Sustainable Biomass for the Bioeconomy – S2BIOM project: first results and tools

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S2Biom

Structure

- FP7 Programme
- 4 Mio € EC co-funding
- 36 months (9/2013 – 8/2016)
- 31 Partners
- Geographic scope: EU28 & Energy Community (Western Balkans, Moldova, Ukraine, Turkey)
- www.s2biom.eu

Aims

- To provide consistent & scientific evidence on sustainable supply of non-food biomass to support a resource-efficient bioeconomy in Europe
- To analyse the complete biomass value chain from primary biomass to end-use incl. logistics, pre-treatment, conversion technologies and have respective datasets and approaches online in the toolset
- To disaggregate data and information from NUTS1 to NUTS3

Work plan

Coordination & Management

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

- Current and future sustainable lignocellulosic biomass cost supply (domestic and from imports) in EU28; Western Balkans, Moldova, Ukraine and Turkey (37 countries).
- 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/ Energy Community level by visualizing the outcomes of proposed policies
- Case Studies
- Stakeholder engagement
- Information Campaign/ Consultations/ Webinars
- Improvement of public awareness, education, and outreach

What we have accomplished so far

Large datasets in databases

- Sustainable cost supply of solid lignocellulosic biomass (forestry, biomass crops, agricultural residues, and secondary residues from wood and food industry, wastes) at **NUTS3 level for 37 countries in Europe**.
- Characteristics of biomass for thermochemical and biochemical conversion pathways- **beyond energy & fuels, with selected Product to Market combinations (PMCs)**
- Pre-treatment technologies and logistics components
- Market techno-economic data for biobased product to market combinations
- Policies and support mechanisms for energy, agriculture, waste, environment, etc. (**overall more than 700 measures up to date; work continues**).

What we have accomplished so far

Harmonised methodologies to asses biobased economy

- Biomass cost supply assessment: building on BEE; EUWood, Biomass Futures, Biomass Policies- **in collaboration with JRC, BISO and in discussions with BeO**
- Standardized biomass characterisation and quality requirement for each biomass conversion technology
- Characterization of main logistical components, i.e. storage, pre-treatment and transportation technologies & application to selected case studies
- Life-cycle based environmental sustainability assessment with sustainability criteria and indicators.
- Policy analysis

Validity & accuracy of data/ (i) Supply

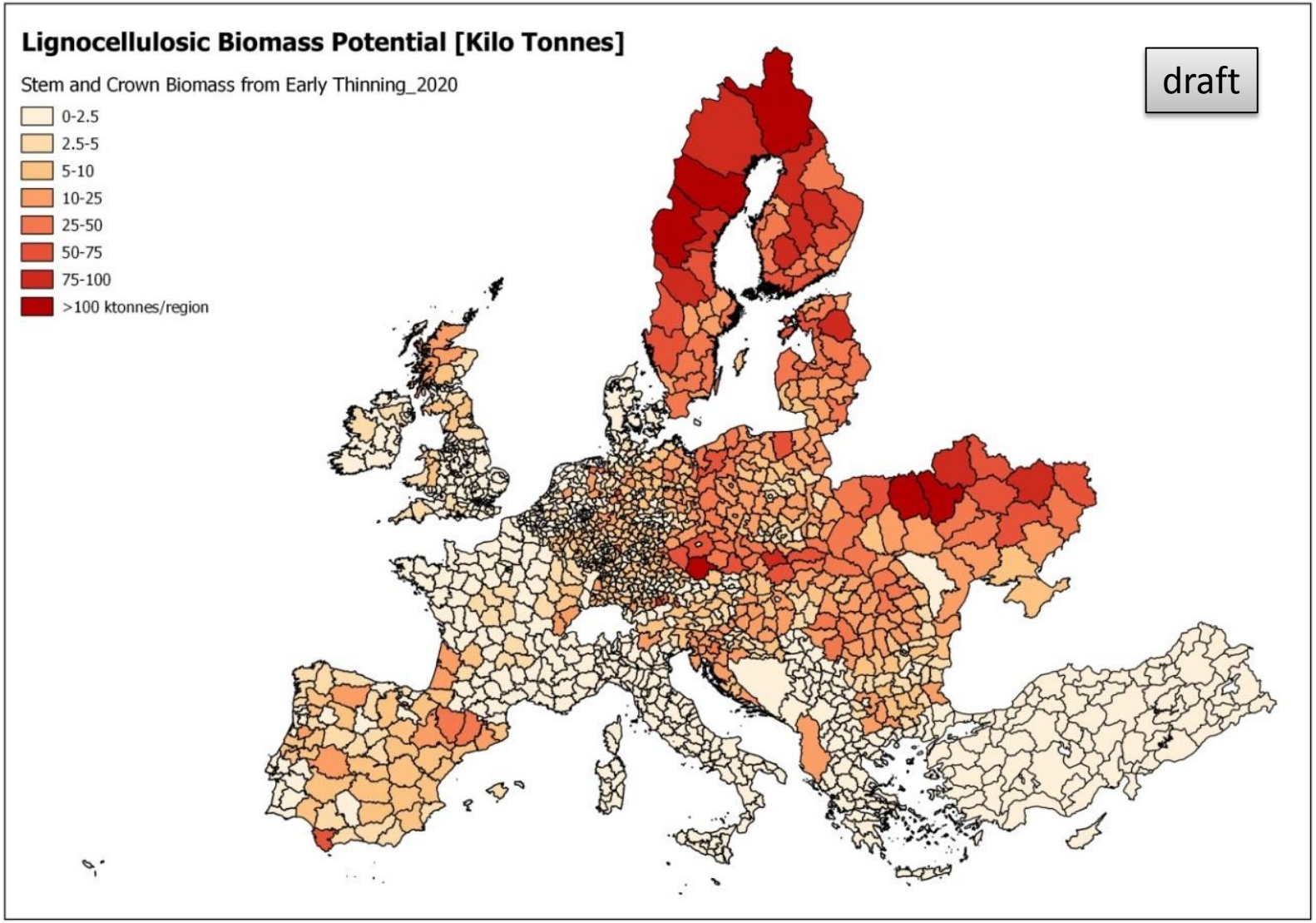
Types of potentials

- **Technical potential**
  - Technical constraints &
  - Current uses for food, feed, biobased products, energy & fuels
- **Base potential**
  - Sustainable potential – RED criteria
  - Considering agreed and established sustainability standards at EU & intl level
- **User-defined potentials**
  - **Vary in terms of type and number of considerations per biomass type**
  - **Options to choose & combine**

