

GreenerSites

ENVIRONMENTAL REHABILITATION OF BROWNFIELD SITES IN CENTRAL EUROPE

Final Report



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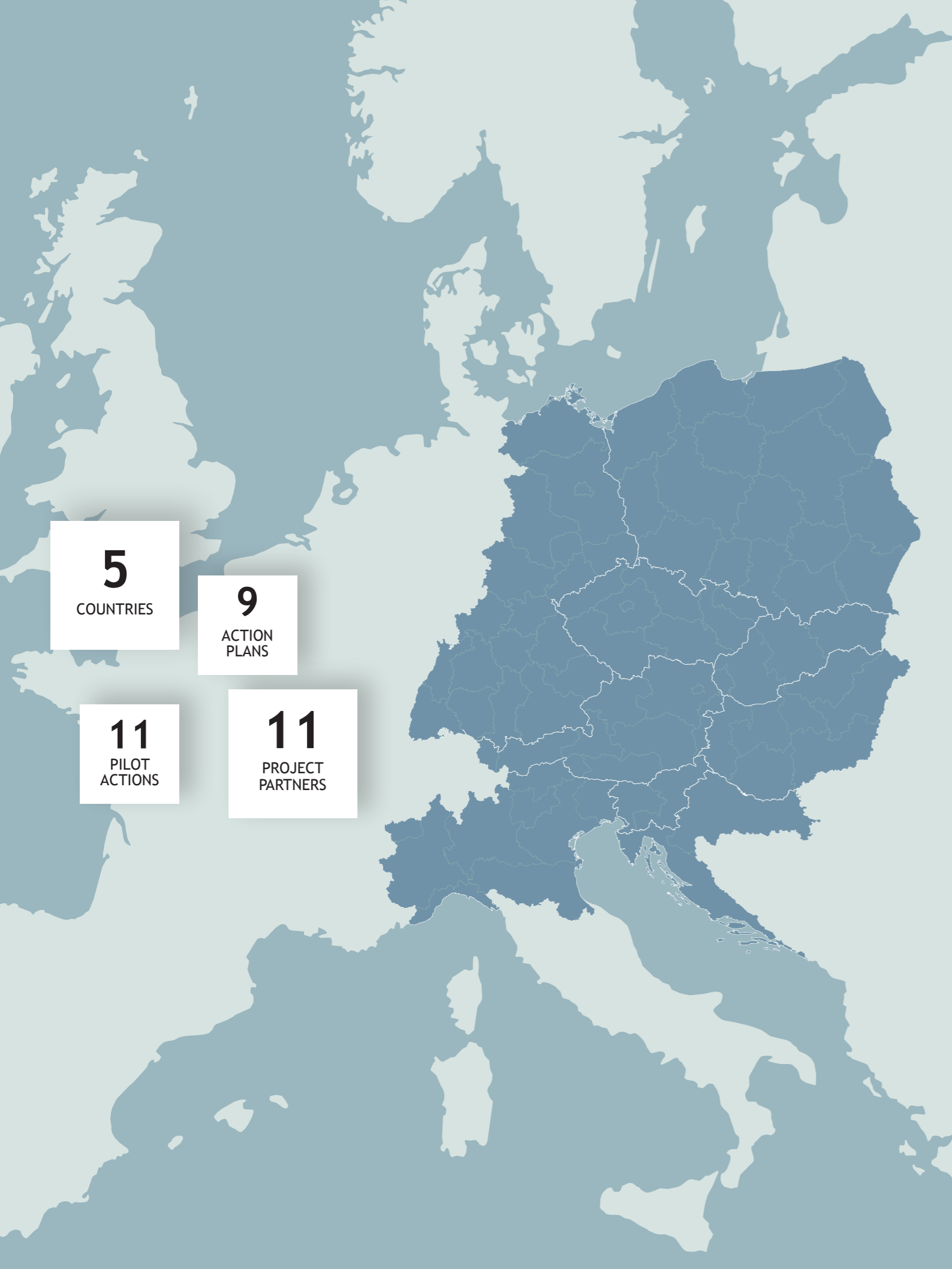
Project management team

Paola Ravenna, City of Venice - Manager of European Policies Department
Silvia Comiati, City of Venice - Project Manager from June 2016 to March 2017
Alessia Porcu, City of Venice - Project Manager
Franca Pullia, City of Venice - Communication Manager
Chiara Tenderini, City of Venice - Financial Manager

Project Partners

City of Venice - Lead Partner (Italy)
North Adriatic Sea Port Authority, Ports of Venice and Chioggia (Italy)
Veneto Region (Italy)
isw - Institute for structural policy and economic development (Germany)
Ministry of Regional development and transport of Saxony Anhalt (Germany)
Rijeka Port Authority (Croatia)
City of Rijeka (Croatia)
ARM SA - Mazovia Development Agency (Poland)
Municipality of Solec Kujawski (Poland)
City of Bydgoszcz (Poland)
Municipality of Celje (Slovenia)

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Introduction

This final report comes at the end of three years of intense work and fruitful collaboration among eleven partners from five central Europe countries, led by the City of Venice and strongly committed to address the common challenge of improving the management of brownfield sites in their respective Functional Urban Areas.

More than half of the European population lives in urban areas. The relatively recent trends, however, such as economic globalization, changes in political systems, new regulations, growing awareness about our impact on climate and environment have immensely changed the function and character of the European cities. Those changes, though, have also created a legacy of abandoned, frequently contaminated post-industrial areas in prime urban locations. Such areas create a considerable environmental and social issue but at the same time, an opportunity for redevelopment.

GreenerSites has meant to address these issues, working hand in hand with municipalities, helping them with sustainable redevelopment of the brownfield sites.

GreenerSites is a very strategic project for the City of Venice Economic Development and Environment Departments: the industrial site of Porto Marghera selected as pilot area, is a key economic node for Venice and for the Veneto Region.

This report contains a summary of the main project achievements and products developed through the successful cooperation of all partners. In particular, the Common Transferability Manual and the Pilot Actions results are fundamental parts of the legacy of this project.

Our wish is that the lessons learnt and the results obtained will continue to produce an added value which goes beyond both the duration of the project and its partnership.

We hope you will find the report interesting and inspiring!

Paola Ravenna
Manager of European Policies Department - City of Venice

1. The programme and the project



1.1 The GreenerSites Project

With an estimated three million sites affected by industrial contamination, Europe faces real challenges in improving brownfield areas. GreenerSites is a three-year European project funded by the Interreg CENTRAL EUROPE Programme which aimed to improve the environmental management of unused or underused industrial areas (brownfields) to make involved Functional Urban Areas (FUA) cleaner, healthier and more liveable places. The project brought together, under the coordination of the City of Venice, 11 partners from Germany, Poland, Italy, Croatia and Slovenia who jointly cooperated to implement and test actions based on a sustainable, integrated approach to reach a higher environmental performance of brownfields located in their territories.

The project started its activities in June 2016 and developed its approach in 5 main steps:

- Building a common knowledge framework on the status of their brownfields.
- Developing a Capacity Building program for public employees and stakeholders.
- Testing more sustainable and novel technical solutions in brownfields.
- Planning strategic actions to ensure the sustainability of the solutions tested.
- Promoting a shared governance for a long term sustainable development.

In the initial phase of the project, partners drew an analysis of the environmental and socio-economic status of their brownfields. This preliminary assessment was necessary to identify the priorities for the rehabilitation of the involved sites and highlight synergies, common goals and challenges.

To improve the environmental performance of their brownfields, project partners involved their stakeholders

in the implementation of 11 pilot actions meant to test more sustainable and novel technical solutions in their brownfields. Each pilot action investigated a specific aspect on brownfield management:

- Elaboration of new strategies for the rehabilitation and regeneration of the contaminated sites.
- Setting up new systems for monitoring the contamination in the groundwater, soil and air.
- Testing of some remediation methods.
- Implementation and testing of a geo-information tool to collect and manage brownfield data.

The solutions found assisted project partners and their stakeholders in the elaboration and deployment of Strategic Action Plans supported by political commitment for the sustainable environmental management of brownfields. The partners used the results to identify concrete actions to be implemented after project completion to promote the environmental rehabilitation of brownfield sites in their Functional Urban Areas.

The project meant also to reinforce capacities of the public sector to plan and carry out brownfield regeneration in a sustainable way by providing public employees with new skills and know-how on the environmental management of unused industrial sites. Technicians from the partners' institutions and their stakeholders benefited from a full training package which included transnational seminars, local training sessions and study visits to improve their skills and knowledge on environmental management. Project partners have also identified and visited some remediated sites in Vienna, Stuttgart and Lyon to reinforce their know-how by learning from others' experiences.

Prominent European networks operating on brownfield management (NICOLE, SURF and COMMON FORUM) collaborated within the project providing important inputs to the partnership and their stakeholders.

1.2 The GreenerSites Partnership

The GreenerSites partnership is made of 11 organisations from 5 central Europe countries (Italy, Germany, Poland, Croatia and Slovenia) constituting a well-balanced partnership which focuses its actions at local or regional level: 2 regions, 4 cities, 2 port authorities, 1 development agency, 1 private institution. All bear specific institutional competences on the management of the involved brownfield sites, share the same concern and need to find appropriate solutions for the rehabilitation and the future reuse of the sites.

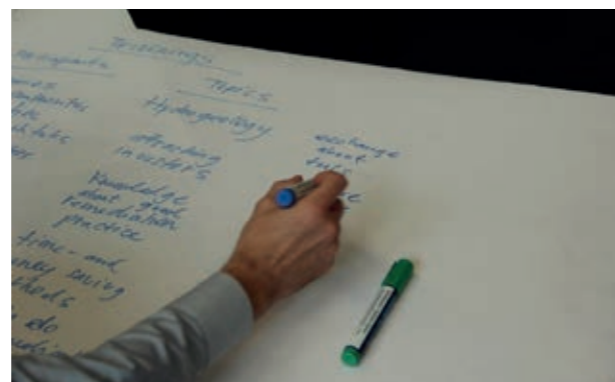
14 institutions are involved as Associated Partners in GreenerSites. They represent prominent networks operating at EU level on brownfield management & organisations (private and public) which are competent for the involved sites. Their cooperation provided different opportunities to exchange and reinforce know-how, learn from others' experiences and disseminate project results.

Partners

- City of Venice - Lead Partner (Italy)
- North Adriatic Sea Port Authority, Ports of Venice and Chioggia (Italy)
- Veneto Region (Italy)
- isw - Institute for structural policy and economic development (Germany)
- Ministry of Regional development and transport of Saxony Anhalt (Germany)
- Rijeka Port Authority (Croatia)
- City of Rijeka (Croatia)
- ARM SA - Mazovia Development Agency (Poland)
- Municipality of Solec Kujawski (Poland)
- City of Bydgoszcz (Poland)
- Municipality of Celje (Slovenia)

Associated Partners

- Metropolitan City of Venice (Italy)
- Association of the Industrial Zone of Porto Marghera (Italy)
- Environment Agency Austria (Austria)
- SuRF Italy (Italy)
- Kujawsko-Pomorskie Region (Poland)
- NICOLE - Network for industrially Contaminated Land Europe (Netherlands)
- Municipality of Radom (Poland)
- Brownfield Authority Saxony-Anhalt (Germany)
- Bydgoszcz Regional Directorate of Environment (Poland)
- Bydgoszcz Regional Inspectorate of Environment (Poland)
- Bydgoszcz Industrial Park (Poland)
- Slovene Ministry of Environment (Slovenia)
- Energo Ltd (Croatia)
- City of Halle (Germany)



1.3 The Interreg CENTRAL EUROPE Programme

The Interreg CENTRAL EUROPE is an EU programme that encourages cooperation on shared challenges in central Europe. With 246 million Euro of funding from the European Regional Development Fund, the programme supports institutions to work together beyond borders to improve cities and regions in Austria, Croatia, Czech Republic, Germany, Hungary, Italy, Poland, Slovakia and Slovenia.

The programme provided financial support to cooperation projects that address shared regional challenges in four thematic fields: innovation, low-carbon economy, environment, culture and transport.

The Interreg CENTRAL EUROPE Programme is currently funding 129 cooperation projects across central Europe.



2. Preliminary brownfield analysis



2.1. Overview

The first phase of the project was aimed at drawing a picture of the status of the urban/peri-urban brownfields involved in the project and help the project partners moving towards a more sustainable and integrated approach to environmental management of brownfields. Initially, all project partners carried out specific research activities by collecting quantitative and qualitative data on environmental and socio-economic status, infrastructure, legal framework, remediation measures as well as monitoring systems already in place in their Functional Urban Area. The result of the research was 9 detailed *Brownfield Analyses* (November 2016) which assessed the environmental, economic, social and institutional status of the sites. The analyses produced interesting results and made it possible to highlight, synergies, common goals, similar problems and critical issues among the territories involved. The analyses were carried out at partner level with the involvement of local stakeholders and provided relevant information with reference to the **air, soil and groundwater contamination**, the governance process, the existing infrastructures land use restrictions, the planned and carried-out interventions. Overall, Greener-Sites project partners described 11 brownfields in 9 Functional Urban Areas, and in particular:

- 1 in Italy: Porto Marghera in the Venice FUA;
- 2 in Germany: Ammendorf in the Halle FUA; Magdeburg-Rothensee in the Magdeburg FUA;
- 6 in Poland: the former Power Plant industrial site in Radom and Pionki FUA, the ZTS “Pronit” area of the former sugar factory Borowiczki in the Plock FUA; the post-industrial zone Kamionek in Warsaw FUA; the Former factory of railway sleepers preservation in Solec Kuyawski and the old “Zachem” Chemical Plant in the Bydgoszcz-Toruń FUA.
- 1 in Slovenia: the Old Cinkarna site in the Celje FUA;
- 1 in Croatia: Mlaka area in the Rijeka FUA.

However, it must be said that the total number of brownfields in the partner regions is much higher than this (4,920 brownfields are mentioned). The **main environmental concerns** result from current or past industrial activities undertaken in the sites. The most frequently mentioned industries causing pollution and environmental harm are (raw) chemical industry and refinery (mentioned 6 times), lignite mining (1), military (1), potash mining (1), metallurgy (2), machinery (1), food industry (1), and tannery (1). Further environmental impact is caused by improper waste disposal, production-related transport as well as urban traffic.

