Forestry companies and the forest industry's thoughts on future timber qualities

A compilation from four stakeholder forums as a part of Assess4EST (WP5)

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Preface

This report is part of the Assess4EST project. WoodWorks! Cluster and Nibio were responsible for arranging workshops with the forest industry and other partners, to get their opinion on what kind of wood qualities the breeders should aim for in their breeding programs.

Financing came from The joint European research projects under the Forest Value Research Program in 2021 and business members in WoodWorks! Cluster.

These workshops were carried out online:

Workshop 23. september 2022 – in norwegian	
Hvilke valg står en overfor i planteforedlingen og skogskjøtselen, og hvordan må industrien bidra til at vi tar de rette valgene	Arne Steffenrem, NIBIO
Skogressurser i Norge: prognoser for fremtidig virkestilgang (15 min.)	Gro Hylen, Clara Antón Fernández, Aksel Granhus, NIBIO
Råstoffets kvalitet sett opp mot sagbruksnæringas ønsker og behov, nå og for framtiden	Sverre Luktvasslimo, InnTre Kjeldstad AS), Hallvard Olden, Moelven Virke AS, Knut Johan Dreier, Moelven Van Severen
Framtidig virkesbehov for «fibersiden»	Lars Johansson, WoodWorks! Cluster
Sitkagran – erfaringer fra Skottland	Paul McLean, NIBIO
Diskusjon	

Workshop 25. january 2023	
Introduction: Breeding and forest management for the future pile of logs: the users must tell us what quality that is needed!	Arne Steffenrem, NIBIO
The forest industry's need for tree breeding for future wood properties, increased growth and resistance to pathogens	Ola Kårén, SCA
More value from less harvest: the future of biomass cascade processing for novel biohybrid and added value products of circular bioeconomy	Tuula Jyske, University of Helsinki.
Wood quality and its influence of building constructions	Joakim Dørum, Green Advisers AS
Short presentations of Paper Province and WoodWorks!Cluster concerning coordination of further activities	Sandra Sundbäck, Paper Province and Kjersti Kinderås, WoodWorks! Cluster
Discussion	

Workshop 09. october 2024 in norwegian	
Hvordan tenker en aktør som bygger opp industri som trenger mye virke, når kampen om råstoffet strammer seg enda mer til?	Fabrikksjef Håkon Helgerud Myhra, Hasås avd. Telemarksbruket.
Hva vet man om egenskapene til trevirke fra norske skoger, og hvordan kan man utnytte den kunnskapen?	Professor Geir I. Vestøl, NMBU.
Er planteforedla materiale et problem i et moderne byggeri?	Adm.dir. Audun Øvrum, Treteknisk

Workshop 11. september 2024 in norwegian	
Hvordan tenker Sødra rundt valg av treslag, intensivt/ekstensivt skogbruk og planteforedling når vi står overfor de forventede klimaendringene?	Magnus Petersson, Sødra
Skogplanteforedlingens tilpasninger til et klima i endring	Tor Myking, Nibio
Framtidas skogforvaltning: forventede endringer, klimatilpasning og ivaretakelse av biodiversitet.	Clara Anton Fernandez, NIBIO
Skogsertifiseringsregler og treslagsvalg	Thomas Husum, PEFC Norge
Hvilke rammer kan avskogingsforordningen komme til å sette for et klimatilpasset skogbruket?	Trond Svanøe-Hafstad, Landbruksdirektoratet

Photo front page: Norway spruce logs. Rune Hedegart/WoodWorks!

