Towards Circular Bioeconomy in the Czech Republic

The identification of sustainable business cases for agricultural residues

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Projekt číslo TL02000234 s názvem „Cirkulární ekonomika jako příležitost pro ČR - Dlouhodobá koncepce pro přechod na oběhové hospodářství" který je spolufinancován se státní podporou Technologické agentury ČT v rámci Programu ÉTA

bic BRNO podnikatelské a inovační centrum

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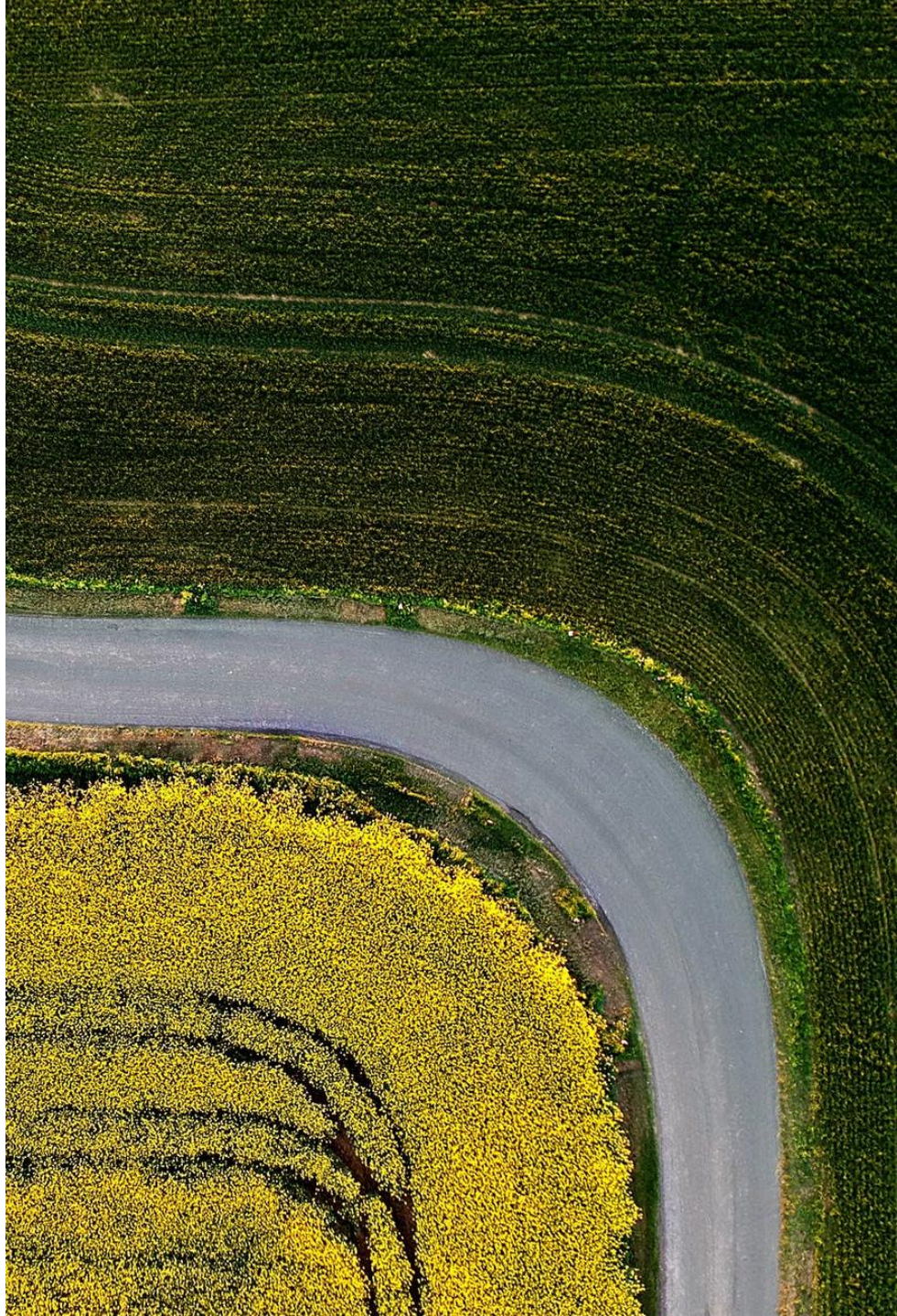
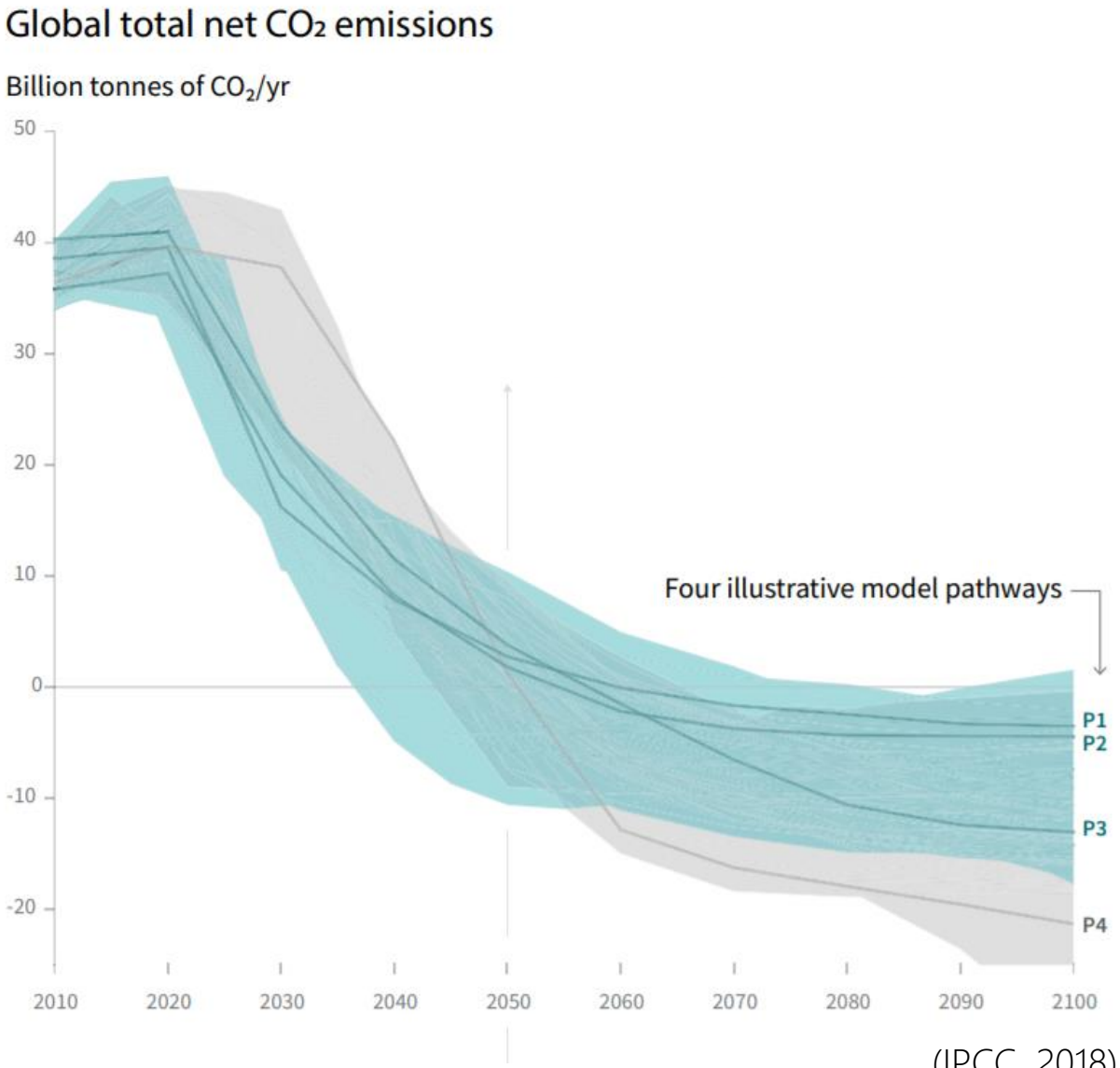
Outline

- Problem context & Theoretical aspects
- Research Questions
- Analytical framework
- Research Design
- Methods (MFA & Survey)
- Results (MFA & Survey)
- Conclusion & Limitations



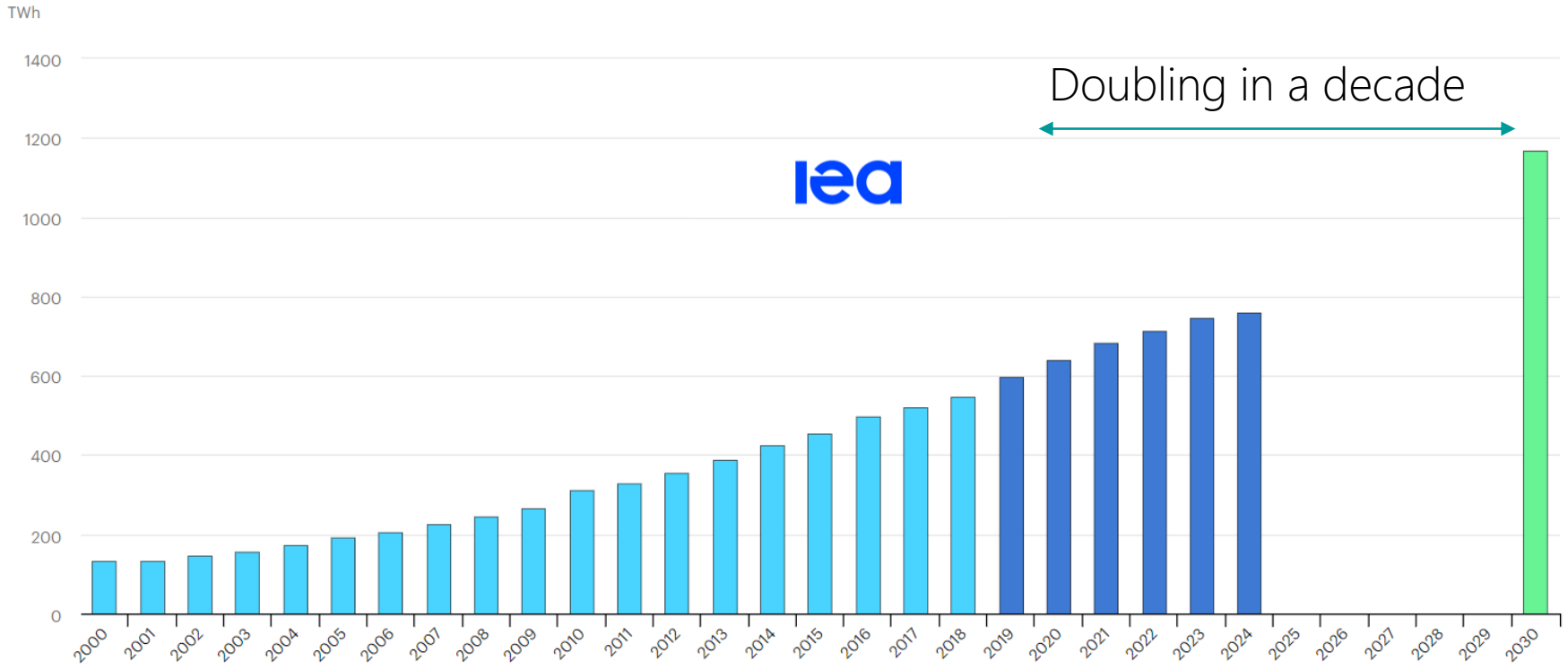
Climate targets to 2050

- Unprecedented GHG reductions in the upcoming decades
- Biomass will play a crucial role
- Industry sectors with limited substitutes (aviation, chemical)
- IRENA REmap – quadrupling of bioenergy by 2050



