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"Holistic Management of Brownfield Regeneration"

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Summary

This report describes the HOMBRE land management and decision guidance framework that integrates the knowledge on the early indicators of impending Brownfield (BF) formation and the cost-effective monitoring of the different stages of the land use cycle, including the BF stage.

Starting from the circular land management framework developed within CircUse[1], the HOMBRE "Zero Brownfields" perspective is worked out. At the base of the HOMBRE framework are a land use cycle consisting of two phases: use and transition; and a land management cycle that incorporates three phases: 1) anticipating change, 2) planning transition and realisation, and 3) managing realisation. Monitoring activities are specifically related to the first and last of these phases. 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)

This decision guidance framework will be further developed and implemented as part of the Brownfield Navigator in WP 3. There, the HOMBRE concepts and technologies that could help overcome any of the key obstacles, or could provide the necessary information will be identified for each phase, and the relevant BF Navigator tools listed.

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-. In the HOMBRE framework, "early 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. Based on literature study, a basic set of early indicators was already presented in HOMBRE deliverable D2.1 'Early Indicators for Brownfield origination'. 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. In this report we therefore focus on how an adequate selection of BF related (early) indicators could effectively be monitored in practice. HOMBRE envisages this type of monitoring and management to take place by administration at the municipal level. Evidently, municipal size and capacity to collect and interpret the required indicator data may vary considerably. Thus, in addition to the potential local relevance of the indicators, the issue of availability and accessibility of indicator data are addressed.

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

[1] www.Circuse.eu

through protecting or enhancing naturally provided ecosystem services or through technological inputs). If the targets for these project services are defined in terms of site specific indicators, these can be monitored during and after the realisation of the land use to ensure long term. Choosing and defining service indicators is part of the planning management phase, service indicator monitoring is part of the realisation management. Based on available literature, general background on how such site specific indicators are /can be derived and how their monitoring should/can be organised is provided. The stepwise approach as developed and described by the World Bank[2] was chosen as sufficiently pragmatic, to be a starting point for adapting into a 4-step approach for indicator construction in BF regeneration projects:

- Agreeing on goals/objectives
- Selecting key indicators
- Obtaining baseline data
- Defining targets.

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

- **C**lear: precise and unambiguous.
- **R**elevant: appropriate to the subject at hand.
- **E**conomic: available at a reasonable cost.
- **A**dequate: provide a sufficient basis to assess performance.
- **M**onitorable: amenable to independent validation.

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

Finally, a number of HOMBRE cases is presented that provide a reality check for the Zero BF early indicator and other HOMBRE concepts, and the value of the set of indicators as presented, within context specific situations.

[2] World Bank (2004)

Contents

1 Introduction

1.1 Brownfields and Circular Land Management

At the macro-economic level, land use change due to industrial and urban transformations is no new phenomenon. Ever since the early 19th century, the development and decline of cities and city centres has been seen as a natural and inevitable process (Weinstein 2007; Martinez-Fernandez, 2012). Where the process of transition is stalled for a longer period than desirable, there is a risk of Brownfield (BF) formation. According to the definition of CABERNET (Oliver et al., 2005), 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.

As described in some more detail in HOMBRE deliverable D2.1 (Ellen *et al*, 2013), deindustrialisation and suburbanisation have been the main drivers for site dereliction up to the 1980s. Since, military downsizing, abandonment of transport infrastructures, on-going globalisation and overinvestment in residential and commercial real estate have become additional causes of vacant sites (Tang and Nathanail, 2012; Ferber, 2010; Ramsden, 2010). The existence of BFs implies unsustainable use of the land resource, with underuse of available developed land and unnecessary consumption of Greenfield land. Furthermore, sustainable development is thwarted as communities with BFs often face economic and social concerns, such as unemployment, substandard housing, outdated or faulty public infrastructure, and crime.

The concept of 'recycling' of developed land was first advocated by the German research project "Fläche im Kreis" and later adopted in the European project Circular Flow Land Use Management (CircUse; www.Circuse.eu). Circular land management aims to stimulate BF regeneration, by considering the land resource to be in a continuous cycle of allocation of building land, development, use, abandonment and re-use (Figure 1). The cycle is influenced by social, environmental and economic drivers (and vice versa); these drivers in turn can be influenced by legal regulation, economic incentives, and other instruments.

Brownfields occur if the current land use comes to an end (cessation of use in Figure 1) and no timely new initiatives for the reintroduction of the land in the use cycle emerge. Interim, non-permanent use is advocated within CircUse, as a step-by-step regeneration approach to smoothen the transition from traditional to future use in a given area. It can buy more time to plan and realise new long term use, meanwhile not "wasting" the land resource altogether. Interim uses specifically considered are those that in themselves may contribute to a more sustainable society and societal ambitions, such as production of biomass for sustainable energy, city farms and allotments, or the creation of outdoor amenities and open space for human well-being and health.

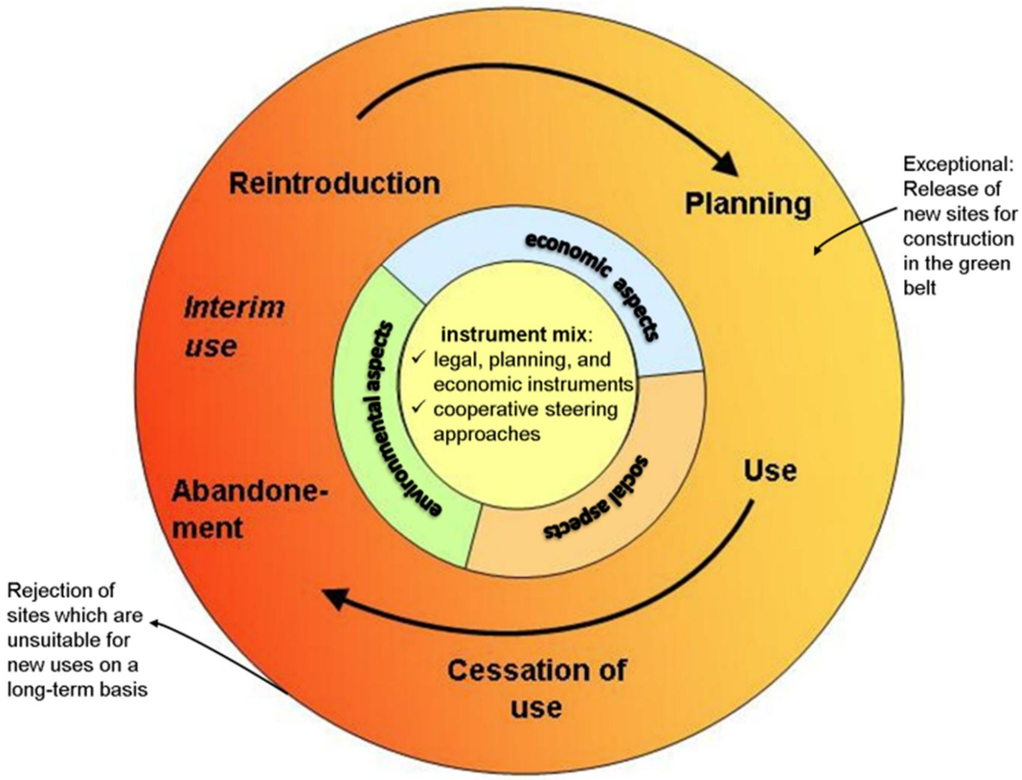


Figure 1. The land use cycle (www.Circuse.eu)

1.2 The HOMBRE "Zero Brownfields" perspective

Within HOMBRE we aim for yet another step further. The projects' vision is to enable a 'Zero Brownfield' development (in analogy to zero waste), within a HOlistic Management of Brownfield REgeneration (HOMBRE). In addition to avoiding underused, wasted land, the mission of HOMBRE is to promote full consideration of sustainability aspects in decision making within BF regeneration and land transformation projects. For this, 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. HOMBRE therefore focuses 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.

With this in mind, HOMBRE has identified the following research objectives:

1. *Better understanding why, how, where and when BFs are formed* in order to avoid future BFs, in different areas in the EU and in three main fields: urban, industrial and mining areas,
2. *Better planning and more attractive communication technologies*, that allow more holistic appraisal of BF regeneration options and early stakeholder involvement,
3. *Better operations,* better implementation of state of the art technologies, and development of *innovative technology combinations* for more sustainable integrated BF regeneration,
4. Better and *more creative solutions for long-term land use* of current and potential future BFs.

The primary focus of HOMBRE Work Package 2 (WP2) 'BF roadmap for Zero Brownfields perspective' is on the first research objective: a better understanding of BF formation. Based on that, development of the HOMBRE management, monitoring and decision framework is a joint effort of WP2 and WP3. The framework aims to support better planning and communication amongst stakeholders involved in BF identification, management and regeneration (second research objective). Implementation of this framework into a software or web-based decision guidance is the specific task of WP3 'BF Navigator'. Within the BF Navigator also practical decision support tools will be provided. Input from WP4-5 (resp. 'Innovative BF technology trains' and 'Enabling BF soft re-use'; research objectives 3-4) will be incorporated in this framework for holistic BF management, which will be completed in WP6 'Holistic Framework for Zero Brownfields perspective'. Additionally, through a CEN Workshop Agreement (within WP7 'Networking, Dissemination and Business plan'), a glossary of terms for holistic BF regeneration will be provided.

1.3 On early indicators, service indicators, and success and sustainability indicators

An indicator is a quantitative or qualitative variable, that is well defined in operationally measurable terms (quantity, quality, time), and is used to monitor an on-going process, be it an autonomous development or a managed intervention. Indicators provide a simple and reliable means to measure achievement, to reflect the changes connected to an external driver or intervention, or to help assess the performance of an actor (based on Kumar, 1989; DAC/OECD 2002; EC, 2001)

In the context of Zero BF land management, an early indicator reflects changes in the balance between costs and benefits (be it economic, environmental or social) of current land use. Specifically, an early indicator signals whether an area or site is at risk of becoming underused (and eventually a BF), and when management intervention is required.

In Deliverable D5.1 of the HOMBRE project (Menger et al, 2013, see Box 1) the term "project service" is used to express the benefits obtained by specific beneficiaries or "receptors" (i.e. nature, people or society). In the context of HOMBRE, services are delivered through the implementation of processes during the regeneration of BFs and through the maintenance of specific land uses. As such they constitute the specific outcomes of designed processes as opposed to conventional "ecosystem services" which are naturally provided without technological inputs. The protection or enhancement of ecosystem services is itself a possible "service" which could be designed into a regeneration project.

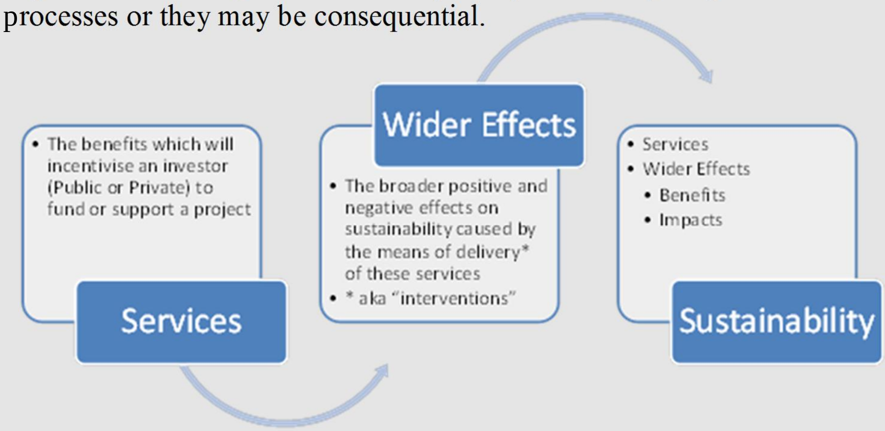
A service indicator is then defined as an indicator reflecting changes in the benefits obtained from a specific service that is being delivered by a chosen land use or by a technology or technology train that is utilised in a BF regeneration or land transformation project. A service indicator could serve as an early indicator - when it is used to monitor the impact of quasi-autonomous societal processes on a service -, or to specifically assess the success of a BF regeneration project. In the latter case it can also be termed a success indicator. A success indicator is specifically designed to measure achievement of the goals set out for a managed intervention, either relating to the intervention process (technologies applied during BF regeneration) or to its result (land use benefits). When the service considered is specifically intended to contribute to sustainability, it can be termed a sustainability indicator, which is specifically designed to measure achievement of a managed intervention with regards to sustainability, again either during the intervention or after the goals set out for the managed intervention have been achieved.

Box 1. Services from BF regeneration and ecosystem services

Services are specific outcomes of a project design process that only partly overlap with "ecosystem services". The ecosystem service concept does not fully align with the concept of BF regeneration project services for three reasons:

- Not all benefits or value improvements through BF regeneration are true ecosystem services, for example the generation of recyclate.
- Some project services are *consequential* economic benefits, for example recovery of land value and improved balance sheets, or intangible values such as reputation or independence from primary and/or less secure resources for energy and raw materials.
- While the ecosystem service concept describes a more or less "steady state" of provision; benefits from BF regeneration not only may accrue from the *outcome* of the regeneration process but may be generated also during the *process* itself.

Hence project services may be delivered by ecosystems, they may be delivered by non-eco-system processes or they may be consequential.



1.4 This report

This report focusses on:

- the Zero Brownfields perspective as the overall HOMBRE framework, and
- the setup of adequate monitoring strategies within that framework.

The report is divided in sections. Starting from the concept of circular land management as developed previously, Section 2 will work out the Zero Brownfield perspective in more detail, and briefly outline the decision guidance framework required for its implementation. Based on literature study, a basic set of early indicators was already presented in HOMBRE deliverable D2.1 'Early Indicators for Brownfield origination' (Ellen *et al.*, 2013). In Section 3, we elaborate on the rationale behind these indicators. In addition to their potential local relevance, the issue of availability and accessibility of indicator data is addressed. General background on how additional site specific indicators are /can be derived and monitored will be the subject of Section 4. Selection and construction of indicators is discussed there primarily from the viewpoint of deriving service indicators. However, the approaches presented may also be used in deriving other types of indicators, such as the early indicators. Additionally, a number of HOMBRE cases will be used to test the applicability of the HOMBRE framework and the use of indicators within context specific situations (Section 5), followed by some concluding remarks (Section 6).

2 Framework and decision support for Zero Brownfields

2.1 From the CircUse circular land management to the HOMBRE Zero Brownfields perspective

Analysing the cycle of Figure 1 in some detail, reveals that it incorporates a number of different perspectives and related “sub cycles”; the basic *Land use cycle*, the management cycle from a *site developer’s perspective*, and the land management cycle from an *administrative perspective.*

2.1.1 Land use cycle, occupational perspective

The *Land use cycle* represents the physical perspective of a site’s occupancy. In the CircUse framework (Figure 1), it more or less encompasses four stages: a *“Blank”* stage, when either a Greenfield is released for construction or a former BF is reintroduced; the *Use* period; a BF stage (*Cessation of use* and *Abandonment*); and *Interim use*. In the HOMBRE perspective, the land use cycle consists of only two phases: a *Use* phase and a *Transition* phase (Figure 2). 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.

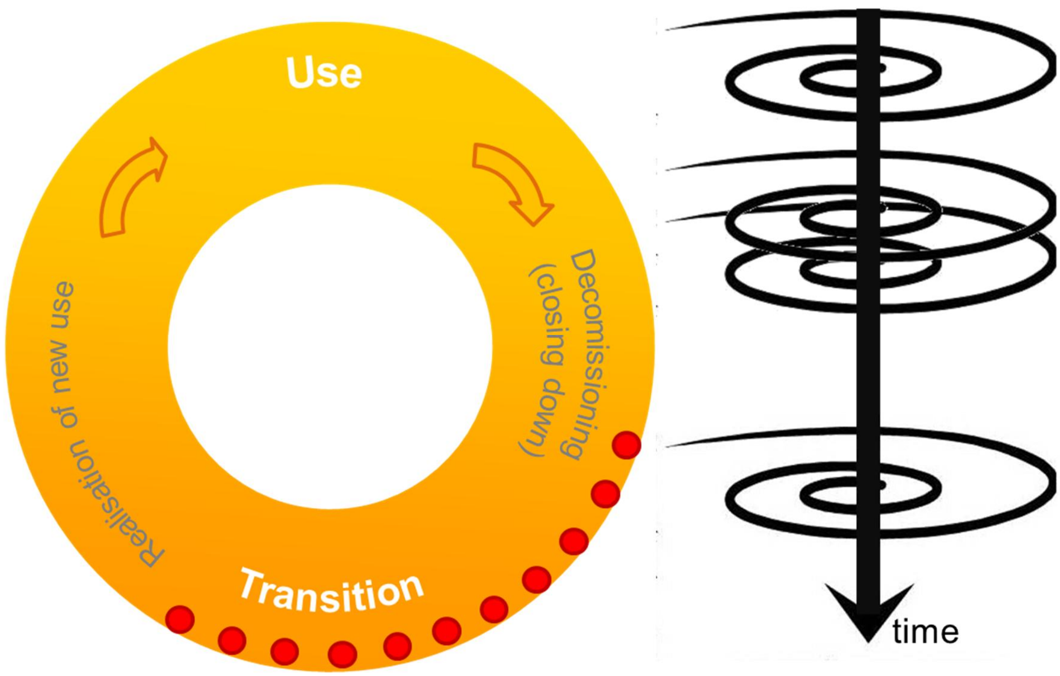


Figure 2. HOMBRE basic land use cycle, consisting of two phases: Use and Transition. The red dots indicate where in the cycle BFs may potentially emerge. The duration of subsequent use phases may vary from less than a year to various decades, as indicated on the right, where the spirals represent subsequent transition phases. Note that the HOMBRE cycle is rotated as compared to the CircUse cycle, having the Use phase at the top.

2.1.2 *Site management cycle, developer's perspective*

The right side of the CircUse land use cycle represents the developer's perspective. Developers are involved in the *Planning* stage, after the release or reintroduction of land for construction, and the *Use* period itself (Figure 3, bottom left). A closed management cycle as viewed from a developer's perspective, as presented on the Housing Expo 2013 in London (http://www.housing-expo.com/), is also depicted in Figure 3 (top). Within this cycle, land is purchased at the beginning and disposed of at the end, when the developer starts a new cycle at a new site. In terms of the HOMBRE land use cycle, for a specific site, it includes the realisation of new use, the use phase, and the decommissioning (Figure 3, bottom right). Evidently, site development management does not cover the core of a site's transition phase where the risk of BF emergence is high.

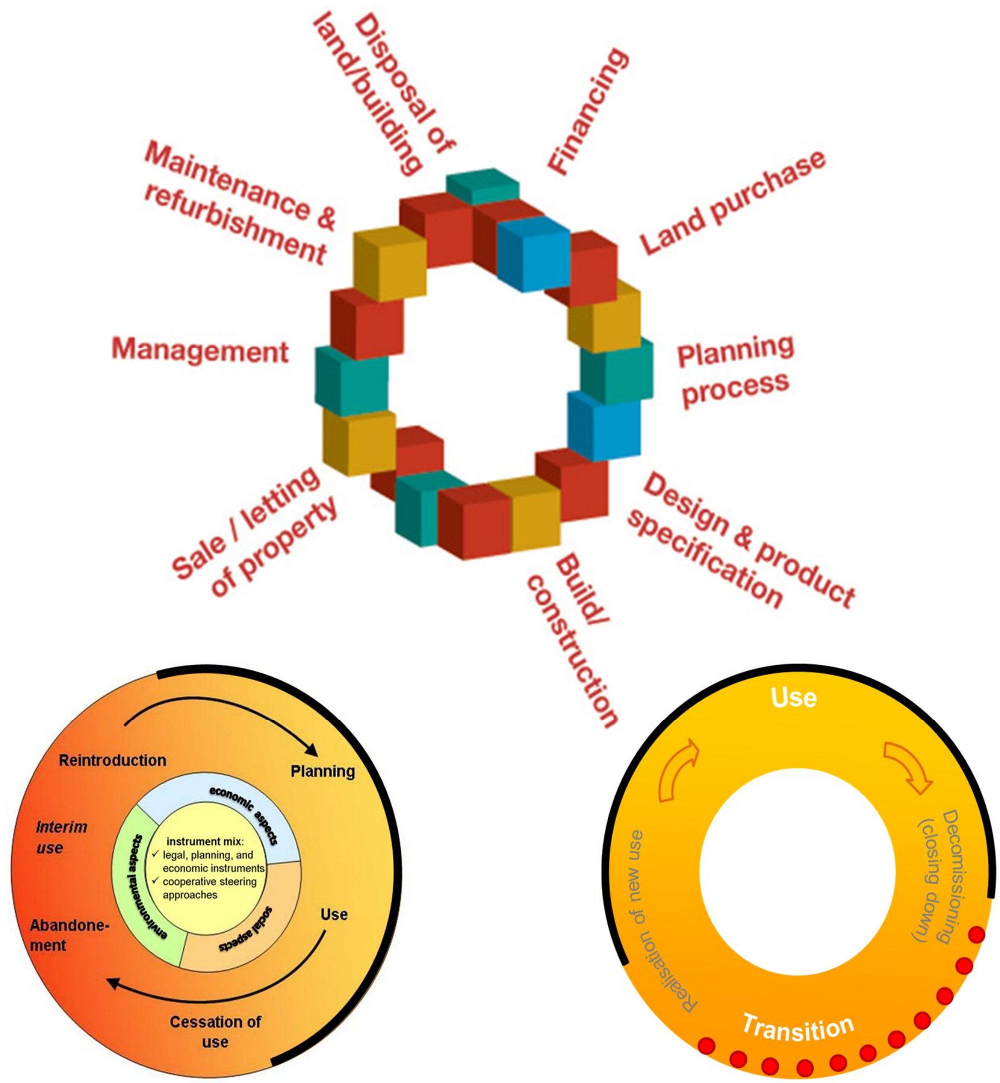


Figure 3. Site development cycle (top; from http://www.housing-expo.com), and its coverage of the CircUse (bottom left) and HOMBRE (bottom right) land use cycles as indicated by the black arches. The BF risk phase (red dots) and regeneration phase are not covered by the site development cycle, as the developer starts a new cycle at a new site.

