



## Executive Summary

Humanity is facing a climate crisis and must act fast to meet the many challenges this presents. The extent to which populations are already observing the effects of climate change depends on locality. In many parts of the world, communities are already facing the real impact, such as those in low-lying areas who have seen their homes under increasing threat of flooding due to rising sea levels. Despite this, some governments have not yet felt the impetus to act, particularly where the effects have been less pronounced. Many of the more affluent regions of the world have seen little impact of the global rise in temperature on farming, the overall economy, access to resources or services. Therefore, those that do accept the need for action may not appreciate the urgency.

Despite the array of positions on the climate crisis, the global community has indeed recognised the challenges humanity is facing, through the commitment signed in Paris in 2015. This acknowledges the need for action to counter and mitigate the effects of rising temperatures, biodiversity loss, reduced availability of drinking water, increased pressure from exceptional weather events, loss of topsoil and desertification.

The development of alternative waste treatment methods (rather than simply dumping them in open spaces) and the need for non-fossil fuel-based energy sources (substituting coal, oil and gas), have led to the growth of the anaerobic digestion (AD) industry which produces biogas. AD is a ready-to-use technology to decarbonise heat for our buildings and transport for ourselves and our goods (moving away from the internal combustion engine), while producing a natural fertiliser co-product that can recycle nutrients back to the soil.

This report aims to highlight the potential of AD as a technology to generate renewable energy, abate GHG emissions and recover organic nutrients and carbon for use on soil. The report also sets out the potential of AD to help meet the climate change targets under the Paris Agreement.

**The key finding of this report is that AD has the potential to reduce global GHG emissions by 3,290 to 4,360 Mt CO<sub>2</sub> eq., which is equivalent to 10-13% of the world's current greenhouse gas emissions<sup>1</sup>. This is achieved through the generation of renewable energy in the form of biogas from the anaerobic digestion of wastes and landfill gas, combined with emissions avoided through the management of organic wastes and avoided fossil fertiliser manufacture, crop burning and deforestation, using technology available and widely used today.**

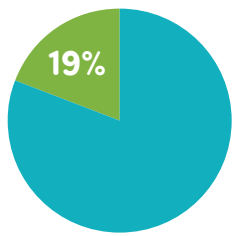
The above means that, despite the 50 million micro-digesters, 132,000 small, medium and large scale digesters and 700 upgrading plants operating globally, we are tapping into just 1.6-2.2% of the global potential of AD<sup>2</sup>. The potential for the growth of the biogas industry is therefore extraordinary and involves every country.

### Sponsors



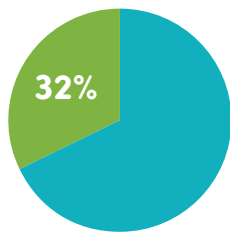
<sup>1</sup> Data IEA/OECD (2018), World Energy Outlook, Paris