With regard to the **FUA ownership**, it can be noted that there is a mixed ownership structure in the partner regions with both, publicly and privately owned areas. The area of pilot site of Bydgoszcz is mostly part of the former “Zachem” chemical plant area in Bydgoszcz. It is managed by a trustee in bankruptcy. Private companies won other parts, a minority is under city management.

When it comes to **air, soil and groundwater contamination** there is a heterogeneous situation in the partner regions. Some FUAs suffer from severe contamination, mostly related to current or past industrial activities, production-related transport and urban traffic. Some FUAs have good air, soil or/and groundwater conditions and there are some FUAs lacking of information or further environmental data analyses.

Partners provided specific information covering status of remediation process and sustainable remediation techniques already experimented, as to have a clearer picture of the sustainable environmental investigations performed in the FUAs.

The analyses referred to economic, environmental and social dimensions of **sustainable development** (as e.g. defined in the CABERNET project¹):




- **Economic:** Mobilising human resources, using existing sites and infrastructure to modernise and improve the urban fabric. Generate economic growth in urban quarters, increase public and private income;
- **Environmental:** Cleaning up, restoring previously used land. Placing brownfields regeneration at the forefront of regeneration strategies and using this programme as a driver for the clean-up of contaminated land. Reducing land consumption and urban sprawl by encouraging sustainable brownfield regeneration projects;
- **Social:** Ensuring the long-term sustainability of brownfields redevelopment by including socio-cultural dimensions. Mobilising communities to ensure representative and equitable sustainable development, which may reduce the potential for subsequent decline and recreation of brownfields, improving the quality of life in city areas.

Though not in every partner territory a clear sustainable approach was experimented in the applied remediation techniques in most of the project territories this approach was often adopted in the activities achieved so far. These findings are categorised as follows²:

¹ CABERNET - Concerted Action on Brownfield and Economic Regeneration Network <http://www.eugris.info/displayproject.asp?Projectid=4415>, project duration 2001-20004.

² Please consider that often a clear allocation to the three dimensions is not possible due to overlapping areas between economic, environmental, and social aspects. Mostly, they even are conditional on each other.



Sustainability dimension	Remediation approaches, measures, and techniques	FUA / country
 Economic	<p>Redevelopment of site into a Science and Technology Park, called VEGA.</p> <p>Two different Agreements were signed by the MISE (Italian Ministry of the Environment), the Veneto Region, the Venice Port Authority and the Municipality of Venice, which contained investments for industrial reconversion and requalification of Porto Marghera</p>	Venice, Italy
	<p>Identification of potential development areas have been carried out. Deeper contamination analysis is required for further settlements (depends on the future use of the area / settlement - commercial, production etc.)</p>	Halle-Ammendorf, Germany
	<p>Identification of potential development areas have been carried out. Deeper contamination analysis is required for further settlements (depends on the future use of the area / settlement - commercial, production etc.)</p>	Refinery Rijeka, Croatia
 Environmental	<ul style="list-style-type: none"> • Phytoremediation area of 150 ha has been developed to treat civil wastewater in order to reuse it for industrial purposes. • Groundwater related clean-up activities and embankments of port areas. • Standardisation of characterisation protocols, and remediation selection protocols. • Reuse building rubbles and excavated soil for regeneration and remediation sites. • “in-situ” system for cleaning-up polluted groundwater. • -Science and Technology Park (VEGA) - bioremediation (biopile) process. 	Venice, Porto Marghera, Italy
	<ul style="list-style-type: none"> • ENA field-testing for in-situ biodegradation of contaminated groundwater. • A ground water clean-up project based on air sparging <p>(Air sparging is an in-situ subsurface contaminant remediation technology that involves the injection of pressurised oxygen into contaminated ground water enabling the hydrocarbons to transform from a dissolved to a vaporous state.)</p>	Magdeburg-Rothensee, Germany
	<p>A conceptual design of an “in situ” decontamination method was developed. In 2010 based on additional geochemical studies and the first microbiological tests performed, an alternative concept of land and groundwater bioremediation was proposed - using the indigenous (inoculated and multiplied) micro-organisms capable of decomposition and reduction in the concentrations of several aromatic hydrocarbon compounds.</p>	Bydgoszcz-Toruń, Solec Kujawski, Poland
 Social	<p>During construction of basic utility infrastructure in 2008, excavated soil was classified as hazardous waste.</p> <p>For remediation of 15,327 m³ of material Stonetech 2 method was chosen. Basis is immobilization of contaminants with cementation. It uses excavated soil and industry ash from papermaking industry in ration 2.66:1.</p>	Municipality of Celje, Stara Cinkarna (Old Cinkarna), Slovenia
	<p><i>Since environmental and economic measures are necessary preconditions for socio-cultural development, all above-mentioned aspects do have a social dimension as well.</i></p>	



Partners have also identified some difficulties to have a detailed picture of all GreenerSites FUAs in relation to some aspects. The partners mentioned the following reasons:

National regulations

Sometimes it is not clear whether there are clearly defined obligations to perform environmental research and to undertake remedial actions.

Data acquisition

Often there is only fragmentary inventory of contaminated areas.

Data accessibility

In some cases, it is not clear who collects and provides specific data (public bodies, private owners etc.).

For those reasons, brownfield remediation should consistently be part of a coherent spatial and strategic land management approach, particularly with respect to the wider concept of economic, environmental and social dimensions of sustainable development. It seems appropriate to further improve the brownfield remediation process - particularly when it comes to data accessibility, clearly assignable responsibilities, capacity building of public bodies and increased communication efforts towards stakeholders and citizens.

2.2. Main features of the selected brownfields

Venice Porto Marghera (Italy)

Characteristics of the brownfield:

- Size: 1828 ha.
- Location: on the edge of the Venice lagoon.
- Ownership: 35% public, 65% private.
- Since 1998 (Law n. 426/1998) it is declared “Remediation Site of National Interest” because of its potential impact on the environment, due to its surface extension and risk posed by contaminants. Despite its decline, the industrial site of Porto Marghera is still active and remains an economic node of the Venetian and Veneto Region area, with 841 economic activities and 10.480 employees.

Main issues/problems:

- Specific contamination of soil and groundwater deriving from the former petrochemical production.
- Sanitary risk posed by contamination: in particular, potential impacts on population due to the presence of 9 factories using dangerous substances.
- Serious hazard for Venice lagoon due to pollution of groundwater of the site.
- In 49% of the total area the remediation projects have been approved by the relevant authorities but not yet started.
- Remediation procedures have been completed only in 14% of the area (241 ha).
- Fragmentation of the governance process in different levels of competence - national, regional, local.
- Intrinsic complexity of the clean-up and administrative procedures.
- Progressive crisis of the industrial production in the site.



Photo credits: Giorgio Bombieri, City of Venice

FUA Halle Halle Ammendorf (Germany)

Characteristics of the area:

- Halle-Ammendorf (407 ha) is a former industrial site: lignite mining, chemical industry and mechanical engineering.
- Brownfields are all in private ownership;

Main issues/problems:

- Transition process after German unification: privatisation & closure of companies - many brownfields as left over;
- For many brownfields a lot of information is missing.
- Contact and cooperation with owners is at low level.
- There is little knowledge about the real barriers for development and what needs to be done for the redevelopment.
- Very little development area in the city - increasing demand from investor.
- No holistic concept for the development of area (industry/housing).



FUA Magdeburg Magdeburg-Rothensee (Germany)

Characteristics of the area:

- Size: 945 ha.
- Location: The Magdeburg-Rothensee port and industrial complex is situated on the banks of the river Elbe to the north of Magdeburg.
- Ownership: 54 % privately owned; 27 % City of Magdeburg; 15 % Magdeburger Hafen GmbH; 4 % State of Saxony-Anhalt / Federal Republic of Germany;

Main issues/problems:

- Ground Water contamination.
- Soil contamination.
- High traffic volume (high number of trucks passing through) - high degree of air and noise pollution.
- Public transport (bus, tram), bicycle and walkways need to be improved.
- Public utility infrastructure requires modernisation.
- Several sites are unused or underused or used for inferior, low value purposes.
- Many industrial buildings and granaries, some of which enjoy listed building status, are currently unoccupied or are not being adequately utilised.
- The remediation and redevelopment of brownfield sites and the renovation and upgrading of existing building stocks continue to be important objectives in terms of environmental rehabilitation and urban development.



FUA City of Radom and City of Pionki (Poland)

1. ZTS "Pronit"

Characteristics of the area:

- Size: about 300 ha.
- Location: ZTS "Pronit" is located in the south of the city of Pionki.
- Ownership: The owner of the site is the Municipality of Pionki.

Main issues/problems:

- Air contamination.
- PM10 exceeding the target level.
- Soil contamination: the soil used for agriculture is very poor.



2. Industrial area on the territory of the former Power Plant in Radom

Characteristics of the area:

- The area of the former Power Plant in Nowa Wola Gołębiewska is incorporated to the Municipal Heating Company Radpec S.A., in the North of Radom. The area is located in the Northern part of the city, where local authorities are currently preparing a revitalization micro-programme.
- Ownership: public and private.

Main issues/problems:

- Air contamination; PM10 exceeding the target level.
- Soil contamination: poor quality of the soil due to impurity.
- The revitalization programme is related to the solution of social problems. There are 6 blocks of social housing put into use in 2004 and 2010 for 370 families. The buildings were largely devastated. The residents complain about the safety and the access problems to the city centre. There is socio-therapeutic centre but only for children. Young people and adults have no recreation places, so they are at risk of social exclusion.



FUA City of Plock The former sugar factory Borowiczki (Poland)

Characteristics of the area:

- Size: 26,02 ha.
- Location: on the river Stupianka.
- Ownership: Public and private.

Main issues/problems:

- Air contamination: the concentration levels of PM10 are very high.
- Superficial water contamination: food industry is characterized by a high degree of water consumption, causing the production of large amounts of waste water.
- It is not possible to assess the current quality of the soil area of this brownfield site because of the lack of available sources of information.

FUA City of Warsaw - Kamionek post-industrial zone (Poland)

Characteristics of the area:

- Location: the area is located on the right bank of the Vistula River, in the north-western part of the Praga South district, stretching north from the street Grochowska, belonging to the historical part of the district.
- Ownership: The ownership structure of the area is diverse. The largest share is owned by the City of Warsaw.

Main issues/problems:

- Groundwater contamination: the main source of surface water pollution are urban and industrial effluents, discharged from the area of the city of Warsaw primarily drainage system.
- Poor quality of the soil: debris, glass, municipal waste, concrete, wood, chemical substances from transport (including flue gas, fuel oil), heavy metals and other contaminants from industry, transport, services and chemicals used for road maintenance in winter.

FUA Bydgoszcz-Toruń (Poland)

1. The former factory of railway sleepers preservation in Solec Kujawski (Poland)

Characteristics of the area:

- Size: approximately 16,44 ha.
- Location: this area is close to the city centre and near the largest housing estate and recreation and sports facilities.
- Ownership: public. The land was purchased in 2008 by the Municipality of Solec Kujawski.
- The Solec Kujawski brownfield is the site of the former wood preservation factory for which in years 2013-2016 remediation was carried out using funds from the European Union Operational Programme 'Infrastructure and Environment' and for which pilot environmental monitoring tools are needed.

Main issues/problems:

- Poor quality of groundwater: the presence of heavy non-aqueous liquid (DNAPL) was indicated after several drillings carried out in 2013 and 2015. It was detected that the DNAPL is very slowly migrating from the area of former contamination sources.
- On the south side of the area there is a flow of water similarly heavily contaminated with BTEX, PAHs and phenols from a different old post-industrial area.



2. The old "Zachem" Chemical Plant in Bydgoszcz

Characteristics of the area:

- The Zachem factory, from the Sixties until 2013, was the largest producer of organic chemicals in Poland.
- Size: approximately 2000 ha.
- Location: It is located in the south-eastern part of the city, at a distance of approximately 7 km from the centre. It is located in the Central European Plain province. The area of Natura 2000, located the nearest to the former Chemical Plant, and being within the reach of the potential impact of post-industrial areas is the "Valley of the Lower Vistula: there is a number of different forms of nature conservation within this valley.
- Ownership: Because the area of the former "Zachem" Chemical Plant in Bydgoszcz is managed by a trustee in bankruptcy, the main objective of the company in liquidation is oversold assets, provision of services and the settlement of liabilities.



Main issues/problems:

- Highly toxic substances get into the soil and groundwater causing a strong contamination.
- It is difficult to reliably determine the current state of environmental pollution due to the defective existing monitoring system.
- The long-term emission of pollutants to the environment, as well as the lack of actions preventing their migration, have caused that highly toxic, carcinogenic and mutagenic pollutants move outside the premises of Zakłady Chemiczne "Zachem" to inhabited areas (Łęgowo and Płatnowo settlements), causing health hazards to resident.



FUA Municipality of Celje Old Cinkarna (Slovenia)

Characteristics of the area

- The pilot site was used by metallurgical-chemical company Cinkarna Celje. In the late 1980's, it was left abandoned and in need of environmental rehabilitation
- Size: the Old Cinkarna brownfield site has a size of 17 ha reflecting different types of degradation. It constitutes around 1% of the city area and it is the biggest contaminated area in the city.
- Ownership: public (100% of the City).

Main issues/problems:

- Contaminated soil with heavy metals and mineral oils. They can surface during construction and excavation works as wastes, which may contain hazardous substances.
- Estimates of buried industrial waste and tar pits.
- Estimates of buried reservoirs and underground drainage technology.
- Lack of information/research on soil contamination in depth and groundwater in the area.
- High costs for remediation.



FUA Rijeka, Mlaka area The Refinery Rijeka

Characteristics of the area

- Some part of the area is residential but most parts are industrial. It represents one of the biggest pollutants in the area.
- Size: it is one of the main brownfields in the territorial Functional Urban Area (200.000,00 m²).
- Location: INA Refinery is situated in the west coast of the City of Rijeka (area Mlaka), very close to the city centre.
- Ownership: The largest share of the area (approx 98%) belongs to a private owner. The traffic area surrounding the refinery are state roads and some small part of the area is state property.

