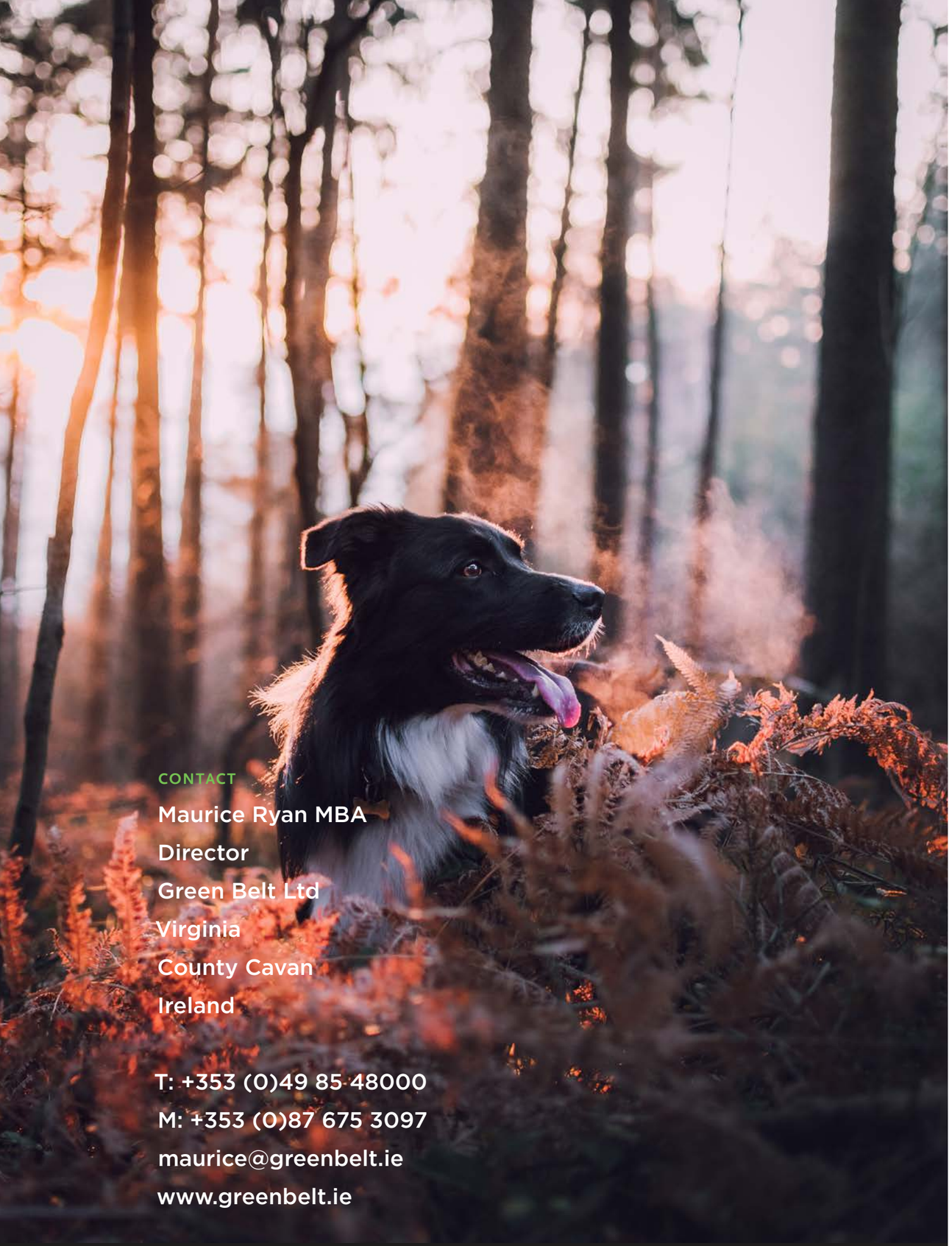
# GREEN BELT BIOCHAR

## REFORESTATION FOR CARBON OFFSETTING

MARCH 2021

GREEN BELT

YOUR FOREST · YOUR FUTURE

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# REPLANTING IRELAND'S FORESTS USING BIOCHAR: STORING CARBON AND INCREASING YIELD CLASS WITHIN THESE FORESTS

## REFORESTATION

Ireland has a low forestry cover (11%) and significantly below our European counterparts, where the average is at 33%. Ireland's private forestry began in earnest in the late 1980's and thrived throughout the 1990's, but has seen a falling off of new planting areas in the last 5 years. Much of the private estate planted in the 1980's and 1990's is coming to maturity now and the forest owners are reaping the rewards from their grown timber. However, many of these forest owners are now interested in selling their 'brown' land. This is the opportunity.

