

D 8.8 Participation in and/or organization of workshops, press conferences, stakeholder events, policy-oriented seminars

D 8.9 Exploitation plan (month #36)

D 8.10 Comprehensive Dissemination Kit (project legacy) (month #48)

D 8.11 Final data management plan (month #48)

D 8.12 Final report on dissemination and exploitation of project results (month #48)

D8.1 : Corporate identity [2]

First CI for use in all documents, maps, on-line activities. Will be updated during the project.

D8.2 : Communication Handbook [3]

Handbook of communication and dissemination activities.

D8.3 : Basic Dissemination plan [3]

Basic Dissemination plan with first strategy for all dissemination activities.

D8.4 : Data management plan [6]

Draft research data management plan, adapted during the project.

D8.5 : Project website [6]

Project website, with public and internal restricted area. Updated during the project.

D8.6 : Dissemination Plan and Dissemination Kit [12]

Detailed Dissemination Plan and Dissemination Kit, that will guide dissemination activities through out the project and after the project duration.

D8.7 : Scientific publications [48]

A number of scientific publications, by different project partners, to be defined in the dissemination plan.

D8.8 : Workshops, press conferences, policy oriented seminars [48]

Participation in and/or organization of workshops, press conferences, policy oriented seminars which will be nearer defined in the dissemination plan.

D8.9 : Exploitation plan [36]

Exploitation plan for the GDSE during the last phase of REPAiR as well as after the project.

D8.10 : Dissemination Kit [48]

Comprehensive Dissemination Kit in order to provide a comprehensive package of PR material, explaining the essence of the REPAiR project and including, among other things, the descriptions of the project results, visual materials (infographics, pictures) and videos to communicate the REPAiR project in the broadest sense.

D8.11 : Final data management plan [48]

the final data management plan will explain how project data will be exploited and/or shared/made accessible for verification and re-use, and how this data will be curated and preserved and will be developed at the end of the project. The purpose of the data management plan within REPAiR is to support the data management life cycle for all data that will be collected, processed or generated.

D8.12 : Dissemination and exploitation report [48]

Final report on dissemination and exploitation of project results.

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS29	REPAiR website	6 - IGiPZ	2	Draft REPAiR website up and running.
MS30	Dissemination kit	6 - IGiPZ	3	Basic dissemination kit ready to use.

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS31	Final Seminar	6 - IGiPZ	46	A final event will be organised.

Work package number ⁹	WP9	Lead beneficiary ¹⁰	1 - TUD
Work package title	Ethics requirements		
Start month	1	End month	48

Objectives

The objective is to ensure compliance with the 'ethics requirements' set out in this work package.

Description of work and role of partners

WP9 - Ethics requirements [Months: 1-48]

TUD

This work package sets out the 'ethics requirements' that the project must comply with.

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
D9.1	POPD - Requirement No. 7	1 - TUD	Ethics	Confidential, only for members of the consortium (including the Commission Services)	2
D9.2	H - Requirement No. 6	1 - TUD	Ethics	Confidential, only for members of the consortium (including the Commission Services)	2
D9.3	H - Requirement No. 5	1 - TUD	Ethics	Confidential, only for members of the consortium (including the Commission Services)	2
D9.4	H - Requirement No. 4	1 - TUD	Ethics	Confidential, only for members of the consortium (including the Commission Services)	2
D9.5	POPD - Requirement No. 3	1 - TUD	Ethics	Confidential, only for members of the consortium (including the Commission Services)	2
D9.6	H - Requirement No. 2	1 - TUD	Ethics	Confidential, only for members of the consortium	2

List of deliverables

Deliverable Number ¹⁴	Deliverable Title	Lead beneficiary	Type ¹⁵	Dissemination level ¹⁶	Due Date (in months) ¹⁷
				(including the Commission Services)	
D9.7	POPD - Requirement No. 1	1 - TUD	Ethics	Confidential, only for members of the consortium (including the Commission Services)	2

Description of deliverables

The 'ethics requirements' that the project must comply with are included as deliverables in this work package.

D9.1 : POPD - Requirement No. 7 [2]

Copies of opinion or confirmation by the competent Institutional Data Protection Officer and/or authorization or notification by the National Data Protection Authority must be submitted (which ever applies according to the Data Protection Directive (EC Directive 95/46, currently under revision, and the national law).

D9.2 : H - Requirement No. 6 [2]

Templates of the informed consent forms and information sheet must be submitted on request.

D9.3 : H - Requirement No. 5 [2]

Detailed information must be provided on the informed consent procedures that will be implemented for the participation of humans.

D9.4 : H - Requirement No. 4 [2]

Details on the procedures and criteria that will be used to identify/recruit research participants must be provided.

D9.5 : POPD - Requirement No. 3 [2]

Detailed information must be provided on the procedures that will be implemented for data collection, storage, protection, retention and destruction and confirmation that they comply with national and EU legislation.

D9.6 : H - Requirement No. 2 [2]

The applicant must clarify whether vulnerable individuals/groups will be involved. Details must be provided about the measures taken to prevent the risk of enhancing vulnerability/stigmatisation of individuals/groups.

D9.7 : POPD - Requirement No. 1 [2]

Detailed information on the informed consent procedures that will be implemented in regard to the collection, storage and protection of personal data must be submitted on request.

Schedule of relevant Milestones

Milestone number ¹⁸	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
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1.3.4. WT4 List of milestones

Milestone number ¹⁸	Milestone title	WP number ⁹	Lead beneficiary	Due Date (in months) ¹⁷	Means of verification
MS1	Catalogue of minimum requirements for the GDSE	WP2	11 - GGR	4	A Catalogue of minimum requirements for the GDSE agreed on by the project board
MS2	Detailed technical concept for each GIS-based components	WP2	11 - GGR	10	Detailed technical concept for each GIS-based component, taking into account the specific requirements as well as existing data and models of each of the six geodesign projects. Delivered in form of a report.
MS3	Programmed modules for the two pilot applications in Naples and Amsterdam	WP2	11 - GGR	14	A ready-to-use beta version of Programmed modules for the two pilot applications in Naples and Amsterdam.
MS4	Geodesign workshop Amsterdam	WP2	1 - TUD	25	Geodesign workshops with stakeholders in the case of Amsterdam. As final event of every case study, one geodesign session will be held with the aim of developing one agreed resource management strategy.
MS5	Geodesign workshop Naples	WP2	3 - UNINA	26	Geodesign workshops with stakeholders in the case of Naples. As final event of every case study, one geodesign session will be held with the aim of developing one agreed resource management strategy.
MS6	Geodesign workshop Ghent	WP2	2 - UGENT	32	Geodesign workshops with stakeholders in the case of Ghent. As final event of every case study, one geodesign session will be held with the aim of developing one agreed resource management strategy
MS7	Geodesign workshop Łódź	WP2	6 - IGiPZ	35	Geodesign workshops with stakeholders in the case of Łódź. As final event of every case study, one

Milestone number ¹⁸	Milestone title	WP number ⁹	Lead beneficiary	Due Date (in months) ¹⁷	Means of verification
					geodesign session will be held with the aim of developing one agreed resource management strategy.
MS8	Geodesign workshop Hamburg.	WP2	4 - HCU	38	Geodesign workshop with stakeholders in Hamburg. As final event of every case study, one geodesign session will be held with the aim of developing one agreed resource management strategy.
MS9	Geodesign workshop Pécs	WP2	5 - RKI	41	Geodesign workshops with stakeholders in Pécs. As final event of every case study, one geodesign session will be held with the aim of developing one agreed resource management strategy.
MS10	Definition of system boundaries and goals and data assessment	WP3	1 - TUD	10	Definition of system boundaries and goals and data assessment of core material flows and subcategories, spatial qualities, social aspects from the two pilot studies agreed on by the project board.
MS11	Questionnaire for Household and Companies Surveys	WP3	5 - RKI	10	Elaborated questionnaire for T-3.3 surveys ready to use and agreed on by the project board.
MS12	Preliminary representation and process models	WP3	1 - TUD	13	Preliminary representation and process models ready to be integrated into GDSE. First maps and data bases delivered in order to test within the GDSE
MS13	Validation of Pilot Study Models	WP3	1 - TUD	19	Validation of the methodology and calibration of models from the 2 pilot studies agreed on by the project board in order to prepare models for the follow up studies.
MS14	Benchmark of available data versus existing indicator	WP4	2 - UGENT	8	Benchmark of available data versus existing indicator framework ready

Milestone number ¹⁸	Milestone title	WP number ⁹	Lead beneficiary	Due Date (in months) ¹⁷	Means of verification
					and agreed on by the project board.
MS15	possibilities of sustainability assessment at regional level	WP4	7 - JRC	12	Possibilities analysed of sustainability assessment at regional level and agreed on by the project board.
MS16	Test of framework for assessment	WP4	2 - UGENT	12	Test of assessment framework in the pilot cases ready and applied during workshop with stakeholders.
MS17	Handbook Sustainability Assessment	WP4	2 - UGENT	26	Handbook for sustainability assessment in the repair project ready and available on the project webpage
MS18	Preparation of Pilot Pulls	WP5	3 - UNINA	5	Definitive location, organizational settings and educational outline for two pilot PULLs. Amsterdam and Naples ready and agreed on by the project board. Facilitation of PULLs secured.
MS19	International Student Workshops	WP5	1 - TUD	21	International student workshops bringing together the multidisciplinary teams from both pilot cases (month #13 and #21) WS took place and outputs are documented on the project webpage.
MS20	First Set of solutions for pilot cases	WP5	3 - UNINA	15	First set of solutions for a selection of challenges in pilot cases is ready for testing the GDSE.
MS21	Organizational settings of PULLs for follow-up studie	WP5	3 - UNINA	15	Definitive location and organizational settings of PULLs for follow-up studies ready and agreed on by the project board and facilitation of PULLs is secured.
MS22	Student Presentation follow up Pulls	WP5	3 - UNINA	31	Final presentation and evaluation of student work of the follow-up PULLs. (months #22, 25, 28, 31). Presentations took place in front of members of the consortium and key stakeholders of the area.

Milestone number ¹⁸	Milestone title	WP number ⁹	Lead beneficiary	Due Date (in months) ¹⁷	Means of verification
					Results documented on the project webpage.
MS23	List of key priorities of stakeholders in pilot cases	WP6	4 - HCU	6	First list of key priorities of stakeholders in pilot studies available and ready to be integrated into GDSE testing.
MS24	Draft decision models for pilot studies	WP6	1 - TUD	10	Draft decision models for GDSE developing in pilot studies. Decision models integrated into GDSE for testing.
MS25	Key priorities of stakeholders in follow-up studies	WP6	4 - HCU	12	First list of key priorities of stakeholders in follow-up studies ready to be integrated into GDSE.
MS26	Draft decision models for follow-up studies	WP6	4 - HCU	24	Draft decision models in follow-up studies ready to be integrated into the GDSE.
MS27	Knowledge Transfers Events	WP7	1 - TUD	31	Organizing and conducting knowledge transfers events as part of PULLs. (months #13 ,17, 22, 25, 28 and 31)
MS28	methodology for knowledge transfer	WP7	5 - RKI	22	Draft methodology for knowledge transfer ready and agreed on by the project board.
MS29	REPAiR website	WP8	6 - IGiPZ	2	Draft REPAiR website up and running.
MS30	Dissemination kit	WP8	6 - IGiPZ	3	Basic dissemination kit ready to use.
MS31	Final Seminar	WP8	6 - IGiPZ	46	A final event will be organised.

1.3.5. WT5 Critical Implementation risks and mitigation actions

Risk number	Description of risk	WP Number	Proposed risk-mitigation measures
R1	Involvement of illegal organisations in 'waste management' specifically in the case of Naples. a) Official data on waste are incorrect. b) Security of researchers during fieldwork has to be guaranteed.	WP3, WP5, WP6	At a) Data has to be verified through fieldwork and waste and soil analyses have to be performed. Consortium partners have the necessary expertise and equipment At b) Local partners are familiar with the situation and are able to assess the risk of specific situations. If necessary, specific security measure will be taken.
R2	Project time line and teaching schedules of universities may not coincide with the project start. Which may cause delays in setting up the pilot PULLs.	WP2, WP5	The pilot PULLs have a modular structure and are iterative; if the first module cannot take place as planned, it can be replaced by shorter workshops, or even completely omitted without having major negative impacts on the final outcome.
R3	Partners that drop out	WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8	Strict governance mechanisms Key expertise are redundant
R4	Partner communication problem	WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8	Team building efforts like common vision building at the beginning , intensive face to face contacts during the PULLs.
R5	Experts leaving the consortium/personal changes	WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8	Redundancy of experts in WPs; Quick replacements in consultation with EC
R6	Interdependencies between WPs	WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8	Develop back up plans Multiple people in multiple WPs – most partners involved in all WPs - Lead partner involve in all WPs
R7	Financial Risks	WP1, WP2, WP3, WP4, WP5, WP6, WP7, WP8	Careful monitoring of estimation and expenditure; RE-assessment of priorities for budget/resources

1.3.6. WT6 Summary of project effort in person-months

	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	Total Person/Months per Participant
1 - TUD	21.50	17	15	12	17	4.70	10	12		109.20
2 - UGENT	0.50	2	12	26	5.50	1	3.20	3		53.20
3 - UNINA	1	3	11	3	33	1	5.20	4.10		61.30
4 - HCU	0.50	5	9	2	2	18	4.20	2.10		42.80
5 - RKI	0.50	4	22	10	9	20	20	4.60		90.10
6 - IGiPZ	0.50	3	13	10	9	2.40	7.10	13.10		58.10
7 - JRC	0	1	10	24	5	0.70	0.40	6.10		47.20
8 - Geo-Col	0	10	2	2	2.50	0.70	0.40	1.10		18.70
9 - Delta	0	1	1	1	3	2	1	1.60		10.60
10 - BIOKOM	0	1	1	1	3	0.70	3.40	3.10		13.20
11 - GGR	0	29	1	2.50	1	0.40	0.40	2.60		36.90
12 - OVAM	0	1	1	3	3	4	0.40	1.60		14
13 - GHM	0	1	1	0	3.50	1	0.40	1.10		8
14 - CAMPANIA	0	1	1	0	6	1	0.40	1.10		10.50
15 - PHH	0	1	1	1	5	1	0.40	1.10		10.50
16 - BAUER	0	1	1	1	3	0.70	0.40	1.10		8.20
17 - IVAGO	0	1	1.50	0.50	3	1	0.40	1.10		8.50
18 - SRH	0	1	1	1	3.50	1	0.40	1.10		9
Total Person/Months	24.50	83	104.50	100	117	61.30	58.10	61.60		610

1.3.7. WT7 Tentative schedule of project reviews

Review number ¹⁹	Tentative timing	Planned venue of review	Comments, if any
RV1	16	to be confirmed	
RV2	32	to be confirmed	
RV3	48	to be confirmed	

1. Project number

The project number has been assigned by the Commission as the unique identifier for your project. It cannot be changed. The project number **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

2. Project acronym

Use the project acronym as given in the submitted proposal. It can generally not be changed. The same acronym **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

3. Project title

Use the title (preferably no longer than 200 characters) as indicated in the submitted proposal. Minor corrections are possible if agreed during the preparation of the grant agreement.

4. Starting date

Unless a specific (fixed) starting date is duly justified and agreed upon during the preparation of the Grant Agreement, the project will start on the first day of the month following the entry into force of the Grant Agreement (NB : entry into force = signature by the Commission). Please note that if a fixed starting date is used, you will be required to provide a written justification.

5. Duration

Insert the duration of the project in full months.

6. Call (part) identifier

The Call (part) identifier is the reference number given in the call or part of the call you were addressing, as indicated in the publication of the call in the Official Journal of the European Union. You have to use the identifier given by the Commission in the letter inviting to prepare the grant agreement.

7. Abstract

8. Project Entry Month

The month at which the participant joined the consortium, month 1 marking the start date of the project, and all other start dates being relative to this start date.

9. Work Package number

Work package number: WP1, WP2, WP3, ..., WPn

10. Lead beneficiary

This must be one of the beneficiaries in the grant (not a third party) - Number of the beneficiary leading the work in this work package

11. Person-months per work package

The total number of person-months allocated to each work package.

12. Start month

Relative start date for the work in the specific work packages, month 1 marking the start date of the project, and all other start dates being relative to this start date.

13. End month

Relative end date, month 1 marking the start date of the project, and all end dates being relative to this start date.

14. Deliverable number

Deliverable numbers: D1 - Dn

15. Type

Please indicate the type of the deliverable using one of the following codes:

- R Document, report
- DEM Demonstrator, pilot, prototype
- DEC Websites, patent filings, videos, etc.
- OTHER
- ETHICS Ethics requirement

16. Dissemination level

Please indicate the dissemination level using one of the following codes:

PU Public
CO Confidential, only for members of the consortium (including the Commission Services)
EU-RES Classified Information: RESTREINT UE (Commission Decision 2005/444/EC)
EU-CON Classified Information: CONFIDENTIEL UE (Commission Decision 2005/444/EC)
EU-SEC Classified Information: SECRET UE (Commission Decision 2005/444/EC)

17. Delivery date for Deliverable

Month in which the deliverables will be available, month 1 marking the start date of the project, and all delivery dates being relative to this start date.

18. Milestone number

Milestone number: MS1, MS2, ..., MSn

19. Review number

Review number: RV1, RV2, ..., RVn

20. Installation Number

Number progressively the installations of a same infrastructure. An installation is a part of an infrastructure that could be used independently from the rest.

21. Installation country

Code of the country where the installation is located or IO if the access provider (the beneficiary or linked third party) is an international organization, an ERIC or a similar legal entity.

22. Type of access

VA if virtual access,
TA-uc if trans-national access with access costs declared on the basis of unit cost,
TA-ac if trans-national access with access costs declared as actual costs, and
TA-cb if trans-national access with access costs declared as a combination of actual costs and costs on the basis of unit cost.

23. Access costs

Cost of the access provided under the project. For virtual access fill only the second column. For trans-national access fill one of the two columns or both according to the way access costs are declared. Trans-national access costs on the basis of unit cost will result from the unit cost by the quantity of access to be provided.

Table of history of changes

<u>Version</u>	<u>Date</u>	<u>Description of change</u>
02	22-12-2015	Update of table 3,4b other cost, included auditing cost and corrected errors; in accordance with document financial and legal matter from 21-12-2015
	10-01-2016	Chapter 4.1 – stated clearly the employment relations of key personal.
	12-01-2016	Adapted chapter 5.2 ethics in response to Ethics Summary Report -
03	09-02-2016	Additional change to chapter 5.2 ethics in response to Ethics Summary Report
	09-02-2016	Adaptation of 2.2.5 Research data and knowledge management to fulfil requirements of the open Research Data pilot.
	11-02-2016	Added additional description of key personal involved – to respond to the comment of limited gender studies competence in the consortium.
04	29-03-2016	Changes to chapter 3.4 and related tables Resources to be committed in accordance to comments from MS Rogival and the now better defined role of the 3TU Datacentre
	29-03-2016	Update of key personal involved Bauer
05	30-03-2016	Correcting tables 3.4b and describing subcontracting in chapter 4.2

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1 Excellence

1.1 Objectives

The core objective of REPAiR is to provide local and regional authorities with an innovative geodesign decision support environment (GDSE) that will be used to create integrated, place-based eco-innovative spatial development strategies promoting the use of waste as a resource. GDSE draws on the concept of geodesign (Steinitz, 2012, Campagna, 2014) and will be developed and implemented in living labs (Mitchell 2003, Bilgram et al., 2008). The strategies produced using GDSE will support the ongoing initiatives of the European Commission towards establishing a strong *circular economy* (CE) in Europe (EC, 2011a, 2014b). To this end, and as supported by current EU waste management legislation, eco-innovative strategies are based to the greatest extent possible on *life cycle thinking* (LCT), thus ensuring that all lifecycle stages are considered, while avoiding burden shifting.

1.1.1 Background

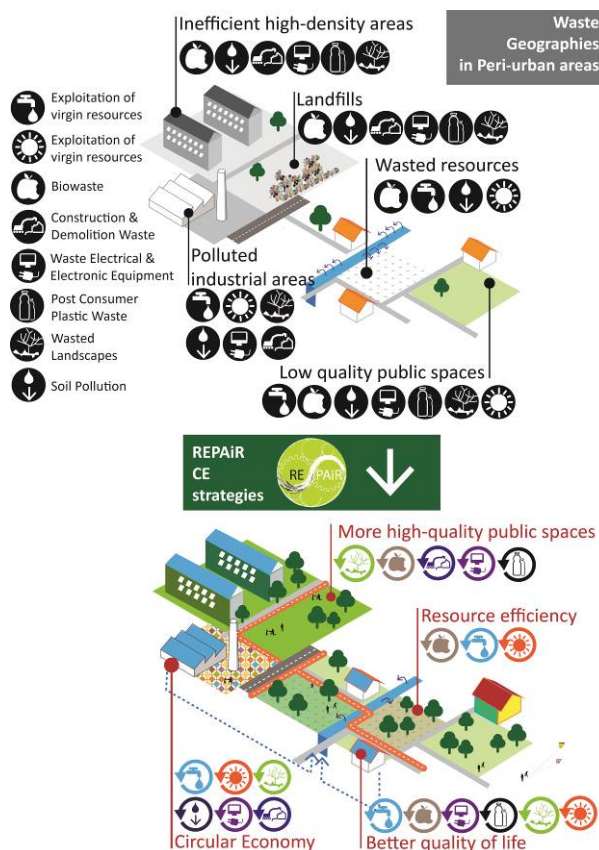
In the European Union (EU), 16 tonnes of material are used per person per year. The inflows that stay in urban areas become part of the urban ecosystem in the form of landfills, wastewater treatment plants, and physical infrastructure, while the outflows of urban spaces are exported back to the hinterlands and distant localities as pollutants and consumer products. Research in industrial ecology and related fields have framed these material and energy inflows and outflows as a city's 'urban metabolism' (UM). In the EU, out of these 16 tonnes, 6 tonnes become waste (EC, 2010). This waste production indicates the limited ability to use resources efficiently both in their transformation into consumer goods and waste's transformation back into valuable resources. Moreover, waste production results in competition for water and land use, increasing risks of adverse environmental effects such as climate change and ecosystem toxicity, and finally reduces quality of life.

