Image Ref:1

Circular Economy

From Linear to Circular

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CIRCULAR ECONOMY
Circular spaces

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an der Technischen Hochschule Wildau

Sommersemester 2024

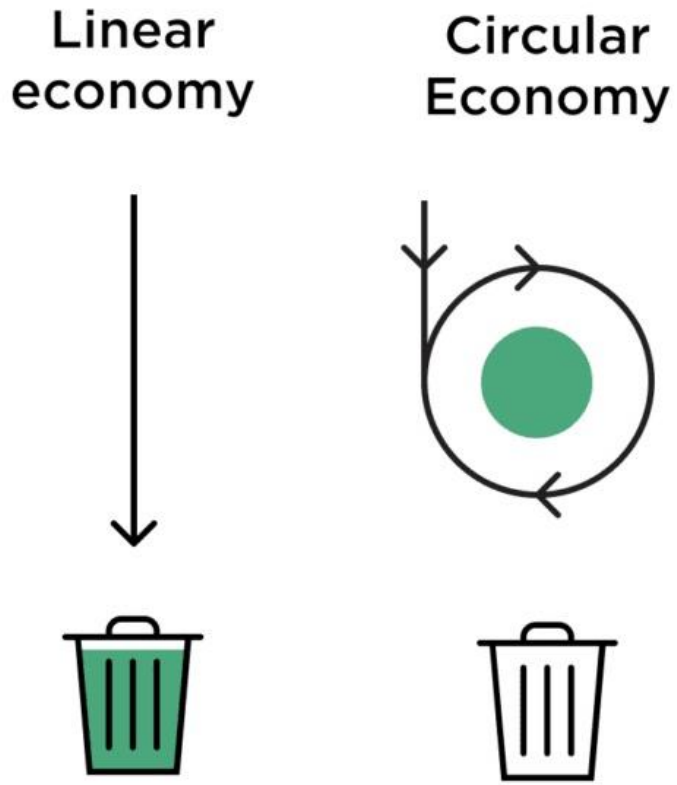
From Linear to Circular

- Circular economy
- Linear economy
- Pros and Cons of Linear and Circular Economy

- Planned obsolescence
- Right to Repair
- Circular raw materials

- Circular design
- Circularity and sustainability

- Cases Studies
- Bibliografie



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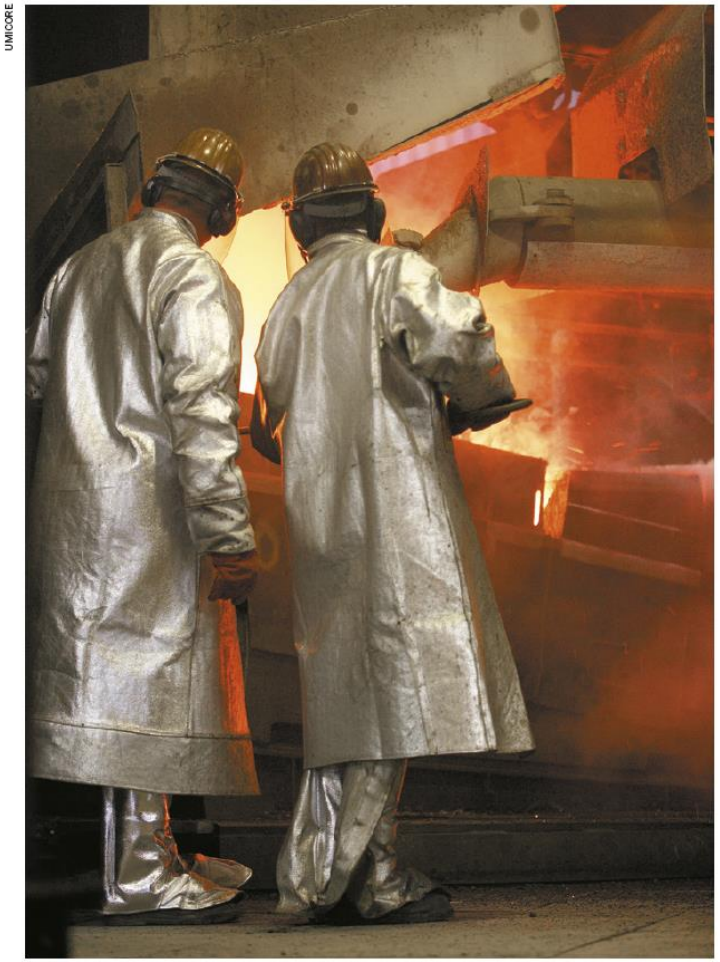
Circular Economy I

“When my battered 1969 Toyota car approached the age of 30, I decided that her body deserved to be remanufactured. After 2 months and 100 hours of work, she returned home in her original beauty. “I am so glad you finally bought a new car,” my neighbour remarked. Quality is still associated with newness not with caring; long-term use as undesirable, not resourceful.”(Ref1:https://www.nature.com/articles/531435a#citeas)



Workers at Umicore in Brussels separate out precious metals from electronic waste.

