Circular Economy

One of the solutions to the current climate and environmental Crises?

Mentimeter

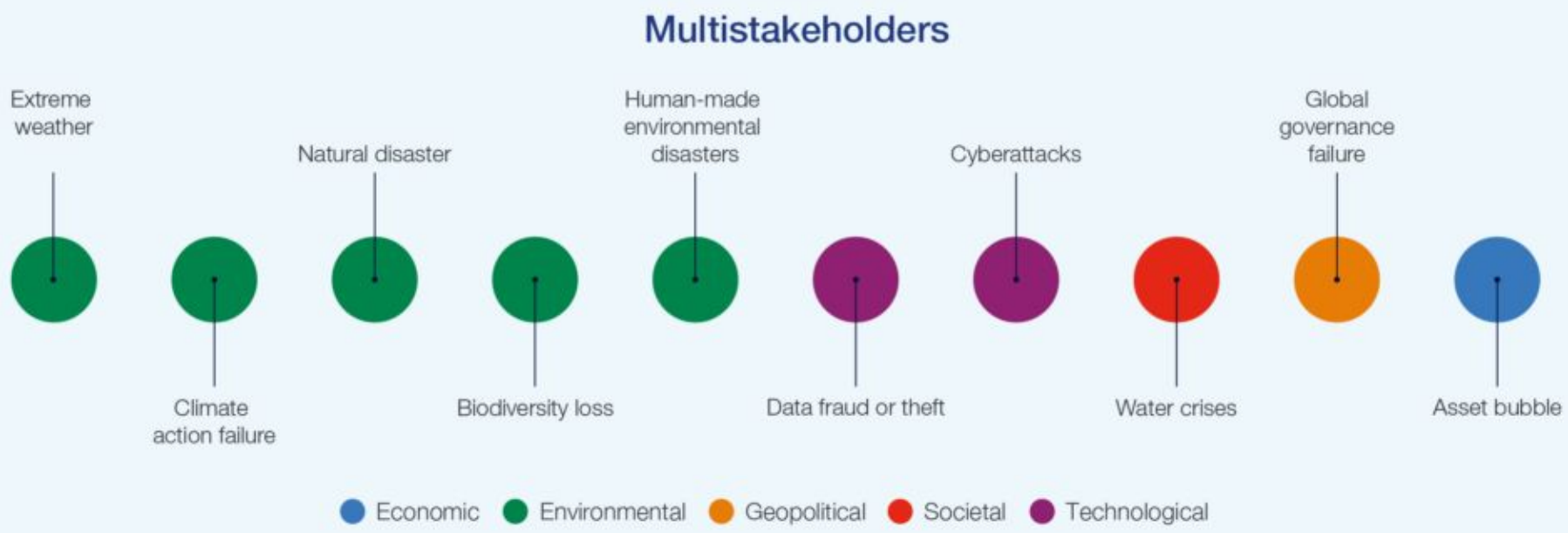
Which 3 words or word combinations do you associate with "circular economy"?

Why are we talking about this?

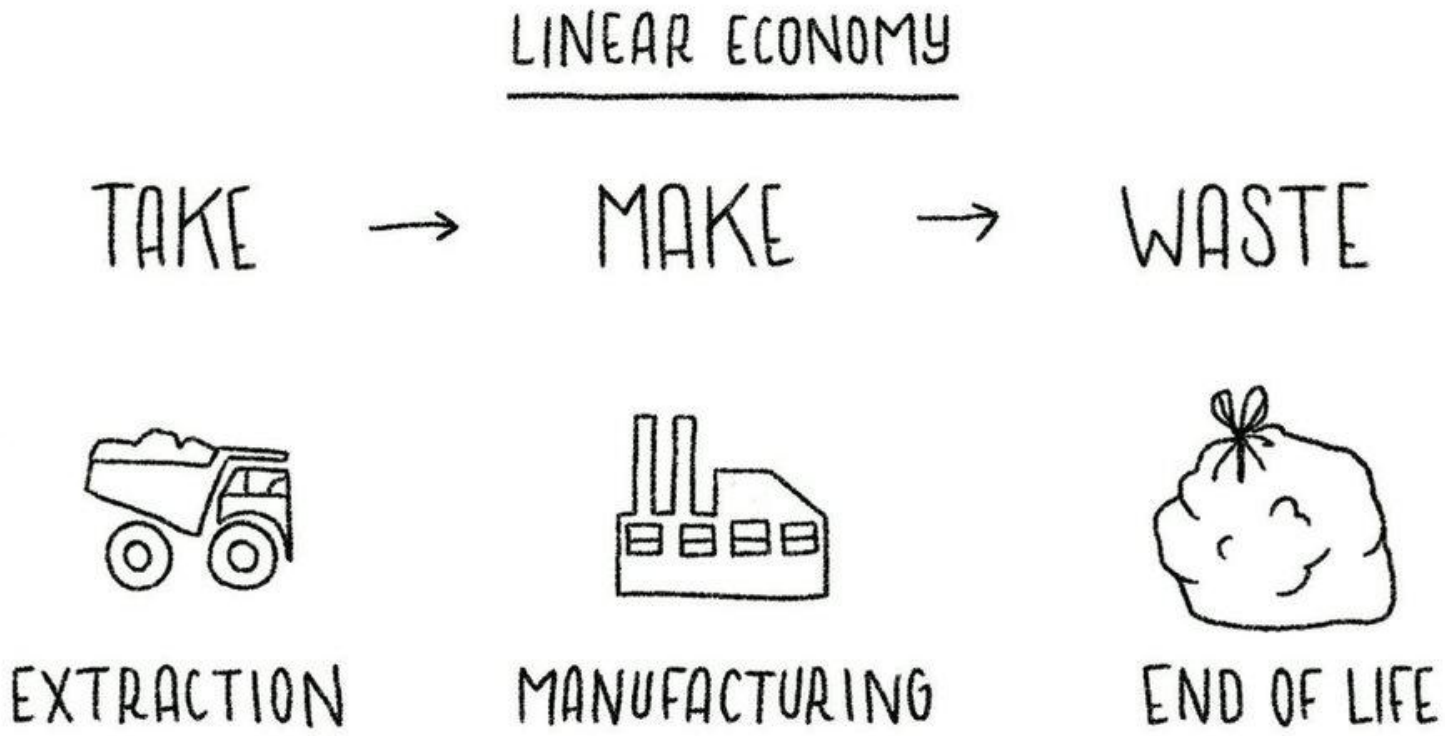
TOP 10 RISKS OVER THE NEXT 10 YEARS

Long-Term Risk Outlook: Likelihood

WORLD ECONOMIC FORUM



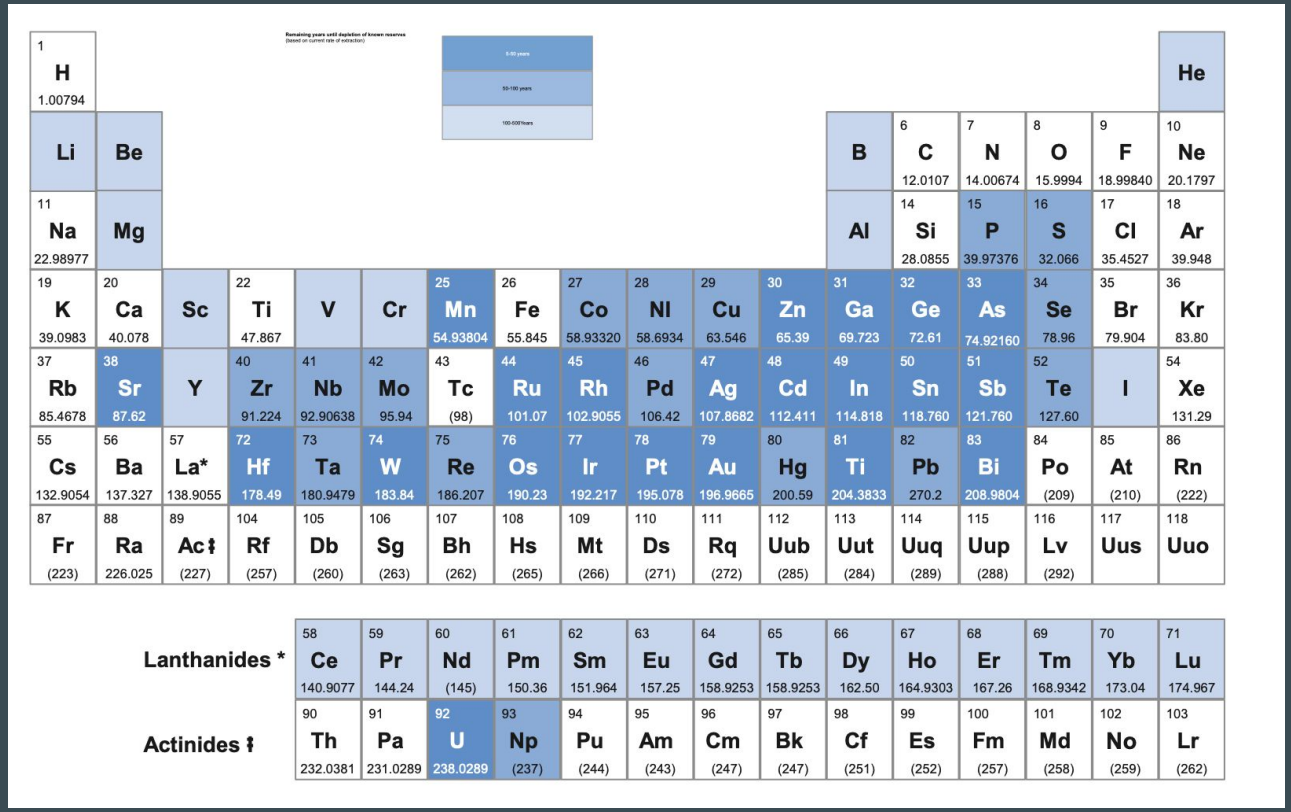
Reason?


