GA no 282826

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

Deliverable No. D2.3

Profiles of the selected raw materials - Part 2

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

This is the continuation and update of Deliverable D2.1 (Profiles of the selected raw materials part 1) submitted in 2012 in an early stage of the SECTOR project to enable experimental activities to start without delays. The feedstock profiles selected in D2.1 were reviewed and discussed their relevancy in the remainder of the project with partners involved, in order to propose new materials for torrefaction and/or pelletisation, or remove uninteresting material from previous selection, all based on lab and pilot test carried out until now.

The feedstock profile template was reviewed and updated with proposal and commentaries of partners, mainly those involved in lab and pilot test of selected raw materials. The feedstock profiles have been refilled with updated information from laboratory and pilot plant performed so far, and other information related (photos, experiences, commentaries etc.).

2 Changes in selection of raw materials

The criteria of changes in selection of raw materials was based on results of lab and pilot test performed so far, and conclusions of SECTOR Deliverable D2.2 (Market assessment of biomass feedstock available for torrefaction) and SECTOR Deliverable 9.1 (Description of the relevant biomass to-end-use chains, including torrefied biofuels). Until now, lab and pilot tests have been performed to several materials, as table below shows.

Table 1. Feedstock and type of test performed in the SECTOR project until now

Raw material name	Profile number in the project	Test type performed until now
Pine (Ref. 1)	1	Lab and pilot
Beech (Ref. 2)	6	Lab and pilot
Bamboo	12	Lab and pilot
Spruce (Ref. 1)	1	Lab and pilot
Poplar	7	Pilot
Used wood	4	Lab and pilot
Straw	8	Lab and pilot
Forest residue	2	Pilot
Willow	18	Pilot

From SECTOR deliverables D2.2 and D9.1 it is possible to conclude that forests are important for providing wood for products and energy and the demand is expected to increase. Forest covers approximately 30% of Earth's landmass and the total forestry land area is 3.95 billion hectares. Wood is the most important fuel in developing countries in Africa, Asia and Latin America. In addition, those documents remark the importance of using agricultural by-products and residues, mainly straw. That is due the largest part from the potential comes from common cereal straw, followed by rape straw and corn straw. The straw potential is well spread over practically in whole Europe, but countries like France,

Germany, Poland, Italy, Hungary and in the future UK have the largest potentials, and countries which show particularly large increases towards 2020 and 2030 are France, Poland, Hungary, Romania, UK and Denmark. Differences in growth conditions, soil quality and soil type and texture complicate estimates of residue potential, but on general at 20 – 30% of the potential straw could be used for bioenergy. Straw potential in EU-27 is reported in different studies and varies from 560 to 982 PJ/a (SECTOR deliverable D2.2).

Therefore, after discussed those facts above with partners, and results of raw materials tested so far, keeping the 21 selected in previous SECTOR deliverable D2.1 was agreed jointly with involved partners, with increased emphasis on straw, forest wood and their residues, as well as type of test type to be performed during project, as table below shows.

Table 2. Final selection of feedstock in the project and type of test to perform

No.	Selected feedstock	Test type to perform
1	Delimbed coniferous stem wood without bark : Pine and spruce (Reference raw material 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 raw material 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

As Table 2 shows, materials interesting to increase emphasis according to SECTOR deliverables D2.2, D9.1 and feedback of the project (straw, forest wood and their residues) has been chosen for laboratory and pilot test, of which many have already done. Exotic

feedstocks (Miscanthus, sun flower residues etc) and and those difficult to get in large quantities (corn cobs, barley and rape straw, bark etc) will be only lab tested.

3 Changes in feedstock profile template

After discussion with partners involved in WP2 regarding on the objectivity of the data provided by the feedstock profiles, it was agreed to eliminate the “Life cycle assessment” section because for now there is no relevant information about it, and until by the end of the project this information will be available. Therefore, the updated profiles consist now on two parts only, as described below.

3.1 Identification and general information

Biomass name: It is the name which describes the feedstock e.g. Stem wood, coniferous. It is important to note that reference fuels shall be marked separately.

Description of feedstock: Describe shortly biomass e.g. text of production method or other information.

Raw material: According EN 14961-1. Examples: Wine prunings, 1.1.7, Stem wood, spruce 1.1.3.2

Traded form: Form of material for torrefaction or other end-use according EN 14961-1, e.g. wood chips, hog fuel, chopped straw.

Selection criteria for feedstock profile: Inform why this biomass is selected for data collection, e.g. high potential (rough estimation), availability, low price, unused potential.

Selected for laboratory and/or pilot tests: Make a proposal should this raw material be selected for laboratory test and/or pilot test. It is important to note that both reference fuels and agrobiomass raw material are needed.

3.2 Quality information for raw material and torrefaction

This part is covered with multiple tables to be filled with EN standards for analysis. If EN standards are not used, analysis method is added in the same place as EN standard is currently written.

4 Updated profiles

The partners performing laboratory and / or pilot plant have provided respective data and were collected by CENER to update the profiles. As many partners have tested the same raw materials, averages of the results of them have been used to fill the profiles, so the source of this data is "SECTOR partners". In addition, the reactivity of materials has been updated by results of the pilot plant tests and thermo gravimetric experiments conducted previously. Photos of all collected materials at different institutes participating in the SECTOR project have also been updated. Many of profiles will be completed by the end of the project, as the most of materials have not been tested in laboratory until now, since the objetive of

this deliverable is to establish the final selection of the materials to be tested in laboratory and pilot plant from now until to complete the project. All updated profiles appear in the appendix of this deliverable.

5 ANNEX

The annex consists on the 21 raw materials profiles selected for the project SECTOR in this deliverable, as shown below.

	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)	ºC	ºC	ºC	ºC
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	

2. QUALITY INFORMATION FOR TORREFACTION

2.1 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.

2.2 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

	PROFILE No. 2	
	LOGGING RESIDUES CONIFEROUS	
Description of feedstock	Logging residues, coniferous	
Raw material according to EN 14961-1 Table 1	Forest, plantation and other virgin wood 1.1.4.2 / 1.1.4.4	
Traded form (e.g. wood chips) according Table 2 of EN 14961-1 or other	Wood chips	
Selection criteria for feedstock profile (e.g. high potential, availability)	High potential in some countries, Theoretical annual forest fuel potential 785 million m³ and the technically harvestable volume of 187 million m³ (36 Mtoe/a, 411 TWh) Source: Metla	
Remarks (e.g. biomass cutting step, place of origin, pretreatment etc.)	Cutting of trees and piling logging residues and round wood separately, forwarding logging residues to road-side, chipping logging residues transportation to plant	
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	0,5	< 0,02	0,01
Variation (min-max)	0,3 0,8	< 0,02 0,06	< 0,01 0,06

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)	ºC	ºC	ºC	ºC
Typical value	3				
variation	1 – 10	1175	1205	1230	1250

Macro elements CEN/TS 15290	Composition	Al	Ca	Fe	Mg	P	K	As	Si	Na	Ti			
	Unit	mg/kg (DB)												
	Range		2000	500	400		1000	0,2	200	75				
			8000	2000	2000	500	5000	1	10000	300				
Micro elements CEN/TS 15297	Composition	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Sb	V	Zn	
	Unit	mg/kg (DB)												
	Range	0,1		0,7	10		80		0,4	0,4		0,1	8	
		0,8		1,2	200	0,03	170		3	4		1	30	

