MUSIC

Market Uptake Support for Intermediate Bioenergy Carriers

WP4: Optimisation tools

Deliverable 4.1.
Inventory of software and tools for biomass sourcing and biomass supply chains

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EXECUTIVE SUMMARY

MUSIC project aims to facilitate further market uptake of three types of IBC (pyrolysis oil, torrefied biomass and microbial oil) by developing feedstock mobilisation strategies, improving logistics and development of IBC trade centres. Core project actions are the development of regional feedstock mobilisation strategies and tools for mobilising biomass and optimising size and location of trade centres, which will end up in optimised, cost-effective solutions for logistics along the entire IBC value chain in specific, industry-driven advanced and strategic case studies in the four target regions (Greece, Italy, Sweden/Finland and International).

The **purpose** of this work is:

- To review existing software and tools developed in other EU-funded projects, on biomass availability assessment and biomass mobilisation as well as models on regional biomass potential.
- To identify and/or apply such tools for local use in order to assess regional biomass flows and to facilitate regional biomass trade.

The development of the inventory for software and tools that could be of benefit for the MUSIC project has followed five steps: a) Literature review, b) Set-up of selection criteria, c) Selection of tools for evaluation, d) Evaluation of selected tools and, finally e) Identification of the most relevant ones that could potentially be applicable in the MUSIC project.

The review was built on internet search and contains information that was produced by previous, completed or still on-going, EU-funded projects, so as to capitalise the results already obtained at EU level. Several selection criteria were set and tools were evaluated against them. In this document only the online and free to use tools are discussed so as to identify whether they could also be used for the biomass and IBCs logistics and mobilisation applied in MUSIC. Each tool is discussed in separate chapters, according to identified criteria, which constitute the sub-chapters. Apart from the selected criteria, more information on the tools is provided.

The recent review concluded that, apart for the models being developed specifically for the MUSIC Case-Studies, the most significant models to be used are **BIORAISE**, a web tool with GIS functionalities that focuses on residual agricultural and forestry biomass and that covers five EU Mediterranean countries, and **S2BIOM toolsets,** containing biomass data at local, regional and pan European level, including also information on logistics. Both models are currently being updated by their developers and their potential application in the MUSIC case-studies will be examined. In addition, **INFER-NRG** is developed and currently maintained by the University of Florence, thus could be easily used and adjusted in order to fulfil the needs and reach the goals of the MUSIC project. Despite the fact that the project Bioboost ended several years ago, part of the work carried out for the logistics in the **Geoportal model** could be optimized and biomass maps could be upgraded with the most interesting feedstock along the recent EU-policies.

Apart from the modelling work, two more projects have been spotted, containing interesting information on the organisation of biomass trade centers, the **Enabling** and the **Biomass Trade Centers II** projects. This information as well as the developed platforms will be taken into

consideration when organising the IBCs trading in the targeted case studies of the MUSIC project.

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1 Introduction

MUSIC project aims to facilitate further market uptake of three types of intermediate bioenergy carriers (IBC), namely pyrolysis oil, torrefied biomass and microbial oil, by developing feedstock mobilisation strategies, improving logistics and developing of IBC trade centres. Core project actions are the development of regional feedstock mobilisation strategies and tools for mobilising biomass and optimising size and location of trade centres, which will end up in optimised, cost-effective solutions for logistics along the entire IBC value chain in specific, industry-driven advanced and strategic case studies in the four target regions of the project: Greece, Italy, Sweden/Finland and one International case-study.

The aim of this deliverable is to review the software and tools produced already in the EU on biomass sourcing, biomass supply chains, and biomass/IBC trade centers, in order to find tools and data that could be applied in the four targeted case studies. This work belongs to 'Task 4.1 Software and tools for biomass sourcing and biomass supply chains of the project'.

There are a range of EU projects, completed or still on-going, dealing with biomass availability assessment and biomass mobilisation including AgroCycle, BEE, BECOOL, Bioboost, Biomasud and Biomasud Plus, EUBIONET, EUROBIOREF, EUROPRUNNING, Forest Refine, Forest Power, Green-Agrichains, INFRES, Power4bio, Proforbiomed, S2BIOM, SIMWOOD, and others.

Within these projects, or beyond, a number of models and tools have been developed and used, which quantified the actual and potential biomass availability in Europe and mapped the geographic allocation of the most promising types in NUTS2 and some in NUTS3 levels. Tools follow different assumptions as to the feedstock groups they cover (i.e lignocellulosic/oil/starch crop residues, broadleaved/conifer woody crop residues, agro/forest industrial residues, or new dedicated energy crops annual or perennial, oil or lignocellulosic crops). Differences are also reported or the type of biomass potentials (theoretical, technical, sustainable, economic, actual). In addition the geographic coverage is different (EU, national or regional level), the time frames (actual, 2030, 2050), as well as other additional information that the tools provide regarding biomass quality, production/procurement costs, harvesting and transportation costs in economic and environmental terms, etc.

However, in their majority tools do not consider actual logistics of the feedstock or the logistics of the energy/IBC products. Even if tools cover the logistics of full supply chains they are usually designed for specific feedstock in specific regions and for specific final products and plant capacities.

Therefore, the purpose of this activity is:

- To review existing software and tools developed in other EU-funded projects, on biomass availability assessment and biomass mobilisation as well as models on regional biomass potential.
- To identify the tools that could be locally used for the regional biomass flows in the targeted case studies, in order to facilitate regional biomass and/or IBC trade.

In the course of this work, several relevant projects were reviewed and shortly characterised. The tools developed in these projects were then tested if they are still available online and operational. Only those were listed and further evaluated according to selected criteria.

Each tool is then extensively discussed in separate chapters, according to identified criteria, which constitute the sub-chapters, in order to reveal potential relevance to MUSIC objectives and further use in the selected Case-Studies of the MUSIC project. Apart from the selected criteria, more information on the tools is provided in each chapter.

In the 'Task 4.2. Software and tools for the selected case studies', which aims to apply and build on earlier developed GIS systems in the targeted case study regions (NW Greece; Puglia, Sicily and Venice regions in Italy; parts of Sweden and Finland), dedicated to MUSIC project GIS systems will be developed to provide information on biomass mobilisation in the selected regions but also on cost-effective solutions for logistics along the entire IBC value chain.

The selected tools from this work will be further tested in the case-studies, to check if they could provide the requested information or if some of their functionalities should be incorporated into the tools under development so as the latter cover all the required parameters.

2 Approach

The development of the inventory for software and tools that could be of benefit for the MUSIC project followed five steps (Figure 1):

a. Literature review
b. Selection criteria
c. Selection of tools for evaluation
d. Evaluation of selected tools and,
e. Identification of the most relevant ones that could potentially be applicable in the MUSIC project

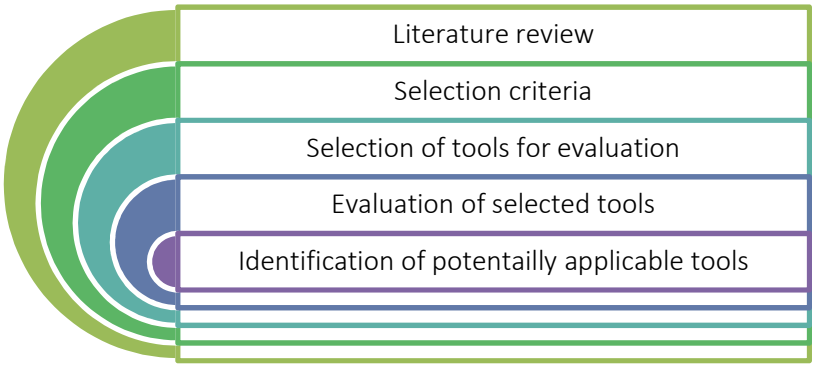

Figure 1: Approach of the work

Two telco's were organised with CRES and RECORD teams to discuss on the structure of the literature review and on the selection criteria of the tools that would be further evaluated.

2.1 Literature review

The review on the software and tools was built on internet search and contains information that was produced by previous, completed or still on-going, EU-funded projects, so as to capitalise the results already obtained at EU level. An initial draft list with 15 projects and tools that were dealing with biomass assessments and logistics was prepared by the WP leader CRES and discussed with both teams during the first telco, organised for this purpose.

During the second telco, it was decided to drop the projects that are no longer online, whereas some more projects were added.

The extended list of projects and tools is shown below (Table 1).

Table 1: List of projects and tools

a/a	Name	Description
1.	AgroCycle www.agrocycle.eu (2016 –2019)	The AgroCycle project undertook a holistic analysis of agri-food waste value chains, from farm-to-table, including livestock and crop production, food processing and the retail sector for a wide range of end products, like bio-fuels, high value-added biopolymers, energy and microbial fuel cells. The Agrocycle developed a joint Stakeholder Platform, a place where the stakeholders can learn of turning agricultural waste into products with practical examples, create new business opportunities (buy and sell products online), share knowledge and experiences etc.
2.	BEE Biomass Energy Europe www.bee.eu (2008 –2010)	The project was focused to improve the accuracy and comparability of future biomass resource assessments for energy by reducing heterogeneity, increasing harmonization and exchanging knowledge.
3.	Bioboost http://bioboost.eu/home.php) (2012-2015)	The project was focused on the decentral conversion of residual biomass to optimised, high energy density carriers, which can be utilised in large scale applications for the synthesis of transportation fuel and chemicals or directly in small-scale combined heat and power (CHP) plants. The project addressed the complete value chain from feedstock potential, the investigation of pyrolysis and hydrothermal carbonisation conversion technologies, the optimisation of transport and logistics to the exploitation of the energy carrier and its by-products.
4.	BiomassTradeCentreII http://www.biomasstradecentre2.eu/Biomass-Trade-CentreII/ (2011-2014)	The BiomassTradeCentreII project aimed at increasing the production and the use of energy from wood biomass by organising motivation events that engaged identified target groups to invest in biomass business and biomass logistic and trade centres (BLTC) in 9 EU countries (Austria, Croatia, Germany, Greece, Ireland, Italy, Romania, Slovenia and Spain).
5.	BIOMASUD PLUS (www.biomasudplus.eu) (2016- 2019)	Biomasud Plus 'Developing the sustainable market of residential Mediterranean solid biofuels' aimed to develop tools and databases with information about sustainable biomass resources to have a global vision and identifying sustainable solid biofuels supply chains.
6a.	BIORAISE	BIORAISE is a web tool with GIS functionalities that focus on residual agricultural and forestry biomass and covers five EU Mediterranean countries: Spain, Portugal, France, Italy and Greece. It is a product of Biomasud Plus project.

