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Limits to production of renewable and low-carbon fuels: Feedstock biodiversity impact assessment

AFRY

MARIA MANSO MARTIN

AGENDA

1. Introduction
2. Feedstock removal affecting biodiversity
3. Biodiversity impact assessment- case study
4. Key messages




Sector specific engineering, design, and advisory services around the world

EMPLOYEES GLOBALLY

~ 19,000

(2022)

NET SALES

>2.3 bn

Euros (2022)

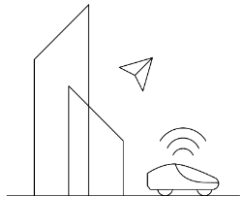
NUMBER OF COUNTRIES WITH OFFICES

> 50

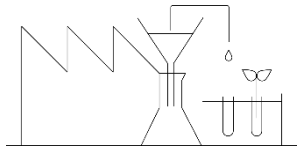
NUMBER OF COUNTRIES WITH PROJECTS

> 100

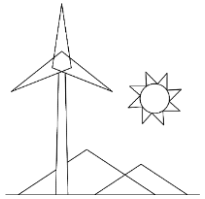
AFRY TRANSFORMING SEGMENTS



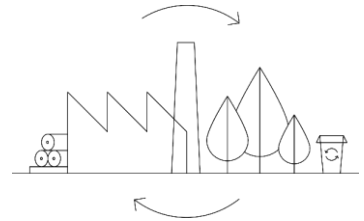
INFRASTRUCTURE



FOOD AND LIFE SCIENCE

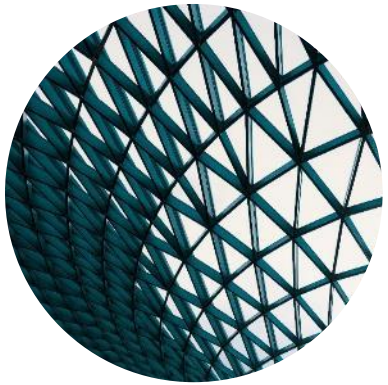


CLEAN ENERGY



BIOINDUSTRY

AFRY CORE EXPERTISE



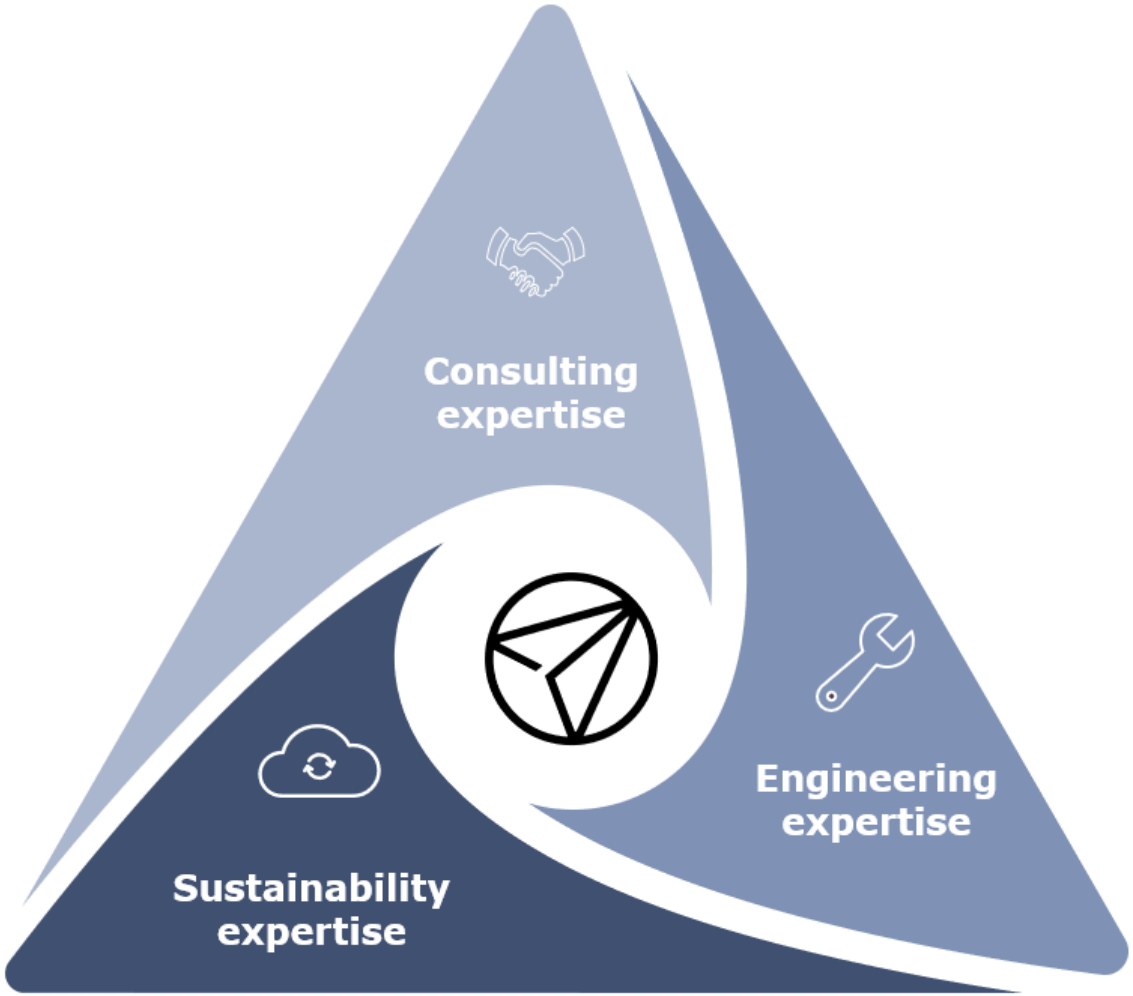
ENGINEERING

DESIGN

