WEEK 3

UNDERSTANDING THE CIRCULAR ECONOMY

Managing Sustainability
BMA6105

Learning Outcomes

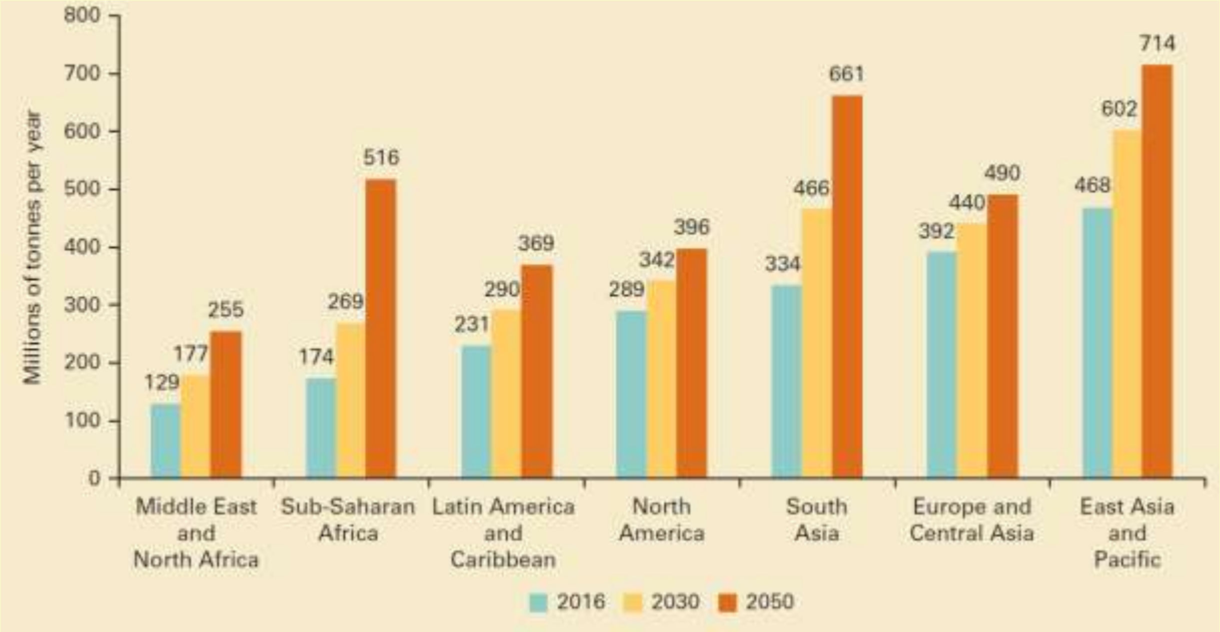
- Main issues in a circular economy:
  - End goal of eco-effectiveness, not eco-efficiency
  - Retain highest value of materials and products in productive use
  - Separate technological and biological nutrient flows
  - Cascading cycles for material flows
    - Technosphere
    - Biosphere
  - Shift to renewable energy
  - Celebrate diversity in adaptation to local environments

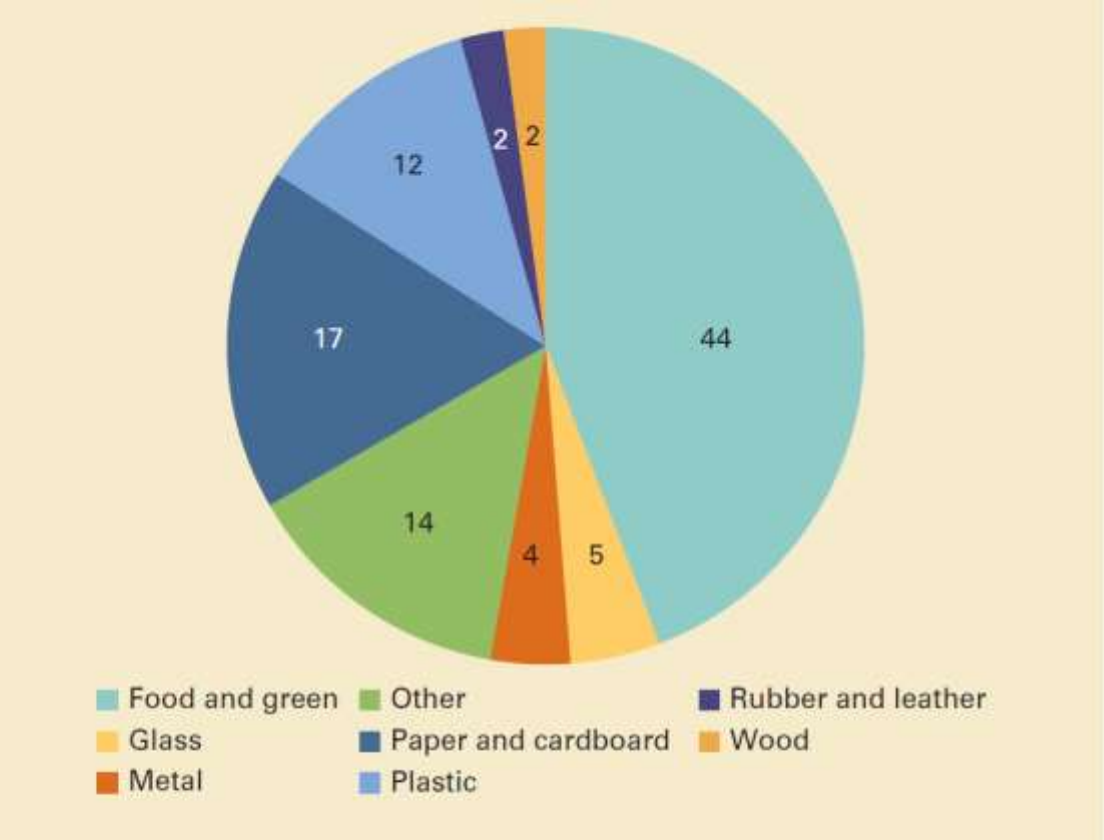
A critique of striving for eco-efficiency

- Release fewer pounds of toxic wastes into the air, soil, and water every year
- Measure prosperity by less activity
- Meet the stipulations of thousands of complex regulations to keep people and natural systems from being poisoned too quickly
- Produce fewer materials that are so dangerous that they will require future generations to maintain constant vigilance while living in terror (nuclear power)
- Result in smaller amounts of useless waste
- Put smaller amounts of valuable materials in holes all over the planet where they can never be retrieved

Braungart, M. and McDonough, W., 2002. *Cradle to cradle*. Random House.