6b.	BIORAISE SE	A web tool with GIS functionalities was developed to assess the potential of selected energy crops in Spain.
7.	EUBIONET II www.eubionet.eu (2002)	The EUBIONET II - European bioenergy network analysed current and future biomass fuel market trends and biomass fuel prices. Country reports.
8.	EUROPRUNING www.europruning.eu (2013- 2016)	The project aims to the development of new improved logistics for pruning residues. This includes harvesting, transport and storage for agricultural prunings (fruit tree, vineyards and olive grove prunings and branches from up-rooted trees).
9.	Forest Refine. EU Interreg Botnia Alantica https://biofuelregion.se/en/projekt/forest-refine/results/ (2012–2014)	The overall objective was to acquire knowledge of ways to optimize biomass supplies for refineries in the Botnia-Atlantica Region from existing, planned or potential procurements areas. All the results are compiled into a final paper, "Synthesis report: Forest Refine, 2012-2014". The project has been unique in its aim and scope, and the results presented plays an important role for developing the coming biobased markets in the BA region
10.	Forest Power EU Interreg Botnia Alantica (2009-2012)	A cross-border research project with the aim of increasing the utilisation of forest biomass in the Botnia-Atlantica area. The project had the goal of increasing the value and quality of products and services within the forest fuel supply, feed-stock conversion and combustion chains.
11.	GLOBIOM (https://www.globiom.org/)	IIASA's Global Biosphere Management Model (GLOBIOM) is used to analyze the competition for land use between agriculture, forestry, and bioenergy, which are the main land-based production sectors.
12.	Enabling (https://www.enabling-project.com/) (2017-2020)	ENABLING is a 3-year project that intends to develop the great potential of the bio-based industry, encouraging the creation of efficient and structured biomass supply chains for the production of bio-based products (BBP).
13.	INFRES www.infres.eu (2012 – 2015)	It aims to accelerate the technological development and to open paths to EU´s renewable targets by producing research based knowledge, technological solutions and service innovations for forest residue feedstock supply.
14.	LOGISTEC – improving logistics for energy crops (www.logistecproject.eu) (2012 –2016)	It aims to develop new or improved technologies of the biomass logistics chains.
15.	Power4bio – Empowering regional stakeholders for realising the full potential of European bioeconomy	A literature review of projects and tools

	H2020-RUR-2018-2020	
16.	Proforbiomed www.proforbiomed.eu (2011 – 2014)	Proforbiomed 'PROMOTION OF FOREST BIOMASS IN THE MEDITERRANEAN' aims to develop and promote the use of forest biomass for the creation of a sustainable energy production chain in Mediterranean forests.
17.	S2BIOM www.s2biom.eu (2013 – 2016)	S2BIOM toolset contains data, tools, documents and reports generated in the S2BIOM project regarding the sustainable delivery of non-food biomass feedstock at local, regional and pan European level
18.	SIMWOOD – Sustainable mobilisation of wood www.simwood-project.eu (2013 – 2017)	The SIMWOOD project aims to increase the mobilisation of wood from forests and woodlands in Europe.
19.	The GREEN-AgriChains www.green-agrichains.eu/ (2013-2015)	It aims at tackling all aspects of Green Supply Chain Management (SCM) and Logistics, focused on the Agrifood sector. It will deal with sustainable farming, reverse logistics, green procurement and sourcing, waste management and packaging reuse, transportation, etc.
20.	Our framework (INFER NRG)	Integrated system developed by University of Florence and RECORD aimed at estimating the total cost of the biomass from field to fuel: GIS system with crop growth simulation model, climate scenarios, directions services etc.

The tools still available online are listed below:

Table 2: List of tools

a/a	Tools
1.	BIORAISE and BIORAISE SE http://BIORAISE.ciemat.es/BIORAISE/home/main
	S2BIOM - Bio2Match - Locagistics https://s2biom.wenr.wur.nl/web/guest/bio2match - BeWhere https://www.iiasa.ac.at/web/home/research/researchPrograms/EcosystemsServicesandManagement/BEWHERE/BEWHERE.en.html
3.	GLOBIOM https://www.globiom.org/
4.	Enabling https://www.enabling-project.com/
5.	Geoportal model (http://bioboost.iung.pl/)
6.	BiomassTradeCentreII (http://www.biomasstradecentre2.eu/Biomass-Trade-CentreII/)
7.	INFER-NRG (Own model developed by the University of Florence)

2.2 Selection criteria

Selection criteria were set, after thorough discussions during our two telcos, in order to identify whether the reviewed tools are able to be used also in MUSIC project (Table 3).

Table 3: Selection criteria

a/a	Selection criteria	Description of what the tools should provide:
1.	Free to use	Available online and free to use
2.	Biomass availability	Lignocellulosic residual biomass
3.	Biomass logistics	Harvesting, transportation, storage, etc.
4.	Biomass quality	Ash content, moisture content, elemental analysis
5.	Cost data	Biomass procurements cost assessment, cost and supply curves, market prices
6.	Final uses	Energy, IBC, biofuels
7.	Logistics of final products	Transportation, storage in biomass/IBCs trade centers

- Free to use:

Only the tools online available and free to use will be considered in this review.

- Biomass availability:

Several feedstocks will be taken into account in the targeted case studies, including those sourced from agricultural and forest residues (cereal straw, wood) as well as from new resources, like lignocellulosic energy crops. The residual biomass types mainly refer to cereal straw and woody biomass (from forestry and related activities), as these are the main residual forms of biomass available in large quantities throughout Europe, with well-known feedstock chemical and bio-chemical characteristics. All these residual types of materials can be used as lignocellulosic feedstock for IBCs production with virtually no additional land requirements or impacts on food production.

- Biomass logistics:

The seasonality of the various types of biomass is a challenge. The available quantities and forms of collected biomass (straw bales, bundles, chips, branches and leaves, etc.) as well as the quality of each specific type of biomass can pose more restrictions. All the above fuels and more that will be considered in each case study are provided by a large number of biomass providers, at different times, by different means, in different quantities and in different qualities. The combination of different types of biomass may be needed to solve availability and seasonality problems or to ameliorate the quality of the fuel used in respect to specific technologies. Biomass logistics consist of harvesting, collection/piling, storage and transportation of the feedstocks. Biomass logistics are among the most important features that the selected tools must have.

- Biomass quality

The various agricultural residues, forest residues, bark and bark containing pruning have different physical and fuel characteristics, such ash content and calorific value (Low, High), and elemental analysis.

- Cost data

Estimations of costs for the various biomass types, covering costs for biomass collection and logistics, market prices are very valuable assets in the online tools as the costs of each stage in the value chain could be assessed so as to have an estimation of the final biomass procurement and logistics costs

- Final uses (energy, IBC)

Different energy products are considered in the existing tools, depending on the project in the frame of which they were developed. They can be energy in general or specific IBCs from specific technologies (i.e pyrolysis oils, biogas, etc.) like in the Bioboost project, or solid biomass in general, like in the BIOmasudplus project. In the case a rational exploitation of the residual biomass is to take place, energy or IBC production with greater flexibility in raw material (CHP, district heating) will have to cover their needs with several types of biomass or a combination of them

- Logistics of final products

Biomass and/or IBC trade centres are a new and innovative way to develop and organise the biomass supply and IBC's trade. These centers are regional centers with optimized logistics and trading organization, where different biomass intermediate bioenergy carriers can be stored and marketed at contracted terms.

2.3 Selection of tools

The selection of the tools to be further analysed was based on the fulfilment of the selection criteria (**Error! Reference source not found.**).

Table 4: Characterisation of tools

a/a	Tools	Free to use	Lignocellulosic biomass availability	Biomass logistics	Biomass quality	Cost data	Final products (Energy)	Final products (IBC)	Logistics of final products
1.	BIORAISE and BIORAISE SE	X	X	X	X	X	X	X	
2.	S2BIOM - Bio2Match - LocaGIStics - BeWhere	X	X	X	X	X	X		
3.	GLOBIOM	X	X	X	X	X	X		

4.	Enabling								
5.	Geoportal model (Bioboost project)	X	X	X	X	X	X	X	X
6.	INFER-NRG	X	X	X	X	X			
7.	Biomass Trade Centers II		X	X	X	X			

2.4 Evaluation of the selected tools

Each tool is analysed in separate chapters, according to the identified topic areas: Biomass types, biomass potential types, geographic coverage, time coverage, biomass logistics (harvesting, transportation, storage, etc.), biomass quality, costs, and final product), logistics of final products, and relevance to MUSIC objectives (**Error! Not a valid bookmark self-reference.**).

