REPAiR

REsource Management in Peri-urban AReas: Going Beyond Urban Metabolism

D5.3 Eco-Innovative Solutions Naples

Version 1.29

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1.18	20 November 2018	Gustavo Arciniegas Cecilia Furlan Viktor Varjù	GEO-COL TUD RKI	General comments on version 1.17 General comments General comments and Section 3.4
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1.21	28 November 2018	Gustavo Arciniegas	GEO-COL	Update introduction
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1.27	10 December 2018	Enrico Formato	UNINA	Conclusions
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1.32	08 February 2020	Valentina Vittiglio	UNINA	Graphical improvements

Acronyms and Abbreviations used in this Deliverable

CM	Consortium Meeting
CDW	Construction and Demolition Waste
EC	European Commission
EIS	Eco-Innovative Solution
EU	European Union
GA	Grant Agreement
GDSE	Geodesign Decision Support Environment
ISPRA	Italian Environmental Protection and Research Institute
ISTAT	National Institute of Statistic
KT	Knowledge Transfer
MAN	Metropolitan Area of Naples
MSW	Municipal Solid Waste
OW	Organic Waste
PULL	Peri-Urban Living Lab
PRGRU	Piano Regionale Gestione Rifiuti Urbani
SW	Special Waste
UW	Urban Waste
WEEE	Waste Electrical and Electronic Equipment
WP	Work Package
WMP	Waste Management Plan

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Publishable Summary

The Deliverable D5.3 “Catalogue of solutions and strategies for Naples” presents a catalogue of Eco-Innovative Solutions (EIS) which aim to transform material and territorial waste into resources. More specifically, EIS aim to prevent the generation of waste, within the contexts of the Metropolitan Area of Naples (MAN), one of the two pilot cases of REPAiR.

Each of the EIS has been developed based on the research explored within Naples pilot Peri-Urban Living Lab (PULL), following the five-step methodology, which includes the phases: Co-Exploring, Co-Design, Co-Production, Co-Decision, Co-Governance. This methodology is further explained in the Deliverable 5.4 “Handbook: how to run a PULL”.

This report is divided into three main parts. The first part addresses the definition of EIS and its position in the innovation sector across the several disciplines involved in the REPAiR Project. The second part outlines the method used to develop the EIS within the Naples case. The third part presents a catalogue divided into: EIS developed during the Naples PULL; EIS from literature or practice; EIS from student courses or university activities.

Introduction[1]

The Deliverable D5.3 "Catalogue of solutions and strategies for Naples" presents a catalogue of Eco-Innovative Solutions (EIS) which aim to transform material and territorial waste into resources. More specifically, EIS aim to prevent the generation of waste, within the contexts of the Metropolitan Area of Naples (MAN), one of the two pilot cases of REPAiR.

Each of the EIS has been developed based on the research explored within Naples pilot Peri-Urban Living Lab (PULL), following the five-step methodology, which includes the phases: Co-Exploring, Co-Design, Co-Production, Co-Decision, Co-Governance. This methodology is further explained in the Deliverable 5.4 "Handbook: how to run a PULL".

The phases pay specific attention to site-specificity, general context, data, models, and availability of stakeholder inputs.

For an effective identification of challenges and objectives towards the definition of preferred, feasible and transferable Eco-Innovative Solutions, the methodology further explained in the following chapters for defining/refining the EIS was developed by the WP5 team in deep collaboration and interaction with WP6 and WP7. Furthermore, the role of the work developed within WP3 was crucial as well, for constructing the basic knowledge for discussion within the MAN PULL.
For the particular case of key resource flows, an analysis conducted by WP3 indicated the system of areas in which the experimentations of EIS could be more easily applied and where the general process of regeneration could be tested and implemented at first (e.g. publicly owned spaces). To do so, WP3 developed the concept of enabling contexts, which defines specific locations within pilot-case focus areas that are more suitable for developing the Eco-Innovative Solutions and Strategies, identifying four different groups of enabling conditions: social/behavioral, cognitive/epistemic, informational, business/managerial. The identification of the four major groups of enabling conditions, which can be singly or freely combined into different PULL processes and that guide social contextual interactions, providing a fertile ground for knowledge creation and innovation. At the same time, the identification of the specific enabling conditions supports the PULL activation and is useful to define the favorable conditions for the EIS to be implemented and able to achieve significant results in a short time, helping to build operational decision-making processes with positive feedbacks able to build trust among the participants and generate new economic and non-economic values by collaborative and cooperative processes.

[1] The Introduction, the Chapters 1, 2 and 3 present parts in common with the Deliverable D5.2 "Catalogue of solutions and strategies for Amsterdam" since they describe the general approach for defining the Eco-Innovative Solutions within the PULLs. This shows common characteristics between the two cases.

In collaboration with WP3, the **focus area** was identified. The focus area was identified within the Metropolitan City of Naples, and it consists of eleven municipalities: Napoli, Casoria, Afragola, Acerra, Casalnuovo, Caivano, Cardito, Crispano, Frattaminore, Volla, Cercola. Within WP3, with reference to the focus area, **wastescapes** have been identified and mapped, too (see more details in Deliverable 3.3).

Moreover, at a smaller scale, **sample areas** have been identified within the Focus Area as it facilitates a better interaction with citizens and local stakeholders (see more details in Deliverable 3.3 p. 23).
Finally, the specific target locations for developing Eco-Innovative Solutions were defined as **enabling contexts**. The enabling contexts are selected among the areas for which it is more urgent to develop Eco-Innovative Solutions, where it is easier to start the process of definition and implementation of EIS (e.g. they are publicly owned areas) because the different conditions of enabling exist (See more details in the Deliverable 3.3 p. 26).

The enabling contexts, were produced combining several layers of spatial, socio-economic and material flow information in an iterative and discursive process by the consortium members. Therefore, these contexts are sensitive to different actors and interests in the territory and their meaning depends greatly on the precision with which data was processed, maps were generated, and perspectives of stakeholders and experts were collected and employed.

As such, 'enabling contexts' were determined as follows:

> The Naples case considered the pressure of flows on wastescapes in a specific part of the focus area (a sample), pointing out the necessity to focus on critical conditions that affected those territories, leading to the development of place-based territorial strategies, in which eco-innovative actions can be distinguished.

This report is divided into three main parts. The first part addresses the definition of EIS and its position in the innovation sector across the several disciplines involved in the REPAiR Project. The second part outlines the method used to develop the EIS within the Naples case. The third part presents a catalogue divided into: EIS developed during the Naples PULL; EIS selected from literature or practice; EIS elaborated from student courses or university activities.

1. REPAiR definition of Eco-Innovative Strategies and Solutions

The awareness to move towards circularity has raised the necessity to change and renew existing technological production and socio-political, environmental and economic behavioural patterns. At best, such awareness may produce different types of responses, the so-called solutions and strategies, to make the shift towards circularity. This consciousness for change has led to increasing application of the

term 'eco-innovation' in environmental, technological, economic management, urban planning and policy making. Many kinds of innovation can be defined as eco-innovations. This raises the importance of a common understanding across the different disciplines and roles involved in REPAiR on what eco-innovation and eco-innovative solutions exactly mean.

In literature, several attempts have been made to define eco-innovation, however a common understanding is still missing (Kiefer et al. 2017; Carillo-Hermosilla & Könnölä 2010). As stated in the REPAiR Deliverable 5.4 (REPAiR 2018a), the definition included in the Eco-Innovation Action Plan of 2011 is shared between the different partners of REPAiR.

> *"Eco-innovation refers to all forms of innovation – technological and non-technological – that create business opportunities and benefit the environment by preventing or reducing their impact, or by optimising the use of resources. Eco-innovation is closely linked to the way we use our natural resources, to how we produce and consume and also to the concepts of eco-efficiency and eco-industries. It encourages a shift among manufacturing firms from "end-of-pipe" solutions to "closed-loop" approaches that minimise material and energy flows by changing products and production methods – bringing a competitive advantage across many businesses and sectors"* [EC 2011].

Moreover, the Horizon 2020 REPAiR call "WASTE-6a-2015" stated that eco-innovative solutions are:

> "*demonstration, at an appropriate pilot scale, and market replication, of integrated eco-innovative cost and energy-efficient TECHNOLOGIES, PROCESSES and/or SERVICES for waste prevention, treatment, enhanced collection, recycling and recovery of high- grade valuable materials from waste.*"

The REPAiR team, with the support of the user board members, aims at developing **Eco-Innovative Solutions** (EIS) and integrate them into systemic and territorial Eco-Innovative Strategies. Indeed, Eco-Innovative Strategies and Solutions can be defined as follows:

> **Eco-Innovative Strategy** is an alternative course of action aimed at addressing both the objectives and challenges identified within a PULL and develop a more Circular Economy in peri-urban areas (REPAiR 2018a, p.10).

The Strategy can be composed of a systemic integration of two or more actions, namely EIS. According to the REPAiR Grant Agreement 688920, the "Eco-innovative solutions developed will improve the capacity of urban environments to deal with future resource management challenges, while triggering positive transformations in spatial qualities, sustainability and urban metabolism. These shifts will together enhance quality of life" (EC 2016, p.157).
EIS will encompass decisions on the following aspects:

- The development and implementation of new materials, technologies or processes in connection with the development of sustainable economic

activities, or adding new activities in value chains with the modification of the status of the current waste management systems, and the resource flows, also capable of modifying the spatial configuration of peri-urban areas (also from an environmental perspective);

- The modification of existing policies and governance, or new policy/governance developments;
- The definition of spatial and environmental design proposals.

These solutions will potentially lead to the modification of existing flows of materials, development of new flows and processes and/or change the spatial design of areas, and will generate change in the behaviour of stakeholders and inhabitants in the case study areas.
REPAiR's attempt to conceptualise solutions towards eco-innovation arises through a systemic process that refers to the interconnectedness and dynamic interaction between different actors, waste flows, policy and governance factors influencing the innovation process in the built environment. These premises invite us to explore-design the wide array of eco-innovations and to examine the occurred changes in several dimensions of eco-innovations. In other words, EIS are creative and smart ideas aimed to innovate and improve a specific and fixed process in relation of the management of waste as a resource and wastescapes (Figure 2).

More specifically, EIS:

- **Are elementary** responses to **case-specific** problems, in a contextual approach towards innovation, where the real innovation is the process to achieve the result**.** EIS derives from situated case-specific problems, but their final configuration is such that they can be used all over the cases. Their transferability is obtained by abstracting how they function, trimming their structure from site-specific features. For example, in the MAN one example can be the EIS referred to the hemp plantations that can be used for the remediation of polluted soils. More generally, hemp has to be intended as a "traditional cultivation" to be defined, case by case.
- **Depend on local/regional/national policies/resources** (managerial, economic/financial, administrative capacity, etc.);
- **Are the result of a co-creation process implemented in the PULL environments**, which means that their content depends on the needs of the multiple stakeholders involved in the PULLs;
- **Cross the multiple scales, the different dimensions and characteristics and densities** of the peri-urban territories investigated;
- **Assure the reciprocities between the natural and the built environment** (EC 2016, p.153). EIS are not just changes in current technologies, but also **process innovations** (Dente and Coletti, 2011) "contributing to the

EU's ambition of a paradigm shift towards Circular Economy and a near-zero waste society" (EC 2016, p.153);

- **And are based on the key environmental principle "Reduce-Reuse-Recycle-Recover".**

Furthermore, through EIS, a new level of creativity is reached. Such creativity is needed to face the crisis of waste management and resource scarcity in a context of transition to circular economy as well as the problems related to regeneration processes of wastescapes.

To facilitate entry and testing of the EIS in the GDSE, EIS are classified according to the PESTEL framework following the dimensions that they can take, as:

- Political/organisational (P),
- Economic (E),
- Social (S),
- Technical (T),
- Environmental (E),
- and Legal (L).

Developing and refining the EIS for both the case of Naples was made possible through the inputs from:

- PULLs (Fig.1.1) (including PULL workshops with stakeholders' inputs, Consortium Meetings, desktop research, UNINA Team internal meetings, etc.);
- Student's work;
- and literature review.

Fig.1.1 MAN PULL workshop
Source: UNINA Team, 2018

Strategies and solutions towards eco-innovation are normally used in the context of complex problems. According to Van de Ven et al. (2009)[2], non-structured or complex problems are defined as those which do not necessarily have a well-defined objective and/or set of strategies and solutions used to address the problem. In this decision context, different disciplines have traditionally worked under different approaches, related to different parts of the problem-solving process. Engineering disciplines are used to optimise processes, strategies and solutions when both solutions and objectives are well defined, while architects and urban designers usually work in contexts in which neither of those are well defined, using design to reveal new possibilities. In this light, the position of REPAiR is in the Innovation phase where the problems and objectives are well defined (they are the outcome of the work of the PULLs) but the solutions are not defined yet (Fig. 1.2).

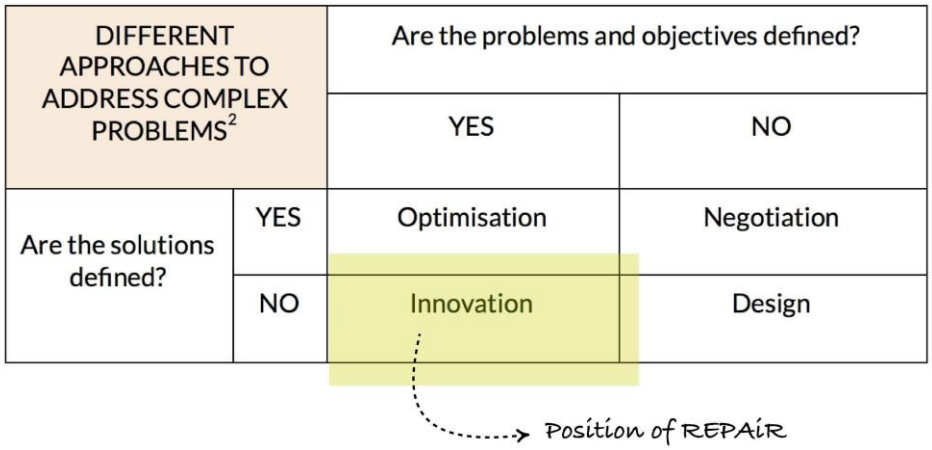


Fig. 1.2 The position of REPAiR in the matrix of solutions and objective when dealing with complex problems, Source: elaboration of the TUD Team based on "Solution Strategies to address various complex problems", source: Land & Water Management in the Urban Environment (2009) Van de Ven, F.H.M., H. Gehrels, H. van Meerten, B. van de Pas, E. Ruijgh, D. Vatvani, N. van Oostrom and Th van der Linden, Deltares, Utrecht/Delft (p. 37).

2. Design towards circularity: positioning the EIS

In the process of evaluating and developing EIS, design played a crucial role, addressing both how to improve existing systems and how to create or transform to an entirely new system. Within a circular economy perspective, two different design rationales of eco-innovations can be distinguished: one considers the design of completely circular actions while the other focuses on designing strategies that optimise existing processes towards circularity, minimizing the production of waste and maximizing the re-use/transformation of waste into valuable products. Based on the study of Carrillo-Hermosilla and Könnölä (2010), when these two perspectives are combined with the incremental and/or radical nature of Political, Economic, Social, Technological, Legal and Environmental changes and the degree of impacts to

[2] Based on Table "*Solution Strategies to address various complex problems*". Source: *Land & Water Management in the Urban Environment* (2009) Van de Ven, F.H.M., H. Gehrels, H. van Meerten, B. van de Pas, E. Ruijgh, D. Vatvani, N. van Oostrom and Th van der Linden, Deltares, Utrecht/Delft (p. 37)

the systems, three different types of actions can be proposed to help the transition towards circularity (Fig 2.1).

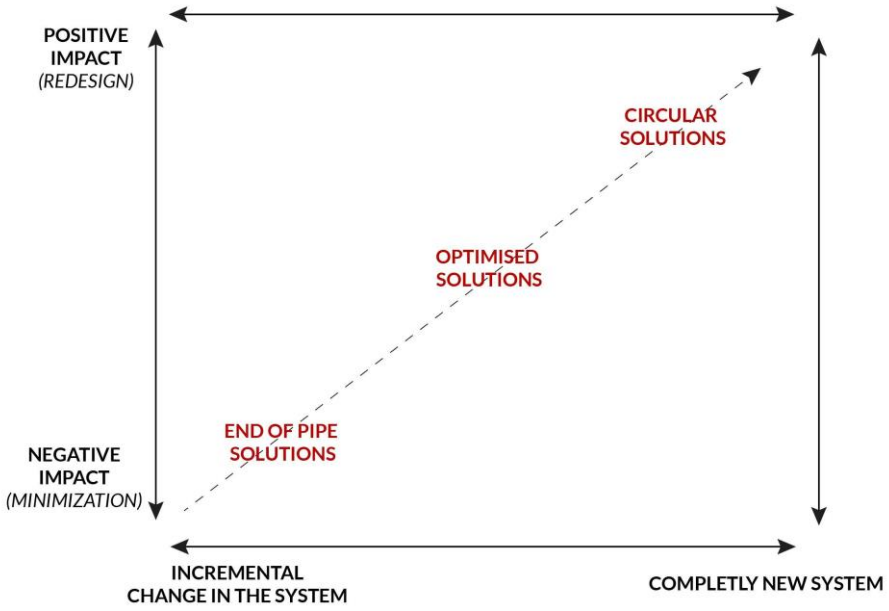


Fig. 2.1 Typology of EIS Source: TUD Team (based on the study of Hermosilla et al. 2009, p.1076)

End of pipe solutions are actions tending to minimize the negative impacts without necessarily changing the process and system that generate those impacts in the first place. These actions do not change the main process, they will only solve part of the problem, at the end of the pipe (e.g. treatment of hazardous emissions).

Optimised solutions toward circularity are actions tending to change one or more systems, i.e. by addressing its components and subsystems. These actions are designed with a view to shift from linear systems, in which resources move through the system to become waste, to circular systems in which wastes become inputs for new processes.

Circular solutions. Following the interpretation of McDonough and Braungart (2002), circular solutions are actions in which products, processes and systems are designed taking into account the entire life cycle of the product, process and system optimizing material health, "recyclability", renewable energy use, water efficiency and quality, and social responsibility. Ideally circular solutions are designed to safely cycle within either a biological or technical metabolism and to be reused or recovered at their highest possible value.

In conclusion, the development of EIS leads to two alternative design perspectives: closed and open cycles. Closed cycles imply that recycling can be done indefinitely without degradation of properties, eliminating the creation of waste, whereas open cycles allow for downgrading (or 'downcycling') steps, postponing but not eliminating the creation of waste. In relation to the well-known *waste hierarchy*, also followed by the EC in its Waste Framework Directive (2008), closed cycles focus on the prefered steps: 1) prevention, 2) reduction, 3) reuse, and 4) recycling/upcycling, while open

cycles essentially lead to the less preferred steps: 5) recycling/downcycling, 6) energy recovery, and 7) disposal/landfill[3].

Within REPAiR, both closed and open cycle perspectives are considered. However, taking into account REPAiR's ambition to move from linear to circular systems, the open cycle perspective is approached as a 'transition perspective', ie. not an ultimate solution, but the best temporary solution in the given - social, cultural, economic, and spatial - context.

In the end, designing EIS goes beyond mere improvements in existing activities and waste management processes. Most of all, it imposes to public and private stakeholders, and society at large, to redefine production processes and behavioural patterns.

3. PULL phases and methodology for developing the Eco-Innovative Solutions[4]

In line with the PULL phases described in the abovementioned Deliverable 5.4 "Handbook: how to run a PULL" (REPAiR 2018a, p.14), the Co-creation process of the EIS developed within the REPAiR PULLs has followed so far the structure of the five iterative phases (Figure 3), which were already elucidated in the Deliverable 5.1 (REPAiR 2017 b, Section 3.1, page 29) and include:

1. Co-Exploring;

The Co-Exploring phase is based on the cooperation between (mainly) WP5 and WP6, using interviews and workshops to define focus and sample areas. Interviews, workshops and surveys were used to define CE challenges and objectives.

2. Co-Design;

The Co-design phase is based on workshops with the AMA stakeholders and experts, and cooperation with education institutions (when possible), developing preliminary EIS as part of a research and design studio

3. Co-Production;

In november 2018, the PULLs are carrying on the phases of co-production and co-evaluation and scaling-up the solutions. Like the Co-design phase, this phase is based on workshops with the MAN stakeholders and experts, and cooperation with education.

"This phase focuses on co-production of Eco-Innovative Solutions and Strategies, using the First Catalogue of Eco-Innovative Solutions, which has been made in previous phases and PULL workshops and/or within internal research of the case study team members, refining and expanding its results. The aim is to move from

[3] There are multiple versions and interpretations of the waste hierarchy. Here, we follow 7 steps, with particular attention for the distinction between step 4 (recycling as 'upcycling': restoring value) and step 5 (recycling as 'downcycling': destroying value).

[4] This Chapter presents parts in common with the Deliverable D5.2 "Catalogue of solutions and strategies for Amsterdam" since it describes the general approach for defining the Eco-Innovative Solutions within the PULLs that shows common characteristics between the two cases.

concepts (or first sets of solutions) to specific, operationalised, assessable solutions, with a focus on stakeholders' identified needs throughout the iterative process of GDSE" (Deliverable 5.4 p. 40). In this phase, the concrete feasibility of the EIS is verified with the contribution of the various actors involved who, progressively, structure a relationship of public-private-people partnership according to the Living Lab approach.

The co-production and co-evaluation phases will be concluded in February 2019. Then, the solutions will be implemented in the GDSE, such that the phases Co-decision and Co-governance can start.

4. Co-Decision;

Phase yet to be completed

5. Co-Governance.

Phase yet to be completed

However, they are now in the Co-production phase, and specifically they are, at this moment, in the process of **co-evaluating and scaling-up the solutions** (Fig. 3.1 and Fig. 3.2), also thanks to knowledge transfer exercises, within expert groups in the MAN and AMA PULL workshops, and Consortium Meetings.

Specifically, during the Co-production phase we respond to the following question:

- How might the study area be modified?

This phase focuses on the co-production of Eco-Innovative Solutions and Strategies, moving from concepts (or first sets of solutions) to specific, operationalised, assessable solutions, with a focus on stakeholders' identified needs. The main objective is to look beyond first impressions and to spatialize solutions (see D.5.4, p. 40-45).

This phase will continue until next February 2019. Therefore, the phases of Co-Decision and Co-Governance have not started yet.

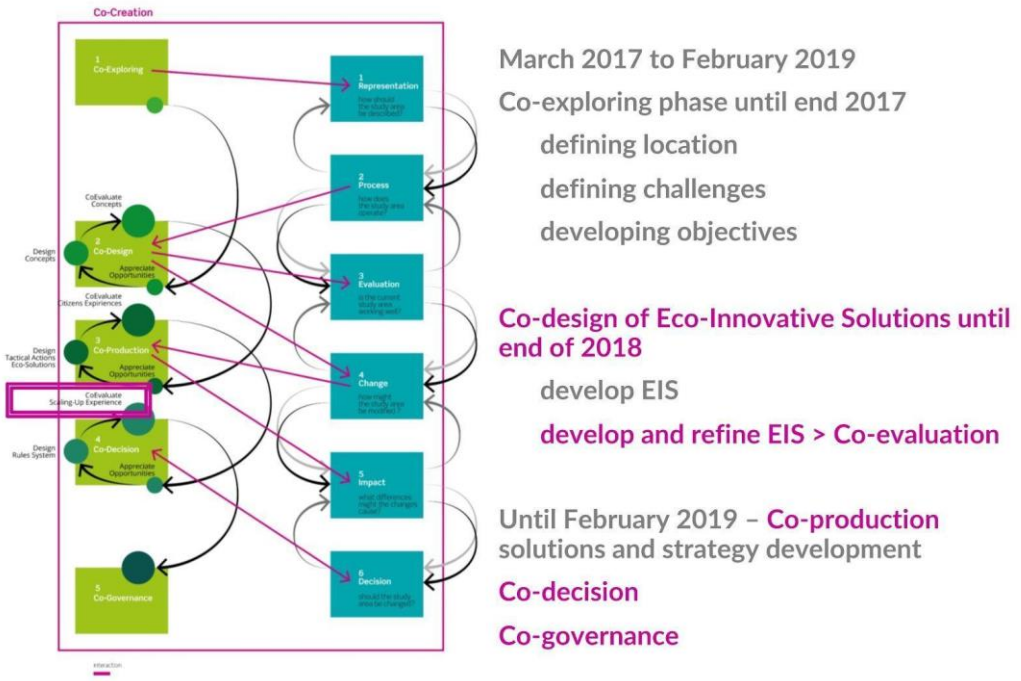


Fig. 3.1 Peri-Urban Living Lab - steps and timeline. Source: UNINA Team

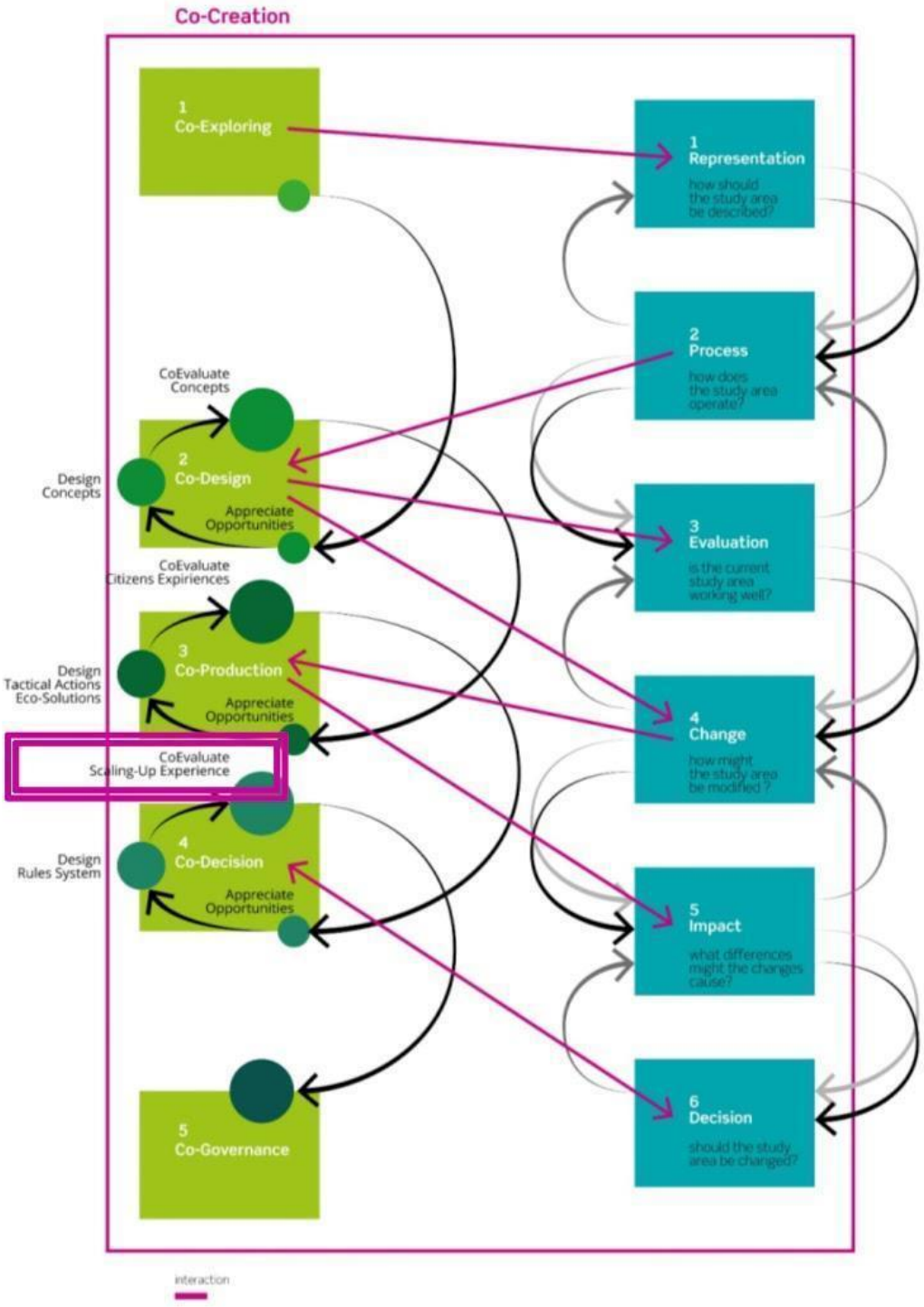


Fig. 3.2 Peri-Urban Living Lab - steps and timeline (zoom-in on the phases). Source: UNINA Team

3.1. Methodology for defining the EIS

The methodology for defining/refining the EIS was developed by the WP5 team in deep collaboration with WP6 and WP7. Furthermore, the role of the work developed

within WP3 was crucial as well, particularly for constructing the basic knowledge for discussion within the MAN PULL.

The first steps were focused on the identification of challenges and the construction of a first list of objectives. **The identification of challenges and objectives** was carried out through individual interviews with stakeholders and in the interactions within the first MAN PULL workshops. At the beginning, from April to November 2017, four PULL meetings had the objective to open up the debate around circular economy topics by constructing a shared knowledge among stakeholders and the REPAiR team on the objectives of the project (REPAiR 2018b, D6.4). Critical issues of the waste management cycle were deeply analysed; then, two meetings focused respectively on organic, and on construction and demolition waste. Thereafter, the **Co-creation process for the development of the EIS** started, mainly within the MAN PULL workshops held from February 2018 to July 2018. At this stage, in order to allow a better interaction with local stakeholders, it was considered useful to work on a sample of the focus area. Treasuring the challenges emerging from the previous meetings, particular attention was mainly paid to **wastescapes**.

The selected sample area is composed of five municipalities (Acerra, Casoria, Casalnuovo, Afragola, Caivano), characterized by similar problems on the waste cycle and whose political actors demonstrated to be active during the four initial PULL meetings. Starting from the definition of wastescapes, the participants pointed out the necessity to **focus on some critical areas** identifying the main issues to solve, co-designing place-based territorial strategies, in which eco-innovative actions can be distinguished. From the proposed actions it was possible, on the one hand, to deduce objectives, and on the other, to identify the EIS as (elementary) responses to site-specific problems.

The PULL events were collectively organised by UNINA team with the support of Campania Region Authority (CRA). In the first four PULL events, participants included representatives of regional, metropolitan and local governments and policy makers, waste management administrators, local companies' representatives and UNINA and CRA REPAiR teams. From the fifth PULL event on, social organisations and active citizens were involved, due to the focus on the real problems of their territories.

In the fifth PULL event, the categories of wastescapes on which UNINA group was working were presented with the idea of starting a collaborative process to collectively update the map. Two parallel focus groups were organized to work on the map and its legend. In the sixth, seventh, and eight Naples PULL workshop, the participants decided to split into **three work-tables focusing on three different territorial strategies**. The work-tables' topics were proposed by groups of participants and each participant chose to which work-table to contribute. Participants in the work-tables included: local practitioners, active citizens and social organizations, UNINA team and CRA representatives, and students.