Main issues/problems:

- Ecological status: chemical reactions of ozone precursors, local sources, transport, inadequate waste disposal, contamination of soil in dismissed industrial areas.
- Ownership relations and responsibilities for its rehabilitation, future purpose.



3. Capacity building activities

One of the objectives of GreenerSites was to reinforce the capabilities of the public sector to plan and carry out brownfield regeneration in a sustainable way, by providing public employees with new skills and know-how on the environmental management of unused industrial sites.

Technicians and officers from partner institutions and their stakeholders benefited from a **full training package** which included cross-border seminars, local training initiatives, and site and study visits. Specifically, this approach was taken to facilitate the sustainability of GreenerSites' activities even after the end of the project. In particular, GreenerSites partners have organised 2 transnational training sessions, 9 local training sessions and 8 site visits for public employees and stakeholders so as to increase their capacity to effectively manage brownfield regeneration in a sustainable way.

Overall, a total number of **351 people** were trained within the project.



3.1. Transnational trainings

The first transnational training session was organized in Bydgoszcz between 10th and 11th May 2017, and tackled the subjects of sustainability measures, and experiences and practices in remediation. The knowledge gained was aimed at supporting partners in the implementation of their pilot actions and at favouring the exchange of know-how among technicians who work daily in the field of brownfield management and remediation. The main topics were the economic and environmental aspects of sustainability. About 60 people attended the training session: ranging from project and associated partners and local Polish stakeholders. The format of the training session consisted in presentations from experts, site visits, a workshop on IT modelling, and small one-to-one talks with the experts.

The second transnational training session was held in Venice on 9th of November 2017. It focused mainly on the presentation and use of the Web gis tool developed within the project for the collation and management of brownfield data. The format was structured into two parts: the first consisted in presentations from experts, discussions and a practical testing of the tool, the second was a more practical session, aimed at enabling partners to effectively learn to configure, adapt and use the tool according to their needs. In addition, a short session was included which covered the theme of sustainability in the remediation and rehabilitation of brownfields from a social perspective. The total number of participants in the training was 50.

3.2. Local trainings

Starting from May 2018, project partners organized specific training sessions at a local level, touching on topics connected with their territorial stakeholders' needs. To reach this goal, training materials were prepared and adapted to the specific contexts.

The training sessions, jointly organized by partners cooperating in the same pilot site, were addressed not only to the technicians from the involved partner institutions but also to their relevant stakeholders. They were aimed at providing the necessary know-how to deal with the rehabilitation of the pilot areas, with particular focus on the GreenerSites web gis tool.



3.3. Pilot site Visits

In occasion of each transnational project meeting, partners visited the brownfield sites where the pilot actions were implemented to better understand the challenges faced by partners in their respective sites.

Site visits took place in Venice (twice), Magdeburg, Bydgoszcz, Solec Kujawski, Celje, Radom and Rijeka.

3.4. Study Visits

Study visits were meant to give the project partner the opportunity to learn from other brownfield management experiences through a method of peer to peer learning. These visits offer the visitors the opportunity to see first-hand the new solutions and initiatives developed by institutions working on the same issue. This method facilitates the exchange of experience and knowledge among participants in a dynamic interactive way. Project partners, associated partners and project stakeholders identified and visited some remediated sites in Stuttgart, Lyon and Vienna. These sites were selected on the basis of the thematic focus of the pilot actions.

The visit to Stuttgart was staged between 17th and 18th May 2018 and was hosted by the City of Stuttgart. The participants visited three different brownfield sites, with various features and different challenges: the Schoch Site Feuerbach, the Bosch Site Block 1 Feuerbach, the Neckarpark bad Cannstatt.

The visit to Lyon was staged between 23rd and 24th May 2018 and was hosted by the Metropolitan City of Lyon (Grand Lyon). Participants were welcomed by a number of officials from the Metropolitan City and visited the Chemical Valley (La Vallée de la Chemie), a 373-hectare industrial area along the Rhone river where, since 2014, the Metropolitan City of Lyon has been carrying out a huge redevelopment process.

The visit to Vienna was staged between 7th and 8th June 2018 and was hosted by the GreenerSites Associated Partner EAA - Environment Agency Austria. The participants visited two different brownfield sites: the Simmering Gasworks and the Northern Railway Station, each with varying features but similar environmental problems in groundwater and soil pollution.



For more details on the transnational study visits, and in particular on the experience gained and lessons learnt by GreenerSites partners, please refer to the publication "Study Visits short stories", available in the GreenerSites website in the "Publications" section.

4. Pilot Actions

All of the 11 GreenerSites partners have planned, implemented and evaluated local Pilot Actions for a more sustainable environmental regeneration & reactivation of brownfields.

Each Pilot Action investigated a specific critical aspect of brownfield management, including: elaboration of brownfield revitalisation strategies and tools, novel monitoring systems, effective remediation methods, as specified below.

Pilot solutions are designed to be replicable in other contaminated sites. Strategies and tools can be adapted to different contexts: as described in the table below. They consist in brownfield revitalisation strategies, novel systems for monitoring the contamination in the groundwater soil and air, identification and testing of the most effective sustainable remediation methods, and the testing of new tools for brownfield management.

Type of Pilot action	Project Partner	Name of the Site	
Elaboration of new strategies for the rehabilitation and regeneration of the contaminated sites	City of Venice	Porto Marghera industrial area	Reviewing the remediation plans in light of the envisaged re-use of the site and the changed regulations; Defining specific measures and fiscal instruments to attract new investment in the area
	isw - Institute for structural policy and economic development	Halle-Ammendorf in Halle (Saale)	Promoting the revitalisation of the area by improving the site's marketability
	Port of Rijeka	Mlaka area in Rijeka Harbour	Definition of a Strategy for the environmental and economic rehabilitation of a harbour brownfield
	City of Rijeka	Mlaka area in Rijeka Harbour	Assessment of the environmental impact in the inhabited area surrounding the brownfield in the harbour
	ARM SA Mazovia development agency	Former CH Plant in Radom	Definition of a strategy for the revitalisation of the brownfield area based on social sustainability and on public participation principles
New systems for monitoring the contamination in the groundwater, soil and air	Veneto Region	Porto Marghera industrial area	Setting up of a system in the Porto Marghera area for the monitoring of the soil/gas levels in the air
	Municipality of Solec Kujawsky	Former railway sleepers preservation plant in Solec Kujawsky	Setting up of a system for the diagnosis of the type of water contamination, and the monitoring of the changes in concentration, the direction of migration, and overall composition so as to prevent any threat to the population
	City of Bydgoszcz	Former chemical plant "Zachem" in Bydgoszcz,	Setting up of a system for the monitoring of ground and groundwater contamination in inhabited areas near the brownfield site
Testing of some remediation methods	City of Celje	Stara Cinkarna in Celje	Testing and comparison of some remediation methods in the brownfield site
	North Adriatic Sea Port Authority	Porto Marghera industrial area	Testing of the capping method for cleaning up of a polluted site in the so-called Montesyndial area
Tools for the management of the brownfield sites	Ministry of Regional development and transport of Saxony Anhalt	The Magdeburg-Rothensee port	Implementation and testing of a geo-information tool to collect and manage brownfield data

Photo credits: Giorgio Bombieri, City of Venice



4.1. The City of Venice Pilot Action Four studies to support the rehabilitation of Porto Marghera

The City of Venice elaborated some research studies aimed at linking remediation strategies with the need for future productive settlements in the area of Porto Marghera, taking into consideration both the deeply interlinked environmental and the economic aspects.

The necessary action and the goals achieved by the City of Venice Pilot Action were the following:

- Reviewing the remediation plans in the light of the envisaged re-use of the site and the changed regulations
- Speeding up the procedures taking into account the new regulations and the sustainability of the interventions
- Defining specific measures and fiscal instruments to attract new investments in the area.

Activities undertaken consisted in the elaboration of studies and research to identify innovative and sustainable solutions for the remediation of a specific brownfield within Porto Marghera and to find relevant financial and fiscal measures to be applied to the area to facilitate the reconversion of the dismissed industrial areas, so as to attract investment and aid development of Porto Marghera. In particular, four different studies were elaborated. The first two sought to provide on the state of the art environmental management and the status of the economic activities currently undertaken Porto Marghera; while the remaining two propose new solutions both for the environmental rehabilitation and the economic redevelopment of Porto Marghera.

The Report on the state of art of environmental management and particularly remediation in pilot areas provides the state of remediation procedures carried out so far in the area identifying the critical issues that influence and create obstacles for the implementation of the remediation process. Within the vast area of Porto Marghera, a Site of National Interest, some sections of the site have been identified whose total area is equivalent to 108 hectares, for which the Municipal Administration has recognized excellent redevelopment potential.

Hence the need to review the remediation projects in the light of the new use requirements, whilst also taking into consideration the new regulatory orientation which calls for greater attention to the environmental and economic sustainability of the interventions to be performed. The *Study on the most valuable, sustainable and cost-effective remediation methods for pilot area* identifies ground-breaking, sustainable technical solutions for environmental rehabilitation through a general review of the already approved soil remediation projects. In particular, the work consisted in the review of the sustainability aspects of two remediation projects, dating back to 2005 (therefore pursuant to Ministerial Decree 471/99) and up until now (2019) not yet implemented, which relate to the treatment of contaminated soils. The objectives of the revision were to define certain sustainability indicators and the method of assessing them, making use of the technical simplifications introduced by the Programme Agreement dated 16/04/2012 and the related implementation protocols. The study also identified possible technological alternatives which enable the same results to be achieved, whilst reducing their impacts. However, the basic choice of opting for in situ technologies (i.e. technologies that can be implemented within the site area) was maintained, limiting top-soil removal jobs and excavation and earth moving activities. The strategy of the City of Venice for the site also envisages its economic development. The *Study on the potential use of the pilot area for new productive activities* investigated the potential use of the pilot area of Porto Marghera for such activities as well as looking into which fiscal, legislative and financial instruments can favour its establishment.

The study is articulated into two sections:

- the definition of Guidelines for the drafting of contracts for the purchase and sale of industrial areas included in the Venice - Porto Marghera site;
- the preparation of a study of the regulatory and fiscal instruments that can enable the attraction of investment and the development of the Porto Marghera area.

The Guidelines represent a strategic tool capable of guiding potential investors with respect to complex legal, fiscal and legislative issues which inevitably interfere with the activities of buying and selling areas in industrial contexts. Additionally, a promotional booklet was produced to enhance the marketability of the Porto Marghera area.

City of Venice Best practice *Identification of the most valuable, sustainable and cost-effective remediation methods for a specific area.*

This best practice refers to the development of a methodology to compare different available remediation technologies and identify the most suitable and sustainable ones for a specific contaminated area. This includes a list of sustainability indicators and the method of assessing them. The work carried out by the City of Venice consisted in the definition of a new method to select the most appropriate available technologies in order to clean up contaminated sites. This method is based on three fundamental aspects: the best remediation technologies with respect to the contaminants, the current regulation framework and the degree of sustainability of the remediation. The sustainability evaluation of the intervention was developed and based both on the methods proposed by Surf UK (United Kingdom's Sustainable Remediation Forum) and ISPRA (Italian Institute for Environmental protection).

The final outcome gives some technical guidelines for the planning of new remediation interventions in contaminated sites or in the revising of existing ones. This method can be applied to any site in any territory.





4.2. The Veneto Region Pilot Action A system to monitor the air quality in Porto Marghera

The Veneto Region, supported by ARPAV - Regional Environmental Agency, implemented a system to monitor the air quality in order to define the specific soil-gas reference level. To do so, the innovative MLE - Multiple line of evidence" approach was adopted.

The Veneto Region Pilot Action carried out in collaboration with ARPAV (Veneto Region Environmental Agency) aimed to put in place a system to monitor the air quality in Porto Marghera in order to define the specific soil-gas reference levels in sites subject to remediation.

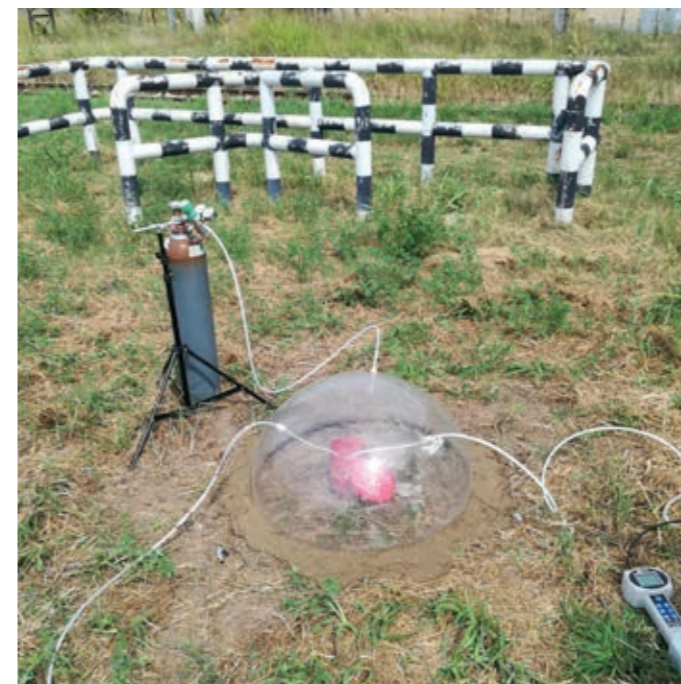
The implemented activities allowed for a system to be put into practice to identify the different sources of chemicals in indoor air and to distinguish their contribution to air pollution in relation to VOCs (volatile organic compounds) migration from the subsurface.

Activities carried out were implemented to achieve the following goals:

- developing monitoring procedures for gaseous matrices that are in line with risk assessment requirements;
- studying the temporal variability of VOCs concentrations and their link to soil-atmosphere dynamics;
- selecting best sampling techniques for Venice - Porto Marghera Mega site i.e. for contaminated sites characterized by superficial water bearing unit and medium-fine soil texture.