Table 5. Topics for tool description

a/a	Topics	Remarks
1.	Biomass types	What are the biomass types covered in the tool; cereal residues, pruning, forest residues, other.
2.	Biomass potential types	Theoretical, technical, economic, sustainable
3.	Geographic coverage	EU level, national, other
4.	Time frame coverage	Recent, 2030, 2040 etc.
5.	Biomass logistics	Harvesting, transportation, storage, etc.
6.	Biomass quality	Ash content, moisture content, elemental analysis
7.	Costs	Biomass procurements cost assessment, cost and supply curves, market prices
8.	Final products	bioenergy, IBC, biofuels
9.	Logistics of final products	Transportation, storage in biomass/IBCs trade centers
10.	Relevance to the MUSIC purposes	

2.5 Identification of the most relevant tools for the MUSIC project

The identification of the most relevant tools for the MUSIC project is based on the results of the selected tools' evaluation.

3 BIORAISE

The tool was developed and refined over time in a sequence of projects. The BIORAISE model was developed in 2009, in the frame of the Chrisgas project and was made available on internet (www.BIORAISE.ciemat.es/). It is a computer GIS based tool designed for the calculation of agricultural and forest biomass resources and costs in 12 European countries including France, Italy, Portugal, Spain and Greece (southern EU countries); Austria, Germany and Poland (central EU countries); and Sweden, Finland, Norway and Denmark (northern EU countries).

Within the Biomasud project funded by the Interreg Sudoe programme, the BIORAISE model was updated and upgraded containing also information about agro-industrial residues and pellets production and the relevant producers. The target of the tool at this stage was the countries of the EU Sudoe Region.
Currently, under the H2020 projects BIOMASUD Plus and BECOOL, the tool is radically updated and improved, in order to provide more accurate and reliable calculations. The new BIORAISE was extended to include further countries like Croatia, France, Greece, Italy, Portugal, Slovenia, Spain and Turkey (Figure 2).

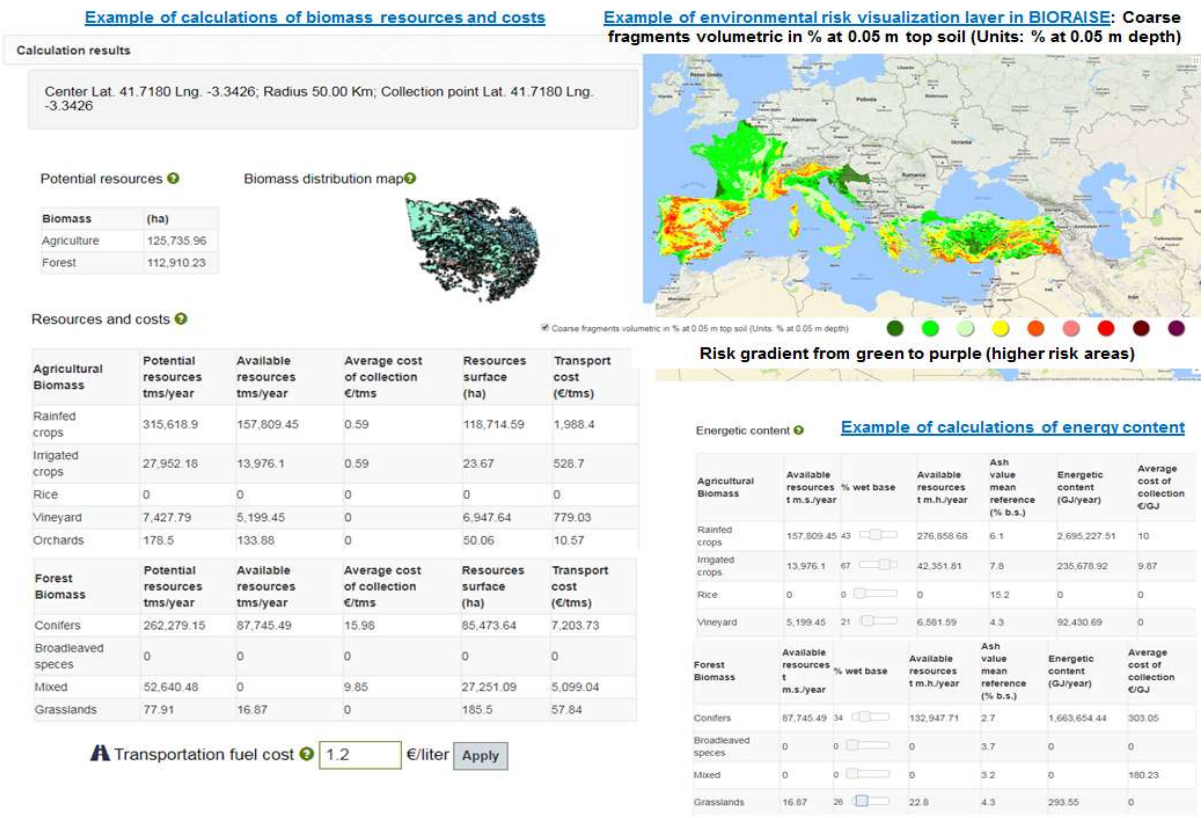

Figure 2: The BIORAISE model

(Source: http://BIORAISE.ciemat.es/BIORAISE/home/main)

3.1 Biomass types

BIORAISE is a GIS tool for the assessment of the availability of agricultural and forest residues, originally targeting Mediterranean countries. The new BIORAISE tool improved for the BECOOL project considers biomass potentials from two types or resources:

i) agricultural residues, and
   a. irrigated crops,
   b. rainfed crops,
   c. rice,
   d. vineyard,
   e. orchards and
   f. mixed crops (agroforestry systems consisting of herbaceous crops under sparse tree cover).

ii) forest and shrub land resources
   a. broadleaved species,
   b. coniferous mixed stands,
   c. shrub lands (Shrub and/or herbaceous vegetation associations) and
   d. dehesas (agroforestry areas)

3.2 Biomass potential types

The model calculates the technically available biomass.

In the case of agriculture resources, the biomass potentials are calculated using EUROSTAT data, and surfaces are linked to the geospatial data of CORINE LAND COVER (version 2012). Biomass availability is calculated by applying residue-to-production ratio on statistical data of the agriculture production. On top of that efficiency rates related to harvesting processes are used to calculate the biomass technical potential.

The theoretically potential and technically available potential of the biomass resources allocated to several categories mentioned above (Chapter 3.1).

Likewise, the forestry and shrub land resources are allocated to the categories mentioned above (Chapter 3.1). Data are taken from CORINE LAND COVER, integrating the Pan-European Map of Forest Biomass Increment (Mg ha^{-1} yr^{-1}),: (https://data.europa.eu/euodp/es/data/dataset/38a3b611-eae1-423f-a4aa-c5cfdea03bd9) and the net primary productivity NPP (g m^{-2} yr) (http://bio.discomap.eea.europa.eu/arcgis/services/NPP/NPP/ImageServer) with productivity tables derived from national forest inventories from the countries included in the tool, where available. Estimations of the available resources are applied when the national forest inventories do not perfectly match the CORINE land uses, surfaces or dates. Available resources consider environmental restrictions related to terrain slope, erosion risk values from the areas covered by the PESERA Soil Product (Soil erosion estimates (t ha^{-1} yr^{-1}) 2000-2003 https://esdac.jrc.ec.europa.eu/themes/pesera-model) and the Soil organic carbon content (fine earth fraction) in g per kg at depth 0.30 m from SoilGrids (https://soilgrids.org/). In addition, dominant stands (> 50% principal species) of tree specific geospatial data from the

Joint Research Centre (http://data.jrc.ec.europa.eu/collection/fise) are shown in case the user wants to download the surfaces and apply a particular productivity rate.

This version of BIORAISE considers also environmental burdens. As there are no clear definitions regarding exploitation of resources for the diversity of stakeholders, it was decided to depict visually the vulnerability of the areas considering variables like slopes, depth to bedrock, coarse fragments, RUSLE equation erosion due to rainfall, net primary productivity, soil organic carbon content and soil erosion risk. It is an intuitive representation regarding a sustainable management.

3.3 Geographic coverage

The new BIORAISE was extended to cover additional Mediterranean countries including Croatia, France, Greece, Italy, Portugal, Slovenia, Spain and Turkey.

3.4 Time coverage

The tool refers to current time framework

3.5 Biomass logistics (harvesting, transportation, storage, etc.)

Biomass logistics cover harvesting, piling and transportation. The tool computes resources in a circular area from user-selected points and provides data in administrative regions level (NUTS2 regions, which is the statistical territorial units in the European Union databases.

The databases for the involved stakeholders have been also extended and updated, consisting of producers (raw biomass producers, wood, olive oil, nut hulling, and wine sector –distilleries-industries) and other actors (e.g., equipment and machines for industry, services and facilities, manufacture of biofuels and biomass valorisation, biofuel dealers, research centres, large consumers, and biofuel producers).

3.6 Biomass quality

The energy content (GJ yr-1), and ash content (% dry matter) is taken from average references obtained from laboratory characterization of selected samples (calorific values are recalculated according to moisture content).

3.7 Cost assessment, cost and supply curves, market prices

The cost assessment of the logistic chain consists of harvesting, piling and transport costs, which are calculated as €/tonne of dry matter at NUTS2 level.

3.8 Final products (energy, IBC)

The final products addressed are solid biofuels for residential heating.

3.9 Logistics of final products

Not available.

