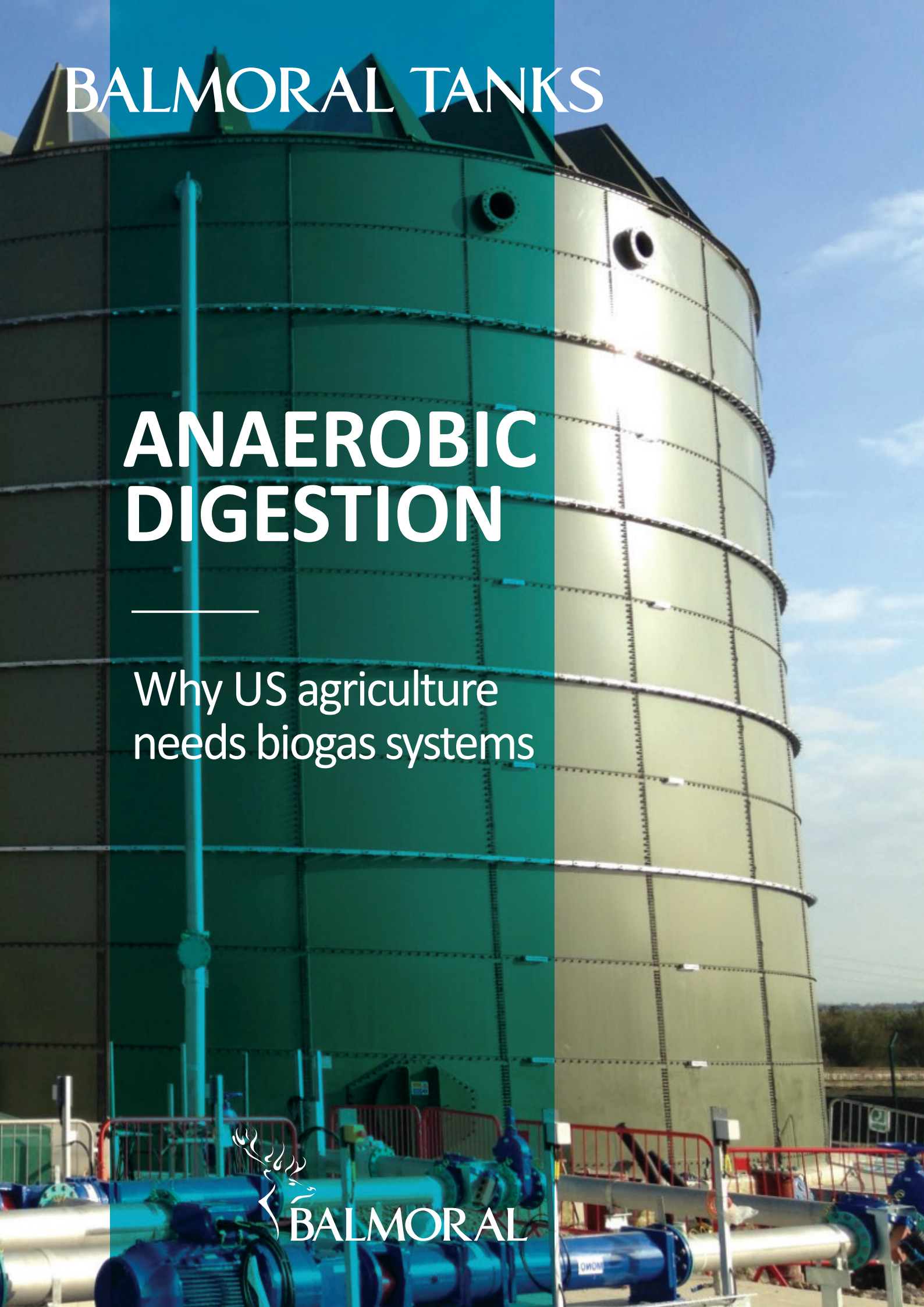
BALMORAL TANKS

ANAEROBIC DIGESTION

Why US agriculture needs biogas systems



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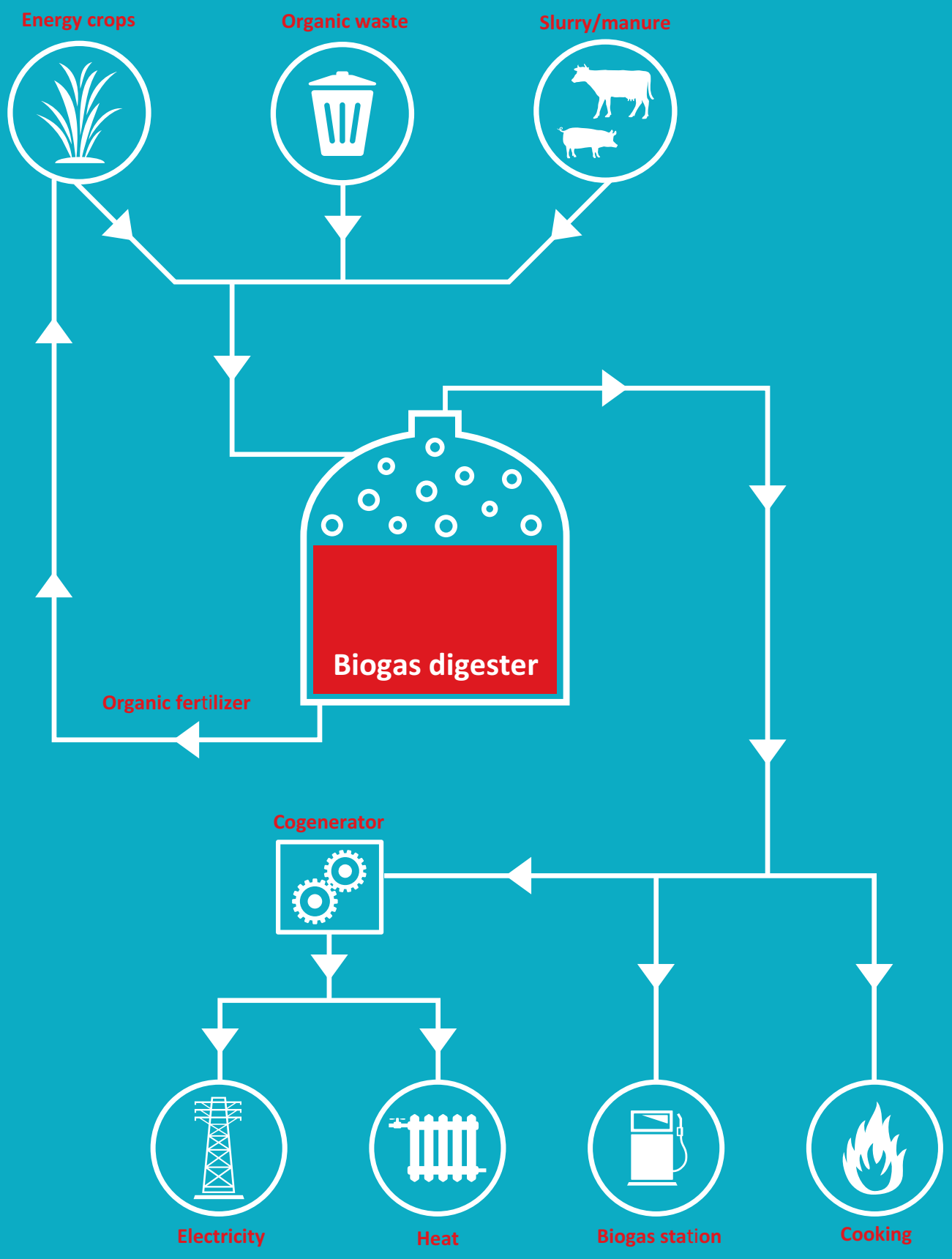
Anaerobic digestion

The process by which organic matter such as animal and food waste is broken down to produce biogas. This takes place in a sealed, oxygen-free tank called an anaerobic digester.



