MOVECO

CIRCULAR ECONOMY INNOVATION TOOLS
Schools of thought – section Cradle to Cradle

Qualification Programme Handbook Module 3

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1. TABLE OF CONTENTS

To eliminate the concept of waste means to design things – products, packaging, and systems – from the very beginning on the understanding that the waste does not exist[1]

[1] McDonough, W & Braungart, M: Cradle to Cradle – Remaking the way we do things 2002, first edition , page 104

2. INTRODUCTION

2.1. INTRODUCTION

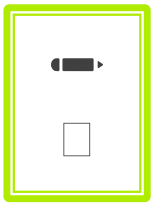
This document can either be used as background material for trainers and participants in a **workshop** or also by individual readers (**self-study** or within a self-formed study-group). For both cases, there are notes provided that guide through the material.

Indicative questions encourage you to reflect what you have just read.

In addition, throughout the text, you will find some indicative questions framed and marked by "?" that encourage to reflect what you have just read.

Cross-references to the case studies and further MOVECO materials help to deepen your knowledge about circular economy.

Moreover, there are cross- references to the case studies or other MOVECO material (such as the fact sheets) marked by "💡".



Practical exercises are pointed out for trainer-led workshops or self-study by individual readers or a self-formed study group

Further, the pencil sign points out practical exercises that can be done as part of a trainer-led workshop or in self-study by individual readers or a self-formed study group.

For the **practical** work, there are several **case studies** that invite discussion or reflection – paired with empty templates for worksheets that encourage looking at a self-chosen practical product example. In the end, there is a short quiz to test the knowledge gained in this section of the toolbox. You will find any specific terminology explained in the **glossary**. If you use this section as part of a workshop, there is an **evaluation form** at the very end that can be used to collect feedback at the end of the workshop.

3. CONTENT

3.1. SCHOOLS OF THOUGHT – GENERAL OVERVIEW

Circular economy represents a transition momentum for business including innovation, development and research activities, so it is important to understand how the concept evolved and developed. Over time, schools of thought have been developed that underpin new business models. In this module we will analyse the main schools of thought and we will identify how materials that enter the economy are used and the end of life process.

There are many schools of thought, and we will refer here to seven of them and once you will have studied them you will understand that there is something that connects everything: nature does not produce waste.

An important moment in time was the definition of sustainability provided by the World Commission on Environment and Development (WCED), in the report entitled "Our common future". The document is known as the "Brundtland Report" after the Commission's chairwoman, Gro Harlem Brundtland. The report defines sustainable development as development that meets" the needs of the present without compromising the ability of future generations to meet their own needs"[2]. It underlines the high risks upon the environment including new forms of pollution such as plastic waste in the oceans that decrease the corals life causing a huge pressure upon marine environment. One of the findings is presented below:

"A mainspring of economic growth is new technology, and while this technology offers the potential for slowing the dangerously rapid consumption of finite resources, it also entails high risks, including new forms of pollution and the introduction to the planet of new variations of life forms that could change evolutionary pathways. Meanwhile, the industry's most heavily reliant on environmental resources and most heavily polluting are growing most rapidly in the developing world, where there is both more urgency for growth and less capacity to minimize damaging side effects"[3].

It was an important step and even now, people and companies are developing environmental actions based on guiding principles for sustainable development described within the report. Some of "proposals for institutional and legal change at the national, regional, and international levels are embodied in six priority areas:

- getting at the sources,
- dealing with the effects,
- assessing global risks,
- making informed choices,
- providing the legal means, and
- investing in our future.

[2] Report of the World Commission on Environment and Development: Our Common Future- http://www.un-documents.net/our-common-future.pdf visited 01.03.2018

[3] Report of the World Commission on Environment and Development: Our Common Future- http://www.un-documents.net/our-common-future.pdf, page 13/247

Together, these priorities represent the main directions for institutional and legal change needed to make the transition to sustainable development. Concerted action is needed under all six"[4].

All these priorities are important to improve linear economy but they are not enough anymore. According to Circularity Gap Report [5]– "Our world economy is only 9.1% circular, leaving a massive 'Circularity Gap'", meaning that almost 90% of the row materials do not return to the global economic cycle and … "our planet is left with a massive strain on its natural resources and climate that needs to be urgently relieved….[6]"

3.2. CRADLE TO CRADLE – SCHOOLS OF THOUGHT

Considering the new industrial wave the phrase "without compromising the ability of future generations to meet their own needs" is no longer enough for improving the environmental issues as well as to diminish the pressure on resources (such as row materials) along the global value chain. New ideas are revealed in the schools of thought such as Cradle to Cradle is and step by step we will discover them, together.

According to the sustainability dictionary[7] Cradle to Cradle is a phrase invented by Walter R. Stahel in the 1970s[8]. The idea behind the phrase is that new "production techniques should be not just efficient but essentially waste free". The term was coined and popularized by William McDonough and Michael Braungart in their 2002 "Cradle to Cradle – Remaking the way we do things"

3.2.1 WHAT IS CRADLE TO CRADLE?

People use, different things, material goods, and have own patterns of consumption, on the one hand; businesses, on the other hand, use materials each day without thinking on what will happened to them when the product life ends. Maybe some of us think about recycling them, and part is recycled while the rest is landfilled or incinerated.

[4] Report of the World Commission on Environment and Development: Our Common Future- http://www.un-documents.net/our-common-future.pdf/Chapter 12: Towards Common Action:Proposals For institutional and Legal Change
[5] https://www.circularity-gap.world/ visited 29.05.2018
[6] Circle Economy - Press release - Davos January 2018
[7] http://sustainabilitydictionary.com/ visited 29.03.2017
[8] http://sustainabilitydictionary.com/index.php?s=cradle+to+cradle visited 29.03.2017

The most used definition is: Cradle to Cradle (C2C) or designing products "for continuous recovery and reutilisation as biological and technical nutrients"[9]

According to Wikipedia[10] – "Cradle to cradle design - (also referred to as Cradle to Cradle, C2C, cradle 2 cradle, or regenerative design) is a biomimetic approach to the design of products and systems that models human industry on nature's processes viewing materials as nutrients circulating in healthy, safe metabolisms".

or

"Cradle-to-cradle designs are examples of "eco-effective" business practices that optimize human health, recyclable and compostable materials, product life, use of renewable energy, water efficiency and quality while keeping the manufacturers socially responsible. The eco-effective, cradle-to-cradle philosophy responds to the "eco-efficiency" approach, which only seeks to minimize the negative environmental impacts of a business or industry"[11].

