S2BIOM WP2:
Biomass & Conversion Technology Matching

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Matching Biomass & Technology

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Introduction WP2 - in short

- WP2.1: selection and characterization of conversion technologies (Lead BTG).
- WP2.2: linking quality of biomass with input requirements conversion technology (Lead VTT, DLO).
- WP2.3: model optimal match between biomass type and conversion technology, for instance to achieve maximum level of biomass utilization in the EU28 (Lead BTG).
- Partners involved: BTG (Lead), DLO, VTT, ECN, FNR, IINAS, SYNCOM.

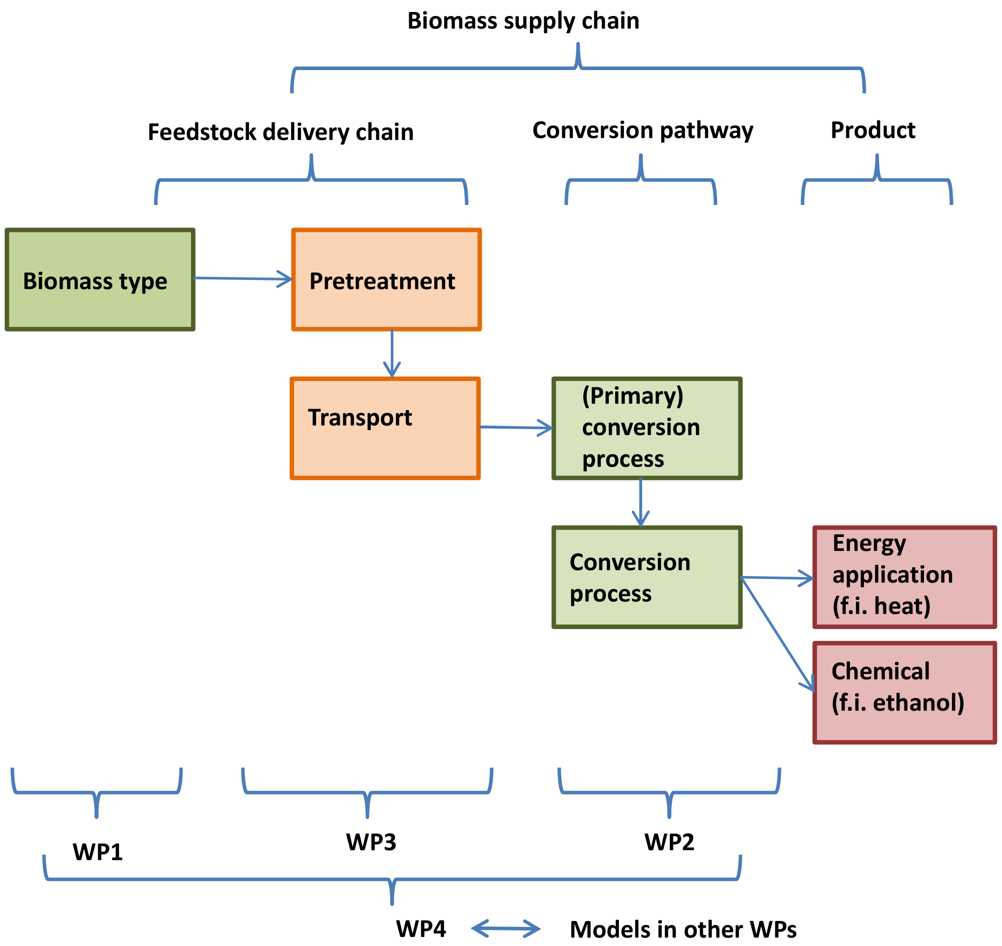
Interaction with other WPs

WP1: definition & properties of biomass classes.

WP3: continuous collaboration. Next step: modelling interaction between biomass resource, pretreatment, logistics and conversion technology.

WP4: setup of database structure for biomass properties after harvest at roadside

WP4: development of tool for viewing and matching biomass with resources



Introduction WP2 – in short

Database of technologies & input requirements

WP2.1
MS3
MS5
D2.3

Database of biomass types and their properties

WP2.2
MS4
MS6
D2.4

D2.1

Selection method to match biomass types and conversion technologies

WP2.3
D2.2

Tool for matching biomass technologies and biomass types

WP4.2
D4.5

Task 2.1 Technology database

S2Biom

Database provides quality demand per conversion technology.

