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Circularity practices in Swedish manufacturing companies

Filip Skärin, Jönköping University

THE NEED FOR CIRCULARITY

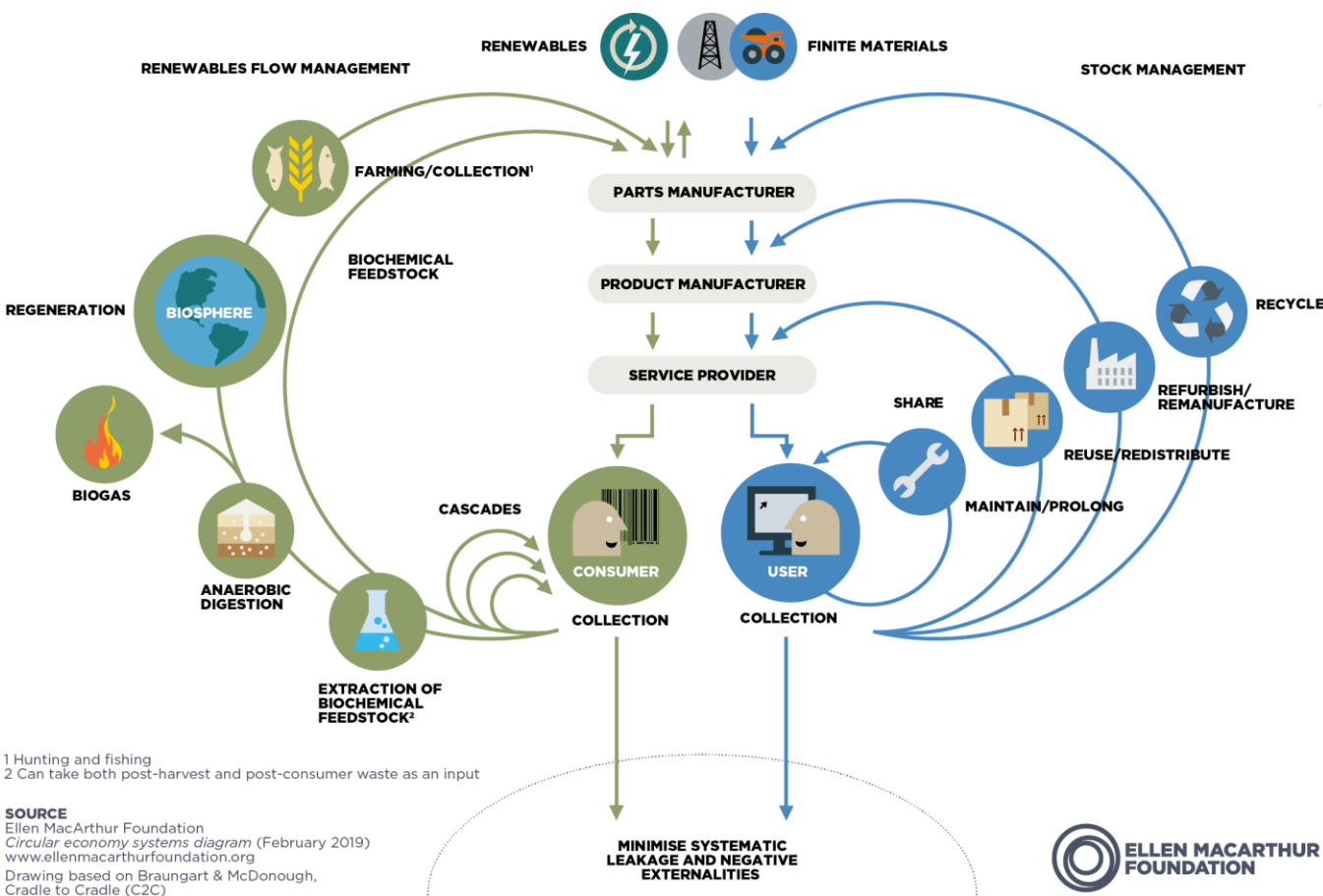
Linear economy



Circular economy

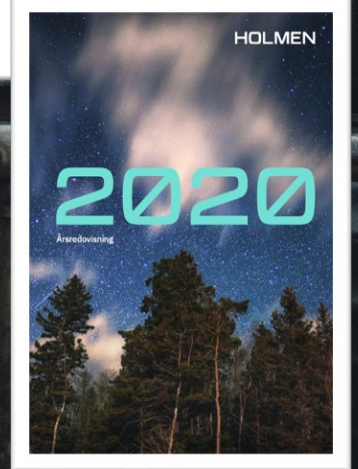
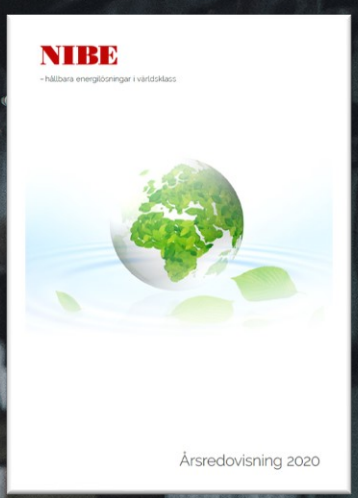
Manufacturing companies play a major part:

- US: 23 % of total CO₂-e emissions^[1]
- Sweden: 32 % of total CO₂-e emissions^[2]



