Final Report Summary - HOMBRE (Holistic Management of Brownfield Regeneration)

Executive Summary:
Holistic Management of Brownfield Regeneration (HOMBRE) is a 4-year European project financed under the 7th European Union Framework Programme. Starting in December 2010 its activities have been carried out by a consortium of 14 European partners coordinated by Deltares (NL). The total allocated budget for project activities amounted to 3.48 million Euros.

Over recent decades, land recycling has become a major concern in European regional policies. Land and soil are being increasingly recognised as vital resources in European’s continued development. Since the 1990s the rate of land take in the EU is around 1000km² per year and the EC intends to limit this land take and to promote reuse of the land in already built-up areas. Preventing sites from becoming brownfields (BF’s) and regenerating existing BF’s is key in tackling urban sprawl and ensuring a more sustainable built environment. Europe’s policy of creative, stable and eco-efficient cities is nearer to being realised because of the deeper understanding and more sophisticated solutions HOMBRE has developed.

The strategic goal of HOMBRE, improving the dividend from BF regeneration for environment, economy and society and thereby preventing an increase in the carbon footprint, is specified by the following research objectives:
1. Better understanding why, how, where and when brownfields are formed in order to avoid future brownfields.
2. Better and more creative solutions for long term land use of current and potential future brownfields.
3. Better operations, better implementation of state of the art technologies into practice and development of more sustainable integrated regeneration technologies for successful brownfield regeneration.
4. Better planning and more attractive communication technologies, that allow more holistic appraisal of brownfield regeneration options and early stakeholder involvement.

To achieve its aims, at the heart of the project the ambition is to create a paradigm shift to ‘Zero Brownfields’ where BFs become areas of opportunity that deliver useful services for society, instead of derelict areas that are considered useless. By looking at synergies between improvements in environmental condition, economic performance and social services it expands opportunities and becomes a leverage return of investment for BF redevelopment. Technology trains that deliver multiple services have been developed and tested to serve as examples for end-users. A procedure is set up for assembling technology trains for BF sites. “Hard uses” are engineered solutions which give direct impacts on the subsurface, water, energy or construction conditions. “Soft uses” are directed to more so-called green approaches such as bio energy, dealing with carbon sequestration and improving soil condition.

The HOMBRE shift in thinking relates not only to the redevelopment itself, but also to gain better understanding in early recognition and prevention of land that might become a BF in the future, and how to monitor this as part of (and closing) the land use cycle.

The visual decision support tool the Brownfield Navigator (BFN), guides end users through the process of anticipating and accelerating the return of the BF to beneficial use and beginning the redevelopment process. The life cycle of urban land use and the associated management cycle are at the core of the BFN and the results of the different project elements are included.

With several workshops, some held at case study sites, the developed concepts, tools and technologies were tested and
validated by project partners and stakeholders. The main results of HOMBRE were presented during the HOMBRE Final conference “CABERNET 2014: Tailored & Sustainable Redevelopment towards Zero Brownfields” organised in cooperation with the EU FP7 Projects “GLOCOM”, “Greenland” and “TIMBRE”. Most of the project’s achievements are highlighted on the website (www.zerobrownfields.eu).

Project Context and Objectives:
The HOMBRE project started as a FP7 research project in December 2010. Over recent decades, land recycling has become a major concern in European regional policies. Land and soil are being increasingly recognised as vital resources in European’s continued development. Since the 1990s the rate of land take in the EU is around 1000km² per year and the European Commission (EC) intends to limit this land take and to promote reuse of the land in already built-up areas. Therefore comprehensive strategies and programmes to limit urban sprawl, to deal with the problems of shrinking cities and to encourage brownfield (BF) revitalization have been developed in many cities, regions and countries of Europe. Recent initiatives by the EC make the stewardship of soil resources and the management of land use activities as key policy objectives of the European Union. The flagship initiative “A Resource Efficient Europe” (COM (2011) 571 final) of the EUROPE 2020 Strategy explicitly recognises land as a resource and for the first time the EC sets a target for zero land consumption by the year 2050. With this ambition and vision in mind the EC launched a number of research and development initiatives aimed at preventing sites from becoming BFs and regenerating existing BFs. The project HOMBRE aligns itself with this integrative perspective on land as a multi-purpose resource and also recognises the important role played by actors on the European level in influencing land use and its management.

Brownfields are sites that have been affected by the former use 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 (CABERNET, 2005). Communities with BF’s often face economic and social concerns, such as unemployment, substandard housing, outdated or faulty public infrastructure, and crime. Preventing sites from becoming BF’s and regenerating existing BF’s is key in tackling urban sprawl and ensuring a more sustainable built environment. Market rules predict that additional time, costs and liability risks of BF development – as compared to a Greenfield site- at present will only be balanced when there is a strong economic drive.

The principal aim of the project is to achieve a paradigm shift in sustainable brownfield management practice. HOMBRE seeks to minimise the costs and maximise the benefits from the (re-)use of BF. HOMBRE therefore focuses on strategies and technologies that will facilitate the integrated assessment of BF regeneration options within local and regional development, and highlights the BF site potential through available resources and opportunities for local and regional stakeholders.

This strategic goal sustainable brownfield management practice, with focus on improving the dividend from BF redevelopment for environment, economy and society and thereby preventing an increase in the carbon footprint, is specified by the following research objectives:
1. Better understanding why, how, where and when brownfields are formed in order to avoid future brownfields.
2. Better and more creative solutions for long term land use of current and potential future brownfields.
3. Better operations, better implementation of state of the art technologies into practice and development of more sustainable integrated regeneration technologies for successful brownfield regeneration.
4. Better planning and more attractive communication technologies, that allow more holistic appraisal of brownfield regeneration options and early stakeholder involvement.

Case studies have an important role in the project to (a) test and validate research results, (b) involve stakeholders and (c) improve practical applicability of the products of HOMBRE.

Work Package 2 BF ROADMAP FOR ZERO BROWNFIELDS PERSPECTIVE

The main objective of WP 2 was to better understand why, how, where and when BF’s are formed in order to avoid future BF’s. BF regeneration should not be considered as a stand-alone negative issue, but as part of a more positive perspective in a
closed land use cycle (Ferber et al., 2004). This theoretical concept is put into practice, by further developing the framework and strategy for circular land management, the HOMBRE Zero Brownfield Framework.

The land management cycle is decoupled from the dynamics of the land use cycle, avoiding unnecessary emergence and undue persistence of BF’s. The basic land use cycle comprises two phases of “Use” and “Transition”. Between these two phases there is a danger that BF’s may emerge and persist too long. The land management cycle is represented by the three phases: Anticipate change, Make the Transition, and Check Performance. Besides the tools and concepts developed for the Make the Transition phase (the brownfield redevelopment phase), the strategy includes indicators for early recognition (early warning indicators) of why, how, and when BF’s come into existence (Anticipate change), as well as indicators that determine the actual sustainability of the new land use against the service needs (Check the Performance). By monitoring these indicators, timely intervention may avoid BF formation or at least mitigate the negative effects. By including these indicators the land management cycle is closed. A clear benefit of land management within the HOMBRE Zero BF Framework is restricting the magnitude and duration of negative societal impacts from land in decline.

This WP has set up indicators and monitoring approaches to better understand why, how, where and when BF’s are formed and a strategy on how BF regeneration can effectively help tackle urban sprawl and ensure a sustainable built environment: the HOMBRE Zero BF Framework (Fig 1). Also a method is developed based on the early warning indicators to identify the potential of BF emergence in various districts of a study area.

**WP 3 BF NAVIGATOR**

The main objective of WP 3 was to provide better planning and more attractive communication technology that allows a more holistic appraisal of BF regeneration options and early stakeholder involvement. To choose the best regeneration strategies, technologies and approaches for BF regeneration, there is a need for more elaborate and integrated decision making tools and processes during the planning phase of a BF that help stakeholders to ‘navigate’ holistically towards a successful BF regeneration. The BF Navigator (BFN) aims to facilitate a more holistic appraisal of BF redevelopment opportunities and early stakeholder involvement by offering an attractive online collaboration tool.

The BFN guides end users through the process of anticipating and accelerating the return of the BF to beneficial use and beginning the redevelopment process. The BFN facilitates interactive stakeholder involvement, which helps to picture planning scenarios and balance the financial viability and conformity of planning objectives with broader sustainability indicators. It is targeted in decision making at the level of area planning, managing a portfolio of sites, or project planning. With the BFN, stakeholders can visualize alternatives of development scenarios and regeneration plans, enabling them to design better balanced combinations of uses that will meet planning objectives and indicators (quicker, cheaper and more sustainable). The different management phases are linked to the available tools and methodologies developed in HOMBRE to support the framework in practice.

Input is provided from other WPs (top-down) and comments used from the practitioners in cases (bottom up). Testing of the BFN has been done on different levels: testing of parts of the BFN (BFN items) on cases (in co-operation with other WPs) and “technical testing” by members of the project team, as preparation of the software sprints and making the e-learning materials (together with WP7).

**WP 4 INNOVATIVE BF TECHNOLOGY TRAINS**

The main objective of WP 4 was to achieve better operations, better implementation of state of the art technologies into practice, by developing innovative Technology Trains (TTs) for sustainable, cost-effective and timely regeneration of BF’s. TTs draw on the knowledge and techniques from different fields to overcome environmental and resource challenges (with focus on soil, energy, water and materials) in BF redevelopment by systematically assessing resources and service supply and demand of the redevelopment site and its vicinity. It aims to define the playing field in which technological solutions needs to be found to enable the BF redevelopment in an economic, ecologically and socially favourable way.
As at each BF the obstacles and boundary conditions are different, a framework is developed to define the playing field within which technologies have to operate. This framework seeks to effectively use resources that are present at the BF to fulfil demands on goods and services that are needed at the redeveloped site. A workshop structure is developed and tested on two HOMBRE cases Solec and Terni to help stakeholder unlocking hidden values of BF sites with six Golden Questions/Key Considerations.
Three specific TTs were elaborated and tested in the lab by HOMBRE as examples to represent the different basic demands for goods and services, namely 1) energy and water, 2) building material and soils, and 3) soil and water.

WP 5 ENABLING BF SOFT RE-USE
In this work package, creative solutions for interim and/or long term use of current and potential future BF’s are provided by developing and improving methodologies, tools and technologies for BF regeneration into green uses under the umbrella of the “soft re-use” concept. Soft re-use of BF sites, such as for biomass production or green space, can provide services which enhance regeneration.