What is anaerobic digestion? How does it help US agriculture?

Anaerobic digestion is a process that converts farms' organic waste into methane biogas so it can be used for environmentally friendly heating and power.

You can transform any plant-based biomass into biogas. It could be crop residues, compost and food waste – along with livestock slurry, paper and wastewater.

This important renewable energy technology:

- creates free energy for farmers and communities
- provides lucrative surplus energy to sell to power companies
- significantly reduces the harmful emissions going into the atmosphere
- also creates digestate – rich in potassium, nitrogen and other nutrients – that can be used as fertilizer and soil conditioner.

So everybody wins.

How does anaerobic digestion take place?

Anaerobic digestion is a natural process. Naturally-occurring micro-organisms (mesophiles) break down plant and animal waste in the absence of air – just like they do in cows' stomachs. The bacteria digest biomass and create methane as a by-product.

Modern agriculture simply replicates this process on an industrial scale in large digester tanks. There are currently 2,200 of these biogas systems in operation across the USA – with the potential to add at least 13,500 more. All of them providing clean, renewable energy and lowering methane emissions.

Tried and trusted technology

Anaerobic digestion is nothing new. It has been occurring in nature for millions of years. This is how marsh gas is created – as discovered in 1776 by Alessandro Volta, the pioneering Italian physicist and chemist credited with inventing the battery. (Though in the 17th century, Flemish scientist Jan Baptista Van Helmont first determined that decaying organic matter could create flammable gases).

In 1859, the world's first anaerobic digestion plant was built in Bombay (Mumbai), India. By 1895, the English city of Exeter was using gas from sewage to power its streetlamps.

And for decades, modern sewage plants have used anaerobic digestion to generate electricity by creating and burning biogas. The electricity powering your computer or mobile phone right now may well have been generated by anaerobic digestion.

Global imperative: Why we need anaerobic digestion more than ever

Methane is naturally occurring – courtesy of marsh gas and the digestive systems of cattle, buffalo, deer, sheep, goats and camels. But it still has a huge impact on the planet: methane is 28 times worse than carbon dioxide at causing global warming – resulting in more frequent extreme weather events.

Sadly, most of the methane in the Earth's atmosphere is the result of human activity or influence. We generate more than 105 billion tonnes of organic waste globally every year: waste that could – and should – be used to generate cleaner, cheaper energy for agriculture, its customers, communities and other stakeholders.

Time is running out: a critical temperature rise of 1.5 degrees C is expected by the year 2040. Humankind has just 10 years to slow rising temperatures and stop the 1.5-degree increase from happening earlier, warns the UN's Intergovernmental Panel on Climate Change (IPCC), the group of scientists whose findings are endorsed by the world's governments.

World Biogas Association President David Newman said: “If we do not address methane emissions from organic wastes, all our efforts to tackle the climate crisis will fail.

“Anaerobic digestion is one of the ready-to-go, ready-to-scale technologies that can do this. The path we must take is clear.”

So isn’t it time US farmers started becoming net producers of clean biogas energy?

Generate all the free energy you need. Sell the surplus. Save the planet.

Why biogas is environmentally friendly

Biogas is 50-70% methane and 30-40% carbon dioxide – depending on the biomass used to create it. There are also trace elements of other gases. Biogas can produce heat and/or electricity.

Or you can upgrade it to pure biomethane by removing the carbon dioxide, other trace gases and water vapor – enabling you to pump it directly into the grid as renewable natural gas (RNG). This has the potential to replace up to 10% of US natural gas consumption.

RNG can also be converted to compressed natural gas (CNG) or liquefied natural gas (LNG) to power vehicles. Both gases are best suited to fleet vehicles that return to base for refuelling.

CNG generated from renewable feedstocks is so environmentally friendly that it is carbon negative. In Q1 2021, the California Air Resources Board reported that bio-CNG’s emission intensity was -16.57gCO2e/MJ. This made it the lowest average of any currently available vehicle fuel – including renewable electricity.