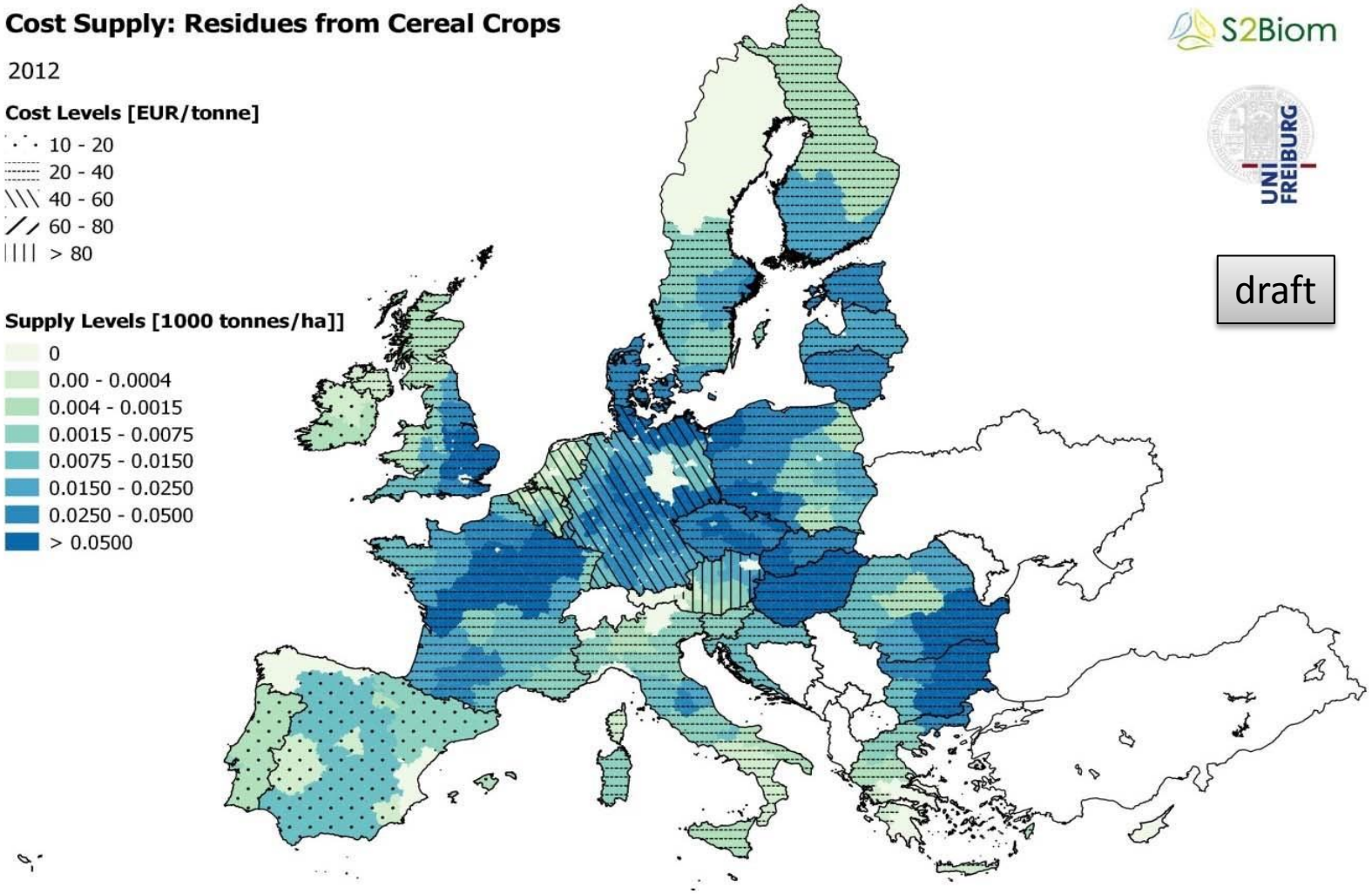
Types of feedstocks

- **Primary production of biomass crops (lignocellulosic and woody crops)**
  - Miscanthus, giant reed, cardoon, sorghum, etc.
- **Agricultural residues**
  - From arable crops cereals, rape, sunflower, grain maize and sugarbeet (leaves).
  - Secondary from agro indusrties
- **Grassland**
- **Forestry**
  - Stemwood, thinnings, etc
  - Secondary- wood processing industries
- **Road verge grass**
- **Landscape care management biomass**
- **Waste/ tertiary residues**

Display of results in the toolset/ atlas: Stem and Crown Biomass from Early Thinnings 2020



Display of results in the toolset/ atlas: Cost-supply potential for residues from cereal crops



Validity & accuracy of data (ii) Demand, Market projections

S2Biom

- **Key question S2Biom modelling focuses: To what extent the additional biomass demand for chemicals and materials could be sufficiently significant to:**
  - influence lignocellulosic biomass prices and
  - induce scarcity and competition issues with
  - energy applications?

- **Focus of specific product to market combinations (PMCs- see next slide): Uncertainties are substantial with respect to:**
  - technologies that are to be further developed
  - supporting policies required
  - the future of (petro)chemical industry in EU
  - the oil price, being a strong factor affecting the
  - prospects for biobased chemicals and
  - materials
- **BIOTIC project**

S2Biom product to market combinations (PMCs)

	Product	Market
1	Heat	District heating
2	Electricity	Power market
3	Advanced Biofuels	Transport fuel
4	C6 sugars	C6 chemistry: polymers & plastics, others
5	C5 sugars	C5 chemistry: polymers & plastics, others
6	Bio-methane	Grid, transport
7	BTX	Petrochemical industry
8	Methanol	Transport, chemical industry
9	Hydrogen	Transport, (petro)chemical industry
10	Ethylene	(petro)chemical industry

What we have accomplished so far

Tool demo for testing; two webinars so far- new update within May – initial tailoring to case studies

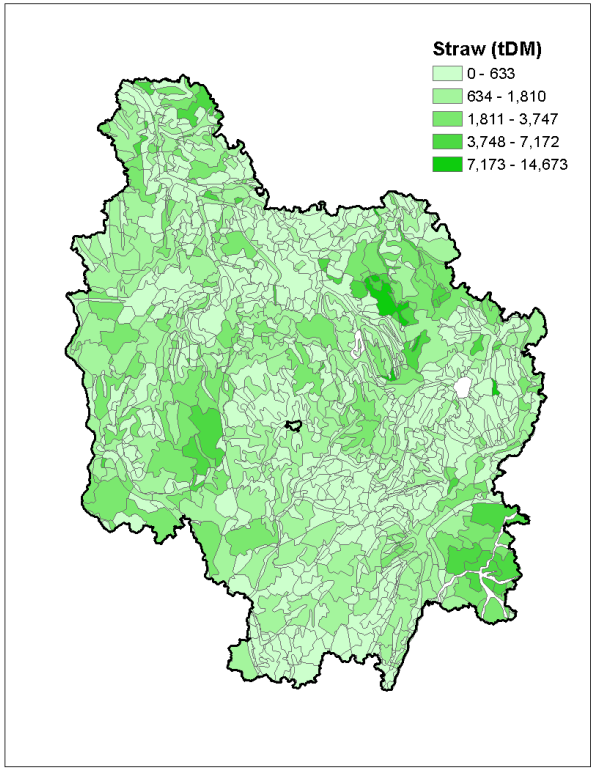
Current state of biomass use for bioenergy, biofuels and bio-based materials & scenarios for modelling future demand in Europe

Strategic and advanced case study work ongoing

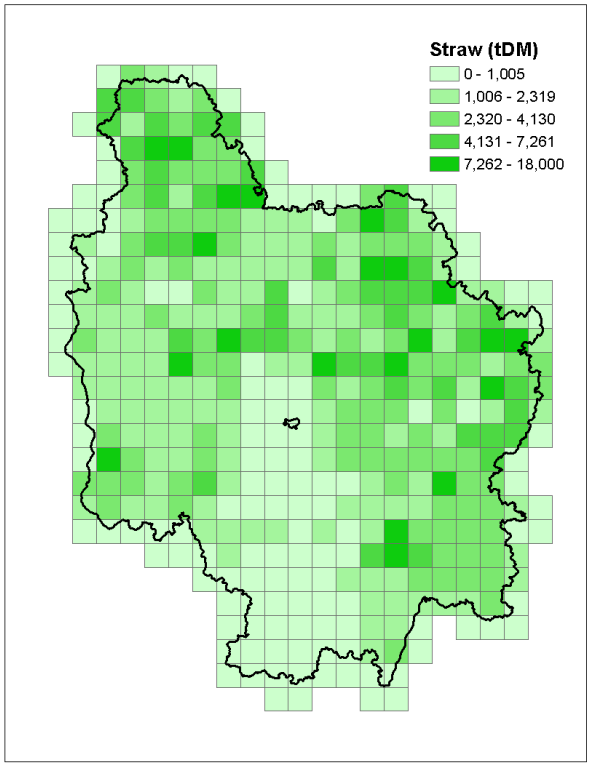
Vision of 1 Billion tonnes lignocellulosic biomass in Europe by 2030- open consultation & ongoing validation (see slides in Annex)

