MOVECO

CIRCULAR ECONOMY INNOVATION TOOLS
Schools of thought - Regenerative design

Qualification Programme Handbook Module 3

Prepared by Monica Muresan, Iulia Szekeres | June 2018

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1. TABLE OF CONTENTS

2. INTRODUCTION

2.1. INTRODUCTION

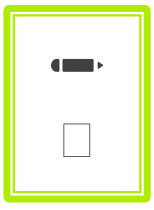
This document can either be used as background material for trainers and participants in a **workshop** or also by individual readers (**self-study** or within a self-formed study-group). For both cases, there are notes provided that guide through the material.

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 – REGENERATIV DESIGN GENERAL OVERVIEW

Regenerative design is a theory about designing systems capable to restore, renew or revitalize their own sources of energy and materials via specific processes, thus creating sustainable systems that form synergies and symbiosis between natural and artificial ecosystems. The basis of regenerative design is system ecology by adding closed loops between inputs and outputs or creating models where all outputs are viable and all inputs are accounted and where Σoutputs ≥ Σinputs.

Regenerative design is the biomimicry of ecological systems to artificial systems that work as a closed viable eco-economic system for all industries. Regenerative design is about finding solutions in order to metamorphose organic (biotic) and synthetic (abiotic) materials into new viable materials, not just to metabolize them. Regenerative design intends to create ecosystems that are absolutely waste free and can be applied to many aspects of human habitation such as urbanization, building construction, economic flow, industrial value chains and social systems. The ultimate goal of regenerative design is to redevelop systems with 100% effectiveness for co-evolution of humans along with other species.

The concept "regeneration" includes the concept "sustainable" and moves a step forward in the sense it act such that a lost ecological system to be brought back to existence. Regenerative design and development aims to reverse the degradation and negative environmental impacts. In this respect, we have to see human (eco)-systems and natural (eco)-systems strong interconnected and to apply whole systems thinking approaches to create living systems that are beneficial and co-evolving with natural systems. In simple words, regenerative design is about believing that it is possible to regenerate lost ecosystems.

Regenerative design and development is about architecture, urbanization, people and their activities. The challenge in this case is that both human and natural ecosystems are complex, non-linear and adaptable systems, where classical, deterministic cause-effect rules cannot be applied so easy, or not at all. The well-known "butterfly effect" is ubiquitous in such cases. From this perspective the job in regenerative design is to think on regenerative cyclic systems instead of one-way linear systems and to optimize evolution and maximize resilience, not to maximize efficiency and satisfaction of human "greedy" needs now and with any costs. The difference between a degenerative and regenerative system results by comparing the block schemes from Figure 1 and Figure 2.

