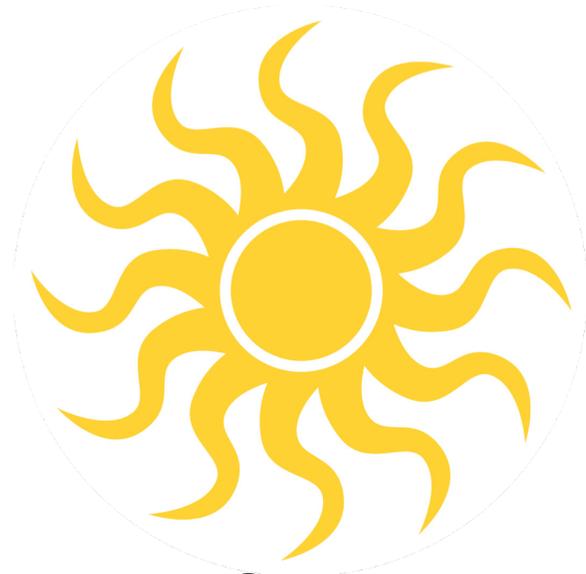


Global Approaches to Waste Governance: Moving from Linear to Circular Economy

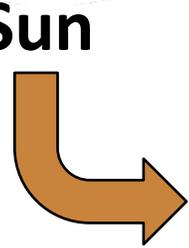
Alen Amirkhanian
AUA Acopian Center for the Environment
American University of Armenia
alen@aua.am

Production-Consumption-Waste Process



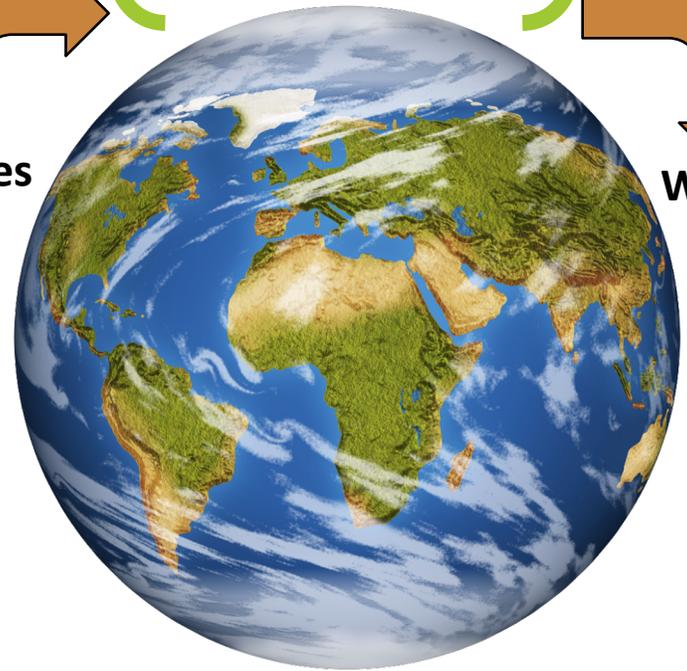
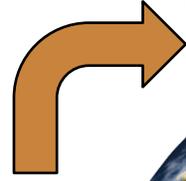
Sun

- Food
- Energy
- Water
- Transport
- Human habitation
- Clothing
- Electronics
- Other consumer goods



Resources

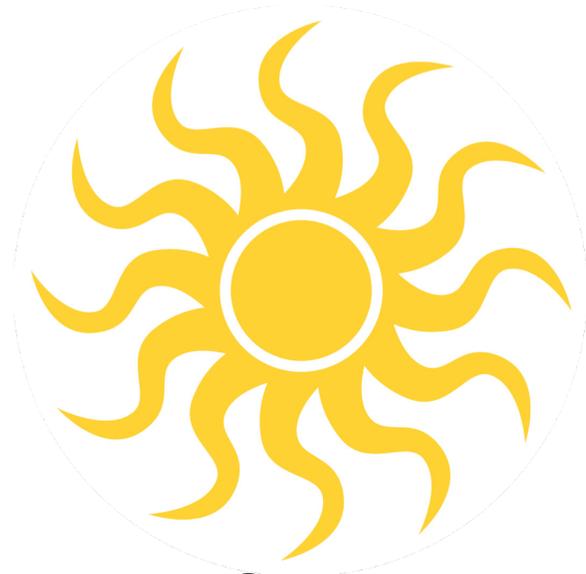
- Air**
- Land**
- Water**
- Biomass**
- Minerals**



Waste

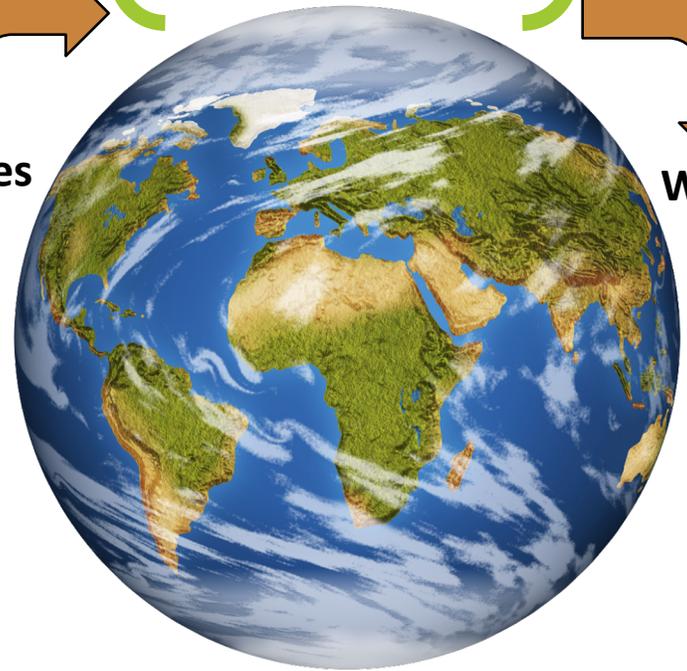
- Solid**
- Liquid**
- Gas/Particulate**
- Heat**
- Radiation**

Production-Consumption-Waste Process



Sun

Food
Energy
Water
Transport
Human habitation
Clothing
Electronics
Other consumer goods