[1] United States Environmental Protection Agency (2021)

[2] Statistics Sweden (2021)



1) Explore if Swedish manufacturing companies actually are circular

Is it used for greenwashing?

2) Investigate what circularity practices are mentioned in sustainability reports

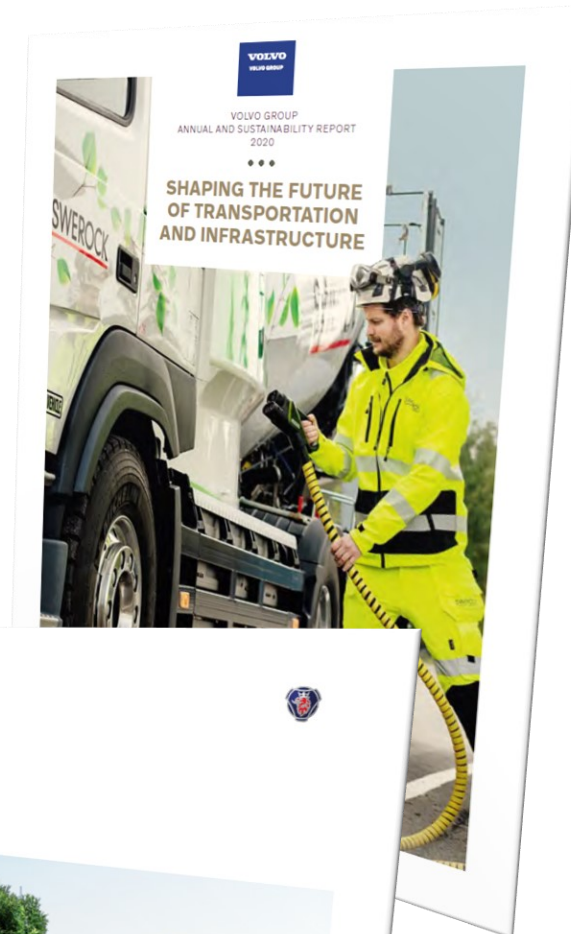
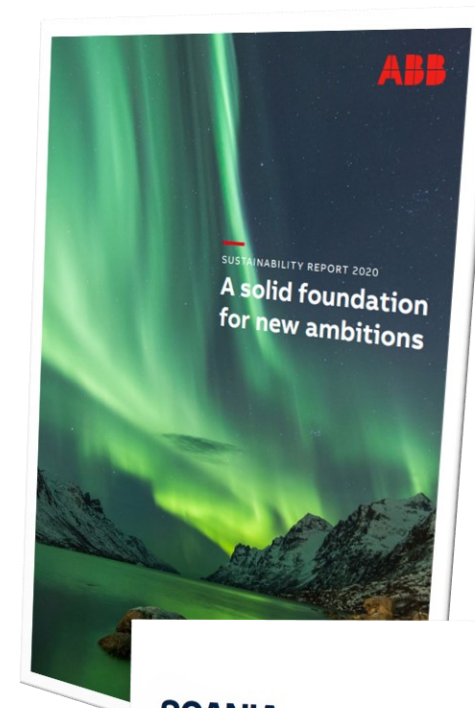


SUSTAINABILITY REPORTS

Mandatory public document for companies if fulfilling **2 out of 3** requirements:

- (i) Total assets of more than 175 million SEK
- (ii) Net sales of more than 350 million SEK
- (iii) 250 employees or more

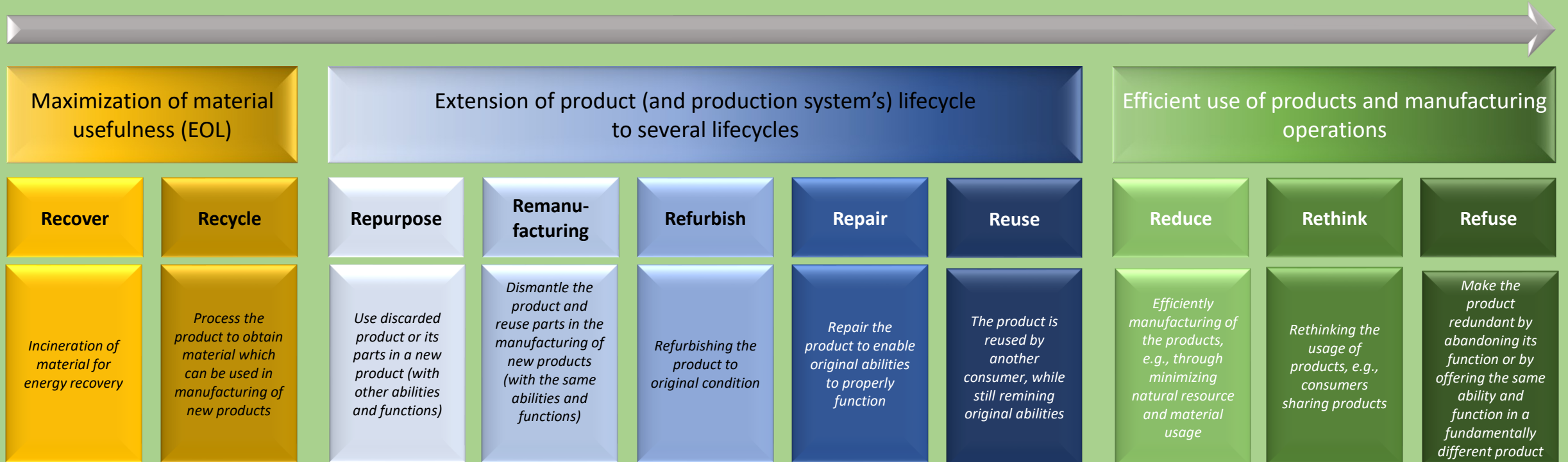
- Separate document or included in annual report
- **Vague** requirements of contents



POSSIBLE STRATEGIES TO ACHIEVE CIRCULARITY

Linear economy

Circular economy



WHAT DID WE DO?

STEP 1 – CATEGORIZATION

R	Circularity Category
R0—Refuse	Refuse harmful materials in products
	Refuse non-recyclable materials in products
	Refuse non-renewable resources
R1—Rethink	Apply sustainable chemical management
	Develop and adapt circular business models
	Develop and launch circular innovations
	Develop sustainable lubricants
	Use recyclable, recycled, renewable, and sustainable materials in products
	Rethink packaging solutions
	Use recyclable, recycled, and renewable packaging materials
	Rethink ways to enable customer sustainability
	Rethink product design to make it more sustainable and circular
	Increase usage of renewable energy
	Use new sustainable processes and technologies
	Initiate new collaborations which support circularity
	Rethink transportation patterns
	Rethink ways to manage and evaluate supplier sustainability
R2—Reduce	Reduce chemical usage
	Reduce energy usage
	Reduce fuel usage
	Reduce GhG emissions
	Reduce packaging material
	Reduce pollution in air, land, and water
	Reduce resource usage
	Reduce hazardous waste
	Reduce waste sent to landfill
	Reduce waste sent for disposal
	Reduce waste in general
Reduce water usage	

R3—Reuse	Reuse heat, steam from own production
	Reuse residual materials from manufacturing
	Reuse metals
	Reuse thermoplastics
	Reuse materials in general
	Reuse packaging material
	Reuse products
	Reuse resources
	Reuse in general
R4—Repair	Reuse waste (hazardous and non-hazardous)
	Reuse water
	Repair products
R5—Refurbish	Repair in general
	Refurbish products
R6—Remanufacture	Remanufacture products
	Remanufacture in general
R7—Repurpose	Repurpose packaging materials
	Repurpose products
	Repurpose residual materials from manufacturing
	Repurpose waste (hazardous and non-hazardous)
R8—Recycle	Recycle energy from production
	Recycle heat from wastewater and machines
	Recycle excess material from production
	Recycle metals
	Recycle thermoplastics
	Recycle materials in general
	Recycle packaging materials
	Recycle products
	Recycling in general
Recycle waste (hazardous and non-hazardous)	
R9—Recover	Recycle water
	Recover energy through incineration

WHAT DID WE DO?