About 60 percent of the land used to meet the EU's consumption demand is located outside its territory. Europe is thus the continent most dependent on land and resources beyond its borders to sustain its consumption patterns, agricultural industry, and energy demands (Unmüßig et al., 2015). Transitioning towards a more circular economy is crucial to delivering the resource efficiency agenda established under the *Europe 2020 Strategy for smart, sustainable, and inclusive growth*. The recently withdrawn amendment of the EU Commission's Directives on Waste (2008/98/EC), Packaging, Landfill, and other wastes had foreseen concrete goals for the recycling and preparing for re-use of municipal waste, as well as a variety of other waste fractions, and moreover the phasing out of landfills. REPAiR develops, in this phase of reshaping policies towards a CE, the possibility for public and private local actors to simulate and assess projects, policies and spatial plans towards a more circular economy.

A resource-efficient Europe can only be achieved with 'a policy mix that optimises synergies and addresses trade-offs between different areas and policies' (EC, 2011a). Thus, local authorities, citizens, and other stakeholders need a collaborative and science-informed decision environment that allows for developing different waste and resource management options and assessing their impacts on environmental resilience, spatial quality and the quality of life. Conducting robust assessments of options for improving waste and resource management in the EU is essential, but 'the availability of data remains a key challenge' (UNECE, 2014). Ideally, waste management data should include variables affecting complex system behaviour in order to understand the relationships between socio-economic and environmental dynamics and the built environment, making the concept of urban metabolism more applicable.

Therefore, the key innovations of this project are the integration of dynamic resource flow modelling, resource allocation together with urban and regional planning, and human behavioural aspects. REPAiR uses six peri-urban regions across Europe to develop, test and implement a GDSE as a tool for devising place-specific solutions to enhance resource efficiency and urban metabolism.

REPAiR focuses on peri-urban areas, landscapes characterised by a patchwork of dispersed urbanised areas, agricultural land, open space and high density residential areas within a discontinuous countryside. This focus is underpinned by DG Regio's statements in *Cities of Tomorrow* (EC, 2011b), which pinpoints problems for sustainable urban development like urban sprawl and extensive land consumption, fragmented local governments and planning systems as well as excessive use of resources and waste production in peri-urban areas. Peri-urban areas are particularly relevant as a source of problems, but their specific spatial configurations also offer a range of possibilities to establish a CE. Moreover, the presence of both urban, rural and hybrid spatial characteristics allows for developing eco-innovative strategies that are



transferable to rural as well as urban areas. For example, the local and regional economic networks of small and medium sized enterprises (SMEs) in the fields of manufacturing, creativity, design, telecommunications, energy and environmental technologies - key characteristics of peri-urban areas - provide REPAiR the possibility to support a strong, competitive, and diversified manufacturing and value chain in the spirit of the "Innovation Union" of the European Commission 2010 (EC 2010b)

The concept of Urban Metabolism is particularly strong in supporting improvements in urban and regional planning. It can, in fact, be used to develop policy support tools capable of assessing the impact of development scenarios against normative ideas on sustainable development. This applies not only in energy and resource use terms, but also in relation to most technical and socio-economic processes in urbanised territories related to growth, the production of energy and products, elimination of waste as well as to related spatial qualities and the quality of life. In order to make the concept of urban metabolism more effectively implementable, REPAiR addresses the main shortcomings of earlier UM approaches.

Figure 1.3a. Waste Geographies and 'circular futures' in Peri-urban areas.

- First, it accentuates the inner workings of the case study areas, rather than treating them as black boxes for general input-output accounting. By choosing subparts of metropolitan regions as the smallest scales of the system, REPAiR examines the processes that drive the transformation of resources into products, services and waste, as well as their impacts. Related to this is the choice and selection of sustainability indicators to be driven by the decision needs of key actors and not by data availability.
- Secondly, by concentrating on peri-urban areas, the interlinkages between the urban form and metabolic processes are brought to the foreground. The need to do so was highlighted as one of the key areas for further research by the SUME project. Overcoming the methodological barriers among industrial ecology and spatial planning and design is crucial to achieve this linkage. REPAiR therefore aims to integrate material flow analyses and lifecycle analyses into spatial models and planning policies.
- Thirdly, REPAiR uses a sociometabolic perspective, which does not reduce UM to an accounting exercise of gigatons and megajoules, but embraces existing knowledge, creativity and capabilities to redesign, invent and test strategies for a circular economy in living labs across Europe to achieve a more sustainable future. In this way, REPAiR will contribute to preventing waste generation and promoting the use of waste as a resource in order to enhance the natural and living environments.

In short, REPAiR focuses on how the design of physical structures and their social and urban metabolisms, including health, economy, well-being and happiness, are affected by material flows and their environmental impacts and will thereby contribute to improving the quality of life in Europe and building a greener society.

1.1.2 Summary of project objectives

The key challenge for REPAiR is to integrate models and methods from, among others, the environmental sciences, geographic sciences and economic sciences with design and spatial planning methods, both on a software and process level. The integrated models and methods will enable local and regional stakeholders to use the GDSE within a workshop setting to develop fast and reliable alternatives for spatial sustainable development strategies. The main objective of REPAiR is to demonstrate the feasibility and validity of the GDSE as a tool for enhancing waste and resource management. To successfully develop, test and implement the GDSE, the following project objectives have been defined:

- To provide decision-makers with comparative assessments of different integrated spatial resource management strategies (WP2, WP6) by combining forecasting methods (WP4), strategy conceptualisations (WP5) and an integrated assessment of economic, environmental and social sustainability in a collaborative decision support environment (WP4).

- To develop an understanding of the characteristics, mechanisms and dynamics of European resource management systems by analysing the relations between waste flows, environmental and spatial quality, allocation and governance in six peri-urban areas using life cycle thinking (WP3).
- To better interpret the link between metabolic flows and urban processes, by extending the assessment of urban metabolism to include urban driver concepts and urban patterns, as well as environmental and spatial quality, and co-benefits (WP3, WP4).
- To improve the knowledge and reliability of waste related data by reversed material flow accounting (WP3).
- To implement living labs in peri-urban areas across Europe in order to develop, test, implement and assess place-specific eco-innovative solutions for resource management to improve environmental and spatial quality and quality of life (WP2, WP5).
- To understand decision making structures and processes in the case study areas with regard to interests and priorities of different stakeholders in order to add transparency to the decision making process (WP6).
- To develop a framework for transferring (a) the key modules of the GDSE itself; and, (b) the solutions and change models that it will produce across differentiated peri-urban areas (WP7).
- To disseminate and ensure the further uptake of the project's insights on aspects of resource management and GDSE development by including local and regional planning authorities, NGOs, public and private waste management companies, and future urban planners in the project. Moreover, open dissemination of insights, tools and technologies is provided across Europe, establishing the foundation for knowledge-based consultancy services that support local implementation of policies and spatial investments aimed at developing a circular economy (WP8, WP2).

The REPAiR consortium consists of a good balance of partners from the case areas. The REPAiR consortium members can rely on their expertise in waste and resource management, spatial decision support, territorial governance, spatial planning and urban design. Moreover, the members have profound knowledge of the six case study areas. This allows us to develop a GDSE that is scientifically sound, apt for local decision makers and adaptable enough to be used in different locations. Together with the members of the user board, the entire REPAiR team comprises a complete range of representatives of the major stakeholders in all the metropolitan regions involved. The REPAiR user board includes key stakeholders for the development of a circular economy like planning authorities and public/private organisations involved in the strategic environmental assessment, and NGOs and industrial actors in waste and resource management.

1.2 Relation to the Work Programme

The key challenges formulated in the work programme are boosting eco-innovative solutions to prevent waste generation and promote the use of waste as a resource. The aim is to enhance the natural and living environment in urban and peri-urban areas and assure that developing and demonstrating eco-innovative solutions in real-life environments will enhance their market uptake and contribute to sustainable urbanisation worldwide. Table 1.1 gives an overview of how REPAiR address the general as well as the specific challenge of the call.

Table 1.2a. Contribution of REPAiR to the call objectives: WASTE-6b-2015 issue b) Eco-innovative strategies.

Specific Challenge	REPAIR response
Prevent waste generation and promote waste as resource	Identify and combine quantitative and qualitative information on material flow dynamics as well as the localisation of symbiotic relationships enabling local stakeholders to develop waste prevention strategies supporting a circular economy.
Enhance natural and living environments	Optimise urban and regional infrastructures and living environments in (peri-) urban areas through a CE based on the smart clustering of solutions to improve resource metabolism and spatial quality, consequently securing both social and spatial values (liveability), as well as environmental, economic and cultural values (prosperity).
Eco-innovative solution in real life environment	The 'living lab' approach provides a real-life test for the GDSE in six highly relevant case study areas. I.e. setting up pilot projects for better separation, collection and treatment of the organic waste fraction of household waste or increasing the sustainability of newly (re-)developed industrial areas by applying a circular economy approach.

Specific Challenge	REPAIR response
Understand the growing waste as a valuable stock of resources	Development of a method for inventorying waste flows via an improved spatial-environmental approach to waste as resource through agent-based smart clustering, supporting innovative governance and business models. An in-depth inventory of waste flows and stocks in six European peri-urban areas will be developed, along with an evaluation of the inventory's related economic, environmental, spatial and social potentials.
Scope	REPAIR response
Integrated urban metabolism approach (interdisciplinary, innovation and gender related aspects)	The proposed geodesign approach is strongly interdisciplinary. By putting design solutions at the core of the decision process, innovation and adoption in the case study areas can be guaranteed; by (1) securing women's participation in the research activities and (2) by investigating and considering gender-nuanced patterns of resource use and consumption, decision-making and public governance.
Engage local authorities, citizen and other relevant stakeholders	All stakeholder groups as determined by Freeman (1999) are represented in the activities, both as partners in the consortium and in the user board. 'Living lab' as research approach that facilitates public-private-people partnerships in order to integrate current research and innovation processes in a user-centred, open-innovation ecosystem operating in a wider territorial context.
Specific Scope (Issue b)	REPAIR response
Development of strategies for waste prevention	Development of six collaboratively developed integrated resource management strategies for the case study areas and a framework for strategy development and software modules transferable to other metropolitan areas in Europe and abroad.
Urban metabolism in relation to urban patterns, consumer behaviour, lifestyle, culture and socio-economic issues	Utilising the specific socio spatial configuration of peri-urban areas to enable smart and sustainable use of resources, while improving spatial and socio economic issues. To this aim, REPAiR combines quantitative and qualitative research and adds spatial quality and innovative governance and business models to the concept of urban metabolism.

1.3 REPAiR's Concept and Approach

1.3.1 REPAiR's overall concept

REPAiR applies - for the first time - a geodesign approach including waste and resource management in order to reveal the local space-specific challenges of waste and resource management using life cycle analyses (LCA) and UM. Campagna (2014) defines geodesign as 'an integrated process informed by environmental sustainability appraisal, which includes project conceptualisation, analysis, projection and forecasting, diagnosis, alternative design, impact simulation and assessment, and which involves a number of technical, political and social actors in collaborative decision-making'. The advances of geodesign compared to older landscape and environmental planning approaches are threefold. It allows for (1) an extensive use of digital data in design, evaluation and communication; (2) gives a prominent role to design, by developing spatial solutions to specific place-based (*genius loci*) problems; and (3) its transdisciplinary nature calls for collaboration.

REPAiR adapts Carl Steinitz's (2012) geodesign framework, comprising six questions (see Figure 1.3b) that are asked at, at least three points in a geodesign project: (1) to understand the study area, (2) to specify the methods and (3) to perform the study. The answers to Steinitz's questions are six models of current functions and performance, as well as possible future alterations to a specific area. The models build the components of the GSDE in terms of software solutions and the decision-making process, and reflect the work package structure of REPAiR.

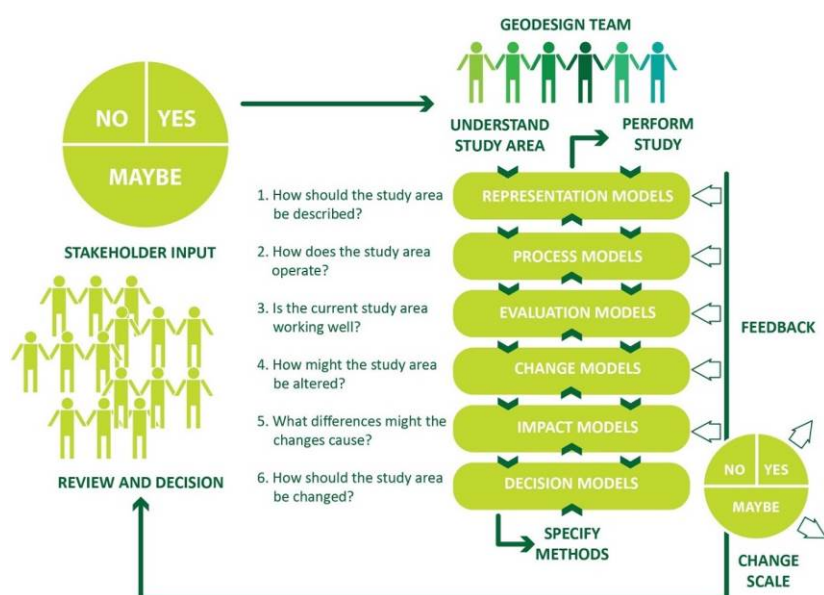


Figure 1.3b. The six questions and three iterations of Steinitz's geodesign framework (in reality the process is much more iterative).

Using Steinitz's framework has distinctive advantages. First, the use of methods and data is decision-driven; representing local waste prevention and resource management challenges, and the specific needs of the actors involved. Second, the change models comprise designs of several solutions to specific challenges, tested in real-life environments. The designs involve urban design, planning, policy-making and governance, triggering a collective planning process. Third, the

collected data represent relevant scale(s) and detail levels. Fourth, case-specific, relevant sustainability indicators are revealed. Finally, using the framework triggers a transparent decision-making process.

An extended Urban Metabolism Approach

REPAiR integrates life cycle thinking and geodesign to operationalise urban metabolism (UM). UM describes the continuous flows of energy, resources, waste, information and people into, out of, and within any given metropolitan area. It considers the area as interacting subsystems, permanently adapting to political, economic and natural environments. The UM concept has *inter alia* been used as an analytical tool to examine the energy and material exchanges 'between cities and the rest of the world' (Fischer-Kowalski, 2002). In other words, UM is a framework for modelling complex urban systems' material and energy streams as if the city were an ecosystem. Using this framework enables studying the dynamics of cities in relation to scarcity, carrying capacity, and conservation of mass and energy (Newman et al., 2009). REPAiR builds on the extended UM approaches (e.g. Minx et al. 2011, Schremmer et al. 2011, Pincetl et al. 2012), in which urban subsystems with their environmental and spatial impacts are addressed more explicitly. REPAiR also builds upon the notion of *synergism* in UM studies, focusing on the benefits of the intrinsic relationships existing within the urban metabolic system (Zhang et al. 2014).

Waste as Resource

REPAiR's understanding of UM facilitates the shift to seeing waste as a resource, while determining the implications of this shift and exploring ways to tackle it. Therefore, REPAiR does not focus on 'end-of-pipe' potential alone, but traces waste flows back to resource consumption patterns. This is essential for two reasons: (1) the role of consumption behaviour in sustainable urban development is still insufficiently studied; and (2) this approach enables estimating the best possible change routes towards a circular economy. An adequate classification of waste, fitting all European waste management policies and regulations, is required for this purpose. While a definition of waste is provided within the Waste Framework Directive (2008/98/EC) and includes by-products and end-of-waste criteria, (see e.g. EC (2011c)), REPAiR offers an outstanding contribution to these efforts by including technological and social developments, both up and downstream, and defining if, when and where waste becomes a resource. REPAiR addresses five preliminary flow categories: construction & demolition waste, biowaste, post-consumer plastic waste, electrical waste and electronic equipment, and municipal solid waste. Along the project's trajectory, other flows may emerge as priorities in each case study area, such as post-industrial waste or medical waste. Furthermore, REPAiR innovates by focusing on 'wasted landscapes' (WL), which apply to open spaces as well as built entities, like buildings and infrastructure.

Trans-disciplinary considerations

The geodesign approach is by definition transdisciplinary. REPAiR uses two key strategies to achieve a successful transdisciplinary working environment. First, the first six months of the project are allocated to developing a shared understanding of key concepts and methods used to develop the GDSE. Specific deliverables are a joint vision of the

GDSE and methodological handbooks. Second, REPAiR uses peri-urban living labs (PULLs), which integrate the research and teaching activities related to REPAiR with the activities of local consortium partners. In situ development of strategies for a circular economy (CE) within multidisciplinary teams will enforce the transdisciplinary collaboration.

1.3.2 Positioning REPAiR in relation to Technology Readiness level (TRL) and Societal Relevance Level (SRL)

The core product developed by REPAiR is a GDSE, combining and further developing existing simulation modelling, assessment tools and spatial decision support systems and other commonly used tools (CAD, GIS, BIM and system dynamics). Moreover, REPAiR develops some new 'best practice' techniques, such as object-oriented diagrams or interactive touch-enabled interfaces. A key challenge is to integrate collaborative approaches and design capabilities into these tools. So far, few geodesign decision environments have been developed and none of them focuses on integrating waste management with spatial analyses.

Common limitations of current geodesign systems include a lack of full decision-process support, stakeholder selection based on decision stages, trans-disciplinary communication and learning, and integration of design and analysis tasks. Several consortium members (Geo-Col, GGR, TUD, UG, IGIPZ, JRC) have experience developing geodesign systems or traditional (spatial) decision support systems. Using the experience of the consortium partners, REPAiR addresses these limitations by developing and providing a trans-disciplinary platform that offers stage-specific support, with modules that combine design tasks with analytical models in the context of waste and resource management.

The software products used for the GDSE have primarily been delivered by ESRI (US leader of commercial GIS software). REPAiR innovates in this respect by adopting an open source approach in the development of the different modules of the GDSE and connecting them with existing open source LCA databases and DSS like open LCA. REPAiR also develops several comprehensive eco innovative solutions from ideas from strategy implementation, to scenarios and simulations.

Table 1.3a. Key technologies, concepts and policies dealt with by REPAiR and their expected changes in technological readiness and societal relevance level, following McCarthy (2013).

Technology / Concept / Policy	Current TRL/SLR level	Post REPAiR TRL/SRL level
Methodological Improvements		
Geodesign decision support environment	Experimental proof of concept	Integrated design capabilities and tested in relevant multi actor environment. (TLR 7)
Urban metabolism	Concept applied to metropolitan system	Concept applied to subsystems of metropolitan areas and related to urban planning and design
Circular economy	Applied to cradle to cradle products	Tested and assessed on business park development
Reversed material flow accounting	Applied to pilot studies for single waste streams	Standardised application for several waste streams in relation to urban planning and design
Planning in peri-urban areas	Fragmented planning systems	Piloting integrated spatial planning in living labs
UM related sustainability indicators	Focus on whole economy	Indicator set integrating economy-wide and local indicators.
Exemplary Eco Innovative Strategies		
Ghent – Increase of energy-efficient renovations from 1500 to 3000 buildings per year and improve the separate collection and recycling rate of glass and mineral wool waste	Policy agreement	Simulated and assessed in a wider policy and spatial development arena with a variety of stakeholders
Haarlemmermeer - Development of a circular economy business park	Initial development phase	Simulated, evaluated and assessed CE business park in a wider policy and spatial arena with a variety of stakeholders
Naples - The Covenant for the Land of	Initial funding scheme and proposal	Simulated, assessed and partly

Fires was signed, allocating resources for Naples metropolitan area to improve territorial control and environmental protection	of a prevention bill	implemented integrated approach using UM methodology to link land remediation and recovery projects to land use planning with various stakeholders
Pécs - Exceeding the increase and optimisation of recycling (rate) of household waste, the concept is to maximise avoidance of disposal.	Renewed recycling and disposal system. (30% of recycling rate)	Alternative technologies in use instead of disposal (recycling and e.g. energetic use, pyrolysis). 50% or higher recycling rate
Łódź – Development of a planning policy for the city (structural and land use plans) with particular focus on limiting suburbanisation.	Planning system works but focuses on land use regulation. Strong pressure on agricultural land. Limited urbanisation demand causes fallow agricultural lands.	Integrated approach to link land use planning to management strategies for disused agricultural lands via collective UM methodologies.
Hamburg - Development of methods to increase bio-waste recycling rates in private households and improve bio-waste cycles in horticulture enterprises and tree nurseries.	Bio-waste recycling is introduced to households, but the percentage is limited. Bio-waste cycles only closed in a limited way.	Developed and implemented methods to introduce bio-waste recycling to all household types. Developed methods to improve bio-waste cycles.

1.1.3 Activities Linked to REPAiR

It is essential to be aware of and use knowledge obtained in the past and current national and international research projects in the fields relevant for REPAiR. A selection of related projects is summarised in Table 3, including the REPAiR consortium members involved in the project.

Table 1.3b. Selection of key projects by partners in most recent years.

