Environmental Assessment procedures addressing resource efficient land use: The role of learning and options in framing 'land' as an environmental factor

A comparative analysis of case studies in England and Germany

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ZUSAMMENFASSUNG

Als integraler Bestandteil von Planaufstellungsverfahren zielt die Strategische Umweltprüfung (SUP)/Umweltprüfung in der Bauleitplanung auf eine systematische Ermittlung und Bewertung von Umweltauswirkungen in einer frühen Planungsphase ab. Mit der Umsetzung der novellierten UVP-Richtlinie (2014/52/EU) wird die Integration von ‚Fläche' als eigenständigem Schutzgut, zunächst in die projektbezogene Umweltverträglichkeitsprüfung (UVP), erforderlich. Im Hinblick auf daraus entstehende Chancen einer konsequenten Verankerung von Fläche als Ressource in Entscheidungsprozessen und basierend auf Forschungssträngen zu einer ressourceneffizienten Flächennutzung untersucht die vorliegende Arbeit, ob und inwieweit Aspekte des zu definierenden Schutzguts gegenwärtig Berücksichtigung in Umweltprüfverfahren finden. Eine Dokumentenanalyse ausgewählter Umweltprüfberichte wird dazu mit leitfadengestützten Experteninterviews verknüpft. Diese Analyse wird mit der Frage verbunden, welche Anpassungs- und Entwicklungsbedarfe für Fläche als separates Schutzgut identifiziert werden können, verknüpft mit Fragen nach der Rolle von Bewertungsunsicherheiten sowie von Bestimmungsfaktoren für Lernprozesse im Rahmen von Umweltbewertungsverfahren. Diese Fragestellungen werden anhand eines vergleichenden Ansatzes mit Fallstudien aus Deutschland und England bearbeitet. Dabei liegt der Fokus auf den ehemals erheblich schrumpfenden, mittlerweile aber wachsenden und durch Reurbanisierungstendenzen gekennzeichneten, mittleren Großstädten Liverpool und Leipzig, die durch vergleichbare und kontrastierende (ländlich geprägte) Fälle ergänzt werden. Die Arbeit fokussiert dabei auf den Landnutzungssektor Wohnen in Umweltprüfverfahren für kommunale Landnutzungsplanung (englische *Local Plans*; deutsche Flächennutzungs- und Bebauungspläne).

Anhand eines systematischen Untersuchungsrahmens ergibt sich eine bisher fragmentierte Betrachtung von Fläche, die einen starken Einfluss von in übergeordneten Strategien bzw. gesetzlichen Regelwerken formulierten Zielen nahelegt. Für die deutsche Fallstudie steht der Bereich Flächenneuinanspruchnahme (allerdings selten quantifiziert in Bezug auf übergeordnete Zielwerte), für die englische Fallstudie der Bereich Flächennutzungseffizienz (vor allem Wiedernutzung von Innenentwicklungspotenzialen) im Fokus der analysierten Umweltberichte. In beiden Fallstudien zeigt sich eine umfassende Betrachtung von Flächenqualitäten im Rahmen der Bewertung von Auswirkungen auf andere Schutzgüter. Beide Fallstudien ergeben zudem das weitgehende Fehlen von (bindenden) Grenz-/Schwellenwerten für Fläche sowie Präferenzen für eine Quantifizierung von Auswirkungen auf Fläche sowie für eine funktionsbasierte Ausgestaltung von Bewertungsansätzen. Hier zeigen sich einerseits der in Deutschland ausgeprägte Fachdiskurs zu ressourceneffizienter Flächennutzung bei gleichzeitig anhaltend hoher Flächenneuinanspruchnahme als Impulsgeber. Andererseits stellt die vergleichsweise hohe Effizienz der Flächennutzung in England vor dem Hintergrund ehemals verbindlich quantifizierter Zielsetzungen und des greenbelt Instrumentariums bei zugleich gegenläufigen statistischen Trends und erheblichen Veränderungen des planerischen Rahmens in den letzten Jahren die Volatilität der Zielerreichung dar.

Lernprozesse können vorrangig für inkrementelle Weiterentwicklungen von Methoden und Begriffsverständnis (single-loop) identifiziert werden, während weiterreichende Modifikationen (double-loop) vor allem in Vorschlägen für andere Bewertungssystematiken bestehen. Wesentliche Faktoren dafür scheinen in Problemdruck, neuen Anforderungen, neuer Daten- und Richtlinienverfügbarkeit und in Beteiligungsergebnissen (induziertes Lernen), sowie in Erfahrungen mit Umweltprüfverfahren, (sektorenübergreifender) Kommunikation und

Engagement in Fachgemeinschaften/Arbeitsgruppen (aktiv vorangebrachtes Lernen) zu bestehen. Bewertungsunsicherheiten scheinen vor allem in dem Fehlen von Grenz-/Schwellenwerten und der Bestimmung der Erheblichkeit zu bestehen, scheinen bisher aber nicht standardmäßig transparent dargelegt zu werden. Während in einer Reihe von Fällen als förderlich für eine erhöhte Transparenz von Bewertungsentscheidungen sowie für eine zielgerichtete Verbesserung von Bewertungsmethoden wahrgenommen werden (unterstützt durch externe Reviews und Sitzungen zur Fehleranalyse insbesondere in der englischen Fallstudie), erfordert ein belastbareres Verständnis dieses Zusammenhangs weitergehende Forschung.

Für den Kontext der deutschen Fallstudien und der Umweltprüfung in der Bauleitplanung sowie auf Basis der im Rahmen eines Expertenworkshops weiter diskutierten Ergebnisse der Interviews wird ein Bewertungsansatz für das Schutzgut Fläche entwickelt und auf einen exemplarischen Bebauungsplan aus Leipzig angewandt. Dieser Ansatz schlägt für die drei zentralen Ziele Reduktion, Effizienz und Schutz geeignete Indikatoren vor und entwickelt auf Basis einer Analyse und Systematisierung verfügbarer Daten standardisierte Bewertungsschemata, die bisher in beiden Fallstudien weitgehend unverknüpft betrachtete Aspekte zusammenführen. Das Problem bisher weitgehend fehlender Orientierungs- und Schwellenwerte wird vertieft für den Bereich Flächennutzungseffizienz betrachtet, indem anhand eines Reviews von Kenn- und Zielwerten für den Parameter Wohnungsdichte geeignete Orientierungswerte abgeleitet werden. Damit liefert die Arbeit einen praktisch handhabbaren Ansatz für die Bewertung von Fläche als Ressource in der Umweltprüfung, der die Transparenz und Nachprüfbarkeit von Umweltauswirkungen durch Flächenausweisungen verbessern und in nachfolgenden Arbeiten auf andere Landnutzungssektoren und übergeordnete Planungsebenen erweitert werden kann.

ABSTRACT

As an integral part of plan making procedures, Strategic Environmental Assessment (SEA) aims to systematically identify and evaluate environmental impacts at an early planning phase. With the implementation of the revised EIA Directive (2014/52/EU), the integration of 'land' as a separate environmental factor, as a first step into project-related Environmental Impact Assessment (EIA), is required. With regard to chances related to a more concise consideration of land as a resource in decision-making procedures and based on strands of research on resource efficient land use, this PhD research has scrutinized if and to what extent aspects of the environmental factor to be defined are currently considered in environmental assessment procedures (EA). For that purpose, a document analysis of selected environmental reports is combined with semi-structured expert interviews. This analysis is connected with an investigation into what requirements for adaptation can be established for land as a separate environmental factor. This is linked to questions on the role of assessment uncertainties as well as on determining factors for learning in the context of EA. These issues are approached by a comparative perspective with case studies from Germany and England. The focus is on two major cities; Liverpool and Leipzig, both being characterised by reurbanisation and growth tendencies after considerable shrinkage processes throughout the 20th century. They are supplemented by both, comparable and contrasting (rural) cases. The study focuses on the housing land use sector in EA for municipal land use plans (English Local Plans; German comprehensive and binding land use plans).

Based on a systematic framework for analysis it is revealed that land has been considered in a rather fragmented manner to date, indicating influence of objectives and targets formulated by overarching legal frameworks and strategies. For the German case study the aspect of land take (however, rarely quantified with regard to overarching target values) and for the English case study the aspect of land use efficiency (PDL reuse in particular) lie at the centre of the analysed EA reports. For both cases, a thorough consideration of land qualities by assessing impacts on other environmental factors is identified. Both cases reveal a prevalent absence of binding standards and thresholds for land as well as preferences for quantification of impacts on land and a function-based design of assessment approaches. The German research and policy discourse on resource efficient land use, in combination with a continuing high amount of land take, triggers action; in England, an attempted efficient use of land against previously binding quantified targets and greenbelt policy, and with recent adverse statistical trends and considerable changes to the planning framework, reveals the volatility of targets.

Learning processes could be primarily identified for an incremental advancement in methods and problem comprehension (single-loop) whereas wider-reaching modifications (double-loop) mainly occur with regards to different assessment methodologies suggested. Key factors for these observations appear to comprise problem pressure, new requirements, new data and guidance provision as well as participation outcomes (induced learning), as well as EA experience, (cross-sectoral) communication and involvement in communities of practice/working groups for actively promoted learning. With assessment uncertainties mainly consisting in a lack of thresholds and the determination of significance, they do not tend to be transparently displayed by default. While they appear to foster learning via enhanced transparency and related targeted knowledge acquisition (supported by external reviews and lessons learnt sessions in the English case in particular), a more reliable understanding of such a link requires further research.

For Germany, based on interview findings which were further discussed as part of an expert workshop, an assessment methodology for land has been developed for the case of EA for

municipal land use planning. This approach has been applied to an exemplary binding land use plan from Leipzig. This suggests suitable indicators for the three key objectives of reduction, efficiency and protection. Standardized assessment schemes are developed based on an analysis and categorization of available datasets, merging aspects that had been considered in both case studies in a largely unrelated way. The problem of largely absent thresholds for land is considered in depth for the aspect of land use efficiency through a review of orientation values for the parameter of dwelling density. As a result, this PhD research provides a fit-for-purpose approach for assessing impacts on land as a resource in EA that can improve the transparency and accountability of environmental impacts through site allocations and that can be extended to other land use sectors and overarching planning scales in future research.

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Annotations

Translations of German interview quotes were done by the author. Potential loss in meaning is thus ascribed to the author and not to the interviewed experts.

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Repp, A.; Dickhaut, W. (2017): „Fläche“ als komplexer Umweltfaktor in der Strategischen Umweltprüfung? Begriffliche Komponenten, gegenwärtige Bewertungspraxis und Optionen einer Ausgestaltung als Schutzgut. In: UVP-report 31 (2), 136–144.

Repp, A. (2016): Umweltprüfverfahren und Flächenmanagement: Gegenwärtige Praxis und Optionen für das Schutzgut 'Fläche' in der Strategischen Umweltprüfung. In: Meinel, G.; Förtsch, D.; Schwarz, S.; Krüger, T. (eds.): Flächennutzungsmonitoring VIII. Flächensparen – Ökosystemleistungen– Handlungsstrategien. Berlin: Rhombos-Verlag, 83–92.

List of abbreviations

AONB	Area of Outstanding Natural Beauty
BauGB	Federal Building Code (*Baugesetzbuch*)
BauNVO	Federal Land Utilisation Ordinance (*Baunutzungsverordnung*)
BBSR	Federal Institute for Research on Building, Urban Affairs and Spatial Development (*Bundesinstitut für Bau-, Stadt- und Raumforschung*)
BNatSchG	Federal Nature Conservation Act (*Bundesnaturschutzgesetz*)
B-Plan	Binding Site Plan/Binding Municipal Land Use Plan (*Bebauungsplan*)
CAP	Common Agricultural Policy
CPRE	Campaign to Protect Rural England
DAAD	German Academic Exchange Service (*Deutscher Akademischer Austauschdienst*)
DCLG	Department for Communities and Local Government
DE	Germany
DEFRA	Department for Environment, Food and Rural Affairs
DG	Directorate General
dph	dwellings per hectare
EA	Environmental Assessment
EAP	Environmental Action Programme
EC	European Commission
EEA	European Environment Agency
EFTA	European Free Trade Agreement
EIA	Environmental Impact Assessment
ERDF	European Regional Development Fund
EU	European Union
FNP	Comprehensive Municipal Land Use Plan (*Flächennutzungsplan*)
GFZ	Floor space index (*Geschossflächenzahl*)
GRZ	Site occupancy index (*Grundflächenzahl*)
ha	hectare
HELAA	Housing and Economic Land Availability Assessment

IAIA	International Association for Impact Assessment
IEMA	Institute of Environmental Management and Assessment
INSEK	Integrated Urban Development Concept (*Integriertes Stadtentwicklungskonzept*)
LABO	Federal/state cooperative working group on soil protection (*Bund-/Länder-Arbeitsgemeinschaft Bodenschutz*)
LDF	Local Development Framework
LUCS	Land Use Change Statistics
MHCLG	Ministry of Housing, Communities and Local Government
MKRO	Conference of Ministers for Spatial Planning (*Ministerkonferenz für Raumordnung*)
NEPA	National Environmental Policy Act
NGO	Non-Governmental Organisation
NIMBY	‚Not-in-my-backyard' phenomenon
NPPF	National Planning Policy Framework
OAN	Objectively Assessed Need
ODPM	Office of the Deputy Prime Minister
OECD	Organisation for Economic Cooperation and Development
PDL	Previously Developed Land
PlanZVO	Plan Notation Ordinance (*Planzeichenverordnung*)
PPG	Planning Policy Guidance Note
PPP	policies, plans, programmes
PPPP	policies, plans, programmes, projects
PPS	Planning Policy Statement
ROG	Federal Spatial Planning Act (*Bundesraumordnungsgesetz*)
RSS	Regional Spatial Strategy
RTPI	Royal Town Planning Institute
SA	Sustainability Appraisal
SDGs	Sustainable Development Goals
SEA	Strategic Environmental Assessment
SEKo	Urban Development Concept (*Stadtentwicklungskonzept*)
SHLAA	Strategic Housing Land Availability Assessment
SHMA	Strategic Housing Market Assessment

UK	United Kingdom
STEP	Urban Development Plan (*Stadtentwicklungsplan*)
SuV	Land for settlement and transport purposes (*Siedlungs- und Verkehrsfläche*)
UBA	German Environment Agency (*Umweltbundesamt*)
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNECE	United Nations Economic Commission for Europe
US	United States
UVPG	German EA Act (*Gesetz über die Umweltverträglichkeitsprüfung*)
WHO	World Health Organisation

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1. Introduction

Land consumption (‘*Flächenfraß*’), suburban ‘seas of houses’, urban sprawl – described by a number of terms and concepts, the problem of an ongoing consumption of previously undeveloped (or greenfield) land for development, and the problems arising from that in ecological, economic and social terms have been discussed by the planning profession in particular for quite some time. However, it is not just the quantitative figures on land take that represent a constant concern for planners. In connection with it, greenfield land that has been allocated for development is often used inefficiently, together with an insufficient reuse of previously developed (or brownfield) land that restricts the implementation of more efficient land use patterns (e.g. Bock & Preuß, 2018; CPRE, 2017b; Gerber et al., 2018). Whereas a number of policy objectives and targets have been formulated at European and national levels in order to tackle this problem over the last decade in particular, it meets with problems associated to the protection of collective/common goods (see also Hardin, 1968; Ostrom, 1990: ‘tragedy of the commons’), strongly influenced by property conditions and development interest, which is often inhibiting the implementation of environmental objectives and standards.

The problem of how to arrive at a more resource efficient use of land has gained further momentum with increasing urbanization and the resulting demand for housing in many major European city regions. This has accordingly been reflected by the 2016 Sustainable Development Goals SDGs (UN, 2015) and debates surrounding the Great Transformation of human-environment relations (Rockström et al., 2009; Kraas et al., 2016). Additionally, and beyond land demand for settlement-related purposes, there is a growing recognition of land demands from other sectors, such as agriculture and energy production, of land use conflicts and of global interconnections of land use, as depicted by the land footprint concept, for instance (e.g. Wackernagel et al., 2004; Haber & Bückmann, 2013; UBA, 2017a). An advancement of activities and instruments for reducing land take in legislation and administrative practice has thus been increasingly requested by research and environmental policy as well as NGOs (e.g. BMU, 2018; CPRE, 2017b; Ferber et al., 2016; Nathanail & Ashmore, 2016). Ongoing ‘business as usual’, i.e. accommodating for demand through extensive low-density development on greenfield land, is increasingly evoking criticism. A German essay with the provocative title *‘Verbietet das Bauen’* (‘Ban construction’; Fuhrhop, 2015) addresses the need for a consistent shift of focus on the building stock and vacant land, and suggests a number of innovative – while not necessarily ready-to-use, given current framework conditions – approaches to make use of these resources.

Whereas the objectives of reduced land consumption and enhanced reuse of previously developed land have been included in sustainable development and planning strategies at different spatial scales, policies and regulations differ considerably, depending on national, regional and local institutional frameworks. In Germany, both formal and informal planning instruments have been introduced in order to either enforce or encourage the reduction of land take and an increase in both land use efficiency and land use quality, with a key role of the 30 ha target first developed for the German Sustainability Strategy in 2002. The lack of a binding character of most of these instruments, however, has evoked requests for more effective instruments. Current revisions of the national building code BauGB envision a further strengthening of regulations regarding the need to justify greenfield development against the amount of brownfield land available for development, on the one hand, while at the same time being criticized for – at least temporarily – loosening the need for EA in the development of these greenfield sites. In England, with its central government taking a stronger role in planning decisions, a number of binding targets with regards

to the reuse of previously developed land or establishing minimum dwelling density for developing new sites had been in place before the most recent planning reform saw their abolition. With a strong focus of planning debates on the need to provide additional housing, green belts surrounding urban areas as a core element of the English planning system have come under pressure in being targeted for accommodating development sites.

Against this backdrop, Strategic Environmental Assessment (SEA) constitutes a promising tool to incorporate aspects of resource efficient land use in a comprehensive manner. Rooted in attempts to identify, minimize and mitigate significant environmental impacts of development plans, SEA has been developed to adopt an inherently strategic perspective in assessing impacts on a programme, plan (and policy) scale and as a framework for concrete projects to be implemented. SEA's comprehensive perspective on key environmental media leads to the presumption that land in its context-rich understanding could potentially be well addressed by related assessment procedures. This potential has become particularly topical through the insertion of 'land' as a separate environmental factor in the revised EIA Directive 2014/52/EU, requiring related EA procedures to explicitly address impacts of proposed developments on land. This legal requirement has raised the question as to how 'land' as a factor is to be defined and operationalized for EA practice. Whereas the revision to date only pertains to EIA, whether this will be extended to SEA and a resulting harmonization of environmental factors to be assessed remains to be seen (Balla & Peters, 2015; Jacoby, 2016; with in DE, EIA already applying to EA for municipal land use plans: Wende, 2016).

The question as to how an encompassing factor such as land, with its various interdependencies with other environmental media, can be grasped by SEA procedures and thereby contribute to a more consistent consideration of resource efficient land use in plan making, may benefit from theoretical insights into the functioning of SEA. Learning theory and earlier findings on learning in and through EA will be applied in order to better understand how and why the comprehension of terms as well as the application of assessment methods evolve (or not), and what factors can contribute to or hinder such advancements. Also, the focus of this research constitutes a test case for how types of assessment uncertainties are perceived, how transparent they are made – and how approaches towards dealing with assessment uncertainties potentially contribute to learning processes in EA. Starting points for the examination of these questions consist in frameworks that have been developed for other factors (e.g. Fischer, 2014a; Jiricka et al., 2016) as well as in preliminary work on potential indicators not yet further taken up by SEA practice and research (e.g. Geneletti, 2015a). Meanwhile, with SEA constituting a statutory instrument to support evidence-based PPP making, it has significant potential to systematically include aspects of resource efficient land use more than what rather informal, voluntary instruments may do.

For the purpose of this study, a comparative research approach, comprising case studies from England and Germany, is utilized. This comparative perspective prompts mutual insights that would not be detectable when focusing on one country case study restricted to a particular institutional setting alone. In particular, significant differences between land use patterns, underlying rationales for planning and implications of different planning systems are expected to help understand what key factors for assessing land should be applied in future procedures. Thus, land as a factor provides a window of opportunity to strengthen a key environmental issue, while at the same time further adapt assessment approaches to pressing environmental problems. A key precondition for utilizing this potential is the provision of suitable indicators, thresholds and data which will – to some extent – be developed by this research.

Against that backdrop, this research pursues the following **key objectives**:

First, it strives to analyse how and to what extent land and land-related aspects have been covered by EA procedures for municipal land use planning to date ("Status Quo", **Objective 1**).

Second, it aims at a refined understanding of the role of assessment uncertainties and their potential transparent disclosure as part of EA reports, as well as of determinants for learning through EA in the context of requirements for integrating a new environmental factor (**Objective 2**).

Third, it intends to develop a methodology for land as a new environmental factor for the scale of municipal land use planning ("Future Assessment Approach", **Objective 3**).

For delineating the research interest, **hypotheses** have been formulated and are displayed below. Hypotheses are understood as an "assumption on a certain issue or situation", or, more specifically, "a proposition about an interdependency between social features, i.e. a relation between two or more variables" (Diekmann, 2011: 124; translated by the author).

1. The integration of land as a separate environmental factor is currently discussed as an element of the revised EIA Directive. Aspects of resource efficient land use have to date been addressed by EA procedures as part of various existing environmental factors; however, in a fragmented and unsystematic way.
2. For the assessment of factor-related impacts different types of data, information and knowledge have been applied to date. These depend on subject field and involved experts; a systematic analysis has not been conducted yet; qualitative aspects and intersectoral links have been underrepresented.
3. Learning processes in EA occur as a result of previous experience with EA procedures, with individual and single-loop learning as prevalent types. Factors for learning derived from previous experience enable an improvement of subsequent EA procedures.
4. Assessment uncertainties are only partly displayed by EA procedures and related reports. If uncertainties are transparently displayed, they enable advancements of subsequent EA procedures in methodological and substantial terms. Active approaches towards addressing assessment uncertainties foster learning processes.
5. From interviewees' understandings of land in EA and a review of research-based concepts of land, the science-practice gap can be narrowed in order to develop an applicable assessment approach for land.
6. The definition and interpretation of land varies between different planning systems. A comparison of EA procedures within the context of the planning systems of England and Germany enables mutual learning effects.

These objectives will be supported by a catalogue of guiding questions, specifying the objectives and serving as a structure for further research, in the following chapter.

2. Research Approach and Methodology

2.1 Research Design

2.1.1 General Considerations and Guiding Research Questions

Previous research in the field has been approached and compiled through a 'narrative review' in order to critically work out and connect relevant findings as a precondition for specifying the research questions (Bryman, 2012). A 'systematic review', solely based on research databases such as Web of Science or Scopus would not have been suitable or sufficient for this purpose, given the need to include a wide spectrum of reports, policy documents, strategies and discussion papers regarding resource efficient land use for both case study contexts. This narrative review is therefore based on a keyword search in literature databases and e-mail alerts of key EA-focused journals (Environmental Impact Assessment Review, Impact Assessment and Project Appraisal, Journal of Environmental Assessment Policy and Management), as well as on a snowball-based analysis of bibliographies of reports and newsletters with reference to the role of land in SEA and, more generally, in planning practice. This review has been considered ongoing, with updated findings and policies leading to continuous revision throughout the course of the study.

The analytical framework for approaching the conceptual, theory-led questions depicted above is based on connecting two major strands of research, i.e. assessment uncertainties and learning processes in EA as theoretical concepts that serve as a rationale from the perspective of which findings are interpreted (Bryman, 2012). The research design thus focuses on SEA frameworks and theories on the one hand and land use policy and planning on the other, looking to identify and construct links between the two strands. By that, it seizes on what has been framed as being required for SEA research (Fischer & Noble, 2015), namely an attempt to bridge the science-practice gap and to look beyond the EA 'silo' in considering a wide spectrum of policy documents as well as research findings on framing land for their potential application in assessment procedures. This approach is regarded as being positioned in the tradition of 'exploring beyond the boundaries' of a specific field in order to gain more encompassing insights (Leung et al., 2015). Potential new elements of theory may emerge from empirical research and contribute to advancing existing theoretical knowledge. Hence, this research design follows a mainly inductive approach according to key elements of Grounded Theory (Bryman, 2012; Yin, 2014).

This focus, however, needs to be contextualized with regard to core critique applying to inductive and deductive approaches as the two poles of empirical research design: On the one hand, there is the certainty of deduction, arguing from the general to the specific. On the other hand, there is relative uncertainty (but often a higher informative content) connected with induction, arguing from the specific to the general, as described by Popper (1934; in Diekmann, 2011). This means that there can be no ultimate logical conclusion by induction, hypotheses being falsifiable but not (ultimately) verifiable. Therefore, according to Popper's critical rationalism, while all knowledge is uncertain and preliminary it can be continuously enhanced through critically testing hypotheses and accepting them as long as no falsification has been found, i.e. following the 'white swan paradigm'. From this argumentation, a basic rationale and need for inductive, case-study based empirical research can be derived (Diekmann, 2011; Flyvbjerg, 2011).

For the purpose of this research, and in line with an understanding of deductive and inductive approaches not as clear-cut opposites (Bryman, 2012), a combination of elements of deduction and induction is realized. Deductive elements apply to the formulation of research hypotheses based on the literature review, and to hypothesis testing, whereas induction applies to the derivation of theoretical findings based on the data collected, as illustrated in figure 1. While the latter constitutes a less linear process, it allows for feedback loops and for an integration of new developments throughout the research process, such as advancing considerations of how to address land, or updates and revisions to legal and policy documents. Reflecting on this research design from the perspective of Diekmann's (2011) contexts of discovery and justification (*Entdeckungs- und Begründungszusammenhang*), the original research interest (passion) can be attributed to deductive elements, while the analytical explanation (ratio) is supported by induction based on empirical research. Further consideration of how these approaches interact will be provided below with regard to data analysis.

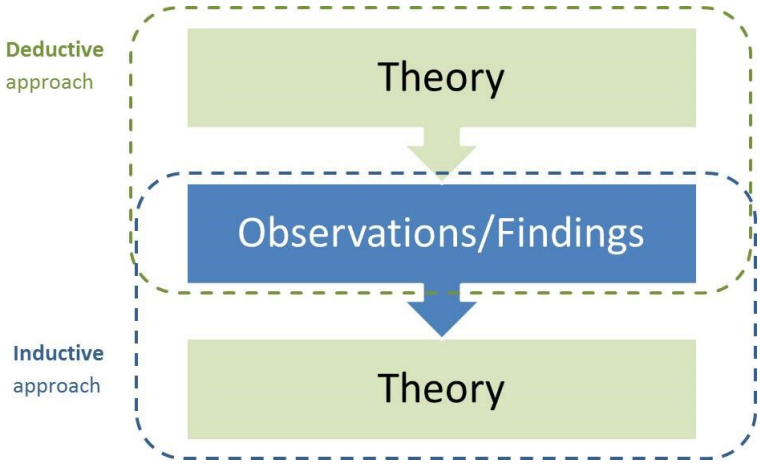


Figure 1: Deduction and induction (modified based on Bryman, 2012: 26)

When discussing the role of theory for research, it can be distinguished between "grand theories" with a high level of abstraction and accordingly relatively direct value for guiding empirical research, and "middle-range theories" (Merton, 1967; in Bryman, 2012) that function as frameworks for categorizing and explaining observations and social phenomena. According to Kørnøv's (2015) categorization of the use of theory as depicted in table 1, this research is located at 'mid-range', i.e. focused on "theory interpretation and discussion" as well as on "theory development and extension". For moving further 'up this scale', a larger and more representative empirical basis, or a different study design, for instance with comparable studies running in parallel, would be required.

Table 1: Roles of theory in research design; focus of this study highlighted (modified based on Kørnøv, 2015)

Use of theory	Explanation
No explicit theory used	„Pure" empirical research
Non-attached theory	Theories mentioned in the introduction or literature review, but without explicit evidence that the theory is used to any other purposes than to establish legitimacy or support the author's ideas
Theory informing	Theories are used to focus and inform the design of the study
Theory interpretation and discussion	Theories are brought in after the empirical findings are presented and used to interpret and discuss the findings
Theory testing	Theories are used to develop hypotheses being tested through empirical analysis
Theory development	Existing theories are modified or extended
New theory development	New theory proposed – and possibly implementation in the research design
"Pure" theory research	Discussion of and upon theories

The literature review serves to specify hypotheses and objectives formulated before and to depict their dimensions (Diekmann, 2011). Hence, research questions have been formulated in order to delineate what exactly is to be examined by the study (Bryman, 2012; Yin, 2014), i.e. to provide a 'golden thread' for all further research steps. According to Flick (2002: 84; translation by the author), research questions can be regarded as a "[…] gateway to the field of research scrutinized", significantly determining whether the empirical research and selected methods generate meaningful results. The catalogue of research questions as replicated in table 2 thus specifies aspects raised by the hypotheses and is structured by the three key objectives mentioned above.

Table 2: Key research fields and related guiding questions (own table)

Objective 1: Analysis of how and to what extent land and land-related aspects have been covered by EA procedures for municipal land use planning to date ("Status Quo")
How has land been addressed in EA to date? What role do different planning scales play in that regard?
As part of which environmental factors has land been addressed to date; what do key interdependencies consist in?
What key stakeholders are involved in assessing aspects of land?
Which land-related objectives and targets are applied to assessment procedures?
What land-related aspects and indicators are applied in assessment procedures; what assessment methods are used?
What data and information is called upon for assessing land-related aspects? What land-related data deficits are observed?
What are land-related lines of argumentation in concluding assessment; what are final decisions shaped by?
Objective 2: Refined understanding of the role of assessment uncertainties and their potential transparent disclosure as part of EA reports, as well as of determinants for learning through EA – in the context of requirements for integrating a new environmental factor
What do assessment uncertainties consist in?
To what extent are assessment uncertainties displayed transparently?
What effects does a transparent display of uncertainties result in?
What experiences and approaches exist with regard to reducing assessment uncertainties; to what extent and how have improvements in addressing assessment uncertainties been achieved?
To what extent have plans been changed through considering aspects of land in assessment; to what extent has the approach towards land changed and by what factors?
What factors support learning processes in the course of and as a result of EA procedures?
Objective 3: Development of a methodology for operationalizing land as a new environmental factor for the scale of municipal land use planning ("Future Assessment Approach")
What driving factors and strands of debate have led to ‚land' being integrated into the revised directive?
What is the potential contribution seen in the new environmental factor for an early assessment of impacts on land?
How should land be defined as an environmental factor? What aspects should be covered by land, in quantitative and qualitative terms?

2.1.2 Qualitative and comparative research approach: Key features

For the purpose of this research, a **case-study based qualitative, and mainly explorative research approach**, as illustrated in figure 2, is employed. Compared to quantitative research focused on identifying statistically significant findings, qualitative case study research is particularly suited to analyse the complexity of individual cases (Bryman, 2012; Yin, 2014). It needs to be acknowledged, however, that for the purpose of this study there is also an interest to generalize the case-specific findings, in particular with regard to the development of an assessment methodology for land as an environmental factor. Hence the research interest is also a nomothetic one, and does not lie exclusively on the idiographic, case-specific characteristics

alone (cf. Bryman, 2012). Given the resemblance of both cases to the representative or exemplifying case type according to the typology of cases developed by Yin (2009; in Bryman, 2012), this approach appears to bear sufficient justification. Additionally, the research design integrates a comparative element, i.e. the intent to enhance understanding of observed phenomena by researching comparable but in parts contrasting cases with identical methods (Bryman, 2012). However, cross-national comparative research design also has challenges with regard to context sensitivity and the risk of jumping to seemingly evident conclusions. These aspects have been considered and prepared by an intensive study of background material on the English planning and environmental assessment system in particular, by following blogs and newsletters on current developments regarding housing and land use for both case study contexts, and was further enriched by discussions at the host department at the University of Liverpool during the author's research stay.

Compared with quantitative approaches that are of a mainly deductive character and focused on the quantification of findings, qualitative approaches focus on induction and the interpretation of findings with regard to social phenomena (Bryman, 2012; Yin, 2014). Nevertheless, this focus should not prevent qualitative research from, for instance, displaying quantitative amounts of categories of a concept, where useful. The option of a mixed methods approach, explicitly combining quantitative and qualitative methods, has not been considered suitable for the purpose of this research, however. Issues in the focus of research, such as ways of dealing with uncertainties, learning effects, and also viewpoints and experiences with regard to land as an environmental factor would only to a very limited extent have been researchable by questionnaires or similar standardized instruments. Those fields of interest rather require in-depth interviews and an interpretation of implicitly transported information based on individual cases. The decision for a qualitative approach is further supported by its capability in considering context-dependent knowledge, embedding the results in their spatial and institutional context and looking at decision making structures, roles of stakeholders and institutional frameworks (phronetic science according to Hayes, 2013; Flyvbjerg, 2001; Denzin & Lincoln, 2011). Furthermore, the suitability of qualitative research for the purpose of this study is backed by its focus on people as objects of research who attribute meaning to their environment and the resulting possibility to interpret findings with regard to the perspective of the people studied (Bryman, 2012; Flick, 2002). An important rationale for this approach that particularly applies to the expert interviews is that theory-led questions on assessment uncertainties and learning effects can hardly be identified through direct questions but need to be approached through sets of questions that allow for detecting aspects of them implicitly (Przyborski & Wohlrab-Sahr, 2010).

A **comparative research approach** focusing on case studies from the UK (England) and Germany has been chosen for several reasons: First, a comparison between two European countries to which the same revisions of the EIA Directive apply but that at the same time feature considerable differences with regard to their planning systems and to the role of environmental assessment procedures suggests potential for analyzing the research questions in focus from an abstracting perspective with potential mutual learning effects. Second, while both countries face similar problems with regard to land demand, they exhibit different perceptions and attitudes towards land as well as different spatial structures and related driving factors for land use patterns. Third, the context within which SEA procedures are conducted vary to a considerable extent, with SEA being embedded into Sustainability Appraisal and a predominance of rather task- and objectives-based approaches in SEA in England, as opposed to a mere environmental focus of SEA and a

prevalence of topic- and baseline-led approaches in Germany (e.g. Fischer, 2007; Therivel, 2010; Hayes, 2013). Also, an overall successful achievement of land-related targets in England in the past with considerable recent changes, compared to a complex set of related instruments with ongoing debates in Germany on how to achieve the '30 ha-target' (e.g. Ganser, 2005; BMVBS & BBR; 2007; UBA, 2018a; CPRE, 2018) poses the question what these differences are based upon and what they imply for SEA procedures for land use planning. These features and differences will be further explained in section 4.

Based on the general reasons for comparing cases from England and Germany that have been illustrated so far, Liverpool and Leipzig have been selected as focus cases for analysis. This selection is based on a number of aspects that underpin their suitability for comparison with regard to the focus of this research (e.g. Couch et al., 2005; Rink et al., 2012): First of all, both cities are situated in less prosperous regions in their respective country context, at the same time, however, functioning as powerhouses of their regions overall. Second, and as Rink et al. (2012) state, the two cities share similar development pathways from growth towards shrinkage towards recent re-growth while having at the same time been shaped by different political frame conditions and developments. Both experienced a boom phase in the 19th and early 20th centuries with up to 800,000 inhabitants in the 1930s (Couch et al., 2005), followed by decline and shrinkage until the late 1990s in Leipzig and up until the 2000s in Liverpool due to deindustrialization and suburbanization (Rink et al., 2012). However, and of particular interest for land use planning, both cities again are characterized by recent trends towards stabilization and even reurbanisation (Rink et al., 2012), to a particularly strong extent observable in Leipzig. Related figures are provided in section 4. Against that backdrop, the need for both cities to deal with significant amounts of vacant housing and derelict land as well as with rising population figures and related housing demand after periods of decline represents a particular motivation for their selection as major case studies for the purpose of this study.

Against that backdrop, the research design predominantly comprises of three methods: First, the **narrative review** and an **analysis of secondary data** on how land has been framed so far allow for a comprehensive perspective on potential components of it as a designated factor in EA. In that regard, strategies and policy documents as well as guidelines on how to address the problem of land consumption have been analysed in order to derive potential aspects and indicators for assessment. Additionally, documentations of current policy debates (e.g. webinars and policy statements on transposition of the revised directive) have been analysed with regard to land-related aspects being discussed at the moment. It is important to note from the beginning that although the revised directive only applies to EIA at the moment, the focus of research is on SEA (and EA for municipal land use planning in Germany, respectively) for two main reasons: One is the more strategic character of SEA due to its reference to higher planning scales as compared to project-related EIA. The other draws from assumptions that similar topic-related changes will apply to a likely subsequent revision of the SEA Directive as well (Balla & Peters, 2015; Köppel et al., 2016). Second, a **document analysis** and **semi-structured expert interviews** have been conducted in order to approach the three key research fields, related guiding questions and to scrutinize the initial hypotheses. Third, a **compilation of potential land-related indicators and data** has been prepared and taken as a basis for the development of an assessment methodology for land in EA for municipal land use plans, verified and further elaborated by an **expert workshop** conducted as part of the research process. Such a multi-method approach, applying the principle of triangulation by considering and contextualizing multiple sources as well as applying different methods can be regarded as particularly helpful in detecting interdependencies

and striving to achieve "greater confidence in findings" (Bryman, 2012: 392; Flick, 2002; Yin, 2014).

Caution is necessary, however, with regard to non-intended influences on the research results and their interpretation and contextualisation, in particular with regard to personal and profession-related values of the researcher. Values often already determine the formulation of the research question, certainly to be considered in planning studies with its to some extent normative elements, here represented by the overarching interest in enhancing resource efficient land use (Bryman, 2012). A systematic, thorough and careful justification of sampling, a coding process structured by a carefully applied set of codes, equal consideration of cases and derivation of generalized findings, as well as reflexivity with regard to the context of these findings, appears to be key to reducing the (hidden) influence of these values and biases (Yin, 2014).

In this regard, the unlocking of the research field and its context conditions needs to be understood as accompanying the complete research process (Przyborski & Wohlrab-Sahr, 2010): In a first step, comprising the review and gathering of material on both case study contexts as a basis for the research design, a deepened understanding of institutional structures and stakeholder constellations was aimed at. Second, this facilitated the identification of key documents for analysis and of key stakeholders for accessing the 'field', drafting interview guidelines and adapting the guidelines to place-specific conditions as required (planning scales, types of assessment instruments etc.). Further and during data gathering, a continuously refined understanding of detailed context conditions and further insights into the contextualization of phenomena observed was pursued, together with the identification of additional interviewees. An ideal sequence of stages in the research process is presented by Bryman (2012), comprising a literature review for delineating existing research of relevance to the field of interest, the identification of overarching concepts and theories framing the further steps and empirical work, the formulation of research questions, the sampling of cases for empirical data collection, the actual data collection, the analysis and interpretation of these data and the writing up and discussion of the research findings. An application of this sequence to the research design of this study is illustrated in figure 2, being replicated with respective emphases at the beginning of each major chapter for readers' guidance.

2.2 Document Analysis

Based on the formulation of a number of core categories for analysis as derived from the guiding questions displayed above, selected environmental reports from the case study regions have been analysed with regard to their reference to strategic objectives on land, their mentioning of land-related aspects, the use of relevant assessment aspects and indicators, as well as the occurrence of disclosed assessment uncertainties and the role of land in concluding assessment statements (Objectives 1 and 2). The framework for analysis is shown in section 5. While the focus of analysis is on environmental reports for plans that require SEA, related strategies and informal plans were considered with regard to the potentially decisive role of 'informal strategic advice' for decision making (see Fischer, 2001).

For the German case, the focus was set on environmental reports for land use plans at the municipal level, i.e. on comprehensive land use plans for the whole area of a municipality (*Flächennutzungspläne*) and on binding land use plans for specific sites (*Bebauungspläne*). This focus is in line with the majority of SEAs in Germany having been carried out for comprehensive spatial plans at regional and municipal scale (Geißler & Rehhausen, 2014; in Rehhausen & Burchartz, 2017). For the English case, focus was accordingly set on Local Plans, including Site

Allocation Plans, and preceding Core Strategies. A more detailed explanation of the selection process will also be provided in section 5. It is important to note here that the analysis is focused on municipal land use plans, and there on planning for housing provision. While acknowledging that considerable land use decisions are taken by overarching plans and other sectors as well, especially through designations for commercial and industrial sites as well as transport infrastructure, this narrowing of the focus of analysis mirrors the need to develop options for a future assessment methodology focused on one spatial scale and type of plan first, due to feasibility and timeframe of the study.

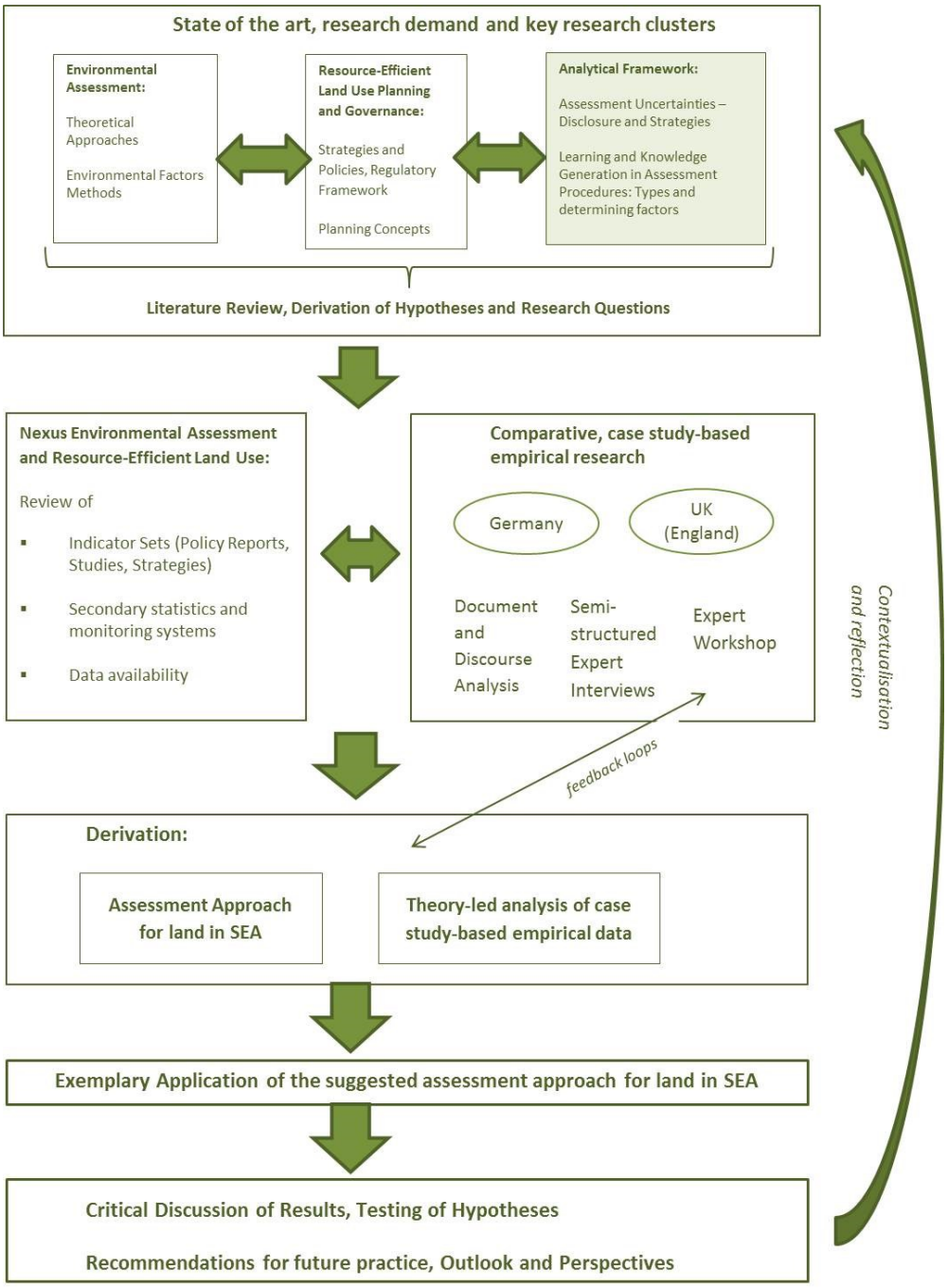


Figure 2: Research Design and Process (own figure)

Since documents can only depict a "'documentary reality'" (Bryman, 2012; according to Atkinson & Coffey, 2011) of codified contents, and hence only rarely reveal comprehensive insights into organizational structures and processes that mostly belong to the non-codified, i.e. tacit realms of knowledge (see also section 3), expert interviews constitute a key complementary method for the research interest in focus here.

2.3 Expert Interviews

2.3.1 Structure

2.3.1.1 Purpose and characteristics of semi-structured expert interviews

Against that backdrop, semi-structured expert interviews were designed with regard to two components of the research interest: On the one hand, they serve to explore insights gained from the document analysis in more detail and to access information that could not be derived at that stage, with the first two sections of the interview guidelines being dedicated to understanding how land has been addressed in EA procedures so far (Objective 1). This part is connected with the more conceptual, theory-led research questions, i.e. the consideration of assessment uncertainties and factors for learning in SEA (Objective 2). On the other hand, the interviews aim at the identification of options for a future framing of land as an environmental factor, defining elements as mentioned by the interviewees, related indicators and data (Objective 3). For developing appropriate questions that are suited to motivate interviewees to reflect on potential shortcomings and requirements, without biasing the set of questions by the interviewer's background, findings on how the role of other factors in EA has been studied and framed have been consulted (in particular, Jiricka et al., 2016, on climate change and Fischer, 2014a; Kågström et al., 2013 on health).

The expert character of interviews has been explicated by Meuser & Nagel (2005; in Przyborski & Wohlrab-Sahr, 2010): Generally, this type of research interview is characterised by the role of the expert as disposing of specific, i.e. 'expert' knowledge, in a particular field and related experience-based knowledge linked to their professional role. Typically, this role-specific knowledge is tied to a certain interpretational power accepted by the community in question. By that, experts can open up both insights into institutional structures and procedural characteristics, i.e. organization-related aspects (organizational knowledge), and into opinions on and interpretations of issues, developments and their relevance, i.e. content-related aspects (interpretational knowledge and contextual knowledge) – both of which are of importance for the research questions addressed by this study. In that context, there is a certain risk of choosing interview partners that dispose of a strong interpretational power and general overview knowledge but are positioned at a level in the organizational hierarchy that is too high for providing information on actual working structures and types of knowledge. Through a careful selection of interviewees, however, this risk could be minimized, and did only occur with a few authority representatives in a coordinating position, whereas all consultancy representatives had been directly involved with concrete SEA procedures.

Expert interviews are conducted as semi-structured interviews that are particularly suited to approach a relatively well-defined set of questions while, as opposed to questionnaires or structured interviews, allowing for sufficient openness regarding the field of interest. This interview type particularly corresponds to the complex knowledge held by the interviewee (Flick, 2002), and particularly suited for comparative case study research since it allows for applying a comparable structure of data acquisition to both case study contexts (Bryman, 2012; Diekmann,

2011). Semi-structured interviews are thus not designed to follow a "guideline-bureaucracy" (Przyborski & Wohlrab-Sahr, 2010: 139; translated by the author) but on the contrary demand a high degree of focus and flexibility from the interviewer in that sufficient space is given to the interviewee's own flow of speech. At the same time, however, the use of guidelines, albeit in a flexible way ('semi-structured') ensures that key points of interest are covered, with similar, comparable wording used in each interview, while continuously adapting key questions to the development of the interview situation. This is enabled through accepting that the interview situation differs from ordinary, everyday communication in that it does not adhere to the principle of reciprocity but is instead conducted in an interrogative style, at least to some extent (Diekmann, 2011; Yin, 2014). However, a too strict 'working off' of the guidelines is avoided through asking open questions that motivate the interview partner to develop their answer according to their own priorities, and, as depicted above, to delve deeper into background information provided by asking additional sub-questions where suitable (Bryman, 2012; Przyborski & Wohlrab-Sahr, 2010).

It should also be noted that expert interviews bear the risk of influencing interviewees on the one hand, be it through the way questions are formulated or through mimics and non-verbal reactions of the interviewer (Diekmann, 2011; Yin, 2014). Since for the purpose of this research, however, estimations and experiences are in the focus of interest (as opposed to, for instance, in-depth research on social behavior), this risk can be judged as being comparatively low. A further minimization of potential influence was also sought by predefined question styles and by asking open questions without offering potential answer sets, while handling the order of questions flexibly. Generally, open questions were employed almost exclusively in order to not limit possible answers to predefined categories (Diekmann, 2011). For making sure that the interviewer keeps track of the research interest during the interview, the major guiding questions have been supported by optional detailing questions as well as by potential categories for analysis that were derived from the literature review and the formulation of own hypotheses. Importantly however, these sub-aspects serve as a common thread and as a general support for the interviewer in ensuring progress of the interview, but do not restrict the answers, remaining open to additional aspects and categories to be recorded. Therefore, these sub-questions and categories were only part of the interviewer's personal guidelines and not distributed to interviewees by e-mail.

2.3.1.2 Structure of the interview guidelines

Against that backdrop, section 1 of the interview guidelines comprises of an introductory set of questions, motivating interviewees to think about the background of inserting land into the directive, and framing their own understanding of it. This introductory part thus serves to capture general insights into what interviewees understand by land, based on their EA experiences, and to examine what ad-hoc attributes are ascribed to land, without the potential influence of more specific questions to follow. For the purpose of dismantling major influencing factors for current SEA practice in regard to land, section 2 contains a set of questions regarding the status quo of addressing land as part of SEA. These questions look in particular to understand what role it plays in consultation procedures, what data and external studies assessment results can be based upon and what role land plays as part of the final assessment statement.

On the other hand, expert interviews aim in particular at researching the conceptual, theory-led questions in focus. These are covered by a set of questions in section 2 of the interview guidelines. In that context, they put a focus on examining approaches towards dealing with assessment uncertainties, especially with regard to those aspects that might be present in an implicit way but

rather not displayed explicitly as part of reports. Building on that, interviews aim at carving out factors for learning processes. Since these have to be scrutinized more indirectly, they have been considered as part of answers to a number of questions, especially concerning the occurrence of changes to plans, changes to the awareness for land, and also through a cross-connection with questions on dealing with assessment uncertainties and their contribution to improved assessment procedures. This section is particularly demanding for the interviewer in working a lot with specifying and, to some extent, interpreting questions, in order to enhance aspects that the interviewees raised, later to be contextualized against the background of the conceptual framework.

Finally, interviews also serve to grasp estimates on a draft assessment scheme for land suggested by the author. For that purpose, a two-way approach was applied. First, a set of general questions (section 3 of the guidelines) was posed regarding the potential contribution of SEA towards strengthening land as resource, its framing as a separate factor or sub-factor in SEA practice, and aspects to consider as part of land. Second, a preliminary draft assessment scheme for land was sent to the interviewees for their review, with additional factors and deficits observed by the interviewees being recorded during the interview. The interview guidelines are displayed in appendices B and C. Both comprehensibility and suitability of the interview guidelines for approaching the research questions were reviewed by discussions with supervisors and colleagues and thus tightened and further improved before the first interview was conducted.

2.3.1.3 Interview procedure

With regard to the interviewing procedure, the interview guidelines have also been designed to help avoid attempts of particularly committed and interested interviewees to contribute to analysis in abstracting from their own experiences themselves, given that "Interviewees are not experts for the analysis of their life but 'experts' for the mere course of their life" (Przyborski & Wohlrab-Sahr, 2010: 74; translated by the author). Also, attention was paid to avoid unnecessary interruptions of interviewees' responses and to let them finish their considerations before enquiries for further comprehension were added. Similarly, the interviewer attempted to avoid or at least reduce statements of consensus as a habit common to regular conversation, and instead tried to motivate further detailing of information provided by interview partners through further questions (Przyborski & Wohlrab-Sahr, 2010; Yin, 2014)

Before the interview was started, each interviewee has been asked for permission for recording the conversation which all of them agreed to. In order to ensure anonymity as far as possible, interviewees are only listed in table 3 according to their institutional affiliations (acknowledging that for small municipal authorities and consultancies, this might already reduce anonymity to some extent). Additionally, and in order to ensure research ethics and obtain informed consent (Bryman, 2012; Yin, 2014), separate permission was acquired by e-mail for all direct quotes during the data analysis phase. After every interview and in addition to the recorded material, a short summary was written, including key observations, as well as contributing to generalization by comparing the individual case in question to interviews conducted before, and thus achieving a gradual carving out of generalizable phenomena.

Compared with quantitative research methodology, qualitative approaches have not yet reached corresponding consensus on quality criteria. However, standard criteria such as validity, reliability and objectivity have also been formulated for qualitative research (Bryman, 2012; Przyborski & Wohlrab-Sahr, 2010 according to Reichertz, 2000): Validity hence refers to the adequacy of the research approach, which in qualitative research is ensured by understanding

context conditions of the individual communicative situation. Reliability refers to the reproducibility of findings which for qualitative research is not defined by exact repeatability of data gathering and analysis but by the general replicability of findings. Nevertheless, this replicability is to some extent restricted by the specific characteristics of case studies and individual interviews. For reliability in qualitative research, therefore, a systematic search for recurring phenomena and logical structures in the data are decisive. Objectivity, finally, describes the independence of findings from the person applying the methods, i.e. an intersubjective testability of results. This is particularly relevant for coding, i.e. the application of a system of categories to the original (interview) data, and for multi-coder situations in larger research projects (Przyborski & Wohlrab-Sahr, 2010). Given the challenges in applying criteria originally developed with regard to quantitative methods, however, alternative criteria have been suggested more recently (Bryman, 2012), key ones comprising context sensitivity, transparency, coherence and reflexivity regarding methods and arguments, as well as relevance, or impact on theory and practice.

2.3.2 Groups of Interviewees

Based on Sadler's (2011) categorization of key actors in SEA, i.e. politicians, public administrators, researchers/consultants and the general public, two major groups were defined as central to the study: On the one hand, planning authorities at different scales were considered key to understanding responsible authorities' perception of SEA procedures, the role of land therein, potential deficits and expectations as well as needs for action regarding the transposition of the revised directive. On the other hand, consultancies working on EA for land use plans were considered in order to gain in-depth insights on practical experience with SEA procedures. Further interviews were conducted with representatives of the European Commission in order to include information on the original intention of the revised directive as well as on related negotiation processes.

Contacts were selected based on a web search for respective institutions and companies, on recommendations by colleagues, as well as using snowball-sampling based on professionals already known to the author. This approach constitutes purposive sampling typical of qualitative research, based on selecting units of analysis (i.e. interviewees) that are relevant to the research questions and at the same time covering an adequate spectrum of characteristics (Bryman, 2012). Potential interviewees were contacted by e-mail, with the request describing the general background and interest of the study, its reference to the field of expertise of the person contacted, and a suggestion for a possible timespan regarding interview appointments. This e-mail request is displayed in appendix D. In those cases where the original request was not answered, a reminder e-mail was sent one to two weeks later. In a few cases that did not receive a reply by e-mail, an additional phone request was used to ask for an interview personally. Once a positive response had been received, the interview guidelines, not including the subset of questions focused on carving out the more conceptual questions, were sent to the interviewees for them to be able to prepare the discussion in advance.

Due to time restrictions for the English case study, and also given the spatial dispersal of consultancies and related travel costs, some expert interviews were conducted by telephone. A couple of interviewees even preferred to be interviewed on the phone. Although a face-to-face interview situation is generally preferable, telephone interviews proved adequately suitable due to a rather insignificant role of mimics and speaking habits. Recording problems did not occur,

and Bryman's (2012: 488) finding that "comprehensive replies suggested that the method can generate detailed and considered replies" can be confirmed.

For the German case study, expert interviews were largely conducted from May to August 2016. A total of 11 expert interviews were successfully conducted, a list of interviewed experts is provided in table 3. For the English case study, expert interviews were conducted during a DAAD-funded research stay at the University of Liverpool from February to April 2017. A total of 18 expert interviews were successfully conducted, table 3 correspondingly indicating the experts interviewed:

Table 3: List of Interviewees (own table, not further personalized)

Local Authorities, Government Agencies	Consultancies
EU COM, DG Environment	
European Commission, DG Environment, Unit Mainstreaming and Environmental Assessments	
European Commission, DG Environment, Unit Land and Soil	
Germany	
Municipality of Leipzig, Departments for Urban Planning and Landscape Planning	Bosch & Partner, Hannover
Municipality of Bremen, Department for Spatial Planning and Development	Freie Planungsgruppe, Berlin
Regional Planning Association Western Saxony, Leipzig	Planungsgruppe Umwelt, Hannover
State Agency for Environmental Affairs, Agriculture and Geology, Saxony, Freiberg	Planungsgruppe agl, Saarbrücken
Federal Environment Agency, Dessau, Department for Sustainable Spatial Development and Environmental Assessment	TerraIN, Leipzig
German Institute for Urban Affairs (difu), Berlin	
UK (England)	
Liverpool City Council	AECOM, Manchester
St Helens Council (part of Liverpool City Region)	Amec Foster Wheeler, Leamington Spa
Stockport Metropolitan Borough Council, IA Officer	Arup, London
South Lanarkshire Council, Planning and SEA Officer	Atkins, London
Environment Agency UK, Environmental Assessment Service	Collingwood Environmental Planning, London
Natural England, Environmental Planning and EIA Consultations	Levett Therivel Sustainability Consultants, Oxford
Institute of Environmental Management and Assessment (IEMA), Lincoln	LUC Land Use Consultants, London
	Mott MacDonald, Cambridge and Norwich
	RSK, Runcorn
	The Environment Partnership, Warrington
	WYG, Leeds

The sample size underlying this research is thus strongly determined by the limited number of relevant authority representatives for each case, whereas consultancies have been selected regarding their representative character of those particularly active in the SEA community and those regularly working in the field of SEA for land use plans, as well as in order to include consultancies of different sizes. Further aspects regarding the sample size and its achievement of theoretical saturation, also with regard to the larger number of interviews conducted for the English case study, will be reflected upon as part of section 7. Throughout the phase of gathering

empirical data, ongoing developments were observed and considered for adapting the research design as they happened: These developments included additional guidance documents and strategies referred to by experts, exemplary good practice assessments, as well as new policies such as the Housing White Paper issued by the UK Government or the updated Sustainability Strategy and land-related indicators issued by the German federal government in 2017. Also, ongoing debates led by professional associations such as the *UVP-Gesellschaft* in Germany and IEMA in the UK were followed closely and integrated into the research design.

2.4 Interview Analysis

2.4.1 Processing of interview data

In order to ensure an intersubjective testability and replicability of the interview material, transcripts of each interview audiofile have been created. Based on and guided by an agreement on a set of common transcription rules as compiled by Dresing et al. (2015), the transcription process has been supported by student assistants in autumn 2016 for the German case study and in summer 2017 for the English case study. Transcripts have been created via the qualitative data analysis software MaxQDA, in order to make transcribed interview documents directly available for subsequent coding and analysis. These transcripts constitute the basic material, the 'raw' data, for subsequent analysis and interpretation, in that they enable a precise allocation of findings to specific text sequences in the interview material. The process of constructing reality is thus based on data recording, their processing (i.e. transcription) and the carving out of a 'new' reality in and through the text-based stock of data (Flick, 2002).

2.4.2 Grounded Theory Approach

Whereas the approach developed here is not clearly attributable to the differentiation made by Yin (2014: 136 f.) between analysis shaped by reliance on theoretical propositions and "working […] data from the 'ground up'", the analysis of expert interviews can be said to be based on elements of Content Analysis (according to Mayring, 2010) or Thematic Analysis (according to Bryman, 2012), not completely generating but rather testing and elaborating theory, and on elements of Grounded Theory, with its generalization of initially case-specific findings through systematic and continuous comparison. This need for combining both approaches as frequently realized (cf. Charmaz, 2011) is also motivated by the 'restrictions' (or criticism) of pure Grounded Theory such as a lack of awareness of existing theories whereas here rather theory advancement and links of existing theories are considered (Bryman, 2012; see also Kørnøv, 2015 above).

Nevertheless, the research approach applies key elements of the Grounded Theory Approach, as developed by Glaser & Strauss (1965; in Przyborski & Wohlrab-Sahr, 2010): Grounded Theory neither focuses only on conceptual thinking without empirical basis nor requires complete standardization as in experiment-based science, i.e. is focused on substantiating ('grounding') theory by and in the data generated. It thus aims at a close link between empirical research and theory-generation, i.e. "weaving back and forth between data and theory" (Bryman, 2012: 26). In its early days, it was characterised by a strong emphasis on inductive approaches, emphasizing the role of data for emerging theory and rejecting theory testing by applying existing categories to newly generated data (Przyborski & Wohlrab-Sahr, 2010; according to Glaser & Strauss, 1965). This rejection of theory testing, however, has later been partly abandoned and replaced by also acknowledging the role of contextual knowledge and state of the art reviews as a basis for further research. By that, the necessary interplay of inductive and deductive approaches has increasingly been recognized for organizing the research process, including the formulation of hypotheses,

generation of data based on these hypotheses and resulting testing and advancement of theoretical concepts.

At the core of analysis is a continuous interconnection between theory-led data gathering and analysis, continuous comparison, process-based writing of memos, and a corresponding theory-led coding procedure that allows for a systematic analysis and interpretation of the material (Przyborski & Wohlrab-Sahr, 2010; Bryman, 2012; Yin, 2014). As mentioned above with regard to sampling, theoretical saturation is as well applied to analysis, in that the coding process is finalized once further reviews of data do not generate further findings with regard to concepts underlying theories, i.e. labels for aspects of the social world that share common features (Bryman, 2012). By these characteristics, Grounded Theory is to be distinguished from Content Analysis or Thematic Analysis that is predominantly focused on systematic classification of qualitative data and not as suitable for understanding implicit meanings and detecting structures of meanings (Przyborski & Wohlrab-Sahr, 2010; Bryman, 2012). However, it is important to note here that the research approach also includes elements of Content Analysis by testing and elaborating on existing concepts as well as by deriving options of an assessment methodology for land that is not explicitly theory-led.

Beyond that, significant challenges have been discussed with regard to the degree of generalization to be achieved through case study research (see also Flyvbjerg, 2011): Here, the approach of analytical generalization (cf. Mayntz, 2002; in Przyborski & Wohlrab-Sahr, 2010) has been applied, i.e. developing specific patterns or mechanisms of general significance out of the analysis of one or several cases. It needs to be acknowledged, however, that this approach in parts evokes a problematic relation of abstraction and concretion in that the more abstract the finding is presented, the more mundane it tends to be/the more concrete the finding is presented, the less comparable it normally is to other cases, i.e. the less generalizable it tends to be. Being aware of this situation, particular caution is used with regard to the risk of selective perception and interpretation of observations, and the potential influence of own expectations on the interpretation and prioritization of findings. This risk has been balanced by skepticism with regard to apparently obvious findings and correlations and an explicit search for hidden aspects and potentially contrasting manifestations of a category (Diekmann, 2011; Yin, 2014), emphasizing the need for constant comparison, as contained in Grounded Theory and depicted in figure 3 below (Flick, 2002).

Coding of the 'raw' data, i.e. of the interview transcripts, constitutes a key step in Grounded Theory (Bryman, 2012): "'Codes … serve as shorthand devices to *label*, *separate*, *compile*, and *organize* data'" (Charmaz, 1983; in Bryman, 2012: 568; emphases in original). Coding refers to the transformation or breaking down of empirical data into concepts and categories that are given labels and out of which theory is developed (Bryman, 2012; Przyborski & Wohlrab-Sahr, 2010; Yin, 2014) or elaborated. It starts by abstracting from the material itself and developing concepts from it, thus attributing concepts (represented by codes) to the data, out of which thematic categories are developed (Bryman, 2012). The coding process has been informed by overall categories for analysis, as underlying the interview structure, such as procedural steps, assessment methods and types of impacts (Fischer, 2001). On that basis, the development of categories has been derived from theoretical concepts (i.e. Content Analysis-based) as well as from the addition of further categories as derived from the data (i.e. Grounded Theory-based).

The coding process has been realized based on software for data analysis, creating codes for relevant passages and keywords in the transcripts. As for the transcripts, MAXQDA software has

been used, i.e. computer-assisted qualitative data analysis that is also regarded as contributing to greater transparency in qualitative research (Bryman, 2012). MAXQDA allows for the systematic attribution of codes and the retrieval of these codes, as well as text searches, thus connecting "strengths of human coding activity (comprehension of meanings) to the advantages of computer use (logical connections and data analysis)" (Diekmann, 2011: 615; translated by the author).

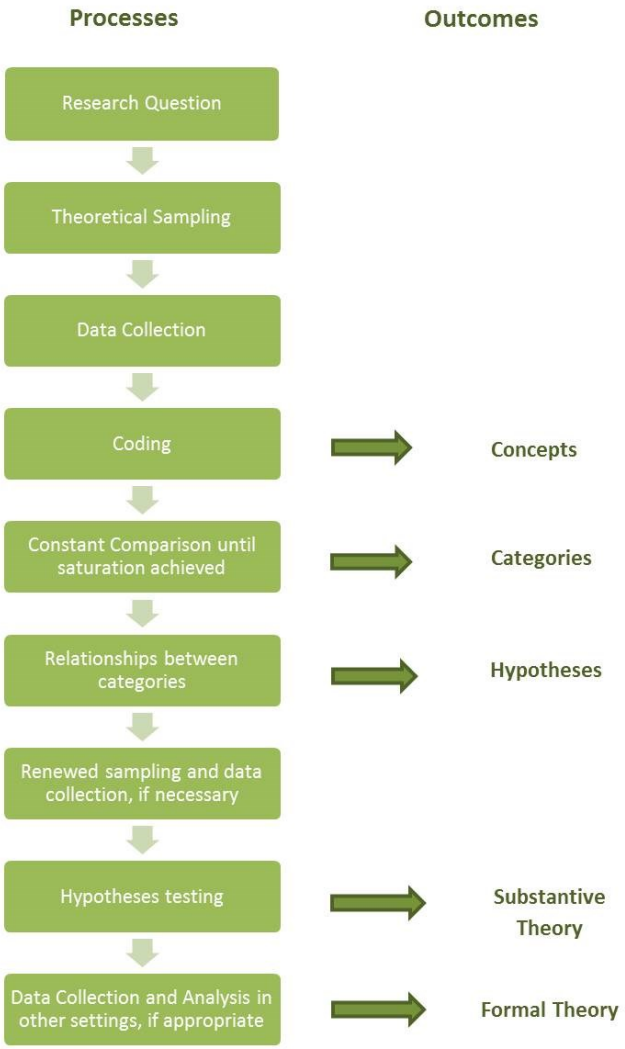


Figure 3: Grounded Theory-based structure of research process and outcomes (modified based on Bryman, 2012: 571)

2.5 Development and Testing of an assessment methodology for land in SEA

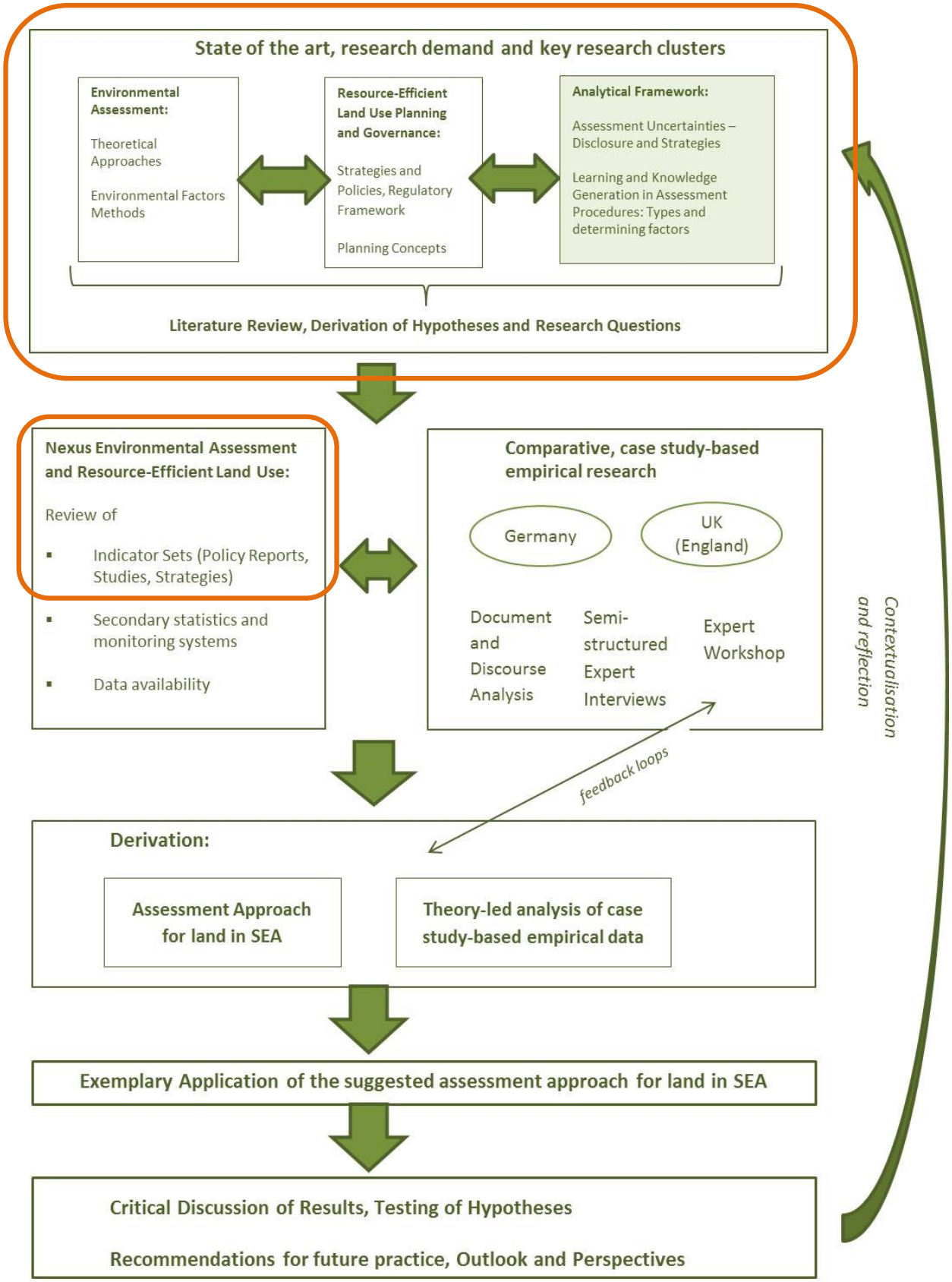
Initially based on the review of literature and relevant policies, a draft assessment scheme for land as a new environmental factor in SEA for municipal land use plans has been developed and included into the interviews for being considered by the interviewed experts. Based on these findings and a detailed review of potential indicators and available data, a refined assessment methodology has been developed and discussed as part of an expert workshop and subsequent conference-related presentations. Interested participants for the intended expert workshop were initially identified during the expert interviews, supplemented by a half-page call in the German Journal on Environmental Assessment (*uvp report*) in early 2017. In addition to feedback received on the call for participation, an e-mail invitation was sent to all previous interviewees as well as

to consultancies active in SEAs for municipal land use plans. This extended mailing list was derived from the one established for the SEA working group within the *UVP-Gesellschaft*/German IAIA affiliate.

The expert workshop took place in June 2017 in Hamburg, with a dedicated timeframe of six hours. Due to some short-notice inabilities to attend, the number of participants reduced to six. While this small size initially raised some concern for the researcher with regard to the representative character of the results, effective and efficient discussions eventually appeared to be rather fostered by the small group size. Furthermore, the composition of the expert group, with two professionals from planning and EA practice, two experienced research professionals in the field, and the researcher and a colleague representing the work of the department, facilitated an adequate representation of relevant professional backgrounds and expertise. Whereas, due to the timeframe of research, results could not be finalized before the end of the transposition period of the revised EIA Directive in May 2017, the expert workshop still happened at a suitable point in time for launching and supporting this implementation process in SEA practice, given the development of methodological advancements over time.

While the scheme and its constituting assessment aspects will be explained in detail in section 8, key steps regarding its development are to be mentioned here: Based on the estimations captured through discussing the provisional assessment scheme as part of the expert interviews, a number of questions were collected regarding the applicability of this scheme. While it is beyond the scope of this study, as well as subject to data availability, to provide a generally applicable methodology for assessing land in SEA, the study intends to provide starting points for a more systematic approach, initially focusing on land use for housing at the scale of municipal land use plans for the German context. This scheme should be seen as a starting point that can be built upon for applying it to land use demands arising from different sectoral interests as well as to other planning scales.

A second field test for the assessment scheme was enabled through presentation and discussion at the City of Leipzig's Department of Environmental Planning in July 2017, invited by the coordinator for EA procedures in Leipzig. Here, representatives from both the Departments for Urban Planning and Environmental Planning participated. The assessment scheme was presented in its modified version based on the results of the expert workshop, however, providing the participants with background information on its development and reasons for modification. A third professional discussion of the approach and sample applications to Leipzig municipal land use plans was made possible through a dedicated session of the SEA working group within the German *UVP-Gesellschaft* in October 2017 in Hannover. A detailed account of how this approach was developed and refined by discussion will be provided in section 8.


State of the art, research demand and key research clusters
Environmental Assessment:
Theoretical Approaches
Environmental Factors Methods
Resource-Efficient Land Use Planning and Governance:
Strategies and Policies, Regulatory Framework
Planning Concepts
Analytical Framework:
Assessment Uncertainties – Disclosure and Strategies
Learning and Knowledge Generation in Assessment Procedures: Types and determining factors
Literature Review, Derivation of Hypotheses and Research Questions
Nexus Environmental Assessment and Resource-Efficient Land Use:
Review of
Indicator Sets (Policy Reports, Studies, Strategies)
Secondary statistics and monitoring systems
Data availability
Comparative, case study-based empirical research
Germany
UK (England)
Document and Discourse Analysis
Semi-structured Expert Interviews
Expert Workshop
feedback loops
Contextualisation and reflection
Derivation:
Assessment Approach for land in SEA
Theory-led analysis of case study-based empirical data
Exemplary Application of the suggested assessment approach for land in SEA
Critical Discussion of Results, Testing of Hypotheses
Recommendations for future practice, Outlook and Perspectives

3 Analytical Framework: Resource efficient land use as an environmental problem and dimensions of Strategic Environmental Assessment (SEA) as a problem-solving approach

In this section, key concepts of relevance for this research will be reviewed and contextualized: First, the problem of resource efficient land use will be scrutinized, referring to major conceptual aspects of land and depicting reasons for ongoing land take, as well as consequences resulting from related land use patterns. Based on that, objectives formulated for tackling the problem and the role of planning strategies and instruments will be introduced. These aspects will be presented in a generalized way here, with precise figures and specific features of both case study contexts being provided in section 4. Subsequently, challenges connected with resource efficient land use will be linked with the role of Environmental Assessment in identifying and assessing impacts on environmental factors to be protected. Here, a brief review of SEA rationale and development will be followed by a focus on learning processes and assessment uncertainties. Institutional settings in England and Germany will be explained in section 4.

3.1 Problem dimensions of land use and response strategies discussed

3.1.1 Problem dimensions and need for action

The focus of this research on land as a resource and its framing in SEA is understood as part of a larger and overarching debate captured by the concept of the Great Transformation towards sustainability (Kraas et al., 2016; Schneidewind, 2018). This concept, focusing on the necessity of fundamental changes to consumption patterns in particular, has gained in importance for the discussion of ecological processes and sustainability strategies in recent years. This is based on the observation that planetary boundaries based on ecological carrying capacities are increasingly being exceeded through human activities and their consequences in what has been termed the Anthropocene (Kraas et al., 2016; Rockström et al., 2009; Sadler, 2016). Consequently, the problem of unsustainable land use patterns has also been prominently addressed by the so-called grand challenges for society, explicitly emphasised as part of the UN Sustainable Development Goals (SDGs; UN, 2015). In particular as part of SDG 11 and 15, the loss of land to development – or, reversed, the need to protect undeveloped land as a resource – has been formulated as a key indicator due to its connection with a range of pressing environmental problems such as urbanization, climate change and loss of biodiversity. Against this backdrop, this research strives to be understood as one contributing element to such a change of patterns in consumption and use of (land) resources, through conceptually and methodologically substantiating the orientation of Environmental Assessment towards resource protection and resource efficiency. In this regard, the concept of critical planetary boundaries as a dedicated framework for defining assessment thresholds differentiates between “sharp” thresholds on a global scale with “’top-down’” impacts on subsystems, such as climate change and ocean acidification, and less clearly identifiable thresholds that relate to slower processes on a regional scale with “’bottom-up’” impacts, such as land use change (Sadler, 2016: 25; according to Rockström et al., 2009). This understanding is also closely linked to an increasing number of contributions from different thematic fields that question the presumption of development or growth paradigm which has prevailed in decision-making procedures to date (e.g. Jackson, 2009; Weiss & Cattaneo, 2017; Kraas et al., 2016). Accordingly, these debates have also requested paradigm changes with regard to the framing of existing and new environmental factors in EA, as exemplified by Kørnøv et al. (2016) with regard

to climate change or Sadler (2016) with regard to ecosystem services. With regard to land in particular, recent starting points have been formulated by Fuhrhop (2015) and UBA (2018a), exploring a so-called land moratorium that allows for additional land take only where previously used land is transformed into a more natural state elsewhere, as has also been postulated by the no-net-land take concept that will be outlined further below.

The explicit integration of land as a separate factor in environmental assessment finds itself rooted in planning debates surrounding the ongoing increase in land take for development (mainly for housing, commerce as well as industry and transport) and the complex consequences arising from that. Despite problem dimensions of land use being measured differently in different national contexts, depending on indicators and data used, earlier comparative analyses have revealed the general significance and international dimension of the problem. Approximations of land taken for development purposes in Europe have been provided by Meinel et al. (2007) and illustrated by Bock & Preuß (2011), indicating comparably high growth rates for both Germany and the UK. On the European scale, the continuous decrease in undeveloped land and corresponding increase in artificial surface has been found to amount to about 100.000 ha (1000 km^2) per year, i.e. about 270 ha per day for the EEA-39 countries, with about half of this amounting for sealed surface (UBA, 2003; EC, 2016; EC, 2011; EC, 2012). Rates of increase as a share of overall developed land are illustrated in figure 4 (projection), absolute figures of annual land take based on Corine Land Cover data for different land use sectors are presented in figure 5. Furthermore, an EEA (2016b) assessment of urban sprawl in Europe identified an increase in levels of sprawl in all countries investigated compared to a similar report issued ten years before. This is exacerbated by a projected further increase of urban population by 2050 that already amounts to more than 70 % of the European population living in cities. Thus, while a slowing pace of land take in Europe is expected after 2030 due to a decreasing population, an aggravating risk of settlement perforation, given the decoupling of land take and population development in many cases, is postulated (EEA, 2016a; EEA, 2016b).

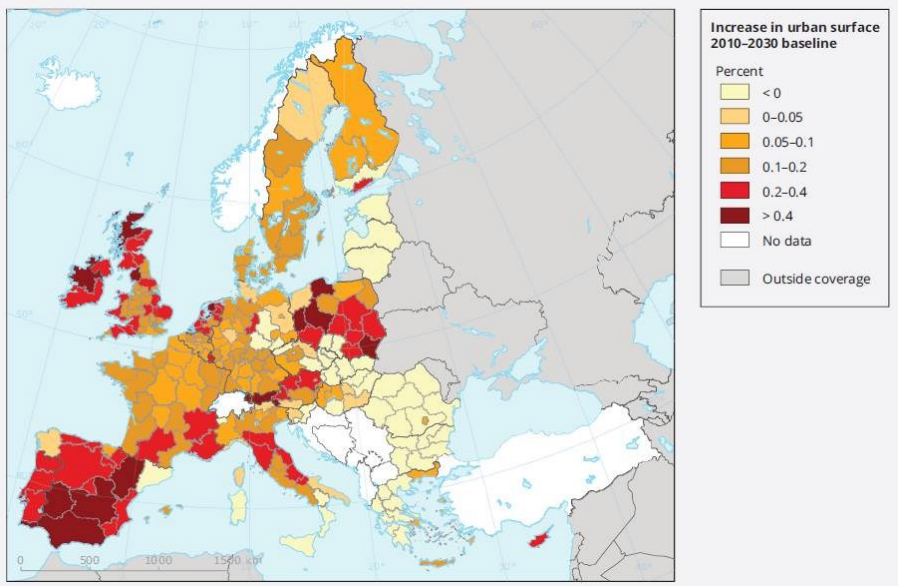


Figure 4: Increase in urban surface (as a proxy for land take) in EU countries 2010-2030 (EEA, 2016a: 19)

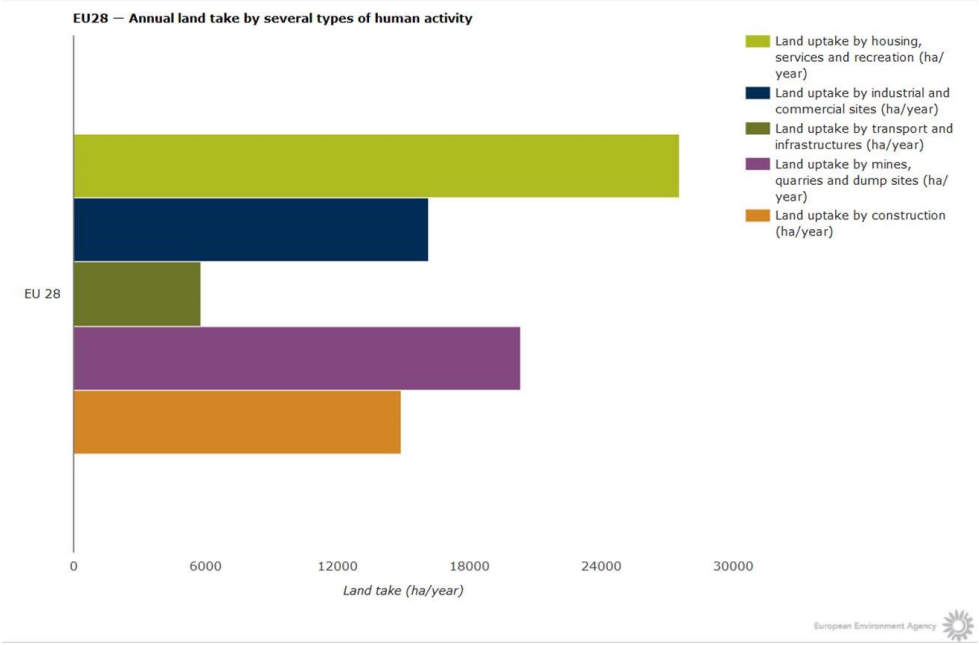


Figure 5: Annual land take for the EU 28, by types of land use activity (https://www.eea.europa.eu/data-and-maps/indicators/land-take-2/assessment-1; accessed 28/01/2019)

Detailed figures for Germany and England will be depicted in section 4. As emphasized by EC (2011: 15), "these decisions [on the use of land; *added by the author*] are often taken without proper prior analysis of such impacts, for example through a Strategic Environmental Assessment." This assertion constitutes a key motivation for scrutinizing the current and potential future role of SEA in assessing land use decisions.

