Circular Economy

Circular Economy and Reframing the Path to Zero

By Liubov Volkova and Elaine Lederer

RAMBØLL

Bright ideas.
Sustainable change.

Liubov Volkova

TITLE
ESG Director, FuelCell Energy

LOCATION
Danbury, Connecticut , USA

EDUCATION
MS, Energy & Environment Policy, NYU (NY)
MBA, Zicklin School of Business, CUNY (NY)
PhD, Environmental Policy & Economics (Russia)

UNEP FI Environmental & Social Risk Analysis (ESRA) training
Corporate Sustainability certificate program, NYU Center for Sustainable Business.

EXTRA CURICULARS
Plant-based nutrition & lifestyle
Mindfulness and meditation practice & training

Liubov (Luba) Volkova is corporate sustainability expert with the focus on the energy and manufacturing industries.

Having over 15 years of extensive sustainability experience in academia, government, and private sector, Liubov Volkova applies an integrated and systemic approach to addressing ESG challenges, while driving growth, profitability, and impact for the company. As a Director of Social, Environmental, and Governance (ESG) at FuelCell Energy, she is responsible for developing the company's ESG and Corporate Social Responsibility vision, strategy, priorities, reporting and engagement, drawing together the various strands of the ESG work and focusing on the whole array of stakeholders.

Liubov has published multiple works on waste management and environmental management systems, including four scientific articles and 12 conference talking points. She also developed 18 teaching manuals and wrote a chapter for a collective monography *Managing Natural and Man-Made Complexes (*Management of Natural-Technogenic Complexes, p.33-51. St. Petersburg: SPbSEEU Press, 2011).

EXPERIENCE HIGHLIGHTS

- **Sustainability & Climate Change Strategy –** Advised clients from various sectors, such as energy, transport, and manufacturing, on how to align their business goals with climate action and sustainability. Conduct research and benchmarking on best practices and emerging trends in climate change mitigation and adaptation. Collaborate with multidisciplinary teams of engineers, economists, and other experts to develop net-zero roadmaps, emission reduction plans, high-quality and evidence-based solutions for complex climate-related challenges.

- **Corporate Sustainability & ESG Reporting –** Develop ESG reports, including an annual sustainability report, aligned with relevant standards and guidelines, such as GRI, SASB, TCFD, and CDP. Analyze and verify ESG data from multiple sources and identify gaps and areas for improvement in data quality and reporting processes. Create and execute action plans to achieve ESG objectives and targets.

- **Carbon Accounting –** Conduct carbon accounting and reporting for various clients, following international standards and frameworks such as GHG Protocol, ISO 14064, and CDP. Analyze carbon footprints and emissions reduction scenarios and developed and implemented carbon inventory management plans.

- **Waste Management Strategy** - Develop and implement a waste management strategy for large-scale industrial projects, following the principles of circular economy and minimizing environmental and social impacts.

Elaine Lederer

TITLE
Managing Consultant, Ramboll

LOCATION
Bend, OR, USA

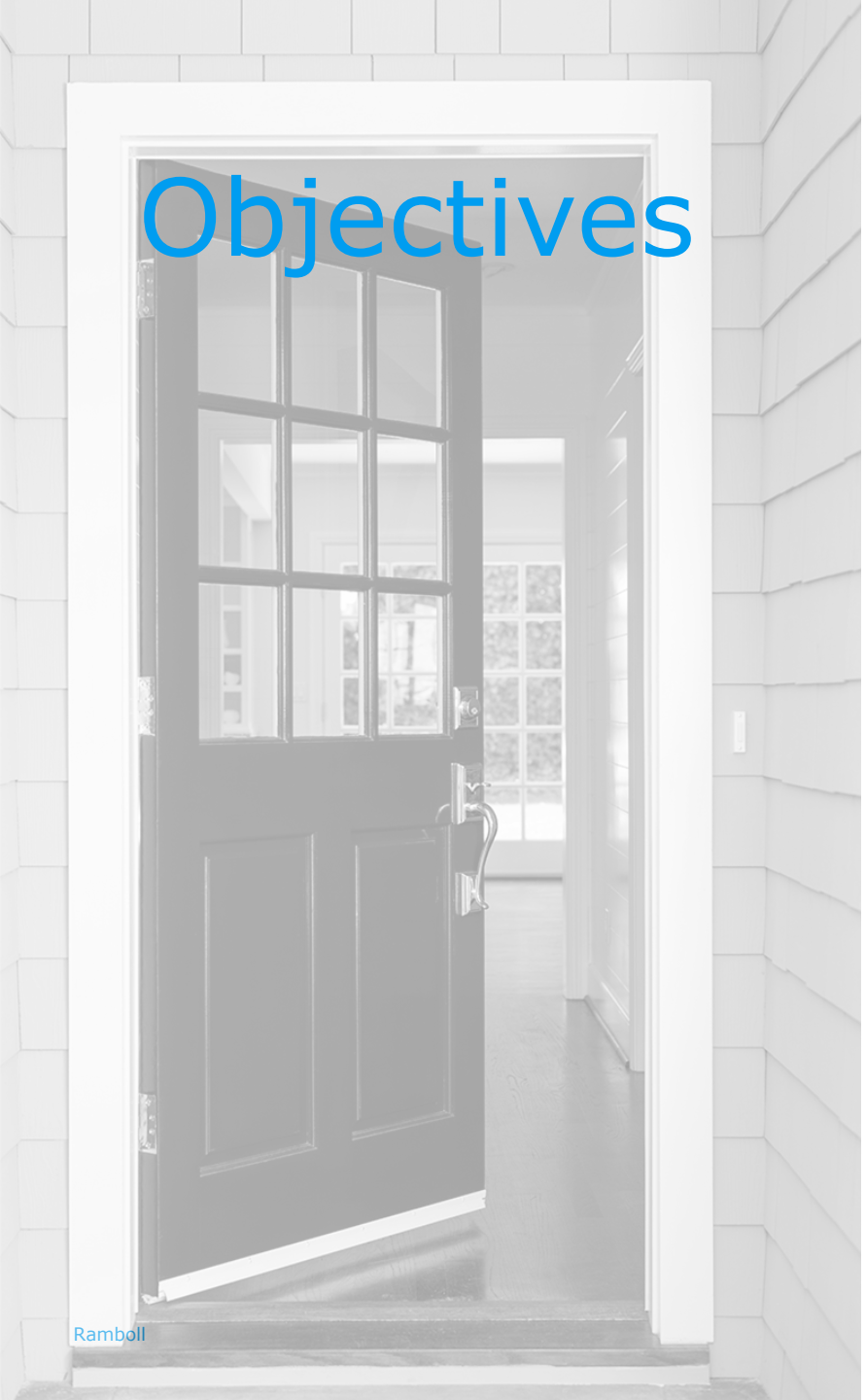
EDUCATION
BS, Geology and Physics,
Western Washington University, WA

EXTRA CURICULARS
Volunteer Board Member for Koniag Education Foundation
Hiker in the summer
Backcountry snowboarder in the winter
Reader of Science Fiction novels

Elaine Lederer is a qualified environmental professional with applied experience in environmental program management and site characterization. She develops, implements, and supports programs best suited for sites and teams by assessing culture, capacity, and perspective. Elaine leads global project teams across multiple geographies, collaborating with technical specialists for custom solutions and tailored support. She has performed onsite waste program development, implementation, and management for oil and gas industry, energy, and manufacturing clients based on state and national regulations and client-specific program compliance. She has provided routine environmental compliance inspections and targeted program audits across geographies for numerous facilities and industries. She has driven efforts to improve circularity for various industries to optimize both environmental and staffing resources. In 2022, Elaine presented seven case studies on circular solutions for industry at the Circular City Week in New York City in a collaborative event with Ramboll Denmark and Ramboll US Consulting. Elaine will engage several Ramboll subject matter experts and specialists to lead the scope of work.

