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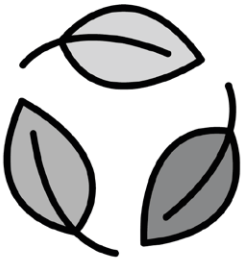
RECYCLING

Proceedings of the 5th International Conference



a cura di / edited by
Adolfo F. L. Baratta
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RECYCLING

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Adolfo F. L. Baratta
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The value of building materials in the ecological transition of the construction sector

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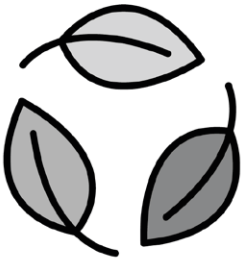
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RECYCLING

Il valore della materia nella transizione ecologica del settore delle costruzioni

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The value of building materials in the ecological transition of the construction sector

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El valor de la materia en la transición ecológica en el sector de las construcciones

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Territorial Ecosystem for circular economies: Eco3R research project

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Summary

Among the transitional processes that could lead to building consistent sustainable solutions, circular economies practices (CE) are complex processes which must take into account different topics such as stakeholder engagement, material flows opportunities, end of life expectations and EU limit perspectives or targets.
This paper introduces briefly the concept of circular territorial ecosystems with respect to the Eco3r research project, carried on by the Politecnico of Turin (DAD) from 2020, in collaboration with CCS, the in-house providing company of 19 municipalities in the area of Turin. Some crucial data on waste management and the main project's targets are presented. Some Eco3r projects' outputs are outlined in order to show this local experiment can become a model to scale or replicate in other communities in Europe.
The paper is structured as follows: Section 1 describes the background problem with main data and critical issues regarding the case study; Section 2 is describing the target of the research project Eco3R and the scientific approach adopted; Section 3 is dedicated on the main output of Eco3R project and the discussion on the further research developments.

Circular economy (CE), Circular ecosystems,
Material flow, GIS analysis

Introduction

The present work, in the context of the ecological transition of cities towards the circular economy, wants to promote a model strategy for the development of circular communities at European level [1]. Almost three quarters (72.5 %) of EU-28 inhabitants lived in urban areas [Eurostat, 2016] and Italy is characterized by a network of medium-sized cities. These territories are the social and productive backbone of Italy and the belief is that they are able to leverage new circular economies (CE). As argued by Campell-Johnston et al. [2019] the implementation of challenges linked to CE at the city scale is scarcely investigated, as well as the involvement of monitoring systems. The main challenge for the built environment to reduce its impacts in terms of natural resources and energy consumption could be achieved through the transition to a circular system, mainly based on circular infrastructures and buildings or circular products and materials [De Filippi and Carbone, 2021]. In order to unlock the development of CE strategies in small-and medium size cities, it is emerging the model of circular ecosystems [Pietrulla, 2022] which has a lack of a clear standard and classification methods. According to Aarikka-Stenroos et al.: "circular economy (CE) ecosystem is a multi-actor entity in which interdependent actors play complementary role. A CE ecosystem emerges or is created around a common, system-level goal related to resource circularity, circular economy knowledge, or circular economy business and business models" [2021, p. 33].

Starting from these premises, the Department of Architecture and Design (DAD) of the Politecnico di Torino, as public entity, together with the CCS (Consorzio Chierese per i Servizi - a waste management service company) [2], as private actor, and nineteen municipalities in the territory between Turin and Asti, as public administrations, developed a research project for the establishment of a circular economy territorial ecosystem called Eco3R [3].

The projects start from the assumption that the impacts on environmental processes and on climate global and local dynamics are influenced by global consumption of materials which is expected to double over the next four decades, while the amount of waste generated each year is expected to increase by 70 % by 2050. The EU produces nearly 2,5 billion tons of waste every year. In particular building sector in most industrialized countries, has