(IPCC, 2018)

Bioenergy power generation scenario by the IEA until 2030

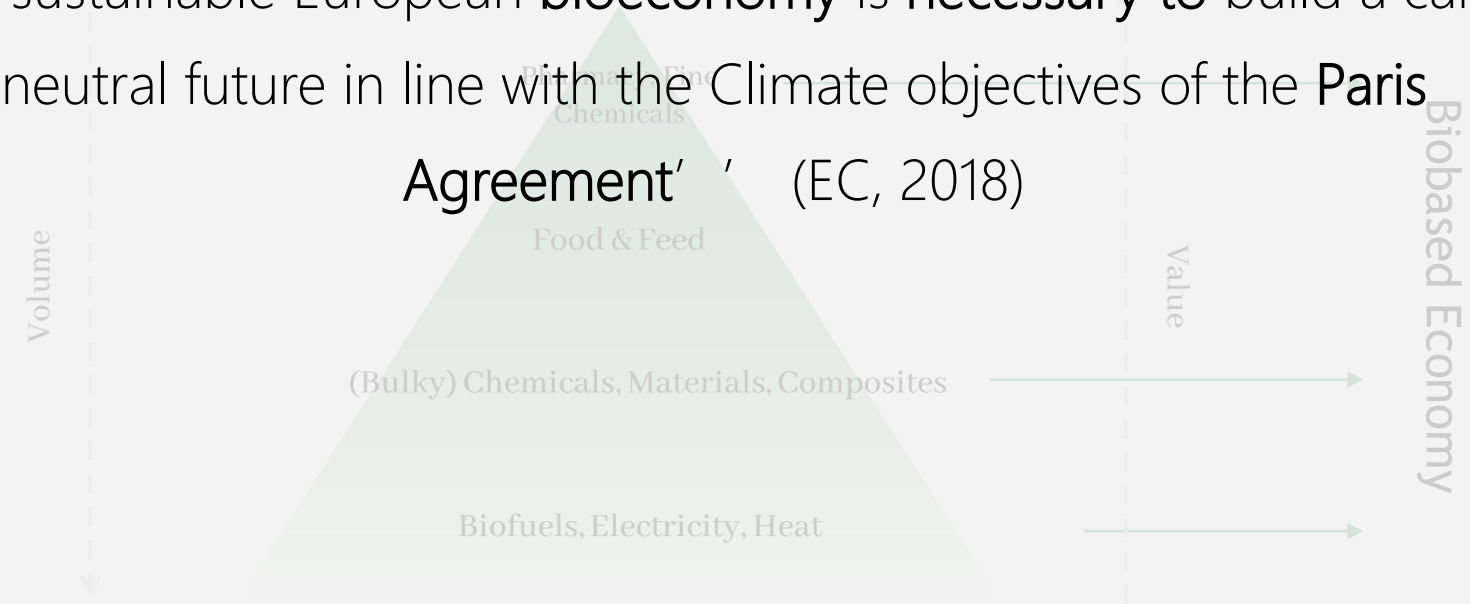


(IEA, 2019)

Bioeconomy & biobased economy

"Production of renewable biological resources and the conversion of these resources into value added products, such as food, feed, bio-based products and bioenergy" (European Commission, 2012).

'' A sustainable European **bioeconomy** is **necessary to** build a carbon neutral future in line with the Climate objectives of the **Paris Agreement**' ' (EC, 2018)



Large differences in the potential and size of BBE

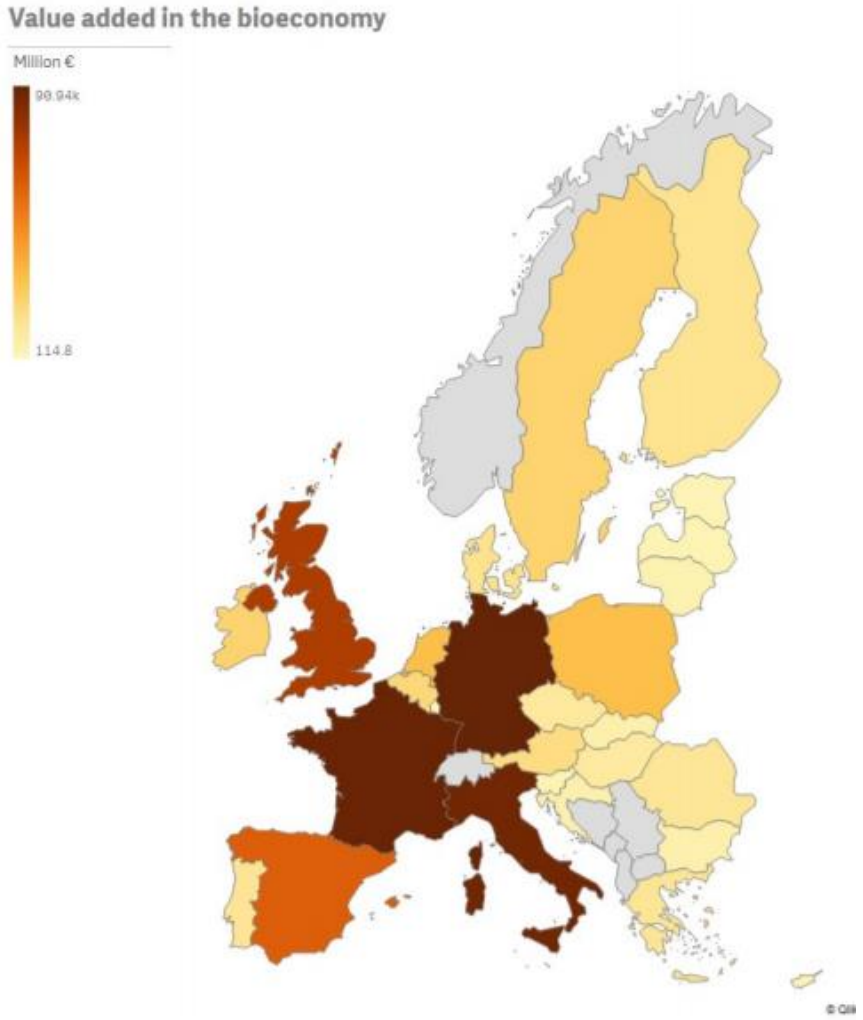
'' (…) low bioeconomy added value in the Central and Eastern European countries is at odds with their high, and, compared to other European regions, yet underutilized biomass potential.'' (EC, 2018, p. 43)

The turnover per person in the Czech bioeconomy is approximately 40 % lower than the EU average (Ronzon & Barek, 2018)

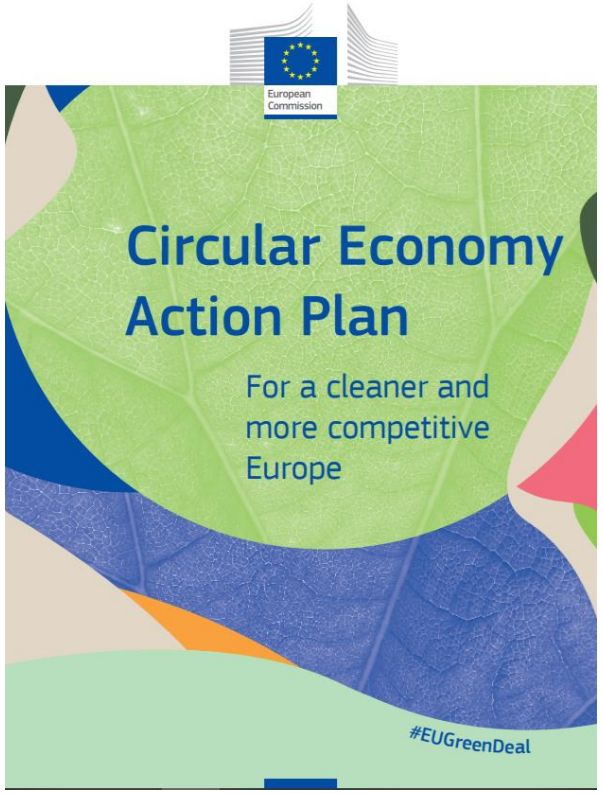
Currently 80 % of renewable energy covered from biomass and a
40 – 50 % increase expected until 2030 (Ministry of Industry, 2018)

RED II targets for advanced biofuels and bioenergy

Large pull of biomass



Resource efficient focus for biomass is needed



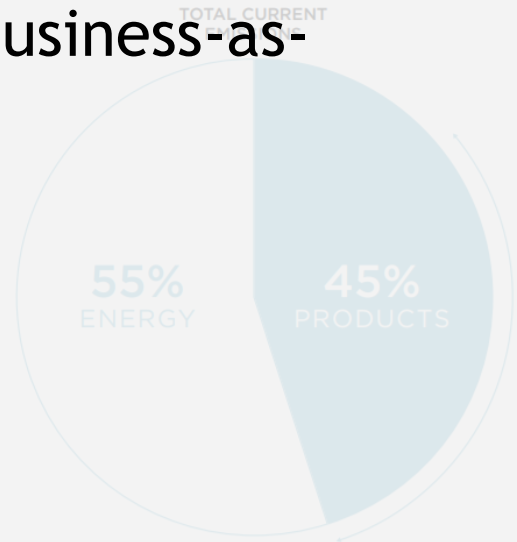
Circular Economy

'' Minimizing the generation of waste and maintaining the value of products, materials and resources for as long as possible.'' (European Commission, 2015)

How?

