GA no 282826

Production of Solid Sustainable Energy Carriers from Biomass by Means of Torrefaction

Deliverable No. D1.2

Midterm Report after the Midterm Project Conference

Dissemination Level		
PU	Public	x
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Nature		
R	Report	x
O	Other	

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1 Summary

The SECTOR midterm project meeting took place from 16.10. to 18.10.2013 at the site of the project partner CENER in Pamplona, Spain. With 45 participants including two advisory board members and three external experts, the meeting was very successful and offered the opportunity to an intensive exchange between the different work packages and partners. A common workshop with external experts from related projects and the IEA Bioenergy Task 40 disclosed links and cooperation possibilities between the projects and SECTOR. An excursion to the CENER semi-industrial pilot scale test facility gave an insight into their biomass physical pre-treatment unit, gasification unit and the biochemical module.

Fig. 1 SECTOR Partners during the visit of the CENER facilities

2 Agenda

The meeting was divided into an internal and an external part.

For the external part three experts were invited, in detail two representatives from the related projects BioBoost and INFRES and one representative of the IEA Bioenergy Task 40. This part consisted of the presentation of all work packages of SECTOR to inform all participants of the most important results achieved in each work package so far and a workshop together with the external experts. After the introduction of each related project, a common discussion was initiated to explore links and other cooperation possibilities between the projects.

The internal part of the meeting consisted of various group discussions with different work packages in each group and the general assembly with organisational matters of the project.

The advisory board members were invited to join the group discussions and to contribute to the different issues.

The group discussions were devided into three sessions. During the first and second session parallel meetings among different groups of work packages took place whereas the third session had its focus on a general discussion on the future of the torrefaction market.

In the first session, the work packages on Torrefaction and Densification (WP 3-5) have exchanged their findings with the work packages on End use and Logistics (WP 6/7). In a parallel group, the work package on Fuel specification, analysis and quality assurance (WP8) was in discussion about standardisation and dissemmination with the related work package (WP10).

In the second session, different representatives of the work packages responsible for the production of the torrefied pellets and the end use (WP 3-7) discussed with either WP 8 about analysis methods and fuel properties or with WP 9 about storylines and scenarios of the life cycle assessment. These two sessions aimed at defining the status quo, analysing the lessons learnt and to find the appropriate way forward.

The third session consisted of two different group meetings, which were assigned by lot at the beginning of the project meeting. Only the leaders of the discussions were defined in advance. The objective of these groups was to talk about the future of torrefaction – market development and implications.

3 Presentations

3.1 Presentations of Work Packages 2-10

The work package presentations include all results and highlights which were achieved in the work packages since the beginning of the project. Please refer to Annex I for the presentations. The objective of these presentations was to provide an overview of the objectives and results in each work package for all participants. Further details were discussed in the different working group sessions during the internal part of the meeting.

3.2 Presentations of the external experts

In the beginning of the workshop, every external expert was invited to give an introduction of their project. These presentations can be found from Annex II – IV. After the introduction, an open discussion led to different approaches for a cooperation with SECTOR.

3.3 Results of group discussions on Future of torrefaction - market development and implications

During this session the work was focused on: (1) identifying the largest market potentials for torrefied biomass; (2) documenting the impressions of a potential change in the market situation for torrefied biomass in the last 2 -3 years; (3) identifying any potential need for changes in the focus/objectives of the project; and if so, specifying the changes and impacts on the project; and (4) compiling any concrete and realistic ideas on how to implement changes in the project.

All participants were divided into two working groups. Before the discussions started, the Advisory Board provided a statement with their point of view to the asked questions. Following is a short compiled summary of the conclusions from the two groups.

3.3.1 Statements of the Advisory Board

Answers to the first question "Where do you see the largest market potentials for torrefied biomass?":

- Coal fired condensing plants
- High volumes required from recycled or renewable sources
- Low cost required, because coal is the cheapest of fuels
- High calorific value required to achieve nominal capacity of the power plant
- Modest additional investments at the plant required– if investing in new fuel storage, preparation and feeding equipment can be avoided, it is a clear bonus
- Problems with air emissions, ash handling and boiler maintenance/reliability must not occur
- Advanced gasification technologies and CHP

The key question is if coal is currently too abundant, too cheap and a too good fuel so that torrefied biomass is in the end a long-term sustainable solution to replace it?

Lowest hanging fruits niche markets – NOW

Current situation:

- No standards

- No volumes

- No experience

→

Current approach:

- Closed and integrated business models based on long term delivery agreements

- Brown field - retrofitting of existing pellet/briquetting plants

- Use of woody biomass feedstock

- North American or European producer and buyers

Largest torrefaction market – EVENTUALLY

Future situation:

- Standards are defined
- Free volumes traded internationally
- Experience of application

Future approach:

- Long haul biomass supply chains
- And/or broad range of biomass feedstock including non-traditional biomass (agricultural biomass, stranded biomass, funny fuels, etc.)
- Selling into an international market to coal fired power -, cement -, or gasification plants , industrial users
- Green field investments
- South America, Australia, New Zealand, Sub-Saharan Africa

Answers to the second question “Do you see a change in the market situation for torrefied biomass in the last 2 - 3 years?”:

- Insecurity of incentive schemes
    - Investment schemes are the clear driver for investments in renewable energy
    - Peak of incentives was reached during the financial crisis
    - Many incentive schemes in Europe are currently under discussion
    - Electricity price is decreasing due to other renewable energy investments (at least in Germany)
    - Carbon credit market is weak
    - Security for new investments is low
- Key question: Revival of incentive schemes, carbon credit or electricity price to be expected?

Answers to the third question: “Is there a need for changes in the focus / objectives of the project and if YES, please specify the changes and impacts on the project.”:

- No need for project focus / objective change
- Key question: Relevance of results?
    - Are markets ready for torrefied biomass NOW?
    - Ensure relevance of results for long term future investments?
    - What are concrete trigger points for implementation?

Answers to the fourth question: "Do you have concrete and realistic ideas on how to implement changes in the project?":

- Pre-contracts of substantial volumes by industry partners?
- Improving efficiency and economic feasibility of the whole value chain?

3.3.2 Summary of the discussion in Group 1 lead by Anders Nordin (UmU) and Nader Padban (Vattenfall)

Compared to what was foreseen and expected a few years ago, torrefaction and its market development presently suffer from two main challenges; (1) the slower progress of commercialization and roll out of industrial torrefaction capacity with sufficient product quality; and (2) the presently low market prize of CO_2 in European emission trading system, combined with a relatively low coal prize.

There are however huge dedicated market segments that would be sufficient for the torrefaction industry to significantly grow and commercially take off (in a decent and healthy progressive way). The identified growth segments were identified as follows:

- Expansion in policy / incentive driven markets:

The national incentives differ much within the EU and a significant part of the coal replacement may well be driven by these national incentives.

- Taking market share from traditional wood pellets:

Industrial replacement of fossil coal, gas and oil is another huge segment where traditional pellets presently are expanding, and where torrefied and compacted material have significant advantages. Even for medium scale oil and gas fired plants there will be a growing market for torrefied and densified biomass materials.

- A fuel for peak load application (oil, gas and low calorific value biomass replacement):

Due to its high energy density torrefaction product has a better opportunity for replacement of fossil fuels during peak load. For normal biomass plants the torrefied fuel might be used as a booster when needed.

- Long term application in liquid fuel or chemicals from biomass:

Torrefaction as a pre-treatment process for centralized gasification and synthesis of liquid fuels and green chemicals may also well be a huge potential market, in the long term.

- Upgrading/ homogenization of low quality biomass sources

Torrefaction might be a route for homogenization of the quality of agricultural residue, increasing their energy density, improving their undesired chemical properties and by that turning those to tradable energy sources.

For a successful industrialization of the technology the SECTOR project and torrefaction industry need to put effort on following actions:

- Communicate the need for a working carbon emission system and market well-functioning CO_2 trading system and how torrefaction could be the major facilitator in the conversion of European energy industry (who else would)
- Document and push the advantages of torrefied materials
- List "all" possible niche markets - prioritize in this list
- Try to make transparent business case calculations
- Build the confidence and reliance in the industrial torrefaction sector
- Explore all potential alternative uses
- Compile present and future national subsidiary systems
- Push converting/replacing/expanding/improving white pellet industry, and
- Stimulate large scale applications of biomass in general

In the long, however it must be realized that coal replacement is and will be the most efficient GHG-remediation use of biomass. It is cost-efficient and also preparing for liquid fuel production. We therefore need to improve the emission trading system to get back to the market prices we had a few years ago.

3.3.3 Summary of the discussion in Group 1 lead by Manuel Schwabl (BE2020) and Hans Hartmann (TFZ)

The torrefaction process is a possibility to upgrade biogenic fuels, resulting in significant advantages in comparison to non-torrefied biofuels:

- An increase in energy density enhances logistic costs (storage and transportation)
- The physical properties are changed by torrefaction: in particular the grinding behaviour and the water uptake are changed.

The feedstock of torrefied fuel is in competition with “white” pellets and coal. The substitution of “white” pellets can only be achieved by taking advantage of the lower transportation costs. For the competition with coal both advantages need to be capitalized. Besides this, attractive incentive schemes will also be necessary to compete with this low-cost feedstock.

One market for such a feedstock is co-firing in coal CHP plants or to completely convert the whole plant to this biogenic fuel. The sales quantity of torrefied fuels can be very high and can deal with different qualities of the biogenic material (within reason). One key issue for this market is thus the fuel costs. Since torrefied fuels would most likely substitute coal, this market would be able to take full advantage out of the changed fuel properties. Thus CHP plants running on torrefied fuels would have the opportunity to fill the energy gap, in particular when it comes to shut down of coal and/or nuclear power plants (“plant re-life”). In the past few years, investors for this market have become more careful, since the expectations concerning the physical properties were not fulfilled.

A second market is the generation of chemicals by entrained flow gasification process. This market would also have a high demand in such fuels, but is more stringent concerning the fuel quality. However, since the torrefied fuel would act as a substitute for coal, this market can take full advantage of the properties of torrefied feedstock.

A third market was identified for small and medium scale combustion systems. This market is characterised by rather small volumes, but would be an interesting starter for the torrefaction industry and to build up capacities. The feedstock, however, needs to be of a certainly high quality. The major opportunity is faced when the “white” pellets market turns into an import market. Then the advantage of increased energy density and lower transportation costs can be fully utilised. However, this market also has some major concerns and challenges, which deal with the public acceptance, legal restraints and ability of the combustion systems on the market to utilise this fuel.

Despite these draw-backs, a step and introduction of torrefied fuels in the heating sector could act rather early as a driving force for the torrefied feedstock market. This would

- ensure the medium to long-term survival of torrefaction industry,
- give time to develop large scale application,
- give time to explore alternative (and cheap) feedstocks and
- give time to demonstrate that a promised quality can be produced at large scale.

For this reason an increase in dissemination measures for small- and medium scale combustion appliances is targeted. A dedicated discussion platform for technology manufacturers and fuel distributers is deemed to support this upcoming market.

4 Conclusions and Outlook

The midterm meeting has shown a good progress in all work packages and an intensive exchange between them has been set. As well as from the successful discussions between the work packages, the partners could benefit from the contribution and interesting input from the advisory board members and the external experts.

The results achieved during the discussions in Session III on the Future of Torrefaction will be used as a starting point for a “strategy paper” of the SECTOR partners giving their view on the further strategic development of the torrefaction market. Key issues will be the identification of a range of potential markets, including niche markets, according to changing market conditions, addressing national and European support schemes (foremost the emission trading system), pushing large scale use of biomass and the setup of show cases to build up confidence in the market. These points, complemented by supporting others, will be compiled into a roadmap. SECTOR will initiate the elaboration of this strategy paper, which will be performed by the project partners and key market players such as associations like the IBTC. The SECTOR plan of use and dissemination will support and reflect the concerted market wide action aiming at the acceleration of market implementation of torrefied (and subsequently other thermally treated) biomass.

To guarantee a continuous exchange during the second phase of the project, it is envisaged to plan regular meetings between the Coordinator and the Work Package leaders (every 6 months) with the possibility to hold work package meetings in connection to these meetings. The final project meeting is planned for spring 2015 at the coordinator´s site in Leipzig.

SECTOR Production of Solid Sustainable Energy Carriers from Biomass by Means of TORrefaction

SECTOR - Production of Solid Sustainable Energy Carriers from Biomass by Means of Torrefaction

A European R&D Project funded within the Seventh Framework Programme by the European Commission

Midterm Meeting in Pamplona, Spain

Presentation of Work Packages 2-10






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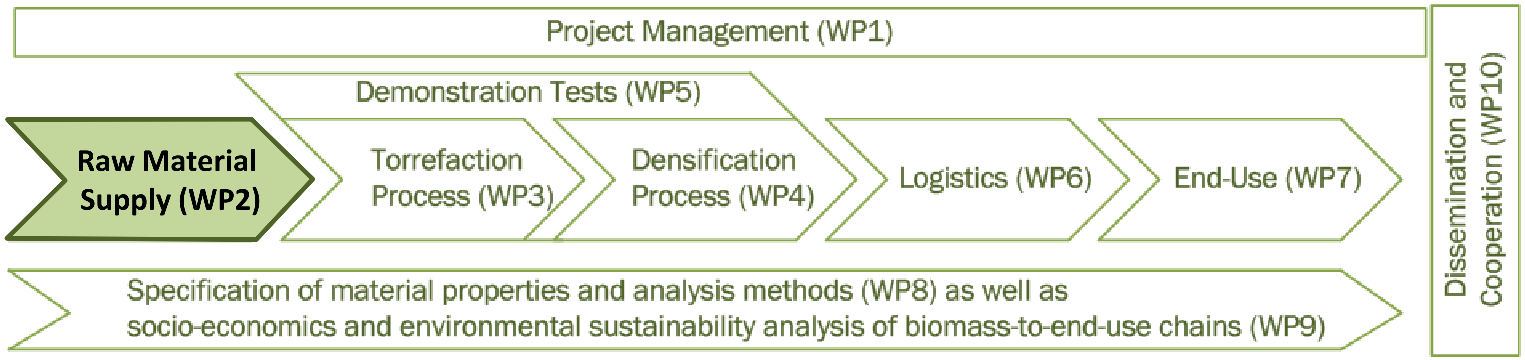
SECTOR Production of Solid Sustainable Energy Carriers from Biomass by Means of TORrefaction

Pamplona, 16.-18. Oct 2013



Production of Solid Sustainable Energy Carriers by Means of Torrefaction

MARKET ASSESSMENT OF BIOMASS FEEDSTOCK (WP2)

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP2: Market assessment of biomass feedstock – Results

- D2.2 Biomass potentials
  - Based on existing studies – technical available potential
- D2.3 Profiles of selected raw material
  - Classification of raw material according to EN 14961-1 standard
  - Done in 2 phases D2.1 (preliminary) and D2.3 (final)
  - Property information from literature and laboratory tests
- D2.4 Quality demands from producers and end users
  - End-users work carried out by questionnaire (report available)
  - Producers (SECTOR partners and International Biomass Torrefaction Council members) – some answers received

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

D2.2 Summary of woody biomass resources in Europe

Source	1,000 solid m³	PJ/a
Stem wood	195 656	1 438
Landscape management wood residues	59	514
Forest residues	166 438	1 186
By-products and residues from wood processing industry	92 164	644
Used wood	52 000	397
Total EU-27	**506 258**	**3 664**
Ukraine	9 300	67
North-West Russia	103 900	748
Belarus, Norway, Switzerland	6 560	157

Sources: BEE-project and EU-Wood project

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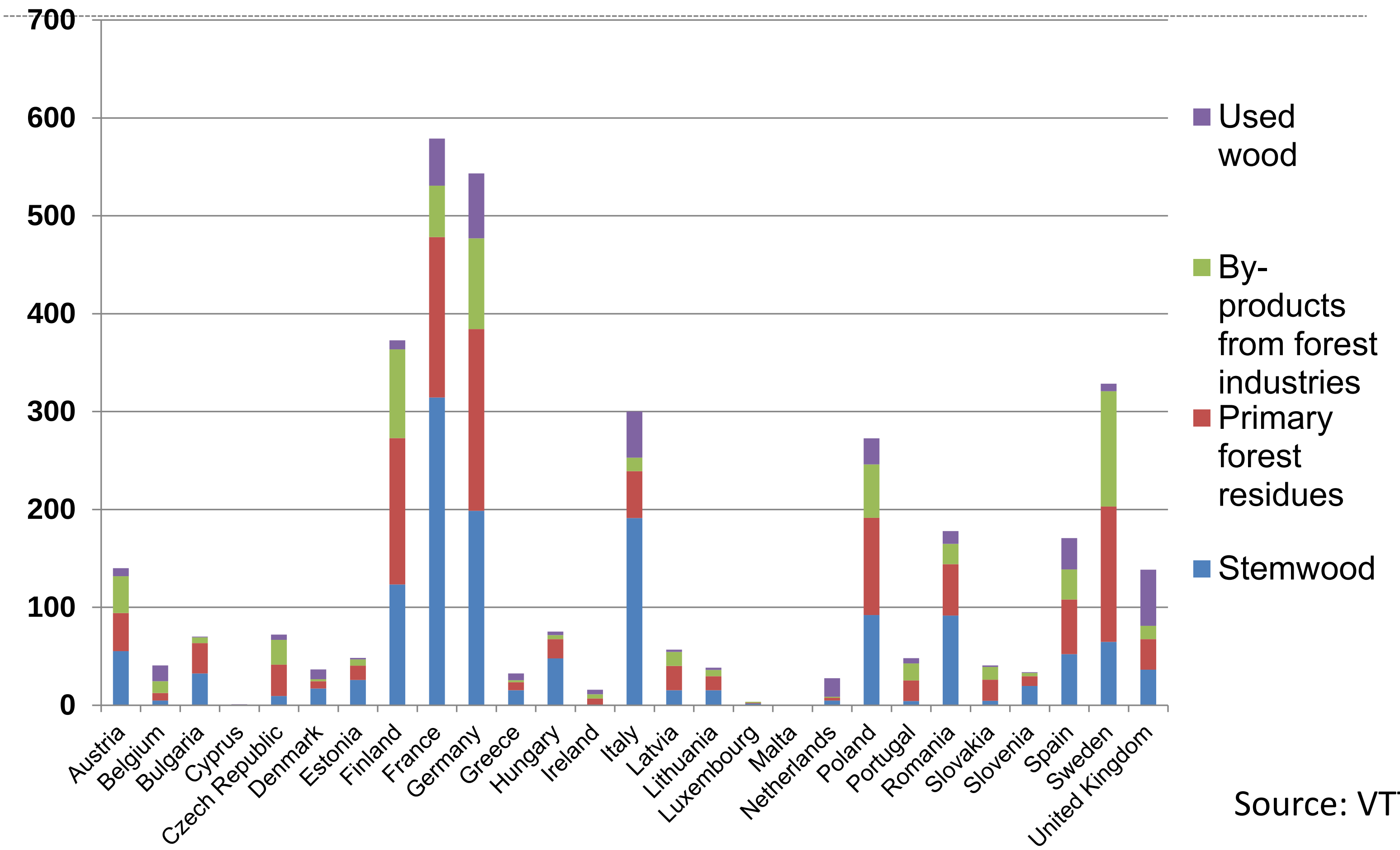
D2.2 Wood energy potentials in EU-27 (PJ/a)



Source: VTT

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D2.2 Agricultural biomass potentials

- Primary agricultural residues (residues remaining in the fields after harvest) are estimated to be 806 PJ.
- Largest part of the potential comes from cereal straw (560 to 600 PJ), rape straw (91 PJ) and corn straw (86 PJ).
- Annual straw potential is estimated to be in some studies from 960 to 983 PJ.
- Largest total potentials are in France, Germany and Spain.

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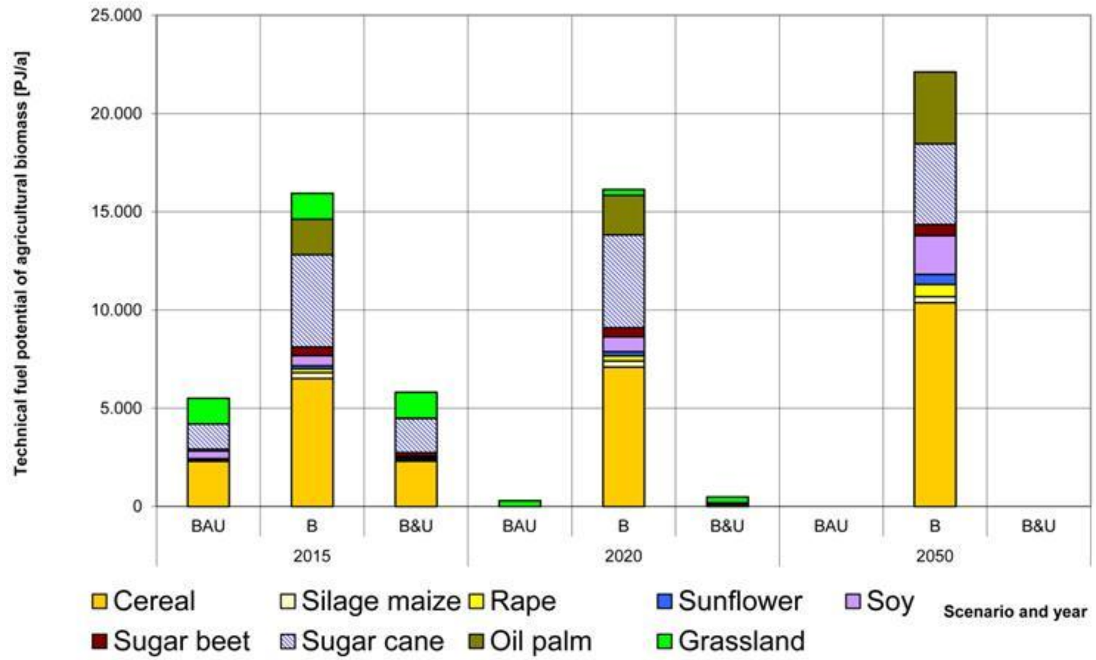
D2.2 Technical fuel potential for agricultural biomass



Source: DBFZ

BAU	Business as usual (extrapolation of the short and medium-term trends
B	Energy use of biomass is strongly forced, e.g. increase of crop yields, most fertile crops are cultivated
B&U	Bioenergy increased restrictions on environmental protection and nature conservation

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D2.3 Summary of agricultural biomass potentials in EU-27

Resource	PJ/a	Source
Cereal straw	560	BEE, Böttcher et al. 2010
	600	DBFZ, Thrän et al. 2010
	960	BIOMASS FUTURES, Elbersen et al 2012
	983	MTT, Pahkala & Lötjönen 2012
Sugar beet	25	BEE, Böttcher et al. 2010
	36	MTT, Pahkala & Lötjönen 2012 (EU-25)
Sunflower	34	BEE, Böttcher et al. 2010
Rice husk	9	BEE, Böttcher et al. 2010
Corn residues	85	BEE, Böttcher et al. 2010
Pruning residues, total	423	BIOMASS FUTURES, Elbersen et al 2012
Vineyard residues	14	BEE, Böttcher et al. 2010
Olive three prunings	28	BEE, Böttcher et al. 2010
Energy crops, vegetable diet	3 465	BEE, Böttcher et al. 2010
Energy crops, mixed diet	742	BEE, Böttcher et al. 2010
Perennial herbaceous biomass	1 642	BIOMASS FUTURES, Elbersen et al 2012
Agricultural residues (sugar beet, legume, potato, oil plants)	656	MTT, Pahkala & Lötjönen 2012
Miscanthus	3 324 – 7 651	RENEW, Seyfried et al. 2004
Reed canary grass (theoretical)	8 110	BEE, Böttcher et al. 2010
Woody crops (poplar, theoretical)	12 713	BEE, Böttcher et al. 2010
Short rotation coppice	2 576 – 5 447	RENEW, Seyfried et al. 2004

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D2.3 Selected raw materials for lab and pilot tests

No.	Selected feedstock (pilot test marked by bold, 12 raw materials)	Test type to perform
1	**Delimbed coniferous stem wood without bark** : Pine and spruce (Reference 1)	Lab and pilot
2	**Logging residue, coniferous**	Lab and pilot
3	Straw, wheat (Nordic conditions)	Lab
4	**Used wood** – post consumer wood, recycled wood, chemically untreated	Lab and pilot
5	Bark	Lab
6	**Delimbed broadleaves stem wood with bark:** Beech (Reference 2)	Lab and pilot
7	**Poplar**	Lab and pilot
8	**Straw** (Oat and wheat, Southern conditions)	Lab and pilot
9	**Prunings from olive trees** –woody biomass	Lab and pilot
10	**Eucalyptus**	Lab and pilot
11	**Paulownia**	Lab and pilot
12	**Bamboo**	Lab and pilot
13	Palm oil residues (e.g. Oil palm fruit bunch, palm kernel or shell)	Lab
14	**Bagasse**	Lab and pilot
15	Corn cobs	Lab
16	Miscanthus	Lab
17	Sun flower residues	Lab
18	**Willow** (Salix)	Lab and pilot
19	Reed canary grass	Lab
20	Straw, barley (Nordic conditions)	Lab
21	Rape straw	Lab

D2.3 Example of profile – Reference raw material

SECTOR	PROFILE No. 1 CONIFEROUS STEM WOOD
Description of feedstock	Stem wood, coniferous without bark (Reference raw material 1)
Raw material according to EN 14961-1 Table 1	Forest, plantation and other virgin wood 1.1.3.2
Traded form (e.g. wood chips) according Table 2 of EN 14961-1 or other	Wood chips, saw dust
Selection criteria for feedstock profile (e.g. high potential, availability)	High potential, total forest wood in EU-27 is about 678 million solid m^3 (Mantau et al 2009, SECTOR report D2.2)
Remarks (e.g. biomass cutting step, place of origin, pretreatment etc.)	Cutting and delimbering trees, forwarding round wood to road-side and transporation to plant, debarking trees and chipping to wood chip.
Selected for laboratory and/or pilot tests	Laboratory test, yes Pilot test, yes

1. QUALITY OF RAW MATERIAL

1.1 Emissions/corrosion related compounds (w-% of dry matter, EN 15104 (N, S) and EN 15289 (Cl))

Component	Nitrogen, N	Sulphur, S	Chlorine, Cl
Typical value	0,1	<0,02	0,01
Variation (min-max)	< 0,1 0,5	<0,01 0,03	< 0,01 0,05

1.2 Ash content, ash melting behavior and ash composition

Parameter	Ash content EN 14775	Ash melting behavior (CEN/TS 15370-1)			
		SST	DT	HT	FT
Unit	% (DB)	°C	°C	°C	°C
Typical value	0,4				
variation	0,3- 0,6	1150	1180	1200	1225

Macro elements CEN/TS 15290	Composition	Al	Ca	Fe	Mg	P	K	As	Si	Na	Ti			
	Unit	mg/kg (DB)												
	Range	30	500	10	100	50	200	<0,01	100	10				
		500	1000	100	200	100	1400	1	200	200	<20			
Micro elements CEN/TS 15297	Composition	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Sb	V	Zn	
	Unit	mg/kg (DB)												
	Range	<0,05	<0,2	0,2	0,5	<0,004	40		<0,1	<0,5	0,01	<0,2	5	
		0,5	0,5	10	10	0,05	200		10	10	0,5	<2	50	

1. QUALITY INFORMATION FOR TORREFACTION

1.1 Quality data of biomass for torrefaction

Property	Typical value	Variation (min. – max.)
Traded form (e.g. chips) EN 14961-1, Table 2	Wood chips, saw dust	
Particle size, P (Dimension /nominal size, mm, use) EN 15149-1, screen size according ISO 3310		P45 or P65(wood chips) 1 – 5 mm (sawdust)
Bulk density (BD), kg/m^3 EN 15103	330	310 – 350
Moisture as received, M (w-%), EN 14774-1 or 3	< 50	30 – 55
Amount of fines, F, w-% (≤ 3,15 mm) EN 15149-1	12	1 -19,6
Hemicelluloses content, w-% dry *)		25 – 28
Cellulose content, w-% dry *)	40	40- 45
Lignin content, w-% dry *)	30	24 -33
C (w-% dry), EN 15104	51	48 – 50
H (w-% dry) EN 15104	6,0	6 – 6,5
O (w-% dry) calculated	40	38 – 42
Volatile content, VM (w-% dry) EN 15148	86	80 – 90
Net calorific value, dry MJ/kg EN 14918	19,3	18,5 – 19,8
Add other properties, S, w-% dry	0,05	
Chlorine, Cl, w-% dry	< 0,01	

Source[1]: SECTOR Partners

Source[2]: Alakangas, E. Analysis of particle size of wood chips and hog fuel – ISO/TC 238, VTT-R-02834-12. 28 p.

1.2 Reactivity of feedstock

Indicator	Weight loss at 280-290 °C with residence time of 30 minutes at T> 200ºC (% AWL)
Torrefaction degree by TGA (Thermogravimetric analysis)	~28%

Source: SECTOR Feedback

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

D2.4 Quality demands from (producers and) end users

- The most important properties are (end-users):
  - net calorific value as received (Q) (19 – 23 MJ/kg)
  - ash content (A) (2 – 3%, one response < 10%)
  - particle size distribution (P) and
    - Typical requirements for particle size distribution of hard coal are less than 20% larger than 90 µm and 100% smaller than 200 µm.

Particle size distribution for industrial wood pellets (FDIS ISO 17225-2, final draft standard)

Property (standard)	Unit	I1	I2	I3
Particle size distribution of disintegrated pellets, (ISO 17830)	w-% dry	≥ 99% (< 3,15 mm) ≥ 95% (< 2,0 mm) ≥ 60% (< 1,0 mm)	≥ 98% (< 3,15 mm) ≥ 90% (< 2,0 mm) ≥ 50% (< 1,0 mm)	≥ 97% (< 3,15 mm) ≥ 85% (< 2,0 mm) ≥ 40% (< 1,0 mm)

  - moisture (M) (< 10 w-%)
  - Other properties
    - minerals like chlorine, calcium, potassium and sodium (so called alkalis).

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D2.4 Other questions to end-users

- Current use of wood pellets/torrefied pellets and cofiring ratios
- Possibilities to use coal mills
- Investments needed for use of torrefied pellets
- Experience of cofiring wood pellets and benefits to use torrefied pellets
- Estimation of demand based on current coal use
  - 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.

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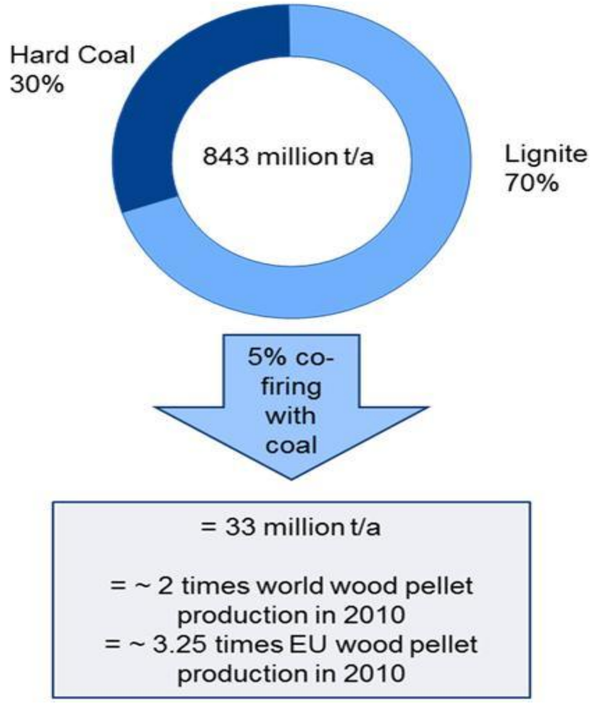
D2.4 Estimation of demand of pellets/torrefied pellets

Wood pellet cofiring potential in more than 100 existing pulverised coal-fired plants in Europe (Source: Pöyry)



- By torrefied pellets replacement could be as high as 50%*, this makes European market hugely significant.

