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HOMBRE

"Holistic Management of Brownfield Regeneration"

D 2.3: Successful Brownfield Regeneration

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Disclaimer

Summary

HOMBRE deliverable D2.3 reports on what is needed for successful brownfield (BF) regeneration (Task 2.3). It 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.

The HOMBRE Zero Brownfields perspective starts with the land use cycle, which considers developed land as a resource in a continuous rotation of development, use, abandonment, redevelopment and re-use. The basic land use cycle according to HOMBRE consists of two phases: a *Use* phase and a *Transition* phase. The various phases of developed land management - from the administrative viewpoint - also interlink into a continuous cycle, aimed at facilitating a smooth transition to new beneficial land use and preventing unnecessary BF emergence.

The land management cycle is decoupled from the physical land use cycle, as more than one management cycle may run at the same time. Early Indicators, that reflect changes in the balance between costs and benefits (economic, environmental or social) of current land use, are used to *Anticipate* and adequately react to *Change* at an early stage. Service Indicators, defined for the planned land use transition, are monitored to *Check* the *Performance* of the specific services delivered by the land use realised or by technologies or technology trains utilised in the realisation of that land use. They promote a forward looking perspective and help prevent that benefits of land use transitions are too short-lived.

The basis for successful BF regeneration must be laid in the *Making* of *the Transition*. The inventory of success factors for BF regeneration, as made by the sister project TIMBRE[1], once more showed that the need for soil and groundwater remediation often is insufficient as a driver for BF regeneration. The main issue is how BF regeneration can be used to answer or contribute to societal challenges (current and future challenges, hence sustainable development). Therefore, HOMBRE has been developing option appraisal tools and technologies that 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. These tools are:

- Brownfield Navigator (BFN)
- Brownfield Remit Response (BR2)
- Opportunity Matrix (OM)
- Systems Exploration Environment & Subsurface (SEES)
- Decision tree for biomass on brownfields (BoB)
- Sustainability Linkages (SL)
- Technology Trains (TT)

In section 4.2 of this report, their approach for enhanced added value in BF regeneration is briefly described, with reference to the HOMBRE deliverables in which they are detailed.

[1] *Tailored Improvement of Brownfield Regeneration in Europe* (www.timbre-project.eu), project granted under the same FP7 call as HOMBRE

Contents

1 Introduction

This HOMBRE deliverable reports on what is needed for successful brownfield (BF) regeneration (Task 2.3). It 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.

1.1 The roadmap for Zero Brownfields

Brownfields (BFs) 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 (Ferber et al, 2006; http://www.cabernet.org.uk).

As laid out at the start of the HOMBRE project, *preventing* sites from becoming BFs and *regenerating* existing BFs is key to tackling urban sprawl and ensuring a more sustainable built environment. Urban sprawl creates an expensive infrastructure and ever increasing commuting population; prevention and re-use of BFs in an urban environment both aids in reducing our carbon footprint as in enhancing the well-being of the population. This challenge calls for innovative approaches that minimise the costs and maximise the benefits from the re-use of BFs or sites at risk of becoming BFs.

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 regeneration, tackling urban sprawl, and ensuring a more sustainable built environment. The WP was divided into three tasks:

Task 2.1. Early indicators and key factors of BF origination,
Task 2.2. Cost effective monitoring system and approaches to follow different stages of BFs,
Task 2.3. Indicators for successful BF regeneration.

Work for the first two tasks has focussed on the development of the overall framework for circular land management from a Zero Brownfields perspective, resulting in two preceding deliverables. In D2.1: *Early Indicators for Brownfield origination* (Ellen et al., 2013a), we presented as the first part of this framework a set of around 40 'early indicators' - identified through literature review - that could aid in anticipating BF formation and related problems in an early stage. The rationale behind the selected indicators was further worked out in D2.2: *Cost effective monitoring within the Circular Land Management Framework* (Ellen et al., 2013b). The specific role and position of the early indicators within the overall management framework was also detailed. In addition, D2.2 provided guidelines for selecting and developing case specific indicators, from the viewpoint of both indicator relevance and cost-effective data acquisition (monitoring).