## REFORESTATION PROJECT

Replanting land previously under forestry is an obligation on the landowner. Therefore, there is ample opportunity to acquire 'brown' land and to assume the replanting obligation. Within this obligation, we can create a carbon pool, enhancing the carbon capturing capacity of the replanted forest ahead of the original forest.

This is achieved by the following:

- Improved planting stock
- Reduction in chemical fertiliser usage
- Application of biochar at replanting stage.

The benefits of these interventions will result in additional Carbon being captured by the higher yielding trees and stored in the soil by the Biochar.

## BIOCHAR

Green Belt produces a high quality, Carbon rich Biochar from certified, low value forestry products in a bespoke facility in County Roscommon. Production of biochar (the carbon (C)-rich solid formed by pyrolysis of biomass) and its storage in soils have been suggested as a means of abating climate change by sequestering carbon, while simultaneously providing energy and increasing crop yields. Biochar is a charcoal-like substance made by heating biomass under low-O2 conditions[1].

Biochar can be used as a soil amendment with the intention to improve soil functions and to reduce emissions from biomass that would otherwise naturally degrade to greenhouse gases. Keeping Global Warming **2 degrees below** can only be achieved by carbon dioxide removal and biochar in one of the 5 recognised categories of Negative Emission Technologies (NET's) – Biomass with Carbon Capture & Storage (BECCS or for biochar, PyCCS).

Many cultivated soils have lost up to 70% of their original Carbon[2] and aligned to that, plants can't store Carbon unless they also have access to water, nitrogen, phosphorous and other nutrients. Traditionally, chemical fertilisers are used to encourage growth across forests. Organic fertilisers deliver these nutrients and biochar is a catalyst to deliver them efficiently and to avoid leaching. The positive, additional benefits to adding biochar to the soil structure can help offset labour and operating costs, as well as reducing nitrous oxide ($N_2O$) emissions[3].

Biomass Energy with Biochar Capture & Storage (BEBCS)is an amendment on a policy recommendation from the **Intergovernmental Panel on Climate Change** (IPCC) to specifically focus on Biochar[4]. Biochar stores fixed carbon in the soil, but also improves the fertility of degraded soils, improves soil water management and other services. Pyrolysis (the chemical decomposition of organic (carbon-based) materials through the application of heat. occurs in the absence or near absence of oxygen) transforms labile (easily broken down), organic carbon into biochar where it can be used as a substitute for chemical fertilisers. Biochar does not decompose to feed plants. Instead, it becomes a long-term habitat for worms, bacteria and fungi, increasing crop yields and adding fertility back to the soil.

1 Rostad and Rutherford, 2011

2 Johannes Lehman & Stephen joseph, Biochar for environmental management, 2008

3 Bhupinder et al, 2010

4 Optimal Bioenergy Power generation for climate change mitigation with or without carbon sequestration", Nature Communications, 2016, Woolf, Lehman & Lee.



Preventing Carbon from returning to the atmosphere by making biochar part of the forestry mix, is a necessary second step after pulling Carbon out of the atmosphere initially.

## PRODUCTION

Biochar has a larger climate-change mitigation potential than combustion of the same sustainably procured biomass for bioenergy. Biochar's climate-mitigation potential stems primarily from its highly recalcitrant nature, which slows the rate at which photosynthetically fixed carbon (C) is returned to the atmosphere. In addition, biochar yields several potential co-benefits. It is a source of renewable bioenergy; it can improve agricultural productivity, particularly in low-fertility and degraded soils. It reduces the losses of nutrients and agricultural chemicals in run-off; it can improve the water-holding capacity of soils; and it is producible from biomass waste. Of the possible strategies to remove CO2 from the atmosphere, biochar is notable, if not unique, in this regard.

Green Belt produces Biocharged™ biochar in Strokestown, County Roscommon. We use certified, sustainably managed Irish timber through our pyrolysis unit. We use the smaller products from timber harvesting, typically used in biomass heating, to create the biochar. The biochar that is produced stores the carbon present within the timber through the pyrolysis process and the Carbon content is independently verified at 80%. There are approximately 2.8 tonnes of carbon sequestered in 1 ton of biochar and the application rate of Biocharged™ biochar is 2.5m3 per hectare. **The biochar can be a net carbon sink if buried, increasing crop yields and adding fertility back to the soil**. Woolf et al. (2010) point to biochar's potential to improve agricultural productivity (particularly in low-fertility and degraded soils) through **reducing nutrient loss and through its water-holding capacity**.