Each territorial strategy has been developed further with the aim to identify specific **Eco-Innovative strategies,** and subsequently **the EIS** for the specific problems related to wastescapes and connected waste flows (for this chapter, see more on the Deliverable D6.4, p.26 - on).

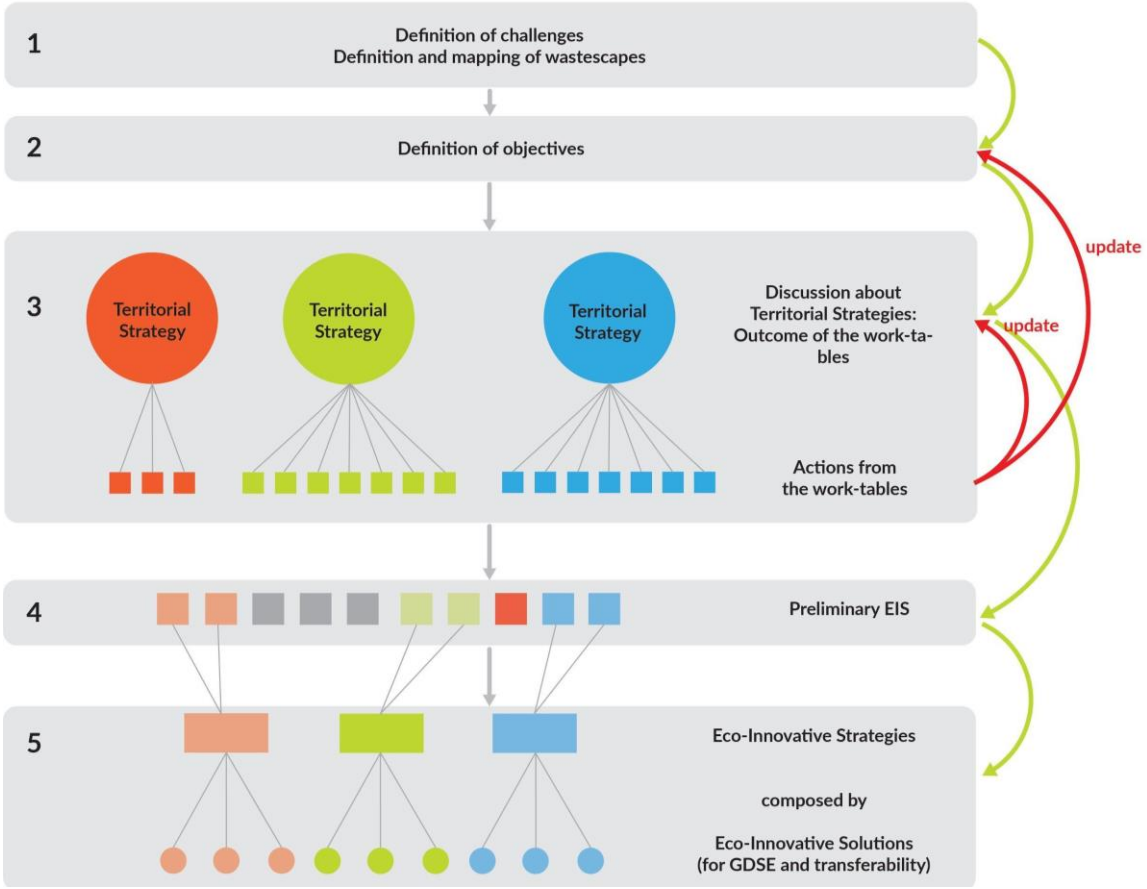


Fig. 3.1.1 Methodology for defining the EIS in the case study of Naples
Source: UNINA Team, 2018

Specifically, the main **problems/challenges** identified in the overall process are:

- Campania waste emergency[5];
- Criminal economy competing with the public waste management;
- Transition from Province to Metropolitan City with the consequent ongoing change;
- Institutional difficulties of overcoming sectors in order to co-design policies;
- Lack of shared knowledge between the sectors and towards citizens;
- Mistrust of citizens towards public institutions;
- Suspicion on the proposals of reusing waste;
- Proliferation of wastelands and wastescapes.

The main **objectives** related to the explored challenges are:

- overcoming the transition on the management of waste;
- precluding organised crime being implicated with the management of waste;
- reversing citizens' distrust of institutions;

[5] From 1994 to early 2008, the region of Campania had a formal State of Emergency, declared due to the saturation of regional waste treatment facilities. On 31 December 2009, waste cycle emergency in Campania was officially closed, as provided for by law. no.123 of 14 July 2008. Waste cycle management returned under the jurisdiction of local authorities, though some effects of the waste emergency are still ongoing. See Deliverable D6.1, p.32 on.

- informing and educating citizens and institutions on environmental issues and the functioning of the waste management cycle;
- planning processes of urban change shared by the different actors;
- planning measures that allow CE processes to be implemented by institutions and citizens;
- resuming existing environmental projects that are considered useful but remain at a stalemate.

The starting point was to define challenges, through interviews and the first PULL workshops focused on the investigated flows. From these challenges a first list of objectives (see D6.1) was identified. Then the PULL participants developed the territorial strategies defining the actions useful to implement them. During the PULL process, objectives were further revised and updated involving also local groups and associations, whose point of view was emerging from the three work-tables.

3.2. Territorial strategies

Preliminary EIS coming from literature or defined by common discussion in the PULL events, were developed further within the work-tables in territorial strategies. Specifically, the **three work-tables** focused respectively on the following three t**erritorial strategies:**

1. Homogeneous collection sites;
2. The Green Mile;
3. New Lands.

3.2.1. Territorial strategy 1: Homogeneous collection sites (First work-table)

The main objective of this **territorial strategy 1,** developed at the work-table 1, is to reduce, and eventually to solve, the problem of illegal dumping of waste (construction and demolition waste, tyres, Waste Electrical and Electronic Equipment identified with the acronym WEEE) in some disused areas along infrastructures and the fires set to dispose of agricultural waste. Among the involved areas, there are also some confiscated properties, formerly owned by criminal organisations. For these areas a repurposing and a new sense of identity is needed, together with the identification of new functions.

This strategy focuses on the reuse of these abandoned plots of land as collection centres for CDW, thus limiting the illegal dumping, also through the implementation of CDW collection centres in which legal recognition is not required by law. Moreover, it aims to collect and transform the organic and green waste to create new fertile materials through a 0-km composting activity. In doing so, it strategically connects to the community gardens and orchard area within the adjacent Masseria Antonio Esposito Ferraioli (a former property belonging to organised crime, recently re-appropriated by a group of social cooperatives and organizations).

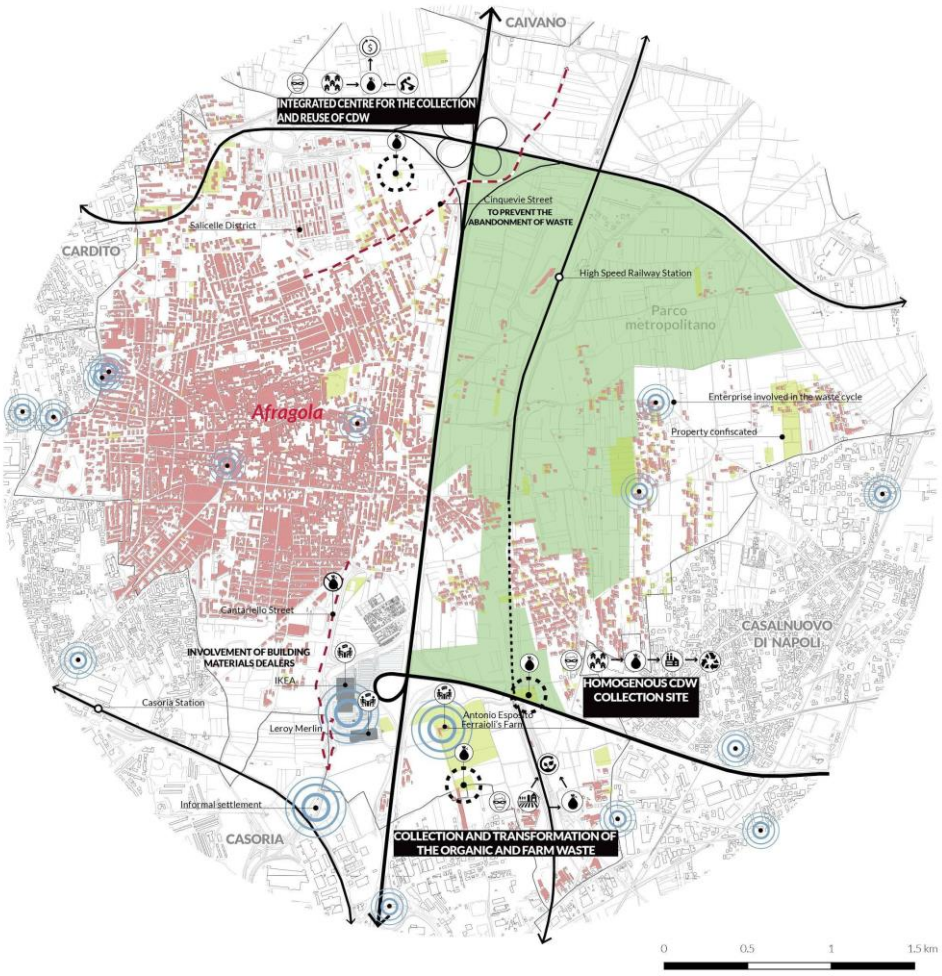
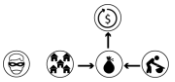
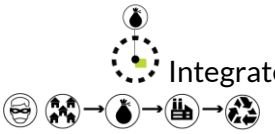


Fig. 3.2.1.1 Homogeneous collection sites strategy
Source: UNINA Team, 2018

This **territorial strategy 1** involves the **following actions**:



-  Integrated centre for the collection and reuse of CDW;
-  Anonymous collection point for CDW;
- Collection and transformation of organic and country waste (leaves, grass clippings, yard or farm waste, etc.).

The objectives of the proposed actions are, respectively:

- reduction of waste production
- preventing abandonment of CDW along infrastructure
- creation of production chains able to ensure an integrated network of specialised recycling plants where waste can be also transformed into Km0 secondary raw material;

All the stakeholders involved in construction, renovation and demolition activities could be interested in this territorial strategy, together with local farmers. The ordinary citizens also will benefit from this strategy. Incentives and awareness campaigns are the basis for the implementation of this strategy.

The strategy has been located in a specific area, after a common work made with the municipality of Afragola in order to identify the disused plots of land in the surroundings.

3.2.2. Territorial strategy 2: The Green Mile (Second work-table)

The main objective of this **territorial strategy 2,** developed at the work-table 2, is to reverse the negative citizens' habit to deposit waste in the places that are perceived as peripheral and wasted. Specifically it aims to recover the existing pedestrian and cycle path along the provincial road connecting Acerra and Pomigliano. This strategy aims to involve the local community, as well as the university, the local schools, and the citizens' associations. Specifically the associations are willing to make a commitment for the implementation of the strategy, facilitating the involvement of the citizens and the other stakeholders.

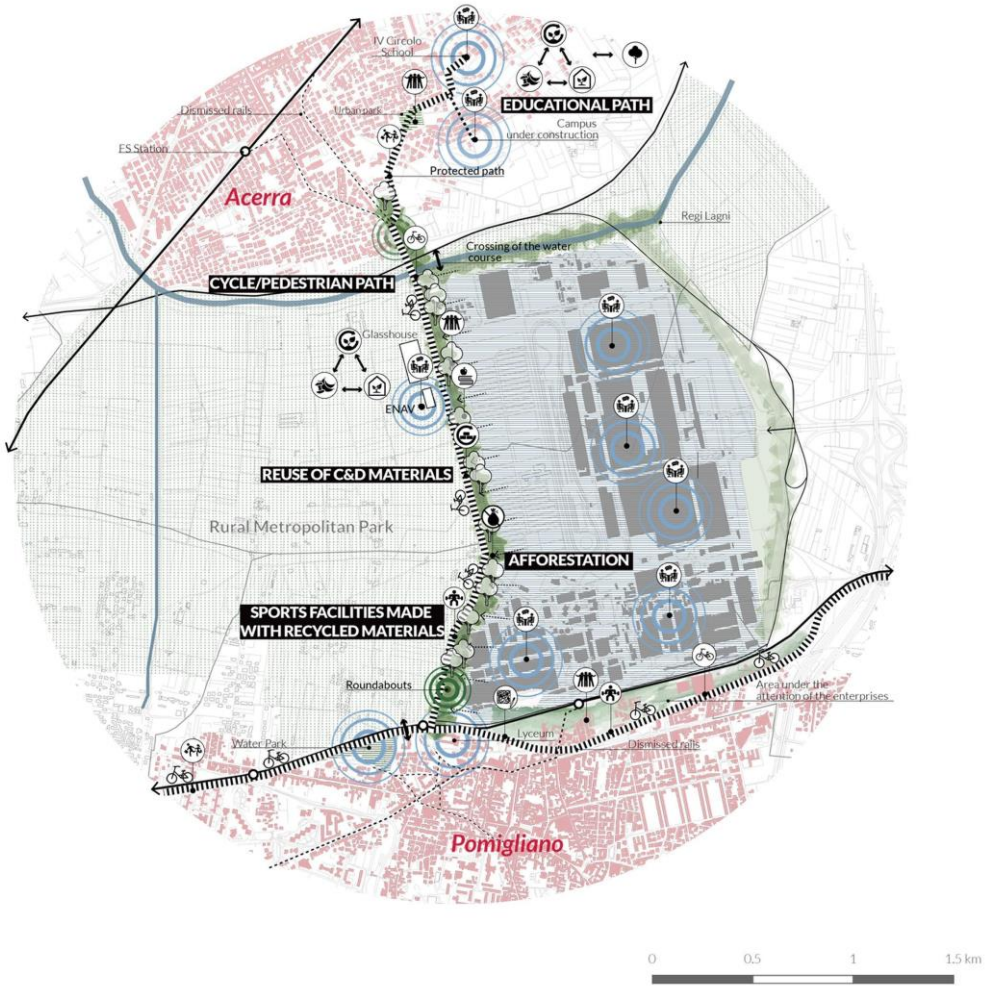
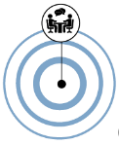
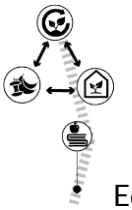


Fig. 3.2.2.1 Green Mile strategy
Source: UNINA Team, 2018

This **territorial strategy 2** involves the **following actions**:

1.  Pedestrian and cycle path: recovery and completion of the cycle path through a co-design process including roundabouts and road buffer strips; redesign of the night lighting; prevision of a protected path for the school; symbolic awareness days.
2.  Afforestation of the infrastructure involving enterprises and owner of the soil (Fiat, Alenia, Cofely), schools and associations to activate living labs on the observation and knowledge of the plants life cycle.
3.  Creation of a Group that can carry out the project and evaluation on the possibility of involving small owners during the definition of a collaborative and feasible project; setting of two planning scale (local / territorial).
4.  Reuse/recycle of C&D waste for new paths prioritising the participation of Green enterprises in the public competition for infrastructures building.
5.  Educational process on the recycle topic: creation of an educational path on recycle and strengthening of the organic cycle within the schools (IV Circolo Acerra) through the use of a glasshouse and composter.
6.  Promotion of events and activities on waste awareness.
7.

8. Fitness trail: experimentation of reuse/recycle of C&D waste for new sport facilities.

The objectives of the proposed actions are:

- Promotion of sustainable mobility, collective use and the defense of the territory
- Avoiding dumping of waste along the Asse Mediano and other road infrastructures
- Defense of the territory against the abandonment of waste
- Minimise the human pressures on areas with a high ecological and environmental fragility
- Educational purposes, improvement of the sense of belonging
- Increasing the project sustainability
- Promotion of healthy lifestyles.

3.2.3. Territorial strategy 3: New Lands (Third work-table)

The objective of **territorial strategy 3** is twofold. Firstly, it concerns the necessity to control the flow of C&D waste coming from the realization of the new railway connections (in several points of the territory) with the High Speed Train station of Afragola. This first aspect of the strategy aims to implement a local reuse of these C&D waste. Secondly, this strategy focuses on the regeneration of the abandoned productive area of the municipality of Acerra (Piano Insediamenti Produttivi or Productive Districts Plan in english).

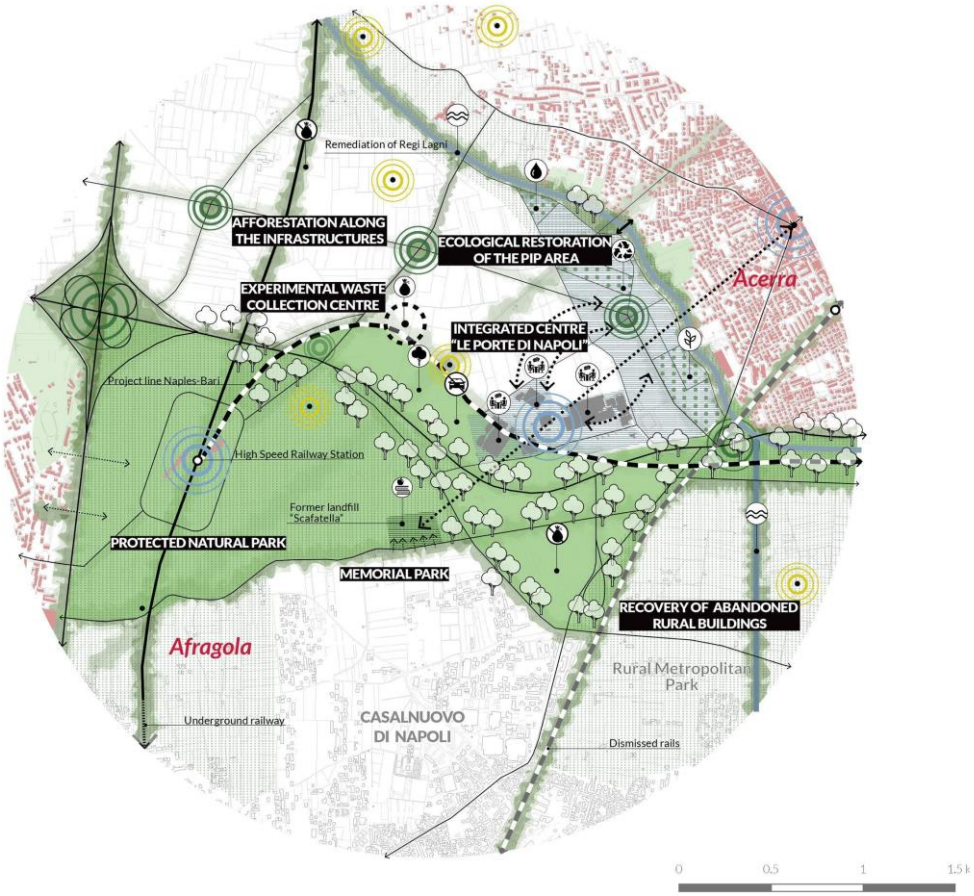
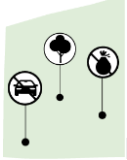


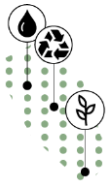
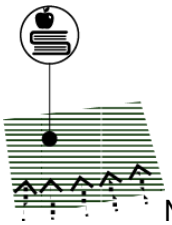
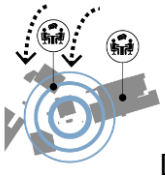
Fig. 3.2.3.1 New Lands strategy
Source: UNINA Team, 2018

This **territorial strategy 3** involves the **following actions**:

1. Afforestation along the road infrastructures: linear afforestation along the existing and scheduled infrastructures recovering CDW on new railway shipyard using compost as new and desertified soils improver along the infrastructures.



2. Protected natural reserve: creation of a protected natural park; vehicular traffic restrictions; delimiting of a natural “border” to define the perimeter of the park.

3.  Experimental recycling point: creation of an experimental waste collection centre in the abandoned parking along the Asse Mediano infrastructure; selection and first treatment of waste by a "Km0" recycling plant located on an adjacent wastescape; installation of electricity production technologies from kinetic energy generated by vehicles.
4.  Ecological re-functioning of the productive area (PIP area): reuse of the Acerra PIP area with environmental and ecological purposes; wetlands to reclaim the water of Regi Lagni and allocation of compatible productive functions connected with the shopping centre.
5.  Memorial Park: creation of a "local memory" park in the locality of Scafatella (former landfill and Church).
6.  Densification of functions around the shopping mall areas (Le Porte di Napoli): functional and settlement densification into the shopping centre area and trade qualification using the presence of the high speed railway station.
7.  Recovering of the abandoned rural buildings and reuse of the public facilities; develop of widespread accommodation.

The objectives of the proposed actions are:

- Improvement of the landscape impact on existing and new infrastructures
- Minimising human pressures on areas marked by high ecological and environmental fragility
- Avoiding dumping waste along the Asse Mediano and other road infrastructures
- Reclamation of Regi Lagni canal (project of the Gardens in Europe)

- Recreation of a local identity discovering degraded places
- Promoting sustainable economic development
- Minimise soil consumption reusing the existing urban fabric
- Encouraging innovative forms of hospitality

3.3. Preliminary EIS

Within Unina desktop research, among the wider number of actions of the work tables, ten preliminary EIS have been selected and grouped as follows.
The first ten EIS are listed below:

1. Free and anonymous disposal of CDW.
   The solution aims to innovate the collection phase of CDW in order to intercept parts of those construction and demolition waste that could not otherwise be transferred to the recycling sites: residues of small household works, realized in absence of administrative requirements.
2. Recycling centre for C&D waste (dis-assembling, reuse and zero-km selling).
   Extending the life cycle of products to reduce the actual number of waste produced, through the practice of the reuse of durable goods.
3. User support centre for European projects on CE.
   The institutional facilitation office should serve as an incubator of innovation and circular economy strategies/policies (ERDF funded) for local administrations and private associations
4. Integration of waste infrastructure in the design of public spaces and roads.
   Planning can incentivize the creation of private spaces in streets and household condominiums to host friendly-collecting sites of waste.
5. Design of urban organic waste infrastructure.
   To avoid the concentration of big treating plants and hyper-specialized spaces, a shared and participated design group is promoted to support the technical design of open and sustainable public spaces in connection with operational infrastructures of waste.
6. Remediation taking advantage of local cultivations.
   Use historically traditional cultivations to remediate landscapes.
7. Phytotechnologies applied to water pollution
   Use historically traditional cultivations to clean polluted waterways.
8. Rule innovation for public works' design
   Updating and adaptation of the public works regulations with the introduction of secondary raw materials use and with Km0 reuse.
9. Eco-district for new soils
   Connect organic waste sites design with urban re-development operations (open public spaces), raising social awareness.
10. 0 Km compost from agricultural lands in order to create new morphologies of soils
    Use of organic fraction in new ground re-landscaping operations.

Aiming to implement a site-specific innovation, and to make sure that the solutions could be transferred to other cases the EIS listed above have been grouped in **four Eco-Innovative Strategies**, as follows. Moreover, some of the solutions were grouped also because they were too similar to be developed further separately.
Therefore, they are now focusing on the following four solutions.
On wastescape: RECALL. REmediation by Cultivating Areas in Living Landscapes.

On organic: Re-compost Land. Short supply chain of organic waste.
On CDW:
a. Beyond INERTia. Circular supply chain for CDW waste.
b. CIRO. Integrated Center for Optimal Reuse of durable goods.
These four strategies are extensively explained in the Chapter 4 “Catalogue of EIS”.

3.4. Eco-Innovative Solutions

To be able to be transferable to follow-up cases, and to be fed into the GDSE the EIS should be elementary. Therefore, the EIS are deducted from the above mentioned three local strategies, also considering the impact categories (as described in the Deliverable D4.5). At first the solutions/strategies are site-specific and complex; eventually they are reduced in their elementary parts (as described in the following catalogue).

The Co-evaluation of the EIS have been carried out in the last WP5/7 workshop at the Consortium Meeting in Hamburg (held in October 2018). In this workshop they have used an evaluation checklist, with the aim to focus on:

1. **Process:** Analyse the production and implementation process of the Eco-Innovative Solution by potentials and critical aspects, barriers to success and supporting factors;

2. **PPP (Public-Private-People) Partnership:** Understand who is willing to do what and with whom: from collaboration to cooperation;

3. **Eco-Innovation:** Check what is “eco-innovative” and what can be improved and how.

Workshop Participants have been asked to respond to the following questions, in order to identify the operative relevance of the selected EIS for the pilot case of Naples:

1. According to your expertise, which are the positive aspects of this EIS?
2. And which are the negative aspects of this EIS?
3. What is missing in this EIS?
4. Is this solution addressing correctly the main criticality of the case study area?
5. Is this solution improving the spatial/environmental/social quality of the case study area appropriately?
6. Who are the actors to be involved?
7. Who could be willing to cooperate with whom?
8. For whom it could be a business model?
9. What are other possible source of funding?

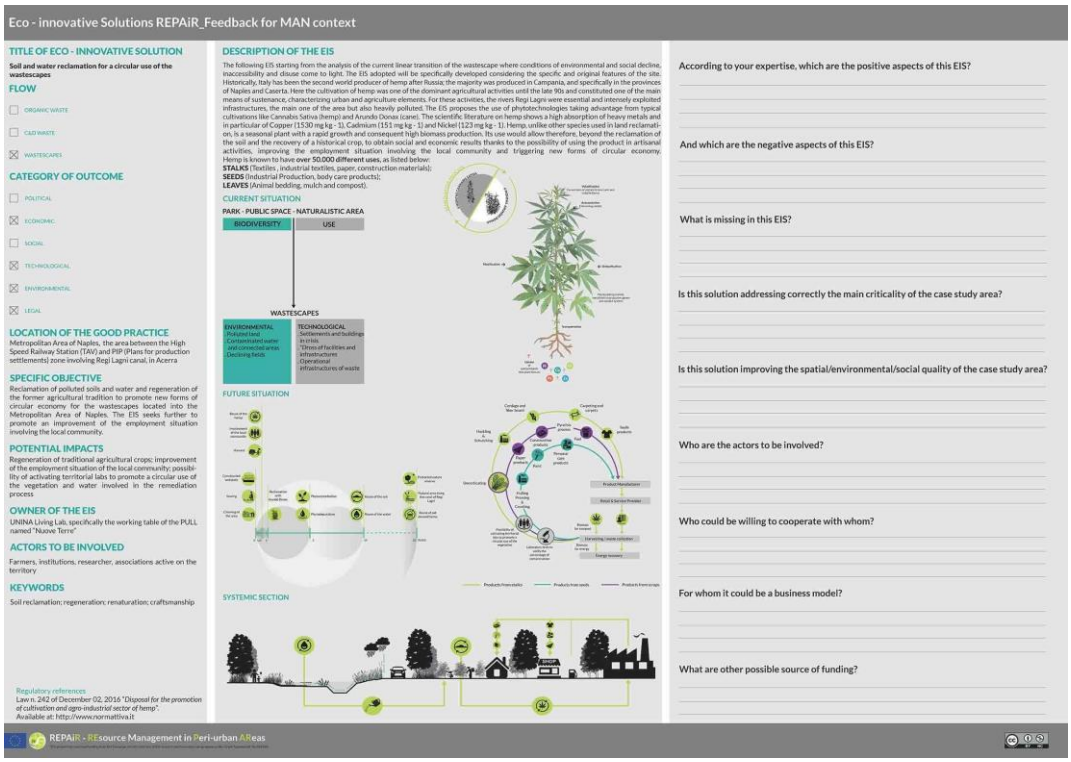


Fig. 3.4.1 Example of one of the Eco-Innovative Solution sheets to collect feedback for the MAN context. Click to enlarge
https://drive.google.com/open?id=1X9uwXxjClbfwnGDXCs9YK3JKwxV4qoyf
Source: UNINA Team, 2018

The MAN EIS have been discussed within the AMA Pull workshop and the CM (WP7 collaboration) in order to be scaled-up (scaling-up experience) and to be transferred to other contexts.
The first draft of MAN EIS have been discussed in Knowledge transfer sessions held within both the 3rd Amsterdam PULL workshop, and the Hamburg Consortium Meeting. Solution sheets have been used to understand to what extent the solution identified for Naples is transferable towards Amsterdam (with the exercise done in the 3rd Amsterdam PULL workshop) and towards the follow-up cases.
Participants have been asked to reply to the following questions:

1. Is this EIS transferable to your region?
2. Where could be this EIS applied in your region (location)?
3. What are the barriers for transferability of this EIS?
4. What adaptation are needed to enable transfer to your region?
5. Who should be the actors involved?

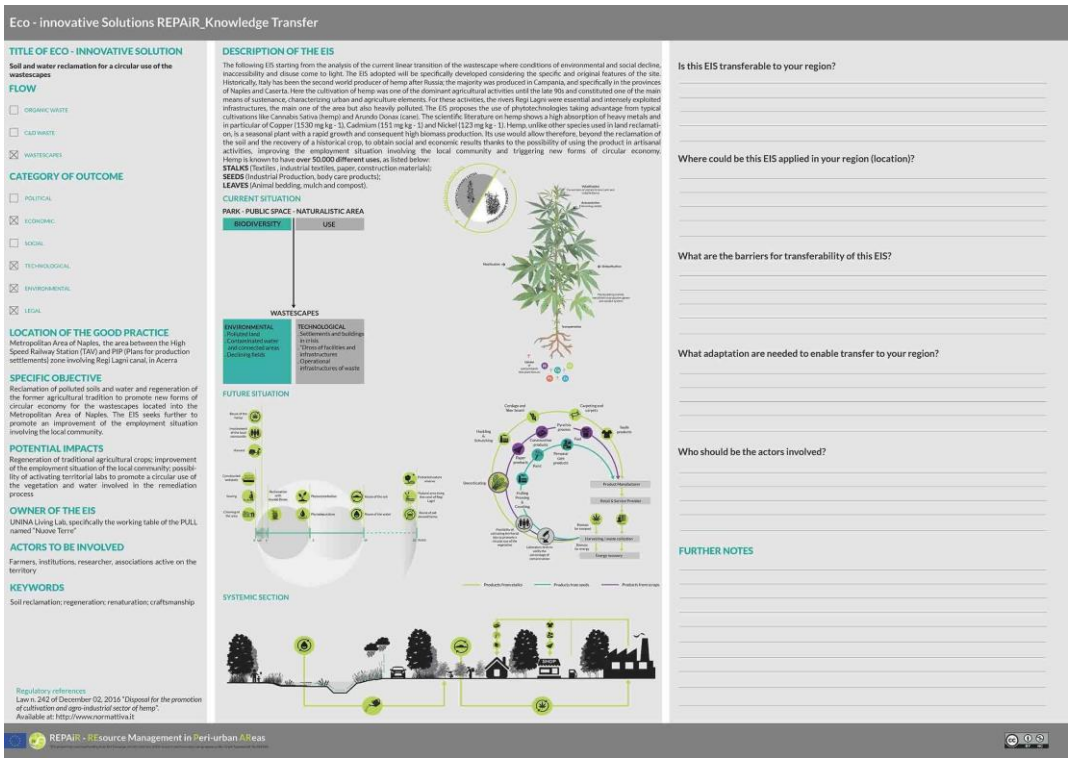


Fig. 3.4.2 Example of one of the Eco-Innovative Solution sheets for the KT exercise.
Click to enlarge: https://drive.google.com/open?id=1UWCHGE3rO6rljJhEhrLw5tVCAy9YoLOA
Source: UNINA Team, 2018

During the AMA workshop, three different EIS were introduced and discussed with AMA stakeholders taking into consideration their transferability to the AMA.
The solution of "Green (spaces) from green (compost) was mainly adaptable to AMA; however, a significant problem appeared: In the AMA, the separate collection of green waste is not common. The issue of the quality of the green "input" and the compost was a crucial question relating to the question in the adaptation to AMA and the implementation in MAN. On the other hand, it has to be emphasised that stakeholders highlighted the 'power' of neighbourhood,. which means that neighbourhood watching can control the quality of green waste: by whom and what to drop into the collector.
Another adaptation and implementation question was the issue of the ownership. While the waste basically belongs to the household, when it is disposed in the neighbourhood for composting, the new ownership can be questionable, legislation should take the change of ownership into consideration. It means that when the neighbourhood is collecting the waste for composting and the compost is used in the neighbourhood, who can be the owner of the deposited green waste, then the compost.
Therefore, eventually, the solutions for the Naples case have been updated accordingly with the feedback received, as can be find in the Catalogue of EIS at the Chapter 4.