2.1.3 Land management cycle, administrative perspective

To prevent BFs from emerging, or accelerating their regeneration once they have formed, a long term - perpetual - administrative management perspective is required. This type of management should facilitate land use transition. However, it should not just cover the high-BF-risk and BF regeneration phase, but already start during the use phase, when changes in the benefits of the current land use and actual demand for services can be anticipated (Figure 4). Planning a well-managed transition can then be taken up in an early stage. Similarly, a forward looking perspective should be used in the management and monitoring of the sustainability of the services provided by the new use, to prevent that its benefits will be too short-lived (Figure 4).

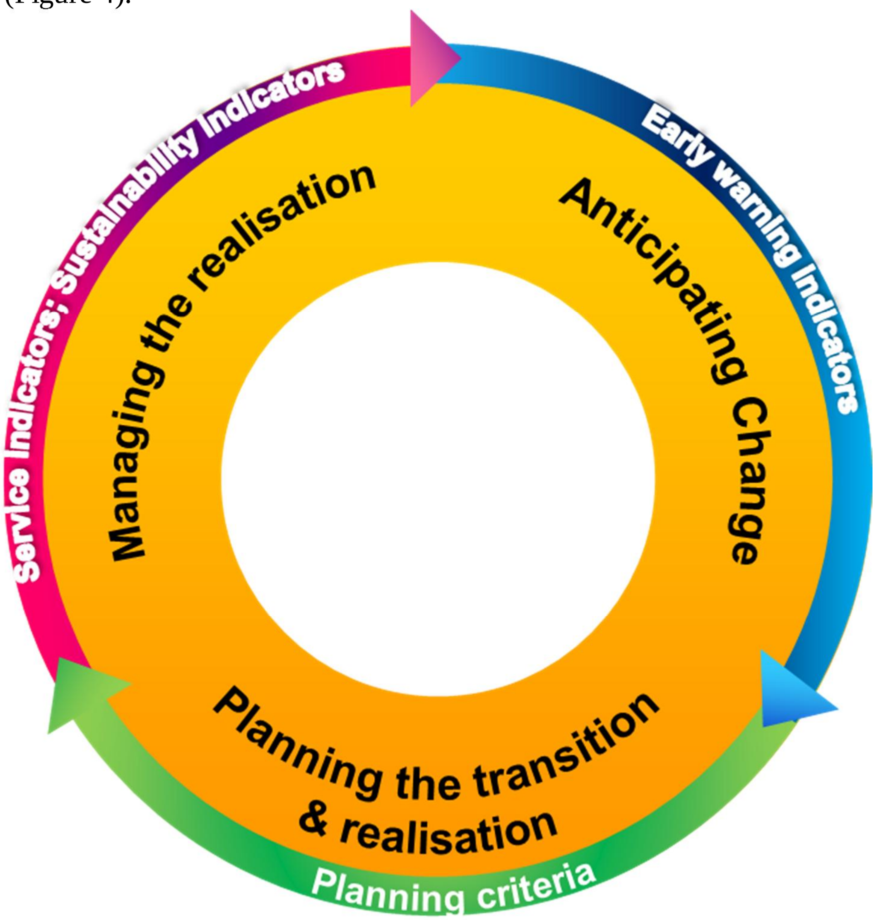


Figure 4. Administrative land management and monitoring cycle, covering the whole land use cycle

In the HOMBRE view, this administrative land management cycle comprises three phases: *anticipating change*, *planning the transition and realisation*, and *managing the realisation*. These are linked to specific monitoring and assessment phases (Figure 4):

- Early warning indicators, that reflect changes in the benefits obtained through the current land use or in the demands for land use services and specific sustainability objectives, should be monitored in the management phase focused on anticipating change. These early indicators may signal whether or not management intervention in the land use cycle is required, to prevent a BF being created in the near future.
- Choices to be made in the planning phase need to be based on relevant criteria that assess the relative benefits of the different options. Benefits can be the services

provided by the regeneration project and resulting land use, contributions to societal ambitions, wider sustainability gains. We refer to HOMBRE deliverable D5.1: 'Valuation approach for services from regeneration of Brownfields for soft re-use on permanent or interim basis' (Menger et al., 2013), where this is explained for non-build up land use in more detail. When a BF has already emerged, this planning phase is concerned with BF regeneration. Ideally, the planning phase guides the smooth transition from current use to subsequent use. The choices to be made include defining the aims of the transition or regeneration process, i.e. the use to be realised, and the administrative and technical means to achieve these goals. As already pointed out in section 1.2 and 1.3, in the HOMBRE vision, both the sustainability of techniques and methodologies used in the generation process, as well as the sustainability of the resulting land use should be assessed.

- In the realisation phase, suitable service and sustainability indicators should be monitored to test the effectuation and continued sustainability of the goals set for the BF regeneration or land use transition. These indicators can be defined based on the goals set in the previous phase, by translating the targets for sustainability ambitions and specific services required into site specific indicators, that can be monitored during and/or after the realisation of the new land. This is also where the cycle closes, as part of these indicators could be included in subsequent long term monitoring to anticipate change, thereby ensuring long term sustainability of land use.

The administrative land management cycle covers the full land use cycle. However, the three management phases distinguished are not strictly sequential or one to one connected to a position in the land use cycle of Figure 2, but may overlap in time (Figure 5, left). Ideally, already during planning and realisation of land use, potential changes in economic, societal or environmental factors and drivers that might influence the sustainability of the chosen use and services aimed for, are anticipated. First steps in planning a smooth transition can already be made while the current land use is still profitable and - on the short term - sustainable.

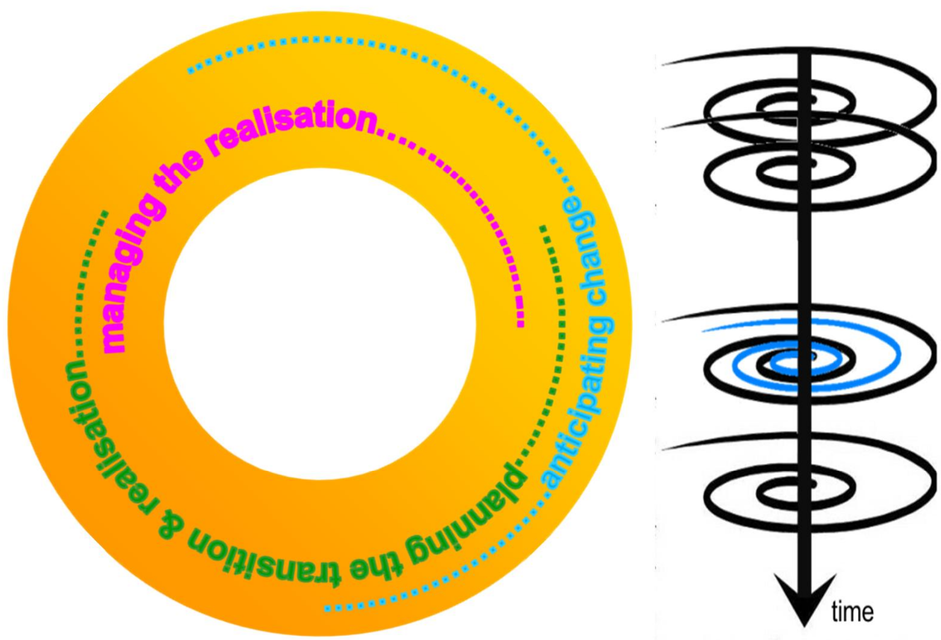


Figure 5. Overlap between the three management phases within one cycle (left) and more than one management cycle running in parallel at the same time (blue and black spiral; right)

Furthermore, multiple subsequent land use cycles may be simultaneously addressed in management. An example would be the transition from a railway marshalling yard near a train station to offices, which requires soil and groundwater remediation. During the groundwater remediation a temporary car park and paved playgrounds could be created on the site. Such a temporary intermediate use was called *interim use* in the Fläche im Kreis/CircUse terminology of Figure 1. Within the Zero Brownfields perspective this is considered as two land management cycles running in parallel (Figure 5, right). The longer term cycle manages the decommissioning of the marshalling yard, the remediation, and the planning and realisation of the offices; the shorter term cycle manages the planning and realisation as well as the later decommissioning of the car park and playgrounds. Together, the management cycles cover two subsequent land use cycles: the transition from use as marshalling yard to use as car park/playgrounds, and from use as car park/playgrounds to use as offices.

2.1.4 Zero Brownfields land management

The conceptual framework for the Zero Brownfields perspective is then best summarised by Figure 6, showing the administrative land management cycle addressing the land use cycle. The focus of Zero Brownfields land management is on facilitating smooth land use transitions when needed, but the land management cycle covers the full land use cycle, to ascertain management continuity throughout.

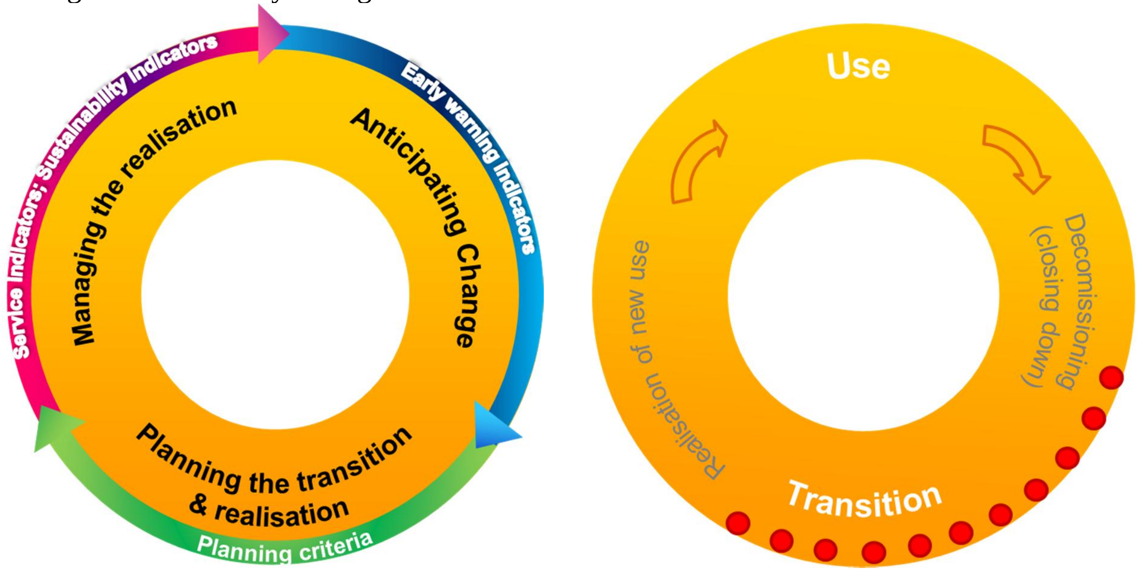


Figure 6. Conceptual framework for the Zero Brownfields perspective: the administrative land management and monitoring cycle with overlapping management phases (left), providing land management continuity throughout the land use cycle (right). Focus is on facilitating smooth land use transitions when needed, thereby avoiding unnecessary emergence of BFs.

2.2 Decision guidance for the management phases

Once it is clear what phase of the management cycle is at hand, a more detailed and context specific analysis of the management challenges, options etc. for that phase can be made. Although the outcome of that analysis will be specific to each phase, the basic questions to be answered are essentially the same. These relate to:

- Stakeholder roles and responsibilities
  The stakeholder analysis not only involves the identification of the relevant parties, but also clarifying their roles (e.g. initiator, actor, beneficiary, financier, involuntary financially or otherwise disadvantaged, authority, regulator, interest group, …..), responsibilities/powers, interests, objectives. Such an analysis can (and should) be made even in the early stages of the *Anticipating change* phase, without all the stakeholders being already actively involved.

- Spatial and temporal scales
  The relevant spatial scales vary from single site, to local, regional or larger areas. The scale could even be global, for example in the case of a multinational having a portfolio of industrial sites that it wants to regenerate or abandon, The geographical scale to be considered may vary with the different aspects/perspectives associated with BF regeneration. Local resources will usually determine what services can be generated by the envisaged land use, but the beneficiaries of these services may be found in a wider area. Impacts in general, whether economic, social or environmental, should usually be considered on more than just one scale level.
  Here, also the time frame of the envisaged transition cycle can be clarified. Is the site still operational or not, what urgent issues are to be resolved, when should future use be realised?

- Key choices
  This forms the core of any decision framework: identifying what choices are at hand, what questions should be answered. Examples are the choice for a new land use, for a remediation option, or for the time frame in which the existing land use needs to cease. With the type of choice, a first list of options can already be available, but deciding what should be on such a long-list or short-list could well be one of the questions to be answered. This part of the analysis has a clear link to the stakeholder analysis, as it should also be made explicit who has the responsibility and power to make the actual decision.

- Information needs
  To answer questions and make choices and decisions, information is needed. This part of the analysis should make clear what type of information is needed, and whether or not it is available. If not, a new key choice emerges: if and how to collect the missing information.

- Key obstacles
  In a way, this is an extension of the key choices analysis. The stakeholders need to identify what precludes the desired progress along the management cycle from being made. For example an essential stakeholder is not on board, crucial information is difficult to obtain, or there are technical issues that need to be resolved. Lack of funding should not be as such termed a key obstacle as it actually means that no interested stakeholder, that could provide the financing in return for expected revenues, has yet been identified. An important issue may be the obvious wish of stakeholders to limit their liability. If needed, an in-depth liability analysis should be made: what are the risks associated with the case or project and who is likely to end up bearing the liability?

Table 1 shows the format that has been generated so far within WP2 to compile the management phase analysis. In a customised and enhanced form, it will be one of the decision guidance tools of the BF Navigator. The table contains two additional panels that focus on the tools and solutions that are appropriate in each phase; during the HOMBRE project, focus is specifically on the added value of HOMBRE concepts and the tools within the BF Navigator:

- HOMBRE solutions
  The (HOMBRE) concepts and technologies that could help overcome any of the key obstacles, or could provide the necessary information are identified.

- Role of the BF Navigator
  Here, the relevant BF Navigator tools (or other decision support tools) should be listed that can be employed in the specific phase and situation, for example generating necessary ideas/information through a stakeholder consultation or mapping out suitable conditions for a chosen technology.

The format is intended to give a one-page overview, where all the issues at stake should be entered as keywords or short phrases. As an example, Table 1 has been partly worked out for the phase of “Planning-the-transition” for a generic/hypothetical case. A more detailed description of each issue should be linked to these entries.

Table 1. Preliminary format for the analysis of each management phase, worked out for the phase of "Planning-the-transition" for a generic/hypothetical case.

Planning the transition & realisation

Stakeholders		Roles (or not)	Responsibilities	Objectives
authorities	municipality: spatial planner..	y +++	social stability-wellbeing	meet regulation / economy / re-election
	regional authorities	y		""
	national authorities	y?		""
owners/users	land owner	y		avoiding costs / avoiding
	Future users	y		liability / making money
	current users/benificiaries	y		not loosing what you have
project executioners	potential investors (1-public, 2- private)	y	Company Social Responsibility (CSR) 1(+2). Longterm €	1-policy, 2-€
	project developer	y	""	
	urban/landscape architect	y	help client	€ minus liability
	contractor	y	""	""
potentially impacted	local residents individually	(Y) depends	depends	better living conditions, € (house price etc)
	local/regional community	y		
(sustainability)	environment	represented by	life support	-
	future generations	action groups?	-	arrive
	the world at large	-	-	-

Overall geographical scale and focus
varied and multiple

HOMBRE Solutions
assessment /identification of options (land owner)
maximizing return of investment by speeding up
interim uses (avoid) further decline →arts / cultural events
encourage flexibility
scenario analysis - what if?
improved understanding
benefit of technology trains

Key choices needed	Who decides?
fear of being first (responsibility) / risk adverse	
who is taking intiative? (why needed, objectives, constraints, options for future use/design)	
→ Is is setting all key choices: what are we going to do next?	
phasing	
to start	
maintain progress & flexibility	
give permissions	

Information required
ecological value
natural resources

Key obstacles
liabilities
conflict of interest
unsupportive policy
(lack of) imagining possible end-situations (due to scale and complexity)

Role of BFN
help to identifying conflicts of interest and manage them
→visualization
→ assisting scale and complexity
share the vision / plan
identify spatial overlap →conflicts, opportunities synergies
portfolio management to easen transition

3 Anticipating change; rationale and data availability for HOMBRE selection of early warning indicators

3.1 General

The basic set of economic, social and environmental early indicators as identified in HOMBRE deliverable D2.1 is reiterated in Tables 2 to 4. A few modifications/additions were made, that will be explained below. The indicators are meant to evaluate trends, and to signal when intervention is required to prevent BFs being created. In total, around 40 early indicators are listed that are viewed to be relevant in most cases. Land managers or stakeholder groups should select the ones that are most relevant and convenient in their situation, or, derive more suitable ones for their specific use. Note that both the optimal set of indicators and the specific features of trends suggesting impending BF status (such as direction, steepness, fluctuation frequency) are case specific.

The tables already show the general line of thinking in the selection/construction of indicators: from relatively broad categories of relevant drivers or factors that influence BF emergence (second column), via more specific issues to be considered within these categories (column 3), to a final selection of indicators (column 4). In the case of for example the economic early indicators for BF formation, the categories are deindustrialisation, transportation, urban sprawl and economic recession (Table 2).

Chosen indicators must be well-defined and measurable, or at least qualitatively assessable (see chapter 4). The defining terms should include the temporal and spatial span of the indicator - in Tables 2-4 roughly indicated in columns 5 and 6 - and how they are going to be measured or what information is needed for their assessment. For the latter, the tables give suggestions in the final column. As such, the tables exemplify that in a specific case, the selection of an indicator (centre column) is determined both by its general relevance for the process being followed - here BF formation - (columns 1-3) and by practical limitations of adequate temporal and spatial scale and data availability (columns 5-7).

In the following sections, we will follow this reasoning towards indicator selection in more detail, for each of the categories in the basic set of early indicators as identified by HOMBRE. This will serve both as an underpinning of the selection made for the early warning indicators, and as example itineraries for indicator selection in general.

3.2 Economic indicators

From a historical perspective, economic drivers appear to have been the most important in the generation of the past and current BFs. Similar or analogous economic processes are likely to be relevant in future land management. Large restructuring of economic activities, such as the process of deindustrialisation in the last quarter of the 20th century, is seen as the main economic driver for BF formation and is therefore given more detailed attention below. Other changes include the reunification of Germany (formerly military sites along the inner German border), taking down of the iron curtain (former Soviet military bases), stricter environmental controls and general technological innovation rendering industries redundant.

Table 2. Basic set of economic early indicators for BF formation

ELEMENT	CATEGORY	ISSUES INDICATORS MIGHT NEED TO CONSIDER	SUGGESTED INDICATORS	Effect on short/long term <10 years >	Scale Local/Regional/ National/Global	Source for data/info
Economy	deindustrialisation or restructuring of the economic activities	Land use	the change of the percentages of areas under industrial land use	Short term	Local and National	EUROSTAT
			floor spaces for industrial, retail and office use	Short term	Local	Local/national statistics For example: http://www.communities.gov.uk/planningandbuilding/planningbuilding/planningstatistics/previouslydevelopedbrownfield/
		Composition of employment	percentages of employment in industrial sector and service sector within municipalities	Short term and long term	Local and national	EUROSTAT Local/national statistics
		Composition of GDP	percentages of GDP in industrial sector and service sector within municipalities	Short term and long term	Local and national	EUROSTAT national statistics
		Employment	long term unemployment	Long term	Local national	EUROSTAT Local/national statistics
		Real estate market	property price	Short term	Local	Local/national statistics Online directories Property assessment cooperation
	transportation	Accessibility, mobility, operational efficiency	average time from facility to major highway network/train facility	Short term/ Long term	Local	Local infrastructure plans
			bridge weight limits	Short term/ Long term	Local	Local infrastructure plans
			lost time due to congestion	Short term/ Long term	Local	Local infrastructure plans
			volume/capacity ratio	Short term/ Long term	Local	Local infrastructure plans
		Safety	Number of accidents	Short term/ Long term	Local	Local statistics
		System Preservation	Percent of roadway/bridge system below standard condition	Long term	Local	Local infrastructure plans
			Age distribution of infrastructural elements	Long term	Local	Local infrastructure plans
	Urban Sprawl	Property Price	ratio of the property price in a municipality to the adjacent municipalities	Short term/ Long term	Regional	
	Recession	Withdrawing investment from regions experiencing recession	National real GDP	Short term/ Long term	National/Global	National Statistic Eurostat
			Real income	Short term/ Long term	National	National Statistic Eurostat
			Employment rate	Short term/ Long term	National	National Statistic Eurostat
			Industrial production	Short term/ Long term	National/Global	National Statistic Eurostat
			Wholesale-retail sales	Short term/ Long term	Local	Chamber of commerce

3.2.1 Deindustrialisation, restructuring of economic activities

One of the origins of BFs (see also Table 2) is deindustrialisation: old industries migrating out and being generally replaced by service sector economic activities (Rowthorn and Ramaswamy, 1997). Locally of course, the out-migration of industries was not always compensated by any new service sectors. Either way, statistically, the percentages of the Gross Domestic Product (GDP) and employment created by the industrial sector will decrease and the proportion contributed by the service sectors will gradually dominate within an administrative unit. Such restructuring of economic activities has implications in land use as well as employment and productivity. For example the workforce is likely to shrink and to be deskilled.