<sup>2</sup> Chapter 1



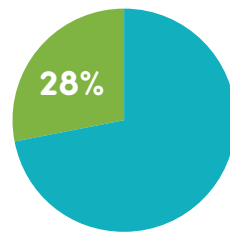
■ AD

AD potential to meet global electricity demand  
Mid point case



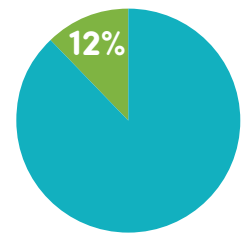
■ AD

AD potential to meet global natural gas demand  
Mid point case



■ AD

AD potential to meet primary energy from coal  
Mid point case



■ AD

AD potential to abate GHG emissions  
Mid point case

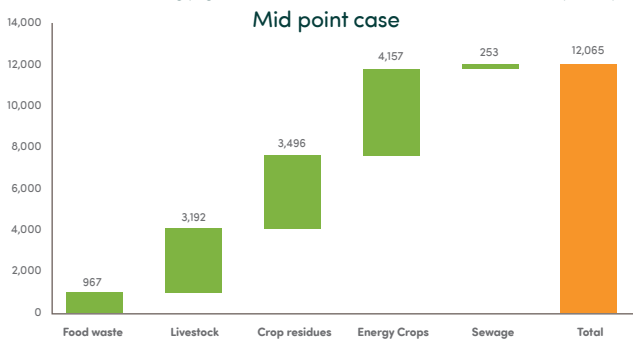
While 195 countries have committed to reducing their greenhouse gas (GHG) emissions under the Paris Agreement, this is in itself not sufficient to keep the temperature increase under 1.5°C by 2100. After stagnating for 3 years, GHG emissions in fact increased in 2017<sup>3</sup>. Urgent action is needed and public pressure, led by Greta Thunberg and Extinction Rebellion among others, is building pressure on governments to act. Every industry, policymaker and individual should now look at what they can do to mitigate climate change or we all collectively face the consequences of destroying the environment upon which we depend.

Policy recommendations and actions are to be found at the end of the Executive Summary.

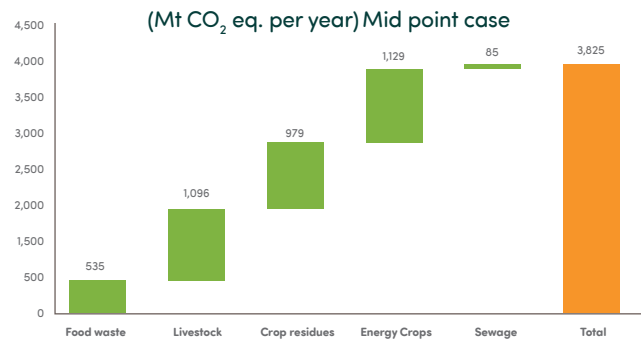
Our industry is already leading in reducing GHG emissions by capturing the methane that would otherwise have entered the atmosphere from rotting food waste, sewage, farm wastes and agri-industrial process wastes. Capturing this methane and then transforming it into electricity, heat or fuel and biofertilisers are processes that have matured. They are rolled out in many countries on both small and large scale, but there is an enormous untapped potential to absorb further uncontrolled GHGs, as well as reduce reliance on fossil fuels to produce energy and fertiliser.

The potential to generate energy from currently available and sustainably grown/recovered major feedstocks (livestock manure, food waste, sewage, crop residues and energy crops) in the world is 10,100 to 14,000 TWh. This energy can meet 6–9% of the world’s primary energy consumption or 23–32% of the world’s coal consumption<sup>4</sup>. When used as electricity, it has the potential to meet 16–22% of the electricity consumed globally<sup>5</sup>. If the energy is utilised as biomethane, it can substitute 993 to 1380 bcm of natural gas, equivalent to 26–37% of the current natural gas consumed<sup>6</sup> globally.

Potential energy generation from various feedstocks (TWh)



Potential GHG abatement from various feedstocks (Mt CO<sub>2</sub> eq. per year) Mid point case



The residue left over from biogas generation, known as digestate or natural fertiliser, can replace 5–7% of inorganic fertiliser currently in use. It can fertilise 82 million hectares of land<sup>7</sup>, equivalent to the combined arable land in Brazil and Indonesia<sup>8</sup>.

While making these contributions the biogas industry can also help provide energy and food security, manage waste, protect water bodies, restore soil health, improve air quality, promote health and sanitation, and provide employment. As humanity urbanises, the health of billions of humans depends upon managing waste correctly in cities and our industry is one of the best solutions to doing so, especially urban food waste and sewage.

