A European overview of the woody biomass feedstock availability and its applications

Sylvain Leduc and many more
International Institute for Applied Systems Analysis (IIASA)

International Wood Biorefining Week
24-26 May 2016

This project is co-funded by the European Union within the 7th Frame Programme. Grant Agreement n°608622.

Outline

- **Project overview**
- **Methodology**
- **Interactive tools**

Objectives

- *In support of the sustainable delivery of non-food lignocellulosic biomass at local, regional and pan-European level through developing Strategies, and Roadmaps that will be informed by a "computerized and easy to use" planning toolset (and respective databases) with up to date harmonized data.*

- **Research** *covers the whole biomass delivery chain from primary biomass to end-use of non-food products and from logistics, pre-treatment to conversion technologies.*

- **EC wanted S2BIOM to assess biomass potential after food and feed demand is satisfied.**

Project Structure

Coordination & Management

Theme 1: Data & Tools (WPs 1-4)

- Current and future sustainable lignocellulosic biomass costs and supply (domestic and from imports) in EU28; Western Balkans, Moldova, Ukraine and Turkey.
- Common operating data, models, and tools representing the entire biomass supply chain
- Incorporation of models and tools for technical, environmental, economic and social impact analysis

Theme 2: Strategies & Roadmaps (WPs 5-8)

- Policy and regulations for supplying the future bioeconomy
- Support for future industrial investments
- Clarity on cross sector sustainability
- Strategies & Roadmap
- Ex ante impact assessment

Theme 3: Validation & project outreach (WPs 9-10)

- Support for policymaking at local, national, regional and EU28 levels by visualizing the outcomes of proposed policies
- Case Studies
- Stakeholder engagement
- Information Campaign
- Improvement of public awareness, education, and outreach

Value chains focus

Biomass types

Forestry

Agriculture

Non food crops

Toolset for online assessment

End Use

Pre-treatment

Conversion

Small Scale

Large Scale

Toolset for online assessment

Sustainability

Criteria

Indicators

Default values

Toolset for online assessment

Logistics

Supply chain

Transportation

Toolset for online assessment

Biomass supply & potentials

Following the BEE assessment*,
five types of biomass potentials are commonly distinguished**

- **Theoretical**
- **Technical** (Theoretical + *current technological possibilities*)
- **Economic** (Technical + economy)
- **Implementation** (Economic + policy, social)
- **Sustainable implementation** (filter of implementation with environment, social, economic sustainable criteria in biomass resource assessment)

* Retenmaier et al., 2008 and Vis et al., 2010
** Torén, J. et al., 2011

Categories

Origin	Category – Level 1	Category – Level 2	Category – Level 3
1. Forestry	1.1 Primary production	1.1.1 Stemwood from thinnings and final fellings	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 Stem and crown biomass from early thinnings	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 Primary residues	1.2.1 Logging residues from final fellings	1-2-1 Logging residues from final fellings originating from broadleaf trees
			1-2-1 Logging residues from final fellings originating from conifer trees
		1.2.2 Stumps from final fellings	1.2.2.1 Stumps from final fellings originating from broadleaf trees
			1.2.2.2 Stumps from final fellings originating from conifer trees

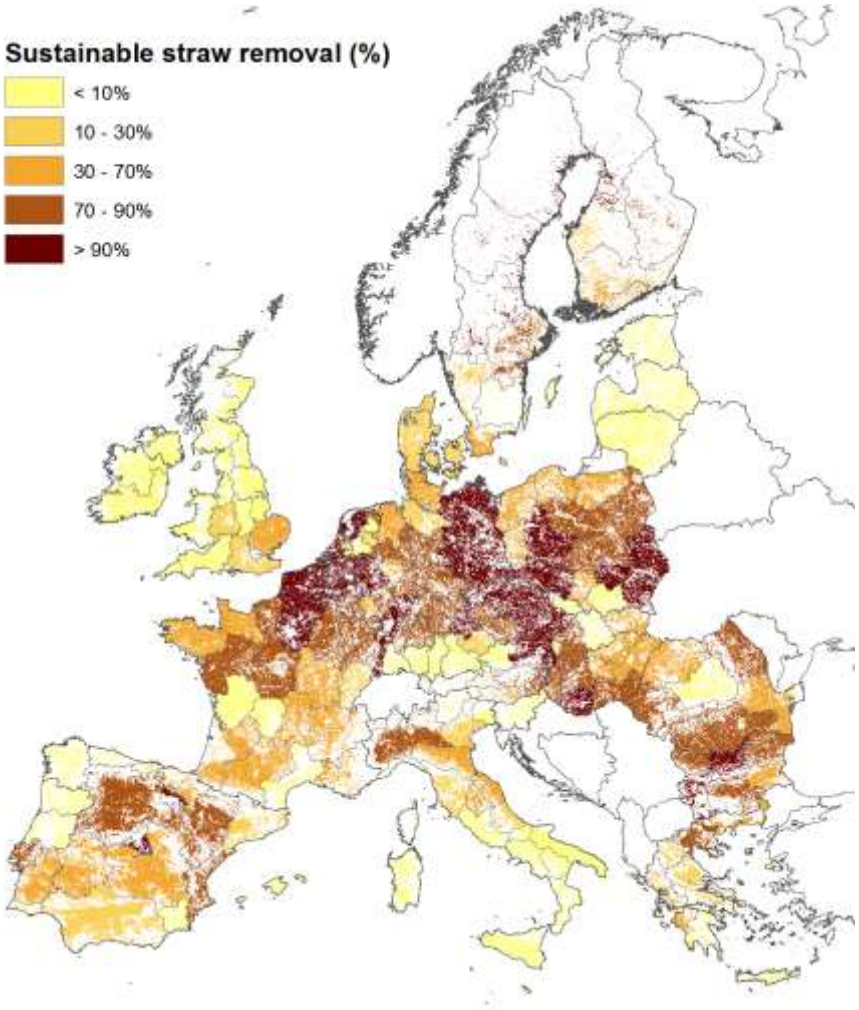
Categories

Origin	Category – Level 1	Category – Level 2	Category – Level 3
2. Agriculture on arable land & grass land	2.1 Primary production of lignocellulosic biomass	2.1.1. Energy grasses, annual & perennial crops (non wood)	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)
			2.1.1.6 Reed Canary Grass (Perennial crop)
		2.1.2 Short rotation coppice on agricultural land	2.1.2.1 Willow
			2.1.2.2 Poplar
			2.1.2.3 Other (incl. Eucalyptus)
		2.2.1 Straw/ stubbles	2.2.1.1 Cereals and rice straw
			2.2.1.2 Sunflower straw & oil seed rape straw
			2.2.1.3 Maize stover
		2.2.2 Primary residues - woody pruning, & orchards residues	2.2.2.1 Residues from vineyards
			2.2.2.2 Residues from fruit tree plantations
			2.2.2.3 Residues from olive tree plantations
			2.2.2.4 Residues from citrus tree plantations
			2.2.2.5 Residues from nuts plantations
			2.2.2.6 Grass biomass from various types of plantations

Categories

Origin	Category – Level 1	Category – Level 2	Category – Level 3
3. Other land use	3.1 Biomass from trees/hedges and other biomass from areas outside forests and outside of agriculture	3.1.1 Biomass from road side verges	3.1.1 Biomass from road side verges
		3.1.2 Biomass from other areas under landscape maintenance	3.1.2 Biomass from other areas under landscape maintenance
4. Production based on lignocellulosic biomass	4.1 Secondary residues from wood industries	4.1.1 Residues from saw mills	4.1.1.1 Saw dust, chips, veneer cores etc. (residues of stemwood)
		4.1.2 Residues from other wood industries	4.1.2.1 Residues from other wood industries
	4.2 Secondary residues of industry utilising agricultural products	4.2.1 By-products and residues from food and fruit processing industry	4.2.1.1 Olive stones
			4.2.1.2 Other by-products and residues from food and fruit processing industry
		4.2.2 Cotton industry by-products	4.2.2.1 Cotton acorns
5. Waste (tertiary residues)	5.1 Biodegradable municipal waste (BMW)	5.1.1 Biodegradable biomass fraction from municipal solid waste	5.1.1.1 Biowaste (Separately collected biodegradable municipal waste, excluding textile and paper)
			5.1.1.2 Biowaste in mixed waste (Not separately collected biodegradable municipal waste, excluding textile and paper)
	5.2 Post consumer wood	5.2.1 Post consumer wood	5.2.1.1 Non hazardous post consumer wood
			5.2.1.2 Hazardous post consumer wood

Results – Sustainable straw removal rate

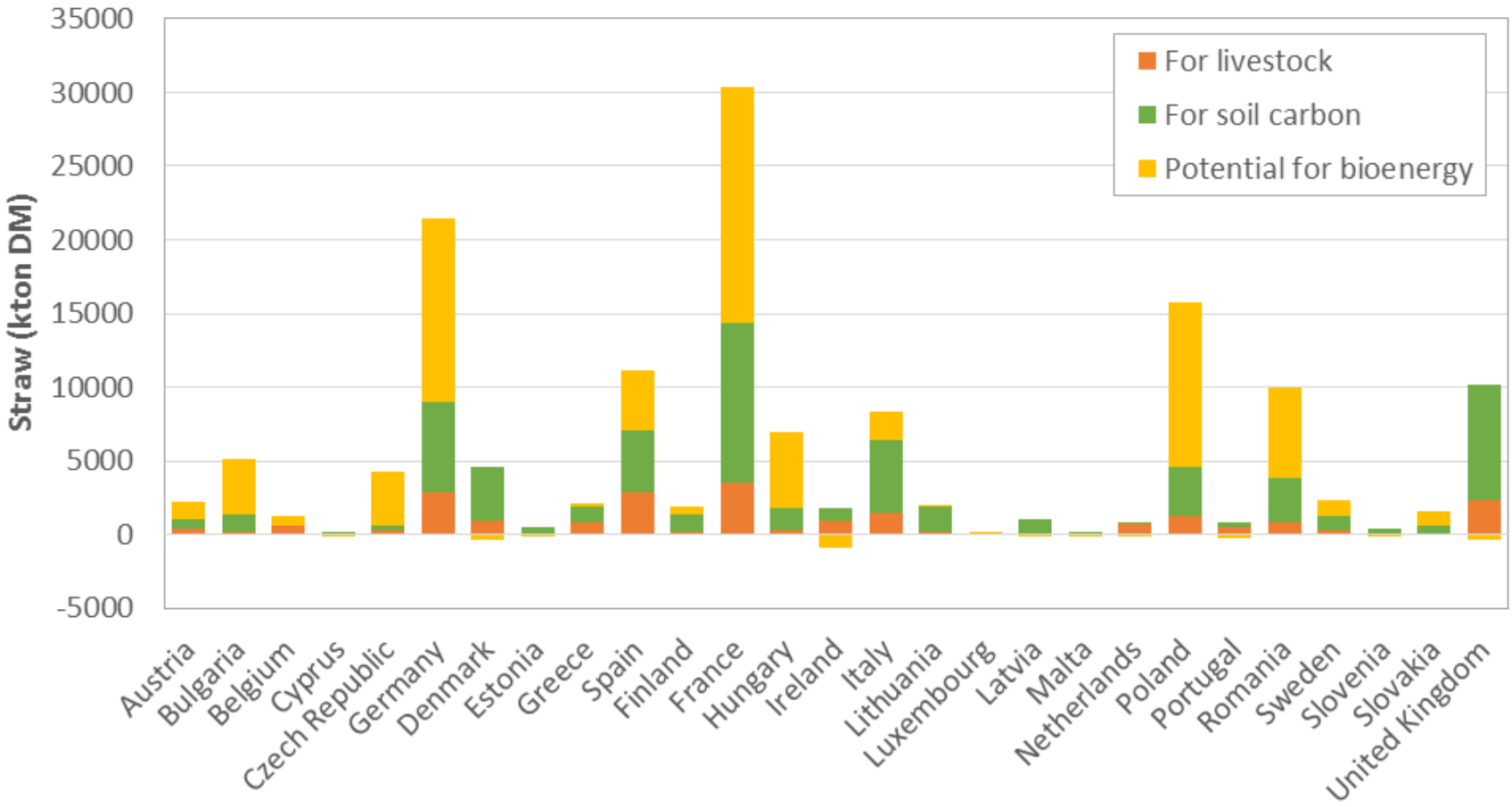


Total straw potential for bioenergy:

66 Mton dry matter

~1100 PJ

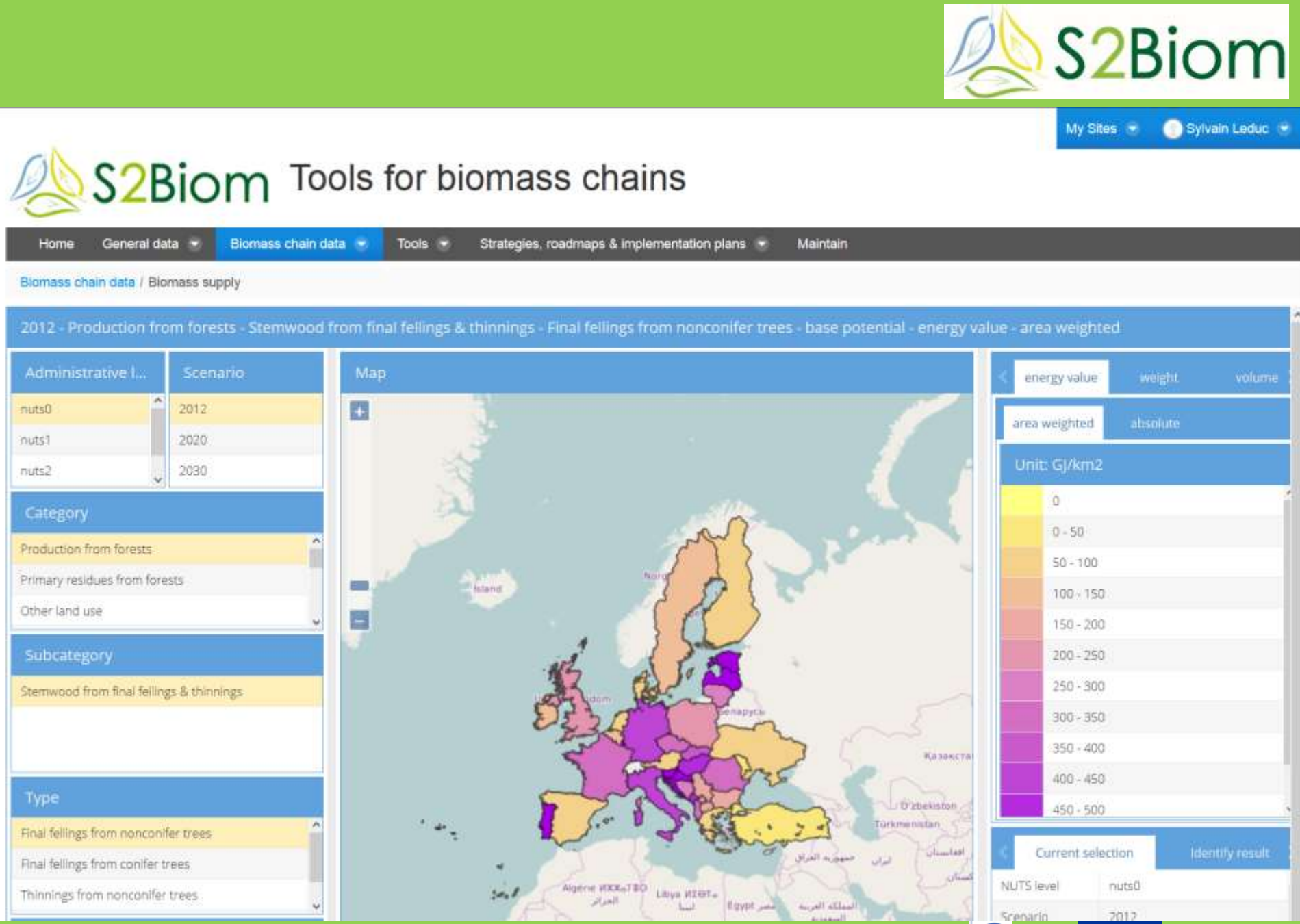
Results – Straw potential per country



Online tools

- **http://S2biom-test.Alterra.wur.nl**

- **Login:**
  - Username: demo
  - Password: helsinki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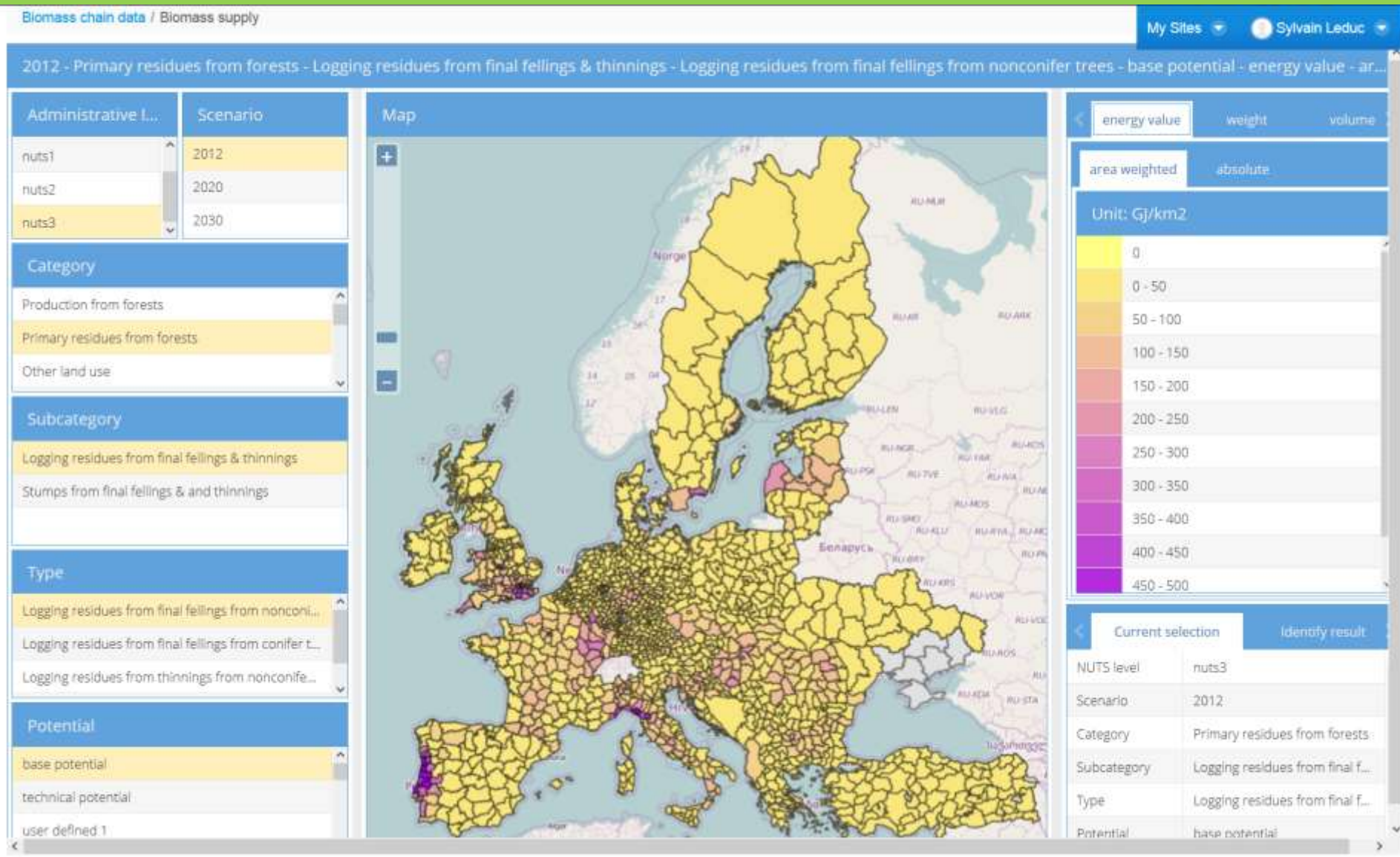
Home
General data
Biomass chain data
Tools
Strategies, roadmaps & implementation plans
Maintain
Biomass chain data / Biomass supply
2012 - Production from forests - Stemwood from final fellings & thinnings - Final fellings from nonconifer trees - base potential - energy value - area weighted
Administrative l...
Scenario
nuts0
nuts1
nuts2
2012
2020
2030
Category
Production from forests
Primary residues from forests
Other land use
Subcategory
Stemwood from final fellings & thinnings
Type
Final fellings from nonconifer trees
Final fellings from conifer trees
Thinnings from nonconifer trees
Map
energy value
weight
volume
area weighted
absolute
Unit: GJ/km2
0
0 - 50
50 - 100
100 - 150
150 - 200
200 - 250
250 - 300
300 - 350
350 - 400
400 - 450
450 - 500
Current selection
Identify result
NUTS level
nuts0
Scenario
2012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Category
Production from forests
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Potential
base potential
technical potential
user defined 1
Map
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energy value
weight
volume
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50 - 100
100 - 150
150 - 200
200 - 250
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350 - 400
400 - 450
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Current selection
Identify result
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nuts3
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2012
Category
Primary residues from forests
Subcategory
Logging residues from final f...
Type
Logging residues from final f...
Potential
base potential

S2Biom Tools for biomass chains

Introduction to S2BIOM GUI

Home: Here general information on the S2BIOM project and on the S2BIOM tool box is placed. It now provides short descriptions of the different items and tools (to be) included in the GUI.

General data: Under this item the following output will be included:

Scenarios (WP7): A short description will be placed of the central scenarios used in the p roject. For more detailed information on the scenarios and how they are used a link will be placed here to the final deliverable explaining the scenarios in detail.

