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DYNAMIC SIMULATION OF BIOENERGY FACILITY LOCATIONS IN GIS ENVIRONMENT

Agent-Based simulation

European area 37 countries

Temporal and spatial variation is taken account

Large dataset imported to model

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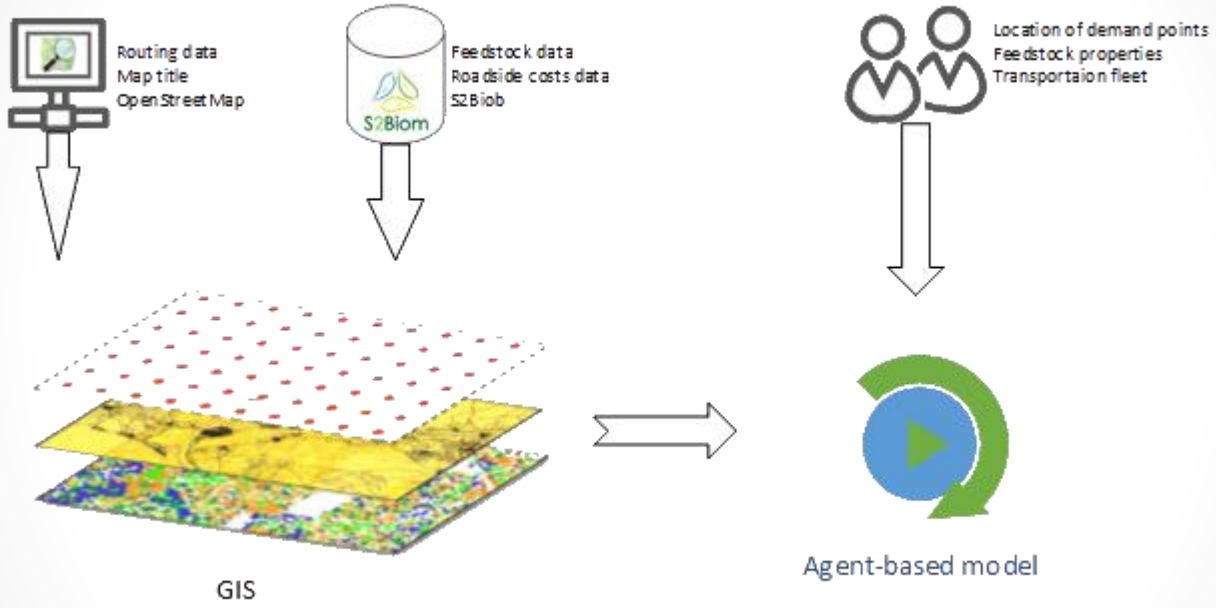
Why dynamic simulation

- Increase interest for forest-based bioenergy and biorefining facilities
  - New facilities are planned all around European
- Many tools for decision making
  - GIS for spatial distribution
  - LCA for environment impact
  - Surveys for local opinions
  - etc.
- Temporal variation can be studied by dynamic simulation
- Agent-based modelling can be used with large datasets

Model in short



Feedstock availability data

- Provided by S2Biom (www.S2Biom.eu)
- Data estimation for 2020
- Two sub categories are used from main category of wood production and primary residues from forests:
  - Primary forest biomass
    - Include stem and crown biomass from felling and thinning
  - Forest residues
    - Includes logging residues from felling and thinning
- Model excludes stumps

Simulation model

- Versatile
- User define demand point location
  - Feedstock availability information is imported to the model for country where demand point location falls in.
- Operations needed to do feedstock are included by time and cost in the model

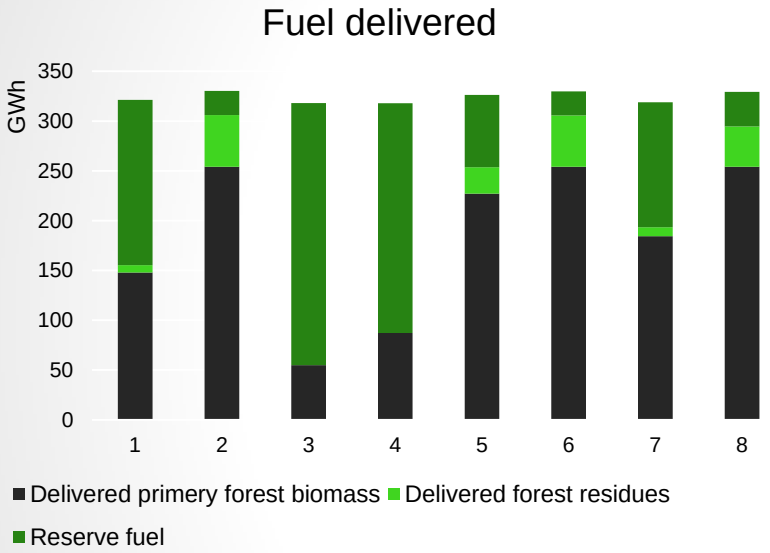
- Possibility to have fuel terminal close proximity to the demand point
- Fuel may arrive by long distance transportation

