

# Lignocellulosic biomass in the Danube region

## Overview of data and tools in the S2BIOM tool box for their evaluation & mobilisation

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**BRATISLAVA**  
**30 NOVEMBER 2016**



# S2Biom at a glance

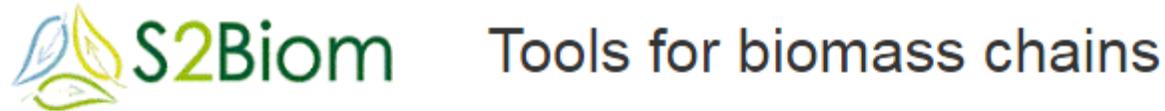
Main objective: Delivery of sustainable supply of non-food biomass to support a resource-efficient Bioeconomy in Europe

- Funding programme: 7<sup>th</sup> Framework Programme (FP7)
- Funding volume: 4 Mio €
- Duration: 36 Month (09/2013 – 11/2016)
- Participation: 31 Partners from 16 countries
- Project website: [www.s2biom.eu](http://www.s2biom.eu)

# Objectives

- Analysis of the biomass potential and respective conversion pathways
- Analysis of political and policy framework conditions and application of sustainability criteria in EU28 and neighbouring countries
- Development of transnational Strategies, Roadmaps and Toolbox for a resource-efficient bioeconomy in Europe
- **Development of a web-based interactive tool and material for the support of the economy, research and policy for local, regional and national stakeholder.**

# S2BIOM tool set: what is in it for me?



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Home

Introduction to S2BIOM GUI

**Welcome to the S2BIOM integrated tool set!**

You have just opened the S2BIOM tool set containing all data, tools, documents and reports generated in the S2BIOM project. Under the different tabs in the main menu above you can click to get access to these different tools, data, documents and reports. The tools enable you as user to interact with the results by making sub-selections for data you are interested in, or to design your own biomass delivery chain and evaluate the performance or to obtain the point information on specific issues of relevance for developing a biomass delivery chains. These can be key characteristics on logistical components, biomass conversion technologies, matching of biomass types with technologies, biomass potentials, cost and characteristics, biomass markets, sustainability issues, policies and regulations, and national biomass strategies.

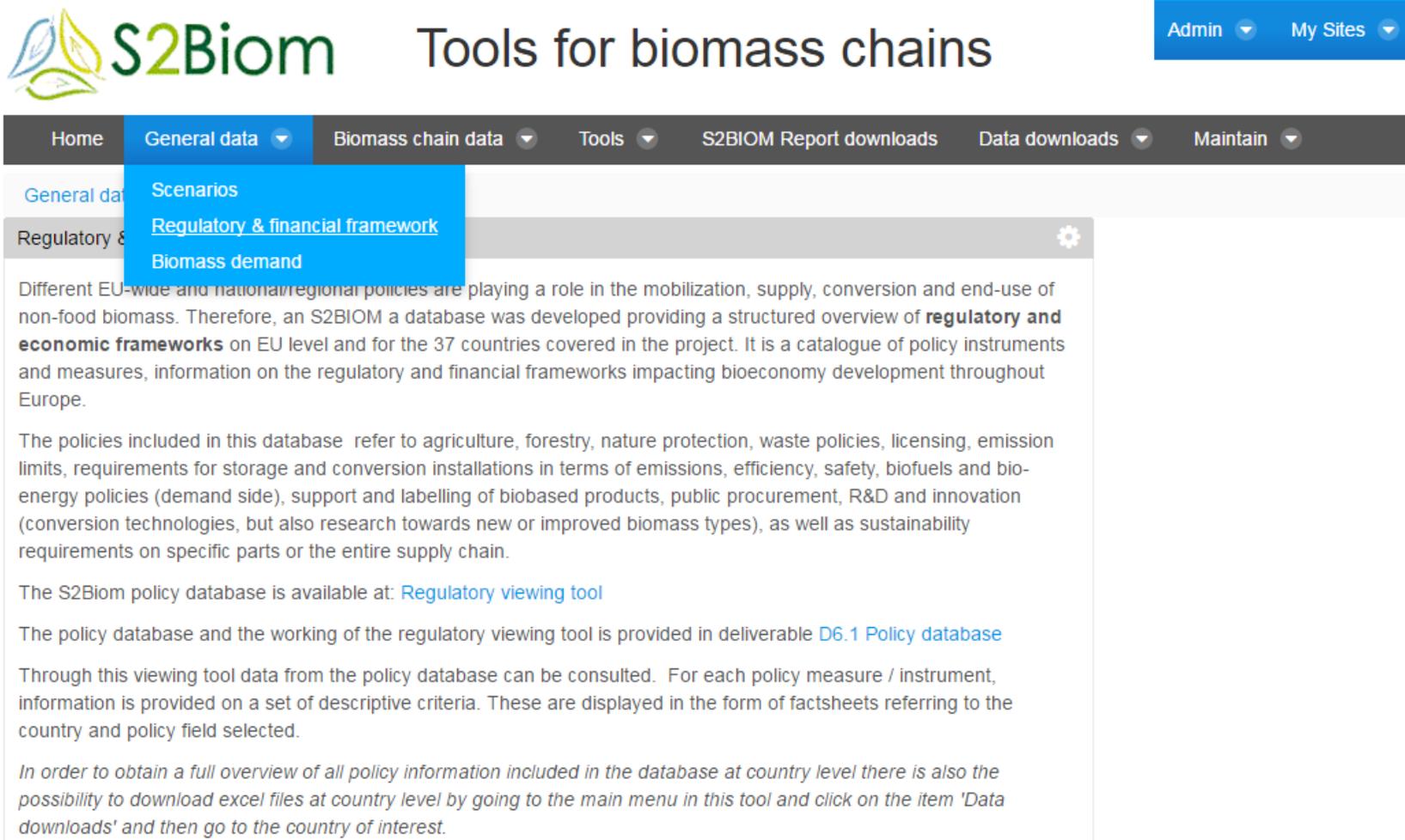
The S2Biom project supports the sustainable delivery of non-food biomass feedstock at local, regional and pan European level through developing harmonised data sets, strategies, and roadmaps at local, regional, national and pan European level for EU28, Western Balkans, Ukraine, Moldova and Turkey that can be accessed via this S2BIOM tool set.

