It is not anaerobic digestion or composting of residual food wastes, it is both

Background

An opinion piece published in "The Spinoff" by Kate Walmsley on 23 August 2020 entitled "Why industrial anaerobic digestion is not the answer to food waste"[1] casts doubt on claims that food waste anaerobic digestion(AD) plant will deliver sustainable outcomes for horticultural customers aligned with achieving a more circular economy in New Zealand. The article specifically refers to the Ecogas anaerobic digestion facility in Reporoa[2].

The article puts the case for composting food wastes to produce biofertiliser, instead of processing the organic waste in anaerobic digestion plant to produce energy and biofertiliser. The article claims that composting provides better environmental outcomes than AD processing due to a better soil conditioning properties of compost versus digestate from AD, lower greenhouse gas emissions and larger societal benefits of composting.

The article misses the point that composting and AD processing of organic waste are two well proven, extensively used and often complimentary technologies used world wide. The choice of processing pathway depends on the composition of the feedstock and the desired products produced in response to the local market demand and opportunities. In some applications with specific feedstocks, composting will be the optimal processing path, while in other applications and feedstock AD processing will be optimal. In general, high energy feedstocks such as food waste are better suited for AD, whereas high fibre feedstocks such as greenwaste are more suited to composting[3]. Most importantly, they both keep waste out of landfills and hence substantially reduce greenhouse gas emissions and other environmental risks and impacts associated with that processing practice[4].

In general terms compost is an organic soil improver and biofertiliser from AD is an organic fertiliser[5].

The purpose of this response is to provide scientifically proven and verified facts to demonstrate the substantial benefits of using anaerobic digestion for processing of the unavoidable fraction of food and commercial/industrial organic waste that cannot be effectively reused in its raw form alongside the alternative benefits of composting organic waste.

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[1] https://thespinoff.co.nz/food/23-08-2020/why-industrial-anaerobic-digestion-is-not-the-answer-to-food-waste/

[2] https://www.biogas.org.nz/news/nz-food-waste-to-energy-facility-gets-underway

[3] https://sustain.ubc.ca/sites/default/files/2012-03_Best%20use%20of%20organice%20solid%20waste%20-%20compost%20vs%20energy%20production_Zhang.pdf

[4] https://www.biogas.org.nz/resource/is47-role-of-biogas-in-transition-to-low-carbon-economy

[5] https://www.iswa.org/uploads/media/Report_2_Benefits_of_Compost_and_Anaerobic_Digestate_01.pdf

The waste hierarchy

In both cases the processing is of residual organic wastes after the quantities of waste have been reduced by minimisation, recycling or reuse. The Reporoa processing facility is a good example of how this works in action. One of the parties sourcing waste for processing is Ecostock who for a number of years have been collecting Auckland food wastes and extracting food types that can be processed into stock food and now propose to provide the food wastes that cannot be fed to cattle for processing into energy and biofertilizer via the Reporoa processing plant.

Both composting and anaerobic digestion require effective source segregation of organic waste from other types of waste. Improved collection of waste with increased focus of business and communities on separation at source has internationally proven to increase the level of recycling and reuse of organic waste which would otherwise have gone to landfill hence underpinning the goal of the waste hierarchy.

Internationally most food waste AD plants produce biogas for heat, electricity and use as a vehicle fuel, and biofertiliser from the digestate. With the ability to reduce global GHG emissions alone by close to 20%, the potential of the AD technology to contribute to a sustainable and carbon neutral future is immense. Further to that, anaerobic digestion contributes to at least nine of the 17 Sustainable Development Goals agreed by the countries of the United Nations to be achieved by 2030. [6]

Greenhouse Gas Emissions

CO_2 emissions from both anaerobic digestion and composting are recognised worldwide as being biogenic, not anthropogenic, so both are treated equally as carbon neutral in the context of climate change greenhouse gas emissions. This classification reflects their biological processes are not contributing to climate change impacts, that is they both contribute to a more circular economy by re-utilising waste resources that might otherwise be lost to landfills, creating harmful greenhouse gas methane emissions[7].

Biogas from anaerobic digestion will therefore reduce harmful methane emissions otherwise coming from landfill, carbon dioxide from natural gas used in boilers and generators, or natural gas currently used to make synthetic fertilisers. Ecogas analysis for the Reporoa facility of avoided greenhouse gas emissions from these three sources shows it will replace at least 10,000 tonnes of these anthropogenic CO_2 emissions per year.