Focus was in development, explanation of key principles and review of relevant literature references for an evaluation system for key services. A decision making procedure was elaborated, the Brownfield Opportunity Matrix, a simple Excel based screening tool to help decision makers identify what services they can get from soft re-use interventions for their site, how these interact and what the initial default design considerations might be.
Bio-energy clusters are an opportunity for marginal urban BF’s to deliver sustainable urban energy and to minimize the maintenance costs of sites without immediate after use plans. HOMBRE developed the “Bioenergy Tool” that helps guiding decision makers in identifying suitable BF sites for the production of biomass product within their local context. The specific details of the case studies in Halle and Gelsenkirchen, in addition to the Markham Willows Masterplan, were included in the determination of the criteria for successful biomass production on BF sites as defined in the Bioenergy Tool.

This WP has also refined knowledge on operating windows for two soft technology trains for greening urban brownfields, i.e. enable brownfield soft re-use. The experimental studies (in collaboration with FP7 Greenland) and literature review examine the use of biochars and composts for supporting soft soil restoration. Outcomes of these assessments contribute to understand the beneficial outcomes of low input techniques for BF regeneration into soft re-use and its relevance for levering project costs and generating multiple benefits.

WP 6 HOLISTIC FRAMEWORK FOR ZERO BROWNFIELDS PERSPECTIVE
The main objective is to demonstrate how the gaps and limitations of present BF regeneration practices identified can be overcome by synthesizing the findings of WP 3-5.
The Brownfield REMIT/RESPONSE (BR2) tool is a system based analysis tool to understand the urban system and to help predict how the proposed BF redevelopment will affect that system established. It has been developed into a spread sheet tool which guides users through the process sequentially focussing on individual system component relationships.
Furthermore a synthesis is drafted of the overall environmental policy related results and communicated to the EC, by setting up a Policy Brief. It contains eight take home messages from the HOMBRE project.

WP 7 NETWORKING, DISSEMINATION AND BUSINESS PLAN
The main objective of this WP is to spread information about project outputs through different dissemination channels such as the website, the final brochure and presentations or workshops at different events and especially the final HOMBRE conference.
One main target was to further elaborate ideas and structures how the outputs of HOMBRE could be used and applied after the end of the project in November 2014. This resulted in the HOMBRE+ business plan.
E-learning materials are developed for the Brownfield Navigator (BFN) as self-explaining presentations on how to use the BFN.
The e-learning modules are available and can be downloaded from the BFN (bfn.deltares.nl).
Also a CEN Workshop Agreement (CWA) is established within the project, the HOMBRE CEN Workshop Agreement 74 “Glossary of Terms for Holistic Management of Brownfield Regeneration”. This is a technical agreement, developed by an open workshop structure within the framework of CEN.

Project Results:

Work Package 2 BF ROADMAP FOR ZERO BROWNFIELDS PERSPECTIVE

1. Background

Preventing sites from becoming brownfields (BFs) and regenerating existing BFs is key to tackling urban sprawl and ensuring a more sustainable built environment. Though BFs are being redeveloped successfully, it is argued that at the current pace more BFs are coming into existence than are being redeveloped (Ferber, in Ramsden, 2010).

One of the keys to improve BF redevelopment is a better understanding of the life cycle of urban land use and the specific role BFs – their emergence, persistence, and redevelopment – has within this cycle. BF’s emerge when a given land use turns from being highly beneficial to society to having a marginal or even detrimental effect or simply comes to an end.

2. Purpose and objectives of WP2 and main outcomes

The overall objective of WP 2 is to better understand why, how, where and when BF’s are formed in order to avoid future BF’s. The specific aim of HOMBRE’s WP2: Roadmap for Zero Brownfields perspective was to further develop a circular land management framework, based on indicators and monitoring approaches that would provide an overall strategy for BF redevelopment, tackling urban sprawl, and ensuring a more sustainable built environment.

The work in this work package is divided in a number of tasks and actions and consisted of the following three main tasks:

Overall Framework (relevant to all WP tasks)

The base of the HOMBRE project is the HOMBRE Zero Brownfield Framework. Starting point was the circular land management framework developed within CircUse, the HOMBRE “Zero Brownfields” perspective has been further elaborated.

The conceptual framework for the Zero Brownfields perspective is summarised in Figure 1. At its heart is the land use cycle; the resource of developed land is considered to be in a continuous cycle of development, use, abandonment, redevelopment and re-use (Ferber et al., 2011, www.Circuse.eu). The basic land use cycle consists of only two phases: a Use phase and a Transition phase (Ellen et al., 2013b). The end of a given use phase may or may not be a formal and adequate decommissioning of activities and clearance of the site. Ideally, it should be followed by the onset of development activities to realise subsequent use. Where the end of the current use phase and the transition to the subsequent use are not well managed, there is a risk that the site may turn into a BF or that an already formed BF persists too long.

From this viewpoint of a continuous land use cycle, the administrative management of developed land should be aimed at facilitating a smooth transition to new beneficial land use, thereby preventing unnecessary BF emergence. This requires that also the various management phases interlink into a continuous management cycle; facilitating land use transition may already start during the use phase. An early start-up and smooth transition both aid in limiting the duration of underuse: ‘Zero BF’.

The land management cycle is decoupled from the physical land use cycle, as more than one management cycle may run at the same time. The different parallel cycles may zoom in on specific sites or parts of sites or zoom out on a wider area, but may also plan ahead several steps in a series of subsequent transitions for one site. It should be noted that the HOMBRE land management cycle has a long term administrative perspective. Management at the level of actual implementation projects and subsequent maintenance is considered to be delegated to other parties or other parts within the administration/organisation.
Task 2.1 Early indicators and key factors of brownfield origination

To apply the HOMBRE Zero Brownfield Framework in practice, those in charge need adequate information that enables them to prepare for upcoming changes and look ahead for potential solutions and synergies.

In Task 2.1 “Early Warning Indicators” are identified that can give support in anticipating BF formation and related problems in an early stage (the management phase of anticipating change). The goal of these early indicators is to have a signalling function towards persons or organisations responsible for land management.

Based on literature review, a set of around 40 early indicators has been identified, that is viewed to be generically usable. The list of early indicators was also reflected upon during a workshop held in Genoa with case site stakeholders.

The indicators were grouped into clusters within the categories of economic, social and environmental indicators (Table 1). Economic drivers were found to dominate BF formation; therefore emphasis was put on these indicators. Municipal (or other) land managers are envisaged to select from the list of suggested indicators the ones that are most relevant and convenient in their situation.

The results of Task 2.1 were laid down in deliverable D2.1: Early Indicators for Brownfield origination.

Task 2.2 Cost effective monitoring system and approaches to follow different stages of Brownfields

Monitoring activities are specifically related to the first and last of the three management phases in the Zero BF approach. Decision guidance within the Zero BF framework is based on a multi-faceted analysis of each management phase, aimed at getting a clear understanding of the following aspects that may impact management decisions:

- Stakeholder roles and responsibilities
- Spatial and temporal scales
- Key choices
- Information needs
- Key obstacles (including potential liabilities)

Anticipating change and subsequent need for intervention, by being warned in advance of unfavourable developments that bring the risk of BF origination, is one of the means to prevent BFs from emerging –or to at least significantly limit their lifespan. Therefore, a large part of Task 2.2 on monitoring was dedicated to these early indicators.

In the HOMBRE framework, “early warning indicators” are identified that signal whether or not management intervention in the land use cycle is required to prevent a BF being created in the near future. It lists some 40 indicators that in general will be worth considering, but of course will not be equally valuable in all situations. To prioritise on specific indicators and interpret the indicator trends in terms of low, moderate or high risk for BF origination should be the tasks of the person or authority locally in charge of Zero BF management, as these are context dependent questions that require local insight and commitment.

D2.2 therefore focuses on how an adequate selection of BF related (early) indicators could effectively be monitored in practice. Starting from relatively broad categories that influence BF emergence, and that may or may not be relevant in the local context, more specific issues can be identified, leading to a final selection of indicators (Table 2). This line of thinking can also identify additional indicators – outside the suggestions given in the list – that are particular suited for a given municipality or responsible organisation. An important aspect in the selection of early warning indicators for BF emergence is that the information should be easily available, preferably from information sources that are already in use within the organisation.

Relevance and availability are the two main criteria in the selection of early warning indicators.

Specific attention was also given to the role of indicators for monitoring the achievement of land use transition and BF
regeneration projects: service indicators and sustainability indicators (Check Performance phase). Planning the transition to a new land use implies selecting a specific land use, or combination of uses, to deliver specific services (the goods and benefits of the chosen land use, both through protecting or enhancing naturally provided ecosystem services or through technological inputs). The stepwise approach as developed and described by the World Bank was chosen as sufficiently pragmatic, to be a starting point for adapting into a 4-step approach for indicator construction in BF regeneration projects:

1. Agreeing on goals/objectives:
This step will start in the “making the transition” phase as here the societal challenges to be met and also wider sustainability goals are defined by stakeholders.

2. Selecting relevant Service Indicators
A similar approach to that used in selecting the Early Warning Indicators can be followed here, going from broader goals as defined to issues of particular importance, to indicators that are both relevant and practical to monitor.

3. Obtaining baseline data
This is both a test of the ease of monitoring and the clarity of definitions, protocols and other operational aspects as well as setting the baseline with which to compare the forthcoming monitoring data.

4. Defining targets
Using the goals and objectives from step 1 and the baseline data from step 3, realistic targets can be set in terms of upper and/or lower limits for the selected indicators.

The set of Service Indicators may shrink with time, as some may become irrelevant when targets are reached or no further change is anticipated. In the longer term, project based Service Indicator monitoring can be integrated into the more general Early Warning Indicator monitoring, providing information on when –not if- a new Zero BF land management intervention may be called for, which effectively closes the Zero BF land management cycle.

From the various criteria for ‘good’ indicators, especially the CREAM rules of thumb were considered useful in guiding the selection of indicators:

- Clear: precise and unambiguous.
- Relevant: appropriate to the subject at hand.
- Economic: available at a reasonable cost.
- Adequate: provide a sufficient basis to assess performance.
- Monitorable: amenable to independent validation.

In addition to relevance and data availability, the CREAM rules stress cost-efficiency and rigorous definition of indicators.

The Framework and indicators was tested within several HOMBRE cases by workshops and interviews: Jiu (Romania), Solec Kujawski (Poland), Terni (Italy), Genoa (Italy) and Markham Vale (UK).

