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Sustainable biomass supply in the context of new bio-based markets beyond 2030

Thursday 21 November 2019, RESfuels in transport sector decarbonisation

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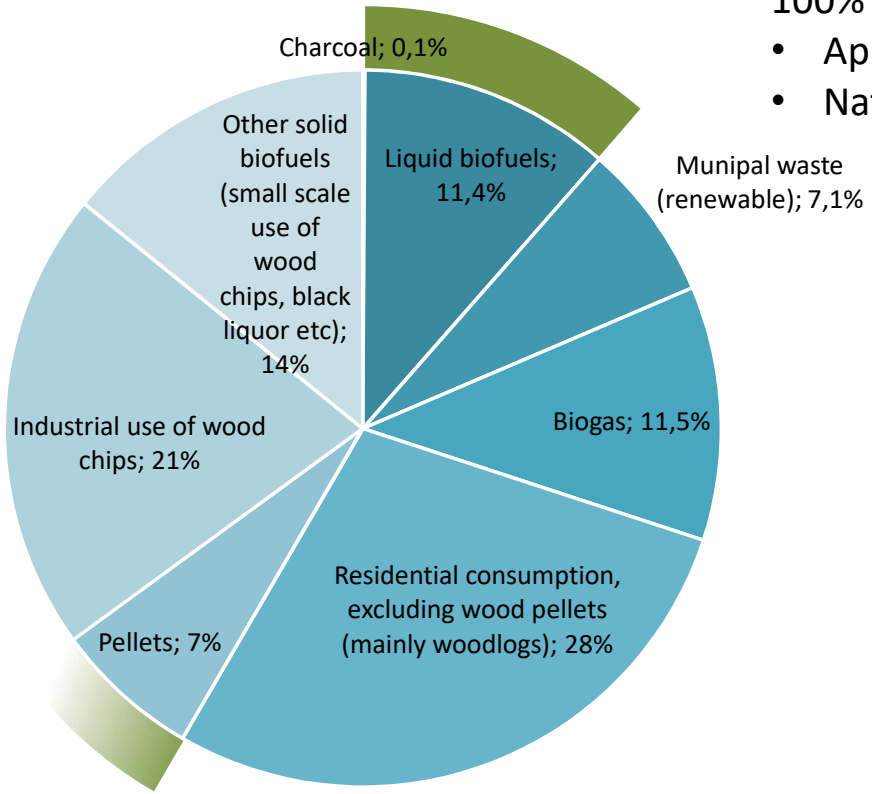
Content

- Current biomass demand
- Future outlook beyond 2030
- Do we have sufficient biomass?
- The role of dedicated energy crops

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

Biomass consumption in the EU28 (2015) and sustainability criteria

- Gross inland consumption of biomass for bioenergy has increased to 136 Mtoe (5.7 EJ) by 2015
- About 70% of biomass is supplied from forest sources and used in heat and power sectors.
- Liquid biofuels used in transport are still almost entirely produced from food and feed based crops and residues.



100% RED compliant, through:

- Approved voluntary schemes
- National legislation

National sustainability criteria / voluntary certification in EU member states that import industrial wood pellets (e.g. UK RO, NL SDE+)

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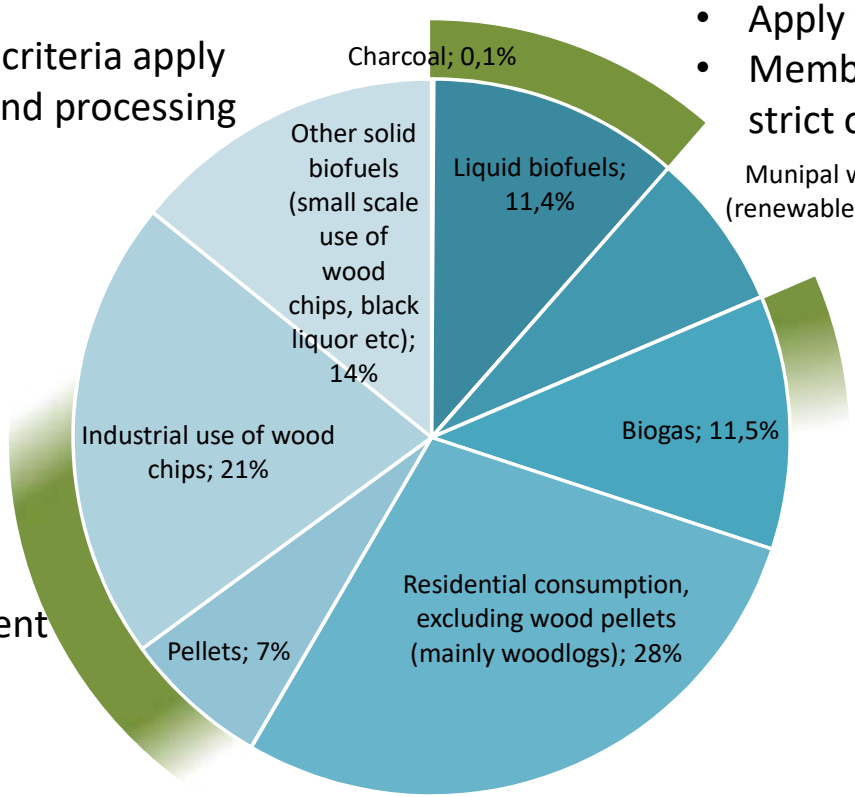
AEBIOM 2018

The revised Renewable Energy Directive (RED II) increases the coverage of sustainability criteria to all bioenergy sectors and includes new criteria to forest and agricultural biomass

- Apply to all biofuels/bioliquids
- Member states are not allowed to add more strict or additional criteria

Only GHG criteria apply to waste and processing residues



Biogas installations => 0.5 MW (fuel capacity)

Solid biomass installations => 20 MW (fuel capacities), 12% of current installations (75% of chips/pellet consumption)