Given the severity of the problem, the German planning discourse has generated a detailed consideration of the problem, spurred by major research projects and programmes over the last 10 to 15 years. Two major trends are of particular importance: On the one hand, there is an ever-increasing demand for residential space per person, supported by reduced household sizes overall, and the tendency of elderly people to remain in their former relatively large family homes (EEA, 2006; EC, 2012; BMVBS, 2012; Bock & Preuß, 2011; Voigtländer & Depenheuer, 2014). This is linked with decreasing housing densities that reduce the efficiency of land use patterns (see section 4). On the other hand, there is a strong and persistent demand for single family homes (Bock & Preuß, 2011; Wunder et al., 2014; EC, 2012), causing a particularly unfavourable ratio between living space and built-up area. This is also underpinned by a comparison of land take per person, being about five times higher in rural than in urban areas (BBSR, 2016; see section 4). Adverse trends in urban agglomerations, with increasing densities at the expense of available green space (BBSR, 2011), have at the same time prompted a need for not only reducing land take but realising housing provision while safeguarding urban green space (BfN, 2015). Besides these demand-related factors, supply-related factors comprise the role of land prices and fiscal systems that lack incentives for developing brownfield land or which motivate (over-) supply of development land by municipal authorities (BBSR, 2011; EC, 2012), with the latter having been identified as a more significant driver of land take in Germany than demographic and economic development trends (BMVBS & BBR, 2009; SRU, 2016).

Beyond what has often been formulated as a problem with regard to the loss of agricultural land (EEA, 2016a; 2016b), land take (for development purposes) should rather be regarded as causing

a multi-dimensional problem field, evoking interacting negative impacts from an ecological as well as from a social and economic point of view. First, a continuous conversion of previously undeveloped land into land for development purposes leads to soil sealing and compaction, with the resulting loss of natural soil functions such as runoff reduction, groundwater recharge, as well as regulatory, filter and buffer functions. Also, land take can evoke habitat fragmentation and destruction with potential impacts on biodiversity through the reduction of habitat sizes and the loss of migration corridors, as well as loss of recreational areas. Furthermore, sealed surfaces exert influence on local climate conditions such as on cold and fresh air production areas and exchange corridors as well as on groundwater recharge, surface runoff and stormwater drainage. Second, the conversion of land of agricultural value into land for development purposes reduces available space not only for food production but also for producing renewable energies. Finally, new housing sites generate additional requirements for infrastructure provision and maintenance, potentially an increase in abandoned property, and often induce additional mobility requirements and corresponding costs (BfN, 2008; BBSR, 2011; Bock et al. 2011; UBA, 2003; Bio by Deloitte, 2014; EEA, 2016b; EC, 2012).

The complexity of these consequences is illustrated in figure 6. Accordingly, the problem of continuous land take and unsustainable land use patterns has also been termed a "prime example of a 'tragedy of the commons'" (EEA, 2016b: 25), given that the benefits of land are predominantly favouring individuals while detrimental effects largely affect society as a whole. Besides these effects of land take, a categorisation of key drivers is rendered in figure 7 below.

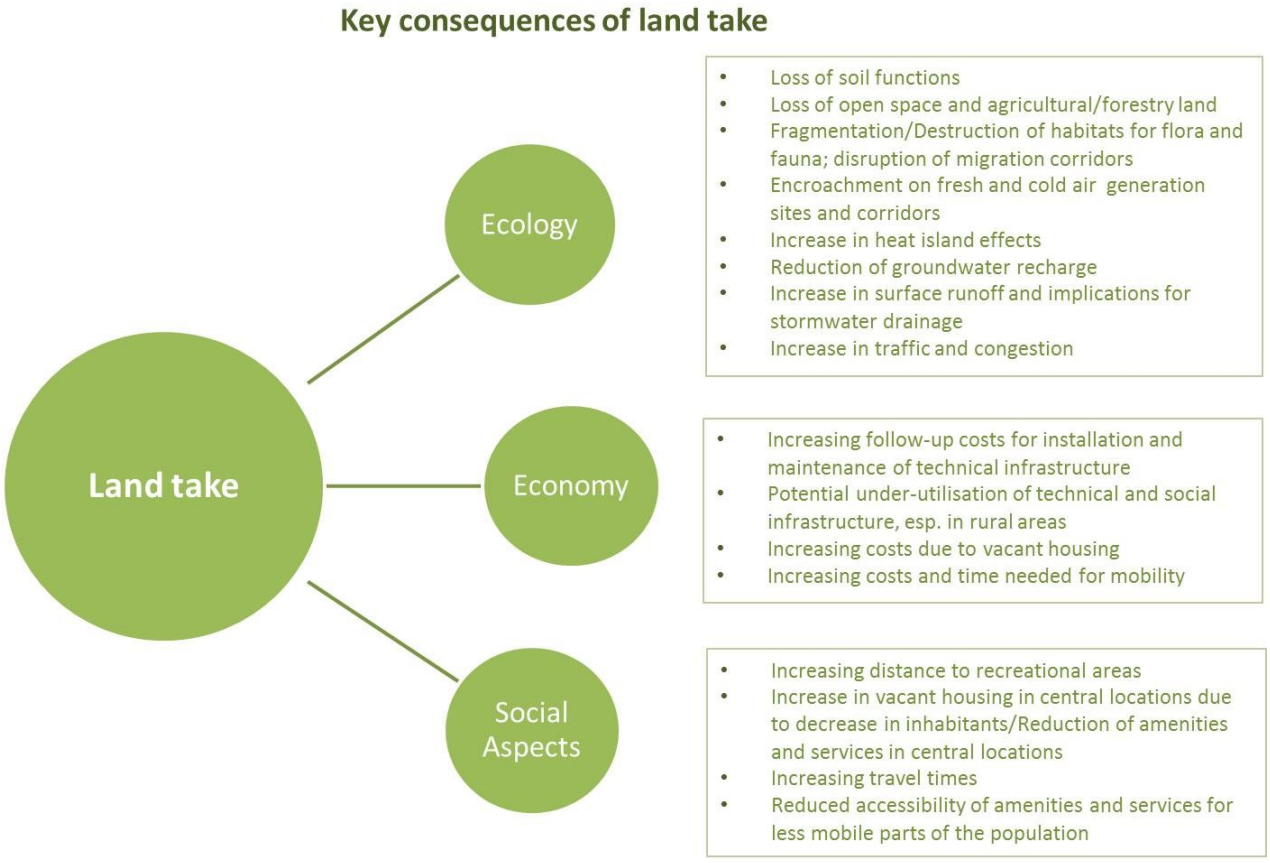


Figure 6: Key consequences of land take (own figure, based on Bock & Preuß, 2011; EEA, 2016b; EC, 2012)

Figure 7: Key drivers for land take (housing sector), including demand and supply side (own figure, based on Fina, 2013 according to EEA, 2010; BMVBS & BBR, 2009; Bio by Deloitte, 2014)

Beyond the effects of land take on the immediate environment, a growing discussion relates to global impacts of land take and demand for land-based products, also framed by the concept of 'land footprint' (Bio by Deloitte, 2014; UBA, 2017a; Bruckner et al., 2015; Wackernagel et al., 2004; Meyfroidt et al., 2013): While these impacts cannot be considered in depth within the scope of this study, they describe impacts of land take in one place, in particular by increasing urban population, on distant places providing land-based resources for these spaces of consumption (EEA, 2016b). Against the backdrop of these multi-dimensional drivers and consequences of land take with statistical evidence indicating the lasting topicality of the problem, a recent report issued by the German Advisory Council on the Environment terms the issue a "persistent environmental problem", due to the lack of significant improvements and the irreversibility of detrimental effects on the environment (SRU, 2016). Before potential responses to that will be detailed further, a closer look at how land is defined and what sub-aspects it comprises is required.

3.1.2 Terminology: What is meant by land?

Considerations surrounding the definition of land meet with a rather diverse field of existing strands of debate, both nationally and internationally. Generally, a distinction can be made between two conceptual approaches. On the one hand, many research approaches and planning instruments focus on the dichotomy of developed and undeveloped land, i.e. on the ongoing increase in artificial, built-up surfaces at the expense of open, undeveloped land. On the other hand, a more encompassing concept focuses on strategies to reduce land use conflicts arising from different land use demands, also considering aspects such as food and energy security and their

global interdependencies (Winter & Lobley, 2009), as also incorporated by the land footprint concept mentioned (see also Alsleben, 2015). Land has also been defined as a key natural resource (BMU, 2012; Bio by Deloitte, 2014; Winter & Lobley, 2009; Kuhlmann et al., 2014), as schematically shown in figure 8. Following the understanding of natural resources as abiotic and biotic ones comprising sources and sinks (Wunder et al., 2014; BMU, 2012), land is a cross-cutting one that refers to the utilization of physical space. Hence, for the protection (and assessment) of land, key strategies of resource efficiency have been suggested, comprising sufficiency, efficiency and consistency (Alsleben, 2015; see also Ferber et al., 2016).

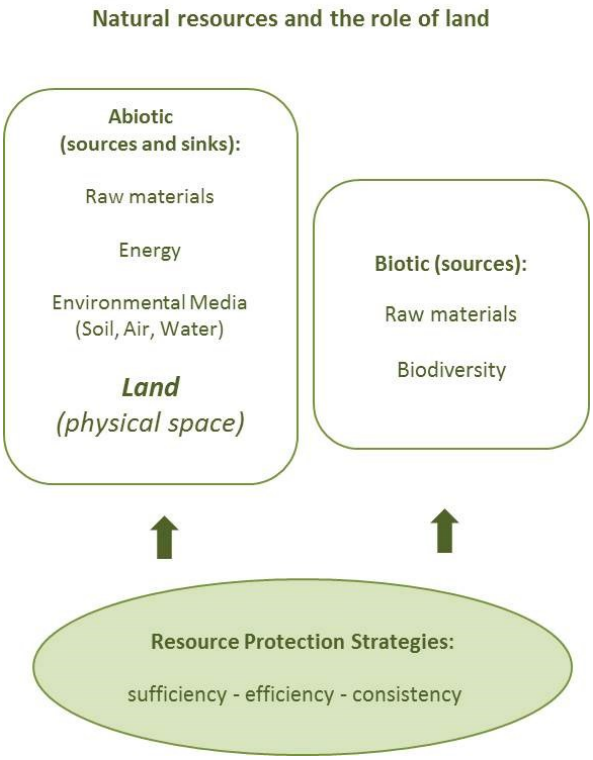


Figure 8: Natural resources and the role of land (own figure, based on Giegrich et al., 2012; Kuhlmann et al., 2014; BMU, 2012; Alsleben, 2015; UBA, 2017b)

A general issue is the frequent confusion or synonymous use of 'land' and 'soil.' Soil has been defined as the "upper layer of the earth's crust, resulting from the alteration of rock and enriched with organic matter, that can support plant life" (Bio by Deloitte, 2014: 16), or according to its functions, with soil containing natural functions, use functions for raw materials, agricultural and forestry use, for housing and recreation as well as for transport, supply and disposal, and archive functions (Wunder et al., 2014 according to BBodSchG). Accordingly, some congruency on a definition of land can be found, essentially referring to its undeveloped, non-built-up character: "Land not built upon, not fragmented and not affected by urban sprawl is a limited resource" (Wunder et al., 2014: 15; translated by the author); similarly: "land not used for building purposes and unsealed" (BfN, 2008: 3; translated by the author). EC (2016) directly contrasts "agricultural or natural land" and "artificial areas". However, the differentiation between land and soil is not always as clear-cut as the definitions provided may suggest: The UNCCD definition describes land as "the terrestrial bio-productive system that comprises soil, vegetation, other biota, and the ecological and hydrological processes that operate within the system" (Bio by Deloitte, 2014: 16) and thus rather as an overarching complex containing soil. The 7th EU EAP mentions soil aspects (reduced soil erosion, increased soil organic matter, remediation of contaminated sites) alongside the objective of no net land take (EEA, 2016a), see also UBA (2018b) for an integrative perspective

on soil and land in the context of operationalizing land degradation neutrality. Figure 9 illustrates the understanding of land replicated here, displaying the dichotomy of developed and undeveloped land as well as the different sectors that land use demands arise from.

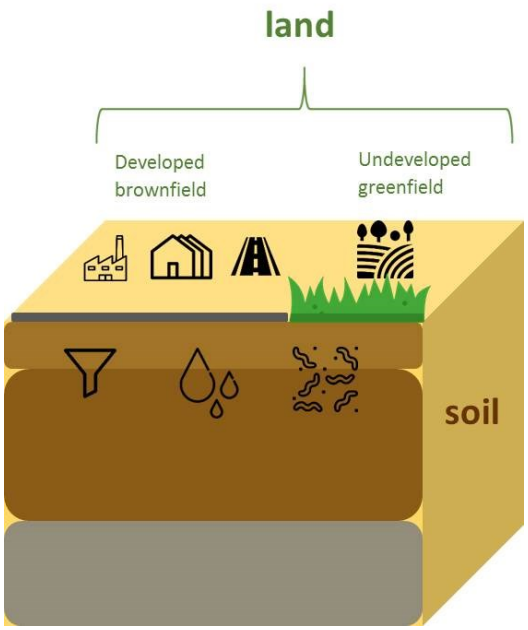


Figure 9: Schematic illustration of land and its differentiation from soil (own figure; icons made by Freepik and monkik from www.flaticon.com)

Recent European activities shed some more light on the framing of land, referring to its use and its capability to fulfill ecological functions/provide ecosystem services (EEA, 2016a): Besides land take or land consumption as already reviewed above, these include land use efficiency, land fragmentation, land quality and land degradation (EEA, 2016a). With regard to land use efficiency, a closer look is required at how reuse potentials have been defined, including the dichotomy of greenfield and brownfield land and the category of previously developed land: Schädler et al. (2011), reviewing definitions from Europe and the US (Cabernet, 2005; USEPA, 2002), derives a definition of brownfield sites as "abandoned or underused properties, for which intervention is required to ensure beneficial reuse because of the real or suspected presence of hazardous substances, pollutants or contaminants", and, hence, a focus on contamination. The German Environment Agency UBA (2015a), acknowledging that there is no official definition for brownfield sites (*Brachflächen*) in Germany, frames them as sites that are not used or not used according to their potential in their settlement context. A similar meaning is represented by the UK NPPF-based definition of PDL: "land which is or was occupied by a permanent structure, including the curtilage of the developed land (although it should not be assumed that the whole of the curtilage should be developed) and any associated fixed surface infrastructure, excluding land occupied by agricultural or forestry buildings, land developed for minerals extraction or waste disposal where provision for restoration has been made through development control procedures, land in built up areas such as private residential gardens, parks, recreation grounds and allotments, and land that was previously developed but where the remains of the permanent structure have blended into the landscape in the process of time" (MHCLG, 2018: 70). Brownfield land, then, has been defined as "unused land or buildings (and most likely derelict or contaminated in some way), not necessarily distinguishing between former agricultural/forestry buildings and buildings in any other use", i.e. as sites that have been affected by former uses of the site or surrounding land/are derelict or underused/are mainly in fully or partly developed urban

areas/require intervention to bring them back to beneficial use/may have real or perceived contamination problems (Dixon & Raco, 2007: 3; similar: Bio by Deloitte, 2014: 15). CPRE (2014b) states for the UK that both terms are often used interchangeably (also Dixon & Raco, 2007), with PDL, however, functioning as the officially defined term in planning. In Germany, the discussion regarding brownfield reuse rather revolves around the term inner-urban development (*Innenentwicklung*) (e.g. Wunder et al., 2014).

Subsequently, sub-aspects of land as mentioned above will be defined in order to provide a background for the further consideration of responses to unsustainable land use patterns.

Land take, as defined by EEA (2016a: 16) refers to a "change of the amount of agriculture, forest and other semi-natural and natural land taken by urban and other artificial land development. It includes areas sealed by construction and urban infrastructure as well as urban green areas and sport and leisure facilities" and thus essentially leads to an increase in built-up areas or "surface covered by man-made structures" (EEA, 2016b: 47). Land take can be differentiated into gross and net land take, with the latter accounting for the amount of land brought back into a more natural state (Bio by Deloitte, 2014). In essence, land take is often used as a proxy for soil sealing (EEA, 2016a), as exemplified by the German land use statistics indicator, with its detailed structure and its non-equation with soil sealing being explained in section 4. Soil sealing has been defined by EEA (2016a: 16): as "the covering of the soil surface with materials like concrete and stone, as a result of new buildings, roads, parking places but also other public and private space", thus referring to the materialized change of the surface cover and leading to impermeability for water (BBSR, 2011; EC, 2012).

Land (use) efficiency has not been defined explicitly by EEA (2016a) but can be regarded as closely linked to land recycling. Land recycling according to UBA (2015a) describes the revitalization and reuse of brownfields that have lost their previous use. A more detailed definition includes the "redevelopment of previously developed land (brownfield) for economic purpose, as well as ecological upgrading for the purpose of soft-use (e.g. green areas in urban centres) and bringing land back into a more natural state by removing existing structures and de-sealing surfaces" (Bio by Deloitte, 2014: 68). Obviously, land use efficiency and land recycling are directly linked to brownfield/PDL reuse or redevelopment. Besides enhanced land recycling, Bio by Deloitte (2014) describes enhanced density of new development as a key component of land use efficiency and reduced land take, and thus as major aspects of land. These interdependencies and the idea of a circular economy in land use are portrayed in figure 10.

Urban Sprawl, as often synonymously (and more colloquially) used for land take in and around urban areas, explicitly refers to low-density expansion of the urban fabric, i.e. "the physical pattern of low-density expansion of large urban areas, under market conditions, mainly into the surrounding agricultural areas" (EEA, 2016b: 20). With various understandings existent in the literature (EEA, 2016b), three common features can be derived, i.e. the expansion of urban areas, the scattering of settlement areas, and low-density development (Jaeger et al., 2010; Couch et al., 2005), thus adding the dispersion dimension to the aspect of land take. Linked to that is also the concept of **land fragmentation** (EEA, 2016a).

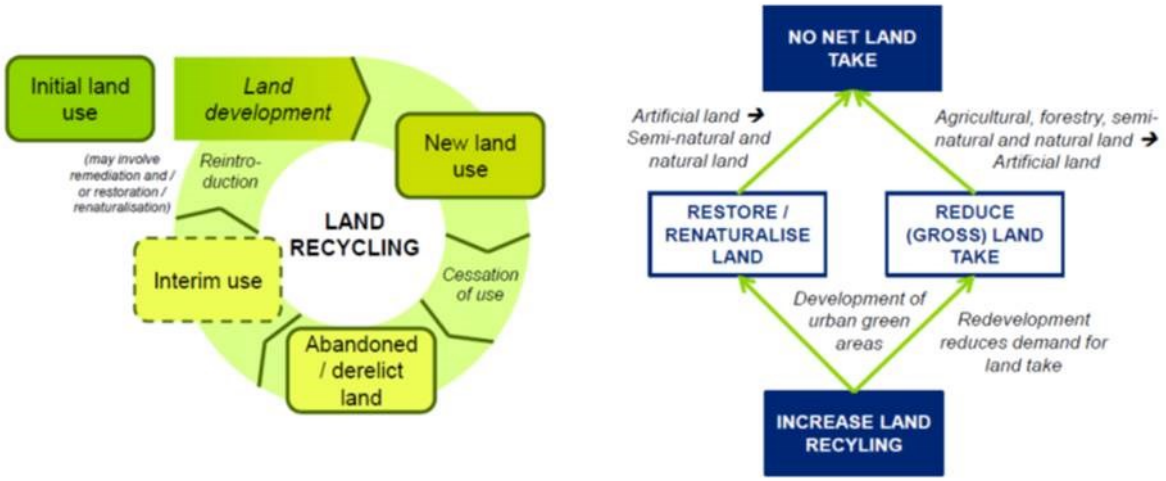


Figure 10: The circular idea of land management and the role of land take and land recycling in achieving no net land take (Bio by Deloitte, 2014: 68; based on BMVBS & BBR, 2008; Preuß & Ferber, 2008)

Finally, **land quality**, and **land degradation** refer to (the loss of) land functions by a "complex phenomenon that is linked to the long-term, biological productivity of land. It brings together several elements, including soil degradation and the capacity of land areas to support water resources, biodiversity and primary productivity" (EEA, 2016a: 16; see also Bio by Deloitte, 2014). Several frameworks have been developed in order to picture land by its functions, such as the Land Use Functions (LUF) concept (ESPON, 2012a, in Bio by Deloitte, 2014), the ecosystem services concept (see below), or the LUCCA indicator set developed by Helbron (2008). Through its impact on ecological processes provided by undeveloped land, including soil functions just as much as climatic regulation and habitat functions, land take (and not only soil sealing, i.e. a complete conversion of the land surface) is linked to land degradation.

Based on these sub-aspects of land, three key objectives/targets have been derived, comprising the **reduction of land take**, the **efficiency of land use** and the **protection/conservation of land quality** (BMVBS & BBR, 2007; Hinzen & Preuß, 2011; Fina, 2013). Here, the reduction target refers to the quantitative reduction of land take and of soil sealing, not considering qualitative aspects related to the respective amount of land affected. The efficiency target then describes the intensity of land use and sets land use demands in relation to minimum land take required. The protection target comprises qualitative aspects of land, referring to ecological functions of other environmental media such as biodiversity, water or soil, potentially impacted through development on land. A fourth aspect, the **structural target**, has been added with regard to land fragmentation and the objective of compact land use patterns. These targets are illustrated in figure 11. An overview of potential indicators to support these targets is depicted in table 4. Both will be further considered with regard to responses and instruments in the following, and taken up by a discussion of assessment indicators and data in sections 4 and 8.

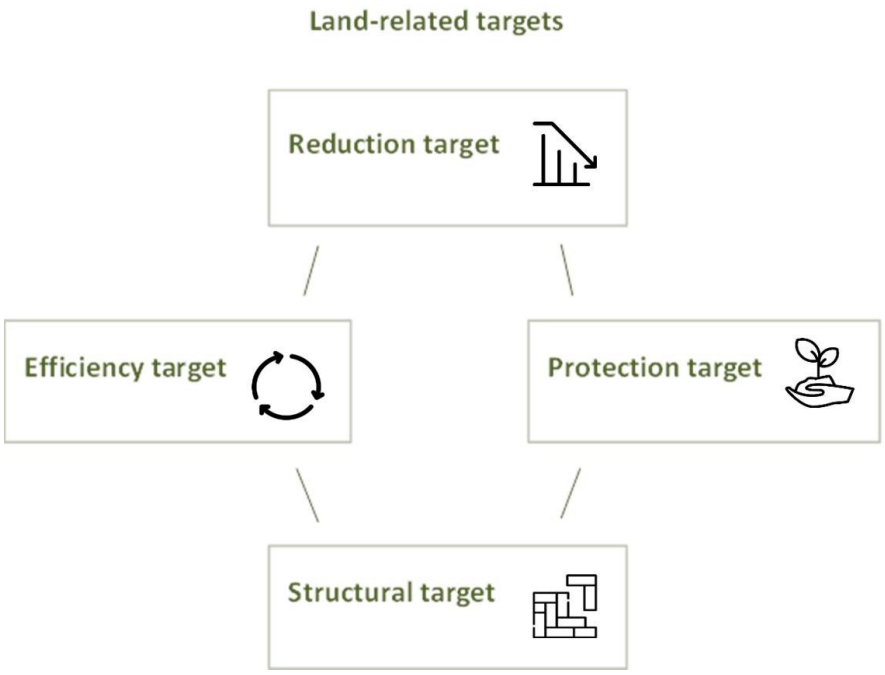


Figure 11: Targets with regard to land as a resource (own figure, based on Fina, 2013; Hinzen & Preuß, 2011; BMVBS & BBR, 2007; BMVBS & BBSR, 2009; EEA, 2016a; icons made by Freepik from www.flaticon.com)

Table 4: Indicators related to land targets (own table, based on BMVBS & BBR, 2007; Bio by Deloitte, 2014; modified)

Land-related indicators

Reduction Target	Efficiency Target	Protection Target	Structural Target
• **Land take** (proportion)	•**Settlement density** (ratio number of inhabitants : development land)	• Land take • **on soils with high productive capacity** • **in designated protected sites** • **in valuable landscapes**	•**Development concentration/dispersal** (proportion/increase of land take in central locations with regard to overall land take)
• **Land take** (increase)	•**Utilisation density** (ratio number of inhabitants and employees : development land)	• **Development land potential with few restrictions** (with respect to flora/fauna, biodiversity, water, soil, climate and raw materials)	•**Locational integration** of new development sites
• **Soil sealing** (proportion)	•**Densification** (ratio dwelling completions single family : multi storey housing)	• **Proportion of open/green space on land for development**	•**Infrastructural accessibility** of new development sites
• **Soil sealing** (increase)	•**Utilisation intensity of new built-up structures** (ratio net usable space of new dwellings : amount of newly developed land)		•**Landscape fragmentation** (effective mesh size)
• **Desealing**	•**Ratio newly built structures : vacant lots**		•**(Amount of brownfield potential)**
	•**Infrastructural costs**		•**(Reuse of brownfield potential** with regard to overall amount of new dwellings realized)
	•**(Amount of brownfield potential)**		
	•**(Reuse of brownfield potential** with regard to overall amount of new dwellings realized)		

3.1.3 Responses: Interdependent Rationales, Strategies and Instruments

Generally, land and the problem of regulating land use lie at the core of planning. Many spatial or land use planning systems and first planning acts developed even as a direct response to an immense conversion of agricultural land into building land in the wake of the Industrial Revolution and the need for regulation (Cullingworth et al., 2015; Winter & Lobley, 2009). At that time, however, focus used to be on regulating new development, without questioning the need for it. This has changed with what has been termed the "resourcial turn in planning" (Gerber et al., 2018: 9), i.e. sustainability objectives enhancing the scarcity of land as a resource the use of which is to be regulated. From the observation that land use planning can evoke both positive effects with regard to environmental issues, such as ensuring an efficient settlement structure, and negative effects, such as in allowing for exhaustive land take, also the need for SEA for land use plans has been derived (Jones et al., 2005).

The role and status of an overarching objective such as resource efficient land use in planning also depends on the general approach to how objectives are implemented and regulations are applied. While resource efficient land use has been increasingly emphasized as a guiding principle in planning in various contexts, it is at the same time confronted with a complex interplay of different planning scales and types of instruments involving a range of different rationales, or "'silo' mentalities" (Dixon & Raco, 2007: 4). First attempts towards more cross-disciplinary and integrated approaches have been developed by the circular land economy approach and urban land management in Germany (Preuß & Ferber, 2008; BMVBS & BBR, 2006; LABO, 2012), further extended to include land use demands arising from other sectors by the concept of sustainable land use governance (Haber & Bückmann, 2013; Weith et al., 2013), and (quests for) comprehensive land (use) strategies in the UK (CPRE, 2017b; Scottish Government, 2011), for instance. For this study, however, in its intention to develop an applicable assessment approach for land, the scope has been narrowed down to land use for housing. While land take for other purposes certainly constitutes a significant part of the problem, this narrowed focus was deemed useful to be able to develop precise indicators first and by that prepare further advancements of the methodology to include other sectors. This (preliminary) focus is supported by the differentiation suggested by EEA (2016a), referring to direct impacts on land (e.g. land take by housing development) and indirect ('second-level land take') impacts (e.g. land take implied/facilitated by a new road).

Generally, and as already alluded to above, a double strategy has been suggested for achieving resource-efficient land use, i.e. the reduction of additional land take and the reuse of previously developed land for development (EC, 2012). Quantitative targets on land take and/or land use efficiency have been formulated in a number of European countries over the last 15 years (Bio by Deloitte, 2014; Geneletti et al., 2017; EC, 2012). A series of instruments has been developed as part of land policy, i.e. varying combinations of instruments developed in order to strengthen public planning objectives with respect to (often opposing) private or other public interests (Gerber et al., 2018). At the European level, two policy strands are of particular relevance. The first consists in EU Regional Policy and the key objective of territorial cohesion. Here, the 1999 European Spatial Development Perspective ESDP (EC, 1999) particularly promotes the compact city, and the 2007 Leipzig Charter (EU Ministers for Urban Development, 2007) similarly emphasizes the role of compact settlement structures and a mix of uses for the viability of European cities. In addition, the EU Territorial Agenda published as a framework for EU Regional Policy in 2011 (EU Ministers responsible for Spatial Planning and Territorial Development, 2011) can be regarded as a stimulus for the stronger recent consideration of land take and resource

efficient land use, and for related EU studies published on that (Spannowsky, 2013; EEA, 2016b; Bio by Deloitte, 2014). A second strand of key relevance for resource efficient land use is EU Environmental Policy, including policies on soil and biodiversity in particular, and, given EU legislative competence in this field, related regulations. Regarding soil, the EU Thematic Strategy for Soil Protection 2006 (Commission of the European Communities, 2006) adopted a comprehensive perspective, with corresponding beneficial effects on land (EC, 2012). Regarding biodiversity, relevant strategies include the Biodiversity Strategy, the Green Infrastructure Strategy, and in particular the Habitats Directive (EEA, 2016b), which includes impact mitigation regulations. Here, the prioritization cascade of avoidance, reduction, and, ultimately, compensation (EC, 2012), constitutes a key instrument as part of EA (Busse et al., 2013; Wende et al., 2018a).

The problem of resource efficient land issue has been more explicitly addressed by the Roadmap to a Resource Efficient Europe, issued in 2011, as part of the overarching Europe 2020 Strategy (EC, 2011) which formulates the target of "no net land take" and the need for EU policies to take into account their direct and indirect impact on land. No net land take is not to be understood as the prohibition of new development but as balancing land use in that no more than the existing maximum stock of developed land is used (SRU, 2016; Bio by Deloitte, 2014; see also figure 10 above). These objectives have been further strengthened by the 7th Environment Action Programme EAP published in 2013 (European Parliament & European Council, 2013; EEA, 2016a) which postulates "to reduce soil erosion and increase soil organic matter, to remediate contaminated sites and to enhance the integration of land use aspects into coordinated decision-making involving all relevant levels of government, supported by the adoption of targets on soil and on land as a resource, and land planning objectives" (Bio by Deloitte, 2014: 28). While the EU does not have a competency for land use planning, there is therefore a strong emphasis on the need for an integration of land objectives into sectoral policies with considerable EU influence (transport, energy, water, environmental, cohesion, common agricultural policy), particularly given the complex interplay of impacts (EC, 2012; EEA, 2016a). In that context, the objective to "include broader resource efficiency considerations in the review of the Environmental Impact Assessment (EIA) Directive" has explicitly been formulated (EC, 2011: 16). This review of land-related sectoral interests, decision-making, interacting strategies and instruments at EU level is also at the centre of a Dialogue Process on "Land as a resource" held by the European Commission based on the Roadmap mentioned above (EC, 2011; Bio by Deloitte, 2014; EC, 2016). These debates constitute a highly complex field that in its complexity has not yet entered planning practice or materialized into applicable approaches for 'daily use' in municipal land use planning. This is to some extent also attributed to the fact that policies regarding land came up later than policies regarding other environmental issues, e.g. air, water and noise, and the lack of binding instruments at the EU level to date, as pointed out by Geneletti et al. (2017).

A first attempt at specifying concepts, objectives and targets outlined above has been provided by Bio by Deloitte (2014) in the wake of the dialogue process initiated by the EU. Key issues revealed here include a particular need for data harmonization with regard to allocating the EU target of no net land take to member states due to different national and EU datasets on land. Further, the lack of a common terminology on land use efficiency and a related lack of data on land recycling, as well as the finding that the prioritization of brownfield land development does not yet constitute common practice have been underlined (Bio by Deloitte, 2014). Further scrutiny of land-related research demand has been conducted by the European Inspiration project. For Germany (Ferber et al., 2016), a concise framework for land use decisions, circular land

management and dual inner-urban development by balancing land recycling and green space provision are mentioned as key challenges. Further major aspects refer to impact mitigation mentioned above, with the problem of double consumption through compensation on agricultural land and a potentially stronger focus on mitigation/compensation through redevelopment (Busse et al., 2013), as well as to a necessary improvement of (quantitative and qualitative) indicators for land, in particular with regard to land use efficiency. For the UK (Nathanail & Ashmore, 2016), while some terminological overlap between land and soil prevails, a quest for a National Land Use Strategy similarly reveals the need for linking different sectoral interests and rationales. Further, a stronger operationalization of functions or provisioning services of land is emphasized as a refined evidence base for allocations, as well as a similar focus on strengthened land recycling in order to reduce land take. Overall, key issues raised refer to (binding) targets on the different aspects of land as described above, a stronger integration into existing legal frameworks, but also a review of fiscal systems with regard to their effects on land use (EEA, 2016a). These issues as well as currently discussed modifications will be considered in more detail for the two specific case study contexts in section 4.

When looking at the key role of planning in tackling the problem of unsustainable land use patterns, potential impacts on the allocation and alteration of property rights need to be reflected. Given that land as a resource is confronted with effects of speculation and short-term profit expectations, planning has been tasked as "not seek[ing] to supersede private initiative, but rather to "discipline" it" (Blomley, 2017: 358; according to Olmsted, 1917). A major instrument of such land (use) policy consists in zoning, by ensuring "a diversity of land uses with plural property relations" (Davy, 2010: XII). A number of debates surrounding how to better grasp this problem reveal its continued topicality, in particular with regard to mechanisms for mobilising development land and the ongoing discussion of tax reforms regarding the reduction of speculation (e.g. UBA, 2003; UBA, 2018a; Cullingworth et al., 2015). A recent international overview of the role of planning and land use policy in dealing with protected property rights on the one hand and enabling the implementation of public interests formulated in land use plans on the other hand is provided by Gerber et al. (2018). This is exemplified against the assertion that most "policy instruments […] proved to be quite effective when it came to shaping the expansion of urban areas at the edge of cities. Greenfield development is something that planners know how to deal with!" (Hartmann & Gerber, 2018: 5), urging for planning to adapt to more complex situations within the existing urban fabric. Hence, private property continues to be a major issue with regard to the reuse of developed land and building in particular, with Blomley (2017: 351) urging "to open the "black box" of land use, in order to understand the important way in which planning practice engages private property."

Before these aspects will be explored in more detail with regard to the two case study contexts, the following sections will review the state of Environmental Assessment and SEA in particular as a basis for subsequently examining its potential role in substantiating resource efficient land use in decision making.

3.2 Environmental Assessment (EA): From early ideas to today's understanding

Early foundations for EA were established in the 1960s, linked to raising awareness for environmental issues and their institutionalized consideration in decision-making. A first step was taken by the introduction of the US National Environmental Policy Act (NEPA) in 1969, followed by formalization of project-related Environmental Impact Assessment (EIA) or its predecessors in many other countries (Nilsson & Dalkmann, 2001; Fischer, 2003). For the EU

situation, the introduction of EA procedures has been directly linked to requirements formulated by the EU Treaty and Environmental Action Programmes, in particular to the need for improving environmental integration and to the precautionary principle (Dalal-Clayton & Sadler, 2005). As a key driver for the introduction of EA the "systematic subordination of environmental aspects to economic growth paradigm-related interests in policy, plan, programme and project decision-making" (Fischer, 2014a: 28) has been described, and thus the provision of an instrument that ensures a systematic identification of likely impacts of a project, plan, programme or policy on the environment. The first EU (EC) EIA Directive was introduced in 1985, requiring subsequent transposition into member states' legislation within three years. Besides EA, the field of Impact Assessment spans a broad range of other types of assessment, covering the "'participative ex-ante policy, plan, programme and project (PPPP) IA community'" (Fischer, 2014b: 10). The spectrum includes various sectoral assessments such as social impact assessment, habitats regulations assessment or equality impact assessment that often require coordination as part of the same decision-making process, with the question of stronger integration having been deemed problematic (see also discussion below; Fischer, 2014b; Fischer, 2016a; Tajima & Fischer, 2013; Vanclay, 2003; IAIA, 2012), certification systems at project scale (e.g. BREEAM, Therivel & Morris, 2009) or territorial impact assessment in order to assess impacts of policies on territorial cohesion (ESPON, 2012b; Fischer et al., 2014).

With growing experience in applying project-level EIA, it became apparent that strategic decisions as well as cumulative effects of decisions taken at higher planning levels and in earlier phases of decision-making could not be covered by EA for concrete projects. In order to fill this gap and to be able to assess potential impacts of such early and strategic decisions in particular, SEA procedures were developed for the scale of policies, plans and programmes (PPP) in order to "focus on the 'source' of environmental impacts rather [than] addressing their symptoms later on" (Dalal-Clayton & Sadler, 2005: 23; Fischer, 2007). While EA at PPP level had already been touched upon and discussed at the end of the 1960s, it was in practice initially excluded from the 1969 NEPA regulations (Dalal-Clayton & Sadler, 2005; Fischer, 2014a; according to Nitz & Brown, 2001). The EU SEA Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment was introduced in 2001. Originally, it was strongly rooted in EIA process and techniques, with procedural steps required by the SEA Directive similar to those required by the EIA Directive (Sadler & Jurkeviciute, 2011). However, and unlike the EIA Directive, the SEA Directive from the beginning included the requirement for assessing alternatives and for monitoring. The introduction of SEA has been regarded as a milestone with regard to its focus on an ex-ante prevention of environmental degradation instead of the prevalent ex-post repair consequence of EIA (Fischer, 2007; DCLG, 2010). The institutionalization of SEA in the two case study contexts will be described in more detail in section 4.

3.3 Strategic Environmental Assessment (SEA) – towards an early and transparent consideration of environmental interests in decision-making

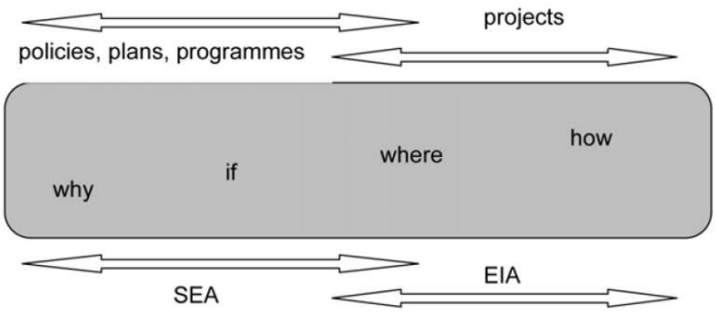
3.3.1 Role and purpose of SEA

Against the developmental background as stated above, "SEA has become the most widely employed notion globally for the assessment of environmental impacts of public and private decision-making activities above the level of individual development projects" (Fischer, 2014a: 23). According to Dalal-Clayton & Sadler (2005), the term SEA was first used in a publication by Wood & Djeddour (1989) and has since developed in a number of ways, with not all SEA-like procedures necessarily labelled by that term (see also Fischer, 2001). It has repeatedly been

emphasized that SEA is not decision-making itself but a tool to aid decision-making (Dalal-Clayton & Sadler, 2005), i.e. "SEA's role is to inform decisions not to make them" (Therivel, 2010: 217). Based on an extensive content analysis, da Silva et al. (2014: 68) propose a definition that is seen as representing the "hegemonic perception of the scientific community": "SEA can be considered a systematic decision-support process, tool or instrument used in order to identify, consider (take account), address (describe), integrate (include, incorporate), and/or assess (evaluate) the impacts, effects, consequences, considerations or issues regarding the environmental dimension [...] arising from policies, plans and programs (PPPs), strategic and high-level decisions, actions, initiatives, proposals and its alternatives (options), in the earliest opportunity (during formulation and development of PPP, or in the stage of initiative/proposal), aiming to influence the decision-making as well as to reduce or mitigate negative impacts associated with it, directing to sustainability and sustainable development." A key feature of EA refers to tiering, i.e. decision-making with different levels of detail at the appropriate spatial scale. In that regard, SEA ideally enables consideration of the 'why', 'if' and 'what' of development at the policy tier and the general 'what, 'where' and 'how' at the plan tier, with the specific 'where', 'how' and 'when' being addressed by EIA at the project tier (Fischer, 2007; Therivel, 2010), as illustrated in figure 12. While policy SEA is not covered by the EU SEA Directive, these interdependencies underpin the case for its introduction (Fischer, 2001; 2004; Sheate et al., 2003), also revealing that SEA based on the EU Directive constitutes only one, albeit important and wide reaching, version, with research and theoretical concepts reaching well beyond (Dalal-Clayton & Sadler, 2005).

Benefits of SEA have been tackled by a number of authors: Key aspects refer to SEA enhancing transparency and efficiency in decision-making, enabling a systematic consideration of impacts and alternatives, enhancing the environmental quality of plans, providing opportunities for dialogue and learning and raising environmental awareness (Fundingsland Tetlow & Hanusch, 2012; Fischer, 2007; Meuleman, 2016). With regard to the latter aspect, SEA has also been described as being able to exert a changing attitudes function and a changing routines function (Fischer, 2007) which will be addressed further below with regard to the role of learning in SEA. In this regard, an early start of the SEA process and a close integration of SEA and decision-making as depicted in figure 13 has been deemed key to the role SEA can fulfil, with research by Therivel & Minas (2002, in Therivel, 2010) showing that changes to plans were more likely to occur when SEA had been an integral part of plan-making and not carried out after the plan had been compiled.

At the same time, a shift has been observed from SEA being strongly influenced by a post-modern focus on facilitating communication and negotiation processes up until the early 2000s. This deliberative paradigm is embedded in what Healey (1996) termed the "'communicative turn in spatial planning theory'" with a focus on the consensus-building process (Fischer, 2003). However, given the inevitability of power constellations in EA, this paradigm has also met considerable criticism in centering on negotiation processes and losing sight of achieving environmentally sustainable outcomes. Thus, a plea for considering both process and outcomes was increasingly voiced (Fischer, 2003; Fischer, 2014a).



Source: Adapted from Swedish National Board of Housing Building and Planning, and Swedish Environmental Protection Agency (2000)

Figure 12: Tiering and the interplay of SEA and EIA (Therivel, 2010: 141)

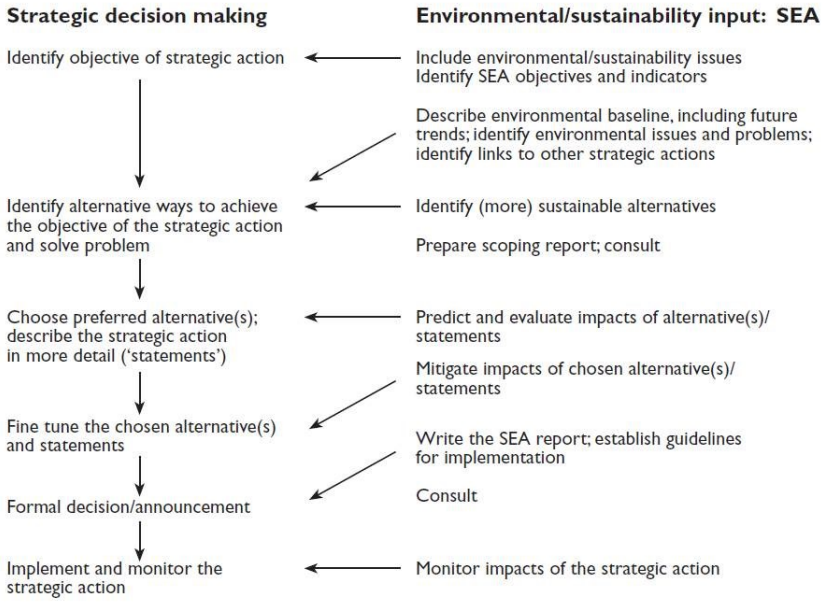


Figure 13: Integration of SEA and decision-making on PPPs (Therivel, 2010: 16)

When analyzing SEA procedures, in particular when looking at different national contexts, a general distinction needs to be made between objectives-led approaches on the one and baseline-led approaches on the other hand (Fischer, 2007; Therivel, 2010): While objective-led approaches assess not only negative impacts but also the contribution of the plan or programme to positive impacts, i.e. to overall objectives, baseline-led approaches mainly assess impacts against the current state of the environment. Baseline-led approaches therefore tend to be more detailed and spatially precise but rather weak in regards to non-spatial, less tangible impacts. Objective-led approaches on the other hand display strengths in addressing impacts of rather abstract policies and links between different assessment aspects. However, they tend to be less precise and have been criticized for their dependence on interpretations (Therivel, 2010).

3.3.2 SEA Policy Framework

3.3.2.1 International

As mentioned above, already the 1969 US NEPA was intended to include EA of PPPs but in practice initially referred to the project level only (Fischer, 2007). Major foundations for SEA were subsequently created by the growing environmental movement in the 1970s and 80s, by the 1987 Brundtland report and the 1992 UNECE report through which participating countries agreed on

general principles of SEA (Dalal-Clayton & Sadler, 2005; Fundingsland Tetlow & Hanusch, 2012). Whereas the formative phase of SEA (1970s to 90s) was mainly characterised by NEPA experiences and environmental appraisal of plans in some countries but limited actual application, SEA was particularly strengthened and institutionalized during its take-up phase (1990 to 2001), in the wake of increasing interest in sustainability, the Agenda 21 process and environmental policy tools, and followed by an expansion stage from 2001 on, largely driven by the introduction of the EU SEA Directive and the UNECE Protocol on SEA launched in 2010 (Sadler, 2016; Dalal-Clayton & Sadler, 2005). SEA development was further shaped by two UNECE binding instruments, i.e. the Aarhus Convention on Access to Information, Public Participation and Access to Justice in Environmental Matters (1998) with a focus on requirements and standards for public participation, and the SEA Protocol to the Convention on EIA in a Transboundary Context/Espoo Convention (2003) that brings together binding procedural elements of SEA closely linked to the EU SEA Directive but applying to a larger group of participating countries and, other than the EU Directive, also including a non-mandatory application to policies (Dalal-Clayton & Sadler, 2005; Fischer, 2007; Fundingsland Tetlow & Hanusch, 2012). A review of SEA characteristics under the institutional frameworks of the EU Directive, the World Bank, UNECE and OECD is provided by Sadler (2016: 30 f.).

Major application fields for SEA comprise spatial or land use plans as well as plans and programmes in the energy, transport, waste and water sector, and also trade agreements or funding programmes (Dalal-Clayton & Sadler, 2005; Fischer, 2007; Geißler & Rehhausen, 2014). Due to its obligatory application in the field and the high amount of respective plans, spatial planning is also regarded as the "possibly […] most successful sector of SEA application" (Fundingsland Tetlow & Hanusch, 2012: 18), with a corresponding focus of SEA research regarding this field of application (Fischer & Onyango, 2012). An exhaustive review of SEA systems in both developed and developing countries is provided by Dalal-Clayton & Sadler (2005); a wealth of country case studies is further provided by Jones et al. (2005), focusing on land use planning, and Fischer et al. (2007).

3.3.2.2 SEA as shaped by the EU SEA Directive

The SEA Directive was formally adopted in June 2001, after initial draft proposals had been discussed for more than a decade, and had to be transposed into national law by member states within a three-year period, i.e. by 2004 (DCLG, 2010; Sadler & Jurkeviciute, 2011, Meuleman, 2016). Since the EU SEA Directive can be regarded as "the best-known SEA 'framework law that establishes a minimum common procedure'" (Fischer, 2007: 3), it has exerted significant influence beyond its actual reference area (Fischer, 2014a). While the EU SEA Directive has led to the wide-spread application of environmental assessment to spatial and sectoral plans and programmes (Fischer, 2014a), it is not obligatory for all types of plans and programmes (Fischer, 2007). More specifically, it is required for plans and programmes in the field of agriculture, forestry, fisheries, energy, industry, transport, waste management, water management, telecommunications, tourism, town and country planning or land use, and those that set the framework for future development consent of projects according to the EIA Directive (in particular land use plans defining frame conditions for future development; Meuleman, 2016), plans or programmes that require an assessment according to the Habitats Directive, while it excludes specific plans such as for defence or budget planning, and plans that determine use of a small area at local level, or minor modification to a plan or programme – unless the plan or programme is likely to have significant environmental effects. Also, the SEA Directive applies only if the respective PP is required by

"'legislative, regulatory or administrative provisions'" (DCLG, 2010: 13), thus only to PPs that have to be formally adopted by an authority (Meuleman, 2016).

Key procedural requirements include screening and scoping, the identification of key issues and options and a related baseline description, the definition of impact significance as part of the environmental report, public participation, a description of how assessment results have been taken into account in decision-making, recommendations on preferred options and monitoring of environmental conditions after PPP implementation (Fischer, 2007). With regard to the identification and assessment of alternatives as a key element of SEA, a hierarchy of alternatives has been developed as illustrated in figure 14 (ODPM, 2005a), ranging from a general question for actual need for development (ideally differentiating between a 'no PPP'/zero alternative and a 'business as usual' alternative) to more specific alternatives in implementing development with regard to location and sequence.

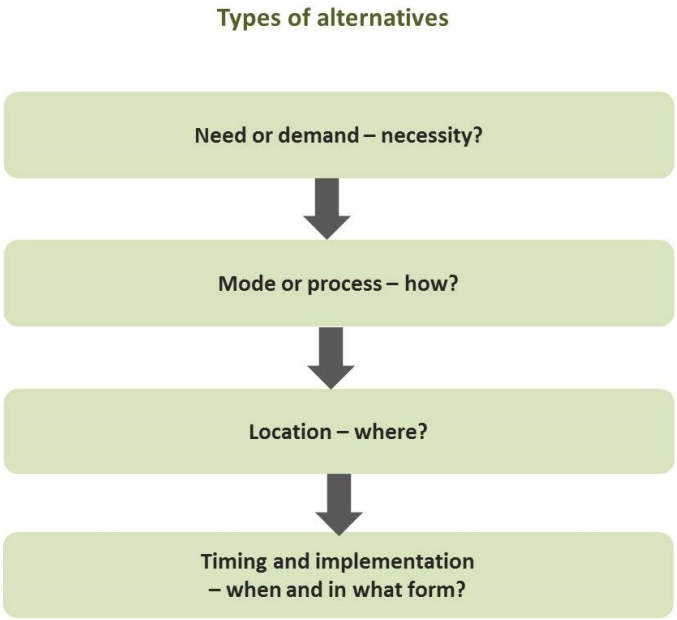


Figure 14: Hierarchy of alternatives to be assessed in SEA (modified based on ODPM, 2005a: 69)

3.3.3 Types of SEA and the question of integration

Obviously, the transposition of the SEA Directive in different EU member states has been shaped by their specific institutional settings and systems of environmental governance (Sadler et al., 2011; Sadler & Jurkeviciute, 2011): The UK has several types of SEA regulations with separate ones for each of the UK's devolved governments, while SEA for municipal land use planning in England is integrated into Sustainability Appraisal. In Germany, there is one piece of legislation for EA, with the EIA Act referring to both EIA and SEA, while EA for municipal land use planning is regulated by the Federal Building Code. Whereas SEA in the understanding of the EU Directive only refers to environmental aspects, Sustainability Appraisal incorporating SEA in England also includes social and economic effects. Whereas some have considered this broader focus as a "stepping stone to integrated assessment or sustainability appraisal" (Dalal-Clayton & Sadler, 2005: 1), others take a skeptical stance with regard to a potential subordination of environmental aspects (Counsell & Haughton, 2006; Therivel & Fischer, 2012; Fischer, 2014b).

Thus, integration has not been rejected in general but deemed as requiring the development of clearly defined sustainability indicators and thresholds in order to prevent trade-off among

different objectives (see also Sheate et al., 2003; Fischer, 2007). In effect, a strong case is made for not "running the risk of sacrificing the only tool available that plays a genuine environmental advocacy role" (Morrison-Saunders & Fischer, 2006: 34), and thus to keep the biophysical emphasis of (S)EA (Sadler, 2016). In a similar way, demands raised with regard to an integration of SEA with other (sector-specific) assessments (e.g. IEMA, 2011) in the wake of more concise linkages between sector-specific institutional settings (see discussion on land policy above) require cautious scrutiny in order to not risk weakening the role of SEA in advocating environmental issues. In this regard, it should be noted that EA is confronted with different value expectations determined by interests of stakeholders involved. Typical types of expectations have been identified by Cape et al. (2018), comprising the public focusing on local issues and own interests, authorities engaged in ensuring accountability and procedural requirements, developers prioritizing efficiency of decision-making and NGOs and public agencies in particular representing specific environmental interests at stake. From that and the assertion that "for an SEA process to be legitimate, the existence of very different value expectations is not an issue, but feelings that those expected values have not been met could be problematic" (Cape et al., 2018: 40), sensitivity for differing interests and their considerate integration while safeguarding EA's role in advocating for environmental issues is derived as a key challenge.

3.3.4 SEA Methods and Standards

As a background for analyzing SEA procedures and for developing an assessment methodology for land, current assessment methodologies are to be briefly reviewed here. The general difference between baseline-led and objectives-led approaches needs to be taken into consideration with regard to methods and techniques predominantly used.

Looking at what assessment means in the context of environmental planning, it generally refers to the relation between an assessing subject and an object being assessed, containing three dimensions, i.e. the depiction of reality, the value system and the value-based judgement (Bechmann, 1991, in Weiland, 1994; Gassner et al., 2010). **Environmental risk** in this regard describes the probability of occurrence of environmental impacts (Scholles, 1997). A key distinction refers to the degree of **sensitivity** of the environment and the **significance/importance** of potential environmental impacts (Scholles, 1997; Gassner et al., 2010). A key principle is the differentiation between facts and values, i.e. the steps of risk description and subsequent risk assessment. (Scholles, 1997; Weiland, 1994; Gassner et al., 2010). As a result, the need to define **objectives** against which assessment is carried out has been derived: "Objectives do not fall into one's lap but are developed through scientific discourse on functional relations in ecosystems […] and through their further development and processing by political decision-makers and the public" (Scholles, 2008a: 280; according to SRU, 1994; translated by the author).

For applying these objectives in assessment procedures, operationalization is required in order to make their achievement measurable through impact factors, indicators and standards/thresholds (Balla et al., 2010). While frameworks of environmental protection objectives (*Umweltqualitätszielkonzepte*), aiming at a standardisation of standards/thresholds, have been discussed since the 1980s and developed for a number of larger German cities (e.g. Weiland, 1994; Dickhaut, 1996; Scholles, 1997; Wickop et al., 1998; Scholles, 2008a), related challenges with regard to a varying binding character of objectives as well as sector-specific differences in quality and availability of standards have improved but to a considerable extent remain until today. **Impact factors** in EA describe those characteristics of a PPP that cause an

impact on the environment or one of its components (Gassner et al., 2010: 43). **Indicators** then depict aspects of the state of a specific resource and measure the degree of achieving objectives (Scholles, 2008c) but do not evaluate this state, so that for assessing the role and significance of relevant impact factors, **standards** or **thresholds** are required. Standards thus provide concrete orientation in defining significance, pressure and intended quality for a specific indicator (Fürst et al., 1992; in Scholles, 2008a: 300). As has been depicted for objectives above, standards are neither defined by science alone but have a political-societal dimension as well (Scholles, 1997). Interdependencies between these elements of assessment are illustrated in figure 15.

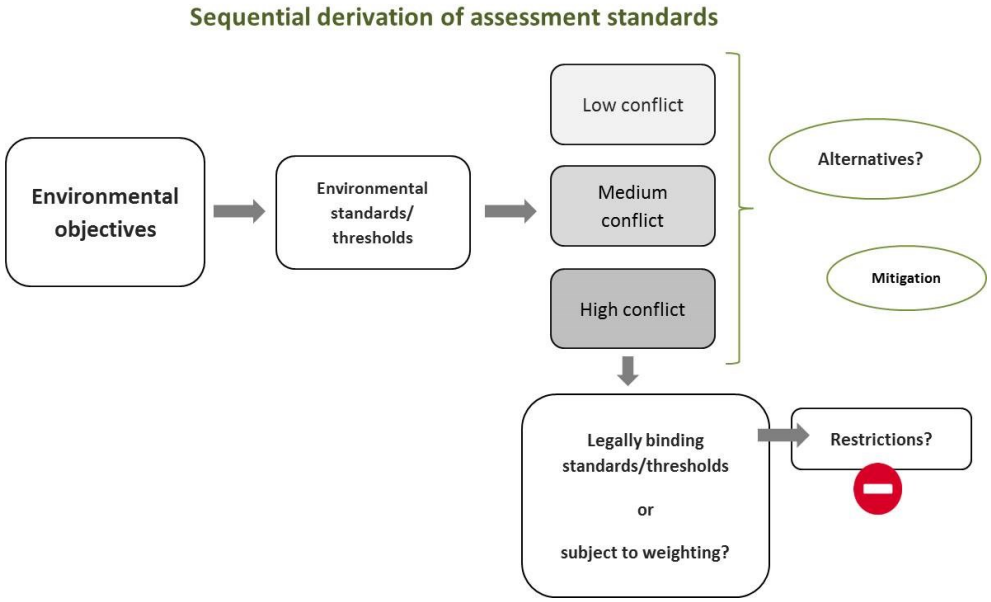


Figure 15: Sequential derivation and application of assessment standards (own figure, modified based on Helbron, 2008: 97; icon made by Freepik from www.flaticon.com)

For defining standards, a key challenge lies in the operationalization of legal principles/objectives that lack concrete definition and quantification (for the German civil law-based system with codified substantive requirements: *unbestimmte Rechtsbegriffe* (Weiland, 1994)*;* for the UK common law-based system largely dependent on jurisdiction), while it needs to be acknowledged that not all objectives can be quantified in an equally standardized way (Scholles, 2008a; Balla et al., 2010). Sources for defining assessment standards can hence be classified by function or objectives and legally binding effect, with major types of sources being displayed in figure 16. In general, there are **precautionary standards** that aim at conservation and improvement of environmental quality, and **pressure thresholds (maximum values/critical load)** that define maximum possible environmental pressure that can be buffered by the ecosystem, with (approval) standards tending to be defined along the range between both points (Gassner et al., 2010; Scholles, 2008a; Weiland, 1994). Particularly relevant for deriving assessment standards in SEA are also existing plans and strategies at higher spatial scales or from individual sectors (Gassner et al., 2010). Further, the role of 'informal' plans and strategy documents is particularly significant, as has been argued by Fischer (2001; 2005).

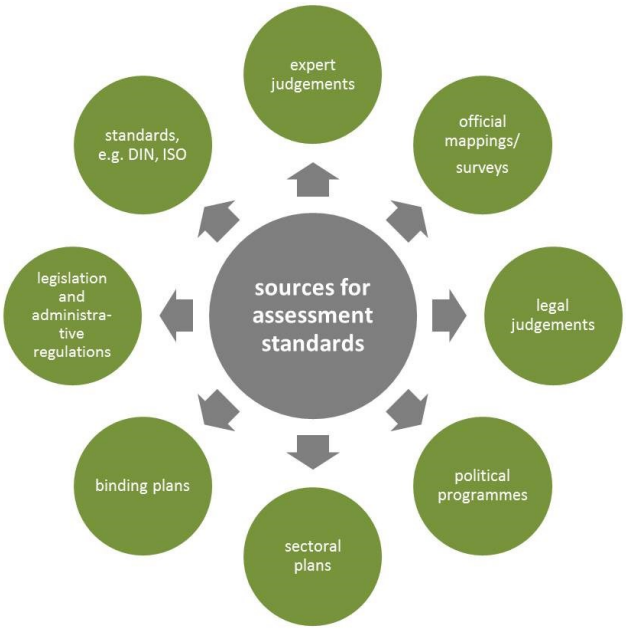


Figure 16: Sources for assessment standards (own figure based on Gassner et al., 2010: 46)

For final assessment (which, in spatial or land use planning is always based on weighting, as opposed to bound permission, for instance in a number of project EIAs), the need to make a number of diverse issues comparable, together with different levels of assertiveness of 'strong' (mostly codified and quantifiable) and 'weak' (mostly non-codified and qualitatively described) issues (Scholles, 2008a; see also figure 15) constitutes a key problem that will be of particular relevance for developing an assessment approach for land.

In that regard, **methodology** refers to an overarching framework of steps in a process, techniques provide data, whereas methods refer to the classification of these data and the identification of impacts (Noble & Storey, 2001). Methods such as matrices, checklists and impact trees, expert judgements, and GIS overlay techniques have proven to clearly prevail in SEA practice (Noble et al., 2012; Joao & Annandale, 2016; Fischer, 2007; Fischer, 2002). For baseline-led approaches, (elements of) **ecological risk analysis**, with the definition of ecological risk through the variables of sensitivity, impact intensity and probability of occurrence (Bachfischer, 1978) prevail in practice (Scholles, 2008b). In line with difficulties in defining (quantified) standards as depicted above, ecological risk analysis is often combined with other methods such as expert judgement, often summarized as 'argumentative assessment methods' (Scholles, 2008d), with criticism referring to their potentially arbitrary or subjective character. Suitable assessment methods for the strategic level of land use plans are thus still considered a key deficiency, given the question whether impacts are quantifiable or whether they depend on a "reliance on judgement" (Therivel & Walsh, 2006; in DCLG, 2010: 39; Sadler, 2016; Geneletti, 2015a; in Noble & Nwanekezie, 2017). Before reviewing starting points for framing land as an environmental factor, the following will look at findings for the future path of SEA research and practice.

3.3.5 SEA Performance and Effectiveness

According to a recent review by Sadler & Dusík (2016: 14), SEA can be described as being at "both a milestone and a crossroad", with both progress and deficiencies. From a number of perspectives, demands for moving more towards 'systems thinking" have been formulated, with Sadler (2016) discussing the need for incorporating the concept of planetary boundaries and looking beyond the prevalent "presumption for development". Among a number of future perspectives, a stronger

focus on supporting learning processes and better uncertainty disclosure, together with an active management of uncertainties (Therivel et al., 2016), has been demanded and will be focused on by this study. Apart from the introduction of new or modified environmental factors (besides land, human health and population, biodiversity with reference to Natura 2000, vulnerability to accidents and natural disasters, stronger focus on climate change and climate adaptation), the revised EIA Directive introduced changes with regard to a quality control/certification system and the accessibility of documents via central hubs (Balla & Peters, 2015; Hartlik, 2014; Jha-Thakur & Fischer, 2016; Fischer et al., 2016). However, as opposed to the first draft of the revised directive, the final omission of more fundamental changes, including stronger requirements for the assessment of alternatives, have been criticised (Hartlik, 2014; Mitschang, 2015b). At the time of writing, an EU initiative on evaluating the SEA Directive (constituting the first 'official' evaluation) was under development, with a roadmap for an evaluation process launched (EC, 2017). Before, evaluation-like reports had been issued in 2009 and 2016 (Commission of the European Communities, 2009; EC, 2017a; 2017b). Given potential attempts towards streamlining the assessment process (see also DCLG, 2010) and the old argument "E(I)A costs money and slows down development" (Fischer, 2016b), the need for better research on and communication of (particularly substantive) outcomes and benefits of SEA suggests a brief consideration of how and by what aspects SEA has been evaluated to date.

The question whether SEA has been successful has been considered from different perspectives. Many empirical studies have scrutinized SEA from the angle of procedural performance, i.e. the fulfilment of procedural requirements (Fischer, 2007). Criteria, having been formulated from its early phases on (e.g. Kørnøv & Thissen, 2000; Fischer, 1999; 2001) comprise the complete coverage of procedural stages, a tiered approach, an early assessment start and integration into the decision-making process as well as appropriate consultation and public participation. While procedural performance is relatively well measurable, substantive performance has shown to constitute a less well researched and more complex field (Fischer, 2018; Fischer & Noble, 2015; Fischer et al., 2015). From that perspective, substantive performance has predominantly been described as SEA effectiveness and defined by providing decision-makers with better information, enabling attitudes and perceptions to change through participation and involvement and thus generating changes from established routines (Fischer, 2007; Sadler, 2016). A similar dichotomy distinguishes between direct impacts of EA, referring to the conformity of decisions with the assessment report and changes in decision-makers' understanding of environmental issues, and indirect impacts of EA, describing effects on more sustainable decisions in advance and ideas used in subsequent PPP formulation (Runhaar & Driessen, 2007; Acharibasam & Noble, 2014). Given that most studies to date have focused on direct effects of SEA, they underpin the finding that more research has been generated on procedural than on substantive impacts which has recently been confirmed by Rehhausen & Burchartz (2017).

A key strength of SEA lies in its contribution to planners' awareness of environmental issues in both Germany and the UK (Fischer, 2007; Fischer et al., 2009; Bond et al., 2012; in Therivel et al., 2016). Clear evidence has particularly been found for SEA succeeding in integrating environmental issues into decision-making procedures while unambiguous evidence of SEA evoking a reduction of detrimental impacts on environmental functions and resources remains difficult to obtain (Weiland, 2010; Sadler & Dusík, 2016; Phylip-Jones & Fischer; 2015; Fundingsland Tetlow & Hanusch, 2012). A suggestion to relate the discourse on SEA effectiveness to the observation of environmental change is judged as tricky due to the mere impossibility to

clearly attribute the latter to an influence (or the lack of it) of the first (Weiland, 2010; Sadler, 2016). Rather, studies repeatedly suggest that the identification of SEA effectiveness rather requires long-term monitoring and longitudinal studies (DCLG, 2010; Fischer, 2007; Runhaar, 2008; Levett-Therivel, 2007, in DCLG, 2010; Sheate & Eales, 2016). Research need regarding the evaluation of SEA effectiveness has thus been identified as a priority area for SEA research (Fischer & Onyango, 2012; Rehhausen & Burchartz, 2017; Fischer, 2018). Prevailing difficulties in measuring SEA effectiveness prompt a closer consideration of learning processes in SEA, as suggested by Fundingsland Tetlow & Hanusch (2012). Given the difficulty to measure indirect/substantive effectiveness in particular, learning appears to be well suited to approximate SEA effectiveness, in that it does not necessarily evoke immediate changes to PPPs but rather takes the first step to change mindsets, approaches and incremental amendments to subsequent SEA procedures – and PPPs (see also Acharibasam & Noble, 2014; Bond et al., 2017; White & Noble, 2013; Sadler, 2016). Before learning processes in SEA will be examined in more detail below, the following section will summarise key strands of debate on the framing of complex environmental factors for SEA.

3.3.6 Framing of complex environmental factors for SEA: Previous experience

A general issue is a lack of fit-for-purpose methodologies for assessment, especially for more complex factors. Advancements have, for instance, been suggested with regard to applying scenario techniques to SEA (Hanusch et al., 2016; Joao & Annandale, 2016; Bragagnolo & Geneletti, 2013). Whereas recent guidance has predominantly been issued on the assessment of climate change and biodiversity (EC, 2013; IEMA, 2015; Meuleman, 2016), an Austrian-German based study has tackled the operationalization of a factor comparably complex as land, i.e. both climate change impacts and adaptation in EIA (Jiricka et al., 2016). It has been observed that climate change as such, and adaptation in particular, have either not been addressed so far, or in a partial and often implicit manner. Climate change impacts are in most cases considered at an abstract level, with main barriers to a more detailed assessment lying in uncertainties regarding climate change itself, and a lack of suitable data and prognoses. Similarly, it is acknowledged that a lot of information on climate change adaptation is available but in a fragmented and not directly applicable way. Key steps are therefore seen in more specific legal specifications, related subject-specific guidance, as well as better communication between authorities, consultants and developers with regard to data provision, underlining the importance of active stakeholders in integrating new and rather complex issues into EA (see also Donner et al., 2017). In line with the focus on SEA decided-upon for this study, Jiricka et al. (2016) as well as Fundingsland Tetlow & Hanusch (2012) explicitly emphasise the need for assessing climate change related aspects at a strategic level as a framework for subsequent decision-making procedures.

Similarly, there is an increasing interest in framing (human) health as a factor in SEA which has particularly been looked at by WHO-related studies (Fischer, 2014a). Here it is found that while (human) health plays a considerable role in current SEA practice, this consideration tends to remain limited to physical components while not often extending to social and behavioural aspects of health, or differentiating between the requirements of different population groups (Harris & Haigh, 2015; Köppel et al., 2014 for the extension of health to aspects of environmental justice in the US). The extent of consideration is also found to be dependent on the institutional embedding of the assessment instrument (see also figure 17), with English SAs including social and economic aspects while these are not considered by German SEAs but covered by separate (partly informal) plans, as mentioned above with regard to the role of 'informal advice' (Fischer et al., 2010; Martin & Morrison-Saunders, 2015). Kågström & Richardson (2015: 116) highlight

the role of practitioners' understanding for how new issues are addressed in EA procedures, pointing to a gap between often limited actual spaces for action determined by institutional responsibilities and established practice, and potential spaces for action. With regard to the latter, the authors show that most practitioners had a broader understanding of health than the one they applied to EA and that their preparedness to integrate this broader understanding strongly depended on their role and requirements, with a prevailing "self-limitation" in regards to operationalizing the factor (see also Kågström, 2016).

These conceptualisations or understandings of health have been termed 'frames' (Kågström et al., 2013: 199), i.e. "social constructions […] in which human beings are seen as social, while reality is socially constructed and reconstructed in communication and interaction between people", resulting in a frequent contrast between consultants' understanding of an assessment factor and what they perceived as being required for approval (Kagström, 2016; Kagström & Richardson, 2015). This hints to the need to activate (broader) frames EA practitioners are potentially aware of and to reduce restrictions imposed by established but potentially insufficient frames. Also, this links to a barrier that has frequently been observed with regard to considering cross-cutting issues in SEA, i.e. the distribution of individual aspects of a factor to different functions, responsibilities and disciplinary backgrounds of people involved (Fischer, 2014a; Fischer et al., 2009).

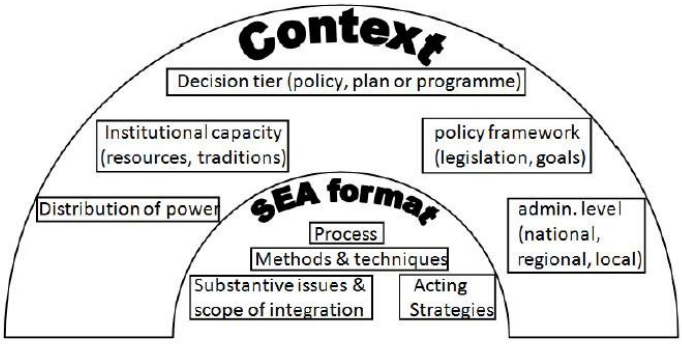


Figure 17: Contextual factors determining the format of SEA (Fischer, 2014a: 32)

However, compared to health-related professions, land-related professions tend to have a more direct link to environmental planning and thus also to SEA, with planning being inextricably linked to impacts on land. A promising starting point for an operationalisation is that land (take) has been mentioned alongside health and ecosystem services as one of the issues that have experienced recent advancements in their evidence base, while these have not yet been concisely integrated into SEA practice, with most studies "rely[ing] on qualitative estimates" (Geneletti, 2015a: 4; Geneletti et al., 2017).

3.3.7 Starting points for framing land as an environmental factor in SEA

The question of how to operationalize land for SEA needs to be understood in the context of "pushing the margins" (Sadler & Dusík, 2016: 15) in order to improve current practice. Hence, while it constitutes more of an incremental improvement, it particularly addresses the question how SEA as a formalized assessment procedure that has to be applied to the majority of (land use) plans can contribute to a more concise and transparent consideration of land. For that purpose, it is to be asked what attempts have been made so far in order to frame land as an environmental factor, and what requirements and land-related concepts SEA-relevant legislation includes as a

precondition. Case study-specific conditions in this regard will be presented in section 4, whereas here, overarching aspects will be considered.

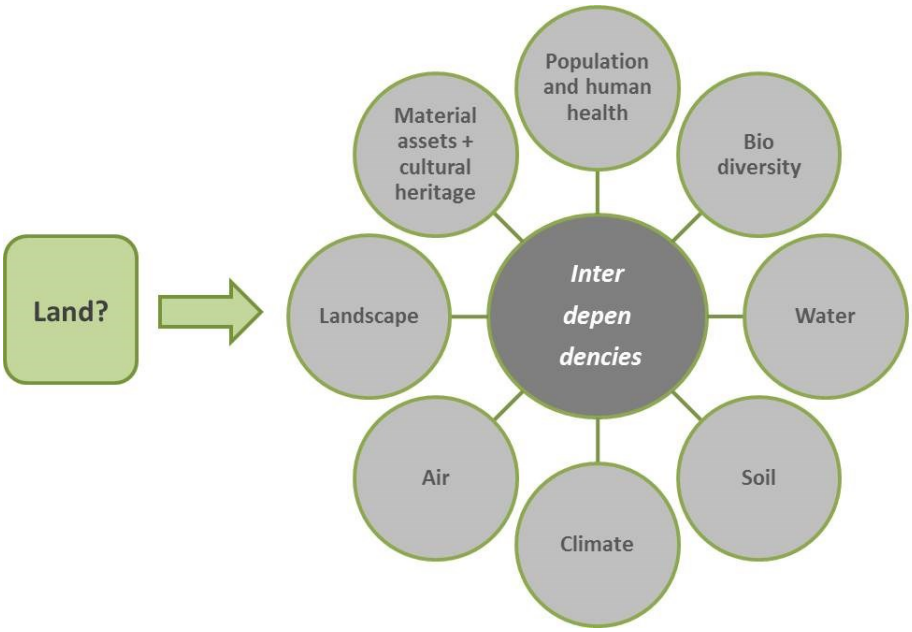


Figure 18: Environmental factors and interdependencies, according to revised EIA Directive 2014/52/EU (own figure)

When looking at what EU Directive 2014/52/EU (for EIA) says explicitly with regard to land, information is relatively scarce. Environmental factors to be assessed are not further defined by the directive, with recitals and annex only indicating to some extent what is meant by land. Recital 7 refers to the increasing status of resource efficiency and sustainability in the policy discourse and thus their role as important elements of assessment and decision-making, with recital 8 explicitly referring to the Roadmap to a Resource Efficient Europe, i.e. including the target of no net land take mentioned above. Recital 9 then mentions land take, and sub-terms, as a key aspect to be assessed. The requirement to integrate land as an environmental factor is included in Art. 3 c) of the revised directive, with annex II.a, IIIb and IV containing some further information on the need to assess impacts with regard to sensitivity and existing land use, as well as to the need to also consider land take during construction phases that, due to its major relevance for projects, will not be looked at further in this study (EU Directive 2014/52/EU; see also Alsleben, 2015).

In line with Fischer & Onyango's (2012) finding that out of the considerable body of SEA research only 1 % of all articles dealt with health explicitly, there is a comparably limited number of papers dealing with land in SEA (some indirectly), and most of them within the German context (e.g. Alsleben, 2015; Jacoby, 2016; Storch & Schmidt, 2008). Urges for establishing resource-based targets and indicators in SEA, with explicit mentioning of a "land-take threshold", had been formulated by Bragagnolo et al. (2012: 107) as well as Geneletti et al. (2017). Such quests, though certainly not dominating publications and rather being brought up infrequently by individual authors, are not restricted to the issue of land take alone. Rather, a comprehensive study of potential indicators and data sources for land emphasizes the need for EIA (and other policy instruments) to also better take land use efficiency into account (Bio by Deloitte, 2014). Accordingly, EC (2011), EEA (2016a) and UBA (2015a; 2018c) explicitly urge for a stronger consideration of land-related aspects by EA instruments through the formulation of suitable indicators and thresholds.

Beyond these quantitative aspects, attention has also been raised for qualitative, function-related aspects of land use. On the one hand this concerns "indirect land use changes" (Kørnøv et al., 2016, following Schmidt et al., 2012, 2015), connected to the concept of land footprint mentioned above. On the other hand, and related to concepts for a more profound reform of assessment methodologies, the ecosystem services approach has been brought up for framing the various (not only ecological) functions that land fulfils (Fundingsland Tetlow & Hanusch, 2012; Sadler & Dusík, 2016; Geneletti, 2015b; Sheate & Eales, 2016). Sheate et al. (2012) developed a typology of ecosystem services and connected this to existing land cover datasets in order to make the concept of ecosystem services applicable to decision-making and EA. Based on the Millennium Ecosystem Assessment (2005: v) definition of ecosystem services as "benefits people obtain from ecosystems, […] includ[ing] provisioning services such as food and water, regulating services such as regulation of floods, drought, land degradation, and disease, supporting services such as soil formation and nutrient cycling, and cultural services such as recreational, spiritual, religious and other nonmaterial benefits", and on a review of open and green space categories, land cover types are suggested as proxies for specific ecosystem services. A similar approach for assessing land use changes based on "service providing units" has been developed by Broekx et al., (2013; in UBA, 2018d). Benefits have particularly been described with regard to better grasping the multifunctionality of land and enabling a more comprehensive perspective on environmental impacts for stakeholder involvement (UBA, 2018d; Geneletti, 2015b). At the same time, however, it poses the question to what extent such an approach would cover overarching environmental objectives in a balanced manner (e.g. Baker et al., 2013). Research demand with regard to the role of the approach for EA has been formulated by UBA (2018d).

This connects to Arabadjieva (2016: 168) stating that the changes implied by the revised directive constitute „a significant evolutionary (though perhaps not revolutionary) step", with its impacts depending strongly on whether it will be implemented in a narrow compliance-focused way or through making use of its potential for a better integration of environmental aspects into decision-making. With regard to the role of new requirements, a SWOT analysis of the UK EIA system showed the significant role of directive amendments in advancing EA practice and, by that, learning processes, given that "EIA practitioners in the UK look up to the EIA Directive for inspiration to improve practices" (Jha-Thakur & Fischer, 2016: 22).

3.3.8 The role of assessment uncertainties and learning processes for advancing SEA

With considerable unused potential in applying theory to research on EA (Kørnøv, 2015; Köppel & Geißler, 2015; Fischer & Onyango, 2012), an attempt is made here to connect two theoretical strands of EA research with regard to enhancing the understanding of how a new environmental factor is framed, i.e. research on how assessment uncertainties are addressed on the one hand and research on how learning processes occur in and through EA on the other hand.

3.3.8.1 Knowledge and Learning

In accordance with Rydin (2007), **knowledge** in this research is understood as being constructed through social processes. With this understanding, knowledge is based on establishing a causal relationship between different parts of information, whereas information constitutes the compilation and useful processing of data. Data constitute underlying symbols that without further processing do not generate sense in and of themselves (Bloom et al., 1956, in Sheate & Partidário, 2010; Jarvis, 2012). In the context of EA, this difference is pointed out by Nilsson & Dalkmann (2001: 320) in stating that "while there might be a wealth of information, however, there is often very little knowledge", i.e. while detailed baseline data are available, there is still a

prevalence of knowledge gaps with regard to human-environment interrelations and impact significance, as pointed out above. Whereas **explicit or codified knowledge** is documented and can thus be accessed by everyone interested, **implicit or tacit knowledge** remains restricted to those involved in the process of knowledge generation, with its further distribution being dependent on communication processes (Polanyi, 1958; Lam, 2000; Jarvis, 2012). A major categorization is based on the level of action related to that knowledge, with **know-that/know-what** and **know-how** referring to the development of understanding capacity and skills and **know-why/knowing-to-what-end** moving further to questioning and potentially adjusting values and behaviours (Jha-Thakur et al., 2009: 135; Fischer et al., 2009; Davoudi, 2015), as illustrated in figure 19. In the context of transition research towards the Great Transformation (see above), these types of knowledge relate to the concepts of systems knowledge, target knowledge and transformation knowledge (Schneidewind, 2018).

Since Rydin (2007) states that knowledge can be constructed through social processes, the question in what way discourses enabled by EA procedures contribute to the generation of knowledge is of particular importance. This also relates to the concept of communities of practice (Rydin, 2007; Wenger, 1998; 2000) that describe networks of specialists in a specific field. A key role attributed to planning in that regard, i.e. handling multiple knowledges and rationalities (Rydin, 2007; Richardson, 2005), is equally relevant to EA, especially given the incorporation of experiential and contextualized (rather implicit) knowledge. However, concerns regarding asymmetric power distribution and an over-emphasis on implicit knowledge, including the danger of powerful voices being over-represented, have been raised repeatedly (Flyvbjerg, 1998; Rydin, 2007; Richardson, 2005; Schmidt-Thomé & Mäntysalo, 2014). Arising from this tension, the need to consider various knowledges but to also test them for validity and soundness and to distinguish between knowledge and other claims, may even be more relevant to EA. With "planning [and, perhaps even more so, EA; added by the author] practice as a user of knowledge in the pursuit of progress" (Rydin, 2007: 53), the question how this is realized through EA and what types of knowledge are generated through learning processes, will be pursued through this research.

