






EUBCE conference, Amsterdam, 9 June, 2016


Workshop: Matching Biomass and Conversion Technologies with Bio2Match

Tijs Lammens


This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 608622. The sole responsibility of this publication lies with the author. The European Union is not responsible for any use that may be made of the information contained therein.

Agenda






- 11:30 • Introduction
 - Tool methodology and matching indicators
 - Databases underlying the tool
 - Technology database
 - Biomass properties database
 - Using the tool
- 11:45 Workshop: work with Bio2Match
- 12:15 Discussion, feedback, and conclusions
- 12:30 Lunch



09/06/2016


1

Introduction S2Biom

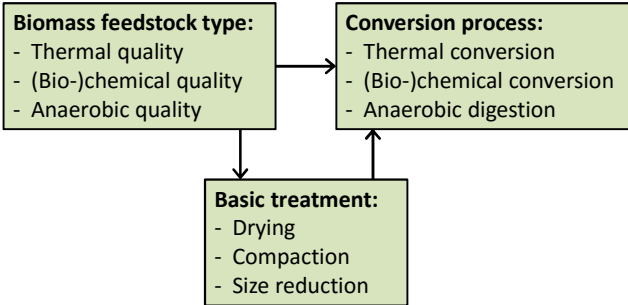




- Different regions...
 - Supply different types of biomass with different characteristics
 - Demand different products
- How to optimize the resource-efficient use of biomass at EU level?
- Goal: support stakeholders in the bio-economy with a matching tool.

09/06/2016


3

Tool methodology S2Biom



- Biomass and technology matching, classification system:

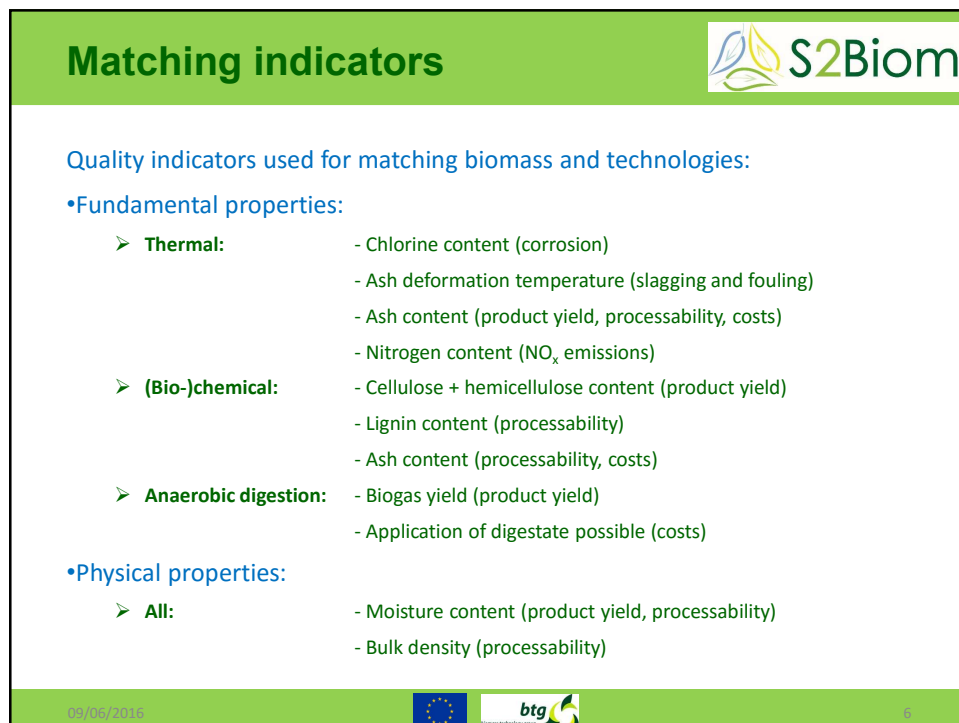
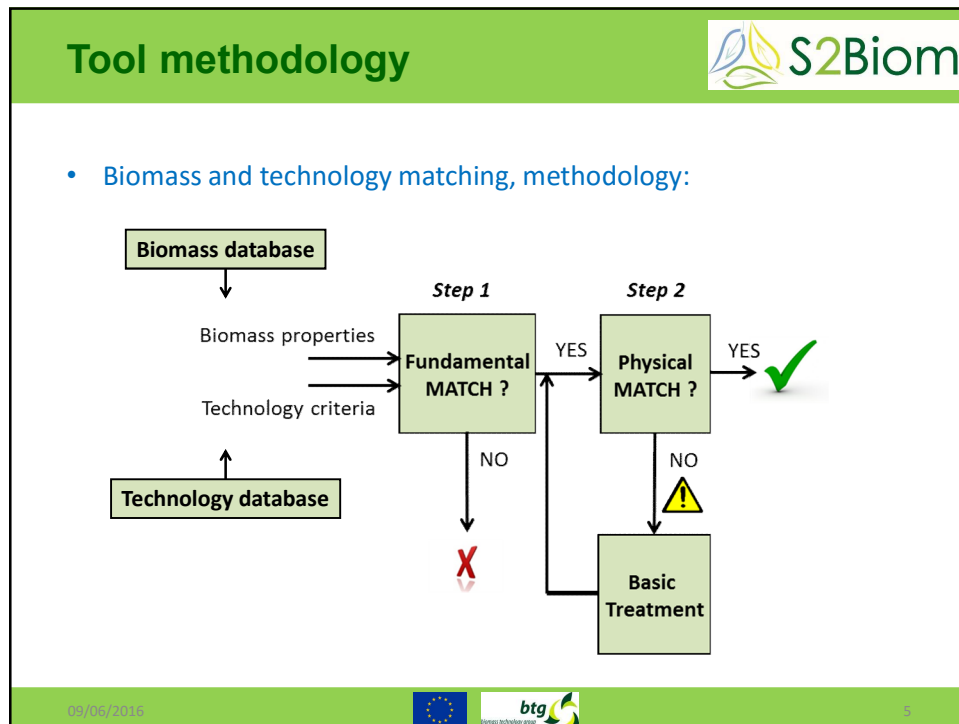


```

            graph TD
            A["Biomass feedstock type:  
- Thermal quality  
- (Bio-)chemical quality  
- Anaerobic quality"] --> B["Conversion process:  
- Thermal conversion  
- (Bio-)chemical conversion  
- Anaerobic digestion"]
            C["Basic treatment:  
- Drying  
- Compaction  
- Size reduction"] --> A
            C --> B
            
```