DIGITALISATION

ADVISORY SERVICES

AFRY combines management consulting, technology expertise and sustainability services



AFRY Management Consulting is present in 20 countries worldwide and has a strong foothold in Europe

Our team

MARIA MANSO MARTIN

Senior Consultant,
AFRY Management
Consulting Division

maria.mansomartin@afry.com

SAMI PASTILA

Senior Principal,
AFRY Management
Consulting Division

sami.pastila@afry.com

JACK LONSDALE

Principal,
AFRY Management
Consulting Division

jack.lonsdale@afry.com

FREYA SANTANA CUBAS

Analyst,
AFRY Management
Consulting Division,
Sustainability Consulting

freya.santanacubas@afry.com

Biodiversity loss and ecosystem collapse rank top 5 threat to humanity in the next 10 years

> **50%+ of global GDP ($44 Trillion) is threatened by nature loss**

Natural ecosystems have declined by 47% on average

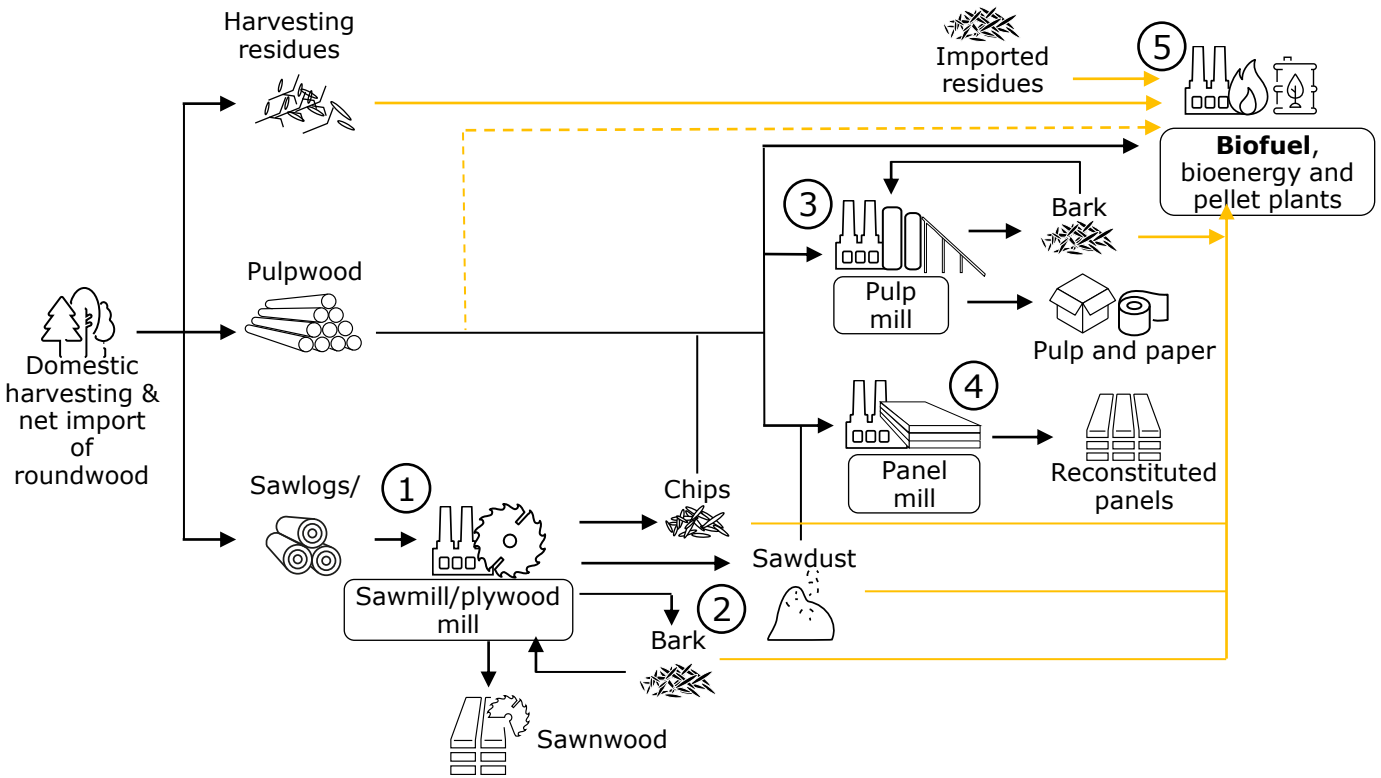
69% reduction of wildlife population on average