3.10 Relevance to the MUSIC purposes

The BIORAISE model is partly related to the MUSIC purposes, as it covers the whole supply chain of the lignocellulosic residues from agricultural and forest residues for energy purposes (solid biomass), in terms of available quantities, fuel characteristics, feedstock logistics and relevant costs, in economic and environmental terms. It covers mainly the Southern Europe, among which Italy and Greece, where specific Case-Studies are being developed.

However, the model does not cover the logistics of the final energy products (solid biomass) nor their trade.

The model currently is being upgraded in the frame of the Biomassudplus and BECOOL projects thus it will be considered at least for the Greek case-study, along with the GIS model that is currently being developed.

In the course of Task 4.2, we will run the model for the Greek and Italian case-studies, as far as the feedstock types, quantities and qualities are concerned, cross-checking our data and calculations with these of the tool. If they match then we can benefit of the tool database to work in other regions or countries that are covered by the tool. Contacts will be made with the developers aiming to check whether the current updates also consider the logistics of the solid biomass fuels.

4 S2BIOM

The S2Biom project aimed to support the sustainable delivery of non-food biomass feedstock at local, regional and pan European level. This target was to be achieved by the development f a toolset, “computerized and easy to use”, which contained harmonized datasets at local, regional, national and pan European level for EU28, Western Balkans, Moldova, Turkey and Ukraine.

The toolset consisted of the Bio2Match, BeWhere and LocaGIStics tools, which covered the whole biomass supply chain, from the collection of biomass, harvesting and logistics, to the final energy uses.

- Bio2Match (https://s2biom.wenr.wur.nl/web/guest/bio2match)

It is a tool designed to match biomass resources with the most suitable conversion technologies, taking into account the pyramid of end use applications (materials, chemicals, fuels, energy).

The concept behind it is that each biomass type (agricultural, forest, or bio-industrial residues, dedicated crops) has different fuel properties (moisture content, ash content, cellulose/hemicellulose/lignin content) or forms (fine, coarse, chips, bales, etc) while also

conversion technologies have their own biomass input requirements (moisture and ash content, particle size, density, etc). Technologies may use only certain biomass types, which may have to be pretreated, while others are feedstock agnostic. The Bio2match tool is built on this oncept and by using the specific databases developed in the S2BIOM project it aims to provide the end users with information on which biomass can be used by which technology in order to produce specified end products, in an optimal supply chain (Figure 3).

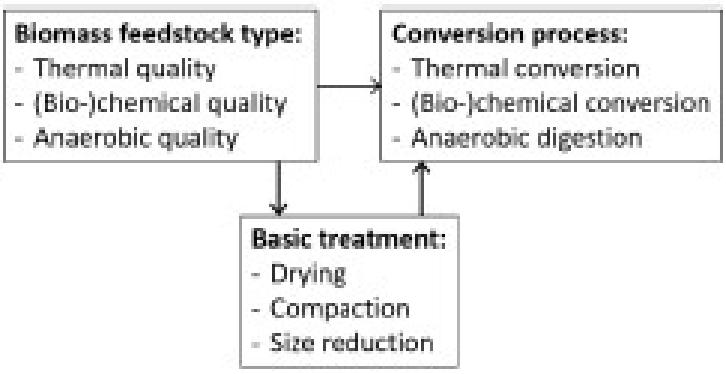

Figure 3: The concept of the Bio2Match tool

(Source: S2BIOM project, D3.5 Formalized stepwise approach for implementing logistical concepts using BeWhere and LocaGIStics)

- BeWhere model

The BeWhere model (www.iiasa.ac.at/bewhere) supports the development of EU-wide and national strategies for optimal network of biomass supply chains.

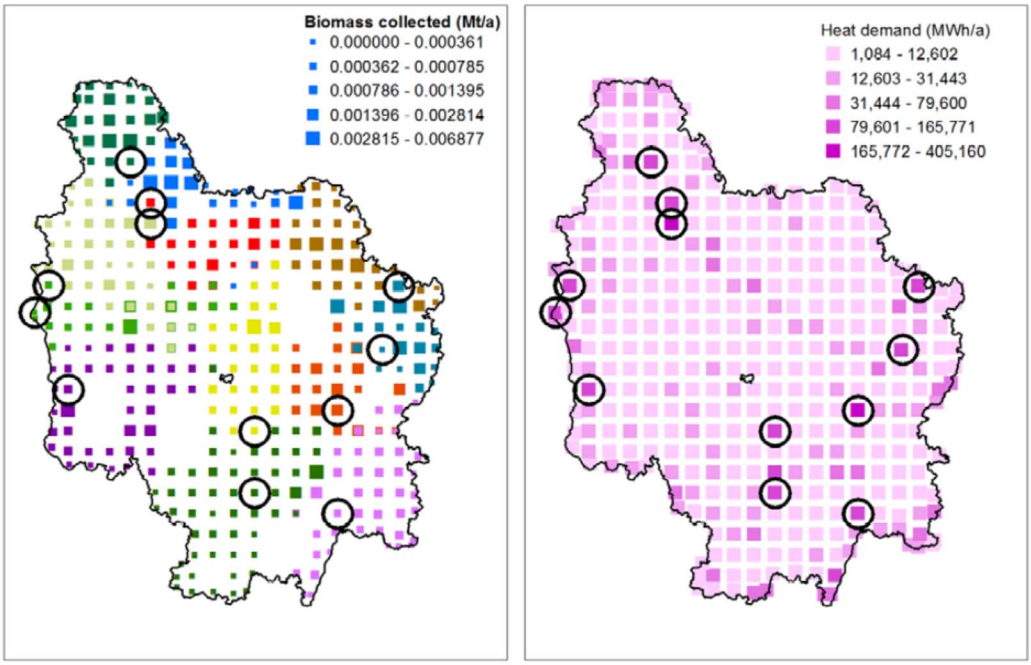

Figure 4: Example of BeWhere output.

(Source: S2BIOM project, D3.5 Formalized stepwise approach for implementing logistical concepts using BeWhere and LocaGIStics)

The tool is built on a techno-economic spatial model that allows to design site-specific cost-effective and environmental friendly biomass supply chains, taking account economies of scale, in order to meet certain demands (i.e heat and electicity).

The spatial resolution in BeWhere can be different between case studies, ranging e.g., from 10 km grid resolution to 40 km grid resolution. The output of the model shows for instance locations where the biomass can be collected (Figure 4 on the left), and locations where conversion plans are located or where energy demand is (Figure 4 on the right).

- LocaGIStics model

The BeWhere and LocaGIStics were closely interlinked (Figure 5). The output of BeWhere can be used as input for further analysis and more precise chain design and evaluation in the LocaGIStics tool. BeWhere will provide to LocaGIStics the locations of the selected production plants, their capacity and technology chosen. LocaGIStics could further refine and detail the outcomes of the BeWhere model whereas the BeWhere model could use the outcome of the LocaGIStics model to modify their calculations if needed.

LocaGIStics is a regional assessment tool for biomass delivery chains. This tool can support the user to design optimal biomass supply chains and networks at regional level and analyze in a comparative way the spatial implications, environmental and economic performance of different supply chains. It takes account of the biomass cost-supply, the conversion and pre-treatment technology options and novel logistical concepts. The scale of assessment ca be as detailed as data allows in the case studies for which the tool is developed. The tool was developed and validated only in two case study regions during the S2BIOM project (Figure 5).

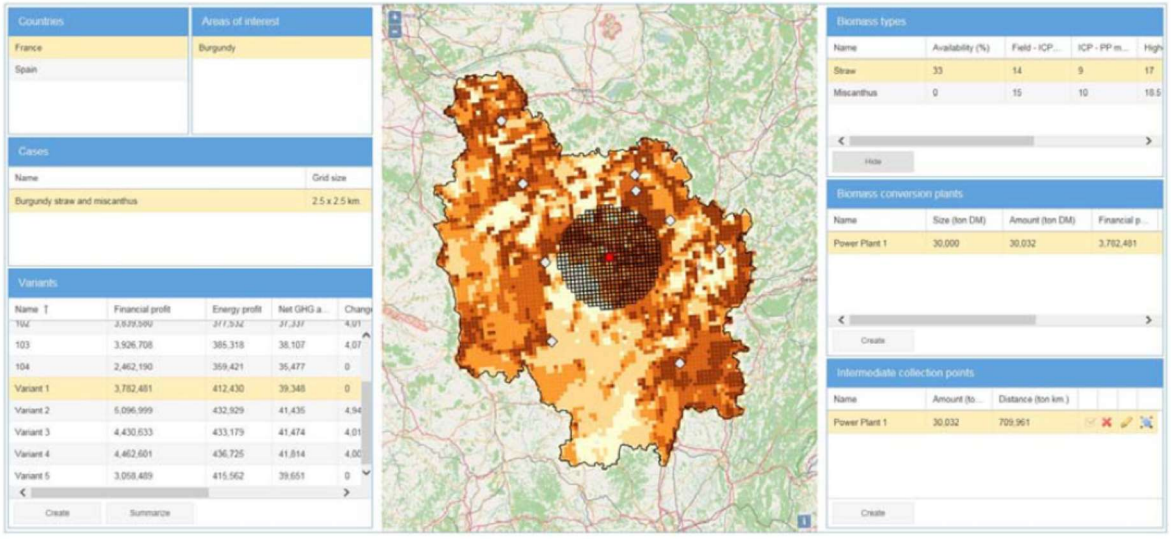

Figure 5: Example of the LocaGIStics output

(Source: S2BIOM project, D3.5 Formalized stepwise approach for implementing logistical concepts using BeWhere and LocaGIStics)

The S2BIOM set of tools is presented in Figure 6.

