SESSION V - Strategy and perspectives for market implementation

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Drivers for a new Market Strategy

- Torrefaction is an important conversion technology especially for the sustainable substitution of fossil coal
- R&D activities are needed to stimulate future market development
- SECTOR is the leading R&D project globally - thus interest in results from market actors is high
- BUT: Timing has changed in the global biomass business, industrial market implementation might come later than expected and after SECTOR finalization

→ New strategy might be needed for market implementation

Source: statement advisory board, Hubert Röder, Brussels, 18.03.2014
Torrefaction is an important conversion technology especially for the sustainable substitution of fossil coal

Wood pellet cofiring potential (5% with coal) in more than 100 existing pulverised coal-fired plants in Europe

- Hard Coal: 30%
- Lignite: 70%
- 843 million t/a
- 5% cofiring with coal
- = 33 million t/a

= ~ 2 times world wood pellet production in 2010
= ~ 3.25 times EU wood pellet production in 2010

source: Pöyry, pelletforum
Torrefaction is an important conversion technology especially for the sustainable substitution of fossil coal.

*World pellet production/consumption in 2013 [in million of tonnes]*

Source: AEBIOM European Bioenergy Outlook 2014

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Torrefaction is an important conversion technology especially for the sustainable substitution of fossil coal

Wood pellet cofiring potential (5% with coal) in more than 100 existing pulverised coal-fired plants in Europe

- Total coal use was 772 million tons in Europe in 2012.
- Biggest coal users in Europe are Germany, Poland, Ukraine, United Kingdom and Czech Republic.
- By torrefied pellets replacement could be as high as 50%* from the technical point
- Today we know maybe 30% will be most cost efficient

However, this makes European market hugely significant.

source: Pöyry, pelletforum

2013: worldwide wood pellet production about 25 Mio. t
2014: EU production approximately 20 Mio. t wood pellets

SECTOR is the leading R&D project globally - thus interest in results from market actors is high

Market situation May 2015 outside SECTOR: Distribution of (soon) operational torrefaction plants

- **Status**: in operation, in construction, probably closed, closed, status unknown, project terminated, planned

- **(Proposed) Production capacity**:
  - Below 100,000 t/a and more
  - Below 50,000 t/a
  - Below 20,000 t/a
  - Below 3,500 t/a
R&D activities are needed to stimulate future market development

<table>
<thead>
<tr>
<th>Capacity</th>
<th>5-10 kg/h</th>
<th>30-200 kg/h</th>
<th>20-50 kton/a</th>
<th>60-200 kton/a</th>
</tr>
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<tbody>
<tr>
<td>Woody biomass</td>
<td>Proof-of-principle</td>
<td>Proof-of-concept</td>
<td>Prototype (pilot-scale)</td>
<td>Technical demonstration</td>
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<tr>
<td>Non-woody biomass residues</td>
<td>Proof-of-principle</td>
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<td>Technical demonstration</td>
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**BUT:** Timing has changed in the global biomass business, industrial market implementation might come later than expected and after SECTOR finalization

→ original project focus on large scale applications (power market)
→ NOW: orientation towards alternative markets (e.g. small and medium heating and CHP application, additionally intermediate product for transport fuel market and / or bioeconomy sector

**STILL REQUIRED:** Investors are needed to build up commercial plants

source: ECN
Key Questions for the market implementation strategy

- **Political Framework** conditions - Is a revival of incentive schemes or carbon credits to be expected to improve cost competitiveness of sustainable biofuels in the short term?
- Which **new markets** are attractive for torrefied biomass?
- What are concrete **trigger points** for implementation?
- How to ensure **relevance of results** for medium to long term future investments?

Source: statement advisory board, Hubert Röder, Brussels, 18.03.2014
Political Framework: R&D focus areas - EC goals

- **20-20-20 goals defined for 2020**
  - CO₂ emission reduction of 20% compared to 1990
  - Energy efficiency increase of 20%
  - Renewable energy share of 20% in the overall energy consumption

- **Targets for 2030 of the EC**
  - CO₂ emission reduction of 40% compared to 1990
  - Renewable energy share of 27% in the overall energy consumption
  - 30% improvement in energy efficiency (compared to projections)

The way ahead: EC policies to achieve the targets

- A reformed EU emissions trading scheme (ETS)
- New indicators for the competitiveness and security of the energy system, such as price differences with major trading partners, diversification of supply, and interconnection capacity between EU countries
- First ideas on a new governance system based on national plans for competitive, secure, and sustainable energy. These plans will follow a common EU approach. They will ensure stronger investor certainty, greater transparency, enhanced policy coherence and improved coordination across the EU.