Project	Funding Framework	Input for / Synergy with REPAiR	Involved REPAiR Partner
SUME	FP7	Sustainable Urban Metabolism in Europe –relating UM with urban patterns	TUD
Better Airport Regions (BAR)	NWO (NL)	Reciprocities of essential resource flows with environmental and spatial qualities	TUD
C2C Islands	InterReg	Area development based on C2C approach around the North Sea	TUD
G-FORS Gov. for Sustainability	FP6	Governance and knowledge forms of sustainable policy roots (SEA, AQM, ETS)	RKI
ET2050	ESPON	Territorial scenarios and visions for Europe	RKI
Investments in your future	ERDF	Treatment of sediments containing heavy metals with microorganisms	BMU
Cilento Labscape	FARO	A living lab in the national park of Cilento e Vallo di Diano	UNINA
Recycle Italy	PRIN	Re-landscaping drosscapes in Campania Region	UNINA
KnowSeas	FP7	Geodesign tool for marine spatial planning workshops;	Geo-Col
FOODMETRES	FP7	Geodesign for Food Planning and Innovation for Sustainable Metropolitan Regions	Geo-Col
PROSUITE	FP7	Prospective Sustainability Assessments of Technologies	UG
Summa	Flanders	The policy research centre for sustainable materials management	UG, OVAM
Regions for recycling	Interreg	Improving household waste recycling in Europe	OVAM
PLUREL	FP7	Peri-urban Land Use Relationships - Strategies and Sustainability Assessment Tools for Urban-Rural Linkages	IGiPZ
SURF(Sustainable Urban Fringes)	Interreg	Development of policy guidelines for the sustainable development of urban fringes	HCU
URMA	Interreg	Improving urban-rural partnerships for territorial cohesion.	HCU
RegioProjekt Check	FONA (BMBF, D)	Open-Source GIS-based assessment tool for projects of regional importance	GGR
PARK 20 20	Private equity	The first full service cradle to cradle working environment in the Netherlands	DELTA

BERBION	BMBF	Die Stadt der Zukunft: Eine bedarfsangepasste Zero-Waste Bioraffinerie.(2009-2014)	SRH
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As the projects in Table 3 show, the REPAiR partners are involved in the latest research, policy development and implementation of CE principles and collaborative decision-making. REPAiR partners are members of relevant international networks like the Cradle-to-Cradle Network, Climate KiC, PLUREL, the Society of Environmental Toxicology and Chemistry (SETAC) and the UNEP/SETAC Life Cycle Initiative. Beyond REPAiR partners' existing activities, REPAiR establishes links with ongoing research projects such as DESIRE and the European Resource Efficiency Platform. Through the user board members, REPAiR also connects to the peri-urban regions platform Europe (purple). The Dutch government has adopted the Amsterdam REPAiR case as a national iconic project, underlining its "Netherlands as a CE Hotspot" policy during its EU Presidency in 2016. REPAiR is thus connecting with the European and global CE field both during and after this project.

1.3.4 REPAiR's Project Structure and Methodology

REPAiR follows in its structure the six questions and models of the geodesign framework and is organised in two levels (Figure 1.3b). WPs 3 to 6 develop the six models of the geodesign framework for each study area, whereas WPs 1, 2, 7 and 8 manage different aspects across the cases and coordinate activities related to knowledge dissemination and data management.

WP 1 | Project Management

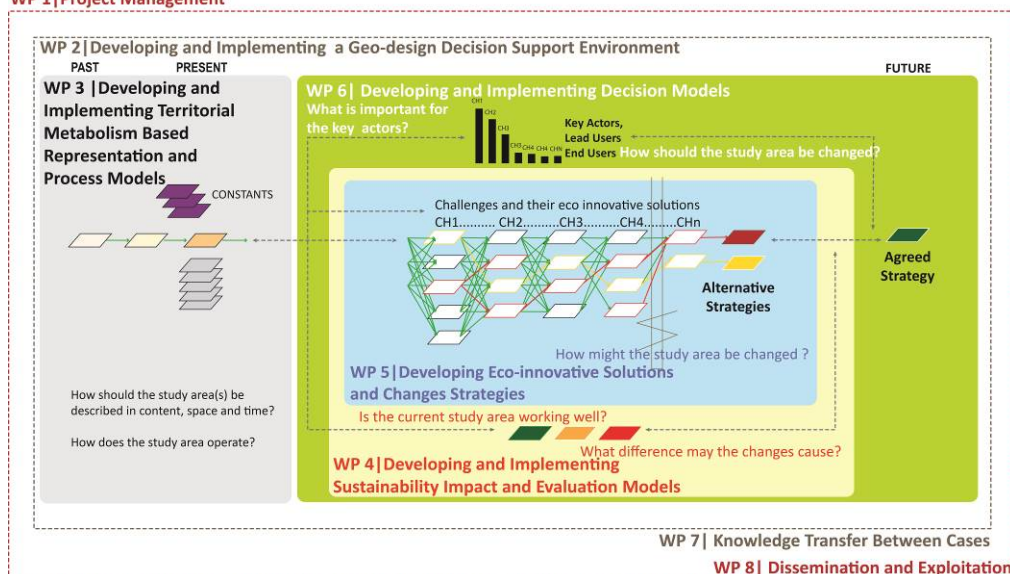


Figure 1.3c. REPAiR WP-structure. The empty parallelograms represent alternative spatial representations of proposed eco-innovative solutions. The bar diagram symbolises the levels of importance for specific stakeholder groups.

planning, environmental policies and other relevant fields and stakeholders from particular regions. This approach calls for a methodology facilitating regular inter-team interaction in a real world environment. Accordingly, the REPAiR team needs to:

- understand the decision needs of key actors in the study areas;
- specify the concept of urban metabolism to describe the crucial processes in the study area;
- generate manifold ideas for possible changes and engage future users, local stakeholders as well as thematic experts in strategy development;
- develop a framework of indicators to assess these ideas against the current situation;
- develop a framework of knowledge transfer;
- develop data management structures and user interfaces for the GDSE to enable decision makers to assess their decision alternatives quickly.

There are four types of activities in the project, namely (a) research activities, (b) technological innovation, (c) peri-urban living labs and (d) promotion activities. These are tightly interlinked to ensure a quick market uptake of the GDSE, which will foster change and improvement in resource management, and thereby prevent waste generation and promote waste as resource.

A) Research Activities:

The four main research activities are:

- Developing and implementing territorial metabolism models - WP 3
- Developing and implementing evaluation and impact models –WP 4
- Developing and implementing decision models – WP 6

- Develop a knowledge transfer methodology- WP 5

For all thematic WPs, REPAiR uses three dimensions: (1) **flows and stocks**, (2) **place** (peri-urban landscape, environmental and spatial quality), and (3) **behaviour & governance** (organisation, lifestyle, institutions, etc). This allows for a comprehensive analysis and assessment of quantitative and qualitative data, because patterns characterising the processes in the area emerge through the interplay of these three dimensions. They will be investigated at four interrelated scales: (1) **local**, i.e. the specific peri-urban area; (2) **metropolitan** – the larger urban area; (3) **European**; and (4) **global**.

REPAiR combines, because of its interdisciplinary nature, different methods to gather, validate and triangulate data. A selection of the key methods is presented below.

Mathematical and computational modelling used for developing the evaluation and impact models:

- A variety of spatial modelling (cellular automata, agent base, land use,...)
- (Spatial) statistics
- Multi criteria assessment techniques

Quantitative research methods in order to develop and feed the representation and process models:

- environmental life cycle assessment
- reversed material flow accounting
- discrete choice modelling
- Geographic/spatial analysis
- Spatial network analyses

Qualitative research methods used to develop the decision model and transfer models:

- Analyses of secondary sources (e.g. policy documents, scientific literature, business reports)
- Interviews
- Mapping of stakeholders and space
-

(Urban and regional) Design methods used during the PULLS to develop alternatives for the physical urban structure, physiological processes, landscape designs and policies related to waste management through:

- collective (multi-expert) iterative design and assessments
- cooperative (stakeholder and experts) iterative design and assessments
- diagrammatic reduction to translate designs to spatial data for their assessment.

The four WPs that organise the research activities are described in more detail below.

Developing and implementing territorial metabolism based representation and process models (WP 3)

The dynamic relationships between physical, social and economic characteristics from the study cases will be gathered and analysed through the **evolution of material flows and stocks** with focus on output flows and their related environmental impacts. REPAiR's approach stands out from previous UM research as it examines **selected waste flows whilst focusing on the local level**, instead of aiming for a complete mass & energy balance of all metabolic flows relevant to the given system. For the case studies where material and waste flows are not well mapped and documented, we introduce a **reversed material flow accounting**, a bottom-up method to trace the waste output flow back to examine the inputs.

Five preliminary waste flows are selected, based on classifications defined in European Commission directives, whilst taking into account the decision needs in the study cases and the in-consortium expertise. Other waste flows will be considered depending on the specific study area in question.

- *Construction & demolition waste* (CDW). CDW accounts for 25% - 30% of all waste generated in the EU. The level of recycling and re-use of CDW waste varies greatly (between <10% and >90%) across the EU (EC: http://ec.europa.eu/environment/waste/construction_demolition.htm).
- *Biowaste*. This waste flow can include different types of organic streams, depending on the case study area, and may differ slightly from the biodegradable waste classification deployed by the EC, which excludes e.g. forestry and agricultural residues. Two current primary areas of concern in Europe are: the production of methane from biowaste decomposing in landfills, and the growth in food waste (EC: <http://ec.europa.eu/environment/waste/compost/index.htm> & EC: <http://ec.europa.eu/environment/eussd/food.htm>).

- *Post consumer plastic waste*. In Europe, only 24% of plastic waste is recycled, close to 50% is landfilled, and the rest is incinerated. Large differences exist between the waste-management measures of the EU member states (EC: <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52013DC0123&from=EN>).
- *Waste electrical and electronic equipment (WEEE)*. WEEE is one the fastest growing waste streams in the EU. Due to its hazardous content, WEEE may cause major environmental and health problems. Moreover, the production of modern electronics requires the use of scarce and expensive resources. (EC: http://ec.europa.eu/environment/waste/weee/index_en.htm). In 2013, from the list of fifty-four candidate materials, twenty one raw materials were assessed as critical at EU level (Oakdene Hollins/Fraunhofer, 2013).
- *Municipal solid waste (MSW)*. Depending on consumption patterns, lifestyle, and waste management policies, the composition of MSW varies by country and even by municipality. Recycling performance of MSW has increased over the years in most European countries, but dumping untreated MSW in landfills is still common practice in some countries (European Environment Agency, 2013).

To summarise, WP3 creates an understanding of each study area's driving characteristics and metabolic patterns with two objectives: 1) to describe relevant system boundaries and interlinked functional subsystems, comprising physical, social, environmental, technical and economic components, and 2) to reveal the subsystems' operation. These diagnostic steps shed light on an area's consumption and waste related baseline scenario and challenges, and as such inform the evaluation and change models (WP4 and WP5). REPAiR builds upon the rich experience of UM studies of UG, JRC, IGIPZ and TUD.

Developing and implementing evaluation and impact models – (WP 4)

The main objective of WP 4 is to analyse the sustainability of the present UM in the case study areas and the influences of eco-innovative solutions in a spatially differentiated and trans-disciplinary way. This is one of the key challenges of REPAiR and has not been done before. REPAiR's starting points are the endpoints of the assessment framework developed in the PROSUITE project: natural environment, resources, human health, welfare and wellbeing. This framework will be enriched by state-of-the-art methodologies such as the Product and Organisation Environmental Footprint (PEF/OEF), waste management indicators and recycling benefits, and will be extended by widely overlooked indicators related to ecosystem services. The key challenge is to tailor the framework to evaluate peri-urban areas in a multidisciplinary (economic, ecologic, social) and spatially differentiated way. Therefore, the following questions need to be answered in order to improve the PROSUITE framework:

- Which impacts occurring at a peri-urban level are typically missed when performing traditional sustainability assessments?
- Which indicators are available and which can be of added value to the sustainability framework?
- How can these local impacts be linked to existing/new impact categories?
- Which data are available at which level?
- Which data need to be generated?

Three steps will be undertaken to develop the assessment framework:

- collecting and assessing available data on regional and local scale. Where necessary and possible, additional data will be collected or generated;
- establishing a consistent inventory (consistent with a selected system level and its boundaries; consistent with physical laws, input = output + stock increase);
- integrating the information to a relevant and limited set of indicators at an economy-wide and peri-urban area level, using multi criteria assessment techniques.

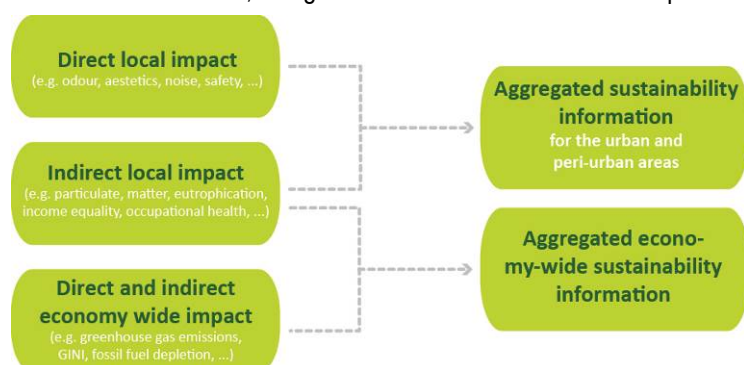


Figure 1.3d Merging of direct and indirect impacts to peri-urban and economy wide sustainability information.

A balance is established between the complexity of information and the need for clear input to decision making. Many sustainability assessment practices such as LCA focus on gathering economy-wide sustainability information. Given the nature of the REPAiR project, it will gain insights into effects at a local urban/peri-urban

area level. Therefore, it will merge sustainability information at the local and economy-wide levels.

To summarise, WP4 analyses the sustainability of the urban metabolism (WP3) in the case study areas and the influences of eco-innovative solutions (WP5). A framework of quantitative indicators will be developed and applied. REPAiR starts from the framework developed by the PROSUITE project (UG): natural environment, resources, human health, welfare and human well-being. Building upon their expertise in environmental and spatial quality assessment, UG, JRC, TUD and IGiPZ are adjusting this framework to evaluate peri-urban areas in a spatially differentiated and trans-disciplinary way.

Developing and implementing decision models (WP 6)

The geodesign approach is driven by the decision needs of key actors. These could range from policy needs of a governmental body to business decisions of single persons. Using actor-centred institutionalism and actor network theory as conceptual frameworks, REPAiR studies the decision needs, first through literature research and, subsequently, through interviews with key stakeholders. In parallel, secondary sources, including legislation, policy reports, contracts, and newspaper articles will be analysed in order to understand the interrelation between decision possibilities of stakeholders within their institutional settings. Based on the two previous steps, in-depth interviews with actors will be conducted to acquire information and knowledge needed to answer the following questions:

- What are the priorities of the key stakeholders?
- What are their positions and how do they differ or even clash?
- What are the objectives and requirements of the decision-makers?
- What do the decision-makers need to know in order to implement changes?
- What is the relative importance of objectives, and on what are these objectives based?

The knowledge of this decision landscape allows REPAiR to focus the activities of WP3 - 7, whilst ensuring the implementation of strategies developed as they are related to the needs of future GDSE users (WP8).

Next, WP6 develops methods to relate the change models' impacts to the key actors' priorities in order to integrate the decision models into the GDSE. REPAiR uses the PULLs to test different decision models and their applicability and feasibility with different stakeholders.

To summarise, WP6 analyses the decision making landscape of the case study areas (stakeholders, processes, legal framework) through document analyses and interviews to identify the key challenges for CE development. These form the basis of the various decision models for all cases and will be implemented and tested in cooperation with stakeholders. REPAiR draws upon the in-depth experience of HCU and RKI in the field of governance and their detailed knowledge of the case-specific actor landscapes of GHM, CRA, PHH, BIOKOM, OVAM, SRH and IVAGO.

Organising the knowledge transfer between cases (WP 7)

The goal of WP7 is to elaborate a knowledge transfer methodology that reveals the most effective and appropriate knowledge transfer channels, tools and processes across peri-urban areas with differentiated knowledge, technological, socio-cultural and governance characteristics. The objects of the transfer across the case study areas will be eco-innovative strategies and solutions. WP contains five steps:

- a critical review of the theoretical literature on knowledge transfer and related concepts (policy transfer, lesson-drawing, policy diffusion).
- developing a preliminary methodology for knowledge transfer
- organising knowledge transfer events bringing together the relevant stakeholders as part of the living labs to demonstrate transferable solutions as well as to gather feedback to refine the knowledge transfer methodology
- developing the final methodology for knowledge transfer
- producing an open access online handbook which will present the methodology for ensuring that the transfer of strategies and eco-innovative solutions defined in living labs to other contexts is purposeful, tailored to the local context and, thus, successful.

The handbook will (1) introduce the theoretical model of knowledge transferability; (2) describe the key lessons on knowledge transfer drawn from REPAiR; (3) discuss the potential barriers and characteristics of the knowledge transfer observed; and (4) offer guidelines for better transferability by considering local peculiarities.

To summarize, WP7 facilitates the transfer of knowledge and solutions across the case study areas. Recognising the context-dependency of resource management solutions and the limits to transferring 'best practices', WP 7 elaborates a model of transferability for change models and solutions. A collaboration of RKI, HCU and TUD with their expertise in comparative

studies and OVAM, BMU, DELTA, BIOKOM, SRH and IVAGO as leading waste management companies assures the policy and practice relevance of this typology.

B) Technological Innovation activities – (WP 2)

Technological innovation at REPAiR is mainly in the area of software development for the GDSE. For the software development, REPAiR will follow an iterative and interactive process in which problem formulations and solutions evolve together through collaboration between the different partners, members of the user board, as well as students of the involved faculties. The process will be based on rapid development of prototypes in parallel with pilot tests (for verification & validation),

to allow continuous improvement and adaptation with the evolving formulations of the problems and solutions.

The GDSE is built of five modules: data management (DBM), dialogue management (DM), model management (MM), knowledge management (KM), and stakeholder management (SM), see Figure 1.3d. Software, hardware and process-ware have to be developed, tested and implemented.

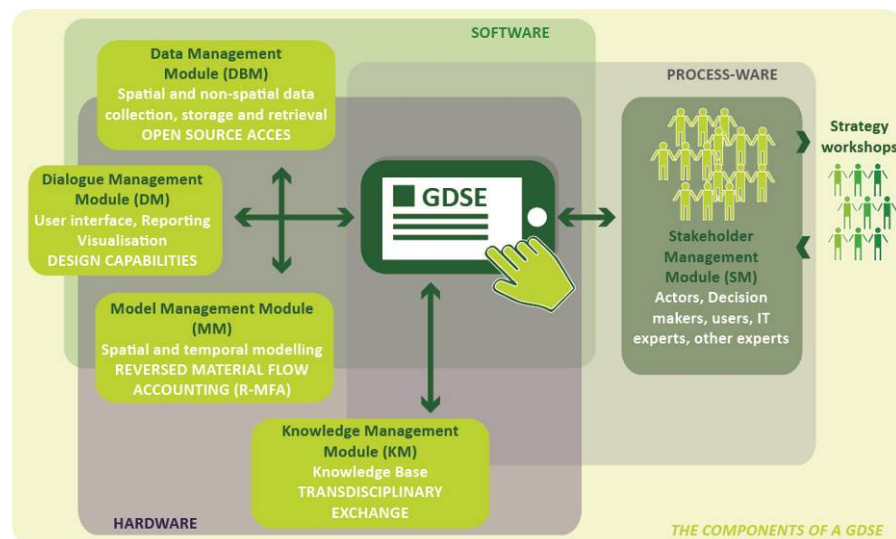


Figure 1.3e. The five modules of the GDSE.

- DBM – This module deals with the collection, storage and retrieval of spatial and non-spatial data (WP3-6) for the different workshop sessions, and for the project overall (with WP8). The module features a database structure for storing, managing, consulting and analysing the data according to a standard model (viz. Inspire).
- MM – This module features spatial and temporal modelling, specifically focused on a workflow that integrates decision models, process support, change evaluation, and impact assessment. The key is to translate scientific models and their output into interactive maps that can be used during the stakeholder workshops and to model the impacts of the different eco-innovative solutions proposed.
- KM – This module facilitates knowledge flow and exchange between local experts, actors, and the project team experts into the GDSE, utilizing feedback generated by the models developed in WP3 and WP7.
- DM – This module features a user interface as well as capabilities for reporting, visualisation and design of the GDSE.
- SM – This module focuses on organizing a sequence of workshops in which experts, actors, stakeholders, and end users test the GDSE. Two pilot case studies with key stakeholders and the university teaching environment collaborate to test the components of the software and the process-ware stepwise.

To summarize, WP2 provides the necessary open source software components to integrate the five modules of the GDSE. WP2 develops and organises the implementation process of a series of strategy workshops and organises the exchange and workflow between WP3 and WP5. WP2 builds upon the expertise in SDSS development of Geo-Col, GGR, and TUD together with the decision-making know-how of the public authorities involved: GHM, CRA, PHH, OVAM, SRH and IVAGO.

C) Peri-urban living labs

REPAiR agrees with Ferrao et al.(2013) 'that we need to begin to redesign parts of the structure that underlies the process of achieving sustainability, based on new ideas from every trace of sustainability we can locate'. Hence, design in its widest sense plays a crucial role in developing strategies for CE. REPAiR organises peri-urban living labs (PULLs), where key actors, representatives of regions, municipalities, corporations, individuals, design professionals, information technologists, scientists and students collaboratively generate new ideas and strategies for the development of CE. WP 5 organised the PULLs and is described in more detail below.

Developing eco-innovative solutions and change strategies (WP 5)

The main aim of the PULLs is to develop strategies for a more circular economy by first **generating input** for the development of the six models that build the GDSE as well as test the environment of the GDSE itself. The PULLs are the main place and time of transdisciplinary integration within REPAiR. REPAiR integrates activities of ongoing teaching activities at the participating universities and AMS with research conducted in the WPs by consortium partners. This is a win-win situation:

- students of urbanism, environmental ecology, building technology, geomatics and spatial planning, real estate and management and other related fields will be future users of the GDSE and are therefore the ideal test group for its development;
- student groups working on the study areas over several years help to conduct the basic research on the three thematic dimensions described above;
- the sheer number of people from different disciplines and backgrounds thinking about specific solutions in pressure cooker settings of PULLs increases the pool of eco-innovative solutions to be included in the strategies.
- for the students, participation brings the advantage of working in multidisciplinary teams on real life projects on the interface of research and design, and therefore learn skills that will be crucial for their future employability and professional success (and entrepreneurial skills).

The PULLs will be organised by a Management Board (MB) that will lead them and be responsible for concluding and reporting the results. The different workshops and other interactive and participatory events of all WPs will be integrated in time and place during the PULLs. REPAiR will conduct two different kinds of PULLs: for the pilot studies and the follow up studies. A preliminary structure is presented below.

