

Biodiversity Net Gain: Market analysis study

Final Report

Defra

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Disclaimer

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Summary

This is the final report for the Biodiversity Net Gain: Market Analysis Study Defra. The objective of this study was to model the expected size and dynamics of the terrestrial market for biodiversity units (BUs) and their prices in England. It aims to provide an understanding of how the market is likely to grow over time, and makes recommendations to inform policy development, including in relation to Government’s powers as a BU seller of last resort.

Table S1: Biodiversity Unit Market Factors

	Supply	Demand
Initial determinants:	<i>Available land</i>	<i>Rate of land development in each LPA</i>
	<i>Costs</i>	<i>Quality of habitats developed</i>
	<i>Expected price</i>	<i>Available skills and knowledge</i>
	<i>Skills and knowledge</i>	<i>Available resources</i>
	<i>Motivation to help biodiversity</i>	<i>Use of pre-market steps of mitigation hierarchy</i>
	<i>Resources to invest in generating supply</i>	<i>Financial decisions</i>
Responsiveness of Supply/ Demand will be higher when there is more:	<i>Contractual certainty</i>	
	<i>Market information</i>	
	<i>Presence of intermediaries</i>	
	<i>Presence of habitat banks</i>	<i>Change in the use of the mitigation hierarchy</i>
	<i>Supply in adjacent LPAs</i>	<i>Change in the use of the mitigation hierarchy</i>
Key policy and Market Failure Risks:	<i>Reduction of market entry costs</i>	
	<i>Government as last resort seller</i>	<i>Inconsistent on-/off-site enforcement</i>
	<i>Lack of human resource and skill</i> <i>Lack of clarity on stacking and bundling</i>	

Approach

Spatial and economic analysis was used to generate data allowing modelling of the expected BU market. The study has:

- Conducted a literature and evidence review into: (i) existing and potential biodiversity offset markets in the UK; (ii) biodiversity offset markets abroad; and (iii) other payments for ecosystem services markets globally. This has informed key issues relevant to future market design, and also identified the likely costs of actions to supply BUs.
- Used GIS analysis and modelling to estimate the potential supply and expected demand of BUs across the local planning authorities (LPAs) of England. This has:

- Identified the annual terrestrial footprint of development (using data kindly provided by Ordnance Survey) over the last two decades by LPAs, and used this to estimate loss of priority habitats and other habitats. From this, applying Biodiversity Metric¹ parameters and other assumptions (such as 50% of BNG being delivered through on-site actions) allows modelling of the expected potential demand for BUs;
- Identified land likely to be suitable for habitat management actions that can produce a supply of BUs; and
- Developed equivalent information for intertidal habitats² (drawing on a number of data, planning and compensation features) to add to this terrestrial analysis.
- Undertaken two rounds of interviews (35 in total). Round 1 engaged with experts on: (i) international biodiversity markets; (ii) local authority markets; and (iii) potential demand and supply for BUs in the UK. Round 2 engaged representative stakeholders from across the range of expected market participants in England including public, private and third sector, developers and land owners / managers.
- Conducted surveys of potential buyers and sellers of BUs through controlled Strutt and Parker distribution lists. Total clicks³ were relatively low as a proportion of the surveys' distribution (4% for sellers, and 6% for buyers), but full participation was high (45-50%) amongst those who clicked the link and read through the background information. This response rate is not unexpected for a newly developing area of policy, and indicates sufficient interest in the design and development of the market to offer meaningful feedback.
- Brought together this evidence to model the likely shape of the market in its first 10 years of operation (starting from the mandating of BNG 2 years after Assent of the Environment Act).

Market Modelling

The market analysis conducted in this study started by assessing where there is likely to be scarcity in BUs in LPAs across England. This initial snapshot identified LPAs at risk of BU scarcity based on the ratio between the estimated *total* potential supply and potential *annual* demand of BUs. A ratio of 100:1 (between *total* supply and *annual* demand of BUs) is used to define a likelihood of scarcity in the market. Given the comparison of annual and total data, this means that over 10 years there would need to be at least 10 times more total supply than annual demand in an LPA to meet expected demand. In reality only a proportion of supply is expected to enter the market.

There is little evidence on which to base this ratio directly, but there is some evidence to help understand the factors that influence it over different time periods. Some potential suppliers are already preparing units to be available in the first year of the market, so except for specific urban and coastal locations, immediate scarcity of supply is considered unlikely. In the medium term (years 5 to 10), a ratio of 100 would mean 10% of all potential supply would need to enter the market to meet demand. This is considered possible at price level of £20,000 per BU, which could stimulate

¹ [The Biodiversity Metric 2.0 - JP029 \(naturalengland.org.uk\)](https://naturalengland.org.uk)

² The scope of the analysis is the terrestrial area of England to the low water mark.

³ Those following the link to the survey starting page.

new entrants to the market to ensure a stream of supply of BU beyond the initial years of activity. A ratio of < 100 suggests a risk of scarcity of supply such that BU prices would be expected to rise.

To assess potential market size, we used an estimated national average price of £20,000 per BU – based on the expected costs of generating BUs presented in **Section 1** of the Evidence Annex, and a higher price of £25,000 per BU in LPAs with risk of scarcity. Assuming that 50% (based on the expert judgement of the project team and external stakeholders) or 100% of BUs are delivered off-site, this gives a total estimated size of the BNG market of around £135m - £274m per year⁴.

The analysis is based on an assumed 50% on-site delivery of BU to achieve BNG by developers. Based on this assumption, 58 LPAs are identified as having a risk of scarcity. However, a combination of more on-site delivery of BUs by developers and allowing trading with adjacent LPAs would alleviate this scarcity in the majority of the LPAs identified.

The remaining LPAs likely to have scarcity are predominantly highly urban areas. This scarcity may be over-estimated by our modelling approach (which underestimates development rates on brownfield sites). There is also a greater risk of supply scarcity for intertidal habitats. Strategic policy measures may be required in these urban and coastal locations - further policy research is recommended.

Further measures to ensure adequate supply include:

- Encouraging market supply, by providing information and building trust and certainty in the policy and regulatory processes governing the market;
- Encouraging habitat banking, which involves investment in supply ex-ante of demand, and helps smooth supply over time;
- Investing ex-ante in supply, for example by central Government taking a minority share in habitat banks;
- Brokering demand and supply, such as through a double-sided auction, and
- Giving demand guarantees (similar to the floor price given within the Woodland Carbon Code).

Many caveats and assumptions have been necessary to develop the market modelling. The research is carried out in a context of changing land markets and uncertainty on some policy details, which restricted the potential to gather detailed and accurate information from potential market stakeholders. As a result, confidence in the results is moderate – hence a range of data are given for some key outputs.

⁴ Calculated as the total demand in LPAs with expected surplus multiplied by £20,000 plus the total demand in LPAs with expected scarcity multiplied by £25,000. For 50% off-site delivery, this equals £135m (4,030BU * £20,000) + (2,193 * £25,000).

Further work is recommended to address key uncertainties. For example, building maps of past habitat distribution (and if possible their condition) would enable more accurate analysis of the distribution and trends in development impacts on biodiversity.

Policy Implications

Key observations for Government policy from the study include the following:

- BNG will be a compliance market created by regulation and its function will be strongly influenced by those regulations;
- Accurate use of the biodiversity metric is essential, and there is some evidence of inconsistency;
- Market design through the regulations is the key determinant of success of the policy – both for the effectiveness for biodiversity and efficiency of delivery;
- Policy risk is significant: the Government’s proposed role as a seller of last resort, could have a perverse incentive: deterring investment in supply, increasing the risk of supply shortages which it is designed to address;
- There are some clear needs for awareness raising to address knowledge gaps amongst stakeholders and an overall need to invest in institutional capacity; and
- The expected market activity is dependent on the level of on-site BNG delivered by developers – therefore consistent standards, monitoring and enforcement of on-site as well as off-site generation of BUs is important for market confidence as much as for securing BNG.

Box S1: Summary of recommendations

1. Increase understanding of the BNG market
 - Clearly communicate that trading of BUs will be in a BNG compliance market.
2. Ensure clear and effective regulation of the BNG market
 - Build trust in the policy process and how it will be implemented.
 - Regulate on-site and off-site delivery of BUs consistently.
 - Establish national registry of BU transactions (including on-site and off-site units) as soon as possible.
 - Sufficient capacity at the local scale to enable effective regulation of planning applications/developments and their BU transactions by LPAs.
 - An independent national body with responsibility for oversight of BNG market outcomes.
 - Provide guidance:
 - On stacking and bundling of BUs and other Payments for Ecosystem Services.
 - For specific contexts such as highly urban areas or the two island LPAs.

3. Avoid policy failures

- Have a single government strategy coordinating the actions of relevant ministries (including Defra, DfT, MHCLG, and HMT), with adequate resources.
- Require high standards of public activity (i.e. applying the Nolan Principles) throughout the market.

4. Minimise Government's role as the seller of last resort

- The proposed seller of last resort powers present a major policy risk and could generate perverse outcome of making supply shortages worse. They should be dropped, or limited in scope and have a sunset clause.
- Use alternative interventions to stimulate supply, ideally ones that give Government incentives to regulate the market effectively.

5. Demand-side interventions

- Promote good mitigation hierarchy practice
- Extend the BNG requirement to Infrastructure Projects, possibly with some flexibility to enable strategic planning and delivery of BNG.
- Existing coastal compensation activities and constraints mean strategic partnership approaches may be more efficient to develop supply for intertidal habitats.

6. Invest in institutional capacity, training and transparency

- Quantify the LPA staff time, training and information needed for the BU market to function.
- Provide training in LPAs and other market stakeholders collectively.
- Ensure sufficient LPA capacity – such as ecologists – to allow the market to function.
- Train the public sector to identify public land for use for BU supply.
- Provide sufficient independent capacity for oversight of the market – both at a transaction level, and a national BNG outcome level.
- Commit to a review of the regulatory framework, responsibility and skills by the National Audit Office within the first two years of market operation.
- Create incentives for LPAs to prepare for the market.

7. Research the strategic policy need for urban areas and coastal habitats

- Strategic policy measures may be required to overcome restrictions on market activity.
- For intertidal habitat, this should complement existing compensation under the habitats regulations, and develop habitat banking.

8. Explore further spatial analysis

- Producing further detailed GIS modelling of the impacts of development on biodiversity would increase confidence in the expected market.

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Glossary & Terminology

The term biodiversity ‘units’ (BUs) is used to mean the measure of biodiversity impact calculated by using the Biodiversity Metric tool⁵. The term ‘credit’ is also used by many stakeholders to mean either BUs generally, or specifically for BUs created in advance of sale and banked (known as habitat banking). This meaning of the term ‘credit’ has longstanding use in literature and policy analysis, and therefore re-defining them for the purposes of English policy is likely to cause confusion. The following provides a glossary of key BNG markets terms used in this report.

Appropriate Assessment	An assessment required by the Habitats Directive where a project (or plan) would be likely to have a significant effect on a European site, either alone or in combination with other plans or projects (part of the Habitats Regulations Assessment process in the UK and the Appropriate Assessment process in Ireland).
Area habitats	Habitats that are given an area value in the SSM1. This includes grasslands, woodlands, ponds, wetlands and heathlands.
Assemblage	A group of species found in the same location.
Avoidance	Prevention of impacts occurring, having regard to predictions about potentially negative environmental effects (e.g. project decisions about site location or design).
Baseline conditions	The conditions that would pertain in the absence of the proposed project at the time that the project would be constructed / operated / decommissioned. The definition of these baseline conditions should be informed by changes arising from other causes (e.g. other consented developments).
Biodiversity	The variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems.
Biodiversity net gain	A specific, measurable outcome of a development that deliver demonstrable and quantifiable benefits to biodiversity compared to the baseline situation.
Biodiversity offsets	Measurable conservation outcomes resulting from actions designed to compensate for unavoidable significant negative effects on biodiversity. The goal of biodiversity offsets is to achieve no net loss, or preferably a net gain, of biodiversity.
Biodiversity unit	A proxy measure of the value of an area of biodiversity based on various aspects of habitats, including the type, size, condition and location.
Compensation	Measures taken to offset the loss of, or permanent damage to, ecological features despite mitigation. Compensation addresses negative effects which are residual, after avoidance and mitigation have been considered. It is this objective of compensation, and not its location, that distinguishes compensation from ‘mitigation’. Depending on circumstances, compensation measures may be located within or outside the project site.
Condition	A score based on the quality of the habitat. This is determined by condition criteria set out in the technical supplement for Biodiversity metric 2.0. For the SSM1 the starting condition is set at medium or low (depending on the habitat). The condition score ranges from 1 to 3, with 1 denoting poor condition and 3 denoting good condition.
Connectivity	A measure of the functional availability of the habitats needed for a particular species to move through a given area. Examples include the flight lines used by bats to travel between roosts and foraging areas or the corridors of appropriate habitat needed by some slow colonising species if they are to spread.
Conservation covenants	Private, voluntary agreements between a landowner and a responsible body, such as a conservation charity or public body, allowing for positive or restrictive obligations to fulfil a conservation objective. They are capable of being binding not only the landowner, but also subsequent landowners, so have the potential to deliver lasting conservation benefits for the public

⁵ [The Biodiversity Metric 2.0 - JP029 \(naturalengland.org.uk\)](https://naturalengland.org.uk)

	good. Covenants offer flexibility as the parties negotiate the terms to suit their particular circumstances, including the covenant duration.
Creation	The act of planting and managing a habitat from on an area of land where there is no evidence of that habitat being present.
Cumulative impact / effect	Additional changes caused by a proposed development in conjunction with other developments or the combined effect of a set of developments taken together.
Distinctiveness	A score based on the type of habitat present. This ranges from 2 to 8 within the Biodiversity Metric 2.0 and 2 to 4 within the SSM1. For example, modified /amenity grassland is given a score of 2.
Ecosystem services.	Ecosystem services are the benefits that people derive from the natural environment. The natural environment can be considered as a stock of 'natural capital' from which many benefits flow – social, health-related, cultural or economic.
Enhancement	Simple definition: The act of managing a habitat so that the existing habitat is made better for biodiversity. In detail: Improved management of ecological features or provision of new ecological features, resulting in a net benefit to biodiversity, which is unrelated to a negative impact or is 'over and above' that required to mitigate/compensate for an impact.
Favourable condition	Satisfactory condition of an ecological feature. In some cases, favourable condition is specifically defined (e.g. for some designated sites).
Fragmentation	The breaking up of a habitat, ecosystem or land-use type into smaller parcels with a consequent impairment of ecological function.
Habitat	The place or type of site where an organism or population naturally occurs. Often used in the wider sense referring to major assemblages of plants and animals found together.
Habitat Banking	A market mechanism where credits from actions with beneficial biodiversity outcomes can be purchased to offset the debit from environmental damage. Credits can be produced in advance of, and without ex-ante links to, the debits they compensate for, and stored over time.
Habitats Regulations Assessment	An assessment of projects (or plans) potentially affecting European sites in the UK, required under the Habitats Directive and Regulations.
Linear habitats	Habitats that are given a length value in the SSM1. These include hedgerows and lines of trees.
Irreplaceable habitat	Habitats which would be technically very difficult (or take a very significant time) to restore, recreate or replace once destroyed, taking into account their age, uniqueness, species diversity or rarity. They include ancient woodland and veteran trees, blanket bog, limestone pavement, sand dunes, salt marsh and lowland fen.
Mitigation	Measures taken to avoid or reduce negative impacts and effects.
Mitigation hierarchy	A hierarchy of actions to mitigate negative impacts on biodiversity: avoidance of biodiversity loss in development plans, minimisation in project design, on-site mitigation, and off-site compensation.
No net loss	The outcome resulting from losses being offset by gains.
Priority habitats and species	Species and Habitats of Principal Importance included in the England Biodiversity List published by the Secretary of State under section 41 of the Natural Environment and Rural Communities Act 2006.
Project	In these guidelines 'project' is used to refer to all types of proposals to which EclA might be applied (e.g. development proposal/scheme or other land use change).
Restoration	The re-establishment of a damaged or degraded system or habitat to a close approximation of its pre-degraded condition.
River habitats	River or stream habitats that are given a length value in the SSM1. These include any habitat with flowing water.
Site of Special Scientific Interest	(SSSI): Sites designated by Natural England under the Wildlife and Countryside Act 1981.

Strategic significance	A score based on whether the location of the development has been identified locally as significant for nature. This is given a score of 1 for sites that are not identified as significant and 1.15 for those that are.
Target condition	The condition of the habitat that will be delivered as a result of the post development habitat management.

1. Introduction

This is the final report for the Biodiversity Net Gain: Market Analysis Study.

1.1 Context and purpose

The Environment Bill, currently before Parliament, will legislate for mandatory net gains for biodiversity as a planning condition of most new development consented by LPAs. To achieve this, where they cannot deliver biodiversity gains themselves, either on-site or off-site, developers will be able to purchase biodiversity units (BU) from 3rd parties on land unaffected by the development.

