S2Biom

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

S2Biom summer school, Athens, Greece, 17-20 May, 2016

Bio2Match: A Tool for Matching Biomass and Conversion Technologies

Dr. T.M. Lammens

btg biomass technology group

ALTERRA WAGENINGEN UR




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.

Contents

- 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

Introduction

- 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.

Introduction

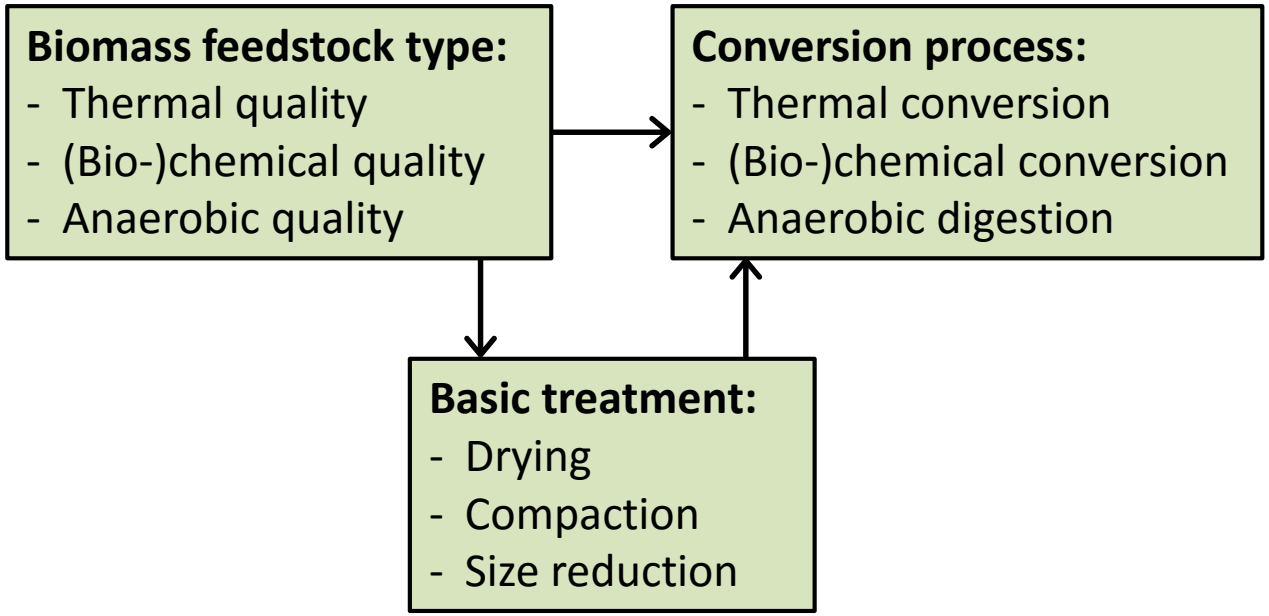
- Bio2Match should help stakeholders in the bio-economy to find feasible and logical combinations of lignocellulosic biomass and technologies.