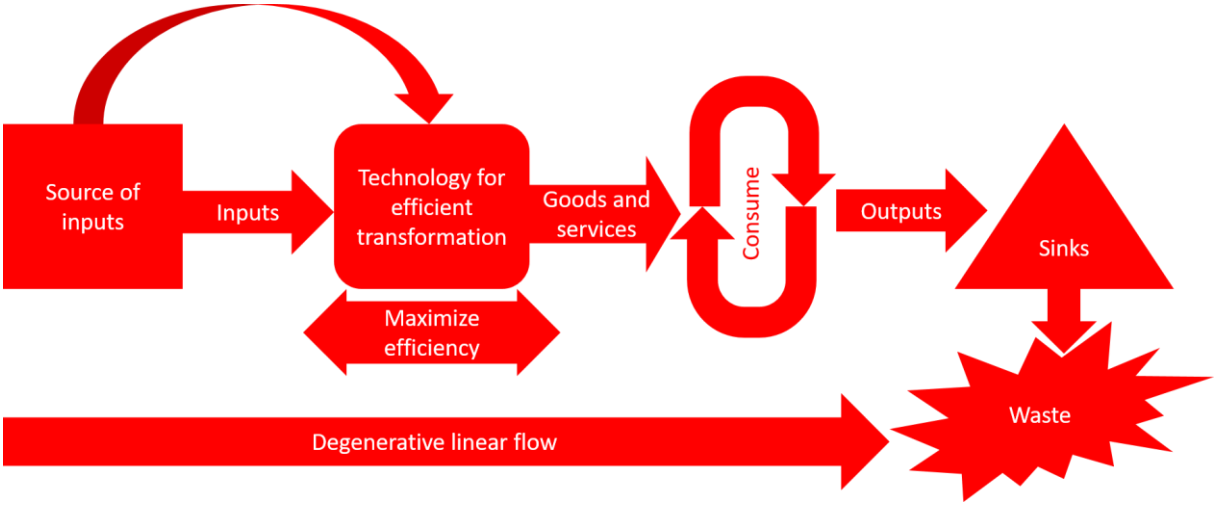


Figure 1. Degenerative system

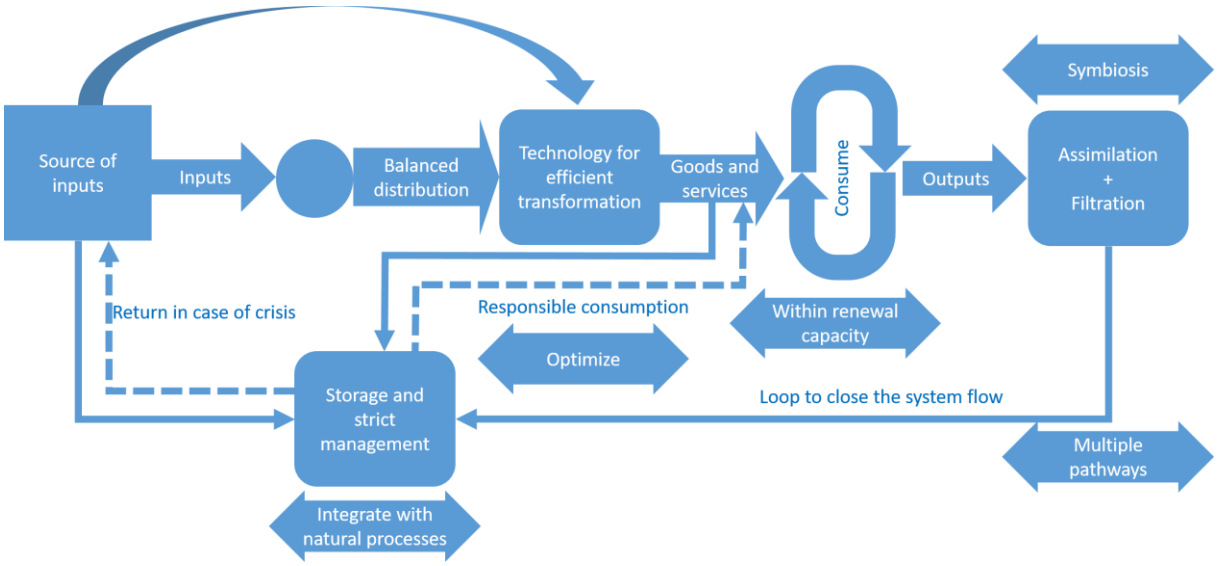


Figure 2. Regenerative system

The paradigm shift between degenerative and regenerative design and development is to shift from "output-driven thinking" (result) to "outcome-driven thinking" (result & impact of result). This is suggestively illustrated in Figure 3.

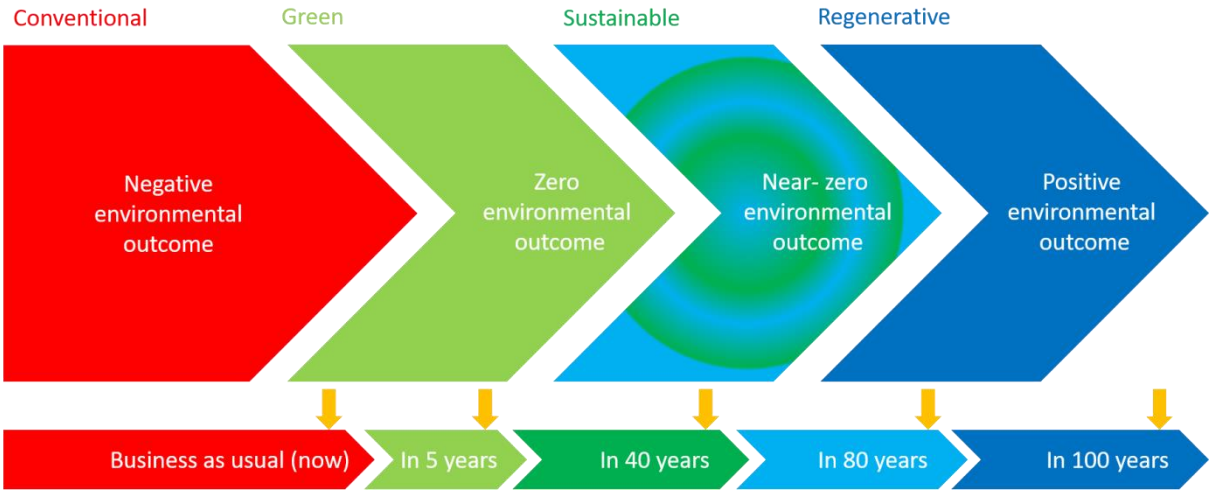


Figure 3. Paradigm shift in developing ecosystems and action scheduling

As Figure 3 shows, it is not possible to jump from conventional ecosystems to regenerative ecosystems. We need to pass through some intermediary phases for learning lessons and optimizing solutions. Nevertheless, a short, mid and long-term strategic agenda shall be in place such as to achieve this goal. Regenerative design is not only about preservation of natural ecosystems, but also to improve natural ecosystem by human contribution. Fauna and flora from a place try to keep in balance with nature. They are not capable to bring more to environment, but human being is obliged to do more for environment because he is the single truly intelligent species on Earth; thus people must act such as to increase the capacity of natural environment to evolve in a positive way and to be resilient to various changes of the planet (e.g. changes of the magnetic field, changes of the sun intensity, influences of the global natural climate changes to local places, etc.).

3.2. THE PATH TOWARDS REGENERATIVE SYSTEM DEVELOPMENT

Regenerative development starts when people realize that the place where they leave is a dynamic entity with its own unique past and future, continuously influenced by the larger system in which it is embedded. The second step is to turn to action. This requires a strategic partnership between all stakeholders in order to design and put in practice a plan to harmonize all ecosystems from a place such as create endogenic capabilities for regeneration. The last stage is the one of co-evolution to sustain the regenerative capabilities. These stages are suggestively illustrated in Figure 4.