Biodiversity net gain⁶ (BNG) is a major step in pursuing environmental net gain to deliver the 25 Year Environment Plan objective to improve the environment for the next generation. Mandating BNG will lead to two changes. Firstly, mandating BNG through purchasing BUs will incentivise actions at the preceding steps in the mitigation hierarchy - avoidance of biodiversity loss in development plans, minimisation in project design and on-site mitigation. Secondly, it will enable BNG to be achieved through the purchase of biodiversity units generated by off-site actions (credits). This will create a new regulated environmental market.

1.2 Biodiversity net gain

Biodiversity Net Gain is the end result of a process applied to development so that overall, there is a positive outcome for biodiversity. This process follows the mitigation hierarchy, which sets out that everything possible must be done to firstly avoid, secondly minimise and thirdly restore / rehabilitate losses of biodiversity on-site. Only as a last resort, residual losses are compensated for off-site, contributing towards local and national policies and strategies for conserving and enhancing biodiversity.

1.2.1 Biodiversity net gain policy

The 2019 National Planning Policy Framework⁷ makes clear the expectations for development to achieve biodiversity net gain in England. This sets out that:

'Planning policies and decisions should contribute to and enhance the natural and local environment by: minimising impacts on and providing net gains for biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures' (paragraph 170)

'To protect and enhance biodiversity and geodiversity, plans should: promote the conservation, restoration and enhancement of priority habitats, ecological networks and the protection and recovery of priority species; and identify and pursue opportunities for securing measurable net gains for biodiversity.' (paragraph 174) and

'When determining planning applications, local planning authorities should apply the following principles: development whose primary objective is to conserve or enhance biodiversity should be supported; while opportunities to incorporate biodiversity improvements in and around developments should be encouraged, especially where this can secure measurable net gains for

⁶ The current policy proposal is for net gain of 10%.

⁷ Ministry of Housing, Communities and Local Government (2019). National Planning Policy Framework. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/779764/NPPF_Feb_2019_web.pdf

biodiversity.’ (paragraph 175)

Government has set out plans to strengthen this requirement through the forthcoming Environment Bill⁸ which will make biodiversity net gain a condition of planning permission, though this requirement is expected to exclude nationally significant infrastructure.

Several stakeholders interviewed for this project expressed concerns with respect to uncertainties in the policy proposals, and commented that BNG would not be a ‘true market’. This is correct in that it is a compliance market being *created by regulation* and its performance will be dependent on the detail of those regulations. The distinction between compliance markets and open markets is not understood by important stakeholders, and therefore is worth communicating clearly:

- Open markets are ones in which buyers and sellers participate freely, and can choose not to participate.
- In the BU market, buyers are compelled to achieve BNG, and therefore must use preceding steps of the mitigation hierarchy or purchase of BUs.
- In the BU market, sellers are free to enter the market or not, as they choose.

A simplified outline of the BNG compliance market, including current expectation about how it would operate, is shown in **Figure 1.1**.

The Environment Bill (Bill 220 2019-21 as amended in Public Bill Committee) makes provision for biodiversity gain to be a condition of planning permission in England (under the Town and Country Planning Act 1990). This will require a 10% net gain, measured in biodiversity units calculated using the biodiversity metric to be produced and published by the Secretary of State.

Alongside the requirement for development to deliver biodiversity gain the Bill will set up a ‘Biodiversity gain site register’. This register will be accessible to the public and hold information on the location of the site, the works to be carried out, the habitat before the gains are delivered, the person responsible for delivering the gains and the biodiversity value of the enhancement. It is understood that this register will hold information on sites assigned for ‘off site’ habitat creation or enhancement, and not actions taken on the development site.

⁸ Defra (2019c). *Environment Bill 2019*. Available: <https://publications.parliament.uk/pa/bills/cbill/2019-2019/0003/20003.pdf>

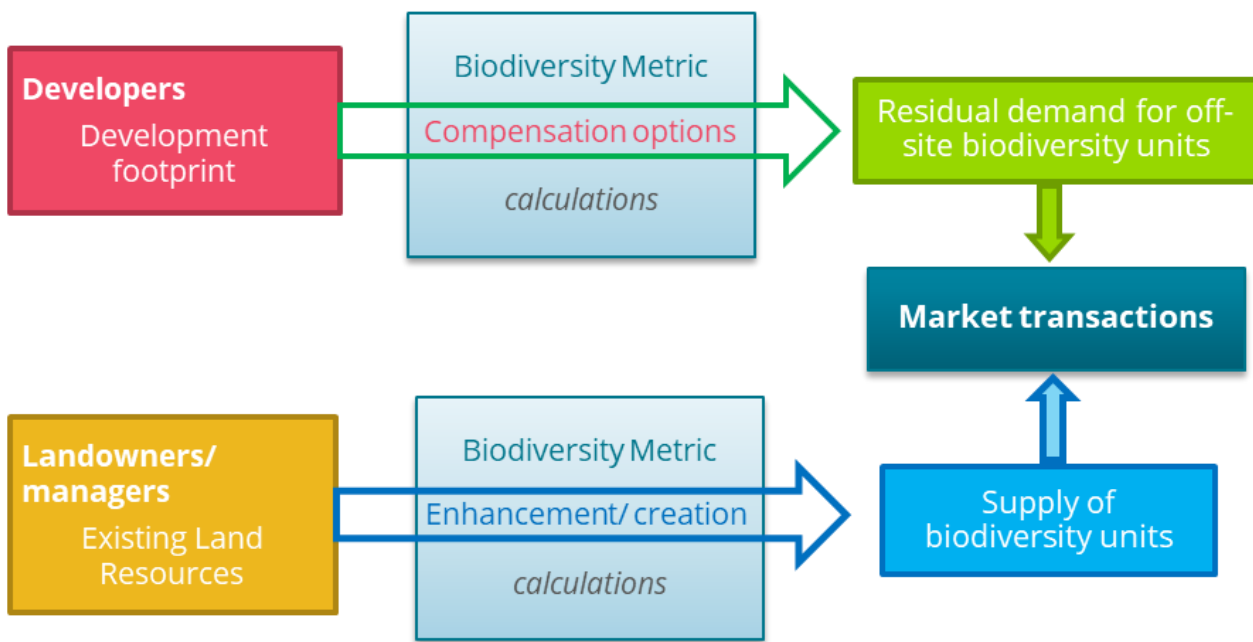


Figure 1.1: Simplified diagram of BNG market process

1.2.2 Measuring biodiversity net gain

This Biodiversity Metric 2.0 developed by Defra and Natural England is the standard method in England for measuring biodiversity change from development in order to demonstrate that the requirement biodiversity net gain has been met. The analysis in this study uses information from the December 2019 version of the Biodiversity Metric (BM2.0) toolkit, such as ratios, assumptions, and habitat classifications. These assumptions are described, but the data used are not listed in detail. The metric is designed to quantify biodiversity to inform and improve planning, design and decision-making. It can support planning applications to calculate the direct losses and gains in biodiversity from development.

The Biodiversity metric 2.0 uses habitat as a proxy to describe biodiversity. These habitats are converted into measurable 'biodiversity units' (BUs). These biodiversity units are the 'currency' of the metric.

Biodiversity units are calculated using the size of a parcel of habitat and its quality. The metric uses habitat area as its core measurement, except for linear habitats where habitat length is used. To assess the quality of a habitat the metric scores habitats of different types, such as woodland or grassland, according to their relative biodiversity value. Habitats that are scarce or declining typically score highly relative to habitats that are more common and widespread. The metric also takes account of the condition of a habitat.

Where new habitat is created, or existing habitat is enhanced, the difficulty and associated risks of doing so are taken into account by the metric. To measure the biodiversity value of habitats it is first necessary to define the site boundaries and then divide it into appropriate parcels, as needed. Parcels are simply distinct portions of each habitat type present. The habitat type and size of these parcels, and the condition of the habitat they contain, should then be recorded. The metric uses standard methodologies for categorising habitats so this can be done alongside routine ecological surveying. The biodiversity unit value of each

habitat parcel is then calculated. To determine the unit value of a habitat parcel its 'quality' is assessed from the following components:

- Distinctiveness - A score based on the type of habitat present. This ranges from 2 to 8 within the Biodiversity Metric 2.0. For example, modified /amenity grassland is given a score of 2.
- Condition - A score based on the quality of the habitat. This is determined by condition criteria set out in the technical supplement for Biodiversity metric 2.0. The condition score ranges from 1 to 3, with 1 denoting poor condition and 3 denoting good condition.
- Strategic Significance - A score based on whether the location of the development has been identified locally as significant for nature. This is given a score of 1 for sites that are not identified as significant and 1.15 for those that are

The metric operates by applying a score to each of these elements. It then multiplies the size of each habitat parcel using with each of these 'quality' scores to produce a number that represents the biodiversity unit value of each habitat. The initial calculation represents the 'baseline' or 'pre-intervention' value in biodiversity units.

The calculation is then repeated for the post-development scenario. This calculation should include any measures to retain existing habitats and create or enhance habitats to generate additional biodiversity units. This gives the user a post-development biodiversity unit score. At this point, because the metric is measuring predicted changes rather than existing habitats, additional factors to account for the risk associated with creating, restoring or enhancing habitats are also considered. As with the baseline, to get the post development biodiversity unit figure, the area or length and 'quality scores' are multiplied together along with the associated risk factor values:

- Difficulty of creating or enhancing a habitat - A standard score based on how difficult the habitat type is to create. This starts at a score of 1 for habitats that are easy to create and decreases to 0.1 for habitats that are very difficult to create.
- Temporal risk - A standard score based on how long the habitat type takes to establish. This ranges from 0.965 for habitats that are quick to create to 0.32 for habitats that take a long time to create.
- Spatial risk - A standard score based on how close the impact is to the area of offset. Within the same local planning authority (LPA) or national character area (NCA) gets a score of 1 (no risk); in the neighbouring LPA or NCA gains a score of 0.75 and outside this area gains a score of 0.5.

The predicted value of the habitats in biodiversity units 'post-development' is then deducted from the 'baseline' pre-intervention unit score to give a net change unit value. For 10% biodiversity net gain, the biodiversity units 'post-development' need to be 10% higher than the 'baseline' pre-intervention biodiversity units.

1.3 Objectives of the study

The objective of this study is to model the expected size and dynamics of the market for BUs and the likely prices of BUs for different habitats in different parts of England. It aims to inform policy development with an understanding of how the market is likely to grow over time, and how Government can best use its powers as a BU seller of last resort. Modelling, consultations with experts and stakeholders, a survey and case studies are used to investigate these issues.

This report provides information on the following aspects of the BNG market to inform policy refinement and delivery:

- The availability of suitable land for supply of BUs in different parts of the country;
- The costs of generating BUs (covering habitat creation and management, opportunity costs, and transaction costs), as most sellers will not be expected to sell for less than their costs. Transaction costs will include monitoring and reporting on the sites and the cost of the oversight role that the Local Planning Authority (LPA) or local record centres might take;
- The expected demand for BUs, which is a product of the rate of land use development on different habitats, taking into account links between habitats;
- Substitutes for market purchases of BUs, in particular actions that can be taken in preceding stages of the mitigation hierarchy, and possibly also uses of land banks held by developers;
- Other factors which could potentially influence prices, such as where scarcity (demand exceeding supply) is expected, and how different risks (e.g. of generating BUs, of public acceptance) are managed; and
- How Government should utilise its proposed powers as a seller of last resort, and other policy implementation observations to help establish a liquid market.

1.4 Structure of report

The remainder of this report is structured as follows:

- **Section 2** details the methodology followed in this study;
- **Section 3** summarises the evidence and literature review;
- **Section 4** presents the findings of the project so far;
- **Section 5** summarises the case studies being considered; and
- **Section 6** provides initial conclusions and lists issues for further research.

2. Methodology

This section details the methodology followed during the study in terms of background research into the biodiversity market (**Annex Section 1**) and the spatial and economic analysis (**Annex Section 3**). The research aimed to gather evidence on the range of factors that will determine supply and demand, price responses and the market equilibrium in the BNG market. These factors are summarised in Table 2.1

Table 2.1: BNG Market Factors

	Supply	Demand
Initial determinants:	<i>Available land</i>	<i>Rate of land development in each LPA</i>
	<i>Costs</i>	<i>Quality of habitats developed</i>
	<i>Expected price</i>	<i>Available skills and knowledge</i>
	<i>Skills and knowledge</i>	<i>Available resources</i>
	<i>Motivation to help biodiversity</i>	<i>Use of pre-market steps of mitigation hierarchy</i>
	<i>Resources to invest in generating supply</i>	<i>Financial decisions</i>
	<i>Contractual certainty</i>	
Responsiveness of Supply/ Demand will be higher when there is more:	<i>Market information</i>	
	<i>Presence of intermediaries</i>	
	<i>Presence of habitat banks</i>	<i>Change in the use of the mitigation hierarchy</i>
	<i>Supply in adjacent LPAs</i>	
<i>Reduction of market entry costs</i>		

The factors in **Table 2.1** are listed in **Appendix E**, which gives details of the evidence sources used to research them, their expected relationship with the BNG market and the degree of influence Government has over them.

2.1 Research activities

This section summarises the research processes used: the literature and evidence review in **Section 2.1.1**, the expert interviews in **Section 2.1.2** and the online supplier and buyer surveys in **Section 2.1.3**. Each type of research is conducted to understand the factors in **Table 2.1**, and thereby understand the size and design of the BNG market described in **Section 1**.

2.1.1 Literature and evidence review

The literature and evidence review did not exclude any of the range of market factors shown in **Table 2.1**. However, the available evidence inevitably covers some factors less well than others. As expected, published evidence is limited on some factors, such as available land and rates of development. These were therefore the focus for spatial modelling (**see Section 2.2**).

The review has been coordinated through an evidence database and review template, highlighting the most relevant sources to review. This database has been compiled and kept up to date by the project team and shared with Defra. This includes lessons learnt from: (i) biodiversity offset markets in the UK; (ii) biodiversity offset markets abroad; and (iii) other payments for ecosystem services markets.

Evidence has been researched in the following areas to provide detailed inputs to the modelling and analysis in the study:

- Activity in existing biodiversity markets established by local planning authorities in England;
- Evidence of biodiversity unit supply-side activity;
- Estimates of the costs of habitat creation/ enhancement actions, in order to estimate the costs of supplying BUs;
- Estimates of the costs of supplying BUs;
- Global biodiversity offsets experience, particularly around market development;
- Global Payments for Ecosystem Services (PES)⁹ experience on key issues (e.g. market structure, evolution over time), and
- Marginal costs of additional actions in the mitigation hierarchy to reduce demand for biodiversity units.

2.1.2 Expert Interviews

The interviews were developed to gain insights into a range of market factors shown in **Table 2.1**, in particular some harder to measure elements such as skills and knowledge, current activities and behaviours, and current activities. The interviews were managed through a contact database, developed using the project team and expert panel's widespread contacts amongst interested stakeholders, inputs from Defra, and contacts identified during the evidence review. The database has been structured in order to ensure a wide range of inputs are gathered through the interviews, covering:

- Actors in BNG market transactions: purchasers, suppliers, brokers, contractors, regulators, and those with market knowledge;
- Sector subdivisions, such as public sector (Central and Local Government and advisory bodies), infrastructure, housing, land-owners or managers, credit brokers or regulators and biodiversity interests;
- Business size; and
- Location (English regions, and rural or peri-urban interests).

The key purpose of the interviews has been to provide insight into the size and function of the BU market to inform:

⁹ Payments offered to land managers to manage their land in a way that delivers ecosystem services. PES may be offered by private sector (e.g. water companies) and/or public sector buyers (e.g. agri-environment schemes to procure environmental public goods).

- The potential supply of BUs in England – how this would vary across England and the costs involved in generating BUs;
- The potential demand for BUs in England, in particular how this would vary across England and time;
- How Government should utilise its proposed powers as a seller of last resort, and other policy implementation observations to help establish a liquid market; and
- The development of the mechanism to dispose of government biodiversity credit liability.

This insight aims to help understand how regulation of the market (e.g. standards and enforcement for the generation of units on-site and off-site) might influence demand and outcomes. A full list of questions is provided in **Appendix A**. Findings have informed data analysis described in **Annex Section 2** and led to refinement of the economic model.

First round

The first round of interviews covered 12 experts with existing knowledge and understanding of BNG markets. This included experts on (i) international biodiversity markets; (ii) local authority markets; (iii) demand; and (iv) supply.

