1 How do we achieve nature positive? A vision and targets for the

- 2 UK residential and commercial development sector
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33 Abstract

34 The Kunming-Montreal Global Biodiversity Framework's 2050 Vision depicts a world living in 35 harmony with nature where "biodiversity is valued, conserved, restored and wisely used, 36 maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for 37 all people". To achieve this vision, alternatives to business-as-usual are urgently needed, 38 especially in the highest impacting sectors. Here we demonstrate the use of visioning and target 39 setting to create an actionable roadmap to a 'nature positive' future for the UK residential and 40 commercial development sector. During an online workshop, ten expert participants defined a 41 shared vision for the development sector in 2050, and worked collaboratively to identify interim 42 targets required to achieve that vision. The resulting roadmap highlights the need to improve 43 biodiversity monitoring and assessment methods, strengthen Biodiversity Net Gain metrics, 44 increase ecological literacy and conservation funding, and enhance community access to, and 45 connection with, nature.

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47 **1. Introduction**

48 The Global Biodiversity Framework agreed to by 196 governments in Montreal, 2022, explicitly 49 calls for action to halt and reverse biodiversity loss by 2030, and to create a society where 50 "biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, 51 sustaining a healthy planet and delivering benefits essential for all people" by 2050¹. This has 52 amplified discussion around the concept of 'nature positive', especially in the private sector and 53 government. The term nature positive refers to the goal of having greater biodiversity in the 54 future, compared to a baseline of 2020^{2,3}. To achieve net positive biodiversity by 2030 and the 55 Global Biodiversity Framework's 2050 Vision for Biodiversity, alternatives to business-as-usual 56 approaches are urgently needed in the highest impacting sectors⁴. It is critical to reach these 57 goals if we hope to recover threatened species, maintain the ecosystem services society 58 depends on, mitigate climate change and minimise its impacts globally. However, the pathway 59 to a nature positive future is still unclear, and has generated multiple questions around where to 60 invest resources, what actions should be prioritised, how to measure impacts on biodiversity, 61 and who the important actors are for realising the Global Biodiversity Framework's 2050 62 Vision^{5,6}.

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64 The Global Biodiversity Framework's Target 12 aims to "enhance green spaces and urban 65 planning for human well-being and biodiversity" by increasing "the area and quality, and 66 connectivity of, access to, and benefits from green and blue spaces in urban and densely 67 populated areas sustainably". This target is particularly important for the residential and 68 commercial development sector as the expansion of urban areas is one of the largest contributors to biodiversity loss globally⁸. Urban development influences biodiversity directly via 69 70 i) vegetation clearing, which reduces the extent, quality and connectivity of habitat^{9–11}, and ii) the 71 construction of infrastructure, which is associated with increased threats and disturbances from 72 people, domestic pets, vehicles, anthropogenic noise and artificial light at night^{10,12-16}, and 73 indirectly through iii) the extraction of raw materials, production of building supplies and related

- supply chains, and carbon emissions which exacerbate climate change^{17–20}. Considering the
- 75 global population is projected to increase by almost two billion people by the year 2050²¹, these
- 76 impacts are likely to increase significantly in the coming decades.
- 77

78 Despite the many threats posed by residential and commercial development, urban areas can 79 represent critical habitat for biodiversity²², including threatened species^{23,24}. Research has 80 shown that the provision of quality habitat in cities, such as native vegetation, mature trees, 81 biodiverse gardens, riparian corridors and freshwater ecosystems, can help promote the occurrence of individual species and the diversity of multiple taxonomic groups, including 82 birds^{25–28}, insects^{29–31}, mammals^{28,32,33}, and amphibians^{34–36}. Such actions may enable the 83 conservation of species in modified environments, while also providing benefits for people in the 84 85 form of improved physical health, mental wellbeing, and the provision of key ecosystem services^{37–39}. For example, neighbourhoods with high levels of greenery are associated with a 86 reduced risk of cardiovascular disease and mortality³⁸, and children in more biodiverse childcare 87 centres and schools often have healthier skin and gut microbiota, improved lung function, and 88 89 fewer allergies^{40–42}. Further, urban areas with more trees and vegetation cover, a greater abundance and diversity of birds, and more natural green space are correlated with improved 90 mental health outcomes^{37,43,44}, greater life satisfaction⁴⁵, and stronger social relations among 91 residents⁴⁶. The inclusion of biodiversity in residential neighbourhoods can also help deliver key 92 93 ecosystem services that support human habitation, such as shade and cooling, air and water