- Cascading
- R-Strategies: Refuse – (Energy) Recovery
- Alternative business models

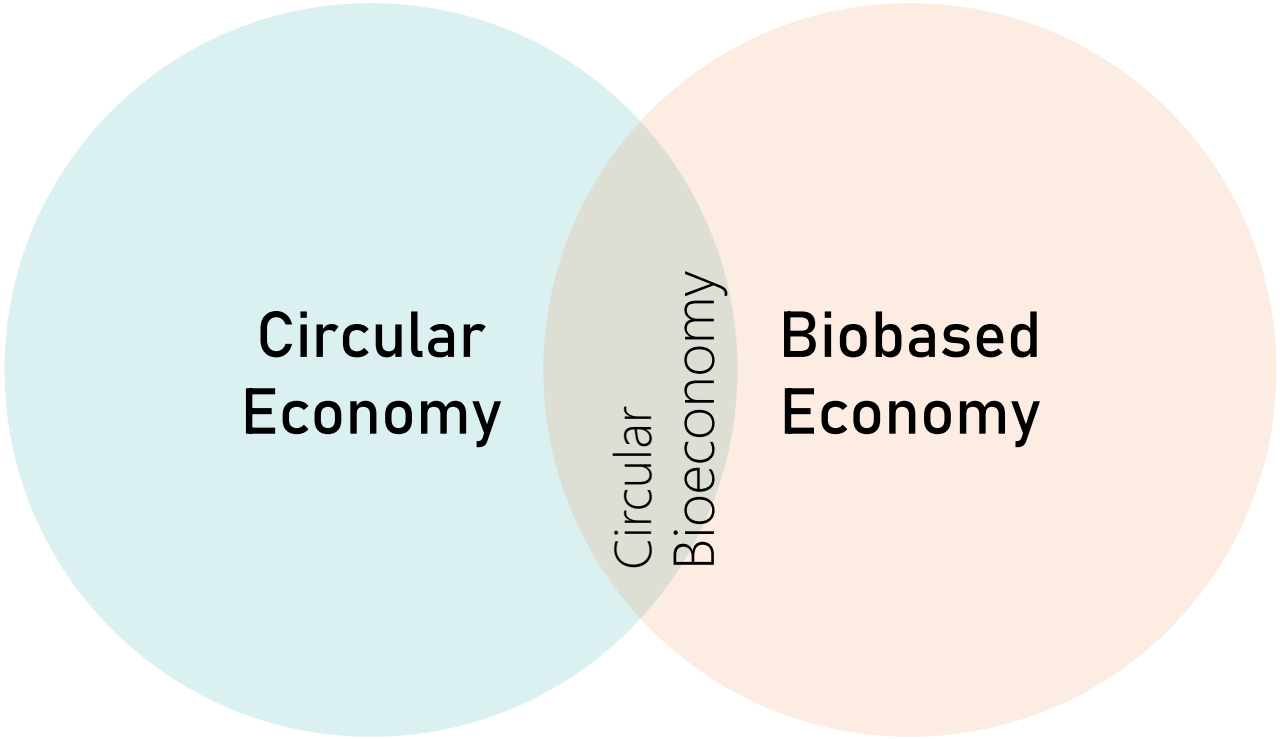
(De Wit et al., 2018)



(EMF, 2019)

Hetemäki et al. (2017) warns that without the consideration of circularity aspects, the bio-based economy could risk becoming too much of a 'business-as-usual' scenario.

Towards Circular Bioeconomy



- Utilization of organic waste streams
- Resource-efficiency (leakages)
- Renewable & bio-based products
- R-strategies
- Cascading use
- Organic recycling, nutrient cycling

Carus & Dammer (2018)

Questions?

What does the concept of Circular Bioeconomy mean to you?

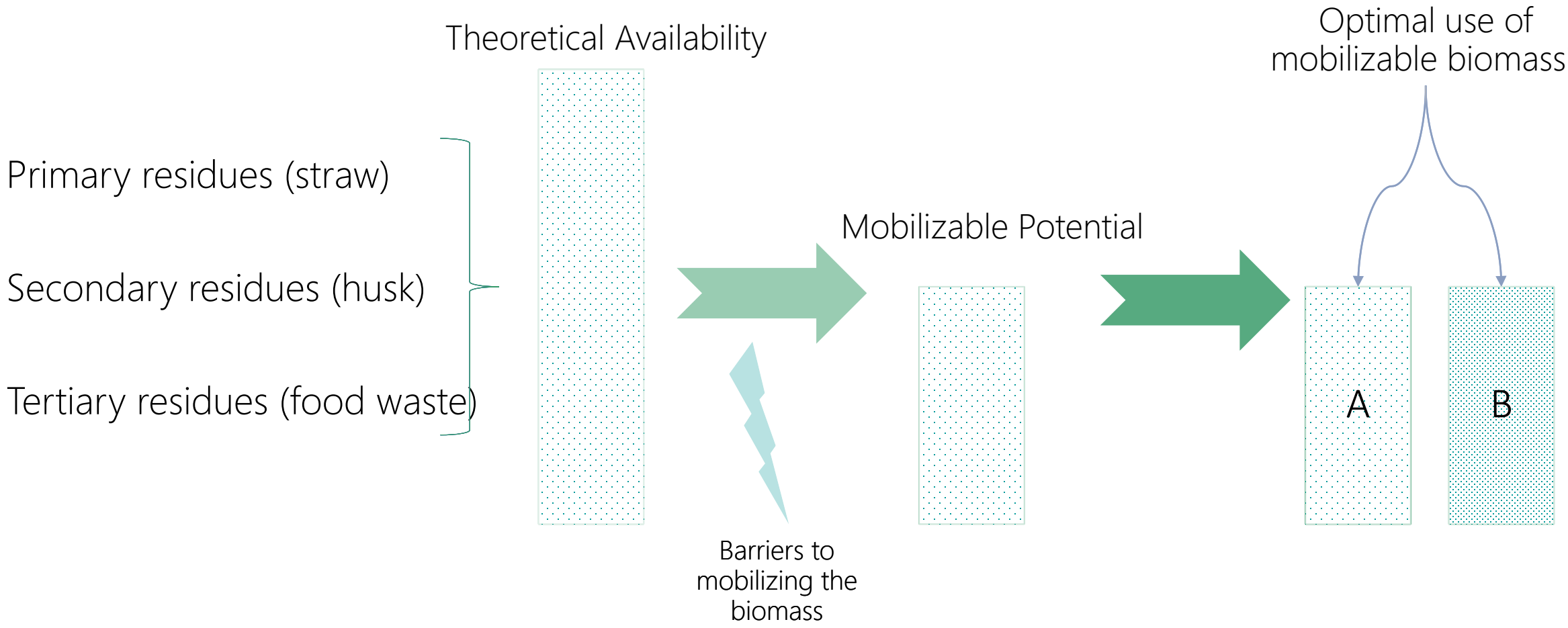
Do you find it as (un)important/illustrative/useful?

Research Question

How can the bio-based economy and circular economy be aligned so that they contribute to climate-change mitigation while creating new high-value added business cases in the Czech Republic?

- What is the current state of play in terms of size, utilization and processing of the agricultural biomass?
- How large is the circularity gap in the agricultural sector and which interventions could reduce this gap?
- What are the barriers that hinder the mobilization of regional biomass feedstock into high-value added bio-based industries and what strategies might help overcome these barriers?
- What is an optimal utilization of residual biomass in the Czech Republic considering climate targets, economic feasibility and circularity?

