

Biomass feedstocks for composite manufacturing

Centre for Sustainability
Leiden-Delft-Erasmus Universities

AIRBUS



The Challenge

"Enabling Sustainable Composites: Uncovering Promising Biomass Sources for Carbon-Reinforced Composites in Aviation?"

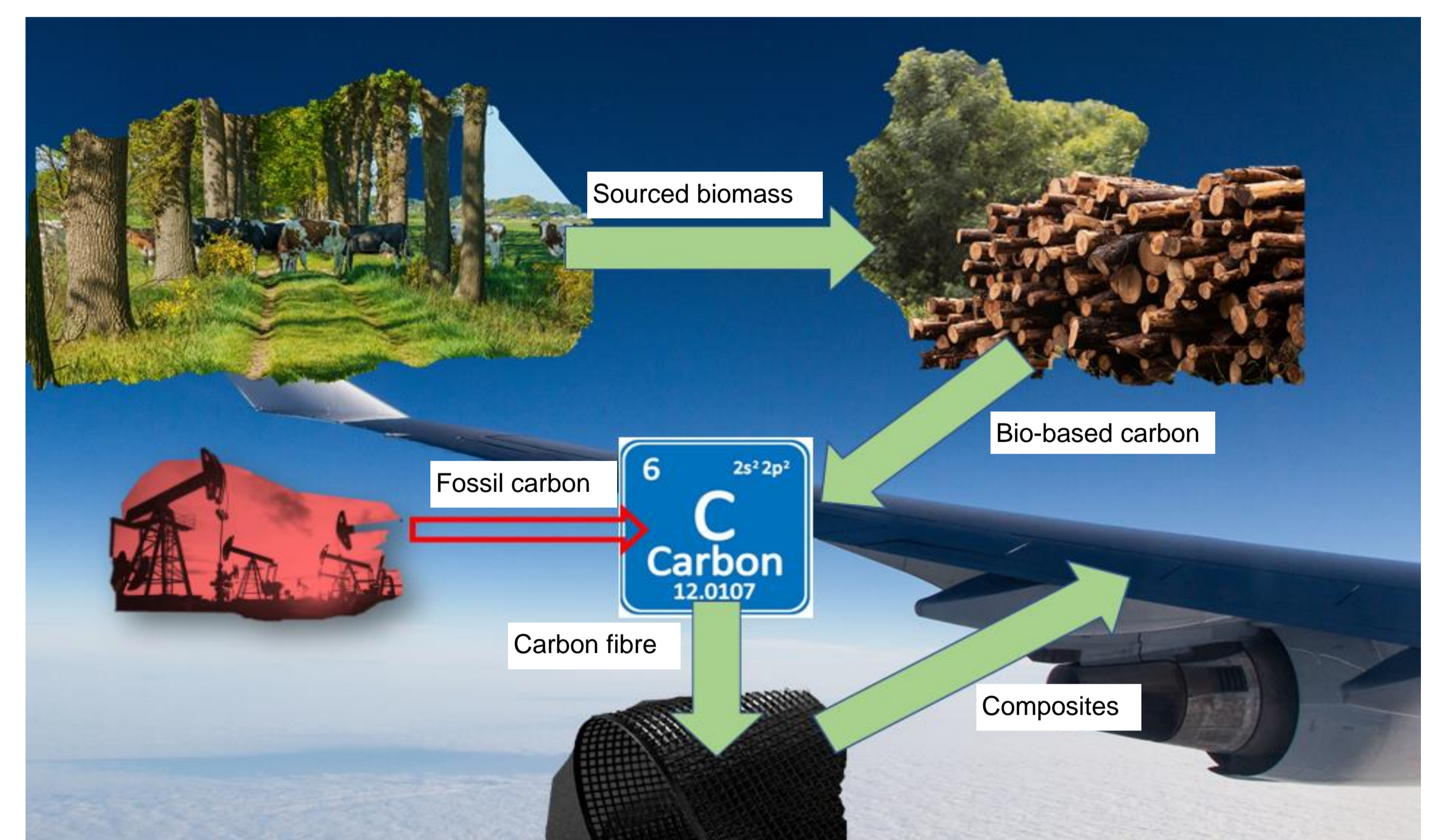
Biomass for composite manufacturing

Moving away from fossil fuel based composites

- Composites are key to achieve reductions in: weight-fuel-emissions
- Composites' carbon fibres (CFs) are manufactured from fossil fuel feedstocks
- A sustainable use of composites needs to phase out the use of fossil fuels

