ROSE WOOD 4.0 Sustainable Wood for Europe

CENTRAL-WEST HUB ROADMAP

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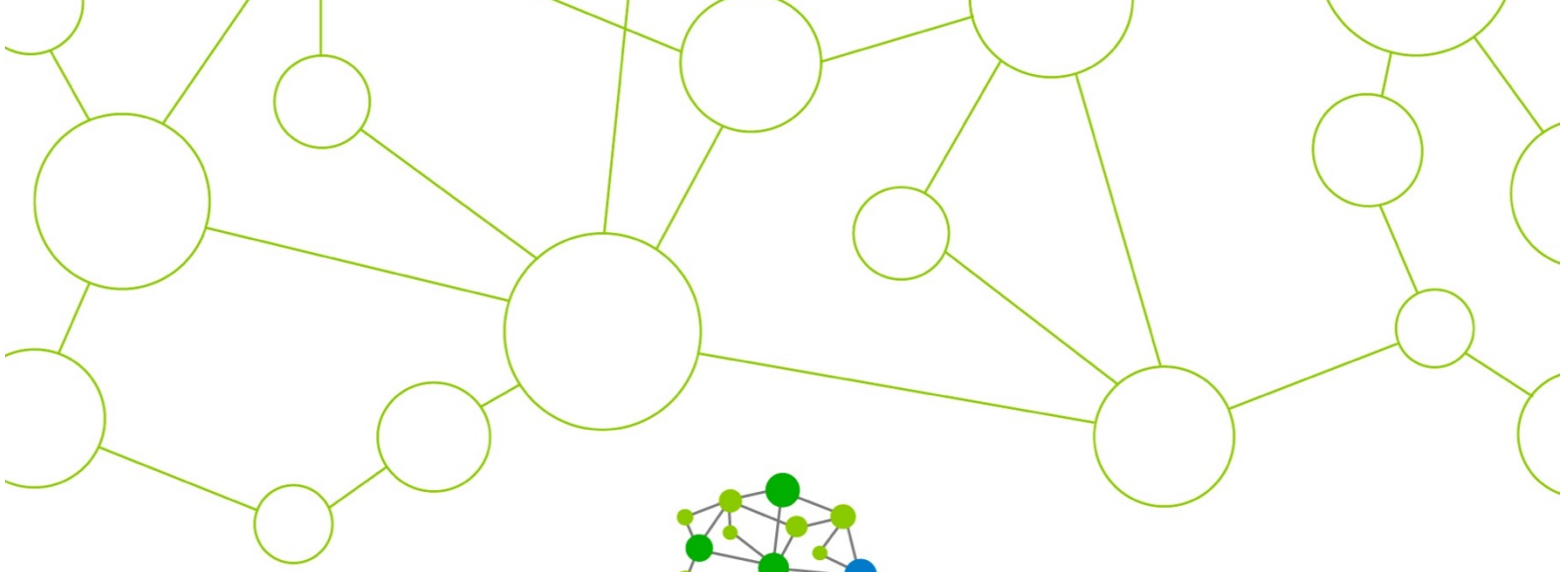

ROSEWOOD 4.0 Sustainable Wood for Europe

Central-West Hub Roadmap

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1. Introduction

Modern information and communication technologies (ITC) continue to develop rapidly in all sectors of the economy and society. The forestry sector (compared to agriculture or manufacturing sectors) is however lagging behind in terms of adaptation and spreading of modern ICT solutions. A major challenge is the large variety of ecosystems, forest owner types, supply chain actors and stakeholders, and regional disparities of technological progress. Forest industry 4.0 solutions (including new measurement sensors, high resolution digital maps, forest planning tools, risk monitoring, realtime data exchange and control, logistical optimisation, etc.) are a major field of innovation and future market, which will enable continuous information exchange at all stages in the supply chain, tracking timber flows from forest harvesting to processed wood products and markets. Furthermore, Decision Support Systems (DSS), educational tools and marketing platforms for forest owners are more and more emerging to connect knowledge and practice, and the actors within a region. This will leverage huge benefits for resource efficiency, sustainable use and climate change mitigation. These solutions can however only be exploited to their full potential, if they are more adapted and adopted, disseminated and deployed in the various regional contexts. The need for broader sharing of ITC-driven solutions and best practices is imminent and increasing, to maintain and enhance the competitiveness of Europe's forest industry by transforming it to a forest industry 4.0.

Digitalisation is one of the most powerful drivers of change in all aspects of society. In forestry, it has the potential to enhance the information flows and the relationships between actors (owners, managers, authorities, workers, communities and society) at all steps of the value chain. It has the potential to improve decision-making, empower forest managers and workers to achieve greater sustainability and fulfilment of multi-functionality standards as well as improving efficiency and transparency. However, the adoption of digital solutions is generally slow and very uneven across Europe. Through its Roadmaps, ROSEWOOD4.0 identifies and supports the adoption of close to market solutions and the replication of success cases by stakeholders of the value-chain.

Throughout Europe, the challenges for a sustainable wood mobilisation are diverse and often a lack of specific knowledge leads to non-ideal solutions. However, international and interregional knowledge transfer offers the potential to improve this situation. Against this background, the ROSEWOOD4.0 project has initiated five regional Hubs throughout Europe bringing together 21 partners from 18 countries to steer the interregional knowledge transfer on sustainable wood mobilisation:

- Northern Europe: Finland, Sweden, Norway, Baltic countries, Denmark
- Central-West Europe: Germany, Belgium, France, Switzerland, Austria
- Central-East Europe: Czech Republic, Hungary, Poland, Romania, Slovakia, Ukraine
- Southern-West Europe: Spain, Italy, Portugal and South of France
- Southern-East Europe: Bulgaria, Croatia, Greece, Slovenia

These 5 communities within ROSEWOOD4.0 will facilitate wood mobilisation through mutual learning across European regions. ROSEWOOD4.0 builds on the insights and experience gained in recent research and innovation efforts and will implement specific activities to reinforce digitalisation of the forestry domain with a sharp focus in the most relevant innovation opportunities in the following areas which are highly impacting the sustainable wood mobilisation: (a) Engaging forest owners and overcoming land tenure fragmentation, improved forest planning and risk management, adapted silvicultural measures for increased multifunctionality and biodiversity conservation; (b) Design and maintenance of infrastructures, optimized forest operations and logistics for improved economic and environmental performance; (c) Organisation and transparency of regional wood markets; new business models and market arrangements; (d) Access to finance and business support, including through EAFRD measures and PES (payment for environmental services) type mechanisms; legal and fiscal regimes; (e) Education, training and skills development.

By creating adapted materials and extensively sharing technological and non-technological innovations, best practice cases and RDI results, **ROSEWOOD4.0 multi-stakeholders approach** closes knowledge gaps and creates new opportunities for economic partnerships within the whole wood mobilisation value-chain. ROSEWOOD4.0 focuses on tailored (user- and region-specific) **transfer of know-how and information** that enables and supports **stakeholders of the wood value-chain to exploit innovations and best-practices** and facilitates the capture of innovative ideas enhancing the development of the field. ROSEWOOD4.0 aims also to provide practitioners with development skills (educational and entrepreneurial) and facilitate organisational innovations leading to **novel exploitation actions** leveraging the uptake of new ideas and Best Practices in daily business.

The roadmaps presented here address stakeholders throughout Europe for facilitating the transfer of knowledge and collaboration between partnership regions. The roadmaps represent the collection, the analysis and strategic direction of the results from the five Hub regions including their validation. The main objective of the roadmaps on Hub level is to strengthen the regions through transfer of the gathered knowledge, experiences and circumstances. With the accurate description and assessment of well-functioning best practices and innovations as inputs, there is an active support in strengthening the local wood value-chain development thanks to newly developed digital tools. Further, the roadmaps enhance cooperations by increasing interactions between stakeholders and regions for creating opportunities to initiate further and new developments. Relying on networks, it supports the self-initiative and empowers the forestry to push new actions. For this purpose, the roadmaps highlight best practices and innovations (BPI) that have the potential to serve as tools for prosperous and sustainable wood mobilisation among European regions. ROSEWOOD4.0 has initiated a web-portal for presenting the best practices and innovations to the wider public and stakeholders. This way, new solutions can be incorporated and the transfer of best practices monitored. The roadmaps give readers insights into regional perspectives of wood mobilization, capitalizing on information and cooperation possibilities between European regions. By steering the knowledge transfer between the regions, the roadmaps aim to provide a European perspective on digitalization issues in the forestry domain. In times of structural changes, a changing climate and new technologies, the ROSEWOOD4.0 Hubs can rely on a broad knowledge base from various countries for identifying suitable approaches for their regions. For this purpose, the roadmaps shall pave the road towards more collaboration between the regions, transfer of best practices and innovations meeting the needs of the regions. All this will further develop the ROSEWOOD4.0 network and strengthen the individual regions onto their path towards a sustainable wood mobilization and the transition to a bio-based economy in Europe.