Second round

The second round of interviews involved a wider range of stakeholders (23 in total), with experience of specific factors related to the market (e.g. views on opportunity costs associated with changing long term land uses), with fewer having an overview or expectations of the full working of BNG/ environmental markets. This round included interviews with the following types of organisations:

- Public and third sector bodies supplying, brokering or advising on units such as wildlife trusts and Natural England;
- Developers, such as housebuilders, water companies and the transport sector;
- Professional service organisations such as environmental consultancies, financial services and law firms specialising in BNG;
- Public sector bodies framing the BNG system, such as combined authorities and county councils, and
- Private Landowners and managers, including the agricultural sector.

It should be noted that the remaining lack of clarity on the law and policy under development restricts respondents' ability to give accurate inputs to the study. It could create incentives for strategic responses to influence policy development.

2.1.3 *Online surveys*

Following the in-depth interviews, targeted versions of the questionnaire were distributed to both potential suppliers (e.g. small land owners/ managers) and buyers (e.g. developers) in the market. The full list of questions included in the two surveys are presented in **Appendices B and C** along with a summary of

responses for each. The surveys helped to quantify some of the factors in **Table 2.1**, such as rates of market participation and potential reactions to market prices for BUs.

On the supply side, the survey was tailored to ensure it was suitable for all sizes of land managers and farms (including smaller land managers and farmers from whom it is harder to get responses) to examine their motivations and barriers for entering the BU market as well as the types of habitats they could provide and responses to price changes.

On the demand side, the survey targeted developers and asked about their considerations for utilising the steps in the mitigation hierarchy before purchases of BUs (which is important to assess the price-elasticity of demand over time); the habitats that their development would be likely to affect; and expectations for the potential demand of BUs over time.

In both surveys, respondents were also asked about their expectation of the Government's role in supporting the market for BUs as well as alternative policies to address biodiversity loss and restoration through the planning system.

The survey was conducted through SmartSurvey¹⁰ from mid to late November 2020. The survey distribution and response rates were:

1. **Suppliers:** The survey was sent to 8,349 contacts from Strutt & Parker's rural contact database of including land managers and advisers¹¹. There were follow up communications to individual contacts on this list from each of Strutt and Parker's rural offices (around 20 in England). 304 (4%) contacts clicked the survey link, 139 (47% of those who clicked or 2% of total) of whom were eligible to answer the survey and chose to continue after reading the background information. To be eligible, the respondent (or their organisation) had to operate in England and consider themselves to be a potential seller of BUs (Questions 1 and 2 of the survey – see **Appendix B**).
2. **Buyers:** The survey was sent to 1,190 individuals, 67 (6%) of whom clicked the link, of whom 34 (51% of those who clicked or 3% of total) were eligible to answer the survey and chose to continue after reading the background information. To be eligible, the respondent (or their organisation) must operate in England and consider themselves to be a potential buyer of BUs (Questions 1 and 2 of the survey – see **Appendix C**).

The known size of the distribution lists allowed for response rates (which are informative of potential engagement in the BNG market) to be measured. It also enabled data to be gathered from a wide range of individuals, particularly by including potential suppliers such as smaller land managers, who may lack representation within membership bodies. The representativeness of the survey sample is discussed in **Sections 2.1.1** and **2.2.1** in the **Evidence Annex**.

¹⁰ Which complies with the provisions of the Data Protection Act 2018 and General Data Protection Regulation (GDPR).

¹¹ Contacts based in Scotland and Wales will be excluded.

2.1.4 Case studies

Four case studies were developed to test modelling assumptions and outputs, and these are presented throughout the report. They have been chosen to illustrate a range of issues and specific market features, such as supply and demand responses that determine price elasticity. The four case studies are summarised in **Table 2.2** below.

Table 2.2: Case studies

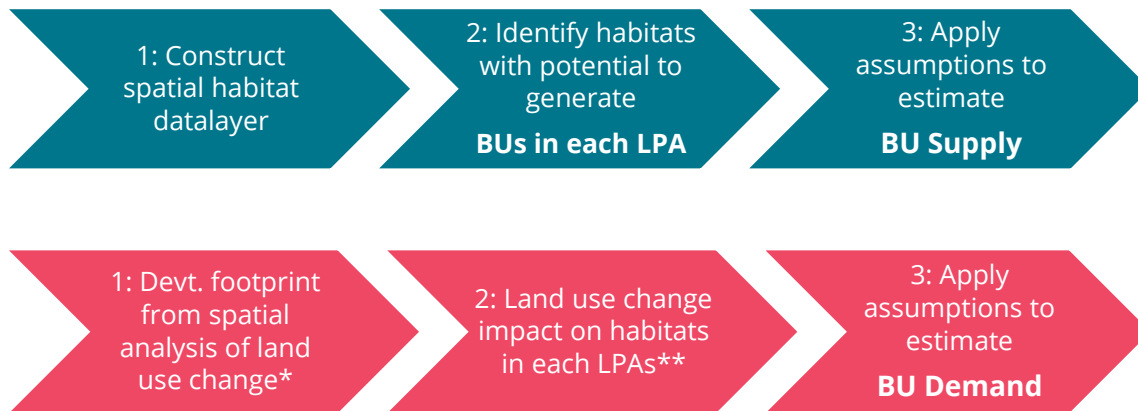
Issues illustrated	Case	Location in report
Development of market over time, including public sector as a seller in initial market.	Warwickshire	Section 1.1.3 of the Evidence Annex
Coastal habitat issues	Humber	Section 3.9
Brownfield development	Urban land use	Section 3.8
Trading across adjacent LPA boundaries	Exeter	Section 3.1.3 – Box 3.1 of the Evidence Annex

2.2 Spatial analysis methodology and assumptions

To understand the BU market, the study has identified and modelled several of the factors in **Table 2.1** that are likely to influence the potential demand, the supply and the equilibrium outcome. This has been through a combination of GIS and economic analysis using ArcGIS and MS Excel. Throughout the analysis, the December 2019 version of the Biodiversity Metric (BM2.0) toolkit, along with the associated default values and trading rules, were used to calculate baseline biodiversity units (BU). This metric will be updated and replaced by The Biodiversity Metric 3.0 (BM3.0) in the spring of 2021. This updated version is expected to constitute the Secretary of State's metric that will form part of the mandatory biodiversity net gain (BNG) requirement set out in the Environment Bill. The changes expected in BM3.0 will result in different outcomes from those calculated in this study using the BM2.0, but the model has been designed to allow the user to update it in line with the new metric.

The potential demand and supply for BUs have been quantified through spatial GIS analysis of habitats impacted by development, and those where there is potential to generate BUs. The processes involved are summarised in **Figure 2.1**, and the key steps and assumptions made are described in the Sections below.

The analysis is run at the LPA level (based on districts, boroughs and unitary authorities – see **Appendix D**) and generates data for the 12 broad habitat categories in the BM2.0 calculation tool (Coastal lagoons, Lakes, Coastal saltmarsh, Rocky shore, Cropland, Sparsely vegetated land, Grassland, Urban, Heathland and shrub, Wetland, Intertidal sediment, Woodland and forest). Note that linear features (such as hedges and rivers) were excluded.



* Based on Ordnance Survey data between 2000 and 2019 and the Marine Management Organisation Marine Licence applications data between 2011 and 2020.

** Impacts assumed pro-rata by areas to widespread habitats, after overlaps with the 2014 Priority Habitat Inventory calculated.

Figure 2.1: Spatial Modelling Processes to Estimate BU Supply and Demand

2.2.1 Spatial modelling

Current habitat extent - terrestrial

The following datasets and nested hierarchy were used to generate a baseline terrestrial biodiversity dataset:

- Sites excluded from requirements to deliver Biodiversity Net Gain (especially where impacts should be avoided);
 - Natural England Sites of Special Scientific Interest (SSSI) data;
 - Natural England Ancient Woodland Inventory (AWI) data;
- Natural England Priority Habitats Inventory data;
- National Forest Inventory data
- CORINE (excluding rivers, marine and intertidal habitats)

Separately, EMODNET fine scale data was used to identify the current extent of coastal habitats (coastal saltmarsh, rocky shore and intertidal sediment). Statutory designated sites were then also excluded, and the data combined with the above terrestrial dataset within the MS Excel model. Please see the Intertidal Habitat Calculations for more information.

Current habitat extent - intertidal

The current extent of each of the broad habitat (BH) types (coastal saltmarsh, rocky shore and intertidal sediment) has been approximated based on EMODNET fine scale data. It should be recognised that the EMODNET fine scale datalayer is a combination of survey and predictive data. This results in a high degree of uncertainty in the mapped habitat extents and as such these should only be viewed as an indication of the extent of the BH types per LPA. A comparison was made, for example, between the extent of saltmarsh

within the EMODNET fine scale datalayer and the Environment Agency saltmarsh layer. Large differences in saltmarsh extent per LPA were apparent between the datasets. Despite these differences the EMODNET data was used within the analysis as it also provides indicative intertidal sediment and rocky shore extents in a consistent format. The extent of coastal lagoon has been based on the JNCC and Coastal Physiographic Features - Coastal Lagoons datalayer.

The seaward limit of the LPA boundary file was compared with the OS MLW datalayer. Overall, there was general alignment between these data sources and as such the LPA boundary file was considered to include a sufficient representation of the intertidal zone.

Areas of the intertidal zone that are already subject to international and national environmental designation (SPA, SAC, Ramsar, SSSI and MCZ) were removed from the analysis. The remaining intertidal EMODNET and coastal lagoon data was intersected with the LPA boundaries to determine the extent of each of the non-designated BHs per LPA.

Note that the EMODNET data is comprised of a series of polygons mapped according to the EUNIS classification system. There is considerable overlap between polygons within the dataset including those for different habitat types. These overlaps were therefore removed by assuming an equal extent of the respective overlapping BH types and dividing the area by the number of overlapping BH types.

Habitat classifications

Terrestrial habitat types were assigned a UKHab classification and intertidal habitats a EUNIS classification, to the highest definition possible based on the source data quality, but to a broad habitat category as a minimum.

Where broad habitat categories have been used, they have been assigned a typical baseline UKHab / EUNIS classification, and an optimal post-development habitat type¹². This enables calculation of both current and potential BU/ha, drawing on BM2.0 default values. Assessments cover England down to the mean low water mark as defined in OSMM. Linear features (hedges and rivers) have been excluded.

Habitat condition

Scenarios for demand/supply were presented for habitat creation, enhancement and (for woodland only) accelerated succession. Whilst BM3.0 will drop the accelerated succession option, it is expected that a similar outcome will be achieved as a result of changes to default values for creation.

Further assumptions applied are that:

- i. For both baseline and post-development, habitats of low distinctiveness were assumed to be in poor condition and all other distinctiveness habitats will be assumed to be in moderate condition. Exceptions to this assumption follow BM2.0 rules in which certain habitats cannot achieve a condition score higher than 1, for example felled woodland and the majority of cropland habitats.
- ii. For both baseline and post-development, connectivity is assumed to be low for terrestrial habitats. Intertidal habitats were assumed to have a connectivity score of high.

¹² Optimal for biodiversity conservation in terms of being a high distinctive priority habitat from within the same broad category as the habitat type impacted.

- iii. For both baseline and post-development, habitats were assumed to be of low Strategic Significance in the absence of a common national dataset.
- iv. In the first instance, compensation will be assumed to be delivered within the same LPA as the location of impact.

These assumptions are applied in the market modelling (see **Section 3.1** of the Evidence Annex).

2.2.2 Modelling demand

Demand – terrestrial development trends

An estimate of the area of land taken up annually by development was required per LPA to determine the scale of impact and therefore the potential demand for offsets. Ordnance Survey provided a non-commercial dataset of new development that is updated throughout the year based on Earth Observation and site visit information. It was used to identify an annual historic extent of development, averaged from development over the preceding 20 years. For the purposes of the model, this rate of development will be expected to continue into the future. It was assumed that future development will impact broad habitat types relative to their current proportional land cover, with the exception of priority habitats.

A historic version of Natural England's Priority Habitat Inventory from 2014 was compared with the extent of development in the years to 2020 to provide an estimate of loss of priority habitats from development. These were averaged to provide an estimate of the annual scope and scale of priority habitat loss for each LPA to complement the above rate of other habitat loss. This approach was applied to more accurately reflect the actual impact on the priority habitats.

The estimate of habitat loss due to development was further refined based on whether the LPA was highly urban. If the area of urban habitats was above a certain threshold percentage of the total area, then the LPA was considered highly urban. In this case, development was assumed to be split between brownfield and greenfield based on MHCLG data¹³. Brownfield development was assumed to have no biodiversity impact¹⁴, therefore reducing potential demand for compensation within the LPA. This is further explored in the case-study below, where the reasons for this refinement are given.

Due to limitations of data, time/budget and the increasing expectation amongst the sectors involved, that Nationally Significant Infrastructure Projects (NSIP) will deliver BNG or at least no net loss (NNL), all development identified within the OS dataset, including all infrastructure, was included within the model. Bespoke compensation will be required for development within SSSI, AWI and very high distinctiveness habitats. These were excluded from further analysis of demand.

BM2.0 habitat trading rules were applied to identify the type of habitat required in compensation. For example:

- Within the same broad habitat category; and
- According to the current proportion of broad habitat categories for each LPA for low distinctiveness habitats. This was determined from the baseline habitat dataset and ensure consistent application of the metric principle (5) of enhancing not transforming nature.

¹³ *Land Use Change Statistics in England: 2017-18*

¹⁴ *It is noted that this is not always the case, and is therefore a limitation of the model – data to factor biodiversity on brownfield land into the model was not available.*

Demand – intertidal development trends

Marine Licence applications (2011 to 2020) that have been downloaded from the Defra Data Services Platform were used to provide an estimate of potential demand for each of the intertidal BH types. The Marine Licence application data is mapped as polygons, points and lines. Each of these datalayers was intersected with the LPA boundaries to provide the number of Marine Licence applications, per year, per LPA. Those Marine Licence applications that overlapped with international and national environmental designations (SPA, SAC, Ramsar, SSSI and MCZ) were removed from the analysis.

The remaining Marine Licence applications were summarised according to the number per project type per LPA. The project type is a high-level categorisation that is typically assigned by the applicant at the point of submitting a Marine Licence request. At the scale of the analysis undertaken for this project no account has been taken of whether each data entry is related to the same or different ML reference numbers (i.e. each data entry is assumed to relate to a distinct area or phase of a project even if it has same ML reference number).

An assumption has been made with respect to the likely habitat loss associated with each of the broad project types (see **Table 2.3**). This has been based on the professional judgement of project team members with coastal habitat, biodiversity compensation and BNG experience. The estimations of habitat loss per year have been averaged over the 2011 to 2020 period to provide a projected rate of development going forward for each LPA (effectively assuming the rate of Marine Licence applications and the associated project types remain unchanged). It should be noted that in practice the amount of habitat impacted by a particular project will be highly variable and dependent on the specifics of what is proposed as well as the receiving environment. The resulting estimates for potential demand of BUs is therefore very sensitive to this assumption.

The resulting predicted non-designated habitat loss per LPA was then compared to the current mapped extent of each of the BHs. Where the predicted rate of loss was higher than the amount of the respective BH within an LPA it was downscaled accordingly. This adjustment was made at the scale of the individual LPA, where necessary, to reflect the baseline extent of each BH type. In the first instance any predicted saltmarsh loss that was greater than the mapped extent of saltmarsh within an LPA was re-classified as intertidal sediment loss. This adjustment (which was typically in the order of 1 ha) was required in approximately 67% of LPAs and was based on the assumption that the predicted losses still occurred within the intertidal zone.

Following this adjustment there were only 9 LPAs in which the predicted intertidal sediment loss exceeded the respective mapped habitat extent. The predicted losses was downscaled to match the mapped habitat extent within these LPAs on the basis it is not possible to lose intertidal sediment/saltmarsh in these locations.

