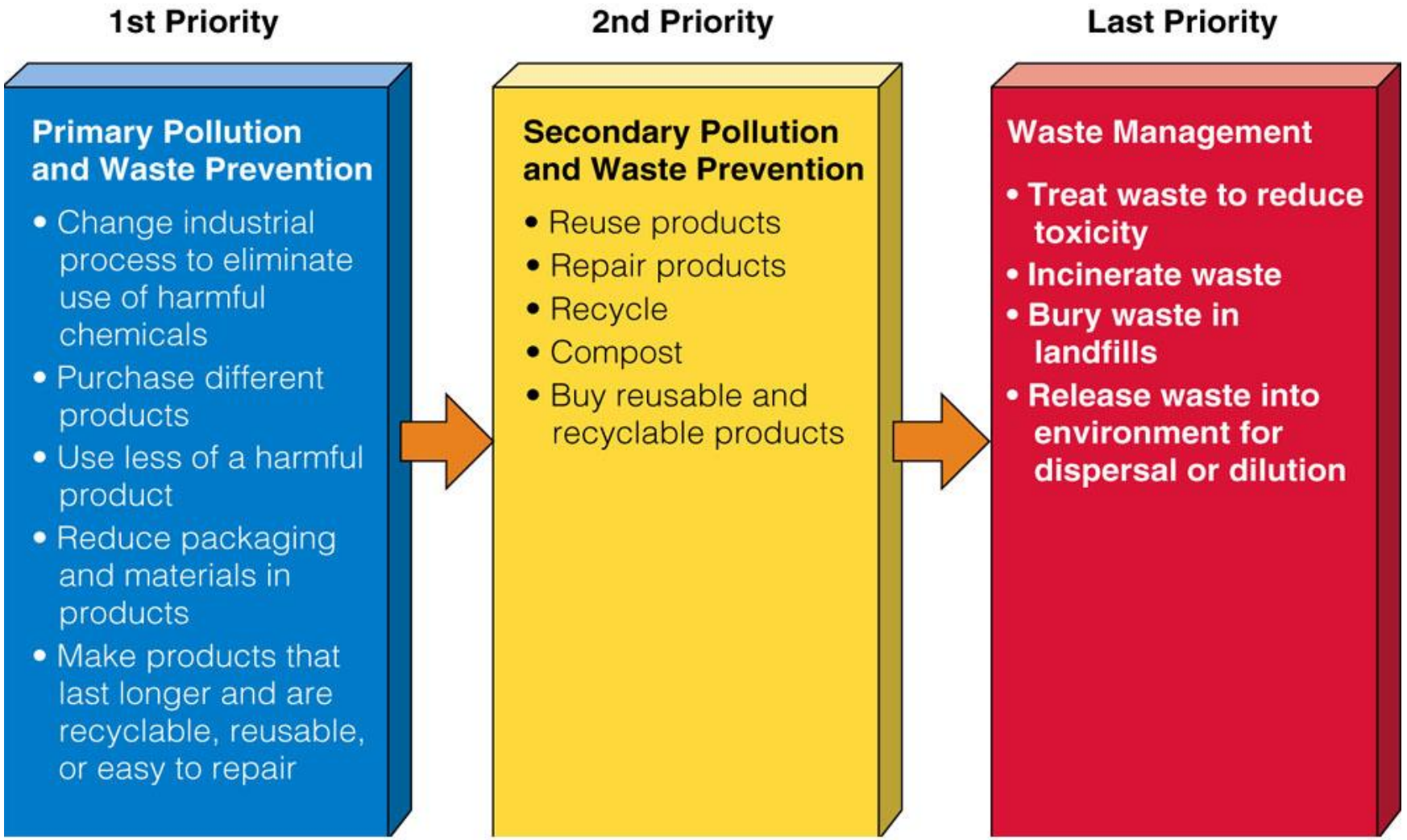
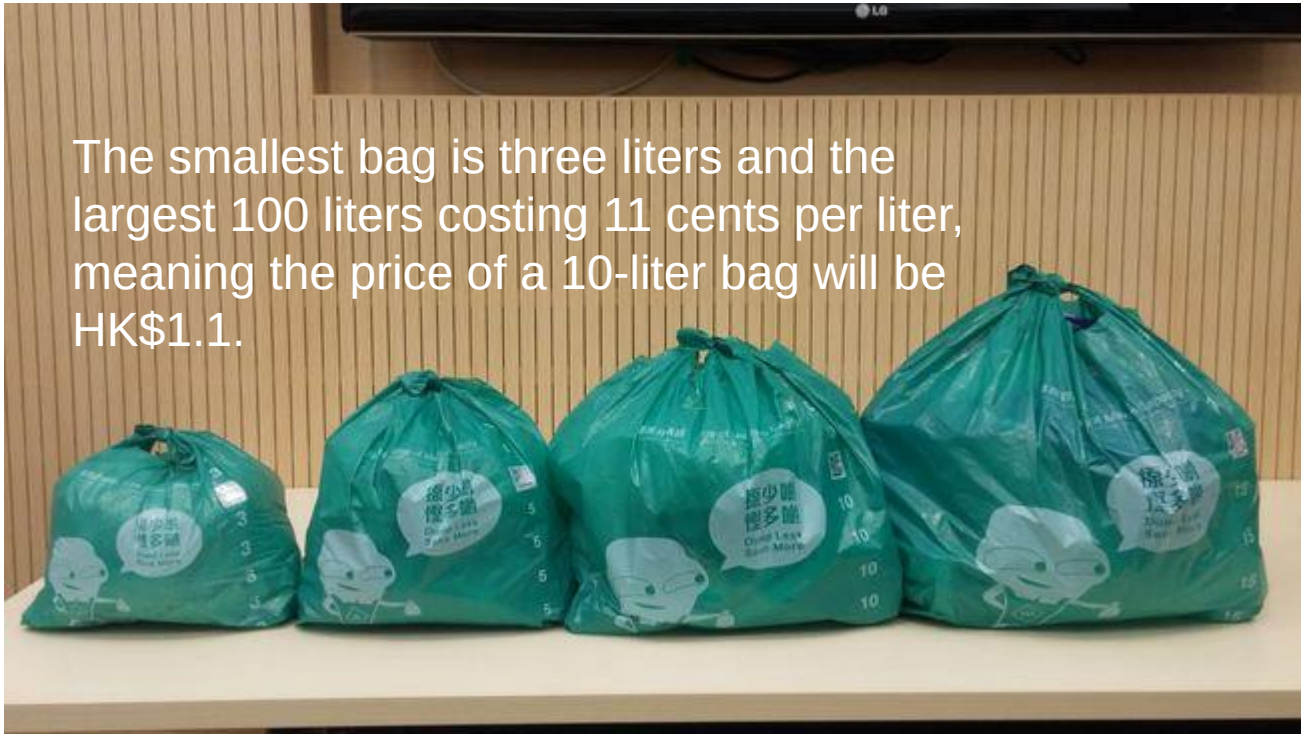
Week	Topics	Assignment issued	Key dates
Week 1	Course introduction; Climate Change and the Engineering approach		**Quiz 1**
Week 2	**MODULE I** Introduction to Sustainability Energy, Natural Resources and pollution, Electromagnetic energy; Electrical energy – Lighting, Light pollution, Policy	**Semester-long Project**	
Week 3		**Project deliverable 1.1**	
Week 4	**MODULE II** Energy and Environmental Implications– Transportation Human-Environment Impacts		
Week 5		**Project deliverable 1.2**	**Project deliverable 1.1**
Week 6	**MODULE III** Noise Pollution in Urban Environment	**Project deliverable 1.3**	**Quiz2**
Week 7	**MODULE IV** Urban Sustainability and Resilience		**Project deliverable 1.2**
Week 8	**MODULE V** Tools: Systems Analysis for Sustainability Cost-Benefit Analysis		
Week 9			
Week 10	Material Flow Analysis, Life Cycle Assessment		**Project deliverable 1.3; Quiz3**
Week 11	**MODULE VI** Advances in Environmental and Energy Engineering	**Project deliverable 1.4**	
Week 12	**MODULE VII** Waste management and Circular Economy	**Project deliverable 1.5 (Now this is extra credit-BONUS!)**	
Week 13	**Review and Individual Presentations (5-mins)**		**Quiz4** **Final Project Report (merged with Project deliverable 1.4)** **5 min Presentation**
April 18th			**Project deliverable 5 due 18th April**