LINEAR ECONOMY
TAKE → MAKE → WASTE
EXTRACTION
MANUFACTURING
END OF LIFE

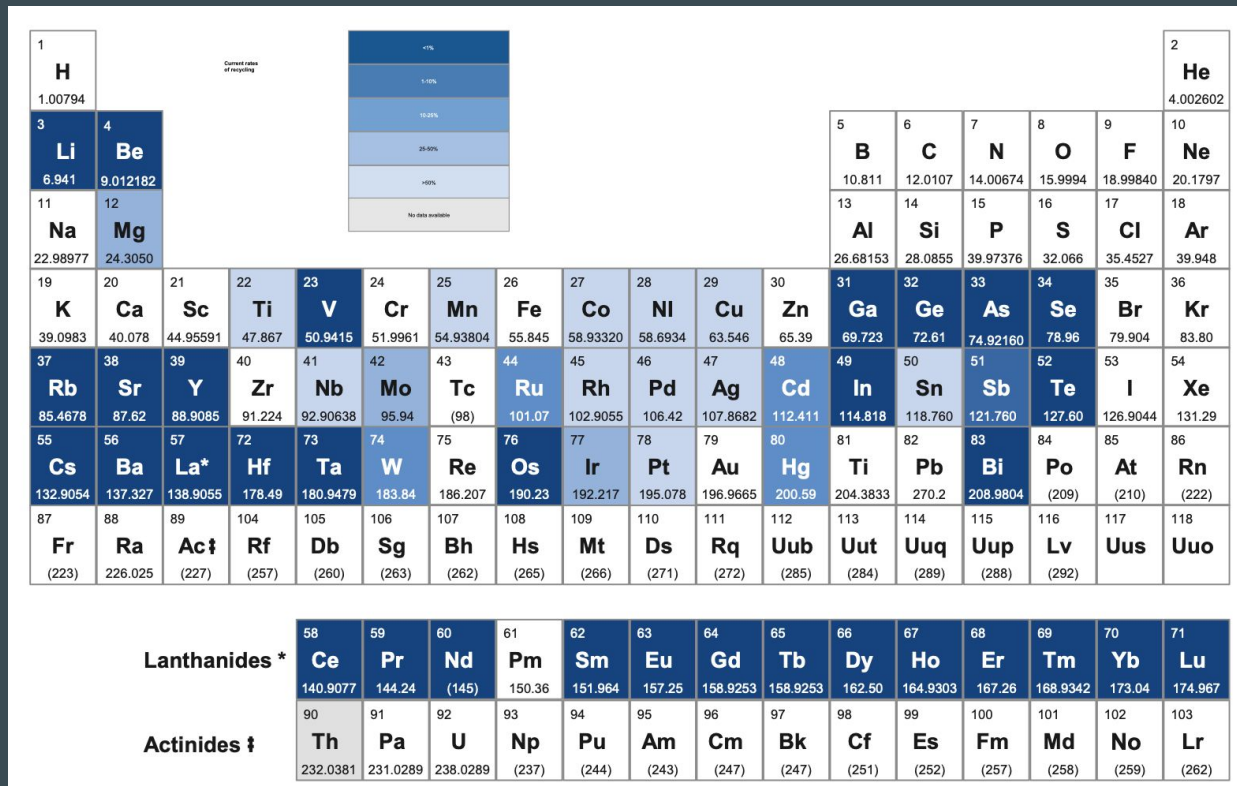
Issues with linear economy model (in numbers)

- Overproduction
  - 40% of the food goes to waste in the United States
  - 30% of clothes made around the world are never sold and end up at landfills
- Reduced lifecycles (esp. of technological products)
  - 99% of things we buy end up as waste within 6 months
- Accumulation of waste
  - global waste may grow by 70% by 2050
  - the world produced 8 billion tonnes of plastic: more than 1 tonne of plastic per person alive today (most of this plastic was discarded)
- Depletion and over-exploitation of natural resources

Supplies of key resources are limited



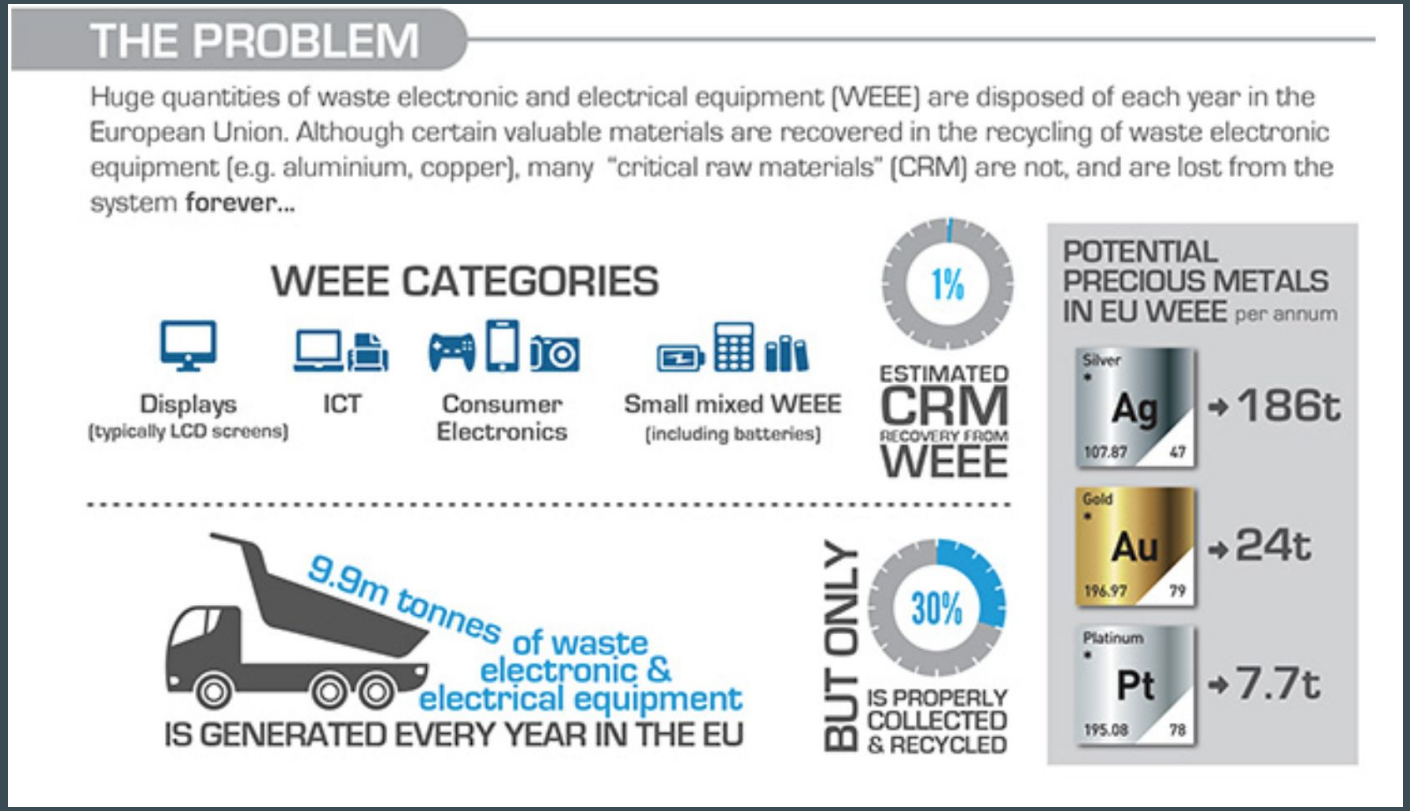
… while recycling rates for many remain low



1 H 1.00794																	2 He 4.002602
3 Li 6.941	4 Be 9.012182											5 B 10.811	6 C 12.0107	7 N 14.00674	8 O 15.9994	9 F 18.99840	10 Ne 20.1797
11 Na 22.98977	12 Mg 24.3050											13 Al 26.68153	14 Si 28.0855	15 P 39.97376	16 S 32.066	17 Cl 35.4527	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.95591	22 Ti 47.867	23 V 50.9415	24 Cr 51.9961	25 Mn 54.93804	26 Fe 55.845	27 Co 58.93320	28 Nl 58.6934	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.61	33 As 74.92160	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.9085	40 Zr 91.224	41 Nb 92.90638	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.9055	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.411	49 In 114.818	50 Sn 118.760	51 Sb 121.760	52 Te 127.60	53 I 126.9044	54 Xe 131.29
55 Cs 132.9054	56 Ba 137.327	57 La* 138.9055	72 Hf 178.49	73 Ta 180.9479	74 W 183.84	75 Re 186.207	76 Os 190.23	77 Ir 192.217	78 Pt 195.078	79 Au 196.9665	80 Hg 200.59	81 Ti 204.3833	82 Pb 270.2	83 Bi 208.9804	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.025	89 Ac‡ (227)	104 Rf (257)	105 Db (260)	106 Sg (263)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 Ds (271)	111 Rq (272)	112 Uub (285)	113 Uut (284)	114 Uuq (289)	115 Uup (288)	116 Lv (292)	117 Uus	118 Uuo

Lanthanides *	58 Ce 140.9077	59 Pr 144.24	60 Nd (145)	61 Pm 150.36	62 Sm 151.964	63 Eu 157.25	64 Gd 158.9253	65 Tb 158.9253	66 Dy 162.50	67 Ho 164.9303	68 Er 167.26	69 Tm 168.9342	70 Yb 173.04	71 Lu 174.967
Actinides ‡	90 Th 232.0381	91 Pa 231.0289	92 U 238.0289	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)

Recovery rates and material leakages in the EU (2014)



Theory of circular economy

Definition, history and application

Definition

Circular economy is a system where the value of products, materials and resources are maintained in the economy for as long as possible, and the generation of waste is minimised.

