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The technology platform for agricultural based lignocellulosic substrates – Case examples from R&D and full scale implementation.

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1. Introduction

The rapidly growing biogas sector in Europe is facing the challenge of integrating the use of cheap, sustainable lignocellulosic biomasses. In the last and current decade, several research groups and developing projects within innovative technology have focused on the use of lignocellulosic biomasses [1]
The challenge is to map, design, negotiate, agree and fully implement such agricultural based lignocellulosic biomasses in the entire supply chain, and to make it techno-economic-environmental feasible. The future looks bright for such biomasses, i.e. various kinds of by-products from the primary agricultural production or biomasses from non-utilised natural or semi-natural agricultural areas.
Understanding the "Two-platform biorefinery" concept (fig. 1) for general pretreatment is of high importance for developing lignocellulosic materials for biogas and/or biorefinery platforms in large numbers in the coming 5-15 years [2].

2. Method

The potential of two types of lignocellulosic biomass have been mapped for the EU: straw from cereal production, and excess grass from both rotational and permanent grasslands and meadows [3]. The biomasses were mapped by using a geographical information system (GIS) and statistical data on the agricultural crop production from Eurostat [4]. The potential availability of these crops in 2030 were projected based on forecasts from Bruinsma (2012) [5].

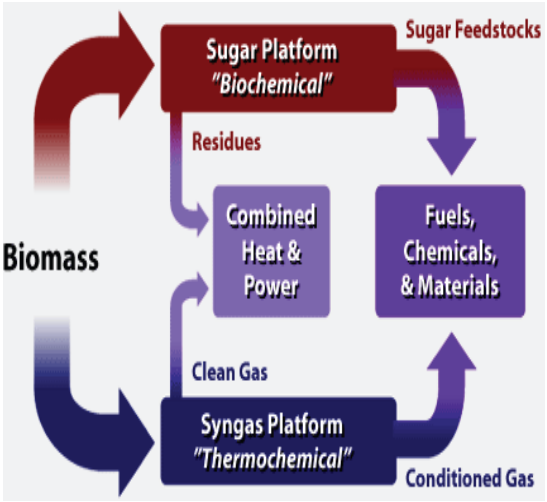

Figure 1. The "two-platform biorefinery concept [2]

3. Results

The projected area with cereal production in 2030 is illustrated in fig 2. In total 48.7 million ha is projected to be cultivated with cereal in Europe in 2030. The total energy yields from the potentially available straw from cereal production in Europe were estimated to range from 14.76 to 28.02 Mtoe. Considering that straw very often is treated as a waste or by- product with no or low agricultural use, the actual potential of straw in Europe could play a very significant role for the production of renewable energy if processed anaerobically or bio-technologically.

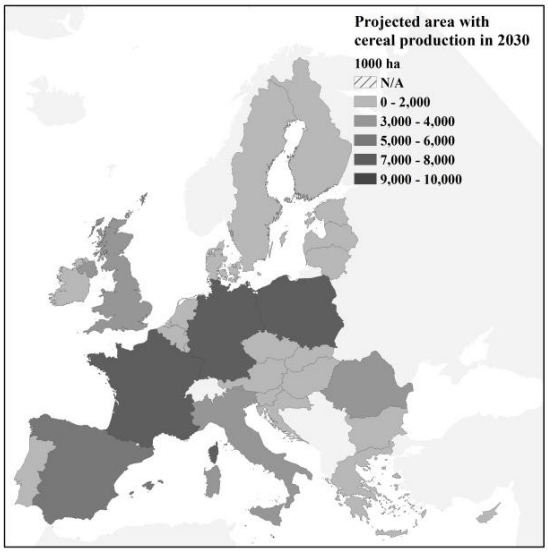

Figure 2. The projected area with cereal production in 2030.

The projected area with rotational grassland, permanent grassland and meadows are illustrated in fig 3 and fig 4.