5 areas were selected for the field tests after a preliminary evaluation of the air quality by means of a systematization of existing data:

- 1 site located on a "Refineries and Tanks" Macroisland whose soil and groundwater are contaminated mainly by petroleum hydrocarbons;
- 2 sites located on a "New Petrochemical Plant" Macroisland, whose soil and groundwater are contaminated mainly by organochlorides;
- 1 site located on a "Old Petrochemical Plant" Macroisland, whose soil and groundwater are contaminated mainly by organochlorides;



Three measurement periods totalling six days were carried out in the course of 2018.

ARPAV undertook field tests based on a multiple line of evidence (MLE) approach to obtain a direct characterization of the VOCs migration process. In the MLE approach, the decision-making process is based on the investigation of different environmental media and all available results are evaluated to assess risks related to the vapour migration pathway, if complete. The selected approach helped to distinguish the contribution of subsurface sources to air pollution from those contributions related to other sources, like anthropogenic background levels or productive cycles. This method has several advantages in comparison with a more traditional approach, because it enabled a better calibration of subsequent remediation interventions.

A surveillance committee was also established for the evaluation and control of the monitoring system with the task of producing annual report on the data elaborated.



Region of Veneto Best practice The MLE approach for a more realistic and less conservative risk assessment

This best practice is based on the MLE (multiple line of evidence) approach to monitor the air quality in contaminated sites. The MLE approach has been applied at the Marghera Pilot Site to analyse the subsoil contamination and its contribution to air pollution with respect to other contributions from widespread sources and production activities. The MLE approach was more precise than normal transport models and widely applicable in contaminated areas. Therefore, it can be used to better calibrate the remediation interventions that are needed in any given site.

The Pilot action demonstrated that transport models normally overestimate the contamination level and risks. This over-estimation regards the first phase of the volatilization process (from liquid to soil-gas): for the majority of soil-gas analysed the concentration measured through the model is higher than that measured in the field. This means that a remediation intervention designed on the basis of transport models results would probably be more complex and more expensive than that which would be necessary in that specific site.



4.3. The North Adriatic Sea Port Authority - NASPA - Pilot Action *Test of a more environmental friendly and cost effective way to provide the capping*

The Pilot Action implemented by the North Adriatic Sea Port Authority had the objective to check the stability of the soil over which the environmental capping will be realized where NASPA foresees to build a container terminal.

The Pilot action of the North Adriatic Sea Port Authority aimed to **test a more environmentally friendly and cost-effective way to provide capping** in the so-called Montesyndial area, which NASPA plans to redevelop into a container terminal.

The final goal of the action was to check the stability of the soil over which the environmental capping will be realized. The main scope of the capping is to interrupt the pathways of contaminants and also to provide statics quality to the container terminal surface pavement.

A preparatory study was developed in 2017 which consisted in geognostic/geotechnical and environmental analyses the results of which were necessary to plan, develop and test the capping.

To consolidate the soil over which the capping was to be placed, NASPA placed a layer made of not-polluted soil, in two selected areas, one with and one without a drainage system. Such layers were made re-using non-polluted soil from nearby sites so as to reduce the costs of its transportation and CO2 emissions. Following the realisation of the two layers of not polluted soil, monitoring devices (e.g. settlement gauges in steel) were installed as well as a drainage system on one of the two areas.

The outcomes of NASPA Pilot Action tests will support the detailed design of the container terminal. The tested technology will be adopted in combination with other in situ remediation technologies for the entire Ex-Monte-Syndial site (90 hectares), with the aim of interrupting the pathways of contaminants.



North Adriatic Sea Port Authority Best practice *Environmental capping*

This best practice consists in the realisation and testing of a more environmentally friendly and cost-effective way of providing capping and of interrupting the pathways of contaminants in underground water sources. The realization and testing of a "layer made of non-polluted soil" was a preliminary step before the realization of the capping. The capping method represents a sustainable solution according to the following considerations:

- it is considered to be one of the available remediation technologies by ISPRA - Italian Environmental Protection Agency - (adapted and based on Matrix, developed by the Federal Remediation Technologies Roundtable);
- In this specific case, the technology is meant to be adopted in combination with other in situ remediation technologies.
- Reusing in-situ non-polluted soil made the approach environmentally friendly (less transportation required, and so less CO2 production) and cost effective.





4.4. The Institute for Structural Policy and Economic Development - isw Pilot Action Revitalization and improvement of site marketability in Halle-Ammendorf

isw developed a brownfield revitalisation strategy for the urban sites located in Halle- Ammendorf, aimed at improving both the environmental management process and, consequently, the marketability of the area.

The Institute for Structural Policy and Economic Development, active on the Halle FUA, focused its Pilot Action on the area of Halle-Ammendorf.

This Pilot Action had the objective as expressed by the City administration of promoting revitalisation and improving the site's marketability, as well as considering the environmental aspects (e.g. reduction of space utilisation, unsealing), categorisation of sites according to specific criteria, and identification of positive and adverse determinants for site marketability.

To achieve this, isw and City of Halle defined several specific sub-objectives:

- Increasing the amount of relevant data available to improve marketability, including: regular updates of existing data and the addition of missing data to the site information system via research (e.g. environmental data, owner structure, current activities on-site);
- Elaborating a **common and transferable methodology** for analysing and assessing brownfields in Halle (Saale) FUA;
- Compiling **recommendations** on how to improve the administrative processes in the field of brownfield management;
- Stakeholder involvement to increase knowledge of brownfield management (including interdepartmental exchange in the city administration, communication with private owners and relevant local and regional authorities);
- Paving the way for a holistic concept in the redevelopment of the Halle-Ammendorf area.



The Institute for Structural Policy and Economic Development developed a **brownfield revitalisation strategy** for the urban sites located in Halle-Ammendorf improving both the environmental management process and the marketability of the sites, with the key of it all being strongly linked to environmental aspects (e.g. reduction of space utilisation, unsealing). Moreover, a methodology was developed to categorize brownfields sites according to specific criteria and identify positive and adverse determinants for site marketability.

The analysis was applied to 11 of the 37 sites in Halle-Ammendorf, but the result was a common and transferable methodology for strategic area management in the City of Halle: this methodology will increase the capacity of public stakeholders to plan and implement activities for brownfield regeneration in Halle.

As a final step, the **Final Report on the revitalisation of brownfield areas in Halle** provided recommendations for the City of Halle regarding actions to be carried out in order to improve the administrative processes in brownfield management.

Several stakeholders were involved during the implementation of the activities; an intensive cooperation was established between the city administration (Economic Promotion, Urban Planning, Environment), Regional Agency for Brownfield Remediation, Regional Administration Agency (Responsible Environmental Authority), owners of the brownfields, and civil society .

isw Best practice A holistic approach to analysing, assessing and re-thinking brownfields

This best practice refers to the development of an integrated and transferable methodology developed in Halle for the co-planning and co-design of remediation strategies for local brownfields. The implemented methodology is composed of a series of steps that can be transferred and replicated in similar contexts. The proposed methodology is composed by the following steps:

- Joint selection of relevant brownfield sites for potential development on the basis of the site information system;
- Drawing up of a questionnaire to involve owners and to increase knowledge about the brownfield sites;
- Surveys/interviews with brownfield site owners and analysis of the replies to the questionnaire;
- Desktop research and data collection to complete missing data in the site information system;
- Analysis of brownfield features (e.g. owner situation, construction and planning law regulations, infrastructure, geology, hydrology, and settlement structure);
- Prioritisation of brownfield sites according to their positive and adverse determinants;
- Use of a common and transferable methodology for brownfield analysis and assessment;
- Individual assessment of each selected brownfield site;
- Presenting possible solutions to face adverse determinants (e.g., removal of vegetation, remediation of contaminated sites, clearing of sites suspected to contain unexploded ordnance, risk assessment from the former mining operations);
- Elaboration of final recommendations of action for the area.



4.5. The Ministry of Regional Development and Transport of Saxony Anhalt Pilot Action

Implementation and testing of a web-gis tool for brownfield management in Magdeburg

The Ministry of Regional Development and Transport of Saxony Anhalt implemented and tested a web-gis tool with relevant data and maps on the brownfields, and then provided the installation package to other partners, enabling its implementation in all the project territories.

The Ministry of Regional Development and Transport of Saxony Anhalt, active on the Magdeburg FUA, focused its Pilot Action on the area of Magdeburg-Rothensee.

In particular, the Pilot Action consisted in the implementation and testing of the **GreenerSites web-gis tool**, a site information system with map viewer containing relevant data and maps on the brownfields; furthermore,

it was the area of Magdeburg-Rothensee to be used as a reference site for data testing of the web-gis tool.

The web gis tool, developed in practice by the company *MENA GmbH*, is an easy-to-use web tool planned to facilitate the on-line cooperation between public authorities and other stakeholders concerned with brownfield rehabilitation.

After the delivery and presentation of the web-gis tool to project partners at the end of 2017, a test phase took place involving local stakeholders with the purpose of explaining its components, the operational concept and all the steps related to its implementation and testing. This step was necessary to carry out the fine-tuning of the tool, on the basis of the feedback received from the technical meeting and other requirements.

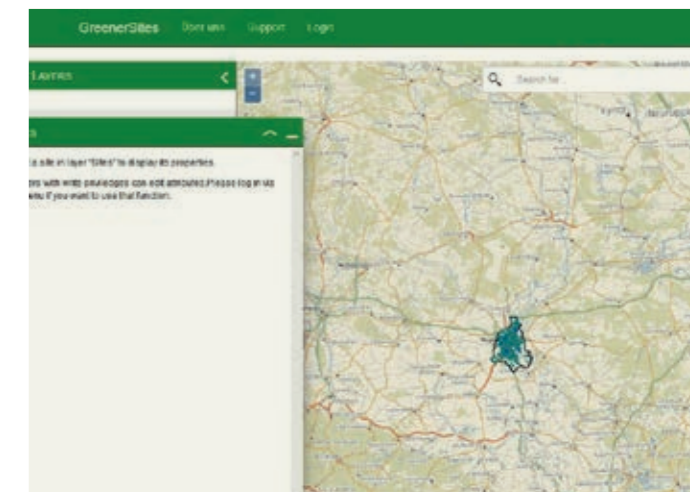
The Web GIS application is based on open source technologies. The system includes basic maps and orthophotos, as well as selected thematic maps and other geodata as required for each specific project. The tool meets the OCG (Open Geospatial Consortium) standards and is thereby fully interoperable with the common interfaces for web services based on the INSPIRE directive.



Three pilot training seminars with representatives from several municipal districts were also organized to build up expertise and transfer knowledge for the future use of the tool by local administrations.

Several key players were involved in the Pilot Action: In the tool testing phase, the following stakeholders were involved: City of Magdeburg Planning Department, Brownfield Authority (LAF), City of Magdeburg IT-Services (KID Magdeburg).

During the pilot seminar phase, the following local stakeholders were addressed: City of Magdeburg, including: The Departments of environment, business development and land register; Regional Planning Association Magdeburg, Port of Magdeburg GmbH, Land development Agency Saxony-Anhalt (Landgesellschaft mbH), Administrations of the counties of the FUA Magdeburg (Börd district, Salzland district, Jerichower Land district) and other regions of Saxony-Anhalt.



Ministry of Regional Development and Transport Saxony Anhalt Best practice

Designing a collaborative GIS Tool

Implementing a collaborative GIS Tool meant providing partners institutions and their stakeholders involved in the brownfield rehabilitation process with a collaborative platform to share DATA.

The GreenerSites Web GIS tool is a spatial information system that enables on-line cooperation between public administration authorities and other entities involved in and related to the rehabilitation and management of brownfields. The tool is a ready-to-use application that allows data storing and sharing and can be used for supporting analysis, the implementing of interventions, decision-making and marketing purposes. It is based on open source technologies and meets the OCG (Open Geospatial Consortium) standards and is thereby fully interoperable with the common interfaces for web services based on the INSPIRE directive.

The GreenerSites Web GIS tool is not a centrally operated application and database. It is designed to be used locally and temporarily to support a certain project. Thus specific local versions of the tool can exist. The tool can be operated openly, or through internet password protection, or again internally via the intranet of a specific institution.



4.6. The Mazovia Development Agency - ARM SA - Pilot Action *Remediation strategy to restore the socio-economic functions of a brownfield area in Radom*

ARM SA developed a brownfield regeneration strategy based on environmental analyses and research and focused on consultations with stakeholders and local groups in order to achieve full rehabilitation of the area and the restoration of its social and economic functions.

The Mazovia Development Agency plc, active in the City of Radom and City of Pionki FUA, focused its Pilot Action on the area of the former Power Plant in Radom.

The main goal of the Pilot Action was to develop a **brownfield regeneration strategy** based on specific environmental analyses and research with a clear focus on consultations with stakeholders for the full revitalization of the area and restoration of its social and economic functions. To achieve this goal, a collection of documentation, an analysis of existing data, as well as the development of a land regeneration plan were necessary.

The development of the strategy was preceded by a detailed investigation into the soil contamination and a description of the technical conditions of the buildings in this area, followed by the preparation of a methodology for brownfield remediation including a report on the analysis of the quality of the soil environment in the pilot area, a concept of neutralization of the possible contamination and some ground remediation methods.



The Public Participation Guide and best practices elaborated by ARM SA provides information on how to establish a strategic and comprehensive dialogue with stakeholders. Based on the results of analyses and consultation with stakeholders, ARM SA was able to elaborate the **Report on economic potential and investment possibilities**. This report includes an assessment of the true value of the area after its revitalization process.

Key territorial stakeholders were involved in the delivery of the Pilot Action. This included landowners (Municipality of Radom and municipal heating company Radpec S.A.), and residents of housing estates which also consisted of residents of social housing: entrepreneurs/employers, institutions and NGOs which help residents (social welfare centres, labour offices, local schools, church parishes, local charities).

ARM SA Best practice *Local communities' involvement and participation in the planning and implementation phase of a brownfield redevelopment project.*

In dealing with the deep social exclusion of the area's inhabitants and their supposed negative attitude, ARM SA had to pay particular attention to the dialogue with the local community for the implementation of its Pilot Action.

The adopted solution included a combination of different methods and an innovative, yet demanding Planning for Real method (PFR). This approach gave great results and the inhabitants of the social buildings neighbouring the brownfield willingly cooperated and showed great commitment to the planned changes. Public consultations were conducted with the residents of three housing estates located near the degraded area. The "Planning for Real" approach was also used, and consisted of a method that helped support the communities to identify issues in their neighbourhoods whilst working together in partnership with decision makers to think about ways to change or improve their neighbourhood.