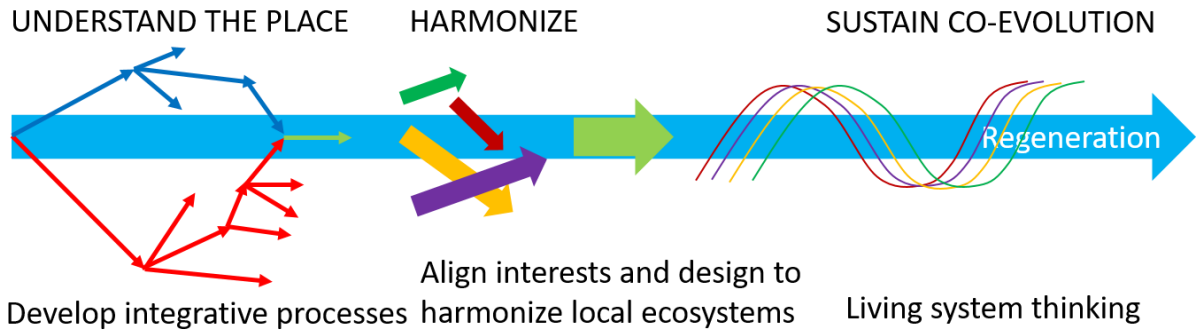


Figure 4. Stages towards creation of regenerative systems

Regenerative design and development considers that construction of a system needs to serve the well-being of people, the planet and all living things. This implies a co-creative partnership with nature based on strategies of adaptation, resilience and regeneration. For human habitation, people build various systems, from buildings to streets and utility infrastructure. Human habitats are linked via various network systems to support communication, connectivity and transfer of resources and goods. In regenerative design every system of the human habitat has to be designed such as to keep the harmony in the wider ecosystem. This means, the list of input requirements in system design should include at least elements related to resilience, restoration, sustainability, and wellness. However, a regenerative system must have intrinsic capabilities for self-reconstruction and self-production. If natural systems incorporate such capabilities, discussion is how artificial systems can do this. It is clear that, without a harmonious integration within the natural ecosystem, an artificial system cannot possess such capabilities by itself. For example, considering the construction of a school in the paradigm of regenerative design, developers must take into account several key aspects.

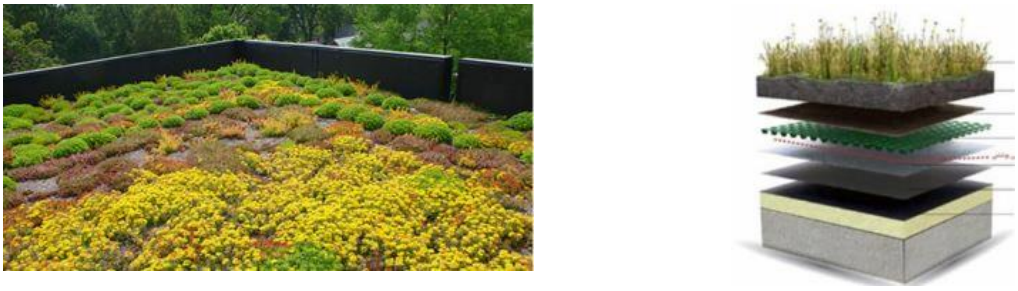


Figure 5. Natural insulation of a roof in regenerative design

First of all, the upper layer of the dislocated earth has to be stored and preserved (see Figure 2) for later use on the roof, as natural insulation (see Figure 5). If there are some trees on the site, they have to be replanted in the proximity (see Figure 6). Another preoccupation is to design a passive building of the school such as its impact on local environment to be minimal and to ensure a symbiosis with the natural environment. An example is shown in Figure 6. These actions are part of the so-called "holistic design" or "system thinking design", sometimes known as "whole living system design".

Figure 6. Passive building of a school in regenerative design

From the perspective of "holistic design" we have to see the effect of the new construction of the surrounding places, as well as of the whole habitat. This means, we do not have to see the network of streets and sites around the school as static elements. We have to see everything as dynamic processes; that is, the flows of people and cars that come and go from the school, what they behave and how this will impact the natural environment. Maybe the wrong placement of the school can create traffic jams in the morning, meaning negative externalities in the ecosystem, more pollution, etc. To balance this effect, in regenerative design we have to plant additional trees in the area and along the flow of cars. Moreover, around the school sufficient access and exit lines have to be considered to avoid blockages of cars. In regenerative design we have to see the people interacting with the school as part of the nested, dynamic and complex natural ecosystem. This means co-evolution; and we have to understand the interdependence human-nature. In regenerative design, humans must evolve with nature in a mutually beneficial and partnered way. Co-evolution covers social, economic and ecological aspects. From the perspective of co-evolution, a practical approach in the case of school regenerative design, is the inclusion in the site of permaculture gardens where young students run practical activities and interact with nature. An example is shown in Figure 7.

Figure 7. Permaculture gardens in the site of regenerative school

Regenerative development also sees a built environment as a catalyst for positive change. It aims to heal and improve the health and vitality of both human communities and other living organisms and systems through this type of development. In the example with the school, this characteristic is achieved both by the passive construction and permaculture gardens. In addition, young students can be involved in practical activities to build wild habitats for insects, birds and

small animals (e.g. squirrels) in the trees of the school and in some artificial constructions (see Figure 8).

Figure 8. Building wild habitats in the site of a regenerative school

Regenerative design is also an opportunity of hope and positive direction in time of crises. People should see a crisis as an opportunity for innovation and renewal. In the case of school project, regenerative design could bring into equation the problem of global climate change. In this context, many activities can be included in the school's curricula on circular economy and in site application of this concept. This would include selective waste management, as well as entrepreneurial projects for the young students on circular economy (see Figure 9).

