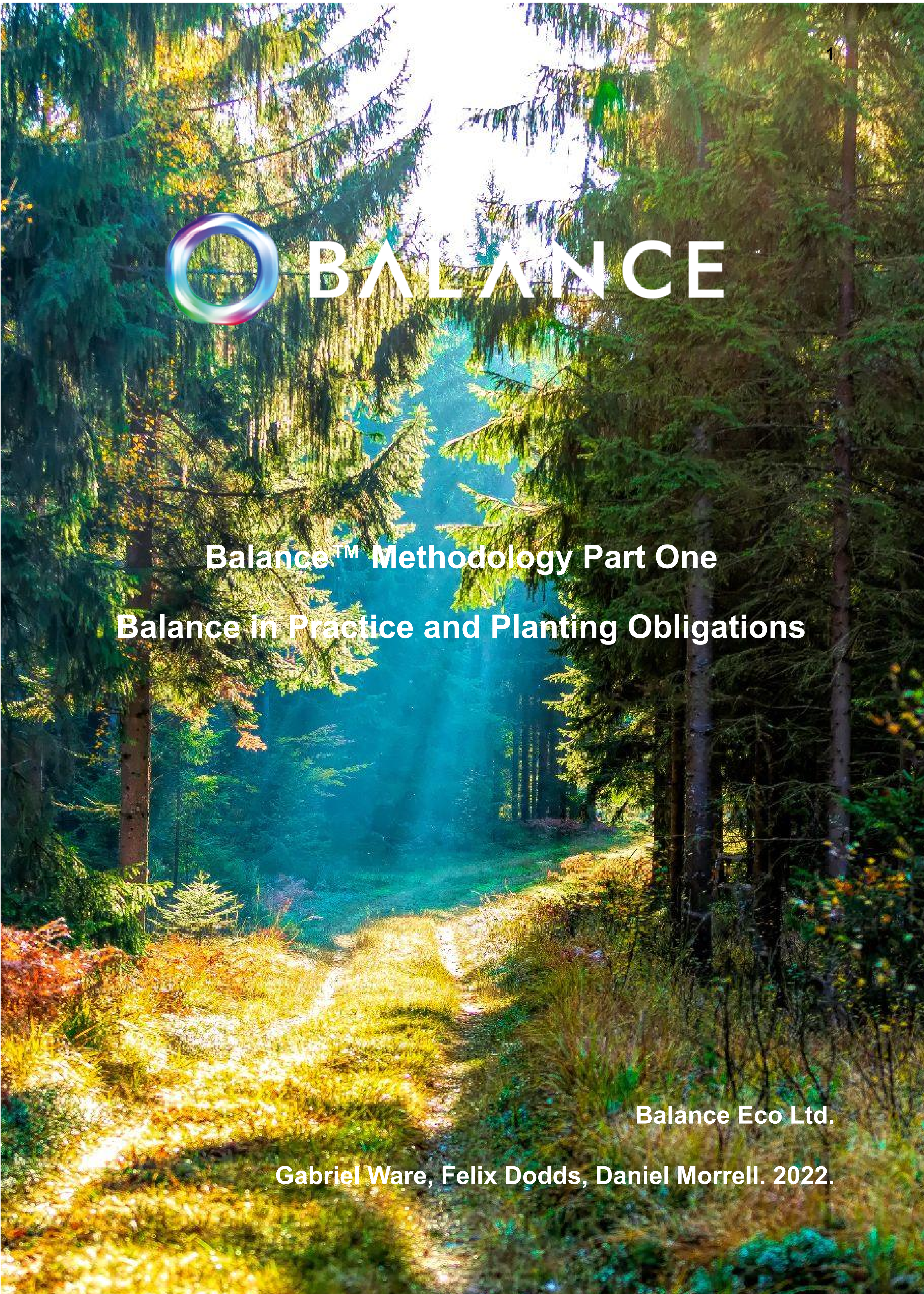

# Balance™ Methodology Part One

## Balance In Practice and Planting Obligations

Balance Eco Ltd.

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# Contents



# Abstract

‘Balance Methodology Part One: Balance in Practice and Planting Obligations’ discusses and explains the structure and functioning of Balance as an organisation, with reference to the Balance philosophy, the innovative obligations for planting and management processes of associated forests, and how Balance diverges from other voluntary and compliance offsetting companies, while demonstrating the ways in which Balance represents a new type of carbon offset initiative which has the potential to prove a vital contributor to global climate mitigation efforts. Synthesising the lessons learned from past carbon offsetting and NbS (Nature-Based Solutions), the latest available scientific evidence and the wide support for the value of biodiversity and ecosystem creation, this methodology describes how these have been incorporated into the formation of Balance as a concept and how they have been put into practice with economic, social and environmental considerations in mind. Similarly, the necessity and multi-faceted ecological, climatic, social and economic benefits of Balance as a redesigned, biodiversity-focused offsetting company are discussed, informed by the latest research on the necessity for incorporating biodiversity and considering an ecosystem as a whole within the forest planting process in order to optimise numerous benefits, including ecosystem services, carbon sequestration, and long-term forest sustainability.

Serving as the core purpose of this methodology, the ‘Balance Planting Principles’ established prescriptive guidelines and explains the necessary obligations with which our selected planting partners must comply, as detailed on our Planting Partner Contract. These obligations combine to form steadfast guarantees on behalf of Balance that we are involved in planting and protecting diverse, sustainable and efficient carbon-sequestering forest, including soil and climate context, topography, land use history, species diversity, disease and pest mitigation, forest resilience to climate change, and forest sustainability. The Balance Planting Principles provide a framework not only for our own projects, but for all future reforestation-based carbon offset providers. A detailed discussion of the benefits of biodiversity follows the Planting Principles, providing a number of arguments for the validity and necessity of Balance’s approach to planting forests. Finally, two short case studies, the first on the current state of forestry and reforestation in the UK and the changes in approach required, and the other on the Forest of Marston Vale, one of our major initial planting partners, are reviewed to display both the type of projects with which the customer will see Balance become involved in, how Balance can act in practice to combat the current lack of action in the UK, as well as to lend evidence for the benefits of applying Balance principles both in the short and long term.

The evidence used in this paper derives from a variety of sources. A comprehensive literature review was conducted on the basis of supplementing Balance’s philosophy with a firm scientific standing, with use of both quantitative and qualitative studies ranging from scientific journals to news articles, policy declarations and procedural methodologies for various sustainability standards. Where possible, the unifying focus of the sources used was recency, as understanding upon the role, impact and importance of biodiversity, as well as the threat to forests in cases where diversity is largely absent, is constantly evolving. With this in mind, Balance declares that its methodology shall be reviewed annually to update its obligations and recommendations in line with the latest verified research and declarations in the fields of ecology, sustainability and environmental policy.

# 1. Introduction

### 1.1 The Balance Philosophy

Voluntary carbon credits, particularly those stemming from Nature-Based Solutions reforestation projects, can create a great number of benefits. These include, if they are created by the most promising projects, biodiversity protection, emissions reduction, public physical and mental health improvements, job creation and a variety of ecosystem services depending on the type of project. At the core of Balance is the recognition of these benefits, and the way in which they coalesce into the variety of services that create Balance as a business and as a concept. The current context, including the recognition of the increasing popularity, financial support and environmental necessity for the voluntary carbon market, in line with the most recent national and international policy, as well as global climate mitigation targets, has created a need for pioneering solutions to optimise long-term emissions reductions and compensation. To achieve this, in line with the Sustainable Development Goal 15 of the 2030 Agenda for Sustainable Development, Balance repurposes biodiversity as the key differentiator in addressing the increasingly urgent global biodiversity and climate crises.

**What Is Balance?**

'Balance', as we define it, describes an essential state of harmony with the natural environment. This is not achieved only through offsetting emissions, but through the creation or flourishing of biodiversity, of productive and naturally functioning ecosystems, by means of optimised emissions reductions and a wholehearted commitment to environmental protection. The Balance philosophy dictates that balancing environmental impact requires far more detailed and wide-ranging consideration than past initiatives have made it seem, counting many more factors than the simple notion of planting trees or reducing emissions while systemising the creation of both, while, critically, avoiding making this task a burden to the consumer. Balance, as a trademarked term, represents an evolution from carbon neutral, or carbon neutral 2.0, with renewed focus and the potential to produce a great number of co-benefits. Balance foregoes the shortcomings of previous and current voluntary carbon offset organisations by allowing the consumer to be safe in the knowledge that their investment will go beyond sequestering carbon to supporting viable and sustainable change, promoting the survival and flourishing of biodiversity with long-term resilience of forest ecosystems in mind. Being a balanced company, therefore, is not only a commitment to compensating for emissions by storing carbon, but also a commitment to the development of pioneering biodiversity and climate solutions, tackling both the biodiversity and climate crises which, of course, are all too often distinguished as exclusive problems. This philosophy underpins what Balance offers today, and hopes to develop for the years to come.

Balance provides comfort to those who are invested in the concept of the protection and regrowth of ecological diversity. Our product is not only carbon, it is the synthesis of carbon and biodiversity. A tonne of carbon, produced in the balance process, does not solely represent a particular quantity of trees; it represents the land mass required for the biodiverse forest to store a tonne of carbon, a quantity which varies depending upon the land's capability to store carbon both in its soil and the planted biomass, which in itself is dependant on a great many number of factors. The Balance Unit is, in the simplest of terms, a way of valuing nature and its reciprocal benefits to humanity, and through the creation and growth of Balance we hope to develop a new marketplace for Nature-Based Solutions carbon credits, which, we hope, will pioneer the concept of valuing nature as more than carbon in the carbon market. In this hypothetical marketplace, with the

Balance unit as a carbon denominated instrument, it will have a multiplier attached to it due to its additional values, which include higher quality, integrity, and the creation of natural capital.

Each tonne of carbon is allocated to a Balance credit. In the UK, through our affiliation with the Woodland Carbon Code, we assign WCUs to clients. They are acquired upon the verification of a project, but before that the units are called Pending Issuance Units (PIUs), the purpose of which is to demonstrate the quantity of potential future sequestration at the outset of the project, which can be assigned to buyers but cannot yet be used or retired until they are transferred into WCUs, which can be used as full carbon credits. [1] The lack of retirement which has long been a factor of the compliance market has attracted attention for permitting excess emissions elsewhere, or "carbon leakage." The retirement of offset credits is critical to avoid double counting and non-additional credits being resold on the carbon market. This issue, along with the various others which have plagued the carbon market since its creation and which Balance mitigates, is discussed in ‘Part Two: The History of Carbon Offsetting and the Context for Balance’.

The specific details and context for the selection of specific tree species based on a number of factors are discussed in the "Balance Planting Principles" section below, but prioritisation of indigenous species, and the planting of a variety of species adapted to the local abiotic context of the present and near future, is guaranteed. Established forests in accordance with the UKFS (UK Forestry Standard), are verified through the UK Woodland Carbon Registry, the public registry of the Woodland Carbon Code (described in detail below), and validated by a certification body accredited by the UK Accreditation Service.

### 1.2. The Planting Partner Contract

The Balance planting partner contract highlights five key points (with an extra, non-obligatory point) which distinguish Balancing from offsetting emissions:

- 1. Permanence. Creation of natural forest cover with a minimum of 99 year protection and carbon with its carbon sequestration capacity independently monitored, promoting permanence and longevity of created carbon sequestration and biodiverse ecosystems. This is done in consideration of the radiative forcing cycle of carbon dioxide in the atmosphere, and the necessity for trees to die and create deadwood to optimise biodiversity and additional carbon sequestration benefits.
- 2. Force Majeure, ensuring compensation in case of unforeseen events, including but not limited to an epizootic or a plant disease affecting part or all of the Woodland, road construction, compulsory purchase, buildings, or a severe natural disaster gravely affecting the Woodland.
- 3. Public Access. Customers and clients and the wider public are able to physically visit the forest areas which they have chosen to create.
- 4. Additionality. If the funding has not arrived, purchased trees cannot be planted, thus ensuring additionality of Balance’s affiliated planting projects, and that all investment contributes towards actual reforestation. Additionality protocols for Balance’s UK-based projects are set out in the Woodland Carbon Code (WCC) verification system in the UK (discussed p. 35-41), Gold Standard and REDD++ internationally. Balance is also interested in various other reputable verification standards worldwide.

[1] Full details of the purchase, assignment and retiring process as per Woodland Carbon Code regulations are outlined comprehensively on p. 35.

- 5. Species Diversity. Before contacting potential partner projects, Balance ensures that a number of biodiversity-based planting principles are met as obligations. These are detailed in depth on pages 17-32, and include, first, the prioritisation of indigenous tree species and local genetic stock.
    - The right trees in the right places, including an understanding of the land's historical context, and planting exclusively on previously forested land.
    - The prioritisation of native species.
    - Consideration of soil type and soil organic matter when planting, and planning for carbon sequestration in soil.
    - The formation of a varied stand with genetic diversity, a healthy understorey, and the use of relevant agement cycles to enhance biodiversity.
    - Inclusivity and equality in social and economic benefits where necessary.
    - Necessary considerations in tree planting for adaptation to climate change.
    - A displayed consideration of mitigation of the threats of pests and diseases.
    - The reduction of dependence on invasive species.
    - An understanding of the importance of forest structure, connectivity between forest ecosystems and tree size both for carbon sequestration and forest resilience purposes.
    - Commitment to the production of data and the frequent review of management and planting strategies based upon findings.

- 6. For each tonne of balance, an additional tree is planted in a non-carbon forest. This can be close to the consumer or the client’s business, and can be planted in locations accessible to customers and beneficial to their communities, even in urban areas, and is linked to the carbon tonne through Balance’s public database. This is unique amongst offset initiatives, and is designed to increase biodiversity benefits and create wildlife corridors in urban and rural environments. It also allows us to supply funding in locations that would not otherwise receive carbon financed tree planting benefits. This extra step is important for creating enhanced trust and furthering the standards of best practice amongst offset initiatives, and creates a high impact icon near the clients business enabling further communication to customers and stakeholders.