consumed 50% of all materials [Herczeg et al., 2014], determining 36% of the total waste in European Union [Eurostat, 2021] contributing to the 39% of global energy-related greenhouse gas (GHG) emissions [IPCC, 2018] due to its linear model, characterized by extraction, production, use, and discard of building materials.
Urban waste, which is a complex issue in terms of mix of materials, production sources and efficient management, has a lower impact in terms of quantity of waste than building dependent processes. However, about urban waste, the overall opinion and European Directive is to avoid dump sites and reduce burning waste treatments in the limits of maximum 10% within 2035. About waste from building sectors there is no one clear and comprehensive policy or limitation other than increasing the recycling practices and circular economies. In Italy, building places produce 42,5% of the total amount of waste mainly for maintenance activities [4] and has met the 2020 EU targets because much of the special construction waste is recovered. Also in the Piedmont region, the main quantity of waste is coming from building places and the production sector of building materials (C&D waste - 4 million tons on average out of 9,4 million). In Piedmont, recycling of these waste is mainly focused on recovering inorganic substances (68,2%), metals (10,3%), spreading on the soil of organic substances (10,7%). However, only a fraction of special construction waste (about 7 %) is reused in construction. This result depends on various factors including, for example, the collection capacity of demolition material for reuse in construction, which has not yet built stable supply chains.
In June 2020, the Consortium CCS in collaboration with DAD, promoted a study to uncover the potential of territorial ecosystems for the reuse, recycling and reduction of waste within the reference territorial system of 125.647 resident inhabitants living in an area of 434,56 km^2. The Eco3R project, financed by ATO-R [5] has adopted the concept of a previous project named ReLand [6] developed by the Municipality of Cambiano (TO), in collaboration with DAD and the association OFF grid Italia.

CE territorial ecosystem: the case of the "Observatory for the circular territorial economy"

The research-based project developed by DAD had the goal to envision possible medium-long term strategies and actions through the involve-

ment of citizens, educational institutions, the business sectors, within the area of the nineteen municipalities involved by the consortium.
In general, the stakeholders involved were challenged to co-design pilot circular ecosystems that make experiments on the reuse/recycling of objects qualified as "non-waste", before they are transferred to the waste collection circuits, in order to identify new possible use for the local communities.
A specific goal was to provide a design support system called "Observatory for the circular territorial economy". The Observatory has:

- set up design principles and study the supply chains of local materials. The actors involved were mapped to identify local specific CE strategies.
- studied national guidelines and regulations to develop a coherent Observatory model with the current national and european frameworks.

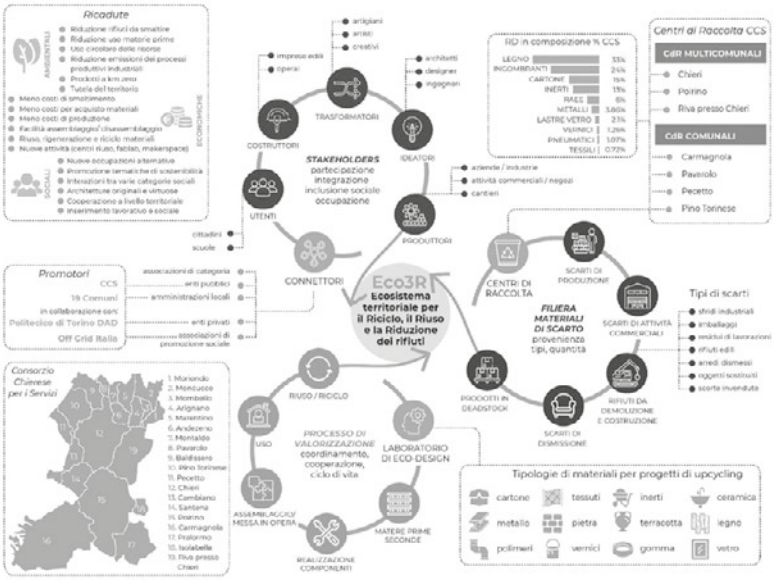


Figure 1. The manifesto of Eco3R showing nodes of interest in the ecosystem: impacts, promoters, territories involved, waste collection centers, waste, and types of materials [Source: Lusso Nadia, Degree thesis, Politecnico di Torino. Academic year 2021-2022. Supervisors: G. Callegari, G. Roccasalva].

As a guiding tool, a process map (Figure 1) has been developed for the ex-ante assessment of the territorial ecosystem, including the representation of the processes, the relationships between the various institutional actors, the potential flows of materials to introduce in a potential local circular ecosystem. This map was shared with the administrators and technicians of the municipalities engaged in the project.
More in detail, based on geo-referenced and socio-economic information, the map (Figure 2) has identified the main companies in the area, grouping them by type of materials production chain or type of wastes produced. This map was useful to support the municipalities and CCS in the preliminary identification of actors and potential supply chains of materials that in the future could generate a territorial CE local ecosystem. The future