3.2.2 *Land use*

Industry usually needs larger areas of land for production compared to the service sector. During the process of deindustrialisation, a location needs to attract more service sector entrepreneurs to occupy the original space used by the lost industry. When this is not possible, derelict industrial land appears. Even if service sector jobs are created, tracts of unused (BF) land may still remain. Under these circumstances, stringent planning and land use regulation are quite likely to influence the time before land re-use. Service sectors or other possible development projects may shy away from the area if such regulations are seen as too restrictive and slow. Alternatively regulations which prioritise reuse of BFs have been successfully used to secure redevelopment. By contrast, more flexibility for economic land use, while not necessarily preventing the emergence of a BF, removes part of the barriers for BF regeneration in an area. An example is the removal of the need for planning permission to change land use from retail to residential introduced by the Government in England in recent years. Therefore, the type and flexibility of economic land use in a municipality may indicate how easily emerging BFs may be regenerated or become derelict.

The strictness of regulations as such may not be easy to quantify but the variety and temporal variability in land use type could be. From the rate of change in the percentage of industrial land in a municipality, the municipality may sense whether systematic loss of industry is happening and evaluate the possibility of dereliction. From the variety in economic activity and trends therein, the municipality may assess the resilience of the area and its potential for quick adaptation.

The percentages of different types of land use within a municipality should be easily available if a regular land use survey has been conducted. Changes in land use are often accompanied by a change in ownership. The responsibility for collecting and updating ownership information varies widely between EU member states (http://eulis.eu/service/ countries/). Ownership registry may be based on the property or on the person, may be compulsory or not and cover only part of the overall land area. The frequency of updating will probably differ even within countries. For example within the Netherlands, the national “Kadaster” registers ownership and changes therein of all land. It also manages the municipal registers of addresses and buildings, and other related data. Customised data selections and aggregations are provided to authorities to help develop spatial planning policies. In Belgium, coverage by the “Administration générale de la Documentation patrimoniale (Cadastre, Enregistrement, Domaines et Hypothèques)” is also 100%, but the registry is person based and the information needs to be combined with complementary (map) data to derive land based statistics. The Land Registry of Spain comprises Land Registry offices which are spread all over the country (in total 1,086). The Colegio de Registradores is also responsible for Commerce Registry offices (there are 67). Property registration is not compulsory, hence also the land area covered is unknown. However, information on land use, and changes therein, should be available within most European municipalities. Some indication of land use may also be available through local business tax collection mechanisms.

To test the applicability of land use indicators for BF formation in this report, we have to make use of publicly available information. A search on the internet proves that data on land use is not widely available to the public at the municipal level. On the other hand, it was found that data on floor space in England is open to the public (www.communities.gov.uk), so we used these data in the following discussion. We analysed the transition of floor space within different sectors in England to show what kind of precautions need to be taken when using relative changes in land use or floor space distribution among economic uses as early indicators for BF formation.

Statistics for two periods (1974~1985 and 1998~2005; ODPM, 2005) showed that although the number of industries and factories (as represented by the number of individual hereditaments[3]) increased over time, the floor space decreased slightly. As a result, the floor space per hereditament decreased dramatically (Figure 7).

This observation has two implications. As England became an effectively post-industrialised society since the 1970s (Couch, Sykes and Börstinghaus, 2011), the decrease of floor space used for industrial practice verifies our assumption that decrease of industrial land use can be seen as a proxy for deindustrialisation, and as a potential early indicator for the emergence of BFs. However, the decrease of floor space per hereditament reflects that, as technology progresses, the land resources required for industrial production may be streamlined. This means the industrial land use in a municipality may be reduced even when the industry has not out-migrated. In that case a BF may appear simply because the advance of technology reduces the demand for land resources.

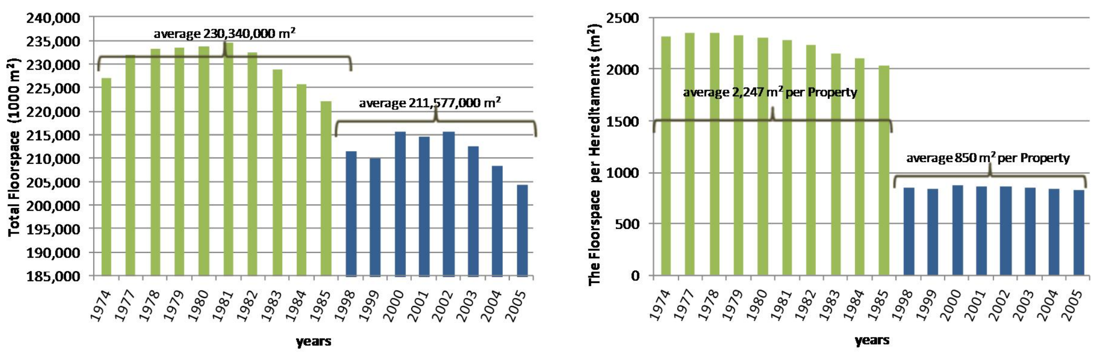


Figure 7. Change in floor space (left) and in floor space per hereditament (right) for industrial production purposes in England (ODPM, 2005, detailed floor space data from www.communities.gov.uk)

The floor spaces for retail premises and offices in the statistics represent the floor space for the service sector. The total floor space under these two classes has been increasing in England during the period of deindustrialisation, but the space per hereditament also increased between the two survey periods (Figure 8). Overall, this verifies the assumption that the land use for the service sector increases during the process of deindustrialisation. However, retail and office purpose floor space is more likely to be multi-storeyed as compared to industrial floor space. Hence, the increase in floor space may not be directly translated into an increase in the area of land use.

The changes in floor space of industry and service sector during the period of deindustrialisation in England fit the assumption that changes in land area or floor space for these economic purposes can be good indictors of deindustrialisation. Further analyses and verification based on land use data from different countries or municipalities may be useful, given that considerable variation in economic activities exists across Europe. Moreover, it should be noted that these indicators may be sufficient to mark the progress of deindustrialisation or economic restructuring in general, but whether such transition of the use of space necessarily threatens to create BFs requires more local assessment within individual

[3] any kind of property that can be inherited

municipalities. For example, an additional class in the floor space statistics is that of warehouses: “small storage units and depots to very large distribution warehouses”. A warehouse could mean a small addition of a commercial or office space (such as post offices and local shops) or a large area attached to a factory (Bruhns and Steadman, 2000). While the floor space for industrial purposes in England decreased over the period of deindustrialisation, the total warehouse floor space did not change much. In cities such as London the space used for warehouses has increased (Graham and Spence, 1997). Thus, some land resources released from early industrial practice in the urban areas already may have turned into warehouses, an example of land recycling that reduces the potential for dereliction. The statistics did not include the housing floor space (ODPM, 2005). For areas where population is growing and planning regulation allows, released industrial land could be transformed into residential use.

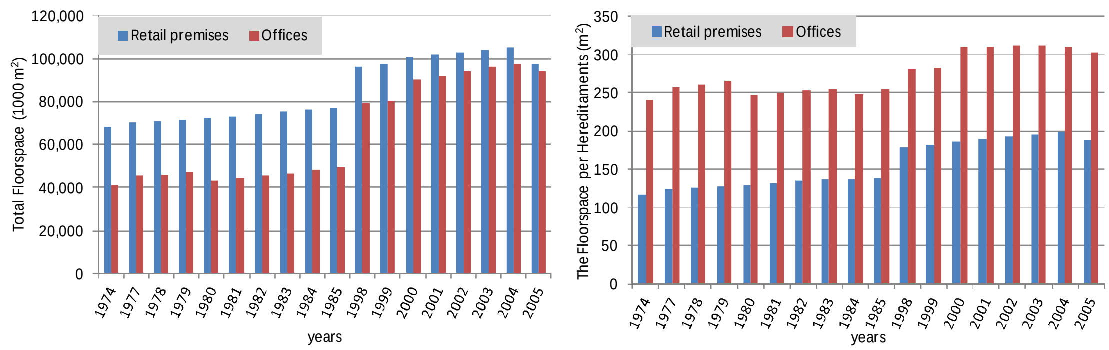


Figure 8. Change in floor space (left) and in floor space per hereditament (right) for retail and office purposes in England (ODPM, 2005, detailed floor space data from www.communities.gov.uk)

3.2.2.a Composition of employment and GDP

Deindustrialisation and economic restructuring are usually marked by changes in the compositions of GDP, employment, and profit returned in an area (Rowthorn *and* Ramaswamy, 1997). This is expected to be observed also at the municipal level. The change in sector dominancy may bring at least two different changes that facilitate the emergence of BFs. One is a change in land use as discussed in the previous section. Another is a change in class, income-group and/or professional composition of inhabitants. Historically, the large factories providing extensive employment opportunities attracted a dedicated working force to live nearby. These working class people tended to live near where they worked to save money in transportation (Hamnett, 2004). The people that work for the service sector, which is often spread out over more locations, and especially workers with higher income have more choice and might prefer to live in the suburb for better quality of life (Couch, Sykes and Börstinghaus, 2011). Therefore, if a city experiences significant shifts in professional compositions, it is likely to be accompanied by a change in demand for residential areas in the inner city and BFs could appear. It should be noted, that after this first wave of outmigration towards the suburbs, a trend of renewed interest in inner city areas that have been regenerated and revitalised, may be observed (Hamnett, 2004).

Therefore, the change of composition in professional workers (types of employment) and in GDP for industrial and service sectors can be early indicators of BF formation. A shift in dominancy of a particular economic sector should signal the need for further investigation on its relevancy and significance for BF formation.

As for the data availability, the composition of industrial sectors and service sectors can be obtained, as for example shown in Couch *et al.* (2005). The EU Urban Audit (http://www.urbanaudit.org/) provides comprehensive data for the socio-economic profiles for cities and regions throughout Europe. Data collection currently takes place every three years, but an annual data collection is being planned for a smaller number of targeted variables. Changes in GDP and employment composition for the larger cities could be derived from the database. Cities not included in the current list of 185 could adopt a similar data collection strategy. Alternative data sources could be the Chambers of Commerce within a region.

3.2.2.b Employment

According to Lange and McNeil (2004) important criteria for successful BF regeneration are the creation of long-term jobs, increase in the local real estate and income taxes. This indicates that the opposite could be considered as a warning sign of possible deterioration: decrease of number of jobs, decrease in occupancy rates for businesses, less tax revenues, lower Return on Investment and lower local land and real estate values.

Among these factors, the long term unemployment rate might be a good early indicator for BF formation considering data availability. Long term unemployment is usually referred to as unemployment of persons for more than 6 months. An increase in the long term unemployment rate may be the result of economic recession as well as of restructuring of the local economy. Both could result in the emergence of BFs. A recession results in the withdrawal of investment by industry as well as in the estate market, potentially creating dereliction. The restructuring of local economy: old economic activities fading away and new economic activities moving into an area, may result in increasing unemployment for people less flexible with regard to working skills. As it takes time to develop the new skills, such unemployment would likely be long term. Because of this, some BF regeneration projects particularly included a training programme for the local resident to help them get work in the new economic sectors after regeneration (Howland, 2007). For these reasons, the rise of long term unemployment can be an early indicator for BF formation. Furthermore, this is an economic indicator commonly measured and reported; it is likely that municipalities have access to such data, ready to be used.

3.2.3 Transportation

Poor accessibility to public facilities such as hospitals and post offices has been considered a form of deprivation (CLG, 2008). A poorly maintained or lacking transportation infrastructure may reduce the incentive for redevelopment of an area. On the other hand, sites previously used as large scale railway and harbour infrastructure easily become BFs in the post-industrialised European cities (Grimski and Ferber, 2001), when they lose their function. Transportation developments have been used in several projects to facilitate BF regeneration (some examples described in Amekudzi and Fomunung, 2004 and Lange and McNeil, 2004). Successfully regenerated sites usually have a good transportation network nearby (Lange and McNeil, 2004). Therefore, the effectiveness of transportation infrastructure and municipal or regional investments to maintain or update the infrastructure may be useful early indicators for BF formation.

Canadian government measured the transportation effectiveness from several aspects (Transportation Association of Canada, 2006). Based on the consideration of what types of ineffectiveness would result in lack of incentive for further investment on development, the issues most relevant to evaluate appear to be accessibility, mobility, operational efficiency and system preservation. The suggested indicators are listed in table 2, the relevance and availability of such data at municipal level for a specific area may need further investigation.

3.2.4 Urban sprawl, change of property value

Rent gap theory (Smith, 1979) explained the lack of incentive to maintain properties within urban areas by landlords or land owners during the suburbanisation. Based on this theory, before residential properties become underused or derelict, the capitalised ground rent[4] would decrease while the potential ground rent should increase over time if an urban settlement is expanding. The theory, however, does not consider the demand of the regeneration project (or consumption side of the land redevelopment) (Ley, 1986; Hamnett, 2004). Diappi and Bolchi (2008) suggested that the theory is more applicable at the district level but not for specific sites. This level of application would help the municipality to focus on specific districts for potential brownfield issues. Furthermore, since the emergence of BFs is the product of the changes (de-industrialisation, suburbanisation, recession) occurring at the wider geographic scale, monitoring the changes of capitalised rent gap at district level can help a municipality visualise the background issues at an early stage and therefore, plan strategically on the land use to prevent or reduce BFs from appearing.

Based on the first part of rent gap theory, the ratio of the property price in a district to those in adjacent districts can be one of the useful indicators for a municipality to spot possible future BF locations. If the ratio is significantly lower, a municipality should investigate further to more precisely identify possible future BF sites within the area. In Diappi and Bolchi's (2008) simulation, the capitalised rent was represented by the actual market price for the properties and the optimised rent was represented by the rent estimated under the assumptions that urban areas continue to grow. The price of the land was taken to be negatively correlated with the distance to the city centre. The price also increased over the urbanisation process. The model generated from this theory has also been applied to historical data of property prices obtained from several cities such as Adelaide in Australian, Malmo in Sweden, and Minneapolis in the USA. The values applied in each study to represent the rent gap varied and sometimes needed adjustment (Lees, Slater and Wyly, 2008).

Similar to other indicators, using property prices to find districts with potential BF problems has limitations. For example, if a city is shrinking rather than expanding, BFs may appear without a significant rent gap. Another point to consider is the change of land use. The rent gap theory is concerned with residential land use and does not consider the situation of derelict industrial areas in the post-industrialised city. The decrease of residential property price could be only part of the story of BF origination. Whether the rent gap theory can be modified and applied to other types of land use may be an interesting subject for further investigation. However, for now, we can restrict the comparison of property prices within the same land use categories. We can rely on other economic indicators relevant to de-industrialisation to provide a more complete picture of BF origination.

3.2.5 Recession

An economic recession may be an influential economic aspect for BF formation at national and international scale. For example, the UK was one of the countries seriously affected by the recession following the 1970s oil crisis and urban dereliction emerged concurrently (Couch, Sykes and Börstinghaus, 2011). France and Germany on the European continent were

[4] ground rent: rent paid for land to be used chiefly for building

less affected by the crisis and they faced the issues of urban dereliction later during the 1980s. Recently, the “ghost estates” in Dublin were the products of 2008’s Irish financial crisis and following recessions in the country (Coen and Maguire, 2012). For all these cases, dereliction was the consequence of the withdrawal of investment from the urban development resulting from the recession.

“A recession is a period of falling economic activity spread across the economy, lasting more than a few months, normally visible in real GDP, real income, employment, industrial production, and wholesale-retail sales.” (NBER, 2010). Therefore, the trend of national real GDP, real income, employment, industrial production and wholesale-retail sales may be early indicators for recession and a possible warning sign for BF formation. A recession is a national or global circumstance, and as such does not pinpoint to a specific area that is at risk of becoming a BF. However, early signals of recession would stress the importance of looking at other indicators for BF emergence.

3.3 Social indicators

At first glance, social aspects are expected to be impacts of, rather than drivers for BF emergence. Yet, they can be among the first signals that an area is on decline. The social perspective also tends to broaden the scope from just BFs towards urban development in general. For this wider scope, we consider a number of previous and on-going European projects and programmes. Specifically, we will address the European Urban Audit; the mainstream funding indicators of the European Regional Development Fund (ERDF); the 2009 Survey on perception of quality of life in 75 European cities and other city rankings studies; and the FP5 project on Large Urban Distressed Areas (LUDA, 2004-2006), all of which are briefly described below. In all of these projects, cities have been assessed or compared based on sets of indicators, for which evidently data were sufficiently available at the city level. We analysed these available indicators against the basic list of early indicators as given in HOMBRE deliverable D2.1 (Ellen *et al*., 2013), for their relevance as early indicators for BF emergence.

3.3.1 Projects considered

Urban Audit. The first full-scale European Urban Audit took place in 2003 for the then 15 countries of the European Union, following a pilot project for the collection of comparable statistics and indicators for European cities. In 2004 the project was extended to the 10 new Member States plus Bulgaria, Romania and Turkey. Under Eurostat coordination, the work of the Urban Audit involves all national statistical offices as well as some of the cities themselves. The second full-scale Urban Audit took place between 2006 and 2007, and involved 321 European cities in the then 27 countries of the European Union, along with 36 additional cities in Norway, Switzerland and Turkey. Data collection currently takes place every three years, but an annual data collection is being planned for a smaller number of targeted variables. The methodological handbook presents many variables and related indicators that are suitable to characterize urban change. Some of these could help define early warning social indicators for BF origination.

ERDF. The European Union promotes sustainable development as an element of the Cohesion Policy. Member States and their regions have the possibility, through drawing on the experience of the URBAN Community Initiative and the European *urban acquis*, to design, programme and implement appropriate, integrated development interventions in all European towns and cities. In the application of ERDF programs, indicators are used to designate priorities in funding. The objective is to allocate funds towards integrated urban development in deprived areas. An example is the region of Saxony in Germany (Figure 9)[5]. The Operational Program (OP) of the ERDF in the period 2007-2013 supports projects on "sustainable urban development" in 23 areas of various cities. The aim of the funding is to support cities and urban areas that have significant obstacles present that halt the development and implementation of structural, infrastructural, energy and/or education-oriented strategies and measures. The support focuses on areas affected by the expanding industrialisation of urban areas between 1870 and 1948. These areas are still marked by a significant number of buildings from this period. Urban planning, demographic, economic, environmental, cultural and social problems that have accrued in these areas are to be eliminated with a package of strategic measures. Integrated action plans are therefore the basis for the promotion and development of these urban areas. After conducting a problem analysis, the action plans present a range of different measures concerning up to five areas of action. These areas of action aim at strengthening and consolidating the program activities.

Figure 9. Example of halted development of urban area

City rankings. City rankings focuses specifically on the economic prosperity and quality of life in cities. The regular survey, most recently conducted in 2009, tests the perception of quality of life in 75 European cities, based on interviews with local citizens (EU, 2010). Social aspects included questions on the "Perceptions about social reality". However, difficulties may arise in establishing a clear cause-and-effect relationship between land related actions and BF appearance.

LUDA. Parts of cities with complex problems regarding the quality of life, e.g. economic, social, environmental conditions, urban structure and institutional capacity were named Large Urban Distressed Areas (LUDAs). They are usually not homogeneous but simultaneously comprise both substandard areas with multiple deprivations and more prosperous and rather intact areas which may be functionally interlinked with each other (LUDA, 2006). They are marked by spatially concentrated 'pockets' of decline, embedded in dynamic and

[5] http://www.nachhaltige-stadtentwicklung-sachsen.de/

heterogeneous spatial structures. These dynamic and heterogeneous structures are larger than single neighbourhoods and are characterised by complex struggles over the quality of life. According to the OECD (1998) urban distress is most intractable in developed countries, where issues surrounding improvements in the quality of life have become a matter of increasing political significance and challenge for policy-makers across Europe. In European cities, urban distress poses a particular challenge for policy-makers because it is experienced as an interlocking mix of social, economic and environmental problems. Social indicators for multi-faceted urban distress were developed by the LUDA project. In the context of environmental, economic and social distress the project proposed a strategic approach of sustainable rehabilitation and redevelopment of these areas. Similar to the HOMBRE objectives, LUDA intended to initiate the process of sustainable rehabilitation and development during the initial stages of decline. However, it did not yet embrace the viewpoint of perpetual land recycling.

