

# BIOGAS SOLUTIONS

Empowering  
sustainable growth  
across Southeast  
Asia

JENBACHER



# GENERATING AND MANAGING ENERGY SUSTAINABLY

## in one of the world's fastest growing regions

As the energy transition progresses with a push to net zero, the demands on power generation are increasing worldwide. The need for decarbonization and energy system modernization is particularly urgent in Southeast Asia. Here, the demand for food and energy is matching pace with an expanding gross domestic product (GDP) and population, making this one of the fastest growing regions in the world.<sup>1</sup>

Strong annual economic growth has meant a doubling of the region's energy demand over the past three decades. And that demand is expected to increase 4% each year through 2040<sup>1</sup> when the region's estimated oil demand will exceed 9 million barrels per day (mbpd), up from a little more than 6.5 mbpd today<sup>1</sup>. More than three quarters of the energy demand in the region today is met with fossil fuels such as oil, coal, and gas<sup>1</sup> for industrial applications, transportation, and electricity generation. In fact, demand for oil and other fossil fuels already has outpaced production in the region.<sup>1</sup>

In some countries in Southeast Asia, policies dictate that no new coal-based power plants will be built. Meanwhile, the region has seen an increase in the number of smaller, decentralized wind energy and photovoltaic plants. Yet, because fossil fuels often are used for heat here, the use of wind or solar energy poses a unique challenge. Another downside to the increased use of these renewable energy sources is their volatility, which leads to fluctuations in energy production. To avoid blackouts, the missing electricity must be generated through other available sources, quickly. That's where another renewable energy source, biogas, comes into play. Dispatchable energy resources (DERs) considered key enablers for the energy transition can effortlessly operate on biogas.

The trend of electrification is another accelerator for increasing electricity demand. The switch to electric vehicles in certain regions, as well as advancing digitalization, not only increases energy demand, but also makes it more difficult to calculate. Energy producers require intelligent digital tools to successfully navigate the energy market—and make a profit.

### Energy security and the path to net zero for Southeast Asia

Power generated from biogas can be created from agricultural and municipal residues and wastes. This flexible and renewable energy source can be used instead of fossil fuels, improving energy security in Southeast Asia and helping the region better meet its future sustainability goals.

<sup>1</sup>IRENA (2022), Scaling up biomass for the energy transition:

Untapped opportunities in Southeast Asia, International Renewable Energy Agency, Abu Dhabi.

# BIOGAS AS A RENEWABLE POWER SOURCE

## Tapping the potential in Southeast Asia

A mixture of methane and carbon dioxide, biogas is created during anaerobic fermentation of organic matter such as dung, liquid manure, biodegradable waste, and the growth from nature conservation and flowering areas—most of which would need to be disposed of otherwise. The digested material can even be turned into fertilizer.

In rapidly growing energy demand areas like Southeast Asia, biogas presents a viable alternative to fossil fuels, given the region's large quantities of organic waste generated from various activities, including agriculture, forestry, and municipal waste. Instead of producing waste that creates emissions, biogas uses the organic waste as a valuable energy source.

### A growing interest in biogas

In recent years, interest has grown in the use of waste to create biogas and generate electricity in Southeast Asia. Many countries in the region have set ambitious targets for renewable energy deployment, including biogas, and governments are implementing policies and regulations, such as feed-in tariffs, tax incentives, and subsidies, to support the development of biogas projects. Several countries in the region have achieved success, and biogas adoption as a means of generating electricity in the region continues to expand.

That's because this renewable energy source is a vital building block in the transition to a resilient energy supply, along with other renewable energy sources such as wind and solar—with a couple of key differences. Most important: Biogas production is not dependent on the weather! And, biogas-powered engines improve waste management while benefiting from an economical energy supply. This locally produced renewable energy source can enable your journey toward net zero as you face the challenges of the energy transition.



### Significant potential in the energy mix

Countries such as Malaysia, Indonesia, and Thailand already have carried out a number of biogas projects using agriculture byproducts such as palm oil mill effluent (POME), sugarcane molasses, rice husks, and cassava industrial waste to produce energy, and a number of countries have developed targets or strategies to further promote bioenergy development. Apart from some biodiesel and bioethanol projects, most of the bioenergy projects are being implemented at small scale to generate power and heat for on-site use. Significant bioenergy potential remains untapped for further development in the region. IRENA believes it possibly could account for more than 40% of the total primary energy supply by 2050.<sup>1</sup>

The high productivity of Southeast Asia’s agriculture sector generates considerable volumes of under-utilized residues. The table below provides estimated volumes for selected bioenergy resources in 2050 in Indonesia, Malaysia, and Thailand.<sup>1</sup>

Country	Feedstock	Available Quantity*
Indonesia	Agricultural residues (palm oil, rice, & sugarcane)	197.4
	Rubber	13.7
	Acacia	5.0
	Palm oil mill effluent (POME)	78.8
	Cassava pulp	10.0
Thailand	Agricultural residues (sugarcane, rice, & palm oil)	63.7
	Rubber	7.1
	Teak	1.9
	Cassava pulp	9.0
	Sugarcane molasses	7.9 (ethanol: 2 billion liters)
	Cassava roots & starch	25.4 (ethanol: 4.8 billion liters)
Malaysia	Acacia	6.3
	Rubber	5.2
	Palm oil mill effluent (POME)	>60 (produced annually as of 2018) <sup>2</sup>

#### Criteria for a successful, sustainable biogas solution

Beyond the availability of a local and secure supply of bioenergy feedstock, the following additional criteria must be considered when making the decision to produce sustainable biogas for use in power generation:

- Incentive and promotional programs
- Feed-in structure and off-take agreements
- Involvement of various stakeholders
- Investor-friendly environment with support from financial institutions

