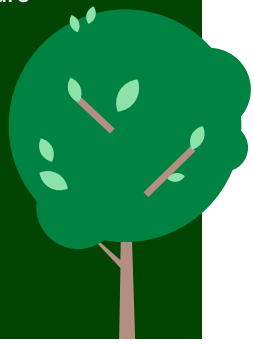
# Certified. Verified. Proven.

## European beech as a climate smart choice for renewable biochemicals

### Contents

# European beech – a smart choice

- European beech, *Fagus sylvatica,* is a native species in Germany and Central Europe. It has proven to be a climate fit species, resilient to biotic and abiotic hazards.
- Beech forests have continued growing for the past decade, and have remained as a significant carbon sink .
- Near nature management and diverse forest structure are common in beech forests. Natural regeneration is mainstreamed and over 85 per cent of the forests are grown in two or more tree age classes.
- Climate smart management of forests require promotion of beech, mixed species stands and active management such as thinning to facilitate growth.
- Beech harvesting is at low levels, and clearly below annual allowable cuts.
- Beech value creation potential has been neglected; majority of beech being burnt for energy purposes.
- Beech forestry is highly sustainable. Forest certifications ensure third party verification of sustainable practices.
- Beech is sourced regionally. Short supply chains are transparent, secure and benefit local economy.



## European beech, *Fagus sylvatica*

UPM Biochemical's new biorefinery in Leuna, Germany, uses European beech, *Fagus sylvatica* as a raw material. All wood sourced for the biorefinery originates exclusively from certified forests of Germany and Central Europe. European beech is a native broadleaf species (endemic) in Germany and other countries in the regions, found on a wide range of soils and sites. Beech forests and beech stocks in Central Europe are sustainably managed and continuously growing, offering important habitats for a wide range of species. In Germany beech covers currently around of 1.8 million hectares, thus the area covered by beech has increased around 8 per cent in the past decade [1].

## Upgrading the beech value chain – innovation, efficiency and diversity

UPM Biochemicals upgrades the beech value chain and diversifies industry use of species. This is welcome in the region where the industry is traditionally suffering from high dependency on softwoods [2]. European beech is transformed through innovative processes to renewable products. UPM biorefinery uses (or we use) industrial wood assortment of beech and nothing is wasted in the process: Cellulose, hemicellulose and lignin all end up as products improving environmental performance of various end use applications.

Industrial wood is smaller trunks and damaged wood removed from the forest during forest management activities. Industrial wood is removed from the forest during thinning practices that aim to make space for new natural regeneration and larger trees to grow. Thinning is thus serving also other beech value chains, such as furniture industry, and pave way for biodiversity benefits. Until now, the potential of the industrial wood assortment of beech has been neglected, with the majority to of beech being burnt for energy purposes or just left in the forest. UPM Biochemicals' innovations transform high-value beech forestry even more valuable.

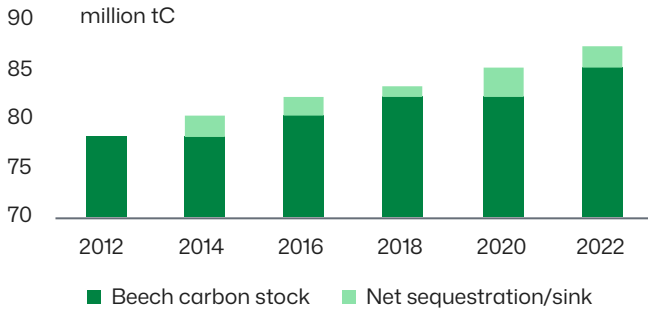
1 Thünen-Institut. German National Forest Inventory 2022. Bundesministerium für Ernährung und Landwirtschaft, 2024. https://www.bundeswaldinventur.de

2 Sotirov M., Malovrh S.P., Jonsson R. 2024: Policy factors, chapter 3, in Egger C., Grima N., Kleine M. and Radosavljevic M. (eds.). 2024. Europe's wood supply in disruptive times. An evidence-based synthesis report. IUFRO World Series Volume 42. Vienna.