The project fits under the overall umbrella of the Europe 2020 strategy for the building of a bio-economy, as well as the targets for deployment of renewable energies and reduction of greenhouse gas emissions. For further information about the project visit the [S2BIOM website](#) and open underneath documents:

- [S2BIOM poster](#)
- [S2BIOM brochure](#)
- [S2BIOM brochure 2](#)

[Edit, Settings, Add icons]

# General user interface



The screenshot displays the S2Biom website header and a navigation menu. The header includes the S2Biom logo and the text 'Tools for biomass chains'. A blue navigation bar contains 'Admin' and 'My Sites' dropdown menus. Below this is a dark grey navigation bar with 'Home', 'General data', 'Biomass chain data', 'Tools', 'S2BIOM Report downloads', 'Data downloads', and 'Maintain' dropdown menus. The 'General data' dropdown is open, showing 'Scenarios', 'Regulatory & financial framework' (highlighted in blue), and 'Biomass demand'. The main content area features a grey header for 'Regulatory & financial framework' with a gear icon. The text below describes the database's purpose, lists included policies, and provides links to a viewing tool and a policy database deliverable.

**S2Biom** Tools for biomass chains

Admin My Sites

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General data Scenarios  
Regulatory & financial framework  
Biomass demand

Different EU-wide and national/regional policies are playing a role in the mobilization, supply, conversion and end-use of non-food biomass. Therefore, an S2BIOM a database was developed providing a structured overview of **regulatory and economic frameworks** on EU level and for the 37 countries covered in the project. It is a catalogue of policy instruments and measures, information on the regulatory and financial frameworks impacting bioeconomy development throughout Europe.

The policies included in this database refer to agriculture, forestry, nature protection, waste policies, licensing, emission limits, requirements for storage and conversion installations in terms of emissions, efficiency, safety, biofuels and bio-energy policies (demand side), support and labelling of biobased products, public procurement, R&D and innovation (conversion technologies, but also research towards new or improved biomass types), as well as sustainability requirements on specific parts or the entire supply chain.

The S2Biom policy database is available at: [Regulatory viewing tool](#)

The policy database and the working of the regulatory viewing tool is provided in deliverable [D6.1 Policy database](#)

Through this viewing tool data from the policy database can be consulted. For each policy measure / instrument, information is provided on a set of descriptive criteria. These are displayed in the form of factsheets referring to the country and policy field selected.

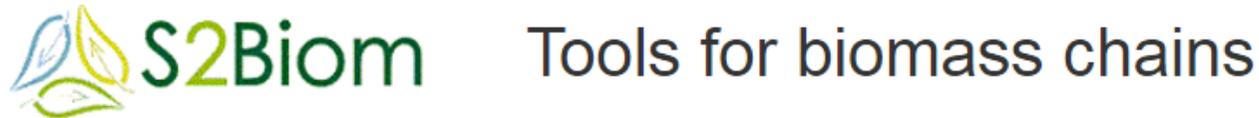
*In order to obtain a full overview of all policy information included in the database at country level there is also the possibility to download excel files at country level by going to the main menu in this tool and click on the item 'Data downloads' and then go to the country of interest.*



# Policy data Slovakia

IS O	Country/Region	Short name of Instrument or Measure	Type of Instrument & Measure	Sector/Topic targeted	URL
1K	SLOVAKIA (SLOVENSKO)	Act on protection of nature and landscape	Requirements	Environment (soil, water, air, nature, biodiversity,...)	<a href="https://s2biom.vito.be/node/1468">https://s2biom.vito.be/node/1468</a>
2K	SLOVAKIA (SLOVENSKO)	Agricultural soils - cultivation of fast growing trees	Requirements	Agriculture	<a href="https://s2biom.vito.be/node/1465">https://s2biom.vito.be/node/1465</a>
3K	SLOVAKIA (SLOVENSKO)	CAP: Slovakian Rural Development Programmes	Requirements, Investment Subsidies	Agriculture	<a href="https://s2biom.vito.be/node/2490">https://s2biom.vito.be/node/2490</a>
4K	SLOVAKIA (SLOVENSKO)	Decree on biofuel Sustainability Criteria and transport fuel GHG targets	Requirements	Mobility, transport and logistics	<a href="https://s2biom.vito.be/node/1466">https://s2biom.vito.be/node/1466</a>
5K	SLOVAKIA (SLOVENSKO)	Emissions from stationary sources	Requirements	Environment (soil, water, air, nature, biodiversity,...)	<a href="https://s2biom.vito.be/node/1470">https://s2biom.vito.be/node/1470</a>
6K	SLOVAKIA (SLOVENSKO)	Excise Tax Act	Tax Reduction	Energy, Taxation and Trade	<a href="https://s2biom.vito.be/node/1459">https://s2biom.vito.be/node/1459</a>
7K	SLOVAKIA (SLOVENSKO)	Forestry act	Requirements	Forestry	<a href="https://s2biom.vito.be/node/1467">https://s2biom.vito.be/node/1467</a>
8K	SLOVAKIA (SLOVENSKO)	Fuel tax	Tax Reduction	Mobility, transport and logistics, Taxation and Trade	<a href="https://s2biom.vito.be/node/1464">https://s2biom.vito.be/node/1464</a>
9K	SLOVAKIA (SLOVENSKO)	Higher Use of Biomass and Solar Energy in Households	Investment Subsidies	Energy	<a href="https://s2biom.vito.be/node/1461">https://s2biom.vito.be/node/1461</a>
10K	Bratislavský kraj	Operational programme Bratislava region	Investment Subsidies	Economy, Energy	<a href="https://s2biom.vito.be/node/1462">https://s2biom.vito.be/node/1462</a>
11K	SLOVAKIA (SLOVENSKO)	Operational programme competitiveness and economic growth	Investment Subsidies	Economy, Energy	<a href="https://s2biom.vito.be/node/1458">https://s2biom.vito.be/node/1458</a>
12K	SLOVAKIA (SLOVENSKO)	Operational Programme Environment	Investment Subsidies	Environment (soil, water, air, nature, biodiversity,...) Energy	<a href="https://s2biom.vito.be/node/1460">https://s2biom.vito.be/node/1460</a>

# Biomass demand consumption in Europe in 2020 & 2030 scenarios



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General data Scenarios

Biomass demand Regulatory & financial framework

Biomass demand Biomass demand

In S2BIOM a forward analysis was done on the demand for biomass in 2020 and 2030 from the bioenergy and the biomaterials sectors.

