



BIOGAS FORUM INDIA
(BigFIN)
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From the Editorial Desk

First of all, in this unprecedented situation of COVID-19 pandemic we would like to wish all the members of the biogas forum and other readers good health and safety.

It is a fact that all the sectors faced an unexpected fall with above 90% of the global population being under restricted movement since the COVID-19 pandemic and subsequent imposition of lockdown starting from January 2020 in China then to other nations in one form or the other. The state of biogas sector was also not different either. Even though, there are limitations and difficulties exist even in this current situation, several novel and promising developments and events have been reported in the biogas sector across the world.

From the national policy perspective, in order to instill a surge in the economic activity inside the nation Prime Minister Shri. Narendra Modi announced “Atma Nirbhar Bharat” (Self-Reliant India) on 12th May 2020, a mission that is solely focused on improving local circular economy. We believe, the development of biogas sector (production, upgradation and its dissemination) can contribute to local circular economy and sustainable living, irrespective of urban and rural context across the country. Several initiatives are being formulated and planned by different ministries of Govt. of India to make this huge task possible.

In the last one year, many new developments in biogas sector have taken place. The MoPNG, GOI has extended priority to SATAT scheme (Compressed Biogas CBG) and it's PSU IOCL, HPCL and BPCL have issued many letters of intent (LOI) to entrepreneurs across the country with a focus on Punjab and Haryana. Reserve Bank of India has instructed financing banks/agencies to provide collateral free loans to CBG projects. The Ministry of Agriculture-Fertilizer Control Order (FCO) has issued order to recognize biogas slurry as fertilizer and subsidy on it. These are new development for scaling up biogas sector for self-reliant India.

This newsletter proposes to cover the recent developments that could give a positive push in the biogas sector in terms of technological interests for mainstream application, also, to its research and development. In the current issue, main focus is devoted for the development and application of compressed biogas (CBG) as an energy fuel. A brief summarization of global and national status through the assortment of recent events, news and research articles which is related to the biogas sector is what this newsletter is aimed for.

We hope that you find this special issue interesting and inspiring. We also welcome innovative ideas and inputs contributing to the growth of this sector.

Virendra Kumar Vijay

General Secretary, Biogas Forum India (BigFIN)

Professor, CRDT, IIT Delhi

President's Column

India's renewable energy expansion programme has been largely led by both wind energy and solar photovoltaic (SPV) technologies. Those technologies are now strong competitors for fossil fuel-based power plants not only in terms of economic viability, but also in terms of acceptance amongst policy makers and the public. SPV installations in India have witnessed a rapid growth owing to a strong policy support and rapidly de-escalating prices of the SPV modules. Similarly, India's wind energy sector is mature and is ranked fourth in terms of the total capacity of the wind installations in the world, after China, the USA and Germany.

On the contrary, bioenergy in India is yet to find its place in the energy mix of the country, despite the fact that it pre-dates both wind energy and SPV. The Ministry of New and Renewable Energy has set a goal of 10 GW of bioenergy and one hundred thousand family sized biogas plants by 2022. The Indian biogas industry is, therefore, on course for continued growth and success. Moreover, the spectrum of the use of biogas, as an energy source, has become wider in the recent years.

Smaller biogas plants can improve the financial and ecological footprint of the system. Concept ideas abound – from heating apartments and stables to green-houses and drying systems; they all reflect the imaginative scope of the biogas industry.

As environmental consciousness is growing, renewable energy sources in general, and biogas use in particular, are gaining in importance. Biogas is versatile, both in generation and use; it can be obtained from liquid manure, waste food, slaughterhouse waste and a variety of energy crops and can be converted into electricity and heat, directly fed into the natural gas network or used to power automobiles.

The Indian biogas sector is slowly, but steadily, growing and is ready to take on the world. Biogas use still has a large potential to tap in India, the subcontinent and the world. With specialist knowledge, innovative ideas can be spread throughout the world that can help solve the pressing issues of reliable, environmentally sound and safe supply of energy for the future.

