

# How to Profit from Biogas Market Developments

GIA Industries White Paper



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# Introduction



- The global megatrends such as climate change are driving the increased adoption of renewable energy sources in general, whereas the price volatility, supply issues and environmental hazards of fossil fuel production are about to accelerate the pace in the investments of non-fossil fuels production in particular.
- Biogas, the most sustainable of biofuels, is in a starting point of an exponential market growth curve.
- This paper will cover the latest developments and future scenarios of the rapidly developing biogas business, starting with a global outlook and going through special market characteristics of Europe, USA and Asia Pacific.

## Concepts and abbreviations

Anaerobic Digestion	Anaerobic metabolic processes caused through microbial enzymatic activities
AD	Anaerobic digester. An installation to produce biogas with anaerobic digestion of organic material
Biogas	A combination of methane, CO <sub>2</sub> and trace gases released during anaerobic digestion
Distributed Generation	Generating electricity from many small sources
WWTF	Wastewater treatment facility
FIT	Feed in tariffs

# Executive Summary

# Executive Summary

A company with the right expertise and timing can capture it's share of the billions that are invested in the infrastructure in the coming years

## Primary profiteers of biogas industry growth

- Anaerobic digester providers, especially those in Asia today
- Biogas condensation and upgrade technology developers
- Centralized and specialized plants producing, utilizing and distributing biogas

Under an optimistic scenario, the 2 Billion EUR plant installations business to grow up to 25 Billion by 2020.

Global suppliers to profit out of increased demand for components, services and chemicals

## Secondary profiteers

- Suppliers of power plants and process equipment
- Maintenance, service and certification businesses
- Companies specialized in environmental management
- Chemical companies developing the production yield and efficiency

# Executive Summary

As a global trend, the larger sites will improve the efficiency of power generation, profitability of biogas upgrade and the utilization of by-products

“Laws similar to German model have lead to growth in other markets as well.”

*Andrea Horbelt, European Biogas Association*

The US market to provide innovative applications and new business models

European companies and technologies will be the ones to watch between 2010-2015

Asia will be the main growth area, installing basic sites on WWTF's and landfills

“Price volatility of gas and oil will be the main drivers for the biogas industry; a sufficient price increase of gas and oil will make biogas profitable everywhere!”

*Kim Söderman, Finnish Biogas Association*

# Global Outlook



# Global megatrends drive the biogas growth

## Biogas industry growth



**Inevitable end of fossil oil and gas**



**Climate change**

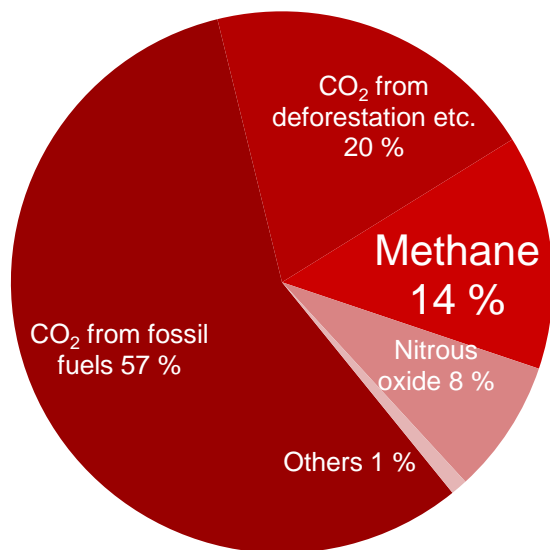


**Increased utilization of technology**

## Biogas - what's in it for me? (1/2)

A chance to reduce both organic methane and fossile CO<sub>2</sub> in the atmosphere