www.biomass-tools.eu/web/guest/conversion

Biomass chain data / Conversion technologies

My Sites 0 Tijs Lammens

52	Syngas platform	Fluidised bed gasification for FT-fuels production	Syngas to FT-diesel	Power, Heat, FT-diesel			Mozaffarian
44	Syngas platform	Indirect gasification for SNG production	Producer gas to biomethane	Methane		Power	Hamid Mozaffarian
41	Syngas platform	Fluidised bed gasification for methanol production	Syngas to methanol	Heat, Methanol		Power	Hamid Mozaffarian
40	Fast pyrolysis	Pyrolysis and hydrogenation for diesel fuel	Pyrolysis oil diesel	Pyrolysis diesel		Power	Rik te Raa
39	Fast pyrolysis	Pyrolysis plus boiler for heat and steam	Pyrolysis oil to steam	Heat		Natural gas	Rik te Raa
38	Fast pyrolysis	Pyrolysis plus boiler for heat and steam	Pyrolysis oil to heat	Heat		Natural gas	Rik te Raa
35	Anaerobic digestion	Plug flow digester	Dry Batch Digestion (MSW)	Power, Biogas, Methane		Power, Heat (useful, not process steam)	Wolter Elbersen
34	Direct combustion of solid biomass	Domestic residential batch fired stoves for heat	Batch stove for heat	Heat			Janne Kärki
33	Direct combustion of solid biomass	Domestic pellet burners for heat	Pellet boiler for heat	Heat			Janne Kärki

Task 2.1 Technology database

TECHNICAL PROPERTIES

Capacity of outputs (typical values)

Power (MWe) 0.53
Conversion efficiencies: net returns electricity(GJ/GJ biomass input) typical: 0.0221 min: max: typical in 2020: 0.02 typical in 2030: 0.019

Heat (MWth) 6.24
Conversion efficiencies: net returns usable heat(GJ/GJ biomass input) typical: 0.26 min: max: typical in 2020: 0.24 typical in 2030: 0.22

Pyrolysis oil (m3/hour) 2.775 LHV (GJ / m^3) 19.2
Conversion efficiencies: net returns fuel(GJ/GJ biomass input) typical: 0.62 min: max: typical in 2020: 0.65 typical in 2030: 0.68

Data sources used to define conversion efficiencies in 2014:

Data sources used to define conversion efficiencies in 2020:

External inputs (not generated by the biomass in the conversion process)
- No external inputs

Data sources used to define conversion efficiencies in 2030:

Indication: experience based data No

General data sources for technical properties:

Number of possible full load hours per year (hours)	8000
Number of typical full load hours per year (hours)	7000
Typical Lifetime of Equipment (years)	25

BIOMASS INPUT SPECIFICATIONS

Biomass input, common for the technology used:
Biomass input, technically possible but not common:

Traded form Wood chips
Dimensions P16S: 3,15 mm < P < 16 mm Fine fraction F30: < 30 %

Moisture content	(% wet basis) typical 10 max 10
Minimal bulk density	(kg/m^3, wet basis) 400
Maximum ash content	(% dry basis) 1
Minimal ash melting point (= initial deformation temperature)	(°C) 1000
Volatile matter (only for thermally trated material, torrefied or steam exploded)	(VM%)

Maximum allowable contents
Nitrogen, N (wt%, dry) 0.3 Sulphur, S (wt%, dry) 0.03 Chlorine, Cl (wt%, dry) 0.05

Optional attributes

Net caloric value	(MJ/kg) min 15	max 17
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

Investments costs	in 2014 (€):	expected in 2020 (€):	expected in 2030 (€):
	15000000	15000000	12000000

Labour needed Operators (FTE): 6 Staff and engineering (FTE): 1

- Status: Nearly finished, little further input needed.
- Ready to test with matching tool for:
  Fast Pyrolysis, Gasification, Combustion, Anaerobic Digestion, Fermentation.

Task 2.2 Biomass database

Database set-up to classify biomass types according to suitability indicators for the main lignocellulose conversion options.