Image Ref:4

Image Ref:3

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Circular Economy I

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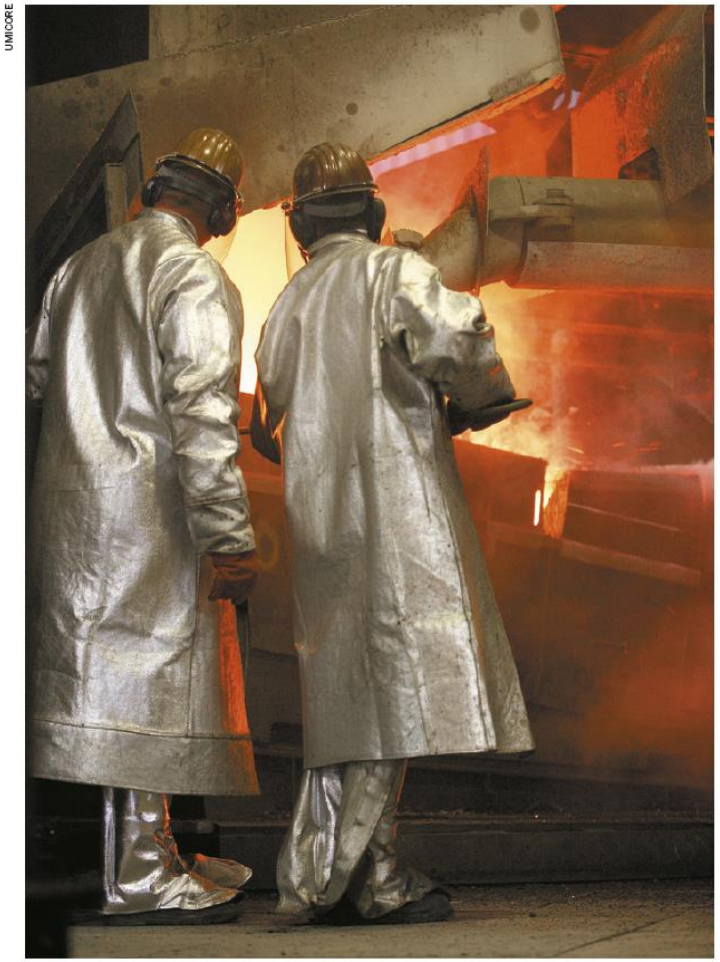
- Circular economy model: Involves sharing, leasing, reusing, repairing, refurbishing, and recycling to extend product life cycles.
- Goal: Minimize waste by keeping materials within the economy through recycling, creating further value.
- Departure from linear economic model: Traditional take-make-consume-throw away pattern replaced.



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Circular Economy I

Definition / Values

- **Circular Economy: Two Key Groups.**

1. Extend Service Life.
- Focused on reuse, repair, remanufacture, upgrades, and retrofits.
- Goal: Prolong the lifespan of goods.

2. Transform into Resources.
- Emphasizes recycling materials from old goods.
- Goal: Turn old items into new resources.

- **People-Centric Model**

- Ownership to Stewardship: Shift from owning to managing goods.
- Consumers as Users and Creators: Active involvement in product use and creation.

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Circular Economy I

Definition / Values

- Circular Economy: Two Key Groups.
- People-Centric Model

- **Remanufacturing Benefits.**

– Infrastructure Building: Supports new infrastructure development.
– Job Creation: Generates new skill jobs.

- **Global Initiatives.**

– South Korea, China, and the United States: Research programs to boost circular economies with a focus on remanufacturing and reuse.
– Europe: Taking gradual steps; initiatives from the Swiss foundation MISTRA and the EU Horizon 2020 Program since 2014.

Image Ref:5

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Circular Economy I

- **Circular Economy vs. 'Take-Make-Dispose**

  - Circular: Emphasizes sustainability and recycling.
  - Linear: Focuses on efficiency in resource use.

- **Benefits of Circular Model.**

  - Infrastructure and Jobs: Promotes development and job creation.
  - Sustainability: Reduces waste and environmental impact.
  - Cost Savings: Offers economic efficiency.

Scaling the Concept.

  - Learn from Success: Identify and replicate successful circular business models.
  - Key Factors: Understand elements contributing to success.
  - Sector Potential: Identify sectors and products suitable for circular practices.

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Circular Economy I

- Circular Economy vs. 'Take-Make-Dispose
- Benefits of Circular Model.
- Scaling the Concept.

- **Leveraging Shifts**

– Technology: Use advancements to accelerate circular transition.
– Consumer Behaviour: Align with changing consumer preferences.

- **EU Research Highlights.**

– Methodology: Reviewed products, conducted economic analysis, and interviewed experts.
– Potential Savings: Up to USD 630 billion in advanced scenarios fo EU manufacturing sectors.

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Linear Economy I

Definition

- **Operation Type**

– Operates linearly, resembling a river, where natural resources are transformed into products through a series of value-adding steps.

- **Values**

– Driven by the "bigger-better-faster-safer" syndrome, influenced by fashion, emotion, and the pursuit of progress.
– Efficient at overcoming scarcity challenges but tends to be profligate in resource usage, particularly in markets already saturated with products.

- **Individual and collective stewardship**

– Companies thrive by focusing on the mass production and sale of high volumes of inexpensive and trendy goods.
– Ownership and responsibility for risks and waste transfer to the buyer at the point of sale, allowing them to decide on the fate of the product, such as reuse, recycling, or disposal.

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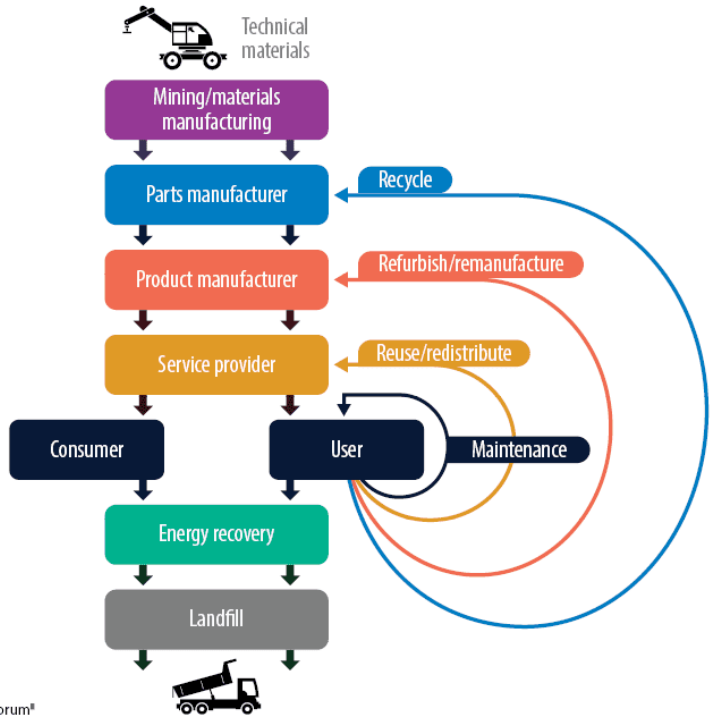
Linear Economy I

1. Linear Consumption Limits.

- Industrial economy primarily follows a 'take-make-dispose' pattern.
- In 2010, about 65 billion tonnes of raw materials entered the economic system, expected to rise to approximately 82 billion tonnes in 2020.
- Despite improvements in resource efficiency, the linear model lacks systematic approaches to eliminate material leakage and disposal.

