



BIOGAS:

CONVERTING WASTE TO ENERGY



AHK

Deutsch-Philippinische
Industrie- und Handelskammer
German-Philippine Chamber
of Commerce and Industry



Federal Ministry
for Economic Cooperation
and Development

About

This brochure has been developed as part of a develoPPP project, initiated by German biogas tank producer Lipp GmbH, to train Filipino biogas technicians on the construction, maintenance and safe handling of biogas plants in the Philippines. In line with the project's goals, workshops on biogas biology, technology, and biogas plant safety were conducted by trainers of the German Biogas Association, International Biogas and Bioenergy Centre of Competence, and representatives of Lipp GmbH. Through a research partnership between Lipp GmbH and Mapúa University Intramuros, a biogas yield testing laboratory is being established. Creating the local capacity to conduct commercial yield testing – the first of its kind in the Philippines – will support the development of the local biogas industry. Integrating the topic of biogas into the local curriculum will further ensure that biogas production and its use will find their deserved place in the renewable energy mix of the Philippines.

This three-year develoPPP project is 50% co-financed by the German Investment Corporation (Deutsche Investitions- und Entwicklungsgesellschaft – DEG) through public funds of the German Federal Ministry for Economic Cooperation and Development (BMZ).

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Biogas in The Philippines

BACKGROUND

Biogas technology was first introduced in the Philippines in 1965. However, the technology received little social or economic support at the time. Biogas plants were not yet economically feasible as abundant and cheap coal was primarily used to generate power. In the following decades, practical biogas applications were limited to biogas digesters for home use.

Today, there are several industrial-scale biogas plants in the Philippines that generate energy from organic waste. Despite this development biogas production still plays a rather small role as a renewable energy source. Biogas has accounted for less than 1% of the power generation mix in 2020.

Power Generation by Source

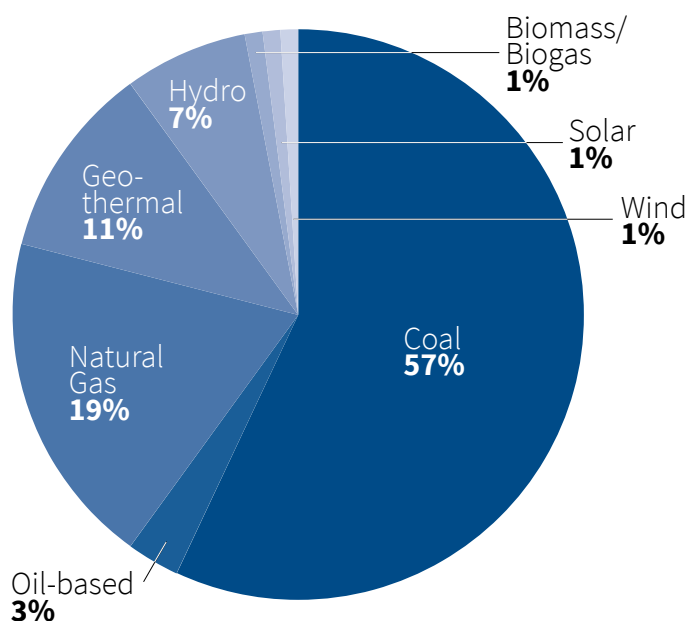


Figure 1. The Philippine Energy Mix 2020 (source: DOE)





GOVERNMENT INITIATIVES

In 2016, the Philippines signed the Paris Climate Accord and committed to address climate change by reducing greenhouse gas emissions by 75% and to increase renewable energy sources to 35% by 2030. Since then, the Department of Energy (DOE) is committed to lessen the Philippine's dependence on fossil fuels.

In compliance with the provisions of the Biofuel Act of 2006, the DOE is working to expand biofuel's contribution to the Philippine energy mix through its Biofuels Roadmap 2020-2040. The DOE's Biomass Energy Management Division spearheads the technology development, evaluation, registration and monitoring of biomass and biofuel energy technologies.

The Department of Science and Technology (DOST) has been promoting biogas technologies throughout the Philippines for more than 20 years, mainly focusing on dome type digesters that can convert wastes from piggeries and poultry farms. In addition, the Environmental and Biotechnology Division of Industrial Technology Development Institute (ITDI) of DOST has been promoting portable digesters to produce biogas from the kitchen or food waste. This aims to promote the conversion of biodegradable waste from the Materials Recovery Facility of several barangays in Metro Manila.

The biogas experience in the Philippines is still mostly based on small-scale applications.