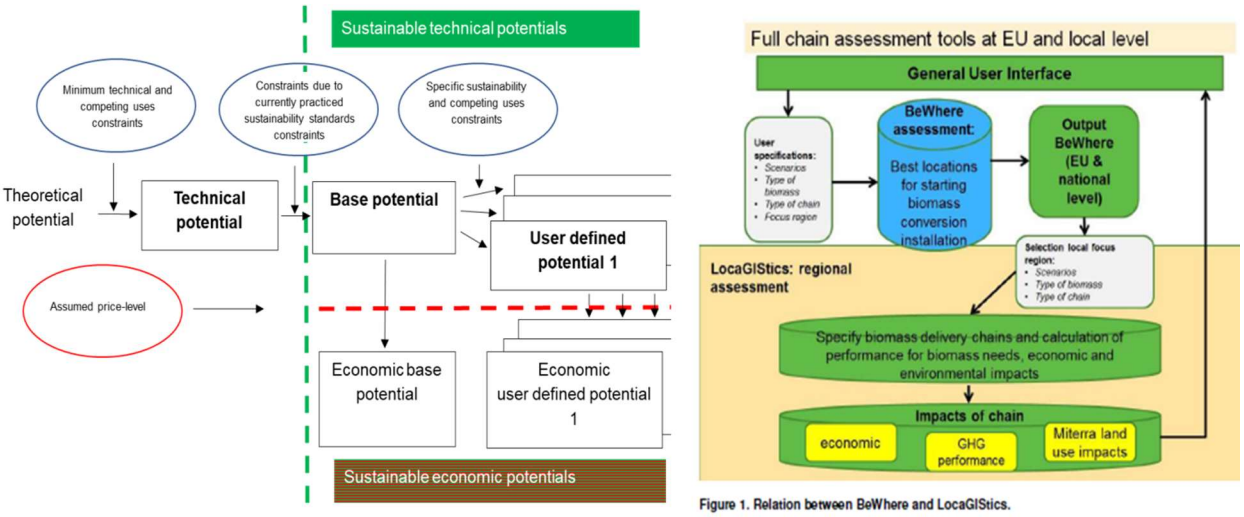

Figure 6: the S2BIOM set of models

4.1 Biomass types

- Primary residues from agriculture: Straw/stubbles, Woody pruning & orchards residues
- Dedicated cropping of lignocellulos biomass on agricultural area: Energy grasses, annual & perennial crops, Short rotation coppice.
- Wood production and primary residues from forests: Stemwood from final fellings & thinnings, logging residues and stumps from final fellings)
- Other land use: Grassland cuttings from nature protection areas, recreational areas, dykes and road side verges
- Secondary residues from wood industry: Saw mill residues, wood processing industry residues, secondary residues from pulp and paper industry
- Secondary residues of industry utilising agricultural products: Products like olive pits, cotton gin residues, cereal bran, rice husk, soy bean, sunflower and rape seed oil residues, nut peelings etc.
- Waste collection/ tertiary residues: There are two types of waste: Biowaste according to Waste Framework Directive (2008/98/EC) and Post-consumer wood, which includes all kinds of wooden material that is available at the end of its use as a wooden product

4.2 Biomass potential types

There are three potential types: Base, technical and user defined.

According to report D1.6 of the S2Biom project, the technical potential represents the absolute maximum amount of lignocellulosic biomass potentially available for energy use, assuming the absolute minimum of technical constraints and constraints by competing uses. The base potential can be defined as the technical potential considering agreed sustainability standards for agricultural forestry and land management. The base potential is thus considered as the

"sustainable technical potential" considering agreed sustainability standards in CAP (Common Agricultural Policy).

The "user defined" potentials vary in terms of type and number of constraints per biomass type. They can be also considered as "sustainable technical potentials" but differ in the constraints considered vs the base potential and among each other. The user can choose the type of constraints he wants to use in every different type of biomass, so he can understand the effect in total biomass potential for every constraint he used.

4.3 Geographic coverage

The S2BIOM had an extended geographic coverage to EU28, Western Balkan Countries (Montenegro, North Macedonia, Albania, Bosnia and Herzegovina, Serbia, Kosovo), Moldavia, Turkey and Ukraine; a total of 37 countries.

4.4 Time coverage

It refers to the years 2012, 2020, 2030

4.5 Biomass logistics (harvesting, transportation, storage, etc.)

A logistical components database was developed, organised in categories and sub-categories according to the main functionalities. For each of them general properties (like category, main operating principle, suitable applications etc.) are described, along with technical properties (like type of energy needed, capacity, transportability etc.), biomass input and output specifications, and financial and economic properties.

4.6 Biomass quality

In S2BIOM a database for standardized biomass characterization was developed and populated for all lignocellulosic biomass types covered in the project. This database lists a number of qualitative characteristics for every biomass type that concerns the project, like net/gross calorific value, ash content, moisture content, bulk density, ash melting behavior, cellulose, hemicellulose content, elemental analysis etc.

4.7 Cost assessment, cost and supply curves, market prices

Cost assessments are provided in two ways: First from Biomass Chain Data tab - Biomass Supply option it can provide (in nuts 3 level) information about road side cost in euros per ton DM. Secondly from the same tab and Biomass Cost/Supply (Europe) can provide information about road side cost (and nuts 0 level) in euro/ton dry matter and in euro/Gj. In the latter case the cost is described in the form of a cost-supply graph, showing the total amount of biomass in the vertical axis (in Kton dry matter or Pj) and the road side cost in horizontal axis (in euro/ton dry matter or euro/Gj).

4.8 Final products (energy, IBC)

Energy uses (Heat and power),

4.9 Logistics of final products

Not available.

4.10 Relevance to the MUSIC purposes

As in the case of BIORAISE, the S2Biom set of tools includes all relevant information required by the MUSIC project, including logistics. But again, as in the case of BIORAISE, the tools are being upgraded by their developers, thus at the moment they are not available to use.

However, the toolset of the S2BIOM model considers a number of interesting functionalities, especially in the logistics of the feedstock.

In the course of Task 4.2, functionalities of the whole toolset will be examined and evaluated to see which and how they could be actually integrated in the developing of the project models. At the same time, contacts will be made with the tool developers, so as to gain inside information on the updating procedure and the possibilities of using the updated versions within the MUSIC project.

5 GLOBIOM

GLOBIOM (https://www.globiom.org/). IIASA's Global Biosphere Management Model (GLOBIOM) is used to analyse the competition for land use between agriculture, forestry, and bioenergy, which are the main land-based production sectors. As such, the model can provide scientists and policymakers with the means to assess, on a global basis, the rational production of food, forest fiber, and bioenergy, all of which contribute to human welfare. The model simulates competition for land between different uses driven by price and productivity changes (Figure 7).

As from the definition given by its developers, “GLOBIOM is a global recursive dynamic partial equilibrium model integrating the agricultural, bioenergy and forestry sectors with the aim to provide policy analysis on global issues concerning land use competition between the major land-based production sectors”.

5.1 Biomass types

The GLOBIOM model considers biomass potentials from two types or resources:

i) agricultural products and residues, and

ii) woody biomass from managed forest and short rotation tree plantations (i.e industrial roundwood, non-commercial roundwood, harvest losses and branches and stump).

As regards the agricultural products, globally the model includes 18 major crops, which represented about 80 % of the 2007 global harvested area (namely barley, dry beans, cassava, chick peas, corn, cotton, groundnut, millet, potatoes, rapeseed, rice, soybeans, sorghum, sugarcane, sunflower, sweet potatoes, wheat, and oil palm). The GLOBIOM-EU regional version extends this to 27 crops. GLOBIOM also contains yield information of energy crops, such as switchgrass and miscanthus.

In addition to crop feedstocks, GLOBIOM also provides potential for woody biomass feedstock extraction that can be used for bioelectricity and second generation biofuels. GLOBIOM explicitly models the extraction of five primary wood products (and distinguishes between short rotation plantations and managed forests).

Biomass from managed forests: the G4M model used in GLOBIOM allows four main primary woody resources to be represented: industrial roundwood, non-commercial roundwood, harvest losses and branches and stumps.