Biomass carbon precursors: same performance higher sustainability

- The substitution of CFs with natural or recycled fibres is not feasible today
- The use of biomass as a chemical precursor for CFs reduce the environmental impact and maintains the properties of the CFs
- Gasification of biomass for the production of CF precursor (ACN), is today the most promising pathway regarding from a technical and environmental perspective



A new Bioeconomy

Biomass sourcing is not always sustainable

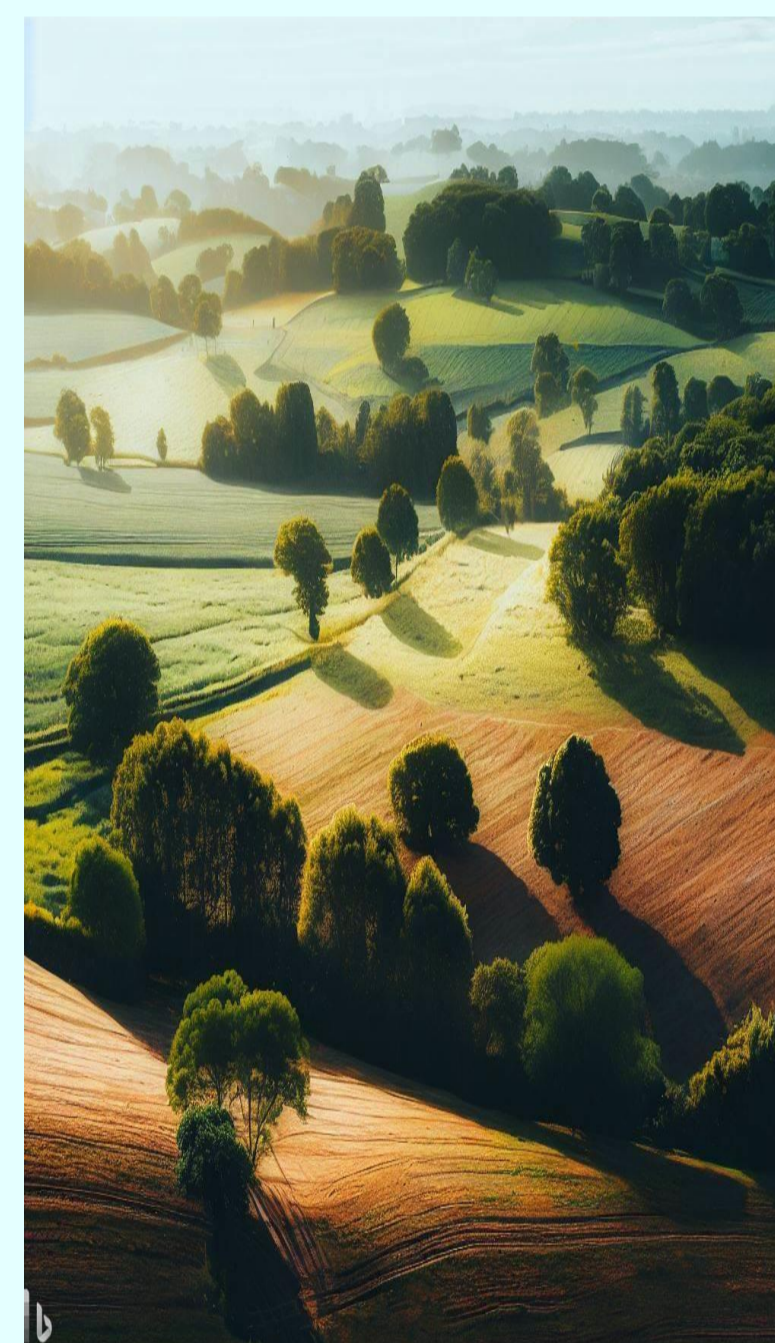
Biomass use is predicted to highly increase particularly in the chemical industry