Global waste generation, areas and proportions



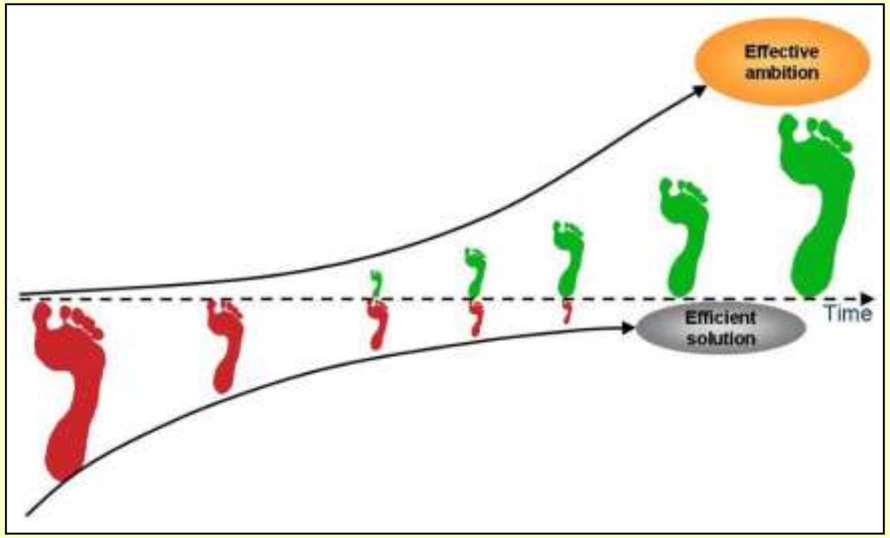


Replace the idea of eco-efficiency with 'eco-effectiveness'

- Focusing on minimizing negatives is not the right goal
    - Limits capacity and opportunities

- Do not aim to do 'less bad', but to 'do well' right from the start
    - Rethinking design possibilities

- Inspiration from natural processes:
    - Cherry tree produces abundant blossoms
    - Abundant fruit for birds, humans, & other animals
    - Enriches soil with leaves and fruit
    - Goal is for **one** pit to grow **one more** tree
    - Perfectly in tune with surroundings & resources



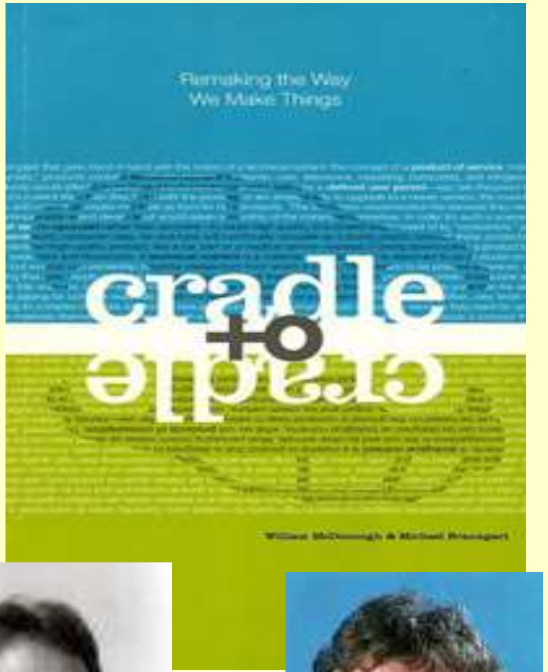
Reshaping the outcomes from business and economic processes

- Buildings that, like trees, produce more energy than they consume and purify their own waste water
- Products that, when their useful life is over, can decompose and become food for plants and animals as well as nutrients for the soil.
- Products that can return to industrial cycles to supply high-quality raw materials for new products
- Transportation that improves the quality of life while delivering goods and services

A world of abundance, not one of limits, pollution, and waste

Cradle to Cradle: Remaking the way we make things (2002)

- Written by architect William McDonough and chemist Michael Braungart
- Summarised their three core principles:
  - **Waste = Food**
  - **Use solar energy**
  - **Respect diversity**
- The book itself:
  - Printed on waterproof paper, using recoverable inks, with the potential to be remanufactured into a new book