Source: WEF (2020), WWF (2022)

Low-carbon second generation biofuels are derived from lignocellulosic feedstock

Lignocellulosic materials, from herbaceous crops, hardwood and softwood, are the main feedstocks used for the production of liquid biofuels, particularly ethanol[1]. Woody feedstocks are sourced as a result from the Forest Industry supply chain operations

WOOD FLOWS FROM FOREST TO INDUSTRY PRODUCTS AND ENERGY USE[1)]

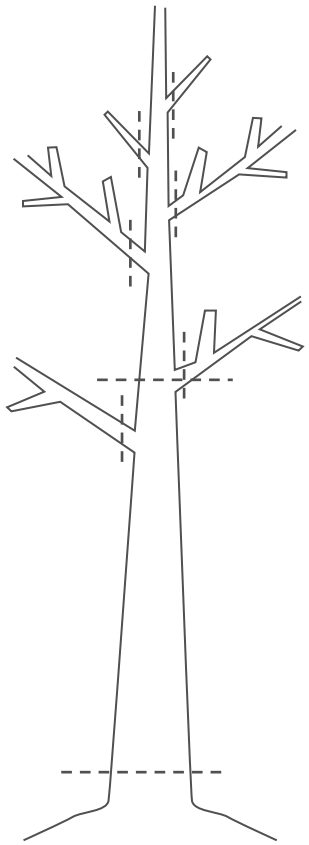


PRODUCTS

HARVESTING RESIDUES

SMALL DIAMETER ROUNDWOOD (PULPWOOD)

SAWLOGS



[1)] Orange arrows highlighting the biomass fractions used for bioenergy production, [1](Valdivia et al, 2016).

Source: AFRY

European Biodiversity strategy and its key element, the Nature Restoration Law, includes deadwood as target

One of the specific targets of the law includes forest ecosystems –

The goal is achieving an increasing trend for standing and lying deadwood, uneven aged forests, forest connectivity, abundance of common forest birds and stock of organic carbon