*Source: *Wilén, C., Jukola, P., Järvinen, T., Sipilä, K. Verhoeff, F. & Kiel, J. 2013.* Wood torrefaction – pilot tests and utilisation prospects, VTT Technology 122. 73 p.

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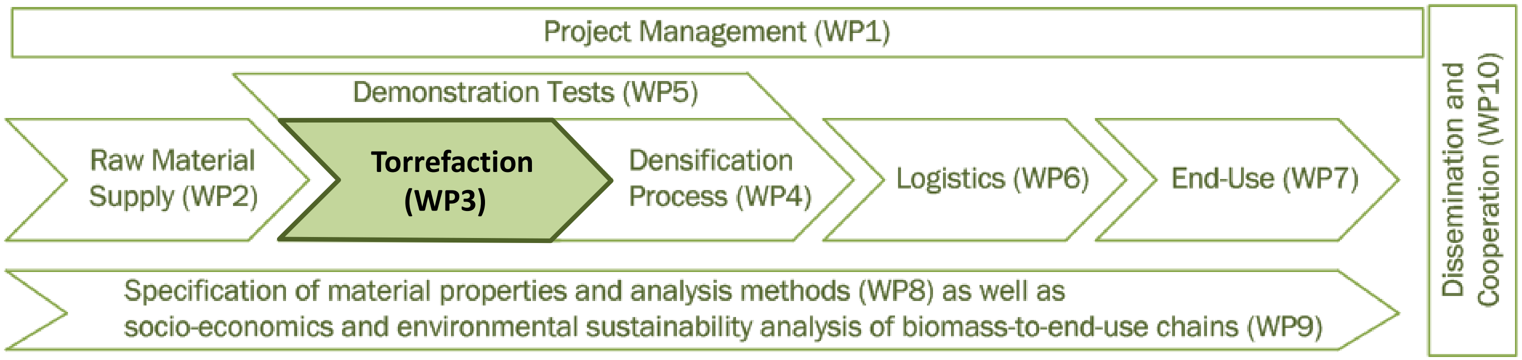

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Production of Solid Sustainable Energy Carriers by Means of Torrefaction

TORREFACTION (WP3)

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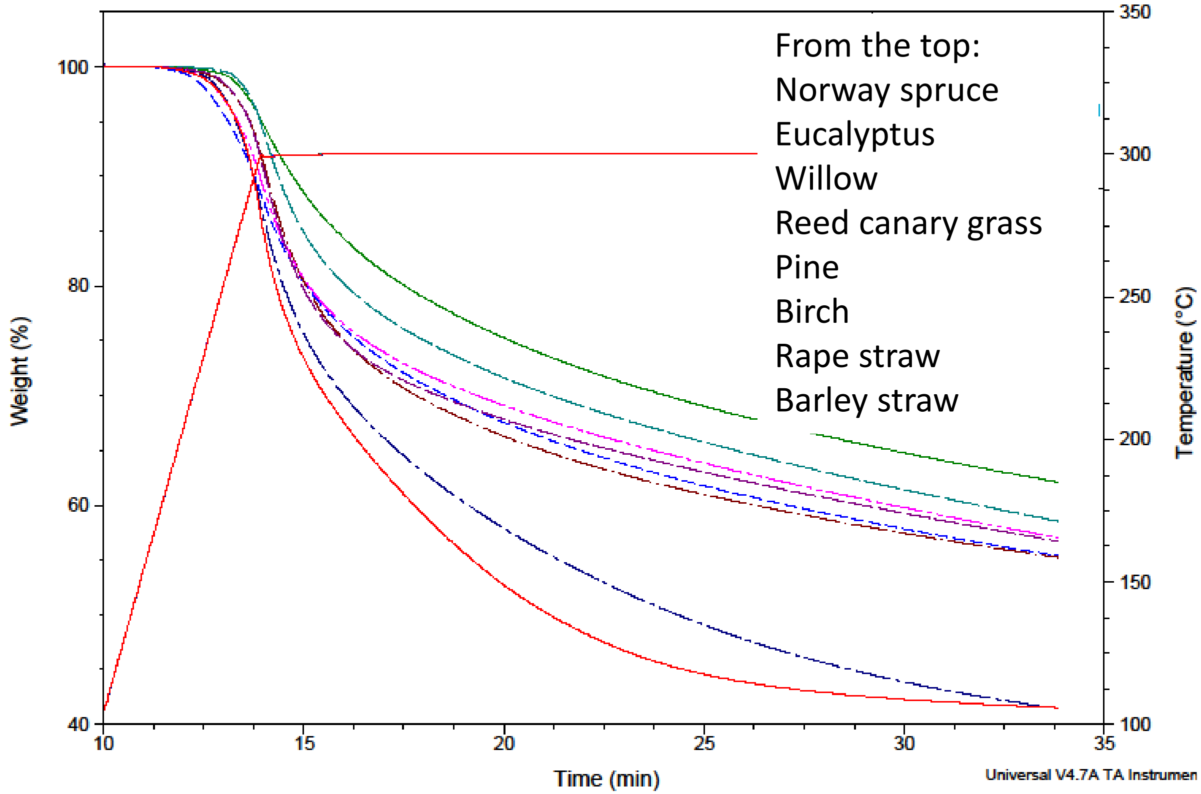
WP3.1: Lab tests (Umea)

- Mass loss rate profiles (TGA experiments)



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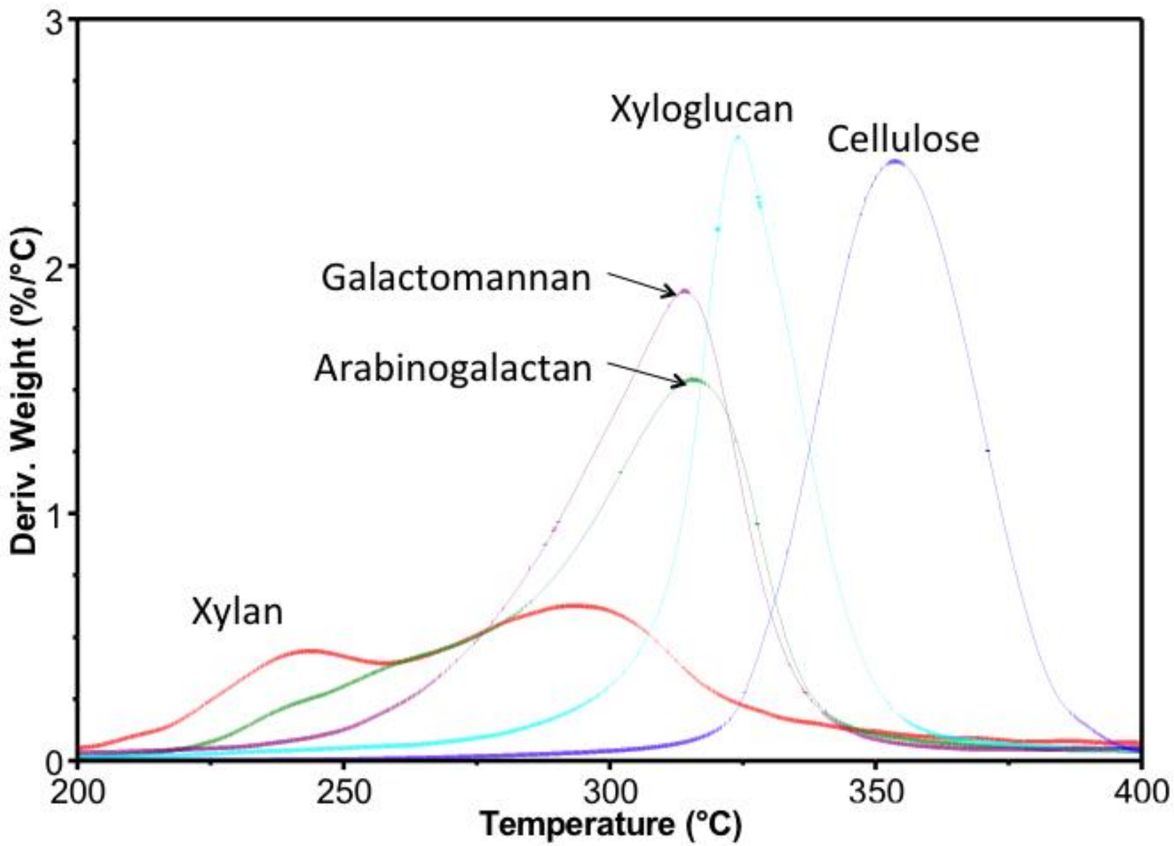
WP3.1: Lab tests (Umea)

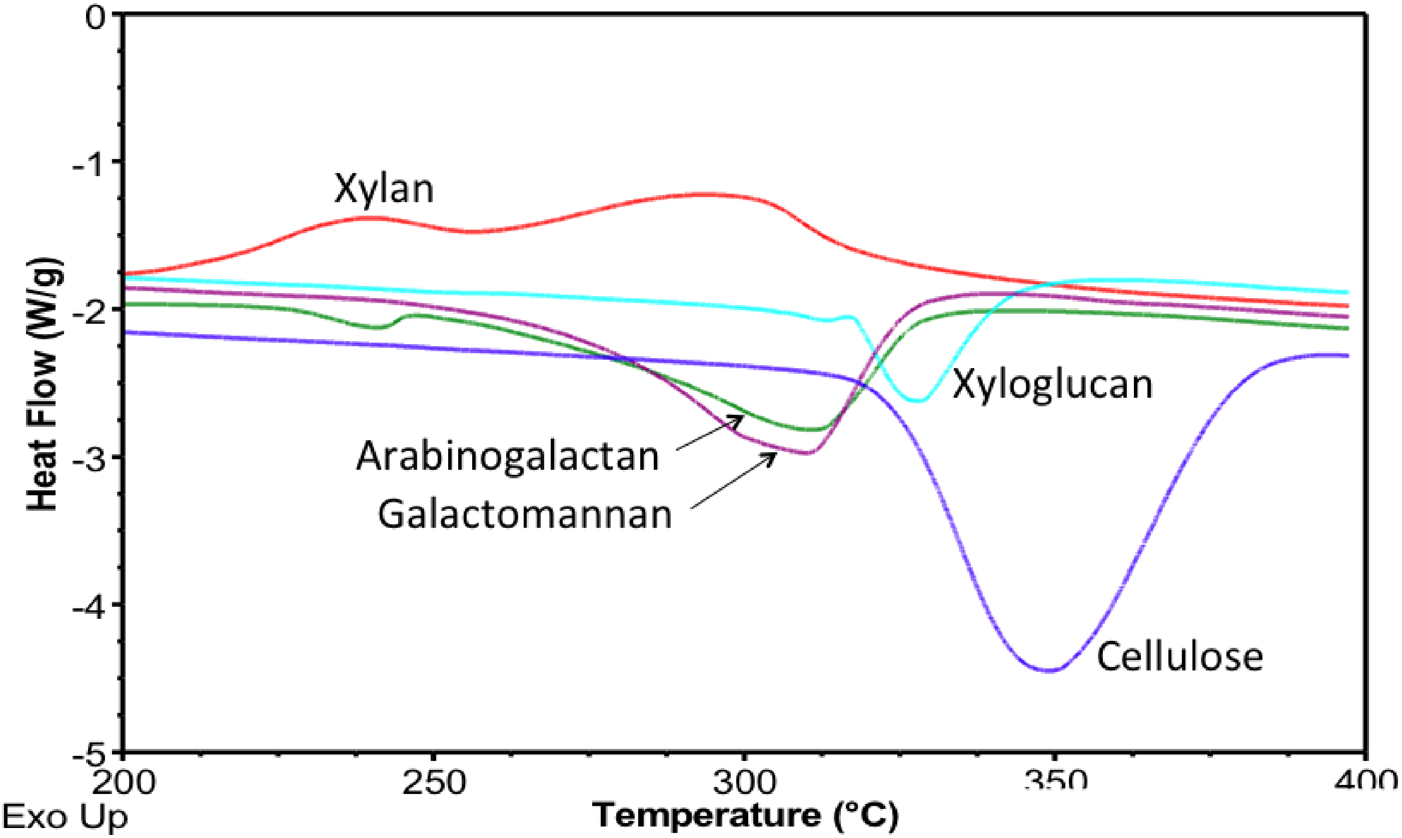
- Mass loss rate profiles (hemicelluloses)



The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP3.1: Lab tests (Umea)

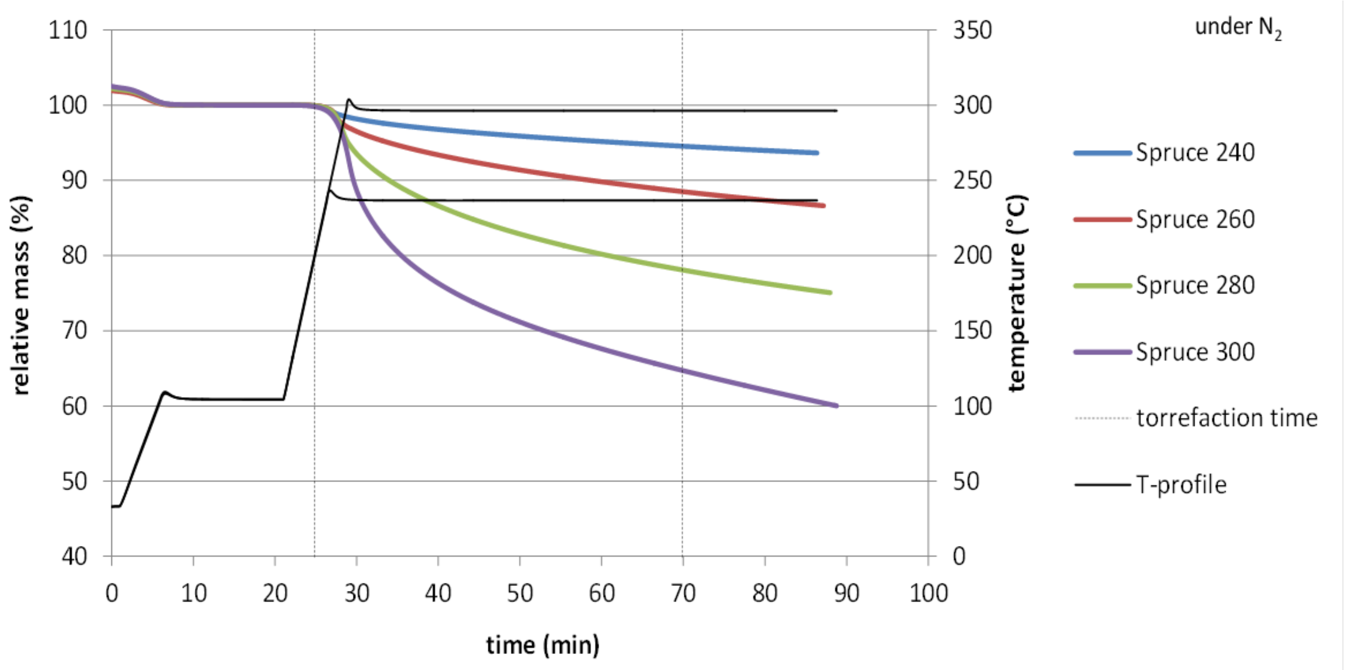
- Enthalpy profiles (hemicelluloses)



The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP3.1: Lab tests (ECN)

- Mass los profiles spruce torrefaction:
  - Temperature profiles shown for 240 and 300°C measurements
  - Torrefaction time is 45 min starting at 200°C



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SECTOR Production of Solid Sustainable Energy Carriers from Biomass by Means of TORrefaction

WP3.2: Pilot tests (ECN)

- Material Supply & Demand sheet was introduced to track individual (torrefied) material shipments
- Approximately 45 ton material has been distributed from producers to partners up to now (incl. WP5)

	No.	SECTOR sample ID number	provider	recipient	quantity in kg	production date	date expected	actual delivery	biomass	product	Torr-Temp	material necessary for	included in SECTOR
68	1063	ECN_spruce-240_torrefied pellets_210113	ECN	EON	6	210113		??1013	spruce	torrefied pellets	240	durability/leaching	yes
69	1064	ECN_spruce-280_torrefied pellets_230113	ECN	EON	6	230113		??1013	spruce	torrefied pellets	280	durability/leaching	yes
70	1065	ECN_spruce-260_torrefied pellets_180113	ECN	VTT	50	180113		??1013	spruce	torrefied pellets	260	logistic tests	yes
71	1066	ECN_poplar-270_torrefied pellets_060513	ECN	VTT	30	060513		??1013	poplar	torrefied pellets	270	logistic tests	yes
72	1067	ECN_pine-270_torrefied pellets_060513	ECN	VTT	30	060513		??1013	pine	torrefied pellets	270	logistic tests	yes
73	1068	ECN_bamboo-_torrefied chips_NA	ECN	OFI	2	NA		??1013	bamboo	torrefied chips		characterisation	yes
74	1069	ECN_bamboo-245_torrefied chips_240212	ECN	OFI	2	240212		??1013	bamboo	torrefied chips	245	characterisation	yes
75	1070	ECN_bamboo-255_torrefied chips_230212	ECN	OFI	2	230212		??1013	bamboo	torrefied chips	255	characterisation	yes
76	1071	ECN_bamboo-265_torrefied chips_220212	ECN	OFI	2	220212		??1013	bamboo	torrefied chips	265	characterisation	yes
77		_-__											
78		_-__											
79	2001	UmU_pine-285_torrefied pellets_150913	UmU	DBFZ	60	150913	301013		pine	torrefied pellets	285	grinding	yes
80	2002	UmU_forest residue-285_torrefied pellets_190613	UmU	DBFZ	60	190613	300913		forest residue	torrefied pellets	285	grinding	yes
81	2003	UmU_willow-308_torrefied pellets_190613	UmU	DBFZ	60	190613	300613	130713	willow	torrefied pellets	308	grinding	yes
82	2004	UmU_pine-285_white chips_NA	UmU	ECN	5	NA	301013		pine	white chips	285	TGA	yes
83	2005	UmU_forest residue-285_white chips_NA	UmU	ECN	5	NA	300913		forest residue	white chips	285	TGA	yes
84	2006	UmU_willow-308_white chips_NA	UmU	ECN	5	NA	300613	130713	willow	white chips	308	TGA	yes
85	2007	UmU_pine-285_torrefied chips_280813	UmU	DTI	4	280813	301013		pine	torrefied chips	285	characterisation pelletization	yes
86	2008	UmU_forest residue-285_torrefied chips_170513	UmU	DTI	4	170513	300913		forest residue	torrefied chips	285	characterisation pelletization	yes
87	2009	UmU_willow-308_torrefied chips_170513	UmU	DTI	4	170513	300613	130713	willow	torrefied chips	308	characterisation pelletization	yes
88	2010	UmU_pine-285_torrefied pellets_150913	UmU	DTI	2	150913	301013		pine	torrefied pellets	285	O2 depl./self-heating	yes
89	2011	UmU_forest residue-285_torrefied pellets_190613	UmU	DTI	2	190613	300913		forest residue	torrefied pellets	285	O2 depl./self-heating	yes
90	2012	UmU_willow-308_torrefied pellets_190613	UmU	DTI	2	190613	300613	130713	willow	torrefied pellets	308	O2 depl./self-heating	yes
91	2013	UmU_pine-285_torrefied pellets_150913	UmU	EON	6	150913	301013		pine	torrefied pellets	285	durability/leaching	yes
92	2014	UmU_forest residue-285_torrefied pellets_190613	UmU	EON	6	190613	300913		forest residue	torrefied pellets	285	durability/leaching	yes
93	2015	UmU_willow-308_torrefied pellets_190613	UmU	EON	6	190613	300613	130713	willow	torrefied pellets	308	durability/leaching	yes
94	2016	UmU_pine-285_white chips_NA	UmU	USTUTT	7	NA	301013		pine	white chips	285	analysis	yes
95	2017	UmU_forest residue-285_white chips_NA	UmU	USTUTT	7	NA	300913		forest residue	white chips	285	analysis	yes

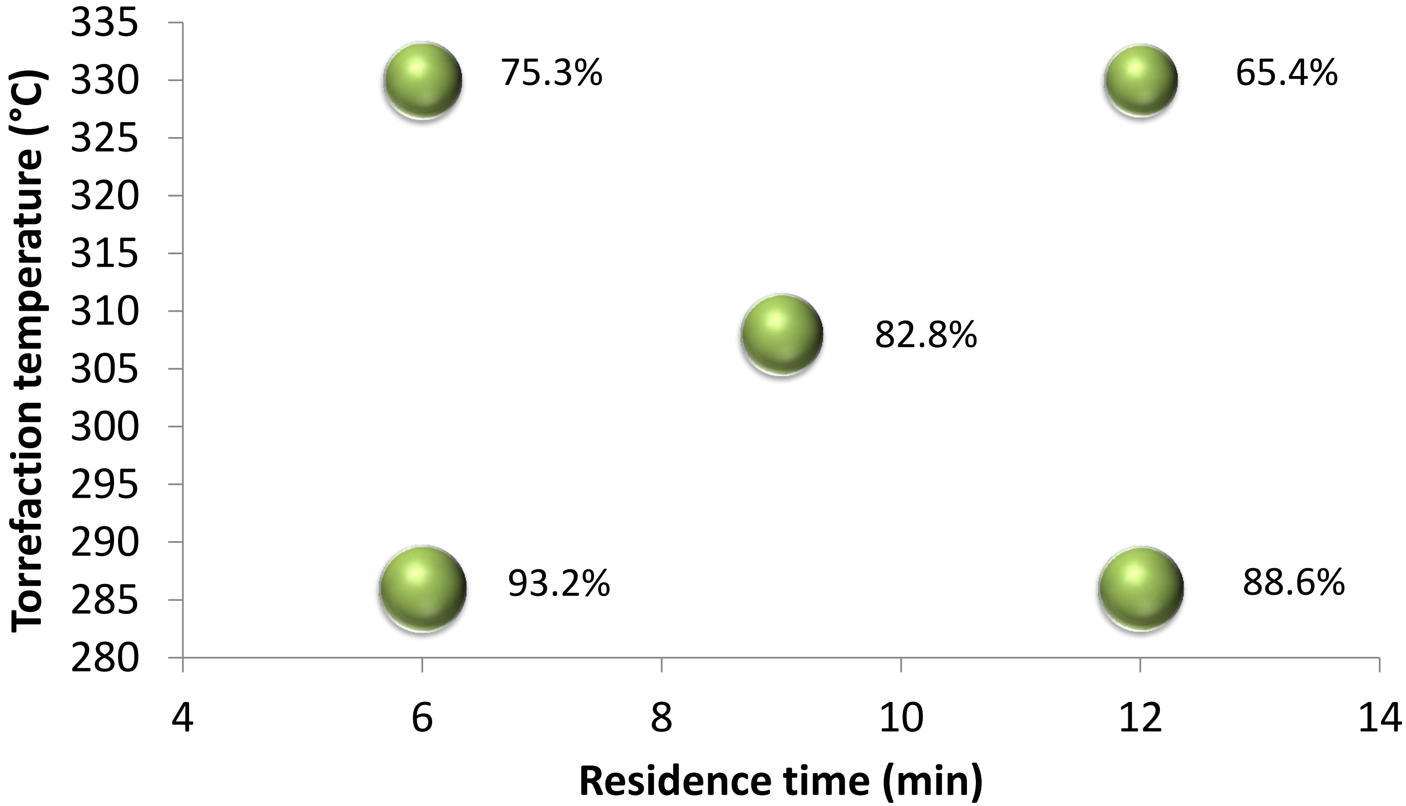
The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP-presentations, 16.10.13

SECTOR Production of Solid Sustainable Energy Carriers from Biomass by Means of TORrefaction

WP3.2: Pilot tests (Umea)

- Mass yield comparison torrefied willow



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SECTOR Production of Solid Sustainable Energy Carriers from Biomass by Means of TORrefaction

WP3.2: Pilot tests (Umea)

- Torrefied salix from pilot torrefaction reactor

Temp.

330°C

308°C

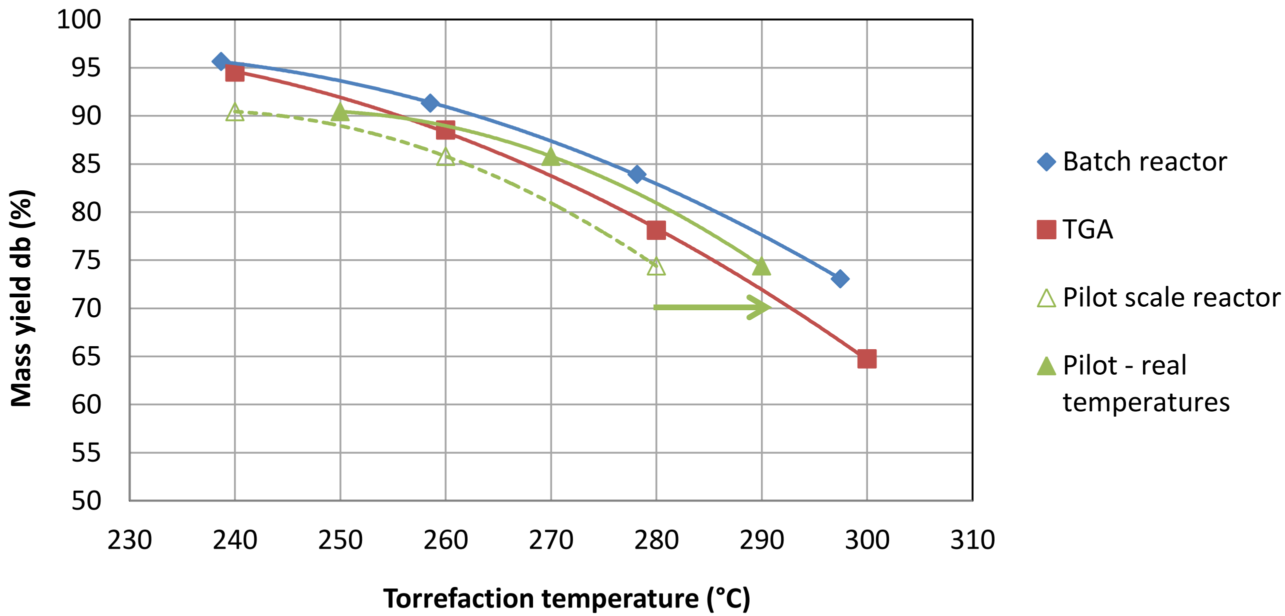
286°C

6 min 9 min 12 min Time

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP3.2: Pilot tests (ECN)

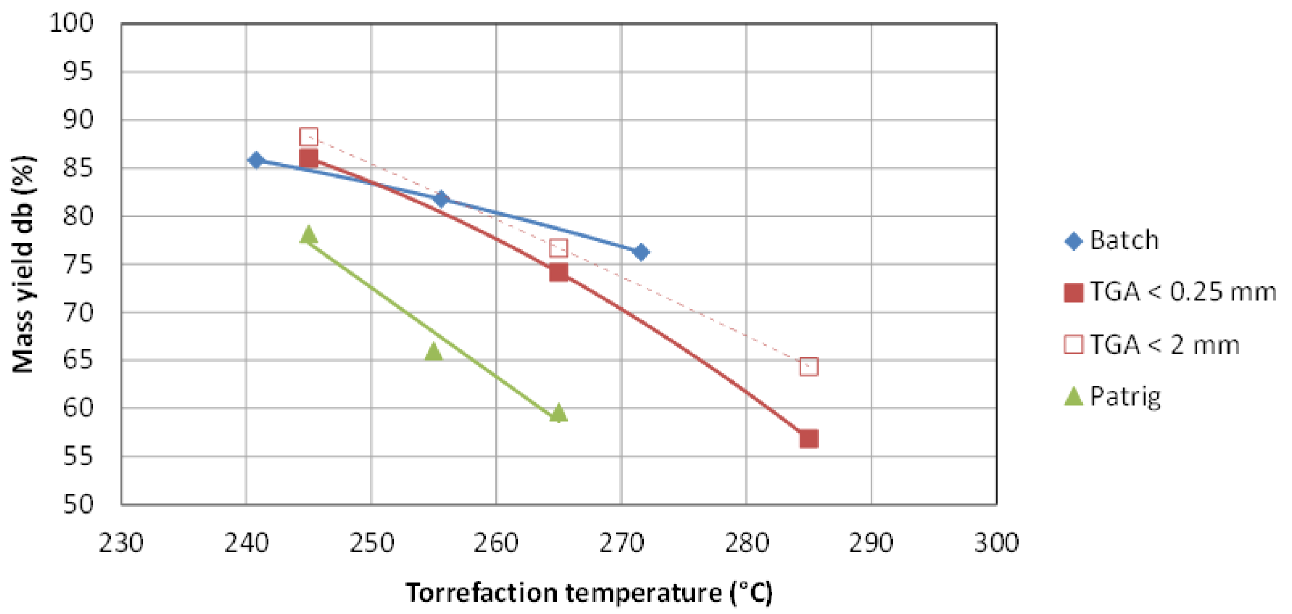
- Mass yield comparison spruce torrefaction:
  - Pilot torrefaction temperatures expected to have been ±10 °C higher, due exothermicity of spruce



The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP3.2: Pilot tests (ECN)

- Mass yield comparison bamboo torrefaction:
  - Pilot torrefaction temperatures expected to have been ±23 °C higher, due exothermicity of bamboo



The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP3.2: Pilot tests (CENER)

- Pilot torrefaction test results

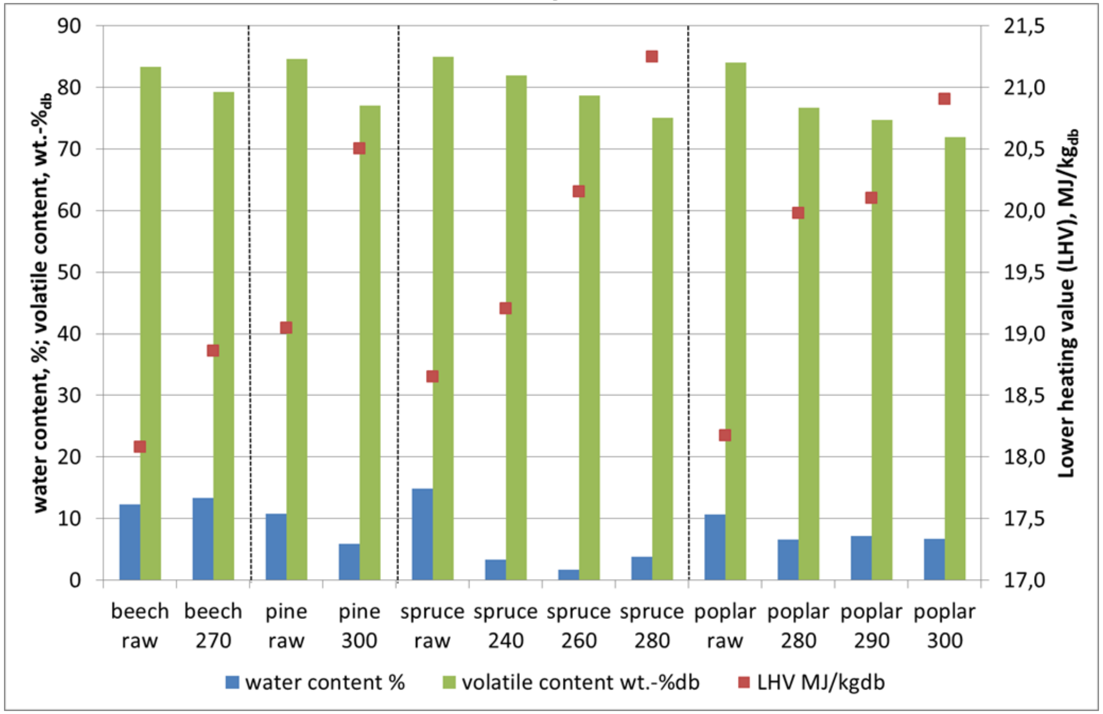
Biomass type	Torr. Temp. (ºC)	Process parameters							Thermal consumption (kJ/kg)
		Feedstock			Gas		Product		
		Humidity (% wb)	Flow rate (kg/h)	Nitrogen (kg/h)	Temp. (ºC)	Flow rate (Kg/h)	Torr. degree (% db)	Flow rate (Kg/h)	
BEECH	270	14	350	12	212	106	15	256	1.116
PINE	280	8	350	12	225	85	14	277	951
	290	14	300	12	229	98	17	214	1.351
	300	13	350	12	238	115	19	247	1.278
STRAW	250	12	300	12	197	82	13	230	957
	260	11	290	12	214	85	16	217	1.051
	270	11	290	12	220	96	20	206	1.100
POPLAR	280	10	400	12	224	102	14	310	972
	290	10	400	12	231	113	17	299	1.115
	300	10	400	12	240	135	23	277	1.201