Content

1 Summary

The report synthesizes insights from three stakeholder forums conducted between 2022 and 2024, where forestry companies and forest-industry representatives discussed the future use of Nordic wood and the qualities needed in timber to meet emerging industrial and societal expectations. It highlights how Northern European forests provide essential resources for timber production, biodiversity, CO_2 storage and societal well-being, and stresses that forest management must balance these functions under accelerating climate change. The discussions showed that while advanced bioproducts will expand, building materials will remain the main destination for coniferous timber, as this sector offers the highest value creation for large volumes. Participants emphasized the need for strong, dimensionally stable and visually appealing sawn timber, shaped by traits such as density, knot size, fibre-angle and the proportion of juvenile wood—qualities that breeding and silviculture must jointly improve. Both structural and visual applications were considered, underscoring the dual requirement for strength and aesthetics in modern engineered wood products like CLT and glulam. The forums also examined the potential of species such as birch, Sitka spruce, Lutz spruce and Contorta pine, noting opportunities but also grading, market and logistical barriers. A strong message from stakeholders was that competition for timber is intensifying, especially for coniferous construction wood, as Central European forestry adapts to climate stress and geopolitical changes reduce supply. Scenarios for future management pointed to shorter rotations, species mixes, and more robust planting material—strategies meant to reduce risk under warmer, more variable conditions. The report concludes that industry must largely adapt to available raw material, making it crucial for breeding programs to enhance juvenile-wood properties, fibre structure and strength–density ratios. Climate-resilient plant material, effective silviculture and innovations in harvesting technology are highlighted as prerequisites for maintaining stable, predictable wood supply chains. Ultimately, the workshops indicate that Nordic wood will continue to play a central role in construction, and that aligning forest management and breeding with future industrial needs is essential for sustainable value creation.

2 Introduction

The forest of Northern Europe makes tremendous resource of timber, non-timber values, biodiversity and CO_2-storage. The timber resource is grown and harvested from important ecosystems for biodiversity, while they also serve as basis for recreation and wellbeing of the societies surrounded by the forest. The CO_2-storage in forest or forest products depends on the quality and end-use of the wood. So does the displacement of fossil-based products, by using wood products. Hence, the production and management of the timber resource is a balancing act to fulfil all needs of the forests and role as mitigator of climate change.

The purpose of the Assess4EST project is to improve the knowledgebase needed to manage the forest resources in a manner that fulfils the UN sustainability goals, from the genetics of regeneration, through management and harvest. The project aims to build a bridge between forest management and the wood processing industry, so that the resource of raw materials of the future is tailored to the needs of the industry, and vice versa. The project relies on engaged industrial stakeholders that combine futuristic visions with a realistic opinion of the future use of wood.

The interaction with industry took place in stakeholder forums that were arranged by the Industrial partner WoodWorks! Cluster. The first forum was a national Norwegian workshop the 23rd of September 2022. The second forum was an international workshop the 25th of January 2023. The last arrangement was an international workshop 11th of November 2024. The workshops were carried out with a combination of prepared contributions by experts and stakeholders and comments of opinions from the participants, who were mostly people from leading positions in the forest industry and forest companies. This report is a synthesis of the workshops, interpreted by the authors, and act as a background for the following work on simulations in WP4 in Assess4EST.

3 Assessment of the future use of wood and wood quality needed

The assessment of the future use of wood, the types of wood that will be desired as raw material for various applications, tends to be based on the general situation and use of wood today. The need for future wood quality is determined by the industry's ideal desire and an understanding that one must adapt to what becomes available.

There is currently a strong competition for the wood raw material for a range of purposes. This situation has in fact developed considerably during the project period, and will probably continue.

In the workshops, the general opinion among the participants was that it still is desirable that as much as possible of the timber raw material goes to building purposes, on the basis that this usually provides the best value creation for large volumes (not niche products). Although advanced bio-based products created through biorefining can offer significantly higher value per unit of wood, they typically rely on side streams from timber production.

A rough distinction can be made between sawn timber for structural purposes, where strength is the key factor, and sawn timber for visual purposes, where appearance is paramount and strength is less critical. However, in many cases—such as when wooden structures have exposed surfaces—it is desirable to combine both strength and aesthetics. This is particularly

relevant for engineered wood products like cross-laminated timber (CLT) and glued laminated timber (glulam), which are designed to be both load-bearing and visually appealing.

When wood is used as a raw material for structural applications where strength is critical, two key factors determine its strength class: knot size and density. The type of knot—whether dry, black, or fresh—is less important than its size, which directly affects the wood's structural integrity. Additionally, fibre angle plays a significant role. A pronounced deviation in fibre direction can reduce strength and also lead to shape distortions, making the wood less suitable for various applications.