4. Eco-Innovative Strategies/Solutions from Naples PULL

The Eco-Innovative Solutions (EISs), developed for the peri-urban area of Naples, focus on strategies for the territorial regeneration. The proposed EISs underlines an integrated analyses of OW nd CDW waste flows allowed to identify possible starting point for the regenerative and design interventions of wastescapes (Russo et al., 2019). Each EIS is the result of an iterative and co-creative process of site-specific strategies implemented within Living Lab activated on the territory with local communities. The first step of this process was the mapping of wastescapes, understood like ecologically compromised areas and of priority interest of transformation for the local stakeholders. Relatively to the found criticalities in these latent and compromised places, each EIS was elaborated, implemented and validated, and derive from the system of technological and territorial aspects and an adaptive and open design that can generate new territorial geographies. The first proposed EIS, closely related to the regeneration and reclamation of wastescapes, is entitled RECALL. The solution proposes the environmental rehabilitation of the place through phyto technologies that exploit the capacity of some local agronomic crops, such as Cannabis sativa, Arundo donax and Poplars, to buffer against potential soil pollutants. After safety measures against potential soil contaminants, new soils can be generated on the site using recycled inert CDW material and, finally the quality of the soil will be improved, using OW of appropriate and tested quality. That approach shall define an innovative public space that leads to the definition of unexpected landscapes of waste, similar to land-art works, synthetic places between artifice and nature. Specifically, the new soils represent the outcome of two other EISs intercepted within the Living Lab: RE-compost, relating to organic waste flow, and Beyond Inertia, focused on construction and demolition waste. The innovative aspect of the proposed EISs is not so much related to the product they design, while it could be found in the process they are capable of triggering when eventually implemented. In line with the principles of the circular economy, each EIS proposes environmental regeneration strategies working on the short supply chain (Russo et al. 2019). In the case of organic waste, the short supply chain is realized in the design of treatment plants of medium dimension in which the material in exit will be used like fertilizer for the agricultural productions and as top soil for naturalization approaches and environmental and landscape mitigation. In the case of construction and demolition waste, the EIS proposes instead a set of actions aimed at improving the life cycle of inert waste, starting from critical findings in the Regional Plan for Special Waste in Campania (PRGRS, 2011). The solutions mentioned below which are retrieved from existing projects and processes, so mentioned as references from literature are merely intended to provide validity to the proposed technological approach. In the same way, the final section of the Deliverable is using an overview of experiments already carried out in other contexts to achieve the aim.

From the specificities of the Neapolitan context and the proposed EISS, it emerges that the mismanagement of the considered waste flows and the proliferation of wastescapes are closely interrelated elements. They become the vectors of change on a large scale, they are the inflection point where the overturning of their negative meaning produces innovation with a view to circularity and urban metabolism. The innovation that characterizes each EISs therefore focuses on the process. The latter acts on the supply chain of the material and subsequently on the design of the peri-urban space to increase its resilience.

The proposed EISs listed in this deliverable are coherent with the guidelines that the Municipality of Naples approved in the last City Council (document n. 7 del 26 marzo 2019) aimed to define the new Municipal plan. The document entitled "Napoli 2019-2030. Città, ambiente, diritti e beni comuni" (in English: Naples 2019-2030. City, landscape, right and commons", identifies five strategies for the city of Naples:

1. Accessible and multiscale city;
2. Safe and sustainable city;
3. Welcoming and collective city;
4. Productive and liveable city;
5. Attractive and regenerated city.

All the identified EISs – as explained in this Deliverable - share the main principles of the abovementioned five strategies which are aimed at the urban regeneration, through specific actions which are: environmental protection and valorisation, reconversion of abandoned areas/settlements, equalisation and transformation of the territory, actions to respond to the new needs related to the mobility and social empowerment.

References

- Amenta L., Attademo A., Remøy H., Berruti G., Cerreta M., Formato E., Palestino F., Russo M. (2019) Managing the Transition towards Circular Metabolisms: The Peri-Urban Living Labs (PULL) Decision Model. Urban Planning, vol. 4, n. 3, ISSN 2183-7635 DOI: http://dx.doi.org/10.17645/up.v4i3.2170
- Russo, M., Cerreta, M., Garzilli, F., Mazzarella, C., Vittiglio, V.,(2019). *Nuovi paesaggi del periurbano*. Eco-Innovative Solutions del progetto REPAiR in Atti della XXII Conferenza Nazionale Società Italiana degli Urbanisti, l'Urbanistica Italiana di fronte all'Agenda 2030 per lo sviluppo sostenibile. Bari - Matera, 5-6-7- June 2019, in Planum, The journal of Urbanism (ongoing publication)

- Russo, M., Amenta, L, Attademo, A., Cerreta, M., Formato, E., Garzilli, F., Mazzarella, C., Rigillo, M., Vittiglio, V., (2019). *SHORT SUPPLY CHAIN OF WASTE FLOWS FOR LANDSCAPE REGENERATION IN PERI-URBAN AREAS*, pp. 1-11 in Sardinia Symposium_17th waste management and Landfill Symposium - ISBN: 9788862650144

On WASTESCAPE

4.1. RECALL: REmediation by Cultivating Areas in Living Landscapes through phytotechnologies

Flow: Wastescapes

Category of outcome: Economic, Environmental, Technological and Legal

Location of the good practice: Metropolitan Area of Naples (MAN). Within the work-table *New Land*, the considered area is located between the High Speed Railway Station (TAV) and the PIP (Plans for production settlements) zone involving Regi Lagni canal, in Acerra (Fig. 4.1.1). The work-table *Green Mile*, includes the area related to the cycle/pedestrian path along the provincial road axis Pomigliano-Acerra (2,5 Km) and its adjacent spaces (Fig. 4.1.2).

POTENTIAL CONTAMINATED SITES

CENSUS OF POTENTIAL CONTAMINATED SITES
Ex SIN Litorale Domitio Flegreo and Agro Aversano (2016)

1 FORMER LANDFILL "SCAFATELLA"

WASTESCAPES

PUBLIC PROPERTIES

	Name	Code	Adress	Municipality	Prov.	Property	Tipology of site	Contaminated matrix	Pollutants	Process 2016	Activity	Area	coord. X	coord. Y
	Pellini S.r.l.	3001A504	Via Tappia, 35	Acerra	NA	Private	Waste treatment plant				Waste treatment plant	0	444986	4533208
2	Zito Recupero Plastica s.a.s.	3001A520	Via Volturno, 61	Acerra	NA	Private	Waste treatment plant			Approved Characterisation Plan	Waste treatment plant	4754	445042	4533174
	Ecotrasporti	3001A549	Via Volturno 61	Acerra	NA	Private	Productive activity				Productive activity	0	445051	4533180
3	Regi Lagni	1506A001	Regi Lagni	Regional Site	------	Pubblic	Surface water	Soil/ Surface and groundwater	Dioxin and Furans, Metals, PCB, IPA, Hydrocarbons, Pesticides, Carcinogens chlorinated aliphatic	ImplementedCharacterisation Plan	Other	0	0	0
4	Sommarco Salvatore	3001A513	Corso Italia, 91	Acerra	NA	Private	Productive activity				Productive activity	0	446439	4531619
5	Ex F.lli Costa	3001A536	Loc. Marchese	Acerra	NA	Private	Dismissed activity				Productive activity	0	446148	4531566
6	P.V.C. Agip - ENI n.IT59353	3001A528	Via Benevento	Acerra	NA	Private	Fuel service station				Fuel service station	0	446036	4530910
	Terracciano Sabato	3001A545	Contrada Area di Settembre	Acerra	NA	Private	Productive activity				Productive activity	0	446579	4530500
7	Leonardo SpA (Ex Alenia Aeronautica SpA)	3057A511	Viale dell'Aeronautica	Pomigliano d'Arco	NA	Private	Productive activity	Soil/ Groundwater	Metals, Carcinogens chlorinated aliphatic, chlorinated aliphatic	Implemented Risk Analysis; Monitoring Groundwater	Productive activity	392520	448573	4529594

Fig. 4.1.1 Work- table New Land. Possible sites where to apply the solution

Source: UNINA Team, 2018

POTENTIAL CONTAMINATED SITES | CENSUS OF CONTAMINATED SITES (Register 2016) | PUBLIC PROPERTIES | WASTESCAPES

	Name	Code	Address	Municipality	Prov.	Property	Tipology of site	Contaminated matrix	Pollutants	Process 2016	Activity	Area	coord. X	coord. Y
1	Scrim	3001A537	Strada Provinciale Pomigliano-Acerra	Acerra	NA	Private	Productive activity				Productive activity	0	447721	4531307
2	Campania Soccorso	3001A509	Via Palermo	Acerra	NA	Private	Productive activity				Productive activity	0	447641	4530518
3	Co.me.sa. Srl	3057A522	Via Pratola	Pomigliano d'Arco	NA	Private	Productive activity				Productive activity	7242	447435	4529834
4	Pomigliano Ambiente (Composting plant)	3057A532	SP Acerra - Pomigliano	Pomigliano d'Arco	NA	Private	Waste treatment plant				Waste treatment plant	17378	448274	4530105
5	Pomigliano Ambiente	3057A531	SP Acerra - Pomigliano	Pomigliano d'Arco	NA	Private	Waste treatment plant				Waste treatment plant	12197	448162	4529785
6	Leonardo SpA (Ex Alenia Aeronautica SpA)	3057A511	Viale dell' Aeronautica	Pomigliano d'Arco	NA	Private	Productive activity	Soil/ Groundwater	Metals, Carcinogens chlorinated aliphatic, chlorinated Aliphatic	Implemented Risk Analysis; Monitoring Groundwater	Productive activitv	392520	448573	4529594
7	Fiat Auto SpA complex Sogetel group Fiat	3001A538	Via Ex Aeroporto Acerra Pomigliano	Acerra	NA	Private	Productive activity				Productive activity	0	448667	4531204
8	Fiat Auto SpA	3057A503	Via Ex Aeroporto, ASI area	Pomigliano d'Arco	NA	Private	Productive activity	Groundwater	Carcinogens chlorinated Aliphatic	Implemented Characterisation Plan	Productive activity	2101015	449005	4530887
9	Avio S.p.A	3057A543	ASI area	Pomigliano d'Arco	NA	Private	Plant with a major accident hazard	Soil/ Groundwater	Metals,Hydrocarbons, Dioxin, chlorinated Aliphatic	Implementation MISE/Presented Operating ground waterremediation project	Productive activity	192400	449252	4529816
10	Fenice S.p.A. Plant T.A.R.	3057A573	Viale Impero c/o Avio Plant S.p.A.	Pomigliano d'Arco	NA	Private	Waste treatment plant	Soil	Metals	Implemented Characterisation Plan	Waste treatment plant	80	449366	4529948
11	Consorzio il Sole	3057A546	ASI Pomigliano D'arco Via Strada Comunale del Cimitero	Pomigliano d'Arco	NA	Private	Productive activity	Groundwater	Metals	Implemented Characterisation Plan	Productive activity	130000	449494	4529924
12	Se.L.C.A. Srl	3025A516	Via Kennedy	Castello di Cisterna	NA	Private	Productive activity				Productive activity	19588	449678	4529898
13	Romana Chimici S.p.A.	3025A506	Via Kennedy	Castello di Cisterna	NA	Private	Plant with a major accident hazard	Groundwater	Chlorinated Aliphatic	Implemented Characterisation Plan	Productive activity	5831	449830	4529670
14	De Vizia Transfert S.p.A.	3057A524	Viale Impero	Pomigliano d'Arco	NA	Private	Waste treatment plant				Waste treatment plant	3697	449706	4529650
15	P.V.C. Agip n.55345 di Romano Antonio s.n.c	3025A520	Strada S.S. 7 Bis	Castello di Cisterna	NA	Private	Fuel service station			Implemented Characterisation Plan	Fuel service station	1200	449681	4529432
16	Ex Ima	3057A523	Viale Impero	Pomigliano d'Arco	NA	Private	Dismissed activity				Productive activity	15651	449463	4529540
17	P.V.C. Q8 n.7064	3057A564	Via Mauro Leone 115	Pomigliano d'Arco	NA	Private	Fuel service station	Soil/ Groundwater	Metals and chlorinated Aliphatic	Implemented Characterisation	Fuel service station	1200	449437	4529364
18	P.V.C. IP (Soc Mercurio S.r.l)	3057A548	Via Roma (Ex S.S. 7 bis km 40,845)	Pomigliano d'Arco	NA	Private	Fuel service station				Fuel service station	70	448987	4529250
19	Tufano Luigi & C. Sas	3057A529	Via Roma	Pomigliano d'Arco	NA	Private	Productive activity			Implemented Characterisation	Productive activity	647	448822	4529144
20	P.V.C. Q8 n.7129	3057A563	Via Roma 111	Pomigliano d'Arco	NA	Private	Fuel service station	Groundwater	Metals,Hydrocarbons, Dioxin, chlorinated Aliphatic	Implemented Risk Analysis; Monitoring Groundwater	Fuel service station	100	448213	4529084
21	Ex Mondo	3057A521	Via Principe di Piemonte	Pomigliano d'Arco	NA	Private	Dismissed activity				Productive activity	5492	447840	4529063

Fig. 4.1.2 Work- table Green Mile. Possible sites where to apply the solution
Source: UNINA Team, 2018

Specific objective: Reclamation of polluted soils and water, and restoration of the former agricultural tradition to promote new forms of circular economy for the wastescapes located into the MAN. Furthermore, this EIS seeks to promote an improvement of the employment situation involving the local community in the agricultural activities.

The table below refers to the specific relationship between objectives and actions for Wastescapes (retrieved from the *Deliverable 6.4, UNINA Team, 2018*):

OBJECTIVES	ACTIONS
waste is not illegally disposed in the streets	• protection and safeguard of territories • reuse of confiscated lands • reuse of former landfills or wastelands
planning processes of urban change shared by different actors	• activation of multi-actor co-design processes • involvement of private actors • reuse of confiscated lands • linear forestation along infrastructure
organized crime is not implicated in waste management	• introduction of measures that allow CE processes to be implemented
citizens and institutions are aware of environmental issues and the functioning of the administrative machine	• construction of a sense of belonging to places through the direct care of public spaces • experimentations on sustainability principles at landscape, urban and design scale • enhancement of public knowledge on the waste management cycle
existing environmental projects at a stalemate are resumed	• recovery and completion of the green infrastructure between Acerra and Pomigliano • protection from hydraulic risk along the Regi Lagni

Table 4.1.3 Relationship between objectives and actions for Wastescapes. Source: UNINA Team ,2018

Potential impacts: Restoration of traditional agricultural crops and consequent improvement of the identity of the area; improvement of the employment situation

of the local community; possibility of activating territorial labs to promote a circular use of the crop and water involved in the remediation process.

Owner of the EIS: UNINA Living Lab, specifically the working tables of the PULL named "New Land" and "Green Mile".

Actors to be involved: Campania Region Authority, farmers, land owners, institutions, environmental organizations, enterprises, researchers, associations that are active on the territory (e.g. citizens' association namely: *Donne 29 Agosto*, Acerra).

Description of the EIS

Current situation

The development of this EIS started from the analysis of the current linear situation of the wastescapes of the MAN, where conditions of environmental and social decline, inaccessibility and disuse come to light (Fig. 4.1.4). The EIS adopted has as a starting point the specific and original features of the site. In fact, historically, Italy has been the second world producer of hemp after Russia; the majority was produced in Campania, and specifically in the provinces of Naples and Caserta. Here the cultivation of hemp was one of the dominant agricultural activities until the late 90s and constituted one of the main means of sustenance, characterizing urban and agriculture elements. For these activities, the Regi Lagni rivers were (and still actually are) essential infrastructures. Moreover, the Regi Lagni rivers were intensely exploited and consequently also heavily polluted.

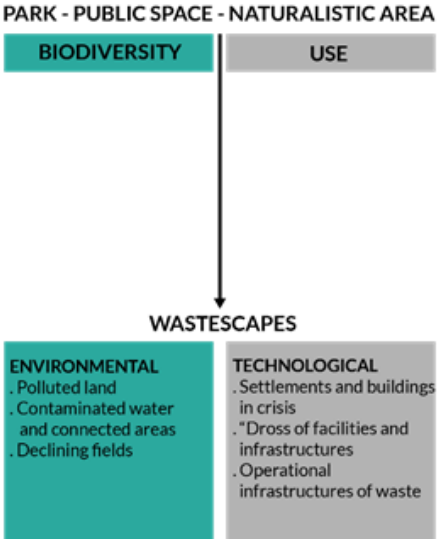


Fig. 4.1.4 Linear scheme of the current situation of the wastescapes
Source: UNINA Team, 2018

Future situation

To decontaminate the soil, this EIS, consistent with the Ecoremed project (Life Ecoremed, 2017), proposes the use of phytotechnologies to be implemented with some agronomic proposals related to typical cultivations suitable for that purpose (Fig. 4.1.5). In particular, the EIS considers the use of *Cannabis Sativa* (hemp) and *Arundo Donax* (cane), in accordance with what emerged during the PULL. *Cannabis Sativa* is a hyperaccumulator (Fig. 4.1.6), thus it is able to collect and tolerate high concentration of heavy metals from polluted soils. It has been used in the treatment of water and soils contaminated by heavy metals, in particular of Copper (1530 mg kg - 1), Cadmium (151 mg kg - 1) and Nickel (123 mg kg - 1), radionuclides, and aromatic compounds (hydrocarbons and PCBs) (R. Ahmad, Z. Tehsin, S. Tanvir Malik, S. Ahmad Asad, M. Shahzad, M. Bilal, M. Maroof Shah, S. Ali Khan, 2016). In addition, after harvesting the hemp once elapsed a period of six months, the EIS proposes the use of *Arundo Donax*, a perennial cane, sowed simultaneously with hemp, in order to continue the reclamation process. This EIS also foresees, in the long term, the creation of wetlands with phytodepurating vegetation in which allowing the overflow of the water of the Regi Lagni rivers, in case of heavy rains. This long term solution can also have a positive effect on the reclamation of the polluted river water and rainwater. Nowadays these are not treated by any means, being absorbed directly from the ground or flowing into the sewer system. In sum, among the expected positive impacts of the solution, there is the possibility of contributing to the purification of the Regi Lagni system, but also of decreasing the flow of rainwater into the sewer, re-using it for agricultural purposes (e.g. irrigation) or for recreational purposes.

SPECIES	ACCUMULATED METALS
Brassica juncea	Pb, Zn, Cd
Helianthus annus	Pb, Zn, Cd, Cu
Zea mays	Pb, Zn, Cd, Cu, Cr
Nicotiana tabacum	Pb, Zn, Cd, Cu, Cr
Populus alba	Various
Populus spp	Various
Salix spp	Various

Fig. 4.1.5 Suitable species for phytotechnologies
Source: UNINA Team, 2018

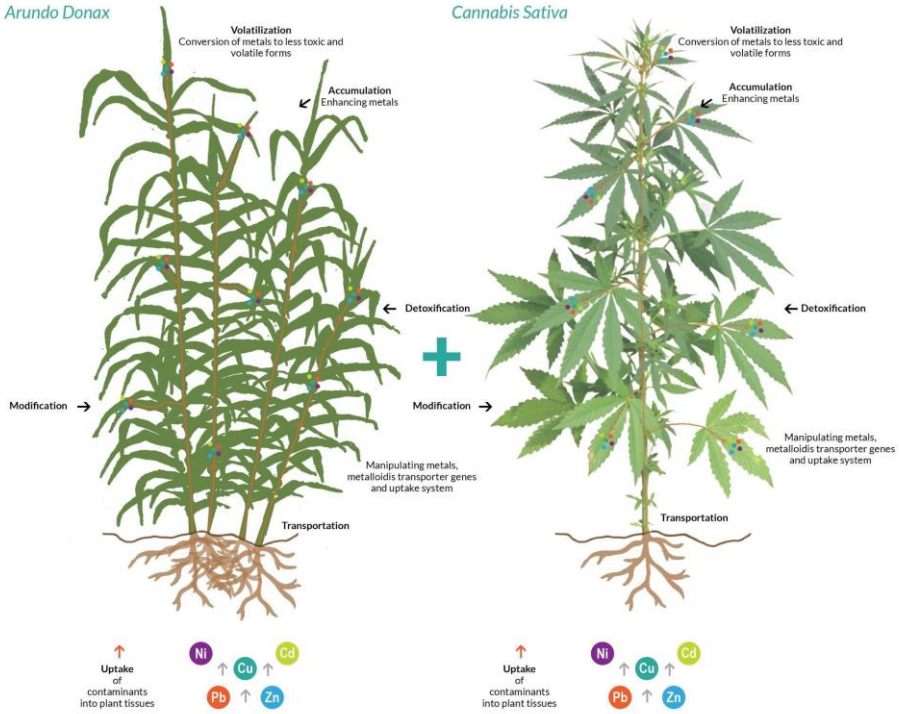


Fig. 4.1.6 Phytoremediation process for contaminated soils with Cannabis Sativa in combination with Arundo Donax
Source: UNINA Team, 2018

Phytechnologies, including phytoremediation and phytodepuration, are good and sustainable alternatives to the traditional remediation methods both in economic and environmental terms. They allow gradual extraction of pollutants from contaminated matrices and the reduction of diffuse pollution directly on site, biomass production, improvement of soil and water quality and of ecological and landscape features. Phytodepuration "*is a system aimed to the waste water treatment based on biological, chemical and physical-chemical processes characteristic of aquatic environment and wetlands*" (ISPRA 2012, p.13). Phytoremediation "*is the use of plants to partially or substantially remediate selected contaminants in contaminated soil, sludge, sediment, ground water, surface water, and waste water. It utilizes a variety of plant biological processes and the physical characteristics of plants to aid in site remediation*" (EPA 2001, p.1).
According to the principles of sustainable developments, phytoremediation and phytodepuration take advantages from the selective capacities of the root system to extract pollutants from the ground, without harming the environment. However, they require longer time to decontaminate the site compared with the traditional techniques (Fig. 4.1.7). In this sense, over a ten year-period - during the remediation process - with this solution, we propose that the site could be used temporarily welcoming initiatives supported by local associations and citizens promoting the activation of urban labs and, to avoid the contact with the polluted soil, the installation of a winding walkway aimed to a safe use of the site (e.g. for references De ceuvel Project in Amsterdam https://deceuvel.nl/en).

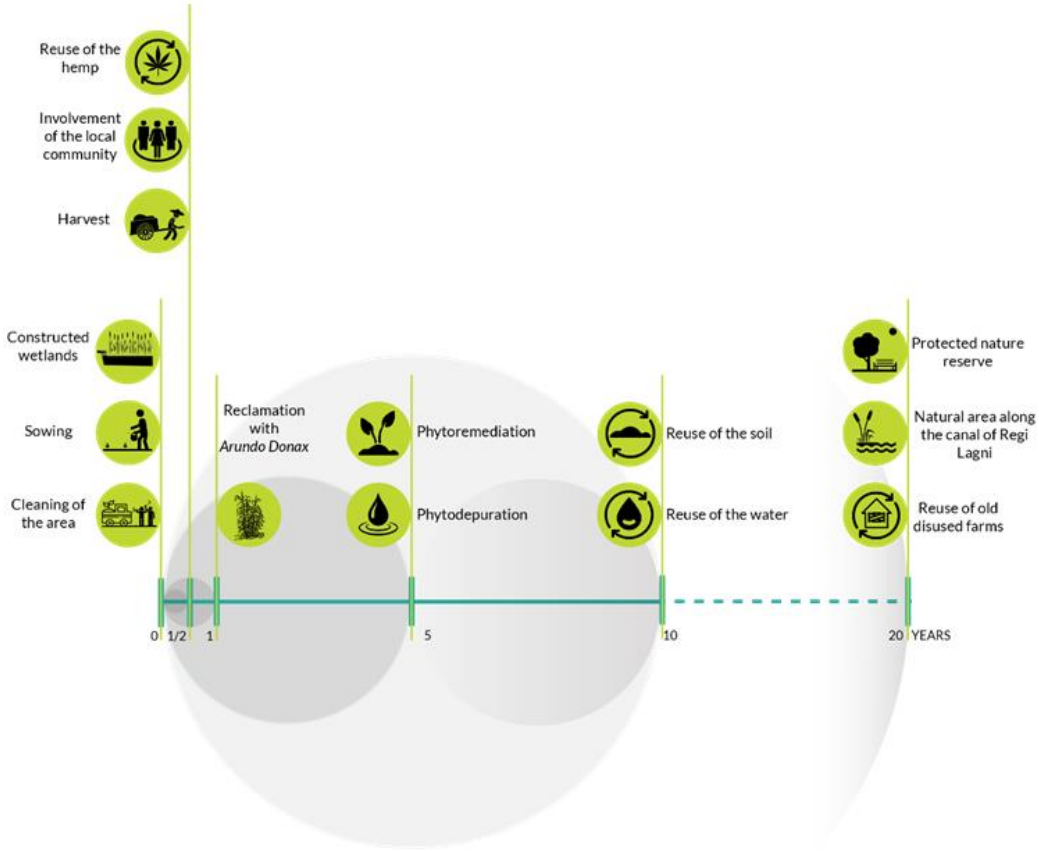


Fig. 4.1.7 Eco-Innovative Solution Life Cycle
Source: UNINA Team, 2018

After harvesting and laboratory testing to evaluate the level of contamination of the crop itself, the different parts of the hemp plant could be reused (Fig.4.1.8). Specifically, from stalks, seeds and leaves derive textiles, paper, construction materials, body care products, animal bedding, mulch and compost. The most used part is the fibre, one acre of hemp produces 3 – 8 tonnes of dry fibre and 3500 liters of methanol, while fuel derives from scraps through the pyrolysis process.

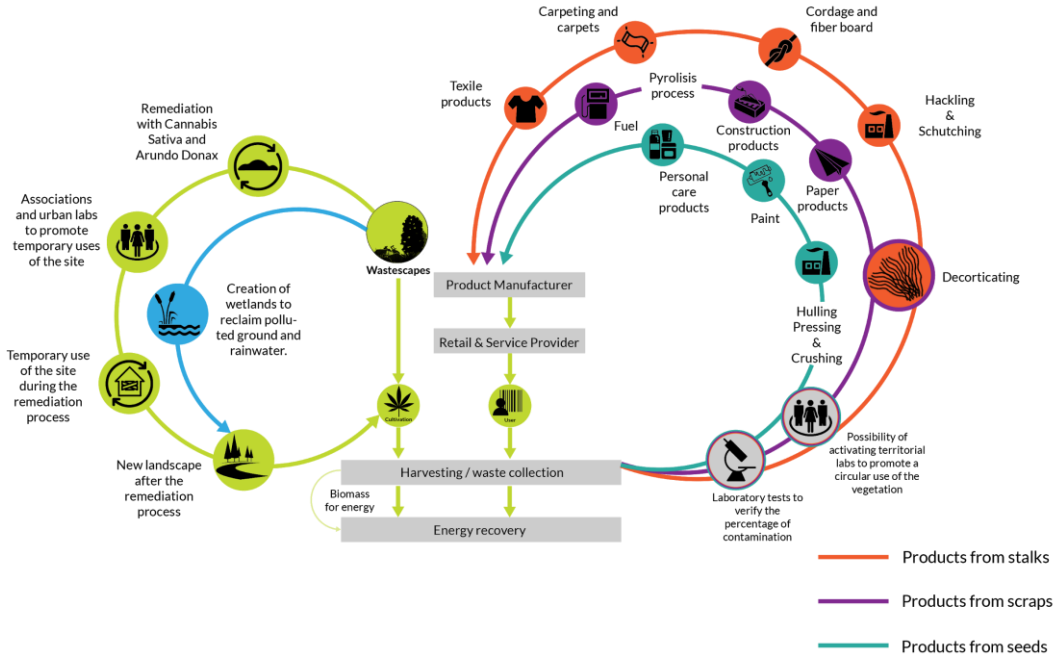


Fig. 4.1.8 Circular process scheme on the circularity of wastescapes during and after the remediation process
Based on the graphic of Ellen MacArthur Foundation https://www.ellenmacarthurfoundation.org/
Source: UNINA Team, 2018

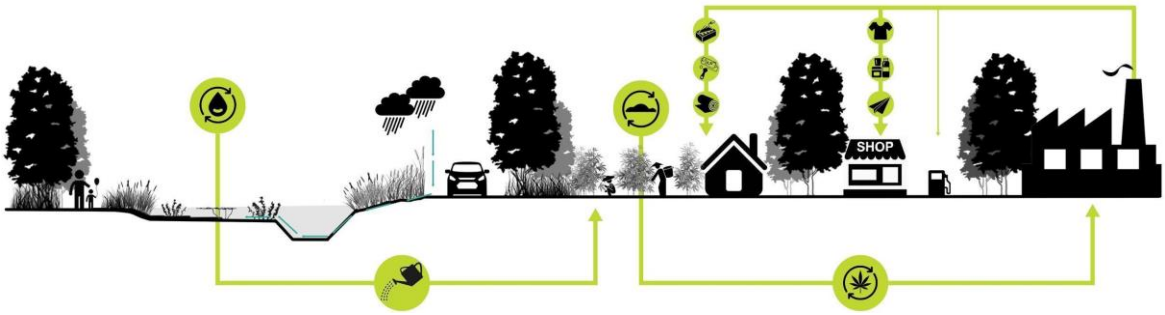


Fig. 4.1.9 Systemic section of RECALL the Eco - Innovative Solution
Source: UNINA Team, 2018

The high biomass production (one acre of hemp cultivation corresponds to 10 tonnes of biomass), the large plasticity, which allows hemp to be grown under a wide variety of agro-ecological conditions, and the possibility to use its biomass in non-food industries, make this species attractive for phytoremediation. Therefore, its use would allow, beyond the reclamation of the soil and the recovery of a historical crop, to obtain social and economic results thanks to the possibility of using the product in artisanal activities, triggering new forms of circular economy.