Cradle to Cradle can also represent a new, sustainable business model that mimics the natural regeneration cycle in which all waste is reused.

In the Cradle-to-Cradle production life cycle everything is connected and we can speak about material inputs and outputs that are seen either as technical or biological nutrients. The difference between them is that technical nutrients can be recycled or reconditioned and reused with no loss of quality (upcycling) and biological nutrients can become compost or can be consumed. By contrast, Cradle to Grave (the linear economy approach – make, use, dispose) refers to a situation when a business takes the entire responsibility for the disposal of goods it has produced (at their end of life), but is not necessarily interested to extract and put the product components back into service in their own production process or to sell them to other interested companies.

[9] https://www.ellenmacarthurfoundation.org/circular-economy/schools-of-thought/cradle2cradle visited 29.03.2017
[10] https://en.wikipedia.org/wiki/Cradle-to-cradle_design visited 03.06.2018
[11] http://www.ecomii.com/ecopedia/cradle-to-cradle, visited 04.06.2018

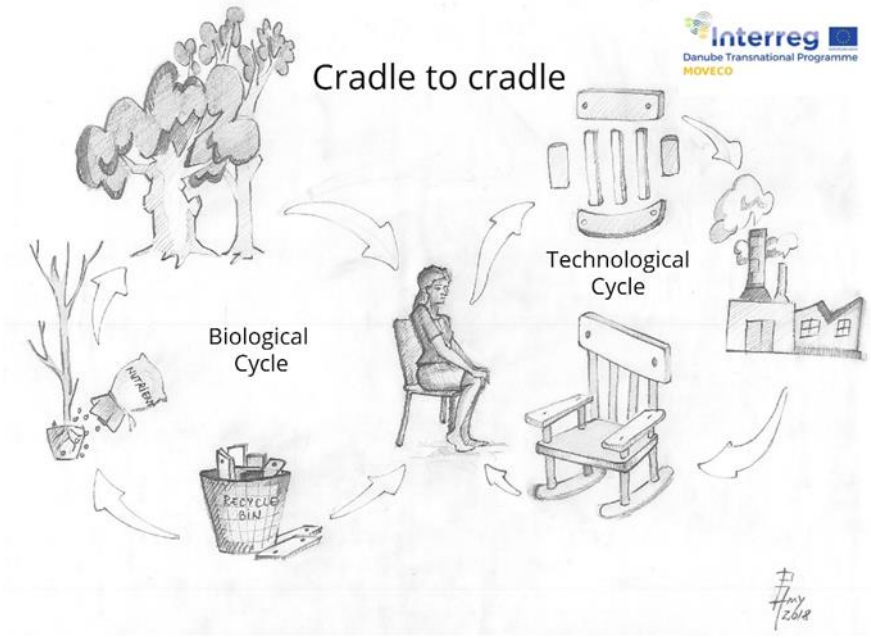


Figure 1- Cradle to Cradle model[12] Design –

There are five criteria for cradle to cradle model

- 100% renewable energy use
- Water stewardship – clean water output
- Social responsibility – positive impact on community
- Material Reutilization – recyclability/composability
- Material health

3.2.2 100% RENEWABLE ENERGY

"Renewable energy is energy that is collected from renewable resources, which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat. Renewable energy often provides energy in four important areas: electricity generation, air and water heating/cooling, transportation, and rural (off-grid) energy services"[13]

The sources of renewable energy are very important and they could power most of the companies or world.

What kind of technology should be used?

- Wind mills.

- Solar plants - Residential rooftop panels

Sources

[12] Picture credit – Chamber of Commerce and Industry, Pop Mustafa, Amalia
[13] Wikipedia - https://en.wikipedia.org/wiki/Renewable_energy

- Onshore wind

- Offshore wind

- Wave energy

- Geothermal energy

- Tides mills,

What can people and companies do? They can invest in technologies that will generate energy for own consumption with a benefit for the reduction of ecological footprint.

Governments can create new policies to encourage citisens and companies to become greener by using renewable energy.

3.2.3 WATER STEWARDSHIP

Water is a very important resource both for businesses, governments and communities and it is a shared resource that needs to be managed in a sustainable way.

Considering business sector, water represents both a risk and opportunity as lack of water means business failure that is why, more than others, businesses need to manage water flows in premises, manufacturing processes and supply chains. The opportunity means that businesses can provide innovative solutions to freshwater challenges.

Water recirculation facility in the pool - Casa EMA_Bistrita_Romania

Because of the susceptibility of being ingested at all times, the water in the swimming pools must reach the quality of the drinking water. Regardless of the norms used drinking water is that water which by consumption does not destroy the individual's health. It must not contain pathogenic germs (bacteria, viruses, parasites) and no undesirable or toxic chemical agents susceptible to cause damage in the shortest or longer term.

Exercise 1- Can you find some examples, around you concerning water stewardship?

Can you describe some situation you know (in your company or other companies) concerning water stewardship having in mind: the discharged water quality, violation of national water management rules, the discharging process, the water quantities used and discharged, and more. Can you imagine a better situation? For more information please check the study case - Water recirculation facility in the swimming pool - Casa EMA_Bistrita_Romania (page 18)

3.2.4 SOCIAL RESPONSIBILITY

According to UNIDO – "Corporate Social Responsibility is a management concept whereby companies integrate social and environmental concerns in their business operations and interactions with their stakeholders".[14]

Corporate Social Responsibility can be a strategic business management voluntary model or a charity, sponsorships or philanthropy model "that addresses many and various topics such as human rights, corporate governance, health and safety, environmental effects, working conditions and contribution to economic development. Whatever the definition is, the purpose of CSR is to drive change towards sustainability".[15]

You can have a look to ROMBAT study case included in the Module: Circular Economy Principles

Best practice example is company ROMBAT, Romania that voluntary includes CSR as business management strategy.