Case study example: Burgundy

Straw availability



Aggregated straw availability



Input: biomass (WP1)

- Biomass
  - Location
  - Availability
  - Collecting cost

BeWhere model; IIASA

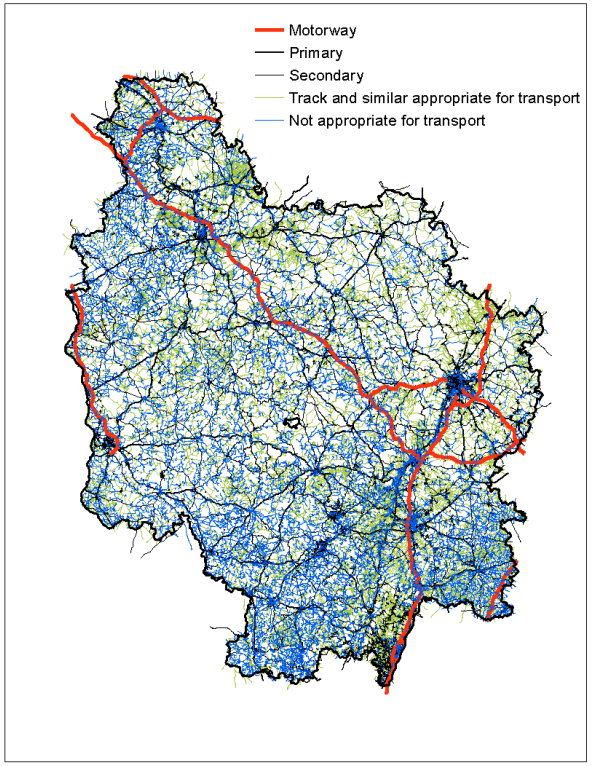
Input: technology

Key parameters	*Unit*	*Methanol* [a, b]	*Ethanol* [c]	*FT diesel* [b]	*CHP* [d]
Feedstock		Wood chips	Wood chips	Wood chips	Straw
Base plant capacity	$t_{biomass}$/hour	357	105	100	3.75
Cost					
Base investment	M€/a	505	143	67	0.63
O&M	M€/$PJ_{biofuel}$	1.2	2.5	2.9	1.75
Efficiencies					
Total	GJ_{in}/GJ_{out}	0.66	0.81	0.57	0.85
Biofuel	$GJ_{biofuel}/GJ_{biomass}$	0.55	0.30	0.45	–
Electrical	$GJ_{electricity}/GJ_{biomass}$	0	0.11	0.06	0.25
District heating	$GJ_{heat}/Gj_{biomass}$	0.11	0.40	0.06	0.60

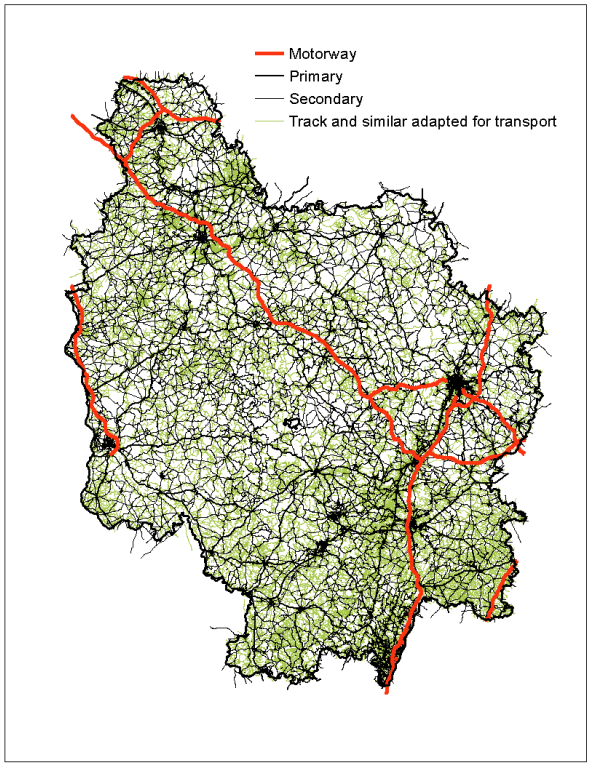
[a] *Hamelinck, et al., 2002.*
[b] *Wahlund, et al., 2004.*
[c] *Barta, et al., 2010.*
[d] *S2Biom*

Input: logistics

Road Network



Used road network



Input

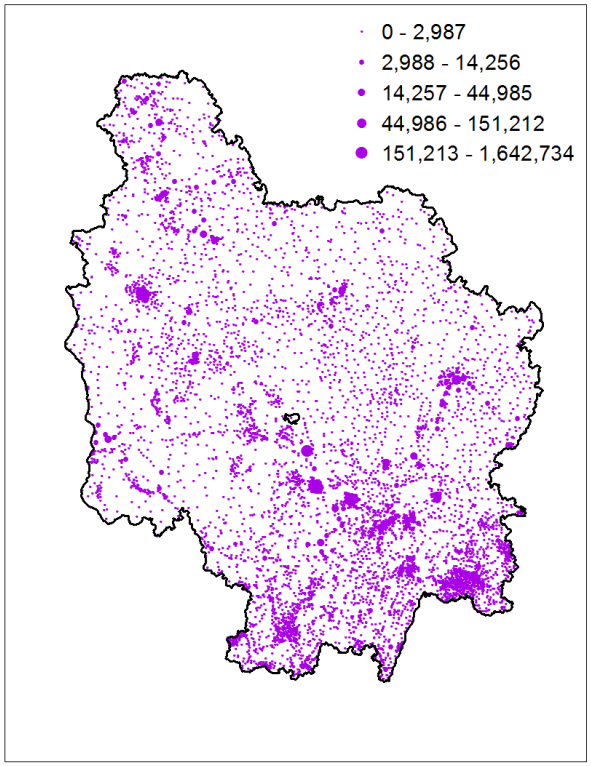
- Transport cost
- Emissions
- Terminals / pretreatment

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

Source: OpenStreetMap.org

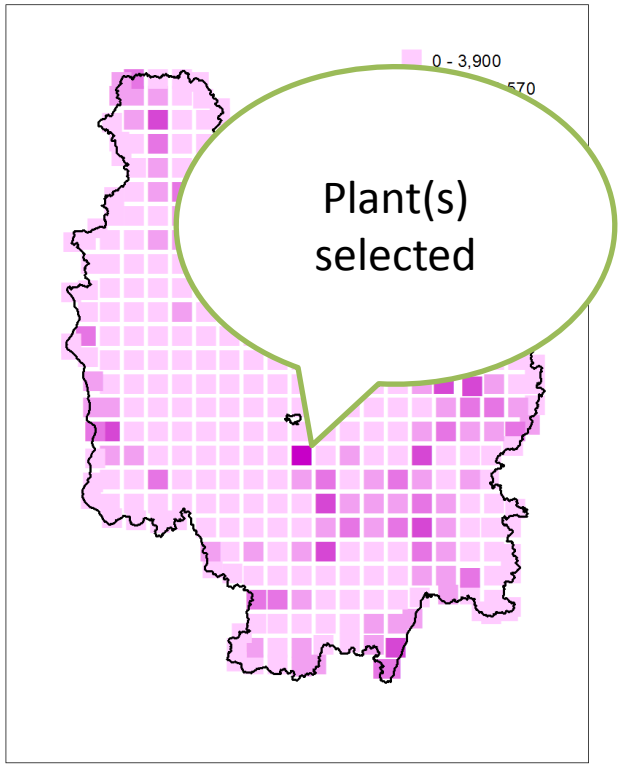
Input: demand

Population



Source: OpenStreetMap.org

Aggregated population



- Existing industries
  - Location
  - Feedstock demand
  - Power/heat output
- Production plants
  - Type of biomass
  - Biomass need
  - Economic parameters
  - Conversion efficiency