These key points, in tandem with our specific selection process for particular trees and forest composition, ensure that our forests are planted and protected to optimise additionality and accessibility, while promoting biodiversity, longevity, forest resilience and sustainability. As outlined below, too, our planting process incorporates predictive climate modelling to ensure that selected species are able to survive local and regional climate change in the near future. The degree to which predictive climate modelling is accurate is accounted for by maintaining a strong prioritisation for native species adapted to the current climate and abiotic factors. Varying sapling quantities are planted depending on the location, as some locations require greater density of trees in order to store one tonne of carbon, depending primarily on soil type, favoured tree species and the variable influence of abiotic factors. Trees purchased by the consumer are found in the Balance inventory, which is sold with a location reference. All sales are listed on the Balance website (https://balance.eco), ensuring transparency and preventing multiple selling. Once sold, the inventory is publicly retired, along with the WCU (Woodland Carbon Credit) allocated to each tonne of carbon.

In the wider world of the voluntary carbon market, various reviewal and best practice processes are underway which Balance are committed to tracking and reacting to accordingly. These include the upcoming Voluntary Carbon Market Initiative (VCMI), which promises to be a focal point for integrity in voluntary carbon markets. Another initiative, the Tasfkforce for Scaling Voluntary Carbon Markets (TSVCM), an oversight board for carbon offsetting headed by Mark Carney, is dedicated to developing new methodologies for the voluntary carbon market in an attempt to steer the trajectory of carbon credit validity, additionality and the provision of additional benefits. Along with a number of other bodies, these organisations are grappling with integrity, claims, scale, standards, and the position of the voluntary market in relation to net zero. Balance is following these processes with a keen eye, and we are willing to address our own methodology by enacting and following the highest standards of the changing recommendations and requirements which they provide. Although it is impossible to guarantee that the current form of the Balance Methodology will function for all time, it is guaranteed that, as a standard governance procedure, Balance will review and, where appropriate, incorporate the most recent research into the carbon market in this methodology on at least on an annual basis. In this way, Balance ensures that it will work to deliver the most optimal environmental and ecological outcomes.

### 1.3. The Conception of Balance

Balance began as the product of Balance Founder and CEO Daniel Morrell's vision to reconsider offsetting in its current form as an endeavour which has failed to fulfil its promises and potential, with the idea of designing the modernised 'carbon neutral'. Morrell's career has seen success in a number of climate action ventures, establishing a number of eco-conscious businesses and services including Carbon Gold, the Global Cool Campaign and Carbon Advisory Service, as well as founding Natural Capital Partners. The original conception of the term 'carbon neutral' was coined by Morrell because, when considering the name carbon sequestration, it was clear that it did not effectively communicate the process and the outcome of offsetting carbon emissions, which was in its infancy. Shortly afterwards, Morrell made the acquaintance of Rodney Bickerstaffe, leader of the trade union Unison, who was taken with the idea and promised to share it with his union members via their newsletter. A few weeks later Morrell received a cheque in the post from a docker in Hull, asking him to plant a tree for him to offset his carbon footprint. More cheques arrived and when the stream turned into a flood Morrell established a company called The Reforestation Britain Campaign, thereby becoming director of arguably the first ever business to address the consequences of global warming. Initially Morrell wanted to establish the campaign as a charity, but the Charities Commission objected that by planting trees and not harvesting them the campaign would effectively be giving away its assets in contradiction of CC rules.

These pioneering activities were the start of a remarkable journey which would take Dan to places ranging from Downing Street to the Oxford English Dictionary, via the United Nations General Assembly. During these early activities Dan, in conversation with Rima Sams, came up with (and eventually trademarked), "carbon neutral," a phrase that would go on to enter the vernacular.. Like many popular phrases it has some limitations, but its value was to simplify and popularise the complex concept of balancing carbon emissions by planting and protecting forests. It also achieved the distinction of appearing in the Oxford English Dictionary and became that organisation's 'word of the year' in 2006.

Morrell went on to found Future Forests in 1992, providing a way for businesses to 'go green'. The original system involved a payment of £UK3 per tree – £UK1 for a sapling, £UK1 for tree management and £UK1 towards running Future Forests. This model later changed to £UK1 for four saplings, ensuring at least one survived to maturity at an average maturation rate of 4:1. His partner in this was marketing consultant Sue Welland, with the vital science around carbon sequestration being provided by Dr. Richard Tipper, who has worked as a science and policy advisor on climate change issues for major businesses, international organisations and governments, a lead author on IPCC reports, and CEO at Resilience Constellation and Chairman at Ecometrica.

Although many people still found some of the issues around climate change and carbon offsetting confusing, the idea of planting trees to help the environment, popularised by Morrell, was a relatively easy one to understand and get behind. This effort was greatly helped by the prominent support of many musicians and artists, beginning with Joe Strummer of the Clash after a meeting with Morrell at Glastonbury in 1995. Strummer instantly committed to becoming the world's first carbon neutral citizen, and the spontaneous support of such a respected figure proved a tipping point. Artists such as The Rolling Stones, Pink Floyd, and Leonardo Di Caprio committed to becoming carbon neutral, eventually resulting in over 100 million CDs being produced on a carbon neutral basis. The Sex Pistols commissioned the 'Filthy Furious Forest' to be planted on the verge of the M25 near the Ford Motor Company plant at Dagenham. Of course some forests faced challenges - the 'Ronnie Wood' did not survive its early years but was recently re-planted by Dan in an Argentine cloud forest. This was at a time before there existed any methodologies for carbon absorption per hectare of land and was the first testing and experimentation in this arena.

In 2006, Morrell began an ambitious campaign to inspire a billion people to act against climate change. If that many people could reduce their own emissions by just a ton a year, a significant blow would be struck in the battle against irreversible global climate change. Hence the name of the organisation – Global Cool – and its rallying cry 'One By One, Tonne By Tonne.' A personal CO2 calculator was developed so that any individual could easily quantify their own environmental impact, and understand how to reduce their footprint both by being more efficient in their own energy consumption, and by participating in carbon offsetting through tree planting. The far-reaching initiative was funded by environmentally-conscious companies such as Vodafone, Man Group, Logica, and The Body Shop and enthusiastically endorsed by leaders in both politics and culture.

Global Cool was launched by Orlando Bloom and Leonardo DiCaprio at Fuji Rock Festival in Japan in 2006, and in January 2007 Stephen Fry spoke eloquently about it at a Downing St. reception hosted by Prime Minister Tony Blair. Thanks to Global Cool, Morrell gained other opportunities to drive action on climate change, for instance becoming a panelist at the Accounting for Sustainability project supported by Prince Charles. At a time when the world was waking up to the need for substantive action on climate change, Global Cool was an important voice and a galvanising force. Dan became a well-known figure in the fight to solve the problem of climate change, leading him into many extraordinary situations. One such situation was the 2012 Doha Climate Change Conference (COP 18). After a chance conversation in a hotel lobby with eminent economist Lord Nicholas Stern, Morrell found himself being asked to stand up before a distinguished audience including the Saudi and Qatari royal families to open COP 18 by acknowledging his historic part in the world's first carbon trade. This was Morrell's second interaction with the UN after an unscripted appearance in front of the General Assembly in New York in 1999. Very few people get to appear once in front of the UN, fully prepared. Hardly anyone gets to do it twice without any preparation whatsoever.

Morrell then went on to form the Carbon Advisory Service in 2007. The company refurbished existing buildings and designed efficient new builds, using new technology within an existing budget rather than simply renewing dated designs. It has included a diverse range of organisations including Shell, Six Senses, and the Republic of Maldives among its clients. CAS offered the full range of services needed to build and refurbish energy-efficient buildings, from assessments to design, modeling, implementation, and ongoing advice.

Opening another front in the climate battle, Morrell (along with Green & Black's founder Craig Sams) started Carbon Gold in 2008 in order to realise the carbon-reducing potential of one of the planet's most widely available assets, the earth beneath our feet. Carbon Gold is the first modern biochar company, broadening the appeal of a practice known for thousands of years which not only improves soil fertility but actually removes existing, harmful CO2 from the atmosphere.

While the original 'carbon neutral' idea was sufficient at a time when the climate crisis received far less attention than today, Balance acknowledges that the time has well and truly come to recognise that carbon neutrality, in its most basic conception, is not enough. The forests created by offsetting carbon emissions need to be sustainable in themselves in order for an initiative to truly work. Balance has thus been established to be a revolutionary initiative that takes the lessons learned from the mistakes of past carbon offset and reforestation projects and create a streamlined pathway through which conscious consumers can invest in a revitalised global sustainability effort, utilising the organisation's proficiency in creating and maintaining biodiversity, and its multitude of benefits, to reestablish long-lost natural forest ecosystems, capable of absorbing far more carbon than previous and current man-made forests.

A true commitment to biodiversity means not only hitting a number, but encouraging the symbiotic chains on which nature depends, such as leaving dead wood for bugs that can in turn be enjoyed by woodpeckers. When this happens, we are truly protecting our futures, not just hoping for the best. Balance also supports natural regeneration and re-wilding projects which can help with this process. As such, Balance is dedicated to moving beyond the arbitrary commodification of carbon as a cipher through which the growing carbon market can justify its lack of effectiveness in providing tangible reductions in atmospheric carbon levels, while contributing to the adaption of the carbon market to the most relevant and recent knowledge on how emissions reductions can be most effectively attained through offsetting.

# 2. Balance And What It Is

## Balance in Business

Balance in Business offers an easy-to-use system for Small and Mid-Sized Enterprises (SMEs) and larger companies that wish to act in an environmentally responsible way and be seen to do so, but find the existing processes time-consuming and expensive.

### 2.1 Balance Products: More than Offsetting

Beyond offset credits, Balance provides a growing range of services and tools through its consultation with client companies that are designed not only to support the environment long-term, but also to capture imaginations in the here and now. While Balance products can make a big difference to climate protection, Balance acknowledges that they need to be accompanied by other measures which help people and companies to reduce their environmental impact. Before considering offsetting greenhouse gas emissions through Balance, businesses and other organisations need to complete at least the following:

- Measure: Understand and quantify their carbon or carbon dioxide equivalent ($CO_2e$) output.
- Avoid: Take steps to prevent avoidable emissions.
- Reduce: Reduce remaining emissions where possible.

As an integral part of the Balance process, advice upon the necessary efficiencies and reductions that can be implemented with considerable ease within the business is given, together with our acknowledgement that offsetting must be accompanied by emissions reductions in order for global atmospheric GHG levels to be lowered most efficiently. This tool takes the user through a step-by-step process of understanding climate impacts from square footage of property, energy usage in heating and cooling, car mileage, number of staff, and flights and other travel. They will be offered guidance appropriate to the business, including *production, property, materials, building efficiency, switching to renewable energy, recycling, using locally sourced and sustainable produced foods, using low energy supplies, procurement from low carbon policy and ethical suppliers, studying the supply chain, reducing single use plastics and even social and behavioural change*, in order that they can enhance reductions and efficiencies in a variety of areas. It is imperative to Balance that each **client** makes a valuable effort towards reducing emissions throughout their supply chain, and that only excess emissions are considered for offsetting.

### Balance Eco-Foundation

The Balance Eco-Foundation charity directly supports biodiverse forest planting and protection. It receives 20 percent of the revenue from sales of the ground-breaking Chant with Balance music and art app, the remainder of which is largely used to pay music rights holders and artists fairly. Operating costs of the Balance Eco-Foundation are entirely paid by the parent Balance Organisation, so that all the money coming into the Foundation can be used for forest planting and protection. This ensures that anyone using Chant with Balance knows their exact contribution towards protecting life on Earth. The Foundation also pays the direct costs of tree planting wherever possible, so that the absolute maximum from contributions goes directly into climate protection rather than administrative costs. Balance Eco-Foundation is registered with the charity commission No 1162529. Its trustees are David Taylor, Craig Sams, and Daniel Morrell.

**Chant with Balance**

As part of the Balance philosophy, we believe that climate issues are most understood when translated through cultural media, and that climate action is most effective in engaging people when putting them at the centre of a creative collaboration. As such, Chant with Balance, as a collaborative performance-based app, allows music fans to use their own voices to make a difference, engaging people both through art and musical performance. It was developed in conjunction with musician and producer Martin Glover, also known by his stage name 'Youth', producer of Pink Floyd, Primal Scream, U2, and Paul McCartney. The app allows fans to upload their own voice, which is then mixed into actual tracks or live performances by their favourite artists. At the same time, 20 percent of the £1.99 purchase price is used to support Balance's forest planting and protection programmes. Through the app, fans are not only 'joining the band', they are supporting Balance's mission to protect the environment. **The Chant Live Band** includes:

- Dave Barbarossa (Adam and the Ants, Bow Wow Wow)
- Jon Moss (Culture Club, Clash, The Damned)
- Youth, aka Martin Glover (Killing Joke, The Orb, producer of U2, Pink Floyd, Primal Scream),
- Guy Pratt (Pink Floyd, Michael Jackson, Madonna),
- Matt Black (Coldcut)

The app also includes an ever-expanding drum and percussion circle drawn from the crowd and very 'special guest' musicians. Chant's core mission of placing the audience at the centre of the musical experience, allowing them to be co-creators in a space where rhythm and melody combine, inspires people to become active participants in 'their music', rather than passive recipients of pre-packaged sound. Currently, Youth has written and produced 49 tracks in seven different genres for Chant, including Trance, Dub, House, Indie Disco, Ambient, Indigenous and Kosmiche.

https://www.chant.live/

**2.2 Planting, Offset Credit Provision and Insurance**

Balance's forest programme, operated by carefully selected associate planting partners, is carried out with integrated ecological knowledge to support long-term biodiversity, and is fully transparent and verifiable, with exact carbon sequestration amounts attached and the location of planting made visible. For every tonne of carbon identified through balance, Balance plants a tree. However, unlike previous and other existing carbon offset initiatives, that tree is far more than just a tree; it will, by virtue of the deliberate creation of biodiversity through the planting of a variety of species, play its own ecological role amongst a varied canopy of vegetation and wildlife, forming a web of codependent relationships that create an effective carbon sequestering land sink, while simultaneously providing homes to endangered species. With the appropriate measures taken, a single tree planted by Balance becomes an integral part of a far more resilient and effective carbon-storing forest.

