Ukraine

Roadmap for lignocellulosic biomass and relevant policies for a bio-based economy in 2030

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What types of lignocellulosic biomass are included in the analysis?

Lignocellulosic biomass in this analysis includes:

- Forest biomass from primary forestry productions (fellings), primary field residues and secondary forest industry residues;
- Agricultural biomass from primary field activities;
- Biowastes and post consumer wood;
- Dedicated perennial crops.

Context

The roadmap provides scientific evidence for policy, industry and regional stakeholders for the following issues:

- domestic, sustainable lignocellulosic biomass feedstock potentials at national/regional/local levels;
- resource and energy efficient value chains which are expected to be implemented at scale by 2030;
- Sustainability Risks;
- Key indicators per value chain;
- Policies that can facilitate uptake of indigenous lignocellulosic biomass;
- Recommended roadmap actions based on current good practices.

Key questions, addressed by S2Biom

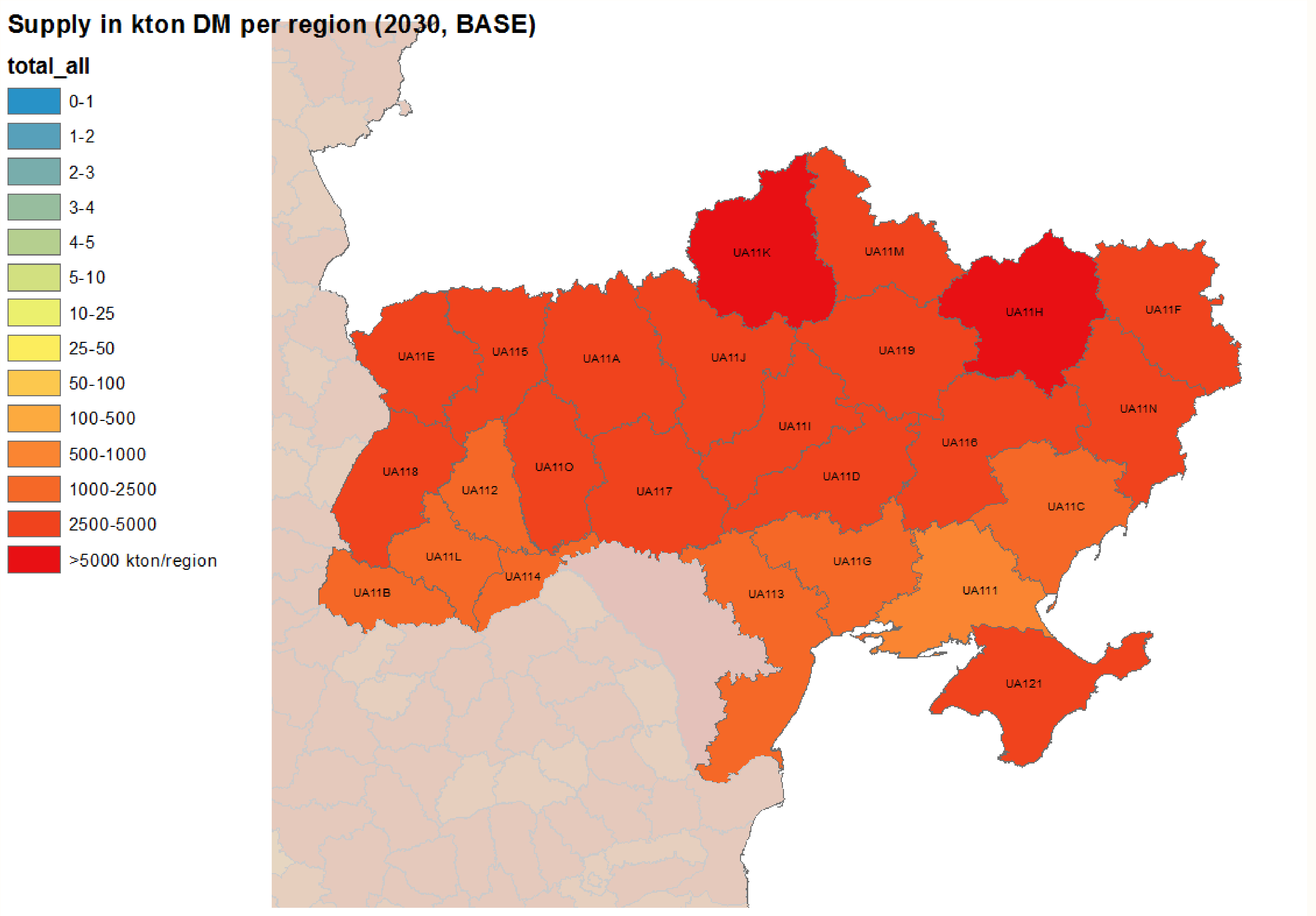
- Where is biomass found?
- What is estimated sustainable potential by 2030?
- What are the sustainable potentials by biomass type and where can they be found?
- How do feedstocks perform in terms of sustainability risks?
- Which value chains have high resource and energy efficiency?
- What is the national policy landscape?
- What future policy interventions can be considered based on good practice?

Where is biomass found?

- The following slide presents a map with total sustainable* occurrence of lignocellulosic biomass by region, measured in ‘000 dry tonnes per year

* The estimated potentials include sustainability criteria as required by the Renewable Energy Directive.

