**

Dr. Linda Godfrey, “Economic value of South Africa’s waste”, CSIR, 2014

Stream	Unit value (R/t)	Current recycling rate (%)
Plastic	3119.54	18
Waste oils	2777.78	44
Metals	2270.00	80
WEEE	1000.00	11
Paper	744.47	57
Glass	490.00	32
Tyres	367.00	4
Municipal waste (non-recyclable portion)	367.38	0
Organic component of municipal waste	188.63	35
Biomass waste from industry	188.63	0
Slag	175.00	50
Construction and demolition waste	87.50	16
Ash	3.00	6

Dr. Linda Godfrey, “Economic value of South Africa’s waste”, CSIR, 2014

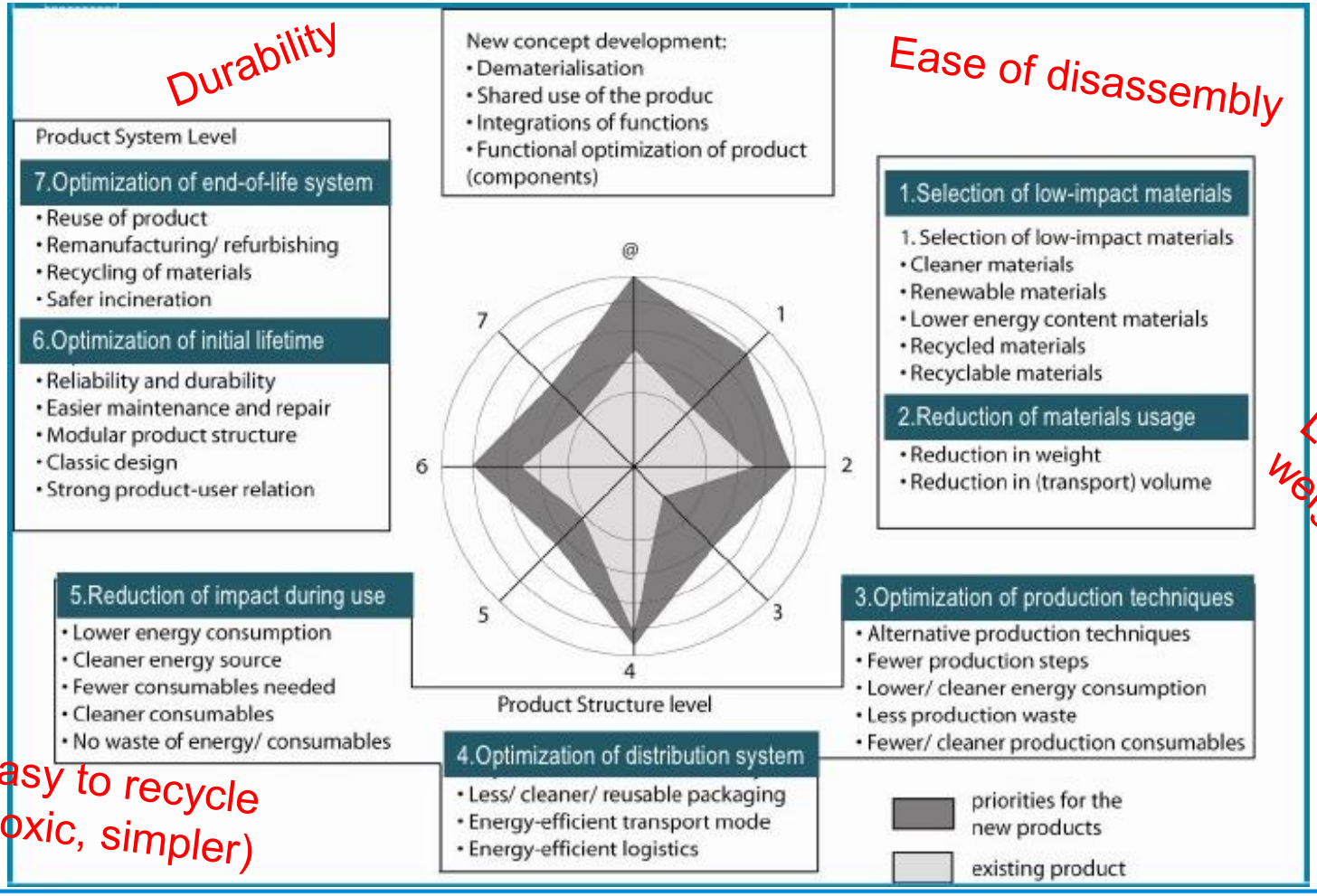


South Africa

To **minimize**, reuse, recycle and recover waste:

- Operationalization of the Waste Management Bureau
- Design of economic incentives
- Industry waste management plans
- Extended Producer Responsibility schemes

Designing waste out (eco-design strategies)



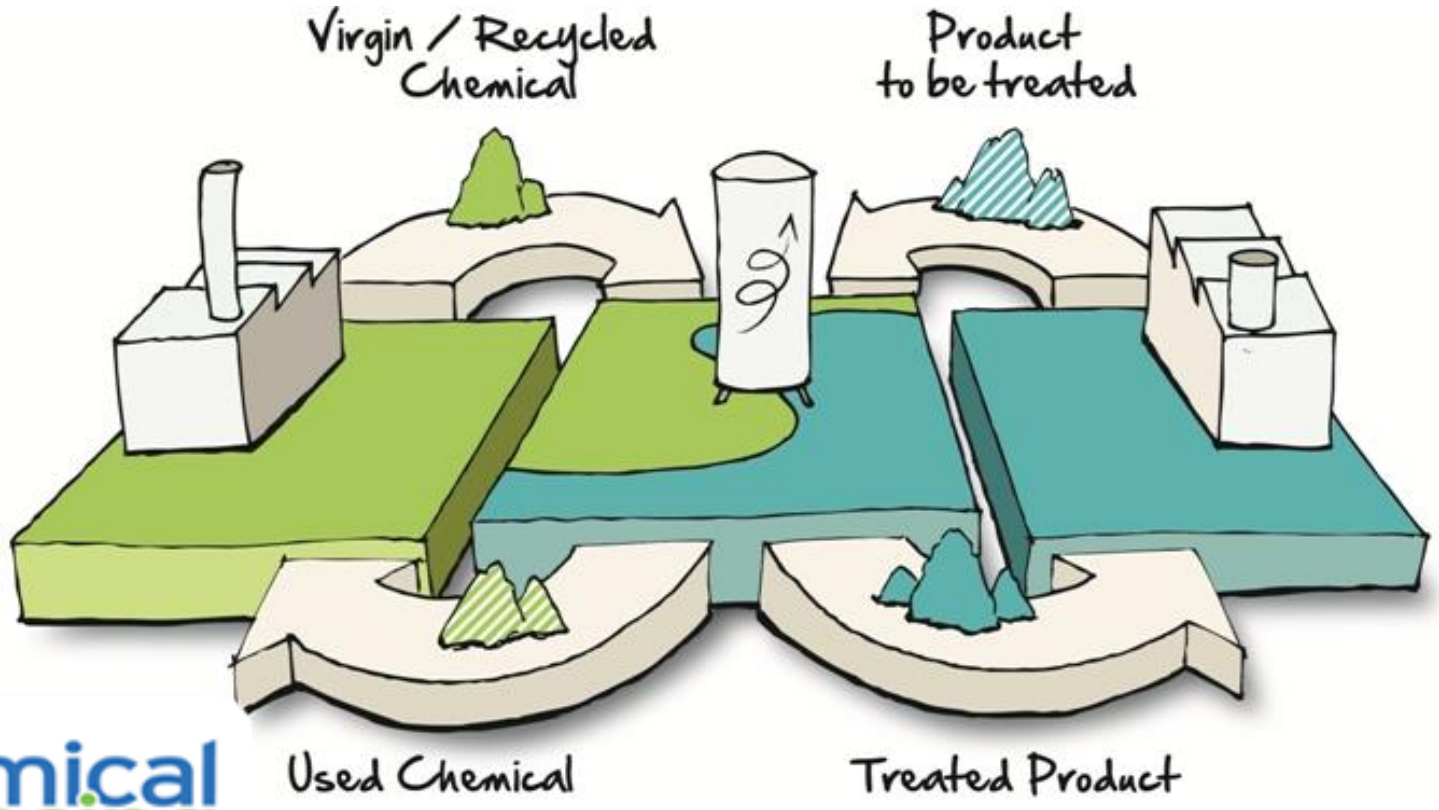
Business models III

Business models	Brief description	Illustrative examples	Illustrative circular economy benefits/advantages
Incentivized return/extended producer responsibility	Incentivizes customers to return used/unwanted items back to the producer via a convenient system. Producer then either recycles materials or repairs/refurbishes/ remanufactures the product. Incentive usually in the form of a discount offered on a new product for surrendering the old one.	Scope to implement at scale via national take-back schemes for product categories, in particular, via extended producer responsibility (e.g. batteries, light bulbs, appliances) Financial or alternative incentive offered for the return of used or unwanted electrical items. Store credit (money-off) on new purchases when returning worn/unwanted clothes items. Jeans returned for repair/refurbishment.	Facilitates recovery of used/unwanted products (and embodied materials) through a controlled and auditable system.
PRODUCT AS A SERVICE/PRODUCT–SERVICE SYSTEMS (PSS)			
Lease agreement	Leasing access to and not selling ownership of a product or service. This can be on a B2B or B2C basis. In general, an "operating lease" model is likely to be best suited for PSS models in the context of a circular economy as ownership of the asset is retained by the lessor and can be combined with service or performance-based business models.	Lease agreements on: fleet and domestic cars, industrial solvents, power tools, TVs and DVD players, etc., over a 6-or 12-month contract. B2B: leasing of floor/wall coverings. B2C: clothes leasing (e.g. jeans). Subscription to TV sports channel.	The lessee's capital outlay is typically lower when compared to outright purchase when taking depreciation, maintenance and disposal/replacement costs into account. The lessor typically benefits from higher overall profitability during the lease period and retains ownership.