Biogas in The Philippines

WASTE-TO-ENERGY

In the Philippines several laws were established to promote waste to energy conversion. Waste-to-energy technology refers to “systems which convert biodegradable material such as but not limited to animal manure or agricultural waste, into useful energy through processes such as: anaerobic digestion, fermentation, and gasification. Section 30 of Republic Act (RA) 9513, which promotes the development of renewable energy, provides for the use of “waste-to-energy” technology subject to requirements of RAs 9003 and 8749.

- **RA 9003 (Ecological Solid Waste Management Act of 2000).**

Promotes the establishment and operation of Waste To Energy facilities which aims to help the economy to reduce reliance on imported oils and increase in power generation.

- **RA 8749 (Clean Air Act of 1999).**

Provides for the creation of a national program of air pollution management focusing primarily on pollution prevention. Among its provisions are the regular monitoring of greenhouse gases and prohibition of the use of the incineration methods.

How do biogas plants work?

Biogas plants refer to the various systems used to process biowaste and convert them into biogas energy. Plants can vary in terms of size, equipment, and even output, but the basics of harnessing biogas remain the same.



Substrate supply and pre-treatment. Various organic matter called substrates are stored in a reception area like a silo or a container. The solid biowaste is pretreated by shredding/crushing, and mixed with enough water (can be wastewater) to make it pumpable. The raw materials may or may not have been pre-treated already and liquid is added to the substrate to make it easier to process.

Fermentation. Once the required amount is reached, the substrate is fed to an airtight tank called a digester. The substrate is mixed regularly, and the digester is heated to facilitate the process of anaerobic digestion. With no oxygen and no light, microorganisms start breaking down the substrate as it ferments.

Biogas collection and storage. The biogas produced from the digester is collected in the gas storage area (bubble-shaped tank) in the upper part of the digester.

Post-treatment. The gas storage tanks are connected to a gas pipe condensate shaft to remove moisture (water vapor) then biogas is utilized in a combined heat and power generation unit to produce thermal and electrical energy.

Additional applications. Further steps could be taken to eliminate impurities and generate biomethane for fuel. The residual organic matter left behind called digestate can be stored and used as organic fertilizer, making the whole biogas production process zero-waste.

The circularity of biogas production promotes sustainability by preventing waste in every step, creating a closed-loop system where everything is efficiently utilized. Additionally, the biogas production process reduces carbon dioxide emissions and helps in mitigating climate change.

Digestible Feedstock

Various types of feedstocks generate different amounts of biogas. Abundant in the Philippines are fruit wastes such as pineapple and banana, napier grass, fish wastes, swine and poultry manure, and municipal solid waste which is 52% (by weight) biodegradable. Further research should be conducted in order to assess the viability of these inputs to produce biogas.

Biogas production, on any scale, has great potential to generate energy while eliminating organic wastes that would otherwise be burned or naturally undergo anaerobic digestion in landfills emitting greenhouse gases, such as methane and carbon dioxide, into the atmosphere.

The potential for biopower generation in the Philippines is great. But what exactly can be digested into biogas?



Animal by-products. These include liquid and solid manure, slaughterhouse wastes like blood, feathers, fat separator contents and flotation tailings.



Fruit and Vegetable by-products. Generated during manufacturing or other stages of food preparation. Examples of vegetable by-products are harvest residues, straw, brewers' grains, molasses, husks, brewer's grain, peels, core, leaves, and spent fruits.



Industrial and commercial wastes. Organic waste also includes a wide range of organic materials obtained from industrial and commercial operations engaged in food (kitchen and food wastes, sugar, sauces, cheese), beverage (beer, wine, juice production), distillery wastewater, or feed production.



Biowaste from households. These are the organic fractions of household waste (ideally segregated biowaste), garden, and park waste.



Energy crops. These are densely planted, high-yielding agricultural species that are grown for the purpose of power generation. Energy crops include grass, corn, potatoes, silage.

Potential Biogas Applications

Different to renewable energy that is generated from wind or sun, biogas can be used in many ways. The energy contained in biogas can be converted into electricity or heat (through steam) like many other renewable energy sources. Biogas, however, can be used as gas for cooking, and once upgraded to a higher methane content, can also be used as transportation fuel.