When wood is intended for visual applications, it is especially important to use timber with fresh (green) and/or small knots. A high number of knots can be acceptable, provided they are fresh and consistent in quality. In such cases, careful sorting is essential to achieve a homogeneous surface appearance. While density is less critical for visual grading, a large fibre angle is undesirable, as it can cause deformations that compromise the product's visual integrity and usability.

The workshops explored various aspects of wood utilization. In the Nordic countries, the primary sources of raw material for industries are spruce and pine, used extensively for structural applications in buildings, panelling, interior and exterior wall surfaces, as well as for pulp, paper products, and energy. Birch is commonly used for chip-based boards, interior carpentry, and fibre products, but it is also being considered for higher-quality building materials. However, the lack of operational grading rules for structural applications remains a challenge for using birch on load carrying constructions, even though the strength normally is good.

In some regions of northern Sweden, Contorta pine serves as an important, and increasing, fibre source for the pulp industry. Meanwhile, Sitka spruce and Lutz spruce are relevant raw materials from the coastal areas of western and northern Norway. Despite their potential, these species face barriers to adoption in building applications due to their status as new species in the production line, which introduces technical and logistical challenges, as well as to be accepted in the market.

During the workshops, it was demonstrated how Sitka spruce is successfully used in plantation forests in Scotland, prompting discussions about the future of Nordic forestry. Specifically, participants considered whether more land should be dedicated to intensive plantation forestry, while simultaneously setting aside other areas to meet conservation goals for natural forests with minimal or no management.

Matters that emerged at the workshops were further:

A) Sawn wood

- The importance of the positive climate effect of using wooden materials as a carbon storage and substitution of fossil-based materials with wood was highlighted.
- For construction, and by that make long-lived materials, there is a need for timber with long, light fibres, high ratio between E-module and weight. Constructions can also be based on raw materials with lower strength characteristics, but then it must be compensated with larger dimensions. This is negative regarding the use of materials and dimensions of the structure, such as the thickness of floor dividers for larger buildings. Also, regarding span, which is an important factor for the use of wood in larger buildings, it is important to have raw materials with good strength properties, otherwise other materials will be preferred to achieve the desired span.

  For softwood of spruce and pine, raw materials for construction purposes will be priority number one for a long time to come, and then the following wish list is important regarding plant breeding:

  - High strength/specific gravity ratio to achieve high production, but at the same time satisfactory strength.
  - Long fibres and uniform fibre-structure in the longitudinal direction of the trees.
  - Reduce the negative properties of juvenile wood, both through tree breeding and forest treatment. In particular, this applies to fibre-angle, which leads to unfortunate twist deformations of wood products.
  - Reduced knot size even if production is raised.
  - More green knots to satisfy visual product requirements.
  - Reduce the amount of resin pockets in wood of Norway spruce.
  - Small taper – good stem shape. This is important for the yield at the sawmills.

- Moelven expects that wooden houses will be important also in the future. Today there are built 50'-60' new wooden houses daily in the world. It is expected that the share of wood in office and industrial buildings will increase.
- It is necessary to study the juvenile wood and other quality-elements in wood from fast growing plantations with short rotation to find out more concerning the most limiting factors of juvenile wood:
  - Spiral grain leads to torsional deformations on lumber. Twisting is challenging for wood in competition with other materials because more and more dimensional corrected materials are desired, especially as industrial construction develops and increases.
  - MFA (microfibril angle), which has an influence on the strength of the wood as such, and which provides great length shrinkage if it is large.
  - Density variations near the pith, and this also presents challenges with rapid growth due to that density is lowest a few annual rings from the pith and then increases again towards the bark. With a large annual ring width, this zone of the cross-section will constitute a significant proportion of the lumber.