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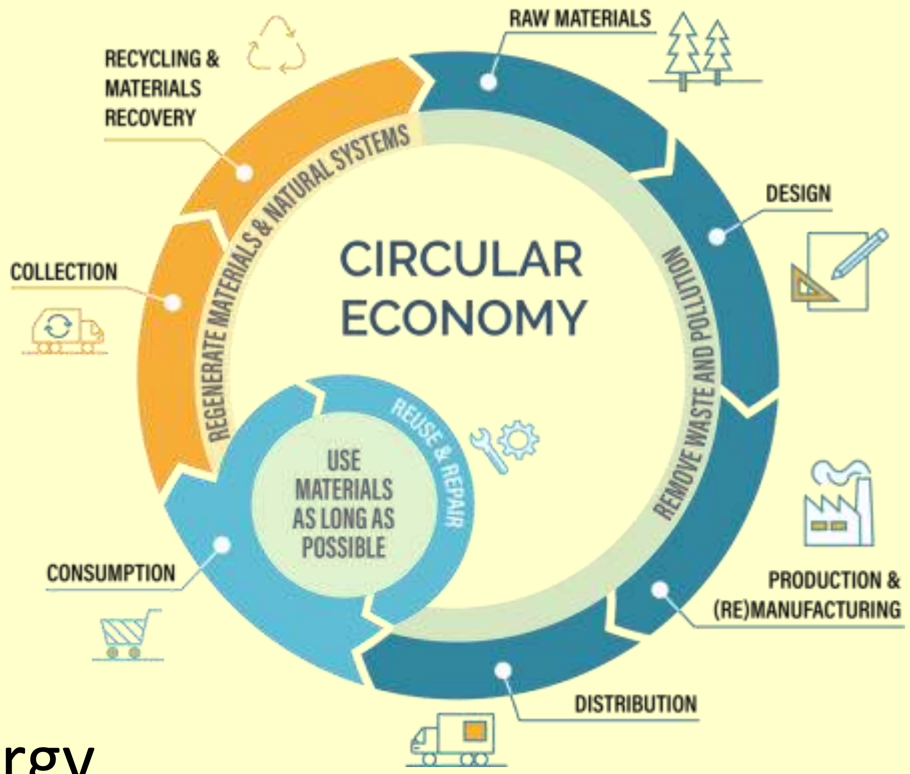
Basic principles of circular economy thinking

- The circular economy is based on three principles, driven by design:

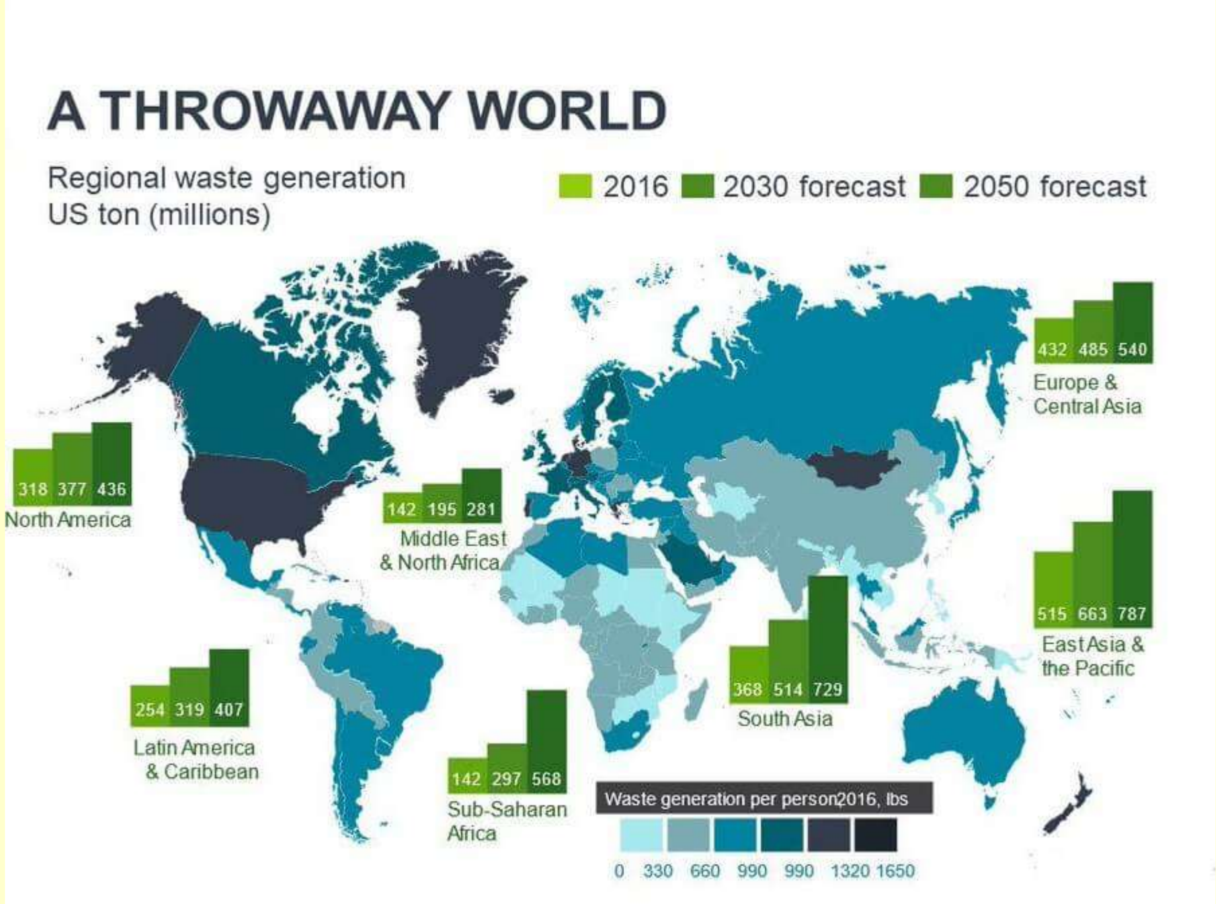
- Eliminate waste and pollution
- Circulate products and materials (at their highest value)
- Regenerate nature

These elements as a whole should be underpinned by using only renewable energy



Rethinking the design of the system

- Bad design is everywhere
- Legacy of Industrial Revolution
- Emphasis on brute force
- ‘Universal’ design
  (ie standardized solutions)
  - Crude products and ‘products plus’