The predicted habitat loss was converted into biodiversity units using the Biodiversity Metric 2.0 calculator based on the following assumptions:

- Distinctiveness = High
- Condition = Moderate

- Connectivity = High
- Strategic significance = Low

Post development assumptions were as follows:

- BNG will be assumed to be delivered within the same LPA
- BUs are generated through habitat creation not enhancement. This assumption is made on the basis that intertidal habitats are already to be assumed to be of high distinctiveness. In addition, there is no data to highlight where enhancement might be required or possible. Furthermore, around 80% of estuaries and 50% of the coastline is designated and as such the principles of enhancement would not apply in these locations due to additionality.
- Condition of created intertidal habitat = Moderate (saltmarsh will take 10 years to achieve and intertidal sediment will take 5 years to achieve)
- Connectivity = High
- Strategic significance = Low

Table 2.3: Assumed habitat loss (ha) per project type

Project Type	Rocky Shore	Intertidal sediment	Coastal Saltmarsh	Coastal Lagoon
Aggregate dredging	0	0	0	0
Alternative use of dredged material	0	0	0	0
Clean-up dredging	0	0	0	0
Construction	0	0.5	0.5	0
Construction of new works	0	0.5	0.5	0
Decommissioning of works	0	0.5	0.5	0
Disposal of dredged material	0	0	0	0
Dredged Material Disposal (Disposal Site)	0	0	0	0
Dredged Material Disposal (Source Site)	0	0	0	0
Dredging	0	0	0	0
Emergency Work	0	0	0	0
Explosive substances or articles	0	0	0	0
Incineration of any substance or object at sea	0	0	0	0
Maintenance of existing works	0	0.5	0.5	0
Miscellaneous Disposal	0	0	0	0
Navigational dredging (capital)	0	0	0	0
Navigational dredging (maintenance)	0	0	0	0
Other deposits	0	0.5	0.5	0
Other dredging	0	0	0	0
Other removals	0	0.5	0.5	0
Other works	0	0.5	0.5	0
Removals (inc. Grab Samples)	0	0	0	0
Renewables	0	0.5	0.5	0
Sampling	0	0	0	0
Scientific instruments	0	0	0	0
Use of tracers	0	0	0	0
Wrecks and other archaeological remains	0	0	0	0

Major Infrastructure

The available data sets do not facilitate distinguishing impacts of major infrastructure projects from smaller scale projects, and many major infrastructure projects are now undertaking biodiversity compensation. It is difficult to exclude major infrastructure projects from development data. It is already good practice in infrastructure projects to aim for BNG or at least no net loss (NNL). Also, BNG may well become mandatory for Nationally Significant Infrastructure Projects (NSIP). For these reasons, all development identified within the OS dataset, including all infrastructure, has been included in the analysis.

2.2.3 Modelling supply

Supply – terrestrial capacity

Land available for the supply of offsets excludes SSSI as they would likely only provide a small number of units and it would be overly complex to model gains that are additional to existing obligations.

The capacity for BU supply estimated for each LPA assumes that creation and accelerated succession are possible on all suitable undeveloped land. A wide range of factors will determine what type of actions to generate supply of BUs will be appropriate in any given location. Most land in England is of low ecological value and so the starting point is most likely to be a low distinctiveness habitat.

In addition, offset providers will want to get the most BUs they can from the land to sell. They will achieve this by generating habitats of high quality. To get the most units per ha this will mean creation onto low distinctiveness starting habitats. For grassland habitats, which are widespread, creation is often easier and quicker, and could be a more cost-effective way to generate BUs, than enhancement. For these two reasons it is assumed that creation will play a major part on providing BUs (note that accelerated succession is only applied to achieve the desired proportion of woodland habitats).

The capacity for enhancement was estimated based on the following scenario: only compensate by enhancing medium distinctiveness habitats to create priority habitats in proportions consistent with the baseline spread of medium distinctiveness habitats. Based on this assumption, only a limited number of habitats are considered eligible for enhancement. As such, not all broad habitat types can be compensated using enhancement, as they fail some of the BM2.0 trading rules. Additional enhancement capacity may be available from changes in condition whilst remaining within the same habitat type, but this has not been explored further since condition values are all based on fixed assumptions.

For both types of compensation, we explored increases in efficiency achieved by delivering biodiversity gains through habitat banking to determine the impact on supply. For such gains from habitat banking, the time to target condition was adjusted to reduce the risk factor, thereby increasing the number of biodiversity units that may be generated. The model assumes no change in the risk factor associated with the difficulty of delivery as a result of habitat banking, though this may be included in future metric updates. The model assumes that the habitat bank was set up 10yrs ahead of the sale of units. Where habitats already had a default time to target condition of 32+ years it was not possible to determine the effect of a reduction of 10yrs on the time to target condition factor and so no change in BU outcome was assumed from habitat banking.

Supply – intertidal capacity

A datalayer representing land at the coast which is potentially suitable for intertidal habitat creation (particularly mudflat and saltmarsh) was produced by ABPmer for the MMO in 2018 (MMO1135). This is principally based on assumptions surrounding land at a suitable elevation in the tidal frame to create intertidal habitats with a corresponding lack of infrastructure constraints. Areas that are already subject to international and national environmental designation (SPA, SAC, Ramsar, SSSI and MCZ) have subsequently been removed from this datalayer. It should be noted that a large proportion of this land will not be available, not be feasible or only be feasible at disproportionate cost (this is discussed further in **Section 3.9**). Scarcity of supply is likely to be a significant issue for intertidal BNG if left to the market.

The remaining areas were intersected with the LPA boundaries to provide an indication of the extent of potential intertidal habitat creation per LPA. Based on high level consideration of tidal levels and land elevations, an approximation was made of the amount of mudflat (30%) and saltmarsh (50%) that would be expected to form within the sites. The remaining 20% would be assumed to be transitional/terrestrial habitat.

Designated sites and Ancient Woodland

Bespoke compensation will be required for any consented development within SSSI and Ancient Woodland. Where historic development is shown to have impacted these areas, it will be noted, but excluded from further analysis of demand. Land available for the supply of offsets will exclude SSSI as they are only likely to provide a small number of units and it would be overly complex to model gains that are additional to existing obligations. Ancient woodland has also been excluded from the supply calculation as we are assuming the habitats will be created or achieved under accelerated succession rather than enhancement.

Trading

BM2.0 habitat trading rules will be applied to identify the type of habitat required in compensation. For example:

- Like-for-like for specific HPI and high distinctiveness habitats;
- Within the same broad habitat category for medium distinctiveness habitats; and
- According to the current proportion of broad habitat categories for each LPA for low distinctiveness habitats. This will be determined from the baseline habitat dataset and ensure consistent application of the metric principle (5) of enhancing not transforming nature.

2.3 Economic modelling

Building on the GIS analysis, economic modelling has been undertaken to understand evidence on the behaviour of those involved in the market such as the supply capability and responses to price signals. The modelling uses assumptions on a range of the factors identified in **Table 2.1**, informed by the evidence review, interviews and surveys, to analyse spatial data on potential supply and demand of BUs. The Economic modelling calculates the balance between the expected supply and demand for BUs for 317 LPAs in England, to highlight where in the country there is likely to be a scarcity of BUs. The market relationships examined are shown in detail in **Figure 2.2**.

The LPAs and other geographies used are listed in **Appendix D**. There are approximately 350 LPAs in England (the exact number is fluid due to ongoing mergers of authorities). Within this number the modelling excludes 3 Development Corporations, 10 National Parks, and 21 counties which are subdivided into other LPAs.

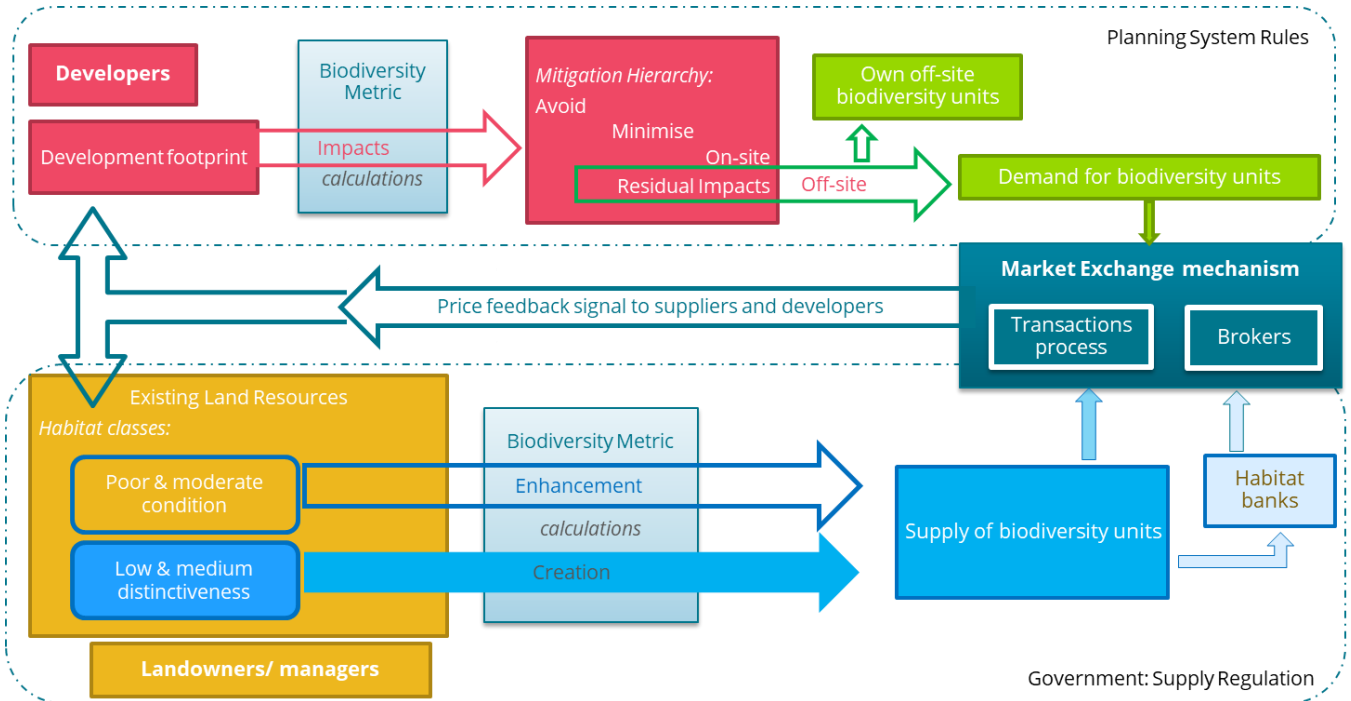


Figure 2.2: Schematic of BNG market process

The structure of the BNG market model will be based around analysis of supply, demand and equilibrium factors, to determine price.

To understand the biodiversity unit market, this study has identified and modelled factors that influence the demand, supply and the equilibrium outcome – i.e. prices of biodiversity units. These factors structure the presentation of the research undertaken and are summarised in **Table 3.1** below. A full list of these factors is given in **Appendix E** along with (i) their likely impact on supply and demand of BUs; (ii) the evidence source used to identify their likely magnitude and impact on the market; (iii) whether Government has any real influence on the factor in the short term; and (iv) the expected movement of these factors over the next 10 years.

Analysis considers whether scarcity of BUs in a given LPA can be overcome through trading across planning authority boundaries. Trading across LPA boundaries is expected to be subject to a spatial risk factor of 0.75 as given in the Biodiversity Metric 2.0 (Natural England, 2019a), increasing the number of BUs required, and therefore habitat area required and costs of BNG. Thus, it is only likely to occur where there is scarcity of supply. This spatial risk factor may translate into a 33% price premium for these BUs¹⁵. However, the price premium may be lower than this, as LPAs without scarcity will have less pressure on land and therefore the opportunity costs of land, and thus the costs of supplying BUs, would be expected to be lower. Therefore, we analyse the potential effects of trading BUs with neighbouring LPAs based on a 25% price premium, increasing the price from £20,000/BU to £25,000/BU.

¹⁵ $1/0.75 = 1.33$ (33% increase)

In reality, markets work through a multitude of price signals and responses, and so the modelling short-cuts these processes in steps that reflect the order of market price signals. To determine prices for the quantities of demand and supply identified through spatial modelling it first establishes costs of supply, and then applies market equilibrium factors.

Establish supply cost

The starting point for the pricing model is the cost of the BUs generating opportunities that are eligible to meet the identified potential demand. As a compliance market, there is no option to leave biodiversity damage unaddressed: actions must be taken to avoid damage or to purchase BUs. Sellers cannot be expected to sell for less than the costs of supply, with costs therefore giving a minimum price for market transactions.

Costs are calculated for relevant actions to generate BUs. The current evidence on these costs is usually focussed on the environmental actions involved, and does not always include other elements of the full costs, such as opportunity costs, transactions costs (contracts, monitoring, verification etc) and costs of finance and compensation for risks to supplier. The combined influence of opportunity costs and risk factors are expected to influence prices. Some actions to generate BUs, over the 30-year timeframe required, effectively amount to a land use change that is permanent or impractically expensive to reverse. However, uncertainty over agricultural returns and attitudes to long-term risks make this aspect of BU prices hard to assess,

Price premiums due to scarcity of supply are also factored in as part of the economic modelling (see [Table 2.4](#)).

Market equilibrium factors

The cost-based prices are adjusted according the following factors where relevant to an LPA:

- a. Apply a scarcity premium where it is determined from the BU modelling that there is a risk of scarcity of BU supply relative to demand in an LPA;
- b. Adjust for elasticity of demand to expected prices, such as how much additional on-site BNG can be delivered at lower cost; and
- c. Adjust for elasticity of supply - at what price per BU the supply of units is expected to increase, and by how much.

The parameters for these factors have been developed through the research presented in **Sections 1-3** of the Evidence Annex and summarised in **Section 3**. Adjustments to prices have been calculated in the model as absolute values (e.g. reflecting higher costs of relevant actions or opportunity costs), or as % price premiums (e.g. to reflect risk-rewards sought for changes in land use).

Revisions to the market model could help interpret the results and understand influencing factors, including, but not limited to:

- Time periods for creating different habitat types;
- Where potential areas of habitats impacted are likely to be very small and therefore subject to avoidance/ on-site mitigation and unlikely to lead to a market of more than one transaction;

- Economies of scale in creating and managing habitats and providing BUs, which can be significant, and
- Stacking of other benefits alongside BUs (if permitted) which could provide other revenue to co-fund habitat creation, reducing the price of BUs. A potential example relates to Woodland Carbon Code credits.

Dynamic mechanisms

A key component of the economic modelling is how the market is expected to develop over time. The time periods considered by the study are the first, fifth and tenth years of the expected market (2023: 2028: 2033). Note that this is distinct from the lifetimes of BUs, which are expected to be delivered over a 30-year period.

Where there is a constraint in the market (supply insufficient to meet expected demand), a scarcity premium is expected such that national average costs of achieving BNG are 25% higher than in locations without scarcity (as detailed above). This cost increase may be due to prices within the LPA being higher, or purchases of more BUs from adjacent LPAs due to the metric's spatial risk factor.

This premium has been applied to demand from those LPAs with scarcity, increasing prices. This is to reflect the higher prices suppliers are expected to charge in response to the need for developers to look to neighbouring LPAs (and face a regulatory price premium) to meet their demand. Based on these two initial price points (supply costs and scarcity premium), substitutes have been factored in, taking effect in 2027 and 2032. Substitutes involve those discussed in **Section 1.1.5** of the Evidence Annex such as developers reacting to higher prices by performing actions earlier in the mitigation hierarchy than offsets, (e.g. on-site mitigation) as well as the use of developer's land banks or local authority land. Similarly, additional supply is expected to come forward as behavioural and practical barriers are lowered (see **Section 1.1.5** of the Evidence Annex). Prices predicted by the model for the years 2028 and 2033 are the result of these adjustments to the cost-based starting point.

This analysis therefore acts to inform Government as to how it should set its prices as seller of last resort, taking into account wider factors (such as habitat creation needs at county scale) as well as maintaining market liquidity (without undermining incentives to supply BUs in future) where scarcity is likely to exist. The analysis takes into account the need for LPAs to have oversight of the BNG delivery in their area, and sets out how LPAs can recoup costs for this from BNG trading costs. This will support the aim that LPAs are resourced to support BNG without impacting on existing Government budgets.

Outputs

The economic model has been constructed in a single MS Excel file (ensuring all data and assumptions remain linked). To enable understanding and future adjustment of the model, the data and assumptions have been clearly laid out in separate cells, colour coded (e.g. for input data, assumptions, results filters and results), with different text colours and fonts to distinguish between calculations and instructions to model users.

The model also has a separate inputs worksheet containing all the assumptions and rules that can be adjusted in the model in the future for changes in certain data and assumptions (e.g. when the upcoming Biodiversity Metric is published, or if there is a significant change in development rates). It also contains a

coversheet showing the model’s structure, with hyperlinks to enable navigation, and instructions and tips for data entry and analysis. An accompanying user guide will be produced which will describe the structure and principles of the model, and the functions in each worksheet. These will be shared following the final report.

Modelling parameters

The parameters applied in the economic modelling are listed in Table 2.4, along with the source of evidence used to determine them. Several parameters are based on expert judgement of the study team, interpreting the evidence examined for this study.