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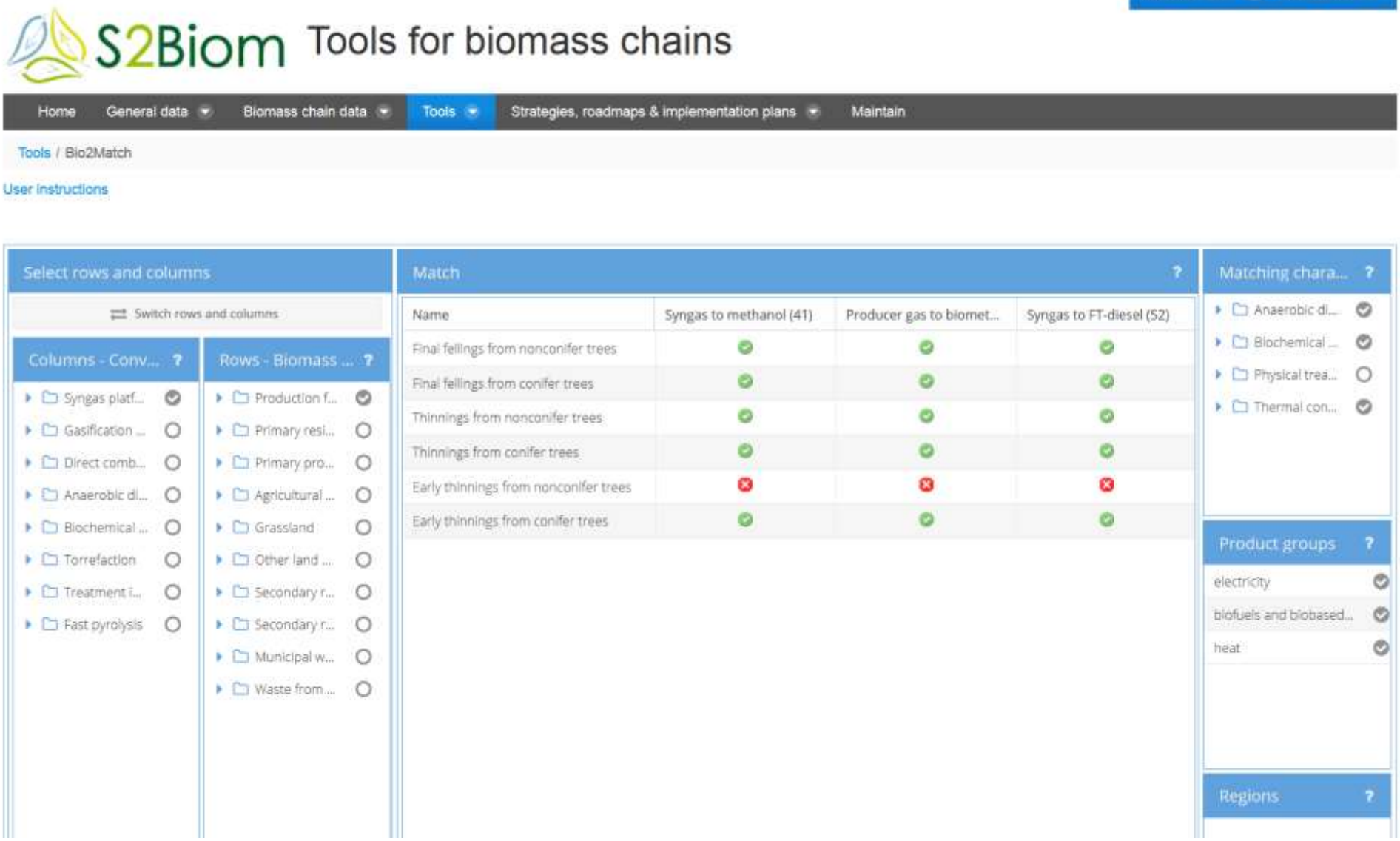
terra.wur.nl/web/guest/bewhere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Maintain
Tools / Bio2Match
User instructions
Select rows and columns
Switch rows and columns
Columns - Conv...
Syngas platf...
Gasification ...
Direct comb...
Anaerobic di...
Biochemical ...
Torrefaction
Treatment i...
Fast pyrolysis
Rows - Biomass ...
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Grassland
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Waste from ...
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Syngas to FT-diesel (52)
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Final fellings from conifer trees
Thinnings from nonconifer trees
Thinnings from conifer trees
Early thinnings from nonconifer trees
Early thinnings from conifer trees
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Anaerobic di...
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Physical trea...
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Product groups
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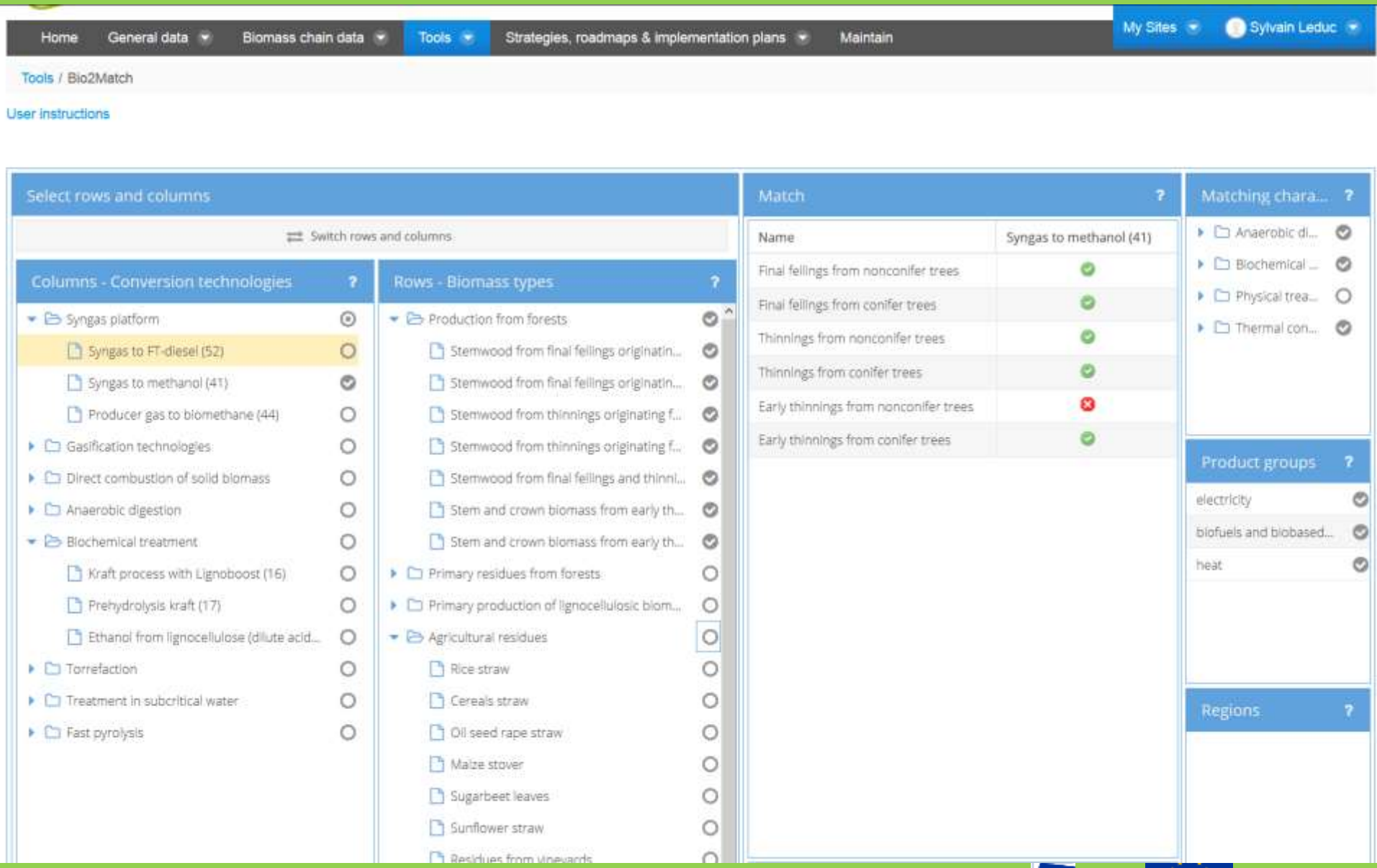
Regions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Switch rows and columns
Columns - Conversion technologies
Syngas platform
Syngas to FT-diesel (52)
Syngas to methanol (41)
Producer gas to biomethane (44)
Gasification technologies
Direct combustion of solid biomass
Anaerobic digestion
Biochemical treatment
Kraft process with Lignoboost (16)
Prehydrolysis kraft (17)
Ethanol from lignocellulose (dilute acid...
Torrefaction
Treatment in subcritical water
Fast pyrolysis
Rows - Biomass types
Production from forests
Stemwood from final fellings originatin...
Stemwood from final fellings originatin...
Stemwood from thinnings originating f...
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Stem and crown biomass from early th...
Primary residues from forests
Primary production of lignocellulosic biom...
Agricultural residues
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Cereals straw
Oil seed rape straw
Maize stover
Sugarbeet leaves
Sunflower straw
Residues from vineyards
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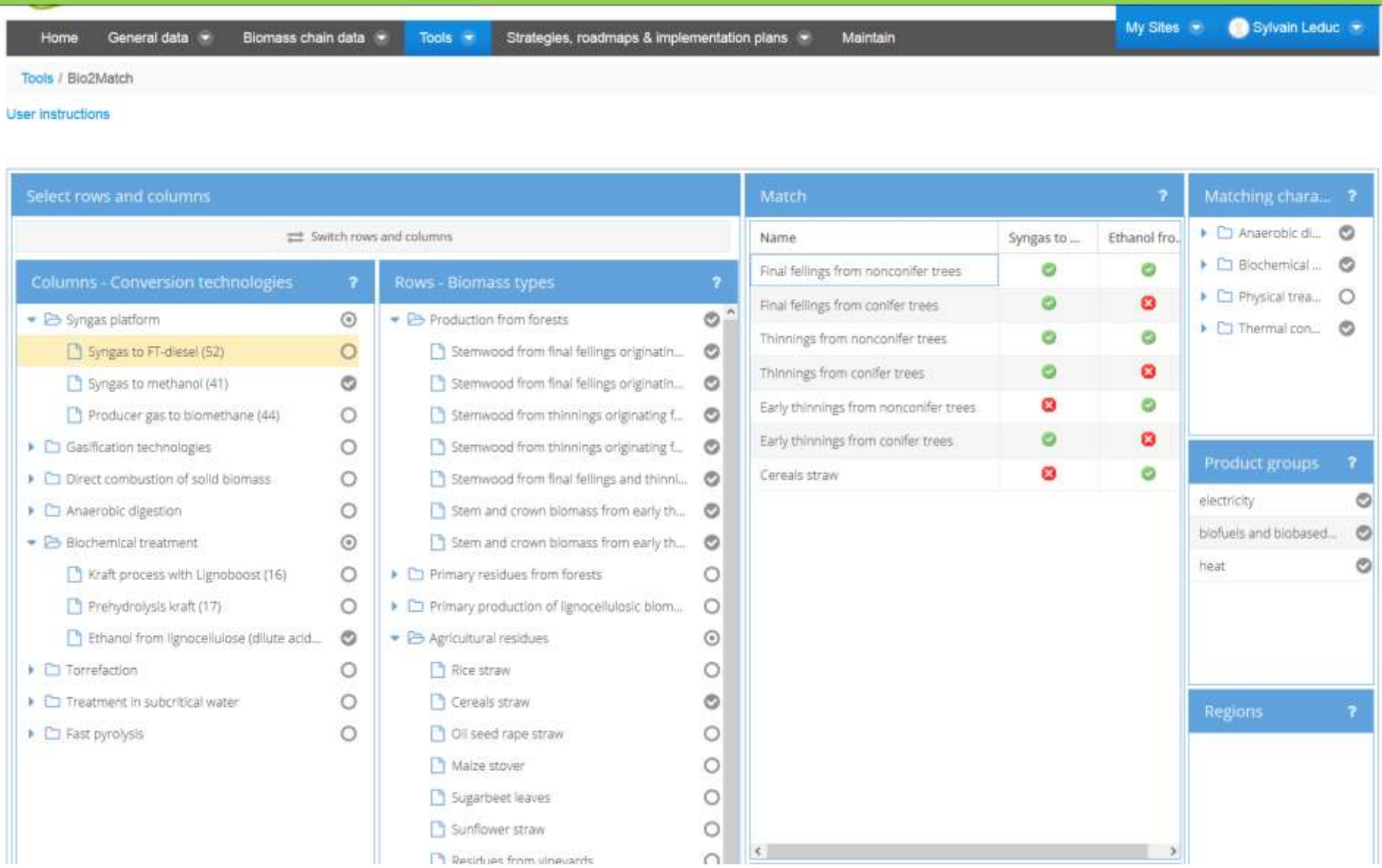
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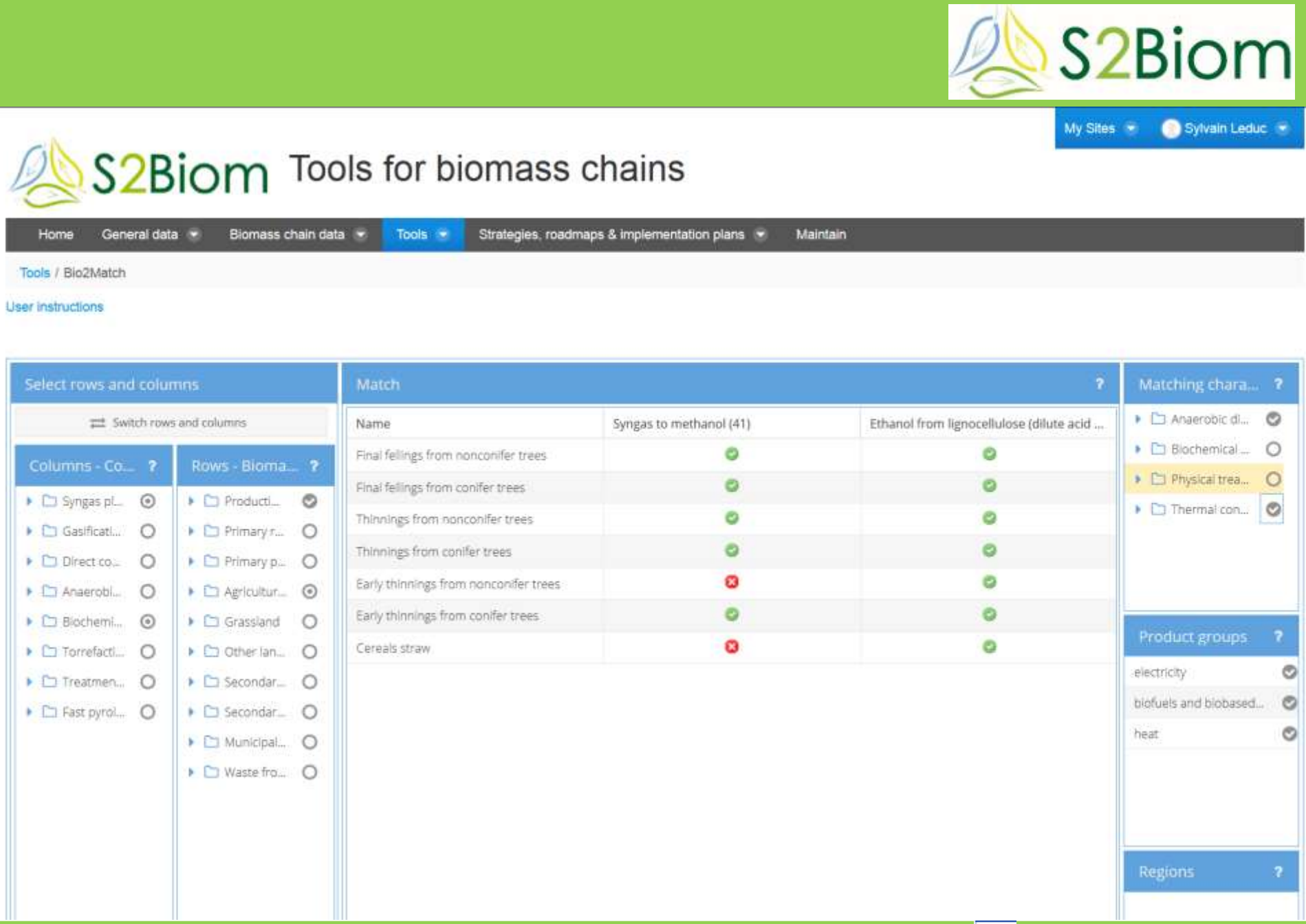
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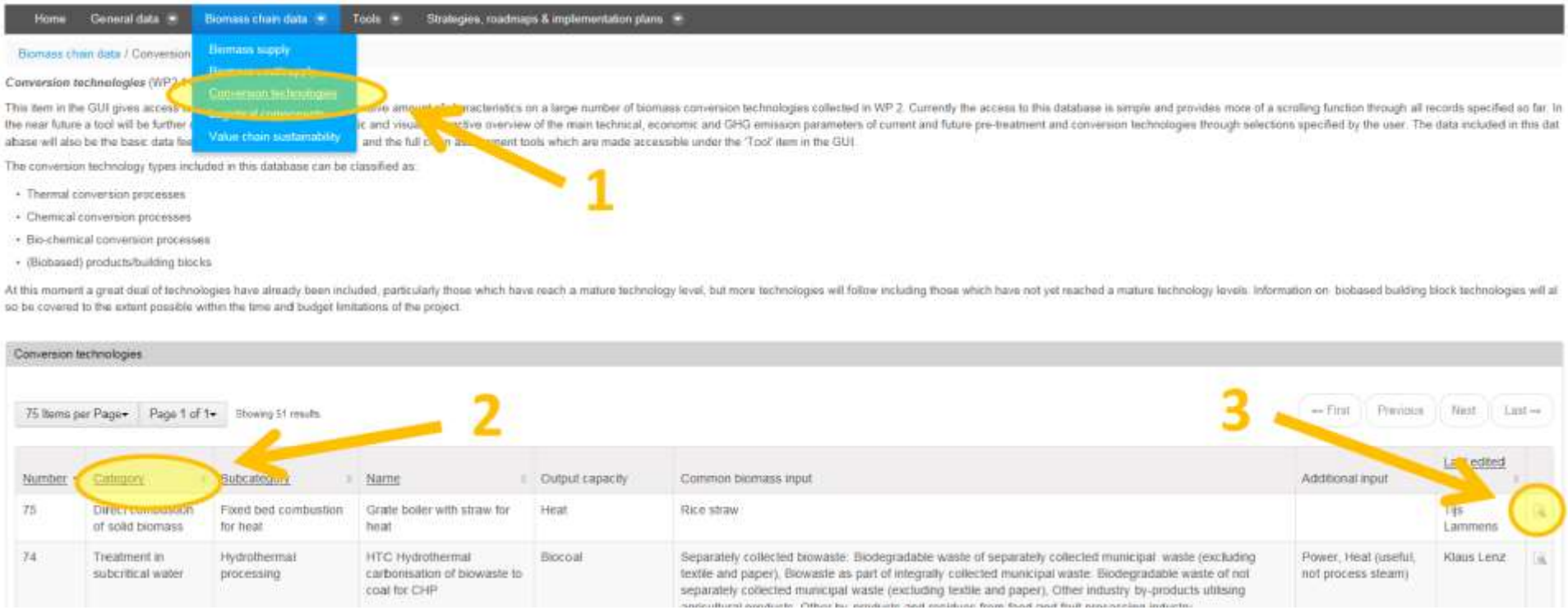
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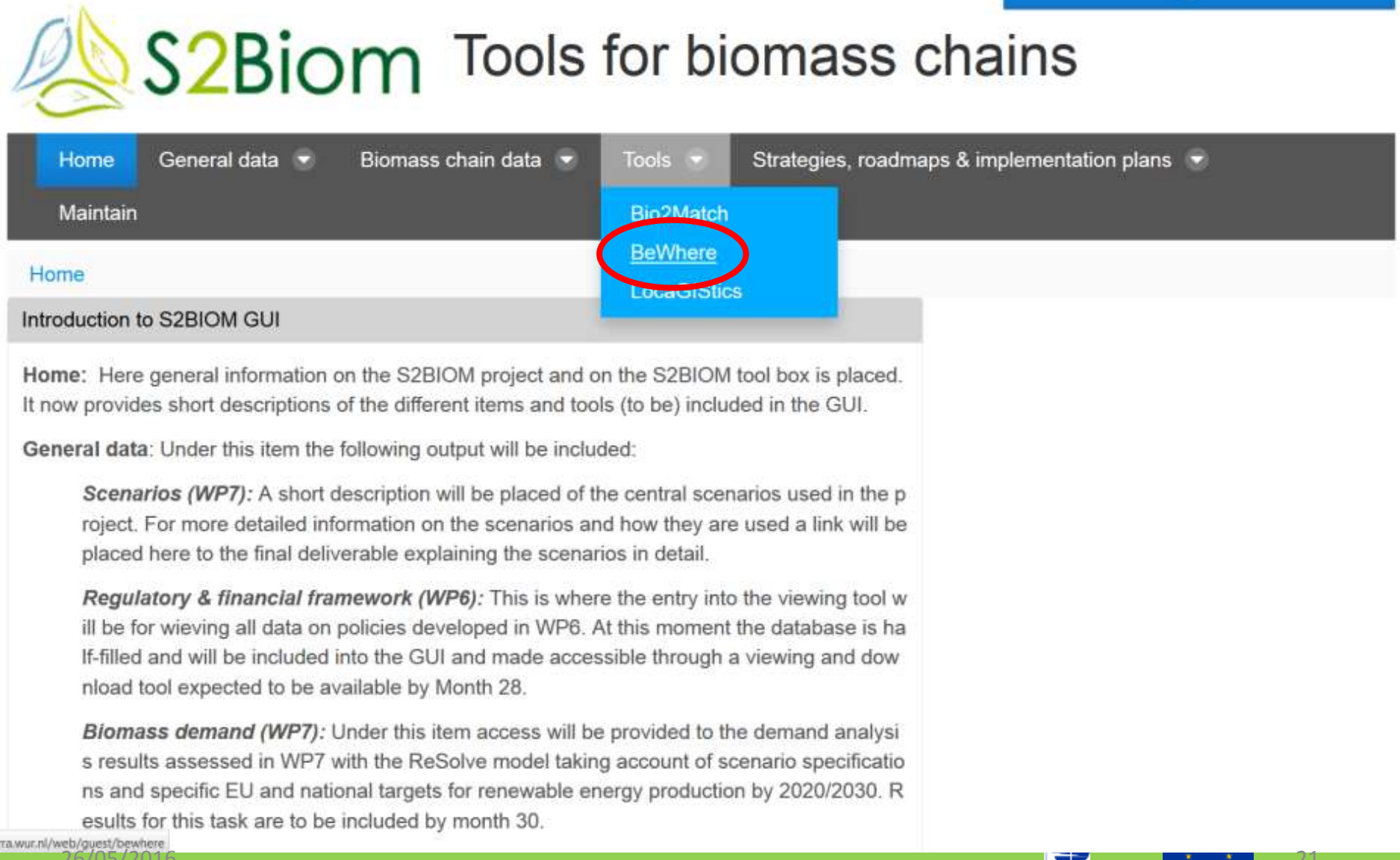
Conversion technologies
Value chain sustainability
1
2
3
Conversion technologies
75 items per Page
Page 1 of 1
Showing 51 results
First
Previous
Next
Last
Number
Category
Subcategory
Name
Output capacity
Common biomass input
Additional input
Last edited
75
Fixed bed combustion for heat
Grate boiler with straw for heat
Heat
Rice straw
Tijs Lammens
74
Treatment in subcritical water
Hydrothermal processing
HTC Hydrothermal carbonisation of biowaste to coal for CHP
Biocoal
Separately collected biowaste: Biodegradable waste of separately collected municipal waste (excluding textile and paper), Biowaste as part of integrally collected municipal waste: Biodegradable waste of not separately collected municipal waste (excluding textile and paper), Other industry by-products utilising
Power, Heat (useful, not process steam)
Klaus Lenz