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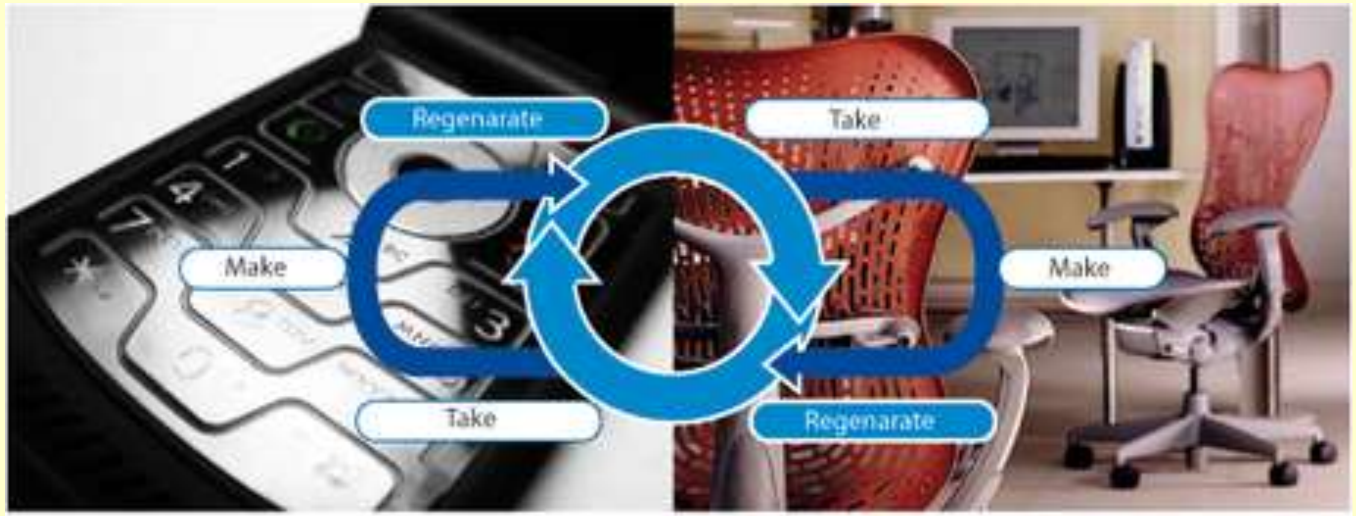
Components of a circular economy system

- Design for a Circular economy
  - Choice of materials, composition, components
- Innovative business models
  - Connecting producers and consumers in new ways
- Reverse product and material cycles
  - Developing new supply chains, storage and inventory management
- Revised enablers and system/network properties
  - Changing incentives and regulations, enabling collaboration

Technical and biological nutrients

- **Technical nutrients**

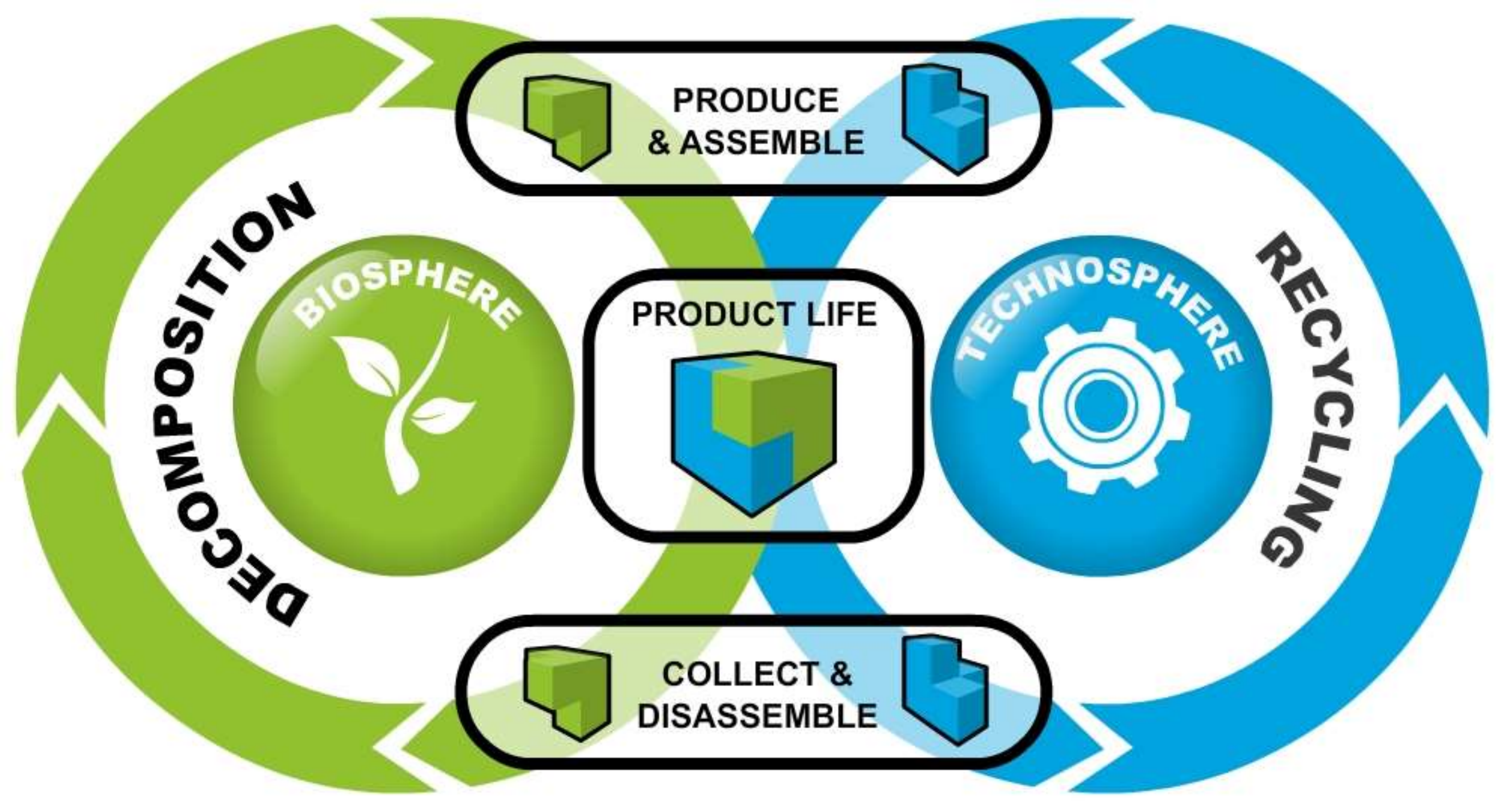
  Man-made materials extracted, refined and/or fabricated from the earth's crust, not naturally occurring



