

Delivery of sustainable supply of non-food biomass to support a resource-efficient Bioeconomy in Europe

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Bio2Match: A Tool for Matching Biomass and Conversion Technologies

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- Introduction and your expectations
- Tool methodology and matching indicators
- Databases underlying the tool
 - Technology database
 - Biomass properties database
- Using the tool
- Workshop: work with Bio2Match
- Discuss your experiences
- Conclusions



- Different regions...
 - Supply different types of biomass with different characteristics
 - Demand different products
- How to optimize the resource-efficient use of biomass at EU level?
- Goal: support stakeholders in the bio-economy with a matching tool.

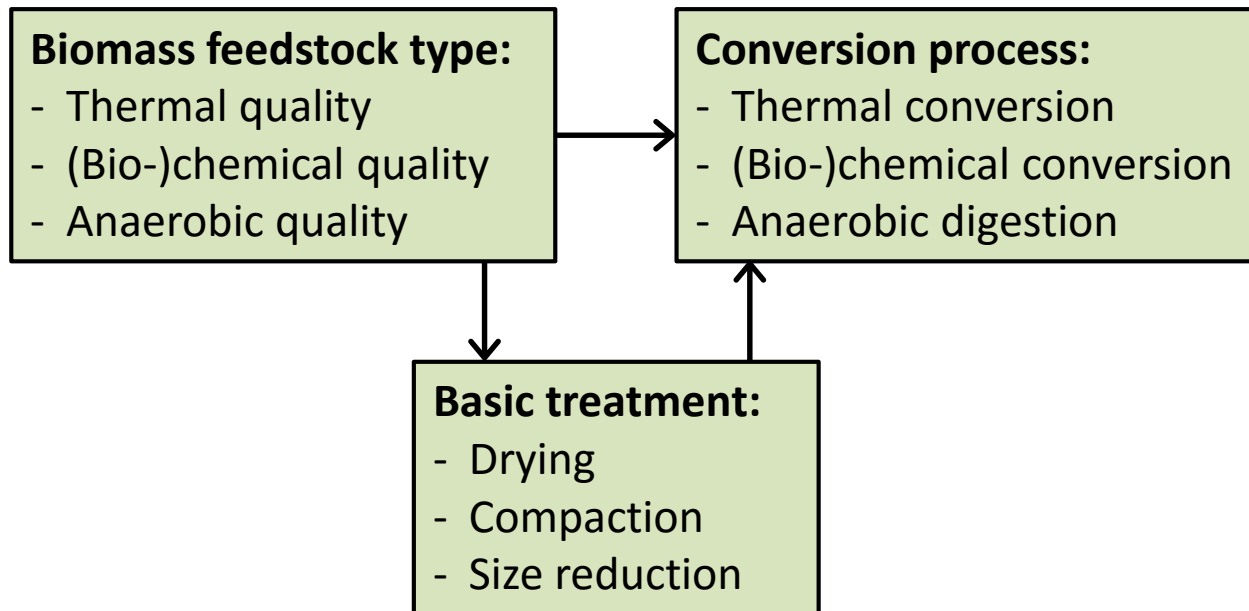


- Bio2Match should help stakeholders in the bio-economy to find feasible and logical combinations of lignocellulosic biomass and technologies.

What are your expectations?