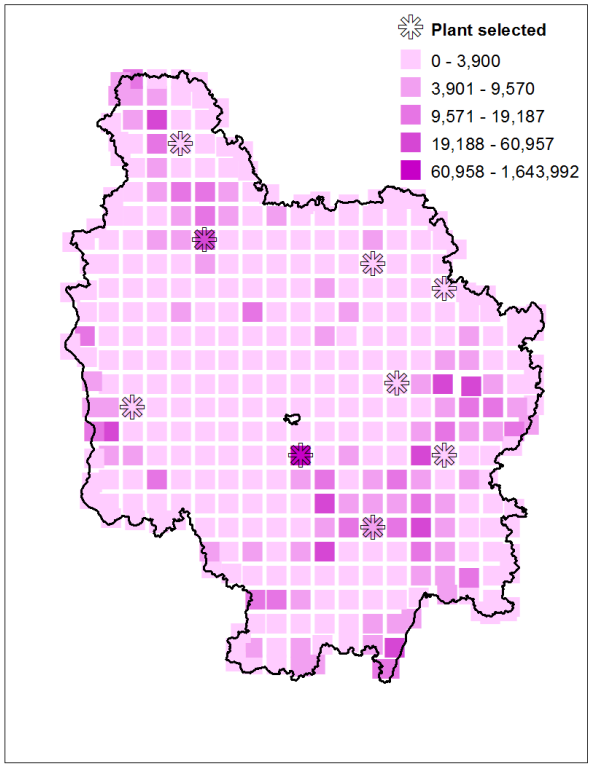
- **Heat** consumption
- **Power** consumption
- **Transport fuel** consumption

Based on statistics and weighted by number of inhabitants.

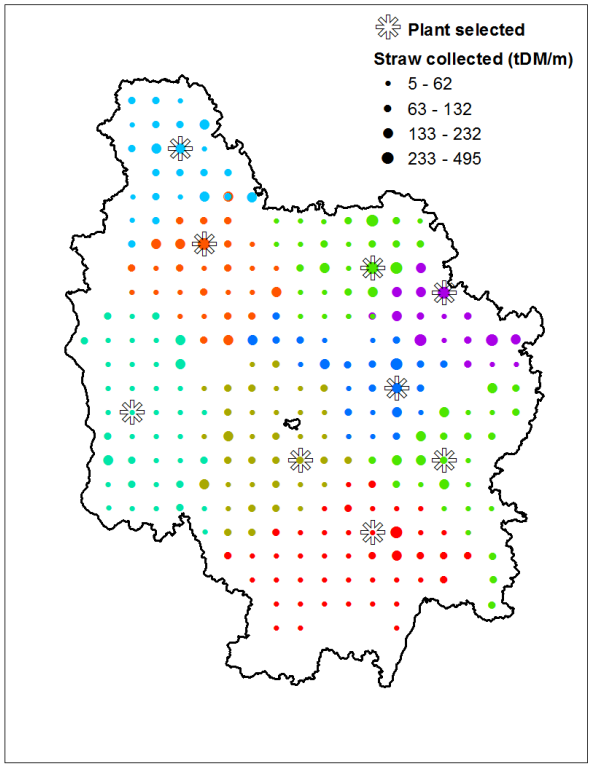
- **Price** of competing fossil fuel based heat / power / transport fuel

Result Example

Plant selected



Biomass allocated



Output

- Biomass used
- Technology allocated
- Heat, power produced

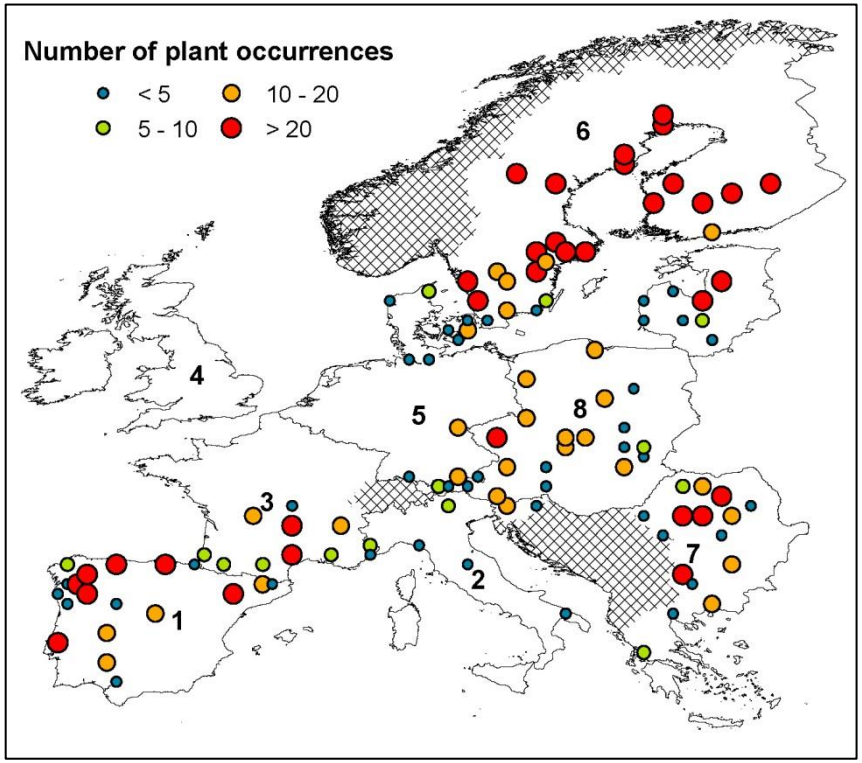
- Costs
- Emissions avoided

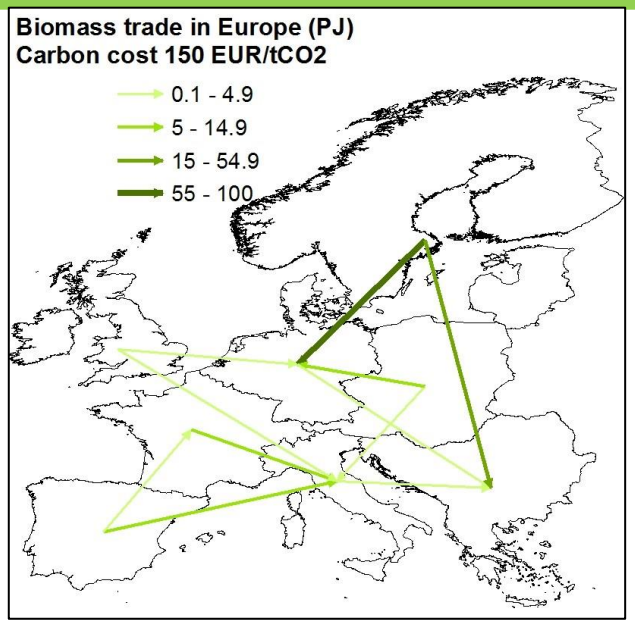
→ LOCAgistics tool

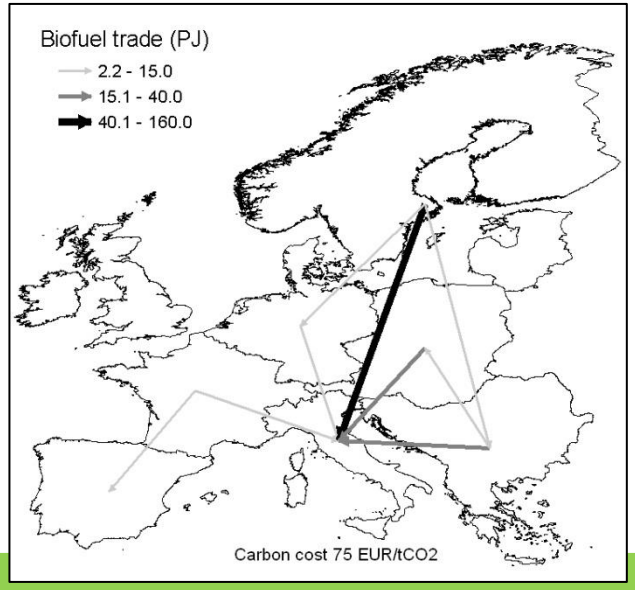
Results

- **Biomass**
  - Site used
  - To which plant
- **Production plants**
  - Number
  - Technologies
  - Capacities
- **Demand**
  - Demand met
  - Import and fossil fuel used
- **Additional information**
  - Quantities
  - Costs
  - Emission