Pyrolysis has been recognized by the **Intergovernmental Panel on Climate Change** (IPCC) as one of only a handful of **negative emission technologies** (NETs). In addition, biochar used in soils has recently been added to the IPCC's list of mechanisms for countries to reach their Nationally Determined Contributions (NDC), or reduction commitments.

The goal is to **permanently lock carbon underground** instead of letting CO2 re-enter the atmosphere, so such long-term sequestration requires high biochar stability, which will depend on the type of feedstock and process. Wood is more stable than grasses and manure and Green Belt Biochar is created using sustainable, certified Irish timber residues.

The relative benefit producing biochar compared with biomass combustion (using biomass to generate heat and/or electricity) is greatest when biochar is added to marginal lands and the energy produced by pyrolysis is used to offset natural gas, renewable or nuclear energy. When biochar is added to the most infertile cropland to offset the current global primary energy mix, which has a carbon intensity of 16.5kgCGJ−1, the relative benefit from biochar is as much as 64% greater than that from bioenergy[5].

Biochar shows a greater climate-mitigation potential than bioenergy. The relative benefit of producing biochar compared with bioenergy is greatest when biomass crops are used as feedstocks, because avoided CH4 emissions from the use of manure, green waste and rice residues occur regardless of whether these other feedstocks are used for energy or biochar.

Biochar additions have been shown to increase water retention, increase drainage in clay soils, and reduce N leaching losses in a variety of soil types (Singh et al., 2010; Barnes et al., 2014; Li et al., 2018).

## #MAKEYOURDIFFERENCE

How do you make your difference? Working with Green Belt, we can acquire suitable land packages based on budget and geography for example, and carry out the replanting works using our network of professional foresters. We will arrange for the high-quality biochar to be delivered and spread across the forest and mixed into the soil along the replanting lines to ensure maximum efficacy of the application. The application rate is 2.5m$^3$ per hectare.

Green Belt will work with you, the new landowner, to ensure the crop reaches its potential and we can provide annual reports on its development, the development of the Carbon markets and the performance of the timber asset, as well as recommendations for further enhancements.

