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WORLD BIOGAS ASSOCIATION

ANAEROBIC DIGESTION MARKET REPORT

UNITED STATES OF AMERICA

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Introduction

With the diversity and volume of feedstock available, the United States of America's (USA's) anaerobic digestion (AD) industry is well developed and expected to grow further. The industry is now well established and is being driven by regulatory initiatives such as the Renewable Fuel Standard and organics recycling requirements as well as by industry and local authority initiatives.

Current status

- According to the American Biogas Council (ABC), there are currently over 2200 digesters in the US with an installed capacity of 977MW. Of these, 1,269 are at wastewater recovery facilities, 636 capture landfill gas, 259 treat dairy or swine manure, 39 treat only food waste, and the rest treat industrial waste.

- The increase in value of credits ('renewable identification numbers' or 'RINs') from the advanced cellulosic section of the Renewable Fuel Standard coupled with low natural gas prices for generating cheap fossil electricity has made biogas projects that produce vehicle fuel much more economically attractive to develop than biogas projects that produce electricity in most locations.

- Co-digestion of foodwaste with wastewater sludge at wastewater treatment plants is driving up both methane yield and profitability for early adopters. According to the ABC, some systems are reporting a twofold increase in biogas yield from adding just 10% more food waste, thus turning food waste from municipalities, restaurants, grocery stores, food processing facilities and agriculture from a liability into an asset.

- Livestock farms in the US tend to be large in size: 44% of the dairy cows in the US are in farms with herds of 1,000 cows or more. 90% of hog and pig farms have herd sizes of 2,000 or more. Incorporating AD into the operations of these large-scale farms can be economically feasible and is environmentally necessary.

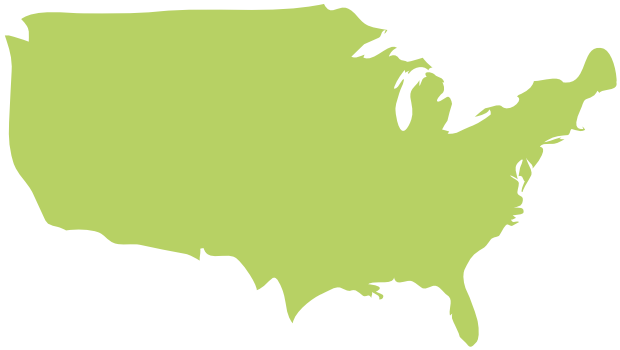
Potential

- **Co-digestion of wastewater sludge and food waste:** Foodwaste is a valuable feedstock for an AD facility as it has high methane potential. The 1,269 wastewater treatment plants currently operating anaerobic digesters on-site (around 8% of over 16,000 treatment plants), can often be made more profitable by adding food waste from nearby communities. This in turn boosts the collection of food and organic waste from these communities by making such collection more environmentally and economically viable. This could be an effective strategy in cities and states with a high population density (such as District of Columbia, New York City, Rhode Island and Massachusetts).

- **Biomethane:** Biomethane is now included in the Renewable Fuel Standard for vehicular fuels. This is likely to stimulate the upgrading of biogas to biomethane for use in vehicles and, as the technology becomes more widespread, for feeding into the gas grid.

- **Animal manures:** Iowa, North Carolina and Minnesota account for 56% of the 66 million hogs/pigs in the US. California and Wisconsin alone have 3.1 million dairy cows – by comparison, the UK has a total of 1.89 million dairy cows. Most of the US poultry industry is concentrated in the south-eastern part of the country. With this scale and concentration of livestock, the opportunity for reaping the benefits of digesting animal manure in the US is immense. Farms are coming under increasing scrutiny for their methane emissions and the nutrients they need to manage in manure. Market forces are therefore being created that will encourage more and more digesters to be built.

- **Crop residues:** Minnesota, Iowa, Illinois, North Dakota, Nebraska and Arkansas have high availability of crop residues from corn, wheat, and soybean, which can all be digested for biogas production (NREL, 2014).



Drivers

- **Renewable Fuel Standard:** Biomethane, usually called in the US Renewable Natural Gas or Renewable Liquefied Natural Gas if used as a vehicle fuel, can be used to comply with the Renewable Fuel Standard. Approved projects can generate credits that can be sold to oil companies and fuel blenders on an open market in addition to the sale of the fuel itself. This revenue opportunity combined with the very low electricity rates that US utilities are willing to pay, is now driving most new plants to upgrade biogas to biomethane and many existing electricity-generating biogas systems to consider switching to biomethane.

- **Organics recycling requirements:** Six US states (California, Vermont, Connecticut, Massachusetts, Minnesota and Rhode Island) and four municipalities (New York City, NY, Austin, TX, San Francisco, CA, and Seattle, WA) have banned or limited the volume of organic waste that can be sent to landfill, requiring it be recycled in biogas or composting systems instead if there's an operational facility nearby and if that facility is willing to take the organic material. An ABC factsheet summarising US state and local policies regarding organic recycling can be found here. **http://bit.ly/2hAOXey**

- **Federal food waste target:** In 2015, the US Environmental Protection Agency and Department of Agriculture announced a 50% food waste reduction goal by 2030 (USEPA, 2015).

- **Funding support:** Multiple federal and state initiatives such as the Rural Utilities Services and Environmental Quality Incentives Program provide funding, loan guarantees and technical support for the set-up and operation of AD plants.