Dealing with Material Use and Wastes



Waste Reduction by Waste Charging

- Each household to use pre-paid designated garbage bags and take them out at a designated time and place every time for disposal under monitoring
- To be introduced by late 2022.



http://www.thestandard.com.hk/section-news.php?id=180983

Reuse

- Extends resource supplies
- Saves energy and money
- Reduces pollution
- Creates jobs
- Reusable products

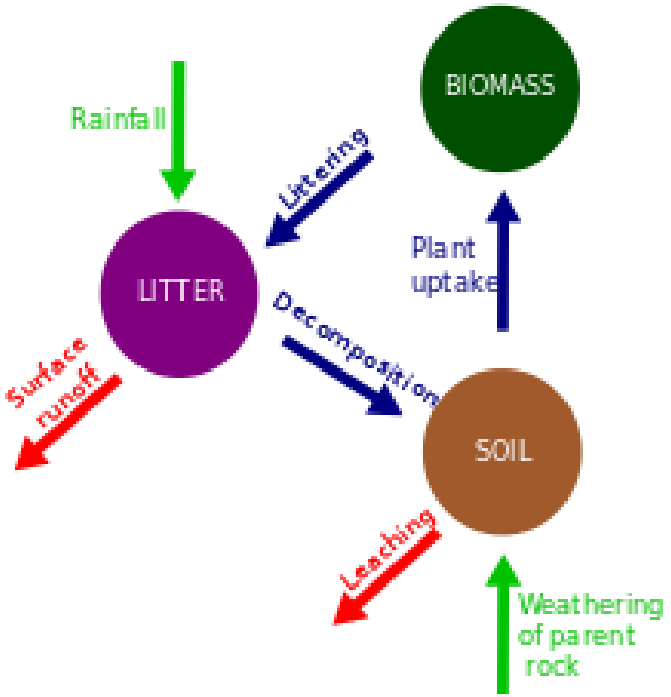
What Can You Do?

Reuse

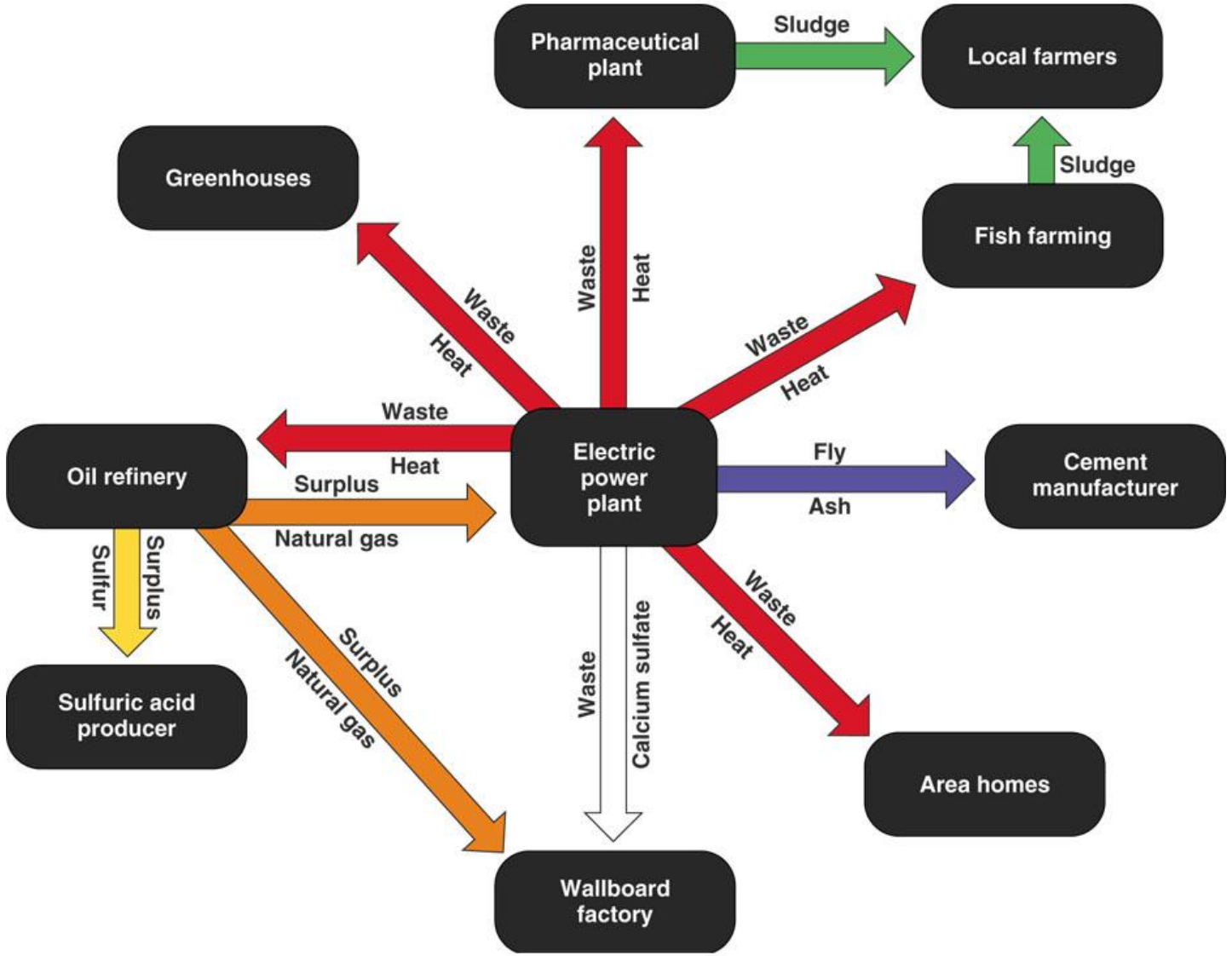
- Buy beverages in refillable glass containers instead of cans or throwaway bottles.
- Use reusable plastic or metal lunchboxes.
- Carry sandwiches and store food in the refrigerator in reusable containers instead of wrapping them in aluminum foil or plastic wrap.
- Use rechargeable batteries and recycle them when their usefull life is over.
- Carry groceries and other items in a reusable basket, a canvas or string bag, or a small cart.
- Use reusable sponges and washable cloth napkins, dishtowels, and handkerchiefs instead of throwaway paper ones.

