Testing bioenergy – an international perspective

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Agenda

- Inspiration from:
  - RHC - Renewable Heating and Cooling platform
  - IEA Bioenergy task 32 Biomass and Co-firing

Question

What kind of problems are we facing in the further development of solid biomass fuels used in boiler systems - and how can these problems be addressed in a test facility?

your Science Partner

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2013

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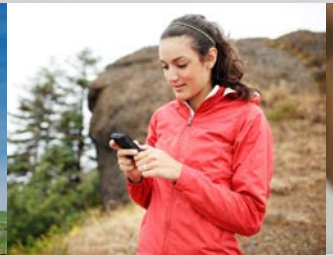




BUSINESS AREAS

- Energy
- Life Science
- The Built Environment
- Transport
- Information and Communications Technology, ICT
- Risk, Safety and Security

SP Technical Research Institute of Sweden

THE INNOVATION PROCESS

– WITH YOU EVERY STEP OF THE WAY

- > 10 000 customers
- Leading edge expertise
- Experimental resources
- Technical scope
- Interdisciplinary working method

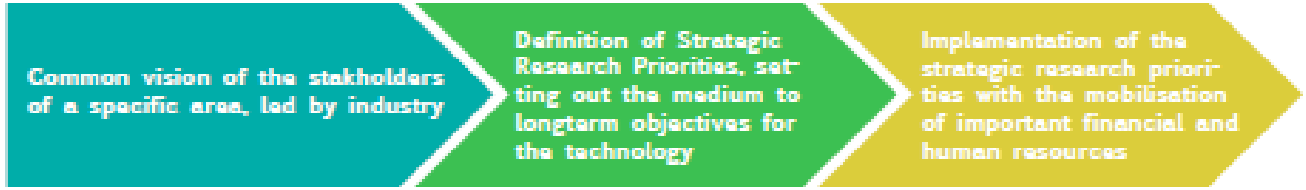
SP Technical Research Institute of Sweden

SP DENMARK
— The first company outside Sweden

- Close links with SP Electronics
- Located together with Aalborg University in Copenhagen
- Test laboratories for EMC (interference testing for electronics), climate and mechanical testing
- Error analysis for electronics, investigating sources of error and repairs

The European Technology Platform Renewable Heat and Cooling (RHC)

- An ETP is a network of researcher, industry and other stakeholders in order to foster research and development in a concerned area
- Focus on strategic issues, to ensure Europe's future growth, competitiveness and sustainability
- Play a key role in aligning EU research priorities to industry's needs

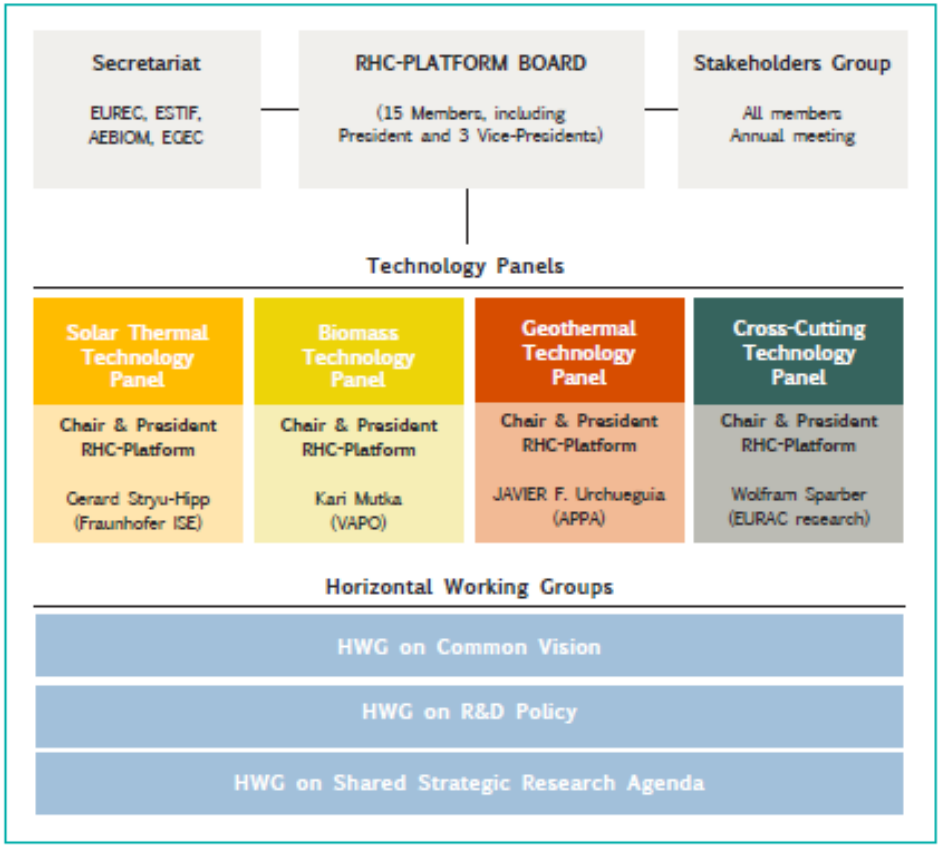


- ➢ Support development and deployment of key technologies in Europe
- ➢ Define a European vision and strategic agenda for the development and deployment of these techniques
- ➢ Support investments by bringing research closer to industry and improving markets for innovative products