1.2 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"[1], or in other words: What will lead

[1] Annex I to HOMBRE Grant Agreement 265097

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 Brownfields 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 Brownfields 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 TIMBRE[2] project (Frantál et al., 2012), for the specific case of the regeneration of large scale, complexly contaminated post-industrial BFs (so-called megasites as defined by WELCOME[3]; Grossman et al., 20063). It was therefore decided to use the results of the 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.

Other projects and initiatives that also considered how to improve the outcomes of BF regeneration and contaminated land remediation and make it more sustainable are for example RESCUE (Edwards et al., 2005) and CL:AIRE/SuRF-UK (CL:AIRE, 2009). Their focus is on sustainability assessment of planned regeneration projects, hence on more adequately defining what will be success. The interest of both TIMBRE and HOMBRE is in what conditions favour successful BF regeneration -ideally hoping to find ways to influence them for the better-, hence on *facilitating* success. To optimise the sustainability of a BF regeneration project (through a sustainability assessment of the various options), conditions to start up a project and get stakeholders together etc. need to be in place first. Within the context of HOMBRE WP2, defining success was covered in D2.2 (Ellen et al., 2013b) when discussing site specific service indicators. In this deliverable, we want to show *how* HOMBRE thinks this, and other decision making, can be supported/facilitated.

1.3 This report

This report starts with a recapitulation of the Zero Brownfields framework as developed so far within the HOMBRE project (Chapter 2). In Chapter 3, the main results on success factors for BF regeneration from the TIMBRE project are summarised. Chapter 4 specifically goes into the HOMBRE Zero Brownfields perspective on success of BF regeneration' and shows how the strategy developed within HOMBRE enables change to happen and thereby delivers sustainable enhancement for a BF impacted area. Concluding remarks are given in Chapter 5.

[2] *Tailored Improvement of Brownfield Regeneration in Europe* (www.timbre-project.eu), project granted under the same FP7 call as HOMBRE

[3] Water, Environment, Landscape Management at Contaminated **Megasites**

2 The Zero Brownfields perspective

2.1 Overall framework

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.