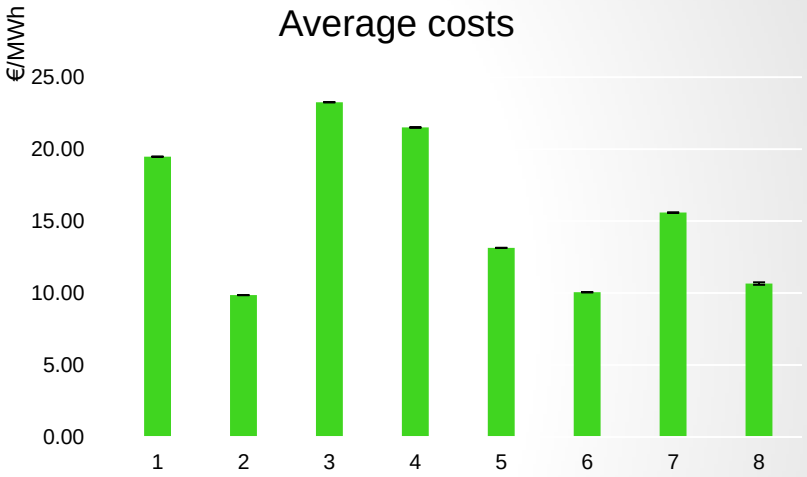
Study case

- Eight locations
- Demand set to 100 000 tons
- Maximum Gather radius 150 km
- Reserve fuel costs 130 €/ton
  - 5 MWh/ton
- Facilities assumed to be CHP

Fuel type	Energy content of raw material [MWh/ton]	Truck transport cost [€/ton/km]	Comminution cost [€/ton]	Unloading costs [€/ton]	Density before comminution [ton/m^3_{-loose}]	Density after comminution [ton/m^3_{-loose}]
Primary	3,2	0,16	4,64	1,40	0,3	0,15
Residue	3,2	0,20	4,32	4,00	0,3	0,3

Results



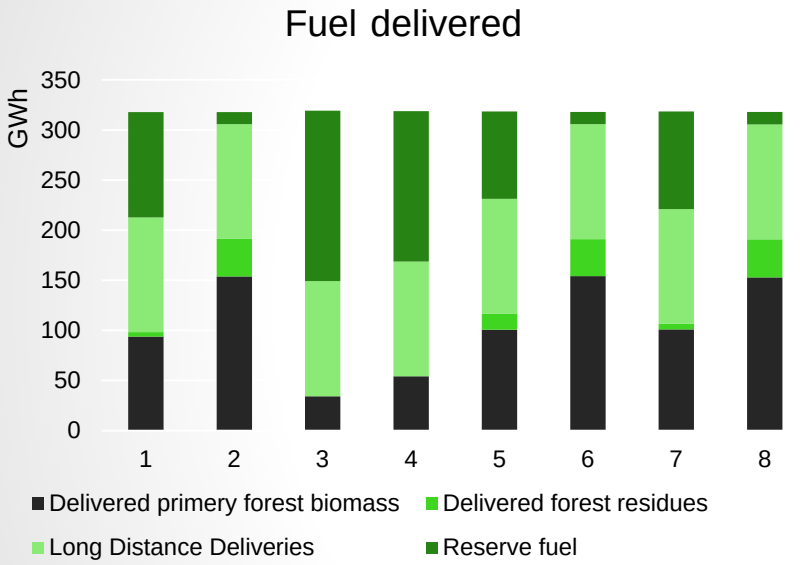


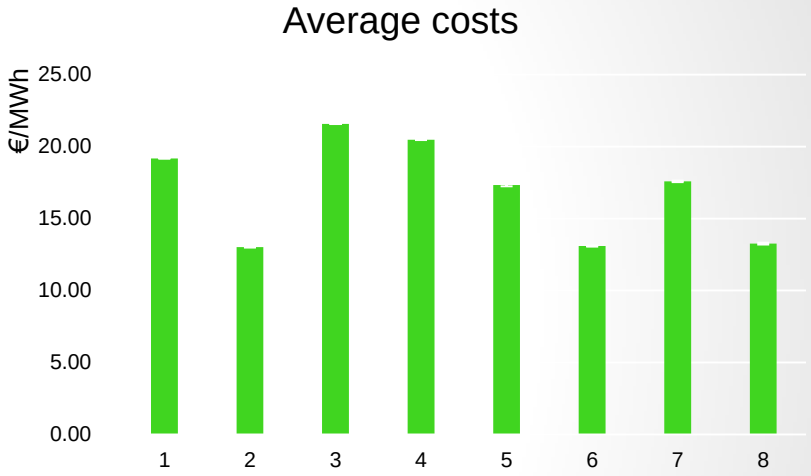
- Over 60 000 m^3-loose storage needed most biomass used locations (2,6 and 8)

Revaluation of study case

- Huge storage area is needed if biomass is used
  - Terminal is located near demand point
    - Cost of transport fuel from terminal to demand point was set to 3.00 €/Trip
    - Fuel is comminuted at terminal
- Locations near coastline and rural areas have limited supply
  - Two long distance vehicles is set to deliver fuel to demand point
    - 500 tons four time every month
    - 1000 tons five time every month at high demand season (October – March)
  - Uncomminuted fuel and costs 50 €/ton

Results of revaluation case





- 5000 m^3-loose storage needed at demand site

Conclusions

- Dynamic simulation takes temporal variables account
- GIS take spatial variables account
- Possibility to study multiple locations at European area
- Give new tool for study planning phase facilities
- Dynamic simulation is more compare oriented study method
  - GIS analyze more suited to find optimal locations
    - → These locations may be verified by dynamic simulation

Thank you for lisening!

- Full article published at Bulletin of the Transilvania University of Braşov vol. 10 (59) SPECIAL ISSUE no. 1 - 2017 Series II - forestry • wood industry • agricultural food engineering
- Aalto, M., Korpinen, O.-J., Ranta, T.: Dynamic Simulation of Bioenergy Facility Locations with Large Geographical Datasets - A Case Study in European Region