

Energy Transition & the Use of Biomass



Biomass in the context of a nature-compatible energy transition

Forest biomass is of outstanding importance among the renewable energy sources in Austria due to its quantitative use and the existing expansion potential. Bioenergy is a by-product and an integral part of the forest-wood value chain. An extension of use should be carried out in a resource-efficient, environmentally friendly and nature-compatible manner. With these considerations in mind, biomass should and will continue to make an important contribution to a sustainable and climate change-adapted forest management and to the increase of the competitiveness of wood processing.

Energy transition and the forest

A sustainable, renewable-energy based energy supply in Austria requires extensive measures. The massive reduction (roughly halving) of the gross inland energy consumption and the nature-compatible expansion of all renewable energy sources are to be listed as the key components for this purpose. The domestic forest is of enormous significance because of its effects on the climate and nature protection on the one side and as a resource for material and energetic use on the other. But at the same time, the effects of the climate crisis (caused by the rampant use of fossil raw materials), such as increasing heat, drought and the spread of pests, put increasing pressure on forests.

Nature-compatible use of biomass

The current publication, developed by the actors involved, presents common solution approaches for an environmentally friendly use of the domestic forest biomass potential. They are the result of extensive research and a stakeholder analysis, which was carried out between December 2017 and June 2020, involving 20 interviews, four round tables (each with 20 to 40 participants) and an excursion to a private forest operation and a wood power plant with a nearby pellet production.

The process aimed at determining the different perspectives of the stakeholders, understanding their fears and worries concerning an intensified use of biomass, pointing out Best-Practice-Examples for a sustainable forest management and biomass utilization, and, finally, developing a common solution for the use of forest biomass.

Experiences and perspectives of experts from public administrations, representations of interest in the field of agriculture and forestry, nature conservation-NGOs, biomass use as well as science and research were particularly taken into account.

The project BIOKONAT

This publication was created as a part of the LE 14-20 project „BIOKONAT – Biomass in the context of a nature-compatible energy transition: role, opportunities and options“. The project was sponsored by the Federal Ministry for Agriculture, Regions and Tourism and the European Union, led by the Umweltdachverband (an environmental umbrella organization) and accomplished together with its cooperation partners Environment Management Austria (UMA), Austrian Biomass Association (ABA) and Forum Science & Environment (FWU). The project united the competencies of the Umweltdachverband with the participation of its member organizations in order to serve as a networking source for actors involved in the production and use of forest biomass.



The wood power plant Rastendorf produces electricity and heat mainly from damaged wood, around the clock and regardless of weather.



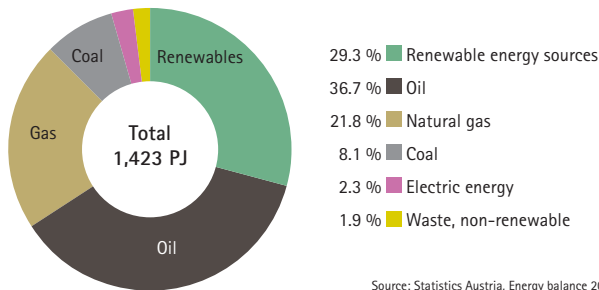
The excursion to the award-winning forestry operation of Altenburg Abbey was a highlight of the BIOKONAT project.



The future of biomass use was actively discussed by stakeholders at several round tables in small groups.