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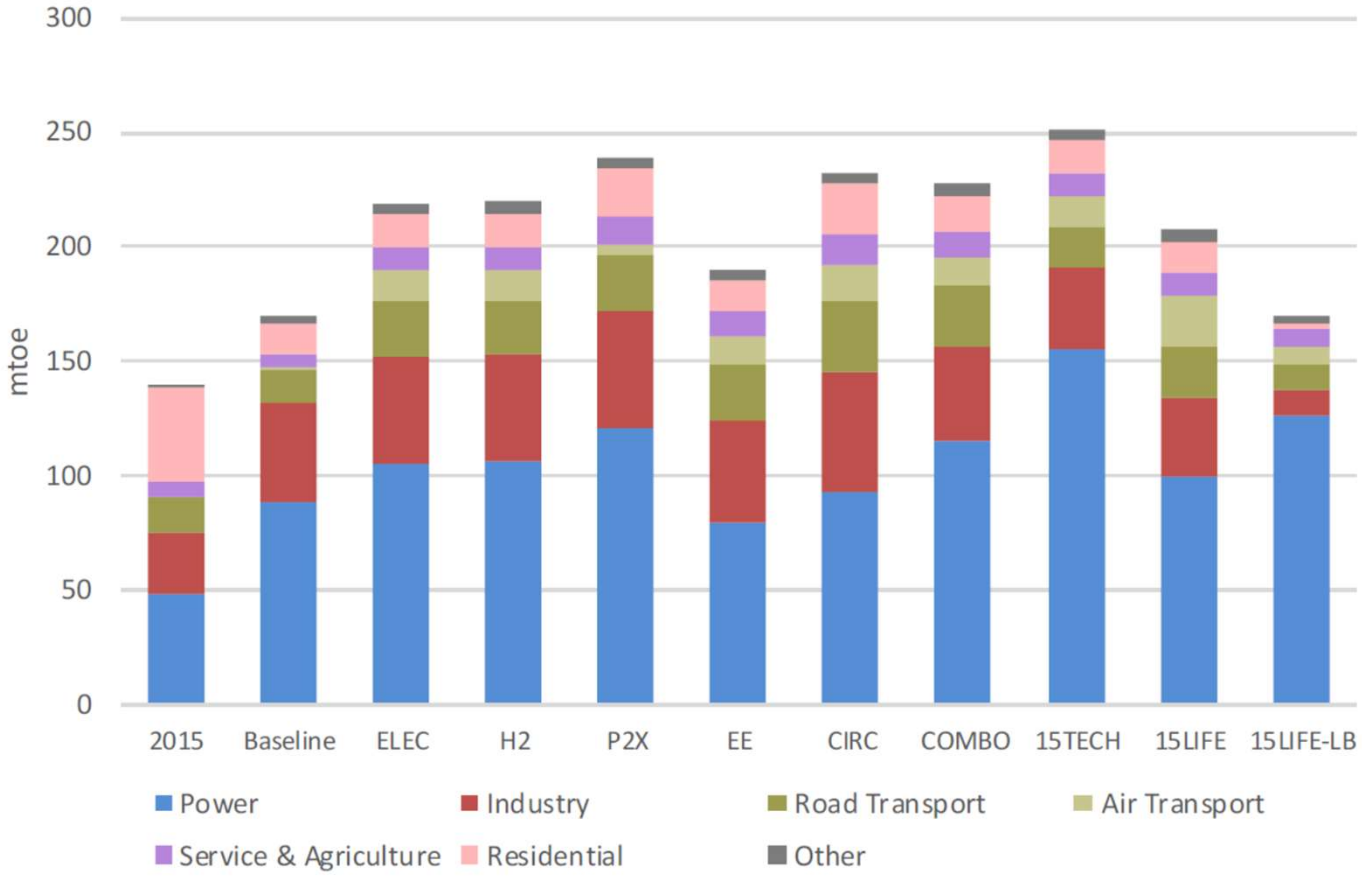
AEBIOM 2018

EU bioenergy use might increase to 190 – 250 Mtoe (7.9 – 10.5 EJ) according to the EC Long Term Strategy scenarios

A decrease in residential sectors (currently 28%)
But also a sharp increase in:

- Industrial use (power, high temperature heat)
- All transport sectors (road, shipping and aviation (>20% in all scenarios)
- And requires a rapid scale-up of advanced biofuel production beyond 2030



Source: EC Long Term Strategy (2018)

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Feedstock supply by 2050 according to the EC Long Term Strategy scenarios

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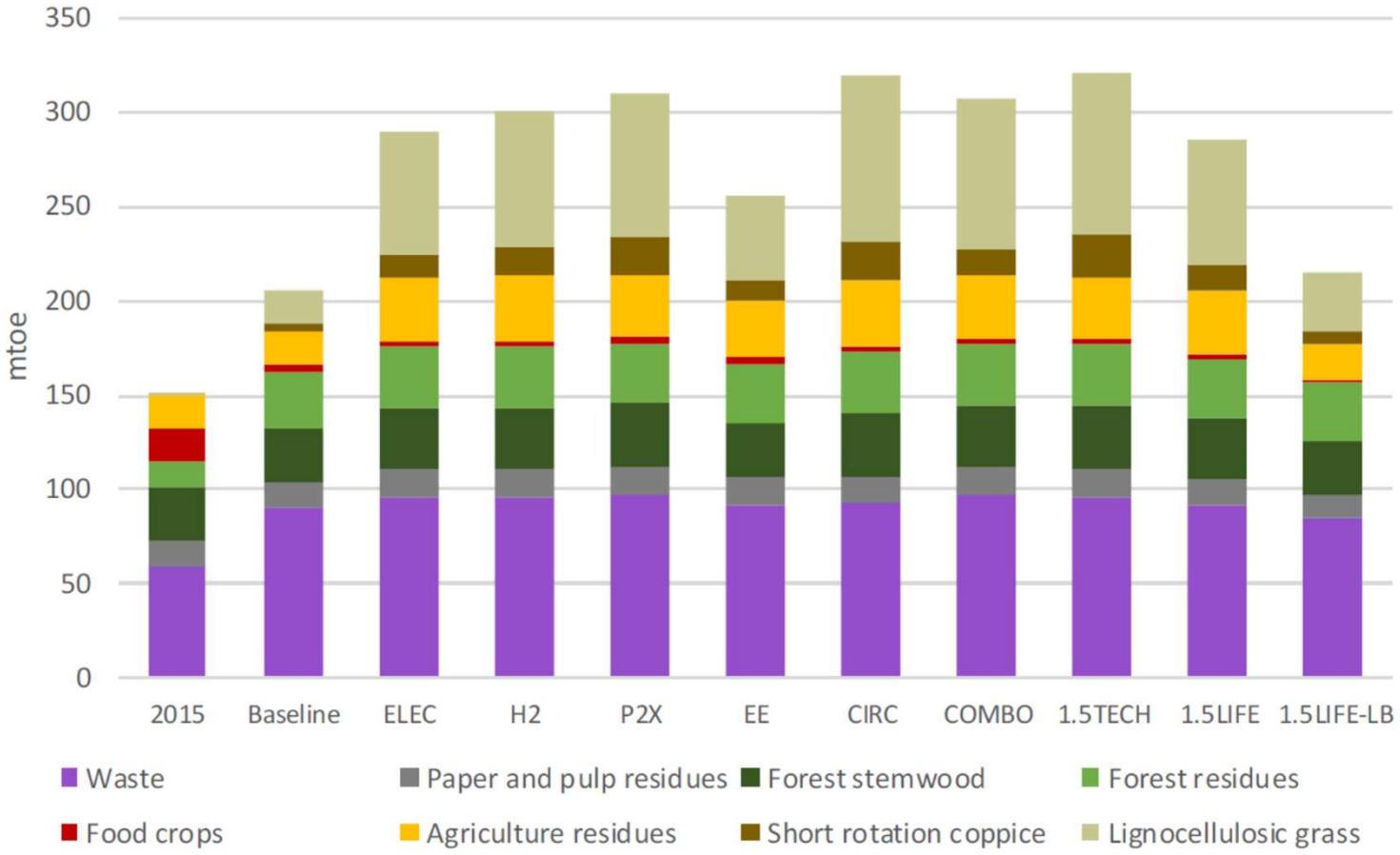
- Stemwood is projected to remain constant
- Forest residues and agriculture residues could increase still to sustainable levels
- But the largest growth is expected in lignocellulosic energy crops (mainly grasses) are projected to supply between 38 – 108 Mtoe
- And with up to 29 Mha of land use to cultivate these crops (currently ~90 000 ha)



