

Territorial Ecosystem for circular economies: Eco3R research project

Original

Territorial Ecosystem for circular economies: Eco3R research project / Callegari, Guido; Ricciardi, Guglielmo; Roccasalva, Giuseppe; Simeone, Paolo. - ELETTRONICO. - (2023), pp. 174-183. (Intervento presentato al convegno Recycling. Il valore della materia nella transizione ecologica del settore delle costruzioni V Convegno Internazionale tenutosi a Roma nel 26/05/2023).

Availability:

This version is available at: 11583/2979079 since: 2023-06-05T00:54:07Z

Publisher:

Anteferma

Published

DOI:

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Atti del V Convegno Internazionale

RECYCLING

Proceedings of the 5th International Conference



a cura di / edited by
Adolfo F. L. Baratta
Laura Calcagnini
Antonio Magarò



RECYCLING

a cura di
Adolfo F. L. Baratta
Laura Calcagnini
Antonio Magarò

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transizione ecologica del
settore delle costruzioni**

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

Acta de el V Congreso Internacional
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Laura Calcagnini
Antonio Magarò**

ISBN: 979-12-5953-046-2

Anteferma Edizioni Srl
via Asolo 12, Conegliano, TV
edizioni@anteferma.it
Prima edizione: maggio 2023

Progetto grafico
Antonio Magarò
www.conferencerecycling.com



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del settore delle costruzioni**

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

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

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Indice
Table of Contents
Índice

Premessa / Foreward / Prólogo

- _16** Premessa. Il Riciclaggio come processo creativo di innovazione

Foreword. Recycling as a creative process of innovation

Adolfo F. L. Baratta - Laura Calcagnini - Antonio Magarò

Saggi / Essays / Ensayos

- _26** Decarbonizzazione dei manufatti edilizi: metodologie per la valutazione della Whole Life Carbon e focus sulla fase di fine vita

Decarbonising buildings: Whole Life Carbon assessment methods and end-of-life stage focusing

Jacopo Andreotti - Roberto Giordano

- _36** Re-manufacturing and re-use practices for extending the value of short-life building components

Nazly Atta - Anna Dalla Valle - Serena Giorgi - Salvatore Viscuso

- _48** Il vetro piano in edilizia: dati e considerazioni in merito a produzione e riciclo

Flat glass in the construction industry: production and recycling data and considerations

Maria Antonia Barucco

- _58** Vivienda circular: Minimización de impactos ambientales y residuos de la construcción

Circular housing: minimizing environmental impacts and construction waste

Fabiola Colmenero Fonseca - Juan Francisco Palomino Bernal - Ramiro Rodríguez Pérez



- _68** Lost in transition. The burden of material resources for renewable energy sources
Massimiliano Condotta - Chiara Scanagatta - Elisa Zatta
- _80** La gestione dei rifiuti edili in Europa: stato dell'arte e prospettive future
Construction waste management in Europe: state of the art and prospects
Marco Giampaolotti - Fabrizio Amadei
- _92** Dalla cultura del riciclo alle buone pratiche
From the recycling culture to the best practices
Enza Santoro - Gigliola Ausiello

Ricerche / Researches / Investigaciones

- _108** Stampa 3D in argilla e lolla di riso. Dall'architettura al design per la transizione ecologica
3D printing in clay and rice husk. From architecture to design for the ecological transition
Paola Altamura - Anna Chiara Perotta
- _120** La circolarità delle risorse come driver d'innovazione nel settore dei laterizi
Circularity of resources as a driver of innovation in the brick sector
Jacopo Andreotti
- _132** Il rovesciamento della piramide. Superiuso dei Termovalorizzatori di Colleferro
The reverse Pyramid. Superuse of Colleferro Incinerators
Serena Baiani - Paola Altamura - Gabriele Rossini
- _146** Note per la lettura ambientale di uno stock edilizio scolastico
Notes for the environmental survey of a school buildings' stock
Roberto Bosco - Savino Giacobbe - Renata Valente