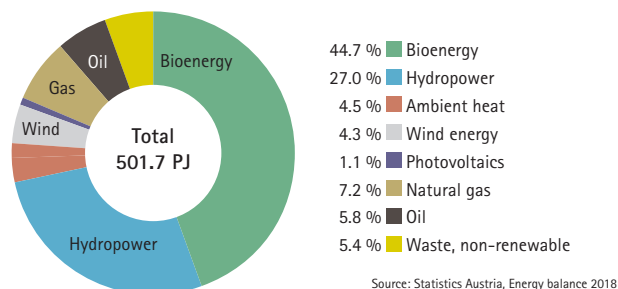
Energy system in numbers

Gross Inland Energy Consumption in Austria 2018



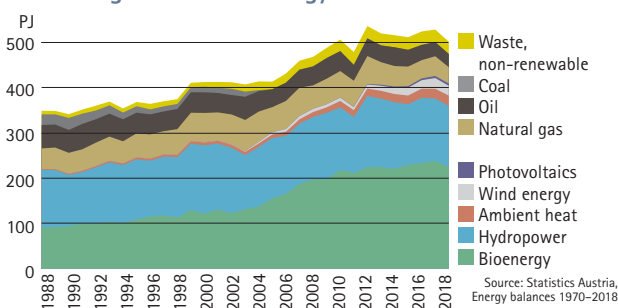
In Austria, energy consumption is covered by around two thirds by mostly imported fossil fuels.

Domestic generation of energy in Austria 2018



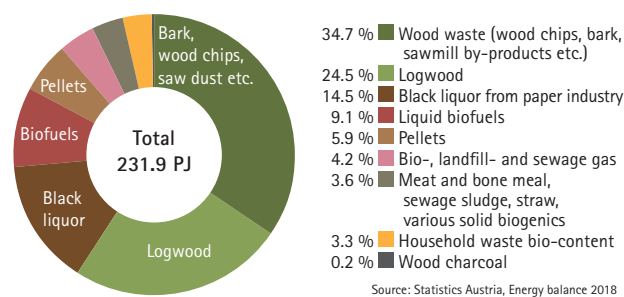
In contrast to imports, renewable sources predominate in domestic energy production with a share of around 82 %.

Domestic generation of energy in Austria 1988 to 2018



Whereas the self-generation of renewables has almost doubled in the last 30 years, the production of fossil fuels has fallen by half.

Gross Inland Bioenergy Consumption in Austria 2018



About 80 % of Austria's bioenergy is extracted from wood-like assortments (wood waste, logwood, pellets, black liquor).

Energy consumption in Austria

The Gross Inland Consumption (GIC), describing the amount of energy consumed in Austria in one year, is the central element of the energy balance. On the supply side, it is calculated from the domestic generation of raw energy and imports (\pm stocks) minus exports. In 2018, the GIC was 1,423 petajoules (PJ). Domestic generation of raw energy accounted for 502 PJ (35 %) and the net imports for 915 PJ (64 %). In addition, roughly 6 PJ came from energy stores.

The Final Energy Consumption (FEC) comprises the amount of energy used by consumers in private households (HH), in transport sector (TS), in material goods production (MGP), in the service industry (SI) and in agriculture and forestry (AF). In 2018, the FEC was 1,126 PJ. TS (36 %) had the largest share, followed by MGP (29 %), HH (24 %), SI (9 %) and AF (2 %).

Energy generation in Austria

In contrast to imports, Austria's domestic generation of raw energy is characterized by a high proportion of renewable energy sources: 81.6 % renewables, 7.2 % natural gas, 5.8 % oil and 5.4 % combustible waste. The generation of renewables rose from 353 PJ to 409 PJ between 2008 and 2018, the (preliminary) maximum was reached in 2017 with 426 PJ. Among the renewables, bioenergy has the highest share of domestic generation with 224 PJ (biogenic fuels with 174 PJ plus logwood with 50 PJ), followed by hydropower with 135 PJ.

In absolute numbers, sources such as ambient heat (23 PJ; heat pump, solar thermal, geothermal and reaction heat), wind energy (22 PJ) and photovoltaics (5 PJ) still play rather minor roles.

Largest increase in bioenergy

Even compared with the increase to 2008, biogenic fuels are ahead with +35 PJ. Within biogenic fuels, this increase amounts to almost two thirds to the energy sources „pellets and wood briquettes“ (+11 PJ) and „wood waste“, such as wood chips, sawmill by-products or bark (+9 PJ). Comparable increases can also be seen in ambient heat (+12 PJ) and wind energy (+14 PJ). Photovoltaics has „only“ gained about 5 PJ. However, due to the low initial quantity from 2008, this means an increase of almost 4,700 %.

The role of bioenergy

In 2018, around 232 PJ of bioenergy (including household waste bio-content, black liquor from paper industry, landfill- and sewage gas) were utilized, of which 224 PJ came from domestic production. About 80 % of this biomass was wood-based. Thus, biomass is particularly important for the energy transition, mainly because of its characteristics such as storage capacity. As opposed to other renewable energy sources, electricity from biomass or wood can firstly be generated regardless of weather conditions and secondly, throughout the year.