The consultation process was summarized in the document called "Report on the process of social participation regarding the post-industrial area at Energetyków Street in Radom", which has become an excellent public participation guide and a set of best practices in community involvement processes.



4.7.
The Municipality of Solec Kujawski
Pilot Action
Identification of a method
of neutralising pollutants below
groundwater level in Solec Kujawski

The Municipality of Solec Kujawski established an environmental monitoring system of soil and water at the former wood preservation plant brownfield. Information obtained from laboratory analyses contributed to identify an innovative and sustainable solution in neutralising pollutants below the groundwater level.

The Municipality of Solec Kujawski, active on the Bydgoszcz-Toruń FUA, focused its Pilot Action on the area formerly used as a wood preservation plant close to the city centre.

The Pilot Action was aimed at facing the following needs and goals: diagnosis of type of contamination in waters, monitoring of changes in concentration, directions of migration, and composition. All were necessary in the development of a project to stop and eliminate the threat. The activities carried out within the Pilot Action consisted in establishing an **environmental monitoring system of soil and water** at the former wood preservation plant brownfield in order to monitor the effectiveness of the remediation techniques already undertaken and to elaborate documents focusing on data obtained from the performed monitoring: six measurement campaigns for groundwater and two campaigns for soil, aimed at determining the concentrations of PAH and BTEX, were carried out by drilling wells and piezometers to calculate the inflow and outflow of groundwater.

The results received from the samples uptake allowed for the preparation of a report on possible remediation improvement. The analysis will directly contribute to



identify and plan the most suitable, sustainable method to carry out further remediation of the brownfield - the passive nano-carbon barrier.

Based on the monitoring results, the Municipality of Solec elaborated a **Land management concept of the site**. This study proposes three different investment variants which could be developed in the area with economic and technical specifications. All data related to the brownfield are collected on a Brownfield Database. This tool will support the Municipality of Solec with the management of the brownfield.

Local meetings were organized with inhabitants and stakeholders to involve them in the delivery of the Pilot Action.

Municipality of Solec Kujawski Best practice
A soil and water monitoring system

The best practice consists in establishing a soil and water monitoring system for long-term maintenance control of the remediation techniques undertaken. The Municipality of Solec Kujawski carried out an extensive monitoring campaign combined with data obtained from additional drilling, results of geophysical analysis and tests with carbon nano-particles. The analyses, carried out in a specialised laboratory, provided valuable information for the target area and also allowed for the determining of the location, span and thickness of a passive nano-carbon barrier for improving remediation interventions.



4.8. The City of Bydgoszcz Pilot Action Investigation on groundwater contamination in Bydgoszcz

The City of Bydgoszcz investigated the environmental risks associated with the contamination brought on by the Zachem former chemical factory as well as its impact on inhabited areas with the aim of assessing the risk to human health and the drafting of guidelines for future monitoring operations.

The City of Bydgoszcz, active on the Bydgoszcz-Toruń FUA, focused its Pilot Action on the area of the “Zachem” Chemical Plant, located in the South-Eastern part of the city.

The Pilot Action was aimed at assessing the environmental risk associated with the contamination brought on by the former chemical factory as well as its impact on the neighbouring area.

The City of Bydgoszcz completed its investigation on the status of the ground and groundwater contamination on the site of the former chemical factory and on the neighbouring area of Legnowo. A report assessing the environmental conditions is now available.

Initially, the City of Bydgoszcz made an inventory of the existing piezometers (observation holes). Following this, 15 piezometers were drilled and soil and water samples were chemically tested. Analyses results showed that in each of the piezometers the first aquifer was contaminated by toxic organic and inorganic compounds.

The city prepared a *Conceptual site model* to define the groundwater flow and migration of contaminants to the inhabited area. As a result of the simulation, the time of groundwater flow was calculated from 19 pollution out-breaks to an inhabited area. Numerical studies on pollutants were documented on 60 graphical annexes in time steps ranging from +25 years for sulphates and chlorides, to +50 years for organic compounds. The analyses show that the area of contamination will gradually expand towards the inhabited area of Legnowo. Based on previous studies, it was possible to draft the *Guidelines* for future

monitoring operations. The Guidelines include recommendations and concrete proposals for the designation of areas subject to groundwater monitoring, including: the type and quantity of samples, methodology, scope of analytical tests, frequency of sampling, presentation of monitoring results, estimation of costs and time plan. The purpose of the planned monitoring will be the ongoing observation of the inflow of groundwater pollution migrating from former “Zachem” towards the Legnowo - Wieś estate, as demonstrated by impact assessments on the residents and the deterioration of the quality of soil and water environments.

At the same time, circa 500 ground samples were collected from inhabited areas in order to complement the data for risk analysis. Health risk analysis was implemented with the aim of analysing the potential negative health effects that may occur as a result of exposure to harmful substances present in the environmental media of soil in residential areas.

All pilot activities were carried out with the involvement of the most important local stakeholders: RDOŚ Regional Directorate of Environmental Protection, WIOŚ Regional Inspectorate for Environmental Protection, SANEPID District Sanitary and Epidemiological Station, MWIK Municipal Waterworks, AGH University, Inhabitants of Legnowo.



City of Bydgoszcz Best practice Testing specific contaminants in order to assess health risks for inhabitants

The best practice consists in assessing the impact of the former chemical plant on a nearby residential area.

The City of Bydgoszcz developed a soil sampling plan of the residential area in order to assess the health risk for local inhabitants. The sampling plan was developed in compliance with national regulations, taking into account cartographic data and the findings of previous investigations. The residential area (31.1 ha) was divided into 20 sampling sections taking into account the location of groundwater pollution clouds and a topographic relief. The location of 9 bore-holes were determined with the coordinates representing the central points of the selected plots. Substances for health risk analysis were selected by assigning appropriate sources and types of pollution to each cloud. There are only a few laboratories that test site specific contaminants in ground and groundwater. There are also no defined levels in most of the European countries. In Bydgoszcz, a pilot site with organic ingredients were tested: Total Organic Carbon (TOC), Phenol, Aniline, components BTEX (Benzene, Toluene, Ethylbenzene, Xylene), Diphenyl sulfone, Chloroaniline, Epichlorohydrin, Hydroxybiphenyl, Nitrobenzene or total of nitro compounds, Octylphenol, Toluenediamine, Toluidine, total PAH, total AOX and PCE and TCE.



4.9. The Municipality of Celje Pilot Action *Three different remediation methods tested in Celje*

The Municipality of Celje successfully tested three different methods for the remediation of contaminated soil in sites in Old Cinkarna, with the purpose of establishing the most effective one in terms of costs and environmental impact.

The Municipality of Celje, active on the Municipality of Celje FUA, focused its Pilot Action on the area of the Old Cinkarna brownfield site, located in the city.

The Pilot Action aimed at addressing the following needs and goals:

- To gain substantial information about soil and groundwater contamination
- To test the effectiveness and cost of selected decontamination methods
- To provide a protocol procedure for dealing with non-hazardous brownfield waste

Three different methods for the remediation of contaminated soil were successfully tested in the Old Cinkarna site next to the Municipality of Celje, with the purpose of establishing the most effective one in terms of costs and environmental impact. This included:

- remediation through immobilization
- remediation with cold recycling
- preparation of a suitable mixture of organic-mineral substrate

The tested methods proved to be effective and useful in the pilot area, to the extent that the local community intends to develop and urbanise in the future.

The results from the tests were collected in a *Technical publication* which is a sort of guide for public employees and other professionals on how to manage a specific soil contamination problem. In addition, the Municipality elaborated the *Protocol for the disposal of non-hazardous waste*, focusing on excavations in the FUA area and in the area of Stara Cinkarna. It is such a Protocol that establishes organizational and technical measures for the proper handling of these types of waste.



The following key local stakeholders were involved in the implementation of the Pilot Action: Ministry of the Environment and Spatial Planning, national and local non-governmental institutions, local public service providers.



Municipality of Celje Best practice *Testing alternative solutions through site remediation*

There are cases, such as the Stara Cinkarna brownfield in Celje, in which trying to ensure a complete cleaning of the site is practically impossible, especially when considering the necessary amount of time, money, and the technical difficulties. In such cases, the risk is that, due to the complexity of the required procedures, nothing is finalised and the site remains as it is.

On the contrary, the Celje Pilot Action demonstrated that there are environmentally friendly and cost-effective methods that can be used to decrease the impact of brownfields on the environment and ensure future use of the location. Three different cost and environmentally effective remediation methods have been tested and validated in the Stara Cinkarna brownfield:

1. Remediation with calcareous paper ash
2. Remediation with cold recycling
3. Preparation of a suitable mixture of organo-mineral substrate



4.10. The Port of Rijeka Authority and the City of Rijeka Pilot Actions *Development measures for the harbour brownfield in Rijeka*

In close synergy and through the constitution of a Local Action Group, the Port of Rijeka Authority and the City of Rijeka monitored the environmental status of the area and analysed its possible future use focusing on spatial planning, urban development, social features, in order to safeguard the security and the quality of life of its inhabitants.

The Port of Rijeka Authority and the City of Rijeka, jointly developed their Pilot Actions in the area of the Old INA Refinery inside the harbour area.

These Pilot Actions were aimed at addressing the need to **rehabilitate this brownfield**, in order to offer the chance of creating access to the sea for the population of Rijeka, and so significantly improving the coastal aspect of the city.

Pilot activities were aimed at monitoring the environmental performance of the refinery and its possible improvements to safeguard the security of the Functional Urban Area inhabitants.

To carry out the related activities, it was necessary to strongly engage the key territorial stakeholders and to cooperate with the City of Rijeka from the beginning, something achieved with the constitution of a **Local action group**. The local action group was composed of representatives of utility societies, companies who deal with the prevention and sanitation of pollution, as well as energy agencies and institutions responsible for controlling the health conditions in the country.



The first phase of the pilot action consisted in a study of the environmental conditions of the area. The result was a detailed **Report on the environmental status of the harbour area**, with a focus on air quality. Based on this report it was possible to elaborate the **Study on the possible future uses of the area**.

The study is in full accordance with the port's Development Plan and in respect of its transport and technological properties, limitations and market circumstances. In addition, the Study proposes measures for the environmental rehabilitation of the area, stemming from the analyses of sea water, marine sediment, animal communities, soil and air.

The main findings from the research activities were collected in a report with proposed measures for rehabilitation that was presented at a national conference in order to gain further input and follow up from stakeholders.

Port of Rijeka Authority and City of Rijeka Best practice *Constitution of the Local Action Group*

The City of Rijeka and the Port of Rijeka Authority established a Local Action Group in Rijeka together with local stakeholders with the aim of finding a means of cooperation in the redevelopment of the area of the ex-industrial zone Mlaka. The Local Action Group was formally established in 2017 in Rijeka. 9 different organizations, both private and public, have been involved in the LAG by signing a Cooperation Agreement. The Petroleum Port area has long been economically abandoned. Local and national authorities have recognized the importance of recovering this area. The port and the surrounding land are spatially and well positioned for sea and land traffic and offer great potential for economic progress in the city of Rijeka and Croatia. The GreenerSites project has contributed by providing information and making the stakeholders aware of the importance and possibilities of revitalizing this valuable area. For the first time all stakeholders at local and national level are organized into a local group and therefore show motivation in taking the necessary steps for the rehabilitation of the area even after the formal conclusion of the GreenerSites project.

5. Common transferability Manual The Roadmap from Brownfields to GreenerSites

“Be inspired by our experience”

In the perspective of achieving a better environmental management of brownfields, the partners jointly implemented an experimental process to define strategies and actions based on a sustainable integrated approach. The collaboration in advancing the environmental performance of brownfields had the ultimate goal of also enhancing the living conditions of the citizens.

Adopting a step by step approach towards a sustainable regeneration of brownfield sites started with the involvement of stakeholders and a state-of-the-art assessment to evolve the Knowledge framework. Following this, and having understood the gaps to be overcome, a capacity building process took place to expand the skills of interested parties that have been up to that point involved in a co-planning process. Finally, strategic action plans have been arranged and stakeholders invited to sign a Memorandum of Understanding towards a long-term regeneration goal.

The **GreenerSites** project developed a PROCESS to provide the stakeholders, the experts and the decision makers involved in the rehabilitation of brownfields with tools and the potential to better manage the regeneration, tackle environmental issues and confront socio-economic concerns affecting the Functional Urban Areas (FUA). The Process tested in the pilot areas demonstrated the importance of the involvement of all interested parties in building both an Integrated Knowledge System and a Shared Governance, as well as the project strived for in increasing collaboration, innovation and smart solutions.