Solutions: Cleaner Production

- Eco-industrial revolution
- Resource exchange webs
  - Waste from one industry is raw material for another
  - Biomimicry (mimic nature)
  - No waste in nature
- Service-flow economy

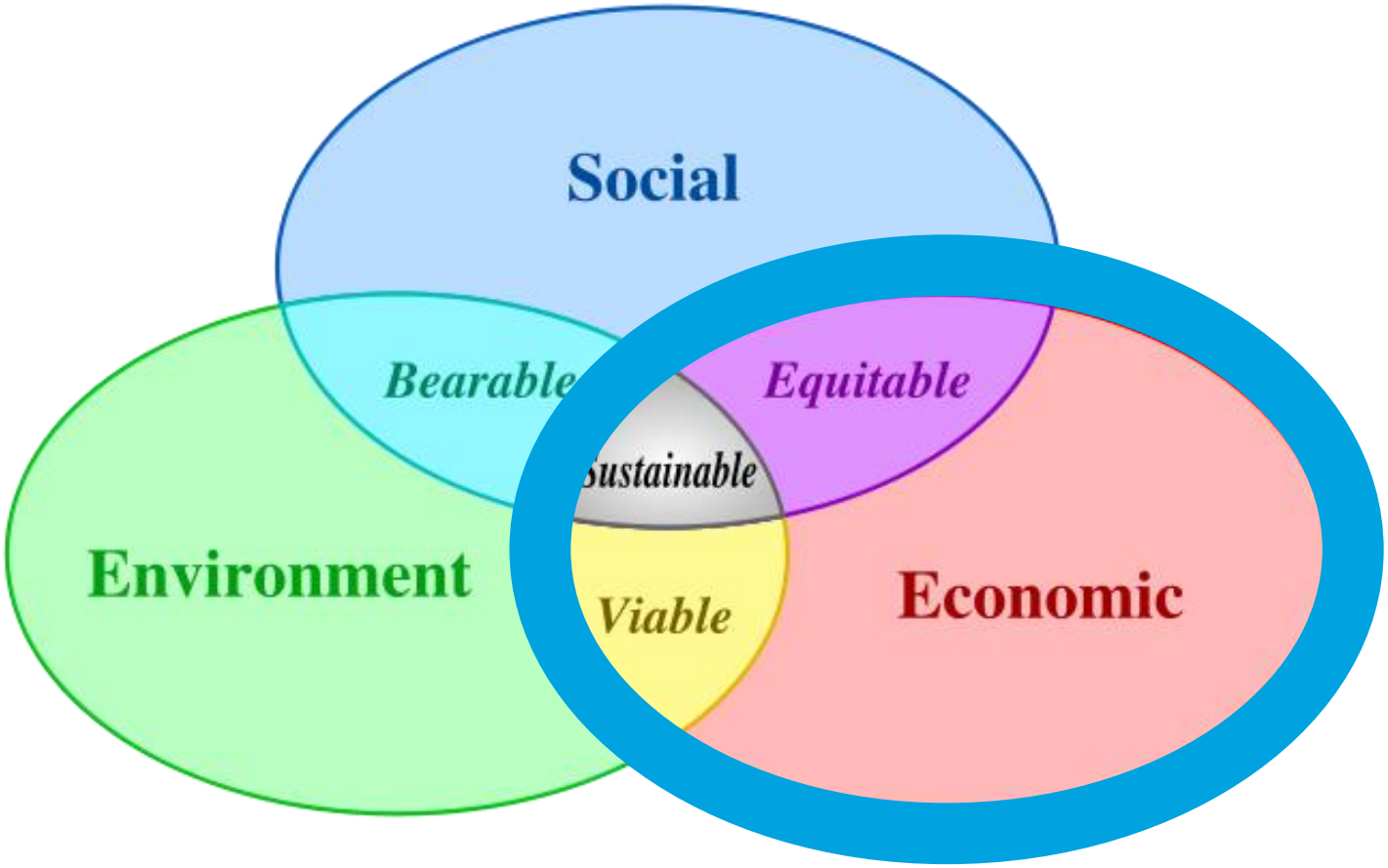


Industrial Ecosystem in Denmark



Kalundborg Symbiosis

Sustainability: Approaches



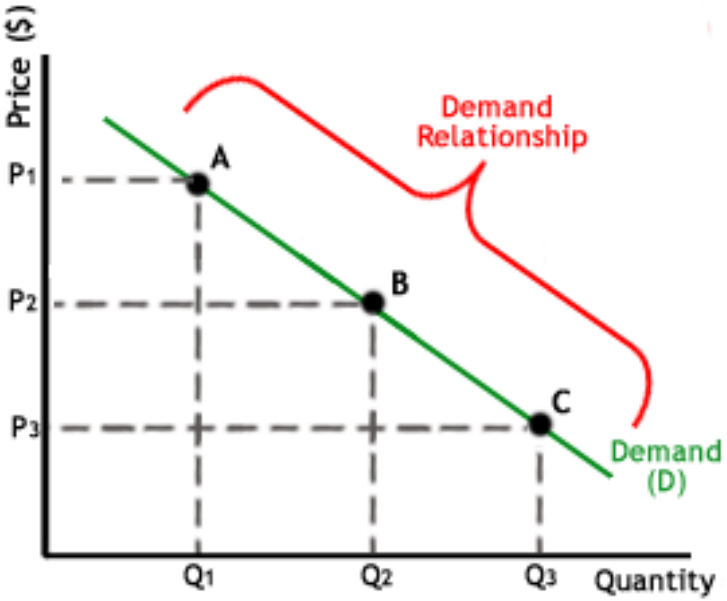
E.g. Circular Economy

Basics of Economics: Supply and Demand

- Supply and demand is perhaps one of the most fundamental concepts of economics and it is the backbone of a market economy
- **Demand** refers to how much (quantity) of a product or service is desired by buyers.
  - The quantity demanded is the amount of a product people are willing to buy at a certain price; the relationship between price and quantity demanded is known as the **demand relationship**.
- **Supply** represents how much the market can offer.
  - The quantity supplied refers to the amount of a certain good producers are willing to supply when receiving a certain price. The correlation between price and how much of a good or service is supplied to the market is known as the **supply relationship**.
- Price, therefore, is a reflection of supply and demand.

