

Sustainability measures in GreenerSites Pilot Actions



Economic



Institutional



Environmental



Social



Interreg 
CENTRAL EUROPE
European Union
European Regional
Development Fund
GreenerSites



PREFACE

More than half of the European population lives in the 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 the 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 challenge but at the same time, a tremendous opportunity for redevelopment.

The GreenerSites project aim is to address those challenges, working hand in hand with municipalities, helping them with sustainable redevelopment of the brownfield sites. We are already completing two years of our works starting with a Pilot Project which goal was to improve the management of the brownfield sites in Central Europe by defining strategies and management tools based on sustainable development approach. Nine Functional Urban Areas in five countries were selected for the Pilot Actions.

The document presents sustainable measures and deliverables undertaken through eleven Pilot Actions. It demonstrates that the work accomplished provided an extensive economic, environmental, institutional and social value. The research though has also pointed out the major obstacles encountered in most countries that hinder the redevelopment of the brownfield sites, with the most notable being the lack of coherent regulations concerning the definition and accountability for those sites.

We hope that with the research results, knowledge sharing, creation of important databases and management tools we will contribute to smart and inclusive growth of the urban areas with sustainable strategic approach.

I would like to thank, in this place, all the partners and people involved in the project for their valuable work input and great commitment.

ARMSA
WP T3 leader



Environmental Rehabilitation of brownfield Sites in central Europe

The European Environment Agency (EEA) estimates that polluting activities have occurred in about 3 million sites in Europe and that “data on the redevelopment of brownfields are patchy and hardly comparable, reflecting the lack of a common definition of the problem across Europe”. Territorial analyses carried out by prominent networks (e.g. Cabernet) show that the issue of brownfield development outlines a core topic for the central Europe area.

GreenerSites seeks to improve the environmental management of un- or underused industrial areas. The project aims to achieve this through the definition of strategies and tools that are based on a sustainable, integrated approach to make Functional Urban Areas (FUAs) cleaner, healthier and more liveable places. Project Partners will bring about a shared and enhanced knowledge on integrated environmental management of brownfields.

They will also reinforce capacities of the public sector to plan and carry out brownfield regeneration and produce well-defined sustainability measures and tools to ensure the effectiveness of environmental planning. GreenerSites will build on know-how from previous EU projects and existing networks.

Main outputs of the project will be:

- A common tool for brownfield regeneration stemming from the preliminary analyses conducted in 9 central European FUAs;
- 9 Strategic Action Plans defined in two steps (joint concept and full definition at FUA level after pilot phase);
- 11 Pilot Actions testing more sustainable and novel technical solutions in brownfields to improve their environmental performance;
- A full training package for public employees and stakeholders;
- A Common transferability manual.

Duration of the project: June 2016 - July 2019

GREENERSITES IN NUMBERS

11 Partners
5 Countries
11 Pilot Actions
9 Strategic Action Plans
85% level of funding
3 795 769,00 Euro Project value
3.117.919,00 Euro Amount of European Union aid

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Size:
2000 ha

FUA population:

785,000

FUA size:

3199 km²

Former chemical plant "Zachem" in Bydgoszcz, Poland

Situation of brownfields:

In Poland there is no official catalog of contaminated areas, including brownfields. Such actions are not taken at national or regional level in contrast to policies in countries such as Italy or Germany. However, there are systems containing fragmentary inventory of contaminated areas. Unfortunately, these data are only available for selected administrative staff and do not represent the public domain.

Location:

The site is located within the borders of the borough City of Bydgoszcz, in the south-eastern part of the city, at a distance of approximately 7 km from the center. Chemical Plant is bounded on the north and east by Vistula and Brdarivers drainage bases. In close vicinity there is a residential residential area.

Ownership:

The main part of the area is managed by a trustee in bankruptcy. The ownership is divided by the State Treasury administered by State Forests, the State Treasury in perpetual usufruct of the Kapuściska Infrastructure JSC in liquidation - the legal successor of "Zachem" Chemical Plant in Bydgoszcz, the State Treasury in perpetual usufruct of other entities, the State Treasury - Municipality of Bydgoszcz.

No. of active economics and employment:

At the former chemical plant territory there is

actually between 120 to 200 economic activities which employ more than 3500 employers.

Contamination/environmental condition:

The site presents specific contamination of soil and ground water from industrial waste dumps and installations. Actually ground water and soil at large part of former "Zachem" plant is highly contaminated by organic pollutants (carcinogenic and mutagenic) with relatively high concentrations. Until now 27 supposed pollutants sources have been identified and 7 plumes of groundwater pollutants. Main organic contaminants are Cl- and Na+, inorganic contaminants: phenol, AOX substances, diphenylsulfone, hydroxybiphenyl, octylphenol and ethoxylated octylphenolesters and chlorinated ethenes and methanes. Further investigations are necessary for the area.

Main challenges:

The main requirements for future needs related to the planning and implementation of effective remediation include:

- execution and current operation of groundwater monitoring network in order to gather reliable data for the optimal selection of techniques and methods of effective remediation including in particular the impact on local residents,
- remediation project execution based on advanced numerical models,
- raising funds for the often long-term remediation, where due to its high cost is necessary participation of the government at the level of voivodeship and even central,
- to take effective remediation to bring its parameters to an acceptable level.

Planned pilot action:

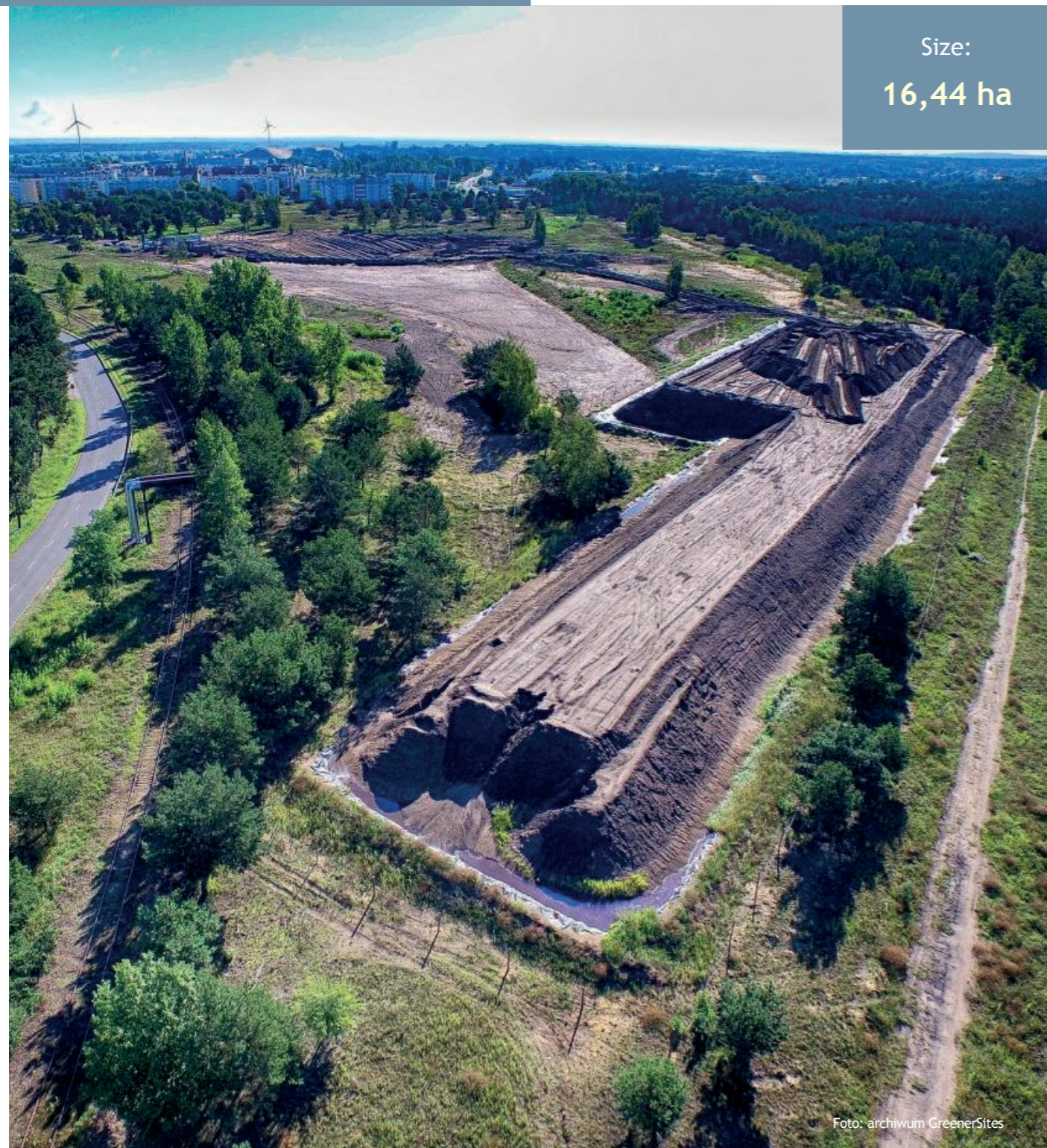
The pilot action aims at assessing environmental and human risks associated with the ground and groundwater contamination of the former chemical factory. It is planned to install an innovative monitoring ground and groundwater system including series of the laboratory tests

and hydrogeological modelling. Pilot activity will be supplemented by series of local trainings and stakeholders meetings that are necessary for long term remediation of the area.

Impact on the environment and human health (alternatively):

In the immediate vicinity of the former "Zachem" Chemical Plant there are areas inhabited by the Bydgoszcz citizens, including the Emergency Housing Estate, Łęgowo, Brdujście and towns Płatnowo and Otorowo. Any environmental pollution has always direct impact on the local community. It is associated with the migration of plumes of contaminated groundwater, contamination of new residential areas, inflow of contaminated water to farm wells and the potential gas exhalation in the river valleys. Citizens of the town Łęgowo are subjected to the greatest threat, as they are exposed to direct contact with organic chemicals, often toxic and of carcinogenic and mutagenic character.





Size:
16,44 ha

Foto: archiwum GreenerSites

FUA population:

785,000

FUA size:

3199 km²

Former railway sleepers preservation plant in Solec Kujawski, Poland

Location:

The area is located in the eastern part of Solec Kujawski, in the Kuyavian-Pomeranian voivodeship at 2 Kujawska Street, in the neighbourhood of a multifamily housing estate, 'JuraPark' entertainment and education park, objects of Sport and Recreation Centre with a swimming pool, sports and entertainment hall and sports stadium. Strategic position of the area in the central part of the town surrounded by streets and railway tracks.

Ownership:

The land was purchased in 2008 by Municipality of Solec Kujawski.

No of active economics and employment:

N/A.

Contamination/environmental condition:

A major problem for the environment is poor quality of groundwater. Existing here earlier for decades hot spots created so-called secondary hot spots in the saturation zone, before they have been removed or significantly reduced. They cause the current long-term contamination of groundwater. As for the soil, after three years of remediation its quality has improved greatly. The hardest to eliminate organic compounds (PAHs) were greatly reduced. Currently the quality improvement is monitored - the bioremediation of soil and subsoil phase takes place.

Main challenges:

Contamination such as creosote oil (impregnate used in railway sleepers) can diffuse deep into the aquifer and it causes permanent pollution of groundwater. Currently, it has been detected that at a depth of 16-20 metres below the ground level, the dense non-aqueous phase liquid (DNAPL), i.e. creosote oil, is very slowly migrating from the area of former contamination sources. Because this process has been ongoing for decades, the plume of concentrated pollutants has flown out of the brownfield area and threatens to degrade the areas designated for housing. Also, it pollutes strongly the groundwater flowing into the Vistula River - the main river in Poland, astride which city Solec Kujawski lies.

Planned pilot action:

One of the tasks is the diagnosis of this specific contamination in waters, monitoring of changes in concentration, directions of migration, composition etc. and development of a method to stop and eliminate the threat. For this purpose, a network

of test holes and a monitoring network have been expanded. Research is carried out using standard methods (analysis of water samples) and passive samplers - measurements are currently in progress.

Impact on the environment and human health:

The plume of concentrated pollutants which have flown out of the brownfield area is a threat to the inhabitants living in the neighbourhood housing estate. Moreover, it strongly pollutes the groundwater flowing into the Vistula River, thus threatening the areas belonging to the European ecological network "Nature 2000".

Best practices in different disciplines:

In the period of 2013-2016 the area was subjected to remediation of soil and partially groundwater due to the work of co-financing from EU funds (Operational Programme Infrastructure and Environment). A conceptual design of an 'in situ' decontamination method was developed.





Foto: archiwum GreenerSites

FUA population:

2,7 mln

FUA size:

2730,23 km²

Former CHP plant in Radom, Poland

Situation of brownfields:

In the Mazovia Region information on its post-industrial areas and environmental conditions is scattered, incomplete and fragmentary. It's also difficult to get reliable data on the degree of the given area degradation. There is lack of comprehensive information about environmental hazards of the degraded areas due to industry and utility categories for the future economic potentials. In the FUA Warsaw, Płock, Radom and Pionki there are identified brownfields, main environmental concerns are related to specific contamination of:

- air quality, quality of surface and ground water, soil quality, natural heritage and its potential impact, land consumption in urban areas.

Location:

It's located in the northern part of Radom, Radom county, Mazovia Region, in the area of the former Radom CHP plant located ca. 6 km north-east from the city center 9/177, 9/231, 9/188, 9/106, 9/103 and 9/110, area 0290 Nowa Wola Gołębiowska.

Ownership:

The owner of the site is the city of Radom (100%)

No of active economics and employment:

No economic activity is carried out in the zone.

Contamination/environmental condition:

The analyzed site have data based on which it would be possible to assess the level of its degradation, as well as directions for further actions. In each

section, surface soil samples were collected, from a depth of 0 - 0.25 m bgl. A comparison of the obtained test results with allowable concentrations determined in the a/m regulation indicates that the sum of C12 - C35 hydrocarbons (mineral oil fraction) and PAH (benzo(a)anthracene, benzo(a)pyrene, Benzo(b)fluoranthene) were exceeded in the sections 11, 12 and 14. The rest of samples from other sections did not indicate an exceeding of any of the tested parameters against threshold concentrations specified for soils of group I and result none of the tested parameters has been exceeded in the tested soil samples. Results of laboratory analyses of groundwater exceeding is allowed for the threshold calcium value when determining the quality class of groundwater at the measuring point.

Main challenges:

A suitably prepared and executed process of preparing the site for investment (including the required remediation, recommended restoration with a dismantling of existing developments), coupled with an analysis of potential social and economic risks, should ensure the safety of future activities, both in the context of the development of the analyzed area, as well as of the people frequenting the area in relation to conducted business activity.

- intensification of investing selected areas (according to the findings SUiKZP),
- improving the investment attractiveness of the city and create jobs by increasing the supply of land for production and service functions.

Impact on the environment and human health:

Due to the lack of data of impact on the environment and human health it is necessary to carry out tests to development on its post-industrial areas .

Planned action:

For the area of the former CHP plant the study suggests the following recommendations for the plan:

- enable investment activities, service and industrial areas and power plants on the plots adjacent areas by increasing the function of service and production,
- realization of the objectives of the public in the field of construction of basic transport system (road a collective move to the western side of the line PKP),
- revitalization of degraded brownfield and change of use of agricultural land for the purposes of building and service industry,
- implementation of applicable laws on the protection of the environment,

Best practices in different disciplines:

Post-industrial area management system introduced in Silesia (Śląsk) can be a good practice example. The Silesian Regional Assembly (Sejmik Województwa Śląskiego) adopted the Regional Assembly Post-industrial and Degraded Areas Transformation Act, no III/31/11/2008, on December, 17, 2008, dedicated to the regional database of post-industrial areas. The aim of the program is to create tools enabling the preliminary and full valorisation of areas and their classification as well as application of these tools for areas included in the regional base.

Photo credits: Giorgio Bombieri, City of Venice



Size:
16,44 ha

Situation of brownfields:

In the FUA there are 101 brownfields. Main environmental concerns are related to specific contamination of soil in active or dismissed industrial areas, as well as areas affected by illegal or environmentally improper waste disposal. Pollutants are various depending on past activities.

FUA population:

855,696

FUA size:

2,472.91 km²

Porto Marghera Industrial area

in Venice, Italy

Name:

Porto Marghera Industrial area

Size: 1828 ha. Porto Marghera is, by extension, environmental critical issues and development, the main brownfield located.

Location:

It is located on the edge of Venice lagoon (northern Adriatic sea): the entire lagoon was designated Special Protection Areas (SPA) for endangered and migratory species in accordance with the European Bird directive.

Ownership:

35% public area (City of Venice, Venice Port Authority); 65% Private area.

No of active economics and employment:

780 economic activities are currently settled in the area with a total of 10.060 employees.