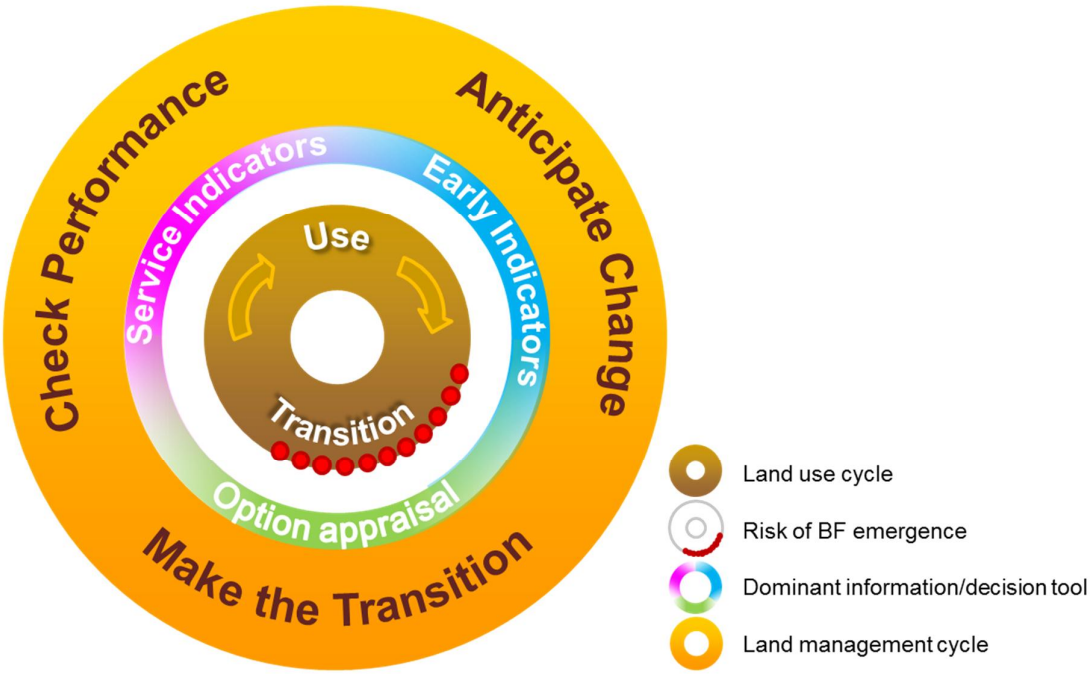

Figure 1. Conceptual framework for the Zero Brownfields perspective: the administrative land management cycle (outer donut), providing land management continuity throughout the land use cycle (inner donut). Focus is on facilitating smooth land use transitions when needed, thereby avoiding unnecessary emergence of BFs. Management phases and use of tools within one cycle may overlap in time. More than one management cycle may run at the same time, where the parallel cycles differ in spatial or temporal focus. Hence the land management cycle is decoupled from the physical land use cycle.

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 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.

2.2 Anticipate Change

In the management phase of Anticipating Change, information from so called early indicators is used to decide whether or not intervention is required. The early indicators reflect changes in the balance between costs and benefits (be it economic, environmental or social) of current land use and may signal whether an area or site is at risk of becoming underused (and eventually a BF). Based on the outcome of early indicator monitoring, organisations or persons responsible for management of developed land -primarily thought to be at municipal level- may change or adapt their policy, to help redirect current, possibly stressed land use into a new, longer lasting or more sustainable use. A set of some 40 indicators, identified through literature review, was presented in HOMBRE deliverable D2.1 (Ellen et al. 2013a). Their rationale, and guidelines for selecting and developing case specific indicators, were discussed in HOMBRE deliverable D2.2 (Ellen et al. 2013b). A prototype tool for a spatially differentiated assessment was presented in Maring et al. (2013a).

2.3 Make the Transition

Planning how to make the transition can then also be taken up in an early stage, providing more time for stakeholder consultations, including the search for potential investors. It also allows for possible synergies between decommissioning and site regeneration. In the HOMBRE view, BF regeneration should contribute to sustainable development in as many ways as possible. For this, the planning process should enable adequate stakeholder participation, and both the sustainability of techniques and methodologies used in the regeneration process, as well as the sustainability of the resulting land use should be assessed.

In HOMBRE WP5 (Menger et al., 3013), the term "project service" was introduced to express the benefits obtained by specific beneficiaries or "receptors" (i.e. nature, people or society), where project services are delivered through the implementation of processes during BF regeneration and/or the maintenance of the resulting land uses. HOMBRE tools are developed that promote the active search for synergies to improve the economic, social and environmental cost/benefit ratio of BF regeneration. Research into Technology Trains for both conventional and soft[4] land use regeneration that may particularly increase sustainability has been performed within the context of work packages (WP) 4 and 5 of the HOMBRE

[4] forms of use that do not involve substantial construction, where the land remains unsealed and the soil remains in biologically productive use for agriculture, habitat, forestry, amenity or landscaping. Examples of soft (land) usage include: land cultivated for non-food crops, urban green-space or parkland, nature conservation areas and public open space.

project (Grotenhuis et al., 2012; Menger et al., 2013). Specific decision support tools for the planning phase in the context of sustainable BF regeneration are being developed and optimised within WP3, WP5 and WP6 (Maring et al, 2013a; Menger et al, 2013, HOMBRE deliverables D5.2, D6.2, in preparation).