EXPERIENCE HIGHLIGHTS

- **Waste Management Compliance and Program Design -** Provide on-going, on-call support across various industries and geographies to improve compliance, modernize programs, and incorporate sustainability and circularity.
- **Environmental, Health, and Safety (EHS) Auditing and Global Project Coordination -** Coordinate and collaborate with local and regional compliance specialists in the United States, Europe, South America, and Asian Pacific preforming assessments around the world to identify, regulatory and company policy noncompliance as well as opportunities to implement best practices. Identify themes based on multi-site assessments, risk ranked findings, and developed realistic solutions based on resources.
- **Process and Waste Regulatory Applicability Review** - Evaluate regulatory applicability for industrial processes and waste management methods for multiple industrial clients as part of compliance evaluations and waste management optimizations. Reviews included suggestions to support circular economy initiatives and reduce regulatory burden.
- **Waste Program Coordination and Oversight** - Onsite secondment at industrial facilities including a specialty-products refinery and a metals smelter as a waste program coordinator providing oversight of waste management and supporting the redevelopment and reimplementation of the facility waste management programs.
- **Waste Electrical and Electronic Equipment (WEEE) Compliance Assessment** - An international effort to perform review of WEEE compliance at several European facilities and evaluate alignment with internal client policies and provide prescription solutions to resolve gaps.
- **Special Project Waste Management Planning** - Provide project-specific management plans, guidance, and onsite facilitation of waste for refineries, energy production, and manufacturing performing facility maintenance events, turnaround events, and expansions. Waste management planning included waste reduction methods and recovery options, prioritizing recovery, regeneration, and recycling methods over disposal. Guidance and scheduling accommodated state and federal waste regulations, DOT requirements, and facility permits.



Objectives

1. Understand the Theory of Circularity and how to define success
   Definitions, Measurements, Prioritizing, and Reporting

2. Learn about case studies highlighting the pathway to circular economy and how to implementing circular solutions into various business models
   Examples of Industry-Specific Circularity Opportunities and Improvements

3. Define and anticipate key decision pivot points in product development
   Emphasizing improvements throughout the lifecycle, not just the end

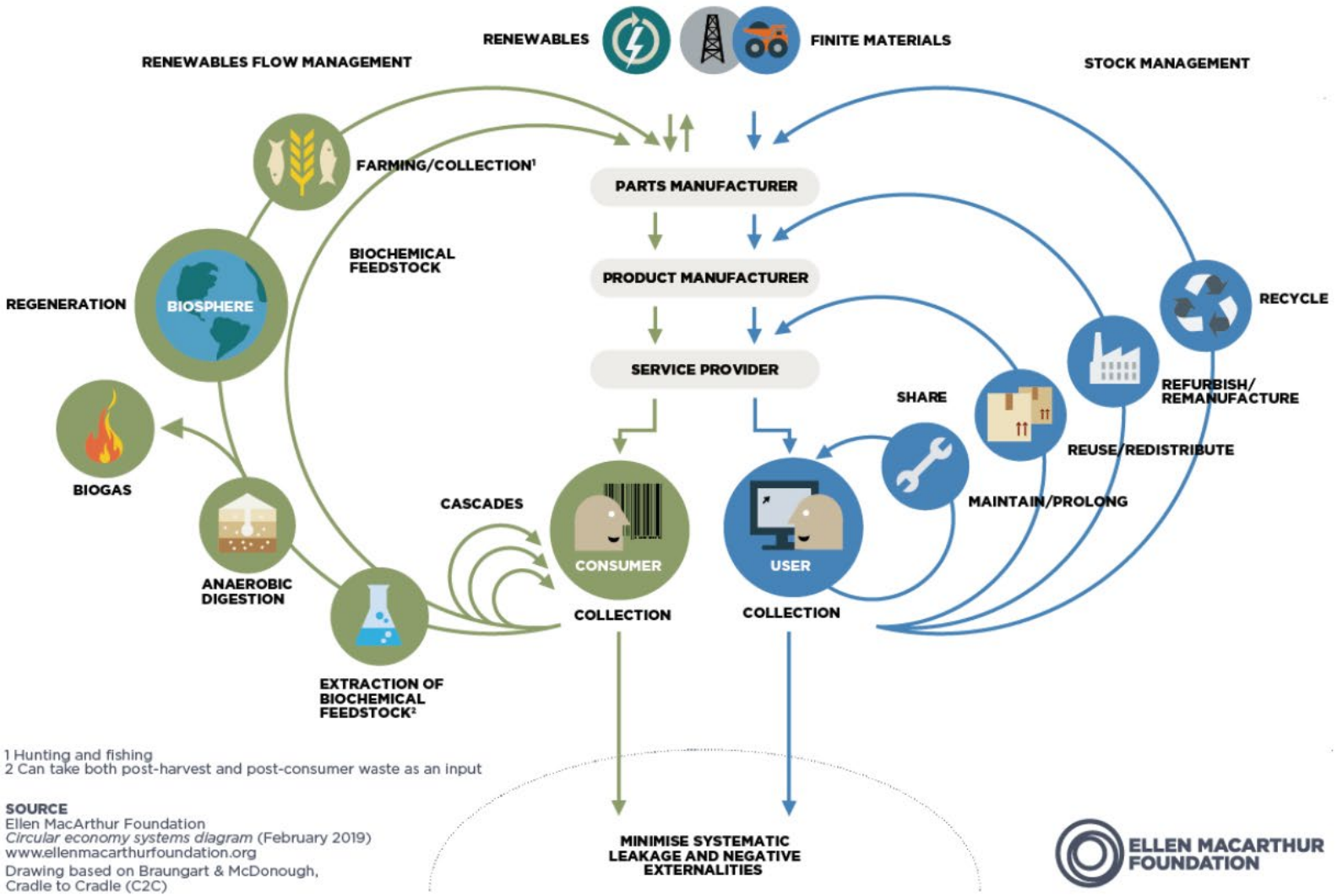
4. Choose Your Own Circular Economy Adventure
   Apply your knowledge by designing a product using our circular economy play book to guide decision making incorporating live audience voting for selection of product process and features at critical pivot points.

What is Circularity or Circular Economy?

What words, terms, or thoughts come to mind when you think of Circular Economy?

What is Circularity or Circular Economy?

A system designed or redesigned around reduction, recovery and reuse of resources



1 Hunting and fishing
2 Can take both post-harvest and post-consumer waste as an input

SOURCE
Ellen MacArthur Foundation
Circular economy systems diagram (February 2019)
www.ellenmacarthurfoundation.org
Drawing based on Braungart & McDonough, Cradle to Cradle (C2C)

Levels of Circularity

Business models will not be fully circular at once. Achieving a high level of circularity requires time and understanding the process as well as seeing clearly what next steps are.