BeWhere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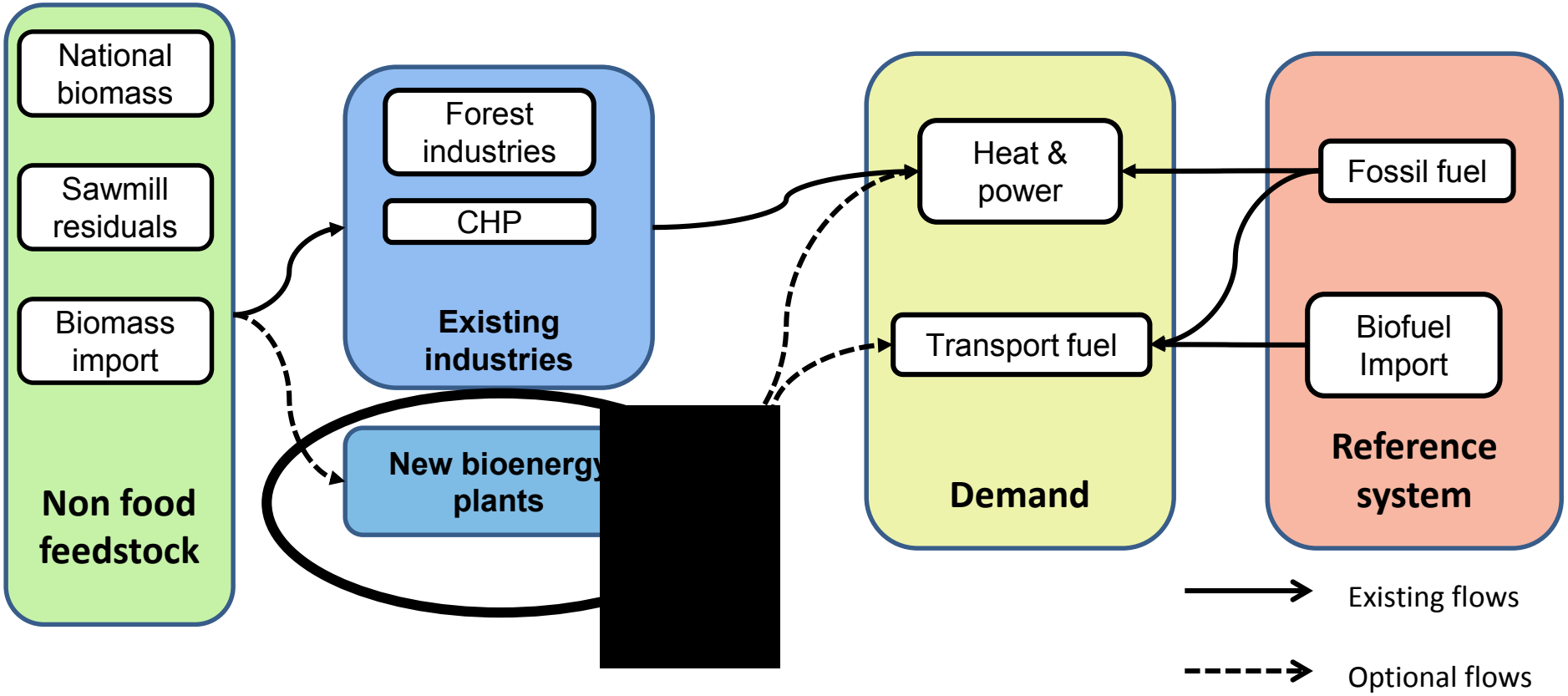
The BeWhere Umbrella