The ultimate contribution of bioenergy to the energy supply does not only depend on the mobilization of additional potential in agriculture and forestry, but also on other uses for biomass. In the long run, not only the non-energetic consumption of fossil raw materials (e.g. for plastic) has to be replaced, but also in the course of the Austrian Bioeconomy Strategy the material and energetic use has to be expanded significantly. This increases concerns about negative effects on the environment and our nature.

The forest in Austria

Forest growing stock at a new peak

Austria is one of the most well-wooded countries in the EU. The forest is managed multifunctionally with regard to its utility, protective, welfare and recreational functions. With an area of 4.02 million hectares and a proportion of 47.9 %, forests cover almost half of the federal territory. Since the beginning of the Austrian Forest Inventory in 1961, the forest area has increased by 330,000 hectares. The forest growing stock has increased by 50 % since the 1960s, leading to a record level of almost 1.2 billion cubic meters today. In the long term, the level of wood harvest in Austria lies significantly below the increment. The increase in stocks mainly took place in small private forests up to 200 hectares. The Austrian Bioeconomy Strategy aims at promoting the mobilization of wood from domestic forests.

More large trees and deadwood

Large diameter trees and deadwood are a habitat or the basis of food for many forest organisms. Austria's forests show a positive trend: the wood stock of trees over 30 cm in diameter at breast height (BHD) is increasing. The growing stock of trees >60 cm BHD has risen strongly (2.7 times) in the last 30 years. Already 20 % of the total stock is made up by trees over 120 years old. Concerning large diameter and old trees, questions of marketing, forest regeneration and the fulfillment of socially desirable forest effects (e.g. protection against natural hazards) have to be considered as well. The number and share of standing dead wood trunks has roughly doubled since the 1980s (with large regional differences). The amount of deadwood in the productive forest is also increasing; it is 20.6 m³/ha.



© Uptay/ABA

The proportion of hardwood and mixed stands is enlarging slowly, but steadily.



© Fraiss/Umweltdachverband

Climate change causes severe bark beetle damages to the spruce in Austria – large areas have to be afforested.

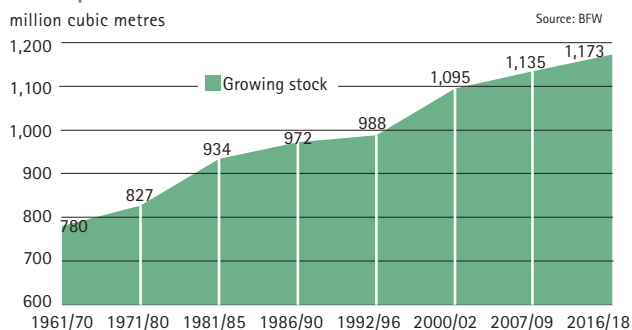
Climate change causes damaged trees

Global warming is becoming more and more noticeable in Austria. 2018 was the warmest year in the 252-year series of measurements by the Central Institute for Meteorology and Geodynamics (ZAMG). Heat and drought have led to catastrophic increases in bark beetle damages since 2015, especially in northeastern Austria. In 2018, the amount of bark beetle-infested wood reached an unprecedented level with 5.2 million solid cubic meters. With 4.7 million cubic meters in 2019, the figures were only slightly smaller (documentation of the forest damage factors by the Department of Forest Protection, BFW). Most of the damages were caused to the spruce, but many other tree species are also suffering from drought stress.