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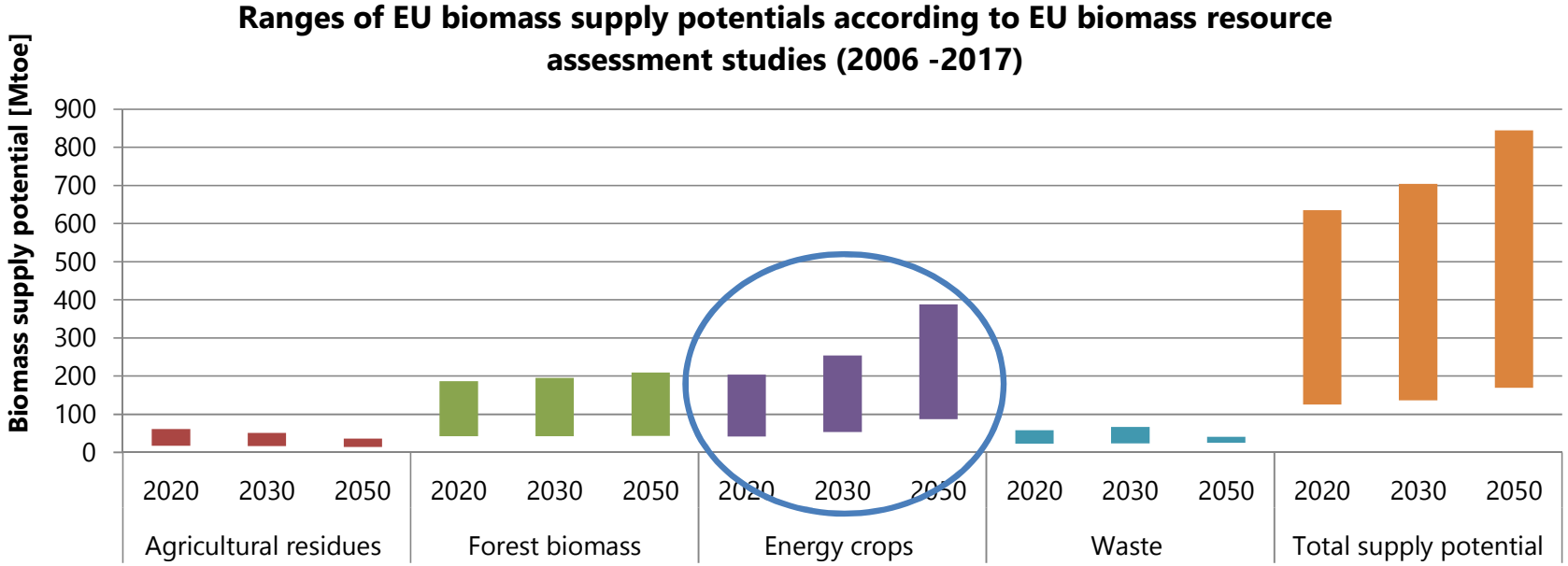
Do we have sufficient sustainable biomass to meet future demands?

- Forest biomass (stemwood and residues) and energy crops (food based and perennial crops) are the largest sources of biomass
- But potentially available does not mean readily available to produce bioenergy at commercial scales.
- And depends also on the sustainability criteria that are applied (risk adverse/back off versus resource driven)
- Projections thus rely heavily on biomass sources that are currently not mobilized (wastes and residues) or not cultivated at large scale (lignocellulosic energy crops including short rotation woody crops and grasses)



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A translation of RED II sustainability criteria to bioenergy supply from lignocellulosic energy crops in the ADVANCEFUEL project (ongoing work)

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RED II Scenario: sustainability criteria

- Exclusions of Natura 2000/protected areas
- Exclusion of High Nature Value farmland (HNVf)
- Exclusion of high carbon stock areas
- Exclusion of wetlands and peatlands
- Exclusion of natural grasslands
- Only use of surplus/abandoned agricultural
- Marginal land: as established in MAGIC

Article 29

Sustainability and greenhouse gas emissions saving criteria for biofuels, bioliquids and biomass fuels

3. Biofuels, bioliquids and biomass fuels produced from agricultural biomass taken into account for the purposes referred to in points (a), (b) and (c) of the first subparagraph of paragraph 1 shall not be made from raw material obtained from land with a high biodiversity value, namely land that had one of the following statuses in or after January 2008, whether or not the land continues to have that status:

(a) primary forest and other wooded land, namely forest and other wooded land of native species where there is no clearly visible indication of human activity and the ecological processes are not significantly disturbed;

(b) highly biodiverse forest and other wooded land which is species-rich and not degraded, or has been identified as being highly biodiverse by the relevant competent authority, unless evidence is provided that the production of that raw material did not interfere with those nature protection purposes;

(c) areas designated:

(i) by law or by the relevant competent authority for nature protection purposes; or

(ii) for the protection of rare, threatened or endangered ecosystems or species recognised by international agreements or included in lists drawn up by intergovernmental organisations or the International Union for the Conservation of Nature, subject to their recognition in accordance with the first subparagraph of Article 30(4),

unless evidence is provided that the production of that raw material did not interfere with those nature protection purposes;

(d) highly biodiverse grassland spanning more than one hectare that is:

(i) natural, namely grassland that would remain grassland in the absence of human intervention and that maintains the natural species composition and ecological characteristics and processes; or

(ii) non-natural, namely grassland that would cease to be grassland in the absence of human intervention and that is species-rich and not degraded and has been identified as being highly biodiverse by the relevant competent authority, unless evidence is provided that the harvesting of the raw material is necessary to preserve its status as highly biodiverse grassland.

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RED II: sustainability criteria

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4. Biofuels, bioliquids and biomass fuels produced from agricultural biomass taken into account for the purposes referred to in points (a), (b) and (c) of the first subparagraph of paragraph 1 shall not be made from raw material obtained from land with high-carbon stock, namely land that had one of the following statuses in January 2008 and no longer has that status:

(a) wetlands, namely land that is covered with or saturated by water permanently or for a significant part of the year;

(b) continuously forested areas, namely land spanning more than one hectare with trees higher than five metres and a canopy cover of more than 30 %, or trees able to reach those thresholds *in situ*;

(c) land spanning more than one hectare with trees higher than five metres and a canopy cover of between 10 % and 30 %, or trees able to reach those thresholds *in situ*, unless evidence is provided that the carbon stock of the area before and after conversion is such that, when the methodology laid down in Part C of Annex V is applied, the conditions laid down in paragraph 10 of this Article would be fulfilled.