Using hemp within the remediation process of wastescapes allows to place them in a circular perspective thanks to the reuse of the space and to the possibility of implementing local production supply chains, associations and experimental

laboratories (Fig.4.1.9). In addition to the direct and indirect benefits of the phytotechnologies, the use of hemp within the remediation process may have relevant and positive environmental, economic and social impacts.

Environmental benefits

Scientific literature provides useful insights to better understand the effectiveness of hemp during a phytoremediation process, as detailed in the table below:

Reference	S. Citterio, A. Santagostino, P. Fumagalli, N. Prato, P. Ranalli, S. Sgorbati, 2003. *Heavy metal tolerance and accumulation of Cd, Cr and Ni by Cannabis sativa L.* Plant and Soil 256: 243–252
Contaminants of concern	Cd, Cr, Ni
Mechanism involved in phytoremediation	Phytoaccumulation (for Cd and Ni), tolerant plant for Cr
Requirements for phytoremediation (specific nutrients, addition of oxygen)	After plant development is appropriate to pull up the total plant
Substrate characteristics	3% organic matter soil, pH 7.0–7,5, obtained by mixing sand with sowing potting compost
Laboratory/field experiment	Laboratory experiment (plants were grown in pots placed in field conditions)
Age of plant at 1st exposure (seed, post-germination, mature)	Seed
Length of experiment	4 month after germination. (The plants were analysed about 2 and 4 month after germination, at development and ripeness stages)
Initial contaminant concentration of the substrate	Soil S1 contains 27, 74, 126 μg/g of Cd, Ni and Cr, respectively. Soil S2 contains 82, 115, 139 μg/g of Cd, Ni and Cr, respectively
Post-experiment contaminant concentration of the substrate	Any statistically significant variation in soil metal content was detected after one crop of hemp. Nevertheless, a consistent amount of Cd and Ni is expected to be extracted by 1 ha biomass of hemp (about 10 t) per year and along the time a slow restoration of deeper soil portions can be obtained by its wide root system. On the average, about 0.4, 46 and 500 μg/g of Cd were extracted by hemp from the control, S1 and S2 soils, respectively. The amount of Ni accumulated in hemp above ground tissues, although not negligible (on average, 19 and 135 μg/g were found in S1 and S2

	plants, respectively), was less than in Ni hyperaccumulator plants. The mean tissue content for Cr was negligible
Post-experiment plant condition	After two months from germination and at ripeness, no significant alteration in plant growth or morphology was detected. On the contrary, a high hemp reactivity to heavy metal stress with an increase in phytochelatin and DNA content was observed during development, suggesting the C. sativa ability to avoid cell damage by activating different molecular mechanisms
Contaminant storage sites in the plant and contaminant concentrations in tissues (root, shoot, leaves, no storage)	Metals were preferentially accumulated in the roots and only partially translocated to the above-ground tissues

Table 4.1.10 Schematization of the results on hemp after the phytoremediation process
Source: www.ibaf.cnr.it/.../cannabis-sativa-cd-cr-ni-pb-zn-organics-radionuclides.pdf

Hemp cultivation could provide other environmental advantages as listed below:

- First of all, the **absorption of carbon dioxide** four times higher than that assimilated by trees. Its use in the construction field does not involve any change for this properties. If the traditional construction accounts for 30-40% on the carbon dioxide emissions, the lime and hemp production supply chain is carbon negative. A ton of hemp straw is able to absorb 325 Kg of CO_2.
- Hemp is a producer of **biomass fuel** which requires a low specialization both in the cultivation and processing of all plant products. This relevant side may help to minimize the consumption of fossil fuels and their impacts on Earth. However, even we are considering it in the description of this solution, this is not the primary objective of the solution since it appears to be anyhow a end-of-pipe solution, outside of the scope of REPAiR.
- With regard to the **hemp bio-plastic**, it is completely biodegradable. This is a good response to the problem of the presence of plastic in the oceans. The Word Economic Forum (WEF, 2016) explains that currently there are 350 million tonnes of plastic in the oceans. Within 2050 instead the plastic will exceed by weight the marine wildlife.
- Currently, at global level, only 5% of the **paper** is made from annual plants like hemp but an increase in this production could help to reverse the deforestation.
- A **reduction in the use of pesticides and herbicides** and a **low water consumption** because hemp does not require them for its growing.

Economic benefits

Growing and cultivation of hemp on contaminated soils could have positive implications also in economic terms (Fig. 4.1.11). The scheme below reports costs and incomes obtainable from the cultivation of hemp on one hectare of soil namely from ten thousand plants. According to an estimate based on the cultivation and subsequent sale of hemp straw and seeds, it emerges clearly that the gross average income per ha equal to twice costs, excluding those related to the labour force.

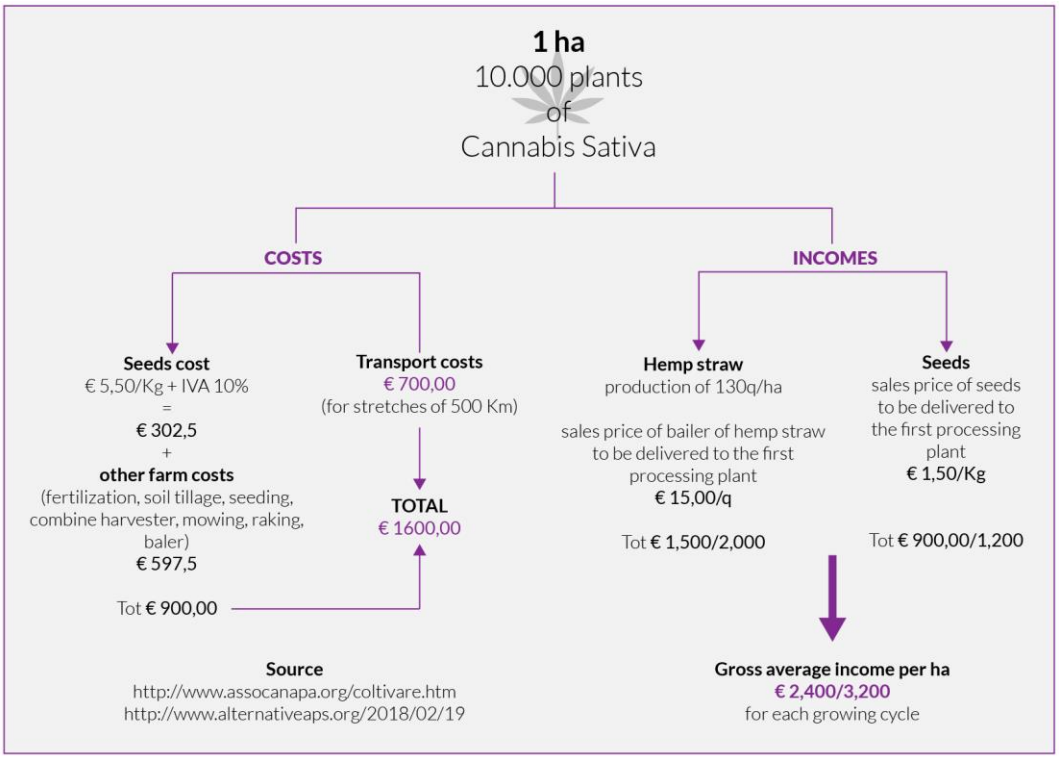


Fig. 4.1.11 Approximate estimate of costs and incomes derived from hemp cultivation
Source: UNINA Team, 2018

Social benefits

Compared to other crops, like wheat, hemp leads to more regional employment per Hectare. Actual figure are 800 jobs on 10,000 farms (4 times as much as wheat per Hectare), 2,000 jobs at 1st processing stage (5 times as much as wheat per Hectare) in around 100 companies. Specifically, the hemp cultivation requires 8 working hours per Hectare, twice as much as wheat (4 hours) due to the greater harvesting required and, during the primary processing stage, 2-3 times more workforce.
In the light of these considerations, it is easy then to understand the value of this crop in terms of employment both for citizens and local enterprises.

Eco-Innovative Solutions

The strategy has been divided as follows in order to provide an easily and immediate reading of the EIS and the objectives that each one propose to reach.

EIS	OBJECTIVES
1.1 Use of Phytotechnologies to reclaim wastescapes, taking advantage from typical cultivations like *Cannabis Sativa* and *Arundo Donax* in order to strengthen local identity	This approach is more sustainable than the tradition remediation methods with a considerable reduction of the impacts on the territory. The willingness to employ local crops aims to strengthen the local identity and rediscovering what once was a theyalth for the Region
1.2 Creation of wetlands with phytodepurating vegetation in which to flow and reclaim the contaminated water of river basins and canals and the polluted rainwater for irrigation purposes in order to reactivate the historical agricultural vocation of the sites	This EIS has twofold purposes. First of all the reuse of water for irrigation, secondly the presence of a naturalistic area allows to improve the landscape quality of the site and to contain the hydrogeological risk
1.3 Activation of urban living labs to promote different uses of hemp and temporary uses of wastescapes during the remediation process	Urban Living Lab, through the involvement of stakeholders, are useful to promote temporary and innovative uses, besides the hemp, during the remediation process declining them on the real and practical needs of the local communities
1.4 Support to the extensive cultivation and hemp grown involving local enterprises for its process, according to the principles of short circular supply chain, improving local employment	An extensive cultivation and production of hemp could contribute to lower the level of unemployment providing also work for small local companies. Hemp cultivation is also an opportunity to discover ancient works once the main source of income on the territory
1.5 Activation of local associations supporting hemp cultivation (linked to the EIS 1.4)	Activation of local associations is more relevant to promote, defend and disseminate hemp cultivation and its uses in the various production sectors. In addition, associations represent the needs of the farmers and the enterprises against regional, national and international institutions involved in the management of agricultural and industrial production. Moreover, local associations encourage and develop the research aimed to support hemp cultivation and its uses with a focus on

	the environmental and human safety (linked to EIS 1.4)

Table 4.1.12 Correspondence in objectives for each EIS
Source: UNINA Team, 2018

References

- Ahmad, R., Tehsin, Z., Tanvir Malik,S., Ahmad Asad, S., Shahzad, M., Bilal, M. Maroof Shah, M., Ali Khan, S. (2016). *Phytoremediation potential of hemp (Cannabis sativa L.): Identification and characterization of heavy metals responsive genes*. CLEAN Soil Air Water, Volume n. 44, Issue n. 2: 195-201.
- Campbell, S., Paquin, D., Awaya, J. D., & Li, Q. X. (2002). *Remediation of benzo [a] pyrene and chrysene-contaminated soil with industrial hemp (Cannabis sativa)*. International journal of phytoremediation, 4(2), 157-168.
- Citterio, S., Santagostino, A., Fumagalli, P., Prato, N., Ranalli, P., Sgorbati, S. (2003). *Heavy metal tolerance and accumulation of Cd, Cr and Ni by Cannabis sativa L.* Plant and Soil 256: 243–252.
- EIHA_European Industrial Hemp Association (http://eiha.org).
- EPA, *Phytoremediation of Contaminated Soil and Ground Water at Hazardous Waste Sites. (https://www.epa.gov/sites/production/files/2015-06/documents/epa_540_s01_500.pdf).*
- ISPRA, (2012). *Guida Tecnica per la progettazione e gestione dei sistemi di fitodepurazione per il trattamento delle acque reflue urbane*. Manuali e Linee Guida 81. (http://www.isprambiente.gov.it/files/pubblicazioni/manuali-lineeguida/Manuale_81_2012.pdf).
- Ellen Macarthur Foundation, 2017. https://www.ellenmacarthurfoundation.org.
- Linger, P., Ostwald, A., Haensler, P. (2005). *Cannabis sativa L. growing on heavy metal contaminated soil: growth, cadmium uptake and photosynthesis*. Biologia Plantarum 49 (4): 567-576.
- Law 2 of December 2016 n. 242 *Disposizioni per la promozione della coltivazione e della filiera agroindustriale della canapa (http://www.normattiva.it).*
- *LIFE ECOREMED, (2017). Operative Handbook. For eco-compatible remediation of degraded soils. http://www.ecoremed.it/images/stories/FinalReport/LIFE%20ECOREMED%20Handbook.pdf.*
- LIFE ECOREMED PROJECT, (2017). *Technical Report*. http://www.ecoremed.it
- METABOLIC, *De Ceuvel Project overview* (2015). https://www.metabolic.nl/projects/de-ceuvel; http://deceuvel.nl/en/about/sustainable-technology
- MultiHemp Project. *Multipurpose hemp for industrial bioproducts and biomass* (2017). (http://multihemp.eu).

- Regional Law 20 of January 2017 n. 5 *Interventi per favorire la coltura della canapa (Cannabis Sativa L.) e le relative filiere produttive.* *http://regione.campania.it/normativa/item.php?7b7fec2087f982d694b26f0cc9f850d6=03036f5e7510b1f235f4b49714555652&pgCode=G19I231R1705&id_doc_type=1&id_tema=23&refresh=on*
- Remediation Technologies Screening Matrix and Reference Guide *In situ Soil Remediation Technologies. Phytoremediation* (https://frtr.gov/matrix2/section4/4-3.html).
- World Economic Forum, 2016. *The New Plastics Economy. Rethinking the future of plastics (https://www.weforum.org/press/2016/01/more-plastic-than-fish-in-the-ocean-by-2050-report-offers-blueprint-for-change/).*

On
ORGANIC WASTE

4.2. Re-Compost Land. Short supply chain of organic waste

Flow
Organic Waste.

Category of outcome
Economic, Social, Environmental, Legal.

Location of the good practice
Metropolitan Area of Naples, peri-urban area surrounding the high-speed railway station of Napoli-Afragola (TAV).

Specific objective
Regeneration of wastescapes, of the buffer areas, and the agricultural fields, through an innovation process which works on the short supply chain, thanks to Regional funding able to trigger the use of community composting plants. The short supply chain allows to collect and treat organic waste in the REPAiR sample area, in order to create:

1. top soils for the new morphologies of the terrain, along the roads, and around the recycling areas;
2. new fertile ground to recover the agricultural lands.

The table below refers to the specific relationship between objectives and actions for Organic waste (retrieved from the Deliverable 6.4, UNINA Team, 2018):

OBJECTIVES	ACTIONS
waste is not illegally disposed in the streets	reuse of confiscated lands
planning processes of urban change shared by different actors	• activation of multi-actor co-design processes • involvement of private actors • reuse of confiscated lands • activation of synergies with pivot actors • linear forestation along infrastructure
organized crime is not implicated in waste management	• introduction of measures that allow CE processes to be implemented • incentives for waste collection centres

citizens and institutions are aware of environmental issues and the functioning of the administrative machine	• construction of a sense of belonging to places through the direct care of public spaces • experimentations on sustainability principles at landscape, urban and design scale • enhancement of public knowledge on the waste management cycle
existing environmental projects at a stalemate are resumed	• reuse of the PIP area in Acerra with ecologic finalities

Table 4.2.1 Relationship between objectives and actions for Organic waste.
Source: UNINA Team, 2018

Potential impacts
The promotion of the short supply chain activates closed territorial loops based on the principles of circular economy. They are oriented towards both short and long-term results. The involvement of the citizens' associations allows a more sudden and lasting appropriation of abandoned public areas as pilot sites for experimenting the EIS. At the same time, the treatment of the urban organic fraction, and the identification of buffer areas (mainly along the roads) are the first steps to re-design the terrains, and to re-think at the process in order to give new quality at the marginal areas.

Owner of the EIS
UNINA Living Lab.

Actors to be involved
Campania Region Authority (CRA), ATO (Optimal Territorial Area), Coldiretti, sectoral association, Metropolitan city of Naples, startup.

Description of the EIS

Current situation
More than 80% of the Organic Waste, collected in the Campania Region, is treated outside of the regional territory, as the equipment of active plants (only two in the whole Region) is totally inadequate. As described in the Urban Report of Waste (ISPRA 2017), the organic waste (OW) produced in the Campania Region, from the household separate collection, up to the 2016 exceed 708 thousand tons, of which only 67 thousand are treated in Campania. These two active plants treat the organic waste through an integrated anaerobic as well as aerobic process; they recover the renewable energies in the form of biogas/biomethane, following the strategies introduced with the DM 23/6/2016, by the "Minister for the Environment and for

the Protection of Land and Sea". In order to transform this treated OW in compost, another aerobic process is carried out (Tab. 3.1.3, pg.105, ISPRA 2017).
Of these two plants, one is located in Caivano (one of the municipality in our Sample Area). The capacity of this plant is 33 000 t, of which 32 070 t are treated wastes of which: 28 400 tonnes are food waste (20 01 08), 2 975 tonnes of urban green (20 02 01) and 695 tonnes (other). Through an anaerobic treatment they produce 3701130 Nmc of Biogas, that are subsequently treated in an aerobic way producing 2076 tonnes of mixed compost. The CEA (consortium of alternative energy) in Caivano, deals only with the processing and not with the collection of organic waste, as it is the main plant in Campania. It is important to mention that in order to produce the best quality compost, a certain amount of good quality of organic waste is bought and treated by the plant.
Although the Campania Region has implemented a series of measures for the realization of new plants (es.: Decreto dirigenziale n. 71 del 22/02/2017 "Community composting plants for the treatment of the organic fraction of municipal waste") to meet the request of the European Union, the majority of the municipalities are strongly resisting scared by the possible effect (D3.3). OW is collected and managed by Municipal Solid Waste and Regional Municipal Waste Management Plan (Piano Regionale di Gestione dei Rifiuti Urbani, PRGRU).

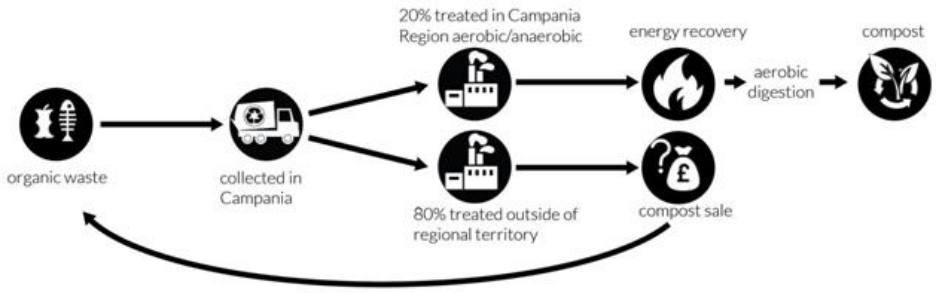


Fig. 4.2.2 Linear scheme of current situation
Source: Francesca Garzilli, UNINA Team, 2018

Future situation
As emerges from the ISPRA data (ISPRA 2017) , the tons of organic waste produced largely exceed the quantities of material that can be treated in the Region. We use the managerial decree ("Decreto Dirigenziale" n.71 / 2017) as the starting point, and in particular: the directives given with regard to the location of the new plants (public areas or open to collective use) and their dimension (60t / year <compost community <130t / year). We calibrate the plants dimension on the reference territorial context (neighborhood, rural or peri-urban unit, etc.). The aim is to avoid an excessive impact of the plant on the territory, to favor the acceptance by the communities, and at the same time, to ensure systemic efficiency. And also to experience a short supply chain, its treatment and its recycling.

The peri-urban areas where the composters will be placed will be public areas, regenerating in this way the wastescapes identified during the PULL workshops, with the involvement of the citizens, and emerged from the research conducted by the DiARC UNINA team. The idea is to create a short supply chain for the organic waste, which allows on the one hand to regenerate the agricultural soils through the treatment of compost and its reuse on site. On the other hand, it aims to define new morphologies of the land reusing the compost produced with the organic waste coming from the household collection, and the urban green waste, as grass clipping (in line with the PRGRU "Regional Plan for Urban Waste Management"). The two processes will be carried out in parallel, working on different time and scales in order to then develop the process gradually. We consider, based on similar processes, as show the literature, that for this entity of territorial reconfiguration it will take at least 20 years, but it is necessary to achieve the first concrete demonstration results from the beginning of the process.
The technological innovation is carried on the size of the plants. Considering the data of "ISPRA 2015" for the Sample Area:

tonnes of organic waste: 45,967 t/y
number of inhabitants: 290,006
surface of mapped wastescapes: 19,294,477 m²

the idea is to localize medium compost plants in each municipality in order to create eco-district as catalyst of territorial reconfiguration and implementation of the supply chain. The ISPRA data (ISPRA 2017) gives a distorted idea of the real production of organic waste, because it shows tonnes produced in each municipality dis-proportionated to the numbers of inhabitants. In these municipalities the first goal is to increase the citizens' awareness of the separate waste collection, providing tax incentives in order to improve the waste management and obtain a real scenario of the tonnes produced too.

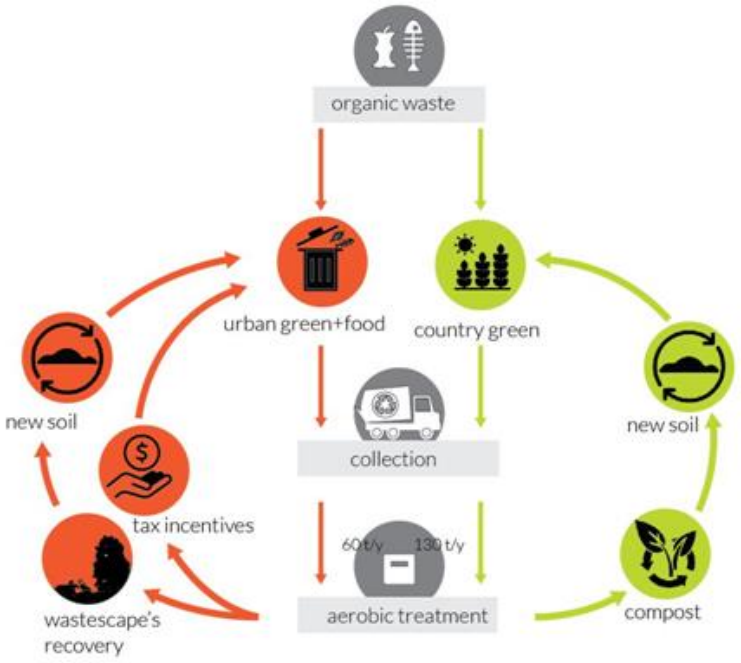


Fig. 4.2.3 Circular process scheme
Based on the graphic of Ellen MacArthur Foundation https://www.ellenmacarthurfoundation.org/
Source: UNINA Team, 2018

Fig. 4.2.4 Systemic section of the Eco-Innovative Solution Re-Compost Land.
Source: UNINA Team, 2018

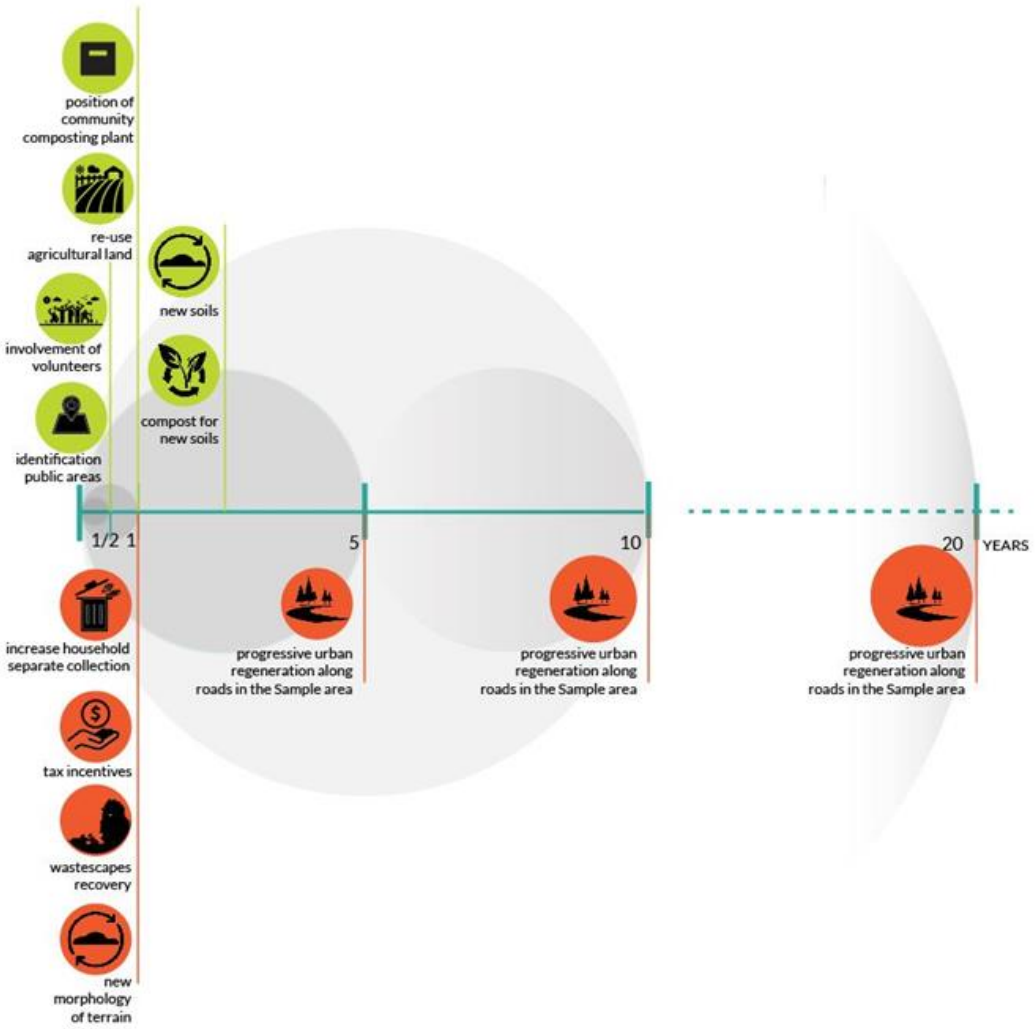


Fig. 4.2.5 Eco-Innovative Solution Life Cycle
Source: UNINA Team, 2018

Eco-Innovative Solutions
This strategy has been divided as follows:

EIS	OBJECTIVES
2.1 Medium size neighborhood compost plant.	Reducing the treatment of organic waste outside of the Region, and making the citizens aware of the needed shifts towards a circular economy.

2.2 Creation of a New Waste Eco-District.	Reducing the visual impact and the negative citizens' perception of these facilities. The compost plants will be located within Eco-Districts. These new plants could also become new landmarks, catalysts of a change of the waste management process in the peri-urban territories, characterised by latent potentiality. In this way, the "New waste district" could become the propagator of new economies and new territorial design.
2.3 Production of safe and high-quality compost to regenerate agricultural soils in the surrounding of neighbourhood compost plants.	Regeneration of abandoned agricultural land at almost 'zero-kilometer'.
2.4 Transformation of wastescapes in peri-urban farms thanks to the short supply chain.	Wastescape regeneration, new land uses: from abandoned peri-urban land to productive land.
2.5 Allocate part of the treated compost to shape new landscape morphologies (linked to EIS 3.5).	Creation of compost as topsoil for new landscape morphologies thanks to the short supply chain (linked to EIS 3.5).
2.6 Tax Incentives to change food waste behaviour of households and companies.	Giving tax incentives to families and companies that produce OW (as the shopping center, restaurants, etc.), aiming to change the attitude of citizens towards separate waste collection.

Fig. 4.2.6 Eco-Innovative Solution Life Cycle
Source: UNINA Team, 2018

In order to image the future scenarios and how many compost plants are needed in the area, the solution analyse the data and the maps produced during the PULLs .

	numbers of inhabitants	organic waste produced (t/y)	surfaces of wastescapes (m^2)	surfaces of public areas (m^2)
Acerra	59 573	14 254,76	4 057 867	1 309 716

Afragola	65 057	7 349,08	7 188 712	2 625 807
Caivano	37 879	3 202,08	1 032 884	936 520
Casalnuovo	49 855	9 001,82	1 443 737	599 995
Casoria	77 642	12 159,21	4 485 372	832 695
TOT.	290 006	45 967	19 294 477	6 304 734

Table 4.2.7 Summary information usable to imagine future scenarios
Source: ISPRA 2015 (wastescape and public areas surfaces are calculated by UNINA Team)

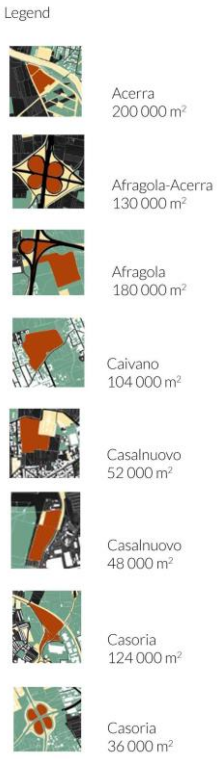
Suitable approach for possible plants location

The hypothesis is to localize several medium-sized plants - 2 or 3 for each municipality of the focus area - in order to promote a better acceptance of the plant themselves by citizens and local stakeholders.

The aim is to link the urban and landscape regeneration of the territories with an improved management of OW. Further measures to enhance the awareness of citizens are taken, also to increase the confidence of the local communities in the waste treatment, and eventually to improve the quality of the separate waste collection.

The size of each plant could be between 5,000 and 10,000 t/y, in order to minimize the impact on the environment. By the aerobic treatment, about 30% of the compost by the organic fraction treated in the plant could be obtained. This treatment allows greater control and would help small farms that could benefit from their management. With combined anaerobic/aerobic plants, smaller than the existing plants in Campania (Caivano and Salerno) around 10,000 t/y, in addition to avoid the NIMBY effect, there could be a greater return in economic terms. If on one hand this plant allows to recover both electricity and biogas, on the other, the outgoing compost will be minimal.

Fig. 4.2.8 Enabling contexts and hypothesis of Eco-district location
Source: UNINA Team, 2018



The localization of the compost plants starts from the identification of the wastescapes and of the public areas where to implement them. The hypothesis came out during the PULL workshops (refer to "Preliminary EIS") and it appears to be an area close to Masseria Ferraioli.

The eco-districts have been identified on the basis of enabling context study: "Enabling contexts can be defined as specific locations within the focus area that are more suitable for developing the eco-innovative solutions and strategies. One of the results of the spatial analysis is therefore to indicate the system of areas in which the experimentations can be more easily applied and where the general process of regeneration can be tested and implemented as of prime importance. Enabling conditions are the premise for the identification of an enabling context" (REPAiR D3.3 *Process model for the two pilot cases: Amsterdam, the Netherlands & Naples*, p. 26).

References

- "Decreto Dirigenziale" n.71 / 2017, *Manifestation of interest and localization of community composting plants for the treatment of organic municipal waste* (Reference Law n.221, 28/12/2015.) http://www.regione.campania.it/assets/documents/decreto-dirigenziale-dip52-5-n-71-del-22-02-2017-1.pdf
- Ellen Macarthur Foundation, 2017. https://www.ellenmacarthurfoundation.org.
- ISPRA, 2017. *Municipal Waste Report*. http://www.isprambiente.gov.it/en/publications/reports/municipal-waste-report-edition-2017
- Regional Law n.14, 26/05/2016 *Rules for the implementation of the European and national regulations on waste*
- REPAiR D3.3 *Process model for the two pilot cases: Amsterdam, the Netherlands & Naples, Italy*, 2018
- PRGRU - *Piano Regionale di Gestione dei Rifiuti Urbani* , update of 16th December 2016.