Main principles

Design out waste and pollution

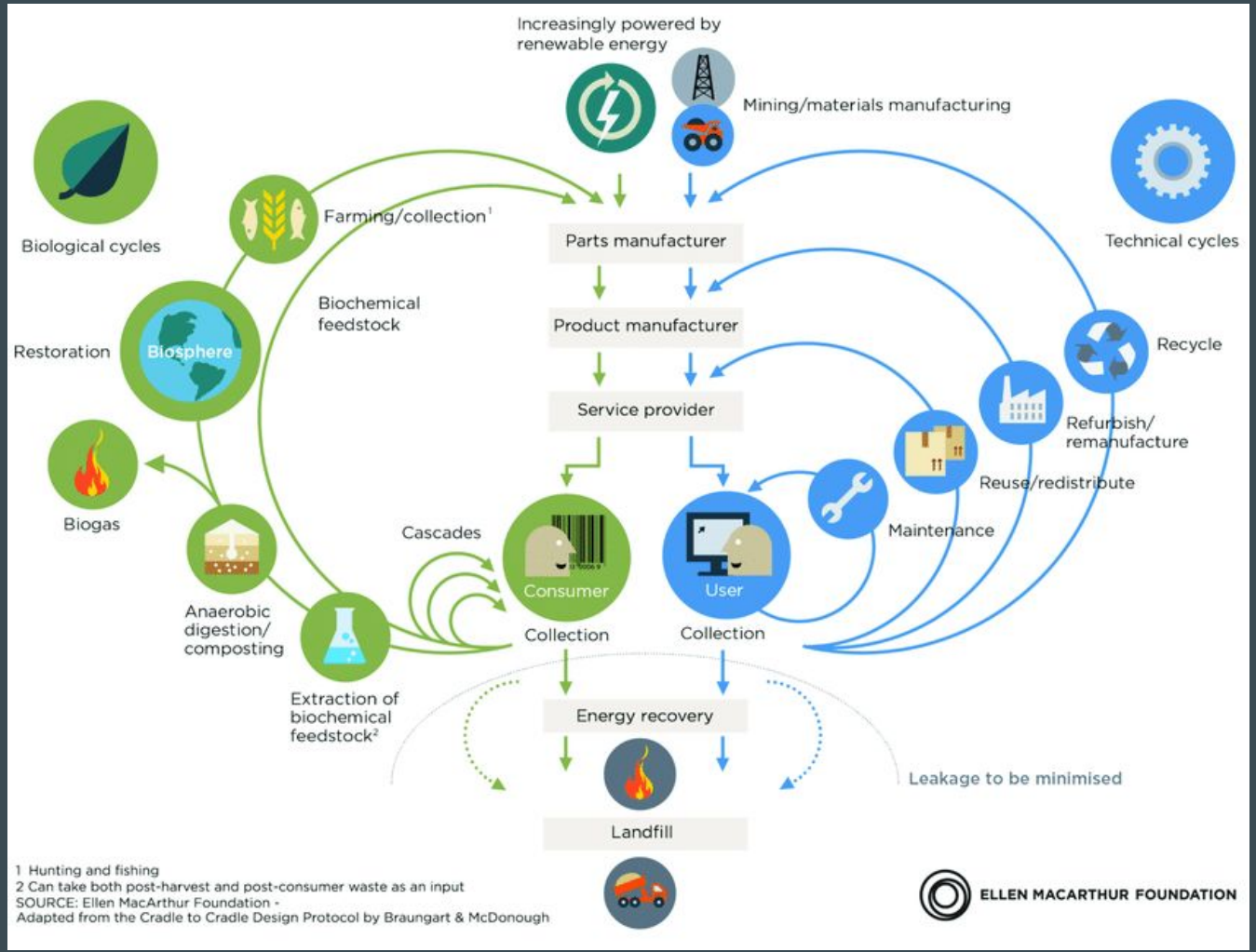
Keep products and materials in use

Regenerate natural systems

Key elements

ELLEN MACARTHUR FOUNDATION
Rethink the future

CIRCLE ECONOMY


Increasingly powered by renewable energy
Mining/materials manufacturing
Biological cycles
Farming/collection[1]
Technical cycles
Parts manufacturer
Biochemical feedstock
Product manufacturer
Restoration
Biosphere
Recycle
Service provider
Refurbish/ remanufacture
Biogas
Reuse/redistribute
Maintenance
Cascades
Consumer
User
Anaerobic digestion/ composting
Collection
Collection
Extraction of biochemical feedstock[2]
Energy recovery
Leakage to be minimised
Landfill
1 Hunting and fishing
2 Can take both post-harvest and post-consumer waste as an input
SOURCE: Ellen MacArthur Foundation -
Adapted from the Cradle to Cradle Design Protocol by Braungart & McDonough
ELLEN MACARTHUR FOUNDATION

Economic opportunity

- CE could increase European Union's **GDP by up to 7%** (*McKinsey*)
- European Union's manufacturing sector can **save USD 630 billion** per year (Ellen *McArthur Foundation*)
- Potential to bring **USD 4.5 trillion in global benefits** (*Accenture*)

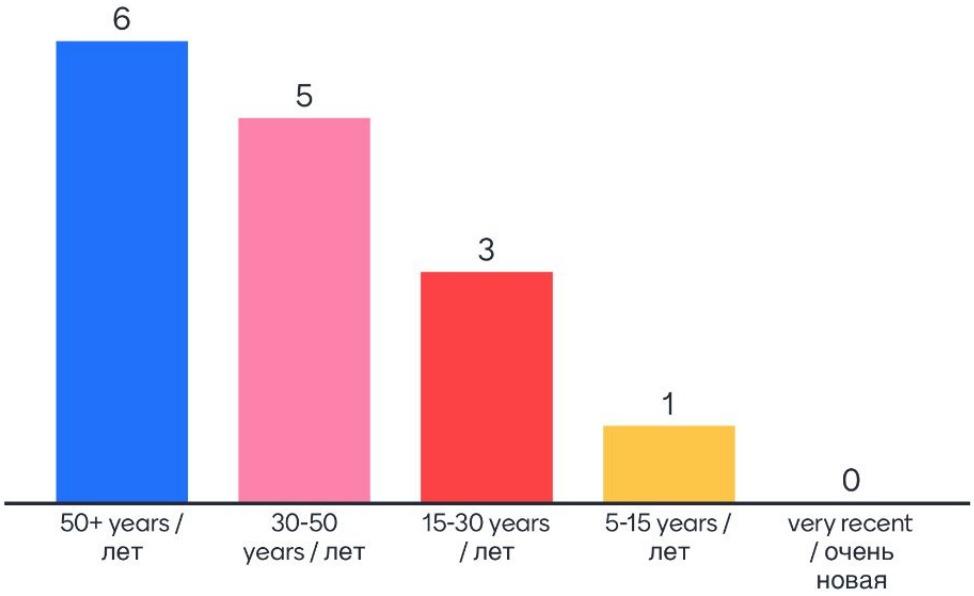
Environmental benefits

- Resource efficiency
- Waste/pollution prevention
- Greenhouse gas emissions reduction
- Nature and biodiversity conservation
- etc

How old is the “circular economy” concept?

Mentimeter

How old do you think the circular economy concept is?



YouTube CH

circular economy

#circulareconomy

Explaining the Circular Economy and How Society Can Re-think Progress | Animated Video Essay

957,683 views • Aug 28, 2011

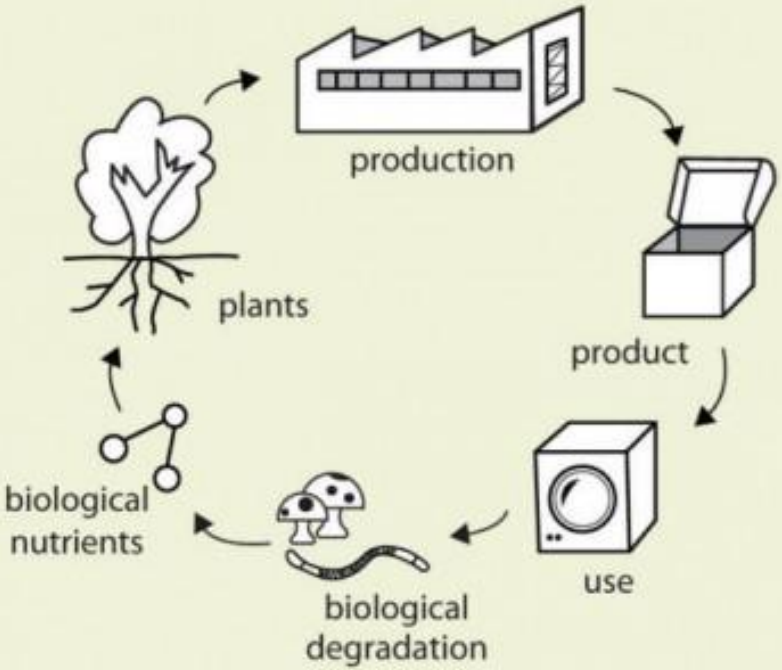
6.5K 131 SHARE SAVE

Ellen MacArthur Foundation
25.2K subscribers

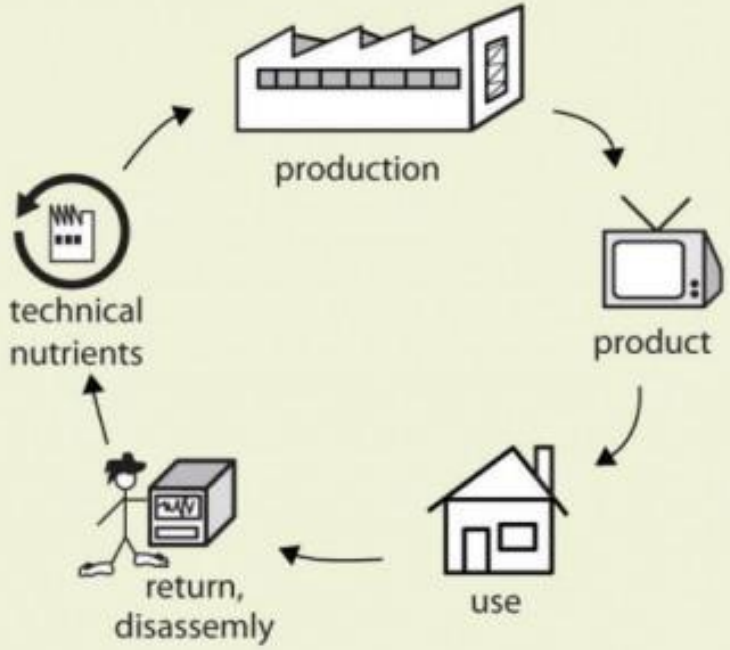
SUBSCRIBE

Glimpse into history

- 1966: Kenneth Boulding, closed economy vs. open economy
- 1970s: Walter R. Stahel, “Cradle to Cradle” vs. “Cradle to Grave”, industrial sustainability, vision of an economy in loops
- 1989: David W. Pearce & R. Kerry Turner, “Economics of Natural Resources and the Environment”, circular economic model with an extensive interdependence between the economy and the environment
- 1990s: Tim Jackson, preventive environmental management
- 2000s: Suren Erkman, industrial ecology, eco-industrial networks
- 2010s: M.Braungart and W. McDonough, “The upcycle: Beyond sustainability - designing for abundance”