The challenging **GreenerSites** experience can be summarised in the following PHASES:

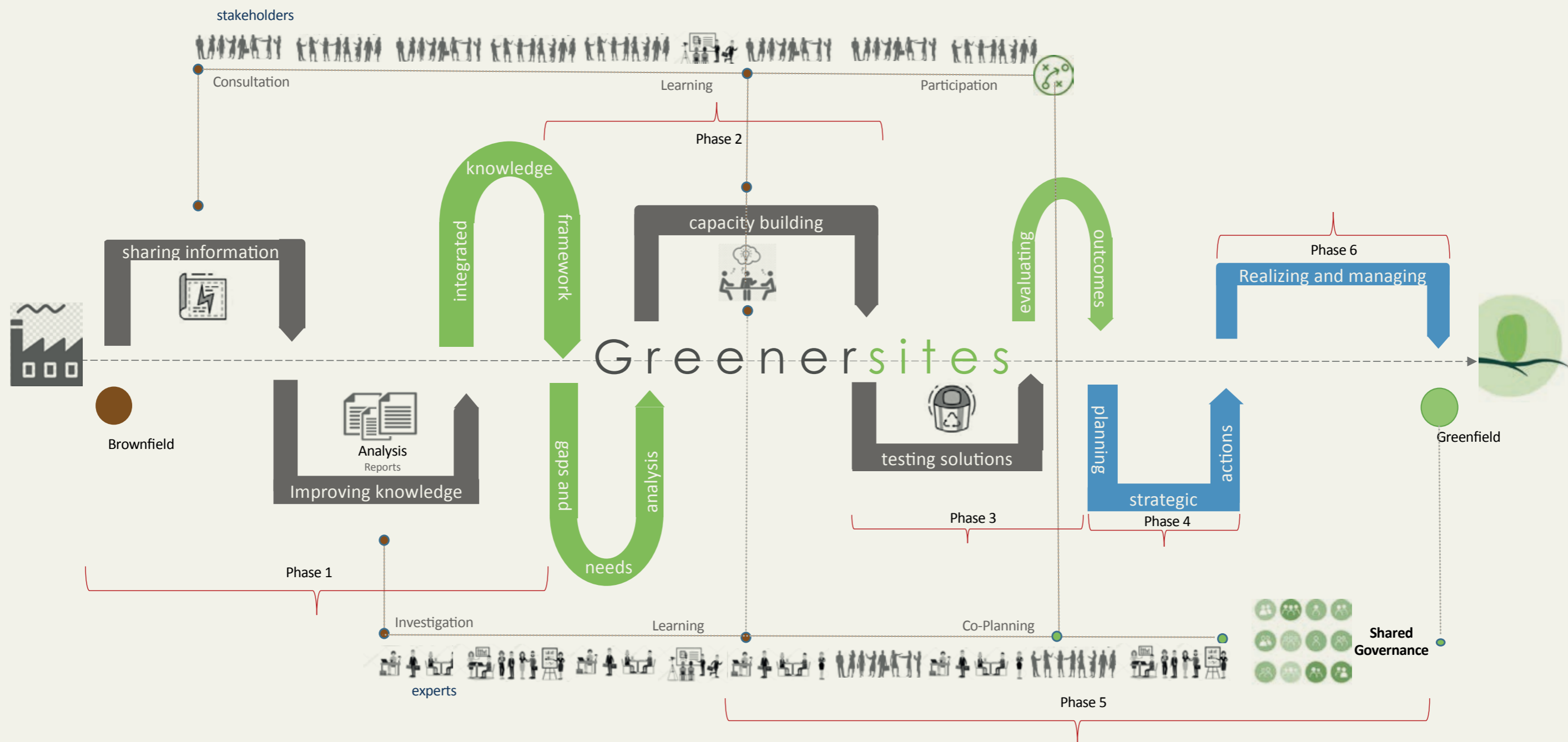
1. Developing an Integrated Knowledge Framework
2. Developing Capacity Building programs
3. Testing, evaluating and scaling up solutions
4. Planning strategic actions
5. Promoting a shared governance for a long-term sustainable development

Furthermore, the project defined also a scale-up strategy in order to ensure that the consequent phase of Realization (n. 6 in the figure enclosed) could be implemented and that the brownfields would become and would actually be managed as “**GreenerSites**”.

List of abbreviations

AF	Application Form
DSS	Decision Support System
FUA	Functional Urban Areas
GIS	Geographic Information System
LWT	Local Working Table
MoU	Memorandum of Understanding
PAs	Pilot Actions
SAP	Strategic Action Plans
IKF	Integrated Knowledge Framework
TM	Training Materials

the roadmap



5.1. Phase 1 Developing an Integrated Knowledge Framework

A comprehensive and **Integrated Knowledge Framework** is a precondition to ensure the awareness of any decisional process and the effectiveness of subsequent planning activities. It means that choices must be based on studies and research, on in-depth investigations, on a broad frame of data and on a set of valid indicators capable of representing the complex situation of both the FUA and the brownfields.

Combining diverse sources of data with different know-how detected by a wide group of stakeholders ranging from owners, public authorities, environmental agencies, research institutes, business support organizations and private companies is not an easy task; still it is recommended in order to take advantage of ITC Tools to create an Integrated Knowledge Framework, while ensuring the awareness contribution of all interested parties.

The engagement of stakeholders and experts in **GreenerSites** was essential to building the **Integrated Knowledge Framework (IKF)** and to achieving long-term sustainability.

The stakeholders collaborated and took part in about 60 meetings throughout the project duration. Participation represented an effective means of increasing awareness about the importance of exchanging data and information among involved institutions.

Experts were engaged in order to elaborate both an in-depth analysis and a literature review; they have also co-operated to create a GIS tool.

Both stakeholders and experts contributed to building an Integrated Knowledge Framework (IKF), essential for the optimisation of the decisional procedures and the planning activities.

The process developed to build the IKF comprised the following **STEPS**:

- a. *involving relevant stakeholders for the sharing of knowledge*
- b. *integrating studies and analysis*
- c. *creating a collaborative GIS Tool*
- d. *promoting IKS as a Decision Support System*

A. Involving the relevant stakeholders implied developing some tasks before, during and after the meetings with the interested parties. First it was important to map stakeholders on the basis of their capacity to influence the process of remediation and regeneration, taking into account decisional power, knowledge and interest. Once the most relevant actors were identified, they were encouraged to take part in the local working TABLEs, established with the purpose of exchanging knowledge and sharing strategies for long term sustainable development of sites.

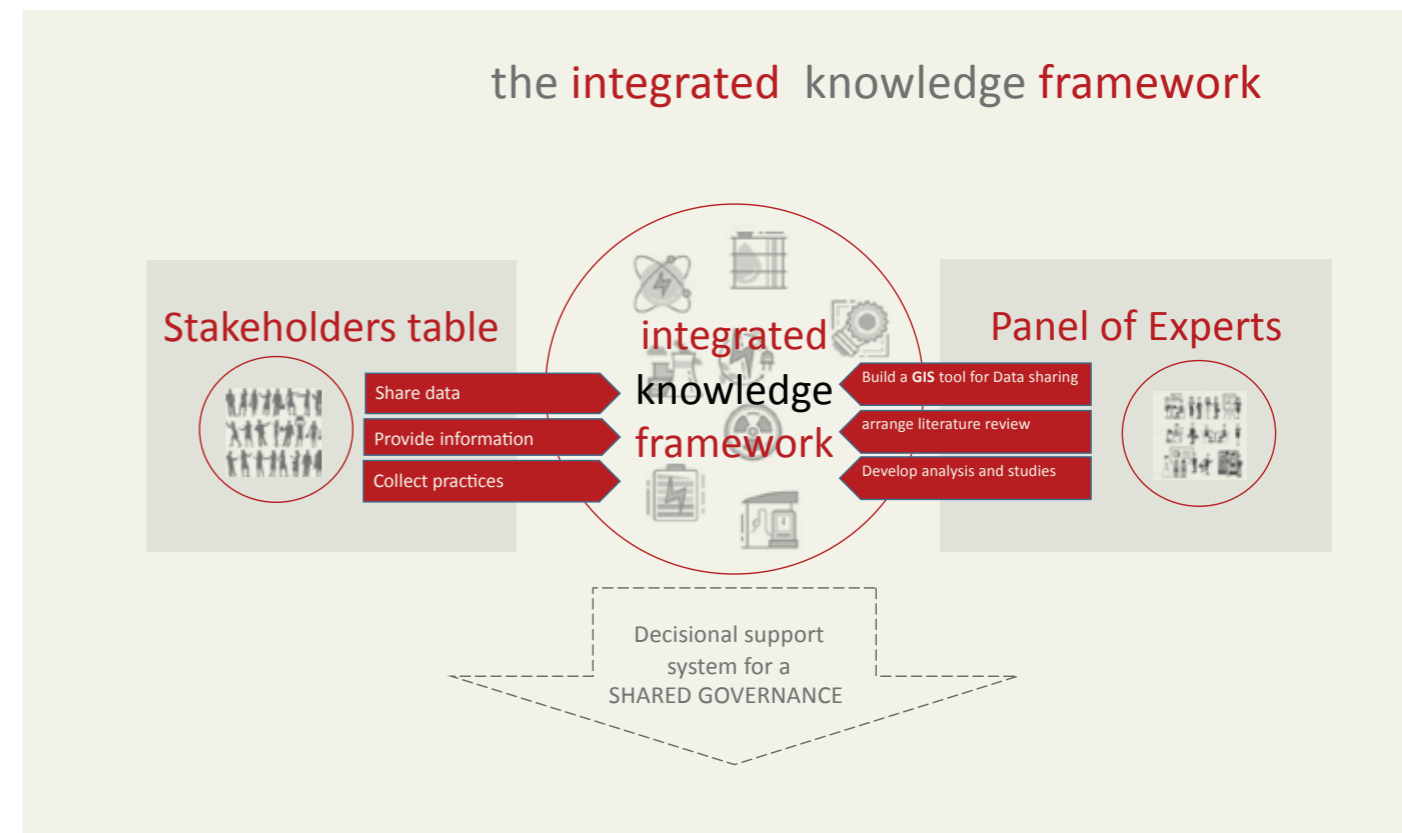
Meetings, workshops and site visits were organized to help maintain the stakeholders' participation: they represented crucial and vital interaction tools.

In the **GreenerSites** project we experienced the importance of **planning** participation, **tracking** and sharing the next steps of cooperation, but most of all, we understood the relevance of giving **value** to all contributions received.

After the meeting we encouraged the stakeholders' collaboration and contribution by sharing working table results, including minutes, pictures, slides, position papers, reports, and useful materials to follow up on.

We invited relevant stakeholders depending on the focus point of each meeting, as planning the participation for each one was strategic for its effectiveness. Thematic workshops involving only interested stakeholders were integral to the achievement of both objectives:

- building a common integrated framework
- strategically co-planning the actions for regeneration and remediation.



B. Integrating studies and analysis required the contribution of a PANEL of EXPERTS.

With the purpose of improving the scientific and technical knowledge, experts were invited to help in:

- investigating existing studies and research
- evaluating knowledge gaps
- developing a comprehensive analysis of the state of play

More details:

In order to investigate existing studies and research, experts proceeded by:

- analysing sustainable approaches and tools in brownfield regeneration and reactivation in order to draw a picture of the status of urban/peri-urban brownfield moving towards a more sustainable and integrated approach to environmental management of brownfields;
- develop a literature review and collecting good practices.

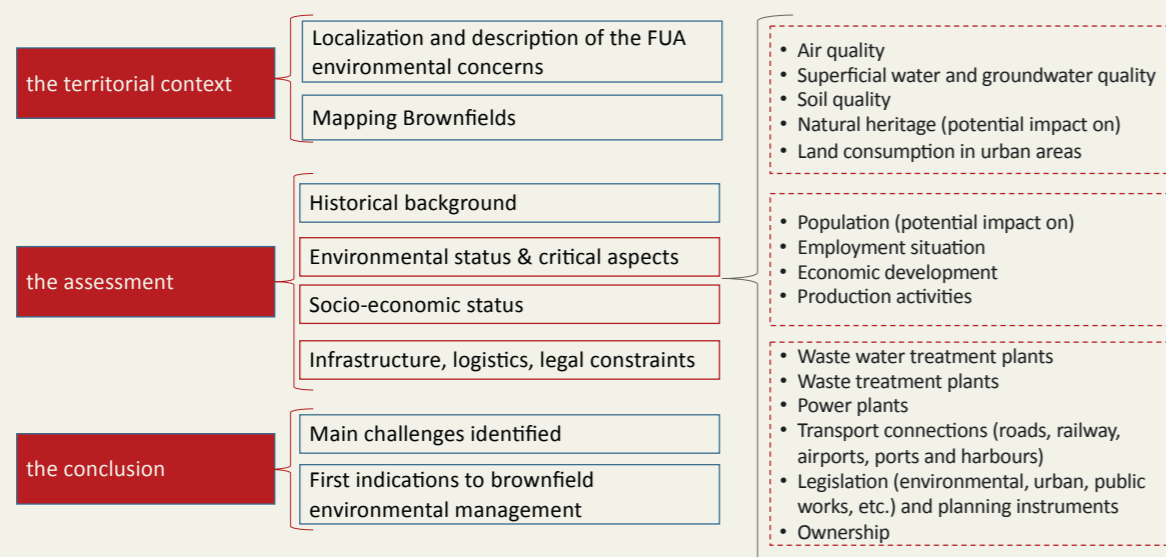
In order to evaluate knowledge gaps, experts proceeded by:

- collecting quantitative and qualitative data from existing instruments (such as remediation & master plans, sustainability & green strategies, monitoring systems already in place) regarding environmental and socio-economic status, infrastructure, legal framework, remediation measures;
- monitoring and understanding of the systems already in place, being aware that it is difficult to have a detailed picture of the sites due to National regulations, the fragmentary inventory of contaminated areas, data collection and accessibility: it was not clear who collects and provides specific data (public bodies, private owners etc.).

In order to develop a comprehensive analysis, experts proceeded by:

- elaborating an in-depth and comprehensive analysis trying to get an accurate picture of the contaminated areas in the region and /or FUA, focusing on the main environmental concerns resulting from current or past industrial activities, as well as on the status of remediation processes and the sustainable remediation techniques already experimented;

The structure for analysis



- describing the FUA territorial context, by mapping related brownfield, indicating their geographic boundaries, specifying proximity to inhabited areas and detecting the main environmental concerns;
- assessing the socio-economic and environmental frameworks;
- identifying the main challenges and detecting the first indications of a more sustainable approach to brownfield environmental management;
- arranging a summary overview of key findings to share with interested parties.

C. Creating a collaborative GIS Tool meant providing partners' institutions and their stakeholders involved in the brownfield rehabilitation process with a collaborative platform to share DATA.

The Web GIS developed by the **GreenerSites** project partners is an application based on open source technologies. The system included basic maps and orthophotos, as well as selected thematic maps and other geodata as required by each specific project. The tool met with OCG (Open Geospatial Consortium) standards and has been thereby fully interoperable with the common interfaces

for web services based on the INSPIRE directive. It has been designed as a ready-to-use application, even if it may require some technical operation preconditions as well as specific administration competencies; the **GreenerSites** GIS tool allows data storing and sharing and it could be used up to this point for supporting analysis, implementing interventions, decision-making and marketing purposes.

The Web GIS tool is not conceived as a centrally operated application and database. It is developed to be used locally and it can be operated openly or solely internally with the intranet of a specific institution.