3.3.2 Demographic development

Demographic changes as such were not yet included in the basic set of social early indicators for BF formation as presented in HOMBRE deliverable D2.1 (Ellen *et al.*, 2013), although changes in the composition of the population were included as indicators for e.g. population wealth and social cohesion (Table 3). Apparently, overall population decline does not yet feature widely in the scientific literature on BF emergence or regeneration. Remarkably, it is also not used as an indicator or background information in the EU city rankings of quality of life. Yet, urban shrinkage is not a new phenomenon at the macro-economic level. According to Martinez-Fernandez *et al.* (2012), "the development and decline of cities and city centres have, since the Chicago School of urban sociology, been viewed as a natural process whereby urban change results from lifecycle that end in inevitable decline."

Table 3. Basic set of social early indicators for BF formation

ELEMENT	CATEGORY	ISSUES INDICATORS MIGHT NEED TO CONSIDER	SUGGESTED INDICATORS	Effect on short/long term <10 years >	Scale Local/Regional/ National/Global	Source for data/info
Social	Demographic development	Population decline	Change in total population	Short term	Local/Regional	Local and national statistics
		Aging	Change in the distribution of age groups in area.	Long term	Local	Local and national statistics
	Societal development	Population wealth	% social rent dwellings % of uniform houses versus diversification of houses % change in income groups in certain period	Short term	Local	Local statistics
		Education level	% of university/higher education in certain period	Short term/ Long term	Local	Local and national statistics
		Available services	Average distance to schools / health care/ shopping areas / restaurants etc (specific to case)	Short term	Local	Local statistics
	State of the social system	Crime	# of vandalism incidents reported in certain period compared to regional statistics # of criminal incidents reported in certain period compared to regional statistics	Short term	Local/Regional	National Databases For example in the Netherlands: http://www.ad.nl/ad/nl/1401/home/integration/nmc/frameset/nieuws/misdaadmeter.dhtml
		Health	Average age of death	Long term	Local/National	Local and national statistics
		Social cohesion	Change in the distribution of age groups in area.	Long term	Local	Local and national statistics
			% of people feeling some sort of commitment with area		Local	

In situ population change forms part of the LUDA indicator set, as well as of the Urban Audit and the ERDF urban dimension programs, and was therefore added to the list of social indicators (Table 3). Evidently, if the total population of a neighbourhood has been significantly shrinking in recent years, the likelihood of BF origination from increased vacancy rates of apartments and houses will increase.

In addition to an overall decline in population, population aging has been added as a more long term predictor of population change. A high proportion of old people could indicate an approaching rise in vacancy rates (exemption nursing/pensioner homes) due to the possible move to nursing/pensioner homes or death. This may especially be the case if the structural features of the building are in bad condition due to an assumed low demand of new renters/owners. The Urban Audit also uses the proportion of households that are lone-pensioner households as an indicator for imminent demographic change. If the pensioners live alone it is even more likely that the house or apartment will become vacant in the upcoming years.

3.3.3 Societal development

This category of indicators covers the social aspects of development or decline. Economic and societal development are of course closely interlinked. Indicators like average rent prices, and property vacancy (or turnover dynamics), used in the Urban Audit, or average income/GDP and unemployment rate/employment opportunities (City rankings, LUDA) were here grouped under the heading of economic indicators (Table 2). Similarly, transport infrastructure is at the backbone of both the economic and social well-functioning of an area. Thus, issues such as the state and effectiveness of the public transport system (Urban Audit) were also grouped under the economy element.

In addition to more “direct” economic indicators, the Urban Audit includes indicators that assess the attractiveness of housing in an area based on the availability of basic amenities or whether they are self-owned or rented. BF origination is more likely in neighbourhoods with a high rate of dwellings lacking basic amenities than in neighbourhoods without this deficiency. Such dwellings are commonly not attractive if alternative affordable living space is available. A high percentage of self-owned property is likely to show a high continuance of residents, which could counteract BF origination. Moreover, especially in countries with a low rate of residential property such as Germany, residents living in their own dwellings indicate a higher attractiveness of the neighbourhood. The ERDF funding indicators include the percentage of welfare recipients and the qualification level of the population. The latter indirectly are also indicators for the attractiveness of an area. In general, a more diverse neighbourhood, both in terms of property and population, with a higher percentage of upper end housing and a larger proportion of higher income and higher education groups, is considered more attractive. Thus, a negative change in these indicators may be a first warning that, on the longer term, there will be a population decline. The basic set of social early indicators therefore includes indicators for population wealth, in part based on their housing situation, and for education level (Table 3).

City rankings considers the availability of health care services as a basic indicator for the quality of urban life. In our list of indicators, we have broadened this to services in general, such as schools, shops etc. The availability and quality of all these services can significantly contribute to the attractiveness of an urban area. Of course, a decline in availability or quality of services can both be the trigger or the consequence of an overall decline in population. The availability of green space and the absence of a high proportion of noise and dust generating roads are also viewed as important urban amenities (Urban Audit), but these categories will be specifically treated under the environment element (Table 4 and section 3.3).

3.3.4 State of the social system

Given overall demographic stability (3.2.1) and the conditions for an attractive living environment being present (3.2.2.), there might still be more interactive social factors that may cause an area to decline. One of the most obvious interactive social factors, that also forms part of the Urban Audit, is the incidence of crime. A crime rate significantly above average (as compared to the city/country) reduces the attractiveness of a neighbourhood or city. If affordable living space is available in areas with lower crime rates, it is likely that residents will move to these areas. Subsequently, vacancy rates could rise if there is no appropriate demand for living space in these - likely cheap - neighbourhoods. In addition to crime rates, the incidence of vandalism was also incorporated in the basic set of social early indicators (Table 3).

Health was identified in HOMBRE deliverable D2.1 (Ellen *et al*, 2013) as a potential early warning indicator. While discussed in the context of social deprivation, it did not turn up as a factor in land dereliction in the projects described in section 3.2.1. An overall decline in health of individuals is probably an example of a secondary indicator; it signals deterioration in other areas like income, crime, substandard housing maintenance, or environmental conditions. The specific indicator chosen: a change in the average age of death (Table 3), is a broad indicator that covers more or less all of these aspects.

A more intangible aspect of the attractiveness of a local community is the level of social capital, which includes issues such as social inclusion, cultural creativity, sense of heritage, and active citizenship (LUDA), in other words a sense of belonging. In the basic set of social early indicators we included the percentage of the population feeling committed to the area (Table 3). The City rankings survey includes questions on the presence and integration of foreigners, mutual trust between citizens, and feelings of safety to assess this issue. The presence of foreigners is viewed as contributing to a more diverse and open, hence attractive urban spirit. The basic set of social early indicators as presented in Table 3 includes changes in age diversity as an early indicator; this could of course be expanded to all other aspects of diversity for which data are available.

3.4 Environmental indicators

Although environmental issues like contamination may severely complicate the process of BF regeneration, environmental drivers did not emerge from the literature study performed for HOMBRE deliverable D2.1 (Ellen *et al*., 2013) as being of high priority for early indicators. Like social indicators, environmental indicators such as noise or air quality may be symptoms of BFs rather than causes. On the other hand, environmental factors contribute to making areas more or less attractive as places to live and work and negative changes in environmental conditions may accelerate other declining trends.

3.4.1 Pollution

The presence of contaminated soil or groundwater as a consequence of past economic activities is part of a BF's heritage, just like remnant buildings or other infrastructure, but has seldom been the direct cause of the cessation of activities. Businesses may have gone bankrupt because of the costs associated with compulsory clean-up, but in such cases the driver causing the change in circumstances is the effectuation of more stringent environmental regulations (or enforcement thereof), rather than an observed gradual increase in the degree of contamination.

Table 4. Basic set of environmental early indicators for BF formation

ELEMENT	CATEGORY	ISSUES INDICATORS MIGHT NEED TO CONSIDER	SUGGESTED INDICATORS	Effect on short/long term <10 years >	Scale Local/Regional/ National/Global	Source for data/info
Environ-mental	Pollution	Soil	Contamination amount/density; soil quality assessment	Short term/ Long term	Local	Local/National statistics
		(Ground)Water	EBI index	Short term/ Long term	Local/Regional	Local/National/EU statistics
		Air	NOX/pm10 concentrations	Short term/ Long term	Local	Local/National/EU statistics
	Green areas	The presence of green area at site and its quality	m2 of green area per inhabitant	Long term	Local	Local/National statistics
	Ecology	Biodiversity	Number of species per m2	Short term	Local	Local/National statistics
	Hindrances	Amount of hinder due to noise	amount of dB at different sites throughout the area	Short term	Local	Local/National statistics

Of course, sudden disastrous contamination spills may cause sites to become unfit for use, but they cannot be monitored as such. A local or regional assessment of disaster-risk can be made, and this would be part of safety monitoring and not specifically monitoring for BF emergence. Were considered relevant, such information could of course be included in the overall early monitoring for BF formation. The following list (COM, 2006b, Annex II) shows the types of land use and economic activity that are considered potentially hazardous, especially with respect to contamination of soil and groundwater:

1. Establishments were dangerous substances are/were present in large quantities[6];
2. Energy industries, production and processing of metals, mineral industry, chemical industry, waste management and other activities listed in Annex I to Council Directive 96/61/EC;
3. Airports;
4. Ports;
5. Former military sites;
6. Petrol and filling stations;
7. Dry cleaners;
8. Mining installations not covered by Council Directive 96/82/EC, including extractive waste facilities as defined in Directive 2006/21/EC
9. Landfills of waste as defined in Council Directive 1999/31/EC;
10. Waste water treatment installations;
11. Pipelines for the transport of dangerous substances.

Ideally, the administrator responsible for early monitoring of BF formation should have an inventory of such establishments in the area considered. This type of information is expected

[6] equal to or in excess of the amounts indicated in Parts 1 and 2, column 2 of Annex I to Council Directive 96/82/EC (Seveso)

to be available at the municipal level in conjunction with the land use data as discussed in section 3.1.1a.

Instead of monitored increases in contamination, growing awareness of the presence of environmental pollution may contribute to an area becoming less favourable for housing or business. This is in part a social issue, but may also be the result of increased monitoring at the European or national scale, because of EU regulations. In order to protect the soil-water system, different regulations are prepared by the EU. For soil there is the Soil Thematic Strategy (STS; COM, 2006a) and the proposed European Soil Framework Directive (SFD; COM, 2006b), for water the Water Framework Directive (WFD; COM 2000/60/EC) came into power in 2000. Following the outcomes of these monitoring efforts in view of their relevance to the local municipal level may also form a useful aspect of early monitoring for BF formation.

3.4.1.a Soil quality

The objective of the STS is to protect the soil while at the same time using it in such a way that it contributes to sustainable development. To this end, further soil degradation must be prevented, soil functions preserved and degraded soils restored. The STS identified as the main soil functions: food and biomass production, the storage and filtering of water, nutrients, and carbon, serving as a platform for human activities, serving as habitat and gene pool, providing raw materials, and being an archive of geological and archaeological heritage. Thus, the main threat to soils as currently perceived is soil sealing, or rather land take: the shift in land use associated with urbanisation (EC-SWD, 2012). Here lies a main contribution of BF regeneration to sustainability, as the re-use of already developed land limits the need for the release of greenfields (Figure 1). The other threats specifically recognised by the STS, in addition to soil contamination, are soil erosion by water or wind, decline in soil organic matter, loss of soil biodiversity, decrease in soil porosity through soil compaction, salinization, and floods and landslides.

As the SFD has not been adopted yet, there are no official regulations regarding soil monitoring. For soil contamination, the procedure proposed within the STS focusses on inventories of contaminated sites. This approach can be followed also at regional/local level, where the number, density, or area of registered or known contaminated sites is monitored. This type of information could also be available at the municipal level in conjunction with the land use data as discussed in section 3.1.1a.

3.4.1.b Surface and groundwater quality

Regulations and measures have significantly reduced pollution of European surface waters by point sources in recent decades. Nevertheless, effluent discharges from wastewater treatment plants and industries and the overflow of waste water from sewage systems (in the case of heavy rainfall) still cause pollution. However, nowadays most pollution of the surface water comes from diffuse sources, the key ones being fertilizers and pesticides in agriculture and pesticides on paved surfaces. Dirt run-off from roads as well as exhaust fumes also affect the quality of the water. The main pollution substances are nitrogen and phosphate, pesticides, PAHs and the priority trace metals (so called heavy metals).

Regarding diffuse sources, groundwater quality is threatened by the same activities as surface water quality. Point sources of groundwater pollution are related to (historic or recent) activities and events causing soil pollution (see section 3.3.1.a). For the Water Framework Directive all the individual member states of the EU have to formulate individual river basin management plans (RBMPs) for their own national part of each river basin. The RBMPs of all

EU member states can be found on the website: http://ec.europa.eu/environment/water/participation/map_mc/map.htm. The essence of the RBMP is an overview of the general and environmental objectives for all waters and a summary of the measures to be taken to achieve them. The RBMP further comprises a general description of the area, an economic analysis, an overview of the main threats to groundwater and surface water, and a description of the effects of climate change on water quality and water management. Moreover, the RBMP includes an overview of the programme of measures and the monitoring programme. For example, the groundwater monitoring locations for the chemical substances in the whole river basin of the Rhine are shown in Figure 10. Finally, the RBMPs incorporate several maps, including those presenting the current state of groundwater and surface water based on the monitoring programme. As an example, the result of the chemical status of the surface water and ground water bodies in the western part of the Rhine river basin is shown in Figure 11.

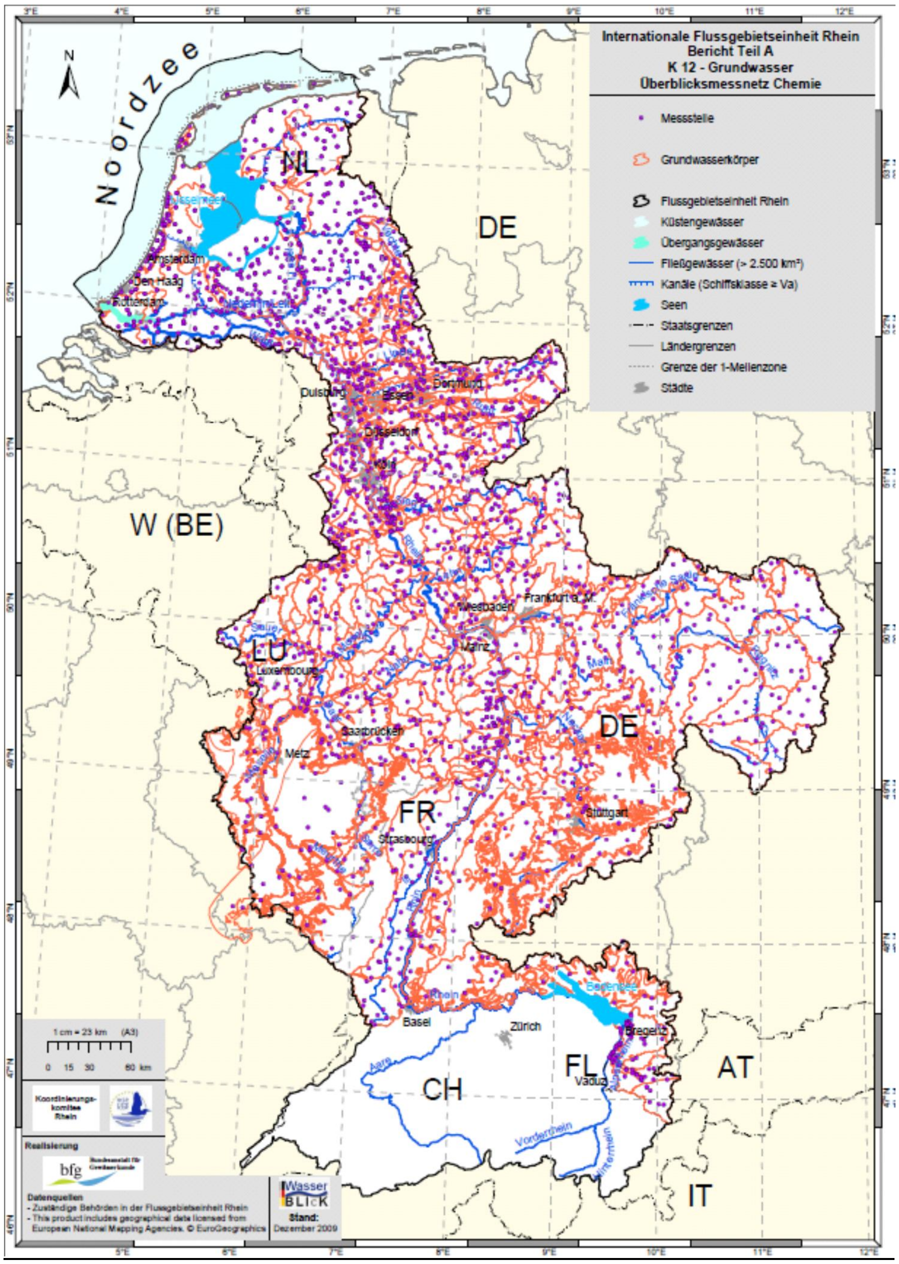


Figure 10. Groundwater monitoring locations for the chemical substances in the river basin of the Rhine.

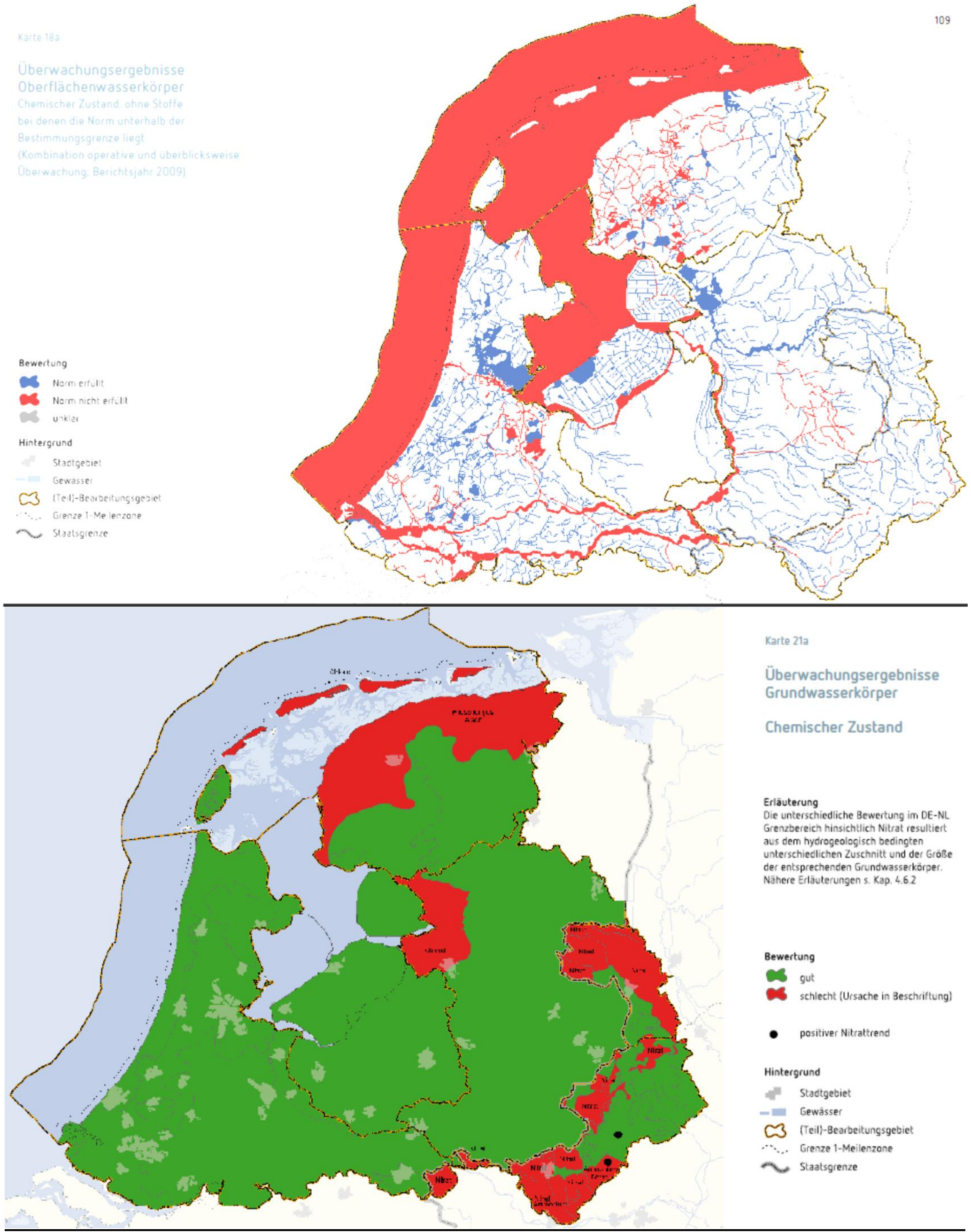


Figure 11. The chemical status of the surface water bodies (top) and the groundwater (bottom) in the western part of the river basin Rhine.