STEP 2 – DETAILED DESCRIPTION

- Detailed description of how circularity *actually* is achieved
- Used as a source of inspiration

Reduce energy usage

Developing innovative products which uses less energy; raising awareness and investing in efficient production equipment; including energy management requirements for purchasing new machines; establishing programs focusing on improving energy consumptions in the company's facilities; annually setting up and following goals for improved energy efficiency; changing to more energy-efficient materials in the production; actively monitoring energy consumption; setting goals for energy efficiency and taking measures to achieve the goals; through reconditioning of products, since it leads to lower maintenance, costs and energy usage; using ISO certified energy management systems; by using a decentralized approach for improving the energy usage and integrating this with the company's environmental management system; linking facilities' energy efficiency to local maintenance strategies; setting group-wide energy targets; though energy recovery at manufacturing sites; through systematic energy management; continuously striving for energy efficiency; installing more energy-saving machines in the manufacturing; by establishing remanufacturing programs

WHAT DID WE DO?

STEP 3 – ZOOMING IN ON PRODUCTION

Category	Circularity practices	Total	V/P	O/R
R0 - Refuse	No practice identified			
R1 - Rethink	Apply sustainable chemical management	1		1
	Implement circular production processes	1		1
	Increase available data from production	1		1
	Increase usage of renewable energy	7	1	6
	Rethink existing production to make more sustainable & circular	1	1	
	Use new sustainable processes and technologies	3	1	2
R2 - Reduce	Reduce chemical usage	1		1
	Reduce energy usage	8		8
	Reduce environmental impact	2	1	1
	Reduce fuel usage	1	1	
	Reduce greenhouse gas (GhG) emissions	11	2	9
	Reduce resource usage	9	3	6
	Reduce generated waste	11	3	8
	Reduce water usage	3		3
R3 - Reuse	Reuse components	6	1	5
	Reuse heat and steam	2	1	1
	Reuse materials	10	1	9
	Reuse packaging material	2		2
	Reuse products	1		1
	Reuse water	2		2

Category	Circularity practices	Total	V/P	O/R
R4 - Repair	Repair own products (as service)	3		3
R5 - Refurbish	Refurbish own products and parts	7		7
R6 - Reman.	Remanufacture products, parts and components	3		3
R7 - Repurpose	Repurpose packaging materials	1		1
	Repurpose product	1		1
	Repurpose residual products	4		4
R8 - Recycle	Recycle energy	1		1
	Recycle hazardous waste	2		2
	Recycle heat from wastewater and machines	1		1
	Recycle metals	3		3
	Recycle packaging materials	2	1	1
	Recycle thermoplastics	1		1
	Recycle in general	3		3
	Recycle waste	5	1	4
R9 - Recover	Recycle water	2		2
	Recover for incineration (energy recovery)	7		7
	Recover for landfill	2		2
	Recover - undefined (only disposal mentioned)	1		1

WHAT DID WE LEARN?

Few mentions of practices within product life extension

Category	Circularity practices	Total	V/P	O/R
R0 - Refuse	No practice identified			
R1 - Rethink	Apply sustainable chemical management	1		1
	Implement circular production processes	1		1
	Increase available data from production	1		1
	Increase usage of renewable energy	7	1	6
	Rethink existing production to make more sustainable & circular	1	1	
R2 - Reduce	Use new sustainable processes and technologies	3	1	2
	Reduce chemical usage	1		1
	Reduce energy usage	8		8
	Reduce environmental impact	2	1	1
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	Recover for incineration (energy recovery)	7		7
	Recover for landfill	2		2
	Recover - undefined (only disposal mentioned)	1		1

3 most common practices – very general

WHAT DID WE LEARN?

