

Alternative Fuels for Agricultural Machinery

What is the challenge?

GHG emissions from burning fossil fuel in agricultural machinery during the normal course of operation is around 10% of the GHG emissions of agriculture in comparison, or ca. 1% of total EU-27 GHG emissions²⁵. As a result, **conventional fuel is not the most critical, but still a contributor to the overall agricultural carbon footprint.**

Many options exist for farmers to reduce their CO₂ footprint. Future farms could, for example, contribute to electricity production with solar panels, windmills, and biogas/biomethane plants on their ground. Consequently, **electrification with batteries (direct electricity storage) and fuel cells (electrification through hydrogen)** of the agricultural machine fleet seems a logical next step. However, its uptake will depend mainly on future technology development to solve the issues of weight, energy density, and fast refuelling of energy storage on-board for a sustainable, effective, and efficient operating range. As a result, for short and mid-term, **full electrification seems more feasible for small-sized agricultural machines, while for medium- and large-sized ones and for high power applications there is no alternative to internal combustion engines (ICE). Technological progress in the coming decade will define the long-term potential of electrification.** Therefore, for farmers fleet of machinery, even with state of the art and anticipated technology, the combustion engine remains relevant in the coming years.

Approaches to reduce the CO₂ footprint of agricultural machinery are multiple, ranging from efficiency gains in the agricultural production process using best practices model predictions, to the utilisation of alternative drives and fuels. Agricultural machinery is characterised by a high level of robustness and reliability, resulting in a long service life. The high average age of the agricultural machinery fleet with combustion engine needs to be considered for planning any transition of engine technologies and energy solutions. **Currently, there is no single technology or energy carrier capable of replacing fossil diesel and diesel technology entirely.** A mix of technologies and energy carriers, most suitable for a given sector, certain region, and farm conditions, will have to be identified and applied.

Policy Recommendations

EU Level: Due to the characteristics of the agricultural machinery fleet and the work it must perform, we believe that internal combustion engines (ICE) remain a viable and suitable solution for the coming decade to deliver on the CO₂ reduction targets. We call on the promotion, production, and use of renewable and low-carbon fuels for agricultural machinery, whilst other technologies (**e.g., electrification or green hydrogen**) come to maturity. In more details, we strongly recommend:

- **Support** in raising awareness that combustion engines remain a necessary key energy converter for agricultural machinery in the long-term due to its specific type of use. Changes to existing designs will be financially impossible to realise with engine development in car and truck industry being halted.
- Agriculture should be **recognised as a key** sector for the use of e-fuels and Hydrotreated Vegetable Oil (HVO i.e., renewable diesel) as **drop-in replacement fuels**. The main reason is the agricultural practice being mainly in remote areas, and the need for storage within farms. Any fuel that can directly replace fossil diesel in the existing storage facilities, to be stored for longer periods of time, means reduced direct costs for farmers. This argument is less true for competing sectors. A **proper political framework** is needed for investment in the scale up and uptake of these fuels. This must facilitate the applicability of alternative fuels for agricultural purposes and grant the necessary financial support to farmers and contractors.
- For a proper adoption of the use of renewable and low-carbon fuels instead of conventional diesel, **a short- and long-term EU-wide strategy must be established** which would include feasible targets and specific taxation and incentives encouraging the use of biomass fuels (crop and waste based), hydrogen and e-fuels in

²⁵ CO₂ from fuel combustion of off-road vehicles and other machinery (from agricultural/forestry excluding stationary machines and fishery: https://di.unfccc.int/detailed_data_by_party)

agricultural industry. Public incentives and taxation should be proportional to the climate contribution of the various biomass fuels and e-fuels, calculated based on a life cycle assessment.

- The transformation to zero CO₂ emission must be seen and handled as an **investment with proper assignment of value**. This is certainly true for agriculture. The farmers, but also the industry, need a **clear perspective** to plan accordingly, as the development processes for new products have a certain lead time.
- To **promote CO₂ reduction** within the agriculture production, authorities should look at a well-to-wheel (well-to-crop for agriculture) and not tailpipe emission approach to enable a portfolio of options, as wide as possible, **to suit farmers' needs**.
- The European Commission should continue to **promote research in alternative biomass resources** for the production of advanced biomass fuels including by exploring sources for potential new feedstocks and by supporting the commercialisation of technologies to convert feedstocks available at scale, in particular wastes and residues, but also non-food crops from new production methods that serve for better carbon sequestration and increase of biodiversity.
- Within the **competition** between Fatty Acid Methyl Ester (FAME i.e. biodiesel) and HVO for feedstock in the form of waste streams such as used cooking oil and animal fat, **preference** should be given to HVO as a perfect drop-in replacement fuel.
- **Awareness raising** of farmers, contractors, advisers towards the state-of-the-art technologies/practices must be promoted. This could be a combination of providing proof of concept of innovative tools/practices through **demonstration farms**. This can be supported by the flagship eco-scheme precision farming.
- Fuels that can be **produced and used by the farmers themselves** should be promoted, such as biodiesel, pure plant oil (PPO) or biomethane. Tractors that can use these fuels were investigated and are used. The advantage of PPO and biodiesel is the simultaneous production of fuels and proteins (for food or feed, e.g., rapeseed cake), the advantage of biomethane is the simultaneous production of fuel and the conversion of agricultural residues such as manure into higher value fertilizers.