Balance's approach to planting incorporates careful analysis of a region's natural vegetation ecology to determine whether a clear, practical understanding of specifically-tailored forest composition is present with planting partner projects.

Balance is focused on ensuring the correct trees are planted in the correct places, with prioritisation of locally-sourced indigenous tree species, with the simultaneous acknowledgment of the necessary introduction of species from relevant geographical areas (for example, in the UK context, from within 2 degrees south), in order to mitigate future climate change and its impact on susceptible tree species. It is through this process that Balance forests are grown with both sustainability and effective carbon sequestration in mind. This process also ensures that stand composition in associated forests is varied and non-uniform, with many different sapling amounts planted depending on location.

Balance also ensures that the consumer is physically engaged in the process, so that information concerning all trees will be publicly accessible to the consumer on a blockchain. Similarly, the forests which Balance plants will be easily accessible to the public, with the hope that their benefits will be experienced as widely as possible.

It is also critical that all Balance forests will be carefully monitored and verified by reputable, globally accredited third-parties, including the Woodlands Carbon Code and REDD+ in the UK, so that every Balance project meets the Woodland Carbon Code which is the UK standard for climate change mitigation. Internationally, Balance meets and exceeds REDD+ standards by following the Gold Standard approach to reforestation carbon offsetting. The carbon absorption provided by Balance is independently verified by the Woodland Carbon Code in the UK and REDD accreditation system globally. Balance also partners with various verification bodies, depending on the project location, so that the planting and protection activities are fully visible and incontestable, as has not always been the case with historical carbon offsetting.

All trees are planted by acclaimed planting partners with a 99-year maintenance and replacement contract, providing insurance for investors and clients. In this way, Balancing your Business is especially valuable because, with the establishment of biodiverse ecosystems, particularly in contrast with previous carbon offset initiatives, benefits are provided over the length of the contract. On a wider scale, Balance advocates governmental guarantees, combining market based insurance with a stopgap, on voluntary carbon market contracts and transactions, which is, unfortunately, as of yet non-existent. Although the WCC and REDD+ both have buffer stocks, which are undoubtedly useful as insurance for investors, these oftentimes require careful management, and there is always a risk that markets will avoid them. The WCC, in particular, has made considerable steps in promoting and ensuring permanence of their forests, and these are outlined in detail in point 2.3 in their Standard & Guidance (https://www.woodlandcarboncode.org.uk/standard-and-guidance/2-project-governance/2-3-management-of-risks-and-permanence).

As another benefit of Balance, unlike other carbon credit associations, our forests are not planted prior to the consumer's investment – in this way, the consumer is directly responsible for the creation of thriving ecosystems where they did not exist before, and every purchase contributes directly to the scope and sustainability of the project. Offset credits are subsequently retired in accordance with the Woodland Carbon Code, meaning that they cannot be recirculated, eradicating the risk of double counting while reducing overall excess emissions which arrive through reselling credits on the voluntary market. The principles by which Balance operates in planting forests, and those which are supported by our planting partners and the standards through which we are accredited, are discussed below.

# 3. Balance Planting Principles - Partner Obligations

As an essential part of Balance's approach to selecting planting partners and associated projects, Balance has established the following list of prescriptive guidelines and obligations to set the standard for biodiversity, sustainability and carbon sequestration ability in Balance forests. They are split into two sections: Forest Creation (3.1), and Resilience and Longevity (3.2), including obligations for consideration of both the initial planting phase and the medium and long term future of the forest with biodiversity and forest sustainability as tandem priorities. The principles are briefly outlined here, and are subsequently explained below:

- **3.1.1. The right trees in the right places, including an understanding of the land's historical context, and planting exclusively on previously forested land.**
- **3.1.2. The prioritisation of native species.**
- **3.1.3. Consideration of soil type and soil organic matter when planting, and planning for carbon sequestration in soil.**
- **3.1.4. The formation of a varied stand with genetic diversity, a healthy understorey, and the use of relevant agement cycles to enhance biodiversity.**
- **3.1.5 Inclusivity and equality in social and economic benefits where necessary.**
- **3.2.2. Necessary considerations in tree planting for adaptation to climate change.**
- **3.2.3. A displayed consideration of mitigation of the threats of pests and diseases.**
- **3.2.4. The reduction of dependence on invasive species.**
- **3.2.5. An understanding of the importance of forest structure, connectivity between forest ecosystems and tree size both for carbon sequestration and forest resilience purposes.**
- **3.2.6. Commitment to the production of data and the frequent review of management and planting strategies based upon findings.**

## 3.1 Forest Creation

Carbon offset projects, as influenced by the rise of forest-based NbS (Nature-Based Solutions), are increasingly building on dynamic ecosystem functions and their co-benefits, and project design and implementation needs to take into account the dynamic nature of biodiversity and ecosystem processes. With more consensus being approached on the value of these elements, forestry of all types has been designed to provide ecosystem services and has employed mixed and native species in line with national commitments to forest and landscape restoration, yet there are still many projects which fall short in terms of biodiversity, resilience and ecosystem services provision.

The Balance ideology thoroughly integrates the lessons learned from the past of carbon offsetting, the current evidence of the most effective, sustainable and valid carbon offset projects through the lens of NbS, and the most promising projections for future carbon offsetting projects, the carbon market, sustainable management and optimised carbon sequestration results, as well as other benefits. Outlined here are the core principles of and supporting evidence for Balance and any forward-thinking carbon offset initiative, including the necessary components for building biodiversity and ecosystem resilience, followed by a number of case studies which supplement Balance's ideology and represent the benefits of implementing such projects. Each of the following points are included within the first motion of the five-point Planting Partner Contract. It is important to note that while these principles are relevant to all current and future afforestation strategies, as any project which centres upon the regrowth of natural forests must fall under the same parameters for optimal performance and provision of benefits, they are particularly relevant to carbon offset reforestation initiatives. Moreover, it is of central importance with such projects to ensure efficient and sustainable carbon sequestration, which entails the key considerations of biodiversity and forest resilience.

### 3.1.1 The Right Trees in the Right Places

The extent to which past offsetting regimes, and indeed any large-scale plantations, have relied on monoculture and/or exotic species which have lacked sustainability and have proved relatively ineffectual in the long-term, has already been discussed, but stressed here is the **necessity to consider, more specifically, the exact types of trees for the location and geographical context of the project, and the importance of planting indigenous species with consideration for forest composition, while allowing the inclusion of exotic species for certain benefits**, though in the right context and quantity to minimise negative ecological consequences.

Reforestation planting areas, including carbon offset-related reforestation, make up 7 percent, or 264 million hectares, of forest cover worldwide (Barsoum et al. 2016), and this area is increasing rapidly with a growing reliance on plantations for wood products, carbon management, the protection of soil and water and the rehabilitation and diversification of impoverished landscapes. In total, this has resulted in a strong anthropogenic influence on the composition of forest stands, with the composition, structure and function of plantations being highly simplified. It is also important to note that afforestation might not be a viable long-term adaptation solution in some regions. Tree planting can be especially problematic in native non-forest ecosystems (Veldman et al., 2015), which are often overlooked by restoration and conservation policies. Balance therefore does not encourage or support planting trees in areas which are non-forest ecosystems.

Tree planting, if planted in inappropriate areas, has the potential to destroy the rich and unique biodiversity of ancient grasslands and savannahs, in which many herbs and grasses are shade-intolerant and adapted to disturbances such as grazing and fires. Indeed, tree planting has the potential to damage any ecosystem which is non-forested. When at a large scale, it can also reduce local water yield due to increased evapotranspiration of planted trees, which leads to moisture redistribution and cloud formation through emission of organic compounds which serve as moisture condensation nuclei. In some areas, scientific research increasingly suggests that allowing forest regeneration to occur naturally can deliver a wider range of climate change adaptation services with fewer trade-offs than plantations. Several of these "rewilding" projects have led to the return of open woody habitats once grazing pressure from domestic livestock is reduced (Tree, 2018), creating some notable successes in restoring rare wildlife. Naturally-established forests can also be more cost and resource efficient to create because they rely on less costly and labour-intensive human interventions, and can also accumulate carbon rapidly once sufficient trees have colonised a site and tend to be more biodiverse than plantations

(Cook-Patton et al. 2020). Almost all evidence is based on the comparison between natural forests and large-scale plantations which lack biodiversity through design, as opposed to anthropogenic afforestation which deliberately incorporates diverse and native tree species.

As discussed in ‘Part Two: The History of Carbon Offsetting and the Context for Balance’, forestry plantations have often come at the expense of vital naturally occurring ecosystems, such as natural grasslands and peatlands (Veldman, et al., 2015), which may be more resilient to climate change impacts and/or support human adaptation in other ways, and may lack diversity entirely. As such, analysis of whether planting a forest in the region will benefit biodiversity, will negatively impact it, and whether natural forest regeneration is more suitable, is necessary at the outset of the Balance project. In this process, it is important to define whether a target area was historically covered by forests, as this can be a key indicator of the suitability of the land for reforestation. Planted areas, generally, are beneficial where natural biodiversity is low, and where the land is suitable for forest regrowth, particularly on lands which were previously forested, as non-forested lands like grasslands or wetlands already contribute to carbon capture, so should be avoided. It is also worth noting that selecting an area that is already in use for agriculture could result in further deforestation elsewhere, resulting in carbon leakage and potential loss to biodiversity. Finally, the number of trees planted with consideration for these factors in a given plantation area should be as close to the maximum as possible, and should not play merely a minor role in a reforestation project’s description or implementation.

Another critical question in analysing the suitability of a forest-based carbon offset project at the outset is whether the area was forested historically, past land uses of the area, and, if possible, what was the natural density of tree cover and the present species. Several studies suggest that prioritising forest restoration spatially based on various criteria, such as potential for natural forest regrowth, conservation value, past land use and opportunity cost from other land uses, can increase restoration feasibility and improve restoration success (Brancalion, 2020). As such, **identifying and analysing the previous forests that existed on or near project locations is of vital importance when formulating plans for species selection and forest composition**.

### 3.1.2 Selecting Native Species

One of the first tasks a project creator must undertake is which and how many species will be planted, how those species will be distributed over the planting area, and at what relative density. **Balance declares, as an obligation, that native species should be the first consideration in any tree planting project.** Local populations of native species are genetically diverse, and locally sourced seed should usually be a core component of future tree planting when biodiversity conservation is a key objective, although there may be opportunities to diversify impoverished flora and expand the range of rare species by introducing species from further afield. A few key species of local provenance or of provenance from locations with climatic conditions suited to those of the project location or suited to projections of future climate change in the project’s region can also be in the mix. These species, in essence, are picked to enhance local biodiversity development and ecosystem services, while space for exotic species should not be discarded at the outset. The potential advantages and disadvantages of all tree species being considered need to be weighed carefully to match the project goals.

In Europe, according to one 2016 study (Barsoum, 2016), 29 percent of forests are composed of a single tree species, and many of these are plantations composed of a single non-native species, with serious implications for biodiversity. According to relevant literature, plantations should be based on indigenous species to the greatest degree possible in a broad geographic sense, taking into account climate change scenarios and plant provenances. Plantings based on indigenous species, and explicitly focusing on species that are in decline, can mimic key characteristics of natural habitats using a biotope template approach, heightening sustainability, biodiversity and carbon sequestration. While indigenous species should be prioritised, a mix of species is also necessary, because mixed-species forests are better at conserving biodiversity, creating habitats for wildlife, and attracting seed dispersers and pollinators. It is important to note that, given the current warming scenario, the selection of 'indigenous' species may be reconsidered with a view to the future, so that species derived from warmer conditions, but as close to the location of the project as possible (from where the species would be migrating), are included. Consequently, the selection of species and genetic material appropriate for current and future abiotic conditions is the top priority.

### 3.1.3 Soil and Topography

Large-scale reforestation initiatives increasingly utilise multidisciplinary studies such as remote sensing and mapping of soils, topography, tree and forest cover, as well as other biophysical variables, to prioritise and choose species for specific planting locations, and to decide whether tree-planting is the correct solution suited to the local conditions. The long-term success of a tree planting initiative depends on the selection of species and genotypes that are adapted to local abiotic conditions, and can thrive with particular soil types and the local topography of the project location.

Soils vary considerably in fertility, texture, colour, depth, acidity, ability to hold water, and in many other ways, depending on:

(1) the type of rocks from which the soils were formed;
(2) the climate (hot or cold, wet or dry);
(3) the trees, bushes, and other plants growing in the soils;
(4) the animal and bird life of the areas;
(5) whether the soils weathered in place from the bedrock, or were moved to the places they now rest by ice (glaciation), water (streamflow), gravity (sliding), or wind;
(6) slope of the land;
(7) age

Each soil type develops distinct layers (horizons), with the layers of a soil forming the soil profile, which is distinctive for each soil type. Forest soils are usually undisturbed as compared with farm soils that are ploughed frequently, so forest soils retain their natural profiles better. The separate layers of a soil differ from one another in various physical and chemical characteristics. They vary in colour, amount of organic (dead plant and animal) material, size and proportions of soil particles, acidity, and in amount of plant nutrients present. Amongst the six basic soil types, for example; clay, sandy, silty, loamy, chalky and peaty, each are favoured by a number of common tree species. Species such as white pine, Norway spruce, white cedar, red maples, poplar and white ash, for example, prefer clay, while red oak, scotch pine, white pine, red pine and European larch prefer sandy. Loamy soil, being a mixture of clay, sandy and silty particles, is favoured by a number of species which straddle both categories, while also providing home for white spruce, sugar and green ash. As soils are distinguished with more specific categorisation based upon smaller and smaller differences found amongst neighbouring regions, the importance of selecting specific tree species is less prominent, because many species are capable of growing with a variety of variable soil types. Understanding the soil preferences of tree species is always critical to sourcing and forest composition at the outset of a project in order to increase the chances of healthy growth of the forest.