Forests are becoming more diverse

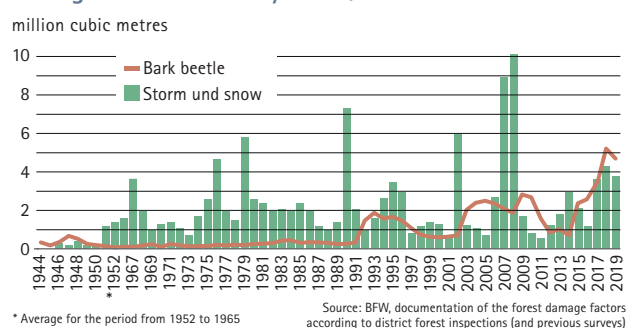
The spruce is dominating the Austrian productive forest with an area coverage of 49 %. However, mixed stands richer in hardwood and a forest management closer to nature are trending. Whereas the covered area with coniferous forest has decreased by 287,000 hectares in the last 30 years, the deciduous forest area has expanded by 130,000 hectares. The biodiversity index for the forest registers a positive development of the diversity of tree species, deadwood and veteran trees, even though from a nature-conservation point of view, there is also a regional shortage of deadwood. Indicators related to rejuvenation were not taken into account in the most recent survey. Despite the positive development, numerous biotope types and species in the forests are endangered. Thus, 53 of the 93 forest biotope types are assigned to an endangered category.

Development of wood stock in Austrian forests



The growing stock in Austria's forests has risen by 50 % since the 1960s – despite an increased use and calamities.

Damaged wood caused by storm, snow and bark beetle



Extreme drought has led to a record amount of bark beetle wood in the last three years – a total of almost 15 million cubic meters.

Conflicts and areas of tension

Opinions on the use of wood

„Intensification can lead to biodiversity problems (e.g. loss of deadwood, nutrient removal).“ (NGO representative)

„If a tree is burned, the exact same amount of CO₂ is released that the tree previously absorbed with growth.“ (Biomass sector representative)

„Usage leading to a long-term carbon bond and/or replacing energy- and greenhouse-gas-intensive products is to be preferred.“ (NGO representative)

„Every expansion of use reduces the sink effect of the forest.“ (NGO representative)

„The forest's sink function cannot be maintained without an active forest management.“ (Biomass sector representative)

General attitude in Austria

The implementation of the energy transition in Austria, considering its compatibility with nature, involves numerous conflicts, which were elaborated using the example of forest biomass. The boxes give an overview of current moods and some central statements. The statements represent assessments of selected stakeholders. Principally, there is a consensus that the sole expansion of renewable energy sources cannot cover the domestic energy demand in Austria. Therefore, the various expansion scenarios are assuming a massive necessity for savings. But there is skepticism about how these energy savings are to be achieved. The main barriers for the expansion of renewables are as follows: lack of investment and bank financing, enduring commercial and official procedures, inadequate technological development (e.g. storage technology) as well as lacking cost accuracy of fossil fuels.

Potential of forest biomass

Implementing the Austrian Bioeconomy Strategy will lead to a continuous increase of demand for the raw material wood. Estimates of the potential for the expansion of forest biomass vary in their evaluation. The ABA assesses the potential for bioenergy from forestry and the wood industry (excluding black liquor) for 2030 at around 208 PJ, whereas the UMA predicts just under 160 PJ (comparison to 2008: 151 PJ). Meanwhile, NGO representatives advocate a careful expansion. Concerns do also exist about the activation of potentials (e.g. in small private forests). The increased utilization can intensify conflicts about usage between the individual branches of industry (material, energetic), however, it can also create synergies.

Opinions on forest management

„In terms of protecting the climate and biodiversity, it is important to have forests that are getting older.“ (Science representative)

„There is no leeway for putting the forest out of use. We do need all existing economic tree species in order to counter climate change.“ (Agriculture and Forestry representative)

„Forests with native trees – having grown naturally from natural regeneration – are the most resilient forests.“ (NGO representative)

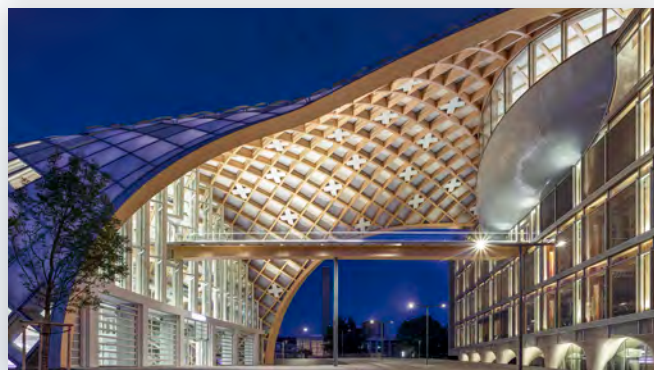
„80 % of coniferous wood is used for material purposes, whereas deciduous wood currently only up to 30 %. The forest modification will, therefore, lead to an increased emergence of wood fuel.“ (Biomass sector representative)