As included in the case study, you can find in Module 2 Principles of Circular Economy, they take some actions:

- To reduce environmental impact, ROMBAT practices include: keeping within the limits imposed in annual environmental plans; redesign the batteries; maintaining and improving the buy-back program of used batteries; optimization of supply with raw materials; optimization of stocks
- Environmental impact is measured by measuring gas emissions, followed up by improvement action plans
- The concept of "extended producer responsibility" is embedded within company's mission and put into practice by CSR and better relationships with distributors and consumers

Moreover ROMBAT developed, together with ONISIM Foundation a new CSR project with the following objectives:

- Increase the possibilities for reintegration into the community of persons previously in detention and other persons at risk;
- Information and awareness of the general population on the need to involve the community in the lives of vulnerable people;

[14] https://www.unido.org/our-focus/advancing-economic-competitiveness/competitive-trade-capacities-and-corporate-responsibility/corporate-social-responsibility-market-integration/what-csr visited 05.06.2018

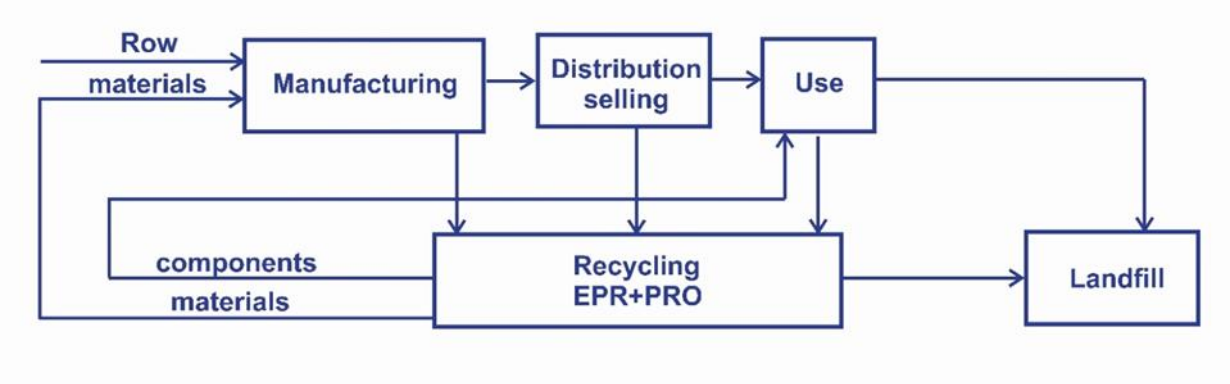
[15] Financial Times - http://lexicon.ft.com/Term?term=corporate-social-responsibility--(CSR) visited 05.06.2018

- Creating jobs for vulnerable groups; they will qualify the target group and then will provide jobs to some of them or assistance to find jobs.

3.2.5 MATERIAL REUTILIZATION – RECYCLABILITY/COMPOSABILITY

Material selection is a critical factor in any design-for-recyclability strategy include one critical factor namely material selection and in the design phase the recycling process can be facilitated by creating modular components or using fewer types of materials thus making easy to separate components. This new design strategy needs to be applied to all product lifecycle, as it is shown in Figure 2.

Figure 2: The design for recycling



Material selection has to consider, as well material health allowing them to enter the technical cycle and be used, in close loops, over and over.

Curious to find out more? Look to Module 4 New Material Pathways, 2.3 Material Choice- „No black-and-white" decissions

3.2.6 MATERIAL HEALTH

Material health: consists of no use of harmful (toxic) substances within a product. From scientifically point of view there is a need to research to find suitable "positive", biocompatible substances to use for manufacturing processes. Of great importance to each and every company is to identify the chemical composition of the materials (row materials or secondary row materials) which are found within the product and can create an impact on human or environment.

Impact on human & environmental, are based on the three principles described by Michael

Braungart[16]:

- "Waste equals food"/ "Everything is a nutrient for something else"
- "Use current solar income"
- "Celebrate diversity"

The first principle: "Waste equals food"/ "Everything is a nutrient for something else" is based on the assumption that all materials return to either the natural environment (biological cycle) or the technical environment (technological cycle), depending on their use. As everything we consume will eventually end up in our natural system, their influence has to be a positive one and that needs to be based on the product design as a first step. A design process that includes this principle will cover the material health and material reutilization.

To better understand the process think about a fruit tree in the nature: it blossoms then produce fruits, food for human, for birds or insects. The unhealthy fruits fall to the ground and become nutrients for green (become compost) or born cyclical process instead of a linear one represented by Cradle to Grave approach.

The fruit tree in the nature is not treated for pests (insects), they are food for birds that make different environmental services. In this way no chemicals are needed and that is the best Cradle to Cradle example nature provide for us as biological cycle as everything comes from nature and return to nature!

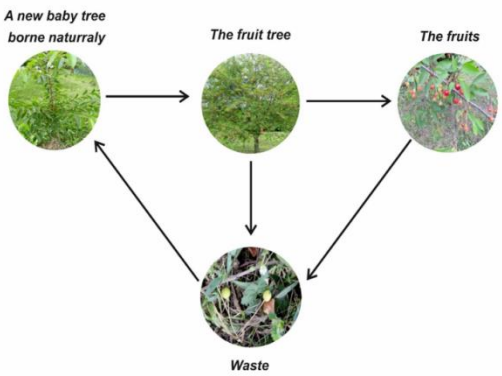


Figure 3 - Cradle to Cradle - Biological cycle[17]

Hence nature recycle and reuse everything. The question is: are we able to act as a tree? To eliminate all waste in our homes? Do you think companies, small or large could use this strategic approach and implement a new business model? The **answer is yes** and of most importance is: the way a product or service is designed provide the future impact on the environment.

No process can take place within manufacturing cycle in a company without energy consumption or waste production. The new innovative cradle to cradle design, using nature as mentor or model, creates new products and systems, where materials are absorbed back in

Biological system (biological nutrients can return into nature)

Or

Technical system (technical nutrients such as nontoxic, non-harmful materials can return to system and reused over and over in a closed loop).

[16] McDonough, W & Braungart, M: Cradle to Cradle – Remaking the way we do things 2002, first edition
[17] Picture credit Chamber of Commerce and Industry- Monica Muresan

You can have a look to ECOVATIVE https://ecovativedesign.com/home

Speaking about healthy we found a very interesting example for new innovative business generated by ECOVATIVE [18] that produce protective packaging called Mushroom® Packaging and Grow-It-Yourself Mushroom Material (GIY).

