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LOCAGISTICS: DESIGN & EVALUATION OF REGIONAL BIOMASS DELIVERY CHAINS

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ABSTRACT: LocaGIStics is a tool for the design of regional biomass delivery chains. The basis for the tool was a GIS tool (Elbersen et al., 2014) developed in a Dutch national project ‘Integrated framework to assess spatial and related implications of increased implementation of biomass delivery chains’. LocaGIStics was further developed within the S2Biom project. It enables to further design and evaluate regional biomass delivery chains that are either suggested by higher level optimization models like e.g. BeWhere or that are the result of initial planning by e.g. an energy company or a biobased producer. These general plans are translated in several biomass delivery designs using the variation in logistical concepts covering transport, pre-treatment and conversion options. The performance of every chain design can then be analysed by comparing the different biomass delivery chains on the following environmental and economic indicators: GHG emissions and mitigation (including land use change emissions), soil C, soil erosion impacts potential and an economic minimum acceptable return analysis. LocaGIStics can take account of high resolution cost-supply information available at 250 m resolution grid. The LocaGIStics tool was first developed using a case study in Burgundy.

Keywords: logistics, supply chain, decision making, geographical information system (GIS).

1 INTRODUCTION

The S2Biom project (www.s2biom.eu) supports the sustainable delivery of non-food biomass feedstock at local, regional and European level. One of the newly developed tools in this project is LocaGIStics. The basis for this tool is a GIS tool developed in the ME4 project ‘Integrated framework to assess spatial and related implications of increased implementation of biomass delivery chains’ [1]. LocaGIStics will be linked to the existing BeWhere model [2] which identifies places in the EU where there will still be enough space to have extra bioenergy production facilities, based on availability and demand of biomass.

2 AIM OF THE LOCAGISTICS TOOL

LocaGIStics supports the design of biomass delivery chains at a regional level. It enables the user to analyze different biomass delivery chains in a comparative way.

The indicators for evaluation are financial profit, energy profit, net GHG avoided, and spatially explicit land use and environmental impacts. LocaGIStics uses data on biomass supply, different biomass conversion and pre-treatment technologies and on novel logistical concepts like biomass hubs. The tool is currently being developed for the Burgundy region and will be further implemented for case studies in Spain and Finland.

3 GETTING STARTED WITH A NEW VARIANT

The starting screen of LocaGIStics (Figure 1) shows a map of the selected country and region (Burgundy). The user is then invited to design one or more biomass delivery chains choosing the size and location of the power plant while designing the chain with or without intermediate collection points.

To operate the tool one starts specifying the choices in the top left hand pane (‘Countries’), going down to ‘Biomass types’ pane on the left side, and then moving to the top right panes specifying ‘Biomass conversion plants’ and finally the ‘Intermediate collection points’.

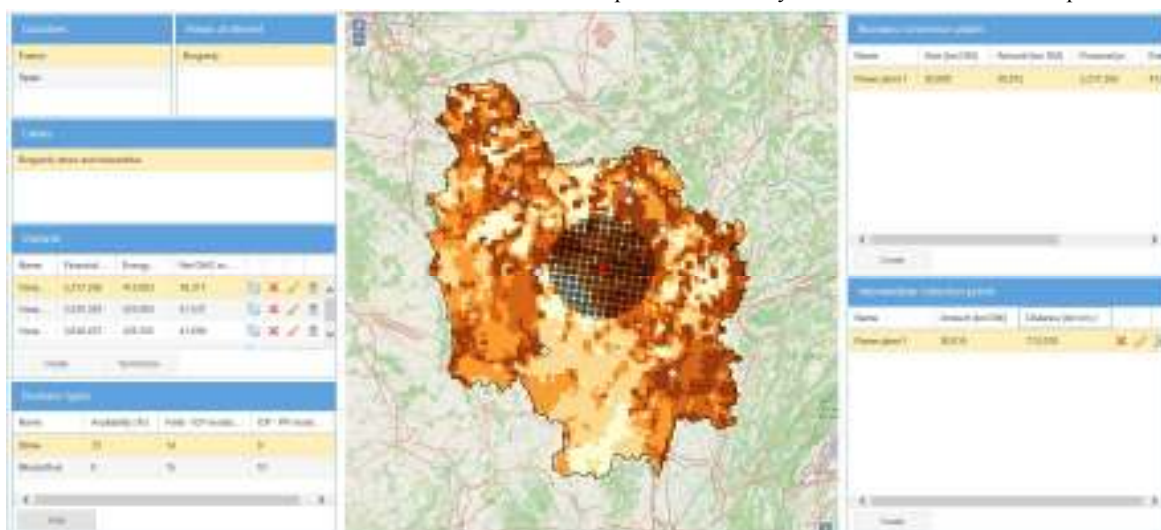


Figure 1: Introduction screen of LocaGIStics.