### Global Greenhouse Gas Emissions



Source: US Environmental Protection Agency

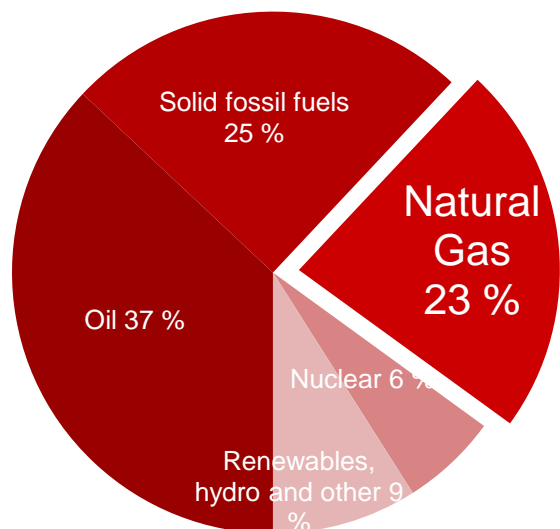
Methane, key component of biogas is 21 times a more powerful greenhouse gas than CO<sub>2</sub>. **During the incineration of biogas, methane is turned into CO<sub>2</sub> and water, thus reducing the negative impact to the climate.**

A chance to profit out of emissions trade carbon credits and government subsidies

## Biogas - what's in it for me? (2/2)

A chance to reduce both organic methane and fossile CO<sub>2</sub> in the atmosphere

### Global Primary Energy Production



Source: US Environmental Protection Agency

Due to the identical chemical composition (methane) upgraded biogas can be used as an alternative to all existing natural gas applications

A ready-to-use, economically sustainable source of energy and a superior second generation transportation fuel!

“Biogas has better yield per Ha than ethanol or biodiesel, making it the most sustainable of biofuels.”

*Kim Söderman, Finnish Biogas Association*

# Agriculture shows greatest potential in biogas

75 %\* of the biogas potential is in the anaerobic digestion of agricultural crops, by-products and manure



