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Resource Wood
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Overview of the main results of the workshops

Introduction

This document describes the main issues discussed during the PhD/post-doc workshops at the 2nd Summer School of ther National Research Programme NRP 66 "Resource Wood" and provides some detail of the results of those discussions.

The working programme of the 2nd Summer School was structured along the dialogue fields and consisted of four sessions, each of which was built up as follows:

1. Keynote lecture(s) by senior representatives from industry, NGO or research
2. Input presentation by doctoral students and post-doc fellows
3. Workshop (partly designed by PhDs/post-docs) with the participation of all, including members of the NRP 66 Steering Committee.

For the elaboration of the input presentations, the participants were guided by the following questions:

1. How are research and development progressing today with regard to your dialogue field? (general and subjective appraisal of the stage of R&D worldwide)
2. Which major challenges are R&D going to face in your dialogue field in the next few years?
3. In which way could your research project(s) contribute to addressing these challenges? Which perspectives may possibly open up?
4. What are the strengths and opportunities for Switzerland as research and business location in your respective dialogue field ? In which form could (or should) the Swiss research and economy contribute [to using these opportunities]?

Based on their specific answers to these guiding questions, each of the four PhD/post-doc teams proposed a set of questions for the subsequent workshop.

Session 1: Provisioning and sustainable use of wood

Setting	Workshop questions
World café with 5 tables	• How can the two perspectives of economy and environment be combined to a more comprehensive sustainable perspective? *Example: From the perspective of your project, what realistic options do we have to influence the price trend in the wood market and how would that change the framework?* • What are important economic and environmental determining factors in the different subprojects of NRP 66? Example: Are there any regulations in your project regarding efficiency criteria? • In what way is the cascade use of wood an issue in the different projects? *Examples: Is there an option to utilise used wood (wood residues, waste wood) in the analysed technologies? How does the potential ex post re-use of wood influence the design of a technology? Is the disposal process of products a topic in the development of your technology?* • To what extent does the consumption and availability of resources influence the development in the different research fields of NRP66? *Example: What are competitive uses for the wood-based resources in your technology?* • What is a reasonable and useful future utilization of wood? *Example: What potential do you see in your technology for a future wood use?*

Main results

Particularly when considering the entire life cycle of products and processes, the benefits of using and re-using wood as a renewable resource are constrained by substantial trade-offs. The following examples may illustrate this point: (1) Using sawdust in cement production is economically attractive; however, the end product is hardly recyclable. (2) The pellet industry is worried about its reputation when using recovered wood because of the related pollutant emissions. (3) Research and industry make great effort to modify wood (UV protection, waterproofing etc.) in order to make it fit for material use; however, in later phases of the life cycle and especially when it comes to biorefining, one expects the same piece of wood to be completely bio-degradable.

The cascade use of wood is fraught with such dilemmas, and in search for solutions, economic arguments prevail in most cases. Nonetheless, researchers are making substantial progress when they start thinking not only in technological but also in economic terms. What is missing now is a greater awareness of life cycle considerations. Particularly, there is a need for innovation in the use of waste materials containing lignin.

The worries about competing on wood resources are compelling, but only as long as we ignore that the cake which we are fighting about can also be made bigger so everyone has a bigger slice of it. Against this background, researchers are well advised to keep their eyes open for innovative solutions with high value added and to watch out for tree species that are best adapted to their technology, instead of focusing only on Swiss wood.

Session 2: Advancements in timber construction

Setting	Workshop questions
3 working groups, presentation of results in full assembly	**Topic 1: Role and orientation of the research on timber** • It is correct to research on timber in order to improve timber buildings? Is it an effective need of our society to use timber for building in future? • What is the interest in making timber the new material for the future in the building industry or in another field? **Topic 2: Timber and urban building** • What is the role of timber constructions as an alternative [to massive constructions] in the urban residential building in the near future? **Topic 3: Tax systems and other privileges** • Could a tax system stimulate building in wood? What is the political chance to introduce such an instrument? **Topic 4: Timber constructions in seismic areas** • Which are the advantages and drawbacks of timber structures in seismicity areas? Does it make sense to use timber in such areas? **Further questions** • Standardisation of newly developed materials: How many steps are needed? • Changes in fire safety rules and public perception of fire safety of timber constructions • Optimisation of structural design with regard to building-physical properties

Main results

Timber has a massive potential in the construction sector but much effort is needed in order to help this building material win more recognition particularly as an alternative to concrete.

The use of wood-based composites and the combination of wood with other materials in hybrid constructions are promising, as they allow the user to benefit from the advantages of each material. However, a great deal of standardization work is still ahead.

Using timber for construction in seismic areas has certain benefits (e. g. temporary fire resistance, vibration damping) but also drawbacks (anisotropy, scattering, high costs etc.) A revision of the current regulation in Switzerland – more precisely, an adaptation to the effective (low) seismicity – could help avoid over-dimensioned structures, save costs and thereby make timber construction more competitive.

