BeWhere tool
for optimal technology, location and capacity of bioenergy production plants

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

2nd South East European Conference on Sustainable Development of Energy, Water and Environment Systems
16 June 2016

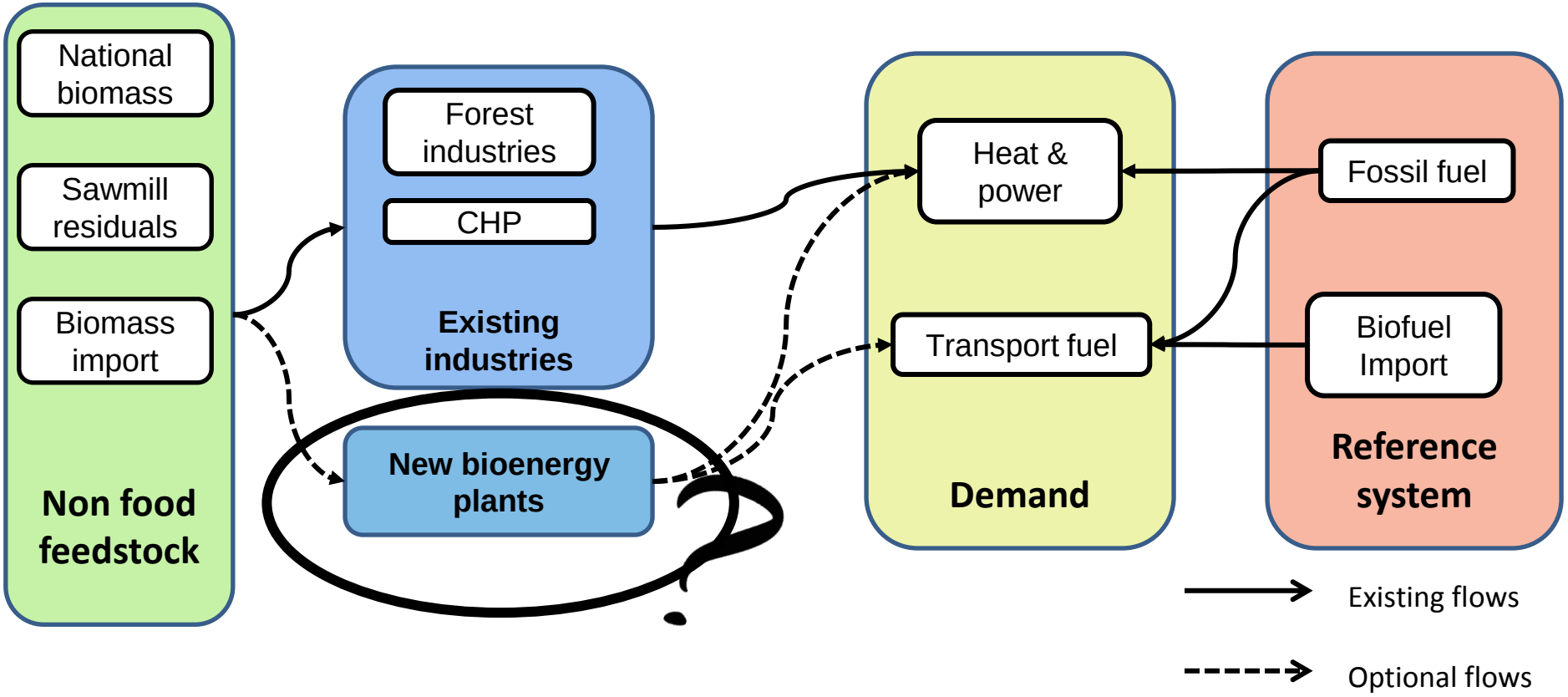



This project is co-funded by the European Union within the 7th Frame Programme. Grant Agreement n°608622.

Outline

- Model description
- Case studies
- Visualization
- Questions?

Supply chain



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

Input data / Summary

- **Biomass**
  - Location
  - Availability
  - Collecting cost
- **Existing industries**
  - Location
  - Feedstock demand
  - Power/heat output
- **Production plants**
  - Type of biomass
  - Biomass need
  - Economic parameters
  - Conversion efficiency
- **Transport**
  - Type of transport per feedstock
  - Costs
  - Emissions
- **Demand**
  - Location
  - Heat / power / transport fuel
  - Price of competing fossil fuel heat / power / transport fuel
- **Policy in place**
  - Carbon cost
  - Biofuel support
  - Subsidies