CareForParis: Climate protection with wood use

The CareForParis study examined the possible contribution of Austrian forests, forestry and timber industry to the fight against the climate crisis in six scenarios. The main result shows that the replacement of fossil raw materials with wood products, accompanied by an avoidance of emissions, is the greatest leverage of the forest sector for climate protection. Although the forest plays an important part in the contribution to CO₂-storage on its own, it cannot be a permanent sink. Selected key statements:

- Every year, 12.5 million tons of CO₂ are being avoided by the use of wood (materially and energetically) in Austria.
- The reduction of wood use leads to an increase of greenhouse gas emissions because then, more fossil raw materials, such as crude oil, coal, natural gas and goods produced with high fossil inputs (metals, concrete or plastics) are being used.
- The sink effect of the forest, solely, is limited to 30 to 100 years, depending on the management scenario.

The study was carried out by the Austrian Research Center for Forests (BFW), Environment Agency Austria, University of Natural Resources and Life Sciences (BOKU) and the Wood K Plus competence center.



2,000 m³ of spruce store 2,000 tons of CO₂ in the new Swatch Headquarter in Biel/CH, which was designed by star architect Shigeru Ban.

Concerns from nature conservation

The expansion of logging and the more intense use of domestic forest biomass for material and energetic purposes raise concerns among NGO representatives with regard to the associated effects, particularly on biodiversity, but also the CO₂-sink effect of the forest and the Austrian climate balance on the whole. The issue of CO₂ neutrality is also causing controversy among the stakeholders. In addition, major reservations are held against the use of non-native tree species, e.g. as an adaptation to climate change.

Forest management in the future

Given the climatic changes, Austria's forest management is facing major challenges. A decline of coniferous wood (in particular, spruce) is being assumed in Austria, eventually. The local sawmill and wood industry specialize in the processing of softwood, especially, spruce. Regarding future tree species, resilient mixed forests are being required. However, there is no agreement yet, which tree species might be the most suitable for this cause. Environmental and nature protection representatives put an emphasis (emphatically) on native, site adapted tree species. Forest owners do not only fight against the effects of climate change, but also against wood prices that are no longer cost-covering.

Solution approaches & recommended actions: Energy transition and bioeconomy

Energy transition as the order of the day

For the reason of climate change alone, the energy transition needs to be the order of the day. In order to be successful, three kinds of change are required: phasing out of fossil fuels, expanding all renewables in a nature-compatible way and roughly halving the gross inland energy consumption. Therefore, legal and financial instruments as well as instruments of information, communication and coordination are necessary. An eco-social tax reform can contribute to the phasing out of fossil energies and to an enhanced material and energetic use of biomass.

Promotion of the circular economy

Although technological developments still need to be driven forward, they cannot reduce our energy consumption alone due to rebound effects. In addition to individual behavioral changes, structural changes – how we live, work and consume – are essential. Furthermore, in terms of the implementation of the bioeconomy strategy, it is desirable to foster the development towards a regional, life-cycle oriented system. This should not only reduce traffic emissions (fewer and shorter routes) and boost regional added value (secure or create jobs and income), but also significantly reduce the consumption of resources.

Biomass replaces fossil fuels

The enhanced utilization of biomass in material and energetic use offers a great savings potential of greenhouse gas emissions. From a technological point of view, biomass can also replace fossil fuels in terms of material use. However, the necessary amount for a 1:1 replacement of fossil fuels is neither available today nor in the future (not even if the other renewables are included). For this reason, the bioeconomy strategy has to be accompanied by a change in values in our society up to its sufficiency as a result of behavioral changes.