Supply chain

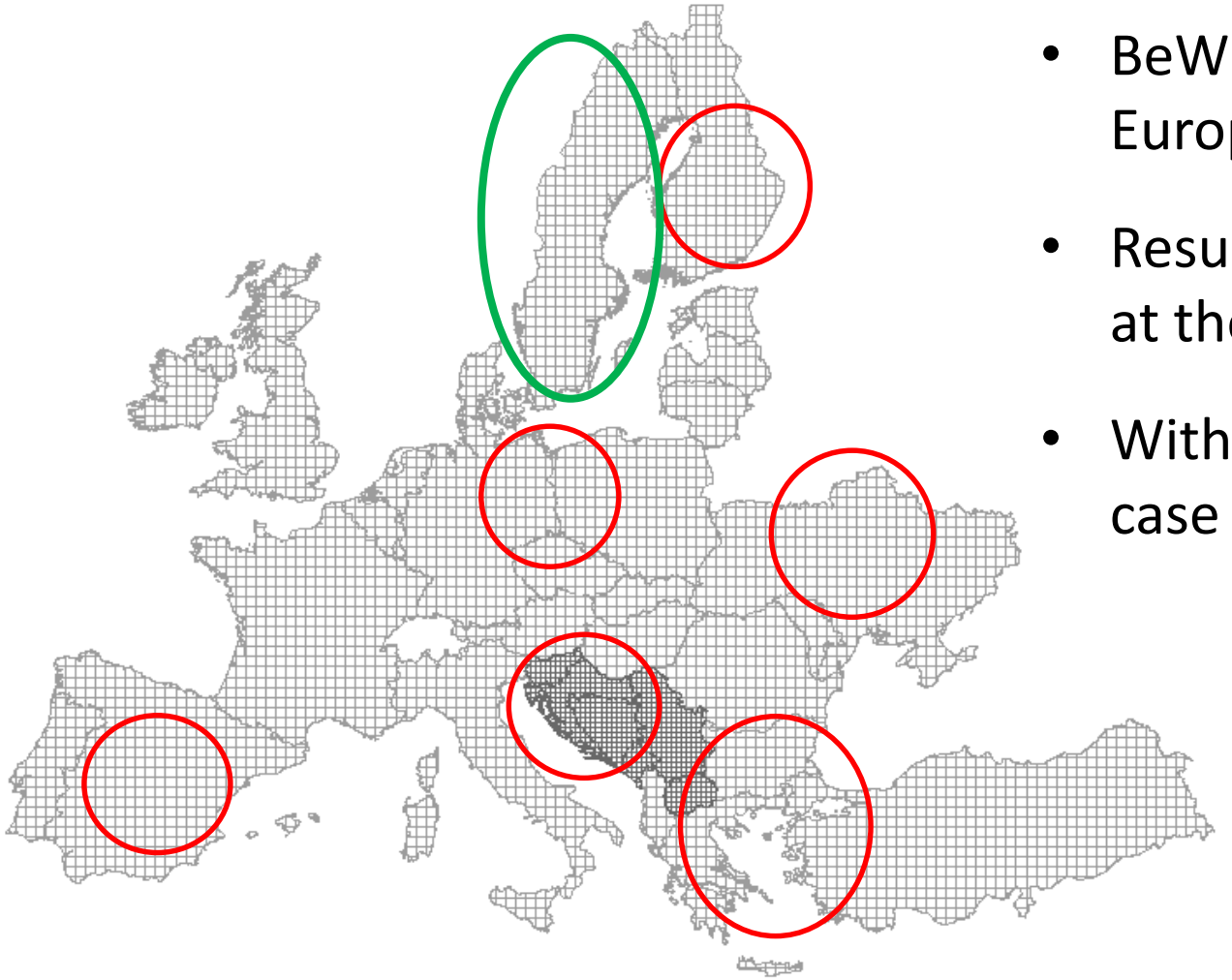


Minimize the total cost for the region's welfare

*min [Cost + Emissions * (Carbon Tax)]*

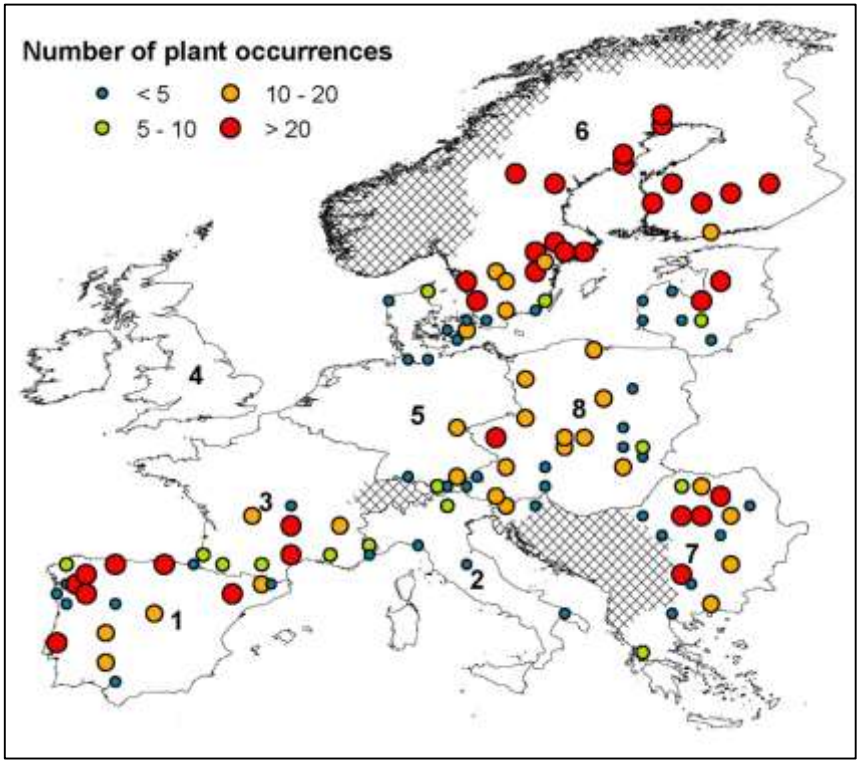
Does not maximize the profit of a plant

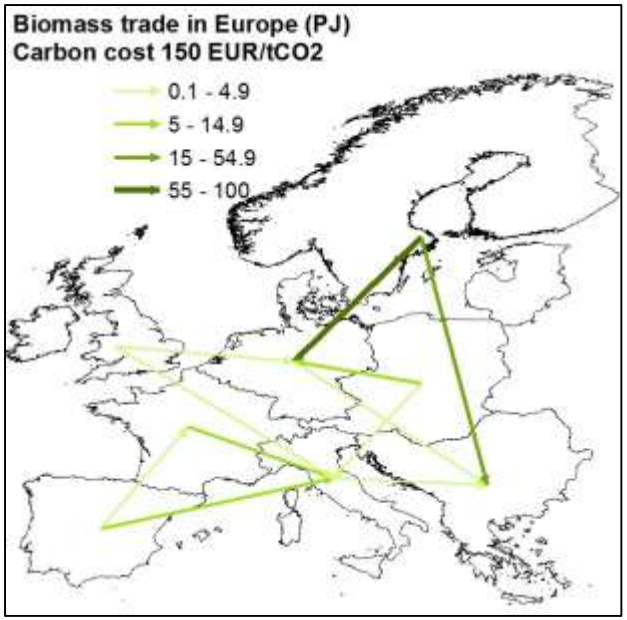
BeWhere and Europe

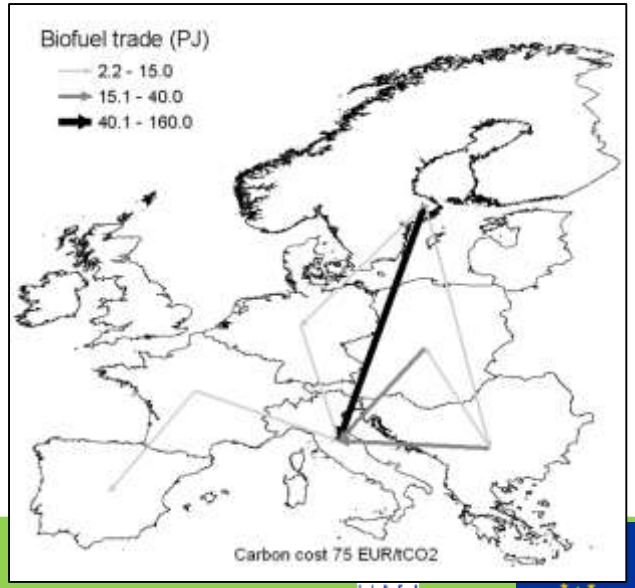


- BeWhere will be run for Europe
- Results will be extracted at the country level
- With a special focus on case studies