Levels of Circularity

10R principle (Cramer. 2017)	Ellen MacArthur Foundation (2015)	Ladder of Lansink (Lansink, 2015)	Three R principle (1970s)	Explanation (Cramer, 2017)
Refuse	Maintain/prolong	Prevention	Reduce	'Prevent raw materials use'
Reduce				'Decrease raw materials use'
Renew/Redesign				'Redesign product in view of circularity'
Reuse	Reuse/redistribute	Reuse	Reuse	'Use product again (second hand)'
Repair				'Maintain and repair product'
Refurbish	Refurbish/ remanufacture			'Revive product'
Remanufacture				'Make new product from second hand'
Repurpose				'Re-use product but with other function'
Recycle	Recycle	Recycling	Recycle	'Salvage material streams with highest possible value'
Recover	Energy recovery	Energy recovery Incineration		'Incinerate waste with energy recovery'
	Landfill	Landfill		

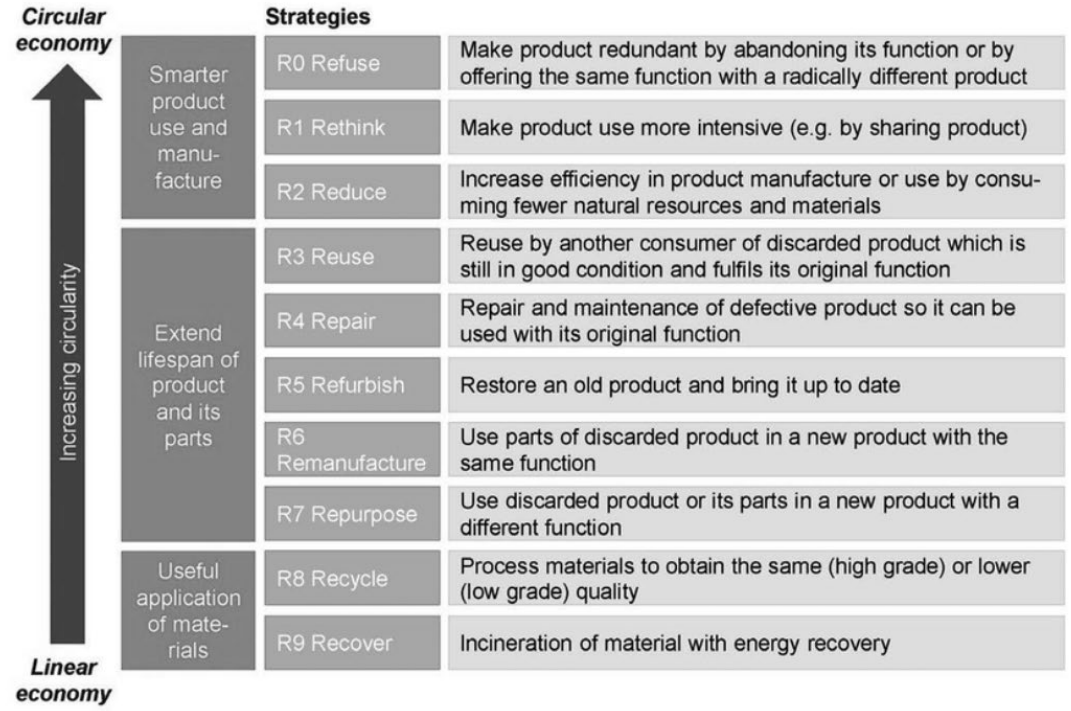
Source: Breteler, 2022

Levels of Circularity: Priority and Strategies

Broad circularity, by recommendation, includes a 10Rs framework: **rethink, repurpose, refuse, reduce, reuse, repair, refurbish, remanufacture, recycle, and recover.**

Regardless of the approach to the 10Rs, the key strategies and priorities should be **refuse, rethink, and reduce.**

Source: Do Kim Chung and Nguyen Phuong Le 2023; Modified from Jacqueline, 2020



-The 10R framework. Source: Kirchherr et alii (2017, p. 224).

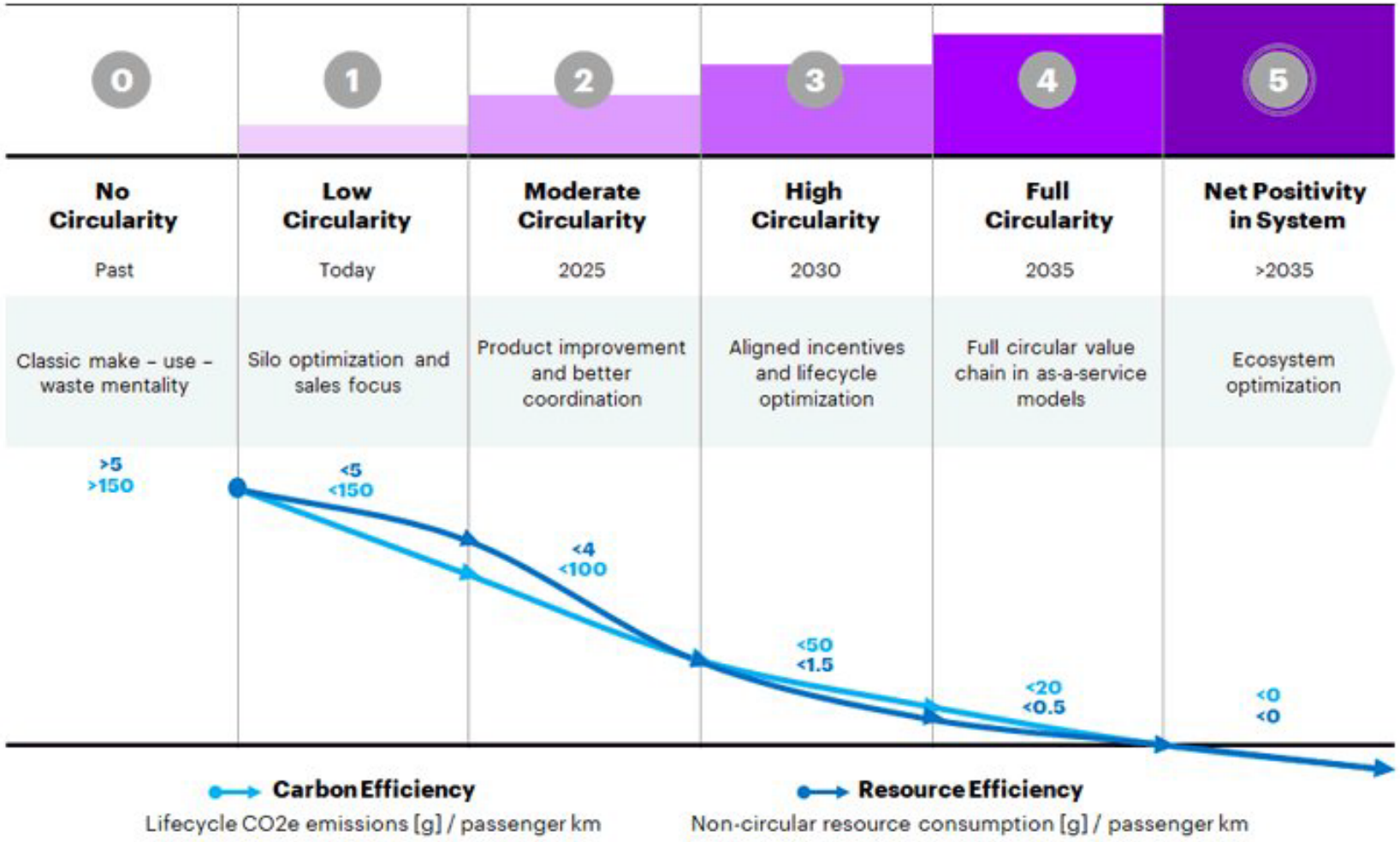
Levels of Circularity

The degree of circularity should be measured in terms of its externalities caused per unit of service provided (Accenture, 2021).

