Newsletter IEA Bioenergy Task 37: 07/2024

New developments and spread of biomethane

Topics:

Mitsubishi and 7 others form coalition to promote electric natural gas

In March, Mitsubishi Corp. said that it will form an international coalition with seven other firms including TotalEnergies, Tokyo Gas, U.S.-based Sempra Infrastructure, Belgium's TES, and Japan's Osaka Gas and Toho Gas to support development and production of electric natural gas (e-NG). They plan to create the group, called "e-NG Coalition", in the first half of the year.
e-NG is a synthetic gas produced from renewable hydrogen and carbon dioxide and can be transported and stored utilizing existing infrastructures, Mitsubishi said in a statement, adding that the companies believe e-NG has a role to play to accelerate the energy transition towards a net-zero carbon future

More

Hydrogen should be treated with caution

This writes Antony Patt in his blog of the ETH in Zurich. Apart from the many positive aspect, there are several risks. He warns that Switzerland should think carefully about whether it wants to jump on this bandwagon. Storage: It takes a lot of energy to pressurize or cool hydrogen. The small and volatile molecules tend to diffuse through many materials. New approaches such as nanomaterials are still a long way off. Production is also challenging. Today, almost all hydrogen is produced from natural gas, which releases a lot of CO2 into the atmosphere. Blue hydrogen is also produced from natural gas, whereby the CO2 is captured add permanently stored underground. Unfortunately, large quantities of natural gas, especially methane, a powerful greenhouse gas, escape in the process. The cleanest option is green hydrogen, which uses renewable energy to split water into hydrogen and oxygen. However, this is extremely inefficient. Leakage: Until recently, leakage was only seen as an economic loss - but there is much more at stake. Leaked hydrogen reacts in the atmosphere with the scarce OH radicals that break down methane. Hydrogen leaks therefore extend the life of methane in the atmosphere.
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Top

Innovative agitator technology for biogas plants

Researchers at Münster University of Applied Sciences together with Trilogik GmbH have developed an innovative generation of agitators with improved suspension behavior and high axial thrust, which enables a significant increase in gas yield while simultaneously reducing energy consumption. The drive control is combined with online process monitoring and can therefore be carried out depending on the state of the digestate. Due to the trend towards increased fermentation of waste materials and the flexible addition of substrates, conventional agitator systems are increasingly reaching their limits and causing high energy costs and inadequate mixing results. Paddle agitators are particularly suitable for highly viscous substrate mixtures due to their large diameters and low speeds. In order to reduce the internal energy requirement and increase the agitator effect, the researchers adapted the geometry of these agitators strictly algorithmically to the properties of the fermenter substrate. To this end, they developed a comprehensive profile catalog which, in combination with different substrate mixtures and simulations of the fermenter flow, allows suitable geometries to be selected. The researchers also designed a substrate-adapted agitator control system. Stirring intervals and the speed of the agitators are controlled depending on the flow velocities at different fermenter positions. In this way, flow-related agitator weaknesses can also be identified and optimized in existing plants.
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Nitrous oxide and methane emissions from the biology of WWTPs

Nitrous oxide emissions from biological treatment stages are the most important source of greenhouse gases at WWTPs. The recording and reduction of emissions requires spatially resolved long-term measurements over at least one year. In Switzerland, measurements are usually carried out in the exhaust air alongside tracer gas methods. The study presented here utilises an independent measurement method, namely the drone-based determination of emissions, validated. The DFM method is a suitable validation procedure because all measured values are recorded on one device (drone) and no modelling assumptions need to be made for extrapolation to determine the total emissions. The DFM method is a patented method of the company Explicit

ApS also for the quantification of methane emissions at wastewater treatment plants. The method was tested on three different WWTPs. The flight altitudes and the flight route were determined in such a way that the entire emission cloud could be captured as far as possible. The DFM method is very well suited for validating the results of point measurement methods. However, the DFM method is unsuitable for long-term measurements, as good wind conditions and the presence of trained personnel are required.

More (in German)

Top

Recovery of liquid CO2 from the biogas process

As early as 2023, the Tekniska verken Group Linköpig made an investment decision to build a facility to handle the biogenic carbon dioxide formed during the digestion of food waste, slaughterhouse waste, and more, which is then removed during biogas production. Bright Renewables has won the technical tender. The CO2 liquefaction system, with a capacity of 2,500 kg/hr of bioCO2, includes technology to recover CO2 from the biogas upgrading process to purify and liquefy CO2 using natural refrigerant CO2 (R744). The system features four 70 m3 storage tanks for the liquid bioCO2 and a liquid CO2 analyzer for certifying the food-grade quality. CCU (Carbon Capture Utilization) is strategically important for Tekniska verken as part of the Group's efforts to turn carbon dioxide emissions into a resource. In parallel, the Group is investigating opportunities to capture, store, or use the carbon dioxide that currently arises in activities other than biogas production. The facility, which will annually produce 20,000 tons of food-grade quality bioCO2, is expected to be completed before next summer in 2025.

