Rehap

Systemic approach to **Reduce Energy** demand and CO_2 emissions of processes that transform agroforestry waste into **High Added** value **Products**

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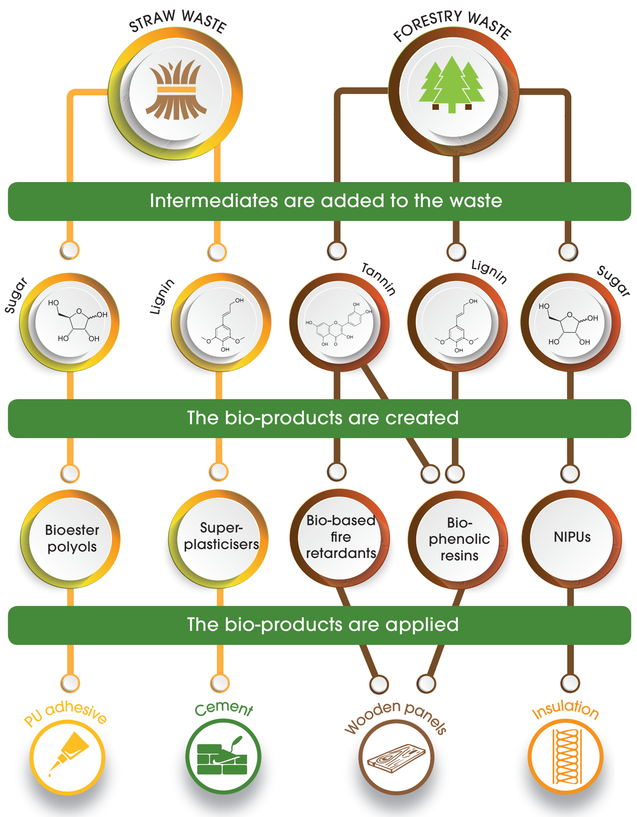
FUTURE AVAILABILITY OF LIGNOCELLULOSE FEEDSTOCK FROM AGRICULTURAL HARVESTING RESIDUES

INTRODUCTION & OBJECTIVE

The **Rehap** project aims to strengthen the European bioeconomy industry by creating novel materials from agricultural and forestry waste, and will demonstrate how they can be used commercially in the green building sector.

The project is substituting petrochemicals found in chemical products with natural building blocks found in biomass components, such as lignin, cellulose, hemicellulose and tannin.

The University of Augsburg's role in Rehap is to analyse the prevalence of underutilised agroforestry residues such as agricultural by-products (harvesting residues) and residues of the forestry and wood industries.



MATERIALS & METHODS

How will the feedstock potentials of the most important agricultural lignocellulose residues develop in the next decade in the EU28? To address this question, one has to answer how harvesting residue potentials are defined and which variables influence the future availability of residues?

1. Theoretical potential

Theoretical Potential = Yield x Area R:C ratio

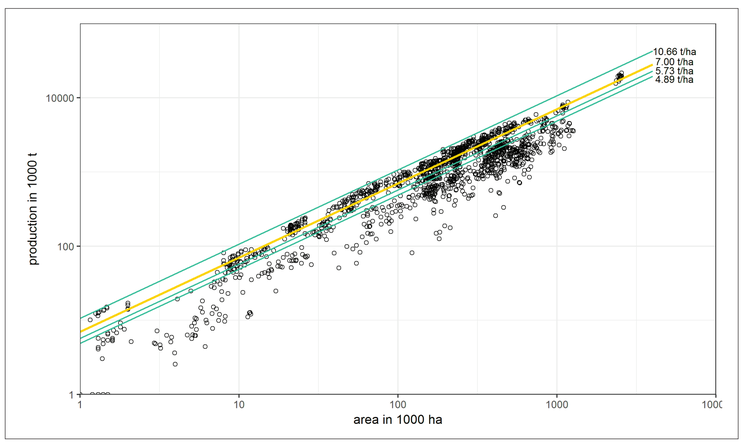
2. Technical potential

Technical Potential = Theoretical Potential x Sustainable Removal Rate

3. Bioeconomic potential

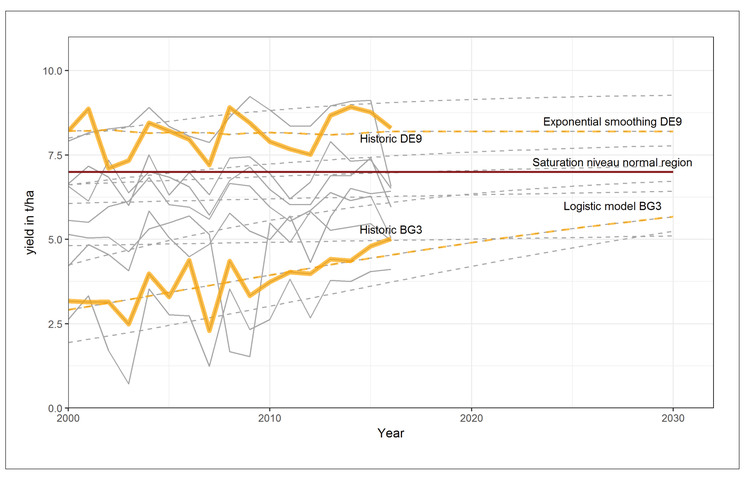
Bioeconomic Potential = Technical Potential –Competing Application

To forecast future potentials, all independent variables need to be forecasted. For the crop yield, the cultivated area and the competing applications, historic time series of each NUTS1 region are analyzed to parametrise time series models (First order exponential smoothing, Holt's linear trend method, Holt's linear trend method with logarithmised values, logistic growth model, naïve prognosis as well as literature based forecasts). For the residue to crop ratio and the sustainable removal rate, constant values are assumed.