BeWhere Europe



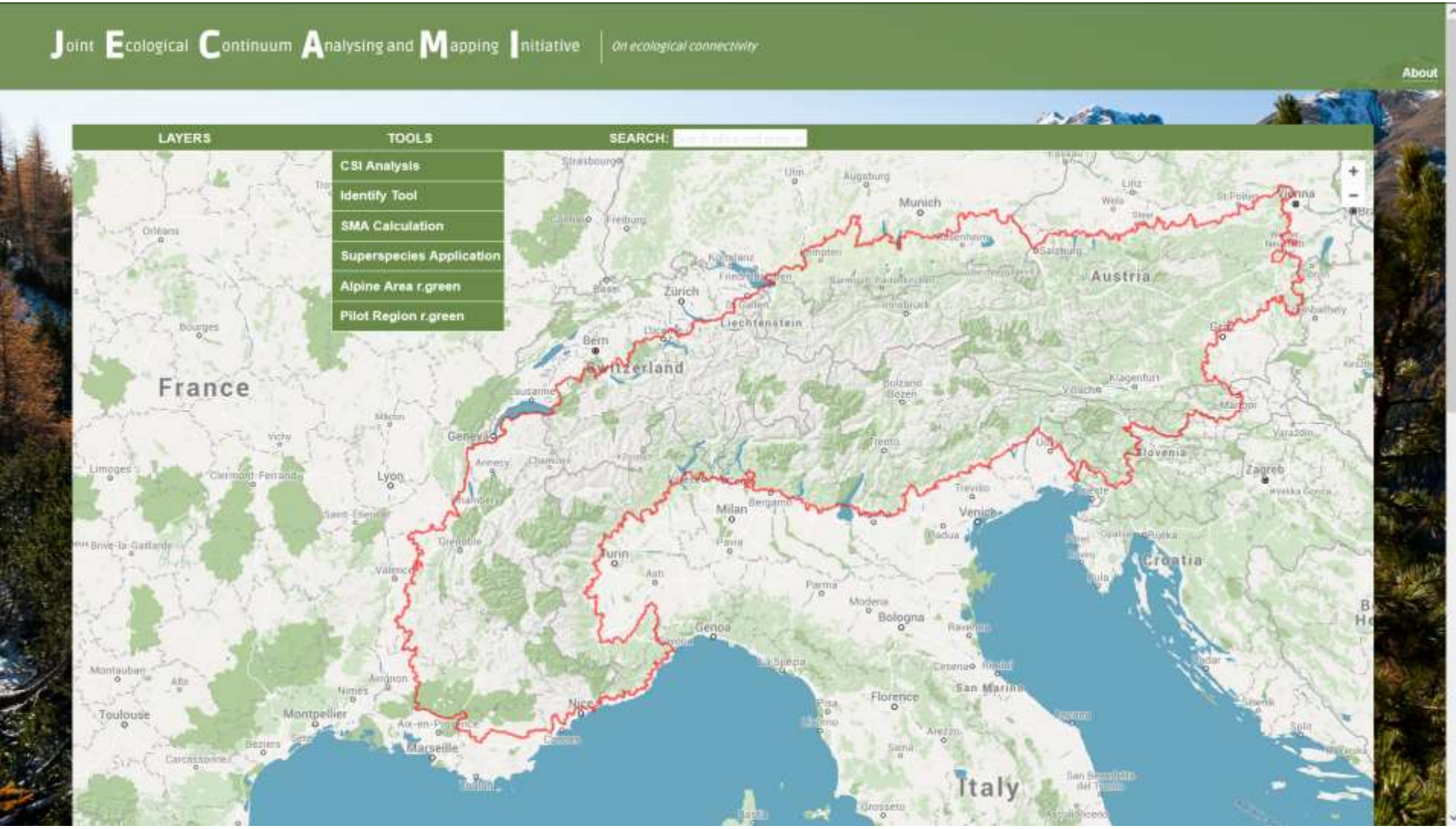




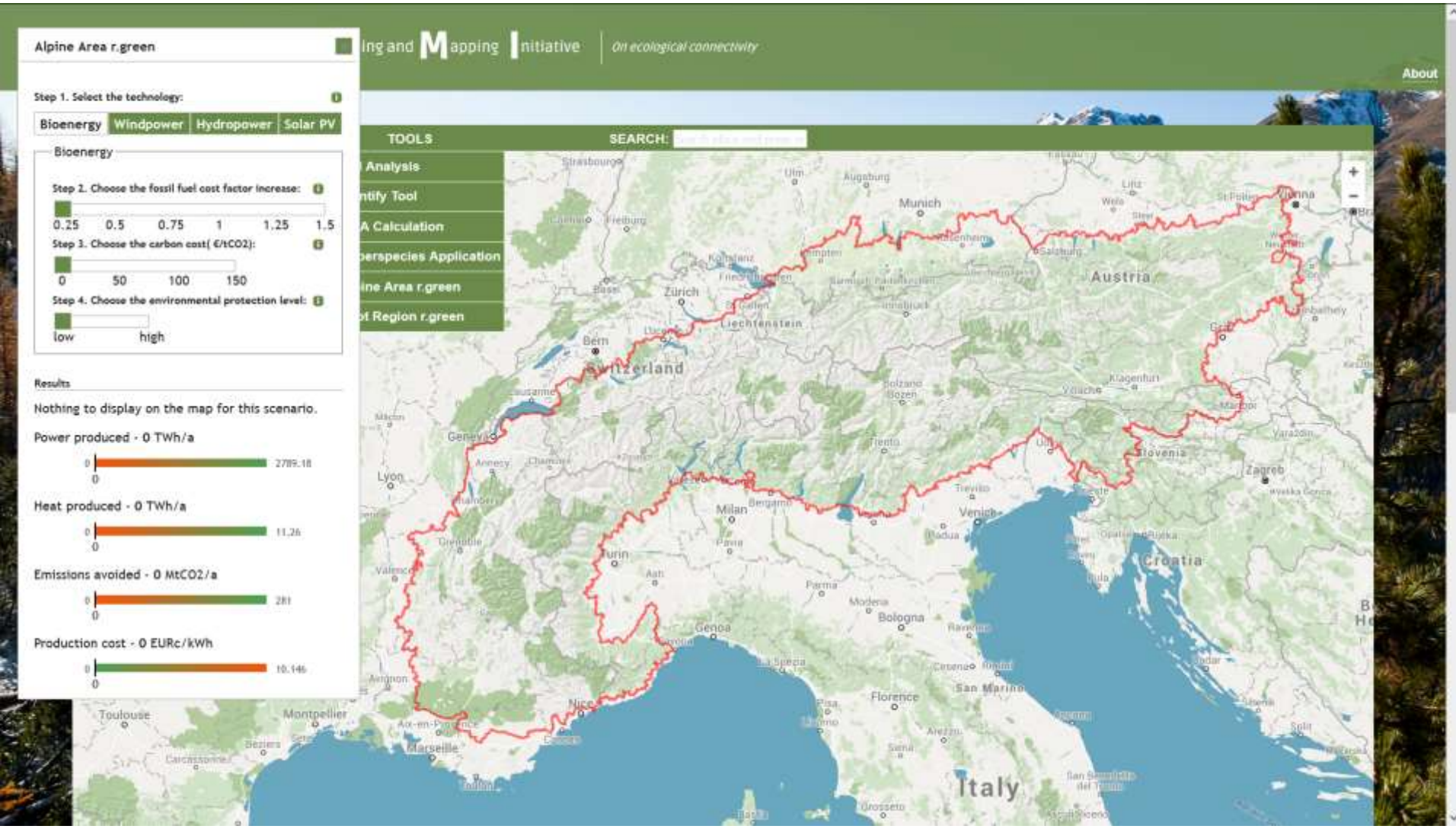
Decision support System

www.jecami.eu

BeWhere - DSS


Joint Ecological Continuum Analysing and Mapping Initiative
On ecological connectivity
About
LAYERS
TOOLS
SEARCH:
CSI Analysis
Identify Tool
SMA Calculation
Superspecies Application
Alpine Area r.green
Pilot Region r.green
France
Switzerland
Austria
Italy
Croatia
Slovenia
Munich
Zürich
Liechtenstein
Geneva
Lyon
Milan
Turin
Genoa
Venice
Florence
Marseille
Nice
Montpellier
Toulouse
Zagreb
San Marino

BeWhere - DSS


Alpine Area r.green
ing and Mapping Initiative
On ecological connectivity
About
Step 1. Select the technology:
Bioenergy
Windpower
Hydropower
Solar PV
Bioenergy
Step 2. Choose the fossil fuel cost factor increase:
0.25 0.5 0.75 1 1.25 1.5
Step 3. Choose the carbon cost(€/tCO2):
0 50 100 150
Step 4. Choose the environmental protection level:
low high
Results
Nothing to display on the map for this scenario.
Power produced - 0 TWh/a
Heat produced - 0 TWh/a
Emissions avoided - 0 MtCO2/a
Production cost - 0 EURc/kWh
TOOLS
SEARCH:
Analysis
ntify Tool
A Calculation
erspecies Application
ine Area r.green
t Region r.green
Switzerland
Austria
Slovenia
Croatia
Italy
Munich
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Montpellier
Toulouse
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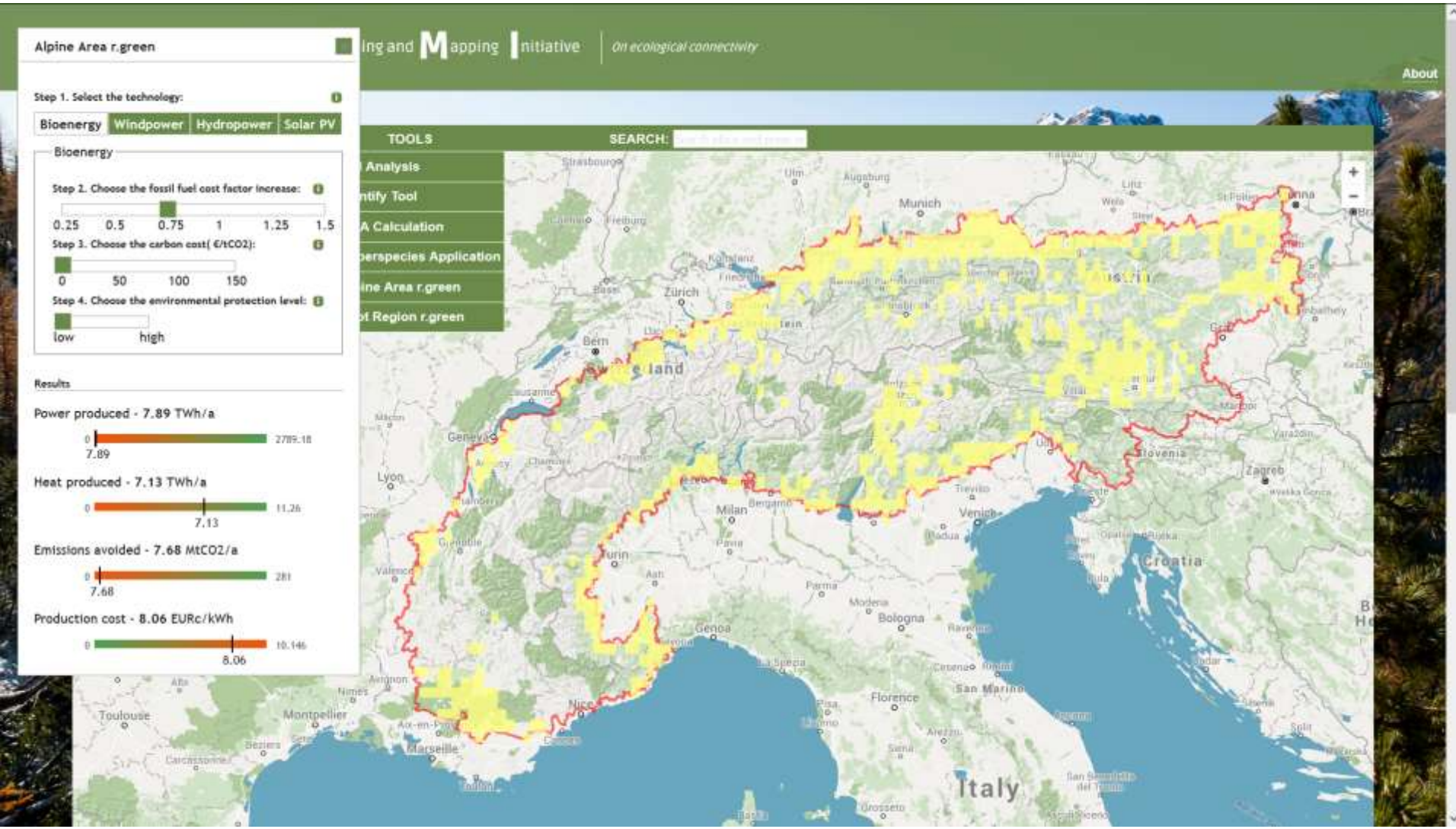
San Marino