Contamination/environmental condition:

The site presents specific contamination of soil and ground water as a result from active or dismissed industrial activities. The water body in front of Porto Marghera should be considered in a poor ecological status. The status of contamination is known is for the 19% of the area but remediation procedures have not yet started. However, in circa 49% of the total area the remediation projects have been approved by relevant public authorities. Remediation procedures have been completed only in 241 ha (14%).

Main challenges:

Porto Marghera is, by Law, since 1998 (Law n. 426/1998), a “Sito di Bonifica di Interesse Nazionale”, which means a remediation site of national interest because of its potential impact on the environment given its surface extension and risk posed by contaminants. In particular the second industrial area - the main brownfield - mainly hosting settlements related to the raw chemical industry, needs a deep requalification or a strong reconversion.

Planned pilot action:

3 different pilot actions will be implemented in the area by the respectively by the City of Venice, the Veneto Region and the North Adriatic Sea.

Port Authority

- reviewing the remediation plans taking into account the new regulations and the sustainability of the interventions and defining specific measures and fiscal instruments to attract new investments in the area;
- setting up a system for monitoring the air quality in the sites subject to remediation and future reuse. The definition of a site specific soil-gas reference level will help to select adequate remediation procedures with a view to their functional reuse;
- testing the capping method in a selected site which, thanks to a cost-effective investment and an environmental-friendly approach, could guarantee sustainable remediation of excavated material.

Impact on the environment and human health:

The presence of 9 factories that use dangerous substances still impacts on the population. According to a risk assessment document, shared between relevant actors and institutions, 3 areas were defined by a different level of risk.

Best practices in different disciplines:

- Phytoremediation of 150 ha has been developed in the area to treat civil waste water in order to reuse it for industrial purposes.
- Between 1993 and 2014 a sustainable regeneration process took place to develop the Science and Technology Park, called VEGA. This process depended on bioremediation (biopile), which, for that time, represented an innovative solution as the excavated soil, with amendment, formed into compost piles (a basic bio-pile system includes a treatment bed, an aeration system, an irrigation/nutrient system and a leachate collection system. Moisture, heat, nutrients, oxygen, and pH are controlled to enhance biodegradation).
- ENI, the greatest Italian oil and gas company which has been present in Porto Marghera since the twenties, converted a traditional oil refinery into a biorefinery, transforming organic raw materials into high-quality biofuels. The company invested €200 million to transform the petrochemical plant into an integrated green chemical hub with the aim to guarantee an economically sustainable future for the site and protect employment levels and at the same time ensure the environmental sustainability of the whole reconversion project.
- An example of completed remediation works are those ones that allowed the redevelopment of a vast area in Venice-Porto Marghera, the so called Ex Alumix Area, which now is used as a port logistics area. The investment only for remediation consisted in 11.250.000 €.





Size:
20 ha

Foto: archiwum GreenerSites

FUA population:

128,384

FUA size:

44 km²

Old Refinery Rijeka

Situation of brownfields:

In the FUA there are 16 brownfields. Main environmental concerns are related to chemical reactions of ozone precursors, local sources (transport, inadequate waste disposal, contamination of soil in dismissed industrial areas). Pollutants are various depending on past activities.

Location:

Refinery Rijeka is situated in the west cost of the City of Rijeka (area Mlaka), and is one of the main brownfield located within the FUA Rijeka. And also one of the biggest pollutants within the area. The location is very close to City center.

Ownership:

The largest share of the area belongs to private owner, app. 98%. The traffic area surroundig the refinery are state roads and some small part of the area is state property.

No of active economics and employment:

In the larger area of Mlaka, app. 117 bussiness entities are currently operating. Most of the 117 subjects are registered as small businesses.

Contamination/environmental condition:

The water surrounding area Mlaka is poor to moderate quality. There are no information available about ground water contamination in the area of Rafinery Mlaka, but considering the soil contamination it is asumed that the main pollutants are the remains of the raw materials used in the past. Contamination caused by former industrial activities; used raw materials in the tanks; oil derivates, petrol, fuel etc.

Main challenges:

The Mlaka Plateau is of utmost importance for the city. The area has its own port which can be one of the most important and feasible way out of the city to the sea. Problems related to this area are mainly connected to the ecological status, due to the industry that was there for years (oil refinery), ownership relations and consequently responsibilities for its rehabilitation and future purpose.

revitalization of Refinery Mlaka, of course, with all necessary tests, analyzes, elaborations etc.

Planned pilot action:

Fundamental research of soil, water and air pollution of the old industrial port Mlaka and study on future use of pilot area.

Impact on the environment and human health (alternatively): Refinery Mlaka is closed, so currently there are not any impacts on the environmental or human health.

Best practices in different disciplines:

An example of good practice was the former military base on Trsat, which was overhauled and completely restored to the University campus. This example and model could also be applicable to



Size:
17 ha

Foto: archiwum GreenerSites

FUA population:

48,868

FUA size:

94,9 km²

Abandoned industrial area of Stara Cinkarna

Situation of brownfields:

In the FSU, the larger industrial area of the Stara Cinkarna is abandoned. The main environmental issues are related to specific soil contamination. From 1874 to 1990, this area was used by the metallurgical and chemical industry Cinkarna Celje. For several decades, the production of zinc ore and zinc smelter was carried out. In parallel with the roaster, new industrial facilities were built in this area, which were intended to support basic production. The main environmental problem is extremely polluted soil with metals (copper, zinc, cadmium and lead). In some cases, critical emission values are also exceeded for arsenic and chromium. There are tar pit and slag remnants. The estimated environmental risks are contaminated soils with heavy metals (extreme values of certain heavy metals) and mineral oils, which, in the event of excavation, represent waste that can contain hazardous substances, buried industrial waste and tar pit, buried tanks and underground technological sewage. There is no data/research on groundwater contamination in the area so far.

Location:

Stara Cinkarna is located on the north-eastern edge of the town in a triangle, which is roughly bounded by the Mariborska road to the west, Tovarniška road to in the north, Hudinja river and the railway Celje - Maribor in the east. In the area of Stara Cinkarna there is also a former waste disposal site, i.e. „Halda rajmovke”, which lies just next to Cinkarna between the railway line and Voglajna river. In the west, north and south, the industrial area in question is continuing to a mixed business residential area. In the east on the left bank of Hudinja river, there are a parking area and a fairground, and in the distance the objects of the cargo freight station Čret and other business facilities.

Ownership:

100% public area (Municipality of Celje)

No of active economics and employment:

There are currently 25 companies operating in this area (Tehnopolis and others). There is no data on the number of employees in this area.

Contamination/environmental condition:

In this area, the soil condition monitoring was carried out at 38 points (depth up to 25 cm, at two points up to 60 cm). Earth monitoring was also performed at a depth of 10 m (8 samples). Groundwater status was determined on 4 temporary wells. Sanation Land redevelopment procedures have not yet been approved by the Slovenian public authorities.

Main challenges:

Existing unmanaged brownfield areas have more synergy-acting negative effects, such as the acquisition of investors, negative impacts on the quality of life, increased social conflicts, the concern of the population and increased pressure on the spread of settlement to agricultural areas. At the government level, the problem of solving degraded areas is not regulated by law yet. Current environmental protection legislation and spatial planning legislation do not define procedures and methodologies for managing abandoned degraded areas.

Planned pilot action:

The Municipality of Celje has already set up a monitoring system to monitor the underground water in the area of Old Cinkarna. A detailed analysis of all pollutants in the pilot area is in process and will be concluded by the end of 2018. We plan to test the effectiveness of solidification method for remediation of the area of Old Cinkarna. Also, a protocol procedure of non-hazardous waste disposal will be made as part of GreenerSites project.

Impact on the environment and human health:

There is no specific risk analysis of human health or the environment in the area. It is estimated that human health can be affected from the naked surfaces pollution of the soil dusting in the area and of the pollutants into groundwater.

Best practices in different disciplines:

In the sanation restoring process of the old Cinkarna area, we propose the following approach:

- to perform a thorough investigation of the entire area and determine which parts of the land are so contaminated that they have the characteristics of hazardous waste. Special attention should be given to contamination with tar and mineral oils. On the basis of the obtained data on the state of the environment in the area the preparation of risk assessment is necessary to identify significant environmental and human health effects,
- to perform a detailed site investigation to identify the types, quantities and properties of waste, products and raw materials remaining in the area,
- to perform screening of the terrain to find out whether any waste is buried in the ground and determine possible remediation methods,
- to implement a screening of the terrain to determine if the cavern is in the ground and take this into account when planning further use of the space,
- to perform hydrogeological research in the area with the implementation of piezometers,
- to remove all hazardous waste remaining in the area,
- to implement remediation or remove the soil contaminated with tar,
- to implement remediation or remove the soil contaminated with mineral oils,
- to implement other necessary measures to protect the environment against pollution,
- to create the timeframe and priorities of the activities in the framework of rehabilitation and to choose various solutions.

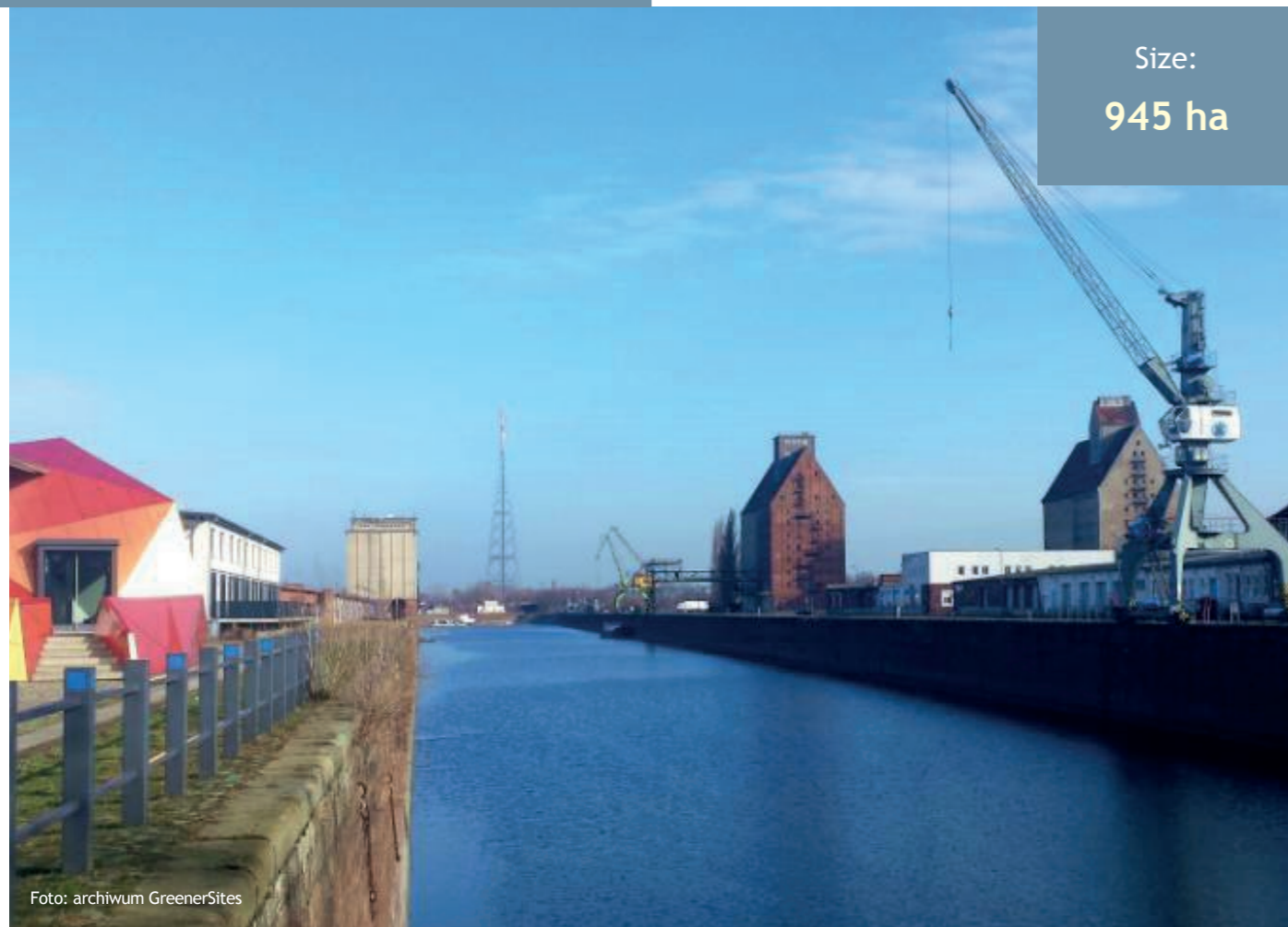


Foto: archiwum GreenerSites

FUA population:

700,000

FUA size:

5,571 km²

Magdeburg-Rothensee in Magdeburg, Germany

Situation of brownfields:

A total of 4.549 suspected contaminated sites officially confirmed by the environmental authority are located in the FUA Magdeburg (2016). 163 of these suspected contaminated sites are situated within the boundaries of the city of Magdeburg. Pollutants are various as a legacy of industrial, mining and military activities in the area.

Location:

The Magdeburg-Rothensee port and industrial complex is situated on the banks of the river Elbe in the northern part of the city of Magdeburg.

Ownership:

46% public (City of Magdeburg, Magdeburger Hafen GmbH, State of Saxony-Anhalt, Federal Republic of Germany), 54 % private.

No of active economics and employment:

Less than 100 economic activities are currently settled in the area with up to 4.000 employees.

Contamination/environmental condition:

A total of 96 pollutant contaminated areas have been identified within the Rothensee pilot site. Essentially, the soil has been penetrated by aliphatic and aromatic hydrocarbons, phenols, polycyclic aromatic hydrocarbon and heavy metals such as

zinc, cadmium, chrome, arsenic and mercury. Because the alluvial loam layer, which covers extensive areas within the pilot site, has been destroyed by the impacts of war and construction projects in many places, contaminants have been able to penetrate right through to the groundwater in these areas. Thus, many product phase lenticular structures of tar and mineral oils have formed on the surface of the ground water.

Main challenges:

A number of different public and private bodies, some of whom are pursuing different strategies and objectives, are currently involved in urban development and urban land-use planning, remediation and safe-making of real estate, as well as the revitalisation and marketing of the respective sites. A close and well coordinated collaboration between these different stakeholders is essential for a successful and efficient land development programme.

Planned pilot action:

Web-based solutions offer a method of simplifying cross-disciplinary agreements and collaboration between the authorities and other stakeholders in the field of site remediation and brownfield redevelopment. In this way, data, plans and documents can be exchanged and shared in a rapid and uncomplicated manner. Information about the various sites and risk statuses can be accessed online at any time. Using the pilot site as an example, and within the framework of the GreenerSites project, a pilot action will be conducted implementing the Web GIS Tool for a sustainable collaboration between the participating local stakeholders.

Impact on the environment and human health:

Extreme high contaminations of soil and groundwater at several spots within the Rothensee pilot site represent a considerable hazard to the environment and human health. Several hazard prevention measures as well as decontamination and remediation activities have been undertaken for the revitalisation of the area.

Best practices in different disciplines

Economic instruments

The Brownfield Authority Saxony-Anhalt is a specialised institution whose objective is the bundling

of complex tasks associated with the elimination of legacy contaminated sites so as to provide targeted support for potential investors. As a matter of principle, the order in which the locations in question are processed depends upon the latent hazard potential. However, whenever investment measures are imminent, the processing of the affected area is prioritised, whereby the development plans for the site in question are coordinated with the potential investor. The objective is the short-term provision of cleaned up sites for economic utilisation.

Remediation techniques

In Magdeburg-Rothensee a ground water clean up project based on Air Sparging was completed in 2015. 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. The air is then sent to vacuum extraction systems to remove the contaminants.

A system of steel piling walls and sealing walls has started in 2010 and is scheduled for completion in 2019. The seal wall system will prevent polluted groundwater from draining into the port and the River Elbe. In addition, action must be taken to dispose of or treat the residual contamination within the sealing wall system circulation system. To this end, an ENA-project (Enhanced Natural Attenuation) is planned whose objective is the in-situ biodegradation of heterocyclic hydrocarbons. The prerequisite safety system is scheduled for completion in 2018. The ENA-project is planned to operate from 2020 onwards.





Size:
407 ha

Foto: archiwum GreenerSites

FUA population:

420,000

FUA size:

1,569 km²

Brownfield site Halle-Ammendorf

in Halle (Saale), Germany

Situation of brownfields:

In Halle area are located 9 brownfields sites. In Saalekreis area were located: 223 brownfields sites. That's give total number of 232 brownfields sites in whole FUA area (officially confirmed by the environmental authority, as of November 2016). Main pollution source have been caused by lignite mining activities and the production of chemical products. It's lead to create various contamination depending on past activities (e.g. chemical production, lignite mining, and machinery).