Resources

- Air**
- Land**
- Water**
- Biomass**
- Minerals**

Waste

- Solid**
- Liquid
- Gas/Particulate
- Heat
- Radiation

Focus of our project, excluding:

- Mine tailings and waste rock
- Radioactive waste
- Sewer sludge

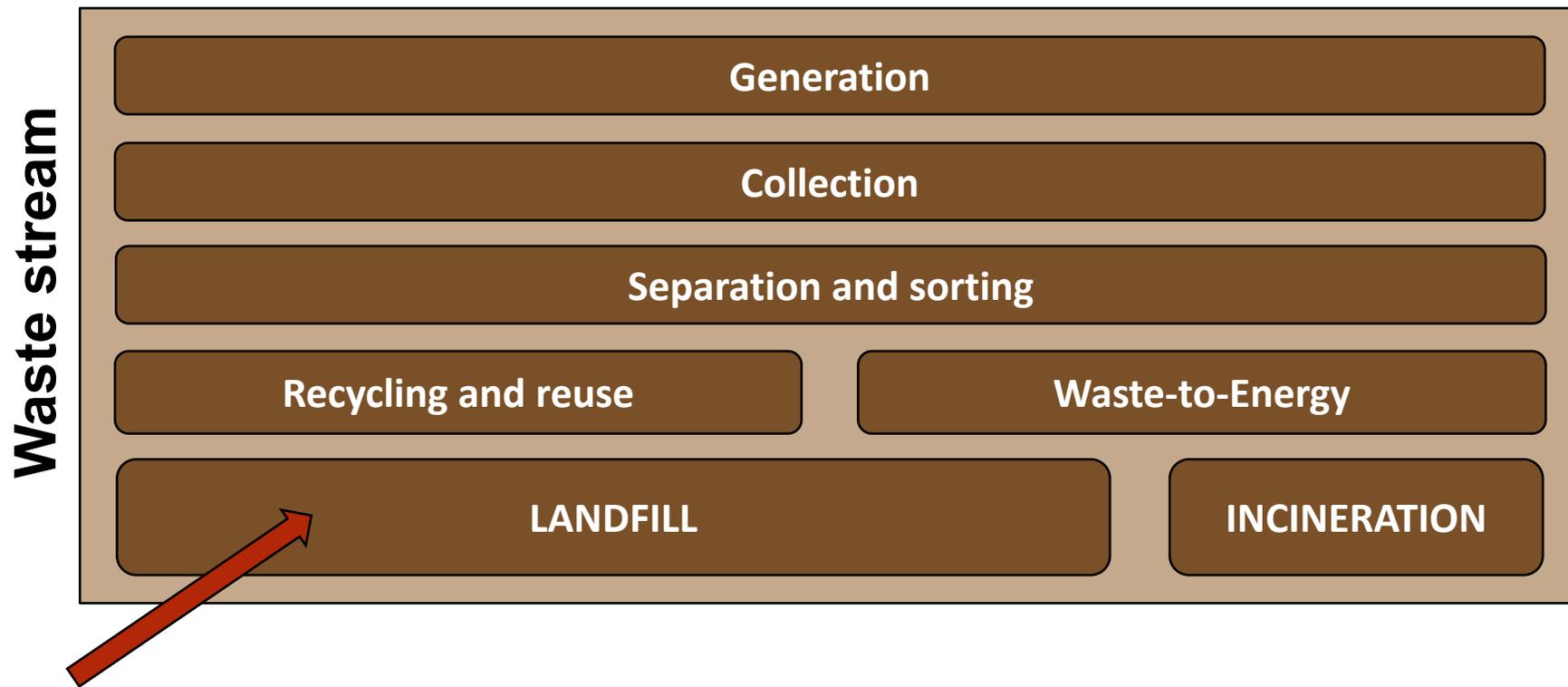


SOLID WASTE STREAMS

- **Most solid waste disposal systems identify various waste streams and regulate each stream.**
- **A waste stream is the complete flow from source to recovery, separation, recycling and/or final disposal or incineration.**
- **Examples of typical waste types:**
 - **Municipal waste (household, restaurant, commercial)**
 - **Construction and demolition waste**
 - **Industrial, chemical, hazardous waste (including pesticides, e.g., POPs)**
 - **Medical waste**
 - **Agricultural waste (non-pesticide)**
 - **Electronic waste (WEEE)**
 - **Etc.**

Our project excludes:

- **Mine tailings and waste rock**
- **Radioactive waste**
- **Sewer sludge**



Many types of LANDFILLS

For our purposes we will focus on extreme types, though specific landfills can range between these in their characteristics:

- a) **Dumps** – waste is placed without much control of what is brought in, no compaction, open for scavengers,
- b) **Sanitary landfills** – waste is placed in an engineered area where the leachate is removed, methane emissions are captured, waste is compacted and may be sealed by layers of soil, and finally topped

