

## **ENERWOODS - wood based energy systems from Nordic and Baltic forests**

### **How to provide bioenergy in the Nordic and Baltic regions? Wood is the future!**

Why:

- Wood and woody biomass is already the most important source of bioenergy in the Nordic and Baltic region.
- Harvesting low-grade wood material can foster an increased biofuel supply in the coming decades.
- Forests can become more productive, and adaptive to climate change by using well-known silvicultural measures
- Forests can thereby contribute much more to a sustainable development of our societies towards carbon neutrality by 2050

How:

- by genetic improvement, introduction of non-native tree species, fast growing nurse trees, fertilization as well as afforestation.

Utilisation and implementation depend on policies and regulations as well as public perceptions of nature conservation, biodiversity, recreation, game management, ground water etc. Diverging interests related to forestry and conservation can be aligned.

The large forest areas and the well-established forest management, forest industry and infrastructure in the Nordic and Baltic regions makes these regions well prepared along all of the value chains to implement the more intensive management if confidence in the profitability can be justified.

Woody biomass is already the largest contributor to our renewable energy systems. An increase of this component is likely to need relatively small additional investments to provide a high impact compared to other alternatives in the renewable energy systems.

The impression is that there is a widespread risk in the forestry and forest industry communities of this region that the lack of understanding for forest functions and forest management potentials in Europe in general may pave the road for decisions that may limit the intensity of forest management. Implemented at a European scale this may severely limit the EU, and as such also the Nordic and Baltic regions in using the potentials to reach low carbon societies.

The Nordic perspective is therefore to act and speak with one voice to the EU and the rest of world, to highlight the important potentials of forests and forest management to contribute significantly to a sustainable and low carbon development of society.

### **Conclusion of the project**

The joint Nordic-Baltic collaborative research project ENERWOODS has now concluded after four years of research and outreach. The project results clearly demonstrate both the leading role of forests and forestry in today's renewable energy systems, and the large and often overlooked potential for further expanding the supply of wood and woody biomass - both in the short run, but particularly when employing a scope of 2050 and beyond.

It is expected that a **50-100 percent increase of forest productivity at the stand scale is possible**. This is a conservative estimate and is viewed relative to today's most common forest types, and in a sustainable forest management context.

The ENERWOODS project included partners from Sweden, Finland, Norway, Latvia, Estonia and Denmark. The results and conclusions apply to these "ENERWOODS-countries".

## **Large potential**

- **Supporting sustainable development of society**

The approach of ENERWOODS is resting on the Brundtland Commission concept of sustainable development, fulfilling the needs of society and particularly future generations. In a forest and forest management context these needs include the entire range of ecosystem services - e.g. wood, woody biomass, biodiversity, clean ground water, recreation, landscape aesthetics etc.

However, the approach of the project is on opportunities for wood supply and has not been on limiting the use of woody products resources within an environmental protection context focusing mainly on biodiversity and nature conservation.

- **Forest legislation**

The main legal issue is whether non-native species will be allowed on a significant scale. Denmark is already using non-native tree species extensively, whereas the forest legislations of the other ENERWOODS countries are more restrictive.

Restricting forest management to use only native species has implications for both the forest productivity and adaptation capacity of our forests to future climate and other challenges.

- **The IEA/NER report "Nordic Energy Technology Perspectives"**

The IEA/NER report projects a 70 percent increased consumption of biomass and waste to meet the needs of the ambitious Carbon Neutral Scenario by 2050. Additionally, the report projects a net biomass import to the Nordic region to fulfil this scenario.

In this project, researchers view the 50-100 percent increase of forest growth at the stand scale as a conservative estimate of the forest potential to support a sustainable development of our societies towards a carbon neutral future.

ENERWOODS - researchers therefore view it as a realistic scenario in the long run to fulfil the needs for domestically produced woody biomass in the Nordic region. However, societies need soon to decide to follow this sustainability trajectory of forests and forest management to avoid significant delay in relation to the 2050 goal of reaching carbon neutrality. There is only 35 years left, which roughly corresponds to half a forest stand rotation length in the region.

## **Measures needed to reach the potentials of forests and forest management**

The region is already in the frontline of replacing fossil energy with renewables. Currently renewables provide 46 percent of the total energy consumed, which is far more than the average EU target of 20 percent by 2020. Bioenergy and waste account for 65 - 97 percent of the renewable energy in Denmark, Finland, Sweden, Estonia and Latvia. Forestry products are the dominant fraction of the bioenergy supply. Unfortunately, statistics do not distinguish between biomass and waste nor the various sources of biomass (forestry, farming, peat etc.)