- **Biological nutrients**

  Organically or naturally occurring materials already present in ecological processes

The circular flow within bio- and techno-spheres



‘Monstrous hybrids’ – inseparable wastes

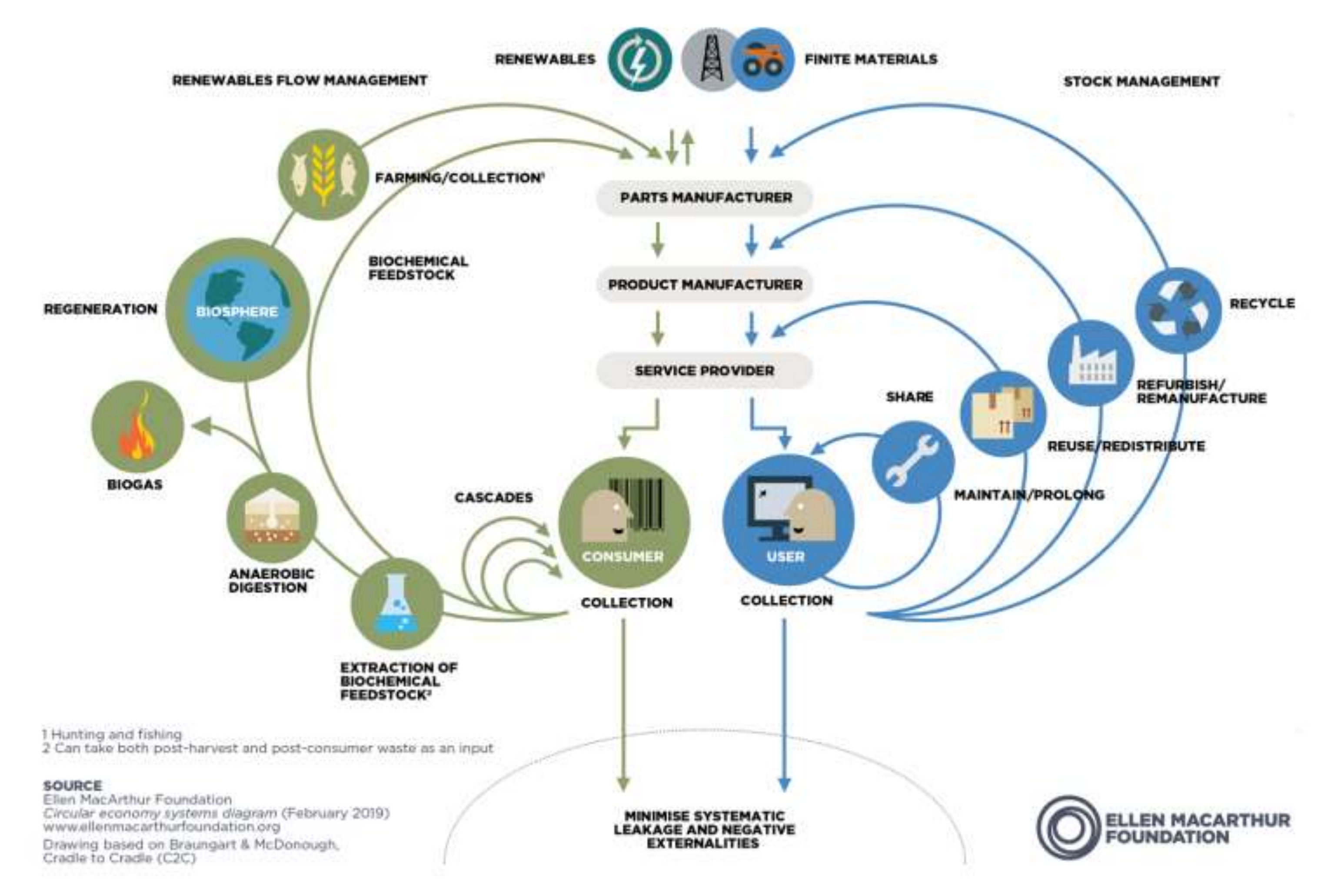
APEX corporate photography

Pic by Nick Gregory. 01/06/2005. The WEEE Man robot sculpture (waste electrical and electronic equipment) towers over the plants outside the Eden Project in Cornwall as Richard Melvin makes final adjustments from a cherrypicker.

eden project

The WEEE Man (Eden Project, Cornwall)

The circular economy: Butterfly diagram



Technosphere:
1a. Maintaining/Prolonging

- The best possible outcome for circularity is to extract value for as long as possible from a product in its current use
- Product life extension can be increased with better opportunities to maintain performance, and better base design
- Improved design challenge:
  - embed long life from the start
  - enable consumer to protect/retain performance over time
  - provide advice and integrated support options for ensuring optimum maintenance

Technosphere:
1b. Sharing

- Many manufactured products are used for a tiny proportion of their lifespan
  - Electric drill: actively drilling for 11 mins out of a 5-10 year lifespan
  - Average car: sits curbside for 90%+ of ownership
- A sharing model expands the value delivered by the product many times by increasing active use
- Leading to business innovations capturing underutilised product value:
  - Zipcar
  - Toronto Tool Library