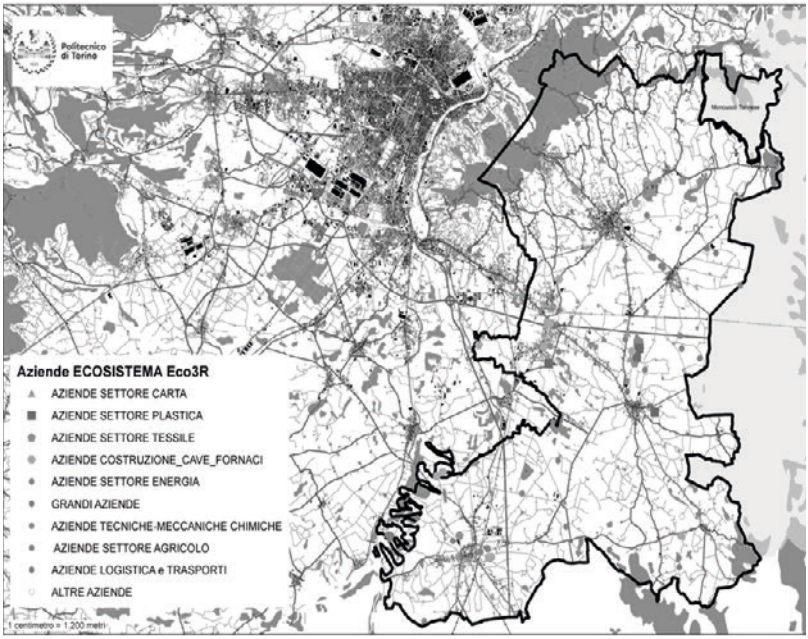


Figure 2. Analysis of material flows generated by companies in the territory of the 19 municipalities in order to forecast circular value chains [Source: analysis by G. Roccasalva Politecnico di Torino, Architecture and Design Department].

CE strategies could be developed horizontally, through reuse or recycling practices in the industrial sector, or vertically with schemes operated by the local communities.

Concluding remarks

Different material and strategic outputs of this research project can be discussed, among them, the construction of a network of municipalities which are more aware that CE processes can be generated locally and must include the collaboration among different actors.

Consistently with the general principles of the Eco3R project, DAD developed the design guidelines for the construction of the "Eco3R Laboratory" for local experimental process of reducing quantity of urban waste and for educational experiments through the involvement of citizens, educational institutions (Figure 3). A study about best practices relating to recovery projects and innovative hubs at national and European level supported the

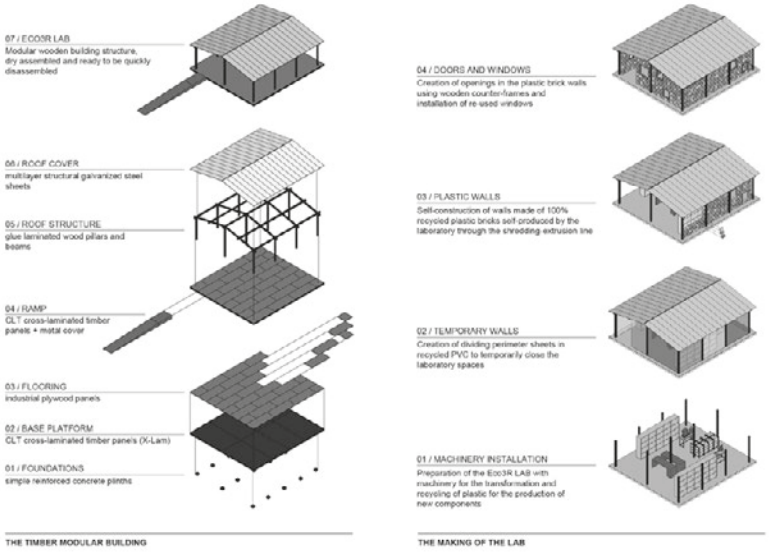


Figure 3. ECO3R LAB: the making of the laboratory [Original graphics by G. Callegari and P. Simeone with N. Lusso, Politecnico di Torino, Architecture and Design Department].

