



Redol
ARAGON'S REGIONAL HUB
FOR CIRCULARITY

D1.4 RRI FIRST PROGRESS REPORT



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Author Names**Organization**

Diego Redondo

CIRCE

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This project has used a standard methodology already developed in the EFORT project (grant agreement number: 101075665), following EU recommendations. Ad hoc modifications were added to comply with the conditions of the Grant Agreement for REDOL project (Grant Agreement number: 101091668).

Executive Summary

The REDOL project is dedicated to transforming cities into circular hubs by implementing zero-residue strategies and fostering industrial-urban symbiosis (I-US) among local and regional stakeholders. The project is driven by the staggering statistic that in 2020, the European Union generated over 500 kg of municipal waste per capita, with only 45% being recycled. Solid urban waste (SUW) is identified as an abundant source for circular product production, yet it remains underutilized.

REDOL focuses on redesigning five value chains related to SUW, resulting in the production of 12 circular products. The key objectives of the project include upgrading waste management technologies, enhancing recycling routes, and implementing cutting-edge digital tools to optimize value chains. Additionally, REDOL aims to develop guidelines and recommendations for decision-making bodies, improving citizens' perception of SUW as a local resource and recycled products.

This initiative is primarily based in the region of Aragon, Spain, with the city of Zaragoza at its core, working towards becoming a zero-residue city by 2040. The project envisions reusing, valorising, or transforming 144,720 tons of SUW annually, yielding substantial economic and environmental benefits. Prato (Italy), Bornholm (Denmark), and Amsterdam (The Netherlands) serve as replication cities to disseminate the project's results across Europe.

The present document updates the approach followed to incorporate Responsible Research and Innovation (RRI) into REDOL as a central focus. RRI involves engaging society in research and innovation processes and includes six policy agendas: Ethics, Gender Equality, Governance, Open Access, Public Engagement, and Science Education. REDOL addresses these agendas in various ways, promoting ethical research, ensuring gender balance, establishing effective governance, prioritizing open access publications, engaging stakeholders, and enhancing science education.

The project has organized 5 physical events to discuss progress, review achievements, and engage with stakeholders. These events offer opportunities for disseminating project awareness and forming industry partnerships. Key performance indicators (KPIs) have been identified to measure the success of RRI integration, including the number of internal sessions related to ethics, gender balance, open access publications, stakeholder engagement initiatives, and presentations at educational institutions.

In conclusion, the REDOL project seeks to address the pressing issue of municipal waste and the underutilization of solid urban waste. By fostering circularity and responsible research and innovation, REDOL aims to create sustainable solutions, benefiting local communities and the environment. The integration of RRI into the project ensures that ethical, gender-balanced, transparent, and socially responsible practices are at the forefront of this transformation. Through collaboration and the dissemination of project results, REDOL aims to inspire other cities across Europe to embrace circularity and sustainable urban practices.

This document will be updated for the last time in November 2026 with the creation of D1.5 RRI Second Progress Report.

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List of Acronyms

Acronym	Meaning
CC	Creative Commons
CC BY	Creative Commons Attribution International Public License
CC O	Creative Commons Public Domain Dedication
CDW	Construction and Demolition Waste
DMP	Data Management Plan
DOI	Digital Object Identifier
EC	European Commission
EOSC	European Open Science Cloud
EU	European Union
FAIR	Findable, Accessible, Interoperable and Re-usable
GDPR	General Data Protection Regulation
ID	Identification
I-US	Industrial-Urban Symbiosis
IPR	Intellectual Property Rights
ISO	International Standards Organization
JEL	Journal of Economic Literature
KoM	Kick off Meeting
MoRRI	Monitoring the Evolution and Benefits of Responsible Research and Innovation
OA	Open Access
NDA	Non-Disclosure Agreement
PC	Project Coordinator
PU	Public
RRI	Responsible Research and Innovation
SUW	Solid Urban Waste
SEN	Sensitive
WP	Work Package
WPL	Work Package Leader

1 Introduction

1.1 REDOL project

REDOL aims to transform cities into hubs for circularity that implement zero residues strategies while fostering industrial-urban symbiosis (I-US) approaches among local and regional actors.