There is a need for awareness and public participation in such programmes to boost the biogas sector. The mission is clear: to raise global awareness on biogas technologies and encourage their uptake as solutions to the challenges of our times.

I will look forward to the feedback and responses of our valued readers.

Neeraj Sinha

Adviser (S&T), NITI Aayog

President, Biogas Forum India (BigFIN)

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SOME INITIATIVES HELD IN CRDT, IIT DELHI DURING LAST ONE YEAR

1. Official meeting of CRDT faculties with CEO, NITI Aayog, Govt. of India

Faculties of CRDT had a fruitful discussion with Shri. Amitabh Kant, CEO, NITI Aayog 6th January 2020 on possibilities for implementing Block Chain for social, agriculture and financial sectors of India, along with its implementation in tracking Sustainable Development Goals.



(6th January 2020, Source: LinkedIn- Prof. V. K. Vijay)

2. Prof. V. K. Vijay was invited for delivering a lecture at FICCI, New Delhi, India

Prof. V. K. Vijay delivered an invited lecture as a panel member on Compressed Biogas CBG in a conference on “Future Fuels for Transport in India” at FICCI, New Delhi on 29 January 2020. Shri. Nitin Gadkari, Hon. Minister of Transport, Govt. of India delivered the key address and future vision.



(29th January 2020, Source: LinkedIn, Prof. V. K. Vijay)

3. Delegate visit from University of Illinois, Chicago in Mahatma Gandhi Gramodaya Parisar, CRDT, IIT Delhi

A delegation led by Prof Timothy L Killeen, President University of Illinois System, USA visited Mahatma Gandhi Gramodaya Parisar, CRDT, IIT Delhi on 31st January 2020. A fruitful discussion was made in regards to research collaborations focusing onto society relevant technology development and dissemination with Discovery Partnership Institute, University of Illinois, Chicago.



(31st January 2020, Source: LinkedIn, Prof. V. K. Vijay)

4. Prof. V. K. Vijay has been conferred with Pt. Deen Dayal Upadhyaya recognition award by re: think India for his leadership and contributions in UBA

Prof. V. K. Vijay has been conferred with Pt. Deen Dayal Upadhyaya recognition award by re: think India for Re- Engineering INDIA 2020 in the Rural Development/ Academia/ individual category award on 11th February 2020 in New Delhi for leading Unnat Bharat Abhiyan.



(11th February 2020; Source: LinkedIn, Prof. V. K. Vijay)

5. Two-day National Training Programme on “Biogas production, purification and power generation” conducted by BDTC, CRDT, IIT Delhi

A two-day national level training programme on “Biogas production, purification and power generation” was conducted by Biogas Development and Training Centre, Centre for Rural Development and Technology, IIT Delhi on March 3-4, 2020. Delegates from governmental, private, academic and non-governmental organization across the country participated.



(4th and 5th March 2020, Source: Programme Co-ordination Team, BDTC, IIT Delhi)

6. CRDT faculties imparts knowledge on rural development during lockdown/Covid-19 period

Faculties comprising of Prof. V. K. Vijay, Prof. Vivek Kumar, Prof. Priyanka Kaushal and Dr. Ram Chandra were invited for delivering expertise lectures in more than 20 webinars and online conferences combinedly, conducted by reputed institutes across the country during the period of March to December 2020. The topics of the webinars ranged from bioenergy, techno-social innovations, self-reliant India to skill development in rural areas.

MANJARA CHARITABLE TRUST
RAJIV GANDHI INSTITUTE OF TECHNOLOGY, MUMBAI
 UNNAT BHARAT ABHIYAN CELL
 Wholesome Rural Development Through Techno-Social Initiatives
 Presents a Three Days National Workshop on
“ग्रामीण विकास”
Enabling Self-Reliant Economy Through Techno-Social Innovation in A Perspective Of Post COVID-19 Rural India
 Date: 25th June 2020 - 27th June 2020
 Time: 11:00 AM to 12:30 PM

Mr. Sunil Chavan, IAS
 Joint Managing Director of MSEDCL, Aurangabad Region

Mr. Sanjeev Karpe
 Managing Director, Native Kombac Bamboo Products Pvt. Ltd.

