



Business from Bioenergy R&D Services in Central Finland



Bioenergy in Central Finland

Central Finland has a long tradition and world class expertise in the development and utilisation of bioenergy throughout the entire value chain. The key strengths of the companies and research centres in the area cover e.g. efficient bioenergy fuel chains, biomass combustion technologies and heating systems, biogas technologies, as well as energy solutions for the industry.

Bioenergy leader

Central Finland is the leading region in Finland in the development and utilisation of bioenergy: Already half (almost 9 TWh/a) of our primary energy demand is met by local biomass sources. Biomass based Combined Heat and Power (CHP) is produced in several plants from farm-scale applications to municipal and industrial boilers up to 500 MW_{th}. District heating is in use in every town centre and wood chips, agrobiomass and pellets are used in thousands of heating units. In addition, Biogas is produced and used as a traffic fuel and heat.

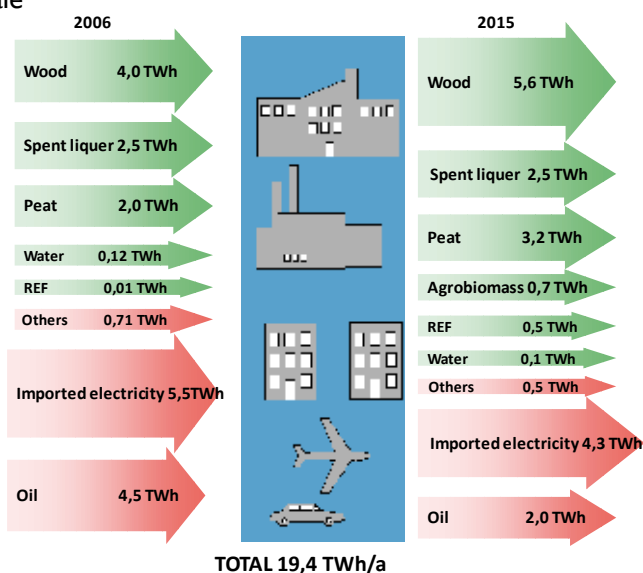
A living lab

Our vision is that by 2015 Central Finland will be independent from fossil fuels in heat and power production. Experience gained during half a century of intensive exploitation and development of bioenergy, combined with numerous bioenergy applications in different scales and wide utilisation of different biomasses, creates a unique environment to observe and study phenomena related to bioenergy production. Local research institutes draw

knowledge and strength from this region-wide bioenergy development laboratory to coincide with other research work performed in other parts of the country and abroad.

Bioenergy research in focus

The main research institutes in Central Finland are VTT, the University of Jyväskylä, and the JAMK University of Applied Sciences. They contribute together with the business life to regional bioenergy cluster development through The Dynamic Bioenergy Programme managed by the JAMK University of Applied Sciences and The Energy Technology Centre of Expertise Programme managed by the Jyväskylä Innovation Oy.



Energy sources in Central Finland: 2006 and target 2015.

Development of Bioenergy in Central Finland

	1983	1993	1998	2004	2006	Target 2015
TWh						
Wood	1 782	1 741	2 833	3 873	4 040	5 600
Spent liquer	953	2 405	2 908	2 266	2 470	2 500
Peat	442	1 900	2 153	1 870	2 035	3 200
Water	168	159	178	170	119	120
Agrobiomass						700
Ref						500
Total Renewables	3 345	6 205	8 073	8 179	8 664	12 620
Others	0	0	3	794	665	500
Imported electricity	2 192	3 994	4 814	5 138	5 490	4 300
Coal	398	195	80	44	57	0
Oil	6 095	4 850	4 845	4 441	4 482	2 000
Total	12 030	15 244	17 815	18 596	19 358	19 420

1 TWh=3,6PJ

Picture on front page: JAMK

University of Jyväskylä

Renewable Energy programme - a multidisciplinary approach

The University of Jyväskylä (JYU) is well known from its multidisciplinary Renewable Energy (RE) programme, where versatile bioenergy research and education is carried out together with other RE concepts. The international Master's Degree Programme of RE brings together five disciplines: chemistry, physics and environmental sciences as well as economic and social sciences.

