

RESEARCH CONFERENCES

ESF-COST High-level Research Conference

The Future Role of Bio-energy from Tree Biomass in Europe

6-11 November 2011

Europahaus, Vienna/Austria

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Highlights & Scientific Report



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Conference Highlights

While forests and forest industries will play a key role in achieving the EU target for 20% renewable energy share by 2020, the issues are global. The conference rallied people from over 30 countries to discuss the future of forest bioenergy. Thus, perspectives from a range of non EU countries were also shared.

1. **Overviews** from a range of policy and R&D perspectives while at Klosterneuberg where participants could also explore a combined heat and power plant using forest fuel. Typical challenges included economics of resource mobilization, land use conflicts (e. g. food vs fuel) and issues relating to this, competition with traditional forest products, examples of national concerns, and how to develop utilization biomass for energy production while balancing various environmental and social issues and opportunities with economic drivers.
2. **Supply and demand** for forest derived biomass was discussed. Challenging political initiatives promote mobilization of forest biomass, sometimes in contrast with technical and environmental constraints, as well as the “moving target” of sustainability. In the EU demand is likely to exceed supply, with labour, biomass transportation and storage capacity and competition with carbon markets as extra limiting factors. Overall improved energy efficiencies is, however, expected to reduce demand. The revival of Japanese urban Satoyama woodlands showed that increased availability of biomass does not necessarily rule out improvements of environment and biodiversity.
3. **Environmental challenges** include establishing and maintaining closed biogeochemical cycles, avoiding nutrient depletion of soils. The gross available biomass must always be reduced to an ecologically available net following the regionally specific ecological limitations.
4. **Logistics and technology**– the session included examples of solutions for large and small scale supply of forest biomass for energy. It was shown that the supply must be further reduced by technical, economic and logistical limitations. But, ideally, energy conversion should be the last step of any wood based product chain.
5. **Biorefineries** regard energy as just one product in conceivable multiple product streams. Experiences and R&D relating to this paradigm were presented and discussed with recent scientific advancements and product development from a range of international experiences e.g. the use of fibre for insulation, manufacture of biopetroleum, and use of lignin and carbon from fibres to make new generation bioproducts including feedstock for the chemical industry. Again, bioenergy was identified as an end-of-life option. The overview included efficiencies in taking biomass through combined heat and power applications.
6. **Think globally – act locally**; a range of local/regional solutions was presented and discussed. Often they exist due to political incentives, relating to the resource available. Different countries (in the EU and globally) face quite different challenges and possibilities. Thus, the solutions must reflect such differences in order to be successful in achieving the principal goal of rendering sustainable solutions while maintaining socially and ecologically acceptable for the society.
7. **Interaction and networking** was unusually vigorous since all participants shared the full duration of the conference together. A further advantage was the small number of people from any one country which promoted international mixing and exchange of ideas. The wide ranging conversations included a strong participation from all categories; established experts, early stage researchers, industrialized and developing countries alike. The social activity at Klosterneuberg held at the beginning of the meeting ensured and promoted the relaxed and contact stimulating atmosphere of the conference.
8. **Interactive discussion session with assigned roles**: The participants in the discussion were asked to find agreement on whether to establish a bioenergy plant . In a first round the participants were briefed on the assumptions on the regional setting and each group member was assigned a specific role. The process of decision finding was monitored. The participants found the approach interesting and educating.

X I hereby authorize ESF – and the conference partners to use the information contained in the above section on ‘Conference Highlights’ in their communication on the scheme.

Date & Author: 2011 Dec 14
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Executive Summary

(2 pages max)

The political expectations in the future relevance of renewable energy sources in Europe are extremely ambitious. The biomass from European forests will play an important role in the implementation of the policy goals. The conferences combined the viewpoints from participants over 30 European and non-European countries.

The supply and demand for forest-derived biomass was discussed in the context of ecological constraints and with hindsight to strong competitors on the biomass market. Energy suppliers and pulp & paper plants may compete for the same resource, but examples from the Nordic countries shows that both segments can develop and co-exist with limited problems. The need for energy and increasing skepticism towards nuclear power as well as the already advanced exploitation of hydropower gives a strong incentive for using wood as a central energy provider. The relevance of biomass from forests is high as other sources of biomass will be insufficient.