Sensible multiple use

Wood should be used multiple times. Wood suitable for material utilization should be reused, if possible, in a cost-effective manner with reasonable effort and only if it saves more greenhouse gas than its energetic use. Long-term CO₂ storage (e.g. timber construction) should be prioritized in comparison to short-term uses (e.g. paper, packaging, energy). Cascading constraints or pre-emption rights for certain uses are leading to distortions on the timber market and, therefore, have to be avoided.



The population's awareness for climate change is growing, especially, because of the actions of the „Fridays For Future“ movement.

Dialogue platform

„Nature-compatible energy transition“

Austria's energy supply needs to be assessed on a national scope and then, be implemented regionally. Thus, regional added value is being created and the dependence on foreign countries is being reduced. Therefore, all actors should work together, step into dialogue with each other and coordinate their actions. Only this way, climate and nature protection can be impelled together and common strategies, including chains of use considering local characteristics, can be acquired. For this purpose, a **dialogue platform for a „Nature-compatible energy transition“** could be established, based on the German model. Current and future challenges make the broad field of biomass an eminently suitable test field and basis. Appropriate information and communication impart the essential knowledge, improve environmental awareness, influence personal behavior, attitudes and values and should also contribute to a more efficient use of technologies and products as well as to the reduction of energy and resource consumption. The dialogue platform aims at obtaining consensus-based solutions for a successful energy transition that is also nature-friendly.

Focus on regional wood supply

Needless to say, biomass district heating plants and wood power plants make use of regionally available raw materials and short transport routes. The used wood should, if possible, be obtained from thinnings and small-sized assortments during final use. Concerning the setup of new biomass power plants, their capacity should be adapted to wood resources and heat consumption.

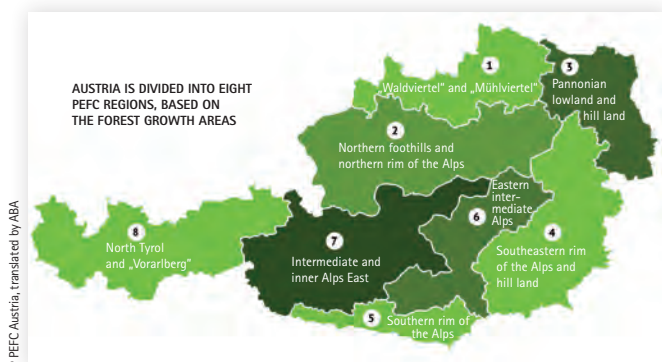


Biomass district heating: Wood from thinnings from surrounding forests in biomass heating plants creates added value in the region.



Showcase Hoho Vienna: Large amounts of by-products, which can be used energetically, come from wood processing for timber construction.

Solution approaches & recommended actions: Nature-compatible use of biomass



The pilot project in the PEFC region 6 sets a particular focus of forest management on the maintenance of biodiversity.

Wholistic solution for biomass

In order to be able to meet the increasing demands of biomass supply, a development of an overarching common strategy should be considered, which again should be based on the Austrian Bioeconomy, Biodiversity and Forest Strategy. In the course of the process, both, the material and the energetic use have to be considered as well as the forest's functions for climate protection and biological diversity. A basic requirement is the preservation of soil fertility by ensuring a long-term balance between nutrient withdrawal and nutrient replenishment.

Guidelines for climate-fit-forests

In the interest of making our forests fitter for the climate, forest owners should increasingly look at future climate-stable and natural forest communities. Concerning the site, its dynamic nature is of great importance (relief, soil, progressive climate change). Furthermore, a closer-to-nature-forest management and diversity must be promoted, while choosing tree species, genetics, structures and habitats. With a view to ensuring the natural regeneration of mixed tree species, the adaptation of ungulate-game management is imperative.

Supporting forest owners

The necessary changes in forest management represent some major challenges for the forest owners. For this reason, help should be offered to them – reaching from relevant advice and assistance up to financial support of services, going beyond the legally prescribed measures.



Numerous animal and plant species depend on deadwood management; the stronger, the higher the ecological value.