\* in millions of metric tons in 2050

<sup>1</sup> IRENA (2022), Scaling up biomass for the energy transition: Untapped opportunities in Southeast Asia, International Renewable Energy Agency, Abu Dhabi

<sup>2</sup> Journal of Cleaner Production (2022), A critical analysis on biogas production and utilisation potential from palm oil mill effluent, [www.sciencedirect.com/science/article/abs/pii/S095965262201647X](https://www.sciencedirect.com/science/article/abs/pii/S095965262201647X)

# GOVERNMENT POLICY IMPACTS TO BIOGAS GROWTH

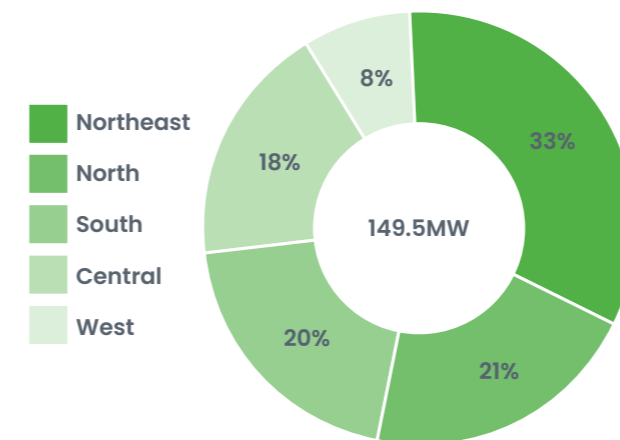
## in 3 key countries in Southeast Asia

As Southeast Asia continues to pursue the use of biogas to generate electricity, several governments in the region are implementing policies and regulations in support of these efforts.

### Thailand

Thailand’s power development plan targets a significant increase in renewable energy capacity, aiming for a 37% share of renewables in the power mix by 2037. As part of the government’s sustainable energy transition, the “Energy for All” policy promotes biomass and biogas-fired power plants, supports the public, and enhances the country’s competitiveness. Under this policy, private investors collaborate with communities to invest in renewable power. The initial bid round focused on generating approximately 150 MW, with equal contributions from biomass and biogas resources.<sup>3</sup>

Furthermore, as part of Thailand’s new renewable power development plan, the Thai government has introduced new feed-in tariffs for bidding. Developers will be required to participate in the bidding process for the feed-in tariffs.



A total of 149.5 MW across 43 projects was awarded: 75 MW of biomass and 74.5 MW of biogas. Each project will include biogas and biomass from energy crops and not exceed 10 MWe. Communities will own approximately 10% of the projects.

<sup>3</sup> BloombergNEF, Thailand Ministry of Energy, Thailand Energy Regulatory Commission (2023)

## Malaysia

With guidance from the National Energy Policy 2022–2040 (NEP 2022), Malaysia aims to meet increased energy demand through a mix of natural gas, hydro, and bioenergy. The Renewable Energy Act of 2011 enables the issuance of an additional license for new power plants that use biogas derived from landfill and agricultural waste.

To promote biogas-to-power generation, Malaysia’s Sustainable Energy Development Authority (SEDA) introduced the Feed-in Tariff (FiT) mechanism, using waste resources like landfill, sewage gas, and agriculture waste, including animal waste.

Additionally, the Malaysian Investment Tax Allowance (ITA) and Income Tax Exemption (ITE) under the Green Technology Incentive, Income Tax Act 1967, provide incentives for companies investing in sustainable, green projects.

The following chart reveals the primary energy mix targeted for Malaysia by 2040.

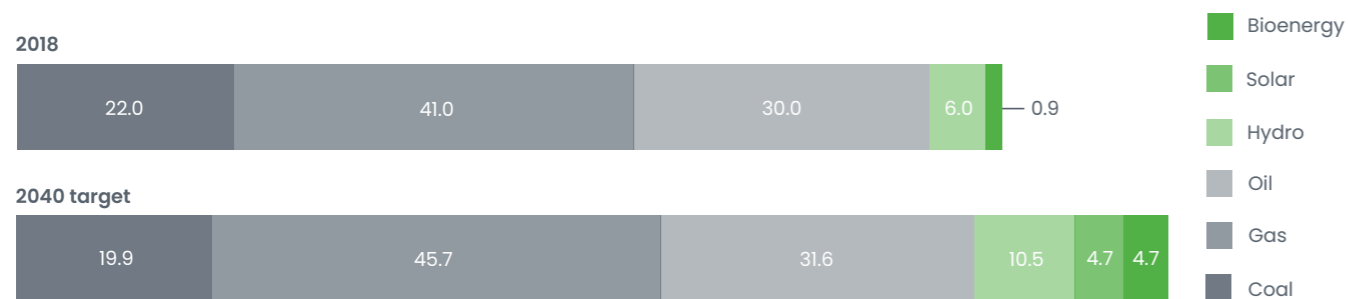
### National Energy Policy 2022–2040 key takeaways

- In September 2022, Malaysia released its National Energy Policy 2022–2040 (NEP 2022).
- The renewable share in Malaysia’s primary energy mix will increase from 7.2% in 2018 to 17% by 2040.
- Fossil fuel consumption is expected to increase by 5% (4.3Mtoe), with the increase driven entirely by natural gas.
- Coal and oil consumption remain at the same level with new demand being met by a mix of renewables and natural gas.
- Malaysia will continue using feed-in tariff capacity allocation to drive waste-to-power projects (currently there is a FiT for biogas, landfill gas, and waste gas).

Plans call for the formulation of a national hydrogen economy roadmap; Malaysia aspires to become a green hydrogen export hub (with green hydrogen produced from hydro).