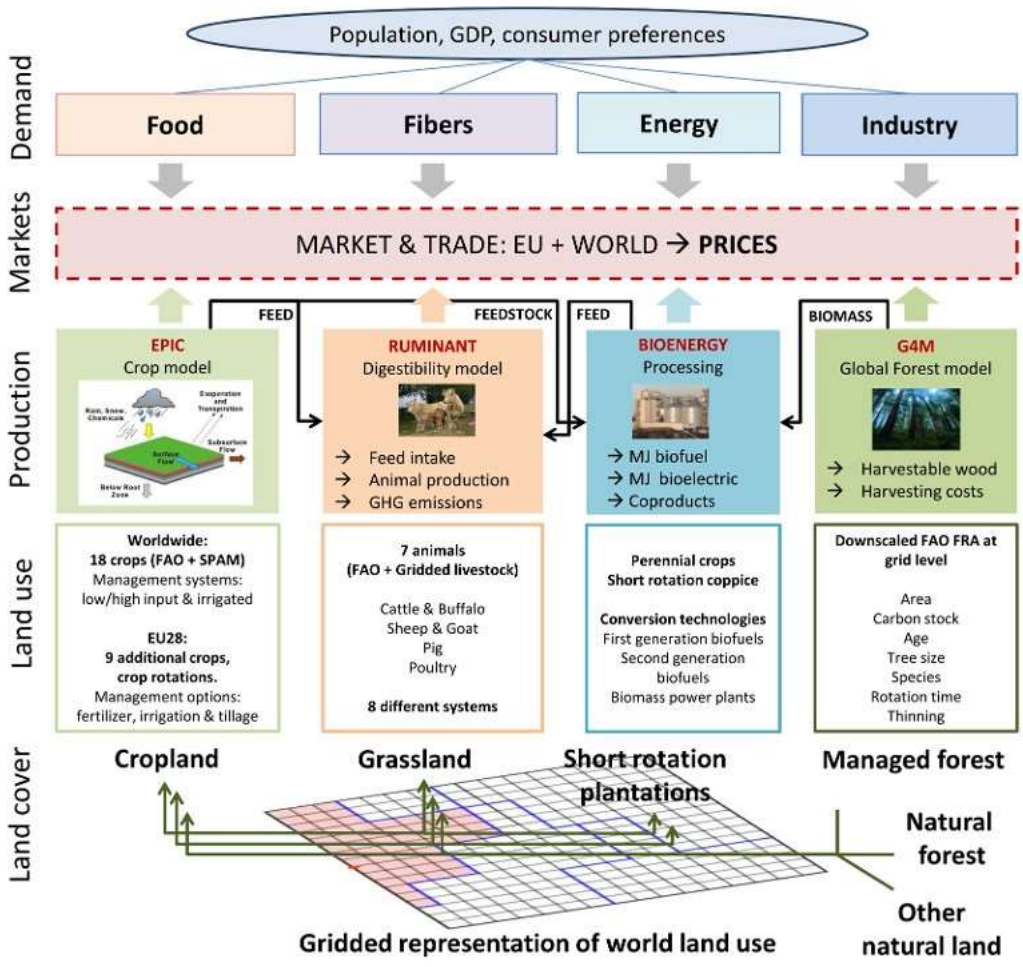

Figure 7: The GLOBIOM model supply chain

5.2 Biomass potential types

The computed biomass potential are subject to resource, technological and policy constraints.

5.3 Geographic coverage

GLOBIOM covers 30 aggregated regions around the globe (Figure 8). In addition to that, there more regional versions of the model, like the GLOBIOM-BRAZIL and GLOBIOM-EU, designed with the respective national and regional institutes. These versions have higher resolution and details, in order to assess the impact of specific regional policies. In the case of the EU, crops are allocated across NUTS2 regions using data from EUROSTAT. Yields for all locations and crops are determined in a geographically explicit framework by the Environmental Policy Integrated Climate Model (EPIC).

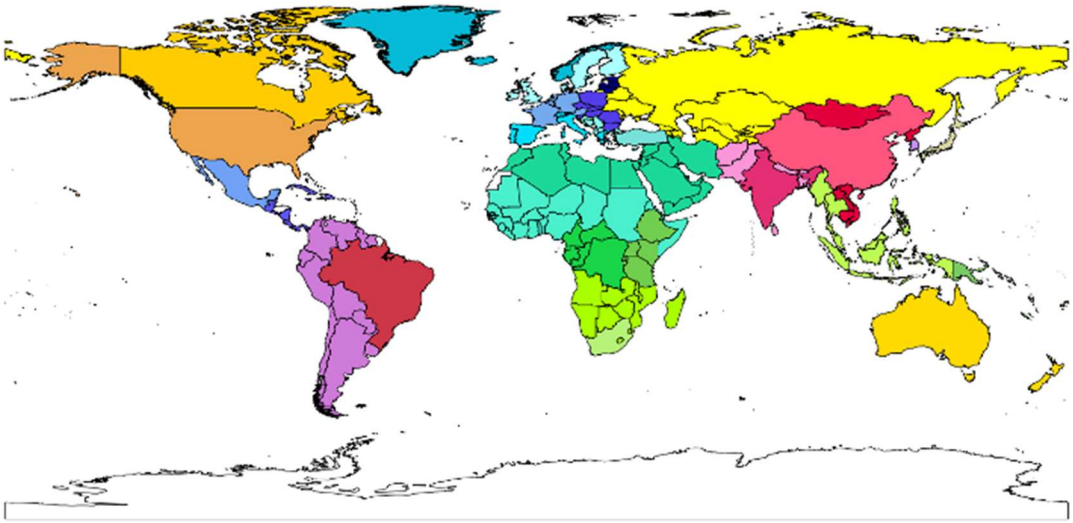

Figure 8: The GLOBIOM regions

5.4 Time coverage

It is based on 10 years long steps, covering the 2000-2030 time frames and it is able to take into account climate change.

5.5 Biomass logistics (harvesting, transportation, storage, etc)

Harvesting costs include logging and timber extraction and depend on harvesting equipment, labour costs and terrain conditions. Primary resources, once extracted, are separated into five primary woody products: sawn wood biomass, pulp wood biomass, energy wood biomass (biofuels, heat and electricity), traditional use biomass (fuel, cooking) directly collected in the forest (no processing chain) and other non-energetic use biomass. Primary forest residues are included (branches and stumps) and can be used for second generation biofuels, electricity and heating. All harvested primary woody products are sent to processing activities which can lead to other types of bioenergy feedstocks (secondary residues such as saw dust and cutter shavings, black liquor, and bark)

5.6 Biomass quality

Biomass quality is represented in details.

5.7 Cost assessment, cost and supply curves, market prices

Within the international trade flow patterns predictions, transportation costs have been computed, based on the distance between each pair of regions and the transportability of the goods. For the prediction of the flow patterns of the commodity trade between supply and demand markets, in the Globium model is assumed that goods are homogenous and that markets are perfectly competitive.

As regards the international trade, tariffs and and transportation costs are calculated and differentiated among each pair of partner and for each product. The applied calibration method (for consistency between trade flows, net trade, trade costs and prices) is adapted from Jansson and Heckelei (2009).

As regards the market, in GLOBIOM it "is represented by implicit product supply functions based on detailed, geographically explicit, Leontief production functions, and through explicit, mostly constant elasticity, product demand functions. The market equilibrium is found through maximization of the sum of producer and consumer surplus subject to resource, technological and political constraints (McCarl and Spreen,1980)[1]".

5.8 Final products (energy, IBC)

The energy biomass, which can come from managed forest and short rotation tree plantations can be used in bioenergy chains for polyproduction of ethanol, methanol, heat and power, and biogas mixes. As for agriculture, additionally to production of grains or fibres, GLOBIOM also represents the production of straw for some of the major crops (barley, wheat) and corn stover (even though only a part of the residues produced is considered available since residues are often re-used in farm for fertilisation purposes). These residues are used for livestock, industry and energy production.

The products of the biomass transformed within GLOBIOM are represented in terms of MJ biofuels and MJ bioelectric.

5.9 Logistics of final products

Not available.

[1] From the GLOBIOM website https://www.iiasa.ac.at/web/home/research/modelsData/GLOBIOM/GLOBIOM-Markets.en.html accessed 21 February 2020

5.10 Relevance to the MUSIC purposes

The GLOBIOM model has been used in several projects, including studies specifically designed for European policy makers and stakeholders. While it is robust and detailed, and having sufficient spatial resolution, being thus scientifically suitable for MUSIC purposes, it is not directly downloadable, since it is an integrated system with different models. While there is no explicit mention, its use is probably bound to the participation of the GLOBIOM developers, a team from IIASA, to the MUSIC project.

6 Enabling

ENABLING (https://www.enabling-project.com/) is a 3-year project that intends to develop the great potential of the bio-based industry, encouraging the creation of efficient and structured biomass supply chains for the production of bio-based products (BBP). To do so, ENABLING proposes tools and methodologies nurturing collaboration and knowledge transfer among practitioners in the sector, through the creation of physical and virtual spaces for sharing best practices, brokering innovation in the bio-economy and providing stakeholders with coaching and guidance on innovation.

The project has developed the "Biomass Trade Platform" released in February 2020 (available at this link: http://www.biomass-trade.eu/). The Biomass Trade Platform" allows biomass producers and biomass processors to search and offer biomass residues and by-products, bio-based products as well as services in the different sectors of bioeconomy. The BiomassTrade Platform operates EU-wide but aims to connect stakeholders on a regional level to foster the exchange of goods and services on that level. Today the platform is still empty, but offers a great potential.

7 Bioboost

BIOBOOST (http://bioboost.eu/home.php) was an EU FP7 project which addressed the study on the complete value chain to produce energy carriers from selected biomass thermochemical conversion processes. The project studied feedstock potential, the investigation of pyrolysis and hydrothermal carbonisation conversion technologies, the optimisation of transport and logistics to the exploitation of the energy carrier and its by-products. The techno/economic and environmental assessment included the complete supply chain.

7.1 Biomass types

The Biomass types considered in this model is agricultural residues, organic wastes and forestry residues in EU27 and Switzerland. The web application allows interactive browsing of the spatial data presenting density and technical potential of:

- agricultural (straw, orchard's pruning, hay) and animal residues (manure surplus);
- forestry residues;

- natural conservation matter (urban maintenance of green areas, hay and shrubs);
- roadside vegetation;
- urban and industrial waste (biodegradable municipal waste, selected waste from the food and wood industry).

Biomass potential was calculated by a webtool, available at: http://bioboost.iung.pl/. The model gives different outputs for each considered biomass for each district.