The yellow line represents the average agro-economic yield maximum of wheat grain.

The upper green line represents the highest historically achieved wheat yield (10.66 t/ha, Ireland in 2015). The 5.73 t/ha yield corresponds to the average wheat grain yield in 2015 and the 4.89 t/ha yield corresponds to the average wheat grain yield in 2000.

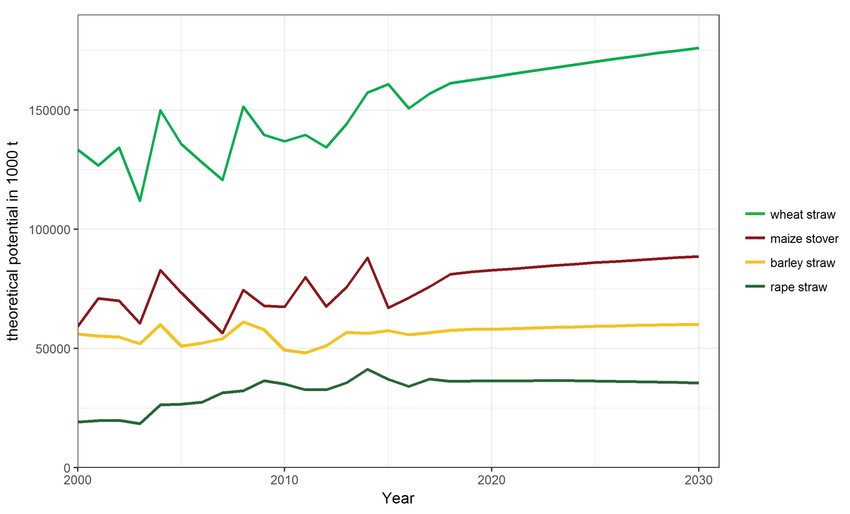


Logistic growth model perform well for time series with saturation like crop yields. The average agro-economic yield maximum for wheat is 7.0 t/ha, for maize 10.4 t/ha, for barley 5.3 t/ha and for rapeseed 3.9 t/ha.

RESULTS & DISCUSSION

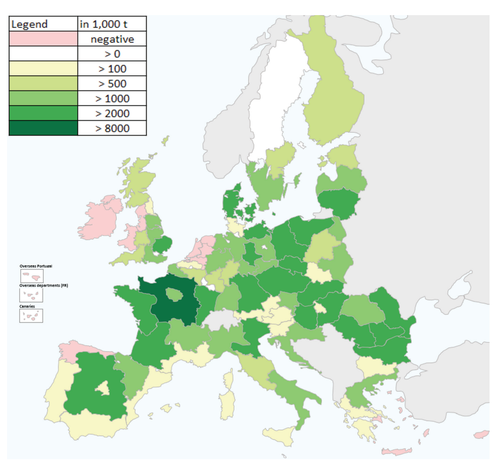
Wheat straw already has the highest potential with expected further growth by about 10 % until 2030 compared to 2017. Grain Maize stover shows the highest growth rate of about 17 %. Barley straw is expected to remain rather constant. Rape straw potentials are expected to slightly drop until 2030.

Aggregated historic and forecasted theoretical potential of the four most promising feedstocks in the EU28

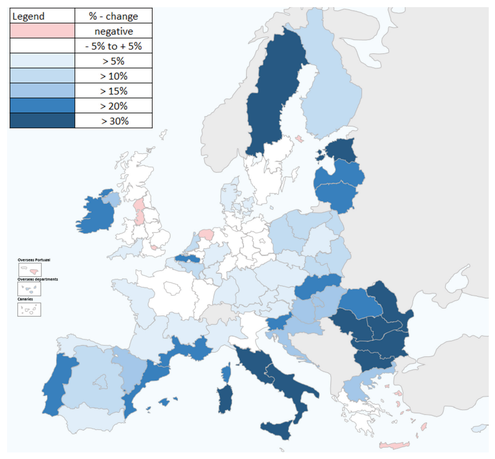


Potentials of agricultural harvesting residues EU28	2017 Theoretical potential (1000t)	2017 Bioeconomic potential (1000t)	2030 Theoretical potential (1000t)	2030 Bioeconomic potential (1000t)	Total % change Theoretical Potential	Total % change Bioeconomic potential
Wheat straw	161,271	51,812	176,144	57,227	9.2 %	10.5 %
Grain maize stover	75,961	30,428	88,642	36,503	16.7 %	20.0 %
Barley straw	56,664	16,666	60,251	18,098	6.3 %	8.6 %
Rape straw	37,678	15,807	35,584	15,205	- 5.6 %	- 3.8 %

Eastern countries of the EU28 are especially expected to further increase agricultural production with implicated increasing residue potentials. Due to currently improving farming patterns, countries like Bulgaria, Estland or Romania are likely to increase crop yields in the near future.



(Right) Total bioeconomic potential per NUTS1 region in 2030.



(Right) Total bioeconomic potential per NUTS1 region in 2030.

CONCLUSION & OUTLOOK

Lignocellulose materials from agricultural harvesting residues are expected to become an important renewable resource for materials and biofuel of the post-petrol era.

There are still many technical and economic questions that have to be answered before lignocellulose from agricultural residues can be used in large scales.

Wheat straw shows the highest potentials as well as a robust growth in production until 2030. Maize stover potentials are likely to increase by about 17 % until 2030. Barley straw potentials are supposed to stay nearly constant. Rape straw potentials are likely to contract slightly in the coming decade.

Extreme weather events have strong impacts on the annual agricultural production, respectively on agricultural residues potentials. Future works should focus on the assessment of the impact of extreme weather events on the production and how climate change could lead to a increased numbers of such events.

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