### Primary energy mix in Malaysia, 2040<sup>4</sup>

In million metric tons of oil equivalent (Mtoe)



## Indonesia

Indonesia is focused on accelerating the growth of renewable energy within the country. The new policy introduces tiered price benchmarks for renewable energy power purchase agreements (PPAs) based on operational year, technology, location, capacity, and ownership type. This approach moves away from a single tariff cap based on the average national and local cost of generation. Additionally, renewable projects will have a rupiah-based tariff rate for the first 10 years, which gradually will be reduced beginning in the 11th year. The regulation also establishes ceiling prices for renewable PPAs.

<sup>4</sup>Malaysia’s National Energy Policy 2022–2040 (2022)

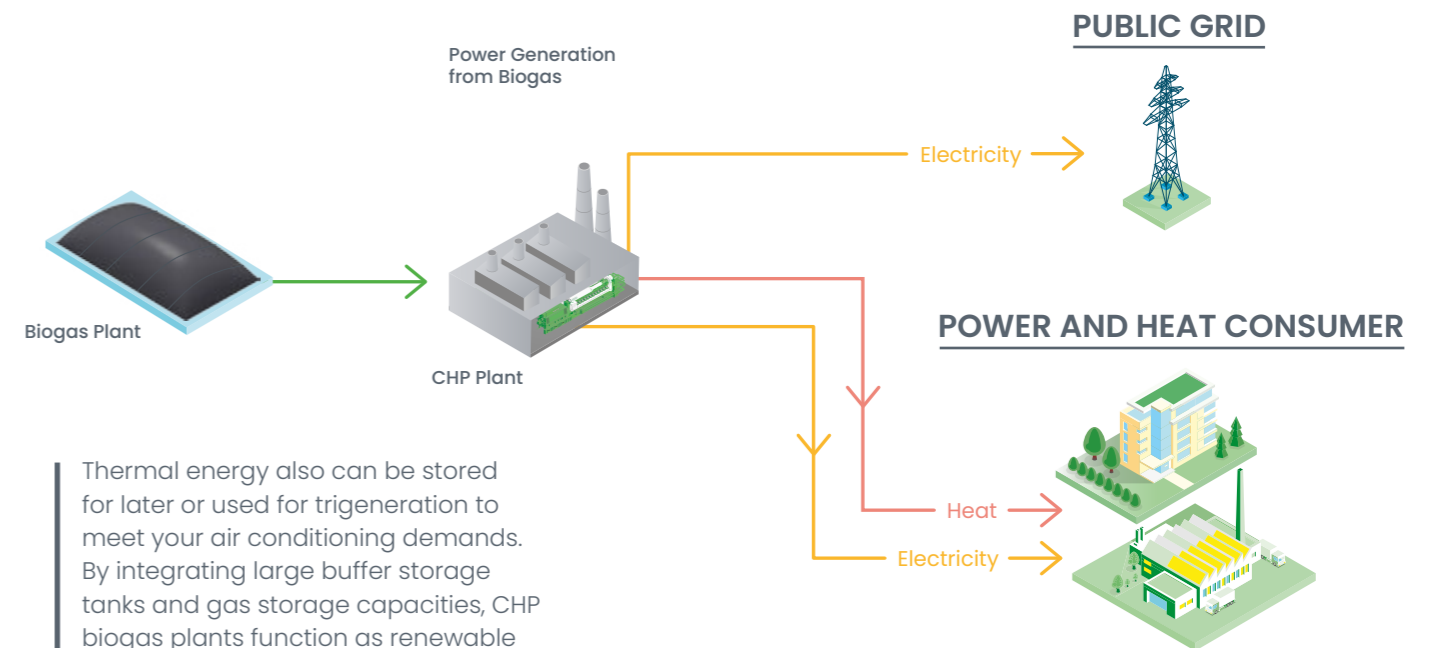
# BIOGAS-POWERED CHP PLANTS

## Turning biogas into power and heat

INNIO Group offers flexible, innovative, and proven Jenbacher combined heat and power (CHP) solutions that turn biogas into renewable power and heat. With a wealth of experience in biogas applications, INNIO Group also is a global technology leader when it comes to engine-based power generation and waste heat recovery solutions including CHP (also called cogeneration).

In fact, our Jenbacher biogas-powered engines are already a green technology—improving waste management while generating energy with high total efficiencies.

In addition to providing power for your local site, Jenbacher CHP technology also can be used to export generated electricity to the public grid, creating additional value streams for you while supporting the local grid as needed. Similarly, you can use the generated thermal energy to satisfy your on-site thermal loads by creating hot water, hot air, steam, or process heat.



Thermal energy also can be stored for later or used for trigeneration to meet your air conditioning demands. By integrating large buffer storage tanks and gas storage capacities, CHP biogas plants function as renewable storage power plants.

## Virtual pipelines: Liquefaction or compression of biogas at the customer site



Biogas can be liquefied through specialized technology and then easily transported to the communities and industries that need it. After regasification, this renewable energy source can provide sustainable power and heat through Jenbacher energy solutions.

In addition to liquefaction, integrated compression solutions can be used to produce Bio-CNG, which also can be transported easily through virtual pipelines.

In Southeast Asia, countries like Vietnam possess a significant number of cattle farms but have relatively low power consumption nearby. With the right solutions in place, Bio-CNG can be produced on site and then supplied via road transport to locations with high power demand. The result: Green power—and eventually heat—is supplied where it is needed while greenhouse emissions are reduced.

Biogas derived from a variety of sources such as non-edible crops, animal manure, dairy waste, and food industry waste must be upgraded before it is compressed or liquefied. Even for smaller applications, this entire process can be done using one integrated solution—accelerating time to market and renewable natural gas monetization.