European Model







What will S2Biom deliver at the end of the project

- **Large datasets in databases:**
  - Facilitate the formation and comparability of comprehensive databases populated with consistent datasets on:
    - Lignocellulosic biomass cost supply, conversion technologies, policies/ support mechanisms
- **Harmonised methodologies to asses biobased economy (cross sector)**
  - Transparency in data collection- harmonised protocols
  - Cross sector integrated frameworks addressing all bioeconomy sectors for: Life Cycle Analysis, Sustainability Criteria & Indicators Economic & energy modelling and Policy
- **S2Biom toolset- improve (feedstocks- geography) IT capacity for biomass cost supply & logistics for a wide range of feedstocks in a large geographic area with high resolution**
- **Bridging policy/ regulatory framework with local capacity and investment opportunities to develop action and investment plans in selected cases**
- **Developing a Vision, Strategies, regional implementation plans (EU28 & EnC) & an R&D roadmap**

Thank you for your attention!

S2Biom

www.s2biom.eu

FNR
Fachagentur Nachwachsende Rohstoffe e.V.

Imperial College London

ALTERRA WAGENINGEN UR

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Annex

Project partners

No.	Institution/Organisation (original language)	Acronym	Country code
1	Agency for Renewable Resources	FNR	DE
2	Imperial College	Imperial	UK
3	Stichting Dienst Landbouwkundig Onderzoek	DLO	NL
4	University of Freiburg	ALU-FR	DE
5	Joanneum Research	JR	AT
6	International Institute for Applied Systems Analysis	IIASA	AT
7	European Forest Institute	EFI	FI
8	Natural Resources Institute Finland	LUKE	FI
9	VTT Technical Research Centre of Finland	VTT	FI
10	University of Bologna	UniBO	IT
11	Energy research Centre of the Netherlands	ECN	NL
12	Flemish Institute for Technological Research	VITO	BR
13	IINAS - International Institute for Sustainability Analysis and -Strategy	IINAS	DE
14	Clever Consult	CC	BE
15	SYNCOM Research and Development Consulting GmbH	SYNCOM	DE
16	WIP Renewable Energies	WIP	DE
17	Biomass technology group BV	BTG	NL
18	Central European Initiative	CEI	IT
19	Institute of Soil Science and Plant Cultivation, State Research Institute	IUNG	PL
20	International Centre for Sustainable Development of Energy, Water and Environment Systems	SDEWES	HR
21	Ege Universtity Solar Energy Institute	EU-SEI	TR
22	National Institute for Agricultural Research	INRA	FR
23	Joint Research Centre	JRC	IT
24	CENER-CIEMAT Foundation	CENER	ES
25	Research Centre for Energy Resources and Consumption	CIRCE	ES
26	Slovenian Forestry Institute	SFI	SI
27	Centre for Research & Technology Hellas	CERTH	EL
28	Renewable Energy Agency	REA	UA
29	University of Belgrade - Faculty of Mechanical Engineering	UBFME	RS
30	Census-Bio	Census-Bio	UK
31	Biomass Research	Biomass Research	NL

S2Biom collaborates with:

- **EU projects: BEE, CEUBIOM, Biomass Futures, Biomass Policies, Biomass Trade Centres, CAPRI, Sector, Bioboost, Logistec, INFRES and EuroPruning;**

- **Biobased industries: close collaboration with key stakeholders from industry and market sectors.**

- **Energy Community: collaboration with the Secretariat and Contracting Parties at national (ministerial) level (Albania, Bosnia & Herzegovina, Kosovo, Macedonia, Moldova, Montenegro, Serbia, Turkey and Ukraine).**

Progress

Knowledge base

Knowledge management

What we know & how we best use the knowledge?

S2Biom work mid term

- Spatial cost supply database & atlas
- Conversion technologies database
- Logistical components database
- GUI; central database; viewing tools
- Environmental Footprint, Criteria & Indicators
- 600 policies in database
- Scenarios, Market analysis
- Current state bioeconomy Vision
- Strategic and Advanced case studies

Planning till end

Deliver scientifically robust and user friendly information

Strategic development

How can the S2Biom outcomes be used to inform the future agendas of policy and industry?

Case studies
Maximise project outreach
PIAC

Key S2Biom outputs

Database, method and atlas of sustainable non-food lignocellulosic biomass feedstocks at NUTS3 level for EU28, western Balkans, Turkey, Moldova and Ukraine.

Database, method and tool with indicators to assist decision makers in matching biomass types with the optimal conversion technologies.

Database, method and tool to evaluate promising logistics supply chains at local, regional level with sustainability and demand criteria

A computerised toolset integrating data and methodologies from biomass cost supply, conversion and logistics which will “facilitate the integrated design and evaluation of optimal biomass delivery chains at European, national, regional and local scale.

Key S2Biom outputs

Harmonized sustainability requirements for bioeconomy value chains, including guidelines for methodologies to determine sustainability performance.

A database on EU and national level, for all 37 counties analysed in this call, and policy guidelines in relation to the mobilization of sustainable non-food biomass for the biobased economy.

Strategies & implementation plans for lignocellulosic biomass supply tailored to a) different levels of governance (i.e. regional and specific local ones linked to case studies) and ii) industrial sectors

Case studies to validate the Strategies, Roadmaps and the Tool from the users' point of view (i.e. Member States, Associates and neighbouring countries, regional authorities, industries)

1 billion tonnes* lignocellulosic biomass for biobased economy by 2030 in Europe

First version- September 2015- under consultation on project website

**** Technical potential of lignocellulosic biomass for all biobased economy sectors***

Purpose of work

- To establish a Vision statement for an expanded role of sustainable non-food biomass supply and delivery in the European **(EU28, Western Balkans, Ukraine, Moldova and Turkey)** bio based economy, including **stretching but realistic goals**.

- Timeframe: **2030** (with analysis for 2020)

This version is a **draft** which will be informed by the S2Biom toolset, against which views will be sought and debated (online consultation on project website), and which will finally form the basis for as a series of strategies, implementation plans (Task 8.3) and an R&D roadmap (Task 8.4).

Vision: general

- How do we see 2030?
  What is the (expected) amount of lignocellulosic biomass to be available in 2030?

- Optimistic & realistic

- This will only be realised under optimal conditions.
  What are the optimal conditions to realise that Vision (yield, costs, logistics, markets, technologies, policy framework, …)?

Current use of lignocellulosic biomass- Forest

Total amount of **forest based lignocellulosic biomass** used for energy and material uses in 2013 (E28 + WB, UKR, MD): **530 million tonnes** (485 in EU28)

An estimated **261 million tonnes** (245 in EU28) of wood used as a "classical" bio-based material primarily used in the woodworking and pulp and paper industry

269 million tonnes (with 240 in EU28) of wood are used for production of energy (mainly heat and power).