ELECTRICITY



HEAT



COOKING GAS



TRANSPORTATION FUEL

Biogas Advantages

01

SUSTAINABLE WASTE MANAGEMENT

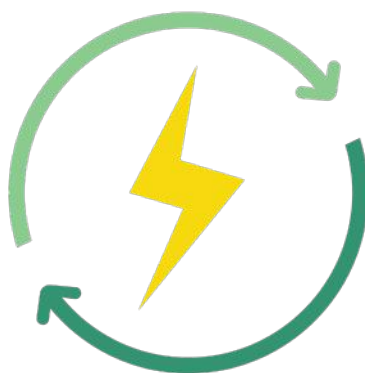
The Philippines' various agricultural activities produce 16 million tons of agricultural waste every year, primarily from rice, palm oil, sugar, wood, and coconut industries. This waste can be used as feedstock for biogas production and significantly reduce agricultural waste.



02

DIVERSIFIES THE ENERGY MIX

The Philippines relies heavily on coal to generate power. However, the rising price of coal, increasing demand, and looming climate issues increase the need to explore more sustainable energy sources such as biogas. This renewable energy can help address power shortages and stabilize electric grids in addition to producing heat and fuel.



03

REDUCES M EMISSIONS

Livestock manure poses an environmental risk to the country due to the harmful methane gas they produce. Biogas plants capture the release of methane from the atmosphere and store it as waste.





3

METHANE

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can mitigate
methane into
by efficiently

04

STORABLE & FLEXIBLE ENERGY SOURCE

Biogas systems are scalable and flexible to match the energy demands of various sectors such as utilities and transport.

05

GENERATES BUSINESS AND CREATES JOBS

Biogas production, including the operation of biogas plants and the production, collection, and preparation of feedstocks can create many jobs along different skills levels in the Philippines.



Biogas FAQs



Q: Is biogas the same as biomethane?

A: Biogas generated in a biogas digester is a gas combination. It contains mainly methane (50 to 80%) and carbon dioxide (25 to 50%), as well as other gases. Biogas can be “upgraded” to a 97% methane content by removing the carbon dioxide. Biomethane can then be used as an alternative fuel for vehicles.

Q: Is biogas the same as biomass?

A: Biomass is typically derived from crop waste, wood, and specific resources that have been grown to generate biomass energy through combustion in the presence of oxygen. Biogas, on the other hand, is a product of anaerobic digestion, in which biodegradable waste is transformed into energy in the absence of oxygen.

Q: What happens if biogas leaks? Is it dangerous?

A: Leakage is rarely harmful since methane requires a spark source and a perfect combination with oxygen to ignite. However, leakage can lead to unwanted greenhouse gas emissions.

Q: Is biogas explosive?

A:

The methane in biogas is combustible, but it needs a high self-ignition temperature of almost 600°C and a precise ratio of oxygen to methane to burn. In comparison, common fuels like petrol (260°C) and diesel (210°C) are easier to ignite. When proper safety precautions are ensured in biogas plants, the whole process of harnessing biogas is proven to be safe.

Q: What can be used as feedstock?

A:

There are several solids and by-products that can undergo the process of anaerobic digestion to generate biogas. These include energy crops, industrial and commercial wastes, biowaste from households, vegetable by-products, and animal by-products.

Q: What happens to spent digestate?

A:

Digestate is the nutrient-rich solid or liquid substance that remains after digestion. Since digestate contains recycled nutrients, it can be used as a biofertilizer to enrich soil for planting.

Q: Does anaerobic digestion cause foul odors?

A:

The absence of oxygen in organic waste and biowaste creates ideal circumstances for anaerobic bacteria to thrive and can cause some foul odor. However, if the waste is properly stored, the odor will not spread. In fact, biogas plants and digesters are an efficient way to manage the foul odor that emanates from manure and waste that are left out in the open.

Germany

Biogas Technology

Germany has been spearheading the advancement of biogas technology and applications through federal and private sector support for biogas-centered initiatives.

Germany is the leading biogas producer in Europe. Of the more than 18,000 biogas plants in Europe, 63% of them are in Germany. German biogas technology has been developed since the 1970's, making Germany a leading country for biogas research and development.



German Biogas Association

The German Biogas Association is a network of biogas technology manufacturers, companies, and researchers in the country. The Association conducts regular seminars and training for Biogas plant operators.



IBBK Fachgruppe Biogas GmbH

The International Biogas and Bioenergy Centre of Competence (IBBK) provides consultations and trainings to biogas plant operators and conducts studies on biogas technology.



Lipp GmbH

Lipp is a steel tank construction specialist that provides system solutions to store solid, liquid, or gaseous materials. In the Philippines, Lipp products are made available through METpower Venture Partners, a subsidiary of the Metro Pacific Investments Corporation.



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Editorial Team

Jana Everett
Glenielle Nanglihan
John Robert Lee

Design & Layout

GPCCI

 **PartnerInThePhilippines**



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