- 94 filtration, and carbon sequestration^{39,47,48}.
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96 Given the need to conserve species in cities and the importance of nature for human health and 97 wellbeing, it is imperative that the development sector integrates biodiversity into their decision 98 making. Whilst the mitigation hierarchy is widely championed as the appropriate framework for 99 alleviating biodiversity loss associated with new developments, in practice, there is limited 100 evidence for robust application of the avoidance step and frequent suggestions that offsetting has become the default option^{49–51}. A reliance on offsetting presents multiple challenges to 101 achieving no net loss of biodiversity^{52–54}. With land scarcity limiting available options for offset 102 sites, in some jurisdictions it may be physically impossible to continue to offset biodiversity loss 103 104 and achieve the Global Biodiversity Framework nature positive 2030 goal⁵⁵. Additionally, 105 capacity constraints weaken the regulatory system so that it can be exploited by developers with financial and political resources⁵⁶. The way in which biodiversity value is assessed also varies 106 107 considerably, from simple measures of habitat area and condition to more functional, ecological 108 metrics such as species diversity, habitat suitability and landscape-level connectivity^{57–60}. 109 Ensuring that offset projects deliver equivalent conservation values to those lost due to 110 development is therefore complex, especially considering factors such as ecological processes, 111 spatial and temporal dynamics, cumulative impacts, and equity considerations such as 112 separating people from the nature that existed at a site⁶¹. Previous research has found that 113 offsets tend to facilitate the relocation of biodiversity away from urban areas and areas with 114 higher land prices⁶². This can lead to the loss of critical ecosystem services in the places where 115 people live, work and play, thereby compromising the climate resilience and sustainability of 116 urban communities.

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119 particularly strong in the United Kingdom. England (environmental policy is devolved in the UK) 120 has committed to a legally-binding target to halt wildlife declines nationally by 2030⁶³ and, since 121 April 2024, has mandated that all new developments - with a few exceptions - achieve a 122 'Biodiversity Net Gain'⁶⁴. At the same time, it has committed to ambitious targets for expanding 123 housing infrastructure, aiming to deliver 1.5 million new homes in the next five years^{65,66}. 124 Housing infrastructure remains one of the largest drivers of biodiversity loss in England⁶⁷. 125 Mitigating the potential trade-offs between residential infrastructure expansion and biodiversity 126 will require a mixture of sound ecological compensation policy and changes in socio-political 127 conditions that allow underutilised housing stock to help meet housing demand (e.g., through 128 policies that tackle inequalities in the consumption of floor space (see ⁶⁸)). 129

The tension between residential and commercial development and biodiversity policy is

- 130 England's Biodiversity Net Gain (BNG) policy stipulates that new developments must leave
- biodiversity in a measurably better state by providing a 10% BNG⁶⁴. This equates to a 10%
- 132 increase in biodiversity units (a habitat-based proxy for measuring biodiversity⁶⁹) post-
- 133 development, achieved by following the mitigation hierarchy, and offsetting any residual losses
- by enhancing habitat on-site (i.e., within the development footprint), or off-site as a last resort.
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136 BNG has increased the consideration of biodiversity in the planning process and the biodiversity

- 137 metric promotes adherence to the mitigation hierarchy by assigning high scores to priority
- habitats, making them costly to offset. However, the use of a simple habitat proxy has led to
- criticism as it may undervalue habitats that are important for biodiversity⁷⁰. Evaluations of the
 metric have found that it does not correlate to other biodiversity metrics, such as the occurrence
- 141 of species of conservation concern^{71,72}. This has led to concerns that BNG may not fully
- 142 compensate for losses of biodiversity from development. Governance presents an additional
- 143 challenge. It is estimated that 27% of biodiversity units delivered are at high risk of non-
- 144 compliance as they are delivered on-site (i.e., within the development footprint) where they are
- 145 unlikely to be monitored⁷³. Indeed, a recent report estimated that just 53% of the promised
- 146 ecological features were present in new developments across the UK⁷⁴. Although BNG is a
- significant step forward for reconciling biodiversity and planning, there are still important
- 148 considerations around whether we are using robust metrics and ensuring the system is subject
- 149 to good monitoring and governance.
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151 Transforming the impact of the residential and commercial development sectors on biodiversity 152 is an extremely challenging task. These sectors drive economies, are major employers, and 153 have political capital due to lobbying and housing shortages. Further, cognitive biases such as 154 confirmation bias - the tendency for people to focus on information that supports what they already believe and ignore information that contradicts it⁷⁵ - can make it difficult for stakeholders 155 to comprehend such a large, insurmountable problem^{75,76}. At present, there is no clear plan for 156 157 transforming the development sector, and further research is urgently required to better define 158 the concept of nature positive development and identify a viable pathway forward. Future 159 visioning and target setting is a form of backcasting which can help stakeholders identify a desired future⁷⁷, and then break it down into discrete, time-bound goals^{78,79}. Such an approach

desired future⁷⁷, and then break it down into discrete, time-bound goals^{78,79}. Such an approach
 may help stakeholders to see beyond problems and solutions that are constrained by business-

- as-usual thinking, in order to articulate the parameters of a nature positive society and
- 163 development sector and then map out a viable pathway to that future. While this method has
- been used to envision climate change mitigation and adaptation pathways⁸⁰, it is yet to be
- 165 widely applied to biodiversity conservation⁷⁷, especially in the context of nature positive
- 166 transitions.
- 167

168 This study examined how changes in the residential and commercial development sector can 169 contribute to achieving the Global Biodiversity Framework's 2050 Vision for Biodiversity and a 170 nature positive future, using the United Kingdom as a case study. This is the first study, to our 171 knowledge, to employ future visioning and target setting in the context of nature positive 172 development. During an online workshop, we tasked a group of ten experts to define a 2050 173 vision for the UK residential and commercial development sector, propose relevant time-bound 174 targets for three time points (2050, 2040 and 2030), and discuss the immediate actions and 175 relevant actors required to achieve this vision. We aimed to: i) demonstrate the application of 176 future visioning and target setting in a nature positive context; ii) identify the key themes 177 emerging from expert discussions; and iii) map out a pathway for transitioning the UK residential 178 and commercial development sector towards a nature positive future.

