

Build Back Better with Biomethane – the Circular Economy Green Gas

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The *Birmingham Biomethane Cluster* was launched by the *Institute for Design, Economic Acceleration and Sustainability (IDEAS)* based at [Birmingham City University](#) in 2020, with participating companies engaged from a range of businesses involved in biomethane production, distribution and deployment across the UK and internationally.

Biomethane is a lesser known circular economy green gas and energy dense fuel produced from naturally occurring organic waste materials – food, crop, animal and human wastes. One kilo of biomethane is equivalent, in energy output terms, to one litre of diesel, with the fuel providing a real alternative to fossil fuels causing climate change through carbon dioxide and other greenhouse gas emissions. It is already available for use in transport, being especially practical as an alternative for heavier vehicles – HGVs, trains, trams, buses, refuse trucks, cement mixers, tractors, as well as for use in heating and energy generation.

Many of the companies involved in the *Birmingham Biomethane Cluster* are headquartered in the West Midlands, highlighting the region's depth of knowledge and expertise in production of this renewable circular economy fuel. These companies include [Severn Trent Water](#), [Severn Trent Green Power](#), [Cadent Gas](#), [Air Liquide](#), [CNG Services](#), [CNG Fuels](#) and [Tyseley Energy Park](#). Academic expertise is provided by Birmingham City University's [Professor Lynsey Melville](#), who leads the Bioresource and Bioenergy Research Group (BBRG), Harper Adams University's [Professor Mike Theodorou, Chair of the Centre for Anaerobic Digestion and Fermentation Technology](#) and [Dr Marie Kirby who has researched optimisation of energy production through anaerobic digestion](#), together with Aston University's [Professor Patricia Thornley, Director of the Energy & Bioproducts Research Institute](#). A host of smaller innovative companies have been working to develop technologies and applications in this area too including [Advanced Anaerobics](#), [Biomethane Ltd](#), [G-Volution](#) and [Ultra Light Rail Partners](#).

Earlier in May 2021, Inger Andersen, UN Under Secretary-General and Executive Director for the United Nations Environment Programme (UNEP) stated, ["Cutting methane is the strongest lever we have to slow climate change over the next 25 years and complements necessary efforts to reduce carbon dioxide. The benefits to society, economies, and the environment are numerous and far outweigh the cost."](#)

The UNEP Report, [Global Methane Assessment: Benefits and Costs of Mitigating Methane Emissions](#), highlighted that by cutting human-caused methane emissions by 45% this decade would keep warming beneath a threshold agreed by world leaders. Reducing human-caused methane emissions was highlighted as one of the most cost-effective strategies to rapidly reduce the rate of warming and contribute significantly to global efforts to limit temperature rise to 1.5°C. This would avoid nearly 0.3°C of global warming by the 2040s and complement all long-term climate change mitigation efforts. It would also prevent, on an annual basis, 255,000 premature deaths, 775,000 asthma related hospital visits, 73 billion hours of lost labour from extreme heat, and 26 million tonnes of crop losses globally.

The *Birmingham Biomethane Cluster* advocates capturing methane emissions to harness this valuable energy source as the most effective manner of cutting methane emissions.

This is precisely what Severn Trent Water and sister company, Severn Trent Green Power, have been doing along with CNG Services and CNG Fuels – companies which are all involved in the *Birmingham Biomethane Cluster*.

Severn Trent Bioresources, which runs 27 AD sites servicing 1008 sewage treatment works, has been developing anaerobic digestion treatment of the waste from 8.1m people in the Midlands to recover two very valuable materials – Biosolids which return nutrients to farmland and Biogas for renewable energy production.

In February 2020 Severn Trent plc announced their 2030 Triple Carbon Pledge to deliver:

- 100% of their energy sourced from Renewable generation

- Net Zero Carbon emissions

- 100% Electrical fleet (where technology allows)

The company has promptly met the first challenge, envisaging a very substantial role for biomethane production and use in assisting them reach their remaining targets – as a power generator, heat generator and a vehicle fuel.