Mr. Jayant Sahasrabudhe
 Organizing Secretary, VIBHA India

Dr. Virendra Kumar Vijay
 National Coordinator, IUBA
 IREDA Chair Professor, CRDT, IIT Delhi

Dr. R. Ramesh
 SEG- Capacity Building, Strategy for Convergence and Implementation of Various Govt. Schemes
 NIRD&P, Hyderabad

Dr. Ram Chandra
 SEG- Rural Energy Systems
 IIT Delhi

Registration Link for Faculty/ Students/ Professionals : <https://bit.ly/2YV0U5x>
 E-certificates will be provided. For any query mail us at: connect.ubargit@gmail.com
 Attend Live on IUBA CELL, RGIT

Launch of CSIR Technologies for Rural Development
 A Joint Initiative of CSIR, UBA and VIBHA
 On
 40th Foundation Day of CSIR-NISTADS
 September 30, 2020 | 03:00 PM to 4:00 PM

Dr. Harsh Vardhan
 Honourable Minister of Science, Technology and Earth Sciences & Minister of Health and Family Welfare

Dr. Shobhar C. Munde
 DO-CIR, Secretary, DSR, GOI

Padma Bhushan Shri. Vijay P. Bhaskar
 Chairman, National Steering Committee, UBA

Prof. V. Rangappa Rao
 Director, IIT Delhi

Prof. Virendra Kumar Vijay
 National Coordinator, UBA, IIT Delhi

Shri Jayant Sahasrabudhe
 National Organizing Secretary, VIBHA

Dr. Ranjana Aggarwal
 Director, CSIR- NISTADS

Technical experts for lecture
 On
BIOENERGY: TRANSITION AND TECHNOLOGY

Prof. Virendra Kumar Vijay, IIT Delhi
 • IREDA Chair Professor
 • National Coordinator: Unnat Bharat Abhiyan of MHRD, Govt of India
 • Coordinator -Biomass Development and Training centre supported by MNRE

Dr. Thallada Bhaskar, IIT-Dehradun
 • Senior Principle Scientist & HoD, Biomass Conversion Area(BCA)
 Head, Materials Resource Efficiency Division

Dr. A K Sharma, SSS NIBE
 Scientist E, Sardar Swaran Singh National Institute of Bio-Energy, Jalandhar

Dr. Priyanka Kaushal, IIT Delhi
 Associate Professor, Centre for Rural Development and Technology, IIT Delhi

Dr. Vandit Vijay, IIT Delhi
 Scientist -Centre for Rural Development and Technology, IIT Delhi

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- Dr Amit Dhruv Saran
- Dr D Giribabu
- Dr Nitin N Pandhare
- Dr Shashikant Yadav
- Dr Deepak Sahu
- Dr Anjireddy Bhavanam

One Day Webinar
TEQIP-III SPONSORED
 On
BIOENERGY: TRANSITION AND TECHNOLOGY

(July 03, 2020)
 Organized by

Centre for Energy and Environment
Dr B R Ambedkar National Institute of Technology, Jalandhar

Prof. M K Jha
 &
Dr. A K Tiwari
 Department of Chemical Engineering
 Dr. B.R. Ambedkar National Institute of Technology, Jalandhar, Punjab

A glimpse of some webinars held at different prominent institutions (March to September 2020, Source: LinkedIn, Prof. V. K. Vijay)

RECENT BIOGAS RELATED ARTICLES

1. Experimental studies on cyclic variations in a single cylinder diesel engine fueled with raw biogas by dual mode of operation