- _158** L'evoluzione normativa dei Criteri Ambientali Minimi per l'economia circolare nel settore edile: materia riciclata e disassemblabilità dei prodotti
The regulatory evolution of Minimum Environmental Criteria for the circular economy in the building sector: recycled material and disassemblability of products
Laura Calcagnini
- _174** Territorial Ecosystem for circular economies: Eco3R research project
Guido Callegari - Guglielmo Ricciardi - Giuseppe Roccasalva - Paolo Simeone
- _184** BIM for recycling management in architectural design
Agostino Catalano - Luigi Mollo - Camilla Sansone
- _194** L'innovazione circolare dei blocchi per murature: soluzioni che nobilitano il rifiuto
The circular innovation of wall blocks: solutions that ennoble waste
Alessandra Cernaro
- _210** Contribución a la economía circular: incorporación de vidrio en la producción de ladrillos
Contributing to the circular economy: glass addition in brick making
Laura Crespo-López - Giuseppe Cultrone
- _220** Modelo International Standards para la sostenibilidad de edificios (Etapa de uso y mantenimiento)
International Standards Model for Building Sustainability (Stage of use and maintenance)
Fabiola Colmenero Fonseca - Consuelo Gómez-Gómez - Andrés Salas Montoya
- _236** Harvest map of tangible and intangible resources in Watamu for sustainable architecture
Stefania De Gregorio



- _248** Estudiando el pasado para construir el futuro. La Arquitectura Vernácula y su aporte a la construcción del futuro como medida de mitigación del cambio climático
Carlos Alberto Duica Cuervo
- _262** L'innovazione tecnologica dei serramenti in PVC verso "modelli di produzione e consumo sostenibili"
The technological innovation of PVC window-frames toward production and consumption sustainable models
Ornella Fiandaca
- _274** Valutazioni multicriteriali per l'efficienza nei processi di riciclaggio
Multicriteria evaluation for recycling process efficiency
Fabrizio Finucci - Antonella G. Masanotti - Daniele Mazzoni
- _286** Fotovoltaico tra prestazione e sostenibilità: una sfida per il futuro
Photovoltaics between performance and sustainability: a challenge for the future
Letizia Giusti - Marianna Rotilio - Gianni Di Giovanni
- _296** Il riutilizzo di spolia edili: Qasr Rabba in Giordania. Un caso esemplare
The reuse of building spolia: Qasr Rabba in Jordan. An exemplary case
Jacqueline Gysens Calzini - Luigi Marino
- _308** Calcestruzzo con aggregati di laterizio riciclato. Machine learning per la previsione prestazionale e trattamento dei dati per la gestione dell'errore
Recycled brick aggregate concrete. Machine Learning for performance prediction and data processing for error management
Antonio Magarò



- _318** Assessing the externalities of a waste management system via life cycle costing: The case study of the Emilia-Romagna Region (Italy)
Chiara Magrini - Alessandro Dal Pozzo - Alessandra Bonoli
- _330** Potenzialità d'utilizzo nell'ambiente costruito delle risorse di prossimità
Potential use of proximity resources in the built environment
Marco Migliore - Matteo Clementi - Giancarlo Paganin
- _340** Scarti di granito e cave dismesse per futuri scenari eco-innovativi in Sardegna
Granite scraps and abandoned quarries for future eco-innovative scenarios in Sardinia
Antonello Monsù Scolaro - Cheren Cappello
- _352** Valutazione BIM-based ex ante dei rifiuti da C&D per la demolizione selettiva
BIM-based preliminary C&D waste assessment for selective demolition
Marina Rigillo - Giuliano Galluccio - Federica Paragliola - Sara Piccirillo - Sergio Tordo
- _366** Concretos de alta resistencia con humo de sílice y con diferentes fuentes de agregados gruesos
High strength concretes with silica fume and three different sources of coarse aggregates
Andrés Salas Montoya - Fabiola Colmenero Fonseca
- _376** Circular strategies within building processes: emerging needs and perspectives
Cinzia Talamo - Giancarlo Paganin - Nazly Atta
- _390** Il vetro piano: potenziale inespreso di un rifiuto da costruzione e demolizione
Flat Glass: untapped potential of a construction and demolition waste
Luca Trulli



Architetture / Architectures / Arquitecturas

- _406** Valorización de residuos de producción industrial en elementos de cierre de edificios
The valorisation of industrial production waste in building closure elements
Graziella Bernardo - Luis Manuel Palmero Iglesias
- _418** Architectural jam sessions. Harmonized improvisations from recycled components in Casamatta, Mulini di Gurone, Malnate, Italy
Gian Luca Brunetti
- _430** Il recladding degli edifici per uffici. Un esempio applicato di progettazione integrata
The recladding of office buildings. An applied example of integrated design
Michele Conteduca - Valerio Fonti
- _442** Riuso e riciclo di elementi e componenti prefabbricati per gli stadi di Qatar 2022
Reuse and recycling of prefabricated elements and components for Qatar 2022 stadiums
Massimo Mariani
- _454** Construcción circular en asentamientos informales: de residuos a hogares
Circular construction in informal settlements: from waste to home
Mónica Alexandra Muñoz Veloza
- _468** Esperienze di progetto attraverso processi di "urban mining"
Design experiences through "urban mining" processes
Alessandro Rogora - Paola Leardini