17%\* in municipal and industrial organic waste



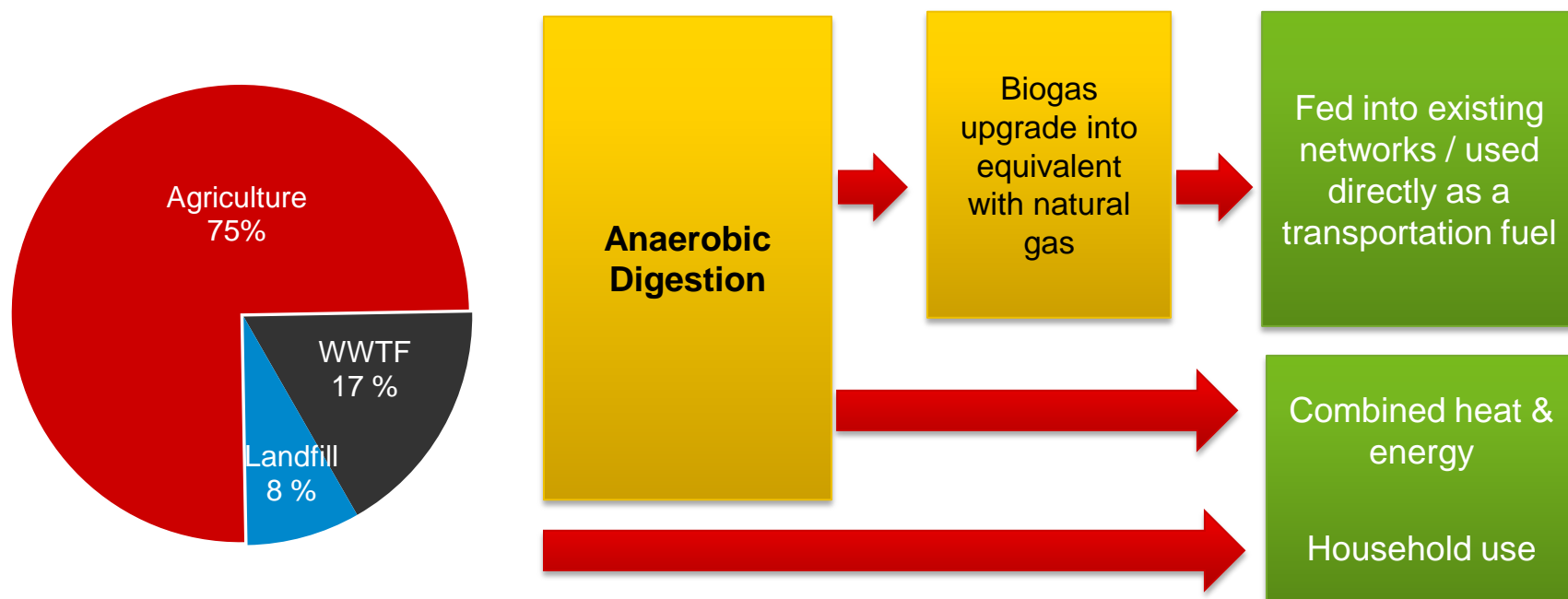
8%\* in sewage WWTF's



*\* The higher utilization rate of farmland as an energy resource could increase the share of manure, agricultural crops and by-products to 85%, leaving organic waste a 10% and WWTF's a 5% share*

*Source: Biomass Magazine, Global Water Intelligence, American Biogas Council, Frost And Sullivan, European Biomass Association, Eurostat, Iowa State University*

# Current bottleneck of improved biogas utilization is the cost of upgrade technologies



To date only **7 %** of the plants in Germany are feeding the gas directly in the existing natural gas network.

# Global players to aim at technology and services to secure profit & positive image

## Drivers and constraints



- Climate change
- The end of fossil oil and gas
- Increased utilization of technology

- Lack of long term subsidies
- "Food to energy" in developing countries
- "No in my backyard" effect

## Reproducible technologies and services for locally operating biogas producers:

- Improvement of solid waste and sewage treatment processes
- Process development of anaerobic digestion
- Technology for the production of heat and energy out of biogas
- Upgrade of biogas to suit existing natural gas applications
- Installations to extract chemicals such as CO<sub>2</sub>
- Condensation of upgraded biogas into liquid biogas

# With many potential routes to market, where do companies target limited resources?



1

**Improvement of solid waste and sewage treatment processes:**

*Where does it take place today?*

2

**Process development of anaerobic digestion:**

*Is there a technology jump in sight?*

3

**Technology for the production of heat and energy out of biogas:**

*What size of power plants is required?*

4

**Upgrade of biogas to suit existing natural gas applications:**

*Will there be biogas refineries?*

5

**Installations to extract chemicals such as CO<sub>2</sub>:**

*Is this a business opportunity?*

6

**Condensation of upgraded biogas into liquid biogas:**

*Who to profit out of higher energy concentration?*

# Market Characteristics

## Europe



## The EU-wide targets to fight the climate change and the existing infrastructure boost the business

- A target to **reduce greenhouse gases** by 20% by 2020
- **Transportation fuels need to be blended with renewables** at an accelerated rate
- The initiatives are implemented through **national legislation**

### EU Targets

Biogas capacity worth over 2 modern nuclear power plants

- Arable land available also for **non-food plants**
- **High tech** industry players in energy, chemistry and automotive industry
- A well-established **natural gas network**

### Infrastructure

# Germany, the biogas market leader, runs half of Europe's 9,000 biogas plants

- Most of the gas is currently produced by **independent farmers out of biomass**
- A **feed-in tariff** (FIT) ensures a reasonable payback time for investments (4-5 years)
- Existing **natural gas network** accepts upgraded biogas
- **Larger, more centralized** sites are being built
- Biogas as a transportation fuel is tax free

## Key outcomes of the German model

1. Process know-how & **global players** in the biogas plant installations market eg. Envitec Biogas, Schmack Biogas and Biogas Nord
2. The rural areas have a **new source of income** and jobs as the profitability of the agriculture in general is decreasing
3. Other European countries are starting to **copy** the German model

# Subsidies and country-specific strategies

FIT's exist in most EU countries - their efficiency is rated 7 times higher to other government support



Second generation biofuels such as ethanol and biodiesel are blended with fossil fuels. The existing fuel distribution infrastructure supports liquid fuels over gas.