The results of the transition planning should be a clear definition of the objectives of the transition, in terms of the services to be delivered by the BF regeneration and the new land use, the wider benefits to be obtained, and the impacts to be avoided. It should also provide a first outline of how the stakeholders envisage that the objectives should be achieved, and which stakeholders should be involved in subsequent steps. Objectives, outline and stakeholder inventory provide the basis for more detailed project implementation plans.

2.4 Check Performance

To indeed secure the sustainability of land use transition/BF regeneration, a check on achievement of objectives and continued performance should be built into the transition project. This implies project-specific monitoring of the planned outcomes and performance of the new land use through service indicators. Development and selection of service indicators follows the guidelines for selecting and developing case specific indicators as discussed in HOMBRE deliverable D2.2 (Ellen et al. 2013b). Having to set up the post-project monitoring ensures that a forward looking perspective is taken, which will help prevent that benefits are too short-lived. For subsequent long-term monitoring, to check if the intended services still meet societal needs and challenges, part of a set of service indicators could be incorporated into the early indicator monitoring of the municipality or managing organisation, thereby effectively closing the land management cycle.

3 TIMBRE result on success factors for BF regeneration

The idea of Success Factors was extensively investigated by the TIMBRE project (www.timbre-project.eu; Frantál et al., 2012). In this chapter, the main results as presented by TIMBRE are summarised, a discussion from the HOMBRE viewpoint is given in chapter 4.

TIMBRE defined success factors as traits (conditions, circumstances, actors, agencies) that are determinants of, or at least contributors to, the successful regeneration of BFs. These factors may contribute to

i) attracting stakeholder attention to a BF,
ii) prioritizing a site above others, and/or
iii) successful implementation of new use.

As mentioned before, the TIMBRE focus is specifically on so called megasites: large post-industrial sites with complex contamination. BF regeneration is the subject of specific policy focus, in which inventorying of existing BFs and subsequent prioritization precedes marketing of selected sites and fundraising.

The need for prioritization stems from the notion that there is only limited resource (mainly financial but also in terms of management capacity) for BF regeneration. The TIMBRE success factors (quantified through selected indices) are used in the prioritization to assess the expected/perceived chance of success. Scoring is achieved through consultation of relevant stakeholders. As such, the factors represent both success and failure, depending on a high/low score for the indices.

The success factors are site and context specific. At the macro level TIMBRE discerns the role of a) legislative and regulatory instruments (environmental, landscape and urban planning), b) economic instruments (e.g. special funds, subsidies or tax benefits) and c) management instruments, which include information availability, decision support tools and educational facilities (Table 1). At the meso level, the regional or local socio-economic characteristics come into play, such as demographics, economic attitudes and productivity geographical location and infrastructural connectedness. The characteristics of the site itself (such as size, previous use, ownership, presence of contamination and aboveground obstructions) are grouped at the micro level. In addition to these objective factors, subjective issues like the degree of political involvement (weak or highly supportive) and the (un)willingness of stakeholders to communicate and/or cooperate are recognized as important and often crucial factors.

The initial list of factors, based on literature study and open stakeholder interviews, was further tested by TIMBRE through an extensive questionnaire survey[5]. The TIMBRE interest was also in the influence of the different national political and cultural characteristics, but without exception economical factors were perceived as the most important, i.e. they were considered the most obstructive barriers to BF regeneration (Table 2). At a joint second place came legislative and procedural-administrative factors/barriers, followed by political and information/know-how issues. Physical-technical and socio-cultural aspects of BF sites, in view of the respondents, were least important.

[5] A number of 347 respondents in total from the four countries involved in the TIMBRE project: Czech Republic, Germany, Poland and Romania, and including representatives of state administration, local government, investment/ development firms, academia, and expert practitioners.

