IEA Bioenergy
Technology Collaboration Programme

Task 44 Flexible Bioenergy and System Integration: Best Practices

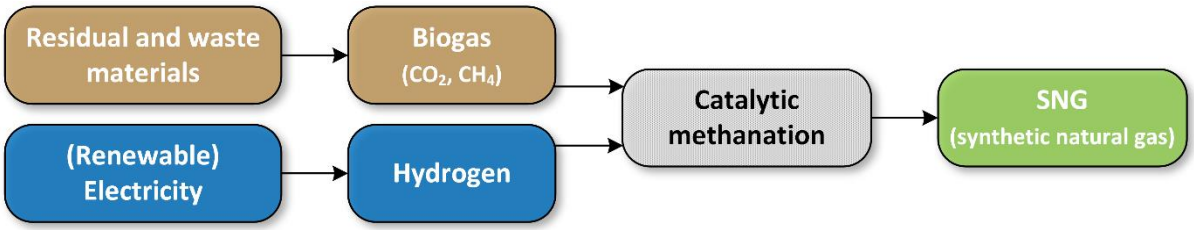
e-gas plant

December 2021

Werlte, Germany

E-GAS PLANT

In Werlte, green hydrogen is initially produced from renewable electricity by electrolysis. The hydrogen is then converted to methane in a catalytic methanation process using carbon dioxide from a biogas plant operated with residual and waste materials. The plant preferably obtains electricity for electrolysis when there is an oversupply due to high feed-in quantities of wind or photovoltaic power. The final product is grid-ready synthetic natural gas (SNG) in a compressed (CNG) or liquefied (LNG) state.



Base information	
Link for more information	http://www.kiwih2.com/
Contact person, email	info@egas-energy.com
Location	Werlte, Germany
Owner/Operator	kiwi AG / e-gas GmbH
Technology supplier	ETOGAS GmbH (now Hitachi Zosen Inova)
Start of the plant	25/06/2013
Construction year	2012
Status	commercial (1st of a kind)
Feedstock	Biogas from residual and waste materials and electrolytic hydrogen from wind power
Products	e-CNG (compressed natural gas) e-LNG (liquefied natural gas) hydrogen
Size	Electrolysis: 6 MW_{el}, 1,300 m^3/h SNG: 350 m^3/h (STP)
Type of flexibility provided	SynBioPtX-plant Flexible hydrogen production with

	electricity surplus Storage of fluctuating electricity in the form of methane in the gas grid
Flexibility characteristics	
Minimum load	Electrolysis: 0-6 MW_{el}
Load change rate	-
Start-up time	5min
Other	-
Investment cost of the plant (€/USD)	high double-digit million amount, 2012

Technical and Commercial Details

In 2013, Audi was the world's first car manufacturer to build a complete process chain to sustainable SNG (synthetic natural gas) for cars with gas engines. The plant was designed by Audi AG and LINDSCHULTE Ingenieurgesellschaft mbH and built by the plant manufacturer ETOGAS GmbH (now Hitachi Zosen Inova). In 2018, an additional hydrogen filling station was added. Since 2021, the world's biggest PtG plant is being operated by kiwi AG / e-gas GmbH.

The plant produces hydrogen by electrolysis using green electricity from wind power. The hydrogen is used to produce methane with the addition of carbon dioxide from a neighboring biogas plant. The added carbon dioxide is obtained from biogas plants in which only residual materials such as slaughterhouse waste are utilized. The produced methane is fed into the natural gas grid and also available at a filling station for liquid methane (LNG). When used in gas-powered vehicles (cars, heavy-duty traffic, shipping), the produced SNG enables CO_2-neutral driving. In addition, the plant produces the hydrogen not only for downstream methanation, but also for direct use as an energy carrier in the mobility sector or industry.

Flexibility is provided by running the electrolysers (6 MW_{el}) preferably when there is an oversupply of renewable electricity. The maximum storage time for hydrogen is 60 minutes. Storage for LNG is about 20 tons. Additionally, continuous unattended operation is possible, as the plant is started up in 5 minutes and can feed in the products into the grid in 12 minutes.

The plant is operated starting at a price of about 4-5 cents per kWh. At this tariff, that is about 4,000 operating hours per year.

The project couples regeneratively generated electricity to the natural gas grid by producing methane. The project can thus help solve the problem of storing surplus wind or solar power. From the gas grid, the energy can be fed back into the power grid at any time, if desired. The e-gas plant in Werlte is the greatest methanation PtG plant with the possibility to feed into the existing gas network.