Table 2.4: Economic parameter values

Parameter	Value	Reference	Comment
Price year	2023	-	Year of market initiation
Discount rate	3.5%	Green Book	-
Management time period	30 years	Environment Bill (06/03/20)	-
Scarcity threshold	100:1	Expert judgement	Sensitivity analysis performed
Habitat banking	0	Expert judgement	Sensitivity analysis performed
Development rate	20-year average	Ordinance Survey	Sensitivity analysis performed
On-site mitigation	50%	Expert judgement	Sensitivity analysis performed
Creation / enhancement ratio	94:6	GIS modelling	Based on available land
Minimum % of urban habitats to total LPA area for which an LPA is considered to be urban	70%	Expert judgement	Value can be varied in the analysis spreadsheet
For urban LPAs, Assumed percentage of development on brownfield sites if:			
Highly Urban	79%	Expert judgement	Value can be varied in the analysis spreadsheet
Non-highly Urban LPAs	49%		
Price per unit in LPAs without scarcity	£20,000	Expert judgement in line with evidence review	In line with the expected costs of generating BUs presented in Section 1 of the Evidence Annex
Price per unit in LPAs with scarcity	£25,000	Expert judgement	25% premium to reflect the price premium suppliers are expected to charge in response to the need for developers to look to neighbouring LPAs (and face a regulatory price premium) to meet their demand

Where relevant sensitivity analysis is applied to these factors (see **Section 3.2** of the Evidence Annex).

3. Discussion

This study has completed a novel process of analysis and consultation which gives an improved understanding of the expected BNG market in England. This section discusses the findings from **Sections 1-3** of the Evidence Annex in relation to the market factors identified in **Section 2**.

The research is carried out in a context of changing land markets and uncertainty on some policy details, which restrict the ability of stakeholders to form firm opinions and hence the ability of this research to gather detailed and accurate information. Nevertheless, a model has been developed to help understand the expected size and dynamics of the market for biodiversity units (BUs) and their prices. This can inform policy development with an understanding of how the market is likely to grow over time, and the role for the Government.

Due to the many caveats and assumptions necessary to construct the analysis, the level of confidence of the results is moderate. While the analysis is based on sound evidence and published data, there is some uncertainty in combining them. For example, the amount of habitat impacted by a particular development project will be highly variable and dependent on the specifics of what is proposed as well as the receiving environment. The resulting estimates for demand of BUs is therefore very sensitive to assumptions, resulting in moderate confidence in using the data to guide policy decisions and spending choices – hence a range of data are given for some key outputs (see **Section 3.7.1** for a summary of the sensitivity analysis undertaken).

3.1 Summary of market factors

The requirement for 10% BNG will establish a new compliance market in England. In general stakeholders lack an understanding of the differences between compliance markets (in which one party - the purchaser - is compelled to act by law), and more standard open markets (in which two parties transact voluntarily). This creates market power for sellers, and therefore adequate competition amongst sellers is vital to generate an efficient market outcome.

Compliance markets function according to the regulations buyers are complying with, and designing policy to deliver such a market is a complex legal and economic challenge. The BNG market will also be influenced by a number of factors that shape supply and demand for BUs, and their responsiveness to price changes (price elasticity) over time. Therefore:

- Accurate use of the Biodiversity Metric and compliance with resulting mitigation actions needed to achieve BNG are essential. There is some evidence of inconsistency in the applications to date, and uncertainty about future consistency of on-site and off-site standards and enforcement;
- Market design through the regulations is the key determinant of success in terms of both effectiveness for biodiversity and efficiency of delivery, and
- Policy risk is significant.

The market supply, demand and their respective responsiveness identified in **Section 2** are summarised in **Table 3.1**. The rest of the section covers the following key issues investigated by the study:

- **Section 3.2:** Market scope
- **Section 3.3:** Market regulation
- **Section 3.4:** Market risks
- **Section 3.5:** Market information and training
- **Section 3.6:** Scarcity of BU supply and impact on market price and development
- **Section 3.7:** Government as the seller of last resort
- **Section 3.8:** Alternative policy mechanisms for the government’s role
- **Section 3.9:** Market responsiveness

Table 3.1: Summary of market factors

Supply			
Suitable land	The total potential supply for England is 17,362,551BUs, covering 9.2m ha of land. Across the 317 LPAs, the average supply of BUs is 55,000 with a minimum of 1 and maximum of 642,000. The utilised agricultural area (UAA) in England was just under 9.06 million ha in 2019. This equates to 70% of England’s 13.03 million ha.		
Costs	There is a wide range of costs for managing different habitats to increase BUs, but excluding outliers the average nominal cost per hectare is £34,746 and per BU is £15,648 (2020 prices). Costs are much higher for some habitat types (e.g. intertidal).		
Expected price	£20,000 per BU. Note this is a gross price. Profit will be the exchange price net of opportunity costs of land, the costs of delivering BUs, and transactions costs.		
Skills and knowledge	Currently low relative to the expected required level of skills and knowledge		
Behavioural	Cultural factors could be a barrier		
Resources	Confidence to invest – reduced by current policy uncertainty		
Contractual uncertainty	Currently may limit supply		
Supply Responsiveness			
Market information	Currently limited – may inhibit supply		
Presence of intermediaries	Currently limited – may inhibit supply		
Presence of habitat banks	Not facilitated by current rules (may inhibit supply), but rules expected to change to improve this.		
Supply in adjacent LPAs	Likely to alleviate scarcity in majority of LPAs with potential scarcity		
Supply from non-adjacent LPAs	Unclear when ‘reasonable search locally will be deemed to justify this.		
Market entry costs	Likely a barrier to smaller landowners/ managers		
Demand			
Overall rate of development	Average total area developed per year in England: 6,330 ha		
Rate of land development by LPA (ha)	Varies significantly. Significantly below potential supply in majority (70%+) of LPAs. Distribution of ha/yr:		
	Min: 0 5th percentile: 4	Median: 16 Mean: 20	95th percentile: 50 Max: 129
Distinctiveness of habitats developed	An average of 487 ha per year of priority habitat is estimated to be lost due to land use development, which represents 6.6% of the total developed area		
Available skills and	Currently may limit market development		

knowledge	
Available resources	Variable – some good practice exists, but many developers covered by BNG have not started preparing to comply with it.
Current use of mitigation hierarchy	Widespread, but effects unclear, as uncertainty over accuracy of use of Biodiversity Metric
Financial decisions	Will drive demand once price information is known
Contractual certainty	Currently may limit planning of demand strategies by developers, making outcomes less predictable.
Demand Responsiveness	
Market information	Currently limited – may inhibit demand strategies
Presence of intermediaries	Currently limited – may inhibit demand strategies
Changes to the use of the mitigation hierarchy	Likely to reduce demand. Avoidance and minimisation of impacts likely to be greater where BU prices are higher (so more likely where there is scarcity of supply), but on-site delivery of BU likely to be lower where there is scarcity (due to higher land prices)

3.2 Market scope

The estimated size of the market is identified in **Section 3.1** of the Evidence Annex at around 6,700 ha of land per year. This Section considers the scope of that market in more detail.

3.2.1 Demand

There are some questions about the scope of the market in terms of inclusion of very small or large projects. Some stakeholders made a case for exemptions based strictly on the size of development, for example for small numbers of housing units, or low ecological impacts. However, with a well-functioning market, in particular the presence of brokers able to sell pre-defined BUs, the current planned lower threshold for market involvement is regarded as suitable.

At the upper end of the market, there is a case for BNG to be applied to all large development projects, including Nationally Significant Infrastructure Projects (NSIPs). As such projects could have a large influence on demand for BUs in individual planning authorities and they could cause local spikes in the price of BUs in LPAs with scarcity of supply. Therefore, they could be given flexibility to source BUs from a wider spatial area (e.g. through agreement within collaborating LPAs).

3.2.2 Supply

We expect the majority of the market to be supplied by habitat creation on low distinctiveness, poor condition habitats (mainly intensively farmed arable and pasture) and enhancement of poor condition habitats (e.g. low-quality woodland).

The specific scope of market supply will be heavily influenced by the Biodiversity Metric. As described in **Section 1.3.2**, this study is based on Metric version 2.0, as version 3.0 is still under development. In general the metric seems capable of supporting the market, but there are specific issues to resolve including whether the Metric:

- Adequately incentivises brownfield development, rewilding, and/or pooling resources by suppliers to achieve regional strategic aims;
- Adequately accounts for temporary losses of biodiversity;

- Provides robust calculations for creation of habitats and appropriately rewards positive action; and
- Sets requirements for habitat compensation at the appropriate and realistic level (for some habitats the metric requires a ratio of 1ha lost to >12ha required as compensation in order to deliver BNG).

Note that many of these factors are known to Natural England and are being addressed in the metric version 3.0 and accompanying guidance. Specific demand and supply issues for urban and coastal environments are discussed in more detail in **Sections 1.8 and 1.9** of the Evidence Annex.

The metric determines the number of BUs provided by different types of supply – whether through creation or enhancement, and whether like-for-like habitats or better. If supply is only through enhancement and is strictly like-for-like, potential scarcity would be greater than identified in the modelling. However, creation of most habitats can occur on different current low-distinctiveness habitats (albeit this may be more expensive, and will face some constraints, such as floodplain land being needed for wetlands). Therefore, like-for-like requirements are not expected to constrain supply and affect scarcity.

Habitat banking can play an important part in supply and ensuring sufficient liquidity of BUs available to the market. This is because banks store BUs ready for sale, avoid the constraint of the needing to align the timing of BU supply agreements with BU demand. Forthcoming developments of the BNG regulations to facilitate habitat banking, by providing greater clarity, such as on what is required to set up a bank and where they should be registered, are therefore important to help avoid risks of scarcity of BUs. Habitat bankers will also be incentivised through a level playing field, including consistent standards and regulation for on-site and off-site actions to deliver BNG.

3.3 Market revenues

For the purposes of the initial analysis in this study, calculations use a price of £20,000 per unit (See **Section 1.3** of the Evidence Annex), giving roughly £40,000 per ha. After costs, the returns to suppliers from market sales will be considerably less than this – possibly at a level of a few £1,000's or £100's, in part depending on how efficiently they generate and manage BUs.

Another factor influencing market returns will be other goods and services sold with or alongside BUs, otherwise known as stacking and bundling. Other functioning PES markets in the UK include the Woodland Carbon Code¹⁶ and nutrient trading schemes. The latter are understood to involve payments of around £100/ha/year, giving a potential present value revenue of around £2,000 over 30 years.

Woodland carbon code returns vary by woodland type and other factors, but can generate around 100-300 tonnes of carbon over 30 years. Historic price levels of around £10 per tonne give a similar present value of revenue as identified for nutrient markets. More recently the Woodland Carbon Guarantee auction has been clearing around £19 per carbon unit, giving slightly higher returns.

These returns are a fraction of the likely price of BU, but if they do not involve any or much additional management action (and therefore costs), could be significant relative to the profits BU sellers may achieve. However, separately selling nutrient, carbon and/or other credits on top of BUs (so called 'stacking') involves

¹⁶ [Home - UK Woodland Carbon Code](#)

complex issues¹⁷, and creates a risk of low additionality. It may also be possible to bundle other services – such as GHG or nutrient regulation, as part of BUs, but such multi-benefit credits are currently a speculative market.

Clear rules are required from Government for whether and how stacking and bundling will operate within the BNG market.

3.4 Market regulation

The majority of stakeholders who contributed to this study want to see proper regulation of the BNG market to avoid the risks to business and the environment from unscrupulous operators (so called ‘cowboys’). The baseline level of trust in Government to deliver a well-regulated market is low.

To function well, the market requires transparent independent regulation of:

- **Individual transactions by LPAs.** This means sufficient resources (time and skills) need to be put in place in LPAs. Government can support this through training and facilitation mechanisms (e.g. online information portals). A coordinated government strategy is needed, as while the policy design is led by Defra, it does not control the Governance and funding of LPAs nor the policy direction set by MHCLG, Department for Transport or others.
- **On-site and off-site delivery of BUs in a consistent manner.** This could be achieved by regulating them through a single regulatory regime, or separate regimes. Having a separate regime for on-site regulation may be efficient to allow a different (e.g. more risk-based) regulatory approach. However, it needs to ensure, and provide evidence of, delivery of an equivalent standard of BNG outcomes for on-site actions as for off-site.
- **The overall functioning of the market and achievement of BNG.** Biodiversity outcomes will be a responsibility of the Office for Environmental Protection (OEP), so it could be given the responsibility for scrutinising the overall functioning of the market and its outcomes. This remit would also require the OEP to examine interactions with carbon and nutrient trading markets (to ensure additionality). The OEP would then need to source appropriate environmental market regulation skills and information to include this in its functions. Alternatively, a new independent regulator could be established for environmental markets.

BNG agreements lasting at least 30 years will involve unusually long time-frames, longer than the norm for contract law (although not unusual for some land uses, such as mining). It is also longer than staff involved are likely to stay within the organisations they work for. As a result, regulations need extra clarity and specialist regulatory skills to ensure the market functions as intended and achieves its aims. This can be supported by clear planning of the milestones in project lifecycles – See **Appendix G** for an example relating to offshore wind.

Regulation should be supported by auditing of both seller (landowner) and developer (delivery of BUs both on-site and as buyers). This can be enabled a public register of BU transactions, and should explicitly check

¹⁷ For example, whether carbon credits delivered through actions to supply BUs should be calculated net of losses of stored carbon due to development project impacts.

that plans and resources are adequate to deliver BNG over the 30 year period. It can be supported by tools good-practice standards, templates for BU supply agreements, and insurance (see **Section 3.6**).

The capacities and adequate skills to deliver the regulatory framework in line with the recommendations above in a 'readiness' study for BNG. This Action is already underway in Defra-sponsored work by ALGE and ADEPT¹⁸. This can act as starting point for quantifying the necessary LPA staff time, training and information to ensure a well-functioning BU market. The sooner this is carried out, the more time will be available for training, and preparation of governance and other issues to be addressed. Capacity can be helpfully reviewed within the first two years of market operation by the National Audit Office.

3.5 Market risks

A number of issues have been identified in this study that are outside the scope of market analysis. Nevertheless, they will influence trust and functioning of the market, and so are highlighted here:

- Demand for BNG could displace funding for biodiversity outcomes that is currently provided by Government, eroding additionality of the policy;
- On the use of the Biodiversity Metric:
 - Developers may attempt to manipulate the system (e.g. they would have an incentive to collude over BU prices);
 - Changes to the metric over time could change requirements on BU buyers and sellers – so it would be helpful to be able to “lock-in” the version of the metric (and therefore the BU score supplier’s projects/ development’s impacts). If a BU score might be revised at some later date it will certainly increase uncertainty and risks, and reduce supply/ increase prices.
 - Inconsistency in use of the Biodiversity Metric across LPAs;
 - Training and clear regulation are required to counter these risks.
- Unintended incentives through operation of the biodiversity metric (e.g. whether enhancement or creation, or accelerated woodland succession).
- Delays in decision-making due to levels of scrutiny applied to metric assessments.
- Moral hazard¹⁹ of self-reporting of outcomes by developers, for their on-site delivery of BUs, and by 3rd parties, for their supply of BUs. This can be addressed through a risk-based monitoring and compliance systems;
- Alignment with other Government policies including design of the Environmental Land Management Scheme (ELMS). BNG and ELMS policy details are subject to further development through the Environment Bill and Agriculture Act, respectively, and can also seek alignment with private sector initiatives such as the Water Industry National Environment Programme (WINEP) scheduled to commence in 2024-2025. Other key policies include housebuilding and transport infrastructure (led by MHCLG and DfT, respectively), and the cross-Government objectives of the

¹⁸ A partnership project by Association of Local Government Ecologists and Association of Directors of Environment, Economy, Planning & Transport with funding from Defra.

¹⁹ Moral hazard is a situation in which one party engages in risky behaviour or fails to act in good faith because it knows the other party bears the economic consequences of their behaviour.

25 year environment plan. Further work is needed to inform policy, and design the mechanisms through which they will collectively operate; and

- International experience has shown that a lack of guarantees for BU delivery seriously undermines the market, increases costs and contributes to policy failure. This could be addressed through insurance for BU, or endowments or including the BU provision in S106 bonds or setting up a similar bond system.

3.6 Market information and training

Economic theory is clear that market operation is dependent on flows of information between participants. A wide range of information and supporting processes for the market can be encouraged and standardised by Government, increasing knowledge and reducing risks for potential market participants. Relevant information which can be provided prior to the market becoming mandatory includes:

- A standard/recommended contract form for BUs to ensure delivery over 30 years, covering issues such as: who is liable for BNG on the ground and operation of conservation covenants, and the process for enforcing them;
- Effects on other land regulations and taxes, including Agricultural Property Relief (APR) if habitat types are changed, and the tax implications of lump-sum or annual payment approaches;
- Application of the Biodiversity Metric, for example fixing the version used from a certain point in transactions;
- Updating of the Biodiversity Metric so that it is predictable when this will change in the future (which can affect the profitability of BU supply). Updates should not be too frequent (e.g. every 3-5 years or longer), and not affect existing contracts;
- Good practice standards and guidance in ensuring delivery of BUs, including the basics of BU contracts, and other issues requiring clarification, such as:
 - How climate change risks will be taken into account in BU delivery, sources of relevant guidance (e.g. selecting species appropriate to expected climate change), and who bears responsibility for this (the buyer, the supplier, or is it force majeure).
 - Opportunities for 'stacking' BUs and nutrient and/or carbon credits.
- Processes for monitoring, verifying auditing BU delivery on both developer and landowner side, including both on-site and off-site;
- Clarity on who will be responsible for market regulation, including processes to ensure delivery over 30 years;
- Develop skills for land managers to understand management of land for BUs;
- Develop LPA capacity for market governance and incentivise increased LPA readiness (e.g. providing resources for LPAs to make local strategic plans);
- How the policy fits with other Government funding mechanisms and regulations, particularly ELMS and the WINEP, and policy priorities like local natural capital priorities, infrastructure and house building targets;

- Processes to pre-register sites for BU supply, but not sell units until delivery has progressed (reducing time to target penalties);
- Communication to land managers of synergies between generation of BUs (e.g. for hedgerows and/or in field margins) and commercial farming. This is supported by Cortes-Capano et al's (2020) observation of increased PES participation in schemes where incentives align better with farmers' attitudes and beliefs on maintaining culturally and ecologically important landscapes (especially amongst smaller farmers), and
- Clarity on the legal status of the land at the end of the 30 year delivery period and how the land will be treated at this time.