Example: Automotive Industry

- Five levels of circularity were developed based on two primary measures (carbon and resource efficiency).
- The levels of circularity range from single owner use and disposal (Level 0) to an aspirational goal of an automobility ecosystem that has net positive impacts (Level 5).

Five Levels of Circularity



Source: Accenture, 2021

Reasons Industries Might Invest in Circular Economy

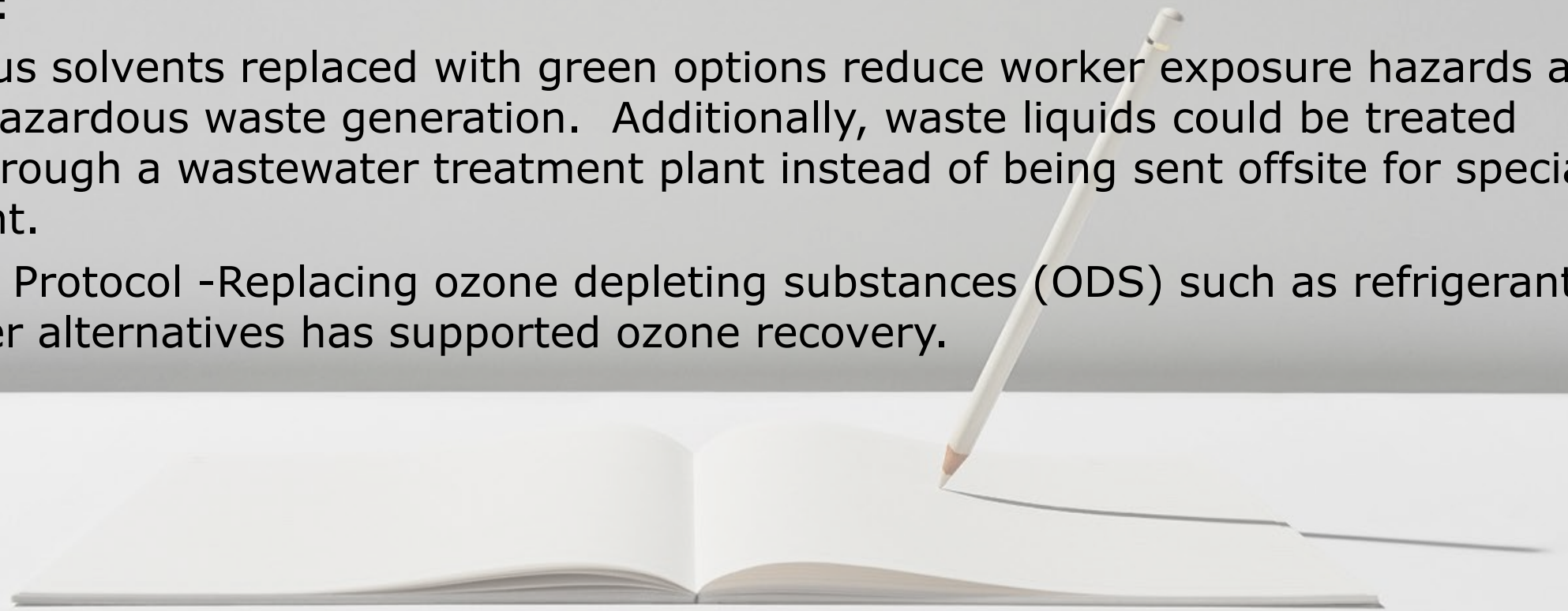
- Compliance with internal (company-specific) or external (regulatory) sustainability initiatives and requirements
- Lean Operations Goal to optimize and reduce cost
- Environmental stewardship and investment beyond cost savings and compliance; perhaps driven by stakeholders including investors and customers

Case Study 1 Reducing Hazardous Constituents

Selecting nonhazardous and/or organic raw materials or components can:

- Reduce process waste with hazardous characteristics
- Make wastes safely recoverable either onside or offsite
- Expand waste recycling opportunities

- Examples:
  - Hazardous solvents replaced with green options reduce worker exposure hazards and reduce hazardous waste generation. Additionally, waste liquids could be treated onsite through a wastewater treatment plant instead of being sent offsite for special treatment.
  - Montreal Protocol -Replacing ozone depleting substances (ODS) such as refrigerants with safer alternatives has supported ozone recovery.