2. Business Risks in the Linear System.

- Companies face increased exposure to risks, including higher resource prices and supply disruptions.
- Rising and unpredictable resource prices coupled with competition and stagnating demand pose challenges.
- Real prices of natural resources have risen since the turn of the millennium, erasing a century's worth of declines.



Source: World Economic Forum[8]

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Linear Economy I

1. Linear Consumption Limits.

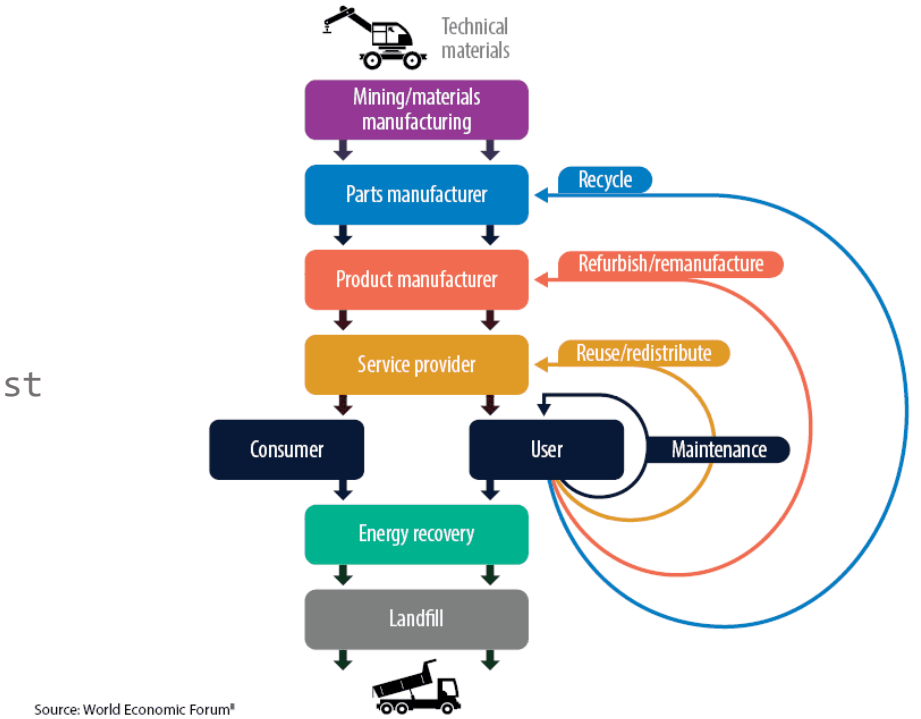
2. Business Risks in the Linear System.

3. Price Volatility and Future Concerns:

- The first decade of the 21st century saw unprecedented price volatility for metals, food, and non-food agricultural output.

- Anticipation of sustained high prices and volatility due to robust growth, population increase, urbanization, and rising resource extraction costs.

- With three billion new middle-class consumers expected by 2030, addressing these challenges becomes crucial for meeting growth requirements.



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Linear Economy I

Pros:

- Familiarity
- Simplicity
- Established Processes
- Immediate Returns
- Lower Initial Costs
- Clear Supply Chains

Cons:

- Resource Depletion
- Environmental Impact
- Waste Generation
- Vulnerability to Disruptions
- Dependence on Scarce Resources
- Limited Long-Term Sustainability

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Linear Economy

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Circular Economy I

Pros:

- Resource Efficiency
- Environmental Benefits
- Innovation, Job Creation
- Cost Savings
- Resilience to Disruptions

Cons:

- Initial Costs
- Resistance to Change
- Complexity, Coordination
- Job Displacement
- Consumer Behavior
- Limited Applicability

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Planned obsolescene I

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Planned obsolescene I

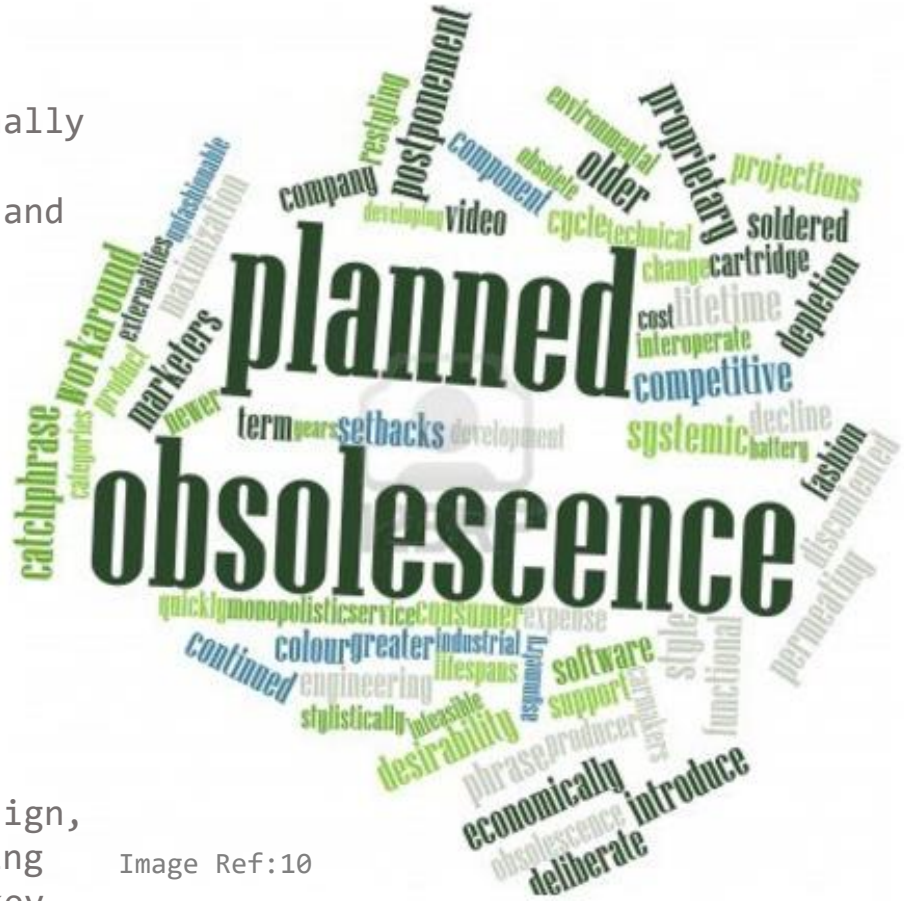
- **Definition**

– Planned obsolescence is a strategy where products are intentionally designed to have a limited lifespan, encouraging consumers to replace them with newer models, thus driving continuous demand and sales.