2. Interregional Roadmap for the Central-West Hub

2.1 Description of the Central-West Hub region

The Central-West Hub (CWE Hub) is one of five ROSEWOOD4.0 Regional Wood Mobilization Hubs, which covers countries in Central West Europe, namely Austria, Belgium, France, Germany (North Rhine-Westphalia) and Switzerland.

The CWE Hub project partners are:

1. Holzcluster Steiermark GmbH (HCS), Austria,
2. InnovaWood (IW), Belgium,
3. Centre National de la Propriété Forestière (CNPF), France,
4. State Enterprise for Forestry and Timber North Rhine-Westphalia - Forest education and training center (FBZ), Germany

5. School of Agricultural, Forest and Food Sciences (HAFL), Bern University of Applied Science (BFH), Switzerland

The CWE Hub countries have a long tradition in sustainable forest management and forest regulations. Forestry has an important role in terms of socio-cultural and socio-economic developments in this region. There is a strong link between forestry and historical and cultural developments, as well as a strong dependence on living standards and ecological stability. This connection is still very prominent, which greatly influences public and political decision-making. Nevertheless, each region has different geological, geographical, and political circumstances, which are the basis for obtaining a clear picture of the current situation in the forest sector in the Central-West-Europe Hub.

Almost 48 % of ***Austria's*** national territory is covered with forest. The Provinces of Styria and Carinthia have the highest share of forest, with more than 60 % of the province area being forested in each case.

Over the past 10 years, the forest share has grown by an average of 3,400 hectares per year, which corresponds to an annual increase by 4,762 soccer fields. As a result, the total forest area has for the first time exceeded 4 million hectares.

The production value of forests along the entire value chain amounts to 12 billion euros. The average export surplus is 3.5 billion euros. A total of around 172,000 holdings are involved in this value creation, and 300,000 people earn an income from it.

82 % of Austrian Forests are privately owned by about 145,000 forest owners. This area covers a total of three million hectares of woodland. Private ownership in Austrian forests can be broken down as such: 50 % own less than 200 hectares (small scale forests), and 22 % own more than 200 hectares (big forest holders). 10 % of Austrian forests are owned by communities, for example agricultural co-ops. 18 % are state-owned. The Austrian federal forests (ÖBf) manage 15 % of the national forest area. [1]

Domestic forests constitute an essential pillar of climate protection: Forests and their soils sequester about 3.6 billion tons of CO_2 equivalents, which is about 40 times the annual emissions in Austria.

Climate change poses great challenges for domestic forests. For example, the year 2018 was marked by a strong bark beetle infestation. According to estimates, about 4 million cbm of wood were damaged, which is the highest damage ever recorded. The high pest pressure is mainly due to long periods of drought. Spruce stands are particularly affected. If possible, these must be felled quickly and removed from the forest.

Domestic forests play an important role in protecting against natural hazards, especially in the alpine region. 800,000 hectares of forest stands are considered protective forest and thus contribute to the protection of settlement areas. Within the framework of torrent and avalanche control, the Federal Ministry of Agriculture, Regions and Tourism (BMLRT) provides funds to ensure these functions of the forest, which are important for life and limb, in the best possible way.

Women play an important role in forestry: 30 % of the owners of small forests are female and 25 % of the forest area is owned by women. However, only 11 % of the forestry workers are women. [2]

One third of the ***French*** territory is forest, representing 16.5 million hectares of forested lands. Most of this forest is used for wood production, whereas 0.7 million hectares are protected and recreational forest. Historically, French forests have been dominated by broadleaved trees such as beech and oak, but nowadays coniferous trees (maritime pine, spruce, and Douglas fir) are more and more present, especially in plantations.

[1] Federal Forestry Agency, Facts and Figures - BFW-Waldzahlen | V9.12 (06/2021).
[2] Federal Forestry Agency, Facts and Figures - Waldinventur des BFW - Daten und Fakten (bmlrt.gv.at) (06/2021).

One feature of the forest in France is the important part of private forest (75 %) over public forest. In the region New Aquitaine, the proportion of privately owned forest reached 93 % in 2019, representing 21 % of the national private forest.

The New Aquitaine region, resulting from the fusion of Aquitaine, Limousin and Poitou-Charentes in 2016, is one of the first forest regions in France and hosts the largest man-made woodland of western Europe, the Landes of Gascony. The forest was planted to fight erosion of the land and plays a big part in the regional economy thanks to wood and paper industry. The standing volume of the New Aquitaine production forest amounts to 383 million m^3 (excluding poplar plantations). From forestry and logging to finished products and retail, the wood-forest sector plays an essential role in the local economy and job market: 28,300 establishments employ 56,300 people; 31,000 of whom work in the four main segments: forestry and logging, sawmill and wood processing, paper and board industry and carpentry work. The main threats for the forest of New Aquitaine are fire hazards, storms, and pests such as bark beetle and pine processionary.

The forest is very fragmented, firstly because of the urbanization of the landscape and the development of road networks, and secondly because of the small properties: on a national scale, 3 million private forest owners do have less than 4 hectares of forest, most of which comes from family heritage.

Forest income comes mostly from wood production, sawmills, and paper industry, but other activities and products linked to the forest are important such as hunting, mushroom and truffles, honey production and cork.

For North Rhine-Westphalia (NRW)in ***Germany,*** the NRW State Forest Report 2019 states that the forested area of 27 % is just below the national average. In absolute terms, NRW ranks fourth with 909,511 hectares, behind Bavaria (2.6 million hectares), Lower Saxony (1.2 million hectares), and Berlin/Brandenburg (1.13 million), meaning that approximately 8 % of Germany's forest area is in NRW. Forest ownership in Germany is basically rather small-structured. 55.8 % of forest owners manage an area of less than two hectares with a total area of 48,000 hectares. The proportion of privately-owned forest in NRW is the highest in Germany – here, almost two-thirds of the forests are privately owned, with around 40 % of these private forest areas being smaller than 20 hectares. Private forest owners with small areas can hardly manage their forests efficiently and therefore often join forces to form forest management associations.

The condition of forests in North Rhine-Westphalia continued to deteriorate in 2020. Although the proportion of trees without damage has increased from 19 % in 2019 to 23 % as of now, the proportion of trees with significant crown defoliation has increased from 42 to 44 %. This is the highest figure since the surveys began in 1984. This increase in severe crown damage is a clear indication of the worrying condition of the forest. The mean needle/leaf loss across all tree species shows a slight increase to 29 % in 2020 (28 % in the previous year) after strong increases in the previous two years. The third drought summer in a row and the massive infestation of bark beetles are hitting spruce particularly hard. By 2020, over 10 % of the spruce stand has died. According to a recent survey by the North Rhine-Westphalia State Forestry and Timber Agency, the amount of damaged spruce timber since 2018 is around 31.5 million m^3 (as of November 2020). The average long-term mortality rate for all tree species has risen from 0.21 % (2018) to 2.4 % (2019) and has nearly doubled in 2020 to 3.98 %.

Measures for resilient reforestation are financially supported by the state. The NRW "reforestation concept" envisions planting trees in groups, as a mixed forest with at least four different tree species that are more drought resistant. Digital location maps for forest owners provide information which tree is particularly suitable in which location.[3]

[3] Landesbetrieb Wald und Holz NRW (2019/2020): Landeswaldbericht NRW 2019; Waldzustandsbericht 2020, accessible online: https://www.wald-und-holz.nrw.de/wald-in-nrw/waldzustand (15.06.2021).

In North Rhine-Westphalia, the forestry and timber industry employ around 160,000 employees subject to social insurance contributions and 31,000 marginally employed persons. The forestry and wood industry cluster achieved a turnover of 39.49 billion euros (2014). With around 7 % of sales and 9 % of employees in the manufacturing sector, the forestry and wood industry cluster are a considerable economic factor in NRW.[4] But, according to the IAB research report "Skilled workers and unfilled jobs in an aging society" (13/2012) 34 % of farms in agriculture and forestry tend to have an older workforce. Many enterprises in the forestry sector anticipate problems in filling skilled labor positions that they cannot counteract with their own operational strategies.[5]

In Germany, women have worked in forestry for around 40 years, but they present only 9 % of the workforce in state forest administration – with significant local differences. In Eastern German states, the share tends to be higher. The share of women owning forests is increasing and expected to rise further in the next years.[6]

One third of ***Switzerland*** is covered with forest. This results in a total of around 1,28 million hectares. It is enclosed by about 11,000km of forest edge which are particularly biodiverse habitats and assume many important functions in connections with stand structures and its stability. Per inhabitant there are around 1,520m^2 of forest.