179

180 **2. Results**

181 2.1 Reflection on the application of future visioning and target setting

182 We conducted a single day, online workshop with ten expert participants. The workshop 183 employed a backcasting approach and the established methods of future visioning and target 184 setting^{78,79,81}. Rather than forecasting a potential future based on current settings, the 185 participants started with a desired end point for 2050 and worked backwards to 2030, allowing 186 them to break down the nature positive transition into discrete, achievable steps. The workshop 187 was divided into three stages in which participants were encouraged to: i) envisage a desired 188 future for 2050 and collaboratively draft a vision statement; ii) work backwards to define interim 189 targets (2050, 2040 and 2030) required to achieve that future; and iii) identify any actions and 190 relevant actors necessary to achieve them. 191

192 The workshop proved to be a novel and effective approach to co-design, with academics,

- industry, government, and non-government organisations represented. Participants found the
- 194 method of starting with a vision for 2050 and working backwards to 2030 to be effective in 195 helping them to think long term. One participant stated that *"it is often challenging to think long-*
- 196 *term like this at work as I am focused on the day-to-day and short-term priorities*".
- 197
- 198 2.2 Overview of workshop outputs

Our expert participants developed a broad vision for how the UK residential and commercial
 development sector could contribute to the Global Biodiversity Framework's 2050 Vision and a
 nature positive future (see Supplementary Material 1 for the full vision statement):

203 Text box 1. Participant developed vision statement 204 "By 2050, the development sector recognises people spaces as nature spaces, whereby nature 205 is comprehensively valued as an asset, nature-based approaches are embedded in 206 development, and nature has a prominent place in decision making across the development 207 cycle. Developments maximise the benefits to people and nature, creating connection with 208 nature, and normalising nature protection, regeneration and stewardship." 209 210 During workshop discussions, the participating experts identified 53 time-bound targets 211 spanning ten different themes, namely: 1) Biodiversity Net Gain and supply chains; 2) Nature-212 based solutions; 3) Community stewardship and connection to nature; 4) Management of 213 waterways; 5) Community access to nature; 6) Corporate governance and leadership; 7) 214 Government budgets; 8) Ecological literacy and education; 9) Biodiversity monitoring and 215 evaluation; and 10) Land-use planning (see Table 1; Figure 1). 216 217 Experts also identified 22 actions and 17 actors which accompanied the targets (see Table 2). 218 The majority of actions discussed (19/22) were focused on immediate priorities for the current 219 decade (i.e., 2030 targets). In our opinion, this is a strength of the backcasting approach. Future 220 visioning enables identification of desirable futures and interim targets that are not constrained 221 by business-as-usual; short-term action planning enables identification of the key actions we 222 need to undertake now to set us on the pathway towards the first and subsequent targets. 223 224 The ideas and concepts communicated by the participating experts were summarised as a 225 potential roadmap to a nature positive future (see Figure 1), and visualised in a pair of 226 landscape renders depicting aspirational urban environments (Figure 2).

Theme	2030	2040	2050
<u>Theme 1:</u> Biodiversity Net Gain (BNG) and supply chains	 75% of new commercial and residential developments deliver a BNG of at least 20% within the development footprint (exceeding the mandatory BNG of 10%). Methods are established for assessing biodiversity impacts from supply chains, and baseline measurements are obtained for the UK residential and commercial development sector. 50% of UK developers pledge to stop clearing trees during the development process. 	 100% of new commercial and residential developments deliver BNG of at least 20% within the development footprint, eliminating the need to offset operational impacts on biodiversity. 50% reduction in biodiversity impacts from supply chains across the development sector, relative to the 2030 baseline. 100% of UK developers pledge to stop clearing trees during the development process. 	 100% of new commercial and residential developments deliver BNG of at least 20% within the development footprint and surrounding the site, across the lifecycle of the build, eliminating the need to offset supply chain impacts on biodiversity. 100% reduction in biodiversity impacts from supply chains across the development sector, relative to the 2030 baseline.
<u>Theme 2:</u> Nature- based solutions	100% of public buildings (e.g., schools, libraries, governments) are retrofitted using nature-based solutions to enhance biodiversity. Public buildings lead the way with positive messaging on the benefits of urban greening and nature-based solutions.	100% of new residential and commercial builds in the UK include green walls and/or biosolar green roofs. 100% of new residential developments incorporate nature-based solutions in shared public spaces (e.g., street trees, rain gardens).	100% of public buildings, private buildings and shared public spaces enhance biodiversity via nature-based solutions. Nature-based solutions are seen as critical infrastructure in the development process including the building materials, design, architecture, engineering, building lifecycle and supply chain.

Table 1. A summary of the targets that emerged from the workshop for 2030, 2040 and 2050.