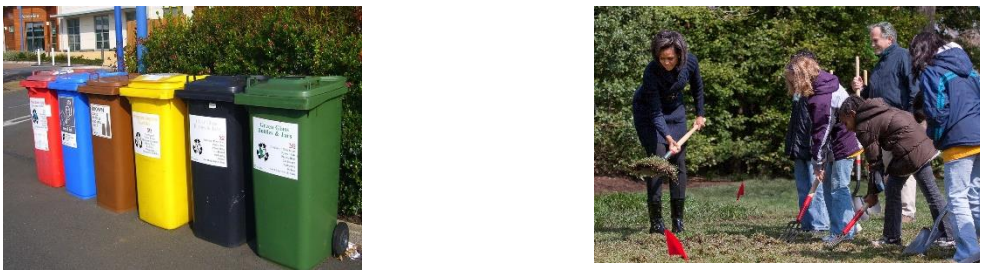


Figure 9. Circular economy initiatives in a regenerative school

Another characteristic of regenerative design is to consider the specificity of place in design. This imposes to integrate the artificial system in the natural place in a smart way. Beautiful examples are illustrated in Figures 10, 11 and 12.

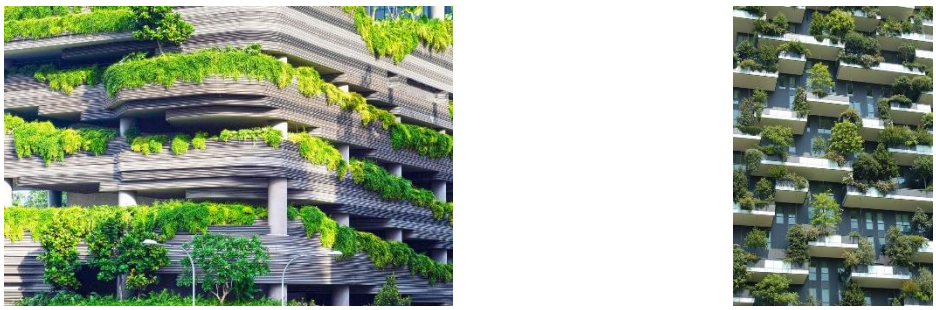


Figure 10. Place as a core and unique entity in regenerative design

Picture 1

Picture 2

Picture 3

Figure 11. Regenerative design of residential places

Figure 12. Regenerative design of factories

Figure 11 introduces examples of designing residential units in harmony with the place. Design includes the unique story of the place and to optimize the presence of people and to engage them to preserve nature. Another characteristic of regenerative design is to explore new patterns and boundaries, to scale and to nest systems. Illustrative examples in case of schools are shown in Figure 13.

Figure 13. New patterns in school building design

A last characteristic of regenerative design is about consideration of long-term perspective. From this perspective, regenerative design is an ongoing process of learning and getting feedback. Uncertainty of time needed for regeneration emergence is one of the challenge. Therefore, regenerative designs necessitates evolutionary resources in order to adapt to new paths and circumstances. Reconfigurable concepts fit very well with this requirement. Reconfigurable systems are systems that incorporates flexibility, modularity, convertibility, integrability, scalability and interoperability. Examples of green modular and easy scalable schools are shown in Figure

14. The concept of portable classrooms can be also taken into account (see the left-bottom corner in Figure 14).

Figure 14. Green modular and scalable classrooms

Regenerative design and development does not end with the delivery of project and approvals and construction. If the culture of co-evolution is embedded in people values, regenerative capacity of a project may sustain through time by integration of people who inhabit and manage it.

3.3. CREATING REGENERATIVE DEVELOPMENT

To design and develop regenerative systems it is important to see the whole picture and how the system as a whole works and keeps the balance. From this perspective, any sectorial problem has to be approached by analysing its interactions with other parts of the overall system, and not in isolation. This requires a structured roadmap. A possible way to do this is the following:

- Identify all subsystems of the system and their links and flows
- Understand how the whole system works or master the pattern of the place beyond site boundaries (place - the network of ecosystems within a geographic region that results from the complex interactions through time of the natural ecology and culture)
- Deploy system patterns into design specifications
- Understand and base design in the local context, considering both ecological and socio-cultural issues
- Understand and align human aspirations to the project keeping in mind that diversity is crucial for sustainability (both ecological, cultural and social)
- Define the sense of the place
- Leverage and understand relationships between subsystems
- Use multi-disciplinary knowledge and design teams to solve problems
- Design for complexity and introduce feedback to support evolution over long time periods
- Use integrated and participatory design and construction processes
- Conserve, restore and regenerate ecosystems; ensure capacity of functioning without the need of human management

According to Brad S., in order to manage regenerative design, it is necessary to develop a comprehensive capability to:

- Handle an increased number of critical issues in a unit of time
- Take appropriate decisions in a very short time
- Select a reliable solution from many possible variants
- Generate, in due time, feasible solutions to every unexpected, critical event
- Assess large amount of information to guarantee for the decision taken
- Forecast and understand the possible side effects of actions
- Develop and implement contingency plans if unpredictable events occur, as a result of various former actions taken
- Handle in a robust way incomplete and fake information
- Search continuously to discover "hidden" resources within the ecosystem
- Find ways to increase the productivity of limited resources and to increase the use of unlimited resources (e.g. creativity), rather than increasing the productivity of work.

In regenerative design it is important to acknowledge that we deal with complex systems. From this perspective, the following behaviours have to be taken into account:

- Under certain circumstances, small inputs can lead to significantly large effects
- Very small variations of the input parameters are able to produce very different outputs
- Global effects are a consequence of the aggregated behaviour of individual entities of the system
- Changes in the external environment may cause the change of the system's structure altogether.

