REA response to Government Consultation on Non-road Mobile Machinery Decarbonisation

The Association for Renewable Energy & Clean Technology (REA) is pleased to submit this response to the above consultation. The REA represents renewable electricity, heat and transport, as well as Electric Vehicle charging infrastructure, Energy Storage and Circular Economy companies. Members encompass a wide variety of organisations, including generators, project developers, fuel and power suppliers, investors, equipment producers and service providers. Members range in size from major multinationals to sole traders. There are around 550 corporate members of the REA, making it the largest renewable energy and clean technology trade association in the UK.

Decarbonising the UK's Non-road Mobile Machinery

As with all elements of decarbonisation, there is no one size fits all approach to this sector, and a range of pathways must be kept open by Government, with a level playing field approach. For example, sustainable renewable biofuels, green gases such as BioCNG, hydrogen and electrification via Battery Electric Vehicles must all be progressed as possible options.

Farming and Agriculture

Farming requirements reflect climatic conditions and timeliness of undertaking certain tasks such as cultivation and sowing. Application of nutrients (in 2024 spring sowing and fertiliser application has been delayed by climatic conditions) and harvesting often takes place under time pressure and this is reflected in the number and size of the machines that farmers operate.
The primary CO2 reduction opportunities are with highly efficient machines. Current diesel machines have 50% lower CO2 emissions compared to 15 years ago. This approach can reduce the cost of machines and can reduce demand for future fuels (like BioCNG, HVO or hydrogen).
Key productivity measures for farming NRMM are operational timing and effectiveness. For optimum commercial effectiveness, operating costs must be minimised and productivity maximised. Farms need fuelling systems for gas fuelled tractors so that they can operate for over 18 hours a day in key periods. There is also a case for support for on-farm production of future fuels for tractors and DfT and Defra should engage with farmers and OEMs on the transition to low carbon fuels.

Potential replacements for diesel include battery electric, biofuels, gas fuels - biomethane is adoption ready and there may be scope for deployment of hydrogen in ICE and fuel cells.

Battery Electric (BEV) – deployment of BEV powertrains (plus robotic vehicles) is expanding in the agricultural sector, with early deployment in protected horticulture

(glasshouses and polytunnels), plus lightweight systems in field horticulture (such as Muddy Machines www.muddymachines.com or Farm Droid www.farmdroid.co.uk). Deployment of BEV power trains will be limited to specific applications.
There is a limitation on the scale of battery powered vehicles. Addition of battery weight to land machinery is a major concern - as efforts to improve soil health requires reduced compaction impacts. At present, larger robotic vehicles, such as Robottii (www.autonomousagrisolutions.co.uk/#ROBOTTI) and Agxeed (www.agxeed.com) are still powered by diesel engines. The next generation will need to embrace alternative fuels such as biodiesel and bioCNG. Increased deployment of autonomous vehicles and AI systems, across the farming sector will also require investment in better rural wifi coverage.
JCB and other OEMs and engine manufacturers are marketing a range of compact battery-electric machines and powertrains. However, models (below circa 3.5 tonnes) are designed for lighter tasks and are not expected to work at full power during the entire working day. However, on-farm energy generation, including solar, wind but also biomass and AD can contribute to farm energy supplies and deployment of BEVs alongside powertrains that run on biofuels or clean gas fuels.

Biofuels – There are 'drop in' replacement low carbon biofuels that can be used in tractors and some OEMs have produced biofuel variants. These include 100% bio-diesel, plus HVO (hydrotreated vegetable oil) and PPP (pure plant oil). These biofuels can be produced from a range of crops that can grown on UK farms and it would be possible to see a return to farmers producing their own fuels, as in the days of horse power!
With no single solution for replacement of diesel as the major power source for farm machinery, policy makers and the industry need to embrace a range of future fuels and powertrains as highlighted in RASE's Farm of the Future Report. Also, many of the major OEMs are based in the EU and the US and hence there may be little that can be done with UK policy levers to boost production. Hence, the drive for transition for new fuels will need to include scrappage payments, incentives or grant support.
While the internal combustion engine will need to be part of the rural landscape for many years, the supply chain for such biofuels needs to be sourced sustainably. The supply chain for biofuel feedstocks generated from bio residues is also limited at this time. Also, with a potential shift towards producing more HVO directly from purpose grown crops, sustainability must as ever continue to be at the forefront of policies here.

Gas Fuels, including BioCNG & hydrogen – a good case can be made for red diesel to be replaced by a range of low carbon fuels and this needs to be part of future planning. Gas fuels offer a viable replacement for diesel. BioCNG is adoption ready, with gas being produced on farms, commercially viable powertrains for tractors and other machinery, plus modular upgrade and gas compression systems. New Holland's T6 180 gas tractor, designed and manufactured in the UK, with support from Innovate UK, is being exported to a number of countries and a second, larger model will be launched in 2025. Farmers should be encouraged to look at gas fuel options, with capital grant support alongside the RTFO.