This research work investigates the cycle-by-cycle variations of a single cylinder, diesel engine operated with raw biogas. The biogas used to run the engine is obtained from food waste and as the composition of 88.10%-CH₄ + 11.895%-CO₂. To study the combustion characteristics, the naturally aspirated diesel engine is converted into dual mode by inducting the biogas into the intake manifold for different proportions from BG20 to BG60 with a step of 10% is mixed with air (i.e. BG60-60% of biogas by mass) respectively. Combustion parameters are measured and recorded by the means of the data acquisition system (DAQ) for 100 combustion cycle. By determining the parameters such as standard deviation, coefficient of variation and return map, the cycle variability is analyzed. From the experimental result, it is observed that as the engine is operated at higher loads and as the biogas is increased from BG20 to BG60 the cyclic variations for maximum cylinder pressure (P_{max}) and indicated mean effective pressure (IMEP) increases. Coefficient of variation of P_{max} for BG20 and BG40 is lower by 2.3% and 11.98% as compared to diesel. From time return map, BG40 showed good combustion stability and lesser NO_x emission compared to diesel. ([Read more...](#))

(Jagdish and Gumtapure, 2020; Fuel; Published on 10th January 2020)

2. Scenarios for upgrading and distribution of compressed and liquefied biogas-Energy, environmental, and economic analysis

In the transition towards fossil-free transports, there is an increasing interest in upgraded biogas, or biomethane, as a vehicle fuel. Liquefied biogas has more than twice as high energy density as compressed biogas, which opens up the opportunity for use in heavy transports and shipping and for more efficient distribution. There are several ways to produce and distribute compressed and liquefied biogas, but very few studies comparing them and providing an overview. This paper investigates the energy balance, environmental impact and economic aspects of different technologies for upgrading, liquefaction and distribution of biogas for use as a vehicle fuel. Furthermore, liquefaction is studied as a method for efficient long-distance distribution.

The results show that the differences between existing technologies for upgrading and liquefaction are small in a well-to-tank perspective, especially if the gas is transported over a long distance before use. Regarding distribution, liquefaction can pay back economically after 25–250 km compared to steel container trailers with compressed gas, and reduce the climate change impact after 10–30 km. Distribution in gas grid is better in all aspects, given that it is available and no addition of propane is required. Liquefaction can potentially expand the geographical boundaries of the market for biogas as a vehicle fuel, and cost reductions resulting from technology maturity allow cost-effective liquefaction even at small production capacities. ([Read more...](#))

(Gutafsson et al., 2020; *Journal of Cleaner Production*; Published on 6th February 2020)

3. The role of biogas and biogas-derived fuels in a 100% renewable energy system in Denmark

The role of biogas and biogas-derived fuels in a 100% renewable energy system for Denmark using the energy system analysis tool Energy PLAN was analysed. The end-fuels evaluated are biogas, biomethane and electro-methane. First, a reference scenario without biogas is created. Then biogas, biomethane and electro-methane replace dry biomass-derived fuels in different sectors of the energy system. The results show that biogas and biomethane reduce dry biomass consumption by up to 16% when used for power, heat or industrial sectors. If biogas feedstock is free for energy purposes, this brings significant energy system cost reductions, but when the energy sector pays for the biogas feedstock, then savings are lower, in which case biogas and biomethane still reduce the energy system costs for use in power, heat or industrial sectors. Replacement of liquid bio-electro fuels for transport with biomethane shows slight cost reductions, but considerably higher costs when using electro-methane. For power, heat, industry and partly transport, electro methane is economically unfeasible, independent of the dry biomass costs. Biogas should be used directly or in the form of biomethane. It is a limited resource dependent on the structure of the agricultural sector, but it can supplement other renewable energy sources. ([Read more...](#))

(Korberg et al., 2020; *Energy*; Published on 18th March 2020)

4. Upgrading of biogas by utilizing aqueous ammonia and the alkaline effluent from air-stripping of anaerobically digested animal manure. Application on the design of a semi-industrial plant unit