	
Square planters - Picture based on courtesy of ECOVATIVE[19]	Pictures based on courtesy of ECOVATIVE

"By adapting a process that occurs every day in nature, ECOVATIVE developed a revolutionary way of producing materials that come entirely from nature and return entirely to nature at the end of their useful life." [20]

ECOVATIVE has a Cradle to Cradle™ gold certificate as "Mushroom Materials fit well within the five categories of evaluation for certification". [21]

They use : available agricultural waste from their neighbour farmers, mycelium (a natural organism), renewable energy, and "…. process fits within the earth's carbon cycle by sequestering carbon atoms for the life of our Mushroom Material products, and then slowing releasing carbon back to the soil or water upon composting. Mushroom Materials are biological nutrients, and are completely compostable in home and municipal systems".[22]

[18] https://ecovativedesign.com/home - visited May 28th 2018
[19] https://ecovativedesign.com/press-kit visited on May 28th 2018
[20] https://www.c2ccertified.org/innovation-stories/ecovative visited May 28th, 2018
[21] https://www.c2ccertified.org/innovation-stories/ecovative visited May 28th, 2018
[22] https://www.c2ccertified.org/innovation-stories/ecovative visited May 28th, 2018

?

Think about your company: Does the selection of materials consider the decomposition and disassembly? Are the used materials healthy?

Are the materials and components upcycled or down-cycled. If so do you know for what cost?

How much secondary materials (recycled) or refurbished parts do you include in the final product?

Cross reference - You can have a look to Module nr. 4: New Material Pathways different study cases such as:

TRIGEMA INH. W. GRUPP E.K., BURLADINGEN, GERMANY – WWW.TRIGEMA.DE

FROSCH – WERNER & MERTZ GMBH, MAINZ, GERMANY – WWW.FROSCH.DE

More about materials you can find in the Handbook, Module no. 4: New Material Pathways.

The second principle **"Use current solar income"** states that there are enough renewable energy sources (e.g. sunlight, wind, biomass, geothermal, rainfall, heat, tides). Fossil fuels are non-renewable energy sources that are limited. Their combustion emits global carbon emissions, which is a driver for climate change. Because this fuels are used on a global scale their depletion puts pressure on mother Earth, which is why it is becoming increasingly important for people, companies and other organizations to use renewable energy technologies as much as possible.

?

Energy is very important for each and every company as well as energy saving. Can you imagine some innovative ways to save energy?

Try to get out from the box!

Think about how much energy you could save, in winter, if your house, or the premise of your company could be heated by sun? How much energy could you save if the hot water is heated by solar power? Do you know companies or houses using this kind of renewable energy? Can you compare?

Think about your business. Do you use sunlight instead of artificial light in your office or into your production facility? If so for how long?

- How long during your working hours you use sunlight for heating your office? Instead of air conditioning?

- What is the percentage of renewable energy you use for your product?

The third principle - "Celebrate diversity", is very important one as well. An example can be water stewardship – as water is an essential resource that needs to be properly managed in a responsible way to preserve and maximise its quality and promote healthy ecosystems. Each company must take measures so that water used in the production can be discharged into natural receptors without harming the ecosystems. As we are going to show later on for Cradle to Cradle™ gold certification, there is a need for companies water footprint, taken and discharged water quantities, water quality, the process of discharging and more.

More about stewardship you can find in the module: principles of circular economy of the MOVECO toolbox.

3.2.7 CRADLE TO CRADLE DESIGN

Cradle to Cradle thinking goes beyond the reduction of negative impact on us or environment and one step is rethinking the design and encourage designers to introduce concepts that enable the value generation such as:

1) Intelligent materials pooling,

2) Eco-effectiveness, and

3) The Triple Top Line.

1. Intelligent Materials Pooling - aims to design healthy products in which every ingredient can be safely returned to biological systems, or can be reused to provide high-quality resources for the next generation of products (Braungart, 2002).[23]

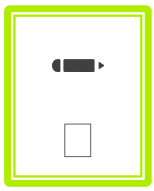
"Intelligent materials pooling is a framework for the collaboration of economic actors within the technical metabolism, which allows companies to pool material resources, specialized knowledge and purchasing power relating to the acquisition, transformation and sale of technical nutrients and their associated products. The result is a mutually beneficial system of cooperation amongst actors along the supply chain that supports the formation of coherent technical metabolisms and the enabling of product-service strategies. "

The base principle is the partnership built between different actors and stakeholders sharing access to a common supply of quality material (material bank), by creating a healthy system based on closed loop material flows. "As partners share knowledge, resources and values they develop a shared commitment to using the healthiest, highest quality materials in all of their products. Together they form a value-based business community focused on eliminating the

[23] Michael Braungart et al., Cradle-to-cradle design: creating healthy emissions et al., Cradle-to-cradle design: creating healthy emissions - strategy for eco-effective product and system design, Journal of Cleaner Production (2006)

concept of waste from manufacturing cycles. Ultimately, Intelligent Materials Pooling creates life support systems for sustainable business" [24]

> As an example think about an economic cluster in your region where companies trust each other and they use the same material bank (owner of the technical nutrients). Each company leases some of the necessary materials (healthy ones) from the bank, use them in the manufacturing process then they provide them to the consumers as a service (no ownership is transferred to customer). In the end the materials will be returned to the bank.



Practical application 2- Can you find some examples, around you concerning such cooperation?

Can you describe some situation you know where such an intelligent material pooling is working?

If you cannot find around you check on the internet and find such an example then discuss it with your peers. Make some conclusions for the future.