- **Reconvert**

1. Factors Driving Premature Obsolescence.
2. Real limits of Circularity.
3. Mitigating Premature Obsolescence.
4. Specific Types of Premature obsolescence
   -The “Weakest Link” Component
   -Fashion Obsolescence
   -Economic Obsolescence

– Transitioning to circular design involves resilient product design, modular production, and a shift in ownership dynamics. Addressing specific obsolescence types—planned, fashion, and economic—is key for sustainability and circularity.



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Planned obsolescene I

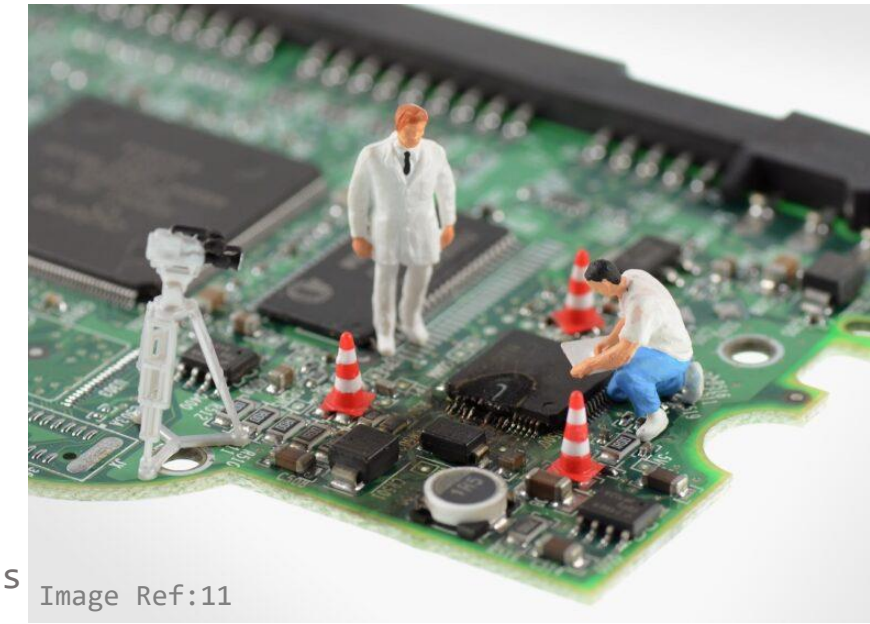
- **Factors driving premature obsolescence**

– **Technical Weaknesses:**
Products prone to technical failures may be discarded prematurely, contributing to unnecessary waste.

– **Fashion Trends.:**
Rapidly changing styles and trends can lead to the premature retirement of functional products for aesthetic reasons.

– **Economic Considerations:**
High maintenance costs or perceived inefficiencies may render products economically obsolete, encouraging early disposal.

Regulatory Factors:
Regulations or policies may influence product lifecycles, potentially leading to premature obsolescence based on compliance requirements or incentives.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Planned obsolescene I

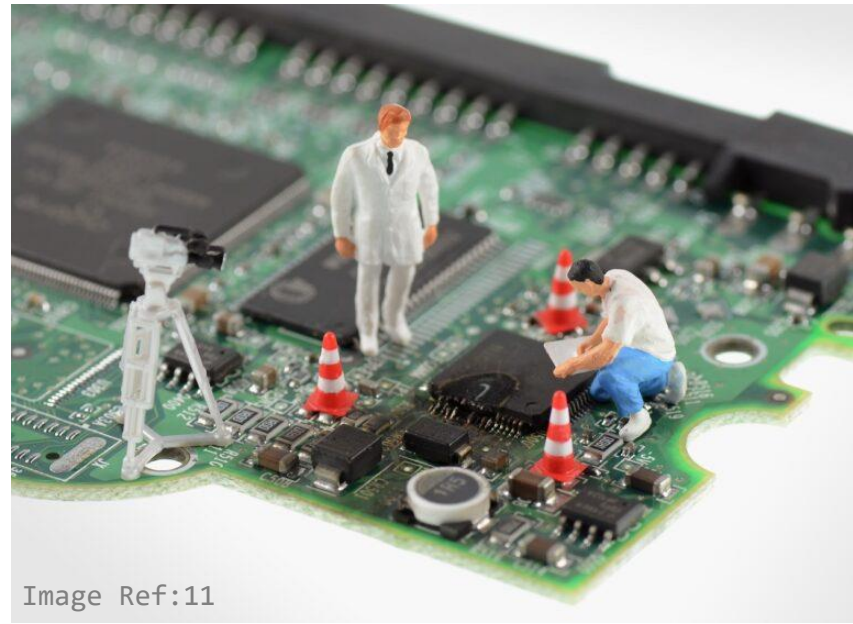
- **Real limits to circularity**

1. Physical Constraints (Second Law of Thermodynamics).

– The natural tendency for systems to move towards disorder, imposing limits on the perpetual reuse of materials and energy.

2. Exception rather than the rule today.

– Achieving complete circularity is currently uncommon, with most systems falling short due to various challenges and constraints.



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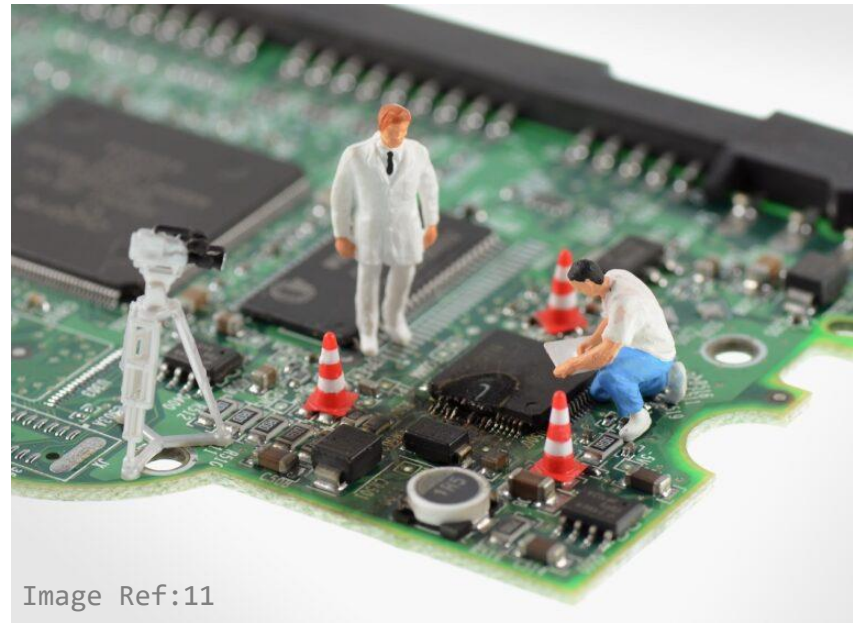
Planned obsolescene I