Task 2.3: Indicators for successful brownfield regeneration.

The third task was meant to identify the main factors that lead to achieve “faster, cost-effective, better integrated and more sustainable renewal”, or in other words: What will lead to successful and sustainable BF regeneration and under which circumstances? Aspects considered relevant a priori were the need to accelerate operations, reduce costs and/or increase benefits of BF regeneration projects, improve fund allocation for BF regeneration, better decision support systems for selecting sustainable new land use, and integration with climate change and other environmental impacts.

With the development of the Zero BF perspective within Task 2.1 and 2.2 focus within HOMBRE shifted from being exclusively on the BF and BF regeneration phase to the land use and land management cycles as a whole. This also influenced the HOMBRE view -the Zero BF's perspective- on what constitutes ‘success’ of BF regeneration. Simultaneous with the HOMBRE project, the concept of Success Factors for BF regeneration was investigated by the FP7 TIMBRE project (Frantál et al., 2012), for the specific case of the regeneration of large scale, complexly contaminated post-industrial BF's (so-called megasites as defined by WELCOME ; Grossman et al., 2006). It was therefore decided to use the results of the FP7 TIMBRE project to support the a priori identified success factors, and to use Task 2.3 and this deliverable to identify if and how the HOMBRE...
concepts, products and results can help to boost these factors in the desired direction.

D2.3 reports on what is needed for successful BF regeneration, presents the strategy for change as developed in HOMBRE, and provides a basic overview of how the HOMBRE concepts, products and results help boost drivers and incentives and contribute to sustainable BF regeneration. It concluded that the basis for successful BF regeneration must be laid in the phase of Making the Transition. As the need for soil and groundwater remediation often is an insufficient driver for BF regeneration, the main driver should be how BF regeneration can be used to contribute to wider societal challenges (current and future challenges, hence sustainable development). Therefore, most of the tools HOMBRE has been developing focus on this Making the Transition phase, aiming to 1) help uncover so far unidentified potential for added value, 2) maximise the benefit/cost ratio (monetary and wider) by linking the services provided by the regenerated BF to site- and area-specific demands, and 3) look for site- and context-specific synergies between different regeneration technologies and between different land uses.

3. Outputs and deliverables

D 2.1 Report describing Early Indicators for Brownfield origination and prevention
D 2.2 Report describing cost effective monitoring within the Circular Land Management Framework
D 2.3 Report describing indicators for successful brownfield regeneration

Furthermore the HOMBRE Zero Brownfield Framework was developed.

Work package 3 BF NAVIGATOR

1. Background
Since BF sites are in most cases difficult to redevelop for many reasons, it is necessary to identify in an early stage how a particular BF site can successfully be redeveloped. To choose the best redevelopment strategies, technologies and approaches for BF redevelopment, there is a need for more elaborate and integrated decision making tools and processes during the planning phase of a BF that help stakeholders to navigate holistically towards a successful BF redevelopment.

2. Purpose and objectives of WP 3 and main outcomes
The main objective for WP 3 is to provide a better planning and more attractive communication technology that allows a more holistic appraisal of BF redevelopment options and early stakeholder involvement.

The BF Navigator (BFN) therefore facilitates interactive stakeholder involvement, which helps to picture planning scenarios and balance the financial viability and conformity of planning objectives with broader sustainability indicators. The BFN is targeted in decision making at the level of area planning, managing a portfolio of sites, or project planning.

The BFN is intended to support the management and the design of BF re-use across a full range of land uses in an integrated way. The BFN supports the design of suitable (combinations of) intervention, regeneration strategies and solutions to meet the requirements of the new use. In case there is no intention to develop any built environment (residential, commercial, infrastructural, etc.) in an area or on a site, the BFN will support the design of alternative or ‘soft’ re-use of the BF.

Ultimately, the BFN will help to obtain an adequate BF redevelopment concept. With the BFN, stakeholders can visualize alternatives of development scenarios and regeneration plans, enabling them to design better balanced combinations of uses that will meet planning objectives and indicators (quicker, cheaper and more sustainable). This will enhance the uptake of BF regeneration projects and therefore prevent urban sprawl.

The main objectives were:
• To set up the BF Navigator framework for successful BF regeneration
• Elaborate tools, concepts into items that fit in the BFN and integration in the framework
• To build and further develop software for the BF Navigator and its items
• Test the BFN and its items and evaluate the test results in case studies
• Make a manual for the BFN in cooperation with WP7 (E-learning)

Task 3.1: Identification and integration of success indicators for BF regeneration into decision support framework

A decisions framework for the Brownfield Navigator (BFN) is set up to facilitate a more holistic appraisal of BF redevelopment opportunities and early stakeholder involvement by offering an attractive online collaboration tool. The decision framework is developed in HOMBRE work package 3, in close cooperation with the work (e.g. tools and concepts developed) of other work packages. Next to regeneration, attention is also paid to the emergence/prevention of BFs. This decision support framework is incorporated in the software tool “the Brownfield Navigator“ (BFN), the ultimate product of work package 3.

The BFN is developed for a “municipal” target group as many BF cases start with the intervention of municipalities or regional authorities. Their actions, or inaction, have a decisive impact on the manner and pace at which brownfield land is brought back into beneficial use, or the degree to which it might remain under-used or derelict.

The decision framework accompanies and supports decision makers, managers and stakeholders through the different management phases in the land cycle. It consists out of three modules, corresponding to the three land management phases: anticipating change, make the transition and check performance. In each module, the BFN offers information, documentation, examples, visualisation possibilities and tools. It offers access to the HOMBRE tools (see figure 2). Although all phases of the land management cycle are represented, the emphasis is on the “make the transition” phase.

The user can use the BFN for different purposes, in different phases of the project and in the order that is suitable for the user. Unique among other online mapping tools, BFN uses the language and provides mapping symbols relevant to land management and land use visioneering. The BFN includes a library of BF redevelopment projects throughout Europe, which include the transitions that were taken up as well as the societal challenges that were dealt with and benefits that were provided. It can also be used in discussions with stakeholders, for example when discussing current situations, ambitions or future land use scenarios. In this case the map-functionality allows users to draw, add notes or symbols and then save and share sketches, which can simplify the production of a spatial overview and record outcomes of discussions.

In cooperation with WP7, the manual (a red line document of the DSS framework and the place of the BFN items in it) and tutorials (“e-learning material”, PowerPoint’s on how to use the BFN and its items) for the BFN were developed. This material was implemented in the BFN in the last software sprint. The “e-learning materials” are part of D7.2 “Networking within technical, scientific and end-user communities, development of training and e-learning materials”

Task 3.2 Development of the BF Navigator

The main activity in this task was to incorporate the BF Navigator Framework, developed in Task 3.1 into software that guides end users through the process of anticipating and accelerating the return of BF to beneficial use and beginning the redevelopment process.

Users can create their own project specific brownfield session in the BFN. The session is secured with a username and a password. Only people provided with this login information can enter the session. In the BFN-session, users can upload and store the BF information: maps, sketches, data, decision made, stakeholder analyses, opportunity plans and feasibility plans. Also research is done in connecting databases and external toolsets to BFN, with boundary conditions and complying to INSPIRE.

The BFN is currently freely available online (bfn.deltares.nl). It can be used on desktop, laptop or tablet computers. The BFN collection of generic tools allows customization for site specific situations and tasks. Since the BFN is based on open Software
architecture users can add functionality (e.g. financial modelling or route visualization).

Task 3.3 Testing the BF Navigator in case studies
For improvement of the decision support framework and its tools, feedback from stakeholders in case studies was needed (bottom-up approach). With workshops and interviews of the stakeholders in different case studies of HOMBRE the successfullness and constrains of BF regeneration in the given case studies is evaluated.

The BFN and its items were tested in workshops at different case studies (HOMBRE cases Genoa (Italy), Solec (Poland), Markham Vale (UK), and additional cases/sites: Rotterdam (The Netherlands), Orléans (France), Meerane (Germany) and by stakeholders in Spain. Because BF redevelopment alone (make the transition phase) can take decades, the BFN could not be tested for the complete phase, let alone for the complete cycle on a case. However, because of the modular set-up of the BFN it was possible to test different BFN items, depending on the phase and dynamics of the case.

Test items in management phase “anticipating brownfield emergence”
The “anticipating BrOWnfield Emergence Tool” (BOWET) summarizes a methodology, including 4 steps and the concept of early warning indicators, to anticipate on brownfield emergence. This method helps to determine and incorporate early warning indicators to detect in time areas that may become brownfields. This method is assessed on feasibility and relevance by applying the method on two European towns in France and Germany. Conclusion was that it is possible to obtain modelling equations to predict brownfield emergence.

Test items in management phase “plan the transition”
The following BFN items were tested in different workshops and cases. This gave different recommendations for the items; however, all items were found useful and easily accessible.

- Map and sketching tool
- Vision, Ambition and societal demand tool
- Bioenergy tool
- Construction and demolition waste flowchart: tested on Spanish cases
- Technology train workshop: tested during a workshop on the HOMBRE case Solec (Poland)
- Example library
- Brownfield Opportunity Matrix: tested on HOMBRE case Markham Vale (UK) and on external HOMBRE case city harbour Merwevierhavens, Rotterdam the Netherlands
- Brownfield Remit response tool: tested on HOMBRE case Markham Vale (UK) and on external HOMBRE case city harbour Merwevierhavens, Rotterdam the Netherlands

The most extensive external test on the overall use of the BFN test was performed by a combined WP3-WPS workshop in Genoa (Italy) with the municipality and the local stakeholder group. In this workshop, the BFN was presented and the following items were tested: Map and Sketching, Example library, Brownfield Opportunity Matrix and Bioenergy tool.

Evaluation of BFN
Stakeholders found the main advantage of the BFN: the easily accessible and understandable content and use of the BFN. The HOMBRE case study partners have reported that using the BFN generated new insights and approaches to their sites and encouraged them to modify their daily practice to a more comprehensive way of BF redevelopment.

What was considered as a point for improvement: the absence of a cost-item. Some valuation, relative or absolute, is a strong requirement for the users. Also some comments were made on the balance between general and site specific items. In many cases more site specific information is needed to be able to apply the items. However, this site specific data makes the BFN also less useable for different areas/regions/countries (e.g. costs are highly site specific, even within member states of the EU). Also language was mentioned to make the tool more useable for the main target group: municipalities, in interaction with...
stakeholders. Currently, the tool and its items are in English.