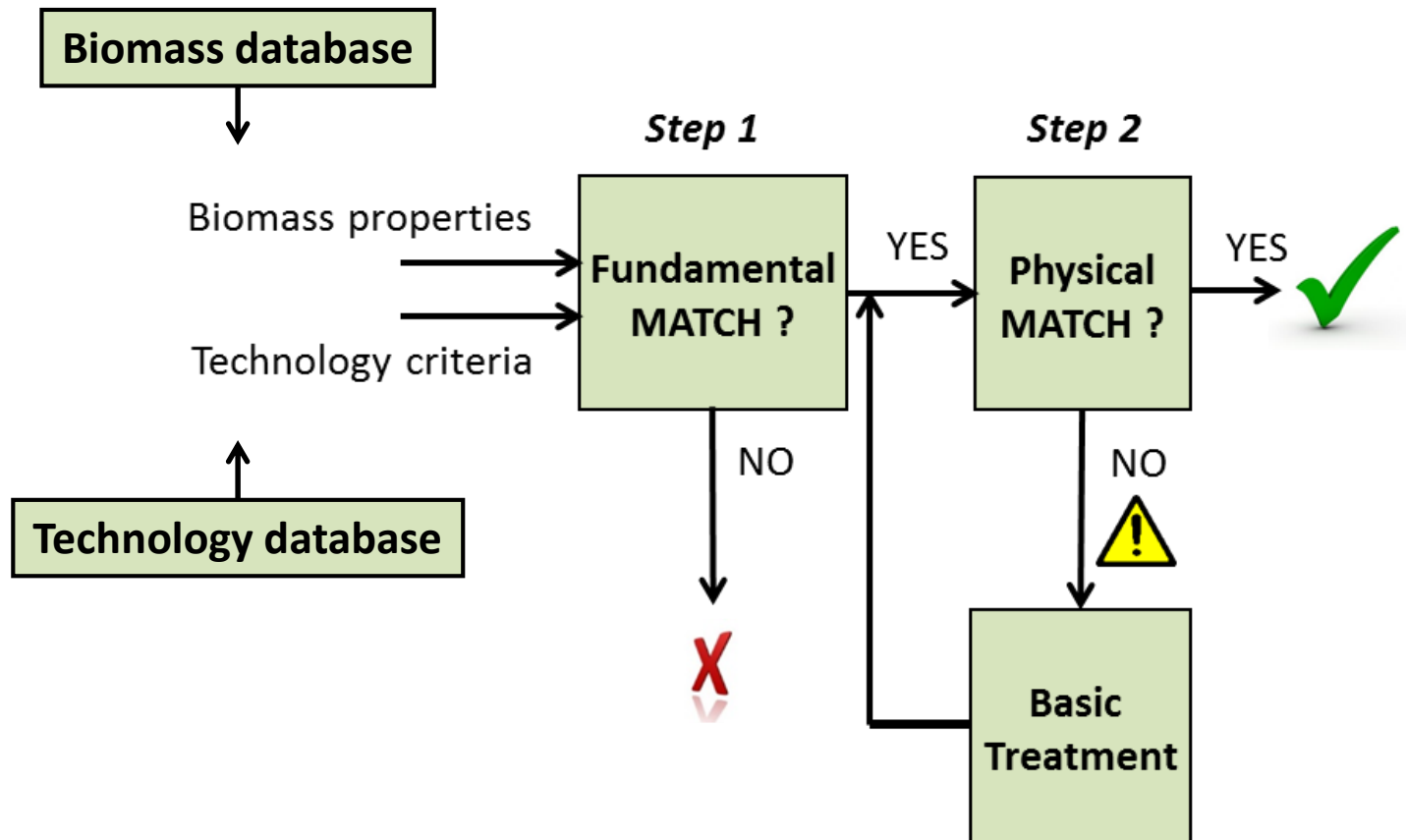
- Would you find such a tool useful?
 - Yes:
 - No:
 - Don't know:
- Why or why not? What should it do for you?
 - ...
 - ...
 - ...

- Biomass and technology matching, classification system:



- Distinction between ‘fundamental’ and ‘easy to modify’ properties.

- Biomass and technology matching, methodology:



Quality indicators used for matching biomass and technologies:

- **Fundamental properties:**

- **Thermal:**
 - Chlorine content (corrosion)
 - Ash deformation temperature (slagging and fouling)
 - Ash content (product yield, processability, costs)
 - Nitrogen content (NO_x emissions)
- **(Bio-)chemical:**
 - Cellulose + hemicellulose content (product yield)
 - Lignin content (processability)
 - Ash content (processability, costs)
- **Anaerobic digestion:**
 - Biogas yield (product yield)
 - Application of digestate possible (costs)

- **Physical properties:**

- **All:**
 - Moisture content (product yield, processability)
 - Bulk density (processability)

Classification of each quality indicator for the matching tool, using ranges:

- Biomass properties:
 - Class 1: ideal biomass (e.g. very low ash content: < 0.02 wt-%)
 - Class 2: desirable biomass (e.g. low ash content: $0.02 - 0.1$ wt-%)
 - Class 3: undesirable biomass (e.g. high ash content: $0.1 - 0.4$ wt-%)
 - Class 4: very undesirable biomass (e.g. very high ash content: > 0.4 wt-%)
- Technology criteria:
 - Property X (e.g. ash content): Able to handle biomass of classes 1-2
 - Property Y (e.g. chlorine content): Able to handle biomass of classes 1-4
 - Property Z (e.g. carbohydrate content): Able to handle biomass of class 1
- In this way you can see if there is a match (or why not) and if a technology could perhaps use lower quality biomass as well.