Theme	2030	2040	2050
<u>Theme 3:</u> Community stewardship and connection to nature	 50% of UK citizens are connected to nature (i.e., have measurable connection to nature; (e.g., ⁸²) and act positively for nature. 50% of natural green spaces have dedicated community groups to support biodiversity management. 	 75% of UK citizens are connected to nature and act positively for nature. 75% of natural green spaces have dedicated community groups to support biodiversity management. 	 100% of UK citizens are connected to nature and act positively for nature. 100% of natural green spaces have dedicated community groups to support biodiversity management.
<u>Theme 4:</u> Management of waterways	 50% of farms adjacent to waterways are implementing nature-based solutions like buffer strips. 25% of rivers and waterbodies in the UK are swimmable. 	 100% of farms adjacent to waterways are implementing nature-based solutions like buffer strips. 50% of rivers and waterbodies in the UK are swimmable. 50% of surface water drainage systems in the UK are upgraded with nature-based solutions approaches to better manage water flows during storm events, and improve water quality and biodiversity outcomes. 	 100% of rivers and waterbodies in the UK record reduced levels of pollutants, so they are no longer considered harmful to human health or natural ecosystems. 100% of rivers and waterbodies in the UK are swimmable. 100% of surface water drainage systems in the UK are upgraded with nature-based solutions approaches to better manage water flows during storm events, and improve water quality and biodiversity outcomes.
<u>Theme 5:</u> Community access to nature	50% of UK residents have immediate access to nature due to the provision of trees, vegetation and natural green space.	75% of UK residents have immediate access to nature due to the provision of trees, vegetation and natural green space.	100% of UK residents have immediate access to nature due to the provision of trees, vegetation and natural green space.

Theme	2030	2040	2050
	50% of UK residents can access quality natural green space via public transport.	75% of UK residents can access quality natural green space via public transport.	100% of UK residents can access quality natural green space via public transport.
<u>Theme 6:</u> Corporate governance and leadership	 25% of UK corporate boards have a voice for nature represented. 100% of corporate boards have an increased diversity of board members, relative to 2023, to ensure a broader diversity of cultural perspectives on nature. 	75% of UK corporate boards have a voice for nature represented.	100% of UK corporate boards have a voice for nature represented.
<u>Theme 7:</u> Government budgets	1% of the UK government budget is spent on nature conservation.	5% of the UK government budget is spent on nature conservation.	20% of the UK government budget is spent on nature conservation.
<u>Theme 8:</u> Ecological literacy and education	 100% of UK local authorities employ an ecologist or natural environment expert. 25% of stakeholders involved in urban development projects have attended an ecological literacy program. 25% of UK school children have completed biodiversity-focused curricula, including a specific unit on the value of urban nature. 	 75% of stakeholders involved in urban development projects have attended an ecological literacy program. 75% of UK school children have completed biodiversity-focused curricula, including a specific unit on the value of urban nature. 	 100% of stakeholders involved in urban development projects have attended an ecological literacy program. 100% of UK school children have completed biodiversity-focused curricula, including a specific unit on the value of urban nature.
<u>Theme 9:</u> Biodiversity	100% of UK local authorities have completed a natural capital assessment.	100% of UK local authorities use natural capital accounts to understand	The monitoring and evaluation of biodiversity is a mainstream and independent process.

Theme	2030	2040	2050
monitoring and evaluation	More meaningful, holistic and independent methods are established by the national Government and implemented by 75% of local authorities and developers to monitor biodiversity.	trends in natural capital and inform decision-making. The established independent, national methods are implemented by 100% of local authorities and developers to monitor biodiversity.	
Theme 10: Land-use planning	Land-use planning in the UK takes a more holistic approach and considers all land-uses, including land for biodiversity and agriculture.	100% of urban spaces are designed to be multi-functional and provide amenities for people and nature.	Nature is afforded legal person status in the UK.

9	Table 2. A summar	y of the immediate actions and	d relevant actors required to achieve the	identified targets.
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Category	2030	2040	2050
Actions	Advocate for stronger BNG metrics and supply chain measures.	Establish an ecological evidence-base and fill knowledge gaps to inform future decision making.	Develop a portfolio of stewardship investment approaches including funding from public, private and
	Establish a working group to develop a more holistic, independent BNG measurement.	Advocate for corporations and governments to view every surface as a potential space for nature.	partnership investments. Mandate corporate investment in biodiversity conservation and/or
	Devise a new BNG measurement that considers individual species and ongoing maintenance and monitoring.		climate change mitigation
	Develop investment models to fund the retrofitting of nature-based solutions into existing developments.		

Category	2030	2040	2050
Actions (cont.)	Allocate sufficient funding to support local stewardship programs (e.g., through local authorities).		
	Develop a plan to upgrade every surface water drainage system in the UK by 2050. Compile and roll out a communications plan which highlights case studies of corporations making nature positive changes, and others that have been 'busted' for environmentally damaging practices.		
	Establish an alliance of NGOs to coordinate advocacy and communications for better board representation.		
	Legislate TNFD or another form of mandatory disclosure for all corporations in the UK. Redirect harmful subsidies to nature conservation programs across the UK.		
	Establish blended finance schemes (public and private investment) to adequately fund the Nature Positive transition (e.g., UK Nature).		
	Develop and roll out a corporate nature literacy program aimed at urban development professionals.		
	Introduce a new policy, backed by adequate funding, to require all local authorities in the		

Category	2030	2040	2050
Actions (cont.)	UK to employ sufficient natural environment expertise to meet demand.		
	Regulate the profession of ecology by requiring all ecologists employed in England to be accredited with the Chartered Institute of Ecology and Environmental Management.		
	Incentivise and promote environmental consulting as a career path for graduates.		
	Synthesise information and raise the profile of the economic cost of inaction.		
	Shift the burden of proof to focus on the value of a natural capital approach, rather than the cost of implementing changes.		
	Legislate mandatory contributions from relevant government departments to natural capital accounts.		
	Develop tools to collect, store and publicly share nature-based information to inform future decision making.		
Actors	Ecologists, soil scientists, water specialists, social scientists, health scientists, environmental practitioners, communications and marketing specialists, governments (national and local), financial investment firms, educators, local communities, homeowners, developers, landscape architects, urban planners, green space designers, maintenance contractors.		