About ten professors and their research teams focus on bioenergy related research at JYU. Annually 1-3 bioenergy-related doctoral thesis and 10-15 master's thesis have been published during the last ten years.

Key research areas

The bioenergy research at JYU aims to develop sustainable production and process technology. Research focusing on biogas and biorefinery processes are those areas having the longest history and tradition at JYU, including the biological, physical and chemical analysis of solid, liquid and gaseous biomasses as well as process and system studies. An example of new upcoming research within the RE programme is small-scale wood combustion with heat and power production options (micro-CHP).

Research groups

The biogas team aim to deepen the knowledge of biogas production from various feedstocks and upgrading processes and to develop digestate fractions to value added products. The research groups of chemistry deal with biorefinery concepts, among those the chemical analysis of solid and liquid biofuels and the utilisation of black liquors from kraft pulping. The characteristic feature of eg. the chemical research is to further develop



R&D on biogas production is one important topic. Biogas can be used as vehicle fuel. Metener Ltd. is a leading company in biogas business.



The wood chemistry related to biorefinery is being studied at the University of Jyväskylä.

analytical methods currently available by means of a deep understanding of analytical chemistry together with modern analytical instrumentation

The research group of business and economics develops new business models based on renewable energy sources (e.g. climate business, biorefineries, distribution network of biogas). Energy conservation and efficiency are issues also covered by the business researchers.

In social sciences (sociology/social public policy) the research teams are focusing on links between renewable energy and sustainable development, the aspect of social sustainability in particular. The processes of change in defined institutional operating environment (regulation and deregulation, impact of globalisation and environmental science) has given rise to this multidisciplinary research collaboration, consisting of natural scientists, political researchers and economic historians.

Cooperation

The sustainable utilisation of biomass is a research theme which brings together many research groups at JYU with other universities and research institutions like VTT and MTT. These cooperating groups have strong expertise in natural sciences and in the technical side of research such as combustion gas and particle emissions, efficiency in energy systems, emission balances of greenhouse gases and research of energy economics and environmental impacts. JYU also cooperates with municipalities and companies.

Versatile R&D for bioenergy and biomass fuels at VTT

VTT Technical Research Centre of Finland is the biggest multitechnological applied research organisation in Northern Europe.

A main goal of bioenergy research at VTT is to reduce greenhouse gas emissions related to the production of electricity by creating preconditions for increased use of biomass fuels for different purposes and size classes. On the other hand, our goal is to develop new technologies and new solutions to produce low-emission transportation fuels based on biomaterials and bio-based products replacing fossil fuels. In these research fields, our goal is to emphasize the significance of Finnish bioenergy expertise on the international market and to strengthen the production and competitiveness of bioenergy on a global scale. We will accomplish these goals by developing:

- more cost-effective and low-emission biomass fuel production and logistics chains
- electricity and heat production solutions based on renewable energy sources and carbon dioxide capture
- production concepts of transportation and synthetic fuels integrated with the forest industry and other industries
- solutions combining the utilisation of materials and energy
- energy solutions based on fuel cells for decentralised energy production.



VTT's versatile fluidised bed combustion facilities are applied e.g. in fuel characterisation and modelling. VTT has carried out fuel combustion behaviour studies and modelling in co-operation with the world's leading fluidized bed boiler suppliers (e.g. Metso Power and Foster Wheeler Energia). VTT's research results have been applied in planning the fluidised bed boilers for worlds' largest biomass fired plant, Alholmens Kraft in Finland and Lagisza plant in Poland.



VTT has carried out several feasibility studies for biomass production and use e.g. in the following countries: Ukraine, Uruguay, Namibia, Singapore, Indonesia and several European countries. In Namibia VTT has surveyed the utilisation bush biomass for electricity production.