The area of forests is increasing annually by about 5,400 hectares in Switzerland, especially in mountain regions. The total stock of wood in Switzerland's forests is about 427 million m^3, deadwood is included in this number. Switzerland has by far the highest stocks per hectare Europe-wide which are around 375 m^3. Annually, 10 million m^3 of wood grows. In other words, 1 m^3 every 3 seconds. By this process around 2.5 million tons of carbon are sequestered, which corresponds to around 10 million tons of CO_2. In Switzerland 1 ton of CO_2 is traded at a price of 100 francs per ton. This means that the worth of CO_2 sequestration of Switzerland's forests is 1 billion swiss francs (910 million €, on the 24.03.2021).

Together with the shrub species, there are over 130 different native woody plants in Switzerland's forests. The most important tree species, especially in terms of economic importance, as in most European countries, with a share of about 77 % of the wood supply is Norway spruce. Conifers make up a good two-third of the total wood supply resulting in one third for the deciduous tree species.

There are around 250,000 forest owners throughout Switzerland. Of these, more than 244,000 are private and almost 3,500 are public forest owners. Around 30 % of the forest area belongs to private owners (natural persons or legal entities), 35 % to public-law organizations without fiscal sovereignty (civic communities, corporations), 30 % to municipalities and 5 % is owned by the Confederation and the cantons. Public forest owners own an average of 300 hectares and the private forest holders own an average of 1.3 hectares.

Switzerland's annual wood consumption, including imported wood, is around 11 million m^3. Without overexploiting the forest (sustainable wood production), Switzerland could harvest 7-8 million m^3 domestically. Currently, only about 4.5 million m^3 of wood worth approx. 380 million Swiss francs (344 million €) are harvested annually, about two-thirds is coniferous and one-third hardwood. About half of the harvested wood is sold as "trunk wood", about one third is "energy wood". The gross value added of the Swiss forestry and timber industry is 4.5 billion Swiss francs (4.07 billion €) per year. Switzerland has a well-developed

[4] Umwelt.nrw (2021): Die Holzwirtschaft im Branchen-Cluster Forst und Holz, accessible online: https://www.umwelt.nrw.de/naturschutz/wald/die-holzwirtschaft-im-branchen-cluster-forst-und-holz (15.06.2021).
[5] Bechmann, Sebastian et al. (2012): Fachkräfte und unbesetzte Stellen in einer alternden Gesellschaft. Problemlagen und betriebliche Reaktionen, in: IAB Forschungsbericht 13/2012, accessible online: http://doku.iab.de/forschungsbericht/2012/fb1312.pdf (15.06.2021).
[6] PRO Forstverein Wald (2018): Frauen im Forst: Nach wie vor die Ausnahme, in: proWald August 2018, accessible online: https://www.forstwirtschaft-in deutschland.de/fileadmin/content/pdf/Frauen-Beitraege.pdf (15.06.2021).

network of forest roads with about 30,500 km of forest roads. This simplifies the management and timber harvesting but is also a big cost factor in the Swiss forestry sector.

More than 700 forest enterprises manage certain forest districts: approx. 850 mobile/flexible forestry contractors support them in their work. In addition, thousands of private individuals (e.g. farmers) use and maintain their forest themselves. The forestry sector employs 6,200 people; around 7,500 are involved in raw wood processing (sawmills, etc.). The forestry sector and the entire timber industry, including carpenters, joineries, woodworkers, pulp, and paper industry provide almost 100,000 jobs. Despite many advances in the past decade with the aid of an increasing mechanization, working in the forest is still dangerous and indeed one of the most dangerous professions. Unfortunately, more than 1,500 occupational accidents (302 / 1,000 full-time positions) occur each year.

A good 40 % of the forest has a protective effect (e.g. against rockfall, avalanches, debris flows). That is about 6,000 km^2 of forest. Forest protects around 130,000 buildings and several thousand km of traffic routes. The protective effect of the forest has an economic value of approx. 4 billion Swiss francs (3.6 billion €) per year. Around 40 % of drinking water comes from the forest. More than half of all groundwater protection zones in Switzerland are in the forest. The natural water filtering effect of the forest saves about 80 million Swiss francs (72.4 million €) in treatment costs. The value of the forest as a recreational resource is estimated at 2-4 billion Swiss francs. More than 6 % of the Swiss forest area are reserves. About 25,000 plants, animals and fungi are dependent on the forest, i.e. around 40 % of the total biodiversity.

In our forest, around 150 million tons of carbon are stored (approx. 550 million tons CO_2).

A total of around 130 million Swiss francs (118 million €) is paid annually in federal contributions to forestry. Of this amount, 100 million Swiss francs (91 million €) is spent on protection services (protective forest management and protective structures). Forest biodiversity is currently being promoted with around 10 million Swiss francs (9.1 million €). Young forest maintenance is supported with about 12 million Swiss francs (10.8 million €). Another 11 million Swiss francs (10 million €) are used for areas such as research, climate change, etc.

By way of comparison: agriculture receives annual federal funding amounting to a good 3.5 billion Swiss francs (3.17 billion €). [7]

2.1.1 Political targets for Wood mobilization and Forestry

In ***Austria,*** The „Austrian forest strategy 2020“ is prepared in the framework of the Austrian forest dialogue — in cooperation with all stakeholders. The Forest Strategy is intended as an instrument to harmonize the multiple interests and demands made on Austrian forests and to find solutions to utilization conflicts. The Forest Strategy 2020 is to provide forest-political cornerstones to ensure and continuously optimize the sustainable management and maintenance of Austrian forests. The overall objective of the Strategy is to ensure and optimize the ecological, economic, and social dimensions of sustainable forest management in a well-balanced way. Special attention is paid to the added value and the potential of the Austrian forestry and timber sectors for a „livable Austria“. The Forest Strategy 2020 is to help ensure the multifunctional services rendered by forests for present and future generations.

For consistency with the Austrian Forest Report, the Austrian Forest Programme as well as national and international reporting obligations, the Strategy is structured along the following seven forest-political fields of action (in the present Forest Report referred to as „criteria“):

[7] WaldSchweiz (2021): Zahlen und Fakten, accessible online: https://www.waldschweiz.ch/schweizer-wald/wissen/schweizer-wald/zahlen-fakten/ (24.03.2021).

1. Contribution of Austrian forests to climate protection
2. Health and vitality of Austrian forests
3. Productivity and economic aspects of Austrian forests
4. Biodiversity in Austrian forests
5. Protective functions of Austrian forests
6. Social and economic aspects of Austrian forests
7. Austria's international responsibility for sustainable forest management.

The forest-based sector is very important in *France* as well as in the region New Aquitaine. Softwood lumber accounts for 50 % of the harvest, pulpwood, and energy wood for 39 % and 11 % respectively. New Aquitaine is France's leading surplus region in terms of external trade, with nearly 250 million € released in 2016. Primary transformation (sawmill industries, wood-based boards, and pulp) produced 11 million tons of goods in 2014. Secondary transformation produced more than 20 million tons of wood and paperboard products in 2014, 70 % of which goes to the paper industry.

The two main political axes for wood mobilization are 1) strengthening the competitiveness of the sector and 2) stimulating silviculture and sustainable forest management. Indeed, strengthening the competitiveness of the forestry sector is essential to enhance the value of local wood resources and create jobs in rural areas. This involves supporting companies in their positioning on new markets, stepping up research and innovation, and finally encouraging partnerships between stakeholders. Concerning sustainable forest management, the diversity of forest areas and species implies a diversity of silvicultural practices. Hardwood forests generally have little wood mobilization, while softwood forests are managed more intensively. The stimulation of silviculture in New Aquitaine's forests must include sustainable practices to tackle the challenges due to the multiple functions of the forest. Boosting sustainable management requires complementary actions, such as reinforcing present efforts and certification of sustainability, grouping forests, and updating the silvicultural techniques and education for forest owners.

These political targets of sustainability together with competitiveness are encouraged by the 2020 recovery plan ("France Relance") presented by the French ministry for agriculture and food. Thanks to this plan, financial support will be given to forest owners and operators who wish to invest and adapt their forest to climate change in the years 2021 and 2022. This concerns poor, unmanaged or vulnerable forest lands, and the requirements include for example that 20 % of the forest should be diversified for surfaces above 10 hectares. This shall help to reconnect private owners to their forest and empower themselves in the decision-making process. Initiatives have already started, such as the creation of a free service platform for private owners (LaForêtBouge).

Moreover, New Aquitaine contributes to mitigating climate change in additional ways. Plantation forests offer a resource and substitute for other more carbon-producing materials. and mixed hardwood forests are more likely to store carbon in the forest ecosystem. The adaptation of the forests of New Aquitaine to a new climate is a major concern, and another priority in forest policies is limiting the emissions of greenhouse gases, increasing carbon capture and storage.