- Broadleaved species: quite large standing volumes. Today mostly used for low or lower quality/valued products as heating, tissue, packing, but to some extent also high quality/valued products as kitchen, furniture, parquet. There are large potentials in improvement by breeding. The improved trees should give more even qualities, so a bigger part of the stem gives higher value. Must be followed up by good management. Can hardwoods be used as construction wood on the larger scale? Can it replace softwood? Or at least supplement softwood-based structures by adding higher strength and rigidity to the structures (e.g. birch). Larger homogeneous volumes with predictable quality are important to achieve this.
    - For the large volume of wood, the use in the future will be similar as today, where about 80 % of the net value in forestry is sawn products. Quality must be *good enough* for construction purposes. But the very special qualities are not so important any longer (for instance clearwood for window frames). The use of wood might develop more towards laminated wood and massive elements. More processing of the sawn wood into e.g. painted, stained and finger-joined products.
    - The sawmills don't see any strong trend in quality as they change from natural grown towards cultivated spruce. Well managed cultivated forest gives the best result at the sawmill. But small dimensions from very early harvests (young trees) are difficult to make into strength graded products. There is large geographic variation in the quality of wood, but the variation wasn't explained in depth. But fast grown west-coast spruce is more difficult.
    - At the construction site, there will be a focus on time saving and reducing waste/loss. More products in fixed lengths; a homogenous base of raw material is effective.
    - Focus on sustainability (FSC, PEFC).

Fiber

In general the quality demands for wood in the fibre-industry is somewhat different from the building industry, and narrower. The quality is very much linked to fibre-length and the yield to density.

- The impression is that the use of structural wood will not change that much, but the use of fibres is under great development.
- Increased interest for birch fibre; it has the same properties as eucalyptus and can mainly go into the same products.
- Spruce will continue to be important, and we will probably see an increased demand. Pine is useful, but the demand is not expected to increase.
- Sitka is useful. Why is it so little used in the Nordic counties today? There is a potential.
- The fibre-industry doesn't see any other use for other northern hardwoods than what is mentioned above.

The general feedback from stakeholders was that timber as raw material for a wide range of products is a limited resource today, and the competition about the resource will increase. Particularly wood from conifers for construction will be a limited resource, since forest management in central Europe is changing (to increase resilience, diversity and non-timber values), as well as trade with Russia has ceased, and the overall supply will be reduced. Our impression is that wood from spruce and pine still will be fundamental for the market, and that forest management in the north must take adaptive measures to assure a sustainable industrial chain based on these species. Stable and predictable supply is important. Climate change must be considered in the forest management.

4 Scenarios for future forest management to fulfil the needs for wood quality

The project has focused on the management of Northern-European forests. Climate change will influence survival, damage (biotic and abiotic), productivity and management. In Central Europe, measures are taken to diversify forest management from the large monocultures of spruce that were stressed after severe droughts (maximized in 2018) with subsequent bark beetle attacks. In Northern Europe, we can observe a general decline in productivity of the forest after the drought in 2018, and in southern and Mid-Sweden about 25 mill m^3 of spruce has been killed by bark beetle attacks.

However, the age of the forest is an important factor and most of the damaged forests were in the riskier age for different calamities. Higher temperatures will on the other hand give this region a longer growing season and a larger potential for production under appropriate management.

Most important risk elements in forest production

- Plantations with monoculture are exposed to higher risk of damage.
- Plantations with long rotation are more likely to be damaged. Long-rotation species, such as oak, are likely to be exposed to considerable risks, as the climate- and environmental change the next 100 – 120 years are very uncertain.
- Interaction between climate change and pathogens may cause increased and unpredictable problems.
- Some species are more exposed to negative effects from climate changes than others. In Sweeden there is for instance a shift to use more pine, on behalf of spruce, since one expects pine to stand drought and higher temperatures better than spruce.

Basic solutions

- High production is a priority.
- Robust plants with good survival and fast establishment are necessary for a good start. To avoid loss of growth (mortality or decreased growth) is just as important as increasing growth. Robustness of plants must be developed in breeding programs, testing the materials in multiple environments.
- The combination of improved plant material and silviculture is essential to utilize the prolonged growing season and avoid calamities. Improved plant material by itself is not enough, it must be followed up by appropriate silviculture.
- Shorter rotations reduce risk of damages from wind, drought, root rot and insects.
- A mix of species in the stands, or a fragmentation of smaller monocultures in the landscape, is likely to reduce the risks.
- Must take the climate changes into account, to get the right tree species / mix of species on the right spot. Dynamic deployment guidelines for species, species mix and genetic material.
- Since the proportion of juvenile wood will increase under management regimes with shorter rotations, breeding for improved juvenile wood properties is most important. Mature wood properties are probably good enough regardless.