Eco-effectiveness: "The concept of eco-effectiveness offers a positive alternative to traditional eco-efficiency approaches for the development of healthy and environmentally benign products and product systems" [25]. That means Eco-effectiveness provides an absolute positive environmental impact on systems as it "is modelled on the successful interdependence and regenerative productivity of natural systems. In nature, all outputs from one process become inputs for another. The concept of waste does not exist."[26]

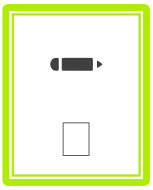
On one hand eco-efficiency strategy is an approach based on zero waste concepts and linear flow of materials (cradle to grave), on the other hand eco-effectiveness target sustainable solutions hence industry needs to reinvent sustainable regenerative solution mimicking nature and its abundance. That means a continuous process of learning and developing knowledge, which must be at the heart of the business and all levels in the company need to work together to share knowledge. One of the most difficult things in eco-management is to make the decisions, which you know will change the way of thinking. That means to take responsibility. This is the situation when a company decides that "less bad" (eco-efficiency) is not enough and

[24] Baungart, M : Intelligent Materials Pooling: Evolving a Profitable Technical Metabolism by Michael Braungart , MBDC Article originally appeared on www.mbdc.com, as the Sept/Oct 2002 monthly feature story

[25] Michael Braungart et al., Cradle-to-cradle design: creating healthy emissions et al., Cradle-to-cradle design: creating healthy emissions- strategy for eco-effective product and system design, Journal of Cleaner Production (2006),

[26] Michael Braungart et al., Cradle-to-cradle design: creating healthy emissions et al., Cradle-to-cradle design: creating healthy emissions- strategy for eco-effective product and system design, Journal of Cleaner Production (2006),

they commit themselves to use eco-effectiveness instead. More about managerial skills you may find in the module: Green entrepreneurial skills.



Practical application 3- Can you find some examples, around you concerning water stewardship?

Can you describe from your own company how an output from one process becomes input for another? If you do not find please have a look the case studies in the Module nr. 4 New Material Pathways.

Triple Top Line (TLL) thinking is important by providing the transfer of responsibility for the product in the initial stage, i.e. in the design stage, generating a positive long-term effect on Economics, Equity, and Ecology, balancing the three value systems by asking simple questions connected to costs, aesthetics and performance.

According to Sustainability dictionary – TTL is "The effect that attention to sustainable management of natural, financial, and human capital has to an organization by increasing revenues (by offering more desirable products and services) and reducing costs and expenses throughout operations (through more streamlined operations. While many of these benefits are measured in terms of triple bottom line accounting, even more valuable are their effects to a company's top-line financial performance because they require less capital investment and reduce the cost of capital."

No company is an island and it works (as a living organism) in an interconnected world. TTL introduces challenges that can lead to opportunities that respect the balance of all three systems of values (economic, environmental and social equity) instead of limiting the influence of one or the other. It is a modern designing tool that introduces a balance between eco-efficiency, cost-effectiveness and socio-efficacy in modern company management allowing innovation and creativity mining.

3.2.8 CRADLE TO CRADLE IMPORTANCE FOR BUSINESS

What makes this model important for business? Why would a business decide to move from eco-efficiency to eco-effectiveness? We speak about closed-loop systems, healthy ingredients in healthy products (biodegradable naturally or regenerated, or completely recycled and turned into materials that are of higher quality than originally).

When using eco-effectiveness, the aim is to design industrial systems that are similar with the one produced by nature based to the principle of Cradle to Cradle: waste equals food. When a product returns to production at the end of each of its use phase, upcycling in new products, the closed loop generates new value for the

The benefits for companies consists in new business models implementation. Check Module 3 to improve your knwledge about business models in

business and creates new business models.

You will be able to find some interesting business models such as:

- Product Life Extension - the lifecycle of a product can be extended by repairing, upgrading & reselling
- Resource Recovery - modularity and material maximize economic value of product return flows
- Circular Supplies - supply fully renewable, biodegradable or recyclable resource inputs
- Product as a Service - products are used by customer by means of lease or pay-for-use
- Sharing Platforms - customer collaboration among product use

3.2.9 CRADLE TO CRADLE CERTIFICATION

Cradle to Cradle® is a registered trademark of McDonough Braungart Design Chemistry, LLC (MBDC). Cradle to Cradle Certified™ is a certification mark licensed exclusively for the Cradle to Cradle Products Innovation Institute.[27]

This important product quality certification is based on five levels: Basic, Bronze, Silver, Gold, and Platinum. For each level, a product must meet the minimum criteria in all five categories. It is not a simple process as the criteria in each category become increasingly demanding with each level of certification.

1. Material Health in a nutshell - Materials must be defined as technical or biological nutrients that are safe and healthy for humans and the environment.

2. Material Reutilization in a nutshell- Check if your products contain recycled or renewable materials and if they are designed to be recycled as technical or biological nutrients in future life cycles.

3. Renewable Energy Use in a nutshell- What kind of energy do you use? Is it solar, wind, geothermal, or other renewable sources of energy during the manufacturing process? Is your energy consumption efficient? Where could you save energy?

4. Water Stewardship in a nutshell- Do you operate in a way that respects the need for all living things to have clean water?

5. Social Responsibility in a nutshell-Do you respect the health, safety, and rights of people and the planet?

[27] https://www.c2ccertified.org

3.2.10 OTHER PRACTICAL INFORMATION

Should you need more information about the certification process you can visit Cradle to Cradle Products Innovation Institute.

If you need to learn about C2C certified products you can visit the Cradle to Cradle Certified Products Registry

3.3 CASE STUDIES – CASA EMA/BISTRITA ROMANIA

The problem: Because of the susceptibility of being ingested at all times, the water in the swimming pools must reach the quality of the drinking water.

Regardless of the norms used, drinking water is that water which by consumption does not destroy the individual's health. It must not contain pathogenic germs (bacteria, viruses, parasites) and no undesirable or toxic chemical agents susceptible to cause damage in the shortest or longer term.

Swimming pool water and swimming pools are continually prone to contamination with existing microorganisms in the atmosphere or introduced into the pool of users (skin and mucous and accidental urine and faces).

To monitor the water quality in swimming pools, physicochemical indicators are used: free pH, temperature free and free chlorine, and as microbiological indicators: total colony count at 37°C, coliform bacteria, Escherichia coli, enterococci , Pseudomonas aeruginosa.

Water disinfection can be done by two types of methods:

- Chemical methods:
  - With residual disinfectant: chlorine, chlorine
  - Brominated bromine-based substances
  - No residual disinfectant: ozone.
  - Physical methods: UV.

Physical methods are usually not used on their own but in combination with a chemical method. Chemicals used as bathing water disinfectants fall into the category of biocides and require an opinion issued by the National Biocide Products Commission. The quality of the water after disinfection must comply with the quality requirements of the legislation in force.