General recommendation and future development is to focus on more specific versions on the BFN, for member states and maybe even for specific tasks within BFN redevelopment. A challenge is to spend more time on the checking financial viability and conformity of planning objectives with broader sustainability indicators. Integrating costs can also be a very useful aspect in a more specific BFN.

3. Outputs and deliverables

D 3.1: Decision support framework for the successful regeneration of brownfields
D 3.2: Software and procedure of the Brownfield Navigator
D 3.3: Evaluation of test results from the Brownfield Navigator use in case studies

And the online software tool, the BF Navigator bfn.deltares.nl).

Work Package 4 INNOVATIVE BF TECHNOLOGY TRAINS

1. Background

Preventing sites from becoming BF and regenerating existing BF is key to tackling urban sprawl and ensuring a more sustainable built. However, real and perceived barriers make stakeholders choose for the development of greenfields rather than redeveloping BF. One of the reasons is that the planning and execution of the remediation and new land use phase is often separated. This makes that the return of investment for the regeneration/remediation is often not clear, making it unfavourable to execute.

2. Purpose and objectives of WP 4 and main outcomes

The main objective of WP 4 is to achieve better operations, better implementation of state of the art technologies into practice, and to develop innovative Technology Trains for sustainable, cost-effective and timely regeneration of BF’s. Technology Trains are set up by combining different existing technologies that maximise (re-) use of resources to close cycles on Soil, Energy, Water and Materials.

The Technology Train (TT) concept contributes to smoothen the transition from BF to its new functional use by offering a structured way to select technological and non-technological interventions to create optimized added value for the stakeholders and the community at large.

In order to answer the research needs and to meet the objectives a dualistic approach is chosen. On one hand the generic, more abstract research questions will be addressed that will help integration of the different work packages. These relate to the data requirements of the BFN and to the use of the indicators as set in WP2.

On the other hand three specific technology combinations are elaborated to test the generic principles of the Technology Trains both in the laboratory as with the HOMBRE case studies. The three specific Technology Trains are:

1. Energy-water: directed to in situ remediation for BF regeneration in which energy and water reuse is maximized,
2. Building materials-soil: directed to maximizing the reuse of materials and soil,
3. Soil-water: directed to realizing optimal soil and water management conditions.

Task 4.1 In depth analysis and feasibility of the Technology Trains

At present, single-issue approaches are most often applied, that can respond to a site specific need, such as removal of
contamination or waste management, in order to “fix” the site for a specific use or simply to comply with environmental protection legislation (e.g. urgent cases). HOMBRE, and specifically WP4 Innovative BF Technology Trains, pursues the goal of coupling this traditional approach with an approach that is based on identifying the potential services and opportunities that can be offered by the BF itself. In this approach, technology trains (TTs) aim to bridge the gap between available resources or negative valued properties of the brownfield such as contaminated groundwater and required services or positive valued properties such as clean water to regenerate brownfields into a next cycle of valuable land use. TTs also address the issue of closing the water, materials (including soil) and energy cycles, thereby reducing the use of primary resources and making the continuous use of resources more sustainable. Although in many cases single technologies can fulfil this gap, it is expected that combined technologies may offer even better results at more acceptable costs within the desired timeframe.

The general concept of Technology Trains
The TTs provide a quality shift in regeneration of BF’s as they aim to provide simultaneously site specific solutions to identified priorities (e.g. risk management, aesthetic issue, waste problem) and opportunities for third parties to make the best of “resources” and services so far not considered (benefits and value). Inputs towards conceptual approaches of services from TTs have been provided and key elements on operating windows of specific technologies have been provided. Although these aspects make the true assessment of feasibility of technology (trains) very site-specific, the principles (methodology) are much more generic and applicable in any BF.

Generic versus case specific approach
A major difficulty in the design of TTs is the country specific legislation, especially regarding the soil, C&D waste, water and groundwater system. While in some countries (e.g. Netherlands, UK, and Germany) a risk based assessment is accepted, other countries (e.g. Poland, Italy, and Spain) focus on contaminant concentration targets. Also the possibility to use waste on-site or off-site strongly depends on national legislation. The freedom of choosing an optimal remediation or re-use strategy is thereby country specific.

Specific Technology Trains
In addition, the feasibility of the three technology trains (energy/water, soil/materials, and soil/water) was analysed. In deliverable D 4.1 “In depth analysis and feasibility of the Technology Trains”, examples are given that show the application of such technology combinations, suggesting the feasibility of the concepts. However, as explained in the previous section, required technology trains are very site specific due to the combination of location and required services.

Task 4.2 Testing of principle of the Technology Trains
Research on three specific technology combinations is done to demonstrate the surplus of synergy. In addition, by laboratory studies, extreme conditions were tested to determine whether application of these TTs could be established within a wider technological range than was possible before these studies were performed. Although the testing of TTs was not possible on application level, considerable progress was made on the understanding of the technological aspects of the TTs, which helps the implementation of the TTs in other real cases.

Train 1: Energy-Water train.
Aquifer Thermal Energy Storage (ATES) combined with bioremediation of chlorinated ethenes to reduce primary energy demand for buildings and improve aquifer quality.

The extraction and re-infiltration of large volumes of groundwater (more than 50,000 m³ per year per well) for ATES affects the soil chemistry and thereby the redox process. In Fe(III) reducing aquifers, the mobilization of organic compounds improved the bioremediation potential which reduced the need for additional (more costly) interventions. Long term operation of ATES systems therefore contribute to improved groundwater quality.

Lab research resulted in an increased understanding of the relation between the local characteristics of the subsurface like the redox chemistry of the subsoil, and the possibilities to enhance the capacity for attenuation of contaminants in the
groundwater. Further, the relation between design of the buildings and its operation on the performance of the ATES system showed that the technology is technically very robust.

Train 2: Building Materials and Soil train
This train aims to minimise off-site disposal by converting the contaminated soil on site into building and construction materials that can be used on the site itself or the surrounding areas. Research is done in Stabilization /Solidification of contaminated (industrial) soils by carbonation. This combination of remediation and materials manufacture was shown to be a promising approach for obtaining a product with sufficient mechanical strength to be used in civil engineering application and improved physical/chemical behaviour (i.e. minimal leaching). Results were an increased understanding of the relation between initial soil characteristics and additives on the mechanical (strength) and chemical (leaching of metals) properties of the produced aggregates.

Train 3: Soil and Water train:
Reinforce unstable soils by the EcoGrout process. In the EcoGrout process, cementation of soil particles is achieved by reaction between CaCl2 and NaHCO3 which are injected in the aquifer or other porous matrix. The CO2 produced by the EcoGrout reaction may be employed to aid stripping of Volatile Organic Compounds, such as toluene or trichloroethene, from groundwater.

The research resulted in the understanding of applicability criteria to employ EcoGrout on large scale for soil improvement.

Combined Technology Train (TT2 + TT3):
In situ carbonation of alkaline material by the combined EcoGrout-carbonation process
The possibility of applying the carbonation concept (TT2) in the framework of the EcoGrout process (TT3) is intriguing and the proof of concept was positive, but more efforts are required to make it ready for field application and the conditions for its application need to be further investigated.

Technological studies at lab scale showed possibilities for development of the TTs as such. However at present the stage of development for application for TT1 (water and energy) is close to application at full scale, whereas the two other TTs need to overcome some technical drawbacks before application at full scale is possible.

The elaboration of the three technology trains to assess critical design parameters revealed that many technical parameters are available that can be adjusted to optimize its functioning. In general it can be stated that the proposed TTs can all function within a wide range of technological boundary conditions. All TTs can be adjusted in order to meet the required quality of specific end-points. Therefore they provide an excellent ground to build on within the field of BF redevelopment. Here in this study it is shown that the TTs can function in a wide variety of environmental and technological boundaries. In fact the developed TTs can in principle deliver goods and services to meet the basic needs at BFs regarding energy, building materials and water quality.

All performed lab experiments are reported in Deliverable 4.2 Testing of principles and description of critical design parameters of technological and process aspects of the technology trains

Task 4.3 Defining operating windows for Technology Trains
For Task 4.3 a more abstract evaluation of information that is required to be able to select technologies in order to deliver those services and goods that have beneficial value for the transition of the BF itself and the surrounding area (probably on a municipal level) is reported.

The strategy upon TTs starts with the definition and exploration of available resources at a specific BF. In parallel, an inventory is performed on the possible future demands that will show up in the new land use of the BF site and the surrounding areas. With the information that was obtained by assessing the resources and demands of the BF and its surroundings, a first
iterative exercise can be done to estimate the level at which self-sufficiency can be obtained for the different goods and services. Together with the local ambitions regarding (for instance) renewable energy, water management, materials use, environmental quality, and an indication of the timescale at which the redevelopment is implemented, a generic exploration of preferred options can be made: the operating windows within which TTs should be designed. The design of TTs for BF reuse itself, however, needs study for each specific technology to smoothen the transition of the land use at a specific BF into a new land use after redevelopment. Such study can be performed by focus on technology push by showing that a specific technology train can be applied widely, either by technology pull. Within the technology pull type of development the demands and boundary conditions at a specific BF site are dominant in the technology development.

Three TTs were elaborated in order to demonstrate the design of a TT and to inspire stakeholders to include technology experts at an early stage for optimizing technology solutions. The three TTs are characterized by:

1. TTs are directed to fit basic needs and services at BF sites (chosen needs and services are: 1) Energy and water, 2) building material and soils, 3) Soil and water).
2. TTs are directed to combinations of technologies
3. TTs support sustainability, meaning reduction of energy consumption, and thus reduction of Green House Gas emissions, reduction of use of resources like water and primary resources for production of building materials.
4. Design of TTs are the result of technology pull processes and are aiming at to operate at a required operating window that is determined from the balancing of supplies and demands at a specific BF site.

Surprisingly from the case studies it became clear that the technological aspects for the three TTs were not limiting the Operating Window for application of the concept of these TTs. Rather economic, environmental and social aspects seem to determine the Operating Windows for application of TTs in the redevelopment of BF. Without the context in which technological solutions need to be found, technologies cannot be selected nor compared to deliver the required services and goods. System understanding, including planning economy, mass and energy flows, and organizational aspects is, however, an undervalued step in the field of holistic BF remediation.