The Law of Demand

- The law of demand states that, if all other factors remain equal, the **higher the price of a good**, the **less people will demand that good**.
- Amount of a good that buyers purchase at a higher price is less because as the price of a good goes up, so does the **opportunity cost** of buying that good

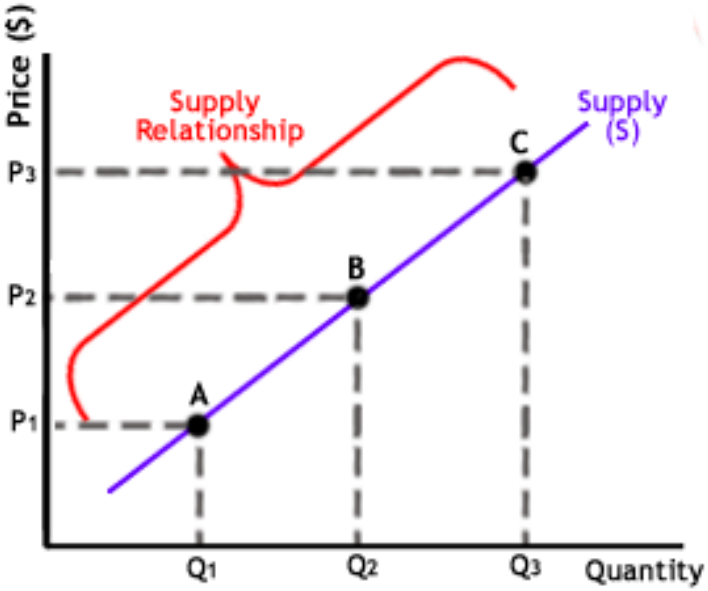


A, B and C are points on the demand curve that reflect a direct correlation between quantity demanded (Q) and price (P)

At point A, the quantity demanded will be Q1 and the price will be P1, and so on

The Law of Supply

- The law of supply demonstrates the quantities that will be sold at a certain price.
  - unlike the law of demand, the supply relationship shows an upward slope => **the higher the price, the higher the quantity supplied**
- Producers supply more at a higher price because selling a higher quantity at a higher price increases revenue.



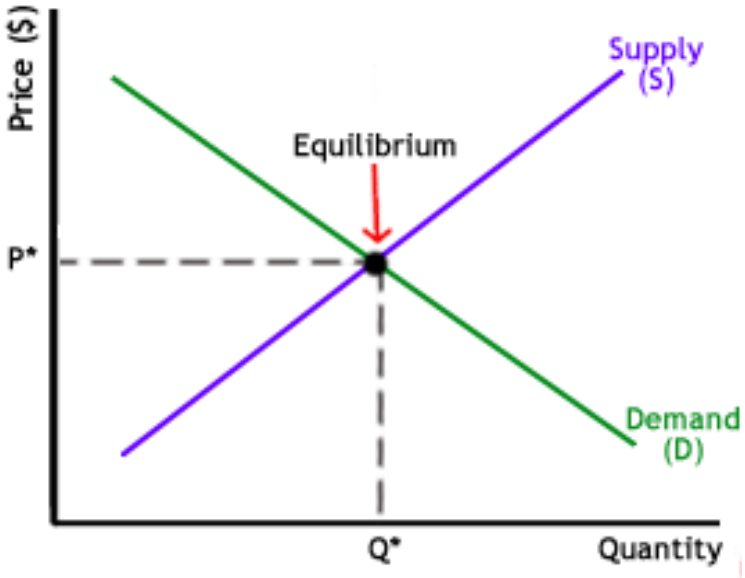
A, B and C are points on the supply curve that reflect a direct correlation between quantity supplied (Q) and price (P).

At point B, the quantity supplied will be Q2 and the price will be P2, and so on.

Time is important to supply because suppliers must, but cannot always, react quickly to a change in demand or price.

Supply and Demand Relationship

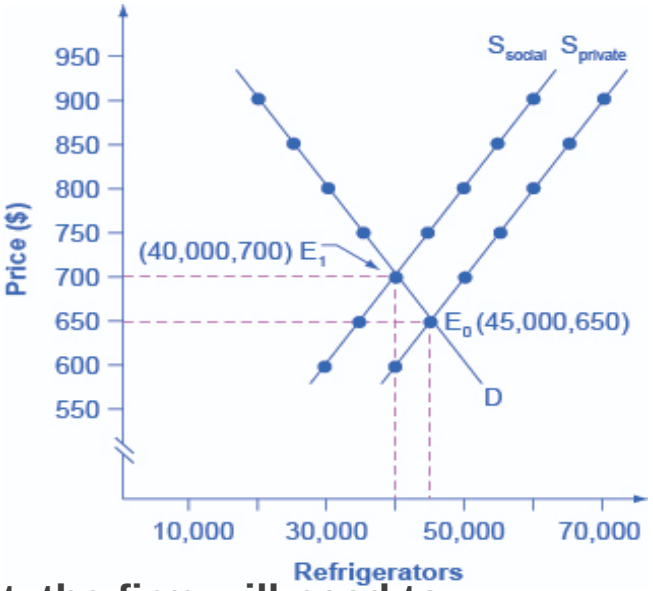
- When supply and demand are equal (i.e. when the supply function and demand function intersect) the economy is said to be at **equilibrium**.



equilibrium occurs **at the intersection of the demand and supply curve**, which indicates no allocative inefficiency. At this point, the price of the goods will be P* and the quantity will be Q*. These figures are referred to as equilibrium price and quantity.

Economics of pollution

- Economic production can **cause environmental damage**.
- Voluntary exchange benefits both buyers and sellers is a fundamental building block of the economic way of thinking.
  - But what happens when a voluntary exchange affects a third party who is neither the buyer nor the seller?
- The effect of a market exchange on a third party who is outside, or external, to the exchange is called an *externality*.
  - Negative externality
  - Positive externality



- Waste and pollution is a negative externality.

Externalities represent a case where markets no longer consider all social costs

Taking external costs of pollution into account, the firm will need to receive a price of $700 per refrigerator and produce a quantity of 40,000.