Technosphere:
2a. Redistributing/Reusing

- Redistribution, or reallocation, of the product enables a new user to continue to extract value from the product in its current form
- Reuse enables continued use with no loss of quality and no additional input of materials or energy
- Online platforms such as ebay have enabled a huge increase in C2C reuse
- Businesses are actively employing reuse strategies in recovering packaging and distribution materials:
  - Braiform: previously no collection of hangers from retailers and distributors due to low cost of an individual hanger
  - now recovers clothing hangers and aims for x8 reuse before remanufacturing new hangers

Technosphere:
2b. Repurposing/Upcycling

- Repurposing or upcycling products enables a new value stream to be created with minimal loss of materials or value in the original product
- Additional value may be added in the process of upcycling
- Consumers generate new and unintended value streams, particularly for damaged or redundant items
- Already developed in some areas such as recycled fashion and furniture restoration

Technosphere:
3. Refurbishing/Repairing

- Once a product is damaged, repairing or refurbishing it with minimal intervention means it can stay in circulation with recovery of its highest value purpose
- Products need to be designed for refurbishing/repairing:
    - Easy to disassemble: simple tools, clip joints, screws not glues
    - Modular design with easy replacement of individual components
    - Clear guidance to enable simple and appropriate replacement of parts
    - Standardised and available replacement parts

Technosphere:
4. Remanufacturing

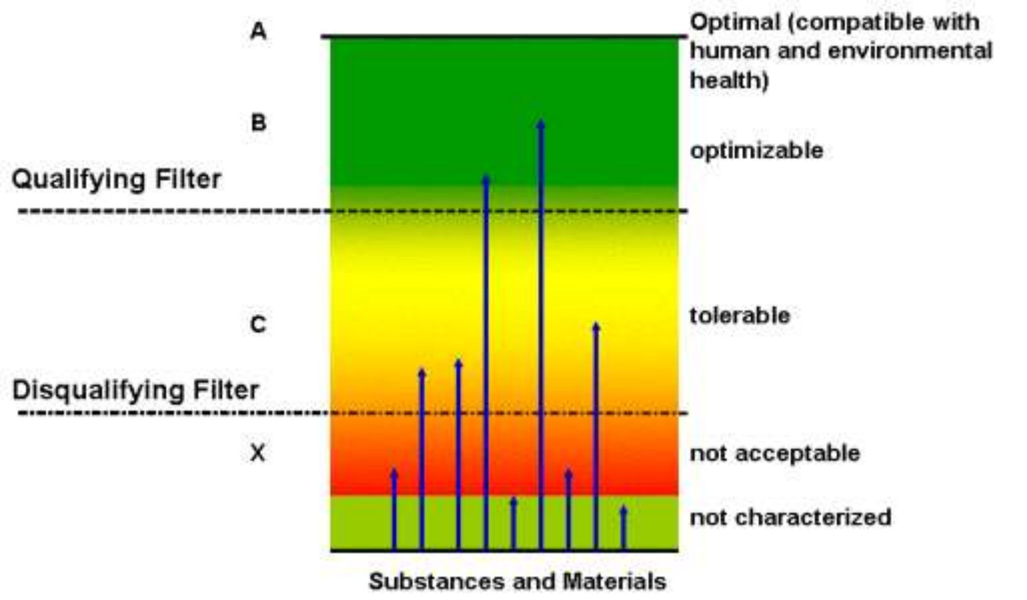
- If intensive repair work is required, the product may need to be taken out of circulation and remanufactured
  - For example, a warped engine block will need recasting with other damaged components replaced
- Remanufacturing can apply to a complete product, or to a component part that is retooled or made specifically to restore useability of the end product
- Remanufacture minimises material loss and enables full value recovery
  - a high value activity preventing loss of original product value

Technosphere:
5. Recycling

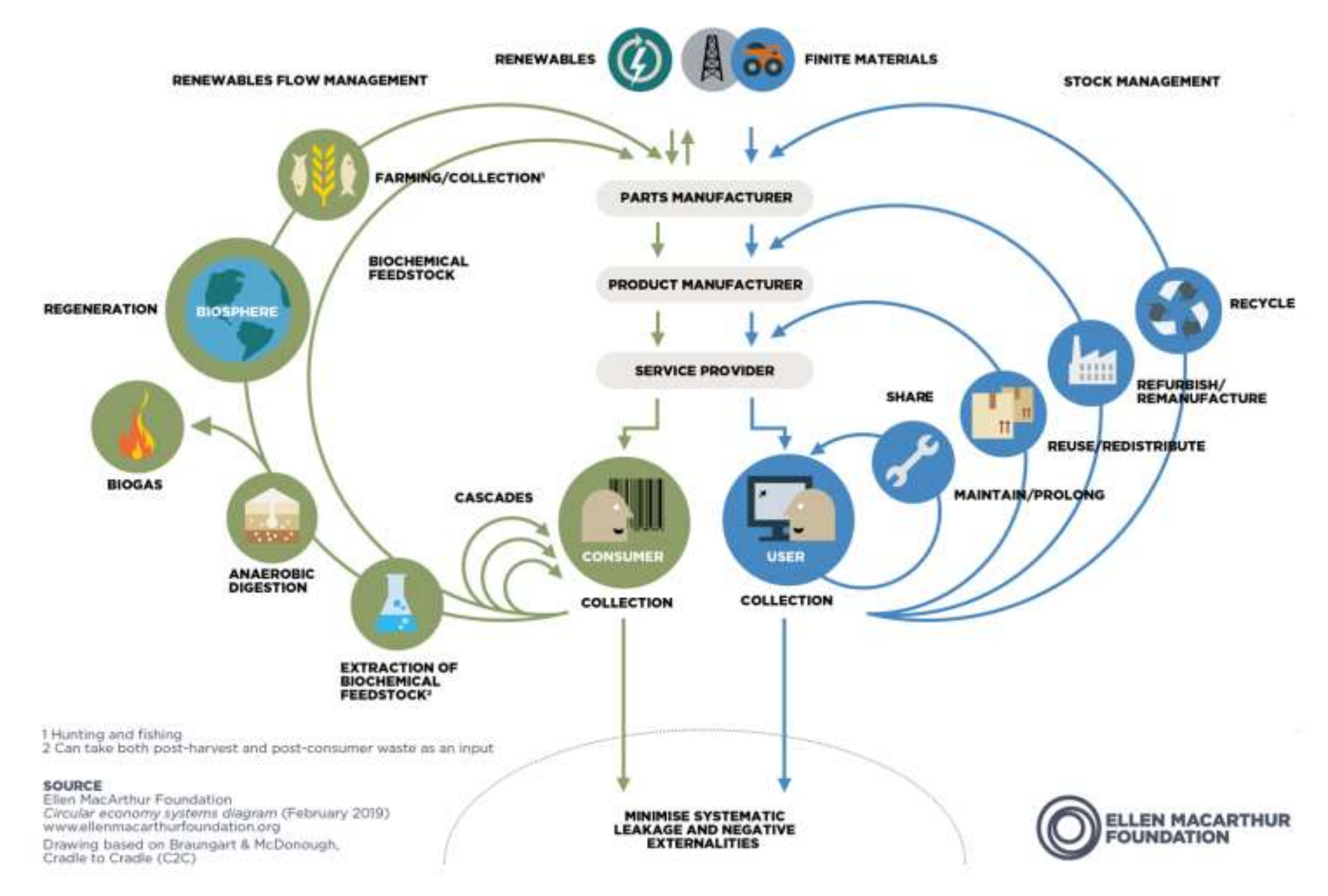
- Recycling retains the value of the materials within the product, but it loses the embedded value involved in the original product manufacture (shaped materials, energy, design skills)
- Recycling therefore represents a loss of value to the system
- Many materials lose quality after one or two cycles, referred to as 'downcycling' by McDonough when material quality is degraded over time
- Many hybrid and composite materials are not capable of being recycled
- Processes are often energy intensive