Conventional use of biomass for the industry has big sustainability risk:

- Land use change and associated carbon emissions
- Competition and increase in food prices
- Soil depletion, water use and biodiversity loss

Resource extraction to nature restoration

The use of biomass resources for industry should come from bioeconomy models that not only provide biomass feedstocks but are able to provide multiple ecosystem services like **carbon sequestration, climate adaptation, biodiversity increase, water provision...**



Agroforestry systems

Limited Availability of sustainable biomass

For biomass gasification, woody feedstocks are the most suitable

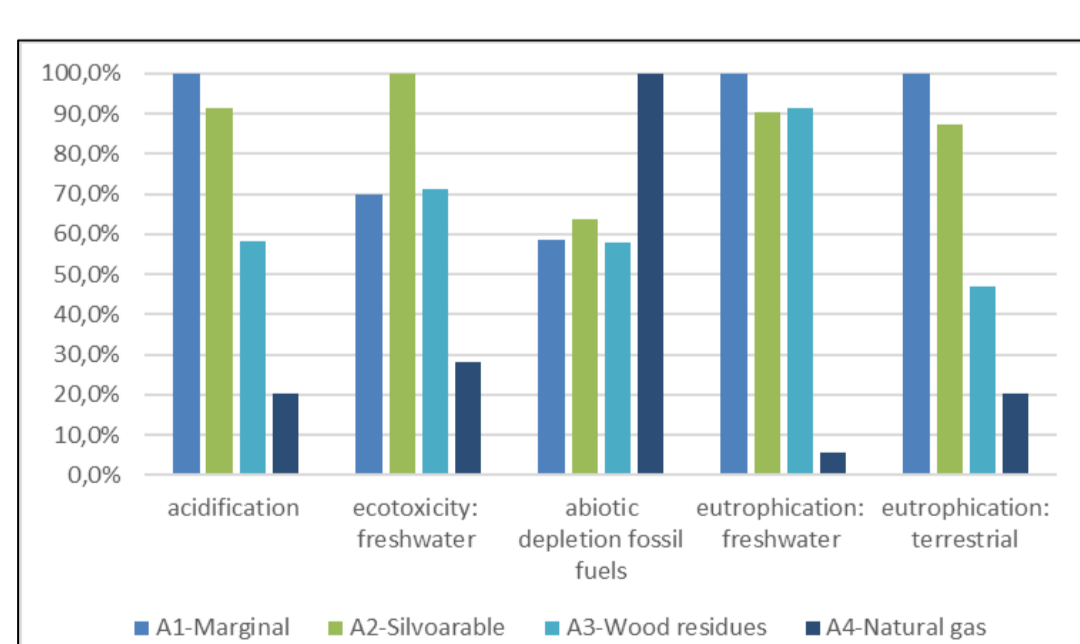
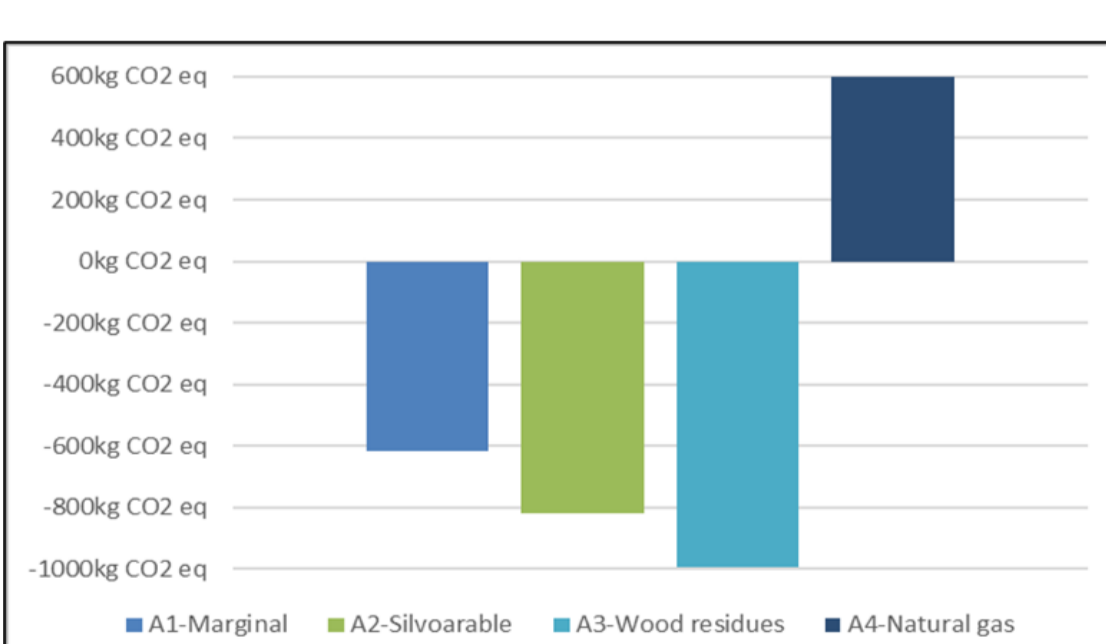
- The availability of forest residues will be limited soon
- Short rotation coppice surrounded by a lot of uncertainty on where to grow it. Marginal lands most explored options → Low productivity

