ADVANCE FUEL

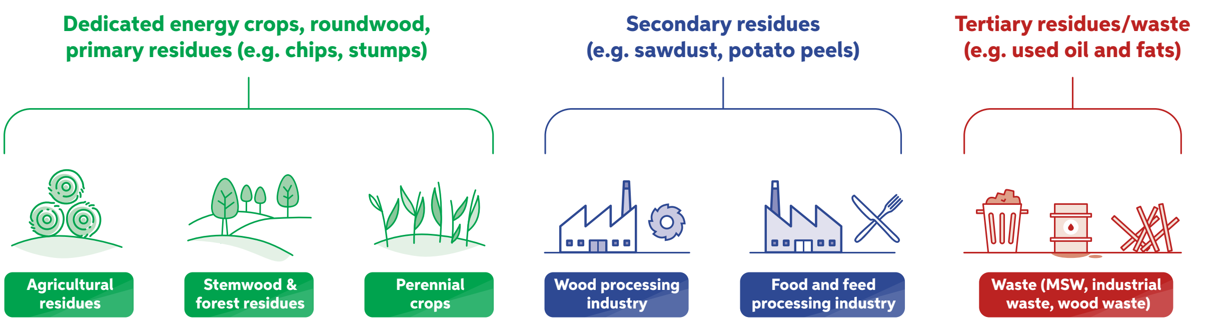
Energy crops and strengthening the potential of RESFuels

Context

Biomass is expected to play an essential role in sectors that are difficult to decarbonize. In the transport sector, the production of advanced liquid biofuels and other liquid renewable fuels – RESFuels – as a valuable strategy to meet greenhouse gas (GHG) emission reduction targets towards 2050 will require a substantial deployment from different biomass sources. However, current biomass production volumes are limited and far from meeting future bioenergy requirements. In addition, biomass production in the EU will have to comply with strict sustainability criteria, amongst others, from the recast Renewable Energy Directive (RED II). Of the many types of biomass available, lignocellulosic energy crops are of particular interest for the production of RESFuels (FIGURE 1).

This factsheet explores the role that lignocellulosic energy crops play in increasing RESFuels' contribution to GHG emissions reductions targets.

FIGURE 1. **FEEDSTOCK CATEGORIES**



Source: D2.1 Report on lignocellulosic feedstock availability p17.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N.°764799

Growing potential for lignocellulosic energy crops

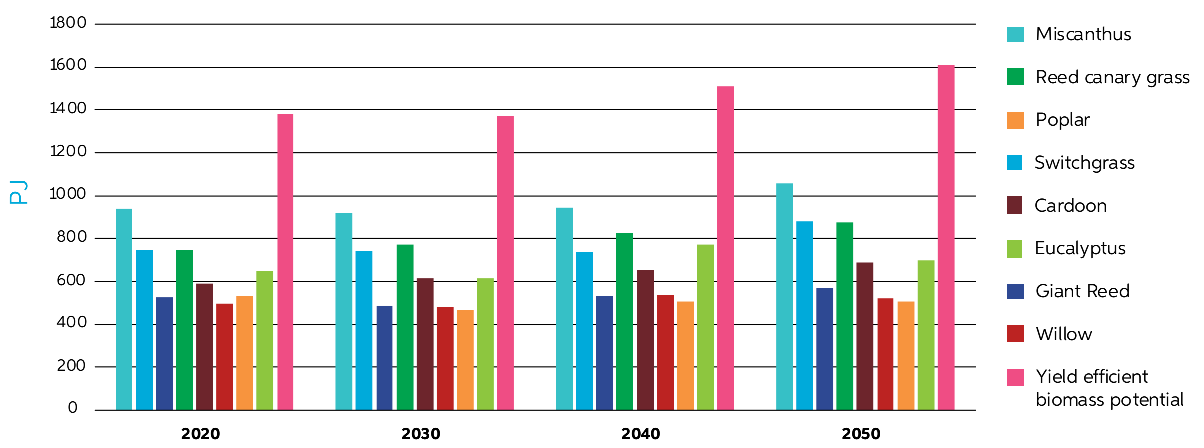
Lignocellulosic energy crops can be grown on unproductive or marginal lands[1], decreasing the risk of competing with food production while contributing to positive environmental impacts if cultivated under right conditions.