Location:

Ammendorf is located in the Southern part of Halle and was incorporated into Halle as an urban district in 1950. It's have 6,953 inhabitants (Ammendorf/Beesen, as of December 2015). Area could be characterised by mixed structure, both residential and industrial. In area were located Railway track, single-family house structure, domestic gardens, allotments and large uncultivated farmland. Alongside the Eastern boundary of the industrial area Ammendorf, there is an elongated area with legally protected biotopes as per § 22 Nature Conservation Act (NatSchG) of Saxony Anhalt, outside the exploration area on the margin of former open cast mine Bruckdorf. Also there are Areas of Outstanding Natural Beauty and Nature Conservation Areas in the south along the river Weiße Elster.

Ownership:

The largest share of properties on the site belong to private owners. The traffic area for public use is in municipal property. The former railyard Ammendorf is in the property of the public transport utility HAVAG.

N. of active economic activities:

Ongoing industrial development

a) Northern part of Ammendorf:

- MSG (machinery), Elektro-Thermit (welding and measuring for railway tracks), S.M.A. (metal technology), INDU LIGHT (light and ventilation systems)

b) Southern part of Ammendorf (Radewell / Osendorf):

- Tief- und Spezialbau Halle (underground engineering and special-purpose construction), TSR Recycling (disposal and waste management), Fehr Umwelt Ost (disposal and waste management), Metallbau Hofmann (metal construction), Chamber of crafts: new training centre

Main challenges:

Main challenges is that contaminated brownfield sites are fragmented, mixed and parcelled, with diverse ownership structure. Other problem is limited availability and development of existing brownfields to meet current requirements (e.g. revitalisation, marketing, and expansion area for existing companies).

Planned pilot action:

Institute for Structural Policy and Economic Development pilot action is about site analysis and

N. of workers:

630 employees (number refers to the Northern part of Ammendorf)

Contamination/environmental condition:

- Air contamination. There have been noticed increased traffic-related pollution near Merseburger Street. The evaluation of the daily average of fine dust PM10 (limit value 50 µg/m³) in the area of Merseburger Street has been tending to decrease since 2011. Since 2012, the measured values (PM10: 23 to 12 µg/m³) have been clearly below the limit value of 50 µg/m³. In the exploration area, the annual average values for ozone are also clearly below the threshold (110 µg/m³).
- Superficial Water contamination: Surface waters are not present in the exploration area. Approximately 2 km to the south, there is the course of the river Weiße Elster that flows in the Saale within the area of Beesen-Ammendorf. As stagnant surface waters, the open cast mine lakes „Osendorfer See“ and „Blaues Auge“ are to be mentioned that are in a distance of approx. 2 km to the East/Northeast.
- Ground Water contamination: The recharge rate of groundwater for the exploration area is low due to the high degree of sealing. Due to the industrial development since the middle of the 19th century, high quantities of environmentally and especially water- hazardous substances were handled over a long time. Some rehabilitation works are still running or are at the planning stage. Due to the proximity to Nature Conservation Areas, the specific ground water contamination needs to be analysed for future settlements.
- Soil contamination: Possible contamination caused by former industrial activities. Were observed high degree of sealing.

site development of selected brownfields in Halle-Ammendorf. The main goal is to improve the site marketability, considering environmental aspects (e.g. reduction of space utilisation, unsealing). By categorising the sites according to specific criteria, positive and adverse determinants for site marketability become evident. Institute developed an action plan that was agreed on with the City of Halle.

Italy

- City of Venice - Lead Partner
- Veneto Region
- North Adriatic Sea Port Authority

Germany

- ISW - Institute for structural policy and economic development
- Ministry of Regional development and transport Saxony Anhalt

Croatia

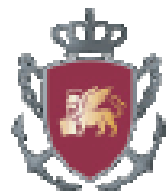
- City of Rijeka
- Rijeka Port Authority

Poland

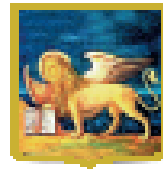
- ARM SA - Mazovia development agency
- City of Bydgoszcz
- Municipality of Solec Kujawski

Slovenia

- Municipality of Celje



NORTH ADRIATIC SEA
PORT AUTHORITY



REGIONE DEL VENETO



MESTNA OBČINA CELJE
MUNICIPALITY OF CELJE



LUČKA UPRAVA RIJEKA
PORT OF RIJEKA AUTHORITY



Solec Kujawski



City of Rijeka



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Sustainability Measures in the GreenerSites Pilot Actions





Sustainability Measures in the GreenerSites Pilot Actions

Smart and inclusive growth of cities form one of the most important pillar of sustainable development. The idea of smart growth of cities is further enhanced by 2030 UN Sustainability Goals, adapted by all EU member states. Goal 11 - safe, resilient and sustainable cities and human settlements directly refers to urban planning.

The inclusive, smart city growth require frequently redevelopment of brownfield sites. There is no common European definition of a brownfield site. Based on EUGRIS (Portal for soil and water management in Europe) brownfield sites can be defined as: “The sites that have been affected by the former uses of the site and surrounding land, are derelict or underused, may have real or perceived contamination problems, are mainly in developed urban areas and require intervention to bring them back to beneficial use”.

The definition is derived from works of the European expert network CABERNET (Concerted Action on Brownfield and Economic Regenera-

tion Network) that further clarifies the definition of a brownfield as sites which:

- have been affected by former uses of the site or surrounding land;
- are derelict or underused,
- are mainly in developed urban areas,
- may have real or perceived contamination problems,
- require intervention to bring them back to beneficial use;

RESCUE defines sustainable brownfield regeneration as “the management, rehabilitation and return to beneficial use of brownfield land in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations in environmentally sensitive, economically viable, institutionally robust and socially acceptable ways within the particular regional context”.

Whereas there is a clear need of brownfield sites redevelopment across all the EU countries, there are no pre-defined, universal indicators which would enable to establish “a hierarchy list” of sites that should be prioritized in terms of redevelopment. Current EU approach points out 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.

The GreenerSites project

The objective of the GreenerSites project is to improve the environmental management of brownfield sites across Central Europe through the definition of strategies & tools based on a sustainable integrated approach to make involved Functional Urban Areas (FUAs) cleaner, healthier & more liveable places. Based on the experience of the project partners, current approach of public authorities to brownfield regeneration needs to be modified broadening the territorial scope of environmental planning & management which will result in more effective, viable & sustainable strategies.

The project aims to achieve three specific objectives:

- To increase capacities of the public sector to plan and carry out brownfield regeneration by means of training & peer exchange opportunities;
- To apply more sustainable & comprehensive approaches in brownfield regeneration by drawing up Strategic Action Plans targeting Functional Urban Areas;
- To ensure valuable solutions to brownfield rehabilitation and their concrete sustainability by testing Pilot Actions and related supporting measures.

The project is realised in several stages commencing with the Pilot Actions (please see Chapter 3 for detailed project description). The main outputs of the project consisted of:

1. GreenerSites Web-GIS Tool for all the project partners. The tool presents information and database on brownfield sites across the studied regions. It enables partners to equally share their information in a web-based application which can be accessed by all users.
2. 9 Strategic Action Plans for each of the CE FUA sites being analysed, developed in two stages: a conceptual stage at the phase of the Pilot Action Plans and full documents after the initial project phase.
3. A *Common transferability manual for sustainable environmental brownfield management*, prepared upon completion of the Pilot Action phase.
4. Comprehensive training and know-how transfer of brownfield management for the local regulators and other stakeholders.
5. 11 Pilot Actions (PAs) testing more sustainable & novel technical solutions in brownfields to improve their environmental performance.

In order to improve the efficiency of the project management a unique approach has been implemented to ensure the desired outcomes. A matrix management structure was created whereby each project partner had horizontal and vertical responsibilities towards the outcome, i.e. preparation of Pilot Actions specific outcomes and implementation/communication of the outcomes across all the project partners. Such approach allowed not only greater consistency of the outcomes but also improved overall management of the project.



The economic, environmental and social dimensions of sustainable development of brownfield sites defined by CABERNET include:

- 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 of cities and using this project 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.

The fourth aspect of sustainable development includes appropriate governance of all those aforementioned dimensions through improved management of brownfield sites and assurance that the sites are developed in a sustainable manner.

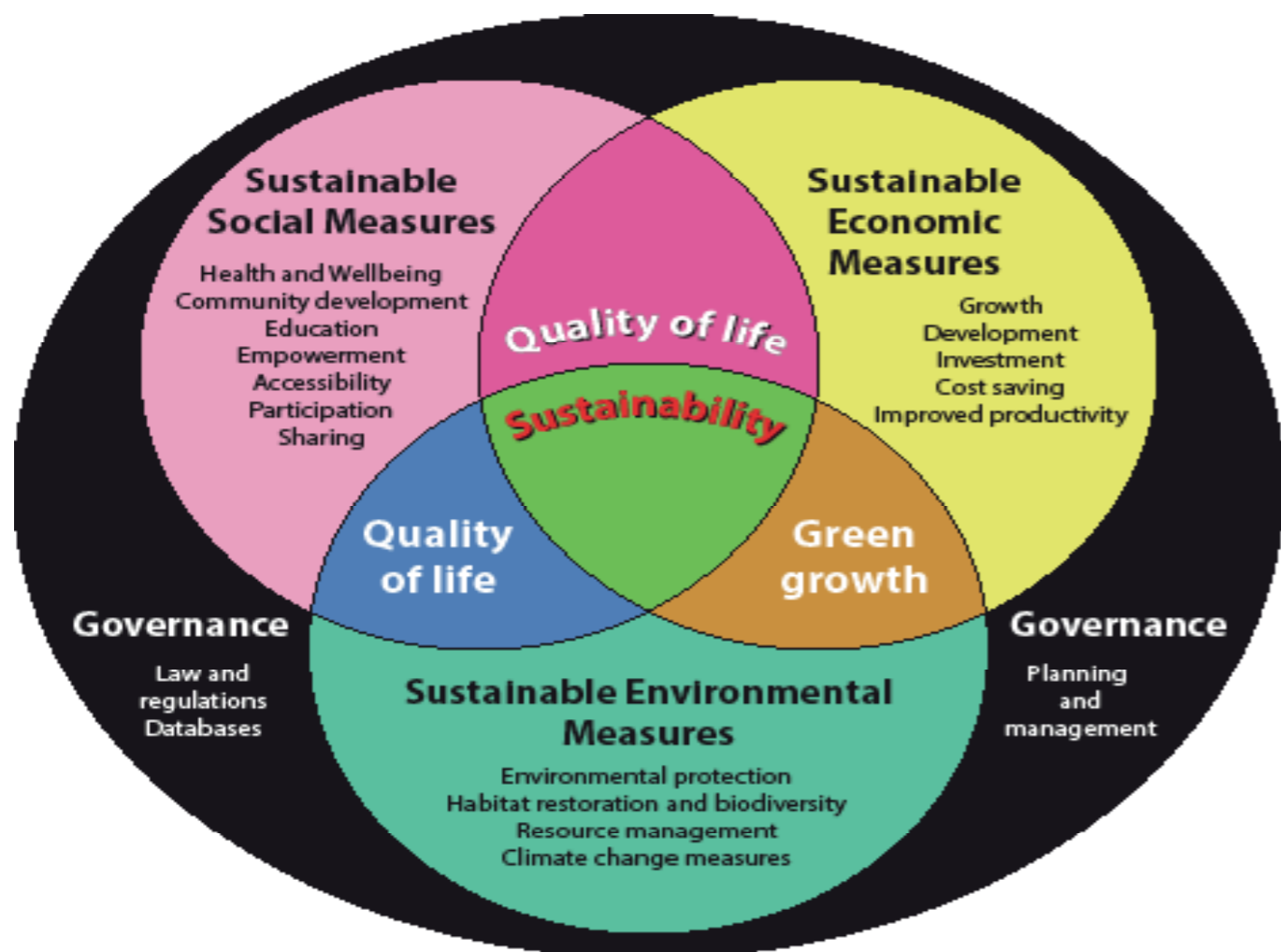


Fig. 1 The pillars of sustainability

The project encompassed various sustainability measures, which add value to all fundamental pillars of sustainability: economics, society and environment. Additionally, the project contributed to the improvement of governance at institutional level. 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).

The chart below presents sustainability measures that are relevant for the project. All the three pillars of sustainability are strongly dependant on appropriate governance at institutional level, both: site and project related, thus the governance is sometimes considered as the fourth pillar of sustainability.

Added sustainable value could have tangible and intangible form. It could also have a short and long-term effect. The table below classifies sustainable values, relevant to the Pilot Actions in relation to those factors.

As pointed out earlier, the sustainable decision making process should take into consideration both tangible and intangible values over short and long-term periods. This approach, however, creates some difficulties in comparative analysis of sustainable benefits and values created by the project and the Pilot Actions as there is no approved methodology for evaluation of the Pilot Actions results through a set of indicators.

The analysis will therefore concentrate on evaluation of short-term measures that have been applied and are the results of the Pilot Actions. Long-term benefits, however, should not be overlooked as they frequently form the goal of all of the actions undertaken.

The planning issue appeared twice in the table: both as short and long-term intangible value. That's because some Pilot Action projects had direct impact on a short-term decision making process made by municipalities regarding the studied FUAs (please see below for further details) while others through indirect research and analyses could have impact on a long-term city planning only.

	Tangible values	sustainable	Intangible values	sustainable
Short-term	Research & development Monitoring and databases Tools for better management of FUAs Development of innovative technologies		Enhanced management of FUAs redevelopment Sharing of know-how Stakeholders' engagement Better allocation of funds for further development of FUAs Improved marketability of FUAs Improved planning of FUAs Risk management	
Long-term	Cost saving New investment Increased market value of the site Direct generation of local tax revenue		Smart city planning Leveraging the employment rate Improved health and quality of life of local communities Improved fiscal policies (grants, tax cuts, other incentives for FUAs development) Improved city branding	



Economic Sustainability Measures





Economic Sustainability Measures

Economic sustainability involves creating economic value out of project or decision that undertaken. The decision making process should be based on long term benefits and should consider other aspects of sustainability, ideally having positive effect on the society and environment.

Brownfield redevelopment is an ideal example of actions based on economic sustainability principles. In a short term, in majority of cases, those sites require some form of additional investments prior to their redevelopment when compared to investments in greenfield sites. Additional investment, however, should not be the only factor considered in the planning process of a city's development. Capitalizing on short-term financial gains may create an uncontrolled growth of a city's peripheral areas, which - in turn - not only affects the environment but also impacts the overall negative effect on the quality of life of local communities. The long-term economic benefits of the inclusive growth of the city include: increased economic productivity of surrounding land, increased tax revenues, lower municipal infrastructure costs, reduced health risks, preservation of agricultural land, less air pollution and improved neighbourhoods. Therefore, the sustainable, economic growth of the city, adapting a concept of a smart, green and inclusive growth, where careful planning is preceded by comprehensive research and development with environmental and social long-

term impact consideration has proved to add a greater value in a long-term planning than the growth based solely on a short-term economic profitability.

Economic sustainability of GreenerSites Pilot Actions could be defined as adding value to the Functional Urban Areas by conducting research and diagnosis and developing outputs from the research results for more effective management of brownfield sites. There are multiple ways in which research achieves impact and creates economic value¹:

- Increasing the stock of useful knowledge.
- Training skilled people
- Creating new scientific instrumentation and methodologies and collaborating with users of such facilities or processes.
- Collaborating in research projects and networks with users.

Numerous studies have addressed the rate of return on public investment in research by tracing the linkages between research and innovations in the market across a variety of industries. According to most studies, the overall value gen-

1. The Economic benefits of publicly funded basic research: a critical review. Ammon J. Salter and Ben Martin. 2001.

erated by public research is between three and eight times the initial investment over the entire life cycle of the effects².

The activities conducted within the Pilot Actions (PAs) add tangible and intangible values to the brownfield sites development. The measures applied through the PAs are classified as tangible economic values as the work performed and the outputs generated would require a concrete set of investment by the institutions. Furthermore - as the research quoted earlier indicated - gaining knowledge has direct impact on improving economic cycle.

Tangible economic measures of the Pilot Actions

Tangible economic measures include:

1. Research and diagnosis
2. Development of tools to improve management of brownfield sites

Research and diagnosis

All of the 11 Pilot Actions involved research and diagnosis on various economical, institutional, environmental or social topics. Each one of the site specific research outcomes and all of them collectively were subsequently used for development of tools that aim to improve the management of brownfield sites.

Specific Pilot Action research and diagnosis that concerned economic studies were carried out in the following sites: *Venice, Halle, Radom* and *Rijeka*.