Biogas is acknowledged worldwide as an increasingly important renewable energy source. After treatment, the upgraded biogas (biomethane) can be injected into the existing natural gas infrastructure, or it can be compressed for usage as a vehicle fuel. Upgrading of biogas by chemical absorption is considered among the most attractive scrubbing technologies. There are disadvantages though when using alkylamines, such as the energy-intensive regeneration step, degradation of the amines and the potential to form harmful chemical compounds. However, the latter disadvantages could be overcome by using non-conventional methods. In our lab-scale experiments, aqueous ammonia derived from air-stripping of a lime-treated anaerobic digestate proved very effective as biogas scrubber, decreasing carbon dioxide substantially (over 90%), and removing hydrogen sulfide (H₂S) completely. Moreover, the alkaline aqueous effluent of the latter air-stripping process was very effectively neutralized by the biogas, while it also exhibited an important scrubbing potential (removing CO₂ and H₂S partially). Based upon the above experimental results, the flowsheets of an ammonia air-stripping/wet-scrubber and a biogas scrubbing unit, at a semi-industrial scale, were constructed and presented. Taking advantage of both the above acid gas chemical scrubbers could prove very beneficial for a cost-effective conversion of biogas to biomethane. ([Read more...](#))

(Georgiou et al., 2020; Journal of Water Process Engineering; Published on 21st April 2020)

5. Biogas beyond CHP: The HPC (heat, power & chemicals) process

The techno-economic feasibility of three biogas utilization processes was assessed through computer simulations on commercial process simulator Aspen HYSYS: HPC (biogas to methanol), BioCH₄ (biogas to biomethane) and CHP (biogas to heat & electricity). The last two processes are already used commercially with the aid of subsidy policies. The economic analysis indicates that, without these policies, none of these attain economic self-sustainability due to high overall manufacturing costs. The estimated minimum support cost (MSCs) were 108, 62 and 109 €/MWh for the HPC, BioCH₄ and CHP processes, respectively. The model could explain currently practiced government subsidies in Italy and Germany. It was seen that the newly proposed HPC process is economically

comparable to the traditional CHP process. Therefore, the HPC process is a possible alternative to biogas usage. A support policy was proposed: 50, 66, 158 and 148 €/MWh for available heat, methane, electricity and methanol (respectively); the proposed energy policy results in a 10% OpEx rate of return for any of the processes, thus avoiding a disparity in the production of different products. ([Read more...](#))

(Amaral et al., 2020; Energy; Published on 6th May 2020)

6. Biological Co-treatment of H₂S and reduction of CO₂ to methane in an anoxic biological trickling filter upgrading biogas

This study investigates the feasibility of co-treating H₂S and CO₂ in a biological trickling filter (BTF) inoculated with hydrogenotrophic methanogens (HMs) and nitrate-reducing, sulfur-oxidizing bacteria. This was accomplished by introducing a pure culture of *Thiobacillus denitrificans* in a BTF that was successfully upgrading a biogas mimic (60:40 CH₄: CO₂) to >97% methane using an enriched HM consortium. Nitrate was fed as the electron acceptor to oxidize H₂S. The results revealed that a severe competition for hydrogen's electrons occurred between carbon dioxide and nitrate. Due to this competition, N:S loading rates of 16:1 was required to achieve >98% H₂S removal, a ratio which is four times greater than the theoretical N:S ratio for complete sulfur oxidation. However, such high nitrate loading rates (>50 g N-NO₃⁻ m⁻³ h⁻¹) had a negative impact on the BTF's biogas upgrading performance. An electron balance illustrated the increasing diversion of H₂ electrons towards nitrate reduction as nitrate loading increased. Overall, this study showed that simultaneous biogas upgrading and H₂S removal in a single bioreactor is possible, but that achieving high yields for both reactions requires further research in process and culture optimization. ([Read more...](#))

(Dupnock and Deshusses, 2020; Chemosphere; Published on 13th May 2020)

7. Bioelectromethanogenesis reaction in a tubular Microbial Electrolysis Cell (MEC) for biogas upgrading

The utilization of a pilot scale tubular Microbial Electrolysis Cell (MEC), has been tested as an innovative biogas upgrading technology. The bioelectromethanogenesis reaction permits the reduction of the CO₂ into CH₄ by using a biocathode as electrons donor, while

the electroactive oxidation of organic matter in the bioanode partially sustains the energy demand of the process. The MEC has been tested with a synthetic wastewater and biogas by using two different polarization strategies, i.e., the three-electrode configuration, in which a reference electrode is utilized to set the potential at a chosen value, and a two-electrode configuration in which a fixed potential difference is applied between the anode and the cathode. The tubular MEC showed that the utilization of a simple two electrode configuration does not allow to control the electrodic reaction in the anodic chamber, which causes the increase of the energy consumption of the process. Indeed, the most promising performances regarding the COD and CO₂ removal have been obtained by controlling the anode potential at +0.2 V vs SHE with a three electrodes configuration, with an energy consumption of 0.47 kWh/kg COD and 0.33 kWh/Nm³ of CO₂ removed, which is a comparable energy consumption with respect the available technologies on the market. ([Read more...](#))