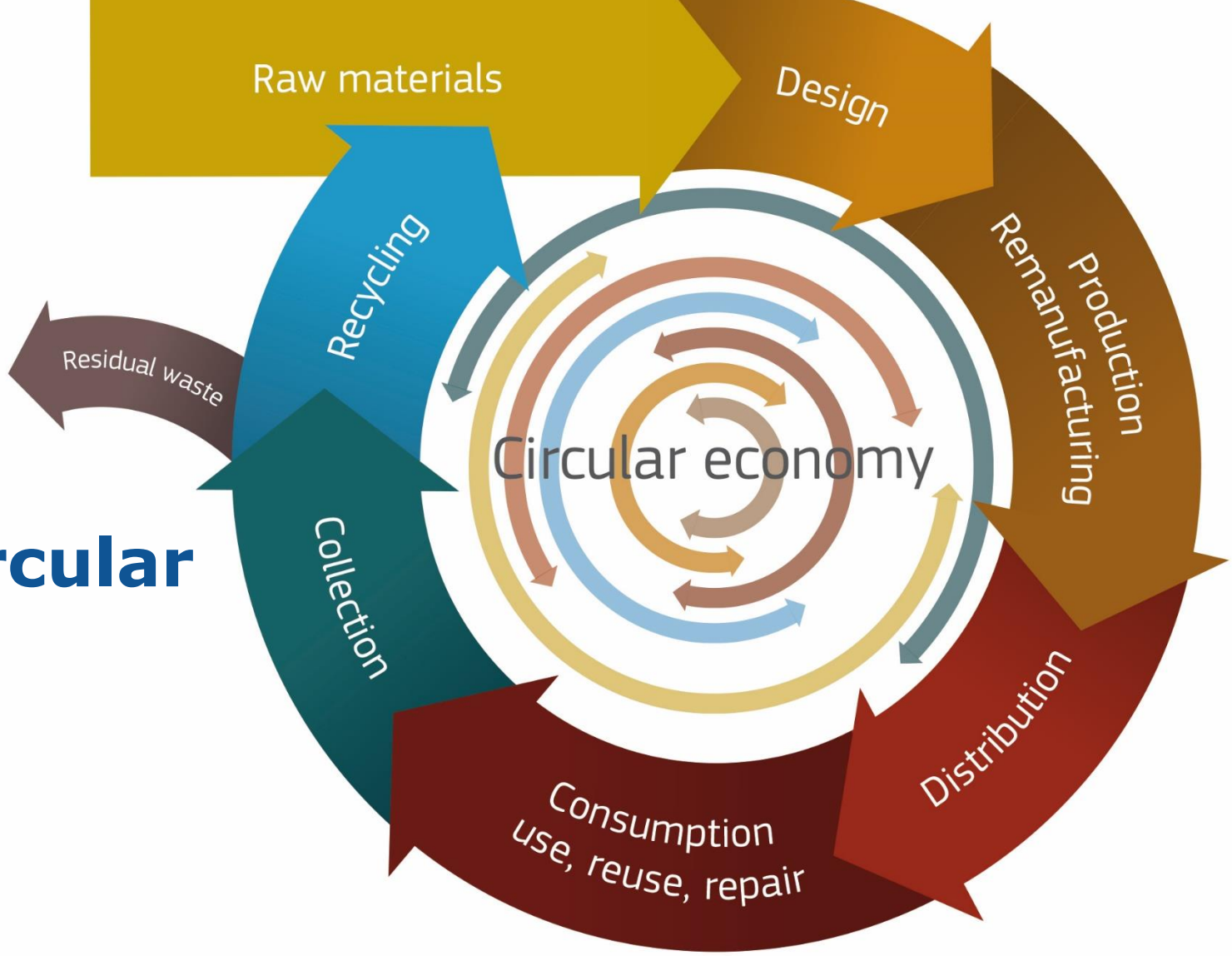
HERE IS A QUOTE WE RATHER LIKE:

"The goods of today are the resources of tomorrow at the resource prices of yesterday"