In short, without a joint understanding of the BF problem and the benefits that are sought for by the stakeholders, optimal technologies cannot be selected as the results that need to be achieved are ill defined. When TTs are integrated in such holistic redevelopment of BF sites, they may enlighten and even speed up the redevelopment from BF sites to new use sites.

Task 4.4 Evaluation of the technology trains

As at each BF site the obstacles and boundary conditions are different, it is unrealistic to formulate a complete list of technologies that can potentially be applied in the redevelopment of brownfield sites. In addition, often technology-push leads to resistance in the redevelopment process. However, it was also recognized by stakeholders of the HOMBRE cases that TTs can play an essential role in the realization of the BF redevelopment.

To overcome the dilemma for either technology push or technology pull approaches a workshop structure was developed to help stakeholders in unlocking hidden values of BF sites with key considerations. These key considerations define the playing field and boundary conditions which technologies have to operate. The considerations are divided into three categories of questions:

1) Local context to define relevant fields for technology trains
   a) What are the early warning indicators for BF site emergence and/or what are the identified barriers for BF redevelopment?
   b) What are the adverse effects if nothing is done on the BF site?
   c) What are the (local) policies on energy supply/ greenhouse gas emission, water quantity, environmental quality, waste handling to establish demand for services?
   d) What are the markets and opportunities in the region for services that can potentially be provided by the brownfield site to define which supply is needed?
2) Defining the scope for technology design: how can technology trains support the redevelopment plan of the BF site in time
a) Application of technologies to enhance the competitiveness of the redeveloped BF compared to greenfield development (e.g. lower remediation and infrastructure or utilities costs during redevelopment and lower energy costs during usage)
b) Application of technologies that contribute to meeting demands (and policy targets) outside the BF site without major investments with respect to:
   i) Energy usage/Greenhouse gases
   ii) Water management
   iii) Water quality
   iv) Noise and visual impact
   v) Risk of accidents
3) Elaborating the technology trains:
   a) How to organise technological interventions during BF redevelopment?
   b) How to organise their financing during BF redevelopment?

Based on the experiences from the cases Solec Kujawski and the Terni-Papigno, it became clear that the Key Considerations helped the end-users to become more aware of the possibilities for redevelopment.

In addition a Construction and Demolition Waste (C&DW) flowchart tool has been developed to support stakeholders in waste management decisions and to assess and promote reusing and recycling C&DW materials in BF regeneration. The C&D waste tool has shown to be very useful for in the tender and offer phase in order to evaluate in the proposal stage the quantification and type of waste that can be generated and proposes alternatives to landfill or specialised manager for the end-use of waste. The tool is available in the BF Navigator.

3. Outputs and deliverables

The following deliverable reports are available:
D 4.1: Report of in Depth Analysis and Feasibility of the Technology Trains
D 4.2: Report of testing of principles and description of critical design parameters of technological and process aspects of the technology trains
D 4.3: Description of Operating Windows for successful implementation of the Technology Trains
D 4.4: Evaluation of technological and process aspects for development of the Zero Brownfield Perspective

Work Package 5 ENABLING BF SOFT RE-USE

1. Background
Brownfields in urban and peri-urban areas for which there is no upmarket need (or solution) may still be rehabilitated to provide important services to assist sustainable urban living. This is of special importance for many depopulating areas that suffer from urban decay (blight) by large tracts of land from former extractive or primary processing industries.

2. Purpose and objectives of WP 5 and main outcomes
The main goal of the project is to reduce the consumption of greenfield land and the production of BF land. This can be achieved by maintaining land in productive use as far as possible, but where it falls out of use, to make sure its transition to a new land use is as rapid as possible. The return to use of land could be for built redevelopment, or for soft end uses such as urban green space. Soft re-use of BF sites, such as for biomass production or green space, can provide services which enhance regeneration, both in their own right and when integrated with hard uses such as for buildings.

The main objective of WP 5 is to provide better and more creative and more creative solutions for long term land use of current and potential future BF’s, by developing and improving methodologies, tools and technologies for BF regeneration into
green uses under the umbrella of the ‘soft re-use’ concept.

The main goals were to:
• Develop and finalize outlines of concepts for the evaluation system for key services and technologies;
• Develop a decision making procedure based on the concepts developed above;
• Assess bio-energy project cases through questionnaire survey and compile key recommendations and guidance for decision making;
• Assess performance of biochar amendments on soil contamination in terms of heavy metal stabilization and effects on phytotoxicity.

The work in this work package is divided in the following four main tasks:

Task 5.1 Prioritisation and development of an evaluation system for key services and technologies

The main aim of this work package is evidencing the whole value of soft re-uses on BF. A valuation frame is provided that identifies and highlights overall benefits of implementing soft re-use through “soft technology trains”. The approach of the system focuses on two principle classes of soft re-uses: 1) open space (i.e. land used for the provision of public amenities like urban parks) and 2) land for biomass and bio-energy production. The approach considers services and sustainability provided by regeneration options as overarching principles for value creation. The exact choice of project services and the most efficient way in which they can be delivered determines the usefulness and hence the value of a redevelopment project. Project designs will likely need to consider a range of synergies, trade-offs and potential net losses:
• Synergy describes the simultaneous enhancement of more than one service, for instance, because improving the value of one service can enhance the value of another service (for example non-food crops can help managing risks associated to soil contamination on a site as well as providing resources for bio-energy production)
• A trade-off refers to the increase of the provisioning of one service that is accompanied by the simultaneous decline of another service at the same location
• A loss describes a situation where two project services are incompatible, and trying to deliver both will result in poorer performance for both.

Overall value
One of the underpinning concepts is that redevelopment projects that deliver a broader range of services have improved overall sustainability and economic value. In specific contexts where the conventional financial benefits of redevelopment are not always easily identifiable, as is the case when BF are to be deployed for soft end-uses, decision-makers should be fully aware of the broader opportunities and benefits that can emerge. Soft re-uses can address not only local but also regional and even global challenges (for example climate change resilience, energy generation, preserving biodiversity, reducing car dependency, offering educational and health facilities). The totality of services delivered by a completed project is seen as the project drivers that incentivise the investment necessary for a redevelopment to take place. This likely depends on a greater value of the regeneration outcome than the value of the investment made. The term overall value is taken to be the incentive for Public and or Private investment in brownfields regeneration, which may be improvements in wider environmental, social or economic value, as well as improvements in direct monetary returns (direct financial value). Overall value can therefore be seen as having three components:
• Direct financial value
• Tangible wider value
• Intangible wider value

Sustainability Linkages
Improving overall value should be a key part of project scoping and design, identifying opportunities for synergies and
additional project services. A holistic approach to understanding project sustainability increases the chances of identifying these opportunities. The concept of “sustainability linkages” can be used to relate project services and project wider effects and facilitate this design and evaluation of designs, guiding stakeholders in decision making all along the life cycle of regeneration projects and land use.

Ideas of “linkages” and conceptual site models widely used in contaminated land risk assessment can be used to provide a tool for crystallising available and relevant information for “sustainability”. The aim is to help stakeholders recognise, prioritise and deal with the management of the sustainability for a particular site and project, and better understand overall value. An iterative development of such a conceptual model is likely to include reviewing initial conditions, identify the most pressing sustainability concerns / opportunities, project design, option appraisal, understanding overall value, implementation, verification and maintenance.

A sustainability linkage is proposed as having three connected components:

• A source (pressure or change): this describes a factor that might cause an effect,
• A mechanism: this describes how harm or benefit might be brought to a particular receptor,
• A receptor which is the constituent of economy, environment or society which could affected by a change / pressure via a mechanism.

All three components need to be connected for a sustainability effect to exist.

This is an iterative discussion process supported by simple tools to help decision makers identify what services they can expect from possible interventions on their site, how these interact and what the initial default design considerations might be. It supports the activities taking place during the pre-exploratory and exploratory stages of decision making, with the objective of improving overall sustainability and value.

Some important drivers for soft re-uses of brownfields can be identified:

• In many European countries, densely urbanised areas still need the development of open spaces. Brownfield sites are potential locations for such open space.
• A renaissance of and innovations in urban gardening, community gardens and urban farming increases demand for urban brownfields.
• Soft re-uses are an option for renewable energy generation (non-food biomass production).
• Soft re-uses, if designed appropriately and sited at strategic locations, represent green infrastructure that offers communities such as mitigation of heat island effects, improved urban comfort.
• Trees can improve urban air quality by filtering and retaining air particles and contaminants generated by traffic and industry as well as providing shade and eye-candy. Green infrastructure provides habitat for migrating birds and other species.
• Many leisure activities are more enjoyable and effective in soft rather than hard landscapes (e.g. Nordic walking, ball games, boot camps, cricket).

The work developed has been compiled in the deliverable D5.1 “Valuation Approach for services from regeneration of Brownfields for soft re-use on a permanent or interim basis”

Task 5.2 Decision support system on soft uses and technologies using the operating window concept

A framework and procedure is developed for evaluating opportunities of BF regeneration into soft re-use considering: (1) the services that can be provided, their wider effects, and any synergies or trade-offs between them; (2) the processes or interventions that might deliver these services; (3) their overall value to a project both directly and considering a wider sustainable development context. The approach taken is an iterative one with explicit use of stakeholder engagement.

The “Brownfield Opportunity Matrix” is a simple Excel based screening tool to help decision makers identify what services they
can get from soft reuse interventions for their site, how these interact and what the initial default design considerations might be. It supports the activities taking place during the pre-exploratory and exploratory stages of decision making, with the objective of improving overall sustainability and value. The brownfield opportunity matrix allows stakeholders to examine opportunities for valorisation of a brownfield site by mapping desired/interesting services against the interventions that can deliver these services.

The matrix essentially maps the services that might add value to a redevelopment project against interventions that can deliver those services, as shown in broad terms in table 3.

The matrix identifies where there are strong synergies between interventions and services, and also the relatively infrequent occurrences of antagonism. Wherever a particular intervention delivers a service, this interaction creates an opportunity to add value. The matrix describes the kinds of value that each opportunity might generate.

The types of value generated by soft re-use considered are:
• Revenue Generation Opportunity
• Natural Capital: developed in a number of ways, including (but not limited to) providing green infrastructure, improvement of the local climate, improvement of water resources and mitigation of contamination (protecting and enhancing local ecosystem/environment).
• Cultural Capital: developed by improving the social environment (by improving the aesthetics of an area and/or creating a sense of place/belonging for e.g.) and can be a direct result of an increase in natural capital.
• Economic Capital – tangibles: e.g. increase of land and property values in the area (feeding back into Cultural Capital) providing benefits to the local community and also the investor.
• Economic Capital – intangibles: benefits that are immeasurable but can include for example, an improvement of the image of the investor (be it a company or individual)

The matrix can be used to map the prospective range of opportunities that might be realised by a brownfield redevelopment project and the projects consequent sources of value. For each opportunity there is a hyperlink to additional information, including a case study. There is also supporting information to describe the various services and interventions listed in the matrix.