When the market is functioning, details of BU transactions can be made available through a national registry. As well as providing information about the market, Defra can improve the function of the market by providing training to market participants (suppliers, buyers, and regulators, and their contractors). This can cover the expected market structure and regulatory system, resources needed to produce and trade BUs, pitfalls to avoid²⁰ and the list of ex-ante market information above.

Training before the market becomes mandatory (expected in 2023) will improve its functions in its initial years of trading, which can help build confidence and therefore improve the efficiency of the market. Its success depends on there being adequate staff capacity (e.g. in LPAs) to train. Collectively training a range of stakeholders could also have the benefit of increasing trust and facilitating new collaborations, helping to make BNG policy a success.

A register would cover transactions, so would not be sufficient to ensure the right skills and capacities of buyers and sellers in the market. It can therefore be complemented by standards (especially on the BU supply side) and possibly other mechanisms to guarantee delivery, such as accreditation of sellers, guidance on endowments or insurance products. More information on current skills and capacities, and views on the register and other mechanisms could be informed by a 'readiness' study for BNG. This should be carried out as soon as possible to allow necessary preparation of governance and other issues to be addressed.

3.7 Scarcity of BU supply and impact on market price and development

The spatial analysis has informed an assessment of where there is likely to be scarcity in BUs within each LPA across England. It is noted that there is a high level of uncertainty concerning estimates of scarcity for intertidal BUs due to uncertainties both availability of supply and future demand. Scarcity identifies LPAs at risk of BU scarcity based on the ratio between the estimated *total* potential supply and *annual* demand of BUs. Given the comparison of annual and total data, there would need to be at least 10 times more supply than annual demand in an LPA to meet expected demand over 10 years.

²⁰ One of the most important reasons for mitigation failure is because ecologists/planners design unrealistic mitigation measures, assert these will succeed, and do their BNG accounting accordingly. Typical examples are 'avoidance' measures which leave orphan plots whose integrity is compromised by surrounding activities and indirect impacts; 'restoration' measures that are speculative and don't in fact succeed; and 'offsets' (especially on-site ones) that never fully function because of too much disturbance. This is sometimes called 'the mitigation myth'. (BBOP, 2018)

However, in reality, only a proportion of the potential supply is expected to enter the market, so the definition of market scarcity used a potential supply:demand ratio of between 20 and 200 to identify a risk of supply scarcity. There is little evidence on which to base this ratio directly, but it is informed by the sellers survey response rate, and has been discussed with a range of stakeholders and a central ratio of 100:1 is regarded as the best available central assumption. Furthermore, there is some evidence to help understand the factors that influence this ratio over different time periods:

- In the short term (years 1 and 2), a lower ratio is relevant. Even a ratio of just 20 (total potential supply being 20 times expected annual demand) means that making just 5% of potential supply available is sufficient to meet demand in year 1;
- In the medium term (year 5 and 10), a ratio of 20 would mean half of all potential supply would need to enter the market to meet potential demand by year 10. This is considered highly unlikely at an average price level, therefore prices would be expected to rise significantly. However, supply would be possible from adjacent LPAs to alleviate this scarcity (see below), and
- In the long term (30 years), further responsiveness of market supply to price signals is harder to predict.

These factors are discussed further under Market Responses (**Section 4.9**), below. However, the modelling is less sensitive to this ratio assumption than the assumed % of BU compensation that are delivered on-site by developers. The estimate of 58 LPAs with scarcity, based on an assumption of 50% on-site delivery, falls to 46 LPAs if 75% of delivery of BUs is on-site.

3.7.1 Market model sensitivity analysis

Table 3.1 summarises the findings of the sensitivity analysis, in particular the impact of changes in the modelling parameters on supply and demand as well as the number of LPAs with scarcity. As presented in **Section 3.2** of the Evidence Annex, the outcomes show a low level of sensitivity to the parameters used - with the impact on the number of LPAs with scarcity being generally low.

This is because the overall patterns of development and areas of undeveloped land are larger drivers of the modelling results than these assumptions. Note that these sensitivity tests can be replicated using the analysis spreadsheet along with other parameters such as conditions in the Biodiversity Metric.

Table 3.1: Sensitivity analysis (summary)

Modelling parameter	Baseline	Sensitivity tests	Impact on supply / demand	Relationship to no. LPAs with scarcity	Level of sensitivity
Scarcity factor	100	20; 50; 200	No effect	Positive	Low
Habitat banking	0%	25%; 50%	Increases supply	Negative	Low
Development rate	Average	-20%; +20%	Increases demand	Positive	Low
On-site mitigation	50%	0%; 25%; 75%; 100%	Decreases demand	Negative	Moderate

To assess potential market size, we used the estimated average price of £20,000 per BU, and a higher price of £25,000 per BU in LPAs with risk of scarcity. This price factors in management costs, opportunity costs

and transaction costs over the 30-year period. Assuming that 50% or 100% of BUs are delivered off-site, this gives a total estimated size of the BNG market of around £135m - £274m per year²¹.

A further market influence is the potential for BNG to apply to Nationally Significant Infrastructure projects (NSIPs). Their development footprint could not be distinguished within the spatial data used for this study's modelling, but data can be drawn from the analysis of NSIPs and BNG by WSP et. al (2020). That report examined six NSIPs with larger than average biodiversity footprints, and potential maximum demand for 6,000 BUs from 2,088ha of land. However, the project included two very large projects (covering 1,788 ha between them), and the BU demand was calculated using different assumptions to those applied in this study - in particular, it did not account for 50% or more of BNG being delivered on-site.

Major infrastructure projects (particularly those with larger spatial footprints) may have more flexibility than average to use the pre-market steps in the mitigation hierarchy, and therefore are expected to result in approximately 1 BU of demand for each 1 ha developed. Government data suggests that there are an average of approximately 6 terrestrial NSIPs approved each year in England²². Assuming an average size of 100 ha of previously undeveloped land, and demand for 1 BU per ha, they could generate demand for approximately 600 BUs per year. From the national modelling (see **Evidence Report Section 3.1.2**) annual development (of all types) uses 6,680 ha in England, resulting in potential demand for 6,223 BUs. Demand from NSIPs is therefore estimated to make up less than 10% of the total national demand for BUs.

This suggests that:

- A small proportion of the demand for BUs is driven by impacts of NSIPs.
- Their inclusion in the OS datalayer showing land use developments means that the modelling may have slightly overestimated the market demand, but sensitivity analysis for other factors suggests this will not significantly affect the results.
- Inclusion of NSIPs in BNG requirements could increase demand. This is unlikely to increase scarcity significantly, but overall could help stimulate supply.

3.7.2 Short-term supply analysis

This section presents additional modelling performed to better understand short term supply issues (up to 5 years after BNG becomes mandatory). In particular a number of changes were made to the economic modelling assumptions used in Section 3.1:

- The scarcity factor has been reduced from 100 to 50 to reflect the shorter period of analysis;
- The demand in each LPA has been increased by 20% to reflect the expected increase in housebuilding rates to meet current housing targets in the short-term; and
- The supply in each LPA has been reduced by 30% to account for tenanted land in England (Defra, 2020b) being unable to come forward in the short-term.

Following these adjustments to the economic model, 54 LPAs are likely to have scarcity issues, just over

²¹ Calculated as the total demand in LPAs with expected surplus multiplied by £20,000 plus the total demand in LPAs with expected scarcity multiplied by £25,000. For 50% off-site delivery, this equals £135m (4,030BU * £20,000) + (2,193 * £25,000).

²² 132 projects since 2010 are listed for the 11 years since 2010 at: [Register of applications | National Infrastructure Planning \(planninginspectorate.gov.uk\)](https://www.planninginspectorate.gov.uk/register-of-applications/)

17% of all LPAs, and would therefore be expected to need to look to neighbouring LPAs to meet some of their demand. Of these 54 LPAs, 7 are entirely neighboured by LPAs which also have scarcity and would therefore be required to look nationally for BUs, all of which are in London and are the same as in the analysis presented in Section 3.1. Similarly, an additional 8 are neighboured by LPAs with a combined insufficient surplus to meet the demand from LPAs with scarcity, and would likewise therefore be required to look elsewhere for BUs.

In addition, the supplier survey suggested that 2% of the land managers were considering supplying BUs in the short term (see Section 2.1.3). This evidence suggests that there won't be an increased risk of BU supply scarcity in the first few years of the BU market than over the 10 year period examined by this study.

3.8 Urban biodiversity net gain

Initially, the model assumed that all development occurred on greenfield land. This is likely to be the predominant approach across the majority of the land area of England - in rural areas and at the urban fringe. However, in more densely developed urban locations, there is likely to be a high proportion of brownfield development as much of the remaining areas of green space are already highly valued, if not protected. To reflect this, the model has been refined to include development on brownfield land in highly urban Local Planning Authorities (LPA). Development in the remaining LPA's is still assumed to be on greenfield land which is still likely to overestimate potential demand for offsets.

As a starting point, the model considers an LPA as highly urban if the area of urban habitats is above 70% of the total habitat area. In this case, development is then assumed to be split between greenfield and brownfield with the model providing a starting ratio of 21:79. For non-highly urban LPAs, this split is assumed to be 51:49. Within the model, brownfield development is assumed to occur on sites of no biodiversity value and that therefore create no demand for BUs. Alternative assumptions were not considered feasible for modelling, in part due urban habitats being poorly classified (they are often classified based on the structure- green roof, green wall, brown field site etc. - rather than the biodiversity value).

This feature of the model is provided as a tool for sensitivity analysis and whilst it provides starting values, they are not to be considered as absolute or prescriptive recommendations. In trying to set a starting definition for an urban LPA, a visual comparison was made to the LPAs in the Office of National Statistics (ONS) Rural Urban Classification²³. However the ONS definition is based on population numbers whilst our model is based on land cover data.

Urban areas are harder to analyse with the available modelling information and methods. In reality, there is variation in brownfield development across the LPAs that are considered highly urban within the model. They may face constraints that inhibit market activity, including lack of local supply, so strategic policy measures may be required and further policy research is recommended.

²³ ONS (2011). 2011 rural-urban classification (RUC2011). Available at: <https://www.ons.gov.uk/methodology/geography/geographicalproducts/ruralurbanclassifications> [Accessed: 03/12/2020]

3.8.1 Urban case study

An example of this special case for highly urban areas is illustrated by the Ministry for Housing, Communities & Local Government (MHCLG)'s Residential Address Change Statistics Live Tables²⁴. For example, within the City of London, 100% of residential development occurred on previously developed land between 2015 and 2018, compared to 55% for Epsom and Ewell. Both LPAs are considered highly urban within the model due to the high proportion of urban habitats (above the model's starting figure of 70%).

Currently, LPAs are defined as having scarcity by a 100:1 supply to annual demand ratio and the model shows that LPAs with such levels of scarcity are predominantly urban. Of the 58 LPAs showing scarcity, 46 are urban (of a total number of 52 urban LPAs). Development within these highly urban LPAs is likely to predominantly impact very low and low distinctiveness habitats and therefore unlikely to generate significant biodiversity losses. Further, there is likely scope for onsite compensation by urban greening, for example through the creation of green roofs and green walls. However, there is also a risk of remaining green spaces within these areas being built on, placing increasing recreational demand on fewer remaining green spaces.

3.9 Coastal biodiversity net gain

The Biodiversity Metric 2.0 remains under revision by Natural England. Considerable uncertainty remains over the application of the metric in the intertidal zone, particularly issues around habitat condition and the large ratios for habitat area to deliver a 10% net gain that the metric generates (currently more than 5:1 for saltmarsh). Consultation on its application remains ongoing.

One of the key complexities in the intertidal zone is that most nearshore areas are protected (e.g. under the Habitats Regulations and the Marine and Coastal Access Act). Around 80% of UK estuaries and 50% of coastlines lie within designated Marine Protected Areas (MPAs). The existing legal protections to MPAs and their interest features will need to be complied with as a priority. These existing protections will limit the application of any intertidal metric.

In general the research did not gather as much evidence about the views of coastal stakeholders as terrestrial stakeholders. Interviewees included some organisations with a coastal and terrestrial remit. However, the detail of policy proposals, and the biodiversity metric, are less well developed for coastal environments. This means that there is more uncertainty over how BNG will be implemented in coastal areas, and stakeholders found it harder to give specific views.

The modelling of the BNG market found that:

- Just 5% of development impact, by area, is intertidal habitats.
- Due to the high penalty for developing intertidal areas (see below), intertidal development drives a significant proportion of demand for BUs (43% of potential BU demand identified).
- The modelling process likely overestimates supply for intertidal habitats, this will result in

²⁴ MHCLG (2019). *Land Use Change Statistics 2017-18 residential address based change tables*. Available at: <https://www.gov.uk/government/statistical-data-sets/live-tables-on-land-use-change-statistics> [Accessed: 03/12/2020]

underestimation of scarcity risks on the coast (but see below).

- Of the 58 LPAs with predicted scarcity, the majority are in urban areas, but of the 12 that are rural, 9 are coastal.
- There are some authorities where demand and supply is dominated by intertidal issues – for example the Isles of Scilly is clearly a special case.

These factors suggest a more strategic approach may be needed, based on availability of land for supply of intertidal BUs across adjacent/regional groups of LPAs. There are several further considerations in this respect.

First, greater use of the mitigation hierarchy faces restrictions in intertidal area. Developers only encroach into the marine environment if it is unavoidable. The high costs of intertidal development mean there is already an incentive to follow the mitigation hierarchy. Furthermore, on-site actions to deliver BNG are rarely practicable in intertidal environments, supply of BUs will predominantly come from habitat creation. This contrasts with terrestrial BU supply, significant supply can also come from habitat enhancement.

Second, availability of land for intertidal habitat creation has historically been limited by extensive existing designations and the challenges of intertidal habitat creation. These challenges include technical feasibility (requiring low distinctiveness terrestrial habitats on land of a suitable elevation to facilitate tidal inundation without large scale interventions), and landowner attitudes. The latter may be altered by market incentives (higher prices), but face some distinct issues with respect to BNG. Whereas terrestrial delivery of BUs for 30 years then theoretically leaves land available for other purposes, intertidal habitat creation is in practical terms irreversible. Furthermore, the availability of suitable land for supplying intertidal BUs is highly variable across LPAs and existing uses of such land may preclude a change in use. The challenges in delivering intertidal Net Gain projects are much greater than for terrestrial projects and thus the costs of delivering such projects are potentially much greater than on land.

Third, Defra's Net Gain Impact Assessment (Defra 2019a) estimated that the large majority of the costs of the policy to developers would translate into reductions in future land purchase prices (rather than lower profits for developers or higher prices for the subsequent developments). However, this is not relevant for land that is already bought. Development processes and timescales on the coast are often longer than is typical terrestrially, and development needs are strategic (e.g. for specific marine infrastructure). Therefore the costs of coastal BNG are more likely to be borne directly by developers during the first 5 – 10 years of the policy.

Fourth, the high cost and engineering complexity of realignment actions to deliver intertidal BUs mean that supply may take longer than is typical for terrestrial habitats, and suppliers are unlikely to enter the market speculatively. Therefore, arranging supply in a timely manner to match potential demand may be problematic.

Fifth, these factors may increase the use of Government 'seller of last resort' units in coastal environments. As these units are likely to be sold at a premium to standard market prices, this may increase prices for intertidal BUs, as more limited competition amongst non-Government sellers may not be sufficient to suppress prices.