231 2.3 A roadmap for nature positive development

The synthesis of workshop discussions and outputs resulted in the following narrative descriptions for each time point along the roadmap (Figure 1).

234

235 By 2030, more meaningful and holistic methods must be established and implemented to 236 monitor biodiversity and assess the biodiversity impacts from supply chains across the 237 development sector. Innovators and early adopters within the industry will have pledged to stop 238 clearing vegetation for development. All schools, libraries and government buildings should be 239 retrofitted using nature-based solutions to enhance biodiversity and deliver vital ecosystem 240 services for people and nature. These public buildings will lead the way with positive messaging 241 on the benefits of urban greening and help educate the wider community. By the close of this 242 decade, all local authorities in the UK will employ an ecologist or natural environment expert and 243 should have completed a natural capital assessment to establish a baseline and track progress. 244 One guarter of corporate boards will include a voice for nature that is informed by diverse

- cultures and perspectives.
- 246

247 By 2040, developers in the UK will have ceased clearing vegetation and all new commercial and 248 residential developments will deliver a BNG of at least 20% within the development footprint. 249 Collectively, this will eliminate the need to offset any operational impacts on biodiversity. The 250 inclusion of green walls and/or biosolar roofs on infrastructure, and street trees, rain gardens 251 and other nature-based solutions in public spaces, will ensure that all new developments are 252 multi-functional and provide amenities for people and nature (see examples in Figure 2). Every 253 UK local authority will use natural capital accounting to understand trends in their natural capital 254 and inform local decision-making.

255

256 By 2050, the biodiversity impacts from supply chains will be significantly reduced relative to the 257 2030 baseline. Rivers and freshwater bodies in the UK will be swimmable following upgrades to 258 surface water drainage systems. All residents should have immediate access to nature where 259 they live, and easy access to quality natural green space via public transport, active paths and 260 cycleways (Figure 2). Following the implementation of an ecological literacy program for 261 development stakeholders and urban biodiversity-focused curricula for school students, all 262 citizens will feel connected to nature and will act positively for nature. Finally, all corporate 263 boards will have a voice for nature represented and a minimum of 20% of the UK government 264 budget will be spent on nature conservation.

265

266 3. Discussion

267 The nature positive agenda includes a call for *transformative change*, acknowledging that

approaches that support 'business-as-usual' will not work^{83,84}. Achieving nature positive

269 outcomes in cities will demand innovative approaches to design, construction and governance

such that development not only minimises harm to biodiversity, but actively enhances and

271 restores ecosystems, aiming for a net positive impact on nature. In this study, we demonstrate a

272 practical method for envisaging a nature positive society and development sector in the year 273 2050, and eliciting the time-bound targets required to move from business-as-usual to that 274 desired future. The diversity of solutions generated by our approach was expansive, targeting 275 actions in settings as contrasting as school yards and corporate boards. The importance of 276 community engagement was also highlighted, including designs that encourage active 277 stewardship of nature, as depicted in Figure 2. Here we describe the key themes that emerged 278 from expert discussions, as well as the challenges to implementing nature positive interventions. 279 We also reflect critically on the method and discuss the next steps in achieving real world 280 change.

281

282 The vision statement agreed upon by our expert participants was comprehensive and extended 283 beyond the realm of the residential and commercial development sector. Represented in this 284 vision were aspects of all three perspectives, or value systems, identified in the Urban Nature 285 Futures Framework, namely: Nature for Nature, Nature for Society, and Nature as Culture⁸⁵. 286 Utilitarian values associated with Nature for Society⁸⁵ were particularly dominant amongst our 287 participants, with many targets and actions focused on the co-benefits that urban biodiversity 288 and nature-based solutions can bring to society via improvements to human health, mental 289 wellbeing and connection with nature. Setting a future vision unconstrained by status guo 290 settings enabled participants to identify immediate actions to assist in industry transformation 291 that may not otherwise have been salient to them.

292

293 The participants in the workshop shared inspired and innovative solutions. One of the more 294 unexpected and novel ideas was to ensure the interests of 'nature' are represented on 295 corporate boards. Over the past decade, there has been considerable academic and practical efforts given to granting nature legal rights⁸⁶, or even legal personhood (e.g., the Whanganui 296 297 River in Aotearoa⁸⁷). This requires a person or group of people to act on behalf of nature, 298 providing guardianship over its interest. Less attention has been given to consideration of the 299 environment as a stakeholder, or as our participants suggested, giving a voice to nature on corporate boards⁸⁸. This was a widely supported suggestion, not only for development 300 companies but across all sectors to generate broad transformative change. The impetus for this 301 302 radical move was the belief that it could mainstream environmental considerations through a 303 top-down process. While this may be deemed idealistic, there is at least one instance where a 304 similar approach has been successful in influencing company decisions: Faith In Nature was the 305 first organisation to give formal representation to nature on their board of directors⁸⁹ and now 306 considers potential environmental impacts in all company decision-making⁹⁰.