More

High H_2 content in the converted natural gas network

In order to achieve a climate-neutral gas supply in Europe, substitution with green hydrogen is unavoidable. The European research project "Hydrogen in Gas Grids" (HIGGS) investigated the influence of hydrogen (H_2) concentrations between 10 and 100% in the gas transport network theoretically and experimentally. Two major approaches were chosen: 1) Modelling of transport cost and 2) experimental material testing. The aim of modelling was to assess the influence of higher H_2 proportions on the economic efficiency of gas transport. For this purpose, a numerical model was created to describe the technical operation and the economic impact. The model makes it possible to analyze the various technical adaptations of the network (depending on the volume % H_2) as well as the operational strategies for a network with H_2 feed-in. The model shows that only minor adjustments to the infrastructure are required to feed up to 6 vol% H_2 into the grids. The transport cost amount to approx. 3 € per MWh per 1000 km without separation of H2 at consumer's site. Scenario two looks at mixtures of 10, 20 and 30 vol% H_2. A separation technology (palladium membranes) is installed at the level of the transport network and ensures that the H_2 concentrations in the distribution network do not exceed 2 vol% H_2 and 10 vol% H_2. The separated H_2 is recompressed to the pressure of the transport pipeline and fed back into it. The calculated transport costs amount to 10.7 to 21.1 €/MWh/1000 km in summer. In winter, the costs are higher and amount to €18.1 to €47.3/MWh/1000 km.

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Top

Russian scientists propose converting natural gas into hydrogen directly in gas fields

Researchers from the Skolkovo Institute of Science and Technology in Russia explored the conversion of methane into hydrogen in the gas reservoir with zero oil saturation via steam methane reforming initiated by in situ gas combustion. Hydrogen from natural gas can be

produced with 45% efficiency right in the gas field by injecting steam and a catalyst into a well and adding oxygen to ignite the gas. Catalyst assisted combustion produces a mixture of carbon monoxide and hydrogen, from which the latter can be easily extracted. This technology will help accelerate the transition from fossil fuels to clean hydrogen power. The study was published in Fuel.

More

SFP Zeeland: Production of biomethane, biogenic CO2 and digestate

Located in the province of Zeeland, in the Netherlands, the SFP Zeeland plant is a cutting-edge project and one of Europe's best practices. The plant produces renewable and high-quality biomethane from 400,000 m3 of manure and residual organic materials, both solid and liquid, which are managed in 9 digesters with a capacity of 10,000 m3 each. From the purification of 7,000 m3 of biogas per hour with membrane upgrading systems, 5,000 m3 of biomethane per hour (38 million Nm3 per year) are produced, which are injected into the grid. CO2 is also recovered and liquefied for the production of biogenic CO2. Finally, the digestate, both liquid and solid, is reused as fertilizer.

More

Top

RNG facilities begin production in South Dakota

Clean Energy has completed a new renewable natural gas (RNG) production facility at Drumgoon Dairy in Lake Norden, South Dakota. The 6500-cow dairy farm is expected to supply 6.28 million liters of negative carbon-intensity RNG annually to the transportation market when at full capacity. Construction of the US$38 million RNG digester project was completed in early-December 2023 and injection into the interstate natural gas pipeline system of the RNG began within weeks. All the RNG produced at Drumgoon will be available at Clean Energy's fueling infrastructure. Clean Energy also announced the successful completion and operational launch of an RNG production facility at Tri-Cross Dairy in Viborg, South Dakota. The 5000-cow dairy farm is expected to supply 3.79 million liters of negative carbon-intensity RNG annually to the transportation market when at full capacity. The construction costs of the RNG production facility, including the building of digesters and the processing plant, totaled US$34 million and was completed in December 2023.

More

TotalEnergies' 18th biogas unit commences operation in France

End of 2023, TotalEnergies commissioned the BioBéarn biogas production unit in Mourenx in the south-west of France. The facility has an annual production capacity of 160GWh. BioBéarn has been built on a 7-hectare former brownfield site in the center of the Lacq basin and represents TotalEnergies' 18th biogas production unit in France. The unit will be capable of converting 220,000 tons of organic waste every year from local farming activities and the agri-food industry.

As of January this year, the unit has been feeding its biomethane into the natural gas transmission network operated by Teréga. It will gradually be scaled up to produce up to 160 GWh at 100% capacity, which is equivalent to the average annual consumption of 32,000 inhabitants. The unit is supplied with organic waste from 90 local suppliers within an average radius of 40 kilometers of the site.