Member state Level:

- In Italy, during a meeting of 13 February 2023 attended by political parties and members of the relevant ministries of the Italian Government, the Technical Advisory Committee on Biofuels, for the purpose of carrying out the activities to which it is delegated, has expressed the need to investigate some issues relating to the world of biofuels through the preparation of a specific study, financed with the proceeds of the penalties for non-compliance with the legislation by the companies required to comply with the obligation to release biofuels for consumption. In this regard, the Committee signalled the need for in-depth analysis on issues relating to the potential and prospects for the production of bio-hydrogen (Steam Reforming) obtained from biomethane deriving from the biogas chain from sugary-starchy biomass. The study referred to in the tender must be carried out by November 2023; ad hoc policies will then be formulated by the ministries of reference for the matter in question.
- Mission booster is a special program in autumn 2022 with a focus on supporting the contribution of small and medium-sized enterprises (SMEs) to future solutions to the green challenges. The mission booster program specifically aims to support the creation of companies' innovative knowledge base for future solutions within green fuels for transport and industry (Power-to-X etc.).

Expected Impacts

For most of the EU agricultural machinery fleet to deliver a significant CO₂ reduction, **renewable and low-carbon fuels, notably liquid and gaseous biomass fuels, green hydrogen, and e-fuels will be an important source of energy**, by which internal combustion engine (ICE) remains a viable and suitable solution. There is the option for blending with fossil diesel and there is the option of hydrogen used directly in ICE, if uncertainties can be overcome on hydrogen production capacity, logistics and storage on-farm and on-vehicle. Sustainable biomass fuels can

reduce GHG emissions at least by 60% and **biomethane** potentially even **by more than 200%**, in comparison to fossil diesel, when produced from waste and manure.

The higher cost of biomass fuels, hydrogen and e-fuels compared to fossil diesel, together with the lack of economic incentives for production and usage of these fuels in agricultural machines, along with uncertainties around fuel taxation and subsidy regulations, are among major risks for their broader uptake by EU farmers. The easy way to achieve the Green Deal targets in agriculture is to make these sustainable fuels a more attractive alternative. Therefore, each fuel should be taxed in accordance with its climate contribution and based on the same principle subsidy schemes targeting production, storage, and use of those fuels should be deployed. A long-term **alignment** between EU regulations and national initiatives around promotion of different fuels expected to be used in agriculture is also necessary.

Clear targets, taxation and incentives will encourage farmers to invest or participate, with good return of investment, into machinery running on biomass-based fuels, into local or regional production plants and farm or farms fuelling infrastructure. Within a long-term EU vision and planning, well-targeted programs are needed to **financially support farmers' and contractors' investments into their machinery fleet and (re)fuelling infrastructure**, for accessing the best available CO₂ friendly technologies, and/or adjusting to harmonised practices for energy-optimised agricultural production. As there is no universal solution for all economic players, agricultural investment support programs must fit with the advancing developments of other sectors, the availability of energy carriers and technologies, and the specific energy needs of agricultural operations to maximise full potential benefit for every use case and end market. We fully support the ambition to make European agriculture climate- and energy-neutral. Energy produced within short carbon cycles of circular agriculture – in a form of sustainable biomass fuels and valuable by-product proteins and organic fertilizers – **can play a significant role in ensuring European feed and food supply security and should be considered as unique assets of agriculture**. With self-supply of energy, **agriculture can become a prosumer as well as an energy supplier** for local communities, which would increase the economic health of rural communities, improve their energy security, and make them more resilient to climate change and energy market fluctuations. Primary food production will be more resilient by independence from fossil fuel. Within a circular agriculture, biomass fuel production can be sustainable within certain land use boundaries, whilst not compromising the food and feed demands. In the case of **biomethane produced from fugitive emissions from livestock manure**, it can also contribute to delivering a circular economy model for livestock agriculture and be part of solving the ammonia and methane emission problem. Risk of indirect GHG emissions from crop-based biomass fuels can be further diminished by focusing on low Indirect Land Use Change (ILUC) feedstock production. It can materialize, so that there is no conflict with existing crop production. For allocation of the ecological value of crop-based biomass fuels the substitution effects of co-products like digested biological material as an excellent natural fertilizer or protein source, should be taken into account as the Renewable Energy Directive (RED II) recommends for political decisions only. The co-product of high value animal feed can substitute imports from abroad. **As a result, biomass fuels are not necessarily a transition fuel till 2030 but also beyond.**




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