The Reporoa AD plant will convert the unavoidable fraction of food waste and other commercial or industrial organic wastes unsuitable for reuse in its raw form into biogas composed of 65% biomethane and 35% biogenic CO_2. Up to 3,000 tonnes per year of the biogenic CO_2 will be made available for glasshouse fertilisation with the potential for improving horticultural growth by up to 30%[8]. More than 9,500 tonnes of fossil fuel CO_2 emissions will also be avoided by replacing the natural gas currently being used for heating of the glasshouses and by generation of renewable electricity. This is calculated by multiplying the customer's forecast energy demand to be supplied from biogas by the NZ ETS emissions factors for natural gas and electricity.

[6] https://www.worldbiogasassociation.org/the-contribution-of-anaerobic-digestion-and-biogas-towards-achieving-the-un-sustainable-development-goals-2016/

[7] Environmental sustainability of anaerobic digestion of household food waste https://www.sciencedirect.com/science/article/pii/S0301479719301422

[8] http://www.crophouse.co.nz/crophouse/pdf/CO2%20%26%20Plant%20Growth%20-Nederhof-PH%26G-may04-proofs.pdf

The estimated emissions offset does not consider additional greenhouse gas emissions reduction realised through substitution of mineral fertiliser with digestate.

The article fails to mention the methane and nitrous oxide emissions produced during composting. Typically this methane and nitrous oxide is between 2.5% and 10% of the feed carbon and 1% of feed nitrogen being released to the atmosphere, respectively. With methane and nitrous oxide having 21 times and 289 times more greenhouse effect than the CO_2 equivalent respectively, the total CO2 equivalent emitted per tonne of waste processed are similar for both compost and AD[9][10]. Trucking of the food waste adds a small component of emissions from diesel, however over time this fuel can be replaced by Biomethane from the AD plant.

A significant amount of meat sourced food waste processed at the Reporoa plant could not be composted. The type of food waste typically treated using AD would require the addition of at least twice as much again of "woody" material to allow good compost to be formed. This would result in 3 times the transport cost if enough woody material can be found and consequently higher transport emissions for spreading. There is also substantial energy cost and greenhouse gas emissions associated with composting operation including the fuel cost for turning and at larger scales the electricity consumed for aeration and odour capture and processing. This demonstrates that even composting is not free of emissions and full life-cycle analysis is required to compare the project-specific environmental impacts of composting and AD.

Biofertiliser

In the article the author references materials that were largely mineral fertilisers, rather than digestate and therefore the article is based on accusations rather than supported facts.

The biofertiliser from composting or AD processing are different fertilisers[11] and so it is not a good vs bad choice of biofertiliser for application to land. Compost offers better soil conditioning properties due to the higher carbon content, while biofertiliser from AD has nutrients present in a more plant-available form.

As for all fertilisers, different ones are used for different plant growth outcomes. AD sourced biofertiliser can also be mixed with composts to provide a biofertiliser with yet different plant growth characteristics. Farmers have a choice of using either or both products and will select what suits their specific needs.

The Reporoa AD plant will produce around 85,000 tonnes per annum of biofertiliser product that will be spread onto more than 2,500 Ha of pasture or cropping land within a 50km radius of the Reporoa plant. Biofertiliser will displace nitrogen, phosphorous and potassium which would otherwise be supplied from synthetic fertilisers transported around the world or made from natural gas here in New Zealand[12].

European Biogas Association[13] quotes;

> "1 tonne of artificial fertiliser replaced with digestate (made from AD plant) saves 1 tonne of oil, 108 tonnes of water and 7 tonnes of CO2 emissions.

Nutrients derived from an AD plant as biofertiliser are no different in nature as nutrients that could be derived from composting the very same food scraps. The main differences between the application of compost to land and biofertilisers is that compost processing requires more bulking agents which are generally sourced

[9] https://ec.europa.eu/environment/waste/compost/presentations/hogg.pdf
[10] https://www.biocycle.net/composting-and-greenhouse-gas-emissions-a-producers-perspective/
[11] https://www.iswa.org/uploads/media/Report_2_Benefits_of_Compost_and_Anaerobic_Digestate_01.pdf
[12] https://www.biogas.org.nz/documents/biogas/Biogas-Digestate-Factsheet_Renquist-Heubeck.pdf
[13] https://www.europeanbiogas.eu/wp-content/uploads/2019/07/Digestate-paper-final.pdf

from green waste. Both products will replace synthetic fertilisers and lower climate change emissions, both products must be applied to pasture or crops in accordance with their respective compliance codes and both products are circular and more sustainable than synthetic fertilisers.