On CONSTRUCTION& DEMOLITION WASTE

4.3. Beyond INERTia. Circular supply chain for CDW

Flow
Wastescapes, Construction and Demolition Waste.

Category of outcome
Economic, Technologic, Environmental, Legal.

Location of the good practice
Metropolitan Area of Naples, peri-urban area surrounding the high speed railway station of Napoli- Afragola (TAV).

Specific objective
Beyond INERTia strategy introduce a set of EISs to trigger specific weak points in current supply chain of recycled aggregates (crushed concrete, bricks, tiles or asphalt from construction debris) from production to reuse. Moreover, it has the goal to create services that aim at improving the recovery and recycling of inert waste. In the technology of conglomerates and mortars, inert is both cement and other binder, and all those materials (as sand, gravel, crushed stone) that do not undergo any chemical modification during the phenomenon of the setting and hardening of the binder (Treccani, 2018).
Waste produced in Campania Region is classified in Urban Waste, better known as Municipal Solid Waste (MSW), and Special Waste, that can be divided in hazardous and non-hazardous (see 2008/98/CE, 2018/851/CE, Regional Law n. 14/2016, REPAiR, 2018, D.3.3, p. 141). Considering these two flows of the same type of waste, we can observe two families of related issues:

1. The main problem concerning CDW from MSW is their abandonment along the roads or in quieter locations.
2. Instead, CDW that are classified as Special Waste, are produced by companies, and therefore have a good rate of recycling, even if there are some critical passages in their supply chain.

As first objectives of MAN consist in avoiding illegal dumping (for wastescape prevention) and regenerating wastescapes, Beyond INERTia Strategy promotes the prevention of the abandonment of CDW, reuse and recycle of inert waste aiming at intercept CDW flows of individuals and small producers.
Therefore the Beyond INERTia Strategy is composed by two kind of EISs:
a. On the one hand, the Strategy respond to unauthorised disposals of CDW from MSW in urban and peri-urban areas. For that, it provides for increasing of places where is allowed to bring CDW, reducing transports burden for users.
b. On the other hand, the Strategy considers CDW from Special Waste flows. This part of the flow is composed by inert waste for the most. Recycled Aggregates are the main product currently produced from Inert Waste (ANPAR), but the process from waste to the recycled product is not still fluent. Thus, in Campania it seems

necessary to consider the whole supply chain of Inert Waste to trigger those rules that do not facilitate Recycled Aggregates spreading in the market.
Therefore, EISs of Beyond INERTia Strategy will offer the following benefits:

- enabling selective demolition by improving CDW separation, and meliorating the flow quality;
- avoiding illegal dumping;
- recovering inert waste from mixed rubble from MSW;
- implementing regional actions like the "regional mark of Environmental Sustainability" for recycled aggregates;
- providing inert waste for local uses and facilitating a short supply chain.

Owner of the EIS
UNINA Living Lab

Actors to be involved
Campania Region, ATO (Optimal Territorial Area), sectoral associations, Neapolitan Association of Building Contractors (ACEN), Metropolitan city of Naples, startups.

Description of the EIS
Beyond INERTia Eco-Innovative Strategy acts on weak points of CDW supply chain, activating practices to operationalize circular economy and to create conditions for wastescapes prevention and remediation. According the two classifications of CDW in MSW and SW, six punctual EISs have been designed to reveal shadow flows in waste management (Hebel et al.,2014) and to trigger locked passages in inert waste supply chain (relative to SW management). In the next paragraph difficulties in CDW recycle are explained. These are mostly due to boundary conditions than to the recycle process itself.

1. INERTIA LAB. Free collection Eco-Points for CDW from MSW, disposed by little producers. The Laboratory will provide to: separate inert waste from MSW, sort and sell them to sector companies.
2. QUARRY TAX. Increase Regional Concession Fee on quarries of sand and gravel.
3. SELECT. Incentives to companies that make Selective demolition.
4. CERT. Activation of "Regional Sustainability Certification" for Recycled Aggregates from Inert Waste.
5. B€ST. Putting the item and price of "Recycled Aggregates" in tender specifications.
6. SHAPES. Using recycled aggregates in backfilling operations for new morphologies of terrains along roads and around recycling areas. *linked to EIS 2.5.

Current situation
CDW represents the most substantial waste flow in Italy, being the 40% of the total Special Waste (SW) flows with almost 52.7 millions of tonnes of non-hazardous waste from construction and demolition activities according to ISPRA (2015).

Although at the national level 76% of CDW were recycled in 2012, 24% of CDW still goes to landfill (ISPRA, 2014).
The amount of CDW recovered in backfilling operations amounted approximately 160 thousand tonnes in 2012. ISPRA (2014) reports that 102,000 tonnes of CDW were exported in 2012.
If we analyse production of SW per hazardous and non-hazardous, it is evident that production of non-hazardous SW is mostly due to the construction and demolition sector. In Campania region CDW amounts to 43.3% of total regional waste production divided as follow.

Year	Non Hazardous Special Waste (t)	Hazardous Special Waste (t)	RS CER code ND (t)	Total (t)
2015	6,685,909	340,352	1	7,026,262

Table A. SW Report. 2015 Data.
Source: ISPRA, 2017.

Economic Activities	NACE code	Total Special Waste (t)	Total Non-Hazardous Special Waste (t)	Total Hazardous Special Waste (t)
Constructions	41, 42, 43	3,028,689	3,024,317	4,372

Table B. SW report. (2015 Data).
Source: ISPRA, 2017.

EWC	EWC code	Total Special Waste (t)	Total Non-Hazardous Special Waste (t)	Total Hazardous Special Waste (t)
Construction and Demolition	17	3,039,033	3,012,970	26,063

Table C SW report. 2015 Data.
Source: ISPRA, 2017.

These data are actually partial. In fact, production of CDW can result from the combination of the activities of at least four sectors:

1. Construction and demolition activity;
2. Unauthorized construction and demolition activity;
3. Domestic “Micro renovations” made on own account;
4. Other activities.

In accordance to paragraph 3 of article 189 (Waste Cadastre) of Legislative Decree n.152/2006, only Institutions and Companies that produce hazardous waste and those who produce non-hazardous waste, with a number of minimum ten employers, are due to the annual *single model of environmental declaration*, named MUD (see REPAiR, 2018, D.3.3, p.143-147). That is the main reason why is not possible to have a complete information about non-hazardous SW from all free MUD sectors and small companies with less than 10 employers.
Inert waste from MSW are a very small part, it seems that the most is not traceable.

This lack of information in part correspond to shadow flows (Fig. 4.3.2).

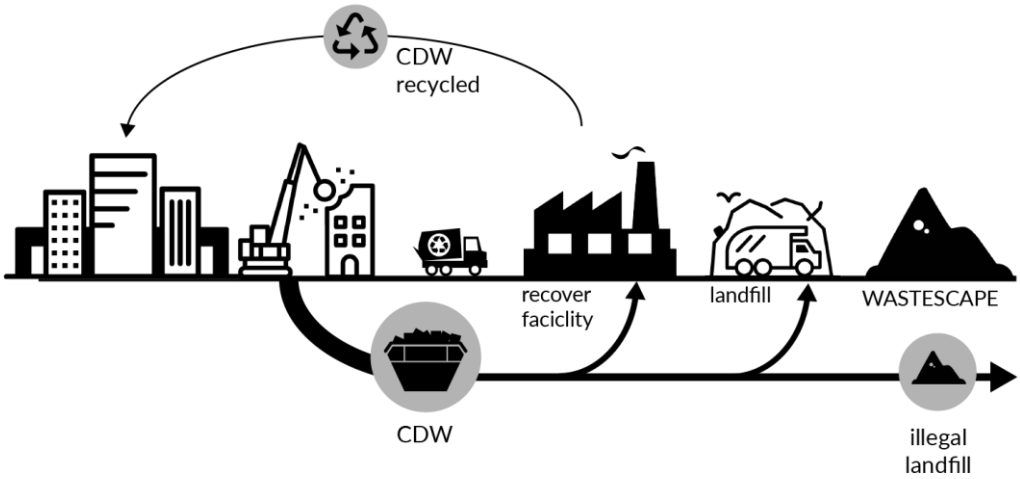


Fig. 4.3.2 Current Situation of CDW in Campania Region.
Source: UNINA Team, 2018

CDW have two possible destinations:

1. Recovery of materials for production of base layer for roads;
2. Disposal in landfills for inert waste[6].

In parallel, in Italy there is a huge quantity of extraction of sand and gravel and a similar quantity of inert waste produced per year. The quantity of material produced in quarries is one of the reasons behind the low reuse of CDW. There are around 2.500 quarries of inerts in Italy (over 4.700 quarries in total) and at least 14.000 abandoned, of which the half are former quarries of sand and crushed rock (Recycle Observatory Report of Legambiente, 2017). Most of materials extracted is sand and gravel, 39,6% in 2014 (ISPRA).

COUNTRY	Sand and gravel extracted	Recycled aggregates	Aggregates reused in situ	Artificial aggregates

[6] Source: Piano Regionale di Gestione dei Rifiuti Speciali (PRGRS), 2012.

	[millions of t]	[million of m^3]	[million of m^3]	[million of m^3]
Germany	370	180.8	0	46.5
Poland	268.8	8	11.2	17.6
France	177.6	32	8*	6.4
Italy	100.8	6.4	0	0
United Kingdom	78.4	83.2	3.2	19.2
Netherlands	80	28.8	0	0
Spain	33.6	1.6	0	0
Belgium	29.8	24	0	1.6

Table 4.3.3 Aggregates sectors in main European Countries, 2015.
Source: Legambiente elaboration on UEPG data, 2017.

In 2013, the Italian associations for concrete named ATECAP has produced a report on the evaluation of recycled aggregates used for the production of concrete. The report describes the use of recycled aggregates in concrete manufacturing, but also the reasons for difficulties in increasing the share of recycled aggregates in this industry. Main critical issues in the supply chain of the recycle of inert waste are bureaucracy, illegality and non-application of some laws. Very few producers use recycled aggregates for backfilling operations and for the production of concrete. Price is not the main factor limiting the use of recycled aggregates. Reasons for not using recycled aggregates are the following: very fragmented offer; products available not everywhere; limited knowledge of the technical characteristics; high price of transports; incompatible properties of some recycled aggregates with technical standards; lack of demand, etc. (ATECAP, 2013).

Regional and general issues concerning CDW in Naples focus area, have been discussed with local actors during the fourth PULL meeting, at the Association of building contractors (ACEN) in Naples, in November 2017, in a group of composed by Campania Region Authority, REPAiR Team Unina, ACEN, ARPAC, Local institutions, Municipality of Afragola.
They can be linked to different points of the whole process of CDW management, that can be summarized as follows:

- selective demolition, although introduced at a regulatory level in 2013, has never been adopted;
- secondary raw material (Materia Prima Seconda - MPS) stored in the company does not have a good market and does not meet the requirements of the tender dossier;
- the process of demolition and disposal must be designed from the beginning;

- aggregates can be can be recycled for the reconfiguration of territories (for example where there is risk of flooding), determining the construction of a new landscape;
- it could be possible to use door-to-door containers for disposal of CDW.

Eventually, during the three PULLs workshops - focused on Wastescapes, and held in Afragola from February to April 2018 - citizens and local actors from Afragola, Caivano and Casoria highlighted the emergency of CDW from MSW, mainly caused by abandonment along roads and in some points of the peri-urban areas. The main problem of abandonment along the roads is mostly caused by individuals and small companies. The PULL participants of the worktable "Homogeneous Ecological Centers" found two actions related to CDW recovering near wastescapes areas. Citizens, who took active part in the PULL workshops, identified two parcels in Afragola where could be possible to place integrated collection center for CDW from MSW (indicated in violet in Fig. 4.3.4 and Fig. 4.3.5).

Fig. 4.3.4 Work- table Homogeneous Ecological Centers. Possible sites where to apply the solution Recover of parcel n.99 at Sheet 5 of Afragola Cadastre Terrain for the proposed integrated collection center for building materials recover.
Source: UNINA Team, 2018

Fig. 4.3.5 Work- table Homogeneous Ecological Centers. Possible sites where to apply the solution. Recover of parcel adjacent to Naples-Bari highline for building materials recover. Source: UNINA Team, 2018.

Thus, considering all issues emerged during PULL meetings on CDW and PULL workshops in Afragola, and deepening the current situation of CDW in the MAN, both from MSW and from SW, we set out two different but interacting categories of critical issues: avoiding abandonment and improving recovering, recycling and reusing phases. These issues have been pointed out on the Hierarchy of Waste Pyramid as follow (Fig. 4.3.6), linking them to their main field: prevention, preparing for reuse, recycling, recovery and disposal. From this point of view, each critical issue can lead to an EIS that would circularize the current process.

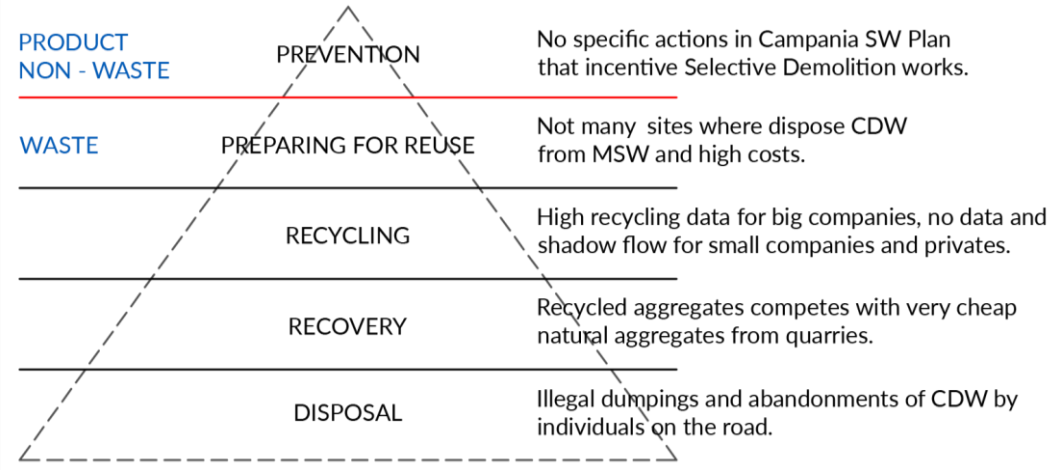


Fig. 4.3.6 Backwards Hierarchy of CD Waste Current Situation in Italy and relative main critical issues in Campania Region. Source: UNINA Team, 2018.

Future Situation

As main part of CDW flow consist in inerts, the objective is to make the supply chain shorter and circular. *Beyond INERTia* aims to address those weak elements described in the current situation of the supply chain process, considering identified dysfunctions in local inert waste supply chain. The supply chain based on Recycled Aggregates (RA) is more sustainable than the one based on Natural Aggregates,

because of environmental aspects, avoiding natural resources depletion, as well as for social and economic ones; in fact, RA supply chain can generate 30% of more employment.
Considering the critical issues described in the current process and emerged from PULLs a set of EISs has been elaborated and then embedded by UNINA team. The set of solutions and related objectives is outlined, as follow.

Eco-Innovative Solution	Objectives
3.1 INERTIA LAB Free collection Eco-Points for CDW from MSW, disposed by little producers. The Laboratory will provide to: separate inert waste from MSW, sort and sell them to sector companies	Increase collection points of CDW in the area to reduce transports and avoiding the abandonment on the roads
3.2 QUARRY TAX Increase Regional Concession Fee on quarries of sand and gravel	Making the natural materials - used to produce aggregates - more expensive
3.3. SELECT Incentives to companies that make Selective demolition	Enable Selective demolition introduced at regulatory level in 2013
3.4. CERT Activation of Regional Sustainability Certification for Recycled Aggregates from Inert Waste	Overcome mistrust in recycled aggregates and facilitate RA selling
3.5 B€ST Put the item and price of "Recycled Aggregates" in tender specifications	Introduce specifications would facilitate the use of RA in public and private works
3.6. SHAPES Using recycled aggregates in backfilling[7] operations, for new morphologies of terrains along roads and around recycling areas *linked to EIS 2.5	Using class C recycled aggregates and reduce extraction of natural materials for backfilling operations*

Table 4.3.7 Beyond Inertia Strategy: EISs and Objectives.
Source: UNINA Team, 2018.

The set of EISs proposed in Beyond Inertia Strategy is, as follow, indicated according Hierarchy of Waste Pyramid and Waste Management Processes (Fig. 4.3.8) and then in the Circular process scheme (Fig. 4.3.9).

[7] *Backfilling* is a recovery operation where suitable waste are used for reclamation in excavated areas or for landscaping and where the waste replace materials that are not waste (ISPRA, 2014) based on d.lgs. n. 152/2006.

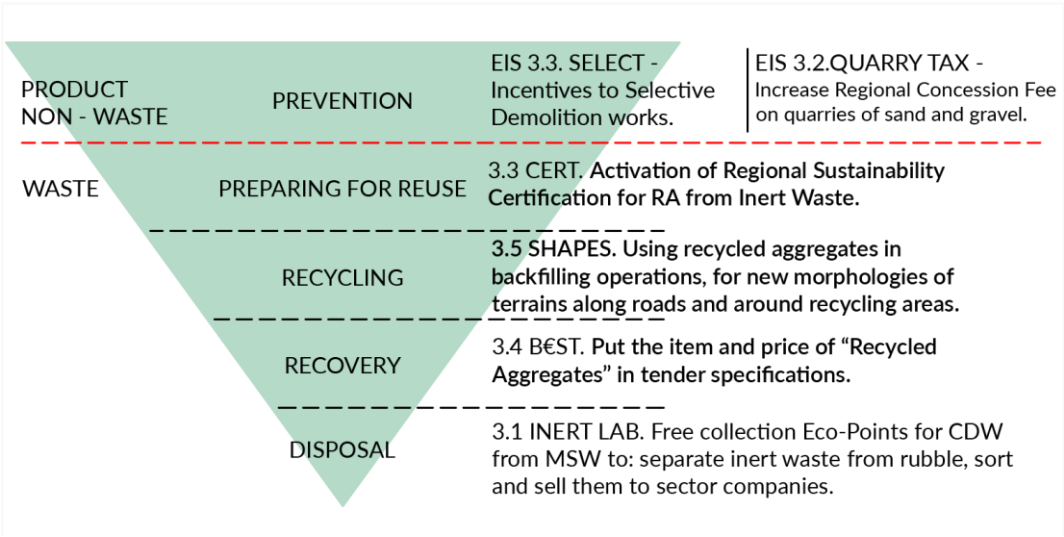


Fig. 4.3.8 EISs of Beyond Inertia Strategy in Waste Hierarchy according to the Waste Framework Directive (2008/98/EC).
Source: UNINA Team, 2018.

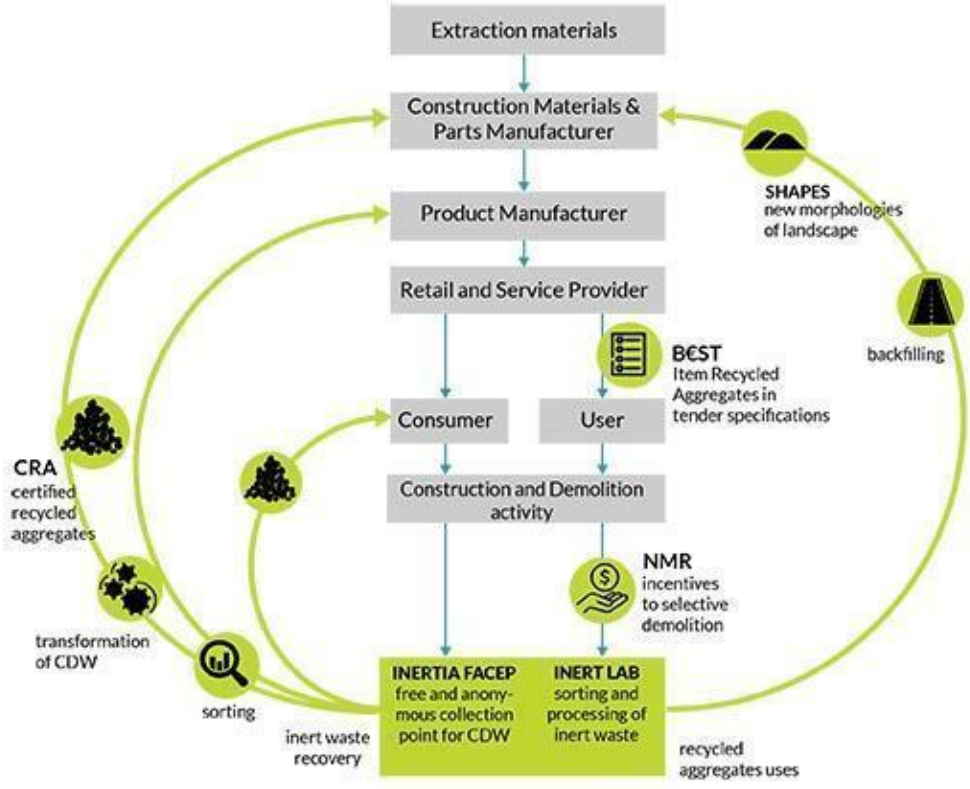


Fig. 4.3.9 Circular process scheme of Beyond Inertia Strategy and EISs.
Based on the graphic of Ellen MacArthur Foundation https://www.ellenmacarthurfoundation.org/
Source: UNINA Team, 2018

Fig. 4.3.10 Systemic section of Beyond Inertia Eco Innovative Solutions
Source: *UNINA Team, 2018*

Considering categories used for the aggregation of sustainability information (REPAiR, Deliverable 4.5, 2018) each EIS can generate positive impacts, as indicated in the Table 4.3.11.

Eco-Innovative Solutions	Impact Categories		
	ENVIRONMENTAL	ECONOMIC	SOCIO - ECONOMIC
3.1 INERTIA LAB Free collection Eco-Points for CDW from MSW, disposed by little producers. The Laboratory provides the separation of inert waste from MSW, sort and sell them to sector companies	Land use	Direct Capital Requirement Direct and total compensation of employees Backward linkages Labour Productivity and Resources Productivity	Total employment Knowledge intensive jobs
3.2 QUARRY TAX Increasing Regional Concession Fee on quarries of sand and gravel	Land use Resource depletion	Backward linkages Forward linkages	
3.3. SELECT Incentives to companies that make Selective demolition	Land use		
3.4. CERT Activation of Regional Sustainability Certification for Recycled Aggregates from Inert Waste	Climate Change Land use	Backward linkages Forward linkages Resource productivity	Total employment Knowledge intensive jobs

3.5 B€ST Put the item and price of "Recycled Aggregates" in tender specifications	Resource Depletion	Backward linkages Forward linkages Resource productivity	
3.6 SHAPES Using recycled aggregates in backfilling operations, for new morphologies of terrains along roads and around recycling areas *linked to EIS 2.5	Land Use Resource depletion	Direct Capital Requirement Direct and total compensation of employees Backward linkages Labour Productivity and Resources Productivity	Total employment

Table 4.3.11 Beyond Inertia Strategy:
Eco-Innovative Solutions and Impact Category Indicators.
Source: UNINA Team, 2018.

References

- D.Lgs 152/2006 of April 3, *Norme in materia ambientale*
- Piano Regionale di Gestione dei Rifiuti Speciali in Campania PRGRS DGR n. 212 of 24/05/2011

No national waste management plan, as the legislation provides that plans should be developed at regional level.

No measures dedicate to CDW to the item "Reduction of C&D waste nell'aggiornamento del Piano regionale per la gestione dei rifiuti urbani ai sensi dei commi 2 e 6 dell'art. 15 della Legge regionale 14/2016 ed avvio procedure di consultazione pubblica."

- ATECAP - Associazione Tecnico Economica del Calcestruzzo Preconfezionato (ATECAP), 2013. http://www.atecap.it/download/rapporto_atecap_2013.pd
- Ellen Macarthur Foundation, 2017. https://www.ellenmacarthurfoundation.org.
- Hebel, D.E., Wisniewska, M.H., Heisel, F. 2014. *Building from waste: recovered materials in architecture and construction.* Birkhauser Verlag GmbH. pag. 6-7.
- Recycle. La sfida nel settore delle costruzioni. Secondo rapporto dell'osservatorio Recycle. Legambiente, 2016.
- REPAiR D3.3 *Process model for the two pilot cases: Amsterdam, the Netherlands & Naples, Italy*, 2018, doi:55988e03-ea52-406d-a18f-57ff00630fbd.
- REPAiR *D4.5 Aggregation of sustainability information. EU Commission Participant portal. Brussels.* Grant Agreement No 688920, 2018.
- Screening template for Construction and Demolition Waste management in Italy, V2 (2015). Deloitte Touche Tohmatsu Limited

- Resource Efficient Use of Mixed Wastes http://ec.europa.eu/environment/waste/studies/mixed_waste.htm (last access, December 2018)
- UEPG Annual Review 2017-2018 http://www.uepg.eu/uploads/Modules/Publications/uepg-ar2016-17_32pages_v04_small.pdf

4.4. CIRO+. Integrated Center for Optimal Reuse of durable goods

Flow
Wastescapes, CDW.

Category of outcome
Political, Technological, Social, Legal.

Location of the good practice
Wastescapes in the Focus Area.

Specific objective
Avoid abandonments of durable goods on the road by individuals, and creating a new circular supply chain for the refurbishment and upcycle of durable goods.

Owner of the EIS
Campania Region Authority and UNINA group.

Actors to be involved
Campania Municipalities with more than 25000 Inhabitants, ASIA, Confartigianato Napoli, Naples Fab Lab network, Fab City Global Initiative, Design Students.

Description of the EIS
CIRO is an Action introduced by CRA in Campania *Integrated implemented plan for waste prevention* (2013) but never activated. CIRO action intends to provide a service of collection to citizens who want to deliver bulky waste and WEEE. The objective of this action is to prevent the downgrading of a good into waste through recovering not too damaged durable goods, fixing them and selling of reconditioned products.
UNINA team work implemented this action proposed by CRA embedding the accepted flows with from Selective Demolitions and adding the Fab Lab for upcycling works.
Fab Labs are small scale workshops that make available spaces and tools for digital fabrication. Customizing goods, giving them new design, is the way that would allow CIROs to find a broader market to sell its products and to spread the idea of waste as resource, to overcome mistrust in recycled products.
Thus, CIRO+ Integrated Center for Optimal Reuse of durable goods, is a Strategy that aims to recover all the bulky waste from households (as old furniture) and a selection of construction system technological components (like windows, doors, hygiene, electrical etc.), fix and upcycle them.
CIRO^{+} FabLab is a place where durable goods from households and from selective demolition activities can be upcycled and transformed into something new.

Current situation

In MAN, ASIA deals with disposal of bulky waste that don't belong to the normal cycle of separated collection. Bulky goods belong to MSW. Currently they can be freely disposed in two ways: bringing them to *fix Ecologic Points* or bringing them to *mobile Ecologic Points* in some places of the city, according some time slots and according the two types accepted: household appliances (RAEE; EWC 16 02) and bulky waste (EWC 20 03 07).

Materials that can be carried to household appliances EcoPoints are:

- *Intact small household appliances, batteries, toner, ink cartridges, TV-Monitor.*

Materials that can be carries to bulky waste EcoPoints are:

- *Christmas Trees.*
- *Medicines.*
- *Fridges and air-conditionings.*
- *Bulky goods as: furniture, couches, mattresses, suitcases, shelving, pallets, wooden, iron, fiberglass and hard plastics things.*
- *Plates and big glasses*
- *Intact small household appliances as: telephones, clocks, computer, printers, battery-powered toys, ceiling lamps, video-recorders, remote controls and any battery-powered object.* (ASIA NAPOLI, 2017)

This service seems not be sufficient to manage all these flows in MAN focus area.

During Afragola PULLs workshops on wastescapes, local actors detected several wastescapes all over the sample area generated by unauthorized landfills. After plenary discussions, participants to *Homogeneous Ecological Center* work table focused on the current situation, and pointed out causes of wastescapes generation as follow:

- illegal dumping of building materials from small renovations, abandoning of appliances, tyres, resulting materials from farming activities;
- impossibility of deliver CDW in existing Homogeneous Ecologic Island as private;
- illegal burning of agricultural waste, often in locality Cantariello (Municipality of Afragola);
- lack of environmental education (Fig. 4.3.1).

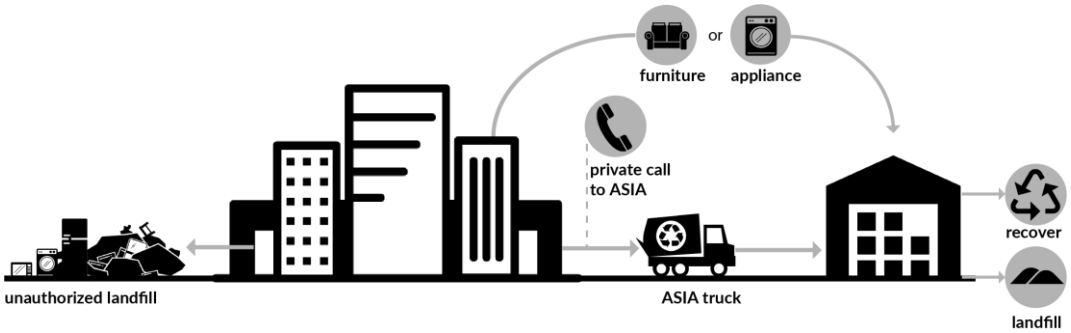


Fig. 4.3.1 Current Situation of wastescapes generation in Naples focus area. Source: UNINA Team, 2018.

This causes seems to be connected to the lack of *homogeneous ecological centers*, where citizens can dispose bulky waste and CDW intact components, as windows or doors components.
In the last Afragola PULL workshop, Campania Regional Authority took part to this worktable and presented a set of actions, including CIRO (in Italian *Centro Integrato per il Riutilizzo Ottimale di beni durevoli* - Integrated Center for Optimal Reuse of durable goods). This *action* has similar functions of *homogeneous ecological centers*, *it* aims at reusing *RAEE*, *wood*, *metal*, *bulky waste and textiles*. CIRO has been introduced in 2013 in the "Integrated implemented plan for waste prevention" (*Piano attuativo integrato per la prevenzione dei rifiuti*), and after in 2016 in Regional Urban Waste Management Plan (Piano Regionale per la Gestione dei Rifiuti Urbani, PRGRU) as part of a set of 14 actions to address the reduction of specific waste product fractions and to ensure "*environmental mainstreaming*", but it has never become effective. As the core objective of this action is avoiding waste production and preventing wastescapes generation, UNINA Lab integrated this proposal to the one resulted from *Homogeneous Ecological Center* worktable (*Beyond Inertia* Strategy, circular supply chain for CDW) for their common ground and developed it.
Two main products have resulted from the shared work of UNINA with Campania Region:

- embedding of flows accepted in CIRO+ with that part of flow of CDW from Selective Demolition;
- the extension of a CIRO$^+$ Fab Lab, containing functions to operationalize circular economy and to enable the Action to innovative social and economic processes, that qualify an EIS.