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

SECTOR Production of Solid Sustainable Energy Carriers from Biomass by Means of TORrefaction

WP3.3: Feedstock and product analysis (OFI)

- Example for analysis of beech, pine, spruce and poplar torrefied pellets at different temperatures (water content, lower heating value, volatile content)



The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP3.3: Feedstock and product analysis (OFI)

- On-going analysis of received samples
- 55 samples received and 44 analyzed
- Data distribution
  - Excel file in member area on SECTOR homepage – for all project partners to use; info mail about updating
- Data comparison
  - All analysis data from different laboratories should be collected and distributed for comparison and evaluated
  - Suggestion: Data collection by OFI and distribution within data excel file

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP3.3: Feedstock and product analysis (CENER)

- Homogeneity of torrefied product during pilot production

	Homogeneity of the process: Sample analisys of each big-bag produced								
No.	Sample number	Big-bag code	production hours		Elemental analisys (% db)			Heat value (MJ/kg	
			Start	finish	C	H	N	HHV	LHV
1	230	12/007/TO03	10:45	11:45	54,0	6,0	0,18	21,68	20,43
2	231	12/007/TO04	11:45	12:36	53,8	6,0	0,13	21,65	20,40
3	232	12/007/TO05	12:36	13:22	53,7	6,1	0,16	21,63	20,38
4	233	12/007/TO06	13:22	14:09	53,4	6,1	0,16	21,39	20,14
5	234	12/007/TO07	14:09	14:55	53,4	6,1	0,11	21,55	20,30
6	235	12/007/TO08	14:55	15:41	53,4	6,1	0,13	21,44	20,19
7	236	12/007/TO09	15:41	16:20	53,4	6,0	0,13	21,51	20,27
8	237	12/007/TO10	16:20	17:11	53,3	6,1	0,11	21,44	20,19
9	238	12/007/TO11	17:11	17:55	53,5	6,1	0,14	21,53	20,27
10	239	12/007/TO12	17:55	18:37	53,5	6,1	0,13	21,51	20,26
11	240	12/007/TO13	18:37	19:23	53,3	6,2	0,14	21,37	20,08
12	241	12/007/TO14	19:23	20:08	53,1	6,1	0,12	21,41	20,15
Mean					53,5	6,1	0,14	21,51	20,25
Maximum					54,00	6,20	0,18	21,68	20,43
Minimum					53,10	6,00	0,11	21,37	20,08
Averaged desviation (%)					0,18	0,04	0,02	0,08	0,09
Maximun desviation (%)					0,52	0,12	0,04	0,17	
Analysis acceptance repeatability criteria					0,39%	<0,2%	<0,03%	<0,12 MJ	

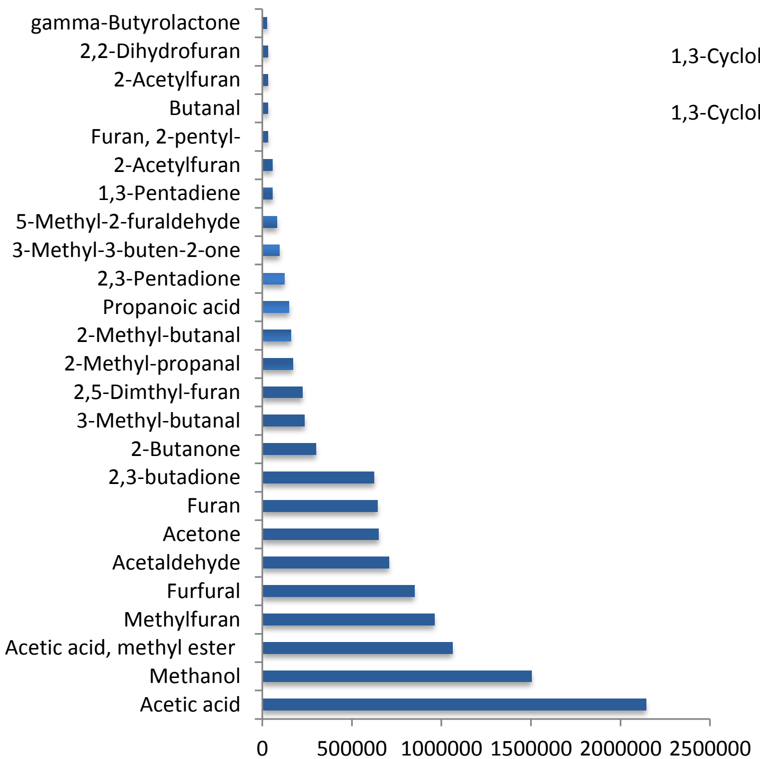
Differences are similar to analysis acceptance repeatability criteria

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/200[illegible] agreement n° 282826

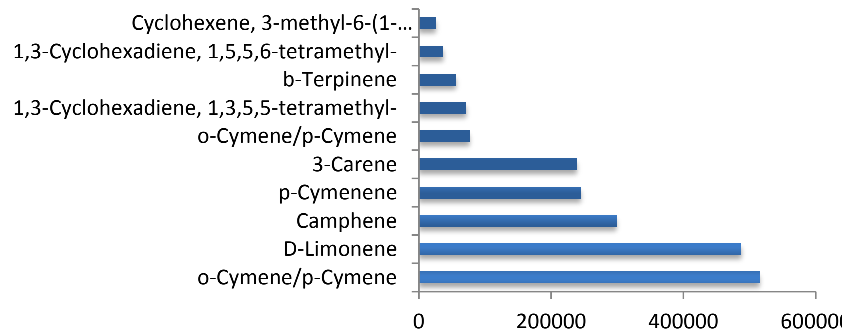
WP3.3: Feedstock and product analysis (Umea)

- Analysis torrefaction gas

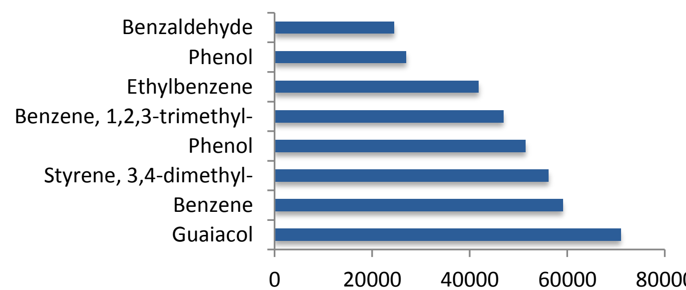
Polysaccharide derived



Terpenoids



Lignin derived



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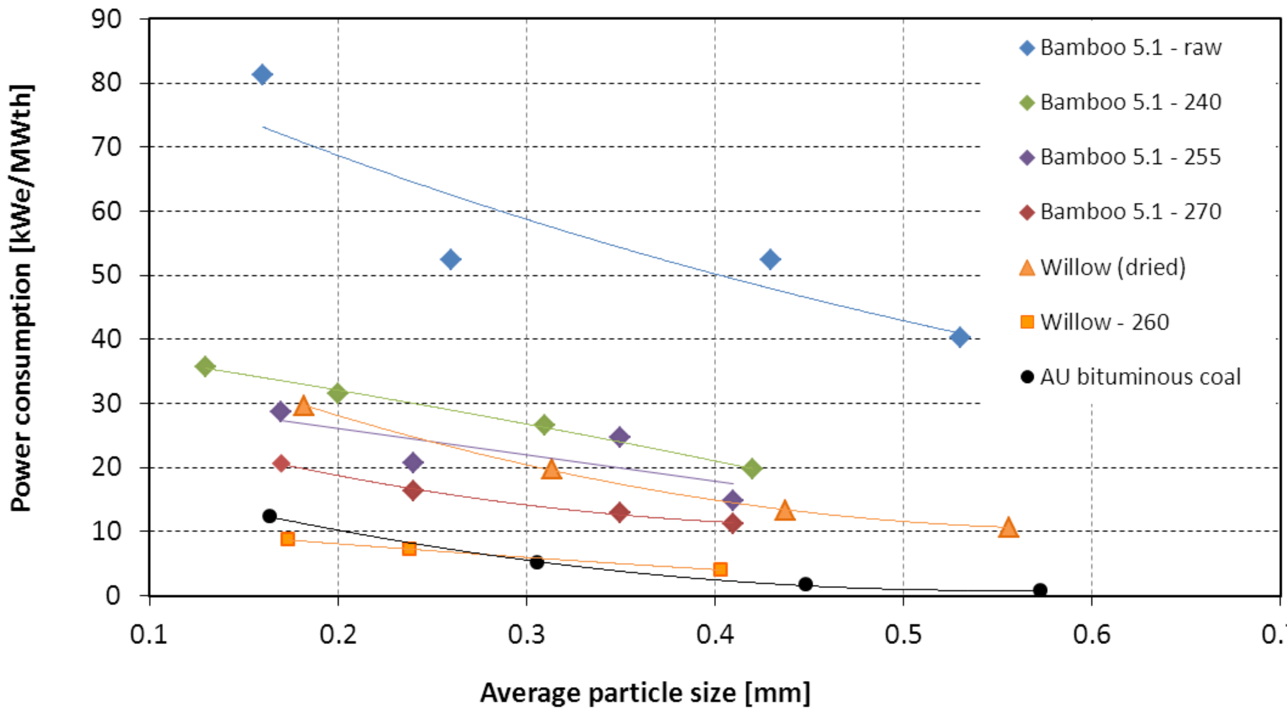
WP3.3: Feedstock and product analysis (ECN)

- Grindability torrefied bamboo



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SECTOR Production of Solid Sustainable Energy Carriers from Biomass by Means of TORrefaction

WP3.4: Torrefaction process optimisation/integration (VTT)

- Harmonised mass and energy balances (with belt dryer) presented in the flow sheets of ECN, Topell and CENER processes
- All stand-alone processes were calculated with same principles.
- The product of all processes was TOP-pellet from wood.
- Energy need in drying for all cases was 4.0 MJ/kg evaporated H_2O for belt drier.
- The lower heating value (LHV) of wood for torrefaction processes was in all cases 7.6 MJ/kg and moisture content 50 wt% (from ECN data).
- The wood feed is in all cases 48.5 MW_{th}
- Torrefaction temperature was 280°C in ECN and Topell cases and 270 °C in CENER case.
- LHV of TOP-pellets was 19.7 MJ/kg in ECN and Topell cases and 19.1 MJ/kg in CENER case (ECN data)
- Power need for grinding and pelleting was 18 kWh_e/t TOP pellet and 64 kWh_e/t TOP pellet, respectively
- Thermal efficiencies based on LHV values, without electricity use, were practically near the same i.e. 88-90 %
- Higher thermal efficiencies possible by using flue gas dryers with typical energy need 3.5 MJ/kg evaporated H_2O.

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP3.4: Torrefaction process optimisation/integration (VTT)

- Three main integration options: Saw mill, CHP, P&P mill
- Black box mass and energy balance data for calculations about integrated torrefaction
- Both feedstock and energy integration was explored
- The energy production of integrated torrefaction plants was based on biomass use (no energy use of natural gas or oil based product)
- The main advantages of integrations:
  - front end: wood acquisition, logistics, wood handling and pretreatment
  - more efficient energy use compared to stand-alone plants
  - favorable power and heat prices
  - lower the production price of TOP-pellets (bigger boiler in integrated concepts, scaleup and efficiency benefits)
- Subcontractor Pöyry (consultant) involved

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WP3.4: Torrefaction process optimisation/integration (VTT)

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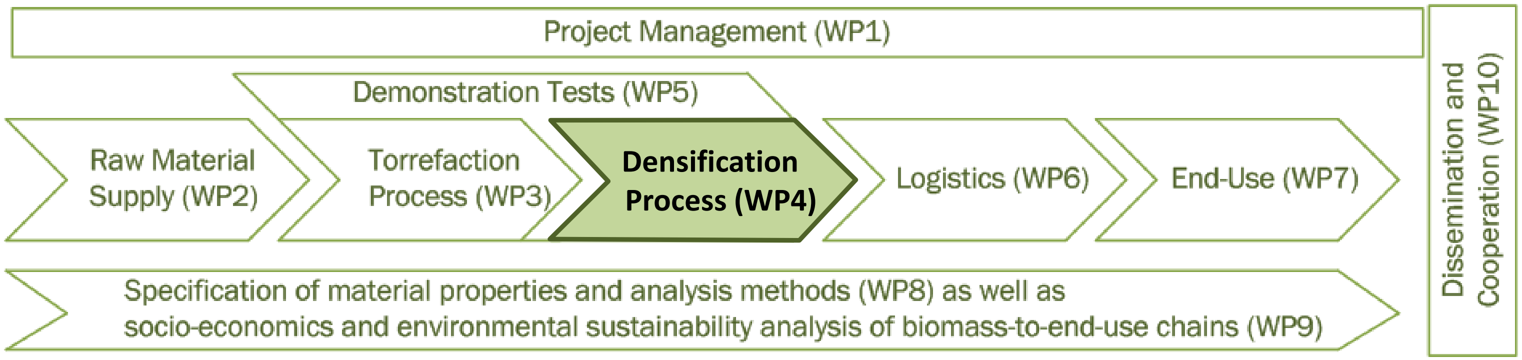


Production of Solid Sustainable Energy Carriers by Means of Torrefaction

DENSIFICATION (WP4)

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP4: Densification of torrefied biomass

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP4: Densification of torrefied biomass

Focus areas in WP4:

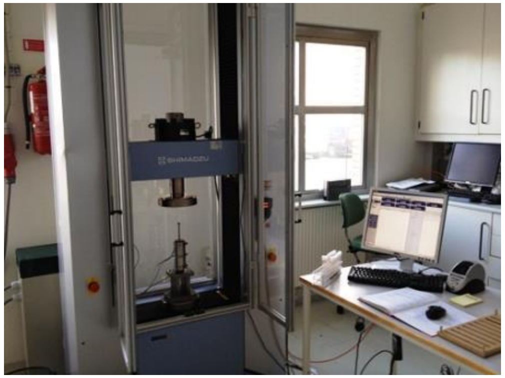
- **Laboratory scale densification**
  - Testing of torrefied biomass provided by SECTOR partners
  - Parametric study
  - Data collection and analysis → Feedback and process optimization
- **Bench/Industrial scale densification**
  - Production in pilot plants of CENER, UMU, ECN, (Topell WP5)
  - Data collection and analysis → Process improvement
- **Product Quality**
  - Compilation of analysis data from SECTOR-partners
  - Comparison of analysis data (in cooperation with WP8)

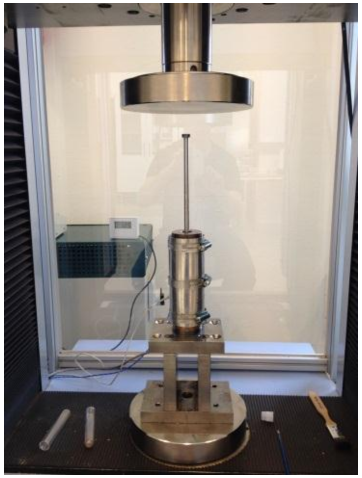
The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

SECTOR Production of Solid Sustainable Energy Carriers from Biomass by Means of TORrefaction

WP4: Laboratory scale densification

Set-up allows variation of: Temperature, pressure, particle size, moisture, and additive addition





Determination of: Compression energy, friction and quality analysis of pellets

Earlier tests have shown correlation between friction and energy consumption of industrial scale pellet press

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

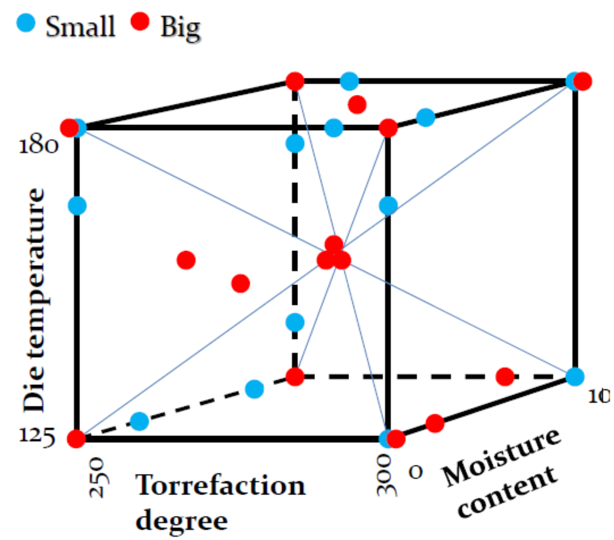
WP4: Laboratory scale densification

Parametric study:

- Torrefaction degree expressed as mass yield (90.5% - 71.1%)
  - Temperature 250 to 300 °C
- Moisture content (0 to 10%)
- Die temperature (125-180°C)
- Particle size (<1 and 1-2 mm)

Material torrefied at SLU (Sweden) in batch reactor

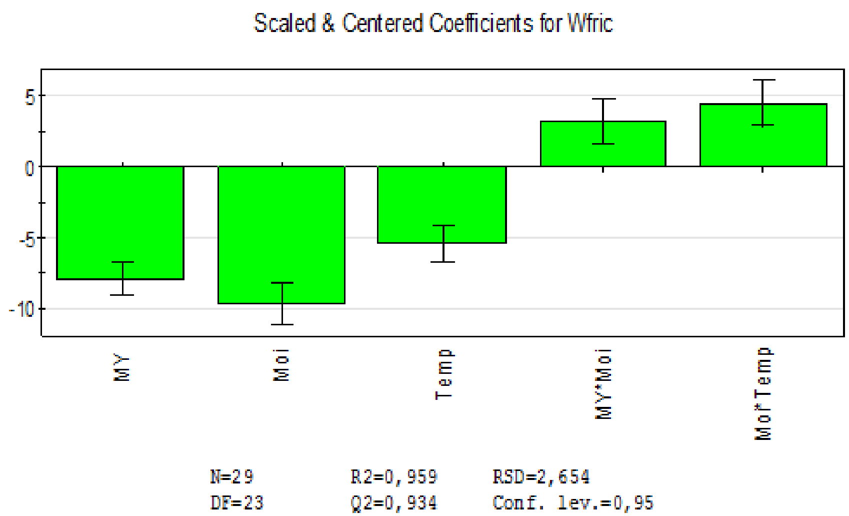
Pelletizing tests at DTI (Denmark)



The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP4: Parametric study torrefaction-densification

Selected results: Friction / Energy consumption of pelletizing process



MY: Mass Yield - Torrefaction degree (90.5% - 71.1%)

Moi: Moisture content torrefied biomass (0 - 10 %)

Size: Particle size (<1 and 1-2 mm)

Temperature: Die temperature (125 to 180 °C)

→ The higher temperature, moisture and mass yield (= lower torrefaction degree) - The less friction (energy consumption of pelletizing process)

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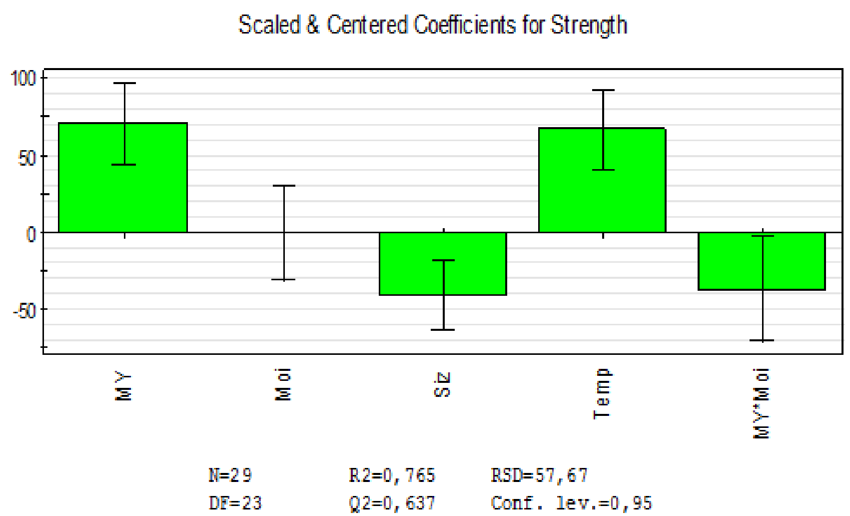
WP4: Parametric study torrefaction-densification

Selected results: Pellet strength / Pellet quality



MY: Mass Yield - Torrefaction degree (90.5% - 71.1%)

Moi: Moisture content torrefied biomass (0 - 10 %)

Size: Particle size (<1 and 1-2 mm)

Temperature: Die temperature (125 to 180 °C)

→ Smaller particles, higher temperature and higher mass yield (= low torrefaction degree) resulted in higher pellet strength

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

SECTOR Production of Solid Sustainable Energy Carriers from Biomass by Means of TORrefaction

WP4: Pilot scale densification

Briquetting tests:

Material torrefied at ECN: Spruce and Bamboo
Briquetting tests DTI in cooperation with CF Nielsen

Materials tested

Spruce
240 °C
260 °C
280 °C

Bamboo
245°C
255°C
265°C

300 kg each material

→ Briquetting gets more challenging with increasing torrefaction degree
→ Keeping the briquette hot and under pressure for extended time improves quality
→ Good quality: Smooth surface, high density, stability but still optimization potential

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP4: Pilot scale densification

Pelletization at SECTOR partners ECN, UMU/SLU, CENER

Partner	Biomass type	Torr. Temp. (ºC)	Durability
CENER	BEECH	270	96
CENER	PINE	280	90
CENER		290	95
CENER		300	95
CENER	STRAW	250	84
CENER	POPLAR	280	95
CENER		290	96
CENER		300	96
ECN	SPRUCE	240	95
ECN		260	98
ECN		280	86
ECN	BAMBOO	245	N.A.
ECN		255	N.A.
ECN		265	N.A.
ECN	POPLAR	270	98
ECN	PINE	270	92
UMU	WILLOW	285	N.A.

Production of pellets is ongoing at SECTOR partners

“Demand and Supply scheme” for sample production and distribution

Data from production and quality tests will be compiled in a report

Data from lab and pilot scale tests will be reviewed

→ Slow start with many delay/problems but lots of activities and good results now

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP4: Pilot scale densification

Large quantities have been produced in SECTOR project during last year:

CENER:

Biomass type	Torr. Temp. (°C)	Material code		MATERIALS INVENTORY (Kg)					
				PRODUCTION		DELIVERED		AVAILABLE	
		Chips	Pellets	Chips	Pellets	Chips	Pellets	Chips	Pellets
BEECH	270	CENER_Ref 2 - Beech_270_Chips_12092012	CENER_Ref 2 - Beech_270_Pellets_17092012	458	4.283	49	3.366	409	917
PINE	280	CENER_Ref 1 - Pine_280_Chips_02102012	CENER_Ref 1- pine_280_Pellets_29012013	30	2.339	29	0	1	2.339
	290	CENER_Ref 1 - Pine_290_Chips_21032013	CENER_Ref 1 - Pine_290_Pellets_06062013	3.193	4.730	0	3.304	3.193	1.426
	300	CENER_Ref 1 - Pine_300_Chips_22112012	CENER_Ref 1- pine_300_Pellets_31012013	150	2.200	149	383	1	1.817
STRAW	250	CENER_Straw _250_Chips_14022013	CENER_Straw _250_Pellets_28022013	95	3.001	0	3.001	95	0
	260	CENER_Straw _260_Chips_26062013	CENER_Straw _260_Pellets_?	174	0	0	0	174	0
	270	CENER_Straw _270_Chips_26062013	CENER_Straw _270_Pellets_?	963	0	0	0	963	0
POPLAR	280	CENER_Poplar_280_Chips_29052013	CENER_Poplar_280_Pellets_11072013	230	950	120	110	110	840
	290	CENER_Poplar_290_Chips_29052013	CENER_Poplar_290_Pellets_10072013	205	1.588	0	0	205	1.588
	300	CENER_Poplar_300_Chips_28052013	CENER_Poplar_300_Pellets_09072013	219	853	0	0	219	853
			SUBTOTAL	5.717	19.944	347	10.164	5.370	9.780
			TOTAL	25.661		10.511		15.150	

ECN: Several hundred kg batches of torrefied spruce, bamboo

UmU: Upgraded torrefaction plant → very active now

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

SECTOR Production of Solid Sustainable Energy Carriers from Biomass by Means of TORrefaction

WP4 – Status

- End user requirements for quality of torrefied pellets
  - Data collection finished
  - Ongoing reporting
- Comparison of quality analysis from different labs (close cooperation with WP8)
  - Round Robin tests in cooperation with WP8 (finished)
  - Data collection from all densification partners (ongoing)
  - Reporting end of 2013
- Parametric study: Torrefaction and densification parameters influence on processing and quality
  - Experimental part completed
  - Data modeling and interpretation
  - How can data be used in project → Feedback to SECTOR partners to optimize process

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP4 - Status

- Screening of all torrefied sample in SECTOR for densification properties → Compilation of data, modeling and conclusions
  - Ongoing tasks (depending on availability of torrefied material)
  - Compilation of data / data analysis → Feedback to project partners
- Production of ton scale batches for logistics and end-user testing
  - Partners have been very active (CENER alone has produced more than 20t of torrefied pellets)
  - Ongoing production
- Mass and energy balance for different densification concepts
  - Data collection is in progress
  - Will be reported next year

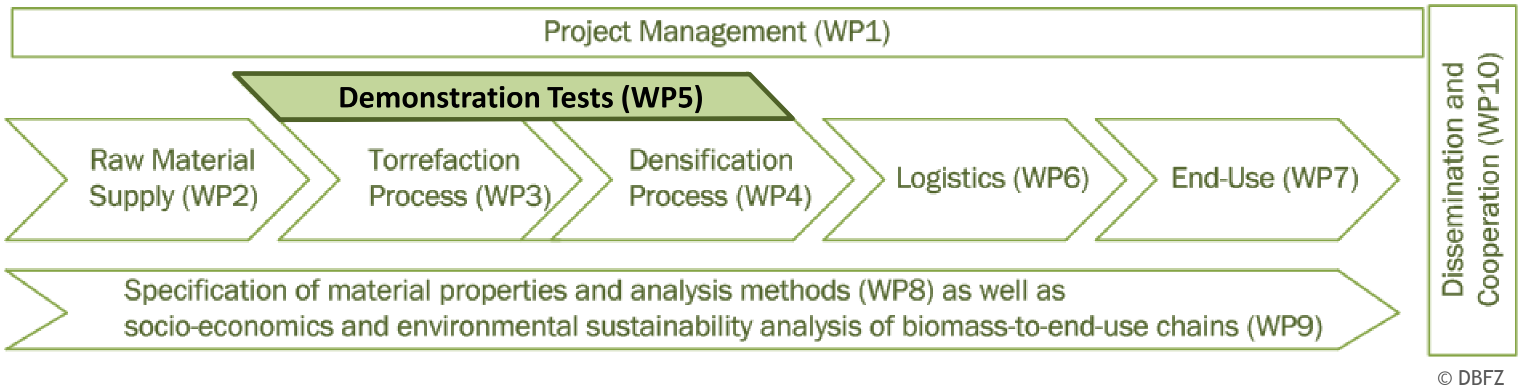
The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP4 - Conclusions

- Hard start-up phase but densification activities are running very well now
- Densification is a complex tasks with many pitfalls but we have learned a lot and becoming better and better
- A lot of data available in SECTOR project → Data is being collected, analyzed and will be used to improve the process

→ Bring in your ideas/expectations to WP4 in the discussions today and tomorrow!