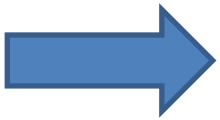
BeWhere answers…

(1)Number

(2)Technologies

(3)Size

(4)Locations



Policy tool

Costs

Emission avoided

Direct emissions

Economic potential

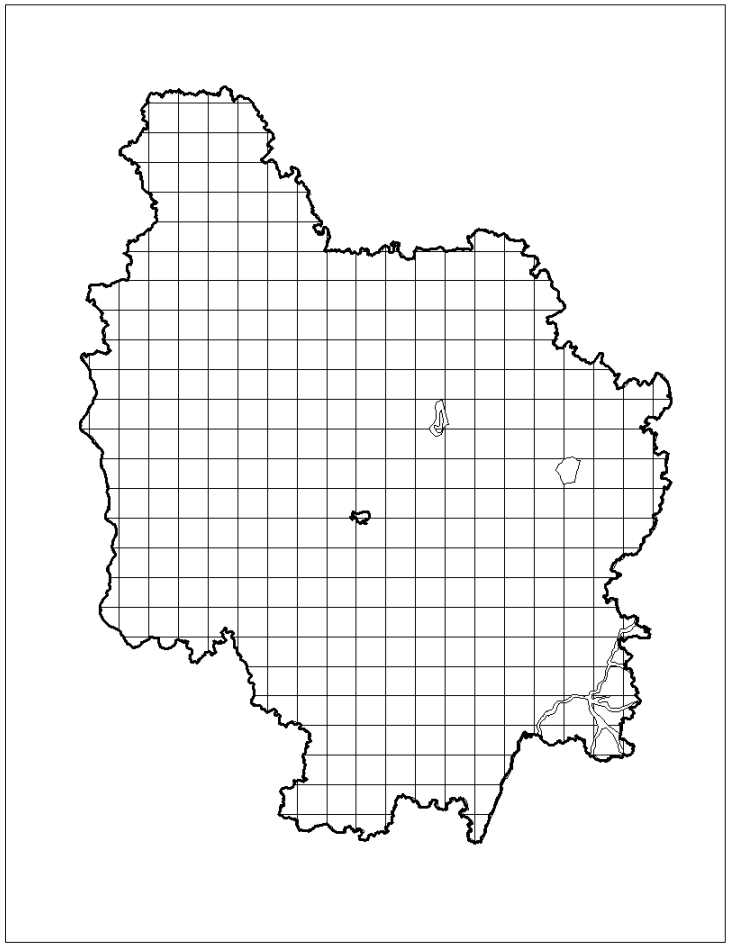
Trades

BeWhere / LocaGIStics

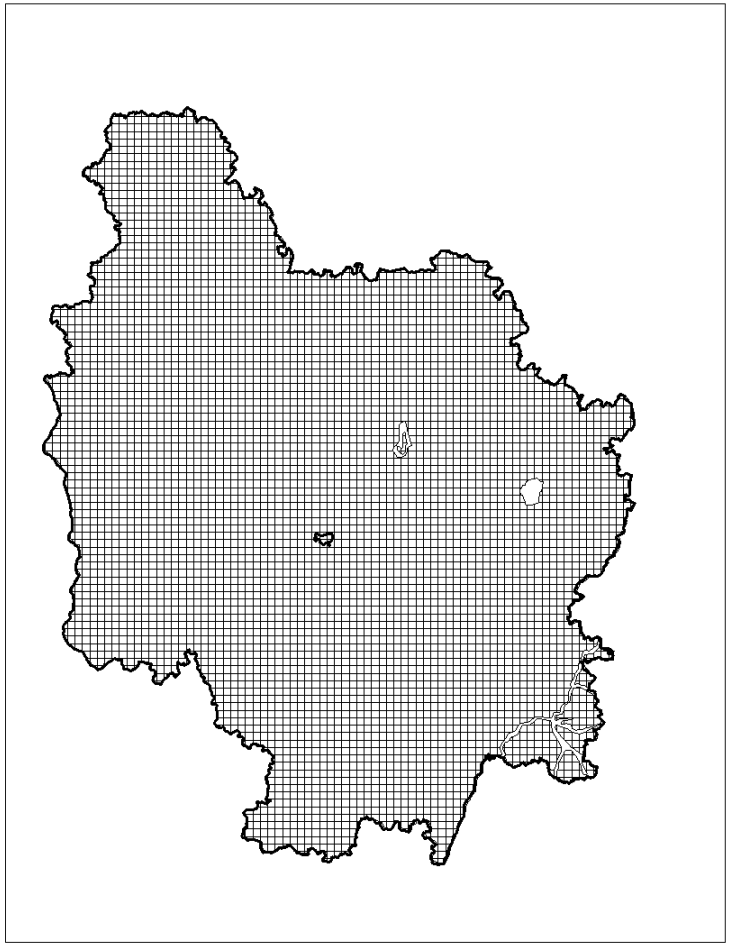
- **BeWhere**
  - Supply chain optimization
  - National level
  - Rough grid
  - Determine the optimal geographic location of production plants
- **LocaGIStics**
  - Supply chain simulation
  - Regional level
  - Finer grid
  - Use the plant location optimized from BeWHere

Burgundy case study

BeWhere 377 grid points

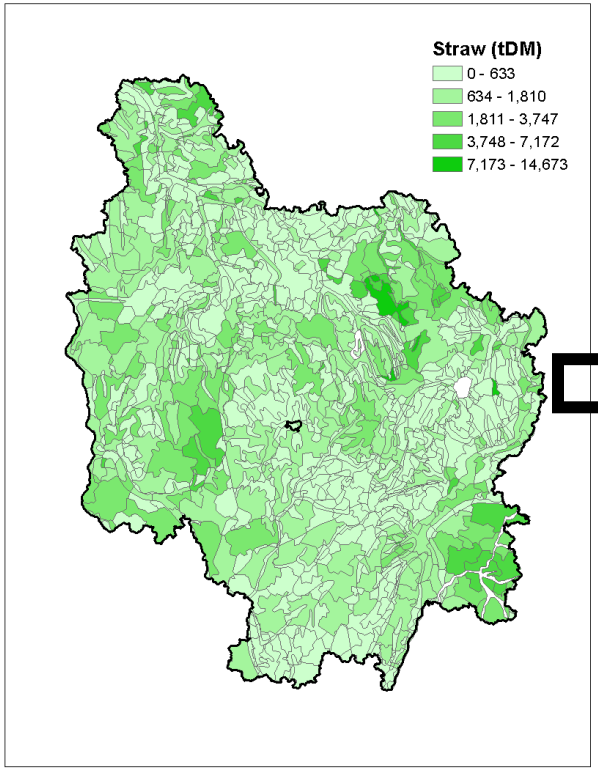


LocaGIStics - 5,357 grid points

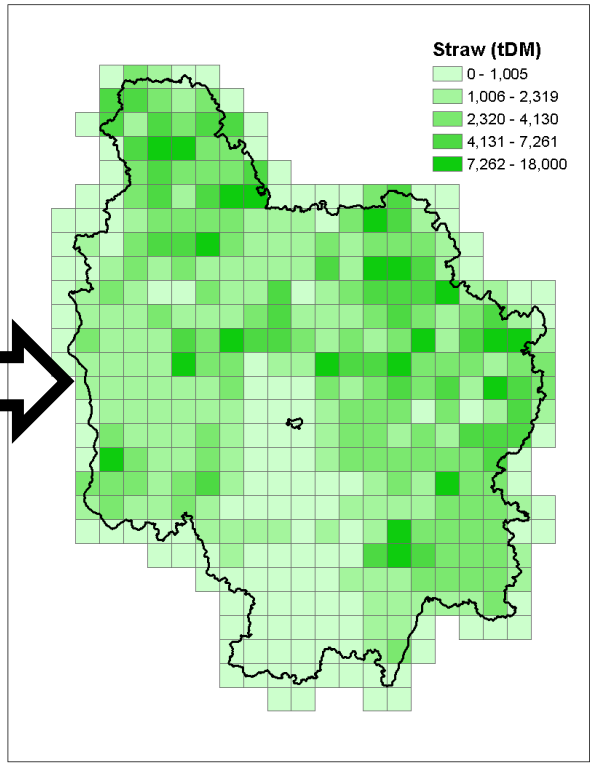


Input: biomass

Straw availability



Aggregation

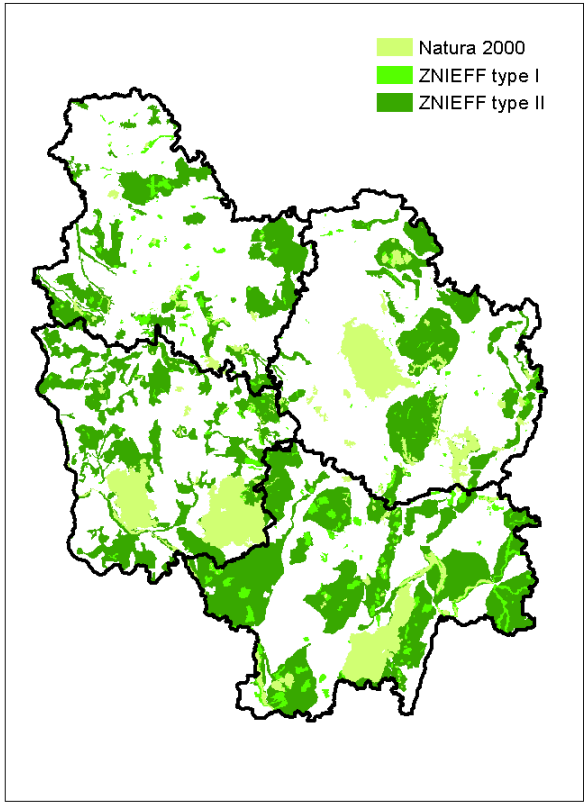


Source: INRA

Input

- Biomass available
- Biomass cost
- Emissions

Protected areas



Source:
Inventaire National du Patrimoine Naturel
European Environment Agency (EEA)