2. QUALITY INFORMATION FOR TORREFACTION

2.1 Quality data of biomass for torrefaction

Property	Typical value	Variation (min. – max.)
Traded form (e.g. chips) EN 14961-1, Table 2	wood chips	
Particle size, P (Dimension /nominal size, mm, use) EN 15149-1, screen size according ISO 3310		5 – 100 (P45 or P63)
Bulk density (BD), kg/m^3 EN 15103	300	270 – 360
Moisture as received, M (w-%), EN 14774-1 or 3	< 50	35 – 55
Amount of fines, F, w-% (≤ 3,15 mm) EN 15149-1	19,5 – 33,7	Varies greatly
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 – 52
H (w-% dry) EN 15104	6,1	5,7 – 6,2
O (w-% dry) calculated	40	38 – 44
Volatile content, VM (w-% dry) EN 15148		84 – 86
Net calorific value, dry MJ/kg EN 14918	19,2	18,5 – 20,5
Add other properties, if needed		

Source: VTT

2.2 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)	

	PROFILE No. 3 **WHEAT STRAW**	
Description of feedstock	Straw, wheat (Nordic conditions)	
Raw material according to EN 14961-1 Table 1	Herbaceous biomass from agriculture 2.1.1.2	
Traded form (e.g. wood chips) according Table 2 of EN 14961-1 or other	Bales	
Selection criteria for feedstock profile (e.g. high potential, availability)	Potential of wheat staw in EU27 is about 400 PJ/a and Nordic countries about 24 PJ/a.	
Remarks (e.g. biomass cutting step, place of origin, pretreatment etc.)	Cutting straw, baling, storage of bales and transportation to plant	
Selected for laboratory and/or pilot tests	Laboratory test, yes Pilot test, no	

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	0,5	0,1	0,4
Variation (min-max)	0,2 1,5	< 0,05 0,2	< 0,1 1,2

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)	ºC	ºC	ºC	ºC
Typical value	5		1050	1200	1210
variation	2- 10		1080	1350	1400

Major elements EN 15290	Composition	Al	Ca	Fe	Mg	P	K	As	Si	Na	Ti			
	Unit	mg/kg (DB)												
	Range	50	2000	100	400	300	2000	0,1	1000	500	5			
		700	7000	500	1300	2900	2600	2	20000	3000	200			
Micro elements EN 15297	Composition	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Sb	V	Zn	
	Unit	mg/kg (DB)												
	Range	<0,05		1	1	<0,02	20		0,2	0,1		1	3	
		0,3		60	10	0,05	100		4	3		6	60	

2. QUALITY INFORMATION FOR TORREFACTION

2.1 Quality data of biomass for torrefaction

Property	Typical value	Variation (min. – max.)
Traded form (e.g. chips) EN 14961-1, Table 2	Bales	
Particle size, P (Dimension /nominal size, mm, use) EN 15149-1, screen size according ISO 3310		10 – 200
Bulk density (BD), kg/m^3 EN 15103		160 - 200
Moisture as received, M (w-%), EN 14774-1 or 3	15	10 -30
Amount of fines, F, w-% (≤ 3,15 mm) EN 15149-1		
Hemicelluloses content, w-% dry		23 -30
Cellulose content, w-% dry	37	
Lignin content, w-% dry	20	
C (w-% dry), EN 15104	47	41 – 50
H (w-% dry) EN 15104	6,0	5,4 – 6,5
O (w-% dry) calculated	41	36 – 45
Volatile content, VM (w-% dry) EN 15148	77	75 – 81
Net calorific value, dry MJ/kg EN 14918	17,6	16,6 – 20,1
Add other properties, if needed		

Source: VTT

2.2 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)	

	PROFILE No. 4	
	USED WOOD	
Description of feedstock	Used wood – Post consumer wood, recycled wood, chemically untreated	
Raw material according to EN 14961-1 Table 1	Chemically untreated wood 1.3.1	
Traded form (e.g. wood chips) according Table 2 of EN 14961-1 or other	Hog fuel	
Selection criteria for feedstock profile (e.g. high potential, availability)	Potential in EU27 about 397 PJ/a	
Remarks (e.g. biomass cutting step, place of origin, pretreatment etc.)	Collecting used wood to waste handling plant, pretreatment of used wood, crushing to hog fuel and transportation to plant	
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			
Variation (min-max)	0,25 1,0	< 0,02 0,08	0,02 0,12

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)	ºC	ºC	ºC	ºC
Typical value	0,7		1150	1200	1210
variation	0,5 - 2		1220	1260	1265

Major elements EN 15290	Composition	Al	Ca	Fe	Mg	P	K	As	Si	Na	Ti			
	Unit	mg/kg (DB)												
	Range	130		490		5,4	630	<2		200				
		600				76	910	34		630				
Micro elements EN 15297	Composition	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Sb	V	Zn	
	Unit	mg/kg(DB)												
	Range	0,12		5,2	5,5	49	72		3,2	200		0,5	79	
		0,5		60	80		115		10	630		2,2	300	

2. QUALITY INFORMATION FOR TORREFACTION

2.1 Quality data of biomass for torrefaction

Property	Typical value	Variation (min. – max.)
Traded form (e.g. chips) EN 14961-1, Table 2	Hog fuel	
Particle size, P (Dimension /nominal size, mm, use) EN 15149-1, screen size according ISO 3310	varying	
Bulk density (BD), kg/m^3 EN 15103	200	140 - 260
Moisture as received, M (w-%), EN 14774-1 or 3	20	15 - 30
Amount of fines, F, w-% (≤ 3,15 mm) EN 15149-1		
Hemicelluloses content, w-% dry		25 - 35
Cellulose content, w-% dry	40	
Lignin content, w-% dry		20 -30
C (w-% dry), EN 15104		49,1 -52,3
H (w-% dry) EN 15104		5,9 – 6,4
O (w-% dry) calculated		N.A
Volatile content, VM (w-% dry) EN 15148		84 - 86
Net calorific value, dry MJ/kg EN 14918		18,6 – 18,9
Add other properties, if needed		

Source: [1] Alakangas& Wiik: Käytöstä poistetun puun luokittelu ja hyvien käytäntöjen kuvaus. VTT – R-04989-08. 1.9.2008 (Classification and good practices for used wood, in Finnish)

2.2 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)	

	PROFILE No. 5 **BARK**	
Description of feedstock	Bark, coniferous	
Raw material according to EN 14961-1 Table 1	Bark from industry operations 1.2.1.5	
Traded form (e.g. wood chips) according Table 2 of EN 14961-1 or other	Debarking residues from trees. Can be shredded or unshredded.	
Selection criteria for feedstock profile (e.g. high potential, availability)	Moderate potential, availability from mechanical wood processing industry, mainly utilized at industry plant for process heat and power production. Usually roundwood include about 11% of bark.	
Remarks (e.g. biomass cutting step, place of origin, pretreatment etc.)	Debarking at plant and shredding into smaller pieces.	
Selected for laboratory and/or pilot tests	Laboratory test, yes Pilot test, no	