And the reason is clear, since over 500 kg of municipal waste per capita were generated in the EU in 2020, while only 45% was recycled [1], and therefore, solid urban waste (SUW) is an abundant source for circular products production, but it is generally not exploited.

To this end, REDOL is redesigning 5 value chains for SUW (packaging, plastics, CDW, textiles, WEEE) ending-up in the production of 12 circular products: (1) recycled paper, (2), PE bottles, (3) PET sticks, (4), PE bags, (5) automotive parts (PE/Pa + fibre) (7) reinforced particle board, (8) cement, (9) concrete, (10) Green cast polymer, (11) precious metals and/or rare metals and (12) PET yarns through:

- 1) Upgrading management technologies to collect, sort and classify SUW.
- 2) Enhancing the recycling routes of sorted materials to avoid landfilling.
- 3) Applying cutting-edge digital tools to optimize value chains and interaction among key players.

Moreover, REDOL is developing guidelines and recommendations for major decision-making bodies and is trying to improve citizens' perception on SUW as a local resource and on recycled products, thus increasing their participation in separate collection schemes. To this end, organizational procedures, business models and social innovation actions required for the establishment of successful I-US interactions and hubs for circularity at local level are being used as basis.

Finally, it is important to remark that REDOL is being implemented in the region of Aragon (Spain), with the city of Zaragoza in the centre of the hub for circularity, supporting them to its transition towards a zero residues city by 2040. This implies that 144.720 tons SUW/year being re-used, valorised or transformed into secondary raw materials, leveraging economic and CHG emissions savings over 14B€ and 280 ktCO₂/year. Moreover, Prato (Italy), Bornholm (Denmark) and Amsterdam (The Netherlands) are designated as replications cities, so the REDOL results are being spread around Europe.

1.2 RRI scope

This document is the second version of the Responsible Research and Innovation report (RRI) prepared under the Project REDOL EC-GA contract no 101091668.

This open deliverable, shortened as D1.4, has been developed under the activities of the task 1.4 for "Integration of the Responsible Research and Innovation approach" and it is an update of D1.3 RRI first report, submitted in November 2023.

The intended audience of the present document is each individual participant of the Project Consortium and, being a public deliverable, this one will be accessible from the project's website.

As per the RRI Toolkit (<https://rri-tools.eu/about-rri>) [2], Responsible Research and Innovation is:

- a) Involving society in science and innovation 'very upstream' in the processes of Research and Innovation (R&I) to align its outcomes with the values of society.
- b) A wide umbrella connecting different aspects of the relationship between R&I and society: public engagement, open access, gender equality, science education, ethics, and governance.
- c) A cross-cutting issue in Horizon 2020, the EU Programme for Research and Innovation 2014-2020.

The present document explains the approach followed to integrate the RRI in REDOL as well as the first progress update during the first 30 months of the project. In this line, the RRI's 6 policy agendas (a) Ethics, b) Gender Equality, c) Governance, d) Open Access, e) Public Engagement, and f) Science Education) have been taken into consideration.

In general terms, CIRCE, as coordinator, is providing the consortium with an overview of the innovations within the project, so all the partners have a common idea and approach of them. In this sense, information on the project innovation is being provided from different points of view including technical, regulatory, social and organizational aspects. Moreover, the coordinator is governing throughout the project execution the innovation management process, working in strict cooperation with the WP Leaders, supporting REDOL partners in every step of the methodology development.

Besides that, STRANE, as WP8 leader and expert in exploitation issues is supporting the project in adjusting its objectives and requirements, in order to better identify exploitable results, the potential for patents applications and maximize the replication potentials.

During this task, cross cutting issues are being considered to ensure the interoperable, interdisciplinary and international approach of the REDOL project. In this sense, all the partners are being initiated in RRI practices, ensuring that the project considers important aspects such as public engagement, open access, gender, ethics, education, governance and science education, promoting institutional change among partners to adopt RRI approach.

To ensure that the RRI is being correctly addressed during the whole execution of REDOL, "MoRRI – Monitoring the Evolution and Benefits of Responsible Research and Innovation" indicators are being considered to monitor the project development and reported through progress reports.