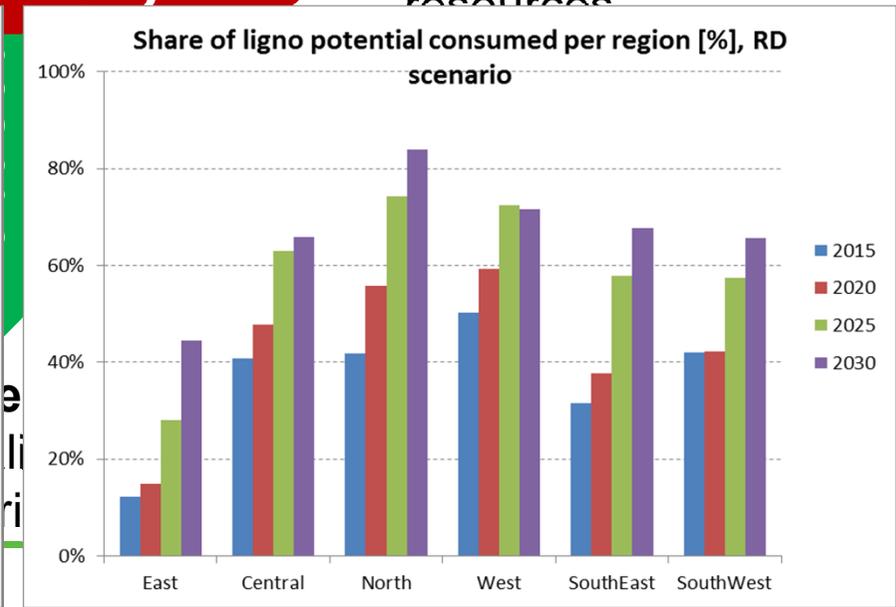
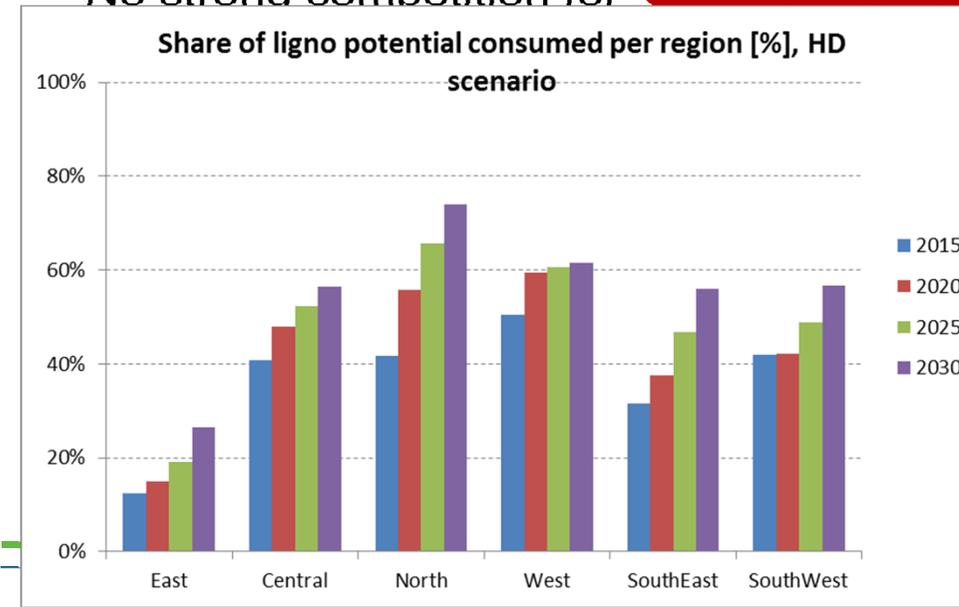
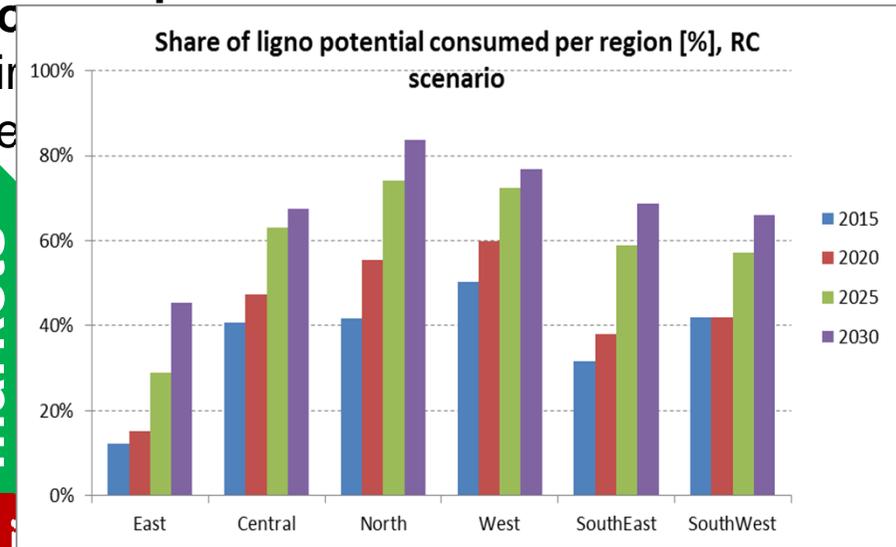
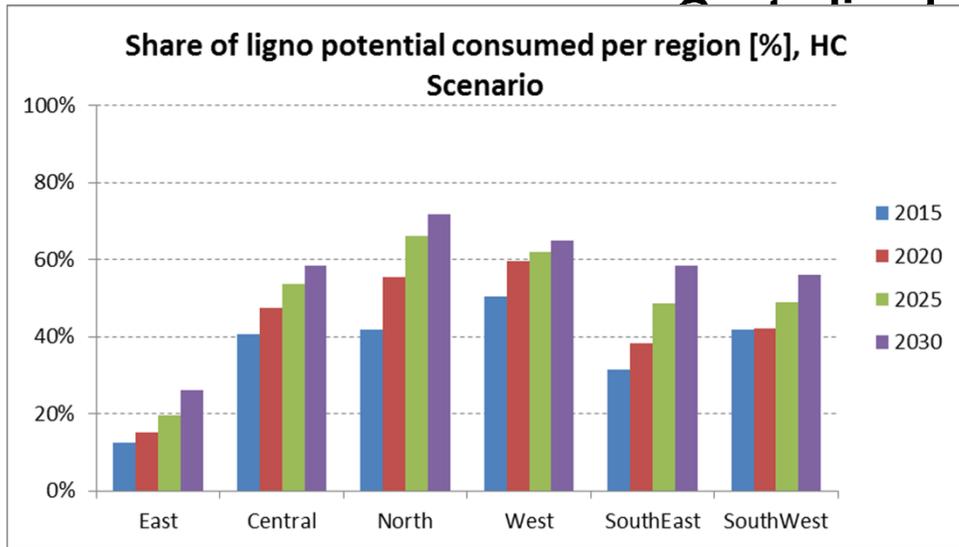
The future biomass demand and consumption patterns from energy and biomaterials sectors were assessed with the ReSolve model. This was done for the **4 S2BIOM scenarios**. The scenarios have been specified in a continuum of two key uncertainties:

- The availability level of (sustainable) biomass, influenced by the strictness of sustainability criteria and the level of competition for resources.
- The extent to which biobased options will produce in relatively large-scale, centralized conversion systems, or in relatively small-scale, decentralized units.

The results on biomass demand and consumption are presented for the four scenarios: [High Central](#) (HC), [Restricted Central](#) (RC), [High Decentral](#) (HD) and [Restricted Decentral](#) (RD) for the years 2015, 2002, 2025 ad 2030. They consist of:

- Consumption of domestic biomass(PJ); broken down to feedstock types
- Consumption of domestic biomass (Mton\_dry): broken down to lingo, non-lingo, wastes
- Unused domestic biomass potential (PJ): broken down to feedstock types

# Scenarios: axes specification for demand & consumption



# Cost-supply viewing tool

**S2Biom** Tools for biomass chains

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Biomass chain data / Biomass supply (Europe)

Welcome to the biomass supply viewer! This tool enables the user to make selections of biomass types for which data can be displayed in a map in relation to amount of biomass available per year and potential type combination. The user can select the regional level, the year and the different types of potentials. In addition the user can also choose the level entities in absolute level (dm or TJ), area weighted (Kton dm/km<sup>2</sup> or GJ/km<sup>2</sup>) and weighted average road side cost (€/ton dm).

For further user instructions open [user instructions document](#). The background report providing an extensive description of how the cost supply data was assessed per biomass type is [D1.5](#).

For further information on biomass supply data assessments, potential types covered see text underneath the supply viewing tool.

Print | Select Web Content | Add

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2020 - Production from forests - Stemwood from final fellings & thinnings - Final fellings from nonconifer trees - base potential - energy value - area weighted