At the most recent meeting of the *Birmingham Biomethane Cluster* on 14th May, two case studies covered by Severn Trent Water outlined their current biomethane production. The company currently produces just under 600 gigawatt hours (GWh) per annum of biogas from anaerobic digestion, with 118 GWh of this converted into biomethane and injected into the grid (the remainder is used for CHP generation). This amount of biomethane is equivalent to providing heating for approximately 10,000 homes or powering 240 HGVs they estimate. If Severn Trent Water converted all of its biogas into biomethane, they could heat approximately 50,000 homes or power around 1,200 HGVs. The current combined biomethane produced by both Severn Trent Water and Severn Trent Green Power would heat 22,000 homes or power over 500 HGVs.

The Severn Trent treatment plant at Minworth, servicing just over 2m people, produces 1400 normal meter cubes per hour (nmch) of biomethane. Commissioned in 2014, Minworth was the first commercial sewage to biomethane plant in the UK. It was also the first to inject biomethane into the national gas grid working with Cadent Gas.

A water scrubbing system was selected to produce biomethane appropriate for injection to grid at Minworth, having been chosen as a well-established technology and widely used throughout Europe with a low heating requirement and a 97% methane recovery potential.

The Finham sewage treatment works in Coventry processes waste from 1m households. First commissioned in early 2021, it produces 1500 nmch of biomethane. It represents Severn Trent Water's fourth sewage to biomethane production plant drawing on a membrane upgrading system as a proven technology in use in the UK since 2016. This method of biomethane production has the advantage of a higher methane recovery rate at 99%+ with the potential for CO₂ recovery, not possible through water scrubbing systems.

Like other companies operating HGV fleets on biomethane, including Waitrose, John Lewis, Hermes and most recently, Royal Mail, Severn Trent Water are also trialling the use of biomethane for their fleet of 90 tankers in seeking to reach 2030 targets. The company is aware of a continuing role for

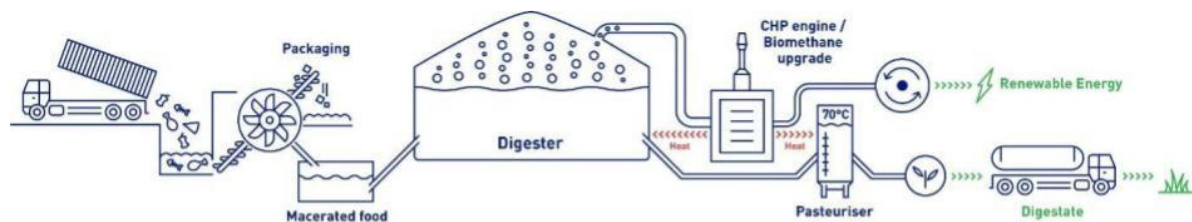
steam reformation of methane in the production of Hydrogen. However rather than using fossil fuel methane, currently used in the production of around 96% of all hydrogen in use worldwide, their ambitions include using renewable biomethane as a basis for hydrogen production.

Severn Trent Water is currently developing three new Advanced Anaerobic Digestion (AAD) sites, combining these with new biomethane plants to join the existing biomethane production in Birmingham and Stoke on Trent. Two of these sites have construction underway, with their gas to grid plant already on stream. They are also planning to commission a plant using CO₂ from the biomethane upgrader, or a CHP exhaust, to produce a pelletized fertilizer product.

Whilst Severn Trent Water handles the regulated business of supplying water and recycling human waste safely, Severn Trent Green Power was established to set up and run anaerobic digestion facilities running on food and crop waste as a separate renewables subsidiary of the PLC & water business. Severn Trent Green Power is not regulated by Ofwat and works as a separate organics recycling and renewables production business. In late 2018 this business acquired Agrivert which had built, owned and operated five food waste AD plants as well as five compost plants, with Agrivert having previously contracted two food waste AD plants to Severn Trent Green Power.

Severn Trent Green Power now owns and operates seven plants in Oxfordshire, Berkshire, South Wales, North and West London and East and West Birmingham, with all its plants following the same design drawing on their proven track record. An eighth plant is going through the final stages of commissioning in Derby.

Through these plants the company has capacity to process food waste from over 4 million households or 400,000 tonnes of food waste in total.



The process involves tipping food waste into a bunker, passing this through the 'mouth' enabling the separation of any packaging or contamination from the organic material and converted into a soup. The soup is fed, in turn, into one of five digesters with long retention times of around 90 days, helping to ensure stability, assisting gas extraction and improving quality of the resulting digestate.