BioCNG which is affordable, adoption ready and requires limited vehicle modification, can be deployed now and can deliver over 80% emissions reduction. New Holland are looking at facilitating gas fuelling infrastructure (inc. in-field refuelling). Gas fuels can play a key role in the pathway for agriculture away from red diesel. Also, BioCNG can help with the transition to other gas fuels such as Hydrogen (H2), possibly produced

locally. While NOx emissions are higher than for H2, BioCNG is available and viable now and helps support diesel replacement in advance of electrolytic (green) H2 becoming widely available.
There are challenges with regards to cost effective production and supply of compressed or liquified gas fuels in rural areas, including transport and storage. This applies to BioCNG but there are efforts to develop off-grid gas distribution. Government needs to support the development of virtual gas grid distribution systems to ensure that gas fuels like BioCNG and H2 can be available in off grid rural areas.

The H2 Internal Combustion (IC) powertrain developed by JCB for its diggers and loaders has potential applications in agriculture. However, the power intensity required in agricultural use could be a challenge for some fuel cell applications here. Complexity, cost and supply issues create added barriers. Hence, H2 IC powertrains may be better suited to farm deployment, compared to H2 fuel cells.
H2 IC powertrains are being trialled by other engine manufacturers too and are closer than fuel cells to commercial availability for heavy vehicles. (Renewable) Gas engines are lower cost and less inflationary than battery and hydrogen fuel cell options at present, for these applications.

Energy from waste and Circular Bioresources Sectors

This sector has been hit hard in recent years by the introduction of Red Diesel taxation changes – without the incentives to move to greener forms of machinery offered to other sectors. So progress in progressing this sector's equipment away from fossil fuels has an added necessity.

As with farming, a range of technological options exist, and often there is overlap in mobile machinery used by farmers for example in on-farm digesters and composting operations.

The energy from waste, resource management and circular bioresources sector must not be overlooked on this occasion (as with the Red Diesel changes) in terms of Government support to decarbonise. The sector strongly welcomes advances to decarbonise machinery for these sectors and seeks manufacturer innovation to serve the industry.

A report on the sector from ERM recommending conducting further analysis of industrial NRMM at a site-level: Site-level factors such as number of NRMM on site and the size and duration of the site are likely to affect the ease of deploying hydrogen or electric-powered machinery which require new infrastructure. However, data on these is limited, as well as the feasibility of deploying multiple different solutions on a single site. Understanding whether multiple abatement solutions can be supported on one site and how the solutions may interact could help shape the overall approach to decarbonising the sector.

<u>Operational matters for circular bioresources sites:</u>

• Additional space might be required on-site to enable the use of low and zero carbon NRMM. Certain fuels, such as hydrogen, require more space to be stored, per unit of energy, compared to fossil fuels. Additional or enhanced storage solutions, onsite and on the machine, might also be required to manage safety risks associated with these

fuels. Whereas battery electric machines might require minimum distances between them when recharging due to fire risks. This may be a barrier where space is limited, for example on a construction site or at a seaport.

• Where machines are used for extended operating hours, this may require more frequent refuelling of machinery than what currently happens or, in the case of battery electric NRMM, two or more machines operating in shifts might be required to replace a single machine.

• Alternative powertrains, such as the inclusion of battery packs, might increase the overall weight of NRMM. This might be a consideration when transporting units by road or, in the case of TRUs, it might reduce the overall payload of the vehicle or limit the situations in which they can be deployed.

• Overestimating the size of machine required to complete a task or not receiving the appropriately sized machine that has been specified is a barrier to the efficient use of a machine.

ERM's report states that data on site-level factors is limited as too is feasibility of deploying multiple different solutions on a single site. We agree with ERM that understanding whether multiple abatement solutions can be supported on one site and how the solutions may interact would shape the overall approach to decarbonising the sector. It's important the biowaste treatment sector (waste-fed AD and composting sites), the energy-crop-fed AD and the manure-slurry-fed AD sectors are researched because they range in size from small (operating under registered exemptions from permits) to large, there are many of them (e.g. 371 AD sites and 272 composting sites in England, using data for the year 2018), they treat millions of tonnes of biowastes and non-waste materials annually, and the NRMM types they use are not all the same and space-constraints could be non-extendable at numerous waste-fed sites located off-farms.