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?
  - …
  - …
  - …

Tool methodology

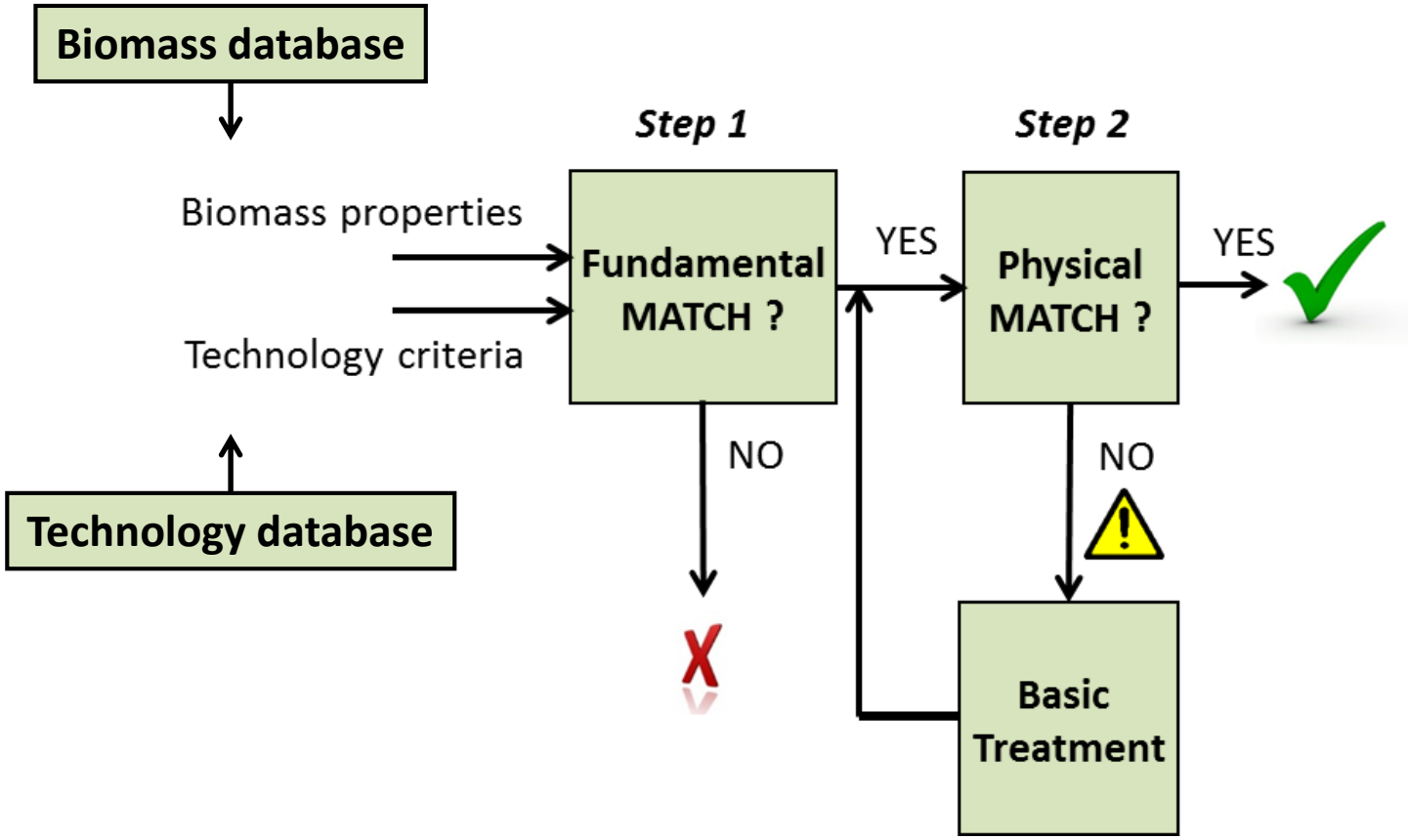
- Biomass and technology matching, classification system:



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

Tool methodology

- Biomass and technology matching, methodology:



Matching indicators

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)

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: < 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.

Technology database

- 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

Technology database

View details of BFB for syngas

GENERAL PROPERTIES

Name	BFB for syngas	Level of commercial application	
Main category	Gasification technologies	Important pilots and EU projects	
Subcategory	Bubbling fluidized bed for syngas production	Expected Developments	
Image url		Current Technology Readiness Level in 2014	Level 7, Integrated pilot system demonstrated
Year of first implementation		Expected Technology Readiness Level in 2030	Level 9, System ready for full scale deployment
Estimated number of systems in operation		Justify expected Level in 2030	
Main operating principle:		References:	
Biomass is gasified with steam and oxygen at pressurised BFB gasifier operated at ca. 8 bar and 870 C. 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.		Carbona/Andritz	

TECHNICAL PROPERTIES

Capacity of outputs (typical values)

Heat	(MWth) 45					
Conversion efficiencies: net returns usable heat(GJ/GJ biomass input)		typical: 0.15	min: 0	max: 0.2	typical in 2020: 0.1	typical in 2030: 0.1
Methanol	(m3/hour) 26	LHV (GJ / m^3) 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, 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

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

Data sources used to define conversion efficiencies in 2020:

Data sources used to define conversion efficiencies in 2030:

General data sources for technical properties:

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	
Minimal bulk density		(kg/m^3, wet basis) 120	
Maximum ash content		(% dry basis) 5	
Minimal ash melting point (= initial deformation temperature)		(°C) 1000	
Volatile matter (only for thermally trated material, torrefied or steam explosed)		(VM%)	