BeWhere - DSS


Alpine Area r.green
ing and Mapping Initiative
On ecological connectivity
About
Step 1. Select the technology:
Bioenergy
Windpower
Hydropower
Solar PV
Bioenergy
Step 2. Choose the fossil fuel cost factor increase:
0.25 0.5 0.75 1 1.25 1.5
Step 3. Choose the carbon cost(€/tCO2):
0 50 100 150
Step 4. Choose the environmental protection level:
low high
Results
Power produced - 7.89 TWh/a
7.89
Heat produced - 7.13 TWh/a
7.13
Emissions avoided - 7.68 MtCO2/a
7.68
Production cost - 8.06 EURc/kWh
8.06
TOOLS
SEARCH:
Analysis
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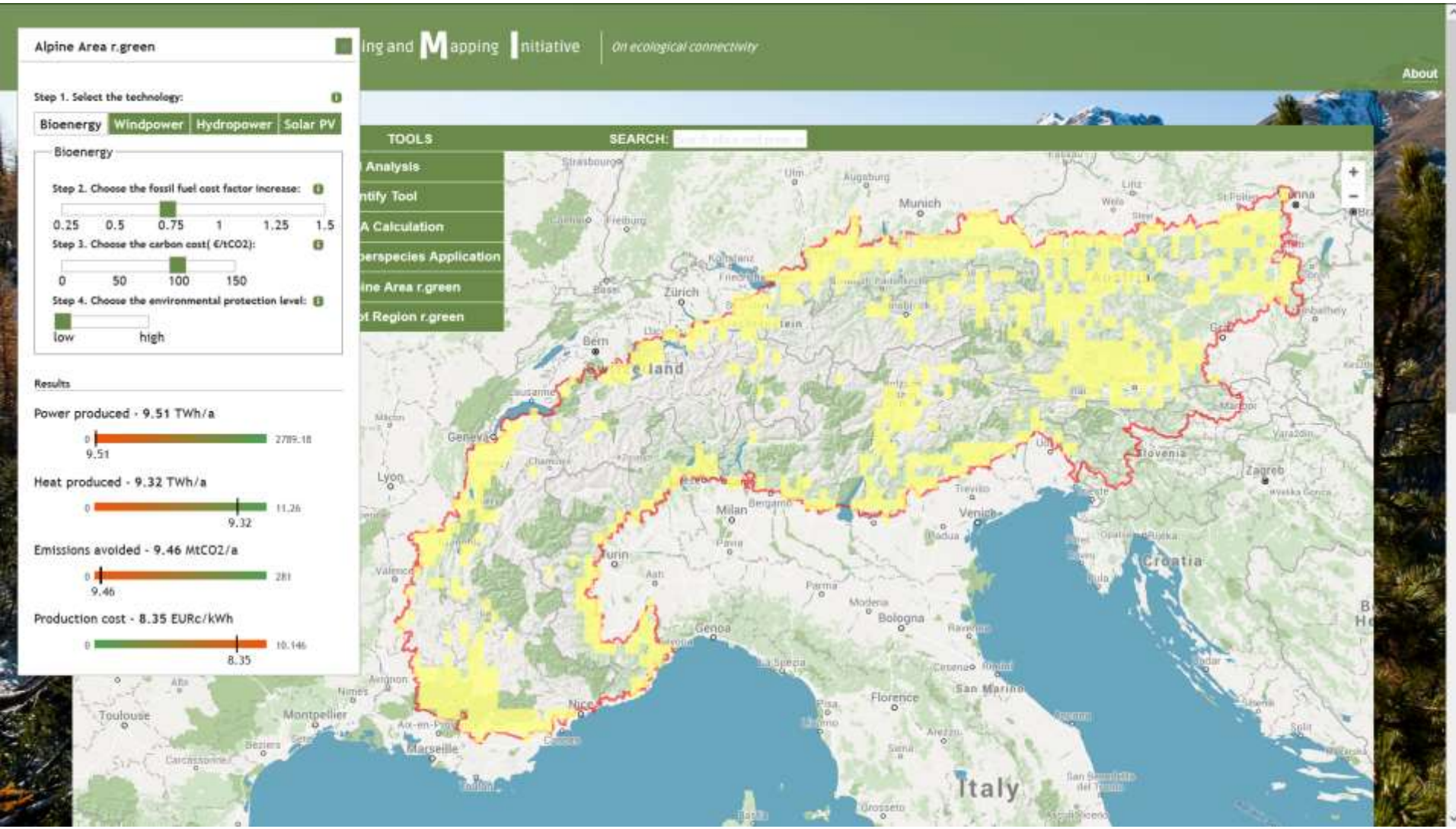
t Region r.green
Munich
Zürich
Bern
Geneva
Lyon
Milan
Turin
Genoa
Venice
Bologna
Florence
Marseille
Nice
Montpellier
Toulouse
Slovenia
Zagreb
Croatia
San Marino
Italy

BeWhere - DSS


Alpine Area r.green
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Solar PV
Bioenergy
Step 2. Choose the fossil fuel cost factor increase:
0.25 0.5 0.75 1 1.25 1.5
Step 3. Choose the carbon cost(€/tCO2):
0 50 100 150
Step 4. Choose the environmental protection level:
low high
Results
Power produced - 9.51 TWh/a
9.51
Heat produced - 9.32 TWh/a
9.32
Emissions avoided - 9.46 MtCO2/a
9.46
Production cost - 8.35 EURc/kWh
8.35
TOOLS
SEARCH:
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A Calculation
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Munich
Zürich
Bern
Geneva
Lyon
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Venice
Bologna
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Marseille
Montpellier
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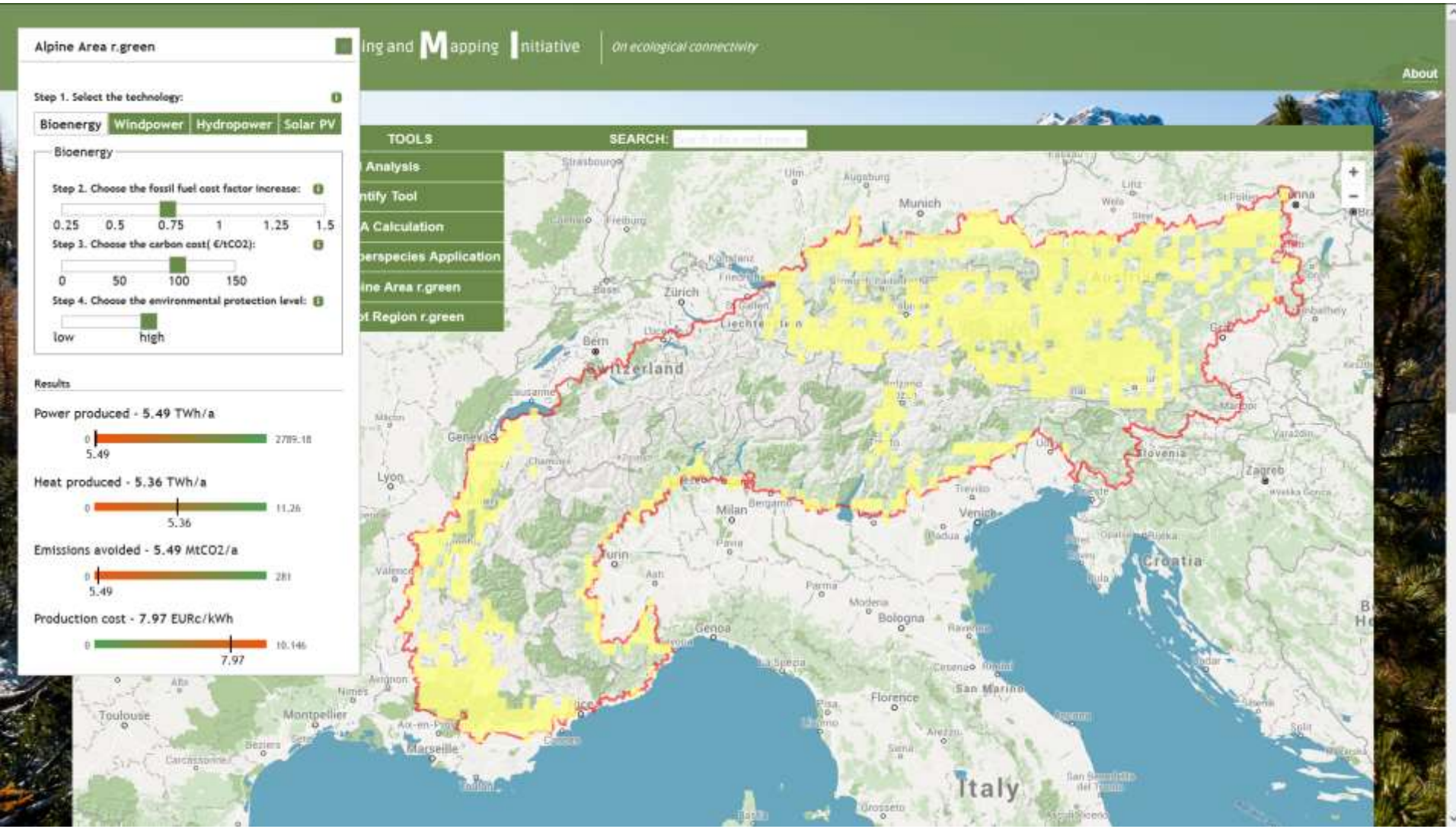
Italy