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826



Production of Solid Sustainable Energy Carriers by Means of Torrefaction

DEMONSTRATION TESTS (WP5)

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP5: Introduction

- Tasks under WP5
- Past activities
- Current status
- Outlook

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP5: Tasks under WP5

- D5.1 100-200 tonnes batches of torrefied woody material for large scale logistics & end-use tests.
- D5.2 Tonnes of pelletised torrefied woody material for logistics and end user testing.
- D5.3 Working paper on general mass and energy balances of specific torrefaction concepts.
- D5.4 Mass and energy balances of the milling and densification process for the value chain analysis
- M4 Large scale batches of fully characterized densified torrefied feedstock for tests in WP6 and 7

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WP5: Past activities

- Production of several thousand of tons of torrefied wood pellets.
- Material used: Forest residue
- Delivery of material from:
  - Topell
  - external provider (stem wood)
- D5.1

Partner	Quantity (kg)	Provider	Biomass
USTUTT	4,000	Topell	Wood residues
USTUTT	4,000	external provider	Stem wood
EON	10,000	external provider	Stem wood
Vattenfall	2x2,000	external provider	Stem wood

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WP5: Past activities

- D5.2

Partner	Quantity (kg)	Provider	Biomass
DTI	10.5	Topell	Wood residues
OFI	600	Topell	Wood residues
TFZ	1,180	Topell	Wood residues
TFZ	1,100	Topell	Wood residues
TFZ	1,100	external provider	Stem wood
BIOS	750	external provider	Stem wood
BE2020	1,575	external provider	Stem wood

- D5.3 – On going, calculations with different feedstocks
- D5.4 – On going, new data after overhaul
- M4 – Finished for WP6, still pending for WP7

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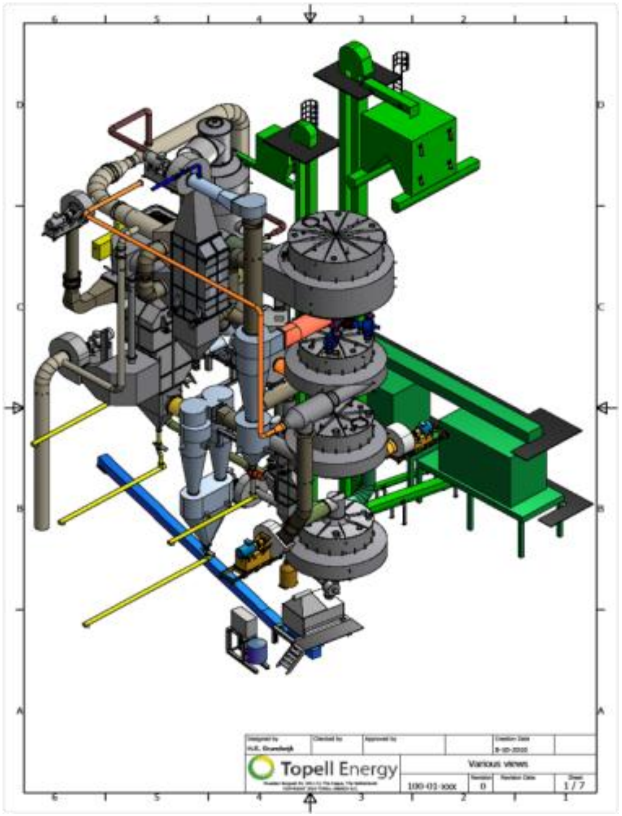
WP5: Past activities

- Major overhaul plant



- Change combustor
- Heat integration
- Densification process
- Process finished

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WP5: Current status

- Plant
  - Hot commissioning of combustor finished
  - Hot commissioning of torrefaction unit finished
  - Hot commissioning of densification process ongoing
- Process
  - Successful production runs 4-6 tons/h
  - Developing production recipies for different feedstocks
  - Several tons of pellets already produced
  - Optimisation of densification process

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP5: Outlook

- Continue developing torrefaction recipies for different feedstocks
- Optimisation of densification process
- Paper on mass and energy balance of torrefaction concept
- Mass and energy balance densification process
- Complete pending shipments during Autumn 2013

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WP5: Outlook

- Questions?
- Thanks for your attention

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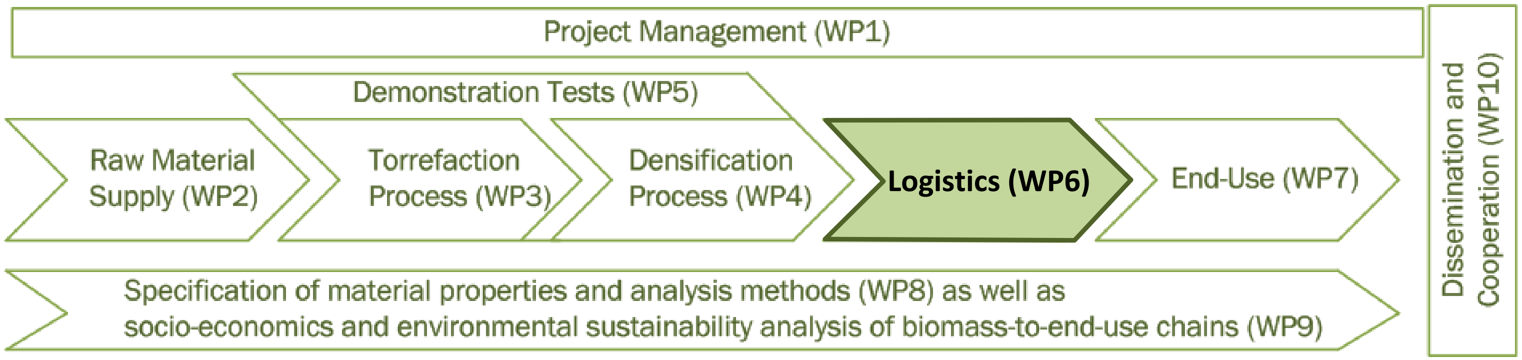

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Production of Solid Sustainable Energy Carriers by Means of Torrefaction

LOGISTICS (WP6)

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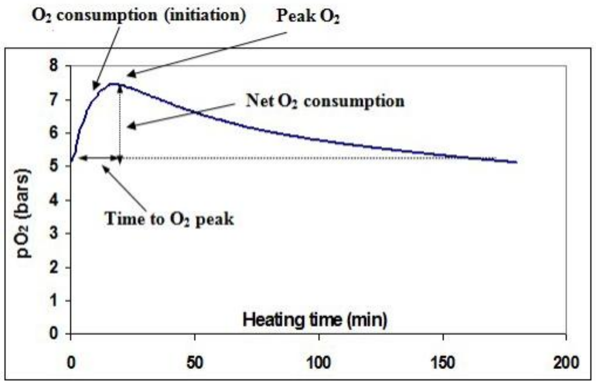
SECTOR Production of Solid Sustainable Energy Carriers from Biomass by Means of TORrefaction

WP6.1: Small-scale tests (DTI)

- Oxygen depletion of torrefied pellets
  - Oxipress method: A "rapid" predictive tool to measure the oxidative stability of compounds susceptible to oxidation
  - Standard method in food industry
  - 40 °C / 100 °C, 99,9% O2 , 5 bar
  - Ca. 50 g of pellets (300 ml container)
  - The faster the pressure decreases the faster is the oxygen consumption (i.e. the more "reactive are the pellets")



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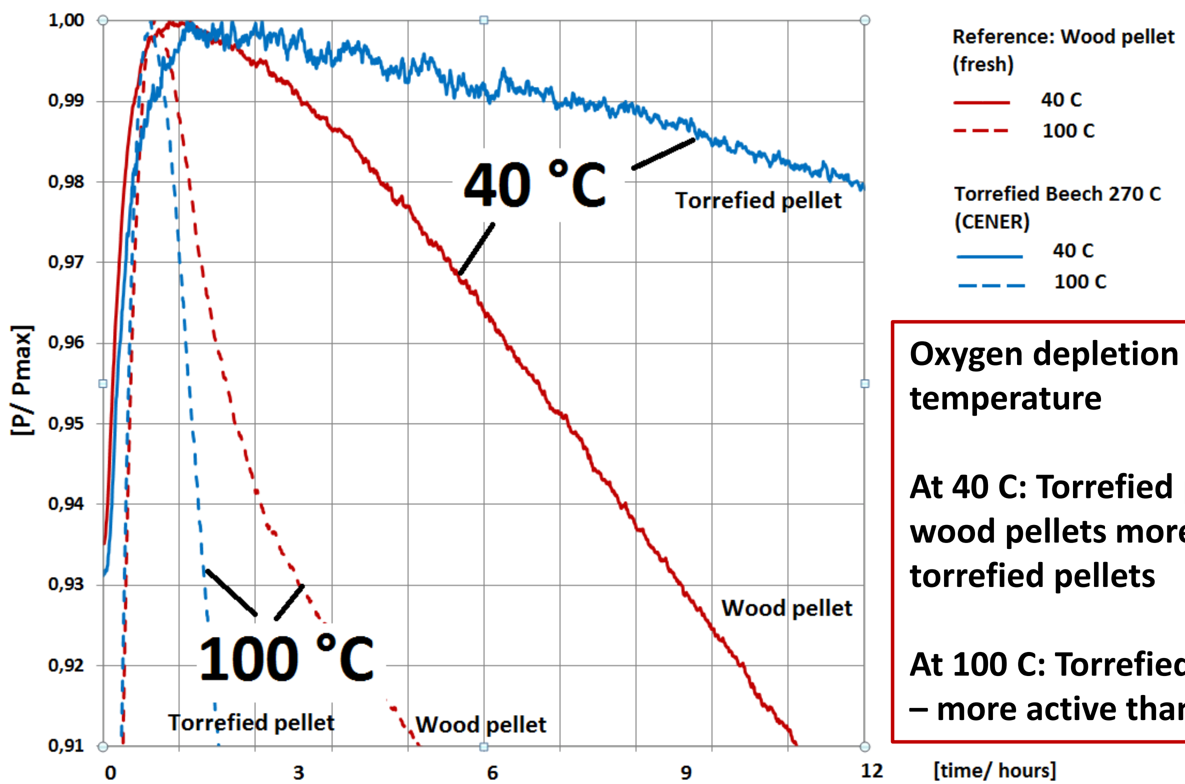
WP6.1: Small-scale tests (DTI)

- Oxygen depletion of torrefied pellets vs. wood pellets



Oxygen depletion increasing with temperature

At 40 C: Torrefied pellets hardly active – wood pellets more reactive than torrefied pellets

At 100 C: Torrefied pellets very reactive – more active than wood pellets

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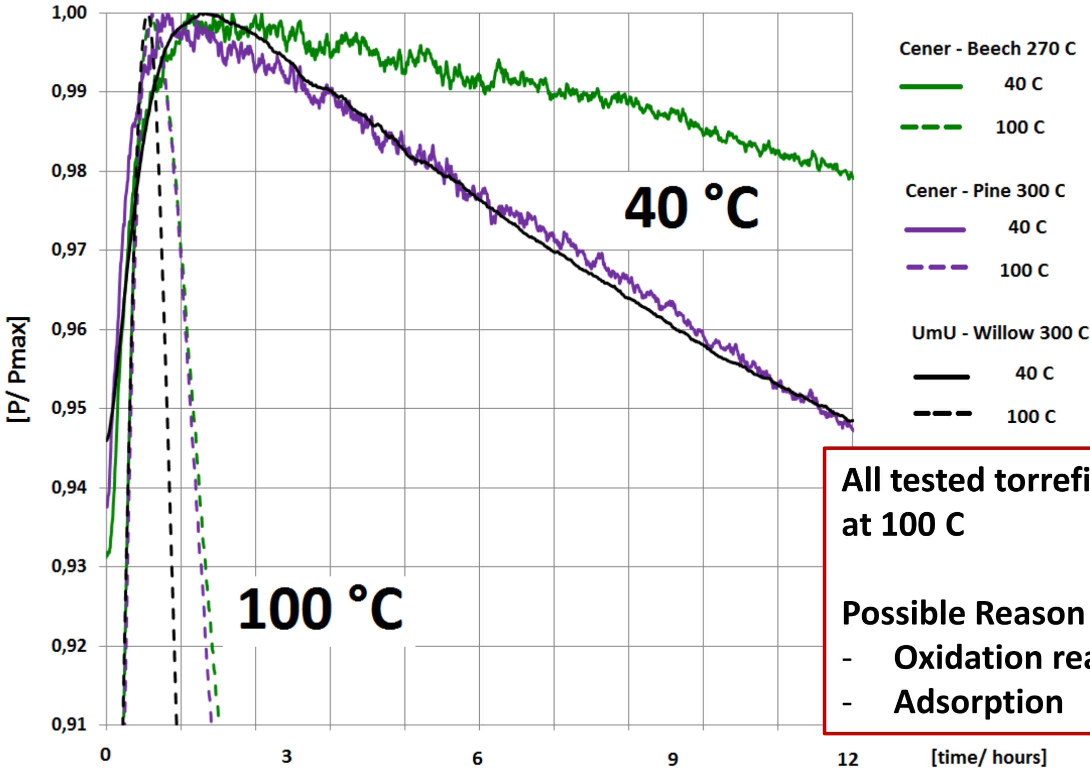
WP6.1: Small-scale tests (DTI)

- Oxygen depletion of torrefied pellets



All tested torrefied pellets more "active" at 100 C

Possible Reason for oxygen depletion:

- **Oxidation reactions**
- **Adsorption**

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WP6.1: Small-scale tests (VTT)

Climatic testing chamber for determination of equilibrium moisture content

- Methods developed for small scale logistics performance characterisation have been tested in national torrefaction project.
- Methods have been and will further be developed, e.g. automatisation of rain exposure test.
- Experimental work will be started as soon as materials to be tested are delivered to VTT
  - Torrefied stem wood pellets from ECN
  - Wood residue pellets from Topell
  - Torrefied straw pellets from CENER
- Dust explosion risks: Reporting of previous studies has been started and report will be finalised when other partners have identified the same risks. VTT will make the comparison of these risks.

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP6.1: Small-scale tests (UmU)

- Hydrophobicity, climate chamber exposure, 11°C, 80% RH, preliminary results after 1 week exposure

Biomass		Mass yield (%)	Temperature (°C)	Residence time (min)	Weight increase (%)
Forest residue raw	Chips		-	-	14.31
Forest residue	Chips	87.3%	286	6	8.09
Forest residue	Chips	87.9%	286	12	7.52
Forest residue	Chips	80.2%	308	9	6.68
Forest residue	Chips	72.4%	325	6	7.09
Forest residue	Chips	72.2%	325	12	7.30
Forest residue	Pellets				8.93

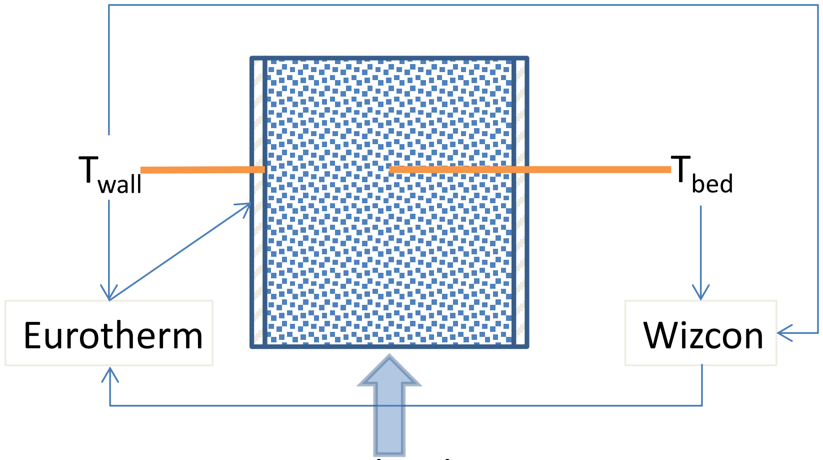
Biomass		Mass yield (%)	Temperature (°C)	Residence time (min)	Weight increase (%)
Willow raw	Chips		-	-	14.58
Willow	Chips	93.2%	286	6	7.94
Willow	Chips	88.6%	286	12	8.05
Willow	Chips	82.8%	308	9	7.18
Willow	Chips	75.3%	330	6	7.13
Willow	Chips	65.4%	330	12	7.00
Willow	Pellets				9.48

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP6.1: Small-scale tests (ECN)

- Self ignition tests and exothermal behaviour
  - Torrefaction Batch Reactor with additional controls to create adiabatic conditions is operational
  - Set-up allows assessment of tendency to self-heat (self-heating ≠ self-ignition)

Ideally adiabatic when
$T_{wall} = T_{bed}$



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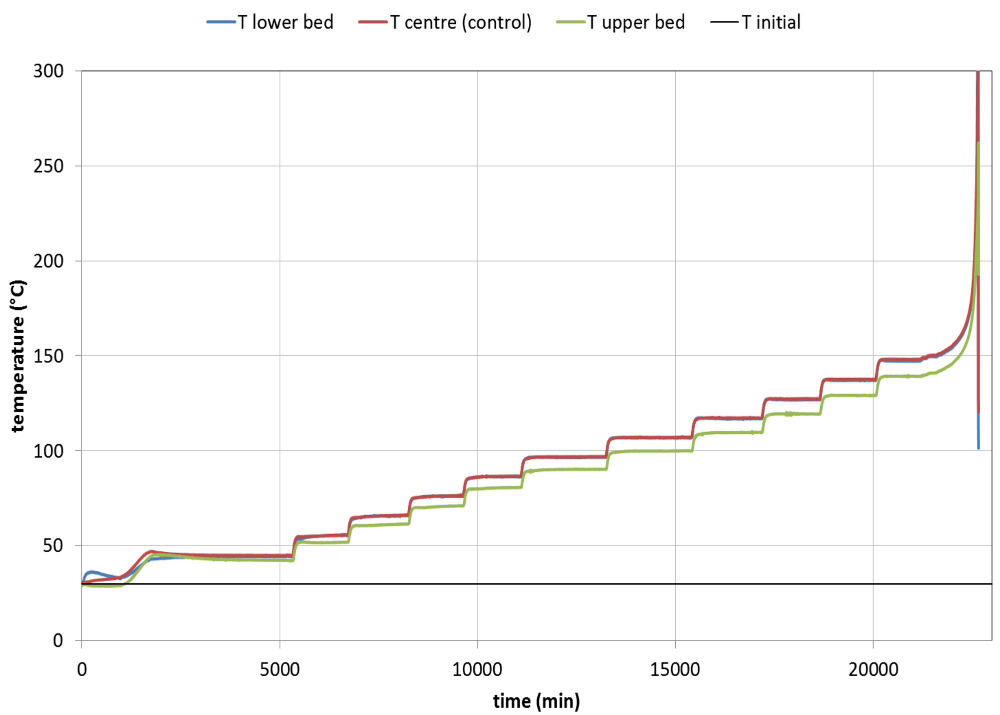
WP6.1: Small-scale tests (ECN)

- Self ignition tests and exothermal behaviour



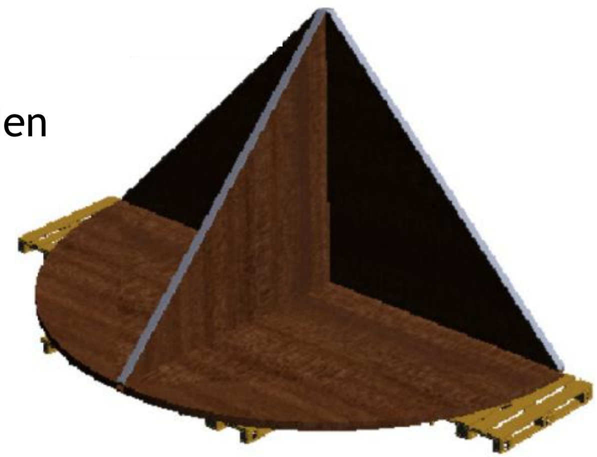
Softwood chips, moist air

Tests with torrefied chips and torrefied pellets are in progress

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP6.2: Outdoor storage and handling tests (Vattenfall)

- Location:
  - Vattenfall's R&D centre in Älvkarleby, Sweden (~150 km north of Stockholm)
- Test volumes:
  - 2 tonnes torrefied poplar
  - 2 tonnes torrefied spruce
- Storage method:
  - "Piece of cake" storage construction applied to simulate larger volumes
- Test period:
  - June 2013 to February 2014



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WP6.2: Outdoor storage and handling tests (Vattenfall)




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WP6.2: Outdoor storage and handling tests (Vattenfall)

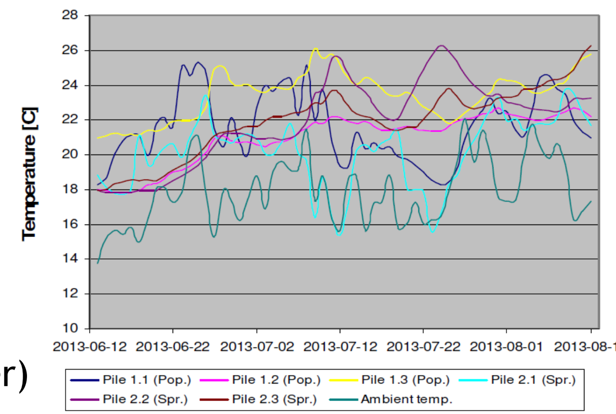
- Weather data from Swedish Metrological and Hydrological institute (daily averages)
  - Temperature, pressure, relative humidity, wind speed/direction, solar radiation
- Pile temperatures continuously logged
  - 3 thermocouples in each pile at different heights + 1 logging ambient temperature
- Solid samples on monthly basis (inside + surface of piles)
  - Heating value
  - Proximate analysis (moisture, ash, volatiles, fixed carbon)
- Additional solids sample analyses at start/mid/end of test period
  - H, C, N, Cl, S
  - Ash melting temperatures
  - Bulk density
  - Mechanical durability
- Leach water analyses (according to specification as distributed/ discussed within project group in May)

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP6.2: Outdoor storage and handling tests (Vattenfall)

- Test program progressing according to plan – too early / too few samples to draw definitive conclusions:
  - Inside piles - no apparent degradation of pellets
  - On surface of piles - slight degradation (pellets swollen and more porous in consistency)
  - Initial samples indicate increase in pellet moisture – especially on surface but inside piles as well (the spruce pellets seem to be more susceptible to moisture than the poplar pellets)
  - Slight temperature increase in piles observed but so far difficulty to conclude if it is solely ambient temperature dependent
- Handling tests (will be carried out before end October)
  - Critical angle of conveyor belts
  - Dust formation dropping/handling of pellets (simulating transition points)
  - Angle of repose
  - Etc…
- Further input and suggestions regarding possible handling tests from partners still welcome

Pile 1 and 2 temperture profile June-August



Parameter	Unit	ECN	Topell
		Poplar	Spruce
Moisture (ar)	[%]	3.9	3.9
Ash (ar)	[%]	0.7	0.4
Volatile (ar)	[%]	75.2	71.1
Fixed cabon (ar)	[%]	20.3	24.6
LHV (ar)	[MJ/kg]	19.28	19.95
LHV (db)	[MJ/kg]	20.16	20.84
Bulk density	[kg/m3]	701	708
Mech. Durability	[%]	97.5	96.4

Temperature profiles in piles as logged between early June to early August (above). Initial pellet data as analysed at arrival (below).

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP6.2: Outdoor storage and handling tests (EON)

Two outdoor storage piles were built in June 2013:

Peaked-topped pellets

- Model the formation of pellets after it has been delivered.
- 4 tonnes
- 2.34 x 2.36 x 1.5 m

Flat- topped pellets

- Model the formation of pellets after com-paction (though no compaction has occurred)
- 3 tonnes
- 2.34 x 2.36 x 1.5 m

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WP6.2: Outdoor storage and handling tests (EON)

- In-situ measurements
  - Temperatures in piles
  - Weather data (ambient temp, humidity, wind speed, wind direction, rainfall)
- Sampling
  - Surface and middle of each pile
- Physical parameter tests
  - Pellet durability
  - Diameter
  - Particulate size
  - Particle distribution
- Proximate Analysis
  - Moisture
  - Ash
  - Volatiles
  - Calorific Value

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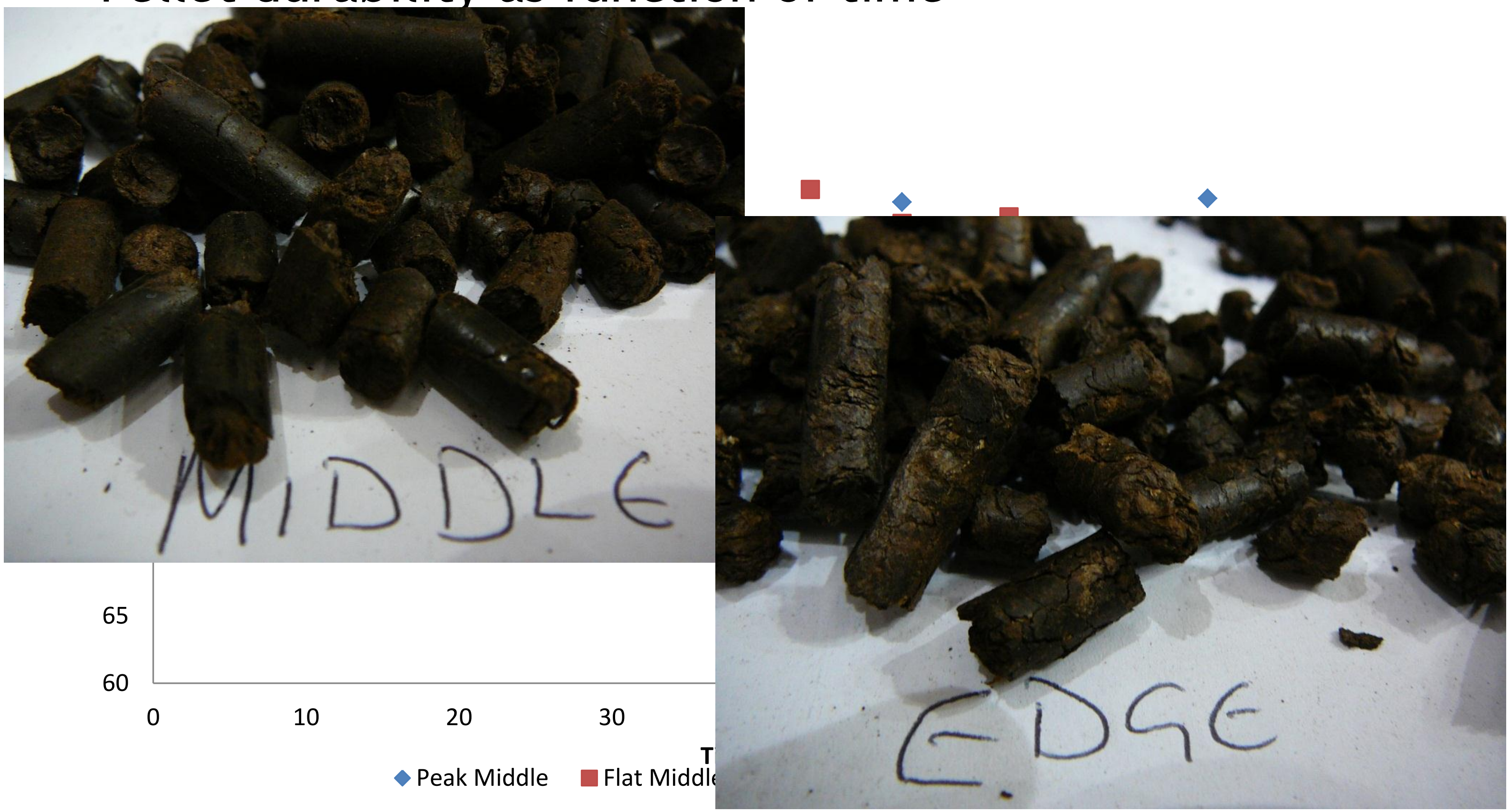
WP6.2: Outdoor storage and handling tests (EON)

- Pellet durability as function of time



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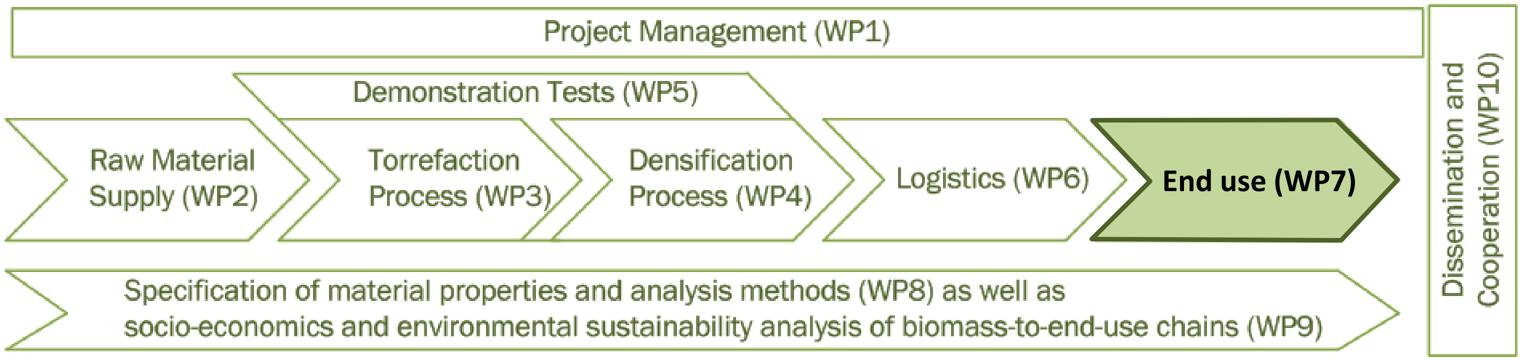
Pamplona, 16.-18. Oct 2013



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Production of Solid Sustainable Energy Carriers by Means of Torrefaction

END USE(WP7)

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

SECTOR Production of Solid Sustainable Energy Carriers from Biomass by Means of TORrefaction

WP7.1 Milling & feeding (USTUTT, ECN, UmU, DB): Results and work planning status

- Milling tests performed at USTUTT in a hammer mill (200kg/h):
  - Torrefied pellets from Topell (woodmix), ECN (Spruce), CENER (Beech and Pine), and reference white wood pellets.
  - Preliminary results show significantly lower energy consumption for torrefied pellets with finer and more spherical material output.
- Preliminary results of feeding tests for both 20kW and 500kW PF burners at USTUTT show no bridging and agglomeration problems.

Task start date	Task end date	Deliverables/Due date	Deliverable status	Justifications/ Impact of delay/Remedies
01.03.2013	30.10.2014	Report due October 2014	As planned	None

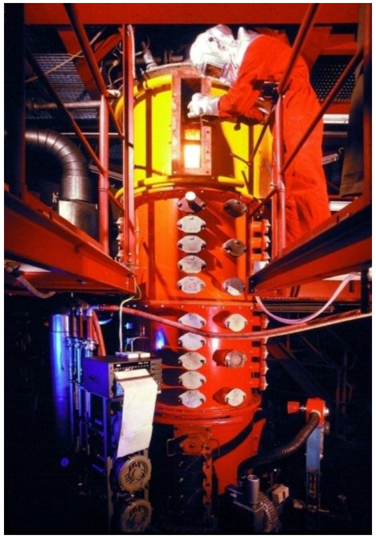
The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

Pamplona, 16.-18. Oct 2013

SECTOR Production of Solid Sustainable Energy Carriers from Biomass by Means of TORrefaction

WP7.2 Co-firing in pulverized-fuel boilers (Procede, USTUTT, EON, Vattenfall, RWE, ECN, IEN): Results and work planning status

- Co-combustion tests (10%, 25%, 50%, 75% as well as 100%) at USTUTT's 20kW and 500kW facilities with focus on emissions, burn-out, staging, deposition, fouling and corrosion.
  - Torrefied pellets from Topell (woodmix), ECN (Spruce), CENER (Beech and Pine) and reference white wood pellets. Brown Coal (LaTBK) and Colombian hard coal (El Cerrejon).
  - Preliminary results show that torrefaction improves flame stability and potentially burn-out.
- Lab-scale combustion experiments at ECN (100% thermal share, end-point kinetics) performed with materials from ECN, CENER and an external provider
- RWEInnogy's role to change to advisory role due decision to pull out of biomass business.



KSVA(500kW), USTUTT

Task start date	Task end date	Deliverables/Due date	Deliverable status	Justifications/ Impact of delay/Remedies
01.03.2013	30.09.2014	D7.5 Report on torrefied biomass co-firing tests with lignite and hard coal/ **December 2013**	Delayed > 1 month	Late fuel delivery **New Date: February 2014**
		Updated report with materials from an external provider /**April 2014**		

WP7.3 (Co-)gasification in entrained flow gasifiers (UmU, Vattenfall, ECN): Results

The 500 kW Cyclone EF gasifier fed by torrefied biomass (UmU).

From Deliverable D7.2

- Torrefied briquetted and milled spruce, compared with ref. spruce
- Feeding OK, performed well
- Good gas composition
- Torrefied material is more reactive, may well and generally be used as a feedstock for EFG
- No show-stoppers have evolved (Vattenfall)
- Fuel mixing as well as additives may be utilized to control ash and slag behavior in the EFG process

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP7.3 (Co-)gasification in entrained flow gasifiers (UmU, Vattenfall, ECN: Adjustments/work planning status

- Adjustment to work plan due to Buggenum plant (Vattenfall) closure.
- Vattenfall presents the results from tests performed outside SECTOR in 2012 and further tests to be performed at UmU based on experiences from Vattenfall's tests.

Task start date	Task end date	Deliverables/Due date	Deliverable status
01.03.2013	30.09.2014	D7.2 Report on short to long term gasification tests/ August, 2013.	completed
		D7.6 Fluxing strategy, ash fusion temperatures, and gasification tests in a lab-scale simulator/December 2013.	As planned

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP7.4 Small-to-medium scale pellet boilers (BIOS,TFZ,BE2020): Status

- Performance and evaluation of lab-scale reactor tests with 3 different kinds of torrefied pellets (BIOS): completed
- Definition of the testing procedure for small-scale combustion tests (All Partners): completed
- Adaptation of the particle layer model for CFD-simulation of softwood pellets combustion to torr-biomass combustion (BIOS): completed
- Test runs with softwood pellets and torr-pellets in a 21 kW overfed pellet boiler on which the CFD simulations are based to gain validation data (BIOS): test runs completed, evaluation ongoing

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

SECTOR Production of Solid Sustainable Energy Carriers from Biomass by Means of TORrefaction

WP7.4 Small-to-medium scale pellet boilers (BIOS,TFZ,BE2020): Work planning status

Task start date	Task end date	Deliverables/Due date	Deliverable status	Justifications/ Impact of delay/Remedies
03.09.2012	30.04.2014	D.7.3 Combustion behavior of torrefied pellets in pellet boilers and corrosion load on chimneys/ August, 2013.	delayed>1 month	delayed delivery of the torrefied fuel/ **New Date: December 2013**
		D7.4 Combustion screening of three pellet boiler technologies and fuel assessment trials/August 2013.	delayed>1 month	delayed delivery of the torrefied fuel/ **New Date: December 2013**

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

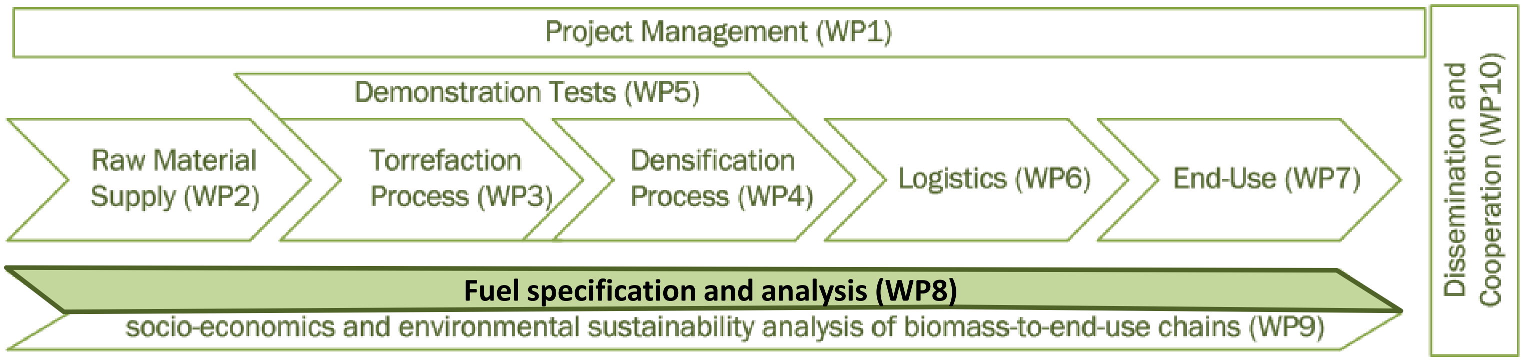
WP7.5 Production of chemicals or biomaterials (ECN, VTT): Results and work planning status

- Differences in the amounts and compositions of condensates between the feedstocks and the temperature phases were obtained.
- The high final temperature proved to be critical, because at 290 °C strong exothermic reactions occurred decreased the yield of torrefied material and produced tarry condensates.
- Condensates obtained at <240 °C are promising, for example, to be used as biodegradable pesticides to replace synthetic ones.
- The condensates obtained at higher temperatures may have potential in wood protection.
- The quality and utilization potential of the condensates can be affected by the temperature phases.