Performance based (Pay for success)	Company delivers product performance or defined results rather than the product or service itself. The customer purchases a defined level of performance, where the company's primary revenue stream comes from payments for performance delivered or demand-fulfilment. Ownership remains with the operating company.	Leasing a washing machine for 1 000 washing cycles or providing a pick-up and delivery laundry service. Other examples include: lighting (pay per lux); printing (pay per print); aero-engines (power by the hour).	Customer purchases a solution delivering the desired level of performance.

Source: BSI 8001/2017

FIRMS

Pay for performance



Chemical Leasing

http://www.chemicalleasing.com

Chemical Leasing

General Motors & Badawi Chemical Works, Egypt

Before:

- Badawi sold HC solvent to GM for cleaning metal parts
- After use, GM had to dispose of the waste solvent

After:

- Badawi “leases” HC solvent and supervises its use in the factory. After use, Badawi takes the solvent back to its factory for recycling.

Economic benefits:

- Badawi has increased efficiency of solvent use, and GM has reduced costs linked to solvent use by 15%. Proper solvent recycling has reduced GM’s liability from solvent waste. Badawi now has a long-term relationship with GM (much less chance that GM will purchase solvent from another company).

Environmental benefits:

- Less solvent is used, and it is properly recycled.

Michelin Fleet Solutions: pay for km travelled

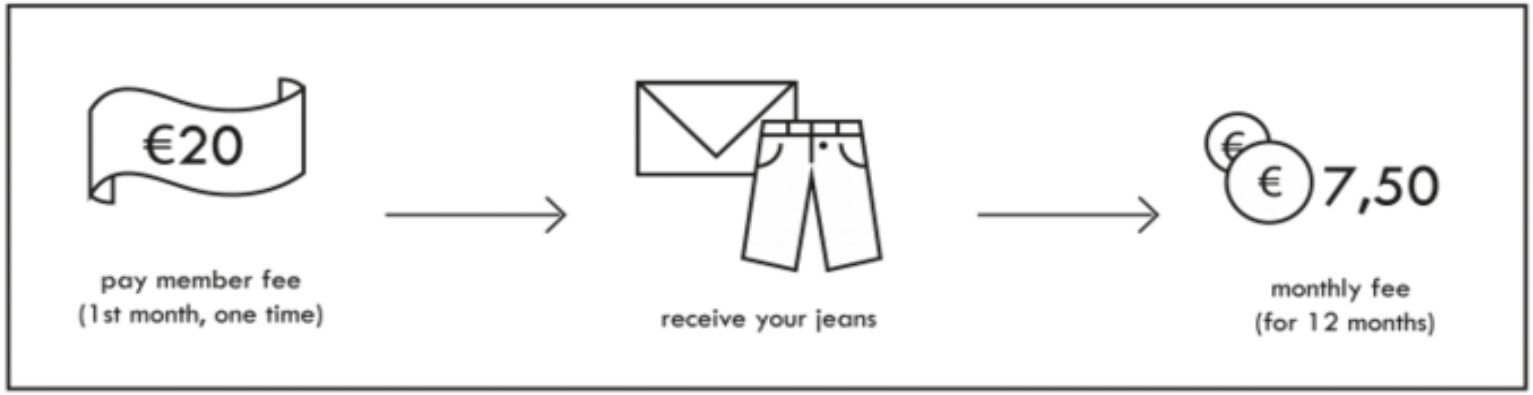
320,000 subscribers of the service

Pay for a service

Industry 4.0!