<sup>3</sup> [https://wedocs.unep.org/bitstream/handle/20.500.11822/26879/EGR2018\\_ESEN.pdf?sequence=10](https://wedocs.unep.org/bitstream/handle/20.500.11822/26879/EGR2018_ESEN.pdf?sequence=10)

<sup>4,5,6</sup> Data IEA/OECD (2018), World Energy Outlook, Paris

<sup>7</sup> <https://data.worldbank.org/indicator/ag.con.fert.zs>

<sup>8</sup> [www.nationmaster.com/country-info/stats/Agriculture/Arable-land/Hectares](http://www.nationmaster.com/country-info/stats/Agriculture/Arable-land/Hectares)

## POLICY RECOMMENDATIONS

To achieve this potential, policy and regulatory support is required because the ability to decarbonise energy production is dependent upon being able to operate at least on a level playing field with entrenched and existing operators. The multiple contributions of biogas (treating waste as well as producing energy and fertilisers) are often not accounted for as a value, so operators do not receive payment for these. Therefore, biogas is often considered to be more expensive than fossil fuels and policymakers have difficulty in understanding the full intrinsic value, especially where fossil fuels receive substantial incentives and tax breaks.

The types of support required will vary depending on the particular geography in question, but at the high level the global industry needs:

- The removal of all fossil fuel subsidies to create a level playing field. This includes the gradual removal of subsidies to lower the retail price of fuels to consumers, with attention paid to the impact on fuel poverty, as well as eliminating tax breaks for exploration and exploitation of fossil fuel reserves. According to the IMF current fossil fuel subsidies represent 6.5% of global GDP, the highest externality ever recorded.<sup>9</sup>
- National commitments to reduce greenhouse gas emissions to net zero by 2050. The United Kingdom has announced this commitment and put binding legislation before Parliament to ensure it is enforced long term.<sup>10</sup>
- National energy plans to raise the level of renewable energy production and consumption over a future period (a decade is normal), incorporating targets for the production of biogas by AD.<sup>11</sup>
- AD to be urgently included in all government strategies for meeting GHG abatement targets, recognising the GHG abatement benefits of AD and incentivised via carbon markets.<sup>12</sup>
- AD to be included in all renewable energy generation incentives.<sup>13</sup>
- To develop knowledge, raise awareness and implement regulations, standards and certification for safe trading and use of digestate.<sup>14</sup>
- The implementation of circular economy strategies with AD at their core.
- AD to be nominated as the preferred method of treatment of all biodegradable wastes (human – sewage and food; agricultural; commercial; industrial), accompanied by policies to increase capture.<sup>15</sup>

All policies should consider the circular nature of the AD industry, and consider the full potential for energy generation, nutrient recovery and recycling, use as waste treatment and the potential to fuel buses and fleet transport:

- Improved sanitation infrastructure around the globe will significantly improve health and environmental outcomes, as well as increase collection of sewage for wastewater treatment. This should be accompanied by the connection of centralised wastewater treatment plants to anaerobic digesters and decentralised sanitation facilities or community toilets to micro- or small-scale digesters.
- Local governments should provide separate food waste collection to all citizens of towns and cities, and to rural communities where feasible. This increase in food waste collection should be met with increased AD capacity to process the new waste stream and convert it into biomethane to fuel the boilers, cookers and buses of the localities.
- Businesses above a certain size should be mandated to report and separately collect food waste for treatment. The biogas generated can then be upgraded to power their business and fuel their delivery fleets. Businesses powered by biogas can be certified with the biogas mark to signal their support for the AD industry.

<sup>9</sup> [www.imf.org/en/Publications/WP/Issues/2019/05/02/Global-Fossil-Fuel-Subsidies-Remain-Large-An-Update-Based-on-Country-Level-Estimates-46509](http://www.imf.org/en/Publications/WP/Issues/2019/05/02/Global-Fossil-Fuel-Subsidies-Remain-Large-An-Update-Based-on-Country-Level-Estimates-46509)

<sup>10</sup> [www.parliament.uk/business/news/2019/june/government-gives-details-on-setting-a-uk-net-zero-emissions-target/](http://www.parliament.uk/business/news/2019/june/government-gives-details-on-setting-a-uk-net-zero-emissions-target/)

<sup>11</sup> <https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/governance-energy-union/national-energy-climate-plans>

<sup>12</sup> [www.worldbank.org/en/programs/pricing-carbon](http://www.worldbank.org/en/programs/pricing-carbon)