BeWhere - DSS


Alpine Area r.green
ing and Mapping Initiative
On ecological connectivity
About
Step 1. Select the technology:
Bioenergy
Windpower
Hydropower
Solar PV
Bioenergy
Step 2. Choose the fossil fuel cost factor increase:
0.25 0.5 0.75 1 1.25 1.5
Step 3. Choose the carbon cost(€/tCO2):
0 50 100 150
Step 4. Choose the environmental protection level:
low high
Results
Power produced - 5.49 TWh/a
5.49
Heat produced - 5.36 TWh/a
5.36
Emissions avoided - 5.49 MtCO2/a
5.49
Production cost - 7.97 EURc/kWh
7.97
TOOLS
SEARCH:
Analysis
ntify Tool
A Calculation
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t Region r.green
Switzerland
Italy
Croatia
Slovenia
Munich
Zürich
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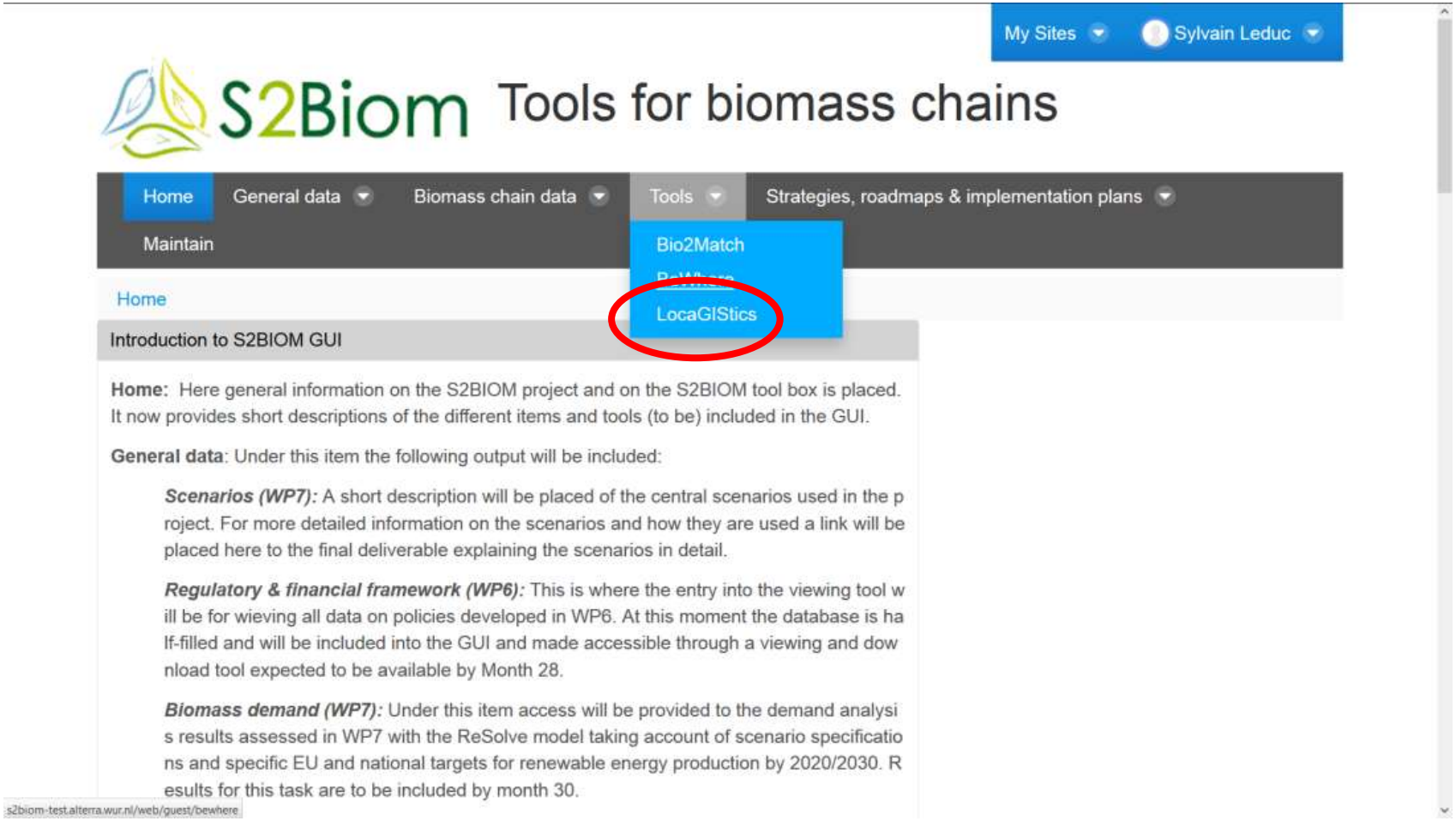
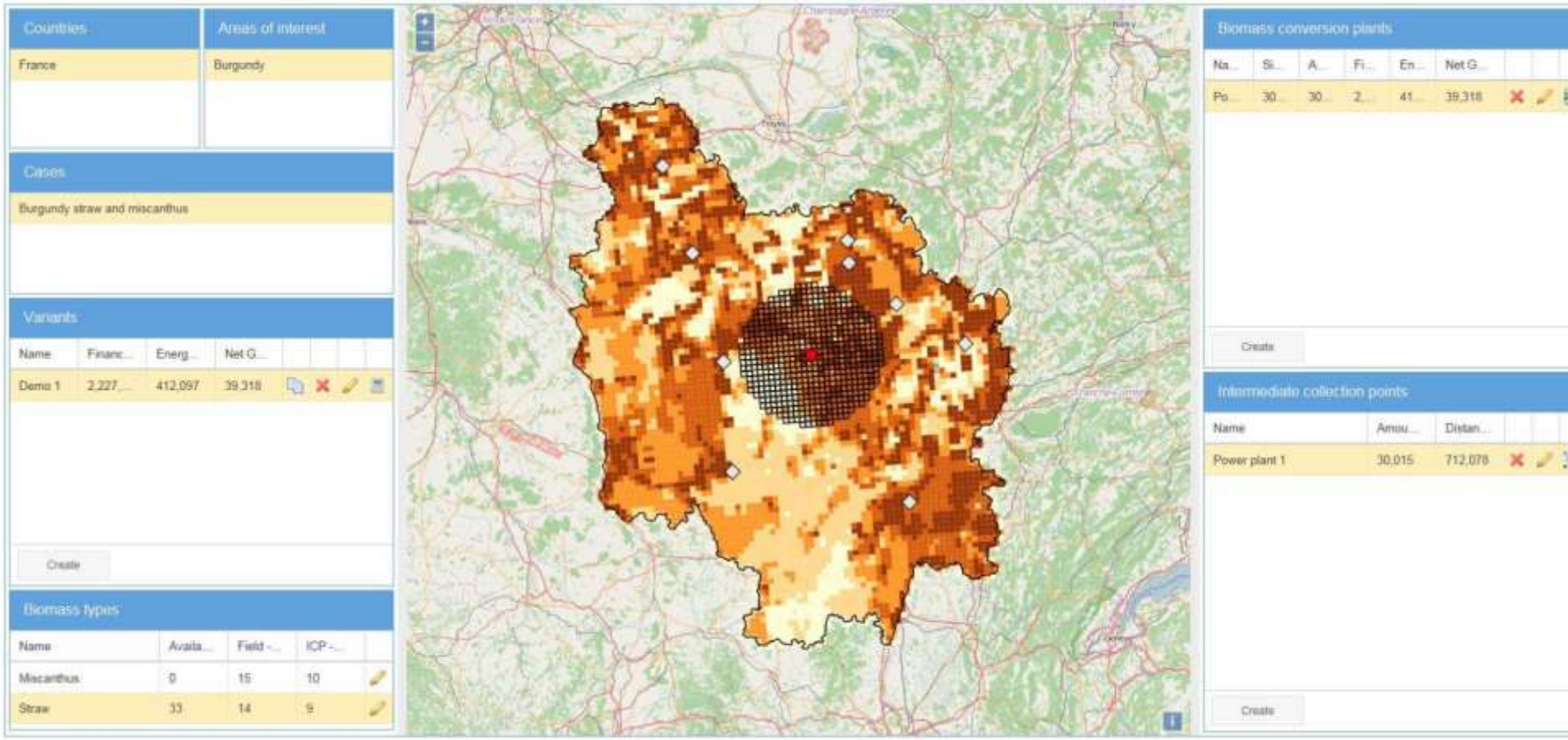
Montpellier
Toulouse
Lyon
Zagreb
San Marino

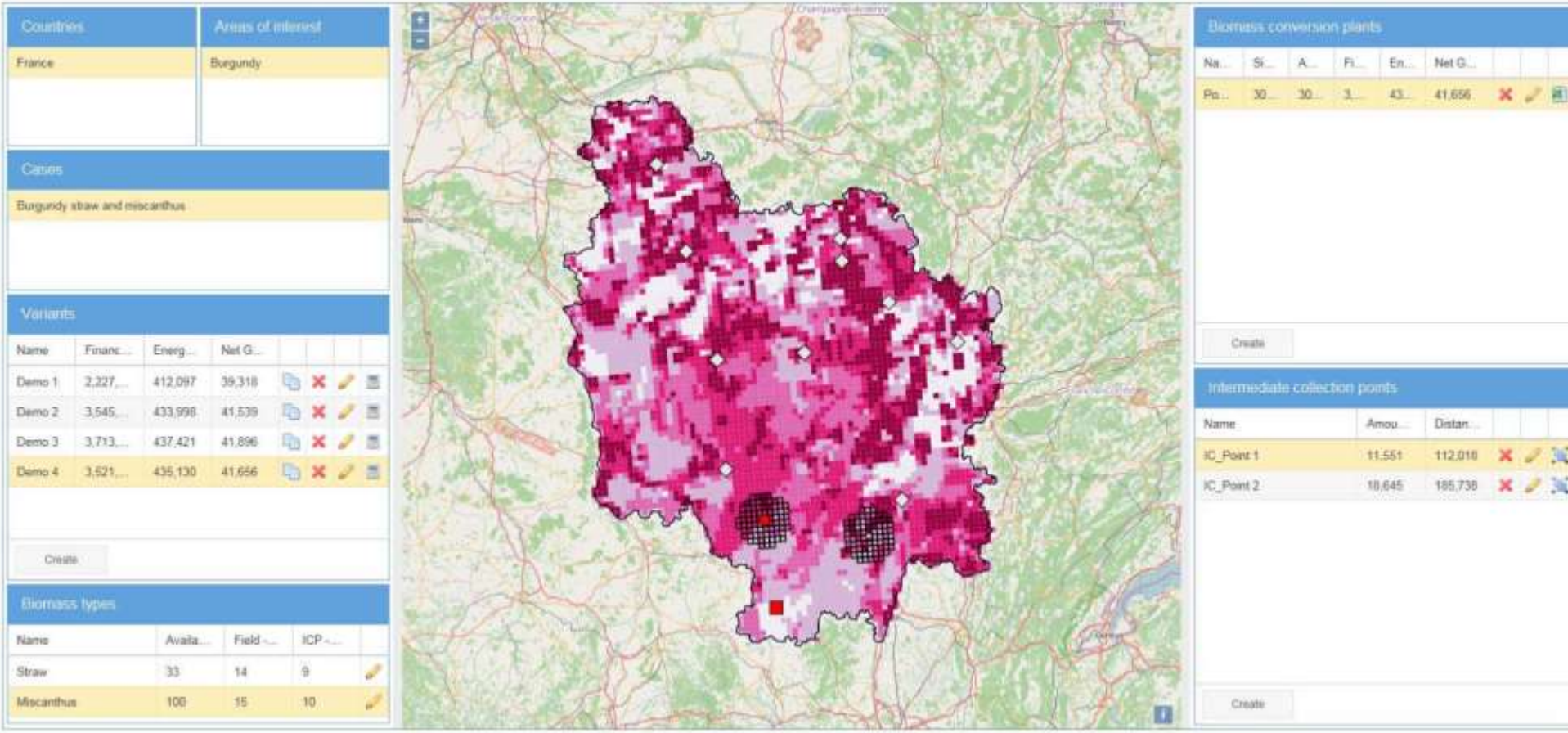
LocaGistics



LocaGistics



LocaGistics



BeWhere / Locagistic

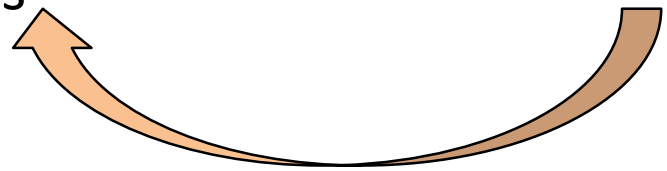
- Plants location, size and technology
- Biomass used
- Costs
- Emissions avoided

BeWhere

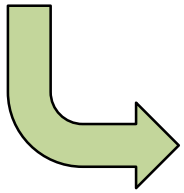
Determine the optimal location of plants

LOCAgistics

Calculations at the plant level



Quality check!



Final results

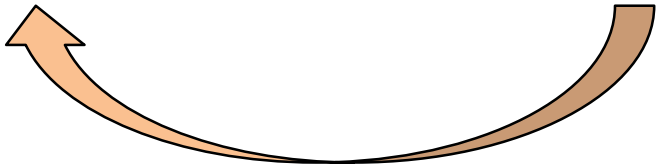
BeWhere / BeWhere

- Plants location, size and technology
- Biomass used
- Costs

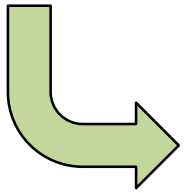
- Emissions avoided
- Biomass and biofuel trades

BeWhere Europe

BeWhere Sweden



Quality check!



Final results

Thank you for your attention !!

Sylvain Leduc

leduc@iiasa.ac.at
+43-(0)2236 807 267

More about BeWhere

www.iiasa.ac.at/bewhere

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