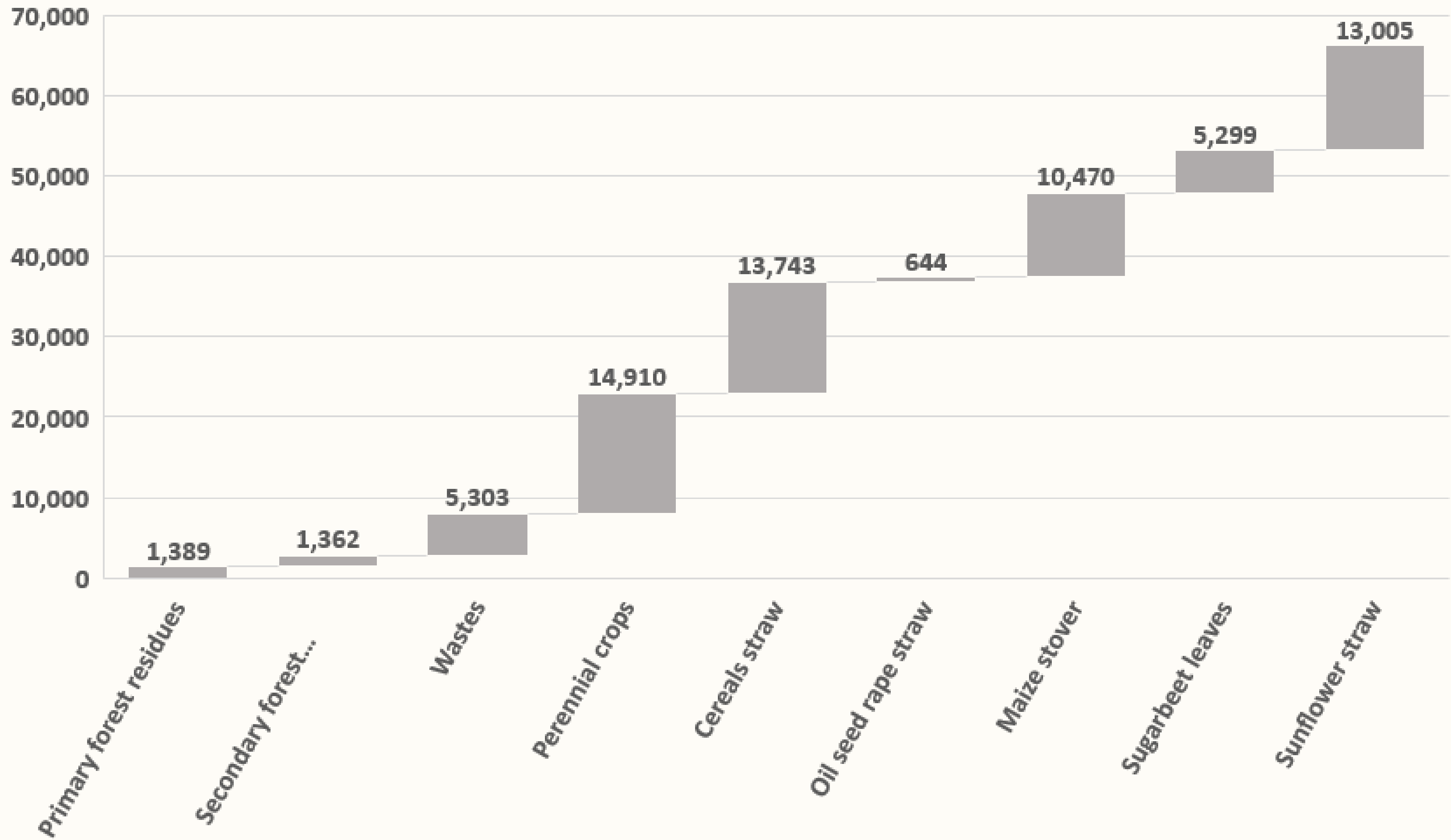
Total lignocellulosic biomass by region



What is the availability per biomass type?

- Sustainable potential from residues, dedicated perennial crops, biowastes and post consumer wood totals 66.13m dry tonnes / year.
- Primary forestry production accounts for an additional 13.8m dry tonnes / year.
- The following slide presents a graph of potential available lignocellulosic biomass by source, excluding primary forestry production.

