

# 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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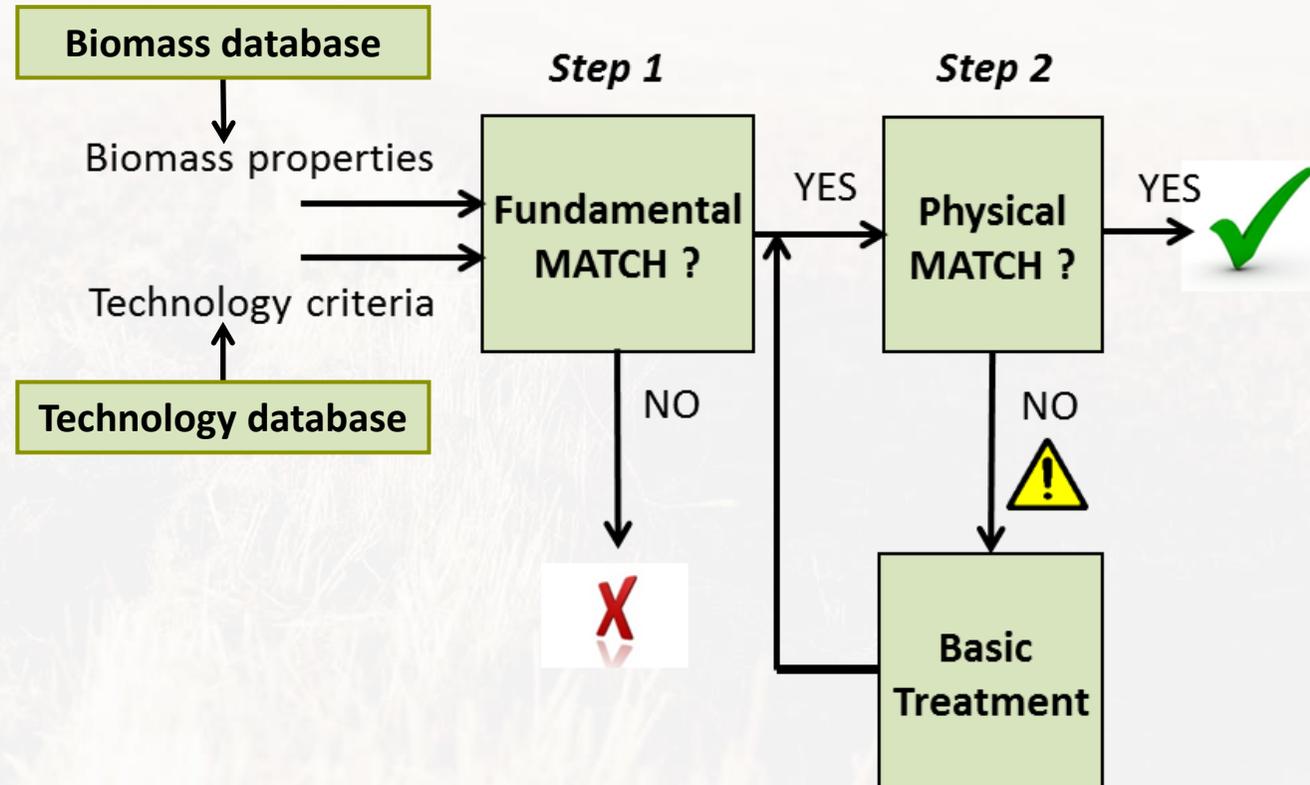
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# Working principle of the tool