Barriers

- Uncertainty over federal regulatory requirements
- Political uncertainty
- Wide availability of inexpensive natural gas and correspondingly low electricity rates
- Lack of willingness and very high costs from utilities for electricity and gas interconnection
- Lack of awareness of the benefits of biogas among investors, policy makers and the public
- Fragmentation and inconsistency in federal, state, and local policies
- Lack of mature markets for greenhouse-gas-reducing and non-energy products such as soil improvers, pelletised and pumpable fertilisers, and feedstock for plastics
- Lack of full valuation of the non-energy benefits of anaerobic digestion
- Little access to low-cost financing.

CASE STUDIES

Pixley Biogas, California (AgWeb, 2015)

- **Inputs:** Cow manure from a dairy (90%) and miscellaneous industrial and municipal waste.
- **Outputs:** Biogas is used as a substitute for natural gas to power Calgren Renewable Fuels' ethanol production. The digestate is returned to the dairy farm, solid fraction is used as bedding for the cows, and liquid fraction is used as fertiliser for field crops.
- **What is unique:** The arrangement at this plant is the first of its kind. Agricultural waste in the form of dairy manure is used to generate renewable energy in a biogas plant; this renewable energy is used in turn to power a production facility that produces ethanol, which is used as low carbon vehicle fuel.This cooperation has resulted in:
  - A reduction in emissions of 15,000 tonnes of CO_2 per year in the form of avoided emissions from manure and substitution of fossil-fuel-based energy.
  - 90 million gallons of water being reclaimed.
  - The creation of 46 temporary jobs during construction and two full-time permanent jobs (California Energy Commission, 2016).

City of Gresham, Oregon (ABC, 2016)

- **Inputs:** 13 million gallons of municipal sewage, 10,000 gallons per day of fats, oils and grease (FOG) from restaurant grease traps and food industry waste.
- **Outputs:** The electricity generated covers 92% of the energy needs of the wastewater treatment plant, with the remaining being met by a solar array. The hot water is used to meet the thermal requirements of the plant processes and heating on-site buildings.
- **What is unique:**
  - The wastewater treatment plant has saved an estimated $500,000 per year in energy costs.
  - The plant has generated additional revenue of $250,000 per year in tipping fees by accepting FOG.
  - The digestate is applied to agricultural land at no cost to the farmers.

"THE US BIOGAS INDUSTRY CONTINUES TO MARCH AHEAD WITH NEW SYSTEMS COMING ONLINE AND DEVELOPERS FILLING THEIR PIPELINES WITH OPPORTUNITY. CURRENTLY, MOST INTEREST IS IN BIOGAS TO RNG/BIOMETHANE PROJECTS TO TAKE ADVANTAGE OF THE RENEWABLE FUEL STANDARD, WHICH CREATES EXTRA REVENUE-GENERATING CREDITS. WHEN RNG IS USED FOR VEHICLE FUEL IT CAN BE WORTH UP TO TEN TIMES MORE THAN THE GAS ITSELF.

A LOT OF ATTENTION IS ALSO BEING PUT ON GENERATING REVENUE FROM DIGESTATE, WHICH WE THINK OUR DIGESTATE CERTIFICATION PROGRAM WILL HELP WITH, AND ON INCREASING THE KNOWLEDGE OF OPERATORS TO SMARTLY HANDLE COMPLEX AND VARIABLE MIXTURES OF ORGANIC MATERIALS.

WE STILL HAVE A CRITICAL NEED FOR LONGER-TERM POLITICAL AND POLICY CERTAINTY AT A NATIONAL LEVEL, PARITY NOT ONLY WITH FOSSIL FUELS BUT ALSO NOW WIND AND SOLAR, AND MORE ACCESS TO LOW-COST FINANCING."

Patrick Serfass, Executive Director, ABC

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American Biogas Council (2016): *City of Gresham Cogen and FOG Receiving Station Expansion project – Municipal Biogas Project of the Year.* **http://bit.ly/2sOaZmF**

California Energy Commission (2016): *Pixley Biogas, LLC, Junio Dairy and Calgren Renewable Fuels partner to produce the lowest carbon footprint ethanol in California.* Accessed on 01/06/2017. **http://bit.ly/2rHBnik**

Commercial organics recycling requirement:
- Factsheet: **http://bit.ly/1Ypuevg**
- California: **http://bit.ly/1FwEeGA**
- Vermont: **http://bit.ly/1Pr6nnp**
- Massachusetts: **http://bit.ly/1vdgfHV**
- Connecticut: **http://bit.ly/1YomzNc**

National Renewable Energy Laboratory (2013): *Biogas potential in the United States.* **http://bit.ly/2sJHdzO**

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Solid Waste Association of North America (2016): *Food Waste Diversion Programs and Their Impacts on MSW Systems.* **http://bit.ly/1Q0Vsq4**

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United States Environment Protection Agency (2015): *EPA and USDA Join Private Sector, Charitable Organizations to Set Nations First Goals to Reduce Wasted Food.* **http://bit.ly/2sOcJw0**

Water Environment Federation (2015): *Biogas Data: Water resource recovery facilities with operating anaerobic digestion.* **http://bit.ly/1OupJqb**

Special thanks to:
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