Task start date	Task end date	Deliverables/Due date	Deliverable status
01.08.12	20.01.14	D7.1 Report on the production of chemicals and biomaterials/ June 2013	Completed and draft uploaded July, 2013

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

Pamplona, 16.-18. Oct 2013



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Production of Solid Sustainable Energy Carriers by Means of Torrefaction

FUEL SPECIFICATION AND ANALYSIS (WP8)

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

Task 8.1 Fuel properties & investigation of "non-standard" parameters - Results

- Round Robin test I conducted (sample shipment 07/2012)
  - D8.1 Report Round Robin I – Validation of "standard" test methods
- 43 Participants
- 18 Countries
- 11 Parameter
- 19-41 Participants per parameter

Parameter	Method/ Standard
Bulk density	acc. EN 15103
Mechanical durability	acc. EN 15210-1
Moisture content	acc. EN 14774-1 or 2
Ash content	acc. EN 14775
Calorific value	acc. EN 14918
Content of chlorine and sulphur	acc. EN 15289
Content of volatile matter	acc. EN 15148
Content of carbon, hydrogen, nitrogen	acc. EN 15104
Content of major elements	acc. EN 15290
Content of minor elements	acc. EN 15297
Ash melting behaviour	acc. CEN/TS 15370

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

Task 8.1 RR I - Findings

- Ash content, water content, chlorine and sulfur content, CHN analysis – comparable to solid biofuels performance
- LHV – reproducibility limit is higher than for solid biofuels
- Ash melting behavior – same difficulties as for solid biofuels
- Minor elements – low concentration/detection limits as for solid biofuels
- Mercury and Antimony – too less results as for solid biomass

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

Task 8.1 New method development

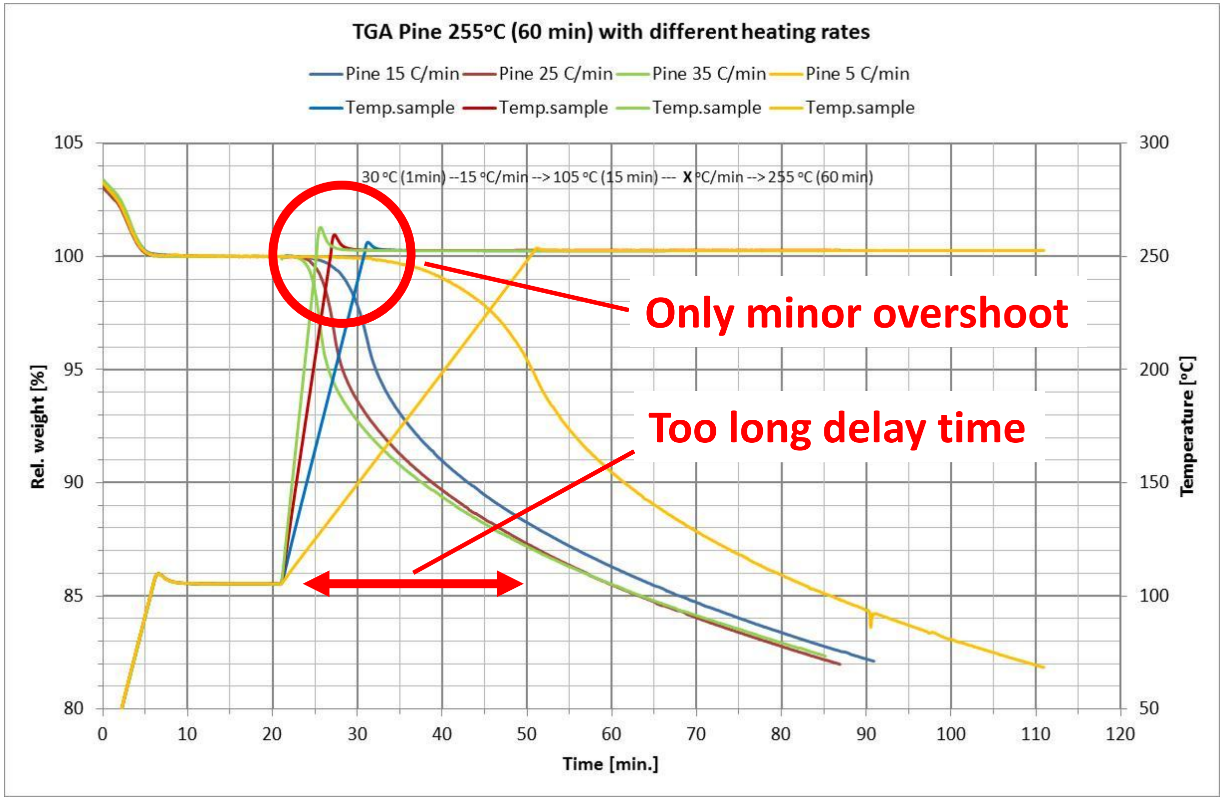
- TGA method (ECN)
- Leaching behavior (VTT)
- Hydrophobicity – water absorption and degree of torrefication (OFI)
- NIR Spectroscopy (SLU)
- Particle size distribution and flowability properties for both pellets and powder (TFZ)
- Grindability, Hardness (DBFZ)

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

SECTOR Production of Solid Sustainable Energy Carriers from Biomass by Means of TORrefaction

Task 8.1 Thermogravimetric analysis (ECN) - Results

- TGA profile based on heating rate comparison testing



The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

Task 8.1 Leaching behavior (VTT) - Results

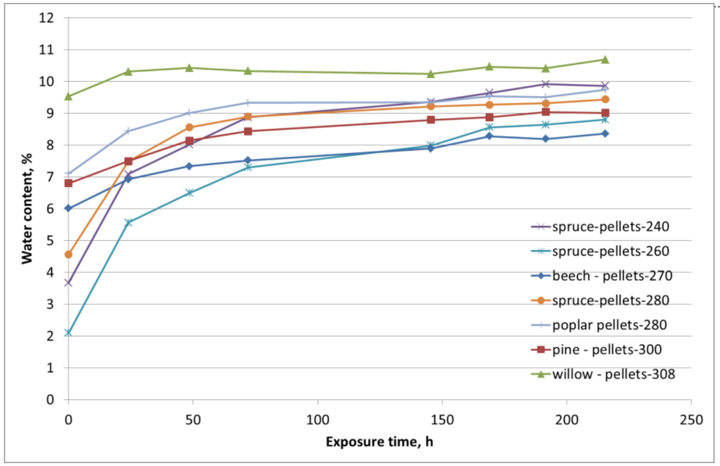
- 3 waters from immersion tests of national research project ”Torrefaction of woody biomasses as energy carriers for the European markets”* were analysed
  - Wood leachate (Pine wood pellets)
  - Wood 245C leachate (Torrefied whole tree wood chips, coniferous)
  - CENER 273C leachate (Torrefied beech wood)
- Results:

	Wood	Wood 245C	CENER 273C
pH	5.9	4.8	6.23
TOC, ppm	220	390	405
TC, ppm	230	392	425
COD, mg/l	600	1070	1285
Solids content , mg/l	420	100	92
Water-soluble low-molecular organic compounds, wt%	0.00	0.00	0.00

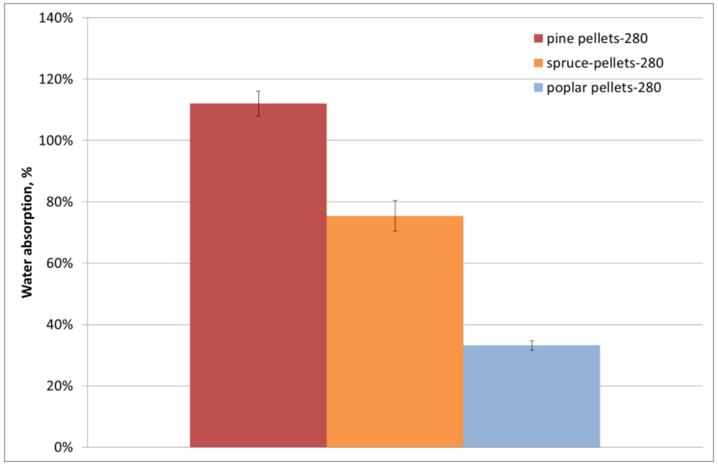
*Project report available http://www.vtt.fi/inf/pdf/technology/2013/T122.pdf

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

Task 8.1 Hydrophobicity - water absorption (OFI) - Results



- Exposure tests
  - Saturated NaCl solution - 73% rel. Humidity
  - Tests with higher rel. humidity



- Absorption tests
  - Water immersion (15 min)
  - Problematic in handling
  - With torr. chips to be repeated

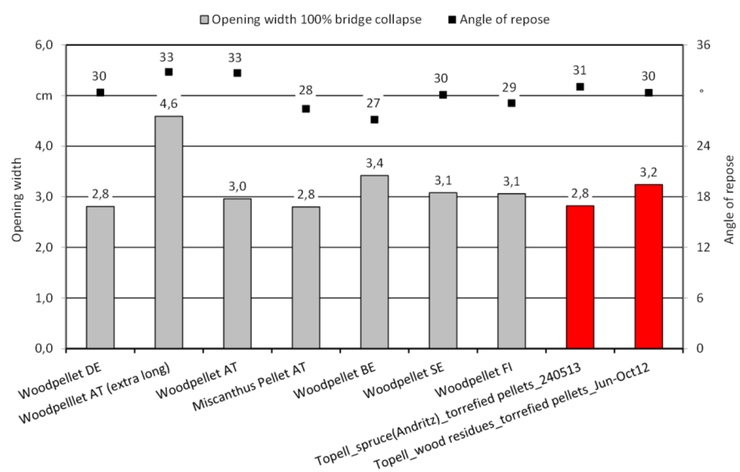
The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

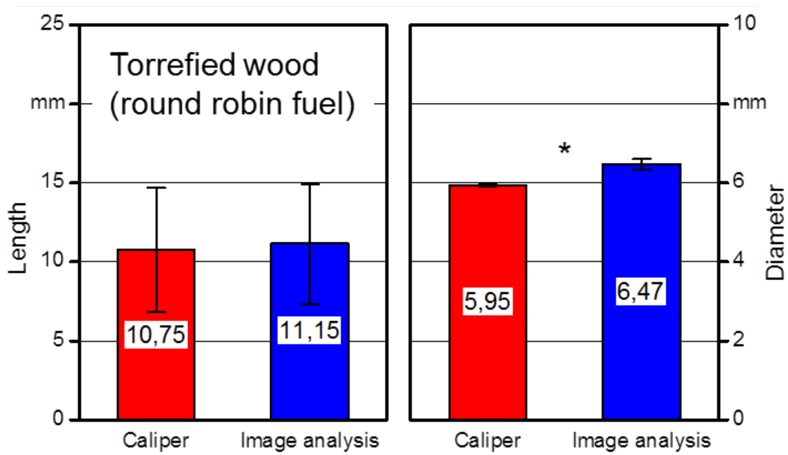
NIR Methode (SLU) - Results

- Properties of torrefied materials can be predicted with high accuracy (e.g. molecular ratio; contents: energy, ash, moisture, volatiles, etc.)
- fast techniques to monitor and control torrefaction processes

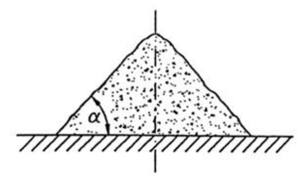
The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

Task 8.1 Particle size and flowability (TFZ) - Results





- **Bridging** (Movable floor with expandable opening - direct measurement)
- **Angle of repose**
  (acc. FEM 2581)



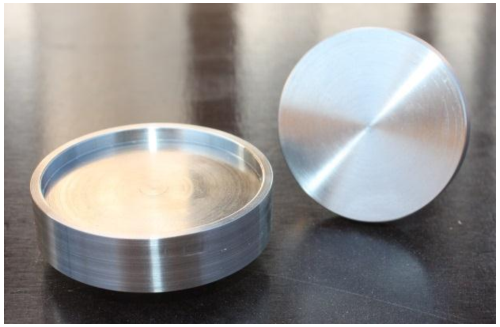
- **Particle size**
  - Image analysis versus caliper measurement

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

Task 8.1 Hardness (DBFZ) - Results

- Definition: power of resistance to fracture
- Development of a measurement methodology
- Variation of installed equipment with different load settings

standard procedure – point loading



1st modification - area loading

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

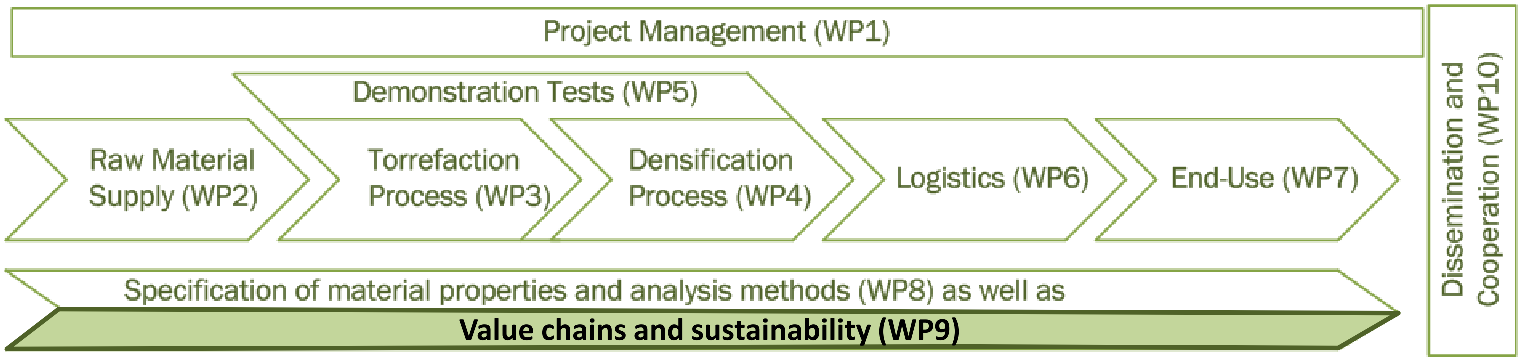
Task 8.2 Development of material safety data sheet (DBFZ)

- Requirements for MSDS for torrefied material according EU REACH published
- Further input from WPs and industry required

Task 8.3: Preparation of CEN and ISO product standards (VTT) - Results

- ISO 17225-1 General requirements (final vote phase)
  - All values agreed and final voting 24 October to 24 December
  - To be published in the beginning of year 2014 as EN ISO standard and EN 14961-1 will be withdraw
- ISO 17225-8 (tbc) Graded thermally treated densified biomass fuels (WI phase)
  - Proposal for ISO/TC 238 work item (WI) has been sent to ISO.
  - Work will start in the beginning of 2014 under WG 2 led by Eija Alakangas, VTT and will finish in 2016.

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826



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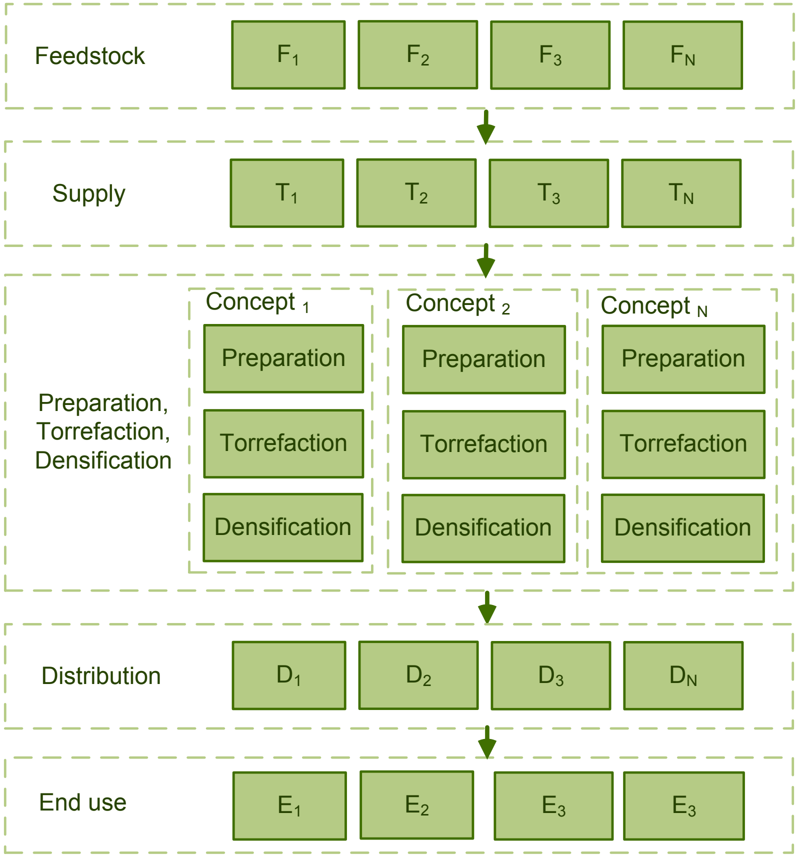
Production of Solid Sustainable Energy Carriers by Means of Torrefaction

VALUE CHAINS AND SUSTAINABILITY (WP9)

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP9 objectives

- WP9 aims to assess the environmental and socio-economic impacts of torrefied solid biomass in different value chains
- Each chain is characterized by certain properties regarding feedstock, torrefaction technology, transportation options (mode and vehicle selection) and storage strategy (shape and location), types of end-use and other parameters. Four basic types of the torrefaction technologies (rotary-drum moving-bed, torbed, fluidised-bed) will be considered.
- Building on these chains selective deployment scenarios for energy supply structures based on torrefaction up to 2030 will be analysed.



Different (torrefied) biomass to end use chains investigated in WP9

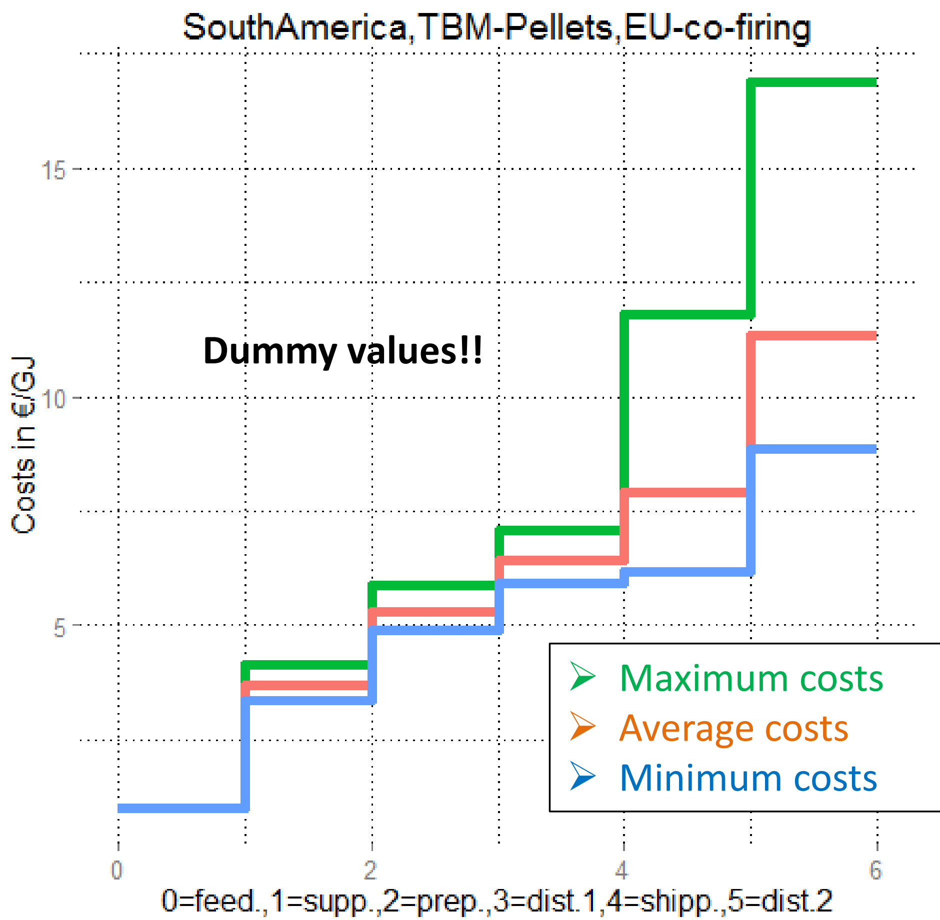
The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP9 D9.3 results

- Methodological approach for the simulation of deployment scenarios of torrefied biomass
  - Structure of generic biomass-to-end-use chain assessment
  - Theoretical background of the realisation of the software tool **BioChainS**
  - Storyline development for calculation of scenarios
  - First biomass-to-end-use chain calculations with **!dummy values!**

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP9 D9.3 results



Structure of results:

- Origin & Feedstock
- Technology
- End user type
- Year & Scenario

Range of results through probability distributions:

- Distances & Transport modes
- Torrefaction plant size
- Central or mobile comminution
- Primary fuel used for heat demand of torrefaction plant (Gais/Oil/BM)

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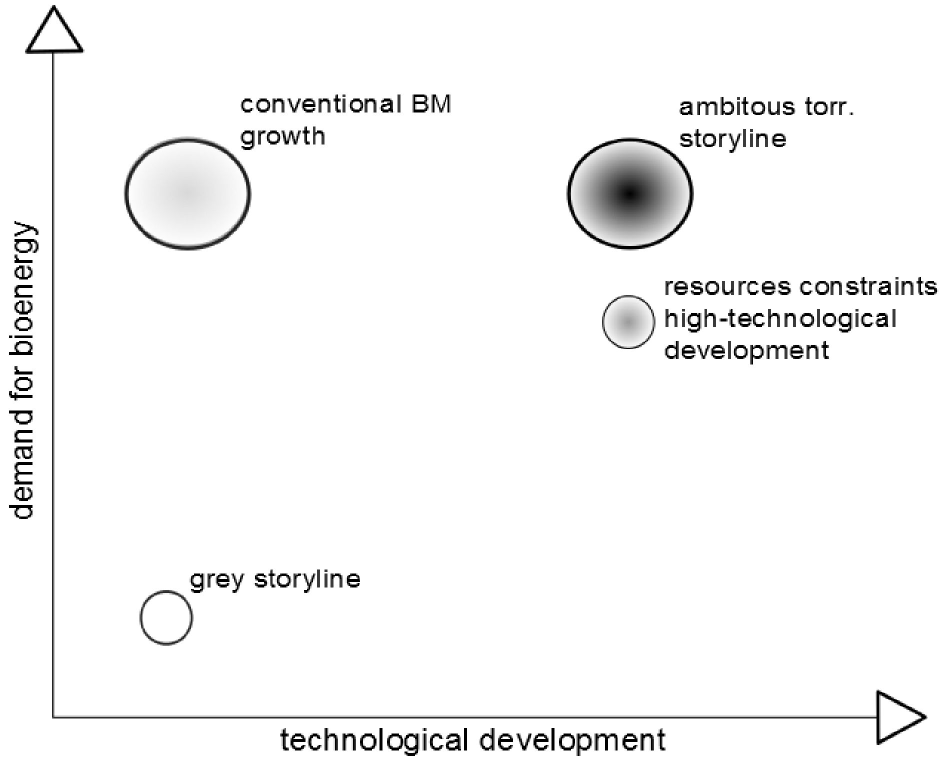
WP9 D9.3 results



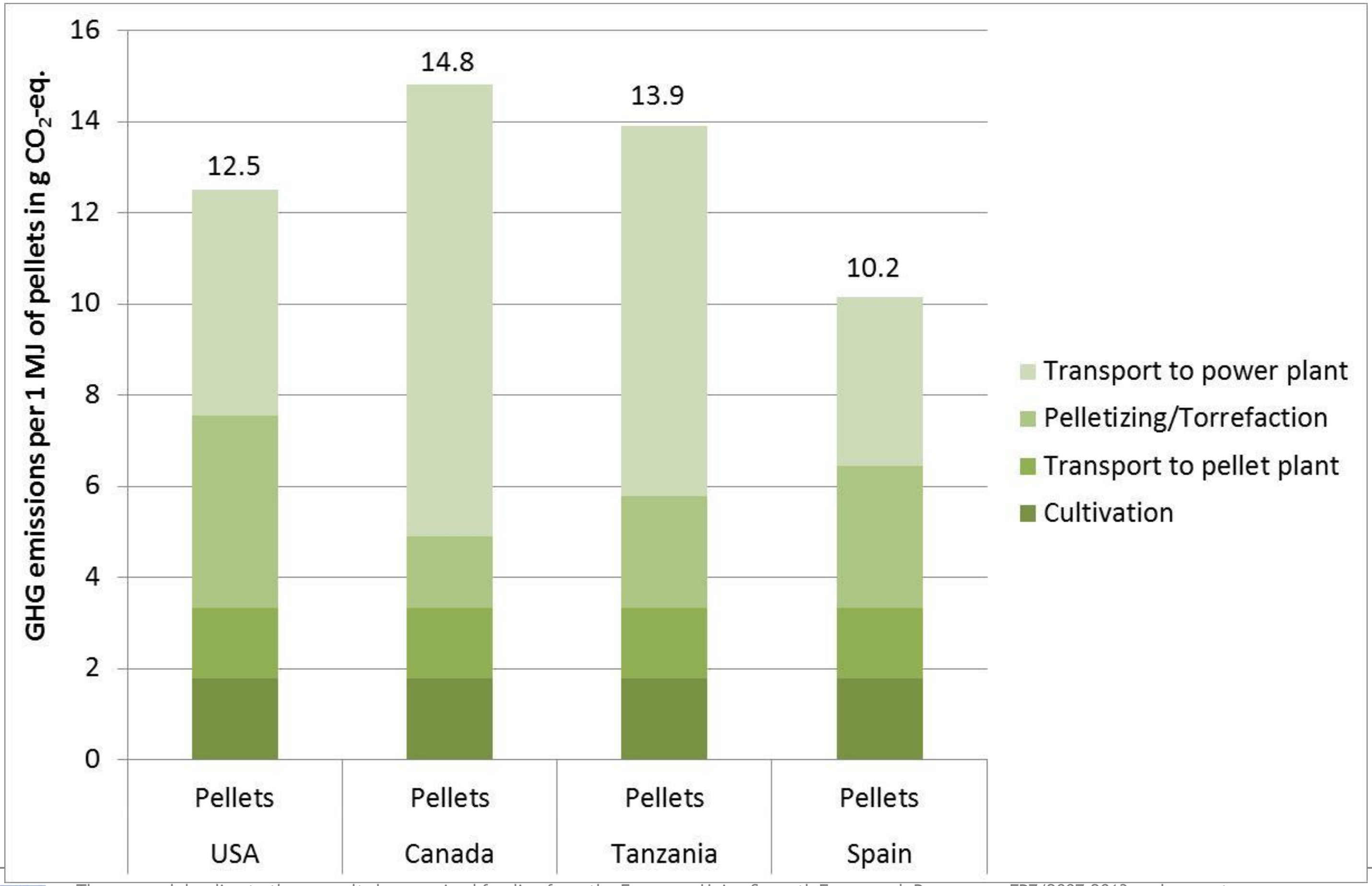
Legend:
Size of circle indicates BM availability
Shading indicates BM penetration of EU-market

Parameters defined for deployment scenarios:

- Techn. Development
- Climate change mitigation policies (global or EU)
- Biomass support schemes

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

WP 9 D9.4 results I – GHG-emissions per MJ supplied pellets



The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

Task 9.4: 1st Results of Sustainability Assessment

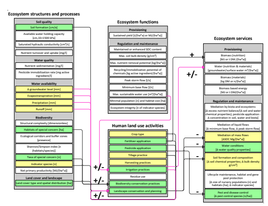
Development of a new indicator matrix to analyse iLUC risks of potential feedstocks

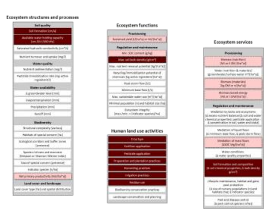
Type of Feedstock (Crop)	Residues	By products	Invasive species	Dedicated energy plantation	Crop area	Yield	Total growth period of the plant	Sustainable harvest Level	Carbon content of biomass	Soil Organic Content	Carbon pay back period time	Type of Land	Competing Uses
	t/ha	Yes /No	Yes /No	Yes/No	Ha	t/has	years	t/ha	t of C/ha	t of C/ha	Years		yes/No
Primary Forest Products													
Secondary Forest													
Short Rotation Coppice													
Agricultural Residues or products													

→ Ranking of iLUC risk

Review of criteria & indicators in certification schemes

Certification schemes	Indicators				Causal links
	Ecosystem structures and processes	Ecosystem functions	ES	Human land use activities	
GBEP	1	2	1	1	1
NTA8080	1	1	1	3	2
ISCC	1	2	1	2	1
REDcert	2	2	1	3	1
GGLS2	1	1	1	3	2
RSB	2	3	2	3	3
CSBP	1	1	1	3	2
IWPB	1	1	2	3	1
SAN	3	1	1	3	3
GlobalGAP	1	1	1	3	1
Forestry	3	2	3	3	1



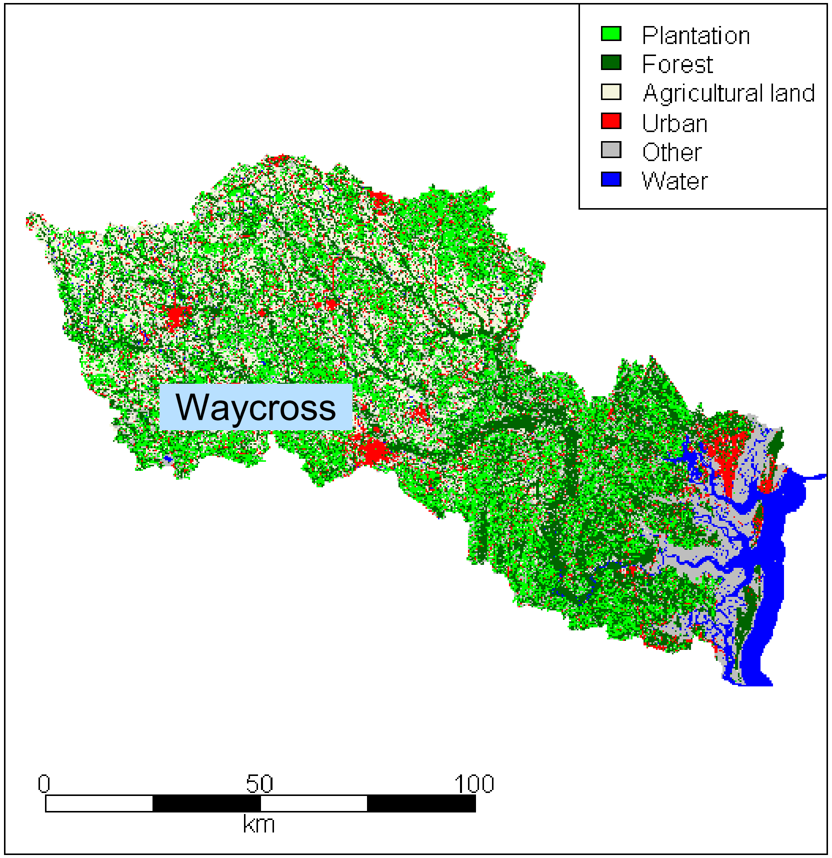


→ Improve applicability and reliability of CS

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2 agreement n° 282826

Task 9.4: Environmental assessment

Satilla watershed



Southern USA (Georgia)