The aim of forest management in Europe and in most parts of the world include 'sustainability' in all aspects; productive, economic, ecological and social. With an increased demand for wood and higher management intensities, especially the meaning of productive and ecological sustainability needs to be scrutinized. With incentives and subsidies being introduced to promote an increase in utilization of forest biomass for energy, also economic and social sustainability needs to be closely monitored.

The substitution of fossil fuel by biomass is elusive per se and would benefit from a major advance in the efficient use of energy in order to meet the energy demand with the available resources. Further, the production of energy from wood biomass is an important element of the forest biomass biorefinery, heat being an unavoidable 'by-product' of conversion.

The economic use of forest biomass, especially in the form of byproducts from conventional logging operations, is challenging. The supply is scattered over the landscape and over the individual sites with limited concentration. Efficient logistics and technology for harvesting, transportation and concentration must be developed and applied to supply the points of consumption. Demand is cyclic while supply is steady, which calls for over-season storing. Further, the material itself is heterogeneous, bulky, unwieldy and often moist and contaminated, decreasing its value as a fuel and as a feedstock for biorefining. Purposeful integration with the main logging, seasoning, pre-processing and compaction combined with rinsing and sorting has been developed to alleviate such problems, the exact methods and technologies being very much situation specific..

A main outcome of the conference was the high involvement of many early stage researchers as presenters, as participants in discussions and through invitations to participate in multilateral projects. The rich blend of nationalities, experiences, fields of expertise and the joint interest in developing forest biomass as a sustainable feedstock for future needs was made fruitful through the social activities starting the conference and the exclusiveness of the venue which created the right environment to meet and interact with new people.

Scientific Content of the Conference

(1 page min.)

Session 1.

1. Impact of EUWood project and various national analyses
 - EU – 700 M m³ solid wood equivalents expected by 2030 = doubling in size of energy demand from 2011 (supply can't meet demand) so target efficiency gains in energy, housing as well as land use intensification. (undeclared issue of potential limitation due to need to move biomass around EU and sustainable cost of this)
 - Future scenarios worked out for countries with good data (e.g. Sweden and Austria) but most countries limited information on all aspects and costs in value chain.
 - Expectation that subsidies are likely to play a big part in use of forest biomass for bioenergy
 - Challenge of coordinating and accessing materials from very small forest holdings
 - Bottlenecks for growth identified which include labour, likely import of tree biomass to EU overall needed.
 2. Japan – combining landscape aesthetics, biodiversity goals and biomass production
 - Loss of old uses for (Satoyama) woodlands in large cities becomes a local new source of bioenergy. Japanese strategy to access untouched resource for wood pellets and develop local gasification plants
 - Investigations on interplay between scenic value, recreational use, biodiversity values and economic benefit from bioenergy. Impact of distant ownership versus local users
 - Satoyama woodlands and bioenergy plants as part of rebuilding tsunami ravaged towns.
- General discussion – need to free up real estate/property rights challenges?, industrial underuse of forests is tragedy of the commons, short term versus long term approaches, tradeoffs for multiple uses in land not manageable in some circumstances?

Session 2.

1. Biodiversity and landscape issues challenging biomass intensification.
 - Analysis of fertilizer needs and soil and water impacts across EU generally northern EU applications. Led to proposal of network of long term sites for evaluation of fertilizers of a Canadian study.
 - Data to date suggests minimal impact of forest intensification except for a decline in soil organic matter; questions on data that varies on impact of whole tree harvesting versus leaving remnant stumps; questions on potential soil acidification due to fertilization with ash from bioenergy combined heat and power plants. Still lack of clarity on manner of the Swedish mercury pollution of fish believed to be due to forestry activities.
 - Overall impact in Sweden of sustainability regulations discussed, experience of old forecasts on biomass production generally underestimating the market effect.
2. Challenge that there is a global lack of food
 - Analyses showing sugar crops more efficient than starch crops for bioenergy, annual people food deficit could be supplied by food used for animal feed
 - 3% of current grasslands could supply bioenergy needs within EU.
 - Need harmonized certification systems and standards for sustainability measures.
3. Carbon markets, emissions and bioenergy
 - Comparison of several models, relating to climate change policy of 20% reduction in GHG by 2020. Biggest opportunities forest and waste biomasses for EU.
 - Predict total wood production increase but still need to meet bioenergy targets via imports, a lack of clarity due to different model outcomes for sink decline due to uncertainty of the future. Overall conclusions of a sink decline of 15% by 2020, 25-40% by 2030 versus 2010 (excluding afforestation). Expected shifts to older forests may result in lower carbon accumulation – hence short rotations beneficial – but how short?
 - Challenges in strategies for use of poplar or willow as short rotation in Austria: grow single

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clones or mixed to reduce risk from disease and climate variations, design blocks of sufficient size for single harvest operations, change genetic material as in standard crop practices, use marginal sites, cost of transport large percentage of cost. Generally competes with maize growing sites hence price of maize impacts. Short rotation poplar in Sweden, no subsidies and acceptable profits.