AD biofertiliser has a significant humic content that improves the soil in the same way that compost does. They just have different characteristics[14]. Research demonstrates that the remaining organic carbon after anaerobic digestion is much more recalcitrant than the input feedstocks (food waste) leading to a stabilisation of the organic matter and a lower organic matter degradation rate after field application. This enables a similar reproduction of the soil organic matter as obtained by direct application of the raw organic waste or compost.

The AD-derived biofertiliser contains nutrients in a balanced slow release form with some soluble nutrients to give a little boost on application. The nutrient concentration while much higher than compost is still lower than that of mineral fertilisers. At reasonable application rates there is no evidence of "burning" of plants or similar[15]. Recent New Zealand-based trials with a fertiliser produced from anaerobic digestion of horticulture residues demonstrated that the AD biofertiliser gave better plant growth and nutrient uptake results than the residue applied fresh or in a composted form[16].

Biofertiliser from AD is an established product overseas while New Zealand lags far behind. For example, Italy produces up to 30 million tonnes of AD biofertiliser annually, which equals to about €400 million fossil fertilisers savings.[17]

Sustainable, renewable energy

Bioenergy and biofertiliser are acknowledged internationally as suitable for offsetting anthropogenic emissions that would otherwise be created by the natural gas fuel used for making synthetic fertilisers and supplying process heat or electricity generation. Renewable energy supplied by the Reporoa processing facility from AD biogas will replace more than 10,000 tonnes CO_2 per annum of emissions from fossil fuel alternatives. Compost cannot be used to offset natural gas or coal emissions from boilers or from electricity generators, whereas AD biogas can be used to replace fossil fuel emissions.

For glasshouse producers in New Zealand, rising emissions costs for heating and CO_2 production currently from fossil fuels are a big issue and Ecogas at its Reporoa facility is investing in a comprehensive and sustainable solution. Ecogas is providing a unique solution that will reduces climate change emissions, fertilises plants and return nutrients to the soils.

Environmental best practice

Both processing pathways use living organisms to break down the organic matter. As a result they have to be carefully and professionally managed. The difference between the technologies is that composting is undertaken with air and AD is undertaken in the absence of oxygen. Each technology needs to be installed and managed to best practice. At larger scale, compost leachate management and disposal alone becomes

[14] https://link.springer.com/article/10.1007/s13593-015-0284-3
[15] http://www.wrap.org.uk/content/dc-agri-videos-1
[16] Data available on request.
[17] http://europeanbiogas.eu/wp-content/uploads/2015/07/Digestate-paper-final-08072015.pdf

a significant cost and needs to be managed adequately. Some composting plants in New Zealand have experienced compliance issues due to poor leachate management and/or insufficient odour control[18][19][20].

The article states that a composting facility for processing 75,000 tonnes of food waste annually has a potential to generate 1,500 FTE of long-term jobs. At minimum wage, the composting operation would require $786/tonne of waste gate fees just to cover wages. At any reasonable scale, wages can be expected to be of the order of 40% of operating costs of an AD plant. Landfilling costs in New Zealand generally range from about $80-300/tonne and composting with these labour costs would not compete on price with AD technology.

Comparing anaerobic digestion to waste incineration is not appropriate. Waste incineration is typically applied to mixed municipal waste, rather than source segregated food waste due to the low energy content of organic wastes.

Unlike in other markets, AD facilities in New Zealand are not driven by the aim to produce electricity. While electricity production is an added benefit, it is the avoidance of GHG emissions from landfilling of organic waste and from the use of natural gas as energy source that are the key drivers for the Reporoa project. As such, the project helps New Zealand to achieve its emission targets.

Conclusions

Anaerobic digestion and composting are complementary technologies. They both:

- provide sustainable alternative to landfill disposal
- reduce GHG emissions generated at landfills and assist NZ in achieving its emission and sustainable development targets
- preserve nutrients contained in food waste enabling their reuse on land
- reduce NZ's dependence on largely imported synthetic fertilisers produced using mainly fossil fuel driven processes
- require adequate management of the biofertiliser product application to avoid adverse effects on the environment
- need to be designed and operated to high standard

In addition to the above, anaerobic digestion also provide:

- sustainable fuel source to replace fossil-fuel and reduce GHG emissions
- renewable source of CO_2 for glasshouse enrichment

The choice between using anaerobic digestion or composting for processing of organic waste needs to be based on life cycle analysis, market demand for products and types and amounts of waste available.

[18] https://www.nzherald.co.nz/ucklander/news/article.cfm?c_id=1503378&objectid=11048446
[19] https://www.nzgeo.com/audio/complaints-about-composting-plants-smell-rising/
[20] https://www.stuff.co.nz/dominion-post/news/69437447/te-mata-mushroom-company-prosecuted-over-smelly-compost