Administrative level	Scenario
nut1	2012
nut2	2020

Category

- Production from forests
- Primary residues from forests

Subcategory

- Stemwood from final fellings & thinnings

Type

- Final fellings from nonconifer trees
- Final fellings from conifer trees

Potential

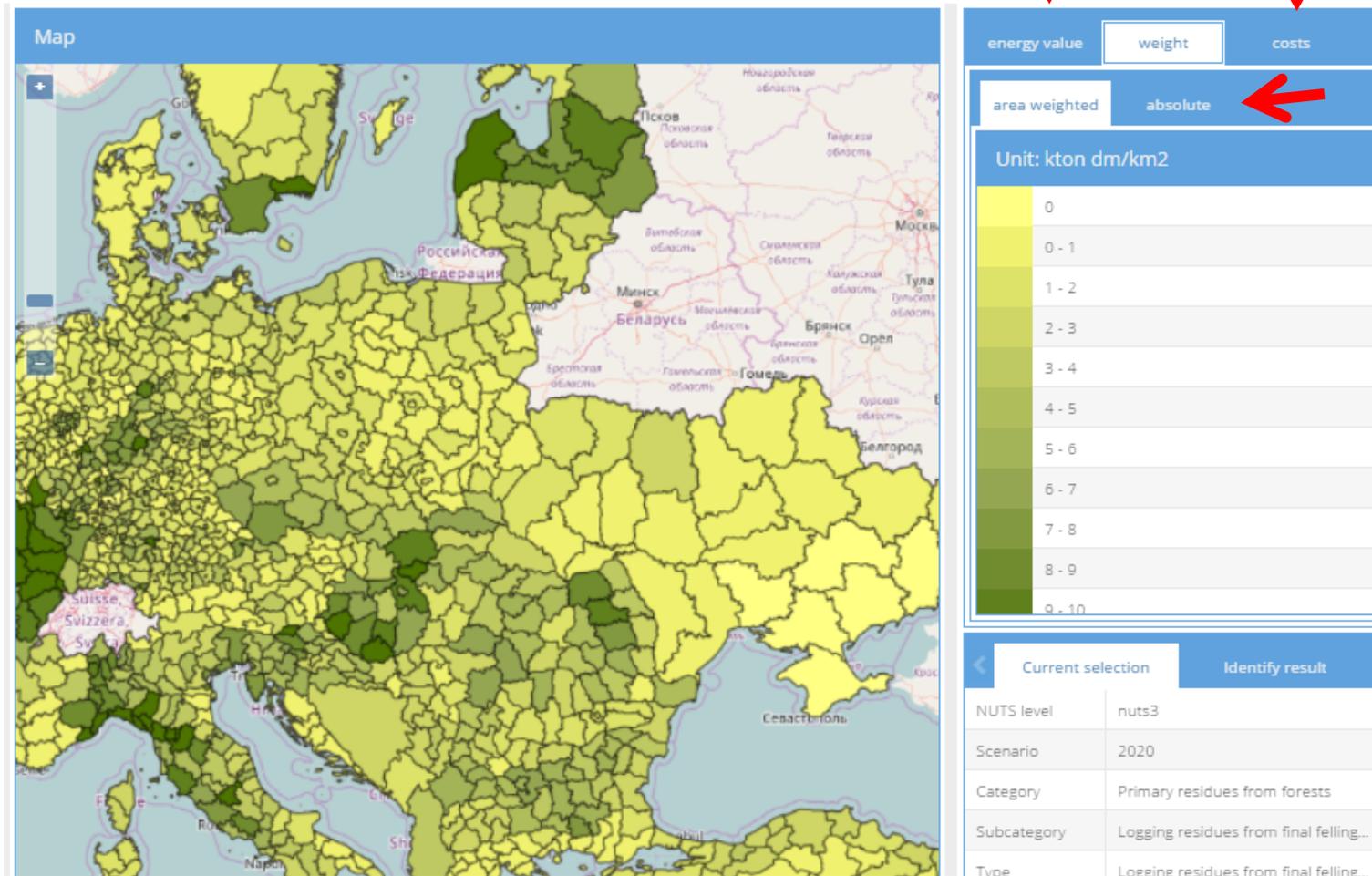
- base potential
- technical potential

Map

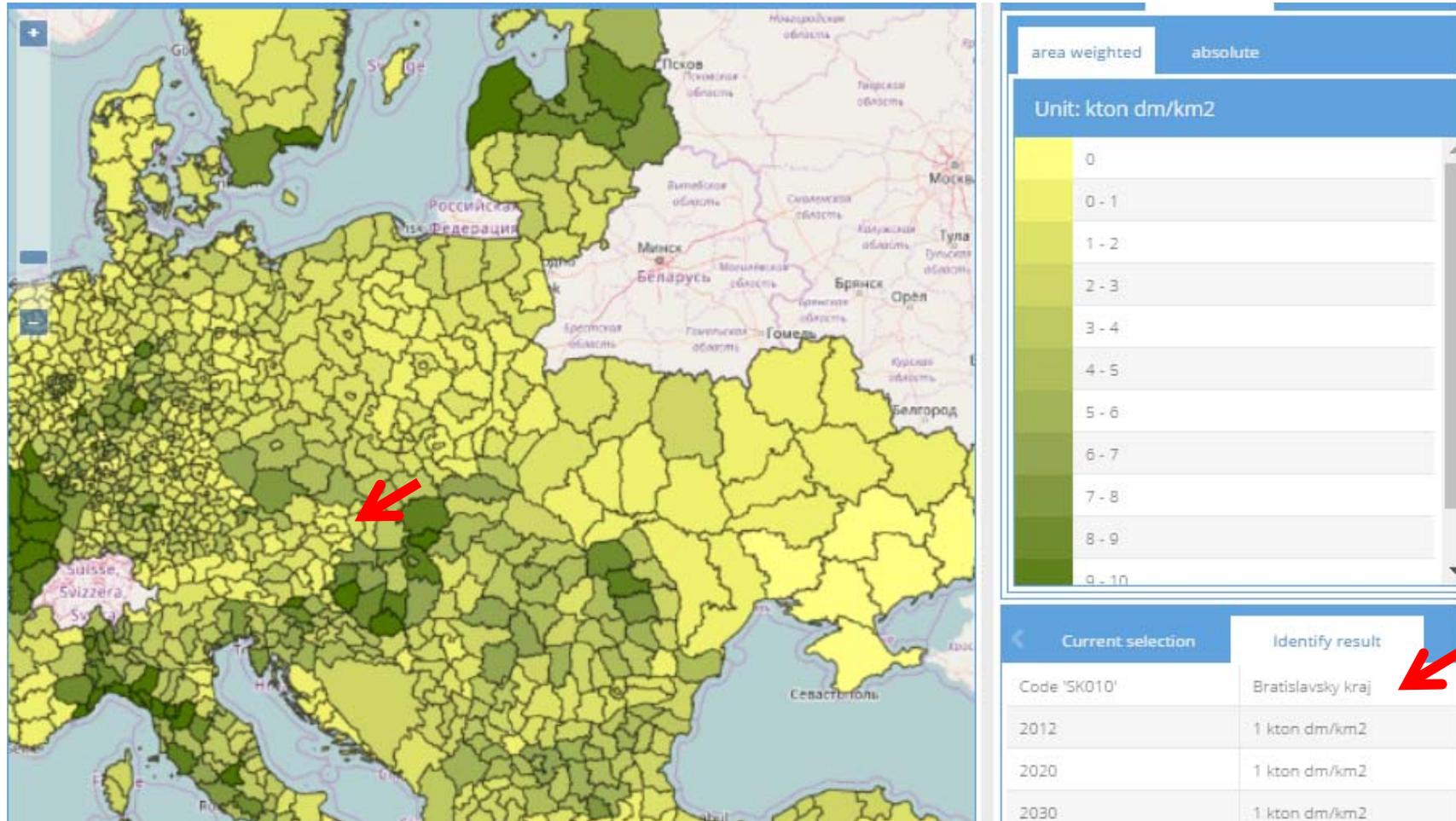
energy value	weight	costs
area weighted	absolute	
Unit: GJ/km <sup>2</sup>		
0		
0 - 100		
100 - 200		
200 - 300		
300 - 400		
400 - 500		
500 - 600		
600 - 700		
700 - 800		

Current selection	Identify result	Selected regions
NUTS level	nut5	
Scenario	2020	
Category	Production from forests	
Subcategory	Stemwood from final fellings & thinnings	
Type	Final fellings from nonconifer trees	

# Cost supply viewing: Primary forest residues: Kton dm/km<sup>2</sup>



# Cost supply viewing: Primary forest residues: Kton dm/km<sup>2</sup>



# Cost-supply viewing tool

Europe's Energy Portal Europe's Energy Portal Europe's Energy Portal Free Hotmail Try AOL for FREE! Imported From IE New Folder S2BIOM

**S2Biom** Tools for biomass chains Admin My Sites Beren Elbesen

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Biomass chain data / Biomass supply (Europe) Biomass cost/supply (Europe) Biomass cost/supply (Imports)

Welcome to the biomass cost-supply tool. To make selections of biomass types for which cost levels can be displayed in a cost-supply graph. The graph displays the total accumulated biomass (ordered from cheap to expensive) against the average road side cost level for the country/countries and scenario years selected. The amount of biomass is displayed in kiloton dry matter (ktDM) on the y-axis and the road side cost level (euro/ton dry matter) on the x-axis.

For further user instructions open up the user manual. The user manual provides an extensive description of how the cost supply data was assessed per biomass type in D1.6.

Road side cost refers to all biomass types. The road side cost is a fraction of the total 'at-gate-cost'. Cost levels assessed here do NOT refer to market prices!

For further short information on biomass cost-supply, please refer to the information underneath the cost-supply viewing tool.