	Origin			1. Forestry									
	Category – Level 1			1.1 Primary forestry production						1.2 Primary forestry residues			
	Category – Level 2			1.1.1 Stemwood from thinnings and final fellings				1.1.2 Stem and crown biomass from early thinnings (whole tree)		1.2.1 Logging residues from final fellings (tops and branches mainly)		1.2.2 Stumps from final fellings	
	Category – Level 3			1.1.1.1 Stemwood from **final fellings** originating from **broadleaf** trees	1.1.1.2 Stemwood from **final fellings** originating from **conifer** trees	1.1.1.3 Stemwood from **thinnings** originating from broadleaf trees	1.1.1.4 Stemwood from **thinnings** originating from **conifer** trees	1.1.2.1 Stem and crown biomass from early thinnings originating from **broadleaf** trees	1.1.2.2 Stem and crown biomass from early thinnings originating from **conifer** trees	1.2.1.1 Logging residues from **final fellings** originating from **broadleaf** trees	1.2.1.2 Logging residues from **final fellings** originating from **conifer** trees	1.2.2.1 Stumps from final fellings originating from **broadleaf** trees	1.2.2.2 Stumps from final fellings originating from **conifer** trees
	Considered by S2BIOM			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
	Responsible WP1 partner			Supply - EFI(Joanne Fitz	Supply - EFI(Joanne Fitz	Supply - EFI(Joanne Fitz	Supply - EFI(Joanne Fitz	Supply - EFI(Joanne Fitz	Supply - EFI(Joanne Fitz	Supply - EFI(Joanne Fitz	Supply - EFI(Joanne Fitzgera	Supply - EFI(Joanne Fitz	Supply - EFI(Joanne Fitz
	Responsible WP2 partner			VTT (Eija Alakangas))	VTT (Eija Alakangas)	VTT (Eija Alakangas)	VTT (Eija Alakangas)	VTT (Eija Alakangas)	VTT (Eija Alakangas)	VTT (Eija Alakangas)	VTT (Eija Alakangas)	VTT (Eija Alakangas)	VTT (Eija Alakangas)
	Biomass similar to					See 1.1.1.1	See 1.1.1.2						
12	Net calorific value as received	MJ/kg	Typical	10.4	8.4	11.5	11.6	11.6	11.7	10.2	8.4	11.1	11.1
			Minimum	7.7	7	10.2	10.4	10.2	10.6	7.9	7	10.8	10.8
			Maximum	12.7	13	13.9	13.9	13.9	14	11.8	12.5	12.7	12.7
13	Gross Calorific value	MJ/kg	Typical	20.3	20.6	20.3	20.5	20.5	20.6	19.7			
			Minimum	19.1	19.8	20	20.3	20	20.6	19.5			
			Maximum	20.5	21.2	20.6	20.6	20.6	20.8	20			
14	Ash content	w-% dry	Typical	0.7	0.5	0.9	0.8	1	0.9	4	3	6	6
			Minimum	0.3	0.3	0.7	0.7	1	0.9	2	1	4	4
			Maximum	1	0.7	1	1.3	1.3	1.6	10	10	20	20
15	Ash melting behavior (DT)	°C	Typical	1320									
			Minimum	1200									
			Maximum	1370									
16	Content of lignin (see sheet 4)	w-% dry	Typical	23.4	28.6	23.4	28.6	23.4	28.6				
			Minimum	20.8	26.8	20.8	26.8	20.8	26.8				
			Maximum	26.1	32.1	26.1	32.1	26.1	32.1				
17	Content of cellulose	w-% dry	Typical	43	38.7	43	38.7	43	38.7				
			Minimum	38.8	33	38.8	33	38.8	33				
			Maximum	51.3	41.7	51.3	41.7	51.3	41.7				
18	Content of hemicellulose	w-% dry	Typical	29.8	29.2	29.8	29.2	29.8	29.2				
			Minimum	21.1	26.3	21.1	26.3	21.1	26.3				

	Origin			2. Agriculture on arable land & grass land					
	Category – Level 1			2.1 Primary production of lignocellulosic biomass crops					
	Category – Level 2			2.1.1. Energy grasses, annual & perennial crops					
	Category – Level 3			2.1.1.1 Sweet and biomass sorghum (Annual grasses)	2.1.1.2 Miscanthus (Perennial grass)	2.1.1.3 Switchgrass (Perennial grass)	2.1.1.4 Giant reed (Perennial grass)	2.1.1.5 Cardoon (Perennial crop)	2.1.1. Cana (Pere
	Considered by S2BIOM			YES	YES	YES	YES	YES	YES
	Responsible WP1 partner			UniBo/DLO(Jacqueline R	UniBo/DLO(Jacqueline R	UniBo/DLO(Jacqueline R	UniBo/DLO(Jacqueline R	UniBo/DLO(Jacqueline R	UniBo
	Responsible WP2 partner			DLO (Wolter Elbersen)	DLO (Wolter Elbersen)	DLO (Wolter Elbersen)	DLO (Wolter Elbersen)	DLO (Wolter Elbersen)	DLO (

- Status: Awaiting a lot of input. Ready to test for wood.