The forests of the ENERWOODS countries cover in total 61 million hectares corresponding to 52 percent of forest cover. Denmark has the lowest cover, 14 percent, but plan to increase this to 20-25 percent. The annual growth of the forests corresponds to 276 million cubic meters. On average 65 percent is harvested (179 million cubic meters). The most profitable use of the harvest is for timber. Using wood to replace energy intensive materials like concrete, steel and aluminum for e.g. construction and buildings in the first place and then in a longer time perspective either recycle or burn that wood to replace (substitute) fossil fuels is the most energy and climate effective use of wood. However, large proportions of wood waste and low-grade materials are only suitable for direct use as energy, pulpwood or fiber boards etc.

- **Short run potential for increased energy supply**

The annual supply of woody biomass energy is estimated by ENERWOODS to be between 230 and 410 TWh for the ENERWOODS countries depending on what levels of legislative and practical restrictions that are implemented in the individual countries. To put this into perspective, the present annual supply of bioenergy and waste (Eurostat 2010) in the ENERWOODS countries corresponds to 300 TWh. Bioenergy and waste is not only woody biomass, but woody biomass is by far the dominant part of this component.

It is difficult to develop a robust estimate of how much biomass that can be extracted from current forests. A 230 TWh woody biomass supply is probably somewhat closer to today's supply of the woody biomass part of the bioenergy system.

- **Long run potential for increased forest production**

ENERWOODS assess that it is possible to increase productivity by 50-100 percent at the current level by changing species, genetic improvement, nurse crops and fertilization. These measures can be combined and thereby provide even more powerful solutions.

- **More tree species and Genetic improved trees**

The potential increase by introducing more productive tree species - often mixed with the the common species - will typically be 25-50 percent at the stand scale after stand regeneration.

The potential gain by using genetically improved material is typically 20-50 percent by 2050.

For example is the current average genetic gain 10-15 percent of Norway spruce based on existing seed orchards compared to unimproved material, whereas by 2050 it is expected to be 20-25 percent.

- **Nurse crops**

By utilizing different growth dynamics it is possible to achieve much higher (e.g. 100 percent or more) productivity in the regeneration and early stand phases. The nurse species provide shelter that favour survival of many desired and late successional species in the early regeneration phases, but also require careful management and thinnings in due time to later avoid detrimental competition and thereby damages of the intermixed late successional species.

- **Fertilization and Afforestation**

Fertilization can shorten the rotation age and provide an average annual growth increase of approximately 30 percent in mature stands- the effect that depends on site, species and management in general.

A production increase of more than 3 percent of the total regional production is expected when the afforestation program is completed.

There is a potential to increase the forest area by 1.6–2 mio. hectares through afforestation of abandoned farmland.

- **Logistics**

ENERWOODS results indicate that modern logistic systems should be based on larger trucks than now, in addition to the trains and ships that generally are recognized at the most cost and climate efficient means for transportation whenever feasible.

Some of the measures mentioned can be implemented with short notice (fertilization and afforestation). A common rotation length in the region is now typically 70 years - longer under colder climate and shorter under warmer climate, and very much depending on e.g. other site conditions and species. Consequently, a full implementation will take longer than the 70 years.

## **Some challenges to reach the potentials of forests and forest management**

- **Lack of understanding of sustainably managed forestry and the forest function in society**

It is the impression after having completed the ENERWOODS project that there is a widespread lack of understanding of the dynamics and functions of forests. Consequently, there is also very little understanding of the potentials offered by forests and forest management for increased productivity and contribution to a sustainable development of society towards carbon neutrality.

- **High productivity is not against nature conservation and biodiversity on the landscape scale**

Stakeholders representing nature and biodiversity interests may generally view increased production and harvest of wood and biomass as counterproductive in relation to their interests.

This is viewed as an oversimplified assumption. High productive sustainably forests managed to support a low carbon society include good opportunities to support nature conservation and biodiversity.

- **Forest legislation and certification**

Forest legislations and forest certification schemes in most of the Nordic and Baltic countries are very restrictive towards introducing particularly non-native species, and perhaps also in some areas improved genetic material. Especially, improved material based on clonal selection is often considered with skepticism due to fear of reducing the genetic diversity too much.

- **Forest owners and managers need to have confidence in the future markets**

The investments in high productive forest types are resting on the decisions of the forest owners and managers. Since forestry has a longer time perspective than most other industries there is also a need for the professionals to apply long time perspective in their analyses of the returns on the investments.