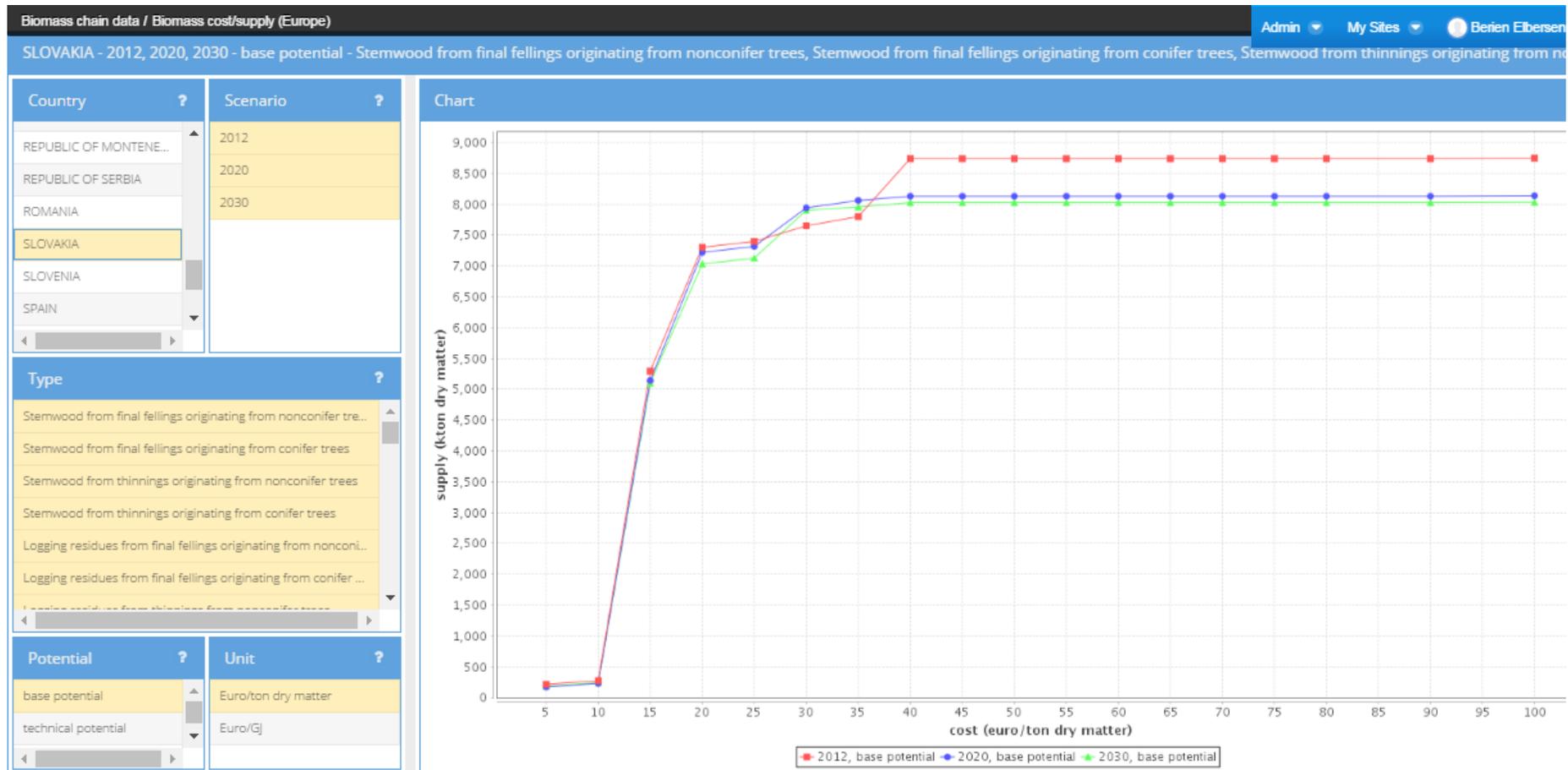
ALBANIA, AUSTRIA, BELGIUM, BOSNIA AND HERZEGOVINA, etc. - 2012, 2020, 2030 - base potential - Stemwood from final fellings originating from nonconifer trees, Stemwood from final fellings originating from conifer trees, Stemwood from thinnings originating from nonconifer trees, Stemwood from thinnings originating from conifer trees...

Country	Scenario
LITHUANIA	2012
LUXEMBOURG	2020
MACEDONIA THE FORMER YUGOSLAV REP...	2030
MALTA	
NETHERLANDS	
POLAND	

Type
Stemwood from final fellings originating from nonconifer trees
Stemwood from final fellings originating from conifer trees
Stemwood from thinnings originating from nonconifer trees
Stemwood from thinnings originating from conifer trees
Logging residues from final fellings originating from nonconifer trees
Logging residues from final fellings originating from conifer trees

Potential	Unit
base potential	Euro/ton dry matter
technical potential	Euro/GJ

# Cost-supply viewing tool: focus on Slovakia



# Matching Biomass & Technology



## Tools for biomass chains

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Tools / Bio2Match

Bio2Match  
BeWhere  
LocaGISTICS

This Bio2Match tool guides the user to the optimal match between biomass characteristics and conversion technologies. Each conversion technology has specific biomass input requirements, while the composition and characteristics of biomass at roadside varies widely. Some biomass types are suitable for many different technology options, while others are hard to process or will need extensive pretreatment. The matching tool uses extensive information from the S2Biom databases to show the user which types of biomass can be processed by which technologies to certain end-products, and thereby helps the user to find an optimal supply chain.

Before you start using the tool we recommend to consult the [User instructions](#).

The design of the methodology for matching technologies with biomass used in Bio2Match tool is described in [D4.5](#).