The City of Venice focused its research on the economic activities settled in the productive area of *Porto Marghera*. The deliverable - "*Study on the potential use of the pilot area for new*

2 https://ec.europa.eu/research/innovation-union/pdf/expert-groups/rise/georghiou-value_research.pdf

productive activities" addressed normative and fiscal tools which can boost investments and development in the Porto Marghera area, in order to verify the applicability of the recent regulatory provisions concerning the special economic areas and simplified logistic areas, and the innovations introduced by these latter ones with respect to the - currently in force - national legislation on free zones. The innovative management of finances can be considered the unique aspect of this project. This involved financial aid which will be related to a subcontractor performance and will rely on discounting and expedited payment terms. The main conclusions of the study have been collected in a guideline, prepared as part of the project, concerning the drafting of purchase and sale contracts and recommendations of various contractual schemes (leasing, buying or selling, remediation status, superficies rights, remediation obligations) which can be applied in the industrial areas in Porto Marghera. The guidelines aim to share a functional tool to arrange contracts for the acquisition of property rights and/or rights of superficies with institutions and economic operators. The final outcome of the research has been described in a booklet titled "*Venice. A strategic Area to invest on*".

lsw selected 11 brownfields in the city of Halle for a comprehensive analysis to describe the main barriers and potentials for the development. Six post-industrial areas with high potential were identified. The area categorisation based on specific criteria allowed to show the positive and negative factors determining potential new investments and their potential marketability (e.g. reduction of space utilisation, unsealing). The developed outcome - brownfield survey template enabled to prioritize selected brownfields for redevelopment. Improving marketability of the brownfield sites and prioritizing investment costs to the ones achieving highest rating, the administrative bodies can contribute to overall cost reduction of brownfield management.

In *Radom* the Pilot Action involved a comprehensive study concerning environmental, technical, economic and social conditions of an area



of Pionki, located several kilometres from Radom city centre to identify measures improving the site's management and economic value.

In *Rijeka*, the studies of Rijeka Port and its impact on the city involved the future use of the aforementioned sites. Proposed measures for the environmental and economic rehabilitation of the areas provided an overview of the economic transformation of the port area and the surrounding sites. The proposed measures have foreseen several port models for future use, some of which would provide significant benefits to local stakeholders and the local community. However, the study has also revealed that despite clear socio-economic and environmental benefits for such proposed development, future destination of the site will also be driven by political decisions of central administrative bodies.

Several Pilot Actions involved other studies that concentrated on environmental status, planning and social aspects of the sustainability. Whereas their contribution towards improving economic sustainability is undeniable, more detailed analyses of those actions will be presented in subsequent chapters.

Development of tools to improve management of brownfield sites

Databases

One of the most important database created and distributed within the project specific outcome included the GreenerSites Web-GIS Tool. The project partner - Ministry of Regional Development and Transport of Saxony Anhalt - was responsible for the development of a geographic information system (GIS) software. The GIS software is a computer system designed to capture, store, modify, analyse, manage, and present all types of geospatial data. The GIS programme was initially tested in Magdeburg as one of the Pilot Action and after completion of the research and development phase, the tool was provided to all of the project partners with a full training package.

The GIS software, is a site information system for online collaboration of public authorities and other stakeholders that are concerned with brownfield rehabilitation and site development. It is an open source tool that includes only the most essential maps and data. Those comprise of basic maps and orthophotos as well as selected thematic maps and a manageable amount of detailed site information. The Web-GIS can be expanded or tailored by a system administrator if new data or new layers are to be added. Basic features of the software include data sharing, a map viewer, a search function, spatial analysis functions (via *QGIS*) and the possibility to create and export fact sheets.

As the tool is based on open source components it can be used freely by all stakeholders, even those who do not have access to GIS computer programme. Its value will be significantly magnified when more interoperable geodata will be published following the *INSPIRE EU Directive*. The Directive aims to create a European Union spatial data infrastructure for the purposes of EU environmental policies and policies or activities which may have an impact on the environment. The legislation will be fully implemented by all Member States by 2021.

Another important database includes information concerning the stakeholders for each project. One of the fundamental principle of the GreenerSites project was to conduct all activities with an active engagement of stakeholders. In most of the projects, the initial data was scarce or non-existent, thus it had to be developed by a thorough research. The database concerning the stakeholders will enable the organisations responsible for a brownfield site redevelopment to easily access the information and engage the stakeholders for future decision making process. There are also other, project specific valuable databases created within the project that could vastly improve the brownfield management. An example of those include an alignment of the remediation interventions dating back to 1999 targeting a petrochemical area in Porto Marghera to the recent sustainability criteria established by the "Sustainable Remediation Forum"

(SURF) and Italian Institute for Environmental Protection and Research - *ISPRA* and an inventory of monitoring wells, conducted within *Bydgoszcz Pilot Action*.

Remediation methods

Provision of data concerning the most suitable and cost-effective methodology of a brownfield remediation can be considered as both: direct investment (cost of the research supported by the project) and an estimation of the economic value of a site. Despite several factors affecting the site value, according to the World Bank one of the critical factor of a prospective development of a contaminated brownfield is the cost of remediation³. This is why identifying an innovative and cost-effective method for brownfield redevelopment has become the essential component of the GreenrSites project.

An innovative element for the brownfield sites remediation brings additional economic value - possibility to apply the solution to similar sites with comparable problems.

The Pilot Actions tested several innovative remediation methods and approaches to remediation and all could be successfully implemented on other brownfield sites, subject to local regulations. All of the recommended approaches provided a significant cost reduction measures in comparison to standard remedial measures and have made the redevelopment of the sites economically feasible.

The innovative measures were recommended in four of the Pilot sites: *Venice -Porto Marghera*, *Celje*, *Radom - Pionki* and *Solec Kujawski*. The technical description of the methods is described under the environmental sustainable values.

³ Brownfield Redevelopment and Urban Regeneration with a focus on cities in East and Central Europe: a proposed work program Christine Kessides, with assistance of Marcel Ionescu-Heroiu and Wolfhart Pohl Sustainable Development Department World Bank October 8, 2008



Fig. 2 Remediation cost and prospective value of redeveloped brownfield site

Concepts and action or management plans

The Pilot Actions will be completed with a 9 Strategic Action Plans (SAPs), prepared for all of the involved project FUA's. Initially a concept of such plans has been elaborated, and a detailed, specific Action Plan for the 9 FUA's being analysed will be delivered upon the PAs completion. The Action Plans will help the project partners to develop a vision for the organization's future and determine the necessary priorities, procedures, and operations (strategies) to achieve that vision.

At conceptual stage the SAP development has been preceded by elaboration of guidelines which addressed critical aspects identified in the initial FUA assessment, discussions on ex-

expectations from the common tool and identification of possible measures for sustainability of Pilot Actions. The guidelines will provide input to the SAP template.

The Strategic Action Plans will combine the results of project specific research and analyses, deliverables, databases, tools as well as key findings and recommendations applicable to other sites. The Action Plans will help sustainable strategic planning of the interventions needed, by testing pilot solutions and disseminating this new approach to sustainable brownfield management on similar cases in the FUAs and beyond.

The SAP will be first tested at local level to draw up the assessment and the Action Plan development of the whole FUA as well as to ensure the largest possible deployment of project results. The three Project Partners (the City of Venice, the Port Authority and the Veneto Region) will analyse existing models and available data, defining a common vision to cross with the local stakeholders needs; drawing up the definition of integrated approaches, including long-term strategic visions, to ensure compliance with environmental policies at different administrative levels; realizing and testing pilot applications and innovative solutions for the rehabilitation of brownfield site.

Guidelines

In addition to the site specific Strategic Action Plans, the Pilot Actions envisages preparation of a document called “Common transferability manual for sustainable environmental brownfield management” (henceforth referred to as “The Common transferability manual”) for the Project Partners. Such a Common transferability manual for sustainable environmental brownfield management will adapt a multilevel and cross-sector governance approach, based on a holistic resolutions and aiming at the integrated management of brownfield sites redevelopment.

The Common transferability manual will address common issues to all parties responsible for the redevelopment such as: data collection, stakeholders’ engagement, financial management, sustainable soil and groundwater monitoring, mitigation of environmental impact, socio-economic development, risk management, accounting and auditing as well as improvement of marketability.

Intangible economic values

Know-how transfer and stakeholders’ engagement

All of the deliverables described earlier aim to improve the overall management of brownfield sites beyond the ones studied at the Pilot Actions. The quality of management has been further enhanced by know-how transfer, series of trainings and the management of stakeholders’ engagement. Stakeholders’ engagement ensures better and more appropriate planning activities, better time management, reduce risk of future project interruptions by for example protests of local communities and risk of corrective actions. All of those benefits have direct, although intangible effect on the institutional budget. Some research proves that a stakeholders’ engagement could substantially improve future net economic value of an organisation⁴.

The project conducted both: local and transnational trainings on brownfield management. Additionally, planned and well managed stakeholders’ identification, engagement and management ensured efficiency and positive repercussions on expected outcomes of the project. Effective engagement helped translate stakeholders’ needs into organisational goals and created the basis of effective strategy development.

⁴ Corporate Diplomacy - building reputation and relationship with external stakeholders. Prof. Witold J. Henisz. ISBN-13: 978-1783530557

Lessons learnt from the Pilot Actions concerning sustainable economic value

GreenerSites project has undeniably added a sustainable economic value at local and European level through research and diagnosis and development of tools that improves brownfield sites management by the Project Partners. The construction of the project itself had a goal to magnify the key findings and effects of activities at the local level by know-how transfer and stakeholders’ engagement.

Each Pilot Action was designed to complement each other in order to address all of the sustainability pillars. Thus a number of actions concentrated its activities on economic development, others on institutional, environmental and social development. The role of some Pilot Actions was also to develop effective tools for brownfield management. The findings of all the activities were then collated in a series of documents such as a FUA specific Action Plans and a Common transferability manual on brownfield sites management for all the Project Partners.

The project has improved environmental management capacities of responsible bodies, by detailing actions to help sustainable strategic planning of the interventions needed. The solutions of Pilot Actions will be disseminated and transferred to similar cases in the FUAs and beyond. The increase in the environmental performance of brownfield sites will result in an improvement of working and living conditions of the citizens in the involved areas. By doing so, the project will directly contribute to the overall project goal of “*cooperating to make cities and regions better places to live and work*”.

The project has delivered both: tangible and intangible economic values to the analysed FUAs creating short and long-term economic benefits. The magnitude of those benefits cannot be assessed over a short-term period. The effects

of generating database and tools, trainings and know-how transfer, provided during the course of the project, can only be assessed over a longer period. Thus it is impossible to assess the full economic impact of the project. Some projects’ outcomes had an immediate effect (e.g. Venice - *Porto Marghera* when the findings were used for subsequent works on a complex industrial crisis area and *Rijeka* where findings were implemented through a launch of the breakwater reconstruction of an infrastructure) while others may require additional works and funds to deliver desirable effects. Nonetheless, acquiring knowledge on major obstacles of project implementation (e.g. lack of institutions responsible for a comprehensive brownfield management in Poland) is also a valuable lesson and a starting point for future actions.

Brownfield redevelopment is a complex problem that must be addressed at multi-level, multi-stakeholder approach, and often it is dependent on complex land economics and the market. The Pilot Actions can only be treated as valuable contribution towards the redevelopment but the actions themselves will not solve the problems on their own.



Institutional Sustainability Measures





Institutional Sustainability Measures

Appropriate governance of the local regulators and institutions play a key role in sustainable development of cities. Frequently the legacy of contaminated, abandoned brownfield sites falls in the hands of municipalities. However, such areas could also have an immense value once properly rehabilitated due to their location (often central or strategic), existing network of good infrastructure and - on many occasions - historic legacy that forms a part of wider community identity with the city and the region.

The decisions made by institutions concerning brownfield redevelopment are therefore driven not only by the pure economic factors but also by a stewardship towards local communities through enhancement of their quality of life by making the city a vibrant and thriving place to live. The institutions must also ensure appropriate implementation of national regulations and create local regulations to stimulate brownfield development. Finally, the institutions have the means to stimulate growth in form of appropriate fiscal instruments and policies.

Sustainable brownfield redevelopment from the governance perspective should therefore encompass the following goals:

- Economic - to revitalise the area by making it either an attractive place of an investment and/or a place that would enhance the quality of life of local communities.

- Environmental - to improve the environmental status and health and well-being of the local communities.
- Social - to create a healthy and vibrant living space that will enhance the quality of life of local communities.
- Those goals are accomplished through several stages. The institutions must first of all identify key factors that triggers redevelopment of a brownfield site and aspects that could hinder the development. Once the research is completed the institutions should develop a planning strategy and tools facilitating the planning activities. Stakeholders engagement plays a critical role in all aforementioned activities. The next stage of the redevelopment depends on site specific conditions and results of the research and development. In some instances, the institutions may conduct the site rehabilitation themselves by for example conducting remediation activities and making strategic infrastructure investments to raise the value of a site, and/or reducing anticipated costs. In other cases, the decision may be ceded to local investors. In such instance some form of incentive may be required to attract the investors, for example tax increment financing, property tax waivers, grants, delayed payment, etc.

The CABERNET project (Concerted Action on Brownfield and Economic Regeneration Network) created an A-B-C Model to classify various types of brownfield rehabilitation projects on the basis of their economic status and possible funding method¹.

“A” sites are the development projects that can be funded solely by private investors. Those types of brownfield sites have high economic potential and the cost of their redevelopment will be returned within a financially viable period. “B” or “potential development sites” must require some form of an incentive by the regulators to attract private investment and to stimulate the rehabilitation process. “C” or the “reserve sites” represent a financial loss for the private investors. In such instances the regeneration is carried out in justified cases such as environment protection, safety, real estate

¹ Project CABERNET Sustainable Brownfield Regeneration: CABERNET Network Report (2005)

market support, etc. with public funding and often by public enterprise.

Major challenges concerning brownfield development from the institutional perspective include:

- Unclear regulations concerning the brownfield rehabilitation;
- Unclear ownership or lack of development interest/financial means by current owners;
- Unclear environmental status or remediation requirements beyond the institutional budgets;
- Technical status - e.g. need to demolish buildings and infrastructures or create new infrastructure;
- Legacy of historical inappropriate planning and development;
- Unclear future planning resulting from insuf-

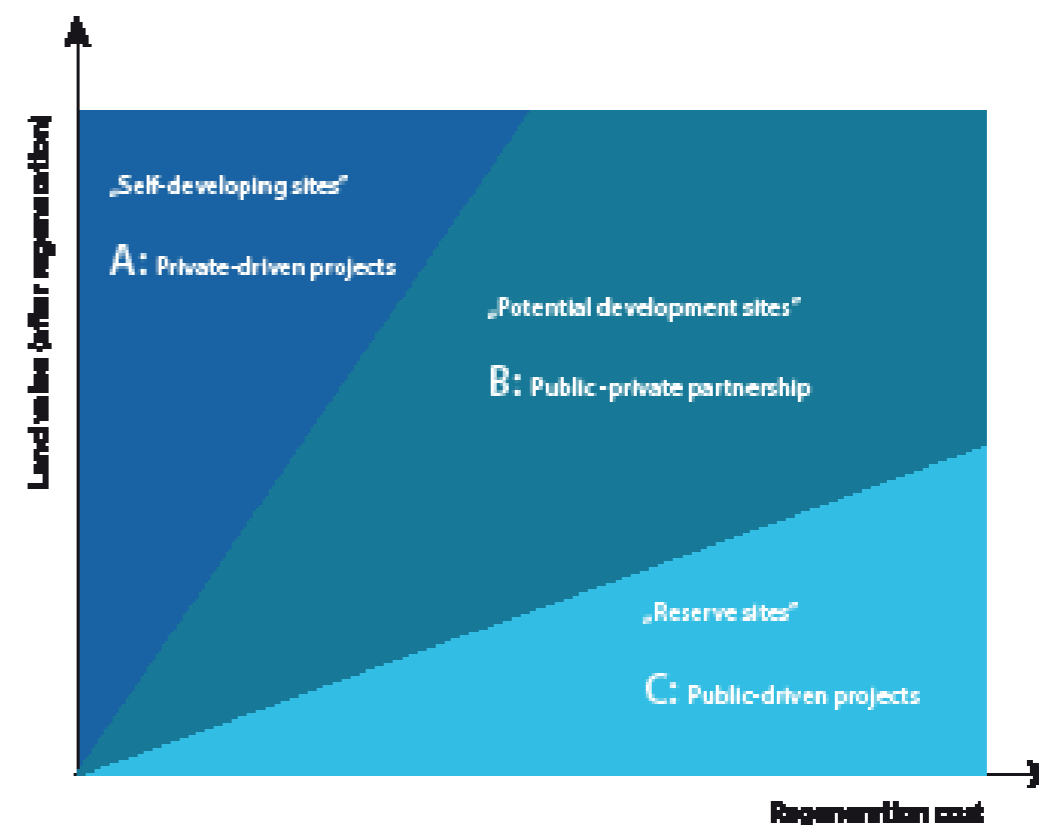


Fig. 3 A-B-C Model of classifying brownfield sites based on their redevelopment cost



efficient information and a lack of experience in brownfield redevelopment;

- Low potential to attract private investment;

The aim of the GreenerSites Pilot Actions was to address all of those major challenges through three pillars of sustainability to help the institutions improve the management of brownfield rehabilitation. The Pilot Actions concentrated on potential economic development of the brownfield sites, improvement of environmental status and communication with stakeholders to better understand the needs of local communities.