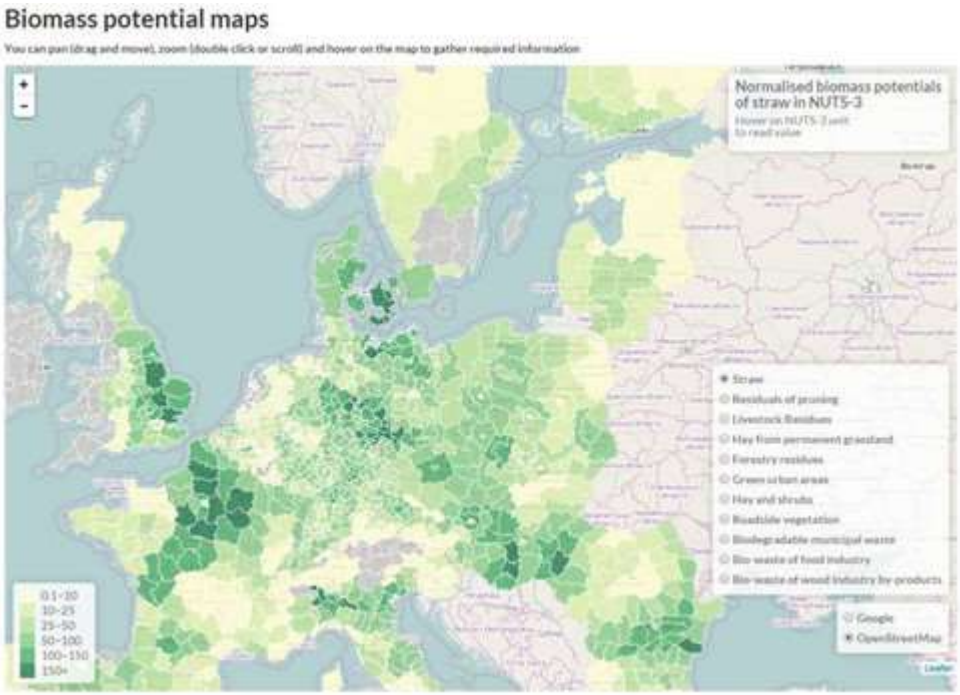

Figure 9: The online geoportal available from BioBoost project.

The Geoportal presents the analysis of the biomass potential in the EU-27 with their possible use for energy purposes. Estimates were made for spatial unit's NUTS-3, which are small regions with geocode standard for referencing the subdivisions of countries for statistical purposes (Figure 9).

7.2 Biomass potential types

Theoretical and technical biomass potentials in NUTS-3 were modelled and mapped in the Bioboost project. Additionally normalized potentials are presented for the visualisation of the biomass density and spatial variability in larger regions.

7.3 Geographic coverage

As mentioned here above, the geoportal covers EU27 and Switzerland. A GEO portal was set up to demonstrate results of the geographical information system (GIS). Interactive maps are based on a web browser and are supporting operations like:

- panning and zooming;
- display of selected object (NUTS) attributes (e.g.: potential of mass, energy, density);

- change of a base layer between OpenStreetMap and Google Maps;
- change the contents of overlay layer

7.4 Time coverage

The model does not consider simulation for future scenario. Only current data were used.

7.5 Biomass logistics (harvesting, transportation, storage, etc.)

A holistic logistic model was developed to optimize biomass and energy carrier transportation regarding distances, costs and CO_2 emissions and to identify optimum locations for de-central and central plants. Storage requirements, start-up and operation costs were simulated and evaluated by calculating performance figures such as cost or environmental impact.

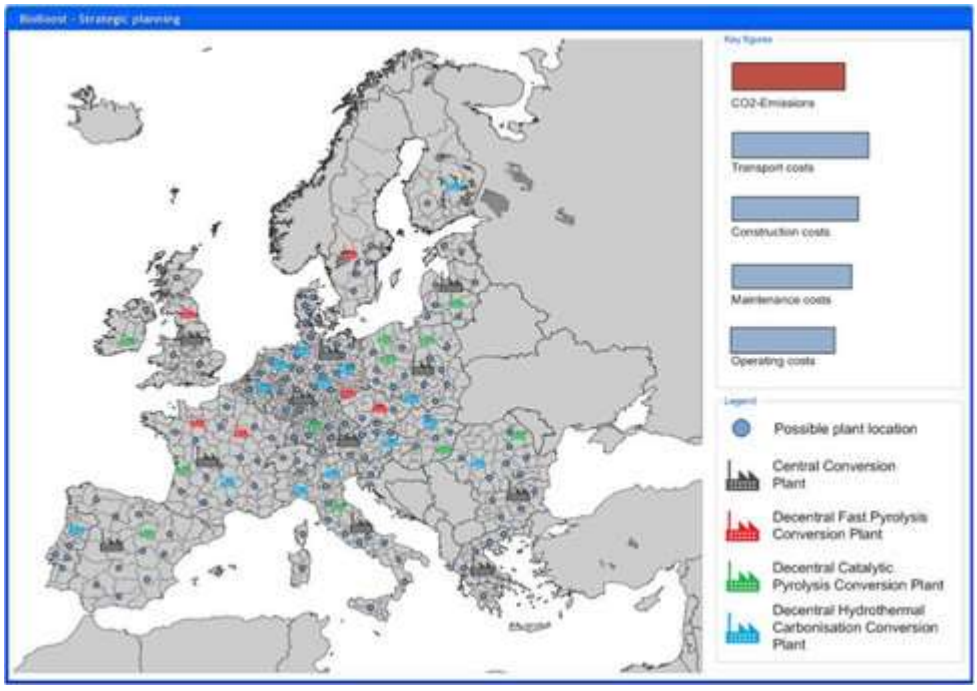

Figure 10: Map used on the logistic model.

A sophisticated optimization environment was constructed in order to automatically select optimal locations, means, modes and times of transport of the whole supply chain as well as incorporate partially user-provided selection of these parameters (Figure 10).

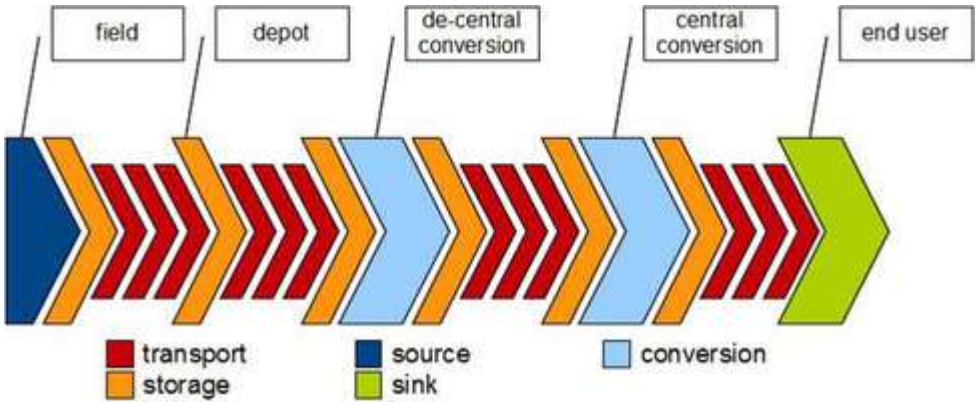

Figure 11: Process scheme used the whole value chains.

Simulation considers the holistic logistic model by the parameters feedstock supply, transportation routes, storage size, means of transport, plant locations and size in regard to CO_2 emission, distances, applied vehicles, risks and distribution costs. The BioBoost Simulator a model was developed for the evaluation of processes for 2nd generation bio-fuels (Figure 11).

7.6 Biomass quality

Biomass has been characterized in order to fit the most appropriate conversion processes, as presented below.

7.7 Cost assessment, cost and supply curves, market prices

The project focused on the identification, assessment and optimization of the techno-economic feasibility and environmental and social sustainability of the bio-energy carrier pathways in Europe, as well as on the preparation of a Market Implementation Plan for biomass energy carrier based value chains.

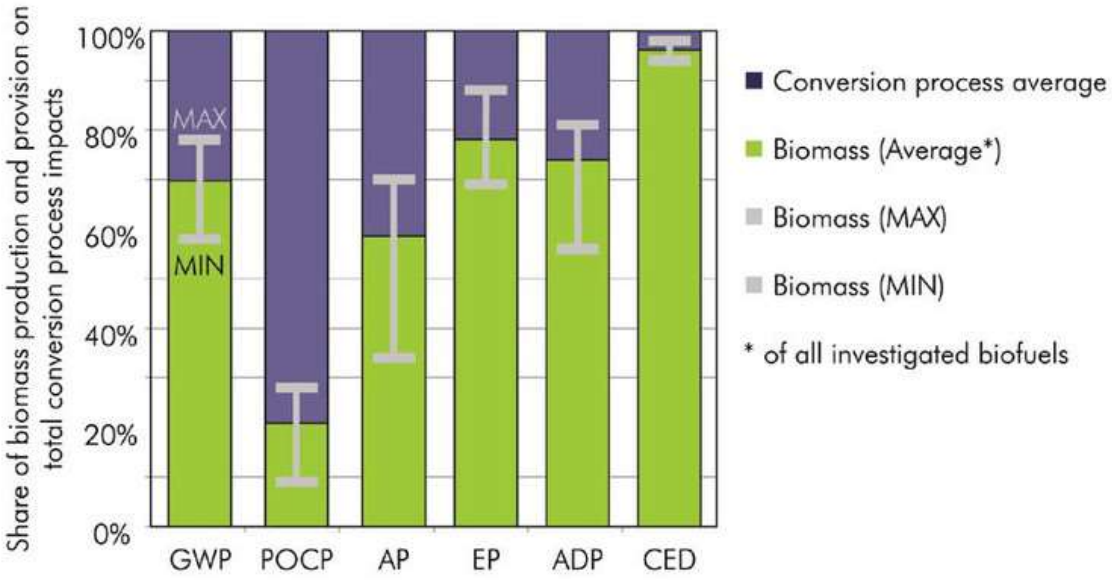

Figure 12: Share of biomass (production and provision) in total conversion processes (incl. fuel distribution) impacts