Land availability and sustainable land use are key for lignocellulosic energy crops production

ADVANCEFUEL estimates that by 2050 in 25 European countries in addition to the UK, 210,000 km² of marginal land can be allocated potentially for biomass production while meeting the land sustainability criteria of the RED II. However from the available land, approximately only 1/3 is projected to be suitable for lignocellulosic energy crop production. Still, extending biomass production to marginal lands could increase the available land proportion and at the same time reduce GHG emissions related to land-use change.

Estimated biomass potentials on this land are projected to be highest for grassy lignocellulosic crops such as Miscanthus and Switchgrass. Both with an estimated individual potential of 1,050,000 and 880,000 PJ for 2050. When including for each potential production site the crop with the highest attainable yield under local conditions, the biomass potential increases up to 1,610 PJ in 2050 (FIGURE 2). In 2017, gross inland consumption of bioenergy was at 6,033 PJ, from which 1,089 PJ were supplied from agriculture (Bioenergy Europe 2019). Accordingly, the use of marginal lands for biomass production appears as a valuable strategy to increase biomass supply for bioenergy purposes. However, achievable yields from marginal lands can be lower when compared to common agricultural land if no fertilizer is applied. But the magnitude of this effect is uncertain as only a few trial studies have been performed on marginal lands.

FIGURE 2. **BIOMASS POTENTIALS FOR LIGNOCELLULOSIC ENERGY CROPS**



Biomass potentials for lignocellulosic energy crops (all available land is allocated to one crop) and yield efficient biomass potential (for each location the crop with highest potential biomass yield is selected) in the EU28 for 2020, 2030, 2040 and 2050.

1 MAGIC defines marginal lands as: "lands having limitations which in aggregate are severe for sustained application of a given use and/or are sensitive to land degradation, as a result of inappropriate human intervention, and/or have lost already part or all of their productive capacity" (Elbersen et al., 2017)

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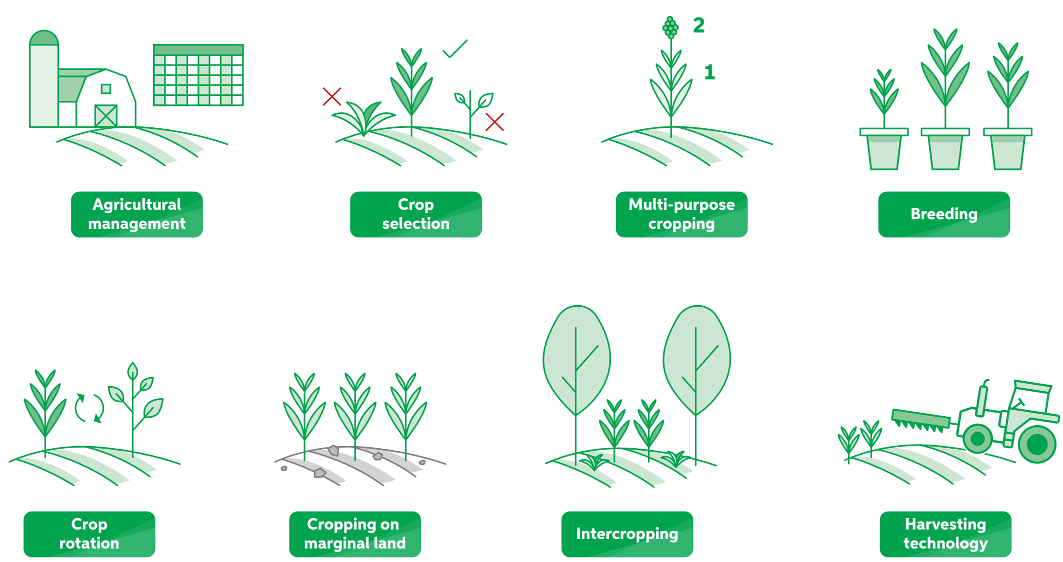
Implementing innovative cropping schemes

The feedstock supply of lignocellulosic crops can be enhanced by extending the cropping area of sustainable biomass production or by increasing achievable yields. Yield increases can potentially be achieved by innovative cropping systems. Several fields of innovation regarding lignocellulosic crop production have been studied in past and running EU projects (FIGURE 3). While some of them have the potential to increase yields through breeding, crop selection, and agricultural management, there is not one strategy that leads to substantial increase of yields. But it is expected that yield increase over time, can be achieved through a combination of an increase of technical solutions (breeding, harvesting) and of knowledge (agricultural management, crop selection, crop rotation, intercropping) to establish the most suitable cropping scheme and varieties per site.