Analytical framework: CBE focus on biomass (agricultural) residues

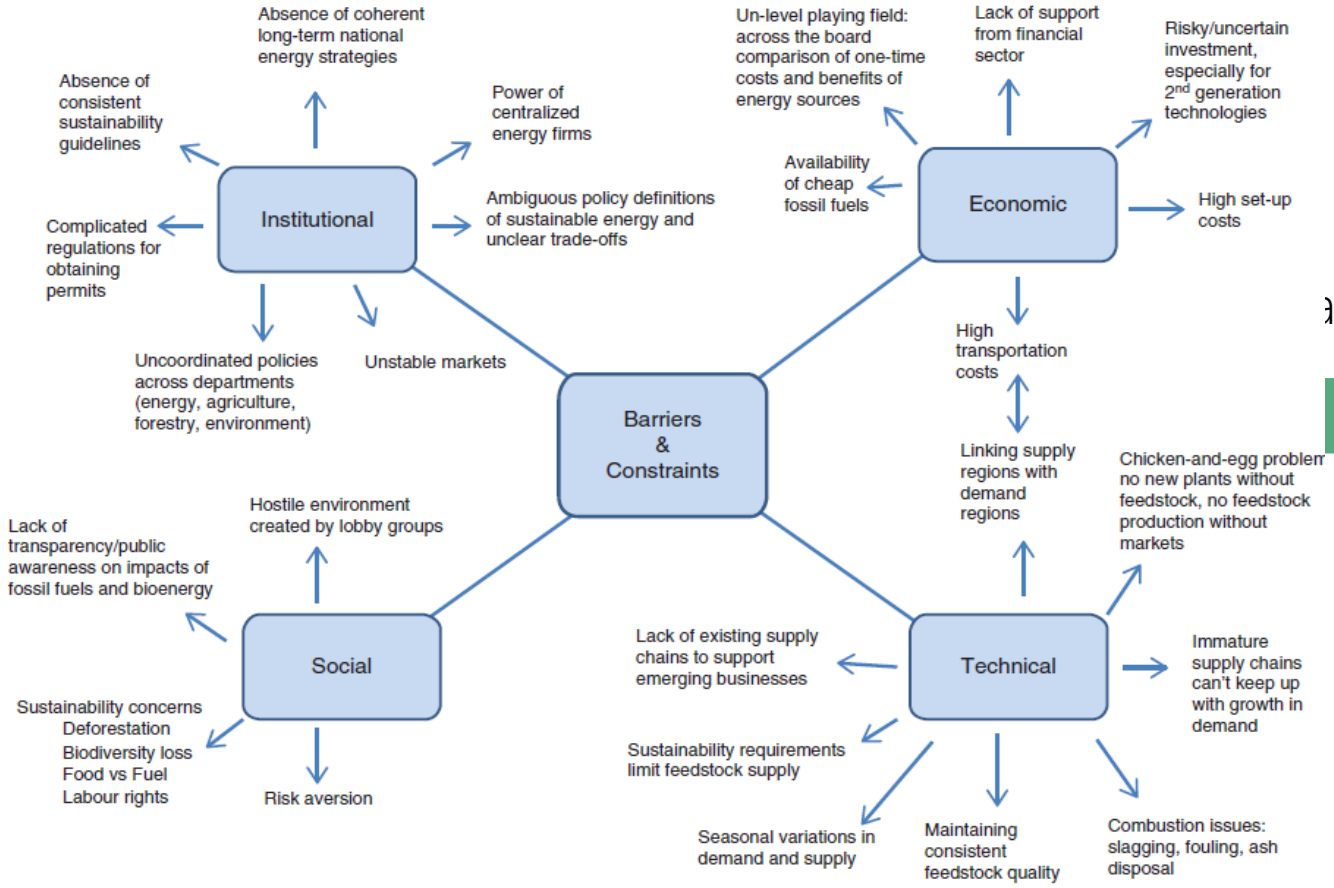


CBE focus on biomass (agricultural) residues

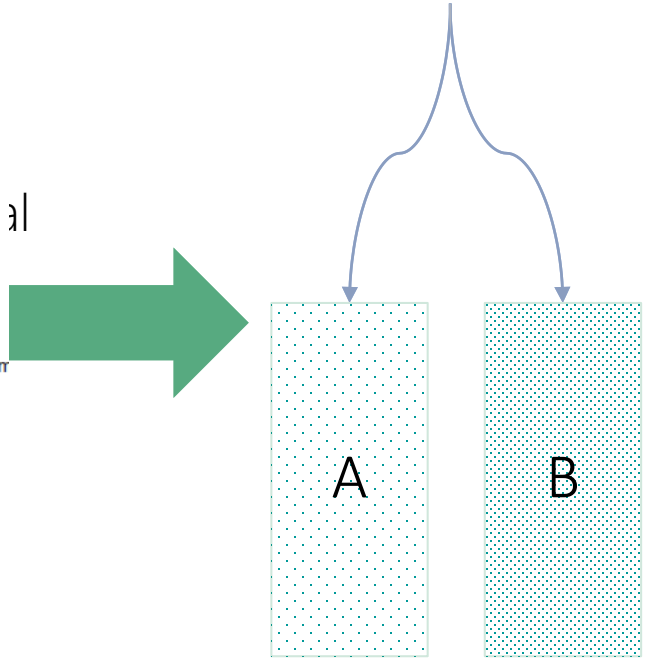
Primary residu

Secondary res

Tertiary residu

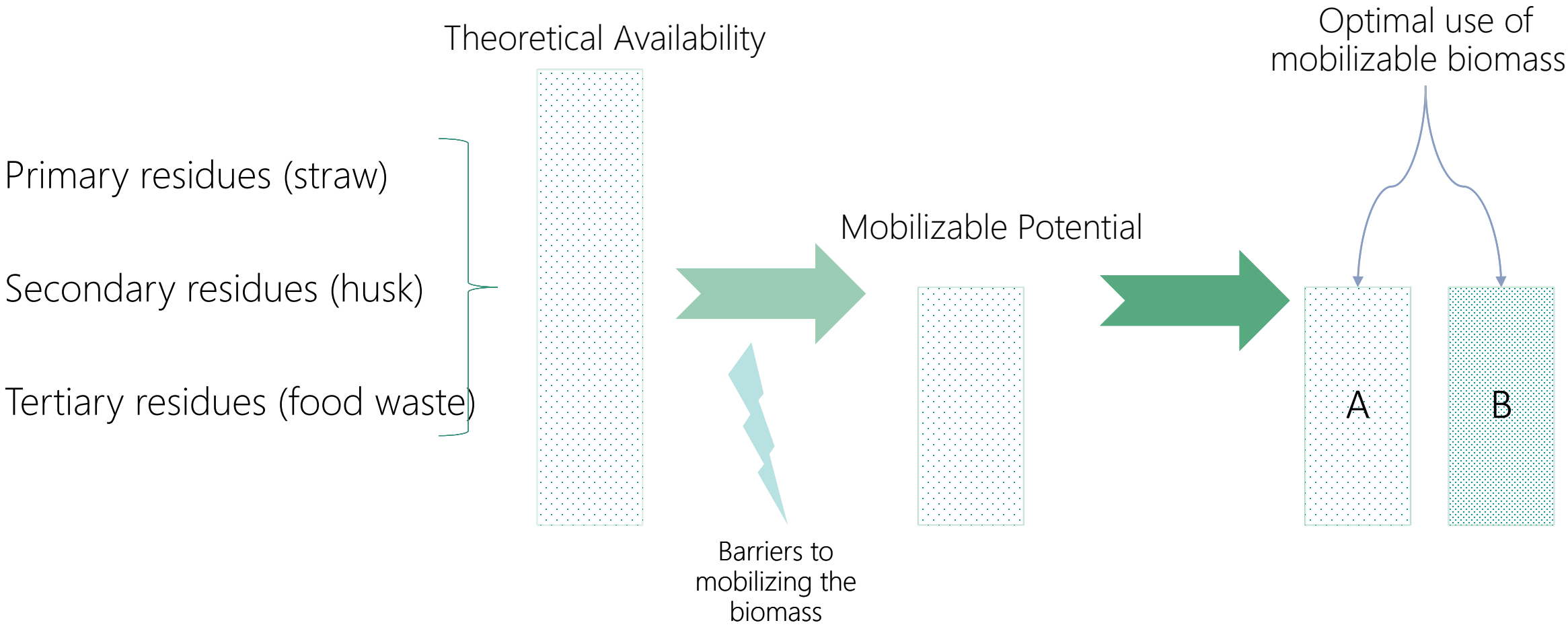


Optimal use of mobilizable biomass?



Smith (2017)

CBE focus on biomass (agricultural) residues



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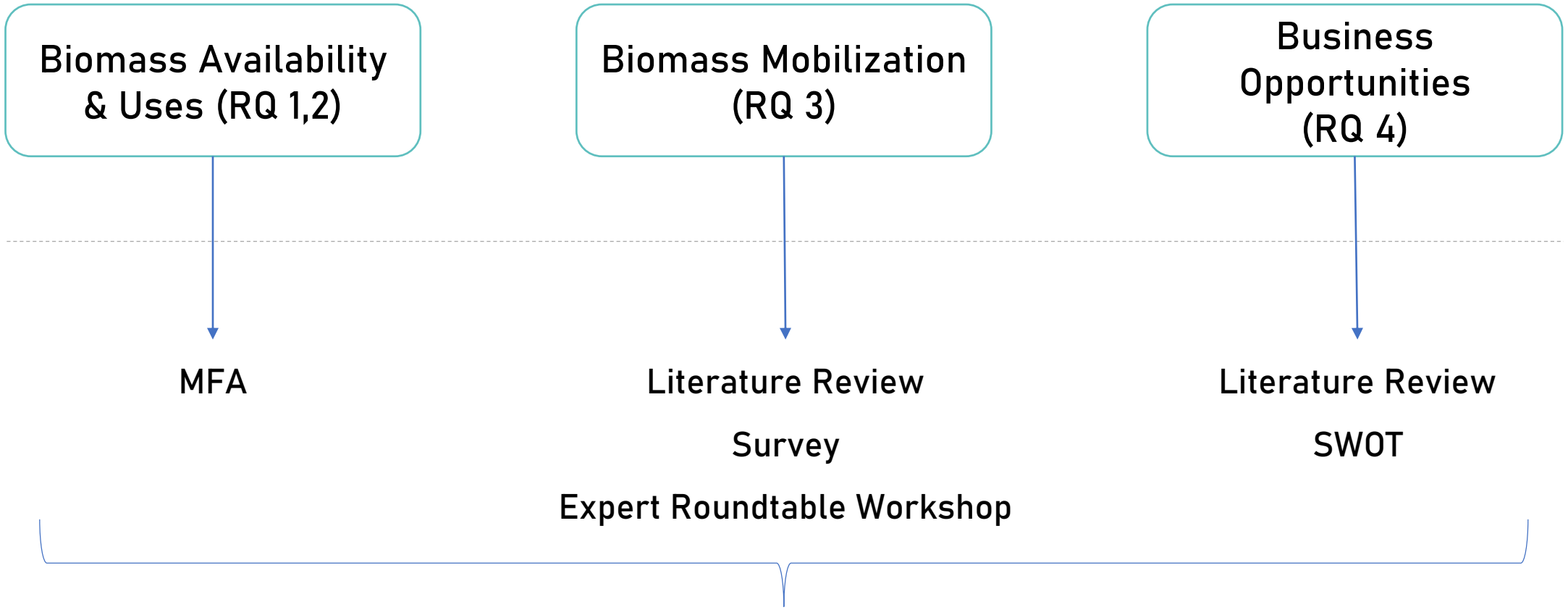
Research Design & Methodology



Overarching research question: Combination of CE and BBE

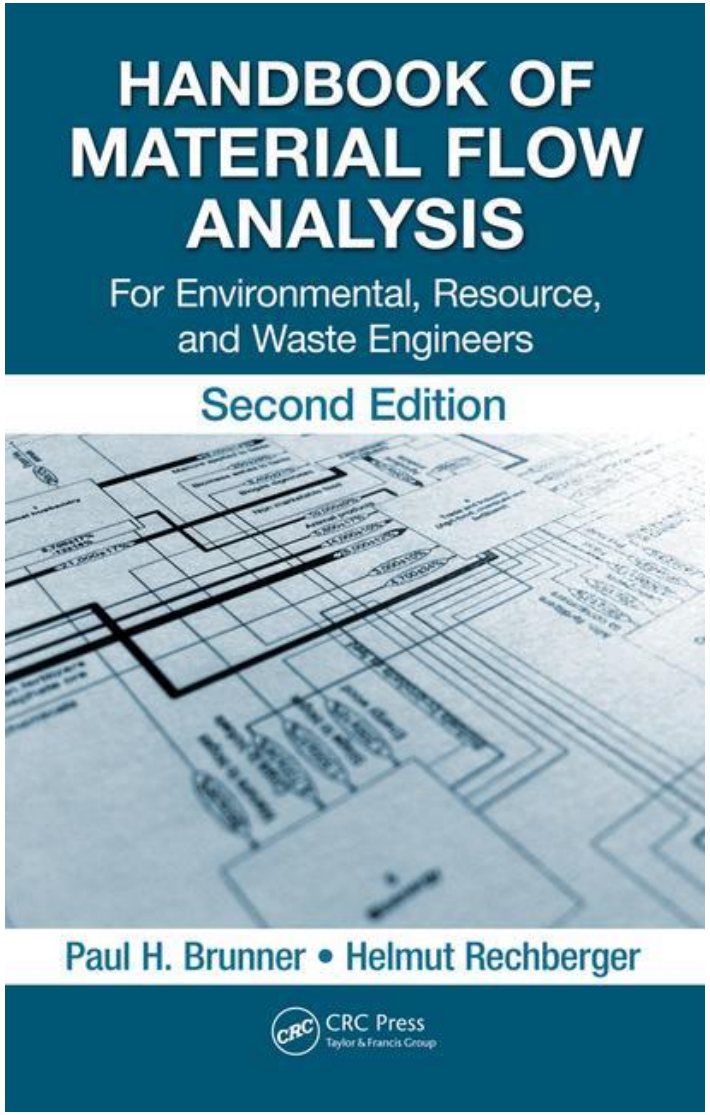
Background visits

Date	Place	Person met / Event attended / Short description
4.12.2019	Prague	Action group on Circular Economy at the City of Prague on tertiary residues (biogenic waste)
5.12.2019	Choťovice	Farmer - visit at the farm and a semi-structured interview on straw and on biomass use in agriculture
5.12.2019	Kněžice	Mayor of a village Kněžice - visit at the local waste biogas plant and a small straw biomass incineration plant
19.12.2019	Brno	Lead author of the Bioeconomy report for the Czech Republic - debate on the different biomass potentials in agriculture
29.1.2020	Kutná Hora	Supply chain director of a straw incineration plant EC Kutná Hora - visit at the straw incineration plant and a semi-structured interview on straw supply chains and sustainability guidelines
29.1.2020	Přelouč	Director of a company Ekopanely - visit at a company manufacturing construction desks from straw and a semi-structured interview on straw supply chains
28.1.2020	Prague	Director of the Czech Technological Platform for Biofuels – discussion on the Restep project that analyzed the potential of bioeconomy in the Czech Republic
26.9.2019	Prague	Event: Best practices in bioeconomy. Organized by the Czech University of Life Sciences
17.10.2019	Prague	Event: Conference on biodiversity and agriculture under the Czech Ministry of Environment
3.11.2019	Brno	Event: ''Break through the droughts'' Conference organized by the Czech parliamentary group on droughts and the impact on agriculture
13.12.2019	Prague	Event: Seminar in the Czech parliament organized by the Institutue of Circular Economy on the Circular Economy legislative package from the

(1) Methodology: MFA

'' Systematic assessment of flows and stocks of materials within an arbitrarily complex system defined in space and time.'' (Cencic & Rechberger, 2008, p.440).