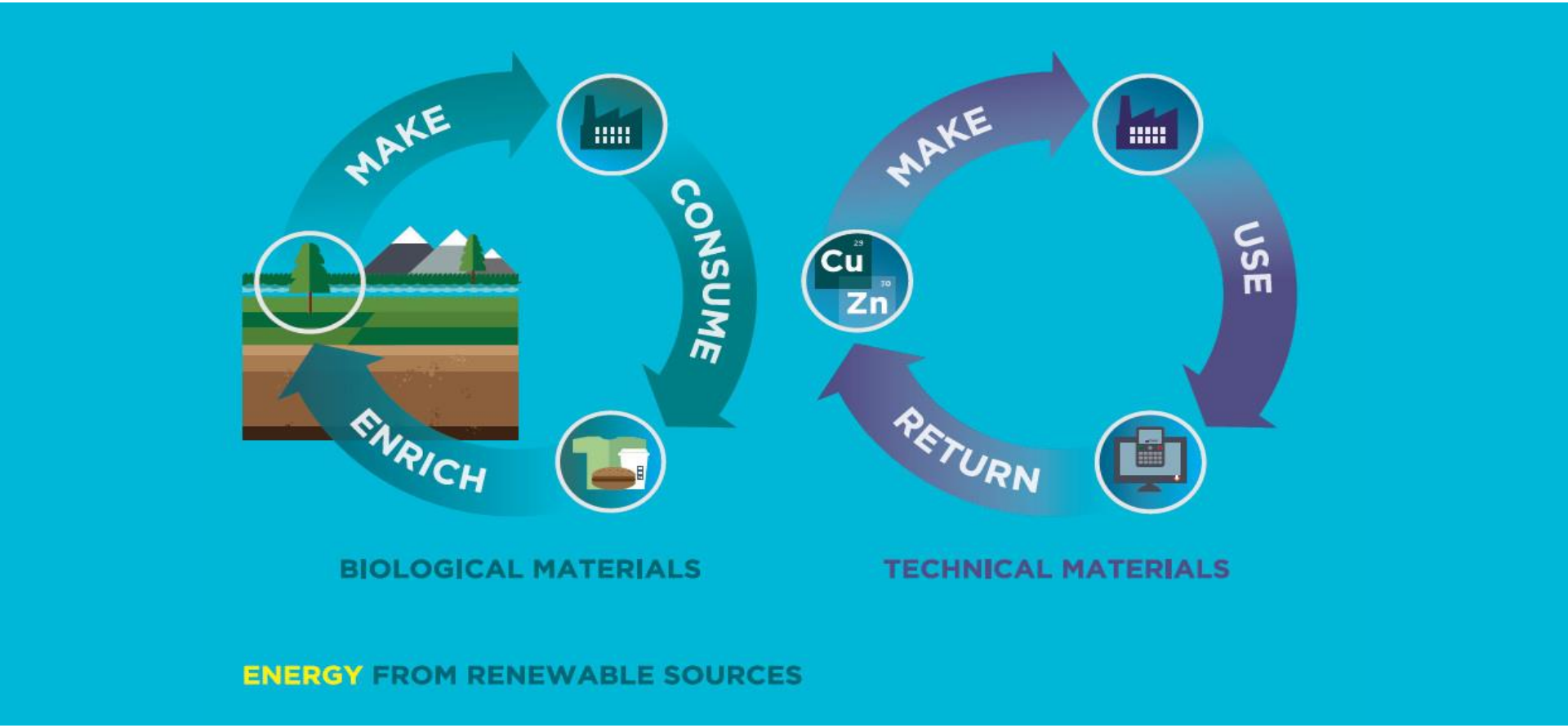
- WALTER STAHEL

From a linear economy …

… to a circular economy

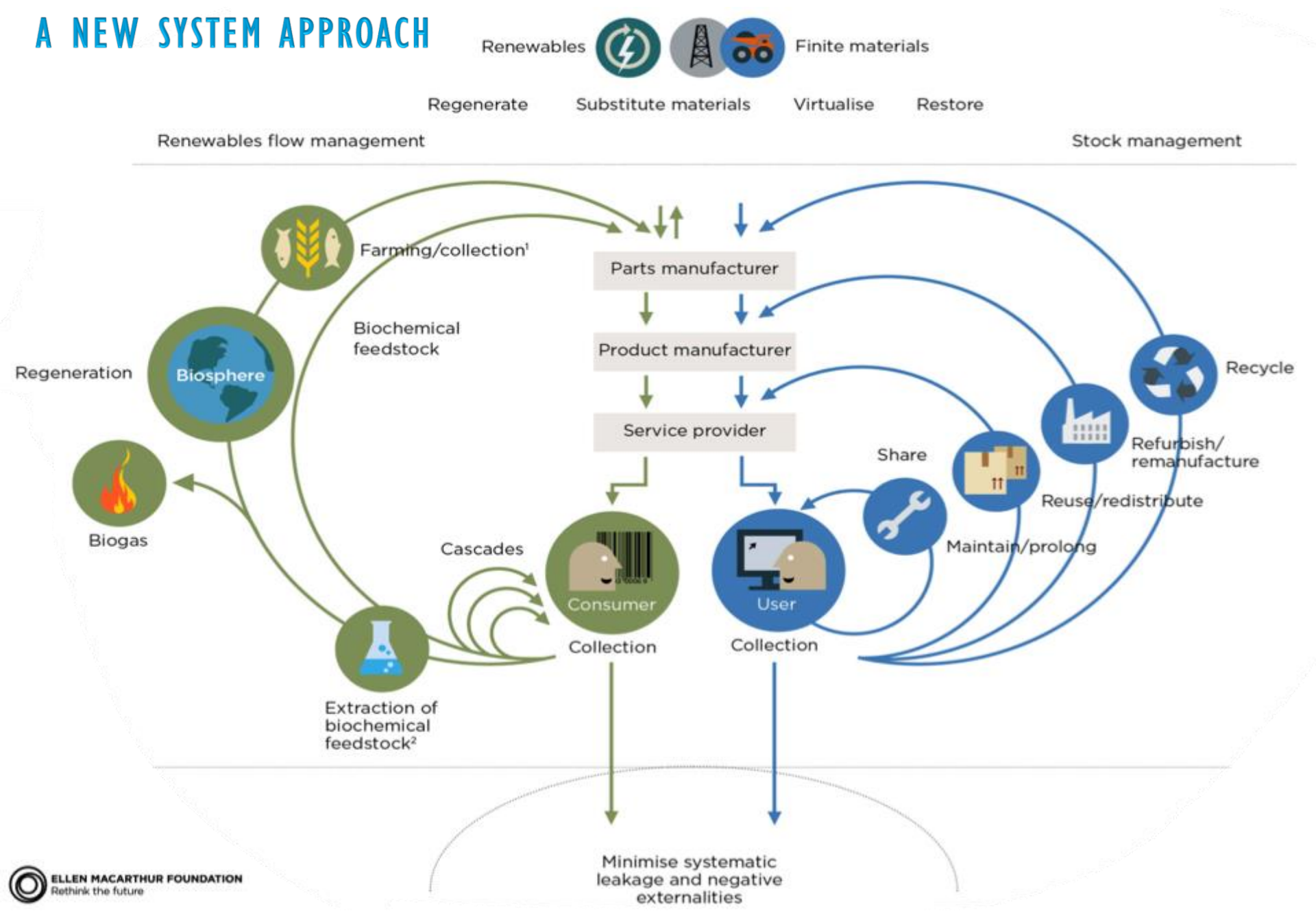


THE CIRCULAR ECONOMY

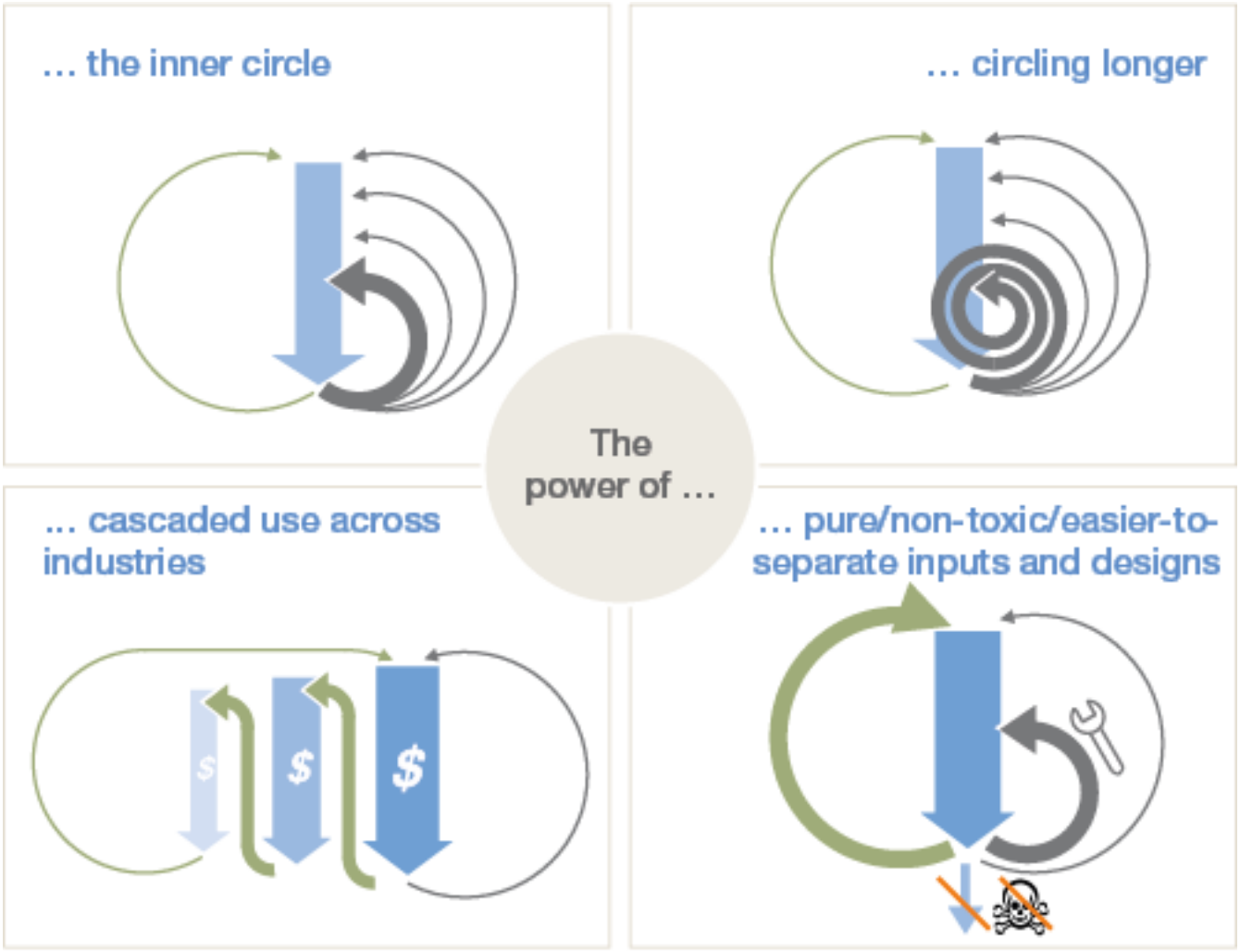


ELLEN MACARTHUR FOUNDATION

A NEW SYSTEM APPROACH

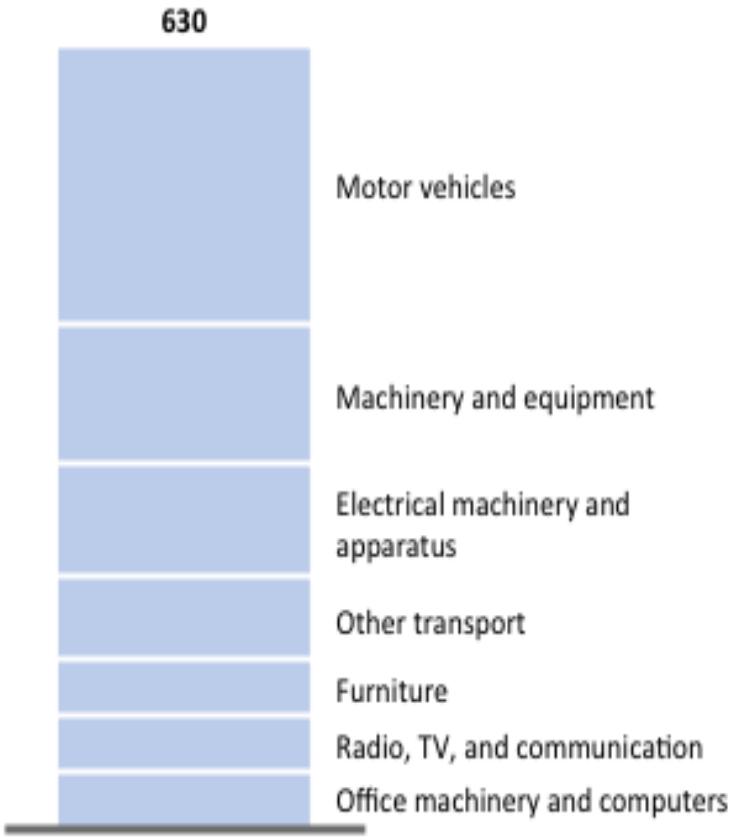


ELLEN MACARTHUR FOUNDATION
Rethink the future


… the inner circle
… circling longer
The power of …
… cascaded use across industries
… pure/non-toxic/easier-to-separate inputs and designs