Learning, in the context of EA, has been described as an "increase in the capability for effective action in relation to the subject matter at hand, such as sustainable development, thereby encompassing the acquisition of knowledge and/or skill" (Jha-Thakur et al., 2009: 135; based on Fiol & Lyles, 1985). While learning can be proactive or reactive, it is generally associated with change (Jha-Thakur et al., 2009). For Wenger (2000: 227), learning is "an interplay between social competence and personal experience", stressing the importance of social relations for learning to occur and linking back to the concept of communities of practice based on a set of shared knowledge and related interactions. Jarvis (2007; 2012) adds to this the occurrence of "disjuncture", i.e. a gap between existing knowledge and skills and the need to adapt to novel situations, as a precondition for learning. Whereas Fischer et al. (2015a) point out that learning has to date been covered by a small amount of EA contributions only, learning processes have been increasingly addressed with regard to spatial governance for sustainability in recent years (e.g., Armitage et al., 2008; Berkes et al., 2009; Folke et al., 2005; Schneidewind & Scheck, 2012; White & Noble, 2013).

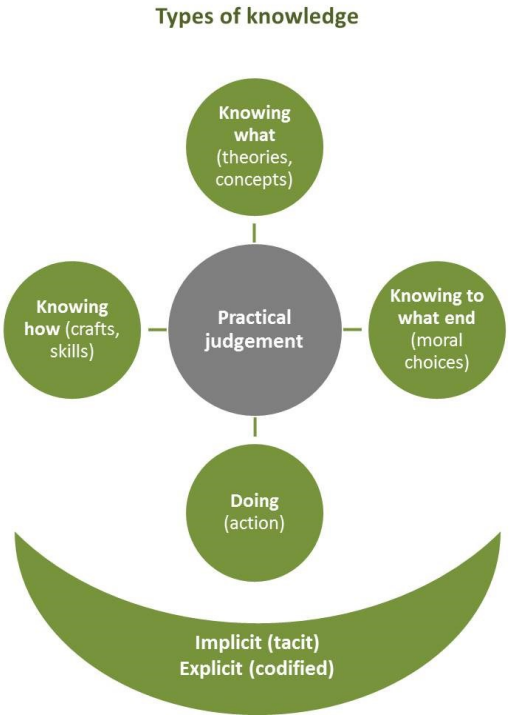


Figure 19: Types of knowledge (own figure, modified based on Davoudi, 2015: 327)

3.3.8.2 Organisational Learning through EA

The use of SEA as a learning platform has been suggested by a number of authors (e.g. Partidário & Sheate, 2013, Cashmore & Partidário, 2016; Lobos & Partidário, 2014), with a particular focus on enabling conditions for not only learning by individual EA actors (individual learning) but for organizational or institutional learning. In this context, an institution has been defined as "'routines, procedures, conventions, roles, strategies, organizational forms and technologies around which political activity is constructed'" (Fischer, 2007: 18 f.; according to March & Olsen, 1989: 22), with the understanding of institutional learning processes in and through SEA having also been termed a key research question by Köppel et al. (2014) and Kidd et al. (2011: 53; modified): "How can a regulatory instrument be utilized as a site of learning for generic skills?".

In accordance with Gazzola et al. (2011: 201), learning in EA as understood in this research is characterized by "the process of improving the integration of the environment in policy, plan and programme making as a result of enhanced know-how and know-why, and of achieving effectiveness", i.e. linking back to questions scrutinized above. Despite the little number of studies to date, EA has been regarded as a learning process from its early stages (Jha-Thakur et al., 2009; Fischer, 2003; according to Caldwell, 1982; Elliott, 1981). Whereas earlier studies focused on how learning about EA occurred, more recent work exhibits an emphasis on **learning through EA** (Jha-Thakur et al, 2009). As Therivel (2010: 21) puts it, there are various facets of learning through SEA procedures: "there are also times when, in the middle of filling in an SEA assessment matrix or thinking about alternatives to the strategic action, the decision-maker comes up with a new, elegant approach to a problem. Or where a doubtful politician is convinced to take a more sustainable option because of the findings of an SEA. Or where the decision-maker starts approaching their strategic action in a different way because the SEA made them explicitly aware of an environmental problem that they had only vaguely appreciated before." A synthesis of research on EA and organizational learning has been provided by Jha-Thakur et al. (2009) and

Gazzola et al. (2011), further specifying general observations by Rydin (2007) on theorizing knowledge in planning.

Two basic types of learning have been attributed to EA processes (Jha-Thakur et al., 2009; Bina et al., 2011). **Individual** learning emphasises the role of experience and reflection while acknowledging prior knowledge and value systems as important determinants for the individual learning outcome. **Organizational** or institutional learning as described by Argyris & Schön (1978: 28; in Jarvis, 2007) "occurs when members of the organization act as learning agents, responding to the internal and external environments of the organization by detecting and correcting errors in organizational theory-in-use, and embedding the results of their inquiry in private images and shared maps of organization". Gazzola et al. (2011) derive a typology of internal context conditions for learning in EIA, comprising cultural, structural and behavioural conditions. For cultural conditions, the existence of opportunities for debate and reflection of attitudes and routines within the organization (Fischer, 2007), but at the same time, the mobilizing role of this reflection by individuals in the organization (Müller & Siebenhüner, 2007; Kidd et al., 2011) are stressed. In that regard, the role of acquisition and exchange of tacit knowledge, termed as "'informal knowledge' sharing" between team members in a consultancy has been found to be essential by Sánchez & Mitchell (2017: 5). In regards to structural conditions, inter-departmental and inter-disciplinary collaboration, processes of information exchange as well as dialogue with external stakeholders and related openness to new ways of thinking (Simon, 1997; Kidd et al., 2011) constitute key aspects. Behavioural conditions, finally, comprise the provision of space for reflection apart from daily routines, the questioning of established routines and processes and therefore openness to learning (Nykvist & Nilsson, 2009; Small & Irvine, 2006). Consequently, the role of EA in improving links within an organization through opportunities for dialogue and reflection, combined with formal reporting and dissemination of knowledge, an openness to external input and the mobilizing role of individuals are emphasised as **key factors for organisational learning** (Gazzola et al., 2011; Cruz et al., 2018; Schneidewind & Scheck, 2012), however, again facing the need for a balance between these communicative elements and the role of EA in providing a systematic evidence base (Jha-Thakur et al., 2009). The role of external input for learning has been deemed more ambivalent, with on the one hand avoiding a "resistance to change" and related path dependency but on the other hand risking a loss of skills in permanent staff so that Jha-Thakur et al. (2009: 142) conclude: "[…] creating mechanisms that would retain the learning experience within the organization may be critical to avoid reinventing the wheel". Social interactions are therefore seen as essential to learning but can at the same time be barriers as well (see also Wenger, 2000; Partidário & Wilson, 2011). Given these external and internal conditions, the way learning occurs and the different stages it may achieve have been conceptualized based on Kolb's (1976; 1984; in Kidd et al., 2011) four stage learning cycle, as well as Bloom's (1956; in Kidd et al., 2011) taxonomy of educational objectives: While Kolb defines different learning strategies along a spectrum from experiencing, reviewing/reflecting, concluding and planning, Bloom categorises different **levels of learning**. These start with knowledge acquisition and comprehension, proceed with analysis and application and reach the full potential of learning with synthesis and evaluation. Here, learning about SEA can be associated with know that-learning as introduced above, while learning through SEA rather includes know-how and know-why learning (Jha-Thakur et al., 2009). Based on that, a **taxonomy of learning** in IA has been presented by Sánchez & Mitchell (2017), as illustrated in table 5 below.

Learning in SEA has been further grasped by the concept of learning loops, as illustrated in figure 20. While **single-loop learning** refers to the object of learning, i.e. to the acquisition or correction

of factors, methods or thresholds, **double-loop learning** goes beyond that 'factual' level and describes the reframing of values and approaches based on new or changed insights (Argyris & Schön, 1978; Armitage et al., 2008; Jha-Thakur et al., 2009). Single-loop learning thus remains restricted to modifying existing approaches without profound changes, i.e. acquisition/comprehension and analysis/application – know-that and know-how, whereas double-loop learning allows for a "more fundamental adjustment of […] general knowledge and beliefs" (Therivel, 2010: 35), also termed transformative learning (Walker et al., 2014), i.e. evaluation/synthesis – know-why, being "more about changing hearts and minds" (Kidd et al., 2011: 57). In that context, the concept of **'ownership'** is regarded as essential for learning by Stöglehner et al. (2009) and Stöglehner (2014), comprising the active integration of individual knowledge, ideas and experience by involved actors into the process (see also Donner et al., 2017), and again pointing to the role of existing values and belief systems. Beyond that, triple-loop learning has been conceptualized as further-reaching reflection in the sense of "'how do we decide what is right'"? (Sánchez & Mitchell, 2017: 4).

Evidence of organisational learning through SEA, based on European case studies (Jha-Thakur et al., 2009; Fischer et al., 2009; Kidd et al., 2011), does not show clear trends with regard to levels of learning but prompts a dependence on the starting point of SEA within the wider planning context. So far, however, there has been little evidence on double-loop learning, with most learning effects in SEA remaining at the stage of new methods or standards acquired. The weak role of double-loop learning has mainly been attributed to the problem of decisions that have often already been taken before the SEA procedure starts, the existence of procedural constraints, as well as EIA-based assessment methods that do not allow for more encompassing changes to approaches (Stöglehner, 2014; Sánchez & Mitchell, 2017; Jha-Thakur et al., 2009). It should be emphasized, however, that the more frequently observed single-loop learning effects should not be underestimated in evoking gradual changes to approaches (Fischer et al., 2009; Therivel, 2010). In particular, EA often prepares the ground for higher levels of learning by developing working structures between involved individuals and organisations (Jha-Thakur et al., 2009; Jha-Thakur & Fischer, 2016; see also Jones & Morrison-Saunders, 2017). With regard to the role of public participation, Sinclair et al. (2008) emphasise the integration of local, often tacit knowledge, into decision-making processes enabled through EA as "platforms for learning" (ibid.: 417).

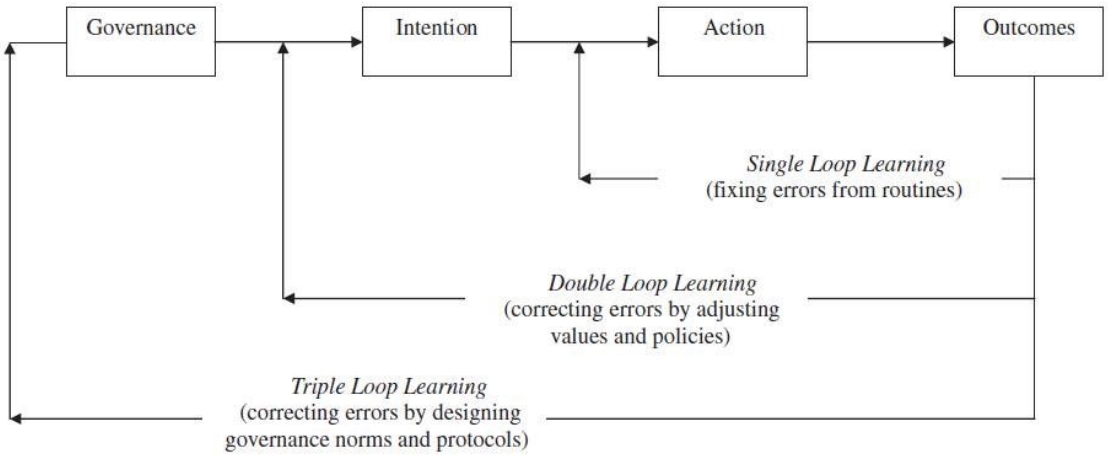


Figure 20: The concept of learning loops (Armitage et al., 2008: 89)

As touched upon above, barriers to (double-loop) learning have particularly been found in power structures and hierarchies, suggesting that "[…] individual learning does not guarantee organizational learning" (Jarvis, 2007: 113; based on Senge, 1990: 139; Bina et al, 2011; Köppel et al., 2016). Further obstacles have been described with regard to a lack of time for reflection, the pressure for legal compliance, and a frequent weakness of SEA arguments as opposed to economic interests that require less formal justification (Kidd et al., 2011; Walker et al., 2014; for a "minimum requirements approach" in EIA see also Jones & Morrison-Saunders, 2017). Sánchez & Mitchell (2017) add the danger for organisations to unlearn and thus the need for regular reviews of finalized EA procedures. Jones & Morrison-Saunders (2017), supported by a review of EIA-based studies on learning, seize the problem of clearly identifying cause-effect relationships and thus underpin what has been mentioned above with regard to the need for longitudinal studies (Bina et al., 2011; Fischer, 2007), pleading for an in-depth analysis of only one case study over a longer period of time. By that, the identification of learning could also serve as a more valid indicator of EA effectiveness, as stated by Gazzola et al. (2011). Kidd et al. (2011) bring these elements of research together and suggest four dimensions of learning, i.e. **who** learns (individual and organizational learning), **where** learning occurs (contextual factors), **how** learning occurs (decisive features of the assessment procedure; learning cycle), and **what effect** learning generates (levels of learning; learning loops).

The often limited actual spaces of action raised by Kågström (2016) and Kågström & Richardson (2015) strongly underline the case made by Kidd et al. (2011) for strengthening SEA practitioners' ability and mandate, in particular when integrating concerns that cross 'traditional' sectors into planning and assessment procedures. Against that backdrop, this study aims at contributing to a more pronounced research focus on learning through SEA, specifically looking at the role of land as a new factor and the related policy and planning discourse as outlined above, and scrutinising a potential link between the way assessment uncertainties are dealt with and the occurrence of learning.

Table 5: Taxonomy of Learning (own table, based on Sánchez & Mitchell, 2017: 196)

Taxonomy of Learning	
Questions	**Categories**
Who can learn?	Developers, Consultants, Regulators, Stakeholders, other IA participants as: - Individuals - Groups - Organisations
What can be learned?	Skills and knowledge (single-loop learning) New behaviours (double-loop learning) Norms and values (triple-loop learning)
How can learning be achieved?	Formal education Experience Public participation Learning organization approach

3.3.8.3 Addressing uncertainties in EA

Uncertainties constitute a major challenge in assessment procedures but at the same time motivate a need and unique chance for learning: "Uncertainty inherent in many resource and

environmental decisions underscores the importance of experiential learning and adaptive capacity" (Sinclair et al., 2008: 416), with the need to consider uncertainties more explicitly having been increasingly brought up in recent years (Köppel et al., 2016; Rehhausen et al., 2015; Pavlyuk et al., 2017). This is against the observation that uncertainties tend to be identified but hardly further addressed by subsequent assessment stages (Bragagnolo et al., 2012; Lobos & Partidário, 2014). However, relatively little research has been undertaken focused specifically on how assessment uncertainties are addressed in EA, and less so on the relation between how uncertainties are dealt with and learning processes.

While "uncertainty is almost unavoidable in EIAs" (Cardenas & Halman, 2016: 24), a universal definition can hardly be provided. In general, uncertainty relates to assessment results that contain subjective influence and that have a probability of occurrence of less than one. Uncertainty can be **defined** or **undefined**, with the first referring to uncertainty in predicting a future state (which can be attributed to natural variability or measurement-/model-based flaws, as well as to underlying values and attitudes, also having been termed aleatory and epistemic uncertainty), the latter referring to the absence of knowledge about an issue (also termed deep uncertainty; Scholles, 2008e; Committee on Decision Making under Uncertainty, 2013). Generally, however, uncertainty refers to "a situation in which a person does not have the required information to precisely describe, prescribe, or predict an event or its characteristics" (Cardenas & Halman, 2016: 25), which can be caused by methodological deficits or a lack of knowledge alike, as stated above. Albeit their focus on EIA, Cardenas & Halman's (2016) review of situations in which uncertainties occur provide a helpful starting point. Situations range from lack of knowledge about the magnitude of impacts, possible interactions between impacts, and the validity of assumptions taken, to criteria suitable to assess the importance of impacts, and the effectiveness of measures to tackle these impacts.

Nevertheless, in order to make research on assessment uncertainties more comparable and generalizable, Leung et al. (2015) underline the need for agreeing upon a common conceptual framework. A starting point for that is provided by Walker et al. (2003), suggesting a framework that comprises **location**, **level** and **nature** of uncertainty, as displayed in figure 21. Location of uncertainty within this framework refers to the procedural stages of EA, level of uncertainty ranges from no uncertainty via a good understanding and statistical explicability of uncertainty, to a lack of knowledge about functional relationships and probabilities and finally to an absence of knowledge about what is not known. Nature of uncertainty refers to it being caused by imperfect knowledge, inherent variability, or a combination of both, i.e. incorporates what has been termed defined and undefined uncertainty above (Leung et al., 2016). Findings by Leung et al. (2016) for a Canadian case study reveal that with regard to their location, uncertainties were particularly assigned to impact prediction, significance of impacts and adequate mitigation measures as well as to assessing cumulative effects. Accordingly, lowest levels of uncertainty were attributed to establishing the environmental baseline, medium levels of uncertainty to predicting potential impacts, identifying mitigation measures and determining the significance of potential impacts. Highest levels of uncertainty were attributed to assessing cumulative effects. Regarding the nature of uncertainty, the authors show that a combination of both imperfect knowledge and inherent variability was prevalent, with a focus of imperfect knowledge on follow-up and monitoring as well as the environmental baseline, and a focus of inherent variability on identifying and assessing socioeconomic aspects.

Research on what Cardenas & Halman (2016) term **techniques**, i.e. measures identified by previous studies in order to address uncertainties, has particularly focused on improved methods for impact prediction as well as related adaptive management strategies (Leung et al., 2015). A second key aspect of research on uncertainty according to Leung et al. (2015; 2016) refers to the transparent display and communication, or **disclosure**, of uncertainties. Here, the focus is on how knowledge about uncertainties can contribute to better decision-making through enhanced transparency and awareness of the determinants of alternatives, related risks and preferences (Pavlyuk et al., 2017; Committee on Decision Making under Uncertainty, 2013; Geneletti et al., 2003). With reference to EA, uncertainty disclosure constitutes a rather recent field of interest and has so far mainly been examined with regard to climate change and biodiversity in EA (Leung et al., 2015), urging for a more transparent communication of uncertainties and explication of underlying assumptions (Tennøy et al., 2006; Wardekker et al., 2008). Wardekker et al. (2008) thematise a major objection against disclosing uncertainties, i.e. the risk of causing distrust in information provided and confusion among the public, but show that psychological studies have not revealed significant effects in that regard.

Key demands therefore point to the need for practitioners to explain assumptions underlying their assessments and inherent knowledge gaps, in order to enable decision-makers to judge the validity of the predictions upon which their decisions are based. This argument is strengthened by potential benefits arising from knowledge of uncertainties in developing more legitimate decisions between alternatives (Tennøy et al., 2006; Geneletti et al., 2003; Duncan, 2013; based on Leung et al., 2015). Guidance is particularly needed with regard to "what needs to be communicated, how it should be communicated, the perceived risks of doing so, and the nature and quality of information needed for informed decision-making", i.e. guidance for practitioners on how to disclose uncertainties, and guidance for decision makers on how to use the disclosed information (Leung et al., 2015: 120; Pavlyuk et al., 2017).

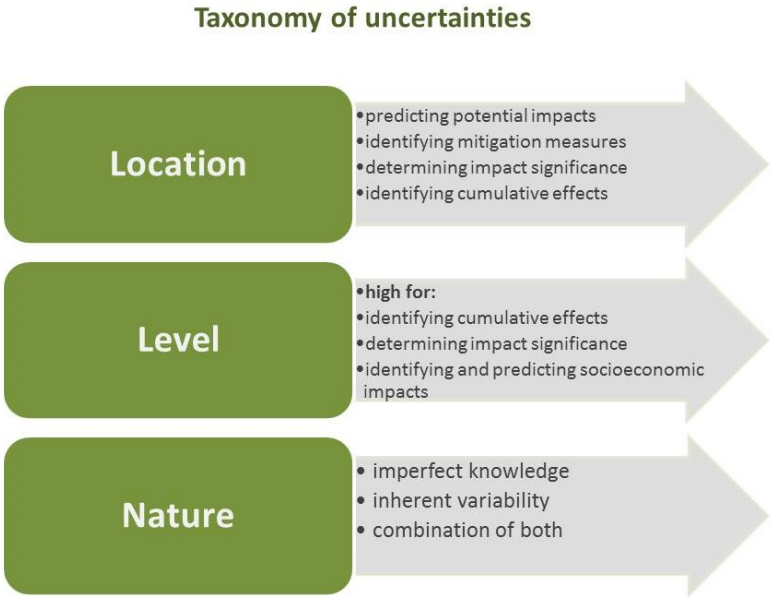


Figure 21: Taxonomy of uncertainties (own figure, based on Leung et al., 2015; Walker et al., 2003)

Leung et al. (2016), based on a Canadian study, find that there is a strong consensus on the occurrence of uncertainties in EA reports and on frequent overconfidence in the certainty of predictions and mitigation measures. Interestingly, their study also finds that for over 80 % of

study participants the open disclosure of uncertainties characterizes good EA procedures, whereas the risk of reduced credibility through communicating uncertainties shows a mixed picture. Despite general agreement with the importance of disclosing uncertainties, their consideration was seen as more critical, as has also been found by Wardekker et al. (2008) with regard to a frequent inability of policy makers to deal with uncertainties. Risks for consultants or proponents with regard to confidence or project approval were seen as minor whereas almost half of the study participants saw a risk for reduced public acceptability when disclosing uncertainties. This problem is contextualized by the authors with regard to the prevalent "adversarial system" EA is characterized by, i.e. the situation of "information provision and 'courtroom style' hearing process" (Leung et al., 2016: 98). With regard to performance in disclosing uncertainties, about 40 % of study participants indicated a lack of considering uncertainties in decision making, with consultants and proponents estimating their performance higher than what resulted from them being assessed by other groups: "those closest to the knowledge generated in EA (consultants), and those potentially with the most at risk if the project is not approved (proponents), appear to be more satisfied with current practices of uncertainty consideration and disclosure than those furthest removed from the knowledge generated ([…] interest groups, academics)" (Leung et al., 2016: 97).

Regarding benefits of uncertainty disclosure, Leung et al. (2016) emphasize an improved process of assessment and decision-making through more realistic ways of predicting impacts and identifying mitigation measures, as well as enhanced transparency and trust, as displayed in table 6. Risks to uncertainty disclosure are however identified with regard to difficulties in explaining uncertainties for consultation procedures, as well as to different approaches towards interpreting risks and acceptance levels of uncertainty. Wardekker et al. (2008) also point to the role of uncertainty information in clarifying options and in preventing decisions based on insufficient information but also mention associated risks of using uncertainty information unilaterally to undermine proposals that do not suit particular interests. Further research demand has been formulated with regard to not only examine uncertainty disclosure but also the way this information is used and responded to. They (ibid.: 634), for instance, suggest a "level-of-knowledge indicator" and an introductory section in environmental reports that depicts how uncertainties have been dealt with.

Table 6: Benefits of Uncertainty Disclosure (own table, based on Leung et al., 2016: 97)

Benefits of uncertainty disclosure	
Improved EA procedure and decision-making	- Better prediction - Realistic view of impacts - More effective mitigation and identification of adaptive management measures
Transparency and Trust	- More balanced discussion - More robust review process

Figure 22 summarises the analytical framework outlined here as a background for empirical research, displaying key previous findings on types of uncertainties and their disclosure, approaches towards addressing these uncertainties, and types of as well as determining factors for learning in EA.

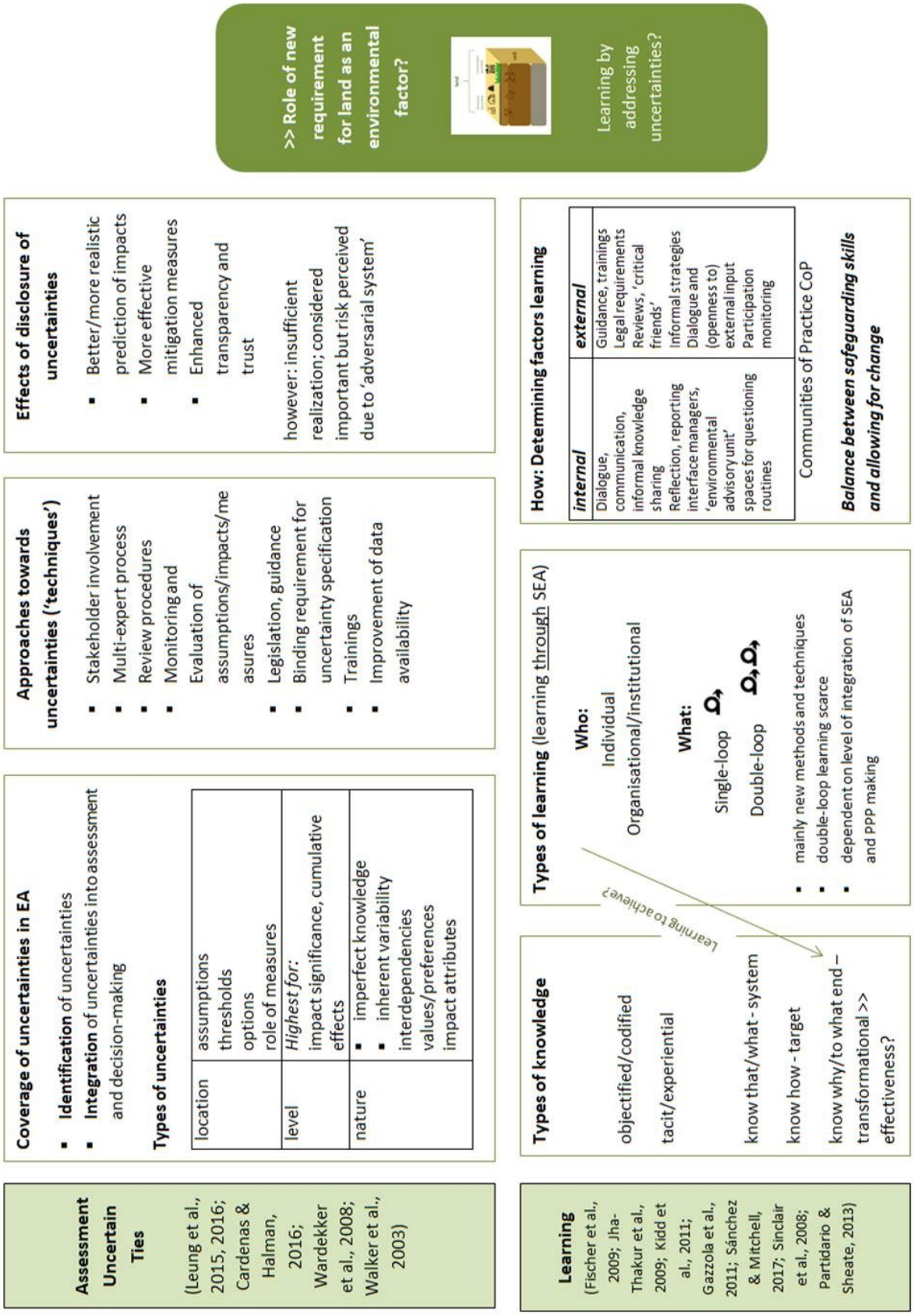
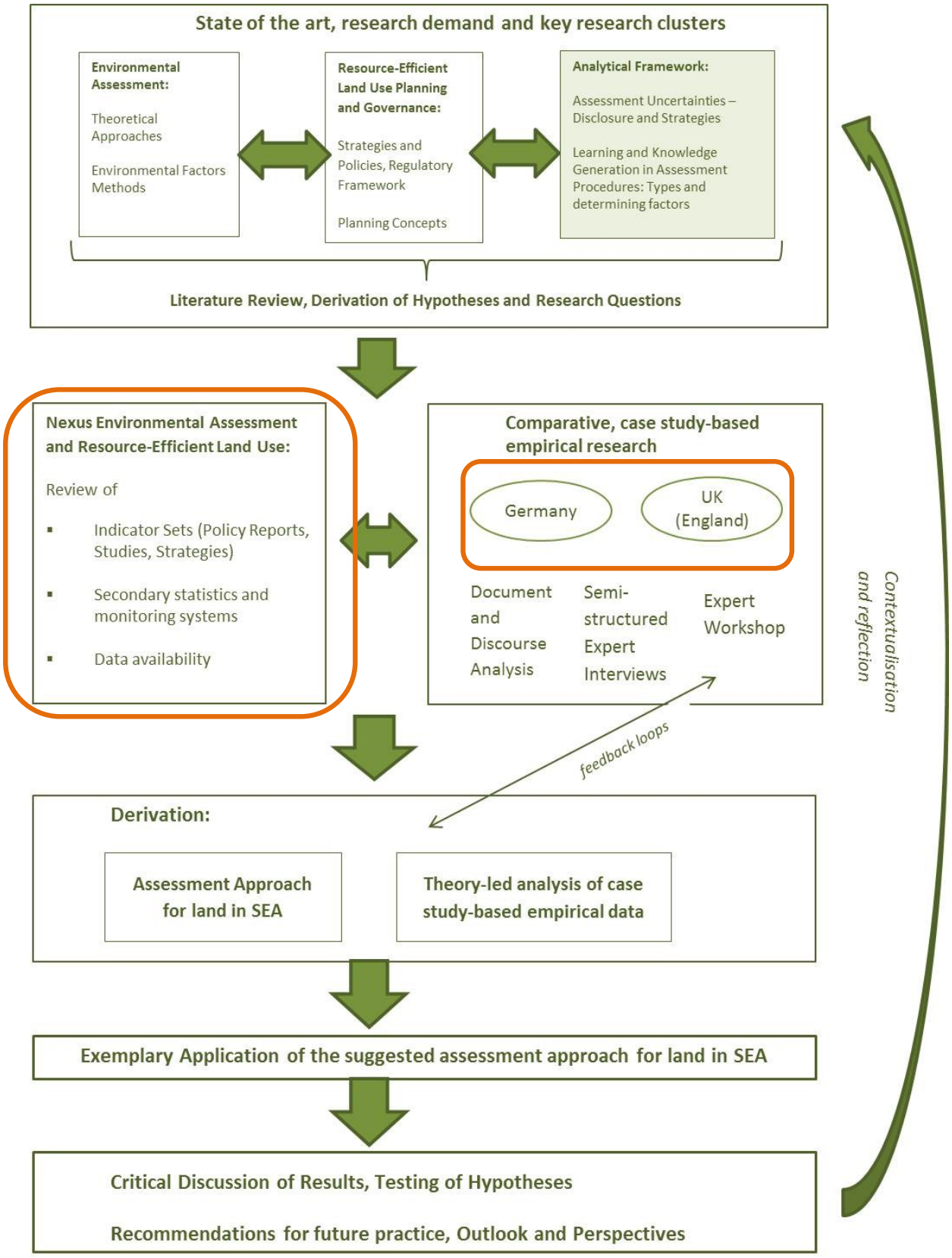


Figure 22: Condensed analytical framework: Key findings on the role of uncertainties and learning in EA (own figure; icons made by Freepik from www.flaticon.com)


State of the art, research demand and key research clusters
Environmental Assessment:
Theoretical Approaches
Environmental Factors Methods
Resource-Efficient Land Use Planning and Governance:
Strategies and Policies, Regulatory Framework
Planning Concepts
Analytical Framework:
Assessment Uncertainties – Disclosure and Strategies
Learning and Knowledge Generation in Assessment Procedures: Types and determining factors
Literature Review, Derivation of Hypotheses and Research Questions
Nexus Environmental Assessment and Resource-Efficient Land Use:
Review of
Indicator Sets (Policy Reports, Studies, Strategies)
Secondary statistics and monitoring systems
Data availability
Comparative, case study-based empirical research
Germany
UK (England)
Document and Discourse Analysis
Semi-structured Expert Interviews
Expert Workshop
feedback loops
Contextualisation and reflection
Derivation:
Assessment Approach for land in SEA
Theory-led analysis of case study-based empirical data
Exemplary Application of the suggested assessment approach for land in SEA
Critical Discussion of Results, Testing of Hypotheses
Recommendations for future practice, Outlook and Perspectives

4 Case Studies: Land Use Planning Systems and the role of SEA

The following sections will look at England's and Germany's land use planning contexts in more detail and explore key frame conditions for analyzing and interpreting findings generated through empirical research.

4.1 Land Use Planning Systems as a framework for SEA

The comparative research is based on analyzing the application of the same EU Directive to SEA procedures that are conducted within considerably different planning systems. The development of these planning systems or models of spatial planning is rooted in and determined by the respective historical context and corresponding socio-economic and political frame conditions that shaped underlying forms of government and law (Nadin & Stead, 2008). Characteristics of European planning systems have been analysed by Dühr et al. (2010) and Reimer et al. (2014), identifying four basic models of spatial planning in Europe (see also EC, 1997). Although these models all overlap to some extent, England and Germany feature a strong representation of two archetypes. This mirrors findings on considerable differences between planning in England and continental Europe, evoked by different legal traditions, i.e. common law (case law) in England based on case-specific decision-making that then provides orientation for subsequent cases (combinations of both partly apply to other devolved nations of the UK), and civil law in continental Europe based on a legally defined set of abstract rules in advance of decision-making (Nadin & Stead, 2008; Ganser, 2005). Moreover, whereas England has a centrally organized government, based on common law without a codified constitution, Germany is characterized by a federal and a state government level, based on civil law and constitutional limits to federal planning competences, particularly manifested in municipal administrative autonomy (Dransfeld, 1997; Ganser, 2005; Pahl-Weber & Henckel, 2008).

Against that backdrop, the UK is strongly linked to the 'land use management model', displaying a rather reactive character through an emphasis on the regulation of private sector-led development. Here, the role of planning is rather narrowly defined, with a dominance of national government's decisions and a regulating function of strategic and local plans (EEA, 2016a). In contrast to many other European planning systems, there are no binding zoning instruments in the English system (Dühr et al., 2010; Nadin & Stead, 2008), with spatial plans focusing on "statements of development intent" and thus contain greater flexibility than spatial plans in (continental) systems with a zoning approach (Therivel & Fischer, 2012: 17). Hence, it can be described as a unitary system with a discretionary planning approach due to the absence of constitutional constraint (Fischer, 2007; Grohs, 2012; Cullingworth et al., 2015), with land use decisions mainly being taken through planning permission for developers. Land use plans thus possess a less binding character, as opposed to Germany where land use decisions are more tightly regulated by a zoning approach and plan-led decisions (Dransfeld, 1997; Ganser, 2005; Grohs, 2012). Germany, therefore, displays features of both the comprehensive integrated and the regional economic planning model, focusing on spatial coordination and multi-level plan making that tend to attribute a stronger role to the public sector, as well as on the mitigation of spatial disparities (Dühr et al., 2010; EEA, 2016a). The German spatial planning system can thus be described as a federal system with a non-discretionary land allocation approach through zoning (Fischer, 2007). An overview of both planning systems and their tiers is provided in figure 23.

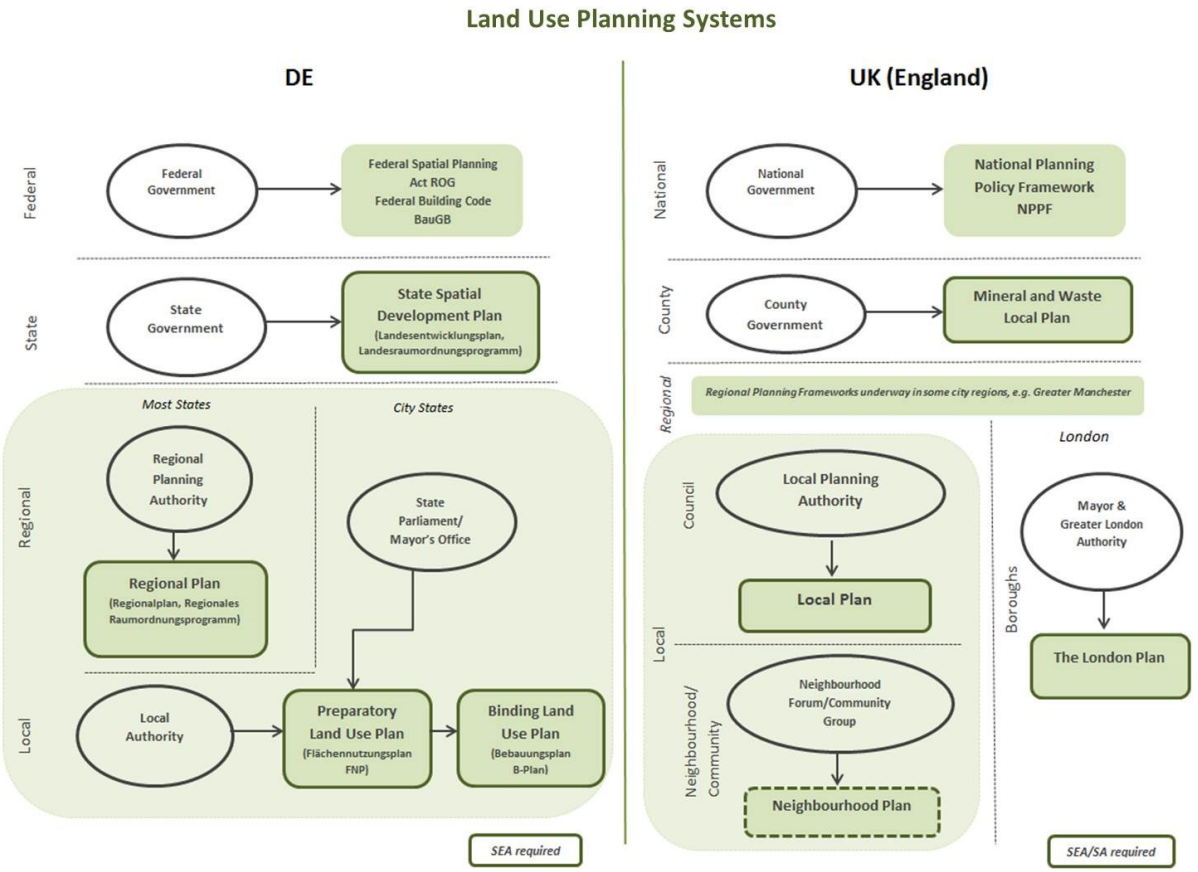


Figure 23: Structure of case study-related national planning systems (own figure, based on Balla et al., 2010; Cullingworth et al., 2014; ODPM, 2005a; Reimer et al., 2014)

4.1.1 Characteristics of the Land Use Planning System: England

This difference needs to be seen within the context of a traditionally high degree of institutional autonomy and initially little involvement of central government with plan making and permission in England (Wray, 2014; 2015; Grohs, 2012). Opposed to that, however, a strong influence of central government developed after the Second World War based on the Town and Country Planning Act 1947, and has even been strengthened from the late 1970s ('Thatcher era') on with the introduction of measures by which central government (in particular, the Planning Inspectorate) can influence local planning decisions to a significantly greater extent than in most other European planning systems (Grohs, 2012; Cullingworth et al., 2015). This is also reflected in a comparably small amount of local revenue that is generated from local taxes, with changes, however, provisioned for 2020 (Morphet & Clifford, 2017).

As described by Cullingworth et al. (2015), early post-war planning in England was strongly focused on housing, with a large amount of council housing being realized and private house building incentivized. Towards the end of the 1950s, an increasing pressure on undeveloped land evoked the introduction of green belts as a planning instrument, followed by rapid implementation in most major urban areas. While the 1970s were characterised by a policy focus on the revitalization of inner urban areas, with a (rhetoric) shift towards planning seen as inhibiting economic development from the end of the 1970s, the 1990s were characterized by the introduction of Planning Policy Guidance Documents (PPGs) and intensified consideration of environmental and sustainability issues. Major change was created through the 2004 planning reforms, aiming at a stronger "'spatial planning' approach" (Shaw & Lord, 2009: 425) and

including the introduction of regional planning, as opposed to the traditional focus on regulating land use, or as Cullingworth et al. (2015: 7) put it, "the strong and long-established land preservation ethic". Since 2010, however, most of these regulations as well as the regional planning tier have been abolished, with DCLG (2015: 4; adapted by the author) emphasizing the intent to "simplify the planning system" and "enabling planning decisions to be taken at the lowest possible level with the involvement of local people". Former Regional Spatial Strategies (RSS), however, have been described as exerting significant importance for the definition of housing targets at the regional level (Cullingworth et al., 2015; DCLG, 2015; Boddy & Hickman, 2018). Notably since, some city regions, especially Greater Manchester, have started to develop Spatial Frameworks in order to strategically shape future development at a regional scale. The 2010 reform saw the replacement of previous PPGs by the National Planning Policy Framework (NPPF) prompting a renewed strong role of central government (Cullingworth et al., 2015).

The structure and terminology of the UK planning system differ considerably between its parts ('devolved nations'), i.e. England, Wales, Scotland and Northern Ireland. In the following, key characteristics for the situation in England are illustrated in detail. Primary planning legislation has been laid down in the Town and Country Planning Act 1990, updated by the Planning and Compulsory Purchase Act 2004 as well as the Town and Country Planning (Local Planning) Regulations 2012 (Ganser, 2005; Grohs, 2012; DCLG, 2015). These regulations, however, only include procedural aspects. Substantial planning policies as in German planning regulations are to some extent included in the NPPF but are as such not subject to regular legislative procedures and to be treated as 'material considerations' on a case-by-case basis instead (Grohs, 2012). Secondary planning legislation comprises regulations and orders, among them the EIA Regulations for England (Ganser, 2005). Within this regulatory context and until 2004, the English planning system disposed of a two-tier system of rather strategic Structure Plans and detailed Local Plans containing concrete land allocations that had been merged to one single plan document, the Local Development Frameworks through the 2004 planning reform. Since the 2010 planning reform, with the introduction of the NPPF and of Neighbourhood Planning, together with the Localism Act 2011 (Grohs, 2012; Cullingworth et al., 2015), Local Authorities are required to develop Local Plans that contain the Core Strategy, i.e. the general spatial strategy for the territory of the respective Local Authority, as well as Site Allocation Documents, i.e. individual site designations for future development.

At the national level in England, key decisions on planning are taken by the Ministry of Housing, Communities and Local Government MHCLG (before, Department for Communities and Local Government (DCLG), and before 2006, Office of the Deputy Prime Minister ODPM) and by the Department for the Environment, Food and Rural Affairs (DEFRA), with the latter focusing on agricultural land and rural development more generally. The government departments are complemented by executive agencies and public bodies, with the Homes and Communities Agency, the Environment Agency, Natural England and English Heritage constituting key players with regard to land use. An important feature of the English planning system, in particular compared to Germany, is the role of the Planning Inspectorate for England and Wales that has the authority to review local authorities' plans and decisions with regard to planning applications (Cullingworth et al., 2015; Ganser, 2005; DCLG, 2015). As for Germany, EU influence is mainly exerted through regional policy and environmental legislation, thus particularly the SEA Directive can be seen as constituting a key European impact on spatial/land use planning (Cullingworth et al., 2015M see also section 3).

Institutionally, England disposes of different types of Local Authorities that are responsible for developing Local Plans for their territory: For metropolitan areas except for London, there are unitary authorities represented by the district councils. In non-metropolitan, 'shire' areas, there is for the most parts a two-tier system containing county and district councils (Cullingworth et al., 2015; see figure 24). Local Plans as introduced by the latest planning reform are to retain their task of developing the strategic planning framework for the local authority, and can be supplemented by Neighbourhood Plans for the development of an individual local community or parish council (DCLG, 2015; Cullingworth et al., 2015; Fischer & Yu, 2018). While Local Plans are broadly comparable in scope to German comprehensive land use plans, they do not contain a comparable level of detail, and due to the discretionary character of the planning system there is no instrument that corresponds to the German binding land use plan (Ganser, 2005). A schematic overview of the Local Plan preparation process is given in figure 25. Local Plans constitute the key documents for setting out the future development of an area, have to go through a proof of "soundness" by an independent inspector and are complemented by a number of evidence-base documents. With regard to land use, these primarily include Strategic Housing Land Availability Assessments (SHLAAs) that assess availability, suitability and achievability of potential development sites, as well as Strategic Housing Market Assessments (SHMAs) that define the objectively assessed need (OAN) for additional housing and identify a 'five year supply' of deliverable sites (DCLG, 2015). Besides those, open space studies, green infrastructure studies and brownfield land registers have been carried out in order to inform decisions on land use. All Local Plans require a Sustainability Appraisal Report including SEA (Cullingworth et al., 2015).

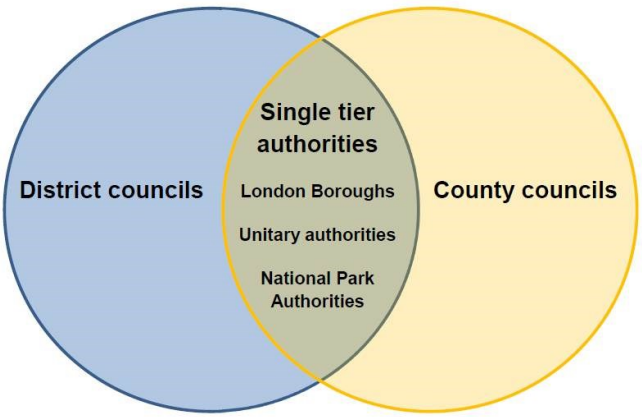


Figure 24: Types of local authorities in the UK (England) (DCLG, 2015: 5)

Besides development plans as explained above, a second key element of the English planning system refers to development management/control through the planning application process, with development being understood as generally requiring planning permission (Cullingworth et al., 2015). Two mechanisms are to be mentioned, comprising the option of appeal, i.e. directly addressing the Planning Inspectorate in cases where a local planning authority refuses planning permission and an inspector decision might result in a different weighting of issues, and the option of a call-in process, i.e. the Secretary of State at DCLG taking over a particular planning application process in place of the respective local authority, mostly when issues of national significance are involved (DCLG, 2015; Cullingworth et al., 2015). Accordingly, planning applications are considered with regard to plan policies whereas, and as opposed to planning systems with a

zoning approach, a plan does not constitute the basis for project implementation but rather has an indicative function (Cullingworth et al., 2015: 137).

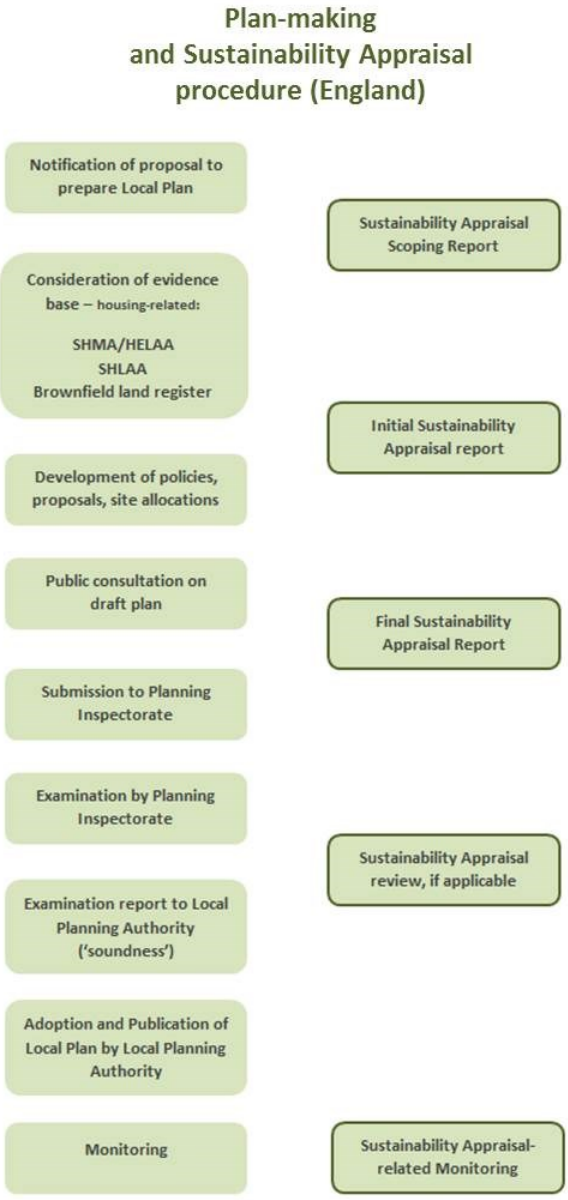


Figure 25: Plan-making procedure and related SEA/SA stages in England (own figure, based on Cullingworth et al., 2015; DCLG, 2015)

4.1.2 Characteristics of the Land Use Planning System: Germany

Germany, as already touched upon, disposes of a significantly different planning system, particularly given the federally organised system and the role of civil law and codified legislation. Key differences consist in the absence of an overarching national planning authority with the federal level only issuing guiding principles for spatial planning, the stronger role of land use plans at different spatial scales and resulting less discretion in granting planning permission as well as constitutionally enshrined municipal planning autonomy (Pahl-Weber & Henckel, 2008; Ganser, 2005; Blotevogel et al., 2014). The overarching framework for spatial planning is contained in the Federal Spatial Planning Act (*Bundesraumordnungsgesetz*), together with planning guidelines (*Leitbilder der Raumentwicklung*). Key legislation for municipal land use planning is included in

the Federal Building Code (*BauGB*), supplemented by the Land Utilisation Ordinance (*BauNVO*) and Plan Notation Ordinance (*PlanZVO*). Within that regulatory framework, specific planning procedures are individually defined by the federal states (Pahl-Weber & Henckel, 2008).

The German planning system is based on a tiered interaction of several plans (Fischer, 2007; Pahl-Weber & Henckel, 2008; Blotevogel et al., 2014): State Spatial Development Plans (*Landesentwicklungspläne/-programme*) address the overarching rationale and general locations of development, subsequent Regional Plans (*Regionalpläne/Regionale Raumordnungskonzepte*) address more specific locations and modes of development at the regional scale. At local scale, preparatory, comprehensive land use plans (*Flächennutzungspläne, FNP*) are compiled for the entire territory of the respective municipality whereas binding land use plans (*Bebauungspläne, B-Pläne*) refer to a specific part of this territory, are to be based on the preparatory land use plan and address the specific why, what, where, how and when of development through binding land allocations at the local scale. Therein, the counter-current or mutual feedback principle applies, requiring coordination between decision-making levels. In addition, the German planning system disposes of the instrument of landscape planning, issuing Landscape Programmes and Plans at the respective spatial scales that address ecological issues of development in particular. Landscape Plans in Germany can to some extent be regarded as predecessors of SEA, in that they already covered many of its functions (Lipp, 2016; Fischer, 2002). An overview of the plan-making procedure at municipal scale and related SEA stages in Germany is provided in figure 26. In procedural terms, the tiered German planning system, since the introduction of the BauGB in the 1960s, has seen a lot less change compared to the UK situation. Changes and additions have rather applied to substantial requirements of planning that will be explained further below.

Compared to England, Germany, given weak federal competences for spatial planning, does not know an institution such as the Planning Inspectorate and hence features a stronger separation of planning and control, as ascribed to the municipality and the superordinate administrative authority respectively (Ganser, 2005). At local scale, comprehensive planning lies with municipalities that either belong to a county or constitute county-free cities, i.e. with municipality and county coinciding. In some federal states there are administrative districts between county and state scale that bundle a number of supra-local competences (see figure 27). The German institutional structure implies a proportionally higher number of local planning authorities, either in the form of municipalities (*Gemeinden*) or of planning associations (e.g. *Planungsgemeinschaften/Ämter*) that bundle administrative tasks of several small municipalities (Pahl-Weber & Henckel, 2008). Besides comprehensive spatial planning, key stakeholders in land use planning comprise different sectoral authorities (at state scale) or departments (at regional and municipal scale) such as for nature protection, for economic development and (at state scale) for agriculture and energy that function as public agencies (*Träger öffentlicher Belange*) and thus have to be consulted during plan-making. However, the coordination of sectoral policies and plans that exert an influence on land use decisions constitutes an ongoing challenge (Blotevogel et al., 2014), as has been touched upon in section 3.

An important characteristic of the German planning system is the differentiation between grounds on which proposed development is to be judged: Development within the so-called internal area or existing urban fabric (*Innenbereich*) is based either on a binding land use plan or to be judged on the grounds of § 34 BauGB, requiring primarily for it to integrate into the existing built environment and including a general presumption in favour of development. Development in the so-called external area/undesignated outer zone (*Außenbereich*) according to § 35 BauGB is

generally to be avoided and restricted to the so-called 'privileged projects' such as agricultural premises or facilities for energy production (Pahl-Weber & Henckel, 2008). While such a differentiation does not exist in England, Ganser (2005) states that an instrument like development control would mean for Germany that decisions on land use would only be taken on the basis of § 34 BauGB.

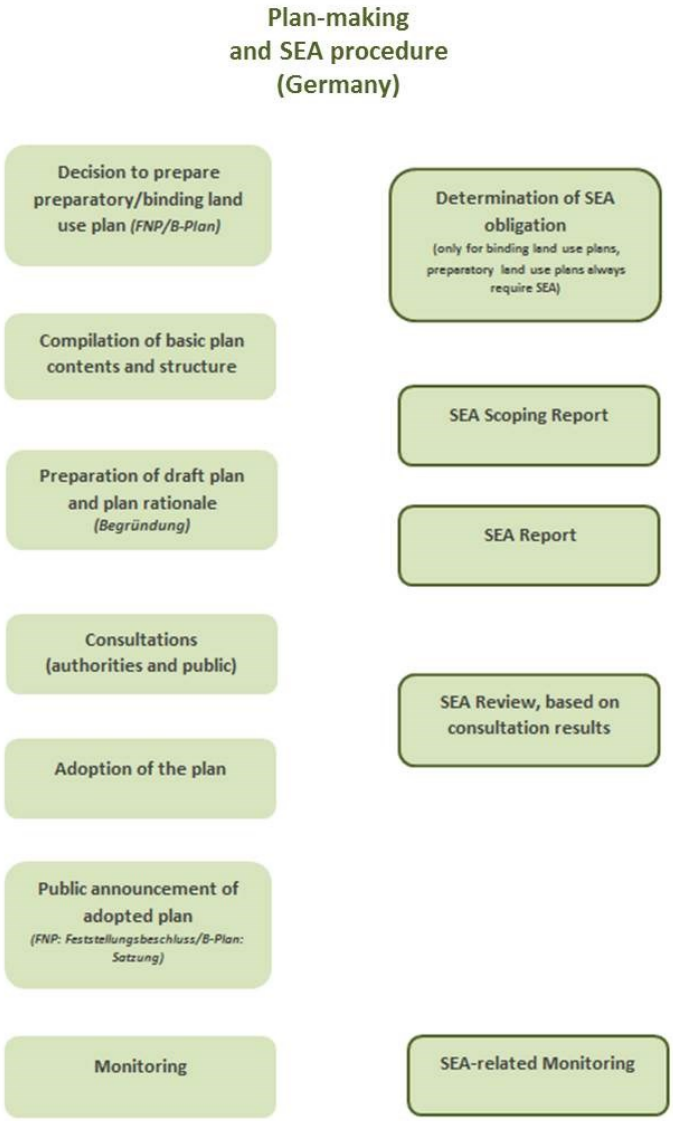


Figure 26: Plan-making procedure and related SEA stages in Germany (own figure based on Balla et al., 2010)

Moreover, implications for land use decisions arise from the different modes of how local authorities are financed. While these are foreseen to develop more towards local income generation in the UK (Morphet & Clifford, 2017), German authorities' budgets tend to be based to a significantly larger extent on local taxes (about 40 % of local authorities' revenue; Pahl-Weber & Henckel, 2008). This situation, spurring inter-municipal competition for revenue through new inhabitants and hence the development of land for housing purposes even in low-demand regions implies significant challenges for coordinating the realization of overarching targets (Ganser, 2005; UBA, 2018a; Blotevogel et al., 2014).

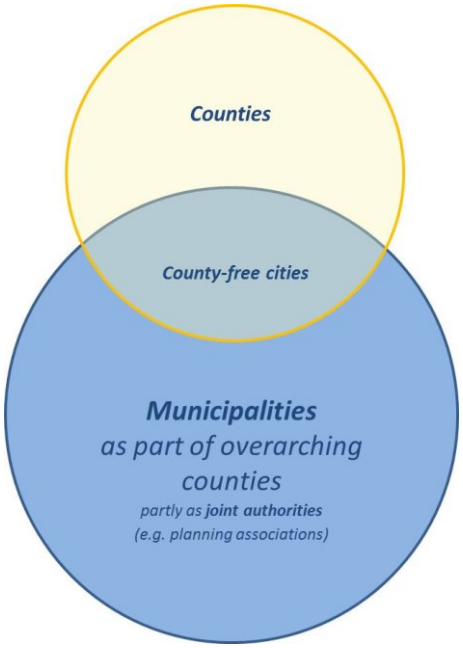


Figure 27: Types of local authorities in Germany (own figure, based on Pahl-Weber & Henckel, 2008)

4.2 Land use patterns and the role of land in policy and planning

Beyond these features of the two planning systems, the two country case studies examined for this research differ considerably with regard to determinants of land use patterns: One factor for these differences has been seen in the fact that while both countries can be regarded as being densely populated, England on its own has a significantly higher population density that has significantly increased over the last 10 years (427 inhabitants/km^2; Statista 2018) than Germany (230 inhabitants/km^2; Statista 2018; relatively constant since 2005), constituting a driver for addressing resource efficient land use (Ganser, 2005). Despite low-rise housing in the form of prevalent terraced houses largely built in the second half of the 19th century being much more common in central locations in England than in Germany where multi-storey apartment buildings tend to dominate these locations (Eurostat, 2018b), greenbelt designations surrounding bigger cities have for a long time been highly efficient in preventing urban sprawl in England (Couch & Karecha, 2006). Given the traditionally strong valuation of the open countryside in the UK, a culturally rooted intent to protect greenfield land and avoid urban sprawl can be observed ("rural idyll", Sturzaker & Mell, 2016), supported by environmental organizations such as CPRE (Adams et al., 2010). Another factor is the structure of the property markets, with the UK displaying a much lower proportion of rented accommodation than Germany (Eurostat, 2018a). As opposed to a self-owned house built on it, however, less importance tends to be attributed to an own patch of land in the UK, also due to a legal separation between real estate in regard to building property and sustaining land (Dransfeld, 1997).

Related to that is the rationale driving local authorities' stance towards land supply, with German municipalities tending to compete with each other in attracting new inhabitants and companies as a basis for financing their infrastructure, often resulting in an over-supply of development land (UBA, 2003). However, the 'New Homes Bonus' introduced in the UK in 2011 installs a mechanism that aims at rewarding local authorities more directly for the amount of new housing realized, and by that now constitutes "one of the few ways in which councils can fund essential services" (CPRE, 2017a: 8). To both countries, the problem of an insufficient land or property tax that would bring

more vacant land and building stock forward for redevelopment, applies (e.g. UBA, 2018a; CPRE, 2017d).

4.2.1 Land Use Patterns and Policy: England

4.2.1.1 Land Use Patterns and statistical evidence

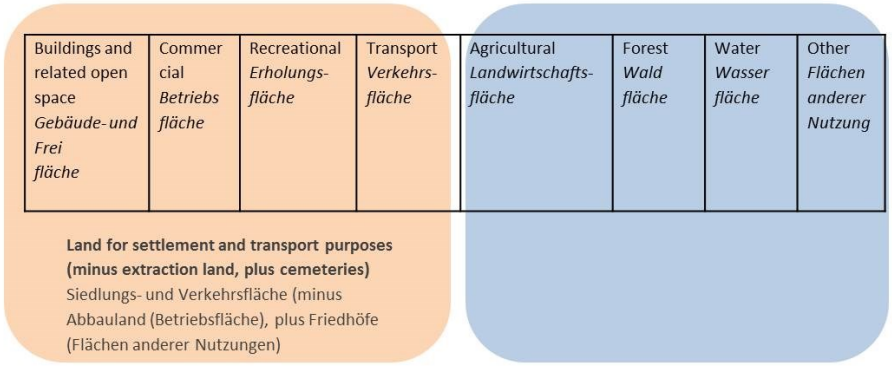
As Couch & Karecha (2006) state with regard to mechanisms for controlling urban sprawl, until the 1990s a continuous additional uptake of rural land for development, especially where no green belt was in place, was realised. A shift of approaches began in the early 1990s, with PPG 3 'Housing' requiring an "optimum use of brownfield sites" (ibid.: 354; The Stationery Office, 1992) for the first time. A sequential approach was applied, allowing the release of greenfield land for development only if options of reusing brownfield/PDL, increased densities or better use/conversion of existing dwellings had been assessed beforehand, and formulating a quantitative target of 60% of new housing to be provided on previously developed land (PDL), as well as of minimum densities between 30 and 50 dwellings per hectare net (Cullingworth et al., 2015).

Regarding available datasets on land use, essential data for England are included in the Land Use Change Statistics (MHCLG LUCS). Here, changes between different land use categories as well as the amount of development on PDL are given in absolute and relative figures. Regarding land take, an indication can be derived from figures for land changing from undeveloped to developed use categories (Williams, 2012), amounting to 46 ha per day in 2015/16 (MHCLG LUCS; see also CPRE, 2017a; CPRE, 2018). A direct comparison of the two cases' land use statistics is, however, not possible due to their significantly different structure and survey methodology, with a juxtaposition of categories provided in figure 28. Earlier findings by von Haaren & Nadin (2003) as well as BMVBS & BBR (2007) indicated significantly higher land take for Germany than for England, being about four times higher throughout the 1990s. However, with higher recent increase in land take in England and some success in reduction in Germany, these figures have somewhat converged in recent years, as compiled in table 8 below.

As opposed to Germany, and based on the former 60 % target mentioned above, LUCS enable the derivation of figures on PDL reuse for England (however, with methodology having been changed, comparable figures only go back to 2013). The National Land Use Database of PDL NLUD, basic data being gathered from local authorities (HCA, 2014; Adams et al., 2010), used to cover the amount of PDL from 1998 up until 2012, distinguishing different categories and reuse potential of PDL. As Ganser (2005) carves out, however, resource efficiency of land use cannot be assessed on the grounds of relative reuse of PDL alone, given that such figures do not necessarily imply an increase in PDL reuse in absolute terms but can also be caused by an increase in PDL overall.

With regard to the above-mentioned targets, the 60 % on PDL-target was achieved for the first time in 2000 (Ganser, 2005; Williams, 2012), with levels of more than 70 % being measured in 2005 and 2010. However, a steady decline in the proportion of new housing on PDL has been detectable since a peak was reached with 81% in 2008 (CPRE, 2014; according to LUCS), and as illustrated in figure 29. However, the proportionate target introduced in 1998 has also been observed as producing problems such as a reduction of homes being built, little additional efforts for activation, and building in gardens and ecologically valuable brownfield sites (Adams et al., 2010; Bio by Deloitte, 2014).

Germany: Land survey according to actual use/*Flächenerhebung nach Art der tatsächlichen Nutzung* (Destatis)



England: Land Use Change Statistics LUCS (Ministry of Housing, Communities and Local Government)

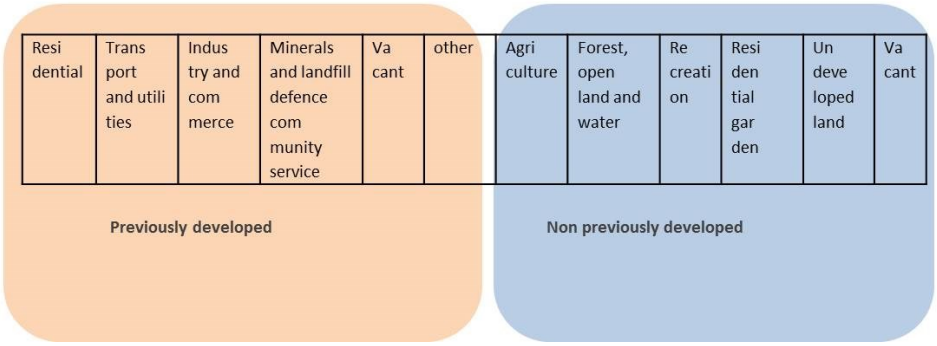


Figure 28: Structure of official land use statistics (own figure based on destatis; MHCLG)

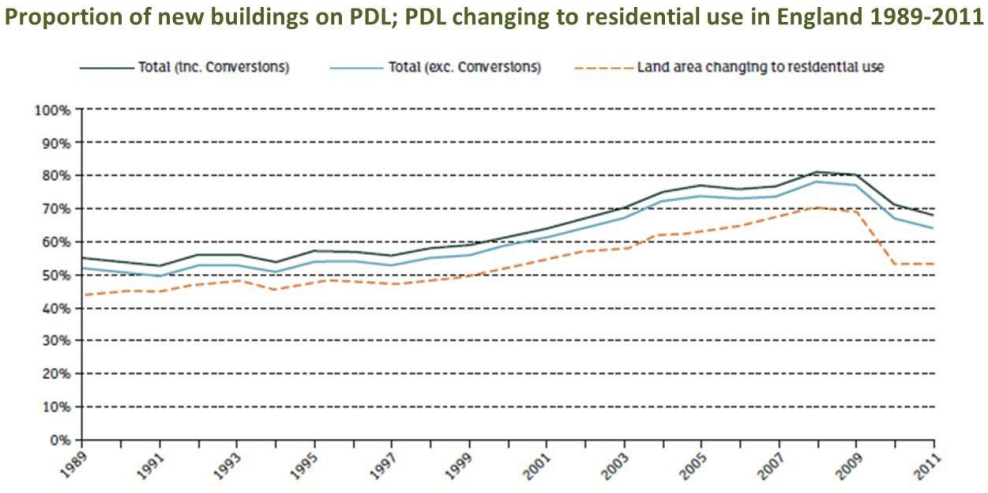


Figure 29: Proportion of new buildings on PDL; PDL changing to residential use in England 1989-2011 (CPRE, 2014: 7)

With regard to the above-mentioned density targets, in 2003 average density on PDL (33 dwellings/ha) was higher than on greenfield (26 dwellings/ha) (Ganser, 2005, according to LUCS), and had increased to 43 dwellings/ha on brownfield and greenfield in 2011 (CPRE, 2014; Cullingworth et al., 2015). However, an analysis of recent figures, as depicted in table 8 and figure 30, shows that average dwelling densities have again decreased significantly since then, together with the reduced amount of development on PDL (see also The Planner, 2015).

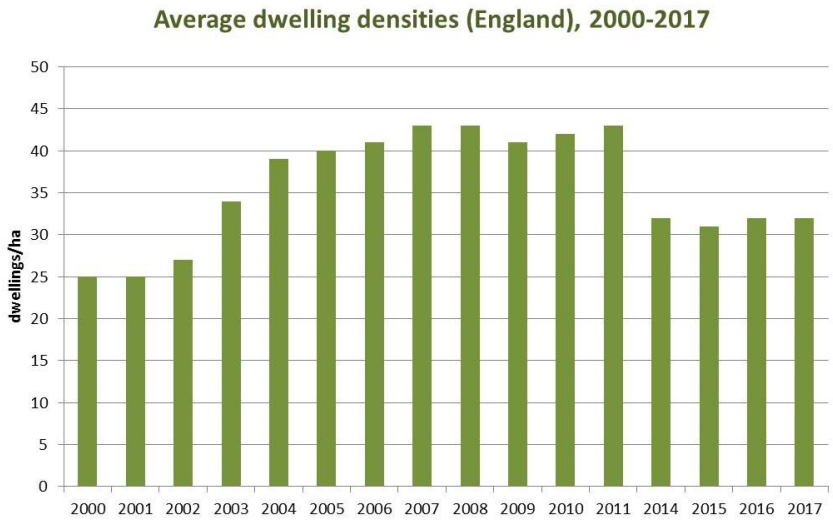


Figure 30: Average dwelling densities in England, 2000-2017 (own figure, based on MHCLG LUCS)

4.2.1.2 Review of Instruments for attaining resource efficient land use

Land-related objectives

Overarching policies of relevance for resource efficient land use include a number of strategies, in general sustainability terms the 2005 UK Sustainable Development Strategy 'Securing the Future' (HM Government, 2005). More specific land-related strategies include the National Brownfield Strategy for England published in 2008 (Syms, 2008), not being retrievable on government webpages any more, however, and the Strategy 'Safeguarding our Soils', focusing on the protection of soil quality and functions (DEFRA, 2009). An indicative list of relevant environmental protection objectives and sources of baseline information can be derived from SEA guidance (ODPM, 2005a). Until the planning reform 2010, there also was a full coordinating position for the PDL database in place in the UK (Bio by Deloitte, 2014). Funding for brownfield reuse used to be provided by the Homes and Communities Agency (EC, 2012). Land-related objectives included in the NPPF will be reviewed separately below; a summary of land-related objectives and targets is provided in table 10.

Role of debates on housing provision

Land as a resource has gained particular momentum with a recent increase in debates on how to provide sufficient and affordable housing. This has been spurred first and foremost by the frequently coined 'housing crisis' and subsequent Housing White Paper, asserting to a slow pace of home building, a reliance of the property market on a few large developers, and a lack of planning for required homes by the respective local authorities (DCLG, 2017a). As a reaction, a target of 1 million new homes by 2020 initially formulated in 2015 has been revised and shifted to 300,000 new homes to be provided per year (House of Lords, 2016), opposed to an average 160,000 completions per year (DCLG, 2017a). Of particular relevance is a shortage in affordable housing in the economically prosperous southern part of England, already addressed in 2003/04 by the so-called Barker Reviews (Cullingworth et al., 2015). Legal changes regarding housing supply have been introduced by the Housing and Planning Act 2016, including enhanced central government power and intervention options on Local and Neighbourhood Plans as well as the requirement to prepare local brownfield land registers (Johnston, 2016; CPRE, 2017c; Boddy & Hickman, 2018). Further measures have been suggested by RTPI (2016), emphasizing remedial

programmes to remove constraints on brownfield development, high quality densification, cautious release of greenfield land through a phased approach, and a cautious review of green belt boundaries from a supra-local perspective.

In the wake of the observed shortage in affordable housing in particular, national government requires local authorities to facilitate the provision of the projected number of homes needed through their Local Plans. For that purpose, local authorities are to assess their Objectively Assessed Need (OAN), with a contested methodology (Cullingworth et al., 2015) being based on DCLG household projections (based on official population projections) and spatially specific demographic trends (past provision and market signals), acknowledging that "assessing housing needs is not an exact science" (PAS, 2015: 1). The problem of determining land demand for housing has also been acknowledged by an ambiguity between need and targets, as well as a mutual influence between housing projections and economic forecasts (PAS, 2015). Further, considerable data incongruency has been identified, together with the lack of considering supply side factors, i.e. physical and policy constraints as well as land availability (LPEG, 2016; CPRE, 2015; 2017d). While the Housing White Paper intends to introduce a standardized methodology for calculating OAN (DCLG, 2017a), due to its mere focus on need (without considering reuse potentials and capacity) it is considered likely to evoke decreasing land use efficiency in high demand areas and increased releases of greenbelt land (see e.g. The Planner, 2017a; 2017b).

Hence, current debates revolve around the question whether required housing can be provided for through a more active approach towards redeveloping PDL, or whether the release of greenfield – and greenbelt – land is required to meet these housing targets (RTPI, 2016; TCPA, 2016; The Planner, 2017a; see also comparison of figures on required dwellings and PDL potential in table 9). The question whether there actually is a 'housing crisis' constitutes a much contested field of debate: "[the] level of provision for new housing is frequently an area for debate […], with a not untypical position being that local opinion and often the draft local plan propose a level of provision which is below the level that policy at a national level sees as necessary." (Cullingworth et al., 2015: 52). This is also expressed by Sykes & Shaw's (2017) reflections on the Housing White Paper: While the authors welcome an evidence-based approach to housing in principle, they clearly criticize centralist imposition of targets as opposed to previous government's localism, together with the complex planning system being blamed for a lack of housing provision on the one hand, and the existing gap between the number of planning permissions and actual realisations by developers on the other hand. Similarly, Fischer (2015: 1 f.) states that "it was considered slightly ironic that the current Conservative government considers housing as a key challenge, putting a lot of pressure on local planning authorities in the form of e.g. housing targets, whilst the dramatic changes made to the planning system over recent years by central government appear to have led to a dramatic drop in the actual delivery of those targets".

Green belt policy

The pressure that these developments put on land as a resource also prompts demands for a more strategic, less 'piecemeal' approach towards land (CPRE, 2017a; CPRE 2017b). Here, a broad understanding of land use is demanded, as well as a bundling of land use competences instead of the current fragmentary approach, in order to "no longer treat land as a disposable asset" (CPRE, 2017b: 38; modified by the author). While green belts as a key instrument in English land use planning appear to have contributed to moderate levels of land take and urban sprawl, the question remains whether they have specifically protected high-quality landscape or rather low-quality urban fringe areas, leading Sturzaker & Mell (2016) to discuss a cautious release of green

belt land in exchange for conversion of PDL into inner urban green space. CPRE (2017a) however, emphasizes the function of green belts in providing green space for urban dwellers and argue that green belt land released for development mainly constitutes low density development and does for the most part not contribute to the provision of affordable housing. In that regard they criticize that the 'exceptional circumstances' required for justifying greenbelt land release are increasingly met by high levels of housing demand and urge for a more targeted approach towards housing on brownfield land: "more and more houses are being built on Green Belt when plenty of brownfield land is available, close to jobs and services" (CPRE, 2017a: 2). This is supported by evidence on the amount of greenbelt land proposed for release in local plans (adopted and draft), as depicted in table 7. The 2017 figure almost tripled the amount proposed in 2009, with the number of planning applications for greenbelt land having doubled since 2012 (CPRE, 2017a).

Table 7: Development proposed in Local Plans, and related proposed greenbelt release (CPRE, 2017a: 4)

Date	Houses proposed for land released from the Green Belt	New homes proposed per month
2009 (draft regional plans)	147,000	
August 2012	81,000	
August 2013	150,000	5,750
March 2015	219,000	3,830
March 2016	275,000	4,670
May 2017	425,000	10,710

Land-related policies as part of the NPPF

Given recent research depicting brownfield land availability and suitability for more than 1 million homes (CPRE, 2017a; see also table 8) and at the same time an increasing proportion of development on greenfield and greenbelt land, more targeted policy measures regarding the activation of PDL have been urged (CPRE, 2014; 2017c). The NPPF as replacing previous specific PPG/PPS that used to guide land use planning has been strongly debated, some welcoming the reduction of opposing planning principles, others criticizing "unchecked […] development in the undesignated countryside" (Cullingworth et al., 2015: 100). Whereas the 2012 version of the NPPF put a strong focus on housing supply and the need for local plans to fulfil overarching targets (see also Cullingworth et al., 2015), the revised version published in July 2018 appears to have kept but alleviated this focus to some extent: In general, the NPPF requires " Strategic policies […] [to] provide a clear strategy for bringing sufficient land forward, and at a sufficient rate, to address objectively assessed needs over the plan period, in line with the presumption in favour of sustainable development" (MHCLG, 2018: 9). It puts a focus on the need "to support the Government's objective of significantly boosting the supply of homes", that a "sufficient amount and variety of land […] [is provided] where it is needed" (ibid.: 17), requiring plans to be "informed by a local housing need assessment, conducted using the standard method in national planning guidance" (ibid.: 17). In that regard, it urges for an "effective use of land", with "a clear strategy for accommodating objectively assessed needs, in a way that makes as much use as possible of previously-developed or 'brownfield' land" (ibid.: 35). With respect to SHLAAs, it also explicitly emphasizes the role of "small and medium sized sites [that] can make an important contribution to meeting the housing requirement of an area, and are often built-out relatively quickly. To promote the development of a good mix of sites local planning authorities should:

a) identify, through the development plan and brownfield registers, land to accommodate at least 10% of their housing requirement on sites no larger than one hectare; unless it can be shown, through the preparation of relevant plan policies, that there are strong reasons why this 10% target cannot be achieved;
b) use tools such as area-wide design assessments and Local Development Orders to help bring small and medium sized sites forward;
c) support the development of windfall sites through their policies and decisions – giving great weight to the benefits of using suitable sites within existing settlements for homes; and
d) work with developers to encourage the sub-division of large sites where this could help to speed up the delivery of homes." (ibid.: 18 f.)

Also, "planning policies and decisions should:

a) encourage multiple benefits from both urban and rural land, including through mixed use schemes and taking opportunities to achieve net environmental gains – such as developments that would enable new habitat creation or improve public access to the countryside;
b) recognise that some undeveloped land can perform many functions, such as for wildlife, recreation, flood risk mitigation, cooling/shading, carbon storage or food production;
c) give substantial weight to the value of using suitable brownfield land within settlements for homes and other identified needs, and support appropriate opportunities to remediate despoiled, degraded, derelict, contaminated or unstable land;
d) promote and support the development of under-utilised land and buildings, especially if this would help to meet identified needs for housing where land supply is constrained and available sites could be used more effectively (for example converting space above shops, and building on or above service yards, car parks, lock-ups and railway infrastructure); and
e) support opportunities to use the airspace above existing residential and commercial premises for new homes." (ibid.: 35)

In this regard, it strongly refers to land use efficiency in pointing out that "where there is an existing or anticipated shortage of land for meeting identified housing needs, it is especially important that planning policies and decisions avoid homes being built at low densities, and ensure that developments make optimal use of the potential of each site." (ibid.: 36; cf. focus on inner-urban development in German planning regulations and strategies below). Still, a continuous focus on ensuring housing supply prevails, postulating that "Strategic policies should include a trajectory illustrating the expected rate of housing delivery over the plan period, and all plans should consider whether it is appropriate to set out the anticipated rate of development for specific sites. Local planning authorities should identify and update annually a supply of specific deliverable sites sufficient to provide a minimum of five years' worth of housing against their housing requirement set out in adopted strategic policies […]." (ibid.: 20) This is underpinned by the introduction of a "Housing Delivery Test" scrutinizing whether "delivery of housing was substantially below […] housing requirement over the previous three years." (ibid.: 6; 62). Further, the revised NPPF enables "The designation of land as Local Green Space through local and neighbourhood plans [allowing] communities to identify and protect green areas of particular importance to them." (ibid.: 28). It also underpins the role of Green Belts: "Once established, Green Belt boundaries should only be altered where exceptional circumstances are fully evidenced and justified, through the preparation or updating of plans." (ibid.: 40). Generally, "a local planning authority should regard the construction of new buildings as inappropriate in the Green Belt." (ibid.: 42 f.), however, with a number of exceptional purposes being listed (cf. priority use categories in the undeveloped outer area in Germany, see below).

Beyond these general objectives, the NPPF provides further detail on how Local Authorities are to plan for housing: As a prerequisite for site allocations, OAN as described above is elaborated on through a Strategic Housing Market Assessment (SHMA). Based on that, the Strategic Housing

Land Availability Assessment (SHLAA) is to be prepared focusing on availability, suitability and achievability/viability of land for development. The SHLAA process has been replaced by guidance on Housing and Economic Land Availability Assessment HELAA under the framework of the NPPF (MHCLG, 2014a): Here, the three major assessment aspects are further explained, comprising suitability (determined by plan, policies, market requirements, physical limitations such as access, infrastructure, ground conditions, flood risk, hazardous risks, pollution or contamination; potential impacts referring to landscape features, nature and heritage conservation), availability (no legal or ownership problems) and achievability (essentially economic viability) of land for development. Deliverability is defined as land allocated in the local plan or with planning permission. Thus, SHMAs ascertain housing need, while SHLAAs are to mirror this need and its provision against the existing land potential measured by its three criteria (Cullingworth et al., 2015). Intense debates regarding the methodology underlying OAN/SHMAs (Boddy & Hickman, 2018) have led to requests to take not only the demand-side but also the supply-side (in particular, constraints and availability) into account, and thus to link SHMAs and SHLAAs through impact assessment (CPRE, 2015). The SHLAA approach has been reviewed by a University of Liverpool (2015) study finding that the quality of how these aspects are covered varies strongly. The study also brings up the question whether SHLAAs (as an evidence base document to a Local Plan and related Sustainability Appraisal) need to assess impacts of a proposed site on the environment or should remain restricted to assess impacts of the environmental situation on the proposed development with regard to suitability, finding that comprehensive, good practice SHLAAs combined both approaches.

Conclusively, intensive debates on housing provision, shaped by urges for a comprehensive land policy, the activation of PDL potential and protection of greenfield and especially greenbelt land on the one hand, and for delivering housing targets and arguing for the need to release greenbelt land to a certain extent on the other hand, have significantly spurred the debate on land as a resource in England.

4.2.2 Land Use Patterns and Policy: Germany

4.2.2.1 Land Use Patterns and statistical evidence

As a sub-category of German federal land use statistics (Destatis; UBA, 2017c; SRU, 2016; see figure 28 above), the development of figures on the indicator of land for development and transport purposes (*Siedlungs- und Verkehrsfläche SuV*) are used as a proxy for land take, with the sub-indicator of land for buildings and related open space depicting land take for housing. With the indicator also including building-related open space/residential gardens, it is essential to point out that it is not to be equated with sealed surface, with the proportion of sealed surface in SuV having been estimated at 45-50 %, and related critique referring to its inability to depict land use quality or local land use change (BBSR, 2011; Meinel et al. 2014). German federal land use statistics thus focus on absolute figures of land take and do not include information on the reuse of PDL/brownfield land (Ferber et al., 2016), as opposed to proportionate changes displayed by English LUCS. Given inaccuracies of the SuV indicator in mirroring actual land take, the supplementary use of statistics on building activity, i.e. on permissions and actual completions, has been suggested but could not be realized yet due to data privacy concerns (see Fina, 2013; Meinel, 2017). Against that backdrop, although there has been a reduction in land take in recent years, as illustrated in figure 31, most recent figures display an increase in SuV of 62 ha per day in 2016 and are hence still far from what has been targeted in policies and strategies (Bundesregierung 2002; 2016; EC 2011; see below). Moreover, land use statistics show strongest

increase rates in land for buildings and building-related open space as part of the indicator, mainly at the expense of agricultural land (BBSR, 2011; SRU, 2016). High proportions of recreational space at the same time also need to be attributed to changes in survey methodology in some federal states that has probably led to an overestimation of the increase to some extent (BBSR, 2011; Bock & Preuß, 2011). Spatial differences in land take become apparent by that in relative terms, land take is highest in stagnating or even shrinking, often rural, regions (BBSR, 2011), as illustrated in figure 32.