- Based on mass balance in a predefined space and time
- According to Brenner & Rechberger (2016)
- A production-based approach which uses physical inputs as opposed to monetary inputs (consumption-based approach)
- Scope: main agricultural crops (>95 %) and their residues, year 2018
- Open system (import / export)
- E-Sankey programme and an Excel sheet



(2) Methodology: MFA

1. Literature search
2. Preliminary structure
3. Identification of relevant data sources and data collection
4. Filling in the preliminary structure (dry weight vs. moisture)
5. Identification of redundant data and inconsistent flows
6. Interpretation

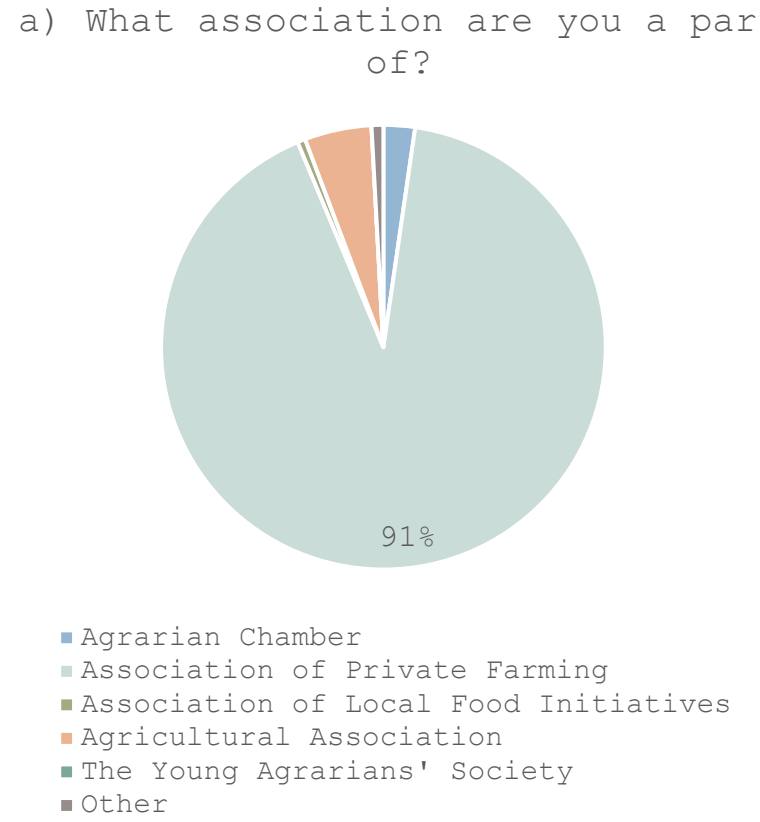
From MFA results

Source of flow	Sink of flow	Commodity / Biomass type	Flow quantity Mt (dry)	Mt (wet)	Water Content	Reliability of data
Crop Arable Land	Harvest Crop Supply	Cereal Grains	6.062	6.968	0.13	++
Crop Arable Land	Harvest Crop Supply	Straw (theoretical)	10.897	11.768	8%	+
Crop Arable Land	Harvest Crop Supply	Oilseeds	1.283	1.410	9%	++
Crop Arable Land	Harvest Crop Supply	Sugar Beet	0.818	3.720	78%	++
Crop Arable Land	Harvest Crop Supply	Potatoes	0.156	0.710	78%	++
Crop Arable Land	Harvest Crop Supply	Vegetables	0.025	0.250	90%	++
Crop Arable Land	Harvest Crop Supply	Fruits	0.030	0.200	85%	++
Crop Arable Land	Harvest Crop Supply	Green and Silage maize	2.342	6.690	65%	++
Crop Arable Land	Harvest Crop Supply	Arable fodder crops	3.372	3.967	15%	++
Crop Arable Land	Harvest Crop Supply	Perennial Fodder crops	0.901	1.060	15%	++
Crop Arable Land	Harvest Crop Supply	Total	25.89	36.74	-	-
Imports	Harvest Crop Supply	Cereal Grains	0.365	0.420	13%	++
Imports	Harvest Crop Supply	Oilseeds	0.262	0.288	9%	++
Imports	Harvest Crop Supply	Sugar Beet	0.020	0.090	78%	++
Imports	Harvest Crop Supply	Potatoes	0.040	0.182	78%	++
Imports	Harvest Crop Supply	Vegetables	0.065	0.648	90%	++
Imports	Harvest Crop Supply	Fruit	0.111	0.740	85%	++
Imports	Harvest Crop Supply	Total	0.86	2.37	-	-
Harvest / Crop Supply	Plant Food Production	Cereal Grains	1.784	2.050	13%	+
Harvest / Crop Supply	Plant Food Production	Oilseeds	0.469	0.510	8%	+
Harvest / Crop Supply	Plant Food Production	Sugar Beet	0.814	3.700	78%	+
Harvest / Crop Supply	Plant Food Production	Potatoes	0.141	0.640	78%	+
Harvest / Crop Supply	Plant Food Production	Vegetables	0.025	0.250	90%	+
Harvest / Crop Supply	Plant Food Production	Fruit	0.030	0.200	85%	+
Harvest / Crop Supply	Plant Food Production	Total	3.26	7.35	44%	
Import	Plant Food Products	Miscellaneous plant products	1.05	1.9	45%	+
Plant Food Products	Export	Miscellaneous plant products	1.23	2.25	45%	+
Plant Food Products	Secondary Residues	Cereal Grains (wheat bran)	0.446	0.513	13%	0
Plant Food Products	Secondary Residues	Oilseeds	0.188	0.255	8%	0
Plant Food Products	Secondary Residues	Sugar Beet	0.204	0.555	78%	0

- Circularity Gap Analysis
- Ratio of materials returned to the (eco)system / extracted (De Wit et al., 2018)
- 0 – 100 %

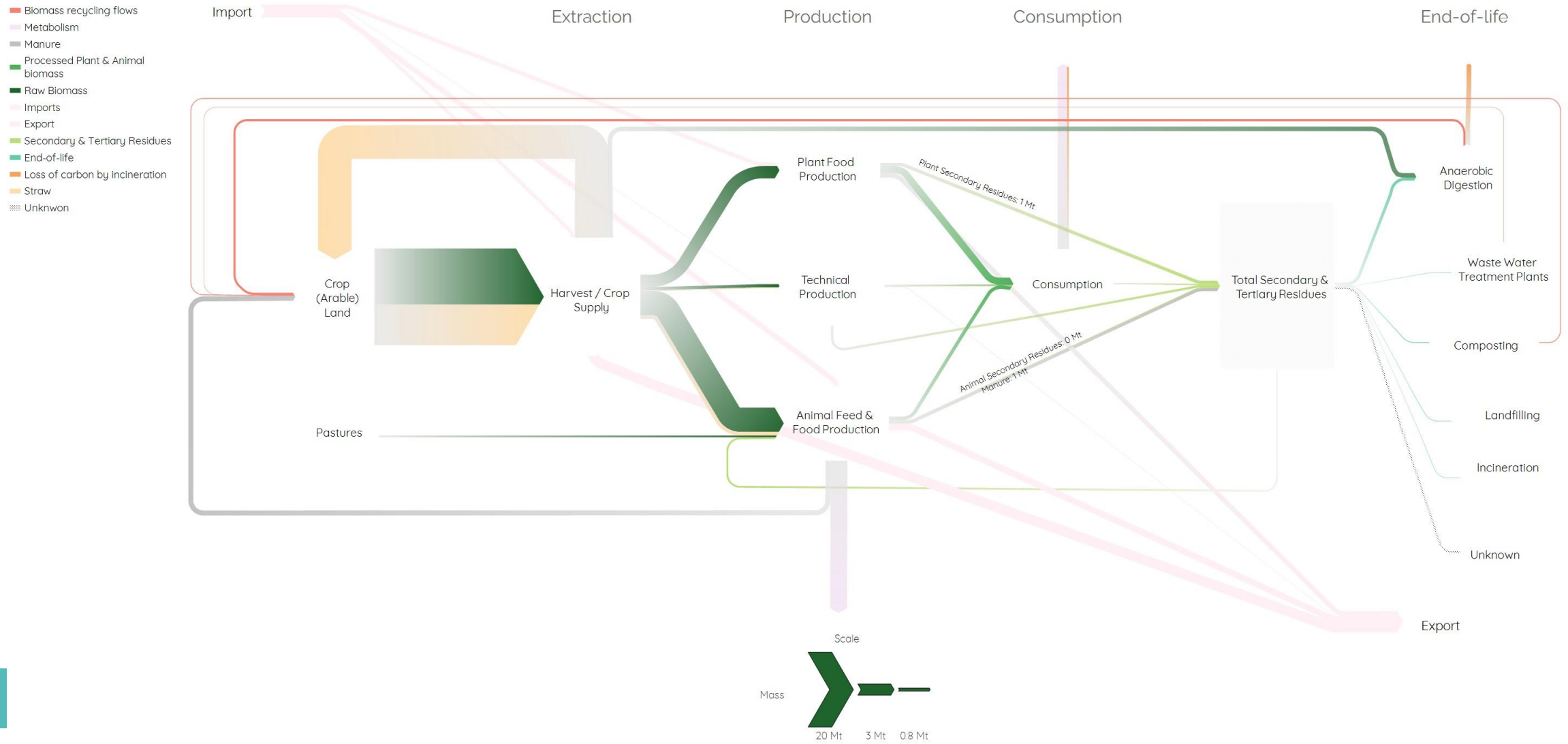
(3) Methodology: Biomass Mobilization / Survey

- Literature review for overview of barriers
- Farmers' Survey on the use of straw – Czech specific
- Aim was to identify the perception of farmers on straw and on their agricultural practices
- Open and closed questions
- Largest farmers association
- Sample group questions
- Straw specific questions
- 360 responses via google forms