Just like with the economic sustainability measures, the actions taken as a result of the Pilot Actions have tangible and intangible values for the institutions.

Tangible short-term institutional values delivered by the Pilot Actions include:

- Results of research and diagnosis
- Provision of databases
- Monitoring and management systems

Intangible institutional values include:

- Improved planning of FUAs
- Improved marketability of FUAs
- Better allocation of funds for further development of FUAs.
- Risk management
- Stakeholders identification and engagement
- Know-how transfer

The success of the project cannot therefore be assessed by any specific short-term indicators. The Pilot Actions have concentrated on delivering sustainable values to the institutions that have both: tangible and intangible form, demonstrated over short and long-term period. Additionally, the success of the project also

depends on how the institutions will utilise the value provided through the Pilot Actions.

Tangible Institutional Values of the Pilot Actions

Research and diagnosis

Collectively all of the Pilot Actions conducted research and diagnosis of the existing economic, social, institutional and environmental status of the studied FUA. The measures that are unique to the institutions included:

- Analysis of local law and regulations
- Analysis of ownership structure and key stakeholders
- Analysis of databases
- Analysis of existing management of brownfield sites by the regulators
- Analysis of existing planning

The research concerning specific economic, environmental and social conditions conducted within the project is described in other chapters.

Analysis of local law and regulations

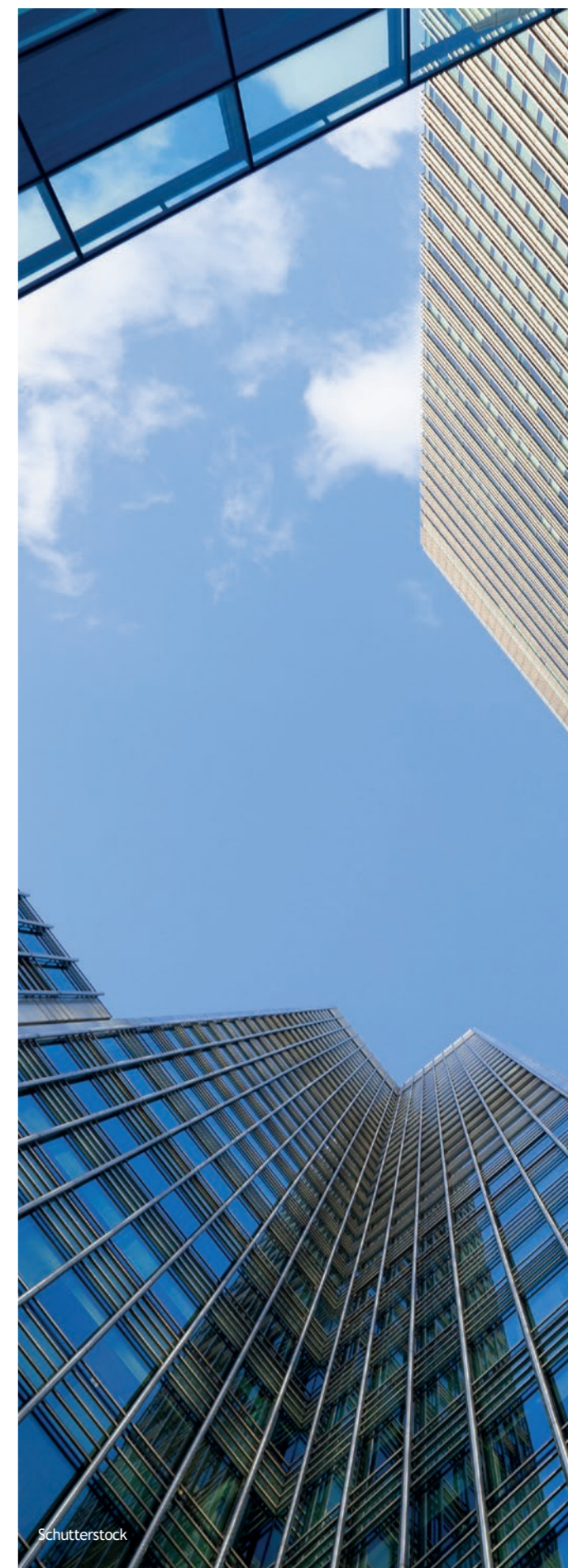
Despite the fact that all the analysed brownfield sites are located in the EU, the regulations concerning brownfield redevelopment differed quite considerably. Furthermore, some sites (*Venice Porto Marghera*) are designed as national crisis areas where special regulations have been implemented in order to clean up the site and stimulate economic growth.

City of Venice. In addition to the study on economic development the analyses have addressed regulatory tools which can be implemented in order to boost investments and manufacturing development of the port area. In particular, the study examined incentives of special economic areas, feasibility of simplified logistic zones and

potentials of customs free zones which envisage financial and procedural benefits to those intended to launch a productive activity in the area. The research identified that the competencies for designating such special zones through appropriate regulations are not under the local administration but under the national Ministry, and they require an adoption of a decree establishing the nature of the area and the financial benefits which can be granted to whom carries out the economic activities.

City of Rijeka and Port of Rijeka. Among other topics the Pilot Action concentrated on studying environmental regulations concerning potential clean-up responsibilities. The authors found out that the current Croatian legislation recognizes the pollutant, but there are no mechanisms to force public institutions responsible for remediation of an idle, contaminated site in a reasonable period. This may hinder the future redevelopment if the rehabilitation is to be managed by local or state authorities. Additionally, there are no legal means to conduct a remediation of a contaminated site owned by a private organisation.

The *Mazovian Development Agency (PP4)*. The Pilot Action analysed environmental and brownfield redevelopment regulations in Poland and the region. The environmental regulations are relatively coherent with the EU Directives concerning defining a contamination and responsibilities for the clean-up actions, although it is still rare among the authorities to permit remediation other than restoring the site to conditions appropriate to a threshold levels. Thus, some recommendations from other Pilot Actions (e.g. capping the contamination) may not be accepted by some local Polish regulators. Poland has adapted the polluter pays principal and - when the polluter cannot be identified - the responsibility falls into the regional authorities. In practice, however, the authorities rarely perform the remediation due to high cost (please see Fig.3 ABC model of brownfield redevelopment) and insufficient legislation.



The study has also identified that there is no direct legislation on classification of brownfields and their redevelopment. The national regulations define contaminated sites and areas for rehabilitation (so called “*revitalisation*”). The revitalised areas may not necessarily be classified as brownfields as their designation has primarily social context. On the other hand, a contaminated site may not be the brownfield of institutions’ interest for redevelopment as it can be actively used by an organisation.

Analysis of the ownership structure

One of the conditions of all of the projects was to identify ownership structure of the analysed FUA. Key notes from some of the projects concerning the ownership include the sites in *Venice, Halle, Rijeka, Radom* and *Bydgoszcz*.

City of Venice LP has identified several organisations that have been established on the former greater port area. Those include mainly industrial companies. However, a vast part of the undeveloped land has fallen into the hands of either the port authorities or the City of Venice.

In the City of Halle, Isw carried out a research on the ownership structure of the selected brownfields. It was identified that several sites were owned by private organisations, which were extremely difficult to access due to data protection regulations.

Rijeka. The study identified that the analysed area is owned by two organisations: the marine part is owned by Rijeka Port Authorities (PA) whereas the land site belongs to a private oil refinery. As a result, any potential redevelopment of the port area, which appears to be the most attractive economic and planning solution, is hindered by the fact that the port authority has no rights to use or manage the area. The study recommended that key aspects for the area redevelopment must include changes in the ownership structure.

City of Bydgoszcz. Although the Pilot Action’s goal was to provide data on environmental

monitoring of groundwater and check the risk for human health, it became apparent that the ownership structure in the studied FUA played a crucial role in the analysis. The identified contamination, leaching into the groundwater from polluted ground, is located on several hot spots that were historically owned by “Zachem” chemical plant and after the plant announced its financial insolvency the contaminated sites fell into hands of public and private organisations as well as trustee in bankruptcy. Such a situation, together with an immense cost of environmental rehabilitation, renders any future actions very difficult. The local stakeholders meeting that were organized shows that this is the only way of dealing with such a complex problem. Also the information system about pilot site is needed to improve the institutional capacities. Training that aimed at improving the institutional capacities organised within project was very successful.

Analysis of existing databases

The Pilot Action projects aimed at identifying databases concerning: location of brownfields in the studied FUA, ownership structure, stakeholders for each FUA, recognised environmental status, institutions responsible for management of brownfields and data collection. Additionally, some PAs have studied pilot specific databases. For example, the *City of Bydgoszcz* PA studied data concerning location of all existing groundwater monitoring wells in the FUA, whereas the *Halle* PA studied information concerning marketability of the site.

One of the most comprehensive study concerning existing brownfield database was performed by the PA conducted in the Mazovian District, Poland. The project analysed current situation of post-industrial zones based on three urban functional zones: the capital City of Warsaw, the City of Płock and the City of Radom, including the Pionki District (collectively referred to as the *Mazovian District* PA). The study revealed that in the Mazovian District information on post-industrial areas and their environmental condition is scattered, incomplete and

fragmented. Furthermore, data on brownfield sites acquired has proved to be inconsistent and incompatible. Particularly noticeable was the lack of comprehensive information on environmental risks occurring in degraded post-industrial areas as well as suitability categories for a future broadly understood economic use. The dispersion of information among various institutions and the lack of a proper brownfield sites inventory hinders the possibility of redevelopment of such sites. The project identified that there is a clear need to achieve the data standard on the regional level by generating and maintaining the unified data system.

The findings have been confirmed in other Pilot sites such as *Rijeka, Halle, Bydgoszcz* and *Magdeburg*, concluding that the database information on brownfield sites should be addressed at wider level.

Analysis of planning and management brownfield redevelopment

Good planning process of brownfield redevelopment should encompass three dimensions of sustainable development: economic, environmental and social and should present a vision over a long planning horizon². The sustainable planning differs from a standard, regulatory development plan by adding another dimension of a community’s vision, becoming an “agent of change” for the community to realize a sustainable vision³.

Most of the Pilot Actions involved some form of planning analysis. For example, one of the deliverable of the *Celje* PA has been a protocol to deal with non-hazardous waste. The protocol will affect the Strategic Environmental Assessment of the city. The Pilot Actions that specifically aimed at studying the planning conditions

² Healey P, Shaw T, 1997, “Planners, plans and sustainable development” *Regional Studies* 27 769 - 776

³ Neuman M, 1998, “Does planning need the plan?” *Journal of the American Planning Association* 64 208 - 22

included: *City of Venice LP, City of Halle, Radom* and *Rijeka*. The Pilot Actions have concentrated on analysis of the environmental status, technical conditions (buildings and infrastructure), current management of record keeping and spatial planning, stakeholders’ identification and local communities’ presence. Each of the studies had slightly different focus and approach. However, general conclusion of the research was that there is a clear need to improve the record keeping, management process and active stakeholders’ engagement by the institutions. The *Halle* and the *Mazovian District* PAs recommended establishing a single unit for data collection, the *Radom* project further recommended to create an integrated investment management structure that focuses not just on economic aspects but also on social problems of local communities living in a post-industrial, frequently abandoned with environmental legacies areas. Similar conclusions were also made by the *Bydgoszcz* PA. Generally, most Pilot Actions concluded that among the studied FUA there are no exemplary practices in the management processes of degraded post-industrial area rehabilitation.

Provision of databases

The Pilot Actions through their research and analysis created a comprehensive database of the studied FUA. Some of the database information was delivered in form of Web-GIS.

The databases contained information concerning location of brownfields in the studied FUA, ownership structure, environmental status, stakeholders for each FUA, institutions responsible for management of brownfields and data collection. Additionally, some PAs have studied pilot specific databases. For example, the *Bydgoszcz* PA studied data concerning location of all existing groundwater monitoring wells in the FUA, the *Halle* PA studied information concerning marketability of the identified brownfields and *City of Venice* PA collated all environmental remediation interventions performed on a petrochemical area internal to Porto Marghera since 1999.



The databases are valuable source of information for the institutions to enhance the management process of brownfield redevelopment. Furthermore, some data have been presented in form of a Web-GIS mapping, available for public viewing, which can improve the process of communication with stakeholders and local communities. Most of the institutions involved in the Pilot Actions pointed out that they have not used the GIS mapping yet for displaying the location of the brownfields. This form of geo-spatial information can be combined with other information that is already in the hands of the institutions in form of GIS layers such as the cadastral information, infrastructure layout, location of valuable, protected habitats, etc. providing an important tool for the whole city development.

Management systems

The GreenerSites project has delivered valuable tools for the institutions to improve the management of brownfields. Apart from the aforementioned Web-GIS, Strategic Action Plans (SAPs) will be elaborated for each of the studied FUA upon completion of the project. The SAPs will help the Project Partners to develop a vision for the FUAs' future and determine the necessary priorities, procedures, and operations (strategies) to achieve that vision.

The Strategic Action Plans will be developed on the basis of all the studies performed through the Pilot Actions, not just for a specific FUA for which the SAP will be prepared. Lessons learned from other projects will help to establish the most optimal solutions for a specific FUA. Furthermore, results of other studies and development of tools will vastly enhance the quality of the Strategic Action Plans. For example, the development of marketability potential index by the *City of Halle* Pilot Action can be applied universally by other FUAs. Similarly, the SAP can recommend remediation technologies developed in other PAs that will effectively help reducing cost of such actions and thus enhance the possibility of the brownfield development.

Apart from the Strategic Action Plans the project envisages also preparation of a Common transferability manual for the Project Partners. Such a transferability manual for sustainable environmental brownfield management will be prepared with a clear vision of sustainable planning thus a structured methodology for such a planning will be provided. Example includes the methodology of stakeholders and local community involvement in the planning process. The guidelines will also address common issues to all parties responsible for the redevelopment such as: data collection, financial management, sustainable soil and groundwater monitoring, mitigation of environmental impact, socio-economic development, risk management, accounting and auditing as well as improvement of a brownfield marketability.

Lessons learnt from the Pilot Actions concerning institutional sustainable value

The Pilot Actions involved cooperation with local institutions in order to perform research and diagnosis and deliver outputs in form of environmental status, database, Strategic Action Plans and Guidelines for future brownfield management. Most Pilot Actions concluded that it was extremely challenging to obtain a detailed picture of the current situation regarding the GreenerSites FUAs, mainly due to a lack of coherent source of database and unclear local regulations concerning the brownfield regeneration.

The research has revealed that there is no clear definition of a brownfield site across the countries involved in the project. In some instances, it is defined as a post-industrial area, in other countries it is understood that it's a contaminated field. None of such classifications are based on the EUGRIS definition of brownfields. Whereas identifying and mapping an idle post-industrial site would require only a desktop study (under right regulations), understanding complex environmental status on such sites involves a considerable investment. The regulations are unclear regarding obligations to perform such

an investigation or - as it was identified through *Rijeka* Pilot Action - who should undertake some remedial actions.

Equally challenging was a task to collect existing database of post-industrial/contaminated sites of the studied FUAs. Often the data was only fragmentary and had to be collected from various institutions as there has not been a single institution responsible for maintaining the portfolio of brownfield sites. The regulators don't maintain the register of stakeholders either and the planning strategy barely involves local communities. General approach of the institutions is to perform a minimum involvement of the local community imposed by national regulations, for example by announcing an information concerning spatial planning on regulators' web-pages. None of the projects identified a practice of proactive approach of the local communities by the institutions.

Brownfield rehabilitation should become a 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 rehabilitation process, particularly when it comes to data accessibility, clearly assignable responsibilities, capacity building of public bodies, and increased communication efforts towards stakeholders and citizens. Those important aspects should be considered in future actions of the project.

Nevertheless, the project has delivered not only valuable information, database and tools for brownfield management but also demonstrated a strategic approach to spatial planning and land rehabilitation with a proactive engagement of stakeholders and local communities. Furthermore, geo-information system will help institutions to better use available data and manage environmental problems in a more effective way. The software will allow both: public institutions that will managing the tool and site owners to feed-in the data.



Environmental Sustainability Measures





Environmental Sustainability Measures

Environmental status of a brownfield is frequently the key factor hindering further rehabilitation of a site. Contamination of soil, surface and groundwater and even buildings and infrastructure can in some cases substantially impact health and well-being of the local community and damage valuable habitats. The contamination can also migrate through such receptors as the air and groundwater beyond the site and even beyond a region. Whereas it's apparent that cleaning up brownfield sites is of paramount importance as it was pointed out earlier, the cost of remediation can sometimes become prohibitive for any local institutions or private organisations. Furthermore, unclear regulations concerning the factors triggering the obligation for the research and remediation, remediation methods as well as the assignment of responsibilities for such actions have resulted in a legacy of contaminated, abandoned, idle or underutilized commercial or industrial properties across Europe. If left undeveloped, the sites may not only pose risks to human health and the environment but also act as a blight and economic drain on the surrounding areas.