Net material cost savings in complex durables with medium lifespans

US$ billion per year, based on current total input costs per sector, EU



Net material cost savings in consumers industries

US$ billion per year, based on total material savings from consumer categories, global

EXAMPLE 1 OF 3: PHILIPS AND TURNTOO

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EXAMPLE 2 OF 3: FLOOW2

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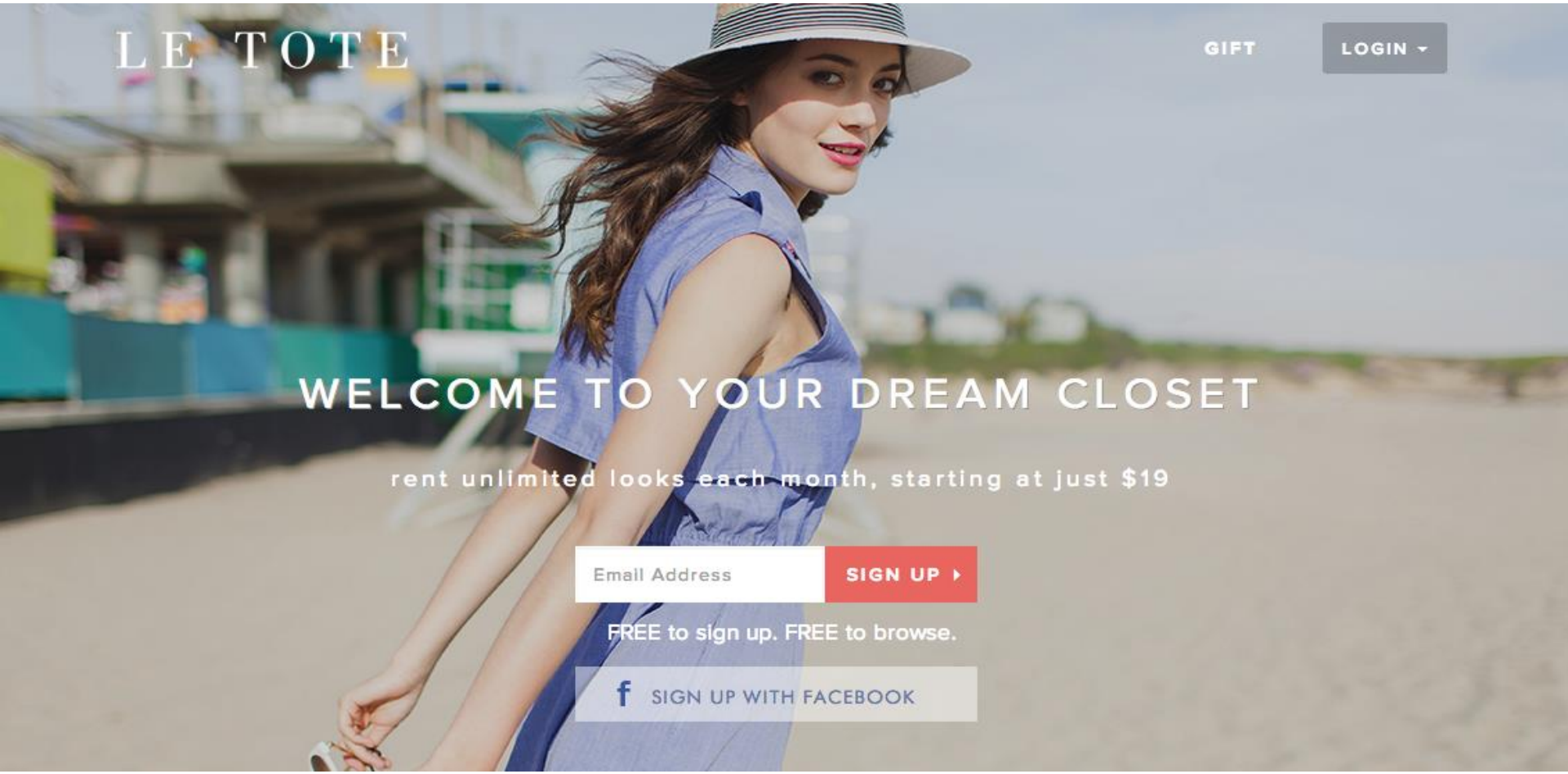
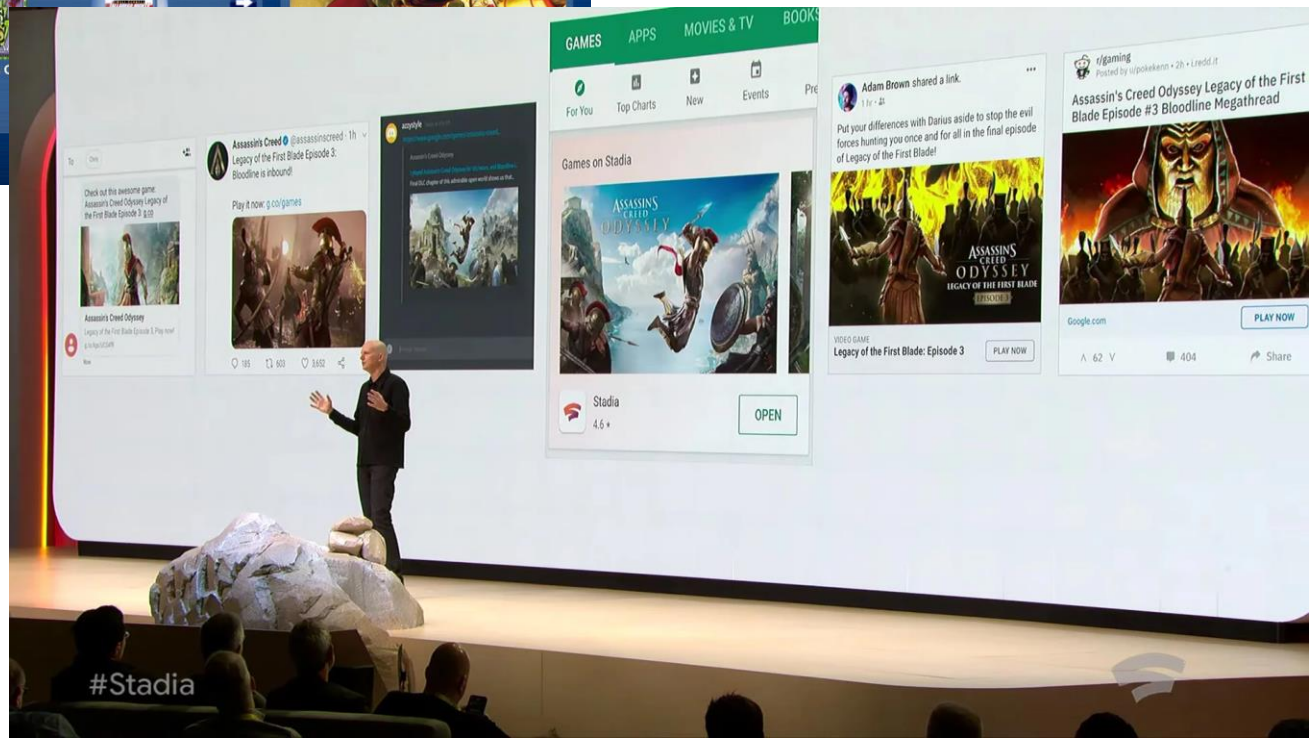
EXAMPLE 3 OF 3: LE TOTE