This paragraph shall not apply if, at the time the raw material was obtained, the land had the same status as it had in January 2008.

5. Biofuels, bioliquids and biomass fuels produced from agricultural biomass taken into account for the purposes referred to in points (a), (b) and (c) of the first subparagraph of paragraph 1 shall not be made from raw material obtained from land that was peatland in January 2008, unless evidence is provided that the cultivation and harvesting of that raw material does not involve drainage of previously undrained soil.

.....Indirect land-use change occurs when the cultivation of crops for biofuels, bioliquids and biomass fuels displaces traditional production of crops for food and feed purposes. Such additional demand increases the pressure on land and can lead to the extension of agricultural land into areas with high-carbon stock, such as forests, wetlands and peatland, causing additional greenhouse gas emissions.

.....The restoration of land that has been severely degraded and therefore cannot otherwise be used for agricultural purposes is a way of increasing the amount of land available for cultivation.

Special attention

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Example: exclusion of high biodiverse and other

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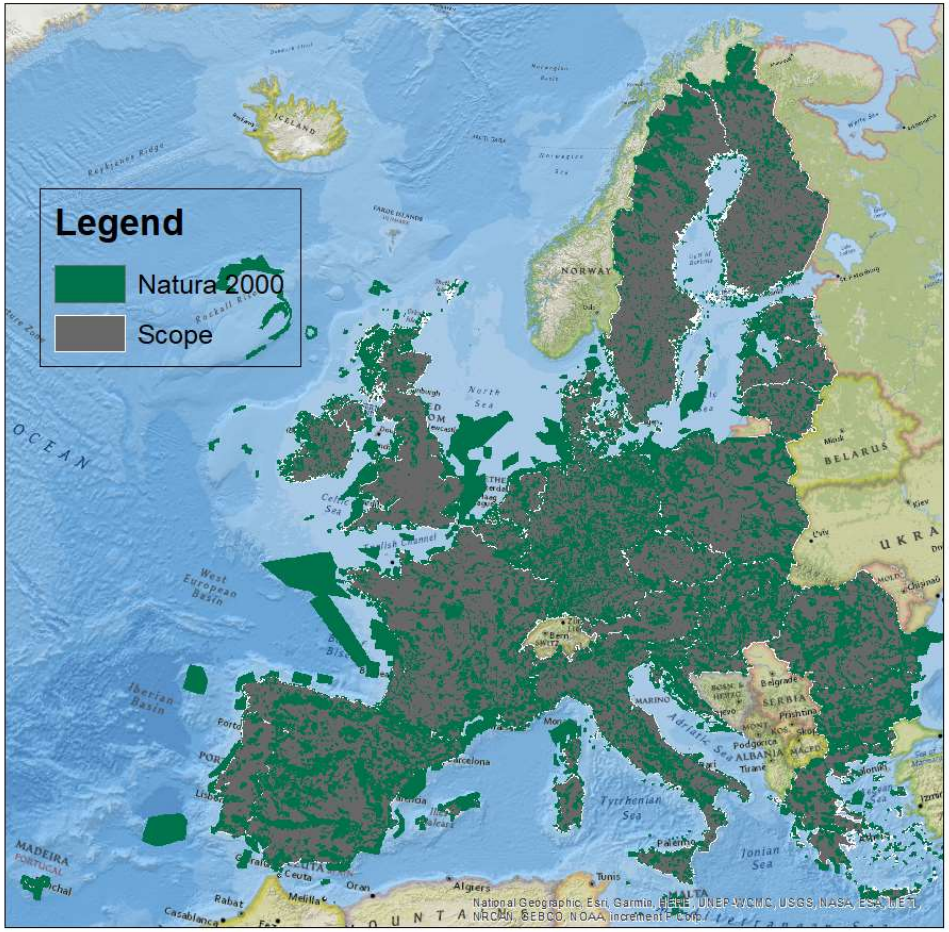

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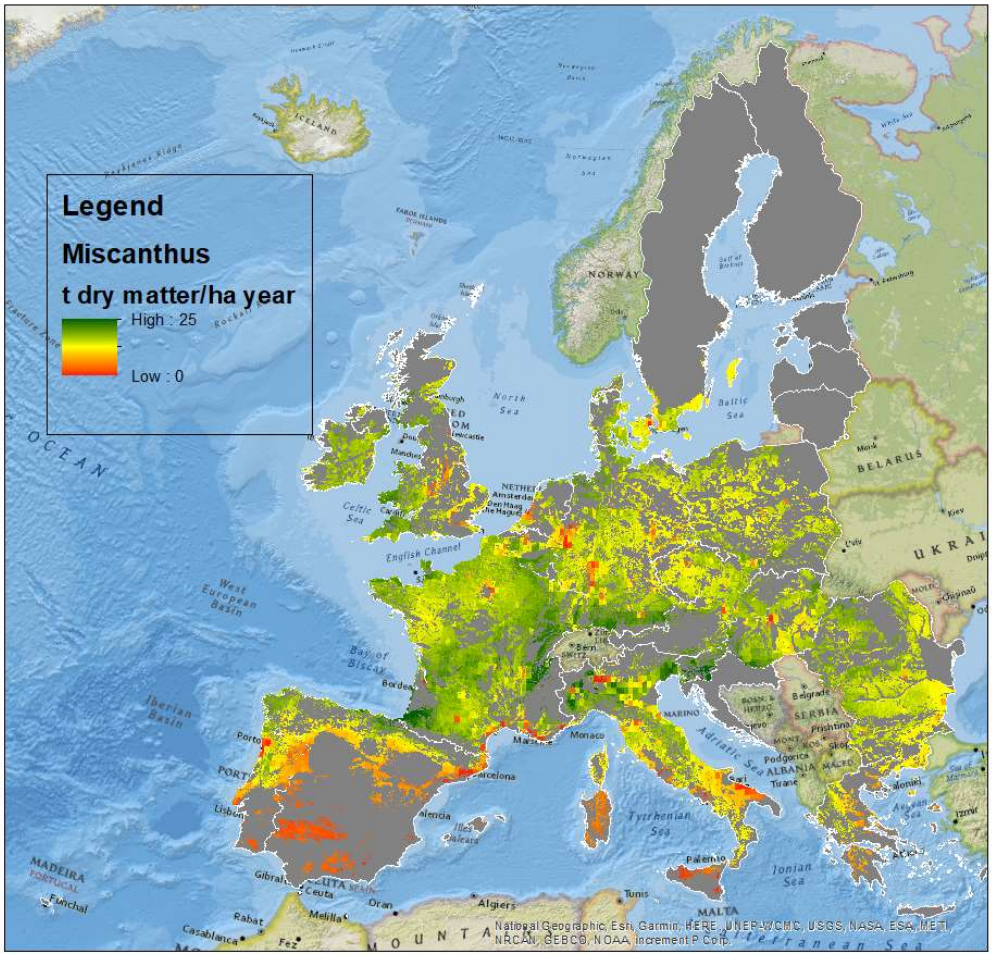
Crop specific biomass potential (dry biomass/ha year)