ZNIEFF: Natural Areas of Ecological Fauna and Flora Interest

- type I: areas of great biological or ecological interest
- type II: large, rich and slightly modified natural landscapes, providing significant biological potential

Assumptions for Natura 2000 areas

- No extraction of biomass
- No power plants can be installed

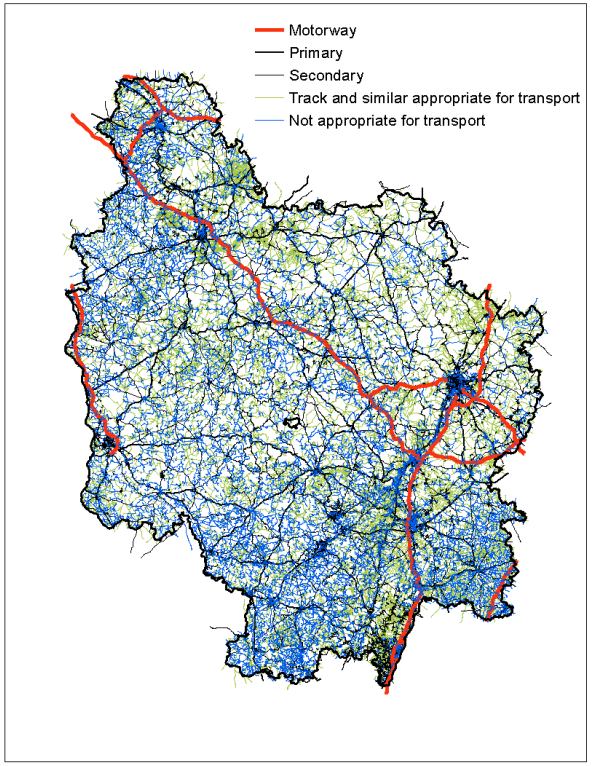
Input: technology

Technology	Operating hours hours/year	Investment cost MEUR	Heat MW_{th}	Power MW_e	Heat efficiency	Power efficiency
Fixed bed for CHP	7,200	0.2	0.1	0.05	0.5	0.23
Pyrolysis combustion engine (compression-ignition)	7,500	0.7	0.25	0.25	0.4	0.4
Fixed bed, direct combustion	8,500	2.5	5		0.88	
BFB for CHP	8,500	18	8	5	0.52	0.3
Grate boiler for CHP	8,500	25	10	5	0.6	0.25

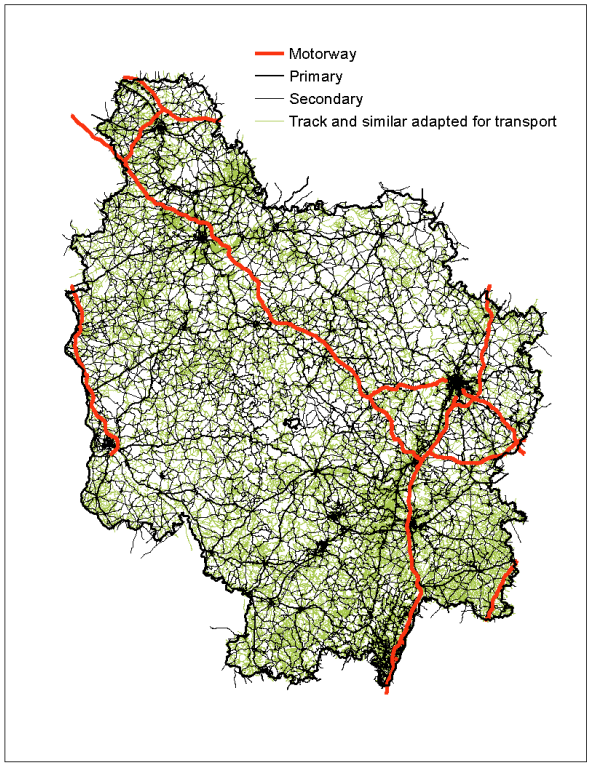
Source: S2Biom, WP2

Input: logistics

Road Network



Used road network



Input

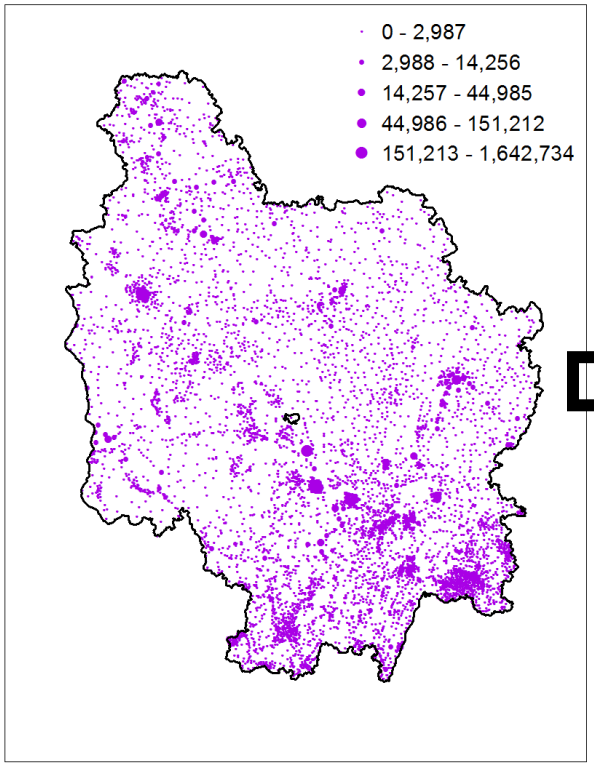
- Transport cost
- Emissions
- Terminals / pretreatment

- Distances from all points to all points based on Min(*t*) or Min(*d*)