EU Biodiversity strategy

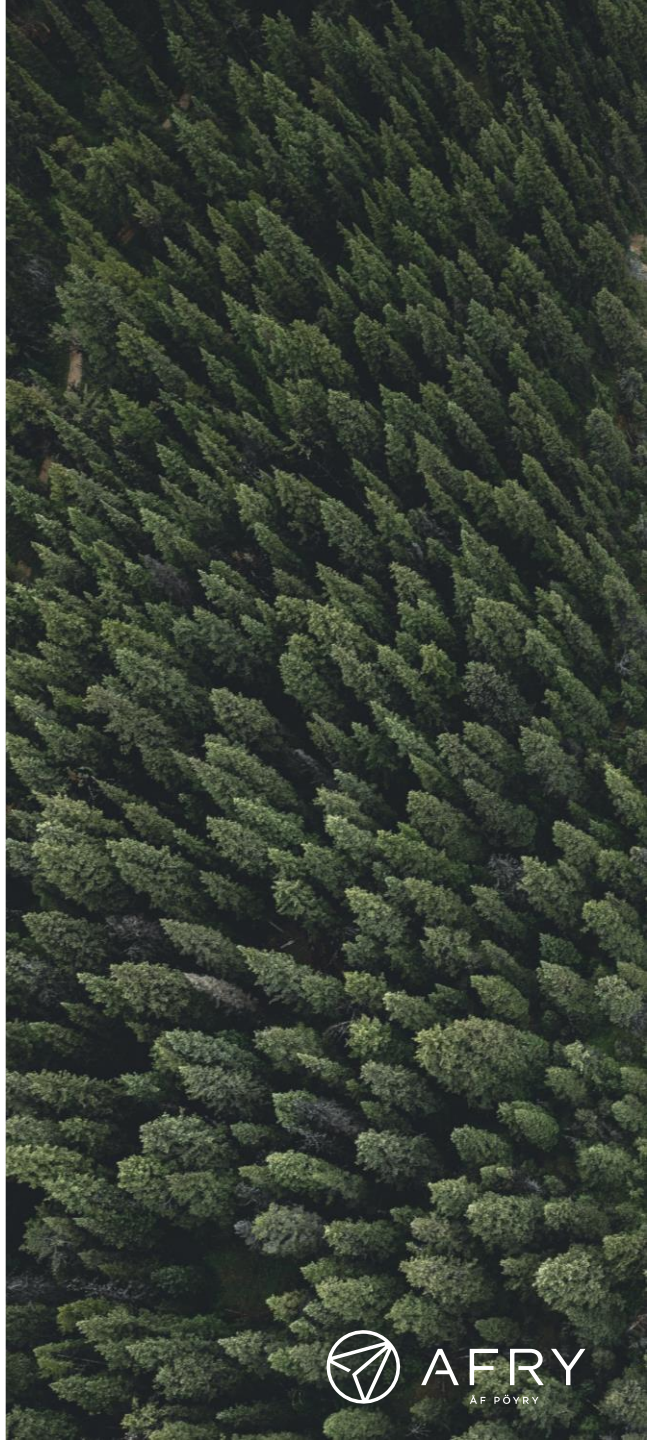
Several scientific studies identify **deadwood** as a parameter affecting **biodiversity** levels in the forest. The extraction of deadwood from forests has been shown to have detrimental effect on species that depend on it for survival.

Nature Restoration Law

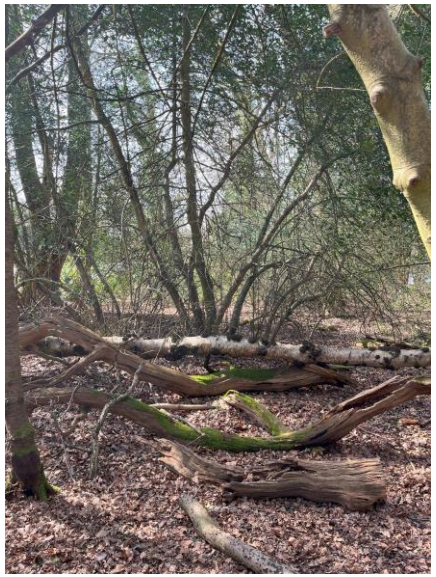
calls for binding targets to restore degraded ecosystems, in particular those with the most potential to capture and store carbon and to prevent and reduce the impact of natural disasters.

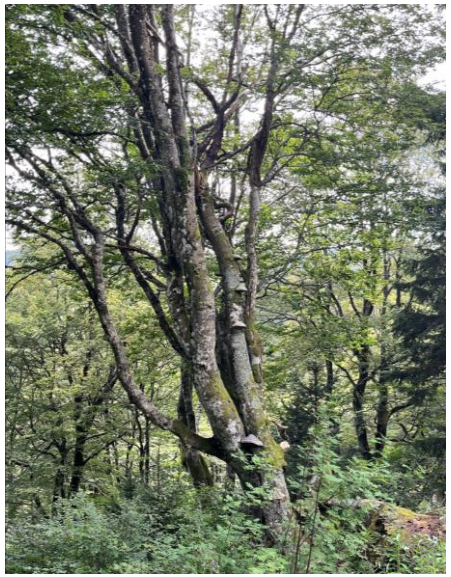
Restoration measures should cover at least 20% of the EU's land and sea areas by 2030, and ultimately all ecosystems in need of restoration by 2050.

Source: European Commission. Environment October 2023. AFRY



What is deadwood and how is it linked with biofuel production? How is its removal impacting biodiversity?





Source: AFRY

Deadwood is woody necromass in a stand created and left in the forest as result of natural processes or silvicultural treatments (left crown, branches, stumps)

The formation of the deadwood occurs in different stages, different species find habitat in deadwood throughout the cycle

- first the decomposition of branches and bark,
- progressing and including sapwood, stem tops and further parts of the stem, with appearance of holes,
- decomposing until the woody material forms part of the ground.