# THE ADVANTAGES OF USING BIOGAS FOR ENERGY

## Boosting sustainability and your bottom line

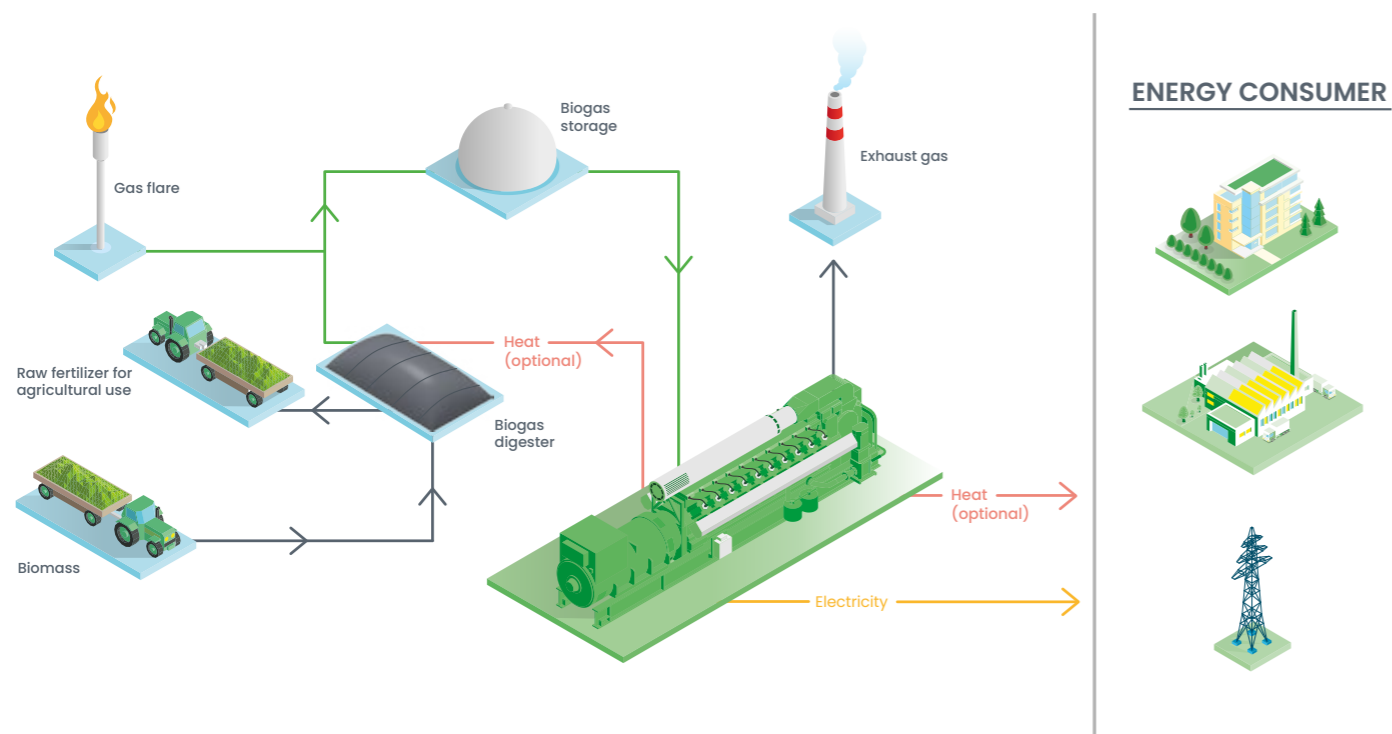
A Jenbacher CHP solution offers benefits that let you:

- 
**Increase revenue from power and heat**  
 by feeding any surplus into the public grid and even supplying warm water or steam to the consumer
- 
**Achieve excellent overall efficiency**  
 with up to 95% in CHP applications and more than 43% in power generation alone
- 
**Get fast load capability**  
 from demand to 100% load in 5 minutes
- 
**Install quickly, even in tight spaces**  
 with a compact and modular design that meets low footprint and dynamic weight-per-kW requirements
- 
**Meet sustainability goals**  
 by using resources that otherwise would be wasted and/or removed at great cost, while also reducing harmful emissions
- 
**Gain higher earnings**  
 in select areas, with an economical Jenbacher biogas-CHP plant that delivers high total efficiency and allows you to operate your assets flexibly—running the plant when electricity prices are high and buffering heat to balance differences in thermal energy production and demand
- 
**Increase energy resilience**  
 with on-demand biogas-powered CHP systems that can quickly start during a blackout, be operated in island mode, and include decoupling devices to monitor voltage, frequency, and short interruptions to support your critical facility operations when the local or regional electric grid fails
- 
**Produce less waste**  
 by using the substrate that remains after the biogas is formed as a high-quality agricultural fertilizer that is characterized by its neutralized acid, higher pH value, retained nutrients, and lack of odor
- 
**Get advanced service support**  
 and quick reaction times through our extensive local service and distributor network as well as Contractual Service Agreements

# PROVEN JENBACHER BIOGAS TECHNOLOGY

## for power and heat generation

Here is a look at some of the Jenbacher technology needed at a typical biogas plant:



### Robust, low-maintenance design

In hot and humid tropical climates like Southeast Asia's, robust engine design and operational flexibility are musts. With special compression ratios and high-performance turbochargers, Jenbacher engines can operate at full load without any power derating—even with high intercooler water temperatures and high intake air temperatures.

### Customized hydraulic integration

Through special hydraulic integration variants, Jenbacher solutions allow for flexible sequencing of the cogeneration unit's different heat sources. This provides thermal energy at temperature levels specifically tailored to your needs.

