

# Bio2Match-tool

## User guide



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# Bio2Match tool

Bio2Match tool guides the user to the optimal match between biomass resources and conversion technologies. The conversion technologies have specific requirements for the biomass input while biomass varies widely in composition and characteristics.

The tool uses **2 databases** to find **an optimal match** for each biomass and technology.

One database consist of **technology criteria**, specific for each technology. The other database consist of **biomass characteristics**. The matching tool uses these databases to create an optimal match for each technology and biomass. This helps the user to find the most suitable combination to process biomass to certain end-products.

In the next slides one can see step by step how to select the conversion technologies and biomass, the matching overview and the details of the matches and no-matches.

Bio2Match tool is developed by BTG Biomass Technology Group and Wageningen University and Research. The tool is first released in S2Biom-project and upgraded further in MAGIC-project.

The tool is available at: <http://magic-h2020.eu/bio2match-tool/>



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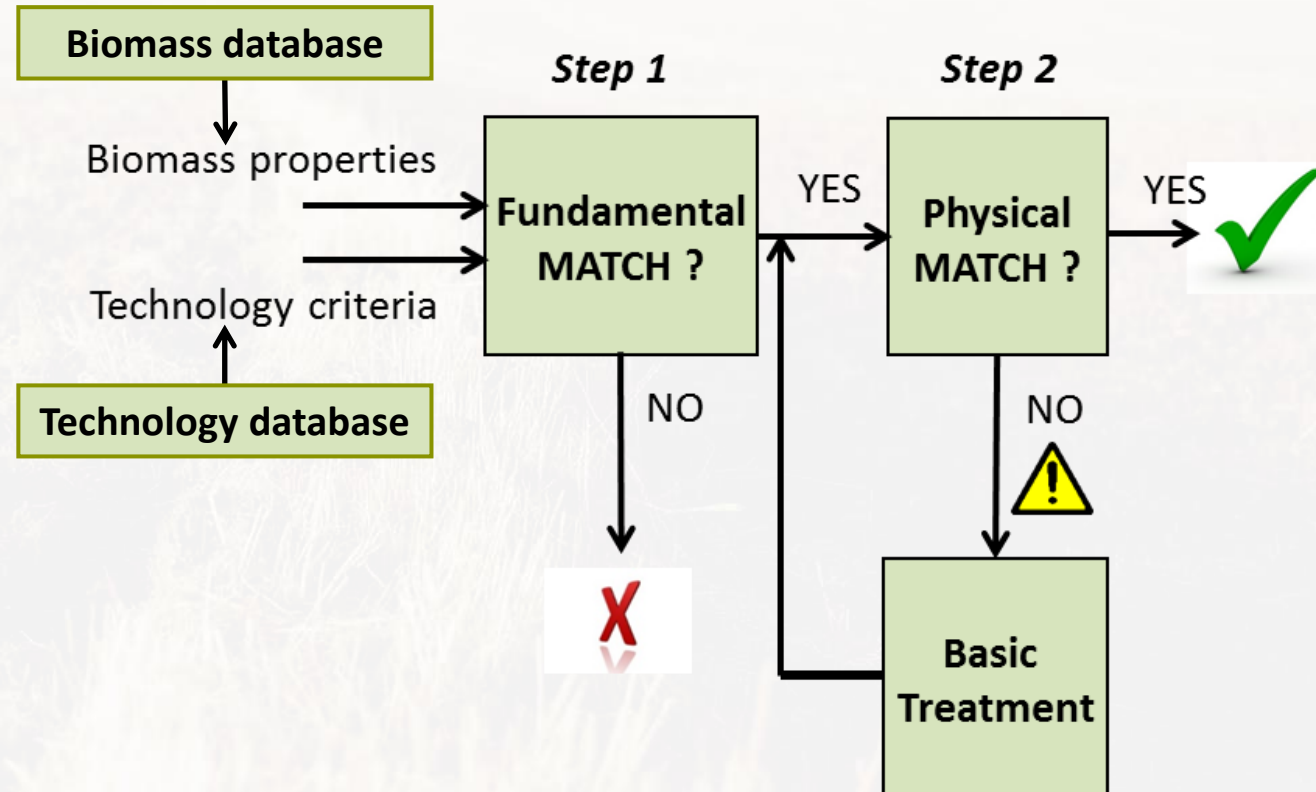
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# Working principle of the tool

- The tool will use biomass properties and the technology criteria to make a match.
- If there is a fundamental match, the conversion can be carried out.
- In case there is no physical match a pre-treatment, such as drying, can be carried out to make the conversion possible.
- The tool allows to search and review several biomass types and conversion technologies at one glance.