VTT has actively participated in the developing grate combustion technology together with MW Power, which is a joint venture of Metso and Wärtsilä. Recently VTT has carried studies with test container at S & N's Royal Brewery in Manchester, testing the fuel blend of spent grain and wood chips. Photo MW Power.



In Finland reed canary grass is grown about on 15 000 hectares. VTT is developing technology for whole supply chain including harvesting, storage, transportation and use of reed canary grass at plants. Research is carried out in cooperation with fuel producers like Vapo Oy and boiler manufacturers and in existing power stations in Finland



VTT is developing with Forestry Centre Central Finland and Fixteri Oy technology for whole-tree bundling.

Main research challenges

A main future challenge of the energy industry is to curb climate change by reducing greenhouse gas emissions. Solutions based on bioenergy and carbon dioxide capture play an important role in the limitation of greenhouse gas emissions. On the other hand, the demand for biomaterial for different applications is significantly increasing. The growing demand leads to the expansion and diversification of the variety of fuels used in electricity and heat production, such as agricultural biomass and non-recyclable fractions of waste. The broadening of the variety of fuels often means, from a production, treatment and energy production technology perspective, a more challenging use of these fuels in various size classes. Another main challenge in the energy and environment industry is the reduction of greenhouse gas emissions in transportation. Several transportation fuel production technologies are under development world-wide. Their competitiveness will be verified in the near future by constructing demonstration plants.

Research areas at VTT

Our key research areas in the bioenergy field include:

- biomass fuel and biomaterial production, handling and treatment technologies;
- low-emission combustion and gasification solutions for the production of biomass fuels for heat and electricity production and for transportation;
- increasing the variety of fuels used in heat and power plants;
- modelling industrial flows and combustion;
- biotechnical processing plant concepts for the production of new refined biofuels; and
- fuel cells and hydrogen technology.

Resources

VTT employs 140 researchers at bioenergy field and has versatile research facilities for laboratory, bench and pilot scale research facilities for biomass fuel production, handling and treatment technologies, fluidised bed combustion, grate combustion, small-scale combustion, gasification and pyrolysis.



VTT has developed tools for on-line fouling diagnostics of multi-fuel boilers. Tools have been applied in several plants in Finland and Europe. So called deposit monitoring probes are used as one part of the diagnostics method.

JAMK University of Applied Sciences

JAMK is a multidisciplinary university of applied sciences which has four educational units and an administrative unit. The educational units offer bachelor's and master's level education, continuing education and research and development services for business and industry. The number of students is about 8 000 and the number of staff is about 700 where about half is teaching staff.

Applied R&D

JAMK participates in several national and EU-funded projects both as expert and as administrator. Projects undertaking preliminary analyses and practical product development, as well as supporting regional development, are implemented in cooperation with local and international enterprises, experts and other interest groups.

The multidisciplinary environment and expertise is an advantage that has been utilized at JAMK in many R&D projects.

Competence in bioenergy

Bioenergy is one of the top areas of expertise of JAMK. The applied research in bioenergy is centrally implemented at the Bioenergy Development Centre (BDC) of the Institute of Natural Resources, located in Saarijärvi. The Institute of Natural Resources, a part of the School



The new Bioenergy Development Centre offers advanced R&D and training services.



of Technology, has actively developed applied R&D competence and education in bioenergy. JAMK offers companies and organizations educational, development and testing services.

The key competence areas of the Institute of Natural Resources are

- wood fuel procurement and utilisation
- energy crops and biogas production
- bioenergy entrepreneurship

Resources

JAMK's Bioenergy Development Centre (BDC) employs about 10 bioenergy experts. The BDC is an on-the-job learning environment and centre of expertise for bioenergy technology. It is equipped with several biomass heating systems, fuel laboratory, biogas test reactor, biodiesel production plant, and solid fuel dryer.

The new, up-to-date bioenergy R&D and training centre will be opened in January 2010 in Saarijärvi. It will host official, standardized boiler testing laboratory in co-operation with VTT.