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

09/06/2016


4



Matching indicators



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

- **Biomass properties:**
 - Class 1: ideal biomass (e.g. very low ash content: < 1 wt-%)
 - Class 2: desirable biomass (e.g. low ash content: 1 - 3 wt-%)
 - Class 3: undesirable biomass (e.g. high ash content: 3 - 10 wt-%)
 - Class 4: very undesirable biomass (e.g. very high ash content: > 10 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.

09/06/2016



7

Technology database



- Database prepared by experts from within the consortium, based on information from literature and industry, containing for example:

➢ Description of operating principle	➢ Conversion efficiencies
➢ Level of commercial application	➢ Investment costs
➢ Technology Readiness Level	➢ Labour requirement
➢ Type and capacity of product output	➢ Feedstock quality criteria
- Technologies were divided into the following main categories:


➢ Direct combustion of solid biomass	➢ Techniques from pulp and paper industry
➢ Gasification technologies	➢ Chemical pretreatment
➢ Syngas platform	➢ Biochemical hydrolysis
➢ Fast pyrolysis	➢ Fermentation to ethanol and bio-based products
➢ Torrefaction	➢ Anaerobic digestion
➢ Treatment in subcritical water	
- Each category contains different subcategories, currently ~50 entries.

09/06/2016



8



Technology database




szbiom.altera.wur.nl/web/guest/conversion

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

09/06/2016


9

Technology database



View details of BFB for syngas

GENERAL PROPERTIES

Name: BFB for syngas
 Main category: Catalytic technologies
 Subcategory: Bubbling fluidized bed for syngas production
 Image url:
 Year of first implementation:
 Estimated number of systems in operation:
 Main operating principle:
 Biomass is gasified with steam and oxygen at pressurized BFB gasifier operated at ca. 8 bar and 670 °C. Product gas is cooled to 600 °C. Mixed and bed into catalytic reformer where tars and hydrocarbon gases are reformed. Then product gas is cleaned, conditioned and pressurized to fuel synthesis.

TECHNICAL PROPERTIES

Capacity of outputs (typical values)

Heat (MWth): 45
 Conversion efficiencies: net returns usable heat(SJ/GJ biomass input) typical: 0.15 min: 0 max: 0.2 typical in 2020: 0.1 typical in 2030: 0.1

Methanol (MWh/yr): 26 LHV (GJ / m³): 25.3
 Conversion efficiencies: net returns fuel(GJ/GJ biomass input) typical: 0.6 min: 0.5 max: 0.67 typical in 2020: 0.65 typical in 2030: 0.65

Data sources used to define conversion efficiencies in 2014: VTT Technology 91, 2013 Hannula, Bika & Kuitila, Eka, 2013. Liquid transportation fuels via large-scale fluidized-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 (MW): 5

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:
 Biomass input, technically possible but not common:

Traded form: Wood chips
 Dimensions: P31, 3, 15 mm < P < 31,5 mm Fine fraction F25 < 25 %
 Moisture content: (% wet basis) typical: 15 max: 20
 Minimum bulk density: (g/cm³, wet basis): 120
 Maximum ash content: (% dry basis): 5
 Minimum ash melting point (= initial deformation temperature) (°C): 1500
 Volatile matter (only for thermally treated material, torrefied or steam exploded) (%wt):
 Maximum allowable contents: Sulphur, S (%wt, dry): 0.3 Chlorine, Cl (%wt, dry): 0.3
 Nitrogen, N (%wt, dry):
 Investments costs: in 2014 (€): 50000000 expected in 2020 (€): 35000000 expected in 2030 (€): 35000000
 Operation (FTE): 25 Staff and engineering (FTE): 20

Level of commercial application

Important pilot and EU projects
 Expected Development:
 Current Technology Readiness Level in 2014: Level 7, Integrated pilot system demonstrated
 Expected Technology Readiness Level in 2030: Level 9, System ready for full scale deployment
 Justify expected Level in 2030:
 References:
 Carbon/Nestite:


Optional attributes

Net caloric value (MJ/kg) min max
 Gross caloric value (MJ/kg) min max
 Biogas yield (m³ gas/ton dry biomass) % methane
 Cellulose content (g/kg dry matter) min max
 Hemicellulose content (g/kg dry matter) min max
 Lignin content (g/kg dry matter) min max
 Glucan content (g/kg dry matter) min max
 Starch content (g/kg dry matter) min max
 Sugar content (g/kg dry matter) min max
 Fat content (g/kg dry matter) min max
 Protein content (g/kg dry matter) min max
 Acetyl group content (g/kg dry matter) min max



09/06/2016


10


Biomass properties database



- 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.

09/06/2016


13

Using Bio2Match



Select rows and columns

Columns - Biomass types

- Production from forests
- Primary residues from forests
- Primary production of lignocellulosic bi...
- Agricultural residues
 - Rice straw
 - Cereals straw
 - Oil seed rape straw
 - Maize stover
 - Sugarbeet leaves
 - Sunflower straw
- Grassland
- Other land use
- Secondary residues from wood industr...
 - Bark residues from pulp and paper...
 - Black liquor
 - Residues industries producing sem...
 - Residues from further woodproces...
 - Sawdust from sawmills from conifers...
 - Sawdust from sawmills from noncon...
 - Sawmill residues: excluding sawdus...
 - Sawmill residues: excluding sawdus...
- Secondary residues of industry utilis...
- Municipal waste
- Waste from wood

Rows - Conversion technologies

- Syngas platform
 - Syngas to FT-diesel (52)
 - Syngas to methanol (41)
 - Producer gas to biomethane (44)
- Gasification technologies
- Direct combustion of solid biomass
- Anaerobic digestion
 - Complete mix digester state of the ...
 - Dry Batch Digestion (M9V) (35)
- Biochemical treatment
 - Kraft process with LignoBoost (14)
 - Pnethydrolysis kraft (17)
 - Ethanol from lignocellulose (slute a...
- Torrefaction
- Treatment in subcritical water
- Fast pyrolysis
 - Pyrolysis oil diesel (40)
 - Fast pyrolysis + Multiple diesel com...
 - Fast pyrolysis + CHP plant, value ch...
 - Fast pyrolysis + Industrial steam bo...
 - Agricultural residues to pyrolysis oil...
 - Fast Pyrolysis of residues + Boiler fo...
 - Fast pyrolysis of residues + CHP pla...
 - Wood chips to pyrolysis oil (23)
 - Fast pyrolysis + Boiler for heat, valu...

Match

Name	Thinnings from conifer trees	Cereals straw	Bark
Agricultural residues to pyrolysis oil (24)	●	●	●
Complete mix digester state of the art 2014 (2)	●	●	●
Ethanol from lignocellulose (dilute acid pretreatm...	●	●	●
Grate boiler with agrobiomass for CHP (73)	●	●	●
Grate boiler with wood chips for CHP (33)	●	●	●
Syngas to methanol (41)	●	●	●

Matching overview for biomass type "Cereals straw" and conversion "Grate boiler with wood chips fo..."