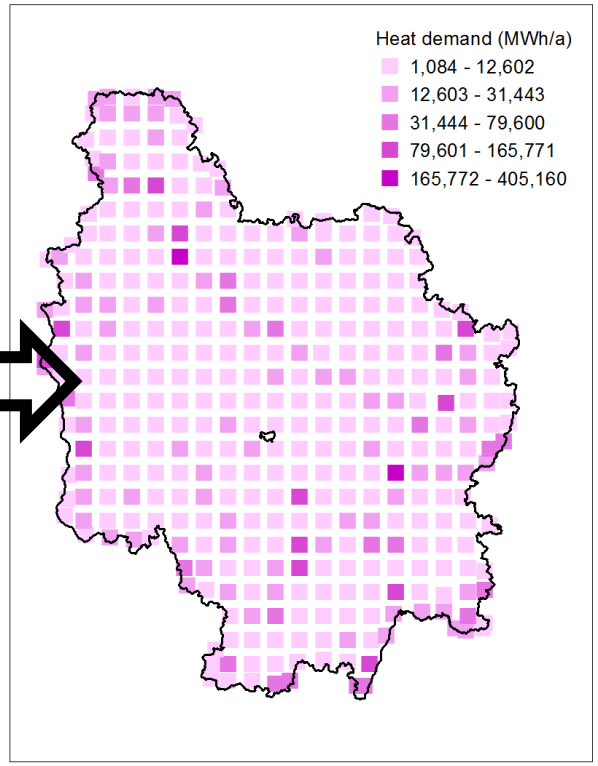
Source: OpenStreetMap.org

Input: demand

Population



Aggregation



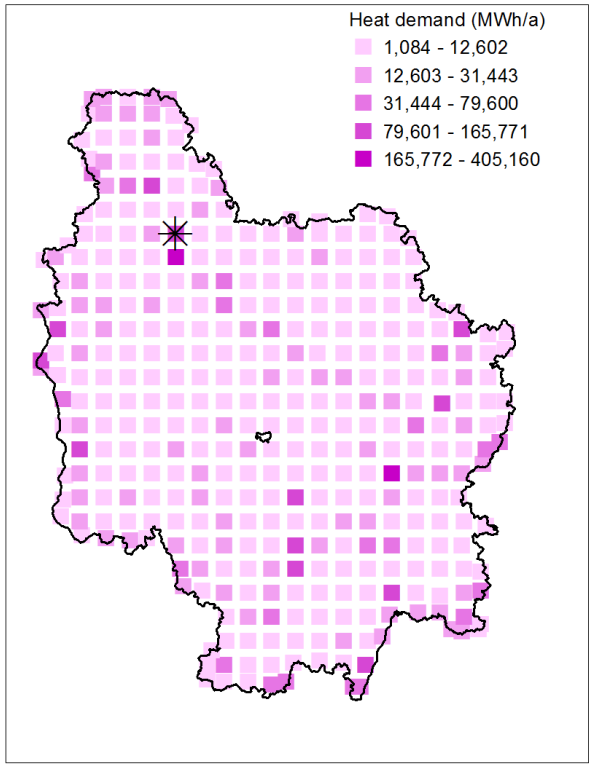
Input needed

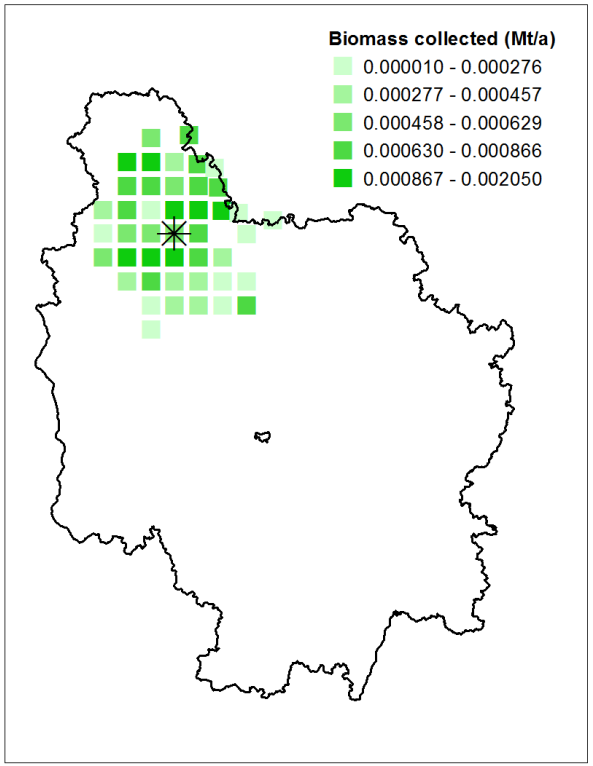
- Heat consumption
- Power consumption
- Transport fuel consumption
- Price of competing
  - heat
  - power
  - transport fuel

Source:
OpenStreetMap.org
Réseau de Transport d'Électricité, www.rte-france.com

Result Example

First plant



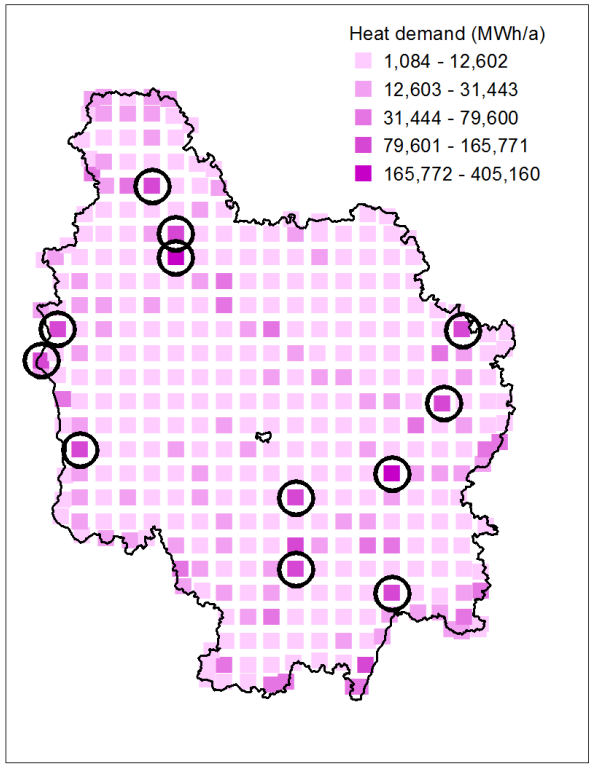


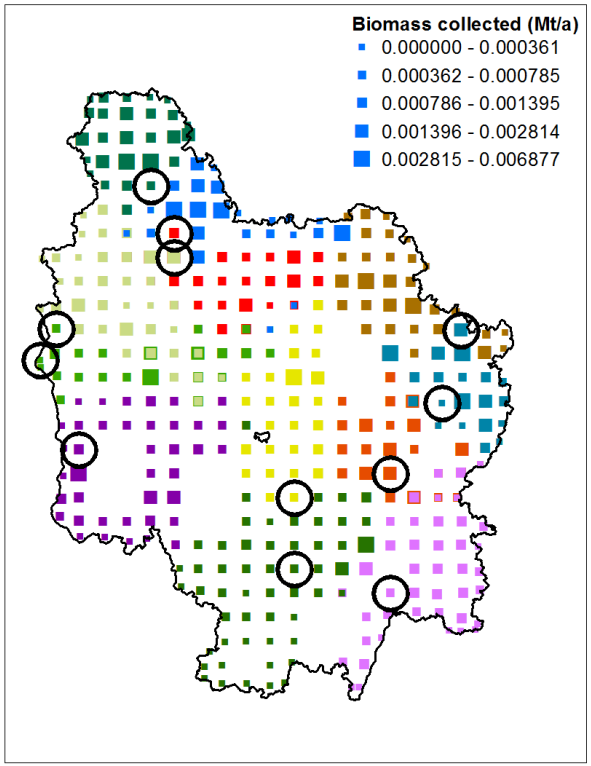
Radius (km)	65
Straw (t/a)	0
Miscanthus (t/a)	30,000
Power (MWh)	35,417
Heat (MWh)	85,000