For all of the above reasons, it is recommended that a more strategic approach to intertidal habitat delivery should be considered, largely driven by the public sector to pursue national and regional habitat creation priorities. A recommended approach to intertidal BNG policy is for Government to take a coordinating role in intertidal BNG work, involving:

- Investment targeted towards national/regional/local priorities, and coordinated with Habitats Regulations requirements.
- Actions that work with natural systems, are aligned with existing Shoreline Management Plan, and coastal and marine plan policies, and that are done at meaningful ecological scale.
- Government management of a range of delivery risks.
- Habitat banking of BUs to ensure there are no temporary shortages of supply, and in some cases this may deliver more than 10% biodiversity gain, which can contribute to other policy targets (e.g. compensation under the habitats regulations, national biodiversity targets).

3.9.1 *Intertidal case study*

A comparison is provided of the potential compensation requirement for a hypothetical project in a designated intertidal zone as compared to the application of the Biodiversity Metric 2.0 in a non-designated area. The hypothetical project scenario assumes a 2 ha loss of both intertidal mudflat and saltmarsh (4 ha in total) lost either in a designated or non designated location.

Under the designated scenario the replacement habitat requirement would be expected to be in the order of 8 ha of intertidal habitat (to include as a minimum 2 ha of intertidal mudflat and 2 ha of saltmarsh – with greater flexibility with respect to the remaining habitat types). The most likely delivery mechanism would be through the managed realignment of existing sea defences to allow saline inundation of terrestrial habitats thereby creating intertidal conditions. Specific consideration would be given during the site selection process to avoid the potential for consequent compensation/mitigation, however, in practice this cannot always be avoided.

It is assumed that the intertidal habitat would be created in relatively close proximity to the location of the damage. In practice this does not necessarily mean within the same LPA boundary as the connectivity and functionality of the system is taken into consideration. On the Humber Estuary, for example, compensation has been provided outside of the LPA boundary where the damage occurred but within the same estuary system. The timing of the delivery of the compensation is again dependent on a number of factors but as a minimum the means to deliver the requirements must be secured prior to the damage occurring. Once implemented, such schemes would be subject to comprehensive monitoring and reporting to ensure the respective objectives are fully delivered.

Using the same case example, but with the assumption of loss of non-designated habitat, the loss of 2 ha of each habitat type constitutes a loss 27.6 Biodiversity Units (BU) in each case. Applying a target of 10% net gain, this relates to a 30.4 BUs requirement for each habitat type. Based on the Biodiversity Metric 2.0 calculator assumptions applied in this study (see **Section 1.2.2**), and allowing for the loss of BUs from the low distinctiveness poor condition terrestrial habitat used, the area of compensation required would be 3.8

ha of intertidal mudflat and 14.1 ha of saltmarsh. These values factor in the requirement to consider the losses of respective Low distinctiveness, Poor condition terrestrial habitats to ensure overall BNG.

The intertidal habitat requirements under this scenario are sensitive to the assumptions applied in the metric. If, for example, the intertidal habitat is replaced outside of the LPA boundary in which the losses occurred, the intertidal habitat requirement would be higher. In this context the practical complexities and potential economies of scale of creating intertidal habitat should be recognised. Such schemes are dependent on specific environmental conditions to effectively deliver intertidal habitats. This includes, for example, the requirement for land of a suitable elevation to facilitate tidal inundation without large scale interventions. The availability of suitable land is highly variable across LPAs and existing uses of such land may preclude a change in use. The challenges in delivering intertidal Net Gain projects are much greater than for terrestrial projects and thus the costs of delivering such projects are potentially much greater than on land. For all of the above reasons, it is recommended that a more strategic approach should be pursued, largely driven by the public sector, to deliver the creation of national and regional priority intertidal habitat.

3.10 Government as the seller of last resort

An option in the Environment Bill is for Government to act as a seller of last resort in response to market supply scarcity that results in price increases. This policy mechanism could cap price rises, for example if it was triggered when prices rose above a certain % (say 50% or 100%) above average prices. However, such a threshold is challenging to implement because at the outset of the market the 'average price' in any LPA may not be clear, and will also vary across habitats (depending on like-for-like requirements or whether trading-up is possible).

Furthermore, there is a challenge over how the location of Government-supplied BUs would be determined. The location should be as local as possible to the development, but the need for Government to act as seller of last resort will be triggered when local supply is scarce. If Government can supply through agri-environment schemes locally when other local supply is not available, there will be a strong need to demonstrate additionality, and avoid damaging the confidence of suppliers and other stakeholders.

The Government's seller of last resort powers present a major policy risk, because they could be a major deterrent to investment in market supply. Investment in supply might be compromised by Government intervening in the market and leaving the suppliers short of the buyers needed to achieve profitable returns on their investment. Consideration should therefore be given to alternative policy mechanisms (see below), and if powers of last resort are used, they should be controlled based on specific, pre-determined and transparent criteria:

- The threshold at which the powers are used should be set high enough to ensure it does not undermine private suppliers and that the mitigation hierarchy is followed in the first instance. It will be important to balance this objective with ensuring that the tariff is not so high as to mean that development cannot take place in areas where on-site or local habitat compensation is impossible;
- The transactions under the powers should be disclosed and completely transparent, with all relevant information in the public domain;

- The transactions should be subject to the same high standards with respect to market regulations, scrutiny and verification as apply to other market transactions, and
- There should be a requirement for Government to have already identified BUs, and agreed a price for them (an option contract) before the transaction is finalised. There should also be a requirement for Government to purchase BUs within a set time period of receiving payments as a seller – for example within 6 or 12 months.

Without these measures, the seller of last resort powers could produce a perverse incentive: by deterring supply it could exacerbate the market scarcity that it is designed to alleviate. To mitigate this, the seller of last resort powers can have a sunset clause: meaning they will come to an end after a specific period of time (say 2 years), and can only be renewed through explicit decisions of ministers in line with pre-defined criteria relating to market conditions caused by inadequate supply. This would also align with the need to reconsider the BNG market in relation to the ELMS and other land use policies that could have more clarity in the coming years. This phased approach reflects the pattern of activity in Warwickshire, which initially supplied BUs, then acted as a broker, to help initiate and stimulate the market within a group of LPAs, before stepping back from the market (see **Section 1.1.3** of the Evidence Annex).

If utilising the seller of last resort powers, Government needs to be very careful to maintain good practice and to generate trust across all stakeholders. This relates particularly to:

- The quality of the biodiversity units Government delivers – applying low standards will be seen as a way for Government to subsidise development, including potentially developments paid for by other parts of Government, and
- Transparency around how decisions are made and how much Government is paying, and what contracts and guarantees are in place for delivering the BUs.

3.11 Alternative policy mechanisms

There are a number of policy mechanisms that Government could use instead of or as well as its powers of seller of last resort to help alleviate supply shortages. More direct supply interventions are discussed in **Section 3.11.1**. The following are general actions which will help encourage the suppliers of BUs:

- **Make BUs from different locations comparable:** The Environment Bill already includes options to purchase BUs from outside an LPA, with a penalty attached (of 25% reduction in BUs in neighbouring LPAs, and 50% beyond this). Ensuring this option is properly implemented will alleviate potential scarcity in the majority of LPAs at risk of scarcity;
- **Improve market information:** discussed further **Section 3.6**, above;
- **Invest in suppliers:** This would align to the Government's Green Finance Strategy²⁵. Government could take a minority first-loss share in suppliers (e.g. habitat banks). As well as funding investment in supply, this would also create an incentive for Government to ensure the market functions (so it does not lose its investment), giving confidence to other market participants;

²⁵https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/820284/190716_BEIS_Green_Finance_Strategy_Accessible_Final.pdf

- **Grants to suppliers:** this would be similar to investing (above), but lack the incentives created by investments. In either case, relevant suppliers could be identified through a reverse auction.
- **Guarantee demand:** This has been used in other environmental markets (e.g. through the floor price in the Woodland Carbon Code credits). Government could commit to purchase a certain level of BUs in each LPA (or other zone, such as local nature recovery strategy areas). The anticipated purchases could be determined through spatial modelling (extending the work of this project) and advertised ex-ante to encourage supply. Purchases could be spread evenly over all supply of an adequate standard put forward by a certain date. Government could then broker this supply (see below). Purchases could be through sales options, allowing suppliers to choose not to sell to Government should they wish;
- **Insuring BU supply:** The Government could develop, and possibly, co-fund, insurance (or re-insurance) for supply of BUs. This would help build confidence in the market, and also give the Government an incentive to regulate the market effectively to reduce its insurer risks, as better regulation will reduce the likelihood of ineffective BU delivery and insurance payouts. A re-insurance system could work like the Flood-Re scheme, with a standard % payment for insurance contributing to a re-insurance fund, supported by Government.
- **Strategic Planning of BNG:** In some contexts, particularly coastal and highly urban locations, conditions may mean that a strategic approach to delivery of BNG is more efficient than an open market. The conditions dictating this include the existing high cost of development and the high cost and limited opportunities of supplying BUs (e.g. often requiring managed realignment on the coast), and existing compensation requirements for much of the coast (the majority of intertidal areas are designated). This approach could also help ensure consistency between existing habitat regulation compensation and BNG.

It should be noted that several of these interventions that spend money to stimulate supply would have a no-regrets element in that the worst case outcome would be biodiversity enhancements that helped deliver 25 Year Environment Plan objectives. Another advantage of ex-ante interventions would be to help establish actual costs of supply, helping signal expected prices to the market.

There may be a particular case for Government interventions in coastal areas. Intertidal habitat supply is likely to be restricted due to existing designations and the limited area of the intertidal zone. There are also much greater constraints on where interventions can practically be progressed compared to the terrestrial environment. Experience over the last two decades in relation to compensatory measures under the Birds & Habitats Directives confirms the challenges in identifying and securing suitable land for intertidal interventions. Where this has been achieved, it primarily relates to compensation for major port development or for flood and coast defence works. In addition, economies of scale are very important for intertidal habitat creation, so encouraging habitat banking is a priority.

3.11.1 Interventions to improve BNG market liquidity

The intervention by Government as a seller of last resort is designed to overcome potential problems from a lack of market liquidity (specifically adequate supply), particularly in the early years of the market. The above actions would encourage suppliers and the supply-side of the market in general.

The modelling suggests that, once trading with neighbouring LPAs is allowed for, shortage of BU supply is

unlikely to be an overall constraint to development. However, there could be a constraint on supply for a limited period of time that was problematic for developers – here habitat banking and brokering services would be very helpful, and/or Government could step in to improve the liquidity of the market. Habitat banks or brokers services can reduce market entry costs to buyers and/or sellers. Accordingly, there are a number of other ways that Government could act to directly improve market liquidity, including to ensure timing of supply and demand to enable transactions:

- **Broker supply and demand:** Government could provide a system for registration of available supply and expected future demand, by habitat and LPA. It could then at fixed time-points allocate supply to meet demand, using predetermined rules (e.g. based on timing of registration and habitat matches of BUs) including in circumstances where its powers of last resort apply;
- **Act as a broker by running double-sided auctions** (Deng et al., 2014): This is where the auctioneer (Government in this case) collects both bids from buyers (their willingness to pay) and sellers (their willingness to accept) and uses that information to identify a market clearing price. This can be done transparently by publishing anonymised aggregated supply and potential demand data and gives the right incentives to all involved in the market. It avoids possible inefficiencies, such as from monopoly market power of Government and transaction costs associated with decentralised identification of trading partners.
- **Actual supply of BUs on public land:** Here the Government generates BUs by undertaking actual restoration projects on publicly-owned land. Given motivations for the “last resort” role, this model would ask the public sector to bank BUS from projects on public land, for release only when other supply is severely limited. This is not an efficient use of public land, but could help to encourage supply while also providing a ‘last resort’ mechanism.
- **Actual supply of BUs on private land:** Here Government pays for restoration projects on privately-owned land through, for example, ELMs and takes ownership of the BUs delivered by that activity that it can sell on to developers in the offset market. This involves complex issues of stacking and bundling of BUs generated from different payment schemes. The first thing to note, is that if the price for land management actions for BUs is higher than that offered by ELMs, then we would imagine that private landowners would choose not to enter ELMs, but rather take advantage of higher prices in BU markets. Since the circumstances in which the Government is likely to need to take on the “seller of last resort” role are exactly those where the price of BUs in offset markets are going to be very high, it’s not clear how the Government would somehow be able to source an alternative supply from ELMs in response to BU market scarcity (it could do so in advance). There’s ELMs payments are supposedly paying for environmental improvements that deliver welfare improvements for society from current conditions. Development is worsening current conditions such that more environmental improvement is needed over and above that being offered by ELMs; that additional required improvement would not be achieved under this model.
- **Payment for BUs but no BUs actually supplied:** Here the Government simply institutes a “safety valve” price for BUs (as per the Robert and Spence (1976) hybrid mechanism). Developers can pay this price per BU rather than buy actual BUs in the offset market. Compared to the last two models, there is some logic to this approach, particularly if the “safety valve” price is set sufficiently high to avoid its use except in extreme circumstances ... and also during the initial phases of the scheme

as markets are forming. However, knowing what is a 'sufficiently high' price could be problematic, and biodiversity objectives would not be directly delivered.

- **Deposit Payment for BUs until supply secured:** Here the Government allows developers to pay the "safety valve" price for BUs at the point in time when they wish to commence activity, giving the developer some time period over which they can source a supply of actual BUs, at which point their payment to the government would be refunded. Such a scheme could encourage developers to seek out actual BUs as quickly as possible, for example, by reducing the amount of the deposit to be repaid each year by, say, 5%. This ensures BUs are actually provided, but provides flexibility to developers.

3.12 Market responsiveness

A number of factors have been identified which will determine the responsiveness of potential supply and demand to market prices for BUs, i.e. price elasticity. These factors will influence the degree of price change where there is scarcity of supply, and include, but are not limited to:

Supply:

- The ability to trade across LPA boundaries, and the extent to which this can be facilitated through specific rules for trading between neighbouring local planning authorities. As discussed in the section above, ensuring this option is properly implemented will alleviate potential scarcity in the majority of LPAs at risk of scarcity. The exceptions to this are mainly highly urban LPAs, which may require specific rules or policy mechanisms;
- The ability of tenant farmers to enter the land they farm and manage to the market;
- Investments in supply by habitat bankers, who can be flexible in the timing of their supply to the market;
- The potential for a given plot of land to increase BU supply by additional habitat management (e.g. to achieve a bigger increase in distinctiveness by enhancement) or the potential for subsequent sales of BU from the same land after the initial 30 year contract have been achieved (based on enhancement in addition to the level of distinctiveness delivered through the initial BU transaction);
- Supply from aggregates extraction sites (which has not been included in this study's spatial modelling). This could be a significant source of supply of BUs, with potential to ease scarcity in some LPAs. However, there would need to be additionality above existing restoration plans, and
- Supply from high distinctiveness habitats that are currently in low condition. This may be limited as most such habitats are part of designated sites, so supply of BU would not be additional to existing management obligations. However, there may be areas of high distinctiveness habitats where supply of additional BUs is possible. This supply may involve higher costs, but could be stimulated in areas where scarcity results in a price premium for BUs.

Demand:

- The use of the mitigation hierarchy:
 - In the short term this may mean more careful site management for biodiversity; and

- In the medium-longer term it can also involve avoiding biodiversity impacts in the design of land use developments, and/or increased use of on-site generation of BUs to achieve BNG (possibly as the result of including the necessary areas of land in developments).
- Market information flows, such as through a BU register or the activities of brokers, to connect buyers and sellers, and to communicate demand signals to potential sellers.

4. Conclusions and recommendations

This section summarises initial findings from the work, including key areas for further analysis.

4.1 Conclusions

The evidence and analysis undertaken provide the following conclusions:

- In general, there is sufficient supply for the BNG market. There is a risk of scarcity in a minority (up to 18%) of LPAs, and in specific habitats (e.g. intertidal). The risk of scarcity isn't considered to be higher in the short-term (within the first 5 years).
- This risk of scarcity is overestimated in this study's modelling of the market due to difficulties in representing urban brownfield/ redevelopment activity in spatial data. Scarcity will be reduced (at least halved) by:
 - Supply factors, in particular trading with adjacent LPAs (which can reduce the risk of scarcity by at least half). Government can take measures to encourage supply, including from public land, and to avoid deterring supply, and
 - Demand factors, involving greater use of the mitigation hierarchy, in particular increased on-site mitigation (which should be to an equivalent standard as off-site);
- Where local scarcity remains – potentially in highly urban LPAs, mainly in London – this can be mitigated by trading with non-adjacent LPAs (i.e. nationally). If searches are recognised to not identify reasonable supply options, and this is permitted, it likely alleviates any scarcity (albeit at a price premium), and so negates the need for Government to sell as a last resort;
- Better information about the requirements to enter the market (see recommendations 1 and 2) is needed urgently to give buyers and sellers more certainty, and encourage adequate supply of BU to be available in year 1 of the market;
- A range of stakeholders are ready to act to provide demand and supply for terrestrial habitats in the short-term (< 5 years) and medium term (5-10 years), but want to act in line with confirmed Government policy; and
- More widely and in the medium term, a larger pool of suppliers are interested in market involvement, but will only become involved in the market once they see it operating. New entrants mean scarcity of supply is unlikely to increase over the first decade of market operation.