Soil, of course, is also a significant carbon sink, including both within soil organic matter and inorganic carbon as carbonate minerals. The creation of biodiversity and natural woodlands is beneficial to soil health and its ability to store carbon, which in turn aids the healthy growth of forests and the carbon stored within plant biomass. The selection and growth of diverse species is certainly beneficial to carbon sequestration in soils, thus elevating the potential benefits of planting based upon soil types as it heightens the sustainability and success rates of forest growth, and further promoting the benefits of biodiversity-based planting. Forests are also well recorded for their benefits to soil protection and health. The provision of semi-permanent land cover, for example, creates physical shelter to minimise soil disturbance and thus reduces erosion. It also aids in the reduction of soil contamination through avoiding the high inputs of fertilisers and pesticides associated with many forms of agriculture, and restores organic content to soils through organic decomposition and heightened presence of diverse biotic matter. Similarly, woodlands indirectly aid in reducing the incidence of landslides through the shelter of soils and the reduction of grazing pressures.

As a result of these issues, it is considered an **obligation that partner projects show a degree of understanding of both the appropriateness of selected tree species for soil types present at the project location, and that they have incorporated soil organic matter in their quantification of carbon sequestration for the project in question**.

### 3.1.4 Forest Composition and Ecosystem Services

**Balance requires a detailed understanding of the necessity for varied forest stands for the provision of ecosystem services, and for their benefits to the formulation of biodiverse forests.** The relative failures of past offset initiatives in sufficiently considering forest composition is discussed in Part Two (p. 25-26).

The ability of forests to deliver ecosystem services and the various co-benefits outlined in the nature-based solutions section relies on biodiversity and the necessary focus on the forest ecosystem as a whole, not just the trees. In fact, trees represent less than a third of the plant species across a range of forest types (Spicer, Mellor, & Carson, 2020). Forests host a diverse range of plants, animals, fungi and microbes that form symbiotic relationships that are critical to forest recovery. The explicit consideration of the natural composition of locally situated ancient forests is therefore particularly useful, taking into account stand diversity and composition, as well as understorey vegetation such as shrubs and herbs.

Current forestry policy increasingly advocates a diversification of forest stands to achieve both more productivity and sustainability, favouring mixed age structures and polycultures over single-aged monocultures. Canopy phenology, defined as the timing of recurring the biological regrowth of the canopy, relies on biotic and abiotic forces and the interrelation among phases of the same or different species. It is also important to widen forest species diversity due to the diversification of traits between species (Barsoum et al., 2016).

The creation of forests with ‘contrasting’ traits can ‘neutralise’ the influence of specific tree identities on the composition of understorey vegetation, which allows for the proliferation of ground plant species that are often suppressed or excluded in a monoculture plantation due to the presence of a limited number of species identity influences. In contrast, monoculture stands generally have poor nutrient retention that reduces plant species recruitment in the understorey. Mixed stands thus reduce the abundance of species that would otherwise tend to dominate and limit the growth of ground vegetation communities in a monoculture.

Understorey vegetation is also an undervalued component of overall carbon sequestration in forests, and of forest ecosystem processes more generally. For example, it has an impact on recruitment patterns of the overstorey, nutrient cycling and disturbance mediation; it also plays an important role in the provisioning of habitat and foraging material (e.g. pollen, nectar, foliage) for many associated species. Ground vegetation, in turn, is strongly influenced by the composition and structure of the overstorey, responding to differences in temperatures and the availability of light, water and soil nutrients at the forest floor level. Therefore, selection of varied tree species which facilitate the growth of understorey vegetation is necessary for the greater function of the forest in its entirety, including its resilience, health and carbon sequestration capabilities.

Also important are forest management cycles which allow healthy growth of selected species, whereby trees are planted, allowed to grow, then certain trees are ‘thinned’ (a proportion cut and harvested), allowing space for the remaining trees to grow larger and more effectively and for new growth to be accelerated through cyclical procedure. Through this process, carried out to varying degrees throughout the planted forest, a patchwork of stands of different ages are developed, allowing for biodiversity and, ideally, native species, to be developed in the area more quickly. This process takes decades, which makes effective and thorough planning of the management cycles for biodiversity development and native species absolutely essential.

The creation of woodlands also plays a role in natural flood management, particularly with reforestation of hill slopes and gullies and the restoration of wetlands, floodplains and river channel meanders. Modelling work and field-based evidence indicates that the presence of woodland can increase hydraulic “roughness” by slowing down and reducing run-off as water storage is increased and drainage to streams is delayed, which can help to desynchronise multiple flood peaks within a catchment and decrease overall geographic scale, depth and frequency of floods (Scottish Forestry Commission, 2020).

### 3.1.5 Inclusivity and Equality

Balance will also, as part of our due diligence process, examine every partner project to ensure that issues of inclusivity, equality, and economic benefits are both understood and that mitigation strategies have been implemented, particularly in locations where local communities are relatively disadvantaged. **A detailed description of the necessary considerations for economic and social co-benefits, as well as inclusivity and equality for the purpose of optimising co-benefits of forest planting projects for local communities, is discussed in Part Three (p. 12-16).**

## 3.2 Resilience and Longevity

### 3.2.1 Definition of Resilience

Resilience is the capability of a forest to withstand external pressures and, in time, to recover from disturbances, which may involve returning to its pre-disturbance state so as to retain the same function, structure, identity and feedbacks (Cavers, Cottrell, 2014). It is the extent of perturbation that a system can experience before it undergoes a shift to an alternative state; in other words, a system's ability to maintain elasticity and avoid reaching a state of malleability.

When viewed over an appropriate time span, a resilient forest ecosystem is able to maintain its 'identity' in terms of taxonomic composition, structure, ecological functions, and process rates. Current scientific evidence strongly supports the conclusion that forest resilience largely depends on biodiversity at multiple scales, and that maintaining or restoring biodiversity in forests is pivotal to promoting their resilience to different types of external pressures. Direct evidence for the relationship between diversity and resilience is typically experimental but has been shown for ecosystem resilience in many systems. Amongst plantations where biodiversity has been lost and replaced with monoculture, fast-growing forests, resilience to climate change and certain other threats has largely been shown to decrease considerably. Monoculture plantations have also limited the large number of environmental and socio-economic co-benefits of functional ecosystems that more diverse forests provide.

Adaptation and building biodiversity for the resilience of ecosystems will play an increasingly important role in reducing the loss of flora and fauna by helping habitats and species to respond to climate change. Biodiversity, crucially, should be considered at all scales, from ecosystem level to individual stands or trees, and in terms of all elements, whether that be genes, communities or species (Thompson et al., 2009). This is another reason for carbon offsetting plantations to incorporate biodiversity as well as taking the necessary actions to protect biodiversity and ecosystem resilience in the future.

### 3.2.2 Adaptation to Climate Change

The high level of uncertainty regarding whether locations that are currently climatically suitable for forests will remain so in the future is a major concern. Climate change may threaten woodlands by increasing the frequency of disturbance events that kill trees. Unlike other sectors, adaptive measures for forestry need to account for long time lags between tree establishment and maturity. The importance of biodiverse forests is paramount in the context of climate change and more extreme climate events, and ensuring the survival and growth of trees will be even more challenging in the future with increased temperatures and climate-induced changes to disturbance regimes, such as drought, fire, hurricanes, disease outbreaks and their interactions. The regional impacts of such events, climate change, and other land use pressures, might be sufficient to overcome the resilience of even some large areas of primary forests, pushing them into a permanently changed state. With more forest ecosystems being pushed past this ecological 'tipping point', they could be transformed into a different forest type, and even into a new non-forest ecosystem state which most often reduces the ecosystem's carbon sequestering abilities, biological diversity and ecosystem service capabilities. Therefore, it is necessary that the management of planted forests in an ecologically sustainable way recognises and plans for commonly-predicted trajectories for future climate changes is necessary at all levels. **Balance**

**therefore requires planting partners to display their consideration of the impacts of climate change upon forest locations, and the necessary alterations to the considered tree species for planting.**

Native, locally-sourced trees are the optimal choice for the main tree species in most cases. However, particularly with a view to the future, it is increasingly seen as necessary to look outwards, or, more specifically, in the UK context, southwards. Knowing exactly how the climate will change in the near future is impossible, but projects should work under the assumption that we will continue to experience a warming scenario, and thus choose species accordingly. The inclusion of species which are more resilient to higher temperatures, even if not native to the specific locale in which a project is located, is worthwhile, as long as harm does not come to biodiversity and exotic species do not become the dominant species.

The Forestry Commission in the UK recommends including species and provenances with more southerly origins (DEFRA, 2014). FC England, similarly, advises that at least one third of the planting stock should be sourced locally, but the inclusion of stock from southerly provenances should be considered, specifically from 2 to 5 degrees of latitude further south than the project location, with the exception of Eastern European sources in the UK due to a lack of suitability. Generally, wherever the project is located, to reduce the odds of long-term failure, apportion at least some areas for assisted regeneration for trees from regional provenances and climates that suit approximates for medium or long-term climate conditions, based on climate modelling from reliable sources if possible. Nevertheless, local provenances should still be prioritised for their adaptive capacity and overall benefit to local biodiversity and resilience. Furthermore, this assumes that forests with native species in England lack the adaptive capacity to cope with climate change, which is not necessarily the case. Provenances from further south might well be adapted to the warmer conditions predicted under climate change, but they are not necessarily well adapted to other conditions at British sites, and this might only result in exchanging one type of maladaptation risk for another. It is necessary, then, to display to Balance that **the project has carried out careful planning for any inclusion of exotic species and their potential risks even in cases where they might be potentially suited to climatic conditions in the near future**.

### 3.2.3 Accounting For Pests and Diseases

Significant barriers to forest adaptation and resilience include widespread tree mortality from pests and diseases, with risks increasing due to reliance on imported plants and the planting of monoculture forests. With limited genetic diversity, any pest or disease which targets the majority species of a monoculture forest threatens a large proportion of the forest's trees. Using the UK as an example, the UK Plant Health Risk Register currently includes approximately 300 pest and disease species likely to attack trees and pose a greater immediate risk to woodlands than climate change. Resistance strategies, such as integrated pest management practices, raising more planting stock in the UK, using natural establishment where possible, improving biosecurity to prevent the movement of contaminated water and soil, and increasing surveillance to catch outbreaks early, will reduce their likelihood and frequency. Increasing the biodiversity of a forest is also proven to increase resilience to pests and diseases, as monocultures are widely reported to be susceptible to disease and insect attack (Pichancourt, 2014). **As an obligation, Balance requires planting partners to display an understanding and inclusion of such preventative measures**.

### 3.2.4 Reducing Invasive Species

Invasive species, both plant and animal, which have been introduced on wide scales for reasons varying from increased productivity, growth rate or for prioritisation of particular resources, have the ability to replace native species in respect to their particular ecological niches, and can introduce fatal diseases which prove disastrous to native species. Primary, native forests are also generally more resilient and stable than modified forests or plantations, though forced removal and replacement of native species drastically reduces the forest ecosystem's resilience. Nevertheless, it must be recognised that certain degraded forests, especially those with invasive alien species, may be stable and resilient, and these forests can become serious management challenges if attempts are made to re-establish the natural ecosystem to recover original goods and services. This presents a complex problem in the reestablishment of native, diverse forests for their variety of benefits, though can be mitigated in the medium and long term by mitigation efforts against excess introduction of exotic species, particularly through the reduction of reliance on non-native tree crop species for plantation or reforestation projects, and the destabilisation which they bring to primary forests, as well as increase in reforestation projects which take into account these lessons and plant biodiverse, native forests. Valuable potential approaches include; reducing or eliminating populations of deer and uncontrolled livestock which browse on seedlings and prevent regeneration from occurring, recognising that UK woodlands lack the predators that would have once kept these herbivores in check; clearing of invasive species, such as Rhododendron ponticum, to enable natural regeneration processes to resume, and planting ground flora and epiphytes to recover. **Balance therefore requires partner projects to display a deliberate minimisation of unnecessary inclusion of invasive or exotic species in planting phases.**

### 3.2.5 Forest Structure, Connectivity and Tree Size

New woodlands, whether forestry plantations or new native woodland, can be established with diverse canopy and forest structure planned from the outset, to increase resilience to hazards. For example, planting in some areas can be delayed, fast-growing species can be planted in mixtures with slower-growing species, and wider spacings can be used to allow some natural vegetation to establish or thinning regimes can be planned to ensure structural diversity develops with stand age and size (Dieler et al., 2017). The generation and maintenance of stand and landscape structural complexity, with natural, primary forests used as models, is therefore paramount. Connecting or expanding reforested sites to an existing forest would help the new forest to regenerate naturally and expand the size of the existing forest, thus benefiting biodiversity and forest resilience. This can be achieved by maintaining connectivity across forest landscapes by reducing fragmentation, expanding protected area networks and establishing ecological corridors. **Balance therefore prioritises projects which display an incorporation of forest connectivity and stand variety in its planting phases**.