Restoring the brownfield sites generates significant environmental benefits for the city and larger communities. The most important advantages include:

- **Reduced hazard to public health.** Toxic pollutants can directly reach human bodies through inhaling, ingestion and absorption through the skin. Furthermore, accumulation of toxic chemicals in a food chain create equally hazardous conditions affecting human health. Thus the pollutants present on a contaminated site and dispersed through air and water could have practically unlimited zone of impact. Several Pilot Projects revealed that the contamination has already reached nearby marine environment. Therefore, one of the most paramount importance of brownfield remediation is to prevent vertical and horizontal migration of the pollutants off-site and prevent the pollutants impacting people and wildlife.
- **Preventing damage to valuable habitats and ecosystems.** The same mechanism concerning impact of the pollutants on human health applies to all living organisms. The contamination present in a brownfield, whether on-site or migrating many kilometres away, can significantly affect natural habitats.
- **Preventing urban sprawl development.** One hectare of redeveloped brownfields has been estimated to conserve 4.5 hectares of greenfield sprawl development¹. The popu-

¹ The Environmental and Economic Impacts Of Brownfields Redevelopment, Evans

larity of remediated brownfield sites used for residential, commercial and mix redevelopment is continuously growing, creating a particular opportunity for environmentally responsible accommodation of population growth in the cities. Such fill-in development utilizes already existing roads and infrastructure, and often provides amenities close to where people are already living, reducing the need for transportation and the risk of destroying valuable agricultural land.

- **Saving energy and reducing greenhouse gases (GHG).** The regeneration of a brownfield site, located in an inner city, reduces transportation-related greenhouse gas (GHG) emissions in comparison to sprawling/spread development patterns. The research of Urban Land Institute reveals that compact urban redevelopment reduces vehicle travel by 20 to 40% which can contribute to 7-12% reduction of GHG by 2050²
- **Air quality improvement.** The improvement of air quality due to a brownfield regeneration results from direct and indirect effects: reducing migration of pollutants through the air, reducing the vehicle travel, maintaining greenfields that would otherwise be developed in urban sprawl, maintaining urban ventilation corridors that can also be affected by urban sprawl and mitigating the impact of the contamination on natural habitats.
- **Water quality improvement.** Remediation of brownfield sites can have a positive impact on all the aquatic forms: groundwater, surface waters, storm water and marine water qualities. Development of a post-industrial area located in the city centres can also contribute to overall water consumption by reducing run-off storm water per dwelling unit and preventing watering of places developed through urban sprawl.

² Paull, Northeast-Midwest Institute, July, 2008

² Urban Land Institute, et al, 2008

Environmental Sustainability in the Pilot Actions

The aim of the project was to provide all of the aforementioned environmental rewards by identifying environmental status of the studied FUAs through research and diagnosis, risk management, monitoring the pollutant's migration paths and recommending most appropriate method of remediation.

The sustainable environmental value of the projects, however, aimed at providing not only environmental benefits but also delivering clear economic, social and institutional value at the same time. Those have been achieved through delivering information on environmental conditions, provision of databases and risk management systems to the institution, studying potential health hazards of the local communities from the identified contamination and recommending most appropriate, cost-effective and innovating methods of remediation.

The environmental sustainability of the project thus delivered tangible and intangible values.

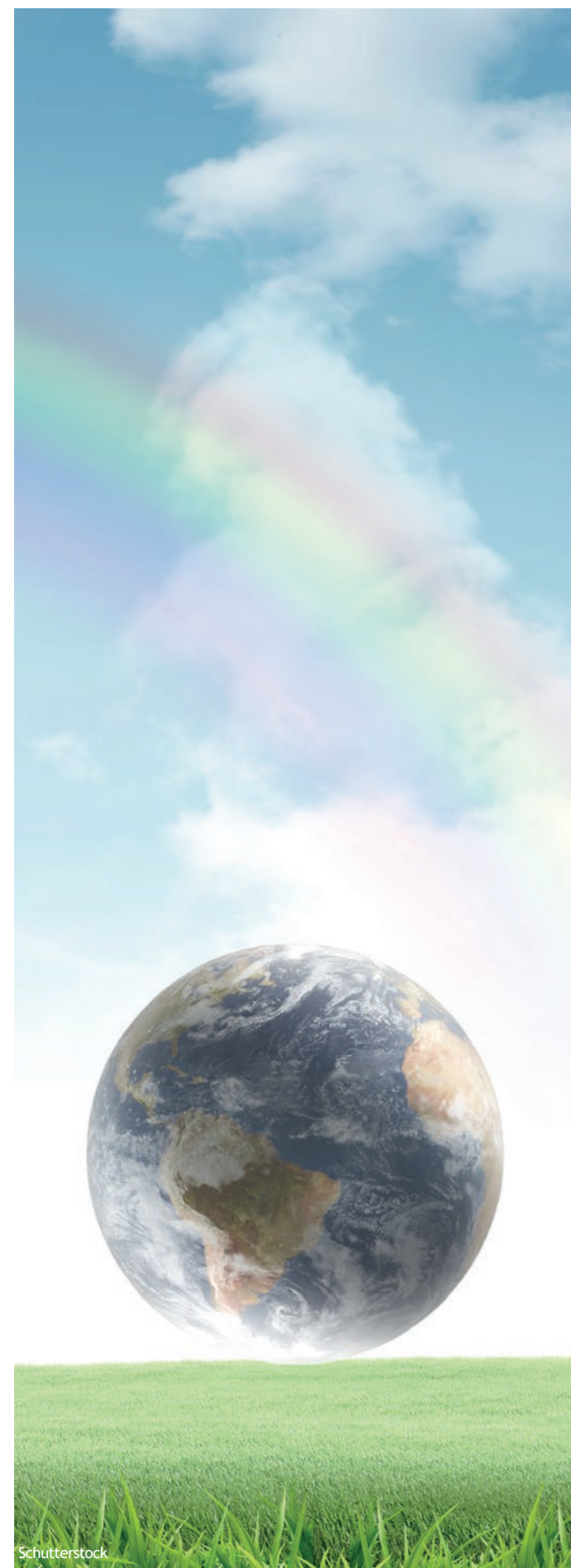
Tangible environmental values include:

- Research and diagnosis
- Remediation methods
- Databases
- Procedures
- Monitoring and risk management systems

Intangible environmental values will be achieved after appropriate implementation of the Strategic Action Plans. The intangible values include:

- Reduced impact of the contamination on human health;
- Reduced impact of the contamination on nearby ecosystems and natural habitats;
- Improved quality of the environment (soil, groundwater, surface water and the air);
- Reducing Green House Gas emissions.





Just like with other sustainable values, the environmental benefits should therefore be assessed not by short-term outcomes but values delivered to the environment and the society over a longer period. Each of the Pilot Actions had slightly different aims and therefore there is no direct measure that can compare and evaluate the deliverables. The goal of the project was to find site-specific and more universal environmental measures by learning something from each of the Pilot Actions and applying a solution recommended in one FUA to other brownfield sites.

Tangible Environmental Values of the Pilot Actions

Research and diagnosis

Two types of environmental research were conducted in Venice by the Veneto Region and the Port of Venice.

The first research involved testing of an innovative experimental method of Multiple Lines of Evidence (MLE) to identify the level of soil contamination with Volatile Organic Compounds (VOCs) based on their vapour concentration in indoor air. The main objective of this activity consisted of the identification of different sources of chemicals in indoor air and in the distinction of the contribution to air pollution related to Volatile Organic Compounds (VOC) migration from the soil subsurface. The final aim of the monitoring activities was to better calibrate the remediation interventions of polluted areas during the risk analysis, *in itinere* and in the *ex-post* periods, in order to optimize the remediation procedures as well as to update the existing protocols in the field. The method allows to obtain a more comprehensive and accurate measurement of pollutant migration paths and to assess the risks associated with the emission of gases.

Those innovative techniques not only leave the subsoil undisturbed but also generate significantly lower cost of initial contamination as-

essment and the assessment of the pollution on health and well-being of the site users. The concrete application of MLE provides further evidence to improve and update the existing monitoring procedures for aeriforms. The application of this methodology can, moreover, be easily extended to other contaminated sites in order to measure in a more realistic way the risk associated and, therefore, better calibrate potential remediation interventions.

The second study concentrated on identifying most applicable, environmentally friendly and cost-effective method to provide capping of contaminants in the soil. The capping has been designed to provide not only an effective barrier against migration of pollutants but also to be used as an industrial flooring for logistics systems. The results of the initial preparatory study and intrusive investigation of the site have revealed that the level of contamination is much lower than initially anticipated, thus the most optimal and cost-effective source of clean soil that can be used for capping may come from the site itself, not from a material stocked off-site. This approach is more environmentally friendly (reducing transport and CO₂ emissions). The second phase of the Pilot Action involved geoenvironmental testing of the capping layers and the soil beneath in order to identify their suitability for using the site as a container terminal. The third phase concentrated on preparation of procedures for excavation, transport and clean-up of the contaminated soil identified on site and preparation of an environmental impact assessment for disposing of the excavated and dredged material. The results of the work allowed to obtain in-depth, up-to-date knowledge on the state of the environment and geotechnical conditions of the pilot area.

The PA in Celje concentrated its environmental study on a post-industrial area used in the past by a galvanising plant (Stara Cinkarna). The galvanising plants have a well-recognised legacy of soil and groundwater contamination with metals - especially lead, zinc, cadmium copper, chromium and arsenic. Initial study has also identified remains of tar pitch and slag on the

site, adding the mineral oils and Polycyclic Aromatic Hydrocarbons (PAHs) to the list of potential contaminants. The objective of the study was to assess the level of the contamination with those pollutants in the soil and groundwater and to test cost-effective remedial techniques that can be utilised to mitigate the pollution. Initially the aim of the project was to apply thermal soil treatment as a primary remediation method. However, the environmental experts involved in the study recommended to implement various combined technologies that rely on cold treatment methods to effectively immobilize the contaminants with calcite ash. The proposed technology proved to be an innovative and cost-effective solution to in-situ remediation of soil affected by heavy metals. The costs of remediation of the area using traditional technologies are prohibitive and can vastly reduce the possibility of the site development. Therefore, this new innovative method of immobilisation seems to provide the only viable solution to revitalise the area.

The PA in Radom studied environmental conditions of a formal coal-fired power plant site located in Pionki, near Radom. The analysis included desktop study, intrusive investigation of the ground, groundwater, potential presence of hazardous materials in derelict buildings on site (for example asbestos fibres) and health hazard of those harmful substances to a local community. The studies have concluded that despite unquestionable impact of the power plant on local environment, the level of contamination was much lower than initially anticipated and can be mitigated with simple and cost-effective methods such as natural bioremediation with existing herbaceous vegetation, possibly supported by phytoremediation. The phytoremediation relies on a direct use of living green plants for in situ removal, degradation, or containment of contaminants in soils. It's a low-cost, solar energy driven clean-up technique. It is still considered innovative method in Poland and could only be applied when a legislative approach towards remediation of contaminated sites was aligned with EU regulations (i.e. since 2016). The researches in Radom tested several





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plants before recommending the optimal species for phytoremediation. The detail analysis of phytoremediation techniques and most applicable plants could provide a valuable academic guidance for all brownfield sites affected with heavy metals contamination.

The PA in *Solec Kujawski* concentrated its environmental studies on the impact of a former railway sleepers preservation plant on current groundwater conditions. The study has identified that indeed the past industrial activities resulted in a considerable soil and groundwater contamination. The PA ended with a development of an innovative method of neutralising pollutants below the groundwater level with an application of a nanocarbon barrier adsorbing harmful organic compounds and creating natural conditions for bioremediation of contamination in water-bearing stratum.

The PAs in *Rijeka* involved environmental study of the Rijeka port (Mlaka), including terrain and marine part. Another research concentrated on the assessment of the environmental impact of the site on the surroundings, including inhabited areas. The analysis has identified a considerable and wide-spread contamination of the port area with organic hydrocarbons, which migrate directly to the Adriatic Sea. The study concluded that at a minimum an obligation for monitoring the contamination flow should be imposed by the authorities after the formal completion of the project. The technologies for in-situ remediation of hydrocarbon impacted soil and groundwater are well recognized and can be implemented once the local and national regulators achieve consent on the future destination of the site.

The objective of the City of Bydgoszcz PA was the study the impact of contamination of ground and groundwater of the former Chemical Production Facility “Zachem” on bordering areas, especially Łęgowo village, located downstream from the identified contamination sources. First part of the project involved detail study of the area in order to identify valuable habitats and potential impact of the contami-

nation on the local community. The second part consisted of an inventory of existing monitoring wells in the area, collection and analysis of the groundwater quality from those wells. The results have indeed confirmed presence of contaminants in the groundwater. The study concluded that the available monitoring wells were designed individually and therefore their location and depth have not been adapted to the hydrogeological conditions found in the investigated area and therefore only some of them might be used in the future for building a new monitoring system. 15 new piezometers were installed and the ground water testes, all of them are contaminated with organic substances that migrate to the residential area. Model tests on migration of pollutants were carried out on a model with a total area of 73,78 km. The migration of pollutants in groundwater from identified pollution outbreaks and contaminated areas in the area of the former Zakłady Chemiczne “Zachem” was forecasted in the period T+25 years at intervals of every five years, and T+50 years in time steps every 10 years. All of the environmental research finally lead to assessing the risk for human health, additional ground probes were collected from individual houses and risk analysis performed based on US EPA methodology. Guidelines for future monitoring needed in residential area were defined. The analyses of pollution migration show that the area of contaminated groundwater, in particular with organic compounds from the former chemical plant “Zachem”, will gradually expand towards the built-up areas of Łęgowo, causing the progressive degradation of groundwater.

Databases

The project has delivered database of brownfield sites and contaminated lands in form of a geospatial computer software for all of the studied FUA. The Web-GIS programme was initially tested in the City of Magdeburg as one of the Pilot Action and after completion of the research and development phase, the tool was provided to all of the Project Partners with a full training package. The software maps, ac-

cessible for all stakeholders, are an important source of knowledge in decision making process. Most of the Project Partners have stressed out the importance of such geospatial information to understand better “hot spots” of contamination, their migration off-sites and their impact on health and well-being of the local community and wildlife. Such maps will enable to assess wider environmental risk and prioritize the brownfields that should be remediated in the first instance. On the other hand - as pointed out in the Pas carried out in the Mazovian District and in the City of Halle - the existing data concerning location of the brownfields, post-industrial areas and/or contaminated areas are incomplete and scattered among various institutions. Such conclusions, together with revealing the real potential of such maps may create a genuine demand by the institutions to continue the research and complete the comprehensive database of brownfields displayed through the Web-GIS software.

Apart for the Web-GIS brownfield mapping applicable to all projects, some of the Pilot Actions have concentrated on collecting site specific information. For example, City of Venice PA collected all data concerning remediation intervention in the petrochemical site conducted since 1999. Such research can then be used to assess effectiveness of past remediation techniques, select areas for further remedial action and locate those that do not require further intervention. The aim of the Pilot Action was also to collect information on unrealized remediation projects in the petrochemical area and to undertake a revision of sustainability features by defining a set of sustainability indicators and evaluating the projects against those indicators. The study represents an excellent starting point for new remediation projects, more convenient in terms of environmental sustainability and more efficient from an economic point of view.

Another important database was created within the City of Bydgoszcz PA. The study concentrated on identifying existing monitoring wells in the area and in the vicinity of a site occupied





in the past by a chemical plant “Zachem”. The aim of the project was to collate all available information in order to assess its applicability to conduct meaningful monitoring of groundwater contamination and migration data of the contamination plume (chemical and physical parameters such as type of contaminants, flow direction, velocity, depth, etc.). Based on the inventory of the monitoring wells the project concluded that they are not sufficient in terms of number, location and depth to map the flow of contamination. Such data could form an excellent basis to design a network of monitoring wells for conducting further research of the entire area affected by the contamination.

Finally, the information concerning environmental status, collected through desktop and on-site studies and analyses in other PAs (Venice -Porto Marghera, City of Halle, Celje, Radom, Solec Kujawski, Rijeka) and presented in form of detailed maps can also be treated as a valuable database for future implementation of targeted rehabilitation measures.

Monitoring

Environmental analyses conducted on site involved in many instances research of the groundwater. For this purpose, a network of monitoring wells was established on sites in *Celje, Solec Kujawski, Bydgoszcz and Rijeka*. The ultimate goal of the groundwater monitoring projects was the assessment of the depth of the first aquifer, direction and velocity of the groundwater flow and the level of groundwater contamination. Based on this information it was possible to assess the impact of the contamination on health and well-being of the local community, wildlife, protected habitats and marine ecosystem (Rijeka) and to assess the effectiveness of the undertaken remediation techniques (Solec Kujawski). Finally, the groundwater monitoring wells have become a valuable source of information for further works concerning designing and implementation of sites' remediation methods. The monitoring wells will remain on the sites after completion of the Pilot Actions. They can be used by the stakeholders (institutions, ex-

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perts, site owners, etc.) for future study of the area. Moreover, the *Rijeka* PA recommended to maintain the monitoring of sea contamination with polluting leachates beyond the project's lifetime.