A CHALLENGE FOR FUTURE ENGINEERS

RE-THINK AND RE-DESIGN A PRODUCT OR A SERVICE FOR A CIRCULAR ECONOMY

SOME INSPIRATIONS… Gaming without CDs or consoles



SOME INSPIRATIONS… Biodegradable shoes

SOME INSPIRATIONS…

THE RESOLVE FRAMEWORK

	Examples
REGENERATE	• Shift to renewable energy and materials • Reclaim, retain, and restore health of ecosystems • Return recovered biological resources to the biosphere
SHARE	• Share assets (e.g. cars, rooms, appliances) • Reuse/secondhand • Prolong life through maintenance, design for durability, upgradability, etc.
OPTIMISE	• Increase performance/efficiency of product • Remove waste in production and supply chain • Leverage big data, automation, remote sensing and steering
LOOP	• Remanufacture products or components • Recycle materials • Digest anaerobic • Extract biochemicals from organic waste
VIRTUALISE	• Dematerialise directly, e.g., books, CDs, DVDs, travel • Dematerialise indirectly, e.g., online shopping, autonomous vehicles
EXPLORE	• Replace old with advanced non-renewable materials • Apply new technologies (e.g. 3D printing) • Choose new product/service (e.g. multimodal transport)

CIRCULAR ECONOMY - VALUE & BENEFIT LEVERS

ELLEN MACARTHUR FOUNDATION

THE BIG QUESTION…

WHAT WILL YOU REDESIGN?

In-Class Activity:

1. Hong Kong loves Bubble tea!
2. Identify new business models based on the resolve framework that may solve the issue of waste generation from this sector.

TLQ

- TLQ is important for getting money to SEE.
  - Higher TLQ, the more funds given to the department
  - Funds that are used to support UG activities
- Filling out TLQ of SEE1003 Intro to Sustainable Energy & Environmental Engineering to improve teaching and inform personnel decisions.
  - Completion of it is voluntary and does not contribute to the final grade. Please complete with great care - share your valuable opinions NOW!

a. Students can access the TLQ system during the evaluation period in the following ways: a. through a link in an invitation email

b. through the course site on Canvas;

c. by logging into the TLQ system directly (https://onlinesurvey.cityu.edu.hk/);

d. by scanning the TLQ QR Code by smart phones or tablets.

SEE 1003: Final Exam on 28th April

- Open-book exam (use any resource!)
- 100 points AND Answer all questions
- Students are allowed to use the following materials/aids:
  - Notes, books and internet.
  - Calculator
- Students will be subject to disciplinary action if any plagiarism is detected in their exams. Both students will be penalized. Very Serious!

SEE 1003: Final Exam on 28th April

1. Comprehension question; impact on Hong Kong; 2 parts (5 pts)
2. Comprehension & Diagram question with open ended answer; 3 parts (10 pts)
3. Calculation problem; 4 parts (15 pts)
4. Calculation problem; 4 parts (15 pts)
5. Concept question (6 pts)
6. Hong Kong specific examples; 2 parts (8 pts)
7. Calculation question and interpretation of answer; 3 parts (10 pts)
8. Comprehension & Diagram question with open ended answer; 4 parts (17 pts)
9. Concept + *example* question (6 pts)
10. Diagram question; 3 parts (8 pts)

SEE 1003 class overview

Week	Topics
Week 1	Course introduction; Climate Change and the Engineering approach
Week 2 Week 3	**MODULE I** Introduction to Sustainability Energy, Natural Resources and pollution, Electromagnetic energy; Electrical energy – Lighting, Light pollution, Policy
Week 4 Week 5	**MODULE II** Energy and Environmental Implications– Transportation Human-Environment Impacts
Week 6	**MODULE III** Noise Pollution in Urban Environment
Week 7	**MODULE IV** Urban Sustainability and Resilience
Week 8 Week 9	**MODULE V** Tools: Systems Analysis for Sustainability Cost-Benefit Analysis
Week 10	Material Flow Analysis, Life Cycle Assessment
Week 11	**MODULE VI** Advances in Environmental and Energy Engineering
Week 12	**MODULE VII** Waste management
Week 13	Circular Economy and Exam Review

Things to keep in mind

- When learning concepts or methods, make a list of example situations where they may be used or applied.
- Practice calculations performed in class and as HW.
- Read long questions carefully, take notes about them. Difficulty level highest.
- Diagram questions are tricky! You will be asked to interpret and draw.
- Lecture notes and reading assignment. Both important.

TLQ

- TLQ is important for getting money to SEE.
  - Higher TLQ, the more funds given to the department
  - Funds that are used to support UG activities

- Filling out TLQ of SEE1003 Intro to Sustainable Energy & Environmental Engineering to improve teaching and inform personnel decisions. Completion of it is voluntary and does not contribute to the final grade. Please complete with great care - share your valuable opinions NOW!
- https://canvas.cityu.edu.hk/courses/27978/assignments/86952#

Thank you for being such an enjoyable class to teach!

- Keep being inquisitive!
- Ask tough questions to teachers!
- Many challenges for your generation, get the skills to solve those problems!
- Be bold and be the change!
  - You can be entrepreneurs, don’t take university too easy.
- Always welcome to my office!