3.4. BASIC DESIGN RULES OF REGENERATIVE SYSTEMS

Because regenerative design deals with complex ecosystems, adequate rules have to be applied. Brad S. proposes 16 design rules in this respect, which are further introduced:

Rule 1: A system has to be seen as a group of many "agents" (parts, modules, subsystems, interfaces) that interact continuously and mutually affect each other. Thus, a regenerative system should be organized into adaptive structures that continuously learn from their own experience and from the exchange of knowledge with other agents.

Rule 2: A regenerative system must be developed considering several small-scale and interrelated "experiments" (increments, prototypes). These "experiments" should be adaptable to wide ranges of possibilities. Finally, it should be found out which one or which ones are the most robust. This recommendation comes up from the principle of complexity which stipulates that "small changes can lead to large and unexpected effects". This is also asked by the fact that real world requires more than one formal model to define it (in other words, there is no universal model of the complex world, but many projections of reality). For complex systems, modelling is rather an art

than a science because real world cannot be "computed". Complexity is the property of a real world system that manifests in the incapacity of any formalism to comprise all its properties; there are actually distinctly various ways of interacting with the system.

Rule 3: The way in which requirements related to a certain regenerative system will evolve over the system life-cycle is very unpredictable. In this respect, it is more suitable to create conditions (via radical innovation) for constructing a certain predictable state of the future and to design intrinsic properties within the regenerative system such that changes to be done easily. In other words, the best design way is to define evolving system solutions, rather than rigid ones (that are based on very detailed planning). Detailed planning does not work in a fast-changing world; so that, a regenerative system must evolve naturally. Vision and goals are absolutely necessary, but very detailed plans worth to be done only for short term. Long term system definition can be mastered through various ways, such as: radical innovation, intrinsic flexibility, adaptive processes (see, for example, reconfigurable processes), etc.

Rule 4: Because adaptability of the regenerative system to external conditions over its life-cycle is required, greater diversity of "interacting agents" within the system increases the chances to reach emergent patterns when necessary. So, heterogeneous (non-uniform) parts in the system are necessary both for enhancing and prolonging system's sustainability.

Rule 5: Complex regenerative systems are both "distinct" and "connected". To fix this conflicting problem, innovative approaches are required. The following recommendations are considered here for designing regenerative systems: (a) apply the principle of "universality", which asks to include parts capable to perform multiple functions; (b) apply the principle "new physical states of the system", which asks to replace "solid" parts with other types of systems ("softer") or elements (e.g. "fields").

Rule 6: Because in a complex world, "under certain circumstances, small inputs can lead to significantly large effects", regenerative systems must be designed not only to adapt to their external environments, but to contribute to the creation of external environments.

Rule 7: The design process should see the conflicts within the regenerative system as driving forces of innovation. The design framework must identify conflicts and afterwards integrate them for bordering the design process. In a complex world, success mainly comes from contradictions and consistencies.

Rule 8: When designing a regenerative system, better results could be obtained when the solution is built from a self-reinforcing cycle, rather than from a very explicit "vision" of the system.

Rule 9: Synergic solutions come up from novel ideas and they are not easily understandable from lower level perspective. Because of this, design approaches should encourage early trial-and-error experiments for learning (the concept of "useful errors").

Rule 10: Seeing a regenerative system as a hyper-system that integrate several complex systems, the design process should take into account that every decision affects multiple events (or in other words, every event has multiple causes). Also, effects in regenerative systems are connected back to causes (there is no isolated cause-effect chain), so the design process should consider a holistic view on the system. More than this, regenerative systems comprise a mix of attractors; that is, there

are multiple reliable solutions to any problem. Thus, we cannot talk about the best solution in absolute terms, only in contextual ones.

Rule 11: The design process should take into account the fact that regenerative systems are far-from-equilibrium. They need energy to persist. This energy comes from the hyper-system and should be renewable, otherwise the system will die. So, design of regenerative systems should follow the concept of "design for excellence" (i.e. design with respect to multiple target functions that cover various aspects of system's life-cycle).

Rule 12: Excessive individualisation of regenerative systems is a poor aim. The most effective solutions, able at least to adapt, if not self-organize to various perturbations over their life-cycle, are those designed in a modular way. System's modules have to be relatively small; not too small to fail because of lack of diversity, not too large and too connected to fail because of lack of flexibility.

Rule 13: Any innovation within a regenerative system creates a circular causality. Because of interactions with the external environment, the dynamics of values within regenerative systems could both escalates in win-win or win-lose scenarios. Synergy requires positive escalations, so the design process should consider a close monitoring of system evolution and dynamics. Regenerative systems are not stable, even if we like to be so. Also, due to the external nature of feedback loops, regenerative systems can generate attractors at remote points in time, with significant effects. From this perspective, the design process of regenerative systems should be aware about the long-term effects of any contemporary decision.

Rule 14: The challenge during the design process of regenerative systems is to find the overall "natural" balance between stability and adaptability (this is actually the optimisation goal). However, regenerative systems are constantly evolving; stable become unstable over time, so changes should be expected from the very beginning and adequate plans to accommodate the unforeseen have to be constructed.

Rule 15: Regenerative systems are emergent systems; that is, properties of the whole do not relate to the "mathematics" of the separate components. In this respect, qualitative rather than quantitative methods have to be used during analysis and synthesis processes of regenerative systems. Quantitative methods should be used only where the qualitative methods require this and not vice versa. Because connectivity characterises regenerative systems, reductionism leads to very different conclusions than for the synergic overall system. Also, because of upward and downward causation, even abstract ideas that are used within the design process affect the real system and vice versa.