## Getting started

Below is the tool window as user will see it when starting. On the most left are **Conversion technology** categories in the tool (1). Next to it are **Biomass types** (2).

Select rows and columns

Switch rows and columns

Columns - Conversion technologies

- Syngas platform
- Extraction of fibers
- Oleochemical processing
- Direct combustion of solid biomass
- Anaerobic digestion
- Biochemical treatment
- Torrefaction
- Extraction of protein
- Treatment in subcritical water
- Fast pyrolysis
- Gasification technologies

1.

Rows - Biomass types

- Production from forests
- Primary residues from forests
- Primary production of lignocellulosic bio...
- Agricultural residues
- Grassland
- Other land use
- Secondary residues from wood industries
- Secondary residues of industry utilising ...
- Municipal waste
- Waste from wood
- Oil from oil crops
- Multipurpose crops

2.

Match

Name	Syngas to methanol (41)	Producer gas to biomethane (44)	Syngas to FT-diesel (52)
Final fellings from nonconifer trees			
Final fellings from conifer trees			
Thinnings from nonconifer trees			
Thinnings from conifer trees			

Matching characteristics

- Anaerobic digestion
- Biochemical treatment
- Extraction of fibers
- Extraction of protein
- Oleochemical processing
- Physical treatment
- Thermal conversion

Product groups

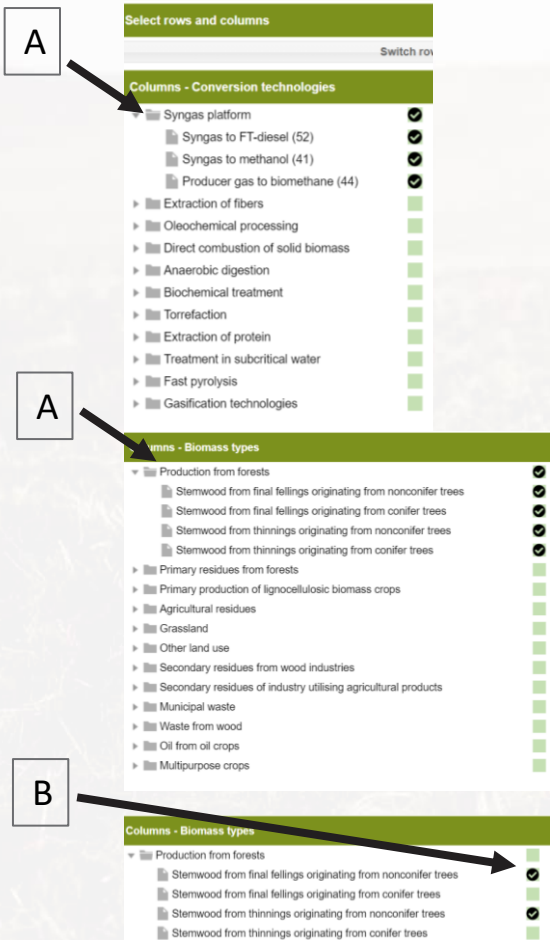
- heat
- electricity
- biofuels and biobased products

Matching overview

Name	Group
------	-------

Legend

- Physical match
- Fundamental match, no physical match
- No match
- Not taken into consideration
- Missing data



## Making the selection

A) By clicking each group, one can see all the possible conversion technologies/biomass types under the category.

For example: under Syngas platform one can see three different conversion options. Under Production from forests, all this type of biomass in the database is shown.

B) One can select the whole group, like in the top two figures, or select only some of them for the comparison.

## Looking at the Match overview

When one has selected the conversion technology and the biomass types of interest, the match is shown in the middle in the **Match** box (3). The green mark indicates **a match** and the red cross indicates **a no-match**.

The characteristics that are taken into account for the matching are shown in box (4). By default all of them, except *Physical treatment* is selected. This is explained in more detail in the next slide.

When one selects one of the **match/no-match** (box 3), **Matching overview** (5) shows an explanation.

The symbols used in the tool are shown in the **Legend** box (6). One can filter out their desired product in the **Product groups** box (7). This selection removes the conversion technologies from the selection that do not produce this product.