Energy crops biomass
Miscanthus
Switchgrass
Gian reed
Reed canary grass
Cardoon
Willow
Poplar
Eucalyptus

$$TB = (ABs * BGr) + ABs)$$

Total biomass production for specific crop suitability (spatially explicit)



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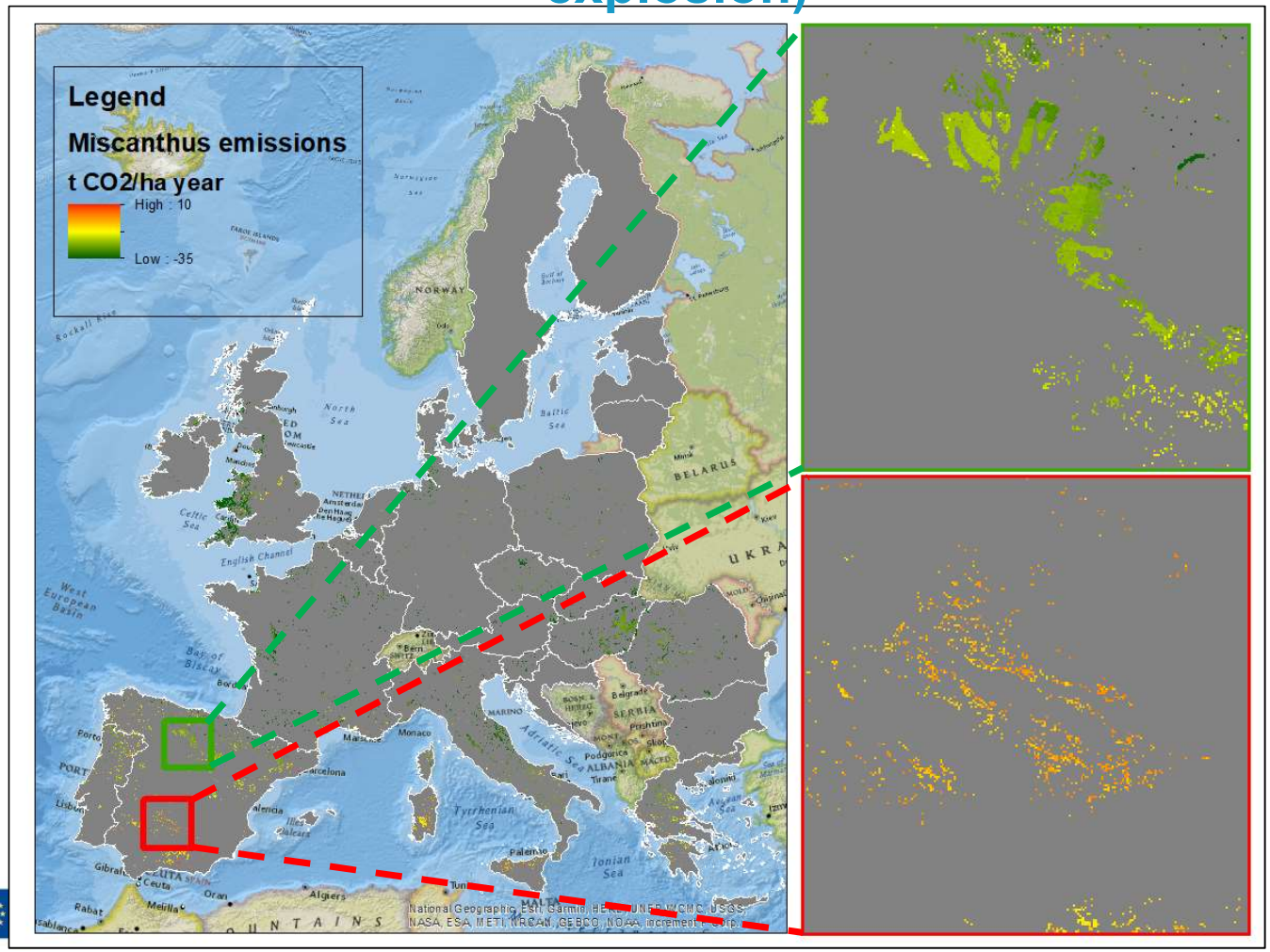
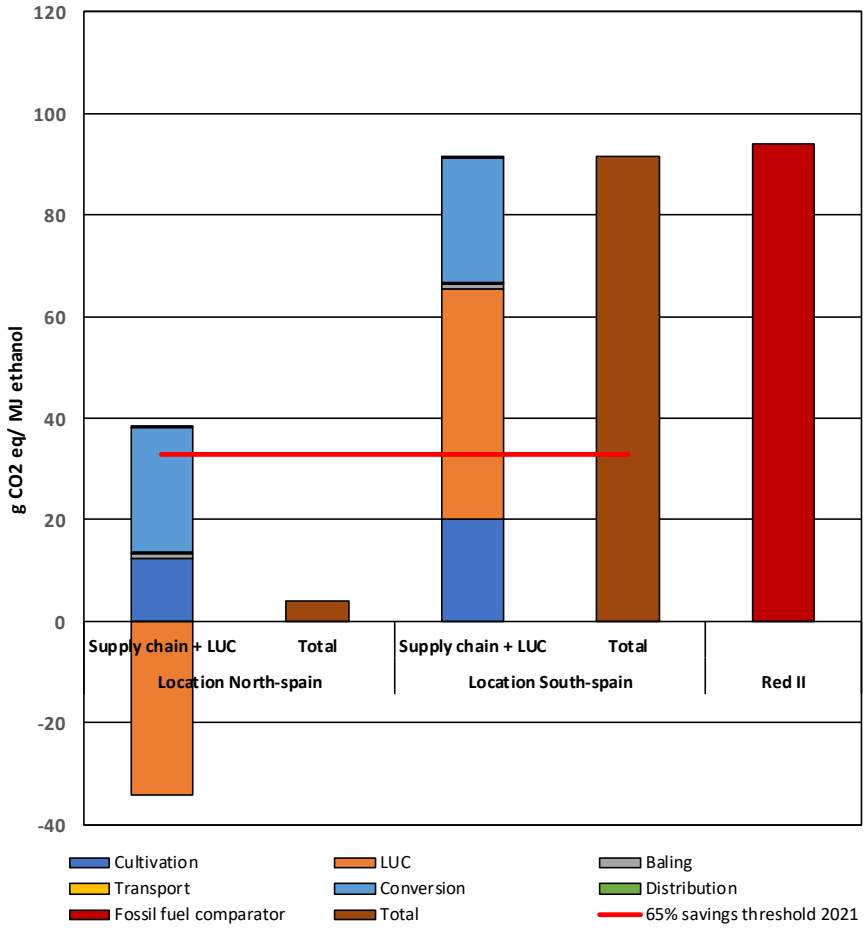
Example: Miscanthus to ethanol (via steam explosion)