RHC

The Biomass Technology Panel 4 Issue groups:

- Biomass fuels (whole supply chain)
- Technologies for residential heating and cooling
- Technologies for industries and district heating and cooling
- Market and policy deployment, communication and training



RHC visions

For 2020:

The biomass heat market share in Europe should rise from 11 % in 2007 to about 25 % in 2020, even considering the reduction in heat demand.
By 2020, technically reliable, environmentally friendly and economically attractive renewable heat solutions should be available for almost each type of consumer as alternative to fossil based system.

For 2050:

by 2050 the energy needs will have radically shifted towards increased electricity and reduced heat demand. Bioenergy will still play a key role in all markets and sustainable land use and resource management will be crucial for secure the availability of biomass for heating and cooling. High conversion efficiency will be absolutely essential.

Priorities to reach the visions

- Security of supply
  - Biomass supply will double with a significant increase of energy crops, by-products and residues from agriculture and logging residues. Focus on improving fuel quality and on the development on high grade fuels.
- Fuel and load flexibility
  - Limited amount of high quality fuels. Multi-fuel units using a variety of fuels must be developed. Operation in lower part loads and with faster load change
- Efficiency and emissions
  - Increased air quality and efficiency requirements
- Integrated concepts and management
  - Biomass will be used for peak loads and for load regulation. Integration with other energy sources should be optimized. Regional concepts for co-utilisation: biorefineries, hybrid systems, heat storages technologies has to be developed
- Sustainability
  - Sustainability will be an important driving force

Residential heating and cooling - Stoves, cookers and fireplaces

The 2020 vision for residential bioenergy technologies is to replace oil today in the boiler exchange and refurbishment market, to strongly compete with natural gas and to add value to other renewable energy technologies in the new building sector

Strategic research priorities

- Open fireplaces should no longer be sold in densely populated areas but fully substituted by closed fireplaces and chimney inserts
- New concepts for log wood stoves, chimney inserts and cookers need to be developed
- Secondary measures to reduce emissions will be widely used
- Pellet stoves will almost perform as pellet boilers
- Insulation materials with catalytic surfaces need to be developed
- New heat storing materials and concepts should be an option in low-energy buildings
- Stoves with water heat exchanger will be an established technology
- User influence will be widely eliminated

Residential heating and cooling - Boilers

Strategic research priorities

- Close the gap between testing efficiencies (up to > 90%) and real life (annual) efficiency (70% or less)
- Wood chips and non-wood pellet boilers will require secondary measures for reduction of NOx and PM
- Intelligent load control
- System integration (solar thermal, heat storage) and building integration
- New heat storing concepts
- Advanced primary measures for PM reduction such as extreme air staging combined with bed temperature control
- Secondary measures (electrostatic precipitators, bag house filters from various filter materials)

Industrial and district heating and cooling

By 2020, bioenergy produced from large scale and industrial systems should increase significantly by developing multifuel units with high efficiency and increased operational availability

Strategic research priorities

- Efficiency and operational bottlenecks (slagging, fouling, corrosion etc) will be driving forces
- District heating and cooling networks will be largely developed also in rural villages, increased life-span and low efficiency losses in terms of tube insulation
- Co-generation and tri-generation (heat-power-cold) will be interesting both for industry and for DH
- 40 % of industrial by-products and residues will be recovered for energy
- Efficiency up to 100 %
- Stringent emission thresholds

Objectives for industrial heating and cooling

	Today	2020	2030	Beyond 2030
Energy recovery on biomass based industrial by-products	5% Identification of by-products and (alternative) energy ways of valorisation	30% Identification of by-products and (alternative) energy ways of valorisation	60% Identification of by-products and (alternative) energy ways of valorisation	100% Identification of by-products and (alternative) energy ways of valorisation
Boiler efficiency/ conversion efficiency	85%	Condensing boiler 100%	104%	106%
Emissions CO-NOx	200-150 mg/m^3_N	100-75 mg/m^3_N	50-75 mg/m^3_N	<10 mg/m^3_N
Emissions dust	100 mg/m^3_N	50 mg/m^3_N	30 mg/m^3_N	<10 mg/m^3_N
Solid residues re-use	100% landfilled of uncontrolled use	10% landfilled 50% controlled reuse	5% landfilled 80% controlled reuse	0% landfilled All utilized