3.4.1.c Air quality

With the demise of coal as a major resource for household heating, nowadays the main sources of air contamination are air and road traffic and industry. A change in air quality thus could also indicate an increase in traffic intensity, which might lead to other types of hindrance (see 3.3.3) as well, that combined make an area less attractive for housing, offices or other services. If air quality deteriorates because of industrial emissions, this could be an indication of a decline in operational good practice of the industry, signalling potential future down cuts or closure.

In May 2008 the European directive on ambient air quality and cleaner air for Europe came into force (EC, 2008). In the directive a distinction is made between assessment of ambient air quality in relation to on the one hand sulphur dioxide, nitrogen oxides, particulate matter, lead, benzene and carbon monoxide, and on the other hand ozone. In principle, the assessment of air quality is based on continuous measurements, with regulatory limits defined for hourly, daily or yearly averages and/or peak values. If possible, random measurements that are adequately spaced in time, may serve as an alternative to continuous measurements.

A network of stations for measuring air quality has been implemented at EU level. As an example, Figure 12 shows locations operational for NO_2 (nitrogen dioxide) in 2010 with the annual mean concentration class. The majority of these monitoring stations have long term time series. Information on the existing monitoring networks and monitoring results for the various air contaminants can be found on the website of the European Environment Agency (http://www.eea.europa.eu/themes/air). Additionally, several of the larger European cities or industrial regions have more dense monitoring networks, for example Athens, (Touloumi *et al.*, 1996), Berlin (Lenschow *et al.*, 2001), or the Carpathian Mountain area (Bytnerowicz *et al.*, 2002).

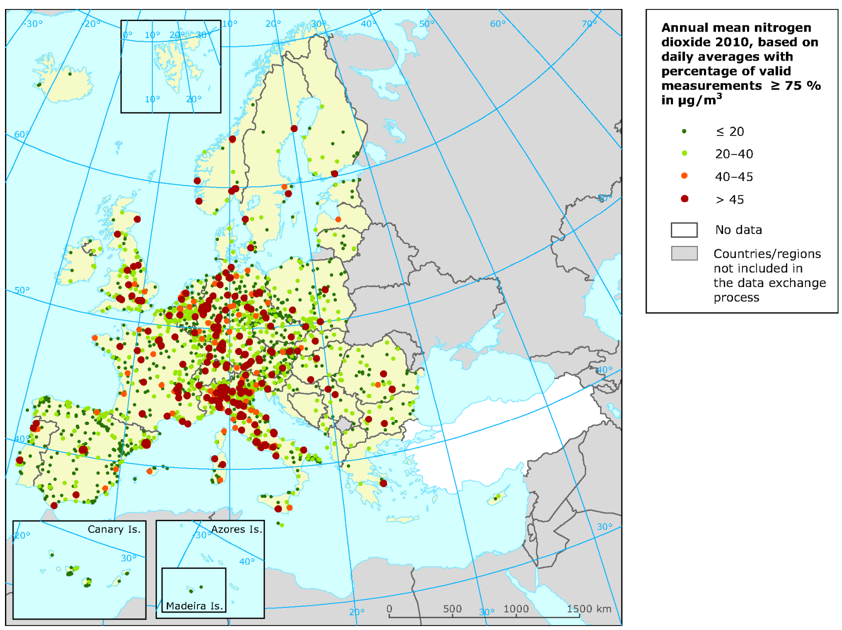


Figure 12. Annual mean Nitrogen Dioxide concentrations for the year 2010.

3.4.1.d Green area and ecology

The indicators “green area” and “ecology” address different aspects of the role of the natural environment in the - assessment of - the attractiveness and well-functioning of an urban environment. The presence of green areas generally plays a role in the well-being of residents, as they provide space for leisure activities and the possibility to be in contact with “nature”. Additionally, unsealed vegetated land contributes to the regulation of urban climate, air quality, and groundwater recharge. The chosen indicator, the available green space per inhabitant, may indicate a trend towards higher population density with or without increased soil sealing (e.g. with high rise buildings replacing single family dwellings), as well as a trend towards increased soil sealing to accommodate traffic and parking. Both may have negative impacts on an area. Thus, the green area indicator monitors a potential driver for BF emergence. The ecological status within an area reflects not only the quality of the green spaces, but the integral functioning of the urban ecological structure, which includes private (roof) gardens, waterways, vegetated road shoulders, presence of planter boxes etc. Like human health, this is an example of a secondary indicator that signals the impact of other drivers. Ecological data may be more difficult to obtain.

3.4.2 Hindrances (noise)

By environmental hindrances, we mean environmental impacts that can be detected by the human sensory system: eyesight, hearing, smell, taste, and touch. The latter two seem less relevant in this context. Environmental odour is more or less covered under air pollution, although significant odour problems may occur at air concentration levels below the detection limits of even the most sophisticated measuring techniques. In such cases, odour monitoring would need to be addressed at the perception level of individuals, which seems to be out of the scope of early indicator monitoring that makes use of already available information. The same would probably be true for monitoring visual pollution. We therefore focus here on noise as the most relevant environmental hindrance. Increased noise levels have a negative impact on the attractiveness of an area for most land uses (maybe with the exception of heavy industry). The major sources emitting noise are road and rail vehicles and infrastructure, aircraft, outdoor and industrial equipment and mobile machinery.

An example of a monitoring network for noise is the network of “Geluidsnet” (http://www.geluidsnet.nl/). Geluidsnet is a Dutch company that measures noise level in real time. Via internet they provide a real-time view of aircraft noise, an example snapshot is shown in Figure 13. Historical data are also available. Road, railway and industrial noise levels are measured within specific projects. The local noise sensors can measure every second, 24 hours a day and 365 days a year. Measurement results are sent real-time via the internet to a central computer. By analysing the noise pattern, noise from other sources than the target source can be filtered out.

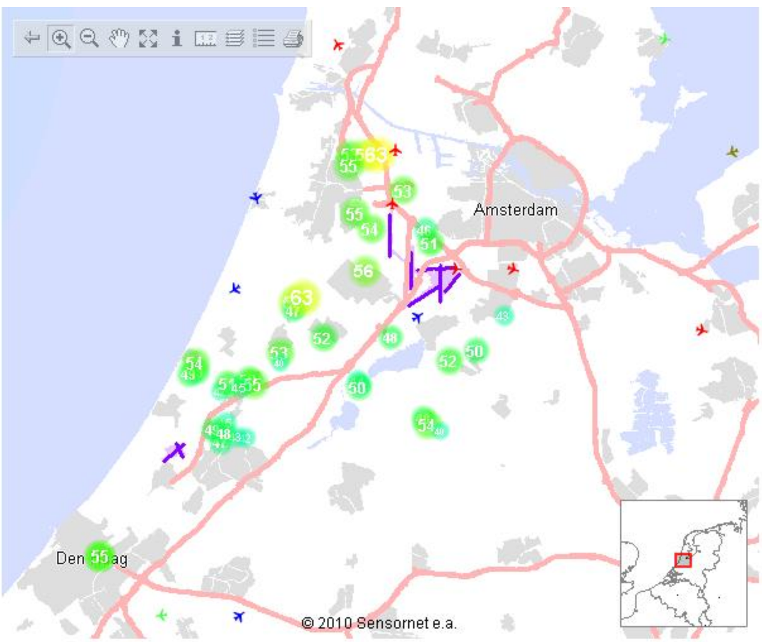


Figure 13. Example of a real-time snapshot of aircraft noise (29-03-2012, 11:00 CET; http://www.geluidsnet.nl/)

A European monitoring network for noise is the European Aircraft Noise Services (EANS; http://www.eans.net/). EANS is formed by a group of organisations that measure aircraft noise in their respective countries. The current monitoring network covers relevant areas in Austria, France, Germany, Greece, the Netherlands and Switzerland. In addition to providing data via internet, they publish scientific assessments on the impact of air traffic through noise and on the earth climate. Noise data are provided per country or region and airport statistics are given on different time scales (yearly, monthly, daily). An example of the yearly aircraft noise and the total noise near Salzburg in 2012 is given in Figure 14.

Noise Indicator L_{den} (Table):

☐ Switch from: L_{den} to L_{eq3}

☑ Lden (aircraft noise) ☑ Lden (total noise)

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	Aircraft noise						Total noise					
Month	L_{Day} (06-19)	$L_{Evening}$ (19-22)	L_{Night} (00-06+22-24)	L_{den} (1) (00-24)	L_{Day} (06-22)	L_{dn} (3) (00-24)	L_{Day} (06-19)	$L_{Evening}$ (19-22)	L_{Night} (00-06+22-24)	L_{den} (2) (00-24)	L_{Day} (06-22)	L_{dn} (4) (00-24)
January	46.0	45.7	33.6	46.4	45.9	45.3	49.5	48.1	52.9	58.6	49.3	58.5
February	45.6	45.5	36.7	46.9	45.6	46.0	49.4	47.1	40.6	50.2	49.1	49.6
March	47.5	45.6	31.7	47.0	47.2	46.0	56.0	51.9	48.9	57.3	55.5	56.9
April	44.6	42.3	32.3	44.6	44.3	43.8	59.0	58.4	53.0	61.3	58.9	60.6
May	46.5	43.6	36.1	46.7	46.1	46.1	59.7	59.8	55.8	63.2	59.7	62.6
June	48.4	47.4	37.5	49.0	48.3	48.1	55.9	56.0	52.2	59.3	55.9	58.7
July	49.2	49.2	37.9	50.1	49.2	49.0	55.0	52.1	46.9	55.8	54.6	55.3
August	49.3	49.9	37.3	50.3	49.4	49.0	54.4	53.8	46.0	55.6	54.3	54.7
September	48.5	48.6	35.8	49.2	48.5	48.0	52.5	50.3	43.5	53.2	52.2	52.6
October	46.8	47.6	36.8	48.1	46.9	46.9	54.3	49.8	41.8	53.9	53.8	53.5
November	----	----	----	----	----	----	----	----	----	----	----	----
December	----	----	----	----	----	----	----	----	----	----	----	----
Ø Year	47.4	46.8	35.6	48.0	47.3	46.9	55.9	55.0	51.4	58.7	55.7	58.2

XLS Export

(1) L_{den} according to European Environmental Noise Directive 2002/49/EC
Only the above-listed incidents of overflights will be included in the noise calculation, which means that the calculated value will be rather poor for stations with bad overflight detection.
The **grey** values **contain the evening- (+5dB) and night surcharge (+10dB)** according to the 'European Environmental Noise Directive'.

(2) L_{den} same as (1), but the **complete noise** is calculated, independent from the flight detection.

(3) L_{dn} same as L_{den}, but without evening surcharge

(4) L_{dn} same as (3), but the **complete noise** is calculated, independent from the flight detection.

Figure 14. Yearly aircraft noise and the total noise near Salzburg, Austria, 2012 (http://www.eans.net)

4 Definition and monitoring of service indicators

Building a results-based monitoring and evaluation system is first and foremost a political activity with technical dimensions rather than vice versa. (World Bank, 2004).

4.1 General purpose of service indicators

In the previous chapter we have focused our discussion on early indicators. In this chapter we will describe the definition - selection and/or construction – and monitoring of case-specific indicators primarily form the viewpoint of service and sustainability indicators. With the term 'selection' we mean that already existing indicators – from previous projects, or from other sources such as policy documents, literature - are used as an inspiration for a unique set of indicators for the project or program of BF regeneration that is being implemented. With the term construction[7] we refer to the process of building up an indicator from the start: what are our (sustainability) goals, which causal relations can we identify, how can we measure this causal relation, etc.

As described in Chapter 1, service indicators are site specific indicators for services being delivered, in terms of goods and benefits of the land use or of the regeneration process. They can be monitored during and after the realisation of the land use, to ensure that project goals, including longer term sustainability goals and as defined by the stakeholders, are met. Before we start on the selection and construction of service indicators we want to make two important points:

First of all, there is no such thing as a set of universal service indicators for BF regeneration (Silverthorne, 2006, Lichtenberg et al.,, 2007, Warhurst, 2002). Users and stakeholders must select, adapt and/or construct indicators suited for the purpose of monitoring their own sustainability goals for a specific BF regeneration or land transition process during the "planning the transition and realisation" phase of the administrative land management cycle (see figure 4 of section 2.1). In this phase it is already important to consider how indicators will be monitored and who will collect the relevant information (see section 4.4).

Second of all: the selection and/or construction of the service indicators and the following monitoring are not aimed at an *ex ante* evaluation of the costs and benefits as a means to select a certain option/technology train. In other words, the monitoring of the selected/constructed set of indicators is *not* a (societal) cost benefit analyses[8]. And although the definition of service/sustainability indicators for monitoring has parallels to the definition of sustainability criteria in planning, these do not one-to-one overlap (see Box 2). The aim of monitoring the service indicators is to certify on an *ex post* basis if the (sustainability) goals set for the project by its stakeholders are actually met, and if the project is successful in delivering the required 'services', both on the short and long term.

[7] With construction we refer to the design process of creating service indicators. When it comes to 'construction' of indicators many synonyms are used for example design, construction, development.

[8] A cost-benefit analyses concerning the selection of (technological) options/technology trains could also be part of the "planning the transition and realisation" and can sometimes even be required by law, similarly as an environmental impact assessment. The concept and application of a cost-benefit analyses is, however, not further considered in this deliverable. For more information on cost benefit analysis we refer to: http://ec.europa.eu/regional_policy/sources/docgener/guides/cost/guide2008_en.pdf

Box 2. Indicators versus criteria

Criteria are set in the planning phase to be able to select between different options for BF regeneration or land use transition. They usually set the goals for what a project should deliver in terms of essentials (must-haves), preferential requirements (that result in relative rating of options), and optional bonuses (that could make the difference in case of otherwise equally rating options). The main parallel with indicators is that both are used to set well-defined goals. The differences lie in the way they are used and assessed, and in their relevance in either the planning or the management/monitoring phase.

Criteria are used to select between options, indicators are used to monitor actual performance. By definition, the essential criteria are of main importance in the planning phase as they separate feasible from unfeasible options. As a consequence, the topics they refer to may no longer be relevant in monitoring, unless they also relate to a preferential requirement. Also, as criteria refer to a future situation, they cannot be strictly measured; based on available information they are calculated or estimated to some degree of certainty. Criteria for which large differences between regeneration scenarios are expected may only be qualitatively assessed. The gain with regards to such a criterion being "obvious" for a specific scenario may imply that monitoring of the analogous indicator would be superfluous once the scenario has been chosen. Furthermore, topics that may be relatively easy to calculate or estimate for a regeneration scenario may be far less realistic or cost-effective when monitoring is concerned or vice versa. Examples of the first are the total projected CO_2 emissions related to a regeneration project, or the decrease in contaminant flux to a surface water receptor; an example of the other would be local residents' satisfaction when measured in terms of number of complaints received.

4.1.1 Criteria for a 'good' service indicator?

What defines a good indicator depends on the purpose that the indicator will be used for. Some general criteria for the quality of indicators have been identified in practice and in various disciplines of science (Table 5). Most of the criteria in Table 5 are self-explanatory. However, a challenge for practical application could be how these criteria are met. Some of them could also be contradictory, for example *precise* and *available at reasonable cost*. Therefore it is always important to look at these criteria in a specific case.

4.1.2 Use and users of service indicators

When using indicators it is important to keep in mind what we are using the indicators for and who will be using them. This to prevent that *what* we want to measure and *how* becomes more important than the purpose of the indicator and the process it feeds into and the actual user of the indicator (Rigby *et al*. 2000). Both theoretical and applied literature on indicators agree on this, stressing the importance of explicitly defining objectives prior to compiling (performance) indicators. Warhurst (2002) argues that a clear, unambiguous definition of purpose – which also involves specifying the target user group(s) – is essential in constructing meaningful indicators.

Table 5. Examples of criteria for a 'good' indicator

Author/Project	Criteria for indicators
Warhurst, 2002	1. Meaningful and realistic measure (of environmental, health and safety performance). 2. Feasible to obtain in a cost-effective manner. 3. Easily understood and clearly defined. 4. Useful to senior management, the company, and line management 5. Able to facilitate comparisons between performance and company policies 6. Scientifically credible. 7. Able to provide early warning signals of unfavourable performance.
Singh *et al.* (2009)	The classification and evaluation of indicators can be done based on the following general dimensions of measurement: 1. Clarity and simplicity in its content, purpose, method, comparative application and focus. 2. Data availability for the various indicators across time and space. 3. Flexibility in the indicator for allowing change, purpose, method and comparative application.
Martin and Sauvageot, 2011	1. Relevance. 2. Capacity to summarize information without distorting it. 3. Precision and comparability. 4. Reliability and accuracy.
"SMART" (Drucker, 1954)	1. Specific – outline in a clear statement precisely what is required. 2. Measurable – include a measure to enable you to monitor progress and to know when the objective has been achieved. 3. Achievable – objectives can be designed to be challenging, but it is important that failure is not built into objectives. Employees and managers should agree to the objectives to ensure commitment to them. 4. Realistic – focus on outcomes rather than the means of achieving them. 5. Timely – (or time-bound) – agree the date by which the outcome must be achieved.
"CREAM" (Schiavo-Campo & Tomassi, 1999)	Performance indicators should be clear, relevant, economic, adequate, and monitorable (CREAM). This amounts to an insurance policy, because the more precise and coherent the indicators, the better focused the measurement strategies will be. 1. Clear: precise and unambiguous. 2. Relevant: appropriate to the subject at hand. 3. Economic: available at a reasonable cost. 4. Adequate: provide a sufficient basis to assess performance. 5. Monitorable: amenable to independent validation. If any one of these five criteria are not met, formal performance indicators will suffer and be less useful.
Practitioners (Hombre team)	1. Easy to communicate, 2. Understandable by uninitiated people 3. Supported by the stakeholders involved 4. Cost-effective: the effort of collecting information should be in balance with the improved certainty in decision making achieved.

4.1.2.a Use for service indicators?

As described by Alkan Olsson *et al.* (2004) different approaches may be discerned here. In the first approach the indicator measures the closeness to a defined target, with the aim to get the indicator to equal the target. In the second approach a direction for the indicator is defined, with the aim to g*et all* or some of the indicators to move in the desired direction. The first, i.e. using a defined target, is the most commonly used approach (Mitchell, 1996). This approach allows decision-makers to assess the gap or distance between the actual state and the desired reference condition. This desired reference condition could either be based on historical conditions, scientific data or for example the viewpoints of stakeholders. What level of deviation from the reference condition is considered acceptable could vary from zero to all sorts of compromises arising out of what is then essentially a political process. In the second approach, status is presented in relative terms. For example, the motivation for change could be to perform better over time. Other goals can be:

- Contribution to selected societal ambitions
- To show progress: for example to inform policy-makers on the functioning of set of policies, to prove to stakeholders that there is work in progress in the field of specific societal ambitions, and to be able to benchmark if goals are reached in the end.

4.1.2.b Users of service indicators

When constructing indicators it is very important to involve the users, – which does not only entail the people who will be collecting and managing the data behind the indicator, also the politicians and stakeholders who will be using the indicator as a base for decision making. Potential users of the service indicators that can be constructed using the approach described in the Hombre project can therefore be a widespread group of stakeholders. According to Susskind (1999): stakeholders are: *people, organisations or groups affected by an issue or conflict, with the power to make the decision or block the decision, or with relevant expertise*. To give some idea about the potential stakeholders in BF regeneration we refer to the CABERNET stakeholder wheel (Figure 15). When looking at this wheel it is important to keep in mind that:

1. Some of the stakeholders described (for example financiers and landowners) can either be private (companies) or public parties (international, national, regional and local government institutions)

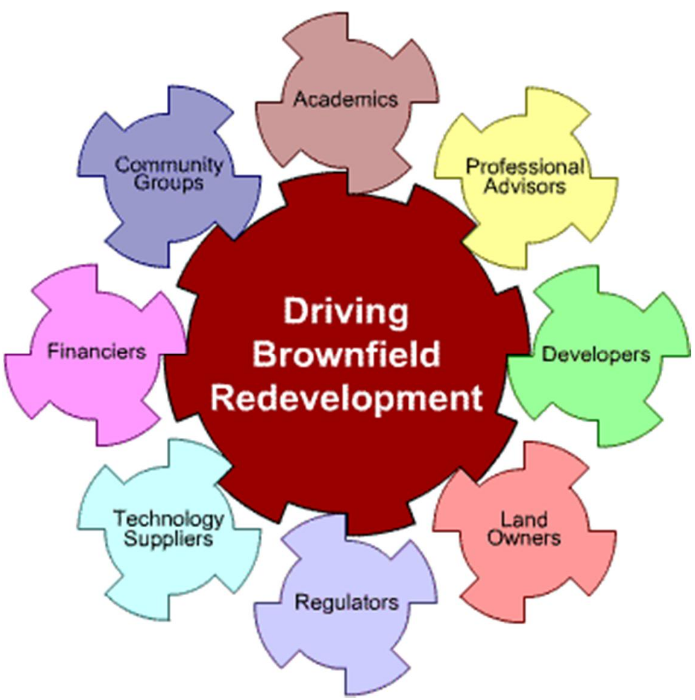


Figure 15. CABERNET: Stakeholder groups (http://www.cabernet.org.uk/)

2. Stakeholders are not only the organisations, institutions or persons outside the organisation taking initiative or (feeling) responsible, but also colleagues and other departments within the own organisation.