Refuse

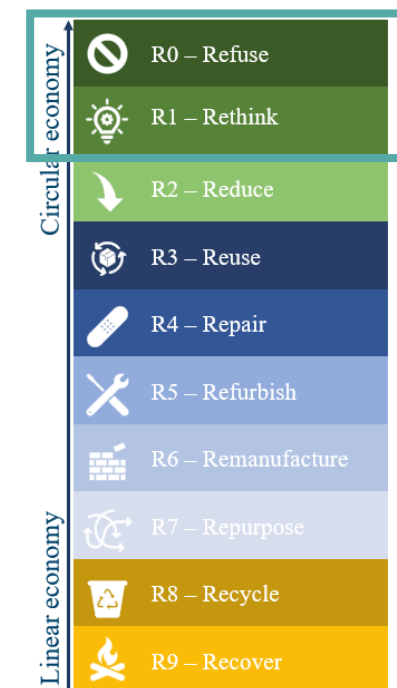
- Refuse harmful materials
- Refuse non-recyclable materials
- Refuse non-renewable resources

Rethink

- Rethink ways to enable customer sustainability
- Rethink product design and packaging
- Initiate collaborations supporting circularity

Examples:

- Essity starting to produce tissues from wheat straw, a residual material from agriculture.
- Registering products with the Environmental Product Declaration (EPD) - providing transparent information about environmental impacts of products from a lifecycle perspective.
- Including energy management requirements for purchasing new machines.



WHAT DID WE LEARN?

Reduce

- Focus on reducing GhG emissions, energy usage, water usage, pollution, resource usage, and waste.
- Often a consequence of other activities.

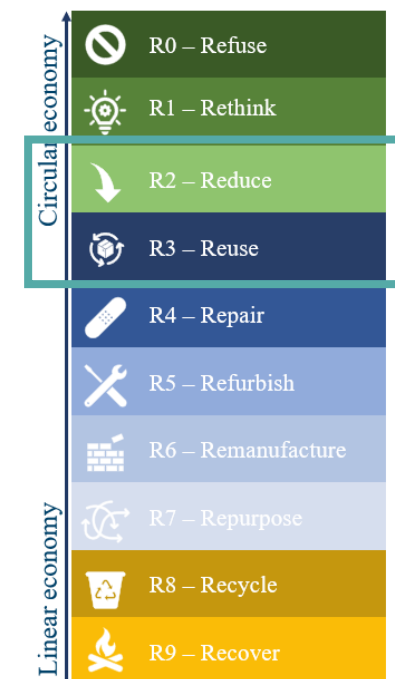
Reuse

- Heat, steam, packaging materials, water, waste, etc.
- Reusing with limited efforts of change. Create a second lifetime of resources within the factory.

Examples of reusing:

“*Steam from the mills is **[re]used** in the drying processes in the integrated sawmills.*” (Holmen).

“*We **recirculate** much of the material generated from our production back into our own processes, thereby reducing the need for virgin raw materials, CO₂ emissions and waste.*”(SSAB)

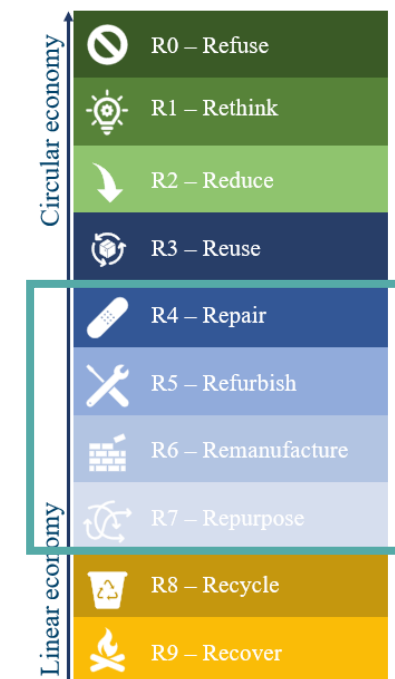


WHAT DID WE LEARN?