The utilization of biogas as a transportation fuel is neglected

## Sweden: Innovation



- Community buses increasingly using biogas
- Liquid biogas to enable long distance transportation
- Technologies to extract chemicals out of biogas

## Poland today is "Germany in 1990"



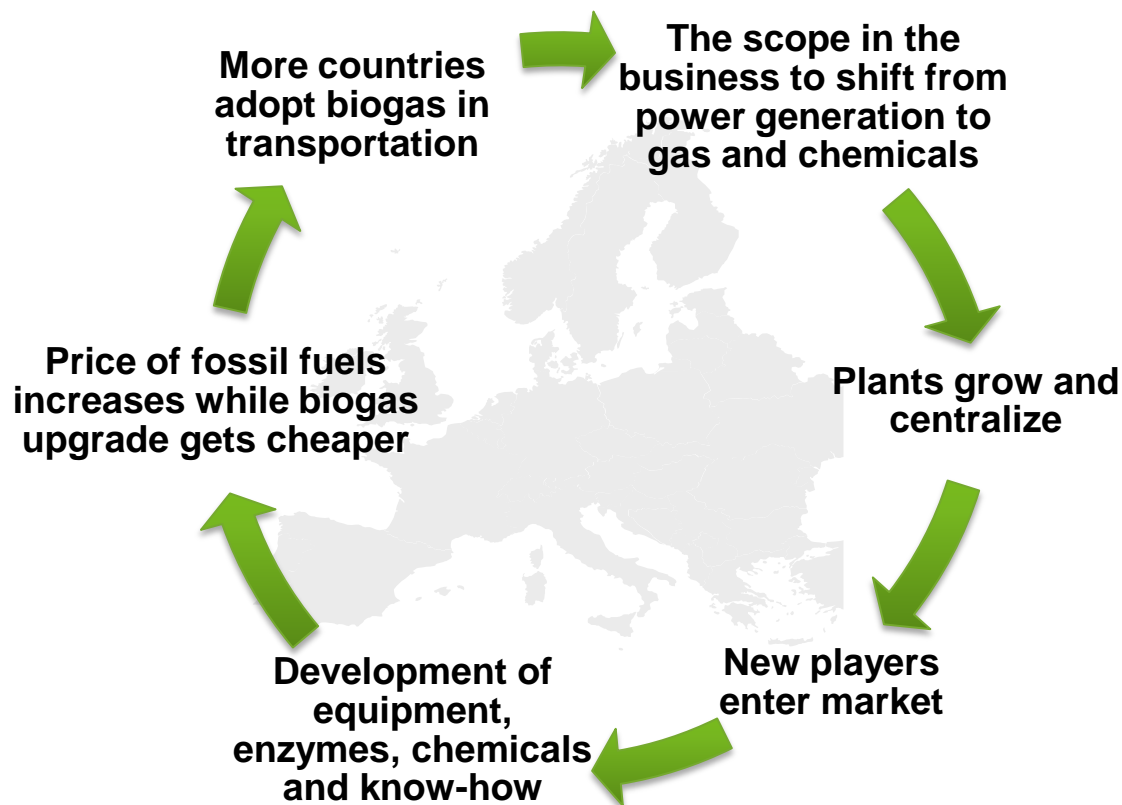
- Limited biogas production
- Excessive food production and wealthy resources of arable land
- Good infrastructure and an existing natural gas network in place
- A need to find alternatives for imported natural gas

# A bright future for European high tech players

The market in Europe to **grow at a two-digit rate.**

The main growth will take place in **refinery projects** and **>1MW power plants.**

The **share of exports will increase** from the current 10 -15%.



# Country trends highlighted by industry experts

“There’s a biogas boom in the UK. Poland and Ukraine (non-EU) are showing growth. Swedish market is interesting due to innovations.

Germany potentially to replace 10-20% of natural gas with biogas.”

*Jukka Rintala, Jyväskylä University*

“Poland has lot’s of plans and potential but so far not that much action. Denmark and Norway are rising, so is Sweden, at a high level.”