Maximum allowable contents

Nitrogen, N (wt%, dry) 1 Sulphur, S (wt%, dry) 0.3 Chlorine, Cl (wt%, dry) 0.3

Optional attributes

Net caloric value	(MJ/kg) min	max
Gross caloric value	(MJ/kg) min	max
Biogas yield	(m^3 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
Crude fibre 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

FINANCIAL AND ECONOMIC PROPERTIES

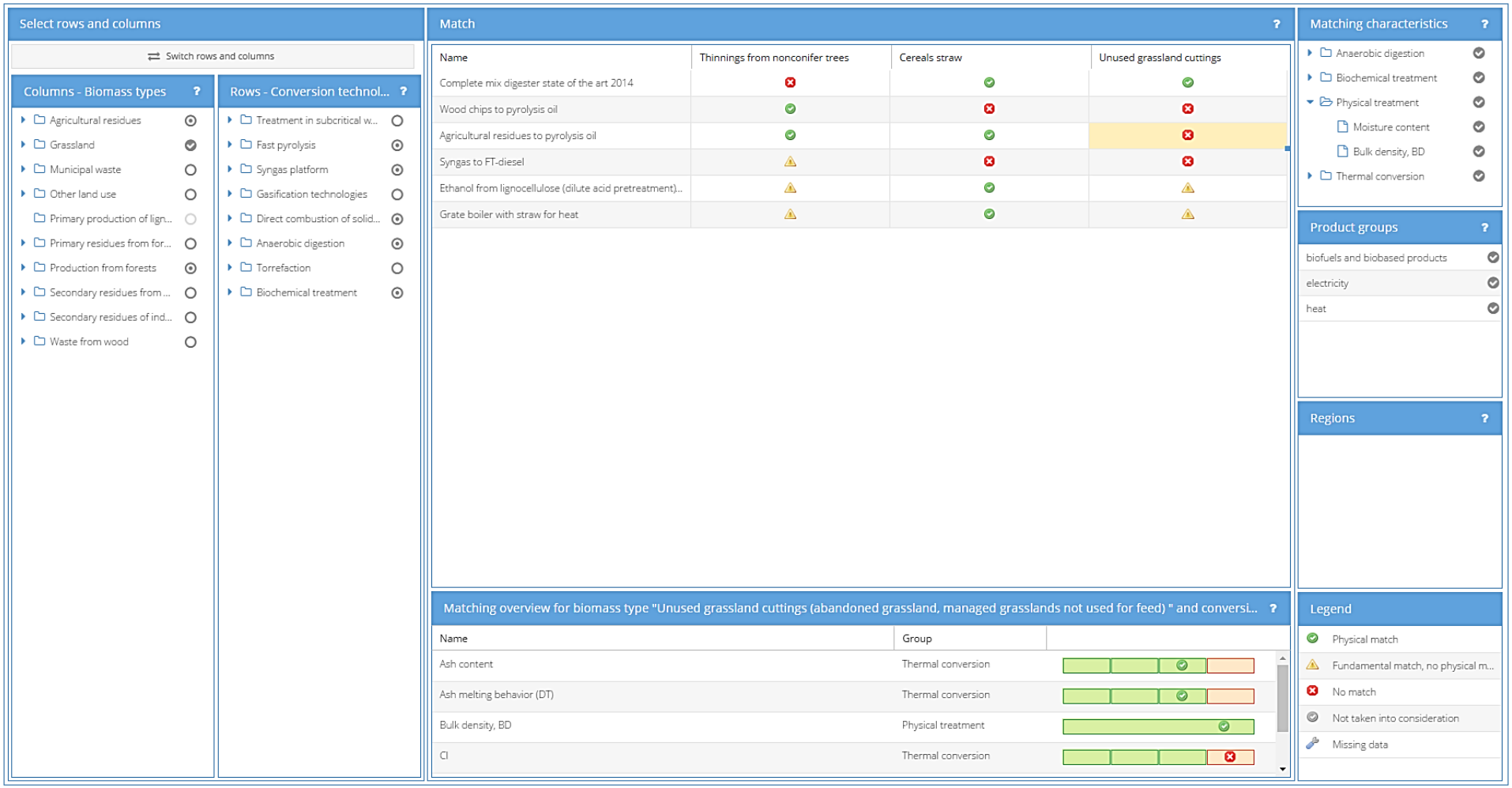
	in 2014 (€):	expected in 2020 (€):	expected in 2030 (€):
Investments costs	500000000	350000000	350000000