Little wonder then that growing numbers of US transport fleets are turning to near-zero-emission (NZE) natural gas vehicles (NGVs) and carbon-negative RNG. Matheson Postal Services (a subsidiary of Matheson Trucking) operates 95 NZE trucks on its mail routes – transporting 78,000lbs loads more than 16.4 million miles per year.

Methane that would previously have gone straight into the atmosphere can instead be put to good use, replacing polluting fossil fuels. Compressed natural gas derived from biogas reduces greenhouse gas emissions by up to 91% compared with gasoline.

New York City alone spends $400 million a year transporting 14 million tons of waste to incinerators and landfill. Diverting that waste to anaerobic digestion would turn a cost into a revenue-generating opportunity and help to clean up the atmosphere.

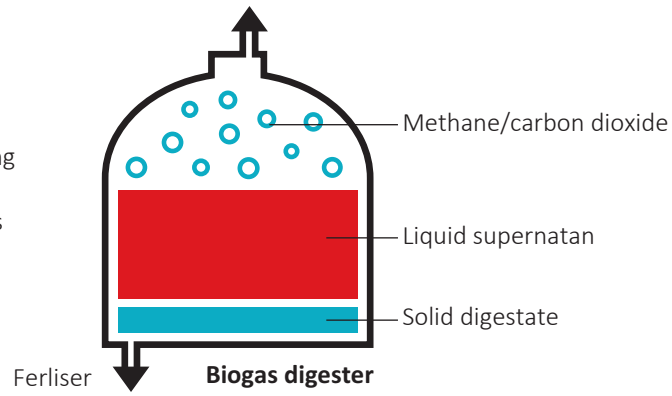
How do anaerobic digestion systems work?

Slurry and feedstock are pumped into the top of an AD tank. Then it is simply a matter of waiting for nature to take its course. And it does not take long.

Digestion times vary, depending on the nature of the feedstock and the type of digester. Typical durations range from 10-30 days, but they can be as short as five days or as long as 90 days.

At the end of the process, your AD tank will be filled with:

- (Top) methane and carbon dioxide – which you can pipe out
- (Middle) liquid supernatant – this is cleaner than the slurry which went in but you will still need to treat it before allowing it back into the environment
- (Bottom) solid digestate – which you can pipe out and use as nutrient-rich fertilizer.



Which types of biomass are best for anaerobic digestion?

Power grids around the world already depend on human waste as a source of methane for generating electricity. For that reason, you would assume that animal manure would offer an ideal opportunity for AD projects.

Yes, animal slurry can be used – but it's not the best source of methane/biogas. This is because much of the energy has already been lost: the cows have digested it and are consuming the energy themselves.

Cows are ruminant animals – their digestive systems are very different from our own. A cow's stomach is divided into four compartments. So the slurry is what's left after the cows have digested the grass four times…and much of the energy has been lost in the digestive process.

You will need to supplement the slurry with wet, sticky and energy-rich feedstock that hasn't been digested by cows. King Grass and Napier Grass are ideal.

Palm oil mill effluent (POME) is also good because it is dirty and full of energy. Transforming this highly polluting wastewater into clean biogas helps to mitigate the impact of the palm oil industry.

Anaerobic digestion is widely used in the treatment of POME. It is recognised as a Clean Development Mechanism (CDM) under the Kyoto protocol, the international treaty that extended the 1992 United Nations Framework Convention on Climate Change. Certified Emission Reduction (CER) can be obtained by using methane gas sourced from POME to create renewable energy.

Other forms of biomass can also be digested anaerobically. These include hooves, bone, skin and leather – but they need more aggressive mesophiles and more aggressive aeration.