Mitigating Premature Obsolescence:

- **The 'Weakest Link' Component:**
  - Planned obsolescence often results from the failure of a single component, leading to the discarding of the entire product. To counteract this, mitigation strategies include designing for even wear, promoting individual component sales, and reconsidering business models to encourage ownership retention.

- **Fashion Obsolescence:**
  - To combat premature product retirement due to evolving fashion trends, consider refreshing products through cosmetic redesign. This approach provides consumers with a renewed sense of novelty and added value without the need for new material inputs.

- **Economic Obsolescence:**
  - When the cost of ownership surpasses that of purchasing a new item, economic obsolescence occurs. Mitigation involves designing products for easy disassembly and strategic part replacement. Additionally, creating infrastructure to facilitate the return of products to manufacturers can support the reuse of components and simplify exchanges or upgrades, aligning with technological progress.



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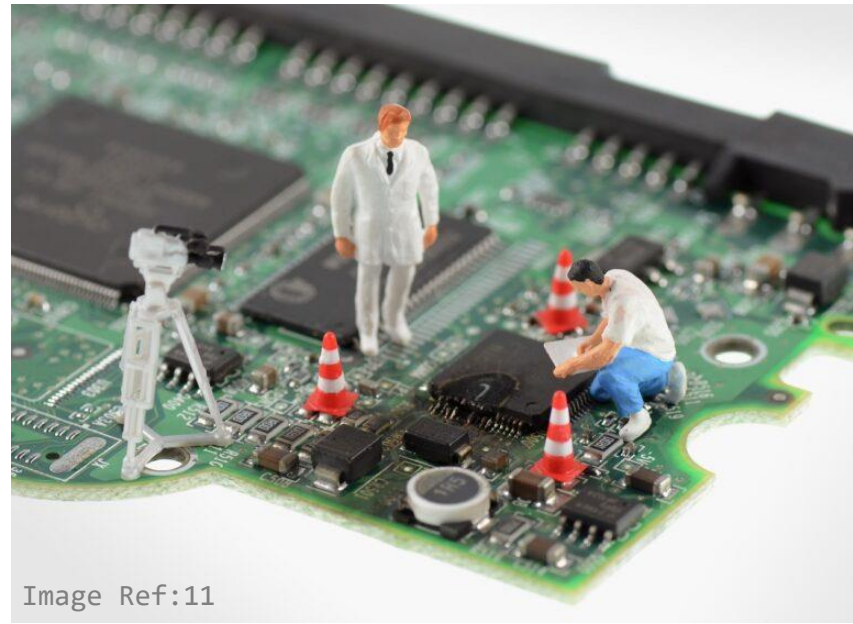
Planned obsolescene I

- **To tackle Planned Obsolescence**

– Addressing Plan Obsolescence requires a multifaceted approach, encompassing technical, fashion-related, economic, and regulatory considerations. By emphasizing even wear in design, refreshing products cosmetically, and implementing strategies for disassembly and part replacement, the transition towards a more circular and sustainable product lifecycle becomes feasible.



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Right to Repair I

Introduction to Sustainable Development

- Urgent Call for Transformation: Sustainable development urges a transformation in how society fulfils its needs.
- Linear Model Obsolete: The traditional 'take-make-dispose' model is no longer a viable option for meeting evolving demands.
- Diverse Approaches: Over the past 40 years, various approaches have been developed to promote sustainable products and services.

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Right to Repair I

Introduction to Sustainable Development

Importance of Repairability in Circular Economy

- Circular Economy Emphasis: Circular economy models stress the importance of longer product lifespans through technical and biological cascades.
- Crucial Role of Repairability: Repairability is a fundamental aspect of technical cascades, minimizing the demand for new resources in the production of goods.
- Dependence on Variables: The ability to repair products is contingent on multiple variables, including design, business models, and consumer behavior.

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Right to Repair I

Introduction to Sustainable Development
Importance of Repairability in Circular Economy

Factors Inhibiting Repairability

- Lack of Knowledge: Consumers often lack knowledge about how products function, hindering their ability to perform repairs.
- Limited Access: Insufficient access to spare parts, technical information, and restrictive contracts restricts repair options.
- Economic Incentives: Economic factors, such as the cost of repair compared to buying new products, often discourage repair efforts.
- Emotional and Economic Attachment: Consumer attachment, both emotionally and economically, influences decisions to repair or replace products.
- Design and Manufacturing Challenges: Poor design and manufacturing features, like non-modular structures, can impede the repairability of product

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Right to Repair I

Introduction to Sustainable Development
Importance of Repairability in Circular Economy
Factors Inhibiting Repairability

EU Directive - Right to Repair

- Directive Overview: The new EU directive, known as "Right to Repair," underscores the importance of repairability in fostering circular economies.

- Addressing Barriers: Expected to address current barriers to repairing products, facilitating a shift in consumer-producer-product dynamics.
- Transformation Potential: Potential to transform relationships between producers, users, and products by promoting repair as a sustainable practice.

- Discussion and Proposed Actions: Exploring the anticipated impact and proposing necessary actions for the successful implementation of the "Right to Repair" directive.

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Circular Raw Materials I

Critical Raw Materials and Circular Economy
JRC (Joint Recerch Center) Contribution to the EU Circular Economy Action Plan

- **Importance of Raw Materials:**

Raw materials are the foundation of Europe's current and future economy, crucial for jobs, competitiveness, and enhancing the quality of life.

- **Critical Raw Materials (CRMs):**

Some raw materials are of particular concern due to their high economic importance and supply risk; these are termed Critical Raw Materials.