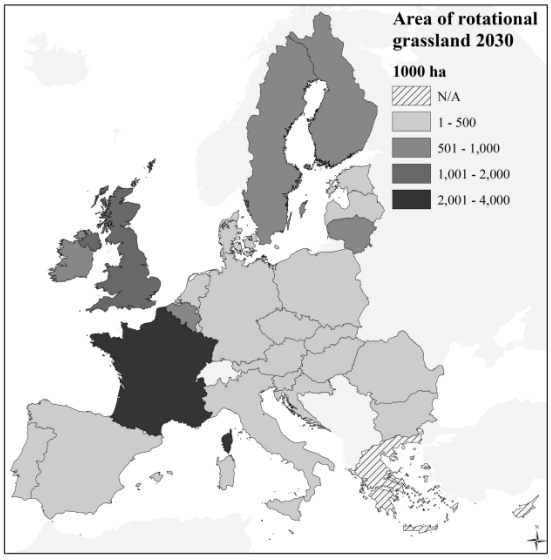

Figure 3. The projected area with rotational grassland in 2030.

In total more than 70 million ha of rotational grassland, permanent grassland and meadows is projected for Europe in 2030. The total energy yields from the potentially available grass from these areas in Europe were estimated to range from 3.7 to 18.0 Mtoe. Excess grass, and straw were found to be present in the majority of the member states, thus the utilisation of these resources is a possibility which could enhance the efficiency and economically feasibility of the bioenergy production, where the input consists of cheap carbon sources.

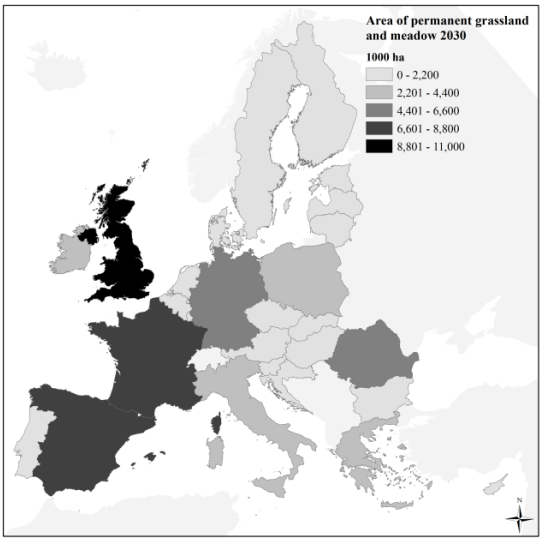

Figure 4. The projected area with permanent grassland and meadow in 2030.

5. Discussion & Conclusion

Two case examples of mechanical and/ or thermochemical pretreatment full scale solutions are presented at the IBBA workshop, Malmø, Sweden, September 2015. Both demonstration cases shows clearly that lignocellulosic biomass will play a significantly role in the future feedstock composition for biogas and biorefinery production to energy and materials. One example documents that 12-14 tons of Straw (Rye/Wheat) can fully replace 35-40 tons of whole crop maize silage. The other that hey, grass silage and straw can replace a large amount of organic waste from food industries, and keep the biogas production at high capacity

Lignocellulosic materials from agriculture and forestry biomasses, by-products and waste streams will play a major role in the biomass supply chain integrated with

animal manure. This way the European biogas production can be quadrupled in year 2030 on sustainable conditions compared to the biogas production these years, accounting for 15Mtoe of biogas.

6. References

[1] Holm-Nielsen J.B. & E.A.Ehimen (2014) Biorefinery plant design, engineering and process optimisation. In: Waldron K., Advances in Biorefineries – Biomass and Waste Supply Chain Exploitation. Woodhead Publishing series in Energy: number 53; 2014.

[2] NREL 2006, Biomass Program, DOE/US

[3] Meyer, A. K. P, Ehimen, E. A., Holm-Nielsen, J. B. The future of European biogas production – an outlook for 2030 focussing on sustainable biomass utilisation of animal manure, straw and grass. Submitted to Fuels, June 2015.

[4] Eurostat, 2015. Cattle population - annual data [apro_mt_lscatl], 2015, http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=apro_mt_lscatl&lang=en.

[5] European and Central Asian Agriculture Towards 2030 and 2050. Policy Studies on Rural Transition No. 2012-1, FAO Regional Office for Europe and Central Asia.