Plant technology: Grate boiler for CHP
Largest capacity
Close to high heat demand

Result Example

Maximize the fossil fuel substitution





	Min	Max
Radius (km)	70	158
Straw (kt/a)	6,5	20,5
Miscanthus (kt/a)	9,5	18,5
Power (MWh)	24,792	35,417
Heat (MWh)	59,500	85,000

Plant technology: Grate boiler for CHP
Largest capacity
Close to high heat demand

Heat demand has stronger impact on the location than the distribution of biomass

BeWhere / LocaGIStics

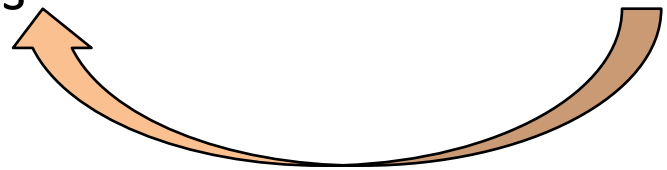
- Plants location, size and technology
- Biomass used
- Costs
- Emissions avoided

BeWhere

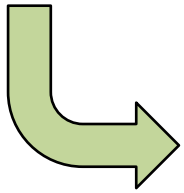
Determine the optimal location of plants

LocaGIStics

Calculations at the plant level



Quality check!

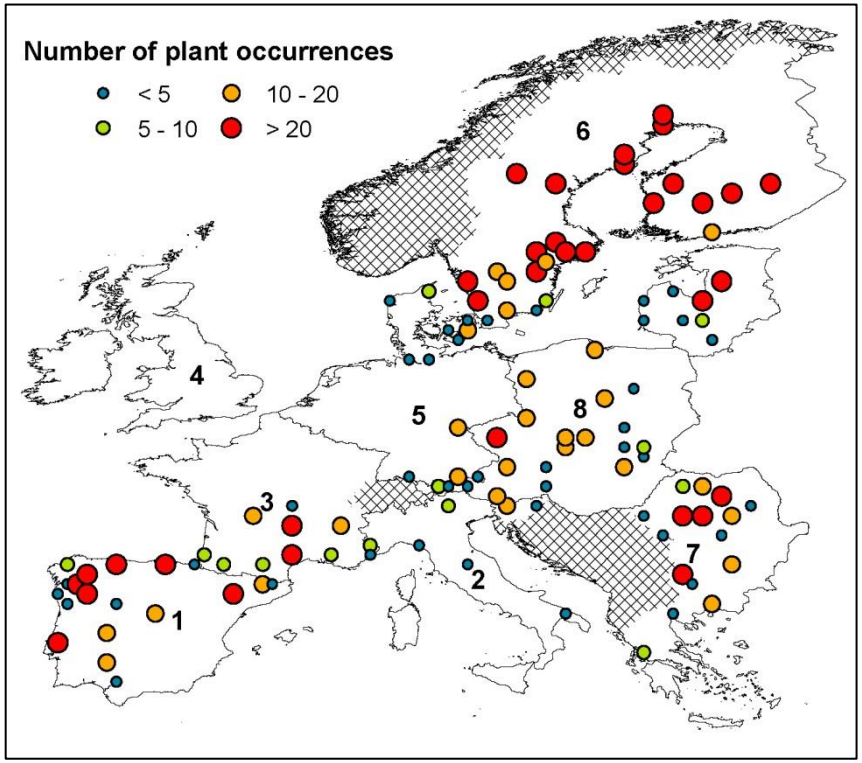


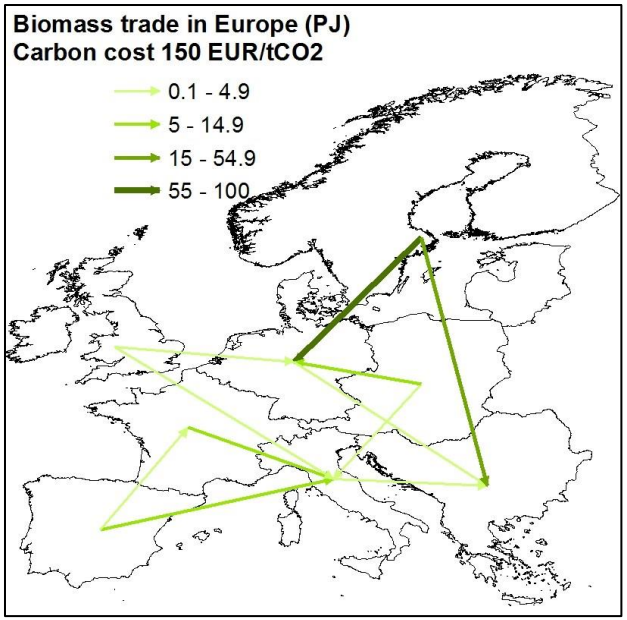
Final results

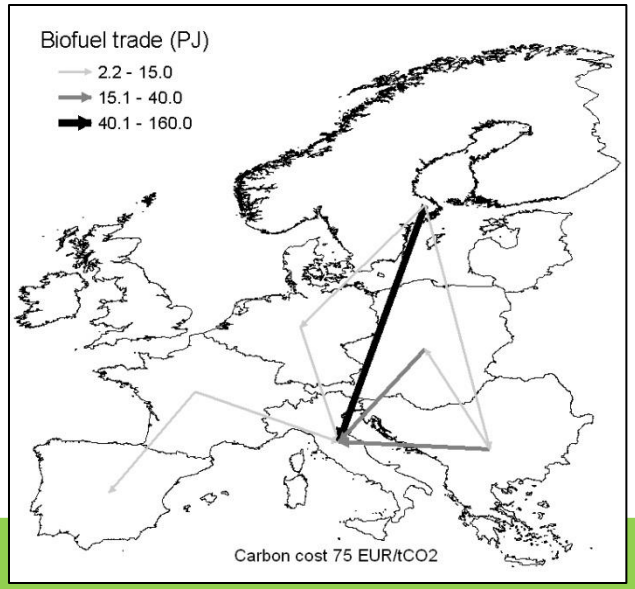
BeWhere and Europe

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

European Model





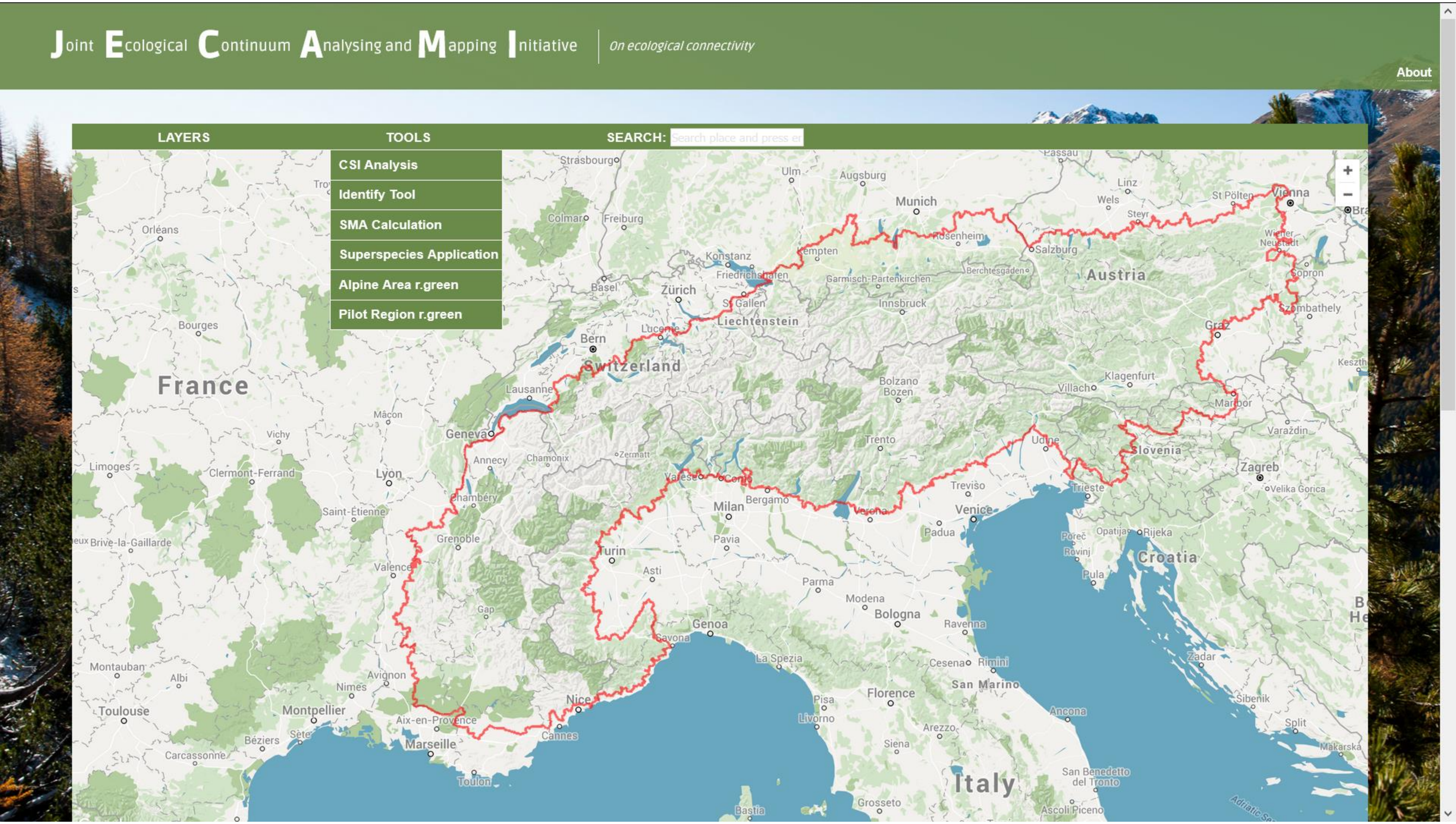


Visualization

www.jecami.eu

http://webarchive.iiasa.ac.at/Research/FOR/bewhere/Results/

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
Liechtenstein
Munich
Zürich
Bern
Geneva
Lyon
Milan
Turin
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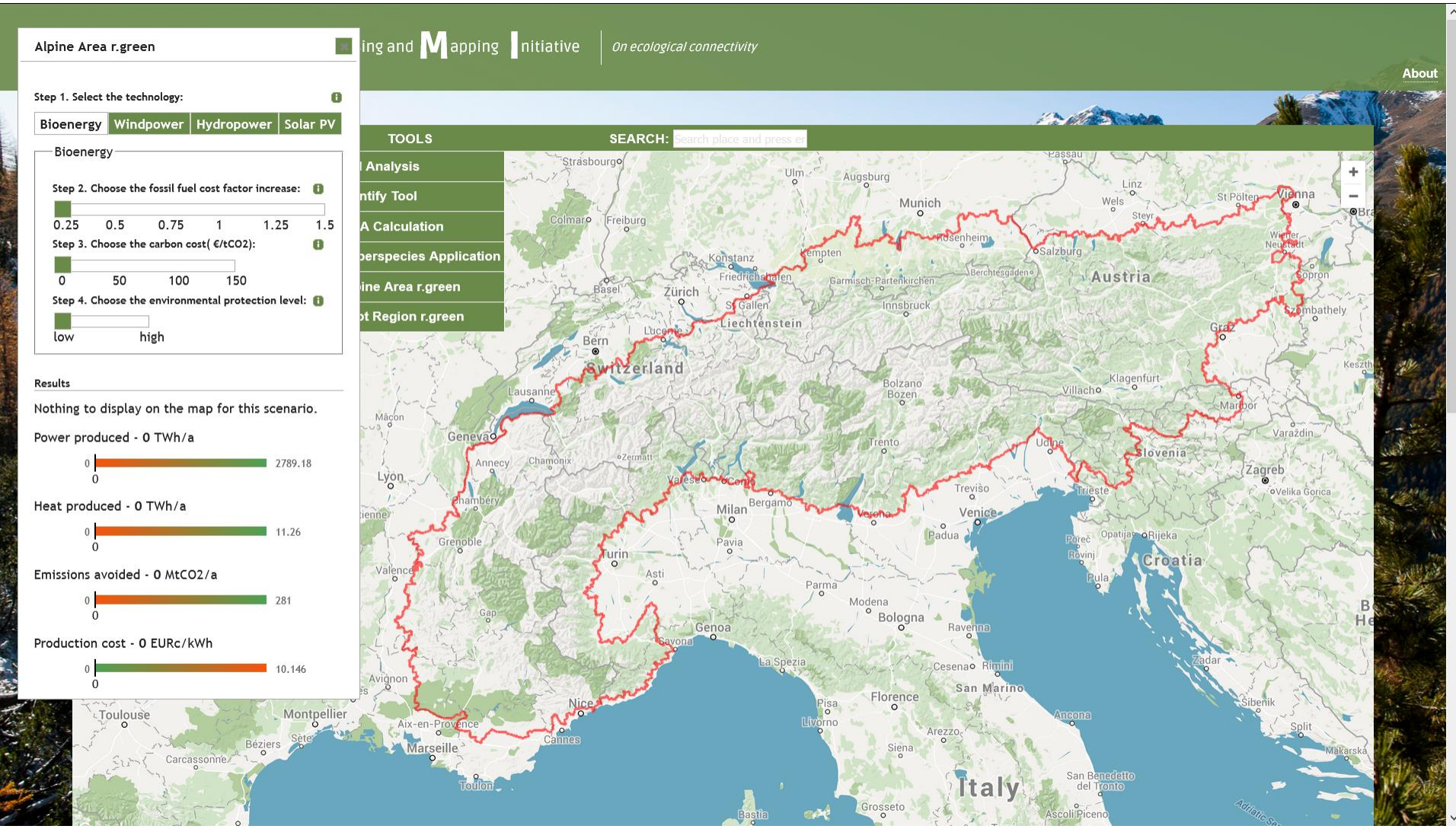
Venice
Vienna
Graz
Innsbruck
Salzburg
Zagreb
Florence
Bologna
Marseille
Nice