In the past, in order to keep the water at an acceptable level of clarity, it was necessary to refill the basin at short intervals, which meant a high water consumption. With time, research in all areas has improved water quality. This also applies to swimming pools. Simple but effective filtering systems have been put in place which, in combination with innovative disinfection methods (ozone), keep clean and clear water, and it does not require replenishment of the pool at short intervals. Pool water is treated and reused, which greatly reduces water consumption.

The solution

The EMA House Processing Technology stream consists of: water treatment with ozone, filtration and final disinfection with chlorine. Innovative pool water treatment technology at Casa EMA keeps pool water within legal limits, allowing it to be reused for several months, reducing drinking water considerably, which is very low (add only water evaporate). This technology reduces water consumption considerably, making it a sustainable economy to reduce water consumption.

The process consists in treating the main stream of gas-ozone recirculation in a pressurized system by means of a gas-liquid contact system (Venturi injector and static mixer integrated in a contact, reaction and degassing, ensures optimum contact time to maintain a residual ozone concentration at system exit of 0.3 oz. ozone / litter of water). The stream of ozone-treated water then follows the filtering path on multimedia filters containing a superior layer of active carbon, in order to adsorb oxidized compounds and retention of residual ozone. The water-ozone contact time in the contact system should be at least 3 minutes for optimal oxidation and disinfection action.

Functional description:

1. Pump station. This delivers the main flow rate, which allows a total recirculation of the water volume in the recreation pool within a max. 5 hours. The water flow is taken from the equalizing basin by means of 4 pumps.

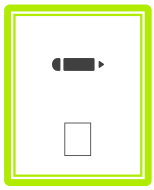
2. Ozone injection and injection system includes Injection Venturi, Contact and Reaction Vessel System (M1, M2) including Integrated Static Mixer System, Calibration Column (CL), Automatic Degassing Valve (SAD2), and Destroyer catalytic residual ozone with oxygen evacuation in the atmosphere (DOC). Recirculated flow is taken directly from the pool or after the existing filter battery through a pumping system. The Venturi Injector allows ozone to flow into the water stream. Treated flow continues through a static mixer integrated into the two reaction vessels, which homogenizes and improves the ozone solubility efficiency. Upon leaving the mixer, the solubilized ozone fraction exceeds the percentage of 90% of the ozone supplied by the system. Here are the main oxidation reactions of the organic substances and the bactericidal processes take place. The residual ozone level in the water flow at the outlet of the contact vessel will be at least 0.3 g O3 / m3 of water. The reaction vessels are provided with an ozone-depleting ozone exhaust valve degassed in an ozone destroyer.

3. Filter battery. Ozone-treated water is transferred to the multimedia filter battery (sand and granular activated charcoal). These are 4 for the recreational pool, and 2 for the hydro massage pool. After the filter battery, the hydraulic track continues through the heat exchanger and feeds the pools.

The benefits

- The water quality is = drinking water
- The water consumption decreases
- The water consumption costs decrease
- The clients trust increase
- An increased number of services provided to clients
-

3.4 EXERCISE 1



Exercise 1 Design a biological and technical metabolism for preferred materials

Step 1 **Design - Define material flows**

- Choose one or more materials in your product (all if possible)
- Make two lists: a) Biological nutrients (BN)
  b) Technological nutrients (TN)
- Identify the material reutilization (what do you reutilize once the product life ends)
- Identify energy use and source(s) for final stage of product manufacture/assembly
- Design a technical metabolism for preferred materials

Step 2 **Manufacture – Answer these questions:**

- Does all water (including the quantities generated by production processes) leaving your premises meets drinking water quality standards?

- Is your company involved within social responsibility projects? Please describe if social aspects of supply chain, or recycling/reuse issues are considered?

- Do you believe that the life-time of your most important product can be extended by using different materials?

- Do you use renewable energy?

Step 3 **Use**

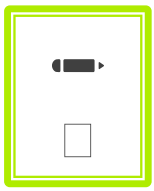
- Does your product have a sharing potential or can you sell the performance instead of good?
- Can the product be down - or upcycled and at what cost?
- Can the use of the product be adapted?
- Can the product be repaired refurbished or remanufactured?

Step 4 **End of life**

Make a list of what kind of materials are reaching the landfill:

- What can you do to decrease the list?
- Is your company applying the Extended Producer Responsibility (EPR)?
- Are there any benefits for the company from EPR?

3.5 EXERCISE 2 - CRADLE TO CRADLE CERTIFICATION



Exercise 2 Use Cradle to Cradle certification criteria to decide your green design priorities.

Source: https://venturewell.org/tools_for_design/measuring-sustainability/cradle-to-cradle/cradle-cradle-exercise/

Time Estimate: 2—4 hours

Goal: Use Cradle to Cradle certification criteria to decide your green design priorities.

Each participant need a laptop and an internet connection

Rate a product in your company according to Cradle to Cradle ("C2C") certification criteria, estimating data as needed, and accounting for variation in your estimates.

Step1: Read the Cradle to Cradle Certification criteria (http://www.c2ccertified.org/get-certified/product-certification)

Time Estimate: 15—30 minutes

Understand the criteria, and plan how you will gather the data to determine whether you will meet each one.

Step 2: Make a spreadsheet to calculate the C2C score of your product

Time Estimate: 1.5—4 hours

You can use the template spreadsheet, or make your own. (https://venturewell.org/wp-content/uploads/C2C_v3_template.xlsx)

In order to be most effective, your spreadsheet should:Be based on as much real data as possible.

Visually flag your uncertainties with red text or highlighting. There will be data unavailable to you, or not yet decided, such as whether ingredients contain hazardous materials or outcomes of social assessments. For points with these uncertainties, show optimistic and pessimistic scores in different columns. Then you can calculate the final score for best and worst likely totals.

List brief notes for each line item to remember why you scored it the way you did. You only need a few words, not a whole paragraph.

Be graphically designed to be clear and easy to interpret by someone other than you. This can be a powerful communication tool between you and your team (or your investors, or your future self). If you keep coming back to it, it can be a dashboard for tracking improvement.

Step 3: Interpret your results

Time Estimate: 5—10 minutes

Would you qualify for C2C certification in your best-case scenario? What about worst-case scenario?

What points would prevent you from qualifying? Where are you scoring well? What would be easy for you to change? Use these answers to set your priorities for green design and operations.