Dumps can range from complete uncontrolled to managed dumps

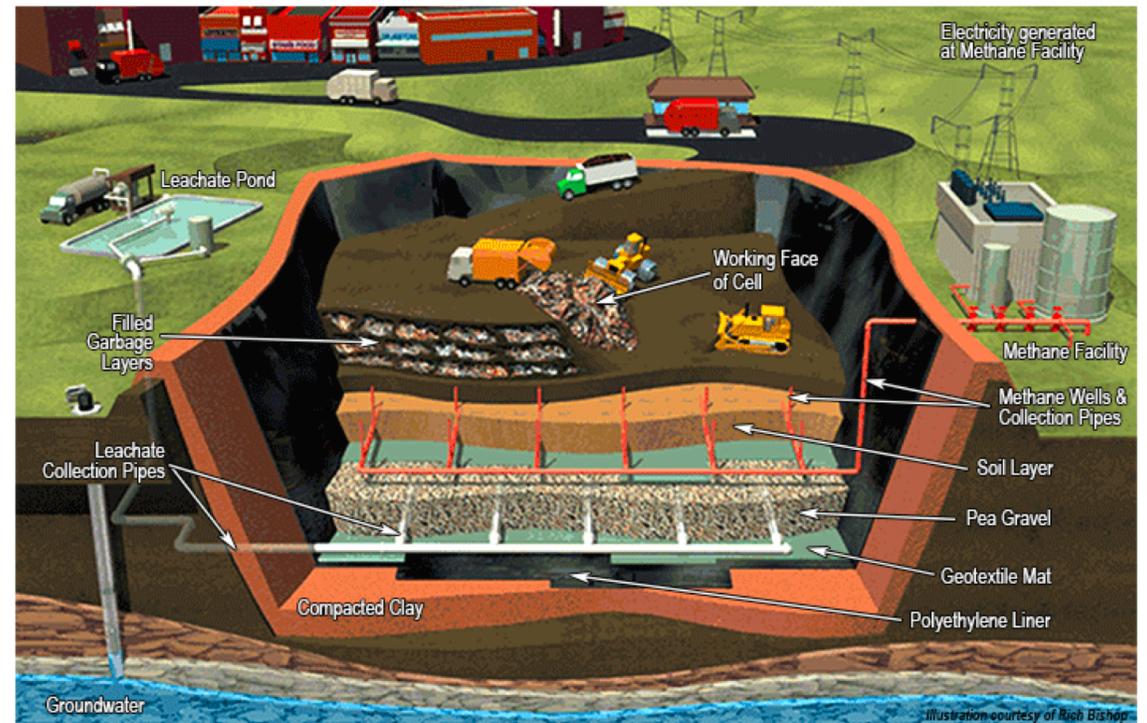
Dump



Sanitary landfills solve a few problems:

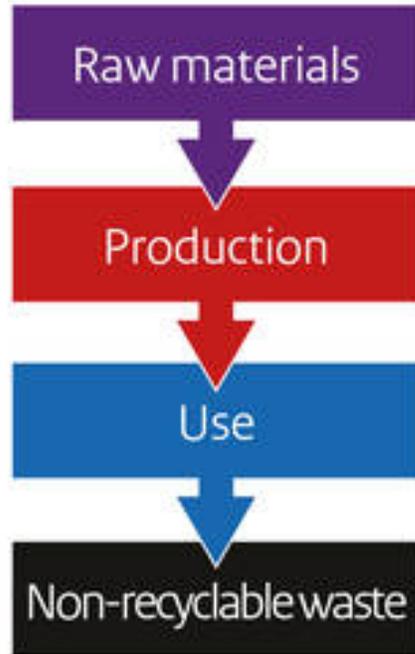
- **Sorting and control over what enters the landfill**
- **Compaction**
- **Fugitive waste (wind, rain, animals)**
- **Leachate control**
- **Methane control (venting, flaring, or energy harvest)**

Sanitary Landfill



From linear to circular economy

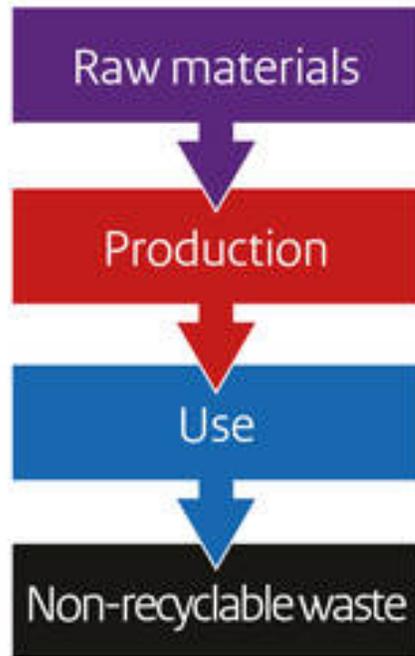
Linear economy



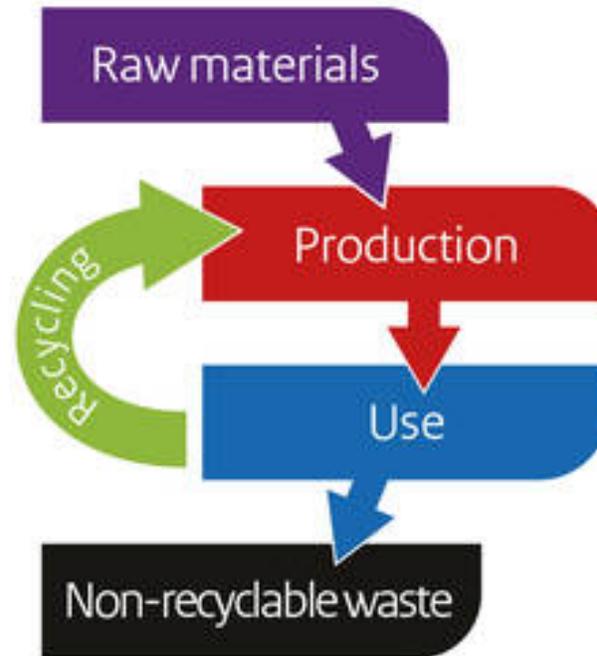
Source: <https://www.government.nl/topics/circular-economy/from-a-linear-to-a-circular-economy>)