5 Sustainable biochar to offset climate change, Dominic Woolf et al, August 2010



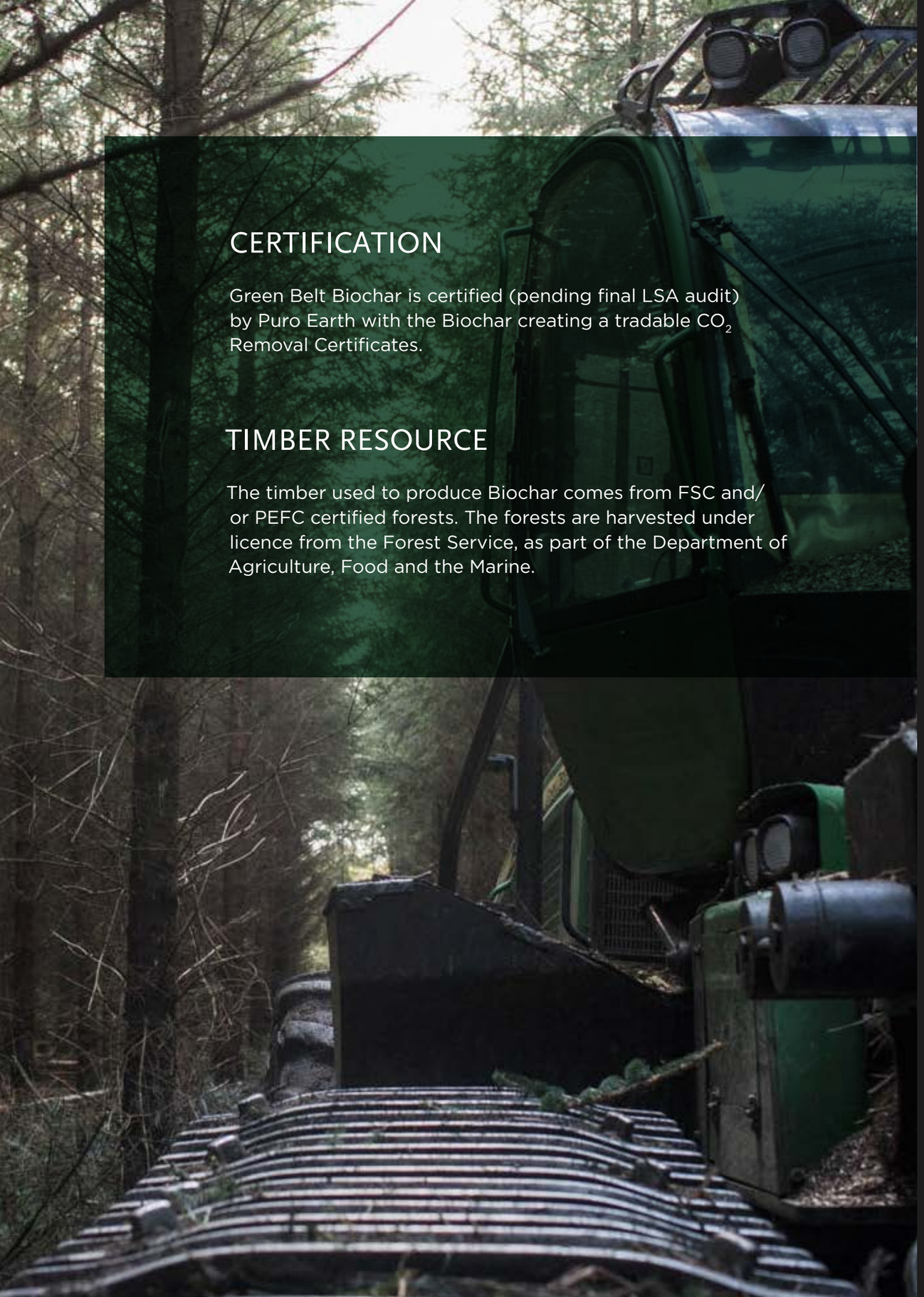
## ADDITIONAL BENEFITS OF BIOCHAR

1. **Biochar keeps compost moist and aerated, promoting in-creased biological activity**
   The composting process is governed by various physical parameters that are subject to alteration by the addition of biochar materials as bulking agents. Some of the parameters that most affect compost are aeration, moisture content, temperature, bulk density, pH, electron buffering and the sorptive capacity of bulking agents. Water and air are both held in biochar pore spaces and voids, and the spaces between particles.

2. **Biochar increases nitrogen retention**
   When nitrogen-containing biomass materials decay, they can release large amounts of ammonia. Ammonium (NH4+) is the aqueous ion of ammonia. Numerous studies have shown that biochar is effective at retaining nitrogen in soils (Steiner et al, 2008; Clough et al, 2013). Several studies have also shown that biochar enhances nitrogen retention in compost, reducing emissions of ammonia and increasing total nitrogen retention by as much as 65% (Steiner et al, 2010; Chen et al, 2010; Huang et al, 2014). The ammonia retention ability of biochar can actually improve during the composting process.

3. **Biochar improves compost maturity and humic content**

4. **Biochar compost improves plant growth**
   Biochar seems to improve the composting process, researchers confirmed that synergistic effects can be achieved by adding biochar to composts.



## CERTIFICATION

Green Belt Biochar is certified (pending final LSA audit) by Puro Earth with the Biochar creating a tradable $CO_2$ Removal Certificates.

## TIMBER RESOURCE

The timber used to produce Biochar comes from FSC and/or PEFC certified forests. The forests are harvested under licence from the Forest Service, as part of the Department of Agriculture, Food and the Marine.

## BIOCHAR IN SOILS

- Improves tilth and reduces soil bulk density
- Increases soil water holding capacity
- Becomes more stable by combining with clay minerals
- Increases cation exchange capacity (CEC - the ability to hold onto and transfer nutrient cations: ammonium, calcium, magnesium, and potassium)
- Improves fertiliser utilisation, by reducing leaching from the root zone
- Retains minerals in plant available form
- Supports soil microbial life and biodiversity
- Helps plants resist diseases and pathogens
- Helps plants grow better in high salt situations
- Adds humus carbon to the soil carbon pool, reducing the atmospheric carbon pool


## THE IMPACT IN NUMBERS

The table in page 8 represents the likely carbon sequestered per hectare over its lifetime. It factors in the sequestration on the site, the harvested wood products and also energy substitution.