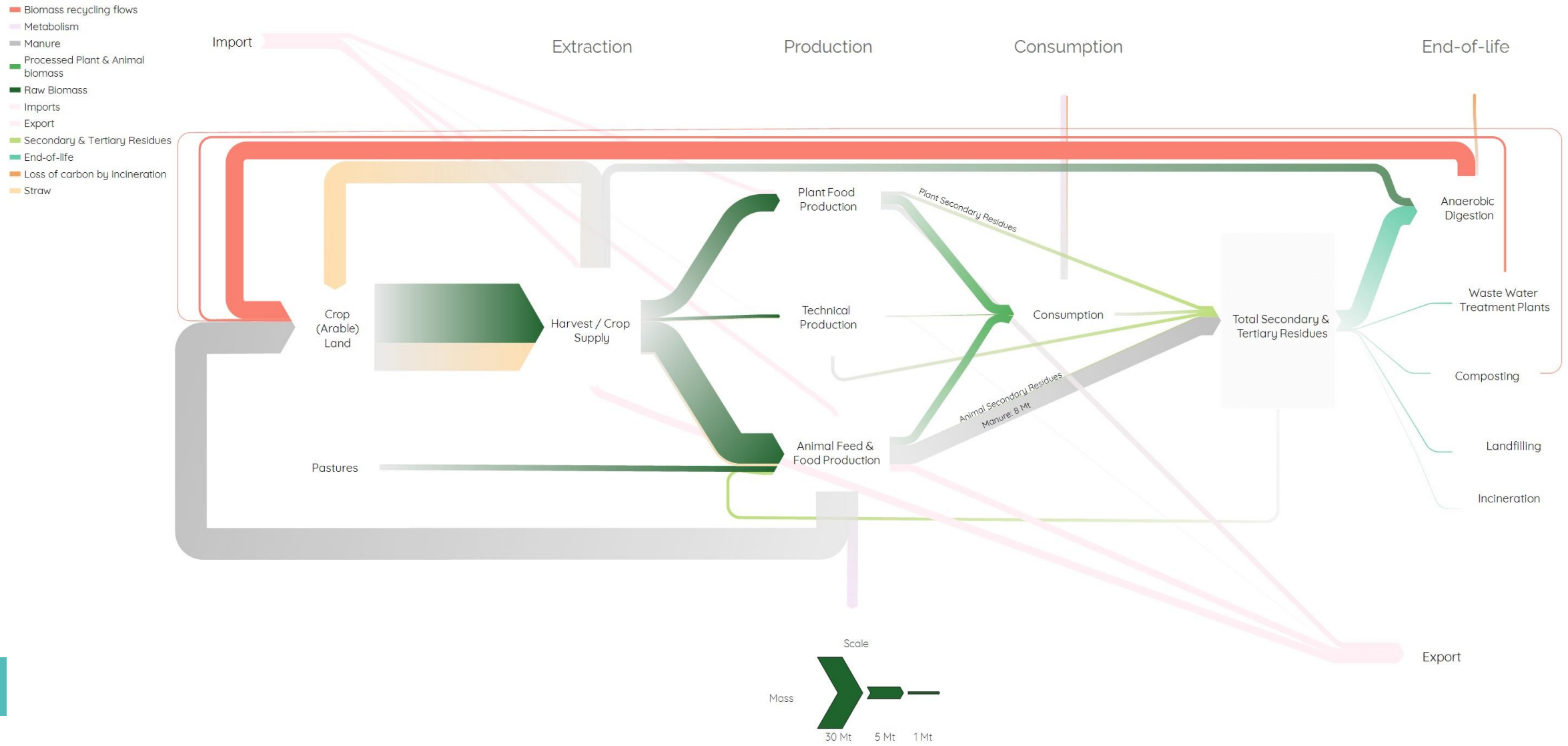


Questions?