Key observations for Government policy are that:

- BNG is a compliance market created by regulation and its function will be strongly influenced by those regulations – recommendations 2b (on-site and off-site consistency); 4 (seller of last resort); and 5a (habitat banking) are key;
- Market design through the regulations is the key determinant of success of the policy – both effectiveness for biodiversity and efficiency of delivery;
- There are some clear needs for awareness raising to address knowledge gaps amongst stakeholders;

- Accurate use of the Biodiversity Metric and compliance with relevant standards for long term management and successful habitat creation/enhancement, both on-site and off-site, are essential, and there is some evidence of inconsistency in current applications;
- A more strategic approach to intertidal net gain is favoured by marine industries, and could also be efficient for highly urban areas. Restrictions on mitigation hierarchy actions and BU supply options on the coast mean that a planned approach, complementing existing compensation under habitats regulations, and contributing to sustainable management of coastal environments, is likely to be more efficient and is favoured by marine industries.

Key risks are for market failures through lack of information and trust, and policy failures through ineffective design and regulation. In particular:

- The confidence of suppliers and wider stakeholders in the market will be undermined by poor regulation or practice. For example, a lack of intention or capacity of local authorities to ensure use of the mitigation hierarchy, and a lack of transparency and/or consistency (such as between on-site and off-site delivery of BUs), risk establishing low standards.
- Government's planned seller of last resort powers present a major policy risk, because they could be a significant deterrent to investment in market supply. The seller of last resort powers could produce a perverse incentive: by deterring supply it could exacerbate the market scarcity that it is designed to alleviate;
- A lack of capacity (both of workforce time and skills), such as in local planning authorities, to operate the regulations shaping the market are a risk, and serve to compound the two risks above, and
- The current lack of clarity on stacking and bundling BUs with carbon and or nutrient credits could also deter supply.

Good operation of market regulations from the outset can create a positive spiral, whereby good practice reinforces confidence in the market. This will encourage investment in supply, reducing the risks of scarcity causing price increases.

4.2 Recommendations

The recommendations presented here are based on the work undertaken in this study, which has analysed the expected market based on current policy proposals and instruments. The recommendations are summarised in Table R1 below, which also provides suggested timing for each.

1. Increase understanding of the BNG market

Underlying these recommendations is a need to increase knowledge amongst stakeholders of the BNG market.

1a. Clearly communicate that trading of BUs will be in a BNG compliance market, and increase understanding across stakeholders of what a compliance market is and how it is expected to function. The diagrams developed for this study offer a starting point to build this understanding and who can control the key factors that will determine its success.

2. Ensure clear and effective regulation of the BNG market

A large majority of stakeholders inputting to our work want to see the BNG market regulated in a comprehensive and transparent way at both the local (i.e. planning application) scale by LPAs, and the national (policy system) scale. As the regulator, the Government needs to:

2a. Take the initiative to build trust in the policy process and how it will be implemented - recognising that self-assessment creates moral hazard, transparent monitoring, independent verification and enforcement of standards is needed to:

- (i) avoid the risks to business and the environment from unscrupulous operators, and
- (ii) improve the baseline level of trust in Government to deliver a well-regulated market, which is low.

Over time, trust can be built for local market participants by developing ratings in the registry (similar to other online ratings, such as on Trustpilot). Nationally, Government should commit to a review of the regulatory system by the National Audit Office within the first two years of market operation.

2b. Ensure consistent application of BNG standards to on-site delivery of BUs by developers, and off-site delivery by 3rd parties. This can be demonstrated through including both on- and off-site actions in the forthcoming online registry, which could contain information such as BU calculations, monitoring plans and results, audit results, and the details of sellers, buyers and auditors.

2c. Provide clear guidance on stacking and bundling of BUs and ELMs payments, carbon and/or nutrients credits - as these help make markets operate transparently and encourage supply.

2d. Further guidance can also help in specific contexts such as highly urban areas or the two island LPAs (Isles of Wight and Scilly).

2e. Have sufficient regulatory capacity in place at both the local scale and the national scale. Local capacity should be sufficient to enable effective regulation of planning applications/developments and their BU transactions by LPAs, including to ensure the data requirements of the national register are met. Data from the register can inform national oversight of the BNG policy system and market outcomes by an independent body with statutory powers, such as the Office for Environmental Protection.

3. Avoid policy failures

As a compliance market, BNG market will be prone to policy failures.

3a. Currently the biggest risk to the future BNG market is governance. While the policy design is led by Defra, the department does not control the governance and funding of LPAs and the development activity that gives rise to BU demand. Policy risk could be reduced by a coordinated government strategy, co-published by Defra, HMT, DfT and MHCLG, committing to:

- Consistent on-site and off-site standards and enforcement;
- Specific circumstances and time period (say 2 years) when the seller of last resort powers will be used (see also 3a);
- Adequate human resources and skills to regulate the market; and
- Clear policies and rules for sellers and buyers (see 1 and other recommendations).

3b. To build confidence in the market regulation process, those involved in BNG markets should implement the Nolan Principles of Public Life (for institutional administration and personal conduct)²⁶, in particular:

- Selflessness, integrity, objectivity, accountability, openness, honesty and leadership, and
- Openness, objectivity, accountability and leadership.

4. Supply side interventions when Government is a supplier of last resort

While the BU market is a regulated one, for it to be sustainable, all stakeholders need to be fully engaged.

4a. Government's role as the seller of last resort should be minimised. The Government's seller of last resort powers presents a major policy risk, because they will deter private investment in BU supply. This could produce a perverse incentive by exacerbating the market scarcity that it is designed to alleviate. Our modelling suggests that the ability to trade across LPA boundaries reduces the need for such powers to a small number of highly urban LPAs. Therefore, the planned seller of last resort powers should be dropped or be very limited.

If the seller of last resort powers are used:

4b. Government can be an exemplar of high standards, helping to maintain them and to generate trust, on the quality of the BUs they supply. Full transparency will be key, in particular around how decisions are made, the form of contracts and how much is paid to suppliers.

4c. The policy risks and perverse incentives will be lower if the powers have a sunset clause²⁷ (possibly of 2 years). This will incentivise all parties to plan for Government's withdrawal from the market, encouraging supply from habitat bankers, and incentivising regulators to enable habitat banking.

4d. The prices set as seller of last resort should be significantly above the market level (at least 30% higher to not undercut trading with neighbouring LPAs, and probably 50% or more higher). Setting this price is challenging as it is difficult to know the market price until the market has formed, and also a need to allow for differences in prices for BUs for different habitats (which may vary by more than 30%). Insights from habitat banking and/or other supply side interventions could help determine prices (see 5).

5. Other supply side interventions

Government may find other market interventions more preferable, or use them alongside the seller of last resort powers, such as:

5a. Investing in supply - potentially including investing in habitat banks (e.g. for coastal habitats, or for supply to highly urban areas), and/or Government making ex-ante commitments to purchase a certain level of BUs in each LPA (or other zone, such as national character area or local nature recovery strategy areas).

This could:

- Link to the design of the ELM scheme, and could give land managers the option to sell to Government. This would require longer time-periods for agreements than typical for past agri-environment schemes (or 5 or 10 years).

²⁶ <https://www.gov.uk/government/publications/the-7-principles-of-public-life>

²⁷ *Meaning they will come to an end after a specific period of time, and can only be renewed through explicit decisions of Ministers in line with pre-defined criteria relating to market conditions caused by inadequate supply*

- Use BU purchase commitments as a mechanism to pump prime the market through a floor price mechanism, encouraging supply through habitat banks (similar to the function of the Woodland Carbon Guarantee).

5b. Running a reverse auction for BU supply (or a double reverse auction for demand and supply) to initiate the market. This could cover the whole country, or (possibly as a pilot) specific spatial areas (e.g. those with predicted scarcity), or certain habitats (e.g. intertidal habitats to shape a strategic policy response).

5c. Providing a scheme to insure or re-insure supply of BUs. This would then provide an incentive for Government to regulate supply effectively to reduce its insurer risks. A re-insurance system could work like the Flood-Re scheme, with a standard payment on insurance contributing to a re-insurance fund, supported by Government.

These three supply side interventions may be no-regrets and more effective actions than acting as seller of last resort. In the worst case their outcome would be biodiversity enhancements that would help deliver 25 Year Environment Plan/ nature recovery strategy objectives. They could also help establish the actual costs of supply, signalling expected prices to the market, and if used, set the price for Government 'seller of last resort' units. They can be introduced to initiate the market and/or as pilots for particular locations/habitats, providing information to help assess if more market support is needed over time.

6. Demand side interventions

BU trading is intended to be the final step in the mitigation hierarchy. To ensure this principle is upheld, the market needs include:

6a. Promoting good mitigation hierarchy practice, including consistent on-site and off-site practices and standards for delivery of BUs, through the same or aligned regulatory processes (See 2b above).

6b. Extending the BNG requirements to cover Nationally Significant Infrastructure Projects, possibly with extra flexibility to source BUs from a wider spatial area (e.g. through agreement within collaborating LPAs), enabling strategic delivery of BNG.

7. Invest in institutional capacity, training and transparency

Effective regulation of a compliance market needs to have adequate staff resources and skills in place across stakeholders, in particular LPAs, but also other bodies to ensure transparency of process and separation of roles to avoid conflicts of interest. The BNG market will involve unusually long time-frames, needing specialist regulatory skills embedded in the institutions to ensure they function as intended and achieve their aims.

7a. Quantify the necessary LPA staff time, training and information to ensure a well-functioning BU market, in line with the recommendations above in a 'readiness' study for BNG - this Action is already underway in Defra-sponsored work by ALGE and ADEPT. The sooner this is carried out, the more time will be available for preparation of governance and other issues to be addressed.

7b. Deliver training for a range of stakeholders collectively²⁸, in order to increase mutual understanding and trust, and facilitate the new collaborations between stakeholders necessary to make BNG policy a success.

7c. Training for the public sector (LPAs, but also departments like MoD) in identifying public land for use for BU supply.

7d. Lay out transparent responsibilities and capacity for oversight of individual BU transactions by LPAs, and of the operation of the market in delivering BNG nationally. The latter should sit with the Office of Environmental Protection or similar independent national body with statutory powers, taking combined oversight of BNG, carbon and other environmental markets.

7e. As a signal of transparency, Government should commit to a review of the regulatory framework, responsibility and skills by the National Audit Office within the first two years of market operation.

7f. Terminology – clarify and establish shared understanding. Biodiversity ‘credits’ are already widely used in net gain literature and practice, and so use of the term to denote Government sold BUs will lead to confusion.

7g. Create incentives for LPAs to prepare for the market – for example putting in place minimum requirements (such as regulatory resources, and monitoring processes for on-site BNG actions) before they can fully participate in the market (e.g. allowing cross-LPA boundary trading for all habitats).

8. Research the strategic policy need for urban areas and coastal habitats

Urban areas and coastal habitats are both harder to analyse with the available modelling information and methods.

8a. Strategic policy measures may be required for coastal habitats and urban areas, and further policy research is recommended to explore the possible geographical constraints that could inhibit market activity, including lack of local supply, and strategic approaches to overcoming them.

8b. Strategic approaches to supply intertidal BUs, that complement the existing habitat regulations and utilise habitat banking should be encouraged, and could be led by Government. Intertidal habitat supply is likely to be restricted due to existing designations and the limited area of the intertidal zone. In addition, compensation activity is already widespread under the Habitats Regulations, and economies of scale are very important for intertidal habitat creation.

9. Explore further spatial analysis

Current spatial analysis capability can combine data layers on consumption of land for development and affected habitats in a more sophisticated way than had previously been thought possible. With further work such analysis could support stronger conclusions and recommendations, in particular, analysis could be extended by:

- Using a detailed 2014 habitat map to better understand the footprint of development;

²⁸ Building on existing training by CIEEM: [Biodiversity Net Gain Through Development \(cieem.net\)](https://www.cieem.net/Biodiversity-Net-Gain-Through-Development)

- Using this to identify enhancement opportunities, linking this to the Metric (2.0 or subsequent version) parameters, such as difficulty, time to target and LPA boundary factors, to understand the supply and demand incentives it gives for different habitats and therefore different areas of England. In particular, the Metric 2.0 design is based on biodiversity conservation (i.e. protection) priorities, and not the dynamic market incentives it will create. For example some 'difficulty factor' weights are very high to deter damage, but will also deter feasible actions to generate BUs by restoring higher-distinctiveness (and priority) habitats (e.g. blanket bog);
- More analysis of coastal development projects, and
- Compare national spatial analyses with data sets within specific LPAs which have been the subject of bespoke analyses.

There is potential for this further mapping to enable better market analysis, constructing a valid demand curve for BUs in each LPA. However, quantifying a supply curve would remain highly uncertain: as local land manager motivations and BU supply opportunities are hard to ascertain and model, and the new incentives provided by BNG policy are designed to change them. Research can also look at future patterns of development, including scenarios where development is concentrated in certain LPAs and/or habitat types.

These recommendations are summarised in the table below. It should be noted that a combination of these recommendations is needed to effectively influence policy implementation – for example combining proper resourcing of local authorities and regulators, together with supportive market mechanisms like a BNG price guarantee and/or reverse auctions.

Recommendation	Lead	Others directly involved	Timescale*				Comments
			Pre	ST	MT	LT	
1. Increase understanding of the BNG market							
1a. Communicate that trading BUs will be a compliance market.	Defra	NE, MHCLG, NE	■	■			
2. Ensure clear and effective regulation of the BNG market							
2a. Independent verification and enforcement of standards	Defra	HMT, LPAs, OEP, EAC	■	■	■	■	
2b. Consistent on-site and off-site BNG standards		NE, LPAs	■	■	■	■	
2c. Clear guidance on stacking and bundling of BUs and other env. credits		NE	■	■	■	■	
2d. Guidance for island LPAs (Wight and Scilly)		NE	■	■	■	■	
2e. Sufficient regulatory capacity is needed		LPAs, OEP	■	■	■	■	
3. Avoid policy failures							
3a. Coordinated Government strategy committing to market operation	Defra & HMT	LPAs, MHCLG, DfT, NE	■	■	■	■	
3b. BNG market actors implement the Nolan Principles of public life			■	■	■	■	
4. Supply side interventions							
4a. Minimise Government's role as the seller of last resort.	Defra	LPAs, NE	■	■	■		Increasing over time
<i>IF a seller of last resort:</i>							
4b. Government can be an exemplar of high standards	Defra	NE					Whenever a seller
4c. Apply a sunset clause	Defra		■	■			
4d. Prices should be significantly above the market level (probably 50% or more higher).			■				& whenever a seller
5. Other supply side interventions							
5a. Government investments in supply (e.g. habitat banks), possibly through floor price	NE	Defra, HMT, LPAs	■				& as long as needed
5b. Government run a reverse auction for BU supply (or a double reverse auction for demand and supply) to initiative the market	NE	Defra, HMT, LPAs		■			
5c. Government (re-)insurance of supply of BUs.	Defra	NE, HMT		■			

Recommendation	Lead	Others directly involved	Timescale*				Comments
			Pre	ST	MT	LT	
6. Demand side interventions							
6a. Promote good mitigation hierarchy practice	Defra	NE, LPAs					
6b. Extend the BNG requirements	Cross-Government						
7. Invest in institutional capacity, training and transparency							
7a. Quantify the necessary resources to ensure a functioning BU market in a readiness study	Defra	LPAs, NE					
7b. Deliver training for a range of stakeholders collectively	NE	Defra, LPAs, DfT, MHCLG, HMT					
7c. Training in identifying public land for use for BU supply	NE	LPAs, all departments who own land					
7d. Lay out clear responsibilities and capacity for oversight of individual BU transactions, and of the operation of the market in delivering BNG	Defra & HMT (as 2)	LPAs, MHCLG, DfT, NE					
7e. Commit to a review of the regulatory framework, responsibility and skills by the National Audit Office within the first 2 years of the market.							
7f. Clarify and established shared understanding Terminology	Defra	NE, HMT					
7g. Create incentives for LPAs to prepare	MHCLG	NE, Defra					
8. Research the strategic policy need for urban areas and coastal habitats							
8a. Strategic policy measures may be required for coastal habitats and urban areas, and further policy research is recommended.	Defra	NE, HMT DfT for coast					
8b. Develop strategic options to supply intertidal BUs	NE	Defra, HMT					
9. Explore further spatial analysis							
e.g. of development impacts on specific habitats, and implications of metric parameters	Defra	NE, HMT		& when metric or market rules revised			
*Timescales: Pre: Pre—market, i.e. before mandatory requirement triggers England wide market ST: market years 1-2 MT: market years 3-5 LT: market years 6-10 and onwards							

References

See Evidence Annex

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