- We calculated the supply chain GHG emissions for two different locations
- For the North-Spain location, LUC GHG emissions are calculated to be – 23,2 t CO2/ha year
- For the South-Spain location, LUC GHG emissions are calculated to be 2,33 t CO2/ha year
- Other parameters such as conversion and transport are calculated with standard values (JRC) and are constant between the two locations

Example: Miscanthus to ethanol (steam explosion), 2



- GHG emissions (in g CO2eq / MJ of ethanol) are strongly driven by LUC emissions and attainable yield on each location
- Other processes different from cultivation, conversion and LUC contribute little to the total supply chain GHG emissions
- The difference in yields between the locations determines higher GHG emissions for the cultivation stage in the South-Spain location (comparable lower yields than in North-Spain)
- When calculating the whole GHG emissions from both supply chains, only the one located in North-Spain is able to comply with RED II GHG saving criteria.
- This example is done to indicate the variation in GHG emissions and influence on RED II compliance.

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Conclusions

- **Bioenergy demand in the EU could still grow substantially in the future, in particular lignocellulosic (solid) biomass demand used for advanced biofuels in climate scenarios beyond 2030**
- **Many biomass sources are potentially available still, but require substantial efforts before they are readily available to produce advanced biofuels at commercial scale**
- **These efforts includes the development of infrastructure, farmers experience, regulatory compliance and support, as well as an effective sustainability tailored to the characteristics of advanced biofuels**

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Thank you for your attention!

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Lignocellulsic energy crops

Short rotation coppice (willow, poplar, eucalyptus) and herbaceous/grassy crops (miscanthus, switchgrass etc)

- 30 years of experience in Europe (with introduction of set-aside in CAP policy in 1988)
- Area of cultivation is however still limited (0.05% of the utilised agricultural area in the EU28)
  - SRC: 68 200 ha
  - Miscanthus: 21 800 ha
- Not competitive with food/feed when cultivated on productive lands (poor cashflow for farmers)
- Could give higher yields on low productive land compared to annual crops
- Not competitive with domestic and imported forest biomass (chips/pellets)
- Lack of skills and infrastructure (growers are often isolated and special machinery and infrastructure need economies of scale)
- Long term commitment is required
- Experience with bioenergy is limited to electricity (e.g. DRAX in the UK) and heat (e.g. district heating and CHP in Sweden)
- The current market is static, but the introduction of SRC as an Ecological Focus Area (EFA) in the CAP could stimulate production (adopted by Germany, Ireland, Poland and Sweden).

Sources: Lindegaard et al (2016) – Short rotation plantations policy history in Europe: lessons from the past and recommendations for the futrue, Food and Energy security 2016;5(3)125-152

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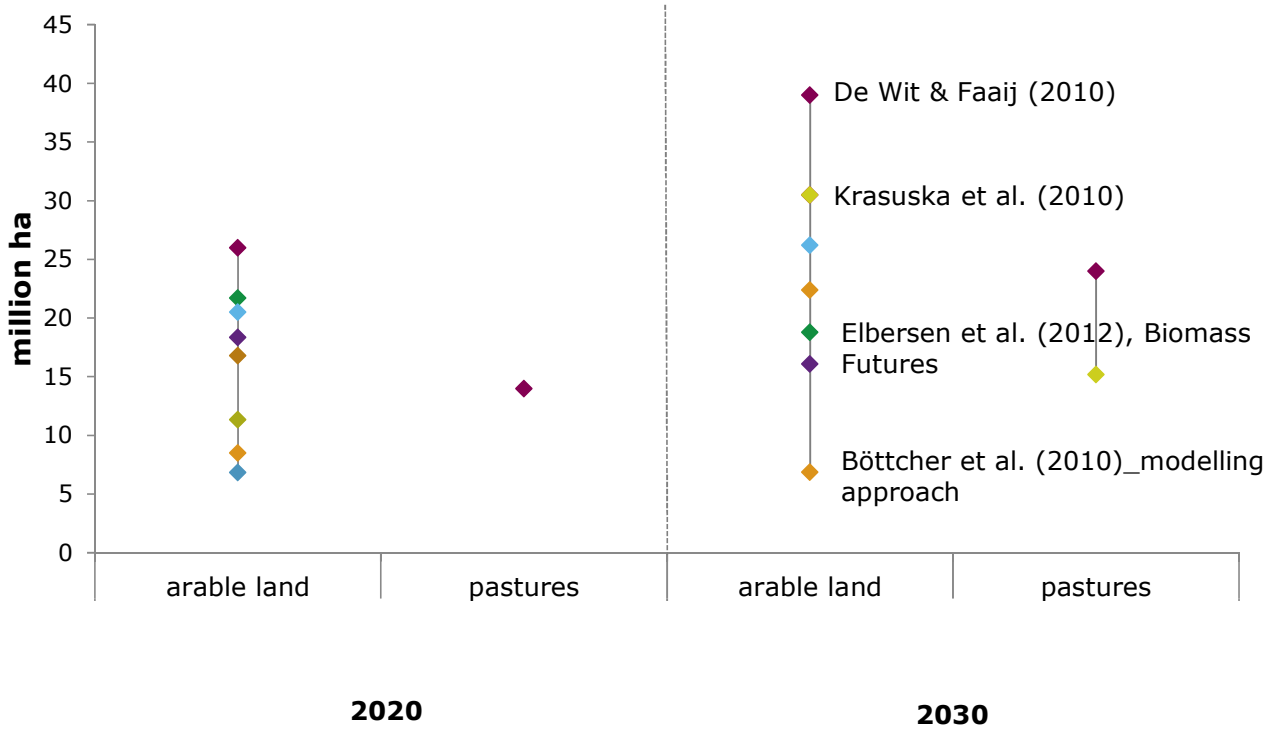
Future land availability for energy cropping is well above the estimated scale up



- 107 Mha of arable land and 59 Mha of pastures, 12 Mha of permanent crops in EU-28 in 2015