4.2 Selection of service indicators

Although as stated above, there is no set of universal service indicators we do want to agree with Warhurst (2002) who states that *tailor made approaches to developing indicators, that address specific stakeholder concerns, are more likely to contribute to sound investment decision processes than approaches which prioritize reporting against generic 'off the shelf' indicators. Notwithstanding, it is suggested that the latter can inform the former; and, that there are merits to developing combined 'top-down' - 'expert derived' and 'bottom up - 'stakeholder scoped' approaches to sustainability performance management (p. 2).*

This is in line with a similar conclusion from the REVIT project (Lichtenberg *et al.*, 2007): *'Indicator lists' from other projects form a good foundation as they may serve as checklists. They cannot, however, eliminate the need for selecting indicators (or objectives and indicators) and adapting them to each specific case. Moreover, as these lists cannot claim to be complete, they need to be supplemented in many cases.*

Caution should also be exercised in setting indicators *only* according to the ease with which data can be collected. "Too often, agencies base their selection of indicators on how readily available the data are, not how important the outcome indicator is in measuring the extent to which the outcomes sought are being achieved" (Hatry 1999, p. 55). This is why in Chapter 3 both relevance and data availability were discussed.

In the choice between predesigned or self-designed indicators there are some advantages and disadvantages to consider (World Bank, 2004, p. 74).

Advantages
- They can be aggregated across similar projects, programs, and policies.
- They reduce costs of building multiple unique measurement systems.
- They make possible greater harmonization of donor requirements.

Dis-advantages according to the World Bank (2004) are:
- They often do not address project/programme/country specific goals.
- They are often viewed as imposed, as coming from the top down.
- They do not promote key stakeholder participation and ownership.
- They can lead to the adoption of multiple competing indicators.

Clearly, the balance between the advantages and disadvantages is influenced by various factors, which are project/program specific. Here we just want to refer to a number of lists of service indicators that already exist, either for direct use or as inspiration for case specific indicators (Table 6). This overview is intended only as a means of providing resources, as we do not even attempt to give an integral overview of all the service indicators that have been constructed by past projects. Furthermore, some of the overviews, such as the European Common Indicators (ECI), are not specific for BF regeneration. For more guidance on how to select case-specific indicators from these general lists, we refer to section 4.3.2b.

Table 6. Examples of sets of sustainable development indicators both generic and specifically aimed at BFs

Project	Description	Country	Reference
European common indicators (ECI)	The European Common Indicators initiative is focused on monitoring environmental sustainability at the local level. A set of 10 environmental sustainability indicators have been developed in conjunction with stakeholders and methodologies for collecting the data for each indicator have also been produced in different European languages.	Europe	ECI-Website
SuRF-UK is the United Kingdom's Sustainable Remediation Forum – an initiative set up to progress the UK understanding of sustainable remediation.	The SuRF-UK Indicator Set for Sustainable Remediation Assessment supports the SuRF-UK framework document. This short document supersedes the initial indicator set published in March 2011 following their further development and refinement through Phase 2 in worked case studies and discussion groups. The document describes 15 categories of indicators spread over environmental, social and economic factors that can be used for sustainability assessment in support of remediation decision-making. It describes the factors included in each of the categories, how the categories were developed and how they can be used to support the SuRF-UK Framework and the key principles underpinning sustainable remediation that the framework identifies.	United Kingdom	SURFUK website
CABERNET (Concerted Action on Brownfield and Economic Regeneration Network)	CABERNET is the European Expert Network addressing the complex multi-stakeholder issues that are raised by brownfield regeneration	Europe	Indicator examples from CABERNET
RESCUE (Regeneration of European Sites in Cities and Urban Environments)	RESCUE was a research project integrating the concept of sustainability into brownfield regeneration. Based on the analysis and evaluation of current practice in industrial core regions.	France, United Kingdom, Poland, Germany.	RESCUE Website
REVIT (Revitalising Industrial Sites, see Figure 16)	REVIT strived to achieve a higher acceptance and better image for revitalised brownfield sites by testing their own models and tools on the local project areas of each partner and reporting best practice examples in this context to other cities and regions in Europe.	Germany, France, UK, The Netherlands	REVIT Website

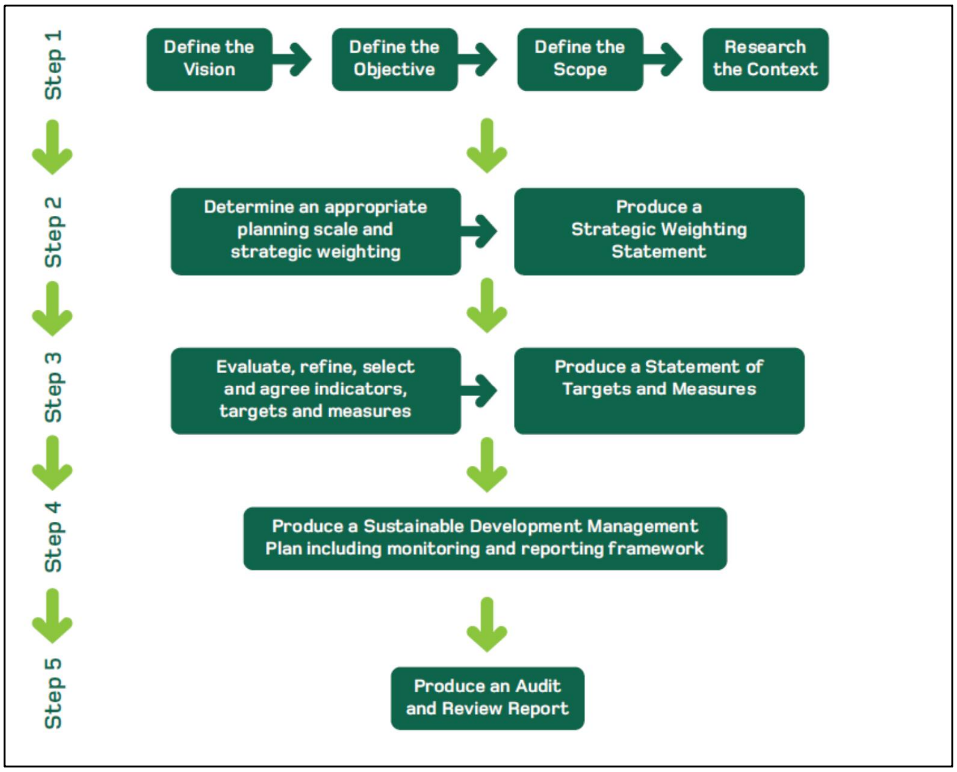


Figure 16. REVIT: Indicator development in the overall process from vision to audit report (Lichtenberg, 2006)

4.3 Construction of service indicators

In this section we will discuss *how* an indicator, or set of indicators, can be constructed "from scratch". We first will present some different approaches found in the literature and then will focus on what is basically a four step generic approach to define indicators. It can be preceded by an additional preparation step, and is followed by the actual monitoring and results assessment. Note that much of what is said below about constructing indicators is also relevant in selecting from a set of pre-designed indicators.

There has been much research from a multitude of disciplines and sectors into the concept of indicators. Descriptions of approaches how to construct them are less numerous. Furthermore these approaches are often scientific and highly conceptual in nature (Singh *et al*, 2009). One of the essential functions of quantitative indicators, however, is to reduce complex situations and developments to a few figures. This requires transforming complex situations into 'condensed information' describing the essentials. This means that indicators always reflect only part of reality, and that further information is mostly required for their interpretation.

A general line of thinking in the construction of indicators was already discussed in section 3.1, based on the basic set of early indicators as presented in Tables 2-4. This starts from relatively broad categories of relevant drivers or factors that influence BF emergence, via more specific issues to be considered within these categories, to a final selection of defined indicators. Table 7 displays selected specific approaches to indicator construction from the literature that show the variety in general approach and also the large differences in the level of detail and expertise that is needed to actually use these approaches.

Table 7. Examples of the construction of indicators both generic and specifically aimed at brownfields.

Handbook on Constructing Composite Indicators (OECD, 2008)
1. Theoretical framework provides the basis for the selection and combination of variables into a meaningful composite indicator under a fitness-for-purpose principle (involvement of experts and stakeholders is envisaged at this step). 2. Data selection should be based on the analytical soundness, measurability, coverage, and relevance of the indicators to the phenomenon being measured and relationship to each other. (involvement of experts and stakeholders is envisaged at this step). 3. Imputation of missing data is needed in order to provide a complete dataset. 4. Multivariate analysis should be used to study the overall structure of the dataset, assess its suitability, and guide subsequent methodological choices (e.g., weighting, aggregation). 5. Normalisation should be carried out to render the variables comparable. 6. Weighting and aggregation should be done along the lines of the underlying theoretical framework. 7. Uncertainty and sensitivity analysis should be undertaken to assess the robustness of the composite indicator. 8. Back to the data Is needed to reveal the main drivers for an overall good or bad performance. Transparency is primordial to good analysis and policymaking. 9. Links to other indicators should be made to correlate the composite indicator (or its dimensions) with existing (simple or composite) indicators as well as to identify linkages through regressions. 10. Visualisation of the results should receive proper attention, given that the visualisation can influence (or help to enhance) interpretability
Approaches to the development of Sustainability Performance Indicators and sustainable development management systems for the non-ferrous metals, oil & gas, power plants and mining sectors in the UK (Warhurst, 2002)
1. Assessment of the industry and review of the issues associated with its potential environmental, social and economic impacts. 2. Identify stakeholders - during the assessment of potential issues - that had a significant interest. 3. Preliminary visits were made to a representative group of industrial operations in order to consult formally and informally with employees and managers. 4. Based on the revised assessment of potential environmental, social and economic issues, plus consultation with the industry, and interested groups, three provisional lists of indicators, for environmental issues, for social issues and for economic issues, respectively were drawn up. These lists then formed the basis of further work. 5. A further round of more formal industry employee consultation was then undertaken – an employee survey was presented to all companies taking part in the second round of site 6. Having developed the three provisional lists of indicators, and following detailed feedback, a second set of site visits was undertaken in order to validate the indicators with the site representative and so to assist in the process of selecting those that are the most significant and useful indicators. **7.** Final stage in validating the lists of indicators was undertaken during the sustainable development process.

Table 7. continued

An Indicator-based Approach to Measuring Sustainable Urban Regeneration Performance: Part 1, Conceptual Foundations and Methodological Framework (Hemphill, 2004)
1. Conceptual consolidation: clarifying the basic concept to be represented by the analysis. 2. Analytical structuring: providing and analytical framework within which indicators will be collated and analysed. 3. Identification of indicators: translation of key issues identified in step 2 info specific measurable indicators. 4. Synthesis of indicator values: synthesizing the identified indicators into composite index/indices or into an analytical summary
Construction and selection of indicators: lessons learned and recommendations from the REVIT project (Langer *et al*., 2006, Lichtenberg et al., 2007)
1. Develop objectives and indicators from existing development plans, political decisions, and available target and indicator sets and complement them as required by additional visionary concepts for the planning area. 2. To be selected, objectives and indicators should be conformable with the relevant scale, meaningful for the area under consideration, pragmatic (verifiability, availability of requisite data), illustrative and easy to understand (communicability, marketing), and capable of exerting a profound controlling effect and meaningful for sustainable urban development. 3. Draft a preliminary list and harmonise it with various offices and departments. 4. Sort objectives and indicators by subject; do not break down too many headings into sub-items. 5. Between 5 and a maximum of 10 characteristic objectives and indicators per heading. 6. Present your list of objectives and indicators in a workshop as an open list containing preliminary selections. 7. Furthermore: It can be very helpful to have a clearly-structured list of suggested objectives and indicators. 8. The mere fact that sustainability objectives and indicators are discussed will improve the integration of the aspect of 'sustainability' in (urban) development. Thus, indicators may play an important role as political signals. This holds particularly true for process-related indicators as they show what control steps are required. 9. In urban development, indicators are normally used in ex-post evaluations forming part of a monitoring process. The REVIT project provides an example of how indicators may be used in the planning process so that consideration may be given to sustainability goals even at this early stage.

According to Singh *et al.* (2009), construction of (composite) indicators should be based on theory, empirical analysis, pragmatism or intuitive appeal, or some combination thereof. The HOMBRE project is aimed at practitioners and because of the importance of pragmatism and empirical analysis in the HOMBRE project we will use the examples of Table 7 as inspiration, but start with yet another approach to construct indicators for the outcomes of a process, as developed and described by the World Bank (2004). This approach uses ten steps for the entire monitoring and evaluation process (**Error! Reference source not found.**17).

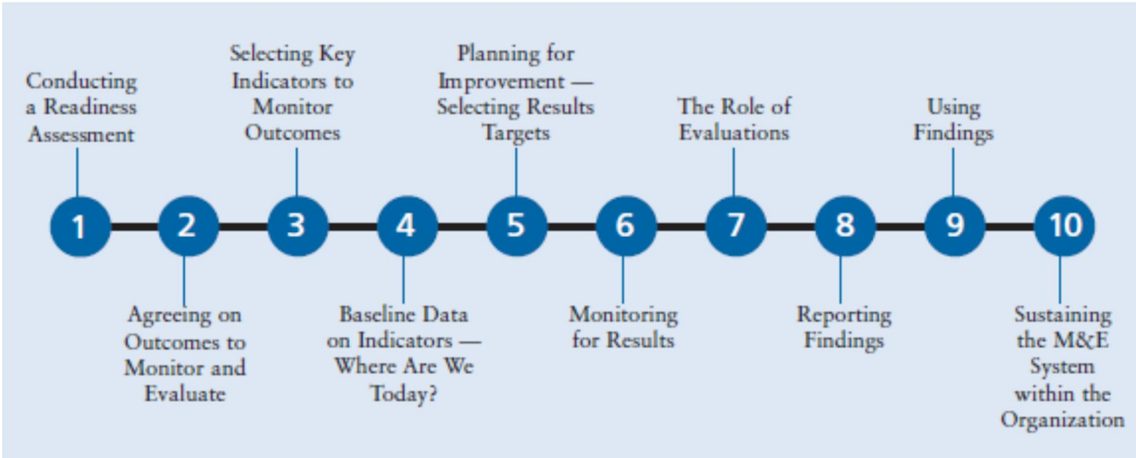


Figure 17. Ten steps to designing, building, and sustaining a results based monitoring and evaluation system (World Bank, 2004, p. 25)

The approach of the World Bank is focused on the national level and on more or less continuous development programmes such as eradication of poverty, increase of the general level of education, or progress towards social equality. Below we will go into the various steps of this approach and adapt them to the specific, more project based situation of BF regeneration or land use transition at the municipal level. The first step (section 4.3.1) can be considered as preparative and optional, steps 2 to 5 (section 4.3.2) in our view comprise the generic approach to define service indicators. Steps 6 to 9 address the actual indicator monitoring and evaluation and will be discussed in section 4.4.

4.3.1 Preparation (step 1): conducting a readiness (self)assessment

The World Bank approach starts the process of using a monitoring and evaluation system (M&E) with a *readiness assessment*. The reason for this is that most experts look at the "what" questions: what are the goals, what are the indicators, and not the "why" questions: why do we want to measure something, why is there a need in a particular municipality to think about BF issues, why do we want to use indicator monitoring to measure our success in reaching sustainability goals? This is also relevant for BF regeneration at municipality level that is the focus of HOMBRE. A readiness assessment provides insight in the ability of the project's coordinator/supervisor - municipal authority, private party, NGO or other user of the HOMBRE approach - to organise the indicator monitoring process. They do this by gathering information on current understanding, capacity, and use of existing monitoring and measuring systems. A readiness assessment consists of three elements (World Bank, 2004):

1. Identifying incentives and demands behind the willingness to construct and use an M&E system.
2. Identifying roles and responsibilities and existing structures for monitoring sustainable development.
3. Considering capacity building requirements for the use of an M&E system: this includes an overview of the current capacity to monitor and evaluate along the following dimensions: technical skills; managerial skills; existence and quality of data systems; available technology; available financial resources; and institutional experience. This is an important part as it can help to identify gaps in the capacity needed to build and sustain an M&E system.

A readiness assessment can be done as a form of self-diagnosis. It is up to the project stakeholders to decide whether to perform a readiness assessment or not. The reason to perform a readiness assessment is mainly to get expectations and opinions on the table concerning the M&E activities.

4.3.2 Developing indicators

4.3.2.a Agreeing on goals/objectives (Step 2), what do we want to achieve with the BF regeneration?

The development of sound indicators always starts with having a clear view on the road ahead: *agreeing on objectives*. This is also pointed out by the REVIT project: i*n the process* [ed. of brownfield regeneration], *it makes sense to distinguish between objectives and indicators, and to begin by identifying general objectives for the regeneration of the brownfield, following this up by deriving indicators from these objectives*' (Langer *et al.*, 2006, see also Table 7).

As such, neither the World Bank (2004) nor Langer et al. (2006) distinguish between formulating goals in terms of selection criteria for different development or BF regeneration options and formulating goals in terms of indicators for a specific option chosen. While this distinction may be less relevant for national programmes for sustainable development - that are usually formulated in broad terms and aimed at long term adaptive management -, as explained in Box 2 these only partly coincide in the case of BF regeneration and managed land use transition. In the HOMBRE Zero BF land management cycle, we distinguish phases of more intensive, project based management (the transition phases), within an overall cycle of continuous adaptive management (anticipating change and monitoring achievement), see the spiralled arrows in Figures 2 and 5 of chapter 2. In our view, most of the discussion below with regard to step 2 of the World Bank approach applies to the initial planning phase, when a selection between options still has to be made. Note that in HOMBRE, planning and realisation may overlap: while part of the goals may already have been defined of monitorable indicators, others could still be in a stage where the choice how to realise them has still to be made (Figure 5 of chapter 2).

Setting objectives in isolation can lead to a lack of ownership on the part of the main internal and external stakeholders. World Bank (2004) states that *indicators cannot be simply turned over to technicians, because the political apparatus has to be consulted and has to agree on both objectives and indicators*. Therefore, also in the specific BF regeneration situation, stakeholders should be involved through a participatory and consultative process. Because a BF regeneration project always takes place in a wider political and societal context it makes sense to adhere to policy and area objectives already in place.

Evidently, being well aware of the relevant stakeholders is crucial. Whether stakeholders are relevant to involve in the process is basically a political or strategic decision. The involvement of stakeholders can for example be based on the amount of influence or interest stakeholders have (Hermans, 2008). Often a stakeholder analysis or actor analysis is used at the start of a complex decision-making process, where it can also help to identify the concerns, objectives, and priorities of different actors and to mobilize relevant knowledge from a broad actor base (Hermans, 2008 p. 2, see also section 2.2). A variety of techniques such as brainstorming, focus groups, surveys, and interviews can be employed to discover the aforementioned actor subjects (see also Menger et al., 2013).

A workshop or meeting(s) should be organized to set the objectives/goals[9] collectively by the relevant stakeholders. In the HOMBRE view, these should be defined both at the level of selection criteria as at the level of measurable objectives for a chosen solution. Note that in the latter case the stakeholders should be those that are actively involved in the design, realisation and use of the M&E system. When setting goals, one should encourage outcomes to be formulated in a positive way as stakeholders will respond and rally better to positive statements, for example, “we want to improve safety in the area” rather than “we want to reduce crime”. Positive statements to which stakeholders can aspire seem to carry more legitimacy. Hence it is easier to reach consensus when speaking positively on the desired outcomes of stakeholders (World Bank, 2004). Furthermore it is important to ‘translate’ concerns or issues raised by stakeholders into more assessable outcomes, for example: ’my employees do not feel safe in the area’ to ‘improve safety in the area’. Examples of goals/objectives are shown in Table 8.

Table 8. Example of goals/objectives

Goal/Objectives	**Indicators**	**Baseline**	**Targets**
Eliminate contaminant risk			
Increase employment			
Improve safety			

4.3.2.b Selecting key indicators to monitor (Step 3)

Indicators can provide continuous feedback and a wealth of performance information. Ultimately, constructing good indicators will be an iterative process. Service indicators help us to answer two fundamental questions: “How will we know success or achievement when we see it? Are we moving toward achieving our desired outcomes?” (World Bank, 2004)

As indicator construction is a stakeholder process, the selection of the key indicators should be guided by the knowledge that the concerns of interested stakeholders must be considered and included. The set of indicators chosen should preferably be relevant across the concerns of multiple stakeholder groups, not just to those of a single stakeholder. This is not to suggest that there must be an indicator for every stakeholder group. Most importantly, the indicators have to be relevant to the responsible managers/decision makers, because the focus of such a system is on performance and its improvement (World Bank, 2004).