- Database prepared by experts from within the consortium, based on information from literature and industry, containing for example:
 - Description of operating principle
 - Level of commercial application
 - Technology Readiness Level
 - Type and capacity of product output
 - Conversion efficiencies
 - Investment costs
 - Labour requirement
 - Feedstock quality criteria
- Technologies were divided into the following main categories:
 - Direct combustion of solid biomass
 - Gasification technologies
 - Syngas platform
 - Fast pyrolysis
 - Torrefaction
 - Treatment in subcritical water
 - Techniques from pulp and paper industry
 - Chemical pretreatment
 - Biochemical hydrolysis
 - Fermentation to ethanol and bio-based products
 - Anaerobic digestion
- Each category contains different subcategories, currently ~50 entries.

Technology database

s2biom.alterra.wur.nl/web/guest/conversion

75 Items per Page Page 1 of 1 Showing 51 results.

Biomass chain data / Conversion technologies

Number ▾	Category ⇅	Subcategory ⇅	Name ⇅	Output capacity
29	Direct combustion of solid biomass	Fixed bed combustion for heat	Grate boiler with wood chips for heat	Heat
27	Treatment in subcritical water	Aqueous Phase Reforming	Aqueous Phase Reforming	Gasoline
24	Fast pyrolysis	Pyrolysis plus boiler for heat and steam	Agricultural residues to pyrolysis oil	Power, Heat, Pyrolysis oil
23	Fast pyrolysis	Pyrolysis plus boiler for heat and steam	Wood chips to pyrolysis oil	Power, Heat, Pyrolysis oil
18	Torrefaction	Moving bed reactor	torrefaction and pelletisation (TOP)	Torrefied biomass
17	Techniques from pulp and paper industry	Prehydrolysis Kraft process in water phase	Prehydrolysis kraft	Power, Pulp, Hemicellulose, Tall oil, Turpentine

View details of BFB for syngas

GENERAL PROPERTIES	
Name	BFB for syngas
Main category	Gasification technologies
Subcategory	Bubbling fluidized bed for syngas production
Image url	
Year of first implementation	Level of commercial application
Estimated number of systems in operation	Important pilots and EU projects
Main operating principle:	Expected Developments
Biomass is gasified with steam and oxygen at pressurised BFB gasifier operated at ca. 8 bar and 870 C.	Current Technology Readiness Level in 2014
Product gas is cooled to 600 C, filtered and led into catalytic reformer where tars and hydrocarbon gases are reformed. Then product gas is cleaned, conditioned and pressurised to fuel synthesis.	Expected Technology Readiness Level in 2030
	Justify expected Level in 2030
	References:
	Carbona/Andritz

Capacity of outputs (typical values)		TECHNICAL PROPERTIES				
Heat (MWh) 45		typical: 0.15	min: 0	max: 0.2	typical in 2020: 0.1	typical in 2030: 0.1
Conversion efficiencies: net returns usable heat(GJ/GJ biomass input)						
Methanol (m3/hour) 26	LHV (GJ / m ³) 25.3	typical: 0.6	min: 0.5	max: 0.67	typical in 2020: 0.65	typical in 2030: 0.65
Conversion efficiencies: net returns fuel(GJ/GJ biomass input)						

Data sources used to define conversion efficiencies in 2014:
 VTT Technology 91, 2013 Hannula, Ilkka; & Kurkela, Esa. 2013. Liquid transportation fuels via large-scale fluidised-bed gasification of lignocellulosic biomass. Espoo, VTT. 114 p. + app. 3 p. VTT Technology; 91
External inputs (not generated by the biomass in the conversion process)
 Power (kW): 5