Select rows and columns

Switch rows and columns

Columns - Conversion technologies

- Syngas platform
- Extraction of fibers
- Oleochemical processing
- Direct combustion of solid biomass
- Anaerobic digestion
- Biochemical treatment
- Torrefaction
- Extraction of protein
- Treatment in subcritical water
- Fast pyrolysis
  - Fast pyrolysis of thermochemical fraction...
  - Fast pyrolysis of thermochemical fraction...
  - Pyrolysis of diesel (40)
  - Co-processing of PPBO in FCC (76)
  - Fast pyrolysis + Multiple diesel combust...
  - Fast pyrolysis of clean wood (23)
  - Residues pyrolysis + Boiler for heat, valu...
  - Residues pyrolysis + CHP plant, value ch...
  - Fast pyrolysis + Boiler for heat, value ch...
  - Fast pyrolysis of residues (24)
  - Fast pyrolysis + Industrial steam boiler, v...
  - Fast pyrolysis + CHP plant, value chain e...
- Gasification technologies

Rows - Biomass types

- Production from forests
- Primary residues from forests
  - Logging residues from final fellings origin...
  - Logging residues from final fellings origin...
  - Logging residues from thinnings from re...
  - Logging residues from thinnings from con...
  - Stumps from final fellings originating from...
  - Stumps from final fellings originating from...
- Primary production of lignocellulosic biomas...
- SRC Willow
- SRC Poplar
- Other SRC
- SRC Black Locust
- SRC Siberian Elm from marginal lands
- Sorghum
- Miscanthus (Perennial grass)
- Switchgrass (Perennial grass)
- Giant reed (Perennial grass)
- Cardoon (Perennial crop)
- Reed Canary Grass (Perennial grass)
- Tall Wheatgrass from marginal lands
- African fodder cane from marginal lands
- Agricultural residues
  - Rice straw
  - Cereals straw
  - Oil seed rape straw
  - Maize stover
  - Sugarbeet leaves
  - Sunflower straw
  - Residues from vineyards
  - Residues from fruit tree plantations (appl...
  - Residues from olive tree plantations
  - Residues from citrus tree plantations
  - Residues from nuts plantations
- Grassland
- Other land use
- Secondary residues from wood industries
- Secondary residues of industry utilising agric...
- Municipal waste
  - Waste from wood
  - Oil from oil crops
  - Multipurpose crops

Match

Name

Fast pyrolysis of clean wood (23)

Fast pyrolysis of residues (24)

Logging residues from final fellings from nonconifer trees

Miscanthus

Tall Wheatgrass from marginal lands

Maize stover

Matching characteristics

- Anaerobic digestion
- Biochemical treatment
- Extraction of fibers
- Extraction of protein
- Oleochemical processing
- Physical treatment
- Thermal conversion

Product groups

- heat
- electricity
- biofuels and biobased products

Legend

- Physical match
- Fundamental match, no physical match
- No match
- Not taken into consideration
- Missing data

Matching overview for biomass type "Tall Wheatgrass from marginal lands" and conversion "Fast pyrolysis of residues (24)"

Name

Group

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

## Details of the Match 1/2

The matching is taking into account the fundamental and physical properties of the biomass. Fundamental properties are properties that cannot be affected after harvesting these are, for example, ash content, ash melting behaviour, chlorine and nitrogen content. Physical properties are the density and moisture content, which can be influenced by a pre-treatment of the biomass. For example, to make too moist biomass suitable to be processed by drying.

In **Matching characteristics** (4), *Physical properties* is by default un-selected. This way the user always has the fundamental match shown. First the match/no-match concept is explained with this setting.

### Match

**Matching overview** (5) shows all the criteria taken into account for the match. In the selected case the following fundamental properties constitute to the match:

- Ash content
- Ash Melting behaviour (DT)
- Chlorine content
- Nitrogen content

The green marker appears in top of the green box (see black circle) for indication that the biomass properties are matching with the technology criteria in a specific range or class. These are explained in more detail on page 10.

As *Physical properties* (\*) are not selected in **Matching characteristics** (4), these are not taken into account and the marker is grey, as described in the **Legend**.

### No-match

In this case, same properties are taken into account as for above. **Matching overview** (5) shows that the reason for excluding the biomass (*Tall wheatgrass from marginal lands*) is because the *Ash content* is too high. *Ash content* is a fundamental property and therefore it results in a no-match.