New market strategy - possible products

- torrefaction technology
  - sublicensing torrefaction technology
  - selling torrefaction technology
- torrfuel production
  - in biomass surplus regions within/outside EU with destination EU
  - in regions with difficult biomass to mobilize it
  - production and sale of torrfuels outside EU, e.g. Asia
- production of chemicals or biomaterials
  - development of bioeconomy products of the torrgas condensate (e.g. biodegradable pesticides, wood protection substances)
Market Conditions: Renewable Energy Outlook

Perspective of Electricity Production in Mrd. \((10^9)\) kWh

Expected growth of electricity production worldwide

- 2010: 20,000
- 2035: 40,000
- +71 %

Expected growth of electricity production in the EU

- 2010: 3,000
- 2035: 4,500
- +23 %

Background:
- World population growth appr. 83 Mio. annually (doubling since 1960). Currently about ¼ of the world population (in total 7,2 Mrd. people) have still no access to electricity.
- The EU produce appr. 16% of the world electricity (3 346 Mrd. kWh); till 2035 a growth of 0,8% annually is estimated.

Source: VGB PowerTech, 2013/14
Planned & announced new power plant projects in Europe

Shares of Energy Carriers (2007 – 2020)

- **Gas** (72 406 MW; 30,21 %)*
- **Oil** (0 MW; 0 %)*
- **Hard Coal** (28 685 MW; 11,97 %)*
- **Lignite and Peat** (4 695 MW; 1,97 %)
- **Nuclear** (57 200 MW; 23,86 %)
- **Hydro** (16 559 MW; 6,91 %)
- **Wind** (57 014 MW; 23,79 %)
- **Biomass**
  - (955 MW; 0,4 %)
- **Residues and Waste**
  - (203 MW; 0,08 %)
- **Other Renewables**
  - (1 983 MW; 0,83 %)

Total: 239 701 MW

Source: Zahlen und Fakten, VGB PowerTech, 2013/14
It is estimated that the needed investment volume must more that double till 2035 to cover the expected demand.

source: World Energy Outlook, IEA 2013
Increasing renewable energy installations need large investments, financial support schemes and favourable framework conditions to be competitive to the fossil energy supply.

source: World Energy Outlook, IEA 2013
Market survey summary: Black & white pellets

- **Supply:**
  - USA Southeast & Northwest Russia: major cost effective suppliers for Europe
  - Canada and Brazil with further biomass potential of wood and bagasse
  - Asia (e.g. India, China): bamboo, palm oil residues

- **Demand:**
  - Asia Pacific: Especially Japan after Fukushima, South Korea
  - South Africa: Plans to substitute coal by 10%
  - US: co-firing schemes emerging
  - white pellets have not been established, chance for torrefied fuels
  - Europe:
    - major market in large scale appliances, depending on policy (switch from coal to biomass, due to low CAPEX), growing demand mostly in UK
    - residential grade pellets (white) strongest markets in Germany, Italy, Austria, growing demand in heating market
Market survey summary: Black & white pellets

=> competition between white and black pellets?

Top ten wood Pellet consuming countries by end-use in 2013 [in millions of tonnes]

Source: AEBIOM European Bioenergy Outlook 2014
What interest have end users on torrefied material?

SECTOR-survey (WP2) in 2012/13:

- **Security of supply:** sufficient and continuous fuel availability in a competitive market ➔ 2012/13 only limited torrefied material could be tested before, within SECTOR 160 tons of torrefied pellets were produced for further tests.

- **Define fuel properties:** replacement of wood pellets cofiring by use of torrefied material (expected cofiring ratios, higher energy density) ➔ SECTOR drafted Fuel specification to ISO/TC 238, 17225-8, meanwhile new fuel parameter could be defined (e.g. degree of torrefaction, grindability).

- **Demonstrate full-scale tests** / availability of experiences and test results to convince strategic decision makers to start midterm contract negotiations; expected information of demonstration tests:
  - Densification of torrefied material: energy density of pellets
  - Large scale co-firing and co-gasification tests: heating value, reactivity, handling
  - (co-)milling and outdoor storage tests: grindability, investments in parallel conveying system necessary?, risks of self heating and off-gasing (CO and VOC emissions), durability, water uptake / leachability
  - Overall cost and sustainability analysis along the whole value chain

➔ SECTOR published Vattenfall-cogasification test results and will perform cofiring test by Helen Limited in autumn.

source: adapted by E. Alakangas, VTT
Helen Limited - potential user

- What: heat and electricity
- What from: coal
- Where: Helsinki, Parrukatu 1-3
- When: 1974
- How much: electricity 220 MW, heat 420 MW

→ Cofiring tests within SECTOR (79 t torrefied material)
Trigger Points I: Market Barriers

- **Price competitiveness:**
  - Torrefied biomass vs. coal + emission certificates
  - Torrefied biomass vs. conventional biomass + infrastructure

- **Size of torrefied biomass production for cofiring/cogasification**
  - Start up needs to be large scale, however up-scaling poses technical and financial problem
  - Even production of test material for relevant share of cofiring over longer periods is difficult in demo plants