International Bioenergy Education

- Use of Wood Fuel for Heat Production (1 year)
- Wood Fuels Basic Information Pack (2-3 days)

Bioenergy services in Central Finland

There are several companies in Central-Finland offering international services in bioenergy field.

Fuel analysis services

ENAS Ltd

There are several companies in Central-Finland offering international services in bioenergy field. Fuel analysis services. ENAS Ltd is an independent laboratory company that provides competitive and reliable energy and environmental analyses to its clients. Company has more than 30 years' experience in analytical services of solid bio fuels and ashes. Our quality system and main methods are accredited. We maintain and continuously develop our methods and services together with our clients and research institutes. www.enas.fi

Consulting services

Benet Ltd

Benet Ltd is a Finnish expert company who markets and implements bioenergy expert services. Benet Ltd administrates the Benet Bioenergy Network. Through our extensive network, we can offer broad and versatile services with over 400 leading experts of the bioenergy field. With our expertise, our aim is to increase the use of environmentally and economically sound bioenergy use. This is done this by creating preconditions for bioenergy use, and by developing, consulting, implementing and coordinating bioenergy related projects. Benet build its business on over 10 years of networking and over 50 implemented projects. www.benet.fi

Elomatic Ltd

Elomatic provides a comprehensive range of engineering and consulting services in the filed of energy production, distribution, consumption and conservation both for industrial and public sector customers. Our services cover all stages from feasibility studies up to implementation and start-up. Our engineering and design services cover pre, basic and detailed design for heat and power plants as well as for district heating plants. Our consulting services include feasibility studies with profitability calculations, project management services. We also provide energy audits for the industrial sector and for the public sector. www.elomatic.com

MK Protech Ltd

MK Protech Ltd is specialized in anaerobic technology, where it applies self developed HLAD technology. The project management, engineering design and construction services are included in the plant delivery wholeness. The company business idea is to supply a whole basic engineering design package, which a local constructor will implement

according to the basic engineering design. The concept is economical for the client, where he will save needless profit charge. The client will receive the whole AD plant just he likes to have. www.mk-protech.fi

Protacon Engineering Ltd

Protacon Engineering Ltd produces plant wide engineering services to the implementation of electrification, automation and information systems in the energy sector. In addition we deliver automation systems and as a separate product for power plants we offer PAS Fuel information system, which can now also be delivered as a SaaS (Software as a Service) service. www.protacon.fi

Ramboll Finland Ltd

Ramboll Finland is a leading engineering, design and consultancy company employing more than 1 200 ambitious experts in 21 offices in Finland. The whole international organisation has a significant presence in Northern Europe, India, Russia and the Middle East with more than 9 000 experts. In Central-Finland we have more than 160 employees in Buildings & Design, Infrastructure & Transport, Water and Environment and Industry and Energy & Climate. In the work with energy companies and power plants, like, for example, power plant electrification and automation as well as boiler plant design, customers benefit from our broad spectrum of services. In Ramboll, we together with our customers, establish strategies and deliver solutions focusing on reducing CO2 emissions and adapting to climate changes. www.ramboll.com

Vaskol Ltd

Vaskol consulting services include feasibility studies with profitability calculations, project management services. We also provide energy audits for the industrial sector and for the public sector. Vaskol Oy is an engineering company established in 2000 and specialises in engineering designs for heat and power plants using biomass based fuels, oil or gas and pellet manufacturing mills. Vaskol Oy will be consolidated into Elomatic as of July 1, 2009. Vaskol's current customer base includes several boiler and pressure device manufacturers, industrial facilities and municipal bodies. www.vaskol.com

Watrec Ltd

Watrec Ltd is a Finnish company specialized in environmental engineering and science. Essential know-how is in biowaste, wastewater, and process water treatment and consultancy services for the both environmental and energy related issues. Our core business is to provide solutions for customers who have challenges with their wastes and wastewaters.. www.watrec.fi

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More detailed information about the the research and services at Jyväskylä University, VTT and JAMK is available at the english site www.finbioenergy.fi.