Timber may also contribute to current efforts to increase population densities in urban areas (smart growth). Additional stories or annexes made of wood are lightweight and easy to assembly.

Notwithstanding the huge potential of wood in construction, offering financial incentives such as grants or tax reliefs to private economic actors could possibly distort competition on the construction market. The availability of such instruments (if ever applied) should be limited in time and in space.

Promoting wood as a building material appears to be a more promising way, but the target groups are yet to be defined. Rather than convincing the public about the benefits of timber, it might be

more reasonable to address investors and lenders who are the most concerned about the durability of wooden constructions. There is also a need for tendering solutions that favour wood. Public sector entities could play a pioneering role here.

Another important question is how to industrialize timber constructions. Pre-fabrication and scale-up make products reproducible, reliable, and hence more adapted to the mass market. Beside the potential for innovation in individual timber construction technologies such as joining, there is still much scope for improvement in the production processes.

Session 3: Innovative wood-based materials for new applications

Setting	Workshop questions
3 working groups, presentation of results in full assembly	• What does a new Swiss innovative wood-based material look like? Is it cheap or expensive? Is it simple or sophisticated? Does it exploit high-tech? • What are promising directions in wood science? Having worked with wood for a while, what are the interesting research questions? What are good methods to study wood and, more importantly, what approaches DO NOT work?

Main results

There is great potential for technologically sophisticated wood-based materials to generate substantial added value in Switzerland. However, it is vital to improve material properties and to reduce or eliminate unpleasant side effects. How to reduce waste or add new value to waste is another important challenge.

A mass production of high-tech wood-based products in Switzerland in the next 10-20 years is not likely to happen. Nevertheless, by promoting its R&D capacities, Switzerland can possibly make up for some of its unfavourable locational factors such as high labour costs or the poor security of timber supply.

Developers of high-tech products should better not target niche markets only but try to enter the market pyramid somewhere in the middle (between mainstream and high-end) or achieve an appropriate balance between mass products and niche products in order to maximize turnover. In this context, a crucial issue is developing high-tech products and offering them at a low price so they can conquer the mass market.

A combination of renewable materials with an appealing design is likely to attract future end consumers. In order to tackle with the durability issue, wood-based products with a short lifetime might be the preferred solution. Exotic or "forgotten" trees species may have interesting properties and are waiting to be discovered.

Nanocellulose is a highly promising material and thus possibly "the next big nano-thing"; however, our current understanding of the nanostructure of wood is still relatively poor. Besides, if research and industry wish to bring cellulose nanofibres to success, they have to change the public's perception of possible toxic effects.

The semi-natural forest management in Europe is certainly good for the environment but is also responsible for a large variability of wood properties. This variability is an obstacle to the industrialization and large-scale production of wood-based materials. Plantations could be a remedy to this problem. However, the mass production of wood-based products requires huge plantations, which would only exacerbate the problem of land use conflict (wood vs. food production) in view of the worldwide population growth.

Session 4: Novel ways in bio-refining of wood

Setting	Workshop questions
3 working groups, presentation of results in full assembly	• What challenges are we facing when integrating bio-based chemicals or fuels into industry and how can we overcome these? (Fossil fuel vs. biomass: price and availability) • What role should or can politics play in a Swiss bio-refinery scenario? • What should the bio-refinery scene in Switzerland look like? (energetic use vs. value-added products)

Main results

Scaling up laboratory-based bio-refining processes for region-wide implementation in Switzerland is one of the major challenges today. There is much uncertainty about the optimum size of bio-refinery plants, the potential return on the invested capital as well as about the ways of getting value out of wood. Another question to be discussed with representatives of the chemical industry concerns the market of bio-refining in Switzerland: Is there any (industrial or end-consumer) demand for value-added products derived from wood through bio-refining?

The price of wood has paramount importance in dealing with these issues. Currently, prices in Switzerland vary heavily (ranging from CHF 30 per m3 for energy wood to about CHF 100 per m3for high-quality construction timber).Using the ligneous biomass solely for energy purposes is thus not reasonable – neither from an economic pont of view, nor against the background of the untapped reserves in Switzerland's forests.

The role of politics with regard to wood energy resides in stimulating the production and consumption of energy based on wood as a renewable resource. Policy instruments in Switzerland include eco-energy labels, subsidies to pilot plants, tax incentives given to consumers of green electricity, and information campaigns for the population. However, not all these efforts seem to be well-perceived. In particular, many investors doubt that the current policy framework could guarantee a minimum period of return on the investments involved (which is over 20 years).

The shape of the bio-refining scene in Switzerland is yet to be defined. There is also a need to strike an appropriate balance between the material and energy use of wood, based on scientific knowledge and technical progress. There is no compelling argument for Switzerland to envisage an entire "park" of bio-refineries exploiting Swiss wood. One should rather think about how to position Switzerland as a developer and exporter of novel bio-refining technologies. Ultimately, the market potential offered by consumers of bio-refining products may outweigh the deficiencies of the framework conditions set by the government. The prospects are bright, which gives cause for optimism. The process of dialogue has just begun and all options are left open for the future.