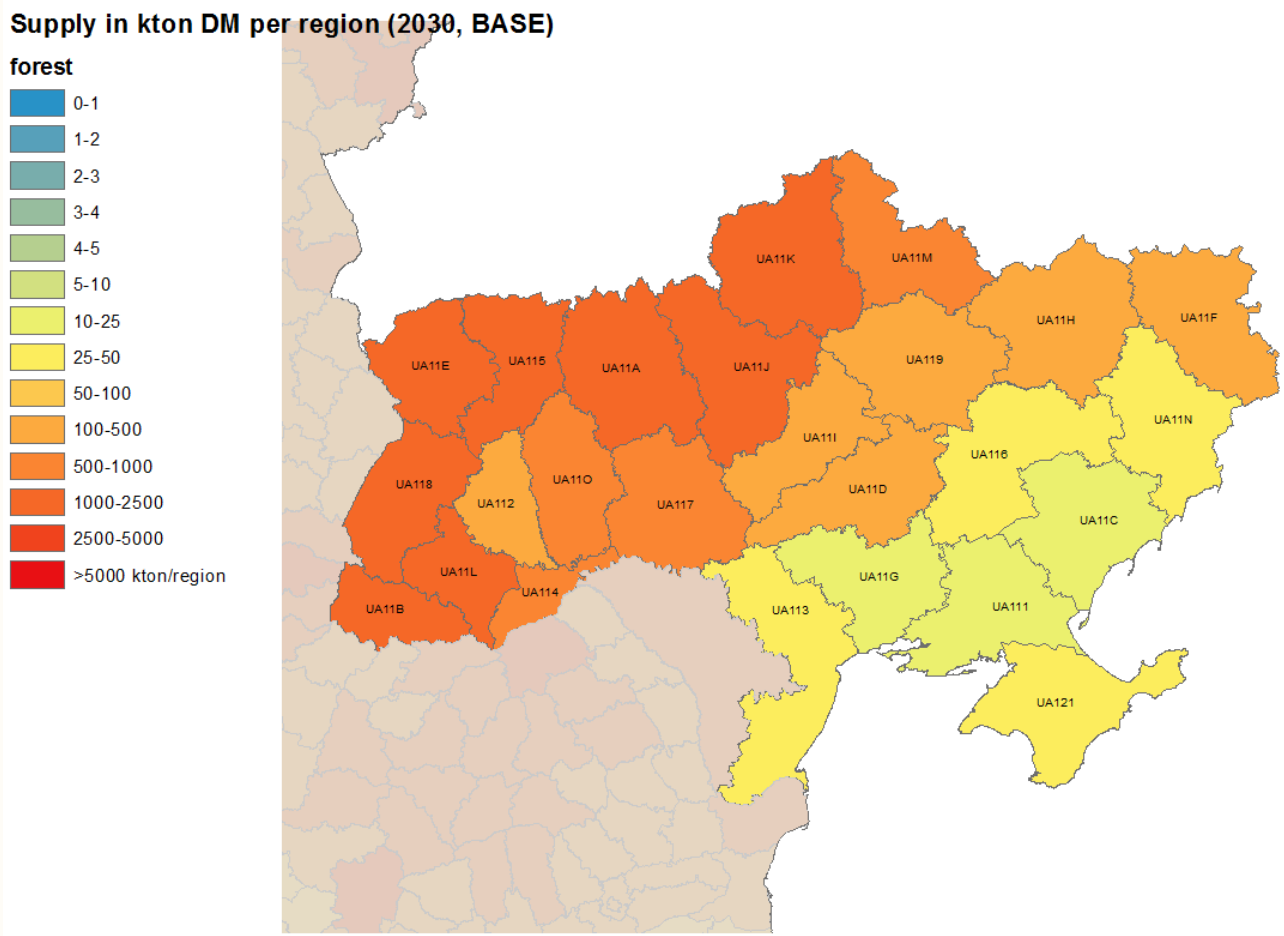
Lignocellulosic biomass availability by source by 2030 (‘000 dry tonnes)



What are the sustainable potentials by biomass type and where can they be found?

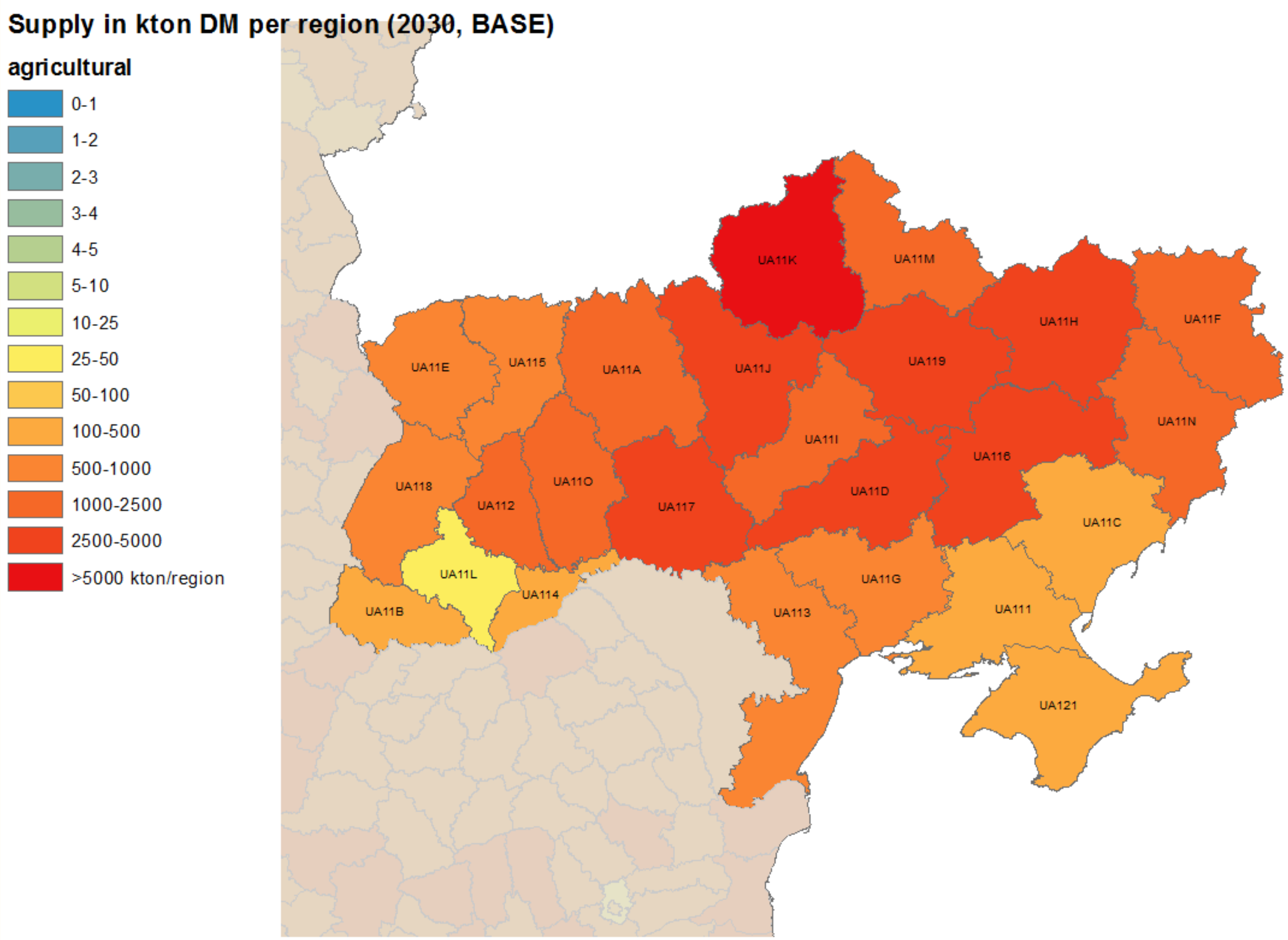
- The following slides present maps of estimated sustainable potential lignocellulosic biomass by region and by main source, namely:
  - Forest (primary forestry production, field residues and secondary forest residues)
  - Agriculture (primary field residues and tree prunings)
  - Biowastes and post consumer wood
  - Dedicated perennial crops