More

Top

RNG poised for $4B market in North America by 2030

The North American renewable natural gas (RNG) market is on the verge of substantial growth, projected to surge from $1.5 billion in 2022 to $4.0 billion by 2030, boasting an impressive CAGR of 13.04%. This growth trajectory is driven by increasingly stringent emissions standards and several government regulations mandating the uptake of clean fuels. The RNG production is projected to quadruple from 2022. landfills are expected to account for 64% of the RNG produced, owing to the large volume of landfill gas (LFG) generated from individual projects, along with most landfills already having LFG collection equipment in place. Agricultural waste based RNG is expected to account for 25% of the RNG produced while wastewater and food-waste or Source Separated Organics (SSO) are relatively less prominent, producing respectively 3% and 8% of the total RNG by 2030. cCarbon's report "North American Renewable Natural Gas Outlook 2030" delves deeper into the strategies, challenges, and opportunities in this rapidly evolving industry.

More

Brazilian Biomethane: Challenges and Opportunities

Data from the Brazilian Biogas Outlook 2022/2023 indicates that 22% of the 2.9 billion m^3 of biogas produced annually is upgraded into biomethane. This represents 82% growth as compared to 2021.

Brazil has 936 plants, with 885 currently in operation (95%), 38 under construction (4%) and 13 under repair (1%). In 2022, these plants produced 2.8 billion Nm^3 of biogas and the industry predicted an increase of 15% for the beginning of 2023. Brazilian Biogas Association – ABiogás states that Brazil has the largest biogas potential in the world, which could reach as high as 84.6 billion Nm^3 of biogas per year. This potential has the capacity to supply almost 40% of national electricity demand or replace 70% of Brazilian diesel consumption.

Despite the immense opportunities that the market can bring to the country's economy, one of the main challenges the industry is facing is **regulation.** Another important challenge is **distribution**, since natural gas consumers are far from biomethane producers. However, there is enormous energy demand close to biomethane production sites that do not take into consideration this renewable energy as an alternative. The biomethane market trends towards significant growth. ABIOGAS' projects the production of 2.2 billion m3/day of biomethane in 2027, most of which will come from 27 new biogas plants planned by the company. Around 60% of this volume comes from biogas generated in landfills. The application of this biogas should be directed to transport and industry, and for the latter, the possibility of interstate sale is very relevant.

More

Brazil's Gás Verde to build biomethane supply point

Gás Verde, part of the Urca Energia group, is setting up Brazil's first biomethane refueling point.

The aim is to meet demand from clients Ambev, Ternium, Saint Gobain and L'Oréal, which are converting their vehicle fleets to run on biomethane. Gás Verde is the largest biomethane producer in Latin America, with 130,000m3/d coming from a landfill site in Seropédica, in Rio de Janeiro's metropolitan region. The company plans to exceed output of 500,000m3/d by 2028, with new plants in Rio de Janeiro,

São Paulo, Minas Gerais, Bahia, Pernambuco and Maranhão states. Although there is strong demand for biomethane, the gap with natural gas remains a challenge for the expansion of the biofuel market.
More

Top

Air Liquide boosts biomethane capacity in U.S. with two new units

Air Liquide persists in broadening its capabilities in biomethane, alternatively recognized as Renewable Natural Gas (RNG), within the United States by erecting two additional production facilities. Positioned in Center Township, Pennsylvania, and Holland Township, Michigan, these facilities are designated to process waste obtained from dairy farms. Utilizing manure feedstock in anaerobic digesters, these production units will generate biogas with a total production capacity of 74 GWh. Presently, Air Liquide operates 26 operational biomethane production units worldwide, boasting a yearly production capacity of approximately 1.8 TWh.
More

$440 Million Food-Waste-to-RNG Facility Breaks Ground in New Jersey

A ceremonial groundbreaking took place Tuesday for the Linden Renewable Energy Project. Spearheaded by partners SJI, Captona and RNG Energy Solutions, the site will be the nation's largest food waste-to-renewable natural gas facility. The $440 million project will convert organic waste into bio-methane using proven anaerobic digestion technology here in the New Jersey/New York Metropolitan area. That bio-methane will then be upgraded to pipeline quality natural gas for injection into the adjacent Elizabethtown Gas system. Construction began in January; completion is slated for the fourth quarter of next year.
More

Archea announces largest modular RNG plant at WM site

In a busy month for partnerships, new facilities were announced in Arizona, British Columbia, California, Kansas and South Dakota, ending with an announcement from BP's Archaea Energy of a new facility at a WM landfill. Archaea has completed construction of a landfill-gas-to-RNG facility at the site in Shawnee, Kansas, the developer announced Tuesday. The facility, fully owned by Archaea, can generate enough gas to heat about 38,000 homes annually, according to the company. Its first such facility, in Medora, Indiana, could process up to 3,200 standard cubic feet of landfill gas per minute. The Shawnee facility can process three times as much: 9,600 scfm.
More

Top