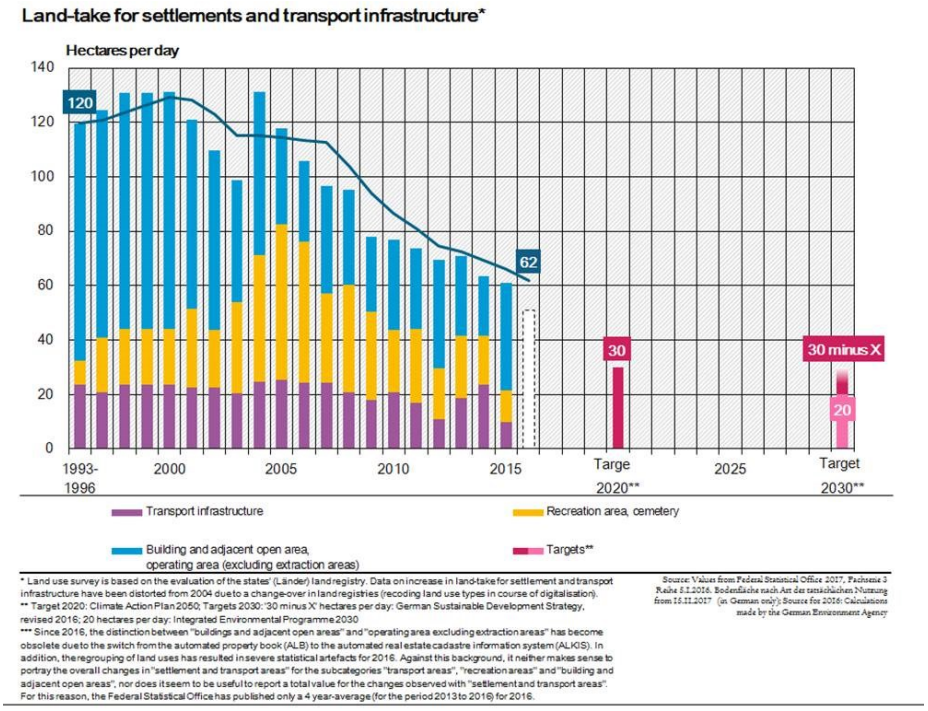


Figure 31: Development of land take in Germany (UBA, 2017c, based on Destatis, 2016; 2017)

This trend is also related to considerable changes in population distribution: After a focus on the effects of demographic change in the early 2000s and an expected significant decrease in additional housing demand at the time (e.g. UBA, 2003), a shift towards increasing in-migration as well as internal migration has developed since 2010, with a particular strong growth of the so-called 'swarm cities' (BBSR, 2015a; GdW, 2017). A high demand is thus postulated for affordable housing in agglomerations and attractive medium-sized cities, while in most rural regions supply tends to be higher than demand (Voigtländer et al., 2017; Deschermaier et al., 2017; SRU, 2016; BBSR, 2015a; 2015b). Generally, however, migration is not regarded as likely to compensate long-term population decrease (SRU, 2016 according to BBSR, 2015b). Annual housing need is projected for 250,000 to 300,000 new dwellings by 2020 (SRU, 2016; BBSR, 2015a). As illustrated in figure 33, residential densities have continuously decreased in recent years. Continuous data on average dwelling densities as displayed for England could not be retrieved for the German case.

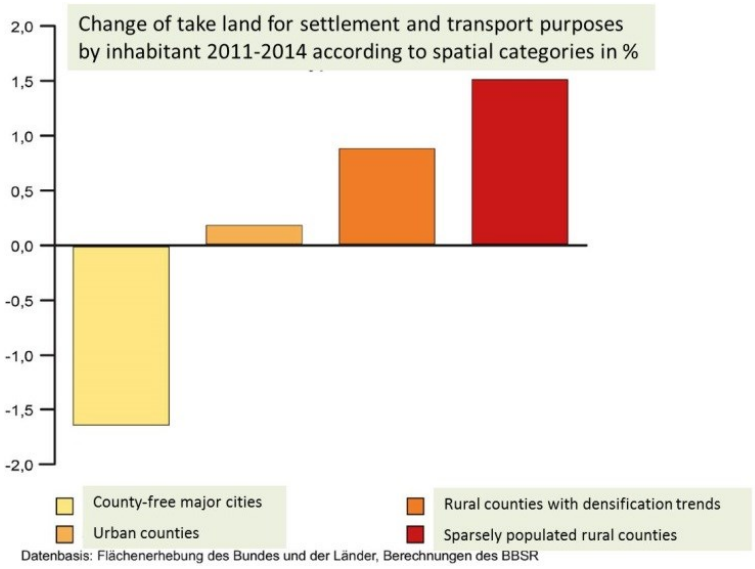


Figure 32: Development of land take for settlement and transport purposes by inhabitant, categorised according to spatial development criteria, 2005-2008 (BBSR, 2016, translation provided by the author)

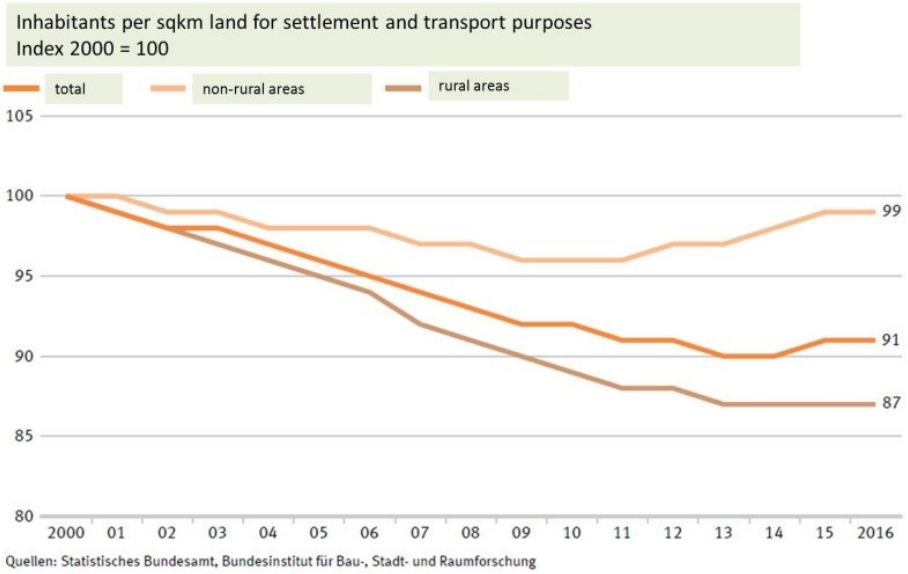


Figure 33: Development of residential density (inhabitants per sqkm land for settlement and transport purposes/SuV) in Germany, 2000-2014 (Destatis, 2018; translation provided by the author)

Against that backdrop, it has been asserted that the potential for reducing land take is particularly large in rural regions, where disproportionate amounts of land take meet with PDL potential that tends to be much higher than in urban areas: According to BBSR (2016), there is an availability of 120,000 ha brownfield and underused lots, i.e. about four times the amount of land taken per year, with land becoming available constantly being higher than the amount being reused (BBSR, 2011). While a comprehensive data set on brownfield potential is not available in Germany, a first nation-wide analysis has been provided by BBSR (2013), identifying an average potential of about 15 m^2 per inhabitant. Other, more detailed databases in Germany have been limited to municipal or state initiatives so far (BfN, 2008; UBA, 2015a; compilation of initiatives: LABO, 2012). Overall data on PDL reuse as presented for England do not exist for Germany.

Based on statistical evidence for both country cases, a compilation of recent data on land use is displayed in table 8. Due to different methodologies of the respective national land use statistics, a direct comparison could not be realized. Nevertheless, setting land take in relation to the amount of developed land for identifying increase rates was applied as a proxy for such a comparative picture. Table 9 summarises existing indicators and available datasets for both case studies, sorted by the four land-related targets and related indicators as introduced in section 3.

Table 8: Land-related parameters and recent figures for the respective national case study contexts (own table)

Land-related parameters and recent figures		
	Germany	**England**
Projected housing demand	230,000-270,000 dwellings per year until 2030 (BBSR, 2015)	300,000 dwellings per year (House of Lords, 2016)
Land take	62 ha/d 0.07 % of total land area developed/a (base data: Destatis, 2017; 2018)	46 ha/d (non-developed to developed use) 0.13 % of total land area developed/a (base data: CPRE, 2018)
Increase in developed land per year (2016-17)	0.7 % (based on Destatis, 2018)	0.9 % (based on LUCS; see also CPRE, 2017b; 2018)
PDL Availability	120,000-165,000 ha (BBSR, 2013) Capacity for up to 6 million dwellings (at 53 dwellings/ha)	70,000 ha; 35,000 ha for housing Capacity for up to 1.8 million dwellings (at 53 dwellings/ha) (NLUD PDL; 2010) 45,000 ha; 22,600 ha for housing, capacity for up to 976,000 dwellings (CPRE, 2014)
PDL Reuse	no data	61 % 2016 (68 % 2011; 81 % 2008) (LUCS, 2017)
Average housing density	11 dwellings/ha (Destatis, 2011)	32 dwellings/ha - On brownfield land: 40 dwellings/ha - On greenbelt land: 21 dwellings/ha (LUCS, 2018)

Table 9: Indicators and available datasets on aspects of land in Germany and England (own table)

Indicators and available datasets		
	Germany	**England**
Reduction Target		
Land Take - **Proportion** - **Increase**	EU Data: Corine Land Cover CLC (conversions into artificial areas; last update 2018) Urban Atlas (satellite images for cities > 100.000 inhab.; last update 2012) Land Use and Coverage Area Frame Survey LUCAS (cover and use of land; point-based, last update 2015) *Sources:* *https://land.copernicus.eu/pan-european/corine-land-cover* *https://land.copernicus.eu/local/urban-atlas/urban-atlas-2012* *https://ec.europa.eu/eurostat/web/lucas* National data: Land use statistics according to actual use (Flächenerhebung nach Art der tatsächlichen Nutzung): Land take for development (Siedlungs- und Verkehrsfläche SuV) (statistical problems with regard to mirroring actual land take) *Source: Destatis, updated annually; + municipal statistics* Statistics on planning applications and dwelling completions (Baugenehmigungen/Baufertigstellungen) (not associated with related area size) *Source: Destatis, updated annually* Local data on dwelling completions (and related area size)	EU Data: Corine Land Cover Urban Atlas LUCAS Survey National data: Land Use Change Statistics LUCS: Land changing to/from developed use (proportional figures) Local Authority Green Belt Statistics *Source: MHCLG, updated annually; + local authority statistics* Statistics on planning applications; Statistics on permanent dwellings started and completed (not associated with related area size) *Source: MHCLG, updated quarterly* Local data on dwelling completions (and related area size)
Soil Sealing - **proportion** - **increase** - **desealing**	EU Data: Copernicus Land Services: High Res Soil Sealing Layer (EEA) - based on CLC 2006 (see above) National data: Data required (partly at local scale, different methodologies)	EU Data: Copernicus Land Services National data: Data required (partly at local scale, different methodologies)

Efficiency Target, (Structural Target)		
Settlement Density **Densification**	EU Data: Land-use intensity per capita (JRC; EEA): estimated artificial surfaces in hectares and artificial surfaces in m^2 per inhabitant National data: Residential Density (Monitoring Report Sustainability Strategy (Destatis)) Building density, floor area density, population density (IÖR Monitor Settlement Analyzer) Dwelling density: Data required Regional/Local data required	EU Data: Land-use intensity per capita (JRC; EEA) National data: Dwelling density (LUCS, MHCLG): dwellings per ha (Housing Land Monitoring at council scale)
Land Demand **Land Development Potential**	Population Projections (Bevölkerungsvorausberechnung) *Source: Destatis, last update 2015* Regional/Local Population Projections Projections of Housing Demand (Wohnungsmarktprognose) *Source: BBSR, last update 2015* Regional/Local Urban Development Plans/Housing Development Concepts etc. (Stadtentwicklungspläne Wohnen, Wohnraumentwicklungskonzepte/-pläne etc.)	Population and Household Projections *Source: ONS, last update 2016* Strategic Housing Market Assessments SHMA Strategic Housing Land Availability Assessments SHLAA
Land Recycling - **Amount of PDL/Brownfield Potential** - **Reuse of PDL /Brownfield Redevelopment** - **Ratio newly-built structures : vacant lots**	PDL/Brownfield Survey (BBSR, 2013) Local PDL/Brownfield Surveys and Databases in many (larger) cities, (partly) data required Data required (partly local data available) To be assessed based on local data on dwelling completions and vacant lots	PDL potential up to 2012 (HCA, National Land Use Database NLUD) Brownfield Land Registers for many (urban) councils (as mandated in the Housing & Planning Act 2016), (partly) data required Development on PDL (LUCS, MHCLG) To be assessed based on local data on dwelling completions and vacant lots
Infrastructural costs	Local data on amount of infrastructure required for development Calculation Tool for follow-up costs of development-related infrastructure (Folgekostenrechner; e.g. www.was-kostet-mein-baugebiet.de)	Local data on amount of infrastructure required for development
Locational integration, infrastructural accessibility	Local data: Distance to infrastructural amenities/location within catchment area of transport infrastructure	

Protection Target		
Land take - **on soils with high productive capacity** - **on soils with high buffer/filter capacity** - **in designated protected sites** - **in valuable landscapes**	EU Data: European Soil Data Centre ESDAC - EU-wide map viewer with soil property data Source: https://esdac.jrc.ec.europa.eu/	EU Data: European Soil Data Centre ESDAC
Proportion of open/green space on land for development	National Data: Sector-specific data (Geodatabases at state level, local authority data)	National Data: Sector-specific data (esp. Magic Map, DEFRA)

4.2.2.2 Review of Instruments for attaining resource efficient land use

Land-related objectives

As already mentioned above, a key role with regard to achieving a reduction of land take in Germany is attributed to the reduction target for land take, based on the Sustainable Development Strategy issued in 2002 and updated in 2016. Whereas in 2002, a target of a maximum of 30 ha land take (i.e. conversion to SuV) per day by 2020 was postulated, this has been postponed to 2030 and complemented by an undefined further reduction "minus x" by the 2016 revised strategy (Bundesregierung, 2002; 2016). This target has also been taken up by the German Biodiversity Strategy (BMU, 2007) and has been further complemented by a proportional target on land recycling, aiming at a ratio of brownfield/PDL and greenfield development of 3:1 (BMU, 2007; Hinzen & Preuß, 2011). In the wake of the 2016 update of the German Sustainability Strategy, two additional monitoring indicators (residential density and loss of open space) have been realised. Rather surprisingly, the monitoring report (Destatis, 2018), as opposed to the progress report 2008 that marked land take as 'red', i.e. running contrary to the target (Bock & Preuß, 2011), now marks the indicator as 'sun', given that the target has been shifted to a later point in time, and despite still exceeding the target value by more than double the amount.

Despite the 30 ha target being a politically defined and not a scientifically justified target, it has been judged as having contributed to problem awareness for negative consequences of land take (SRU, 2016). However, and as repeatedly stated by the LABO (*Bund-/Länder-Arbeitsgemeinschaft Bodenschutz;* federal/state cooperative working group on soil protection) reports (LABO, 2010; 2012), major deficits have been attributed to a lack of consistency in implementing the existing set of instruments, but also to the existence of drivers for continuous land take that cannot be influenced by these instruments (Wunder et al., 2014). Against that backdrop, more ambitious reduction targets have been demanded (e.g. Bundesrat, 2011; BMVBS & BBR, 2007; BMUB, 2016b). For instance, the integrated programme of the Federal Ministry for the Environment (BMUB, 2016b) formulates targets that reach well beyond the one of the Sustainability Strategy, i.e. a maximum of 20 ha by 2030 and of 0 ha by 2050. Also, UBA (2003) already suggested additional quantitative targets, including on desealing (such as a 5 % desealing rate for unused sites in the external area and a 1:1 compensation of new sealing by desealing), on biotope space (minimum 10 % of overall land area) as well as on land take by roads (e.g. reduction of sealed road space to a particular state or reduction of road width for newly-built roads by 5 % with regard to current standards).

Nevertheless, the 30 ha target has functioned as a key basis for strategies and instruments developed with regard to the reduction of land take, particularly as part of related research and model projects in planning (UBA, 2018a; Bock et al., 2011; Preuß & Ferber, 2008). A current initiative consists in the action plan land (*Aktionsplan Fläche*), aiming to intensify the political debate on instruments for reducing land take and for re-discussing instruments that could not be agreed upon so far (Bundestag, 2015; UBA, 2018a). These objectives are also part of the federal resource efficiency strategy ProgRess (BMU, 2012; UBA, 2013). Given that both EU law and German environmental law lack systematic regulations on resource protection, its integration into sectoral legislation as well as options for separate legislation on resource protection are being examined (UBA, 2013; UBA, 2017b). Of particular interest for the problem field of land would be the possibility to include quantitative targets on resource protection in a legally binding way (UBA, 2013: 10 f.).

Land-related substantial requirements in planning law

Beyond the reduction of land take, land recycling constitutes a key strategy for fostering resource efficient land use, with a double strategy being pursued against the backdrop of targets mentioned above (UBA, 2015a; EC, 2012; Mitschang, 2013). Land recycling in Germany has been largely framed by the principle of inner-urban development (*Leitbild der Innenentwicklung*) and has been anchored in spatial planning law, in particular in the Federal Building Code BauGB. Here, § 1a BauGB includes the requirement to consider brownfield potential before additional greenfield sites are allocated for development. However, this requirement remains subject to the weighting procedure as part of decision-making. A need for databases on reuse potential and a more concise and obligatory justification for greenfield development have repeatedly been demanded (BBSR, 2011; BBSR, 2013; BBSR, 2016).

In that regard, inner-urban development does not only have a quantitative but also a qualitative dimension that has been emphasized with regard to the concept of dual inner urban development (*doppelte Innenentwicklung*), urging the need to consider green space provision (recreational function, regulatory function, in particular with regard to effects of climate change) as well as immission control (quality of residential surroundings) alongside land use efficiency (Mitschang, 2013; Schwarz, 2015; Gruehn, 2016). Land use conflicts between housing and green space that have also been described for England with regard to the biodiversity value of PDL sites above have increasingly been described as a yet unsolved challenge (BfN, 2015; Ferber et al., 2016). Further attention for this concept as a key challenge of planning has been raised by the federal Weißbuch process 'Green space in cities' (BMUB, 2017*).*

A plethora of land-related instruments little surprisingly belongs to the field of comprehensive spatial planning at the different scales involved in the German planning system: A universal principle is defined in § 1 Abs. 2 S. 1 ROG (federal spatial planning law), aiming at "sustainable spatial development that balances social and economic demands of space with its ecological functions". § 2 ROG includes several principles (*Grundsätze*) as aspects subject to weighting, referring to the spatial concentration of housing, the protection of open space, the prevention of fragmentation and the reduction of consumption of open space for development purposes through reuse of sites and densification (Spannowsky, 2013; BfN, 2015). However, since only objectives (*Ziele*) are binding, quantitative targets with a corresponding need for justification of the plan's contribution have been deemed desirable (BfN, 2008; EC, 2012; LABO, 2012), with legal expert opinions having confirmed their feasibility (UBA, 2015a). Based on the ROG, spatial development plans at state level typically dispose of varying combinations of binding objectives and principles of spatial planning, designating central places (*Zentrale Orte*) and development axes, and, though in only few cases, defining minimum densities with different degrees of obligation (Spannowsky, 2013; Pahl-Weber & Henckel, 2008). Below the state level, regional plans serve to strategically guide regional development and coordinate spatially relevant sectoral planning (BMVBS, 2012; Pahl-Weber & Henckel, 2008). According to § 8 ROG, designations of binding character for subsequent planning scales are possible but have rarely been implemented (Bock, 2011). Rather, negative-restrictive regulations are predominantly applied, broadly comparable to the role of greenbelts in the UK (EC, 2012). Binding positive-allocative regulations of housing sites (*Vorranggebiete*) remain the exception, as do quantitatively defined reduction and efficiency (density) targets (Bock, 2011; Hinzen & Preuß, 2011; BMVBS & BBR, 2009). Several starting points are thus suggested for future adjustments, including a standardized provision of evidence for housing demand as well as the introduction of quotas for land take and minimum

densities that cannot be overridden by weighting decisions, while the latter have been discussed controversially (see LABO, 2012; SRU, 2016).

At the municipal scale, BauGB and BauNVO contain key regulations with regard to resource efficient land use (Pahl-Weber & Henckel, 2008): General objectives (*Zielsetzungen*) are formulated by § 1 Abs. 5 BauGB, and concretised by planning principles (*Grundsätze*) in § 1 Abs. 6 BauGB. In particular, § 1 Abs. 5 S. 3 defines „urban development primarily [to be realised] via inner-urban development and reuse of sites" (translated by the author), however, as an aspect subject to weighting and not as an overriding interest (Schwarz, 2015). A key role is exerted by the soil protection clause (*Bodenschutzklausel*) and the clause on preventing re-designations (*Umwidmungssperrklausel*). The soil protection clause in § 1a Abs. 2 S. 1 BauGB formulates an economical and resource-protecting way of dealing with land, i.e. a reduction of the first-time consumption of unsealed soil, an avoidance of soil sealing as well as the smallest possible impact on natural soil functions (Schwarz, 2015; Mitschang, 2015a). The clause on preventing re-designations in § 1a Abs. 2 S. 2 and 4 BauGB defines that agricultural, forest and housing sites are only to be re-designated to a necessary extent and also includes an obligation for identifying existing brownfield potentials. However, there is no specific method defined for that, and while it is described as possessing ‚extra weight', it does not exert effect as an overriding interest in weighting (Schwarz, 2015; Mitschang, 2013; 2015a). Considering the key differentiation between internal areas/existing built-up areas (§ 34 BauGB) and external, undeveloped areas (§ 35 BauGB), a general abolition of privileged development according to § 35 I 4 has been suggested (LABO, 2012) in order to make all development foreseen on undeveloped sites subject to case-specific scrutiny. With regard to impact mitigation regulations defined by nature protection law (BNatSchG), § 1a Abs. 3 BauGB (Spannowsky, 2013; Schwarz, 2015; Mitschang, 2015a; Jacoby, 2016) limits the consumption of agricultural and forest sites for compensation measures and thus to some extent prevents double land take through development and compensation measures (Mitschang, 2013; Schwarz, 2015; Busse et al., 2013). This is, however, limited to development sites in the external undeveloped area that require compensation, while for others compensation on valuable soils is still possible (Mitschang, 2015a).

Designations of the comprehensive land use plan have been described as „being not sufficiently legally assertive" (Mitschang, 2013: 328; translation by the author), together with its non-applicability to sites according to § 34 BauGB, and the general problem of parallel procedures being used as standard option instead of regular plan revisions (Mitschang, 2013). With regard to the binding land use plan, BauNVO categories defining the category and intensity of built use (*Art und Maß der baulichen Nutzung*)) including permitted densities have been criticized for being insufficient for requirements of inner-urban development (Pahl-Weber & Henckel, 2008, see also discussion in section 8). A sub-type of binding land use plans of key relevance for resource efficient land use consists in the binding land use plan of inner-urban development (B-*Plan der Innenentwicklung*) that has been introduced through § 13a BauGB in 2007 (Mitschang, 2013; Spannowsky 2013): Being subject to the accelerated procedure, these plans do not need to be derived from the FNP and are not regularly subject to EA. While this instrument has been described as "the most important planning instrument for realizing inner-urban development in municipal land use planning" (Schwarz, 2015: 79; translation by the author), its compliance with EU law, i.e. the competence of national legislature to exempt these plans from EA obligation, has been contested (Jacoby, 2016; LABO, 2012). At the same time, it has been found that often the standard procedure including EA has been conducted in order to systematically compile potential environmental impacts (Schwarz, 2015). Further changes to municipal land use planning have

been implied by the most recent 2017 BauGB revision: Of particular relevance is the introduction of the site category 'Urban Areas' into the BauNVO, allowing for higher densities in central locations (see critical discussion in section 8). A further element is the introduction of the critically debated § 13b, extending the accelerated procedure without EA to particular sites not exceeding 10,000 m^2 in size at the urban fringe, i.e. in the external area. Although this regulation is only of a temporary character until 2019, criticism refers to it weakening the role of EA for additional land take and potentially evoking an accelerating effect on additional site allocations (Jacoby, 2016).

A specific characteristic of the German planning system consists in the instrument of landscape planning as defined by § 9 BNatSchG (Gruehn, 2016). 'Landscape' according to the German understanding of '*Landschaft*' in this context refers to the biophysical environment, as opposed to the English understanding of 'landscape' mostly referring to its visual perception (Hanusch & Fischer, 2011). In providing information/data on environmental impacts of locational decisions and defining nature protection requirements (also with respect to regulations of European law), landscape plans potentially contribute significantly to the overarching objective of resource efficient land use (Spannowsky, 2013; BfN, 2015; Gruehn, 2016). Impact mitigation regulations include the possibility of establishing so-called ecological accounts and pools of sites (BfN, 2015; Breuer, 2016; Wende et al., 2018b). Key shortcomings, however, comprise a lack of obligatory documentation of how the priority of avoidance has been assessed instead of reliance on compensation measures, and of prevalent monetary compensation instead of site-related compensation (Breuer, 2016). A key problem also relates to additional land demand evoked by compensation measures (EC, 2012, see above), and an underrepresented use of desealing as a compensation measure (BfN, 2008; SRU, 2016; LABO, 2010; UBA, 2003).

Other land-related features of the regulatory and instrumental setting

With regard to economic conditions and tax mechanisms, the German land or property tax (*Grundsteuer*), after having been discussed and deemed in need of reform for years (e.g. LABO, 2012; UBA, 2003), has been ruled as unconstitutional in its current form in 2018 (Bundesverfassungsgericht, 2018). UBA (2018a) suggests its framing as a soil value tax (*Bodenwertsteuer*), i.e. to measure tax rates only on grounds of site size and standard land value, and not on grounds of existing buildings as has been the case to date. This is regarded as to some extent being able to resolve the current problem that an abandonment of brownfield land is financially unproblematic (UBA, 2015a; SRU, 2016). Further, the introduction of levies on the increase in property value after development, i.e. on private profits gained from the value of land, have been considered (EEA, 2016b; see also CPRE, 2017d for England).

An economic instrument that is directly linked to the 30 ha target and related quotas discussed above is a trading mechanism for land certificates (UBA, 2012; UBA, 2015a). A number of local and regional campaigns and guidance on activating brownfield and vacant buildings, on connecting stakeholders and on identifying (follow-up) costs related to land take have been conducted in order to raise awareness for problems and for testing instruments (e.g. Bock et al., 2011; BMVBS, 2012; LABO, 2012). Also, inner-urban development concepts have been developed as a basis for municipal land use planning, however, rarely in those cases where stagnating or shrinking population figures mean that there is no pressure for reusing developed sites and buildings perceived (Mitschang, 2013; Schwarz, 2015; BfN, 2015).

Conclusively, a three-fold strategy has been suggested (Bock & Preuß, 2018), comprising the reduction of land take, the activation of the existing building stock and increasing land use

efficiency, arguing that necessary instruments are available but key lies in their concise use through concrete targets. These aspects will be taken up on in section 8 with regard to an assessment approach for land. A summary of land-related objectives and targets for both case study contexts is provided in table 10.

Table 10: Relevant Objectives and Targets with regard to land as an environmental factor (own table)

Relevant Objectives and Targets with regard to land as an environmental factor (housing sector; not considering land-related objectives/targets from other sectors) as a basis for assessment indicators and standards	
EU	
Reduction target No net land take Reduced soil sealing	
Efficiency target + structural target Brownfield regeneration Reduced land fragmentation	
Protection target Reduced land degradation Green infrastructure provision	
(Roadmap to a Resource Efficient Europe, 7th EAP, Soil Thematic Strategy, Biodiversity Strategy, Communication on Green Infrastructure)	
Germany	**England** *(no legally codified substantive standards (common law)); NPPF constitutes planning guidance (treated as quasi-legal document in EA)*
Reduction target 30 ha target (maximum land take of 30 ha minus x per day by 2030) § 1 (2) ROG (sustainable spatial development) § 2 (2) + (6) ROG (reduction of land take, also through quantitative quotas; brownfield regeneration) § 1a (2) 1 BauGB (soil protection clause) § 1a (2) 2+4 BauGB (clause on preventing re-designations)	**Reduction target** Provide sufficient land for development – OAN, Housing Delivery Test Protection of green belts
Efficiency target + structural target Ratio brownfield greenfield development 3:1 Targets on minimum densities partly at state/regional scale § 1 (5) 3 BauGB (priority of brownfield reuse) § 34 BauGB (integration into existing urban fabric) §§ 177, 179 BauGB (option for regeneration and demolition requirements)	**Efficiency target + structural target** Effective use of land, use PDL "as much as possible" Avoid homes being built at low densities 10% of housing requirement to be realised on sites no larger than one hectare Support the development of under-utilised land and buildings Option for local targets on brownfield reuse and density Accessibility *Previous targets on brownfield reuse and minimum densities (PPG 3) abolished*
Protection target § 1a (3) BauGB (compensation regulations) § 35 BauGB (protection of non-built up, external areas) Sectoral regulations (esp. BNatSchG)	**Protection target** Preference for land of lesser environmental and productive value Protection of green belts Sectoral regulations (esp. on designated sites such as AONBs, SSSIs)
(Sustainability Strategy 2002/2016, Biodiversity Strategy 2007)	*(NPPF)*

4.2.3 The role of SEA: England

4.2.3.1 Regulatory Setting

In England, the instrument of Sustainability Appraisal had already been introduced in 1990, first referring to policy appraisal, and in the following also to local and regional development plans

(Dalal-Clayton & Sadler, 2005; DCLG, 2010; Hayes, 2013). As a starting point for EA at a local level, the 1992 PPG 12 is regarded, leading to some local authorities carrying out 'environmental appraisals' for development plans based on the Town and Country Planning Act 1990 (Fischer, 2007; Ganser, 2005; Dalal-Clayton & Sadler, 2005). These initial appraisals, however, still lacked a number of key elements of SEA, such as the consideration of alternatives and rather constituted 'tick-box' exercises (Fischer, 2007; Therivel, 1998, in Dalal-Clayton & Sadler, 2005; Therivel & Fischer, 2012). Driven by the statutory requirement for Sustainability Appraisal for Regional Planning Guidance from 2000 on, while SA for development plans remained discretionary at the time, the assessment process developed from a baseline-led approach further towards an objectives-led process, the assessment of alternatives however still representing an adverse element in the early years of implementing the SEA Directive (Fischer, 2007; DCLG, 2010).

For England, the SEA Directive has been explicitly transposed through the introduction of the Environmental Assessment of Plans and Programmes Regulations 2004 (Cullingworth et al., 2015; DCLG, 2010), requiring practitioners to "merge [the] objectives-led SA with the baseline-led and EIA derived SEA Directive" (Hayes, 2013: 108), initially described as an 'uneasy compromise' (Jackson & Illsley, 2007, in DCLG, 2010: 38). Criticism in this regard has also been formulated in that this approach might lead to an underestimation of environmental impacts, in that SA focuses on assessing whether "the plan 'minimises' its own impacts rather than 'reduces' total environmental impacts" (Therivel & Fischer, 2012: 19). SEA alone can also be required in cases where statutory SA does not apply, such as when Neighbourhood Plans could have significant environmental effects (MHCLG, 2014b). Information on how to implement the SEA Directive is provided by the ODPM (2005a) Practical Guide to the SEA Directive (Fischer, 2007), while earlier guidance (a.o. specifically for land use and spatial plans: ODPM, 2005b) has been archived in the wake of planning reforms. The Institute of Environmental Management and Assessment IEMA functions as the leading professional organization for EA in the UK, including the EIA Quality Mark and regular reviews of environmental reports (Fischer et al., 2015a; Fischer & Fothergill, 2015).

4.2.3.2 Strengths/Weaknesses, and the role of land

As a background for empirical research and for interpreting its findings, in the following key contributions on the development of SA/SEA in England are to be briefly reviewed: An evaluation of SA for local spatial plans (Fischer, 2010) reveals shortcomings with regard to the identification and assessment of options, and to a lack of focus on relevant baseline data, to monitoring and the explanation of uncertainties (similarly, Fischer, 2007; DCLG, 2010). However, in that local authorities are expected to realise housing targets imposed by national government, the consideration of alternatives can only be tackled to a limited extent at the local level (see Fischer, 2007, and discussion above). Against that backdrop, raised screening thresholds for EIA with regard to the size of sites to be assessed have been discussed with regard to government intents towards deregulation (e.g. Fischer et al., 2016). Constant changes to the planning system have been identified as negatively impacting SEA and inhibiting the 'learning curve' (DCLG, 2010; Jha-Thakur & Fischer, 2016: 23; Fischer et al., 2015). However, it is also claimed that learning effects occurring through EA are often "underrated" and should thus be made more prominent (Jha-Thakur & Fischer, 2016: 26).

In this regard, criticism of SA/SEA by the central government-installed Local Plans Expert Group LPEG needs to be mentioned: Against the background of significant delays to issuing Local Plans, reductions in the evidence base, with the introduction of "a simple Sustainability Statement […] to meet the legal requirement for Sustainability Appraisal – thereby dramatically reducing the

burden of one of the most time consuming aspects of plan making" (LPEG 2016: 5) are suggested. Based on the argument that "planning officers […] told us that SA tended to be 'self-serving', capable of being adapted to any outcome and often of little genuine assistance to decision making" (LPEG 2016: 35), the potential for screening out SEA and an audit against requirements of NPPF instead are deemed sufficient. Being particularly critical of those LPEG statements "unsubstantiated by evidence" (Davis et al. 2016: 2; for challenges to EA in the context of post-factual claims see also Fischer, 2017a), this has been responded to by a team of SEA professionals: While a less bureaucratic approach to SEA, enhancing its ability to "improve plan making […] and contribute to sustainable development" (ibid., modified by the author) is explicitly welcomed, it is pointed out that "'SA/SEA is a convenient scapegoat', with many of the problems for which LPEG criticizes SA/SEA actually being problems of the planning system" (ibid.: 3). Suggestions for improving the efficiency of SA/SEA therefore refer to transparent definitions of significance/thresholds that make assessment less open to subjective interpretation. Furthermore, it is suggested to introduce a requirement for planners to respond to SA/SEA to go beyond it to be "taken into account", and to update guidance based on the changed planning system.

With regard to changes arising from the revised directive, Fischer et al. (2016: 109) state that land has been "not routinely considered" albeit to some extent in current practice. Considerable changes are thus deemed necessary "which we believe is already reflected at least to some extent in the planning process's preference for brownfield development, although this is not necessarily documented in EIA reports" (ibid.: 110). Also, it is worth mentioning that a stronger role of SA in site allocation has been suggested, connected with pleas for a stronger focus on spatial evidence, and the potential to compare spatial entities with regard to e.g. deliverable housing land, green space availability etc. (DCLG, 2010; Jha-Thakur & Fischer, 2016). On the other hand, however, such a change to assessment practice, more resembling the German topic-based approach, has also been warned as potentially inhibiting integrated appraisals (Therivel & Fischer, 2012).

Finally, and despite ongoing lack of clarity about potential consequences, the 2016 UK 'Brexit' vote on leaving the EU is to be briefly considered with regard to possible implications for SEA/SA: While it remains subject to a potential EU-UK agreement which environmental law will remain in place in the UK (Fischer et al., 2018), it is neither assumed that 'Brexit' will lead to "a total withdrawal from existing regulations […] nor [that] business as usual" will continue (Fischer et al., 2016: 106). Against that background, three possible scenarios are depicted (Bond et al., 2016), ranging from EEA membership ('Norway model'), including the requirement to cooperate on environmental matters and thus compliance with EIA and SEA Directives, EFTA (but not EEA) membership ('Swiss model'), not including requirement for EIA/SEA compliance, and a separate trade agreement UK-EU that could evoke stipulations regarding EIA/SEA, since EIA had originally been adopted based on the argument of a functioning common market. Also and despite government attempts towards 'streamlining' and lowering thresholds, since EIA and SEA are "primarily derived from EU Directives" (Bond et al., 2016: 1) but also related to international treaties such as UNECE Espoo and the Aarhus Conventions that the UK has ratified as an independent state, SEA will not completely vanish as a result of 'Brexit' (Fischer et al., 2018). With the 2018 'Brexit deal' proposal (heavily debated at the time of writing) having been analysed with regard to environmental aspects, Moore (2019) asserts that "In fact, the UK's non-regression commitments under the backstop are more extensive than those covered by the European Economic Area (EEA) Agreement with Norway".

4.2.4 The role of SEA: Germany

4.2.4.1 Regulatory Setting

In Germany, assessment procedures resembling SEA to some extent had already been carried out for spatial/land use and transport plans before the introduction of the SEA Directive. In particular, Landscape Plans already met a significant number of requirements formulated by the SEA Directive, with the exception of systematically considering alternatives (Fischer, 2002; in Dalal-Clayton & Sadler, 2005). While first initiatives for EIA in the early 1970s had met with considerable opposition, the EIA Act (*UVPG*) was finally enacted in 1990 in the wake of the EU Directive 1985 (Scholles, 1997). The list of environmental factors on which assessment is to be based is procedurally included in legislation whereas material assessment standards are to be derived from relevant sectoral legislation (Gassner et al., 2010). The Act to Accommodate EU Requirements within Federal Construction Law (EAG Bau) was subsequently issued in 2004, making SEA obligatory for most comprehensive spatial plans according to ROG and BauGB (Fischer, 2007; Gassner et al., 2010).

4.2.4.2 Strengths/Weaknesses, and the role of land

Key strengths that have been attributed to the mainly baseline-led German EA system include an area wide application of SEA as part of land use planning at different scales as well as sector-specific guidance available by ministries and environment agencies. Beyond general aspects identified in section 3 (such as deficits with regard to the consideration of alternatives), key weaknesses have been described with regard to the complicated planning system and a weak consideration of uncertainties (Fischer, 2007) as well as for the accessibility of EA documents (Odparlik et al., 2012).

The German case reveals a comparably extensive debate on the implications of 'land' as a new environmental factor in EA: Already about a decade ago and in the early phase of SEA implementation, Ziekow (2009) and Storch & Schmidt (2008) discussed the operationalization of the objective of reduced land take for assessment, the latter focusing on indicators for land use efficiency (residential density, accessibility, land recycling) in particular. With the legislative framework for land having been changed through the revised directive, Wende (2016) makes clear that it not only refers to EIA but also to plans subject to EA in municipal land use planning as regulated by the BauGB. However, with supra-municipal land use plans in principle being covered by the SEA Directive that has not (yet) been changed, a harmonised procedure is expected for transposing both EIA and SEA Directive (see also Balla & Peters, 2015). An advisory legal opinion on changes arising for EA for municipal land use planning has been provided by Battis et al. (2015). Here, the authors refer to Sangenstedt (2014) who terms the integration of land a "welcomed clarification" (translation by the author) but holds the view that land take has already been subject to assessment according to existing regulations, similar to Bunge (2014) who speaks of a "novelty" on the one hand while stating that this has already been included in a wide interpretation of the environmental factor soil. They conclude that there is no need for revisions to the Federal Building Code (BauGB) in this regard (see also Mitschang, 2016; 2018), due to the coverage of resource efficient land use by § 1a Abs. 2 and Abs. 3 S. 5 BauGB already exceeding requirements of the EIA Directive (Mitschang, 2015b). Still, however, the inclusion of land in § 1 Abs. 6 BauGB is suggested in order to ensure implementation of European law.

Beyond legal aspects, the operationalization of land for assessment practice remains a key question. A number of authors clearly demand changes with regard to considering aspects of land, underlined by findings of a simulation game that reveal a lack of thresholds as a key problem for

assessing land in a meaningful way (UBA, 2018c): Balla & Peters (2015) outline what they regard as potential assessment aspects, including the need to explicitly consider the reduction of land take. Paluch & Werk (2014) provide some more detail on what this consideration should cover, highlighting the integration of the actual objective need for additional land take, of options for minimizing soil sealing in the wake of developments, and of analyzing options of land recycling. Moreover, they point to the need to assess the impacts of land take not only in situ but also in evoking indirect effects elsewhere. In the context of resource protection, the potential of EA has been scrutinized by Kuhlmann et al. (2014) as well as Alsleben (2015), emphasising the need to develop reference values and thresholds for assessment, and asking for a clear distinction between the factor soil, with its qualitative dimensions, and the new factor land, with a quantitative dimension. They explicitly point to the option of deriving reference values and thresholds from political targets mentioned, in particular the German 30 ha-target and the EU net zero target. Alsleben (2015) adds to this the quest for framing land not only as land take but also as land use efficiency, consistency of land use (i.e. reversibility/changeability) and sufficiency (i.e. questions of actual demand), and also hints to options of assessing conflicts between different land use demands. This is further supported by Hartlik (2014), Wende (2016) and the 'Paderborn Declaration' (UVP-Gesellschaft, 2015) who argue for differentiating between land and soil, with the latter covering soil quality (organic substance), soil compaction and sealing, whereas land is mainly attributed to introducing thresholds for additional land take. That this goes along with considerable methodological challenges for practitioners in developing a comprehensive and manageable way of assessing land in EA is pointed out by Wende et al. (2014). Jacoby (2016), against the background of the contradictory § 13b BauGB, emphasizes EA as a chance to contribute to qualified regional and local land use planning, linking housing demand with land use efficiency and environmental interests.

Table 11 provides an overview of major land use sectors and related decision competencies for both case studies.

Table 11: Key decision competencies according to land use sectors (own table; based on Pahl-Weber & Henckel, 2008; CPRE, 2017b)

	Key decision competencies according to land use sectors								
	Housing, commercial development, public services/social infrastructure	Transport and waterways, coastal protection	Nature protection	Forestry	Agriculture	Water supply	Energy supply	(Raw) Material supply and disposal; mining	Heritage
Germany	State development planning Regional planning Municipal land use planning (municipalities, partly planning associations) Planning Departments and Local Authorities	State development planning Regional planning Municipal land use planning Road authorities Federal Rail authority Water and waterway authorities	Landscape planning State development planning Regional planning Municipal land use planning Environmental and nature protection authorities	State development planning Regional planning Forestry authorities	CAP State development planning Regional planning Land consolidation authorities Agricultural authorities Farmers	State development planning Regional planning Municipal land use planning Water authorities and regional water boards	State development planning Regional planning Landscape planning (renewable energy) Grid Authority and operators	State development planning Regional planning Mining authorities Environmental authorities	State development planning Regional planning Heritage authorities
	+ major landowners (defence, foundations, churches etc.)								
England	Planning Inspectorate Homes and Communities Agency (Regional Planning Initiatives) Local Authorities	National Infrastructure Commission Highways England Network Rail Canal and River Trust Environment Agency (Reg. Planning Initiatives) Local Authorities	Natural England Environment Agency (Reg. Planning Initiatives) Local Authorities	Woodland Trust Forestry Commission	CAP Environment Agency Farmers	Water Services Regulation Authority Water companies Local drainage boards	National Grid UK and grid operators Oil and Gas Authorities	Coal Authority Environmental Authorities Waste Disposal Authorities	English Heritage (Reg. Planning Initiatives) Local Authorities
	+ major landowners (defence, National Trust etc.)								

4.3 Key Case Study Cities

Whereas most (comparative) studies on the two key case study cities have focused on urban regeneration processes, Couch et al. (2005) have explicitly analysed land use patterns in the former context of decline. For Liverpool/Merseyside, the study reveals that a large amount of PDL, together with weak housing demand due to population loss, led to strong protection of the green belt and one of the highest rates of development on PDL at the time across England. For Leipzig, however, 'postponed suburbanization' after German reunification and a less active role of federal government in imposing land use policies initially led to strong suburban sprawl in the 1990s, coupled with inner city decline and decreasing population density (see also Hall & Mace, 2004 for a comparative analysis of Leipzig and Manchester), followed by a more recent shift on refurbishing the housing stock and PDL reuse, however. Meanwhile, and especially in Leipzig, conditions as stated by Couch et al. (2005: 133) "declining cities like Liverpool and Leipzig should not anticipate a return to their former importance and place in the urban hierarchy. […] Hence, urban policy making and planning will have to concentrate on the organization of shrinking and redevelopment", have changed enormously and since their study has been conducted in the early 2000s, with neither Leipzig nor Liverpool being in decline any longer but rather displaying significant growth rates (see figures below).

4.3.1 Liverpool

Liverpool is a major city in the North West of England, ranking seven among UK cities. Besides Manchester, the region is one of the two major conurbations in the North West. In administrative terms, Liverpool as a district is part of Merseyside Metropolitan County which comprises of two traditional counties, Lancashire and Cheshire. With about 453,000 inhabitants in 2007 and 491,000 inhabitants in 2017 (Liverpool City Council, 2018a), Liverpool is of a broadly similar size category as Leipzig, having featured a growth rate of more than 8 % within ten years (ibid.), with projections postulating a further growth towards 533,000 inhabitants by 2030 (Liverpool City Council, 2018b).

After functioning as one of the major port cities of the UK throughout the 19th and early 20th century and developing as the "second city of the British Empire" (Rink et al., 2012: 168), Liverpool's economic base deteriorated enormously with the decline in industrial manufacturing due to international competition, relocations and the large-scale development of container shipping from the late 1960s on, leading to a decline of the population of more than 40 % (Couch, 2003; Couch et al., 2005). This resulted in an abandonment and decline of considerable parts of the city's housing stock, as well as to a large amount of brownfield land, with large-scale housing estates being developed at the city's periphery in post-war years, resulting in further population loss through suburbanization (Rink et al., 2012). From the late 1970s, with change in central government, the Merseyside Development Corporation was installed as a central government agency, focusing on facilitating economic development through easy access to land resources, with relatively little influence of the local authority. Whereas through that agency, the regeneration of the Liverpool dockland area was realized, it has also been criticized for not considering long-term strategies for other sites (Couch, 2003). An active focus on regeneration through developing both the service sector as well as tourism from the 1990s on has evoked a stabilization and recent growth of the city's population. However, a generally strong focus on private investment prevails, with a weak bargaining position of the public sector being observed, even more pronounced in areas outside of the inner urban centre (Couch, 2003; Rink et al., 2012).

Consequently, recent years have been characterised by reurbanisation tendencies and a growing trend in population figures, albeit not comparable to growth rates projected for Leipzig (see below). This trend reversal has been found to be based on a number of factors (Rink et al., 2012), including European and national public funds dedicated to economic recovery and diversification (Couch, 2003), a major expansion of tertiary education and research at Liverpool's universities as well as a growth focus on IT and biosciences. Also, (now largely abolished) planning mechanisms aiming at restricting urban sprawl are regarded as a factor that has supported urban redevelopment. This is particularly assigned to quantitative targets on PDL reuse and minimum densities mentioned above, and to the introduction of a green belt as well as of neighbourhood renewal programmes. Additionally, the (former) Regional Spatial Strategy is regarded as significant in formulating housing targets that shifted the focus of development to the Merseyside-Greater Manchester corridor. A future continuation of this growth trend, however, is regarded as uncertain due to an austerity-related loss of public funding (Rink et al., 2012) as well as with regard to 'Brexit'-related uncertainties about migration, relocations of companies, and a potential cessation of European funding.

Couch & Karecha (2006) have specifically identified a high efficiency of land use in the Liverpool region: While these findings need to be considered against the different planning policy framework in the early 2000s, they revealed a significant gain of green belt land in the North West

Region, a ratio of new dwellings on PDL for Liverpool of more than 90% (for North West England in total of 70%), and a density of dwellings built per hectare of 44 dph, as compared to an average of 29 dph for North West England. Similarly, Rink et al. (2012) observe that the 60% target has been overachieved with over 80%. This relatively high efficiency of land use in Liverpool can largely be confirmed by the compilation of more recent figures for land-related parameters in table 14. However, the relatively small and compact territory of Liverpool (about 11,000 ha; Liverpool City Council, 2016d), opposed to Leipzig (about 30,000 ha; Stadt Leipzig, 2018d) where considerable parts of the suburban area/surrounding municipalities have been incorporated into the Leipzig territory in the 1990s, need to be reflected with regard to these figures. Still, how these figures and the amount of vacant housing relate to the currently strongly debated ‚housing crisis', together with increase rates in land take for England overall, represents a particularly interesting aspect of the Liverpool case.

4.3.2 Leipzig

Leipzig is the largest city in the German federal state of Saxony and ranks nine among the largest cities in Germany. While an independent, county-free city in administrative terms, it is part of the planning region West Saxony represented by the Regional Planning Association. Together with its neighbouring city Halle it constitutes a functional agglomeration in central Germany. With decline and strategies of shrinkage having been intensively discussed as part of land use planning until the mid-2000s (see below), Leipzig has been characterised by considerable population growth since then: While its total population was at 511,000 in 2007, it had increased to 590,000 in 2017 (Stadt Leipzig, 2018a), with a growth rate of 18 %, and projections postulating a further increase towards 720,000 inhabitants in 2030 (Stadt Leipzig, 2018b).

Before that, Leipzig's total population had fallen about a third from the 1930s to the early 2000s, while the built-up urban area had about doubled in the same time (Doehler-Behzadi & Schiffers, 2004): A phase of economic growth in the 19th and early 20th century was connected to Leipzig functioning as a centre for trade, with initial decline caused through the Nazi regime and Second World War, followed by further decline in the socialist era through the overall neglection of the existing housing stock and a focus on housing development outside of traditional centres instead. After German reunification, decline was spurred through a significant loss of industrial employment and further shrinkage of the inner-city population (Rink et al., 2012; Couch et al., 2005; Doehler-Behzadi & Schiffers, 2004). This development was paralleled by rapid 'postponed suburbanisation' (see also UBA, 2003), resulting in a significant availability of brownfield land and vacant housing, reaching a peak at 20 % in 2000 (Rink et al., 2012). Emphasis at the time was on the discussion of planned loosening against the background of shrinkage (Doehler-Behzadi & Schiffers, 2004). Since then, however, a reurbanisation trend has been observable, with a pronounced rise of population figures from the mid-2000s as depicted above. Key factors for that have been attributed to migration gains (esp. for students and young professionals), a substantially reduced suburbanization rate, a rising birth rate (representing an overarching trend for urban centres), as well as inward investment, esp. in the car industry, and also to comparably affordable housing (Rink et al., 2012). Growth has to date been concentrated in the south and southwest of Leipzig, gradually shifting towards the eastern parts of the city that still exhibit significant need for urban renovation, development foci continuing to be on PDL and vacant lots as well as inner-urban former railway sites (BfN, 2015). Studies on the development of Leipzig also provide points of departure for discussing standards for land use efficiency: As Doehler-Behzadi & Schiffers (2004) show, Leipzig has undergone immense changes in its urban density, from one of the most densely populated German cities (385 inhabitants/ha residential land in

1913) to a fragmented city (76 inhabitants/ha in 2001). Such a historic contextualization hints to options for the reuse of land in a way that combines the legacy of densities once realized with current qualitative requirements (see further discussion in section 8).

The state spatial development plan for Saxony (Sächsische Staatsregierung, 2013) includes a target for maximum land take of 2 ha by 2020 that is, however, not further operationalised for subsequent regional and municipal scales. Informal plans and strategies of relevance for land use planning in Leipzig comprise the integrated urban development concept (INSEK, 2018), the urban development sub-plan housing (STEP W+S; Stadt Leipzig, 2011) as well as the related sectoral concept on PDL (Stadt Leipzig, 2015a, constituting updates to the previous urban development concept SEKo (Stadt Leipzig, 2009), and the Housing Policy Concept (Stadt Leipzig, 2015b), as compiled in table 12 and 13 below and including key figures on land use, site potentials and projected housing need. A soil protection concept has been prepared and is described as being discussed by involved sectoral departments on the department's webpage (Stadt Leipzig, 2014). The 2013 Sustainability Strategy for the federal state of Saxony, referring to the 2 ha target mentioned above (SMUL, 2013), and the action programme on the reduction of land take (SMI & SMUL, 2009) focusing on avoiding land take, mobilizing existing land potentials and revitalizing brownfields constitute a further framework for municipal activities. Moreover, in the 1990s Leipzig has formulated a catalogue of environmental quality protection objectives that includes indicators for land take, land recycling (considering building density, proportion of PDL/brownfields, amount of vacant lots and vacant housing) as well as for residential quality (Wickop et al., 1998).

Recent land-related figures as compiled in table 13 suggest an enhanced land use efficiency through an increase in PDL reuse but also land take for housing still being above overarching targets (however, inaccuracies and a potentially high proportion of recreational space in these figures result from changed survey methodology as described above). Together with the amount of vacant housing and available PDL, the Leipzig case specifically raises the question how resource efficient land use as requested by policies reviewed above can be realized (and quantified for assessment) in the face of population growth and related housing demand.

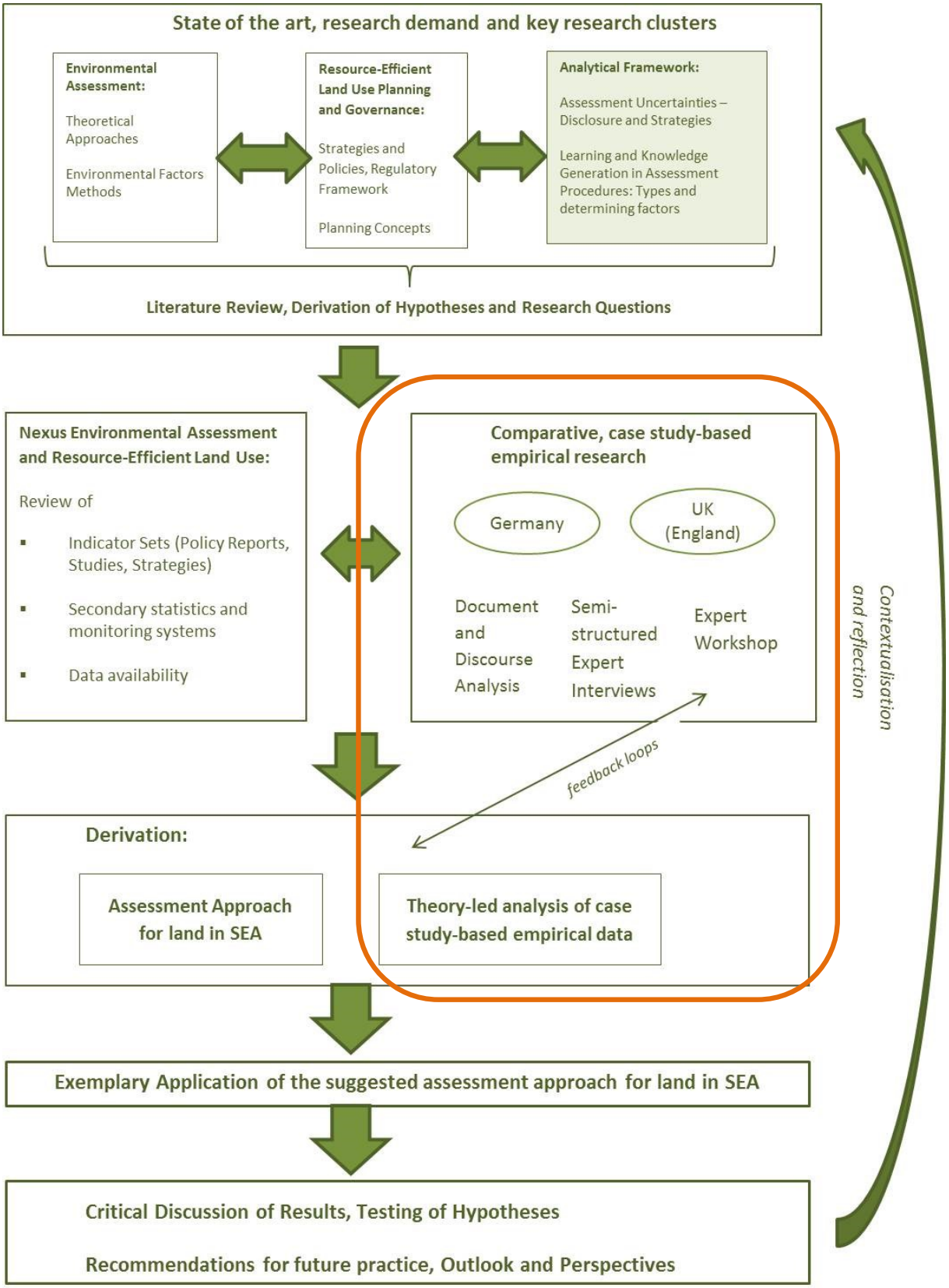
Table 12: Land-related informal plans/evidence-base documents (own table)

Key Case Study Cities: Land-related informal plans and evidence-base documents

Leipzig	Liverpool
Urban Development Plan Housing Stadtentwicklungsplan **STEP** Wohnen + Stadtentwicklung 2000, Teilplan Wohnen updated **2010** **Housing Policy Concept** Wohnungspolitisches Konzept **2015** **Integrated Urban Development Concept, Sectoral Concept Housing, Brownfield Study** Integriertes Stadtentwicklungskonzept **SEKo** Leipzig 2020, Fachkonzept Wohnen, Fachteil Brachen 2015 Updated through: **Integrated Urban Development Concept** Integriertes Stadtentwicklungskonzept **INSEK Leipzig** 2030 **2018** **Monitoring Report Housing** Monitoringbericht Wohnen **2016/17**	**Liverpool Sustainable Development Plan 2005** **Housing Strategy 2013-16** **Liverpool Strategic Housing Market Assessment SHMA 2016** **Strategic Housing Land Availability Assessment SHLAA (2013, update 2016)** **Brownfield Land Register** **Monitoring Report Housing 2017**

Table 13: Land-related parameters and recent figures for Leipzig and Liverpool; relatively larger territory of Leipig to be taken into account (own table)

Key case study cities: Land-related parameters and recent figures		
	Leipzig	**Liverpool**
Population 2017	590,000 (Stadt Leipzig, 2018a)	491,000 (Liverpool City Council, 2018a)
Population growth 2007-17	18 %	8 %
Projected population 2030/31	720,000, i.e. + 22 % (Stadt Leipzig, 2018b)	533,000, i.e. + 8.5 % (Liverpool City Council, 2018b)
Projected additional dwelling demand by 2030/33	51-78,000, i.e. + (up to) 23 % (out of which 8000 single-family houses; Stadt Leipzig, 2018b) i.e. up to 1.4 new dwellings per additional inhabitant projected	29,000, i.e. + 14.5 % (Liverpool City Council, 2016b) i.e. 1.5 new dwellings per additional inhabitant projected
Land take for housing *(for DE: 1/3 SuV as a proxy)*	2003-13: + 4.7 % (Stadt Leipzig, 2018b) 2013-18: + 3.5 % ; increase in total SuV 545 ha, i.e. about 90 ha/a (Stat. Jahrbücher Leipzig 2014-19) Quota (UBA, 2012; Henger & Schier, 2014): 23.8 ha (total SuV); 8 ha/a (1/3 housing)	"housing need largely met through realising unimplemented planning consents; all additional allocations comprise PDL" (Liverpool City Council, 2018c) related housing capacity: 44,448 dwellings (Liverpool City Council, 2016a)
PDL availability	1050 ha, i.e. 3.5 % (Stadt Leipzig, 2018b)	480 ha, i.e. 4.4 % (Liverpool City Council, 2018c)
PDL reuse for housing	73.7 % (100 ha); 13 % increase 2012-14 (Stadt Leipzig, 2018b)	98.2 % until 2017 (Monitoring Report Housing)
Vacant housing	19.000 dwellings (6 %) (Stadt Leipzig, 2018b)	8400 dwellings (3 %) (Liverpool City Council, 2016b)
Proportion of rented dwellings	87 % (Stadt Leipzig, 2018b)	53 % (Liverpool City Council, 2016b)


State of the art, research demand and key research clusters
Environmental Assessment:
Theoretical Approaches
Environmental Factors Methods
Resource-Efficient Land Use Planning and Governance:
Strategies and Policies, Regulatory Framework
Planning Concepts
Analytical Framework:
Assessment Uncertainties – Disclosure and Strategies
Learning and Knowledge Generation in Assessment Procedures: Types and determining factors
Literature Review, Derivation of Hypotheses and Research Questions
Nexus Environmental Assessment and Resource-Efficient Land Use:
Review of
Indicator Sets (Policy Reports, Studies, Strategies)
Secondary statistics and monitoring systems
Data availability
Comparative, case study-based empirical research
Germany
UK (England)
Document and Discourse Analysis
Semi-structured Expert Interviews
Expert Workshop
feedback loops
Derivation:
Assessment Approach for land in SEA
Theory-led analysis of case study-based empirical data
Exemplary Application of the suggested assessment approach for land in SEA
Critical Discussion of Results, Testing of Hypotheses
Recommendations for future practice, Outlook and Perspectives
Contextualisation and reflection

5 Land in current SEA practice

5.1 Scope and framework of analysis

The following section will present key results based on the document analysis of environmental/appraisal reports that has been carried out for both case study contexts. The analysis covers selected municipal land use plans for both case study cities, supplemented by a comparative city of a similar size as well as of selected land use plans from rural areas in order to enable some generalization of results beyond the focus cases. The document analysis follows a standardized scheme including key aspects of **objective 1** and **objective 2**, as formulated in section 2. Key criteria for analysis are depicted in table 14 below: First, it considers the question what objectives and concrete targets with regard to land are referred to by the respective environmental/appraisal report, followed by an identification of land-related indicators applied. Second, the analysis scrutinizes to what extent and in what way uncertainties are openly discussed as part of the assessment reports analyzed, preparing a closer and more in-depth consideration as part of interview analysis in the following section. Finally, a focus on concluding assessment statements with regard to how aspects are weighted to arrive at an overall assessment result and what these mean for land is carved out as part of the analysis.

Table 14: Criteria applied for conducting the document analysis (own table)

Document Analysis: Criteria
(Strategic) Objectives, land-related
Targets, land-related
Indicators, land-related ▪ Quantitative ▪ Qualitative
Addressing uncertainties?
Lines of Argumentation concluding assessment, role of land

In the following, each document analyzed will be briefly described with regard to its planning policy context. For the case of Leipzig, the SEA report for the comprehensive land use plan as well as selected environmental reports for binding land use plans have been analyzed. The decision for the selected sample of EA reports for binding land use plans has been made based on their spatial reference area and their role in establishing the basis for additional land take, also given that binding land use plans for PDL reuse/within the existing urban fabric do not require SEA. For the case of Liverpool, Sustainability Appraisal (SA) reports for the Local Plan were considered for two stages of the plan-making process, first in the form of previous Core Strategies and Site Allocation Plans as part of former LDFs out of which current Local Plan documents have often been developed, and second with regard to the most recent draft version of the respective Local Plan. With regard to comparative cases of a broadly similar size, for the German case, Bremen was selected, due to its relatively new comprehensive land use plan; for the English case Leeds was selected as another major city in Northern England. The decision to widen the focus and to include rather contrasting, rural cases, was based on discussions at earlier stages of this study as well as the author's interest in whether assessment methodologies in rural areas with a significantly lower demand for housing will differ from assessment approaches in urban centres. For the

German case, a random online search for recent consultation procedures and related EA reports for binding land use plans in rural areas of Saxony was conducted via the Central Hub for municipal land use plans Saxony (*Zentrales Landesportal Bauleitplanung Sachsen*). Since binding land use plans do not exist in the English planning system, as explained in section 4, it was considered to additionally include selected Neighbourhood Plans. However, an online quest for EA Reports for such plans revealed that several aspects would render such an analysis little feasible for the research interest in focus: Generally, the compilation of Neighbourhood Plans has a voluntary character and is still in its early phase of implementation with a lack of sound experience, as additionally confirmed by the interviewed experts. Moreover, there were no such plans in a completed version available for Liverpool at the time of writing. Further, and according to Yu (2016) and Fischer & Yu (2018), based on a cross-survey of Sustainability Appraisal reports for Neighbourhood Plans, only half of those plans available at the time of research in 2014/15 had conducted a Sustainability Appraisal procedure. In order to support this finding, and as a random overview analysis of recent neighbourhood plans for Leeds has shown, many screening reports for neighbourhood plans result in SEA/SA not being required. This is justified by their conformity with local plan policies, by related consultation responses and in containing policies but not allocating sites. Instead, an online search for SA reports for Local Plans in rural areas in Northern England has been conducted, focusing on councils in the mainly rural county of North Yorkshire that are located outside of metropolitan areas. An overview of documents analysed is provided in figure 34, with spatial contextualization being depicted in figures 35 and 36.

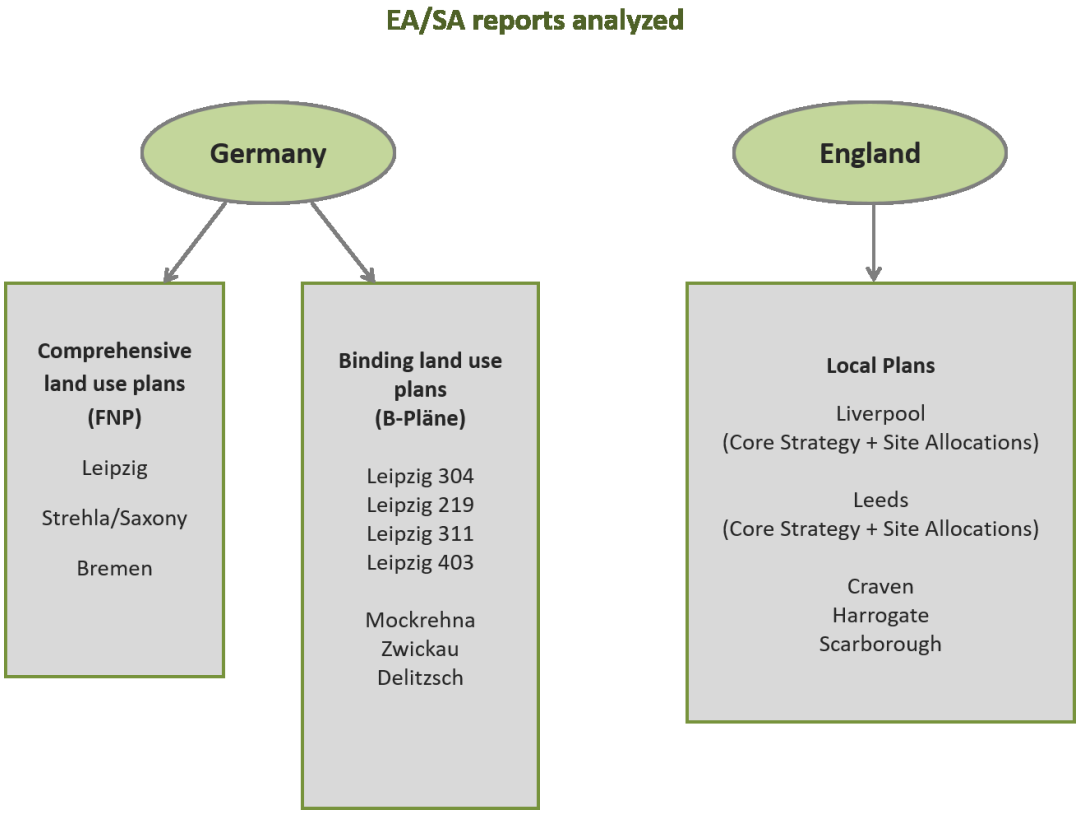
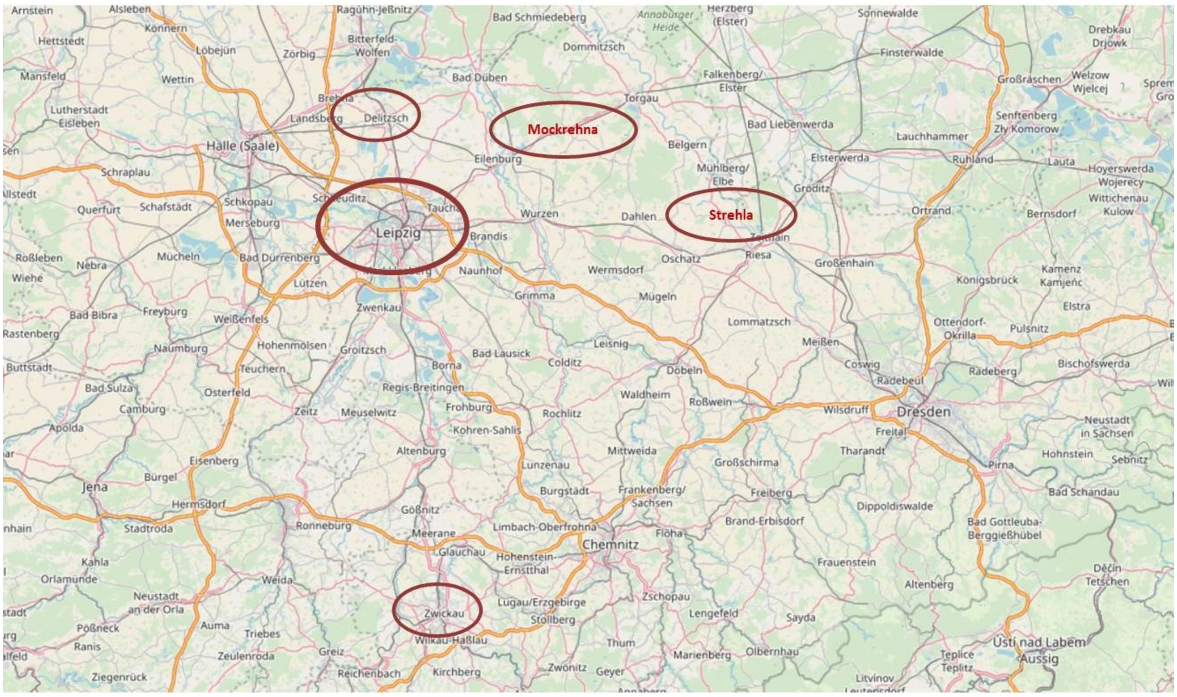


Figure 34: EA/SA Documents analysed (own figure)

Overview map: Location of case studies

Figure 35: Case Study Locations (data by OpenStreetMap - published under ODbL; own emphasis)

Location of German case studies



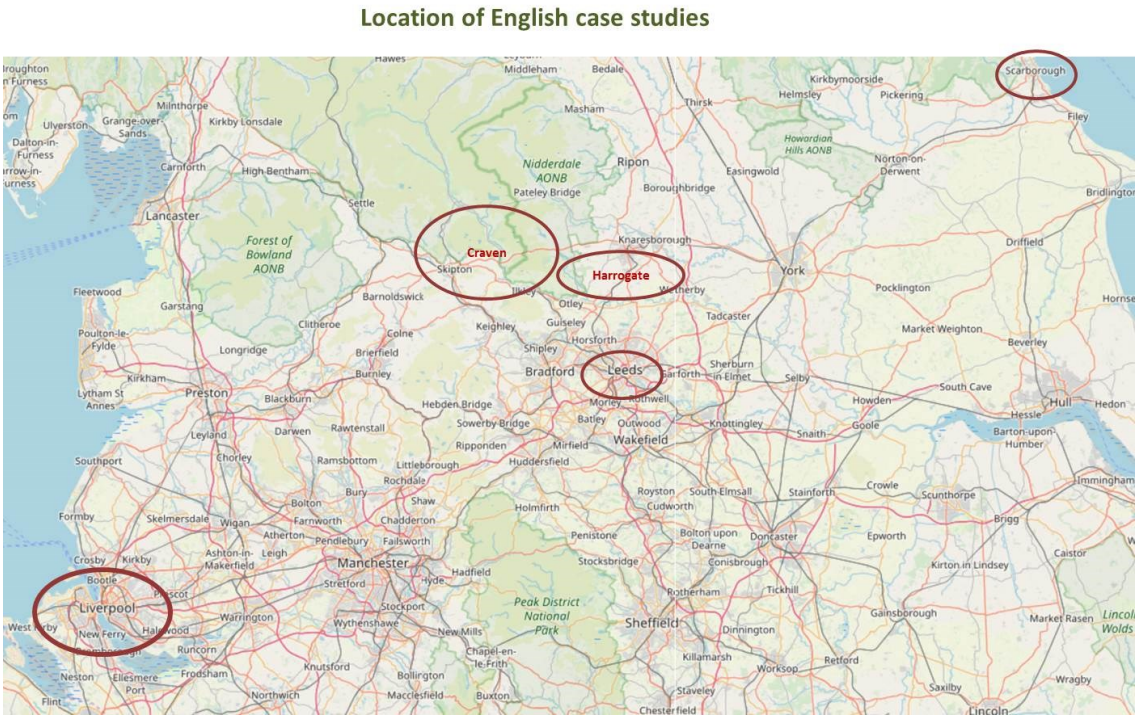


Figure 36: Detailed locations of German and English case studies (data by OpenStreetMap – published under ODbL; own emphasis)

5.2 German Case Study

The **comprehensive land use plan for the city of Leipzig (FNP)** was issued in 2014, replacing the 1995 land use plan that had become outdated due to the incorporation of several surrounding municipalities into the municipal area of Leipzig (FNP Leipzig, 2014b). After holding early consultation phases in 2008, a first draft plan was opened for consultation in 2012, with a second consultation phase having been held in 2013. The final plan was issued in March 2014. SEA was initially carried out based on the early draft plan of 2008, including briefings for all proposed site allocations. Consultation results required considerable changes to the plan, leading to a reduced version of SEA in this second phase, a so-called 'environmental relevance assessment' (*Umwelterheblichkeitsbeurteilung*) for the remaining allocations, with the SEA report published in January 2012 (Stadt Leipzig, 2012). The **comprehensive land use plan Bremen (2014)** has been compiled in order to replace the 1983 plan with regard to changes in demographic and economic development and a related consolidation of site allocations (Freie Hansestadt Bremen, 2014). The **comprehensive land use plan Strehla (draft 2017)** has been prepared due to requirements resulting from revisions to the BauGB (Stadt Strehla, 2017).

Binding land use plans refer to sites for residential purposes of varying sizes and spatial contexts: The **binding land use plan Leipzig 304 (draft for public consultation 2015)** serves to prepare the ground for a small site for single family housing in north-western Leipzig, comprising 0.3 ha in the undeveloped outer area according to § 35 BauGB, with the southern part of the site being part of a designated landscape protection area (Stadt Leipzig, 2015c). The **binding land use plan Leipzig 219 (2015)** refers to a larger site for single family housing in north-western Leipzig, covering 12.5 ha on a site with earlier plans suggesting multi-storey housing and including compensation sites for land on which the Leipzig Porsche factory was developed (Stadt Leipzig, 2015d). The **binding land use plan Leipzig 403 (draft 2017)** serves to develop a residential site for single-family housing, covering 5 ha in south-east Leipzig. The site belongs to the so-called *Außenbereich im Innenbereich*, i.e. located within the inner urban area but in character and size to

be judged as undeveloped outer area on the base of § 35 BauGB, with current use being mainly agricultural (Stadt Leipzig, 2017c). The **binding land use plan Leipzig 311 (2017)** prepares the development of another residential site for single-family housing, covering 2.5 ha in south-east Leipzig. Here the site in question is a previously used one for multi-storey buildings which have since been demolished, with the plan being made to ensure structured plan-led development (Stadt Leipzig, 2017d). The **binding land use plan Zwickau 029 (draft 2017)** constitutes a reduced version of an older not realized plan and prepares a residential site for single and multi-family housing, covering 5.5 ha of former agricultural use (Stadt Zwickau, 2017). The **binding land use plan Mockrehna (draft 2017)** prepares the development of a small residential site for two single family houses at the edge of the village, covering ca. 0.3 ha of previous intensive agricultural use (Gemeinde Mockrehna, 2017). The **binding land use plan Delitzsch 21 (2018)** concerns a residential site for loosely structured housing with the explicit exclusion of double and terraced houses, comprising 16.4 ha, in parts previously used by a garden centre (Große Kreisstadt Delitzsch, 2017).

5.3 English Case Study

The **Liverpool Core Strategy Sustainability Appraisal (submission draft 2012)** had been prepared under the previous planning policy framework, constituting a key element of the Local Development Framework (LDF; Liverpool City Council, 2012). The **Liverpool Local Plan Sustainability Appraisal, including Site Allocations (consultation draft 2016)** as approved for public consultation in September 2016 has been the most recent plan document published at the time of conducting the analysis. The version considered here is based on the 2013 decision to shift work from the previous Core Strategy to a new Local Plan in accordance with related alterations in planning policy and regulations. Explicitly mentioned are the need to comply with the 2012 NPPF requirements and the 2013 revocation of the North West RSS, given its role in shaping housing targets (Liverpool City Council, 2016c). The Local Plan now includes both strategic objectives, based on the previous Core Strategy document, and site allocations. With the key role of evidence base documents, in particular SHLAA and SHMA, housing sites to be allocated by Local Plans significantly depend on these documents and the underlying OAN. Of particular interest from the perspective of this research is the question to what extent these evidence base documents and the resulting draft plan not only consider the requirement for new housing sites but also of reuse potentials and options for re-designations as well as for compact housing patterns in order to fulfil the respective targets.

The Liverpool SHLAA as compiled in 2013 and updated in 2016 surveyed sites with regard to access, neighbourhood character and regeneration issues, also considering potential impacts such as on landscape features, on green belt/green wedges, on biodiversity, and on greenspace. It results in identifying a capacity of about 33,000 dwellings for the period 2016 to 2031 (Liverpool City Council, 2016a). The Liverpool SHMA, updated in 2016 (Liverpool City Council, 2016b), produced housing requirement figures of 29,600 dwellings for the period 2013 to 2033. This figure is based on the methodology required by the NPPF, as explained above, and stated to be lower than the figures issued in the Core Strategy 2012 which was still based on RSS housing figures. The SHMA 2016 results in only a small surplus of new homes (about 400 dwellings) required, based on comparing OAN and existing planning permissions. However, the document also states that additional site allocations are still considered necessary, given that not all consents are expected to be implemented. It is also demonstrated that housing completions have been realized at rates between 94 and 99 % on brownfield land. The majority of housing provision is foreseen through realizing yet unimplemented planning consents, and thus only a small amount

through new site allocations (all of those again comprising PDL). Still however, and represented by a 'Mayoral Recommendation' document, significant changes required for housing provision were identified with regard to consultation on the draft Local Plan and its chances for adoption. This was argued for by changes in population and household projections, requiring accommodating a surplus of 9000 households as compared to the evidence base used as a reference for SHMA and draft Local Plan. The draft local plan and the steps undertaken towards its finalization and publication thus also reflect changes in national planning policy, in particular with regard to housing figures, and potential influence on local plan-making through the option for planning inspectors to take over the production of local plans in case of delay.

Leeds has not yet disposed of a one-document Local Plan but has continued to develop the LDF-based Core Strategy and Site Allocation Plan as separate documents then comprising the Local Plan. The **Leeds Local Development Framework Core Strategy Sustainability Appraisal (publication draft 2012),** with the Core Strategy having been adopted in 2014, has been analysed here, followed by the **Sustainability Appraisal Report for the publication draft Site Allocations Plan as of 2015**, which has been submitted to central government in 2017 (Leeds City Council, 2012; 2014a; 2015a).

With regard to local context conditions, Leeds also faces a growing population with a growth rate of 6 % projected until 2030 (ONS sub-national population projections) and the related housing need to be accommodated. While the proportion realized on brownfield sites has usually been above 90 % in recent years, the Core Strategy mentions a draft green belt review foreseen for longer term growth that is not realizable on existing sites (Leeds City Council, 2014a). In this regard, the Leeds SHMA 2011, in consistency with the former RSS, postulates a demand for 66,000 net new homes for the period 2012 to 2028. With regard to land availability, the Leeds SHLAA 2011 identifies an amount of PDL available for 29,000 dwellings, resulting in the Core Strategy 2014 arguing that the release of greenfield/greenbelt land is to some extent required to meet longer term housing requirements. A SHLAA Update 2014 further specifies the criteria applied, including accessibility of sites, the proportion of brownfield/greenfield and site constraints (Leeds City Council, 2014b). Impacts through development on a site have not explicitly been considered; however, density zones have been developed for determining housing capacity. As a result of the SHLAA 2014 update, an overall potential of all sites assessed is identified for about 57,000 dwellings. Accordingly, the Leeds Core Strategy states that "the 66,000 units identified for new housing will be composed of current, undelivered allocations, extant planning permissions and other sites deemed to be appropriate for housing delivery."

As mentioned above, the **Leeds Site Allocations Plan Sustainability Appraisal (publication draft 2015)** provides the second key element of the Leeds Local Plan, detailing the proposed allocation of sites. Underlying housing figures and targets have been outlined above; the balance of sites as specified by the Site Allocations Plan amounts to about 33,000 dwellings to be realized on already allocated sites, sites with planning permission and on PDL, and about 32,000 dwellings of the remaining demand to be realized through new allocations; thus the brownfield : greenfield ratio would amount to 52 : 48 (Leeds City Council, 2015c). The Site Allocations Plan includes a green belt review, assessing whether development of a site would lead to ribbon development or to an isolated development site not connected to existing boundaries, whether the site is well connected to the built up area, and whether development of the site would effectively 'round off' the settlement pattern. Further, it asks whether site development will safeguard the countryside from encroachment, whether it provides access to the countryside, whether it includes designated

protected sites, and whether it includes any of the best and most versatile, (grade 1, 2 or 3a) agricultural land (Leeds City Council, 2015b).