**4.**

**Matching characteristics**

- > Anaerobic digestion
- > Biochemical treatment
- > Extraction of fibers
- > Extraction of protein
- > Oleochemical processing
- > Physical treatment
- > Thermal conversion

**Match**

Name	Fast pyrolysis of clean wood (23)	Fast pyrolysis of residues (24)
Logging residues from final fellings from nonconifer trees	✓	✓
Miscanthus	✓	✓
Tall Wheatgrass from marginal lands	✗	✓
Maize stover	✓	✓

**5.**

**Matching overview for biomass type "Logging residues from final fellings originating from nonconifer trees" and conversion "Fast pyrolysis of residues (24)"**

Name	Group	Thermal conversion	Physical treatment
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	✓	✓

**6.**

**Legend**

- ✓ Physical match
- ⚠ Fundamental match, no physical match
- ✗ No match
- ⊖ Not taken into consideration
- ⚪ Missing data

**No-match**

**3.**

Name	Fast pyrolysis of clean wood (23)	Fast pyrolysis of residues (24)
Logging residues from final fellings from nonconifer trees	✓	✓
Miscanthus	✓	✓
Tall Wheatgrass from marginal lands	✗	✓
Maize stover	✓	✓

**5.**

**Matching overview for biomass type "Tall Wheatgrass from marginal lands" and conversion "Fast pyrolysis of residues (24)"**

Name	Group	Thermal conversion	Physical treatment
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	✓	✓



## Details of the Match 2/2

Here the difference between fundamental match and physical match is explained.

For this example, another technology (*Ethanol from lignocellulose*) is chosen in the **Conversion technology** (1), the biomass selection remains the same. As by default the *Physical properties* (\*) in the **Matching characteristics** (4) is not selected. And the **Match** box (3) shows all combinations matching.

**Matching overview** (5) shows also that *Physical treatment* is grey (not taken into account).

**Matching characteristics**

- ☒ Anaerobic digestion
- ☒ Biochemical treatment
- ☒ Extraction of fibers
- ☒ Extraction of protein
- ☒ Oleochemical processing
- ☒ Physical treatment
- ☒ Thermal conversion

**Group**

Group	Conversion technology	Biomass types	Physical properties
Biochemical treatment	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Physical treatment	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Biochemical treatment	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Biochemical treatment	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Physical treatment	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

When selecting the *Physical properties* (\*) in the **Matching characteristics** (4) one can see that the overview changes (see the figure on the right).

**Matching characteristics**

- ☒ Anaerobic digestion
- ☒ Biochemical treatment
- ☒ Extraction of fibers
- ☒ Extraction of protein
- ☒ Oleochemical processing
- ☒ Physical treatment
- ☒ Thermal conversion

A triangle appears where a match was indicated in the **Match** box (3). This indicates that fundamental match is possible, but physical match is not. The **Matching overview** (5) has changed now also. A grey marker for *Bulk density* has turned green (arrow a). For *Moisture content* the triangle has appeared (arrow b) meaning that it is too high and the biomass needs a pre-treatment (drying) and therefore, there is no physical match.

**Group**

Group	Conversion technology	Biomass types	Physical properties
Biochemical treatment	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Physical treatment	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Biochemical treatment	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Biochemical treatment	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Physical treatment	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

**Select rows and columns**

**Columns - Conversion technologies**

- ☒ Bio Syngas platform
- ☒ Bio Extraction of fibers
- ☒ Bio Oleochemical processing
- ☒ Bio Direct contribution of solid biomass
- ☒ Bio Anaerobic digestion
- ☒ Bio Biochemical treatment
- ☒ Kraft process with Lignocellulose (16)
- ☒ Phenolysis Kraft (17)
- ☒ Ethanol from Lignocellulose (dilat. acid)
- ☒ Bio Torrefaction
- ☒ Bio Extraction of protein
- ☒ Bio Treatment in subcritical water
- ☒ Bio Fast pyrolysis
- ☒ Bio Gasification technologies