From linear to circular economy

Linear economy



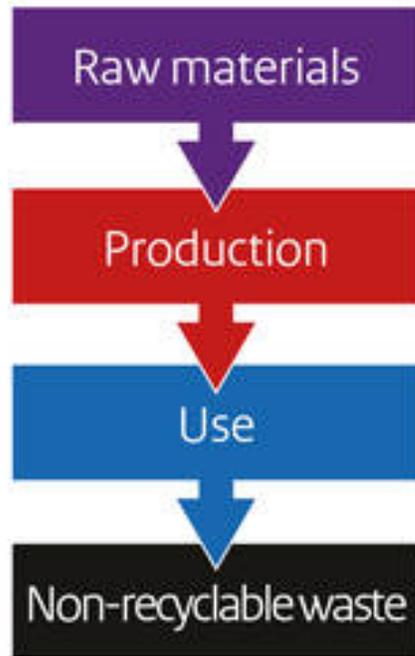
Reuse economy



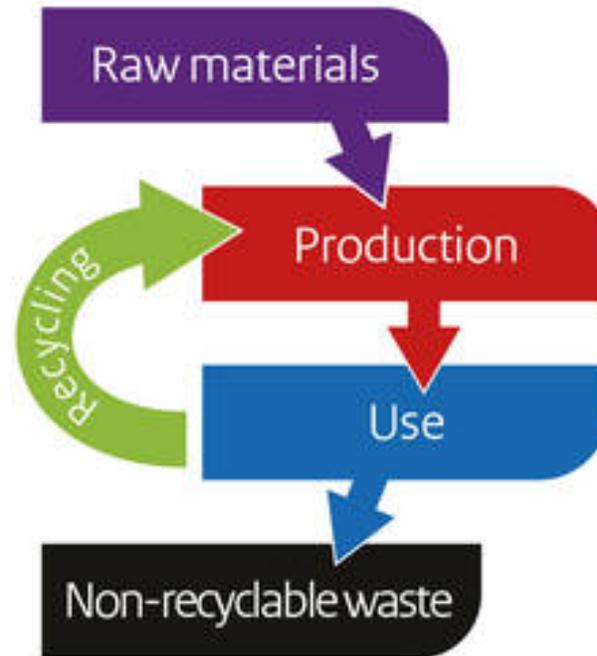
Source: <https://www.government.nl/topics/circular-economy/from-a-linear-to-a-circular-economy>)

From linear to circular economy

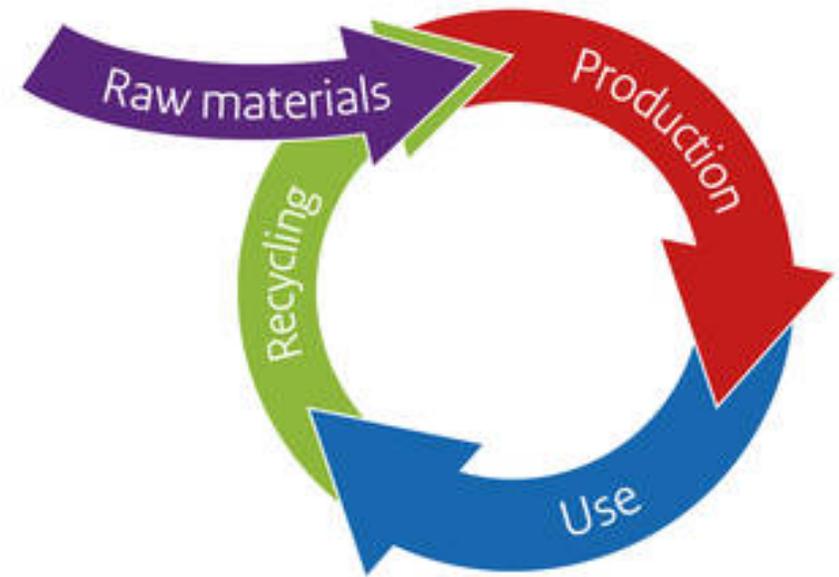
Linear economy



Reuse economy



Circular economy



Source: <https://www.government.nl/topics/circular-economy/from-a-linear-to-a-circular-economy>)



COMMITTED TO
IMPROVING THE STATE
OF THE WORLD

Towards the Circular Economy: Accelerating the scale-up across global supply chains

Prepared in collaboration with the Ellen MacArthur Foundation and McKinsey & Company