Criteria for a ‘good’ indicator were already mentioned in Table 5. Especially CREAM (clear, relevant, economic - in the meaning of cost-efficient -, adequate, and monitorable) can be used as a rule of thumb. In principle, indicators may be qualitative or quantitative. When setting up an M&E system, a simple and quantitatively measurable system is easier than inserting qualitatively measured indicators upfront. Quantitative indicators should be reported in terms of a specific number (number, mean, or median) or percentage. Although qualitative data is also important, it should be taken into consideration that this information is more time consuming to collect, measure, and distil. Furthermore, qualitative indicators are harder to verify because they often involve subjective judgments about circumstances at a given time.

The cost of setting indicators should be considered from the start. This means that indicators should be set with an understanding of the likely expense of collecting and analysing the data which will be gathered. Indicators being adequate implies that they should not be too indirect

[9] The words goals/objectives are used interchangeably in this chapter.

or so abstract that assessing performance becomes complicated and problematic. Indicators should be monitorable, meaning that they can be independently validated or verified. This is another argument in favour of starting with quantitative indicators as opposed to qualitative ones. Indicators should be reliable and valid to ensure that what is being measured at one time is what is also measured at a later time; and that what is measured is actually what is intended.

In summary, indicators should be well thought through. Unless for very good reasons, they should not be changed later on as this obscures the objective and may turn useless the data collected earlier. There should be clarity and agreement in the M&E system on the logic and rationale for each indicator from top level decision makers on to those responsible for data collection (World Bank, 2004). Examples of indicators for the goals listed in Table 8 are given in Table 9.

Table 9. Example of indicators

Goals/Objectives	**Indicators**	**Baseline**	**Targets**
Eliminate contaminant risk	Contaminant concentration in soil vapour at specified location		
Increase employment	Percentage of people employed in specified area		
Improve safety	Incidence of crimes in specified area		

4.3.2.c Gathering baseline data (Step 4), where are we today?

In this step the goal is to establish baselines that can be used at the beginning of the monitoring, as a starting point from which to later monitor and evaluate results. A baseline is the first critical measurement - qualitative or quantitative - of the indicators. (World Bank, 2004). An example of baseline information for specific indicators is given in Table 10.

Table 10. Example of baselines

Goals/Objectives	**Indicators**	**Baseline** (before the start of the BF regeneration project)	**Targets**
Eliminate contaminant risk	Contaminant concentration in soil vapour at specified location	above legal threshold	
Increase employment	Percentage of people employed in specified area	65% of the labour force (people aged between 18 and 65)	
Improve safety	1. Incidence of street robberies in specified area 2. Incidence of burglaries in specified area	1. 50 street robberies in past 3 years 2. 75 burglaries in past 3 years	

The challenge is to obtain adequate information for each indicator selected. With the number of indicators increasing this can quickly become a complex process, as each indicator will need data collection, analysis, and reporting. Already in the previous step 3, stakeholders should be conscious about the number of indicators chosen and have a realistic idea about the data systems that are already in place, what data can presently be produced, and what capacity exists to expand the breadth and depth of data collection and analysis. The baseline step thereby provides a first reality check and may result in reducing the number of indicators. As the World Bank (2004, p. 86) states: *Piloting of indicators and the information requirements behind them should be done—period. The pilot is a means of learning what works and what does not. It is a way of making small mistakes early rather than big mistakes later. A pilot alerts managers that there are some indicators for which data do not exist, or for which data are too costly, time consuming, or complex to obtain.*

According to the World Bank (2004) there are eight key questions that should be asked in building baseline information for every indicator:
1. What are the sources of data?
2. What are the data collection methods?
3. Who will collect the data?
4. How often will the data be collected?
5. What is the cost and difficulty to collect the data?
6. Who will analyse the data?
7. Who will report the data?
8. Who will use the data?

Data sources for indicators can be primary or secondary. Primary data are collected directly by the project organization involved, by means of measurements, questionnaires or interviews. Secondary data have already been collected by outside organizations, and are gathered for purposes other than those of the BF regeneration. They still need to be entered into the M&E system. Examples of secondary data are those provided by the European Environmental Agency (EPA), financial market data, or demographic survey data gathered by commercial organizations. Secondary data are useful when it is impractical or impossible to collect primary data, however, their validity and reliability for the regeneration process at hand should be assessed, e.g. by collecting a limited amount of primary data for validation.

If the sources of data are known, what will be the strategies and instruments for data collection? Decisions will need to be made regarding the remaining questions such as how to obtain the necessary data from each source, how to prepare the data collection instruments to record the information appropriately, what procedures to use (surveys versus interviews, for example), how often to access the data sources, and so forth. (World Bank, 2004). Figure 18 illustrates some of the possible methods of collecting data. The optimal method will depend on resource availability, access, needs, time constraints, etc. and not the least on how much precision is actually needed in light of trade-offs of cost and time. One should choose those indicators that will yield the best information at the lowest cost.

4.3.2.a Defining targets (Step 5)

This final step in the construction of indicators builds on the previous steps and involves the selection of results targets, which means translating the goals/objectives as formulated previously into quantifiable levels of the indicators that should be reached at a certain stage of the BF regeneration or land use transition process.

There are a number of factors to consider when selecting indicator targets. One factor is taking the baseline serious, as previous performance should be considered in projecting new targets. Another consideration in setting targets is their feasibility given the resources that will be employed and overall project capacity to deliver the intended outputs. Stakeholder involvement should ensure that resources are in balance with the required targets and vice versa. In many instances, a target does not point to a single value but sets the minimum or maximum for an acceptable range (Table 11).

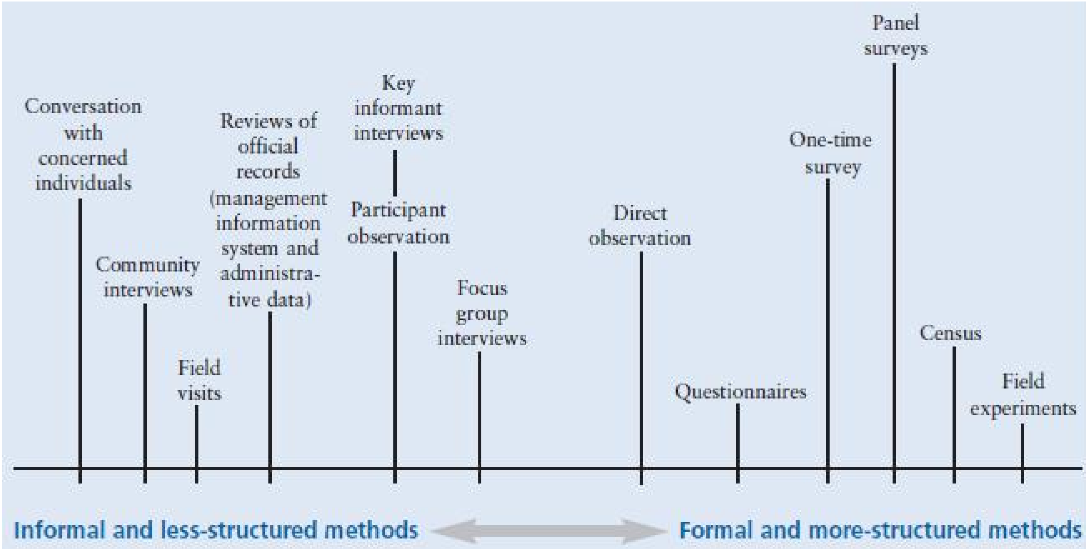


Figure 18. Data collection methods (source: World Bank, 2004, p. 85)

Targets should have a clear time frame. The World Bank also considers setting interim targets on the way to longer-term outcome, and flexibility in view of changing external conditions, but this may be less applicable in the case of BF regeneration. However, the adequacy of the trend observed towards reaching the target at the set time frame can also be included (Table 11). Relatively short time frames will be involved for indicators that monitor the services delivered by technologies during the regeneration process, while longer time frames may be involved for indicators that monitor less direct societal impacts of the regeneration. The time needed before significant (measurable) effects can be observed needs to be taken into account here as well. The realisation that the effect of a BF regeneration project on a chosen indicator may be relevant and significant, but only measurable after considerable time, could be a reason to reject the indicator at this point. An example could be where one of the goals is increase in health of the overall population.

Table 11. Example of targets

Goals/ Objectives	**Indicators**	**Baseline**	**Targets**
Eliminate contaminant risk	Contaminant concentration in soil vapour at specified location	above legal threshold	below legal threshold at the end of the active BF regeneration project
Increase employment	Percentage of people employed in specified area	65% of the labour force (people aged between 18 and 65)	at least 80% of the labour force, one year after the end of the active BF project
Improve safety	1. Incidence of street robberies in specified area 2. Incidence of burglaries in specified area	1. 50 street robberies in past 3 years 2. 75 burglaries in past 3 years	1. Decreasing trend, towards less than 7 /yr, three years after the end of the active project. 2. Decreasing trend, towards less than 10 /yr, three years after the end of the active project.

4.4 Indicator monitoring

As mentioned before, monitoring refers to the regular measurement of indicators that are considered of importance to managers and stakeholders - the 'critical variables' - (Plummer *et al*., 2013). In the literature, three stages are often discerned within the monitoring process (1) monitoring design, the selection of themes, indicators and methods as discussed in the previous section; (2) actual collection of data; and (3) use of results. Clearly, indicator construction or selection and monitoring are two sides of a coin. Where the choice of the indicator seems obvious - for example the nitrate concentration in groundwater in compliance monitoring for a nitrate directive -, the discussion will be approached from the monitoring perspective. A pitfall in such cases may be that the nature of the indicator has already been well-defined, but not the spatial and temporal resolution at which it should be monitored. The latter should be seen as an intrinsic part of indicator construction.

Each of the stages in the indicator monitoring process can be more or less participatory (e.g. Danielsen *et al*., 2009): decision-making on design, data collection or interpretation could be done exclusively by professional researchers (low on participation) or, as recommended, by involvement of local stakeholders (high on participation). In this section, we will discuss some aspects of the actual data collection and outcome assessment (steps 6-9 in Figure 17). These aspects equally apply to both service indicators (managed process) and early indicators (quasi-autonomous processes).

Functions of monitoring include the reduction in risk and uncertainty (a clear aspect of the HOMBRE early warning indicators), enhancement of transparency and accountability towards stakeholders (, the fostering of learning about how a systems function, or about the feasibility and desirability of objectives (Cundill and Fabricius, 2009; Plummer and Armitage, 2007). The most important, but often neglected, aspect of monitoring is that consequences should be directly linked to its outcomes: not reaching a set target should lead to adjustment of management decisions and project implementation. Once indicator targets have been defined, such consequences must be explicated.

The practical aspects of collecting monitoring data further include: defining protocols for the measuring or observation method, the frequency at which data should be collected, the way data should be stored and made available to internal and external stakeholders, the frequency at which data should be evaluated, and identifying the person or organisation responsible for each of these aspects.

When a large investment is needed and monitoring has a long time horizon, it is worthwhile to do an in-depth cost benefit analyses on different types and intensities of monitoring (see Box 3). Within the context of BF regeneration at a municipal level, limited resources will usually be available for the actual monitoring of the indicators chosen. In this situation, looking at both internal and outside resources is recommended.

- Internal resources: the monitoring effort should fit the financial, skills, and knowledge constraints of the project's stakeholders, and respect prerequisites such as time horizon and technical aspects.
- Outside resources: these include on-going monitoring networks and data available as well as available expertise. These should be sought also within other parts of the own stakeholder network or organisation.

Presentation and communication of monitoring results may take a number of forms, depending on who the end-users are. Basic spreadsheet tables and graphs may be sufficient for internal use by project management, whereas more advanced visualisation tools may be preferred for external stakeholder communication. To be useful or understandable to different stakeholders, the indicators may have to be translated into new forms or aggregated, before they are communicated.

Multiple indicators can sometimes be aggregated into a single index. This is usually done to increase simplicity but has the fundamental risk of lack of transparency. One solution to balance simplicity and transparency is present all separate indicators within a single table or diagram (visual integration). Visual integration is basically a means by which individual and sometime quite different indicators are presented together to provide a comprehensive picture.

Box 3. Cost Benefit Analysis of groundwater monitoring (van Geer *et al.*, 2008)

For many water management tasks there is an obligation for groundwater monitoring. Usually the design of the monitoring system is based on the relation between the monitoring effort and the uncertainty of the information. Often the estimation error is used as criterion for the design. An example is a groundwater head monitoring network, based on the maximum allowable Kriging standard deviation. Despite the fact that, for scientists, the standard deviation as a measure of uncertainty is a logical criterion, water managers are unable to deduce the exact value of the standard deviation. Therefore, in practice, the criterion is chosen more or less arbitrarily, and often the available budget is decisive for the monitoring set-up. This practice may lead to either unnecessary high monitoring effort, or to high level of uncertainty. In both cases it might be a waste of money.

It is possible to express the benefits of the monitoring system in economical terms. There exist a relation between the uncertainty of the information and the monitoring effort. The less monitoring effort, the more uncertain information from the monitoring network and consequently the higher the risk of economic damage (financial loss). This enables the comparison between the risk of economic damage with the cost of a monitoring system, and an economical optimal monitoring strategy can be designed.

5 Testing the framework and indicators within HOMBRE cases

5.1 Craiova municipality – Jiu Basin in Romania

Craiova municipality is located in Dolj county, in the Oltenia region in SW Romania, at the eastern bank of the river Jiu. The Jiu basin is one of the largest open cast mining areas of Europe, responsible for 90% of the lignite production in Romania. The lignite is used as fuel for the production of electric power and thermal energy in several power plants in the area. The available energy powered the Industrial Revolution in Romania and has attracted several industrial activities. Mining, power production and industry currently are all related to various contamination problems and other BF issues.

According to Popescu & Pătrăşcoiu (2012), the BF concept has been poorly understood in Romania. Brownfields are defined as contaminated land by the Ministry of Environment and this would explain why Romania is listed as the European country with the highest density of BF sites. There are neither official Romanian government led studies on BF formation and regeneration, nor any financial or legal policy framework, let alone regulations in this domain.

The Jiu Basin was selected as one of the HOMBRE cases studies, as a potential test case for the various concepts and approaches to be developed within the HOMBRE project. Due to economic and organisation changes, not all of the stakeholders that initially had expressed their interest in the HOMBRE project were available for cooperation in the end. The final objective chosen for the "Jiu case" was to test the generic HOMBRE BF-land management framework, in particular looking into indicators for BF emergence. As the framework is viewed to be specifically applicable at the municipal administrative level, the case was narrowed to the Craiova municipality.

The testing focused on identifying and quantifying some of the proposed early warning indicator of BF emergence from HOMBRE Deliverable D2.1 (Ellen & al 2013). It also aimed at assessing data availability for the relevant indicators to Craiova municipality. From a research perspective, on-going monitoring of early warning indicators for potential BF emergence may be only partially informative. Instead, the HOMBRE research focused on retrieving existing monitoring data, compiling historic trends and assessing the relevance of the studied indicators in relation to existing BF sites.

A major cause of BF occurrence in Craiova municipality was the former heavy industrialisation followed by deindustrialisation and dramatic political system changes (fall of communism in 1989). The area has since experienced profound changes in its economic features. The economic crisis, the failure of oversized industrial enterprises to face new market economy and the reluctance of investors to invest in Craiova city industry has resulted in the development of some compact built areas next to areas of redundant infrastructure (Popescu & Pătrăşcoiu, 2012). The major restructuration of the mining sector in 1997 in the Jiu Basin, the damaged landscapes and the contamination issues are further elements that do not attract investors for brownfield regeneration projects.

An inventory of existing BF sites in Craiova municipality has been mapped by Popescu & Pătrăşcoiu, 2012 (Figure 19). Three types of BF sites were revealed: derelict industrial zones, abandoned agricultural buildings and residential BFs. Ash and slag waste produced by the thermal coal power plant Craiova I, in the Isalnita industrial complex 10 km North West of Craiova, is deposited in large dumpsites along the Jiu river. Although not mapped in

Figure 19, these dumpsites are also considered BFs. This waste and the presence of the nearby disused and abandoned fertiliser plant are very likely sources of contamination observed in the groundwater.

Based on the BF formation history in Craiova, the search for available historic data focused principally on economic early warning indicators (See draft report - Limasset & Van Ek 2013). The following economic indicator categories were studied: deindustrialisation and restructuring, urban sprawl and recession. Data availability for social early warning indicators was also assessed (societal development and state of the social system categories). Although the area currently suffers from unresolved environmental problems; environmental drivers as such did not emerge as being of high priority for early warning of BF emergence.

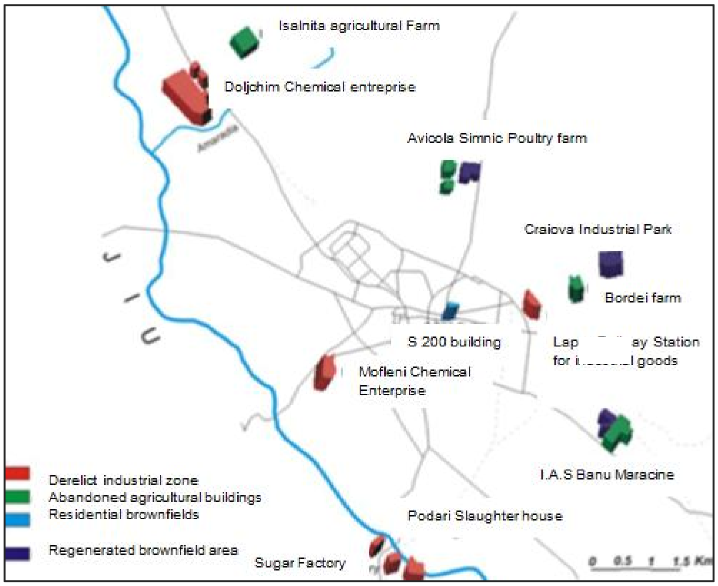


Figure 19. Typology and location of Brownfield sites in the Craiova-Isalnita area (Source: Popescu & Pătrăşcoiu, 2012)

Many data sources could easily be found on the internet, which allowed downloading of statistical data for free and occasionally the visualisation of data trends over several decades (e.g. Eurostat). This exercise resulted in listing metadata for the relevant indicators (where available: source of information, available times series, and scale, etc.) and establishing trends (Limasset & Van Ek, 2013).

The Romanian Institutul Naţional de Statistică (INS) provides all kind of national, regional and local statistical data (i.e. Craiova municipality). It also proposes a very wide set of indicators for sustainable development which data can be downloaded for free for a national coverage and occasionally a regional coverage (i.e. Oltenia region) from 2000 onwards. Most of the proposed categories of indicators coincide with the HOMBRE economic and social indicators (e.g. structural changes and macroeconomic equilibriums, sustainable production and consumption, public health, social inclusion, demography and migration, education and vocational training, administrative capacity and quality of public services, etc.).

The EU Urban Audit provides comprehensive data for the socio-economic profiles for European cities and regions (Eurostat). The indicators and variables cover many aspects of quality of life, for e.g. demography, housing, health, crime, labour market, income disparity, local administration, educational qualifications, environment, climate, travel patterns, information society and cultural infrastructure, etc. Data collection currently takes place every three years. Records go as far as 1989 for Craiova but not many parameters are available. Apart from population statistics they do not really relate to the early warning indicators.

Eurostat publishes data that can be retrieved for the Oltenia region under the NUTS[10] 2 scale and for the Dolj county under NUTS 3 scale. Most of the proposed categories of available data coincide with the HOMBRE economic and social indicators (e.g. demography, economy, education, business, health, migration, poverty and social exclusion, etc.)

Statistical data can also be found from the 2008 Socio-Economic Development Strategy Report for County Dolj (Consiliul Judeţean Dolj, 2008). However, data is usually only presented for 2001, 2002, 2003, 2004 and 2005 and comes from the INS.

Bearing in mind the long history of BF formation, time series for relevant indicators starting from 1960 onwards (beginning of large scale mining) would be of great interest, to show growth and decline and potential incidence on BF formation. However, availability of economical and social time series was mostly good for the period after 1989. Data from before 1990 was harder to come to by.

Overall, data availability would allow evaluating most of the proposed HOMBRE economic early warning indicators based on the available Romanian statistical data. An exception were data on – changes in - land use, for which no data source was found. However, spatial resolution may be limited. Finding relevant data at national, regional or county scales was relatively easy. Data found for Craiova municipality were sometimes less relevant and will certainly not allow zooming in on specific neighbourhoods.

For data that was available and relevant, an attempt at establishing historic trends was made. Because of resource constraints, potential relations between these historic trends and known BF formation in Craiova were not yet assessed.

[10] nomenclature of territorial units for statistics

5.2 Solec Kujawski, Poland

The municipality of Solec Kujawski is located in central Poland, on the southern bank of the Vistula River (Figure 20). The distance to Bydgoszcz –the capital of the Kuiavia-Pomeranian Voivodship– is about 15 km, Torun is about 35 km to the southeast. With a size of about 15000 citizens, Solec Kujawski is representative of a statistically largest group of cities in Poland (Figure 21): relatively small cities with their local problems, including BF issues.