*Kim Söderman, Finnish Biogas Association*

“Italy is a possible growing market in regards of biogas utilization in transportation, Sweden as well – City buses running on natural gas. UK, France, Spain & Italy adopting parts of the German model.”

*Andrea Horbelt, European Biogas Association*

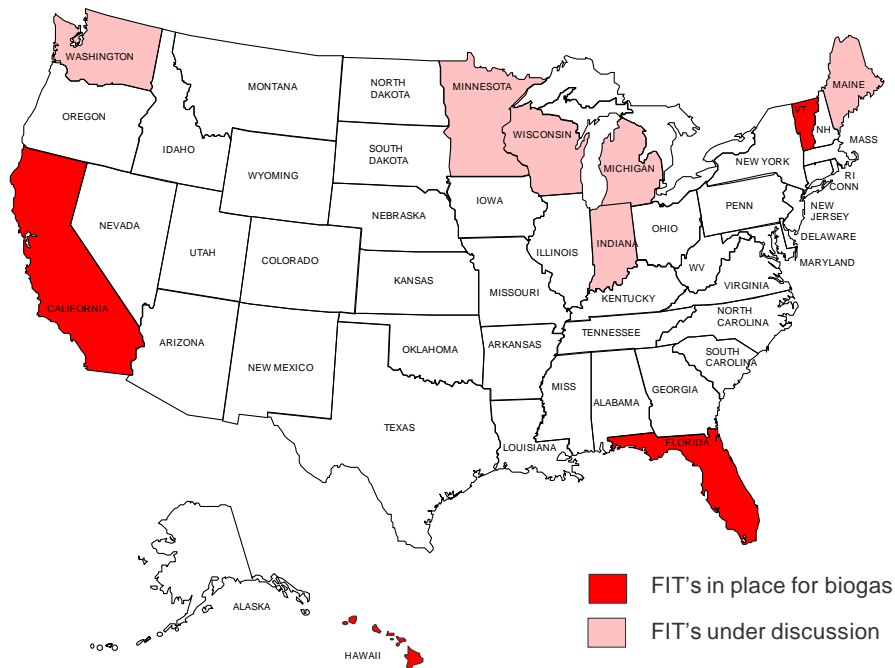


# Market Characteristics

USA

# Private sector beginning to leverage the biogas industry

- European-style FIT's for biogas in the US: California, Florida, Vermont and Hawaii
- The FIT's are limited to a certain size of power plants as private companies and individuals are encouraged to feed electricity into the power grid
- Followed by the examples of Europe and Ontario (Canada), local governments are discussing FIT's in Wisconsin, Indiana, Michigan, Minnesota, Maine and Washington.



# Environmental management is the driver to install new AD's and landfill gas collectors

US farms produce 4x manure than Germany, but have today only 100 - 200 manure AD's.

The total market size for biogas manure in the US would be 8000 AD's; capacity that equals 2% of all electricity production.

10-year payback times not attracting investors for the energy crop AD's.



50% utilization rate of landfill gas.

10% utilization rate in WWTF AD's

In the absence of FIT's in most states, the environmentally driven projects in municipalities and industry are growing the business.





# Three profit scenarios for the US until 2020

## Scenario 1 - stagnation

USA does not surpass Germany nor APAC in capacity as the use of energy crops into biogas is not adapted in large scale.

Assuming the fossil prices develop moderately, FIT's will cover most of the US.

Company-specific power purchase agreements will also be implemented for upgraded biogas.

## Scenario 2 – application innovations

To avoid waste and sewage fees, supermarket chains, schools, hospitals etc. to follow waste-intensive industry operations in the installing of anaerobic digesters.

Other states to copy California in allowing distributed generation and consumers to profit out of selling electricity into the grid.

## Scenario 3 – liquid biogas the leading 2nd generation biofuel

By 2020, biogas upgrade and condensation technologies become available for farm-size operations, making the utilization of biogas as a transportation fuel profitable.

Liquid biogas adopted by transport and defence.

# Market Characteristics

## Asia Pacific

# China and India are Asia's key biogas markets

Small-scale and low tech biogas production is an Asian tradition.