Structure of the two pilot PULLs

Both PULLs take place simultaneously. In the Naples case study, students from UNINA do the work, in Amsterdam students from TUD and AMS. Figure 1.3e presents a preliminary structure of the pilot PULLs, which are iterations of design studios coinciding with GDSE testing, knowledge transfer and stakeholder participation workshops with phases when the results of student work and research activities of the other WPs are integrated.

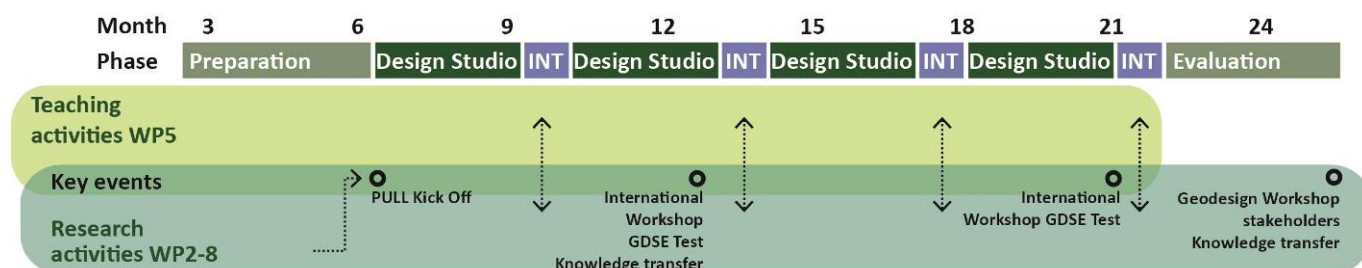


Figure 1.3f. Preliminary structure of pilot PULLs and their relation to deliverables and milestones.

To summarise, WP5 applies a living lab approach to develop space specific eco-innovative solutions and strategies which will be designed, modelled (WP3), and assessed (WP4). The knowledge of the industrial partners, DELTA, BMU, BLOKOM, OVAM, SHR, IVAGO and the teaching scientific institutions, TUD, UG, UNINA and HCU along with their students will be integrated under the lead of UNINA, which has extensive experience with organising living labs.

The key to successfully using the living lab approach for the development of the GDSE is the right choice of study areas; they need to be diverse enough to be representative for most European countries, but also need to be able to test and validate whether the GDSE is flexible enough to be transferable to other contexts, and to detect limits of transferability. Three of the cases are characterised by high recycling rates and low rates of landfilling: Amsterdam (NL), Ghent (BE) and Hamburg (D). The key challenge there is developing a circular economy instead of incinerating waste or exporting it. The other 3 cases, Łódź (PL), Naples (I) and Pécs (H), with lower recycling rates and higher rates of landfills, face parallel challenges of increasing recycling rates and reducing illegal dumping on the way to a CE. The wide array of characteristics within this set of cases (see Figure 1.3f) makes them representative for many other European metropolitan regions.

REPAiR uses two pilot studies in Naples and Amsterdam to develop the GDSE. The rationale behind this being that the Naples case focuses on territorial and landscape questions, whereas the Amsterdam case focuses on waste/resource flow optimisation and business development. The follow-up studies include both challenges.



Figure 1.3g. Key data for the 6 case study areas.

The two pilot studies

Metropolitan Area of Naples (MAN)

Border / inhabitants: The MAN is highly dense (around 3.0 million inhabitants), with peri-urban areas near the Vesuvius volcano. The boundaries of the case-study area are delimited by considering the system of transport and ecological linkages and contain the larger plain area that reaches the Regi Lagni to the north east of the city.

Problems / key material flows: The natural and built environments are highly degraded and compromised. Criminal organisations have significant influence in this area. The Campania Region potentially has 2551 contaminated sites. These are landfills and areas of uncontrolled waste deposit. The region has six Sites of National Interest (SIN), which are polluted areas. 15.8% of the entire region is polluted, a total of 2,157 km2 (ARPAC, 2008).

Aim / objectives /challenges: the main challenges related to waste management are:

1. Governance – rethink the non-existent waste cycle: landfills are saturated. More incinerators are claimed to be necessary, enhanced waste separation, etc.
2. Behaviour – the need to change people's behaviour to adopt recycling. The waste crisis in the city is an impulse that can facilitate mind-set changes.
3. Illegal dumping – serious problems regarding public health and security.
4. Recycle land – poor overview/control of illegal dumping and clean land makes creation and securing of new ecological resources essential.

The main challenges related to the spatial organization of the case-study area are:

1. High density, sprawl and lack of public spaces.
2. High amount of in-between spaces, abandoned and disused areas in central and peri-urban areas clearly connected with waste challenge 4.
3. Recover the value of former agricultural land in peri-urban areas, now used as landfills and contaminated, hence connected with waste challenge 3 and 4.

The Circular Economy (CE) Hotbed in Haarlemmermeer within the Amsterdam Metropolitan Area (AMA)

Border / inhabitants: The AMA encompasses the city of Amsterdam, the provinces North Holland and Flevoland with 36 municipalities, and a total population of over 2.4 million inhabitants. AMA Central Administration (BKG) has the administrative responsibility for the area. REPAiR focuses on developing the CE Hotbed in Haarlemmermeer, a municipality south of Amsterdam and home to Schiphol International Airport. Adjacent to the CE Hotbed, Park 20|20 develops CE in close collaboration with C2C™ founders McDonough and Braungart.

Problems / key material flows: As in Park 20|20, all buildings in the CE Hotbed are designed to have material and energy neutral footprints. Building components are designed to be fully reusable at the end of their intended use-cycle. However, whereas in Park 20|20 only the built environment itself is circular, the CE Hotbed intends to conceptualise the business models of CE within the C2C™ built environment area and to develop them into actual business. The prime movers in the global CE field (i.e. CE100 member companies, McDonough, Braungart, MacArthur, Arizona State University, etc.) are involved to achieve this result. To all parties' benefit, "local" parties and initiatives will be integrated, such as the municipalities of Haarlemmermeer and Amsterdam, Municipal Waste Processor Meerlanden, advisory/user board member AEB, the newly established Amsterdam Institute for Advanced Metropolitan Solutions (AMS), and the adjacent Enginn incubator.

Aim / objectives /challenges: the key challenges for REPAiR in relation to the CE hotbed development are twofold:

1. Develop practical business models, which requires that the irreplaceable materials used to make products, and the technologies to facilitate them, are central.
2. Spatial translation of (1).

The four follow up studies

Ghent

Border / inhabitants: Ghent is the largest city in East Flanders. The municipality comprises several small villages and towns, covers 1205 km² and has more than 240,000 inhabitants.

Problems / key material flows: Ghent has a reasonably good collection and waste processing system. However, 'higher valued' waste valorisation pathways are needed. Building waste and domestic waste (and the organic fraction) represent the key material flows in the area. Practical obstacles to initiatives include parts of the city being medieval (e.g. hard to implement new sewers, source separated collection, etc.). Additionally, lower income families are not necessarily interested in waste treatment, especially if these options raise costs.

Aim / objectives: the city aims to improve its waste management through energy-efficient renovations. Ghent also strives to decrease residual waste by another 15% and shift towards a higher VFG fraction.

Pécs

Border / inhabitants: Pécs has depressed industrial areas and a continuous decline since the 1990's, among the worst in Hungary. Pécs was a pioneer in brownfield revitalisation and recycling activities. Focusing on waste resources, Mecsek-Dráva Waste Management organization is based on a cooperation of municipalities in Pécs peri-urban area, in Baranya county and beyond.

Problems / key material flows: although regulations follow EU directives, implementation is inhibited by socio-cultural situations and centralized management structures. Local citizens, especially the older generations, do not recycle but burn or throw away household waste, plastic and bottles illegally.

Aim / objectives: The city aims to decrease household waste deposit and increase the recycling rate. New eco-innovative solutions should be developed to facilitate citizens' separating household waste. Also, a more effective recycling system should be developed to increase and promote reuse and recycling of plastic and bottles.

Łódź

Border / inhabitants: Łódź is located on the rivers Vistula and Oder. It was highly concentrated until the 1980's, when it was extended into rural areas. Large, unbuilt areas of fragmented private properties on the city fringes are a major development problem. Surrounding rural municipalities experienced a single housing construction boom characterized by lack of deliberate development planning and policy, resulting in uncontrolled urban sprawl.

Problems / key material flows: The processes of de-agrarianisation and uncontrolled urban sprawl contribute to problems linked to reuse and recycling of solid waste, water supply, wastewater and poor air quality.

Aim / objective: The city aims to define and improve the structures and decision processes of waste management in the built environment. This aim considers the main factors of waste production in sprawl areas, the "development path" of major waste producing areas, the impact of uncontrolled sprawl on municipal waste operation, land use of fallow land, legal factors, policy and ability to minimize waste.

Hamburg

Border / inhabitants: The case study area comprises the City District Hamburg-Altona and the County of Pinneberg in the federal states Hamburg and Schleswig-Holstein, is 741.75 km² large with more than 500,000 inhabitants. The area comprises a variety of urban and peri-urban settlement types (e.g. urban cores, village centres, retail, logistic etc.) and open spaces (e.g. agricultural land, natural preservation areas, etc.).

Problems / key material flows: Due to a growing economy and population, open spaces are under pressure for development into housing or commercial areas. The recycling rate is generally high, with bio-waste as the weakest performing waste cycle.

Aim / objectives /challenges: The case study focuses on improving bio-waste cycles in private households as well as in agricultural production. Ideas for improved waste cycles will be developed in cooperation with housing companies, housing cooperatives, local authorities, ecological associations, local initiatives and enterprises. The waste production and recycling behaviour of different settlement typologies will be examined.

To summarize, REPAiR uses the **transdisciplinary framework of geodesigns**, bringing together knowledge and resources from different disciplines to develop strategies for CE, based on decision needs of key stakeholders in six cases across Europe. REPAiR achieves this by developing new methods as well as using **GIS supported modelling and design tools** that allow decision making informed by **environmental sustainability appraisal**, including project conceptualisation, analysis, projection and forecasting, diagnosis, alternative design, impact simulation and assessment.

D) Promotion activities (WP 8)

These are crucial components of *REPAiR* as the project's success ultimately requires aligning complex technical solutions making it possible to develop integrated, place-based eco-innovative spatial development strategies aiming at a quantitative reduction of waste flows in the strategic interface of peri-urban areas, which will promote the use of waste as a resource. Therefore, through the dissemination and increasing the awareness of *REPAiR* objectives, results, knowledge and engagement of internal and external stakeholders (including end-users, other platforms, networks and connections to existing projects), the project will foster the wider acceptance and adoption of the developed GDSE tools by the key stakeholders of the circular economy chain and the REPAiR Consortium and user Board act as a hub for the deployment of focused promotion activities/materials created by *REPAiR*, directly reaching the right target audience in waste and resource management.

We will establish a REPAiR project website to assist in communicating the overall objectives, approach, status and outputs of REPAiR. It will be used to communicate with the scientific community, policy-makers, local and regional governments, industry, NGOs, students and the general public. The website will include project presentations, open access documents (project reports, GDSE manual, knowledge transfer handbook, papers, etc.), downloadable GDSE software packages, links to related projects, news section, etc. It will also include an embedded social media component and regularly updated project news, coupled with a calendar of the events organized as part of REPAiR. For more details on the promotion activities see section 2.2.

1.3.5 Gender Related Issues

The REPAiR consortium is aware of the European Union regulations on this issue and completely supports the principle of equality between women and men, not only to eliminate inequalities, but also to promote equality, as established in the Treaty on European Union, the Treaty of Amsterdam (May 1, 1999). Adhering to the principle of gender equality, REPAiR combines the integration of a gender perspective into all of the project policies and programmes with specific actions in favour of women. To do so, the REPAiR consortium will (1) **secure women's participation** in the research activity, as scientists, engineers, managers and technicians; and (2) **encourage and support women's mobility**. Moreover, all partners have in-house regulations preventing gender discrimination and favouring employment opportunities for women.

Research has shown **gender differences in environmental behaviour** (Denton, 2002). To increase the effectiveness of policies and programmes, gender analysis should ensure that they reach both men and women and that **gender equality is maintained in decision-making**. To fully understand gender differences and avoid stereotypes, the importance and intersection of political, economic, social, technical and legal (PESTL) factors will be applied to gender

analyses. This will entail several measures. First, literature studies will be done on change processes, drivers and ways to change waste management that include a focus on the gender dimension of environmental processes and policies as well as on the role of gender as a factor affecting waste management practices next to PESTL factors. Secondly, on that basis, practices and approaches sensitive to gender issues will be validated and promoted in the living labs. Incorporating the gender perspective into their work will not only ensure a balanced gender ratio among the partners involved, but also facilitate developing solutions for the study areas that actively promote it. Moreover, attention will be paid to the decision-making within stakeholder groups, and whether decisions taken are gender-biased. As a by-product of these activities, validation and comparison of gender differences and issues in the different LL will be carried out. Finally, when simulating the results and effects of different interventions, stakeholders and experts will be selected carefully to ensure gender equality.

1.4 Ambition

1.4.1 Progress beyond the State-of-the-Art

REPAiR will ensure progress beyond the state of the art by:

1. Extending the concept of UM by exploring the roles of governance settings and territorial and socio-cultural characteristics;
2. Extending the concept of UM by strengthening the relation between design, not only of products but also space, and resource management;
3. Shedding new light on participatory and science-based decision-making;
4. Combining local and economy-wide sustainability appraisal, which is partly inherent to the first three points.

Extending the concept of UM by exploring the roles of governance settings and territorial and socio-cultural characteristics

Previous research projects focusing on urban metabolism recognised the importance of coordinating and including sustainability objectives into the policies of actors operating at different scales (BRIDGE –FP7) and underscored the role of complex cross-sectoral and cross-boundary interactions needed to promote sustainable UM (SUME – FP7). Other projects focusing on sustainability and waste management in cities or peri-urban areas explored and proposed solutions for enhancing stakeholder engagement and rural-urban linkages (FOODMETRES - FP7, PLUREL - FP6) or emphasised the notion of the ‘triple helix’ – i.e. promotion of collaboration between sub-national governments, knowledge providers and industry actors to promote innovation in waste management. However, all of those projects dedicated less attention to exploring the roles of the governance settings and territorial and socio-cultural characteristics of different (peri-) urban areas as factors constraining or supporting the capacity to devise place-tailored solutions to promote the use of waste as a resource. This is a knowledge gap that the REPAiR project will bridge by focusing on the ways in which governance, territorial and socio-cultural characteristics shape UM and determine the transferability of solutions across different peri-urban contexts.

Extending the concept of UM by strengthening the relation between design, not only of products but also space, and resource management;

Another significant gap that REPAiR addresses is the lack of integration and application of material flow analyses into spatial planning (Kennedy et al. 2011). There are two key reasons for this lack of integration:

1. the lack of knowledge exchange stemming from poor communication between researchers and planners (Chrysoulakis et al. 2013);
2. the fundamentally different units and geographic scales used in environmental analysis techniques like MFA from those that are most useful in the planning process (Roy et al., 2014).
3. REPAiR will make advancements on both aspects.
4. Through the multidisciplinary PULLs in the six case studies, REPAiR will not only bring experts from different disciplines together in order to develop space specific strategies for waste management, but it will also produce a well-documented and tested methodology of transdisciplinary strategy making;
5. REPAiR will develop a sustainability appraisal framework that will provide insights into effects at a local peri-urban area level. Therefore, it will merge sustainability information at the local and economy-wide levels.

Shedding new light on participatory and science-based decision-making;

The DESIRE – FP7 project, after analysing seven European and international resource efficiency indicators sets, identified the following gaps which need to be closed for science informed political decision making to achieve more efficient resource use:

- insufficiency of indicator disaggregation by economic sectors and household consumption area,

- need for improved indicators for water use and land use and,
- lack of comprehensive biodiversity indicators as well as specific indicators
- covering key areas for a more resource efficient economy, such as circular economy indicators.

To develop indicators that fill this gap, REPAiR will start where PROSUITE ended. The impact assessment on natural environment, resources, human health, welfare and human well-being was applied in PROSUITE at the technological level or macro-economic level (worldwide input output tables). REPAiR aims at improving and applying these assessment techniques in order to use them on a more regional scale, such as the peri-urban area level.

Furthermore, life cycle thinking based assessment (LCA) at micro and macro is quite well established, in particular with respect to environmental sustainability and also recently with respect to social sustainability. But, the regional/urban/peri-urban (meso) level of REPAiR is to be advanced. 'Meso refers to a level in-between product and economy-wide. It may include groups of related products and technologies, [...] Defining and finding appropriate methods and models for this level needs further research' (Guinée et al. 2011)', which is at the core of REPAiR.

REPAiR is going to develop indicator sets that fill the aforementioned gaps by integrating UM into tools for sustainable urban and regional design. REPAiR follows Minx et al. (2011) who suggest that future research should (1) shift from environmental pressure to environmental quality; (2) include urban drivers and urban patterns; and (3) incorporate spatial quality and co-benefit notions,.

Finally, while previous research recognised integration and coordination across policy silos as a challenge and/or a pre-requisite for sustainable waste management (e.g. SUME, PUREFOOD - FP7, WASTEKIT - FP7) the EU's strategic and policy documents (e.g. EC, 2011a, EC, 2014a) underscore a shortage of research proposing actual solutions to enact such joint action. REPAiR will bridge this gap by using the geodesign framework as a tool for facilitating close cooperation between stakeholders and for representing different policy areas and sectors for the design of integrated and place-specific and thus effective strategies for the use of waste as a resource, which are based on state of the art scientific methods and models.

1.4.2 Innovation Potential

Decision support tools were proposed in previous research in the fields of waste management (BRIDGE, SUME, HOLIWAST - FP6, RISCO II - FP5, PROSUITE - FP7) and sustainable development of cities and peri-urban areas (ECOPADEV - FP5, PLUREL). Out of those, the most relevant precedents were the tools developed by the BRIDGE and SUME projects. Those in the former combined quantitative data on waste fluxes with socio-economic data to inform planning decisions, while those in the latter allowed for evaluating the effect of urban development projects on a city's metabolism, particularly its energy flows.

The integration of UM with sustainable urban and regional design tools, however, remains underdeveloped and existing tools, like the integrated resource management (IRM) model by ARUP (Page et. al. 2008), are predominantly applied to planning and designing newly developed areas. The key challenge in Europe lies, however, in the transformation of existing settlements and cultural landscapes and therefore in areas that REPAiR focuses on.

Another shortcoming that REPAiR will address is the heavily criticised static and rigid nature of the master plan approach underpinning the IRM and similar tools. Actual policies take organic planning as a starting point and need further support to avoid falling back into conventional paradigms, particularly regarding peri-urban areas, often leading to the emergence of WL and uncontrolled urbanisation with high waste production, environmental loads and thus missed opportunities for CE.

REPAiR considers spatial planning and design as promoting integrated, inclusive and participatory development and emphasises the necessity of increasing awareness of the availability of decision-making tools amongst target audiences. It will innovate by applying the geodesign framework to resource management. This in turn will allow for developing a GDSE to facilitate concrete place-specific strategies for using waste as a resource. Choosing this approach ensures the necessary flexibility and transparency in the decision-making process.

2 REPAiR's Impact

Waste management performance varies considerably between member states of the EU and, although overall waste generation is relatively stable, some waste streams are ever-increasing [EC, 2011]. Waste production - occurring chiefly in urbanized environments where roughly 75% of EU citizens live -, places significant environmental and economic strains on our society. At the same time, however, there is a significant scope for exploiting the related, so-called, second order effects like reducing the material, water and energy flows in cities [SUME project, Weisz & Steinberger, 2010] as well as an

underutilized potential for using waste as a resource [EC 2011]. In fact, each year 2.7 billion tonnes of waste is generated in the EU and on average only 40% of solid waste is re-used or recycled, the rest ending up in landfills or being incinerated [EC, 2011]. The recycling rate, however, varies from a few percent in some EU Member States up to 70% in others [EC, 2011]. Likewise, landfills have virtually disappeared in countries like the Netherlands, but in many others they represent more than 90% of waste [EC, 2014]. Landfills give off substantial amounts of methane, a dangerous greenhouse gas which is much more potent than carbon dioxide, and release environmentally harmful liquid (leachate) contaminating water and soil, hence causing serious risks for the environment and public health [EC, 2010]. That said, waste stockpiled in landfills can also be seen as a potential resource. For example, the methane produced by an average municipal landfill per year could be used as a resource and converted into electricity provided to approximately 20,000 households, while all the materials stockpiled in landfills could have an annual commercial value of around 5.25 billion euro [EC, 2010].

Addressing these challenges and tapping into these under-used resources requires generating eco-innovative and tailor-made solutions to prevent waste generation and enhance metabolic flows in urban environments,, which in turn will contribute to the EU's ambition of a **paradigm shift towards Circular Economy and a near-zero waste society, based on reciprocities between the natural and the built environment**. Considering that (1) one of the preconditions for achieving EU's long-term goal of reducing greenhouse gas emissions by 80-95% when compared to 1990 levels by 2050 is greater resource and energy efficiency [EC, 2011], (2) that the negative effects of climate change are already felt today, particularly in cities [e.g. Corfee-Morlot et al., 2009], and (3) that urban population keeps on growing (the vast majority of humanity is expected to live in in cities by 2050), there is an urgent need to achieve this paradigm shift by investing already today in the development of game-changing eco-innovative strategies and solutions to improve resource efficiency. The REPAiR project offers the right response to that need not only by designing such strategies and solutions in its six case study areas, but also by providing an enabling framework for achieving this in virtually any urban area in Europe and beyond.