Land use/land cover:

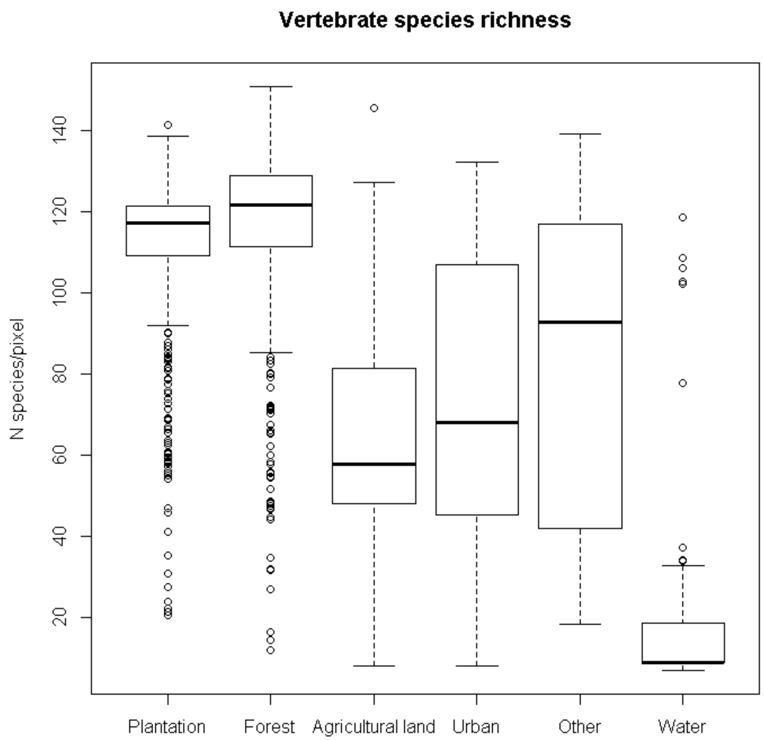
- ~26 % pine plantations and harvested forest
- ~30 % forest
- ~16 % agricultural land

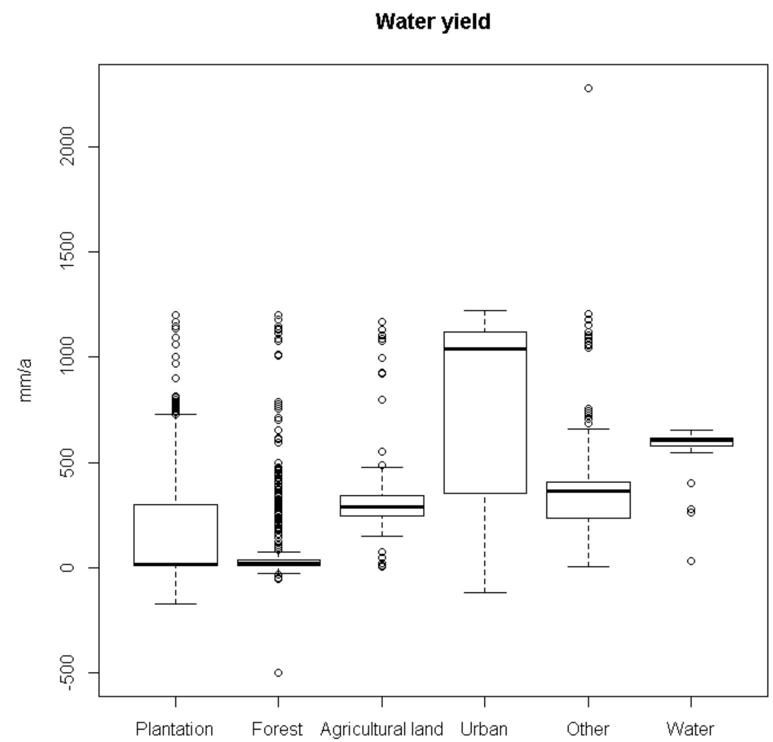
Feedstock:

- Pine poles (previously used as pulpwood)

SECTOR Production of Solid Sustainable Energy Carriers from Biomass by Means of TORrefaction

Biodiversity and water availability – preliminary results



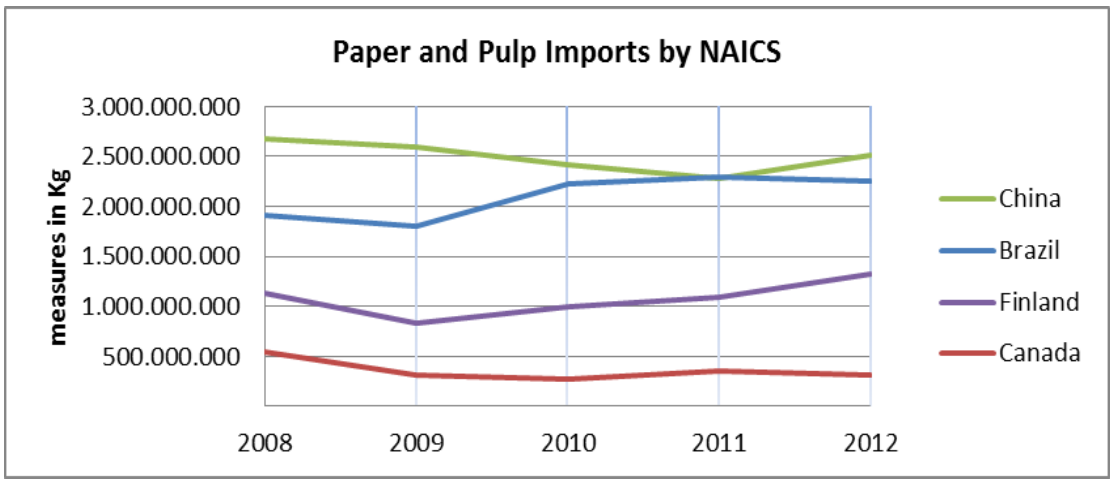


- Pine plantations have a lower vertebrate biodiversity than forests, but higher values than agricultural land
- Water yield (runoff and infiltration) are slightly higher for plantations than forests

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2
agreement n° 282826

Task 9.4: Qualitative Assessment of iLUC effects in Georgia

Current use of Georgia's pine plantations:	mainly **pellet production**
Previous use:	**pulp & paper** production
Current demand for paper:	**constant to increasing**
iLUC-effect:	in pulp & paper **exporting countries**



(North American Industry Classification System (NAICS)

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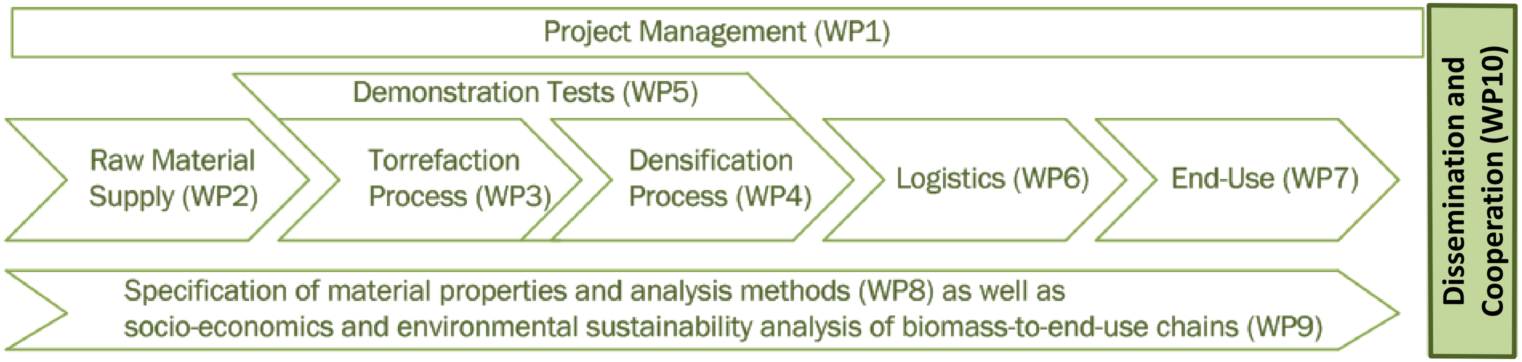
agreement n° 282826



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Production of Solid Sustainable Energy Carriers by Means of Torrefaction

DISSEMINATION AND COOPERATION(WP10)

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

Task 10.1 - Workshop 1

1st SECTOR workshop in Milan as a Side Event at the

EU BC&E 2012

21.06.2012

“Market Implementation of a new Solid Biofuel and its midterm Prospects”

IEA Bioenergy

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

Task 10.1 - Workshop 2

2nd SECTOR workshop in Graz

Central European Biomass Conference

15th to 18th January 2014, Graz, Austria

"International workshop: Torrefaction of biomass"

Österreichischer Biomasse-Verband

Austrian Biomass Association

lk landwirtschaftskammer steiermark

bioenergy2020+

IEA Bioenergy

Task 32 and Task 40

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

Task 10.2 - Dissemination

7 posters

25 presentations

1 workshop

1 exhibition

ISO TC 238 (Solid biofuels) Meeting WG 4+5

ISO TC 238 (Solid biofuels) Convenor Meeting

World Bioenergy 2012

IEA Bioenergy Conference

VGB-Konferenz "Kraftwerke im Wettbewerb 2013"

World Biomass Power Markets

ENERGY EUROPE

EU BC&E 2013 - 21st European Biomass Conference & Exhibition

AEBIOM European Bioenergy Conference

International VDI Conference – Biomass to Energy

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826

Task 10.3: Integration into the "BIODAT" database

- First data sets presented in BIODAT
- chemical and physical characteristics
- template updated
- results of Round Robin included

Version: 20130502

Mandatory information	
Sample name	Torrefied 6mm Pellets
Country of origin (select one)	Netherlands
Date of production (if not produced, date of sampling)	1-5-2012
Category (select one)	Solid_biofuels
Subcategories (select one)	Woody_biomass
	Wood_processing_industry
	Chemically_untreated_wood_residues
	With_bark
Voluntary information	
Details of material:	
Common/alternative name	Torrefied woodchips and wood residues
Description of fuel/biomass	6mm pellets of torrefied woodchips and forest
Photograph (file specification)	
Sampling location	
Date of sampling	1-5-2012
Method(s)/standard(s) of sampling	
Lot size (ton, m^3)	
Latin name	
Producer of fuel/biomass information:	
Name	Topell
Adress	
Country (select one)	Netherlands
Logo of producer (file specification)	
Supplier of material (if not same as producer)	
Submitter of the data to BIODAT/Phyllis2	ofi
Date of input by submitter	21-5-2013
Information from submitter's records	
Literature references	
Links to ash analyses in BIODAT/Phyllis2	
Other information	SECTOR project Round Robin sample

Fuel properties

Property | ref. | Unit | Value | RSD | Det. limit | Laboratory | Date of analysis | Method (standard for analysis)

Proximate Analysis
Moisture co
Ash conten
Ash conten
Loss on Igr
Volatile ma
Ultimate A
Carbon
Hydrogen
Nitrogen
Sulphur
Oxygen
Calorific V
Net. calorifi
Gross calo
Energy den

Physical characteristics

Property | ref. | Unit | Value | RSD | Det. limit | Laboratory | Date of analysis | Method (standard for analysis)

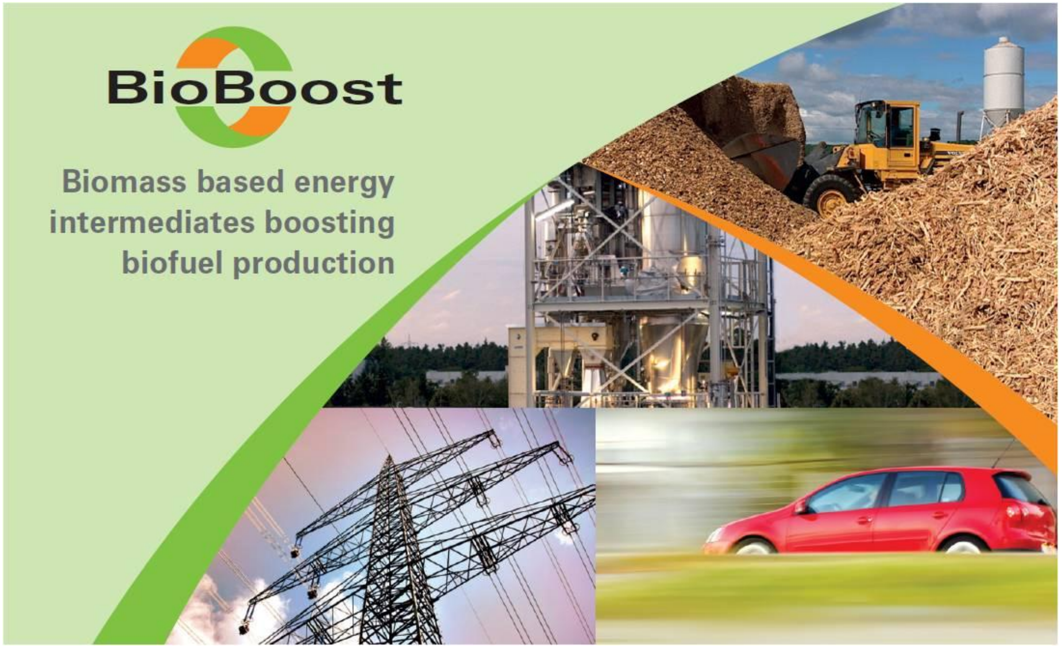
Commonly used properties
Dimension, D
Dimension, D2
Dimension, L
Dimension, L2
Dimension, L3
Mechanic durability
Amount of fines
Particle density
Bulk density
Additives, type
Additives, amount

Particle size distributio
>400 mm
200-400 mm
100-200
63-100 mm
45-63 mm
16-45 mm
8-16 mm
3.15-8 mm
2.8-3.15 mm
2.0-2.8 mm
1.4-2.0 mm
1.0-1.4 mm
0.5-1.0 mm

Chemical analysis

Property	ref.	Unit	Value	RSD	Det. limit	Laboratory	Date of analysis	Method (standard for analysis)
Halogenides								
Fluorine (F)		mg/kg (dry)						
Chlorine (Cl)		mg/kg (dry)	218	104		RR Sector P	June-August 2012	EN 15289:2011 Solid biofuels - De
Bromine (Br)		mg/kg (dry)						
Iodine (I)		mg/kg (dry)						
Major elements								
Aluminium (Al)		mg/kg (dry)	224	86		RR Sector P	June-August 2012	EN 15290:2011 - Solid biofuels - D
Silicon (Si)		mg/kg (dry)	2389	982		RR Sector P	June-August 2012	EN 15290:2011 - Solid biofuels - D
Potassium (K)		mg/kg (dry)	3541	883		RR Sector P	June-August 2012	EN 15290:2011 - Solid biofuels - D
Sodium (Na)		mg/kg (dry)	267	81		RR Sector P	June-August 2012	EN 15290:2011 - Solid biofuels - D
Calcium (Ca)		mg/kg (dry)	6835	1593		RR Sector P	June-August 2012	EN 15290:2011 - Solid biofuels - D
Magnesium (Mg)		mg/kg (dry)	806	165		RR Sector P	June-August 2012	EN 15290:2011 - Solid biofuels - D
Iron (Fe)		mg/kg (dry)	431	138		RR Sector P	June-August 2012	EN 15290:2011 - Solid biofuels - D
Phosphorus (P)		mg/kg (dry)	757	223		RR Sector P	June-August 2012	EN 15290:2011 - Solid biofuels - D
Titanium (Ti)		mg/kg (dry)	12.8	10.7		RR Sector P	June-August 2012	EN 15290:2011 - Solid biofuels - D
Minor elements								

The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826



A European R&D project co-funded under contract 282873 within the Seventh Framework Programme by the European Commission.

Presentation
at SECTOR Plenary Meeting, Pamplona

Andreas Niebel
Karlsruhe Institute of Technology (KIT)

1

Project Facts

Project Acronym	BioBoost
Project Reference	282873 in FP7
Theme	ENERGY.2011.3.7-1: Development of new or improved sustainable bio-energy carriers
Contract type	Collaborative project
Coordinator	Karlsruher Institut fuer Technologie (KIT)
Consortium	13 Beneficiaries from 6 countries
Start	01/2012
Duration	42 month
Budget	7.3 Mio €
Funding	5.1 Mio €

Partners

01	Karlsruher Institut fuer Technologie	KIT
02	Center for Research and Technology Hellas	CERTH
03	AVA-CO2-Forschung GmbH	AVA-CO2
04	CHIMAR Hellas AE	CHIMAR
05	EnBW Energie Baden-Württemberg AG	ENBW
06	Nederlandse Organisatie voor Toegepast Natuurwetenschppelijk Onderzork	TNO
07	GRACE GmbH & CO KG	GRACE
08	Instytut Uprawy Nawozenia I Gleboznawstwa, Panstwowy Instytut Badawczy	IUNG
09	FHOÖ Forschungs & Entwicklungs GmbH	FHOÖ
10	Neste Oil Corporation	NESTE
11	SYNCOM Forschungs- und Entwicklungsberatung GmbH	SYNCOM
12	DSM Chemical Technology R & D BV	DSM
13	Universitaet Stuttgart	USTUTT
14	Deutsches Zentrum fuer Luft- und Raumfahrt	DLR

from 6 European countries

3

Objectives

BioBoost addresses the complete value chain

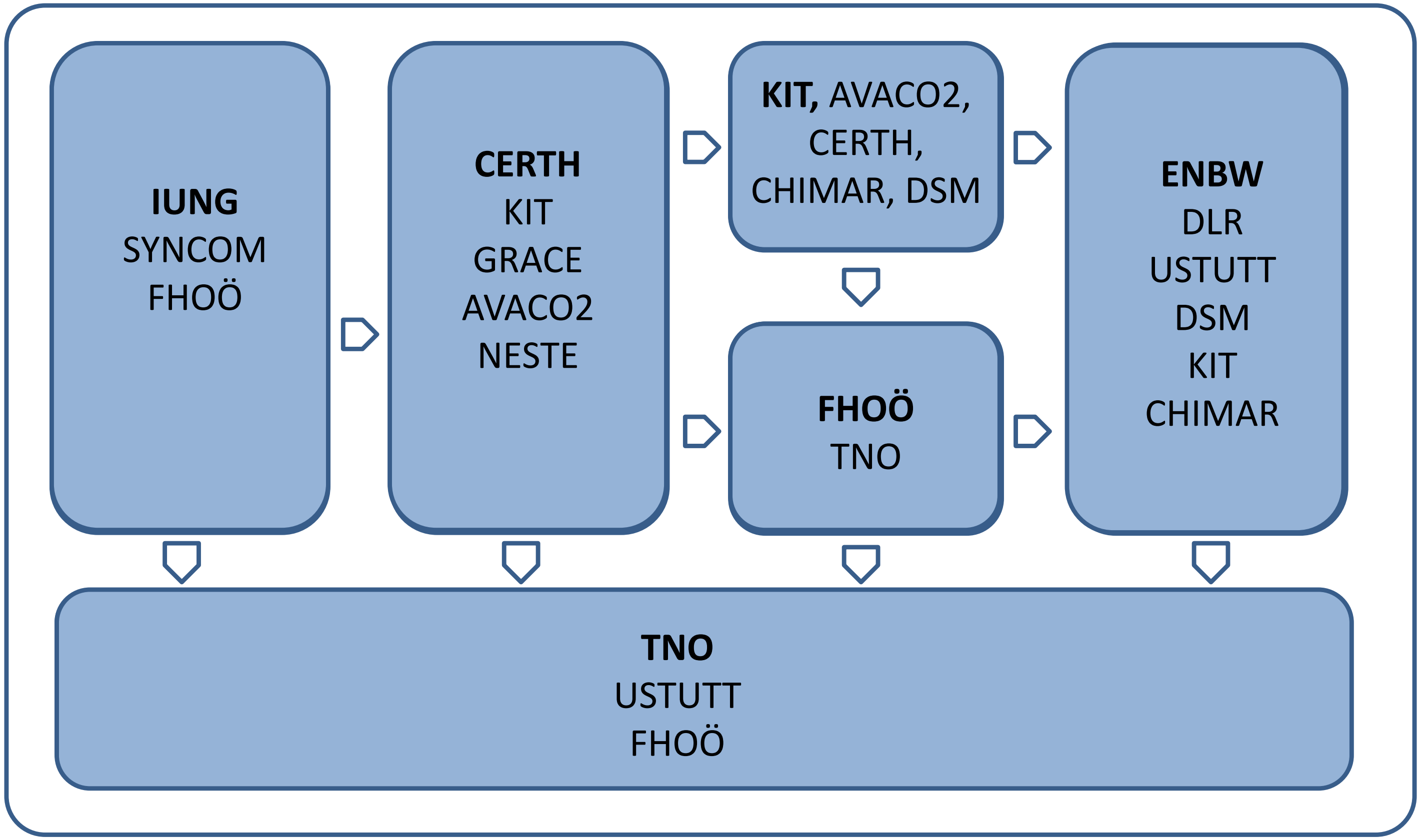
- from the determination of the feedstock potential
- the investigation of pyrolysis and hydrothermal carbonisation conversion technologies,
- the optimisation of transport and logistics
- to the exploitation of the energy carrier and its by-products.
- And the techno-economic and sustainability (social and environmental) assessment of the complete supply chain.

Approach

- Investigate feedstock potential, costs and logistic of residual biomass in EU-28.
- Build-up a GEO-portal to present and display the GIS data.
- Identify an optimized energy carrier(s) produced by de-central conversion by fast pyrolysis, catalytic pyrolysis or hydrothermal carbonisation.
- Increase feedstock flexibility of applications by optimised energy carrier(s).
- Enable the use of wet and dry feedstocks for all applications.
- Investigate chemical byproducts of conversion.
- Develop a logistic model to identify most suitable plant locations based on supply and demand.
- Perform a technical, economical, environmental and social assessment of the chains, sensitivity and scenario analysis and LCA.
- Investigate and demonstrate energy carrier(s) application in CHP, gasification, refinery and chemistry

5

Project Structure



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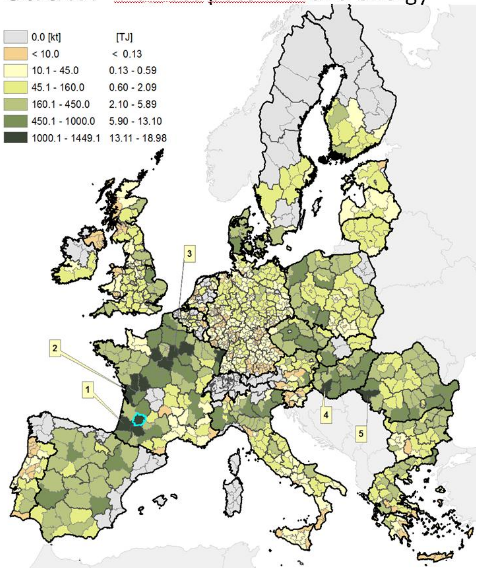
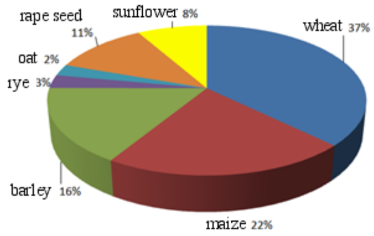
WP 1: Biomass supply

- Develop supply concepts of residual biomass for de-central conversion plants
  - Assessment of theoretical and technical biomass potentials in EU-27+CH
    - Biomass residues and waste
    - Compensation of seasonality by energy crops
  - Costs free field and of logistics
  - Next: Transport and logistic concept, GEO portal

Straw: biomass potential and energy





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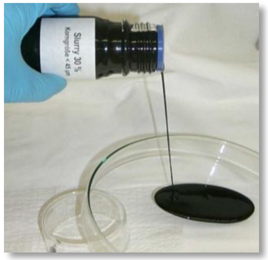
WP 2: De-central conversion technologies

Convert biomass to intermediate energy carriers

- Selection and characterization of biomass types for de-central conversion pathways

- Optimization of conversion technologies

- Further optimization and production of test materials in kg- and ton-scale



8

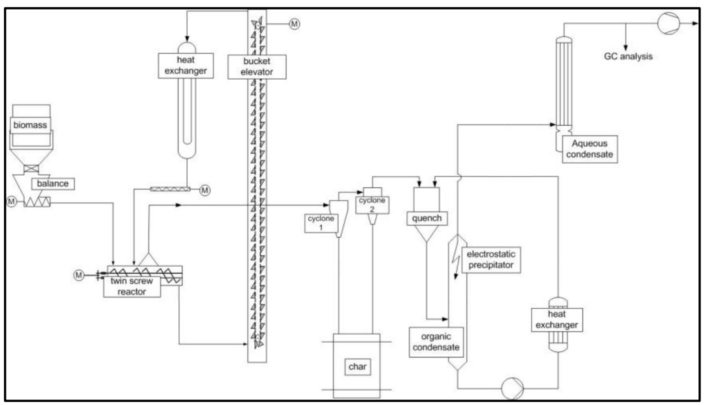
WP 2: De-central conversion

BioBoost

Fast Pyrolysis (FP) at KIT

Conversion of dry feedstock via pyrolysis to an intermediate energy carrier experiments on different process scales:

•Lab-scale fluidised-bed reactor:
biomass feeding rate ~ 0.1 kg/h



•Process demonstration unit:
biomass feeding rate ~ 10-15 kg/h

•bioliq® pilot plant:
biomass feeding rate ~ 500 kg/h

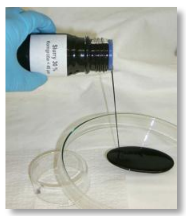
WP 2: De-central conversion

T 2.3: Energy carrier preparation, characterisation, handling and storage

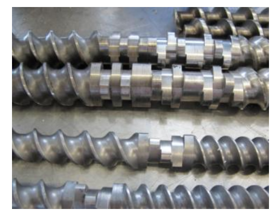
Mixtures of the product fractions *pyrolysis char* and *pyrolysis oil* → slurries or pastes

- Slurry mixing and agitation with different devices
  - Variations in solid content and characterisation of the produced slurries
  - Measuring of the power consumption during the mixing process

Colloidal mixer



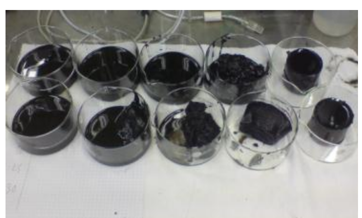
Slurry - flowable



Mixing and conveying with extruders

Paste - non flowing

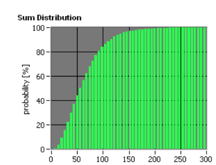
- Investigation of sedimentation behaviour of slurries



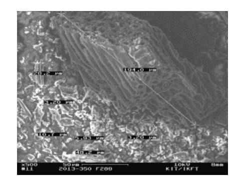
Sedimentation tower with segments and collected suspension-samples after a defined period

- Characterisation of pyrolysis char
  →effects on mixing, sedimentation, powder flow properties

Char powder



Particle size distribution



Shape and structure

WP 3: Extraction of high value by-products

Improve economic performance of integrated process concepts by recovery of valuable materials and nutrients

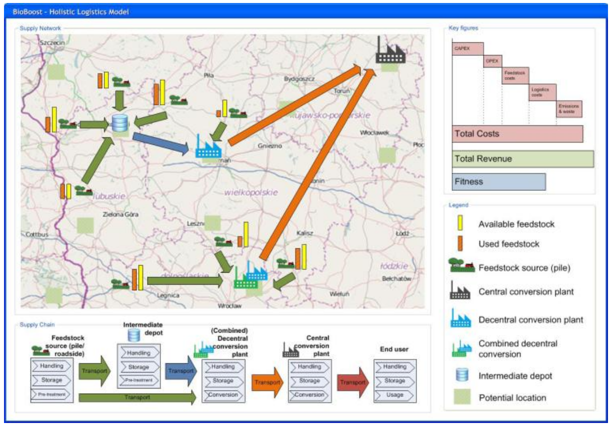
- Analysis of valuable components from pyrolysis liquids and HTC process water
- Development of appropriate separation methods
- Investigation of potential use of phenols for polymers
- Investigation of by-producing HMF in HTC-processes
- Optimizing HTC-process including nutrient recovery

WP 4: Transport and logistics

Develop a logistic model optimizing biomass and derived energy carrier transport for selected supply/conversion scenarios

- Parameters: transportation means, distance, biomass availability, site analysis of pre-conversion plant, CO_2-emission, costs,…
- General model, verified by selected examples

→ Interaction with SECTOR!?



WP 4: Transport and logistics

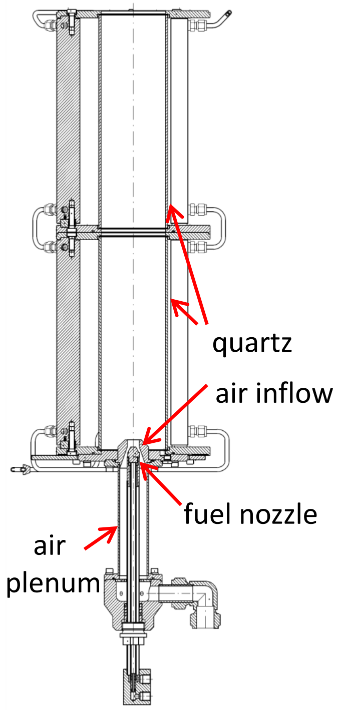
Simulation/Optimization Prototype

- separate chain per feedstock
- evaluation of costs & emissions for
  - feedstock (exponential saturation penalty)
  - feedstock transport & handling (field to plant)
  - feedstock storage (throughput based)
  - conversion & construction (scalable plants)
  - revenue of intermediates
- optimization of
  - feedstock utilization (per region)
  - transport network

WP 5: Application of energy carriers

Check and test for technical and economic utilization of the energy carriers available

- Combustion of pyrolysis and HTC products for heat and power production
- Use of catalytic pyrolysis oils as refinery feed
- Evaluation of syngas production
- Techno-economic assessment of separated valuable components

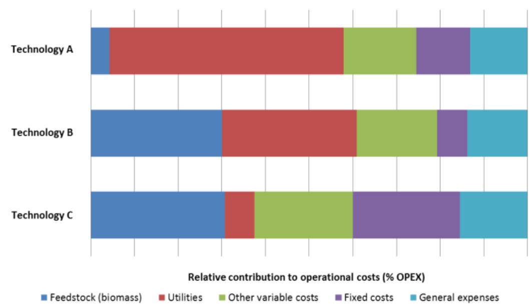


Liquids FLOX burner, DLR

WP 6: Value chain assessment

Assess techno-economic feasibility as well as social and environmental impact of bio-energy carrier pathways in Europe

- Compare to other biomass and energy pathways
- Identify bottle necks and opportunities
- Prepare technical and market implementation
- Support decision making processes



WP 6: Value chain assessment

BioBoost

Feedstock	Pre-conversion process	Energy carrier	*Extraction of valuable substances*	Application
Wheat straw Miscanthus Scrap wood	Fast Pyrolysis	Bio-Oil, char, slurry, paste		Gasification, CHP
Beech wood Cardoon Wheat straw	Catalytic Pyrolysis	Bio-oil		Refinery feed
Spent grain Sewage sludge Municipal waste	Hydro-thermal Carbonisation	HTC coal		CHP
SECTOR				
Wood etc.	Torre-faction	Torrefied biomass		CHP, Gasification etc.