**Rows - Biomass types**

- ☒ Bio Production from forests
- ☒ Bio Primary residues from forests
- ☒ Logging residues from final fellings on...
- ☒ Logging residues from thinning from ...
- ☒ Logging residues from thinning from ...
- ☒ Stumps from final fellings originating f...
- ☒ Stumps from final fellings originating f...
- ☒ Bio Primary production of lignocellulose from...
- ☒ Bio SRC Willow
- ☒ Bio SRC Poplar
- ☒ Bio Other SRC
- ☒ Bio SRC Black Locust
- ☒ Bio SRC Eucalyptus from marginal lands
- ☒ Bio SRC
- ☒ Miscanthus (Perennial grass)
- ☒ Sorghum (Perennial grass)
- ☒ Giant reed (Perennial grass)
- ☒ Carbon (Perennial crop)
- ☒ Reed Canary Grass (Perennial grass)
- ☒ Tall Wheatgrass from marginal lands
- ☒ African fodder cane from marginal lands
- ☒ Bio Agricultural residues
- ☒ Rice straw
- ☒ Cereals straw
- ☒ Oil seed rape straw
- ☒ Maize straw
- ☒ Sugarbeet leaves
- ☒ Sunflower straw
- ☒ Residues from vineyards
- ☒ Residues from fruit tree plantations (a...
- ☒ Residues from olive tree plantations
- ☒ Residues from olive tree plantations
- ☒ Residues from olive tree plantations
- ☒ Bio Grassland
- ☒ Bio Other land use
- ☒ Bio Secondary residues from wood industries
- ☒ Bio Secondary residues of industry cutting a...
- ☒ Bio Municipal waste
- ☒ Bio Waste from wood
- ☒ Bio Oil from oil crops
- ☒ Bio Mulch/crop crops

**Match**

Logging residues from final fellings from non-cropper trees

Miscanthus

African fodder cane from marginal lands

Maize straw

**Matching overview for biomass type "Logging residues from final fellings originating from non-cropper trees" and conversion "Ethanol from Lignocellulose (dilat. acid pre-treatment), value chain example (30)"**

Name	Group
Ash content	Biochemical treatment
Bulk density, BD	Physical treatment
Carbohydrate (cellulose + hemicellulose)	Biochemical treatment
Content of lignin	Biochemical treatment
Moisture content	Physical treatment

**Matching characteristics**

- ☒ Bio Anaerobic digestion
- ☒ Bio Biochemical treatment
- ☒ Bio Extraction of fibers
- ☒ Bio Oleochemical processing
- ☒ Bio Physical treatment
- ☒ Bio Thermal conversion

**Product groups**

heat

electricity

biofuels and bio-based products

**Legend**

- ☒ Physical match
- ☒ Fundamental match, no physical match
- ☒ No match
- ☒ Not taken into consideration
- ☒ Missing data

**Select rows and columns**

**Columns - Conversion technologies**

- ☒ Bio Syngas platform
- ☒ Bio Extraction of fibers
- ☒ Bio Oleochemical processing
- ☒ Bio Direct contribution of solid biomass
- ☒ Bio Anaerobic digestion
- ☒ Bio Biochemical treatment
- ☒ Kraft process with Lignocellulose (16)
- ☒ Phenolysis Kraft (17)
- ☒ Ethanol from Lignocellulose (dilat. acid)
- ☒ Bio Torrefaction
- ☒ Bio Extraction of protein
- ☒ Bio Treatment in subcritical water
- ☒ Bio Fast pyrolysis
- ☒ Bio Gasification technologies

**Rows - Biomass types**

- ☒ Bio Production from forests
- ☒ Bio Primary residues from forests
- ☒ Logging residues from final fellings on...
- ☒ Logging residues from thinning from ...
- ☒ Logging residues from thinning from ...
- ☒ Stumps from final fellings originating f...
- ☒ Stumps from final fellings originating f...
- ☒ Bio Primary production of lignocellulose from...
- ☒ Bio SRC Willow
- ☒ Bio SRC Poplar
- ☒ Bio Other SRC
- ☒ Bio SRC Black Locust
- ☒ Bio SRC Eucalyptus from marginal lands
- ☒ Bio SRC
- ☒ Miscanthus (Perennial grass)
- ☒ Sorghum (Perennial grass)
- ☒ Giant reed (Perennial grass)
- ☒ Carbon (Perennial crop)
- ☒ Reed Canary Grass (Perennial grass)
- ☒ Tall Wheatgrass from marginal lands
- ☒ African fodder cane from marginal lands
- ☒ Bio Agricultural residues
- ☒ Rice straw
- ☒ Cereals straw
- ☒ Oil seed rape straw
- ☒ Maize straw
- ☒ Sugarbeet leaves
- ☒ Sunflower straw
- ☒ Residues from vineyards
- ☒ Residues from fruit tree plantations (a...
- ☒ Residues from olive tree plantations
- ☒ Residues from olive tree plantations
- ☒ Residues from olive tree plantations
- ☒ Bio Grassland
- ☒ Bio Other land use
- ☒ Bio Secondary residues from wood industries
- ☒ Bio Secondary residues of industry cutting a...
- ☒ Bio Municipal waste
- ☒ Bio Waste from wood
- ☒ Bio Oil from oil crops
- ☒ Bio Mulch/crop crops