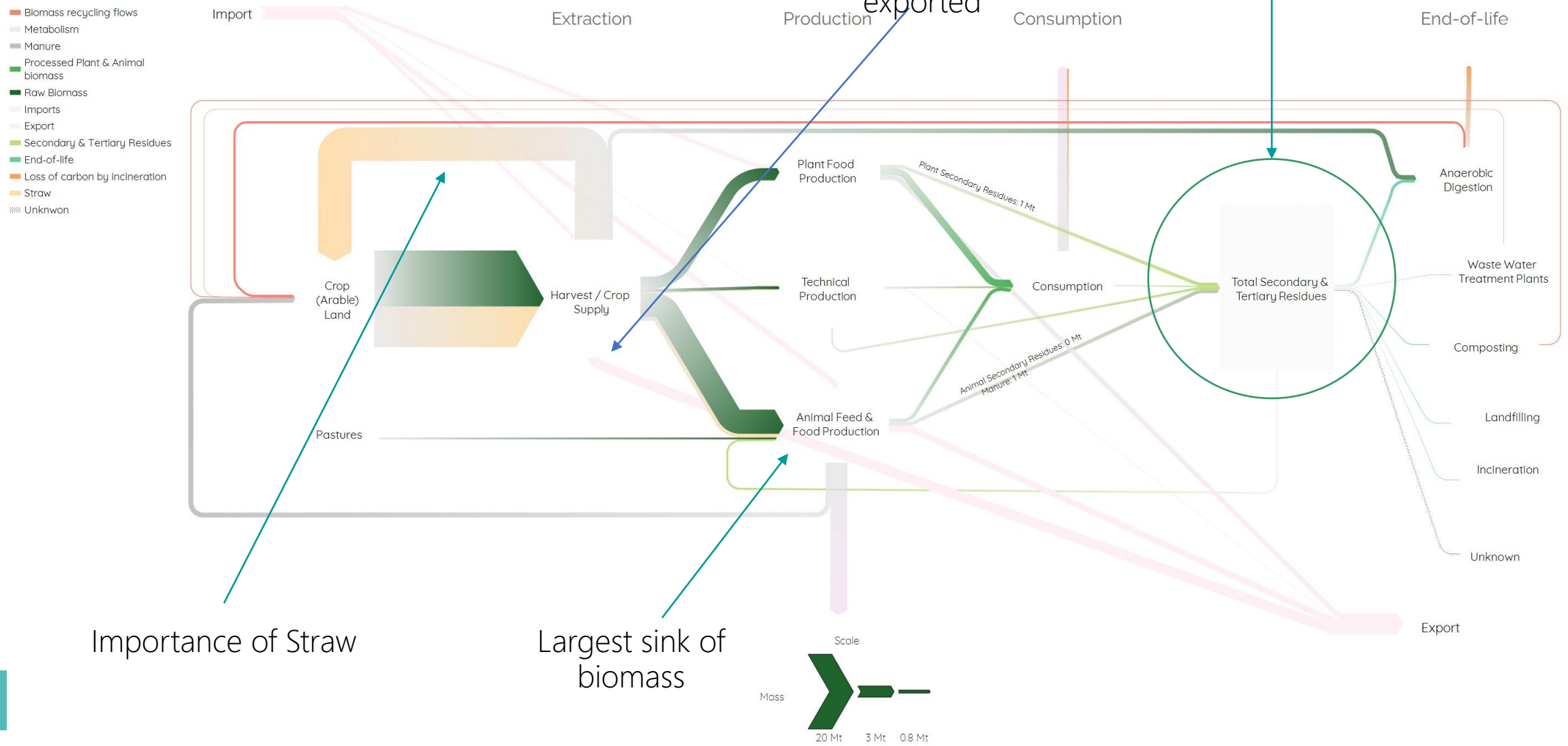
Results – MFA in dry weight



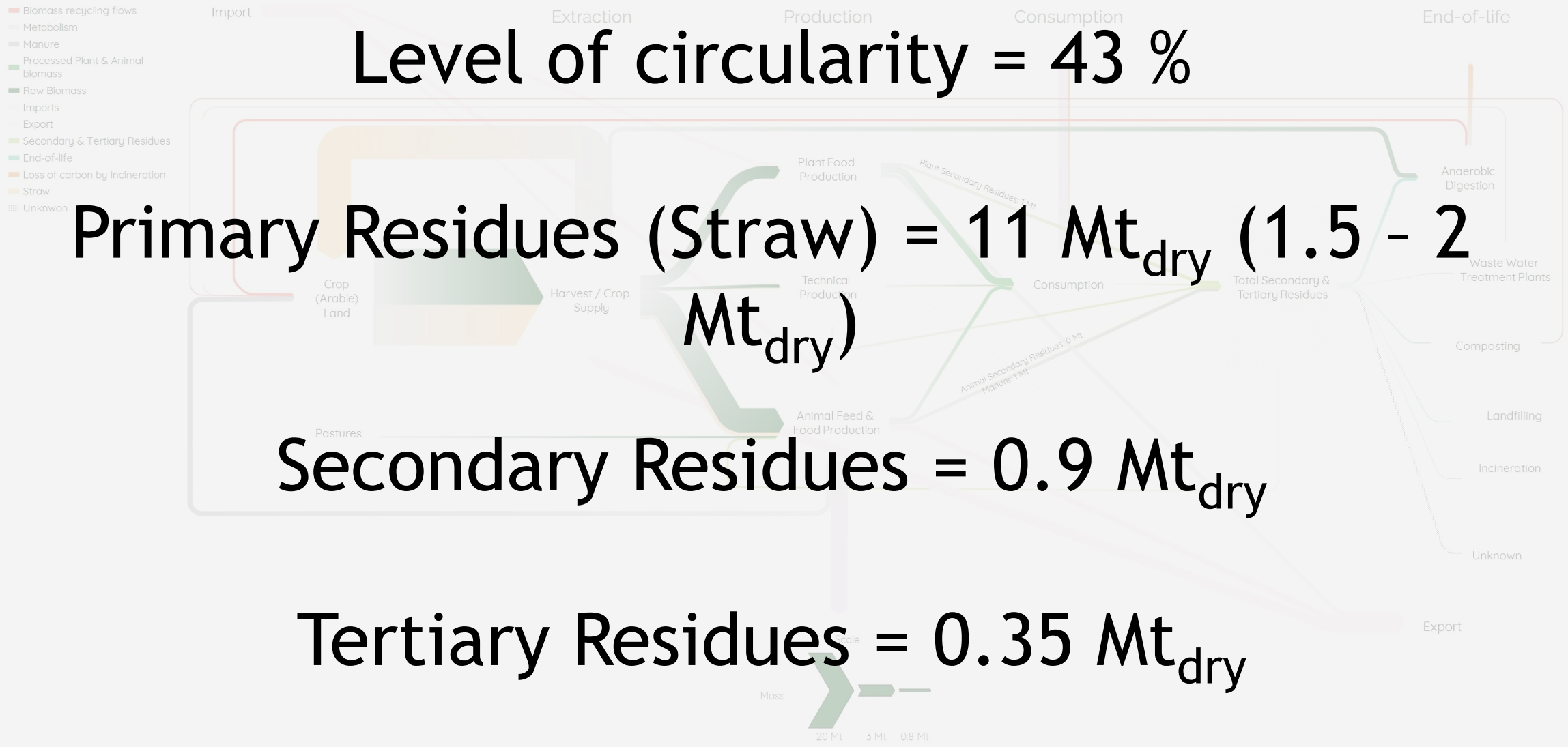
Results – MFA in ‘as received’ weight



Results - MFA dry weight



Main Results



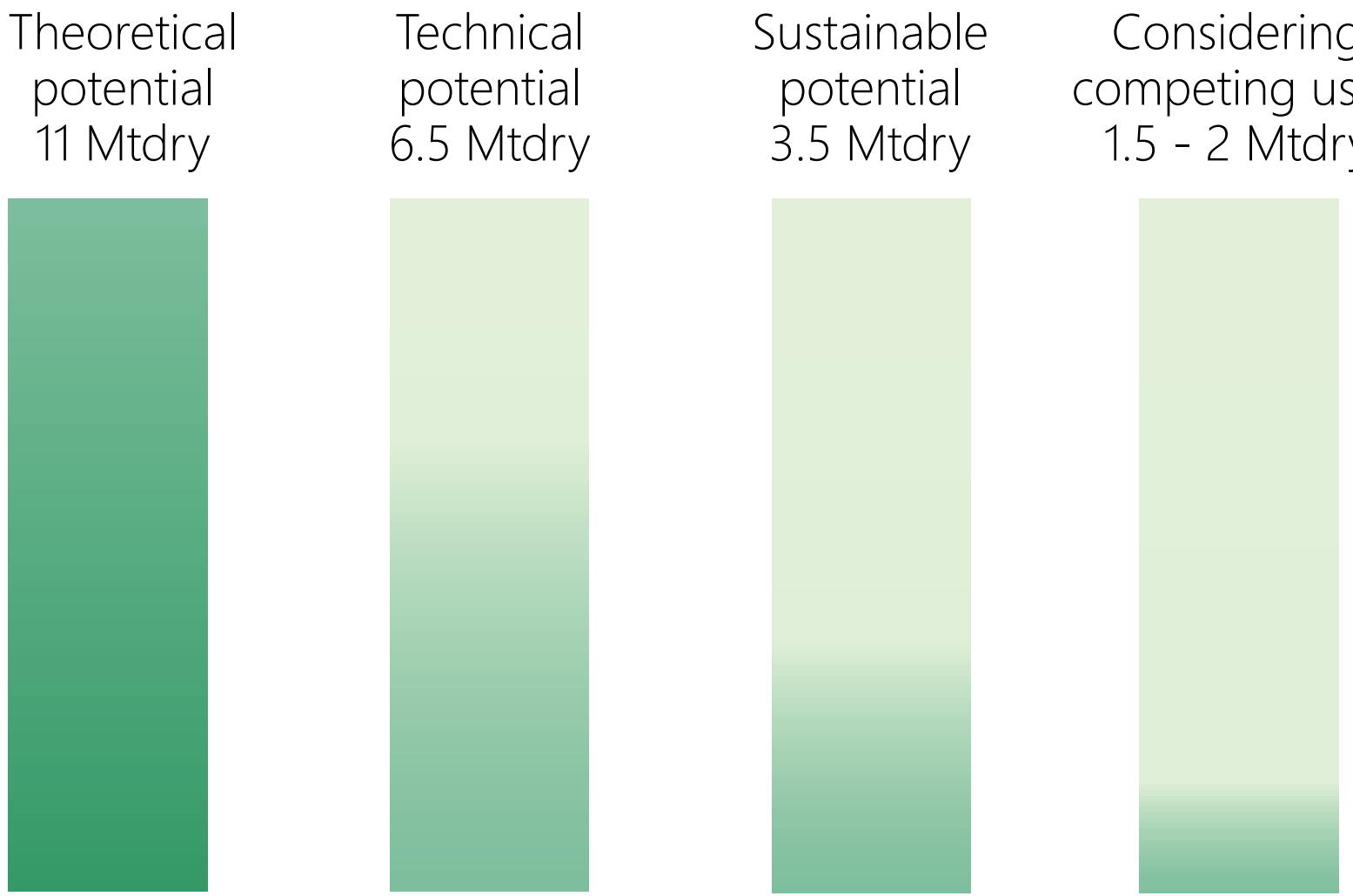
Level of circularity = 43 %

Primary Residues (Straw) = 11 Mt_{dry} (1.5 – 2 Mt_{dry})

Secondary Residues = 0.9 Mt_{dry}

Tertiary Residues = 0.35 Mt_{dry}

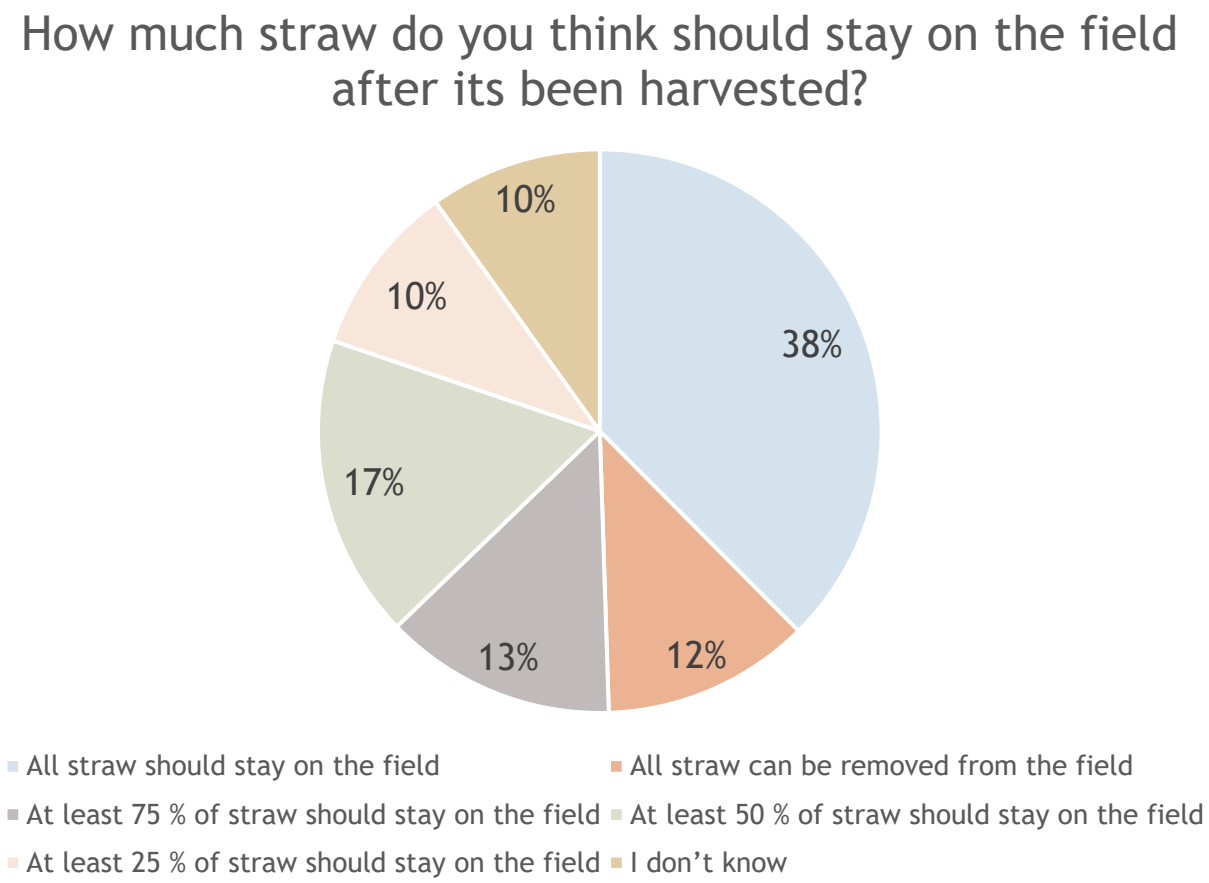
Straw as the most abundant residual source



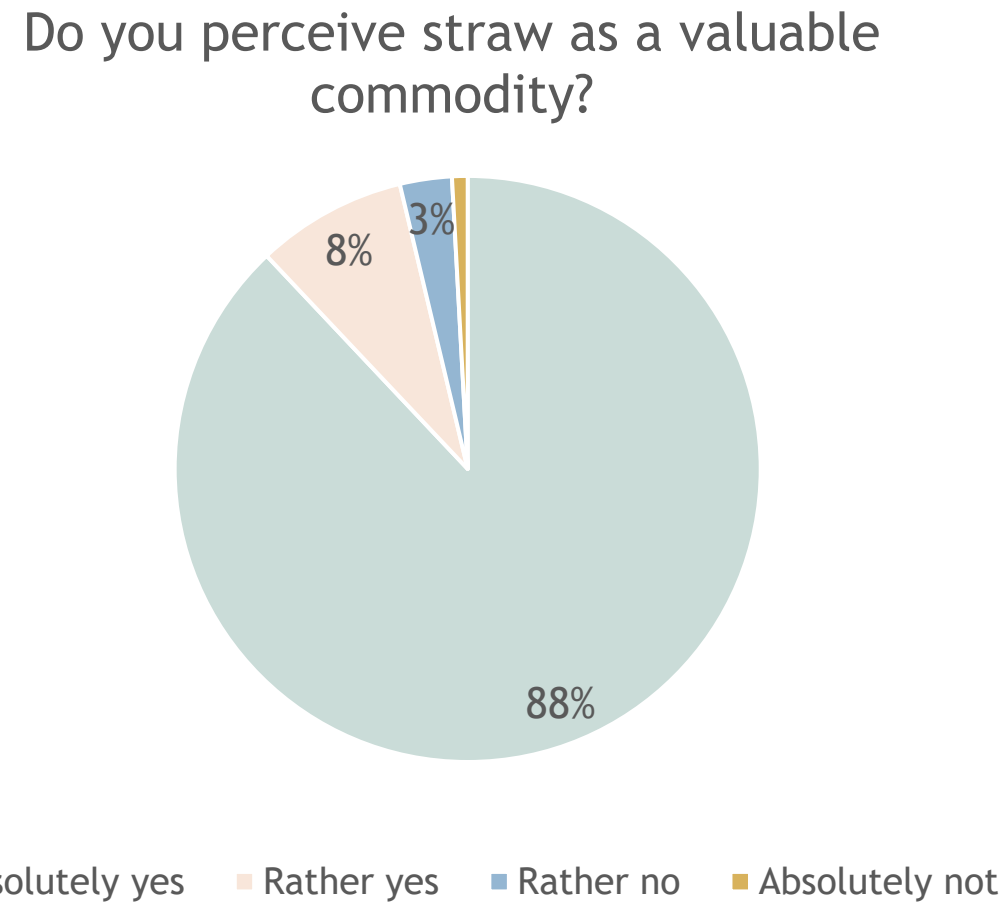
Constant Removal Rate!

Must be regionally based!

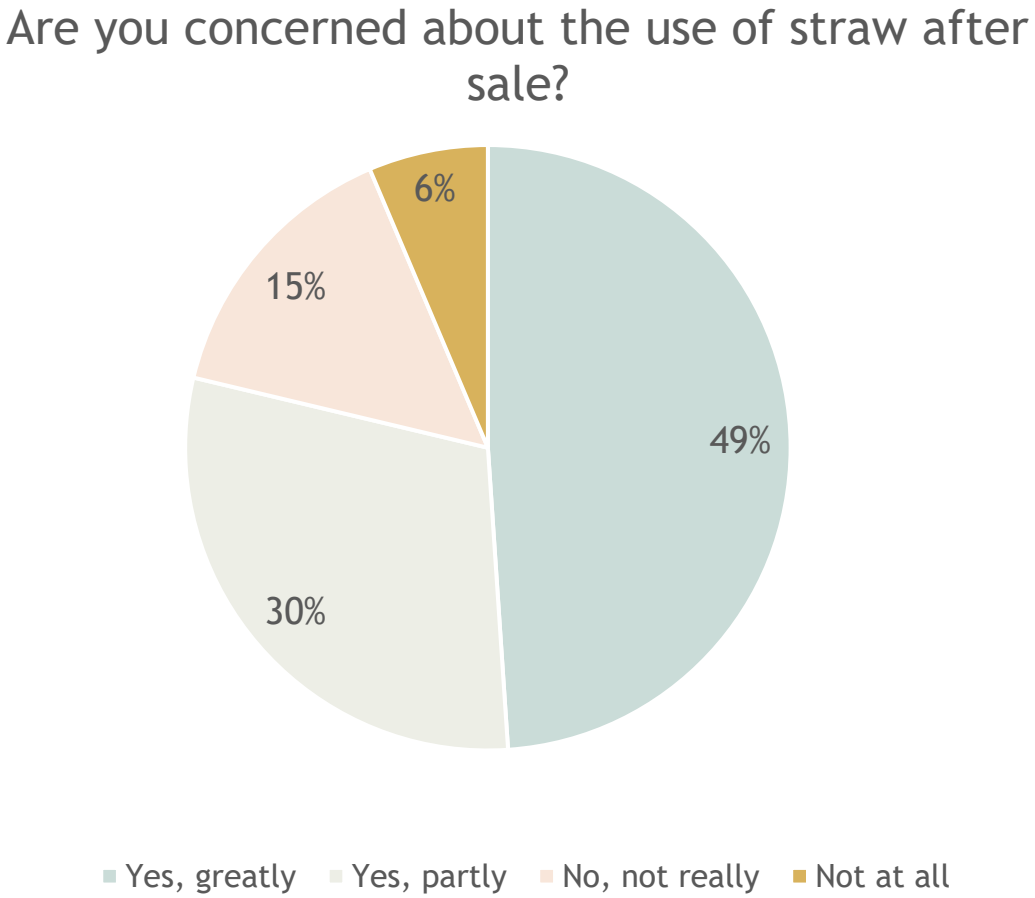
Survey Results (1)



Survey Results (2)



Survey Results (3)



Conclusion & Limitations

RQ: How can the bio-based economy and circular economy be aligned so that they contribute to climate-change mitigation while creating new high-value added business cases in the Czech Republic?