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Concawe has commissioned AFRY to assess the biodiversity impact in producing biofuels from forest residues across Europe

Hypothesis: deadwood levels will impact ecosystem function in the forest-harvesting residues removal in the ecosystem

Background: there is no comprehensive study to date on sustainable levels of residue removals impacting biodiversity in the forest

Main objective: to identify pre-defined thresholds for individual geographies- and to which point residue removals would impair ecosystem function

1

Deadwood removal will impact ecosystem functioning as research states

How to assess the biodiversity impact when utilizing forest residues for biofuel production? Systematic literature review

2

Focus: Deadwood relationship with biodiversity. Additional countries' data (harvesting residues, deadwood records, retention volumes) are considered

Results on deadwood species specific thresholds and curves from literature

3

Countries with retention volumes guidelines, deadwood records and drivers for residue production were identified

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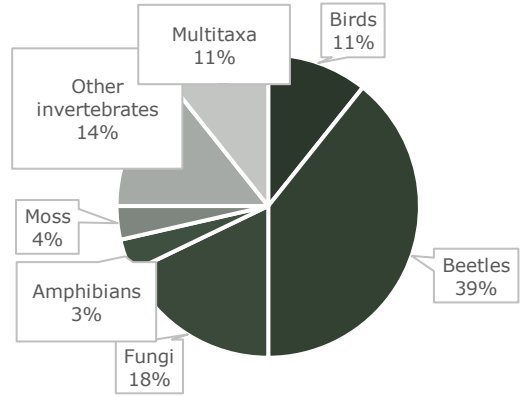
Scientific articles showed significant relationship between biodiversity and deadwood in form of curves and deadwood thresholds.

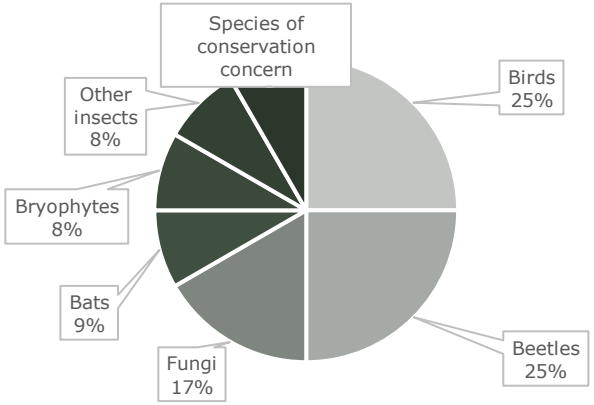
- From the selected articles 21% included species specific deadwood thresholds, to be considered as minimum for ecosystem functioning.
- Curves are related mostly to beetles, fungi and birds and highest number of papers refer to Sweden, Germany and Poland.
- Thresholds are researched mostly for beetles, fungi and birds, and highest number of papers refer to France, Austria and Germany.

#	Examples of relationships
1	Linear relationship between the **volume of stumps** and the **abundance** of saproxylic beetles (Geijer, *et al*., 2014) (Sweden).
2	Correlation between the **number of fungi species** and threatened species, and the **volume of dead wood** (m³/ha) (Penttilä, *et al.*, 2004) (Finland).
3	**Species richness** (bats) plotted against **standing deadwood** (m³/ha) (Tillon*, et al*., 2016) (France).