This document will be updated in November 2026 with the creation of D1.5 RRI Second Progress Report.

2 RRI in REDOL

Aiming to reduce the distance between science and society, latest trends leading to a European-wide approach in Horizon Europe resulted in what is called RRI which seeks to bring issues related to research and innovation into the open, to anticipate their consequences, and to involve society in discussing how science and technology can help create the kind of world and society we want for generations to come.

RRI entails engaging all actors (from individual researchers and innovators to institutions and governments) through inclusive, participatory methodologies in all stages of R&I processes and in all levels of R&I governance (from agenda setting, to design, implementation, and evaluation).

2.1 The 6 policy agendas

The EC provided six policies agendas to provide more concrete normative orientations, as shown below in Figure 1. These thematic elements are: a) Ethics, b) Gender Equality, c) Governance, d) Open Access, e) Public Engagement, and f) Science Education.

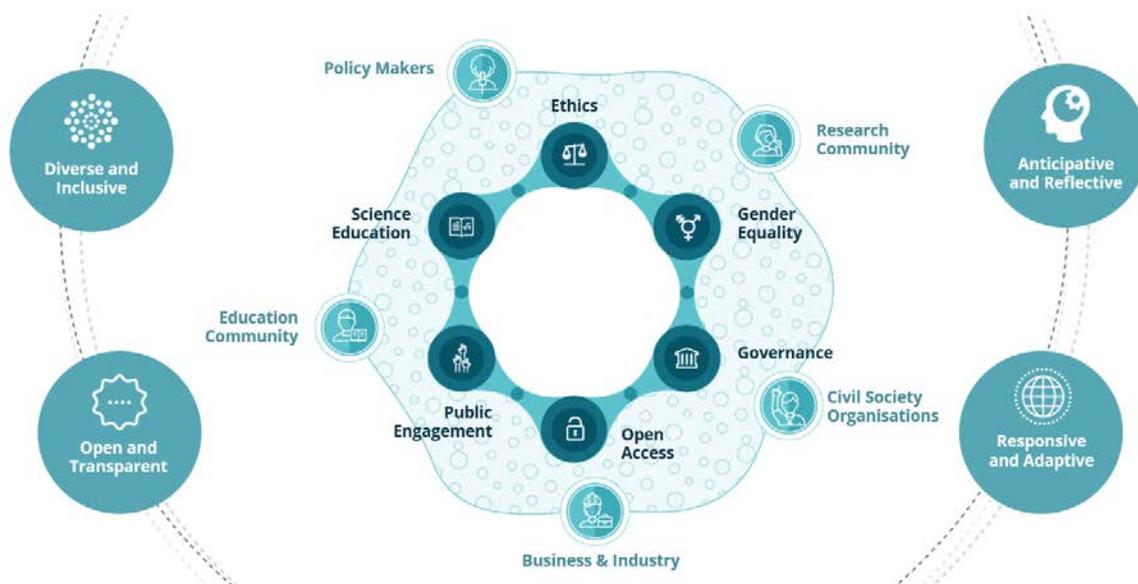


Figure 1. A normative framework for RRI: the six policy agendas

REDOL is considering these aspects within the RRI progress, having special focus on those policies where the thematic and idiosyncrasy of the project are more relevant.

2.1.1 Ethics

Research integrity must be guided by standards, guidelines and protocols, while remaining open to external scrutiny to external scrutiny. The core ethical endeavour is to achieve its integration across the entire R&I process in all project's phases. Integrating ethics into the project requires continuous orientation, reflection and deliberation on the decisions, actions and values at stake.

Reflection is an important factor when it comes to Ethics, involving a philosophical attitude that drives the aim to "do better" in every aspect of the project. Thinking on ethical issues makes aware

of opportunities to think about new project and benefits, acting as a preventive measure against potential failures.

At the current stage, REDOL focuses on the avoidance of unacceptable research. REDOL does not deal with work in ethical-compromised areas, such as the investigation of human embryos, humans, or animals. All the personal data used within the frame of the project will adhere to EU regulations regarding General Data Protection Regulation, to ensure that the data is protected accordingly.