The GIS tool ensures that data concerning the pilot areas can be integrated both from public institutions managing the tool (top down) and from interested economic and social parties (bottom up). Developing and keeping it up to date could help planners, institutions and decision makers to better use available data, tackle environmental problems and manage the site in a more effective and sustainable way. Conceiving the web GIS as a smart open system should facilitate the sharing of datasets detected by different organizations and should ease its ability to constantly update.

D. Promoting Integrated Knowledge System IKS as a Decision Support System represented an important step of the **GreenerSites** process. It implied one side fostering the long-term updating process and the other side raising awareness of the importance of taking decisions based on knowledge.

Ensuring a *long-term updating* of the Integrated Knowledge System implied:

- Increasing the awareness of the importance of building a shared integrated knowledge system among stakeholders and decision makers;
- Stimulating the continuous exchange of knowledge by involving relevant stakeholders in a shared management process;
- Preparing and disseminating a tutorial explaining how the IKS and related GIS can be updated;
- Ensuring training on web GIS development.

Raising awareness and promoting the IKS as a DSS, implied at least:

- including the GIS tool in the agenda of the local working table with stakeholders, and showing interested parties how to manage information;
- explaining the data and contents that can be obtained by using the IKS to decision makers and planners;
- preparing and disseminating a tutorial to explain how to benefit from the IKS.

5.2. Phase 2 Developing Capacity Building programs

Brownfield management is a complex process that requires different skills and expertise and is most of all a continuous update of competences. In the **GreenerSites** project, a training program for public employees was developed, taking into account the gaps observed during phase 1 and considering stakeholders' needs.

The training programme was tailored to both target groups and the features of the sites, thus having to be capable of providing participants with tools to better tackle brownfield management issues.

Managing the process of brownfield rehabilitation, with the wider goal of regenerating the FUA still in mind, requires the capacity to deal with a large sphere of interventions which range from the very technological aspects, to environmental, social and economic concerns. Public employees involved in brownfield management do not need to be specialists on all of these topics, but need to acquire the capacity to interact with all professionals and the understanding of their different technical languages.

The training modules defined and issued in the **GreenerSites** project also addressed other targets involved in the overall strategic plan. By means of tailored training courses, officers of the public territorial authorities, the FUA stakeholders and the brownfield interested parties had the chance to improve their expertise in planning and managing brownfield regeneration in a sustainable way.

The process developed in the **GreenerSites** project to develop capacity building programs comprised the following **STEPS**:

- a. *Analysing gaps and training needs*
- b. *Developing a tailored training program including site visits*
- c. *Evaluating effectiveness and impact of training*

A. Analysing gaps and learning needs of employees of local institutions and their stakeholders meant identifying the competences to be reinforced in order to better manage a brownfield rehabilitation process and to improve the effectiveness of environmental measures to be undertaken in the FUAs.

In the **GreenerSites** project, we arranged a questionnaire to detect participants needs and to understand the interests of the targets in the local context. The figure hereafter provides a synthetic view of the questionnaire used.

Questionnaire to analyse gaps and needs

What institution do you represent?	What kind of remediation technologies would be the most interesting to you (if any)?	Would you like to know more about availability of brownfield data?
What information would be the most helpful regarding sustainable brownfield renewal?	<ul style="list-style-type: none"> options appraisal monitored natural attenuation permeable reactive barriers air sparging / soil vapour extraction ex situ and in situ bioremediation stabilisation / solidification chemical oxidation soil washing thermal desorption all remediation technologies Please list any other remediation methods you might be interested in: 	Yes / No / I don't know
<ul style="list-style-type: none"> legal responsibilities associated with brownfields permits associated with brownfield renewal assessment of ground and ground water contamination methods of probing planning the remediation most efficient remediation methods economics, calculation of remediation costs risk assessment waste management in brownfield remediation monitoring of ground and ground water funding sources for brownfield renewal social aspects of brownfield remediation financial and fiscal measures for brownfield redevelopment institutional governance of the rehabilitation process environmental rehabilitation measures Please list any other topic you deem to be important 	<ul style="list-style-type: none"> how to identify historical contamination the legal aspects of historical contamination the obligation of the owners of the land with historical contamination none 	<ul style="list-style-type: none"> planning: evaluation concept, sustainable remediation concept, stakeholder involvement, investigation remedy options, selection of remedy methods, remedy construction, operation and maintenance monitoring, optimisation and closeup
Please add any comments regarding the expectation from local training here		

Questionnaire to evaluate the satisfaction of participants

Evaluation of results of training on sustainable remediation

General satisfaction

- the training on sustainable remediation met my expectations/needs
- I gained useful knowledge and information
- I will be able to apply such knowledge and information to my work
- The presentation on "topic" by Mr/Mrs was useful and interesting
- I gained lots of information from the site visit, it was very interesting to see the site "....."
- Time allocated was adequate to the contents
- The training materials were useful and well prepared

- ANSWER**
- Strongly agree
 - somewhat agree
 - undecided/neutral
 - somewhat disagree
 - strongly disagree
 - No Answer

Evaluation of results of training on GreenerSites GIS TOOL

General satisfaction

- the training on the GreenerSites web gis tool met my expectations/needs?
- I gained useful knowledge and information?
- I will be able to apply such knowledge and information to my work
- The presentation on "topic" by Mr/Mrs was useful and interesting
- I gain lots of information from site visit, it was very interesting to see the site "....."
- Time allocated was adequate to contents
- The training materials were useful and well prepared

- ANSWER**
- Strongly agree
 - somewhat agree
 - undecided/neutral
 - somewhat disagree
 - strongly disagree
 - No Answer

Evaluation of general organization issues

- How do you reckon the training organisation?
- How do you reckon the technical appliances used during the training?
- How do you reckon the site visit to the site "....."?
- How do you reckon the meeting organisation in ?

- ANSWER**
- Very good
 - Good
 - Satisfactory
 - Poor
 - No Answer

B. Developing a tailored training program implied:

- identifying topics for training on the basis of: the outcomes of the questionnaire, the comprehensive analysis and the IKS updating requirements, as well as taking into account the FUA regeneration objectives;
- selecting and inviting target participants among public environment bodies, environment units in companies, owners of brownfields, NGOs in areas of environmental protection, individuals dealing with brownfields;
- identifying professional trainers, and sharing with them the scope of the capacity building process and asking them for advice regarding training materials;
- organizing training sessions at local level (adopting formal and non-formal approaches to courses);
- sharing the training materials within the community of relevant stakeholders, addressing in particular those not in attendance to the training courses to help disseminate the tools.

The training program developed in the GreenerSites project included formal classroom activities, workshops and non-formal training initiatives, such as study visits to selected remediated sites in Europe.

The study visits were a very effective training approach as it engaged participants and allowed them to learn from peers. A sound organization of the study visit required the selection of the appropriate sites to be visited: the sites had to have similar characteristics and environmental concerns, as well as having to pose comparable societal challenges. Additionally, the sites to be visited could be chosen as best case examples, notably a place where solutions were successfully carried out.

For a successful outcome to the visits, it was important to plan the details with hosts and participants, as well as to prepare questions for hosts, stakeholders, peers or experts in advance, thus enabling the discussion and the peer learning process during the site visit.

Furthermore, a dynamic and interactive event where visitors learned from the hosts by means of short presentations and peer-to-peer discussions proved to be an effective way of facilitating the exchange of experience and knowledge. After the study visits, all participants were invited to fill in a reporting form and to provide their feedback on lessons learnt, and so contributing to the elaboration of a comprehensive joint training report with the purpose of it all being shared with other colleagues and relevant stakeholders that didn't have the chance to take part.

C. Evaluating the impact of training measures implied:

- measuring the knowledge acquired after the training,
- assessing the satisfaction of participants;
- evaluating the impact of the training in terms of expertise acquired and changes of attitude or way of working.

To measure the knowledge acquired varied on the basis of training that was issued, while both the evaluation of satisfaction and the assessment of impact have been jointly undertaken.

Participants' satisfaction has been analysed by means of a questionnaire launched the day after the training event (summarized in the figure above). The impact of the training measures was verified at a later stage by checking participants' capacities to integrate the IKS and to strategically plan actions.

5.3. Phase 3 Testing solutions

In the **GreenerSites** project, the Pilot Actions (PAs) represented a milestone of the developed process, allowing specific challenges to be tackled, as well as the investigation of certain critical aspects on brownfield management and the testing of solutions on the basis of recognized best practices in the concerned sectors and disciplines.

The Pilot Actions developed offered the chance for partners and stakeholders to test the integration of technological solutions focusing on different aspects of the brownfield rehabilitation process.

The process developed in the **GreenerSites** project to test solutions entailed the following **STEPS**:

- a) *Comparing best practices against challenges and select PA*
- b) *Developing and Monitoring the PAs*
- c) *Evaluating results for scaling up*

A. Comparing best practices against any foreseen challenges implied:

- detecting, in collaboration with stakeholders, the main challenge and summarizing it in a very short but comprehensive text to be shared and approved by the interested parties;
- inviting a panel of experts to identify the best practices existing in the sector and in the disciplines capable of facing the challenge detected;
- providing stakeholders, managers and planners with a selection of the most innovative solutions that can be tested at the site, taking into account socio-environmental and economic features. In this way, by comparing challenges and Good Practices the decision makers can define the PA to be implemented at the site, as well as how they can adopt related monitoring schemes to take control in both advancement and potential impacts.

B. Developing and Monitoring the PAs required the adoption of a Quality Management Scheme based on a PDCA cycle (Plan, Do, Check, Act), where the phase of Planning is followed by the phase of Doing, which is then accompanied by a continuous monitoring known as Checking, enabling the detection of problems in due time to finally Act with the necessary corrections and the vital corrective actions to obtain the right improvement to an undergoing ACTION.

Monitoring Pilot Actions is something to be done during each phase's implementation and it is important to design a monitoring system in advance to reduce the risk of gathering data in a non-effective manner.

The Monitoring & Evaluation Plan developed in the **GreenerSites** project was arranged with the following purposes:

- A *documentary* to describe what happens during the PA implementation;
- For *assessment* purposes, to verify strengths and weaknesses of the Pilot Actions and whether their objectives and expected results have been achieved in terms of fulfilment, effectiveness, sustainability and impact;
- As a *formative* means to provide recommendations and appropriate adjustments in order to improve the quality of the following strategic action plan.

At the end of the pilot actions, the partners elaborated a report sharing the outcome of the pilot action. For this purpose, they adopted the following common structure:

- Pilot Action Title
- Place/area of PA implementation
- Duration of PA implementation
- Costs related to PA
- Background and challenges faced
- PA objectives
- Activities carried out
- Technical specifications and solutions tested

- Impact/ results/ experience (how many target groups/ stakeholders were reached, pilot events)
- Contribution to project objectives
- Transnational added value as to how PA contributed to other activities implemented by the project & added value for partners
- Compliance with the sustainability principles
- Media coverage

C. Evaluating results, is a more important task in comparison to monitoring due to a long-term perspective in ensuring the **scale up** of the pilot action. Evaluation should engage the local players actually involved in the Pilot Actions. It is important to encourage the Stakeholders to critically assess the effectiveness of the pilot action by judging its relevance, impacts and effects.

The evaluation is executed with a participatory dialogic and reflective approach in order to better analyse lessons learned by all the interested parties, improve the process in the long term, and transfer know-how and practices, while steering towards both a more effective strategic planning process and a more sustainable management of brownfield.

The evaluation activities aim at:

- establishing recommendations and lessons learned in order to improve the quality of further Actions and plans;
- suggesting, wherever necessary and within an effective timeframe, appropriate adjustments to the Actions and the integration of solutions;
- verifying the strengths and weaknesses of local projects and whether their objectives and expected results have been achieved in terms of fulfilment, effectiveness, sustainability and impact;
- providing an argumentative assessment at the end of the Pilot Actions regarding the achievement of results and objectives.

The evaluation of different Pilot Actions, shared by the **GreenerSites** project has been carried out in order to homogenize the data and the information collected in different pilot areas. We adopted the following tools:

- A Results-Oriented-Monitoring (ROM) review;
- A final evaluation questionnaire;
- A dialogic session with Pilot Action stakeholders.

In particular, the Results-Oriented-Monitoring (ROM) has been developed on the basis of a structured methodology of co-funded project review. In monitoring context, it provides a brief snapshot of the implementation of an intervention at a given moment, considering five dimensions:

- The relevance and quality of project design: the appropriateness of a project's objectives to the real problems, needs and priorities of its target groups/beneficiaries and the quality of the design through which these objectives are to be reached;
- The efficiency of implementation: how well means/inputs and activities were converted into results;
- The effectiveness of the actions carried out: the contribution made by the project's results to the achievement of its overall purpose;
- Project impact: the project's contribution to the Overall Objective;
- Project sustainability: the likelihood of a continuation in the stream of benefits produced by the project after the period of external support has ended.

The ROM is synthetically showed in the following figures:

Evaluating Effectiveness of pilot actions

RELEVANCE: ACHIEVEMENT OF OBJECTIVES

Level of pilot action contribution to >>> **GENERAL OBJECTIVE** 1 2 3 4 5

Explain your answer giving reasons for the assigned score

Describe actions and provide evidence to it

Level of pilot action contribution to >>> **SPECIFIC OBJECTIVES** 1 2 3 4 5

Explain your answer giving reasons for the assigned score

Describe actions and provide evidence to it

IMPACT: MOST SIGNIFICANT CHANGES

If you consider the effects produced by the Pilot Action, which are the most significant changes observed in the local context of intervention?

Please specify the changes in three periods: at the end of the project; after short time (expectation) and long time (possible permanent changes).

Relevant changes (at the end of the project)	Relevant expected changes (short term)	Possible permanent changes (long term)
--	--	--

IMPACT: STRENGTHS, WEAKNESSES AND LESSONS LEARNED

1. STRENGTHS
If you think about activities developed in these months, could you help us to identify the main STRENGTHS of the Pilot Action?

2. WEAKNESSES
If you think about activities developed in these months, could you help us to identify the main WEAKNESSES of the Pilot Action?

3. LESSONS LEARNED
What are the lessons learned that your organization brings home from the project? What did your organization learn from the participation to the project that will be useful for future applications?

4. SUGGESTIONS
Do you have any proposals or suggestions regarding the prosecution of the project as a whole?

a)....
b)....
c)....

a)....
b)....
c)....

a)....
b)....
c)....

a)....
b)....
c)....