CURVES FOR SPECIES



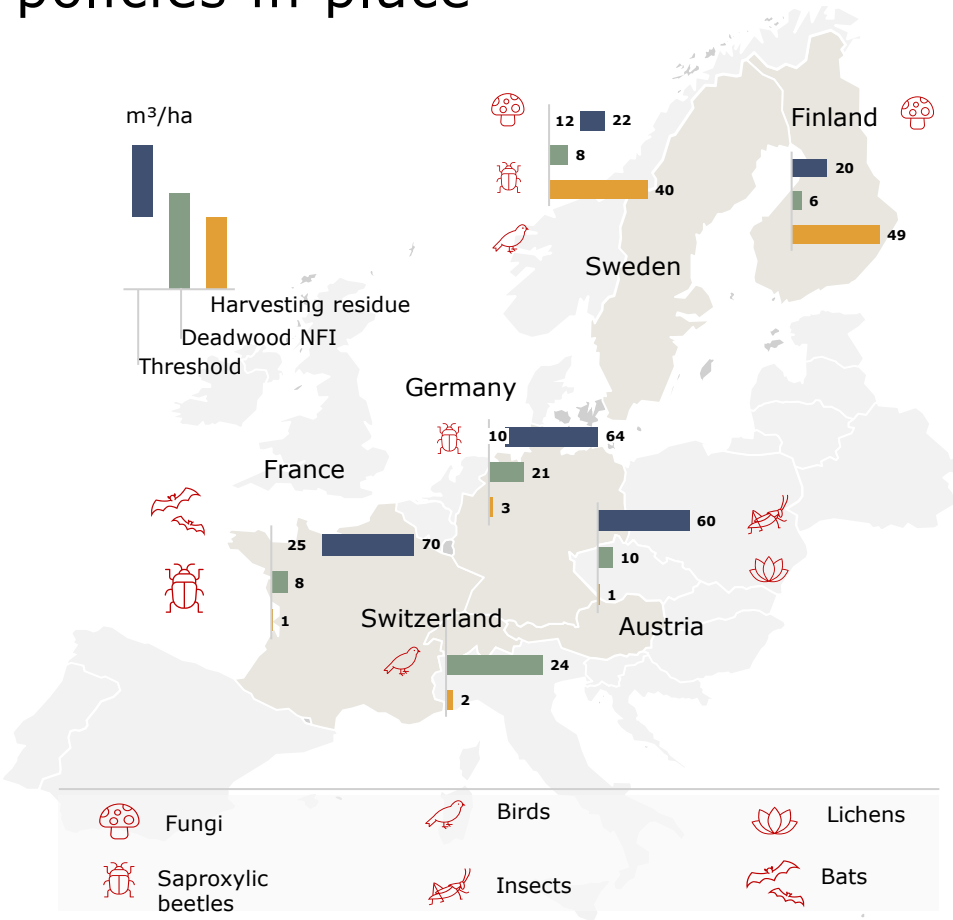
THRESHOLDS FOR SPECIES



Nordic countries and Germany are showing deadwood and harvesting residues records with deadwood related policies in place

DATA COMBINATION- DECISION CRITERIA

- Nordic countries and 4 central european countries have shown records of deadwood in the NFI[1]. Additionally, biodiversity guidelines support the conservation and increment of deadwood volumes in the commercial forest, but no clear limiting restrictions on residue removals have been published to date.
- Species specific deadwood thresholds published in the papers are less than the average amount of harvesting residues estimated in the forest in Sweden and Finland.
- Higher species specific deadwood threholds than deadwood amount recorded in Germany, France and Austria.
- Hightest amount of deadwood recorded in Switzerland.



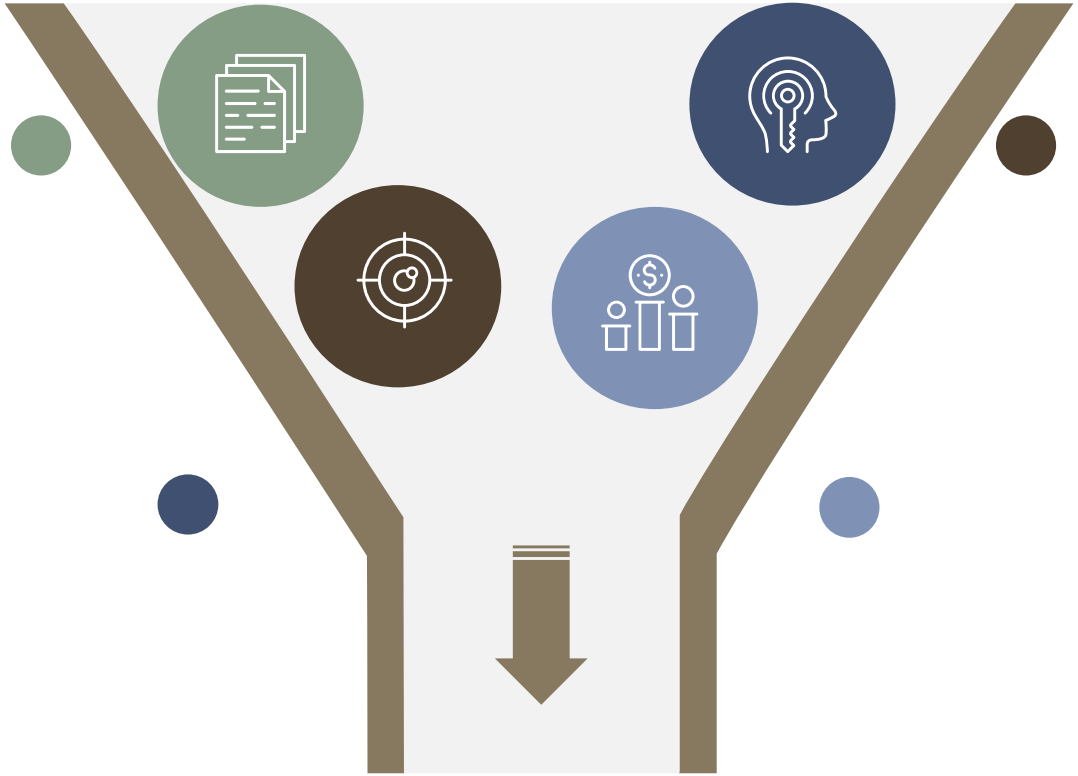
Note: Switzerland's threshold provided as basal area (m²/ha)

Figures from literature, national statistics. AFRY. [1]NFI: National Forest Inventories.