- MFA (primarily CE tool) can be highly insightful on biogenic systems → Untapped potential in biomass residues (1.5 Mt_{dry}, 1 Mt_{dry}, 0.3 Mt_{dry})
- To align CE and BBE → regional and bottom up focus is needed(local soil characteristics and local uses)
- Risk-averse approach of the farmers towards providing straw → Reluctance to provide it as a main barrier
- The Circular Bioeconomy needs to include social dimension (e.g. focus on the farmers)
- Limitation: MFA based on assumptions + conversion to dry weight is reliant on difficult to retrieve data
- Limitation: Sample group from questionnaire is fairly homogenous

What’s next?

- Regional focus is a key (regional (circular) bioeconomy strategies)
- Work on the ground with local stakeholders (again, more regional focus…)
- More detailed analysis of primary, secondary and tertiary residues (narrower scope)
- What is the optimal (most valuable) utilization of biomass? Strategic question and difficult to answer

- INCIEN is working on the biowaste topic

Questions?

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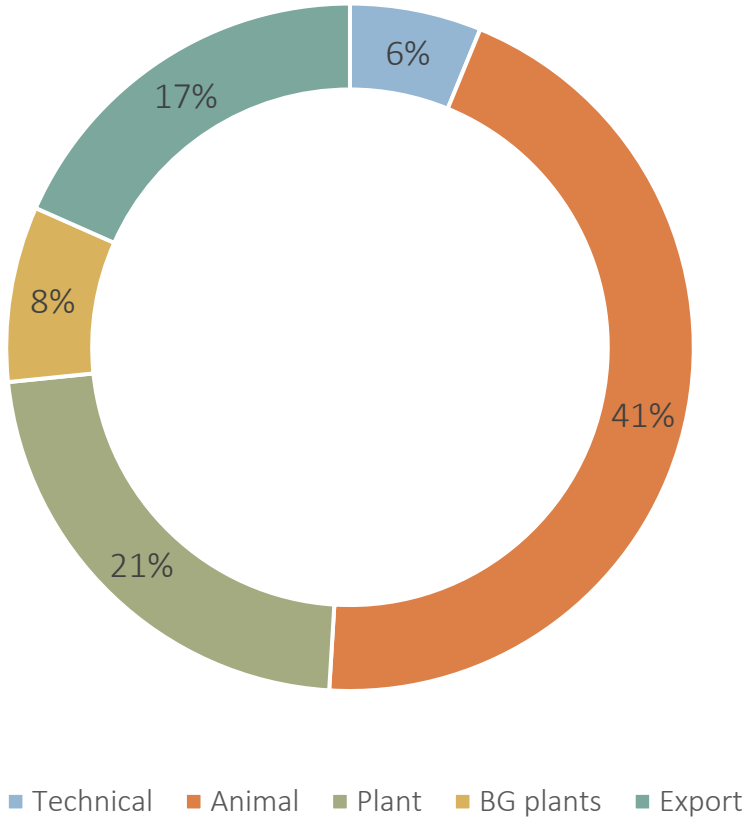
	Renewable Jet Fuels	Renewable Road Transport Fuels	Biochemicals	Biocomposites & construction
Strengths	Lower carbon footprint Low competition from Other than biomass-based RJFs High growth industry	Lower carbon footprint Policy support (RED II targets) Large biofuel know-how within the EU Experience with 1G Biorefineries in the Czech Republic More competitive than RJFs	Lower carbon footprint High value added Higher employment Higher circularity performance (especially for solid materials)	Lower carbon footprint Relatively simple technologies compared to fuels or biochemicals Already competitive
Weaknesses	Low technical maturity High production costs Low price premium compared to biochemicals or RRFs Big-scaled plants needed Lack of aviation fuel standards and of international coordination No target set for blending Very costly R&D	Higher competition from non-biomass fuels (BioCNG, E-fuels) High production costs although lower than RJFs Technically still immature (TRL less than 8) Low reputation of biofuels Dynamic policy and market development	Limited policy support (bioenergy over chemicals) Higher production costs Low TRL (especially for lignocellulosic pathways) High development costs Often lower performance than fossils Applying for REACH regulation is costly	Lower value Often unrecycled (mixed cycles) Often lower performance For lignocellulose still limited uptake Limited attention to biocomposites
Opportunities	High carbon tax High policy support that would incentivize R&D and faster commercialization High oil prices Establishment of a common and stable policy for aviation Cost reductions & technological development	Technological breakthrough Establishment of a cost-effective and reliable technology (e.g. cellulosic ethanol) High oil prices Even More stringent targets by the EU Carbon tax on fuels	Future changes in regulation that would support biobased chemicals Market pull (tax credits, binding targets, procurement) CO2 tax EU policy and guidelines Higher demand from consumers (e.g. cosmetics)	Higher importance of biocomposites Shortage of construction materials Market pull (tax credits, binding targets, procurement) EU policy and guidelines
Threats	Competition from high value added markets (biochemicals) Worsening perception on biofuels Risk aversion of investors due to unsuccessful commercialization Non-biobased alternative	Competition from other renewable fuels (BioCNG. EV) Worsening perception of biofuel Biomass will be prioritized to jet fuels or to biochemicals due to limited substitutes	Low public perception / awareness Prioritization to biofuels, bioenergy, jet fuels Higher stringency of REACH regulation Environmental benefits will be lower than expected	Low public perception / awareness Prioritization to biofuels, bioenergy, jet fuels Limited progress in recyclability

Biomass use



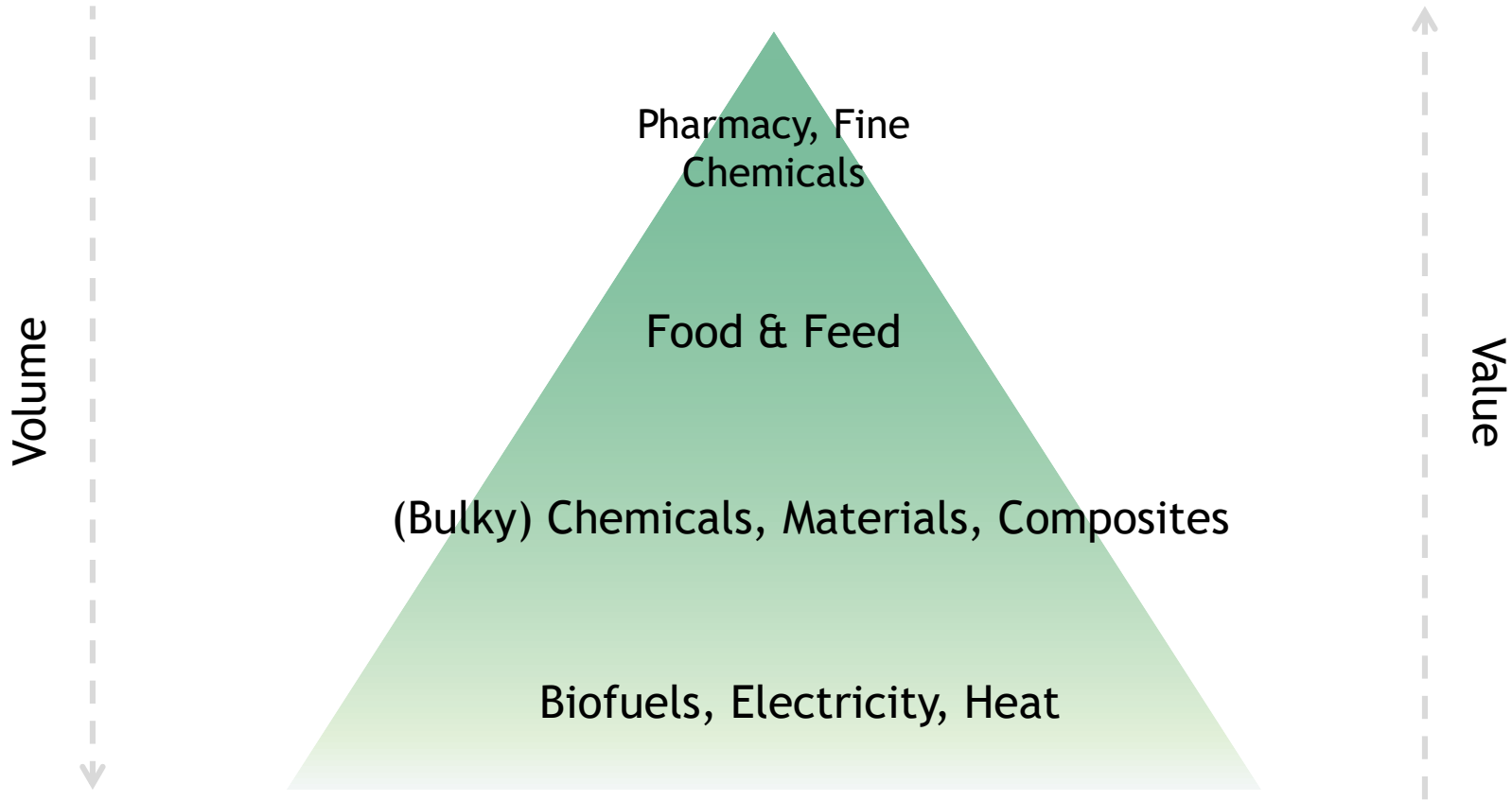
Expert Roundtable Workshop

Stakeholders Invited

- Renewable energy specialist, Alliance of Energy Reliability
- Director of the Biofuel platform of the Czech Republic
- Sustainability specialist, Glopolis – think tank on the environment and energy provision
- Food security specialist, the Institute of Circular Economy

The process of the workshop was following:

- General overview into high-level climate goals (e.g. RED II advanced biofuels and energy targets) and on the potential of biomass to fulfill some of these goals was presented by the author.
- This was followed by a presentation of the preliminary MFA model showing the availability and use of biomass in the Czech Republic as well as by the questionnaires that illustrated the perception of the farmers towards providing biomass. The potential barriers to biomass mobilization were also introduced.
- Every participant than had a dedicated time to express their opinion on the role of biomass in the Czech context as well as on their view on mobilizing biomass.


Volume
Pharmacy, Fine Chemicals
Food & Feed
(Bulky) Chemicals, Materials, Composites
Biofuels, Electricity, Heat
Value