### Boiler systems for steam generation

Combining the cogeneration plant with a boiler system can help you meet heat requirements, leading to added plant flexibility and efficiency with decoupled heat production and consumption. For instance, the steam produced can be used for production processes.

### Support for drying and pre-heating processes

The cogeneration plant's different heat sources can be used to support your on-site production processes such as drying or pre-heating of cassava, rubber, and other agricultural products. Depending on the temperature levels required in your processes, the CHP unit can work independently or be co-fired with other energy sources for even higher temperature levels.

### Trigeneration for cooling

Trigeneration—or combined cooling, heat, and power (CCHP)—provides a substantial advantage over traditional cooling methods. An excellent solution for sites with fluctuating heating and cooling requirements, trigeneration offers you an efficient year-round source for both thermal and cooling power needs. With an absorption chiller linked to the Jenbacher CHP system, excess energy can be used to generate chilled water for air conditioning.

### Efficient operation despite gas quality fluctuations

All Jenbacher engines are designed with the LEANOX system to maintain the appropriate air-to-gas ratio in all operating conditions. Our gas dosing concept and LEANOX system work together to stabilize fluctuations in calorific value that typically are present in biogas applications. As a result, you get efficient operation even with low calorific value gases and significant gas quality fluctuations.



# A POWERFUL PORTFOLIO

## for a variety of biogas-powered CHP applications

INNIO Group offers a comprehensive portfolio of single-unit electrical power output from 250 kW up to 3,360 kW for biogas applications. By using multiple CHP systems in one plant, your power output can be scaled up while part load performance and reliability are significantly increased.

A wide range of available generator voltage levels and flexible hydraulic integration variants is available to allow for excellent integration into your existing electrical and thermal systems. Depending on your needs and capabilities, INNIO Group can provide you with the basic module, including its control system, or with an extended supply scope that includes balance-of-plant equipment.

### Electrical output (kWel)



### Jenbacher containerized solutions

INNIO Group recognizes that you need a reliable and available energy source. With their quick and simple installation, our Jenbacher container solutions can be a good fit for your site.

Containers are available for Jenbacher Type 2, 3, 4, and 6 with a broad range of options to meet your biogas project requirements.



### The main benefits of our container solutions are:

- The pre-installed package, completed with auxiliary systems, helps ensure a quick and easy site installation.
- The compact footprint consumes a minimum amount of space on site.
- All components are well matched and tuned to your specific site requirements by our Jenbacher engineering experts for optimal performance.



# JENBACHER BIOGAS- POWERED CHP TECHNOLOGY

## An investment that pays off

With INNIO Group's biogas-powered Jenbacher CHP solutions, you gain economically—and so does the environment.

Generating electricity from biogas presents a multitude of advantages, both in terms of environmental sustainability and economic efficiency. Notably, biogas is a byproduct of organic waste, making it a readily available and often low-cost energy source for power generation. Additionally, biogas power generation systems boast high levels of efficiency, capable of converting even more than 90% of the energy stored in biogas into usable electricity and heat. This efficiency can help lower overall energy consumption and electricity bills for homes, businesses, and industries.

### An attractive use case

The economic and financial returns of investing in biogas-to-power projects can be impacted by numerous factors, ranging from the size and scale of the project to the price of energy and feedstock, as well as the level of government support or incentives available.

An exemplary business case was developed to illustrate the key factors that may impact the financial viability of biogas-to-power projects. This case study highlights the key assumptions and inputs, such as capital costs, operating expenses, and expected revenue streams, to demonstrate the expected rate of return and payback period for a palm oil and palm mill factory in Malaysia.



## Key business case assumptions and inputs for a 1.4 MW biogas-to-power project

### Key Project Data

Engine Type	1 X J420 (1.56 MW)
Installed Power Gross	1,561 MW
Plant Gross Efficiency (at tropical conditions)	43.0%
Electrical Power Plant Net	1.4 MW
Total Plant Aux Load (including biogas production)	163 kW
Capacity Factor	76%
Operating Hours	6,700 hrs/yr
Net Electricity Export (per year)	9,365,260 kWh
Biogas Consumption	660 Nm <sup>3</sup> /hr
Power Plant EPC Investment Cost (including gas cleaning system)	\$3.12 MM US
Fixed Operating & Maintenance Cost	1 operator per shift/4 shift operations
Engine Maintenance Cost	\$17 US/oph
Annual Variable Cost (excluding lube oil)	\$28,517 US/yr
Lube Oil Cost	\$3 US/liter
Wastewater Cost	No cost
Digester Yield @55% CH <sub>4</sub>	28 Nm <sup>3</sup> of biogas/m <sup>3</sup> wastewater
Location	Malaysia

### Financial Parameters

Electricity Sale Price (FIT)	8.9 US cents/kWh
Depreciation Period	20 yrs
Discounted Rate	10%
Evaluation Period	21 yrs

All energy prices and amortization periods quoted are assumptions only. INNIO makes no warranty of any kind with respect to such information.



The **total investment cost** for a biogas-to-power project can range from \$1.5 million US/MW to \$3 million US/MW depending on project scope and location. Scope can range from a full biogas production plant to smaller projects with only gas cleaning systems and power plant modules. The biogas digester technology employed also has a substantial impact on the overall investment. In our business case, we assume about \$2 million US/MW in total investment cost.

**Electricity price** also is a key factor, with high electricity prices reducing the payback period and government subsidies on electricity prices lengthening the payback period. However, biogas is an attractive option for electricity generation in either case. In this particular business case, we have based the price of electricity on the feed-in tariff (FiT) system implemented by the Malaysian government, with an average FiT rate of about 8.9 US cents/kWh.