FIGURE 3. **FIELDS OF INNOVATIONS**



Source: D2.2 Innovative cropping schemes for lignocellulosic feedstock production

The importance of location

Feedstock-specific yields and biomass potential are largely driven by crop phenological characteristics and local biophysical conditions. The strong variability on biophysical conditions within Europe results in different yields within and between countries. The importance of considering location-specific characteristics becomes apparent for the potential production of lignocellulosic energy crops in order to meet bioenergy demand and thus contribute to more sustainable supply chains with the aim of reducing GHG emissions for a more sustainable Europe (Figure 4).

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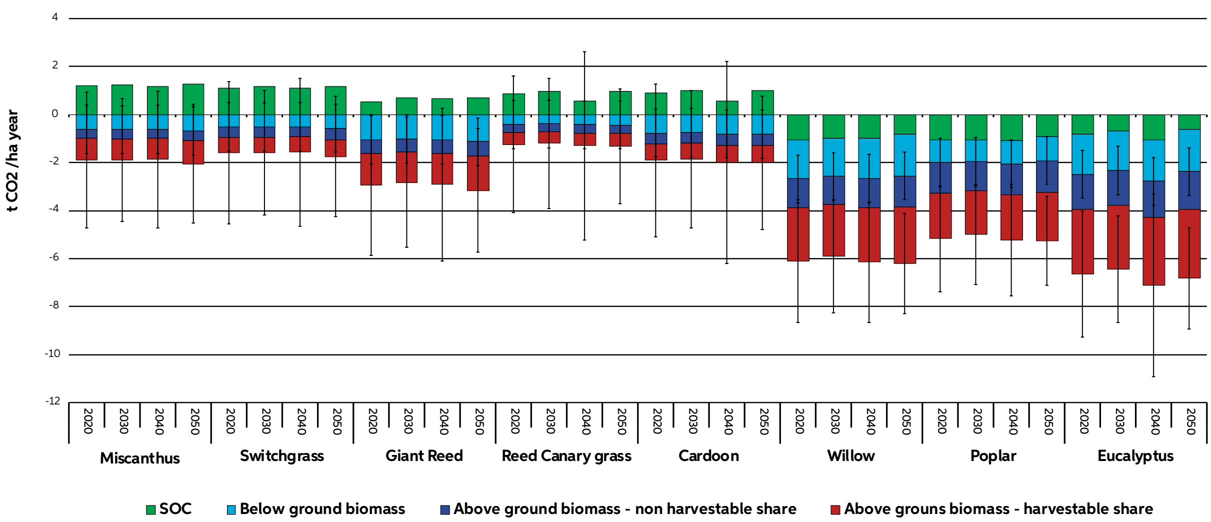
Many biomass sources are available but require substantial efforts before they are readily available. The use of marginal lands for lignocellulosic energy crop production is a valuable strategy to cover to some extent biomass demand that also requires efforts in the development of infrastructure, farming experience, regulatory compliance and support, as well as enabling sustainable biomass production in the EU under RED II sustainability criteria and incorporate innovative cropping schemes. Smart choices on location and crop type for lignocellulosic energy crop production can be made to enable sustainable biomass production in Europe under RED II sustainability criteria.

FIGURE 4. **AVERAGE LUC RELATED GHG EMISSIONS WITH TWO STANDARD DEVIATIONS FOR THE CULTIVATION OF EACH LIGNOCELLULOSIC ENERGY CROPS ON MARGINAL LAND T IN EUROPE FOR 2020, 2030, 2040 AND 2050**



Average LUC related GHG emissions with two standard deviations for the cultivation of each lignocellulosic energy crops on marginal land t in Europe for 2020, 2030, 2040 and 2050. The ranges indicate the spatial variability of LUC GHG emissions due to the heterogeneity in biophysical conditions.

For more information, visit:
[Supply potential, suitability and status of lignocellulosic feedstocks for advanced biofuels (D 2.1)]
[Innovative cropping schemes for lignocellulosic feedstock production (D2.2).]
[Regional Specific Impacts of Biomass Feedstock Sustainability (D4.3).]

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