Figure 20. Location of Solec Kujawski in Poland

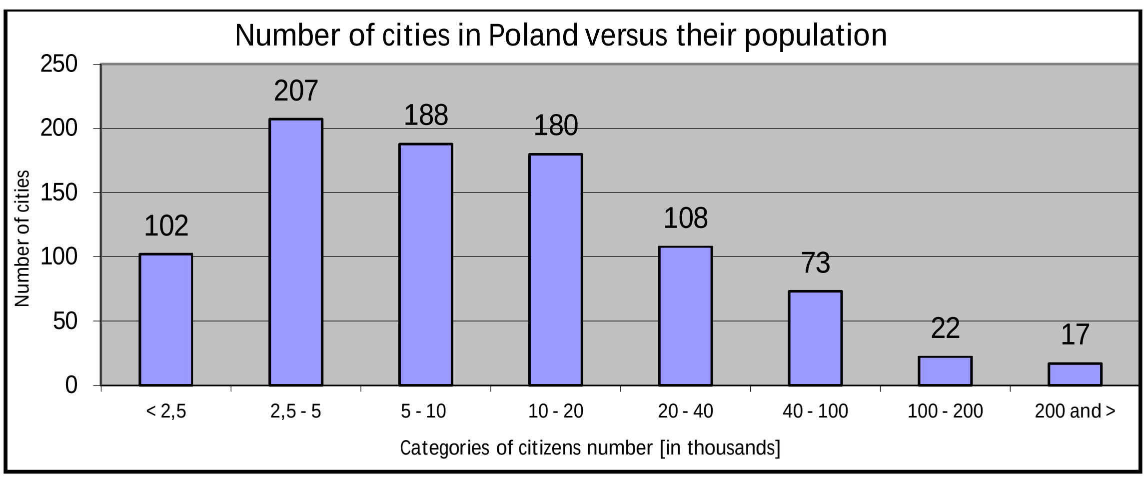


Figure 21. City sizes in Poland

A major BF within Solec Kujawski, and further reason it was selected as a HOMBRE case study, is the location of a former wood preservation factory. The area is now abandoned and the aboveground infrastructure largely demolished, but soil and groundwater are still heavily polluted with creosote (containing the allied products of dry coal distillation like PAHs, BTEX, Phenols), mineral oil and PCBs, that were used as additions. This contaminated site also figures as a case study in the project TIMBRE[11], who tested the possibilities of in-situ soil flushing with recycling of the washing fluid. The BF is located close to the city centre, in

[11] Tailored Improvement of Brownfield Regeneration in Europe, www. Timbre-project-eu.

between a housing estate (high-rise blocks, school, shops etc.), a railway line and a city forest with local touristic attraction named Jura Park. The intended re-use of the area focusses on commercial and recreational activities. Remediation of the area is currently under progress with co-financing from the European Regional Development Fund. A Technology Train is put into practice that consists of selecting the waste dumps and removing the creosote tar and old containers, followed by soil washing and the use of inoculated microorganisms in bio-ponds. Furthermore, old structures like basements are demolished, separated into contaminated or clean, and crushed for re-use.

In April and June 2013, two workshops were organised jointly between the Hombre project and Solec Kujawski municipality. The April workshop was an internal Hombre-Solec affair, in preparation of the June workshop that aimed to address an external and more regional audience. The objectives of the April workshop were for Solec Kujawski to get better acquainted with the Hombre ideas and concepts, and for Hombre to test the concepts developed so far against a real situation. We wanted to know if and how the Hombre concepts contributed to the analysis and subsequent solution of the Solec Kujawski BF issues, seeking answers to questions like:

- Where does Solec Kujawski stand?
- Where does it go?
- What needs to be done to make that work?
- What additional potential benefits may be gained?

and

- Are concepts like circular land management, early indicators, zero BF perspective, synergy, recognised/understood at the practical level?
- Are they relevant?
- What aspects are missing or overlooked in the Hombre framework?

The objectives of the June workshop were to present the approach taken by Solec Kujawski to address its BF issues and disseminate the Hombre concepts and approaches to a wider audience. The June programme also included a presentation of the results of the TIMBRE pilot.

The exchange between Hombre and Solec Kujawski made clear that the municipality of Solec Kujawski easily adopted the Zero BF philosophy of HOMBRE, as it is very much in line with the type of policy they have been implementing for some years already. The municipality is very active in advancing the cities development in general, including the remediation of contaminated BFs and trying to find new solutions for abandoned areas, in order to make an attractive and sustainable city for its inhabitants.

In order to attract new investors an industrial park was founded – here the industries can make use of the benefits of the Solec Kujawski's location between two big cities Bydgoszcz and Torun, close to a big road and Vistula river. Regeneration examples from the recent past are the successful attraction of the National Polish radio station to the municipality, which now settles on a former bomb and military training area; the realisation of the "Jura Park", a theme park built in parts of the old town park with approximately ½ million visitors per year; but also the restoration buildings: the former cinema is now and education centre, and the local museum occupies one of Solec Kujawski's historic buildings.

The cooperation with Hombre made Solec Kujawski realise that these latter restoration initiatives, and not just the cities contaminated locations, are also examples of - former - BFs. Based on that, their analysis showed that Solec Kujawski is confronted with three different types of BFs:

1) Post-industrial (partly contaminated) BFs, specifically the location of the wood preservation factory, a former tannery, an excavation and post construction plants;
2) Abandoned areas that have not been affected by industry, such as the town park Miejski.
3) Buildings that were no longer used for the purpose they were originally built for.

Other Hombre concepts/ideas that were particularly welcomed and/or practised already were :

- The use of early indicators on micro-macro scale, to start thinking about regeneration opportunities in an early stage;
- Including the long term in development strategy and planning, not only to think also about future generations, but to realise that sometimes interventions can already be easily made in preparation of future development;.
- The importance of stakeholder involvement, Solec Kujawski is keen on involving the local community in spatial planning as well as in using public-private partnership structure (for example the Jura Park: the infrastructure is provided by the municipality the park is privately owned).

The Solec Kujawski case study was of particular value for the Hombre project, in that it showed

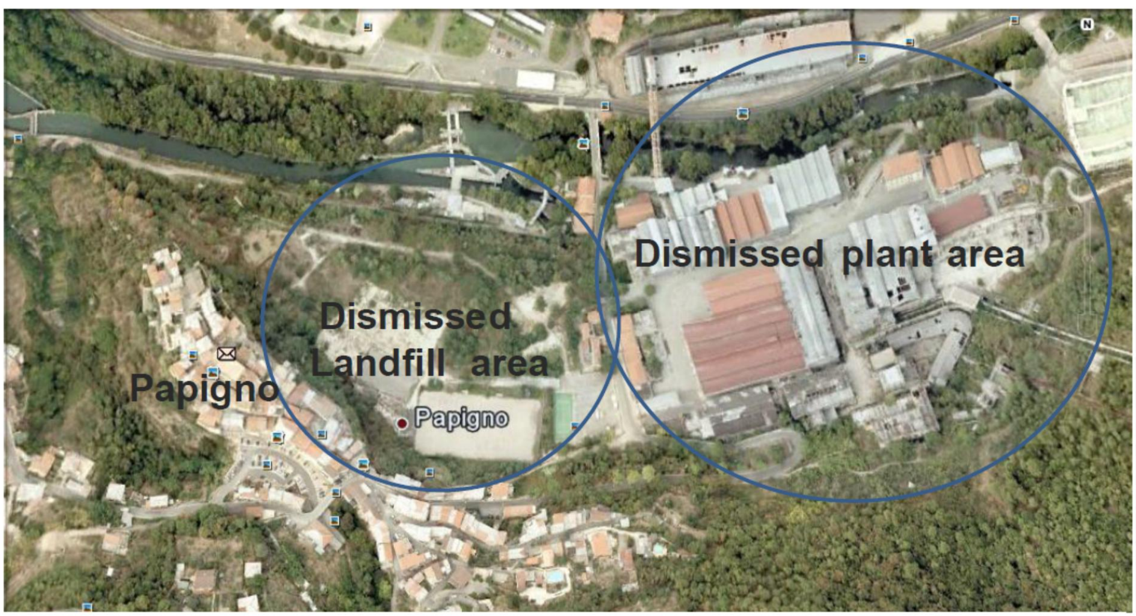
- how circular BF management is executed in practice, and that the framework developed in HOMBRE fits with this practical situation;
- that early warning indicators indeed help to look ahead,
- that a city (or BF regeneration project) needs a “brand” , an overall focus to have a goal for redevelopment (Solec Kujawski focusses on recreation and sports, which is rooted in a long standing tradition);
- that what caused a site to become a BF (for example outfacing of industry) may be another driver than the driver used to regenerate the BF (importance laid by EU on environmental protection); thus different indicators may have different roles during the BF regeneration process.

The stakeholder workshop in June further showed that a method like a “World Café” discussion is indeed a powerful tool to help identify new possible routes and synergies in further regeneration and development planning. Specifically encouraging was that this appeared true for an audience not yet acquainted with this type of informal discussion, and for stakeholder subgroups that had been involved in addressing Solec Kujawski’s challenges for a long time already.

5.3 Terni (Italy)

Terni is located in central Italy, north-east of Rome. The city is located in the province of Terni, in the region of Umbria. The nature around Terni attracts tourism and the nearby waterfalls „Cascate Delle Marmore‟ allocate some 300.000 visitors a year. The river Nera that flows through Terni is used for leisure and activities like canoeing and rafting are offered. The Village of Papigno, near Terni, has a rich industrial history and locates the industrial brownfield of Terni - Papigno.

The industrial site of Terni-Papigno is located on the east side of Terni, along the Nera river. The size of the area that is subject to regeneration is around 105, 450 m2. The site is split into two different parts; one part is a dismissed landfill and the other part is a dismissed plant area. The industrial site is almost completely abandoned. "On the site disused workshops and abandoned infrastructure (e.g. water & carbide penstock) are present. Infrastructure, like pipes and channels, are present in the ground and some of them are still operative and used by the Galleto hydroelectric power station" (Fioretti, personal communication, 2012). As a result of industrial use in history, parts of the soil and groundwater are contaminated.



Political and social context

The political and institutional context of the project is as follows: the land owner is the municipality of Terni and therefore is responsible for remediation and regeneration of the industrial site. On the national level the redevelopment of brownfields initially is approached from the view of environmental protection. In 2001, the national government provides regulation on the national plan for restoration and environmental clean-up. The regions are given the autonomy to select sites of national interest (SNI24). "These sites have to undergo restoration, actions are prioritised, financing measures, monitoring and check legislation" (ministero dell‟ ambiente e della tutela del territorio del mare, 2009:96). The region of Umbria selects the industrial site of Terni-Papigno for the SNI list and the region receives around four million euro for the remediation of the site. In 2008, the region nominates the Papigno site on a second list for revitalisation under the act of 252-bis. The resolution Cipe 2007 provided a programme for the revitalisation of economic production of polluted sites (Regione Umbria, 2008). However, due to governmental changes on the national level subsidy is never made available. Selecting the industrial site as an SNI means that remediation plans have to be approved on national level by the ministry of the environment and territorial protection.

In the Terni case we looked specifically at how *do parties involved in the regeneration process of brownfields deal with complexity and how does this influence the perceived governance capacity of parties in the network in terms of progress, problem solving capacity and legitimacy?*

Studying the way actors demarcate and scope their regeneration projects – called boundary judgements - in the regeneration process shows that the municipality of Terni makes wide substantive boundary judgements and includes a variety of policy domains into the master plan. However, they strictly demarcate the subprojects of urban redevelopment and remediation. Plans in relation to urban planning and remediation are the responsibility of different sections within the municipality. Looking at the strategy that the municipality follows one sees that they follow a rather conservative strategy. The project develops relatively closed to its context and a conservative strategy – a strategy which draws stable and relatively closed boundaries between the project and its related contexts - is followed. Also the region has relatively wide substantive boundary judgements and small structural boundary judgements and follows a conservative strategy.

Both actors are aware of the fact that brownfield regeneration involves multiple policy domains. However, their organisations are institutionally fragmentised and this is reflected on the project. The project is divided into subproject and remediation and reuse are approached separately by different departments. So they have a broad assignment but do not have the possibility or the experience (due to long history of fragmentised policy domains) to connect to the other actors in other domains. In the theoretical framework this is also stated: “Managers who manage a project with a rather broad project scope (with many aspects and domains included) can apply a rather conservative strategy within this broad scope and exclude signals from outside” (Edelenbos et al., 2010). The other actors (a film studio and a government agency on the regional level) have both made small boundary judgements and follow a conservative strategy. Also the province shows a clear connection between the boundary judgements they make and the strategies they follow. The province makes wide substantive and structural boundary judgements and follows an adaptive strategy. The residents association (Comitato) is another exception in this case study. They have made relatively small substantive boundary judgements and small structural boundary judgments. The Comitato has made small boundary judgements but is willing to connect to the municipality and cooperate and flexible to all kind of solutions. However due to the closed strategy of the municipality the residents do not have the possibility to cooperate. The conservative strategy of the municipality results in a project that develops relatively closed from its context. To see whether the followed strategies influence the perceived governance capacity, actors are asked to give their founded opinion on the progress of the project, the problem solving capacity and legitimacy (transparency and support). Each variable scored average (+/-). Support as part of legitimacy stands out from the other variables as it was scored negative.

The conclusions of the research were that:

- The Terni case develops relatively isolated from its context, is more closed to new solutions and rather inflexible.
- There is a strong correlation between the boundary judgments made by actors and the strategies they follow. However, the case study of Terni-Papigno shows some exceptions.

This is a remarkable finding of this research. The case study of Terni-Papigno shows that if managers on the project have a broad assignment their boundary judgements can be wide but their strategy can still be conservative. The explanation can be found in the fact that they do not have the possibility or the experience to connect to other actors and other policy domains. Fragmentation is reflected on the project due to long history of fragmentised policy domains.

- The strongest correlation has been found between the strategies employed and support to the project. The project of Terni-Papigno evolved in a more conservative way. The progress, problem solving capacity and legitimacy (transparency & support) are all scored as average (+/-) in the Terni case. The perceived governance capacity is scored average but the support is scored negative (-)Terni-Papigno case

5.4 Genoa, Italy

In Cornigliano, a “borough” or neighbourhood in the western side of the Genoa urban area, a BF is currently in the process of regeneration.

Map of the Cornigliano area with the BF site (within red line). The gas tanks in the centre of the site have already been demolished. Just north of the gas tanks villa ‘Bombrini’ is shown. (Source: Google Maps)

5.4.1 History of Cornigliano BF site and current situation:

<u>The Iron Factory</u>: The area used to contain steel factories that ceased production in the iron crisis of the 1990’s, due to the loss in competitiveness compared to ‘low salary countries’ (India, China) and stricter environmental laws. Pressure group ‘the Cornigliano mothers’ wanted to have the high furnaces closed because of significant problems with air quality. Eventually, the Italian government provided funds to close the factory and move the workers to another location. In 1996, the production of iron stopped and the site was no longer in use. In 1998, the region created a buffer zone along the margins of the site, because this was the easiest and cheapest solution at that moment.

As part of the current plan to regenerate this area, the majority of the old steel factory buildings have been completely demolished. Contaminations have been cleaned up to the first level, i.e. industrial use is again possible for this location (however, this is not likely to happen). If the site is to be developed for other types of use (e.g. residential area) further remediation will be necessary.

“Villa Bombrini”, a 17th century villa with adjacent garden, is still situated in the north part of the site. This used to be the entrance building for the iron factory. It is part of cultural heritage and therefore preserved; at present it is used as a residence for several companies working in the film industry. The site is at one side bordered by a ‘Mediterranean’ river (rain fed, with seasonal fluctuations in water level), which is part of a migratory route for birds on a regional level/scale. Due to the steel industry, the river sediment is heavily contaminated. Upriver the water quality has an Environmental Benefit Index (EBI) of 3, which goes up to 5 towards the river mouth. Flocks of migratory birds occupy the river waters and fish stocks are also large, however, the number of different species is very small. Since the riverbanks are secured by concrete walls, occasional flooding hazards occur along the last 15 km towards the sea (especially in November: peak discharges). The speed of the water can be high and there is much debris.

5.4.2 Development of Cornigliano BF site:

The redevelopment process started in 1998 with some money from the region for a green buffer zone between the residential streets and industrial area along Villa Bombrini. This area is outside the contaminated area. Also, the area has value due to the historical villa. It is a visible landmark and it is close to the housing area. The most important problems facing the redevelopment of the Cornigliano area are found on the political level. Much time and effort must be spent before all political actors agree on the redevelopment proposed. Other factors influencing the success of redevelopment are economic perspectives and finally some technical problems. Also, the involvement of local people is important. The people are involved through a stakeholder process and are organized in a working group. Within this project, the local community is informed and consulted twice a month.

The most important goals within this project are: high quality of public space and environmental mitigation, i.e. for roads along the river and compensation for urban development on city level. Also, the urban development of Genoa is restricted by a strategical rule to in between the blue line (sea) and 'green line' (line between the rural and urban parts of the city). Part of the area will certainly be developed as a public park with adjacent sports facilities. The villa and a building close by are already in use as offices for creative industry. Along the river, a road will be constructed connecting the area and adjacent areas to the coastal highway to ensure traffic to the port, and lower the pressure on the current roads. More public transport will be realized. New railway knots and networks are integrated within existing railways.

The prospect for redevelopment for this part of the plan is 3 to 4 years to complete the public park and the infrastructure. The adjacent residential area receives financial support. The rest of the area is still under dispute. The largest uncertainty is the planning of a regional hospital for 700 patients. A feasibility study has been commissioned to evaluate the suitability of the Cornigliano area and a nearby alternative hillside area; results are expected before mid-2014. The land use designer of the municipality would like to extend the park and connect it with the river to create a nature area. To overcome the barrier of the riverside highway, a tunnel could be created with a green roof to cover the road and form a green connection between the park and the river. Such green corridor is also the preferred option of the local community. The hospital could be a barrier for this plan.

The river has currently a function as a wildlife area for migratory birds, amphibians and fish. The local community hopes that the delta part of the river could be recognised by the Municipality as a local Wildlife refuge, especially for migratory birds. The concrete riverbanks could be covered with plants and terraces to provide nesting areas for birds and amphibians. By regenerating the river area, the image of the river will improve which will attract more people towards the river, resulting in the local community taking more care of the river. This will eventually lead to better and cleaner river conditions.

5.4.3 Interaction

HOMBRE gained a lot of information about the site and this regeneration project through articles on the project, meetings and interviews with people involved in the project. This happened in an early stage of the HOMBRE project.

The goal was 1) to gather information for the WP2 indicators and 2) to discuss the municipality needs for a tool such as the BFN. Since the problems and plans for the area are very diverse and still disputed, a tool like the BFN - being able to clarify opportunities and implications of certain measurements for the area - can be very useful. Also, the problems found in this case seem exemplary for other BF cases in Europe, so it can serve as a good guidance case within the HOMBRE project.

From the documents and data received from, and meetings with the Genoa case stakeholders, a set of indicators relevant for this case could be derived.

5.5 Markham Vale

The former Markham coal mine has been the site of the Markham Vale business park. Markham Vale has been partially developed but there are large areas of BF land that are available for development and an even area of former coal mining tips that may be amenable for a soft end use.

HOMBRE partners took part in a 3 day exercise to develop suggestions for the site owner and their development partner to consider in creating new employment on part of the site and managing soft landscaping over the area of former coal tips.

The site owners, Derbyshire County Council, demonstrated an in depth understanding not only of their site and its local context but also the importance of placing that site in a regional and national setting. They gave evidence of the use of social and economic indicators to formulate their plans; however, there was little evidence that trends in those indicators are considered routinely.

The overall feedback from DCC was positive and their senior management are now studying the suggestions with a view to deciding which ones to take further.

6 Concluding remarks

Significant progress was made in the development of the HOMBRE framework. Specifically innovative is the awareness that the land us cycle and the land management cycle do not necessarily run synchronous in time, and that multiple management phase and cycles may run in parallel. As it turns out, the concept of early indicators plays a key role within the Zero BF concept, as it specifically aids in setting a long term perspective.

Overall feedback from the case studies confirms that the management approach and decision guidance as presented in HOMBRE's Zero BF perspective (and being further developed within WP3) has practical relevance. Various aspects are in fact already practised, "naming" them and combining them into an overall framework contributes to taking a structured approach towards management of land transition and BF regeneration. The use of indicators for more or less routine monitoring as yet does not seem to be common practice.

The new insights regarding the land use and land management cycle also resulted in the awareness that - although looking ahead is of great importance and achievement should be monitored during and after realisation of a BF regeneration project - the determinative step in the success of a land us transition is to be made in the planning stage. This is where the technologies and concepts as particularly developed in WP4 and WP5 should add value to the BF regeneration process. Success is not dependent on specific indicators, but on other types of case-specific variables that relate to both the BF itself and its surroundings, the latter not just in geographical terms but from a general societal perspective. This will be worked out further in upcoming deliverable D2.3.

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