Session 3

1. EU supply chain and systems evaluations – many examples

- Key driver is optimization and consideration of technical, production and cost aspects; several time and motion studies but with wide range of procedures, similarly economic evaluations wide range of procedures for costing used in analysis (machine rate most common).
- Megatrends impacting on profitability are available forest resource and demand from different markets. An example of Swedish challenges in resource presence, but distant from markets – need efficiency increases to achieve the potential of 5x greater additional biomass harvest than 2010. Greatest overall challenge currently (for heat and power bioenergy) is transport and logistics. Social challenge in impact on environment of perceived intensification of forestry activities
- Another trend is increased use of precision technologies, as tracking systems real time measurement systems, development of virtual forests. The question was raised how well forest companies use these technologies, especially with a reducing labour pool.
- The impact of fire, erosion and slope gradients and underutilization for a case study in Spain illustrated the different challenges facing different parts of the EU. Also demonstrated was an excellent way to integrate horticulture and forestry as biomass resources for a localized bioenergy all year round supply. In this case optimal logistics depended on scale, with a result that short rotation coppice trees were likely to be implemented for greatest benefit.
- Several case studies and analyses on supply chain demonstrating lack of data (eg costs of truck and chipper in Austria); challenges of comparing time bound versus long term and self reported versus externally measured data; quality of data and analysis used in simulations and multicriteria optimizations. Result in Finnish study of scenarios comparing 3 forest tree stands – high numbers of undersize stems single harvest, high quantity of pulpwood and whole tree-bundle harvesting – showed pulp prices had the biggest impact on harvest management scenarios. Pulp was also the biggest cost/price competitor for bioenergy applications in today's environment. An Austrian analysis led to similar conclusions using different methodologies, with a conclusion that fuelwood supply (for heat and power) will worsen in next 20 years in Austria and any improvements will be at the expense of pulp wood and higher prices.
- Again harmonization of standards and methods and language raised as critical.(cf sessions 1 and 2) for repeatability and transparency. Also use of meaningful measures (eg exergy) for comparisons; discussion on models and inclusion of boundaries in LCA analyses (eg including measures of practices that release carbon from soil such as off road traffic, erosion, drainage etc). Further implication of “calamities” (as Canada's bark beetle infestation which has released CO₂ equivalent to Canada's required reduction).

2. Supply chain logistics and evaluations outside the EU27

- In southern Australia efficiency of chip production for energy was much greater if wood was chipped at roadside than in forest skid sites. Sensitivity analysis identified this positioning as the greatest impact on costs relationships. Challenges were to identify are the optimization criteria of distributed versus centralized energy systems; Australian experience is carbon stored in homes 2/3rd that in forests and the future is likely to be one piece of timber having multiple lives ending in bioenergy (eg construction, recycled construction, fibre applications, chemical production and energy). Generally current petroleum/coal based combustion energy has economies of scale but biomass to bioenergy is likely to start at much smaller scale.
- In Turkey a supply chain logistics exercise indicated savings in harvesting costs by integrating site with roading network and biomass transformation facility.
- In Japan, the experience is that there is a lot of logging residue (8 million ton/yr) and construction material unused. The reason is transportation costs, hence exploration of location for chipping,

with a great impact on final cost, similar to the Australian example.

Session 4

1. Many challenges exist for establishing forest biomass based biorefineries. The challenges are similar globally, and include:
 - economic propositions and business cases,
 - what types of co-products, if any, are optimal,
 - what technologies and types of bioenergy are optimal for any given scenario,
 - what size should a facility be,
 - where should it be located,
 - does it exist because of incentives or can it stand alone,
 - what are the sustainability measures and comparisons and
 - how well do new concepts fit with current businesses.

Techno-economic modeling is important at all times during biorefinery concept and product development to identify critical success points.