[Edit](#) [Select Web Content](#) [Add](#)

Select rows and columns	Match				Matching chara...
<p>Switch rows and columns</p> <p>Columns - Con... ?</p> <p>Rows - Biomass... ?</p> <p>Syngas pl... ✓</p> <p>Productio... ✓</p>	Name	Syngas to methanol (41)	Producer gas to biome...	Syngas to FT-diesel (52)	<p>Anaerobic... ✓</p> <p>Biochemic... ✓</p> <p>Physical tr... ○</p> <p>Thermal c... ✓</p>
	Final fellings from nonconifer trees	✓	✓	✓	
	Final fellings from conifer trees	✓	✓	✓	

# Biomass properties database

Origin						
Category – Level 1		1.1 Primary forestry production				
Category – Level 2		1.1.1 Stemwood from thinnings and final fellings				
Category – Level 3		1.1.1.1 Stemwood from <b>final fellings</b> originating from <b>broadleaf trees</b>	1.1.1.2 Stemwood from <b>final fellings</b> originating from <b>conifer trees</b>	1.1.1.3 Stemwood from <b>thinnings</b> originating from broadleaf trees	1.1.1.4 Stemwood from <b>thinnings</b> originating from <b>conifer trees</b>	
Considered by S2BIOM		YES	YES	YES	YES	
Responsible WP1 partner		Supply - EFI(Joanne Fitzgerald)	Supply - EFI(Joanne Fitzgerald)	Supply - EFI(Joanne Fitzgerald)	Supply - EFI(Joanne Fitzgerald)	
Responsible WP2 partner		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	
Moisture content	w-% ar	Typical	48.3	53.9	48.3	53.6
		Minimum	30	30	25	25
		Maximum	31.5	55	40	40
Bulk density, BD	kg/m3 ar	Typical	360	330	250	250
		Minimum	320	310	200	200
		Maximum	420	350	400	350

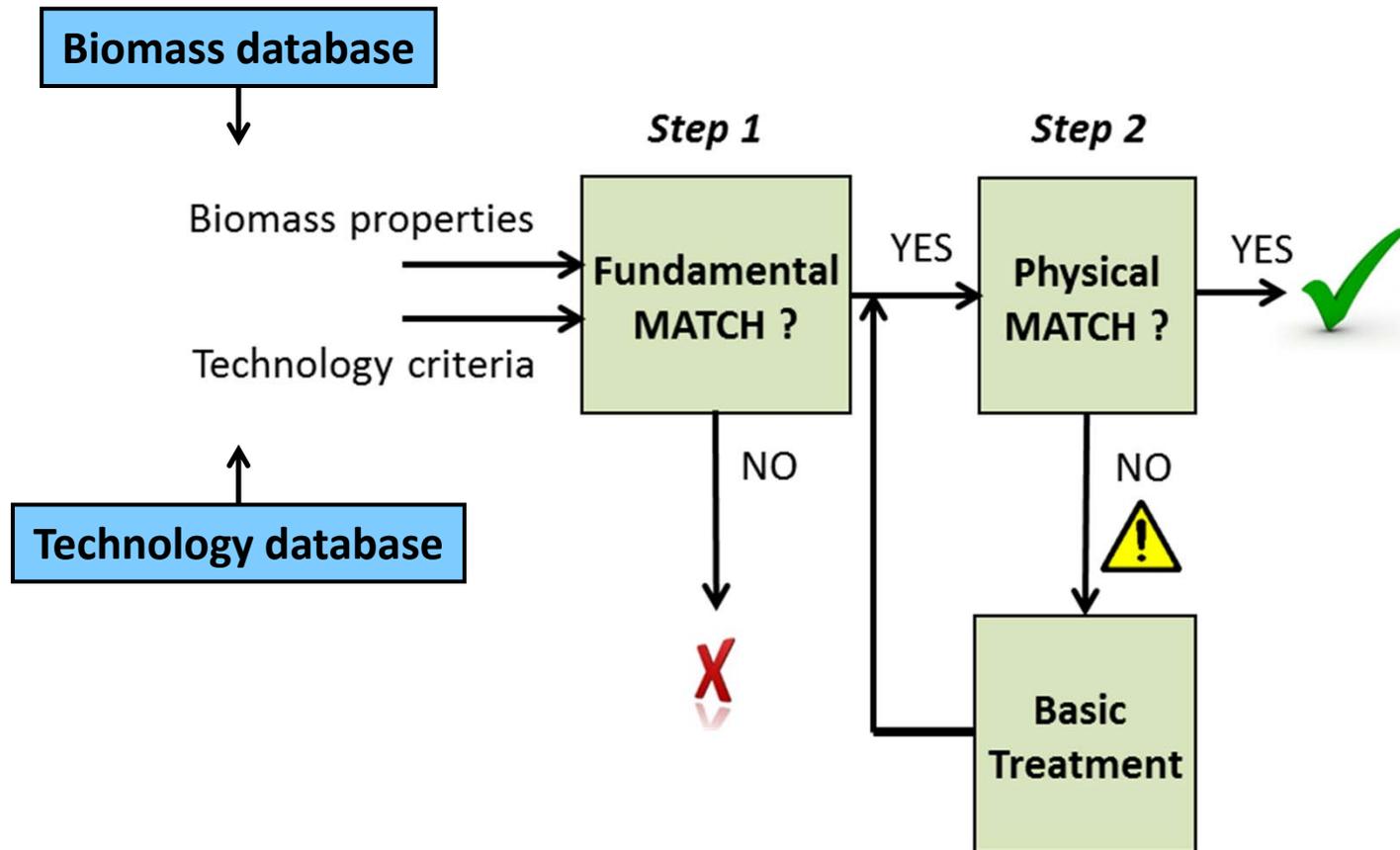
Database was set-up to classify biomass types according to suitability indicators for the main lignocellulose conversion options.

# 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.

# WP2 implementation: Bio2Match tool

Biomass and technology matching, methodology for matching tool:



## 2.3 Matching methodology

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<sub>x</sub> 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)