Since this first version of the tool only contains one case the user does not need to make a selection in the 'Countries' (France), 'Area of interest' (Burgundy) and 'Cases' (Burgundy straw and Miscanthus) panes. The user therefore starts with the 'Variants' pane.

In the variants pane a new variant can be created and a name for the variant of the chain one is going to design (e.g. 'only straw' or 'mixed straw and Miscanthus') has to be chosen. The variant that has been created is highlighted with a yellow bar. If needed the name of the variant can be changed.

4 BIOMASS TYPES

The biomass types section shows the available biomass types (in the Burgundy case these are straw and Miscanthus). One can choose the actual amount of biomass one wants to include in the analysis (this could be lower than the maximum). The choice could be e.g. to use only straw, so then one needs to put the amount of the other biomass types (now only Miscanthus is included) on '0'. The biomass availability and related properties (field moisture % and moisture content after intermediate collection/pre-treatment) can be edited. All biomass properties have a default setting (in this case 33% straw and 0% Miscanthus), but can be changed by the user.

The map shows the biomass availability in a grid pattern (e.g. 2.5x2.5 km). Deep coloured grids have higher biomass availability than light coloured grids. The 'active' biomass type (highlighted with the yellow bar), for which a biomass conversion plant is selected is shown on the map. In the Burgundy case straw is yellow and Miscanthus is purple.

5 BIOMASS CONVERSION PLANTS

In this pane one can define the power plant location and size (in this example the size is chosen to be 30,000 ton dry matter of biomass, and only small size deviations of about 10% can be made). By clicking the 'Create' button one can add a new power plant and specify its name and size in terms of amount of biomass (in ton dry matter) processed on a yearly basis. After clicking 'Submit' a power plant is located on the map (red square) in the center of the region.

Then one can move the red square to the location on the map where you want to locate the plant. The suggested locations by the BeWhere optimization model (grey diamonds in the map) can be used as a reference point, and the biomass density shown on the map (brown grids) is also meant to be a guidance.

6 INTERMEDIATE COLLECTION POINTS

In this pane the intermediate collection points supplying to the biomass conversion plant that was just designed in the former pane can be defined. The first step is to click on 'Create' and then assign a name. Then click on 'Submit'.

One will see a red circle on the map indicating the location of the intermediate collection point. The user can now click on this red circle and drag it to the position where he wants the intermediate collection to be located. Most likely the place selected should be where the

biomass is most concentrated spatially so that you obtain short transport distances to the intermediate collection point.

If the user wants to let the intermediate collection coincide with the power plant itself he can click on the icon in the 'Intermediate collection point' pane. This definition of intermediate collection points can be repeated for a second intermediate collection point.

7 RESULTS

The results will be available on the screen and also in an excel-file. In the 'variants pane' the financial profit, energy profit and the net GHG avoided is specified as assessed for the defined biomass delivery chain. In the 'Intermediate collection points pane' the amount of biomass and the total transport kilometers in every intermediate collection point are shown.

Variants			
Name	Financial profit	Energy profit	Net GHG avoided
Variant 1	2,217,256	412,083	39,317
Variant 2	3,535,329	433,983	41,537
Variant 3	3,640,437	435,355	41,698

Figure 2: Overview of results Variants pane.

Intermediate collection points		
Name	Amount (ton DM)	Distance (ton km)
ICP4_1	13,523	147,467
ICP4_2	16,587	170,712

Figure 3: Overview of results intermediate collection points pane.

8 CONCLUSION

By designing different variants of biomass delivery chains and evaluating them on their environmental and economic performance, the optimal organization and location can be identified by the user of the LocaGISTICS tool.

9 REFERENCES

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