Overall the matrix can:
1. Support initial identification or benchmarking of soft re-use options for BFs at an early stage;
2. Support exploratory discussions with interested stakeholders;
3. Provide a framework to describe an initial design concept, in support for example of planning applications;
4. Provide a framework for more detailed sustainability assessment of different re-use combinations, and similarly for cost benefit comparisons.

Task 5.3 Use of bio-energy clusters for linking marginal urban brownfield site re-use with sustainable urban energy

The aim of this task was to explore the use of bio-energy clusters on marginal urban BF sites which are mainly causing significant problems for the urban environment in shrinking regions. Such projects can have wide ranging positive impacts such as bringing degraded urban BFs back into viable use while also possibly providing a new source of sustainable urban energy.

Based on lessons learned from case studies and inputs from third projects a decision guidance tool is developed. It aims to address decision makers in municipalities as well as land owners or local and regional energy suppliers. The report shows that bio-energy production on BFs depends on multiple factors ranging from the surface area of the site (size), quality of soil, site
conditions and the selection of the type of energy plants to be used on site. Biomass production is suited for BF sites with low to medium land recycling costs combined with a low demand for building land within the city and or region (such as is present in shrinking cities). In order to identify the appropriate locations for biomass production and how to best carry it out, various tools and methods for the identification of biomass potentials are elaborated upon.

The developed HOMBRE “Bioenergy Tool” helps guiding decision makers in identifying suitable BF sites for the production of biomass product within their local context. The tool represents a decision tree which presents questions related to the aspects of biomass production on BF sites such as theoretical and technical potential of the site and its qualities, the legal and planning restrictions that apply in the local context, the feasibility of project implementation and the possible duration of the operation. The decision tree presents questions pertaining to these aspects which are to be evaluated on a site by site basis by the user of the tool. A positive answer to all of the questions in the tool leads to the inclusion of the site in the pool of potential sites for biomass production, whereas a negative answer leads to its exclusion. The end product of the tool is a collection of the BF sites in an area which are suitable for biomass production. This information can guide stakeholders in the implementation of biomass production on brownfield sites.

The tool includes experiences from the REJUVENATE project, which created a decision-making framework for biomass production on marginal and degraded land. The REJUVENATE decision framework looks at crop and site suitability, value and project risks associated with biomass production. Both tools are complementary and allow municipal and private stakeholders to select and prepare for the planning of biomass plantations in their individual urban context. Content and key elements of the tool have been validated by pilot plantation and a pilot application in the City of Cottbus. Furthermore, the Bioenergy Tool has direct links to the GREENLAND project, which is concerned with testing gentle remediation options to remove trace elements in contaminated soil through the plantation and management of biomass product. Synergies were identified between the HOMBRE tool’s application on brownfield sites and the GREENLAND activities with the decontamination of brownfield sites.

The specific details of the case studies in Halle and Gelsenkirchen, in addition to the Markham Willows Masterplan, were included in the determination of the criteria for successful biomass production on brownfield sites as defined in the Bioenergy Tool. The examples show the different backgrounds from former mining, industrial and housing areas and their potential for biomass production. The great number of selected site in the Cottbus case study illustrate the need of the tool for the early pre-selection and decision-making on the local level.

The conclusions of the report should help to consider the appraisal of biomass within their own region by addressing:

• Considerations of the context and examples to biomass production in urban locations
• Illustration of the different decision tool concepts for determining land potential
• A specifically tailored decision-tool for the production of biomass and bio-energy on BF sites
• Landscaping as a factor of value creation in Brownfield regeneration for biomass production

Ideally, with help of this guidance, stakeholders are encouraged to explore the local potential for bio-energy production on unused and underused sites to combine the objectives of urban development with biomass production for sustainable energy use in European cities.

Task 5.4 Technology development: optimising two important low input technologies for greening urban brownfield (operating window investigation)

At BF sites, soil functionality may be limited for one or more of a number of reasons i.e. poor soil ecology, poor chemical soil quality, soil contamination etc. In order to overcome limitations of soil functionalities, a series of interventions may be considered depending on the soft re-use envisaged:

• Engineering works
• Remediation of contamination in soil / groundwater
• Management of soil
• Cultivation of plant cover

In the field of soil remediation conflicts can occur between the needs of soil remediation and soil restoration (soil functionality). Intensive remediation techniques with a strong impact on soils (for example changing pH, removing organic matter, removing soil, heating or solidifying) are not consistent with maintaining and improving soil functionality.

This activity is focused on refining knowledge on operating window for two soft technologies for greening urban BF, i.e. enable BF soft re-use:
1. Biochar and other in situ stabilisation agents
2. Organic matter recycling

These are examples of two important low input technology groups for regenerating BF, supporting specific soil functionality and risk management on site, as well as providing wider environmental benefits (e.g. carbon sequestration). Research is done by using existing literature regarding these technologies and their potential uses, as well as their advantages and disadvantages for utilisation in greening urban BF, and several experimental studies involving the investigation of biochar and recycled organic wastes as potential methods for remediating soil contaminated with copper.

Biochar
Biochar is the carbon-rich end product of the pyrolysis of biomass. General properties of biochar include a high carbon content and high porosity. Amongst other uses, it has been suggested that biochar can be used for carbon sequestration, pollution remediation and recycling of agricultural wastes. There are strong suggestions that biochar may be applied as an amendment to soil. In this application, biochar may provide both cultivation improvements (through nutrient provision, improved water retention and pH control) and immobilisation of soil contaminants. Soil structure, nutrient availability, pH and water retention may all be improved through biochar addition to soil.

Recycled Organic Matter
Recycled organic matter (ROM) can be derived from multiple organic waste sources and can be tailored to suit a specific purpose. Organic waste is biodegradable and may include household and commercial sources. As a soil amendment, input of ROM can improve biomass growth on BF sites, through the improvement of soil conditions and can also be utilised in soil forming. ROM increases nutrient availability, improves soil structure and can increase soil functioning through stimulation of microbial activity. Further, applying ROM to land could increase the amount of carbon stored in soils and so contribute to the reduction of greenhouse gas emissions (therefore helping to mitigate climate change).

Experimental studies
As trace elements are very persistent in the environment and traditional methods of remediation (e.g. involving soil removal and replacement) are often costly, it is important that innovative methods of remediation for trace element contaminated soils are developed. Experimental studies were carried out on the promising combination of biochar and ROM to immobilise trace elements and facilitate revegetation. Several biochars and green waste composts as single and combined amendments were tested for the treatment of a copper contaminated soil.

Experimental work was undertaken as a collaboration between the Greenland project (FP7-KBBE-266124) and HOMBRE. The scoping study examined the effects of compost and biochar, applied both exclusively and combined, on the leachability of copper in the soil and the soil’s phytotoxicity. A series of progressively more detailed leach tests was carried out, alongside a plant trial to establish a “ball park” effective range for the amendments. The detailed study investigated the use of three different biochars as single amendments and in combination with green waste compost on the mobility and phytotoxicity of copper in soil.
The results of the experimental studies demonstrated that mobility and phytotoxicity of copper was reduced in amended soils, with both biochar as a single amendment and in combination with compost proving successful in this capacity. These results were attributed to various factors associated with biochar and compost amendments, including increased sorption sites for soil contaminants, increased pH (decreasing copper availability, and in turn phytotoxicity) and increased nutrient provision (aiding plant growth). It could therefore be concluded that biochar and compost can be used successfully to aid remediation of a copper contaminated site. The amendments can also be used in combination with phytoremediation to further decrease pollution risks and potentially provide a saleable energy crop.

Operating Windows
To help stakeholders establish if ROM and biochar as soil amendments are suitable for risk management and the provision of sought-after additional services, “high level” and “detailed” operating windows have been developed. Operating windows can be used to establish if a particular remediation option may be suitable for use on a site, however further expert advice must be sought to develop a detailed remediation plan ensuring sufficient risk management can be provided by the selected remediation option(s). These are explained in detail in the report.

Recommendations
There is scope for biochar and compost to be successfully used in BF regeneration to soft end-uses. However, more research is required to further establish the detailed operating windows of these amendments and to more clearly define the influence of different feedstock materials on biochar and ROM properties.

3. Outputs and deliverables

D5.1 Valuation Approach for services from regeneration of Brownfields for soft re-use on a permanent or interim basis
D5.2 Decision support system on soft reuses
D5.3 Use of bio-energy clusters for linking marginal urban brownfield site re-use with sustainable urban energy
D 5.4 Operating Windows of Two Important Low Input Technologies for Greening Urban Brownfield

Work Package 6 HOLISTIC FRAMEWORK FOR ZERO BROWNFIELDS PERSPECTIVE

1. Background
In the HOMBRE project the Zero BF Framework is developed and a wide range of tools, concepts and methodologies to support the Framework were developed. WP 6 is an overarching work package that integrates the results from all the work packages into Holistic Framework of BF Regeneration.

2. Purpose and objectives of WP6 and main outcomes
The general objective of WP6 is to integrate the results from all the work packages into Holistic Framework of BF Regeneration. In addition, an integrated systems framework is developed for BF regeneration, based on the outcomes of the other WPs.

Actions and findings from each case study has been synthesised to produce a coherent overview of the HOMBRE activities at each HOMBRE case study. The work of WP 2-6 was applied to different case studies to identify where cost and time savings could be made. In the main it was found that HOMBRE tools and processes served to inform stakeholders about good redevelopment practice across Europe.

Also a Policy Brief is set up with the main outputs of HOMBRE and a synthesis of sustainability recommendation for application in BF policy.

Task 6.2 Production of BR2 systems tool for analysing brownfield systems
The ‘Brownfield REMIT/RESPONSE (BR2) tool is a systems based analysis tool which allows a deeper understanding of an urban system and supports the comparison of the impacts and weaknesses of different redevelopment options for a site. The interacting network of population, environment, economy and regulation in an urban area constitutes a complex system. When deciding between potential futures uses for a site, particularly a long-term brownfield site, it is important to consider, not just each potential use in isolation but also the site’s place within the wider urban system and whether that new use would work with or against that system.