Rule 16: The multitude of possible combinations between the regenerative system and the complex external environment makes impossible an exhaustive testing before launching the system. This means that extra-design resources should be planned such as to react in a timely manner to any possible claim.

3.5. SUPPORTING TOOLS FOR REGENERATIVE DESIGN

In order to guide developers in regenerative design projects, several tools have been proposed. The most known ones are: REGEN, LENSES, Eco-Balance, Perkins & Will Framework, and Living Building Challenge. The LENSES framework is shown in Figure 15.

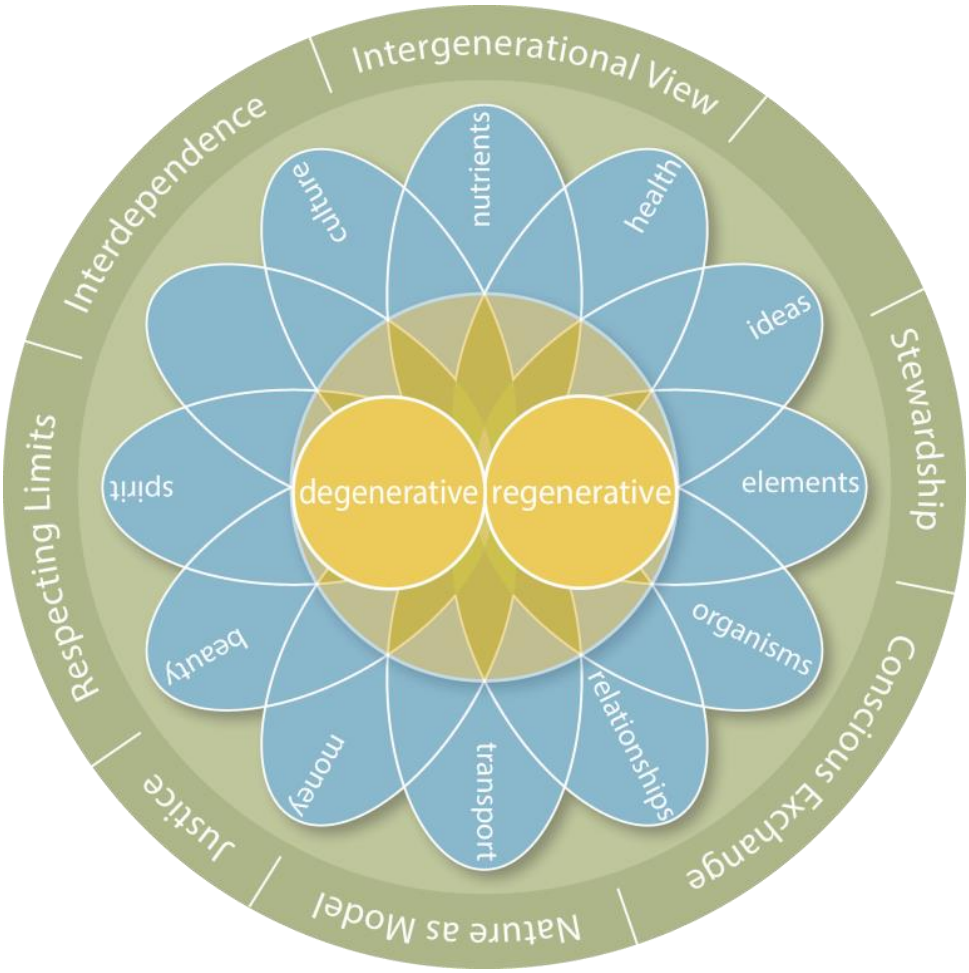


Figure 15. LENSES framework (source: Clear, 2014)

An adaptation of the LENSES framework is further presented. Adaptation is not from the perspective of content, but rather from the perspective of practical usability. LENSES framework was proposed in 2014 and considers three layers or three lenses through which we have to analyse a design. The first layer is the "Foundation Lens". The Foundation Lens includes eight guiding principles: Stewardship, Respecting Limits, Interdependence, Justice, Intergenerational View, Partnership, Health, and Spirit. These principles interact with natural, social and economic systems. Designers must follow all boxes presented in Table 1 and propose positive correlated solutions that fit to the regeneration concept.

Table 1. Foundation lens and regenerative design

Project								
Place								
	Stewardship	Respecting limits	Interdependence	Justice	Intergenerational view	Partnership	Health	Spirit
Natural system	Solution 1.1	Solution 1.2	Solution 1.3	Solution 1.4	Solution 1.5	Solution 1.6	Solution 1.7	Solution 1.8
Social system	Solution 2.1	Solution 2.2	Solution 2.3	Solution 2.4	Solution 2.5	Solution 2.6	Solution 2.7	Solution 2.8
Economic system	Solution 3.1	Solution 3.2	Solution 3.3	Solution 3.4	Solution 3.5	Solution 3.6	Solution 3.7	Solution 3.8

The second layer is the "Flow Lens". This layer includes eleven categories and an open space that can flow into and through a project and define the project context. These categories are Culture, Materials, Wellbeing, Education, Energy, Ecosystems, Land use, Transport, Money, Beauty, and Water. By means of the Flow Lens project context is developed and relationships are discovered. This requires to assess the past and current condition of flows and discover intersections and relationships between the flows. It is also acknowledged that living environment must be allowed having healthy cycles of renewal and regeneration for the flows moving in and through it. Table 2 illustrates a practical tool to analyse the project through the flow lens.

The last layer is the "Vitality Lens". Vitality Lens supports teams to understand the characteristics and qualities comprised in each flow from a regenerative state perspective. It uses a scale of impact from "degenerative" (-3), "degenerative-sustain" (-1), "sustain" (0), "sustain-regenerative" (+1), to "regenerative" (+3).