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	0,05	0,03	0,02
Variation (min-max)	0,3 0,9	< 0,02 0,05	< 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)	ºC	ºC	ºC	ºC
Typical value	1,5	1405	1550	1650	1650
variation	1 -5				

Major elements EN 15290	Composition	Al	Ca	Fe	Mg	P	K	As	Si	Na	Ti			
	Unit	mg/kg (DB)												
	Range	400	1000	100	400	20	1000	0,1	500	70				
		1200	15000	800	1500	600	3000	4	5000	2000				
Micro elements EN 15297	Composition	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Sb	V	Zn	As
	Unit	mg/kg (DB)												
	Range	0,2		1	3	0,01	9		2	1		0,7	70	0,1
		1		10	30	0,1	840		20	30		2	200	4

2. QUALITY INFORMATION FOR TORREFACTION

2.1 Quality data of biomass for torrefaction

Property	Typical value	Variation (min. – max.)
Traded form (e.g. chips) EN 14961-1, Table 2	Debarking residues from round wood	
Particle size, P (Dimension /nominal size, mm, use) EN 15149-1, screen size according ISO 3310	varying	
Bulk density (BD), kg/m^3 EN 15103		240 – 360
Moisture as received, M (w-%), EN 14774-1 or 3	55	50 – 65
Amount of fines, F, w-% (≤ 3,15 mm) EN 15149-1		
Hemicelluloses content, w-% dry		10 -15
Cellulose content, w-% dry		20 – 30
Lignin content, w-% dry		10 – 25
C (w-% dry), EN 15104	52	48 – 55
H (w-% dry) EN 15104	5,9	5,5 – 6,4
O (w-% dry) calculated	38	34 – 42
Volatile content, VM (w-% dry) EN 15148		70 – 80
Net calorific value, dry MJ/kg EN 14918	19,2	17,5 – 20,5
Add other properties, if needed		

Source[1]: VTT

Source[2]: SECTOR Partners

2.2 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)	

	PROFILE No. 6 **BROADLEAVES STEM WOOD**	
Description of feedstock	Delimbed broadleaves stem wood with bark (Reference raw material 2)	
Raw material according to EN 14961-1 Table 1	1.1.3.1	
Traded form (e.g. wood chips) according Table 2 of EN 14961-1 or other	Wood chips	
Selection criteria for feedstock profile (e.g. high potential, availability)	Representative reference material	
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	0,3	0,01	0,007
Variation (min-max)	0,08 1,44	0,00 0,1	0,004 0,011

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)	ºC	ºC	ºC	ºC
Typical value	0,7	1000	1320	1350	1370
variation	0,3- 1,5	970-1080	1200-1370	1340-1390	1360-1450

Major elements EN 15290	Composition	Al	Ca	Fe	Mg	P	K	Si	Na	Ti				
	Unit	% (DB)												
	Range	0,5	55,0	0,7	5,0	1,0	17,0	2,5	0,1	0,05				
		1,0	65,0	1,1	8,0	3,0	25,0	4,0	1,5	0,9				
Micro elements EN 15297	Composition	As	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Sb	V	Zn
	Unit	mg/kg (DB)												
	Range	0,8	0,1	0,5	0,5	1,6		51	0,7	0,9	0,2	0,8	0,1	2,8
		1		24	2,5	1,4		56	0,8	4,1	0,6	26		11

2. QUALITY INFORMATION FOR TORREFACTION

2.1 Quality data of biomass for torrefaction

Property	Typical value	Variation (min. – max.)
Traded form (e.g. chips) EN 14961-1, Table 2	Wood chips	
Particle size, P (Dimension /nominal size, mm, use) EN 15149-1, screen size according ISO 3310	30	20-30
Bulk density (BD), kg/m^3 EN 15103	360	320 – 420
Moisture as received, M (w-%), EN 14774-1 or 3	40	30 - 50
Amount of fines, F, w-% (≤ 3,15 mm) EN 15149-1	15	7 - 30
Hemicelluloses content, w-% dry	25,7	21,1 – 31,8
Cellulose content, w-% dry	42,6	27,7 – 49,0
Lignin content, w-% dry	30,2	29,5 – 31,5
C (w-% dry), EN 15104	48,7	42,6 – 52,0
H (w-% dry) EN 15104	6,03	5,7– 6,4
O (w-% dry) calculated	44,9	41,4 – 51,1
Volatile content, VM (w-% dry) EN 15148	83,1	75,6 – 85,8
Net calorific value, dry MJ/kg EN 14918	17,8	15,0 – 19,2
Add other properties, if needed		

Source: SECTOR Partners

2.2 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)	~33%

Source: SECTOR feedback

	PROFILE No. 7 **POPLAR**	
Description of feedstock	Poplar, with bark	
Raw material according to EN 14961-1 Table 1	1.1.3.1	
Traded form (e.g. wood chips) according Table 2 of EN 14961-1 or other	Wood chips	
Selection criteria for feedstock profile (e.g. high potential, availability)	High potential energy crop, EU-27 potential is estimated to be 12,700 PJ/a	
Remarks (e.g. biomass cutting step, place of origin, pretreatment etc.)	Growing of poplar stems, cutting stems, storage, chipping and transportation to plant	
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	0,3	0,03	0,034
Variation (min-max)	0,1 0,6	0,00 0,05	0,008 0,1

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)	ºC	ºC	ºC	ºC
Typical value	1,2	1010	1340	1360	1390
variation	0,2 – 2,7	1000 - 1080	1320 - 1370	1350 - 1390	1370 - 1450

Major elements EN 15290	Composition	Al	Ca	Fe	Mg	P	K	Si	Na	Ti				
	Unit	% (DB)												
	Range	0,10	59,50	0,4	5,30	8,50	16,7	4,4	0,2	0,04				
		2,00	67,00		8,00	10,00	35,00		2,30					
Micro elements EN 15297	Composition	As	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Sb	V	Zn
	Unit	mg/kg (DB)												
	Range	0,02	0,3	30	<0,1	2,6	<0,004	17		0,3	0,26		<0,1	28
		0,04	1,1		0,23	13				0,4	1,4		<0,2	38

2. QUALITY INFORMATION FOR TORREFACTION

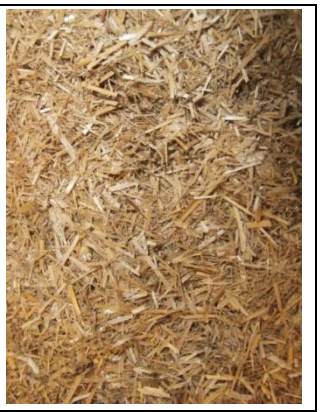
2.1 Quality data of biomass for torrefaction

Property	Typical value	Variation (min. – max.)
Traded form (e.g. chips) EN 14961-1, Table 2	Wood chips	
Particle size, P (Dimension /nominal size, mm, use) EN 15149-1, screen size according ISO 3310	16	10 - 50
Bulk density (BD), kg/m^3 EN 15103	340	320 – 400
Moisture as received, M (w-%), EN 14774-1 or 3	40	30 - 50
Amount of fines, F, w-% (≤ 3,15 mm) EN 15149-1	13	7 – 30
Hemicelluloses content, w-% dry	25,3	12,7 – 39,8
Cellulose content, w-% dry	44,4	35,2 – 50,8
Lignin content, w-% dry	22,9	15,5 – 31,9
C (w-% dry), EN 15104	49,7	44,8 – 52,0
H (w-% dry) EN 15104	6,06	5,6 – 6,3
O (w-% dry) calculated	43,9	41,6 – 48,6
Volatile content, VM (w-% dry) EN 15148	82,6	71,8 – 87,5
Net calorific value, dry MJ/kg EN 14918	18,0	17,3 – 20,0
Add other properties, if needed		