5.4. Phase 4 Planning strategic actions

Strategic Action Plans (SAPs) in the GreenerSites project represented concrete tools to tackling complex issues in both FUA and related brownfields.

Stakeholders were continually involved and requested to collaborate to find and adopt common solutions to environmental, economic and social concerns in brownfields. The challenge was to identify, plan and schedule the most suitable actions that, according to each stakeholders' experience, could increase the effectiveness of environmental management and economic development of the brownfield sites in the overall Functional Urban Area.

The strategic action planning process started by answering the following questions

- What is the current situation?
- What are our goals?
- How will we achieve our goals?
- How can we measure progress?

It was necessary to take into account

- the analysis of the state of the art;
- the outcomes of the pilot actions;
- the results of the consultation of stakeholders
- the contribution of the participatory processes
- and, in case of scarce resources, the impacts/effects of alternative actions

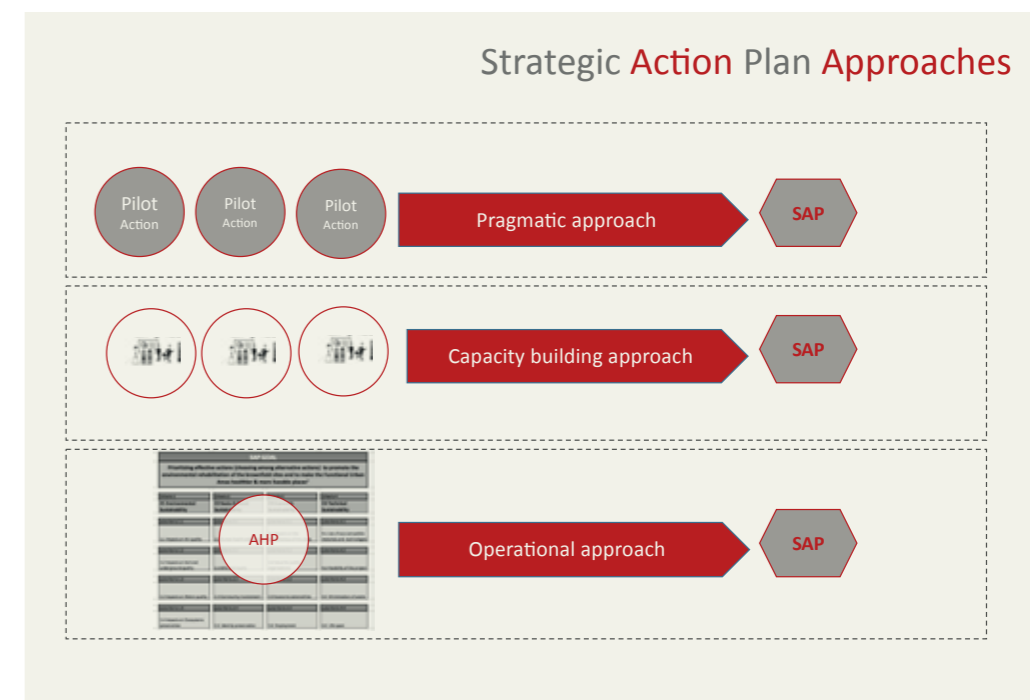
In such a complex context, the perspective of driving the overall regeneration of brownfields meant that it was crucial to engage the relevant stakeholders to develop the following STEPS:

- a) *Selecting actions to be included in the SAP*
- b) *Elaborating the SAP*

A. **Selecting Actions to be included in the SAP** first required the selection of the decisional method. Assuming that it must be based on knowledge, the method adopted to indicate and decide which actions should be included in the strategic plan with a certain priority may vary.

In the GreenerSites project, we experimented with the following:

- Pragmatic approach: an approach based on the outcome of the pilot actions and adopted with the specific purpose of ensuring follow up and improvement;
- Capacity building approach: ensuring a continuous improvement of expertise necessary for the management of the sites and their remediation, the approach is based on human and knowledge capitals more than on structural assets;
- Operational approach: ensuring the unbiased selection of actions on the basis of a prioritization process. Among the operational methods available in literature, the AHP originally developed by Thomas L. Saaty (1977), can be applied to ranking actions within GreenerSites SAP. Actually AHP is a participatory decisional support system capable of comparing alternatives and prioritizing actions against criteria and sub-criteria with different weights in the decisional process, as described in the figure.



Strategic Action Plan Structure

Introduction	PART B (for each Action) Strategic Action n
Scope	Context of the Action
The context: FUA and Brownfields	Problem addressed
The participatory Process	Objectives
The methodological approach to select actions	Participatory and Management Model (who does what)
PART A Executive summary	Planning of activities (timeline)
Brief description of Strategic Action 1	Financing
Brief description of Strategic Action 2	Progress of Implementation and Monitoring
Brief description of Strategic Action 3	References
Brief description of Strategic Action n	Bibliography, Good Practices, PAs, Web Links, Annexes

B. Elaborating the SAP meant organizing the contents using a structure capable of providing targets with overall scope and relevance, a description of resource schedules and finance and references. In the **GreenerSites** project, we adopted the following scheme organized into four main chapters.

- Introduction: including a general presentation of the considered area, the outcomes of pilot actions and experimental solutions tested; specifying the process of key stakeholders involvement and the outcomes of consultation of local players; describing the methodological approach adopted for selecting the relevant action(s) included in the Strategic Action Plan;
- Executive summary of the action(s) strategically identified and planned for an effective management of brownfield sites;
- Detailed description of the action(s), providing details about the area of intervention, the analysis of the specific problem(s) addressed, describing the specific objectives of intervention, the players, roles and timing of activities; identifying the financing sources and detailing the implementation steps and related schedule.
- References: including external relevant documents that may be useful for a deeper understanding of the topics dealt with in the SAP.

5.5. Phase 5 Promoting a shared governance

Establishing and developing a shared governance is a huge challenge that must be taken into account to ensure the scaling up of pilot actions, the long-term impact of the action plan and the effect of the regeneration strategy. Without the collaboration and the commitment of the interested parties, the risk of failure increases. A participatory process or a stakeholder table are not enough to establish an effective shared governance, but they are a very good starting point.

The open governance model simultaneously represents a pre-condition and an opportunity that must be undertaken in order to confront the uncertainty and complexity of brownfield rehabilitation. It is for this reason that the **GreenerSites** project has reinforced the need for it and enabled the process, aware that it does not simply refer to institutional sustainability, but to the overall management process.

The process developed in the **GreenerSites** project to build an effective shared governance included the following **STEPS**:

- a) *Promoting a Memorandum of Understanding to strengthen stakeholders' commitment*
- b) *Defining procedures for governance development*

A. Promoting a Memorandum of Understanding represented a way of ensuring continuity to PA results, scaling up related outputs and developing the SAP.

It is important to engage stakeholders in sharing follow-up measures before arranging the MoU.

The stakeholders' tables, activated during the preliminary stages of the project, were kept active and effectively engaged both in the implementation and evaluation phases in order to strengthen the stakeholders' commitment.

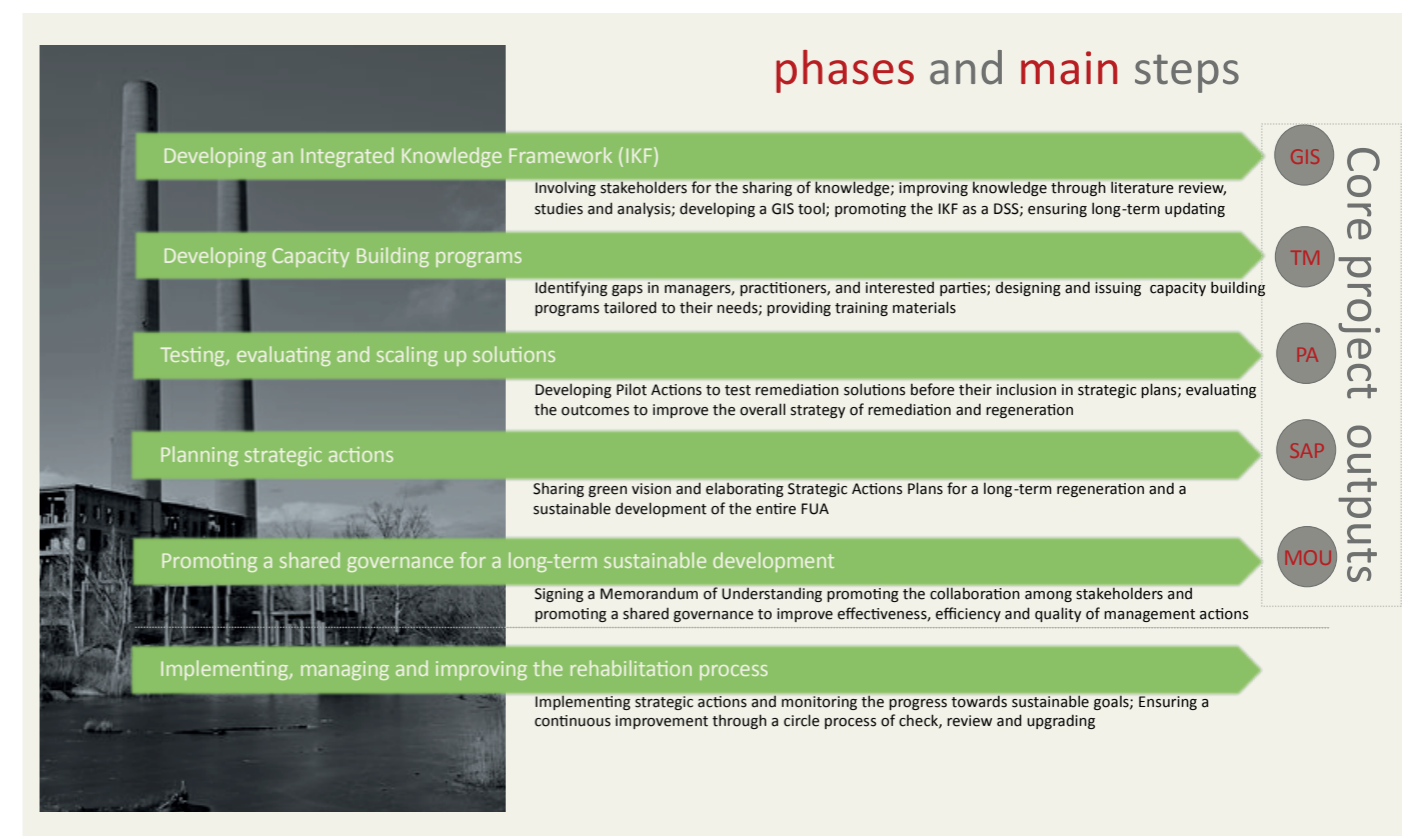
A common understanding of the environmental concerns, a mutual acknowledgement of socio-economic issues and a joint recognition of gaps allowed interested partners to sign the Memorandum of Understanding and agree for a long-term cooperation in the brownfield regeneration process also at FUA level

B. Defining procedures for governance development was a pre-condition to supporting the long-term regeneration process. A joint arrangement of specific procedures and measures was recommended in order to reinforce the institutional, economic, social and environmental overall sustainability.

Procedures have been shared and agreed with different governance levels, committed to the drawing up of specific financial strategies to ensure necessary resources to brownfield redevelopment and to test innovative technical solutions to environmental problems.

5.6. The process in a "snapshot"

The following figure provides a snapshot of the approach followed at each stage of the GreenerSites process.



6. Conclusions

Over the last decade the issue of brownfield redevelopment has more and more evolved towards a question of **strategic land management**.

This approach directly relates to a real **change and commitment** in ensuring an increase in the quality of life of the inhabitants of the involved areas and requires land use planning methodologies and tools.

However, the need of a more **strategic** and complex **vision** still encounters a number of obstacles: regeneration and reuse of brownfield sites represent crucial issues among the environmental challenges addressed by European countries, facing financial, and legal barriers but also the lack of data and the long-standing need for stakeholders' awareness and involvement¹.

Prevalence of brownfield sites across Europe has directly shown the necessity of strategic actions with the ultimate goal of sustainable urban development of cities and municipalities. The GreenerSites project has comprehensively addressed this challenge by delivering valuable information and concrete sets of measures to the institutions responsible for the rehabilitation of the brownfield sites.

The GreenerSites partners believe that a **change** is needed in the way public authorities deal with the regeneration of contaminated sites and this change passes through a **strategic planning** of the actions.

The project has strongly sustained this approach with its activities and results achieved based on the belief that brownfield redevelopment should not concentrate on mere land reuse and its reintegration into an economic cycle but rather should consider more complex aspects that would deliver a combination of social, economic

and environmental goals. Such approach relies heavily on national and regional governance approach: appropriate legislation, management, financial incentives, etc.

GreenerSites has delivered tangible and intangible sustainable values to the analysed FUA's creating short and long term benefits. The importance of those benefits cannot be assessed over a short term period. The effects of generating strategies and tools, training sessions and know-how transfer during the course of the project, can only be determined over a longer period. The analysis of sustainable measures delivered by the project has concentrated on evaluation of the short-term measures that have been applied and are the results of the pilot actions. Each of the Pilot Actions had different goals and objectives, concentrating on different aspects of sustainability yet - through knowledge sharing and exchange of know-how - collectively they obtained a much wider perspective of brownfield management.

Specific aspects of sustainability that were tackled and applied through the project include: **social** (improvement of the quality of life of the local communities, stakeholders' engagement), **economic** (activities to trigger investments and grants), **environmental** (mitigation of environmental impact), **institutional** (sustainable tools for brownfield redevelopment).

We strongly believe that project's achievements represent an important starting point to find more effective ways to meet the **complex challenges of brownfield management** to make functional urban areas cleaner, healthier and more liveable places and pave the way for a sustainable redevelopment of the sites in the involved territories.

¹ Proceedings from the European Conference "Brownfield development in the EU", held in Brussels on 5 April 2019 and organized by the European Commission - DG Environment

GreenerSites Project

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www.linkedin.com/in/GreenerSites

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Contacts

City of Venice

greenersites@comune.venezia.it

european.policies@comune.venezia.it

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City of Venice

EPC srl

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