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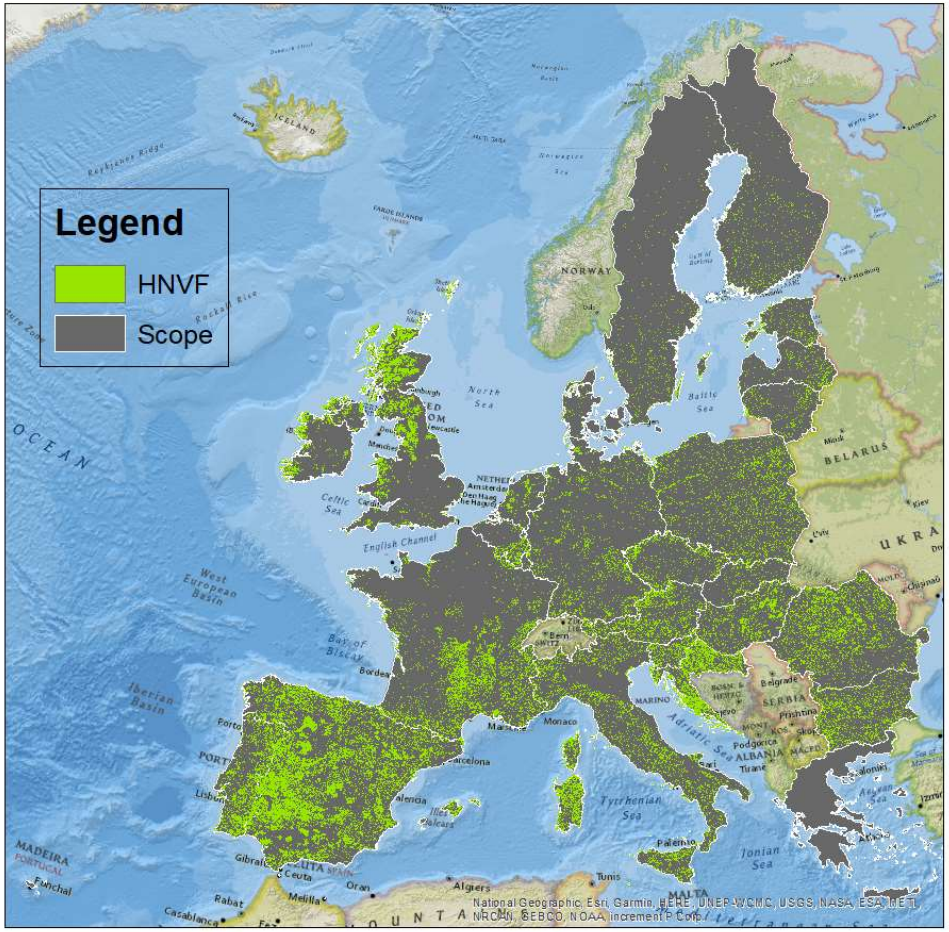

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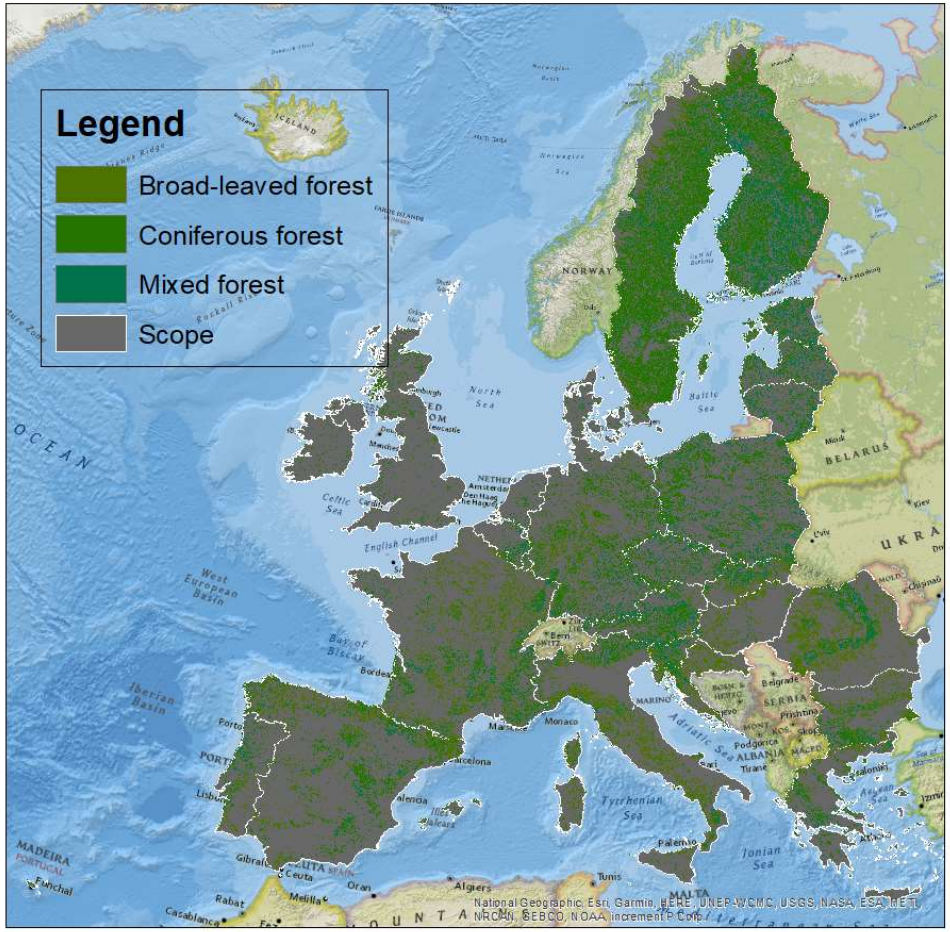

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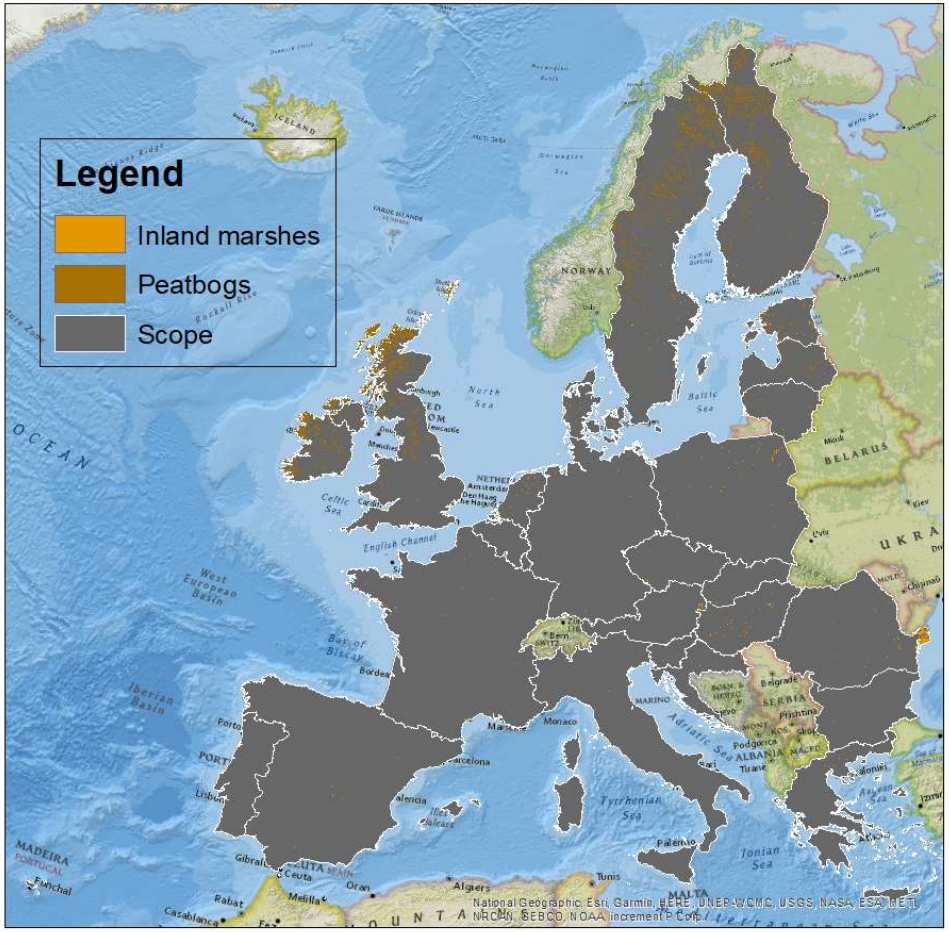