- 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**

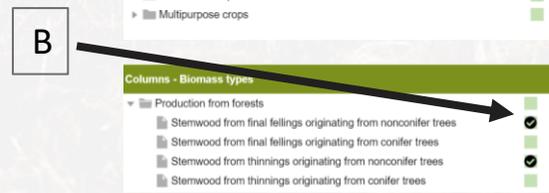
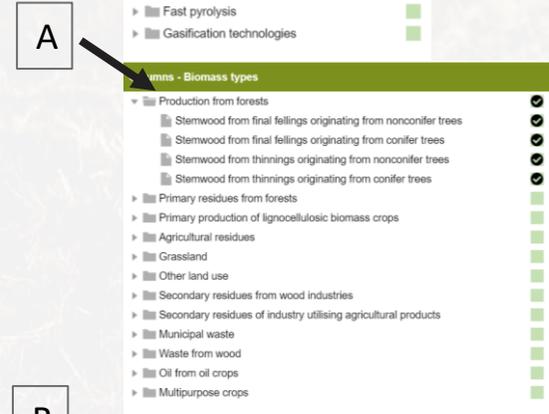
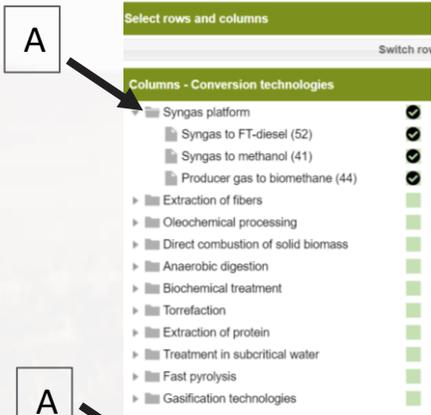
- heat
- electricity
- biofuels and biobased products

**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.

The screenshot displays the Bio2Match tool interface with several key components:

- 1. Select rows and columns:** A panel with two columns: "Columns - Conversion technologies" and "Rows - Biomass types". Both columns contain a list of items with green checkmarks indicating they are selected.
- 2. Match:** A central table showing the match between selected biomass types and conversion technologies. The table has columns for "Name", "Fast pyrolysis of clean wood (23)", and "Fast pyrolysis of residues (24)". The row for "Tall Wheatgrass from marginal lands" and "Fast pyrolysis of residues (24)" is highlighted in blue, with a green checkmark in the "Fast pyrolysis of residues (24)" column, indicating a match.
- 3. Matching characteristics:** A panel on the right showing a list of characteristics with green checkmarks, indicating they are selected for matching.
- 4. Product groups:** A panel on the right showing a list of product groups with green checkmarks, indicating they are selected for filtering.
- 5. Legend:** A panel on the right showing a list of symbols used in the tool, including a green checkmark for "Physical match", a red cross for "No match", a grey circle for "Not taken into consideration", and a blue circle for "Missing data".
- 6. Matching overview for biomass type "Tall Wheatgrass from marginal lands" and conversion "Fast pyrolysis of residues (24)":** A table showing the match between the selected biomass type and conversion technology. The table has columns for "Name", "Group", and "Match". The row for "Ash content" and "Thermal conversion" is highlighted in blue, with a green checkmark in the "Match" column, indicating a match.
- 7. Legend:** A panel on the right showing a list of symbols used in the tool, including a green checkmark for "Physical match", a red cross for "No match", a grey circle for "Not taken into consideration", and a blue circle for "Missing data".

## 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	Match
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**

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	Match
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).

This screenshot shows the 'Matching characteristics' panel (4) with 'Physical treatment' selected. Below it, the 'Matching overview' (5) shows a grid of bars for different groups and treatments. The 'Physical treatment' bar is greyed out, while the 'Biochemical treatment' bars are active.

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

This screenshot shows the 'Matching characteristics' panel (4) with 'Physical treatment' and 'Physical properties' selected. The 'Physical properties' checkbox is checked, and the 'Physical treatment' bar in the overview below is now active (green).

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.

This screenshot shows the 'Matching overview' (5) with 'Physical properties' selected. The 'Bulk density' bar is now green (arrow a), and the 'Moisture content' bar has a warning triangle (arrow b). The 'Physical treatment' bar is now active.

This screenshot shows the full software interface. Panel 1: Conversion technologies. Panel 2: Biomass types. Panel 3: Match box showing various biomass types and their matches. Panel 4: Matching characteristics with 'Physical treatment' and 'Physical properties' selected. Panel 5: Matching overview showing the impact of selecting physical properties on the match results.

This screenshot shows the full software interface with 'Physical properties' selected. Panel 3: Match box shows a warning triangle for 'Moisture content'. Panel 4: Matching characteristics shows 'Physical properties' selected. Panel 5: Matching overview shows 'Bulk density' as green and 'Moisture content' with a warning triangle.

## 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 1w-% 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.

Matching overview for biomass type "Logging residues from final fellings originating from nonconifer trees" and conversion "Ethanol from lignocellulose (dilute acid pretreatment), value chain example (65)"

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

Matching overview for biomass type "Logging residues from final fellings originating from nonconifer trees" and conversion "Ethanol from lignocellulose (dilute acid pretreatment), value chain example (65)"

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](#).