The document analysis further includes SA reports for draft Local Plans for three rural district councils in Northern England**,** comprising **Harrogate, North Yorkshire Local Plan Sustainability Appraisal (publication draft 2018;** Harrogate District, 2018**), Scarborough, North Yorkshire Local Plan Sustainability Appraisal (submission draft 2015;** Scarborough Borough Council, 2015**)** and **Craven, North Yorkshire Local Plan Sustainability Appraisal (publication draft 2018;** Craven District, 2018**).** All three councils are part of North Yorkshire County, with Harrogate located north of Leeds, Scarborough at the North Sea Coast and Craven in the southern part of the Yorkshire Dales.

5.4 Land-related elements and rationale of EA reports analyzed

5.4.1 (Strategic) Objectives, land-related

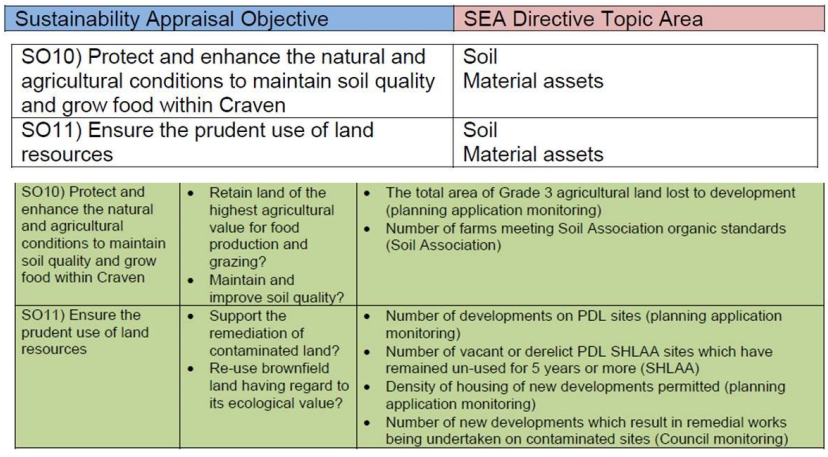
For the comprehensive land use plan Leipzig, overarching objectives regarding land include a resource efficient and traffic-reducing settlement structure, a compact, resource efficient and mixed-use 'European' city structure and a balanced ratio of built-up and green space with regard to the degree of densification. As part of the environmental factor soil, relevant objectives derived from overarching regulations and strategies mentioned are the National Biodiversity Strategy including the reduction of land take and 30 ha target as well as the ratio brownfield : greenfield 3 : 1, the soil protection clause, and environmental protection objectives formulated for Leipzig, including the prevention of further land take, the removal of unused built-up structures and the protection of open space. The environmental report for the comprehensive land use plan Bremen also considers land take, withdrawal/re-designation of sites, brownfield reuse and density, further operationalizing the 30 ha target for Bremen, identifying a threshold of 13 ha/year (with a current figure of 30 ha land taken per year indicated). Further, increasing efforts regarding brownfield reuse, as well as the protection of natural areas and unsealed soil, and the reduction of traffic and commuting through reduced land take at the urban fringe are mentioned. The comprehensive land use plan Strehla (draft 2017) explicitly lists the soil protection clause, federal and state regulations on the protection of natural soil functions, but as well the stabilization of the local population (given the decreasing trend in population figures) and improvement of the municipality's residential function, with new residential sites designated (mainly indicated as inner urban sites and reasonable rounding offs). The Leipzig FNP also notes that site allocations are largely derived from earlier urban development plans (STEP), i.e. have yet been discussed as part of informal planning and urban development strategies.

For SEA reports for binding land use plans (regularly published as part of the plan rationale/*Begründung*), objectives and targets are mostly mentioned as part of the environmental factor soil, including the reduction of land take through land recycling specified by the 30 ha target and the 3 : 1 ratio derived from the German Sustainability Strategy (Leipzig 403), § 1 Abs. 2 BauGB (Leipzig 403), § 1a Abs. 2 BauGB (Leipzig 311), the desealing directive Saxony and the environmental quality objectives for Leipzig (reduction of land take, minimisation of soil sealing; Leipzig 403; Leipzig 311). Further, site types designated as residential for single-family and terraced housing, maintaining a high amount of green space with climate and biotope functions (Leipzig 311) are mentioned. For the rather rural binding site plans, objectives comprise landscape plan designations, in this case 'landscape element worth protecting' that a part of the site belongs to (Zwickau 029), § 2 Abs. 2 BBodSchG and state guidance on soil assessment, soil loss to be as small as possible, the protection of valuable vegetation structures and, with the site

being part of a nature park designation, the protection of natural functions and recreational value (Mockrehna), as well as references to the National Sustainability Strategy (efficient use of soil, protection of natural soil functions; Delitzsch 21).

Objectives referred to by the Liverpool Core Strategy SA (submission draft 2012) include the efficient use of resources, the prioritised development of the city's vacant and derelict land and buildings, the protection and restoration of land and soil quality and an affordable and resource efficient housing provision. The Leeds 2012 Core Strategy SA report also mentions the minimization of pressure on greenfield land by efficient land use patterns that make good use of derelict and previously used sites (as taken up by the Leeds Site Allocations Plan SA Report 2015), the delivery of economic development which makes best use of land in sustainable locations, accessible to the community and wider labour market, and the delivery of housing growth in sustainable locations, by prioritising previously developed land in urban areas and through the phased release of greenfield sites.

Land-related objectives postulated by the SA report for the Harrogate Local Plan comprise the provision of quality housing available to everyone, local needs met locally, a quality built environment and efficient land use patterns as well as a prudent and efficient use of energy and natural resources. Similarly, the SA report for the Scarborough draft Local Plan postulates affordable, good quality housing in accessible locations, efficiency of land use through maximising the re-use of previously developed land and existing buildings, the protection and enhancement of the built environment, and the enhancement of quality and accessibility of the Borough's green infrastructure network. A comparably detailed range of objectives is formulated by the SA report for the Craven draft Local Plan (see figure 37), comprising the development of most new homes situated within and around market towns and villages (on previously developed land where it has been possible and appropriate), between extensive public open spaces, the protection and enhancement of soil quality, the prudent use of land resources, the protection and enhancement of the open countryside and wider landscape character, improved access to green space, enabling all residents to live in suitable and affordable housing, meeting the housing requirements of Craven's present and future population, an improvement of quality, location and choice of housing, retaining land of the highest agricultural value for food production and grazing, supporting the remediation of contaminated land, and re-use of brownfield land having regard to its ecological value.



Sustainability Appraisal Objective	SEA Directive Topic Area
SO10) Protect and enhance the natural and agricultural conditions to maintain soil quality and grow food within Craven	Soil Material assets
SO11) Ensure the prudent use of land resources	Soil Material assets

SO10) Protect and enhance the natural and agricultural conditions to maintain soil quality and grow food within Craven	• Retain land of the highest agricultural value for food production and grazing? • Maintain and improve soil quality?	• The total area of Grade 3 agricultural land lost to development (planning application monitoring) • Number of farms meeting Soil Association organic standards (Soil Association)
SO11) Ensure the prudent use of land resources	• Support the remediation of contaminated land? • Re-use brownfield land having regard to its ecological value?	• Number of developments on PDL sites (planning application monitoring) • Number of vacant or derelict PDL SHLAA sites which have remained un-used for 5 years or more (SHLAA) • Density of housing of new developments permitted (planning application monitoring) • Number of new developments which result in remedial works being undertaken on contaminated sites (Council monitoring)

Figure 37: Extracts from SA report for Craven Local Plan (Craven District, 2018: 11; 20)

Hence, most assessment reports refer to the objective of reduced land take through land recycling and PDL reuse (all English Appraisal reports, all German SEA reports for comprehensive land use plans and about half of SEA reports for binding land use plans), with SAs for Local Plan documents and SEAs for comprehensive land use plans also referring to resource efficiency and compactness of land use as a strategic objective. The reduction of soil loss and/or soil sealing is referred to by a number of assessment documents from both case studies, constituting the dominant assessment objective for most German B-Plan EA reports. Other objectives show less frequent mentioning. Whereas a number of B-Plan EA reports refer to the protection of undeveloped areas, a balanced ratio of built-up and green space is only mentioned by the Leipzig FNP and one B-Plan, whereas green space provision is mentioned by all English appraisal documents. The removal of unused built-up structures is only referred to by the Leipzig FNP, with the Bremen FNP and one B-Plan referring to the qualification of inner-urban development, however. Two English reports also mention the protection of best and most versatile agricultural land as a strategic objective, while most documents also refer to affordable and resource efficient housing provision, given the broader focus of SA. The Strehla FNP, however, also refers to a stabilization of the municipality's residential function.

5.4.2 Targets, land-related

For German SEA reports, the 30 ha target is mentioned by the Leipzig and Bremen FNP SEA reports as well as by two B-Plan SEAs; the 3 : 1 ratio is only referred to by the Leipzig FNP and one B-Plan. Three B-Plan SEAs refer to maximum sealing thresholds as derived from the Leipzig set of environmental protection objectives.

For English SA reports, the Leeds Core Strategy SA report is the only one referring to a quantified proportion of new dwellings to be on PDL (80% of new homes being built on previously developed land), while two English SA reports employ concrete minimum density targets to be between 30 and 50 dwellings per net hectare or at a minimum net density of 30 dwellings per hectare for new housing, with higher densities for housing development within the defined town and city centres and in urban locations with a good standard of accessibility to public transport (as derived from the former PPG3; Leeds 2012; Harrogate). For Craven, targets had been initially discussed as part of a Background Paper to the plan regarding the link between housing mix and housing density, postulating a dwelling density of 37 dph and a net housing density of 32 dph. For Harrogate, targets also refer to the protection of best and most versatile agricultural land (grades 1, 2 and 3a) from development not associated with agriculture or forestry, and a specification for the assessment of agricultural land quality with regard to site allocations.

5.4.3 Indicators, land-related

Land-related aspects considered in SEA reports for comprehensive land use plans comprise land take, brownfield reuse, housing density (Leipzig FNP, Bremen FNP) and soil sealing (Leipzig FNP, Strehla FNP being restricted to the latter aspect). Looking at indicators applied to assess these aspects, land take is assessed quantitatively with regard to the size of land affected by conflicts with existing environmental factors, i.e. intra-plan based but not with regard to any overarching targets or reference figures. In the case of Bremen, the ratio of new designations/withdrawal of designations/re-designations in relation to conflict intensity is used as a proxy (see figure 38). For Leipzig, the change of ratio built-up/open space is assessed with regard to designations proposed by the plan. Brownfield reuse is to some extent quantified with regard to the amount of proposed reuse of sites through the plan (Leipzig FNP); however, without clearly referring to the actual brownfield potential available, in the case of Bremen being estimated on the base of data from

comparably sized cities. Finally, soil sealing (FNP Leipzig, FNP Strehla) and potential for densification (FNP Bremen) is assessed against thresholds defined by BauNVO site types. In qualitative terms, impacts on land characteristics are assessed through a so-called conflict analysis, i.e. by specifying the number and extent of environmental factors affected together with the size of these affected sites. The EA report for the Strehla FNP mainly refers to the detailed assessment of site allocations as part of the plan rationale.

Withdrawal of sites | conversion | new allocations for housing

Rücknahme von Siedlungsflächen	Umwandlung	Neudarstellungen von Siedlungsflächen
· Zentralbereich Osterholzer Feldmark (Wohnbau) · Wölpsche (Wohnbau) · Klöckner-Teiche (Gewerbeflächen)	· Gewerbe- und Wohnbauflächen zu Gemischten Bauflächen, zum Beispiel Woltmershausen, Hemelingen, Huchting · Gewerbeflächen zu Innovationsgebieten	· Bauabschnitte 4/5 Arberger Marsch (Gewerbe) · Gartenstadt Werdersee (Wohnbau)
Von der Darstellung ausgenommene Flächen		
· Brokhuchting (Wohnbau) · Wölpsche (Wohnbau)	· Vorderes Woltmershausen · Steingut-Gelände	

Flächennutzungsplan Bremen - Umweltsteckbriefe

Flächennummer: 271-006

Ortsteil: Strom **Stadtteil: Strom** **Stadtbezirk: Süd**

Darstellung FNP neu: Flächen für Landwirtschaft **FNP alt:** Wohnbauflächen

Planerische Zielsetzung:
Neuschnitt/ Reduzierung der Wohnbauflächen am Stellfeldsweg. Anpassung der Darstellung von Wohnbauflächen entsprechend des städtischen und baulichen Konzepts.

Flächencharakteristik:
Die extensiv landwirtschaftlich genutzte Grünlandfläche befindet sich im Naturraum „Bremer Wesermarsch", nördlich der Stromer Landstraße und westlich des Stellfeldswegs im Stadtteil Strom. Süd-/ südwestlich der Fläche verläuft die Ochtum als Nebenfluss der Weser sowie die Landesgrenze zu Niedersachen
Größe: ca. 6,5 ha

Umweltrelevante Wirkungen

Durch die Änderung entfällt die großflächige Versiegelung und Überprägung durch Bebauung.

Environmental profile for exemplary site

New FNP: agricultural use

Previous FNP: housing use

Planning objective: reduction of housing development sites in the area

Site characteristics: extensive agricultural use (6.5 ha)

Environmental impacts: through the modified designation, large-scale soil sealing and artificialisation by development is omitted

Figure 38: Extracts from EA report for Bremen comprehensive land use plan (Freie Hansestadt Bremen, 2014; 187; Site Profile 271-006; summarized translation by the author)

For German B-Plan EA reports, soil sealing and, partly, land take, constitute key aspects (Leipzig 304; Leipzig 219; Leipzig 403; Leipzig 311; Mockrehna), with a small number of reports also referring to brownfield reuse (Leipzig 311). With regard to indicators applied, in most cases only soil sealing is quantified, while the productive function of land is assessed qualitatively (Leipzig 304 also setting soil sealing in relation to the number of dwellings proposed; Leipzig 219; Leipzig 403; Leipzig 311;). The Zwickau 029 EA report only applies land-related indicators in qualitative terms with regard to the loss of soil/soil functions, while for Delitzsch 21 explicit land-related indicators applied could not be identified. A smaller amount of reports use the BauNVO-derived GRZ as a threshold for building density (Leipzig 403; Leipzig 311; Mockrehna) and also address the role of the plan in reusing brownfield (Leipzig 311). Some reports also refer to designations of overarching plans (Leipzig 219, landscape plan designating the site as residential for single-family housing with a high proportion of green space).

For English SA reports, land-related indicators applied mainly refer to the percentage of new and converted dwellings on previously developed land (per annum) (Liverpool 2012; Liverpool 2016; Leeds 2012; Leeds 2015; Harrogate; Scarborough; Craven; see exemplary framework in figure 39), the reuse of vacant/derelict buildings/space, the encouragement of higher density development in highly accessible locations, for the case of Leeds 2012 and 2015 specified by the percentage of new dwellings completed at less than 30 dwellings per hectare, and the percentage of new residential development within 30 minutes public transport time of a GP, hospital, primary and secondary school, employment and a major health centre (Liverpool 2016, for Craven specified by the density of housing of new developments permitted) or geographical access to services (Harrogate; for Craven specified through percentage of development which is within 400m or 5 minutes of a bus stop which provides regular services or 10 minutes' walk of a railway station). Rather rural EA reports also employ housing completions and/or take-up rate of employment land developed as an indicator (Harrogate; Craven), as well as land available for employment use and employment land by sector taken, and affordable dwellings completed as a % of identified annual need as well as the area of remediated land (Scarborough) or the number of vacant or derelict PDL SHLAA sites which have remained un-used for 5 years or more (Craven). As a proxy for assessing land quality, the agricultural land classification database is used (Liverpool 2016; Leeds 2015; Harrogate; Scarborough; Craven); further indicators include the number of 'sites of potential concern' with regard to land contamination, and changes in access and provision of parks (Liverpool 2016), amount of green spaces lost to development (Harrogate), the amount of new open space/green infrastructure (Scarborough) or green infrastructure area generated (Craven). Other qualitative assessment indicators comprise green space endowment, accessibility of greenspace to residential areas, and areas designated for their intrinsic environmental value (Leeds 2012; Leeds 2015).

SA Objective	Site appraisal criteria	Policy appraisal criteria *Will the policy……*
1. To use natural resources prudently and efficiently, and increase energy generated from low carbon sources.	S1. Previously developed land or building	P1. Reuse vacant/derelict building or a vacant/overgrown space P2. Encourage higher density development in highly accessible locations. P3. Maximise energy and water efficiency in design and construction of new development. P4. Increase energy generated from local and renewable sources
4. To protect and improve water, air and soil quality	S1. Previously developed land or building S4. Groundwater Flooding S5. Groundwater Source Protection Zone S7. Affected by unneighbourly uses - heavy industry, power lines, railway lines, arterial routes etc	P5. Protect and enhance green infrastructure P10. Reduce the need to travel P11. Reduce emissions of greenhouse gases and other pollutants P12. Prevent pollution of water P13. Protect water quality of all water courses and water bodies P14. Improve air quality P15. Protect residential amenity from noise pollution. P16. Assist with the reclamation of contaminated land

Figure 39: Extracts from SA report for Liverpool Local Plan (Liverpool City Council, 2016c: 62 f.)

In line with what has been found for strategic objectives, most FNP and Local Plan assessment reports and all English SA reports but only one B-Plan SEA apply PDL reuse as an indicator, which is, however, rarely quantified as part of assessment. Land take is only quantified by the Leipzig and Bremen FNP SEA reports. A clear majority of German SEA reports refer to soil sealing as an

indicator, mostly specified by thresholds derived from the BauNVO. Also in line with strategic objectives summarized above, most English SA reports further employ green space provision, sensitivity of high quality agricultural land and infrastructural accessibility as indicators, about half of English SA reports refer to densification, and the three rural SA reports to housing completions.

5.4.4 Addressing uncertainties?

The extent to which assessment uncertainties are addressed varies strongly between EA reports analysed: Whereas the Bremen FNP report is relatively detailed, listing uncertainties with reference to fragmented information on soil conditions, to a lack of information on qualitative and quantitative green space provision, on likely future housing density on allocated sites as well as on traffic generation through allocated sites, and also discussing unresolved target conflicts (brownfield reuse, densification, green space provision, climate adaptation), mentioning of assessment uncertainties for the Leipzig FNP could only be found with regard to the existence of two different datasets on PDL potential. Similarly for the FNP Strehla, the relatively low resolution of data is mentioned, with more detailed data not being provided for rural areas in particular. For B-Plan EA reports, assessment uncertainties are only mentioned in one case, referring to a lack of data on cold air generation and flow (Leipzig 403). Most reports lack mentioning of uncertainties (Leipzig 304; Leipzig 219; Leipzig 311; Zwickau 029; Mockrehna; Delitzsch 21).

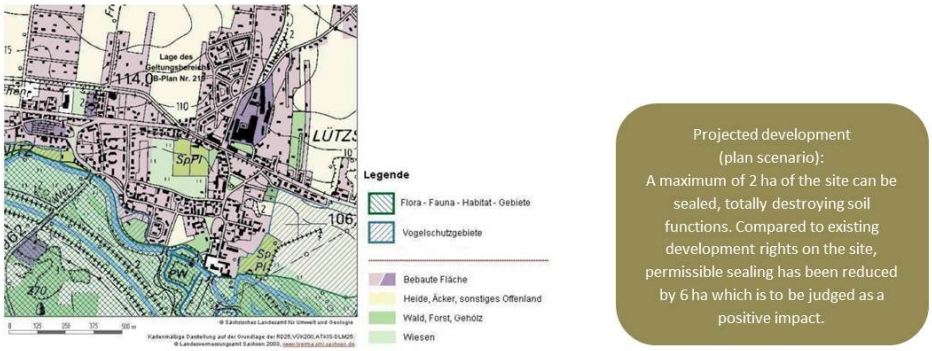
For English SA reports, while level of detail varies, uncertainties are mentioned in most cases: For some, it is only noted that wider-reaching effects of some of the predicted negative environmental effects beyond the City could not be determined or that the strategic nature of the document hampers the prediction of effects (Liverpool 2012; Leeds 2012; Leeds 2015). For Liverpool 2016 and the rather rural EA reports, however, assessment uncertainties are reported on in a comparably detailed manner: For Liverpool 2016, assessment uncertainties are reported with regard to the low resolution of the Agricultural Land Classification dataset, with regard to a number of uncertain impacts on green infrastructure and biodiversity, given that the respective policy does not identify sites which will be allocated. It is, however, stated that a vast majority of sites will most likely be located on previously developed land given the geography of Liverpool and the type of available sites. For Harrogate, it is acknowledged that an uncertain score has been used where there was considerable uncertainty about some effects, and that baseline data has been derived from published sources but new data not been collected, with data gaps revealing the need for additional monitoring indicators (similarly for Scarborough and Craven, in particular given the strategic character of the assessed documents). Further, it is stated that uncertainties exist with regard to transport and accessibility issues of new development, and with regard to the possibility of meeting OAN and completely protecting all biodiverse natural environment. Also, the fulfilment of avoiding the loss of high quality agricultural land is deemed uncertain in this regard.

Accordingly, scope and depth of reference to assessment uncertainties vary strongly, lacking completely for most B-Plan SEA reports. Those assessment reports that mention assessment uncertainties mostly refer to incomplete data availability or insufficient quality of data for the issues to be assessed. Only a few assessment reports, mostly from the English case, mention difficulties related to assess target conflicts between different objectives, of indirect effects beyond the actual spatial reference area of the plan, of sites not yet allocated, and of interdependencies and policies not yet implemented.

5.4.5 Concluding assessment statement and the role of land

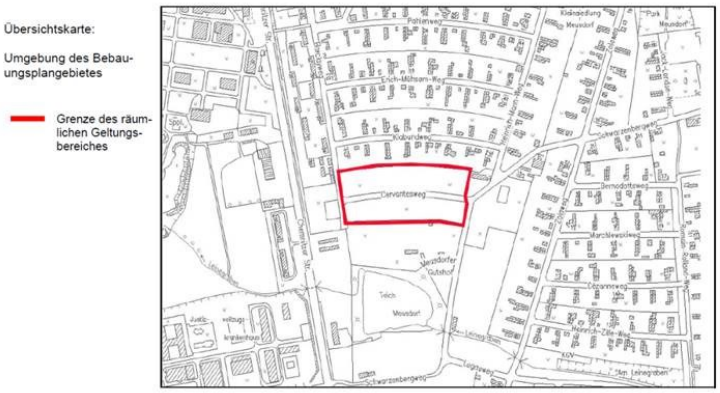
Lines of argumentation with regard to land prevalent in the concluding assessment for German FNP refer to impacts on soil through sealing but assert a reduction of impacts in that sites designated already constitute planned use or reuse of brownfield as well as in that the overall number of sites has been reduced (Leipzig FNP; Bremen FNP; Strehla FNP) and being regarded as the essential amount necessary for covering demand (Strehla FNP). For Bremen, also density issues are discussed in detail, with sites of a GRZ less than 0.3 considered suitable for densification and arguing that the withdrawal of site designations in the undeveloped outer area as well as re-designations from residential to mixed sites enable a demand-oriented land use and intensified mix of uses. Beyond that, there is reference to tiering, i.e. to the inability to assess the impact of individual sites conclusively at FNP level (Leipzig FNP; Strehla FNP). It is also stated that for securing a diverse and promptly available stock of sites a long-term oriented policy of land provision and development of the existing stock of land is pursued, prioritizing brownfield reuse but also securing demand-oriented development sites at the urban fringe (Leipzig FNP). For the Strehla FNP, a focus is on the need to stabilize population figures through attractive housing options and demand caused by an increasing average residential space per person as well as on the set-up of a brownfield register being planned for.

For B-Plan EA reports, some depict a significant impact on soil due to the considerable amount of sealing, however, argued as remaining within the BauNVO thresholds of maximum sealing for the respective type of site (Leipzig 311; see figure 41), partly, however, also referring to the reuse of sites and former building layouts (Leipzig 311). For some reports, minimized sealing together with mitigation and compensation measures result in the final judgement that no significant impact on soil is to be expected (Leipzig 304; Leipzig 403; Zwickau 029). In other cases, the degree of soil sealing is justified as being smaller than in previous versions of the plan, and further mitigated through a reduced number of dwellings or generous parcel sizes (Leipzig 219; Delitzsch 21; see figure 40).



b) Prognose der Entwicklung des Bestandes bei Durchführung der Planung
Bei Durchführung der Planung können maximal knapp 2 ha der Fläche versiegelt werden, auf denen damit die Bodenfunktionen vollständig zerstört werden. Im Vergleich zum bestehenden Baurecht sind 6 ha weniger von zulässiger Versieglung betroffen, was als positive Auswirkung zu bewerten ist.

Figure 40: Extracts from EA report for Leipzig binding land use plan 219 (Stadt Leipzig, 2015d: 19; 25 f.; summarized translation provided by the author)



Die Planung ermöglicht zwar eine Neuversiegelung gegenüber dem Zustand zum Zeitpunkt der Einleitung des Planverfahrens, aber dennoch ist die Versiegelung an einem bereits genutzten Standort positiv gegenüber einer Planung auf einer bisher ungenutzten Fläche zu beurteilen. Insbesondere ist positiv hervorzuheben, dass sich die Ausrichtung der Baufelder weitgehend an den Bestandsgebäuden orientiert. Es werden daher überwiegend bereits stark vorgeprägte Böden für die Planung in Anspruch genommen.

7.4.2 Alternative 2 (Geändertes Maß der Nutzung)

Eine zweite Planungsvariante ginge von einer höheren Dichte aus. Die Festsetzung der GRZ des Bebauungsplanes Nr. 311 erreicht nicht die in § 17 BauNVO geregelte Obergrenze für ein allgemeines Wohngebiet. Diese städtebaulich vorstellbare Festsetzung würde den offenen Charakter mindern und eine der Stadtrandlage widersprechende Verdichtung bedeuten. Diese Planung würde zu wesentlich höheren erheblichen Umweltauswirkungen führen und wird daher ebenfalls verworfen.

A second planning alternative assumes a higher density that would, however, impair the open site character and evoke a degree of densification that contradicts the location at the urban fringe. This alternative would result in significantly higher environmental impacts and has thus been abandoned.

The plan enables additional sealing compared to the current situation; however, this reuse of a PDL site is to be judged positive as opposed to greenfield development. In particular, the orientation of buildings on existing development is positively emphasized, largely focusing on already strongly artificialized soils.

Figure 41: Extracts from EA report for Leipzig binding land use plan 311 (Stadt Leipzig, 2017d: 18; 25; summarized translation by the author)

As part of some EA reports, also higher density/more compact and multi-storey housing structure is discussed as possible but inadequate due to the structure of surrounding sites and a resulting higher amount of soil sealing (Leipzig 403; Leipzig 311; Delitzsch 21). Some reports also refer to local demand, while the development of an already approved site elsewhere in the municipality is discussed as unrealistic due to unclear property conditions (Mockrehna).

English SA reports frequently state that there is an inevitable impact on the land resource but that the emphasis on using brownfield land will help reduce pressure on greenfield sites and could lead to the remediation of contaminated sites (Liverpool 2012; Liverpool 2016; Leeds 2012; Leeds 2015; Craven; see exemplary statement in figure 42). Some reports also point out that the prioritisation of reusing previously developed land and buildings could impair wildlife habitats, recognising that some brownfield sites are important habitat sites, however, with most of the negative effects identified to be offset by other plan policies, for instance by implementing green infrastructure (Liverpool 2016), with Leeds 2012 pointing out the dependence of actual effects on the precise sites to be allocated. Some rather rural reports, however, also argue that despite strong support for the redevelopment of brownfield land, the need to increase housebuilding rates requires some development on greenfield sites (Harrogate; Scarborough), with Craven explicitly arguing for a still prudent use of land resources through choosing agricultural land of poorest quality first and through the majority of development focused on existing towns and villages. The concluding assessment of Leeds 2015, Harrogate and Scarborough is essentially based on site rankings comprising amount of brownfield land reused by a site, potential location of a site on agricultural land, and partly proximity to the centre/accessibility, potential encroachment on a flood zone by a site, and the compatibility of development on the site with adjoining land uses (for detailed rankings, see appendix A).

Sustainability Appraisal Objective 1 – Natural Resources

8.2 As a result of the levels of growth to be delivered through the Local Plan period (in Policy EC1 and H1), there inevitably will be some impact on the land resource, demand for energy and water resources. The Local Plan has a target of delivering 29,600 new homes by the end of the Plan period.

8.3 In the medium to longer term, and in combination with other Local Plan policies, however, it is considered that these impacts will be kept to a minimum through the implementation of SP2 and policies falling under the Strategic Priority 'Use Resource Efficiently', by requiring proposals for new development to: preferably be built on previously developed land and protect green infrastructure; incorporate measures to ensure high levels of water and energy efficiency; and promote energy from renewable or low carbon sources.

Figure 42: Extract from SA report for Liverpool Local Plan (Liverpool City Council, 2016c: 97)

A frequent concluding assessment asserts that impacts have been reduced through that allocated sites partially constitute reuses of PDL, as stated by almost all English SA reports and the Leipzig and Bremen FNP SEA as well as by one B-Plan SEA. German FNP SEAs also refer to a reduction in the overall amount of sites, compared to previous plans, and to tiering, i.e. concrete sites not being assessable at the comprehensive plan scale. About a third of B-Plan SEAs state that there are impacts on soil but by sealing remaining within the BauNVO thresholds and/or by compensation, e.g. through greenroofs, there is no significant impact occurring. Individual B-Plan SEAs also argue that through minimized soil sealing and a reduced number of dwellings impacts could be minimized, or that higher densities have been judged as unsuitable due to the character of the surrounding urban fabric. Individual German SEAs and all English SA reports from rural areas explicitly assign higher weight to assessed sites' suitability for development, given housing need, as compared to soil (and land) issues.

Results for both case studies are summarized and illustrated below. Figure 43 provides an overview of land-related aspects that have been addressed as part of existing environmental factors in current assessment practice, as identified through the documents analysed. Table 15 displays to what extent the assessment reports analysed apply quantitative and qualitative indicators related to land as a factor, as derived from the review of previous strategies and land-related policy documents. Additionally, appendix A provides a detailed compilation of results according to criteria applied for both case studies.

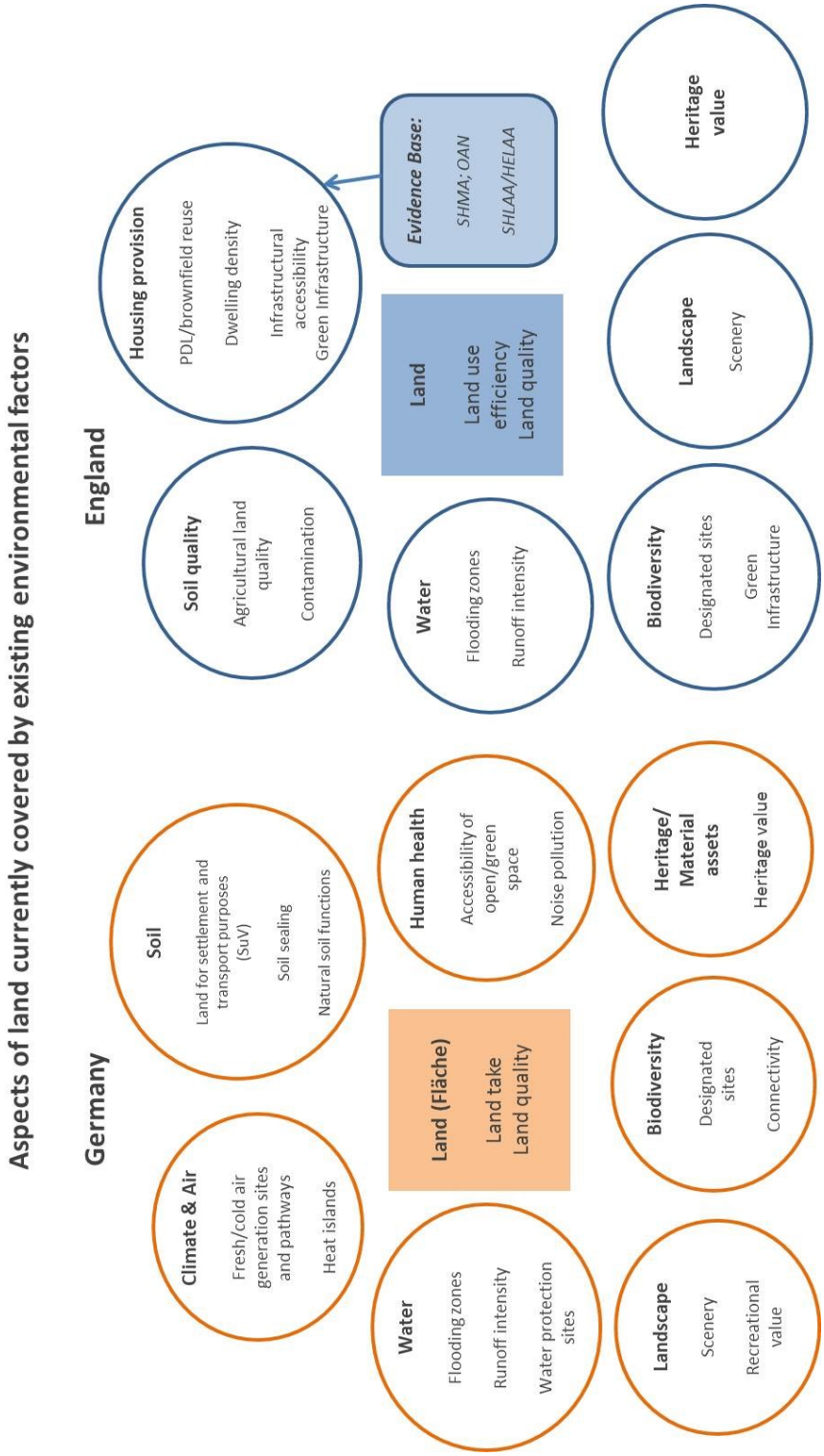


Figure 43: Aspects of land currently covered by existing environmental factors (own figure)

Table 15: Quantitative and qualitative indicators related to land as applied by assessment reports analysed, key gaps highlighted (own table)

Case/Municipality	Document	Aspects of *Land*																							
		Land Take			Land Use Efficiency					Land Quality															
										Soil			Biodiversity		Water		Climate; Air		Land-scape		Population; Human Health		Cultural Heritage
		Additional development on greenfield land/increase in developed land area	Withdrawal of sites with planning permission	Surface Sealing	Brownfield/PDL Redevelopment: argumentative	Site Density: argumentative, or based on general cap (GHZ)	Brownfield/PDL Redevelopment: percentage	Site Density: dwellings/ha	Infrastructural Accessibility	Degree of non-disturbance; filter + buffer function	Productive function/Quality of Agricultural Land	Contamination	Designated protected areas	Green Infrastructure; Open Space Endowment	Surface Water	Groundwater	Cold + Fresh Air: Production Zones and Transport Corridors	Air Quality	Scenic/Visual Value	Recreational Value	Noise Pollution	Open Space Endowmwnt; Green Infrastructure	
Leipzig, DE	Environmental Report Comprehensive Land Use Plan (2012)	X	X	X	X					X	X	X	X		X	X	X	X	X	X	X	X	X
	Environmental report as part of draft binding land use plan Nr. 304 (residential site; 2015)			X						X		X	X	X	X	X	X	X	X		X		X
	Environmental report as part of binding land use plan Nr. 219 (residential site; 2015)		X	X						X		X	X		X	X	X	X	X		X		X
	Environmental report as part of binding land use plan Nr. 311 (residential site; 2017)	X		X	X	X				X			X		X	X	X	X	X	X	X		X
	Environmental report as part of draft binding land use plan Nr. 403 (residential site; 2017)	X		X	X	X				X	X	X	X		X	X	X	X	X		X	X	X
Mockrehna, DE	Environmental report as part of draft binding land use plan (residential site; 2017)			X	X	X			X	X			X		X	X			X		X	X	X
Zwickau, DE	Environmental report as part of draft binding land use plan Nr. 029 (residential site; 2017)									X		X	X		X	X	X	X	X		X	X	X
Delitzsch, DE	Environmental report as part of binding land use plan Nr. 21 (residential site; 2017)	X			X	X				X		X	X		X	X		X	X		X	X	X
Strehla, DE	Environmental report as part of draft comprehensive land use plan (2017)	X		X	X					X	X	X	X		X	X	X	X	X	X	X	X	X
Bremen, DE	Environmental Report as part of comprehensive land use plan (2014)	X	X		X	X				X	X	X	X		X	X	X	X	X	X	X	X	X
Liverpool, UK	Core Strategy Sustainability Appraisal (submission draft 2012)						X	X	X	X		X	X	X	X	X		X			X	X	X
	Local Plan Sustainability Appraisal (including Site Allocations) (consultation draft 2016)					X	X		X		X	X	X	X	X	X		X	X		X		X
Leeds, UK	Local Development Framework Core Strategy Sustainability Appraisal (publication draft 2012)						X	X	X		X	X	X		X	X		X	X		X	X	X
	Site Allocations Plan Sustainability Appraisal (publication draft 2015)						X	X	X		X	X	X		X	X		X	X		X	X	X
Craven, UK	Local Plan Sustainability Appraisal (publication draft 2018)						X	(X)	X	X	X	X	X		X	X		X	X	X	X	X	X
Harrogate, UK	Local Plan Sustainability Appraisal (publication draft 2018)						X	X	X	X	X	X	X		X	X		X		X	X	X	X
Scarborough, UK	Local Plan Sustainability Appraisal (submission draft 2015)						X		X	X	X	X	X		X	X			X	X		X	X

5.5 Summary and Implications for future SEA/SA procedures

Overall, the analysis reveals that land is considered in almost all environmental and appraisal reports scrutinised, however, to a very different extent and operationalized by strongly varying criteria and indicators. With regard to objectives and related indicators applied, it certainly needs to be taken into consideration that the English SA reports, in their function of integrating SEA, also include social and economic aspects of land use, while German EA reports focus on environmental objectives. Further, the analysis differs in scale due to the absence of binding land use plans in England, and the deliberate selection of such plans that prepare the ground for additional land take at the urban fringe for the German case study.

5.5.1 Key findings from a comparative perspective

Generally, a large proportion of EA reports analysed for Leipzig and rural municipalities in Saxony show that assessments of land-related aspects remain confined to assessing impacts within the

scope of the respective site, i.e. with an **intra-plan perspective on potential impacts**. This finding applies to binding land use plan (B-Plan) SEA reports but also to comprehensive land use plans (FNP) for the whole municipality. In particular for FNP, this intra-plan perspective means that the amount of site designations is compared with previous plans, assessing the changing amount of designated sites and changing ratio of built-up and open space but not providing reference figures with regard to the respective plan's contribution to overall targets and national figures on land take and land use efficiency. This also means that **overarching objectives and targets** regarding land take and land use efficiency, despite their frequent mentioning, are **rarely mirrored by actual assessment approaches**, indicators and results. While FNP SEA reports (the limited number of plans of this type analysed here noted), appear to refer to all key land-related objectives and targets by default, i.e. the reduction of land take, the reuse of PDL and the protection of open space, B-Plan SEA reports have not reached this standard, with most of them only referring to some of these objectives or targets and a few ones not mentioning them at all. An explicit consideration of density targets appears to be a relatively new aspect which has only been considered by the SEA report for the FNP Bremen. However, the mainly text-based discussion of considerations regarding densification also suggests considerable **difficulties in defining and applying quantified standards**. Accordingly, the formulation of concrete targets beyond the 30 ha target can hardly be observed, and in parts also reveals difficulties with land use statistics and perhaps of 'user-friendliness' of terminology and underlying data given the confusion of land take and soil sealing by at least one SEA report. Beyond the 30 ha target having been operationalized for the respective municipality by at least two of the SEA reports analysed (albeit a lack of transparency on the method of this operationalization), only BauNVO-derived thresholds for soil sealing are regularly applied to assessment approaches. In their role of defining **maximum sealing rates instead of minimum housing densities**, however, these thresholds rather support assessment results as described above, i.e. positive impacts through generous parcel size and minimized sealing, and cannot be regarded as supporting higher land use efficiency. Nevertheless, the frequent mentioning of the land-related environmental quality objectives formulated for Leipzig suggest their potential influence on establishing land-related aspects in assessment procedures, especially when compared to a less pronounced presence of such objectives in rural SEA reports. With regard to housing figures and demand to be allocated, the role of preceding informal plans and strategies in defining amount and location of sites to be allocated needs to be emphasized.

While soil sealing is mentioned by basically every SEA report in the German case study and also quantified, albeit under an intra-plan perspective as described above, aspects such as land take, reuse of PDL and housing density tend to be mentioned only by FNP SEA reports in a concise way. B-Plan SEA reports only refer to these aspects fragmentarily and in varying combinations. While **land take is mainly specified with regard to the amount of sites affected by environmental conflicts and not with regard to any superordinate figures and targets**, reuse of PDL, where applied to the assessment, is to some extent quantified by FNP SEA reports but **without disclosing actual available PDL potential**. As mentioned above, housing density, apart from Bremen, largely refers to BauNVO thresholds, while land quality is represented by soil quality and characteristics of other environmental factors such as climate and biodiversity. The widely identified **omission of efficiency aspects** is particularly apparent where soil sealing is applied as the main land-related indicator, generating positive assessment results where soil sealing is reduced for the site, and thus without considering the role of the site for overall land take and land use efficiency. One example shows this particularly clearly, arriving at a positive impact due to generous parcel sizes and resulting in a minimum amount of soil sealing.

For the English case, the **absence of an overarching target for reducing land take** on the one hand, and the **legacy of former PPG/PPS guidance documents including targets on proportions of brownfield reuse and on minimum densities** need to be emphasized as key preconditions for assessments. Against that background and the wider focus of Sustainability Appraisal, land-related aspects are considered with regard to land use efficiency, i.e. the reuse of PDL and partly housing density, accessibility of sites, and with regard to different aspects of land quality, in particular green space provision/green infrastructure, contamination/remediation, and agricultural productivity potential of land. Recurring objectives applied by SA reports in this regard (with slight variations in terminology) include the efficient use of land, a minimized pressure on greenfield land by reusing PDL/brownfield, the protection of land and soil quality, and the provision of affordable housing as well as of land for economic development. While rural SEA reports tend to exhibit a stronger focus on local provision for required housing and the quality of the built environment, the Leeds case is an example of also considering the problem of highly biodiverse PDL sites by exempting these from the prioritization of PDL reuse. Targets, as indicated above, are largely derived from former national planning policy, in particular the percentage of homes to be realized on PDL and minimum net housing densities. However, only a limited amount of SA reports actually applies these targets to assessment. It also needs to be noted that relatively low density targets of 30-40 dwellings/ha can only exert a limited role in fostering land use efficiency (see detailed consideration in section 8). As opposed to the German case, targets for housing provision are pre-defined by household projections at national level and further specified by local SHMAs with regard to determining objectively assessed need (OAN), thus ensuring **greater (and quantified) transparency of underlying figures for sites to be allocated**. As described in section 4, however, the question whether these government-defined figures meet local demand is highly debated. Moreover, SA reports also reveal the ongoing influence of now-abolished RSS on the definition of housing sites to be allocated by local plans.

Assessment aspects included in English SA reports strongly mirror objectives mentioned above, i.e. land use efficiency by PDL reuse, accessibility, contamination/remediation, green space endowment and land quality. **Land use efficiency is by default assessed** by the percentage of dwellings on PDL, partly differentiated by its environmental/biodiversity value, and partly by the fulfilment of minimum housing densities or the number of unused SHLAA sites. Further quantitative indicators include accessibility, with the percentage of new development within a certain maximum distance from key facilities, and partly green space endowment, with the amount of public greenspace reachable within a certain distance from new development sites, or the amount of new green space created through the plan. For some SA reports, the amount and type of 'best and most versatile agricultural land' lost to development is also quantified, thereby **emphasizing the productive function of soil**, however. Beyond these indicators applied to SA reports, the role of SHLAAs and also of other evidence base documents such as the Green Belt Review conducted for Leeds need to be noted. While SHLAAs are of varying quality in not only assessing the suitability of a site for development but also the potential environmental impacts by developing a site, the Green Belt review examined includes key criteria for land use efficiency also considered by German land use plans, i.e. the degree of integration of a site into the built-up fabric, its impact on designations for nature protection and on soil quality.

Frequent tone of concluding assessments is on the one hand the mentioning of **tiering**, i.e. the detailed assessment to be conducted at the binding plan level, and a **reduction in the overall amount of sites** by FNP SEA reports. However, at B-Plan level, SEA reports remain largely restricted to intra-plan based assessments with regard to soil sealing and reuse of sites, regularly

resulting in positive impacts through minimized sealing, the non-exceedance of BauNVO thresholds, and a reduction of land take and sealing as compared to previous plans, if applicable. On the other hand, **while a significant negative impact likely to occur on land (or soil) is often acknowledged, its compensation through measures, and its justification through overriding need in the municipality are brought forward**. Albeit their focus on environmental aspects as mentioned, many German concluding assessments also point to the demand for housing (and employment space) with regard to the amount of land take required, resulting in a **frequent higher weighting of a site's suitability for development** and a low-density character of the surrounding area over impacts on soil and land, where alternatives are assessed. Key deficiencies suggested by these findings thus comprise a potential overestimation of the compensatory character of minimization and compensation measures, the widely missing application of reference figures regarding land take and land use efficiency with regard to overarching targets, and the interpretation of generous parcel size and minimum sealing at the B-Plan level as exerting a positive environmental impact. Concluding assessments for English land use plans focus on the role of the reuse of PDL in reducing pressure on greenfield land and in fostering the remediation of contaminated sites. In line with the assessment indicators described above, site rankings with regard to reuse of PDL, loss of best and most versatile agricultural land of different grades and accessibility are applied to the concluding assessment stage. Similar to the prevalent reference to tiering in German FNP SEA reports, a number of English SA reports acknowledge that despite the emphasis on brownfield land some release of greenfield land is necessary of which the concrete impacts can only be identified when the precise sites being developed are known. Repeatedly therefore, a **neutral effect on land-related objectives and targets** is stated.

Requiring further analysis but suggested by the sample of SEA reports scrutinized here, more recent assessments for land use plans in Germany tend to include a more differentiated consideration of land take and brownfield reuse, partly also of housing density issues, compared with the prevalent focus on soil sealing and intra-plan scope of the assessment. No substantial differences can clearly be identified for rural areas. A **higher awareness for land scarcity in urban areas** can thus potentially be regarded as fostering **more differentiated assessment approaches** with regard to land take and land use efficiency. While these indicators show a more unified picture for English SA reports, the case of Leeds suggests an application of a higher number of indicators where problem pressure through the number of dwellings required and the need to release greenfield land is higher. This is prompted by the explicit mentioning of a brownfield monitoring system as well as the compilation of a greenbelt review with regard to the release of sites. Certainly, these findings can only represent the situation for a limited spatial area and for the SEA reports selected. While the highest possible representative character has been attempted utilizing available resources (e.g. by including a selection of land use plans from rather rural areas into the analysis), a larger number of FNP SEA reports and also of B-Plan SEA reports would be required in order to arrive at representative results for both countries.

5.5.2 Implications for future SEA practice

On the one hand, it can thus be stated that improvements to both data availability and assessment approach (suitable indicators, operationalization of objectives and targets) are urgently required in order to arrive at a meaningful assessment of land as an environmental factor. On the other hand, however, the analysis also shows that despite a frequent lack of further operationalisation, land-related objectives, targets and aspects are regularly mentioned by FNP SEA reports and more comprehensive B-Plan SEA reports. Despite a need for operationalizing land take figures with regard to overarching targets and for considering land use efficiency more concisely and based on

quantified indicators, this situation can at least be seen as a starting point for a further refinement and more transparent illustration of plan impacts on land. Similarly for the English case, the standard formulation of land-related objectives and at least partial application of targets regarding reuse of PDL and housing density constitutes a useful starting point for an operationalization of land and its concise assessment. However, more transparent statistical figures on overall land take and the formulation of a national target for the reduction of land take would be required to also identify an individual plan's contribution to these figures. Rather problematic in this regard is the strong focus on agricultural land quality and, albeit a useful initiative in general, the further operationalization of the related database, prompting significant negative impacts in particular where the productive function of land is affected, and a potentially lower weight of other functions. Finally but not necessarily, as studies have shown, the broader scope of SA might facilitate the subordination of resource efficient land use compared to development interests and land demand that could be detected in a number of concluding assessments.

Hence, while a basis for assessing land as an environmental factor in itself has already been created in both case studies, with selected objectives and indicators being applied, different approaches are prevalent in the two case studies, depending on the legacy of previous regulations or strategic objectives and targets. For arriving at a good practice assessment approach that takes key aspects of resource efficient land use into account, **indicators and supporting data need to be developed further in both case study contexts**, with different emphases (**quantification of sub-national reduction targets on land take and of brownfield potential, reuse and density for the German case; potential introduction of targets and database on land take, rethinking of density targets for the English case**). Further, a good practice approach towards linking these mainly quantitative aspects of land with qualitative aspects considered as part of other environmental factors is desirable. A detailed discussion of related options for the German case study will be provided in section 8.

In general and of relevance for both case studies is the role of underlying documents as an evidence base, such as informal development plans or site assessments, for shaping the approach towards land adopted by a formal plan. For Germany in particular and with respect to the **more transparent and quantified evidence base to English Local Plans** as illustrated above for Liverpool and Leeds, it could thus be worth considering tying SEA procedures stronger with these informal strategy-making processes in order to anchor the concise assessment of environmental impacts provided by SEA already at this stage. In particular, the consideration of amount of PDL availability and of unimplemented planning consents, as demonstrated by English SHLAAs and partly Green Belt Reviews, would potentially **enhance a more transparent and accountable consideration of land** as a resource in German EA reports – notwithstanding the contested aspect of assessing land demand and the accuracy of underlying population projections. At the same time, English SA reports could profit from extending the assessment of environmental impacts to SHMAs/HELAAs, linking them with SHLAAs, protentailly also merged to one document, and from a more **spatially specific assessment of site allocations**, linking figures assessed by SHLAAs and SHMAs to concrete spatial entities.

As has been found by Kågström et al. (2013) with regard to the relatively recent introduction of 'health' as a new assessment aspect in EA (see section 3), the framing of new environmental factors tends to be strongly determined by frames used in legislation and policies, as is the case with targets on land take in Germany and (former) targets on land use efficiency in England.

Similarly, however, a broadening of understanding of what health – or, in this case, land – includes by advancing policies and strategies, constitutes a starting point for a more encompassing framing for SEA in the future. This is particularly promising given debates surrounding the net-zero land take concept and dual inner-urban development in Germany or the introduction of brownfield registers in the wake of housing demand and the quest for a concise land use policy in England. This again bears a strong relation as to how practitioners use their "space for interpretation and implementation" (Kågström et al., 2013: 206), and hence this study's focus on potential learning processes in and through SEA.

6 Comprehending land, the role of assessment uncertainties and learning, and starting points for future operationalization: Expert Opinions

The following section will specifically look at results from the expert interviews and by that tackle all three key objectives depicted in section 2: The first part will look at interviewees' perceptions on what aspects of land have been covered by EA procedures and what understanding of land has shaped assessment practice, hence refining and scrutinizing what has been found in the previous section **(Objective 1, "Status Quo").** The second part approaches the theory-led questions in focus by applying the analytical framework developed in section 3 to the case studies analysed here. In that regard, it is asked what types of assessment uncertainties prevail and to what extent these are transparently displayed, connected with the question how and to what extent interviewees observe learning processes and what key factors evoke learning in and through EA, specifically through integrating a new environmental factor such as land **(Objective 2, Role of Assessment Uncertainties and Learning)**. Finally, part three looks at interviewees' opinions on potential future framings of land, indicators suggested for its operationalization and related methodological issues **(Objective 3, Future Assessment Approach")**. Interview results will first be presented and subsequently discussed and further contextualized in section 7.

6.1 Unraveling the role of land in SEA to date

How has land been addressed in EA to date? What role do different planning scales play in that regard?
As part of which environmental factors has land been addressed to date; what do key interdependencies consist in?

Generally, a number of German interviewees state that to date land has been covered to some extent, mainly in order to support other issues as part of existing environmental factors. Here, soil is by far the most frequently mentioned factor, followed by biodiversity, water, climate/air, landscape and human health, hence confirming the picture unfolded by the analysis of documents in the previous section. The non-binding character of soil-related objectives and strategies is seen as hampering its role, and thus the one of land, in current EA practice. According to the majority of German interviewees, land is mainly relevant on the scale of the comprehensive land use plan, designed to make the general decisions on land use (for problems in de facto fulfilling this purpose see section 4). Some also mention the problem of concrete decisions concerning the type and amount of development in fact often being made at the binding plan scale, whereas on that scale, mainly assessment aspects such as the amount of soil sealing and green space endowment are applied, with little impact of binding land use planning on the assessment of alternatives.

> In my opinion the key deficit is that at binding plan level there are no fundamental strategic options left to choose from, it is set that this site will be developed, the major question that is discussed here only relates to the amount and extent of development (C 14: 31)

> On the comprehensive plan scale we cannot decide about individual sites yet, that's what the subsequent scale has to do because […] let's assume we have designated a new housing site at the urban fringe, we don't know at that point how much land, where, which density, number of storeys, green axes, water will be realised there, so we cannot assess impacts that precisely, that's simply on a different scale, left to the binding plan (A 12: 29)

> It has actually always been argued with land, just so far not by the term as such (C 16: 98)

Similarly in line with the results of the document analysis of English EA reports, most interviewees on the one hand mention land use efficiency issues such as the ratio of brownfield and greenfield land, greenbelt designations, and, to a lesser extent, density considerations, on the other hand aspects related to land quality, in particular agricultural land quality, soil quality, biodiversity, water retention and contamination as land-related aspects covered so far. Many interviewees also note that aspects of land are taken up by a range of existing environmental factors but that land as such is hardly addressed in EA reports. Further, a lack of binding standards, methodological problems in framing land as a comprehensive factor and addressing interdependencies in a meaningful way are repeatedly mentioned.

> Well, I mean, basically it comes into soils I think and that's it. That's probably it. (C 8: 42 - 42)

> If you asked most of us what we thought of land in impact assessment, I would think most people would probably jump to either contaminated land or agricultural land classifications. (C 4: 4 - 4)

> Because people think, you know, that's the inherent art of what we're doing, in the SEA process, and equally within the EIA process, you know, exploring the implication of how development would affect perhaps greenbelt zoning or the use of brownfield land, or best and most versatile agricultural land and land use changes in that sense. (A 3: 23 - 23)

What key stakeholders are involved in assessing aspects of land?

For the German case, active cooperation between sectoral departments is regarded as key for considering land as an intersectoral issue: Repeatedly mentioned are the quality of communication with authorities, nature protection agencies in particular, and the openness of their representatives for soil and land issues. The individual stance and professional background of those conducting EA is emphasized as influencing the weight of individual environmental factors. A problem particularly pointed out for SEA is the lacking separation between plan-making and decision-making, which in some cases may lead to reduced evaluation scope for EA reports and a predominance of the authority's position. With regard to participation, interviews show a mixed picture: On the one hand, problem pressure is mentioned as a key factor for land to gain weight in EA procedures, emphasizing the importance of early participative processes, in particular with regard to potentially opposing investor interests. On the other hand, a lack of public accessibility of and interest in EA procedures is perceived as an adverse factor by some interviewees.

> It's also a matter of the nature protection authority, how good the communication is, the arrangements. You also have authorities that are rather restrictive, where communication doesn't work so well. It depends a lot on stakeholders... (C 15: 247 - 247)

> I think it's important to shift the discussion on a deeper level with and that's where I know the individual case officers and with this I try to gain more awareness for the impacts of land use (C 14: 143 - 143)

For the English case, a decisive role of the political power constellation, local problems regarding land availability and the individual stance of local authorities are mentioned, similar to the German case. Dedicated interface managers that connect overarching themes such as sustainability across involved departments, as well as the general attitude built on environmental interest are described as decisive factors in enhancing the weight of land-related aspects in decision-making procedures. While CPRE as a campaigner for the protection of land as a resource is mentioned, the local planning authority is regarded as the only one with a holistic interest in land by some interviewees. The lack of public interest in land-related aspects apart from NIMBY phenomena can also be confirmed for the English case study.

> I suppose the only body that has an interest in land as an entity is the local planning authority, […] It's the local planning authority who decides what consents are granted for and how land might be developed. So probably they're the organization that has that round view on things, the others they've got a partial interest in what happens on and under land. (C 12: 35 - 35)

> The problem comes when you develop the plan and the developers want to head straight for the Green Belt development, because they want to make their money. (A 4: 89 - 89)

Which land-related objectives and targets are applied to assessment procedures?

For the German case and little surprisingly, it is mainly the federal 30 ha target on land take that is referenced as part of the environmental factor soil in current practice. While some authorities mention the existence of derived sub-targets at the federal state or regional scale, most consultancies observe the abstract and non-binding character of the target as being an obstacle to making a real impact on assessment and decision-making procedures.

> The 30 ha target was always mentioned everywhere. That was clear. (A 12: 70 - 70)

For the English case, the priority use of brownfield land is mentioned most frequently, whereas the abolition of former regionalized housing figures, as well as of quantified targets on PDL reuse and density are largely criticized for having reduced clarity. One authority explicitly mentions a locally defined target for brownfield reuse. Land take as such is only mentioned by two consultancies, in that a minimum amount of land take is aimed at, however, without identifying quantified ratios, whereas several interviewees mention the strong role of greenbelt protection. Indirectly, however, land take is also mentioned by two consultancies and one authority referring to quota for the loss of high value agricultural land (however, only referring to the productive function of land as mentioned above). Density tends to be seen as having lost in importance, while former targets are regarded as not having been very ambitious in achieving efficient land use.

> So on land use, so in the end, we don't use quantified figures. (C 2: 56 - 56)

> National planning policy framework and that states that you should, kind of encourage brown field land use, but it doesn't say you have to. There's no legal requirement anywhere that you have to use a certain amount. (C 5: 14 - 14)

> And then there's others, densities for example, housing densities, how many homes per hectare, there used to be rules, then the previous government abolished them, didn't want to be too prescriptive, but now they're talking about bringing high densities back in, but only under certain circumstances. […] (A 2: 19 - 19)

What land-related aspects and indicators are applied in assessment procedures; what assessment methods are used?

Taking up on the lack of binding standards, the German case study confirms the predominance of rather subjective thresholds for assessing land-related aspects, for instance regarding the maximum rate of soil sealing in housing sites. A major shortcoming, mentioned by several authorities and consultancies, consists in the lack of reference values, i.e. in assessments staying restricted to absolute figures of land take that are solely indicated for intra-plan effects or with reference to previous plans, without being set in relation to overarching objectives. Additionally, a lack of connecting these figures to land values and characteristics is observed. This lack of standards is also reflected in the prevailing use of argumentative assessment methods. Another

factor that is brought up by most interviewees is the role that informal plans and strategies play for discussing housing demand, available housing sites, and locational criteria, in particular.

> Ultimately we created great balances and minus minus minus, but what really was behind that, that's what we didn't do. We only calculated m^2 or ha. (A 12: 173 - 173)

> That's where I found it dissatisfying that the classification of sites or of conflict potential was mainly based on actual land take. I mean, the significant impacts primarily were based on the loss of land on affected sites in m^2. And that was not exactly edifying to say, that site is larger, therefore it's a bigger loss than another site. (A 12: 224 - 224)

> You often create your own data, such as, I have the project here now, of these dimensions and that means a sealing of a certain amount, and this is compared to the previous sealing rate, and then you will be able to identify a certain additional soil sealing (A 8: 138 - 138)

Similar to the German case, the lack of standards and the non-binding character of soil- (and thus often land-) related objectives and strategies are frequently brought up for the English case as well. The problematic definition of housing targets as part of evidence base documents external to SEA is particularly emphasized by one authority, with little local influence on the actual number, and the lack of (public) comprehension regarding the role of SHLAAs for allocating housing sites. Another point raised by individual interviewees is the methodological inadequacy of many matrices-based EAs that fail to carve out key points of assessment. As an alternative to that, a systematic consideration of both required housing figures and locational scenarios for new housing sites through SEA is given as a good practice example, for instance.

> A lot of UK SEAs is still objectives-led, so the government expects you to come up with a list of environmental objectives that are generally based upon the topics that are listed in the directive, and then you compare those against the objectives of the plan, the policies of the plan, and then the site level. Now ineffective SEA just uses the objectives and to be honest, it tends to be pretty vague and woolly. (A 3: 25 - 25)

> It wouldn't be like, that's high quality agricultural land there's no way we can turn that. It's not in the same kind of level as say a nationally protected wildlife site. (C 8: 46 - 46)

What data and information is called upon for assessing land-related aspects? What land-related data deficits are observed?

The German interviews mirror the prevalence of argumentative assessment methods and display a varying picture with regard to quantitative data on land. With regard to land take, the problematic structure of land take statistics and flaws due to recent conversions are repeatedly mentioned. Looking at data on soil sealing, their quality is observed as being strongly dependent on individual authorities and the availability of recent surveys. Concerning land use efficiency, for determining the actual realisation of housing on PDL, planning permission statistics are mentioned as a usable proxy. Land demand for housing is stated to be derived from population forecasts and informal plans and strategies, as mentioned above. For data on land quality, the importance of a parallel landscape plan-making process, and in particular detailed biotope maps are regarded as crucial data sources. Further, guidance on minimum standards of green space provision is mentioned. Regarding deficits, the quest for methodologies to set land take caused by an individual plan in relation to overall land take and a respective reduction target, such as the 30 ha target, is brought up most frequently. For land use efficiency, guidance and thresholds for assessing the availability of PDL potential and its capacity to replace additional greenfield development are mentioned. Several interviewees also consider assessment scales for land quality features useful, in order to enable more accountable weighting decisions.

> There is the target of not taking more than 30 ha additional land per day, but related environmental protection objectives are missing, binding ones at the municipal scale. (C 15: 79 - 79)

> So what we didn't do was the question, if we compare two sites and with one of them there are more severe impacts on productive soil and with the other one there are more severe impacts on 26 type biotopes, then it's obviously difficult to arrive at a comparison and to say, one of them is more valuable than the other (A 12: 229 - 229)

For the English case, interviews show a mixed picture. A third of interviewed consultancies state that data is available but that a key problem lies in its meaningful and concise use and interpretation. A key role for assessing land quality, and, indirectly, the significance of land take, is attributed to data on agricultural land value (i.e. on the productive function of land) and its national classification scheme, as mentioned by three consultancies and authorities each, while several interviewees criticize its lack of detail for use at the local plan scale as well as its infrequent updating. Similar to the German case, further data on (ecological) land quality are derived from environmental databases such as on designated protected sites. Regarding deficits and future needs, points raised by several interviewees include local surveys for providing detailed data on land quality, and its stronger role in assessment beyond soil and agricultural land quality. Moreover, one consultancy and one authority explicitly claim a more comprehensive perspective on land as such, thus covering land take in connection with potential loss of functions it provides. Indirectly, this also appears in several interviewees' interest in addressing land through an improved consideration of cumulative effects. Data on land take and land use efficiency is mentioned less. Some consultancies mention data on PDL as being dependent on local authorities' databases, and using desk-based research through aerial images etc. in cases where these are not available. A more systematic consideration, for instance through a nationwide availability of PDL registers, is thus repeatedly suggested. For land take, one authority emphasizes the role of local knowledge in order to determine how much land has been converted into housing sites over a certain period of time. Guidance documents from other devolved nations of the UK or for other sectors are mentioned as important reference documents as to how to address land issues. As referred to by some interviewees, the Scottish SEA Gateway provided as an open database by SEPA (Scottish Environment Protection Agency) plays a key role in this regard.

Table 16 summarises key data gaps currently observed with regard to land.

> One of the problems with the agricultural land classification data is that it's not really supposed to be used at a kind of detailed scale. (C 8: 50 - 50)

> I mean I quite personally haven't seen a lot of brownfield registers yet. I'm sure local authorities are, I think quite a lot of local authorities are in the process of creating them, but I think at the moment it's fairly rare to find a good dataset. (C 8: 28 - 28)

> I'm not sure that is necessarily an aspect of land, but it may well be and that is the cumulative effects; issues which are still, generally, poorly addressed and in a way, a lot of those cumulative effects, will materialize in relation to land, whether that be as a receptor, or as a medium through which other factors manifest themselves (C 10: 35 - 35)

Table 16: Key land-related data gaps and methodological shortcomings (own table)

Key land-related data gaps and methodological shortcomings	
Germany	**England**
Land take (and soil sealing): demand; data structure; operationalized targets; thresholds	Land take: demand (OAN/SHMAs: transparency); standards/thresholds
Land use efficiency: consistent local brownfield data; standards/thresholds	Land use efficiency: consistent local brownfield data/registries
Land quality/functions: links with quantity; thresholds	Land quality (productive value): resolution and up-to-date database agricultural land quality
	Land quality/functions (ecological): links with quantity; standards/thresholds; detailed local data/surveys
	Prevalent objectives-based approach and matrices (>> receptor-based approach and key impacts?)

What are land-related lines of argumentation in concluding assessment; what are final decisions shaped by?

Generally, German interviews reveal a relatively low weight of land aspects in comparison to others, in particular biodiversity and human health, as also attributed to the lack of binding standards in this field. While interviewees differ in their opinion on how well land has been addressed by SEA to date, overall consensus is found with regard to its lack of assertiveness in final weighting, repeatedly ascribed to the predominance of argumentative assessments and the lack of indicators and ratios concerning what the individual plan means for land. Two consultancies explicitly underline the potential of land being addressed as a separate environmental factor for a more pronounced role in future EA reports.

> Land as a topic does not possess the role it should have in weighting decisions, because undeveloped sites are still more attractive regarding an economic point of view, given lower costs, you don't need to demolish anything, deal with contamination, or handle maybe unclear property conditions (C 14: 45 - 45)

> Species protection law will remain the sharper sword, but we need more awareness for land, and that's why I really appreciate land as an individual topic (C 14: 70 - 70)

> Yes that's hardly being considered, and particularly that's one of the chances, to develop one or more new indicators, for it to gain in weight, to be considered under land (C 16: 109 - 109)

For the English case, a significant number of interviewees similarly observe a weak role of land aspects in final weighting, while difficulties in reliably judging this role due to the current practice of land aspects being covered by other factors is also acknowledged. Comparable to Germany, the stronger role of factors such as human health and biodiversity that dispose of binding standards and related thresholds are mentioned repeatedly. Further, the regularly overriding role of housing need and economic interests in SA is seen as an obstacle to a higher weight attributed to land aspects. However, at least one authority also observed improvements with regard to how land has been addressed over time, changing from a mere precondition taken for granted for development to a factor assessed at least partially for potential impacts through development. Notable for the English case is the fact that three consultancies and four authorities do observe a role of land in providing supporting argument for finding locations or implementing plans with less impact on

the environment overall. Almost half of the interviewees emphasise the role of problem pressure, i.e. in particular high land demand in the South of England, together with sensitivity towards greenbelt release, and of an effective assessment of alternatives for a serious consideration of land in SEA.

> It's rare to see a plan or a programme that's radically modified through the findings of the assessment topics. (A 1: 59 - 59)

> It's a bit of an artifice but at the same way it isn't necessarily because at the same time if you hadn't done the SEA/SA, then you wouldn't have made these changes, it would never have occurred to you that there were worthwhile things to change. (A 2: 25 - 25)

> And what I quite like about them is whilst they remain a mandatory requirement for you to do, if we are being pressured from whatever source to change something, and we say, look, if we do that, then it'll score poorly against the SEA/SA and that means we shouldn't be doing that. (A 2: 63 - 63)

6.2 Assessment Uncertainties and Learning

What do assessment uncertainties consist in?

The German case displays assessment uncertainties mainly with respect to the lack of a professional consensus on assessment methods and standards, as well as missing or only vaguely formulated objectives, which almost all consultancies state as a key uncertainty. Most consultancies and authorities observe the operationalization of these vague objectives, and the definition of thresholds for significance, at the same time considering locally specific context conditions, as a key problem. With regard to uncertainties in weighting between all environmental factors, it is mainly insufficient information about spatial carrying capacities, for instance with regard to figures on how much housing can be accommodated by the existing urban fabric through PDL reuse. Further uncertainties are reported with regard to assessing interdependencies between environmental factors, often leading to their mere description without assessing their significance. With regard to land it is in particular the missing operationalisation of the 30 ha-target for the regional and municipal scale, and thus its fuzzy treatment in SEA that is mentioned as a key uncertainty by German interviewees. Thus, the inability to determine precise land take at the comprehensive municipal scale is mentioned as an uncertainty for assessment. Further consideration is given to the partly contradicting issues of PDL reuse, green space provision and climate adaptation that one consultancy mentions as a major uncertainty in weighting the different factors as part of SEA. Another point raised by several interviewees is uncertainty inherent to projections of land demand for the respective type of use.

> Well the 30 ha target isn't graspable for us because we don't know what to orientate on, depending on which reference values one takes, the results are different (A 12: 140 - 140)

> One can say, that's 20 ha that I utilise here. But such a figure can only be contextualised in a verbal-argumentative way, so you can't say by some threshold, that's too much or too little [...] In practice one tends to avoid such a result that clearly expresses: that really is a lot! (C 13: 96 - 96)

> Related to this soil protection concept it has been of concern for us for years that there is no appropriate data on soil sealing, and no updating of existing data either. (C 17: 45 - 45)

The English case similarly shows that major uncertainties include lacking data or insufficient data quality. This does however differ between interviewees, with two consultancies being confident about elaborate methodology to deal with uncertainties, whereas a third of consultancies and one

authority mention the lack of detailed data and targeted surveys at the local scale. In that regard, lack of data on land quality and the amount of land required are brought up again by several interviewees. The problem of how to assess brownfield as being generally preferable to greenfield when the particular brownfield site disposes of a high biodiversity value is brought up by one authority. Another issue mentioned by three consultancies and two authorities is ambiguity about the effect of proposed mitigation measures, also referring to the lack of monitoring mentioned above. This is also connected to the lack of national guidance on SEA methodology and coverage of (new) environmental factors brought up by the majority of interviewees, particularly referring to changes in the planning policy framework. Finally, discontinuity of knowledge, in particular where personnel changes occur or authority positions are not filled again, is brought up as creating uncertainties in assessment procedures. Another key uncertainty observed by the majority of interviewees is the coverage of cumulative effects. Two interviewees also observe that uncertainties and the 'fear of legal challenge' lead to longer EA reports or to uncertain assessment decisions where negative ones would have been more appropriate. A systematic compilation of major assessment uncertainties derived from the interviews can be taken from table 17.

> When we appraise sites options, if they fall within agricultural land, there's no national guidelines, or standards or thresholds to say that if there's a loss of x amount of land, this is significant, there's nothing, there's no guidance at all. So we kind of just have to make our own guidelines, make our own kind of thresholds. (C 5: 100 - 100)

> I think there's a big issue, particularly in SEA, about the presentation of results. We have a lot of matrices with ticks and smiley faces and no really clear process of drawing out what the key impacts are. (A 1: 59 - 59)

> I think actually mitigation measures are often a problem; there's quite often a lot of faith put into mitigation measures, but not always a great deal of evidence (C 10: 45 - 45)

Table 17: Major types of assessment uncertainties (own table)

Major types of assessment uncertainties	
Germany	**England**
Vague objectives: Reduction of land take; protection of greenfield land	Vague and changing objectives: NPPF and (changes in) planning policy
Lack of standards/thresholds: Operationalised objectives/targets Definition of significance: Carrying capacities; role of brownfield potential	Lack of standards/thresholds Definition of significance
Data availability: Land take; land demand	Data quality and availability: Land quality; land demand (OAN, SHMA; SHLAA)
Interdependencies; indirect impacts, cascading effects	Cumulative effects
Weighting: Brownfield reuse and green/open space provision	Weighting: Brownfield reuse and biodiversity value
	Impacts of plan implementation (lack of monitoring) Efficacy of mitigation measures

To what extent are assessment uncertainties displayed transparently? What effects does a transparent display of uncertainties result in?

German interviews show a mixed picture when looking at the extent to which assessment uncertainties are displayed transparently. While some doubt that these are openly communicated, without detailing this further, others state that at least methodological uncertainties and gaps in data availability are mentioned in EA reports, hence largely confirming the impression gained from the document analysis. A key effect of explicitly disclosing uncertainties is seen in enhanced transparency of the assessment process, as explicitly stated by one consultancy. However, two authorities and consultancies each clearly doubt a significant effect of disclosing uncertainties, mainly attributed to a lack of detailed engagement in EA reports by decision makers as well as to a lack of concise monitoring. Two interviewees also clearly criticize the lack of focus arising from lengthy environmental reports, with uncertainties rather evoking extensive argumentation.

> And with regard to baseline data that's being done. I doubt, without being able to provide proof of that, that it's being done with regard to intrinsic uncertainties of models, probably that's often being recognised (C 16: 156 - 156)

> What is done too little in practice, is to disclose the motifs of assessment. (C 13: 267 - 267)

This mixed picture is similar for the English case: Some consultancies state that uncertainties are not transparently explained in EA reports while the majority of interviewees indicate that uncertainties are displayed but do not necessarily see added value in that. An important point raised here is the requirement to be transparent with regard to potential legal procedures, with three consultancies explicitly pointing to the need for and effect of disclosing uncertainties in avoiding future problems. The perception of uncertainties leading to longer and less focused EA reports is represented by two consultancies and one authority, with the balance between comprehensibility for non-experts and precision of the report being acknowledged as a major challenge by some. Also, however, the effect of an improved capacity to respond are mentioned by two consultancies, as well as by IEMA that brings up the role of discussion with regard to defining standards for assessing land quality.

> And it will typically be a paragraph that's called 'Technical difficulties encountered' and it might have a sentence or two about some baseline data that wasn't available [...](C 11: 139 - 139)

> We try to, we try to. Currently for example, I'm writing the baseline for the new version of the local plan, for the appraisal process and within that you are required to identify data limitations and you're also required to produce a 'no change' scenario. So yeah, we have to consider that. (C 9: 100 - 100)

> Public inquiry, we have to deal with them, I think we're asked a lot more questions now from local authorities and hearings about, even the public is better involved and we will be asked the questions and we have to [...] identify what the uncertainties are and what the implications might be. (A 4: 131 - 131)

What experiences and approaches exist with regard to reducing assessment uncertainties; to what extent and how have improvements in addressing assessment uncertainties been achieved?

Reflecting on German interviews, inter-sectoral communication and exchange of data and information, and hence working in multi-disciplinary teams in SEA, appear as a key element of improvements via disclosing uncertainties, as particularly observations by one authority (here represented by a dialogue between two employees as part of an interview) show:

> Yes I think that's what we need to talk about again, I'm not quite sure what we - you only need to look at my site profile - but we didn't take that one as a basis for the sub-plan housing - I see - definitely not, and there lies the rub (A 12: 234 - 238)

Further, experience and targeted knowledge acquisition, especially given requirements through new environmental factors, are detectable from two consultancies' responses. Beyond those aspects, findings on approaches towards tackling uncertainties have been comparably scarce for the German case.

For the English case, the role of both public participation and inquiries and of inspectors' queries can be observed as a key factor in developing approaches for dealing with uncertainties and advancing methodologies, as mentioned by three consultancies and one authority; however, and as illustrated above, this may as well lead to obscure and lengthy EA reports with a lack of clear results. Further, the role of reviews, such as through the IEMA quality mark procedure, is mentioned by one authority as improving the way of dealing with uncertainties. Beyond that, experience and experiential knowledge constitute a major aspect, both with regard to a stronger awareness for previous mistakes or omissions and to an accumulating body of knowledge on good practice from previous EAs, as observed by three consultancies and one authority. Further, targeted knowledge acquisition through new guidance, data and technological possibilities, as well as training opportunities constitute a second major element, as about half of consultancies' and one authority's responses show. Partly, and explicitly brought up by two consultancies, this is even conducted in an institutionalized way through lessons learnt sessions and through IEMA-based reviews. Communication and professional exchange within teams and across a community of experts are mentioned by five interviewees. One consultancy also points out the importance of referring to local experts in order to make use of localized knowledge for the assessment process.

> I think we learn a lot from where we haven't considered something thoroughly and later on it becomes a problem and when we go back and review it we think that if we'd actually approached that earlier, at an early stage, then we would've been able to either, you know, consider mitigation for that or might have looked up at alternatives. (C 9: 108 - 108)

> I think, you're only likely to get significant improvement if there's actually standard guidance really. (C 8: 64 - 64)

> We learn on every project and we also submit a number of our environmental reports to IEMA each year. Those are reviewed and then we get feedback. So we have a lessons learnt process on a lot of the projects that we work on as well. (C 9: 106 - 106)

> Yes, last time I did that very formally was at the end of the last set of reviews of water resource management plans. I convened a working group to discuss our experiences and I put it all together and wrote it up and then circulated it with lessons learnt, for us to employ in common ground. (C 2: 86 - 86)

To what extent have plans been changed through considering aspects of land in assessment; to what extent has the approach towards land changed and by what factors?

Expert interviews conducted for the German case study suggest that changes in addressing land are caused through several factors. However, most of these are only mentioned by one or two interviewees and hence of limited general validity. One factor consists of problem pressure, in particular growing land use conflicts that also lead to more detailed and precise EAs according to one consultancy. Further changes are attributed to updated guidance documents and data availability as well as to growing experience and comparison of own work with other projects. Dedicated lessons learnt sessions are hardly observed by German interviewees, changes are rather seen as also being dependent on the motivation and stances of responsible experts. Whereas it is explicitly stated by one consultancy that changes in regards to land have not been

manifested in altered ways of dealing with development permits yet, an enhanced awareness for considering aspects of land can clearly be perceived.

> Means of EA lie in defining certain measures for avoidance or optimising the location of projects or the scale of projects, and when you've managed to do that, you've achieved quite something (C 13: 273 - 273)

> And as part of this seminar that I mentioned the new factor was announced and that it was unclear in what way it would have to be considered (C 17: 12 - 12)

> That's why I think that it's probably best if there is always someone responsible for SEA involved in planning who always thinks about what is required for assessment. And if that SEA expert properly documents the key arguments of environmental relevance for the decisions taken throughout the plan-making process throughout, material for the SEA report is actually there in the end. (C 13: 309 - 309)

Similarly, the English case shows changes in addressing land mainly with regard to an improved knowledge base, e.g. through site surveys, as stated by five interviewees. Changes are further attributed to growing experience, to team discussion and the role of interface managers linking the various sectoral interests and professions involved in SEA, where applicable. While direct influence on decision-making is regarded as being limited, SEA is seen as being helpful for argumentation and raising confidence in negotiation through systematic data compilation on land use, as seven interviewees state. Figure 44 depicts an overview of the most frequently mentioned factors described here.

> So I suppose there's been a kind of gradual trying of different things and evolution, but I wouldn't say there's been any kind of radical change in the last ten years. (C 8: 48 - 48)

> We have achieved some very good things with SA and SEA in the past. (A 4: 59 - 59)

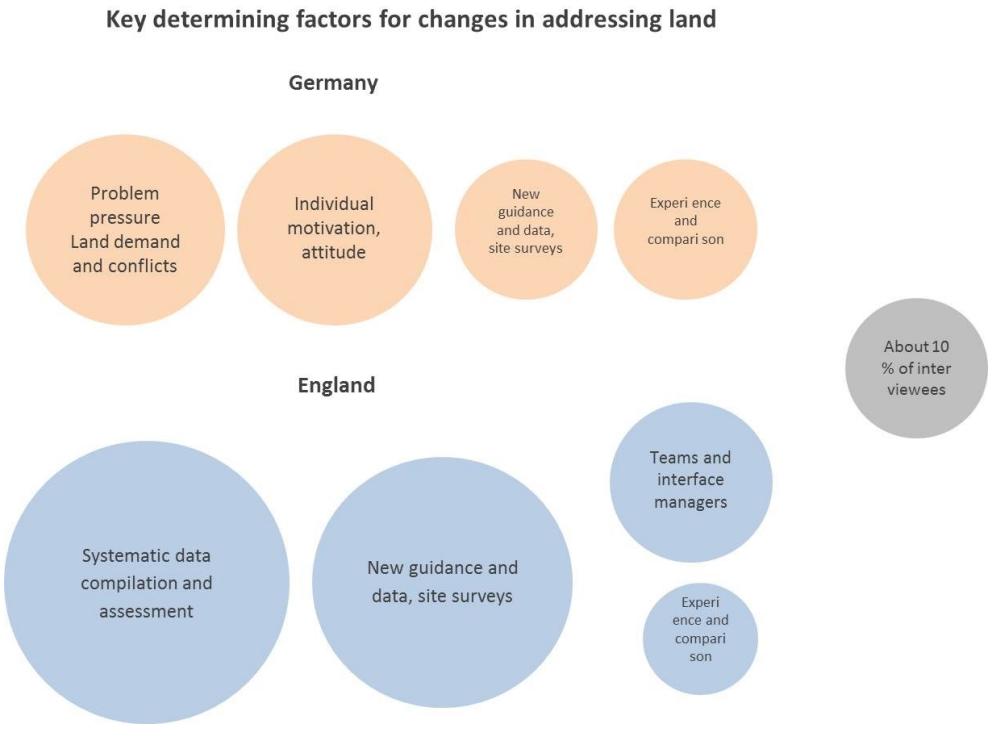


Figure 44: Determining factors for changes in addressing land (bubble size as a proxy for relative frequency of mentioning; DE: 11=100; England: 18=100; own figure)

What factors support learning processes in the course of and as a result of EA procedures?

