CenBio Newsletter

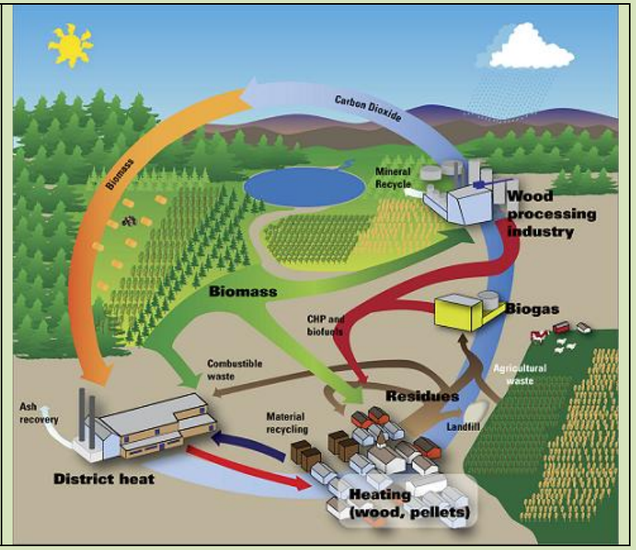
Main topic this issue: Research

In 2009 the research and development platform for CenBio has been established. The consortium involves 19 industry partners and 7 R&D partners. All of them have signed the consortium agreement. Also the contract between the Research Council of Norway and the CenBio host, the Norwegian University of Life Sciences, has been signed. Annual work plan 2009 has been in operation since September, and Annual work plan 2010 will be approved by the CenBio general assembly in January 2010.

This newsletter presents our R&D priorities and some initial findings after a short period of work in 2009. In the next newsletter we will concentrate on innovation and present some of the industry partners in CenBio.

Bioenergy Innovation Centre (CenBio) constitutes the national research team within stationary use of bioenergy. Nineteen bioenergy companies and seven research institutions are partners.
CenBio concentrates on three tasks: to increase the volume of biomass produced in Norway for energy purpose, to improve the conversion efficiency of biomass to energy, and to improve the profitability of the bioenergy industry.

Centre host: Norwegian University of Life Sciences.
Centre lead: SINTEF Energy Research



CenBio Vision 2020

	TWh - Today: Input	Efficiency	Output		TWh - 2020: Input	Efficiency	Output	
Wood / pellet stoves	7	0,6	4,2		12	0,85	10,2	Wood / pellet stoves
District heat	2,7	0,85	2,3		6	0,9	5,4	District heat
Wood industry	4,4	0,85	3,7		5	0,9	4,5	Wood industry
CHP - heat	~ 0	0,6	~ 0	→	4	0,65	2,6	CHP - heat
CHP - power		0,2				0,3	1,2	CHP - power
Power	~ 0	0,4	~ 0		1	0,5	0,5	Power
Biogas	~ 0	0,5	~ 0	Documented overall sustainability	2	0,7	1,4	Biogas
SUM	**14,1**		**10,2**		**30**		**25,8**	**SUM**

The vision of CenBio is to double the biomass input and more than double the bioenergy output by 2020, in a sustainable way. The efficiency for all the relevant conversion technology segments has to be increased.

Partners:

Research and Development
Norwegian University of Life Sciences, Norwegian University of Science and Technology (NTNU), SINTEF Energy Research, Norwegian Forest and Landscape Institute, Norwegian Institute for Agricultural and Environmental Research (Bioforsk), and Vattenfall (S)

Industry
Biomass owners: Norwegian Association of Forest Owners incl. Norwegian Forestry Association (NORSKOG), Norwegian Farmers' Union, Waste Management Norway

Technology companies: Bionordic, Cambi, Energos, Grant Kleber, Jøtul

Energy companies: Agder Energi, Akershus Energy, City of Amsterdam Waste and Energy Company (AEB) (NL), Hafslund, Nord-Trøndelag Elektrisitetsverk, Norske Skog, Oslo Municipality Waste-to-Energy Agency (EGE), Trondheim Energy, Vattenfall Heat Nordic (S), Xynergo

Other: Norwegian Protein

Text/ Layout: Odd Jarle Skjelhaugen, Katrin Wirth-Petzold

Biomass supply and residue utilization

Challenges

A doubling of bioenergy production within 2020 has to rely on a supply of biomass fractions at competitive prices that can be sustained over time. This involves “virgin” forest biomass, biomass from marginal forest areas, and municipal, industrial and agricultural by-products and waste. Biomasses are distributed over large areas and cost-effective supply involves logistical challenges in harvesting, processing, storage and transportation.

Biomass qualities vary greatly related to plant species, growing site as well as processing and storage and have great impact on conversion efficiency and cost. After conversion the residues has to be used in industrial processes or recycled as fertilizer for new biomass production.

wood chips/NFLI

Tasks and status

 Develop and improve tools for long-term analyses of biomass potential (scenarios). A state-of-the-art report about estimation, availability and production of tree biomass resources for energy purposes in Norway has been finalized. Scenarios of future biomass availability in Norway are now being developed.

 Survey machines and equipment to increase the logistics efficiency. A logistics roadmap is now being developed. The roadmap has three major uses; (i) It helps obtain consensus on a set of needs and the technologies required to satisfy those needs, (ii) it provides a mechanism to help forecast technology developments; and (iii) it provides a framework to help plan and coordinate technology developments and incentives.