The biogas is fed either into a CHP to produce electricity or further processed to inject directly into the gas grid – either way producing renewable energy.

Over half of the feedstock input is from local authority household waste – with Severn Trent Green Power servicing over 50 local authorities or 25% of the country's household food waste. The remainder of Severn Trent Green Power's work applies to servicing food manufacturing, major trade waste collectors, many independents and large supermarkets, as well as the commercial sector. The business estimates that mandatory food waste collections, due from 2023, will yield sufficient food waste to power 20-30 additional AD plants across England.

Food waste collection is already mandatory in Scotland and Wales. [The Scottish government began rolling out food waste recycling to all households in 2011](#) leading to a drop in household food waste of 7% across Scotland since 2009 compared with a 4.2% rise in household waste from 2012 to 2015 across the UK as a whole. Just three years ago, FareShare branches in Scotland received 350 tonnes of surplus food from retailers and manufacturers, which increased by 443% to 1,900 tonnes in 2016. In 2017 volumes grew 43%, more than double the 19% growth across the rest of the UK.

Since mandatory food waste collections in Scotland a [survey published in 2019 'Scottish anaerobic digestion and biogas sector survey 2017'](#) showed that overall the AD sector in 2017 generated 217 million m³ of biogas, with significant growth in the industrial and farming sectors accounting for 68% of the total. The survey showed food waste accounted for an overall total of 175,951 tonnes, compared with an overall total of 141,028 tonnes (composting and AD) processed in 2014.

Feedback from stakeholders engaged in the project pointed to other areas with the potential for significant development in the future:

- The industrial sector was considered to have significant room for growth, with many thousands of tonnes of potential feedstock currently being discharged to sea and/or land.
- There was potential in terms of on-site AD at the smaller, more remote distilleries, dairy food processors, brewers etc. The energy value of food residues was not recognised by food companies and much greater effort was needed to highlight what can be done with the opportunity.
- Municipal waste collections, including households, indicated participation levels could be significantly improved. It was estimated, for example, that around 29% of residual, household black bag waste consists of food waste and that in 2017 over one million tonnes of household waste was landfilled. This situation, along with the forthcoming landfill ban of organic waste streams (2021) suggested there was real potential in terms of recovering significant tonnages of food waste for anaerobic digestion (and/or composting).
- Stakeholders identified the importance of increasing the amount of awareness-raising work, to improve participation levels and reduce contamination such as food packaging.

In terms of fuel distribution, companies such as CNG Services Ltd (CSL) have been providing consultancy, design and build services to the biomethane industry, all focused on reducing Greenhouse Gas (GHG) emissions. In the past 10 years their efforts have led to an estimated reduction in CO₂ emissions of 17,500,000 tonnes through:

-Biomethane injection to the gas grid

-Running trucks on Bio-CNG

-Acting as developer and design and build contractor for the Highlands Bio-CNG Project

Modelled Well-to-Wheel (WTW) emissions for Bio-CNG trucks indicate around 85% GHG emissions saving compared to diesel equivalents. Biomethane and fossil gas are chemically identical with the

buying and selling of renewable gas evidenced by certificates and mass balancing via the gas grid (similar to that for green electricity). For manure feedstock the GHG saving is over 100% because of avoided methane emissions.

Whilst many companies are already operating Bio-CNG vehicles – many others could still do so. For example, all construction around Birmingham, including HS2, could use cement mixers run on Bio-CNG as Iveco, Mercedes and Scania are all producing these vehicles.

A national network of stations is being developed by CNG Fuels and Foresight Group, including the Erdington depot in Birmingham, with all located conveniently close to the motorway network. The big advantage of Bio-CNG is that GHG savings can be achieved now without waiting for any new technology developments.

Examples of HGVs, tractors, cement mixers and other heavy vehicles run on biomethane



National Network of Bio-CNG fuelling depots across the UK

Operational 2020

- Leyland
- Crewe
- Northampton
- Warrington
- Erdington
- Knowsley

Operational 2021

- Larkhall
- Eurocentral
- Castletford
- Corby
- Newark
- Avonmouth (North)

Operational 2022

- Avonmouth (South)
- Swindon
- Leeds
- Bangor
- Stoke
- Milton Keynes
- Magor
- Livingston
- Newton Aycliffe
- Bridgwater
- Kent