- **EU's Commitment:**

The European Union is dedicated to fostering a circular economy, and the JRC plays a pivotal role in contributing to the Circular Economy Action Plan.

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Circular Raw Materials I

– Circular Use in the EU

- **EOL-RIR as a Measure:**

The End-of-life Recycling Input Rate (EOL-RIR) is a key metric for assessing circular use, measuring the proportion of total material input from recycled post-consumer scrap.

- **Challenges in Achieving Circularity:**

Despite the potential for high recycling rates, challenges include the lack of cost-effective sorting and recycling technologies, locked-up supply in long-life assets, and growing demand in various sectors.

- **Recycling Performance Examples:**

Specific examples like vanadium, tungsten, cobalt showcase notable recycling input rates.

- **Illustrative Figure:**

A visual representation of EOL-RIR for specific CRMs in the EU, demonstrating the varying rates.

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Circular Raw Materials I

– Circular Use in the EU
– **Sectorial Perspective**

- **Significance of Sector Analysis:**

Understanding CRMs within specific sectors (e.g., automotive, renewable energy) is crucial for a comprehensive view.

- **Examples of Sector-Specific CRMs:**

Highlight critical raw materials in specific sectors, emphasizing the diverse raw material needs across industries.

- **Complementary Assessments:**

Advocate for complementary sector-specific assessments to capture nuances missed in an economy-wide analysis.

- **Illustrative Image:**

Visual representation indicating the complexity of CRM usage within different sectors.

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Circular Raw Materials I

- Circular Use in the EU
- Sectorial Perspective
- **Next Steps**

Summary of Findings:
The presentation provides insights into CRM use in the EU, emphasizing its current non-circular nature.

Policy Recommendations:
Recommendations include enhancing legislative frameworks, developing preventive initiatives, and supporting standardization activities.

Research and Development:
Emphasize the importance of supporting innovative, efficient, and cost-effective technologies for CRM extraction and material-efficient solutions.

Public Awareness:
Highlight the need to raise public awareness about the fundamental role of CRMs.

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Circular Design I

- **Unveiling Circular Design**

- **Circular design:**

A cornerstone of the circular economy.
Shifts from product-focused sustainability to holistic business model

- **Process:**

Designers strategically plan for products with a minimal environmenta impact.

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Ref 9:https://www.researchgate.net/publication/321998000 Critical raw materials and the circular economy
Ref:10: https://www.designorate.com/the-future-circular-economy-circular-design/

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Circular Design I

- Unveiling Circular Design
- **The Essence of Circular Design**

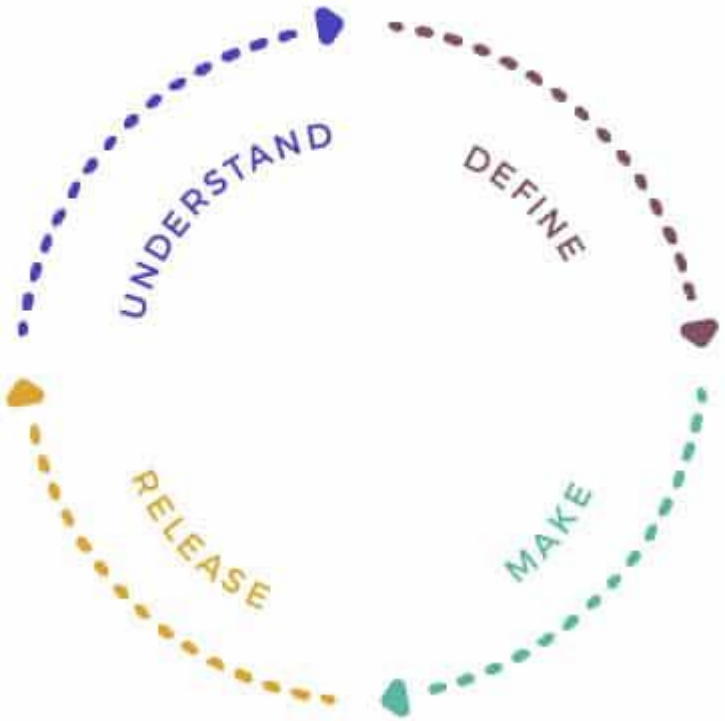
Four-stage Process:

Understand:
Analyzing user needs and brainstorming circular solutions.

Define:
Forming business goals and creating a multidisciplinary team.

Make:
Executing user-centered research, prototyping, and material definition.

Release:
Launching the product, collecting consumer feedback, completing the business model.



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Circular Design I

- Unveiling Circular Design
- The Essence of Circular Design
- **Case Study:**

Local Roots - Transforming Agriculture with Circular Design.

- **Circular Design Implementation:**

Reusing shipping containers as sustainable farms.
Full refurbishment and quality checks ensure longevity.
Remanufacturing: Parts reused in the manufacturing process.
Recycling: Materials recycled for use in other industries.

- **Sustainable Impact:**

Year-round, resource-efficient farming.
97% less water, no pesticides, and herbicides.

- **Business Model Innovation:**

Circular design integrated into the core of Local Roots' business.
Example of successful circular economy principles in action.

- **Conclusion:**

Local Roots stands as a prime example of circular design fostering sustainability.

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Re:11 https://www.builtinla.com/2017/12/13/agtech-local-roots-shipping-containers

Circularity vs Sustainability

- ***Introduction to Circularity vs. Sustainability***

  - Definition of Sustainability:
  - "Sustainability is the pursuit of practices that meet current needs without compromising the ability of future generations to meet their own needs."

  - Definition of Circularity:
  - "Circularity, within the context of the circular economy, emphasizes regenerating resources and minimizing waste through a closed-loop system."

  - Importance:
  - "Understanding these concepts is crucial for businesses and societies to address environmental challenges and foster responsible resource management."

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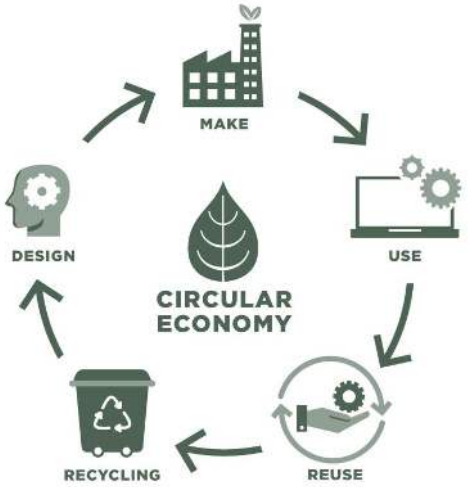

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Ref:12:https://www.sciencedirect.com/science/article/abs/pii/S2452223621000912

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Circularity vs Sustainability I

- *Introduction to Circularity vs. Sustainability*
- **Understanding Sustainability**

  - Sustainability Defined
    Detailed explanation of sustainability as a holistic concept.