 Improve the biomass quality based on knowledge about the variations in important fuel characteristics. Preliminary studies on the variation of density, moisture content, chemical composition, calorific value, ash content and melting point for the ashes have been started.

 Upgrade the residues for further use, e.g. develop a residue based fertilizer. A database for charactarizing problematic waste for incineration is being designed.

Conversion mechanisms

Challenges

To improve the conversion efficiencies with respect to energy yields, costs and raw materials utilization, we need more knowledge about the fundamental mechanisms for production of biogas, heat and power from different types of biomass.
Implications with respect to emissions, flexibility, and operational reliability and robustness will be central.

Tasks and status

 Find additives and fuel mix for reduced fouling, corrosion and NOx emissions during combustion. The Bioenergy Laboratory in Trondheim has been completed with new advanced analysis equipment. Multi-fuel reactor experiments with staged air combustion for NOx emission reduction have been accomplished, and esults are being evaluated.

 Develop simplified models for designing gasification processes and optimise gas yield and quality for targeted end-use. A state-of-the-art study is ongoing.

Increase biogas yield by mixing different feedstocks. A new biogas laboratory with advanced analysis equipment for this purpose will be operational 2010.

steam explosion unit for biomass pretreatment /UMB

Text/ Layout: Odd Jarle Skjelhaugen, Katrin Wirth-Petzold

Two MSc students have finalized their thesis within optimizing biogas yield, and two new PhD-students have started their scientific work.

 Increase biogas yield by novel pretreatment, mainly thermoenzymatic methods. A new flexible steam explosion unit with high throughput has been installed and a wide spectrum of necessary analytical methods has been established, allowing rapid sampling of different biomasses and variationin pretreatment conditions. Results obtained so far show that the steamexplosion set-up functions very well and indicate that steam explosion has the potential to increase biogas yield.

Conversion technologies and emissions

Challenges

To demonstrate that all the energy conversion efficiencies listed in the Cenci Vision 2020 are practically and economically feasible, as well as environmentally benign.

Tasks and status

 In the Small-scale (stove) segment energy efficiencies of 0.85 will be demonstrated, not as peak efficiencies, but as average efficiencies including cold-starts. A status for standards on wood- and pellet stoves and needed improvements has been made. A concept for a new combustion chamber has been developed and is already in use for heat storing stoves.

 In the District Heat segment, efficiencies of 0.9 will be demonstrated.

Multi fuel reactor/energilab NTNU og SINTEF

A literature review on retrofit possibilities for increased electric efficiency as well as literature reviews on additives against fouling and corrosion and oxygen enhanced combustion are ongoing.

 In the Heat and Power segment the feasibility of efficiencies of 0.95 will be demonstrated for the combined production of heat and power. A literature review focusing on cost-efficiency improvements in industrial biomass heating plants is ongoing.

 In the Emissions segment it will be demonstrated how emissions from plants converting biomass to energy may be reduced to below the half of present regulations. Initial work on mapping of emissions from biomass- to-energy plants is ongoing.

Sustainability analysis

Challenges

A systematic effort by Norwegian industry to approach bioenergy production has to rely on documented sustainability. Very few analyses exist on this for Norway. Any new investments in bioenergy production will depend heavily on expectations about the development of future energy prices, public incentives and the price of raw materials.

In particular raw material from forests will appear in strong competition nationally and internationally with the existing forest industries, and some of these industries may also improve their profitability by including bioenergy as a secondary product.

Finally, it is important to clarify and integrate the concept of sustainability with particular reference to bioenergy, based on the three pillars for sustainability: environmental, social and economic factors.

Text/ Layout: Odd Jarle Skjelhaugen, Katrin Wirth-Petzold

Tasks and status

 Survey the existing literature on life cycle assessment, technologies and resource availability to ensure that further research extends from the research frontier.

The first results from the review of LCA of bioenergy systems shows a complex field with different combinations of feedstocks, conversion routes, fuels, end-use applications and methodological assumptions, which leads to a wide range of results not easy to compare.

Significant net reductions in GHG emissions and fossil energy consumption are possible when bioenergy replaces fossil energy, but at the same time, most studies including other impact categories show increased negative impact for these.

 Quantify the effects of increased harvesting of branches and tops on the forest ecosystem. Findings so far indicate that in the short term there is a risk for greater loss of humus and nutrients in the soil than after conventional harvesting.

The effect on ground vegetation is unclear at the present. The knowledge will be used as a basis for development of guidelines for ecosystem management.

Harvesting tops and branches/NFLI

 Quantify the production inputs, costs and fibre use of the bioenergy alternatives. Analyse the national and international supply and demand for forest biomass, with reference to the impacts of increased energy prices and applied policy instructions. This task started 2009, and will be intensified when a new researcher is recruited March 2010.

Bioenergy Graduate School

Challenges

The new jobs in the growing bioenergy business requires skilled work force.
The challenge is to educate and train the current and next generation of bioenergy specialists in Norway. The Bioenergy Graduate School will focus on education on the graduate level (MSc, PhD and PostDoc).

Picture/UMB

Tasks and status

 Define curricula, common activities and shared supervision. One joint UMB-NTNU Master level course within bioenergy is approved for start august 2010.

 Students from different disciplines will come together and work on integrated ideas and projects. The first workshop for students, supervisors and some industry representatives will take place January 2010.

 Establish intensive industry-academia networking. The first action takes place in January 2010.

Text/ Layout: Odd Jarle Skjelhaugen, Katrin Wirth-Petzold