The **cost of fuel** is another consideration in biogas-to-power projects. Typically, biogas is generated from available biomass at no cost. However, if there is insufficient biogas, the project owner may consider purchasing additional biomass or mixing in another feedstock to generate more gas. In such cases, there may be some cost involved, but it generally is not significant. In this business case, we have assumed that although the developer will receive POME at no cost from the palm oil factory, the responsible party will have to construct and maintain a biogas digester.

**Operating hours** vary for biogas-to-power projects. Biogas often can be sourced from industrial effluents from factories tied to agricultural production. These factories typically operate seasonally, resulting in biogas production being unavailable throughout the year. For instance, cassava plants in Thailand generally operate for 9-10 months each year. For our business case, we have assumed that the power plant sourced from palm oil mill effluent (POME) typically operates for 6,700 hours annually, in accordance with the production schedule of the associated palm oil mills.

We also must consider **tax allowances and exemptions**. For instance, the Malaysian Investment Tax Allowance (ITA) and Income Tax Exemption (ITE) under the Green Technology Incentive, Income Tax Act 1967, provide incentives to companies that make investments in specific projects that promote sustainability. In this business case, we assume an ITA of 100% of qualifying capital expenditure (QCE) incurred from the date of application received by MIDA until the end of 2023. The ITA can be used to offset against 70% of statutory income.



© Green Lagoon Technology

**More on FiT rates**

SEDA Malaysia is a statutory body established by the Sustainable Energy Development Authority Act 2011 (Act 726). Its primary responsibility is to manage and oversee the implementation of the feed-in tariff (FiT) mechanism as mandated under the Renewable Energy Act 2011 (Act 725). The FiT mechanism encourages biogas-to-power projects that use waste resources such as landfill, sewage gas, and agriculture waste, including animal waste, as energy sources. The FiT rates for biogas can be found in the following table.<sup>5</sup>

**FiT Rates for Biogas (Landfill/Agriculture Waste)  
(21 years from FiT Commencement Date)**

Description of Qualifying Renewable Energy Installation	FiT Rates (RM per kWh) 01-01-2023
<b>(a) Basic FiT rates having installed capacity of:</b>	
<b>(i) up to and including 5 MW</b>	0.2814
<b>(b) Bonus FiT rates having the following criteria (one or more):</b>	
<b>(i) use of gas engine technology with electrical efficiency above 40%</b>	+0.0199
<b>(ii) use of locally manufactured or assembled gas engine technology</b>	+0.0500
<b>(iii) use of landfill, sewage gas, or agricultural waste, including animal waste, as fuel source</b>	+0.0786

**Economic and social benefits of biogas-to-power solutions**

**Project amortization in less than five years**

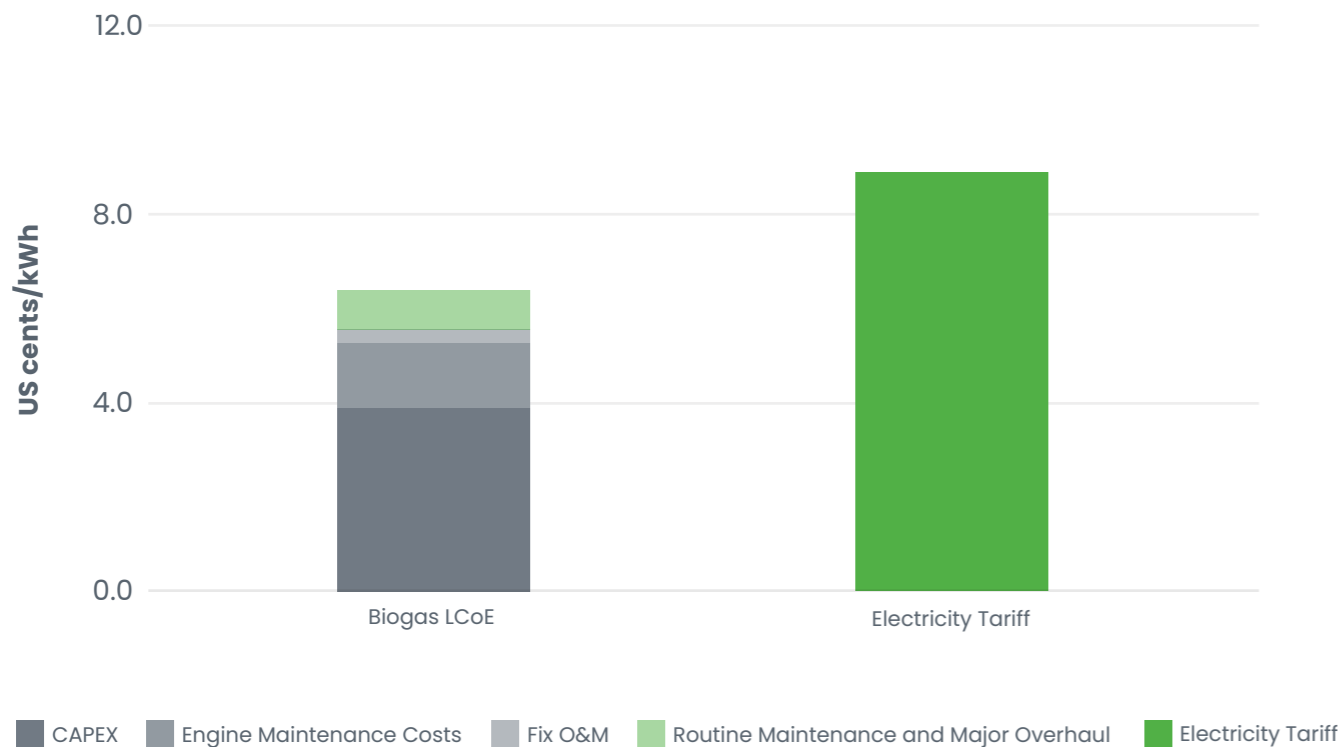
In our business case, the biogas-to-power plant can generate more than 9.3 GWh annually, assuming an electricity price of 8.9 US cents/kWh, resulting in energy production sales of about \$833,500 US each year. Assuming a total project investment of \$2 million US/MW, the return on investment (ROI) is 20% with a **payback period of approximately five years**.