German interviews reveal a number of key factors for learning in EA, with both problem pressure and preceding EA procedures constituting the most frequently mentioned ones. Problem pressure is mentioned by six interviewees, specified with regard to land use conflicts, loss of land quality and housing demand. For Leipzig, changing trends from shrinkage to growth are regarded as having caused more awareness and necessity for considering aspects of resource efficient land use in assessment. Previous plans and EA processes are mentioned as having evoked the integration of land-related aspects such as a gradually standardized integration of land quota, observed by three authorities. Insights from model projects and dedicated research projects are mentioned as influential by about a third of the interviewed experts. Further factors for learning observed by individual interviewees consist in trainings and research results, while these are seen as depending on the precondition of interest and a continuously updated information base. Three experts each mention the involvement in overarching working groups and the availability of publications, information material and guidance, intra-team exchange and discussion as well as exchange in professional associations and working groups, as major aspects. Additionally, the integration of a dedicated SEA expert into all plan-making stages is mentioned as supporting learning processes. Public participation is mentioned by two consultancies as a factor for learning, providing new input and an increased motivation to prevent conflicts. Two authorities also mention external reviews of EA reports as key catalysts for learning. Another important reason for learning is observed in legal requirements, with eight experts attributing methodological improvements to overarching objectives and consultations, with some also mentioning legal action/lawsuits as key drivers. The German interviews also reveal a couple of good practice examples mentioned, mainly referring to recent comprehensive land use plans (FNP) issued for larger cities with more than 500,000 inhabitants. New elements mentioned comprise of a more transparent depiction of ratios between built-up surface and open space (e.g. Frankfurt), the application of operationalised quota for land take (e.g. Düsseldorf), and the application of density values to be achieved (e.g. Berlin) or of densification zones (e.g. Hamburg).

> Agricultural land is not that easy to get anymore, since it can be profitably used in other ways, not only as land for development. That has changed, the competition for land has grown. (C 15: 18 - 18)

> What has come on board since then is the need for justification when agricultural land is to be developed (A 12: 104 - 104)

> It's key to have guidance at hand on how the environmental factors should be covered. That's being developed further, particularly related data, that leads to a continuous advancement of EA results. (C 15: 108 - 108)

> And then there's always quite a lot from outside, it's discussed with the client or as part of consultations, or is taken up somewhere, that's not clearly target-oriented (C 13: 187 - 187)

> On the one hand through exchange of experience, how do others do that and are there new methods? And on the other hand certainly through lawsuits, requiring improvements to suffice formal requirements (C 16: 120 - 120)

> Most innovations actually stem from legislation at the moment […], pulling planners out of daily grind. When a certain practice is judged as non-compliant, that's when practice regularly wakes up and reacts. (C 13: 190 - 190)

The English case study also reveals a strong focus on problem pressure and previous EA procedures as factors for learning. Particularly land demand arising from housing need (and housing figures) is mentioned by eight interviewees as evoking methodological improvements, such as detailed local land surveys and a strengthened consideration of activating brownfield land. Previous EAs are mentioned by about half of the interviewees as evoking learning. This is also

connected to the role of experience and trial-and-error as well as team sessions dedicated to analyzing good practice as well as mistakes. An explicit organization of lessons learnt processes is brought up by two interviewees. Learning related to experience is referred to by more than half of the interviewees, including the consideration of additional aspects of land. In this regard also the role of guidance from other fields and learning through review procedures are mentioned. Knowledge about new research results and innovative approaches is mentioned by six interviewees as key to methodological improvements. Accordingly, communication and exchange as represented by exchange with other consultancies, cross-departmental working groups, open knowledge databases and professional associations are mentioned by more than half of the interviewed experts. A beneficial role is further attributed to consultations' responses, as well as to public participation, in particular with regard to the question of greenbelt land release, as brought up by two interviewees. Frequent mentioning further applies to legal requirements in their role as supporting learning in EA, and the role of lawsuits/legal challenges as mentioned by nine experts. Further catalysts mentioned by individual experts comprise dedicated land policy, locally defined targets, interest of responsible experts as well as client priorities and competition. Good practice is raised by reference to innovative instruments such as compensation funds (financing brownfield regeneration through charges for additional greenfield development), to detailed guidance and training opportunities and of interface managers, connecting various sectoral duties and interests involved in SEA. An overview of factors for learning observed by the interviewed experts is depicted in figure 45.

> I think the public are asking more questions. I think there's a lot more public pressure. (C 5: 82 - 82)

> So nationally you would have to report every year about things like the density of development in the local authority and I thought it was very helpful to have that kind of comparator, you could see how your local authority was doing against all the others. So in a way, if you're lagging far behind, then people could say you're not planning well. (C 11: 15 - 15)

> We also benefit from looking at other practices. When people start, I always try to get them to reflect their experience on what we do and ask the question of how we could do it better in their opinion. (C 2: 78 - 78)

> And I think because I don't have an environmental background and I don't have a planning background, ehm, enabled me to commence things with fresh eyes. (A 7: 5 - 5)

> If you have a look at […] Council and their Core Strategy, they have done really quite a nice job on alternatives and they discuss, like what the need is for housing and where the houses should go. So in terms of alternatives they start with how much need do we have and they look at something like ten reports, different dimensions, which basically say, for us need is anywhere between like 160 homes and 800 homes per year. Then they take four of those numbers, the highest the lowest, two in between and say what will be the impact of this housing growth. Then they say "We have chosen 200 and something because". (C 11: 87 - 87)

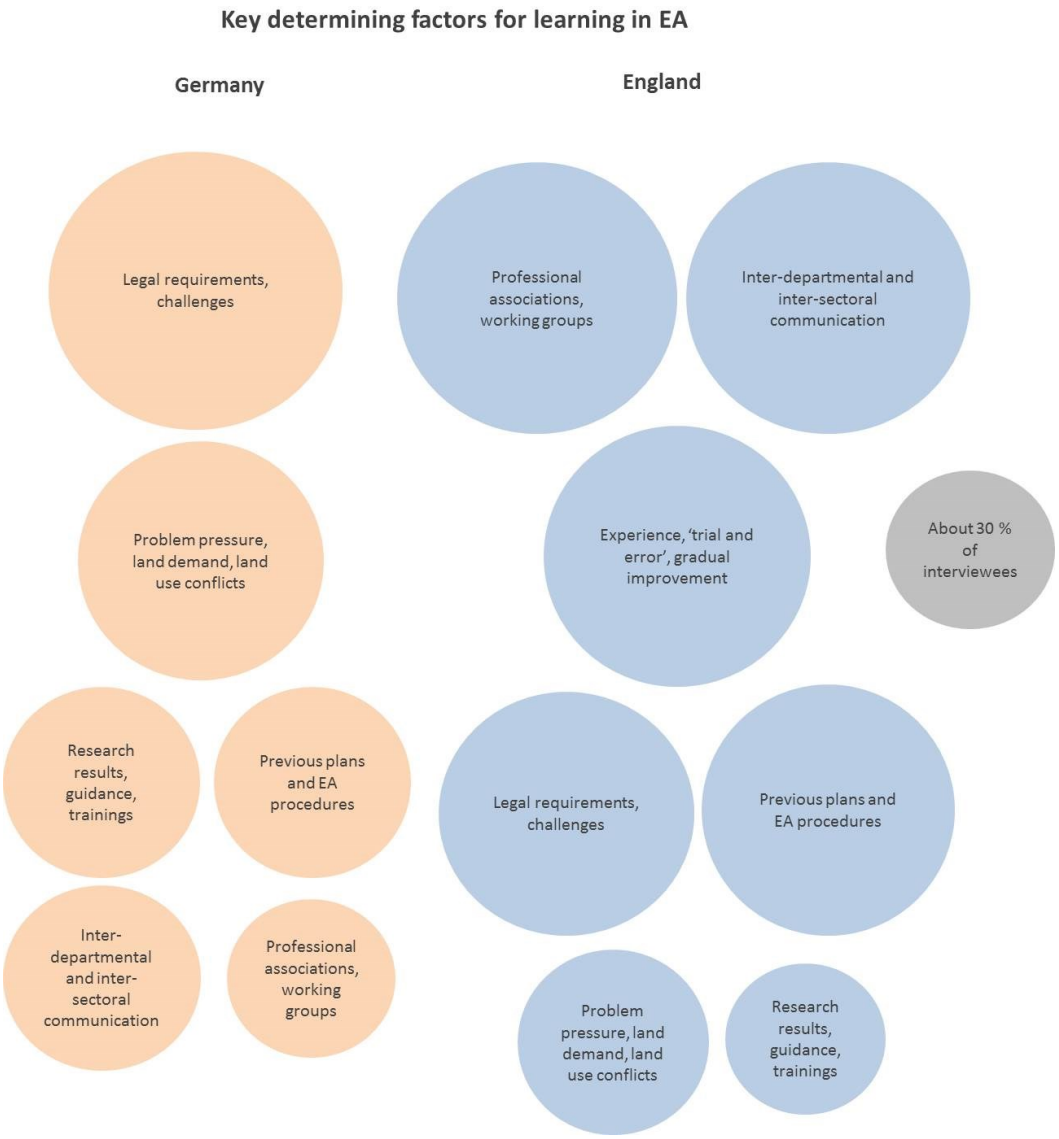


Figure 45: Key determining factors for learning in SEA (bubble size as a proxy for relative frequency of mentioning; DE: 11=100; England: 18=100; own figure)

Potential linkages between approaches towards dealing with assessment uncertainties, effects perceived as a result of their disclosure and factors for learning in EA as presented here will be considered further at the end of this chapter.

6.3 Starting points for operationalizing land as an environmental factor

What driving factors and strands of debate have led to land being integrated into the revised directive? What is the potential contribution seen in the new environmental factor for an early assessment of impacts on land?

Generally, the integration of land as a factor into the catalogue of the EIA Directive is known to all authorities and three consultancies in the German case study and to half of the authorities as well as three quarters of consultancies in the English case study. Most German authorities have a positive attitude towards land as a new factor, as opposed to only two consultancies that explicitly see added value in this element of the revised directive. While some appear to be neutral, two German consultancies are rather critical, doubting any significant change possible through the

integration of the separate factor. English consultancies appear to take a rather positive stance towards the integration of land as a factor, while most authorities adopt a rather neutral position, not expecting much from the new requirement. However, three consultancies explicitly criticize the new factor, stating that all related aspects are already covered by current assessment practice.

For the German case, reasons for the integration of land are predominantly seen in its reference to the reduction of land take and protection of undeveloped land as a resource. A couple of authorities and one consultancy also mention the improvement of land use efficiency, whereas soil protection and the reduction of land fragmentation are mentioned occasionally. Thus, while some expect an appeal function of land as a separate factor to be assessed, its confusion with soil and difficulties in separating between the two terms can be asserted. Whereas the German case reveals general skepticism regarding actual changes to assessment results with the new factor, a number of interviewees see significant chances in that impacts on land as a resource will have to be identified transparently as part of the environmental report.

> And particularly that's one of the chances, to develop one or more new indicators, for it to gain in weight, to be considered under land (C 16: 109 - 109)

> First of all, documenting changes to be able to identify at the end of the year how much land has been sealed additionally, or perhaps a net calculation, also considering desealing as well. That would be an important step. (C 17: 161 - 161)

> Basically for the binding plan nothing relevant will change (A 12: 83 - 83)

English interviewees attribute the introduction of the new factor predominantly to its potential for supporting a more holistic consideration of land-related aspects and thus of land value as such. To a similar extent, land use efficiency and the protection of greenfield land from development (i.e. referring to land take implicitly) are mentioned by almost half of the interviewees. Two interviewees exhibit a strong interest in a reformed assessment methodology based on ecosystem services and thus postulate land as a potential stepping stone towards this. Similar to the German case, about one third of English interviewees are skeptical regarding future changes through the new factor, assuming that all necessary aspects are already covered by current practice. Another third expects a stronger weight of land as a resource in and of itself as opposed to it being regarded as a mere precondition for development or as a carrier of functions provided by other environmental factors. In this regard, a more transparent assessment of land-related aspects through their allocation to one factor instead of its current dispersion across the list of factors is seen as a positive effect by almost half of the experts interviewed. However, it is also emphasized by some that this role to be fulfilled requires national guidance on how land is to be addressed and is also dependent on problem pressure, particularly differing between the north and south of England.

> I guess it needed to be done. I mean land is an important area that perhaps was slightly missed previously. I would support land having more focus and being seen as important to carrying out integrated assessments. (C 6: 21 - 21))

> So I think we are not going to see lots of new assessments coming out of this. But I think it will refocus the way assessments are being done. (A 1: 21 - 21)

> So if land is a separate topic, then it will make the job harder. But as a professional, and removing myself from my current role, I can see the advantages in considering land as a topic on its own. (A 1: 72 - 72)

> I mean I don't really see it having much impact in the UK. We did an analysis of what we would do differently and we concluded pretty much nothing. (C 4: 62 - 62)

> I can't really remember any UK practitioners ever coming to me and saying, land is something that we really want to see, and then equally since 2014, and the transposition process, there's been very little kind of concern in relation to land. (A 3: 21 - 21)

Interviews with representatives of the European Commission reveal some further insight into motivations behind the integration of land into the EIA Directive: This decision is to be seen in the context of the 7th EAP and the Thematic Strategy on Soil, which also led to the target of no net land take formulated by the Roadmap to a Resource Efficient Europe 2011. Another driver mentioned consists in the recent publication of the UN SDGs, in particular SDG 15, and the ongoing process of defining indicators and instruments for their implementation.

How should land be defined as an environmental factor? What aspects should be covered by land, in quantitative and qualitative terms?

With regard to the key question as to how land is to be defined and hence how it will differ from other factors, there were varying opinions in Germany: Generally speaking, considerable uncertainty becomes apparent with regard to land being perceived as a rather abstract term. One authority and two consultancies do not see land as a separate factor but as inextricably linked to other environmental issues, with six interviewees strongly linking land with soil, whereas four interviewees formulate chances related to land as a separate factor. The German case shows a high degree of consent for quantitative components of operationalizing land where sub-targets and criteria for quotas such as the 30 ha target are welcomed by four authorities and all but one consultancy. Two consultancies explicitly argue for considering the withdrawal of already designated sites in revised or new land use plans when assessing land take. Regarding land use efficiency, criteria for assessing density is met with mixed opinion, with most authorities welcoming orientation values for suitable housing densities. Critical voices are particularly uttered by consultancies, given the difficulty in ultimately defining such orientation values. The consideration of PDL potential in order to assess land use efficiency and to arrive at a clearer picture of how much (additional) land is objectively required is largely welcomed by authorities and about half of consultancies, with more reliable data on reuse potential repeatedly mentioned as a key requirement. With regard to qualitative aspects, interviewees are largely united on the need to consider functions of land for its operationalization. While some urge for a systematic model of these functions, others argue for their consideration via interdependencies with other environmental factors. Also brought up is the need for considering global impacts of land use and to not only fulfill national EA requirements but to look at international standards and targets regarding land as a factor. Against that backdrop, key data requirements are observed as comprising an operationalization of the national quota for land take down to the local scale, a better usability of land use statistics for this purpose, and a standard methodology for identifying PDL potential.

> So integrating: no! We have achieved a high degree of differentiation in EIA via the different factors, integrating that into such a super factor land, that would only lead to a blurring of interdependencies, that can be identified much better through the existing differentiation (A 12: 296 - 296)

> I'm rather someone saying that land is part of soil protection and land take has been considered as part of soil (C 13: 36 - 36)

> If quotas are being introduced indeed, that will have immediate consequences, clearly, and I think we will be able to deal with that then. I don't see, however, that that will happen in the near future. Second thing is, if we

> have orientation values, what is not the case at the moment, because these 30 ha on a federal scale, that's nothing a municipality can orientate itself by, that's certainly helpful in order to accentuate the discussion (A 12: 300 - 300)

> That would be quite a leap in quality, if there were some kind of quotas (A 12: 172 - 172)

> So we need two things, one is a projection of demand, […] And the other is a compilation how much of that we can cover by existing sites […] There you can also discuss densities and so on but generally, that there is a stronger focus on the question what we can realise by the existing stock of developed land (A 12: 100 - 100)

For the English case, the qualitative aspect of land and land use conflicts play a strong role when asked for a definition of land as a factor, with half of consultancies emphasizing agricultural land quality as a key sub-aspect, and three consultancies referring to the concept of ecosystem services. An explicit need for quantifying land functions is brought up by four interviewees, mostly connected with the concepts of ecosystem services or natural capital. A more systematic assessment of land functions meets with a high degree of consent among the interviewed experts, with a similar amount of interviewees preferring land to be conceptualized as an integrative factor. A number of others, however, suggest that addressing land separately adds more weight to it or can explicitly target quantitative aspects.

An operationalization of land through quantitative quota for land take is favoured by the majority of consultancies and two authorities; however, most interviewees express skepticism regarding its implementation in practice due to the absence of targets in that regard. While two interviewees appear rather indecisive on the issue, three consultancies and one authority reject the necessity of quantitative quota, referring to a potential negative effect of a spatially unspecified quota in fostering the use of unsuitable land. Land use efficiency displays a much stronger importance attributed to it, at least by the group of consultancies, again presumably mirroring experience with (in this case, former) policies and regulations. About half of consultancies and authorities each welcome the consideration of PDL potential. However, three interviewees are clearly critical towards a potentially strengthened focus on utilizing brownfield land with high biodiversity value. About half of authorities also mention a quantitative consideration of functional integration and compactness. Minimum density values are welcomed explicitly by four consultancies and two authorities, with the latter remarking previous density targets as having been too blunt, thus pleading for the combination with characteristics of a site. Data requirements with regard to quantitative aspects of land are predominantly seen in national quotas and databases for land take, an overarching land policy as well as local surveys on land value and local brownfield registers. A compilation of the defining aspects of land mentioned by the interviewees are shown in figure 46 below.

> I think it's useful perhaps to have it inserted somewhere in the conclusions or in the summary to be addressed to, whether it should be addressed in every single chapter with the notes on land probably not. (C 6: 61 - 61)

> I'm hoping that land will actually, will be seen as more important, because it will be a topic area in its own right, which it currently isn't and it feels like it gets diluted, amidst all the topics (C 9: 52 - 52)

> Land would be the amount and soil would be the quality (C 11: 75 - 75)

> I think quantification would be great. (C 3: 94 - 94)

> I would like to see a more holistic view of sustainability, things like, the sustainable development goals across here and how land use contributes to achieving those sustainable development goals rather than how to protect these areas from development, which is kinda how we look at it. (C 4: 66 - 66)

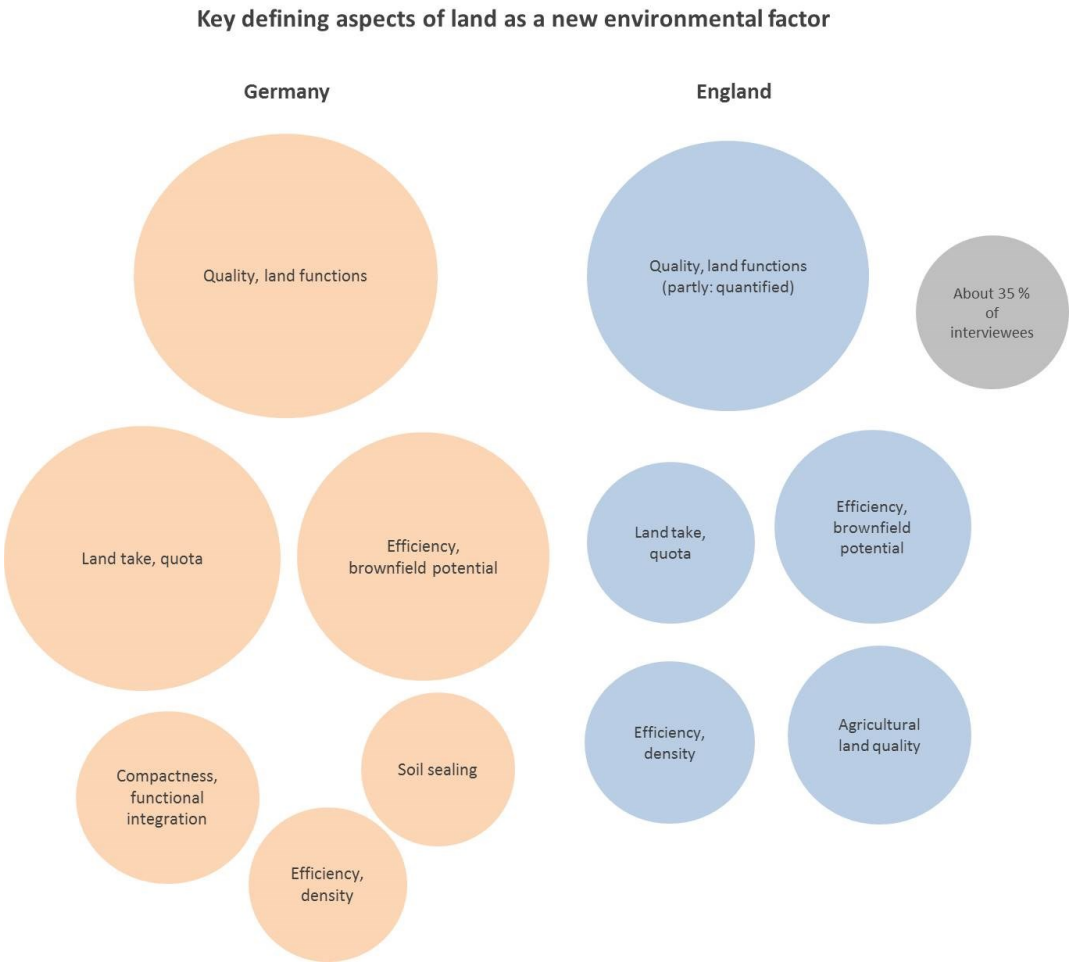


Figure 46: Key defining aspects of land (bubble size as a proxy for relative frequency of mentioning; DE: 11=100; England: 18=100; own figure)

6.4 Summarising remarks from a comparative perspective

Looking at results presented above from a comparative perspective, it is evident for the **status quo situation** that the coverage of land in SEA procedures has been strongly influenced by the legacy of existing or yet abolished policies and regulations, such as on land take in Germany, or on the reuse of PDL in England. Such quantitative aspects of land appear to be regularly addressed as part of the environmental factor soil, while only rudimentary approaches towards a quantification of impacts with regard to overarching targets could be observed. Beyond that, and in both cases, mainly qualitative aspects of land are mentioned as being addressed as part of several existing environmental factors in current practice. Most interviews also reveal that an assessment of land aspects beyond qualitative aspects is considered relevant mainly at the strategic plan scale, i.e. less so for binding land use plans in Germany. Further, the status quo section reveals that – in particular as compared to regulations on biodiversity – land is predominantly represented by non-binding objectives and criteria with relatively little weight. Both case studies thus state that housing demand and development interests regularly override aspects of resource efficient land use. This is related to a frequently mentioned issue, i.e. the lack of accepted methods, standards and thresholds for assessing land and a resulting difficulty in determining the significance of impacts on the resource. A frequent problem observed with regard to the role of land in SEA (and plan-making) is the weighting decision, challenged by public

interest on the one hand and developer preferences on the other hand. Non-transparent weighting decisions in these cases are largely facilitated by the prevalence of argumentative assessment statements and the absence of clearly defined thresholds. In Germany, this refers to the prevalent use of absolute figures on land take or soil sealing and intra-plan based assessment methods without a quantified reference to overarching targets and figures; in England this is also attributed to non-transparent assessment matrices that lack to carve out key results, and an insufficient consideration of cumulative impacts.

Considering the availability of **data** for assessing land-related aspects, the interviews reveal different foci for both case studies, also related to the legacy of policies and strategies as pointed out above: For Germany, inconsistencies in the official land use statistics as well as difficulties in interpreting this data with regard to local land take are brought up repeatedly, together with varying availability and quality of municipal databases on PDL potential and insufficient data on soil sealing. For England, data on PDL potential are perceived as being of varying quality depending on the respective municipality, with a key role also being attributed to data on agricultural land quality and its insufficient topicality and resolution for the local scale. For both cases, the missing link between quantitative figures of land take and land use efficiency on the one hand and impacts on qualitative aspects/functions of that land in its undeveloped state on the other hand is observed.

Asked for their opinion on the **definition and operationalization of land as an environmental factor** in the wake of implementing the revised directive, the general attitude is mixed in both cases. For the German case, particularly authorities appear to expect meaningful change from land becoming an environmental factor on its own, for the English case, consultancies tend to expect more, in particular a comprehensive consideration of land-related aspects in assessment, with a minority being very skeptical, however. Chances related to the introduction of land again somewhat mirror the legacy of regulations and strategies, with German experts mainly mentioning the reduction of land take, the protection of undeveloped land and partly an enhancement of land use efficiency, whereas English experts mainly bring up a more holistic consideration of land aspects, of land use efficiency and the protection of undeveloped land together with a better definition of land value. Asked for a definition of land, the German case reveals that land is frequently seen as a rather abstract term and not necessarily as a separate factor yet. If so, mainly quantitative aspects and functions of land are demanded for its further definition. The English case shows a stronger focus on the consideration of qualitative aspects, i.e. land value or land functions, or of land being framed as an integrative factor for a more concise assessment of cumulative effects.

With these findings as a background for developing an assessment approach for land in EA, a wide range of options and aspects to be potentially operationalized has been opened. The subsequent **discussion of results (section 7) will reflect on these options** and provide reasoning to narrow down the range of options in order to develop a practically applicable approach for a selected focus area.

Assessment uncertainties strongly mirror aspects raised with regard to the status quo of land in EA: For both cases, and with regard to the location of uncertainties, the assessment of significance and the final weighting decision constitute key issues whereas the English case also reveals considerable uncertainties for the stages of data collection and mitigation. With regard to the nature of uncertainties, the lack of assessment standards and thresholds, related difficulties

in determining the significance of impacts as well as the coverage of interdependencies and cumulative impacts are mentioned by a large number of experts. Looking at the question of to what extent uncertainties are transparently displayed, both cases show a mixed picture, with German experts observing a disclosure of methodological and data uncertainties as most frequent while English experts observe disclosure as most likely in order to be transparent with regard to public participation and to avoid potential legal challenges. Effects of disclosing uncertainties are mainly seen in an enhanced transparency of assessment, in a targeted acquisition of required additional information and knowledge, for the English case also in a dedicated analysis of mistakes previously perceived. However, detailed disclosure is also seen as potentially hampering comprehensibility and engagement of decision-makers in EA reports. **Approaches towards dealing with uncertainties** reveal a key role of communication within and across teams, in particular between different disciplines and sectoral departments involved in EA. Also, targeted knowledge acquisition fostered through new requirements and the analysis of previous mistakes, preferably through lessons learnt sessions, are repeatedly mentioned. Further aspects specifically raised by English experts include the important role of external reviews as well as of participation/consultation and inspector inquiries in evoking methodological advancement.

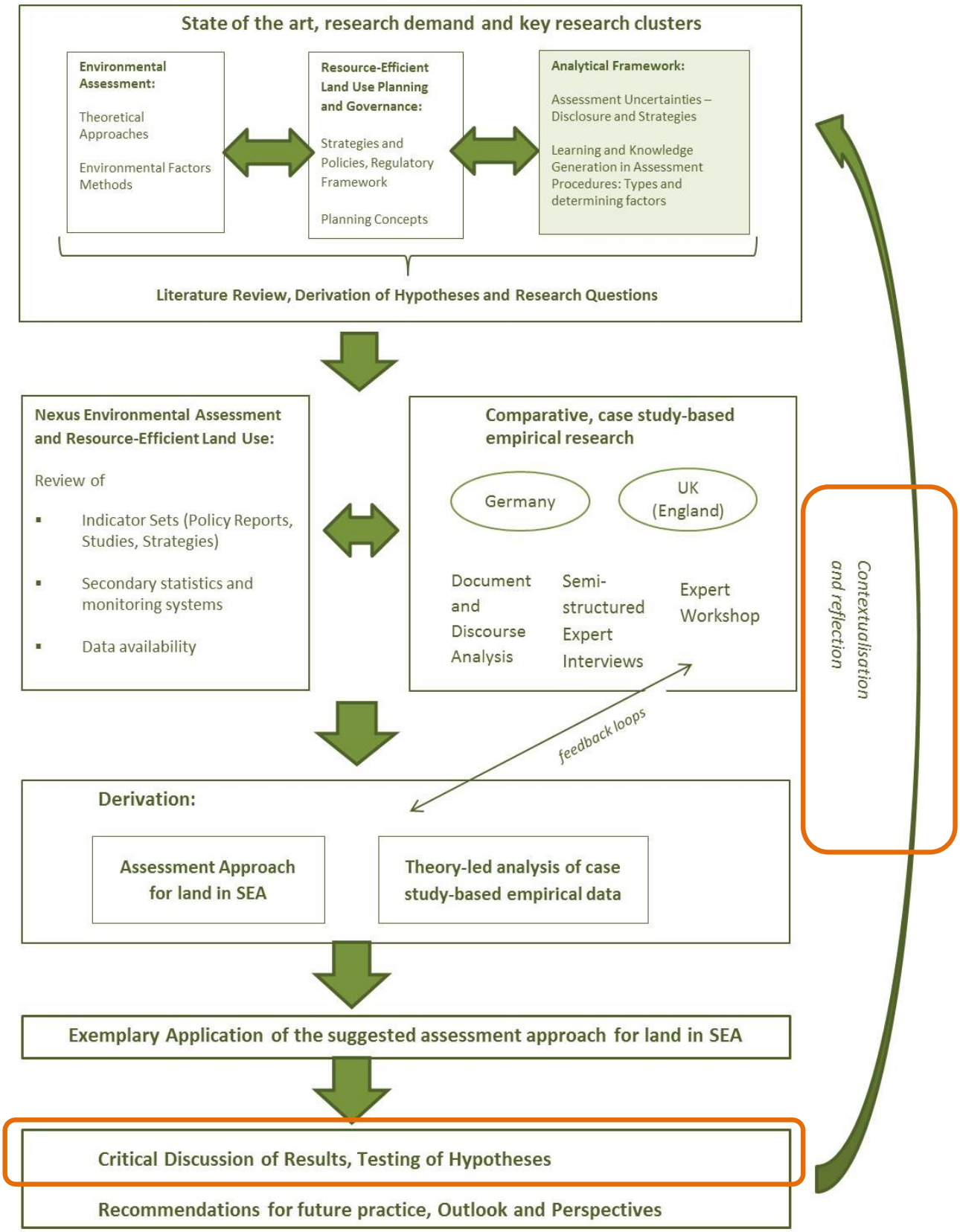
A better understanding of how **learning** occurs in and through EA has been attempted by connecting responses on how approaches towards land have been changed, and on learning factors perceived: Acknowledging that interviews can only provide a certain approximation to this question, experts observe limited direct effects. However, gradually increasing awareness for land as a resource, with land not only being regarded as a precondition for development, is observed. This is also attributed to varying problem pressure and land scarcity. Emphasis is put on the role of inter-sectoral communication within and between authorities involved, particularly highlighted with regard to individual English cases where sustainability or interface managers provide a link between the different sectoral professions and interests involved. Beyond the role of the land discourse, learning is predominantly attributed to previous EA procedures and experience, to problem pressure and legal requirements, to communication, exchange of information within professional communities and good practice examples as well as to trainings, research results and external reviews. By that, the findings reveal a key role of external impetus as well as of exchange and communication within and across teams in order to acquire new knowledge. Factors internal to EA procedures as well as those of an external character appear to be equally relevant for fostering learning.

Linking analytical strands and results: Learning through assessment uncertainties?

Beyond what has been depicted here so far, the analysis raised the question as to what the key effects of disclosing uncertainties are, and how they potentially relate to the occurrence of learning factors perceived. However, given the different concepts observed here, a clear and reliable causal relation between the two is not retrievable from the study sample. Nevertheless, a couple of potential interdependencies repeatedly attracted attention and are hence to be mentioned as starting points for further research: First, uncertainties evoked through new requirements issued for EA procedures as well as through perceived gaps in data and assessment methods appear to foster learning in evoking targeted knowledge acquisition as well as both dedicated and informal (also multi-disciplinary) communication and exchange of information. Second, disclosure of assessment uncertainties enhances transparency of shortcomings and appears to contribute to learning by motivating targeted knowledge acquisition, discussion of possible solutions and dedicated analysis of these shortcomings and resulting lessons learnt

sessions – however, strongly dependent on individual actors' interest and motivation to take up on this knowledge. Potentially, while not directly retrievable from the findings presented here, transparent information on uncertainties may also strengthen EA actors' capacity in demanding and contributing to methodological advancements that have been pointed out but cannot be resolved within EA immediately, such as improvements to data availability or the development of standards with regard to significance and weighting.

Based on that, hypotheses and objectives as initially formulated as a basis for empirical research will be discussed and contextualized in the following section. Moreover, the role of the research approach and selected methods will be reflected with regard to the findings presented here.


State of the art, research demand and key research clusters
Environmental Assessment:
Theoretical Approaches
Environmental Factors Methods
Resource-Efficient Land Use Planning and Governance:
Strategies and Policies, Regulatory Framework
Planning Concepts
Analytical Framework:
Assessment Uncertainties – Disclosure and Strategies
Learning and Knowledge Generation in Assessment Procedures: Types and determining factors
Literature Review, Derivation of Hypotheses and Research Questions
Nexus Environmental Assessment and Resource-Efficient Land Use:
Review of
Indicator Sets (Policy Reports, Studies, Strategies)
Secondary statistics and monitoring systems
Data availability
Comparative, case study-based empirical research
Germany
UK (England)
Document and Discourse Analysis
Semi-structured Expert Interviews
Expert Workshop
feedback loops
Derivation:
Assessment Approach for land in SEA
Theory-led analysis of case study-based empirical data
Exemplary Application of the suggested assessment approach for land in SEA
Critical Discussion of Results, Testing of Hypotheses
Recommendations for future practice, Outlook and Perspectives
Contextualisation and reflection

7 Discussion of key findings and preliminary conclusions

7.1 Reviewing initial hypotheses and objectives

While the detailed research questions were useful for structuring the findings of the expert interviews as presented in the previous chapter, hypotheses as set up initially in order to unfold the field of interest will be taken up again in the following, discussing initial assumptions and deriving lessons learnt with regard to findings presented before.

7.1.1 Contextualising current land-related assessment aspects (Objective 1)

1. The integration of land as a separate environmental factor is currently discussed as an element of the revised EIA Directive. Aspects of resource efficient land use have to date been addressed by EA procedures as part of various existing environmental factors; however, in a fragmented and unsystematic way.

The research findings reveal that land has been addressed to some extent in both case study contexts. Whereas aspects of land are only discussed in a fragmented way, the situation is less unsystematic than initially assumed. For both case studies, similar aspects recur, in Germany mainly with regard to land take and qualitative aspects of land, in England mainly with regard to efficiency, i.e. PDL reuse and accessibility, and quality, often referred to by agricultural land value. Implications of these findings will be discussed below.

2. For the assessment of factor-related impacts, different types of data, information and knowledge have been applied to date. These depend on subject field and involved experts; a systematic analysis has not been conducted yet; qualitative aspects and intersectoral links have been underrepresented.

Both document analysis and expert interviews clearly reveal what aspects of land have already been addressed in current practice and which aspects have so far been neglected. The findings also shed some light on what aspects are part of standard practice and what aspects have been attempted by some more recent EA procedures but in a rather experimental way. The interview findings further enable a more detailed understanding of reasons behind this situation, through considering overarching objectives and targets, data availability and data gaps. While intersectoral links, i.e. interdependencies of land with other factors, have been repeatedly mentioned, their methodological coverage in assessment appears to be a field still underrepresented. It became apparent, however, that qualitative aspects of land have been covered relatively well, albeit in a fragmented manner, whereas quantitative aspects have been significantly underrepresented and limited to an intra-plan perspective instead of reference to overarching targets.

Key problem that land as an environmental factor is confronted with is the **absence of binding standards and thresholds** based on which a meaningful assessment of the significance of impacts could be conducted. The frequent mentioning of such a need shows that a discussion and definition of assessment criteria is vital if the introduction of the additional factor is to bring about real effect and meaning. Based on the findings presented here, core aspects of land in current practice comprise the percentage of development on previously developed land, (agricultural) land quality, green space provision and accessibility of infrastructure in England on the one hand, and soil sealing, land take, green space provision and natural soil functions in Germany on the

other hand. Despite the different foci brought up by the two case studies, mirroring the **legacy of existing or previous regulations and policies**, the interviews prompt a **combination of quantitative and qualitative aspects of land**, considering **land take**, **land use efficiency** and **land quality/land functions**, and thus combining aspects already applied in the two case study contexts so far. Such a framework requires efforts with regard to the provision of related data, in Germany mainly with regard to criteria for operationalizing targets on land take and land use efficiency, in England mainly with regard to targets and criteria for land take as well as on harmonizing data availability on land use efficiency. The concretization of land quality/land functions requires further consideration and discussion. For the English case, the strong focus on agricultural land value with regard to assessing land quality constitutes a rather critical point, mirroring availability of data but not reflecting on its sole focus on the productive function of land.

Particularly given the frequently observed **weak character of land-related objectives and targets in final weighting** as compared to overriding development interest, an introduction of **binding standards** regarding land take, land use efficiency and protection of land quality/land functions could strengthen its position in decision-making procedures. However, given the contested field of introducing such standards, already existing objectives and targets as included in planning policy frameworks, federal/national strategies and regulations in principle already allow for and justify a more concise and transparent assessment of land. For Germany, this would require a **departure from the prevalent argumentative approach**, focusing on operationalized criteria for land take and land use efficiency; for England this might be enabled through the **specification of local with reference to overarching figures (and targets to be formulated)** instead, in both cases methodologically connected to land quality/land functions via an **effective consideration of interdependencies**. Given the frequently mentioned overriding character of development interests, often focusing on easily accessible land without transparently assessing actual economic (and social) gains of such a development, a transparent assessment approach with standards for detrmining significance would potentially play its role in an objective and accountable depiction of impacts on (yet undeveloped) land, provided the will to do so.

Moreover, the integration of SEA into Sustainability Appraisal (SA) in England needs to be kept in mind when discussing the role of land, in particular with regard to the consideration of economic and social aspects such as housing provision, as opposed to the situation in Germany. However, this situation calls even more for a transparent assessment of environmental impacts of land use changes, in particular given the strong political focus on housing and OAN-derived housing figures in England. Beyond that, the observation derived from the document analysis **that the growth paradigm** (i.e. a continuous provision of new housing sites and thus demand for land) **is rarely seriously questioned**, even in shrinking municipalities in Germany, further **calls for a transparent (and quantified) assessment** based on land demand, quotas for land take and criteria for land use efficiency. As suggested by a number of experts pointing out the role of preceding documents in determining the amount and location of new development, it would be worth considering **whether and how SEA could be conducted for these informal plans and evidence base documents** in order to ensure a concise assessment of these preceding decision steps. This integration of informal plans and strategies of significant relevance for land use decisions into the realms of SEA should particularly be discussed for Germany. Still, however, for England, the extension of the environmental focus and assessment criteria of SEA as requested above to the definition of housing and site demand as part of SHMAs and their linkage with SHLAAs would be beneficial.

Furthermore, differences in the legal systems of both countries contain implications for framing land in future SEA procedures: While the common/case law-based English system is connected to a less objectified set of targets and indicators and a stronger focus on procedural quality, the civil law-based German system relies more on binding objectives/standards to be derived from policies and legislation. This situation also prompts the particularly frequent mentioning and strong **role of legal challenges as evoking changes**/learning in the English case while for the German case a consensus on a standard assessment approach for land in EA and its prospective **codification** play a strong role. Given difficulties in implementing continuous monitoring in SEA procedures, findings underline the **importance of regular and concise monitoring systems** in order to reduce the problem of lacking data and knowledge on actual effects of land use decisions. This is equally relevant for both case studies, with the English SA framework potentially even enabling monitoring of economic and social effects of new housing development. Such an evidence base bears **potential to determine the 'reasonableness' of additional land take** more transparently and would potentially generate grounds of argumentation for future S(E)A procedures.

7.1.2 Learning through SEA (Objective 2)

3. Learning processes in EA occur as a result of previous experience with EA procedures, with individual and single-loop learning as prevalent types. Factors for learning derived from previous experience enable an improvement of subsequent EA procedures.

While evidence could mainly be found for individual learning effects and single-loop learning, i.e. improvements to existing procedures, a number of indices for further-reaching effects, i.e. double-loop learning, have also been found. Key factors for learning comprise both internal and external ones, in particular research results and guidance, intra-team as well as inter-sectoral and multi-disciplinary communication, problem pressure, new legal requirements and external reviews. These learning processes, however, appear to be strongly dependent on interviewees' understanding of EA, i.e. in a merely procedural way as an obligation for plan-making, or in a more strategic way with regard to strengthening environmental/sustainability issues in plan-making, as well as on their integration into land-related professional communities. In that regard, with incremental achievements being underlined on the one hand, and more profound changes such as function-based assessments being suggested on the other hand, the field of tension between safeguarding what has been achieved by EA and chances for more comprehensive assessments, is emphasised by those results. Limitations of these findings with regard to methods and sample of this research will be discussed below.

Evidence of single-loop learning could thus clearly be found: This type of learning in the sense of incrementally advancing existing practice appears to be most notably based on new (legal) requirements, new guidance and research results, communication within and across teams and between consultancies and authorities, (institutionalized) lessons learnt sessions and external reviews. It has also become apparent, however, that such learning processes are considerably dependent on personal interest and involvement in advancing assessment approaches, **underpinning the concept of 'ownership'** suggested by Stöglehner (2009; 2014) and that not seldom rather the quick quest for standardized guidance is formulated instead of reflecting on experience and ideas for advancing assessment approaches. In particular, **communication and networks appear to play a decisive role for distributing rather implicit, tacit knowledge** that has not (yet) been codified as part of guidance documents or other publications. Levels of

learning identified can mainly be attributed to the medium range of analysis and synthesis, with some individual cases also exhibiting evidence of evaluation and transformatory learning. Indices of double-loop learning could be identified for a number of individual cases: Key factors for such more profound learning towards questioning existing practice and the development of innovative approaches appear to result from active involvement in professional communities and a discussion of new ideas, to interdisciplinary teams as well as to knowledge about research and model projects on implementing new approaches or data. The English case explicitly reveals the suggestion of innovative assessment techniques by two consultancy experts with respect to a more general change of assessment approaches towards the consideration of functions that environmental factors fulfill and impacts of development on the future provision of these functions.

As derived from the review of earlier findings, the **importance of both factors internal to the EA procedure and external ones** can be confirmed. It is also evident that such **'thinking outside the own local or case-specific box'**, with good practice and guidance material from other cities or regions being known and used, tends to result in options for improving assessment approaches. Here, the role of **external reviews** as offered by UK IEMA should be pointed out as a potential aspect to consider in Germany where a CoP as organized by the *UVP-Gesellschaft* would be suitable to establish such a review structure as a learning mechanism. In that regard, other (procedural) requirements contained in the revised directive, such as quality management for EA and central hubs for EA documents could foster such learning processes. In particular for the case of Germany with the large number of small consultancies, better comparability and knowledge transfer with regard to assessment standards and potentially stronger consensus on good assessment practice could result. Further, the important function of input from other disciplines and sectors underlines the ongoing need to strengthen the **parallel application of SEA and plan-making**, preferably by a SEA representative being present in all stages of plan-making, as good practice from some English municipalities shows. Hence, findings underpin the **value of various knowledge bases** related to stakeholder groups in EA for the development of learning processes as stated by Partidário & Sheate (2013: 35): "A process that draws heavily on knowledge created by learners, through communities of practice that share the power, and the responsibility of contributing solutions to problems, while recognizing there is a decision-making process that may still be administratively 'rational'" – under the precondition of context conditions for learning being created and maintained throughout the process. Findings also underpin the **role of disjunctures** as introduced by Jarvis (2007; 2012), as for instance represented by new requirements, and of integration into networks at the same time, i.e. the need for a **balance between tight and loose professional communities**, enabling regular exchange but new input from other sectors and neighbouring communities as well (see also Granovetter, 1973).

For future practice, a key differentiation to be considered refers to learning driven by external developments (**rather passively induced learning**) and self-organised learning (**actively promoted learning**). While the first can mainly be attributed to (land-related) problem pressure such as scarcity and housing demand, to new requirements, new data and guidance provided as well as to participation outcomes, the latter appears to be based on growing EA experience, take-up of research results and (cross-sectoral) communication with other professionals such as active involvement in working groups and communities of practice. **Enabling and supporting these factors to be made use of by EA professionals hence appears to be key to continuously adapt and improve EA with regard to new challenges and options**, and by that for it to make a

difference for environmental decision-making. Figure 47 illustrates a summary of key findings on learning as mentioned.

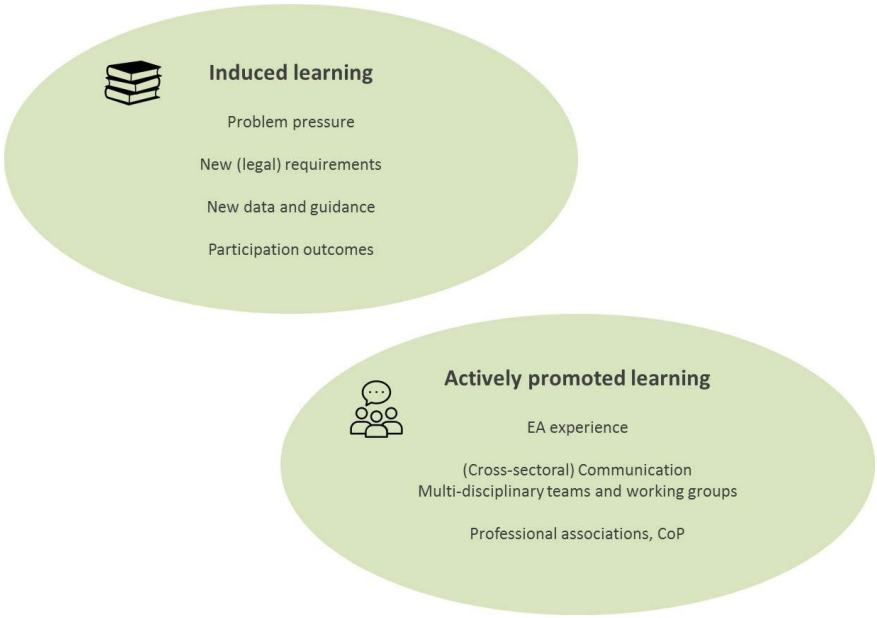


Figure 47: Key factors evoking induced and actively promoted learning in EA procedures (own figure; icons made by Freepik from www.flaticon.com)

4. Assessment uncertainties are only partly displayed by EA procedures and related reports. If uncertainties are transparently displayed, they enable advancements of subsequent EA procedures in methodological and substantial terms. Active approaches towards addressing assessment uncertainties foster learning processes.

It is confirmed that assessment uncertainties are only partly mentioned as part of EA reports and thus still lack transparency in many cases. If there is some mentioning of uncertainties, it mainly refers to methodological and data issues and is frequently argued for by enhanced transparency of assessment results and the avoidance of legal challenge. Whereas some indices could be found for advancements to EA procedures as a result of tackling previously detected uncertainties, explicit approaches towards addressing such uncertainties cannot be regarded as being part of standard practice yet. Due to that and the variety of understandings related to learning and uncertainties, the link between both has been found to be too vague to ascertain general findings. However, starting points on further researching this link could be derived.

While evidence on the disclosure of assessment uncertainties in the documents analysed is rather scarce, expert interviews show a mixed picture, as described above. Whereas **uncertainties regularly find mentioning**, their **explicit take-up** in the further EA procedure could be **detected less frequently**. Benefit of disclosing uncertainties could particularly be attributed to **enhanced transparency of assessment**, with uncertainties most frequently consisting in the lack of thresholds, the definition of significance and the effectiveness of mitigation measures as also found by earlier studies. With regard to a link between addressing uncertainties and learning, findings suggest that a **transparent disclosure of uncertainties** and their reflection as part of

subsequent EA procedures **bears considerable potential to foster learning processes** – notwithstanding that this link could not be sufficiently substantiated. Considering the (potential, i.e. where made use of) role of uncertainties in fostering methodological advancement (particularly detected for England with regard to participation outcomes, inspector queries and lessons learnt sessions), **monitoring** requirements could gain further momentum through an enhanced focus on systematically detecting and reflecting on uncertainties. This could also help in **improving transparency and liability of plan-making** by that SEA facilitates a systematic compilation of environmental effects that the plan does not necessarily consider and thus enhances confidence in environmental reasoning.

Nevertheless, deficits in a strategic use of SEA beyond formal requirements prevail, in particular with regard to assessing (real) alternatives – looking at that the other way round, and based on factors for learning as described before, the **consideration of land** as a separate factor could constitute a **chance in enhancing this consideration of planning and locational alternatives**. Furthermore, and with regard to challenges related to the Great Transformation and planetary boundaries, the concise integration of aspects of resource efficiency into EA procedures could make a considerable contribution – without completely overhauling assessment approaches but through valuing what has been achieved by systematic EA approaches. The strong function of greenbelt designations as an increasingly discussed but yet effective barrier to greenfield development in England should be mentioned again in this context. In principle, the findings discussed here therefore underline an **understanding of SEA as a process that actively supports and enables learning and in the midterm contributes to a strengthened awareness for environmental aspects and interdependencies**: „variations in perspectives and views amongst stakeholders will remain an inherent component […]. However, this is not necessarily a weakness or a threat […]. Rather, it constitutes a basic feature of the tool, which allows it to be flexible and adaptable enabling it to reflect as well as to influence environmental values of a changing society." (Jha-Thakur & Fischer, 2016: 26).

7.1.3 Implications for strengthening the role of land in and through EA (Objectives 1 + 3)

5. From interviewees' understandings of land in EA and a review of research-based concepts of land, the science-practice gap can be narrowed in order to develop an applicable assessment approach for land.

While the interview findings have revealed a diversity of understandings of land and related preferences for its future framing, key starting points for the development of an assessment approach for land could be carved out for both case studies. These will be further discussed below. Given that a number of these options face restrictions by lacking data with regard to their implementation in practice, out of these options and based on a review of data availability, a first suggestion for the selected case of EA for municipal land use plans in Germany has been developed further and will be presented in section 8.

6. The definition and interpretation of land varies between different planning systems. A comparison of EA procedures within the context of the planning systems of England and Germany enables mutual learning effects.

It can be clearly confirmed that the definition of land, aspects considered in current practice and opinions on its future framing as a factor in EA vary considerably between the two case studies.

These differences appear to be strongly based on land-related professional debates and previous as well as current land-related regulations and objectives. While the different frame conditions in both contexts need to be taken into account (in particular, scopes of assessment covered by SEA and SA, respectively), findings enable a derivation of mutual impetus for framing land and advancing current practice that will be discussed below.

For the English situation, it became apparent that land has predominantly been regarded as an underlying factor or receptor for development and has hence been hardly made a subject of discussion with regard to changes required for EA. Here, the comparably narrow focus of the English planning system on regulating land use may play a considerable role as an explanatory factor for less awareness for land as a 'new' environmental factor. On the contrary, this traditionally narrow regulatory role meets with the NPPF "presumption in favour of sustainable development", rather unclosing different options for what this means for land use. As such, sustainable development may mean a focus on urban containment and reduced land take through PDL reuse for some but a focus on affordable housing provision through developing additional land at the urban fringe or even green belt land for others. With respect to the frequently voiced intent of accelerating plan-making in the UK, the above-mentioned stronger link between SA and SHLAAs/SHMAs in order to **assess housing demand also with regard to environmental aspects** appears key to strengthening resource efficient land use within these institutional frame conditions. For the German situation, while the planning system contains more substantial requirements with regard to land use decisions, key lies in operationalising existing targets and objectives and thus in a transparent display of impacts on land that have to date mostly been 'swept under the table' through argumentative assessment. By that, the role of land in decision-making could be strengthened, subject to the condition that the scale of strategic plan-making (i.e. FNP, in particular) is strengthened, that exemptions from EA such as § 13b BauGB are reduced, and that land-related objectives and targets **gain more teeth through the definition of binding standards**.

From a comparative perspective, institutional settings, the role of land in legal documents and regulations, as well as available statistical data play a decisive role for how land is understood and what suggestions are made for its future framing in EA. It can be stated, however, that for a number of interviewed experts the thematisation of the new factor evoked an **activation of broader frames**, i.e. of suggestions for additional aspects or even different assessment approaches for integrating land. With regard to institutional aspects, the **neoclassical/neoliberal paradigm in the UK as opposed to the ordoliberal social market approach in Germany** (see Lockwood, 2015 with regard to the implementation of the energy transition) offer explanatory factors for a less pronounced role of the planning system in allocating land use in England – notwithstanding the important function of greenbelt designations in protecting undeveloped land and the opposing role of tax incentives, as particularly pronounced in Germany. Moreover, the federal structure of Germany as compared to the role of central government in the UK, despite recent localism trends, determine at what spatial scale land use decisions can be made and assessed to what extent. In particular, universal targets and requirements at national scale need to be critically considered, on the one hand enabling the formulation of specific standards (as previous targets on PDL reuse and minimum density did) but on the other hand evoking centrally imposed figures such as for housing provision that tend to lack local plausibility. Also, however, municipal autonomy supports inter-municipal competition with regard to tax incentives and potentially undermines the implementation of strategy-derived targets such as the 30 ha one. From that field of tension, recommendations for

both contexts consist in **strengthening overarching strategic objectives and targets at national/federal scale, supported by concretising standards and orientation values, but leaving their spatially specific implementation to the local scale**.

Against this backdrop, currently considered changes to **municipal financing** in England, together with weakened regulations through the introduction of the NPPF may potentially increase the attractiveness of land allocation for generating tax revenue. Hence, experience from Germany as outlined in section 4, and long-held debates on reforms to land property tax spurred by the 2018 legal decision prompt the necessity of keeping pressure on land through (often only perceived or expected) tax revenue at a low level. This could again be supported by a stronger valorisation and protection of land quality and related ecological functions. Furthermore, experiences from Leipzig and Liverpool in an active planning approach to urban restructuring under previous conditions of shrinkage may as well suggest a **more strategic, planning-led approach under conditions of growth**, for instance through an active regeneration of PDL potential and fostering of more compact housing patterns, supported by suitable assessment standards applied in EA.

7.1.4 Options for framing land in EA (Objective 3)

Consequently, the potential value of EA in integrating the assessment of impacts on land into a systematic consideration of impacts on key environmental media should not be underestimated – acknowledging the need for improvements to availability and applicability/comparability of data and information, in particular with regard to the 'traditional' objectives-based approach prevalent in England and the prevalent 'intra-plan' perspective applied in Germany. Options regarding profound changes to assessment methodology, as raised by a number of experts, for instance with regard to ecosystem services or the concept of land use functions, bear potential with regard to a better consideration of interdependencies and of cumulative effects on land, in particular, and should certainly be discussed further. However, such **options that would potentially treat land as a 'super-factor' should also be treated with some caution** in that they may risk a weakening of the systematic approach developed in EA. At the same time, options discussed here also entail further possibilities for framing land at higher spatial scales in the medium run. For instance, current quantitative targets require a flexible approach and should be regarded as an intermediate step towards the achievement of no net land take and a circular approach to land use (see already Ganser, 2005).

After discussing implications of the selected methodology for the findings generated, the following section will develop concrete starting points for operationalisating land, focusing on a selected field of application. In the sense of a **zoom-in on the selected focus area** and thus ensuring applicability in practice, **concrete assessment aspects that are suggested will be supported by a discussion of indicators and suitable data sources**. Despite the strong role of land functions suggested for framing land found during the interviews, the decision has been made here to tentatively exclude this aspect and to rather focus on the issues of **land take, land use efficiency and land quality** (derived from the land-related taxonomy of targets in section 3), and, in particular its **quantification**, an aspect strongly represented throughout the interviews, for several reasons: First, a focus on land functions would potentially frame land as a 'super-factor', integrating aspects from most other existing factors and could consequently undermine added value of depicting impacts on land separately. Second, a function-based framing of land might weaken the systematic approach towards assessing environmental factors, as particularly having been emphasized for the German baseline-/topic-led approaches. Nevertheless, given the potential benefit of a functional approach towards framing land in better covering cumulative

effects, it is worth further consideration, potentially in combination with quantitative aspects, and in particular at higher planning scales where additional aspects of land use (e.g. for renewable energy production as well as for energy supply and transport infrastructure) are to be assessed. Within the given institutional framework of EA, a functional approach might also be more suitable for English Sustainability Appraisal in integrating social and economic functions of land as well.

Hence, the following section will present a rather rationalist approach according to e.g. Fischer et al. (2009; in Sheate & Partidário, 2010) for assessing land, focusing on a universally applicably scheme for the selected focus area through developing indicators and suggesting suitable data for identifying impacts on land. In this regard, the final weighting step is tasked with considering transparently assessed impacts as part of balanced decision-making in context with other factors and stakeholder interests. Preliminary guidelines for this weighting step will also be suggested. The decision for such an approach assumes that improved information will lead to better decision-making, with development of land-related indicators and data being regarded as a first step in enabling decision-makers to improve knowledge on how to tackle land. In a second step, this is expected to enable learning through SEA and to develop assessment approaches further through experience, review and exchange. Thus, **taking into consideration uncertainty about land as a result of expert interviews and the number of key aspects suggested, a concrete approach 'to start with' is suggested here. This should be understood as a precondition for further advancement as well as open further debate and modification**.

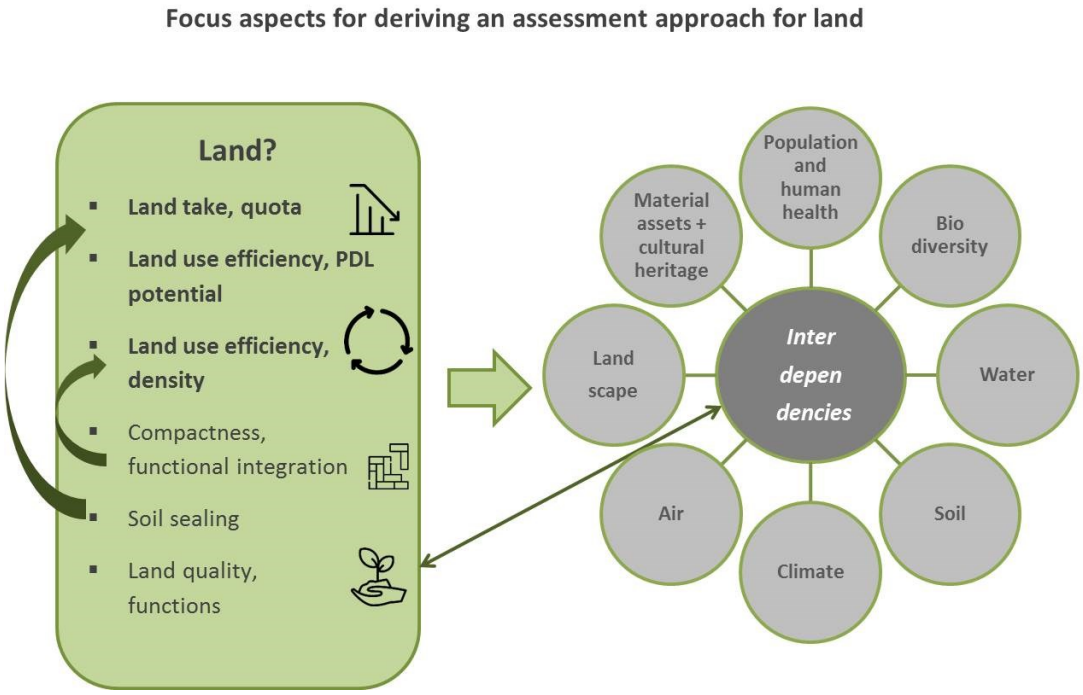


Figure 48: Focus aspects for deriving an assessment approach for land (own figure; icons made by Freepik from www.flaticon.com)

In this context, figure 48 highlights those aspects, i.e. reduction of land take, efficiency of land use and land quality for which the following section will develop concrete methodological starting points based on the operationalization of existing objectives and targets. Represented by arrows, other aspects will be tackled as part of those highlighted elements, or considered via interdependencies with other environmental factors. As already mentioned above, the aspect of

land quality possibly to be represented by land functions with land as a service-providing unit and attributed functions/services, has not been further pursued here.

7.2 Critical Discussion of Research Approach and Methods

7.2.1 Research Approach and comparative perspective

The focus on the selected case studies and their specific context conditions means that some caution is required with regard to a universal validity of the findings. While the range of documents and experts considered means that some representative character could be achieved, the sample size and geographical focus of the case studies does not preclude that there might be cases that would generate different findings with regard to questions examined by this study for both institutional frameworks. Due to the available resources and time, a consideration of a broader range of municipal case studies or relevant consultancies was not possible; instead, a selection of both comparable but also partially different cases has been attempted, further widening the basis of research through integrating a second municipal case study as well as a number of potentially contrasting rural cases into the document analysis. This does, however, also mean that the initially intended focus on the cases of Liverpool and Leipzig, for reasons outlined in section 2, has been loosened to some extent in order to develop a more comprehensive picture of how land is addressed in SEA procedures in England and Germany. This decision should be regarded as a direct outcome of the research process, reacting to increasingly observed differences in EA frameworks and land-related debates in both countries as determinants for the key questions examined. By that, it is argued that a sufficient degree of "theoretical saturation" (Przyborski & Wohlrab-Sahr, 2010: 182; translated by the author) could be achieved, portraying major differences but also recurring phenomena on how land has been addressed to date and on key perceptions on how it should be framed in future EA practice.

It needs to be acknowledged, however, that the findings did not suffice in order to substantiate concise (new) theoretical insights on learning through uncertainties in SEA. Whereas this link was initially to be explored further by the study, varying concepts employed by the interviewed experts hamper the derivation of universal assertions on such a potential link. Nevertheless, from the observations made, starting points for further research dedicated explicitly to scrutinize this link have been formulated. Hence, the study can be said to have contributed to underpin existing analytical frameworks of learning and assessment uncertainties in EA, scrutinizing earlier findings as reviewed and applying those to the field of integrating new environmental issues into EA. Beyond that, and in particular with regard to an applicability of the findings in practice, the study developed starting points for an environmental problem field, i.e. resource efficient land use (see section 8 in particular), that has so far not been looked at explicitly in the context of EA methodology. For that purpose, the combination of a partly inductive/partly deductive approach has proven suitable.

Whereas the comparative research design posed major challenges with regard to considering the influence of different institutional settings and related framings of land, these differences enabled deeper insights into implications of societal and regulatory development paths that most certainly would not have been possible by considering only one case study context. Also, different approaches with regard to structural and procedural aspects of EA led to mutual impetus for methodological advancement that has only become possible through the comparative perspective. The decision to focus on land in the context of housing certainly narrows the immediate applicability of the findings; however, this narrowed perspective enabled a focused

consideration of drivers and indicators for land use, is considered to be adaptable to other land use fields, and can be extended by subsequent studies and practical guidance.

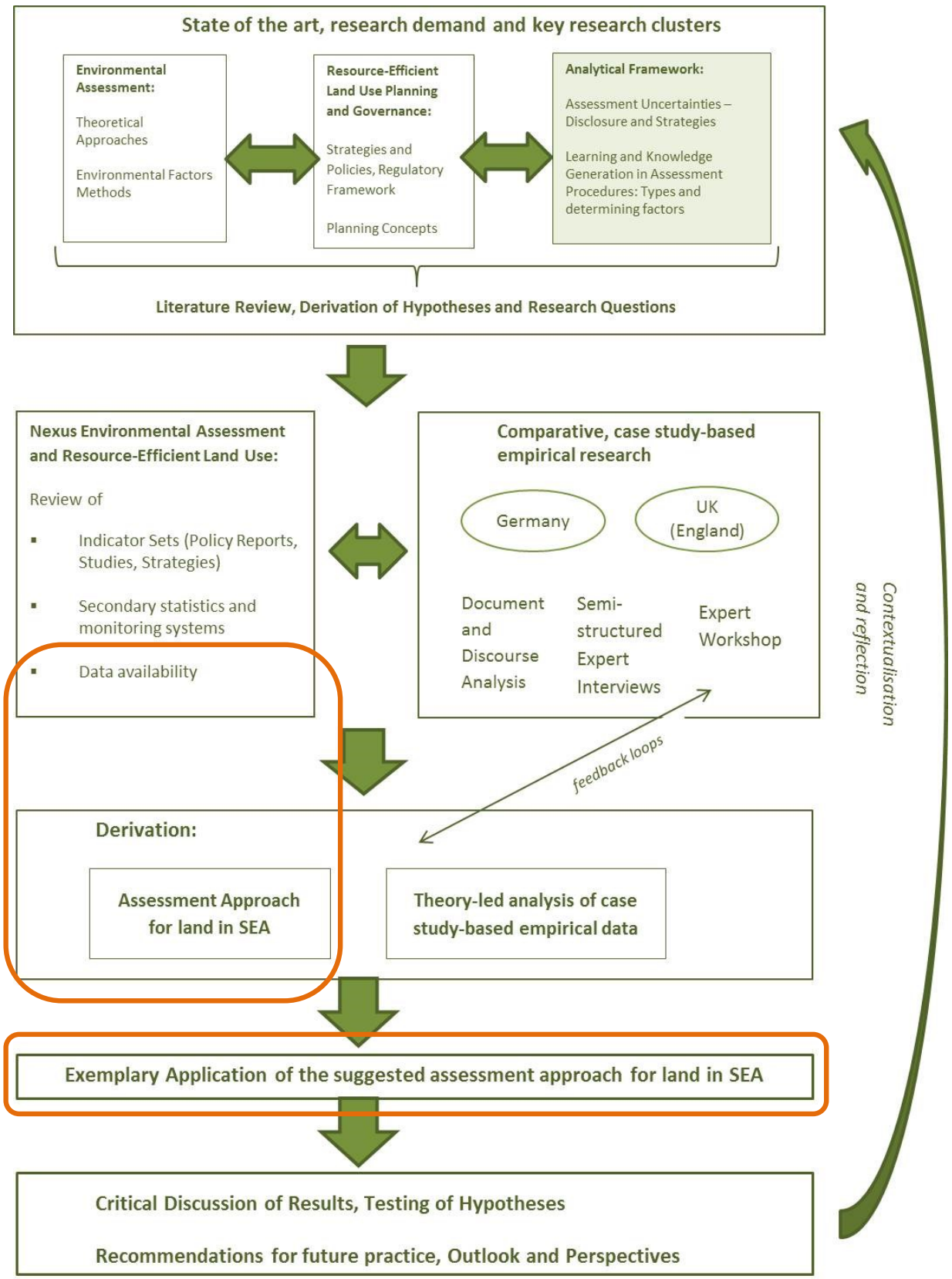
7.2.2 Document Analysis

The document analysis of EA reports constituted a particularly useful starting point for unfolding a picture of how land is addressed and for carving out a general pattern of key aspects and differences between the two case studies, as summarised by the matrix illustration in section 5. Also, the integration of additional comparative documents from smaller, rural municipalities throughout the research process was useful in order to arrive at a more comprehensive picture of how land is addressed in different geographical contexts and for different situations of land use demand. With regard to conclusing assessment statememts/weighting results, some methodological inaccuracy might have resulted from EA reports for German binding land use plans mostly not being issued separately but as part of the overall plan rationale, as mentioned in section 5. A supplementary analysis of land-related evidence base documents informing land use plans (beyond those analysed for comparing benchmark data on land use patterns in section 4) would have been another asset in order to further depict what preliminary analyses are of key relevance for EA procedures. While these documents have been analysed for the major cases of Liverpool, Leeds and Leipzig, this work could not be conducted for all additional cases later integrated into the scope of the document analysis. Especially for England, given the practice of continuous revisions to draft Local Plans and frequent recent changes to regulatory requirements, this analysis can only depict a time-specific snapshot of EA practice, while for Germany informal plan documents often supersede older formal plan documents as is the case for Leipzig (e.g., 2012 FNP vs. 2018 INSEK). However, with a focus on most recent EA reports overall, it is assumed that a representative picture of how land has been addressed by EA in both case study contexts to date could be achieved.

7.2.3 Expert Interviews

Semi-structured expert interviews conducted for this study are, on the one hand, particularly helpful for deepening and validating findings about the current consideration of land, while on the other hand, they serve as a key source for exploring further-reaching interest regarding the future framing of land as well as approaches to addressing uncertainties and factors for learning that could not be derived from the document analysis alone. The limited sample and snapshot character as stated above need to be acknowledged, with a systematic analysis of learning processes requiring a long-term analysis in order to derive valid causal relations. The selection of interviewees, based on a systematic search but also referring to existing contacts and snowball sampling, might have influenced the results to some extent, in particular with regard to the wide range of small consultancies in the German case out of which obviously only a small number of representatives could be interviewed for this research. This selection might contain some bias in selecting those consultancies that are particularly active in the professional community. This appears less problematic for the English case where the range of consultancies (most of them of significantly larger size than in Germany) is smaller, as well as for the group of authorities where relevant contacts used to be relatively unambiguous. While the ratio of the two key groups of interviewees, i.e. consultancies and authorities, is comparable for both case studies, the larger number of interviews for the English one overall was mainly caused by initially delayed responses to interview requests and a resulting higher interest in interviews than initially expected, based on renewed enquiries. Since, however, those interviews also helped to study the English planning and SEA system in detail (more so than the German ones where context conditions were known in more detail beforehand), this higher number of interviews appears justified.

Considering the process of interviewing, it can be said that criteria suggested in section 2 could be fulfilled. The combination of an overarching set of questions related to the main research questions, supported by optional sub-questions, enabled a structuring and steering function of the interview guidelines, at the same time enabling transparency with regard to guiding questions for analysis. The flexible handling of this catalogue of questions and the integration of aspects raised by the interviewees ensured an open and context-sensitive interview situation with regard to the background of individual experts. The interview guidelines being based on a detailed literature research enabled the interviewer to make meaningful links and contextualize additional aspects brought up of relevance for the research objectives. A critical point observed might be a too general character of some questions. Even though their openness proved beneficial for capturing different aspects and viewpoints, they may have generated too broadbrush responses with regard to the role of uncertainties and learning. However, this has been balanced to some extent by asking specifying questions in flexible reaction to the aspects brought up by the individual experts.


State of the art, research demand and key research clusters
Environmental Assessment:
Theoretical Approaches
Environmental Factors Methods
Resource-Efficient Land Use Planning and Governance:
Strategies and Policies, Regulatory Framework
Planning Concepts
Analytical Framework:
Assessment Uncertainties – Disclosure and Strategies
Learning and Knowledge Generation in Assessment Procedures: Types and determining factors
Literature Review, Derivation of Hypotheses and Research Questions
Nexus Environmental Assessment and Resource-Efficient Land Use:
Review of
Indicator Sets (Policy Reports, Studies, Strategies)
Secondary statistics and monitoring systems
Data availability
Comparative, case study-based empirical research
Germany
UK (England)
Document and Discourse Analysis
Semi-structured Expert Interviews
Expert Workshop
feedback loops
Contextualisation and reflection
Derivation:
Assessment Approach for land in SEA
Theory-led analysis of case study-based empirical data
Exemplary Application of the suggested assessment approach for land in SEA
Critical Discussion of Results, Testing of Hypotheses
Recommendations for future practice, Outlook and Perspectives

8 Developing a methodology for assessing land as a factor in EA practice: A fit-for-purpose approach for the scale of EA for German municipal land use plans

Based on the empirical research findings, demonstrating the limited extent to which land has been addressed by EA procedures to date and on requirements observed with regard to its framing as a new environmental factor, potential starting points and related challenges with regard to both case study contexts have been discussed in the previous chapter. Due to these challenges and insufficient data availability in particular, the decision was made to conduct an expert workshop to discuss an operationalization of land that can be implemented with existing data and is of direct use for EA practice. For the preparation of this expert workshop, an overarching framework and standardized assessment schemes were designed as a basis for further discussion. The following section presents this methodology and its further refinement through expert debates, followed by its exemplary application to a recent binding land use plan for Leipzig. The decision has been made to limit the development of such a 'fit for purpose' approach to the German situation and to the scale of municipal land use planning for housing purposes. This is due to the fact that indicators that suit the respective institutional framework as well as related data availability vary between institutional contexts and spatial scales. However, suggestions for adapting this approach to the English situation will be made and subsequently discussed.

The intent of offering such a fit for purpose approach looks beyond those expert statements and critical viewpoints that do not consider significant changes to current practice required, as outlined above for the German situation (for municipal land use plans subject to the revised EIA Directive, as opposed to plans at higher spatial scales that are subject to SEA and thus not (yet) affected by related changes). Instead, it rather follows arguments that emphasise potential added value of explicitly considering land in EA procedures (see section 4) and therefore aims to explore how objectives of resource efficient land use can be assessed more consistently and potentially contribute to providing a clearer picture of impacts on land generated. This also serves to underpin debates for a more ambitious approach in employing binding targets and standards as part of planning practice and legislation – in line with the persistency of unsustainable land use patterns and the often demanded objective of equipping EA and resource efficient land use with 'more teeth' (e.g. Fischer, 2017b; Bock & Preuß, 2018; UBA, 2018a).

Within that context, the following section offers a rather rational approach in order to develop concrete thresholds for assessing land that may serve as a basis for further discussion. It is acknowledged that on the one hand, such an approach somewhat disregards the role of SEA in considering different perspectives on and interests in land use (such as on location-specific densities or trade-offs between impacts on land quality from the perspective of other environmental factors). A general framing of sub-aspects of land that would remain subject to specific assessment as part of the respective individual EA procedure would, however, not have enabled a detailed discussion of potential standards as requested by interviewees and as required for clarifying significance. Hence, a clear focus here is on enabling a more elaborate and transparent identification of impacts on land through systematically structured SEA (see also Fischer, 2003), guided by overarching objectives of resource efficiency. In every individual procedure, different interests and value expectations in the role of SEA as scrutinized by Cape et al. (2018; see section 3) and Fischer (2017b) need to be kept in mind when aiming to strengthen satisfaction of all parties involved with the assessment procedure.

8.1 General methodological considerations

Considerations on the role of resource efficient land use in EA go back to Ziekow (2009) who argued that EA contains substantial potential for addressing land. Here, the argument is made for a differentiation between quantitative aspects of land use, looking at the amount of land impacted, and qualitative aspects, looking at the quality and sensitivity of that land. It is also emphasized that EA may unfold the strongest role as part of those procedures that look at alternatives of land use, i.e. SEA for land use plans, urging for the development of binding reference values, e.g. through an operationalization of the 30 ha-target. More recently and in the wake of changes to regulatory requirements through the revised directive, ways of considering land more systematically were provided by Alsleben (2015), also suggesting land take and the resulting need to operationalize overall targets such as the 30 ha-target for Germany as a key element. Beyond that, and framed by efficiency, consistency and sufficiency of land use, he suggested to assess the actual (objective) need for additional land take, the consideration of redevelopment potentials, the quality of land use and the potential reversibility of land use patterns. The requirement for that is also emphasized by the fact that the (English) text of the revised directive does not only refer to 'land take' but 'land'.

While Fischer (2014b) urges for caution when integrating too many aspects through the instrument of SEA, land is inextricably linked to existing factors as well as already, if implicitly, covered by many plans that are subject to SEA (in current practice, however, often meaning again that land is seen as the taken-for-granted basis for sustaining other factors; cf. Fischer, 2014a for aspects of health). Given the focus on municipal land use planning, tiering implies that the comprehensive municipal land use plan requires a detailing of general site allocations taken by the regional plan. The binding site plan, then, is to specify sites allocated by the comprehensive plan, particularly with regard to type and degree of built use. Hence, site allocations taken by the comprehensive land use plan, regularly evoking negative environmental impacts and setting the framework for projects with EIA obligation, require a detailed assessment for each allocated site as well as an assessment of cumulative impacts of all allocations (Schwarz, 2011). Nevertheless, an assessment of alternatives is not only required for the comprehensive but also for the binding plan scale (§ 9 Abs. 8 und § 2a BauGB; Gassner et al., 2010; Schwarz, 2015). Based on the expert workshop, this has been emphasized, given the prevalence of parallel procedures instead of strategically developing new comprehensive land use plans in current planning practice.

As Jacoby (2016) argued for the German Federal Building Code, current developments appear not to work in favour of the overall objective of reducing land take and enhancing land use efficiency. While the 2013 revision of the Federal Building Code took a decisive step through requirements for local authorities to assess their PDL potential before bringing greenfield land forward for development (§ 1a Abs. 2 BauGB), the 2017 revision questions this intent: On the one hand, it introduces a new site category that is supposed to facilitate compact settlement patterns, the 'Urban Area' (MU; allowing for higher densities than in mixed use sites (GFZ up to 3.0) and an exceedance of noise emission thresholds), as part of the BauNVO. Walter (2016), however, pointed out the problem of an undifferentiated application of BauNVO site categories to spatial categories from rural areas to city centres, as a barrier to enhanced land use efficiency. On the other hand, the extended option for an 'accelerated planning procedure' to greenfield developments of an area size up to 10000 m^2 (§ 13b BauGB), poses a considerable threat to the objective of resource efficient land use through a reduction of regulatory barriers to (unnecessary) land consumption, even though it is only foreseen to be valid until the end of 2019.

For operationalising land, requirements derived from the review of previous studies as well as from empirical findings of this research have been scrutinised with regard to their transferability to indicators, and related data availability. Looking at suitable assessment standards, a key issue refers to the legally defined character of such standards with regard to their role in the final weighting procedure. As Helbron (2008) points out, if binding and quantified values are available these are to be used, if this is not the case, indefinite terms included in legally binding documents need to be applied and interpreted (see also figure 49). Therefore, assessment standards can also be derived from government strategies (such as the 30 ha target from the National Sustainability Strategy for land take), being operationalized as assessment standards according to § 14g UVPG. Based on the compilation of land-related objectives in section 4, therefore, the following will look at potential assessment standards for determining what land as a factor is to be assessed against. Advantages and disadvantages of using static thresholds as opposed to the consideration of individual constellations of sensitivity and impact have also been outlined by Geneletti et al. (2017).

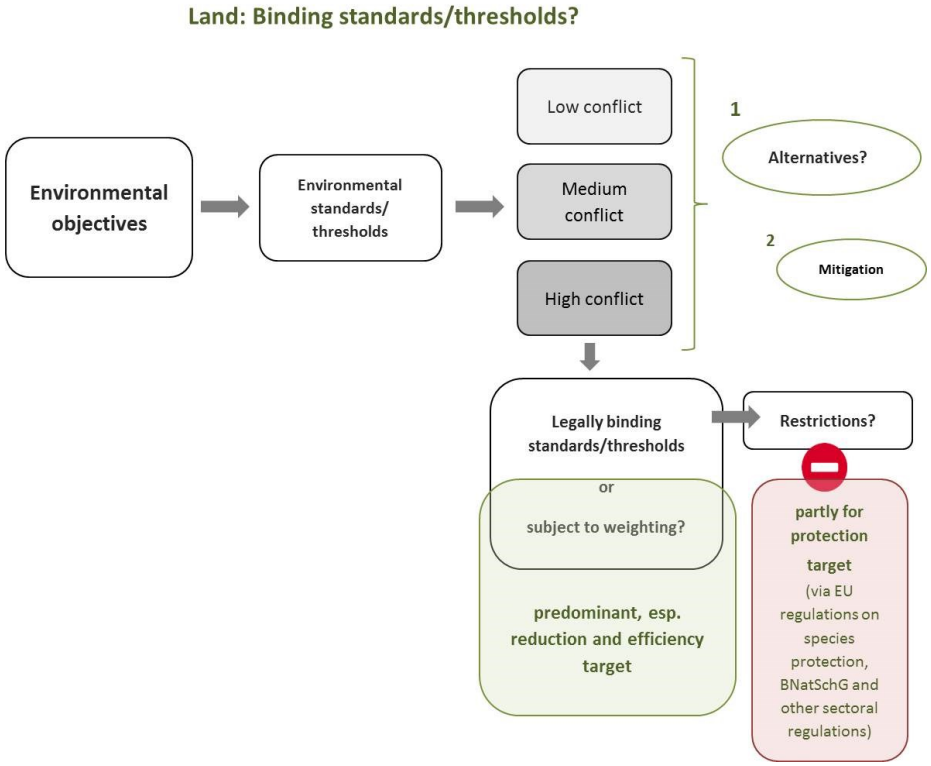


Figure 49: Binding character of land-related objectives and standards to be derived for the German case (modified based on Helbron, 2008; icon made by Freepik from www.flaticon.com)

The suggested approach is based on the key EA steps of identifying, describing and assessing probable significant environmental impacts as well as of assessing alternatives and of identifying mitigation and compensation measures for unavoidable impacts (see section 3): Focus of assessment is on impact intensity, based on comparing the baseline situation of land and changes intended by the plan, given that sensitivity of land in its undeveloped form is in principle the same on all sites. For the further discussion of related indicators and standards, both results of the expert interviews, the discussion of suggested aspects during the expert workshop and, importantly, data availability as reviewed in section 4 need to be taken into account: Hence, the structural target has been excluded for two reasons, comprising the lack of locally applicable data on fragmentation (see e.g. UBA, 2018e) as well as its consideration via the factor biodiversity, and

the infrastructural integration of sites not constituting an environmental aspect (thus not subject to SEA, different for SA in England). All other targets have been further scrutinized for developing the assessment methodology, with potential aspects having been compiled and illustrated in figure 50.