Forest



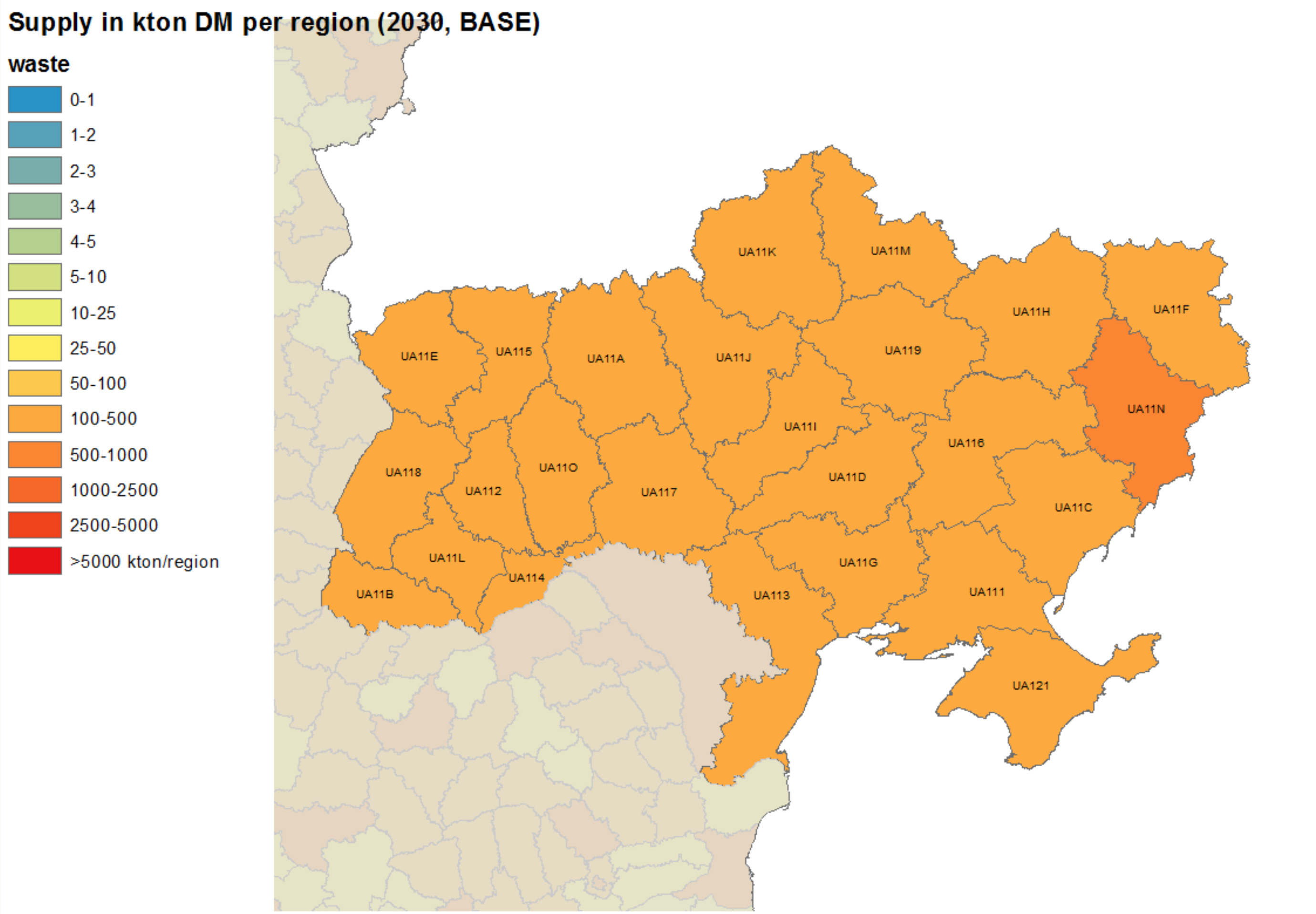
- Estimated sustainable potential can reach up to 16.6m dry tonnes/ year