Future Situation
The Strategy consists in creating a regional network of CIRO$^+$ FabLab to intercept a part of durable goods before they become waste, with the ultimate goal of avoiding the formation of wastescapes.
CIRO+ provides for little works of fixing and repair to let disposed damaged goods to be reintegrated into the market. When these actions are not possible, operators in waste sector will direct the flow toward specific recover or disposal operations. A Fab Lab is a center that is equipped according international requirements defined in the FabLab Charter (the set of rules of global Fab Lab network, drawn up by MIT Lab "Center for Bits and Atoms" (CBA). Makers are artisans, architects, designers, engineer, programmers and anyone who want to share talent and knowledge to create custom objects using new technologies mixed to traditional processings, bypassing limits of economies of scale. Recovering waste parts of materials and goods is an inner tendency of makers. CIRO$^+$ Fab Lab has the specific objective to use goods and appliances from *Homogeneous Ecological Centers*, which would otherwise have been disposed in landfills. The Laboratory production of refurbished goods and custom design objects, according a Circular Business Model, could guarantee self-sustainability of the EIS, employment and spreading a positive perception of *recycled* products. A network of CIRO and CIRO$^+$ Fab Labs (this last connecter to Fab City

Global Initiative) can operationalize circular economy and prevent many wastescapes.
Campania Regional Authority has planned to start-up CIROs in Municipalities with more than 25000 inhabitants. A number of 53 Municipalities would be able to express interest to CIRO action (dark green Municipalities in Fig. 4.3.2), four of which are in MAN focus area (Napoli, Casoria, Casalnuovo di Napoli and Caivano).

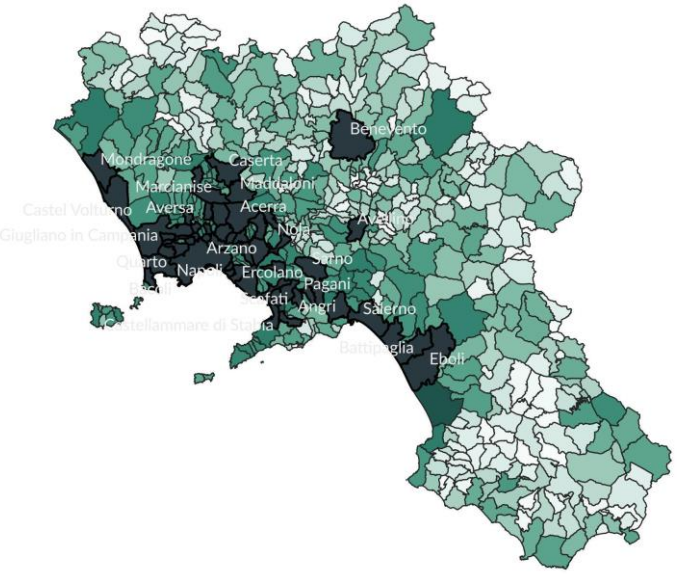


Fig. 4.3.2 In dark green: Municipalities with more than 25000 inhabitants in CR. Source: UNINA Team, 2018

Considering the typology of services offered and in accordance with Regional rules, CIRO⁺ Fab Lab, as CIRO regional action, will be located adjacent to existing *Homogeneous Ecological Center*, Collecting Points of Bulky Waste (when possible), to optimize and centralize the service.
Thus, CIRO⁺ Fab Lab works as a free collection point and, at once, it is a Laboratory to upcycle any appliance and durable good (Fig. 4.3.3).

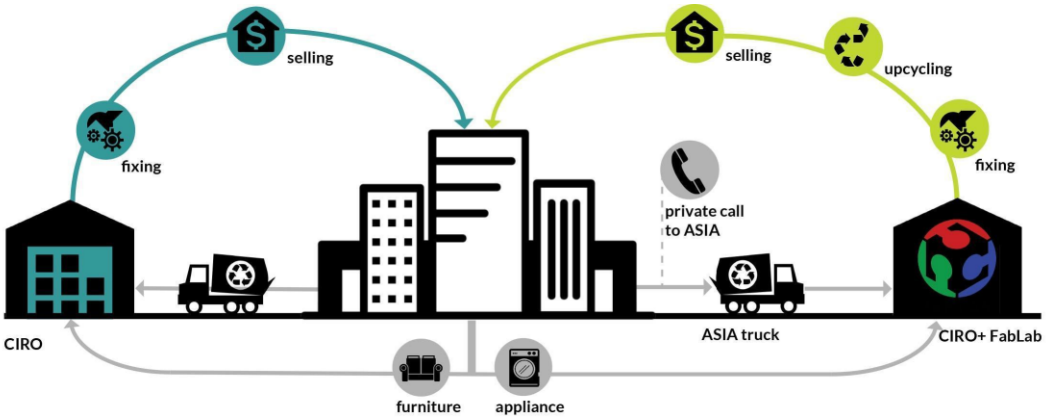


Fig. 4.3.3 Systemic section of CIRO Fab Lab. Eco-Innovative Solution Source: UNINA Team, 2018.

This proposed EIS needs to be implemented with local stakeholders, association and public actors, in the next co-design phase of the Naples PULLs.

References

- Integrated implemented plan for waste prevention. (In Italian: Piano Attuativo Integrato per la prevenzione dei rifiuti) Regione Campania, 2013. http://www.regione.campania.it/assets/documents/piano-attuativo-integrato-per-la-prevenzione-rifiuti.pdf
- Regional Plan for MSW Management. (In italian: Piano Regionale di Gestione dei Rifiuti Urbani - PRGRU), update of 16th December 2016.
- Bulky waste emergency in summer 2018 in Naples from *La Repubblica* newspaper: https://napoli.repubblica.it/cronaca/2018/08/04/foto/rifiuti_ingombranti_citta_invasa-203325567/1/#8 (text in Italian)
- FabLab foundation: www.fabfoundation.org
- Fab City Global Initiative: https://fab.city

Eco-Innovative Solutions from literature/practice

5. Eco-Innovative Solutions from literature/practice

The following list of Solutions coming from literature and/or practice is the product of DiARC Unina desktop research on the field of Eco-Innovative Solutions.
It has been developed partially before, and partially in parallel with the development of Eco-Innovative Strategies/Solutions within the PULLs, as an in-depth analysis from the desktop research aimed at finding inspirations and learning from successful experiences.
Therefore, it is not presented as an all-embracing list on the subject of circular economy solutions, but more specifically as a collection of examples useful as a base to co-produce solutions inside the PULLs, and organized around the combination and the recurrence of some main topics:

- Participatory design-lead process of intervention;
- Behavioural changes;
- Landscape design related to waste prevention/reduction or circularity
- Phytho-technologies/Respect of historical traditions and uses around communities;
- Unusual partnerships of actors/Private-public-people cooperation;
- Waste prevention by intervening on construction sector;
- ICT use in circularity;
- Adaptability of the project to the changing context;
- Life cycle of long time projects/programs.

5.1. 5.1 Berceto compost

Flow
Organic waste.

Category of outcome
Economic, Environmental, Technological and Legal.

Location of the good practice
Town of Berceto, Parma, Emilia Romagna Region, Italy.

Owner of the EIS
Municipality of Berceto.

Actors involved
Camelot Cooperative, Environment Agriculture Center, citizens.

Specific objective
To reach the 73% standard of separate waste collection; to overcome the problems related to the lack of plants for the organic waste treatment.

Past situation
Berceto is a small Italian town of about 2000 inhabitants in the province of Parma, reaching 5000 inhabitants during the summer. Its Territory is extensive and not very densely populated (15 inhabitants/ km^2), creating several problems in the organization of the door-to-door waste collection. In addition, the nearest plant for the treatment of the organic fraction is located close to the city of Modena, an expensive distance from both an economic and environmental point of view. Until 2017, in fact, the waste collection and disposal system did not provide a solution for the organic fraction, despite the high prices paid by citizens as waste collection tax (TARI). In this situation Berceto used to produce more than 500 tons/year of unsorted waste and couldn't reach the 50% standard in separate collection (2015). The development of a solution took time and has involved a large number of actors, from different institutional levels and from civil society. The process started in 2015 when the Emilia-Romagna Region adopted a law that sets as a minimum target for separate waste collection at 73% in 2020 and so, requires the community to seek a solution: in 2016 Berceto citizens have been called to vote for a referendum and they decided to exempt the Province from waste cycle management services, in order to transfer this responsibility to their municipality.

Current situation
The compost program is developed by Berceto Municipality, the cooperative responsible for waste and the Environment Agriculture Center. It represents an

innovative solution in Italy because this is the first municipality with a size above 2000 inhabitants that have applied both domestic and community composting in an integrated system. It started in 2017 and led the 40 % reduction in unsorted waste production in one year, which amounts to about 145 tons less. Waste treatment takes place entirely on site, does not require a collection or transport system but just an operator and some volunteers, thus reducing environmental and economic costs. Due to the shape of the settlement about 80% of residents live in a rural area or have space to install a domestic compost and reuse the compost for the care of their vegetable garden (that is typical of Berceto rural settlement). Those who choose this possibility receive from the Municipality the necessary training in order to use the device and, above all, the 15% discount on the waste tax. Those who live in the dense urban area have access to community composters. In the municipal territory 22 bins have been installed, all of them are less than one km from the houses served, so that the transfer can be comfortable and without using cars. Citizens, even summer tourists, have received instructions and keys to use the community compost bins, in order to be responsible for the material produced, which is then reused as compost in public and neighborhood green areas. The community composters are made of wood, placed on not sealed surfaces and each one works for 100/120 people.

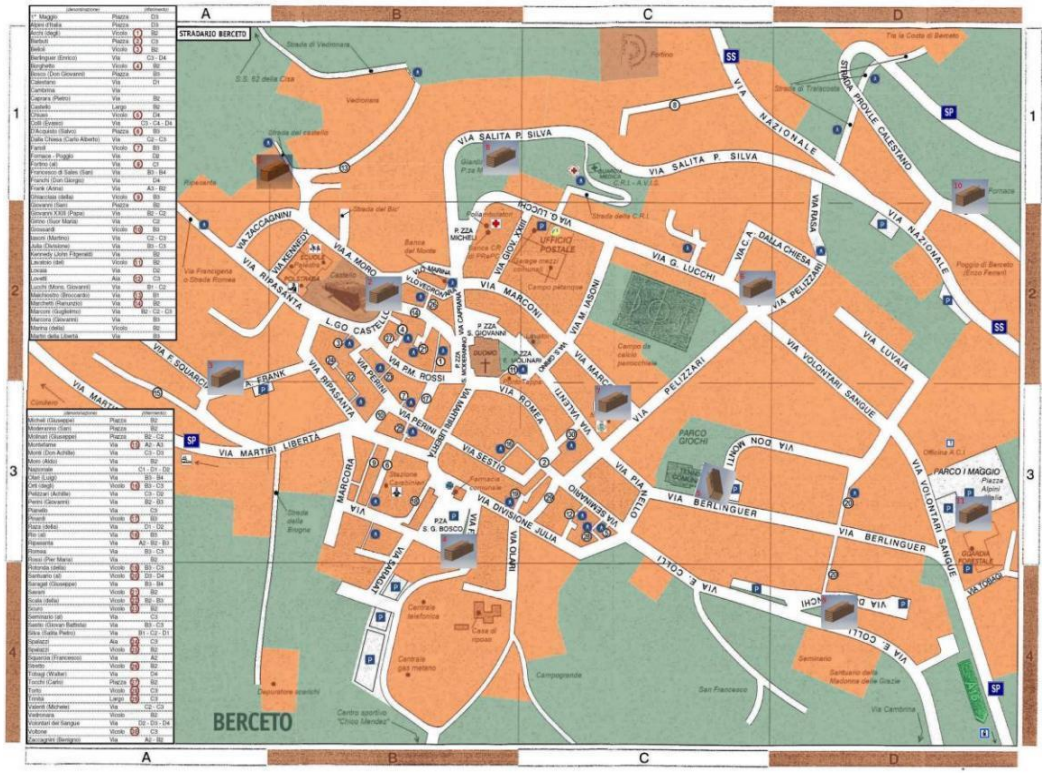


Fig. 5.1.1 Berceto compost map
Source: Berceto Municipality, 2017.

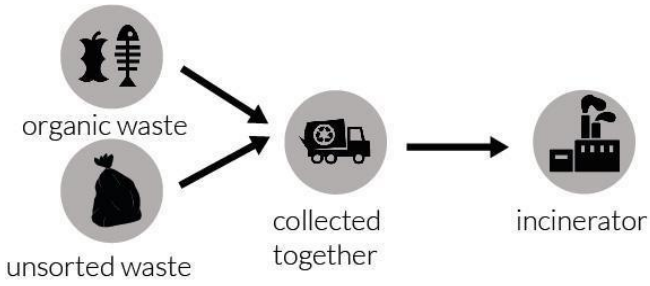


Fig. 5.1.2 Past situation
Source: UNINA Team, 2018

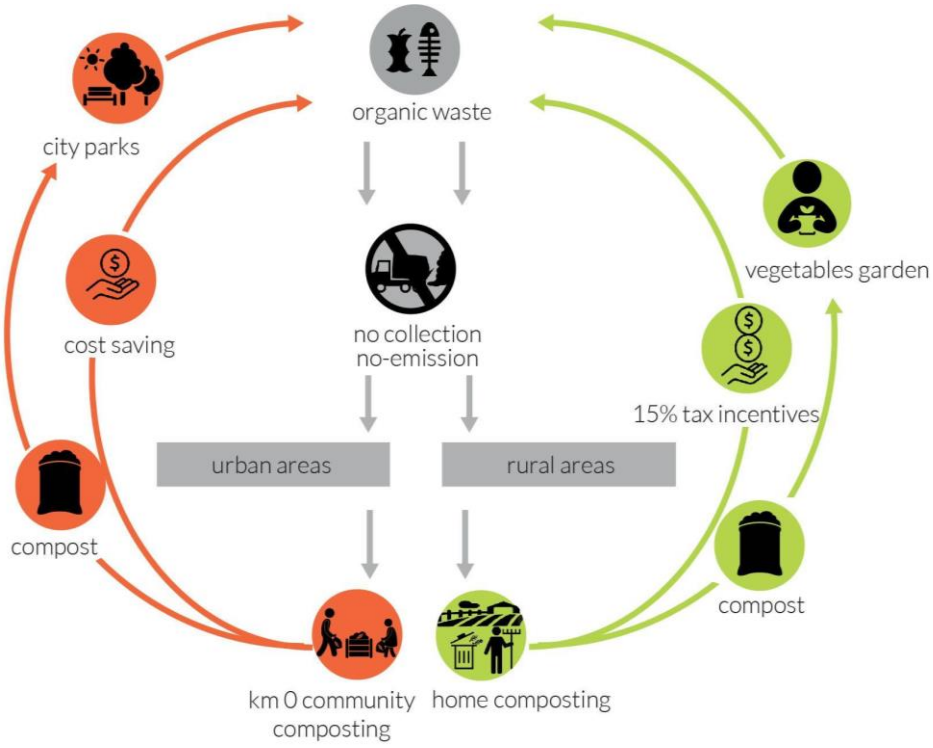


Fig. 5.1.3 Method of intervention
Based on the graphic of Ellen MacArthur Foundation https://www.ellenmacarthurfoundation.org/
Source: UNINA Team, 2018

Other information (texts in Italian)

More information about the project:
http://www.associazioneitalianacompostaggio.it/wp-content/uploads/2017/11/L%E2%80%99esperienza-per-il-compostaggio-di-comunit%C3%A0-BERCETO.pdf

Italian law on soil improvers: (updated) Dlg n.75 of 29 April 2010, http://www.gazzettaufficiale.it/do/atto/serie_generale/caricaPdf?cdimg=15A0589900100010110001&dgu=2015-07-30&art.dataPubblicazioneGazzetta=2015-07-30&art.codiceRedazionale=15A05899&art.num=1&art.tiposerie=SG

5.2. NYC Compost Project

Flow
Organic waste.

Category of outcome
Political, Economic, Social, Environmental.

Location of the good practice
New York City.

Owner of the EIS
New York City, Department of Sanitation (DSNY).

Actors involved
Public bodies, cooperatives, neighborhood association, citizens.

Specific objective
To reduce the flow of organic waste disposed in landfill; to contrast the impoverishment of urban soil.

Method of intervention
New York City is one of the most important and populated city in the world (8 million residents). About 14 million tons of waste are produced in NYC every year, of which the largest single portion is organic, and this costs the city almost $400 million annually. The current organic waste city program serves about 3,5 million people with curbside service for food scraps, food-soiled paper and yard waste, that are composted in order to create energy and new fertilized soil for the city. Curbside collection started in May of 2013 in Staten Island as a voluntary activity, but the high participation rates led to the decision to expand it throughout the city.
In fact, New Yorkers were already used to and aware of the importance and ways in which organic waste has to be differentiated because they have been composting their food waste for decades: back in 1993 the New York City Department of Sanitation's Bureau of Waste Prevention, Reuse, and Recycling created the NYC Composting Project, that is nowadays integrated in the official program. It represents a good practice because it has prepared citizens for composting, and today is still a solid support for organic waste recycling in those neighbourhoods that are not yet served by the door-to-door collection and, especially, for the network of actors that have been involved.
One of the strengths of this project is the synergy between different levels of the process: the institutional level that coordinates and funds, bodies and organizations that manage the plants, the dense network of associations and citizens that make up, manage and feed the drop off points. Those who live in neighborhoods without separate collection can choose, in fact, to drop their organics at drop off sites.

Between 1993 and 2013, over 200 community composting and drop off sites were established, funded by New York's Sanitation Department. Citizens associations are still invited to open new drop off points or community compost sites in their neighborhoods where door-to-door collection doesn't operate. In 2017 drop off accounted for 1200 tons of organic waste being diverted from landfill, some of these points also house community composers, whose products are used to feed neighborhood's green spaces; they are all located in public space and can be found on an update official online map. Once all the residential and drop off waste is collected by the Department of Sanitation, it is sent to a transfer station where machines sort out all the contamination, and then to one of composting places in the metropolitan area: what is collected in staten island, for example, goes directly to the facility there (Fresh Kills) where it is composted on-site. Plants are seven and are managed by different operators: private operators produce compost which is then sold on the city market or given for free to the neighborhood associations that request it. Some of these plants are already able to produce energy from biogas, the remaining facilities are managed directly by institutional bodies such as main parks and city botanical gardens: there the compost is reused in the care of public green spaces and also guest other activities with educational and demonstrative aims.

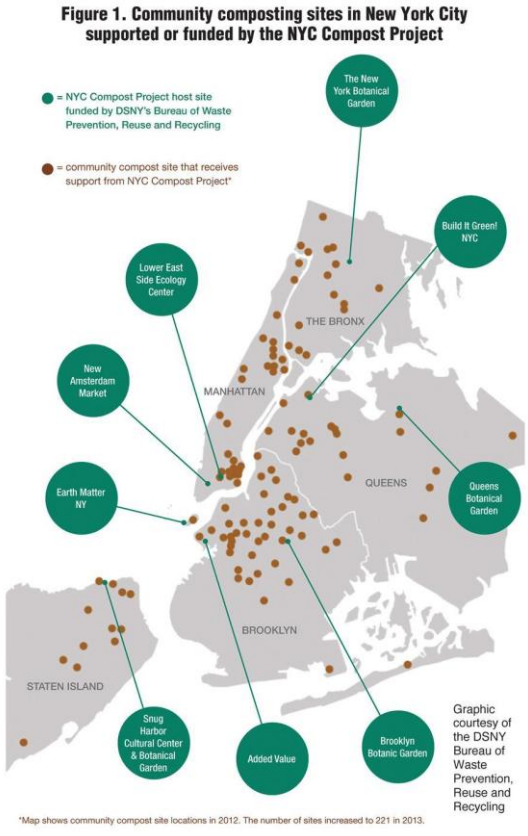


Fig. 5.2.1 Official information campaign
Source: NYC, 2012.

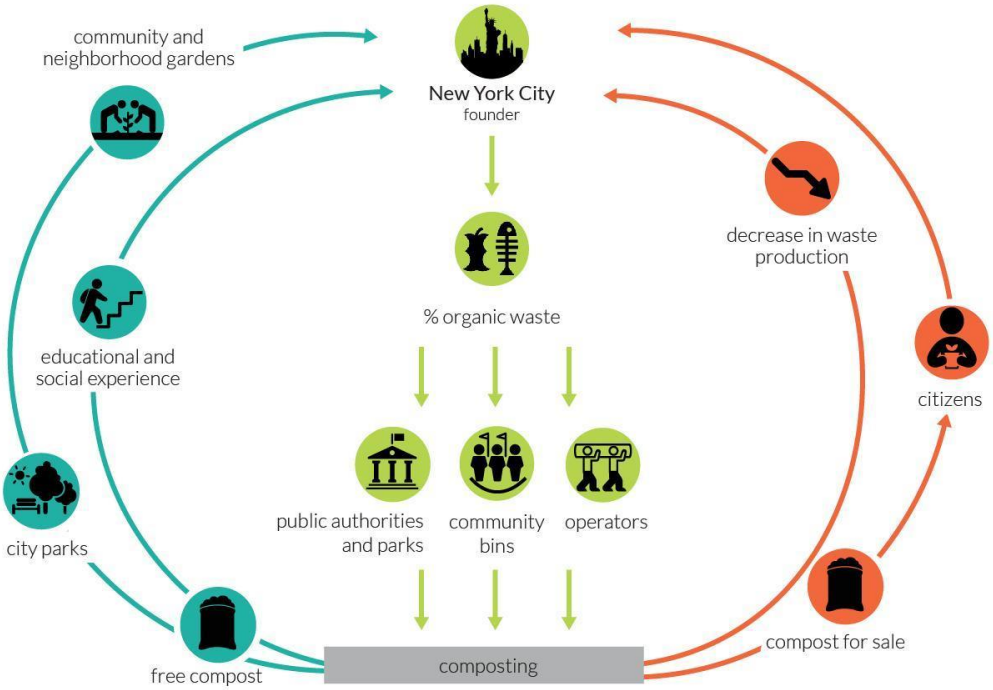


Fig. 5.2.3 NYC Compost project
Based on the graphic of Ellen MacArthur Foundation https://www.ellenmacarthurfoundation.org/
Source: UNINA Team, 2018.

Other information

Official page: www.nyc.gov/compost
More information about the project: https://earthmatter.org/wp-content/uploads/2016/03/about_compost-project-brochure-cp-broch-f_0815.pdf
https://blogs.ei.columbia.edu/2018/10/08/using-food-waste-new-york-city/ity/

5.3. Byxbee Park, Palo Alto

Flow
Wastescapes.

Category of outcome
Social, Technological, Environmental.

Location of the good practice
City of Palo Alto, California, USA.

Owner of the EIS
City of Palo Alto, landscape architects Hargreaves Associates, artists Michael Oppenheimer and Peter Richards.

Actors involved
Palo Alto Public Art Commission.

Specific objective
Urban waste management, public waterfront park.

Method of intervention
The City of Palo Alto in California has more than 61000 inhabitants, one of the most important and largest parks in the city is Byxbee park which overlooks San Francisco Bay. Byxbee Park is a public waterfront park that sits atop a reclaimed landfill. It represents a good practice because it has been able to integrate the project of an operation infrastructure with the city, through the project of its reclamation and its reuse as a public space in a long-term, adaptive vision able to prevent degradation, pollution and abandonment. Moreover the design and the shape of the park are able to express the great landscape potential of the "new lands". The process begins with the 1980 masterplan by Eckbo Kay Associates that provided an initial idea for creating the park that still exists today. Following changes in landfill regulations created requirements for the shape and construction of the landfill while the community asked for a deeper park integration with the Baylands context. The City of Palo Alto Municipal Arts Plan also played a key role in the definition of the park guidelines asking for artists to join the design team of the landscape architects. These instances have merged in the 1991 Byxbee Park Palo Alto Baylands Update by Hargreaves Associates in collaboration with artists Peter Richards and Michael Oppenheimer. The team also included architects and landfill engineers as well as a native grass specialist and its masterplan contains both design documents to construct Phase I and overall plan guidelines for Phase II that have been implemented over decades, in continuity with the remediation of the landfill. In

2010, the City started the reconversion of the Palo Alto Landfill to parkland, implementing the original Byxbee Park Hills with additional hiking trails and views of the Baylands and foothills and closed the landfill to incoming waste in July 2011. Today the park consists of about 60 ha and provides opportunities for recreation and contemplation: the recreational and art elements of the park are, in fact, designed to increase awareness of the natural and human environment and to respond to the conditions of landfill below within the context of complex ecosystems.

Fig. 5.3.1 Byxbee Park
Source: Hargreaves Associates, 1992.

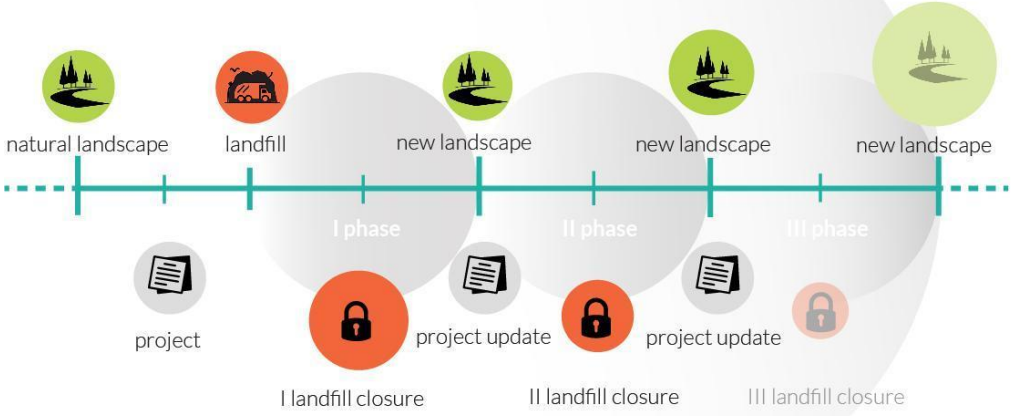


Fig. 5.3.2 Byxbee Park project timeline
Source: UNINA Team, 2018.

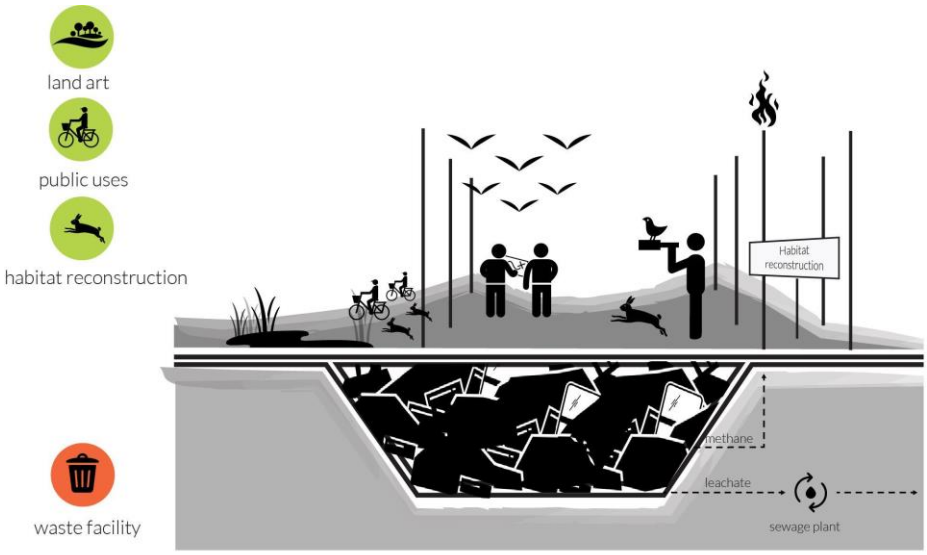


Fig. 5.3.3 Byxbee Park systemic section
UNINA Team, 2018

Other information

Institutional pages:
https://www.cityofpaloalto.org/gov/depts/pwd/infrastructure_plan/byxbee_park.asp
https://cityofpaloalto.org/civicax/filebank/documents/9252
Architects' page: http://www.hargreaves.com/early-work/byxbee-park/

More info about the project: https://landfill.wordpress.com/tag/byxbee-park/

5.4. C.A.N.A.P.A.

Flow
Wastescapes.

Category of outcome
Economic, Social, Technological, Environmental.

Location of the good practice
Masseria del Carmine, Taranto, Italy.

Owner of the EIS
CanaPuglia, ABAP, CRA.

Actors involved
Puglia Regional Authority, hemp sector, citizens.

Specific objective
To test hemp for the reclamation of areas contaminated by ILVA as an alternative to the abandonment of contaminated fields.

Past situation
ILVA in Taranto is the largest steel plant in Europe. Founded in 1961, it is an integrated-cycle steel plant, where all the steps from iron ore to steel take place. The plant is located in immediate surroundings of the neighborhood Tamburi, where currently about 18,000 people live and it has five blast furnaces and a 70 hectares' mineral deposit parks that have enormous environmental impacts. In 2012, in fact, two reports were submitted to the Court of Taranto attesting ILVA's responsibility in the production of dioxin and heavy metal pollution with an impact on human health of an average of 1,650 deaths per year, especially for cardiovascular causes and respiratory tract problems and an average of 3,857 hospitalizations per year, mainly for cardiac, respiratory, and cerebrovascular causes.
The impact of the steel plant on the surrounding territory is damaging also the rural area and the agricultural and farm productions preventing any cultivation and zootechnical activity, typical and traditionally linked to the local food and wine production. In 2010, in fact, an ordinance seized and killed hundreds of animal and banned grazing within 20 km of the ILVA plant, forcing businesses and families to downsize, abandon or reconvert their activities. The solution was born in the Masseria del Carmine in the Taranto countryside in the search for an experimental solution to these problems.

Method of intervention

C.A.N.A.P.A. (Growing Actions to Feed Live and Clean the Air) is a research project in Italy aimed at testing the effectiveness of hemp cultivation in cleaning up the neighboring agricultural territory at the Taranto steel pole. The project was initiated by CanaPuglia Association, CRA and Abap (Apulian Environmental Biologists Association) and farm's owners, that have provided three hectares in Masseria del Carmine for the experimentation of phytoremediation through hemp, overcoming the slowness and inertia of public actions. In the long term, the project aims to create a true hemp green belt around Ilva and to investigate opportunities for employment and entrepreneurship: among these, support for self-entrepreneurship and the birth of new small craft businesses related to cannabis derivatives, especially in the construction field - with lime and hemp brick - and textiles. In 2015, in fact, the project won a local competition for the renovation of a boat and for the creation of hemp fiber fences.

Fig. 5.4.1 Field of hemp around Ilva
Source: Matteo M. Melosini, 2017.