Table 1. Summary of success factors for BF regeneration as identified by stakeholders

Factor level type	Macro (general)	Meso (location)	Micro (site-specific)
political	National policy (legislative, regulative and control tools)		
information	Availability and quality of information (about existing sites, tools, best practices, etc.)		
economic	Availability of financial incentives (grants, subsidies, funds, tax allowances, etc.)		Price of the land and property
	Foreign direct investments		Regeneration costs and return-time of investments
social/ cultural	Public attitudes, rate of the adoption of innovations and new developments	Local involvement & collaboration of stakeholders (politicians, community, NGOs)	
		Social status of the locality (social structure and cohesion of the local community)	
social/ economic		Economic status of the locality (population structure, unemploy-ment rate, entrepreneurial activity)	Attractiveness of site and objects (historical, architectural, esthetic value and image)
		Place marketing (local development strategy, land-use plan, urban study)	Property relations (number and structure of property owners, availability for selling)
geographical		General localization (location within a country, belonging to a region)	
		Specific locality (location within a spatial-functional structure: rural, city, inner city)	
		Concentration of other brownfields in the locality (competition of sites)	
		Transport links (proximity to highway, first class road, railway station)	
physical		Physical conditions of the area (terrain, subgrade properties, etc.)	
environmental		Landscape protection limits (proximity, heritage conservation areas, flooded areas)	Ecological burden (extent of the contamination of soil and groundwater sources)
technical			The size of the brownfield area
			Type of the previous use (industrial, agricultural, military, etc.)
			Type of the expected future use (quality, feasibility, and sustainability of the project)
			Extent of the built-up area and technical conditions of buildings
			Infrastructure networks (functional connections to water supply, sewerage, electricity)

Source: Timbre survey (Frantal et al., 2012)

TIMBRE's prime and ultimate goal is the BF regeneration as such; more specific positive outcomes are presented as impacts of this primary objective (Table 3). While costs (of remediation) are seen as the main barrier for BF regeneration, the environmental impacts are listed as the most important.

Table 2. Assessment by stakeholders (on a scale from 1-10) of main type of barriers to BF regeneration

Barrier type	average score
Economical	8.8
Legislative	7.1
Procedural-administrative	7.0
Political	6.7
Information and know-how	6.5
Technological	6.2
Social-cultural	5.5

Source: Timbre survey (Frantal et al., 2012)

Table 3. Positive impacts of BF regeneration as perceived by stakeholders (average scores on a scale from 1-10)

Impact	score
Restore environment (decontamination and revitalization of areas)	8.8
Raise local economic development with positive effects on the surrounding area	8.3
Reduce development pressures on greenfield areas	8.1
Improve architectural and esthetic image of places	7.6
Increase the employment and local income base (create new jobs)	7.5
Attract new investors and developers	7.5
Dispose of negative symbol/stigma of places (create new place image)	7.3
Preserve monuments of cultural and historical past	7
Attract new tourists and visitors	6.6
Eliminate social segregation and prevent criminality	6.1

Source: Timbre survey (Frantal et al., 2012)

4 HOMBRE success in BF regeneration

4.1 The HOMBRE perspective

The TIMBRE inventory of success factors for BF regeneration somehow confirms that the need for soil and groundwater remediation often is an ineffective driver for BF regeneration. Although the environmental benefits are perceived as highly desirable, they do not outweigh the costs associated. This is a typical type C situation of the CABERNET ABC model (Figure 2). In that model, 'successful' A-type sites are characterised not so much by lower remediation (reclamation) costs, but rather by a higher added value of the new land use realised.