Agriculture



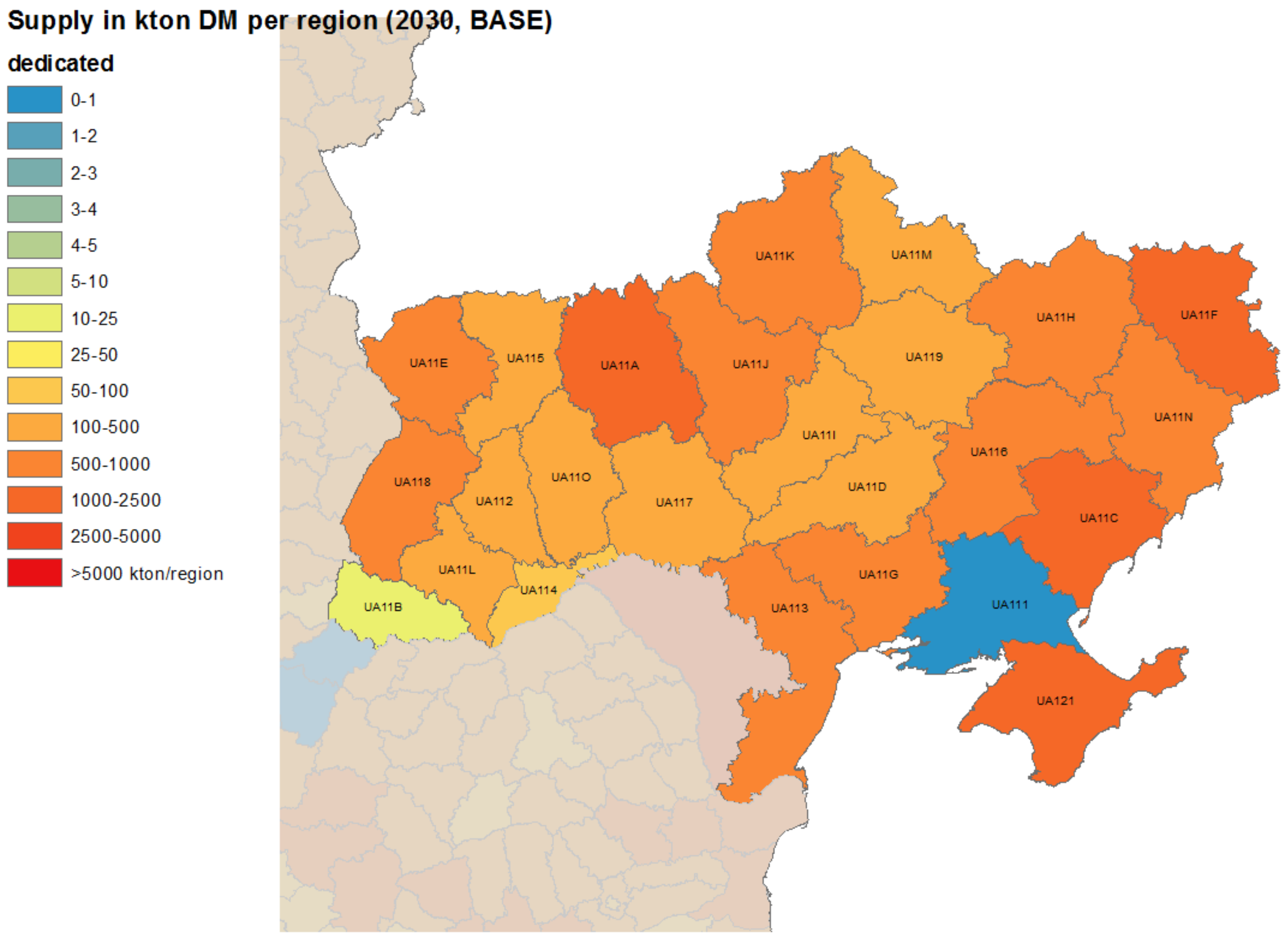
- Estimated sustainable potential can reach up to 43.2m dry tonnes/ year

Biowastes and post consumer wood



- Estimated sustainable potential can reach up to 5.3m dry tonnes/ year

Dedicated perennial crops



- Estimated sustainable potential can reach up to 14.9m dry tonnes/ year

How do feedstocks perform in terms of sustainability risks?