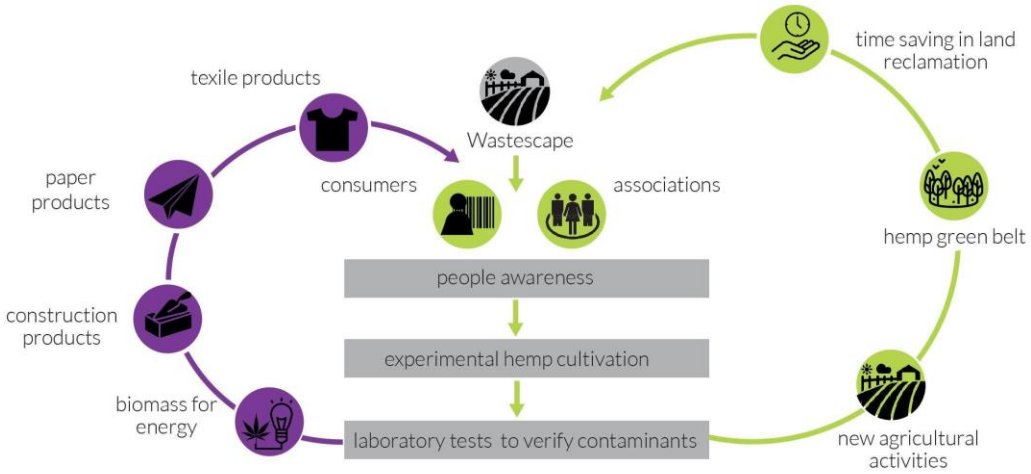


Fig.5.4.2 Land reclamation by hemp around ILVA
Based on the graphic of Ellen MacArthur Foundation https://www.ellenmacarthurfoundation.org/
Source: UNINA Team, 2018

Other information

More information (texts in Italian): https://infoabap.it/progetti-abap/progetto-c-a-n-a-p-a/. https://www.canapuglia.it/it/
https://www.vice.com/it/article/j535g8/canapa-bonifica-area-terreni-taranto
https://www.lastampa.it/2016/06/03/italia/sar-la-cannabis-a-salvare-taranto-dal-disastro-ambientale-dellilva-IaaHoarIYdv68RBV6SCOsI/pagina.html
Regulatory references:
National Law n. 242 of December 02, 2016 “Directive for the promotion of cultivation and agro-industrial sector of hemp”.
Regional Law 6 n. 21 of June 2017 "Promotion of hemp cultivation for productive and environmental purposes"

5.5. SA.T.I.V.A. (Save a Territory Increasing the Value of Agriculture)

Flow
Wastescapes.

Category of outcome
Economic, Social, Environmental.

Location of the good practice
Province of Verbano Cusio Ossola, Lombardia, Italy.

Owner of the EIS
Comitato s.a.t.i.v.a., Ars.Uni.VCO association.

Actors involved
Schools, University of Milan, cooperatives, Municipalities.

Specific objective
To recover mountain abandoned territory through agricultural regeneration actions; to reduce hydrogeological instability; to preserve the local culture linked to cultivation and use of hemp; to stimulate new economic and social development possibilities.

Past situation
Since after World War II the rural depopulation of the Ossola Valleys has been intense causing the abandonment of agricultural practices and the care of the territory, also due to the competition of lowland agriculture. The Ossola landscape is today abandoned and compromised by urban sprawl, building skeletons and the remains of long-closed factories and mostly empty new sheds.
Moreover, along the mountainside the abandonment of agriculture has generated an excessive reforestation, while the terraces have been compromised by speculative construction with houses and related access roads. The abandonment of mountain agriculture means a loss of sense of landscape and a defeat to the communities that affects environmental, economic, cultural and identity aspects.
Until the last century traditional agricultural practices in Piedmont had been characterized by hemp cultivation. Hemp has been, in fact, an important resource in the history of the Italian economy and until the '50s, Italy was the world's second largest producer of hemp, with about 100 thousand hectares of plantation and an annual yield of 800 thousand quintals; in particular, Campania and Piedmont were among the major producing regions. The abandonment of hemp fields has accompanied the depopulation processes of mountain areas and the impoverishment of their economy but it has also produced social damage, such as the

loss of knowledge, know-how, places related to hemp and, especially, impacts on the territory: among these the deep transformation of the agricultural landscape, that often gives way to the fragmentation and construction of areas, or to a more general hydrogeological risk linked to the abandonment of mountain ridges.

Method of intervention

The project stems from the idea of some citizens and aims to reintroduce Canapa Sativa for the recovery of mountain territories and local knowledge in Piedmont, for these reasons it represents a good experimental reference practice.

In 2014 within the regional course "Mountain Territories and Local Development: Designing with the European Funds", some participants have developed the idea of a project for the reintroduction of "SATIVA" hemp cultivation, constituted as a committee. It intends to re-discover and re-evaluate a typical natural resource such as cannabis sativa, to identify new opportunities for economic growth and social development, to preserve and pass on material and immaterial local culture and enhance historic places and work tools that still exist in both public places and private homes. The Association has made available the spaces for the meetings, the committee has offered its time and some plots of mountain land to start a first experimental phase. The Municipality of Baceno has purchased certified seeds that have been given to all interested people, still in informal groups; the members of the adhering Committee made themselves available to provide the data, during the period from sowing to harvest, in exchange for the possibility of using all the data of other participants; the Department of Agriculture of the University of Milan is conducting analysis and scientific research on the basis of the data collected empirically so as to be able to scientifically evaluate the impacts of research.

The project is developed with very little funds but it benefited from the free participation of many actors, both public and private, which contributed to the success of experimentations: schools, associations have in fact, responded positively to activities related to local culture and agricultural traditions, but also private operators showed growing interest in the economic implications of the cultivation and processing of hemp in mountain areas.

Fig. 5.5.1 SA.T.I.V.A. experimental fields in underused areas
Source: SA.T.I.V.A., 2016.

Fig. 5.5.2 SA.T.I.V.A. processing on site
Source: SA.T.I.V.A., 2016.

Other information (texts in Italian):

official page: http://www.univco.it/progetti-2/progetto-sa-t-i-v-a/s-a-t-i-v-a
more info about the project: (ISBN 978-88-98357-07-9)
http://www.univco.it/uploads/public/extra/SATIVA_Atti_Convegno_Villadossola_16.09.2016.pdf

From sowing to harvest (SA.T.I.V.A. video) :
https://www.youtube.com/watch?v=6YSBNspWRPU
Hemp processing (SA.T.I.V.A. video): https://www.youtube.com/watch?v=-d46OhPArM0

5.6. CANOPAES (CANapa: Environmental and Economic Opportunities in Sardinia)

Flow
Wastescapes.

Category of outcome
Economic, Social, Technological, Environmental.

Location of the good practice
Sardinia, Italy.

Owner of the EIS
Sardinia Region.

Actors involved
Agris, farms, hemp industrial sector.

Specific objective
To remediate contaminated territories through hemp cultivation; to stimulate the development of the industrial hemp sector.

Method of intervention
In 2015 the Sardinian Region has tightened its experimentation program for the use of hemp in the land reclamation of contaminated soils by 450,000 € as financial incentives. In 2018, at the end of the first three years the Region had allowed the continuation of the widespread experimentation. The program is named CANOPAES and is implemented by Agris, the regional agency for scientific research, experimentation and technological innovation in the agricultural, agro-industrial and forestry sectors.
The granting of economic incentives to farms for the planting of certain plant species is not a new practice in agriculture in Italy, but in this case the Sardinia Region has set the criteria for allocating incentives to soil pollution levels and to the obligation to provide crop results for scientific and research purposes. Agris is studying how and how many pollutants are extracted by hemp plants and also the possibility of using these crops as new resources for farmers for sustainable development. The project is multidisciplinary and addresses the main problems not only from the environmental point of view, but also cares of economic sustainability. At the same time the regional incentives for the cultivation of industrial hemp have allowed the development of a supply chain as well as the creation of a consortium of hemp producers to spread and encourage the use of products derived from this crop: not only food but also pallets, cloth and building products.

Fig. 5.6.1 Hemp field in Sardinia
Source: Unionesarda.it, 2018.

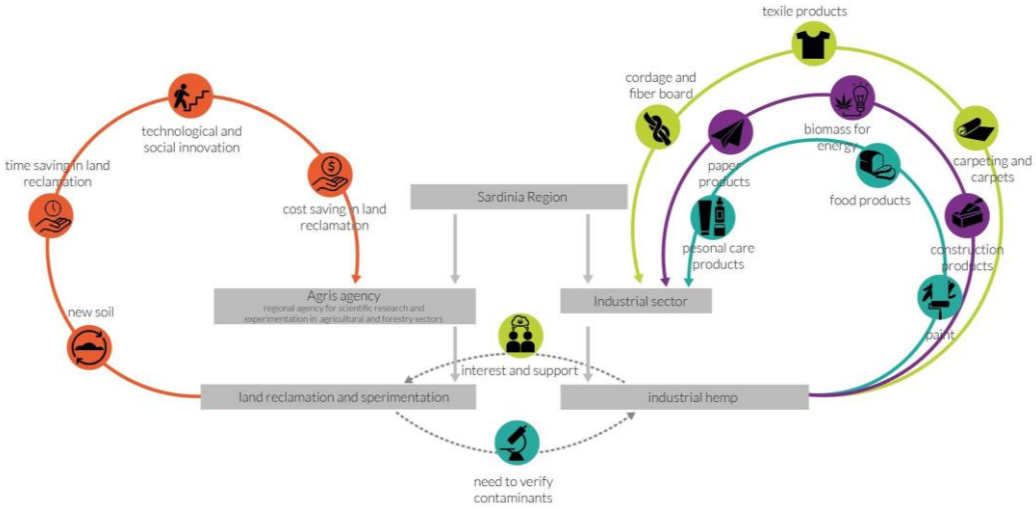


Fig. 5.6.2 Sardinia Region integrated actions for developing hemp sector
Based on the graphic of Ellen MacArthur Foundation https://www.ellenmacarthurfoundation.org/
Source: UNINA Team, 2018

Other information (texts in Italian)

Regulatory references: Regional law n.5 of 0 March 2015; Regional law n.1 of 11 January 2018

Submission of expressions of interest in planting hemp in contaminated land: http://www.sardegnaagricoltura.it/documenti/14_691_20171212084501.pdf

5.7. Rotor Deconstruction

Flow
Construction and demolition waste.

Category of outcome
Economic, Technological, Environmental.

Location of the good practice
Brussels Region, and Paris.

Owner of the EIS
Rotor cooperative, Rotor deconstruction.

Actors involved
Customers (users, building companies).

Specific objective
To reduce the flow of demolition waste by practicing the reuse of construction materials and goods.

Method of intervention
Rotor is a Brussels-based non-profit firm that has been conducted almost 10 years of research on flows of materials in industry and construction, besides projects in architecture and interior design, they produce exhibitions, books, economic models and policy proposals.
In 2012-2013 they have conducted a survey of all existing dealers of secondhand building materials in Belgium and discovered that, unlike the rural and domestic sectors, still few operators work in re-selling and reusing materials from the service building sector, which is the majority of demolished or renovated buildings in metropolitan areas such as Brussels Region. In 2016, therefore, they founded a spin-off, Rotor deconstruction, with the mission of facilitating the reuse of building components. Rotor deconstruction currently operates in the Brussels area, with sporadic episodes in the Netherlands and France providing assistance to building owners, contractors and architects and physically dismantling and selling reusable materials from quality buildings undergoing transformation or demolition. The material thus obtained is conditioned, transported, clean and market in their store or online, where you can read its entire history. Diverting these elements from the waste stream has more than good environmental impacts, it is also a form of preservation of pieces conceived by renowned designers, created by skilled craftsmen or made using technologies now out of reach. Rotor deconstruction sells, in fact, two kinds of products: generic construction elements such as doors, windows,

flooring, lamps, furniture and much more at prices significantly lower than the new one or more exceptional batches of materials from landmark buildings. They also purchase private demolition materials, guaranteeing safety and quality criteria and organize workshops to spread the culture of reuse and recycling.

Fig. 5.7.1 Dismantling of interior fittings at the former headquarters of BNP Paribas Fortis Source: Rotor Deconstruction's website, 2014-2016.

Fig. 5.7.2 Rotor deconstruction services
Based on the graphic of Ellen MacArthur Foundation https://www.ellenmacarthurfoundation.org/
Source: UNINA Team, 2018

Fig.5.7.3 Systemic section of the solution
UNINA Team, 2018

Other information

Rotor Deconstruction website: https://rotordc.com/
Rotor organization website: http://rotordb.org/
More information (PDF): https://jaap-bakema-study-centre.hetnieutheyinstituut.nl/sites/default/files/deconstruction-final-small.pdf

5.8. Material Passport

Flow
Construction and demolition waste.

Category of outcome
Economic, Technological, Environmental.

Location of the good practice
Online (link: https://www.madaster.com/en)

Owner of the EIS
Madaster Foundation.

Actors involved
Sponsors and Customers (private, real estate companies).

Specific objective
To eliminate construction and demolition waste by reusing quality and safe building materials.

Method of intervention
Madaster Foundation is a non-profit organisation under Dutch law. Their main aim is to eliminate waste in the real estate sector by making waste back to being material again and their solution consists of creating and spreading a Material Passport for building waste. They follow buildings and materials throughout their lifecycle, offering services to all the actors that are included in construction, maintenance and demolition processes.
Regarding to their vision, waste from construction and demolition processes is, in turn, nothing other than construction material, but without documents certifying its identity and quality. In order to involve this material in building operations again, and to provide information about them, the organization promotes, founds and oversees the development and usage of the "Material Passport" in real estate sector: it contains information on the materials used to create a building, their quantities, quality and locations, and their economic and "circular economic" value. This way, it becomes easier to reuse materials, minimize waste, and to reduce the environmental cost of material consumption.
Potential impacts of improved and deep insight into the use of materials are the stimulation of circular economy and improved design solutions. The material passport is one of the tools of the online platform used by the foundation to stimulate the transition to a more circular economy: the Madaster Platform works as an independent, public, online library of materials in the built environment with access for everyone (from private individuals, to companies, governments, and scientific organisations). It links the identity of materials to a location and registers this in a

materials passport, changing every building into a valuable depot of "raw" materials. As a private individual you can affordably register and create a dossier of your home: since you uploaded all documents and certifications about your home you receive the material passport of it, containing all “ingredients” of the building. This will enable the reuse of building materials when you no longer need them.
Madaster can be also used as a circular design tool and as a central archive by designers and builders. During the design phase, they are invited to use Madaster Circularity Indicator to provide insight into the degree of circularity of the new property object. More than this the platform also supports (semi-)public sector organizations in their roles of owners and administrators of real estate, and assists them in implementing their social agendas. All the collected data are then anonymised and made available on the platform that contains a rich and growing library of building-specific information on materials, components, and products that is offered to service providers.

Fig. 5.8.1 Madaster slogan
Source: Madaster website, 2017.

Other information

Madaster Organization’s website: https://www.madaster.com/en

Madaster Platform Quick Reference Guide (PDF):
https://www.madaster.com/application/files/1415/0652/4654/EN_Quick_Reference_Guide_V3.pdf

5.9. European Quality Association for Recycling e.V. (EQAR)

Flow
Construction and demolition waste.

Category of outcome
Political, Economic, Environmental.

Location of the good practice
European territory.

Owner of the EIS
European Quality Association for Recycling e.V.

Actors involved
Members of the association (companies) and legislative and legal european bodies affecting the sector.

Specific objective
To eliminate construction and demolition waste by reusing quality and safe building materials.

Method of intervention
The European Quality Association for Recycling e.V. (EQAR) is based in Germany.
It is the roof organization of national quality protection organizations and producers of quality-controlled recycled building materials from the EU member states and works all over Europe. It supports a sustainable and ecological cycle of substance in the sense of circular economy in construction and promotes the production of high-quality, quality-controlled recycled building materials of mineral residual building masses. The organization provides several services to its member such as information on the European laws and regulations, support in political problems on national level, marketing for recycled building materials, technical know-how of modern update recycling materials.
Above all, members are awarded of the EQAR-quality label as a European quality certificate for their recycled material that ensures transparency for the client and environmental compatibility in conformity with regulations of the national states. In order to process waste into new marketable and suitable products. It guarantees pre-selection of material input and removal of harmful substances: material for recycling shall be only accepted if it had been pre-selected through a controlled demolition, in order to prevent the presence of hazardous materials and pollutants. If harmful substances are found in the material anyway, they have to be removed and the data must be documented.

Fig. 5.9.1 EQAR Quality label
Source: EQAR web site, 2018.

Other information

EQAR website: http://www.eqar.info/en/home.html
More information about EQAR (PDF):
http://www.eqar.info/fileadmin/eqar/paper/RC_European_market.pdf

From
research&design studio

6. Eco-Innovative Solutions from research & design studio

6.1. Solution from 2017 Urban Innovative Actions call

Title of the solution

CAR:MEN_Casoria Remix. Motion, Energy, Nature for rethinking Wastescapes

Unina team prepared this proposal to apply to 2017 Urban Innovative Actions call, together with the Municipality of Casoria (one of the municipality of REPAiR Focus Area) and with some innovative start-ups operating in the field of alternative energy sources. Even if it has not been selected for funding in the UIA program, it has been anyway approved by the local administration of Casoria. In fact, the municipality aims to start realising it in the short term; to do so, this green network will be implemented firstly in public owned areas.

This project aims to re-purpose the underused areas along the infrastructure network system of the municipality of Casoria. Specifically, the idea is to envision a systemic Eco-Innovative Solution, in line with the European ambitions related to Eco-Innovations, for the sustainable regeneration of the Wastescapes, along the Road of the Americans (SP1).

The Road of the Americans, object of this study, is the first highway of the Neapolitan area, traced by Allied Forces in 1944. Today, this is one heavily congested road (180,000 cars/day), characterized by constructions on the edges.

These quarters are reached everyday by car, even from close neighbourhoods. This focus-area is 2,5/3,0 km in length and 1,0 km/1,5 km in width (extended to the railway station and to the city center).

The main idea of this project proposal is to transform the kinetic energy produced by the flows of vehicles, passing through the main road axes, into clean electricity. In particular, through this systemic innovation, the project aims to use the clean energy produced to support the development and the maintenance of an ecological network in the form of a continuous linear forest, replacing the existing wastescapes.

With the actions of this project, wastescapes are included within a wide territorial recycling vision and in the perspective of a better spatial integration with the surrounding areas. In addition, they can become engines of transformations, capable of affecting positively the metabolic flows of urban systems, towards a circular urban metabolism.

In fact, the project is exploring the new technologies capable of transforming existing traffic roads towards more sustainable networks. To do so, it investigates the possibility to generate electricity, that can be useful for the nourishing system of new

urban forests (hydraulic pumps, irrigation systems, etc.). As a consequence, forests that, as we know, naturally function as lungs of the planet, are able to absorb the produced CO2 from cars, transforming it into valuable oxygen necessary for life. This vision is complementary to the implementation of a sustainable mobility network: the traffic roads are concentrated only along the main infrastructural roads, and the soft mobility is organised in urban and periurban areas.

The energy produced by the flows of the cars can be used in the short term to promote actions, that will be functioning also in a longer term, like:

- incentives for achieving the energy efficiency of the large commercial malls and buildings for the service sector, with an increased use of renewable energies (such as solar panels and small wind turbines);
- the conversion of parking areas in wooded and permeable plots, with the resulting increasing of the biodiversity within the city, and the reduction of the urban heat island in summer;
- the implementation of diverse collection points for separated waste, in the parking areas of shopping centers, laboratories and offices, matching the specific kind of waste produced: e.g. collection of the post-electric and post-electronic waste, waste from building construction and demolition, neighbourhood composters for organic waste (to be converted into fertilizer for forests and/or into biomass and energy), and so forth.

The natural ecological network system includes a mobility network designed for the cycle lane, as a further mitigation tool for the density of the impact of cars in the city of Casoria. Here, the project idea is to implement a cycle lane that runs along the commercial areas, crossing the linear forest, and connecting the train station and other points of interest, using the energy produced by cars for the night lighting. Together with that, another sustainable transport system will be completed: specifically, an electric bike sharing system, powered by the same energy source obtained from the transformation of the kinetic energy of the cars.

Furthermore, the flow of pedestrians is also included as additional technology to produce clean energy, through the poaching of tiles designed to store energy. This technology can be installed near the railway station, or in the malls, as well as in pedestrian areas where the flows of people are high.

In sum, the project aims to:

- discourage the circulation of private cars in the city centre;
- enhance the environmental quality, through the creation of permeable spaces;
- implement buildings retrofitting;
- improve living comforts;
- promote resource efficiency;
- reduce of climate-altering emissions and wastefulness;

- empower the local community, thanks to the co-management of the project actions with the local citizens associations.

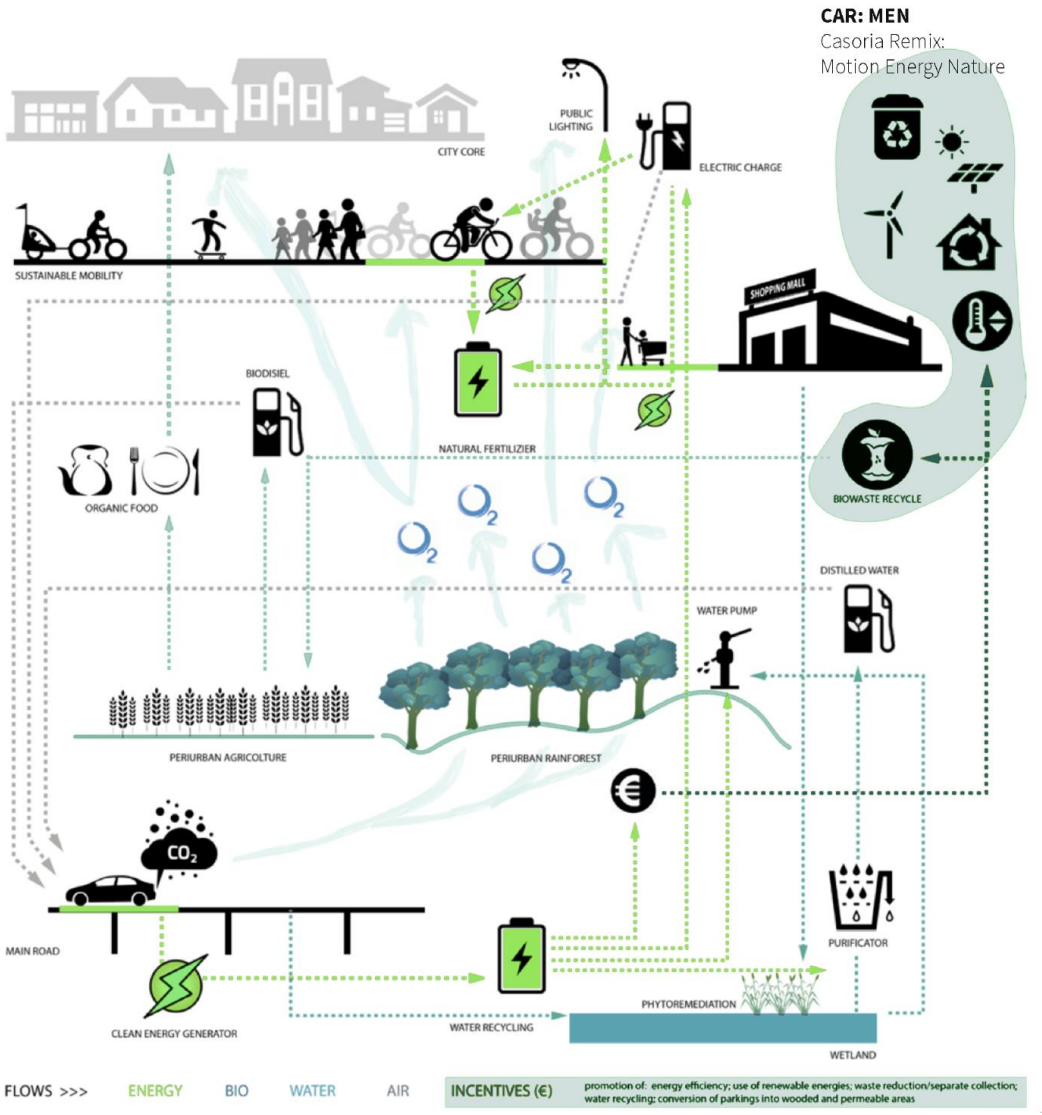


Fig. 6.1.1 Proposed solution
Source: CARMEN, 2017.

6.2. Solutions from the 2017 REPAiR International Workshop "Eco-innovation for Naples wastescapes"

Workshop data:
Delft, May 17, 2017 – Naples, June 7-9, 2017

Faculty of Architecture and the Built Environment, TUDelft

Department of Architecture, University of Naples "Federico II"

Workshop description and scientific content
The aim of the workshop was the co-creation of eco-innovative solutions to prevent waste generation and promote the use of waste as a resource on a peculiar case of study area: the wastescapes of Naples Metropolitan Area. The workshop has been an experimental pilot to exchange methodologies and approaches between two European schools of Architecture and Planning, the Department of Architecture of Naples (Italy) and TUDelft (Netherlands), partners of the REPAiR project. Therefore, the workshop has been articulated in two phases, organized in the two schools, in May and June 2017.

Delft, May 17, 2017
This part of the workshop has been designed as one intensive afternoon workshop in which students from Naples and TUDelft shared their knowledge and the work done in the urbanism courses with a fruitful discussion with their pairs, with Alexander Wandl, Libera Amenta, Janneke van der Leer and Yan Song, from the REPAiR research Team, and with prof. Michelangelo Russo from the University of Naples Federico II. These presentations provided both theoretical guidance and analysis-driven work for the follow-up operative workshop in Naples. The workshop concluded with a lecture about Rotterdam by Peter van Veelen, from TUDelft.

Naples, June 7-9, 2017
The workshop in Naples has been articulated in a 3-days intensive design, and field-work. "Masseria Magliulo", a confiscated asset in Naples Metropolitan Area, that was the site and the object of the study. During the 3 days, in order to give participants, the basic coordinates and main critical perspectives to address their fieldwork, invited guest lecturers presented theoretical frameworks and methods:
RS Architettura and Dianarchitecture, special mention for young Italian architecture talent at 2016 Venice Biennale, link:
http://www.rsarchitettura.com/index.php/10-photos/23-restart

Learning Outcomes
The workshop offered methods for applying circular economy in the built environment. By presenting and discussing respectively their studio projects, the students gained new methodological skills and competences for innovative design,

learning from each other, as well as having a unique opportunity to expand their knowledge in dialogue with international experts working on circular economy and urban regeneration.
The workshop was for students from the Faculty of Architecture and the Built Environment, TUDelft, and for students from Laboratorio di Progettazione Urbanistica 2016-2017 DiARC Unina.

Tutors
Paolo De Martino - Agostino Granatiero - Pasquale Inglese - Yan Song - Valentina Vittiglio - Francesca Zanotto.

In the following pages, the results are presented in a re-elaborated shape, suitable to the aim of this deliverable.

6.2.1. Follow water

Students:
Twan Cortenraede - Yi Wang - Lisa Marie Dubiez - Celine Reymond,
Anna Pinto - Carmen Zampoli - Anna Troiano - Gianguido Passaro.

Keywords:
water management; social activities; self sustaining; connecting public spaces.

The Antonio Esposito Ferraioli Farm or “Masseria” is located in the periurban area of Afragola, where the large infrastructures on one side have encouraged the fragmentation and the abandonment of agriculture and on the other the establishment of large metropolitan commercial mall such as Ikea and Leroy Merlin. The solution identifies the recovery of water cycle as the first action for creating new networks of actors and of landscape forms: the rain waters are channeled into canals from the large impermeable surfaces such as car parks and roofs of shopping centers or road surfaces. Canals are filled with phytodepuration vegetation and clean water can be used for crops and to feed the green buffer strips that are placed along the infrastructures filtering noise and smog. The farm products of the Masseria can be sold both during the markets and in the large commercial structures that accept to participate in the project, while the waste from agricultural activity feeds a composting system that provides fertilizer to vegetables gardens. In addition, the increase in the number of trees in the area provides wood material for the construction of small objects at the masseria's laboratories that can then be sold in partner stores in order to provide economic support to the social activities. The accessibility of this park system is provided by pedestrian and cycle routes to neighboring urban centers.

Fig. 6.2.1.1 Workshop product
Source: Students, 2017.

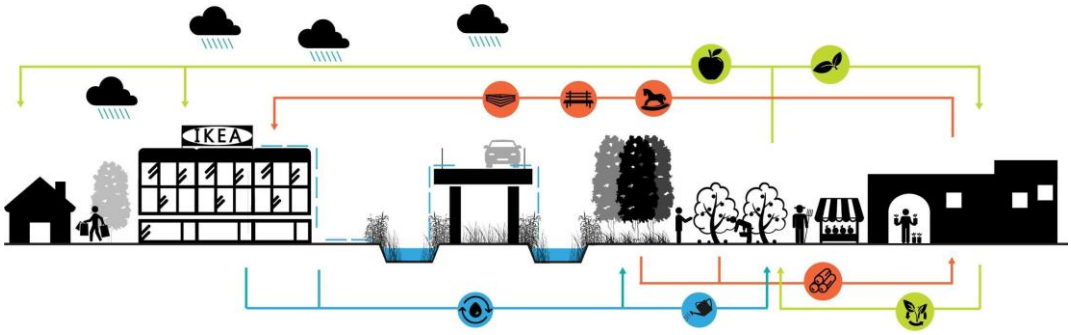


Fig. 6.2.1.2 Systemic section of the solution
Source: UNINA Team, 2018

6.2.2. From Recycle to Bicycle

Students:
Roberta Barbarini – Maria Teresa Ferrara - Federica Petrone - Pietro Pugliese - Valentino Schettini - Anastasia Scialdone - Palma Vuoso.

Keywords:
connections; energetic self-sufficiency; learning.

The recovery project of Antonio Esposito Ferraioli Masseria aims to create a bed & breakfast within the Masseria, the recovery of the surrounding territories and the construction of a cycle path that goes to improve the site accessibility.
The process starts with a study of the place highlighting its criticalities and potentialities. On the one hand, the site is isolated from the main centers, even if located between the towns of Afragola and Casoria, both pedestrians and cars hardly reach the Masseria and also the byke mobility it is tricky in the area. On the other hand, the area is marked by the presence of large green spaces, shopping malls and road transport infrastructures.
The project is implemented through a temporal scan of the interventions: the first step is recovering the green spaces, equipping them and connecting the area through cycle routes and bike sharing points: these actions aim to reduce the isolation of the Masseria. The solution provides, in the medium term, the construction of a rainwater collection and reuse system for the new agricultural park and crops and, over the long term, the replacement of today's intensive crops, in order to avoid the negative effects of such techniques on soil fertility. The waste from new crops will be used to feed a composter and then to create new fertile compost for the agricultural park. The building of the composting site also stimulates and educates citizens to a proper separate waste collection, useful to reduce the phenomenon of waste abandonment which today afflicts the area as revealed by official sources and site inspections. A way to ensure the viability of the agricultural park and a more sustainable lifestyle is to educate the population, especially new generations. This goal is pursued by courses and visits at the farm, that will become a place of education to civil life instead of a place of crime and illegality. The farm, therefore, is a symbol of change.

Fig. 6.2.2.1 Workshop product
Source: Students, 2017.