Nevertheless, REDOL is making use of AI and advanced data to develop new sorting systems and the REDOL platform. The impact of AI-based systems developed in REDOL is being minimized because the involved partners are ensuring that the different ethical aspects (human autonomy, privacy, data protection, cybersecurity, transparency, accountability, and lack of data bias) are considered and ensured in advance.

2.1.2 Gender Equality

Gender equality is a matter of common concern, being crucial to invest in equal opportunities for men and women in R&I promotes teams that perform better and attract top-level players. One of the three main objectives of Horizon Europe's gender equality strategy is to foster gender balance in R&I teams, closing the gap in women's participation. Ensuring gender balance in R&I teams is vital to producing high quality outcomes that benefit everybody.

Gender data for the project is being gathered on several occasions, following the different project's reporting periods. For the purpose of this deliverable and aiming to count with a second version of the data, partners have been asked to fill in an excel file, providing updated data form the gender balance, leading to the following figures. Women representativity in REDOL is 44,8% (after update of number provided by all REDOL partners through a questionnaire). More information can be checked in Table 3. In any case, in a project which mainly involves engineers this ratio seems to be very high. This value will be updated at the end of the project.

2.1.3 Governance

The governance bodies of the project such as Project Coordinator, Steering Committee, General Assembly, Work Package Leaders and Task Leaders have been defined in the KoM of the project. All together are working for the correct execution of the project and also for the implementation of the RRI.

2.1.4 Open Access

Researchers have a core interest in publishing articles in academic journals. Articles represent a crucial source of information and data, and they remain the primary route through which research findings are communicated.

For the purpose of this deliverable, it is worth mentioning that the policy of Open Access has been deeply taken into account within the deliverable Data Management Plan (D1.2) [3] resulting in the preparation of several guidelines to ensure the adherence to the FAIR Principles (Findability, Accessibility, Interoperability, and Reuse of digital assets).

To this end, a project website (<https://www.redolproject.eu/>) has been created (Figure 2) in order to make accessible deliverables, videos, publications, promotional materials, etc.

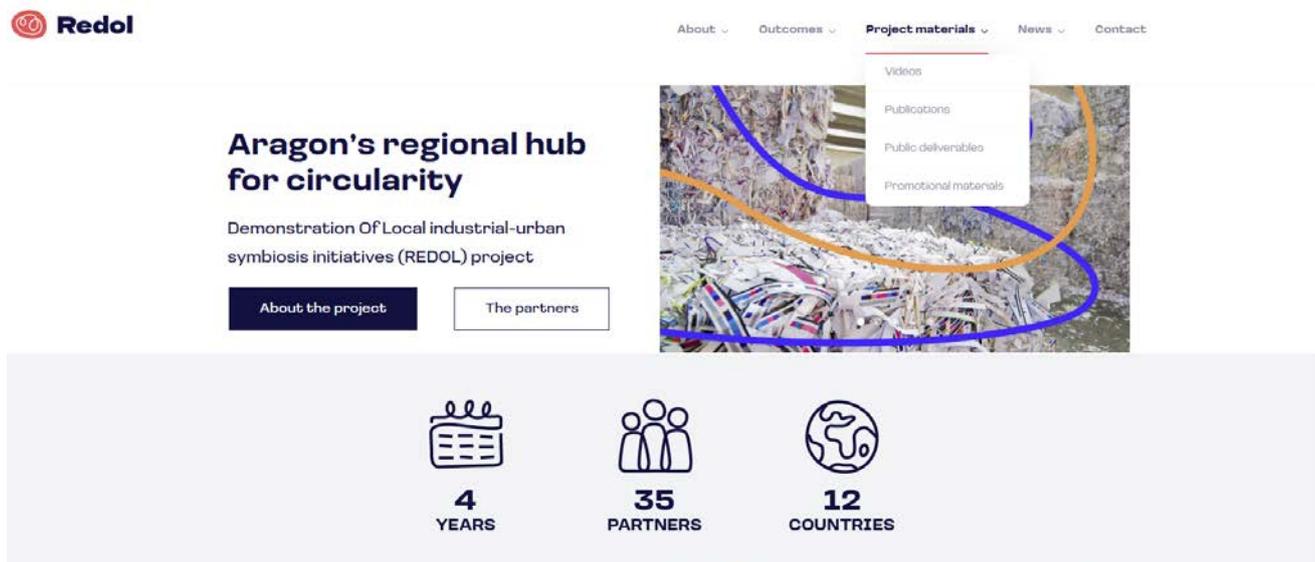


Figure 2. REDOL website

On the other hand, a ZENODO community of the project has been created (<https://zenodo.org/communities/redol>) and updated with access to scientific material developed within the project.