Figure 12 shows the share of biomass (production and provision) in total conversion processes (incl. fuel distribution) impacts. GWP: Global Warming Potential; POCP: Photochemical Ozone Creation Potential; AP: Acidification Potential; EP: Eutrophication Potential; ADP: Abiotic Resource Depletion Potential; CED: CumulativeEnergy Demand. (RENEW)

7.8 Final products (energy, IBC)

After the selection of feedstock for decentralized conversion technologies, the following pathways were considered: Fast pyrolysis (FP), catalytic pyrolysis (CP) and hydrothermal carbonization (HTC).
The energy carriers have been tested and classified to the best technical and economic utilization:

- Investigation of combustion of pyrolysis and hydrothermal carbonisation coal in heat and power production.
- Adaption of a FLOX burner and verification of pyrolysis oil combustion for residential heating.
- Proof of catalytic pyrolysis oil as bio crude input to a refinery.
- Investigation of energy carriers to form syngas for the production of synthetic fuel and chemicals.
- Investigation of the technical and economic potential of separated chemicals.

7.9 Logistics of final products

A customized algorithm optimizes locations and capacities of plants as well as biomass and energy carrier logistics. The Simulator was developed by HEAL the Heuristic and Evolutionary Algorithms Laboratory of the University of Applied Sciences Upper Austria (FHOOE). Using the Simulator helps to analyse which regions in Europe would be ideal for first implementation of industrial-scale plants for 2nd generation bio fuels. You can also easily analyse the profitability of such plants.

7.10 Relevance to the MUSIC purposes

Despite the fact that the project ended several years ago, part of the work carried out for the logistics could be optimized. Moreover, biomass maps can be upgraded with the most interesting feedstock along the recent EU-policies.

8 Biomass Trade Center II

BiomassTradeCentreII (http://www.biomasstradecentre2.eu/Biomass-Trade-CentreII/) - Development of biomass trade and logistics centres for sustainable mobilisation of local wood

biomass resources was a project aiming at increasing the production and the use of energy from wood biomass by organising motivation events to engage identified target groups such as farmers and forest owners, forest entrepreneurs, wood energy contractors and other stakeholders to produce and sell energy products and services to the market and invest in biomass business and biomass logistic and trade centres (BLTC) in 9 EU countries (Austria, Croatia, Germany, Greece, Ireland, Italy, Romania, Slovenia and Spain). The project also fostered wood energy contracting between biomass providers and potential users.

More than 2.100 addresses of service providers (wood chip, firewood, pellet producers, and forest companies but also sawmills) are available in internet catalogue (biomass producers, forest companies – details available on internet) on: http://www.biomasstradecentre2.eu/wood-biomass-production/service-providers/.

Fourteen new biomass trade and logistic centres were built, 40 more were in progress and more than 32 prefeasibility studies for new investments were prepared and presented to possible investors, during the project lifespan (Figure 13)

Very useful information can be found on the project website and relevant deliverables regarding the establishment of new biomass businesses, creation of new biomass trade centres and starting with energy contracting – even if implementation of such model was a big issue in some countries. Booklets on the energy contracting as well as on CEN standards and quality assurance and quality control (QA/QC) are available on the website translated in 9 languages.

In addition, a quality assurance /quality control (QA/QC) system was established for wood fuels that can be easily implemented by smaller biomass / wood fuel producers.

a)

b)

c)

Figure 13: Biomass trade center in Romania (a), Austria (b) and Italy (c)

9 INFER-NRG

The INFER-NRG is an INtegrated system For the simulation of biomassEs flows fRom field to eNeRGy developed by the University of Florence. It is based on multiple transformation sites, to which the produced biomass is transported and transformed into energy. It has been successfully used to estimate the potential production of the territories surrounding two transformation sites owned by an Italian private group. The model is mainly focused on agricultural production, simulates in detail the production of biomass, including crop rotations, and climate change scenarios, and has a simple transportation model.

9.1 Biomass types

The model can represent almost all agricultural biomasses, including different rotations. It could also take into account woody residues from agriculture and forests.

9.2 Biomass potential types

Theoretical and technical potentials are considered.

9.3 Geographic coverage

The model has been used for two Italian sites, but can be used in different areas in the globe, with a spatial resolution up to 1 squared km.

9.4 Time coverage

The INFER-NRG can be used for present, past or future scenarios, including climate change, at 1-year long time step.

9.5 Biomass logistics (harvesting, transportation, storage, etc)

The harvest can be simulated only for agricultural products.
Transportation is represented in terms of km from site of production to site of storage (if any) and to final transformation site, mean of transportation (road, railroad, water), costs and related emissions.

9.6 Biomass quality

Biomass is represented in terms of lignocellulosic (residues) or energy crops, as regards agricultural products, or woody biomass (residues).

9.7 Cost assessment, cost and supply curves, market prices

The model uses average cost estimated from real case studies, applied to transportation. However, other costs can be modelled and applied to biomass production and transformation processes.

9.8 Final products (energy, IBC)

Currently not available

9.9 Logistics of final products

Not available

9.10 Relevance to the MUSIC purposes

Since the model has been developed and it is currently maintained by the University of Florence, it could be easily used and adjusted in order to fulfil the needs and reach the goals of the MUSIC project.

10 Conclusions

MUSIC project aims to facilitate further market uptake of three types of IBC (pyrolysis oil, torrefied biomass and microbial oil) by developing feedstock mobilisation strategies, improving logistics and development of IBC trade centres. Core project actions are the development of regional feedstock mobilisation strategies and tools for mobilising biomass and optimising size and location of trade centres, which will end up in optimised, cost-effective solutions for

logistics along the entire IBC value chain in specific, industry-driven advanced and strategic case studies in the four target regions (Greece, Italy, Sweden/Finland and International).

The current review concludes that the most significant models to be tested in the targeted case studies are the BIORAISE, and the S2BIOM tool sets. Both models are currently being updated by their developers therefore their updated versions, should they still be online and available for use, will be examined along with the models being developed within the MUSIC project in the case-studies.

The BIORAISE model is partly related to the MUSIC purposes, as it covers the whole supply chain of the lignocellulosic residues from agricultural and forest residues for energy purposes (solid biomass), in terms of available quantities, fuel characteristics, feedstock logistics and relevant costs, in economic and environmental terms. It covers mainly the Southern Europe, among which Italy and Greece, where specific Case-Studies are being developed. However, the model does not cover the logistics of the final energy products (solid biomass) nor their trade.

In the course of Task 4.2, we will run the model for the Greek and Italian case-studies, as far as the feedstock types, quantities and qualities are concerned, cross-checking our data and calculations with these of the tool. If they match then we can benefit of the tool database to work in other regions or countries that are covered by the tool. Contacts will be made with the developers aiming to check whether the current updates also consider the logistics of the solid biomass fuels.

Likewise, the S2BIOM tool sets, computerized and easy to use, contain harmonized datasets at local, regional, national and pan European level for EU28, Western Balkans, Moldova, Turkey and Ukraine. The toolset consisted of the Bio2Match, BeWhere and LocaGIStics tools, which covered the whole biomass supply chain, from the collection of biomass, harvesting and logistics, to the final energy uses. As in the case of BIORAISE, the S2Biom set of tools includes all relevant information required by the MUSIC project, including logistics. But again, as in the case of BIORAISE, the tools are being upgraded by their developers, thus at the moment they are not available to use. However, the toolset of the S2BIOM model considers a number of interesting functionalities, especially in the logistics of the feedstock.

In the course of Task 4.2, functionalities of the whole toolset will be examined and evaluated to see which and how they could be actually integrated in the developing of the project models. At the same time, contacts will be made with the tool developers, so as to gain inside information on the updating procedure and the possibilities of using the updated versions within the MUSIC project.

In addition, **INFER-NRG** has been developed and it is currently maintained by the University of Florence, thus could be easily used and adjusted in order to fulfil the needs and reach the goals of the MUSIC project.

Despite the fact that the project Bioboost ended several years ago, part of the work carried out for the logistics in the **Geoportal model** could be optimized and biomass maps could be upgraded with the most interesting feedstock along the recent EU-policies.

Apart from the modelling work, two more projects have been spotted, containing interesting information on the organisation of biomass trade centers, the **Enabling** and the **Biomass Trade Centers II** projects. This information as well as the developed platforms will be taken into consideration when organising the IBCs trading in the targeted case studies of the MUSIC project.

ENABLING is an on-going project that has developed the "Biomass Trade Platform" released in February 2020 (available at this link: http://www.biomass-trade.eu/), which allows biomass producers and biomass processors to search and offer biomass residues and by-products, bio-based products as well as services in the different sectors of bioeconomy. The BiomassTrade Platform operates EU-wide but aims to connect stakeholders on a regional level to foster the exchange of goods and services. Today the platform is still empty, but offers a great potential.

Very useful information can be found on the **Biomass Trade Centers II** project website and relevant deliverables regarding the establishment of new biomass businesses, the creation of new biomass trade centres and the use of energy contracting. Booklets on the energy contracting as well as on CEN standards and quality assurance and quality control (QA/QC) are available on the website translated in 9 languages.