Approximately 6.2 million tonnes of product-status, quality composts and digestates are produced in the UK per year. Amounts of waste-status, waste-regulation-controlled-use composts and digestates produced annually are also significant. Mobile machinery used for spreading composts and digestates in agriculture and field-scale horticulture need careful consideration. It is important to avoid soil compaction so policy measures should support the use of decarbonised machinery that exerts a load per wheel (kilograms per Newton[1]) that does not compact agriculture / field-horticulture sector soils. A challenge fund for improved design of decarbonised NHMM for advancing the design of such machinery could be explored, e.g. managed by Innovate UK and/or another research management body.

Additional points:

We support the need for completely moving away from relying on fossil fuels and moving to renewable fuels as an important part of meeting net zero. We are aware that machine manufacturers are trying hard to find alternatives to diesel engines, and research and development and time will find a way forward.

Currently there is not machinery with alternative fuel sources to replace all the different machinery and technologies used on organics recycling sites. The electric range of

[1] https://www.sciencedirect.com/science/article/pii/S1658077X13000052

some of the machinery used in the sector is still being developed and alternatives to diesel are not currently available for all machinery. For example, shredders and screeners are commonly used on composting sites, and there are no suitable alternatives to diesel powered machines on the market at present – this must be addressed. In addition, such (rural) sites may not have suitable grid connections or capacity to run the machinery and equipment that is needed if electrified.

Therefore, as with the wider decarbonisation and Net Zero challenge, it is a range of different technologies and solutions that is essential, including BioCNG and relevant renewable transport fuels, alongside other solutions.

More public R&D and demonstrator funding is essential to address these challenges and public support for practical on-site solutions where these do exist.

REA, March 2024

Annex:

Nitrogen Oxides (NOx) from Agricultural Tractors

There is a clear need to reduce NOx emissions from all heavy NRMM. While Defra may understand the nature of farm operations there is no reason why this should be something that DfT is fully aware of. Hence it might be suggested that the tractor operator could be exposed to Air Quality (AQ) pollutants but this is not the case - tractors operate alone or in small groups and the driver generally sits in an air conditioned cab. While there may be some exposure in or around farm buildings this is where BEV units may be most viable.

For farm tractors, with a single machine at work in a field, there is limited AQ exposure risk for the driver (operating the tractor from within an air controlled cab in most conditions). While there are plenty of 20 or 30 year old diesel tractors operating without modern cabs, these tend to be used less frequently. The case can be made for low emission vehicles to be used in yards and enclosed building housing livestock, e.g. tractors pulling feeder waggons.

In modern diesel tractors, NOx emissions are lower than they used to be and gas tractors can reduce them even further. The switch to BioCNG tractors fuelled from on-farm AD plants or covered lagoons will also reduce farm CH4 and NH4 emissions from farm slurry. Switching from diesel to BioCNG will cut NOx - New Holland claim a 60%+ percent reduction in NOx[2]

Also, our members tell us there is uncertainty as to how much modern farm tractors and other vehicles are contributing to poor air quality in rural areas. The lower NOx produced by the CNH biomethane tractor will safely dissipate in a rural setting. NOx

[2] Please see: https://eminox.com/news/new-holland-t6-methane-power-tractor-featuring-eminox-emissions-control-technology-wins-sustainable-tractor-of-the-year-2022/

from tailpipe emissions is primarily a problem when being emitted in large volumes in congested urban areas where build up can affect residents or pedestrians.
In dedicated HGV trials run by Cenex, depending on the duty cycle, total GHG emissions ranged between +9% (increase in CO2e emissions 'well to wheel') to -23% (lower CO2e emissions 'well to wheel'). With BioCNG trucks on the road, total GHG emissions are reduced further, with up to 80% emission reduction (well to wheel) for 100% biomethane.

In the Cenex test, air quality emissions were in line with conventional (EURO VI standard) diesel engines (no measured increase beyond EU VI levels was detected) in all drive cycles.
Expropriating emission profiles from HGVs operating 80% of their time on motorway driving carries some risk. However, there will be some correlation between HGV engine emissions and on-farm tractor emissions. Pending further analysis, BioCNG powered farm equipment is expected to significantly reduce well-to-wheel CO2e emissions, with no significant impact on rural air quality from the impact of NOx emissions[3].

Hence NRMM should not face the same limits as HGVs in this regard. Also, it should be noted that the methane IC engine requires a single-stage after-treatment system, not the three-stage after-treatment on conventional diesel engines. This reduces cost with less complexity. This is emphasised by New Holland as a feature of the T6 180 (BioCNG tractor). In addition, it should be noted that farm waste streams (slurry and manure) that are not processed into biogas tend to emit many times more methane (and other pollutants) than those fed to farm AD plants.

An independent Life Cycle Analysis on this topic would be useful for the industry and Government to fully assess this and should be implemented as an outcome of this review.

[3] Please see: Dedicated to Gas - Low Emission Freight and Logistics Trial - Cenex.