Name	Group	Value
Ash content	Thermal conversion	●
Ash melting behavior (DT)	Thermal conversion	●
Bulk density, BD	Physical treatment	●
Chlorine content	Thermal conversion	●
Moisture content	Physical treatment	●
Nitrogen content	Thermal conversion	●

Matching characteristics

- Anaerobic digestion
- Biochemical treatment
- Physical treatment
- Thermal conversion

Product groups



- electricity
- biofuels and biobased products
- heat

Regions


- italy
- France

Legend

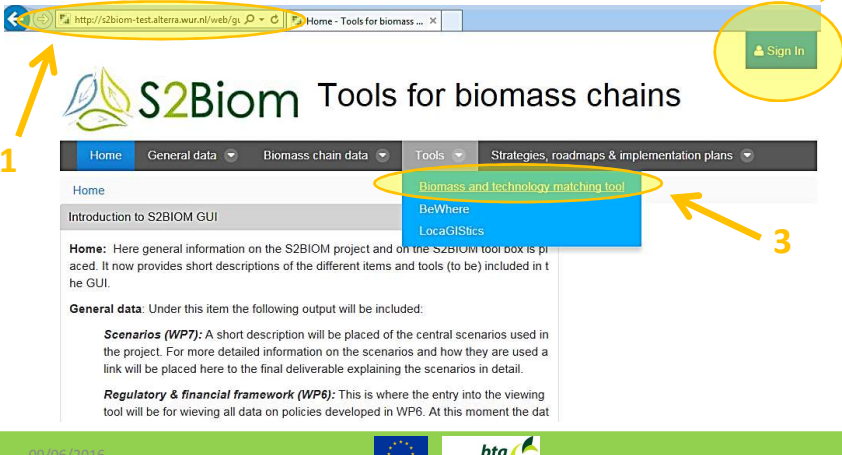
- Physical match
- ▲ Fundamental match, no phys...
- No match
- Not taken into consideration
- Missing data

09/06/2016


13

Work with Bio2Match




1. Go to www.biomass-tools.eu.
2. Sign in, using: screen name 'demo' and password 'helsinki'.
3. Click on 'Tools' – 'Bio2Match'.

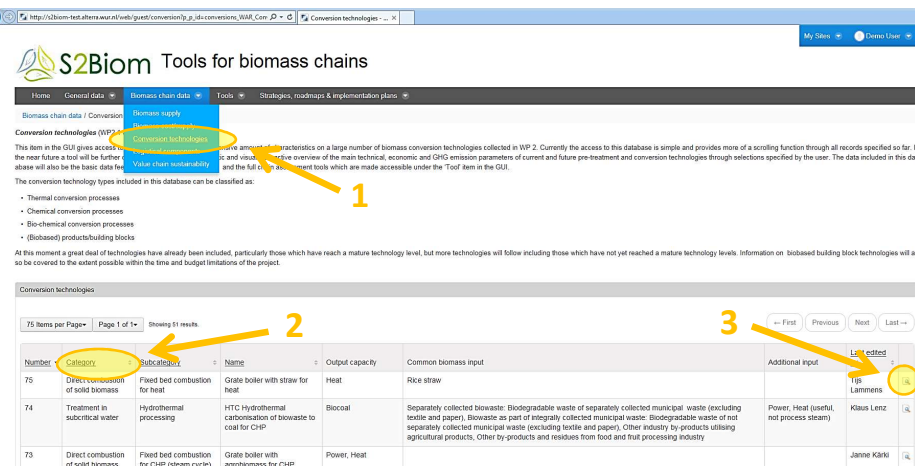


The screenshot shows the S2Biom website interface. The browser address bar displays the URL <http://s2biom-test.alpha.wur.nl/web/guest/>. A 'Sign In' button is circled in yellow. The main navigation menu includes 'Home', 'General data', 'Biomass chain data', 'Tools', and 'Strategies, roadmaps & implementation plans'. The 'Tools' dropdown menu is open, with 'Biomass and technology matching tool' highlighted in blue. The page content includes an introduction to S2BIOM GUI and sections for 'General data', 'Scenarios (WPT)', and 'Regulatory & financial framework (WPF)'. The footer shows the date '09/06/2016' and logos for the European Union and BTG.

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.



The screenshot shows the 'Conversion technologies' database page. The 'Biomass chain data' menu is selected, and the 'Conversion technologies' link is highlighted. The page contains a list of technologies with the following table:

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		Tij Lammen
74	Treatment in subcritical water	Hydrothermal processing	HTC Hydrothermal carbonisation of biomass 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 (open cycle)	Grate boiler with agglomeration for CHP	Power, Heat			Janne Käkki

The table shows 75 items per page, page 1 of 1, and 75 results. A 'Category' dropdown menu is highlighted, and a 'view' icon is circled in yellow. The footer contains the text: '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 level. Information on biobased building block technologies will also be covered to the extent possible within the time and budget limitations of the project.'

Discussion and feedback



What were your observations and 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?

09/06/2016



19



Thank you for your attention!

Tijs Lammens

BTG Biomass Technology Group B.V.

Contact details:

Lammens@btgworld.com

Tel: +31 (0)53 486 1186

www.btgworld.com



This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 608622. The sole responsibility of this publication lies with the author. The European Union is not responsible for any use that may be made of the information contained therein.