Examples:

*“Ericsson **Refurbished** Spares is a commercial offering focusing on buy-back, **refurbishment** and re-use of spare parts from used equipment, to create both customer and sustainability value.” (Ericsson)*

*“For trucks, we also buy back complete vehicles to dismantle and use parts in our network of service workshops. Parts that can be **refurbished** or **remanufactured** are kept and used and the rest is sent for materials recycling.” (Volvo Group)*



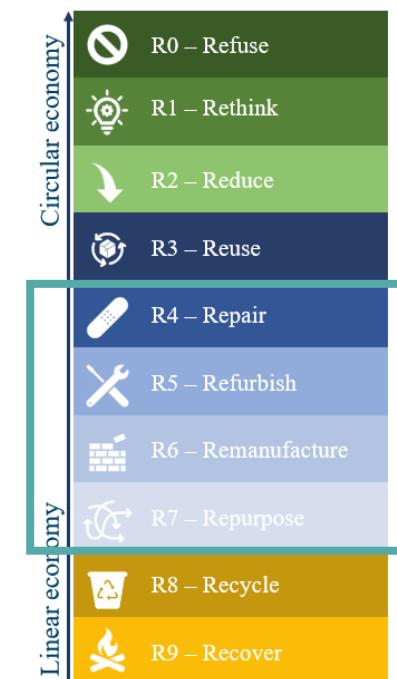
WHAT DID WE LEARN?

More examples:

“Hallsta Pappersbruk basically has no emissions of fossil carbon dioxide... heat is recycled from the wastewater and paper machines, the bark is sold to heating plants and residual products are composted into plant soil”.
(Holmen)

“Materials that cannot be recirculated internally can be processed and sold externally to create new revenue streams whilst reducing CO₂ emissions by substituting natural resources in other industries. For example, the use of blast furnace slag enables the cement industry to significantly reduce their CO₂ emissions”. (SSAB)

“Also in Finland, our MOMG Espoo subsidiary purchased a second-hand cardboard shredder so it could reuse received packaging as padding for outgoing packages” (ABB)



WHAT DID WE LEARN?

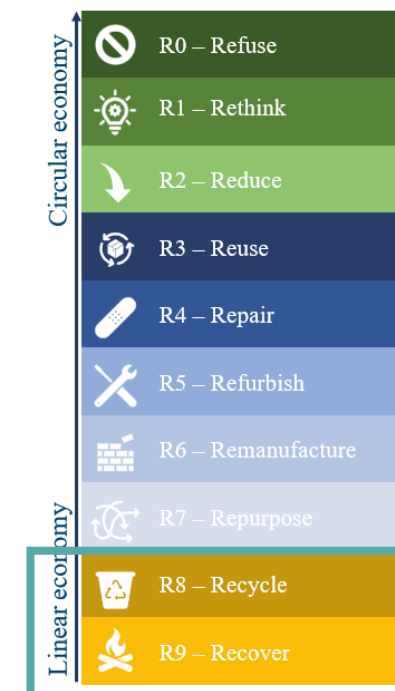
Recycle

- Last option before incineration or landfill
- Modular product design to ease the disassembly.
- Partaking in circular collaborations. For instance, ABB, Stena Recycling, Combitech, and Electrolux initiated a pilot project to improve the recycling process for electrical products.

Examples:

“Scania has a goal that 80 percent of the plastic in packaging, from our incoming flow, will be recycled or biobased by 2025” (Scania)

“Over the past year, in-house recycling and reuse, mainly of packaging materials and thermoplastics, reduced the amount of waste ABB generates by 1700 tons” (ABB)



SUMMARY

- 1) Circularity practices often vaguely described in sustainability reports
- 2) No greenwashing – on the contrary, need more detailed description!
 - What has been done?
 - How has it been done?
 - What improvements did it lead to?
- 3) Seldom explicit comprehensive circular strategies.
- 4) Huge potential in learning what other companies do.




WANT TO LEARN MORE?



Article

An Explorative Study of Circularity Practices in Swedish Manufacturing Companies

Filip Skärin , Carin Rösjö and Ann-Louise Andersen

Department of Industrial Product Development, Production and Design, School of Engineering, Jönköping University, 551 11 Jönköping, Sweden; carin.rosjo@ju.se (C.R.); ann-louise.andersen@ju.se (A.-L.A.)
 * Correspondence: filip.skarin@ju.se