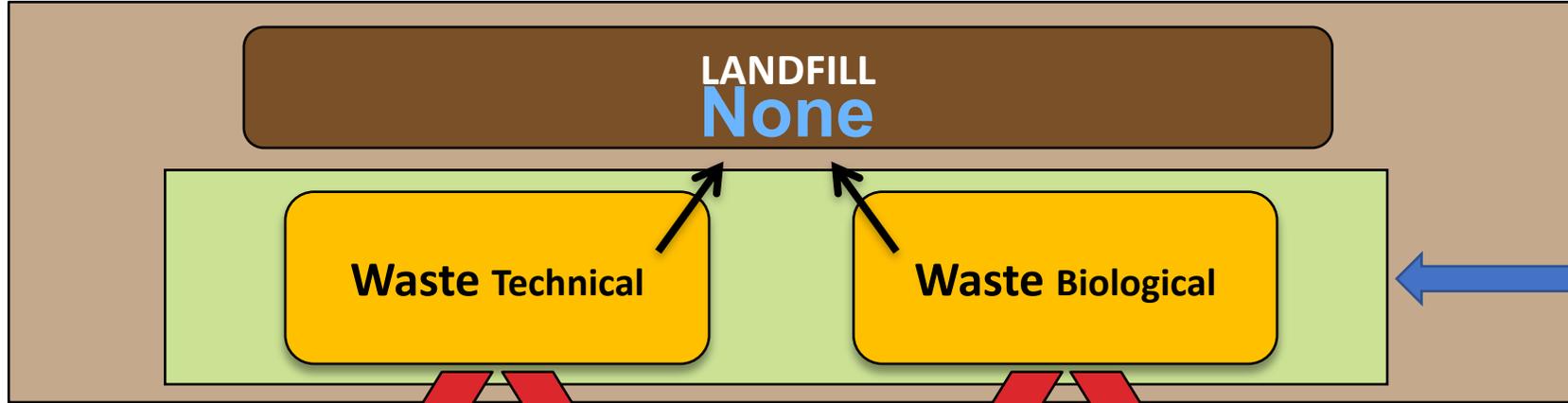
January 2014



**Recommended reading
available online, free of
charge**

Municipal Solid Waste Generation and Metabolism in a Circular Economy

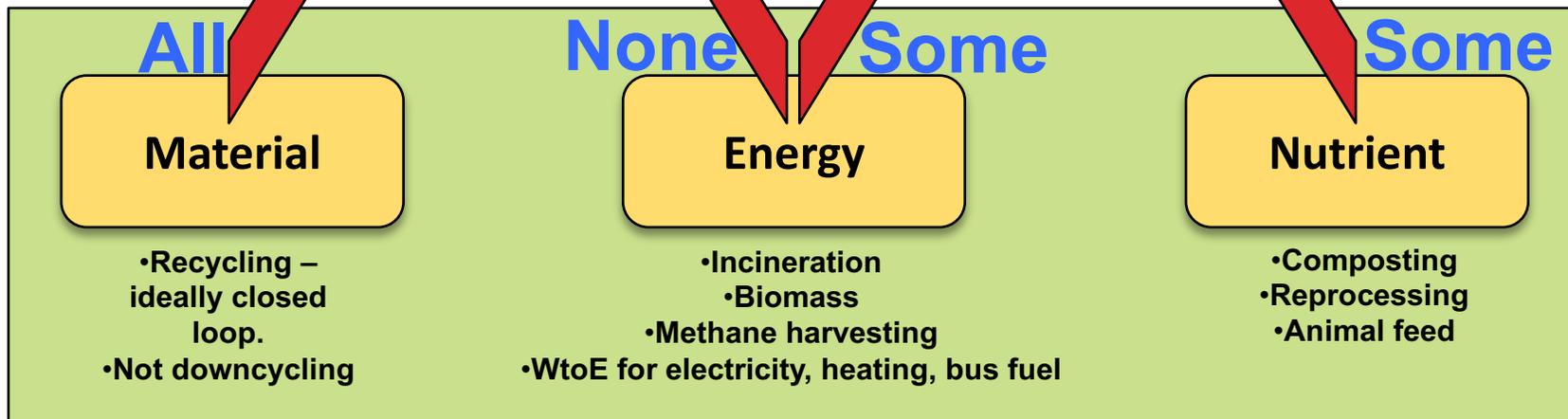
Waste



- Waste reduction or elimination
- Redesign of products
 - Changing consumption patterns
 - Zero waste restaurant?
 - Zero waste supermarket?

IDEAL?

Resource



Waste Management – Plastics and Paper



Photo: Piruza Khalapyan



Photo: Alen Amirkhania



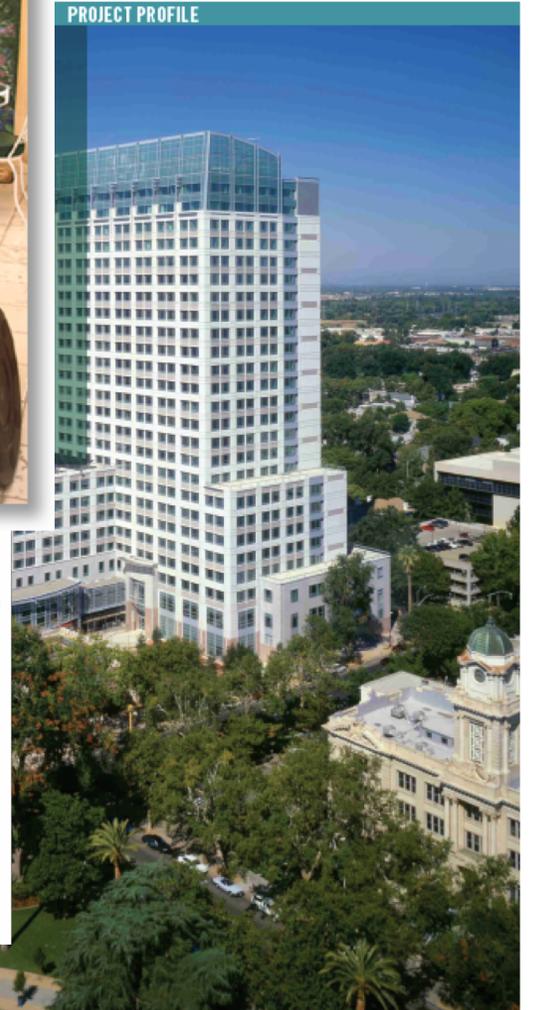
Source: <https://www.euneighbours.eu/en/east/eu-in-action/stories/plastic-waste-be-recycled-building-materials-first-time-armenia>



Photo: Alen Amirkhania

Waste Management -- Food

Vermicomposting inside homes and offices



Waste Management -- Food

Large-Scale Vermicomposting



Vermicomposting has been investigated as a way to convert some agricultural wastes into a soil amendment for more than ten years. Currently France, Germany, Italy, Japan, Hong Kong, India, Australia, and many countries in South America have research or commercial vermicomposting projects underway.

In Honk Kong, for instance, 80 million worms processing tons of waste ever day.



Piles of Peat near Lake Sevan, Armenia

Waste to energy and nutrient – harvesting a natural process



Waste to Energy

1. Thermal technologies:

-  a) **Incineration***: Energy capture – heating or electricity
- b) **Gasification**
- c) **Thermal depolymerization**
- d) **Pyrolysis**

2. Non-thermal technologies:

-  a) **Anaerobic digestion (biogas and methane)**
- b) **Fermentation production (examples are ethanol, lactic acid, hydrogen)**
- c) **Mechanical biological treatment (MBT)**
 - **MBT + Anaerobic digestion**
 - **MBT to Refuse derived fuel**

(*) Traditionally this was done for mass reduction. The incinerated waste is approx. 95% less in mass than the waste before burning. Today when waste is incinerated, energy is also derived from it.

Incineration

- Incineration involves burning municipal solid waste. The burning converts the waste into:
 - Incinerator bottom ash
 - Flue gases
 - Particulates, and
 - **Heat**
- The heat produced by an incinerator can be used to **generate steam** which may then be used:
 - To drive a turbine in order to produce electricity
 - For district heating
- The typical amount of net energy that can be produced per tonne municipal waste is **about 2/3 MWh of electricity and 2 MWh of district heating**



Incineration: Emission Controls

- Incinerator **emissions are controlled in several ways**: particle filtration, scrubbers (to remove the sulfur dioxide, hydrochloric acid, etc.), wastewater treatment plant (for the water used in scrubbers), desulfurisation, among others.
- According to the EPA, US incineration plants are no longer significant sources of dioxins and furans: in 1987, before the governmental regulations, there was a total of 10,000 grams of dioxin emissions from U.S. incinerators. Today, the total emissions from the 87 plants are only 10 grams yearly, a reduction of 99.9 %.
- Backyard barrel burning of household and garden wastes generates 580 grams (20 oz) of dioxins yearly. Studies conducted by the US-EPA demonstrate that the emissions from just one family using a burn barrel produces more emissions than an incineration plant disposing of 200 metric tons (220 short tons) of waste per day.



A low capacity (i.e. 100kgs per hour or less) incinerator mounted on a trailer. This can be used for disposing medical waste in rural areas.