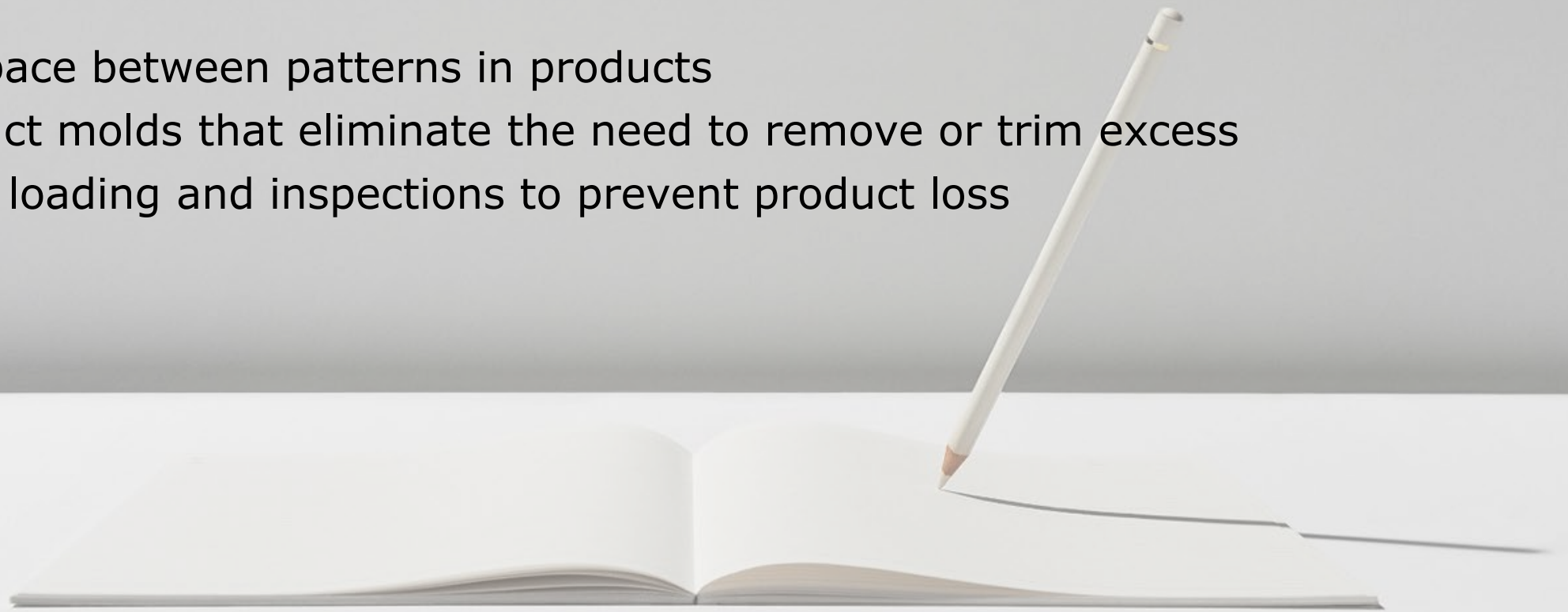


Case Study 2 Optimize Consumption

Optimizing material consumption to reduce scrap waste generation can

- Reduce raw material costs
- Reduce effort and investment in scrap recovery onsite
- Reduce waste management costs

- Examples:
  - Reduce space between patterns in products
  - Use product molds that eliminate the need to remove or trim excess
  - Automate loading and inspections to prevent product loss

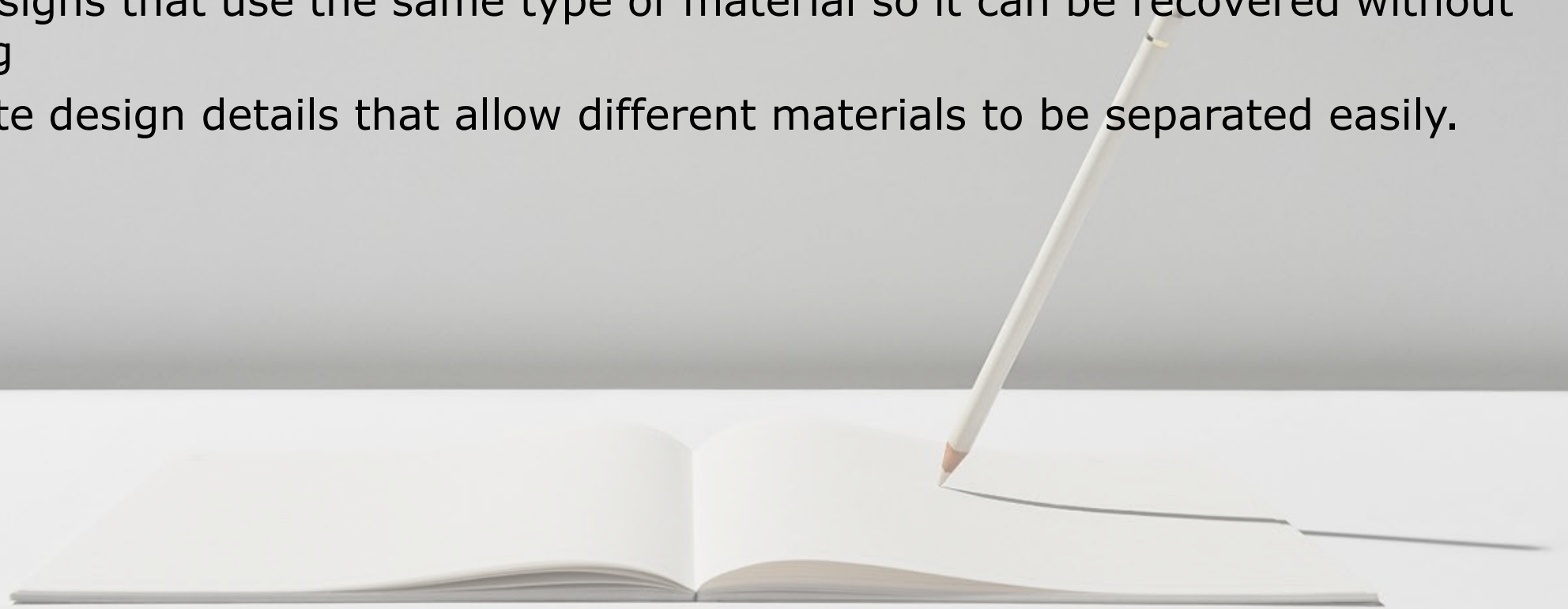


Case Study 3 Design for Deconstruction

Designing multi-faceted products for deconstruction and disassembly

- Improve recycling opportunities onsite for product rejects
- Improve recycling opportunities for clients at end of life

- Examples:
  - Pursue designs that use the same type of material so it can be recovered without processing
  - Incorporate design details that allow different materials to be separated easily.

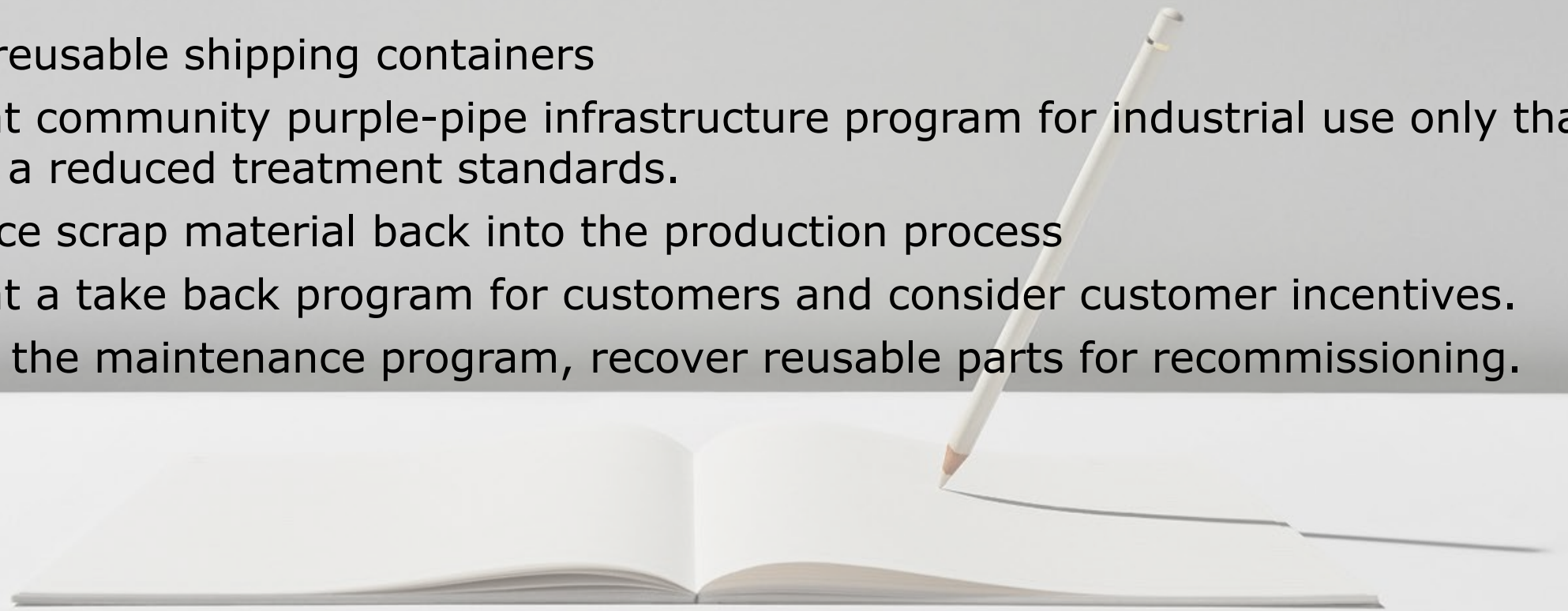


Case Study 4 Close the Loop Within Your Product Circle

Close the loop on a facility or community scale

- Reduce raw materials costs if products can be recovered and reused
- Invest in tools and materials that can be used at multiple facilities within the business portfolio