**Lower Levelized Cost of Electricity (LCoE)**

The Levelized Cost of Electricity (LCoE) is a comprehensive measure that takes into consideration all the costs associated with generating and supplying electricity over its entire lifetime, including the initial capital investment, operating expenses, and fuel costs. In this specific case, the LCoE amounts to 6.4 US cents/kWh. With this highly competitive figure compared to prevailing electricity prices, the production of electricity using biogas as an energy source can be seen as cost-effective and economically viable.

<sup>5</sup> Sustainable Energy Development Authority (SEDA) Malaysia, <https://www.seda.gov.my/>

Levelized Cost of Electricity (LCoE) vs. Electricity Tariff



Attractive return on investment for Independent Power Producers (IPP)

The development of biogas-to-power in Malaysia presents a compelling investment opportunity for IPP developers, with an estimated weighted average cost of capital of 7%, resulting in a return on equity exceeding 40% and a net present value of \$2.6 million US.

Enabling the path to net zero

In addition to its financial benefits, generating electricity through a Jenbacher biogas-to-power solution also provides environmental advantages. The carbon footprint associated with traditional forms of electricity generation is reduced and sustainable energy advanced in the region. The competitive cost of electricity, combined with attractive incentives provided by the Malaysian government, has resulted in a significant increase in Jenbacher biogas-to-power installations in the country. With that, the proportion of power generation from waste products in the country's energy mix also has increased.

# PROVEN BIOGAS EXPERTISE IN SOUTHEAST ASIA

## with growing applications

INNIO Group has delivered more than 6,000 biogas engines that can generate a total electrical output of approximately 5.5 GW of green energy. Our delivered biogas-powered fleet has the potential of an annual production of 44 TWh of electricity<sup>6</sup>. This fleet can reduce CO<sub>2</sub> emissions by more than 28 million tons<sup>7</sup>—powerful proof of INNIO's leadership with our highly efficient Jenbacher biogas-powered systems.

Biogas applications are increasing in the region:

**Thailand** is leading the way in innovative and sustainable energy solutions in Southeast Asia with the potential for more than 300 MW of power generation running on biogas from delivered Jenbacher engines. Many of these engines are powering factories that produce the biogas from wastewater associated with cassava or edible oil processing, very often with excess energy sold to the grid—a further contribution to Thailand's clean energy production.

In **Indonesia**, the delivered Jenbacher engines offer the potential to generate more than 200 MW of power running on biogas. Most of these installations are reducing their independence on non-renewable sources by using biogas generated from edible oil processing wastewater as an energy source to generate electricity for on-site consumption. Some are even exporting excess power to the grid. Indonesia's efforts to harness biogas from these sources highlight the country's commitment to renewable energy.

**Malaysia** has taken significant steps toward achieving renewable energy targets with delivered Jenbacher engines potentially generating about 100 MW of power from biogas, primarily sourced from edible oil processing wastewater. In 2018, the Sustainable Energy Development Authority (SEDA) introduced a feed-in tariff that has encouraged the increased use of biogas in the country. The electricity generated by these engines is exported to the grid. This trend likely will continue, as SEDA has an annual quota of about 30 MW of biogas.

<sup>6</sup> Based on assumed 8,000 oph p.a

<sup>7</sup> Based on EU natural gas emission factor, 2017, EU Open Data Portal

# ADELA BIOGAS PLANT

## Powering Jenbacher engines with biogas made from palm oil byproduct in Malaysia

With a total net export capacity of 13 MW, the Concord Group is a leader in Malaysia’s booming biogas industry. Its seven biogas power plants use palm oil mill effluent (POME) as the feedstock powering 12 Jenbacher engines. POME is an excellent source of biogas production because of its high organic content.

One of the Concord Group’s plants, the Adela Biogas Plant, is powered by two Jenbacher J412 engines. Capable of exporting 1.5 MW of power to the national grid, the plant won the National Energy Award (NEA) in 2021.



» We have chosen Jenbacher technology for all of our palm oil mill effluent biogas projects. Obviously, we are very pleased with the outcome as we help our country meet its goal of 31% renewable energy contribution to the national energy mix by 2025.«

Datuk Khairuddin bin Tan Sri Mohd Hussin, CEO of the Concord Group

### PLANT FACTS

Engines	2 x J412
Energy source	Biogas
Electrical output	1,800 kW
Electrical efficiency	42.6%
Year of commissioning	2019



# CHOK YUEN YOUNG INDUSTRY CO., LTD

## Turning waste into heat and power

Five Jenbacher J420 biogas-powered engines produce more than enough electric power to supply Chok Yuen Yong Industry Co., LTD’s tapioca starch factory. The excess electricity produced by the engines—about 1,000 kW—is supplied to the public grid to further reduce the facility’s power costs.

In addition, an efficient heat recovery system converts exhaust gas from the engines into steam that is used in the starch production process. In 2016, Chok Yuen Yong reported a 2-million-euro (\$2.27+ million US) reduction in energy costs, with the project delivering an exceptional 43.33% return on investment.