Data sources used to define conversion efficiencies in 2020:

Data sources used to define conversion efficiencies in 2030:

General data sources for technical properties:

Indication: experience based data No
 Number of possible full load hours per year (hours) 8500
 Number of typical full load hours per year (hours) 8000
 Typical Lifetime of Equipment (years) 40

BIOMASS INPUT SPECIFICATIONS

Biomass input, common for the technology used:		Optional attributes	
Biomass input, technically possible but not common:			
Traded form	Wood chips	Net calorific value	(MJ/kg) min
Dimensions	P31: 3,15 mm < P < 31,5 mm Fine fraction F25: < 25 %	Gross calorific value	(MJ/kg) min
Moisture content	(% wet basis) typical 15	Biogas yield	(m ³ gas/ton dry biomass) % methane
Minimal bulk density	(kg/m ³ , wet basis) 120	Cellulose content	(g/kg dry matter) min
Maximum ash content	(% dry basis) 5	Hemicellulose content	(g/kg dry matter) min
Minimal ash melting point (= initial deformation temperature)	(°C) 1000	Lignin content	(g/kg dry matter) min
Volatile matter (only for thermally treated material, torrefied or steam exploded)	(VM%)	Crude fibre content	(g/kg dry matter) min
Maximum allowable contents		Starch content	(g/kg dry matter) min
Nitrogen, N (wt%, dry) 1	Sulphur, S (wt%, dry) 0.3	Sugar content	(g/kg dry matter) min
	Chlorine, Cl (wt%, dry) 0.3	Fat content	(g/kg dry matter) min
		Protein content	(g/kg dry matter) min
		Acetyl group content	(g/kg dry matter) min

FINANCIAL AND ECONOMIC PROPERTIES	
Investments	in 2014 (€): expected in 2020 (€):
costs	500000000 350000000
Labour needed	expected in 2030 (€): 350000000
Operators (FTE): 25	Staff and engineering (FTE): 20

- Database prepared by experts from within the consortium, based on literature, containing 50 entries in the following categories:
 - Forestry biomass:
 - Primary forestry products
 - Primary forestry residues
 - Agricultural biomass:
 - Primary production of lignocellulosic crops
 - Agricultural residues
 - Grassland
 - Other land use:
 - Biomass from landscape maintenance
 - Biomass from roadside
 - Industrial residues:
 - Secondary residues of wood industries
 - Secondary residues of industries using agricultural products
 - Consumer waste:
 - Biodegradable municipal waste
 - Post-consumer wood
- Database contains typical, high and low values on the matching indicators.

Using Bio2Match

Select rows and columns

Switch rows and columns

Columns - Biomass types

- Agricultural residues
- Grassland
- Municipal waste
- Other land use
- Primary production of lign...
- Primary residues from for...
- Production from forests
- Secondary residues from ...
- Secondary residues of ind...
- Waste from wood

Rows - Conversion technol...

- Treatment in subcritical w...
- Fast pyrolysis
- Syngas platform
- Gasification technologies
- Direct combustion of solid...
- Anaerobic digestion
- Torrefaction
- Biochemical treatment

Match

Name	Thinnings from nonconifer trees	Cereals straw	Unused grassland cuttings
Complete mix digester state of the art 2014	✘	✔	✔
Wood chips to pyrolysis oil	✔	✘	✘
Agricultural residues to pyrolysis oil	✔	✔	✘
Syngas to FT-diesel	⚠	✘	✘
Ethanol from lignocellulose (dilute acid pretreatment)...	⚠	✔	⚠
Grate boiler with straw for heat	⚠	✔	⚠

Matching characteristics

- Anaerobic digestion
- Biochemical treatment
- Physical treatment
 - Moisture content
 - Bulk density, BD
- Thermal conversion

Matching overview for biomass type "Unused grassland cuttings (abandoned grassland, managed grasslands not used for feed)" and conversi...