The circular economy materials challenge

- A circular economy will need a move eventually to a limited palette of materials
- Capable of continual recycling without loss of quality
- Systems need to be embedded to enable recovery and redistribution of these materials over time
- Must be benign to biological organisms
    - Avoiding the use of additives that are toxic ('products plus')
    - Focus on passive positive (no known negative impacts at any concentration)
- Ultimately, this will eliminate many composite products, waste streams and production processes
- Opportunity to redesign sectors

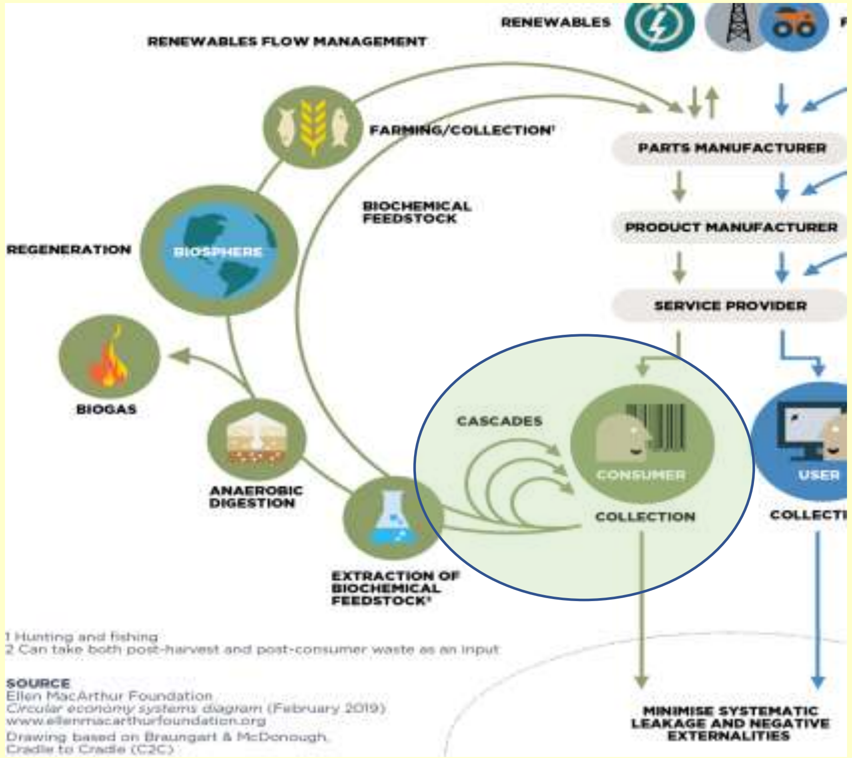


The circular economy: Butterfly diagram



Biosphere:
1. Consumer management - Home composting

- Some cascades or loops in biological nutrient cycling can be closed directly by consumers
- Waste food and other biological matter can be composted at home and returned directly to the natural environment
- Farming systems can also directly use food waste from households as animal feed



Biosphere:
2. Biochemical Feedstock - Extraction

- More advanced biochemical processes can be used to extract nutrients from raw materials or previously waste biological feedstock
- Aims to generate lower volume, high value producsts e.g. nutriceuticals for health, oil substitutes
- Residues from the biochemical refining can be composted and returned to biological systems