Abstract: Due to the accelerating global warming crisis, interest in the concept of circular economy (CE) has started to excel. Adapting to a CE is especially important for manufacturing companies as they play major part in the global warming crisis. Hence, studying how manufacturing companies are transitioning to fit in a CE is highly relevant. Thus, the research question posed in this study is: How are manufacturing companies approaching circularity and which circularity practices can be identified? To answer the research question, a document study was carried out, wherein the latest available sustainability reports of the 20 largest manufacturing companies in Sweden were studied. A four-step process was followed, including sample selection, circularity extraction, data coding and data analysis. The findings include the creation of 61 unique circularity categories based on numerous identified circularity practices. This study focused identifying circularity practices, not only from a product perspective but for all resources and assets utilized by the company; hence, whilst many of the identified circularity practices involve product design, circularity practices have also been identified related uniquely to, e.g., manufacturing, for instance, in terms of reusing resources. Practical implications for this study include a clear overview of how Swedish manufacturing companies are working towards circularity and which specific circularity practices they mention in their sustainability reports.

Keywords: circularity practices; circular economy; manufacturing; production; sustainability; sustainable production

1. Introduction

During the past 150 years, the linear economy, characterised by a “take-make-use-dispose” product and material view, has dominated. However, the limitations of the linear economy are the unrealistic view of bottomless access to natural resources whilst seeing no scarcity in economic growth [1,2]. In line with the accelerating global warming crisis, the approach of circular economy wherein the utilization and lifetimes of resources and materials are maximised has gained significant increase in attention [3–5]. In fact, from an academic point of view, the number of publications published per year on the circular economy increased more than 2.5 times between 2010 and 2015 [6]. Nowadays, the circular economy is generally accepted as a significant support to sustainable development [1,6,7]. Furthermore, due to the ongoing increase in awareness regarding the global impacts of manufacturing companies [8], a tripartite sustainability focus has started to become interesting for many manufacturing companies. This sustainability focus implies operating the manufacturing companies with the aim of reducing the negative impacts on the environment, economy, and society. For manufacturing companies, this is an especially important issue as they play a major part in the global warming crisis. For instance, in 2019, manufacturing companies were responsible for 23% of the United States’ entire carbon dioxide equivalents (CO₂-e) released into the atmosphere [9]. In Sweden, this was even higher the same year, causing almost 32% of the entire country’s CO₂-e emissions [10].

Circularity Practices in Manufacturing—A Study of the 20 Largest Manufacturing Companies in Sweden

Filip Skärin , Carin Rösjö , and Ann-Louise Andersen 

Jönköping University, Gjuterigatan 5, 553 18 Jönköping, Sweden
 filip.skarin@ju.se

Abstract. In line with the accelerating global warming crisis, the concept of circular economy (CE), wherein the utilization and lifetimes of resources and materials are maximised, has gained a significant increase in attention. For manufacturing companies, adapting to a CE is particularly important due to high CO₂-e emissions. In order to increase the knowledge regarding how manufacturing companies have adapted to a CE, sustainability reports wherein the companies themselves report upon their circularity practices can be examined. This study has aimed at investigating the publicly available sustainability reports of the 20 largest manufacturing companies in Sweden, with the purpose of identifying which, and on what level of implementation, circularity practices are mentioned. The 10R framework was used as a foundation for categorizing and analysing the identified circularity practices. The findings in this study include a total of 38 unique circularity practices, whereas 13 are categorized as visioned or planned, and 36 are categorized as ongoing or already realised circularity practices. The circularity practices were primarily related to reducing, reusing, and recycling. Suggestions of further research include elaborately describing the circularity practices as well as further exploring the implementation of repairing, refurbishing and remanufacturing amongst manufacturing companies.

Keywords: Circularity · Circularity practices · Circular economy · Manufacturing · Sustainability

1 Introduction

During the past 150 years, the linear economy characterised by a “take-make-use-dispose” product and material view has dominated [1, 2]. In line with the accelerating global warming crisis, the approach of circular economy (CE) has gained a significant increase in attention, wherein the utilization and lifetimes of resources and materials are maximised [3]–[5]. Nowadays, CE is generally accepted as a significant support to sustainable development [1, 6, 7]. For manufacturing companies, the strive towards a CE is highly relevant as they play a major part in the global warming crisis. For instance, in 2019, manufacturing companies were responsible for 32% of Sweden’s entire CO₂-e

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CONTACT



Filip Skärin

filip.skarin@ju.se

+46 72 146 77 66



Carin Rösiö

carin.rosio@his.se

+46 5004 48553



Ann-Louise Andersen

ala@mp.aau.dk

6167 6375

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