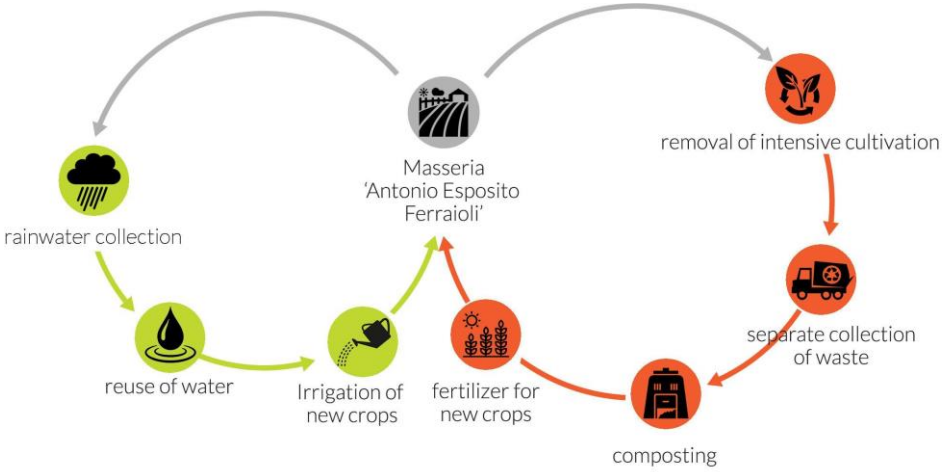


Fig. 6.2.2.2 From Recycle to Bicycle
Based on the graphic of Ellen MacArthur Foundation https://www.ellenmacarthurfoundation.org/
Source: Students, 2018

6.2.3. From Wastescape to Socialscape

Students:
Gaia Borrelli - Valentina Brancaccio - Raffaella Cimmino - Rosalba Diglio - Francesco Varricchione - Miriam Baumheuer - Ibai Bravo - Ruben Zaragoza - Jose Deus - Carmen Llorente - Beatriz Spinella Segura.
Keywords:
reconnection; cooperation; recycling; green line.

Workshop's main aim was to focus on the Masseria Ferraioli, a wastescape located in the rural area of Afragola, little town in the Metropolitan City of Naples.
The Masseria (farm) was owned by a Camorra's family, it was then seized by authorities to be given back to the community. The existing building has become a ruin and is hardly accessible by slow mobility; other critical issues affecting the site are: pollution, no access to public, decay of infrastructures, isolation from the urban center.
This place has a lot of strengths because is located in a green and rural area, very close to metropolitan infrastructures and also to commercial malls such as Ikea and Leroy Merlin. The area is also very close to the city of Naples and to other towns in the surroundings. The aim of the solution is to convert the wastescape into a *socialscape*, regenerating this area following principles of circular economy. The actions aim to reconnect the territory and put the Masseria at the center of a new net of social attractions, encouraging people to rediscover the potential of this territory. For this reason, the solution proposes connections with the commercial areas by green lines for pedestrians and bikes, with the purpose to reduce pollution levels.
One of the main actions is restoring the ancient masseria building, that can be transformed in a place of production and co-working both for agricultural products and for recycling materials from Ikea and Leroy Merlin that can be sold to fund the working place.
Rainwater is collected in canals filled with phytodepuration vegetation for feeding new crops that are grown in community vegetables garden and fertilized trough compost from organic waste. People living in the area can be involved in the solution, but the main actor is supposed to be the Municipality, that can lead a real transformation using the European funds for agricultural development (2020) and involving cooperatives, schools, private citizens, associations and farmers.

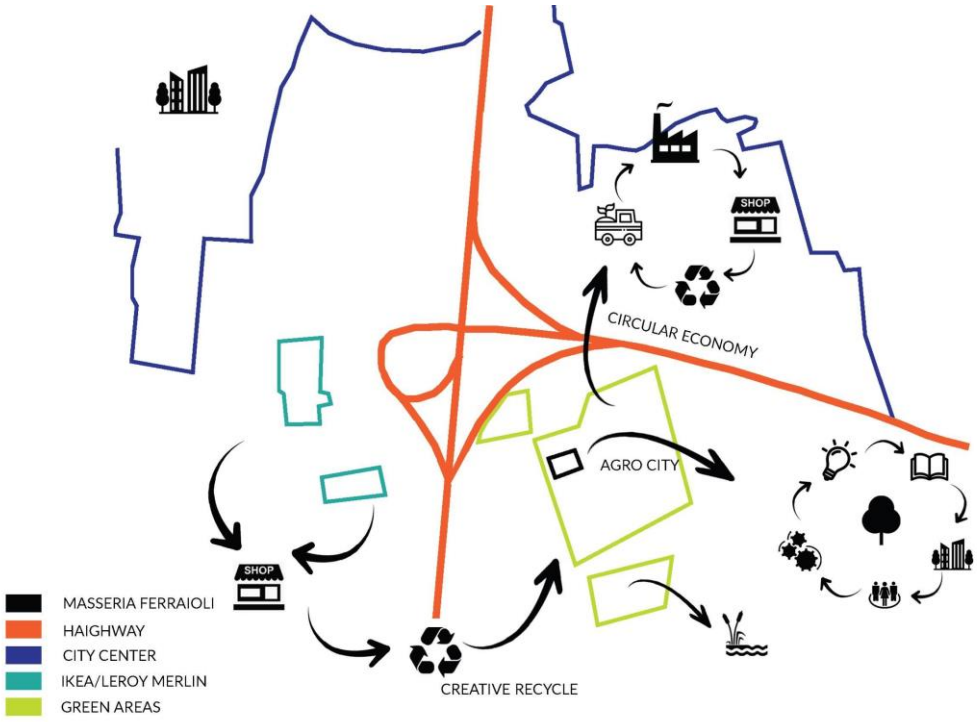


Fig. 6.2.3.1 From Wastescape to Socialscape
Source: Students, 2018

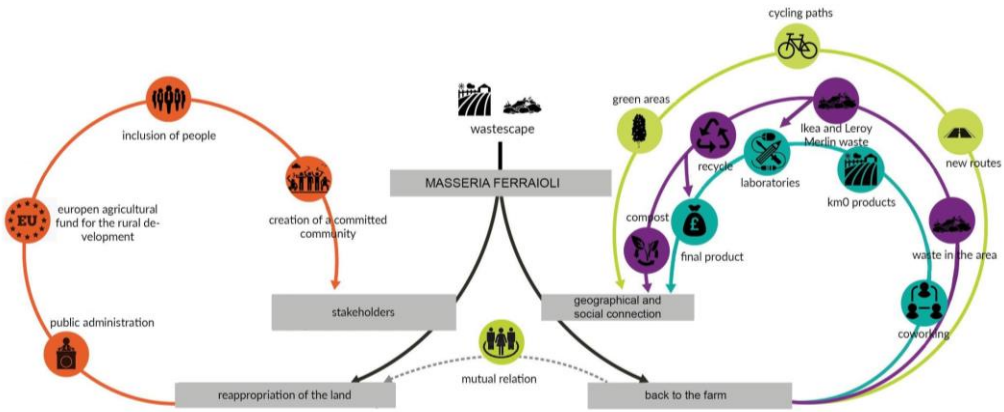


Fig. 6.2.3.2 Circular process scheme on the solution
Based on the graphic of Ellen MacArthur Foundation https://www.ellenmacarthurfoundation.org/
Source: Students, 2018

6.2.4. WASTE: transformable resources for community spaces

Students:
Federica Ammaturo - Katia Federico - Serena Scarano - Ilaria Bergamasco - Lucia Graziano - Imma Izzo - Pasquale Galdiero - Emanuela Madonna.

Keywords:
social inclusion; network; education; re-culture.

The Casoria-Afragola region, located in a strategic position on the outskirts of the city of Naples, presents many critical points related to infrastructures, both in terms of accessibility and in terms of agricultural land fragmentation: many agricultural fields are, in fact, surrounded by abandoned areas close to main infrastructures.
The solution aims to "recycle" material, natural, economic and social resources in order to regenerate this space that had been taken from the community, and make it a place for the transformation of products, ideas and behavior, along with a networks of ecological connections and paths.
The first step consists in reconsidering the waste products released by industries, and then reusing them in a new way. As result of land reclamation processes, the area can become a productive agricultural park where people can grow typical local products and transform them into finished products in a cooperation networks with other actors, such as confectionery companies and restaurants. The productive agricultural park also hosts a center working in environmental education and research on recycling issues.
The remediation of wastescapes stimulates a new and more circular economy that contributes to social inclusion process, educating people to take care of the surrounding environment and its related social problems.

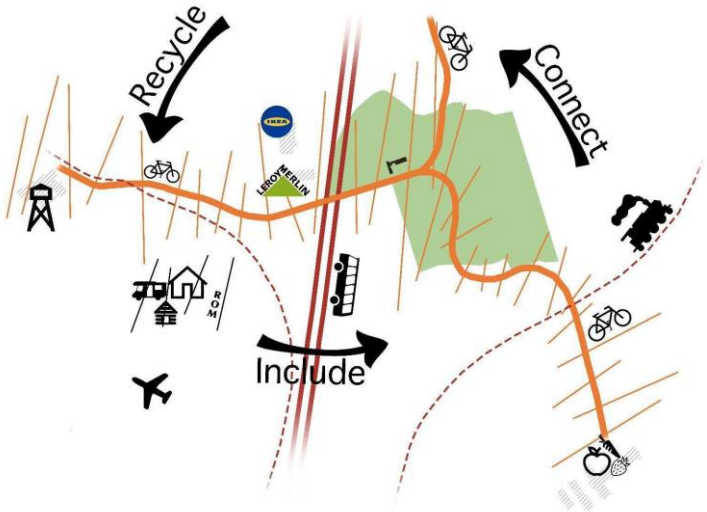


Fig. 6.2.4.1 Workshop product
Source: Students, 2017.

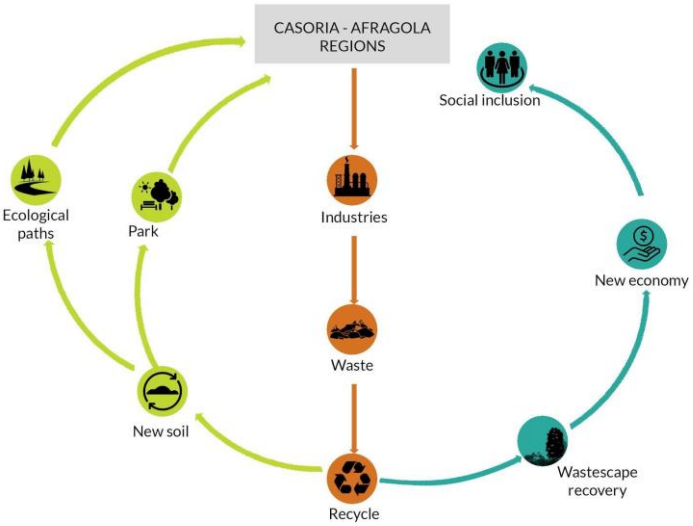


Fig. 6.2.4.2 WASTE: transformable resource to community spaces
Based on the graphic of Ellen MacArthur Foundation https://www.ellenmacarthurfoundation.org/
Source: Students, 2018

7. Knowledge transfer between PULLs: from Naples to Amsterdam

The EIS strategies presented in this catalogue were used as content for knowledge transfer activities conducted within the framework of REPAiR's WP7. The purpose of the latter is facilitating the transfer of knowledge on eco-innovative solutions and strategies between the project's six case study regions using a methodology for knowledge transfer within the 'relational space' of the network of REPAiR's PULLs (see Deliverable 7.1, REPAiR, 2018)[8]. First and foremost, the strategies presented in this catalogue were used as an input into the Knowledge Transfer (KT) event taking place at the Amsterdam PULL workshop on 12 September 2018. Given that the Amsterdam and Naples regions are pilot cases in REPAiR and their respective PULLs initiated the process of co-production of EIS earlier than the PULLs in follow-up regions, only solutions from Naples were available for transferring at this stage. Later on, the said set of three strategies developed in the Naples PULL was also used for KT events in Hamburg (10 October 2018) and Łódź, however, at the time of writing of this deliverable the conclusions from those two events are not yet elaborated, hence the focus here is on the KT event in Amsterdam. The EIS from Naples to be considered in the co-production of EIS for the Amsterdam case were selected carefully in co-operation between the partners from both regions. First, a short list of potentially transferable EIS was established. That list included a larger number of EIS than 3 currently included in this catalogue. The selection was based on (1) the fit between the flows covered in Amsterdam and Naples cases, in occurrence, construction and demolition waste and wastescapes, (2) presence of major barriers in terms of contextual differences in relation to governance, regulations, territorial characteristics, etc. The agreed upon short list contained three EIS which were then discussed with stakeholders of the Amsterdam PULL in the context of the workshop on 12 September 2018. A set of questions on transferability, choice of elements of the EIS, adaptations needed, barriers to transfer, location where the solution would best be implemented and the actors to involve was then discussed with several groups of stakeholders during the workshop. This was done using EIS knowledge transfer sheets prepared by the UNINA and TUD teams. The outcome of the discussions on knowledge transfer with the Amsterdam stakeholders is summarised in the tables included at the end of the descriptions of each of the Naples EIS included in this catalogue, stressing the degree of transferability to the Amsterdam Metropolitan Area (AMA) and elements of the EIS that can be transferred, possible barriers for this and adaptations needed, as well as possible locations for implementation and stakeholders to be involved. These tables draw on the insights from the said KT event, moderated by Marcin Dąbrowski (TUD), Viktor Varju (RKI) and Libera Amenta (TUD/UNINA). The three solutions

[8] REPAiR (2018) REPAiR: REsource Management in Peri-urban AReas: Going Beyond Urban Metabolism: D7.1 Theoretical Model of Knowledge Transfer. Delft University of Technology.

from the Naples PULL were also included the REPAiR's Deliverable 5.2 containing the catalogue of EIS for the AMA case study, elaborated by the TUD REPAiR team[9].

Discussion with stakeholders on the transferability of the EIS from Naples to that of Amsterdam was weaved into the workshop proceedings. The discussion focused on three pre-selected EIS:

1. Beyond INERTia. Circular supply chain for CDW;
2. Re-Compost Land. Short supply chain of organic waste;
3. RECALL: REmediation by Cultivating Areas in Living Landscapes.

The discussion revolved around how to organise knowledge transfer in order facilitate a purposeful and strategic transfer of the solutions or their elements and point to the expected barriers and adaptations needed to make a solution suitable to the Amsterdam context.

The three solutions turned out to be very different in terms of transferability:

- Beyond INERTia was deemed the least transferable by the participants, mainly due to cultural differences when it comes to illegal dumping and the different organisation of disposal, collection and recycling of CDW. Thus, only some of the ideas behind this EIS were deemed transferable (e.g. providing support for handling CDW by individuals and support for informal waste collection from individuals engaged in small-scale construction work).
- Re-Compost Land was deemed to be of medium transferability, with some of its elements transferrable, due to local regulations on the use of food waste and patchy food waste collection across the municipalities.
- The soil reclamation EIS RECALL was deemed the most transferable and suitable to deal with polluted soil in the wastescapes in the AMA. For this EIS, the stakeholders were able to identify the most suitable areas on the map (e.g. port urban expansion areas, areas in the noise contour of Schiphol airport).

In terms of adaptations needed, in the case of Beyond INERTia , assuming that only some elements of this EIS could be implemented in the AMA context, collection would need to happen through a network of neighbourhood collection points. Another adaptation suggested were digital support tools to provide accurate and real-time information on the material to reuse at different collection points. Example of adaptation for the compost district included adjustment to the local food waste framework. What was deemed worth to adapt was to educate people how to compost (and properly segregate organic waste beforehand). Here, the key aspect is that composting facility is close to the community, hence education would have to be on site. The closeness has a spin-off impact in terms of neighbourhood "quality

[9] At the time when the knowledge transfer event in the Amsterdam took place, the EIS in Naples were still being developed, merged and refined. What was used for the discussion with stakeholders for the transfer to Amsterdam region, were draft EIS for Naples. Thus, the EIS from Naples presented in this catalogue and in D5.3 (catalogue of EIS for Amsterdam) have been further elaborated since the said knowledge transfer event. While their core ideas and substance did not change, they were renamed and considered as strategies and broken down into eco-innovative solutions.

control". Based on the stakeholders' statements this aspect is important for the AMA communities as well. For soil the reclamation with hemp adjustments needed entailed mainly accommodating the competing land uses. One option was to combine hemp production with other functions such as recreation landscapes or energy production. A related adaptation proposed entailed a periodic rotation of hemp production on a plot with solar panels and combination of species. Another adaptation proposed was to link to the existing businesses that could use hemp products (e.g. paper industry in Haarlem, creative industries) and consider development of hemp-based body care products.

As mentioned above, the exercise also aimed at identifying potential barriers for transfer, which should be borne in mind when considering 'importing' EIS or merely drawing lessons or inspiration from them. In the case of Beyond INERTia EIS, many barriers for transfer to the Dutch context were identified. First barrier related to the different organisation of the flow of CDW, with hardly any illegal dumping problem and predominance of companies (as opposed to individuals) in the construction sector, having well organised processes to dispose of their waste. The second barrier related to the limited availability of space for storing CDW, making accessibility of collection points a challenge. Finally, a possible legal barrier was identified, with lack of quality assurance and liability for the recovered materials making the operation of the EIS unlikely in the Dutch context, unless it would entail robust certification and quality control.

Relating to the Re-Compost Land EIS the main barrier would be the legislation on organic waste in the AMA. One can process one's own waste but processing someone else's waste is considered as commercial activity and it is against the law. Therefore, the community/neighbourhood based composting and - especially - the use of compost on site cannot work without a central legislative modification. Another key barrier is that organic waste is not collected in some of the municipalities in the AMA. Finally, a cultural barrier was identified. Local food tradition is highly valued in Campania, as everywhere in Italy, while in the AMA local food culture is not prominent and most of the available food on the market is from highly industrialised production and not necessarily "local." It has an effect on the composition of compost and the attitude towards locality, local community actions.

The barriers for transfer in the case of the soil reclamation EIS were mainly the competition for land in the region (and predominance of other uses for the wastescapes, like airport expansion or housing development) and possible cultural associations with cannabis (resulting in confusion and possible vandalism on hemp fields).

Scope for Knowledge Transfer of Beyond INERTia to the AMA

Fig. 7.1 Knowledge transfer event in Amsterdam: discussion with stakeholders on the transferability of EIS from Naples
Photo by Marcin Dabrowski

EIS	**Beyond INERTia**
Transferability from Naples to Amsterdam	Low

Transferable elements	The least transferable EIS from Naples, mainly due to cultural differences and different organisation of disposal. Only some of the ideas behind this EIS were deemed transferable (e.g. providing support for handling CDW by individuals and support for informal waste collection from individuals engaged in small-scale construction work).
Adaptations needed to transfer the EIS	Collection would need to happen through a network of neighbourhood collection points. Digital support tools could provide accurate and real-time information on the material to reuse at different collection points.
Key barriers for transfer	First barrier related to the different organisation of the flow of CDW, with hardly any illegal dumping problem and predominance of companies (as opposed to individuals) in the construction sector, having well organised processes to dispose of their waste. The second barrier related to the limited availability of space for storing CDW, making accessibility of collection points a challenge. Finally, a legal barrier: lack of quality assurance and liability for the recovered materials making the operation of the EIS unlikely in the Dutch context.
Potential location in the AMA	Unspecified, however, the such CDW collection points would have to be more local and decentralised than in the proposed solution for Naples.
Actors to be involved	All actors involved in the CDW flow, from architects, builders, waste management companies, to users.

Scope for Knowledge Transfer of Re-Compost Land to the AMA

Fig.7.2 Knowledge transfer event in Amsterdam: discussion with stakeholders on the transferability of EIS from Naples
Photo by Marcin Dabrowski

EIS	**Re-Compost Land**
Transferability from Naples to Amsterdam	Medium
Transferable elements	Only some elements are transferable, due to local regulations on the use of food waste and patchy food waste collection across the municipalities. The possible transferable aspects are those related to educating and mobilising the local population and offering incentives as well as the landscape transformation idea.
Adaptations needed to transfer the EIS	Need for early separation of rural organic waste streams. Need for changes to the rules for collection and use of organic waste. Need for educating the inhabitants on how to compost and properly segregate organic waste. Composting facility needs to be close to the community to allow for education on site and for neighbourhood "quality control."

Key barriers for transfer	First barrier is the legislation on organic waste in the AMA (processing someone else's waste is considered as commercial activity and it is against the law). Another key barrier is that organic waste is not collected in some of the municipalities in the AMA. Lastly, in the AMA local food culture is not prominent and most of the available food on the market is from highly industrialised production and not necessarily "local," which could limit the suitability of this EIS to this context.
Potential location in the AMA	Around parks and in suburban areas (e.g. Noord, Amstelveen), degraded land. Some stakeholders remarked that it could be applied on the highly built-up urban areas as well.
Actors to be involved	Municipalities, households, training organisations, transport companies, waste management companies, farmers.

Scope for Knowledge Transfer of RECALL the AMA

Fig. 7.3 Knowledge transfer event in Amsterdam: discussion with stakeholders on the transferability of EIS from Naples

Photo by Marcin Dabrowski

EIS	**RECALL**
Transferability from Naples to Amsterdam	High
Transferable elements	Highly transferable and suitable to deal with polluted soil in the wastescapes in the AMA. Practically the entire EIS was considered suitable for transfer, albeit with some extensions and adaptations to fit the local context.
Adaptations needed to transfer the EIS	There is a need to accommodate the competing land uses, given the high pressure on land in Amsterdam and its region. One option identified was to combine hemp production with other functions such as recreation landscapes or energy production. A related adaptation proposed entailed a periodic rotation of hemp production on a plot with solar panels and combination of species. Another adaptation proposed was to link to the existing businesses that could use hemp products (e.g. paper industry in Haarlem, creative industries) and consider development of hemp-based body care products.
Key barriers for transfer	Geographical and economical and (to a degree) also cultural: strong competition for land in the region (and predominance of other uses for the wastescapes, e.g. for airport expansion or housing development) and possible cultural associations with cannabis, a recreational drug.
Potential location in the AMA	Polluted and vacant industrial land in strategic spots for future urban expansion, especially in the port, areas in the noise contour of Schiphol airport (temporary basis), Greenport areas on a longer term basis.
Actors to be involved	Municipalities, Schiphol airport, hemp products companies, other local economic actors (paper industry, 3D printing, etc.), other parties that have 'claims' on the land in question (energy companies, housing associations, developers).

8. Conclusions

The Deliverable D.5.3 presents Eco-Innovative Solutions (EIS) in which innovations works both from the technological side, and from the side of the process - by which they were are conceived and thanks to which they will act.
In the previous paragraphs, the methodology used for their development was widely explained: it is based on the synergies between expert knowledge and widespread knowledge of all the participants to the PULLs processes, developed in the fertile exchange of opinions and interactions of knowledge.
In summary, the methodology is based on a cyclic decision-making process, characterized by

- a continuous change in the scale of observation and evaluation, which moves recursively between the territorial dimensions of the Region (15 x 10^3 sq km), the Focus Area (15 x 10^2 sq km) and the Sample (0,5 x 10 sq km);
- the alternation of site-specific territorial investigations and of considerations carried out within the systemic dimension, that is typical of the study of urban metabolisms;
- the engagement of the different actors able to share their knowledge and available to cooperate to make the EIS operational.

In particular, it shall be stressed the step between the territorial strategies, that can be considered as real "projects" elaborated with the local communities on the specific areas of the sample area (chapter 3), and the eco-innovative solutions (chapter 4), in which the aforementioned territorial strategies are reformulated to a systemic dimension, suitable for their implementation in the GDSE and the transferability to the other European study-case (AMA and the four follow-ups).
The four solutions proposed by REPAiR in the case of the study of the metropolitan area of Naples, focus, as known, on construction and demolition waste (CDW), organic waste (OW) and on the regeneration of wastescape. In fact, the rationalization of the cycles of the first two flows (OW and CDW) is related, as in the premises of REPAiR, with the prospects of regeneration of the wastescapes, the spaces of maximum fragmentation and discontinuity of the metropolitan periurban (see D3.1 and D3.3), characterized by landscape degradation phenomena.

The first of the solutions - “RECALL” - relates the reclamation and soil regeneration with the resumption of crops typical of local contexts, with functions of phytodepuration.
The second solution - “Re-Compost Land” - defines the conditions for a reorganization of the organic waste treatment plants, aimed at linking production and reuse of the OW within defined territorial contexts, according to a logic that can be traced back to that of the neighborhood units.
The third and fourth solutions (“beyond INERTia” and “CIRO +”), are aimed at maximizing the possibilities of reuse, at local level, of waste products from construction sites (CDW), produced both of small private construction sites and of

those of huge public works (railway and road surveys, hydrogeological safety works, foundation excavations, etc.).

From a systemic point of view, the recurring element in the four EIS is the "short supply chain" through which waste recycling can trigger the regeneration of wastescape. This condition (up to a virtual "farm-to-table" of waste), has environmental effects induced on the decrease of Co2 produced by the collection and transport of waste. Furthermore, it is useful to make local communities aware of the importance of separate waste collection: towards an empowerment of citizens, who will have the opportunity to measure, in their daily life, the concrete environmental and economic improvements related to virtuous behavior. Finally, with specific reference to the Neapolitan case, the shortening of the supply chain, can help to discourage the abusive abandonment of CDW (for example, along the buffer areas of infrastructures), thanks to the improvement of the accessibility of the collection points of CDW for citizens and small construction firms.
All the four solutions, focus their action on soil quality, intended both as a means of naturalness production, both as a space for ecological and public reconnections in peri-urban areas.

The innovation process, has started born from the discussions with local stakeholders about the problems of the peri-urban territories; in a second moment, the innovations (very much linked to the territory and therefore site specific) have been transformed and de-territorialised in the EIS. Later on, the EIS will be tested again in the peri-urban territories through the use of the GDSE, defining from time to time, on a collaborative basis, the development of EIS in individual case studies.

However, on the basis of the spatial analysis conducted so far, the geographies of the metropolitan area of Naples seem to suggest principles of innovation grouped into two main morphological models: “green-infrastructure” and “new soil”.

- Green-infrastructures, to be developed along the network of large "gray" existing infrastructures - freeways, equipment, technological systems - and "blue" ones - canals, rivers, reservoirs - of the metropolitan area. Green infrastructures, "nurtured" thanks to the recycling of organic waste from urban and rural metabolisms, provide ecosystem services, contribute to the rationalization and purification of the water cycle, improve the Co2 budget, promote the increase of biodiversity in the peri-urban area; over the years, they will transform the peri-urban landscape, intervening on one of the phenomena that produced it: the break-in of large infrastructures in environmental fragile contexts. Furthermore, green infrastructures promote the improvement of the quality of life and the well-being of citizens.
  The combination of green infrastructure and large transport infrastructures on a metropolitan scale generates what we call "green-gray infrastructure", which, as the outcome of this process, will mainly host the collection and first treatment centers of post-construction waste. The combination of green

infrastructures and river basins generates what we call "green-blue infrastructure", which, as the outcome of this process, will mainly host the phytodepuration basins of the water coming from urban systems, to be used in the activation of the new metropolitan natures. Topologically, the green infrastructure define a network of new public and ecological connections, structurally continuous (given that it relies on infrastructures and canals), "programmed" to progressively infiltrate, in the future, in the densest parts of the urban systems on board.

- "New soils", realized thanks to the recycling of inert materials and subsequent naturalization of the soil, through a soil improver produced on site through the treatment of the OW. The new soils will be the innovative public space connecting the metropolitan periurban in which the infrastructures related to the treatment of the organic will be preferentially located. They define new internal borders of peri-urban settlement, spaces of mediation - buffer-zones - between urbanized areas and fragments of rural space. They allow to gain new points of observation of the landscape and to create topological continuity overcoming the great barriers of the infrastructures and of the owner enclosures in areas with high plot fragmentation. Over time, an iteration of "internal greenbelt" will be promoted (in implementation of Italian Law No. 10 of 2013), with positive effects on the clustering of neighbourhoods and the definition of new balances between the latter and the rural and natural systems.

The two main morphological models support the elaboration of situated “services” able to decline the different eco-innovative solutions and strategies.
The proposed territorial regeneration process is progressive, adaptive and flexible, to be defined from time to time by collaborative and cooperative processes on a local basis (PULLs on the "sample" scale).
It is projected in a long time but has to be “anticipated” by some demonstrative "pilot", easily achievable in the present (Attademo and Formato, 2018). The realization of these pilots will be useful to increase the confidence of the stakeholders in the possibility to modify the territory of the metropolitan context and help to build trust in the opportunities identified. The process is activated through the transformations that can be implemented in the so-called "enabling contexts" (see D3.3), where the enabling conditions are identified as: the areas of simplest transformability, public property, characterized by the presence of wastescapes, good accessibility; economic, political and social feasibility conditions.
The four EISs specified for the Naples pilot case identify the innovation opportunities emerging from the PULLs and take into account the reflections and elaborations of the research team. The co-production phase, typical of the REPAiR methodology applied in the PULLs and in which the decision-making process is found, requires that in the coming months the various significant partners for each EIS verify the feasibility of each of them, making clear how to make operational both the innovation product and innovation process characterizing each EIS. For each EIS, the

type of public-private-people partnership will be gradually identified, which will have to share the specific skills to improve the characteristics of the EIS and allow to testing the effectiveness and efficiency of the processes, and and their scaling-up and transferability.

References[10]

Attademo, A., Formato, E., Fringe shifts, Listlab, Barcelona, 2018.

Carrillo-Hermosilla, Del Río, & Könnölä. (2010). Diversity of eco-innovations: Reflections from selected case studies. Journal of Cleaner Production, 18(10), 1073-1083.

Dente, B. and Coletti, P. (2011) Measuring Governance in Urban Innovation, Local Government Studies, 37(1), pp. 43-56.

EC DIRECTIVE 2008/98/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 November 2008 on waste and repealing certain Directives, 2008.

EC (2016) Grant Agreement n. NUMBER — 688920, 'REPAiR: REsource Management in Peri-urban AReas: Going Beyond Urban Metabolism'.

Kiefer, C.P., Carrillo-Hermosilla, J., Del Río, P. and Callealta Barroso, F.J. (2017), Diversity of eco-innovations: A quantitative approach, Journal of Cleaner Production, 166(C), 1494-506.

McDonough, W., Braungart, M. Cradle to Cradle: Remaking the way we make things; Vintage: London, 2008; ISBN 9780099535478.

REPAiR 2018a. "Deliverable 6.4 First application of the decision model in all case studies"

REPAiR 2018b. "Deliverable 5.4 Handbook: How to Run a PULL."

REPAiR *Decision-Making, D6.1 Governance and Cases, Processes in Pilot*; EU Commission Participant portal, 2017.

Van de Ven, F.H.M., H. Gehrels, H. van Meerten, B. van de Pas, E. Ruijgh, D. Vatvani, N. van Oostrom and Th van der Linden, (2009) *Land & Water Management in the Urban Environment* (2009) Deltares, Utrecht/Delft.

[10] This list of references only refers to the general chapters 1,2,3. The rest of the chapters have their own reference lists.