Phenols

Spray combustion + Gas turbine

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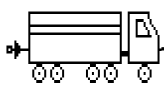
WP 6: Value chain assessment

BioBoost

Key Performance Indicators

Feedstock

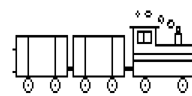
Logistics
Cost to deliver biomass at local plant in €/ton



Local processing plant

Local processing plant
Total Capital Investment
Operational Expenditure

Energy carrier
Cost of producing energy carrier in €/MWh
(minimum selling price)



Logistics
Cost in €/ton

Central processing plant

Central processing plant
Total Capital Investment
Operational Expenditure

Final end product
Cost of producing final energy product in €/MWh
(minimum selling price)

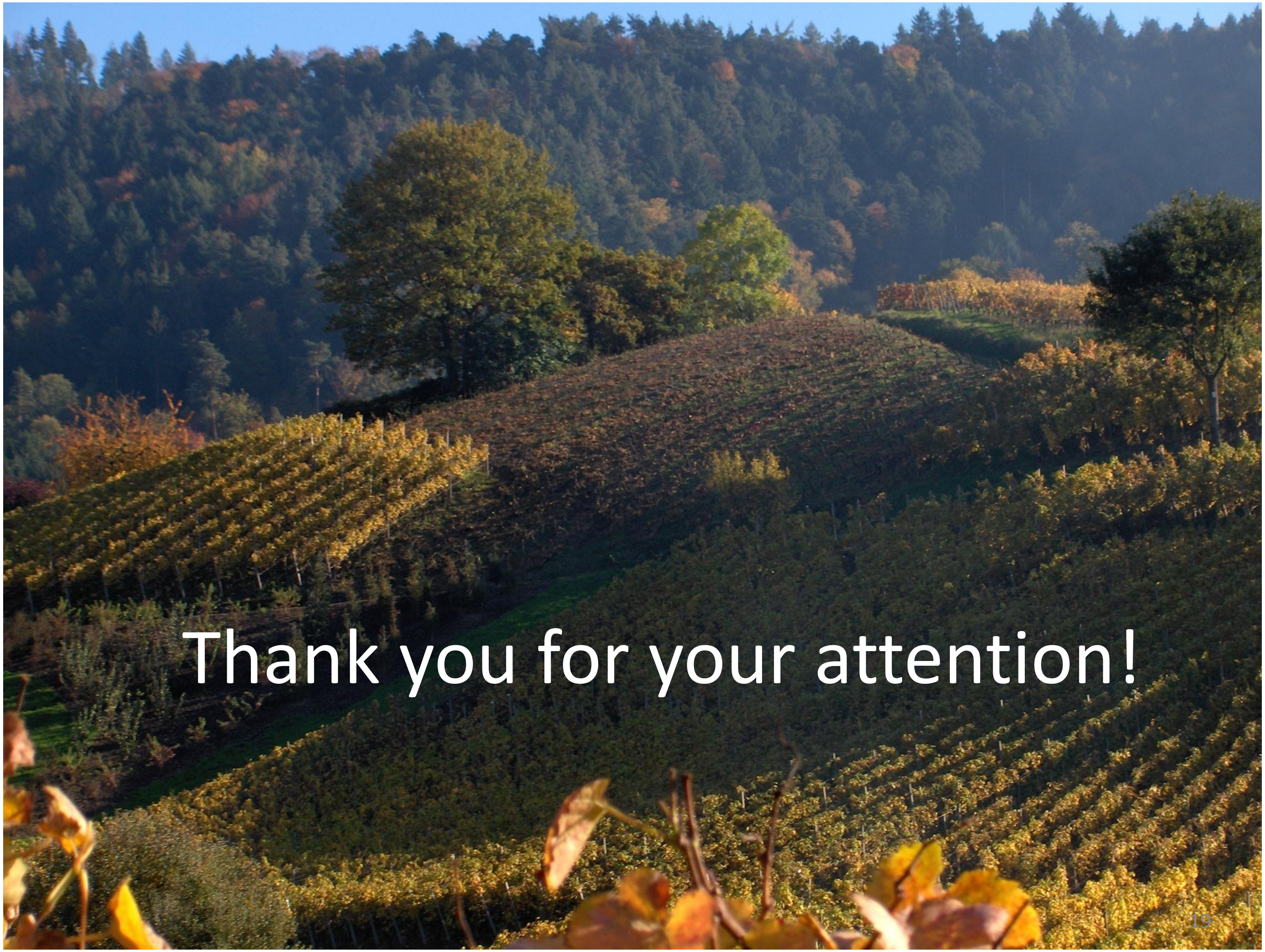
Final energy product

Energy balance
Energy efficiency of converting biomass to final energy product

WP 7: Dissemination

Share scientific results, contribute to strategic European goals, target group specific information to relevant stakeholders

D6.1 Internet page


Thank you for your attention!

inFRes www.infres.eu

Innovative and effective technology and logistics for forest residual biomass supply in the EU

[KBBE.2012.1.2-01]

Antti Asikainen

Metla, Joensuu

SECTOR meeting, PAMPLONA, Spain
16.10.2013

SEVENTH FRAMEWORK PROGRAMME

Objectives

- **INFRES aims at high efficiency and precise deliveries of woody feedstock to heat, power and biorefining industries by:**
  - **Producing technological and logistic innovations** for developing new harvesting, transport and storage
  - **Demonstrating new solutions in full supply chains**
  - Spotting the technological, economic, regulatory and other **bottlenecks in the innovation**
  - Assessing the **environmental, economical and social sustainability**
  - **Disseminating** the outcomes of research and demonstrations to the practices.

2

Storyline

- What is INFRES?
- Sustainability: Dimensions and a few indicators
- Scattered results on sustainability indicators
- What we could do together?

3

Project consortium has 23 partners including

- 9 leading forest energy research organizations
- 13 SME
- 1 larger company

SME's include

- manufacturers of harvesting technology, chippers,
- feedstock supply enterprises,
- forest harvesting and transport providers,
- truck technology and
- IT service provider to manage fleet and storages.

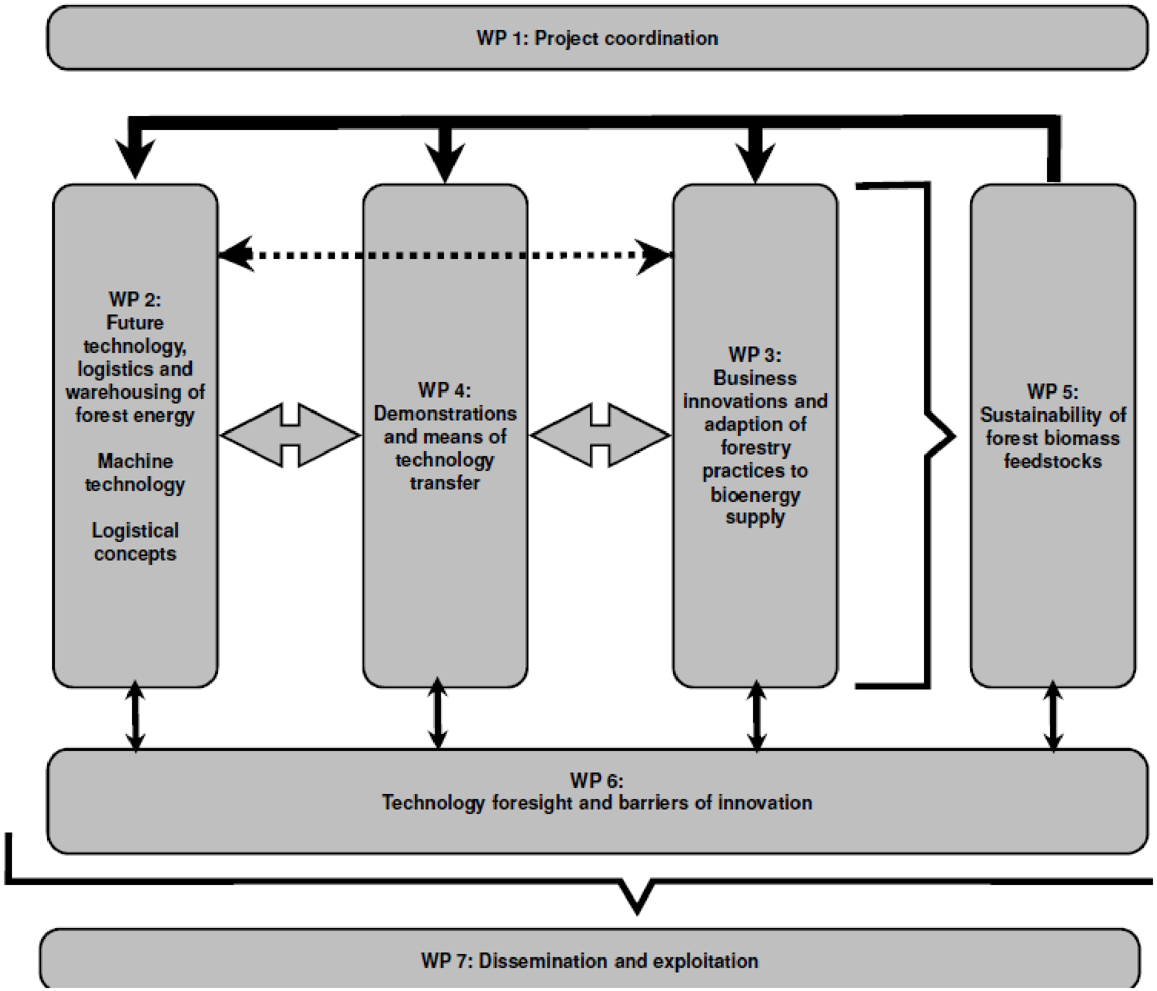
Research organization
SME
Company

Impact

- **INFRES develops and demonstrates technological and logistical solutions that**
  - Decrease the fossil energy input in the biomass supply by 20% and
  - Reduce the raw material losses by 15%.
  - Reduce the cost of supply by 10-20%
  - Improve the economic outcome of CHP production by 10% by precision of supply
  - Diminish the CO2 emissions of feedstock supply by 10%.

5

Work Packages



6

WP5 Sustainability of forest biomass feedstocks

INFRES provides assessments on economic, environmental and social sustainability impacts for all new demonstration cases by

- adopting an assessment framework for sustainability impact assessment **(SIA) of forest biomass supply using key indicators** of environmental, economic and social sustainability

- assessing **sustainability impacts** for different fuel sources and harvest intensities, procurement methods and technologies

- calculating **economic impacts** in terms of costs and revenue of different alternatives and for selected user groups (e.g. forest owners)

7

WP5, continued

• state-of-the art biomass chains are quantified and compared to the INFRES demonstration cases as scenarios

•highlighting **critical factors for forest biomass supply chain sustainability** and identifying the areas of **technological and logistical innovations to improve the sustainability** of forest biomass supply

• ToSIA – Tool for Sustainability Impact Assessment (more info: http://tosia.efi.int/)

8

Systematic Sustainability Impact Assessment approach by (To)SIA

ToSIA is a flexible tool, based on three concepts:

1. Alternative process chains
2. Material flow along the chain
3. Indicators per process multiplied with the material flow

ToSIA assesses the sustainability impacts of alternative supply chains.

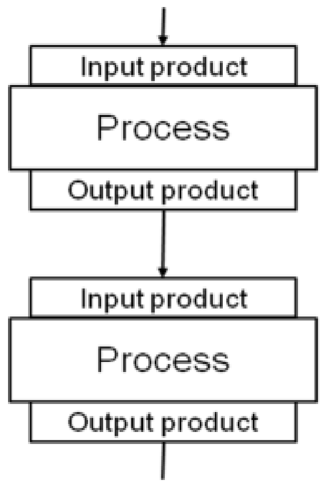
Source: Diana Tuomasjukka, European Forest Institute

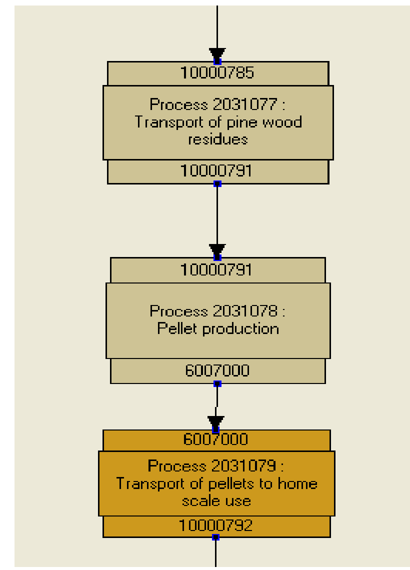
Source: EFI

9

Real world

ToSIA data client





www.efi.int

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Indicators for forest biomass

Indicator ID	Full indicator name	Selection of set
1	(1) GVA	minimum
2	(2) Production cost	minimum
7	(7) Production of goods and services	minimum
8	(8) Labour productivity	minimum
9	(9) Share of forest-based enterprises with new / improved products or processes, and share of turnover	extended
10	(10) Number of persons employed in total and by gender	minimum
11	(11) Wages and salaries	minimum
12	(12) Occupational accidents and diseases	extended
14	(14) Forest holdings and enterprises with third-party certified management and share of wood sourced from third-party certified sustainable production	minimum
15	(15) Persons employed part-time, temporarily employed persons, and self-employed persons	extended

16	(16) Provision of public forest services	extended
18	(18) Energy generation and Energy use	minimum
19	(19) Greenhouse gas emissions and Carbon stock	minimum
20	(20) Transport volume and distance	minimum
22	(22) Forest area and balance of increment and fellings	minimum
23	(23) Soil condition as expressed by chemical soil properties and soil compaction	extended
25	(25) Forest biodiversity	minimum
28	(28) Foraging resources (animal husbandry stock)	extended
31	(31) Recreation and aesthetics	extended
32	(32) Biodiversity perception	extended

New technologies for SIA

Nr	Scenario name	region	definition of scenario	goal	assumption	representative/suitability
7	Demonstrations of novel harvester head for geometric thinning	NEU (Sweden)	novel head - does that mean multiple tree harvesting in precommercial thinnings and thinnings (up to x cm) for bioenergy wood? Geometric thinning_ strips of x meters every y meters, removing z m3/ha (is that more or less than with selective things, or just the same amount?)	Cost savings compared with selective cut 20-30%	increase productivity by x%, reduce fuel consumption by y%	applicable for x% of pre-commercial thinnings and y% of thinnings
8	Demonstrations of extra large trucks	NEU (Finland, Sweden)	reference to ETT project (en trave till) which features 90t trucks	Fuel consumption reduced by 20% and transport cost by 10%	use of 90t trucks as opposed to 60t legal limit in Sweden and Finland	x% of all transported m3 (bioenergy assortments) in Scandinavia
9	Optimized chip truck demonstrations	SEU (Italy), CEU (Germany), NEU (Finland, Sweden)	what is being optimised? Moisture content, form of transport, distance, etc?	Fuel consumption reduced by 20%	Raffaele, can you please explain what differs as opposed to usual procedures	x% of chip transports (from forest to plant?) can be improved by x% in productivity
10	Demonstrations of intermodal transportation and terminal operations	NEU (Finland, Sweden)	Raffaele, can you please explain how that works as opposed to usual procedures		automatisation of what?	x% of all road transports can be shifted to rail/water
11	Demonstrations of precision supply of wood	NEU (Finland, Sweden)	just in time delivery? Or optimised logistics acc to product quality? Or sth else?	Improve competitiveness and economy of conversion	[please describe]	[please describe]
12	Hybrid technology chipper demonstrations	NEU (Finland)	Hybrid chipper means hybrid engine [please give short description of engine, fuels used and productivity]	Fuel consumption reduced by 20%	for forest-road chipping or for terminal chipping? Why is it more fuel efficient?	can be used in x% of chipping operations

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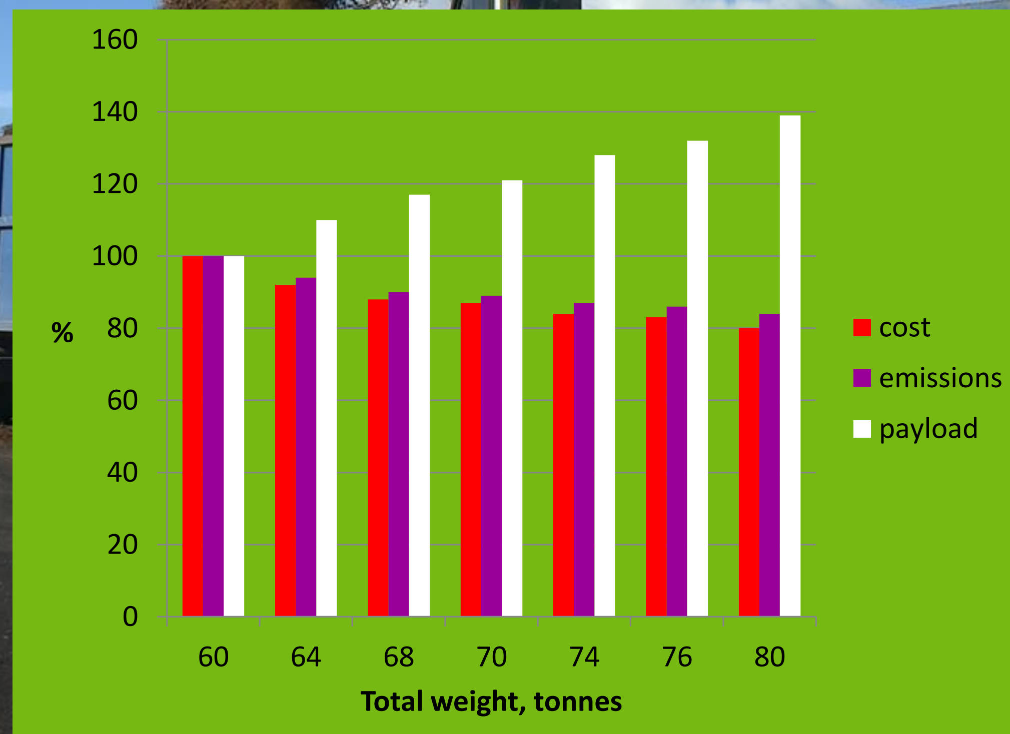
Trucks are growing in volume and weight

- 60 tonne trucks in use for several decades
- 76 tonne trucks nowallowed on roads in Finland 90 tonne trucks have been tested in Sweden and
- 100 tonne trucks will be tested in Finland



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inFRes


DW-3060


KESLA
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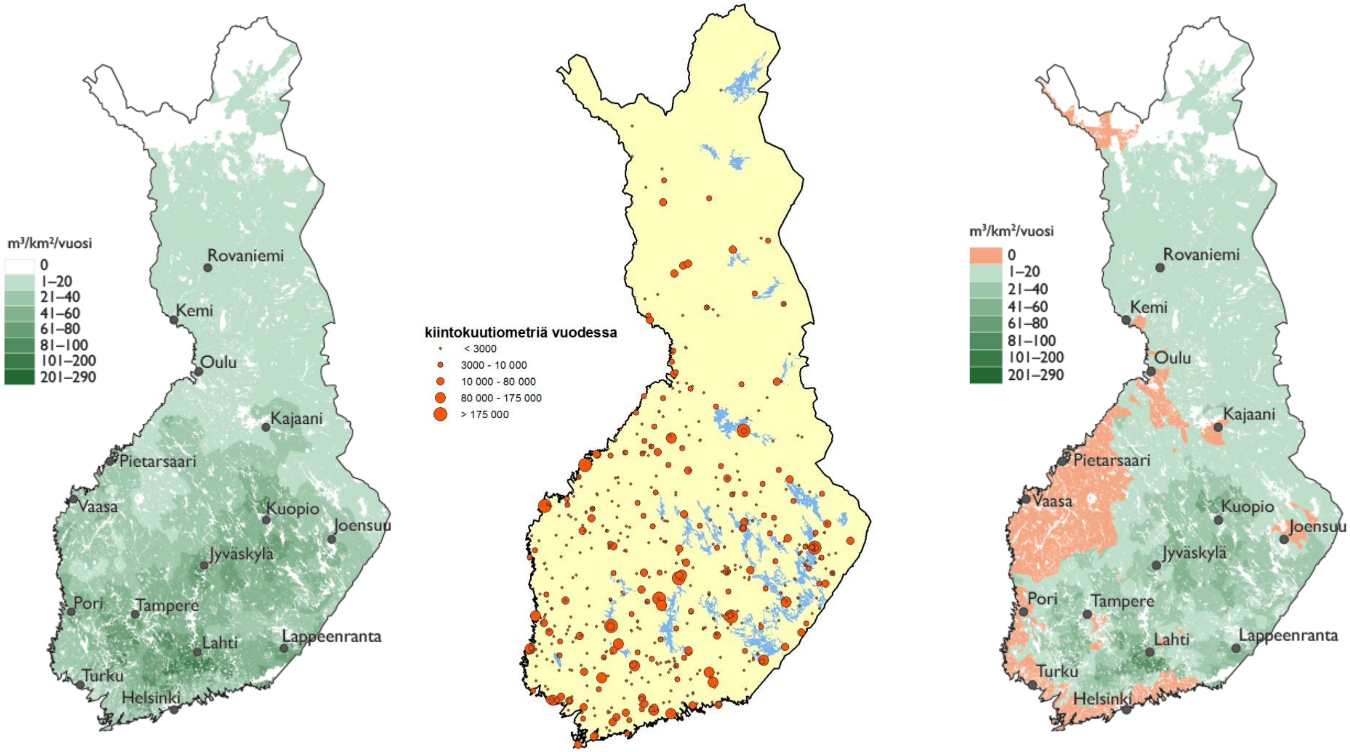
Competition for residual forest biomass

Production - Use = Balance



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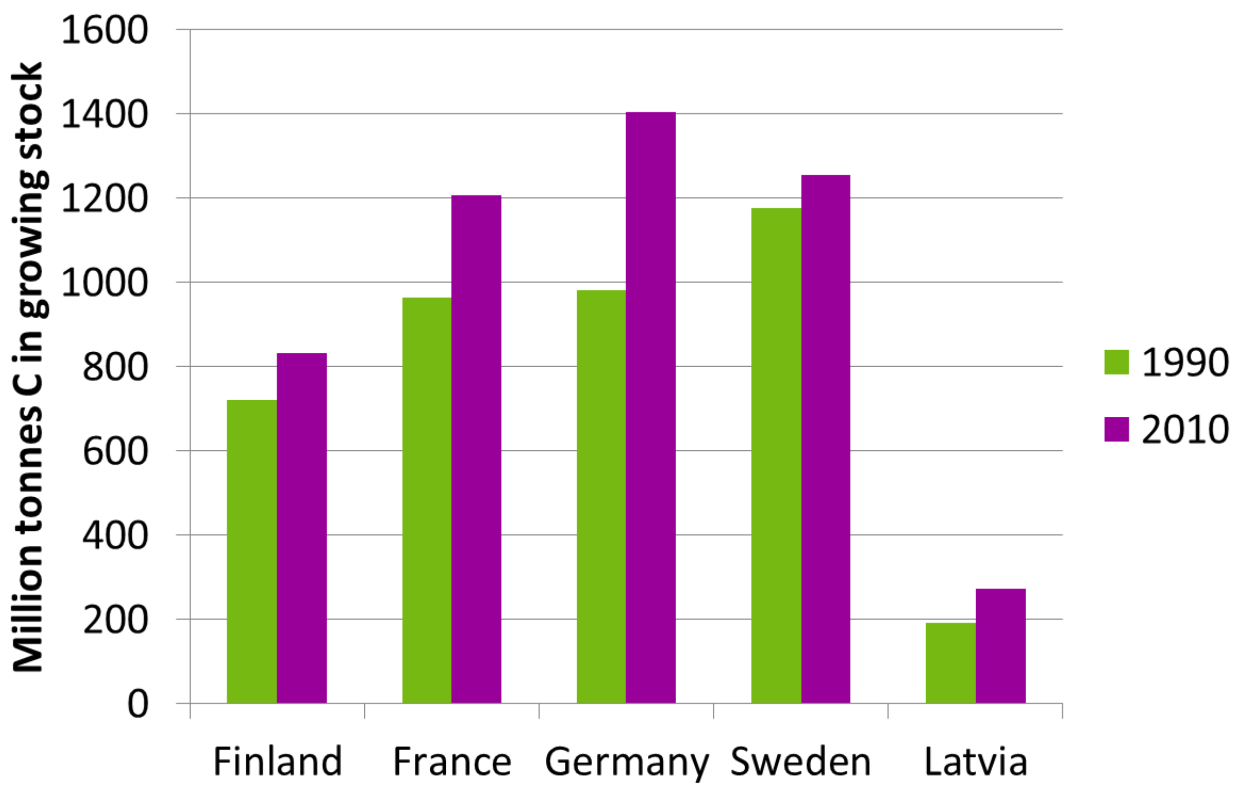
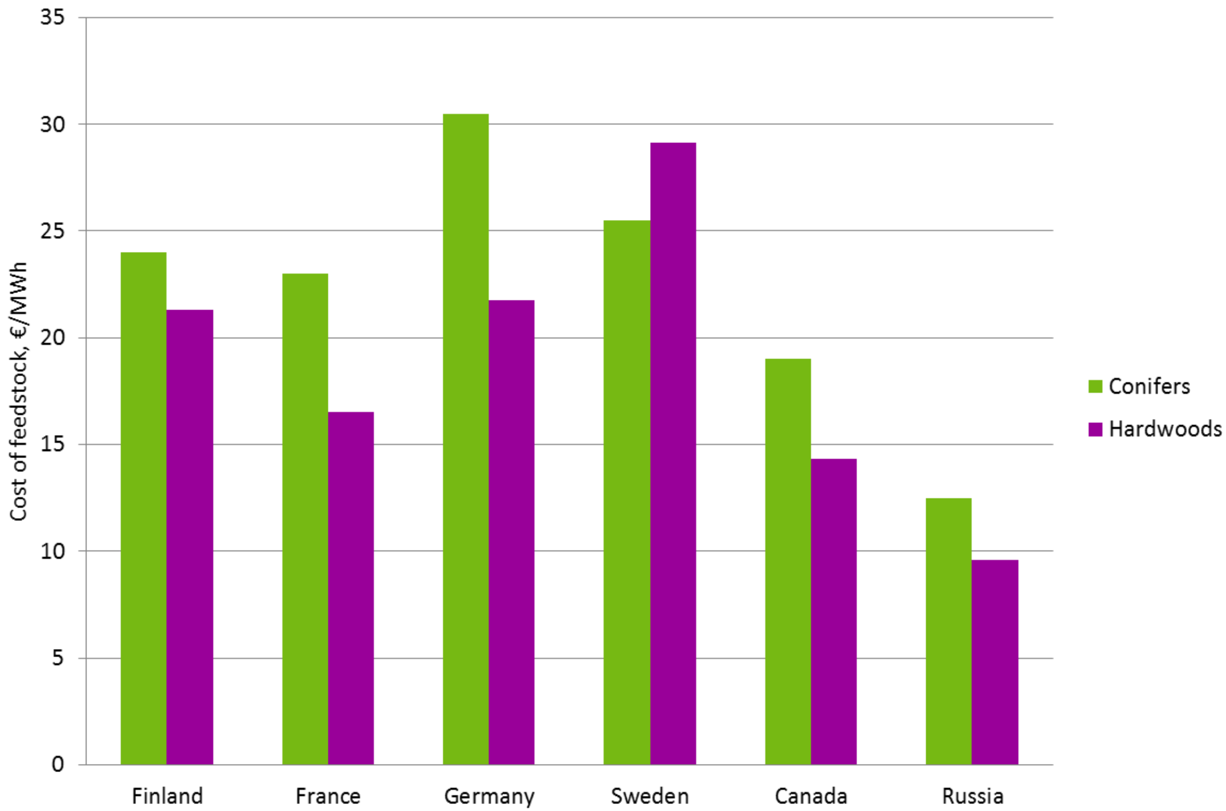
Changes of carbon stock



Cost of pulpwood at plant



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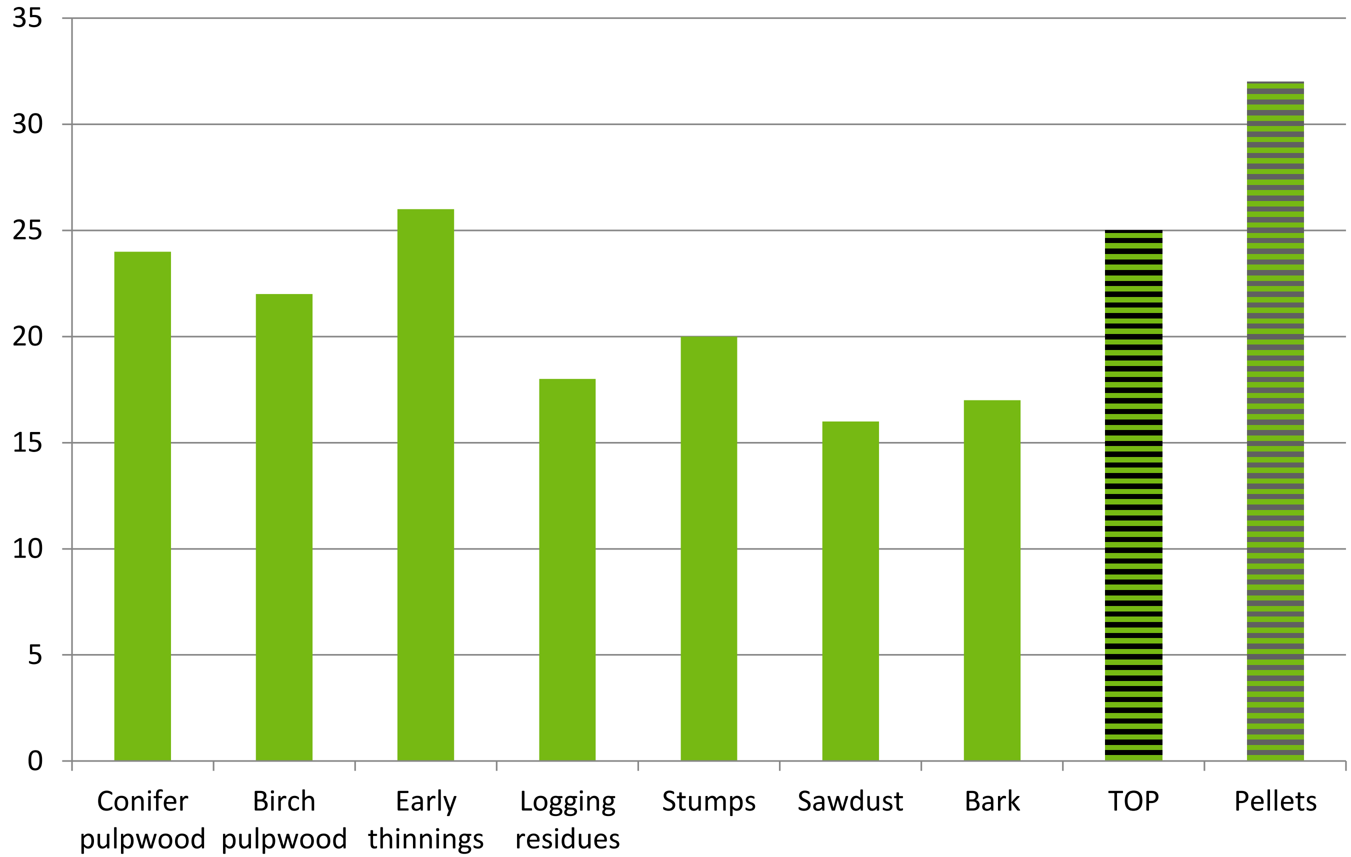
Cost of biomass at plant, Finland, €/MWh