Countries such as India, China and Nepal have traditionally robust, small scale AD's serving only a few households with gas for cooking.

- The benefits in low infrastructure areas include improved sanitation, decreased use of firewood and costly fuels and the access to a free fertilizer.

"A major driver in China is economic disposal of waste and sewage."

*Timo Veijanen, DEWACO Ltd*

In China, the key players adopting biogas technology are the WWTF's & landfills.

Increasing demand for electricity in rural areas has spun off biogas-based distributed generation initiatives.

- With mid-sized units the share of electricity production out of biogas has increased 600% in past 5 years.
- In 2007 China had 26 000 biogas facilities and 26 million households using biogas.

Japan and South Korea are adopting biogas technologies at a high rate.

Malaysia's palm oil residue represents a well-managed resource for biogas.

- Despite high infrastructure, the developed Asian countries not to surpass China, India or even the USA in the production of biogas.

## By 2020, China and India to take the lead globally

FIT's are generally not in place in Asia, but governments do provide financing and tax incentives.

Power purchase agreements take place with local energy companies.

E.g. China's target is to have 300 million rural residents using electricity generated with biogas by 2020

In 2020, the most modern biogas plants will exist in Asia, nearly all of the capacity built between 2010-2020

Germany gradually to lose the tech edge.

When most of the economic waste, sewage and manure resources is being utilized, the use of non-edible biomass accelerates

Asian countries already have high adoption rates of gas vehicles.

The replacement of traditional fuels will take place only after the profits available in petrochemicals surpass the profits in electricity production.

In the absence of FIT's this change will be more rapid than in Europe.

# Conclusions

# With many potential routes to market, where do companies target limited resources?

1

**Improvement of solid waste and sewage treatment processes:**

*Where does it take place today?*

Asia is the main growth area for new WWTF projects

4

**Upgrade of biogas to suit existing natural gas applications:**

*Will there be biogas refineries?*

Large-scale refining to start first in Europe

2

**Process development of anaerobic digestion:**

*Is there a technology jump in sight?*

No tech jumps in sight to revolutionize the industry

5

**Installations to extract chemicals such as CO<sub>2</sub>:**

*Is this a business opportunity?*

By-product chemicals to remain a niche, serving a limited market

3

**Technology for the production of heat and energy out of biogas:**

*What size of power plants is required?*

Increasing demand for > 0.5 MW plants

6

**Condensation of upgraded biogas into liquid biogas:**

*Who to profit out of higher energy concentration?*

Long distance transportation and defense to adopt liquid biogas

## Tech trends highlighted by industry experts

“Technology research on biogas is ongoing but progress is slow; it’s more a walk than a jump!”

*Andrea Horbelt, European Biogas Association*



“While biotechnology will resolve issues with handling big masses of different raw materials, the use of biogas as a transportation fuel increases.”

*Jukka Rintala, Jyväskylä University*

“The bigger the power plants get, the better the efficiency of electricity generation and heat recovery.”

*Fredrik Wilenius, Wärtsilä*

# Breaking news highlighting industry growth

## USA



**The Anheuser-Busch brewery** in Houston US will begin using landfill biogas as an alternative fuel source. The gas will be carried through a pipeline to the Anheuser-Busch brewery to help generate steam energy for the brewery's power plant. More than 55 percent of the brewery's fuel demand will be supplied by biogas.

*Environmental Leader 29.6.2009*



**Walmart has completed biogas installations** at two stores in southern California, each at 400kW, generating approximately 3.4 million kWh annually. Each of these sites has the potential to eliminate 1 million pounds of CO2 annually when powered by biogas.

*Bloomenergy.com*

## Asia Pacific



**Rhodia announces its first business development investment in biogas technology**, by acquiring Econcern Group's participation in six pilot biogas production projects located in China and Vietnam.

*Rhodia 6.7.2009*



**GE biogas engines to be used in Chinese project** to power a Chinese cow manure-based biogas project. The manure from the 250,000 cows at the Liaoning Huishan Farm in Shenyang, China, will be converted into biogas through GE's four engines. The energy produced will be sold to the state grid in China.