Feedstock		Sustainability risks (high- red; moderate- yellow; low- green)			
		Land use (iLUC risk)	Biodiversity	Soil & Carbon stock	Water
Primary forestry production	Stemwood from thinnings & final fellings				
Primary forestry production	Stem and crown biomass from early thinnings				
Primary forestry residues	Logging residues from final fellings				
Primary forestry residues	Stumps from final fellings	None	Loss of dead wood and stumps may negatively influence species diversity and soil fauna. Contrary to this, leaving them all on the ground may result in increased fertilisation (N and wood ash) and negative impacts on vegetation	Increased risk of soil erosion; risk to loose soil organic carbon; risk to loose nutrients and risk of reduced soil fertility and soil structure when overharvesting forest residues	No effect on the quantity; If no removal leads to increased fertilisation the leaching on N to water may increase.
Secondary residues from wood industries	Saw mill residues				
Secondary residues from wood industries	Other wood processing industry residues	None	None	There are debates that using the wood in panel boards, creates a carbon stock in comparison to combustion of the wood	None
Agricultural residues	Straw/stubbles				
Agricultural residues	Woody prunning & orchards residues	None	Biodiversity loss when harvesting too many crop residues. This may also have adverse effect on soil biodiversity	Moderate risk to loose soil organic carbon when overharvesting crop residues; risk to loose nutrients when overharvesting	None
Secondary residues of industry utilising agricultural products	By-products and residues from food and fruit processing industry	None	None	None	None
Biodegradable municipal waste	Biodegradable waste	None	Positive in regions where it avoids landfill	Positive in regions where it avoids landfill; Digested organic waste is a source of soil improving material.	Lower risk of water pollution in regions where it avoids landfill
Post consumer wood	Hazardous post consumer wood				
Post consumer wood	Non hazardous post consumer wood	None	Positive in regions where it avoids landfill	Positive in regions where it avoids landfill	Lower risk of water pollution in regions where it avoids landfill
Perennial lignocellulosic crops	Miscanthus, switchgrass, giant reed, willow, poplar	Higher land productivity when marginal lands used; in case of agricultural lands potential (indirect) land use change;	Can provide winter shelter; birds nesting inside plants; may, however, destroy sensitive habitats (e.g. Steppic habitats, High Nature Value farmland, biodiversity rich grasslands) when introduced.	Potential use of marginal lands, which can increase soil quality and soil carbon stock; Can damage soil structure (e.g. Harvesting, root removal after 20 years),	In arid circumstances ground water abstraction and depletion possible because of deep roots; Some use of fertilisers / pesticides which can be leached to ground water and pollute habitats, but effect is very limited.

How do feedstocks perform in terms of sustainability risks?

Feedstock		Sustainability risks (high- red; moderate- yellow; low- green)			
		Land use (iLUC risk)	**Biodiversity**	**Soil & Carbon stock**	**Water**
Primary forestry production	Stemwood from thinnings & final fellings	green	yellow	yellow	yellow
Primary forestry production	Stem and crown biomass from early thinnings	green	yellow	yellow	yellow
Primary forestry residues	Logging residues from final fellings	green	yellow	yellow	yellow
Primary forestry residues	Stumps from final fellings	green	yellow	yellow	yellow
Secondary residues from wood industries	Saw mill residues	green	green	yellow	green
Secondary residues from wood industries	Other wood processing industry residues	green	green	yellow	green
Agricultural residues	Straw/stubbles	yellow	yellow	yellow	green
Agricultural residues	Woody prunning & orchards residues	yellow	yellow	yellow	green
Secondary residues of industry utilising agricultural products	By-products and residues from food and fruit processing industry	green	green	yellow	green
Biodegradable municipal waste	Biodegradable waste	green	green	green	green
Post consumer wood	Hazardous post consumer wood	green	green	yellow	red
Post consumer wood	Non hazardous post consumer wood	green	green	green	green
Perennial lignocellulosic crops	Miscanthus, switchgrass, giant reed, willow, poplar	red	yellow	yellow	yellow

Which value chains have high resource and energy efficiency?

- The following show value chains with relatively high efficiency in the following aspects:
  - Energy efficiency
  - Greenhouse gas emissions
  - Air quality
  - Technological maturity

Value chains: forest and agriculture

	Energy efficiency	Greenhouse gases	Air quality	Technological maturity
	Combustion at small scale including households			
Strength	High conversion efficiency with modern technology	Low fossil input in the value chain	-	Fully commercial, long experience
Weakness	Older stoves have low conversion efficiency. Heat not always efficiently used.	-	High emissions from older wood stoves.	-
	Combustion at small-medium scale including buildings			
Strength	High conversion efficiency	Low fossil input in the chain	-	Fully commercial, long experience
Weakness	-	-	Emissions better than smaller scale but higher than natural gas.	-
	Combustion at medium scale, heat led			
Strength	High conversion efficiency	Low input of fossil fuels; high GHG savings especially for Combined Heat and Power	Better control options for emissions	Fully commercial
Weakness	-	-	Higher emissions than natural gas combustion.	-
	Biochemical - lignocell. hydrolysis and fermentation			
Strength	-	High GHG savings in case of process integration and limited fossil input.	Ethanol has low emissions as transport fuel.	-
Weakness	Around 50% conversion efficiency	-	-	Pre-commercial phase

Value chains: wastes

	Energy efficiency	Greenhouse gases	Air quality	Technological maturity
	Waste incineration and energy recovery			
Strength	Adding energy recovery to waste management improves its pathway; high efficiency if CHP	High GHG benefit, particularly compared to landfill (avoided methane emissions); energy recovery substitutes fossil fuels	If landfill is avoided, lower air emissions.	Fully commercial
Weakness	Relatively low net energy output; auxiliary fuel may be required due to low calorific value of fuel	-	Issues in terms of emissions of waste incineration. Emission control is circa one third of project cost.	-
	Combustion at medium scale, heat driven)			
Strength	>85% conversion efficiency in case of heat only; 65-85% efficiency for CHP installations.	Low input of fossil fuels; especially in case of CHP GHG savings can be high	Better control options for PM emissions compared to small scale installations.	Fully commercial
Weakness	-	-	Still higher PM emissions than natural gas combustion.	-
	Gasification & CHP at medium scale - heat driven			
Strength	Up to 80% conversion efficiency, depending on heat only or CHP installations.	Low/no input of fossil fuels; especially in case of CHP GHG savings can be high	Low emissions of gas engine or turbine	(Early) commercial