4. QUESTIONS & ANSWERS

4.1. QUIZ – QUESTIONS

1. Closed recycling loop can be:

Cradle to Grave

Cradle to Cradle

Both

2. What is cradle to cradle design?

Is a biomimetic approach to the design of products and systems that models human industry on nature's processes viewing materials as nutrients circulating in healthy, safe metabolisms"

It means as well regenerative design

Both

3. Eco effectiveness is

Equal to eco-efficiency

A process

A design strategy

4. Waste = food, means

Waste would become food for the biosphere or the techno sphere

Design every product in such a way that at the end of its lifecycle the component materials become a new resource

Both

5. Water stewardship is

Mandatory for a company

A Corporate Social Responsibility issue

A voluntary process

4.2. QUIZ – SOLUTIONS

1. Closed recycling loop can be:

Cradle to Grave
Cradle to Cradle
Both

2. What is cradle to cradle design?

Is a biomimetic approach to the design of products and systems that models human industry on nature's processes viewing materials as nutrients circulating in healthy, safe metabolisms"
It means as well regenerative design
Both

3. Eco effectiveness is

Equal to eco-efficiency
A process
A design strategy

4. Waste = food, means

Waste would become food for the biosphere or the techno sphere
Design every product in such a way that at the end of its lifecycle the component materials become a new resource
Both

5. Water stewardship is

Mandatory for a company
Voluntary process
A Corporate Social Responsibility issue

5. GLOSSARY

- **Bio-based material:** ""Bio-"is Greek for life. Bio-based material refers to a products main constituent consisting of a substance, or substances, originally derived from living organisms. These substances may be natural or synthesized organic compounds that exist in nature. This definition could include natural materials such as leather and wood, but typically refers to modern materials. Many of the modern innovations use bio-based materials to create products that biodegrade. Some examples are: cornstarch, derived from a grain and now being used in the creation of packaging pellets; bio-plastics created with soybean oil, now being used in the creation of many modern products like tractors, water bottles, and take away cutlery." [28] **Biodegradable material**: "A material which microorganisms can break down into natural elements (i.e. water, biomass, etc.)."[29]
- **Biological metabolism** - The natural processes of ecosystems are a biological metabolism, making safe and healthy use of materials in cycles of abundance[30]
- **Biological Nutrient** - A material used by living organisms or cells to carry on life processes such as growth, cell division, synthesis of carbohydrates and other complex functions. Biological Nutrients are materials that can biodegrade safely and return to the soil to feed environmental processes[31]
- **Cascading**: see MOVECO fact sheet "Circular Economy: Terms & Definitions"
- **Compostable material**: "Materials that can be disposed with biological materials and decay into nutrient-rich material."[32] **Circular economy** - regenerative economy in which resource input and waste, emission, and energy leakage are minimized by slowing, closing, and narrowing energy and material loops
- **Cradle-to-Cradle®:** see MOVECO fact sheet "Supporting Tools for a Circular Economy"
- **Cradle to Grave** – "A Cradle to Grave system is a linear model for materials that begins with resource extraction, moves to product manufacturing, and, ends with a "grave" – when the product is disposed of in a landfill or incinerator"[33]
- **Decision** – "shall be binding in its entirety. A decision which specifies those to whom it is addressed shall be binding only on them"[34]
- **Directive** – "shall be binding, as to the result to be achieved, upon each Member State to which it is addressed, but shall leave to the national authorities the choice of form and methods"[35]

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[28] https://sustainabilitydictionary.com/2006/02/17/bio-based-material/ (26.03.2018) // "A material that is partially, or entirely made of biomass." https://www.ceguide.org/Glossary (26.03.2018)
[29] https://www.ceguide.org/Glossary (26.03.2018)
[30] Cradle to Cradle terminology – MBDC-http://www.c2cproducts.com/detail.aspx?linkid=1&sublink=26
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[34] European Network of Environmental law Organizations 2012 Implementation of the Waste Framework Directive in the EU Member States
[35] European Network of Environmental law Organisations 2012 Implementation of the Waste Framework Directive in the EU Member States

- **Down-cycle** - to recycle (something) in such a way that the resulting product is of a lower value than the original item : to create an object of lesser value from (a discarded object of higher value)[36] see: MOVECO fact sheet "Circular Economy: Terms & Definitions"
- **Eco-Effectiveness** – "The central strategy in the cradle-to-cradle development method and seeks to create industrial systems that emulate healthy natural systems. The central principle of eco-effectiveness is that "waste equals food." The concept was developed in response to some of the perceived limitations of eco-efficiency which critics claim only slow down the rate of environmental depletion and don't reverse the production of unused or non-recycled waste".[37]
- **Eco efficiency** – "Management philosophy that aims at minimizing ecological damage while maximizing efficiency of the firm's production processes, such as through the lesser use of energy, material, and water, more recycling, and elimination of hazardous emissions or by-products."[38]
- **Ecological sustainability** – "a bio-centric school of sustainability thinking that, based on ecology and living systems principles, focuses on the capacity of ecosystems to maintain their essential functions and processes, and retain their biodiversity in full measure over the long-term contrasts with technological sustainability based on technical and engineering approaches to sustainability"[39]
- **Ecosystem** - the interactive system of living things and their non-living habitat[40]
- **Ecosystem redesign** - a coherent framework for redesigning our landscapes, buildings, cities, and systems of energy, water, food, manufacturing and waste through the effective adaptation to and integration with nature's processes[41]
- **Energy efficiency**: "Energy efficiency improvements refer to a reduction in the energy used for a given service (heating, lighting, etc.) or level of activity. The reduction in the energy consumption is usually associated with technological changes, but not always since it can also result from better organization and management or behavioral changes ("non-technical factors")."[42]
- **Energetic use**: incineration of waste material that includes the use of the generated heat and energy for other processes
- **(Final) disposal**: see MOVECO fact sheet "Circular Economy: Terms & Definitions"
- **Incineration**: Waste destruction in a furnace by controlled burning at high temperatures. Incineration removes water from hazardous sludge, reduces its mass and/or volume, and