Risk management systems and procedures

Another important deliverable are the risk management assessments, i.e. the impact of the contamination and the potential means of managing the recognized hazards. The identified contamination can create hazard to people and the environment and - as many projects revealed - can migrate off-site through groundwater and air dispersion. Specific studies concerning the risk assessment were conducted in *Celje, Radom, Solec Kujawski, Bydgoszcz and Rijeka*. The activities concerning risk assessment based on migration of the contaminants through the groundwater have been described in the previous chapter. Specific risk assessment related to the ground pollution was conducted in *Celje, Radom, Bydgoszcz*. The studies have identified that indeed the contamination is also dispersed by the air and can affect local communities and stakeholders currently using the contaminated area (e.g. business units set up on the brownfields). Furthermore, the health hazard can also be created by other factors. For example *Radom* study has identified derelict buildings that can be partially constructed of asbestos materials, whereas the *Celje* PA identified hazardous waste and infrastructure on site.

Specific procedures to mitigate the environmental risks have been established in most projects in order to manage the identified contamination. They will be further developed in the Strategic Action Plans, prepared upon the completion of the Pilot Actions. Some projects' goal was to develop site specific procedures. For example, one of the activities carried out by the Port of Venice was a preparation of procedures for re-using the soil on site as well as excavation, transport and clean-up of the contaminated soil identified and preparation of an environmental impact assessment for disposing of the excavated and dredged material.

Lessons learnt from the Pilot Actions concerning environmental sustainable value

Environmental sustainability from the perspective of the project can be defined as determination of the environmental status of the studied brownfields, identification of potential hazards resulting from the recognised contamination and recommending appropriate measures to mitigate and manage the hazards in economically sound manner.

Most of the Pilot Actions have concentrated their activities on direct on-site environmental studies to achieve the goal of delivering environmental sustainability value to the project. Some of the PAs have acted as support agents to deliver important tools for the management of the contamination. The supporting project actions include: delivering Web-GIS for mapping the contamination (PA in *Magdeburg*) and preparing environmental management strategies which take into account the environmental aspects.

The pilot actions that concentrated their studies on site investigation have also considerably differed in their approach. Some, like Venice - Porto Marghera, *Radom* and *Rijeka* have concentrated on more profound assessment of one area from an environmental, social, institutional and economic perspective. The investigation conducted in *Solec Kujawski, Bydgoszcz and Celje* on the other hand aimed at recognising mainly the environmental status of the sites and its impact on local communities and surrounding areas.

Overall the projects have not only delivered tangible environmental sustainable value in form of the research and analysis outputs but also created innovative tools and cost-effective remediation methods that can be applied on other sites. Created databases will enable institutions to gain knowledge and better manage the contaminated sites.



Social Sustainability Measures





Social Sustainability Measures

Social sustainability is based on the concept that a decision or project promotes the betterment of society. Social sustainability occurs when the formal and informal processes, systems, structures, and relationships actively support the capacity of current and future generations to create healthy and liveable communities.¹

Brownfield sites have direct and indirect impact on the individual and larger communities. When left unmanaged they can create health hazard, social exclusion and general degradation of the well-being of the local communities living either on or in the vicinity of such sites and an urban sprawl. On the other hand the brownfields also represent an untapped opportunity to revitalize older neighbourhoods and generate wealth for communities. Social benefits of brownfield rehabilitation include: improved quality of life in neighbourhoods, removal of hazards to human health and safety, access to affordable housing, creation of active bridging of the communities to mitigate social inequalities, enhanced identification with the city through tapping on historic and cultural legacy of the brownfield sites and new work opportunities.

Quality of life of the local communities has various definitions and indicators - from multidimensional factors that include everything from

1 Western Australia Council of Social Services (WACOSS). 2000.

physical health, psychological state, level of independence, family, education, wealth, religious beliefs, a sense of optimism, access to local services and transport, employment, social relationships, housing and the environment, cultural perspectives, values, personal expectations and goals to physical, mental and social well-being²

Eurostat defines the quality of life through several contributors³

Whereas the social values created by brownfield redevelopment are unquestionable, equally important in the city's sustainable development is the social participation and involvement at every planning and implementation level of the regeneration process. Such participation requires in-depth knowledge of the current environmental and social status of the area, engagement of stakeholders and sophisticated project management skills and tools.

The aim of the Pilot Actions was to perform study and deliver information and tools to the

2 Defining Quality of Life: A Wild-Goose Chase? Europe Journal of Psychology 9(1):185-203 · Barbara Barcaccia, Giuseppe Esposito, Maria Matarese, Marta Bertolaso and Maria Grazia De Marinis February 2013,

3 <https://ec.europa.eu/eurostat/web/gdp-and-beyond/quality-of-life/data>

institutions to redevelop selected brownfield sites in a sustainable manner. The actions performed have concentrated mainly on delivering environmental and institutional values that are economically sound and can improve the quality of life of the local communities. The quality of live - as pointed out earlier - is a very complex issue and can be addressed at many levels and many focal points. The PAs thus have delivered the social sustainable value by conducting research and delivering outputs on the following aspects of the quality of life:

- Natural living environment
- Health and safety of the local communities
- Mitigating social inequalities
- Governance
- Sustainable socio-economic development

Equally important condition of the PAs social sustainability concerns project management

where the stakeholders' participation has become a paradigm at every project level and every development stage of the brownfield rehabilitation planning process. Finally the added value of the project, at every sustainability level, was gaining or enhancing knowledge of the stakeholders involved, including the main participants of the Project: institutions, scientists, experts and project managers.

Both: research and development on enhancing the quality of life of the local communities as well as stakeholders' identification and engagement deliver social sustainability value that cannot be measured or compared through a set of defined indicators. The social sustainability is a very complex matter that depends on many internal and external factors separate from the Pilot Actions. Furthermore, the effects of the work conducted can only be assessed over a longer time horizon and only if the brownfield redevelopment is conducted with the aid of the database and tools delivered to the institutions through the work of the PAs.



Fig 4. Eurostat definition of factors affecting the quality of life



Tangible Social Values of the Pilot Actions

Quality of life of the local communities - research and diagnosis

Natural living environment

The research of the PAs was primarily involved in studying the environmental status of the brown-field and means to mitigate the environmental hazard. Some studies have specifically assessed the impact of the brownfield contamination on natural living environment - terrestrial and marine ecosystems. In most cases the risk assessment link (contamination source-path-receptor) has proved an adverse effect of the contamination on the quality of natural living environment.

Health and well-being of the local community

The natural living environment affects human health and well-being. Urban green spaces can help with stress recovery, provide opportunities to relax and perform physical activities and improve the quality of the air. The environment provides also valuable resources - water, food, etc. That's why any environmental damage

could have direct impact on health and well-being of the local communities.

The studies that directly concerned health and well-being of the local community include *Radom*, *Solec Kujawski* and *Bydgoszcz*. Indirectly the issue has also been addressed in *Venice*, *Celje* and *Rijeka* PAs.

Part of the deliverable of *Radom* PA was a study called "*Analysis of the Current State of Soil and Buildings Located in the Area of the Former Power Plant in the Northern Part of Radom, in Mazovian Voivodship, as well as Their Potential Environment and Health Risks*". The research identified that the contamination of soil could have a negative impact on the overall health of the local community through dispersion of the shallow contamination present in the ground. Furthermore, potential hazardous materials present in derelict buildings such as asbestos fibres, could also affect negatively the quality of the air.

Before proceed to the remediation, *Solec Kujawski* identified the impact of the contamination of the former railway sleepers plant



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on health of the local community through its migration to the groundwater and the air. People living in the vicinity complained about the odour and nearby wells not connected to the water supply network showed contamination, which was observed by the smell of water. The remediation activities were completed in 2016. As part of the GreenerSites project contamination below the groundwater level was identified which may affect health of the local community and the quality of drinking water.

Bydgoszcz PA revealed the level of groundwater contamination with toxic chemicals and its direct impact on the local communities in several villages, located downstream of the contamination sources. The study has also pointed out that the contamination with those chemicals is dispersed by the air and to some extent by storm water. Therefore, even if the local communities are informed about the significant health hazard associated with drinking the contaminated water, the results of inventory shows that they are still using it in everyday life. Their health is also affected by the quality of the air, and the contact with the ground. Therefore the ground tests will be performed and risk analysis done. Furthermore, the toxic chemicals may accumulate in the food chain, which impacts not only health of the people but also their economic status, rendering any agricultural or farming activities in those area a non-viable economic option for the village communities.

One of the *Veneto Region's* deliverable was a study of an innovative method of assessing soil contamination with volatile organic compounds (VOCs) through measurement of the chemicals concentration in indoor air. The first set of results indicated temperature-related accumulation of the VOCs inside buildings located in the studied area, creating a risk for public health. The subsequent data and detailed software modelling proved that the concentration is too small to have an impact on people's health.

Apart from environmental studies performed at the *Celje* site, the project has also conducted an inventory of hazardous waste present in the

Stara Cinkarna area. Hazardous waste can affect people's health through direct contact or indirect impact.

The *Rijeka* PA assessed soil and groundwater contamination in the former *Mlaka* refinery and the impact of the contamination on people and the environment. The study revealed that the contamination of soil and groundwater is migrating primarily to the Adriatic Sea. From there it may enter the food chain through fish and other seafood. Thus the pollution of the marine environment may not only create a health issue but also cause an economic decline of the local fishing industry.

Mitigating social inequalities

Development of housing estates in a direct vicinity of a major employer, such as a large industrial plant was perceived in the past as a good planning practice. The communities did not have to travel far to work and the organisation has an adequate supply of workforce. The quality of the environment had not been perceived as an impediment in such an arrangement. The social problem had become evident with the plants' closures and growing awareness of the pollution impact on human health. Such a situation has been encountered in the *Radom* PA. The inhabitants of nearby *Pionki* housing estate have been left not only without the major employer but also without a fundamental infrastructure supporting their social activities and connecting them with other parts of the city. This situation creates social inequalities among the city community with the housing estate in *Pionki* being stigmatised as an inferior place for living. Mitigation of those inequalities have been addressed in the *Radom* Strategic Action Plan prepared within the PA through recommendation of the brownfield site and infrastructure sustainable redevelopment.

To some extent the social inequalities have also been addressed by the *Bydgoszcz* PA. The project points out that the local communities point out that the contamination has significantly impacted their quality of life, not just in terms of





health but also in terms of dilapidating infrastructure and economic decline in the area. The project, however, has not envisaged mitigating social inequalities but monitoring environmental impact.

Governance

Sustainable development requires public administration to be effective, transparent, accountable and democratic⁴. The PAs addressed the governance aspect mainly through the delivery of database and effective management tools for sustainable planning of brownfield rehabil-

⁴ Wu Hongbo, UN DESA's Under-Secretary-General, opening speech of the 13th session of the UN Committee of Experts on Public Administration (CEPA)

itation. Another value delivered by the project includes structured approach to stakeholders' identification, engagement and communication with the local communities.

The PA studies and outcomes concerning planning solutions for the brownfield redevelopment have in most cases only general conceptual approach. More detailed studies, involving inventory of existing infrastructure was conducted in *Radom* and *Rijeka*. Probably one of the most advanced and detailed planning of the FUA was encountered in *Solec Kujawski* PA. Despite the fact that the studied area has an excellent location in the city centre and great commercial potential, the local institutions have already designated the site for recreational purposes.

Sustainable socio-economic development

The studied brownfield sites are frequently located in the city centres. Rehabilitation of those sites bring many benefits to the society as demonstrated in this review. Example includes reduced urban sprawl, improved identity with the city, growth of employment rate, reduced crime and overall improvement of the quality of life.

Both: The Strategic Action Plans and the Common transferability manual that will be prepared at the end of the Pilot Actions will address the socio-economic context of the planning process. The sustainable planning involves detailed in-depth knowledge of the environmental and social aspects and appropriate structured methodology of stakeholders' engagement.

Intangible Social Values of the Pilot Actions

Stakeholders' identification and engagement

One of the fundamental principal of the project was identifying and engaging stakeholders at every milestone of the project. The participation of the stakeholders ensured enhanced quality of the outcomes by implementing strategies that improve local relevance and value,

avoiding the unnecessary duplication of analysis, understanding expectations of those who could significantly impact the planning process and learning from experience of others.

The stakeholders varied in each FUA. Apart from a group of 14 Associated Partners (AP), the project involved land owners, enterprises, municipal companies, foundations and non-governmental organisations, regional and government agencies, universities, religious communities and groups of residents. The engagement of the local communities and group of residents will be addressed in subsequent chapter as the communication with them was conducted by slightly different approach.

Every Pilot Action concluded the importance of the stakeholders' engagement in the process of research and preparation of the final outcomes. Some projects though indicated the challenges concerning identification and engagement of the stakeholders.

City of Venice LP emphasized strong cooperation with the local partners and stakeholders, although not without some initial challenges. The project concluded that many stakeholders had different interest in the area (different land ownership, land management competences partly owned by local, regional and national administrations, etc) and future actions should ensure synergy between the *City of Venice* and other stakeholders. On the other hand the Project Partner - *City of Venice* officials - highlighted how the implementation of the Pilot Action required a considerable commitment that strongly contrasts with insufficient amount of staff present in the offices.

Another challenge concerning the engagement of the stakeholders was reported by the project partner *Isw* in *Halle*. The challenge was mainly related to identifying private land owners of the brownfield sites due to data protection regulations. Nevertheless, despite initial obstacles, the project leaders managed to determine all the analysed site's owners. Subsequently a network has been created that connects and integrates various stakeholders. It was strongly rec-

ommended to maintain their involvement and established path of communication between various departments within the municipal administration beyond the project's lifetime.

The *Celje* PA involved contact with various scientific institutions and governmental agencies only. The discussions among the stakeholders have enabled to develop the innovative method of site remediation. Furthermore, the presence of national regulators ensured that the proposed method will be accepted by the decision makers.

The *Radom* PA has strongly emphasised the importance of strong relationship between the regional institution (ARM SA) and the local authorities (the City of Radom) and relatively low interest of other stakeholders. The cooperation with the City of Radom was an important and a fruitful lesson for the Pilot Action leader. The local authorities gave their active support to the project and provided valuable help with their extensive experience in implementing projects concerning social and economic rehabilitation. Another lessons learned by the Radom project was the importance of proper communication with private owners. Similarly the *Solec Kujawski* PA has emphasised strong commitment and support from the local authorities and the importance of cooperation with private land owners.

Probably one of the most challenging task concerning stakeholders' engagement had the *Rijeka* PA. Altogether over 60 stakeholders have been identified and contacted throughout the Pilot Action - representatives of private sector, local and national regulators and various institutions. In order to manage such a large group of people they were organised into smaller thematic groups. Such an arrangement proved to be the key success of the project's management as in those smaller groups the stakeholders became involved in research preparation, data collection, data analysis, and discussion on potential actions and results. They have also actively participated in trainings, work meetings, study visits and other events. The stakeholders' contribution proved



to be extremely valuable to the project's outcomes. In fact, according to the project leader their involvement can be set as a model for other projects and should definitely be continued after completion of the project. Furthermore, for the first time individuals and various organisations at a local and national level had joined to work on the future plan for the port.

The *Bydgoszcz* PA has also gained a great deal through the engagement with stakeholders. The stakeholders showed interest in the project, provided valuable information and documents used as a source of database and proper design of the monitoring system.

Local community participation

Successful adoption of a sustainable development planning paradigm requires the support of the local community⁵. A strong public participation ensures that the planning process and its outcome are representative of the community. The local communities involvement and participation has been achieved by direct discussions with some local communities, participation/organising regional conferences, seminars, events, preparation and distribution of booklets, leaflets and other promotional material (in paper and digital form) as well as setting up a dedicated webpages to each of the Pilot Actions and the overall GreenerSites project.

Direct engagement of the local communities has been conducted by *Radom*, *Solec Kujawski*, *Bydgoszcz* and *Rijeka* PAs.

Probably the most structural form of the discussions with the local communities had taken place in the *Radom* PA. Dealing with a deep social exclusion of the area inhabitants and their supposed negative attitude created a requirement to choose a proper and efficient consultation method. The adopted solution included a combination of different methods and an inno-

⁵ Healey P, Shaw T, 1997, "Planners, plans and sustainable development" *Regional Studies* 27, 769 - 776

vative, very demanding Planning For Real method (PFR). Public consultations were conducted with the residents of three housing estates located near the degraded area. 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 process.