**Match**

Logging residues from final fellings from non-cropper trees

Miscanthus

African fodder cane from marginal lands

Maize straw

**Matching overview for biomass type "Logging residues from final fellings originating from non-cropper trees" and conversion "Ethanol from Lignocellulose (dilat. acid pre-treatment), value chain example (30)"**

Name	Group
Ash content	Biochemical treatment
Bulk density, BD	Physical treatment
Carbohydrate (cellulose + hemicellulose)	Biochemical treatment
Content of lignin	Biochemical treatment
Moisture content	Physical treatment

**Matching characteristics**

- ☒ Bio Anaerobic digestion
- ☒ Bio Biochemical treatment
- ☒ Bio Extraction of fibers
- ☒ Bio Oleochemical processing
- ☒ Bio Physical treatment
- ☒ Bio Thermal conversion

**Product groups**

heat

electricity

biofuels and bio-based products

**Legend**

- ☒ Physical match
- ☒ Fundamental match, no physical match
- ☒ No match
- ☒ Not taken into consideration
- ☒ Missing data

## More information about the matching criteria and the matches

It is possible to get more insights from the tool on the matching criteria and biomass suitability for each conversion technology. This can be found in the **Matching overview** (5) box. By clicking the arrow pointed at (a), one can open a dropdown menu. By clicking *Columns*, one can select more information for the **Matching overview** (5) box.

In this example (**Matching overview** (5A)), the following are shown:

- **Unit**
  - Shows the units used for the data. If the data is classified, the ranges for each class are described. For example, *Ash content* is classified as follows: Class 1:  $\geq 1$  w-% dry, Class 2: 1-3 1 w-% dry, Class 3: 3-10 w-% dry, Class 4:  $>10$  w-% dry.
- **Actual**
  - Shows the actual property for the biomass. For example, *Bulk density, DB* is 250 kg/m<sup>3</sup> as received. If the criteria is classified, it shows the class the biomass belongs to. This is also indicated by the position of the green marker over the boxes. Please see the red box in *Carbohydrate (cellulose + hemicellulose)* group.
- **Technology demand**
  - Shows the requirement for the technology. For example, for *Bulk density, DB* this is 100 kg/m<sup>3</sup> as received. The number of green boxes shows the classes that the technology allows. Please see the black box over *Ash content* group.

The meaning of the other options (not shown) in the drop down menu are:

- **Best, Worst**
  - The best and worst-case values of the biomass properties.
- **Treatment**
  - The pre-treatment needed when physical match is not possible.
- **Match**
  - Shows the match or no-match for each characteristic.

5.

a

b

5A.

Name	Group	
Ash content	Biochemical treatment	
Bulk density, BD	Physical treatment	
Carbohydrate (cellulose + hemicellulose)	Biochemical treatment	
Content of lignin	Biochemical treatment	
Moisture content	Physical treatment	

Name	Group	Unit	Actual	Technology demand
Ash content	Biochemical treatment	Classes 1: $\leq 1$ ; 2: 1-3; 3: 3-10; 4: $>10$ w-% dry.	3	3
Bulk density, BD	Physical treatment	kg/m <sup>3</sup> ar	250	100
Carbohydrate (cellulose + hemicellulose)	Biochemical treatment	Classes 1: $\geq 65$ ; 2: 65-50; 3: 50-30; 4: $<30$ w-% dry.	1	2
Content of lignin	Biochemical treatment	Classes 1: $\leq 100$ ; 2: 100-250; 3: 250-350; 4: $>350$ g/kg.	2	2
Moisture content	Physical treatment	w-% ar	48.3	25

# Final remarks

- The tool is available on the MAGIC website: <http://magic-h2020.eu/bio2match-tool/>
- On this webpage a short tutorial for the tool is available.
- The biomass database and the technology database are downloadable on this webpage.
- Background photo by [Siebe Warmoeskerken](#) on [Unsplash](#).