- Subscription on Clean laundry with a Miele at home (www.bundles.nl)
- Pay for use instead of ownership; Bundles IoT/Big data software platform makes paying for use of household appliances possible
- A quality washing Machine (Miele WKG 120 WCS) in your home for €20,95-€22,95 per month. No investment, no fixed contract, no repair costs and an app to help you use the machine better (www.wasbundles.nl)

MUDJEANS: Recycle materials, lease a jean



"Recycle materials
The starting point of our designs is recycling. The fabrics we use contain at least 98% of cotton, we don't use leather labels but printed logo's and on our knits we use buttons made out of recycled cotton. No polybags are use in our packing and hangtags are made out of recycled paper. We reuse the fabrics and make them useful again. That's why worn out jeans are sent to factories in Spain or in Italy. Here the jeans are shredded and mixed with new organic cotton. A new spun yarn containing recycled denim is born out of which new products are manufactured. An added value is that this circular process promotes job creation in the fields of recycling and remanufacturing."

Business models IV

Business models	Brief description	Illustrative examples	Illustrative circular economy benefits/advantages
SHARING ECONOMY / PLATFORMS AND COLLABORATIVE CONSUMPTION			
Sharing economy	C2C or B2B, but where no direct financial transaction occurs, or income is secured. More socially driven, rather than commercial, where access might strengthen community relationships. For B2B lending, business benefits might include reduced costs over directly sourcing the products/services concerned.	More traditionally dependent on the participation and generosity of community members (C2C) to share goods/ services. Can be more formalized via tool libraries (e.g. electric drill, lawnmower). Increasing interest in community-based lending of skills/know-how. Facilitates the sharing of over-capacity or underutilization (e.g. cars or apartments).	Strengthens local/community engagement. Reduces need for ownership and storage of goods. Sharing of skills/know-how.
Sharing platforms/resources (collaborative consumption)	Peer to peer (P2P) lending or "collaborative consumption" amongst users, either individuals or organizations, but where some form of transactional arrangement (which could be financial) is provided.	Renting out private parking spaces; shared ownership of products (e.g. pressure washer purchased between several neighbours). Space and logistics sharing (e.g. shared containers, storage, shipping and logistics). Bike sharing systems in cities (e.g. self-service cycle hire schemes in London and Paris etc.); users need to take out a subscription. This system can also be viewed as a form of "lease agreement", given that the user has to take out a subscription. The main difference is that the per cycle hire retention period is typically very short (e.g. same day) and payment is not re-occurring.	Enables increased utilization rate of products and services by making possible shared use/ownership among consumers. Enables customers to access a product, rather than owning it outright, and use it only as needed.

FIRMS

Source: BSI 8001/2017

Bike sharing, with mobile phones and apps

Mobike

Both are billion dollar investments, expanding internationally out of China

Ofo

Sharing

- Cars (Car2Go,…)
- Accommodations (Airbnb)
- Tools
- ……

Financing the new business models

Circular aspect	Conventional business models	New business models
Value added	Circular business models could produce products or services that customers value higher.	Increased pricing power, revenues or competitive advantage.
Pay per use	Implementing a pay per use scheme increases the demand for working capital in comparison to a 'sell after production' business model.	Increased working capital demand, spreading of cash flows over time, increased costs for receivables management and possibly increased credit risk on clients.
Cost of materials / production	Increased return flows of used products or materials can lower production costs and the need for working capital if virgin materials are more expensive to source.	Possible lower working capital demand and lower production costs can boost profit margins.
Ownership	If producers retain ownership of products during their life cycle it provides them with strong incentives to look after these products, maintain them well and make them valuable at the end of life. From a circular point of view this has strong advantages but it comes with increased financial obligations.	Balance sheet extension increases capital demand. Ownership also raises the question how to value goods on the balance sheet (valuation).
Asset tracking	Tracking sold products and services in order to perform maintenance over the life span or take them back at the end of the lifecycle requires knowledge about the whereabouts and conditions of the so called 'installed base'. Innovations like the 'internet of things' make easy tracking possible but require investments.	Increased R&D costs or investments in tracking and tracing devices.
Return flow	The return flow of products might be costly to handle.	Increased transportation and handling costs.
Supply Chain Finance	Supply chain finance lowers working capital costs in the supply chain.	Lower working capital costs and better cash flow management

Source: ING Economics Department based on ideas from Jonker (2014) and Accenture (2014)

Discussion

Implications of circular economy activities underway for developing countries? What are the opportunities and challenges?

- Trade in raw materials, wastes and secondary materials?
  - ✓Ferrous and non-ferrous metal scrap
  - ✓Plastics, paper and textiles
  - ✓Waste of electrical and electronic equipment (WEEE)
- When new regulations emerge on
  - ✓Disclosure of contents of secondary raw materials?
  - ✓Waste handling standards?
  - ✓New product standards?

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