The public consultations were also conducted in the *Solec Kujawski* PA. The representatives of nearby housing estates were concerned with the odour of hydrocarbons, especially creosols, which was particularly intensive in summertime.

The *Bydgoszcz* PA reported overall negative attitude of citizens towards the municipal activities including GreenerSites actions and their reluctance for participation in the project. Generally, the local community required actions on a much larger scale that would clean up the entire pollution and improve the groundwater quality in their villages.

The *Rijeka* PAs involved the local community in the process of research and preparation of the Strategic Action Plans. The project leaders organised a series of local events and trainings that briefed citizens and stakeholders on the current activities, project purpose, results of the research, opportunities and examples of best practices. This resulted in a strong interest of both target groups: the stakeholders and the local citizens. The motivation and involvement of the local community in seeking solutions for rehabilitation of area has been considered to be one of the project's great added value.

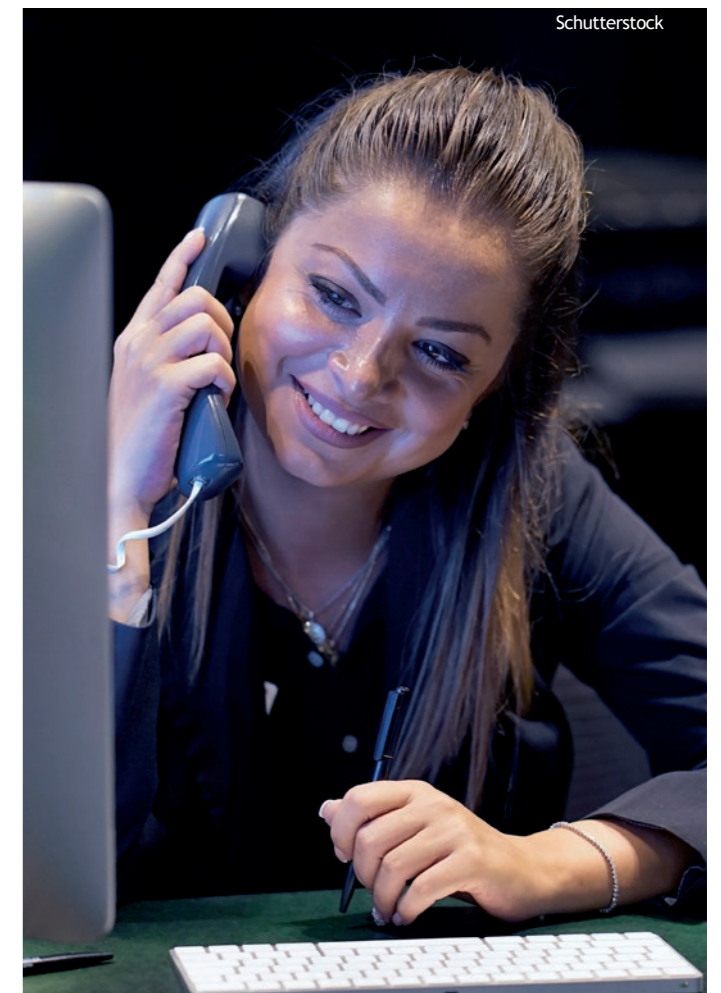
The project partners in *Rijeka* as well as in *Halle* and *Venice* had organised a series of conferences to involve public representatives in the projects. The partner in *Halle* organised two larger "future forums" attended by approximately 100 local inhabitants to speak about further development of the area. The conferences had also

created an opportunity to conduct a set of surveys on understanding the projects goals by the local citizens. The results showed that access to communication with the local community was generally appropriate and successful.

Education and knowledge transfer

Education and knowledge transfer deliver sustainable values at all levels of the projects. The know-how transfer was one of the key tenet of the project. Each of the Pilot Actions had performed slightly different activities but only through the know-how transfer the findings and conclusions could be collated and analysed by a group of panel experts to deliver state-of-the-art recommendations. For example, a group of environmental professionals could learn from each other about various solutions to mitigate certain type of contamination. An innovative and cost-effective remediation method applied in one place could be repeated on other brownfield sites. The information exchange had various forms - apart from direct electronic communication - a series of working meetings, workshops, trainings and study visits were conducted within the project. They served to exchange experiences between participants, to gather best practices and to support the development of materials and tools.

Equally important is gaining knowledge from the engagement with stakeholders and local communities. Several projects partners (*Municipality of Celje*, *City of Bydgoszcz*, *ARM Sa*, *Municipality of Solec Kujawski*, and *the City and Port of Rijeka*) pointed out how contacts with the stakeholders became an invaluable educational experience. The stakeholders not only delivered important information but also helped to solve problems, find solutions and even assisted with developing innovative remediation methods. *Venice* partners reported on the efficiency of cooperation between Veneto Region and both: the *City of Venice* and *the Port Authority of Venice* which gave opportunities to share experiences and gain wider view of the overall project implementation.



Finally, professional training of all the Project Partners on the issues of brownfield management and outcomes of the project was conducted within the scheme. The training sessions were also organised around specific thematic sessions such as environmental legislation, sustainable remediation technologies, and local marketing strategies for brownfields. Additionally, some Project Partners also visited other European brownfield development projects representing state-of-the-art, best European practice solutions. Example includes representatives of the Venice municipalities visiting redeveloped ports in France and Germany. The training sessions were very well received among the institutions. Many pointed out that staff training should become an institutionalised best practice measurement for all projects involving municipalities.



Lessons learned from the Pilot Actions concerning sustainable social values

The project has delivered social sustainability value on two levels: through research and diagnosis outputs and through a specific approach to the project management.

The Pilot Actions concentrated their study on understanding factors that could impact the quality of life of the local communities. Among the relevant factors it was recognised that the existing brownfields could affect health and well-being of the citizens living nearby and in some instances their sense of social equality. The quality of life, however, is a multifold concept that involves individuals, society, governance and economic factors. Therefore, the PA research on other topics, such as a feasibility of economic development, helping with the planning process and even impact of contamination on a wildlife are all indirectly affecting the social aspect of sustainable development.

Another important social value was the cooperation between local partners and stakeholders. The participation of the stakeholders ensured enhanced quality of the outcomes by implementing strategies that improve local relevance and value, avoiding the unnecessary duplication of analysis, understanding expectations of those who could significantly impact the planning process and learning from experience of others. Overall, all of the PAs reported strong added value from the cooperation with stakeholders, some of which - through innovative approach- could be used as a model for future stakeholders' engagement. Many leaders have also pointed out that established communication network of various institutions, governmental and non-governmental agencies should be carried on beyond the project's lifetime for a successful planning and development of brownfield sites.

Involvement of the local communities has proved to be invaluable part of the project. Some PAs contacted directly the local communities, whereas others used various events to exchange knowledge and obtain opinion from the local citizens. Furthermore, the project was widely communicated through various media and publications. In most cases the community involvement brought many positive outcomes. Some of the PAs though (in *Venice*, *Solec Kujawski*) indicated that the community engagement should be greater and conducted in a more structured, professional form. Such a professional public consultation was conducted in *Radom*. The outcomes of the meetings with the local communities have been published in a report, which can be used as an excellent public participation guide and a set of best practices for this subject on other projects.

Finally knowledge transfer can be considered an important educational aspect of the project. The knowledge transfer had a structured, predefined character proving strong understanding of this issue by the project leaders in the context of relevance to delivering sustainable values at all levels. Transferring of knowledge among stakeholders, project executors and institutions in form of planned meetings, trainings and preparation of common tools helped all project participants to become more effective with sustainability deliverables.

The brownfield sites can sometimes carry historic legacy - whether physical in form of historic buildings and structures on site or psychological - in the eyes of the local communities. Tapping on the historic and cultural legacy enhances identification of the local citizens with the city. Although none of the FUA studied within the Pilot Actions represented any cultural value, it is worth considering to enlist such indicator among future projects that aim to deliver sustainable institutional and social values.



Conclusions

The objective of the GreenerSites project was to improve the environmental management of brownfield sites across Central and Eastern Europe through the definition of strategies & tools based on a sustainable integrated approach to make involved Functional Urban Areas (FUAs) cleaner, healthier & more liveable places. Overall, GreenerSites Project Partners selected eight sites for further analysis within the Pilot Action projects. The national share is as follows: Italy (1), Germany (2), Poland (3), Slovenia (1), and Croatia (1).

The project aims to improve the brownfield management by delivering sustainable values through research and diagnosis, delivering databases and tools for better strategic planning of the brownfield sites development by the institutions. The construction of the project itself had a goal to magnify the key findings and effects of activities at the local and European level by know-how transfer and stakeholders' engagement. The project was implemented through 11 Pilot Actions. Each Pilot Action was designed to complement each other in order to address all of the sustainability pillars. Thus a number of actions concentrated its activities on economic development, others on institutional, environmental and social development. The findings of all the activities will then be collated in a series of documents such as a FUA specific Strategic Action Plans and Common transferability manual for sustainable environmental brownfield management. The project has delivered both: tangible and intangible sustainable values to the analysed FUAs creating short and long term benefits. The magnitude of those benefits cannot be assessed over a short term period. The effects of generating database and tools, trainings and know-how transfer, provided during the course of the project, can only be determined over a longer period. The analysis of sustainable values delivered by the project has concentrated on evaluation of short-term measures that have

been applied and are the results of the pilot project. Long-term benefits, however, should not be overlooked as they frequently form the goal of all of the actions undertaken.

Sustainable economic value has been delivered through a research and diagnosis, databases and preparation of management tools for the institutions. All of the research outputs of the PAs bring tangible economic value as they require a concrete financial investment to gain knowledge on current status of the brownfield and measures that should be applied in the sustainable rehabilitation of the sites. Intangible economic value of the research has also been proven scientifically where the return on such investment over a longer period can bring significant financial gains and savings.

Some of the project partners (*City of Venice*, *lsw*, *City of Rijeka* and *ARM SA*) have conducted studies on specific economic measures that should be taken to rehabilitate the sites. The results of the analyses and recommendations have been shared with other project partners and can be applied universally to other sites. For example, *the City of Venice* PA has studied an innovative fiscal approach to encourage financial investment of the private sector on the brownfield sites. *lsw* in Halle on the other hand proposed a set of factors that not only could improve marketability of the sites but also allow to establish a hierarchy for prioritising the development process. Equally important in terms of economic value was delivering databases, some in form of Web-GIS, and tools such as remediation methods, Strategic Action Plans and *the Common Transferability Manual* to improve the process of planning and rehabilitation of brownfields.

As far as the institutional aspect of the sustainable value is concerned, the project conducted a series of research on economic, social, institutional and environmental status of the studied FUAs



and delivered database and tools for effective institutional management of brownfield sites. The research on factors specific to institutions included: analysis of local law and regulations, ownership structure, existing databases, management of brownfield sites and planning practices. The research has revealed that there is no clear definition of a brownfield site across the countries involved in the project, or the definition does not exist in national regulations. This implies a considerable hindrance to the brownfield development. The lack of clear definition and regulations have caused the inconsistency of data management among the institutions. Frequently the information on brownfield sites kept by the local regulators was incomplete, inconsistent and stored among various institutions. Furthermore, due to data protection regulations, the institutions were unwilling to provide any information on brownfield sites that belong to private owners. The effective redevelopment thus requires some changes of existing regulations and creation of a single local unit responsible for maintaining data/brownfield management. Despite those challenges, the PAs managed to deliver valuable databases that contained information concerning location of brownfields in studied FUA, ownership structure, environmental status and stakeholders for each FUA. Some of the information has been presented in form of Web-GIS mapping which can be combined with other database that is already in the hands of the institutions such as the cadastral information, location of valuable, protected habitats, etc. providing an important tool for the whole city development.

The project has delivered not only valuable information and database to the institutions but also presented clear guidance and action plans demonstrating a strategic approach to spatial planning and land rehabilitation with a proactive engagement of stakeholders and local communities.

The sustainable environmental value of the projects has been achieved by delivering information on environmental conditions, provision of databases and risk management systems to the institution, studying potential health hazards of the local com-

munities from the identified contamination and recommending most appropriate, cost-effective and innovative methods of remediation.

Most of the Pilot Actions have concentrated their activities on direct on-site environmental studies whereas some of the PAs have acted as support agents to deliver important tools for the management of the contamination. The pilot actions that concentrated their studies on site investigation have also considerably differed in their approach. Some, like in Venice, Radom and Rijeka specialised in a profound assessment of one area from an environmental, social, institutional and economic perspective whereas the investigation conducted in Solec Kujawski, Bydgoszcz and Celje aimed at recognising mainly the environmental status of the sites and its impact on local communities and surrounding sites. As a result, the project generated not just detailed information on existing environmental status but also developed unique remediation techniques that can be applied on sites with similar environmental concerns.

The project delivered the social sustainable value by conducting research on the quality of life of the local communities. The PAs have addressed such issues as: natural living environment, health and safety, mitigating social inequalities, governance and socio-economic development. The research has proved that indeed the contamination identified on the studied brownfield may have an impact on health and comfort of the people living near those sites. The abandoned post-industrial areas have also created social inequalities among communities living near those areas.

Equally important social sustainability value delivered by the project was the stakeholders' identification and engagement. The participation of the stakeholders, including local communities ensured enhanced quality of the outcomes by implementing strategies that improve local relevance and value, avoiding the unnecessary duplication of analysis, understanding expectations of those who could significantly impact the planning process and learning from experience of others.

Finally, knowledge transfer can be considered an important educational aspect of the project, supporting social sustainability added value. The knowledge transfer had a structured, predefined character proving strong understanding of this issue by the project leaders in the context of relevance to delivering sustainable values at all levels.

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 professional measures to the institutions responsible for the rehabilitation of the brownfield sites. Nevertheless, the project has also revealed potential obstacles in such redevelopment and issues related to project management that should be considered when implementing similar projects or continuing the GreenerSites project. The most important aspects pointed out by the Pilot Actions are:

Institutional Measures

1. The need for specific regulations on brownfield sites should be articulated at a national level. There is a clear lack of regulations promoting inclusive growth, appointing dedicated institution for data collection and an integrated approach to ensure effective environmental management of brownfield sites. Local regulations may not suffice as some PAs demonstrated.
2. The Web-GIS should be adjusted to national regulations that follow the INSPIRE Directive. The developed software has many potentials but only when it follows a particular set of legislative requirements and hindrances. Example includes some data protection.

Environmental Measures

3. The project should involve at least partial assessment of applicable environmental regulations on national levels. Some recommen-

dations of the PAs may indeed provide excellent, reasonable and cost-effective solutions but those solutions may contrast with environmental law in other countries and therefore may not become the universal solutions as emphasised by the PAs.

Social/Project Management Measures

4. The planning process should be conducted with active engagement of local communities. State-imposed regulations promote passive involvement by narrowing down the communication to public presentations and announcements on the institutions web pages. The community engagement should be based on best practice guidelines.
5. Similarly, stakeholders' engagement should be conducted in accordance with professional best practice guidelines. Those tools should be delivered to the project leaders before commencing the project. Such a structured, methodological approach will increase the chances of delivering positive outcomes resulting from the stakeholders' engagement.
6. The training sessions conducted within the Pilot Actions were very well received among the institutions. Such a structured training ought to be considered as an institutionalised best practice measurement for all projects involving municipalities.
7. The brownfield sites can sometimes carry historic legacy - whether physical in form of historic buildings and structures on site or psychological - in the eyes of the local communities. Tapping on the historic and cultural legacy enhances identification of the local citizens with the city. Although none of the FUA studied within the pilot actions represented any cultural value, it is worth considering to enlist such indicator among future environmental projects that aim to deliver sustainable institutional and social values.



Summary Sustainable Measures

		LP City of Venice	PP2 ISW / Halle	PP3 Celje	PP4 Mazovian District/ Radom	PP5 Solec Kujawski	PP6 Veneto	PP7/PP10 Rijeka	PP8 Venice Port	PP9 Bydgoszcz	PP11 Magdeburg
Sustainable economic measures	Financial and economic analyses										
	Improvement of marketing strategy										
	Databases										
	Innovative remediation methods										
	Strategic Action Plans & Guidelines										
	Know-how transfer and stakeholders engagement										
Sustainable institutional measures	Analysis of local law and regulations										
	Analysis of ownership structure and key stakeholders										
	Analysis of existing databases										
	Analysis of existing management of brownfield sites										
	Analysis of existing planning strategies										
	Provision of databases										
	Development of Web-GIS										
Provision of management tools and management systems											
Sustainable environmental measures	Environmental research and diagnosis										
	Provision of remediation methods										
	Provision of environmental databases										
	Provision of environmental procedures										
	Monitoring and risk management systems										
Sustainable social measures	Natural living environment										
	Health and safety of the local communities										
	Mitigating social inequalities										
	Governance										
	Sustainable socio-economic development										
	Stakeholders identification and engagement										
	Local community participation										
	Education and knowledge transfer										