Some species thrive in selectively-logged woodlands, but felling large, old trees and clearing deadwood is harmful to birds, bats, lichens, invertebrates and fungi that are woodland specialists, so these measures should be avoided (British Ecological Society, 2021). Deadwood stands are also important carbon stores. Old trees and deadwood should be retained in managed woodlands, as they are immensely valuable for woodland specialist species (Kirby et al., 2017) and are nationally uncommon (Forest Research, 2021). Ancient woodlands are particularly valuable sites for veteran trees, deadwood and woodland specialists, but occupy just 2.2 percent of the UK

(Rackham, 2020). As it takes many decades to accumulate woodland specialists in secondary woodlands, **Balance obligates that unnecessary harvesting of any veteran trees should be avoided.**

#### 3.2.6 Consulting the Science

Before starting a reforestation project, existing sources of scientific and local knowledge should be consulted to aid decisions like species selection. It is advisable to perform small-scale trials prior to applying techniques on a large scale, to ensure the right trees are used and to test their effectiveness. Success indicators, like the recovery of an endangered species, should be monitored regularly, to see how well an ecosystem is recovering and allow project managers to adapt accordingly. Available models on climate change and whether areas are likely to support trees over the next several decades should be included, and tree species and planned forest composition should be carefully calculated and implemented according to available knowledge of past forests on or near the site, soil topography and hydrology, the intended aims of the project, and to benefit biodiversity to attain a great number of co-benefits. Logistical and management-based principles, though not included here, should also be paramount, and might include planning for the most cost-effective ways to achieve the project's goals, testing of methods prior to scaling up, adherence to regulations, distributing responsibilities for planting, caring for and monitoring the trees, site preparation measures, implementing a variety of restoration strategies, the engagement and inclusion of local people and stakeholders in decision making processes and in implementation, and the necessary training and education on planting methodology and appropriate practices specific to the project. **Balance therefore investigates all partner projects to ensure that the relevant scientific research has been studied and references, as relevant to the project location, based upon the points discussed above**.

Furthermore, in order to contribute to the growth of biodiversity-based carbon offsetting and NbS, projects should produce quantifiable datasets via careful and consistent planning and monitoring. Before the project begins, quantifiable objectives that correspond to project goals to evaluate project success should be identified, as with the relevant variables which require monitoring and the processes by which monitoring and quality control are maintained (i.e. who will be responsible for monitoring, how will the data be used and by whom). As projects are carried out, any unintended consequences of tree planting should be observed and, if possible, corrective actions should be taken, though, of course, undesirable outcomes are to be expected. **Balance, therefore, will not become involved in a project in which quantifiable data is not produced.**

Although tree planting may contribute to achieving many goals, it is impossible to simultaneously maximise them all, as evidenced by the abundant literature on ecosystem services trade-offs, though a number of key points outlined here demonstrate the particular considerations required when planting forests to optimise the essential elements of biodiversity and ecosystem resilience, which are pivotal to the longevity, success and carbon storing abilities of forest-based carbon offsetting projects.

## 3.3 The General Benefits of Biodiversity

### 3.3.1 Biodiversity and Its Impact on Resilience

The biological and ecological resources of a forest ecosystem, including the diversity of species, even down to the microscopic scale, the genetic variability within species (or the diversity genetic traits within species populations), and the wider regional pool of species and ecosystems, all play a role in determining the resilience of a forest to changing environmental conditions and particular environmental threats. Species-rich ecosystems are typically more resilient because different species respond differently to stressors, thereby buffering the system as a whole (Jucker et al. 2014, Isbell et al. 2015). Native tree species, when grown in climates and abiotic contexts suited to them, are aided in producing genetic diversity amongst individuals of the same species, and thus are likely to enable adaptation and resilience to climate change; natural regeneration or locally sourced seed should continue to be a core component of future woodland creation when biodiversity conservation is a key objective (Ennos et al., 2019). Practices which select only certain types of trees for harvesting should be avoided in all cases.

Depending on whether ecosystem resilience or species resilience is being considered, stability may depend on either diversity of species throughout an ecosystem or intraspecific genetic diversity, respectively, and the processes governing their maintenance. The latter might include dispersal mechanisms, recruitment, growth rate, maximum size, resilience to fires, preferred soil types and so on. A tree species, for example, can adapt to specific climatic or biotic factors (the latter including pathogen presence, beneficial species or competition from other species), which may result in divergence in traits such as pathogen resistance, growth rate, tolerance to climate extremes or so on, which heightens the tree and the forest's resilience. Studies show that the level of genetic diversity within an individual species is important for delivering the potential for 'evolutionary rescue'; that is, to adapt and change to different abiotic circumstances.

The mechanism of evolutionary rescue involves initial population decline followed by recovery as genotypes adapted to the new conditions prosper via natural selection. Trees, generally, maintain high levels of genetic diversity and are typically effective at gene dispersal, particularly in northern temperate forests. Many tree species are also capable of adapting genetically to local environments, although the degree and geographic scale over which they are distributed may vary depending on the heterogeneity of the landscape conditions. With the threats presented to forests now and in the future, through the process of natural selection, both individual tree species with optimised resilience through variants of genes or gene combinations, as well as particular forest compositions typically conferred by high biodiversity, will prove most resistant.

The size of forest ecosystems is also influential in improving resilience, as, generally, the larger and less fragmented a forest is, the better, thus targeting the creation of large, connected forests is ideal for optimising resilience. The size of a population of the same species within an ecosystem is also important, as a greater population base allows a higher chance for adaptive traits to develop and proliferate within the same community. Also, large tree species are important as they are likely to act as 'drivers' in an ecosystem, particularly in northern temperate forests such as the UK which are typically species-poor and dominated by one of a few species. As drivers, when a mature tree species is eliminated by a threat for whatever reason, the gap may be filled relatively quickly by successional species, which aids in maintaining the forest's overall resilience while altering the forest's structure. However, the ideal circumstance, particularly in planning for new tree planting projects, is that the intended large tree species are suitably resilient to potential threats, as in these cases significant rearrangement of community interactions will nevertheless take place and, potentially, much of the pre-existing biodiversity and many of the ecosystem processes may not be maintained. Thus, planning for optimal resilience of the primary tree species in any forest is essential. To do this, forest planting projects should plant with varying compositions based upon a variety of species, though prioritising one or two main tree species with intra-specific genetic diversity. Of course, the mode and scale of dispersal of species, as well as particular threats to certain species, must be accounted for.

### 3.3.2 Biodiversity for Carbon Sequestration

Biodiversity in forest ecosystems is increasingly related to the ecosystem's carbon storage capability, though difficulties in analysing this relationship have stunted global calls for biodiversity in carbon storing initiatives such as carbon offsetting. Many studies have explored the trade-offs of planning for biodiversity and carbon sequestration but have generally failed to provide any detailed guidelines on what to plant and how to manage these plantings, and many more studies which have found positive correlations in the past have been conducted in non-forest landscapes such as grasslands. Addressing this issue requires deciphering to what extent forest biodiversity and carbon sequestration influence each other, and few empirical or modelling studies address the trade-offs and synergies that can occur among biodiversity and carbon sequestration in forests, and even fewer have identified any potential mechanisms which facilitate the relationship. A key obstacle has been the need to quantify a less readily quantifiable variable such as biodiversity across a wide variety of ecosystem types and under a number of different socio-economic and biogeographical conditions.

Another stumbling block has been the heterogeneity and lack of regulation (as well as ambiguous categorisation) of carbon sequestration monitoring and quantification. This is because outcomes strongly depend on how the boundaries of the analysis are drawn and which aspects are incorporated, i.e. developments solely within the forest ecosystem itself, or inclusive of wood products and emission substitution effects. Clearer insights might be achieved if the multidimensional outcomes and factors of biodiversity are condensed and made uniform so that a single robust indicator is used, and the same is done with carbon sequestration.

Carbon is sequestered in forests through a mix of several ecosystem processes, of which photosynthesis is key, though respiration and decomposition subsequently play their part. Carbon can be stored as soil organic carbon (SOC), and as carbonates, the latter of which are created over thousands of years when carbon dioxide dissolves in water and percolates the soil, combining with calcium and magnesium minerals, forming “caliche” in desert and arid soil. Photosynthesis, decomposition, and respiration rates are determined partly by climatic factors, most importantly soil temperature and moisture levels. For example, in the cold wet climates of the northern latitudes, rates of photosynthesis exceed decomposition resulting in high levels of SOC, while temperate ecosystems, the likes of which exist in the UK, are likely to have high productivity in the summer with high temperature and sufficient moisture levels.

High levels of soil organic matter (SOM), which consists of a heterogeneous mixture of materials that range in stage of decomposition such as soil microbes including bacteria and fungi, decaying material from once-living organisms such as plant and animal tissues, fecal material, and products formed from their decomposition, typically allow for increased sequestration of carbon (SOC) for several decades, because SOM is made of compounds that are highly enriched in carbon. SOM can benefit soil quality through the increased retention of water and nutrients, resulting in greater productivity of plants in natural environments and a decrease in negative impacts to ecosystems, which in turn benefits biodiversity (Ontl, Schulte, 2012). When carbon inputs and outputs in a forest are in balance with one another, there is no net change in SOC levels. When carbon inputs from photosynthesis exceed C losses, however, SOC levels increase over time. This, of course, is achieved in planting projects, but can be optimised amongst those which directly benefit biodiversity.

One method by which soil can be optimised for carbon sequestration and health is through the continuous improvement by a type of charcoal which we now know as 'biochar', a **rich**, black, fertile earth which can be made from all sorts of organic material including agricultural waste, tree trimmings, manure, and rice husks. It offers many agricultural benefits, improving fertility without the need for synthetic fertilisers, supporting healthy soil by providing a home for armies of microbes and mycorrhizal fungi, and increasing the soil's ability to hold water, mitigating the effects of flooding and improving drought resistance. It is a valuable asset in no-till farming, which is much less damaging than intensive farming to the soil's essential microbial structure. But biochar's biggest benefit is enduring carbon sequestration, removing carbon from the atmosphere and holding it as an inert substance over the very long term. This offers potential not just to balance emissions, but actually to reduce the levels of CO2 accumulated in the upper atmosphere. Biochar, when incorporated in agricultural processes, is aided in its effectiveness by its benefits to biodiversity, as a litter consisting of a variety of species increases the richness of carbon stored in the soil.

In all soil types, the benefits of biodiversity can work to ensure that SOM is more abundant and that this process occurs to store carbon at greater capacities and for longer periods. Similarly, with biodiversity enhancing the resilience of forests, the carbon is stored for longer and the release of carbon into the atmosphere when the plants die is less frequent. Some studies display that optimising the functional diversity of the trees planted does not necessarily always lead to maximised carbon sequestration, complicating the proposed relationship (Pichancourt, 2014).

Generally, primary, native forests, particularly in the tropics, are known as the most effective in storing carbon, as they hold the largest carbon pools of any forest habitats in the world, largely due to their biodiversity, longevity and high resilience. However, a great variation exists in the carbon stock estimates for different types of forests, and can even vary widely among the same forest types. Wide differences in carbon stock in a forest may be due to a number of factors, including variations in tree species richness, stand structural attributes, climatic differences, forest type, altitudinal variations, soil types and individual characteristics such as their mechanisms of dispersal and their ability to recruit new genotypes to a population (Cavers, Cottrell, 2014). Also influential are various stand-specific characteristics such as tree size and stand structure (Sullivan et al., 2001). The particular environmental conditions where species grow, including soil, relative position in the landscape, climate and disturbance regimes as driven by both natural and human processes are significant to determining biodiversity and carbon sequestration.

More recently, however, synergies between species richness and diversity and carbon storage have been found among various forest types all over the world. For example, Biber et al. (2020) argue that, though difficult to analyse, win-win situations for carbon sequestration and biodiversity and forest landscapes across Europe have been shown. Vayreda et al. (2012) found that species richness and structural richness variables are better predictors of C accumulation than climatic and local site variables in Western Mediterranean region. Poorter et al. found that diversity of species is strongly related to carbon storage at smaller scales, while structural attributes of forests are more related to carbon storage at larger scales, though are relevant at all scales. Liu et al. (2018) found that tree species richness enhances ecosystem-level C storage in the subtropical forests of China. Kothandaraman et al. (2020) used tropical forests in India as an example of forests rich in biodiversity proving hugely beneficial for carbon storage by estimating ecosystem-level carbon stock with data from 70 forest plots in three major forest types. Considerable quantities of carbon per hectare were found in the more biodiverse tropical evergreen forests, with an average of 336. Mg C/ha, of which just under a third of the carbon was stored in understorey, litter, deadwood and soil respectively (with the majority stored in trees). Among the forest types, the tropical evergreen forest type, the most biodiverse of the studied forest types, had the highest average carbon stocks when compared to semi-evergreen forests and dry deciduous forests.

Within the tropical evergreen forests, 14.5 percent of carbon was stored in the understorey, raising the overall carbon sequestration per unit area, while the average contribution of understorey over every other forest type is only 2.2 percent. The importance of facilitating the growth of the understorey and allowing the presence of litter and deadwood is therefore obvious. Many current and past planting areas, unfortunately, have restricted the growth of the understorey through planting patterns and management strategies, and most studies conducted prior to recent years focused almost exclusively on aboveground biomass carbon stored in tree species, without considering the role of the understorey, roots, litter, deadwood and soil in storing carbon. Allowing the natural regrowth and biodegradation of tree species is shown to play a key role in permitting the presence of these additional carbon storing factors, and tree species diversity, in particular, is linked to the development of a diverse and prominent understorey. Pichancourt et al. (2014,) found that the type of forest, the landscape context and climate are all significant to determining the relationship. For example, in arid and hot uplands, increasing plant functional diversity does not change significantly the above ground carbon sequestration rate, but changes the soil carbon sequestration rate and the total carbon sequestration rate nonlinearly, whereas forests that are regrown on lowlands with increased plant diversity increase the total carbon sequestration rate by up to 100 percent. Therefore, since there is no 'one size fits all' solution, the best management solutions must include complex planning which must be adjusted to incorporate the climate and local context for sequestration optimisation.