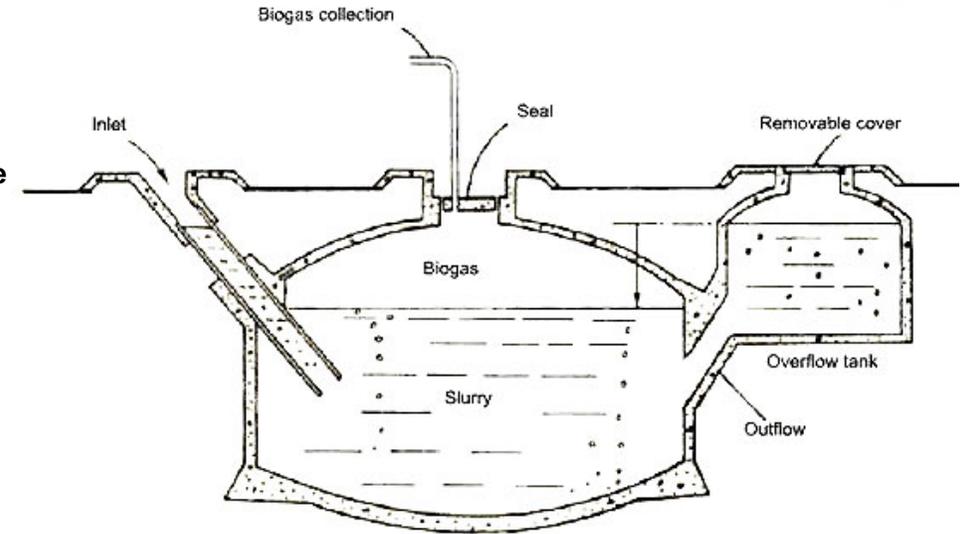


Waste Management -- Energy



Available feedstock to anaerobic digesters:

- Sewerage sludge
- Agricultural waste
- Industrial waste
- Animal by-products
- Municipal solid waste (source separated organics)



E-Waste

In the US & EU, typical personal electronic device becomes obsolete in 2-5 years

In the US & EU a typical household appliance becomes obsolete in 10-15 years

In the US 15-30 million computers are discarded every year

The US and EU have strict standards about how dispose e-waste; esp. ones with heavy metals, lead, mercury, and cadmium.

But a great deal of e-waste ends up in developing countries in Africa and Asia where it poses great environmental and health risks.



Environmental justice: Basel Convention started to focus on e-waste in 2002 but still lots of work left. You can keep updated on the Basel Action Network (<http://ban.org>)

E-waste: some changes

Greater consumer awareness in affluent economies is changing consumer choices and

Putting pressure on producers to reduce or eliminate the negative environmental and social impacts of their products and operations.

- Example 1: Fairphone



Long-Lasting
Design >



Fair Materials
>



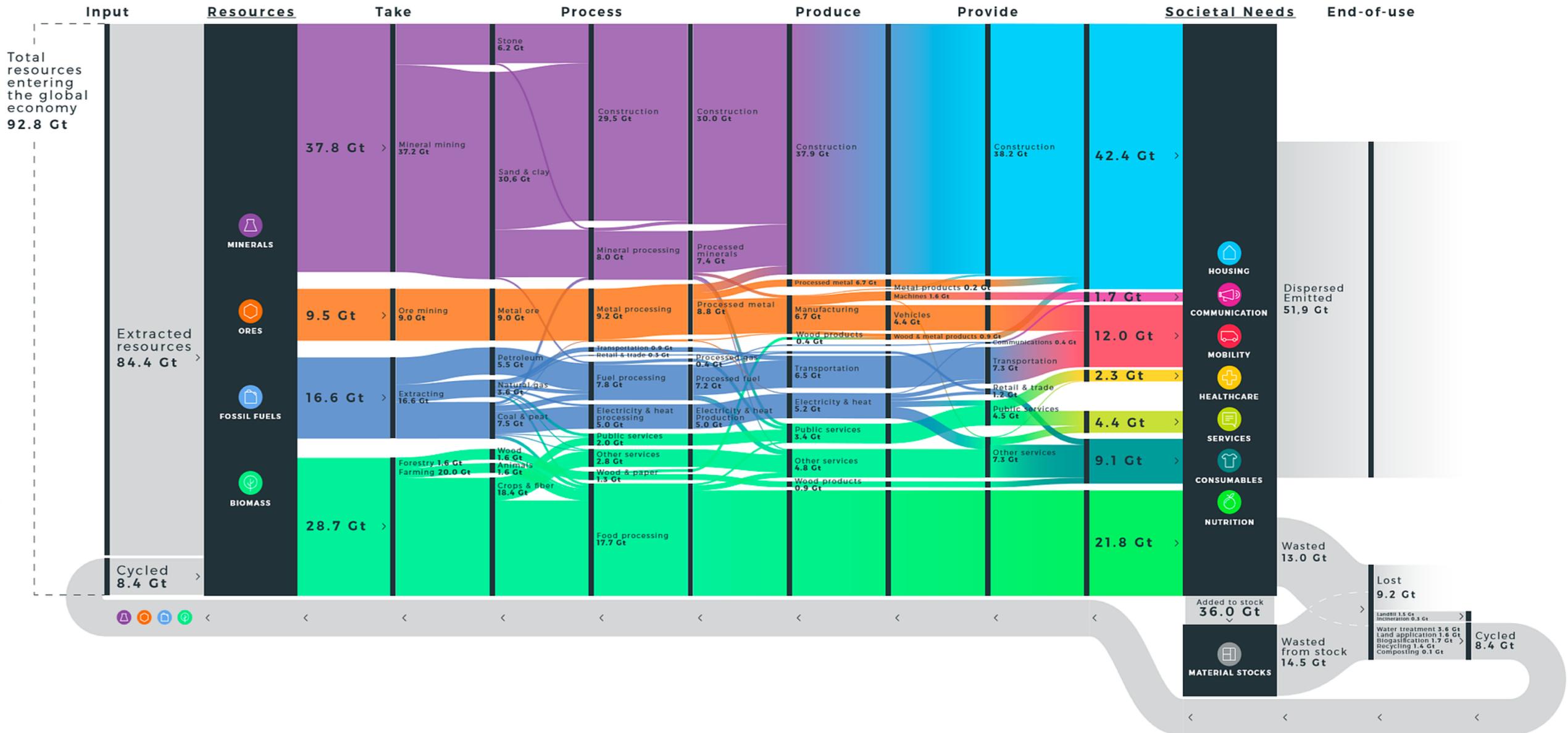
Good Working
Conditions >



Reuse and
Recycling >

- Example 2: Apple's LIAM: <https://youtu.be/AYshVbcEmUc>
And Apple's DAISY: <https://youtu.be/2Bu-gl7v-P8>
- Disruptors: iFixit: <https://youtu.be/tx-9LkVldz0>