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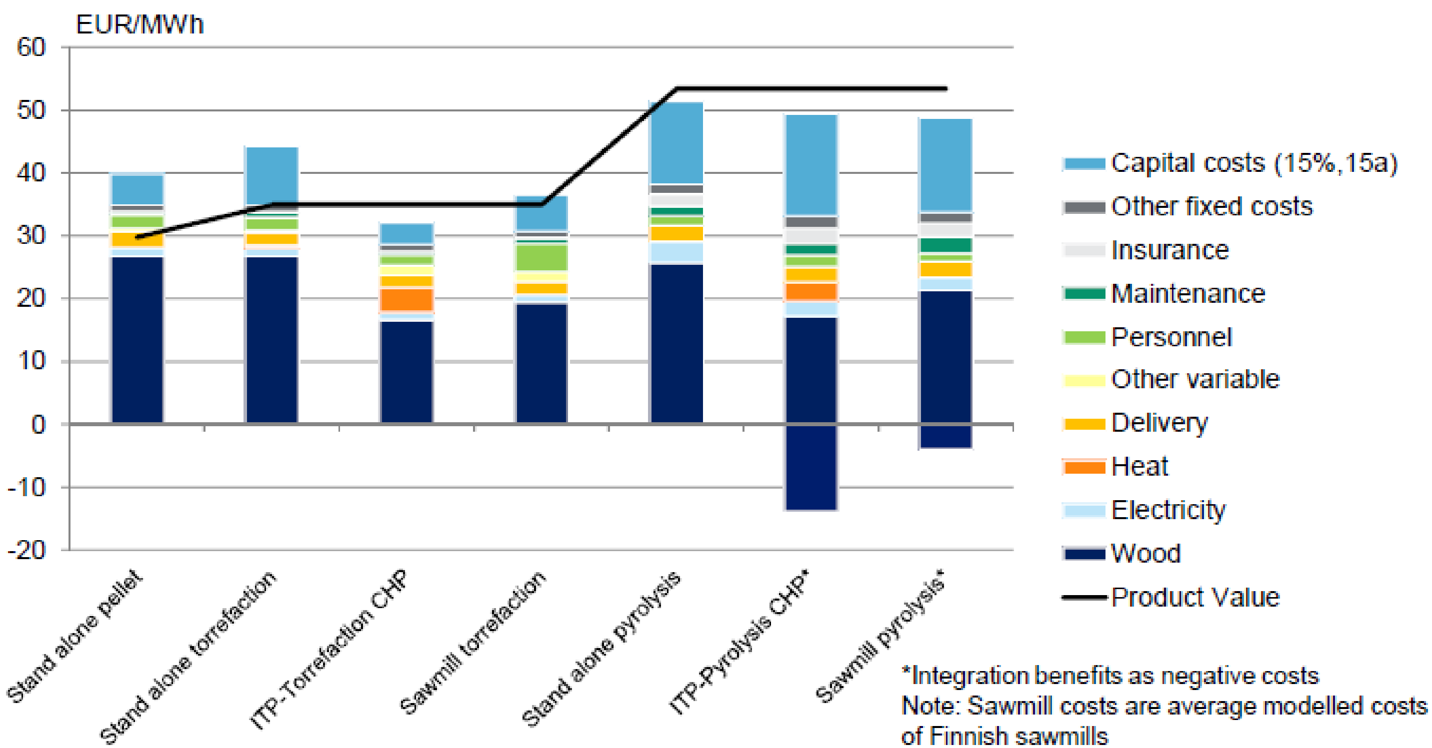
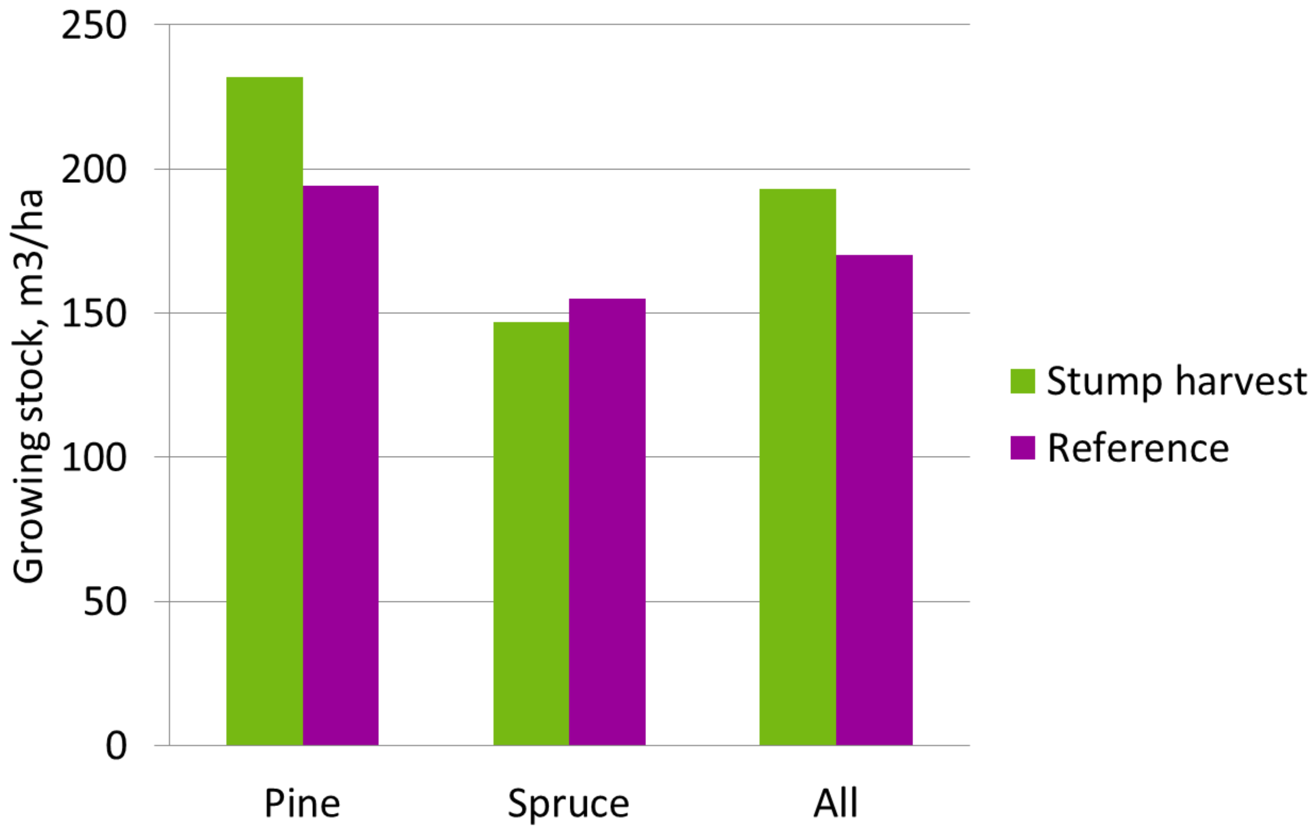
PRODUCTION COST COMPARISON OF BIOENERGY CARRIERS IN FINLAND

Torrefaction and pyrolysis could have feasible production costs versus the value of the products with current cost levels. Integrated concepts seem to have cost benefits against stand alone concepts.



Stump harvest and forest growth



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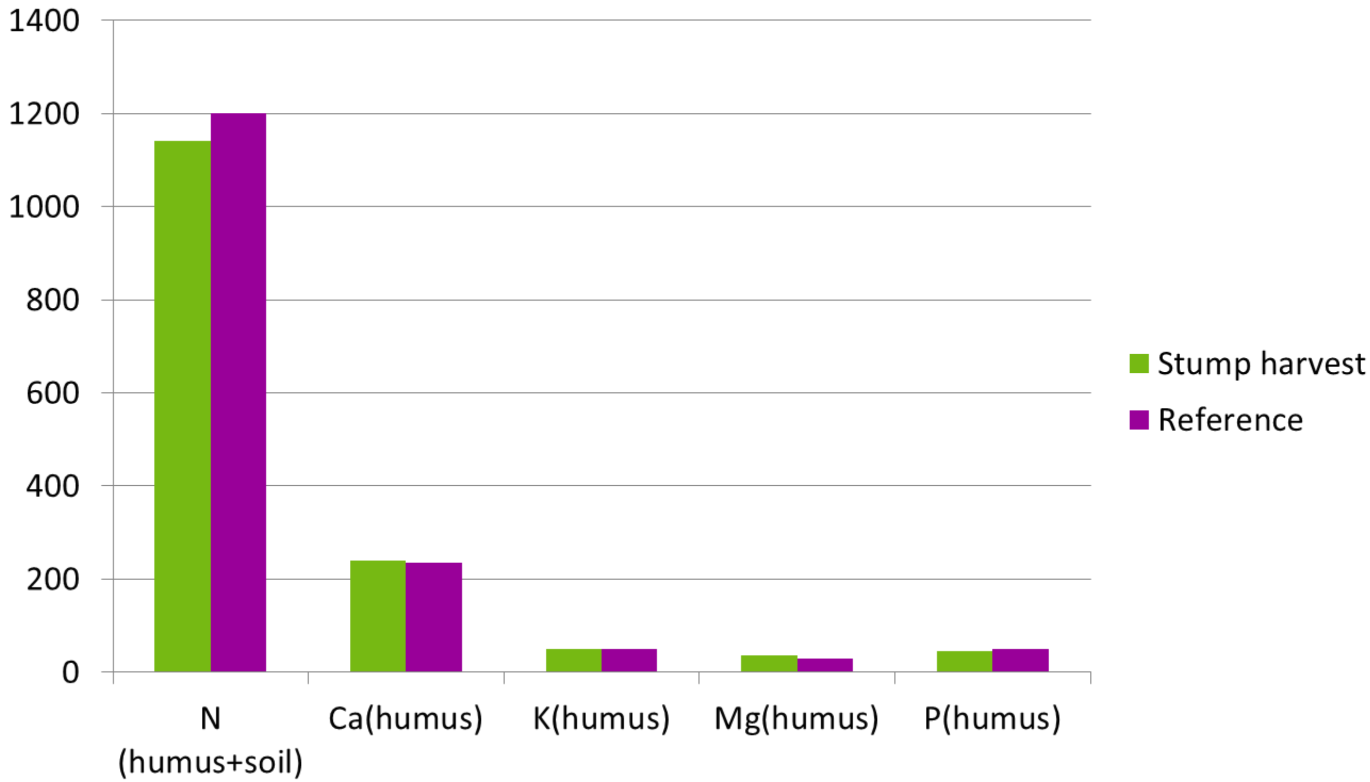
Stump harvest and nutrient status



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INFRES and SECTOR

- INFRES produces quantified sustainability information on feedstock supply of residual forest biomass from EU
  - Northern, Western, Eastern and Southern EU
- SECTOR gives a realistic estimates on the “ability to pay for feedstock” in torrefaction facilities
  - Defines directly the economic viability of feedstock supply (mill gate price – cost of biomass supply = profit margin)
- **INFRES WP5 (ToSIA) & SECTOR WP9 (BioChains)**

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We keep EU's Forest Energy Promises

25

IEA Bioenergy

IEA Bioenergy Task 40

Core objective:

'to support the development of sustainable, international bioenergy markets and international trade, recognising the diversity in resources and biomass applications'

1

IEA Bioenergy

Current Member Countries Task 40

- Netherlands (T.L.)
- Austria
- Belgium
- Brazil
- Denmark
- Finland
- Germany
- Italy
- Norway
- Sweden
- UK
- USA

Observer:
- Canada

Explored:
- Russia (will hopefully join in 2014)
- S. Korea

Global coverage & Good involvement of market parties!

2

IEA Bioenergy

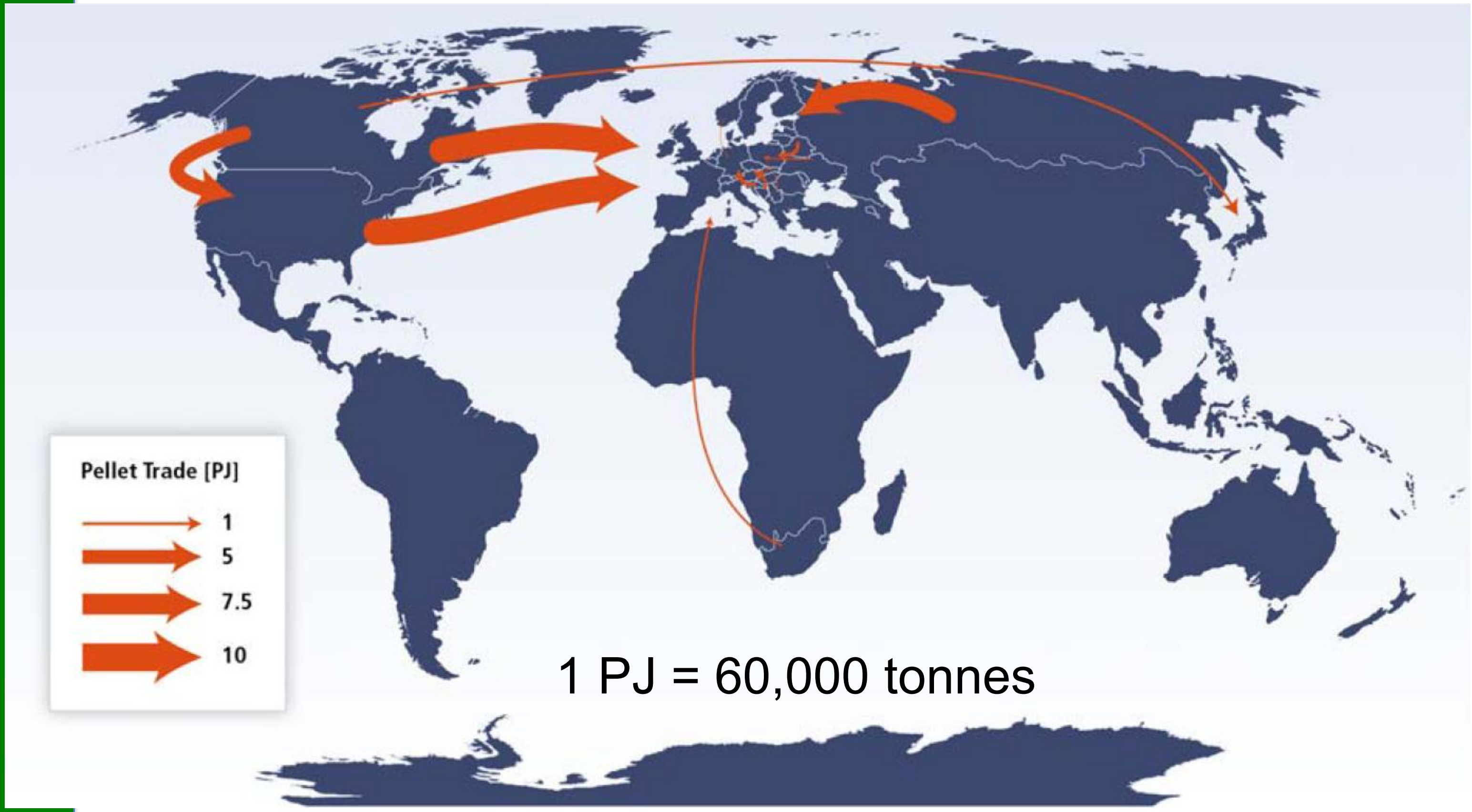
Background

- International bioenergy trade of biodiesel, bioethanol and wood pellets have all increased by a factor of 10 between 2000-2010
- Main drivers: renewable energy and GHG reductions targets & security of supply, also socio-economic development and sustainable land-use

3

IEA Bioenergy

Global wood pellet trade 2009



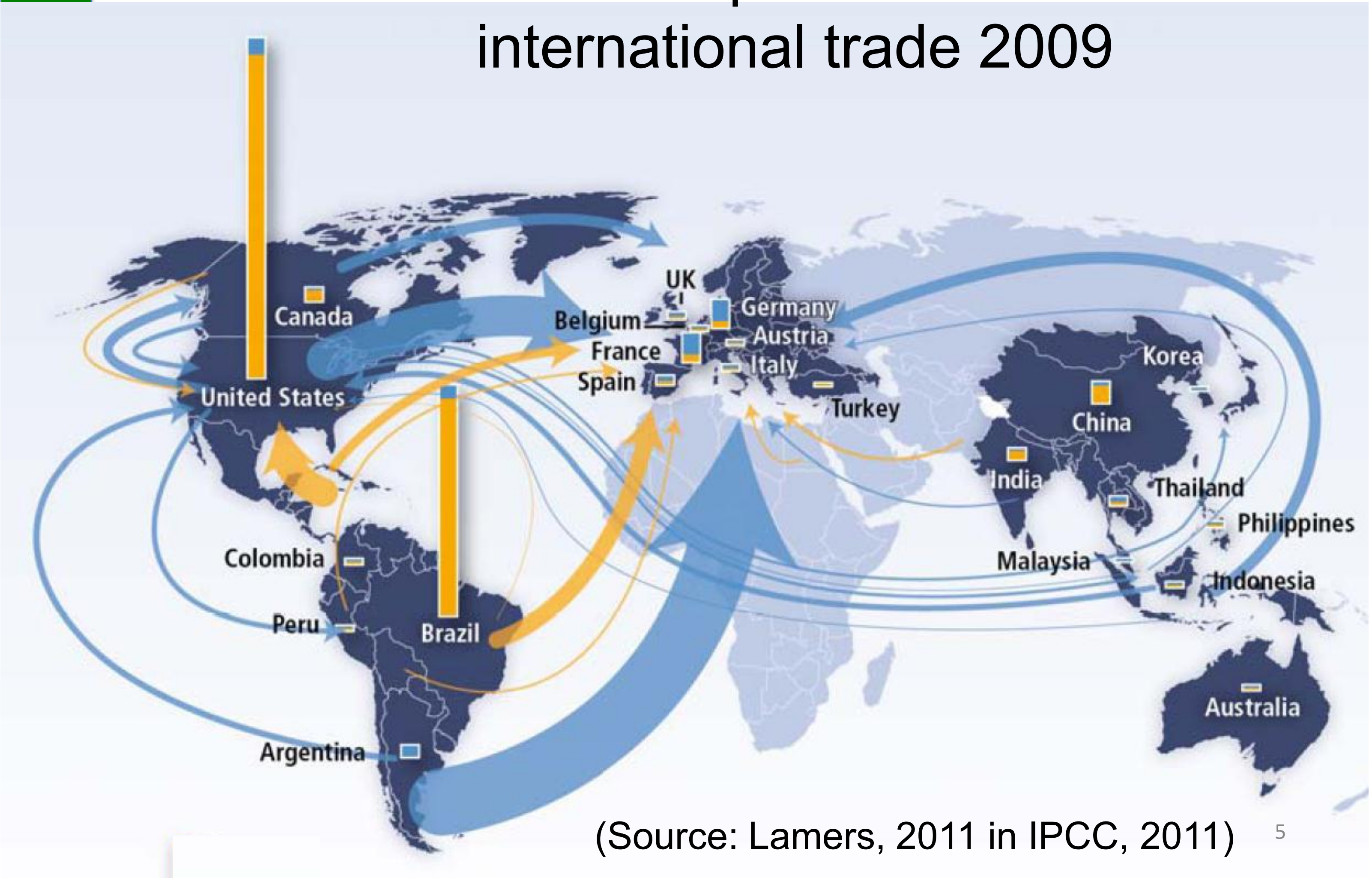
1 PJ = 60,000 tonnes

(Source: Sikkema et al., 2011 in IPCC, 2011)

4

IEA Bioenergy

Global biofuels production and main international trade 2009



(Source: Lamers, 2011 in IPCC, 2011)

5

IEA Bioenergy

Background

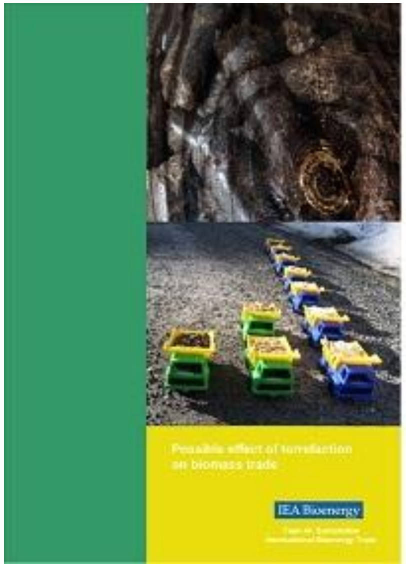
- But many barriers remain: ensuring sustainable supply chains, technical & non-technical trade barriers, lack of (investments in) logistical infrastructure, lack of proper information dissemination etc. etc.
- And strong further growth required to connect supply & demand and allow for e.g. > 50 EJ bioenergy use in 2050

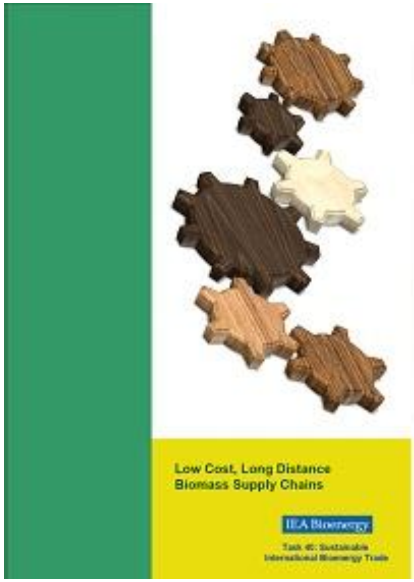
6

IEA Bioenergy

Selection of outputs related to torrefaction

- Joint workshop with Task 32 on torrefaction in Graz: 250 participants (Jan . 2011)
- Low cost, Long Distance Biomass Supply Chains (aug. 2013)
- Possible effect of torrefaction on biomass trade





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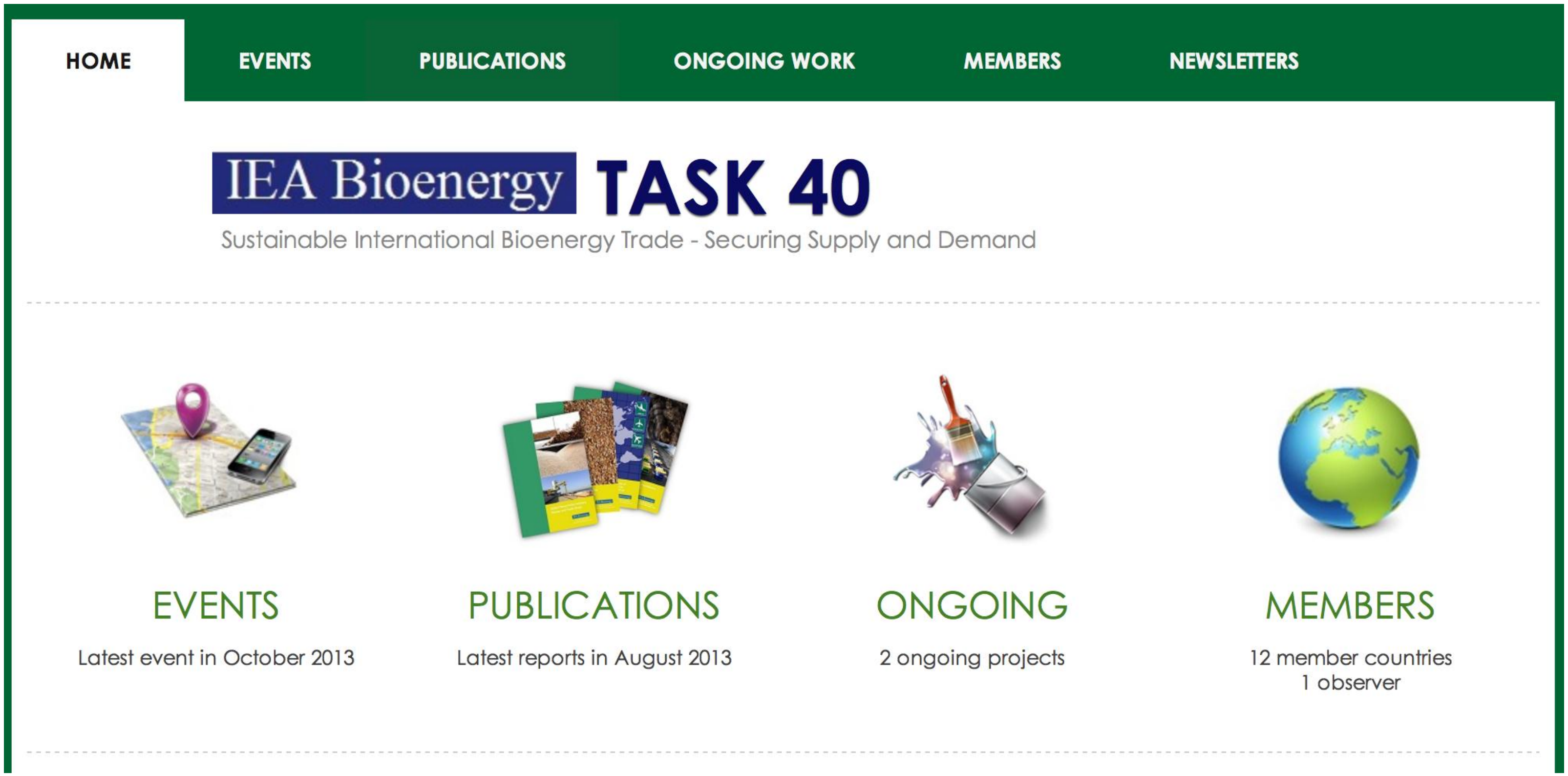
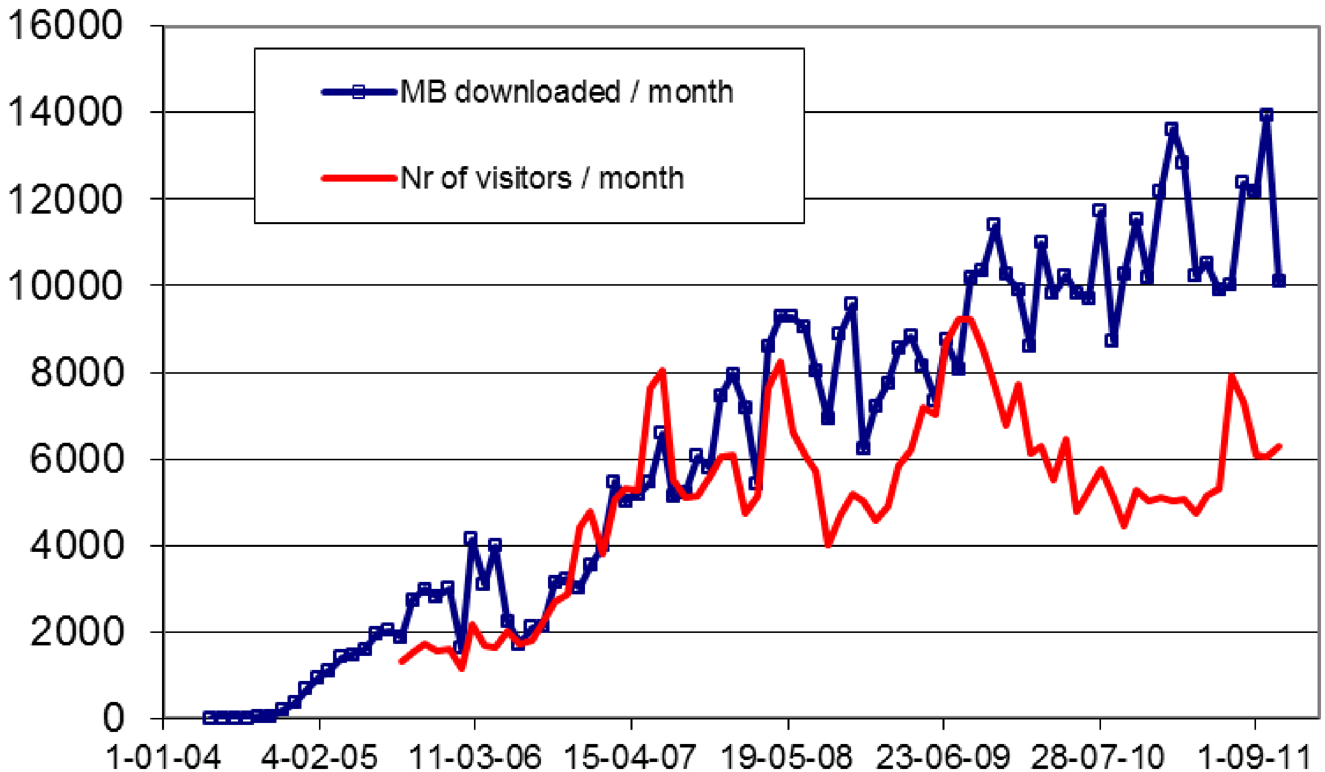
www.bioenergytrade.org



IEA Bioenergy

Dissemination through the task 40 website bioenergytrade.org



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IEA Bioenergy

Work Programme 3rd Triennium

Torrefaction is one of 5 major work topics

Main objective
support the continuation of technology development, dissemination of results and uptake of the "new" energy carrier in the consuming structures

Ongoing monitoring of initiatives and projects resulting in a living structure

Monitoring trading and trade routes, collection of general trading documents and building references

Analysing eventual trade routes to alternative consumer groups and consequences

10

IEA Bioenergy

Task 40 Torrefaction activities 3rd Triennium

		Q 1/2 13	Q 3/4 13	Q 1/2 14	Q 3/4 14	Q 1/2 15	Q 3/4 15
A - technology	**update Chapter 2 Tor.Study**						
	Build database and update annualy						
B - Logistics	**Collect trading docs (MSDS etc)**						
	report on trades realised and results/lessons learned plus update						
C - Application	**is there a market beside pulverised coal boilers - survey and questionaires resulting report**						
	internal workshop task 32+industry						
Dissemination	**workshop Graz**			**Jan 17th**			

11

AEBIOM EUROPEAN BIOMASS ASSOCIATION

IBTC members – June 2013

INTERNATIONAL BIOMASS TORREFACTION COUNCIL

IBTC Full Members

KAHL
ANDRITZ
AREVA
BIOLAKE
cmi
Electrabel GDF SUEZ
RIVER BASIN ENERGY INC
Rotawave
Topell Energy
TORR COAL

IBTC Supporting Members

ECN Your energy. Our passion.
energy valley
KEMA DNV

Statues – Membership Structure of IBTC

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Statues – Decision making in IBTC

INTERNATIONAL BIOMASS TORREFACTION COUNCIL

Membership Assembly

- Full and Suporting Members
- At least one per year

- IBTC activities and financial management
- Decision about specific IBTC membership fees

Steering Comitee

- Full Members and President

- Approve new members and termination of memberships
- Proposal of IBTC specific membership fees
- Changes to the relation AEBIOM - IBTC
- IBTC Statutes
- Strategic orientation of IBTC
- Budget of IBTC
- Election of the President for IBTC

President

General Manager

Objective and Mandate of IBTC

INTERNATIONAL BIOMASS TORREFACTION COUNCIL

- IBTC is a platform for companies organisations and individuals dedicated to the promotion of torrefied biomass for energy. Legally represented by AEBIOM it aims to bring the relevant people and companies in the sector together

- The Council to help developing a common view and approach in non competitive matters (examples H&S, Logistics etc)

- IBTC generally assists in building the torrefaction industry providing special assistance to its members in building the market

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Objective and Mandate of IBTC

- Promote the use of torrefied biomass as energy carrier and help overcoming the barriers to market deployment
  - Express the views of the torrefaction industry to the general public
  - Assist policy initiatives
  - support and participate in initiatives and projects dedicated to biomass torrefaction development (statistics, standarization, regulatory compliance...)

- Assist in removing barriers to market entrance and operation by torrefied biomass

- Promotes the processing technology in general with project developers and resource owners

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Activities ongoing

INTERNATIONAL BIOMASS TORREFACTION COUNCIL

- Forming a common understanding of the product and assisting in development of the ISO standard
- Torrefaction workshops and meetings in conjunction with major biomass events (London, Brussels, Seoul, Miami)
- Comparison of MSDS within IBTC group
- Codes and along the supply chain (customs, IMO etc)
- REACH
- Buiding contacts to consumers, testing of torrefeid Biomass
- Volume Ticker
- Interfacing with task 40, RHC plattform,

17

Thank you for paying attention

Contact

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INTERNATIONAL BIOMASS TORREFACTION COUNCIL

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http://www.aebiom.org/blog/ibtc/