Source: SECTOR Partners

2.2 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)	~30%

	PROFILE No. 8	
	STRAW OF CEREAL	
Description of feedstock	Straw, cereal (oat and wheat, southern conditions)	
Raw material according to EN 14961-1 Table 1	2.1.1.2	
Traded form (e.g. wood chips) according Table 2 of EN 14961-1 or other	Square bales	
Selection criteria for feedstock profile (e.g. high potential, availability)	Potential in southern Europe 80 PJ/a. Total EU27 is 560 – 990 PJ/a	
Remarks (e.g. biomass cutting step, place of origin, pretreatment etc.)	Big square bales, 3.7 m^3, compressed and bound to squares, transportation to plant and chopping in to pieces.	
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	0,7	0,16	0,5
Variation (min-max)	0,3 2,77	0,00 0,46	0,02 2,3

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)	ºC	ºC	ºC	ºC
Typical value	6,7			1200	1220
variation	2,5 – 13,5			1100-1350	1190-1400

Major elements EN 15290	Composition	Al	Ca	Fe	Mg	P	K	Si	Na	Ti				
	Unit	% (DB)												
	Range	0,8	15,7	1,5	6,2	4,7	15,4	46,4	7,8	0,08				
		1,8	18,3	1,7	8,4	7,6	16,8	52,3	7,8	0,5				
Micro elements EN 15297	Composition	As	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Sb	V	Zn
	Unit	mg/kg (DB)												
	Range	0,1	0,0	1	2,7	10	0,02	0,3	0,5	1	0,1	0,3	0,9	12
		2,6	0,6	2,3	81,2	1.777	0,05	112	2,3	423	8,4	7,7	6,7	33,8

2. QUALITY INFORMATION FOR TORREFACTION

2.1 Quality data of biomass for torrefaction

Property	Typical value	Variation (min. – max.)
Traded form (e.g. chips) EN 14961-1, Table 2	Big square bales	
Particle size, P (Dimension /nominal size, mm, use) EN 15149-1, screen size according ISO 3310	40	8-60
Bulk density (BD), kg/m^3 EN 15103	100 (chopped)	80-150
Moisture as received, M (w-%), EN 14774-1 or 3	12	8 -20
Amount of fines, F, w-% (≤ 3,15 mm) EN 15149-1		
Hemicelluloses content, w-% dry	25,0	7,2 – 39,1
Cellulose content, w-% dry	37,0	14,8 – 51,5
Lignin content, w-% dry	17,5	5,0 – 30,0
C (w-% dry), EN 15104	48,9	43,7 – 52,6
H (w-% dry) EN 15104	5,9	3,2 – 6,6
O (w-% dry) calculated	43,9	39,4 – 50,1
Volatile content, VM (w-% dry) EN 15148	81	73 – 87
Net calorific value, dry MJ/kg EN 14918	17,8	14,8 – 20,5
Add other properties, if needed		

Source: SECTOR Feedback

2.2 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)	~45%

Source: SECTOR Partners

	PROFILE No. 9	
	PRUNINGS FROM OLIVE TREES	
Description of feedstock	Prunings from olive trees –woody biomass	
Raw material according to EN 14961-1 Table 1	1.1.4.3	
Traded form (e.g. wood chips) according Table 2 of EN 14961-1 or other	Wood chips	
Selection criteria for feedstock profile (e.g. high potential, availability)	Availability in European southern countries, Potential is 28 – 64 PJ/a.	
Remarks (e.g. biomass cutting step, place of origin, pretreatment etc.)	Pruning trees, collecting residues, storage of residues for seasoning and chipping.	
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	0,6	0,07	0,03
Variation (min-max)	0,5 1,7	0,00 0,2	0,00 0,1

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)	ºC	ºC	ºC	ºC
Typical value		1210	1340	1360	1390
variation		1000 - 1300	1320 - 1370	1350 - 1390	1370 - 1450

Major elements EN 15290	Composition	Al	Ca	Fe	Mg	P	K	Si	Na	Ti				
	Unit	% (DB)												
	Range	0,9	13,0	0,7	6,0	1,8	17,0	52,5	0,1	0,05				
		1,5	15,0	1,1	9,0	3,0	25,0	54,0	1,5	0,9				
Micro elements EN 15297	Composition	As	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Sb	V	Zn
	Unit	mg/kg (DB)												
	Range		0,08			1,7					0,5			3,0
			0,1			2,5					0,7			15

2. QUALITY INFORMATION FOR TORREFACTION

2.1 Quality data of biomass for torrefaction

Property	Typical value	Variation (min. – max.)
Traded form (e.g. chips) EN 14961-1, Table 2	Stem wood, log wood (branches mainly)	
Particle size, P (Dimension /nominal size, mm, use) EN 15149-1, screen size according ISO 3310	200	100 - 1000
Bulk density (BD), kg/m^3 EN 15103	250	220 – 270
Moisture as received, M (w-%), EN 14774-1 or 3	25	10 - 50
Amount of fines, F, w-% (≤ 3,15 mm) EN 15149-1	10	7 – 30
Hemicelluloses content, w-% dry	11,5	10,0 – 12,0
Cellulose content, w-% dry	48,5	47,5 – 49,5
Lignin content, w-% dry	30,5	29,5 – 31,5
C (w-% dry), EN 15104	40,7	39,0 – 45,0
H (w-% dry) EN 15104	5,7	5,0 – 6,0
O (w-% dry) calculated	41,0	40,0 – 42,0
Volatile content, VM (w-% dry) EN 15148	76,2	75,2 – 80,5
Net calorific value, dry MJ/kg EN 14918	16,3	16,0 – 18,5
Add other properties, if needed		

Source: [1] http://www.ecn.nl/phyllis. [2]F. Suárez-García, A. Martínez-Alonso, M. Fernández Llorente, J.M.D. Tarascon: Inorganic matter characterization in vegetable biomass feedstocks. Fuel 81 (2002) 1161-1169.