Forestry policy in *Germany*, NRW, aims at striking a balance between the interests of owners, the recreational needs of almost 18 million inhabitants and the diverse functions of the forest.

The state forestry law guarantees free access to forests and thus ensures all citizens the important function of quiet recreation in near-natural ecosystems. Conflicts of use and objectives resulting from the multifunctionality of the forest must be addressed appropriately.

Forest policy to sustainably guarantee these multifunctional services and to develop recommendations for action that can be applied regionally and locally. In North Rhine-Westphalia with the highest proportion of private forests in Germany, this means taking into account the diverse ownership interests and the participation of the approximately 152,000 owners, and very different silvicultural conditions.

Conflicting goals between economic expectations, societal demands, and nature conservation requirements must be minimized or resolved e.g. by providing appropriate advice from experts, granting subsidies and/or compensation funds, but also by providing a clear legal framework. Expert management of the forest, whether by knowledgeable forest owners or by qualified foresters, ensures the proper and sustainable management of forests in the interests of property and society. Forest policy must also increasingly coordinate with other policy areas such as nature conservation policy, species, and soil protection law, or planning law.

Protecting the diverse functions of the forest is a legal mandate. Based on a nationwide guideline, the protective and recreational functions of the North-Rhine-Westphalian forest were updated and made digitally available in 2019.[8]

With the Forest Policy 2020, the **Swiss Confederation** creates favorable framework conditions so that the forest can fulfil its diverse functions for society, the economy, ecology, and climate. It thus lays the foundations for sustainable, efficient, and innovative forest management.

The Forest Policy 2020 sets out eleven goals:

1. The potential of sustainably usable wood is exploited.
2. The forest and wood use contributes to climate change mitigation and the impact of climate change on forest service's remains minimal.
3. The protective forest service is ensured.
4. Biodiversity is maintained and specifically improved.
5. The forest area is maintained.
6. The economic performance of forestry is improved.
7. Forest soils, drinking water and tree vitality are not endangered.
8. The forest is protected from harmful organisms.
9. The balance between forest and game is guaranteed.
10. Leisure and recreational use are spared.
11. Education, research and knowledge transfer are ensured.

To achieve these goals, the Confederation, together with the cantons and other actors, drew up a plan of measures in 2012. While the implementation of most of the measures could begin immediately, legal adjustments were required for some points.

The action plan provides for two implementation stages. While the second stage will last until 2019, the first stage ended in 2015. A report by ETH Zurich and **the Swiss Federal Institute of Agricultural, Forest and Food Sciences (HAFL)** shows the interim status of the implementation of measures by the Confederation, cantons and other central actors and measures the achievement of objectives.

The interim report finds that the implementation of the Forest Policy 2020 is on track for most of the goals. The study identifies a need to catch up in the exploitation of wood utilization potential, in the economic efficiency of forest management, in forest health (forest soil, groundwater and tree vitality), in the balance

[8] Umwelt.nrw (2021): Forstpolitik, accessible online: https://www.umwelt.nrw.de/naturschutz/wald/forstpolitik inisterium NRW: Forstpolitik (15.06.2021).

between forest and game, and in recreational and leisure use. In contrast, the most significant progress has been made in the protection forest and in biodiversity.

The FOEN sees the interim report as confirmation of the direction it has taken, and in the second implementation stage up to 2019 it will focus on the objectives with a backlog. The cantons, forest owners, managers, forest experts and associations also can take stock and adjust their commitment.

The implementation of the Forest Policy 2020 made it necessary to amend the Forest Act in individual points. The amendments entered into force on 1.1.2017 together with the corresponding amendments to the Forest Ordinance. This will make it easier in the future to protect the forest from harmful organisms, to adapt it to climate change and to promote the use of wood.

The experience with the implementation of the Forest Policy 2020 is good and the interim report on the first stage, which lasted until 2015, gives the process a good report card. Based on the overarching strategic foundations, there are no indications for a fundamental change of course after 2020. From a technical point of view, too, there is only a need for selective adjustments (particularly regarding the indicators and individual measures). The Federal Department of the Environment, Transport, Energy and Communications (DETEC) has therefore decided to continue the objectives and thrusts of the current forest policy beyond 2020. The adjustments to the action plan for the period from 2021 onwards will be closely coordinated primarily with the cantons as central partners of the Confederation.[9]

The vision of the Forest Policy 2020 gets concretized with the vision of the Wood Resource Policy 2017-2020 and its four political goals. An efficient Swiss forestry sector sustainably exploits the wood utilization potential of the Swiss forest. The demand for material wood products is increasing in Switzerland, especially for wood from Swiss forests. Energy wood is harvested sustainably and utilized efficiently and in an environmentally friendly manner. The innovative strength of the forest and wood value chain is increasing.[10]

The Wood Action Plan is the most important instrument for the targeted implementation of the Wood Resource Policy. It has three main topics. The FOEN can support projects on these focal points. One example is WOODVETIA – the campaign which encourages consumers to choose Swiss wood. The Wood Action Plan was launched in 2009 and supports projects that deal with the raw material wood and its utilization. The fourth phase of the Wood Action Plan is currently running from 2021 to 2026, with around 4 million Swiss francs (3.6 million €) available annually for projects.

The Wood Action Plan promotes innovative projects that strengthen and develop the use of Swiss wood (Art 34a and 34b Forest Act). On the one hand by means of applied research and development, on the other hand by means of communication. It responds to current challenges such as the increased occurrence of damaged wood due to storms, drought, and beetle infestation by focusing on new utilization and application areas such as wood-based bioproduct plants.

A monitoring committee of the FOEN steers and manages the Wood Action Plan. A monitoring committee with representatives from the forestry, timber and wood energy industries, other federal agencies, the cantons,

[9] Bundesamt für Umwelt (2018): Waldpolitik 2020, accessible online: https://www.bafu.admin.ch/bafu/de/home/themen/wald/fachinformationen/strategien-und-massnahmen-des-bundes/waldpolitik-2020.html (15.06.2021).
[10] Ibid.: Ressourcenpolitik Holz, accessible online: https://www.bafu.admin.ch/bafu/de/home/themen/wald/fachinformationen/strategien-und-massnahmen-des-bundes/ressourcenpolitik-holz.html (25.03.2021).

nature conservation and environmental protection, the real estate sector and communications advises on strategic issues. A technical expert committee provides support in the assessment of project applications.[11]

Forest programme agreements: With the "restructuring of financial equalization and the division of tasks between the Confederation and the cantons (NFA)", subsidies are generally handled on a performance-oriented basis within the framework of four-year programme agreements.

As of 1.1.2008, the FOEN concluded programme agreements with the cantons for the first time with the corresponding performance and quality indicators. In the forest sector, the Protection Forest, Biodiversity in Forests and Forest Management programmes will be combined into a "Forest" programme agreement from 2020. The period of the agreements from 2020 will exceptionally last five years, from 2020 to 2024.[12]

Since 2008, programme agreements have been the central instrument for the partnership-based implementation of environmental policy between the Confederation and the cantons. For this purpose, the Confederation and the cantons agree every four years on which services a canton will provide to contribute to the Confederation's strategic objectives. At the same time, the Confederation undertakes actions to support the cantons financially. The actual programme agreements define the services to be provided by the canton, the financial contribution, and the modalities for annual reporting, among other things. The "Manual on Programme Agreements in the Environmental Sector" is based on the subsidy and environmental laws and ordinances and brings together in one document the legal, procedural, and technical bases of the programme agreements. It explains the Federal Office for the Environment's (FOEN) guidelines regarding the application, negotiation, conclusion, and implementation of programme agreements. It is divided into a procedural part (Part 1) and a technical part (Parts 2-8).[13]

The previous programmes "Protection Forest", "Forest Biodiversity" and "Forest Management" are now combined in a new "Forest" programme agreement. This programme agreement corresponds with the canton's desire for more flexibility in the use of funds and an optimization of the interfaces between the cantons and the Confederation. At the technical level, the previous programmes will not undergo any significant changes. The annual reporting by the cantons is to remain the same in terms of content but will be carried out per canton in a joint document for all three programmes.[14]

2.1.2 Structures of Decision Making

To steer, promote, develop, and verify sustainable forest management, several institutions and organizations with specific goals and tasks are active in ***Austria***. Basically, they must fulfil three functions: Creating laws and shaping policy; Supporting and supervising compliance with law; Generating and passing on knowledge (research, development, training and further training, advisory services, information).

Legislation and policy development are the responsibility of the Federal Government and the Provincial Governments, the National Assembly and the Provincial Parliaments, the representations of interest and NGOs. The federal and provincial forest authorities are responsible for the execution of the laws.