  - Three pillars of sustainability:
    Environmental, social, and economic.

  - Examples of sustainable practices:
    Renewable energy, responsible sourcing, and ethical labor practices.

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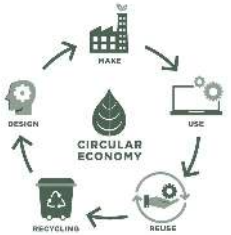

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Circularity vs Sustainability

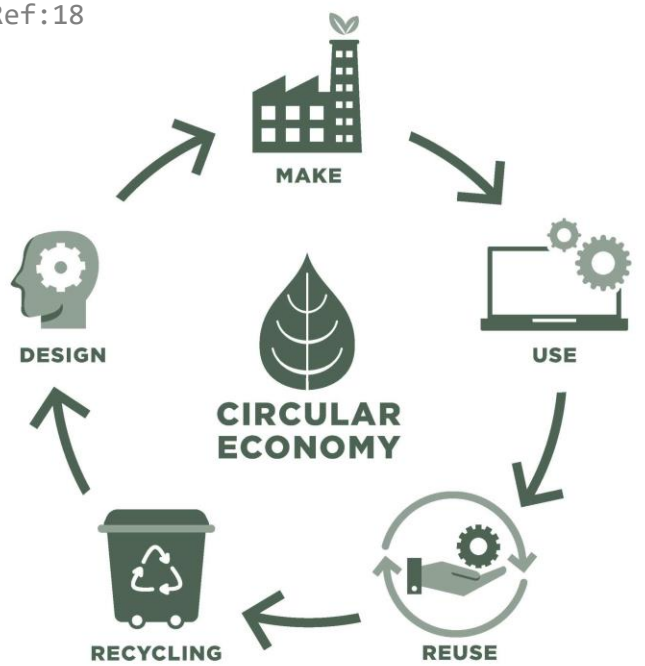
- *Introduction to Circularity vs. Sustainability*
- Understanding Sustainability
- **Exploring Circularity**

Image Ref:18

- ***The Concept of Circularity***
  - "A circular economy is a system designed to minimize waste and make the most of resources by keeping them in use for as long as possible."

- **Circular Economy Principles**
  - "Principles include designing for longevity, recycling, and reusing materials to create a closed-loop system."

- **Benefits**
  - "Circularity aims to reduce environmental impact, enhance resource efficiency, and create a more sustainable economic model."



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Circularity vs Sustainability

- *Introduction to Circularity vs. Sustainability*
- Understanding Sustainability
- Exploring Circularity
- ***Integrating Circularity for Sustainability***

- Circular Practices in Sustainability
  - "Circular economy practices are integral to achieving broader sustainability goals."

- Business Examples
  - "Highlighting successful cases where companies have integrated circular practices to enhance overall sustainability."

- Call to Action
  - "Encouraging businesses to adopt circular thinking for a more sustainable future."

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Ref 9:https://www.researchgate.net/publication/321998000 Critical raw materials and the circular economy
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Case Studies I

- **Bringing Circularity to Events**
  Circular Scenography at Maison & Objet

○ Concept:

Challenge: Addressing material waste in events.
Innovation: Repurposing wood from the previous edition.
Design: Collaborated with WAO for circular scenography.
Execution: Collected 4 tons of wood, stored at Re-Store.
Curation: Enriched with circular economy-themed designs.
Visual: 3D projections of the designed scenography.

○ Results:

Date: Revealed on March 22, 2022, at Maison & Objet.
Feedback: Positive responses from stakeholders and visitors.
Interest: Growing interest in circular practices in the event industry.
Collaborations: Opportunities for similar projects emerged.
Next Steps: Furniture moved to Fab City Hub for extended use.
Commitment: Deepening commitment to circular principles.
Call to Action: Open for collaborations, inviting others to embrace circularity.

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Ref: 13: https://reflowproject.eu/blog/how-to-bring-circularity-into-the-event-industry/

Case Studies I

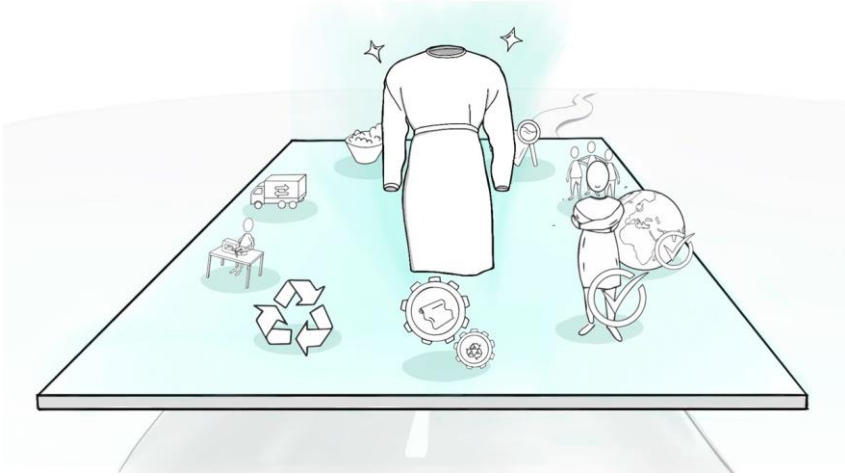
- **Circular Isolation Gowns:**
  A Sustainable Shift

○ Concept:

Challenge: Environmental impact of disposable isolation gowns in healthcare.
Solution: Introduce reusable cotton gowns for a circular textile economy.
Partners: Collaboration with Cleanlease, healthcare institutes, creative agency Makers Unite, ReBlend, Waternet, Purfi, and Reflow.

○ Results:

Prototypes: Successful development of 100% recyclable cotton gowns (25 prototypes).
Environmental Impact: Aiming to replace 5 million oil-based gowns, reducing over 1000 tons of CO_2 annually.
Next Steps: Preparing a 3000-gown demonstrator phase for larger production, actively seeking funding.