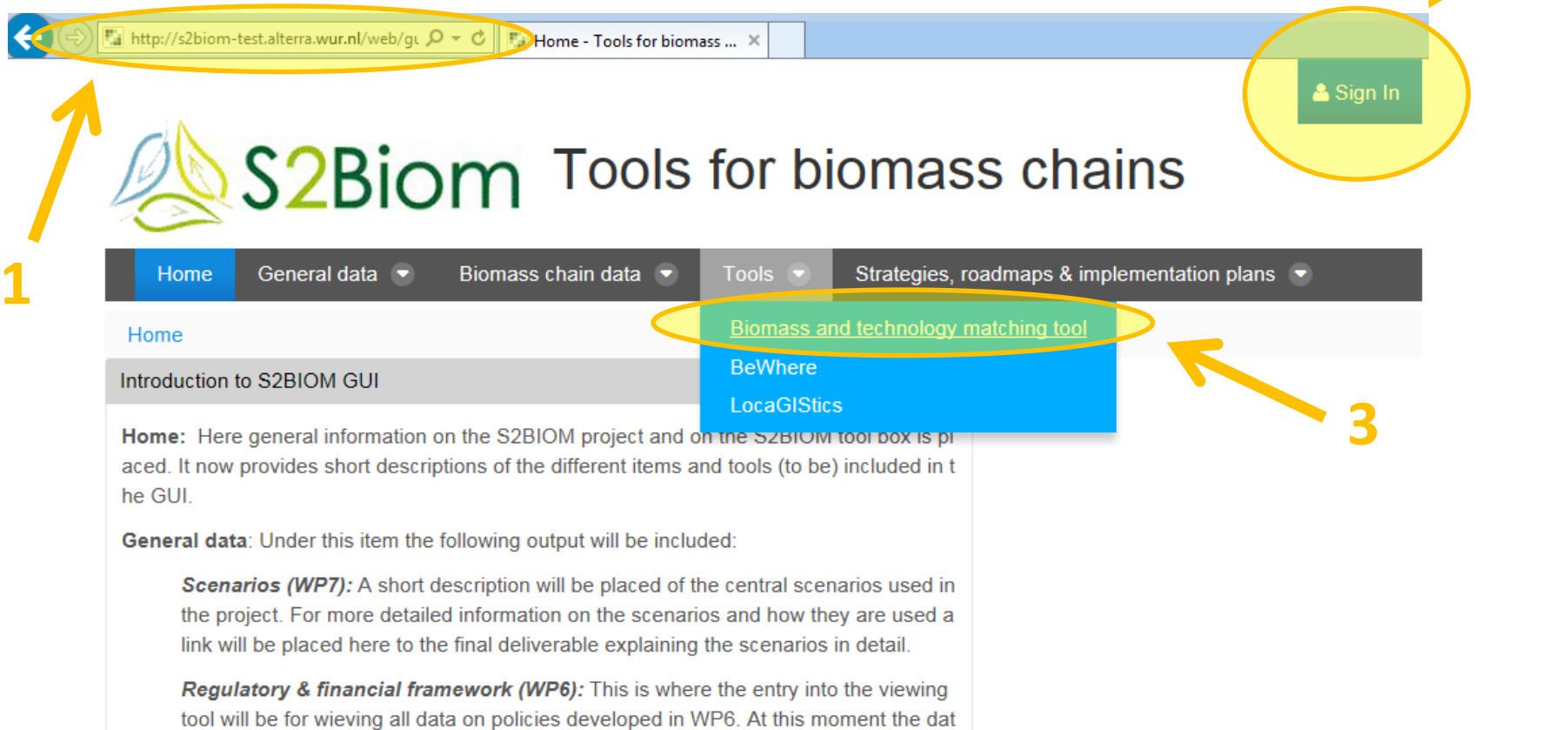
Name	Group	Match
Ash content	Thermal conversion	✔
Ash melting behavior (DT)	Thermal conversion	✔
Bulk density, BD	Physical treatment	✔
CI	Thermal conversion	✘

Legend

- ✔ Physical match
- ⚠ Fundamental match, no physical m...
- ✘ No match
- ⊖ Not taken into consideration
- 🔑 Missing data

Work with Bio2Match

1. Go to <http://s2biom-test.alterra.wur.nl>.
2. Sign in, using: screen name 'demo' and password 'helsinki'.
3. Click on the Biomass and technology matching tool.