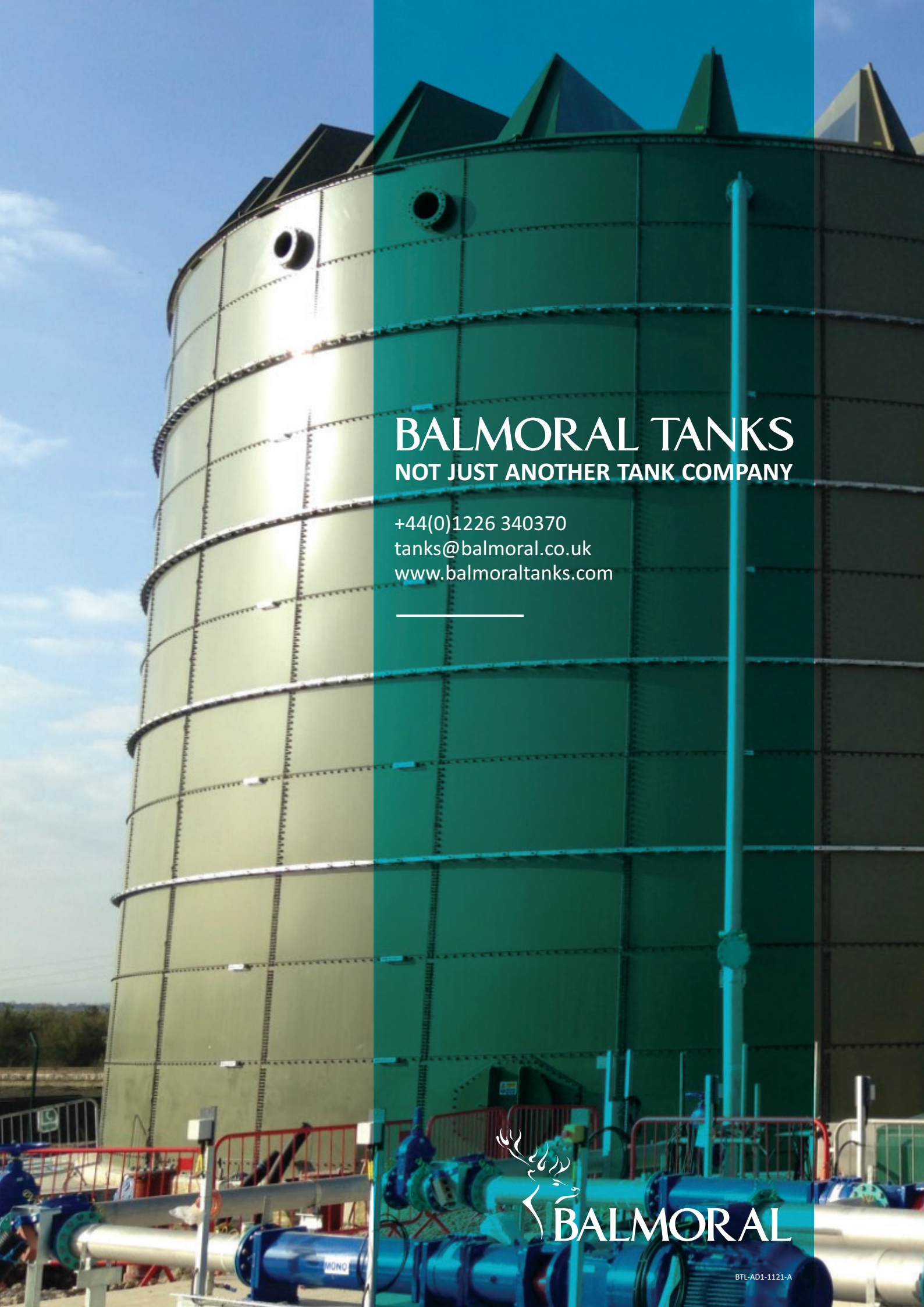
Find out more – Get expert technical advice

Balmoral Tanks is a global leader in the provision of digester tanks for AD plants. Its projects include some of the very largest digesters for multi-tank plants.

Balmoral has decades of experience. And since 2018, the company has invested more than $27 million in its 150,000sq ft state-of-the-art design and manufacturing facilities. They represent the most technically advanced production facilities in the industry, supported by unrivalled levels of expertise and service.

For this reason, many AD project co-ordinators, investors, designers and EPC contractors choose to specify Balmoral-built tanks for their anaerobic digestion plants.

Contact Balmoral Tanks now for expert technical advice.



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