## Climate smart forests require active management

University of Applied Sciences, Weihenstephan-Triesdorf studied the climate impacts of beech forestry in 2012–2022 in the UPM key sourcing area in four German states [3]. The beech growing stock and beech carbon stock had grown steadily over the study period, the average net carbon sequestration was close to 1 million tons of carbon annually (3,5 million $tCO_2$), making the beech forests a valuable carbon sink [4]. Harvesting levels of beech have remained steady or even declined in some cases, while region's beech stock has grown by 34 million $m^3$ over a decade [5]. The study shows that less than 50 per cent of the annual net increment of forests is currently harvested, which is significantly below the annual allowable cuts, which generally reach up to 80 per cent of the net growth.

**Beech carbon stock and sinks**




*Beech carbon stocks have grown and beech forests remained a significant carbon sink in the four German states: Thuringia, Bavaria, Saxony-Anhalt, and Hesse during the study period 2012–2022*

Native beech has proven to be a climate fit species, showing resilience in the face of abiotic and biotic hazards. Recent drought, heat periods and insect outbreaks in Europe have already resulted in diebacks in even-aged spruce forests, making forests in some regions temporarily a source of carbon. European beech is more resilient to drought and heat stress than coniferous species [6]. Beech stands also store on average more soil carbon than other broadleaf species [7]. The fourth national forest inventory published in 2024 calls for active forest transition to climate-adapted mixed forests [8], in which beech has a major role.

Climate smart forestry (CSF) aims to improve climate mitigation and resilience of forests. It requires active forest management, such as fostering growth and diversity in the forests. Forests diminish their net carbon uptake when aging. Again, even-age mono-cultures (only one species planted), are vulnerable in the face of climate hazards [9]. Optimized forest carbon and biodiversity co-benefits requires i) favouring climate fit species such as beech, ii) actively promoting mixed species and mixed-age stands and iii) facilitating natural regeneration and growth with thinning.

3 University of Applied Sciences, Weihenstephan-Triesdorf 2025: Wood production, carbon sequestration and resilience of beechwood forests in in four German states: Thuringia, Bavaria, Saxony-Anhalt, and Hesse -opportunities and trade-offs in the short-, medium- and long-term. www.hswt.de/forschung/projekt/2453-fagufuture

4 See footnote 3

5 See footnote 3

6 Gribbe, S., Enderle, L., Weigel, R., Hertel, D., Leuschner, C., Muffler, L., 2024. Recent growth decline and shifts in climatic growth constraints suggest climate vulnerability of Beech, Douglas fir, Pine and Oakin Northern Germany. Forest Ecology and Management 566, 122022.

7 Boča, Antra; Miegroet, Helga; Gruselle, Marie-Cécile (2014): Forest Overstory Effect on Soil Organic Carbon Storage: A Meta-analysis. In: Soil Science Society of America Journal 78, S35. DOI: 10.2136/sssaj2013.08.0332nafsc.

8 See footnote 1

9 See footnote 1

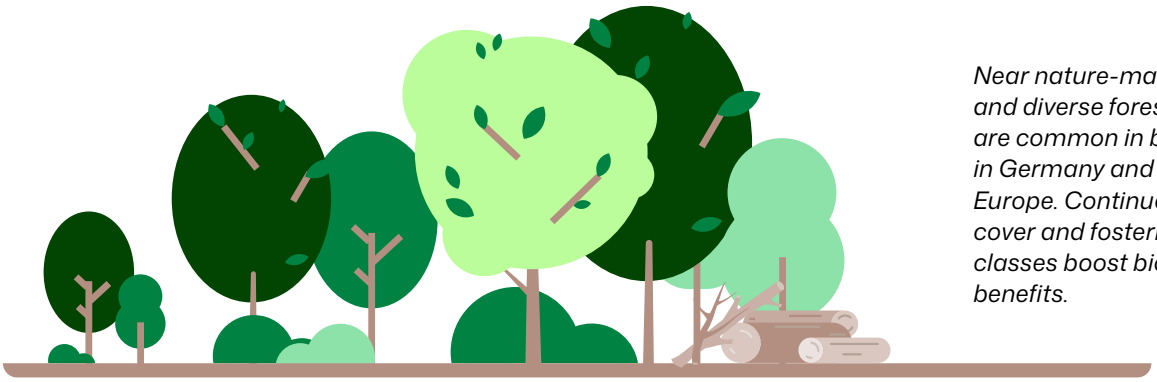
## Highly sustainable beech forestry with biodiversity co-benefits

In beech forests, near-nature management practices are widely adopted, mimicking nature's own diversified structures [10]. Over 85 per cent of beech is grown is two- or multi-layered structures , making beech forestry highly sustainable also in terms of biodiversity benefits.