307

308 Increased funding was raised as a necessity for transitioning to a nature positive future. Our 309 workshop participants set targets to substantially increase the funding that flows to nature over 310 the coming decades from the UK government and the private sector, via blended finance 311 schemes. By supporting any gains made through the development sector, increased funding for 312 nature can catalyse a transformational change in society's relationship for nature. The State of 313 Finance for Nature report released by the UNEP estimates that US\$200 billion of public money 314 was spent on nature-based solutions in 2023; one-third of what is needed by 2030⁹¹. Greater 315 investment could come from reversing harmful public subsidies that generate negative impacts

on biodiversity⁹², such as construction, electric utilities, real estate, oil and gas, tobacco, and
 some fisheries subsidies, and by identifying cross-sector investment wins (e.g., investing in
 biodiversity for equilation and the solution of the

- biodiversity for environmental, public health and social benefits). Part of this funding could beinvested in community stewardship groups and green corps to help manage natural assets and
- 320 create green jobs.
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322 During the workshop, offsetting came up as a surprising point of tension amongst participants. 323 Some experts advocated for off-site biodiversity gains via offsetting, citing the potential benefits 324 aligned with UK Biodiversity Net Gain (BNG) policy. Others felt that offsetting should be 325 eliminated entirely (preferably by 2030) and that nature positive outcomes could only be 326 achieved through on-site gains. This was one area of discussion where participants struggled to 327 reach a clear consensus, especially when discussing specific targets (e.g., the percentage of 328 BNG to be delivered). Ultimately, through discussion, there was agreement that a nature 329 positive society required the gradual phase out of offsetting policies and, alongside this, a 330 commitment to eliminating on-site biodiversity losses altogether. There was also a belief among 331 participants that biodiversity loss would no longer be accepted in a future society. The gradual 332 phasing out of offsetting is reflected in the targets proposed in Table 1, by first eliminating their 333 use to offset direct development impacts and then phasing out their use in offsetting supply 334 chain impacts. Given the current lack of transparency of supply chains, this will be a large 335 undertaking, but there have been recent advances in directly measuring and developing proxies 336 for supply chain impacts⁹³.

337

As it stands, the BNG metric is inadequate⁷⁰ and may result in unintended biodiversity loss. This is likely similar across multiple contexts where biodiversity gain calculators exist⁹⁴, but the UK context is unique as the government plans to assess the current offsetting policy in six years (2030), as well as the metric that underpins biodiversity gain (or loss) measurements. One of the more actionable targets emerging from the workshop was to support a more holistic measurement of the environment and biodiversity to include additional elements such as water, soil and social benefits (e.g., benefits related to human health and connection to nature).

346 Participants expressed a number of potential broad and specific challenges to the targets 347 identified. A concern for any greening project is appealing to the broader public preferences for 348 nature in urban environments. This requires implementing creative solutions that blend 349 biodiversity interventions with functionality. For instance, biodiverse green walls and roofs have the potential to provide habitat and connectivity for native species^{95,96}, while also enhancing 350 local air quality, property value and building cooling, leading to energy savings⁹⁷. Given societal 351 352 preferences, biodiversity integration into urban environments should appear intentional with cues to the public that it is a managed intervention⁹⁸ that provides benefits for people and 353 nature. Similarly, efforts will be needed to manage the expectations of the public to understand 354 355 the timeframes associated with biodiverse plantings increasing amenity value, and the need to 356 continue to fund and maintain such projects in the long-term. 357

Whilst not discussed in detail during our workshop, an increase in biodiversity in cities can result in negative human-nature interactions⁹⁹. For example, urban greening initiatives may lead to an increased abundance of insects, which could evoke feelings of fear and disgust among the
 public¹⁰⁰. Plantings may also exacerbate allergy symptoms for some people¹⁰¹, result in more
 wildlife-vehicle collisions by providing habitat for fauna¹⁰², and contribute to the spread of
 zoonotic diseases¹⁰³. These trade-offs must be considered and addressed as they have the
 capacity to influence the feasibility and acceptance of nature positive development interventions
 (such as those depicted in Figure 2¹⁰⁴).