BeWhere - DSS


Alpine Area r.green
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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
0 2789.18
0
Heat produced - 0 TWh/a
0 11.26
0
Emissions avoided - 0 MtCO2/a
0 281
0
Production cost - 0 EURc/kWh
0 10.146
0
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Friedrichshafen
Kempten
Garmisch-Partenkirchen
Berchtesgaden
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Florence
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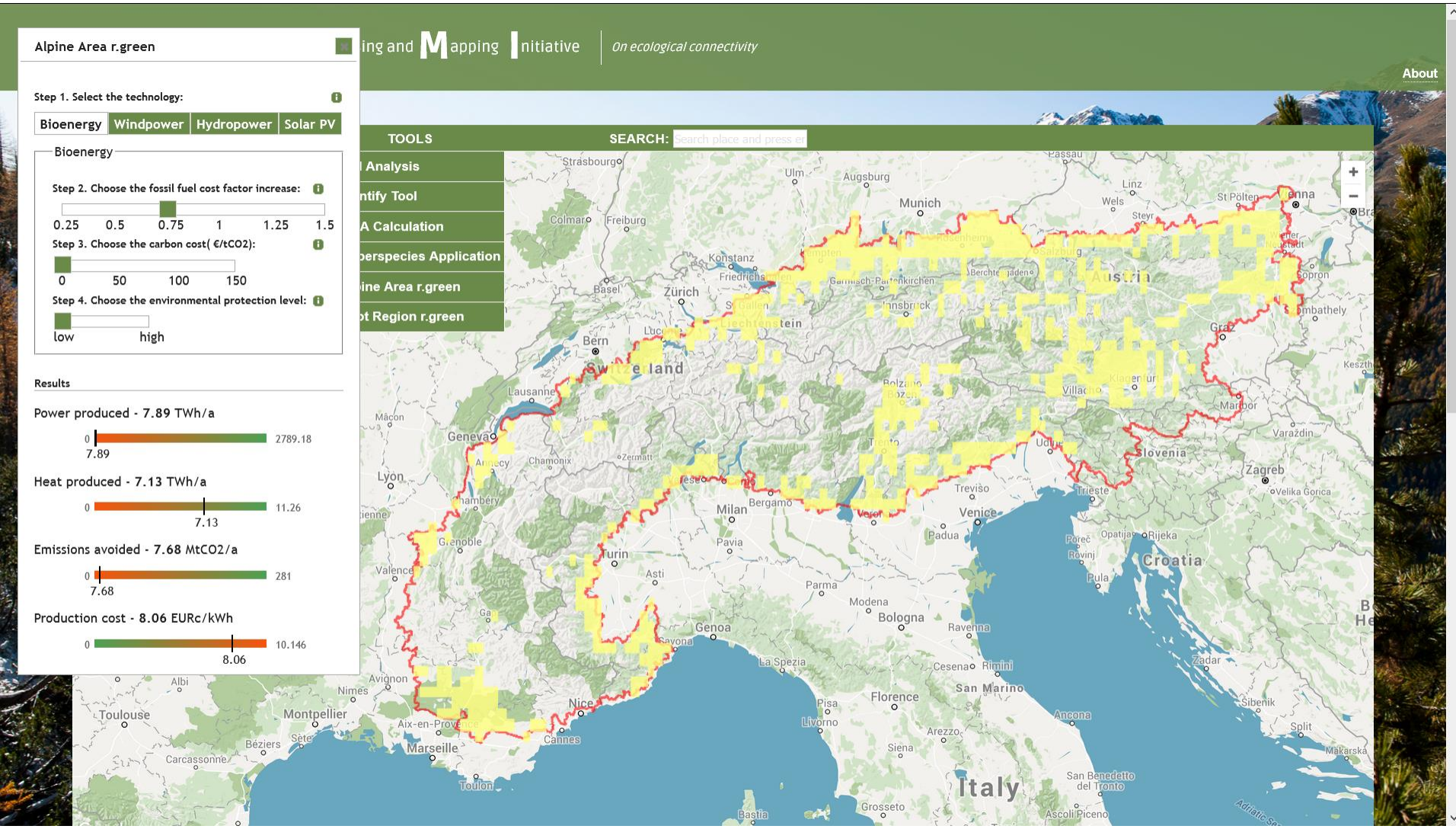
Montpellier
Aix-en-Provence
Cannes
Arezzo
Siena
Béziers
Marseille
Carcassonne
Toulon
Italy
San Benedetto del Tronto
Grosseto
Bastia
Ascoli Piceno
Zadar
Sibenik
Split