2.2 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)	

	PROFILE No. 10	
	EUCALYPTUS	
Description of feedstock	Eucalyptus	
Raw material according to EN 14961-1 Table 1	1.1.3.1	
Traded form (e.g. wood chips) according Table 2 of EN 14961-1 or other	Wood chips	
Selection criteria for feedstock profile (e.g. high potential, availability)	High potential energy crop. Alternative to poplar with similar potential.	
Remarks (e.g. biomass cutting step, place of origin, pretreatment etc.)	Growing of eucalyptus stems, cutting stems, storage, debarking of stems, chipping and transportation to plant	
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	0,29	0,05	0,035
Variation (min-max)	0,03 1,7	0,00 0,4	0,00 0,27

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)	ºC	ºC	ºC	ºC
Typical value	1,2	1025	1330	1370	1390
variation	0,2 – 6,1	995 - 1080	1320 - 1370	1350 - 1390	1370 - 1450

Major elements EN 15290	Composition	Al	Ca	Fe	Mg	P	K	Si	Na	Ti				
	Unit	% (DB)												
	Range	11,4	28,6	2,8	11,4	0,5	28,6	0,00	14,3	2,0				
		4,1	51,5	2,7	15,1	8,0	30,3	0,01	17,1	6,8				
Micro elements EN 15297	Composition	As	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Sb	V	Zn
	Unit	mg/kg (DB)												
	Range	0,8	0,3	0,1	1,3	4	0	27		0,5	0,3	1	0,5	6
				2	10	20	2	39		8	30	2		58

2. QUALITY INFORMATION FOR TORREFACTION

2.1 Quality data of biomass for torrefaction

Property	Typical value	Variation (min. – max.)
Traded form (e.g. chips) EN 14961-1, Table 2	Wood chips	
Particle size, P (Dimension /nominal size, mm, use) EN 15149-1, screen size according ISO 3310	15	10 - 50
Bulk density (BD), kg/m^3 EN 15103	340	320 – 400
Moisture as received, M (w-%), EN 14774-1 or 3	40	30 - 50
Amount of fines, F, w-% (≤ 3,15 mm) EN 15149-1	14	3 – 50
Hemicelluloses content, w-% dry	25,3	8,4 – 43,5
Cellulose content, w-% dry	43,0	8,8 – 57,5
Lignin content, w-% dry	23,2	9 - 37
C (w-% dry), EN 15104	50,3	46,2 – 55,2
H (w-% dry) EN 15104	6,02	4,9 – 6,9
O (w-% dry) calculated	43,3	38,2 – 47,7
Volatile content, VM (w-% dry) EN 15148	83,4	77,5 – 93,6
Net calorific value, dry MJ/kg EN 14918	18,5	17,0 – 21,6
Add other properties, if needed		

Source: [1] http://www.ecn.nl/phyllis. [2]O. Kitani and C. W. Hall: Biomass Handbook, Gordon and Breach science publishers, New York (1989).

2.2 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)	

	PROFILE No. 11	
	PAULOWNIA	
Description of feedstock	Paulownia	
Raw material according to EN 14961-1 Table 1	1.1.3.1	
Traded form (e.g. wood chips) according Table 2 of EN 14961-1 or other	Wood chips	
Selection criteria for feedstock profile (e.g. high potential, availability)	High potential energy crop. Alternative to poplar with similar potential.	
Remarks (e.g. biomass cutting step, place of origin, pretreatment etc.)	Growing of paulownia stems, cutting stems, storage, debarking of stems, chipping and transportation to plant	
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	0,24	0,02	0,01
Variation (min-max)	0,10 0,50	0,00 0,1	0,00 0,1

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)	ºC	ºC	ºC	ºC
Typical value	1,1				
variation	0,5 – 3,5				

Major elements EN 15290	Composition	Al	Ca	Fe	Mg	P	K	Si	Na	Ti			
	Unit	% (DB)											
	Range	0,5	55,0	0,7	5,0	1,0	17,0	2,5	0,1	0,05			
		1,0	65,0	1,1	8,0	3,0	25,0	4,0	1,5	0,9			
Micro elements EN 15297	Composition	As	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Sb	V	Zn
	Unit	mg/kg (DB)												
	Range	0,12		5,2	5,5	49	72		3,2	200		0,5	79	0,12
		0,5		60	80		115		10	630		2,2	300	0,5

2. QUALITY INFORMATION FOR TORREFACTION

2.1 Quality data of biomass for torrefaction

Property	Typical value	Variation (min. – max.)
Traded form (e.g. chips) EN 14961-1, Table 2	Wood chips	
Particle size, P (Dimension /nominal size, mm, use) EN 15149-1, screen size according ISO 3310	20	10 - 50
Bulk density (BD), kg/m^3 EN 15103	340	320 – 400
Moisture as received, M (w-%), EN 14774-1 or 3	40	30 - 50
Amount of fines, F, w-% (≤ 3,15 mm) EN 15149-1		
Hemicelluloses content, w-% dry		
Cellulose content, w-% dry		
Lignin content, w-% dry		
C (w-% dry), EN 15104	49,5	47,9 – 50,0
H (w-% dry) EN 15104	6,4	5,8 – 6,7
O (w-% dry) calculated	43,8	43,2 – 45,0
Volatile content, VM (w-% dry) EN 15148	82,0	81,5 – 84,0
Net calorific value, dry MJ/kg EN 14918	18,6	18,0 – 20,0
Add other properties, if needed		

Source: [1] http://www.vicedex.com.

2.2 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)	

	PROFILE No. 12	
	BAMBOO HERBACEOUS	
Description of feedstock	Chipped bamboo stems	
Raw material according to EN 14961-1 Table 1	2.1.2.2	
Traded form (e.g. wood chips) according Table 2 of EN 14961-1 or other	chips	
Selection criteria for feedstock profile (e.g. high potential, availability)	Available in high quantities, World total to some 37 million hectares or roughly 1% of the global forest area.	
Remarks (e.g. biomass cutting step, place of origin, pretreatment etc.)		
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	0,95	0,35	0,85
Variation (min-max)			

1.2 Ash content, ash melting behavior and ash composition and

Parameter	Ash content EN 14775	Ash melting behavior (CEN/TS 15370-1)			
		SST	DT	HT	FT
Unit	% (DB)	ºC	ºC	ºC	ºC
Typical value	7,7				
variation					

Major elements EN 15290	Composition	Al	Ca	Fe	Mg	P	K	As	Si	Na	Ti			
	Unit	mg/kg (DB)												
	Range													
Micro elements EN 15297	Composition	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Sb	V	Zn	
	Unit	mg/kg (DB)												
	Range													

2. QUALITY INFORMATION FOR TORREFACTION

2.1 Quality data of biomass for torrefaction

Property	Typical value	Variation (min. – max.)
Traded form (e.g. chips) EN 14961-1, Table 2	Chips	
Particle size, P (Dimension /nominal size, mm, use) EN 15149-1, screen size according ISO 3310		
Bulk density (BD), kg/m^3 EN 15104		
Moisture as received, M (w-%), EN 14774-1 or 3		
Amount of fines, F, w-% (≤ 3,15 mm) EN 15149-1		
Hemicelluloses content, w-% dry		
Cellulose content, w-% dry		
Lignin content, w-% dry		
C (w-% dry), EN 15104	46,7	46,7
H (w-% dry) EN 15104	5,6	5,6
O (w-% dry) calculated	37,8	37,8
Volatile content, VM (w-% dry) EN 15148	74,2	74,2
Net calorific value, dry MJ/kg EN 14918	16,9	16,9
Add other properties, if needed		

Source: SECTOR Partners

2.2 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)	

	PROFILE No. 13 **EMPTY FRUIT BUNCHES**	
Description of feedstock	Byproduct from palm oil industry	
Raw material according to EN 14961-1 Table 1	3.2.1.2	
Traded form (e.g. wood chips) according Table 2 of EN 14961-1 or other	Bales or small briquettes	
Selection criteria for feedstock profile (e.g. high potential, availability)	Available in large quantities, total potential of all palm oil residues is more than 250,000 PJ/a.	
Remarks (e.g. biomass cutting step, place of origin, pretreatment etc.)		
Selected for laboratory and/or pilot tests	Laboratory test, yes Pilot test, no	