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Ref: 14:https://reflowproject.eu/blog/the-development-of-circular-isolation-gowns-a-case-study/

Case Studies I

- **Danish Deposit System**

  - *Concept:*

EU Directive & Challenge: Responding to the EU directive on single-use plastics (2021) and aiming for a 90% collection rate by 2029.
Danish Model: Emulate Denmark's 100-year-old deposit system for disposable bottles and cans.

  - *Results:*

High Collection Rate: Since 2002, consistently achieves a 90% collection rate for plastic, glass, and aluminum containers.
Closed Loop System: Preserves value; refillable bottles reused up to 30 times; cans and bottles recycled into new ones.
Record Return (2021): 93% return rate, recycling 1.9 billion bottles, saving 210,000 tonnes of CO2.
Circular Economy Benefits: 95% less energy for recycled cans; effective cooperation reduces fees for manufacturers.

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Ref: 15: https://stateofgreen.com/en/solutions/the-danish-deposit-return-system-for-recycling-drink-cans-and-bottles/

Case Studies I

Leuven River Upcycling - Concept and Results

- Concept:

Collaborative initiative launched on Oct 3, 2021.
Partnership between KSKCL, Dijlejutters, JCI Leuven, and various local organizations.
Objective: Combine sport with waste reuse by collecting and processing river waste for community benefit.
Evolution: Merged efforts of Dijlejutters and JCI Leuven, with developed water routes and support from key stakeholders.

Image Ref:27

- Results:

Waste Processing: High Tech Lab transforms collected plastic waste into raw materials.
New Product Creation: Sticks, pallets, and paddles produced, benefiting local sports clubs.
Circular City Vision: Aligns with Leuven 2030's sustainability model, fostering diverse partnerships.
Public Engagement: Raises awareness about river ecosystem threats, emphasizing collective responsibility.
Climbing Towards Circular City: Advances Leuven's journey to a sustainable, circular city.

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Ref: 16: https://maakleerplek.be/leuvenriverupcycling/

Case Studies I

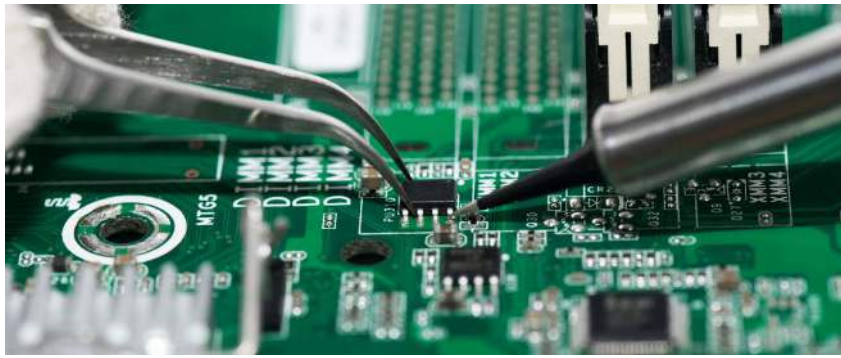
- **HP Brazil & Sinctronics: A Circular Partnership**

  - Concept:

Challenge:50M tons e-waste/year globally.
HP Brazil & Sinctronics join forces.
Solution:HP's outreach + Sinctronics' recovery expertise.
Circular design collaboration for increased efficiency.

  - Results:

Efficiency:50% reduction in collection times.
Up to 30% cost reduction.
Material Reincorporation:97% of collected materials reused.
Closed loop for plastics success.
Environmental Impact: Recycled material in HP products to increase to 45% by 2023.GHG emissions reduction.
Operational Benefits:Cost reduction and stability for HP.
Sinctronics decreases client costs by 30%.
Integrated Ecosystem: Sinctronics as Flex's circular solution unit.echnology for e-waste transformation.
Achievements: Recycled white plastic with 94% recycled material.97% recovered material back into the supply chain.



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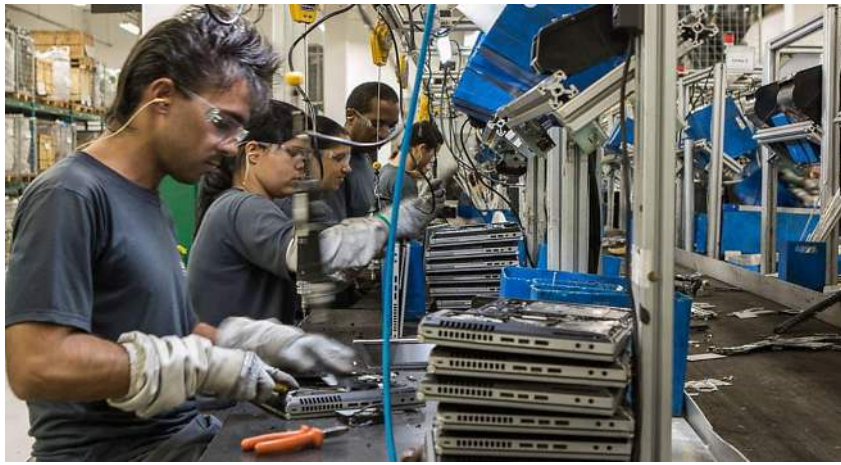

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Case Studies I

- **SodaStream's Circular Economy Efforts**

  - Concept:

Addressing E-waste Surge:E-waste, including plugs, batteries, and bulbs, is a rapidly growing waste stream globally.
Over 50 million tonnes of electronic waste annually.
SodaStream's Circular Approach:
Refurbishment and Recycling:
Initiative to refurbish returned working machines.
Recycling end-of-life sparkling water makers.

  - Results:

Returns Testing and Refurbishment:7022 machines returned and rigorously tested.28% (2016 machines) successfully refurbished.
Efficient Recycling Process: Utilizing local e-waste recycler (eWastec). Shredding process extracts maximum value.Materials like metals and plastics are separated for reuse.
Environmental Impact:29,432 kg of end-of-life sparkling water makers recycled since July 2020.Substantial reduction in landfill waste.
Certification for Accountability: Recyclers provide certificates documenting landfill diversion.Assurance of SodaStream's commitment to sustainability.

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Ref: 18: https://www.cleanup.org.au/sodastreamsustainability

Images References I

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