Table 2. Flow lens and regenerative design

	Culture	Materials	Wellbeing	Education	Energy	Ecosystems	Land use	Transportation	Money	Beauty	Water
Culture		Flow	Flow	Flow	Flow	Flow	Flow	Flow	Flow	Flow	Flow
Materials	Solution		Flow	Flow	Flow	Flow	Flow	Flow	Flow	Flow	Flow
Wellbeing	Solution	Solution		Flow	Flow	Flow	Flow	Flow	Flow	Flow	Flow
Education	Solution	Solution	Solution		Flow	Flow	Flow	Flow	Flow	Flow	Flow
Energy	Solution	Solution	Solution	Solution		Flow	Flow	Flow	Flow	Flow	Flow
Ecosystems	Solution	Solution	Solution	Solution	Solution		Flow	Flow	Flow	Flow	Flow
Land use	Solution	Solution	Solution	Solution	Solution	Solution		Flow	Flow	Flow	Flow
Transportation	Solution	Solution	Solution	Solution	Solution	Solution	Solution		Flow	Flow	Flow
Money	Solution	Solution	Solution	Solution	Solution	Solution	Solution	Solution		Flow	Flow
Beauty	Solution	Solution	Solution	Solution	Solution	Solution	Solution	Solution	Solution		Flow
Water	Solution	Solution	Solution	Solution	Solution	Solution	Solution	Solution	Solution	Solution	

Table 3. Vitality lens and regenerative design

	Rubric: Energy															***
	Focal point: Production					Focal point: Transmission					Focal point: Storage					****
	-3	-1	0	+1	+3	-3	-1	0	+1	+3	-3	-1	0	+1	+3	
Culture																
Materials																
Wellbeing																
Education																
Energy																
Ecosystems																
Land use																
Transportation																
Money																
Beauty																
Water																

The Vitality Lens works in conjunction with the other lenses. While the Flows Lens works for understanding historic and current flows, the Vitality Lens guides teams in envisioning future or potential flows. The lenses of the tool overlap to display the interactions between the foundational attributes and the flows. The Vitality Lens helps teams to set regenerative goals and measure the impacts. It is associated with Rubrics to provide qualitative metrics.

4. QUESTIONS & ANSWERS

4.1. QUIZ – QUESTIONS

1. Regenerative design is :
   - the biomimicry of ecological systems to artificial systems that work as a closed viable eco-economic system for all industries.
   - about finding solutions in order to metamorphose organic (biotic) and synthetic (abiotic) materials into new viable materials,
   - intends to create ecosystems that are absolutely waste free.

2. Is it possible to jump from conventional ecosystems to regenerative ecosystems?
   - YES, on long term
   - NO
   - I do not know

3. Stages towards creation of regenerative systems are:
   - Understand the place, harmonize;
   - Understand the place, sustain co-evolution
   - Understand the place, harmonize, sustain co-evolution;

4. When designing a regenerative system, better results could be obtained
   - When the solution is built from a self-reinforcing cycle,
   - When solution is built from a very explicit "vision" of the system
   - Both are true

5. The challenge during the design process of regenerative systems is to find
   - The overall "natural" balance between stability and adaptability
   - The overall "natural" balance between stability and natural capital
   - The overall "natural" balance between stability and people

4.2. QUIZ – SOLUTIONS

1. Regenerative design is :

√ the biomimicry of ecological systems to artificial systems that work as a closed viable eco-economic system for all industries.

√ about finding solutions in order to metamorphose organic (biotic) and synthetic (abiotic) materials into new viable materials,

√ intends to create ecosystems that are absolutely waste free.

2. Is it possible to jump from conventional ecosystems to regenerative ecosystems?

YES, on long term

√ NO

I do not know

3. Stages towards creation of regenerative systems are:

Understand the place, harmonize;

Understand the place, sustain co-evolution

√ Understand the place, harmonize, sustain co-evolution;

4. When designing a regenerative system, better results could be obtained

√ When the solution is built from a self-reinforcing cycle,

When solution is built from a very explicit "vision" of the system

Both are true

5. The challenge during the design process of regenerative systems is to find

The overall "natural" balance between stability and natural capital

√ The overall "natural" balance between stability and adaptability

The overall "natural" balance between stability and people

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." [1] **Biodegradable material**: "A material which microorganisms can break down into natural elements (i.e. water, biomass, etc.)."[2]
- **Biological metabolism** - The natural processes of ecosystems are a biological metabolism, making safe and healthy use of materials in cycles of abundance[3]
- **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[4]
- **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."[5] **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"[6]
- **Decision** – "shall be binding in its entirety. A decision which specifies those to whom it is addressed shall be binding only on them"[7]

[1] 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)
[2] https://www.ceguide.org/Glossary (26.03.2018)
[3] Cradle to Cradle terminology – MBDC-http://www.c2cproducts.com/detail.aspx?linkid=1&sublink=26
[4] Cradle to Cradle terminology – MBDC-http://www.c2cproducts.com/detail.aspx?linkid=1&sublink=26
[5] https://www.ceguide.org/Glossary (26.03.2018)
[6] Cradle to Cradle terminology – MBDC-http://www.c2cproducts.com/detail.aspx?linkid=1&sublink=26
[7] European Network of Environmental law Organizations 2012 Implementation of the Waste Framework Directive in the EU Member States

- **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"[8]
- **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)[9] 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".[10]
- **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."[11]
- **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"[12]
- **Ecosystem** - the interactive system of living things and their non-living habitat[13]
- **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[14]
- **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")."[15]

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[8] European Network of Environmental law Organisations 2012 Implementation of the Waste Framework Directive in the EU Member States

[9] Merriam Webster dictionary

[10] https://sustainabilitydictionary.com/2005/12/03/eco-effectiveness/visited 26/02/2018

[11] http://www.businessdictionary.com/definition/eco-efficiency.html -visited 01.03.2018

[12] Orr D (1992) Ecological literacy: education and the transition to a post-modern world. State University of New York Press, Albany.