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			
Variation (min-max)	0.5-0.8	0.1 -0.05	0.5-0.6

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)	ºC	ºC	ºC	ºC
Typical value					
variation					

Major elements EN 15290	Composition	Al	Ca	Fe	Mg	P	K	As	Si	Na	Ti		
	Unit	% (DB)											
	Range	0,4	4,2	0,1	2,6	2,8	38,1		9,7	0,2	0,14		
			6,6	0,2	7,3	4,4	42,7		20,3		1,3		
Micro elements EN 15297	Composition	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Sb	V	Zn
	Unit	mg/kg (DB)											
	Range												

2. QUALITY INFORMATION FOR TORREFACTION

2.1 Quality data of biomass for torrefaction

Property	Typical value	Variation (min. – max.)
Traded form (e.g. chips) EN 14961-1, Table 2	e.g. palm kernel shells	
Particle size, P (Dimension /nominal size, mm, use) EN 15149-1, screen size according ISO 3310		
Bulk density (BD), kg/m^3 EN 15104		
Moisture as received, M (w-%), EN 14774-1 or 3		61-72
Amount of fines, F, w-% (≤ 3,15 mm) EN 15149-1		
Hemicelluloses content, w-% dry		
Cellulose content, w-% dry		
Lignin content, w-% dry		
C (w-% dry), EN 15104		48-50
H (w-% dry) EN 15104		4,6-5,0
O (w-% dry) calculated		
Volatile content, VM (w-% dry) EN 15148		72-75
Net calorific value, dry MJ/kg EN 14918		11,5-14,5
Add other properties, if needed		

Source: SECTOR Partners

2.2 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)	

	PROFILE No. 14	
	BAGASSE HERBACEOUS	
Description of feedstock	Fibrous matter that remains after sugar canes stalks are crushed	
Raw material according to EN 14961-1 Table 1	2.2.1.1	
Traded form (e.g. wood chips) according Table 2 of EN 14961-1 or other	Chopped straw	
Selection criteria for feedstock profile (e.g. high potential, availability)	Available in high quantities, potential of ten top producers in the world is 3,600 PJ/a.	
Remarks (e.g. biomass cutting step, place of origin, pretreatment etc.)		
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	0,39	0,43	0,04
Variation (min-max)			

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)	ºC	ºC	ºC	ºC
Typical value					
variation					

Major elements EN 15290	Composition	Al	Ca	Fe	Mg	P	K	As	Si	Na	Ti		
	Unit	% (DB)											
	Range	5,8	5,6	5,3	2,1	1,3	3,8		34	0,25	0,35		
		6,0	16,7	7,5	6,6	9,8	17,8		75	0,7	1,4		
Micro elements EN 15297	Composition	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Sb	V	Zn	As
	Unit	% (DB)												
	Range	0,06		7,7	6,6	<0,01			1,9	2,6		3,5	18,8	0,44

2. QUALITY INFORMATION FOR TORREFACTION

2.1 Quality data of biomass for torrefaction

Property	Typical value	Variation (min. – max.)
Traded form (e.g. chips) EN 14961-1, Table 2	Chopped	
Particle size, P (Dimension /nominal size, mm, use) EN 15149-1, screen size according ISO 3310		
Bulk density (BD), kg/m^3 EN 15104	130	120 - 160
Moisture as received, M (w-%), EN 14774-1 or 3	50	48 - 53
Amount of fines, F, w-% (≤ 3,15 mm) EN 15149-1		
Hemicelluloses content, w-% dry		
Cellulose content, w-% dry		
Lignin content, w-% dry		
C (w-% dry), EN 15104	46	
H (w-% dry) EN 15104	5,7	
O (w-% dry) calculated	39,2	
Volatile content, VM (w-% dry) EN 15148	76,1	
Net calorific value, dry MJ/kg EN 14918	16,7	15 - 19
Add other properties, if needed		

Source: SECTOR Partners

2.2 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)	

	PROFILE No. 15 **CORN COBS**	
Description of feedstock	Central core of a maize ear	
Raw material according to EN 14961-1 Table 1	2.1.1.2	
Traded form (e.g. wood chips) according Table 2 of EN 14961-1 or other	Chopped	
Selection criteria for feedstock profile (e.g. high potential, availability)	High availability, potential in EU27 is from 61 to 250 PJ/a	
Remarks (e.g. biomass cutting step, place of origin, pretreatment etc.)		
Selected for laboratory and/or pilot tests	Laboratory test, yes Pilot test, no	

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	2,83	0,97	0,48
Variation (min-max)	0 – 6,4	0 – 5,5	0,02 – 1,83

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)	ºC	ºC	ºC	ºC
Typical value	15,4			1200	1220
variation	0 – 46,1			1100-1350	1190-1400

Major elements EN 15290	Composition	Al	Ca	Fe	Mg	P	K	As	Si	Na	Ti		
	Unit	mg/kg (DB)											
	Range	269	6100	189	840	740	1700	0,1	1100	2	-		
		43000	60900	44000	11400	9100	5500	10	72000	140	2100		
Micro elements EN 15297	Composition	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Sb	V	Zn
	Unit	mg/kg (DB)											
	Range	0,2	7,9	3,1	1,9	0	1,1	4,1	2	0,7	1	-	21,6
		28	-	296	437	6	393	52	140	652	2,1	21	1228

Source: SECTOR partners

2. QUALITY INFORMATION FOR TORREFACTION

2.1 Quality data of biomass for torrefaction

Property	Typical value	Variation (min. – max.)
Traded form (e.g. chips) EN 14961-1, Table 2	Chopped	
Particle size, P (Dimension /nominal size, mm, use) EN 15149-1, screen size according ISO 3310		
Bulk density (BD), kg/m^3 EN 15104		
Moisture as received, M (w-%), EN 14774-1 or 3		
Amount of fines, F, w-% (≤ 3,15 mm) EN 15149-1		
Hemicelluloses content, w-% dry		
Cellulose content, w-% dry		
Lignin content, w-% dry		
C (w-% dry), EN 15104		
H (w-% dry) EN 15104		
O (w-% dry) calculated		
Volatile content, VM (w-% dry) EN 15148		
Net calorific value, dry MJ/kg EN 14918		
Add other properties, if needed		

2.2 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)	

	PROFILE No. 16	
	MISCANTHUS	
Description of feedstock	Herbaceous biomass	
Raw material according to EN 14961-1 Table 1	2.1.2.1	
Traded form (e.g. wood chips) according Table 2 of EN 14961-1 or other	Chopped or in bales	
Selection criteria for feedstock profile (e.g. high potential, availability)	Available in high quantities, potential is 2000 – 7 000 PJ/a in EU27	
Remarks (e.g. biomass cutting step, place of origin, pretreatment etc.)		
Selected for laboratory and/or pilot tests	Laboratory test, yes Pilot test, no	

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	0,5	0,07	0,21
Variation (min-max)	0,1 – 0,16	0,02 – 0,057	0,02 – 0,58

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)	ºC	ºC	ºC	ºC
Typical value	3,5	1040	1150	1170	1200
variation	1,1 – 7,5				