In addition to their role in enhancing biodiversity, larger trees should also be prioritised for their carbon sequestering capabilities. Lutz e al. (2018) reported that large-sized trees account for nearly 41 percent of carbon storage in forests on a global level. Tree species richness is widely known to increase tree size inequality among and within species, creating varied and diverse structures with a larger number of large trees, thus enhancing overall carbon stocks in a forest. Tree species evenness, monoculture planting or excessive logging for timber, on the other hand, is known to have a negative effect on average large tree size, structural diversity and overall carbon storage (Kothandaraman et al. 2020).

Other studies, such as Chen et al. (2017) and Pichancourt et al. (2014), have identified that species biodiversity in forests is significant for increasing the amount of soil carbon in any given ecosystem, and making the storage of carbon in soils more efficient. Soil carbon depends on two processes: carbon inputs (for example the net carbon gain by plants) and losses (such as decomposition). Recent studies at small scales have displayed that high diversity indexes increase soil carbon storage by elevating the inputs and increasing the soil microbial community activity and diversity, which simultaneously acts to suppress carbon losses from decomposition. In turn, high soil carbon storage has the capability to impose a positive feedback on species richness and productivity by increasing soil water-holding capacity and elevating soil fertility to improve growth rate and success amongst a wide range of plant species. Positive relationships between diversity and soil carbon storage have also been reported in larger-scale studies in forests (Liang et al. 2016) and grasslands (Fraser et al., 2015).

The extent to which the relationship is influenced by either species diversity or specific species identity is another crucial factor in being able to analyse how to approach planting for biodiversity. The influence of the identities between plant functional traits that characterise the variety of species in a forest ecosystem, that is, the traits which impact the role the various species play in the system and how those characteristics compliment those of other species to impact growth, survival and reproduction, has been suggested as the most important factor in determining carbon sequestration. A comparison of more than 200 studies found that species identity (and the specific characteristics of the species chosen) and species diversity, however, contributed roughly equally to dictating the relationship (Pichancourt, 2014), though no clear answers currently exist. It is clear, however, that both identity and diversity of species must be considered at the outset of a project.

Historically, offsetting and conservation initiatives that have been mainly focused on carbon storage have failed to protect many species that exist in species-rich, biodiverse forests, and positive relationships between diversity and carbon sequestration have not been well captured by global carbon models. Today, forests are often planted to maximise a single prime objective, whether that be biodiversity or carbon sequestration, often using just a single metric to determine success, rather than maximising the two objectives concurrently. Ironically, this has damaged the stocks of carbon found in the whole ecosystem, in favour of fast-growing, monoculture tree species, as well as the long-term ability of many projects to sequester carbon by reducing the forests' resilience.

**As such, biodiversity should not be recognised only as a co-benefit of an offsetting project, rather it should be considered mandatory for both short and long-term maintenance and management of carbon stocks. The purpose of the Planting Principles are to ensure that any projects with which Balance becomes associated consider and implement biodiversity with the same urgency with which it is required.** Any form of ecosystem management, including offset projects in forests, should maintain high levels of plant diversity to enhance carbon storage and other ecosystem services that depend on plant diversity. Similarly, the entirety of the carbon pool in any given ecosystem must be included in monitoring carbon sequestration for offsetting initiatives, which will lend further incentives for new projects to prioritise the development of biodiversity as a central target of the project as overall carbon sequestration is consistently found to be greater in biodiverse ecosystems.

### 3.3.3 The Intrinsic Value of Biodiversity

The intrinsic value of protecting and enhancing biodiversity, particularly in the context of the global biodiversity crisis, presents another valuable benefit of biodiversity as practised by Balance. The recent Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) report classified 25 percent of assessed species as threatened (IPBES, 2019). In the UK, the State of Nature Report described a 13 percent decline in average abundance of species and a 5 percent decline in average species' distribution of terrestrial and freshwater species since 1970. It was also found that the key pressures on biodiversity come from agricultural management, climate change, pollution, urbanisation, woodland management, land use change and invasive species (British Ecological Society, 2021). With the current decade addressed as the UN Decade on Ecosystem Restoration as a primary target for all UN nations, it is timely to consider how carbon offsetting projects can contribute to the establishment and conservation of biodiversity.

Forests provide vital habitat for biodiversity and essential ecosystem services (Biber et al. 2020). Forest biodiversity, and the associated goods and services provided, must be sustained or enhanced over the coming century to meet the resource requirements of the global human population, and to halt the biodiversity crisis. The necessity for forests, and any ecosystem redeveloped by carbon offsetting ecosystem-focused carbon offsetting initiatives or NbS, to maintain biodiversity of both plant and animal species is vital, and this should not be drowned out entirely by the desire for ecosystem services and climate mitigation benefits. However, protecting the environment and reducing emissions are significant to combating the biodiversity crisis; climate change, in particular, has been identified as a key driver for biodiversity loss (Stephens et al. 2016), as some species have been forced to change the timing of their seasonal lifecycle patterns, to shift in distribution and to decline in local population. Whilst some species are able to persist or adapt to climate change, others have and will continue to go extinct (Pearce-Higgins et al. 2017, Hickling et al. 2006). Protecting existing habitats is also of vital importance, as well as introducing stricter regulations against land-use change in natural high-biodiversity regions and protection from harmful human activities such as logging and poaching.

### 3.3.4 Transpiration

The benefits of afforestation and, in particular biodiversity-based afforestation, on increasing transpiration and its simultaneous cooling and wetting impacts upon the climate are well-researched, and shall be described very briefly here. When water is absorbed by trees predominately through osmosis, it moves vertically upwards through the inner bark's xylem through capillary action (enabled by the phenomenon of surface tension against the force of gravity). Once water reaches the leaves, it evaporates into water vapour through the stomata (pores), and if this process occurs more than the rate at which water vapour returns to a liquid state on the surface of the leaves, there is net evaporation (Kumagai, 2011). In this context, large quantities of water vapour can be emitted by trees, and larger trees, of course, incur more transpiration. This evaporation causes a decreasing effect on immediate surrounding temperature, as considerable energy is required to vaporise each gram of water. A mature oak tree, for example, transpires more than 400 litres of water on one hot summers' day, and each gram of water transformed into water vapour removes heat. If one imagines this process carried out amongst every tree and plant across an entire forest, it causes a significant cooling impact on the surrounding area. Water also evaporates from soil, so the total output of water vapour into the air from a forest or any ecosystem is called evapotranspiration.

The benefits of transpiration are not limited to the cooling effect on temperatures, they also cause humidifying benefits across a widespread system of air currents. The evapotranspiration from rainforests, other forests, fields, and yards adds water to the atmosphere in the form of clouds and general humidity. Most of these clouds release the water right back onto the local areas. In rather simplified, yet nevertheless strongly evidenced terms, forests are thus often the barriers to desiccation, a process which can spiral into a cycle of aridification and forest destruction whereby both phenomena positively influence each other, while also promoting susceptibility to pests and diseases. Stressed trees, in drier atmospheres and higher temperatures, are also more susceptible to fire, which adds to the cyclical process of destruction. In the Amazon rainforest, for example, "flying rivers", air currents which carry the precipitation from the forest, are critical for the transport of moisture across the continent of South America, and even beyond. Widespread deforestation, through its destructive impacts upon evapotranspiration, is a significant contributor to potentially irreversible tipping points, beyond which mass desiccation is predicted throughout the Amazon, causing untold damage to global freshwater supplies, local communities and carbon sequestration through its further deleterious effects on remaining forest land. A similar process, though predominantly on smaller scales, is possible in all forested regions. The necessity for planting and protecting biodiverse forests, which can sustainably promote the global water cycle, is therefore critical.

# 4. Case Studies

## 4.1 The Current State of Forests and Forestry in the United Kingdom

### 4.1.1 Forestry in the UK

The limited size of the UK's forests in comparison with other European nations, and the particular lack of native ancient forests has caused great concern for the future of the UK's biodiversity and carbon sequestering potential. As individual forest ecosystems in Britain contain relatively few tree species, genetic diversity in planted forests both for resilience, ecosystem services and carbon sequestration benefits is paramount. This section outlines how current and future tree planting projects in the UK can use the principles established in the previous section to increase the likelihood of obtaining these co-benefits while increasing overall reforestation and afforestation efforts.

The current land-cover of forests in the UK (13 percent) is small compared to that of other European countries. It is, however, larger than the forest land cover which existed at the end of the First World War in 1918, when, it is thought, it was only 5 percent. The existing forests at the time were a combination of native woodlands and commercial forests of mostly native species, though a new regime of forest creation through afforestation created intensively managed monoculture forests, typically involving exotic species. General practice involved clear-felling after an economic rotation of between 40 and 70 years, and then replanting with a similar exotic species. Since this time, successive governments have subsidised afforestation with non-native conifers, recognising that Sitka spruce and a handful of other conifers can deliver much greater volumes of merchantable timber than native woodlands. This has created a rural industry that today employs more than 43,000 people in forest management and primary wood processing, providing timber and other wood products to a country heavily reliant on imports. Levels of woodland creation across the UK are nevertheless generally low at present, however, with woodland creation targets of 30,000 hectares per year to aid in meeting the Net Zero by 2050 mission proving particularly challenging.

Even amongst the most recent planting initiatives, many tree planting initiatives have consisted of monoculture forests or mixed forests prioritising exotic species, typically including conifer trees, under the guise of the simple narrative of tree planting as environmentally and economically beneficial. This has been a longstanding issue; in the 1980s, peatlands, bogs and moorlands were planted with conifer, with environmentally damaging results, because planting trees on peatland dries out the soil, whereas peat in its natural state can act as a powerful carbon sink. The promise of planting native broadleaf species and mixed composition forests in place of the more typical monoculture conifer species of past forests is considerable. In terms of adaptive capacity, native tree populations in the UK typically show a degree of adaption to environmental and topographical conditions in Britain to a far greater degree than those from mainland Europe when compared in trials. For example, on the basis of provenance trials of Scots pine, silver birch, sessile oak and alder, British provenances showed superior growth and survival in 90 percent of cases compared with those from continental Europe (Gerber et al. 2014). Also, native mixed-species planting in the UK which leads to oaks dominance also results in more durable carbon stores than achievable by conifer forests. Local provenances are typically, therefore, best adapted to current climatic and abiotic conditions in Britain, and thus should be prioritised in tree planting programmes in the UK.

Despite the continued planting of monoculture forests with exotic species, planting practice in the UK has increasingly come to acknowledge the necessity for native species. Over the last two decades, forestry management in Britain has generally diversified to include native woodlands and forests under a less intensive system which includes mixed ages and species. In these, multiple native broadleaf species, which are recorded to store more carbon than exotic conifers across the drier and warmer parts of the country, have been planted. Multiple guidelines within the UK today recommend the use of local provenances for planting of primarily native species, yet monoculture forests with tree species or exotic origins are still selected, particularly for forests intended for timber production.

Today, according to Cavers and Cottrell (2014), British forests consist of roughly half conifer, 32 percent broadleaf and 8 percent broadleaf/conifer mixtures. Most of the conifer species are of exotic provenance; the principle species grown are Scots pine (native), Sitka spruce (USA/Canada), Lodgepole pine (USA/Canada), Larch (Central Europe or Japan), Norway spruce (North-Central Europe) Corsican pine (Southern Europe) and Douglas fir (USA/Canada). Sitka spruce is the most abundant species, and covers half of the area of commercial conifer forests. The only native conifer species, Scots pine, represents only 18 percent of planted species. The principal broadleaf species are oak, beech, sycamore, ash and birch. In terms of standing volume, oak and ash represent 30 and 14 per cent, respectively, of the total broadleaf species in Britain. Unfortunately, in most cases, studies of genetic diversity in British tree species are few, despite the role that this would play in understanding how forest resilience may be increased. This is because most British species have distributions that extend to mainland Europe and so studies have been carried out across a broad geographic scale with little consideration of the British context.

The UK's forests are under particular threat from new pests and diseases of exotic provenance. Globally, it is estimated that there are at least 28 recognised pests and diseases that could cause substantial devastation to British trees if they gained entry to Britain (Cavers, Cottrill, 2014). There are numerous examples where introduced pathogens have led to mass destruction of tree species elsewhere in the world, for example chestnut blight and white pine blister rust in North America. As discussed, climate change is certain to further increase the threat from pests and diseases, specifically through altering balance between tree hosts and existing diseases; for example, increasing temperatures may impact the synchrony between behavioural patterns of herbivores and plant species, and milder winters may increase the number of disease-susceptible ground plant species such as green spruce aphids. New, warmer climates will also cause species that were not previously considered threats to become so within the UK context, particularly those with provenances from warmer countries.

Today, therefore, a better strategy for establishing resilience and optimisation of biodiversity and carbon sequestration in forest ecosystems is necessary in order to respond to growing threats from climate change within the UK context and to aid in the UK's own climate targets. Indeed, the concept of resilience and biodiversity in forests has been widely established by British policymakers, as evidenced by a number of official policy documents such as the UK's Tree Health Action Plan and Biodiversity 2020: a Strategy for England's Wildlife and Ecosystem Services. There have been a number of key complexities, however, in advocating for the prioritisation of resilience in British forests, however, including differences in operational definitions, quantification of resilience, what pressures must be combated, and what constitutes best practice in tackling these pressures. In these cases, on occasion, results have been ambiguous and often counterintuitive. The further development of practical methods to heighten the resilience of the UK's forests, and the connections between resilience and biodiversity in specific local contexts, is absolutely necessary if current and future tree planting initiatives in the UK, including carbon offsetting projects and NbS, are to be successful.

Generally, in terms of determining the correct context for large-scale tree planting initiatives, current advice maintains that projects should avoid peatlands, productive agricultural lands and habitats of high conservation value, and should focus instead on poor-quality grazing land of which there is more than enough to fulfil government planting commitments. Afforesting high-quality arable land should generally be avoided, at least in the short-term and in the absence of carefully planned compensation, as it reduces the UK's capacity to produce food, leading to an even greater reliance on food imports which are linked to deforestation in the tropics, releasing CO2 from those forests and destroying biodiversity hotspots. Woodlands have the capability to imperil wildlife if allowed to be established on open habitats of high conservation value in the UK, or "priority habitats", such as lowland heathlands and species-rich grasslands, so these should be avoided.