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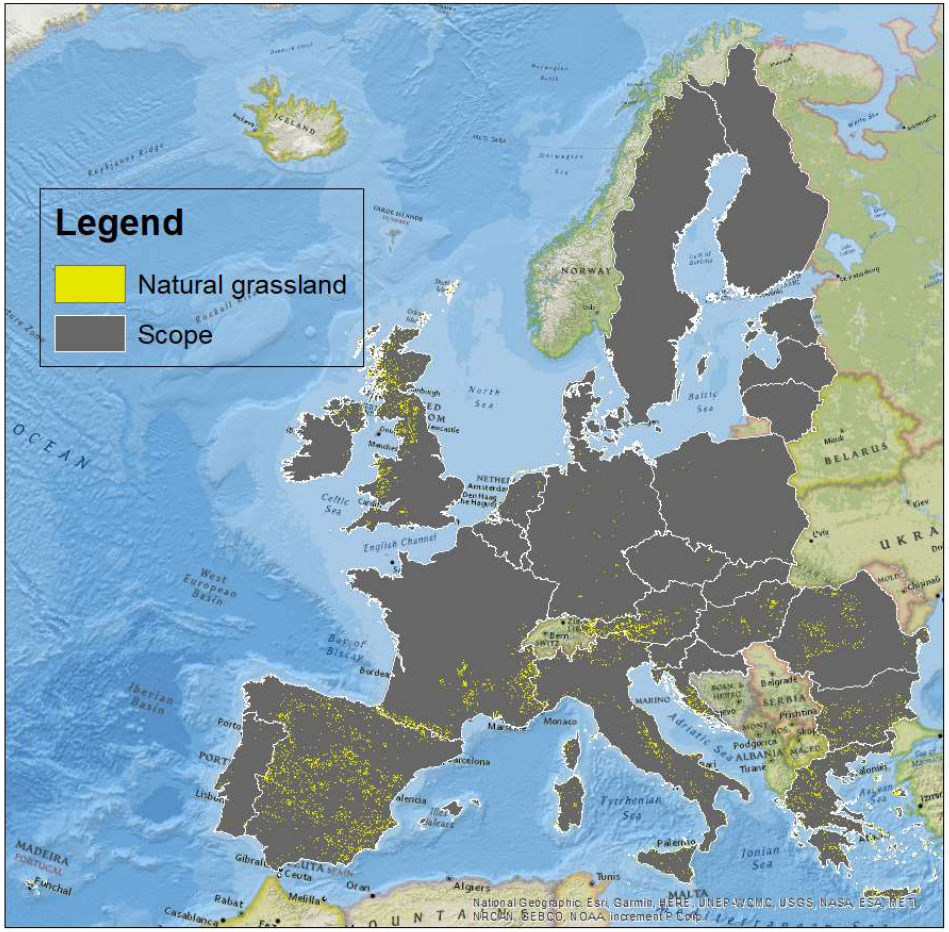

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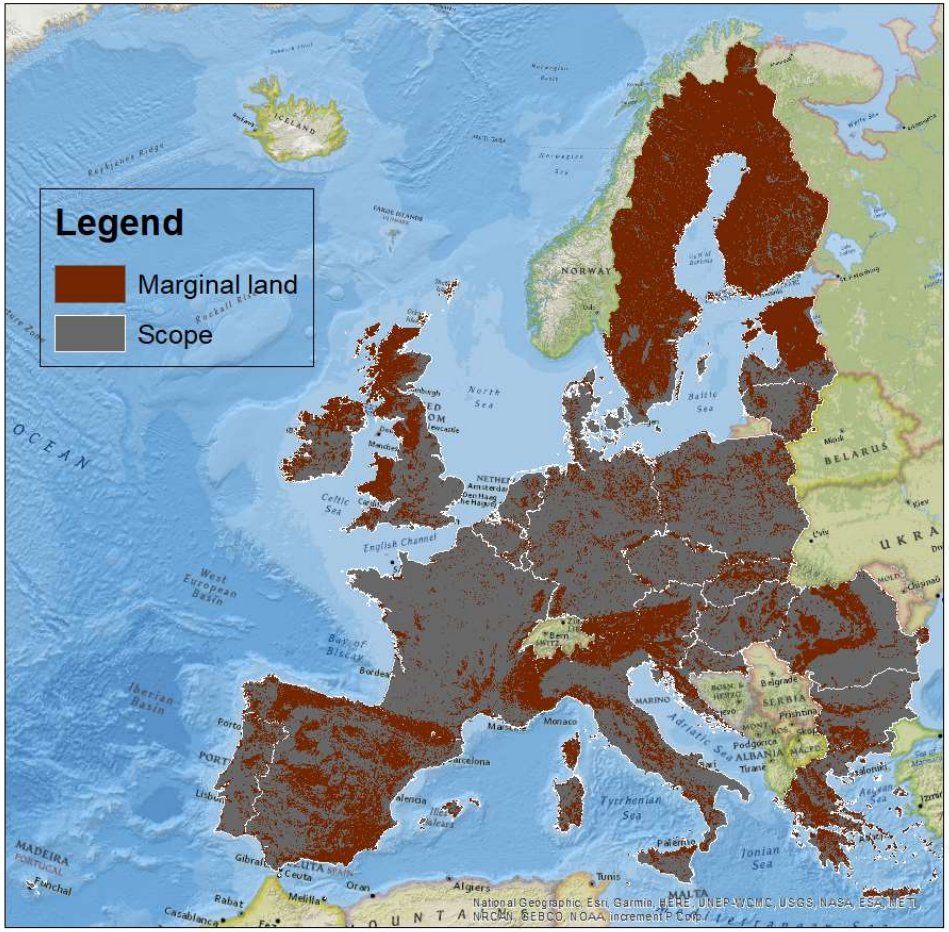

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