Short-rotation trees in farmland a win-win

A good design in the integration of these trees in farmlands could provide benefits at multiple levels:

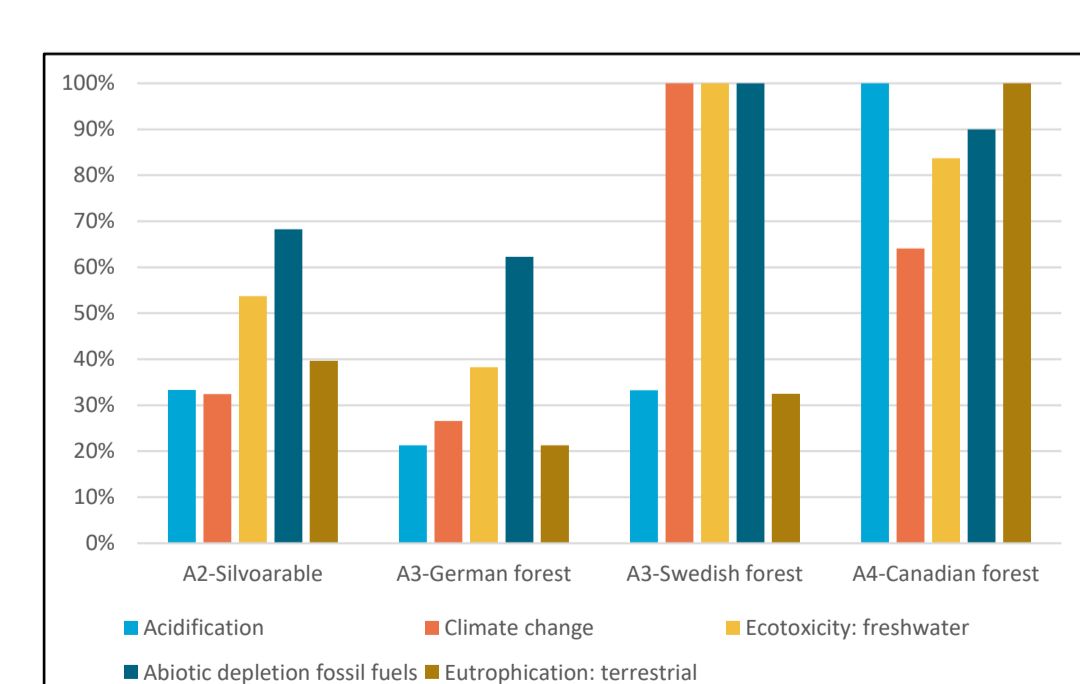
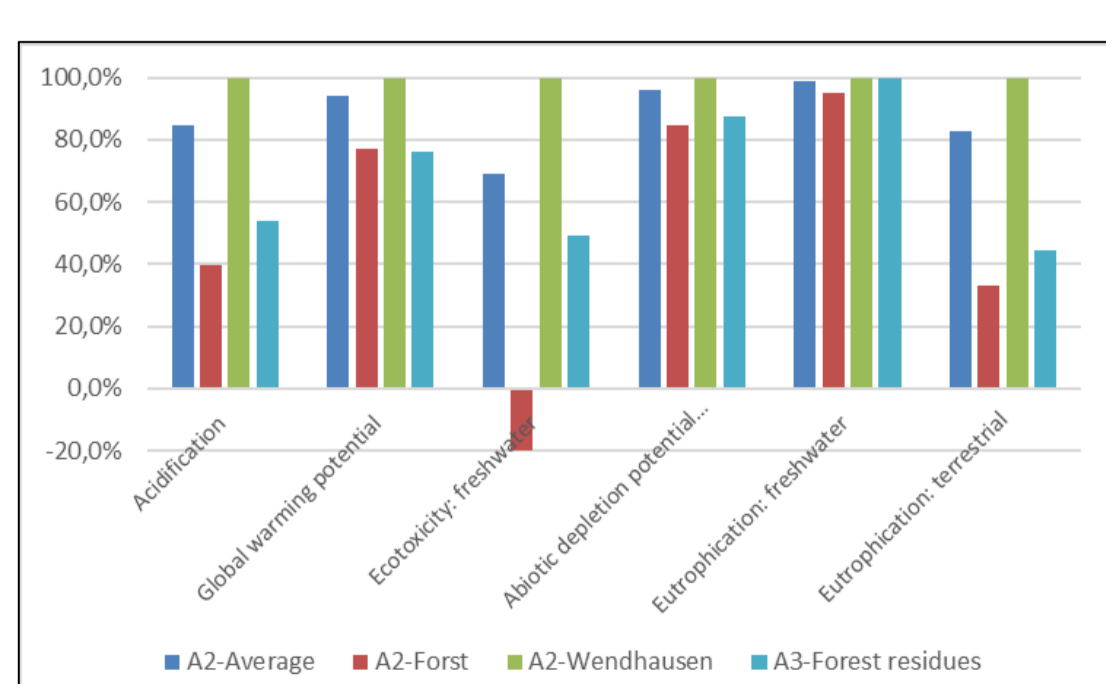
- Increase in the overall resilience and sustainability of agricultural land
- Improve farmer's profitability and foster rural development
- A sustainable biomass feedstock for industrial purposes

LCA results for methanol production



Outperform carbon emissions but...High electricity use penalizes environmental benefits
Future best-case scenario:

Category	Silvoarable (best case)	A4-Natural gas	%Difference
acidification	0,84	0,98	-14%
climate change	-1931,65	599,12	-422%
ecotoxicity: freshwater	-1656,81	1247,78	-233%
abiotic depletion fossil fuels	3155,86	29750,24	-89%
eutrophication: freshwater	0,09	0,09	9%
eutrophication: terrestrial	2,05	3,39	-40%



Silvoarable systems perform better than marginal land poplar plantations but worse than forest residues

However, the import of forest residues or the use of the best-performance silvoarable plantations defines these systems as the best bio-methanol alternative

Conclusion and recommendations

- Short-rotation silvoarable systems are a promising solution for sustainable biomass use not only for Airbus but for the whole industry
- These systems need to be further researched and implemented to realize their full potential
- Farmers need incentives to start transitioning into more sustainable practices and this could be a great opportunity
- Today the cost of these feedstocks might be higher but Airbus has the opportunity to invest in a supply chain that will enhance sustainability in all its dimensions and be profitable in the long run

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