[11] Bundesamt für Umwelt (2021): Aktionsplan Holz, accessible online: https://www.bafu.admin.ch/bafu/de/home/themen/wald/fachinformationen/strategien-und-massnahmen-des-bundes/aktionsplan-holz.html (25.03.2021).
[12] Bundesamt für Umwelt (2019): Programmvereinbarungen Wald, accessible online: https://www.bafu.admin.ch/bafu/de/home/themen/wald/fachinformationen/strategien-und-massnahmen-des-bundes/programmvereinbarungen-wald.html (24.03.2021).
[13] Bundesamt für Umwelt (2018): Handbuch Programmvereinbarungen im Umweltbereich 2020-2024.
[14] Ibid.

Research and education institutions from university to the skilled-workers level, Statistics Austria and many more complete the picture. Their effectiveness depends on well-defined objectives as well as on the availability of sufficient technical equipment, funds, and staff. [15]

Decisions concerning forest in *France* are made both at national and regional levels. On a national level, the Ministry for agriculture and food issues laws and regulations to govern forest policy, both in public and private sectors. The four main goals are:

- Create value in France by mobilizing the resource in a sustainable way
- Meet citizens' expectations and integrate them into territorial projects
- Combine forest mitigation and adaptation to climate change
- Develop synergies between forest and industry

Examples of these directions can be found in the 2014 National Forest and Wood Programme, or more recently in the 2020 Recovery Plan.
A significant proportion of national measures are divided into regional strategies to adapt to specific territorial characteristics, but also to resonate with the competences of local authorities, and regional councils. Each region must develop a Regional Forest and Wood Programme, which serves as a framework for ensuring consistency between all other regional documents. Decisions at regional scales are made together between forest institutions (such as CRPF) and local authorities.

In the federal system present in *Germany*, laws are made on a central level (Bundeswaldgesetz), while administration, regulation, law enforcement and funding policies are within the responsibility of the states.

Switzerland is a federalist state: the power is divided between the Confederation, the cantons, and the communes. The cantons and municipalities have great leeway to fulfil their tasks. Federalism makes it possible for Switzerland to exist as a single entity – despite unity – despite four linguistic cultures and different regional peculiarities.

The Confederation, the 26 cantons and around 2212 municipalities share the power. Cantons and municipalities have extensive competences and a high degree of autonomy. The Confederation only takes on tasks that the cantons and municipalities cannot perform themselves. Each canton has its own constitution, parliament, government, and courts. Of the municipalities, about one fifth have their own parliament, especially the cities.[16]

In the context of Swiss forestry, this means that the Confederation is creating favorable framework conditions with the Forest Policy 2020. With suitable concepts for the implementation, the cantons ensure that the goals set are achieved and can set the accents that are important in their point of view. This ensures that, on the one hand, the cantons can also pursue their own interests and that local conditions are considered during the implementation process. Finally, the communes support the cantons in the concrete implementation on the ground with their knowledge and competences.

[15] Republic of Austria, Federal Ministry of Agriculture, Forestry, Environment and Water Management (2015): Sustainable Forest Management in Austria, Austrian Forest Report 2015.
[16] Bundeskanzlei (2021): Der Bund kurz erklärt, accessible online: file:///C:/Users/jf01/Downloads/DE_BUKU_2021_Einzelseiten.pdf (25.03.2021).

2.1.3 Main actors in forestry in the Central-West Hub

The main actors in the forestry sector in partnership countries of the CWE Hub are the following:

Forestry companies

Austria	Austrian State Forest (ÖBF), Municipality of Vienna, monasteries, former aristocratic families, and families of industrials
France	Forestry contractors, cooperatives, and experts
Germany	Forst-Info Andreas Gohrbandt Waldkontor GmbH Rupert Pichler Forst Service Zitterbart Forstbetrieb B. Beyer GmbH Forstunternehmen Hubert Rüttgers
Switzerland	Forestry contractors Switzerland, Swiss Forestry Contractors, cooperatives, Domat-EMS, Schilliger, Tschopp

Forestry Associations: services for forest owners

Austria	Austrian Forest Owners' Cooperative and eight regional associations
France	CNPF (National Forest Ownership Center), CRPF (local branch of CNPF) French Ministry for agriculture and food
Germany	Waldbauernverband NRW
Switzerland	Association of Forest Owners in Switzerland (Waldschweiz), Bernese Forest Owners Association (BWB), 22 cantonal forestry associations Forestry Associations of Eastern Switzerland, Swiss Forestry Contractors Association (FUS), Association of Swiss Forestry Personnel (VSF), Association of Bernese Foresters and Forest Workers

State Forest Enterprise

Austria	Österreichische Bundesforste AG
France	ONF (National Forestry Office) DRAAF (Regional Directorate of Food, Agriculture and Forestry) DDT (Departmental Directorates of the Territories)
Germany	Landesbetrieb Wald und Holz NRW
Switzerland	State forestry enterprise (canton Berne, canton Zug, canton Lucerne, canton Aargau, Sense (canton Freiburg))

Supervisor of the Forest Act, education of forestry professionals, forestry development

Austria	Forest Chapter of the Chamber of Agriculture (one per province, one on national level)
France	IGN (National Institute for Geographical and forest information) FNB (National Wood Federation)

	FIBOIS (Interprofessional Association for Forest, Wood, Paper)
Germany	Landesbetrieb Wald und Holz NRW
Switzerland	Federal office for the environment (FOEN)

Forest Research Centre	
Austria	Bundesforschungszentrum für Wald (BFW) University of Natural Resources and Life Sciences in Vienna
France	INRAE (National Research Institute for Agriculture, Food and Environment)
Germany	Forstliches Bildungszentrum NRW Universities in Göttingen (Lower Saxony), Weihenstephan, Munich (Bavaria) and Erfurt (Thuringia)
Switzerland	Swiss Federal Institute of Agricultural, Forest and Food Sciences (HAFL), Swiss Federal Institute of Technology Zurich (ETHZ), Swiss Federal Institute for Forest, Snow and Landscape (WSL)

Educational Institutes	
Austria	University of Natural Resources and Life Sciences in Vienna Forestry school Bruck an der Mur Forest training centers in Gmunden, Ossiach, Rotholz, Pichl
France	AgroParisTech, Lorraine university
Germany	Forstliches Bildungszentrum NRW Universities with a BA in forest-related subjects in Göttingen (Lower Saxony), Weihenstephan, Munich (Bavaria) and Erfurt (Thuringia)
Switzerland	Swiss Federal Institute of Agricultural, Forest and Food Sciences (HAFL), Swiss Federal Institute of Technology Zurich (ETHZ), Swiss Federal Institute for Forest, Snow and Landscape (WSL), Forest Education Centre Lyss, Forest Education Centre Maienfeld

Table 1: Main actors in the forestry sector in the Central-West Hub countries.

2.2 Main findings

2.2.1 SWOT Analysis

The Central-West Hub regions were first analyzed by SWOT analyses on national respectively province level. The project partners and experts have then discussed the findings and merged it into one common SWOT for the Central-West Hub (Table 2).

Strengths	Weaknesses
• Sufficient forest resources are available and sustainably managed • High degree of forest utilization • Professional forest owner associations play an important role in supporting small-scale forest owners by providing a broad range of services and up-to-date information e.g. advisory and extension services, access to forest service providers, contracting services, access to timber market, market information, increased market power, etc.) • Forest certification schemes are in place • High safety standards in forestry • Skilled and experienced forest staff, forest service providers and forest machine operators • Dense forest road network with digitally available forest road maps Various digital logistic platforms are available and in use • Highly mechanized and partially automatized softwood sawmilling industry • Consolidated (softwood) sawmilling sector: production is split either into large units or small specialized sawmills. This consolidation process is mirrored by a sharp decrease in the number of sawmills. Switzerland: partially agree • Excellent production know-how with focus on high quality Switzerland: leading in technical and innovative know-how on timber construction (engineering) • High awareness of resource and energy efficiency on company level • Access to R&D units, cluster organization and innovation support agencies dedicated to forestry and wood working industry • Professional vocational and education system for forestry and wood working industry exists	• Low interest in collective forest management / joint forest operations • High share of elderly forest owners • Conflict between forest owners and the general public regarding the extent of forest management (timber production) Non-wood benefits e.g. environmental and recreational services, biodiversity, protection function, etc. gain higher significance in the general public • Lack of advanced digital solutions for real time forest monitoring lack of use cases for artificial intelligence (AI) lack of comprehensive decision support systems (DSS) for forest owners / FOAs • Forest service providers face an aging workforce and do not attract young employees Switzerland: new recruitments are possible, main problem is to keep forest workers in their jobs in the long term (high fluctuation of workforce) • Digitalization / automatic data exchange across companies and actors in the supply chain still not common • Level of digitalization within enterprises lower than in other industrial sectors • High-cost pressure and competition between transport companies leads to opportunistic behaviour • Industry 4.0 only partly applied • Working conditions are not very attractive Switzerland: disagree • Competitiveness of the sawmilling sector lags behind foreign companies (except AT): Switzerland: Yes, due to high wages, small processing volumes, little storage quantities, high prices, and very strong competition from AT and GER Germany: Regionally diversified sector lacking a joint representation of interests, tendency towards overcapacity. Austria: is among the top sawmilling countries (softwood only) • Timber construction still not legally equal to other construction material • Lack of concepts for product lifecycles • Social mistrust against wood harvesting, conflict between nature protection and managed forests