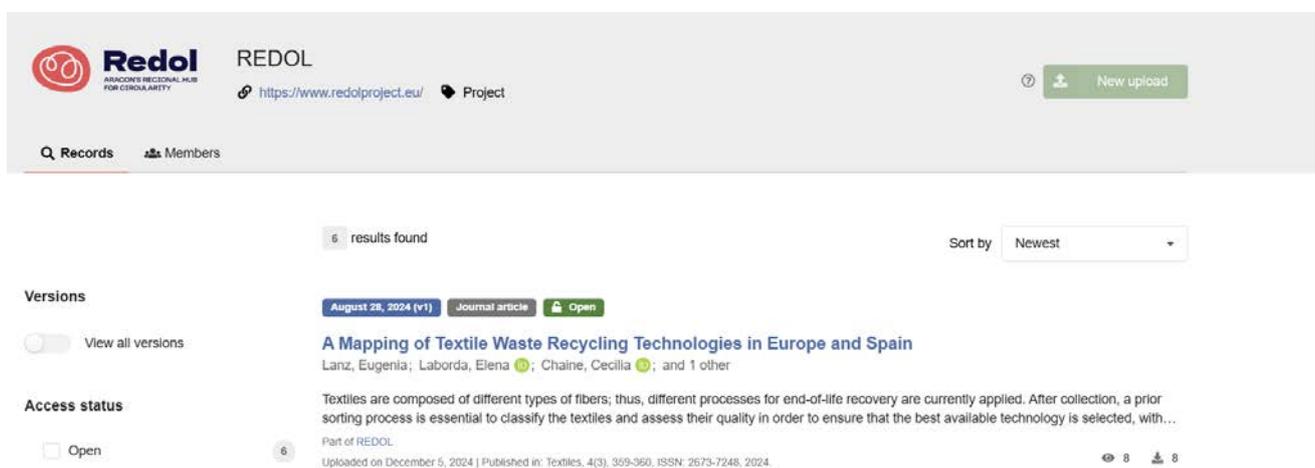


Figure 3. REDOL community in Zenodo

Finally, the number of OA publications are being taken into account as a KPI as well as the importance of providing results to the project via open publishable research. At this moment, six OA publications has been released within REDOL project (Table 1).

Table 1. REDOL scientific publications up to M30

Name article	Partner/s	Date	Link
Challenges and Opportunities for the Recovery of Critical Raw Materials from Electronic Waste: The Spanish Perspective	UZ	January 2023	Link
Advancing Urban Waste Management Using Industry 5.0 Principles: A Novel Smart Bin	ICCS	May 2024	Link
Smart bins for enhanced resource recovery and sustainable urban waste practices in smart cities: A systematic literature review	ICCS	September 2024	Link
Renewable exergy return on investment (RExROI) in energy systems. The case of silicon photovoltaic panels	UZ	September 2024	Link
Applying Circular Thermoconomics for Sustainable Metal Recovery in PCB Recycling	UZ	October 2024	Link
A Mapping of Textile Waste Recycling Technologies in Europe and Spain	CIRCE	October 2024	Link

2.1.5 Public Engagement

To integrate the Public Engagement in RRI related activities, it is important to set up a participatory research agenda including multiple advantages such as identifying stakeholders' unmet needs and what matters to end users, or helping researchers include new perspectives in research, prepare stakeholders for the research process, structure the process for broader collaboration between stakeholder groups, and enable and empower stakeholders to develop their own voice.