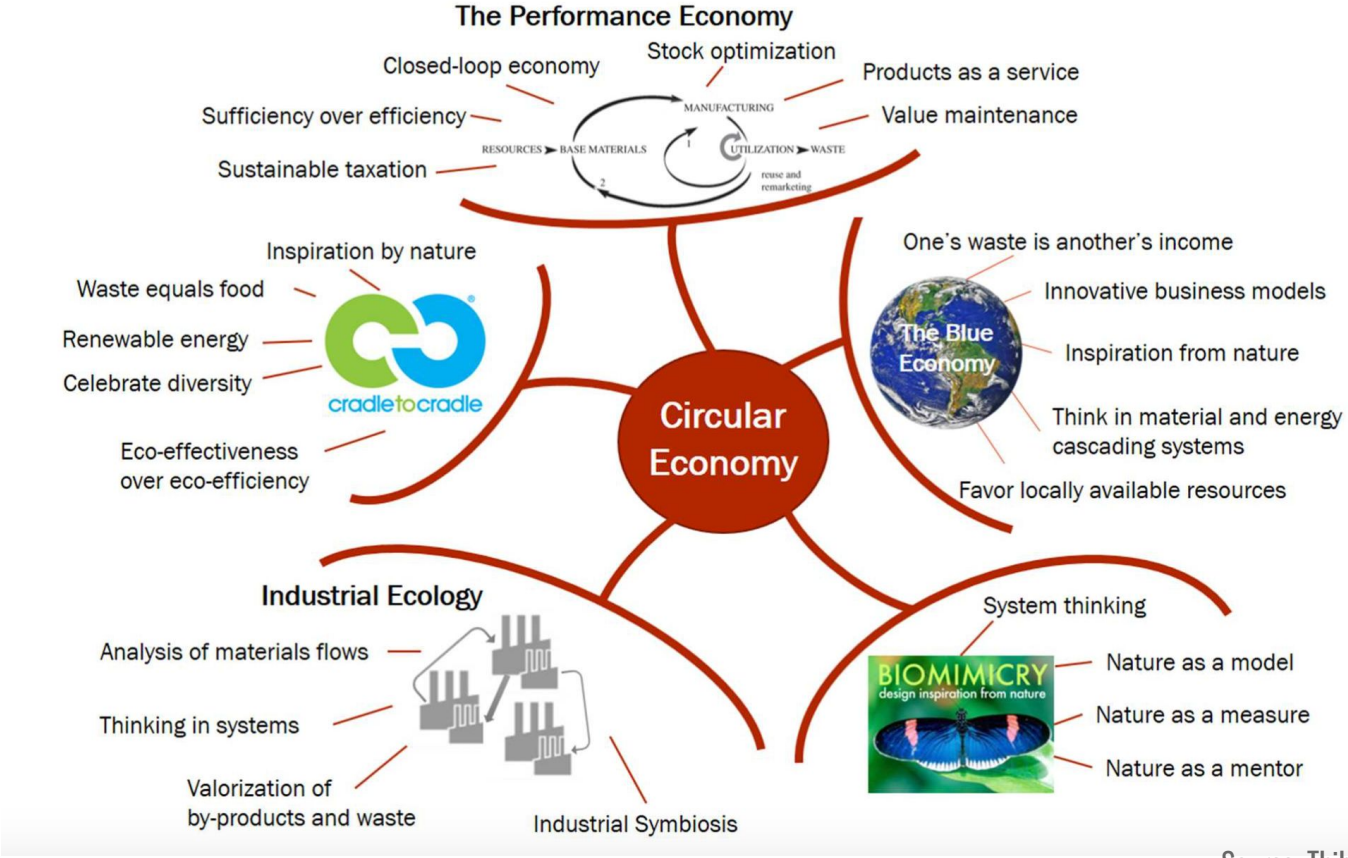


Biological Cycle
for Products for Consumption



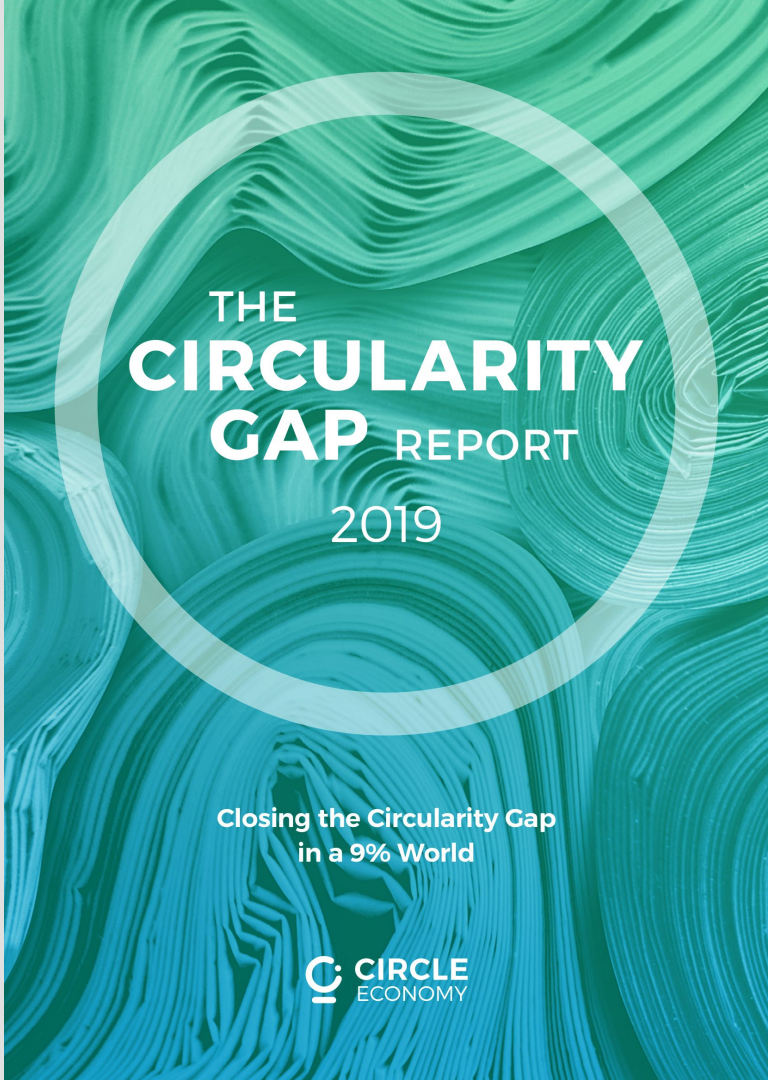
Technical Cycle
for Products for Service

The influence of the various schools of thought on circular economy



Source: Thibaut Wautelet 2018

Global economy is only 9% circular - just 9% of the 92.8 billion tonnes of minerals, fossil fuels, metals and biomass that enter the economy are re-used annually



Circular economy in national/regional policies

CIRCULAR ECONOMY AS A POLICY TOOL

Net-zero emissions by 2050

Conserve 25% of land and 25% of oceans by 2025

Plant 2 billion incremental trees over the next 10 years

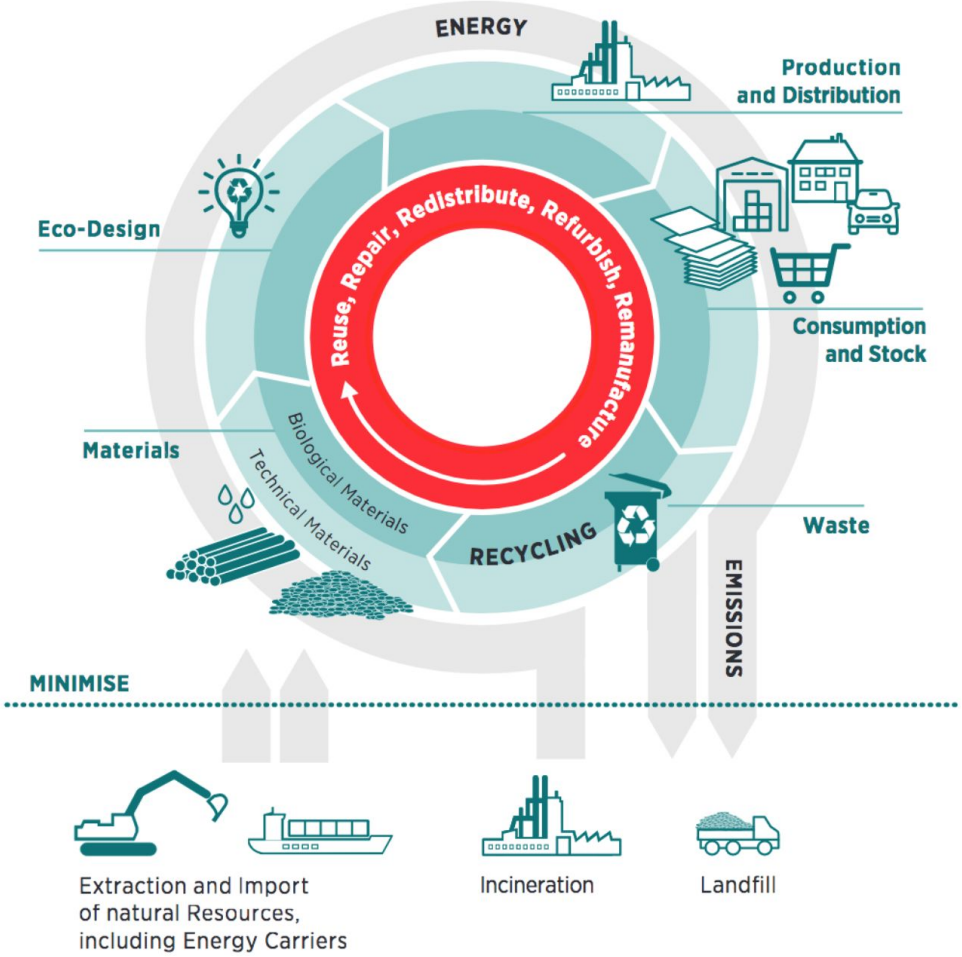
Implement our plan to ban single-use plastic products

Main components to China's circular economy strategy:

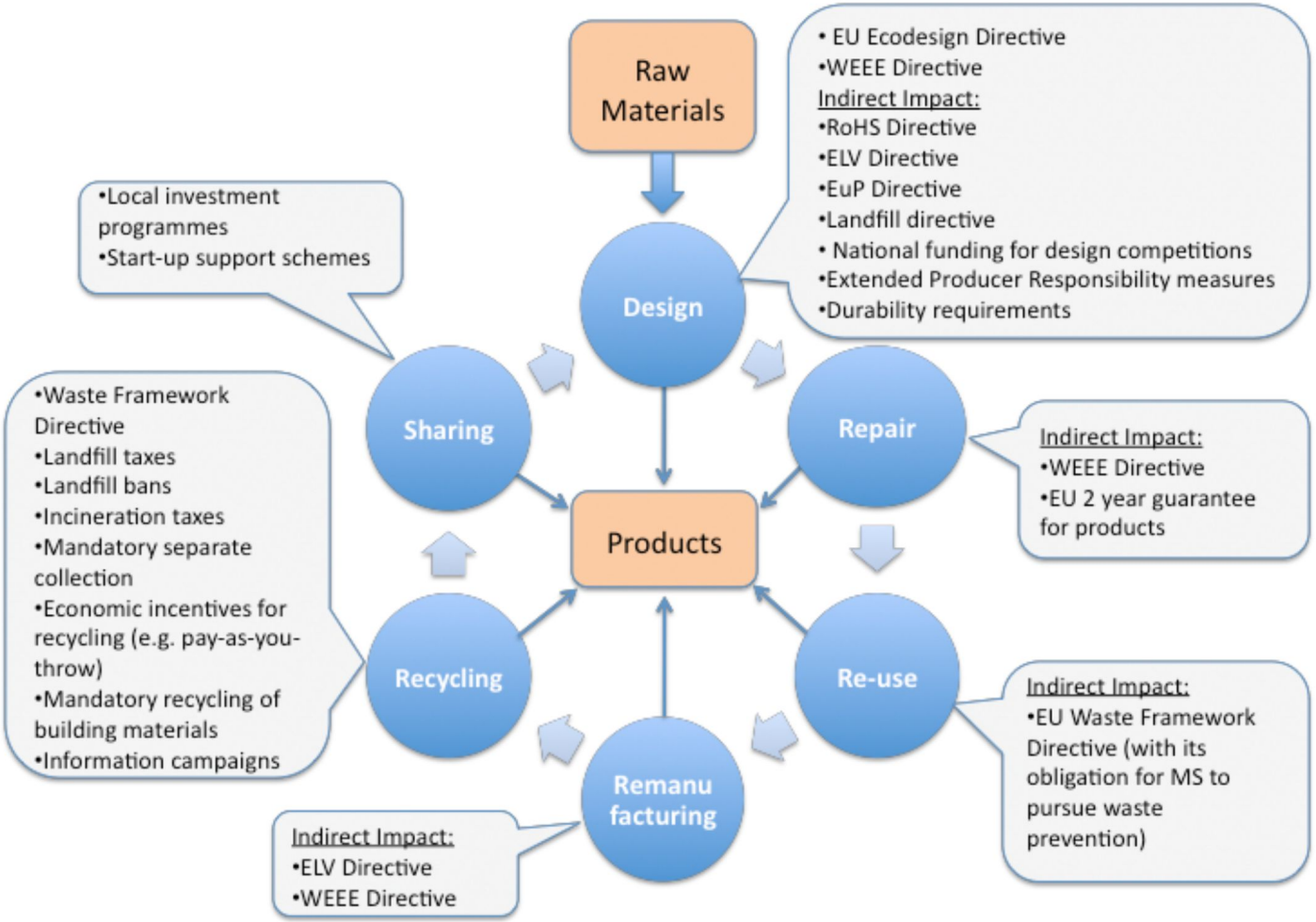
- **Circular systems of industry, agriculture and services** — to follow the principle of optimising industrial processes, greatly supporting circular production;
- **Green consumption ('circular values') —** to guide citizens towards smart, healthy and safe consumption
- **Circular production —** to embed reduce, reuse and recycling into whole production processes;
- **Growth of recycling industry —** to recycle and reuse urban waste streams, focusing on remanufacture and renewable energy

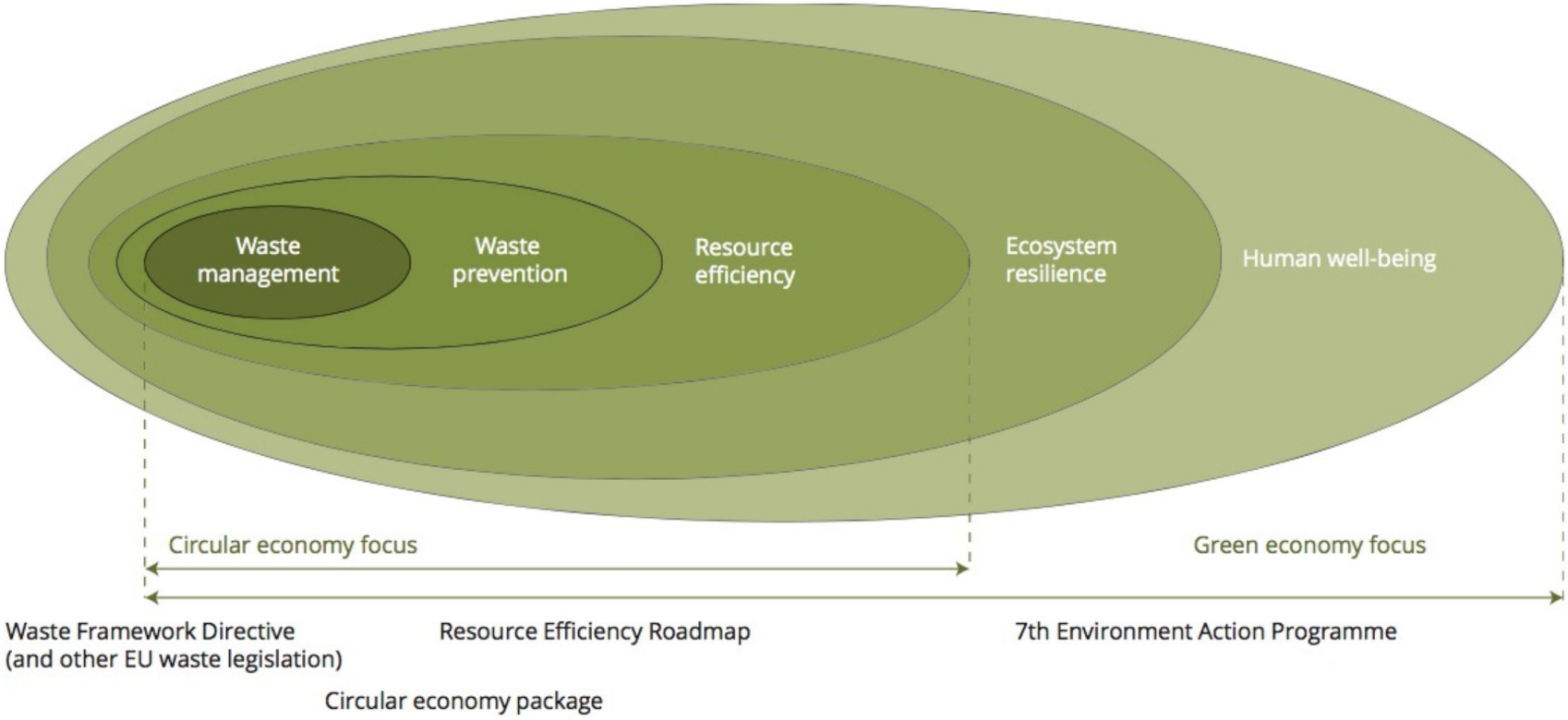
EU Circular Economy Action Plan details measures to:

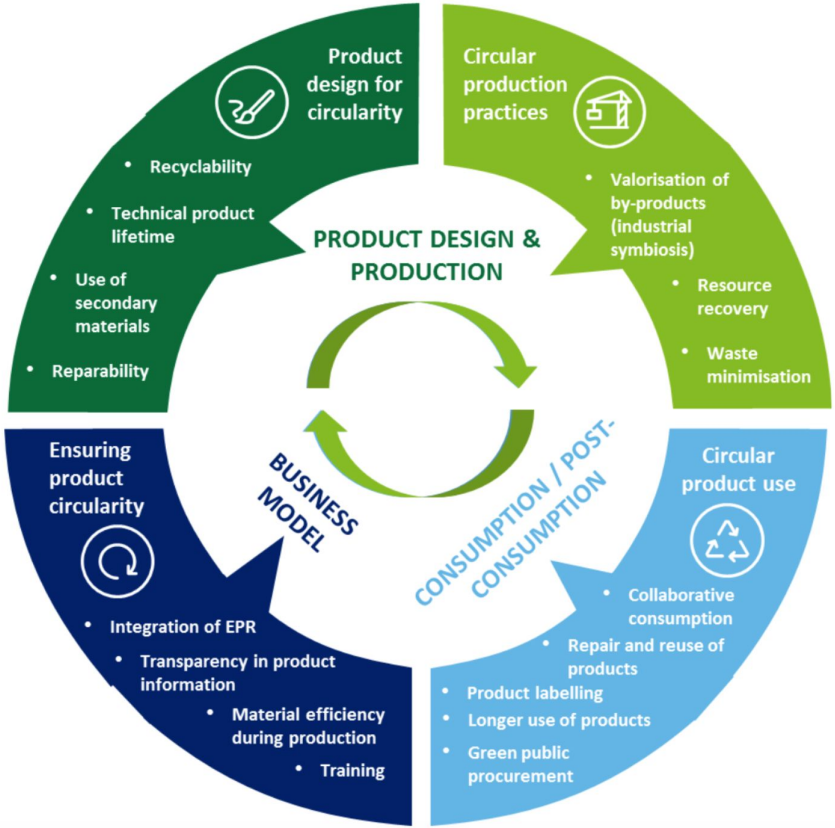
- **make sustainable products the norm** in the EU, including, the restriction of single-use products and ensuring that products on the EU market are designed to last longer, are easier to reuse, repair, and recycle, and incorporate recycled material as much as possible;
- **empower consumers through access to reliable information** about products at the point of sale, including on their life span;
- **focus on sectors that use the most resources** and have the potential for high circularity, including electronics and information and communications technology (ICT), batteries and vehicles, packaging, plastics, textiles, construction and buildings, and food;
- **ensure less waste** by transforming it into high-quality secondary resources and implementing actions to minimize EU waste exports and tackle illegal shipments.