*Bloomberg 5.5.2010*



# Breaking news highlighting industry growth

## Europe



**Schmack Biogas AG has sold a 5 MW biogas feed-in project** to RENION Biogas GmbH & Co. KG at a price of approx. EUR 11.4 million. The raw materials will be transported over an average distance of less than 20 kilometres.

*Financial.de 16.4.2009*

**The construction of a 16 million Euro plant for Liquefied Biogas in Sweden** has started. The facility, which is one of the world's first plants for Liquefied Biogas, is scheduled for completion in winter 2010/2011.

*Biogasmax 22.4.2010*



**Royal DSM N.V. announces an agreement to acquire the enzymes supplier Biopract GmbH**, based in Berlin. The acquisition of privately held Biopract will serve as an entry point for DSM into the promising biogas market.

*AZoM.com 2.6.2009*

# Appendix

# About the Methodology

Discussing the financial potential of biogas is challenging as the output of a biogas plant is a combination renewable electricity, heat and a second generation biofuel.

## 1. The potential of biogas is not an absolute figure.

In the case of anaerobic digestion of wastewater sludge and manure and the collection of landfill gas the raw material base is limited, tangible and the production is continuous, thus reliable calculations of the biogas potential can be performed based on the number of WWTF's and landfills.

With the anaerobic digestion of agricultural plants, crop residue and other biomass, the biogas potential can be valued many times higher. However all farmland cannot be used for the cultivation of energy due to regulations and the need to produce edible plants for food. This explains why the share of energy crop based production ranges from 0% to 85% by region.

## 2. The energy output of a biogas plant is a combination

- Electricity which is either utilized on site or fed into the grid
- Heat that can be used in the anaerobic digestion process or in distant heating of homes
- Gas that can be upgraded to equal the existing natural gas applications.
- In some cases the gas is also flared into the sky

## 3. The measurement of the utilized biogas potential challenging as well

- Most commonly, there is an equipment to convert gas into electricity, thus the use of Watts (W) to illustrate the net and gross capacities is justified. The amount of electricity that is not used on-site is fed into the grid. This value is usually measured and reported. Here kilowatt hours (kWh) are used in quantification.
- The quantification of heat production can only be done to an extent. The heat energy out of the electricity generation is usually utilized either on site or used by a nearby industrial operation. Only in some cases, the heat is contributing a distant heating network and a reliable report exists.
- A biogas upgrade operation is actually a petrochemical refinery and a suitable measures are cubic meter (m<sup>3</sup>) and the tonne of oil equivalent (toe)
- In flaring the gas, the plant is not contributing energy at all and measurements rarely exist.

# About the Methodology (cont'd)

One unit for all applications would help market understanding.

- Energy industry reports about biogas tend to quantify operations with one unit only (either W, kWh, m<sup>3</sup> or toe) thus creativity is required to find descriptive methods to understand potentials of various end uses of biogas. For example, the use of electricity units tend to neglect the use of biogas as a second generation biofuel. Joule (J) would be a fair unit to quantify each biogas energy application.
- Three aspects should be highlighted when discussing the biogas market
  1. A relative number that is mostly referred to in market reports is the total value of new installations per year. This is an interesting figure as the plant installations supplier is looking at the market but does not tell anything about the value of services and maintenance of existing operations.
  2. Theoretically, the annual revenue of a biogas plant can be calculated with a simple formula as the local price of gas or electricity is known. This value should be added with raw material costs (either negative, positive or zero), transportation costs and the average value of the by-products (organic fertilizer, CO<sub>2</sub>, O<sub>2</sub> etc) to make it interesting for a company in the biogas production business.
  3. For political decisionmakers the labor intensity of biogas production (e.g. employment/GJ) in comparison to other renewables would be of interest as well.