- Examples:
  - Invest in reusable shipping containers
  - Implement community purple-pipe infrastructure program for industrial use only that allows for a reduced treatment standards.
  - Reintroduce scrap material back into the production process
  - Implement a take back program for customers and consider customer incentives.
  - As part of the maintenance program, recover reusable parts for recommissioning.



Circular Economy Decision Pivot Points

Throughout the product lifecycle, there are many opportunities to make decisions that may affect the circularity of a product.

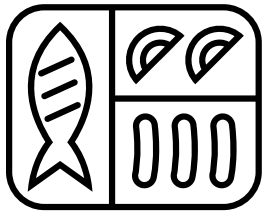
Examples Include:

1. **Design:** Design the product for deconstruction and recovery of materials at end of life
2. **Inputs:** Selection of product inputs based on what can be recycled at end of life or select inputs made from recycle/recovered material (in part or in full)
3. **Process:** Use processes that incorporate material recycling/recovery or resources including selection of process chemicals that can are nonhazardous and can be easily reused or treated, and reuse of resources such as water for cooling.
4. **End of life:** Consider management options such as repair and/or take-back program for recovery of spent products for reuse and interview customers regarding spent product management including opportunities to make end of life recycling through general public programs easier.

Choose Your Own Circular Economy Adventure…

Using our circular economy play book to guide decision making

Circular Exercise



Building a take-away food container

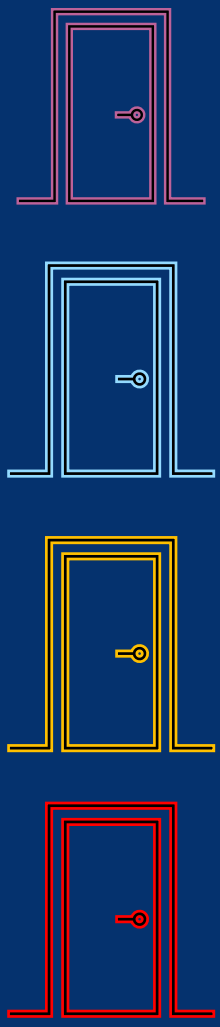
- Consider the goals
- Consider resources
  - Investment
  - Sustainability
  - Capacity
- Consider stakeholders
  - Team and staff
  - Company shareholders
  - Clients
  - Community
- Consider hidden costs
- Consider levels of circularity

Selecting Materials

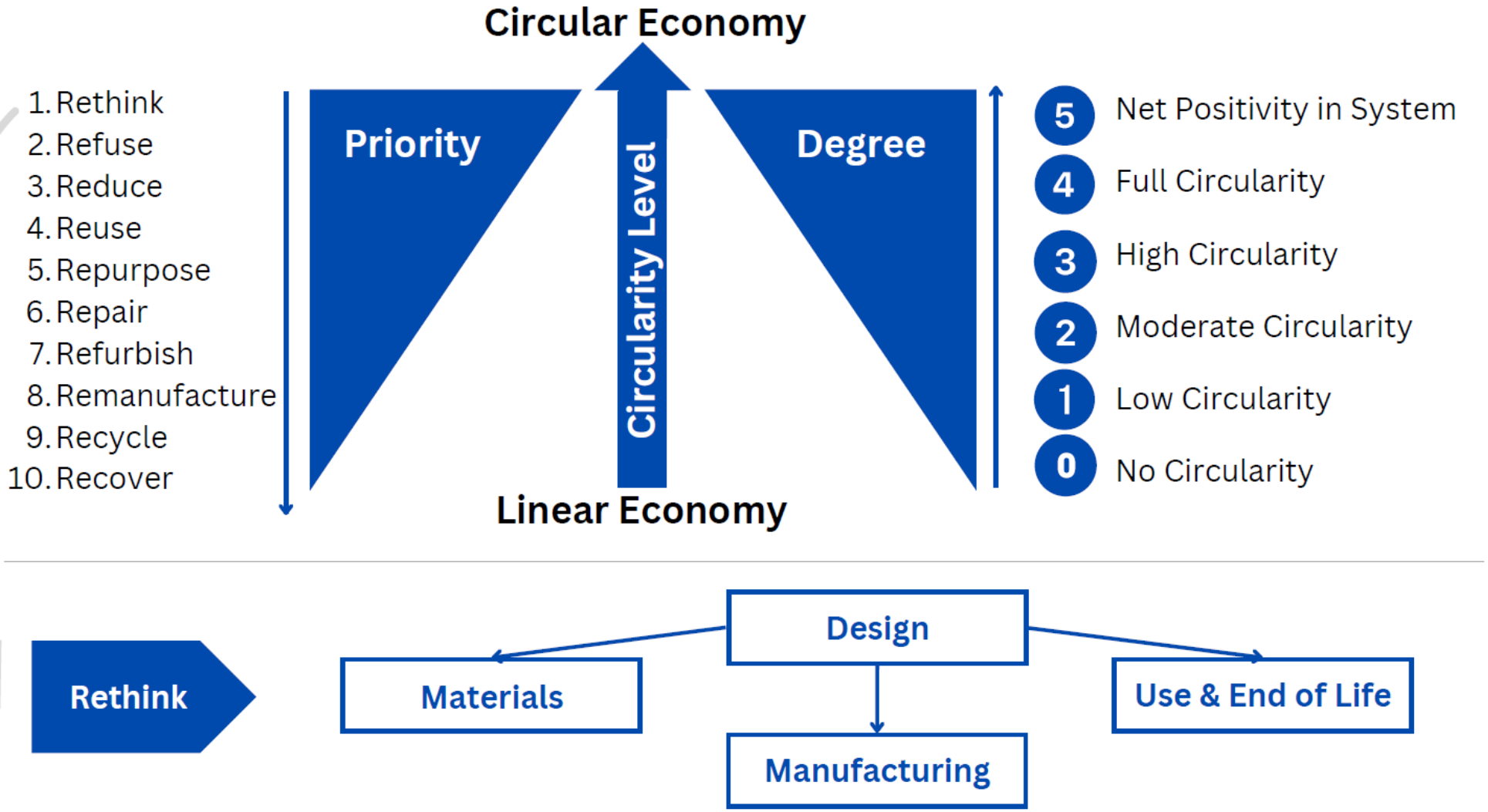
OPTIONS:

1. Cardboard
2. Recycled plastic
3. Glass
4. Aluminum

Please Vote!