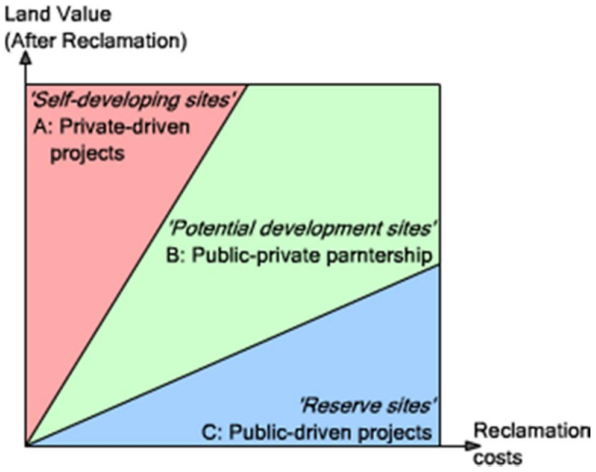

Figure 2. Types of brownfield regeneration projects in relation to their economic status and funding (Source: http://www.cabernet.org.uk)

Therefore, the perspective taken by HOMBRE is different. Instead of focussing on a solution for a certain BF, we focus on how BF regeneration can be used to answer or contribute to societal challenges (current and future challenges, hence sustainable development). For HOMBRE, success is not the BF regeneration as such, but achieving the more specific objectives defined. These specific benefits: the services that are provided by the regeneration and the new land use and how they contribute to the sustainable development of an area or community, must be the real drivers; their added value is what makes the regeneration project worthwhile. The recent policy change in the UK (National Planning Policy Framework, March 2012) where BF regeneration in itself (irrespective of the new use) is no longer a tick mark on the list of sustainability objectives, in principle takes a similar view. However, this should be counterbalanced by proper protection of Greenfield sites and the value they represent in terms of ecosystem services.

Of course part of the societal challenge will be to solve specific problems associated with a BF. However, naming the issues (e.g. contaminant risk, high unemployment level, vandalism) together with other societal needs (e.g. more climate resilient, greener cities; adapting to demographic change, improving sports, cultural, and/or tourism facilities) opens up possibilities to connect them in more than one way. Employment need not be provided by on-site activities but might also be generated in the wider area; contaminant risk could be reduced by combining longer term remediation solutions with short term low-exposure land

use; the on-site vandalism could be mainly due to lack of alternative leisure time activities for the youth, etc.

The success factors as identified by TIMBRE are given traits of the situation that are used to prioritise the BFs that most 'deserve' regeneration. This aids in distributing the available funds (for public driven regeneration projects of C-type BFs) in such a way that the overall added value ($\sum$ economic, environmental and social) for the stakeholders, including the local/regional community, is maximised.

HOMBRE aims to actually change the situation for the better, by 1) uncovering so far unidentified potential for added value, 2) maximising the benefit/cost ratio (monetary and wider) by linking the services provided by the regenerated BF to site- and area-specific demands, and 3) looking for site- and context-specific synergies between different regeneration technologies and between different land uses. Aiming for optimal sustainable development, from the Zero Brownfields perspective each BF should be turned into beneficial use as far as possible through balanced investment (public and/or private). This includes low-effort solutions that address urgent detriments of a current situation only. It should be noted that the negative value that the existence of a BF may represent is not explicitly evident in the CABERNET ABC model. For B- or C-type BFs -that need to be realised in part by public funding- whether or not a regeneration investment is justified depends on the change in overall value. Realising only a moderate positive value through regeneration may considerably contribute to sustainable development when starting from a very deprived, negative-value situation, whereas when the starting point is from near-zero return on investment could be insufficient.

4.2 HOMBRE concepts and tools for enhanced added value

To fulfil its mission, HOMBRE has focused at strategies, technologies and solutions for BF regeneration and management, that emphasize the positive value of available resources and potential social, economic and environmental benefits. Table 4 is an attempt to summarise the various concepts and tools with respect to the factors contributing to successful BF regeneration that are addressed. In the paragraphs below, their approach for enhanced added value in BF regeneration is briefly described, with reference to the HOMBRE deliverables in which they are detailed.