Specifically, REPAiR will realize this by analysing resource flows within cities and designing the Geodesign Decision Support Environment (GDSE), a toolkit for devising place-specific strategies solutions to enhance waste management significantly and promote the development of a circular economy, while contributing to the improvement of spatial quality and the quality of life in urban regions, peri-urban areas in particular. The GDSE will be an open source tool and can be used by regional and local authorities and other stakeholders (see section 2.1.1) for informed and participatory decision-making to develop strategies towards sustainable development of urban regions in an integrated and trans-disciplinary manner. By integrating economic, social and environmental dynamics, and being sensitive to gender equality and social inclusion, this instrument will allow for overcoming the compartmentalised waste management and spatial strategy making approach that so far remains predominant in Europe and hinders the capacity of the regional and local authorities to reduce waste generation, improve the local resources-based urban metabolism and enact a transition towards a circular economy.

REPAiR will deepen the understanding of urban metabolism and share this knowledge with a variety of interested stakeholders within the European circular economy community, while educating the future generations of decision-makers and practitioners dealing with waste and resource management. Moreover, REPAiR aims to raise awareness of the need to boost resource efficiency within the wider society and to provide tools that help in bridging the significant gaps in innovation in waste management and in recycling rates between the EU Member States [EC, 2011].

REPAiR's outcomes will therefore offer a distinctive contribution to the EU's medium- and long-term aims in terms of greater resource efficiency, as outlined in the key strategic documents EC, 2011a, 2014a, 2014b] and supported by the recent proposals for amendments to the EU's waste-related legislation [EC, 2014c]. The key ambition underpinning those initiatives is to support re-using, repairing, refurbishing and recycling existing materials and products in order to enact, by 2050, a transition towards a Circular Economy in Europe 'where nothing is wasted and where natural resources are managed sustainably, and biodiversity is protected, valued and restored in ways that enhance our society's resilience. Our low-carbon growth has long been decoupled from resource use, setting the pace for a safe and sustainable global society' [EC, 2014a]. The anticipated benefits of these initiatives also include *inter alia* reduction of greenhouse gas emissions, new growth and job opportunities, improved health and well-being and spatially better organized cities. REPAiR will seek to generate those beneficial impacts by addressing the nine priority objectives of the EU's 7th Environment Action Programme (EAP) to 2020 [EC, 2014a], as listed in Table 2.1 Below.

Table 2.1a. REPAiR's contribution to the Priority Objectives of the 7th Environmental Action Programme.

Priority Objectives of the 7 th EAP	REPAiR's contribution
1. 'To protect, conserve and enhance the Union's natural capital'	REPAiR will contribute to safeguarding natural capital by (1) ensuring a sound and measurable application of the waste hierarchy i.e. reducing waste generation, maximizing reuse and recycling, limiting waste-to-energy strategies primarily to non-recyclables, phasing out landfilling, and (2) protecting and improving spatial environmental quality.
2. 'To turn the Union into a resource-efficient, green, and competitive low-carbon economy'	REPAiR promotes waste as a resource to improve the efficiency and effectiveness of waste and resource management, while creating new opportunities for growth, job creation and innovation in business and industry, and achieving relevant and accountable carbon emissions reductions. It is estimated that the use of recycled materials compared to virgin materials can reduce energy consumption by up to 50% (e.g. for metals) and thus contribute to EU climate and energy targets as much as resource efficiency and circular economy targets.
3. 'To safeguard the Union's citizens from environment-related pressures and risks to health and wellbeing'	The toolkit developed by REPAiR (GDSE) will be used to devise eco-innovative solutions combining better waste management with reduction of harm to the environment and improvement of spatial quality, which in turn will enhance health, wellbeing and quality of life for its citizens.
4. 'To maximize the benefits of the Union's environment legislation by improving implementation'	By providing a toolkit for informed decision-making (and feedback loops) towards devising eco-innovative solutions for better waste management and the use of waste as a resource, REPAiR will directly contribute to better implementation of the EU's legislation on that matter within the case study areas and beyond.
5. 'To increase knowledge about the environment and widen the evidence base for policy'	REPAiR will provide GDSE on an open source basis and make all of the findings and data available on an open access basis for the purpose of further research, policy-making and education. It will also diffuse the knowledge generated across the case study areas and among the relevant group of stakeholders (public institutions, academia and entrepreneurial) and the general public through a range of dissemination, exploitation, knowledge transfer and communication measures.
6. 'To secure investment for environment and climate policy and account for the environmental costs of any societal activities'	The living labs set up in the case study areas will facilitate close collaboration between the knowledge providers, stakeholders and the relevant small and medium enterprises, which is expected to lead to innovation and, potentially, stimulate investment in the development of new branches of waste management industry. The living labs will also generate knowledge on the negative environmental impacts of waste, while proposing eco-innovative solutions to reduce them.
7. 'To better integrate environmental concerns into other policy areas and ensure coherence when creating new policy'	REPAiR's approach is transdisciplinary and the application of GDSE will entail working across policy silos (waste management, spatial planning, urban design, environmental protection, economic and fiscal policy), to promote integrated policy solutions for the use of waste as a resource and enhance metabolism of urban regions as a whole, and spatial consequences in peri-urban areas in particular.

8. 'To make the Union's cities more sustainable'	Recognising the under-used potential of cities to reduce waste generation and promote a circular economy, as highlighted in the SUME project (Weisz & Steinberger, 2010), REPAiR will provide a toolkit (GDSE) specifically designed to improve waste management in cities, with a special focus on the role and improved potentials of peri-urban areas (as an interface between urban areas and hinterland, between professional stakeholders and citizens) towards more sustainable and reciprocal synergies.
9. 'To help the Union address international environmental and climate challenges more effectively'	REPAiR's dissemination and exploitation strategies, ensuring broad outreach both within the EU and beyond, are in line with the EU's global ambitions on environmental and climate change leadership. Moreover, the interaction between the diverse peri-urban contexts within REPAiR's case studies will diffuse knowledge helpful in bridging the gaps in innovation and recycling rates between them, while potentially accelerating efforts to address cross-border environmental and climate challenges. In fact, improving waste management also reduces greenhouse gas emissions. It is estimated that better waste management across all waste streams could lead to reduction in CO ₂ emissions by 146 to 244 megatonnes, i.e.19-31% of the European climate reduction targets by 2020 (EC, 2010c).

2.1 Expected impacts listed in the work programme

The REPAiR project will provide a toolkit for turning the European Union's environmental ambitions concerning waste management and sustainable cities into reality. In fact, the GDSE will allow for translating the EU's aims into integrated and place-tailored strategies and eco-innovative solutions for using waste as a resource in cities and in particular their peri-urban areas. REPAiR recognises the essential role of cities and their peri-urban hinterlands for ushering



Figure 2.1a REPAiR's impacts.

in a circular economy, and will identify and exploit opportunities for combining the use of waste as a resource to achieve enhanced spatial quality, living conditions (health, well-being) and sustainable urban development. REPAiR is expected to offer a significant contribution to the impacts envisaged for the call WASTE-6b-2015 (issue b) Eco-innovative strategies), as summarised in Table 2.1b and described in more detail below it.

Table 2.1b. Contribution of REPAiR to expected impacts of the call:WASTE-6b-2015 issue b) Eco-innovative strategies.

Expected Impacts	What REPAiR will deliver	How
Measurable improvements in waste management.	Identifying, matching and harvesting potentials for a circular economy for roughly 7,000,000 EU citizens living in the six case study areas, while providing a toolkit to achieve similar paradigm shifts in other EU urban regions.	Via the GDSE and knowledge transfer activities (WP7), and on the basis of inputs from the research conducted in case study regions as part of WP3, WP4, WP5. Dissemination and exploitation activities will ensure outreach beyond the case study areas (WP8).
Operationalization of urban metabolism to support sustainable urban development and reduce negative environmental impacts.	Integration of a dynamic model of resource flow performance assessment with parametric support for related spatial quality, regional planning and design in an open source, effective and manageable geodesign environment.	Via the GDSE, concrete eco-innovative solutions and models tailored to the specificities of the case study regions will be elaborated in such ways that, together with the delivery of the toolkit itself, form relevant references for different urban regional contexts and metabolisms in the EU and abroad.
Promoting research and innovation leadership.	REPAiR will establish knowledge and spur further research, while providing an environment for breeding innovative and place-based solutions for using waste as a resource.	The knowledge network will outlive the project and offer a breeding ground for further research and innovation. The GDSE will provide a platform for innovation, while the exploitation and dissemination strategies supported by the involved joint TU Delft, MIT Boston and Wageningen UR initiative, AMS institute, will ensure that the data produced by REPAiR are used in future research and education worldwide.
Specific impacts (short term)	What REPAiR will deliver	How
Establishing a participatory and science-based tool for decision-making and planning of urban development and waste management.	The GDSE will be a geodesign-based participatory tool for informed decision-making with participatory feedback loops, based on the inputs from a range of circular economy stakeholders.	The toolkit will be developed and then used in an iterative process in close collaboration with the local stakeholders in two different problem typologies, each subsequently iterated in two other relevant urban regional/institutional contexts, while involving a well-balanced user board, providing essential inputs on each of the six cases and the European context.
Collectively built solutions for urban development and re-naturing of cities, measurable by indicators.	Using enhanced urban metabolism, to promote sustainable urban development drawing upon near-field synergies between the built and the natural environment, in particularly focussing on peri-urban areas where cities and hinterland, waste and	By developing eco-innovative, collectively built and gender-sensitive solutions to place-specific waste management challenges within crucial peri-urban areas in six urban regions. The GDSE will provide an open-source decision model and platform allowing for quantification

	resource, nature and culture meet.	and validation of alternative solution paths, while providing feedback loops for essential stakeholders.
Eco-Increased competitiveness of soil-ecology-construction-waste treatment related industries.	A platform for breeding innovation in close collaboration between industry, researchers and other stakeholders. This will benefit the local waste-related industry in case study areas by decreasing laboratory-to-implementation time, providing shorter development paths towards implementation of effective waste management solutions.	Industry partners will use the living labs to present, test and assess newly developed technologies in a 'real world' environment. The solutions and knowledge generated in living labs and through the GDSE and knowledge dissemination (via the platform and included partners like the AMS Institute) will be transferred to other case study areas around Europe and abroad.
Specific impacts (long term)	REPAiR Contribution	How
Enhanced environmental resilience and quality of life.	Development of an integrated approach interweaving solutions to environmental challenges with interventions that can be used not only to enhance environmental and spatial quality, but also address a range of other sustainable development challenges.	Eco-innovative solutions developed will improve the capacity of urban environments to deal with future resource management challenges, while triggering transformations in spatial qualities, sustainability and urban metabolism. These shifts will together enhance quality of life.

General impacts

First, REPAiR will produce measurable improvements in waste management. Without additional waste prevention policies in the EU, waste generation is expected to increase by 7% between 2008 and 2020, which calls for maximizing the opportunities for improved waste management (EC, 2011). REPAiR offers a concrete response to this call and contributes to the European Commission's ambitions (EC, 2014b) to boost reuse and recycling of municipal waste to a minimum of 70% by 2030; increase the recycling rate for packaging waste to 80% by 2030, and ensure that EU Member States virtually eliminate landfill by 2030. This will be achieved through the application of the GDSE for strategically identifying, matching and harvesting potentials for a circular economy in six concrete locations representative of peri-urban areas across Europe. More specifically, this will entail:

- quantification and tracking of essential resource flows (WP3);
- mapping and quantification of environmental, spatial, institutional and economic effects of present and future resource flows (WP4);
- determination of a set of indicators to inform decision makers (WP4);
- optimisation of (re-)use of resources, (environmental, economic and spatial) by qualitative matching of local eco-innovative solutions with potentials and inclusion of feedback loops to stakeholders of the specific resource characteristics (WP 5).

Second, REPAiR will entail operationalization of urban metabolism to support sustainable urban development and reduce negative environmental impacts. REPAiR will integrate a dynamic model of resource flow performance assessment with parametric support for spatial quality, regional planning and design in an effectively implementable and administrable geodesign decision-support environment. This will allow not only for reducing harmful environment impacts on metropolitan areas, but also for generating positive effects in terms of spatial quality and justice, sustainability, resilience and prosperity.

Third, REPAiR will promote research and innovation leadership in a number of ways throughout the project and after its completion. REPAiR will thus establish an innovative WM/CE knowledge network comprising academic, policy and

industry partners both within the study areas (where the consortium members already collaborate with a wide range of organisations in academia, industry and public authorities) and across Europe. This network will serve as a breeding ground for further research and innovation in the areas of waste management, circular economy and sustainable urban development. This will be supported by the cooperation of the consortium with AMS Institute (Institute for Advanced Metropolitan Solutions), a joint initiative of Massachusetts Institute of Technology, TUD and Wageningen University. Moreover, the application of the GDSE in the case study regions and its promotion in other European peri-urban areas will support generating eco-innovative solutions addressing the need to reuse waste as a resource and hence improve the innovation capacity of those urban regions. Promoted and supported by the consortium members, and the AMS institute, the teaching activities as part of REPAiR will allow for engaging the waste management and urban professionals and the future leaders of the circular economy in the research and equip them with knowledge and skills to carry out further scientific work on this topic.

Specific short-term impacts

REPAiR is expected to generate three kinds of short-term impacts. First and foremost, it will establish a participatory and science-based tool for informed decision-making and planning in urban development and waste management. Stakeholder participation and the inclusion of a user board play a crucial role in the iterative development and validation of the GDSE for the two key WM problem typologies. The GDSE will be developed and implemented in six study areas. Subsequently, being a fully customisable toolkit, the GDSE will be promoted more widely and made available on an open source platform to be used by sub-national authorities and stakeholders in peri-urban areas across Europe and beyond. The customisability and flexibility of GDSE (see long term impacts below) are the core advantages of this toolkit, which, supported by well-defined and high-impact dissemination and assistance by the AMS institute, are expected to ensure its wide uptake, facilitated by the project's exploitation strategy.

Second, REPAiR will benefit the case study areas by producing collectively-built and gender-sensitive solutions for urban development and re-naturing of cities, and peri-urban areas in particular, measurable by indicators and sensitive to the issue of social inclusion. REPAiR entails designing a variety of solutions to place-based challenges for the development of a circular economy and of assessment models allowing for quantification and validation of alternative solution paths. Therefore, REPAiR uses an enhanced urban metabolism approach to promote sustainable urban development built upon near-field reciprocities and synergies between the built and the natural environments.

Third, REPAiR will contribute to the increased competitiveness of soil-ecology construction-waste treatment related industries in the case study regions. This will be achieved through the set-up of six PULLs in each of those regions that will enable the relevant industries to present, test and assess newly developed technologies in a 'real world' environment. This will decrease laboratory-to-implementation time, providing shorter development paths towards more applicable and effective solutions, subsequently transferable to other areas. The eco-innovative waste management solutions and strategies generated in PULLs will be selectively and strategically transferred to other case study areas, according to knowledge transfer methodology (WP7).

In the long-term, REPAiR is also expected to enhance environmental resilience and quality of life both in the case study areas and in other regions across Europe. The GDSE addresses the increasing double complexity of urban environments, particularly in peri-urban areas. By integrating principles from landscape ecology, environmental sciences and industrial ecology, complexity science and urbanism, it provides a strong resource management and spatial development framework towards resilient metropolitan areas. The application of eco-innovative solutions developed, tested and assessed in REPAiR will improve the capacity of urban environments to deal with future resource management challenges, by promoting an understanding of metropolitan areas as combined urban-natural systems based upon reciprocities in a circular economy and dynamic equilibrium. These solutions involve breakthrough transformations that radically influence spatial qualities, sustainability, comfort, liveability and the essential (sometimes called crucial) flows of the urban metabolism, which in turn will ensure better quality of life. Beyond that, the participatory, science based decision making tool GDSE, can be used in other thematic areas within the urban metabolism to achieve and secure lasting (resilient) sustainable urban development (e.g. air quality management, renewable energy production).

Other important impacts

The project is also expected to generate **other positive impacts** beyond those outlined in the call, namely in terms of (1) education, skills development and awareness building; (2) institutional capacity and governance; as well as (3) economic growth, employment, competitiveness and reduced carbon footprint of European industry.

Education, skills development and awareness

REPAiR entails integration of its outcomes into teaching activities of four leading European universities, and the AMS institute, meaning that within the lifetime of the project more than one hundred industrial ecology, spatial planning, architecture and urbanism students and, via the planned AMS MOOCs, tens of thousands of urban professionals (and/or interested students world wide), will be educated to promote and implement the shift to a stronger circular economy (one of the three main themes of AMS) and will become its advocates. This ensures that the impact of REPAiR will outlive the project's duration. Moreover, by providing teaching tools and materials on an open access basis, teaching on circular economy will be offered freely to other higher education institutions, educating and sensitising a far larger group of students across Europe.

Better governance through participation

By encouraging the relevant circular economy stakeholders to work together within the GDSE, REPAiR will not only allow for exchange of (often tacit) knowledge between them, but also will contribute to better governance and administrative capacity in European regions, a pre-condition for effective implementation of EU's waste or regional and urban policies (see EC, 2014e). REPAiR's participatory approach will thus strengthen two of the 'pillars' of the regional quality of government (Charron et al, 2014): (1) voice and accountability; and (2) the effectiveness of the regional and local authorities.

Positive impacts on the local economies, competitiveness and carbon footprint of the European industry

REPAiR is expected to generate **positive effects for the local economies**. Thus, through the application of GDSE and the collaboration between relevant industry, knowledge and societal partners within the living labs, and knowledge transfer across the cases, REPAiR will stimulate innovation potential, competitiveness and growth, particularly of the local SMEs dealing with waste management. GDSE will facilitate innovations that will meet existing or new demands in the local, European and possibly global markets. By achieving this, REPAiR will add the European Commission's call for stepped up efforts to remove barriers to eco innovation, and to unlock the full potential of Europe's eco-industries (EC, 2014). Furthermore, improved waste management through REPAiR is expected to generate **benefits for green jobs and growth** (see EC, 2014). It is estimated that reaching a recycling rate of 70% at the European level would generate roughly half a million jobs (EC, 2010c), while resource efficiency improvements all along the value chains could represent an overall yearly savings potential of 630 billion euros for European industry (EC, 2014). Other studies indicate that circular economy approaches could offer potential to boost EU GDP by up to 3.9% by creating new markets, products and value for business (EMF, 2012). Moreover, previous research (Dubois & Christis, 2014) has shown that more recycling **generates new economic activities and creates new jobs**: for example, in Flanders, 27,000 extra jobs would be created and 2.3 billion euros worth of added value would be generated if the region moved to a genuine circular economy. Employment created would then concern not only the field of recycling, but also entail creation of new repair, refurbishment and remanufacturing jobs. Additionally, by enhancing the **quality of life and liveability** in the case study regions, the project would indirectly help to attract talents and skilled employees.

In addition, by including a focus on promoting the recycling of waste of electrical and electronic equipment (WEEE), REPAiR's results will also contribute to the specific goals on recycling of raw materials by European industry. Research (Huisman et al. 2015) has shown that EU countries in 2012 only managed to properly recycle 35% (3,3 million tonnes) of all electronic waste. The EU goals to remedy this situation are outlined in DG GROW's action on Critical Raw Materials (EC, 2011f) and the Raw Materials Initiative (EC, 2014e). One of the three pillars of this initiative is resource efficiency and supply of 'secondary raw materials' through recycling. Thus, the recycling of WEEE, to be promoted by REPAiR, will contribute to the Commission's efforts to cope with critical raw materials supply problems.

Last but not least, REPAiR's positive economic impacts from improved waste management will also generate beneficial second order effects in terms of **reduction of green house gases emissions**, in line with the EU's climate

objectives for 2020. In fact, boosting the circular economy through measures such as recycling and reuse of materials is estimated to not only bring net savings of 600 billion euros, equivalent of 8% of annual turnover of EU businesses, but also reduce greenhouse gas emissions by 2-4% per year (EC, 2014e).

2.1.1 Scenario for further uptake and identification of stakeholders

The outcomes of REPAiR will be of relevance and use to a wide variety of stakeholder groups (see Figure 2.2 below). The strategy to ensure stakeholder uptake of the projects results and developed tools is based on three elements:

1. Careful and strategic mapping of REPAiR's stakeholders' landscape to identify groups of end users of the project's outputs;
2. Outreach measures tailored to the different target groups to encourage them to use REPAiR's outputs in their own activities and distribute these in their networks;
3. A comprehensive representation of those groups within the consortium and outreach to their peers.

Four groups of stakeholders were identified as the Lead Users of the GDSE and the related tools: (1) regional and local



Figure 2.1b REPAiR's main stakeholder groups.

The first group, **regional and local authorities** interested in enhancing waste management within their territories, yet struggling with the complexity of this public task, and involvement of private partners, are expected to take the GDSE. The latter will offer a useful, comprehensive and fully customizable decision-support toolkit based on an integrated and collaborative approach to urban metabolism and relevant feedback loops. More specifically, the GDSE will be of particular interest for the regional and local officials in charge of spatial planning, environmental policy, waste management and energy policy. Their direct involvement in the development of the GDSE and, subsequently, in its application within the six case study areas to address the place-specific challenges formulated by themselves, in collaboration with the other stakeholders involved in REPAiR, will ensure that the toolkit matches their needs and create a sense of ownership of it, which in turn will increase the likelihood of further uptake of The GDSE in their practice beyond REPAiR. The co-development of the GDSE by these officials will also secure that the tool will be relevant, accessible and attractive for users within regional and local public authorities in other urban regions across Europe.

Secondly, the GDSE will also be of interest to relevant industries like:

- waste management industry working for the regional and local governments;
- 2nd order relations, like companies dealing with energy provision (opportunities for innovation in production of energy from waste) and waste-based manufacturing (here: CE industries);
- urban planning and design, as REPAiR puts an emphasis on the role of spatial planning in urban metabolism and the improvement of spatial quality (both qualitatively and in organisational effectiveness) as a by-product of improved waste management.

The GDSE, being an open source platform, will offer the relevant businesses a possibility to adapt it to different uses and/or enhance it to improve its usability in different contexts. The GDSE will thus offer businesses in waste-related industries an attractive and adjustable tool for improving their own practices (reducing waste generation, enhancing waste treatment, promoting recycling of materials, re-using of waste to produce energy, etc.) as well as a basis for developing a new decision-support software tailor-made to their activities and markets. Thus, software developers (first users) within the open source community and/or working for the businesses (e.g. specialized consultancies) wishing to further adapt the GDSE or develop new proprietary software on its basis, will be able to take advantage of the open source platform through which the toolkit will be

made available. This potential for further adaptation and development of the GDSE by businesses is expected to expand REPAiR's long term impacts on waste management practices in Europe.