[13] Tansley AG (1935) The use and abuse of vegetational concepts and terms. Ecology 16:284–307 doi:10.2307/1930070

[14] with adaptations from https://www.researchgate.net/publication/301966198_Regenerative_Development_regenerative_development_and_Design (26.06.2018)

[15] https://hub.globalccsinstitute.com/publications/energy-efficiency-recipe-success/definition-and-scope-energy-efficiency (26.03.2018)

- **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 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.[16]
- **Innovation** - production or adoption, assimilation, and exploitation of a value-added novelty in economic and social areas[17]
- **Landfilling**: "The disposal and burying of solid waste. The degradation of the waste results in the creation of local air and water pollution."[18]
- **Lean production** - approach to management that focuses on cutting out waste, whilst ensuring quality[19]
- **Life-cycle** - series of stages in form and functional activity through which a system passes between successive recurrences of a specified primary stage[20]
- **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[21]
- **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[22]
- **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[23]
- **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[24]
- **Permaculture** - a system of agricultural and social design principles centered around simulating or directly utilizing the patterns and features observed in natural ecosystems[25]
- **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

[16] http://www.businessdictionary.com/definition/incineration.html (27.06.2018)
[17] with adaptations from http://www.ericshaver.com/the-many-definitions-of-innovation/ (27.06.2018)
[18] https://www.ceguide.org/Glossary (26.03.2018)
[19] with adaptations from https://www.tutor2u.net/business/reference/introduction-to-lean-production (27.06.2018)
[20] https://www.merriam-webster.com/dictionary/life%20cycle (26.06.2018)
[21] With adaptations from https://en.wikipedia.org/wiki/Lifetime (26.06.2018)
[22] https://www.researchgate.net/publication/273379786_Regenerative_Development_and_Design (25.06.2018)
[23] with adaptations from https://www.economicshelp.org/micro-economic-essays/marketfailure/negative-externality/ (26.06.2018)
[24] http://www.businessdictionary.com/definition/optimization.html (26.06.2018)
[25] https://en.wikipedia.org/wiki/Permaculture (27.06.2018)

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.)[26]

- **Recommendations and opinions** - shall have no binding force [27]
- **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."[28]
- **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[29]
- **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[30]
- **Regulation** - shall have general application. It shall be binding in its entirety and directly applicable in all Member States. – Source - Article 288 TFEU, [31]
- **Remanufacturing:** "The process of cleaning and repairing used products and parts to be used again for replacements."[32]
- **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[33]
- **Resource efficiency**: "A percentage of the total resources consumed that make up the final product or service."[34] 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."[35]
- **Servitization** - refers to industries using their products to sell "outcome as a service" rather than a one-off sale[36]

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[26] https://www.researchgate.net/publication/273379786_Regenerative_Development_and_Design (25.06.2018)
[27] http://eur-lex.europa.eu/summary/chapter/environment.html?root_default=SUM_1_CODED%3D20,SUM_2_CODED%3D2003&locale=en
[28] https://www.collinsdictionary.com/de/worterbuch/englisch/refurbishment (26.03.2018)
[29] Mang, Pamela & Reed, Bill. (2017). Update Regenerative Development and Design 2nd edition.
[30] https://www.sciencedirect.com/science/article/pii/S2212609015300327 (26.06.2018)
[31] http://eur-lex.europa.eu/legal-content/en/TXT/HTML/?uri=CELEX:12016E288
[32] https://sustainabilitydictionary.com/2005/12/03/remanufacturing/ (26.03.2018)
[33] https://www.researchgate.net/publication/273379786_Regenerative_Development_and_Design (24.06.2018)
[34] https://sustainabilitydictionary.com/2005/12/03/remanufacturing/ (26.03.2018)
[35] https://sustainabilitydictionary.com/2005/12/03/remanufacturing/ (26.03.2018)
[36] https://www.k3syspro.com/servitization/ (24.06.2018)

- **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[37]
- **Stewardship** - ethic of companies, organizations and individuals that embodies the responsible planning and management of resources[38]
- **Sourcing:** "the act of getting something, especially products or materials, from a particular place"[39]
- **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[40]
- **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"[41]
- **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 "[42]
- **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)"[43]
- **Upcycling**: see MOVECO fact sheet "Circular Economy: Terms & Definitions"
- **Waste**: see MOVECO fact sheet "Circular Economy: Terms & Definitions"

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

[37] https://www.researchgate.net/publication/273379786_Regenerative_Development_and_Design (25.06.2018)
[38] https://en.wikipedia.org/wiki/Stewardship (24.06.2018)
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[40] https://searchcio.techtarget.com/definition/systems-thinking (27.06.2018)
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7. IMPRINT

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Lead partner of the project

Chamber of Commerce and Industry of Slovenia
Dimičeva 13
SI-1504 Ljubljana
Slovenia
www.gzs.si

Lead partner of this deliverable

Chamber of Commerce and Industry Bistrita-Nasaud
Str. Petre Ispirescu nr. 15A
RO - 4400 Bistrita
http://www.cciabn.ro

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