The BR2 technique utilises a matrix-based systems analysis approach which a cross-section of stakeholders populate and analyse in order to compare potential re-use scenarios, assessing how each would interact with the prevailing urban system: identifying likely problem areas and bottlenecks affecting the ultimate success of the project, and whether the project itself fits within the system or is disconnected from it. Within agreed system boundaries (for example: within a particular planning authority’s boundaries) BR2 divides the system into a number of generic urban system components: Biodiversity, Natural Environment, Built Environment, Demographics, Quality of Life, Public Economic, Private Economic, Individual Economic, Local Institutional Controls, Central/EU Institutional Controls.

Relationships between pairs of components are considered sequentially and scored according to importance to the system and the site, initially using simple binary coding where a ‘1’ indicates that one component affects another and a ‘0’ indicates no effect, along with justification for the designation. Semi-quantitative scoring systems are then used so that the relative importance of each interaction and whether the effect is positive or negative is captured for a further analysis.

BR2 uses these scores to populate a matrix. Each row and each column of the matrix are summed and these represent the particular component’s effect on the system (row, termed ‘CAUSE’) and the system’s effect on the component (column, ‘EFFECT’). Plots of Cause versus Effect are then produced (C,E plots) (figure 5). The position of each component on the chart and how its position changes for each potential re-use scenario is used to determine the interactivity of the whole system and of each individual component and hence how vulnerable the system is to change. The dominance of a component in the system and its critical relationships are then used to indicate potential weaknesses.

An operations manual was also produced which guides users through the process and directs the interpretation of the outputs. Those who tested the tool, chiefly the stakeholders at Markham Vale case study, also remarked on the value of the process in completing an assessment – either as a means to facilitate stakeholder engagement, or to communicate options to stakeholders.

Task 6.3 Demonstration of the efficiency savings adopting the framework would have delivered for the HOMBRE case studies

Actions and findings from each case study has been synthesised to produce a coherent overview of the HOMBRE activities at each HOMBRE case study. The work of WP 2-6 was applied to the case studies to identify where cost and time savings could be made. In the main it was found that HOMBRE tools and processes served to inform stakeholders about good redevelopment practice across Europe. Perhaps more importantly, the tools applied were found to facilitate communication and dialogue between stakeholders, perhaps structuring and focussing discussions, which could potentially lead to mutually acceptable and timely agreement on redevelopment plans.

The HOMBRE tools and approaches were developed and tested on seven suitable BF case studies sites distributed across Europe and represented a range of former uses: Markham Vale (UK) a former colliery, Genoa and Terni (Italy): an industrial waterway and former steelworks and a former industrial plant and landfill respectively, Gelsenkirchen and Halle (Germany): a former colliery and a former housing estate, Solec (Poland) a timber treatment works and Craiova (Rumania): lignite mining and power station fly-ash dump. The sites also vary in their position in the land use cycle, additionally; the regulatory regimes vary (Figure 7).
Sites were selected to address both technical and managerial issues, for example, Markham Vale concerned management in the selection of soft-end use (BOM) and assessment of system response to regeneration (BR2) while the German case studies focused on soft re-use. The on-going contamination issues at Solec were used to examine the application of technology trains, while the diverse stakeholder views at the Genoa site was used to test the application of the BFN and circular land management and early warning indicators were examined at Terni.

Report D6.3 brings together the activities of the case studies to show where and how the HOMBRE tools and principles were tested. An overview of each case study and description which tools were applied and how successful those tools were found to be along with the lessons learned and thoughts future directions is given. Not all objectives could be realised, for example sites were in the main already in the transition phase and thus HOMBRE tools and concepts were applied retrospectively. So, while this meant that conclusions from tools could be validated to some extent in those cases HOMBRE could add little value some of the sites in question. However, the stakeholders involved in those sites were able to indicate the potential usefulness of the tools if they were available from the outset, and many expressed interest in maintaining contact with HOMBRE partners and using the tools and concepts in future projects.

Task 6.4 Production of a synthesis of sustainability recommendations for application in brownfields policy

Main take home messages:
1. Europe’s urban brownfield sites are valuable latent resources
2. Urban land use decisions should be expected to deliver a clear ‘Return on Investment’ (RoI)
3. Understanding urban systems in terms of their environmental, social, economic and governance performance is an essential part of sustainable urban land management
4. Looking for new opportunities with a future long perspective in mind
5. Multiple land uses are both possible and most likely to deliver adequate RoI
6. Implementing (sub) surface technologies in serial or parallel can uplift RoI
7. Multiple soft end uses can deliver multiple services and uplift RoI for land unsuited or unneeded for hard development
8. Online map tools can assist local stakeholders identify creative land use options

3. Outputs and deliverables
Three main deliverables arise from WP6. These comprise:
D6.2 Integrated Framework for systematic evaluation of brownfield regeneration
D6.3 Demonstration of the efficiency savings adopting this framework would have delivered for the HOMBRE case studies
D 6.4 Profitable places for people: Policy priority or political pipe-dream?

Potential Impact:
Benefits of the project

The HOMBRE project supported European policy on Resource Efficient Europe, to limit land take and promote the re-use of land in already built-up areas, through research aimed at preventing sites becoming brownfields and regenerating existing brownfields. HOMBRE aligns itself with the integrated perspective on land is a multi-purpose resource and also recognises the important role played by actors on the European level influencing land use and its management.

The project included the development of a Framework including supporting tools and methodologies that can be used to benefit communities, to prevent and redevelop already formed brownfields. The project included case-studies across a range of countries, and encouraged integration of the work with environmental scientists, planners and policy makers across Europe.

HOMBRE fosters a shift in mindset from contemplating brownfield restoration, which basically looks back on what has been
lost, to brownfield redevelopment, taking a forward looking perspective of new opportunities for future developments. With changing societal needs, restoring in the past may not be a sustainable solution.

One of the major developments was decoupling the land management cycle from the land use cycle, as land use and land management each have their own tempo and do not – and need not- necessarily run at the same pace. Land management is not only needed during the Transition phase, but also during anticipating change and checking the performance. Together, these phases provide management continuity throughout the life cycle of urban land use and should shorten the time land lies idle or underused. To close the cycle, two methods are developed to identify early warning indicators and service indicators and how to monitor them. Setting up these pre and post transition monitoring ensures early awareness and looking forward perspective.

HOMBRE argues that a clearer vision on what the brownfield site has to offer in responding to current and emerging societal challenges would help overcome such barriers. The project has developed tools and techniques that help uncovering this potential of brownfields to provide beneficial services anew and help develop a vision for overall sustainable urban development and successful social redevelopment.

This includes tools to explore possible synergies between decommissioning, remediation and site redevelopment. A generic concept for setting up Technology Trains is developed, to determine how the specific brownfield site can best contribute to sustainable development, according to stakeholders, depending on the societal challenges to be addressed, what resources and services the site has to offer and what development actions or interventions are feasible and how they will affect the wider urban system. Three specific technology trains, as examples, have been developed that combine remediation with the provision of new useful services such as energy generation, space creation or materials recovery.

Decision guidance is developed to improve the use of soft re-use with BF redevelopment, by improving the overall sustainability and value. This is based on iterative discussion process supported by simple tools to help decision makers identify what services they can expect from possible (green) interventions on their site, how these interact and what the initial default design considerations might be. It supports the activities taking place during the pre-exploratory and exploratory phase staged of decision making. Furthermore an in depth study has been done about the combination of greening a brownfield and improving the soil quality by gentle remediation.

An online decision support tool is developed, the Brownfield Navigator, which guides end users through the process of anticipating and accelerating the return of the brownfield to beneficial use and beginning the redevelopment process. The life cycle of urban land use and the associated management cycle are at the core of the BFN and the results of the different project elements are comprehensively included.

Communication and dissemination has been a core-activity to create benefits from the project. Organising the Cabernet2014 conference, in cooperation with other EU projects TIMBRE, Greenland and GloCom, has created significant impacts. The conference was attended by more than 140 people (policy-makers, practitioners, researchers) from the EU and outside. Additional, a business plan is set up to ensure that the envisaged project results will be used in “the life after the project”. Also a CEN Workshop Agreement (CWA) is established within the project, the HOMBRE CEN Workshop Agreement 74 “Glossary of Terms for Holistic Management of Brownfield Regeneration”. This is a technical agreement, developed by an open workshop structure within the framework of CEN. E-learning materials are developed for the Brownfield Navigator (BFN) as self-explaining presentations on how to use the BFN. The e-learning modules are available and can be downloaded from the BFN (bfn.deltares.nl). A policy brief on environmental policy-related results is available containing the mean messages taken from the project results.

Europe’s policy of creative, stable and eco-efficient cities is nearer to being realised because of the deeper understanding and more sophisticated solution HOMBRE has developed. Previous approaches to the built environment have revolved around a
general linear pattern of land use based on a ‘consume & dispose’ approach to construction materials. Once buildings came to the end of their useful life, they would lie vacant or be demolished and most of the resulting debris would be discarded. A life cycle approach to both land use and resource stewardship is emerging in both land and construction materials. The HOMBRE results support the reduction of urban-industrial land consumption.

Target groups

The core of the stakeholder involvement is the HOMBRE partners, case-owners and Advisory Board. They encompassed a wide range of stakeholders and end-users, such as public authorities, construction companies, ministry, industries, planners and organisations or universities involved in urban land management.

The Advisory Board was staffed by international experts on all aspects of BF regeneration. The members are from authoritative international networks like Common Forum, Cabernet, Nicole, from governmental authorities US EPA, IHOB and from industry Taylor Wimpey and AXA Risk and Claims Services. To ensure that the outcomes of the HOMBRE project are optimal and successful, an internal review by the partners and advisory board (AB) were performed planned at midterm and at the end of the project. Main conclusion was that the applicability of the in HOMBRE developed tools, technologies and strategies and the balance between innovation and practical are rated good-average. Also the dissemination activities are mainly rated between good-average.

Two project-wide workshops were held and all the HOMBRE members were invited to participate in the start phase as well as during the project in the definition or refinement of the key results and products from the project as well as in the definition of pilot activities. Additional case-specific workshops were held with representatives of the public authorities and other stakeholders. The involvement of case-owners and Advisory Board members in the work and the feedback received ensured that HOMBRE produced results as close as possible to the end-users needs and with a high degree of practical applicability. This in turn, supports widespread uptake and acceptance of the methods, tools and technologies developed in the project.