In REDOL, partners has participated in several dissemination events, scientific conferences, etc. showing the advances of the developments done in the project. Moreover, it is important to remark that in the framework of WP7, 3 different sessions have been carried out (2 online and 1 in person) with external stakeholders in order to establish the basis for the creation of a hub of circularity in the region of Aragón.

2.1.6 Science Education

The integration of RRI principles in teaching and learning activities supports multidisciplinary and stronger student engagement as well as student acquisition of critical thinking and collaborative learning skills.

The line between science education and public engagement is actually quite blurry due to the mutual learning processes that take place during public engagement activities, being the main difference the integration in the higher education institution. In the framework of REDOL, University of Zaragoza is a key partner, being in close contact with the students, and sharing some REDOL's results with them.

2.2 Events and actions

Within REDOL, a plan for integrating the RRI into the project was prepared since the early stages. This plan considers, among others, organizing of replication meetings, various promotional and educational activities, etc.

Besides these encounters (explained below) that are occurring during the development of the project, REDOL Consortia plans to physically meet to discuss and move step forwards within the evolution of the project.

Until now, REDOL consortium has been physical meet on 3 occasions and online in 4 occasions. Moreover, it is planned to have 3 more physical meetings and 2 online meetings until the end of the project (Table 2). The meetings, specially focused on the monitoring of project progress, achievements review, decision-making and conflict resolution, as well as technical discussions are hosted by local organizations which are part of the project.

Physical encounters, in this sense, are an excellent opportunity to carry out side-activities benefiting the project's results, boosting the awareness of those among citizens and interested organization and, closely related to the previous, engage companies and industries for an early adoption of the solutions.

Table 2. REDOL's expected encounters calendar

Meeting	Dates	Place	Host partner
Kick-off (I GA)	January 2023	Zaragoza (Spain)	CIRCE
II GA	May 2023	Online	CIRCE
III GA	January 2023 ⁴	Zaragoza (Spain)	ITAINNOVA
IV GA	May 2024	Online	CIRCE
RM1	September 2024	Online	CIRCE
V GA	December 2024	Online	CIRCE
VI GA	April 2025	Amsterdam (The Netherlands)	AMS
VII GA	November 2025	Valencia (Spain)	ITENE
RM2	January 2026	Online	CIRCE
VIII GA	March/April 2026	Prato (Italy)(tentative)	PRATO
IX GA	October/November 2026	Zaragoza (Spain) (tentative)	¿?
RM3	January 2027	Online	CIRCE

* CA: General Assembly; RM: Review Meeting

The agenda of these events includes, besides the technical and administrative related topics, other side activities based on dissemination and exploitation, aiming to not only widespread the awareness of the project but to tie lies among the project partners and the industries themselves (Figure 2). In this sense, the coordinator, CIRCE, has already a wide experience organizing meetings side events to promote projects activities but also other partners such as University of Zaragoza, STRANE or ICLEI, among others. In fact, within the past REDOL consortium meetings, exploitation workshops and visits to stakeholders have been organized during these physical encounters.

Last but not least, the role of CIRCE is to provide the consortium with an overview of the innovations planned within the project in each meeting, so all the partners have a common idea and approach of

them. In this sense, information on the project innovation is being provided from different points of view including technical, regulatory, social and organizational aspects. Moreover, STRANE, as exploitation expert, is helping partners in these issues, working in strict cooperation with the WP leaders.



Figure 4. On the top, exploitation workshop and visit to Zaragoza urban waste treatment centre in the II CA organized in Zaragoza. On the bottom, exploitation workshop and visit to a tyre recycling company in the VI CA organized in Amsterdam (The Netherlands)

2.3 RRI Indicators in REDOL

The Monitoring and Evolution and Benefits of Research and Innovation (MoRRI) is a series of different RRI indicators that are used for identifying the impacts of responsible practices in research and innovation [4].

In Table 3, besides the explanation of each one of them, the impact of different indicators for the first 30 months of the project is being represented.

It worths mentioning that some of the listed KPIs have been inspired by H2020 Prisma Project (CA no: 710059) coordinated by TUDelft in which a practical guideline has been developed to contribute to a new standard for companies aiming at developing a strategy for RRI [5].