_482 C'erano una volta vecchi attrezzi e scarti agricoli: il progetto di un Parco Circolare

Once upon a time there were disused farm tools and agricultural wastes: the Circular Park project

Silvia Tedesco - Elena Montacchini - Annalisa Gino - Jacopo Gasparotto

Ringraziamenti / Acknowledgment / Agradecimientos

_496 Ringraziamenti

Acknowledgement



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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 km². 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-



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

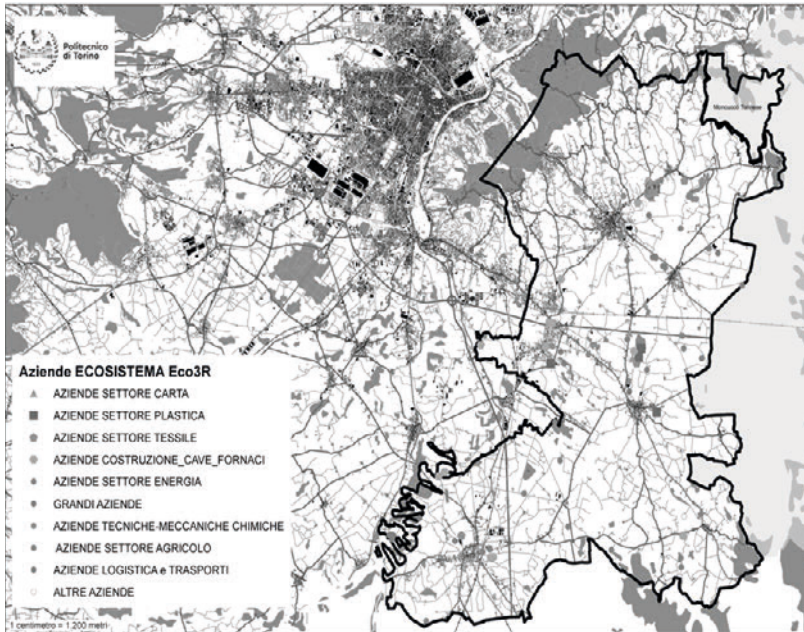


Figure 2. Analysis of material flows generated by companies in the territory of the 19 municipalities in order to forecast circular value chains [Source: analysis by G. Roccasalva Politecnico di Torino, Architecture and Design Department].

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

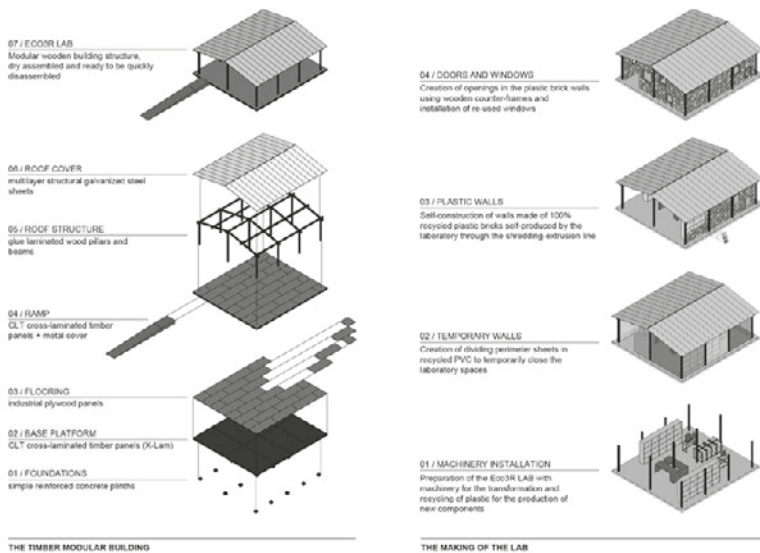


Figure 3. ECO3R LAB: the making of the laboratory [Original graphics by G. Callegari and P. Simeone with N. Lusso, Politecnico di Torino, Architecture and Design Department].



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, Moncuoco 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. Ricciar-di, 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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finito di stampare nel mese di
maggio 2023

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 viewpoints that characterises this volume is probably its greatest value, providing an innovative and creative profile on the subject.

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ISBN 979-12-5953-046-2



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€ 22,00