‘Levels of Circularity’ Model: Priority & Degree



Selecting Materials

LEVELS OF CIRCULARITY: APPLYING THE APPROACH

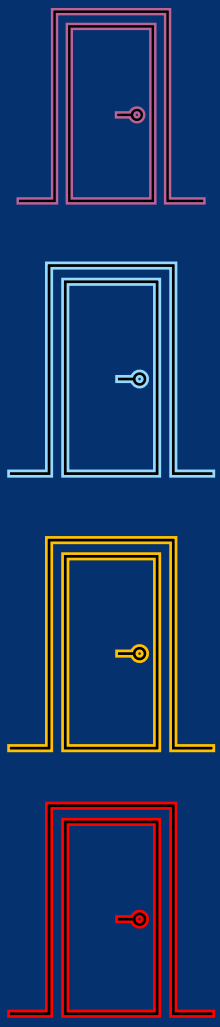
Selecting Materials		1. Cardboard	2. Recycled plastic	3. Glass	4. Aluminum
Cycle	**Biological**	Yes/No (Depends on a coating)	No (doesn't exist in nature; harmful to the environment)	No (not harmful to the environment, but takes too long to decompose)	No (takes long to decompose; may be harmful)
	Technical	Yes (Directly goes to the landfill)	Yes (Recycling & Landfill)	Yes (Can be a part of various stages of the technical cycle)	Yes (Can be a part of various stages of the technical cycle)
10Rs	**Rethink**	Single-use, plastic-free containers	Single-use plastic containers with increased content of recycled plastic	Reusable, plastic-free containers	Reusable, plastic-free containers
	Refuse	No plastic or toxic materials, only recycled paper	N/A	No toxic materials, the primary material is sand	No palstic used. Health concerns (possible toxicity) during use & manufacturing
	Reduce	No plastic, expensive materials (such as metals) or toxic materials used	Reduce the virgin plastic content by 20%	Reduce the use of plastics and other single use materials/products	Reduce the use of plastics and other single use materials/products
	Reuse	Does not hold up over extended time and not great for liquids	Thin, low-quality plastic is not suitable for reuse	Requires collection system and cleaning facility. Not durable, easy to break	Possible
	Repurpose	N/A	N/A	Yes/No	N/A
	Repair	N/A	N/A	N/A	N/A
	Refurbish	N/A	N/A	N/A	N/A
	Remanufacture	N/A	N/A	N/A	N/A
	Recycle	Requires a coating (not recyclable with municipal paper)	Can be recycled by most municipal programs. The quality of recycled plastic quickly degrades, can't be recycled multiple times, has to be blended with virgin plastic	Can be recycled but low availability of recycling facilities, low demand	Well suited for recycling
	Recover	Could be biodegradable, requires a special facility	N/A	N/A	N/A

Select Manufacturing Options

OPTIONS:

1. Lowest cost option
2. Fair trade facility
3. Facility specializing in containers
4. Facility with scrap recovery

Please Vote!

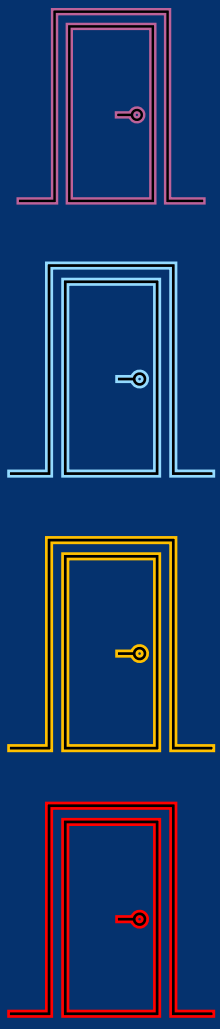


Select Manufacturing Options

OPTIONS:

1. **Lowest cost option**
   - Facility in compliance with local regulations
   - Industry standard resource consumption
   - Up to 15% scrap rate, no scrap reuse
2. **Fair trade facility**
   - Transparency in working practices and conditions
   - Facility in compliance with international standards
   - Up to 15% scrap rate, no scrap reuse
3. **Facility specializing in containers**
   - Facility in compliance with local regulations
   - Scheduled site visits and product inspections
   - Up to 5% scrap rate
4. **Facility with scrap recovery**
   - Facility in compliance with local regulations
   - Flexible site visit scheduling
   - Up to 5% scrap rate with scrap recovery option

Please Vote!

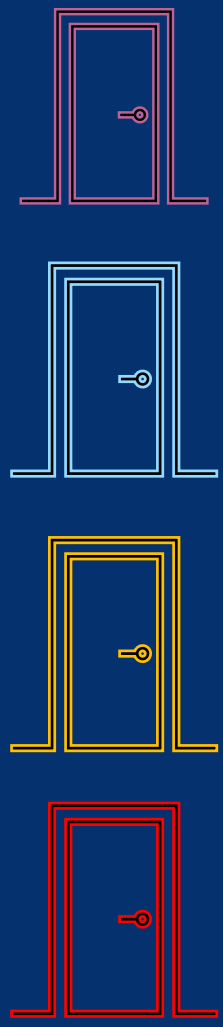


Select End of Life Approach

OPTIONS:

1. Design for single use
2. Design for Municipal recycling
3. Design for reuse by original user
4. Design for takeback/reuse program by restaurant

Please Vote!

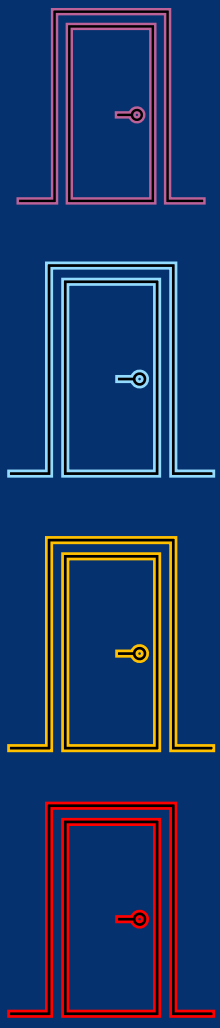


Select End of Life Approach

OPTIONS:

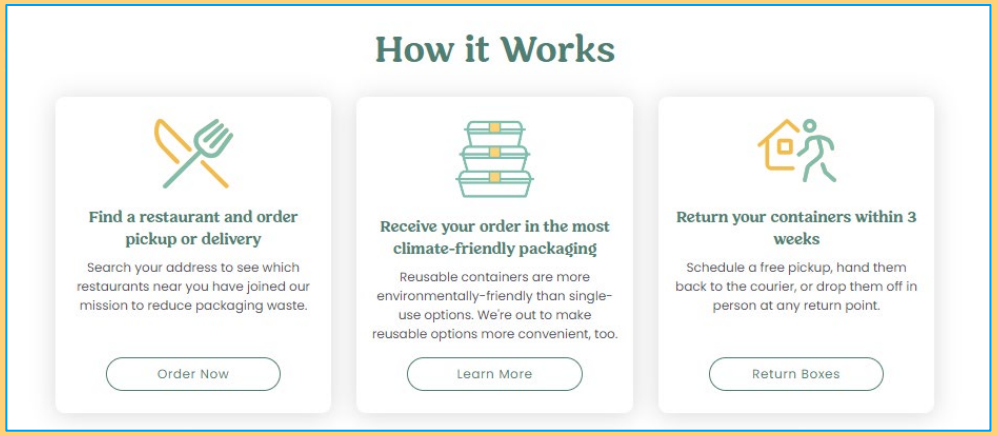
1. **Design for single use**
   - Lower upfront costs
   - No special actions for users
   - Washing/processing not required
2. **Design for Municipal recycling**
   - Costs are a little higher to ensure material types are acceptable
   - Acceptable by most municipalities but not guaranteed
   - Users must clean and place in recycling (rather than garbage bin)
3. **Design for reuse by original user**
   - Quality and thickness increased for durability
   - Assumes users will reuse the container and not throw away.
4. **Design for takeback/reuse program by restaurant**
   - Quality and thickness increased for durability and heat resistance for commercial dish washers.
   - Assumes users will return the container and not throw away.
   - Requires restaurants to opt in with improved convenience if more restaurants participate.