Sources: EuropaBio, Nova Institut, DG ENER, EnC

Current use of lignocellulosic biomass- Agriculture

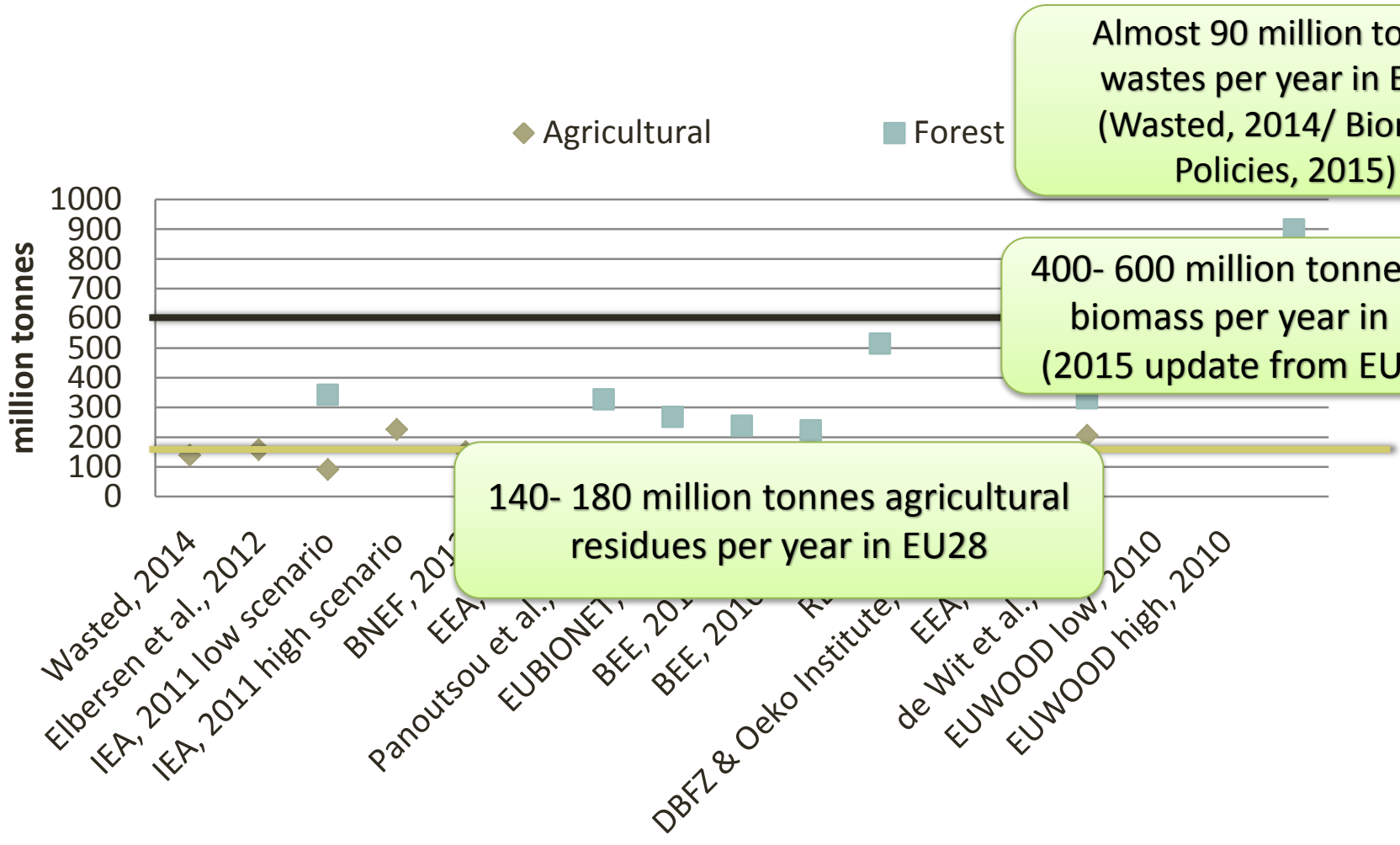
Total amount of **agricultural (non lignocellulosic) biomass** in 2013:
almost 10% (8 million tonnes out of 79) of the raw materials base for the chemical industries in the EU was based on renewables:

- sugar and starch: 1.56 mTonnes)
- plant oils (1.26 mTonnes)
- bioethanol ETBE (1 mTonnes)
- natural rubber (1.06 mTonnes)
- pure bioethanol (0.46 mTonnes)
- animal fats (0.43 mTonnes)
- glycerine (0.41 mTonnes)
- …

Total amount of **agriculture based lignocellulosic biomass:**
Estimates from 5-10 million tonnes (dry) but information relies on individual studies without recent harmonisation across EU

Sources: EuropaBio, Nova Institut, Cefic, VDI, EnC

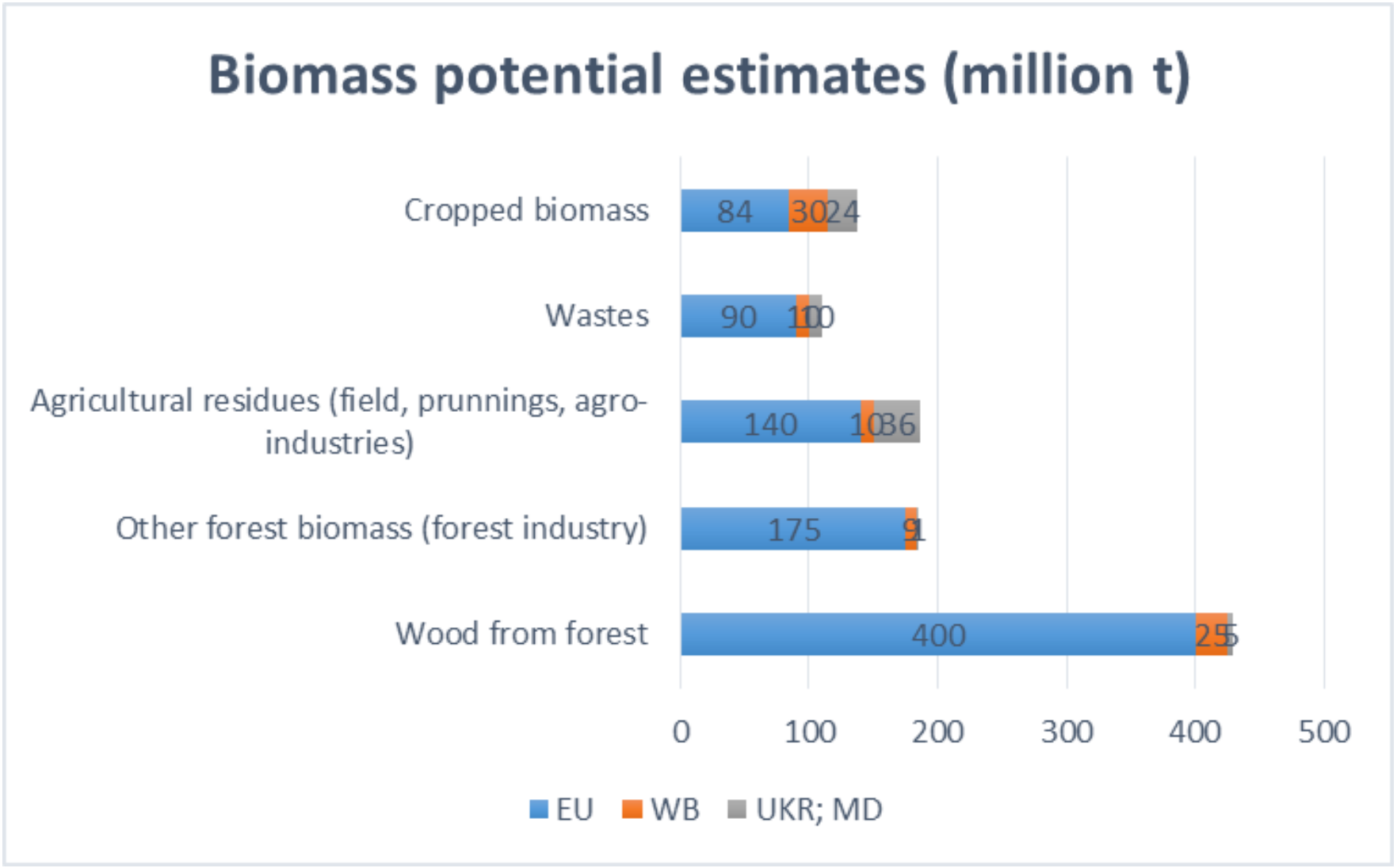
The lignocellulosic biomass base in EU28 in 2030: Forest, Agriculture, Wastes