Global material flows and stocks



Source: The Circularity Gap Report (2018) (<https://www.circularity-gap.world>)

Circular Economy

PRINCIPLE 1

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

Biological materials

RENEWABLES



FINITE MATERIALS

Technical materials

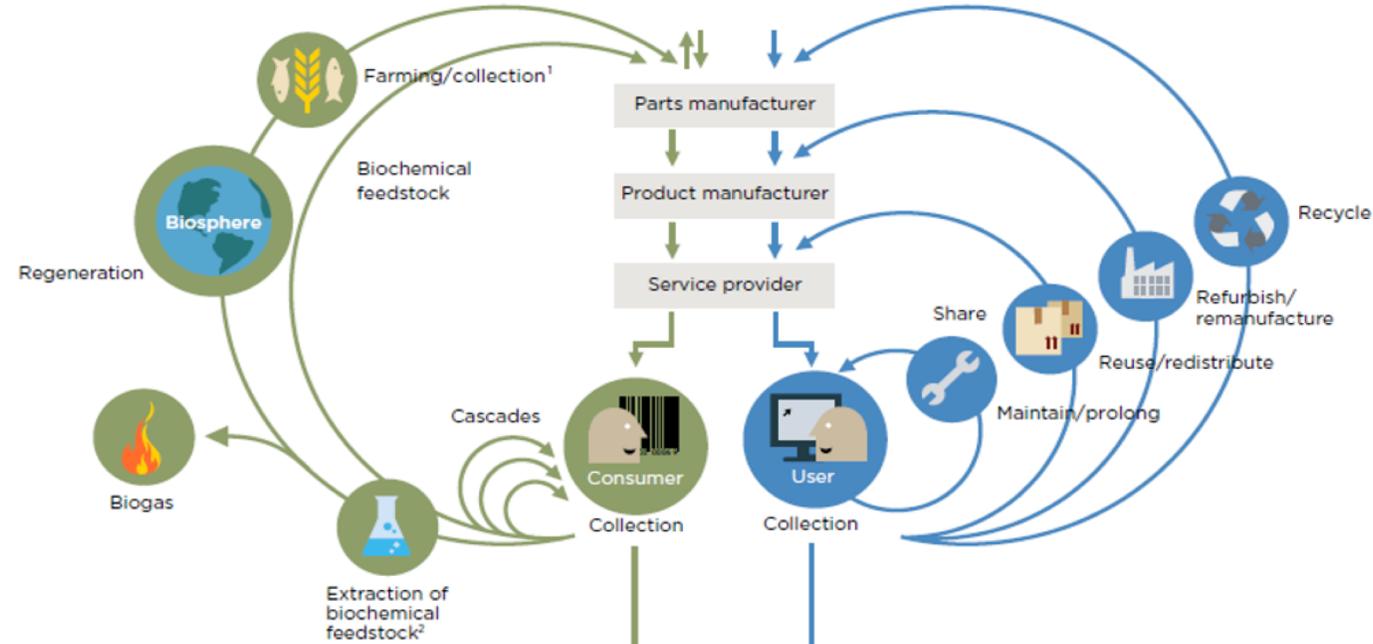
Regenerate Substitute materials Virtualise Restore

Renewables flow management

Stock management

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, SUN and McKinsey Center for Business and Environment, *Growth Within: A Circular Economy Vision for a Competitive Europe* (2015). Drawing from Braungart & McDonough, *Cradle to Cradle* (C2C).

Circular economy strategies and initiatives globally



Since the report was prepared, in late 2017 and the first 6 months of 2018, national circular economy strategies have been published by France, Slovenia, Portugal, and Italy. The map also misses a few national strategies that were developed in 2016 or 2015. These include the Netherlands, Finland, and Catalonia (Spain).

<https://circulareconomy.europa.eu/platform/en/strategies>

Source: Preston, F. and Johanna Lehne. December 2017. A Wider Circle? The Circular Economy in Developing Countries. Chatham House

ENVIRONME

European Commission

European Commission > Environment > Circular economy

Home About us Policies Fu

Circular Economy

Implementation of the Circular Economy Action Plan

2018 Circular Economy Package

As part of its continuous effort to transform Europe's economy into a more sustainable one and to implement the ambitious Circular Economy Action Plan, in January 2018 the European Commission adopted a new set of measures, including:

- A Europe-wide **EU Strategy for Plastics in the Circular Economy** and annex to transform the way plastics and plastics products are designed, produced, used and recycled. By 2030, all plastics packaging should be recyclable. The Strategy also highlights the need for specific measures, possibly a legislative instrument, to reduce the impact of single-use plastics, particularly in our seas and oceans. A public consultation on the Commission has adopted a new proposal on **Port Reception Facilities for the use of oxo-degradable plastic**, including oxo-degradable plastic.
- A Communication on **options to address the interface between products and chemicals** relate to each other.

<http://ec.europa.eu/environment>

General measures

- + Product design
- + Production process
- + Consumption
- + From waste to resources (secondary raw materials)
- + Innovation, investment and other cross-cutting issues

Actions for specific materials and sectors

A number of materials and sectors face specific challenges in the context of the circular economy. These challenges need to be addressed in a targeted way.

- + Plastics
- + Food value chain
- + Critical raw materials
- + Construction and demolition
- + Biomass and bio-based products
- + Review of fertilisers legislation

Commission and its priorities Policies, info

European Commission

Home > Priorities > Jobs, growth and investment > Towards a circular economy

Towards a circular economy

The European Commission has adopted a new set of measures to make the transition to a circular economy. The proposed measures will ensure that resources are used to their maximum value and that products are designed to last longer.