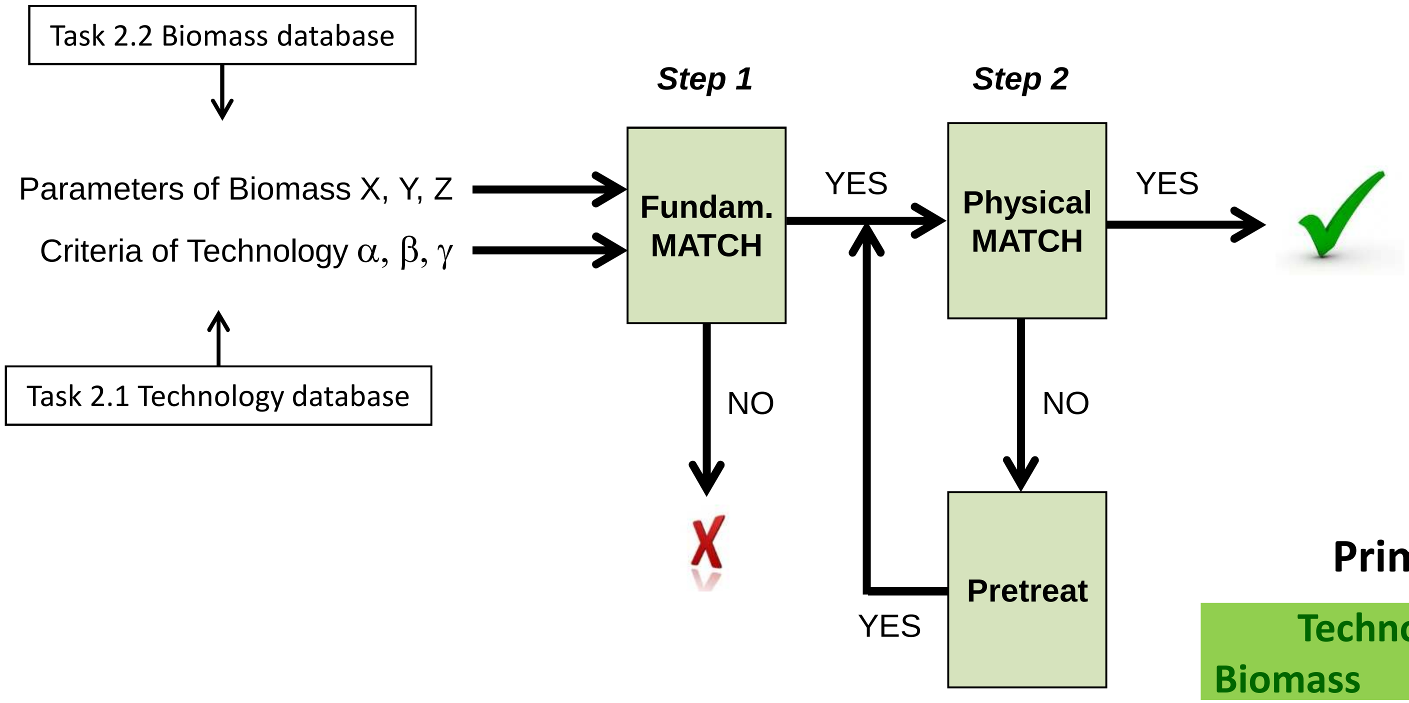
Task 2.3 Selection method

- All biomass types and conversion technologies will be classified according to the suitability classes (1-4).
- A match occurs if for example biomass of class 2 is converted by a technology that can handle class 2 or higher.
- All suitability classes need to match, e.g. corrosion, ash melting point, total ash content and nitrogen content.
- This principle will be refined and serve as basis for development of the matching tool.
- Status: Deliverable D2.2 was submitted in April 2015.

WP 2 – Status overview

Task	Responsible	Deadline	Status
2.1: Technology requirements	**BTG**		
MS3. Draft technology database		June '14	
MS5. Extended technology database		July '15	
D2.3. Final technology database		Feb '16	
2.2: Biomass characteristics	**VTT+DLO+Uni-Fr**		
D2.1. Method for biomass characterization		March '15	
MS4. Draft biomass database		June '14	
MS6. Extended biomass database		July '15	
D2.4. Final biomass database		Feb '16	
2.3: Biomass and technology matching	**BTG**		
D2.2. Selection method for matching		March '15	

Matching Tool



Primary output:

Technology / Biomass	α	β	γ
X	●	●	●
Y	●	●	●
Z	●	●	●

Green: ***Match between biomass and technology.***

Orange: ***Match after modification of physical biomass characteristics.***

Red: ***No match between biomass and technology.***

Planning

Task	Ready	Responsible
MS6. Extended biomass database	Mid-Oct 2015	VTT, DLO
Implement first version of the tool	Nov 2015	DLO, BTG
Tool testing and feedback	Jan 2016	WP9
D2.3. Final technology database	Feb 2016	BTG
D2.4. Final biomass database	Feb 2016	DLO
D4.5. Final matching tool	May 2016	DLO

Thanks for your attention!

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biomass technology group




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