- **Establishment of business relations**
  - Power producers need prove of reliable supply in terms of quality and quantity
  - Producers need long term contract for investing in large scale

- **Still unclear legal regulations**
  - e.g. REACH and sustainability requirements
Trigger Points II: Technical Challenges

- quality and quantity of input biomass
- process control for varying qualities and different fuels to achieve constant quality of output streams
- integration of densification
- component availability (prototype production, adaptation of equipment from other sectors necessary)
- minimisation of logistical and end-use risks
- determination of standardised fuel properties/qualities (ISO/TC 238)
Trigger Points III: Biomass potentials and availability

- **Biomass resources are limited** and an increasing competition with material use is seen about high quality fractions (especially round wood)

- The energetic **use of large potentials are often very inefficient** (especially in non-developed countries)

- The **cultivation of energetic biomass plants (e.g. SRC) is limited according to the area potential** (food & fodder cultivation, natural protection etc.) and expensive

- New market actors compete about available amounts (Bioeconomy)

- **However:** Worldwide are still available biomass potentials, especially in the sector of agricultural and forestry residues as well as organic waste

- **But:** Biomass qualities and risks/benefits are often unknown
  - Agro-biomass contains higher amounts of chlorine, potassium and sodium (corrosion, emission and ash problems must be solved) → torrefaction process does influence such incredience rarely)
  - Experiences with untreated agro-biomass showed that cofiring ratio 10 to 20% should be possible
  - Fuel prices can become competitive by efficient logistic concepts
How to ensure relevance of results for medium to long term future investments? - Strategy Development

- **Tackle the price competitiveness**
  - Regulatory framework: support schemes, quotas and/or effective emission trade
  - Reduction of cost through industry integration, further development, large scale implementation / upscaling technology

- **Tackle the needed installed capacity problem**
  - Focus on smaller markets, diversified markets (e.g. heat, CHP)
  - Support of small distributed plants with lower capacity

- **Establishment of business relations**
  - Support of one best practice example, buffering risks

- **Tackle the unclear regulation**
  - Acceleration of fuel quality standard / specification and regulation development (e.g. REACH registration or not, sustainability)
What can be done in SECTOR additionally?

- Support of Strategy Development
- Policy consulting
  - Knowledge transfer to organisations with direct contact to decision makers like RHC-EP, AEBIOM (input to EU SET-Plan, EIBI) and also large NGO’s
  - Policy Workshop in June (16./17.06.2015)
  - Articles in specific journals such as Parliament, International Innovation
- Technology advancement in the market: availability, price effects through knowledge sharing
  - Further publications (also peer reviewed to reach science)
  - Support of IBTC
  - Cooperation with IEA task 40 /32
- In general: initiation of further R&D based projects on trigger points
CONCLUSIONS - STRATEGY AND PERSPECTIVES FOR MARKET IMPLEMENTATION
Conclusions - Strategy and perspectives for market implementation

- Torrefaction technologies are manifold on the start but only few developers are able to provide a commercial offer for the realisation of a full scale plant.

- Barriers to market implementation:
  - Low price for coal and CO₂-emission allowances vs high biomass price
  - When cofiring / co-gasification, then power plant operators see advantage in use of established / commodity biofuel ➔ white pellets
  - Existing investments of power plant operators in white pellet application (nearly same delivery costs per GJ, outside storage advantage of torrefied fuel covers not additional cost and disadvantage of dirty handling)
  - Project funding of commercial torrefaction plants to supply cofiring plants

- Prospective markets currently:
  - Countries in which supporting schemes exists for biomass cofiring or the use of 100% biomass fuels in large scale applications (e.g. UK, NL, BEL)
  - Countries in which the large scale biomass use starts now; thus appropriate infrastructure and plant modification to torrefied material can directly installed (e.g. Asia, South Africa) ➔ lower CAPEX
Conclusions - Strategy and perspectives for market implementation

- Attractive markets perspectives:
  - Heating /CHP market, due to the higher willingness to pay by end users → However, when introducing into small & medium scale market a separate delivery structure for torrefied fuels has to be established (no direct fuel supply from producer site and in parallel to the white pellets distribution network) → no combined transport and storage facilities for black & white pellets
  - High value applications, e.g. bioeconomy sector, 2nd generation biofuels

- Improving the market frame conditions for the application of torrefied biomass
  - Attractive and stable EU and national policies ➔ SECTOR/BioBoost Policy WS 16./17.06.2015
  - Transparent and fixed sustainability requirements for solid biomass
  - Handling of REACH requirements ➔ SECTOR contribution, MSDS-development in cooperation with IBTC
  - Adaption of national regulations (e.g. German emission standards to integrate torrefied fuels; boiler type license to apply torrefied fuels)

➔ SECTOR contributes to shorten the time to market implementation
thank you very much for your attention

SECTOR contacts: Strategy and perspectives for market implementation

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