366

367 Achieving a transformational change in the development sector and the urban environment will 368 need to coincide with complementary changes across broader society¹⁰⁵. Many of the targets 369 and solutions that were suggested are outside the scope of both the development industry and 370 urban governance. For instance, making the Thames swimmable would require a basin-wide 371 strategy supporting rural landholders to reduce or eliminate agricultural pollutants from entering 372 into the Thames catchment, while also undertaking an engineering feat similar to that attempted for the 2024 Paris Olympic Games (see ^{106,107}). But there is substantial benefit to considering 373 374 these challenges cross-sectorally as the solutions will account for the interconnectivity of the 375 system and the impacts will be amplified. An integrated, systems-thinking approach, 376 underpinned by genuine collaboration and cooperation between governments and the private

- 377 sector, will be necessary to achieve nature's recovery.
- 378

We found the approach of future visioning and target setting to be an effective way of

generating novel solutions to a large, complex problem like the nature positive transition.
 However, our method could be improved in several ways. It is likely that a different group of
 experts may have derived a different suite of targets and actions, although our participants were

383 quite explorative, and their discussions covered significant ground (as evident by the ten themes 384 identified). The expertise of our participants spanned a wide breadth of topics (see section 4.2 385 Expert participants); however, despite invitations, we were unable to attract property developers 386 or builders to the workshop. The inclusion of such representatives may have resulted in less 387 ambitious targets, or different targets and actions entirely. Additionally, we had two subgroups of 388 participants focus on different themes. While the resulting targets were presented, discussed 389 and adapted as a single, large group, if the makeup of the subgroups were different it may have 390 resulted in different targets.

391

Our participants spent longer than anticipated discussing and refining the future vision statement. Whilst this was a beneficial exercise, it left less time for the target setting process, resulting in fewer actions being identified for the 2040 and 2050 targets. Future applications of this method could aim to derive a collaborative vision statement prior to the workshop (via an online collaborative space or email), to maximise the amount of time for the backcasting process.

398

The next steps in this work are to focus on the actions underpinning targets from later decades (2040 and 2050), and to map out the potential barriers and enablers that may arise during the nature positive transition. The dissemination of our findings to the commercial and residential development sector is also of critical importance. This will require a detailed communications plan and clear identification of key stakeholders in the industry. While this was outside the scope of this work, the visualisations we produced (Figures 1 and 2) may help to communicatethe vision and inspire action and real-world change.

406

The timeframe for halting and reversing nature loss articulated in the Global Biodiversity
Framework (2030) is a mere five years away. Approaches to prioritising actions and identifying
actors needed to shift society towards this goal are urgently needed. Using future visioning and

- 410 target setting, we have identified a roadmap to steer the UK development sector towards a
- 411 nature positive future that is ambitious but realistic and actionable. Visioning and target setting
- 412 can be powerful and effective tools for enabling the transformative change needed to tackle the
- 413 biodiversity extinction crisis, together with many other challenges identified under the United
- 414 Nations Sustainable Development Goals.
- 415

416 **4. Methods**

417 4.1 Research approach: Visioning and target setting

We used future visioning and target setting^{78,79,81}, a form of backcasting, to generate a shared 418 419 vision for the UK residential and commercial development sector in 2050, and explore the 420 interim steps required to achieve that vision. During a visioning exercise, participants imagine a 421 desired future state and then collaborate on a shared vision statement that describes that future⁸¹. The resulting statement is intended to guide the transition from the present to a more 422 423 desirable future⁸¹. The process of target setting involves participants working backwards from 424 that desirable future and developing quantitative, time-bound targets to ensure the future vision 425 is achieved.

426

427 4.2 Expert participants

Potential expert participants were identified through research and practitioner networks in the
UK. We aimed to recruit experts from diverse backgrounds by inviting representatives from
academia, local government authorities, consultancy firms and non-government organisations

- 431 spanning multiple counties.
- 432

We contacted 19 potential experts in May 2023; ten accepted our invitation and attended the online workshop held in June 2023. Participant expertise covered the topics of environmental planning, green infrastructure, ecological economics, natural capital accounting, biodiversity offsetting, nature positive transitions, ecology, conservation, forestry, and Biodiversity Net Gain policy.

438

439 4.3 Pre-workshop engagement

Prior to the workshop, all participants were provided with a suite of background materials which
covered relevant framing material, topics of interest, temporal scope and geographic area to be
discussed (see ¹⁰⁸). These materials included: i) a description of the future visioning and target
setting method and each stage of the process; ii) a discussion of the Global Biodiversity

- 444 Framework and the concept of nature positive; iii) a discussion on transformative change which
- included previous social changes and examples of how our society has changed in the last 27
- 446 years (i.e., the same timeframe for achieving the 2050 vision); iv) research and government
- 447 data on the state of the environment in the UK, major drivers of biodiversity loss (both past and
- 448 current), relevant government policies and possible future threats; and v) some key
- 449 assumptions for the year 2050 that we will not be experiencing runaway climate change, and
- that the global human population will continue to increase before tapering off at 9 billion people.
- 451
- 452 4.4 Workshop
- 453 We used the video conferencing software Microsoft Teams (<u>https://www.microsoft.com/en-</u>
- 454 <u>au/microsoft-teams</u>) to hold a single day online workshop. Expert participants shared their ideas 455 via the visual work platform Mural (<u>https://www.mural.co/</u>). The workshop involved three stages 456 where participants were encouraged to: i) envisage a desired future for 2050 and collaboratively 457 draft a vision statement; ii) work backwards to define milestones or interim targets (2050, 2040
- 457 and 2030) required to achieve that future; and iii) identify any actions and relevant actors that
- 459 may arise along the way (see 109).
- 460
- 461 During the first stage of the workshop, participants were presented with a starting point for their 462 vision: The UK commercial and residential development sector is nature positive, and the UK 463 achieves the Global Biodiversity Framework's 2050 Vision for Biodiversity where "biodiversity is 464 valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a 465 healthy planet and delivering benefits essential for all people"¹. Participants were then allocated 466 to one of two breakout rooms, each with five participants and two facilitators. They were asked 467 to independently devise five broad statements that encompassed their desired future vision for 468 the UK residential and commercial development sector in the year 2050. Using the Nominal Group Technique method^{110–112}, we encouraged each participant to share one or more vision 469 470 statements with their breakout room. This sharing session was followed by a facilitated group 471 discussion which aimed to collate and summarise each breakout room's collective 2050 vision. 472 Finally, the two breakout rooms came together to report on their respective discussions.
- 473
- In the second stage of the workshop, the research team condensed the list of future visionsdown to six broad statements, which were then used to guide the development of potential
- 476 targets. We allocated three broad vision statements to each breakout room and encouraged the
- 477 expert participants to work collaboratively to generate relevant targets which could be
- 478 considered stepping stones to achieving the shared vision. Participants were instructed to think
- 479 creatively and ambitiously to generate targets for the years 2050, 2040 and 2030. As targets
- 480 were defined and discussed, participants added them to the Mural platform and grouped them
- 481 under the relevant year.
- 482
- 483 In the final stage of the workshop, each breakout room worked collaboratively to list the
- immediate actions and potential actors required to achieve the 2030 targets they had generated.
- Any additional actions related to subsequent decades (2040 and 2050) were also noted. All
- ideas were added to the Mural platform. The process we followed is summarised in Figure 3.