Key indicators per value chain

			Cumulative energy demand (GJ inputs/GJ outputs)	Non-renewable energy requirement (GJ non-renewable inputs/GJ outputs)	Output service quality (€ outputs- € inputs (excl.biomass), per dry tonne of biomass input at plant gate)	GHG reduction, compared to reference (%)	Levelised life cycle cost, based on CAPEX and OPEX (incl. feedstock cost), expressed in relation to the output of energy carriers (€/GJ energy carriers)	Jobs in FTE along the full value chain
Forest biomass	Households	Residential wood chips boilers - small scale (10-25 kW)	1.39 GJ/GJ	0.044 GJ/GJ	188 €/ton d.m.	92%	17 €/GJ	3 FTE/ MWth
	Services	Wood chip boilers-large size (50 kW)	1.24 GJ/GJ	0.039 GJ/GJ	211 €/ton d.m.	93%	13 €/GJ	3.5 FTE/ MWth
	Industry	CHP using solid biomass > 15MW	2.79 GJ/GJ	0.088 GJ/GJ	198 €/ton d.m.	93%	30 €/GJ	3.8 FTE/ MWth
		CHP using solid biomass 0.5 - 15 MW	1.31 GJ/GJ	0.042 GJ/GJ	280 €/ton d.m.	95%	19 €/GJ	3.5 FTE/ MWth
Agricultural biomass	Households Services	Straw and agricultural residues for small scale local heating plants	1.39 GJ/GJ	0.089 GJ/GJ	170 €/ton d.m.	88%	18 €/MJ	3 FTE/ MWth
	Industry	Straw and agricultural residues for CHP > 10 MW	1.31 GJ/GJ	0.084 GJ/GJ	253 €/ton d.m.	92%	20 €/GJ	3.8 FTE/ MWth
	Utility	Direct co-firing coal process	1.21 GJ/GJ	0.030 GJ/GJ	253 €/ton d.m.	96%	20 €/GJ	3.5 FTE/ MWth
	Bioethanol 2nd	Cellulose-EtOH	2.44 GJ/GJ	0.054 GJ/GJ	144 €/ton d.m.	85%	24 €/GJ	3.5 FTE/ MWth
Biowastes	Industry/ Utility	anaerobic digestion & medium scale CHP	2.00 GJ/GJ	0.007 GJ/GJ	197 €/ton d.m.	88%	28 €/GJ	2 FTE/ MWth
	Transport	anaerobic digestion + upgrading to methane	1.56 GJ/GJ	0.071 GJ/GJ	122 €/ton d.m.	81%	14 €/GJ	2.5 FTE/ MWth

What is the national policy landscape?

- The following slides provide diagrams to illustrate how existing policies / measures support one or more of the following:
  - Biomass supply
  - Logistics
  - Conversion
  - Distribution
  - End use
- Policies / measures are categorised as: (1) Regulation, (2) Financing and (3) Information

*** Policy mapping and respective recommendations are the result of intensive review but as the field is dynamic the authors appreciate there may be missing elements.**

Current policy: forest

Biomass Supply	Logistics	Conversion	Distribution	End Use

- Biomass Supply / Logistics:
  - Afforestation and reforestation
  - Additional activity for development of forestry
  - Forest Code of Ukraine
  - Land Code of Ukraine
  - Law on plant life
  - Law on Safety for Forestry workers
  - Sphere of competence of the State Forestry Committee
  - State Forest Committee validating the form of Certificate of origin of timber and sawn timber for export operations
  - Law for unprocessed timber of Ukraine N 325-VIII of 09.04.2015
  - Forests of Ukraine 2002-2015
  - Certificate timber for export
- Conversion / Distribution / End Use:
  - Alternative Energy Sources
  - Combined Heat and Power (cogeneration) and Waste Energy Potential
  - National Renewable Energy Action Plan- NREAP
  - Feed-in tariffs
  - GHG-Power Plants cut by 2027

Regulations | Financing | Information

Current policy: agriculture & dedicated crops

Biomass Supply | Logistics | Conversion | Distribution | End Use

Land Code of Ukraine

Law on plant life

Alternative Energy Sources

Alternative Fuels

Combined Heat and Power and Waste Energy

National Renewable Energy Action Plan- NREAP

Feed-in tariffs

GHG-Power Plants cut by 2027

Regulations

Financing

Information

Current policy: wastes

Biomass Supply | Logistics | Conversion | Distribution | End Use

Alternative Energy Sources

Alternative Fuels

Combined Heat and Power and Waste Energy

National Renewable Energy Action Plan- NREAP

Feed-in tariffs

GHG-Power Plants cut by 2027

Regulations | Financing | Information

What improvements can be made based on good practice?

- The following slides illustrate selected policies from Member States that have had significant positive impact in promoting the use of lignocellulosic biomass
- Based on this Good Practice, recommended new policies are shown (shaded boxes) to complement existing policies

* Policy mapping and respective recommendations are the result of intensive review but as the field is dynamic the authors appreciate there may be missing elements.