Table 3. REDOL's Responsible Research and Innovation preliminary KPIs

Policy	KPI	Indicators		
		M12	M30	M48
Ethics	Number of internal sessions celebrated having ensured the awareness of the integration of ethical values within the REDOL's Innovation	1	4	
Gender Equality	Percentage of Women involved in the Research activities of the project	45.8%	41.3%	
	Percentage of Women involved in the whole project	48.5%	44.8%	
Governance	Number of internal sessions having the Board Responsibles performed leading actions	2	5	
Open Access	Number of open access publications	1	6	
Public Engagement	Number of Stakeholders engagement initiatives organized in the project	1	4	
Science Education	Number of education institutions where REDOL project has been presented	0	73	

2.4 Golden rules for achieving RRI

Summing up the RRI approach to follow under the framework of the project, the partners need to consider how to include these guides on its work. It can be stated that there are 5 golden rules to follow to achieve RRI [6]. These rules should be used within REDOL to put in practice the RRI approach.

- 1) Think about what society wants
- 2) Involve a wide range of stakeholders and societal actors
- 3) Consider all possible impacts
- 4) Be open and transparent
- 5) Respond and adapt

2.5 Some sources of information

This section aims to provide to the partners with sources of information regarding RRI that should be used during the lifetime of the project, to consider this holistic approach when researching.

- RRI tools: [Home Page - RRI Tools \(rri-tools.eu\)](http://rri-tools.eu)
- "A practical Guide to Responsible Research and Innovation: Key lessons from RRI tools" From RRI project.
[RRI+Tools.+A+practical+guide+to+Responsible+Research+and+Innovation.+Key+Lessons+fr
om+RRI+Tools \(rri-tools.eu\)](http://rri-tools.eu/rri-tools/a-practical-guide-to-responsible-research-and-innovation-key-lessons-from-rri-tools)
- Self-reflecting tool: [Self-Reflection Tool - RRI Tools \(rri-tools.eu\)](http://rri-tools.eu/self-reflection-tool)

- Putting Responsible Research and Innovation into Practice: [Putting Responsible Research and Innovation into Practice: A Multi-Stakeholder Approach | SpringerLink](#)
- Enacting RRI in Europe course: [RRI - Aalborg University \(aau.dk\)](#)

3 Conclusions

The REDOL project, with its ambitious goals of transforming cities into circular hubs and promoting responsible research and innovation, represents a significant step towards addressing the growing challenges of municipal waste and underutilized resources. The project's dedication to upgrading waste management technologies, enhancing recycling routes, and utilizing cutting-edge digital tools to optimize value chains promises to bring about tangible change.

The incorporation of Responsible Research and Innovation (RRI) across the project ensures that ethical standards, gender equality, transparent governance, open access, public engagement, and science education are integrated into every facet of REDOL. The commitment to these RRI principles demonstrates the project's dedication to societal values and responsible practices.

Through a series of planned physical events, REDOL seeks to engage stakeholders, raise awareness, and foster industry partnerships. These gatherings will serve not only as venues for progress assessment but also as opportunities for community involvement and education.

As the project progresses, the REDOL team is continuing to monitor and adapt its approach to ensure that RRI remains at its core. The commitment to the five golden rules – thinking about society's needs, involving diverse stakeholders, considering all impacts, being open and transparent, and responding and adapting – will guide the project's path towards success.

4 References

- [1] European Commission, 2021. Municipal waste generated in the EU, 2020. [Municipal waste generation up to 505 kg per person - Products Eurostat News - Eurostat \(europa.eu\)](#)
- [2] RRI Toolkit (November of 2023). <https://rri-tools.eu/about-rri>
- [3] **Data Management Plan (D1.2)**. REDOL project. Sensitive document (May of 2023).
- [4] **European Commission, 2018**. Monitoring the evolution and benefits of responsible Research and Innovation. Summarising insights from the MoRRI project. <https://op.europa.eu/en/publication-detail/-/publication/fdd7dd10-c071-11e8-9893-01aa75ed71a1>
- [5] **Project H2020 Prisma** (November of 2023). <https://www.rri-prisma.eu/>
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