Major elements EN 15290	Composition	Al	Ca	Fe	Mg	P	K	As	Si	Na	Ti			
	Unit	mg/kg (DB)												
	Range	57	990	61	390	380	3027	0,5	2400	27	3,3			
		160	2400	190	695	760	16400	1,7	10800	640	9			
Micro elements EN 15297	Composition	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Sb	V	Zn	
	Unit	mg/kg (DB)												
	Range	0	0,2	0,4	1,1		7,8	0,5	0,6	0,1	1,2	0,2	10	
		1,2	0,6	16	4,4		82	1,7	2,3	10,2	-	0,4	33	

2. QUALITY INFORMATION FOR TORREFACTION

2.1 2.1 Quality data of biomass for torrefaction

Property	Typical value	Variation (min. – max.)
Traded form (e.g. chips) EN 14961-1, Table 2	Chopped	
Particle size, P (Dimension /nominal size, mm, use) EN 15149-1, screen size according ISO 3310		
Bulk density (BD), kg/m^3 EN 15104		
Moisture as received, M (w-%), EN 14774-1 or 3	16	
Amount of fines, F, w-% (≤ 3,15 mm) EN 15149-1		
Hemicelluloses content, w-% dry		
Cellulose content, w-% dry		
Lignin content, w-% dry		
C (w-% dry), EN 15104	48	
H (w-% dry) EN 15104	5,9	
O (w-% dry) calculated	40,7	
Volatile content, VM (w-% dry) EN 15148	81,9	78,9 - 85,2
Net calorific value, dry MJ/kg EN 14918	17,6	17,2 – 18,2
Add other properties, if needed		

Source: SECTOR partners

2.2 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)	

	PROFILE No. 17	
SECTOR	**SUNFLOWER RESIDUE**	
Description of feedstock	Stalks and leaves from sun flowers	
Raw material according to EN 14961-1 Table 1	2.1.6.2	
Traded form (e.g. wood chips) according Table 2 of EN 14961-1 or other	Chopped straw	
Selection criteria for feedstock profile (e.g. high potential, availability)	High availability, potential in EU27 is 34 PJ/a.	
Remarks (e.g. biomass cutting step, place of origin, pretreatment etc.)		
Selected for laboratory and/or pilot tests	Laboratory test, yes Pilot test, no	

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	1,97	0,54	0,61
Variation (min-max)	0 – 4,80	0 1,64	0,015 – 1,71

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)	ºC	ºC	ºC	ºC
Typical value	7,6				
variation	0 – 16,7				

Major elements EN 15290	Composition	Al	Ca	Fe	Mg	P	K	As	Si	Na	Ti			
	Unit	mg/kg (DB)												
	Range	0,3	1	15	0,7	1	1	10	5,3	0,9	0,2			
		43000	60900	44000	11400	9100	34000	187	72000	13000	2100			
Micro elements EN 15297	Composition	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Sb	V	Zn	
	Unit	mg/kg (DB)												
	Range	0	0,1	0,2	0,9	0	1	0,1	0,2	0,1	0,3	0	1,7	
		28	7,9	174	253	6	34000	10	45	430	7,7	21	1102	

2. QUALITY INFORMATION FOR TORREFACTION

2.1 Quality data of biomass for torrefaction

Property	Typical value	Variation (min. – max.)
Traded form (e.g. chips) EN 14961-1, Table 2		
Particle size, P (Dimension /nominal size, mm, use) EN 15149-1, screen size according ISO 3310		
Bulk density (BD), kg/m^3 EN 15104		
Moisture as received, M (w-%), EN 14774-1 or 3	8.7	
Amount of fines, F, w-% (≤ 3,15 mm) EN 15149-1		
Hemicelluloses content, w-% dry		
Cellulose content, w-% dry		
Lignin content, w-% dry		
C (w-% dry), EN 15104	48,4	
H (w-% dry) EN 15104	5,9	
O (w-% dry) calculated	44,9	
Volatile content, VM (w-% dry) EN 15148	71,7	
Net calorific value, dry MJ/kg EN 14918	19,1	
Add other properties, if needed		

Source: SECTOR Partners

2.2 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)	

	PROFILE No. 18	
	WILLOW	
Description of feedstock	Willow (Salix)	
Raw material according to EN 14961-1 Table 1	1.1.1.3	
Traded form (e.g. wood chips) according Table 2 of EN 14961-1 or other	Wood chips	
Selection criteria for feedstock profile (e.g. high potential, availability)	Main permanent energy crop in Nordic countries.	
Remarks (e.g. biomass cutting step, place of origin, pretreatment etc.)		
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	0,5	0,04	0,02
Variation (min-max)	0,3-0,96	0,02-0,12	0,018-0,04

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)	ºC	ºC	ºC	ºC
Typical value	2,2	1100	1363	1523	1528
variation					

Major elements EN 15290	Composition	Al	Ca	Fe	Mg	P	K	As	Si	Na	Ti		
	Unit	% (DB)											
	Range	0,13	29,36	0,24	1,38	7,6	12,3		0,81	0,35			
		6,43	58,56	1,44	9,64	17,25	33,85		26,62	3,68			
Micro elements CEN/TS 15297	Composition	As	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Sb	V	Zn
	Unit	% (DB)												
	Range	<0,1	0,28	0,17	0,42	3,29	<0,004	45,6		0,65	0,11	<0,05	0,14	50,2

2. QUALITY INFORMATION FOR TORREFACTION

2.1 Quality data of biomass for torrefaction

Property	Typical value	Variation (min. – max.)
Traded form (e.g. chips) EN 14961-1, Table 2	Chips	
Particle size, P (Dimension /nominal size, mm, use) EN 15149-1, screen size according ISO 3310		
Bulk density (BD), kg/m^3 EN 15104	330	300 - 390
Moisture as received, M (w-%), EN 14774-1 or 3	40	35 - 50
Amount of fines, F, w-% (≤ 3,15 mm) EN 15149-1		
Hemicelluloses content, w-% dry		
Cellulose content, w-% dry		
Lignin content, w-% dry		
C (w-% dry), EN 15104	49	47,1-50,3
H (w-% dry) EN 15104	6	5,82-6,2
O (w-% dry) calculated	43	41,3-45,3
Volatile content, VM (w-% dry) EN 15148	82	81 - 86
Net calorific value, dry MJ/kg EN 14918	19,5	
Add other properties, if needed		

Source: SECTOR Partners

2.2 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)	39 (Data at 300°C at time >200°C=12.5 min)

Source: SECTOR Partners

	PROFILE No. 19	
	REED CANARY GRASS	
Description of feedstock	Reed canary grass	
Raw material according to EN 14961-1 Table 1	2.1.2.1	
Traded form (e.g. wood chips) according Table 2 of EN 14961-1 or other	Bales, chopped	
Selection criteria for feedstock profile (e.g. high potential, availability)	Perennial crop from Nordic countries, potential 8,100 PJ/a in EU27	
Remarks (e.g. biomass cutting step, place of origin, pretreatment etc.)	Harvesting in spring, baling, transporation of bales to plant.	
Selected for laboratory and/or pilot tests	Laboratory test, yes Pilot test, no	

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	0,6	0,08	
Variation (min-max)	0,3-1,4	0,04-0,20	0,04