HOMBRE also realized the coordination with projects FP7 TIMBRE265364) and Greenland FP7-KBBE-266124.

Dissemination channels

A wide range of activities are necessary for the efficient and effective communication on the HOMBRE-project and its outcomes. The project-website is seen as core to internal and external communication.

Different audiences for communication are taken into account. For the HOMBRE project these are:
- The project participants
- Stakeholders (managing authorities, pilot projects, constructors, consultants).
- Public authorities
- The academic community (for educational training)
- The general public

The language of communication is in all instances English.

The table 4 gives an overview of the channels used for dissemination and the target groups that correspond with these channels.

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<th>Target Group</th>
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HOMBRE Identity
A suitable and attractive logo was created to firmly establish HOMBRE’s identity and visibility and templates helped create output supporting the project-identity (Figure 8). This logo is consistently used in all dissemination products such as presentations, the website, flyers and brochure, and project reports.

HOMBRE Flyer and Brochure
In total 3 issues of the HOMBRE newsletter and 3 issues of HOMBRE Brochure were published and distributed to approximately 1,300 readers electronically and could also be downloaded from the website. The newsletters introduced case studies of HOMBRE, informed also about HOMBRE (related) events such as the HOMBRE General Assembly and AquaConSoil, as well as about current HOMBRE activities (e.g. CEN Workshop) and a list of the participating institutions. The brochures contained information about the main results achieved and progress made of the HOMBRE project.

Training/ e-learning materials
E-learning materials (PowerPoint presentations) are developed based on the Brownfield Navigator (BFN) as self-explaining presentations on how to use the BFN. The 19 modules comprise an introduction to the background of HOMBRE and the technical use, i.e. an explanation of the general items that the BFN contains and guidance on how to use them. They show the users how he could apply the specific HOMBRE tools (e.g. Brownfield Opportunity Matrix, BR2 tool) for the challenges they face with their specific sites. The e-learning modules are available and can be downloaded from the BFN. In addition, a “red line document“ on the BFN is developed that provides a more detailed background of the different tools and methodologies (items) that are integrated in the BFN.

HOMBRE website
The HOMBRE website is the primary entry point to get to know HOMBRE. The following domain name has been registered: http://www.zerobrownfields.eu/

The HOMBRE website has been made available to the project participants and public early in the project and is in full working order. It will be maintained into 2016.

INTRANET (restricted section): The restricted section contains an archive of the official documents and information related to the project. This includes minutes of meetings, progress reports and overview reports.

EXTRANET (public section): The public section of the website is a powerful dissemination tool, in fact, the visitors is having free access to a selection of papers published related to the project and presentations from scientific conferences, general information on the project and the consortium, and newsletters. In the same area is included a list of disseminations done (events, articles, video etc.) and a list of disseminations planned: this will give the possibility to the interested visitors to recover information on the past and to plan the future participation to events in order to meet personally a HOMBRE representative.

The public section of HOMBRE website is also available for e-learning and external training, in other words training outside the Consortium: through EU Universities, the new technologies will be disseminated to the next generation and they will spread
horizontally the knowledge into other sectors.

Networking within technical, scientific and end user communities
The HOMBRE project is represented at several networks such as NICOLE, CABERNET, ICCL, Common Forum, INTERREG/URBACT networks, EUREGIA, to raise awareness of the existence of the developments. Several presentations about the project are given at these networks.

CEN Workshop Agreement (CWA)
The CEN Workshop Agreement (CWA) is a technical agreement, developed by an open workshop structure within the framework of CEN. It reflects the consensus of identified individuals and organisations responsible for its content. HOMBRE CEN Workshop 74 “Glossary of Terms for Holistic Management of Brownfield Regeneration” provides a concept that supports the implementation of the Zero Brownfield concept beyond the project.

Exploitable results
General
In this section the exploitable results of the HOMBRE project are addressed.
All commercial participants will be exploiters and end-users of the knowledge generated in the project. The research institutes integrate the new knowledge into their ongoing long-term research programmes and improve their specialized consultancy work on urban land management. The industrial partners and SMEs create new opportunities using the newly developed technologies and concepts for the development of new urban land management products and market opportunities in the field of brownfield redevelopment and urban planning.

The detailed descriptions of the products can be found on the website (http://www.zerobrownfields.eu) and contain:
- project outputs incl. all deliverable reports
- project documents
- presentation and proceedings of the Cabernet 2014/HOMBRE final conference

Exploitation of the results is basically open to any practitioner in the field of urban land management through access to the public deliverable reports. All deliverable reports are relevant in this respect, but it is expected especially that the Brownfield Navigator (www.bfn.deltares.nl) incl. the e-learning materials and red-line documents will contribute to the exploitation of project specific results.

The project activities and results have also clearly led to building a more extensive and active network in urban land management as can be seen from the organization of Cabernet 2014/ HOMBRE Final conference, as well as the HOMBRE+ Business Plan describing how the project results together with the knowledge of the HOMBRE+ (expert) network can be beneficially used and exploited after the end of the HOMBRE project.

Management of Knowledge and Intellectual Property by the consortium
The knowledge generated within the scope of the project has been recorded in the reports delivered to the European Commission, but also in the project files with the consolidated detailed information over the whole duration of the project (intranet and ftp-files). The management of this knowledge and IP is regulated by the Consortium Agreement (CA) which covers the following:
• Where no joint ownership agreement has been concluded, each of the joint owners shall be entitled to use their jointly owned foreground on a royalty-free basis and without requiring the prior consent of the other joint owners.
• To date no patents have arisen from the project, but these would belong to those giving origin to the inventive step as far as it originates from a participating company.

Exploitation of the individual consortium partners is expected according to the following.
DELTARES, as a research institute and specialized consultancy firm, benefits from the entire range of developments in this project; these contribute to their long-term research programmes on urban land management and adaptive cities. Deltares works for and cooperates with Dutch government, provinces and water boards, international governments, knowledge institutes and commercial clients on urban land management, and the challenges in physical planning, design and management of brownfields, and river basins and the use of nature-based solutions. This encompasses all aspects treated in the project from the Zero BF Framework including the indicators and monitoring, the online tool the BF Navigator, setting up and developing technology trains and soft re-use possibilities. HOMBRE enhances the consultancy capacities by widening the portfolio of products and potential measures in urban land management and BF prevention that can be offered to their clients.

FUNDACION TECNALIA RESEARCH & INNOVATION, as a private, non-profit research organisation in supporting enterprises and administration bodies in their technological and innovation needs, will use the overall HOMBRE Zero BF Framework concept and the developed concepts on technology trains and soft re-use to support decision taking activities of the administration and industries in sustainable management of land/soil in urban environments.

BUREAU DE RECHERCHES GÉOLOGIQUES ET MINIÈRES/BRGM, as a French Public Institution responsible for mobilizing the Earth Sciences in the sustainable management of natural resources, it has a pivotal role the field of contaminated lands and soils. They will apply the developed land use and land management concept and the knowledge and tool developed on Early Warning Indicators.

ACCIONA INFRAESTRUCTURAS, a construction company, have been working for last decades to make its business a way of improving the quality of life of the citizens following the concept of sustainable development. In this project, a tool and research has been performed about re-using construction and demolition waste. The tool will be used in their tender and offer phase in order to evaluate in the proposal stage the quantification and type of waste that can be generated and proposes alternatives to landfill or specialised manager for the end-use of waste.

DEHEMA, is an interdisciplinary non-profit society supporting research, technological progress and technology implementation in i.e. the fields of environmental protection, evaluation and remediation of contaminated soil and groundwater systems. Outputs of the project will be disseminated to interested parties. Advanced knowledge of the urban land management concept and the developed supporting tools and strategies has value for future research projects.

PROJEKTGRUPPE STADT+ ENTWICKLUNG, are participating in HOMBRE as specialists in urban planning and in the circular land management philosophy. The developed knowledge and tools on circular urban land management and land use will be applied in their work for advising local, regional and national and international clients, in the fields of environmental and urban planning. Furthermore the knowledge about the use of biomass for BF redevelopment shall be used to advise commercial and governmental parties about the possibilities for BF redevelopment.

PN STUDIO, as SME in environmental and landscape planning, they advise for example the Municipality of Genoa in land management. The knowledge and tools developed in WP 5 and WP 3 about soft re-use and the BF Navigator will be used in their design and consultancy projects.

r³ ENVIRONMENTAL TECHNOLOGY LTD , is an specialist research consultancy and SME in brownfield and contaminated land re-use. The results of WP5 will be used in future technical consultancy, product development, research and in feasibility studies for various clients (e.g. governmental, industries). r³ will also develop the ideas of “Brownfield Opportunity Matrix” and the concepts of overall value and sustainability linkages with external academic and implementation partners in the UK and other countries to develop additional research, development and demonstration projects.

UNIVERSITY OF ROME “TOR VERGATA”, will continue their research in waste management and waste treatment technologies, carbon dioxide capture and storage and contaminated soil and groundwater management and remediation. Research on the possibilities of re-using (contaminated) soil for building materials and applying the technology train concept will be continued.

AGH - UNIVERSITY OF SCIENCE AND TECHNOLOGY will continue research in in hydrogeological and hydrochemical investigations of groundwater resources. As they have a leading role in formulating the concept of management and protection of groundwater basins, the overall knowledge developed in the project can be used for their role in advising local authorities concerning land and water management.

WAGENINGEN UNIVERSITY, will continue their research on developing and evaluating environmental technologies and concepts based on processes from nature, to recover and reuse essential components and maintain and create a viable environment. The concept Technology Trains will be used in research for technology combinations and implementation.
UNIVERSITY OF NOTTINGHAM, the School of Geography, undertakes both research and consultancy within the field of sustainable remediation and urban land management. Concepts and tools developed in the project will be used in further research and courses.

GEO-LOGIK, is a SME consultancy, specialized in consultancy in soil and groundwater for projects for regional and local authorities in rehabilitation work, remediation, monitoring programmes, investigation works, soil and water sampling and chemical analysis. Especially the knowledge developed in WP4 will be used in future remediation/ redevelopment projects, where clients have new strategies reached how to redevelop their site.

TOV TNO, as an independent and not-for-profit organisation it is primarily concerned with the application of knowledge to improve the competitiveness of companies and to assist governments with policy matters. Knowledge developed in WP3 will be used in further development of the Urban Strategy tool.

List of Websites:

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Related information

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Subjects

Environmental Protection

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