Opportunities	Threats
• Comprehensive digital decision support systems and tools for forest owners / forest owner associations • Attracting skilled workers / young employees through modernisation of job profiles and digitalisation • Forest owner association (FOA) gain importance and significance in terms of digital transformation, forest owner management and wood mobilization e.g.: -) FOAs as a major facilitator for the digitalization of the wood value chain -) FOAs providing comprehensive information and advisory services to small-scale forest owners. -) FOAs as middlemen in the timber trading business • FOAs as a tool for small-scale forest owners to avoid price disadvantages on the timber market / to guarantee a stable raw material supply to downstream industries • Public and political support of regional value chains and value-added products with a low environmental footprint • Further development of data exchange standards and data interfaces covering all aspects of the wood supply chain • Efficiency gains within enterprises and in the supply chain through the use of digital solutions and cooperative platforms • Further product diversification and new value-added products • New business models and applications in the context of Bioeconomy/Circular economy • Wood hybrid products (softwood + hardwood) e.g. for the construction sector • Implementation of industry 4.0 to increase efficiency and reduce costs • Emerging/growing markets for timber constructions: -) Urban construction market -) Public building sector -) Multistory buildings -) international markets • Increasing demand for CO_2-neutral products /production systems • Eco design concepts for wood buildings enabling the reuse of timber elements after the end-of life of buildings	• Climate change: -) increasing abiotic and biotic risks and damages -) higher economic risk due to calamities and dieback of forest stands -) higher forest management costs / decreasing profitability • Ongoing trend for urbanization: -) increasing public pressure in favor of forest protection / preservation -) higher share of new types of forest owners -) decreasing interest in forest management • Low willingness / capability to invest in new technologies or major digital innovations due to high-cost pressure • Shortage of skilled workers which is further severed by an aging work force • Poor to no broadband network availability in forests hinders consistent digitalisation resp. near real-time communication • Competition instead of cooperation between freight carriers have a negative impact on the overall transaction cost • Very high dependency of the softwood sawmilling sector on a single tree species Austria: Norway spruce (Picea abies) • Highly competitive international players • Lack of strong lobbying on European level may lead to unrealistic / detrimental regulations on the reuse/recycling of wood waste • Preference for/Persistence on the energetic use of wood residues in the forest-based industries may conflict with upcoming European and national environmental and climate protection policies • Persistant lack of public understanding on the economic significance of forests • Phase out of the woodworking sector from the regional/national innovation strategy due to its low (reported) R&D share • Sector cannot attract young talents and potentials

Table 2: Central-West Hub Joint SWOT.

Regarding the strengths, the CWE Hub regions have sufficient available certified resources which are operated under sustainable management systems. The high-quality infrastructure of the forest sector is a powerful

strength of the region with its highly functional supply chain. Moreover, the Central-West Hub holds excellent knowledge of forest management and a well-developed round-wood market, which is an opportunity for the future development of the forestry sector. Well-trained professionals manage forests of any type of ownership professionally and sustainably. In terms of weaknesses, the fragmented ownership with many private, small-scale forestry owners, leaves some of the potentials of the forests unused. Implementation of collective forest management is still not recognized as an opportunity. This can further be detected by the lack of communication between the different sectors of the chain of custody. Except for Switzerland the working conditions are considered not to be very attractive in comparison to other industries.

The CWE Hub is a region with high prices and high wages. To keep this in balance, it is necessary to maintain high productivity and excellent product quality by exploiting state-of-the-art technologies and production concepts. The high concentration in the sawmill and pulp industry results in diminishing profit margins for small forest owner, which leads to an increasing demotivation to participate in the round wood market.
The declining interest in an active forest management is further reinforced by an increasing share of urbanized forest owners disconnected from their forests, on-going public debates on forest conservation, the social demand for close-to-nature forestry, mistrust in established forest advisory and extension services, and a decreasing knowledge on forest practices and management. Therefore, the Central-West Hub faces weaknesses in societal matters like communication outside the sector, lack of public interest, and knowledge transfer.

In the CWE Hub digitalization of harvesting and management services was identified as an opportunity to raise productivity. Education and communication to sensitize the wider public and urbanized forest owners is another opportunity. Especially urbanized forest owners without direct spatial or vocational affiliation to their forests might be reached to raise a sustainable mobilization of roundwood by managing their stands. Development of new value-added product offers opportunities to forest industry by developing new business models in the context of circular economy.

Climate change and the ongoing trend for urbanization are the main threats for the forest sector in the CWE Hub regions. Unmanaged forest stands with a high stock are increasingly vulnerable to calamities e.g. storms, snow break, bark beetles etc. The consequences of climate change and thus the threats are difficult to estimate for the forest vitality and stability. Forecasts of climate change impacts show major impairments for forests, which might lead to losses in forest productivity and biodiversity. This threat is severed due to the focus on spruce as the main tree species for the wood processing industry in Central Europe.

2.2.2 Hub's Best Practices and Innovations Identification

Screening of best practices and innovations (BPI) in the CWE Hub has been carried out through desktop research supported by expert interviews and stakeholder workshops. The total number of selected BPI in the CWE Hub is 96, of which 27 were selected in Austria, 41 in Germany, 17 in Switzerland and 11 in France. Thanks to these figures, it can be concluded that the CWE Hub is rich in best practices, innovations and research projects related to the topic of wood mobilization in forests.

Innovative projects like **iWald, Komsilva** or **HolzMobRegio** are designed to activate and to support new type of forest owners – and are especially targeting urbanized forest owners without deep background knowledge in forestry and forest management. One of the main goals of these BPI is also to improve the direct communication and exchange of information between forest owners, forest owner associations, forest advisory services and forest service providers.

In the CWE Hub, a wide range of ready-to-use forest management Apps like **LogBuch, Moti, Festmeter** are of high relevance. They are programmed to easily collect single tree and forest stand data, make forecasts, or run management simulations as well as giving management advice. Moreover, these apps are designed to

edit, evaluate and share gathered data with other users (e.g. potential service companies, public authorities, forest owner associations) as well as to ease up forest procedures.

Awareness raising and information portals are also areas with good examples. BPI like **Woodpassage, Infoholz** or **Holzbaucharta** are representative BPI of regional and international actions to raise the awareness of the public for wooden buildings, to promote the regional wood value chain and make its economic, social and environmental impact visible to the public.

Communication campaigns addressing the importance of silvicultural care along with practical trainings for passive, small-scale forest owners e.g. **wald-wird-mobil.de**, were identified as one of the major pulls in the region to boost the rate of sustainably harvested wood.

Selection of the most promising BPI from CWE Hub		
Country	*BPI Title*	*Description*
Germany		
DE	KWH4.0	Center of Excellence Forest and Timber 4.0
AT		Application of drones for seedling transport in steep terrains
CH	SiWaWA 2.0	Forest growth simulation model
CH	Moti.ch	Mobile Timber Cruise - Smartphone tool for forest inventory
FR		The forest moves
AT		HolzmobRegio
Switzerland		
DE	GEODAT	Geographic data standard for wood logistics
DE	Virtueller Wald	Virtual Forest
DE	Wald-wird-	Forest becomes mobile initiative
CH	Wegemesslanze	Innovation on forest road quality assessment
CH	Kollegenschutz	Innovation for increased work safety in forest operations
France		
DE	Wald-wird-	Forest becomes mobile initiative
CH	HeProMo	Productivity models for harvesting processes
AT	-	HolzmobRegio
DE	TREEO	Free app for smallholder farmers in developing countries
DE	ForestManager	Forest administration app
AT	-	Forest-IMate
DE	Forstify	App for timber trading
DE	iWald	Comparison of silvicultural concepts by simulation of growth
AT	-	Biomass trading centres calculation tool
CH	Moti.ch	Mobile Timber Cruise - Smartphone tool for forest inventory

Austria		
FR	NEOSYLVAQ	Project NEOSYLVAQ
DE	KWH4.0	Center of Excellence Forest and Timber 4.0
DE	iWald	Comparison of silvicultural concepts by simulation of growth
DE	WASP	WaspWoodlogistics

Table 3: Selection of the most promising BPI from CWE Hub.