BeWhere - DSS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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
0 7.89 2789.18
Heat produced - 7.13 TWh/a
0 7.13 11.26
Emissions avoided - 7.68 MtCO2/a
0 7.68 281
Production cost - 8.06 EURc/kWh
0 8.06 10.146
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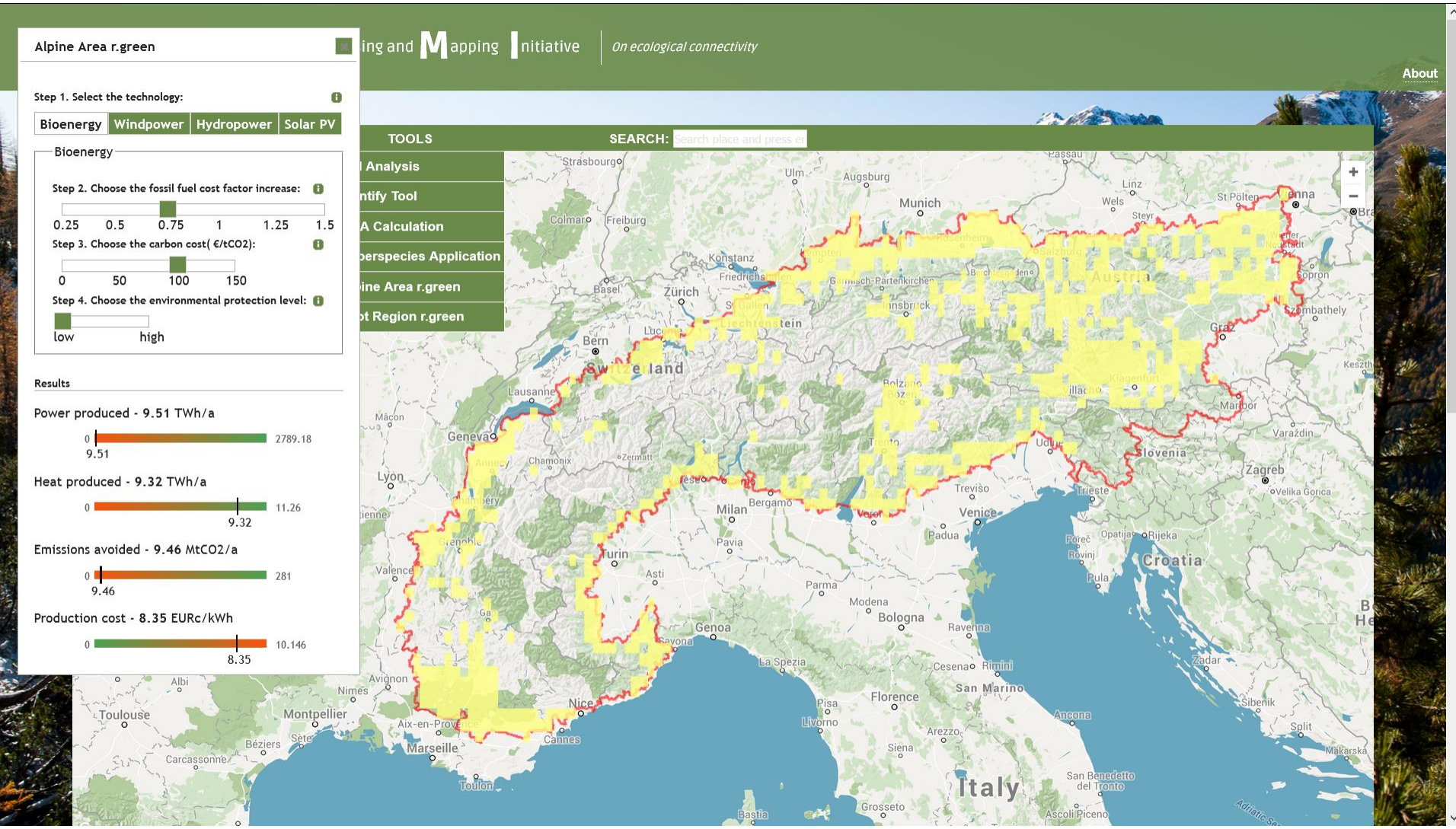
Austria

BeWhere - DSS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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
0 9.51 2789.18
Heat produced - 9.32 TWh/a
0 9.32 11.26
Emissions avoided - 9.46 MtCO2/a
0 9.46 281
Production cost - 8.35 EURc/kWh
0 8.35 10.146
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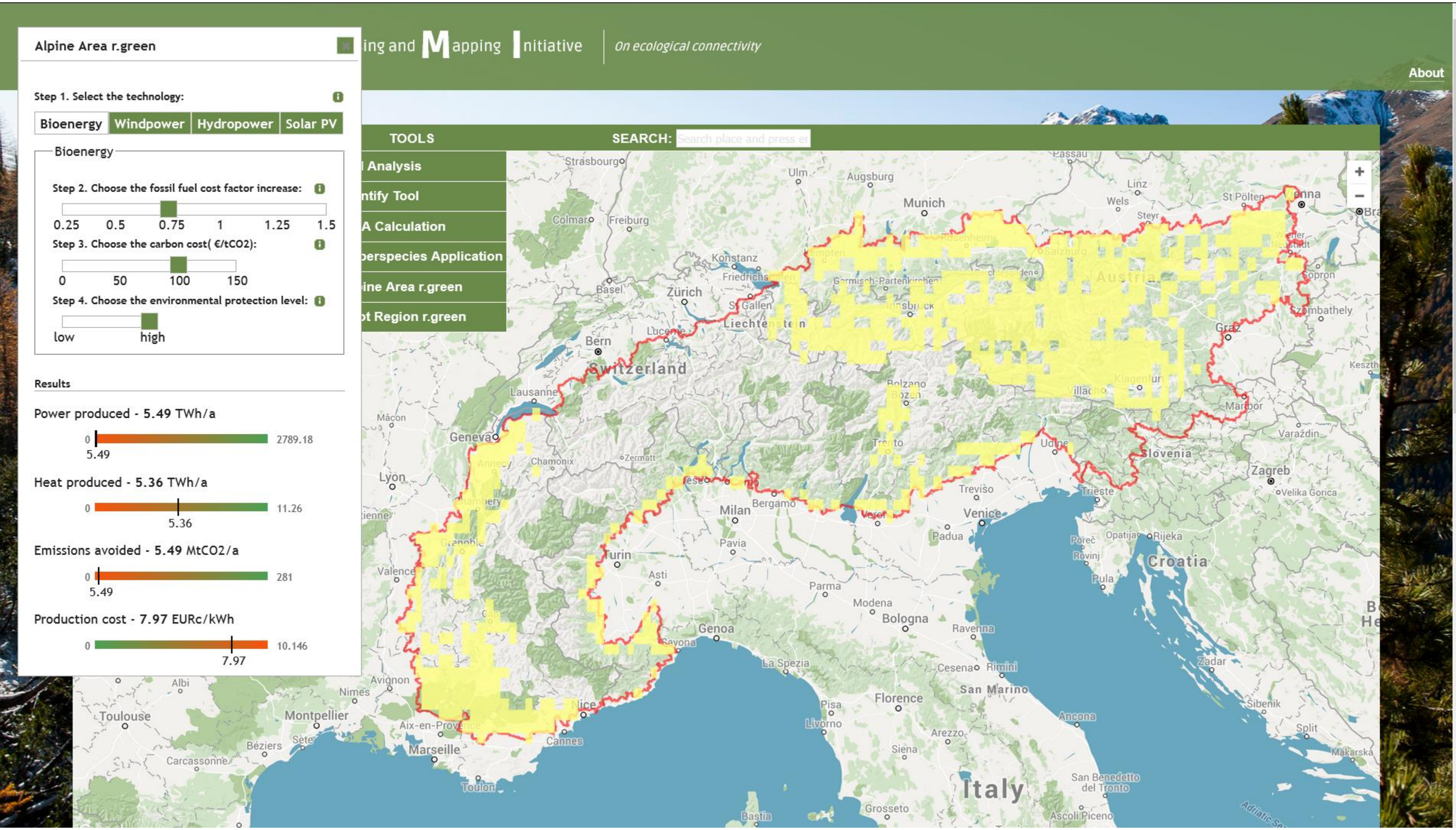
Austria
Switzerland

BeWhere - DSS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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 - 5.49 TWh/a
0 2789.18 5.49
Heat produced - 5.36 TWh/a
0 11.26 5.36
Emissions avoided - 5.49 MtCO2/a
0 281 5.49
Production cost - 7.97 EURc/kWh
0 10.146 7.97
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Thank you for your attention !!

Sylvain Leduc

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

More about BeWhere

www.iiasa.ac.at/bewhere

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