### PLANT FACTS

Engines	5 x J420
Energy source	Biogas
Electrical output	7.1 MW
Thermal output	5.2 MW
Year of commissioning	2012, 2017

» We are very pleased with the project results. The Jenbacher engines provide high reliability and performance while operating in challenging conditions with difficult fuel gases.«

Thanthit Yuenyongtechahiran, Managing Owner, Chok Yuen Yong Industry Co., LTD



# WANGDEE ENERGY

## Turning waste into power

A power plant based on four Jenbacher J320 engines running on biogas delivers 4.27 MW of output—more than enough to supply all the electricity needed for the plant that processes raw cassava root into tapioca starch. What’s more, the engines use all of the facility’s wastewater and solid waste.



Wangdee Energy turned to Souer Co., Ltd.—INNIO Group’s authorized Jenbacher distributor in the region—for a solution that has progressed over time. The resulting highly reliable on-site power production solution brings much lower energy costs to the processing plant, and the facility also can earn extra profits by selling excess power back to the local grid.

### PLANT FACTS

Engines	4 x J320
Energy source	Biogas
Electrical output	4.27 MW
Electrical efficiency	40.2%
Year of commissioning	2015, 2021, 2023

»This project evolved beyond our initial high expectations, and we are very pleased with the results. The high reliability and performance delivered by the first Jenbacher engine at our biogas plant, along with the excellent installation and service support provided by Souer, encouraged us to add additional J320 units. Now, we are no longer reliant on electricity from the grid and heat from crude oil to run the cassava processing plant. And, the Jenbacher systems have allowed us to put our waste byproducts to use to meet our power needs.«

Phonchai Wangkunworakit,  
Managing Director, Wangdee Energy



# OUR COMMITMENT

to you

## Flexibility and experience you can count on

For the last 65-plus years, Jenbacher has been an innovator of power generation technology. Today's highly efficient Jenbacher systems deliver energy independence through an efficient, low emission, secure and cost-effective energy solution.

## Thinking long-term. Thinking circular

With our flexible, scalable, and resilient energy solutions and services, INNIO is embracing the circular economy—recycling, reusing, and upgrading our engines to meet the latest environmental requirements. For example, upgrading to hydrogen operations for a renewed life or using heat that normally would be wasted during power generation are sustainable solutions that can keep entire communities or businesses warm and electrified.

Through our service network in more than 100 countries and our digital capabilities, we provide life-cycle support for our globally installed units, helping to ensure a greater runtime for longer equipment life.

## Zero-carbon H<sub>2</sub> operation tomorrow

In addition, the same proven and economically viable INNIO equipment can be moved from conventional fuels today to full CO<sub>2</sub>-free H<sub>2</sub> operation tomorrow, once H<sub>2</sub> becomes more readily available.



## **BENEFIT**

### from a powerful digital platform



Through our myPlant Performance digital solution, INNIO provides digital remote support for our connected customer-operated systems across the globe. Today, more than 12,000 engines are managed remotely, with more than 1.2 trillion data points evaluated annually—a powerful proof-point of INNIO’s knowledge and experience.

#### **Fulfill emission requirements**

Our engine and fleet emission monitoring solutions help you more easily comply with emissions requirements—until you can operate your plant with 100% H<sub>2</sub> and become carbon-free.

#### **Improve business planning**

Increase your power system’s lifespan by taking advantage of self-learning algorithms that analyze component condition and calculate parts lifetime.

#### **Optimize engine management**

Real-time engine monitoring and operations provide you with remote access to your assets via desktop or app, whenever you need it, by aligning operational practice with maintenance requirements.

#### **Achieve greater availability**

With the ability to solve more than 60% of logged cases remotely, you can reduce the need for travel to your site—saving time and money.

#### **Rely on INNIO’s engagement to sustainability**

For INNIO, ethics and compliance, along with a sustainable way of conducting business, are front and center of everything we do. By selecting INNIO as your supplier, you enter a long-term relationship with a dependable collaborator. Our fundamental mission to accelerate the world’s transition to net zero was recognized with the prestigious EcoVadis ratings. INNIO joined the “Race to Zero” campaign, initiated by the United Nations, to bring together global leadership for a healthy transition to a net-zero future. Thanks to our efforts, INNIO’s ESG Risk Rating secures again the number one position across more than 500 companies globally in the machinery industry assessed by Sustainalytics.\*

\*Rating took place in March 2023

## **INTERESTED?**

**INNIO Group is among the world’s technological leaders in energy solutions and services for biogas applications.**

**Let us develop a powerful energy concept for your company.**

**Reach out today by completing the contact form online:  
[jenbacher.com/contact](https://jenbacher.com/contact)**

**Our Sales team will get back to you.**

INNIO is a leading energy solution and service provider that empowers industries and communities to make sustainable energy work today. With our product brands Jenbacher and Waukesha and our digital platform myPlant, we offer innovative solutions for the power generation and compression segments that help industries and communities generate and manage energy sustainably while navigating the fast-changing landscape of traditional and green energy sources. INNIO is individual in scope, but global in scale. With our flexible, scalable, and resilient energy solutions and services, we enable our customers to manage the energy transition along the energy value chain wherever they are in their transition journey.

INNIO is headquartered in Jenbach (Austria), with other primary operations in Waukesha (Wisconsin, U.S.) and Welland (Ontario, Canada). A team of more than 4,000 experts provides life-cycle support to the more than 55,000 delivered engines globally through a service network in more than 100 countries.

INNIO's improved ESG Risk Rating again secures the number one position across more than 500 companies globally in the machinery industry assessed by Sustainalytics.

For more information, visit the INNIO website at [www.innio.com](http://www.innio.com)

Follow INNIO on  



**ENERGY SOLUTIONS.**  
EVERYWHERE, EVERY TIME.



Online version  
available

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In general, "Ready for H<sub>2</sub>," Jenbacher units can be converted to operate on up to 100% hydrogen in the future. Details on the cost and timeline for a future conversion may vary and need to be clarified individually.

Jenbacher is part of the INNIO Group