Labour needed: Operators (FTE): 25 Staff and engineering (FTE): 20

Biomass properties database

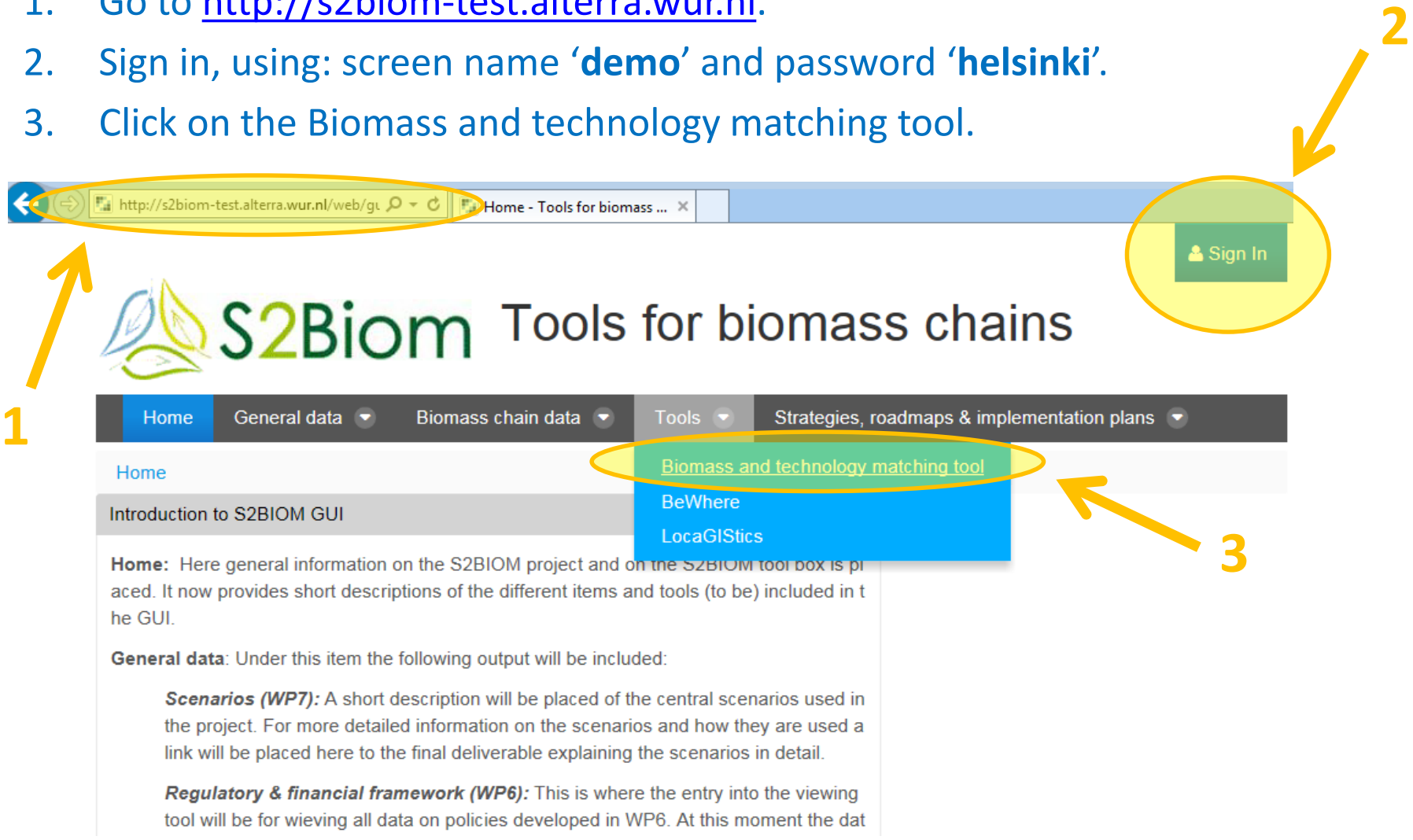
- Database prepared by experts from within the consortium, based on literature, containing 50 entries in the following categories:
  - Forestry biomass: - Primary forestry products
    - Primary forestry residues
  - Agricultural biomass: - Primary production of lignocellulosic crops
    - Agricultural 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.