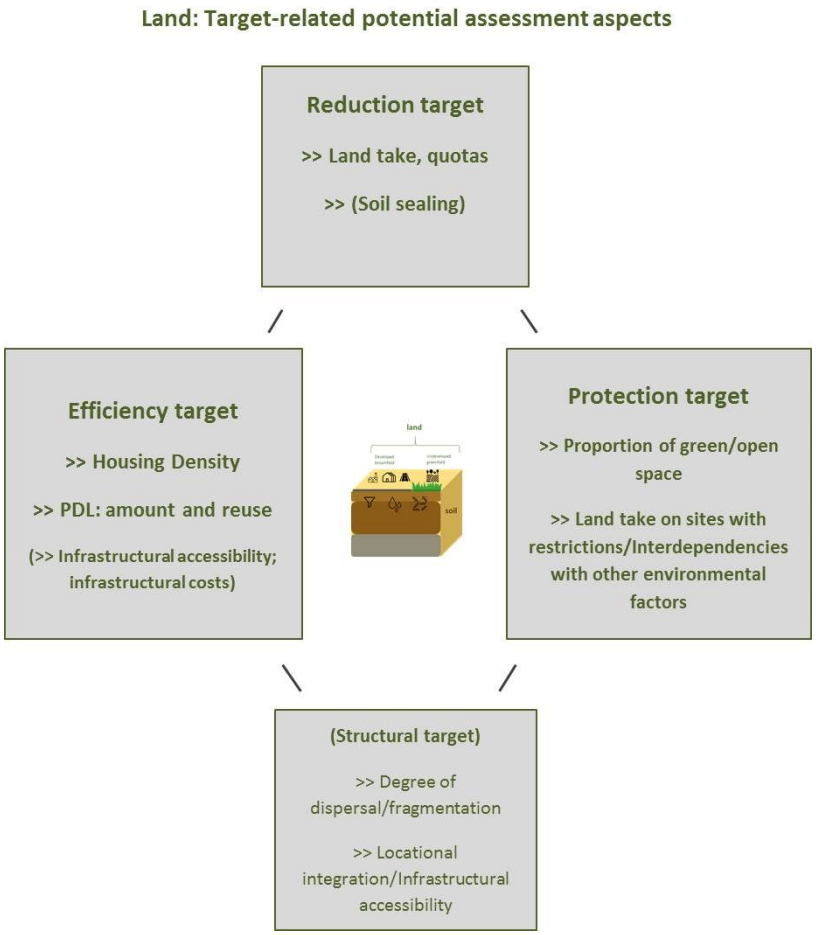


Figure 50: Target-related potential assessment aspects for land (own figure)

8.2 Key elements of an assessment approach for land

8.2.1 Guiding structure

In line with key steps of SEA, a catalogue of assessment questions has been compiled, based on approaches developed for other environmental factors and as part of SEA guidance (e.g. Jiricka et al. 2016, Balla et al. 2010; ODPM, 2005a). In table 18, these assessment questions and detailing sub-questions will be introduced as a framework for discussing suitable indicators and data. Aspects that had been suggested initially but have been omitted as part of further discussion below are marked in grey.

The focus will be on options of identifying and assessing the **significance** of potential impacts in detail. In that regard, potential assessment aspects as suggested will be discussed and further condensed, based on the results of the expert workshop and subsequent debates. For each of the proposed elements, potential indicators and data will be reviewed before their applicability and operationalization for the assessment approach to be developed are discussed. With regard to **data availability**, this discussion draws from the compilation of land-related indicators and data availability as reviewed in section 4. With regard to **mitigation and compensation**, the general

hierarchy is to be applied (see section 3); for compensation, two mechanisms are to be differentiated: In a narrow sense, compensation for EU protected sites is legally required, based on the EU Habitats Directive. In a broader sense and of particular interest for assessing land, however, more comprehensive schemes have been developed that enable compensation also for other ecologically valuable sites (see pools of sites/eco accounts in Germany: Wende et al., 2018b; Breuer, 2016; voluntary and pilot schemes in the UK: Baker et al., 2018), and could potentially be expanded to compensation for changes to previously undeveloped land in line with the no net land take/circular land management concepts as introduced in section 3.

Table 18: Framework for assessing land as an environmental factor (own table)

Assessment framework for land as an environmental factor in EA for municipal land use plans (focus housing)
Screening: General relevance of land in assessing the plan
▪ Are impacts on land as a resource to be expected?
Scoping: Scope and depth of assessment, required information
▪ What general impacts on land as a resource are to be expected? ▪ What information is required in order to identify these impacts? ▪ What data are available in order to provide this information? ▪ What data have to be generated/gathered in order to provide this information? ▪ Which persons/interest groups have to be consulted with regard to impacts on land as a resource?
Baseline situation and sensitivity of land
▪ What objectives and targets (legal requirements, strategies, programmes) are to be considered with regard to land? ▪ What is the current situation of land on the future plan site? • current land use, proportions of individual land use types • degree of soil sealing • availability of PDL potential • proportion of green and open space • other qualitative aspects (as part of existing environmental factors)
▪ What factors currently exert an impact on land on the future plan site? • planned land use changes • land use interests • land use conflicts
Probable impacts
▪ To what extent does the plan generate additional impacts on land? ▪ To what extent does the plan alter existing impacts on land as a resource? • change of current land use, changing proportions of individual land use types • proportion of land take • changing degree of soil sealing • land use efficiency: Availability of PDL potential • land use efficiency: Built-up/residential/dwelling density • land use efficiency: Accessibility/provision of infrastructure • changing proportion of green and open space • changes in other qualitative aspects (as part of existing environmental factors)
Significance of impacts, environmental risk
▪ What is the proportion of PDL reuse to be realized through the plan with regard to the overall availability of PDL potential? ▪ Does the implementation of the plan result in a lower deviation of minimum density of use? ▪ Does the implementation of the plan ensure a sufficient accessibility of infrastructure? ▪ Does the implementation of the plan result in a reduction of the proportion of green and open space? ▪ Will the additional land take/change of land use enabled through the implementation of the plan result in negative impacts on other qualitative aspects (assessed as part of existing environmental factors?

Alternatives

- Is the additional land take/change of land use expected through the implementation of the plan required?

If yes:

- Are there alternative sites for realizing the plan objectives that are less sensitive/at risk?
- Are there alternative sites for realizing the plan objectives for which less significant impacts would be expected?

For assessing alternatives, generally, locational or site alternatives, and design alternatives are to be distinguished. Also, the hierarchy of alternatives in land use planning, i.e. demand, location, timing, and mode of development are to be considered.

If not: (Avoidance), Mitigation and Compensation

- Can the amount of land take be reduced?
- Can the degree of soil sealing be reduced or kept at baseline level?
- Can the reuse of PDL potential be increased?
- Can the density of use be increased?
- Can the accessibility of infrastructure be improved?
- Can the proportion of green and open space be increased or kept at baseline level?
- Can impacts on other qualitative aspects (assessed as part of other environmental factors be reduced or avoided?

>> Potential mitigation and compensation measures

- Desealing
- Activation of PDL potential
- Green roofs/facades
- Multifunctional land use

Monitoring and Monitoring Indicators

- Development of land take (potentially also: statistics on planning permissions and housing completions)
- Development of the degree of soil sealing
- Development of the proportion of PDL reuse (3:1 target)
- Development of density of use
- Development of the proportion of green and open space
- Development of other qualitative aspects (assessed as part of other environmental factors)

8.2.2 Land take (reduction target)

8.2.2.1 Indicators

Land take refers to questions for projected land demand and the role of the amount of land take to be realized by the plan with regard to this demand and to an overall reduction target. Key interest therefore lies in quantifying the specific amount of land take arising from the land use plan in question and relating this amount to an overarching target, i.e. for the case of Germany the 30 ha target, and, looking beyond that, the no net land take target. Due to the reference of the 30 ha target to official land use statistics, this implies the use of the official statistics' land use indicator, i.e. land for settlement and transport purposes (SuV) as a proxy for land take, despite accuracy problems associated with that use as described above. While it also needs to be taken into account that the amount of land allocated for housing by the respective land use plan only depicts designated land for that purpose but not yet actual use, at the stage of EA only designated land take can be assessed, with actual realization being subject to future plan implementation and thus to monitoring (see also debate on the use of statistics on planning permissions/dwelling completions; Meinel, 2017). Another line of discussion refers to the use of soil sealing data in order to depict actual land take better, given the problem of SuV including housing-related open and

green space. Yet data on soil sealing are not available on federal or state level and depend on the availability of respective databases or (quickly outdated) studies at municipal scale. The further employment of the soil sealing indicator therefore did not appear feasible for developing an assessment approach for land that is as universally applicable as possible. Also, soil sealing can only mirror different degrees of artificialisation, whereas SuV enables a more comprehensive picture of land changing to developed use but not necessarily being completely sealed (see also UK LUCS). Hence, with land designated for development constituting a proxy for actual land take, the SuV indicator is considered to be more suitable for further use, due to its utilization by both official land use statistics and the overarching sustainability target.

8.2.2.2 Data

For the identification of actual land demand (only for housing), housing market projections 2030 issued by BBSR (2015a) constitute a key resource available for the complete German territory. Here, demand for new housing has been identified at the district scale, indicated in dwellings/ha with regard to the number of inhabitants, as illustrated in figure 51. For determining if the amount of land take arising from the implementation of the plan is in line with or exceeds a municipal quota derived from an overarching target, related operationalised reference values for land take at the municipal scale need to be identified. Here, key reference is provided by a model project that developed an allocation method for identifying the maximum permissible land take that would still allow for the achievement of the 30 ha target for each German municipality (UBA, 2012; Henger & Schier, 2014). Previously, a proposal for contingencies of land take at the state scale had been made by KBU (2009), based on SuV development 2001 to 2004 and population figures. Although the UBA (2012) allocation method has initially been developed with regard to a land trading mechanism and related distribution of free land certificates, its calculation method appears well suited to derive municipal quotas for land take as a basis for assessment. Method and determinants for allocating quotas to individual municipalities have been intensively discussed by the project. Strands of debate included allocation according to a defined baseline situation ('grandfathering') or according to various criteria such as projected population or economic development, finally deciding on population figures as a key determinant and a degressive attribution of certificates (ha) according to three size groups (Henger & Schier, 2014; BMVBS & BBR, 2007). While in an earlier version of the tool, a related continuous reduction of the overarching target towards 20 ha overall was included, the postponement of the 30 ha target to 2030 and an indefinite further reduction in the wake of the revised German Sustainability Strategy saw a reduction of quotas towards achieving the 30 ha target only. Initially, an online tool at flaechenhandel.de provided a direct number of free certificates for each German municipality via a search mask, requiring these certificates to be transferred into spatial measures, with one certificate amounting to 1000 m^2, i.e. 0.1 ha. By that, annual quota for land take for each municipality can be derived that are in line with the overall 30 ha target. While this online tool is not accessible any more, related data have been provided by the publisher and can be retrieved from annex xx. Inconsistencies in land use statistics and the SuV indicator not necessarily mirroring actual land take need to be taken into account (Fina, 2013).

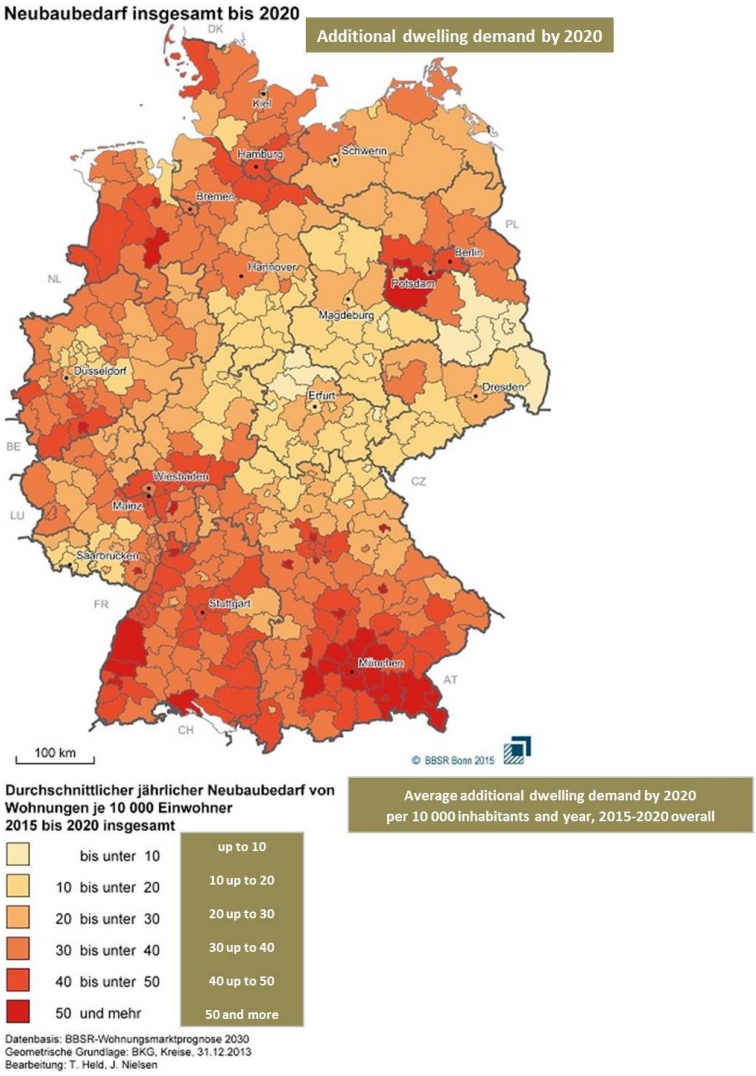


Figure 51: Projected additional dwelling demand by 2020 (BBSR, 2015a; summarized translation provided by the author)

With regard to the focus of the assessment approach on municipal land use plans for housing, it further is to be clarified what the average share of housing on overall land for settlement and transport purposes is. Here, UBA (2003: 75 ff.) estimates that housing amounts to about a third of overall SuV. Values indicated by UBA (2012) thus need to be reduced by two thirds in order to arrive at applicable and plausible quotas for land take for housing. An attempt towards providing comparable data on land take at EU scale has been developed by Corine Land Cover (see also data presented in section 4). However, their coarse resolution as well as infrequent updating constrains their suitability for purposes below the national scale (Bio by Deloitte, 2014).

8.2.2.3 Discussion

As revealed by expert debates, the identification of land demand should only have an informatory function and not be part of the assessment itself, given that SEA is to stay focused on assessing environmental issues. Hence, land demand is to be considered as a background information in SEA, serving to set land take proposed by the plan in relation to actual demand. While land demand projections always meet with considerable uncertainties, BBSR (2015a) projections enable comparability between all German municipalities, whereas municipal housing demand projections may be more recent/more accurate but tend to be based on different methodologies

and are thus of limited comparability. The federal projections suggested here thus appear more suitable as a harmonized basis for assessment, despite the need for regular revision and consideration of changing conditions for housing demand such as national and international migration patterns.

For applying quotas for land take as assessment standards, the currently relatively static orientation towards the 30 ha target needs to be critically taken into account. For the assessment approach to keep pace with changing targets, quotas would need to be adapted with regard to a further reduction of the overall target (30 'minus x'), and in particular with regard to achieving no net land take. For depicting the latter, assessing the ratio of additional land take and bringing PDL back into a more natural state could constitute a suitable indicator for future adaptation of the suggested approach.

8.2.3 Land use efficiency (efficiency target, (structural target))

8.2.3.1 Indicators

For assessing land use efficiency, two key elements have been identified, one referring to reuse of previously developed land with regard to the overall availability of PDL, the other referring to compactness of land use. For the first element, the amount of PDL potential available, and its relation to land take proposed by the plan in question, appears to be the obvious indicator. For the second element, various indicators have been developed in connection with the structural target, such as degree of fragmentation (measured by indicators such as effective mesh size, unfragmented areas little affected by transport infrastructure and weighted urban proliferation WUP (EEA, 2016b; Jaeger et al., 2010; Moser et al., 2007; Esswein et al, 2003)), infrastructural accessibility and integration into the existing urban fabric, as well as various density parameters. However, for the municipal scale, housing density and infrastructural accessibility/integration appear most suitable with regard to measuring the efficiency of how a particular site is to be used (with other indicators being more suitable for the overarching regional and state scale, see also remarks on the structural target above). With the question of how land use efficiency can be quantitatively assessed being a key one with regard to the debate on land use (e.g. Ferber et al., 2016), and the question of housing density constituting a particularly contested one in the planning discourse, it will be considered separately in the following. At the same time, housing density is intrinsically related to the availability of open and green space in particular.

8.2.3.2 Data

With regard to the first element, i.e. the reuse of PDL in relation to overall availability, the varying quality of databases on PDL in municipal administrations constitutes a challenge for a universally applicable assessment approach for land. The lack of consistent data on reuse potential has been described as a key shortcoming for German planning practice by e.g. Fina (2013) and UBA (2015a). Hence, and given that precise and up-to-date PDL databases tend to be available in larger cities only, a comprehensive remote sensing-based study on the identification of PDL potential (BBSR, 2013) may provisionally serve as a proxy for deriving figures for the whole range of municipalities. Here, and as illustrated in figure 52, an average PDL potential of 15-20 m^2 per inhabitant is indicated. Based on this and the number of inhabitants of the respective municipality, a figure for a likely amount of PDL potential can be derived. Where possible and available of course, more accurate figures from municipal databases should be used. Given those differences below the national scale already, at EU scale, a lack of comparable data on PDL availability as well as inconsistent approaches on monitoring PDL reuse need to be identified (Bio by Deloitte, 2014).

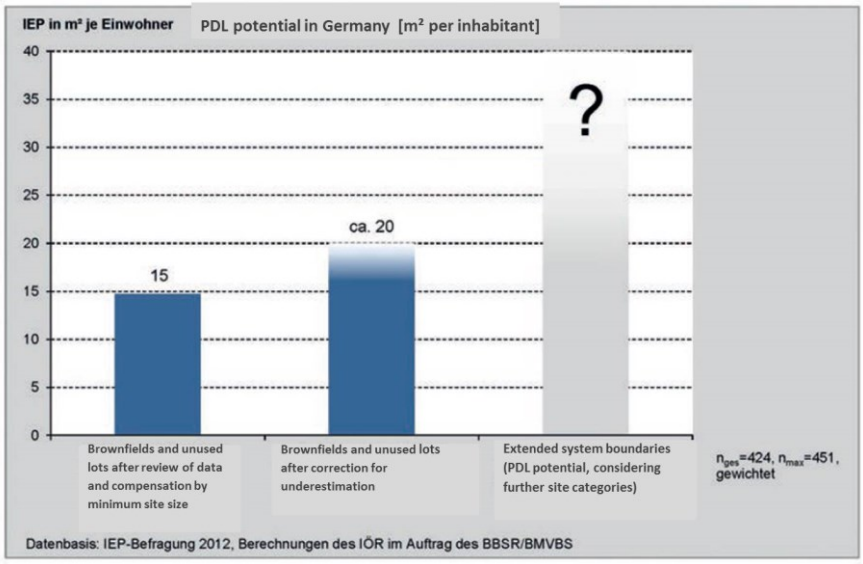


Figure 52: Amount of PDL potential in Germany (BBSR, 2013: 3; translation by the author)

Looking at the second element of compactness, lines of discussion relate to the use of orientation values for minimum housing densities. Besides fostering PDL reuse, a (moderate) increase in housing densities constitutes a key factor for achieving a higher level of land use efficiency (e.g. UBA, 2003; Frick, 2006; Fina, 2013; LABO, 2012). In that regard, Baron & Dross (2016) state for Germany that both sufficient housing supply and the achievement of the 30 ha target are possible, even without considering PDL reuse, on the precondition of an efficient use of available land.

However, concrete standards or orientation values for housing density that are compatible with both housing preferences and objectives of resource efficient land use have to date rarely been defined. The following aims to clarify this discussion, identify explanatory factors arising from the controversial debate, and attempts to display options for appropriate orientation values for the assessment approach developed as part of this research.

8.2.3.3 A review of orientation values and potential standards for housing density

A key question with regard to potential assessment standards for housing density consists in whether these values should be defined universally or in a tiered manner depending on locational criteria, as well as in the definition of adequate reference spaces (see also Scholles, 1997; Libbe, 2014). The following will look at how such values and value ranges have been defined and discussed in the planning literature as well as in guidance and policy documents and as part of land use plans to date.

For locational criteria, so-called **urban or settlement structure types** (*Stadt-/Siedlungsstrukturtypen*) have regularly been categorised, describing „areas with largely homogenous characteristics regarding size, shape and layout of buildings, with a distinctive configuration of built-up and open space as well as of density and built-up area" (Westphal, 2008: 53; translated by the author; see also Wickop, 1998). While these types may differ in detail between different authors and fields of application, for the situation in Germany/Central Europe a number of basic types can be summarised: Libbe (2014) differentiates between medieval old town, pre-industrial urban core, industrial urban expansion in block structure, 1920s to 1960s row housing development, large peripheral housing estates, post 1990 row housing development, terraced housing, compact single- and double-family housing and loosely structured single- and double-family housing. A similar categorisation is suggested by Hegger & Dettmar (2014) with

regard to energy parameters. Based on that and for further use in this chapter, the following (simplified) urban structure types are to be differentiated: **detached single-family housing, compact terraced housing, row multi-storey housing and block multi-storey housing**, as also mentioned by Deilmann et al. (2005) as key categories for distinguishing settlement patterns with regard to land take and land use efficiency.

When approaching the question of suitable densities for achieving higher levels of land use efficiency, different **types of density** are to be taken into consideration. With density in the context of urban planning and development being defined as the relation of objects or people to a defined reference space (Westphal, 2008), the focus here is on **building density/site density** and **dwelling density/residential density**, with other aspects also referring to social density or employment density, for instance (Apel et al., 1997; Apel et al., 2000; Häussermann, 2007; Strauß, 2013; Sonne, 2017). This focus is in line with Roskamm's (2011: 11) assertion that most debates on density from the perspective of urban development are based on an interconnected notion of built-up and residential density. A major difficulty lies in the employment of different reference spaces and resulting limited comparability of values indicated by different studies, related critique having been pointed out by Westphal (2008). A key distinction refers to **gross housing land** (*Bruttobauland*), i.e. building land including internal infrastructure provision as well as green and public space, and **net housing land** (*Nettowohnbauland*), i.e. that part of the building land covered with buildings for housing including site-related courtyards and pathways (Korda, 2005; Prinz, 1999). A general proportion of net housing land plus 20-30 % resulting in gross housing land is assumed, with a conversion factor of net density x 0.7 resulting in gross density, and gross density x 1.4 resulting in net density (Westphal, 2008; based on Siedentop et al., 2006).

For the case of Germany, **building or built-up density** has dominated the definition of density in planning documents, largely due to its utilization for defining site-specific maximum densities as part of the Federal Land Utilisation Ordinance (BauNVO). In particular, site occupancy index (*Grundflächenzahl GRZ*), i.e. ratio of built-up space and overall site size, and floor space index (*Geschossflächenzahl GFZ*), i.e. ratio of total floorspace and overall site size/net housing site space are of relevance here (Korda, 2005). Grabski-Kieron & Raabe (2015) scrutinise values for individual site categories as defined by the BauNVO, illustrated in table 19, finding that with predominantly defining an upper limit for building density according to site categories, they appear little relevant for fostering land use efficient site development. While the regulations (§ 16 (4) BauNVO) also entail the option of defining a minimum GFZ value and thus a minimum utilisation of the available site, this option requires a separate justification on the grounds of site characteristics and has been rarely applied to date (Westphal, 2008).

Table 19: Upper limits to built-up density for key site categories as regulated by the German BauNVO (own table based on Grabski-Kieron & Raabe, 2015)

Site Category	Site occupancy index (GRZ)	Floor space index (GFZ)
Residential-only sites (WR), General residential sites (WA)	0.4	1.2
Village sites (MD), Mixed use sites (MI)	0.6	1.2
Core sites (MK)	1.0	3.0

Roskamm (2011) and Sonne (2017) further consider how these upper limits have come into being, depicting that historical-paradigmatic reasons, in particular the ideological usurpation of residential density (see also section on orientation values below), led to the utilisation of built-up and not of dwelling/residential density in post-war years. Another point is that these upper limits were focused on reducing density and do not correspond any longer with today's needs and preferences, in particular given the attractiveness of many urban neighbourhoods with floor space indices above 3. In this regard, recent developments have enabled some adaptation (see the debate on the Urban Area (MU) site category as part of the revised BauNVO: Walter, 2016; Scholz, 2018). Demands for a more flexible approach towards housing densities, not restricted by upper limits but adjustable to site characteristics (Walter, 2016), on the one hand, and more recent demands for the definition of not only upper limits but of minimum densities in particular, on the other hand, exist in parallel today and will be reviewed further below.

Besides building density as indicated by GRZ and GFZ, key determinants include **dwellings per hectare (dwelling density)** and **inhabitants per hectare (residential density)**, both either referring to gross or net site area. Those four parameters can be regarded as the key indicators describing housing density as used in the planning literature. As opposed to the employment of building density as a key parameter in German planning legislation, **dwelling density** constitutes the dominant parameter in defining suitable value ranges for housing densities in English and German planning documents at higher spatial scales than the municipal one. Whereas GRZ and GFZ constitute absolute measures that indicate the proportion of built-up site area (GRZ) or the proportion of overall floor space with regard to overall site area (GFZ) (Prinz, 1999), they describe the utilisation of a site by built-up structures but not the actual efficiency of use also being determined by the proportion of space for infrastructure provision (Bayer. Staatsministerium des Innern, 2001) as well as by dwelling capacity and intensity of built-up structures. Hence, whereas a high GRZ can also indicate a building with a high amount of residential space per inhabitant and, accordingly, a low intensity of use, the number of dwellings or inhabitants per hectare also indicates this intensity, and hence what housing need can be realised on a particular site. The latter, relative parameters are thus considered more suitable for deriving standards for assessing land use efficiency in EA (see also FHH, 2013, in arguing for the utilization of the more illustrative parameter of site density as opposed to built-up density).

For the further discussion of such standards or orientation values, the focus is to be on dwelling density, i.e. dwellings per hectare, since these, in contrast to residential density/number of inhabitants per dwelling, can be influenced by planning decisions, at least to some extent. The following will provide an overview of related values that have been suggested in the planning literature. Additionally, and given the challenge of dual inner-urban development and the qualitative aspect of land use, a review of orientation values for open/green space provision and for a land use efficient provision of infrastructure is conducted. Key for a further discussion of orientation values is a differentiation between **average values** that have been derived from status quo analyses and **orientation values or standards** that have been developed in order to unfold a normative character for planning decisions on the other hand.

Status quo: Average density values

Average values for housing density can be derived from basic references on urban design and planning as well as from specific contributions on housing density. As mentioned above, however, the variety of parameters used hamper their direct comparability and urge for caution in compiling density indications from different sources. Korda (2005), while mainly providing

average values for built-up density, generally points to the problem of high land take caused by loosely structured single-family housing sites and of limitations to densification of this type of housing, with required minimum site sizes of 400 m^2, as opposed to 300 to 350 m^2 per dwelling for double-family housing and 150 m^2 per dwelling for multi-storey housing. Specification with regard to all above-mentioned density parameters is provided by Hegger & Dettmar (2014) for different urban structure types from the perspective of their energy characteristics. Accordingly, table 20 displays average value ranges for the above-mentioned parameters and key site categories.

As mentioned above, for England, dwelling density prevails as a key parameter. While a utilization of site categories/structure types is less common than in Germany, and hence a direct comparison of values does not appear feasible, average overall dwelling density suggests higher average densities for England (32 dwellings/ha; LUCS 16-17) compared to Germany (11 dwellings/ha; Destatis, 2011) and to EU average that have to some extent been attributed to planning policies on green belts and brownfield reuse (Whitehead; see also section 4). A broader look at the discussion of housing densities from an international perspective is beyond the scope of this study but can, for instance, be retrieved from Rowe & Kan (2014).

Table 20: Average value ranges for different density parameters and structure types (own table)

Compilation of average values for different density parameters and structure types (key source: Hegger & Dettmar, 2014; other sources as indicated)						
	Built-up density		Dwelling density	Residential density	Supplementary parameters	
	site occupancy index (GRZ)	floor space index (GFZ)	dwellings/ha net	inhabitants/ha net	proportion of sealed surface	proportion of open space (including partially sealed surface)
Detached single-family housing	0,14	0,23 0,2-0,5 (Korda, 2005) <0,2-0,4 (FHH, 2013)	21	42 5-150 (FHH, 2013)	26 %	82 %
Terraced housing	0,3	0,59 0,5-0,6 (Korda, 2005)	35	90	32 %	70
Multi storey row structure housing	0,27	0,95 0,7-1,2 (Korda, 2005) 0,2-0,8 (FHH, 2013)	104	188 70-250 (FHH, 2013)	35 %	73 %
Block structure housing	0,54	2,46 1,5->4,0 (FHH, 2013)	270	486 250->550 (FHH, 2013)	75 %	46 %

Starting points for assessment standards? The debate on orientation values for housing density

The question whether it is useful and possible to define suitable or even universally valid density values as planning (and assessment) standards has been judged highly controversial to date. Westphal (2008: 49 ff.) summarises key arguments regarding the application of quantitative standards for housing density: On the one hand, the plea for an abolition of quantitative standards

(and upper limits such as in the BauNVO) and for a flexibilisation of permitted densities instead, enabling for densification in appropriate locations, has been voiced (Keller, 2007). This has also been connected with critique regarding the generalisation of the attractiveness of inner-urban high density housing for the "intellectual elite", and a resulting perceived neglection of housing preferences by other parts of population, for instance those with a focus on possibilities for technical activities and private garden use (Baumberger, 2007: 164). On the other hand, and related to the observation of a general renaissance of quantitative standards in planning, Westphal (2008) outlines advantages of orientation values, referring to increased transparency of decision-making, reliable baseline data and consensus-based guidance for decision-makers. It is also pointed out that the definition of such values is nowadays strongly based on societal negotiation processes and less on earlier claims for scientifically exact values as ultima ratio. Korda (2005) clearly derives a demand for density standards by arguing for restricting the realisation of single-family housing to groups of houses or terraced houses. This demand, however, is far from new but has been postulated as a key setscrew, in particular given the prevalent under-utilisation of permitted density through single- and double-family housing and preferences for free-standing single-family houses in rural municipalities (BMBau, 1986, in Westphal, 2008; Apel et al., 2000; UBA, 2018a). The need to combine quantified values with criteria for residential quality has been pointed out in this regard, with studies pointing to a lack of attractiveness of standard terraced housing without structuring elements (Apel et al., 2000; BMVBS & BBR, 2008; Albers & Wékel, 2008). It therefore appears important to take a sensitive approach towards housing preferences and consider compromises between densification and an enabling of (more compact) single-family housing (see also Roskamm, 2011; Whitehead).

The discussion of adequate densities has been strongly shaped by **changing rationales and guiding principles of spatial and land use planning** (Keller, 2007; Albers & Wékel, 2008; Westphal, 2008; Jessen, 2014; Roskamm, 2011). Early 20th century debates were strongly characterised by negative connotations of density based on experiences with overcrowding at the time of industrialisation, as typified by the Berlin block of flats (*Mietskaserne)* (Westphal, 2008: 60; Sonne, 2017). These experiences constituted the key impetus for the development of reform ideas for housing, characterized by more loosely structured early 20th century garden cities and modern site layouts. However, in the first half of the 20th century density was much connected to a focus on regulating population density related to concepts of carrying capacity, in most cases with a strong ideological character, as depicted by Roskamm (2011) and Sonne (2017). These early occupations with housing density can also be regarded as the basis for related regulations, with origins focused on fire protection and a definition of minimum distances between buildings, hence remaining within the realms of building police and focused on preventing danger. Linked to an increasing development of urban planning as a catalyst of social reform, spurred by the rejection of big city housing as a basis for the garden city idea (Howard, 1898) on the one hand and clearly structured high-rise housing in the wake of modernist urban planning (e.g. Gropius, 1925; Hilberseimer, 1927) on the other hand, demands for a staggered system of permitted density from the centre to the fringe were increasingly formulated (Roskamm, 2011). At that time, however, key arguments focused on the provision of healthy living conditions and the prevention of speculation and rather fostered socio-spatial differences. These ideas were to some extent taken up in the 1950s, together with post-war housing shortage and a focus on motorization, however, tending to lose track of the initial innovative ideas of the early years. Resulting from the increasingly perceived monotony of housing sites, the 1960s saw a turn towards aiming at vivid neighbourhoods through immense densities, resulting in a number of large housing estates at the periphery of major cities. However, it quickly became obvious that most of these estates, due to

their mere size and anonymity, in many cases also due to a lack of public transport and monofunctionality for housing, did not support urban density but rather fostered social problems and segregation. At the same time, while single-family housing at the urban fringe continued to be a preferred way of living, inner-urban high-density housing increasingly became attractive sites for urban lifestyles (Häussermann, 2007; Scholz, 2018).

As opposed to peripheral housing estates, the **configuration of buildings and their relation to each other as well as to their surrounding public space have been identified as key factors for attractiveness and liveability of inner-urban neighbourhoods** with high built-up and dwelling densities (Frick, 2006; Scholz, 2018; see also Jacobs, 1961, on the quality of traditional patterns of cities, related density and mixed use). From the 1970s onwards, the debate on density values lost in importance, due to a rejection of a rationalist approach to planning, but has been revitalized through debates on sustainability and resource efficiency in urban development since the 1990s (Roskamm, 2011; Frick, 2006; LABO, 2012; SRU, 2016; UBA, 2018a). Experiences outlined above warn for sensitivity in defining appropriate density, in particular given the utilization of density calculations for arguing for idealized housing types at their respective time. Hence, the dilemma of providing sufficient density for ensuring urban atmosphere/liveability on the one hand and keeping this density at a level that still enables healthy living conditions in terms of noise and accessibility of open space is one that planners haven't found themselves in not only since yesterday. The current situation of a generally positive connotation of density in the planning discourse but a rather abstract attitude towards discussing appropriate densities has been illustrated by Lampugnani et al. (2007: 18; translated by the author): "The necessity of density is not an issue because it is inevitable from a functional, economic, ecological, societal and cultural-political point of view; its realization, however, is indeed."

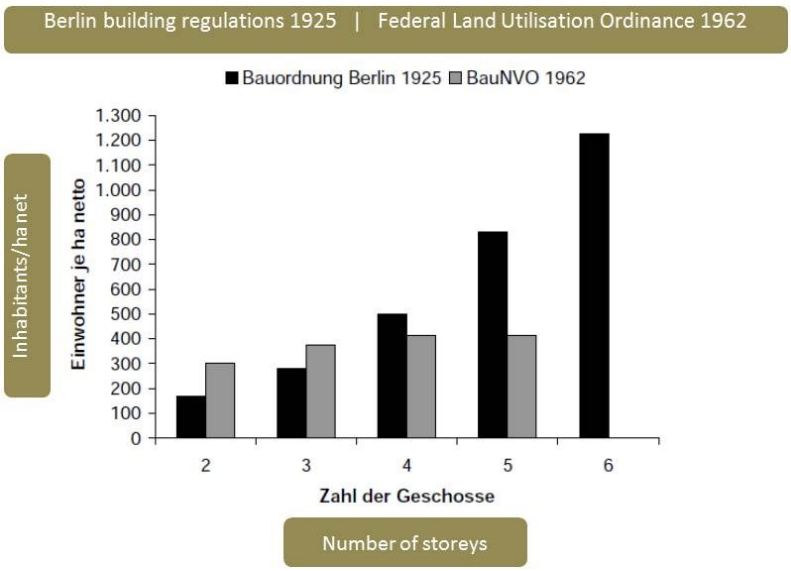


Figure 53: Residential densities enabled by building regulations 1925 (Berlin Bauordnung) and 1962 (German BauNVO) (Westphal, 2008: 64; translation provided by the author)

That these changes in planning rationales and societal attitudes towards density tend to manifest themselves in related regulations, though with some time-lag, is exemplified by the comparison of permitted residential densities in German building regulations from 1925 and 1962, as depicted in figure 53. While studies on neighbourhood-specific densities underpin prevalent critique regarding a definition of universal minimum densities, arguing that „each place has its own density" (Pahl-Weber et al., 2000: 16, in Grabski-Kieron & Raabe, 2015), other density models

refer to densification potential due to accessibility of public transport (e.g. Hamburg; Karlsruhe; Apel et al., 2000; Westphal, 2008) or to characteristics of the urban fabric (e.g. Heidelberg; Westphal & Hutter, 2006). Given the difficulty of defining criteria, Tröger & Eberle (2015) suggest urban atmosphere, measured by location within the overall urban fabric, street scenes and ambiance, in order to also grasp softer factors related to how the built environment is perceived, pleading for small-scale structuring of outdoor space, attractiveness for pedestrian traffic, direct accessibility of the public road network and a diverse publicly accessible use of ground floors (see also Sonne, 2017 on the need to combine quantitative and qualitative aspects of density). Whereas English planning displays a more active approach towards defining minimum densities, difficulties associated with communicating values and a resulting urge for discussing residential qualities have been similarly voiced: "housing density is an emotive and contentious subject" and "In all our work with existing communities density quickly becomes a difficult issue and we have learned to avoid using the D-word. It is more constructive to talk about what makes good places." (Munday, 2002). Against that backdrop, the overall rationale of sustainable and resource efficient development in the sense of the Leipzig Charter can be regarded as shaping the development of planning strategies today: "Urban density for good reason constitutes an ongoing topical issue for architects and urban planners. Density […] usually does not occur any longer on its own but linked with the objectives of mixed uses and ecological quality" (Jessen, 2014: 5; translated by the author).

In this context, it is on the one hand stated that optimum or ideal densities of universal validity cannot be defined, due to them always being context-specific and in need for adaptation to the concrete in-situ situation (Strauß, 2013; Grabski-Kieron & Raabe, 2016; Sonne, 2017). On the other hand, the debate surrounding the question how to promote resource efficient land use prompts an **active debate regarding the definition and application of minimum densities** in order to foster compact land use patterns. This is particularly relevant where Sonne's (2017: 39; translation by the author) assertion that "urban design due to economic and social reasons tends to evoke densification by itself" does not apply, i.e. for the majority of low-demand regions that exhibit continuously high land take as a result of inter-municipal competition for inhabitants. That a renewed debate on suitable densities thus meets with growing interest is demonstrated by the growing number of publications, be it of scientific, planning practice-related or essayistic nature, in recent years. Prominently, LABO (2012) explicitly urges for the „introduction of minimum densities in regional spatial plans" (3; translated by the author), and SRU (2016) postulates a more consistent utilization of permitted floor space indices as a minimum requirement in this regard. Hutter et al. (2004; in Westphal, 2008) underline the possibility of defining ranges of adequate density values, and Frick (2006: 155; translated by the author) pleas for a „minimum population and built-up density […] that fosters adjacent, compact building types and thus treats the traditional detached single-family house as well as the free-standing multi-storey housing or office tower rather as an exception."

In that regard, ways of realising more compact settlement structures have been intensively discussed from an architectural perspective and linked with proposals through model sketches and plans for the building scale: The German Association of Architects (BDA), for instance, pleas for courage to rethink standards in planning regulations and funding programmes, given increasingly "individual 'land biographies'" with diversified living and housing styles (Koch, 2016). Frank & Eberle (2012) derive related orientation values for ensuring qualitative aspects alongside densification, underpinning Tröger's demand for safeguarding urban atmosphere above: Here, a proportion of between 30 and 40 % public space is recommended as a precondition

for lively urban quarters, together with minimum built-up densities of 1.5 deemed required for mixed neighbourhoods, walkability and usable squares. Examples of a more compact realization of single- and double-family housing at floor space indices of 0.5 to 0.8, for instance through cubus houses in a staggered layout, have been explored by BMVBS & BBR (2008) and Schramm (2005), for instance. Recent quests have even taken up on notions of a land moratorium and a circular economy of land use, i.e. a refocus of building activities to previously developed sites and a departure from continuous new site development (Fuhrhop, 2015; BUND, 2016).

Nevertheless, there have been relatively few attempts to define orientation values for minimum densities beyond those linked to idealised settlement patterns promoted at their respective time and as reviewed above (see also Lord et al., 2015). Early attempts can be found with Borchard (1974), systematising achievable **net residential densities** that range from **50 inhabitants/ha for detached single-family housing** to **400 inhabitants/ha for six-storey row development**. Slightly higher figures can be found with Prinz (1999), indicating **70 to 90 inhabitants/ha for detached single-family housing** and up to **400 inhabitants/ha for multi-storey housing**, with Frick (2006) arguing for adequate residential densities of **70 to 300 inhabitants per ha** in enabling both efficient infrastructure provision and social interaction as well as open and green space provision. Here, a study on housing density in Leipzig is of particular interest (Doehler-Behzadi & Lütke Daldrup, 2004), depicting the city's development towards one of Germany's densest ones in the 1930s, i.e. before the beginning of population loss and perforation, reaching residential densities of up to **350 inhabitants per ha at well perceived residential qualities**. This has, for instance, been taken up on by the discussion of the 'Garden City of the 21st century' by the Berlin urban planning department in the wake of increasing population figures and related housing demand, postulating a focus on multi-storey housing and an achievability of higher densities through well-accessible open space (SenStadtUm Berlin, 2016a). Similarly, a Hamburg-based study explores the question of 'right densities' and related residential qualities, also in the context of a designated 'urbanization zone' with potential for densification (FHH, 2007; FHH, 2013). Prinz (1999) also indicates figures for **net dwelling densities**, along a spectrum from **20 to 25 dwellings/ha for detached single-family housing, 50 to 62 for terraced housing,** and **92 to 138 for multi-storey housing**. UBA (2003) suggests minimum dwelling densities of **40** (net) and **25** (gross, **60** for urban areas) **dwellings per ha**, with 25 dwellings per hectare net being deemed as the bottom line of economic viability (BMVBS, 2012), and provides various examples of high residential quality realized at **gross dwelling densities of 60 to 100** (see also Apel, 1997; Apel et al., 2000). As part of these debates on achievable housing density the role of land demand for technical and transport infrastructure provision, in particular for parking space, is pointed out. Site examples that include only 0.3 parking spaces per dwelling are mentioned as enabling higher densities with high residential quality at the same time (Apel et al., 2000). Examples from the UK (Munday, 2002) even postulate well-working examples with high residential quality at densities of up to **400 to 500 dwellings per ha** (e.g. Baltimore Court, Vauxhall Bridge Road London).

A more differentiated consideration of density values can be derived from a study that scrutinises threshold ranges of minimum densities from the perspective of urban infrastructure provision in the context of shrinking cities (Westphal, 2008). Whereas those are clearly below values that are being discussed with regard to resource efficient land use and partly contradicting each other due to different rationales, they are opposed to optimum densities with regard to housing demand, based on studies focused on compact settlement patterns in growing cities. Indicated values range from **net residential densities of 80 to 120 inhabitants/ha for single-family housing, 150 to**

250 inhabitants/ha for multi-storey row development and 130 to 440 inhabitants/ha for multi-storey block development (ibid.: 14). While displaying a broad range, particularly those indicated for single-family housing reach well beyond the ones mentioned by other authors before. Figure 54 displays these value ranges at a glance.

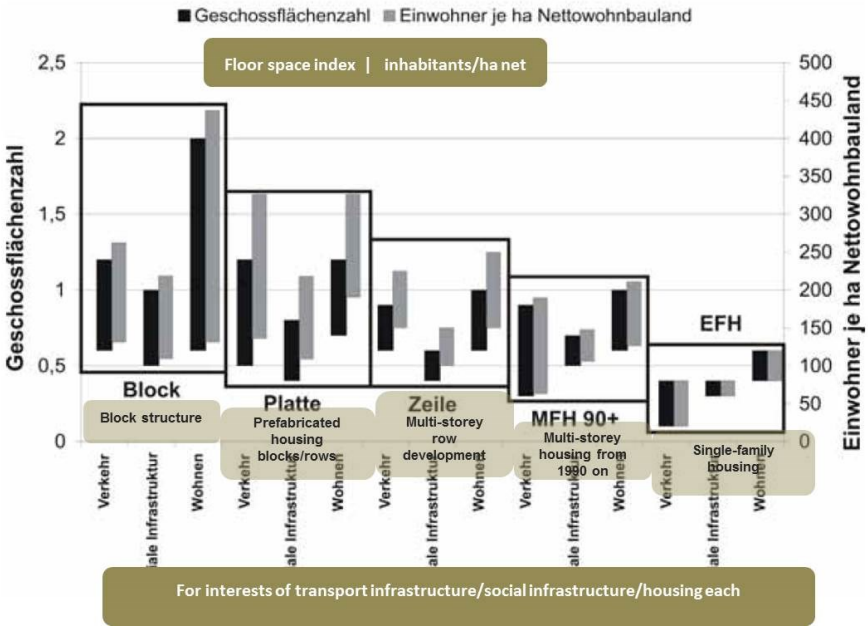


Figure 54: Density target values from different perspectives of urban infrastructure and from the perspective of housing demand in comparison (Westphal, 2008: 168; translation provided by the author)

Beside these research-based indications, a couple of planning documents can be found that employ quantified minimum densities in allocating new housing sites, albeit relatively small in number to date. The Stuttgart Regional Plan postulates minimum gross residential densities of **50 to 90 inhabitants/ha**, dependent on the respective spatial category and centrality function (see figure 55; VR Stuttgart, 2009). The Hesse State Development Plan indicates dwelling densities of **15 to 60 dwellings/ha** (Hessisches Ministerium für Wirtschaft, Verkehr und Landesentwicklung, 2000); the Saarland State Development Plan of **15 to 40 dwellings/ha** with ascending centrality (Saarland, Der Chef der Staatskanzlei, 2006; see also BMVBS, 2012). Given these values, it is critically acknowledged by BMVBS (2012) that only the Stuttgart density targets appear suitable for contributing to higher land use efficiency, with others rather tending to be based on previous development paths.

2.4.0.8 (Z) Freiraumsicherung / Bruttowohndichte	Zur Reduzierung der Belastung von Freiräumen durch neue Siedlungsflächeninanspruchnahme ist bei allen Neubebauungen eine angemessene Bruttowohndichte festzulegen. In der Region werden für neu zu erschließende Wohnsiedlungen die folgende Werte vorgegeben:	
	Oberzentrum	90 EW*/ha
	Schwerpunkte des Wohnungsbaus	90 EW*/ha
	Mittelzentren	80 EW*/ha
	Unterzentren	70 EW*/ha
	sonstige Gemeinden mit verstärkter Siedlungstätigkeit	60 EW*/ha
	Gemeinden beschränkt auf Eigenentwicklung im Verdichtungsraum und der Randzone um den Verdichtungsraum	55 EW*/ha
	übrige Gemeinden beschränkt auf Eigenentwicklung	50 EW*/ha

Intended density values (inhabitants/ha) for:

Major regional centres
Housing growth zones
Medium regional centres
Small regional centres
Other municipalities with pronounced housing demand
Municipalities focused on intrinsic development within the agglomeration
Municipalities focused on intrinsic development

* EW = Einwohner

Figure 55: Minimum residential densities as required by the Stuttgart Regional Plan (VR Stuttgart, 2009: 56; translation by the author)

Further attempts of defining minimum densities (for the zoning-based planning tradition) can be found in Switzerland: Individual cantonal orientation plans (*kantonale Richtpläne*) contain concrete definitions for minimum densities that are specified through the number of users per spatial entity (*Raumnutzer*), i.e. the sum of inhabitants and employees per ha. The respective plan for the largely rural canton of Thurgau defines five density types, ranging from 32 users/ha in sparsely populated areas to 86 users/ha in cantonal centres (Amt für Raumentwicklung Thurgau, 2017). Here, it is specifically acknowledged that these minimum values have regularly been achieved and do not impose a particular challenge for site developments. Opposed to that, the Zürich Regional Orientation Plan (*Regionaler Richtplan*) indicates "desired densities" ranging from 100 users/ha in two-storey residential zones to more than 300 users/ha in core areas of the urban centre (Kanton Zürich, 2014). This development links to quests by Swiss planning researchers such as Lampugnani et al. (2007) and Desax et al. (2016) who urge for a more courageous approach towards realizing dense settlement structures with high quality, particularly given trends towards increasing demand for residential space per person.

Compared to these examples, the situation in the UK is somewhat different, with **minimum dwelling densities of 30 to 50 dwellings per hectare** having been defined as part of the former planning guidance document PPG 3 (The Stationery Office, 1992), followed by a number of density studies as part of Local Plans. After the abolition of PPG 3, local authorities may define minimum densities themselves, examples including Leeds with minimum values ranging from **30 to 65** dph net, or the rather rural Telford & Wrekin Local Plan Density Study postulating average ('acceptable') densities between **45 and 75** dph (Telford & Wrekin Council, 2015; Leeds City Council, 2015a), finding that most new developments are already above the former requirement of 30 dph. In most cases, hence, these densities have been described as being relatively low (Whitehead), and in line with average densities being realized anyway, albeit these tending to be higher in the UK than in Germany. An exception is represented by the 2016 London Plan, with minimum densities ranging from **35** units per ha in remote areas up to **405** units per ha in central locations (Greater London Authority, 2016), underpinning more ambitious value definitions in high-demand regions (cf. Stuttgart for the German case).

Against that backdrop, Grabski-Kieron & Raabe (2016) explicitly point out the use of density value ranges as useful assessment criteria in allocating new housing sites, explicitly mentioning their potential suitability as an assessment aspect for SEA. A compilation of orientation values for housing density as indicated by studies and planning documents will be provided below. Before, however, and given challenges of ensuring resource efficient land use not only through more compact housing types but also through efficient land use for transport infrastructure as well as maintaining a sufficient level of open space provision (see also Jessen, 2014 and sections 3 and 4), potential standards and orientation values for these aspects are to be briefly outlined in the following.

Potential standards for provision of open space and transport infrastructure

Open/green space provision

With regard to minimum standards for the provision of open and green space, various larger German cities have defined standards for both **size** and **accessibility** of green space at the neighbourhood scale (Helbron, 2008; SenStadtUm Berlin, 2016b; Wickop et al., 1998; FHH, 1997; BfN, 2015). Related to these examples and based on an agreement by the board of those heading green space departments (GALK; BfN, 2015), standards have largely been indicated at minimum

sizes of 6 m^2 per inhabitant for open structure types such as terraced housing or multi-storey row development and 3 m^2 per inhabitant for closed structured types, i.e. block structure housing. For accessibility of green space, standards of 0.5 to 1 ha reachable within 500 m and of 10 ha within 1000 m have been defined.

As an additional parameter for assessing green and open space provision at site scale, different types of green space ratios have been developed. An example that has been operationalised for Berlin is the biotope area factor (*Biotopflächenfaktor*), indicating the ratio of site area relevant for ecological functions and overall site area. While such ratios can serve for defining planning requirements for green space provision, they have also been deemed suitable as an indicator for assessing plan effects (Bunzel, 1992; Landschaft Planen & Bauen, 1993; Morawetz et al., 2016). As such, factors are defined on a scale from totally sealed surface (0.0) to different qualities of green space for plant growth (up to 1.0). From that, Landschaft Planen & Bauen (1993) defines target values for different urban structures, ranging from 0.3 for developments within the existing urban fabric to 0.6 for new housing developments. Beyond that, however, the practical application of such green space ratios in land use planning is still rare, as BfN (2015) has found, with the white book on green space in cities (BMUB, 2017) postulating an advancement of existing guidance and orientation values.

For the situation in England, national standards comparable to the GALK ones for Germany had previously been provided through the Accessible Natural Greenspace Standards (now archived; Natural England, 2010). Here, a minimum of 2 ha greenspace within no more than 300 m, of 20 ha within two km; of 100 ha within five km and of 500 ha within ten km are suggested. However, the (now also withdrawn) PPG 17 and related guidance document postulate that "open space standards are best set locally" (ODPM, 2002). At the local scale, exemplary standards have been set by a number of major urban regions: For Liverpool, the Open Space Study indicates accessibility standards of 400 m for Neighbourhood Parks, 1.2 km for District Parks and 3.2 km for City Parks and size standards of 2.74 ha public park per 1,000 population; 1 ha of Local Nature Reserve per 1,000 population, and 0.18 ha of allotment land per 1,000 population (The City of Liverpool & Atkins, 2005). These values appear generally suitable for determining residential quality alongside appropriate housing density. Their role for developing an assessment approach for land will be further discussed below.

Transport infrastructure provision

With regard to land demand for transport infrastructure provision, a number of studies (e.g. Apel, 1997; Apel et al., 2000) have pointed to the **ratio of dwellings and parking spaces** and significant potential for realizing both high-density and high-quality residential environments by reducing this ratio. While this ratio is in many cases still at 1 or even higher for single-family housing, studies have shown that by a significantly reduced ratio of 0.3 parking space per dwelling (e.g. Apel et al., 2000) more compact and still well-perceived housing development can be realised. In that regard, the proof of adequate parking space required by German building law has been identified as a key factor of land take, urging for its abolition or at least a reduction of obligatory parking space per dwelling (Bunzel, 1992). Meanwhile, a number of major German cities have in fact reduced or even abolished respective requirements (Völklein, 2017).

Beyond the role of parking space, another factor for the land use efficiency of transport infrastructure provision consists in the site-related **road network**. General standards for Germany are available from guidelines on urban road design (RASt 06; FGSV, 2007), determining

appropriate **road width** as a function of the urban fabric and requirements of traffic safety. From that, width value ranges are indicated for typical situations and types of roads, ranging from 4.5 to > 10 m for a residential path, 9 to > 16.5 m for a residential road, 11.5 to > 26.7 m for collecting roads and 12 to > 20.7 m for major neighbourhood roads. These value ranges, however, are not explicitly based on the intention of minimum land take, albeit arguing that if less space is available, the adequacy of a narrower road width or the reduction of road-related parking space can be scrutinised. An analysis of urban road design with an explicit focus on land use efficiency is provided by Bavarian guidance material, indicating standards that are within the lower third of those referenced by the above mentioned RASt 06 (Bayer. Staatsministerium des Innern, 2001). Another determinant is related to the **pattern of the road network**. Here, the Bavarian example-based study illustrates ways of efficient transport infrastructure provision through housing development on both sides of a residential road, an avoidance of double road connection of sites, and an efficient site arrangement through minimum possible road front width (Bayer. Staatsministerium des Innern, 2001).

For the English situation, indicative values for road width can accordingly be derived from a Manual for Streets (DfT, 2007), including 7.5 to 12 m for small residential lanes, 12 to 18 m for residential streets, and 18 to 30 m for high streets. With regard to parking space, former PPG 13 and now NPPF urge local authorities to develop own standards where considered necessary but issued respective planning guidance documents (ODPM, 2001; MHCLG, 2018; The Planning Service, 2005). Indicative ratios as included there and in local parking standards issued by a number of councils (e.g. Reading Borough Council, 2011) used to be at 1 or above as well, whereas Liverpool, for instance, proposed a reduced standard of 0.7 for city centre housing (Liverpool City Council, n.d.).

Against that backdrop, parking space ratios appear applicable as an indicator for assessment but would require more elaborate studies on suitable standards beyond the examples mentioned here. Standards for road width as available from the guidelines referenced appear less suitable for immediate application to assessment, given that they are based on different criteria rather than on resource efficient land use. Also, difficulties associated with deriving data on the proportion of land use for the site-related road network as part of the German SuV indicator from draft plans limit their applicability for a fit-for-purpose assessment approach. Therefore, the development of upper limits to land demand for road design for different structure types, based on both requirements of resource efficient land use and traffic requirements would be advisable.

Summary and discussion of standards for housing density as an indicator for assessing land use efficiency

The review of density parameters and standards presented here conveys the difficulty of different, and not directly convertible, measures used for discussing densities, as well as varying reference spaces used for their indication. As explained above, for a further discussion of minimum densities the use of dwelling densities appears most suitable, due to them being both a proxy for land use efficiency and to some extent influenceable by planning decisions. Thus, table 21 extracts values and value ranges suggested for dwelling densities only, both as suggested by key studies and relevant planning documents.

Table 21: Standards for minimum dwelling densities as derived from studies and exemplary plans (own table)

Dwelling densities: Compilation of standards/minimum values discussed so far			
Net Dwelling Density [dwellings/ha net]		Gross Dwelling Density [dwellings/ha gross]	
25 (BMVBS, 2012)	Bottom line of economic viability		
40 min (UBA, 2003) 200 max (Apel et al., 2000)		25 min/60 min in urban areas (UBA, 2003) 128 max (Apel et al., 2000)	
		60-100 frequently realised (Apel et al., 2000)	
Minimum values (UK plans)		*Minimum values (German plans)*	
30-50 (PPG 3); 30 (Leeds Local Plan)	Rural areas/remote suburban areas	15 (LEP Saarland), 15-20 (LEP Hessen)	Rural areas
30-50 (PPG 3); 35-40 (Leeds Local Plan); 35-130 (London Plan)	Suburban areas	20 (LEP Saarland), 18-30 (LEP Hessen), 30 (Karlsruhe)	Suburban areas
30-50 (PPG 3); 65 (Leeds Local Plan); 35-405 (London Plan)	Urban centres	40 (LEP Saarland), 60 (LEP Hessen), 80 (Karlsruhe)	Urban centres
Achievable value ranges			
20-25 (Prinz, 1999)	Detached single-family housing		
50-62 (Prinz, 1999)	Terraced housing		
92-139 (Prinz, 1999)	Multi storey housing		
Conversion factors net building site/gross building site/overall site (Westphal, 2008; based on Siedentop et al., 2006): net housing density x 0.7 = gross housing density; gross housing density x 1.4 = net housing density			

In general, table 21 shows a wide range of achievable density values as identified in the literature, together with a few more ambitious targets postulated by scientific studies, while most minimum densities formulated by actual planning documents, in particular for rural and remote suburban areas, tend to remain significantly lower. This is illustrated by the juxtaposition of the lowest and highest values derived from studies and planning documents in figure 56. This juxtaposition of achievable and normative dwelling densities (bottom and upper limits each) suggests that there is still maneuvering room for more ambitious minimum density standards, especially in those (rural and suburban remote) areas with a widening gap between high land take and low population growth.

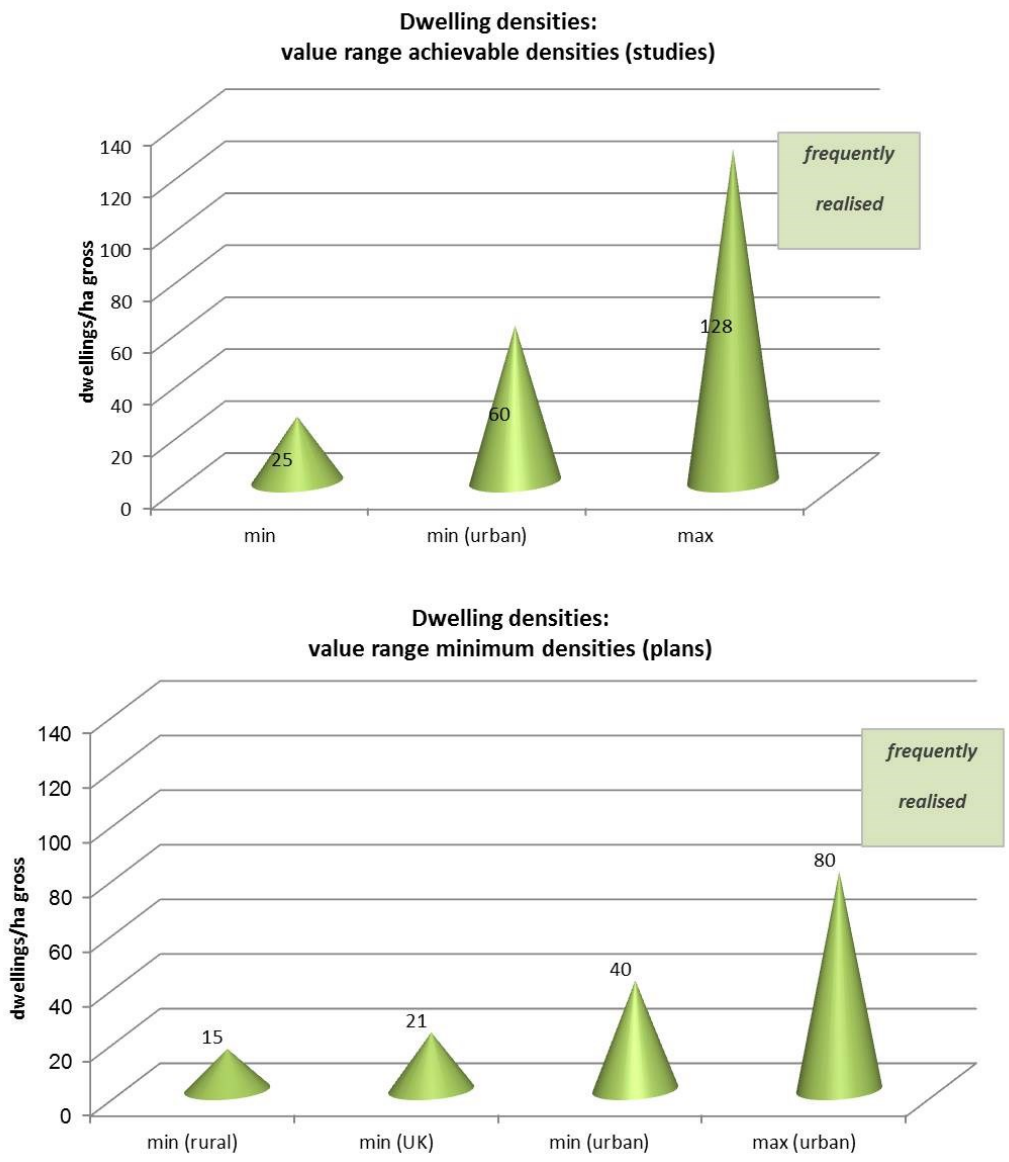


Figure 56: Minimum/maximum value ranges for dwelling density as suggested by studies (above) and as included in exemplary land use plans (below) (own figure)

Based on this review, it becomes clear that there is no consensus on appropriate housing densities nor on introducing minimum density standards yet. However, value ranges derived suggest that there is some overlapping of values identified by different studies, and hence justification for defining thresholds for minimum densities as a means of fostering higher land use efficiency through planning. Against that backdrop, the question remains:

- whether the suggested value ranges are sufficient for achieving higher land use efficiency,
- whether flexible value ranges or concrete thresholds should be used as standards for assessment,
- and whether density standards should be defined universally or subject to different spatial categories/structure types (as is the case with the planning documents reviewed above).

Based on the above, two options for employing dwelling density as an element of assessing land use efficiency have been raised. On the one hand, the option of defining minimum value ranges depending on locational criteria, i.e. along a site spectrum from rural to central urban locations,

has been depicted, resembling the approach chosen by those land use plans that employ minimum densities as introduced above. However, only an approximation of higher land use efficiency without clear reference to overall targets (acknowledging, however, that efficiency targets have not been quantified for Germany and are thus only indirectly retrievable from quantitative reduction targets) would thereby become subject to assessment. On the other hand, another option with direct reference to the overall target has been carved out. This option is based on the question which dwelling density would be required in order to both achieve the 30 ha target and provide sufficient housing for covering projected demand, given assertions that the provision of sufficient new housing and the achievement of the 30 ha target have not been deemed contradictory (Bundestag, 2015; Baron & Dross, 2016). In this regard, calculations by Penn-Bressel (2017a; 2017b) juxtapose the 30 ha target and its proportion for housing, respectively, and projected additional dwelling demands in order to illustrate ranges of required housing densities for achieving both targets. From that, it can be argued that for achieving both the 11 ha proportional target for housing and meeting a projected housing demand of 272.000 dwellings/year by 2020, a **minimum density of about 65 dwellings/ha (net), hence equating about 45 dwellings/ha (gross),** correspondingly higher when considering projected demand of 350,000 dwellings per year as issued by the federal housing report in 2017, would be required.

8.2.3.4 Discussion

Whereas the employment of PDL availability as an indicator for assessing land use efficiency appears to be uncontroversial, arguments with regard to the second indicator, i.e. dwelling density, tend to favour the second approach, employing a universal minimum dwelling density standard that enables an achievement of the (now valid) 30 ha target. This acknowledges that such a standard needs to be treated as one to be achieved on average by a municipality, allowing for and requiring site-dependent upper and lower deviations, in particular in rural areas. Certainly, however, and related to a further development of reduction targets for land take, the suggested dwelling density standard requires future adaptation and revision.

Generally, the increasingly and intensively debated conflict between housing provision and residential quality, in particular open and green space provision, requires particular attention when developing an assessment approach for land in EA and especially so when developing assessment standards for housing density. Whereas the initially suggested framework involved the consideration of green space provision and related standards, as well as of infrastructural accessibility/locational integration, expert debates revealed advantages of a rather narrow focus for land as a separate factor. For the German situation of EA in municipal land use planning, green space provision is already assessed as part of the factor human health/population and should thus stay with that factor while being considered via interdependencies as supporting information for assessing land. For the aspect of infrastructural accessibility not being an environmental one, it is considered to not belong to the realms of SEA (different for SA in England) and thus to be judged as part of the final weighting.

8.2.4 Land quality

In line with what has been discussed so far, whereas the locational integration of land developed for housing, as well as the proportion and quality of open and green space as part of housing developments had initially been suggested as assessment aspects for land use quality, these were subsequently allocated to existing environmental factors and to the final weighting/decision-making, or would reach beyond the scope of SEA (albeit not of SA in England). Against that backdrop, aspects to be assessed as part of land as a separate environmental factor have been

condensed to those discussed for land take reduction and land use efficiency, and thus mainly to quantitative aspects. Nevertheless, and given the challenge of dual inner-urban development and the consideration of both compactness and sufficient open and green space provision in growing urban areas, qualitative aspects of land are to play an important role in assessing interdependencies between land and other factors as part of the weighting procedure. In that regard, these interdependencies have been included as key supporting information into standardized assessment schemes and are introduced in the following.

8.3 Combining the elements: Standardised assessment schemes

8.3.1 Comprehensive municipal land use plan (FNP) scale

For providing a structured approach to assessing land, assessment elements as introduced above have been assembled into standardised assessment schemes for both scales of municipal land use planning through which relations between individual assessment elements have been elaborated and categories of significance defined. Here, these schemes will be systematically explained, based on tables 22 and 23, before they will be applied to an exemplary land use plan in the next section.

The structured assessment scheme for the scale of the comprehensive municipal land use plan is composed of two key parts, the first referring to the assessment of individual sites as allocated by the plan, the second referring to the assessment of the total amount of allocated sites. The assessment of individual sites in the first section refers to the reduction and efficiency target, i.e. land take caused as well as dwelling density foreseen by development on the individual sites (A1, B1). In the second section, the sum of total land take caused by these sites is identified and set in relation to the quota for land take for the respective municipality. Similarly, the achievement of the proposed minimum dwelling density is identified based on the average value for all sites assessed. Subsequently, several factors are counted towards overall land take caused by the allocated sites. These factors comprise the demand for additional housing as derived from projections introduced above (A2), and a potential exceedance of that by the plan, the availability of PDL potential (A3) as also derived from the survey introduced above or from respective municipal databases, if applicable, and a potential withdrawal of sites allocated by previous plans (A4). Given that a complete activation and reuse of available PDL potential cannot be regarded as realistic due to various difficulties such as site access, an allowance of either 40 % of this potential overall or of 5 % annually, is suggested. From that, a total balance of A (reduction target), under consideration of B (PDL potential), is derived. The second part of individual site assessment refers to the protection target and therefore considers interdependencies with other environmental factors (C). Here, the significance of land-related impacts on other environmental factors is assessed based on a traffic light rating, ranging from no negative impacts (green) to negative impacts (negative impacts on less than three other factors, or significantly negative impacts on one other factor; orange) and significantly negative impacts (negative impacts on three or more other factors, or significantly negative impacts on two or more other factors; red).

The second part of the assessment scheme considers all three assessment aspects (A to C) together and suggests an overall system of categories of significance, again based on a traffic light rating: In this regard, no or only slightly negative impacts (green) occur if the municipal quota for land take is not exceeded, if minimum dwelling density is achieved and if there are no or only slightly negative impacts on other environmental factors. Negative impacts (orange) occur if the municipal quota for land take is exceeded by 5-20 %, if dwelling density falls short of the minimum threshold by 5-20 %, and if there are negative impacts on less than three other environmental factors or significantly negative impacts on one other environmental factor. Significantly negative

impacts (red) occur if the municipal land take quota is exceeded by more than 20 %, if dwelling density falls short of the minimum threshold by more than 20 %, and if there are negative impacts on three or more other environmental factors or significantly negative impacts on two or more other environmental factors.

Given the role of the FNP scale in making strategic decisions on suitable amount and locations for development, this assessment should be conducted for the plan scenario as well as for reasonable alternative plan scenarios. From the overall assessment, recommendations are derived, following the mitigation hierarchy of avoidance, mitigation and compensation, with mitigation and compensation measures being suggested if the assessment of alternatives has proven that certain plan impacts cannot be avoided. Monitoring is not part of the assessment scheme itself but should be based on suitable indicators as mentioned above.

Table 22: Standardised assessment scheme for the scale of the comprehensive land use plan (own table; icons made by Freepik from www.flaticon.com)

Plan to be assessed: Comprehensive land use plan xx

To be applied to:
- Plan scenario
- Reasonable alternatives

Individual site assessment, applying the following targets and criteria:

Reduction target	**Efficiency target**	**Protection target**
▪ Land take	▪ Dwelling density ▪ PDL reuse potential	▪ Land-related aspects as part of other environmental factors (interdependencies)

A) Reduction target + B) Efficiency target

	A 1 Land take [ha]	**B 1 Dwelling density [WE/ha]**
Site A		
Site B		
Site C		
…		
Sum	**Overall balance with regard to municipal quota for land take for settlement and transport purposes [ha] for plan period, proportion for housing (1/3)**	**Degree of target achievement dwelling density [%]**

Allowing for:

A 2 Projected dwelling demand for plan period, potential exceedance of demand?	
A 3 PDL reuse potential in the inner urban area (unused lots, brownfields, densification potential), allowable: Lump ratio of 40 % (s. BBSR, 2013) or 5 % annually, considering difficulties in activing PDL reuse potential, dependent on extent of proposed allocations	
A 4 Withdrawal of already allocated sites [ha]	
Overall balance A	

C) Protection target:

Conflict assessment, dependent on sensitivity (relevant aspects for individual environmental factors each)

Categorisation of significance according to traffic light rating:
No negative impacts
Negative impacts: negative impacts on less than three other environmental factors (or significantly negative impacts on one other environmental factor)
Significantly negative impacts: Negative impacts on three and more other environmental factors (or significantly negative impacts on two and more other environmental factors)

Overall assessment A - C: Reduction + Efficiency + Protection

No to slightly negative impacts:

- Non-exceedance of quota for land take
- Achievement of minimum density
- *No or slightly negative impacts on land-related aspects of other environmental factors*

Negative impacts:

- Exceedance of quota for land take by 5-20 %
- Lower deviation from minimum density by 5-20 %
- *Negative impacts on land-related aspects of less than three other environmental factors (or significantly negative impacts on one other environmental factor)*

Significantly negative impacts:

- Exceedance of quota for land take by > 20 %
- Lower deviation from minimum density by > 20 %
- *Negative impacts on three and more land-related aspects of other environmental factors (or significantly negative impacts on two and more other environmental factors)*

Site A	
Site B	
Site C	
...	
Overall assessment	
Recommendations	
Mitigation **Compensation**	

A 1: UBA FORUM quotas for land take (Henger & Schier, 2014; http://www.flaechenhandel.de/)

B 1: Review of standards for dwelling density

A 2: BBSR (2015) projections on housing demand Wohnungsmarktprognose 2030, + specific reports/surveys, if applicable

A 3: BBSR (2013) survey on PDL potential, + municipal databases/surveys, if applicable

8.3.2 Binding, site-specific land use plan (B-Plan) scale

Whereas the comprehensive municipal land use plan constitutes the scale most suited for assessing the resource efficiency of land use, the development of an assessment approach for land is faced with the situation that in practice rather the parallel procedure of updating existing, often outdated comprehensive land use plans with regard to changes implemented through a binding site-related plan is applied. Since this practice undermines the strategic character of the FNP, an assessment method for the scale of the binding land use plan is also needed in order to enable an assessment of impacts on land regularly generated at this scale.

For that purpose, a structured assessment scheme has been developed that follows the general rationale of the one suggested for the comprehensive plan scale and has been adapted to characteristics of the binding site plan scale. For assessing the reduction target (A), first the overall amount of land take prepared by the plan (1) is identified, followed by the housing-related municipal quota for a timespan of three years, i.e. respecting the approximate realization period of the plan (2), deriving the proportion of land take suggested with regard to the quota available (3). Based on that, the overall municipal amount of land take for housing for the selected timespan, based on allocated sites, is identified (4), and the proportion of this overall land take with regard to the municipal quota established (5). This step explicitly serves to provide a picture of overall municipal land take proposed beyond the specific site, and thus to somewhat compensate for the practical problem of the overall municipal amount of land take in many cases not being assessed on FNP scale.

For assessing the efficiency target (B), the minimum dwelling density threshold is filled in (1), followed by the actual housing density foreseen by the plan (2) and the resulting degree of achievement (3). Initially, at this stage of the scheme, the assessment of green space provision was suggested but omitted due to its attribution to the factors biodiversity and human health. In a next step, a balancing of A and B is realized by the scheme (A+B), first transferring A4, i.e. overall land take, and then counting projected dwelling demand (1) and PDL potential (2; again with a proportion of 40 % overall or 5 % annually, given difficulties in activating this potential), each broken down to the three-year time span, against that. By that and the balance of 1 and 2, the need for additional land take is examined, followed by filling in a potential exceedance of the municipal land take quota (based on A5), and the degree of achievement of minimum dwelling density (B3). For assessing the protection target (C), the procedure is basically the same as for the comprehensive land use plan, with a traffic light rating system based on the assessment results for land-related aspects of other environmental factors and their consideration via the assessment of interdependencies. Finally, and again comparable to the comprehensive plan scale, the overall assessment of all three assessment elements employs a traffic light rating system: No or only slightly negative impacts on land (green) occur if the municipal land take quota is not exceeded, if minimum density is achieved, and if there are no or only slightly negative impacts on other environmental factors; negative impacts (orange) occur if the quota for land take is exceeded by 5-20 %, dwelling density falls short of the target by 5-20 % and if there are negative impacts on less than three other environmental factors or significantly negative impacts on one other factor; significantly negative impacts occur if the quota for land take is exceeded by more than 20 %, if density falls short of the target by more than 20 % and if there negative impacts on three or more other land-related aspects of other environmental factors or significantly negative on two or more other environmental factors. The balance of A+B 1-2 rather has an indicative function, disclosing the role of the plan with regard to actual need as projected by the respective studies and available PDL potential.

Based on the assessment results for the individual aspects, recommendations should refer to the potential for reducing environmental impacts on land, such as increasing dwelling density or reducing the amount of land take prepared by the plan, through activating PDL sites, or through avoiding particularly sensitive sites. As with the comprehensive plan scale, suitable mitigation and compensation measures as well as monitoring indicators are compiled above in section 2.

Respective data sources for the information employed by the assessment schemes are indicated at the respective stages of the schemes, linked with information boxes summarising these sources, and as explained above.

Table 23: Standardised assessment scheme for the scale of the binding land use plan (own table; icons made by Freepik from www.flaticon.com)

Plan to be assessed: Binding site plan xx		
Alternatives to be assessed for potential sites		
Assessment applying the following targets and criteria:		
Reduction target ▪ Land take 	**Efficiency target** ▪ Dwelling density ▪ PDL reuse potential 	**Protection target** ▪ Land-related aspects as part of other environmental factors (interdependencies) 
A) Reduction target		
1 Overall amount of land take generated by the plan [ha]		
2 Municipal quota for land take for settlement and transport purposes [ha] for plan period 2017-2019, proportion for housing (1/3) 		
3 Proportion of land take generated through the plan on municipal quota for settlement and transport purposes, proportion for housing [%]		
4 Overall municipal land take [ha] for plan period 2017-2017, proportion for housing (assumption)		
5 Proportion of overall municipal land take for housing for plan period 2017-2019 on quota, potentially identification of exceedance [%]		
B) Efficiency target		
2.1 Minimum value for dwelling density [dph] 		
2.2 Dwelling density [dph] of the plan to be assessed		
2.3 Degree of achievement minimum dwelling density [%]		
Balance A + B		
Amount from A 4		
>> Allowing for:		
1 Projected demand for plan period 2017-2019, potentially exceedance of demand? 		
2 PDL reuse potential in the inner urban area (unused lots, brownfields, densification potential), allowable: Lump ratio of 40 % (s. BBSR, 2013) or 5 % annually, considering difficulties in activing PDL reuse potential, dependent on extent of proposed allocations 		
Overall balance land take and land use efficiency • **Balance 1-2** • **Exceedance of quota (amount from A 5)?** • **Degree of achievement minimum dwelling density**		
C) Protection target: **Conflict assessment, dependent on sensitivity (relevant aspects for individual environmental factors each)** **Categorisation of significance according to traffic light rating:** No negative impacts Negative impacts: negative impacts on less than three other environmental factors (or significantly negative impacts on one other environmental factor) Significantly negative impacts: Negative impacts on three and more other environmental factors (or significantly negative impacts on two and more other environmental factors)		

Soil Filter and buffer function Productivity function Archive function Contamination	**Water** Ground water recharge Water protection zones Flood areas	**Climate, Air** Sites for cold air generation Sites for fresh air generation Sites for cold air transport Sites for fresh air transport Heat island areas	**Landscape** Scenic value Recreational value	**Biodiversity** Protected sites Biotope connectivity	**Human health/population** Recreation, open and green space provision Noise pollution	**Heritage and material assets**

Overall assessment A - C: Reduction + Efficiency + Protection



No to slightly negative impacts:

- Non-exceedance of quota for land take
- Achievement of minimum density
- *No or slightly negative impacts on land-related aspects of other environmental factors*

Negative impacts:

- Exceedance of quota for land take by 5-20 %
- Lower deviation from minimum density by 5-20 %
- *Negative impacts on land-related aspects of less than three other environmental factors (or significantly negative impacts on one other environmental factor)*

Significantly negative impacts:

- Exceedance of quota for land take by > 20 %
- Lower deviation from minimum density by > 20 %
- *Negative impacts on three and more land-related aspects of other environmental factors (or significantly negative impacts on two and more other environmental factors)*

Overall assessment	

Recommendations
Mitigation and compensation

A 2: UBA FORUM quotas for land take (Henger & Schier, 2014; http://www.flaechenhandel.de/)

B 1: Review of standards for dwelling density

A+B 1: BBSR (2015) projections on housing, + specific reports/surveys, if applicable

A+B 2: BBSR (2013) survey on PDL potential, + municipal databases/surveys, if applicable

8.4 Practical application: Assessing a municipal land use plan for its impacts on land

In order to demonstrate how the approach developed above can be applied to a concrete planning example, a recent municipal land use plan for Leipzig has been selected. The decision was made to choose a binding land use plan, due to the lack of a recent (draft) comprehensive land use plan for Leipzig and related figures. Hence, from a web search of recent binding land use plans that establish the legal basis for additional land take in the external area (*Außenbereich*) in planning terms and thus are subject to EA, B-Plan 219 (residential site; Stadt Leipzig, 2015d; 2015e) has been selected. The statutory decision on this plan had been made in 2015, preparing the grounds for developing a site for single-family housing on previous agricultural land in the northwestern part of Leipzig (borough of Lützschena-Stahmeln, see figures 57 and 58). Nonetheless, the approach could as well be applied to binding land use plans for inner urban development of a particular size that exceed thresholds for plans according to § 13a BauGB and thus also require EA.

Location of B-Plan Site 219 within the Leipzig area

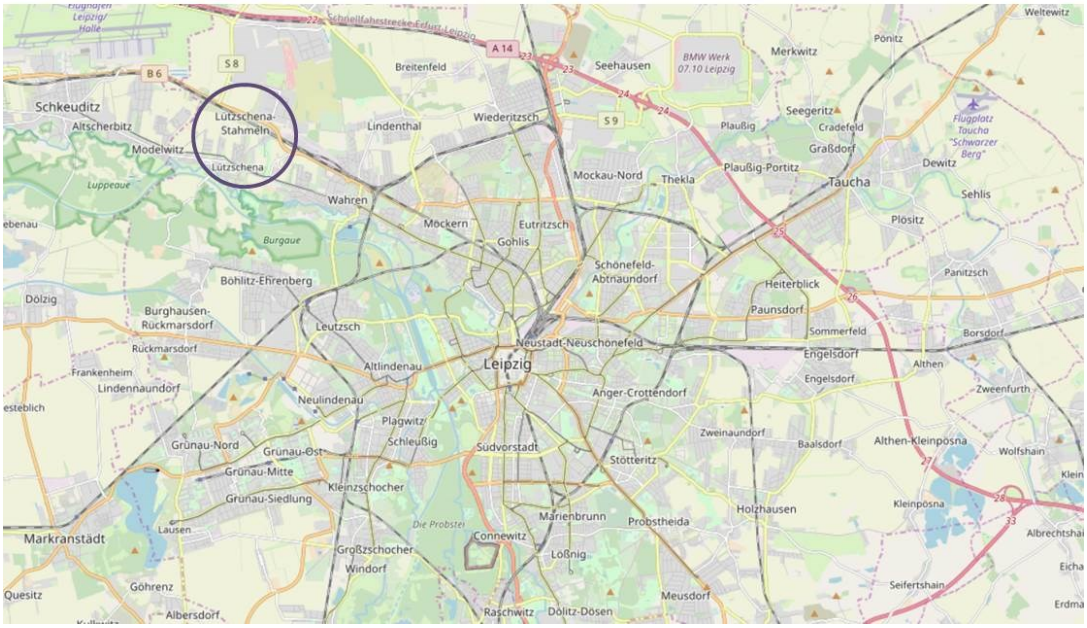


Figure 57: Location of B-Plan 219 within the Leipzig area (data by OpenStreetMap – published under ODbL; own emphasis)

The overall plan site comprises 12.5 ha, of which land for housing purposes (overall site size for housing/net building land, excluding infrastructure provision and public green space) amounts to 2.84 ha while the remaining plan site comprises public green space, sites for nature and landscape development measures (mainly forestation) as well as compensation sites for an external development (industrial site for automotive industry), including open drainage along an existing trench. Further, B-Plan 219 replaces a former binding land use plan for the area that was supposed to enable multi-storey housing, arguing that this previous plan would not be in line with today's requirements and situation on the housing market any longer. Plan layout and related symbology are depicted in figures 59 and 60.