# Sources

In alphabetical order:

American Biogas Council

AZoM.com

Biocycle

Biogasmax

Biomass Magazine

Bloomberg

Bloomenergy

Energy Information Administration

Environmental Leader

European Biomass Association

Eurostat

Financial.de

Frost and Sullivan

Global Water Intelligence

Helmut Kaiser Consultancy

Iowa State University

Renewable Cogen Asia

Renewable Energy World

Scandinavian GTS

The New York Times

US Environmental Protection Agency

US Department of Energy

Wikipedia

# About GIA

## GIA is a strategic market Intelligence and advisory group

Global Intelligence Alliance (GIA) was formed in 1995 when a team of market intelligence specialists, management consultants, industry analysts and technology experts came together to build a powerful suite of customized solutions ranging from outsourced market monitoring services and software, to strategic analysis and advisory.

Today, we are the preferred partner for organizations seeking to understand, compete and grow in international markets. Our industry expertise and coverage of over 100 countries enables our customers to make better informed decisions worldwide.



## Access local knowledge in over 100 countries

GIA Group has 12 offices on 4 continents. Together with affiliated GIA Member companies, certified GIA Research Partners and consultants, GIA provides access to local knowledge in over 100 countries.

All GIA Network companies adhere to GIA's Research and Analysis Quality System as well as the SCIP Code of Ethics.

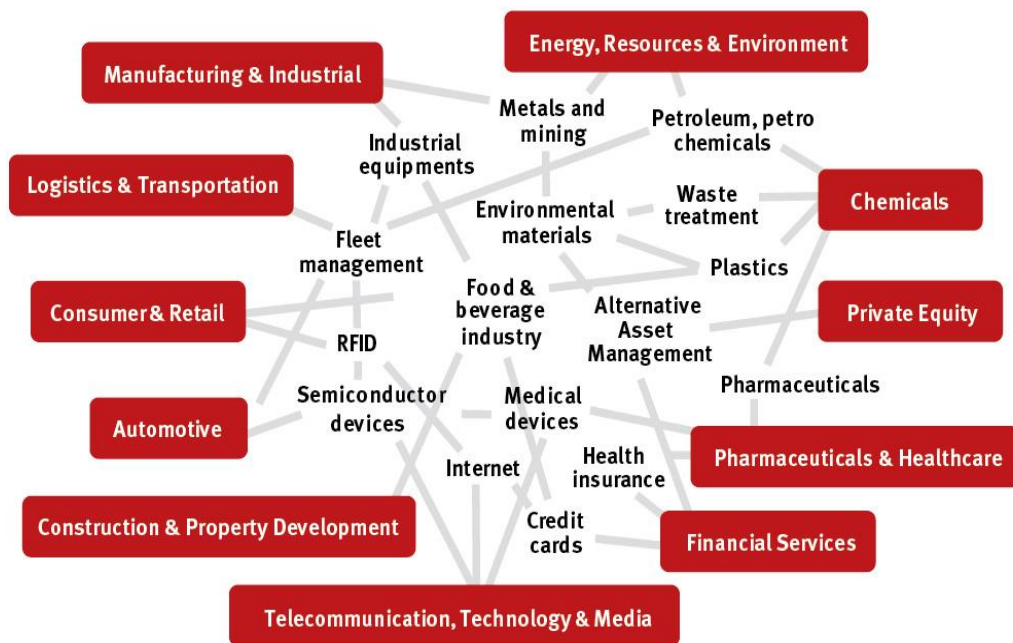




# We understand your business

With a track record of supporting thousands of clients around the world, we bring you practical expertise in your markets, as well as knowledge from our practices covering 11 industries and all the key business functions.

## Examples of industry practice knowledge cross-pollination



## Industry Practices

- Automotive
- Chemicals
- Construction & Property Development
- Consumer & Retail
- Energy, Resources & Environment
- Financial Services
- Private Equity
- Logistics & Transportation
- Manufacturing & Industrial
- Pharmaceuticals & Healthcare
- Telecommunication, Technology & Media

## Functional Practices

- World Class Market Intelligence
- MI for Strategic Planning
- MI for Marketing & Sales
- MI for Product & Innovation Management
- MI for Supply Chain Management
- M&A and Partnering



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