2. Experiences and opportunities differed depending on local skills and types of business, type of bioenergy need. Limiting factors for commercial development will differ and may be localized. Some choices of bioenergy and transformation system lead to limitations in options for co-product development, but may lead to greater “closed loop” operations. One example was Sweden where forest biomass used for heat and power uses ash from bioenergy operations to stabilize forest roads. Another example was Canada where the challenges of using mixed tree stands indicates a need to reinvest in silviculture to make these stands more effective at biomass capture and utilization.
3. This session and earlier ones reinforced the impact of moisture (at harvest, during storage, when used) on the economics of bioenergy utilization of forest biomass.
4. Comparisons were made with petroleum refineries by two presentations.
 - Alternate products included lignin based materials substituting for petroleum based,
 - development of bioplastics, polymer and extractive chemicals,
 - textiles, sustainable and technological packaging and structural composites,
 - liquid biofuels from sugar precursors obtained from wood fibres,
 - biofuels obtained from pyrolysis and the challenge of higher oxygen content than petroleum.

Already commercializing new products included hemicellulose based films, car parts using lignin and cellulose, additives for cosmetics, new fibre plastic design materials.
5. Brazil is targeting bio-oil from Eucalyptus and other woody residues as a substitute for gasoline with a product called BioFlex which increases the octane number for bioethanol. An Austrian visualization breakthrough gave new insight on the interaction of celluloses with fibres to produce sugars for biofuel production – currently one of the roadblocks in cost effective biofuel production from lignocellulosic biomass due to hydrolytic inhibition.
6. An interesting challenge was seen in the choice of use of fibres for insulation and not directly into bioenergy/biorefinery applications. Energy balances and economics supported better insulation for housing over supplying heating energy, but fibres at the end of life could also be used to supply energy as well
7. Pulp and paper mills were commented on as the first adopters of biorefineries for bioenergy production for external supply and for greater co-product development. Several examples were outlined in Finland where 3 examples of heat and power and two examples of demonstration/industrial scale biofuel plants. Future challenges in R and D programmes in Finland were focused on products other than energy and fuels.

Session 5

1. Several examples of visionary studies were mentioned including those from IEA, OECD, and EU.
2. Challenges laid out included
 - Developing competitive supply and value chains
 - Quantifying sustainability impacts of bioenergy supply chains

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- Simplifying governance of supply chains including international agreements, certification systems (currently more than 50 in forestry) and regulatory regimes.
 - Need to integrate all participants in the room – eg Finland, Sweden and Canada have built their contribution to bioenergy in last 15 years, but many countries staying static with status quo.
 - Total volume and sources of forest energy must change significantly
 - Deal with complexities of supply chains and diversity of data on available biomass
 - Which technologies will attract capital (need return of 11% or more)
3. Recent publications outlining the enormous subsidies currently received globally by the petroleum industry (>\$US1T) versus the \$US60B currently. – an area of misperception in the media.
 4. Forest science challenges were laid out for the EU
 - Increased demand for forest products and increased complexity of forest biomass
 - Competition for same research funding and limited national funding
 - Often dealing with global topics and more multidisciplinary projects
 - Protectionism and resistance to change

Increased collaboration was regarded as the solution with benefits of:

- Validating national research results and better interlinkages in work
- Higher productivity over time
- Strengthen qualities of each partner
- Valuation of good work
- Increase in all our knowledge – new ideas
- Cannot solve all problems alone
- Don't have to hire experts! Use the network. BUT
 - Need to do homework to cooperate
 - Too many cooks can spoil the broth
 - Some challenges may only be national level
 - communication

Forward Look

(1 page min.)

- *Assessment of the results*
- *Contribution to the future direction of the field – identification of issues in the 5-10 years & timeframe*
- *Identification of emerging topics*

What next?

Re IUFRO Case Study work

1. Need case studies to illustrate bioenergy from forest biomass approaches and results; bioenergy is a complex area.
2. Lots of general knowledge and great examples of differences between countries
3. Need good practical stories
4. Cases could inspire, warn or educate
5. Need to deal with misconceptions out there internationally
6. Need strategy of communication with NGOs
7. A template will be provided with an example.