1.2 Ash content, ash melting behavior and ash composition

Parameter	Ash content EN 14775	Ash melting behavior (EN 15370-1)			
		SST	DT	HT	FT
Unit	% (DB)	ºC	ºC	ºC	ºC
Typical value	8	1040-1390	1000-1200	1100-1400	1160-1500
variation	3 - 22				

Major elements EN 15290	Composition	Al	Ca	Fe	Mg	P	K	As	Si	Na	Ti			
	Unit	% (DB)												
	Range	0,21	1,87	0,27	0,93	0,4	2,01	<0,1	45,14	0,04				
		11,0	16,74	2,2	5,55	14,49	19,0		93,05	2,46				
Micro elements CEN/TS 15297	Composition	As	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Sb	V	Zn
	Unit	mg/kg (DB)												
	Range		>0,03	0,16	1,73	5,56	0,02		0,43	1,06	0,87		0,63	51,45

2. QUALITY INFORMATION FOR TORREFACTION

2.1 Quality data of biomass for torrefaction

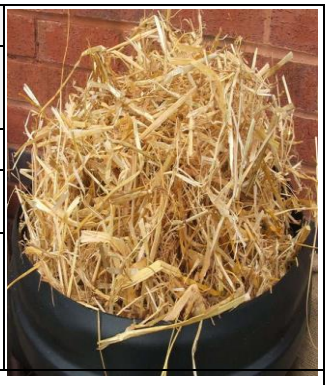
Property	Typical value	Variation (min. – max.)
Traded form (e.g. chips) EN 14961-1, Table 2	Bales (chopped)	
Particle size, P (Dimension /nominal size, mm, use) EN 15149-1, screen size according ISO 3310		
Bulk density (BD), kg/m^3 EN 15104		
Moisture as received, M (w-%), EN 14774-1 or 3		
Amount of fines, F, w-% (≤ 3,15 mm) EN 15149-1		
Hemicelluloses content, w-% dry	30	
Cellulose content, w-% dry	46	
Lignin content, w-% dry	22	
C (w-% dry), EN 15104	45,3	44-48
H (w-% dry) EN 15104	5,6	5,2-6,21
O (w-% dry) calculated	41.2	38,9-43,9
Volatile content, VM (w-% dry) EN 15148	77	74-81
Net calorific value, dry MJ/kg EN 14918	16,6	14,6-17,5
Add other properties, if needed		

Source: SECTOR Partners

2.2 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)	39,5 (Data at 300°C at time >200°C=12.5 min)

Source: SECTOR Partners

	PROFILE No. 20 **BARLEY STRAW**	
Description of feedstock	Barley straw	
Raw material according to EN 14961-1 Table 1	2.1.1.2	
Traded form (e.g. wood chips) according Table 2 of EN 14961-1 or other	Bales, chopped	
Selection criteria for feedstock profile (e.g. high potential, availability)	Potential is 176 PJ/a in EU27.	
Remarks (e.g. biomass cutting step, place of origin, pretreatment etc.)	Baling of straw, storage and transporation bales to plant, chopping of straw	
Selected for laboratory and/or pilot tests	Laboratory test, yes Pilot test, no	

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	0,6	0,12	
Variation (min-max)	0,41-1,25	0,09-0,16	0,2-0,7

1.2 Ash content, ash melting behavior and ash composition

Parameter	Ash content EN 14775	Ash melting behavior (EN 15370-1)			
		SST	DT	HT	FT
Unit	% (DB)	ºC	ºC	ºC	ºC
Typical value	4-6,5				
variation					

Major elements EN 15290	Composition	Al	Ca	Fe	Mg	P	K	As	Si	Na	Ti		
	Unit	mg/kg (DB)											
	Range	0,23	6,9	0,19	1,08	1,62	7,58		26,99	0,41			
		1,12	14,94	1,69	3,42	5,34	49,45		80,38	2,73			
Micro elements CEN/TS 15297	Composition	As	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Sb	V	Zn
	Unit	mg/kg (DB)												
	Range													

2. QUALITY INFORMATION FOR TORREFACTION

2.1 Quality data of biomass for torrefaction

Property	Typical value	Variation (min. – max.)
Traded form (e.g. chips) EN 14961-1, Table 2	Bales (chopped)	
Particle size, P (Dimension /nominal size, mm, use) EN 15149-1, screen size according ISO 3310		
Bulk density (BD), kg/m^3 EN 15104		
Moisture as received, M (w-%), EN 14774-1 or 3		
Amount of fines, F, w-% (≤ 3,15 mm) EN 15149-1		
Hemicelluloses content, w-% dry		
Cellulose content, w-% dry		
Lignin content, w-% dry		
C (w-% dry), EN 15104	45,4	39,9-47,5
H (w-% dry) EN 15104	5,6	5,3-5,9
O (w-% dry) calculated	42,1	41,2-43,8
Volatile content, VM (w-% dry) EN 15148		
Net calorific value, dry MJ/kg EN 14918	18,9	
Add other properties, if needed		

Source: Umeå University

2.2 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)	58 (Data at 300°C at time >200°C=12.5 min)

Source: SECTOR Partners

	PROFILE No. 21 **RAPE STRAW**	
Description of feedstock	Rape straw	
Raw material according to EN 14961-1 Table 1	2.1.1.2	
Traded form (e.g. wood chips) according Table 2 of EN 14961-1 or other	Bales, chopped	
Selection criteria for feedstock profile (e.g. high potential, availability)	Potential in EU27 is 90 PJ/a.	
Remarks (e.g. biomass cutting step, place of origin, pretreatment etc.)		
Selected for laboratory and/or pilot tests	Laboratory test, yes Pilot test, no	

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	0,5	0,2	
Variation (min-max)	0,48-2.3	0,1-0,40	0,2

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)	ºC	ºC	ºC	ºC
Typical value	5,8				
variation					

Major elements EN 15290	Composition	Al	Ca	Fe	Mg	P	K	As	Si	Na	Ti		
	Unit	mg/kg (DB)											
	Range	0,24	30,77	0,16	1,55	2,23	13,49		5,42	0,44			
		5,47	53,16	2,01	2,94	5,8	32,23		40,91	2,21			
Micro elements EN 15297	Composition	As	Cd	Co	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Sb	V	Zn
	Unit	mg/kg (DB)												
	Range													

2. QUALITY INFORMATION FOR TORREFACTION

2.1 Quality data of biomass for torrefaction

Property	Typical value	Variation (min. – max.)
Traded form (e.g. chips) EN 14961-1, Table 2	chopped	
Particle size, P (Dimension /nominal size, mm, use) EN 15149-1, screen size according ISO 3310		
Bulk density (BD), kg/m^3 EN 15104		
Moisture as received, M (w-%), EN 14774-1 or 3		
Amount of fines, F, w-% (≤ 3,15 mm) EN 15149-1		
Hemicelluloses content, w-% dry		
Cellulose content, w-% dry		
Lignin content, w-% dry		
C (w-% dry), EN 15104	47,7	46,2-51,1
H (w-% dry) EN 15104	6,2	6-6,4
O (w-% dry) calculated	39,9	34-42,5
Volatile content, VM (w-% dry) EN 15148		
Net calorific value, dry MJ/kg EN 14918		18,2
Add other properties, if needed		

Source: Umeå University

2.2 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)	55 (Data at 300°C at time >200°C=12.5 min)

Source: SECTOR Partners