- For other wood species ("new wood species"), raw materials with long fibres and good strength properties can be used for traditional construction wood. For wood with shorter fibres, various applications, such as packaging and panel products, will be relevant, but also different visual products in the form of furniture, interiors, panels, etc. There are also wood species with shorter fibres, but still good strength properties that can be combined with traditional construction timber in, for example, glulam, CLT and SWP.

5 Discussion on the knowledge needed to implement these scenarios in tree-breeding and forest management

Understanding the expected use of wood in the future will help tree breeders and forest managers identify traits that can be important to improve or control by breeding and silviculture.

- The feedback from stakeholders does not support the idea that future needs for raw materials from the long-rotation forestry should be tailored for specific purposes. The industry that is most adaptable (to available raw materials on one hand and markets on the other) will survive. Our impression is that the industry will and must adapt to the resource, not opposite.
- Generally good quality will continue to be important for conifer wood. This relates to traits important for stiffness, dimensional stability and knots.

- One should be careful to sacrifice wood density for increased volume production. Particularly in regions with environmental conditions that yields very fast growth (e.g. West Coast Norway), or northern and higher elevations where density is generally lower due to cooler growing conditions.
- Forest managers should manage forests in a more complex way, for instance through more frequent management efforts, but the question is if that is realistic? Is it possible to think we can manage:
  - CCF (Continuous cover forestry) – more often harvest, the distribution of dimensions important to keep the stand in uneven-aged state.
  - Mixed species forestry – species might be harvestable at different age. E.g. an overstory of birch might have to be harvested before the undergrowth of spruce. One could question if the remaining monoculture of spruce would be as susceptible to calamities as any other monoculture.
- How would more complex management influence the cost of wood for industry? Will the end-users pay for this, or find timber somewhere else or use other materials? Or will the development in effective harvesting techniques compensate for it?

6 Conclusions

The main conclusions from the workshops are:

- Breeding and silviculture must go hand in hand. Today silviculture is neglected many places, which leads to less effect from the tree improvement.
- Robust plants are important to avoid lack of production from start, and throughout the rotation.
- Age at harvest-time is of importance for quality. With climate change the rotation age will probably be shortened. The proportion of juvenile wood will therefore increase. One should reduce the negative properties of juvenile wood, both through tree breeding and forest treatment
- Climate changes must be considered. Today's plants must stand the weather of tomorrow.
- Volume production trumps quality for industrial use. The industry will adapt to the qualities available at a given time. It is therefore even more important for plant breeding to be able to influence the properties so that they can be improved despite increased volume production. This is, first of all:
  - Increase the strength-density ratio.
  - Reduce knot size – and quantity.
  - Long straight fibres.
  - Reduction of fibre-angle – especially in the juvenile wood.

    - Still, it is assumed that wood for building purposes will be most important for the application of Nordic wood raw materials in the next decades, and it is therefore important to focus on quality for this purpose (strength properties of construction wood and visual properties of visible wood).
- In the workshops, it was highlighted the importance of good strength properties of wood for construction purposes, in order to compete with other materials in terms of, for example, the span of the structures. In addition, good strength properties will result in slim wooden structures given the same strength requirements, with reduced material consumption. In principle, one would think this will result in a lower greenhouse gas footprint than if more material had to be used. However, it is interesting to analyze what effect it will have on the greenhouse gas footprint if wood with high strength, and thus slim structures, is used, instead of timber with lower strength, and thus higher material consumption. It is very interesting to investigate how the total accounting for greenhouse gases for these two alternatives will be, where forest conditions are also included, together with harvesting.
- It is important to have innovative developments in harvesting technology to achieve cost-effective forestry where requirements for good forest treatment and less clear-cutting can be satisfied. This can also provide opportunities to exploit the combination opportunity by both refining the plant material and utilizing optimal forest treatment to produce the desired raw material.

The workshops also provided indications and forecasts for what can be expected of available materials in the coming decades, on the basis of various scenarios.