CICERONE
Circular economy platform for European priorities strategic agenda


Raw Materials
• EU Ecodesign Directive
•WEEE Directive
Indirect Impact:
•RoHS Directive
•ELV Directive
•EuP Directive
•Landfill directive
• National funding for design competitions
•Extended Producer Responsibility measures
•Durability requirements
Design
•Local investment programmes
•Start-up support schemes
Sharing
Repair
Indirect Impact:
•WEEE Directive
•EU 2 year guarantee for products
•Waste Framework Directive
•Landfill taxes
•Landfill bans
•Incineration taxes
•Mandatory separate collection
•Economic incentives for recycling (e.g. pay-as-you-throw)
•Mandatory recycling of building materials
•Information campaigns
Products
Recycling
Re-use
Indirect Impact:
•EU Waste Framework Directive (with its obligation for MS to pursue waste prevention)
Remanufacturing
Indirect Impact:
•ELV Directive
•WEEE Directive


Waste management
Waste prevention
Resource efficiency
Ecosystem resilience
Human well-being
Circular economy focus
Green economy focus
Waste Framework Directive (and other EU waste legislation)
Resource Efficiency Roadmap
7th Environment Action Programme
Circular economy package



CICERONE
Circular economy platform for European priorities strategic agenda

Framework for monitoring and evaluation of product eco-innovation for the circular economy

Key actors

National, regional, local authorities & agencies dealing with industrial development and waste

Businesses & industries

National, regional or local innovation agencies & intermediaries

Research organisations, cluster organisations & universities

NGOs, citizens, user groups

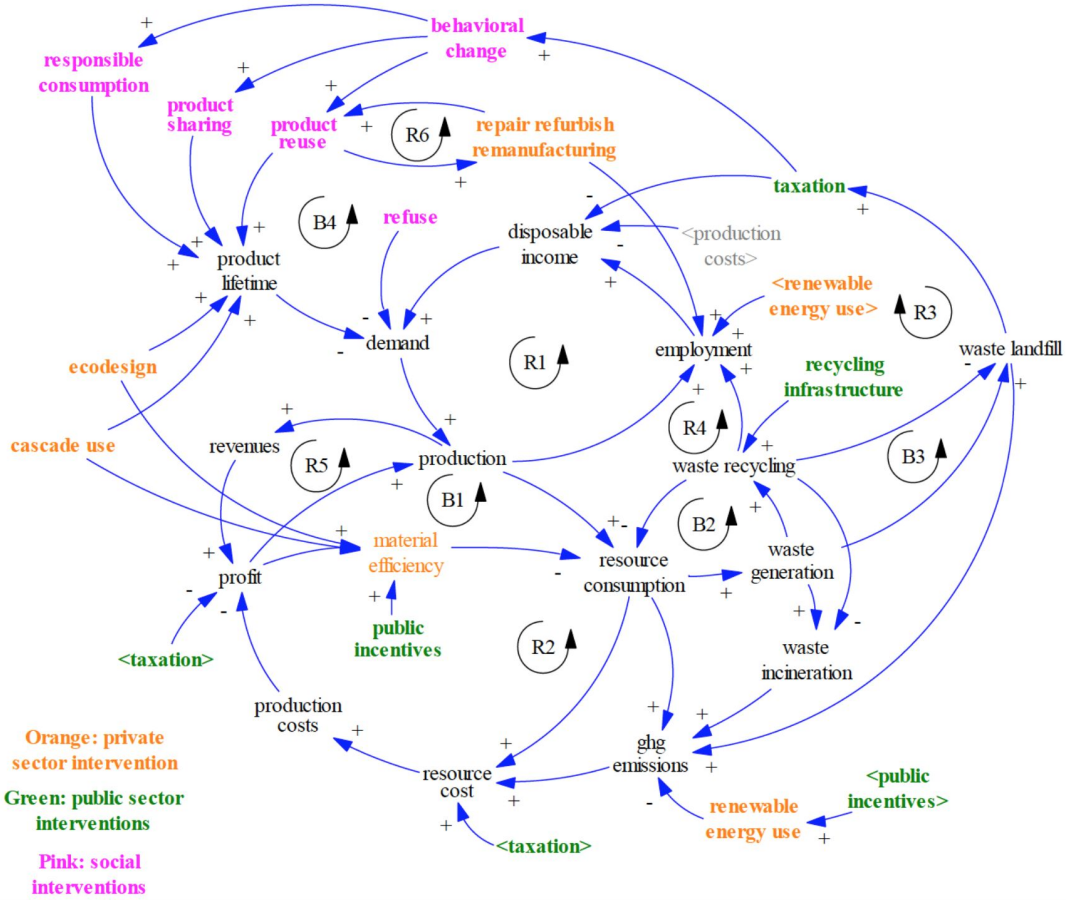
Circular economy in practice

Do you already do anything yourself that fits into circular economy concept?

Renewable energy

Current energy sources:

- 75% of the global energy production is based on non-renewable and emissions intensive fossil fuels
- Years of fossil fuel reserves left (at current rate of consumption):
  - Coal: 114
  - Natural gas: 53
  - Oil: 51
- Fossil fuels are not suitable for the economies over the next ten million generations, not suitable for CE concept
- Sun, wind and water are available for millions of years, do not pollute and do not cause greenhouse gas emissions



CICERONE
Circular economy platform for European priorities strategic agenda

Causal loop diagram for the circular economy and its interlinkages

Wind energy: renewable, but not yet fully green

- By 2030, many wind farms in Europe will reach the end of their 20-25 year lives
- 80-90% of a modern wind turbine is recyclable
- wind turbine blades are made of fibreglass or carbon fibre and are complicated to recycle, often ending up in landfill sites once they reach their end of life

Solar energy: renewable, also not yet fully green

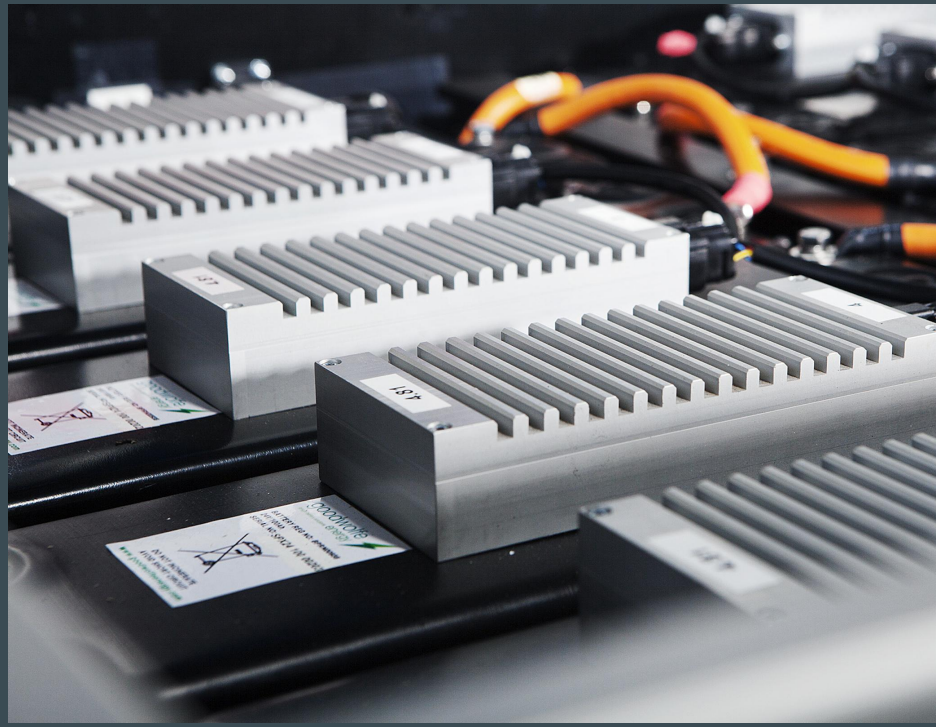
- Average life expectancy of solar panels is 30 years
- Solar panels recycling ≃ 95% efficiency
- Common belief of solar panels not being recyclable is a myth
- What matters: introducing relevant policies at national level
- EU: solar PV panels are defined as e-waste in the Waste Electrical and Electronic Equipment Directive

Metal	$Demand_{20xx}/Production_{2013}$		Emerging technologies
	2013	2035	
Lithium	0.0	3.9	Lithiumion batteries, lightweight airframes
Heavy rare earths (Dy/Tb)	0.9	3.1	Magnets, e-cars, wind power
Rhenium	1.0	2.5	Super alloys
Light rare earths (Nd/Pr)	0.8	1.7	Magnets, e-cars, wind power
Tantalum	0.4	1.6	Microcapacitors, medical technology
Scandium	0.2	1.4	SOFC fuel cells
Cobalt	0.0	0.9	Lithium-ion batteries, XtL.
Germanium	0.4	0.8	Fiber optic, IR technology
Platinum	0.0	0.6	Catalysts, seawater desalination
Tin	0.6	0.5	Transparent electrodes, solders
Palladium	0.1	0.5	Catalysts, seawater desalination
Indium	0.3	0.5	Displays, thin layer photovoltaics
Gallium	0.3	0.4	Thin layer photovoltaics, IC, WLED
Silver	0.2	0.3	RFID
Copper	0.1	0.3	Electric motors, RFID
Titanium	0.0	0.2	Seawater desalination, implants

Global demand for metals for 42 emerging technologies in 2013 and 2035 compared to the global production volume of the respective metals in 2013