Selection of the most promising BPI from other Hubs		
Germany		
Country	*BPI Title*	*Description*
FI	Virtuaalimetsä	Virtual Forest 2.0 Innovation
FI	LogForce	LogForce
FI	Biomassa-atlas	Biomass atlas
EU	Forwarder2020	Smart Forwarder for sustainable and efficient forest operation and
SI	MojGozdar	MyForester - Quality assessment of forestry contractors
Switzerland		
ES	E-MONTE	Timber trade platform
SE	HiVision	Digitalized truck crane
ES	ChainWood	Blockchain for Immutable Timber
IR	Forest HQ	Central platform to help improve operational performance and
FI		Open Source Wood Initiative
Austria		
IE	Forest HQ	Central platform to help improve operational performance and
FI	-	Online network for machinery transfer
FI	-	Metsäverkko
FI	Industry4.0	Open Source Wood Initiative
SE	-	What Wood You Do?
EU	-	Biobord.eu
NO		School of forestry
NO		The Forestry Extension Institute
NO		Use of drones in vocational education
SE	Industry4.0	Digital sawmill
NO		Ydalir district

SE		Lindbäcks Bygg
DE	KWH4.0	Center of Excellence Forest and Timber 4.0

Table 4: Selection of the most promising BPI from other Hubs.

2.2.3 Needs analysis

Finding **responses to climate changes** and their negative impact on the forestry sector is one of the challenges facing the forestry sector in the CWE Hub. Forest management, products and productivity are closely linked with and dependent on climatic conditions. Climate change calls for adaptive forest management. The uncertainty of the extent of climate change and the responses of local forest stands, and the limits of interpretations of climate-change experiments leave forest managers with a wide range of practical options, but few clear-cut recommendations for management decisions. Whereas forestry professionals are familiar and comfortable with decision-making within wide margins of evidence, lay-persons may be overwhelmed by the lack of guidance. The increasing number of non-expert forest owners of small forest properties finds itself in an unexpectedly difficult situation when making decisions on forest management with long-term implications.

Urbanization and globalization are one of the biggest challenges facing the CWE Hub region. The significant number of **private forest owners** live in urban areas, sometimes at a considerable distance from their property. The move of owners from rural to urban areas continues or is even speeding up.

The knowledge held by new urban small-scale forest owners about forestry and its benefits is often at a low level. Informing them about the multiple benefits of sustainable forest management and increased wood mobilization is crucial. These groups of forest owners can often not be reached by forest administrations with their traditional programs for counselling or encouragement. In addition, the forest management goals of these type of forest owners are diverse, and many owners do not act in a market-driven way. Therefore, the cooperation of authorities, associations, and forest owners should be intensified relying on modern communication and digitalization. Customized approaches are needed to motivate each owner.

In almost all CWE Hub countries, except in Switzerland, there is an evident **need for skilled workforce**. Forest contractors find it difficult to reach the workforce and to retain the existing workforce. The trained workforce often leaves the job in the forest sector due to better conditions in other sectors. In most countries, forest-related jobs need to be modernized and digitized to attract young labor, but also to prevent the outflow of existing labor. By using new technologies and more progressive marketing, it would be possible to make such jobs more attractive to women as a new target group.

2.3 Development targets for sustainable wood mobilization

Based on the SWOT analysis and selected BPI at the local and Hub level, the following main conclusions can be reached:

- In the CWE Hub, softwood products are dominating in construction and chemical use. A large share of softwood stands is owned by small-scale private forest holders. To develop and support sustainable wood mobilization in these forests, it is necessary to utilize digital tools and platforms to reach out to private forest owners (communication), to provide them with near-real time information on their forests, to provide instant and customer-tailored advisory and extension services, and to link them to the round wood market.
- Another important aspect is to strengthen intermediary organizations like forest owner associations to enable small scale forest owners to adapt their forest to climate change effects, to maintain the

multi-faceted societal functions of the eco-system forest in Europe, and to strengthen their position on the round wood market.

2.4 Presentation of the interregional roadmap

Selected examples of best practices and innovations from other Hubs but also from the CWE Hub were presented to the local stakeholders and experts within two validation workshops. Prioritization of BPI was done according to the selection of main threats and main weaknesses identified within the CWE SWOT and following these criteria: technological impact, economic impact, ecological impact, social impact, mobilization impact, replicability, and priority.

Main Threats CWE Hub			
Threats	*BPI Country*	*BPI Title*	*Selected by*
Climate change • increasing abiotic and biotic risks and damages • higher economic risk due to calamities and dieback of forest stands • higher forest management costs / decreasing profitability	GER GER FI FI GER GER NO SE	DroneMapper Virtual Forest Climate Smart Forestry Ground laser measurement -innovation Waldinfo NRW iWald Afforestation as a climate mitigation action Bark beetle risk map	AT AT AT/GER AT CH AT GER AT
Low willingness / capability to invest in new technologies or major digital innovations due to high-cost pressure	GER FI FI AT GER GER NO	Wood logistics company co-owned by forest owner associations WoodForce LogForce FelixForst Smart Forest Worker KWH4.0 WASP Forestry value creation fund	AT AT AT AT CH AT GER
Shortage of skilled workers which is further severed by an aging work force	DE FR NO SE	AVATAR Harvester simulator Choose Forest HiVision	CH FR GER AT
Competition instead of cooperation between freight carriers have a negative impact on the overall transaction costs	FI FR FR	Digitally Connected Forest Operation Value Chain- Innovation FORLOG Foretdata	GER CH FR/GER
Persistent lack of public understanding on the economic significance of forests	FR CH AT AT	La forêt bouge Woodvetia Woodpassage wooddays	AT CH GER GER

	FR NO NO NO	Je me forme pour mes bois Choose Forest Women in Forestry Think Tree	FR AT AT AT

Table 5: BPIs matched with main threats.

Main Weaknesses CWE Hub			
Weaknesses	*BPI Country*	*BPI Title*	*Selected by*
Conflict between forest owners and the general public regarding the extent of forest management (timber production)	GER AT FR NO FR FR	TREEO APP ins Holz FORETDATA ALLMA Je me forme pour mes bois Climafor	AT GER AT CH FR FR
Lack of advanced digital solutions for real time forest monitoring lack of use cases for artificial intelligence (AI) lack of comprehensive decision support systems (DSS) for forest owners / FOAs	CH CH DE FI FI FI FR AT NO SE FI SE DE DE CH DE DE SE FR IR	SiWaWA 2.0 Moti.ch Virtueller Wald Virtuaalimetsä 2.0 Kuutio.fi Wuudis The forest moves Festmeter ALLMA Arboair Trestima HiVision iWald ForestManager Road condition monitoring LogBuch AJA KATAM™ Forest STERES Forest HQ	AT AT/GER AT GER AT AT AT AT AT AT AT AT AT AT AT AT GER CH AT FR AT
Digitalization / automatic data exchange across companies and actors in the supply chain still not common	EU FI FR FR AT CH PT	Flexwood LogForce Forlog Foretdata FHPDat F2020 Forscope	CH AT/GER FR FR GER AT CH

Timber construction still not legally equal to other construction materials	FI NO AT AT CH	Open Source Wood Initiative Ydalir district dataholz wooddays Lignum	GER AT/GER GER/CH GER GER
Social mistrust against wood harvesting, conflict between nature protection and managed forests	FR CH AT AT FR NO	La forêt bouge Woodvetia KLAR Woodpassage Je me forme pour mes bois Think Tree	FR CH GER CH FR AT

Table 6: BPIs matched with main weaknesses.

1. One of main threats in all CWE Hub regions is **climate change**. Forests and forest management systems need to adapt to these changes and must be able to meet a multitude of challenges. Although the CWE region has a very developed forestry sector and has managed forests in a sustainable way for centuries, it is evident that **advanced digital real-time forest monitoring solutions are not being used at full capacity**. One of the main reasons for this low willingness to invest in new technologies or large digital innovations is a lack of knowledge on digital solutions, the challenging integration of new solutions into the existing company infrastructure, lack of digital competence at all company levels, fear of too much transparency, and uncertainty on the total benefit of digitalization. Related to this topic numerous best practices from CWE hub but also from other hubs are available:

    - Virtuaalimetsä 2.0 – FI
      Virtual Forest 2.0 Innovation is a research and development project, which develops an innovation tool that enables efficient visualization of forest resource and spatial data in 3D. Virtual forest is an application, which can be used in the participatory planning of land use, guidance of forest owners and for combining interests of different stakeholder groups concerning the utilization of natural resources and areas. Virtual forest 2.0 project also aims to enhance the quality of visualization by developing new data to enable more precise visualization. The project aims to enhance the use of visualization e.g. in the forest bioeconomy sector.