Using Bio2Match



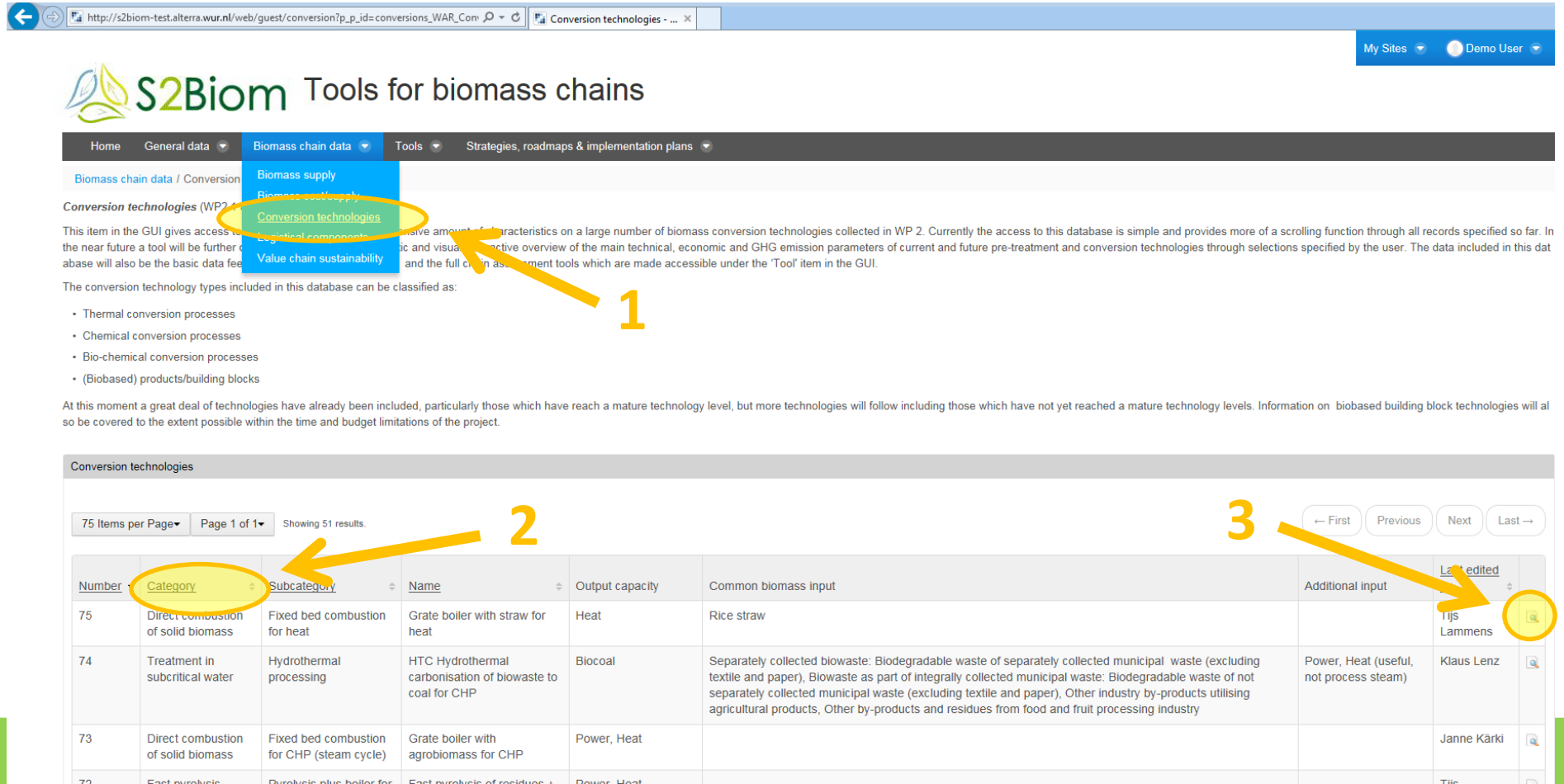
Work with Bio2Match

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.



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.



Discussion

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!

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.

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	*^{o}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