Send ideas to Rolf Björheden or Elspeth MacRae

Discussion on a new COST Action proposal

1. New proposal tabled: "Creating new solutions; sustainable forest biomass and bioenergy"
 - Problem statements included
 - i. Forest energy has the potential to undo much good work in sustainable forest management

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- ii. As more biomass and energy is used more will be required
 - iii. Recent public debate on sustainable forest biomass harvest can hamper or stop further development
 - iv. Lack of good professional PR and include activity with kids
- Benefits and outcomes expected
 - i. Consensus on sustainable forest biomass for energy
 - ii. Research platform analyzing and creating consensus
 - iii. Innovative tools and methods safeguard sustainability of forest biomass
 - iv. Knowledge transfer and policy transfer
 - v. Build bridges in forest disciplines
 - vi. Develop innovative approaches for communications
- 2. Discussion agreed that this as too large and extensive and should focus on less to achieve more.
- 3. Two other possibilities of COST proposals also surfaced.
- 4. Key issue is the need to get data now to back up facts when dealing with media and future policy needs.

Wrap up discussion session

Key suggestions;

1. Set up an information centre – especially to help correct misconceptions – acting as QC for information?
2. Develop lobbying power to get more subsidies to keep up with petroleum industry
3. Think of likely future processes and develop with that in mind eg develop enzymes working effectively at room temperature for hydrolysis of fibres
4. Need to put as much effort into durable products and recycle to gain energy at end of life.
5. For the first time there is strong competition in the market for forest biomass for multiple uses – where will energy sit ultimately in purchasing power; tech transfer is not happening fast enough
6. Not enough research examining what the impact on customers eg heat oriented versus electricity needs or bioproducts.
7. Congo has a big challenge relating to land tenure issues and who has rights to the forest, and various EU member states have different land ownerships structures which will impact on developments.
8. Overall dissemination of information isn't happening well enough or fast enough or with the right media and language for the public and business. We all need to speak the same language – and make this area “sexy” for the next generation of students. ALL agreed (developed and transitional participants) much information is NOT transferred to the right people.
9. Should investigate cross country comparisons on policy frameworks which are then used (or not) to promote bioenergy from tree biomass.
10. We need to define what are successful bioenergy models and what are not and publish these as case studies.
11. Link IEA Task 42 to this area of activity in IUFRO and EU
12. Main bottleneck to success is the harvesting sector which needs to double the number of enterprises. (logging enterprises are not very successful in N Europe or N. America – lowest profit, highest debt, greatest insolvency)
13. Need social acceptance of all bioenergy systems
14. Look at plantation options – NZ, Chile, Brazil, China has the largest plantation in the world, but aren't using it for bioenergy.
15. Build collaborations with other fields of renewable energies through transformational conferences and workshops

Key learnings and action:

Case studies (many presented at this meeting) such as comparing multiple current and future scenarios globally are likely to be valuable for understanding the wider potential of forest biomass for bioenergy. These however, should include comparable analysis of sustainability measures as well as economics based on local experiences. It would be valuable to identify the impact of regulatory

and incentive schemes by policy makers by imposing examples from one place onto a scenario at another. An example can be seen in the Canadian Future Bio-pathways project where the impact of local interventions have shown different results depending on the state.

Emerging topics and future issues

- Continue to draw together and lead development of harmonized approaches and use of models and technologies and industrial/political parameters that are globally comparable (cf the trends in fast moving consumer goods with global metrics and language for sustainability measures)
- Multiple sequential use of tree biomass as fibres ending with bioenergy as an end-of life option
- Economic tradeoffs with environmental and societal needs and with and without regulatory interference
- Rapid development of technologies, especially in the biorefinery area, over next 5-10 years.
- Multiple product streams likely in most applications of tree biomass to bioenergy, but no-one size fits all.
- Most co-product development in research, development and early scale up phases in 2011.
- Role of distributed forest biomass to bioenergy technologies and what parts of the value chain could be distributed and what consolidated (centralised)
- Multiple supply chain models and analyses all focused on optimization of tree biomass to bioenergy, but harmonization needed across these. Too many require scenarios with future unknown possibilities with forest resource (including short rotation agroforestry) and markets the key drivers.
- Challenges and types of scale up from lab or pilot scale to industrial operation and economic feasibility – likely to be different depending on location, including optimizing logistics.
- Value chain analysis needed for decision making
- Member states likely to find local solutions depending on local conditions and infrastructure and political intervention but using global technologies and frameworks for thinking.
- Impact of policy of R and D and industry development in forest biomass to bioenergy
- The need for embedded and consistently applied sustainability measures with a common language

▪ Is there a need for a foresight-type initiative?

Atmosphere and Infrastructure

The participants gave a very positive feedback to the event. The location was well chosen and the policy of shared rooms worked out fine. The event was well organized. After an initial shyness the exchange between the participants was vivid. All participants did speak up and defended their respective positions.

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