Thirdly, the knowledge and the tools produced by REPAiR will inform the regional and urban, environmental, energy and economic policies of the European Commission and the national governments having the improvement of waste management and development of Circular Economy on their policy agendas. The officials from DGs for Regional and Urban Policy (DG REGIO), Environment (DG ENV), Energy (DG ENER), and Internal Market, Industry, Entrepreneurship and SMEs (DG GROW) as well as the national ministries dealing with spatial planning, urban policy, environmental protection, economic development and energy policy, will be interested both in promoting this GDSE as an integrated tool for enhancing waste management, competitiveness of the waste-related industry. and They are thus an important additional group of stakeholders targeted by REPAiR and expected to have a strong interest in taking up the project's results.

Fourthly, REPAiR's results will be of interest for the social stakeholders, including a range of groups within the civil society, such as non-governmental organisations (NGOs) dealing with environmental issues, groups and associations of local inhabitants concerned with the local environment, the local economy or the spatial quality.

Beyond those four kinds of Lead Users, the project's scientific results - diffused through academic papers, reports, conference presentations and other means – will be taken up by the interdisciplinary research and education community working on urban metabolism and waste management spanning a range of disciplines, from urban and regional studies, spatial planning to geography and environmental sciences. The researchers will also take advantage of the data produced by REPAiR, which will be made available on an open access basis for the purpose of further research drawing on REPAiR's findings.

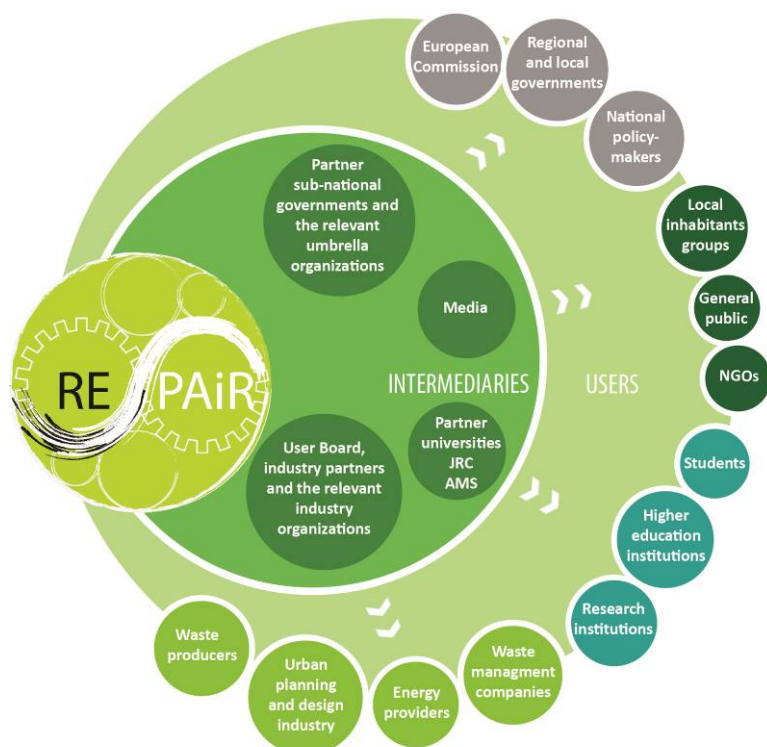


Figure 2.1c REPAiR's stakeholders landscape.

Moreover, the project's results will also be used to design open access teaching materials - a valuable educational aid for higher education institutions offering education grounded in cutting-edge research on circular economy and urban metabolism. These materials will also serve as a basis for the development an AMS massive online open course (MOOC) on the topic of circular economy of interest to students and practitioners.

Last but not least, REPAiR's findings will also be of interest for the general public, which is increasingly aware of the environmental challenges in cities and receptive to the practices associated with circular economy, such as recycling and reusing waste as a resource to produce energy or new products.

It is important to stress that REPAiR will reach out to the above mentioned groups of end users of REPAiR's results directly (e.g. through the website, events, conference presentations, reports, publications) and through intermediaries, from among the consortium members and the user board, who will contribute to the expected impacts. The consortium includes partners representing the European Commission's own research institution (JRC), academic research and higher education institutions (e.g. TUD, UNINA), the joint TUD/MIT/WUR AMS institute, local and regional governments (e.g. GHM, CRA, OVAM), and industry (e.g. BLOKOM, DELTA). Like the lead users within regional and local authorities, the industry partners in the consortium and the user board will be particularly interested in taking up REPAiR's outputs because they will play a key role in the development of the GDSE, used to respond to the waste management and spatial problems that they will have formulated.

At the same time, all of the abovementioned organisations will play a key role as REPAiR's ambassadors and intermediaries in the outreach activities within their jurisdictions and peer groups during the project's implementation

and after its completion. This will ensure that REPAiR's outputs are further developed to increase their TRL level (for the GDSE) and SRL (for other outputs). The organisations have extensive networks of partners and contacts with organisations in the value chain in waste management in the case study areas. Those networks are at the very heart of REPAiR's strategy to ensure adoption of the project's outputs and will be mobilised throughout the project's duration and continue operating after its completion. Moreover, the members of the user board will play a similar role as intermediaries in contact with relevant stakeholders.

Finally, the consortium will approach and use relevant external intermediaries capable of reaching out to a significant number of actors within a particular stakeholder group. These include:

- thematic international networks and associations focused on:
- waste management, circular economy and related topics (e.g. European Recycling Industries' Confederation (International Solid Waste Association, European Recycling Industries' Confederation, European Compost Network, UNEP/SETAC Life Cycle Initiative, Association of Cities & Regions for Recycling and for sustainable Resource management, WEEE Forum, , BDE Federation of the German Waste, Water and Raw Materials Management Industry Business and Employers Confederation),
- sustainable urban development (e.g. Covenant of Mayors, AMS/Smart Cities, PLUREL, The German Institute of Urban Affairs – Difu)) and spatial planning (European Council of Spatial Planners - ECTP-CEU);
- environmental and climate change issues (e.g. European Network of Environmental Professionals, Society of Environmental Toxicology and Chemistry, Climate KiC);
- European and national representative bodies, networking and lobby groups for regions and cities (e.g. METREX - The Network of European Metropolitan Regions and Areas, EUROcities, European Urban Knowledge Network, The Association of Flemish Cities and Municipalities - VVSG, The Association of Dutch Municipalities – VNG, The Association of German Cities);
- European and national non-governmental organisations and their federations (e.g. European Environmental Citizens Organisation for Standardisation, German League for Nature, Animal and Environment Protection – DNR);
- governmental organisations operating at different scales (European Commission, The Committee of the Regions, European Economic and Social Committee, national ministries, the Dutch Presidency of the EU in 2016, regional and local environmental, planning or waste management agencies).

These intermediaries, both internal and external, will play a crucial role in:

1. Promoting the further development of the GDSE beyond TRL7, thus overcoming the so-called 'Valley of Death' or the critical stage at which the development of new technologies tends to get stuck;
2. Further development of the other outputs of the project towards higher SRL by the regional and local authorities, research institutions and industry actors (see Fig. 2.1d below).

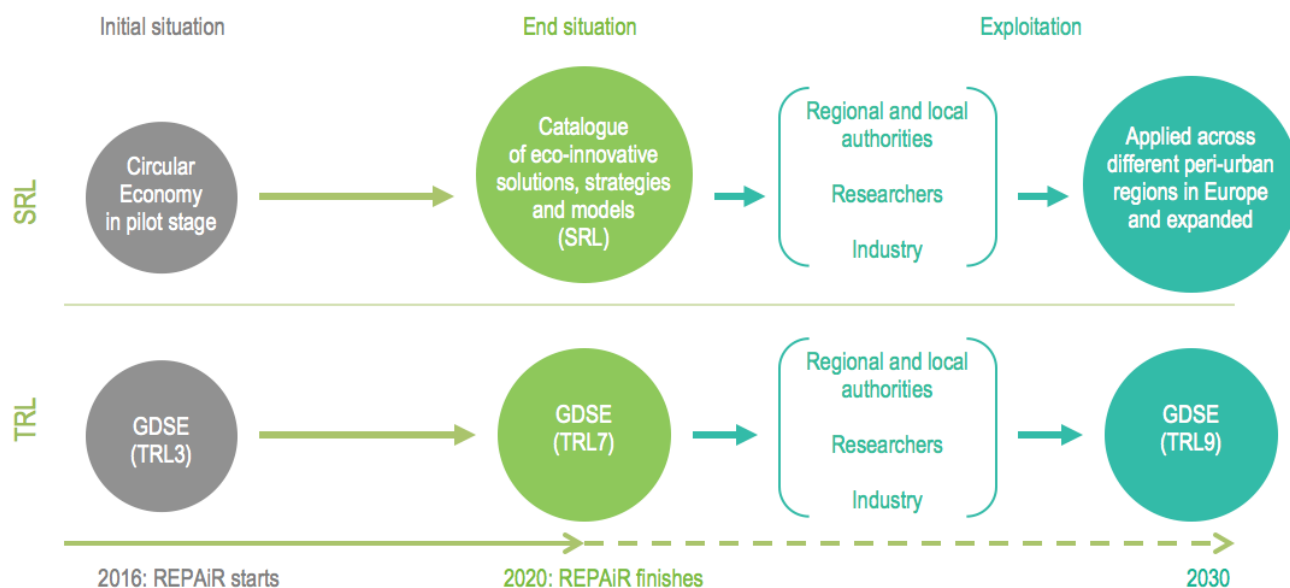


Figure 2.1d Timeline towards reaching higher technology readiness level (TRL) and societal relevance level (SRL) of REPAiR's outputs .

2.1.2 Innovation Capacity and New Knowledge

REPAiR's integrated approach to waste management, based on a joint geodesign and urban metabolism approach, and its core product, the GDSE, are expected to be game-changers in waste management practice and attract significant interest of the companies in this sector. The project's outcomes will lead to support of decisions towards more efficient waste management in cities and promote the use of waste as a resource. This will be achieved through eco- solutions and change strategies devised in close cooperation between the researchers, industry partners, the territorial governments and other stakeholders within the PULL set up in the six case areas and transferred across those regions using a knowledge transfer methodology to ensure adaptation to the differentiated local contexts. REPAiR will thus provide the local SMEs in the relevant branches of the economy (waste management, energy provision, urban planning and design) with a test bench and diffusion platform for innovation emerging from cross-sectoral collaborations in the case study areas. This is expected to contribute to a paradigm shift in waste management towards one based on recycling and reusing waste, while ensuring positive spin off effects in spatial quality, quality of life and other educational, economic and environmental benefits. It is also expected that the use of the GDSE and the innovation activity as part of REPAiR's PULL could lead to spin-off applications and adaptation of the GDSE to be used not only in the waste management industry but also in other fields (e.g. air quality management, energy transition). Potential barriers, obstacles and framework conditions Sound project management requires anticipation of potential external barriers to the delivery of the planned project outcomes. The expected possible obstacles to success and the remedies envisaged to mitigate them are listed in Table 2.1. below.

Table 2.1c. Potential external barriers to the project's success and the means to overcome them.

Barrier	Probability	Impact	Remedy available
Institutional and legal barriers. Differences in national administrative systems and regulatory regimes concerning waste management across and within the EU member states. These differences may potentially entail obstacles to the transfer of eco-innovative solutions and change models across case study regions.	Low	Low	It is the intention of the consortium to investigate such issues. WP 7 will produce a methodology for knowledge transfer that focuses on enhancing the transferability of solutions by scrutinising the differences between the governance context from which the solution originates and the one to which it is to be transferred and selecting the most transferable solutions and adapting them to ensure that it produces the expected impacts.
Knowledge barriers. Knowledge on and experience with geodesign tools remains limited.	High	Low	The living labs will introduce the local stakeholders to geodesign and the GDSE and guide users in a collaborative process of learning-by-doing. Moreover, the GDSE will be designed with user-friendliness as a core principle and marketed as a package including an accessible user handbook. Additional information and guidance will be offered via the website, while the teaching activities offered will include an introduction to the GDSE. Finally, the dissemination and communication activities will endeavour to sensitize future users to the benefits of geodesign and raise awareness among the general public of this approach as a tool for addressing the resource efficiency challenge.
Uptake barriers. The extent to which the lead users in regions beyond the case study areas will be willing to	Low	High	The consortium places a great deal of importance on targeted exploitation and communication activities related to the GDSE (WP 8), which are based on carefully thought-through plans. The uptake of the GDSE will be favoured by the activities of

use GDSE remains unknown. Regional and local governments can be wary of modelling tools.			the intermediaries between the consortium and the lead users, namely the industry and government partners involved in the consortium as well as the Advisory Board. Moreover, the consortium will also endeavour to reach out to and collaborate with national policy-makers, the relevant bodies within the European Commission, and other intermediaries on the promotion of the use of the GDSE among the regional and local authorities across Europe.
Barriers in access to data. Availability of data, for instance for sustainability assessment or for mapping illegal waste dumping, may be limited. In particular this concerns the regional/peri-urban scale on which REPAiR focuses.	Medium	Medium	In case of unavailability of data, the consortium will undertake fieldwork to collect it, drawing on the expertise and support of the government and industry partners in the case study areas concerned.

2.2 Measures to maximise impact

To maximise REPAiR's impacts, a set of actions for dissemination and exploitation has been planned, so that all stakeholders and potential users will realize the envisaged benefits of the project's outputs and that a way is paved for further deployment and exploitation. First, this section will describe the overall approach to dissemination and exploitation and then outline the specific dissemination strategy for the different target groups. Second, it will present REPAiR's approach to exploitation of its results. Third, communication measures will be discussed. The section will close with an outline of REPAiR's approach to research data and knowledge management.

2.2.1 Dissemination and exploitation of results

The overall goal of REPAiR's dissemination and exploitation strategy is to accompany the delivery of the project results with cleverly targeted actions so that all stakeholders and potential users realize the benefits of the project's outputs, thus stimulating exploitation of those outputs. More specifically, this strategy aims at ensuring:

- Effective and sustainable dissemination of the knowledge, tools and solutions developed by REPAiR across the entire European circular economy community, and through the implementation of suitable and specialized dissemination and communication activities for each of the project's identified target groups and end users;
- Exploitation of the project's results by end users within the governmental sector, the relevant industries and civil society stakeholders, the researchers' community and higher education institutions, so as to promote the shift towards a circular economy and reinforce the European Union's leadership (both in terms of technology and policy) in sustainable waste management;
- Interconnection with other industrial sectors beyond waste management with the potential to exploit the findings and outcomes of the project;
- Conveyance of new knowledge to the education base provided across European universities, so as to meet the evolving skill needs of the sector and train future leaders of the circular economy;
- Possibilities for exploitation of the REPAiR's results and foregrounds outside of the waste management field, e.g. in air quality management, renewable energy.

The inclusion of a comprehensive representation of the stakeholders within the consortium, the user board as well as the planned recourse to key intermediaries (the key representative and umbrella organizations for the different stakeholder groups, see 2.1.3) outside of the consortium make up the cornerstone of this strategy. Their extensive networks, expertise and the knowledge of the needs of REPAiR's target groups will contribute to effective dissemination and exploitation.

The primary objective of the draft REPAiR dissemination and exploitation strategy is to identify and organize the activities to be performed (during and after the project), in order to maximize its influence and while taking into account the dissemination needs of the project at each stage of its lifecycle, as well as the specific technical, market, organizational issues

and interests of each of the various pre-defined REPAiR target groups/end users. Consequently, the main aims of the planned dissemination and exploitation approach are to:

- **Disseminate knowledge** - Regularly provide information about the REPAiR outputs through carefully selected channels tailored to the target groups (see section 2.2.4);
- **Support REPAiR exploitation** - Pave the way for a successful exploitation of the project's results by addressing the full range of potential users and applications, including research, commercial, investment, social, environmental, policy making, setting standards, skills and educational training.

2.2.2 Dissemination strategy

The dissemination strategy of REPAiR focuses on three elements:

- **Project partners**, who represent all user categories and provide direct personal contact with colleagues and disseminate project information through channels appropriate to their peer groups;
- **User board**, consisting of the representatives of all user categories who will disseminate information about the project's results and its products to a highly targeted audience;
- **Broad range of targeted and tailor-made communications measures** to reach out to lead users and other stakeholders, as specified in Section 2.2.2.

The dissemination activities will focus on four **target groups** using tailored communication channels:

- **1. Researchers.** The dissemination activities will target researchers at universities and other research institutions working in a range of disciplines (spatial planning, economic geography, urban studies, regional science, environmental studies, organizational studies, or management). The dissemination to this group will enhance the understanding of urban metabolism and the potential of geodesign to promote better waste management and, importantly, will add to the on-going academic debates on circular economy topics. This in turn is expected to spur further research projects, cross-fertilization of ideas, and publications, thus offering a valuable contribution to knowledge. *Channels:* open access articles in leading peer-reviewed academic journals, presentation of the project's findings at national and international conferences, seminars and workshops, and the newsletter.
- **2. European Circular Economy community.** The dissemination strategy focuses on reaching out to the practitioners dealing with Circular Economy, including (1) the relevant public authorities operating at different scales (chiefly regional and local authorities) as well as (2) businesses dealing with waste management, both in the case study areas and in other European regions. These actors are among the Lead Users of GDSE. It is therefore essential to disseminate REPAiR's results among them in order to (1) promote the use of GDSE as a tool for promoting the use of waste as a resource; (2) raise the awareness of the importance of that issue; and (3) spur them to take action to turn the European ambition to build a circular economy into reality, both through activities within their respective remits and through collaboration among them. *Channels:* practice-oriented workshops in each of the case study regions, *with particular attention paid on the promotion of the GDSE among the most relevant stakeholders.*
- **3. Non-governmental organizations and the general public.** Dissemination to this group aims at building stakeholder awareness of the importance of the shift towards a circular economy and educating the general public. This in turn is expected not only to muster public support to efforts towards this European ambition, but also to promote the engagement of non-governmental organizations focusing on waste, sustainable cities and wider environmental issues in (1) scrutinizing the implementation of waste management policies and (2) in decision-making concerning these policies. *Channels:* seminars and workshops, newsletter, social media, features in online and printed media as well as informal contacts and networks that project partners have within their regions and beyond (other regions, national and EU level organisations).
- **4. Students.** A further target group are students in regional and urban studies, spatial planning, environmental studies, and other relevant disciplines. The underpinning aim here is both long-term and normative: to promote the values and good practice in waste management *by educating the next generation of decision-makers and ambassadors of the circular economy.* *Channels:* academic courses (including a MOOC to be developed with AMS Institute) on the circular economy and the use of waste as a resource (including student work contributing to a range of activities from data gathering, spatial analysis, flows analysis to generation of ideas for solutions to be applied in these regions) offered by the consortium universities, with educational institutions as partners to the research-oriented consortium-members (e.g. University of Pécs, University of Łódź).

The dissemination plan and the related dissemination kit (developed as part of WP8) will translate this strategy into be practice. They will provide concrete guidelines to all project partners to ensure that the channels of dissemination (see Table

2.2.1) are matched with the relevant project deliverables and with the identified groups of end users in order to ensure the outcomes of the project (at any stage) are shared with appropriate audiences and in a comprehensible manner. The dissemination plan will clearly define the double role of end users as target groups and as providers of critical input into the deliverables of all WPs, including the dissemination strategy itself.

2.2.3 Exploitation strategy

REPAiR will exploit the networks and knowledge of the consortium partners representing all user groups to pave the way for successful exploitation of the project's results. These activities will concern three REPAiR products with high potential for exploitation: (1) the GDSE, (2) the data produced in the research, and (3) the teaching materials (see Fig. 2.5).

The REPAiR team is very well connected to the European circular economy community through academic, policy and industrial networks, and will thus be able to directly reach out to and cooperate with the relevant external intermediaries (see section 2.1.3).

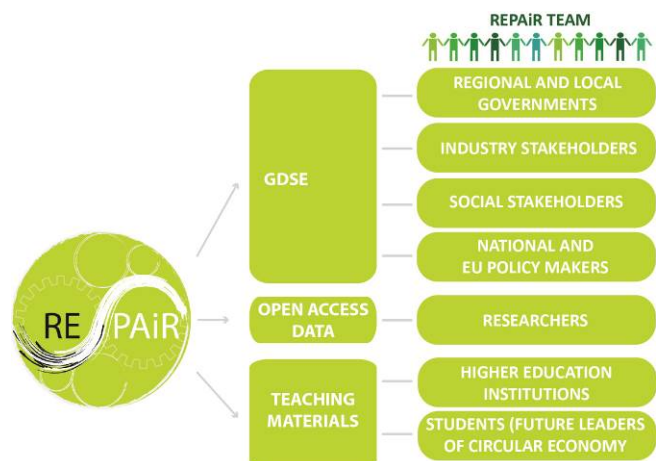


Figure 2.2a Exploitation of REPAiR's results.

Moreover, to ensure the realization of the exploitation strategy, the workshops organised within PULLs in case study areas will be an opportunity to gather feedback and input from local and regional authorities and industry stakeholders on the design of the GDSE and on the formulation of a detailed exploitation plan (WP 8). The exploitation plan will be produced in the project's final year and provide specific exploitation guidelines for the three different user groups.

These groups include:

1. **GDSE Lead Users.** This group comprises experts in regional and local authorities (e.g. spatial planners, urban designers, waste management and sustainability officers), industry (businesses dealing with waste, sustainability, and/or urban planning and design) as well as social stakeholders (e.g. non-governmental organizations dealing with waste or environmental issues, local inhabitants groups). Focusing on those Lead Users will ensure the realisation of the core goal of the exploitation strategy: the uptake the GDSE, which in turn is expected to enhance waste management and urban metabolism in the case study areas and other European regions. The feedback on the GDSE from this group will be gathered during the workshops in PULLs. This activity will be essential in making sure that the GDSE matches their needs and will therefore increase the chances for its future uptake. Moreover, the GDSE will be promoted among this group of users by presentations at various events at the national (policy conferences, workshops) and EU (e.g. Open Days) levels. Finally, the user board and the governmental and industrial consortium members will use their networks acting as exploitation intermediaries between the consortium and the Lead Users.