Please Vote!



Example Modern Innovative Solution to Takeaway Containers

Takeout and delivery in reusable containers you can return at your door.



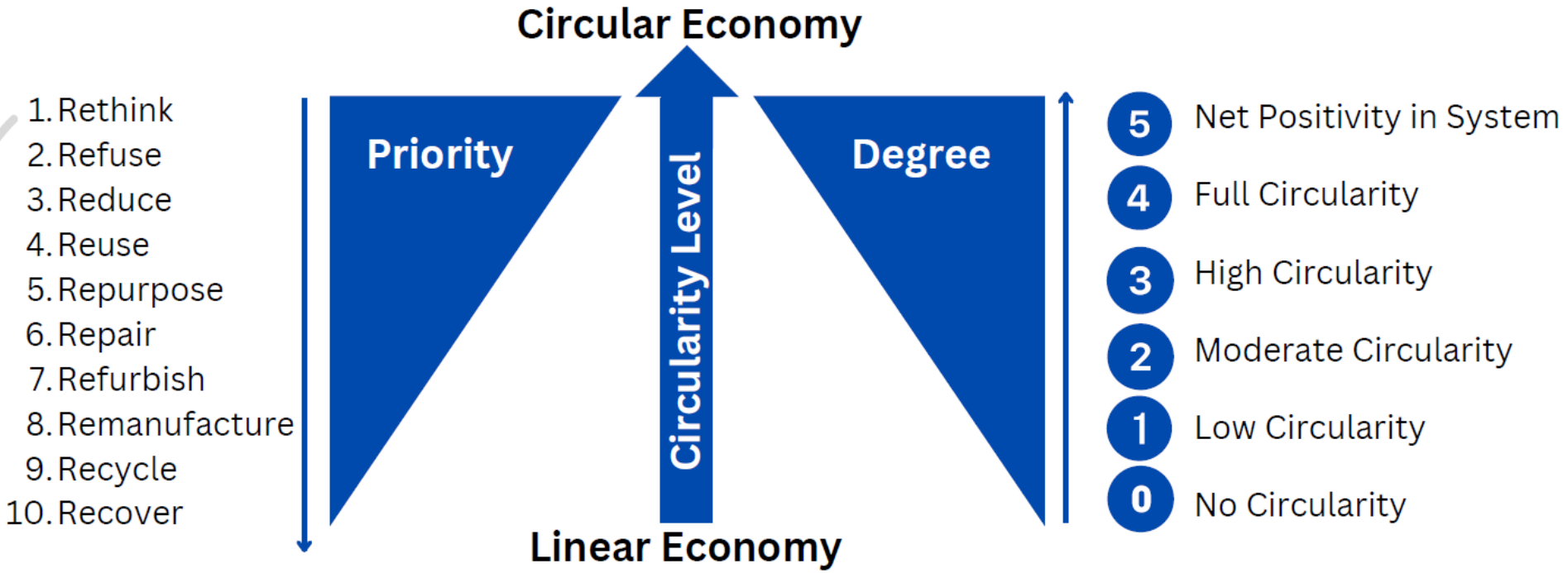
Check out: [DeliverZero - Food to go in reusable containers]

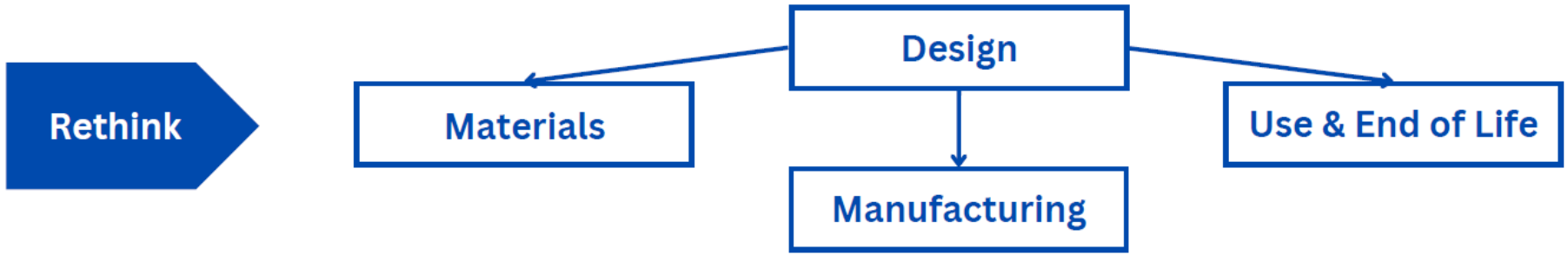
Selecting Materials

LEVELS OF CIRCULARITY: APPLYING THE APPROACH TO THE ALTERNATIVE OPTION

Selecting Materials		Reusable Plastic Container (Case Study: DeliverZero)
Cycle	**Biological**	No
	Technical	Yes (multiple stages)
10Rs	**Rethink**	New Concept: "Takeout and delivery in reusable containers you can return at your door." High quality, BPA free, NSF-certified reusable containers designed to be reused up to 1,000 times.
	Refuse	No BPA, low-quality plastic, no single-use options
	Reduce	No plastic, expensive materials (such as metals) or toxic materials used
	Reuse	Designed to be reused up to **1,000 times**. Created an app, a network of partners, convenient solutions for various users (both delivery and recipients' side)
	Repurpose	Can't be used outside of restaurants (home, workplace)
	Repair	N/A
	Refurbish	Yes/No
	Remanufacture	N/A
	Recycle	High quality plastic has a higher recyclability rate
	Recover	N/A

‘Levels of Circularity’ Model: Priority & Degree





Container Design by Popular Vote

Thank you!

Questions?

Would you have chose a different material for construction?
Would you have made different decisions?
Did this change your perspective on circular economy?
Did any of the concepts surprise you?

Resources

1. **Ellen MacArthur Foundation: How to Build a Circular Economy**
   https://www.ellenmacarthurfoundation.org/
2. **PACE: Platform Accelerating Circular Economy**
   https://pacecircular.org/
3. **Circle Economy: Experts Aiming to Drive a Circular Transition**
   https://www.circle-economy.com/funding
4. **The Circularity Gap Report 2024**
   https://www.circularity-gap.world/