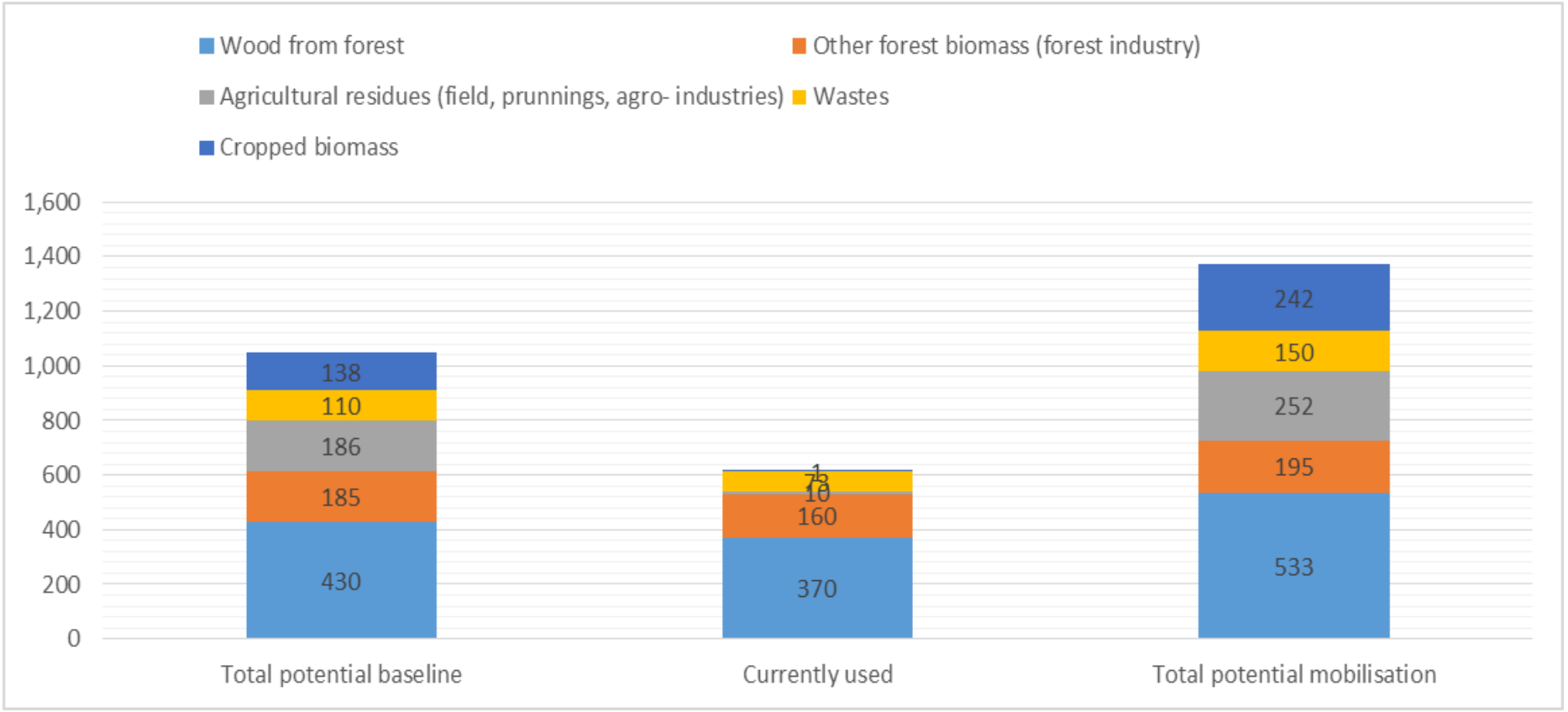
Cropped biomass and released agricultural land in EU28 in 2030

Study	Cropped Biomass Potential (million tonnes)	Comments
Commission's 2030 impact assessment for BBI JU (2014)	84- 180	The impact assessment estimates **7-12 million ha** being available for biomass crops. We assumed that the low value will result in 84 million tonnes by using an average crop yield of 12t/ha while the high mobilization will result in 180 million tonnes by using an average crop yield of 15t/ha
Biomass Policies (2015)	230	**20 million ha** in 2030, reference scenario - Biomass Policies project
EEA, 2012	217	**16.7 million ha** available in 2020 in Storyline 1 (economy & market first)
Biomass Futures, 2012	234	**18.8 million ha** in 2030, reference scenario - Biomass Futures project
REFUEL, 2010	575	Agricultural land potentially available for growing biofuel feedstocks in 2030: EU27 & Ukraine/ LU-Env scenario: **44.2 million ha**

Total potential baseline
EU28 + WB, UKR, MD



1 Billion tonne supply by 2030



Resource costs

- **Local agricultural residues** were estimated to
  - €60-80 per tonne (delivered) for northern/ central Europe
  - €30-40 per tonne for southern and eastern Europe.

- Current market prices for **industrial wood chips** of around €59-65 per tonne.