Electric cars: raw materials & batteries issue

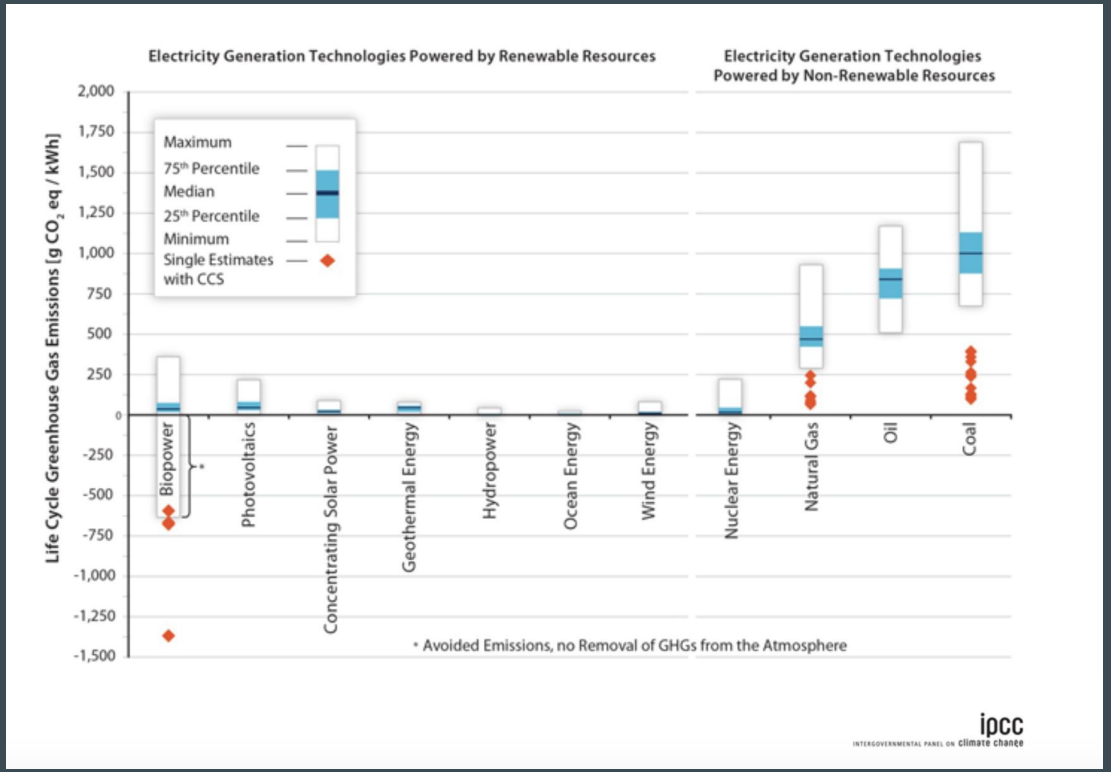
- 95% of lithium-ion battery can be reused
- BUT lithium-ion devices are arranged within battery packs to maximize safety and cell longevity at the expense of recyclability
- there are no global standards for battery labeling, which is needed to clearly indicate device composition to recyclers

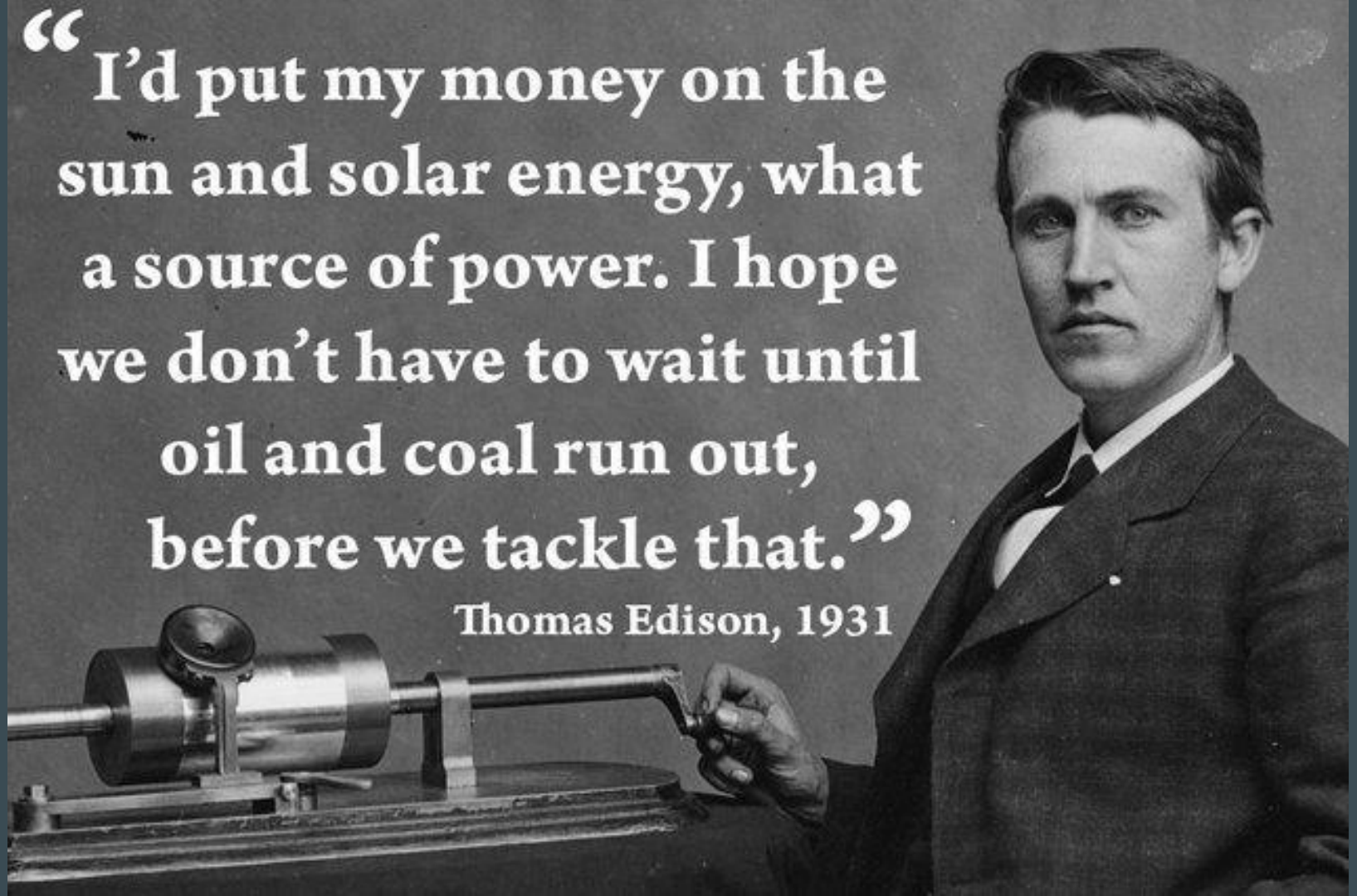


Does it mean all available solutions are equally not perfect?

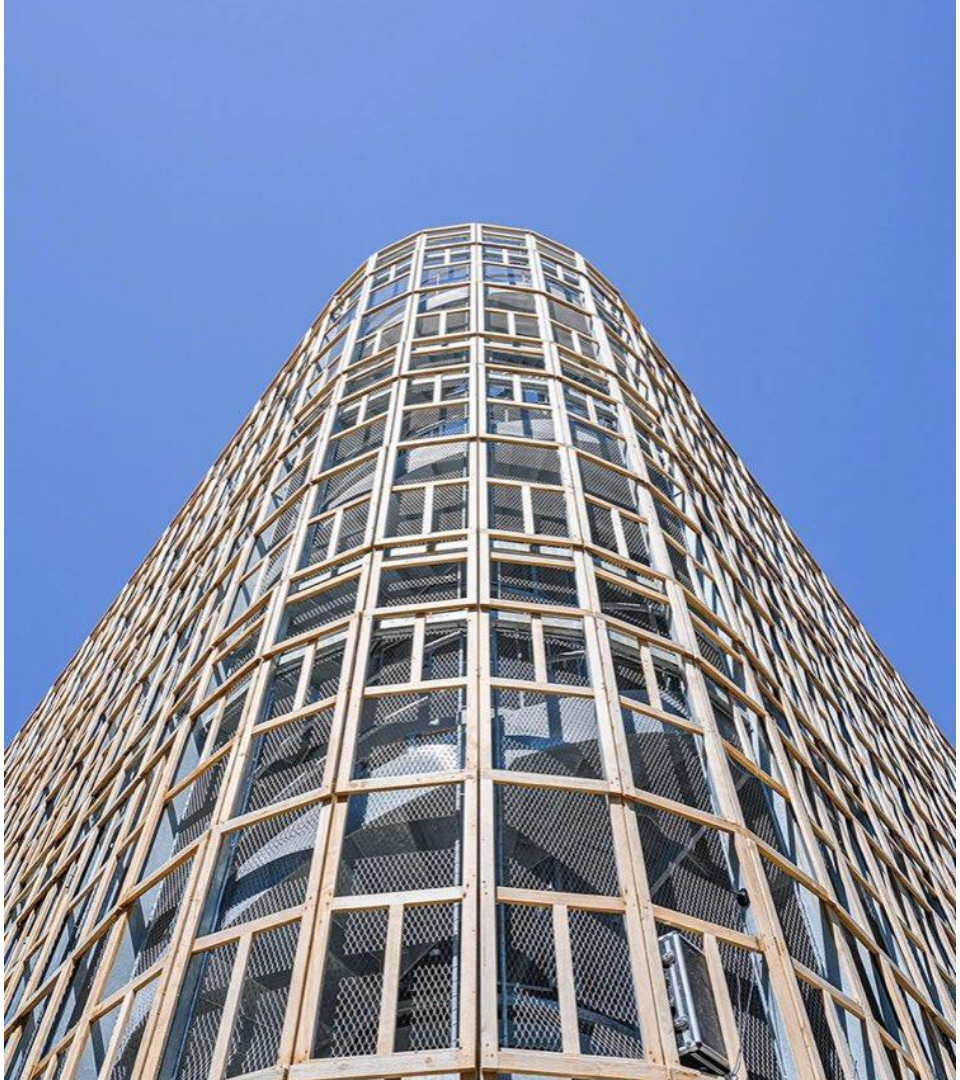
Among the tools that help to compare different solutions & technologies:

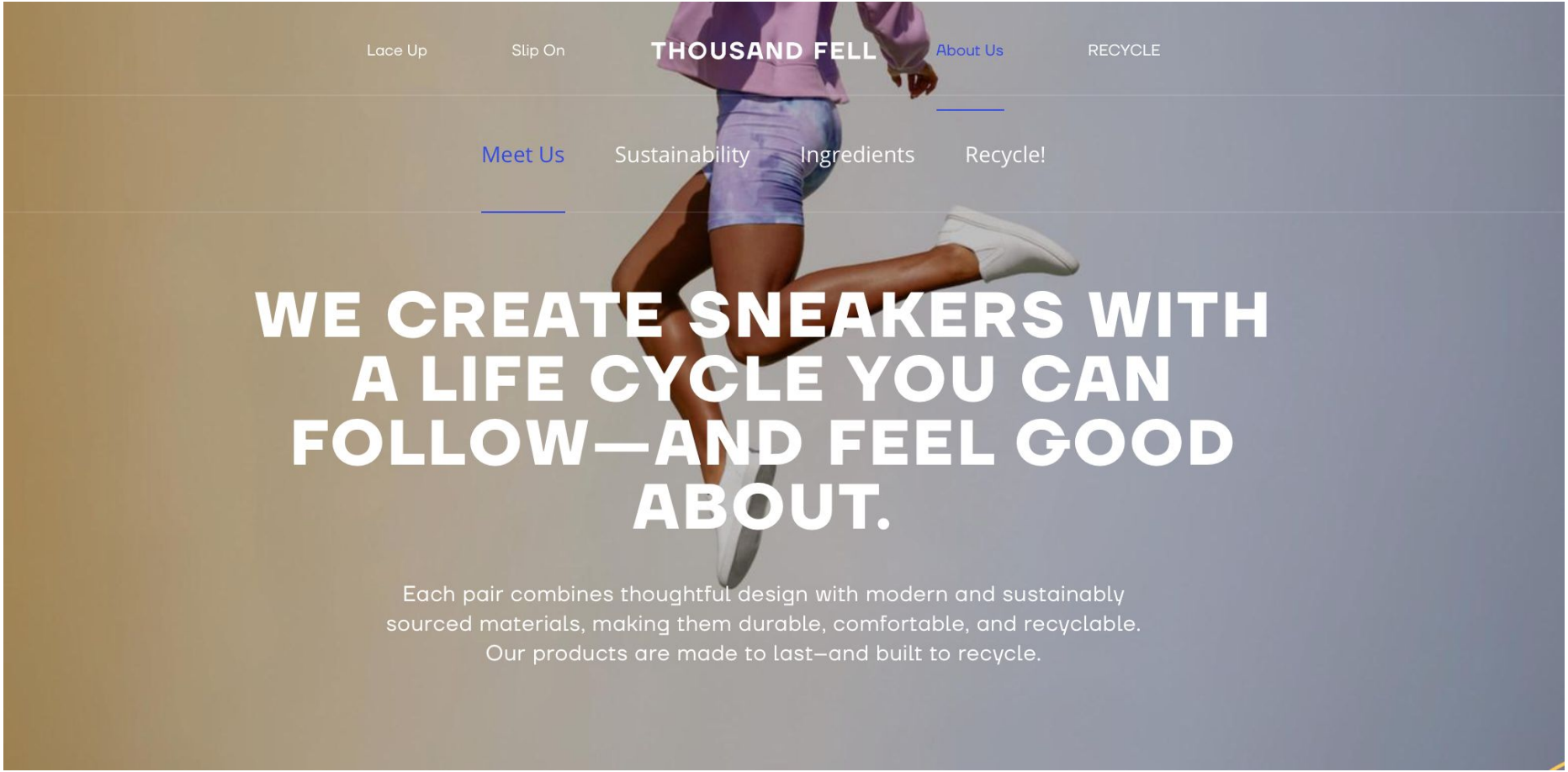
lifecycle analysis (LCA)




“I’d put my money on the sun and solar energy, what a source of power. I hope we don’t have to wait until oil and coal run out, before we tackle that.”
Thomas Edison, 1931

Applications around the world




Lace Up
Slip On
THOUSAND FELL
About Us
RECYCLE
Meet Us
Sustainability
Ingredients
Recycle!
WE CREATE SNEAKERS WITH A LIFE CYCLE YOU CAN FOLLOW—AND FEEL GOOD ABOUT.
Each pair combines thoughtful design with modern and sustainably sourced materials, making them durable, comfortable, and recyclable. Our products are made to last—and built to recycle.


ERSTE HILFE

100% recycled tin in the solder

zero waste

sent to landfill from final assembly supplier sites

100% virgin wood fiber from responsibly managed forests

99% recycled tungsten in the whole product

100% recycled tungsten in the Taptic Engine

100% recycled rare earth elements in the magnets

98% recycled rare earth elements in the whole product

More than 90% recyclable fiber packaging

Arsenic-free display glass

Transitioning to 100% renewable energy for Apple production

No BFR
No PVC
No Beryllium
No Mercury

35% recycled plastics in at least eight different components


精细化拆解，高技术分类，


循环中国，创建受全球尊敬的
Recycling the Resources in China, Creating a World Respectful

What about Eastern Partnership countries?

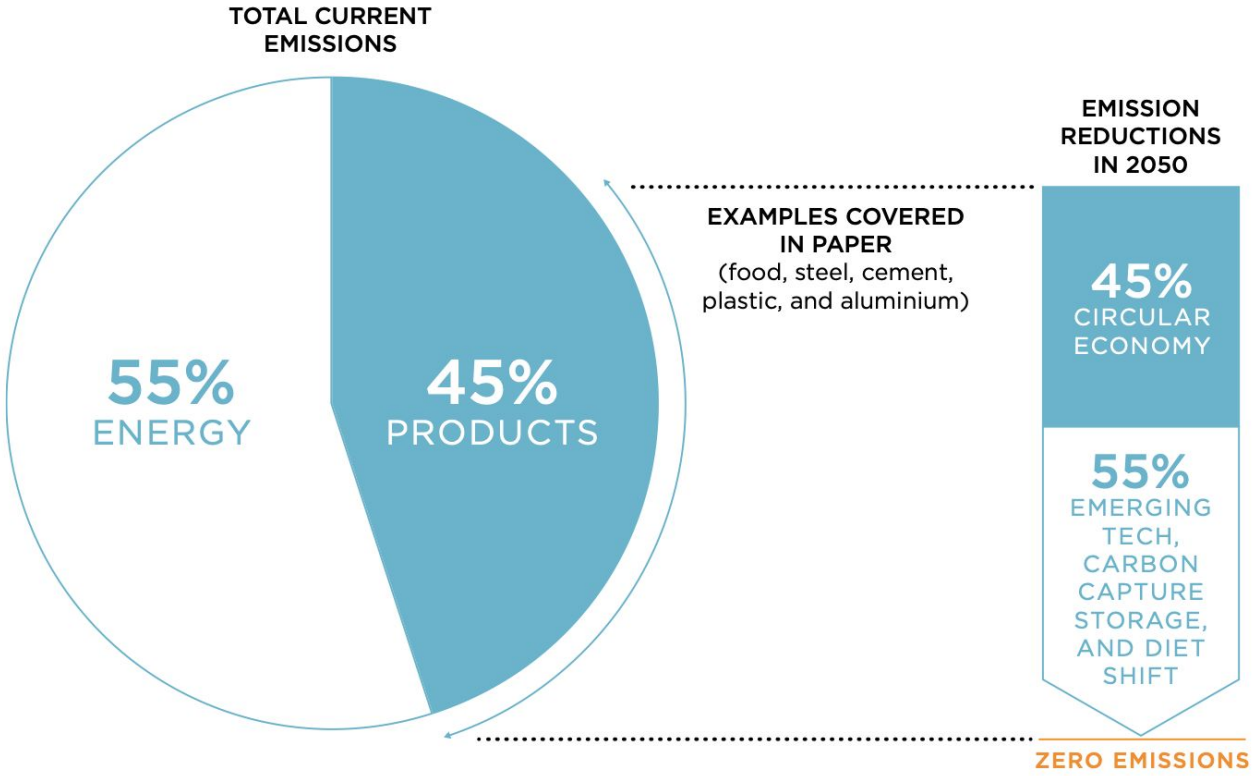
Is circular economy the solution?

Advantages and challenges

Circular economy for Paris Climate Goals

- “A 1.5 degree world can only be a circular world” (*Harald Fried, Circle Economy*)
- CE fills a gap addressing products & materials lifecycle
- 62% of global greenhouse gas emissions (excl. land use & forestry) are released during extraction, processing and manufacturing of goods to serve society’s needs
- Circular strategies to reduce waste are particularly important in the built environment, which accounts for a fifth of global emissions
- CE can reduce global CO2 emissions from cement, steel, plastic and aluminium by 40%

COMPLETING THE PICTURE: TACKLING THE OVERLOOKED EMISSIONS



Advantages

- CE attracts both the **businesses and policy-makers** to sustainability work
- **Environmental benefits**: waste prevention, reducing pressure on the environment, less greenhouse gas emissions
- Stimulating **innovation**, boosting **economic growth** and creating jobs
- Improved **security** of raw materials supplies
- Consumers provided with more **durable and innovative products** with increased quality of life and allowing to save money in the long term

Would you be ready to repair, reuse, recycle instead of buying new?

What would help to change your consumption habits?

Limitations

- There is **no common ground** (yet) **for CE theory and knowledge**. How much time do we have to establish this knowledge and implement it?
- **Lock-in effect**. Demand for circular products and alternatives is still small, laws & regulations are not prepared for innovations
- A **cyclic flow does not secure a sustainable outcome** (e.g., using forest residues as a renewable energy source). Sustainability contribution of CE projects is a question that needs a case-by-case analysis.
- **Waste recovery can never make 100%**
- **What about all the existing waste** that humanity has been stockpiling for the last 100+ years? Circular economy does not directly address this issue

Useful links

- Ellen MacArthur Foundation
  https://www.ellenmacarthurfoundation.org/circular-economy/what-is-the-circular-economy
- World Business Council for Sustainable Development
  https://www.wbcsd.org/Programs/Circular-Economy
- World Economic Forum
  https://www.weforum.org/projects/circular-economy
- Platform for Accelerating the Circular Economy (PACE)
  https://pacecircular.org
- EU Circular Economy Action Plan:
  https://ec.europa.eu/environment/circular-economy/

Q & A

Now let’s take a product from everyday life and try to apply to it circular economy principles

Recommendations:

- Improve **waste management** practices
- Introduce **financial incentives** to change habits of consumers, retailers and manufacturers
- Push for a more **circular model of design and production**
- Finance research and development of **alternative materials**
- **Raise awareness** among consumers, ensure plastic products are properly labelled

Anna Ackermann

Board member
Ecoaction - Centre for Environmental Initiatives
ecoaction.org.ua

Founder
Climate Online
climateonline.net