487

488 *4.5 Post-workshop analysis*

Following the workshop, we collated all responses on the Mural platform and listened to the workshop recording to identify any points that may have been missed. We integrated the vision themes together to create a single, shared statement which broadly and fully captured the ideas discussed. This was then sent to the participants for two rounds of revisions to derive the final vision statement.

494

We also identified ten key themes and summarised the targets and key actions proposed by
experts in a visual roadmap (see Figure 1). Finally, we used MidJourney (version 6) and Adobe
Photoshop (version 25.6) to generate two landscape renders of the nature positive future
described by our expert participants (see Figure 2): one represented a nature positive suburban
housing development, and the other depicted a nature positive urban streetscape.

500

501 All participants were given an opportunity to provide feedback on the themes, targets, actions,

actors and visualisations that emerged from discussions, and were offered co-authorship on this

- 503 paper.
- 504

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777 6. Figure captions

Figure 1. A roadmap to a nature positive future for the UK residential and commercialdevelopment sector.

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Figure 2. A visualisation of nature positive development in the UK in the year 2050, capturing
the key outcomes identified by expert participants. Renders were generated in MidJourney
(version 6) using 35mm/landscape architecture style, a warm green and orange colour palette,
and an aspect ratio of 2:1. Images were then finalised in Adobe Photoshop (version 25.6).

785

Figure 3. A summary of the method followed to generate a roadmap to a nature positive futurefor the UK residential and commercial development sector.

788

789 7. Author contributions

790 Jacinta E. Humphrey: Visualization, Writing - Original Draft, Writing - Review & Editing, Project 791 administration. Matthew J. Selinske: Conceptualization, Methodology, Investigation, Writing -792 Original Draft, Writing - Review & Editing, Project administration, Funding acquisition. Georgia 793 E. Garrard: Conceptualization, Methodology, Investigation, Writing - Review & Editing, 794 Supervision, Funding acquisition, Sophus O.S.E. zu Ermgassen; Writing - Original Draft. 795 Writing - Review & Editing. Prue F.E. Addison: Writing - Review & Editing. Bethany M. Kiss: 796 Visualization, Writing - Review & Editing. Michael Burgass: Writing - Review & Editing. Sarah 797 J. Chimbwandira: Writing - Review & Editing. Stuart Connop: Writing - Review & Editing. 798 Natalie E. Duffus: Writing - Original Draft, Writing - Review & Editing. Russell Hartwell: 799 Writing - Review & Editing. Rebecca Moberly: Writing - Review & Editing. Caroline Nash: 800 Writing - Review & Editing. Paul Nolan: Writing - Review & Editing. Juliet Staples: Writing -801 Review & Editing. Sarah A. Bekessy: Conceptualization, Methodology, Investigation, Writing -802 Original Draft, Writing - Review & Editing, Supervision, Funding acquisition.

803

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815 9. Competing interests

- 816 All authors declare no financial or non-financial competing interests.
- 817

818 **10. Data availability**

- 819 The data analysed in this study will be made available from the corresponding author upon
- 820 reasonable request.
- 821





824 Figure 2.825

Pre-workshop

- 1. Method guidance materials shared with participants (via email)
- 2. Framing and context materials shared with participants (via email)



Workshop

- 1. Presentation and discussion of the method
- 2. Presentation and discussion of the framing and context materials
- 3. Independent future visioning exercise
- 4. Visions shared, discussed and refined in subgroups
- 5. Visions shared, discussed and refined as a whole group
- 6. Targets identified and discussed (starting from 2050) in subgroups
- 7. Targets shared, discussed and refined as a whole group
- 8. Actions and actors identified and discussed in subgroups



Post-workshop

- 1. Vision statement discussed and refined (via email)
- 2. Targets discussed and refined (via email)
- 3. Representative future visualizations developed and refined (via email)

826 Figure 3.