Afforestation of peatlands and organic-rich soils should also be avoided. Afforestation requires improved drainage to achieve strong tree growth, but aeration accelerates microbial decomposition of the peat, releasing CO2 and generating a major initial carbon "debt" that takes years to repay through tree growth. Planting on peat that is deeper than 50 cm is now outlawed under the UK Forestry Standard, but planting on shallow peat continues, supported by evidence that these forests can sequester carbon over the production cycle if the productivity is high enough. However, modelling suggests that peats should be avoided altogether to avoid damaging the soil, and that new forests should be created in low-grade agricultural land instead. In all, policies regarding the establishment of woodlands on carbon-rich soils need further refinement if evidence emerges of adverse effects on the large stocks of carbon held below ground.

Forests in the UK should generally be planted on low-diversity lands, in particular grasslands, which offer the best prospects for large-scale afforestation. The Forestry Commission has identified five million ha of "low risk" land (CCC, 2019), while the Friends of the Earth's figure is 1.4 million ha, having screened out species-rich grassland and priority habitat for conservation (Friends of the Earth, 2020). The incorporation of biodiversity in legislation and private recommendations in the UK is growing rapidly, too. The Woodland Trust recommends that planting should prioritise a mix of native species, citing that UK woods are under pressure from pollution, climate change, pests and diseases, and that including a broad range of native tree species will make your planting more resilient to these pressures.

The signs are generally promising, as political frameworks increasingly incorporate notions of forest resilience, native species and biodiversity. The UK Forestry Standard provides a framework for more sustainable forestry, discouraging geometric plantings of single species in large even-aged blocks in favour of mixed systems including native species (at least five per cent). It is recommended that any government subsidies should be intended for biodiversity conservation of native woodland creation and management, both for resilience, carbon storage and economic gain. In terms of the latter, it is apparent that, although there is currently little incentive for planting native woodlands in any other forestry initiative than carbon offsetting or NbS, the value of this service will soon far exceed the market value of timber production, and increased prioritisation in governmental incentive schemes will mean more native woodlands will be planted.

**4.1.2 Forestry in Scotland**

Scotland is considered the most advanced in its modernisation of forestry techniques and renewing targets set for forest creation with incorporation of biodiversity and native species restoration. Although regimented monoculture forests of conifer, which are managed primarily for timber, can still be seen on a large scale in Scotland, recent efforts have been made to redress this issue by building a vision for Scottish woodlands in line with modern consensus on the necessary ecological, environmental, social and economic concerns when planting forests. Forests in Scotland, on the whole, are now far more diverse in structure, with forest certification and political readdressing of forestry in Scotland as one of the most important drivers for this change in approach.

A report written in 2008 outlined the need for conversion of large areas of conifer forests in Scotland into native woodlands (Sing et al. 2008), for general expansion of native species and the protection of existing ancient woodlands from destructive logging and land use change. Habitat Action Plan Targets for native woods in Scotlands were revised as early as 2006 along with the rest of the UK with the wide review of UK Biodiversity Action Plan targets. At that time, it was recorded that conifer constituted 39,741 hectares of the total 59,057, or 67 percent, of planted woodland sites in Scotland. Targeted for their replacement were ancient broadleaved woods and Scots pine in areas suitable to their proliferation, with ambitious targets of 51 percent potential expansion area for 1km woodland networks, and 43 percent for 250m woodland networks, citing that these native species should be able to disperse freely, and attract more investment as success is evidenced.

Unfortunately, in the decade since this report, such progress has been limited. As outlined by the Forestry Commission Scotland (2020), a report aimed to provide government advice to planning authorities on planning for forestry and woodlands, much more still needs to be done to expand native woodland cover. The major drivers for native reforestation outlined in the report are to aid Scotland in mitigating climate change, to heighten Scotland’s timber productivity, support sustainable economic growth, support community development, improve quality of life and wellbeing, improve health through greater access to woodlands, conserve and enhance Scotland’s biodiversity, and protect ecosystem services. Those ecosystem services include improving water quality, reduction of wind erosion and sedimentation of water courses, reduction of run-off, increased entry of rainwater into soil, maintaining soil health, minimising soil disturbance, managing floods, and providing shelter for farmland and riparian habitats. The development and enhancement of native woodlands is also supported for its help in developing forest habitat networks, as part of integrated habitat networks, to enhance habitat interconnectivity and resilience to climate pressures. As such, Scotland’s current political trajectory is particularly promising, and encompasses the key principles for reforestation outlined above, including biodiversity, forest sustainability and resilience, connection of forest ecosystems and habitat networks, climate change mitigation, social and economic benefits, and ecosystem services. In regard to the latter, natural flood management schemes through the strategic placement of floodplain woodlands, the protection of water and soil resources against climate extremes through the stabilisation of slopes and river banks, and the management of ammonia emissions are all included. The carbon sequestration potential of forestry within the context of the Scottish Climate Change Programme is also discussed, with a specific target to deliver annual carbon savings of 0.6MtC by 2010, rising to 1MtC by 2020. In addition, the Scottish Climate Change Act 2009 sets a target of achieving an 80 percent reduction in Scotland's emissions by 2050, and an interim target of a 42 percent reduction by 2020. Forestry is expected to have a significant role in helping to achieve these targets, primarily through the creation of carbon sinks by woodland creation, through the restoration and expansion of lost habitats and native woodlands to improve resilience and sustainable ecological adaption.

The vision set out in Scotland is to increase woodland cover to 25 percent of land area by 2050, focusing on native species and the maximisation of the delivery of multiple benefits from Scottish woodlands, including the restoration of lost habitats and climate mitigation through the increased effectiveness of carbon sequestration in biodiverse, native forests. Scotland's native woodlands support a disproportionately high proportion (36 percent) of threatened species in Scotland, as well as 7 UK priority habitat types, and are a key element of Scotland's landscape and cultural heritage; the concern for conserving this is central to the Scottish Government's new Scottish Biodiversity Strategy. Nevertheless, despite the promising nature of the suggested outcomes of their renewed forestry strategies, the Scottish government has not entirely shifted their priorities to native, mixed forests, but has instead included four main types of woodland envisaged as the future of Scotland's forests:

(1) native woodlands;
(2) mixed woodlands;
(3) softwood forests;
(4) energy forests.

As such, native woodlands are thus positioned on equal terms of importance as "energy forests", which are explicitly monoculture forests for the primary purpose of energy generation, and, tangentially, timber production. As long as "energy forests" are still included in long-term plans for national forestry strategies, the positive impacts of biodiverse forests cannot be optimised on a scale that would see widespread impacts. Though signs are promising in Scotland, much more can still be done to redress the balance of necessary approaches to forest restoration and protection, as there exists considerable potential for the incorporation of biodiversity and forest resilience as critical aspects of national forestry targets.

## 4.2 The Woodland Carbon Code and The Forest of Marston Vale

### 4.2.1 The Woodland Carbon Code

Afforestation-centred carbon offset initiatives are limited in number and scope within the UK context, as many are located in developing regions of the Global South. Nevertheless, promising examples of successful forests which are aligned with the principles established in this methodology do exist, one of which is the Forest of Marston Vale, one of the afforestation projects through which Balance offers Balance units.

The Forest of Marston Vale operates through the Woodland Carbon Code (WCC), a voluntary standard for woodland creation projects in the UK, based on the methodology established by Daniel Morrell and Richard Tipper in the 1990s, which today offers offsetting projects the greatest opportunity for tangible verification and validity based upon a number of integrated considerations. Other voluntary carbon standards, such as the UK Peatland Code, Verra's Verified Carbon Standard, the Gold Standard, and Plan Vivo all operate for organisations within the UK, yet the WCC has seen endorsement and promotion accelerate under governmental decree in recent years when compared with the other standards. Defra's 25 year Environment plan, for example, states that the government will introduce a reporting framework for businesses to drive demand for Domestic Offset Units and consider a Forest Carbon Guarantee scheme, using the existing Woodland Carbon Code, and the Scottish government's Climate Change Plan has policies in both the Forestry and the Agriculture sectors to promote the WCC. The guidelines established in 2019 in the UK encourage organisations to offset emissions by voluntary and compliance market offsets, and explicitly advertise the purchasing and retiring of UK Woodland Carbon Units (WCUs).

In the most basic sense, the WCC encourages a much-needed consistency and uniformity among approaches to woodland offsetting projects, while providing validation and independent verification to projects based upon sustainable management to national standards, reliable estimation and monitoring of the amount of carbon sequestered, and the adherence to transparent criteria and standards to ensure that benefits are delivered. To meet the requirements of the code, projects must demonstrate additionality, scalability and guaranteed maintenance for their duration, use standardised methods for estimating sequestered carbon, and have integrated long-term management plans to ensure project sustainability. The code accounts for most types of forest growth or regeneration and associated carbon sequestration and emissions reductions, including woodland created by planting and natural regeneration, multiple types of management regimes from frequent clear felling to minimum intervention woodland, and even emissions outside the woodland boundary which result from the project. The code does not, however, account for additional carbon sequestration due to changes to the management of existing woodland, or carbon stored in forest products.

The WCC ensures comprehensive planning and managing, including an outline of the necessary inputs and resources including a full financial analysis, a summary of operational techniques, consideration of species selection for current and future benefits, consideration of longevity and resilience in created forests, maps of the areas being planted, and a chronological plan of all key project operations to be established at the outset of the project. The code ensures that the management plan is updated regularly with renewed longer-term management targets and intentions beyond the project duration.

The WCC operates by allocating WCUs to organisations and individuals based on projects within the UK. WCUs are voluntary offset units and thus cannot be used in the compliance market, and cannot currently be used for emissions made outside the UK, thus are restricted purely to the voluntary market for organisations based primarily within the UK. They are acquired upon the verification of a project, but before that the units are called Pending Issuance Units (PIUs), the purpose of which is to demonstrate the quantity of potential future sequestration at the outset of the project, which can be assigned to buyers but cannot yet be used or retired until they are transferred into WCUs, which can be used as full carbon credits. All units are assigned a vintage, which is the period in which their delivery is anticipated, as determined by monitoring and verification schedules. When the vintage has ended, the quantity of PIUs assigned to it is automatically converted into WCUs, and only verified WCUs can be used or retired to help compensate for an organisation's emissions. All retirements are shown on the public view of the UK Land Carbon Registry, prior to using WCUs in any reports. This process helps to ensure the validity of all carbon units sold, with each unit designed to represent real and tangible carbon sequestration, and that carbon units cannot be resold to create further carbon leakage through excess emissions which are 'compensated for' elsewhere.

The designation of WCUs is achieved through determining the project's net carbon sequestration, which is the total amount of carbon sequestered by the project which can be converted into carbon units. These are divided between the proportion that will contribute to the shared WCC buffer and the claimable carbon sequestration which is the amount the project can sell or claim. The net carbon sequestration is derived from the simple equation:

**Net Carbon Sequestration = Project Carbon + Leakage – Baseline**

By this, the predicted number of carbon units is identified in accordance with the project's verification schedule, and will then be divided into the claimable carbon sequestration units, WCUs, and the contribution to the WCC buffer. Offset value is only delivered when the offsetting has actually taken place. Monitoring of the carbon sequestered at 5 years into the project is based on the projected carbon sequestration established at the outset of the project, but from year 15 onwards (at intervals of 10 years), it is based upon field survey measurements.

In order to avoid the complex issue of baseline manipulation prior to project activities, developers are required to thoroughly describe the original condition of the location, including details about vegetation cover, soil type and carbon content, through which they are to estimate the baseline for the carbon quantities at the site for the duration of the project in the hypothetical absence of the project's activities. The WCC's conservative approach to baseline construction, which does not include GHG emissions from land use prior to the woodland creation, means project activities must be more effective to accrue additional benefits, meaning only the most efficient carbon sequestering woodlands create a significant number of WCUs. Included in the baseline are carbon pools made up from tree biomass, soil, non-tree biomass and litter and deadwood, and measuring can be achieved with reference to any photographs, maps, field survey results or remotely-sensed images which indicate the condition of the vegetation and soil before project commencement. For tree biomass in the baseline scenario, which is most often the largest carbon pool prior to the start of a project, assessment can be done by determining the density of the trees and their current age, converting this to an equivalent area of woodland of a given age and using Carbon Lookup Tables to estimate the likely changes to that stock over time. The inclusion of non-tree biomass and litter and deadwood in the baseline scenario encourages the growth of biodiverse forests which facilitate understorey development as well as mixed stand structure and tree age, which, as discussed, enhances the resilience of the forest and its capability to sequester carbon. This is a measure which advocates the viability and multifactorial benefits of biodiverse forests in the future of British carbon offsetting woodland creation. Also significant is that all units are expressly publicly visible in regard to their current status and owner, providing clarity and transparency of carbon owners and claims that are made, and avoiding duplicity or 'double counting'. Social aspects of sustainable forest management are also incorporated within the UK Forestry standard and are maintained throughout WCC affiliated projects, and developers can use the Woodlands Benefits Tool as a way of consistently presenting the likely social outcomes of their projects.

Considerations of carbon leakage are taken into account by the WCC; small projects (of equal to or less than 5 hectares in planting area) are assumed to produce no leakage due to UK legislation which is designed to protect semi-natural habitats from threats such as deforestation, while standard projects (of 5 hectares or more in planting area) should account for any significant GHG emissions through land use changes in other areas over the project duration. If there is more than 5 percent of the projected carbon sequestration offered by the project over its duration, thorough accounting of all of the same carbon pools as the ones included in the project baseline scenario and their relative decreases or increases in size, with the addition of the increased emissions from management of the land, should be completed.

Additionality, of course, is also thoroughly accounted for by the WCC. In order to assess additionally, the project must pass

•Test 1 (legal).
•Test 2 (contribution of carbon finance).