4.2.1 The Brownfield Navigator

The BF Navigator is a software environment that provides overall guidance on the Zero BF perspective and associated continuous land management, and facilitates interactive stakeholder involvement and record keeping of project progress and decisions (Maring et al., 2013a,b). Within a structured presentation of the administrative land management phases (Anticipate Change, Make the Transition, Check Performance) and different steps within the transition phase (Scoping, Opportunities, Assessment) it offers: map visualisation and sketching facilities; a library of relevant reference documents; an example library of successful BF regeneration projects; and different worked out items that represent proposed HOMBRE tools (e.g. tool for early indicator (4.2.2); opportunity matrix for soft re-use (4.2.5)).

Table 4. Concepts and tools developed within HOMBRE, showing which factors that contribute to successful BF regeneration are addressed. The first column lists the types of factors as discerned by TIMBRE (see Table 1), the second column the aspects considered a priori relevant by HOMBRE to enhance the 'success' of BF regeneration.

		HOMBRE concepts and tools								
Factor	**means for factor tuning**	**BF Navigator**	**Early Indicators**	**Service Indicators**	**BF REMIT RESPONSE (BR2)**	**Opportunity Matrix (OM)**	**Systems Exploration Environment & Subsurface (SEES)**	**Decision tree for biomass on BFs**	**Sustainability Linkages**	**Technology Trains**
overall	**accelerate BFR**	X	X				X			
political		X			X					
information		X	X	X	X	X	X	X	X	
	improve DSS to assess successfulness of BFR project	x		x	x	x		x	x	
	DSS that consider necessary time scales	x	x	x	x	x	x	x	x	
economic		X	X	X	X	X	X		X	X
	financially improve BFR operations	x		x	x					
	increase effectiveness of funds for BFR	x		x	x		x			
	determining factors for benefit/cost of BFR	x		x	x	x	x		x	
social/cultural		X	X	X	X	X	X			
geographical		X	X	X	X		X	X		
physical		X			X	X	X			X
environmental		X	X	X	X	X	X		X	X
	impact of natural/ environmental cycles on BFR management	x	x	x	x	x	x			
	integration concepts for adapting to change (incl. extreme events)	x	x	x	x	x	x			x
technical		X	X	X		X	X	X		X

4.2.2 Early Indicators

As already mentioned in section 2.2, the early indicators are intended to reflect changes in the balance between costs and benefits (economic, environmental or social) of current land use, and to signal whether an area or site is at risk of becoming underused and eventually a BF (Ellen et al., 2013a,b). In the management phase of Anticipating Change, they can be part of continuous monitoring, but also for first screening in a consultation approach. A prototype spatial decision support tool has been developed within WP3 (Maring et al., 2013b). This "Early Warning Indicators" (EWI) tool integrates the indicator results on BF potential and displays zones of potential brownfield formation within an urban area. The objective is that spatial information aids end-users in anticipating changes and making decisions in urban planning for sustainable urban development.

4.2.3 Service Indicators

Choosing and defining objectives is part of Making the Transition, service indicator monitoring is part of Checking Performance. Based on available literature, Ellen et al., 2013b provides general background on how such site specific indicators can be derived and how their monitoring should be organised. The 4-step approach for indicator construction in BF regeneration projects consists of: agreeing on goals/objectives; selecting key indicators; obtaining baseline data; defining targets. The relevance of possible indicators and the ease of obtaining the required information are the key factors in the selection process.

4.2.4 Brownfield Remit Response

The Brownfield Remit Response (BR2, Nathanail, 2005; Leney, 2008) interaction matrix and related cause & effect diagram can be used to analyse the relevant drivers/pressures and impacts for the urban system at hand and assess the effects of various intervention scenarios. The approach involves a well-defined sequence of actions that ensures that factors relevant to a proposed BF regeneration scheme in a given location have been explicitly considered.