Forest management practices, retention volumes and deadwood thresholds are crucial for the estimation of residues for biofuel production

Forest management practices

Description of forest management practices, including crop rotation periods, species and estimated harvesting residues volumes per ha on a yearly basis pertaining to removal.



Deadwood thresholds and curves

Species specific thresholds and curves set the scientific evidence for validation purposes and the minimum deadwood quantity to maintain the biodiversity ecosystem levels.

Residue retention

Residue retention volumes for deadwood creation purposes following regional guidelines is important to consider as non-viable volumes for biofuel production.

Residue removal

All considered parameters set the framework scenario for estimating the remaining volume from the forest to be dedicated for biofuel production.

AFRY's main purpose is the development of Forest residue thresholds scenarios taking into consideration deadwood as biodiversity indicator

4. KEY MESSAGES

Further research and a unified ecosystem impact analysis are key to better understand the best use of our forests

- Collaboration between scientists, policy-makers and stakeholders is essential to keep developing evidence-based solutions
- Biodiversity impact analysis should be focused on regions, considering species specific habitats within the different forest ecosystems.
- Future policies and laws will help to create the frameworks of action and ecosystem impact analysis in a standardized manner.
- AFRY aims to provide recommendations and solutions to Concawe in quantifying and identifying forest residues for the biofuel production.


Thank you for your attention
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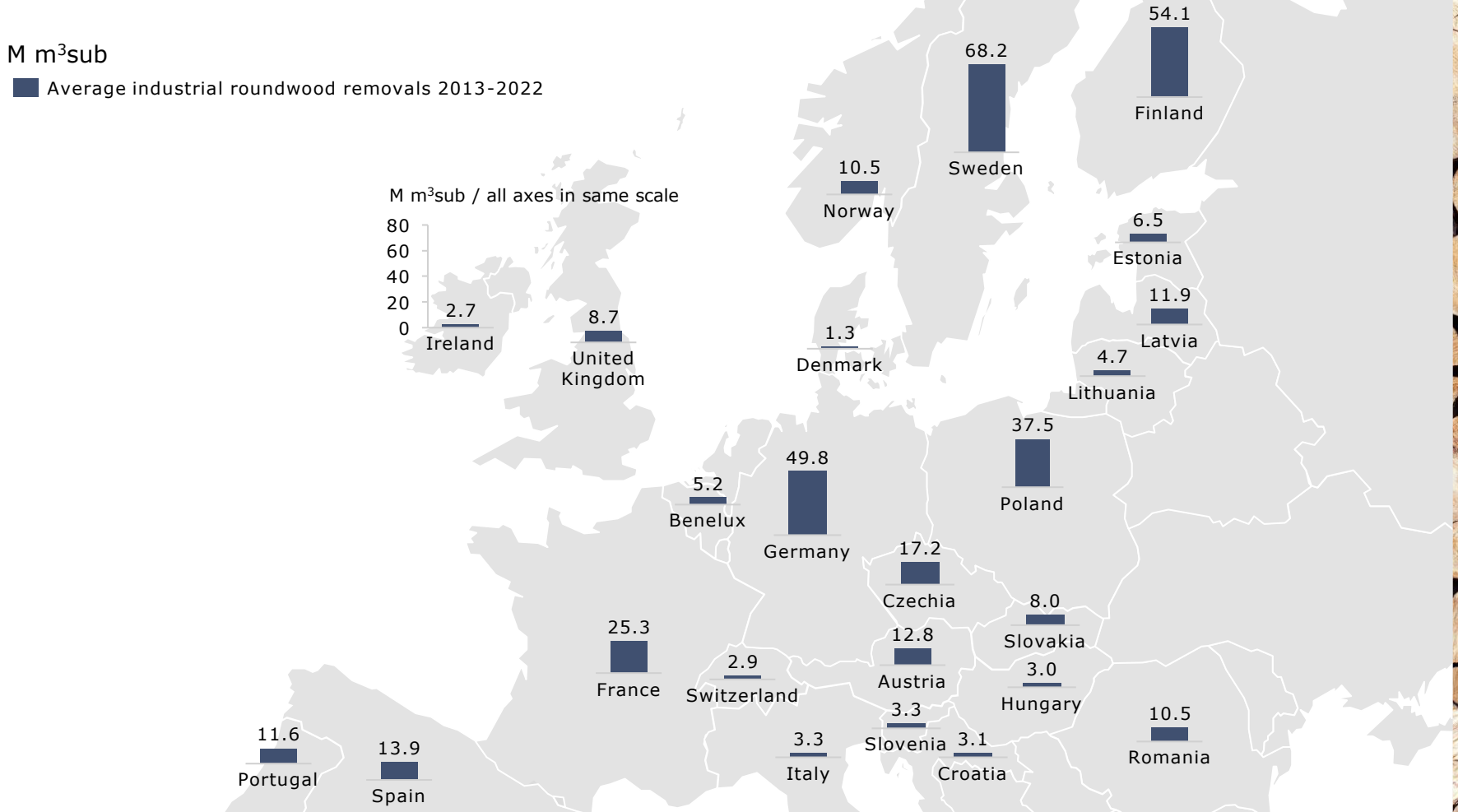
INDUSTRIAL ROUNDWOOD HARVESTING IN EUROPE 2013-2022