If both are passed, the two subsequent tests are…

•Test 3 (investment) is used to confirm a project's additionality, but if it is not passed,
•Test 4 (barrier) may be used.

The legal test is the assessment that there are no laws, regulations, orders, agreement or any legally binding agreement which requires the implementation of the project, and the contribution of carbon finance test is used to show the necessary significance of income from carbon units; from this, projects are meant to demonstrate that income from the sale of carbon units, over the project lifetime, equates to at least 15 percent of the project's planting and establishment costs up to and including year 10. The investment test is used to prove that carbon finance is crucial to making woodland creation economically attractive in the given circumstances, i.e. the net value of woodland creation is positive only with the support of investment. This test, of course, includes the evaluation of all costs and revenues for the project duration. If the investment test is not passed, proof of other economic, environmental or social barriers which stop a project from going ahead with the absence of carbon finance is sufficient to demonstrate additionality.

The WCC is evidently, therefore, a new type of verification for carbon offset initiatives in the UK. Through its comprehensive list of regulations, any project operating through the code is far more likely to provide the benefits which carbon offset projects are supposed to supply, while ensuring that invalid initiatives do not slip through the cracks. This makes the WCC a valuable contributor to a global effort to reinvent carbon offsetting and ensure that it contributes to climate mitigation as efficiently as possible, and aligns with the Balance ethos as established in this methodology.

**4.2.2 The Forest of Marston Vale**

The Forest of Marston Vale is a group project consisting of ten sites, covering 61 square miles between Milton Keynes and Bedford in Bedford Borough and central Bedfordshire, providing a home for newly-grown forest ecosystems. The Forest, originally funded by Daniel Morrell, is one of Balance's major planting partners. Outlined here are some of the many reasons why it perfectly represents the Balance philosophy. The project began in 1991 when the Government designated this area as one of 12 Community Forests across England, and the Forest of Marston Vale Trust was created by the founding partnership of Natural England, the Forestry Commission and local authorities. The individual planting projects in the scheme are managed by the Trust. This includes site assessments, grant application, planning, obtaining quotations from contractors, monitoring, and then overseeing and ensuring the success of the planting. Historically, the site upon which a considerable portion of the Forest has been planted had been damaged by industrial processes such as brick making and refuse sites over many decades, with a section of the site previously home to the London Brick Company which relied upon more than 100 brick chimneys and extensive clay extraction. The decline of the industry, and the abandonment of the brickmaking site, left a scar of an industrial past on a landscape which had long previously been home to forests. At the start of the project, the Forest area had just 3 percent tree cover.

The vision of environmentally focussed regeneration of the site was set out in the first Forest Plan published in 1995. Today, Marston Vale is home to an expanding range of forests which have increased overall tree cover to 15 percent, and have incorporated the key concepts of biodiversity, forest resilience and carbon sequestration to considerable success, with a key target of increasing tree cover to over 30 percent playing a central role in driving the project. Millions of trees have been planted with the participation of local communities and businesses, boosting the local economy and aiding in potential future growth. The site is home to some preexisting semi-natural ancient woodlands, which help to connect and buffer the created forests.

An academic report published by the Forest of Marston Vale highlights the various achievements of the project over its 20 year lifespan (Forest of Marston Vale Trust), with an effort to quantify the social, environmental and economic impacts of the project. Thus far, tree cover has increased from just 3.6 percent in 1995 to more than 15 percent in 2015, and has created over 1,150 hectares of new woodland, more than trebling woodland cover. Overall economic benefits are valued annually at £UK12.83 million, which equates to benefits with a net present value of £UK339 million, and, according to the study, £UK11 of social, economic and environmental benefits for every £UK1. In terms of employment, the report estimates that the project has supported an additional 167 jobs per year for local residents, which includes both direct employment in the project, to service industry positions and contractors. The local economy has been especially supported by the preferential use of local goods and services by the project. In turn, these local businesses provide local jobs and boost local incomes.

The Forest of Marston Vale is a good example of partnership working and community involvement at its best, with local communities included both in the decision making processes and in project engagement and planting. This was a priority of the project from the outset. Local engagement has been facilitated by a series of events for the general public, schools, businesses, other local groups, families, and individuals. Where possible, woodland design has also involved consultation with local inhabitants. Investment has been fruitful, with an average of 15 partnerships with public and private sector organisations per year, which have helped to secure a total inward investment so far of over £UK22.8m. The recreational benefits of creating the forest has helped the visitor economy in the area, bringing in an estimated £UK6.91 million per year from elsewhere.

Economic benefits, though useful for attracting investment, are only a small part of the story, however. The advantages to health and wellbeing of the forest, for example, are numerous; the majority of the new woodlands are close to residential areas, which enhances access and recreational opportunities, and public footpaths cross many of the sites. Using both visitor data and research on how physical activity outdoors can reduce hospital visits and increase life expectancy, the value of the physical health benefits through the provision of recreational space for exercise and contact with nature provided by the Forest was estimated at £UK4.95 per annum. This does not include the benefits to mental health and wellbeing, which, although not quantified, if comprehensive studies from around the world on forests and mental health issues such as stress and anxiety are to be believed, are almost certainly significant. Less quantifiable social impacts, such as the facilitation and fostering of social cohesion and a new sense of place, as well as the benefits derived from increased understanding of natural and ecological processes, are also important.

The Forest has long sold the carbon stored in the woodlands as a voluntary carbon offset initiative, with buyers allocated carbon offset units on the Markit Registry. Today, the Forest operates by the Woodland Carbon Code, and the overall benefits to carbon sequestration, forest resilience and biodiversity as transferred through the various requirements for WCC verification are embodied by the nature of the planting process. The total carbon sequestration of the trees has been estimated at 4,917 tonnes of CO2 annually, and has considerable potential for creating an even larger carbon pool with the planting of more trees. Considered in carbon sequestration modelling is biomass carbon, including below ground root mass, and SOC.

The establishment of woodlands varies between the different sites of the Forest, but generally the woodlands include plant protection (with fencing or the use of tree shelters), ground cultivation and sward establishment using a ‘pollen and nectar’ grass and wildflower mix to form the understorey, which encourages greater biodiversity. Planting is done with reference to the composition of the ancient forests found on site, without consistent structure, stand age or dominance of one individual species (monoculture), but with the addition of other objectives including increased carbon sequestration and productivity for timber extraction; for the latter of which broadleaf species are specifically chosen. Also, the trees are planted **with higher** spatial density than found in ancient forests in the same region; whereas the typical ancient woodland would have trees 8m apart, the Forest of Marston Vale project plants trees at 2m apart, in an attempt to acquire the same benefits from ecosystem services and carbon sequestration as found in ancient woodlands. This is because trees today are considered light-dependant; that is, they need to grow higher quicker to get the light they need to survive, and thus need to be closer together.

The biodiversity value of the forests is greatly advantaged by the avoidance of past forest planting tendencies, and the attempt to resemble ancient forest structures and their associated advantages. Benefits to biodiversity and the health and abundance of wildlife species, though not specifically recorded or monitored by the project, are intrinsic to the specific processes of woodland creation which the project has employed. The woodlands have thus increased biodiversity by providing new areas for wildlife and improving habitat networks across the area.

Importantly, roughly three quarters of the landscape is planted with native species found on site or in local regions, creating a largely unhindered ancient woodland character comprised of oak, pine and maple woods, with particular consideration for resilience in the context of climate change by the inclusion of oak and hornbeam tree species which are projected to fare better with local temperature rises and climatic extremes in the near future. The provenance and sourcing of seedlings is most often exclusive to the UK, from nurseries and contractors located in the UK, thus avoiding importation while selecting species most suited to the heavy clay soil found at the site's location in Bedfordshire. Amongst all the woodlands created in the project, forest composition normally incorporates an intermix of dominant UK native species and fewer exotic species which comprise a core of 2 or 3 species, as well as minor native species, which work to simultaneously create functioning biodiverse ecosystems while preparing the forests for future threats. Similarly, the inclusion of species from between 2 to 5 degrees south to suit projected climate shifts, as recommended by forestry experts, is in line with the Forestry Commission and the Forest of Marston Vale's targets.

Mitigation of the threat of diseases is also considered as part of the project with the explicit avoidance of creating monoculture forests, which are more likely to be seriously impacted by diseases. The focus on native species and creating forest ecosystems which resemble ancient forests that exist on the site increases overall biodiversity, which elevates the forest's overall resilience to pests and diseases. If any one of the species succumbs wholly to disease, the woodland should be able to repair itself.

Environmental benefits and ecosystem services of the project besides the storing of carbon have been numerous. Air pollution, for example, has been significantly reduced; it is estimated that the new woodland thus far created has been able to absorb 0.65 tonnes of sulphur dioxide ($SO_2$ ) and 65 tonnes of particulate matter. While agriculture remains the primary land use within the Forest area, the shift in land use to woodlands has resulted in reduction of impacts such as GHG emissions from fertilisers and machinery, which are common with modern intensive agriculture, and has significantly benefited soil health and reduced soil erosion. To date, it is estimated, the creation of the Forest has reduced agricultural GHG emissions by 1,747 tonnes $CO_2e$ per annum, which is additional to the increased size of the carbon pool as a result of forest creation. Water quality has also been improved, and flood risk reduced, due to the slowing of the flow of water; the quantity of woodland created in the Forest so far is estimated to reduce peak flood flows by 5 percent. A variety of other ecosystem services common to the creation of biodiverse woodlands are included in the Forest of Marston Vale, including the reduction of soil erosion, preventing land degradation and desertification, and, particularly as a result of ensuring the forests' resilience, reducing the risks of natural disasters such as droughts, floods, and landslides.

With the core target of the project being to increase tree cover up to 30 percent, from today, this would require the planting of around 5 million more trees by 2031. Such an ambitious target, if accomplished with the necessary considerations and precautions in planting a biodiverse, sustainable forest, can make an invaluable difference to the local area and provide an example for the rest of the UK on how reforestation can and should be done, while sequestering carbon at an ever greater rate in line with increasing responsibility and targets for reforestation. The project is similarly explicit in extending benefits to other areas, including the regeneration of the area both economically and socially, and the creation of a better and more biodiverse natural environment for the benefit of humans working in and around the forest and the various species which the forest provides a home for. With the adoption of the Woodland Carbon Code, the future of the Forest of Marston Vale is extremely promising, as is its potential for use by Balance.

# 5. Conclusion: The Future of Balance

The Forest of Marston Vale is just one example of the type of reforestation which Balance facilitates through its focus upon biodiversity and ecosystem creation. Going forward, Balance plans to expand to planting forests internationally, with consideration in each location for appropriate forest composition, local topography and climate in order to enhance the resilience of the forest and thus more efficiently and sustainably sequester carbon. Planting shall always occur on previously low-diversity lands, and avoid peatlands or high diversity grasslands or other productive biomes, in order to avoid carbon leakage and negative impacts on biodiversity. Selected planting partners, as a matter of both priority and necessity, shall strictly follow the planting principle obligations set out in this methodology.

Prioritisation of indigenous local species has proven in a number of cases to enhance forest resilience and carbon storage capabilities, and all current and future Balance projects aim to identify and favour native species, while incorporation of trees adapted to climates which resemble those projected in the near future for every location, for example from between 2 to five degrees south within Western Europe for projects based in the UK, is paramount to ensuring that the created forests are capable of surviving climate related threats which promise to exacerbate with the climate crisis in the near future.

Planting a mix of species, however, is of paramount importance, as diverse tree species facilitate the creation and conservation of non-tree plant and animal biodiversity. A useful measure in planning and composing a forest in the modern day is the analysis and replication of ancient primary forests, allowing for the enhancement of native species while allowing a select few, or single, introduced exotic species.

Biodiversity, in the simplest terms, is the key factor in implementing Balance through forest creation. When focusing on biodiversity in selecting and planting species, a positive feedback loop encourages both tree and non-tree species diversity. This in turn promotes forest resilience, carbon sequestration and ecosystem services, as well as the various social, economic and environmental benefits associated with biodiverse forests.

Ultimately, Balance is designed to target the creation of large, connected forest ecosystems, with varying stand age and size, significant and stand and landscape structural complexity dictated by local contexts, complimented by the prioritisation of large native tree species. The mitigation of the threat of diseases and serious climate related threats is simultaneously achieved, as evidenced in a number of cases, through the creation of biodiversity and avoidance of monoculture planting. Of equal importance is the intrinsic value of protecting and enhancing biodiversity in forests, particularly in the UK where biodiversity has been depleted incessantly over the past few centuries and has accelerated in the most recent decades. Creating spaces for refuge for threatened species and facilitating the conservation and regrowth of populations must be a target in itself, and the more space allocated for forest regrowth in the UK means that less space is afforded to damaging practices such as deforestation, logging, agriculture, and urban construction, along with the environmental impacts they incur.

Despite the considerable value of Balance as a new form of carbon offsetting, Balance recognises the requirement for emissions reductions to still be prioritised before offsetting is even considered, and acknowledges the challenges and limitations of offsetting as a practice, including their potential distractions from emissions reductions. Thus, as a part of the online Balance in Business experience, advice upon the necessary efficiencies and reductions that can be implemented within the business is given, with our acknowledgement that offsetting must be accompanied by emissions reductions in order for global atmospheric GHG levels to be most efficiently lowered. It is important to Balance that each consumer makes a valuable effort towards reducing emissions throughout their supply chain, and that only after comprehensive efforts are made to reduce emissions are excess emissions considered for offsetting. Without the collaborative efforts of Balance and the consumer, as indeed is the case in any compliance or voluntary carbon offsetting initiative, it is unlikely that the project will prove additional.

By offsetting with Balance, however, by virtue of the multifactorial benefits of centring reforestation upon biodiversity and recreation of native forests, and the efficiency with which Balance as a business will be able to achieve this, organisations will be contributing to a necessary shift in our attitudes towards forest creation and the critical role it will play in mitigating the climate crisis in the next few decades.