4.2.5 Opportunity Matrix

The Opportunity Matrix (OM, HOMBRE deliverable D5.2, in preparation) maps services against the interventions that can deliver these services, for screening of soft land uses. It allows stakeholders to examine opportunities for valorisation of a BF and the pros and cons of different (combinations of) interventions for soft end uses for a site. The outcome is a "long list" of services that might be feasible, and the processes and interventions necessary to achieve them.

4.2.6 Systems Exploration Environment & Subsurface

System Exploration Environment & Subsurface (SEES[1], Maring & Hooimeijer, 2012) relates the above ground layers of people, urban metabolic cycles, buildings, public space and infrastructure to four thematic qualities of subsurface utilization: civil constructions, water,

[1] http://publicwiki.deltares.nl/display/SEES/HOME+English

energy and soil. It aims to guide the dialogue between the various specialists and stakeholders within a BF regeneration project-team.

4.2.7 HOMBRE Decision tree for biomass on brownfields

Stakeholders require incentives to consider the option of biomass use in their specific local context. The objective of the HOMBRE decision tree for biomass on brownfields (BoB) is to preselect urban sites seen as suitable for biomass on the municipal or sub-regional scale.

4.2.8 Sustainability Linkages

A sustainability linkage (Menger et al., 2013) consists of three connected components, a source (pressure or change), a mechanism (that describes how this might bring harm or benefit to a particular receptor), and a receptor (which is the constituent of economy, environment or society which could be affected). All three components need to be connected for a sustainability effect to exist. Sustainability linkages provide a relatively precise way to describe the potential set of connections that can have an effect on sustainability (positive or negative). A common strategy for determining importance (prioritisation) can be applied across all linkages. Sustainability linkages can be combined using a network diagram to provide a site conceptual model for sustainability, that contributes to stakeholder communication, aids in identifying opportunities for maximising value by exploiting synergies, optimising trade-offs and avoiding net losses, and provides a framework for assessing the components of overall value (direct financial value, tangible economic value and intangible values).

4.2.9 Technology Trains

Technology trains constitute the conceptual framework that links the resources that are available on a BF site with the goods or services that are needed to support the future use of the site and its surroundings. Depending on the desired quality of goods or services and resources, and the available timeframe, different technologies can be integrated to optimally deliver the service. In HOMBRE the focus lies on the production of thermal energy, water, and building material as goods, and (ground)water quality and soil quality as service (HOMBRE deliverable D4.3, in preparation). The technology trains aim to guide the dialogue between thematic program managers of municipalities, spatial planners, site developers, and thematic specialists in order to avoid decisions that become too costly in the long term.

5 Concluding remarks

HOMBRE's Zero Brownfields perspective is aimed at optimising benefits from developed land within the constraints set by the cyclic nature of urban land use, going from development and use to abandonment, redevelopment and re-use. Within the HOMBRE project, a variety of concepts and tools have been developed and explored, that can be adopted by (municipal) authorities and developers to

- smoothen the transition from one land use to the next;
- shorten the duration of vacancy and underuse (not being longer than what is necessary within the dynamics of the land use cycle); and
- properly address sustainable urban development by linking the demands arising from societal challenges to the services and wider benefits of BF regeneration and realised beneficial land use.

Especially the BR2, Opportunity Matrix and SEES tools, developed for use in the management phase of Making the Transition, are envisaged to "add value" to the outcome of BF regeneration projects, as they explore the potential for positive interaction and synergy. Their specific role within the work flow of Zero BF land management will be further worked out within WP6, that will integrate the results from all WPs into a Holistic Framework for Brownfield Regeneration.

The role of WP2 has been to map the Road towards Zero Brownfields, developing the overall framework while incorporating the outcomes of the other WPs. The specific contribution of WP2 to enable "faster, cheaper, and more sustainable" BF regeneration has been to demonstrate the importance of

- administrative land management being continuous throughout the land use cycle,
- the land management cycle working "ahead" of the land use cycle,
- the use of indicators and monitoring in support of a holistic and adaptive approach towards sustainable land use.

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