On average, 380 M m³sub of industrial roundwood was harvested in Europe annually



Source: Eurostat. Includes sawlogs, veneer logs, pulpwood and "other industrial roundwood"

AFRY helps to develop an approach to biodiversity that involves multidisciplinary expertise and commitment

1. CAPACITY BUILDING

- Understanding of economic **impacts and dependencies** on nature
- Current developments in **legislation**
- **Key actors and stakeholders**
- **Initiatives and frameworks** (IUCN, SBTN, TNFD…)
- Understanding a **company's sphere of influence**

2. SECTOR-LEVEL RAPID SCREENING

- **Sector-level, desktop-based screening**
- Identification of **projected impacts and dependencies of a company's production processes on nature**, including selected high-risk suppliers (up/downstream)
- **Red flag screening report**

3. BIODIVERSITY ACTION PLAN

- **Pathways for immediate action and/or a long-term biodiversity strategy** (timeline, indicators, identified relevant management processes…)

4. HIGH-DETAIL BIODIVERSITY FOOTPRINTING

- Asset level **assessment of dependencies and impacts using geospatial information** on location and ecosystem conditions
- Product-level, **integrated biodiversity Lifecycle Assessment**
- **Natural Capital Accounting**

5. BIODIVERSITY STRATEGY

- **Strategic biodiversity path** definition (analysis, policies and management plans)
- **Biodiversity governance model definition** (SBTN science-based targets alignment)
- **Biodiversity Management Systems** (ISO Standards, TNFD reporting, GRI…)
- **Stakeholder engagement**
- **Supply chain management**

SDGs: Sustainable Development Goals | ESG: Environmental, Social, Governance

Our Sustainability Consulting team offers a wide range of services along the entire industry value chain

Sustainability consulting – service areas

Market analysis & research
We assist companies in assessing mega trends and sector impact through scenario & risk analysis.

Sustainability strategy & reporting
We support clients to develop sustainability strategies and roadmaps (NetZero, SBTi).

Sustainable Transformation & operations
We support clients to improve process and performance to reduce resource usage, emissions, accidents (assets and value chain/scope 3).

Transactions & sustainable finance
We help asset owners, investors and financiers to scan and target selection through buyer and vendor ESG due diligence & assessment.

Competence coverage

Climate/GHG

- Strategies, Roadmaps and Risk assessments
- Greenhouse gas inventories and Emission reduction programs
- Reporting of climate-related financial information

Biodiversity

- Sector/Asset-level rapid biodiversity risk screening
- Biodiversity due diligence and red flag reports
- Corporate biodiversity action plans and Natural Capital accounting

Circular economy

- Circular economy strategies, business models and ecosystems
- Value chain and logistics
- Resource and material efficiency

Social Responsibility

- Social responsibility roadmaps and Stakeholder engagement
- Human rights due diligence
- Sustainable supply chain management

References

- Valdivia M, Galan JL, Laffarga J, Ramos JL., 2016. *Biofuels 2020: Biorefineries based on lignocellulosic materials*. Microb Biotechnol. Sep;9(5):585-94.
- Geijer, E. , Andersson, J. Bostedt, G., Brännlund, R., Hjältén, J., 2014. *Safeguarding species richness vs. increasing the use of renewable energy - The effect of stump harvesting on two environmental goals.* Journal of Forest Economics, 20(2), pp. 111-125.
- Penttilä, R., Siitonen, J. & Kuusinen, M., 2004. *Polypore diversity in managed and old-growth boreal Picea abies forests in southern Finland*. Biological Conservation, Volume 117, pp. 271-283.
- Tillon, L., Bouget, C., Paillet, Y. & Aulagnier, S., 2016. *How does deadwood structure temperate forest bat assemblages*?. Eur J Forest Res 135, Issue 135, pp. 433-449.

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