Market opportunities

- The Power-to-Gas (PtG) technology is supporting the expansion of renewable energies and builds an important pillar for converting power surplus into chemical energy.
    - Emission reductions obtained by the generation of CO_2-neutral synthetic fuels for the transport sector are crucial for reaching the climate targets.
    - Additional revenues (e.g. from subsidies) are necessary but currently not provided.

Lessons to Industry

The Werlte e-gas plant is the world's first industrially operated plant for catalytic methanation with CO_2 from biogas and renewable hydrogen. It can serve as a pilot for other plants in the transition of the fuel market towards renewable, decarbonised fuels.

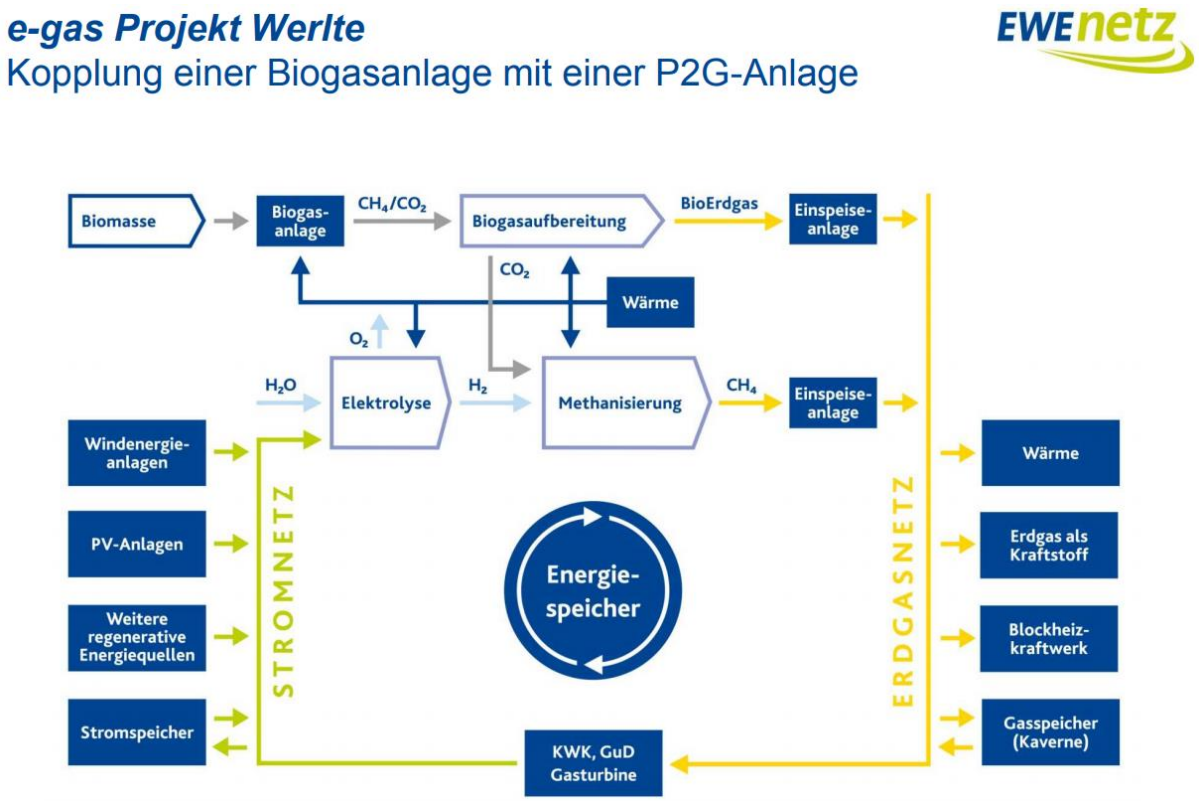
The power costs make up approximately 70% of the operational costs for renewable fuel production. Without exemptions from, or limitations of the EEG (the Renewable Energy Sources Act

in Germany) apportionment, the operation of Power-to-X (PtX) plants is not economically viable. Providing secondary control power at the German power market was tested and rated as not economically useful.
(Secondary control reserve, also known as secondary reserve or SRL for short, is a protective device of the transmission system operators (TSOs) to ensure power grid frequency stability. In general, one could also call the control reserve "operating reserve".)

As hourly start-ups and shut-downs are not economically viable, the operation of the plant should last for four hours in a row.

Off-grid fuel technologies should allow for sufficient storage capacities, e.g. for hydrogen or e-LNG.

Process flow chart



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