Good Practice- Feedstocks

High impact   Moderate impact

	Biomass sourcing	Logistics
Wastes	AT: Waste management & Regulation on recycling of waste wood	BE: VLAREM- collecting & treatment
	DE: Kreislaufwirtschaftsgesetz-KrWG- Waste disposal	
	NL: strategic initiative for anaerobic digestion of MSW- organics	
Forest biomass	FI: private forest owners	
	FI: forest certification	
	BE: Subsidies for afforestation and forest management	
Agricultural biomass	AT: ÖPUL – Austrian Agri-environmental Programme: Tailored investment support with market sector focus	
	DE: EEG- Feedstock bonus for plants using straw	
Dedicated crops	DE: ÖPUL – “Gemeinschaftsaufgabe Agrarstruktur und Küstenschutz” provides farmers with financial support for the cultivation of short rotation coppices.	

Good Practice- End use sectors

High impact (green) · Moderate impact (yellow)

Conversion → Distribution → End Use

Heat

- UK: Renewable Heat Initiatives (RHI) (High impact)
- AT: Climate and Energy Fund-Subsidy scheme wood heating. (High impact)
- NL: Energy Investment Allowance (EIA), tax reductions for boilers (High impact)
- ES: BIOMCASA I & II, funding for efficient use of biomass (High impact)
- DE: repayment bonus from market program (MAP) and soft loans with low interest rates public sector bank KfW (High impact)

CHP

- AT: Green Electricity Act & CHP Act: refines scales of applications and target specific sectors and biomass resource types and end uses. (High impact)
- DE: Renewable Energy Sources Act 2014 - Act (EEG 2014); Market premium (in EEG § 35); Flexibility premium for existing installations (EEG, § 54) (High impact)
- UK:Renewables Obligation (RO) scheme, based on green certificates favouring certain technologies (High impact)

Transport biofuels

- DE: Federal Immission Control Act (BImSchG) (Moderate impact)
- UK: Renewable Transport Fuel Obligation (RTFO) and certification system (High impact)
- DE: Energy Tax Act (EnergieStG) : It accounts for transport biofuels (Moderate impact)
- FI: Act of Excise Duty on Liquid Fuels, a taxation system, in which each component of a liquid fuel is taxed separately, based on its energy content and carbon dioxide emission, meaning reduced taxation for biofuels (High impact)

Biobased products

- DE: National Bioeconomy Strategy
- DE: National Bioeconomy Strategy
- SE : Swedish Research and Innovation Strategy for a Bio-based Economy

Policy interventions to consider: forest

Biomass Supply	Logistics	Conversion	Distribution	End Use

Afforestation and reforestation

Additional activity for development of forestry

Forest Code of Ukraine

Land Code of Ukraine

Law on plant life

Law on Safety for Forestry workers

Sphere of competence of the State Forestry Committee

State Forest Committee validating the form of Certificate of origin of timber and sawn timber for export operations

Law for unprocessed timber of Ukraine N 325-VIII of 09.04.2015

Forests of Ukraine 2002-2015

Certificate timber for export

Forest Certification

Alternative Energy Sources

Combined Heat and Power (cogeneration) and Waste Energy Potential

National Renewable Energy Action Plan- NREAP

Feed-in tariffs

Feed in tariffs: **introduce premiums for specific diameters cuttings; thinnings, etc.**

GHG-Power Plants cut by 2027

Regulations | Financing | Information

Standard containing emission limits for wood boilers

- Shaded boxes show recommended new policies to complement existing policies

Policy interventions to consider: agriculture & dedicated crops

Biomass Supply | Logistics | Conversion | Distribution | End Use

Land Code of Ukraine

Law on plant life

Alternative Energy Sources

Alternative Fuels

Combined Heat and Power and Waste Energy

National Renewable Energy Action Plan- NREAP

GHG-Power Plants cut by 2027

Feed in tariffs
introduce premiums for agricultural residues & dedicated crops

Standards for agricultural biomass

Regulation on agricultural raw materials for biofuels and bioliquids

Regulations | Financing | Information

Policy interventions to consider: wastes

Biomass Supply | Logistics | Conversion | Distribution | End Use

Waste management strategy

Alternative Energy Sources

Alternative Fuels

Combined Heat and Power and Waste Energy

National Renewable Energy Action Plan- NREAP

Feed in tariffs
introduce premiums for wastes

Standards for biowastes

GHG-Power Plants cut by 2027

Fixed premiums

Biomethane injection

Regulations

Financing

Information

Conclusions

- Ukraine has very high national lignocellulosic biomass potential at around 66.1m dry tonnes / year (excluding primary forest harvest), with agriculture being the main source, with dedicated crops also very substantial.
- The existing policy framework is generally well developed with a number of measures for each sector.
- The study has recommended a number of new policies (and refinements to existing policies) that are based on Good Practice and can further facilitate mobilisation of lignocellulosic biomass for a bio based economy by 2030.

Further reading

- www.s2biom.eu
- Deliverable 1.8: A spatial data base on sustainable biomass cost-supply of lignocellulosic biomass in Europe - methods & data sources. From: Dees, M., B. Elbersen, J. Fitzgerald,, M. Vis, P. Anttila, N. Forsell, J. Ramirez-Almeyda, D. García Galindo, B. Glavonjic, I. Staritsky, H. Verkerk, R. Prinz, A. Monti, S.Leduc, M. Höhl, P. Datta, R. Schrijver, M. Lindner, J. Lesschen, K. Diepen & J. Laitila (2016): http://www.s2biom.eu/en/publications-reports/s2biom.html
- www.biomass-tools.eu *click* in main menu on ‘Biomass chain data’ ---> ‘Biomass characteristics’
- www.biomass-tools.eu *click* in main menu on ‘Data downloads’

Project coordinator

Scientific coordinator

Project partners

Maps: DLO Altera, 2016

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