This graph shows the additional carbon capture on a per hectare basis over the typical rotation of a YC 18 forest versus the expected performance of a forest planted without Biochar. This data was gathered from the Teagasc Forestry Carbon Calculator From a commercial perspective, the increase in timber yield class will also reduce the time to maturity for the forest, generating a more positive financial element to the equation.

## #MAKEYOURDIFFERENCE

To actively offset your Carbon Footprint, contact Green Belt.

We will source and secure lands on your behalf and arrange the application of Biochar and replanting of the forest. We will ensure the forest is established to the highest of standards delivering the results and performance you deserve.

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## GLOSSARY

Pyrolysis
Labile

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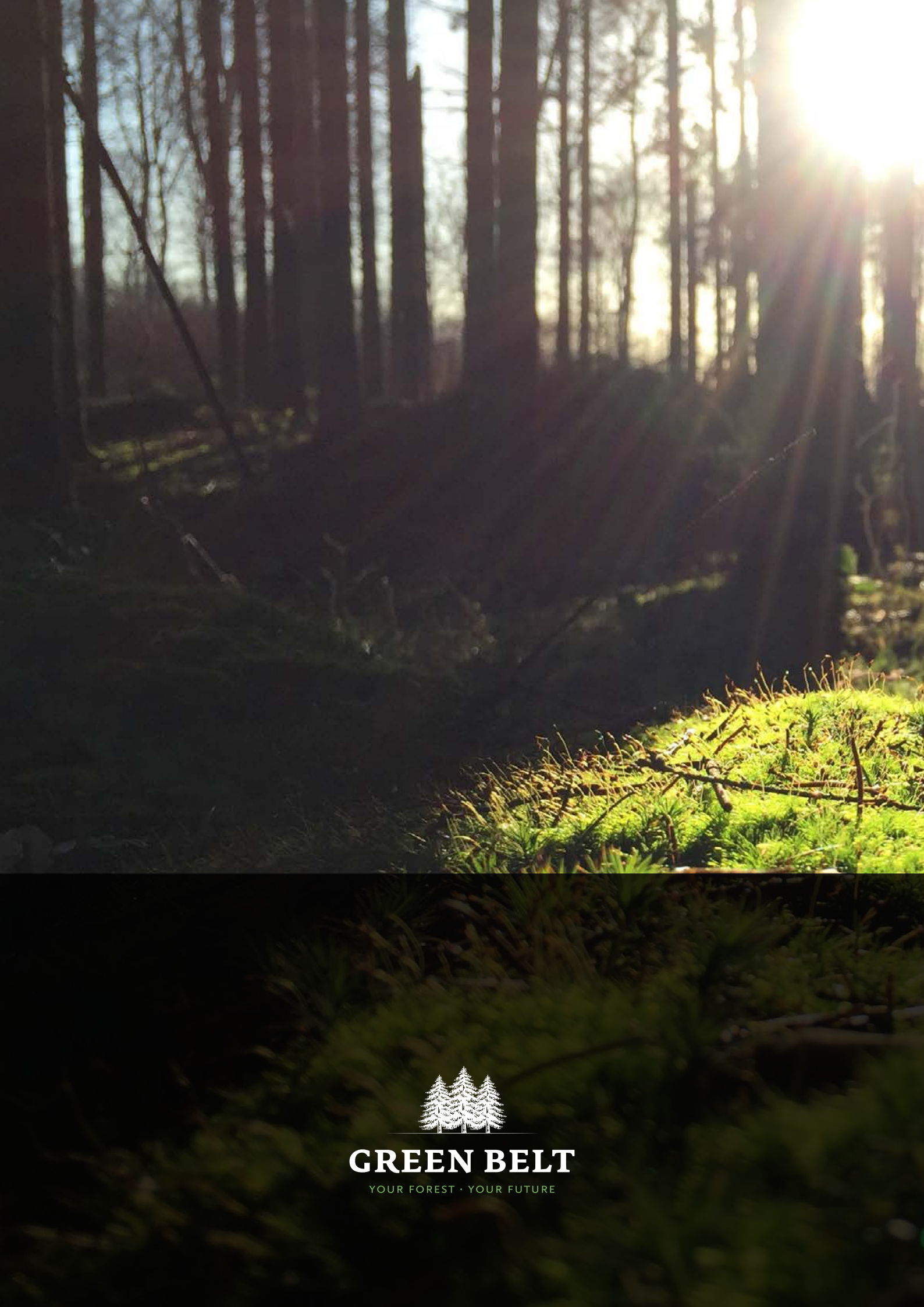
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