Pilot project: Biodiversity and multifunctional forest management

The LE 14-20 project of the Österreichische Bundesforste (Austrian Federal Forests) in the PEFC region 6 „Eastern intermediate Alps“ is making a significant contribution to the comprehensive protection of biodiversity by presenting recommendations for action and instructions for biodiversity-promoting measures in the area. Thus, forest managers should be motivated to implement voluntary measures for the protection of species and habitats. The Red List of threatened biotope types in Austria serves as a functional basis. A forest management system with an integrated preservation of biodiversity can be outlined as the main goal. Regional forest and nature conservation models and fields of action are being developed in order to protect endangered species in commercial forests. Based on this, suggested actions are being elaborated. Conservation measures for biodiversity should be looked at in a dynamic manner. Establishing the concept of this pilot project all over Austria is the primary aim in the medium run.

Implementation of biodiversity goals

In order to achieve biodiversity goals – assuming sustainable forest management – the amount of wood being used is less relevant than the quality of a regionally adapted landscape management (e.g. mature forest patches, deadwood, preservation of endangered biotope types and species) and the expansion of the Natural Forest Reserves Programme.

Protection of ancient forests

Numerous biodiversity strategies list the protection of ancient forests (e.g. national parks, wilderness areas, natural forest reserves) as a top priority. There are no consistent recommendations for the size of these areas. These protected areas function as refuges for highly endangered species and also as research facilities. In any case, they should be preserved (in the manner of balanced interests) for future generations.

Necessary research

The timber industry, specialized in softwood, needs to adapt to higher hardwood quantities. More research about the processing of hardwood for construction purposes or other material uses will be essential to reduce the share of fuelwood. From a silvicultural point of view, an increased cultivation of valuable wood for strong veneer wood or high-quality sawlogs is desirable. Biodiversity research is needed as well, especially, with regard to climate change and forest management.



Timely care decides the future of hardwoods like the oak, which can lie in the tiled stove or on the high-quality timber submission.

Best Practice: Forest and bioenergy

From clear cut to permanent forest

The forestry operation Altenburg Abbey is a model business for forest management in harmony with nature. In 2018, they were awarded with the state prize for outstanding forest management. After decades of clear-cutting with subsequent spruce reforestation, massive hoarfrost damage with around 100,000 m³ (annual cut at 12,000 m³) led the operation to rethink its strategies in the winter of 1995/96. In addition, there has been an enormous bark beetle damage due to extreme drought since 2015, causing 40,000 m³ of damaged wood in 2019.

Hunting secures the fir and the oak

Today, the forestry operation confides in a flourishing natural regeneration of fir, oak, beech or sycamore maple. The shooting of at least ten roe deer on an area of 100 hectares, often fulfilled in driven hunts, has a particular positive effect on diversity and natural rejuvenation, especially, of valuable hardwoods. „The fir trees show the effectiveness of the hunt. As soon as fir trees grow high, we notice that the variety in the stand is all right“, says chief forester Herbert Schmid.

Blackberry instead of game fences

The blackberry can be used as a natural browsing protection instead of fences. The shrub provides shade and keeps the soil cool and moist, which is especially important when rainfall is <400 mm (e.g. 2017). Additionally, 50 hectares of multifunctional strips along the forest roads reduce the pressure of browsing. Moreover, these biodiversity areas are bee pastures. In the course of silvicultural restructuring from spruce to oak and beech, the forestry operation makes use of the jay by providing acorns and beechnuts in feed boxes for burying.

Beetle wood becomes bioenergy

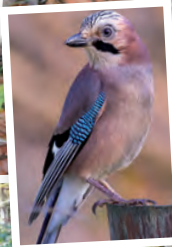
Beetle wood from Altenburg Abbey is converted into electricity and heat in the Rastenfeld wood power plant. The power plant operator NAWARO obtains most of its raw material (90 % damaged wood) from an area within a radius of only 20 kilometers and uses it for the production of CO₂-neutral electricity covering 30,000 households round the clock. The neighboring sawmill and pellet production use waste heat for the drying of sawn timber and sawdust.



Abundant natural regeneration from oak, fir and beech; the seed of the jay is actively promoted (right).

Intense roe deer hunting (left) ensures the diversity of tree species.

The blackberry provides free browsing protection and shade (below).



Power, that grows back: the Rastenfeld wood power plant



The 200-year-old oak forest (right) is the heart of the forestry operation Altenburg Abbey.



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