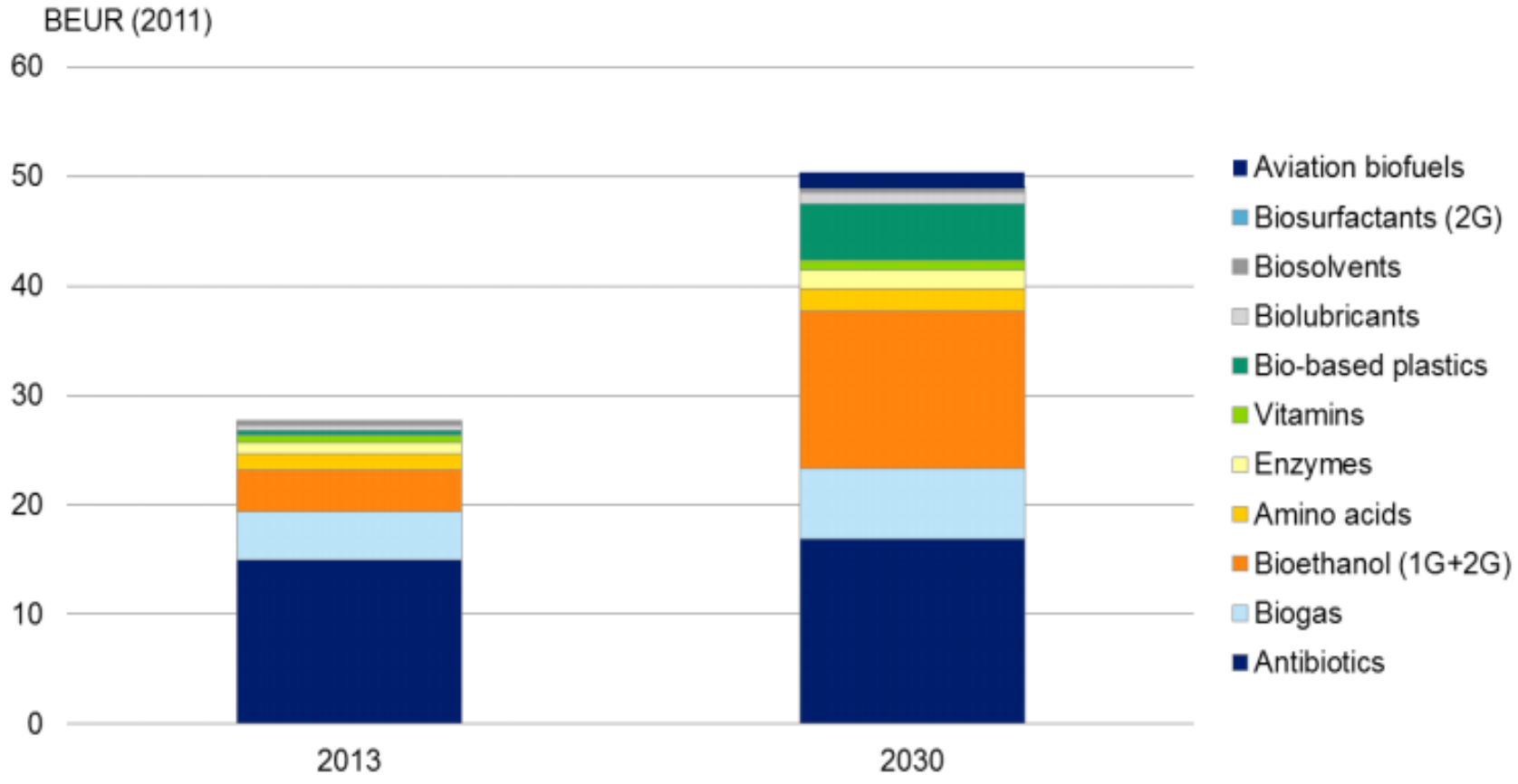
- Biorefinery operations might be able to charge a **gate fee** in the range of €20-40 per tonne for accepting the material.

These are only average representative examples, and one should bear in mind that there will be significant variation in actual feedstock costs, depending on the actual project details

Sources: S2Biom, Biomass Policies, Wasted, EnC

Opportunities for bio-based industries

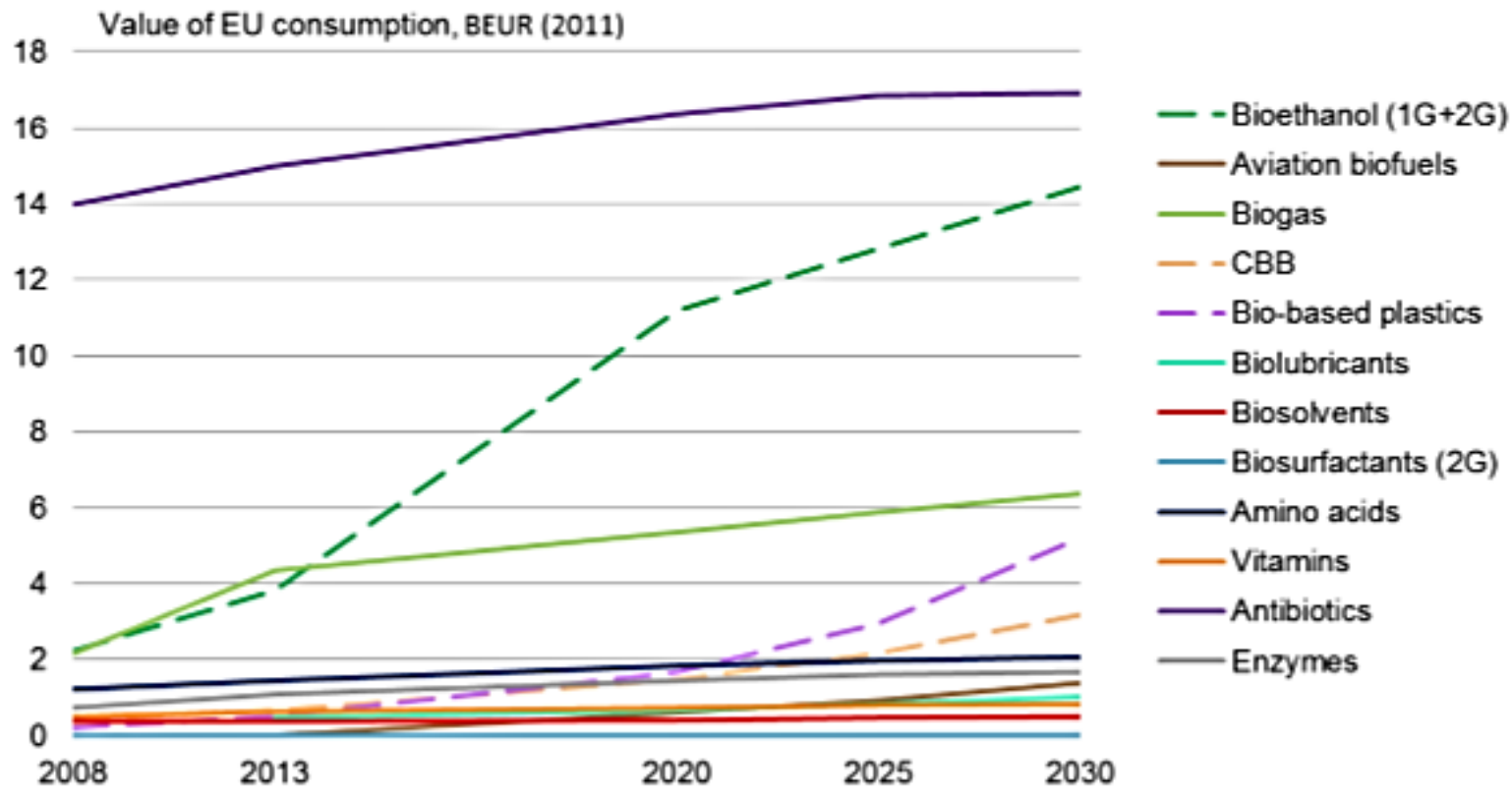
Estimated biobased products market demand in the EU up to 2030*



** BIO-TIC project*

Opportunities for bio-based industries

Estimated market demand in the EU up to 2030 – by product segment*



** BIO-TIC project*

Chemicals and materials: existing studies

	Current state	2020	2030
Bioplastics	• European Bioplastics: 280 kT (2013) • BioTic: around 1 B€	• European Bioplastics: 512 kT (2018) • BioTic: around 2 B€	• - • BioTic: around 5,2 B€
Biolubricants	• ERRMA: 137 kT (2008) • BioChem: 150 kT (2008)	• ERRMA: 420 kT (2020) • BioChem: 230 kT (2020)	• -
Biocomposites	• ERRMA: 362 kT (2010) • Nova institute: 315 kT (2010)	• ERRMA: 920 kT (2020) • Nova institute: 830 kT (2020)	• - • -
Biochemicals	• Chemical industry is estimated to use 8-10% renewable raw materials • BioTic: around 1 B€ (Chemical building blocs - 2013)	• The share of biobased chemicals is expected to be 20% • BioTic: around 1,5 B€ (Chemical building.g blocks)	• The share of biobased chemicals is expected to be 30% (BIC Vision) • BioTic: around 3 B€ (Chemical building blocks)
Bioenergy & biofuels	• BioTic: bioethanol around 4 B€ • Nova institute: biofuels (all) around 6 B€ (2011) • DG Agri: bioethanol 3,3 Mtoe (2013)	• BioTic: bioethanol around 11 B€ and 0,5 B€ aviation fuels • DG Agri: bioethanol 6,1 Mtoe (2023)	• BioTic: bioethanol around 14,2 B€ and 1 B€ aviation fuels