definition of the possible activities of the "Eco3R Laboratory", which will be activated in 2023 at the headquarters of the CCS Consortium.
In Europe, some different case studies tried transitioning from a linear to a circular model of resource management with a focus on how to reuse sources rather than dispose of them as in the linear model. Amsterdam Institute for Advanced Metropolitan Solution (AMS) promotes a cross-fertilization hub of ideas, creating an innovative environment between knowledge institutes, private and public organizations.
In this regard, the effort made by "Eco3r Observatory for the circular territorial economy" project is also about boosting potential supply chains in order to create new circular territorial economies. Eco3R project has tried to analyze material flows, outlining possible strategies of symbiosis and CEs based on the survey of local industries.
Among the results of this analysis, we also highlight the presence of construction companies, which could be possibly interested in the construction supply chain and the strategy of recovery material or using secondary raw materials (SRM).
It is possible to imagine a service, in the logic of product as a service, that generates circular economies by means of economies of scale and proximity. In this way, further development could be made in the future to support the information support network tool, through the digital enable technologies that could help the storage of data coming from different entities and analysis of the territorial material fluxes.
For example, Madaster is an online library of information on materials and products. For registered buildings and infrastructure objects, the digital platform provides insight into the materials and products used and their location, as well as their impact on circularity and the environment. By thus providing these materials with an identity, the digital platform creates awareness and understanding and makes reuse easier, reduces waste and minimizes the impact on the natural environment.
In the future, Eco3R proposed to co-design a memorandum of understanding that facilitates the relationship between construction companies in the area and C&D material recovery activities through, for example, by "selective demolition" processes of almost all materials from local construction sites, in order to turn these wastes into new products.
This circular construction supply chain could aim to create a "sharing plat-

form" that promotes material recovery from construction sites and, at the same time, promotes products that extend the life of the material through new modular products. It could also be envisioned that this arrangement would generate an entry in the regional pricing, which municipalities can also take into account in their green procurement public tenders.

Notes

[1] The Politecnico di Torino work group is part of the ARV-Climate Positive Circular Communities project, [Programme H2020-EU.3.3.] which aims to rapidly implement large-scale climate-positive circular communities (CPCCs).

[2] CCS is a public service company made up of 19 municipalities (Andezeno, Arignano, Baldissero T.se, Cambiano, Carmagnola, Chieri, Isolabella, Marentino, Mombello di Torino, Moncucco T.se, Montaldo T.se, Moriondo, Pavarolo, Pecetto T.se, Pino T.se, Poirino, Pralormo, Riva presso Chieri, Santena). The CCS has reached nearly 83% of separate waste collection.

[3] The Eco3R (Ecosystem Reduce, Reuse, Recycle and Circular Economy) originated from the ReLand project of the Municipality of Cambiano and the association Off Grid Italia. G. Callegari (scientific director) G. Ricciardi, G. Roccasalva, P. Simeone, with the assistance of N. Lusso, E. Merolla, Politecnico di Torino.

[4] Rapporto Rifiuti speciali 2020 - ISPRA n. 322/2020 ISBN 978-88-448-1010-8.

[5] ATO-R (Associazione d'ambito Torinese per il governo dei rifiuti) which in 2020 granted contributions for projects for prevention/reduction of unsorted urban waste.

[6] ReLand is a pilot project developed by Politecnico di Torino (DAD) and Municipality of Cambiano Torinese that has focused on the development of a new public space for the circular economy, resilience and sustainable development approach promotion in social and territorial settlements.

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Il V Convegno Internazionale Recycling, dedicato a "Il valore della materia nella transizione ecologica del settore delle costruzioni" si è tenuto a Roma il 26 maggio 2023, confermandosi come uno dei principali luoghi di confronto tra accademici e *stakeholders*. Il Comitato Scientifico, composto da docenti ed esperti provenienti da 24 Atenei internazionali, distribuiti su 4 Paesi e 3 continenti, ha selezionato i migliori contributi tra quelli pervenuti secondo la procedura *double blind peer review*. Come di consuetudine, i contributi sono stati suddivisi nelle tre sezioni del Convegno Internazionale: "Saggi", "Ricerche" e "Architettura". La raccolta degli atti ha come obiettivo la definizione dello stato dell'arte del riciclaggio nel settore delle costruzioni, oltre a fotografare la direzione verso la quale il mondo della ricerca scientifica si sta orientando. La moltitudine di punti di vista che caratterizza il presente volume è, probabilmente, il suo maggiore valore, restituendo un profilo innovativo e creativo sul tema.

The 5th International Conference Recycling, dedicated to "The value of building materials in the ecological transition of the construction sector" was held in Rome on May 26, 2023 confirming its status as one of the main venues for dialogue between academics and stakeholders. The Scientific Committee, consisting of professors and experts from 24 international universities, spread over 4 countries and 3 continents, selected the best papers among the ones received according to the double blind peer review. As usually, the papers were divided into the three sections of the International Conference: 'Essays', 'Research' and 'Architecture'. The aim of the proceedings is to define the state of the art of recycling in the construction sector, as well as to take a framework of the direction in which the world of scientific research is heading. The multitude of vievpoints that characterises this volume is probably its greatest value, providing an innovative and creative profile on the subject.

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