PAGE CONTENTS

Documents

Related links

[https://ec.europa.eu/commission/press-room/detail/2018/01/16-circular-economy_en](https://ec.europa.eu/commission/press-room/detail/2018/01/16-circular-economy)

<https://circulareconomy.europa.eu/platform/>

Legal notice | Cookies | Contact | Search | English (en)

EUSurvey
User survey questionnaire

Partnership and SMEs

Entrepreneurship and SMEs Access to finance for SMEs Sectors

economy

and materials is maintained for as long as possible, and when a product reaches the end of its life cycle, this can bring major economic benefits, such as job creation.

In the spotlight

16/01/2018

European plastics strategy – part of the Commission's 3rd package of measures to implement the Circular Economy Action Plan

https://circulareconomy.europa.eu/platform/en/ability/circular-economy_en

Copyright Notice | Specific privacy policy statement | Cookies | Contact | Search on Europa

Contribute News & Events About

Latest news and events

Save the date: 2019 Circular Economy Stakeholder Conference

#CEstakeholderEU

ECESP @CEstakeholderEU

Circular Economy Policy

- Product design
- Production process
- Energy sources -- renewable
- Consumption information and behavior
- Secondary raw materials (recycling, recovery)
- Plastics
- Construction and demolition
- Electronic waste (e-waste)
- Biomass and bio-based materials (including fertilizers)

EU Waste Directive Targets based on Circular Economy Action Plan

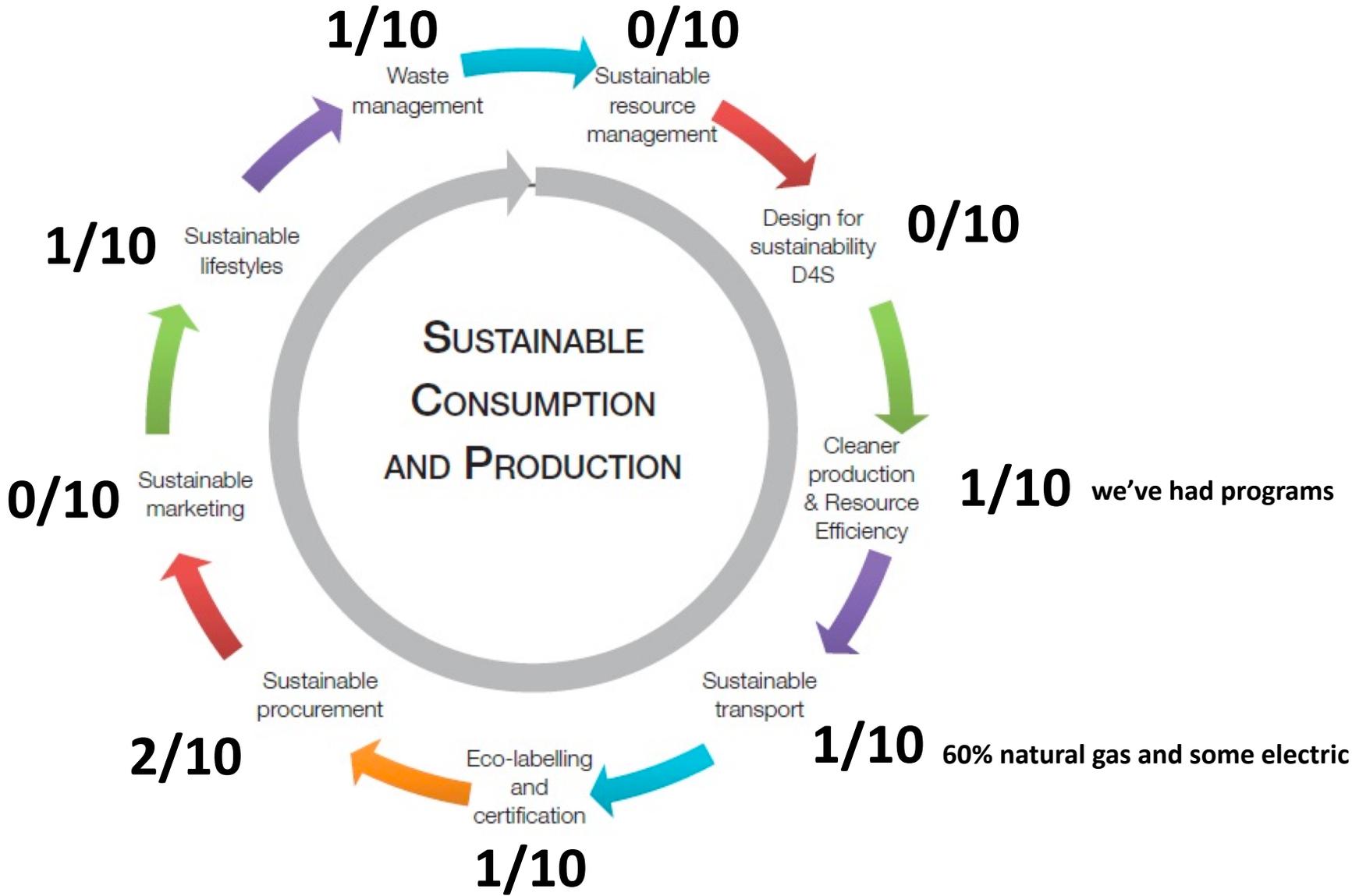
The EU Waste Framework Directive FD has been strengthened in 2018 by the ‘Circular Economy Package’. It now includes the following actions and targets:

- A recycling rate of 50% (including preparing for reuse) of municipal waste by 2020, increasing to 55% by 2025, 60% by 2030 and 65% by 2035.**
- 65% of packaging materials to be recycled by 2025, rising to 70% by 2030**
- A limit will be placed on the landfilling of municipal waste at 10% by 2035**
- Separate collection of recyclables - paper, metal, glass and plastic by 2015.**
- These existing separate collection requirements will be extended to cover biowaste by 2024 and textiles and household hazardous waste by 2025.**
- A recovery rate of 70% (preparing for reuse, recycling and other material recovery) for all non-hazardous construction and demolition waste by 2020.**

Circular Economy Policy – using SDGs to begin

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

- Consumption choices made in all spheres/levels:
- Individual
 - Family
 - Enterprise
 - Government



Let's Begin