# WP2 implementation: Bio2Match

### Select rows and columns

⇄ Switch rows and columns

Columns - Biomass types	Rows - Conversion technologies
<ul style="list-style-type: none"> <li><input checked="" type="radio"/> Production from forests</li> <li><input type="radio"/> Primary residues from forests                             <ul style="list-style-type: none"> <li><input type="radio"/> Primary production of lignocellulosic bi...</li> </ul> </li> <li><input checked="" type="radio"/> Agricultural residues                             <ul style="list-style-type: none"> <li><input type="radio"/> Rice straw</li> <li><input checked="" type="radio"/> Cereals straw</li> <li><input type="radio"/> Oil seed rape straw</li> <li><input type="radio"/> Maize stover</li> <li><input type="radio"/> Sugarbeet leaves</li> <li><input type="radio"/> Sunflower straw</li> </ul> </li> <li><input type="radio"/> Grassland</li> <li><input type="radio"/> Other land use</li> <li><input checked="" type="radio"/> Secondary residues from wood industr...                             <ul style="list-style-type: none"> <li><input checked="" type="radio"/> Bark residues from pulp and paper...</li> <li><input type="radio"/> Black liquor</li> <li><input type="radio"/> Residues industries producing sem...</li> <li><input type="radio"/> Residues from further woodproces...</li> <li><input type="radio"/> Sawdust from sawmills from conifers</li> <li><input type="radio"/> Sawdust from sawmills from nonco...</li> <li><input type="radio"/> Sawmill residues: excluding sawdus...</li> <li><input type="radio"/> Sawmill residues: excluding sawdus...</li> </ul> </li> <li><input type="radio"/> Secondary residues of industry utilis...</li> <li><input type="radio"/> Municipal waste</li> <li><input type="radio"/> Waste from wood</li> </ul>	<ul style="list-style-type: none"> <li><input checked="" type="radio"/> Syngas platform                             <ul style="list-style-type: none"> <li><input type="radio"/> Syngas to FT-diesel (52)</li> <li><input checked="" type="radio"/> Syngas to methanol (41)</li> <li><input type="radio"/> Producer gas to biomethane (44)</li> </ul> </li> <li><input type="radio"/> Gasification technologies</li> <li><input checked="" type="radio"/> Direct combustion of solid biomass</li> <li><input checked="" type="radio"/> Anaerobic digestion                             <ul style="list-style-type: none"> <li><input checked="" type="radio"/> Complete mix digester state of the ...</li> <li><input type="radio"/> Dry Batch Digestion (MSW) (35)</li> </ul> </li> <li><input checked="" type="radio"/> Biochemical treatment                             <ul style="list-style-type: none"> <li><input type="radio"/> Kraft process with Lignoboost (16)</li> <li><input type="radio"/> Prehydrolysis kraft (17)</li> <li><input checked="" type="radio"/> Ethanol from lignocellulose (dilute a...</li> </ul> </li> <li><input type="radio"/> Torrefaction</li> <li><input type="radio"/> Treatment in subcritical water</li> <li><input checked="" type="radio"/> Fast pyrolysis                             <ul style="list-style-type: none"> <li><input type="radio"/> Pyrolysis oil diesel (40)</li> <li><input type="radio"/> Fast pyrolysis + Multiple diesel com...</li> <li><input type="radio"/> Fast pyrolysis + CHP plant, value ch...</li> <li><input type="radio"/> Fast pyrolysis + Industrial steam bo...</li> <li><input checked="" type="radio"/> Agricultural residues to pyrolysis oll...</li> <li><input type="radio"/> Fast Pyrolysis of residues + Boiler fo...</li> <li><input type="radio"/> Fast pyrolysis of residues + CHP pla...</li> <li><input type="radio"/> Wood chips to pyrolysis oil (23)</li> <li><input type="radio"/> Fast pyrolysis + Boiler for heat, valu...</li> </ul> </li> </ul>

### 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 pretreatment...)	✘	✔	✘
Grate boiler with agrobiomass for CHP (73)	⚠	✔	⚠
Grate boiler with wood chips for CHP (30)	✔	✘	⚠
Syngas to methanol (41)	⚠	✘	⚠

### Matching characteristics

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

### Product groups

- electricity
- biofuels and biobased products
- heat

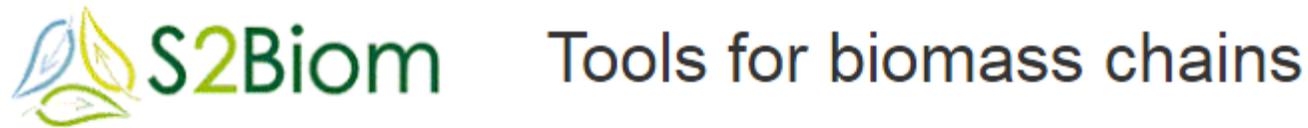
### Regions

- Italia
- France

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

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	✔

# Tools: BeWhere model

A screenshot of the S2Biom website's navigation menu. The menu is dark grey with white text. The 'Tools' dropdown menu is open, showing three options: 'Bio2Match', 'BeWhere', and 'LocaGIStics'. The 'BeWhere' option is highlighted in blue. Below the menu, the text 'Tools / BeWhere' is visible. The main content area shows the heading 'BeWhere' and a paragraph of text: '*This part is still under construction.*  
The user will be able to interact with the BeWhere model output results here. BeWhere has been applied in several case studies in Europe and the simulation results are used for the development of roadmaps for mobilising domestic biomass resources for the development of the bioeconomy.'

- **BeWhere model aims to optimize the supply chain from harvesting to production and is used to analyze:**
  - The cost-competitive location of new conversion facilities.
  - Biomass collection sites and transport routes.
  - Technological combinations for reaching demand targets.

# Online BeWhere tool

## 5 parameters user to select:

1. Type of feedstock
  - a. forestry
  - b. crop residuals
  - c. a+b
2. Final product
  - a. Heat and power
  - b. biofuel
  - c. a+b
3. Carbon cost  
0, 25... 150 EUR/tCO<sub>2</sub>
4. Biofuel support  
0, 5... 25 EUR/GJ
5. Factor for cost of fossil fuel  
0.5, 1... 5

## Output

1. Location of plants on the European map regarding size and technology
2. Results per country:
  - a. amount of resources used
  - b. Amount of import/export
  - c. cost of the final product
  - d. emissions avoided

# Data downloads per country



S2Biom

Tools for biomass chains

Name	Cost-supply data	Policy data	Report
Austria	Cost supply <a href="#">AT</a>	Policy <a href="#">AT</a>	Outlook <a href="#">AT</a>
Belgium	Cost supply <a href="#">BE</a>	Policy <a href="#">BE</a>	
Bulgaria	Cost supply <a href="#">BG</a>	Policy <a href="#">BG</a>	Outlook <a href="#">BG</a>
Croatia	Cost supply <a href="#">HR</a>	Policy <a href="#">HR</a>	Outlook <a href="#">HR</a>
Cyprus	Cost supply <a href="#">CY</a>	Policy <a href="#">CY</a>	

- Cost-supply data per biomass type/potential/year
- Policy data: all relevant regulations & policies per country
- Benchmarking reports of country policy approaches
- Strategies and implementation plans identifying policy & regulatory priorities in per country
- Policy briefs
- Case study reports & validation reports (12 case studies)



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Access to the tool:

Via S2BIOM website:

[www.S2BIOM.eu](http://www.S2BIOM.eu)

or

[s2biom.alterra.wur.nl](http://s2biom.alterra.wur.nl)

Test login provided:

demo

helsinki

Better make your own login under 'Sign in'

**S2Biom**



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QUESTIONS?

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