The screenshot shows the S2Biom website interface. The browser address bar is highlighted with a yellow oval and labeled '1'. The 'Sign In' button is highlighted with a yellow oval and labeled '2'. The 'Biomass and technology matching tool' is highlighted with a yellow oval and labeled '3'. The website header includes the S2Biom logo and the text 'Tools for biomass chains'. The navigation menu includes 'Home', 'General data', 'Biomass chain data', 'Tools', and 'Strategies, roadmaps & implementation plans'. The 'Tools' menu is open, showing 'Biomass and technology matching tool', 'BeWhere', and 'LocaGIStics'. The main content area includes a 'Home' section with general information on the S2BIOM project and a 'General data' section with information on scenarios and regulatory frameworks.

Work with Bio2Match



1. The technology database can be accessed in 'biomass chain data'.
2. Click on 'Category' to alphabetically order the technologies by category.
3. Click on the 'view' icon to access the information about that technology.



S2Biom Tools for biomass chains

Home General data **Biomass chain data** Tools Strategies, roadmaps & implementation plans

Biomass supply
Biomass storage
Conversion technologies
Biological components
Value chain sustainability

Conversion technologies (WP2)

This item in the GUI gives access to a comprehensive amount of characteristics on a large number of biomass conversion technologies collected in WP 2. Currently the access to this database is simple and provides more of a scrolling function through all records specified so far. In the near future a tool will be further developed and visualized to give an interactive overview of the main technical, economic and GHG emission parameters of current and future pre-treatment and conversion technologies through selections specified by the user. The data included in this database will also be the basic data feed for the assessment tools which are made accessible under the 'Tool' item in the GUI.

- The conversion technology types included in this database can be classified as:
- Thermal conversion processes
 - Chemical conversion processes
 - Bio-chemical conversion processes
 - (Biobased) products/building blocks

At this moment a great deal of technologies have already been included, particularly those which have reached a mature technology level, but more technologies will follow including those which have not yet reached a mature technology levels. Information on biobased building block technologies will also be covered to the extent possible within the time and budget limitations of the project.

Conversion technologies

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Number	Category	Subcategory	Name	Output capacity	Common biomass input	Additional input	Last edited
75	Direct combustion of solid biomass	Fixed bed combustion for heat	Grate boiler with straw for heat	Heat	Rice straw		Tijs Lammens
74	Treatment in subcritical water	Hydrothermal processing	HTC Hydrothermal carbonisation of biowaste to coal for CHP	Biocoal	Separately collected biowaste: Biodegradable waste of separately collected municipal waste (excluding textile and paper), Biowaste as part of integrally collected municipal waste: Biodegradable waste of not separately collected municipal waste (excluding textile and paper), Other industry by-products utilising agricultural products, Other by-products and residues from food and fruit processing industry	Power, Heat (useful, not process steam)	Klaus Lenz
73	Direct combustion of solid biomass	Fixed bed combustion for CHP (steam cycle)	Grate boiler with agrobiomass for CHP	Power, Heat			Janne Kärki
72	Fast pyrolysis	Pyrolysis plus boiler for	Fast pyrolysis of residues	Power, Heat			Tijs

How was your experience?

- Does Bio2Match work user-friendly / intuitive?
- Does the tool contain information that is useful for you?
 - Do you agree with the information you found in the matching tool?
- Would you use the tool and if so, what for?
- Is there any other information that you would like to see included?
- Do you have any other feedback?

Thank you for your attention!

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Biomass quality classification

Property	Unit	Quality class			
		1	2	3	4
Chlorine content	wt-% d.m.	<0.02	0.02- 0.1	0.1- 0.4	>0.4
Ash melting temperature	°C	>1200	1000- 1200	800- 1000	<800
Ash content	wt-% d.m.	<1	1-3	3-10	>10
Nitrogen content	wt-% d.m.	<0.3	0.3-1	1-2.5	>2.5
Carbohydrates	wt-% d.m.	>65	50-65	30-50	<30
Lignin content	wt-% d.m.	<10	10-25	25-35	>35
Biogas yield	m ³ /ton a.r.	>300	150- 300	50- 150	<50
Digestate has an application		Yes			No