2. **Researchers.** The researchers dealing with waste management or urban metabolism issues will be able to use the data and other qualitative materials achieved through REPAiR's lifetime for further research projects. Examples of the data to be made available include the sub-models of the GDSE, GIS-based maps and data on actor networks. The availability of this data will be publicised as part of the communication activities targeting researchers.

3. **Higher education institutions and students.** REPAiR will produce open access teaching materials to provide a basis for the elaboration of study programmes related to urban metabolism and the circular economy. These materials will include a syllabus, reading materials, visual aids, lecture scripts and student assignments descriptions that will be available free of charge for use (and possible adaptation) by academic institutions from across the world.

Open Source to boost exploitation

An important aspect of the exploitation strategy is the commitment to distribution of the GDSE under an open source license and using a code-sharing platform (e.g. Github). Partners from TUD, GGR, Geo-Col and JRC will form the core

development group. The open source community of **first users**, including software developers and users within the relevant public authorities and the industry, continue to develop the applications following commonly defined requirements and with well-defined implementation rules to extend and improve the product, and to cater to the needs of the Lead Users of the product. A key requirement is that the GDSE code's intellectual property (IP) is clear and that source code developed in the project is reusable. This approach will make the GDSE easily and freely available to first users to apply, adapt and improve for different contexts, thus significantly increasing the potential market for it and providing the opportunity for continuing innovation. The open source model, in fact is an **excellent strategy for encouraging exploitation, take-up, use and continued development of the GDSE**, because users can be assured that the software will continue to be available and be improved by its user community. The open source platform will make it possible to develop new products (eventually under proprietary licenses) on top of the platform as required by some of the industrial partners to address the needs of their customers and protect their IP.

In summary, using the open source model will help improve the exploitation potential for the GDSE. The collaboration and documentation platform will be a great tool to support continuing development of the GDSE and research on improving waste management. The project partners themselves plan to use it for continuing their own research and product development, and believe it can become a hub for advancing the waste management practice.

2.2.4 Communication activities

Communication activities will provide the tools to implement the project's dissemination and exploitation strategies, giving it proper visibility and ensuring diffusion of regular information on progress and results. The first target of these activities will be the consortium partners themselves – up-dated information made easily accessible for exchange and discussion between partners is a key factor of success. Secondly, the communication activities will address all the above mentioned target groups, using a language and terminology adapted to their respective fields. Moreover, the stakeholders from within the consortium and the stakeholders and customers of the consortium partners will receive information communicated in an appropriate way, both in terms of form and content. To this end, a communication plan will be provided to all partners, laying down the communication strategy, activities and material planned. The communication channels to be used by REPAiR are summarized in Table 2.2.a

Table 2.2.a. REPAiR's communication means.

Communication means	Target groups	Objectives / Impact	Performance indicators
Website	All target audiences	The website will provide a one-stop-shop for communicating all information about the project, news, publications and other deliverables. The website will also serve as an interface for third parties through which they will be able to interact with the consortium.	Number of visitors and downloads of the materials provided per month.
Corporate Identity	All target audiences	Corporate Identity will ensure the recognisability of the project across all materials, media channels and stakeholders.	-
Social media	All target audiences	Social media presence has become the most effective communication means. It will allow for keeping the relevant targets groups informed of the project's milestones, events, and outputs. It will also allow for expanding the potential audience.	Number of followers, 'likes', 'retweets'
Newsletter	All target audiences	Newsletter will allow for keeping targets groups interested and informed on the project's milestones, events, and outputs. Newsletter will complement communication via social media with additional, more extensive content.	Number of subscribers.

Press releases	General public	Press releases will raise the awareness of the project and its results.	Number of press releases published and number of media outlets to which it is distributed.
Features in printed press and online media	General public	Features in printed and online media (general interest newspapers and periodicals as well as EU's own research focused publications, such as Horizon, the EU Research & Innovation Magazine, research*eu magazine) will allow for communicating the key results and sensitizing the general audience to the need for enhanced waste management.	Number of features.
Scientific workshops and conferences and final seminar	Researchers	The project's result will be presented at scientific events (e.g. Geodesign Summit, European Urban Research Association Conference, Regional Studies Association European Conference, Association of European Schools of Planning Congress) to diffuse them to the academic community, receive feedback and discover scientific cooperation opportunities.	Number of events attended.
Workshops and events for industry and final seminar	Practitioners, researchers	The GDSE will be presented at workshops and events focused on issues relevant to regional and local authorities and circular economy practitioners (e.g. Open days organized by European Commission's DG REGIO, ICLEI World congress, Geodesign Summit, European Knowledge Network Policy Labs, International Conference on Waste Management and the Environment, BIR World Recycling Convention). Moreover, PULLs workshops will aim at facilitating exploitation among key user groups in the case study areas.	Number of events at which GDSE is showcased.
Open Access scientific publications in leading peer-reviewed journals	Researchers	The project's scientific advances will be disseminated via open access journal articles. The open access approach will ensure broad readership, while peer-review will serve the purpose of validation of the results. It is planned to deliver at least twelve peer-reviewed journal articles throughout the project.	Number of articles published, downloads, citations.

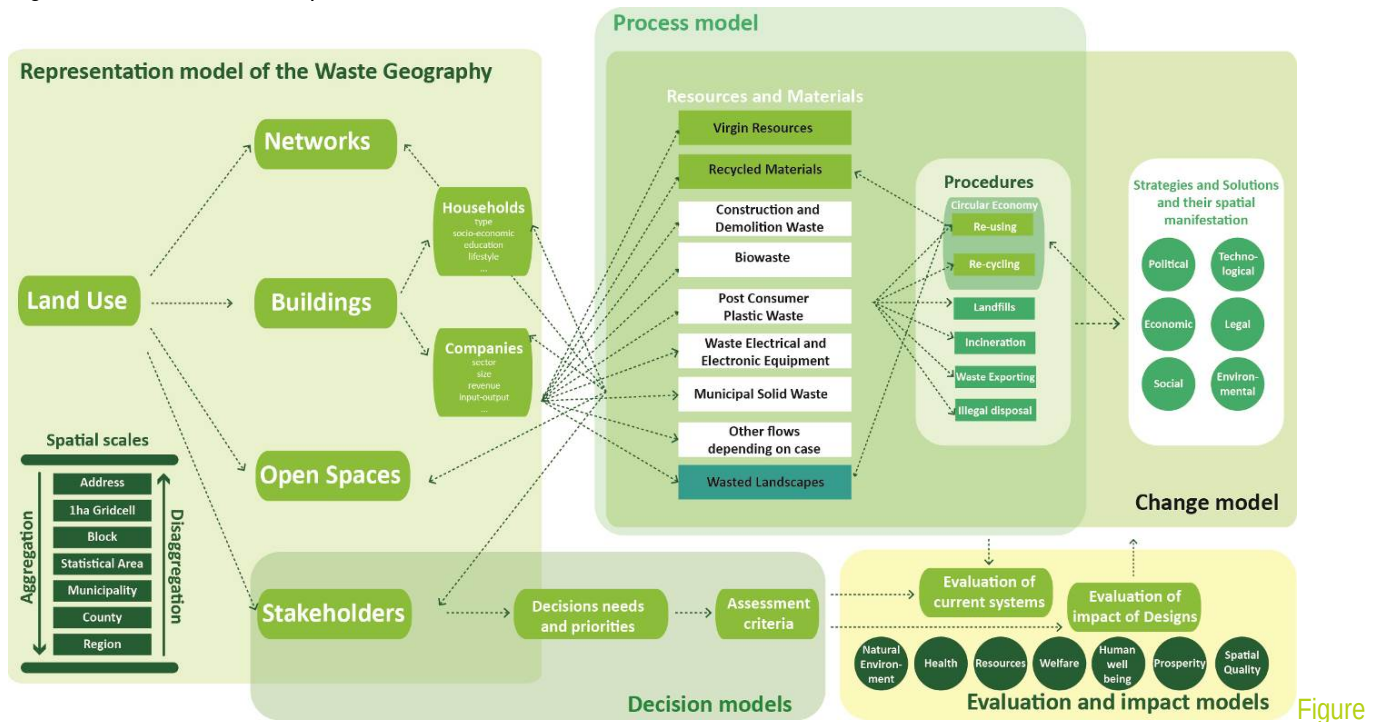
All communication activities will follow the *guidelines for corporate Identity*, to be elaborated as part of WP8. The strategy will define guidelines for the visual presentation of all communication documents (website, newsletter, social media, reports and other publications, etc.) and outline how these materials are to be used in the promotion and presentation of the project.

2.2.5 Research data and knowledge management

The research data gathered in this project will be described in a research data management plan (RDM plan), following the guidelines set by the EC. This RDM plan will be an early deliverable of WP 8 (see lists of deliverables) and updated during the course of the project. A final version of the plan - which will include information about how these data will be exploited, made accessible for verification and re-use and how it will be curated and preserved - will be developed in the end of the project. The purpose of the data management plan within REPAiR is to support the data management life cycle for all data that will be collected, processed or generated.

What types of data will the project generate/collect?

In general, the project will generate a variety of data related to waste and resource management in six European case study areas. This includes data on resource flows and stock (life cycle inventories including not only inputs, but also outputs and energy flows), households, companies, and open spaces. Additional data on the decision needs of the key stakeholders will be collected. Data will be quantitative and qualitative. Most will be geodata, but other types of data will be generated, including photographs, audio files, images, maps, blueprints, etc., resulting from measurements, interviews, or collected from local authorities. Design proposals are a very specific type of data in the case of REPAiR, which very often will take the form of diagrams or policies. In order to make the basic data available and allow a variety of analysis, predictive and assessment models will be performed that also generate data. The integration of different data sources and models is crucial for REPAiR. Figure 2.6 shows a first setup of the data flow and its relation to the different GDSE models.



2.2b REPAiR setup of the data flow and its relation to the different models of the GDSE.

What standards will be used?

REPAiR will use the OpenEarth DataLab provide by 3TU.Datcentrum specifically developed as an online data management working environment for scientific and monitoring data. The OpenEarth DataLab enables collaboration on data standardisation. REPAiR will as much as possible use standards that follow the Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE), as well as related regulations on metadata, data specifications, network services, data and service sharing and monitoring and reporting.

How will this data be exploited and/or shared/made accessible for verification and re-use?

For this aspect, REPAiR also uses the Open Earth Data Lab, where data can be safely stored, shared, edited, processed and visualised. The Data Lab allows uploading and sharing of raw data, scripts, models and data generated within the REPAiR consortium. Once data is uploaded, group members can run Python and Matlab scripts in the cloud. The processed data can be shared again in standard formats. This enables reviewing and improving the scripts that run on the data, thereby increasing the overall quality of the data and analysis.

Data gathered by REPAiR will be made openly available once it has been anonymized in such a way that it cannot be tracked back to individual respondents, directly or indirectly. Data not produced via the project (e.g. existing cases, existing survey data, existing data from statistical offices) will not be made openly available. Data gathered by REPAiR will only be made openly available as long as it does not harm privacy or competitiveness of the business being studied. All sub features and models developed for the GDSE will be openly available to the open source community. The data that is suitable to make open available (including necessary documentation, metadata, code, consent form, software, etc.) will be stored and made

open available in [3TU.Datacentrum data archive](#) under the [Deposit License](#) agreement. By doing so, 3TU.Datacentrum is granted a non-exclusive licence to store the data and make them available to third parties. For data users, the [General Terms of Use](#) applies. These terms specify that, when re-using the data, they will clearly state the name(s) of the original author(s) and that the data will not be used for commercial purposes. 3TU.Datacentrum data archive is a long term archive with a Data Seal of Approval.

How will this data be curated and preserved?

Once a dataset has been completed and is ready for publication, the data set will be transferred from the Open Earth Data Lab to the 3TU.Datacentrum data archive for long-term storage. The 3TU.Datacentrum data archive (<http://datacentrum.3tu.nl>), is a Trusted Digital Repository for technical-scientific research data in the Netherlands. Each dataset deposited will be provided a digital object identifier, or DOI, that facilitates discoverability, accessibility, and re-use. 3TU.Datacentrum has been included in the DataCite search engine and Thomson Reuters Data Citation Index (DCI) to aid data discovery.

2.2.6 Knowledge management and protection

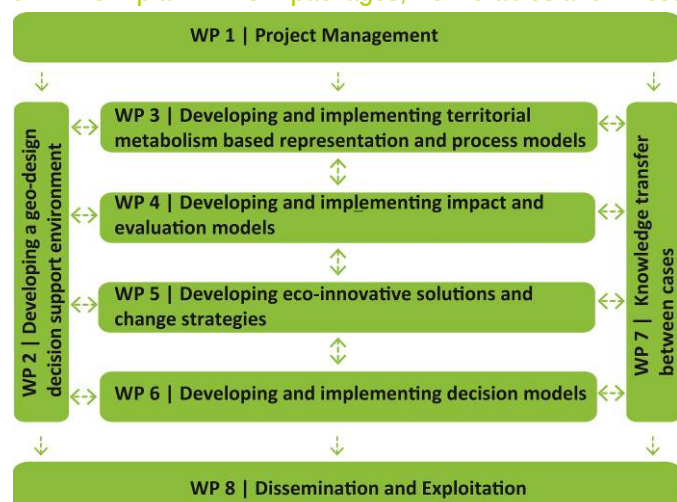
Intellectual property rights (IPR) protection will be agreed upon on the basis of the consortium and grant agreements. As a general rule, inventors or their employers will own results realized within REPAiR. Specifications will be incorporated in the consortium agreement. A method will be defined during the first months of the project for ensuring approval of each planned publication across the consortium, and especially among the involved parties, when and if potentially patentable results are obtained. The Dissemination and Exploitation Manager, DEM (Magdalena Górczyńska, IGI-PZ, the leader of WP 8) will be responsible for monitoring all planned dissemination and exploitation activities so as to ensure that the consortium agreement and grant agreement requirements are respected and that the involved parties' IPRs are properly protected from unauthorized use or any other kind of misuse.

All partners will be responsible for publishing project results in appropriate media, e.g. local and international press, peer-reviewed scientific journals and conferences. All scientific publications resulting from REPAiR will be published in open access mode.

Depending on the nature, importance, cost and available budget, a decision will be taken by the coordinator in cooperation with DEM and the proposing partner as to the most appropriate open access scheme. A dedicated budget for open access scientific publications has been reserved. Alternative repositories such as the Open Access Infrastructure for Research in Europe (OpenAIRE), the Registry of Open Access Repositories (ROAR) and the Directory of Open Access Repositories (OpenDOAR), etc., will also be exploited, as these are supported by the European Commission and there is no cost related to using these repositories. In all cases, as soon as possible and at the latest within six months of publication, DEM will be responsible for collecting a machine-readable electronic copy of the published manuscript for deposit in the project website either as a reproduction, if permitted by the publisher, or as a direct link to the publication. In addition, the research data and bibliographic metadata needed to validate the results presented in the deposited scientific publications will be stored in an appropriate area of the repository.

3 Implementation

3.1 Work plan — Work packages, Deliverables and Milestones



The project has a duration of 48 months. REPAiR's structure is built upon the six questions and models of the geodesign framework and is organised in two levels, as shown in Figure 5. The work is divided into 8 work packages as described above. A PERT chart is provided in Figure 3.1a to show the relationship between the different work packages and the partners involved.

Figure 3.1a: PERT chart

Except for the (non-technical) management work package, a different partner leads each work package, with each having a relatively large number of partners. This is a result of the transdisciplinary nature of REPAiR, with every WP requiring

input from several academic fields as well as input of specific technical and place-based knowledge. Each work package consists of several tasks. To give a more detailed insight into the timing and dependencies between all tasks, a Gantt chart is provided in Figure 3.1b. Following the Gantt chart, detailed work package descriptions (Table 3.1a) are provided followed by the list of work packages (Table 3.1b) and the list of major deliverables (Table 3.1c). .

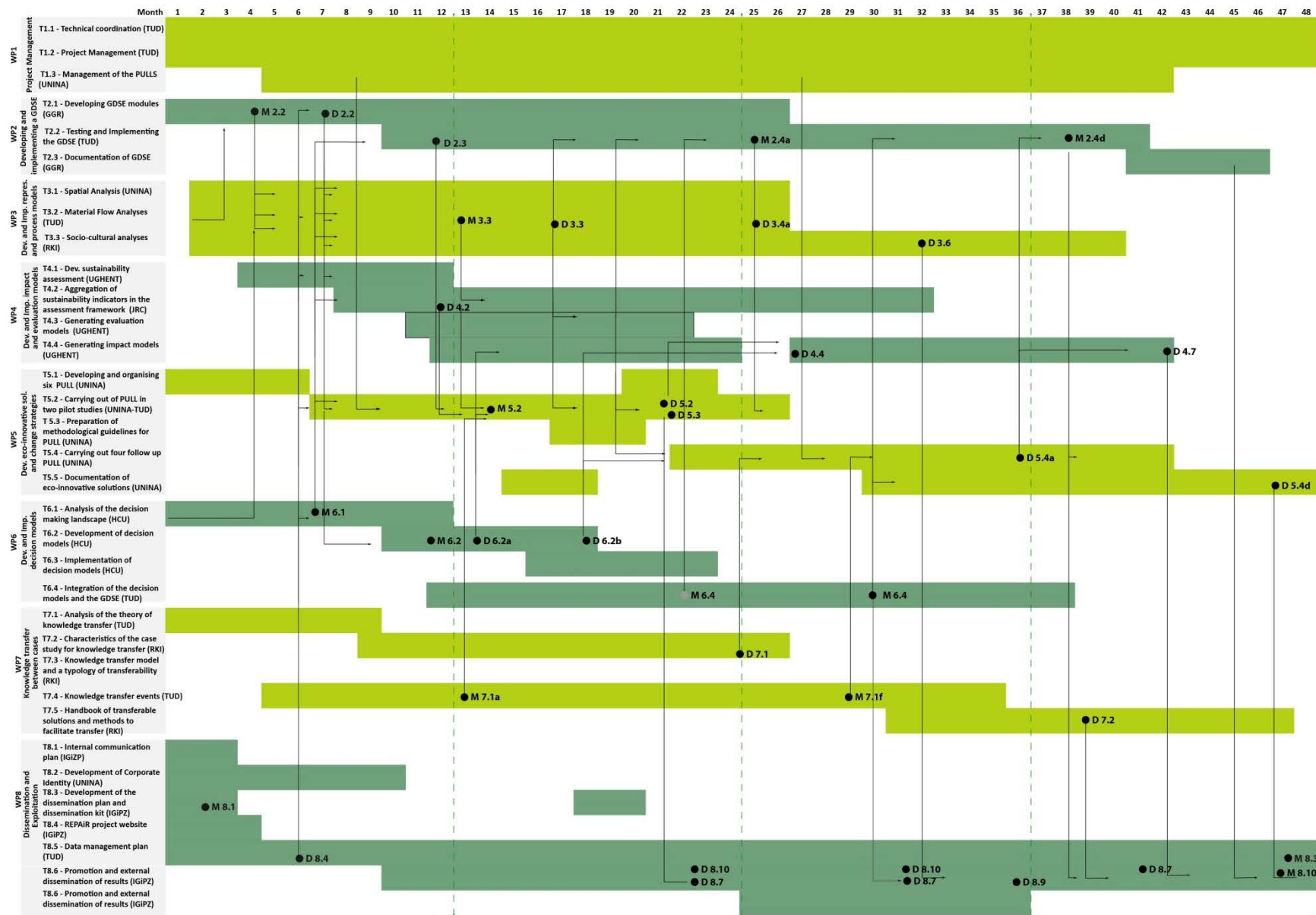


Figure 3.1b: Project Gantt chart showing the main tasks, milestones and deliverables and the interaltions between them..

3.1.1 Detailed Work Description

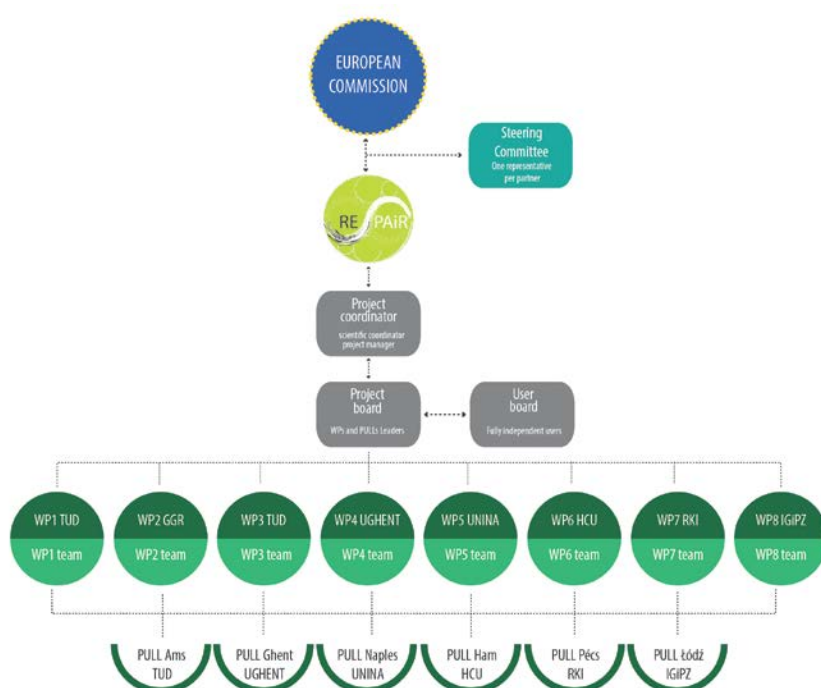
The tables in Part A describe the detailed work description by work package. Deliverables, which have to be produced for all six case studies, are indicated with lower case letters behind the two digits.