Given the focus of B-Plan 219 on creating the preconditions for developing a site for single-family housing (GRZ 0.3; maximum 1-2 floors, maximum 2 dwellings per house; exceptions only for mixed use area in the southern part of the plan site), the maximum number of dwellings to be realized on the site amounts to 80, including so-called 'granny flats' enabled by the plan. However,

the plan rationale acknowledges that most houses will most likely not realise this additional unit so that a smaller number of dwellings will result.

Scope and detailed location of B-Plan Site 219

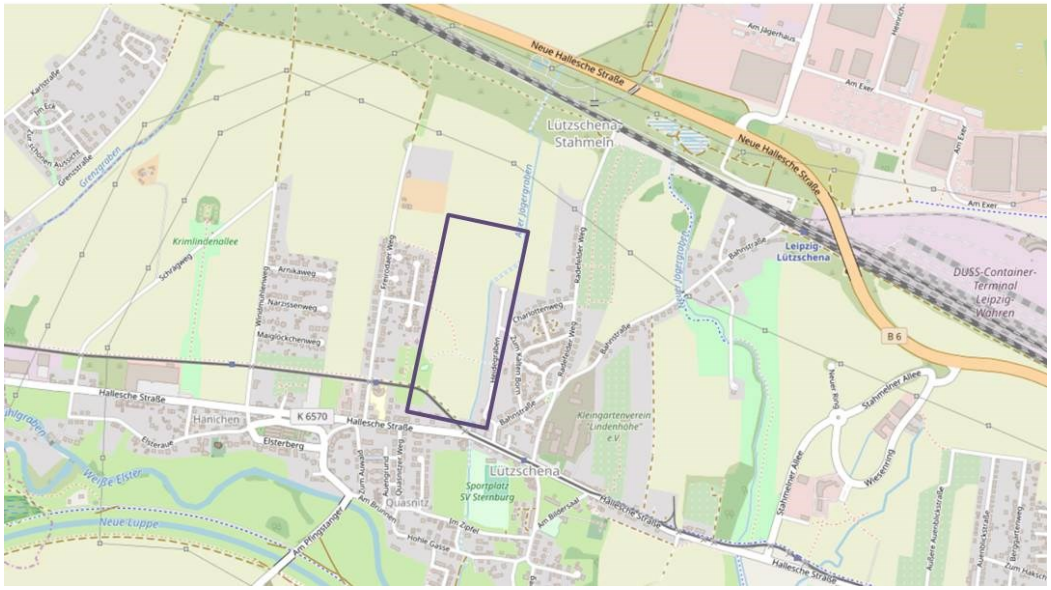


Figure 58: Scope and location of B-Plan 219 (data by OpenStreetMap – published under ODbL; own emphasis)

Draft plan layout, B-Plan 219

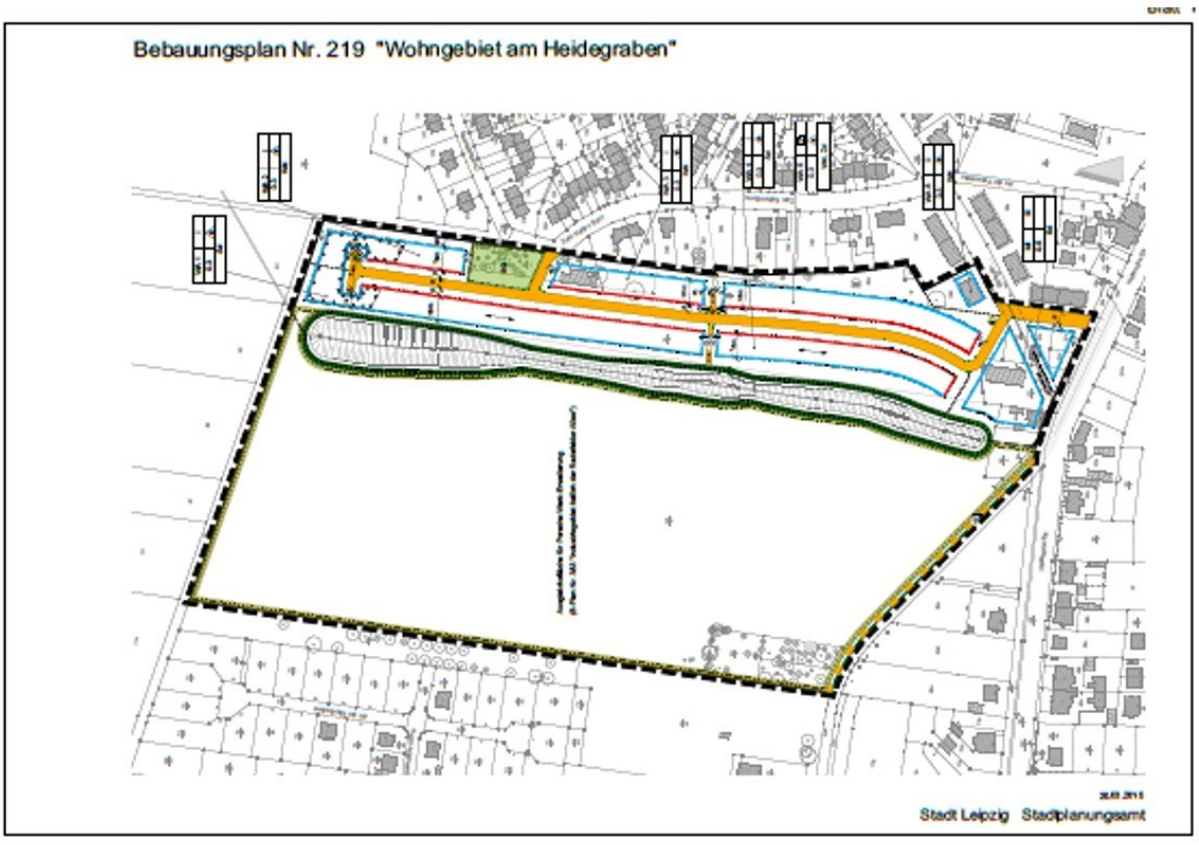


Figure 59: Plan layout for B-Plan 219 (Stadt Leipzig, 2015e)

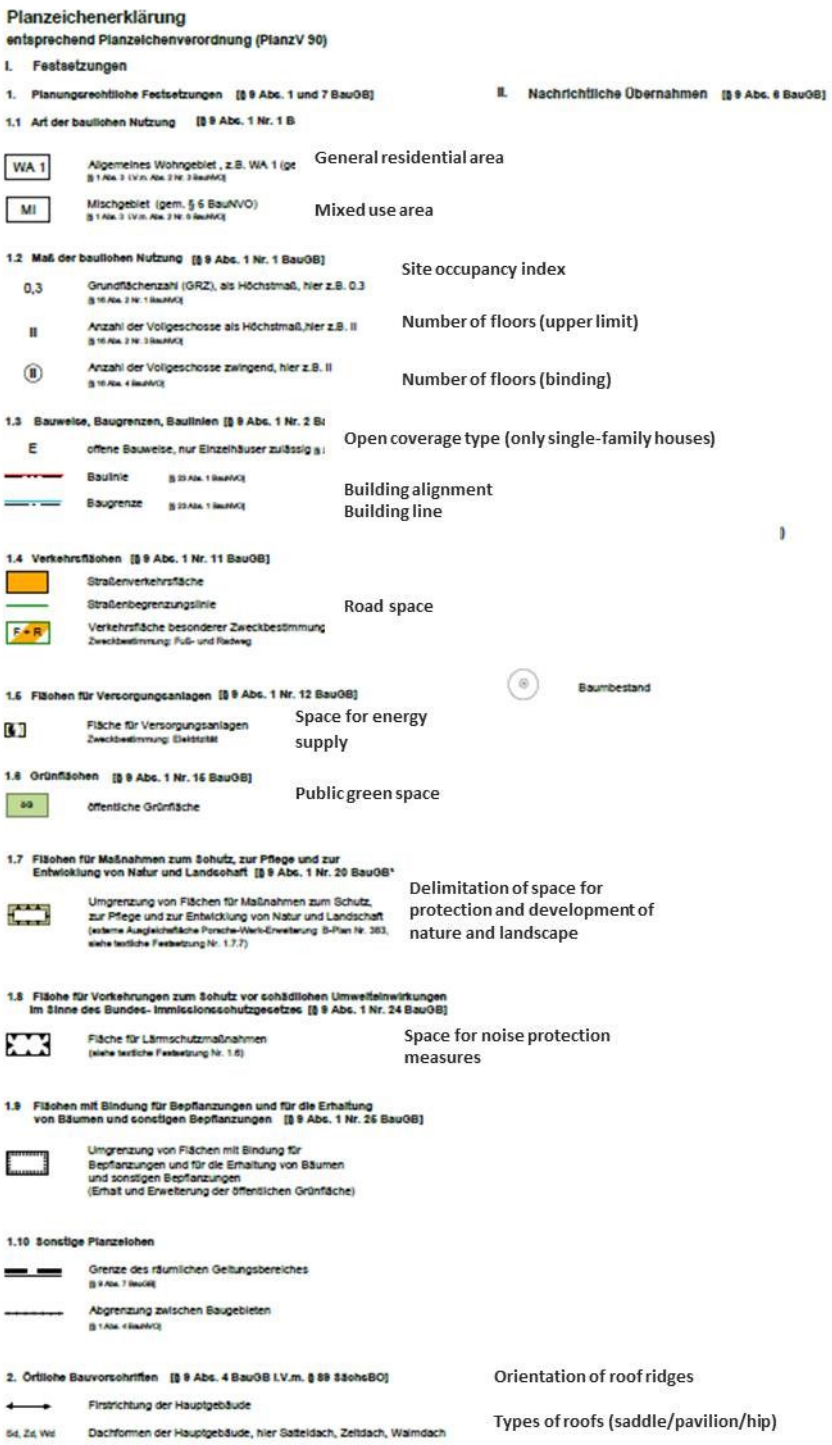


Figure 60: Plan symbols according to PlanZVO for B-Plan 219 (Stadt Leipzig, 2015e, translation provided by the author)

From these plan contents, impacts on land are to be assessed by applying the scheme suggested above, reproduced as including concrete figures in table 24: A1 amounts to 2.84 ha as indicated above, the municipal quota for land take for housing purposes (A2) for a three year period amounts to 23.8 ha (UBA FORUM for Leipzig). These figures result in a proportion of 11.93 % of land take caused by the plan with regard to the overall quota (A3). A4 identifies overall land take for housing within the three year period mentioned above, amounting to 90 ha, based on an assumption that relies on average figures published by UBA FORUM for Leipzig for the years 2011-15 as well as on municipal statistics for Leipzig (see also section 4). A5 measures this overall land

take against the quota presented above, resulting in a clear exceedance. Here, the intent of the assessment scheme in compensating the lack of regularly updated comprehensive land use plans, at least to some extent, is demonstrated through inserting the step of comparing quota for land take and actual overall municipal land take prepared into EA for every binding land use plan.

With regard to land use efficiency, net housing density amounts to 28.17 dwellings/ha when assuming the maximum of 80 dwellings to be realized on the site. Compared with a minimum housing density of 65 dwellings/ha, the degree of target achievement is at about 43 %. Looking at the balance of land take and land use efficiency, additional dwelling need for Leipzig for the three year period 2015-17 is identified at 4428 dwellings (based on BBSR, 2015) and, accordingly, 68 ha housing land (at a minimum density of 65 dwellings/ha). Compared with the available amount of PDL potential, amounting to 1050 ha overall based on SEKo 2015 (Stadt Leipzig, 2015a), and thus an allowance of 5 % annually, i.e. 157 ha for the three year period, it becomes clear that no additional land take would quantitatively be required.

Looking at the protection target, assessment results for other environmental factors reveal that impacts on flora and fauna/biodiversity, on landscape, on human health/population as well as on heritage and material assets do not exist or are negligible. This is, among others, due to the fact that extensive green space is created on the site and that, based on a relatively low baseline biodiversity value, the development of structures for the development of higher biodiversity is foreseen. For the factors soil, water, climate and air, however, assessment is less positive. The available EA report published for the plan assesses impacts mainly with regard to the previous plan for the site and, e.g., higher degrees of soil sealing foreseen by it, arriving at an improvement of the situation in that regard. A closer look, however, reveals that negative impacts on soil due to its high value and degree of non-disturbance, on water due to the reduction of evapotranspiration and disturbance of the water regime as well as on climate and air due to severe encroachment on a high value cold air generation site need to be identified.

In sum, therefore, with an overall exceedance of the municipal quota for land take by far more than 20 %, a degree of target achievement of housing density of less than 80 %, and negative impacts on three other relevant environmental factors, significantly negative impacts on land need to be identified. Key recommendations therefore should aim at an increase in dwelling density and more compact housing types on the site, in particular given previous plans and appropriate accessibility of public transport (both overground/S-Bahn and tram connections), as well as at a reduction of land take with regard to the maintenance of cold air generation potential and natural soil functions.

Table 24: Application of the standardised assessment scheme to B-Plan 219, Leipzig (own table; icons made by Freepik from www.flaticon.com)

Plan to be assessed: Binding site plan 219 (*Wohngebiet am Heidegraben*), statutory decision 2015		
Assessment applying the following targets and criteria:		
Reduction target ▪ Land take 	**Efficiency target** ▪ Dwelling density ▪ PDL reuse potential 	**Protection target** ▪ Land-related aspects as part of other environmental factors (interdependencies) 
A) Reduction target		
4 Overall amount of land take for housing generated by the plan [ha]		**2.84 ha**
5 Municipal quota for land take for settlement and transport purposes [ha] for plan period 2015-2017, proportion for housing (1/3) 		23.8 ha/a; 71.4 ha/three years (overall SuV), for housing (1/3 SuV): **23.8 ha**
6 Proportion of land take generated through the plan on municipal quota for settlement and transport purposes, proportion for housing [%]		**11.93 %**
4 Overall municipal land take [ha] for plan period 2015-2017, proportion for housing (assumption based on Stat. Jahrbücher Leipzig 2014-19 (about 90 ha total SuV/a) and UBA FORUM (125.5 ha total SuV/a 2011-15))		**90 ha**
5 Proportion of overall municipal land take for housing for plan period 2015-2017 on quota, potentially identification of exceedance [%]		**378 %**
B) Efficiency target		
2.1 Minimum value for dwelling density [dph net] 		**65**
2.2 Dwelling density [dph net] of the plan to be assessed		max possible: 80 dwellings, i.e. **28.17 WE/ha** (but likely to be smaller)
2.3 Degree of achievement minimum dwelling density [%]		**43.34 %**
Balance A + B		
Amount from A 4		**90 ha**
>> Allowing for:		
1 Projected demand for plan period 2015-2017, potentially exceedance of demand? 		20-30 dwellings/10000 inh and a, i.e. **4428 dwellings** (inh Leipzig 2017: 590337) at min. 65 dwellings/ha net: **68.1 ha SuV for housing**)
2 PDL reuse potential in the inner urban area (unused lots, brownfields, densification potential), allowable: Lump ratio of 40 % (s. BBSR, 2013) or 5 % annually, considering difficulties in activing PDL reuse potential, dependent on extent of proposed allocations 		1050 ha (Stadt Leipzig, 2018b), i.e. for time period 2015-2017: **157.5 ha**
Overall balance land take and land use efficiency • **Balance 1-2** • **Exceedance of quota (amount from A 5)?** • **Degree of achievement minimum dwelling density**		-89.4 ha , i.e. no additional land take required 378 % 43.34 %

C) Protection target:
Conflict assessment, dependent on sensitivity (relevant aspects for individual environmental factors each)

Categorisation of significance according to traffic light rating:
No negative impacts
Negative impacts: negative impacts on less than three other environmental factors (or significantly negative impacts on one other environmental factor)
Significantly negative impacts: Negative impacts on three and more other environmental factors (or significantly negative impacts on two and more other environmental factors)

Soil	Water	Climate, Air	Landscape	Biodiversity	Human health/population	Heritage and material assets
Filter and buffer function Productivity function Archive function Contamination	Ground water recharge Water protection zones Flood areas	Sites for cold air generation Sites for fresh air generation Sites for cold air transport Sites for fresh air transport Heat island areas	Scenic value Recreational value	Protected sites Biotope connectivity	Recreation, open and green space provision Noise pollution	

Overall assessment A - C: Reduction + Efficiency +Protection

No to slightly negative impacts:

- Non-exceedance of quota for land take
- Achievement of minimum density
- *No or slightly negative impacts on land-related aspects of other environmental factors*

Negative impacts:

- Exceedance of quota for land take by 5-20 %
- Lower deviation from minimum density by 5-20 %
- *Negative impacts on land-related aspects of less than three other environmental factors (or significantly negative impacts on one other environmental factor)*

Significantly negative impacts:

- Exceedance of quota for land take by > 20 %
- Lower deviation from minimum density by > 20 %
- *Negative impacts on three and more land-related aspects of other environmental factors (or significantly negative impacts on two and more other environmental factors)*

Overall assessment	**Significantly negative impacts**

Recommendations

- Increase in housing density and more compact housing types
- Reduction of land take through omitting particularly sensitive areas (natural soil functions, cold air generation)

Mitigation and compensation

Internal:
- Green roofs and facades

External:
- Desealing and renaturalisation of PDL
- Activation of further PDL for housing

A 2: UBA FORUM quotas for land take (Henger & Schier, 2014; http://www.flaechenhandel.de/)

B 1: Information document dwelling density

A+B 1: BBSR (2015) projections on housing, + specific reports/surveys, if applicable

A+B 2: BBSR (2013) survey on PDL potential, + municipal databases/surveys, if applicable

8.5 Discussion, limits, and need for further research and development

Considering the implementation of the suggested assessment approach in practice, several aspects are to be discussed. First, while the assessment of locational alternatives at the B-Plan scale would also be desirable, particularly given the frequent lack of updated FNP, this appears little realistic so that a focus has been set on assessing planning/design alternatives with regard to resource efficiency of land use. Second, while the suggested traffic light rating system is relatively simple and broadbrush, it is considered useful for a first estimation of overall impacts on land. However, the ideal categories suggested certainly bear potential to be rearranged and subdivided with regard to individual assessment constellations. For reasons of applicability, due to difficulties in identifying the proportion of residential roads and parking space on SuV figures, a separate consideration of land demand for transport infrastructure as part of residential development has not been further considered here. It would thus be desirable to develop approaches for quantitatively assessing the compactness of housing-related infrastructure provision. Generally, in this regard, the assessment approach would benefit from improvements of available data and the identification of indicator-related information, in particular with regard to figures on annual overall land take within a municipality, to comparable and precise data on PDL potential and (considering monitoring) on PDL reuse, as well as with regard to inconsistencies in built-up density but not dwelling density being retrievable from draft plans. It also needs to be emphasized that the consideration of interdependencies is particularly important for EA of inner-urban development plans in growing urban areas, ensuring the maintenance of standards for sufficient green space provision and the protection of other qualitative environmental aspects. Beyond these points, a key question arises from the dynamic character of overarching targets, and the need to adapt municipal quota to further reduced figures. With regard to the objective of no net land take this would imply that only as much land take would be deemed acceptable as both reuse and PDL brought back into a more natural state have 'released'. Further, a consideration of urban-rural interdependencies in land demand and housing provision (with assessment potentially being based on functional areas), and longitudinal studies on the effectiveness of regulations set by municipal land use plans with regard to targets tackled here, would be desirable for future activities in the field.

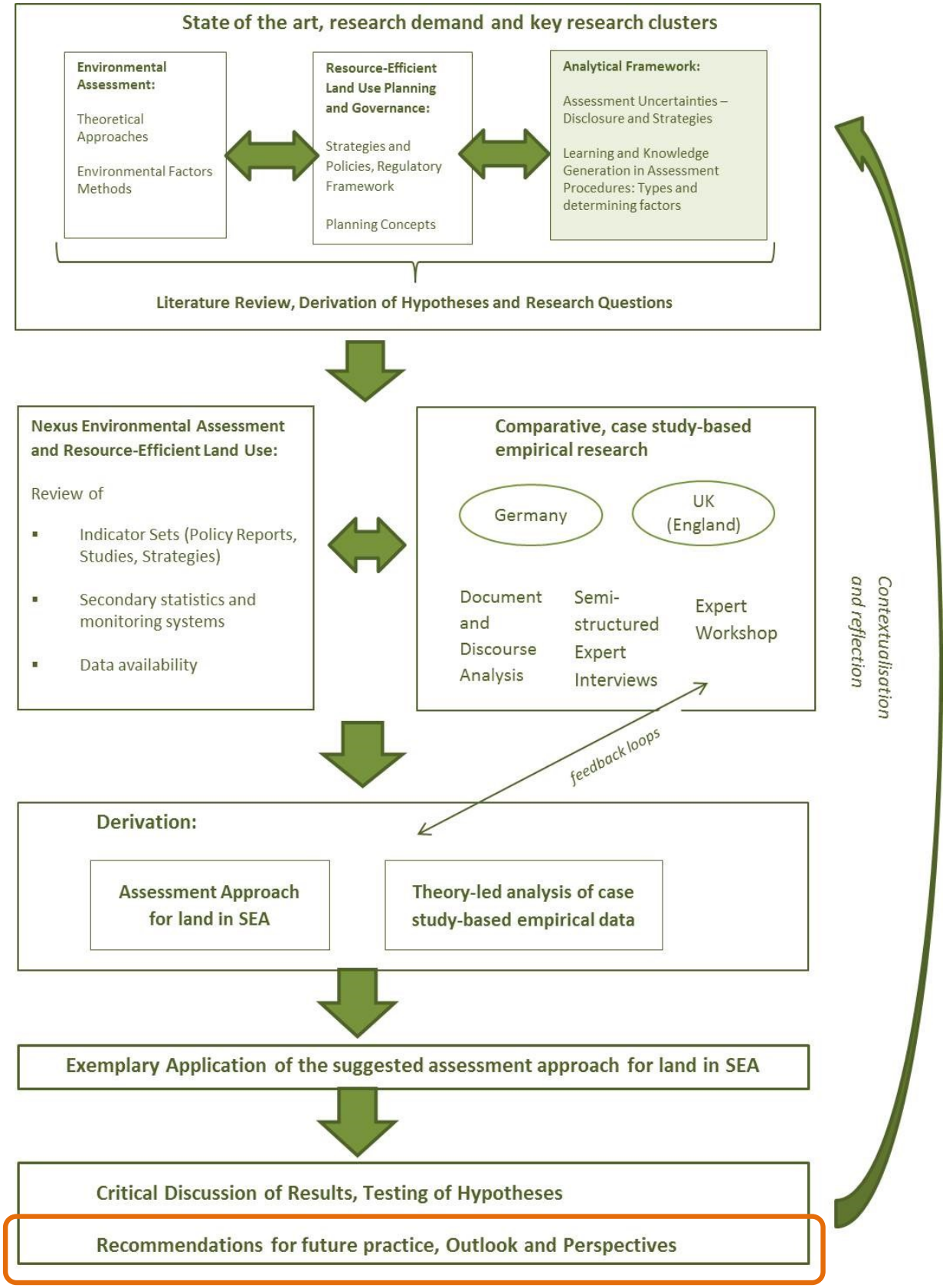
8.6 Starting points for adapting the assessment approach to EA in England

Given that the assessment approach suggested has been developed with regard to frame conditions of the planning and EA institutional setting in Germany, starting points for adapting this approach to the English setting are to be outlined here. First, a consideration of land take in England is met with the absence of an overall reduction target besides the EU no net land take one. Notwithstanding the probability of introducing such a target in political terms, recent debates on land use patterns could help define such a target. Generally, LUCS enable a relatively straightforward picture of land take, measured by the indicator 'land changing to developed use' which would need to be specified for the local scale. For assessing land take prepared by a Local Plan, however, the German approach cannot be directly transferred. With concrete land take only being decided upon at planning permission scale, site allocation plans as part of Local Plans only indicate a rough amount of sites to be allocated which would need to be quantitatively specified, with the related time horizon for implementation remaining unclear due to constant revision processes of Local Plans. An applicable approach in this regard could consist of a comparison of the amount of sites suggested with previous LUCS figures for the respective municipality – or with a potential operationalized reduction target, and respective monitoring of previous land take as demanded by CPRE (2018).

As opposed to that, for assessing land use efficiency, the English situation bears more elaborate preconditions, given the former use of targets for density and PDL reuse. Here, a standard value for minimum dwelling density could accordingly be defined based on projected dwelling demand and a potential reduction target, or set as a normative orientation value with reference to density ranges as demonstrated for the German situation. With regard to PDL potential and reuse, many Local Plans already include statements on PDL reuse that would need to be refined quantitatively, with brownfield land registers being increasingly set up, and LUCS including the indicator of PDL reuse to be specified for the municipal scale.

Looking at land quality, the situation differs from the German one due to the specifics of Sustainability Appraisal. Due to that, socioeconomic factors could also be considered as part of land, in particular infrastructural accessibility and the functional integration of sites, whereas green space provision would similarly remain part of human health and biodiversity and be considered via interdependencies. Furthermore, the strong focus on agricultural land value as an aspect of land, as expressed by many English interviewees, takes up on the productivity function of soil and would thus have to be assessed as part of that factor, following the understanding of undeveloped land as valuable in itself, regardless of its productive value. Alternatively, a comprehensive, function-based understanding of qualitative features could be suitable for advancing objectives-led and task-based appraisal, bearing particular potential for assessing cumulative effects beyond 'tick-box matrices', but preferably to be combined with quantitative aspects of land as suggested here.

A transparent and accountable assessment approach for land appears particularly urgent when looking at figures indicating reduced land use efficiency in recent years as depicted in section 4, as well as at recent proposals on how to reform the definition of housing need (DCLG, 2017b). While the method suggested is based on projections of demographic development and migration and thus offers a transparent approach for calculating OAN, it largely focuses on realising more dwellings in high-demand regions, without clearly considering local capacity, the role of unimplemented sites and of vacancies or options of densification for housing supply, as also criticized by CPRE (2017d). Hence, if the suggested method for defining housing targets remains based on mere quantitative figures to be fulfilled through additional allocations, without considering reuse potential or being combined with targets on land use efficiency, it bears the risk of undermining what has been achieved by former planning policy in England and might hamper the development of more sustainable land use patterns in the future.


State of the art, research demand and key research clusters
Environmental Assessment:
Theoretical Approaches
Environmental Factors Methods
Resource-Efficient Land Use Planning and Governance:
Strategies and Policies, Regulatory Framework
Planning Concepts
Analytical Framework:
Assessment Uncertainties – Disclosure and Strategies
Learning and Knowledge Generation in Assessment Procedures: Types and determining factors
Literature Review, Derivation of Hypotheses and Research Questions
Nexus Environmental Assessment and Resource-Efficient Land Use:
Review of
Indicator Sets (Policy Reports, Studies, Strategies)
Secondary statistics and monitoring systems
Data availability
Comparative, case study-based empirical research
Germany
UK (England)
Document and Discourse Analysis
Semi-structured Expert Interviews
Expert Workshop
feedback loops
Contextualisation and reflection
Derivation:
Assessment Approach for land in SEA
Theory-led analysis of case study-based empirical data
Exemplary Application of the suggested assessment approach for land in SEA
Critical Discussion of Results, Testing of Hypotheses
Recommendations for future practice, Outlook and Perspectives

9 Conclusions and future perspectives

9.1 What this research achieved – and what should be researched further

This research has revealed the complexity of land when considering its concrete framing in EA, the role of planning systems and policies for how it is understood and that there is not the one and only way to deal with it in EA procedures. Nevertheless, the assessment approach suggested in section 8 offers **concrete starting points for transparently disclosing impacts on land by focusing on potential for quantification in particular**. Whereas it needs to be emphasized that land as a factor only remains one among many issues subject to weighting, this approach, related indicators and suggested thresholds may serve as a **significant supporting argument in dealing with different interest constellations and in concisely displaying trends in resource consumption generated through plan-making and concrete site allocations, making impacts on land more transparent and accountable**. This intent also reflects previous demands with regard to the implementation of the revised EIA Directive as reviewed and that for a more comprehensive and concise consideration of land a range of information and data are already available that have in most cases been rather poorly applied to the field of EA to date. While there is therefore 'no need to reinvent the wheel' (cf. Fischer, 2001: 50) completely, this research has made existing objectives, indicators and data applicable to EA – linked with its attempt at advancing orientation values and standards for land use efficiency in particular, and developing a ready-to-use assessment approach for the focus case of German municipal land use planning in a first stage. This also underpins the **need for more transparent evidence base documents on land demand and land availability, assessed by environmental criteria, to plans,** and appears particularly timely given recent adverse trends and figures on land consumption as depicted for both Germany and England. Its transferability to other planning scales and to the situation in England is generally considered possible but will require further research on respective details.

Beyond the contribution of this research on framing land for EA, its consideration of the role of assessment uncertainties and its attempt at better understanding learning processes has revealed a number of insights but also demonstrated boundaries of this case study-based research for advancing theory. In general, findings on how assessment uncertainties are dealt with and how learning in EA is generated **underpin strengths of different disciplinary backgrounds and stakeholder constellations in EA procedures, and thus its role as a tool for gathering all these 'sources of knowledge' and enabling mutual exchange**. This **importance of internal and external communication for actively promoted learning in particular** accentuates the added value of supporting these factors (with impetus for German practice potentially resulting from, e.g., the role of external reviews in England), also in order to make use of the important catalyzing role of new requirements for EA practice. Furthermore, these insights spurred interest in examining a potential link between how assessment uncertainties are dealt with and the occurrence of learning. While preliminary insights on this link could be detected, including an **initiating role of transparently disclosed uncertainties for discussing method advancements**, the sample size of this research was considered insufficient for generating findings of general validity on causal relations between the two phenomena. Still, from these preliminary insights, **a more pronounced way of disclosing and taking up on uncertainties, as particularly mentioned with regard to standards/threesholds and the determination of significance,** should be promoted in EA practice. **Dedicated research on such a link would be worth pursuing** in order to potentially make the explicit consideration of uncertainties fruitful for advancing EA.

Still, however, the field of learning in EA requires more in-depth research and longitudinal studies in order to be able to **understand determining factors for gradual advancements as well as for rather disruptive innovation – or their absence**. In this regard, a better and more wide-spread communication of EA good practice and concise monitoring, also with regard to effects of mitigation and compensation measures, are deemed key for this purpose. Core demands formulated by SEA research and practice professionals in recent years, ranging from a more active use of EA as a supporting instrument for decision-making in accordance with sustainable development (see e.g. Fischer, 2017b), and a pronounced research focus on effectiveness and benefits of SEA (see section 3) with adequate long-term funding are to be supported and emphasized in this context.

In methodological terms, it needs to be acknowledged that the focus of research was on comprehensive land use planning for which land tends to be considered in a comparably detailed manner already. While this might suggest a potentially larger gap between what should and what is actually considered for sectoral plans that have not been further examined here, significant differences in depth of assessment were also identified for those comprehensive land use plans analysed. Questions that could not be further pursued within the scope of this work and that should thus be considered by subsequent research, in particular with regard to extending the methodology suggested to other types and levels of planning, comprise **ways of assessing the potential reversibility of land use, also with regard to the no net land take concept/target, the operationalization of remote impacts such as via the land footprint concept, and a further scrutiny of the ecosystem services/functions-based approach for framing (not only) land in EA**. Also, a methodology for integrating land as a factor, and desealing measures in particular, into **compensation frameworks** beyond those required by the Habitats Directive would be worth further consideration.

9.2 Strengthening the role of land within and beyond EA

With that said, for further strengthening the role of resource efficient land use in decision making, **modifications of the instrumental setting and a more consistent implementation of existing instruments are needed**: Priority aspects with regard to the reduction target refer to the formulation of targets at different spatial scales and the derivation of respective quotas (as realized in Germany to some extent but not yet in England). With regard to the efficiency target and more compact housing patterns, a comprehensive use of PDL/brownfield databases and of orientation values for minimum densities (as to some extent realised in England but only exemplarily in Germany) is indicated. A meaningful use of such indicators and data depends on a better representation of actual land take through land use statistics, a better representation of previous plan impacts through monitoring, and on **closing data gaps** on actual land demand and the amount of reuse potential that can reasonably be activated. Such endeavours could well be enabled through research programmes at EU and national scales, building on earlier findings on the conceptual framing of land developed in recent years in the German policy discourse in particular. In the longer term, such progress could enable a **better contextualisation of local and regional land use with regard to global interdependencies and objectives** (with SDGs to be operationalised for application at underlying spatial scales).

Looking beyond current legal requirements, an integration of land into the catalogue of environmental factors is regarded as particularly promising for SEA and its applicability to strategic plans at overarching spatial scales. This should go together with **requirements for quality control as an institutional tool for fostering learning**, and a **strengthened**

requirement for justifying selected alternatives that might help in enhancing the consideration of actual land demand and rethinking alternatives on its resource efficient use.

Nevertheless, the **ongoing relevance of policy initiatives in both institutional contexts** (see section 4 and already Penn-Bressel, 2004, on the German 30 ha target clearly demonstrating that resource efficient land use in practice requires more than its mentioning in plans and strategies), needs to be emphasized and their model project-based scrutiny in practice be firmly encouraged. This is particularly relevant with regard to a potential conflict of reduced land take with a growing demand for (affordable) housing in many urban regions, aggravated through the challenge of dual inner-urban development. Despite housing demand projections having been revised upwards for a number of regions in both case studies, there is no general contradiction being seen between these two requirements – as long as a number of mechanisms (within and outside the realms of planning and EA) determining where what amount and what types of dwellings are realized, are reconsidered: A **more systematic focus on an efficient use of land** is required, motivating a priority use of PDL potential also in non-growth regions and therefore fostering the revitalization of existing built-up structures in central locations. Related to that, housing demand in growing urban regions constitutes a chance to **develop and qualify the existing urban fabric** outside of inner urban centres, preferably through compact housing types combined with attractive open space. This presupposes a reduced amount of newly allocated sites in non-growth regions and a reasonable distribution of how housing demand is accommodated in functionally linked regions through a stronger role of regional planning and incentives for revitalizing the existing building stock, as well as through a stronger obligation to justify the requirement for greenfield (and greenbelt) development (see also UBA, 2018a).

Such a shift of strategy, however, also requires **reconsidering existing land use rationales, elements of the regulatory setting and economic (dis)incentives**. First, land speculation would need to be better exacerbated by restructuring land taxation with regard to land value (as discussed in Germany with regard to higher taxes on undeveloped land), catalysing the activation of yet undeveloped sites in high-demand regions. Second, and in order to strengthen affordable housing provision as a core public interest and social question, reasonable limits to profit gains from private property (such as currently discussed options of legally restricting rent increases), a more concise use of existing instruments such as public rights of preemption and a (renewed) focus on both acquiring parts of the dwelling stock and developing land by the public sector or through public-private partnerships (see also UBA, 2018a; Bock & Preuß, 2018) constitute key set screws for safeguarding land resources for actual housing demand rather than for real estate speculation. Third, the role of desealing measures as part of compensation regulations should clearly be strengthened, fostering the consideration of the overarching target of no net land take (see sections 3 and 8) in plan-making. Finally, compact housing as a key element of resource efficient land use, with attractive multi-storey housing – for family needs combined with garden plots and community facilities, and for the growing amount of single person households at all ages potentially combined with smaller private refuge entities and shared community lounges instead – not only bears potential for higher land use efficiency but also for responding to the growing (health) problem of social isolation via cross-generational communication and community-based help. EA could, under these conditions, unfold even bigger potential in assessing whether PPPs contribute to such a resource efficient and demand-oriented way of providing affordable housing (and, prospectively, other land use demands) – making impacts on land as a resource more transparent and accountable.

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APPENDICES

Appendix A: Document analysis of EA reports, detailed table

Appendix B: Guidelines for expert interviews (English version)

Appendix C: Guidelines for expert interviews (German version)

Appendix D: E-Mail Requests for expert interviews (English and German)

Appendix E: Municipal quotas for land take as identified by UBA FORUM

	(Strategic) Objectives	Targets	Indicators - Quantitative	Indicators - Qualitative	Addressing uncertainties?	Concluding assessment
Comprehensive land use plan Leipzig (EA Report 2012)	National Biodiversity Strategy § 1a Abs. 2 BauGB (resource efficient land use; balancing densification and protection of green space) environmental quality objectives Leipzig (reduction of land take, desealing, protection of green space)	30 ha target brownfield: greenfield 3:1	land take (ha land, affected by conflicts) brownfield reuse ratio built-up/open space (re. previous plans) soil sealing (GRZ/BauNVO)	conflict intensity (number of factors affected, size of site)	two different datasets on brownfield potentials	reduced conflict potential (reduced amount of sites compared to previous plans -'maximum scenario') further reduction of conflict potential (only limited amount of proposed sites likely to be used in fact) tiering (detailed assessment of actual conflicts at binding plan level) priority for brownfield development, but also need for additional sites at the urban fringe (long-term land availability; supply/demand)
Comprehensive land use plan Bremen (EA Report 2014)	§§ 1, 1a BauGB BBodSchG LSP Bremen reduction of land take in the undeveloped outer area (*Außenbereich*) priority of brownfield reuse	30 ha target, operationalised for Bremen: 13 ha/year (currently 30 ha/year)	ratio new designations/withdrawal of designations/re-designations densification (BauNVO/GRZ) brownfield potential only estimated: „comparison with other major cities	conflict intensity	fragmented information on soil conditions lack of information on qualitative and quantitative green space provision lack of detailed information on likely future housing density on allocated sites	brownfield reuse hardly quantifiable, description of major impact pathways instead slight reduction of site designations overall (amount of withdrawals about as high as new designations); increase in open and green space

	(Strategic) Objectives	Targets	Indicators - Quantitative	Indicators - Qualitative	Addressing uncertainties?	Concluding assessment
	desealing densification where suitable protection of green and open spaces, protection of natural areas and unsealed soil		suggests a high amount of brownfield sites“ (translated by the author)		lack of information on traffic generation throuh allocated sites discussion of target conflicts (brownfield reuse, densification, green space provision, climate adaptation)	suitability for densification mainly on sites with GRZ < 0,3 protection of open space, withdrawal of site designations in undeveloped outer area, re-designation from residential to mixed sites enables demand-oriented land use and intensified mix of uses
Draft Binding land use plan Leipzig 304 (EA Report 2015)	LEP Saxony: reduction of land take SEKo Leipzig: sustainable land policy, inner-urban owner-occupied housing STEP W+S: qualification of and small-scale addition to existing urban fabric	environmental quality objectives Leipzig: 40 % maximum sealing for loosely structured residential sites	soil sealing number of dwellings		n/a	minimized sealing together with roof greening and conservation of meadowland, thus no significant impact on soil
Binding land use plan Leipzig 219 (EA Report 2015)	LSP: residential site, single-family housing with high amount of green space		soil sealing		n/a	degree of soil sealing 15 %, thus much smaller than previous plan

	(Strategic) Objectives	Targets	Indicators - Quantitative	Indicators - Qualitative	Addressing uncertainties?	Concluding assessment
						reduction of number of dwellings, thus less noise emissions through car traffic
Draft Binding land use plan Leipzig 403 (EA Report 2017)	National Sustainability Strategy § 1 Abs. 2 BauGB: reduction of land take desealing directive Saxony environmental quality objectives Leipzig: reduction of land take, minimisation of soil sealing	30 ha target brownfield: greenfield 3:1	soil sealing (GRZ/BauNVO)	loss of soil functions	lack of data on cold air generation and flow	due to amount of sealing (30 %), objectives for environmental factor soil cannot be achieved reduced negative impacts through minimization and compensation measures (ventilation corridors, building orientation, greening) alternatives: more compact and multi-storey housing structure inadequate due to character of surrounding sites and resulting higher amount of soil sealing
Binding land use plan Leipzig 311 (EA Report 2017)	§ 1a Abs. 2 BauGB LSP IEKO (site for single-family and terraced housing): maintaining high amount of green space as well as of climate and biotope functions		soil sealing (GRZ/BauNVO)	reuse of brownfields quality of natural soils	n/a	reuse of former building layouts, thus reduced negative impacts economical use of soil since maximum possible (GRZ/BauNVO) not exploited additional soil sealing (but on previously used site)

	(Strategic) Objectives	Targets	Indicators - Quantitative	Indicators - Qualitative	Addressing uncertainties?	Concluding assessment
	environmental quality objectives Leipzig: priority of brownfield reuse over additional land take					reduced width of streets in order to protect natural soil quality alternatives: higher density not suitable due to existing open character at urban fringe; different building layout not suitable due to less efficient use of land (costs for demolition of previous buildings)
Draft Binding land use plan Zwickau (EA Report 2017)	LSP: in parts 'landscape element worth protecting' (translated by the author)		loss of soil	loss of soil functions	n/a	impacts on several environmental factors, but minimization and compensation measures
Draft Binding land use plan Mockrehna (EA Report 2017)	§ 2 Abs. 2 BBodSchG and state guidance on soil assessment smallest possible soil loss part of nature park (protection of natural functions and recreational value)		land take including soil sealing (GRZ/BauNVO)		n/a	plan serves to cover local demand within the municipality (*Eigenentwicklung*) significant impacts on soil through sealing, but reduced impacts through moderate addition to existing built-up structures and good infrastructural accessibility

	(Strategic) Objectives	Targets	Indicators - Quantitative	Indicators - Qualitative	Addressing uncertainties?	Concluding assessment
						alternative: already approved site as part of B-Plan, but unclear property conditions and higher biotope value , further development unrealistic
Binding land use plan Delitzsch (EA Report 2017)	National Sustainability Strategy: efficient use of soil, protection of natural soil functions				n/a	compact built-up structure and efficient infrastructural development; protection of soil due to generous parcel sizes demand-oriented development, no impact on existing surplus of multi-storey housing
Draft Comprehensive land use plan Strehla (EA Report 2017)	§ 1a Abs. 2 BauGB BBodSchG state regulations (protection of natural soil functions) RP Oberes Elbtal/Osterzgebirge (focus on sustainability of use of agricultural soil) stabilization of population and improvement of residential function		soil sealing demand assessment obsolete due to decreasing population figures envisaged set-up of brownfield register average residential space per person		data relatively coarse but more detailed data not available, especially in rural areas	impact on soil through sealing and reduced natural soil functions amount of new site allocations constitutes essential amount necessary for covering demand for covering "diversification/de-densification and compensation demand (*Auflockerungs- und Ersatzbedarf*; translated by the author), sites are

	(Strategic) Objectives	Targets	Indicators - Quantitative	Indicators - Qualitative	Addressing uncertainties?	Concluding assessment
	(decreasing trend in population figures)					allocated despite decreasing population figures tiering (detailed consideration of environmental impacts at binding plan level)
Liverpool Core Strategy Sustainability Appraisal (submission draft 2012)	provide sufficient quantity and quality of employment land protect, manage and restore land and soil quality provide good quality, affordable and resource efficient housing create residential neighbourhoods that meet housing needs (city centre: higher density residential development; urban core: larger homes with gardens)		% of new and converted dwellings on previously developed land (per annum) % of new residential development within 30 minutes public transport time of a GP, hospital, primary and secondary school, employment and a major health centre level of 'public park' provision per 1000 population		spatial extent and significance beyond the City, of some of the predicted negative environmental effects not known	economic and housing growth likely to lead to increasing demand for resources; however, negative consequences of a more dispersed pattern of development would be even greater and affect an even wider area priority to the redevelopment of previously developed land, thus less pressure on open/greenfield sites emphasis on use of brownfield land will help to maintain soil quality on greenfield sites

	(Strategic) Objectives	Targets	Indicators - Quantitative	Indicators - Qualitative	Addressing uncertainties?	Concluding assessment
	use energy, water and mineral [land] resources prudently and efficiently					emphasis on PDL may also mean contaminated sites are remediated focus on providing 90% of development on previously developed land, thereby expected positive effects through addressing contaminated land and minimising flood risk emphasis on PDL could result in negative impacts on wildlife habitats; however, most negative effects to be offset by other plan policies, e.g. increase in homes with gardens
Liverpool Local Plan Sustainability Appraisal, including Site Allocations (consultation draft 2016)	prioritise redevelopment of vacant and derelict land ensure efficient use of resources (water, energy, land) ensure all new development is highly accessible by		% of new and converted dwellings on previously developed land (per annum) % of new residential development within 30 minutes public transport time of a GP, hospital, primary and secondary school, employment and a major health centre	Agricultural Land Classification (ALC) as an assessment method for land quality	'Agricultural Land Classification Provisional (England)' dataset available at magic.gov.uk classifies majority of Liverpool as being 'urban' and 'non-agricultural' land; however, dataset of a very low resolution and hence not suitable for differentiating specific sites number of uncertain impacts on the historic environment,	plan will direct development away from greenfield sites towards reusing previously developed land and buildings plan will promote reuse of previously developed land and buildings, likely to bring about opportunities to remediate contaminated land

	(Strategic) Objectives	Targets	Indicators - Quantitative	Indicators - Qualitative	Addressing uncertainties?	Concluding assessment
	sustainable modes of transport provide sufficient quantity and quality of employment land protect and enhance green infrastructure resource provide housing to meet local needs new development should, as a first priority, be located on previously developed land		400m maximum distance from a public park		green infrastructure and biodiversity, because policy does not identify sites which will be allocated effects on resources and green infrastructure unknown due to ongoing process of identifying sites (outstanding evidence work); however, more likely that vast majority of sites will be located on previously developed land given the geography of Liverpool and the type of available sites	some potential for conflict between environmental and economic objectives there inevitably will be some impact on the land resource; in the medium to longer term, and in combination with other plan policies, however, considered to be kept to a minimum, by requiring proposals for new development to preferably be built on previously developed land and protect green infrastructure expected positive effects include addressing contaminated land and minimising flood risk emphasis on PDL could result in negative impacts on wildlife habitats; however, most negative effects to be offset by other plan policies despite large number of homes and provision of land for employment, focus on

	(Strategic) Objectives	Targets	Indicators - Quantitative	Indicators - Qualitative	Addressing uncertainties?	Concluding assessment
						PDL and protection of green infrastructure will help preserve soil quality on undeveloped sites
Leeds Local Development Framework Core Strategy Sustainability Appraisal (publication draft 2012)	minimise pressure on greenfield land by efficient land use patterns that make good use of derelict and previously used sites deliver economic development which makes best use of land in sustainable locations deliver housing growth in sustainable locations, by prioritising previously developed land and by phased release of greenfield sites increase and enhance quantity, quality and accessibility of greenspace (PPG 17)	2.8 ha of Local Recreational Areas within 400m and 12ha of Neighbourhood/District Parks within 800m of residential areas (UDP) 80% of new homes on previously developed land housing density to be between 30 and 50 dwellings per hectare net (PPG3)	% of land developed for employment which is on PDL % of new homes on PDL % of new dwellings completed at less than 30 dwellings per hectare quantity of greenspace per 1000 population % of new residential development within 30 minutes public transport time of a GP, hospital, primary and secondary school, employment and a major health centre	accessibility of greenspace to residential areas	strategic nature has made prediction of significant effects difficult dependence upon policies and options that will come forward as part of subsequent plans	level of housing required means that some greenfield land will be released; however policy requires high level of brownfield development, particularly in the first 5 years emphasis on brownfield sites reduces pressure on greenfield sites; however effect on biodiversity, historic and built environment dependent on the sites which come forward protection of green space will also reduce developable brownfield land which will put added pressure on greenfield land positive effect through high density development in the city centre reducing pressure on greenfield land

	(Strategic) Objectives	Targets	Indicators - Quantitative	Indicators - Qualitative	Addressing uncertainties?	Concluding assessment
Leeds Site Allocations Plan Sustainability Appraisal (publication draft 2015)	minimise pressure on greenfield land by efficient land use patterns that make good use of derelict and previously used sites, provided that it is not of high environmental value (defined as ecological value) protect and enhance Green Infrastructure, strategic green corridors, green space, and areas of important landscape character		% of land which is on PDL % of new homes on PDL % of new dwelling completed at less than 30 dwellings / hectare quantity of greenspace per 1000 population % of previously developed land of 'high environmental value' lost to development % of new residential development within 30 minutes public transport time of a GP, hospital, primary and secondary school, employment and a major health centre	accessibility of greenspace to residential areas	scale of plan and number of sites assessed one of the greatest challenges in carrying out the Sustainability Assessment *Response to consultation remark:* The scope of the Site Allocations Plan and the SA process is unable to ascertain the likely impact on heritage assets, therefore the effect should be recorded as uncertain. The detailed planning application stage is the appropriate time to undertake a detailed assessment.	*Site Rankings:* near/in City centre > near/in a town centre > site not near/in a centre but reasonably accessible > not near or in a centre > loss of existing leisure facility derelict brownfield site > occupied brownfield site > part greenfield and brownfield site > greenfield site Flood Zone 1 & brownfield > FZ 1 & greenfield > FZ 2 & brownfield > FZ2 & greenfield > FZ3 & brownfield > FZ3 & greenfield + Existing unattractive brownfield site O Brownfield site, but not unattractive; greenfield site in scale with settlement; greenfield site where development could still maintain distinctiveness - Large Greenfield site, out of character with settlement

	(Strategic) Objectives	Targets	Indicators - Quantitative	Indicators - Qualitative	Addressing uncertainties?	Concluding assessment
						non-agricultural land > ag. land grade 3b or 4 > ag land grade 1, 2, 3, or 3a maximised delivery of brownfield land appropriate phasing will be used to ensure release of brownfield sites early in the plan period; greenfield sites in regeneration areas in more accessible locations come forward in early phases; greenfield sites in other areas come forward in later phases majority of allocations for general employment are greenfield sites, majority of allocations for office use are brownfield; on balance overall effect on SA11 neutral
Local Plan Sustainability Appraisal Harrogate, North Yorkshire (publication draft 2018)	prudent and efficient use of energy and natural resources with minimal production of waste	minimum net density of 30 dwellings per hectare higher densities within the defined centres	housing completions amount of residential development completed on brownfield land	geographical access to services development on best and most versatile agricultural land	uncertain score where there was considerable uncertainty about some effects baseline data collected from published sources (data reports published by the council, census data and	*Site Rankings:* Dark Green: Land is approximately 75-100% previously developed land. Light Green: Land is approximately 50-74% previously developed land.

	(Strategic) Objectives	Targets	Indicators - Quantitative	Indicators - Qualitative	Addressing uncertainties?	Concluding assessment
	quality built environment and efficient land use patterns quality housing available to everyone local needs met locally	and in well accessible urban locations (public transport) protection of best and most versatile agricultural land (grades 1, 2 and 3a) from development not associated with agriculture or forestry planning permission for development affecting best and most versatile agricultural land (grades 1, 2 and 3a) only granted exceptionally if overriding need for the development and either: a. sufficient land of a lower grade (grades 3b, 4 and 5) unavailable or	amount of employment development completed on brownfield land green spaces lost to development		statistical/official websites); new data not collected; where there are gaps in the available data consideration will need to be given to whether this indicator should be monitored in the future still some uncertainty in relation to transport and accessibility issues associated with new development in order to meet the council's objectively assessed need for housing, uncertainty over ability to completely protect and enhance all designated and non-designated historic heritage assets and biodiverse and attractive natural environment policy should have positive environmental effects by seeking to limit the loss of high quality agricultural land; however, may be uncertain as in some areas use of higher quality land may be unavoidable	Yellow: Land is approximately 25-49% previously developed land. Orange:Land is approximately 1-24% previously developed land. Red: Land is approximately 100% greenfield. Dark Green: Would utilise brownfield land as part of the development. Orange: Greenfield land, but not grade 1, 2 and 3a Red: Loss of grade 1, 2 and 3a agricultural land. Red: 50% or more is Grade 1 agricultural land. Orange: 50% or more is Grade 2 agricultural land. Yellow: 50% or more is Grade 3 agricultural land. Light Green: 50% or more is Grade 4 agricultural land. Dark Green: 50% or more is Grade 5 agricultural land given limited supply of brownfield and need to substantially increase housebuilding rates, proportion of new housing

	(Strategic) Objectives	Targets	Indicators - Quantitative	Indicators - Qualitative	Addressing uncertainties?	Concluding assessment
		available lower grade land has environmental value (statutory designation) and outweighs agricultural considerations or b. benefits of development justify loss of high quality agricultural land				on PDL will reduce; nevertheless strong support for redevelopment of brownfield land, where it is not of high environmental value, maintained in 2012/13 substantial percentage of dwellings developed at a density of less than 30 dwellings per hectar, however, looking at permissions granted in 2014/15, around 80% to be constructed at densities of 30dph or above new Strategic Housing Market Assessment (SHMA) provides up to date assessment of housing need, involving the identification of considerably more land for housing than previously planned for; assessment of environmental constraints will be undertaken with regard to avoiding impacts to designated sites, priority habitats and best and most versatile land

	(Strategic) Objectives	Targets	Indicators - Quantitative	Indicators - Qualitative	Addressing uncertainties?	Concluding assessment
						however, likely that re use of previously developed land in preference to greenfield land would be incompatible with requirements given limited supply of brownfield land
Local Plan Sustainability Appraisal Scarborough, North Yorkshire (submission draft 2015)	affordable, good quality housing in accessible locations efficiency of land use through maximised re-use of previously developed land and existing buildings protect and enhance the built environment enhance quality and accessibility of green infrastructure network		% of new homes built on PDL land available for employment use employment land by sector taken affordable dwellings completed as a % of identified annual need area of remediated land (ha) amount of new open space/green infrastructure (ha)	minimized loss of better quality agricultural land to development	*frequent assessment result re. policies:* "Without site specific information it cannot be assessed" local knowledge of the likely implications of the options used to minimise the number of "unknown" effects, as at this stage many issues considered unknown	*Site Rankings:* 100% Brownfield 6 Majority Brownfield 4 Majority Greenfield 2 100% Greenfield 1 loss of best and most versatile agricultural land? No loss 2 Loss of 0.1ha – 5ha -1 Loss of 5.1ha – 10ha -2 Loss of 10.1ha – 20ha -3 More than 20ha -4 development compatible with adjoining land uses? Development compatible. 2 With mitigation, development would be compatible. 2 Incompatible with adjoining uses and mitigation unlikely to be available -3

	(Strategic) Objectives	Targets	Indicators - Quantitative	Indicators - Qualitative	Addressing uncertainties?	Concluding assessment
						despite re-use of land and buildings by concentrating development in existing centres, scale of development required would also involve greenfield sites allocations look to maximise re-use of previously developed land
Local Plan Sustainability Appraisal Craven, North Yorkshire (publication draft 2018)	ensure prudent use of land resources most new homes situated within and around market towns and villages (on previously developed land where possible and appropriate) protect and enhance natural and agricultural conditions to maintain soil quality retain land of highest agricultural value for food production and grazing	4,600 net additional dwellings over the period 2012 to 2032 *(initially discussed with regard to housing density – Background Paper 2017: targets regarding link between housing mix and housing density; housing density 32 dph; corresponding land demand 43 m² per dwelling)*	number of developments on PDL sites total net additional homes delivered proportion of local housing stock which are second homes take-up rate of employment land developed % of development which is within 400m or 5 minutes of a bus stop which provides regular services or 10		Where uncertainty exists or where it is considered that insufficient information has been made available, this has been noted strategic nature of the Local Plan can present challenges in terms of uncertainty as to precisely how the policies will be implemented and achieved in practice; to reduce this uncertainty it is assumed that the policies within the Local Plan will be implemented as written high degree of judgement must be taken in policy appraisals when determining significance of effects;	the higher the housing numbers, the more likely it is that more agricultural land will be taken; somewhat mitigated against by choosing agricultural land of poorest quality first for greenfield development, if possible the higher the housing numbers, the more land resources are required; however, heavy emphasis on utilising brownfield land where available, and using low agricultural quality land adjacent to existing towns and villages; therefore prudent use of land

	(Strategic) Objectives	Targets	Indicators - Quantitative	Indicators - Qualitative	Addressing uncertainties?	Concluding assessment
	support remediation of contaminated land re-use brownfield land having regard to its ecological value protect and enhance open countryside and wider landscape character improve access to green space suitable and affordable housing meet housing requirements, including housing affordability maximise opportunities for economic and business growth enhance access for all to essential facilities	Skipton as primary focus for growth and approximately 50% of the proposed residential development (with further foci for growth assessed similarly)	minutes' walk of a railway station total area of Grade 3 agricultural land lost to development number of vacant or derelict PDL SHLAA sites which have remained un-used for 5 years or more density of new developments permitted number of new developments resulting in remedial works being undertaken on contaminated sites % of new developments providing for green infrastructure, and area of GI generated		sustainability relies on expert judgement, available baseline data and responses and information provided by consultees and other stakeholders whilst each policy and site have been appraised for their sustainability effects, in practice the appropriateness of development proposals will require consideration of how the relevant policies interact with each other	resources given the housing requirement housing numbers under this policy seen as an appropriate balance between housing requirements and the protection of open countryside and wider landscape character minor positive impact envisaged with majority of development concentrated in and adjacent to existing towns and villages, thereby protecting the majority of prime agricultural areas vast majority of new development concentrated in existing towns and villages, thereby ensuring most prudent use of land resources concentrated approach to development, focusing on larger towns such as Skipton, much preferred to a dispersed approach which would not be seen as an

	(Strategic) Objectives	Targets	Indicators - Quantitative	Indicators - Qualitative	Addressing uncertainties?	Concluding assessment
						effective use of land resources policy can be seen as prudent use of land resources as it enables rurally based communities to continue and prosper

Guidelines for Expert Interviews

1. Understanding Land, Revised EIA Directive, Components of Land as an Environmental Factor

1.1 Based on your experience, what have been decision factors for integrating land as a separate factor into the EIA Directive?

1.2 Does land as an environmental factor possess relevance

- rather for SEA/SA
- rather for EIA
- for both in equal measure?
- Why/Why not?

1.3 How would you define land as a resource/as an environmental factor?

2. Status Quo: Addressing land in EA

2.1 To your knowledge, is land already being addressed by EA?

2.2 Thematisation of land in EA, in particular in SEA/SA

- On what planning scale is land addressed?
- Who are key stakeholders/players, what are key positions/interests?
- Is land part of concerns brought forward in the framework of participation (general public, public agencies/statutory bodies)?
- As part of which existing environmental factors has land been addressed so far? How are interdependencies dealt with?
- To what extent are expert opinions/studies used for that? Which ones?
- To what extent does the consideration of land influence the final assessment/weighting?
- To what extent has the consideration of land evoked plan changes so far?
- Based on your experience, to what extent have there been changes in the awareness for/the approach towards land throughout the ca. 10 years of SEA (and 20-25 years of SA) in practice?

2.3 Objective Orientation and Data Availability:

- Which information/which data are used for assessing land as a factor in EA?
- Which information/which data are required in your opinion in order to be able to assess land comprehensively?
- What do you think about the role of existing policy objectives regarding land *(such as reducing land take/enhancing brownfield redevelopment)* for EA?
- To what extent is the assessment based on quantified reference values/quotas? If yes, how have these been defined?

2.4 Do you know of good practice examples for integrating land into EA? Which factors were decisive for their character as good practice?

2.5 What aspects of land have so far not been addressed/not been addressed sufficiently? Why not?

2.6 Dealing with assessment uncertainties

- With regard to which interdependencies are assessment uncertainties most prevalent?

- What assessment uncertainties regularly occur with regard to land?
- Are assessment uncertainties regularly displayed transparently?
- In your opinion, does a transparent display of assessment uncertainties lead to a better assessment result?
- In what cases is SEA/SA conducted by the authority itself, in what cases by external consultants?
- To what extent do you think that the way of dealing with assessment uncertainties has been improved through experience?

3. Options: Future Approach towards assessing land as an environmental factor in EA, in particular in SEA/SA

3.1 In your opinion, can EA contribute to an early-stage impact assessment with regard to land?
- If yes: Why?
- If not: Why not?

3.2 Can EA contribute to a stronger role of land in final weighting/in the concluding assessment statement?
- If yes: Why?
- If not: Why not? What would possibly be required for this to be the case?

3.3 Should land be assessed as
- a separate environmental factor
- a sub-aspect of an existing environmental factor
- an integrative (overarching) factor
- not explicitly?

3.4 What aspects of land should be part of assessment practice?

3.5 What key barriers to assessing land as a factor in EA do exist? What solutions to these barriers are conceivable?

4. Assessment Methodology

Basic Question: To what extent should (quantitative) targets regarding the reduction of land take be subject to assessment, and how could they be considered in EA, in particular in SEA/SA?

- Do you consider an application of quantitative targets/quotas for land take in EA generally feasible?
- If yes, according to what criteria should these quotas be operationalised for which spatial scales?
- What further criteria should be applied for assessing land take quantitatively?
  - Brownfield Redevelopment
    - *Vacant PDL*
    - *Vacant buildings*
    - *PDL allocated in Local Plan/with planning permission*
  - Density

  - Sealing
  - Green Space Endowment
  - Functional Integration
  - Other?
- What data requirements would result from such a quantitative assessment approach?

Please appraise thoroughness and applicability of the provisional assessment scheme suggested:

see extra document

1. Individual Site Assessment			
A) Land Take; Land Use Efficiency			
I. Additional Land Take, based on quantitative quota for greenfield land [ha]	**II. Proportion of sealed surface [%]/Proportion of green space [%]**	**III. Minimum density value [dwellings/ha], based on defined values for structural types/spatial categories**	**IV. Functional spatial context** - public transport accessibility - expenses required for infrastructure provision (technical/social) - accessibility of supply facilities (goods and services) - accessibility of recreational space
Insert Values for Individual Sites			
Total balance, based on quota for planning horizon			

B) Land Use Quality: Conflict Assessment							
Soil Degree of non-disturbance, filter and buffer function Natural fertility/productive function Cultural value, archive function Contamination	**Water** Groundwater: - Recharge - Depth to groundwater table Surface waters: - Ecological State (WFD) - Runoff (Amount and Intensity) Areas prone to Flooding Water Protection Areas	**Air; Climatic Factors** Areas with significance for cold air transport Areas with significance for fresh air transport Areas with significance for cold/fresh air production Air Quality	**Landscape** Appearance of the landscape/scenic value Fragmentation Recreational Value	**Flora/Fauna/Bio-diversity** Protected Sites; Biotope Types Habitat Connectivity Green Space Endowment	**Population, Human Health** Green Space Endowment/Green Infrastructure Noise Pollution	**Cultural Heritage, Material Assets** Listed Buildings Historic Housing and Forest Sites	**Overall Assessment: Conflict Intensity (++/+/0/-/--)**
Insert Values for Individual Sites							
C) Overall Assessment – Land Use Efficiency + Land Use Quality: II. - IV. + B)							
Insert weighted values for individual sites							
2. Whole Plan Assessment with regard to impact on land as a resource:							
Transfer of total balance (see A)); calculation of quota exceedance if applicable							

allowing for:	
Withdrawal of designated sites (> Planning Applications; Planning Permissions)	
Site Demand for planning horizon (> Objectively Assessed Need OAN?)	
Brownfield/PDL Development Potential (gaps, derelict sites, underused sites); lump sum proportion considering difficulties in activating potential sites	
Total balance	
Recommendations and Alternatives, considering C)	
Mitigation Measures - Desealing - Brownfield Development Activities - Multifunctional Use - ...	

Leitfragen für Expertengespräche

1. Verständnis von Fläche, Novellierung der UVP-Richtlinie, Komponenten von Fläche als Umweltfaktor

1.1 Was sind/waren Ihrer Kenntnis/Einschätzung nach die Erwägungs-/Entscheidungsgründe für die Integration von Fläche als eigenständigen Faktor in die UVP-Richtlinie?

1.2 Besitzt Fläche als Umweltfaktor für Sie Relevanz

- eher für die SUP
- eher für die UVP
- für beide gleichermaßen?
- Warum/Warum nicht?

1.3 Wie würden Sie Fläche als Ressource/als Umweltfaktor definieren?

2. Status Quo: Thematisierung von Fläche in der SUP/Umweltprüfung in der Bauleitplanung

2.1 Wird Fläche Ihrer Kenntnis nach bereits im Rahmen der Umweltprüfung thematisiert?

2.2 Thematisierung von Fläche im SUP-Verfahren

- Auf welcher räumlichen Planungsebene wird Fläche thematisiert?
- In welchen Themenbereichen wird Fläche thematisiert?
- Ist Fläche Gegenstand der in der Beteiligung (Öffentlichkeit/TöB) geäußerten Belange?
- Im Rahmen welcher bestehenden Schutzgüter wird Fläche bisher thematisiert? Wie werden Wechselwirkungen aufbereitet?
- Welche Bewertungsmethoden werden dazu genutzt?
- Inwieweit fließt Fläche in die Gesamtbewertung/-abwägung ein?
- Inwiefern hat die Berücksichtigung von Fläche in Ihrem Kenntnisbereich bereits zu Planänderungen geführt?
- Inwiefern hat sich Ihrer Einschätzung nach das Bewusstsein für/der Umgang mit Fläche in den ca. 10 Jahren SUP-Praxis verändert?

2.3 Zielorientierung und Datengrundlagen:

- Welche Informationen/Datengrundlagen werden zur Prüfung von Fläche genutzt/stehen zur Verfügung?
- Welche Informationen/Datengrundlagen werden Ihres Erachtens benötigt/fehlen, um Fläche umfassend prüfen zu können?
- Wie schätzen Sie bestehende Ziele zur Reduzierung der Neuflächeninanspruchnahme/Stärkung der Innenentwicklung in ihrer Rolle für die Umweltprüfung ein?
- Inwieweit werden der Bewertung quantifizierte Referenzwerte (Kontingente) zugrunde gelegt? Wenn ja, wie kommen diese zustande?

2.4 Kennen Sie evtl. Beispiele guter Praxis für die Einbeziehung von Fläche in die SUP? Welche Faktoren waren hier ausschlaggebend für die gute Praxis?

2.5 Welche Aspekte von Fläche werden Ihrer Meinung nach bisher nicht/nicht ausreichend thematisiert? Warum nicht?

2.6 Welche Erfahrungen haben Sie im Umgang mit Bewertungsunsicherheiten in der Umweltprüfung?

- Worin bestehen Bewertungsunsicherheiten?
- In Bezug auf welche Wirkungsbeziehungen/Wechselwirkungen sind Bewertungsunsicherheiten besonders groß?

- Welche Bewertungsunsicherheiten bestehen im Hinblick auf Fläche?
- Wie geht es Ihnen damit, Bewertungsunsicherheiten offen und transparent darzulegen? Wird dies regelmäßig gemacht?
- Führt eine transparente Darlegung von Bewertungsunsicherheiten Ihrer Erfahrung nach zu einer besseren Bewertung/SUP?
- Inwieweit denken Sie, dass erfahrungsbasiert Verbesserungen/Routine im Umgang mit Bewertungsunsicherheiten erlangt werden?

3. Optionen: Zukünftiger Umgang mit Fläche als Umweltfaktor/Schutzgut in der Umweltprüfung

3.1 Kann die SUP/Umweltprüfung in der Bauleitplanung Ihrer Meinung nach zu einer frühzeitigen Folgenabschätzung in Bezug auf Fläche beitragen?
- Wenn ja: Warum?
- Wenn nein: Warum nicht?

3.2 Kann die SUP/Umweltprüfung in der Bauleitplanung zu einer stärkeren Rolle von Fläche in der Abwägung beitragen?
- Wenn ja: Warum?
- Wenn nein: Warum nicht? Was wäre ggf. erforderlich, damit dies resultieren kann?

3.3 Sollte Fläche geprüft werden als
- Separates Schutzgut
- Teilaspekt eines anderes Schutzguts
- Integrierendes (übergreifendes) Schutzgut
- Nicht explizit?

3.4 Welche Aspekte von Fläche sollten in die Prüfung einfließen?

3.5 Welche zentralen Hürden/Grenzen der Prüfung von Fläche als Umweltfaktor sind vorhanden? Welche Lösungsansätze sind denkbar?

4. Einschätzung und Bewertung einer möglichen Prüfsystematik

4.1 Ausgangsfrage: Inwieweit sollten quantitative Ziele zur Begrenzung der Flächeninanspruchnahme Maßstab der Umweltbewertung sein, und wie können diese in der SUP Berücksichtigung finden?

- Halten Sie eine Anwendung quantitativer Ziele in der SUP für grundsätzlich sinnvoll/machbar?
- Wenn ja, anhand welcher Kriterien sollte diese Operationalisierung für welche räumlichen Ebenen erfolgen?
- Welche weiteren Kriterien sollten ggf. in eine quantitative Betrachtung der Neuflächeninanspruchnahme einfließen:
  - Rücknahme ausgewiesener Flächen
  - Höhere Dichte/Flächeneffizienz durch Nutzungsänderung/Umwidmung nach BauNVO
  - Weitere?
- Sollten neben der Neuflächeninanspruchnahme (Indikator: Siedlungs- und Verkehrsfläche) weitere Indikatoren betrachtet werden?
- Wenn ja, welche?

- Siedlungsdichte?
- Fragmentierung?
- Weitere?

- **Welcher Datenbedarf würde sich aus einem solchen quantitativen Ansatz für die SUP ergeben?**

4.2 Ausgangsfrage: Inwieweit sollte die Bewertung des Umweltfaktors ‚Fläche' in der SUP in Abhängigkeit von der Art und Lage der vorhandenen Flächenpotenziale erfolgen?

- Wenn ja, welche Indikatoren sollten dazu herangezogen werden?
  - Bezug zu Raumstruktur, vorhandener Flächennutzung (z.B. Siedlungsentwicklung im ÖPNV-Einzugsbereich)?
  - Bezug zu Innenentwicklungs-Aktivitäten/Ansätzen Flächenmanagement (z.B. Brachflächenrecycling, Nachverdichtung)?
  - Weitere?

- **Welcher Datenbedarf würde sich daraus für die SUP ergeben?**

4.3 Ausgangsfrage: In welcher Form sollten Aspekte der Flächenbeschaffenheit in die Bewertung des Umweltfaktors Fläche in der SUP einfließen?

Bitte geben Sie eine Einschätzung zur Vollständigkeit, Nachvollziehbarkeit und Anwendbarkeit des nachfolgend vorgeschlagenen Prüfschemas ab:

see separate document

Jeweils durchzuführen für:
- Nullvariante (bestehende Planung)
- Planvariante
- Alternativen

Einzelflächenbewertung (Flächen FNP/Flächenkulissen RP) unter Anwendung folgender Ziele und Kriterien:					
A) Reduktionsziel; Nutzungseffizienzziel					
	Anteil der Neuflächeninanspruchnahme an quantitativem Kontingent - Siedlungs- und Verkehrsfläche (30 ha-Ziel) - Versiegelte Fläche	**Dichtewert und/oder Biotopflächenfaktor** differenziert nach Nutzungstypen	**Zunahme Fragmentierung** - Unzerschnittene verkehrsarme Räume - Effektive Maschenweite	**Raumkontext/ Lageparameter** - ÖPNV-Anbindung - Infrastruktur-Anbindung - ? *Modelle?*	**Gesamtbewertung** (++/+/0/-/--)
Fläche A					
Fläche B					
Fläche C					
...					
Gesamtbilanzierung pro Indikator					

B) Schutzziel: Konfliktbewertung (relevante Wirkfaktoren und Erheblichkeitsschwellen für einzelne Schutzgüter)								
	Boden Naturnähe von Böden, Filter- und Pufferfunktion Natürliches Ertragspotenzial/Produktionsfunktion Kulturhistorische Bedeutung, Archivfunktion Erosionsgefährdung Altablagerungen	**Wasser** Grundwasserneubildung Grundwasser-geschütztheit Grundwasserflurabstände /grundwassernahe Standorte Wasserschutzgebiete Ökologischer Zustand der Fließgewässer nach Wasserrahmenrichtlinie (WRRL) Über-schwemmungsbereiche	**Klima, Luft** Siedlungsflächen mit Bedeutung für den Kaltlufttransport Siedlungsflächen mit Bedeutung für den Frischlufttransport Flächen mit Bedeutung für die Kaltluftentstehung Überwärmungsbereiche (unterschiedliche Intensität) Luftschadstoffemissionen durch Gewerbe/Industrie und Kfz-Verkehr	**Landschaft** Landschaftsbild Erholungswert der Landschaft	**Flora/Fauna/ Biodiversität** Schutzgebiete Biotopverbundfunktion	**Mensch** Erholungsräume Lärmbelastung Schadstoffbelastung	**Kultur- und Sachgüter** Historische Siedlungsformen Historische Waldnutzungsformen Bodendenkmäler	**Gesamtbewertung: Anzahl der Konflikte/Raumwiderstand (++/+/0/-/--)**
Fläche A								
Fläche B								
Fläche C								
...								
Gesamtbilanzierung erheblicher Konflikte pro Schutzgut								

Jeweils durchzuführen für:
- Nullvariante (bestehende Planung)
- Planvariante
- Alternativen

Bewertung der Gesamtplanwirkungen nach Einzelflächenbewertung unter zusätzlicher Anwendung folgender Kriterien	
Gesamtbilanz Neuflächeninanspruchnahme (siehe oben)	
Rücknahme von bereits ausgewiesenen Flächen - **nach Nutzungstypen**	
Umwidmung von bereits ausgewiesenen Flächen nach BauNVO - **nach Nutzungstypen**	
Flächenbedarfsprognose für Planungshorizont (Fachgutachten?)	
Reserveflächen außen (Differenz tatsächliche Nutzung/ausgewiesene Flächen)	
Baulandpotenzial innen (Katasterdaten?), ggf. Pauschalanteil unter Einbeziehung von Schwierigkeiten bei Aktivierung von Innenentwicklungspotenzialen	
Bilanzierung - **Reduktion** - **Nutzungseffizienz** - **Schutz**	
Minderungsmaßnahmen - Entsiegelung - Innenentwicklungsaktivitäten - Multifunktionale Nutzung	

E-Mail Request Expert Interview (English)

Dear xx,

in the framework of my PhD project at HafenCity University Hamburg I deal with the question of strategic objectives and methodological challenges of environmental assessment procedures (mainly SEA), in particular with regard to land use as a factor to be addressed in the wake of the revised directive. My supervisor at HCU Hamburg is Prof. Wolfgang Dickhaut, my co-supervisor is Prof. Thomas B. Fischer at the University of Liverpool.

Based on an analysis of exemplary plans and assessment reports from the UK and Germany I have identified a selection of questions that I would be happy to discuss with EA experts. Especially due to your expertise with regard to the Sustainability Appraisal Process for xx I would therefore like to ask if you are interested in such an expert interview (ca. 1 hour).

Within the framework of my research stay at the University of Liverpool from 13th February to 31st March, date and time could be adapted to your availability, and I would be happy to send you my guiding questions in advance.

I would be grateful for a positive response.

With kind regards

Annegret Repp

E-Mail Request Expert Interview (German)

Sehr geehrte/r xx,

im Rahmen meines Promotionsvorhabens an der HafenCity Universität Hamburg beschäftige ich mich mit Zielsetzungen und Herausforderungen der Umweltprüfverfahren, dies insbesondere im Hinblick auf ressourceneffiziente Flächennutzung als Faktor in der Strategischen Umweltprüfung SUP. An der HCU Hamburg werde ich von Prof. Wolfgang Dickhaut betreut, mein Zweitbetreuer ist Prof. Thomas B. Fischer an der Universität Liverpool.

Auf Basis einer Auswertung exemplarischer Pläne und Prüfberichte anhand meiner beiden Fallstudien Leipzig und Liverpool habe ich nun eine Auswahl vertiefender Fragen zu inhaltlichen und methodischen Aspekten formuliert, die ich sehr gern durch Interviews/Fachgespräche mit beteiligten Experten genauer betrachten und diskutieren würde.

Insbesondere aufgrund Ihrer Erfahrungen im Bereich Umweltprüfungen in der Bauleitplanung möchte ich Sie daher fragen, ob Sie zu einem solchen etwa einstündigen Gespräch bereit wären. In der Terminwahl richte ich mich dabei gern nach Ihnen. Gern sende ich Ihnen meine Leitfragen für die Diskussion vorab auch schon einmal zu.

Über eine positive Rückmeldung würde ich mich sehr freuen.

Mit freundlichen Grüßen

Annegret Re

Municipal Quotas for land take as identified by UBA FORUM – exemplary extract

(source: e-mail communication Dr. Henger, IdW Köln, 25/11/2019)

Gemeinde	Einwohner	Postleitzahl	Zuteilung	Zuteilung	SuV
	31.12.2015		Zuteilung 30-Hektar-Ziel	Zuteilung 30-Hektar-Ziel	Vergangene Sieldungsentwicklung
			in ha	in Zertfikaten	vom 31.12.2011 bis 31.12.2015
					in ha/a
Leipzig, Stadt	560.472	04109	23,8	238	125,5
Bad Lausick, Stadt	8.090	04651	1,1	11	
Belgershain	3.339	04683	0,4	4	
Bennewitz	4.906	04828	0,6	6	
Böhlen, Stadt	6.770	04564	0,9	9	
Borna, Stadt	19.672	04552	2,6	26	
Borsdorf	8.252	04451	1,1	11	
Brandis, Stadt	9.426	04821	1,2	12	
Colditz, Stadt	8.752	04680	1,1	11	
Elstertrebnitz	1.283	04523	0,2	2	
Frohburg, Stadt	10.204	04654	1,3	13	
Geithain, Stadt	5.439	04643	0,7	7	
Grimma, Stadt	28.480	04668	3,7	37	
Groitzsch, Stadt	7.626	04539	1	10	
Großpösna	5.324	04463	0,7	7	
Kitzscher, Stadt	5.034	04567	0,7	7	
Kohren-Sahlis, Stadt	2.611	04655	0,3	3	
Lossatal	6.064	04808	0,8	8	0,0
Machern	6.663	04827	0,9	9	
Markkleeberg, Stadt	24.240	04416	3,2	32	
Markranstädt, Stadt	15.119	04420	2	20	
Narsdorf	1.659	04657	0,2	2	
Naunhof, Stadt	8.618	04683	1,1	11	
Neukieritzsch	6.879	04575	0,9	9	
Otterwisch	1.421	04668	0,2	2	
Parthenstein	3.459	04668	0,5	5	
Pegau, Stadt	6.251	04523	0,8	8	
Regis-Breitingen, Stadt	4.020	04565	0,5	5	
Rötha, Stadt	6.118	04571	0,8	8	
Thallwitz	3.563	04808	0,5	5	
Trebsen/Mulde, Stadt	3.854	04687	0,5	5	
Wurzen, Stadt	16.364	04808	2,1	21	
Zwenkau, Stadt	8.908	04442	1,2	12	
Arzberg	1.982	04886	0,3	3	
Bad Düben, Stadt	7.956	04849	1	10	
Beilrode	4.240	04886	0,6	6	
Belgern-Schildau, Stadt	7.889	04874	1	10	0,0
Cavertitz	2.260	04758	0,3	3	
Dahlen, Stadt	4.270	04774	0,6	6	
Delitzsch, Stadt	24.850	04509	3,3	33	

EIDESSTATTLICHE ERKLÄRUNG

Ich erkläre hiermit an Eides statt, dass ich die vorliegende Arbeit selbständig sowie ohne unzulässige Hilfe Dritter und ohne Benutzung anderer als der angegebenen Hilfsmittel angefertigt habe. Die von der Deutschen Forschungsgemeinschaft (DFG) festgelegten Standards guter wissenschaftlicher Praxis wurden eingehalten. Bei der Auswahl und Auswertung folgenden Materials haben mir die nachstehend aufgeführten Personen in der jeweils beschriebenen Weise entgeltlich/unentgeltlich geholfen:

1. Margot Zuckerman (Recherche im Rahmen eines DAAD RISE-Forschungspraktikums, Juni-August 2016)

2. Marie Haibt (Transkription von Interviewmaterial als Studentische Hilfskraft, September-November 2016)

3. Anda Bufi (Transkription von Interviewmaterial als Studentische Hilfskraft, Juni-September 2017)

Weitere Personen waren an der inhaltlich-materiellen Erstellung der vorliegenden Arbeit nicht beteiligt. Insbesondere habe ich hierfür nicht die entgeltliche Hilfe von Vermittlungs- bzw. Beratungsdiensten (Promotionsberater oder anderer Personen) in Anspruch genommen. Niemand hat von mir unmittelbar oder mittelbar geldwerte Leistungen für Arbeiten erhalten, die im Zusammenhang mit dem Inhalt der vorgelegten Dissertation stehen.

Die Arbeit wurde bisher weder im In- noch im Ausland in gleicher oder ähnlicher Form einer anderen Prüfungsbehörde vorgelegt.

Ich versichere an Eides statt, dass ich nach bestem Wissen die reine Wahrheit gesagt und nichts verschwiegen habe.

Vor Aufnahme der obigen Versicherung an Eides statt wurde ich über die Bedeutung der eides-stattlichen Versicherung und die strafrechtlichen Folgen einer unrichtigen oder unvollständigen eidesstattlichen Versicherung belehrt.

....

(Ort, Datum) (Unterschrift)

Unterschrift des die Versicherung an Eides statt aufnehmenden Beamten:

..... ……...

(Ort, Datum) (Unterschrift)