By removing smaller or damaged trees, i.e. conducting thinning, foster younger stands and natural regeneration, while also creating space for younger trees to grow. To boost biodiversity benefits, dead and living retention trees are left to the site. These are called habitat or biotope trees that host and foster various other species such lichens [11] and birds. To protect the biodiversity, intensive land-preparation or pesticides are not used.

Amount of deadwood is one of the key biodiversity indicators, as decaying wood sustain life of various species. In UPM's key sourcing areas deadwood is reaching the recommended levels of 10 per cent of the growing stock. Beech harvest residues are also largely remaining in the forest in larger extent than conifer residues, leaving the important nutrients to be recycled in the forest [12].

Clear-cut fellings are not part of mainstream beech forestry. In beech management so called shelterwood systems are common, in which selected logging is done to individual trees or group of trees, while ensuring the continuous forest cover.



*Near nature-management and diverse forest structures are common in beech forests in Germany and Central Europe. Continuous forest cover and fostering all age classes boost biodiversity benefits.*

## Win-win for forest growers, nature and society

Beechwood forestry meets the demand for ecological, social and economic benefits. For forest growers, fostering nature's own structures and processes in beech forestry can be economically highly beneficial. For forest ecosystems, this management style translates into biodiversity co-benefits. Natural regeneration, combined with thinning and continuous forest cover, provides a steady income source. Forest owners gain a high mean annual net revenue, as the production of valuable timber is achieved with low establishment costs [13]. Near nature-management boosts biodiversity co-benefits by multi-layered, diverse forest structures and natural regeneration without intense land-preparation. Continuous forest cover is enjoyed by forest dependent species, but also by forest owners, and other people that enjoy recreation in forests.

UPM's sourcing collaborates closely with public and private forest owners. Forestry and forest industries provide employment and important investments to support local and regional economic growth. In Germany, this means around 750 000 people employed

10 See footnote 1

11 Emirich D., Kaufmann S., Hauck M. 2025: Selecting dominant or rare tree species as habitat trees: Consequences for epiphyte diversity in temperate mountain forests, Trees, Forests and People, Volume 20, https://doi.org/10.1016/j.tfp.2025.100807.

12 See footnote 3

13 Thomas Nord-Larsen, Allan Bechsgaard, Michael Holm, Per Holten-Andersen, Economic analysis of near-natural beech stand management in Northern Germany, Forest Ecology and Management, Volume 184, Issues 1–3, 2003, Pages 149-165, ISSN 0378-1127, https://doi.org/10.1016/S0378-1127(03)00212-3.

in over 100 000 companies, resulting in 180 billion EUR turnover annually [14]. Active management and use of beechwood is estimated to create 11 billion EUR additional added value in Germany over next 20 years in comparison with high conservation scenarios.[15]

## UPM promoting sustainable forest management: Certifications and beyond

UPM Biochemicals sources only certified wood from sustainably managed forests. All our incoming wood is FSC or PEFC certified [16]. These forest management and chain of custody certification schemes are well recognised worldwide. They have rigid standard requirements for forest management and whole supply chain, that are verified by regular third party audits.

UPM Biochemicals also support research and pilot projects that study climate smart beech management in Germany. The aim is to understand carbon smart management, ensuring that forests remain carbon sinks, but also ensure climate change adaptation of forests.

UPM Biochemicals is committed to UPM's global Forest Action program. The Program's objective is to make UPM a leading forest industry company driven by our science-based commitments to climate-positive forestry and biodiversity enhancement.

14 Fachagentur Nachwachsende Rohstoffe e. V. (2025). Basisdaten Wald und Holz 2025. Bundesministerium für Ernährung und Landwirtschaft. Retrieved from https://www.fnr.de

15 See footnote 3

16 FSC-C210095 and PEFC/04-31-3869