3.2 Management structure and procedures

3.2.1 Organizational Structure

The management of REPAiR has as its major task ensuring the support, coordination and facilitation of the consortium activities in the project as a whole. Measures are included to ensure that the required quality levels are met and that the impact as described in the previous section is achieved. Project management techniques will be used to monitor that all scheduled activities are carried out on time. In particular, special effort must be directed towards harmonisation of work progress in the case of crucial interdependencies of activities, within or across work packages (WP's). This is specifically important for multidisciplinary consortia, so REPAiR includes a handbook, which ensures a common understanding of concepts and methods, as an early deliverable in every WP.

The management structure of the project will be kept small, but efficient enough to support the realisation of the project's objectives with the consortium and within the defined budget limits.



Roles & Consortium Bodies

Each consortium member can have one or several roles in the project. All consortium members are represented in the Steering Committee (SC). TUD has the role of *technical coordinator*, assisted by a *project manager* from the same organisation. A number of consortium members are responsible for monitoring and ensuring progress on specific activities in the role of *Work Package Leader*. Moreover, some members are key responsible for the organisation of a specific PULLs. WP leaders and PULLs leaders together form the project board.

Figure 3.2a : REPAiR Management structure.

Consortium members

The individual consortium members are responsible for executing the tasks allocated to their organisation and to safeguard the timely delivery of results (deliverables) and the required quality level. They are also responsible for the coordination, within their WPs and with other WPs, of their activities especially where they relate directly to the work and progress of other participants. Coordination of the entire project is built into the WP structure and the overlapping membership of the WP teams. In each technical WP there are at least <four> consortium members involved and each consortium member contributes to at least two of the technical WPs. This is an ideal situation for promoting cross-fertilisation between the WPs and an exchange of expertise between consortium members. In principle, all consortium members have the facilities and expertise to individually execute the tasks as described in the description of work. For most of the tasks, there is a complementarity as well as a partial overlap in specific expertise, such that should any consortium member be unable to perform its task in a WP or part of it, this task could likely be taken over by one of the other consortium members.

Coordinator and Project Manager

The coordinator maintains the project-wide overview, promoting synergy, identifying possible inconsistencies and generally overseeing implementation. The coordinator is supported in this work by work package leaders who oversee workflow, research

and development activity coordination and progress, and specific project results in the allocated work package. The coordinator is responsible for the coordination of the project as a whole and as such forms the point of contact for the European Commission representative and is furthermore responsible for project management of both technical content and administrative procedures.

The project coordination is performed at two levels:

1. The technical coordination for the scientific development of the project. The main responsibility of the coordinator is to ensure that the main goals of the project are pursued, to facilitate smooth collaboration within the consortium and to verify the quality of all deliverables.
2. The project management and administration support the activities performed by the consortium. The project manager will perform the following tasks:
 - Acting as liaison with the European Commission;
 - Monitoring contractual obligations, reporting duties;
 - Compiling legal documents, the contract and annexes, consortium agreement, etc.;
 - Submitting deliverables and project reports;
 - Performing budget control and financial management;
 - Overseeing progress control (deadlines, deliverables, etc.);
 - Co-organising project meetings (together with host partner).

Before the contract is signed and the project can begin, a Consortium Agreement (CA) will be drawn up and signed by all consortium partners. It is a legal document containing the rights, obligations and responsibilities of all consortium partners including but not limited to their liability, confidentiality rules, access to and protection of knowledge, protection of intellectual property rights (IPR). It is based on the DESCA model contract, elaborated by academic and industrial parties all over Europe.

WP and PULLs Leaders

A WP leader is appointed for each work package to coordinate and oversee the WP activities. In principle, the representative of the partner with the largest number of person months involved in the particular WP is the WP leader. Notwithstanding the task of the WP leaders, the responsibility of the proper coordination and execution of the entire project formally remains with the coordinator and the consortium as a whole. The WP leaders are responsible for monitoring the milestones and deliverables in their WP and will maintain close and frequent contact with consortium members involved in their WP. For each PULLs, a PULLs leader and a management group are defined. It's the PULLs leader's responsibility to organise and coordinate a PULLs. WP leaders can also be PULLs leaders.

User Board

To support the work of the consortium and the steering committee and advising on the road ahead and the quality assurance of outputs produced. A user board is established. The task of the user board is to monitor adherence of project deliverables to the needs of future GDSE users. The user board will consist of around 20 members primarily from regional and city planning authorities, as they are the future key GDSE users. The user board is complemented by members of GO and NGOs that have a stake in developing a circular economy or the sustainable development of peri-urban areas (PURPLE). The user board will play a crucial role in testing and further developing the GDSE and will therefore be invited to join the regular project meetings, in particular the kick-off meeting and the knowledge transfer and GDSE testing workshops during the PULLs.

Table 3.2. User board members who have already confirmed their participation, others have confirmed but could not provide a letter of support due to the vacation period and are therefore not listed in this table.

	Name	Affiliated to
1	Professor Renato Bocchi	Re-cycle-Italy
2	Professor Karolina Dmochowska - Dudek	University of Łódź
3	Andrzej Górczyński	Agricultural chamber in Łódź Province
4	Przemysław Andrzejak	Łódź Regional Development Agency

5	Małgorzata Grodzicka-Kowalczyk	Łódź Regional Development Agency
6	Sabine Hilfert	Frei Hansestadt Hamburg – District of Altona
7	Sally Talbot	Municipality of Staffordshire - PURPEL
8	Dr. Zoltán Horváth	Government Office of Baranya County
9	Oliver Stolz	County of Pinneberg
10	Daniel Termont	City of Ghent
11	Dr. Laszlo Sitany	STRDA South Transdanubian Regional Development Agency Nonprofit Ltd.
12	Luigi de Magistris	Mayor of City of Naples
13	Sietse A. Agema	AEB Amsterdam
14	Janos Giran,	deputy-mayor, Municipality of Pécs
15	Fonz Dekkers	EVOLV, ASU's Global Sustainability Solutions Services
16	Eveline Jonkhoff	Sustainability Manager, City of Amsterdam

3.2.2 Decision-taking by the Steering Committee (SC)

Formal decisions are taken by the steering committee, which is the formal representation of the consortium as a whole. The SC consists of one representative of each consortium member and convenes at least every six months at the progress meetings. Besides scheduled meetings, SC members will be in contact as often as required to discuss and monitor the project activities of the consortium. The SC takes the following types of decisions:

- Decisions related to the entry of new participants, the exit of existing ones and major shifts in tasks;
- Other decisions related to alterations in contract and budget;
- After quality check of technical coordinator, decision to accept/reject deliverables;
- Planned publications and other dissemination actions;
- All other decisions affecting the project as a whole.

For the sake of simplicity, the WP leaders and the coordinator will not have separate meetings, but instead their interaction is integrated into the project steering committee meetings. Decisions can only be taken in the SC meeting if more than half of the members are present. Decisions concerning individual partners will be based on the principles of equity and fairness. This implies, among other things, that the affected participant should be informed well in advance of the meeting and that the meeting date should be set in cooperation with that partner as much as possible. All decisions of the SC are taken by simple majority where in case of a tie, the coordinator will have the deciding vote. In addition to the 6-month consortium meetings, the SC may organize telephone meetings and written voting procedures may be organized if necessary. Additional rules on decision-making and notification of agenda items will be included in the consortium agreement.

3.2.3 Management procedures

Communication strategy

Project communication and dissemination with external stakeholders will be established by partner IGiPZ in WP 8. A project website will be built, which will have a public section containing general, non-confidential information, as well as a section restricted to the participants, accessible via personal password. The restricted section will be used to store and exchange information in digital format. Information sheets, project documents, agendas and minutes of meetings and reports will be stored and made accessible by the coordinator for later reference. Individual partners will upload their progress reports and deliverables descriptions, as well as any other products of knowledge dissemination, such as scientific publications or

conference presentations related to the work in the project. Phone and e-mail contact will be used for day-to-day work discussions among consortium members involved in the same activity.

Methods of monitoring progress

For monitoring the progress of the scientific work, the consortium has a number of instruments at its disposal (see details below), the most important being:

- The progress meetings;
- The progress reports;
- Milestones and deliverables reviews;
- The mid-term and final reviews.

Progress meetings

The primary meeting events to exercise control and progress monitoring are the SC meetings, which are held every 6 months. At these progress meetings all consortium members are expected to be represented, preferably by their primary responsible, otherwise by a delegated person directly involved in the work of the project. The absence of a consortium member at the meeting can only be accepted in exceptional circumstances, in which case special effort has to be devoted to the quality of the progress report, subject to the approval of the coordinator. At the meetings both scientific results and work progress are reported, either by each partner individually, or in synthesis by the WP leaders, as deemed appropriate by the GA. The 6-month meetings will typically cover one-and-a-half to two days, to allow for sufficient time for presentation of results and discussion of progress. For discussing issues of a purely managerial nature, the SC may organize a separate meeting. In addition, the GA, or a subset thereof, may decide to schedule intermediate meetings if circumstances arise that make this advisable.

Progress reports

Each partner will prepare and submit a progress report to the coordinator every 6 months. In this progress report the results of recent activities are to be reported, the progress in relation to the original project time schedule and the activities planned for the next 6M period. The progress reports are supplementary to the formal deliverables, but may contain elements of them, where appropriate. In case of deviation from the original project schedule, the reasons for this and proposed contingency plans should be addressed. Notwithstanding this, any participant who encounters a problem that may cause a delay in the program is obligated to immediately inform the coordinator and the corresponding WP coordinator, as well as any other participant who may be affected by this delay.

The coordinator will provide a general format/template for the reports to be delivered by the partners. When deemed appropriate by the consortium, the WP leaders will also prepare additional progress reports to synthesize the joint work in the work package. For the mid-term and final reports, the WP leaders will serve as editors for the WP-specific sections, while the coordinator will have final editorial responsibility for the compilation of the complete reports.

Milestones and deliverables review

Specific milestones and deliverables are defined for each WP. Milestones should be clear intermediate GO/NO GO moments and as such become project management tools to measure whether the project is still on track. They are also part of the Gantt chart. The list of deliverables is included in table 3.1.c. The list of milestones is included in table 3.2.a. The progress of the activities in each WP and the outlook for results exploitation will be critically reviewed and compared to the planning and criteria described in the work program. This is primarily the task of the WP leader. The coordinator's team will include a dedicated person who will guarantee the quality management of the deliverables, preferably the technical coordinator. Necessary changes will be decided and implemented. A list and database of all deliverables and publications will be kept and updated by the coordinator, who will be in contact with the WP leaders to monitor progress.

Mid-term and final review

For the mid-term assessment (at month # 24) and the final assessment (at month # 48) a special review meeting will be organized with the representative of the European Commission. The purpose of the mid-term assessment will be to report on the progress to-date and to redefine, if necessary, the project programme for the remainder of the contract. Procedures for managing future exploitation of results will be discussed and assessed. In consultation with the EC officer, external reviewer and possibly members of the advisory board and innovation board will be invited to the mid-term and the final review meetings.

They will be asked to report on project progress. The EU officer and the coordinator will jointly decide how the expenses of the external reviewers will be reimbursed.

Budget control

Budget control and financial management, including the coordination of declarations or payments from or to consortium partner, is to be carried out by the project manager. Verification of cost declarations is made in accordance with the requirements of the EU for the H2020 funding scheme. As coordinator, TUD has access to a large pool of previous knowledge and experience in European-funded projects (in FP7, TUD had over 400 projects, of which 39 as consortium coordinator).

3.2.4 Appropriateness of project management measures

Given the size of the consortium, the management structure will be kept small, with only the minimum number of consortium bodies, to ensure efficient communication flows and avoid unnecessary paperwork. There will be three levels of responsibility: the coordinator and project manager for the entire project, the WP leaders for their respective WPs, and the consortium members for the activities that have been assigned to them. This will result in a flexible management structure that will allow for identifying any deviations from the work plan at an early stage and implementing any necessary corrective actions at short notice.

3.2.5 Effectiveness of innovation management

The structure of the work plan itself is designed to maximise impact on the GDSE. The use of a series of PULLs provides internal and external feedback loops to verify adherence to expected quality levels. The structure of the project enables revising the planning if and when necessary or opportune. Important stakeholders are to be included as consortium members from the beginning and have helped formulate the concept of this project. Additionally, external representatives of the industry value chain provide input both on the overall assumptions and on essential aspects of the project. Their feedback will be sought at intermediate stages of development and specifications can be adapted according to the perceived needs of the sector.

3.2.6 Risk management and handling of conflicts

The systematic progress of the work of REPAiR is secured by monitoring deliverables and progress reporting at the 6M meetings. The latter serve as regular moments where the consortium convenes to report and assess the status of the work of the individual participants, as well as consortium performance as a whole. Any existing or potential problems will be identified at such occasions. In similar European collaborative projects this has proven to be a very effective procedure, resulting in a mechanism of self-control and self-adjustment, which usually makes it unnecessary to explicitly enforce strict measures on progress recovery by the SC. Experience shows that for a consortium of specialized and professional partners, such as assembled in the REPAiR consortium, most difficulties that appear constitute only minor or temporary deviations from the work program, which can be easily managed by the partners themselves.

The procedure to handle conflicts is first to treat them at WP level. If a solution cannot be found, the WP leader reports the conflict to the coordinator and the coordinator attempts to find a proper solution. If this fails, the issue is taken to the following SC meeting. For urgent questions, a video-conference between the partners or an extraordinary SC meeting can be called.

In case of more serious problems that may demand a specific action, such as a modification of the work plan or even task distribution among partners, including modifications to the consortium budget distribution, the following actions will be undertaken:

- identification of the main risks and the potential causes;
- identification of the impact of the risks on the project objectives, resources and budget;
- analysis of possible mitigation plans to reduce the risks, in close cooperation with the affected partners;
- preparation of recovery plans;
- decision making by voting at the Steering Committee meeting.

All the above actions will be instigated by the coordinator but will be realized in full cooperation with the SC and when necessary in consultation with the EU programme officer.

3.3 Consortium as a whole

The goal of REPAIR is to provide local and regional authorities with an innovative geodesign decision support environment (GDS)) developed and implemented in peri-urban labs that create integrated, place-based eco-innovative spatial development strategies. This requires a combination of scientific, technical and local competencies and knowledge.

The consortium REPAIR is technically competent to develop the GDSE and well-balanced, as it brings together expertise from the best European universities, research institutions, local and regional authorities and leading businesses in waste treatment and circular economy development and SMEs leading the development of spatial decision support systems. The partner selection and work distribution have been done strictly according to the distribution of competences as well as knowledge and involvement in resource management and development of the circular economy within the case study areas. The need for a European approach is evident, as none of the partner countries alone could reach the proposed aims and objectives with resources available at a national level. The consortium is completed by the project office of the TU Delft Valorisation Centre, which is in charge of the administrative, legal and financial aspects of the REPAIR project in close cooperation with the scientific coordinator from TUD.

With 18 partners, the consortium is rather large for a research project. This choice was made deliberately, however, because key to the applied geodesign framework is the collaboration of experts from design disciplines, geographic sciences, information technologies and the people from the place in question. The last shows the importance of having access to local knowledge for every case study; data as well as key actors and stakeholders. Therefore the consortium is built of four groups of partners,

1. a group of scientific institutions complementary to each other in their key expertise and who provide with their teaching facilities one way of generating manifold designs for the development of the circular economy.
2. a group of local and regional authorities, which is crucial to embed the project within the local decision needs as well as make the outcome relevant for the local and regional authorities in place.
3. A group of companies that are experts in waste treatment as well as in implementing circular economies. Those are also crucial for the local embeddedness of the project and to insure its future impact.
4. A group of companies that are experts in the development of GDSE and combine ICT expertise, with expertise in spatial planning as well as process organisation.

Groups 1 and 4 work on the general framework and the development of the GDSE for all case studies. Groups 2 and 3 concentrate on the PULLs in one specific case, and provide input and reflections to the other case study areas only at specific times. Travel times and budget can be thus kept to a reasonable amount. As the following table shows, the consortium combines both a high level of compatibility as well as coverage of all key competences by at least two partners.

Table.3.3a: Expertise (E) in the consortium.

	Behavioural Dynamics	Circular Economy & Cradle to Cradle	Complexity Theory	Decision-Support	Environmental assessment	Geo-design	Software development	Industrial Ecology	Landscape Design & Ecology	Life Cycle Studies	Modelling	Policy transfer	Resource Management	Dynamics of socioeconomic spaces	Spatial Planning	Territorial Governance	Urban Design	(Peri-) Urban Metabolism	Waste Collection & Processing
TUD		E	E	E	E	E	E	E	E		E		E		E		E	E	
UG		E		E	E	E		E		E	E							E	E
UNINA									E		E		E		E		E		E
HCU			E									E				E	E	E	
RKI	E			E							E	E			E	E			
IGiPZ	E			E	E							E		E	E	E		E	
JRC		E		E	E			E		E	E	E	E					E	E
Geo-Col						E	E				E								

DELTA				E				E							E
BIOKOM								E		E					E
GGR			E		E	E		E				E			
OVAM		E						E		E					E
GHM									E			E	E	E	
CRA				E								E	E		
PHH												E		E	
BMU								E							E
IVAGO								E							E
SRH								E							E

3.4 Resources to be committed

The requested budget for the REPAiR project equals EUR 5.089.636. The tables below shows the detailed break down. The largest amount of the budget is reserved for direct personal cost. Its distribution is directly linked to the to the person months assigned per WP. Therefore, a summary of stuff effort is provided in table 3.4.b The distribution of workload and budget shows clearly that those partners, who are responsible for a PULLs, have a significantly higher PM number, than those who contribute to the PULLs. The exception are GGR and JRC, the first plays a key role in the development of the GDSE, the second plays a key role in WP3 to 5. Therefore, both have been assigned a similar PM number as the PULLs organising partners. The significant difference between the % of Budget and % PM assigned between partners is the result of the extreme differences in average person month rates between western and eastern European countries.

Table 3.4a Summary of staff effort

		WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	Total PM
1	TUD	21.5	17	15	12	17	4.7	10	12	109.2
2	UGHENT	0.5	2	12	26	5.5	1	3.2	3	53,2
3	UNINA	1	3	11	3	33	1	5.2	4.1	61.3
4	HCU	0.5	5	9	2	2	18	4.2	2.1	42.8
5	RKI	0.5	4	22	10	9	20	20	4.6	90.1
6	IGiPZ	0.5	3	13	10	9	2.4	7.1	13.1	58.1
7	JRC	0	1	10	24	5	0.7	0.4	6.1	47.2
8	Geo-Col	0	10	2	2	2.5	0.7	0.4	1.1	18.7
9	Delta	0	1	1	1	3	2	1	1.6	10.6
10	Biokom	0	1	1	1	3	0.7	3.4	3.1	13.2
11	GGR	0	29	1	2,5	1	0.4	0.4	2.6	36.9
12	OVAM	0	1	1	3	3	4	0.4	1.6	14
13	GMH	0	1	1	0	3.5	1	0.4	1.1	8
14	CRA	0	1	1	0	6	1	0.4	1.1	10.5
15	PHH	0	1	1	1	5	1	0.4	1.1	10.5
16	Bauer	0	1	1	1	3	0.7	0.4	1.1	8.2
17	IVAGO	0	1	1.5	0.5	3	1	0.4	1.1	8.5
18	SRH	0	1	1	1	3.5	1	0.4	1.1	9
Total Person Months		24.5	83	104.5	100	117	61.3	58.1	61.6	

A significant share of the budget is reserved for other direct costs, predominantly for travel and other goods and services. The cost of data acquisition (EUR 100,000), as well as the OpenEarth Data Lab (EUR 25,000) amount to the biggest share of costs for other goods and services and are a result of the lack of existing data on the peri-urban scale. For eight participants, the other direct costs exceed 15% of their respective personnel costs. This is detailed in table 3.4b.

Table 3.4b other direct costs

1: TUD	Cost (€)	Justification
Travel	€ 67.200.00	Travel (including accommodation and allowance) cost of scientific staff from the Faculty of Architecture to: Project meetings, 4 persons 2 meetings per year at 800 Euro = 25,600 PULLs in the other case study areas. 3 persons x2 per year at 1.400 Euro 33,600 Travel costs (including accommodation and allowance) of project manager to bi-annual project meetings: €8.000
Equipment	€ 25,000.00	Equipment, including: Smart boards, laptops/tablets and related software licenses specifically configured and used as interactive devices for the PULLs. for the GDSE development during the PULLs in Amsterdam, partly to be reused in the follow up studies.
Other goods and services	€ 211,900.00	25,000 Euro for data management using and further developing the 3TU Open Earth Data Lab 50,000 Euro traveling cost for the User board 100,000 Euro for Data collection and acquisition in all cases. 12,000 for open access publishing 15,000 for dissemination activities like conferences and final event. 3,000 translations 6,900 Euro for organising PULLs
Total	€ 304,100	

3: UNINA	Cost (€)	Justification
Travel	€ 46,400.00	Travel (including accommodation and allowance) for project meetings 2 persons for 2 meetings per year each 800 Euro = 12,800 EUR Travel (including accommodation and allowance) for PULLs in the other case study areas. 3 persons x2 per year at 1,400 Euro 33,600 EUR
Equipment	€ 25,000.00	Equipment, including: Smart boards, laptops/tablets and related software licenses specifically configured and used as interactive devices for the PULLs. for the GDSE development during the PULLs in Naples, partly to be reused in the follow up studies.
Other goods and services	€ 18,000.00	8,000 EUR for open access publishing 6,000 EUR for dissemination activities like conferences and final event. 3,000 EUR for translations 1,000 EUR security for fieldwork if necessary
Audit costs	€ 10,000	
Total	€99,400.00	

5: RKI	Cost (€)	Justification
Travel	€ 32,250.00	Travel (including accommodation and allowance) to: project meetings (3 persons) € 17,000 selected PULLs (1-2 persons):) € 7,250 dissemination conferences: € 8.000
Equipment	€ 3,000.00	2,000 EUR Smart boards, laptops/tablets and related software licenses specifically configured and used as interactive devices for the PULLs. 1,000 EUR ATLAS.TI software (or equivalent) for content analyses