Fuel and load flexibility in industrial scale boilers

	Today	2020	2030	Beyond 2030
Fuel flexibility	Wood chips or residues from wood processing industry (>80%) Wastes not to be landfilled (<10%)	Standard multi-fuel plants (virgin wood, max 30% agricultural residuals, thermally treated fuels) Wood chips or residuals from wood processing industry (>50%)	Fuel blends and mixtures with enhanced efficiency, max 50% agro-residues	Full fuel flexibility plants
Load flexibility	About 10-70% of wood fuels cofired in multifuel CHP plants	Part load >30% Slow load change	Part load with CHP >20% Load change speed increased, with steam storage	Once through boilers, part load 20% Quick load change with enhanced plant control

Summarizing from RHC – challenges for industrial scale boilers

- Fuel flexibility / other fuels than woody ones
- Load flexibility and low loads
- Efficiency
- Emissions
- Co- and trigeneration / integrated systems

SP Techn

The country participation includes Australia, Austria, Canada, Denmark, Germany, Ireland, Netherlands, Norway, Sweden, Switzerland, Turkey and United Kingdom.

Objectives

Enhancement of industrial participation is realised by formulating joint projects between participating members and industry.

The emphasis of the activities in the Task is on:

- *market introduction* for expanding the use of Biomass Combustion at a short term;
- *optimisation of biomass combustion technology* to remain competitive at a longer term.

Task 42 work plan

- Workshop about ingoing torrefication technologies
- Workshop on the use of CFD modelling techniques for the study of biomass combustion an co-combustion systems
- Workshop on the design of highly efficient and clean stoves and boilers
- Publication on high temperature boiler corrosion and new options to achieve higher superheater temperatures in biomass boilers
- Publication on new fuel characterisation methods
- Report on biomass milling and combustion in pulverized fuel boilers
- Policy paper on standardization in particle emission measurement techniques
- Joint workshop on increased co-firing percentages for power utilities
- Study on good practices for high annual efficiencies of the overall system in district heating
- Best practise of combustion for CHP in comparison to pyrolysis and gasification
- Database and internet based tools

Task 32: Biomass Combustion and Co-firing

Triennium 2013-2015

Drivers behind the global development of bioenergy technologies in general are:

- Diversification of energy carriers, technologies, and infrastructure,
- Improving access to clean energy sources,
- Reducing the use of fossil fuels and thus saving them for other applications and future use,
- Increasing the flexibility of power systems as electricity demand changes,
- Reducing pollution and emissions from conventional energy systems,
- Reducing dependency, and minimising spending on imported fuels, and
- Job creation, mainly related to the biomass fuel supply chain.

GENERAL TRENDS CONCERNING LARGER UNITS

- …
- Biomass based CHP plants based on grate combustion are widely deployed in Scandinavian countries, Austria, Switzerland, Italy, Germany and to a lesser extent USA and France. These systems are generally of increasing scale and have increasing electrical efficiency due to increased understanding of super heater corrosion mechanisms
- CHP plants based on fluid bed combustion in the size of 20-100 MW_e can be considered as well established technology, especially deployed in Finland and Sweden but increasingly in other countries as well
- The co-firing of biomass with coal is widely deployed in a number of European countries and is of increasing interest worldwide. There is also a trend, perhaps short term in nature, towards the conversion of existing coal-fired boilers to 100% biomass firing

Trends for industrial heating and cooling

	2009	2050
Biomass based power generation	290 TWh 1.5% of world generation	3270 TWh 7.5% of world generation

Challenges for further market deployment

For **industrial combustion systems**, most of the challenges are technical

- More challenging fuels with low ash melting temperatures and high N and Cl content, such as agrifuels, reed canary grass, RDF, etc

- The use of such fuels can conflict with the aim to raise steam temperatures in superheaters to obtain higher electric efficiencies, because of the increased risks of ash deposition and corrosion problems

- The development of new fuel pretreatment options, boiler concepts and boiler materials may increase the fuel flexibility of combustion systems

- Increased efficiencies and availability in district heating systems, improved operational performance of biomass fired CHP systems

Directive on the limitation of emissions of certain pollutants into the air from medium combustion plants (MCP Directive) 1 - 50 MW

Limits for dust

	1-5 MW	> 5 MW
Todays limits (mg/Nm3 @ 13 % CO2)	120 (14 plants)	60 (9 plants)
Proposed limits (mg/Nm3)		
@ 6 % O2	45	30
@ 13 % CO2	42	28
New plants	Ca 2018 (one year after impl.)	Ca 2018 (one year after impl.)
Existing plants	2030	2025

Thank you for listening!

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