Biosphere:
2. Anaerobic digestion - Biogas

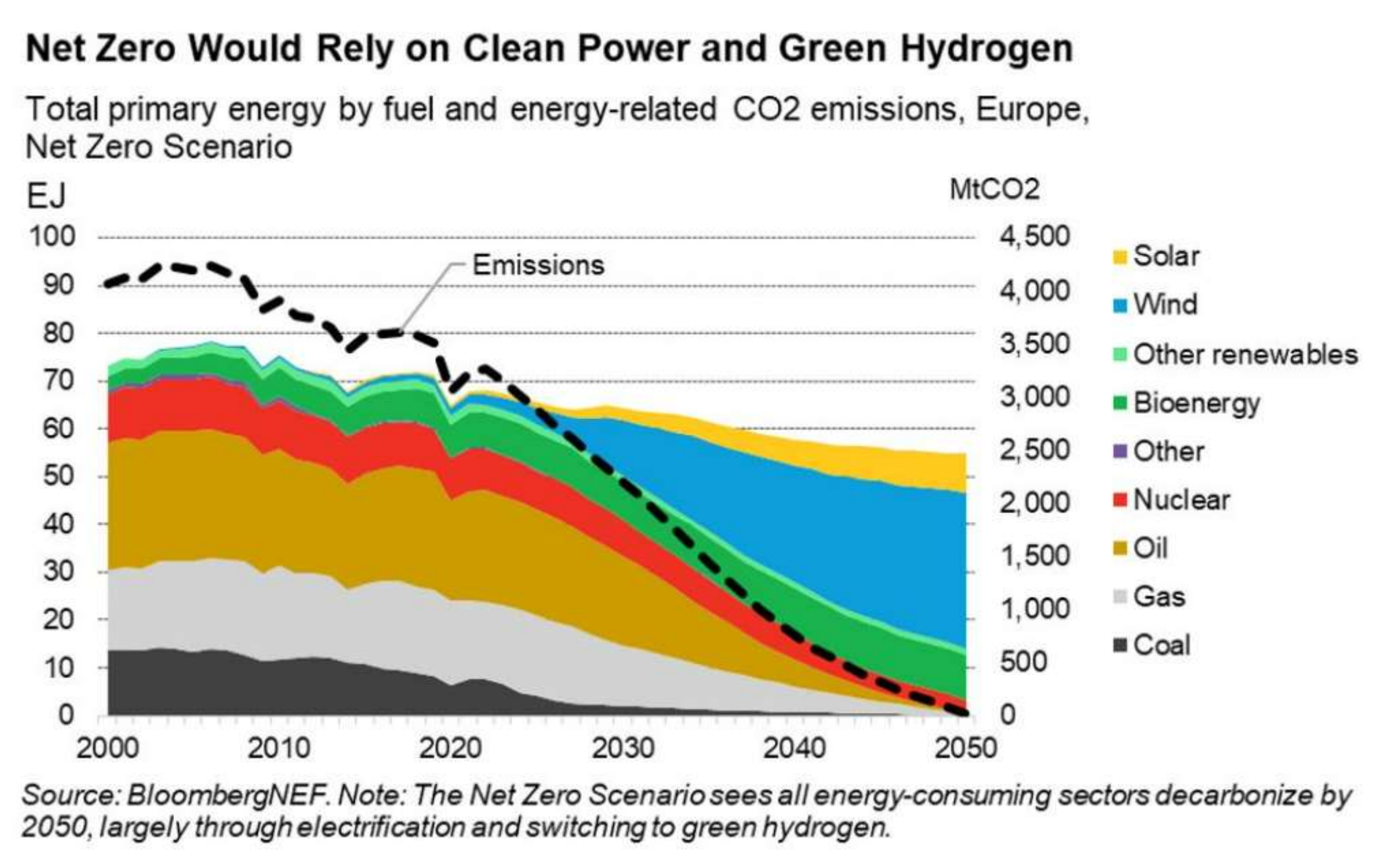
- Anaerobic digestion is the process of composting biological materials in the absence of oxygen
- Naturally occurring micro-organisms break down material into a nutrient-rich fertiliser/soil enhancer
- Methane gas is a bioproduct of the process which can be captured and burnt for fuel
- Although this releases carbon dioxide, this is in balance with in a natural annual or perennial growing cycle driven by sunlight

Biosphere:
3. Regeneration – enriching the biosphere

- A regenerative biosphere loop emphasises the improvement of biological fertility by redistributing biological nutrients back into productive systems
- It also reconsiders farming systems to ensure that they are eco-effective, producing a more diverse, more reliable growing environment not reliant on inputs of artificial fertilises and pesticides for control
- Regenerative agriculture aims to reduce carbon, improve diversity and enhance the supporting natural environment

Circular economy shift to renewable energy

- All fossil fuel use is temporary
- Concerns with climate change pushing to accelerate the shift
- Renewables are the only viable long term strategy
- Wind and solar are well-established, proven technologies
- Hydrogen offers huge potential but remains difficult to deliver economically



Respect for, and celebration of, diversity

- One size does not fit all
- Industrial system has systematically reduced diversity
- Prioritises narrow economic ‘fittest’ - not ‘fitting-est’ (ie. enduring and best adapted to the local conditions and needs)

- Need to move from process of de-evolution to one of re-evolution
- Diversity in context
- Considering sustainability as local

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Outcomes of a Shift to a Circular Economy

1. Focus is placed on the **SERVICE**, not the **PRODUCT** itself, forcing changes in the way both customers and businesses perceive their product.
2. Emphasis will be placed on **DURABILITY** over built-in obsolescence. Manufacturers will want a product to last as long as possible.
3. Products will be designed for dis-assembly and reuse, move to **MODULAR** design
4. Manufacturers will be forced to adopt a more cyclic way of thinking about their production process.
5. Reduced extractive and processing activity upstream from the consumer, reduced disposal downstream.
6. Employment shift from extraction/disposal industries to service, collection and re-processing industries.

Summary

- A circular economy strives to retain products and materials in use within the whole system at their highest value wherever possible
- It aims to eliminate waste from production processes, and create a circular flow of materials that eliminates the need for end of use disposal
- To achieve effective circularity it is critical to separate the flows of man-made, technological products and materials from the cycles of the biological system
- Within the technological and biological cycles, a series of cascading options can be taken to retain products and materials in use for as long as possible.
- These include maintaining, repairing, remanufacturing, recycling in the technosphere; and composting, refining, digesting, recycling and restoring in the biosphere
- Renewable energy is critical to supporting the system