[36] Merriam Webster dictionary
[37] https://sustainabilitydictionary.com/2005/12/03/eco-effectiveness/visited 26/02/2018
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[41] with adaptations from https://www.researchgate.net/publication/301966198_Regenerative_Development_regenerative_development_and_Design (26.06.2018)
[42] https://hub.globalccsinstitute.com/publications/energy-efficiency-recipe-success/definition-and-scope-energy-efficiency (26.03.2018)

converts it to a non-burnable ash that can be safely disposed of on land, in some waters, or in underground pits. However, it is a highly contentious method because incomplete incineration can produce carbon monoxide gas, gaseous dioxins, and/or other harmful substances.[43]

- **Innovation** - production or adoption, assimilation, and exploitation of a value-added novelty in economic and social areas[44]
- **Landfilling**: "The disposal and burying of solid waste. The degradation of the waste results in the creation of local air and water pollution."[45]
- **Lean production** - approach to management that focuses on cutting out waste, whilst ensuring quality[46]
- **Life-cycle** - series of stages in form and functional activity through which a system passes between successive recurrences of a specified primary stage[47]
- **Life-cycle analysis**: see MOVECO fact sheet "Supporting Tools for a Circular Economy"
- **Life-time** - the duration of the existence of a given particular system[48]
- **Locational patterns** - the patterns that depict the distinctive character and potential of a place and provide a dynamic mapping for designing human structures and systems that align with the living systems of a place[49]
- **Negative externality** - occurs when production and/or consumption imposes external costs on third parties outside of the market for which no appropriate compensation is paid[50]
- **Optimization** - finding an alternative with the most cost effective or highest achievable performance under the given constraints, by maximizing desired factors and minimizing undesired ones[51]
- **Permaculture** - a system of agricultural and social design principles centered around simulating or directly utilizing the patterns and features observed in natural ecosystems[52]
- **Place** - the unique, multi-layered network of ecosystems within a geographic region that results from the complex interactions through time of the natural ecology (climate, mineral and other deposits, soil, vegetation, water and wildlife, etc.) and culture (distinctive customs, expressions of values, economic activities, forms of association, ideas for education, traditions, etc.)[53]

[43] http://www.businessdictionary.com/definition/incineration.html (27.06.2018)
[44] with adaptations from http://www.ericshaver.com/the-many-definitions-of-innovation/ (27.06.2018)
[45] https://www.ceguide.org/Glossary (26.03.2018)
[46] with adaptations from https://www.tutor2u.net/business/reference/introduction-to-lean-production (27.06.2018)
[47] https://www.merriam-webster.com/dictionary/life%20cycle (26.06.2018)
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[50] with adaptations from https://www.economicshelp.org/micro-economic-essays/marketfailure/negative-externality/ (26.06.2018)
[51] http://www.businessdictionary.com/definition/optimization.html (26.06.2018)
[52] https://en.wikipedia.org/wiki/Permaculture (27.06.2018)
[53] https://www.researchgate.net/publication/273379786_Regenerative_Development_and_Design (25.06.2018)

- **Recommendations and opinions** - shall have no binding force [54]
- **Recycling:** see MOVECO fact sheet "Circular Economy: Terms & Definitions"
- **Refurbishment:** "The refurbishment of something is the act or process of cleaning it, decorating it, and providing it with new equipment or facilities."[55]
- **Regenerative design** - a system of technologies and strategies, based on an understanding of the inner working of ecosystems that generates designs to regenerate rather than deplete underlying life support systems and resources within socio-ecological wholes[56]
- **Regenerative development** - a system of technologies and strategies for generating the patterned whole system understanding of a place, and developing the strategic systemic thinking capacities, and the stakeholder engagement/commitment required to ensure regenerative design processes to achieve maximum systemic leverage and support, that is self-organizing and self-evolving[57]
- **Regulation** - shall have general application. It shall be binding in its entirety and directly applicable in all Member States. – Source - Article 288 TFEU, [58]
- **Remanufacturing:** "The process of cleaning and repairing used products and parts to be used again for replacements."[59]
- **Restorative design** - sometimes called restorative environmental design; a design system that combines returning polluted, degraded or damaged sites back to a state of acceptable health through human intervention[60]
- **Resource efficiency**: "A percentage of the total resources consumed that make up the final product or service."[61] re-use: see MOVECO fact sheet "Circular Economy: Terms & Definitions"
- **Secondary resource/ secondary raw materials:** "Waste materials that are recovered, recycled and reprocessed for use as raw materials."[62]
- **Servitization** - refers to industries using their products to sell "outcome as a service" rather than a one-off sale[63]
- **Source to sink** - simple linear flows from resource sources (farms, mines, forests, watershed, oilfields, etc.) to sinks (air, water, land) that deplete global sources and overload/pollute global sinks[64]
- **Stewardship** - ethic of companies, organizations and individuals that embodies the responsible planning and management of resources[65]

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[54] http://eur-lex.europa.eu/summary/chapter/environment.html?root_default=SUM_1_CODED%3D20,SUM_2_CODED%3D2003&locale=en
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[58] http://eur-lex.europa.eu/legal-content/en/TXT/HTML/?uri=CELEX:12016E288
[59] https://sustainabilitydictionary.com/2005/12/03/remanufacturing/ (26.03.2018)
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[65] https://en.wikipedia.org/wiki/Stewardship (24.06.2018)

- **Sourcing:** "the act of getting something, especially products or materials, from a particular place"[66]
- **System thinking** - holistic approach of analysis and planning that focuses on the way the parts of a system interrelate each other and how systems work over time and within the context of larger systems[67]
- **Technical metabolism** - "Modelled on natural systems, the technical metabolism is MBDC's term for the processes of human industry that maintain and perpetually reuse valuable synthetic and mineral materials in closed loops"[68]
- **Technical nutrient** – "A material that remains in a closed-loop system of manufacture, reuse, and recovery called the technical metabolism, maintaining its value through infinite product life cycles "[69]
- **Upcycle** – "to recycle (something) in such a way that the resulting product is of a higher value than the original item: to create an object of greater value from (a discarded object of lesser value)"[70]
- **Upcycling**: see MOVECO fact sheet "Circular Economy: Terms & Definitions"
- **Waste**: see MOVECO fact sheet "Circular Economy: Terms & Definitions"

More: https://www.ceguide.org/Glossary

6. REFERENCES

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On line resources

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7. IMPRINT

This document is a publication within the MOVECO project.

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This document has been edited by Monica Muresan on behalf of all project partners of the MOVECO project (project identity: DTP 1-349-1.1).