    - Drones in the service of forestry – CH
      With their prompt, cost-effective and yet very precise terrain and inventory data, drones offer the possibility of digitally recording the dynamic processes in the forest and thus enable the precise planning of timber harvesting, rejuvenation, or other interventions. Single tree detection software uses drone data as the basis for estimating important tree parameters (tree position, height, and diameter). This research project investigates how the workflow with drone data can be optimized and how single tree detection software can be used to increase the efficiency of forest management. The innovative and creative aspect of this project is to create a digital twin of the forest. This twin provides all important tree parameters for the researchers to model the forest, make estimations of interventions, plan and make predictions.

    - Virtual Forest – DE
      In order to support the competitiveness on the worldwide market – but also to overcome efficiency problems related to the forest owner structure in North Rhine-Westphalia (NRW), Germany – the "Virtual Forest" is being developed as an intelligent planning and decision support

tool for forest growth as well as for wood mobilization. In practice, the heart of the Virtual Forest consists of a database of approx. 240 million single trees in NRW, its major wood resource. To identify the trees, latest aerial survey and satellite technology is used and combined with virtual reality and robotics know-how to efficiently gather and visualize the data. Thus, the Virtual Forest serves as a reliable and very up-to-date base and framework for new efficient forest planning, wood mobilization and machine logistics methods.

2. One of the weaknesses of the CWE region is that **digital data exchange between companies and actors in the supply chain is still not common**, which of course affects the productivity and competitiveness of the sector. Examples of good practices, both within and outside the region, have also been identified in this segment:

   - **Forest HQ – IR**
     A central platform to help improve operational performance and optimize log production.
   - **LogForce – FI**
     LogForce is used by both the forest companies and contractors. With CFLogistics LogForce the planner can ensure that requested amounts of wood are transported to the delivery destinations. Also, the driver has a real-time information on what is supposed to be delivered from where and to where. LogForce makes updating the plans easy since the information is delivered digitally to trucks.
   - **Forest Supply Chain Optimization System (Forscope) – PT**
     The Forscope is a prototype of an advanced planning system whose main functionalities include:
     (i) a digital marketplace for non-used forest-based biomass;
     (ii) support supply chains design;
     (iii) support the optimization of logistics processes;
     (iv) planning and control of operations from forest-to-mill.

3. **The shortage of skilled workers which is further fueled by an aging workforce** is one of the selected major weaknesses in the CWE regions. To attract a new workforce, it is necessary to develop and implement new modern ways of communication and job promotion. In addition, the existing workforce needs to be kept motivated by offering them attractive jobs and opportunities for continuous development.

   - A good example is the **EU project AVATAR** which has developed a digital coaching, assistance, and feedback system for improving productivity and job satisfaction for forest machine operators.
   - **Choose forest – NO** works with recruitment, expertise and reputation building for the forest industry. Choose Forest is funded by members of the industry, the Ministry of Agriculture and Food, the Norwegian Forestry Association, and the Confederation of Norwegian Enterprise – FoodDrinkNorway, as well as funds from the forestry's various project funds.
   - Forestry crane work is often an isolated and rugged business carried out in challenging temperatures and harsh environments. Hiab's **HiVision™** is transforming the working conditions and productivity using virtual reality technology, goggles, external cameras. Precision and efficient log lifting every time - all from the safety and comfort of the crane cabin.

4. **The current legal framework is adapted to conventional construction products and technologies.** Not only the building regulations, but also the standards have been established for conventional building. The building laws need to be adapted to allow the development and experiments regarding more sustainable building materials like timber. None of the selected best practices offers a solution to the actual problem. Several best practices like **Open Source Wood Initiative – FI, Ydalir district – NO, dataholz – AT, wooddays – AT or Lignum – CH** have been selected as most promising initiatives to support and encourage changes in building codes.

5. To foster communication and cooperation between forest owners and the public regarding the extent of forest management (timber production) some of relevant BPIs like **APP ins Holz, FORETDATA, ALLMA, Je me forme pour mes bois, Climafor** have been identified. Some of them also target and cover consultation and teaching programmes on forest products and management matters.

6. The forest industries in CWE Hub use the latest technology to grow, manage, harvest, and process its renewable resources. Nevertheless, **negative perceptions regarding forestry, forest products and the forest product industry persist**. Regional and local marketing actions to raise the awareness of and inform the public are considered as the most important instruments to address prevailing negative perceptions:

    - **Think Tree – NO**
      Think Tree is a joint initiative from the forest and wood industry in Norway, aiming to show how forest and wood can contribute to fight the climate change.
    - **Swiss national wood promotion programme (Woodvetia) – CH**
      The awareness campaign aims to positively influence and consolidate people's attitude to Swiss wood on a long-term basis. The forestry and timber industry are combining forces to promote the use of native timber. Consumers are being encouraged to consciously choose Swiss wood when building new houses, carrying out conversion projects and buying furniture. Woodvetia is not using conventional advertising methods such as TV commercials and posters, but instead wants to get people actively involved.
    - **Woodbox and Wooddays – AT**
      Road show on forward-thinking timber architecture on tour through Europe. Dialogues, lectures, and presentations of best practices focus on wood as a topic for the future when it comes to building and living in urban areas.

2.5 Implementation of the interregional roadmap

Each partner country in the CWE Hub has a very long history in sustainable forest management. As such, detailed national and regional forest policies and strategies exist along with well-established administration and implementation structures.
The roadmap of the CWE Hub ROSEWOOD4.0 and the underlying joint SWOT analysis must be understood as a complementary bottom-up approach, where practitioners provided a state-of-the-art picture of the current wood value chain in the CWE Hub. The roadmap focuses on the weaknesses and threats perceived by the involved stakeholders ranging from forest authorities, research and education representatives, forest entrepreneurs and private forest owners. In response to those needs and threats, existing solutions, and promising innovations from within the CWE Hub and from the four other hubs were identified, presented, discussed, and matched by the project partners and their partner networks. The successful transfer or degree of exploitation depends on the partner domain and available resources. Especially BPI from other hubs usually require adaptions to fit to the prevailing forest practices and structures in the CWE Hub and the respective

partner country. Even though some of the available and accessible BPI cannot immediately be implemented by the stakeholders, it must be noted, that these BPI are still utilized through learning from them and providing an inspiration and motivation to actively progress in the digitalization of the forest value chain.

Within the remaining ROSEWOOD4.0 project run-time the focus will be on knowledge transfer of the identified BPI (as outlined in the previous sections) according to the stakeholders needs of the respective hub country, on creating cooperation opportunities by matching stakeholders of different hub partner countries and between the hubs. The project partners will facilitate and moderate this process through regional operational groups and tailor-made transfer and dissemination activities according to the specific needs of the locally rooted forest community. Bi- and multilateral workshops, round tables, tech-talks, moderated match-making events, agenda-setting actions, and the formation of consortia for research and innovation projects will foster the uptake of and cooperation between BPI owners and receiving entities. The stakeholder involvement in the SWOT analysis and the roadmap development has already resulted in several first moderated bilateral meetings and talks on potential cooperation and knowledge transfer in the CWE Hub. For dissemination of the roadmap and the underlying BPIs, a wide range of formats will be used like videos, online study tours, BPI presentations and pitches.

2.6 Conclusions and Outlook

The CWE Hub countries have a long and successful tradition in sustainable forest management and a well-established forest innovation system shaped by the needs of mostly locally rooted actors.
The ROSEWOOD4.0 hub approach enables and boosts the exchange of BPI between forest regions in Europe. Within the first 12 month, the CWE partner countries and their local stakeholders have received a tremendous amount of new ideas for overcoming shortcomings and risks in the wood value chain especially when it comes to the digital transformation of the highly fragmented forest supply chain.

Call for actions is required on the topics of climate change and new forest management regimes, lack of qualified labor, new types of forest owners, and the future role of forest owner associations and similar intermediaries to overcome the high fragmentation of private forests. The CWE roadmap matches successful best practices and upcoming innovations from around Europe with the identified weaknesses and threats in the partner countries. This interregional roadmap provides our locally rooted actors with a unique overview of state-of-the-art solutions and novel technologies to overcome their own weaknesses and to respond to perceived threats to strengthen and progress the whole wood supply chain.

Concerning the weaknesses identified in CWE Hub there is a need for deeper development of co-operation between horizontal and vertical actors by exploiting existing digital solutions and frameworks, getting near-real time information on forest status and changes, data sharing, making use of remote-sensing technologies and mobile applications in the field work, and radically innovating the prevailing communication channels between all actors in the wood value chain. ROSEWOOD4.0 hub network fosters the transfer of knowledge and best practices between locally rooted actors to respond to their current and future needs to maintain a sustainable and responsible forest management in Central Europe.

ROSE WOOD 4.0 Sustainable Wood for Europe

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