<sup>13</sup> [www.ofgem.gov.uk/environmental-programmes/fit/fit-tariff-rates](http://www.ofgem.gov.uk/environmental-programmes/fit/fit-tariff-rates)

<sup>14</sup> [www.iea-biogas.net/files/daten-redaktion/download/publi-task37/digestate\\_quality\\_web\\_new.pdf](http://www.iea-biogas.net/files/daten-redaktion/download/publi-task37/digestate_quality_web_new.pdf)

<sup>15</sup> [www.gov.uk/government/publications/resources-and-waste-strategy-for-england/resources-and-waste-strategy-at-a-glance](http://www.gov.uk/government/publications/resources-and-waste-strategy-for-england/resources-and-waste-strategy-at-a-glance)

- Large farms should have nutrient recovery plans that recycle organic material through AD, including crop residues and manure. Agreements should be arranged in rural communities to collect and digest livestock manure and crop residues from small farms. Rural communities in more isolated geographies should be provided access to digesters to recycle their organic waste and provided with biogas stoves to use the biogas produced. Digestate produced can be applied as fertiliser, or upgraded, to recycle valuable nutrients back to the soil and displace inorganic fertilisers.
- Sustainability and greenhouse gas emissions criteria should be set for all agricultural production to ensure land is managed with due diligence to the environmental impact and energy crops can be integrated into production in the most sustainable way.
- Governments should incentivise widespread investment in refuelling networks for biomethane as a transport fuel and infrastructure for injection of biomethane into the gas grid. Developing the infrastructure network will encourage growth in AD and biomethane upgrading.

#### Policies from around the globe:

- South Korea increased food waste collection from 2% in 1995 to 95% in 2019 by banning food waste to landfill; introducing compulsory food waste recycling; charging for biodegradable bags; using smart bins that weigh food waste as you deposit it and charge residents accordingly; and introducing schemes to establish urban farms and community gardens.
- The European Commission introduced legislation in 2018 to oblige member states to roll-out source segregated food waste collection on households and businesses from 2023. This can be counted towards recycling targets only if treated in AD or composting.
- Specific policies that provide financial incentives have been effective in stimulating increased AD capacity in the UK and Germany. Long term security over incentives helps create a low-risk environment for the growth of the AD sector, as seen in Germany.
- Effective policies regarding the management of agricultural waste streams can incentivise appropriate treatment through AD, for example, Canada's Agricultural Waste Control Regulation in its Environment Act.
- Nutrient management policies can help protect surface water bodies from contamination, eutrophication, growth of algae and decreased oxygen level. India's National Biogas and Manure Management Program promotes the use of small-scale AD plants that use manure as feedstock and fuel domestic cookers, reducing deforestation for firewood and improving sanitation. Sweden has an advanced digestate quality standards programme.
- Germany, in its Biofuels Quota Act, has set a minimum share of biofuels to be sold in the energy market, and Chile has set a minimum requirement for the proportion of energy sourced from renewables, which has been increased to 20% by 2025.
- Feed in Tariffs have been introduced in Malaysia for the treatment of palm oil residues, and South Africa's 2019 national energy plan foresees incentives for renewable energy production.
- In Finland, biomethane is exempt from production and excise tax; in the Dominican Republic, equipment and accessories related to the installation of biodigesters are exempt from tax under the Renewable Energy Development Act; and in the UK a Climate Change Levy taxes businesses for energy use but they are exempt for energy sourced from renewables.
- Credits for renewable transport fuel are applied in Belgium, UK, USA, Italy, Sweden and Norway among others.

The WBA is a non-profit association dedicated to the development of biogas globally. We are available to offer services to countries, cities and industries wanting to know more about biogas, its technologies, the policies and incentives needed to ensure biogas is made a core solution to resolving global challenges around sustainable development, climate change and public health.

Lead Author: **Dr Sarika Jain** Contributors: **David Newman, Ange Nizhou, Harmen Dekker, Pharoah Le Feuvre, Hannah Richter, Frederic Gobe, Charlotte Morton, Rebecca Thompson**