(Zeppilli et al., 2020; Renewable Energy; Published on 30th May 2020)

8. Improving high-pressure water scrubbing through process integration and solvent selection for biogas upgrading

Biogas plays a vital role in many renewable and sustainable energy strategies, where CO₂ removal is required to produce biomethane (i.e., biogas upgrading). New ideas and technologies have been proposed to improve the process efficiency of biogas upgrading with liquid absorbents, and ionic liquids have been identified as promising candidates. Meanwhile, there is an urgent need to effectively utilize low-quality waste heat in industry. In this study, two strategies (i.e., waste heat integration and desorption unit modification) were proposed and compared with the original high-pressure water scrubbing; in addition, the effects of the temperatures of the heat source and solvents on the energy usage and cost were further investigated. The results showed that the total cost of the process integrated with waste heat recovery decreased by 6.2% compared with the original high-pressure water scrubbing, and the higher temperature of the waste heat source corresponded to a lower cost. The comparison of different solvents further confirmed that ionic liquid-based solvents were promising, with a potential cost reduction of 24.7%; the properties of the solvent, such as the CO₂ absorption capacity, selectivity, and viscosity had significant

influences on the total cost, and a new and single index “comparative absorption factor” was proposed to reflect the overall impact of these properties on the cost. ([Read more...](#)) (Wang et al., 2020; Applied Energy; Published on 26th June 2020)

9. Advances in biogas valorization and utilization systems: a comprehensive review

The emission of greenhouse gases and global warming are the major environmental concerns that has affected the normal geochemical cycles and climate conditions on the earth. However, a controlled production, conversion and utilization of these gases for energy generation in day to day activities of human beings can solve the problem of climate change effectively. Biogas has been recognized as a source of renewable energy available to considerably accelerate the socio-economic development. It is a multifaceted fuel containing methane, carbon dioxide and water vapors with multiple utilization options. Biogas can be valorized either directly or indirectly for various applications like the production of value-added chemicals or as a replacement of natural gas. This review article provides an in-depth analysis of various biogas valorization methods (physical, chemical and biological) for its efficient and eco-friendly utilization. The review intends to fill-up the knowledge gap through critically reviewing biogas cleaning and upgrading methods for biomethane and bio-CO₂ production for various applications including power plants, transport and value-added chemicals. The review article also highlights the conversion of biogas into fine chemicals and products of commercial importance. Chemical, biological and hybrid systems of biogas utilization are described in detail. The opportunities and impediments associated with the valorization of biogas, biomethane and bio-CO₂ have also been discussed. The paper highlights that most of the approaches to the implementation of biogas are in their infancy stage. It also identifies the bottlenecks, policies and future research and developments that are still needed in this relatively emerging field. ([Read more...](#))

(Kapoor et al., 2020; Journal of Cleaner Production; Published on 24th June 2020)

10. High levels of ammonia nitrogen for biological biogas upgrading

This study aimed to propose a novel method for ex-situ biogas upgrading by adding ammonium chloride to increase the concentration of ammonia nitrogen. The results showed that ammonia nitrogen had a significant effect on biogas upgrading. The maximum content

of CH₄ reached 94.1% when the concentration of ammonia nitrogen was 5500 mg/L. At the same time, CH₄ yield of increased by 57.5%. High throughput sequencing results showed that the relative abundance of hydrogenotrophic methanogens reached 73.1%, while that of acetotrophic methanogens was only 1.3%, which greatly increased the content and yield of CH₄. For the bacterial community, Clostridium was the dominant bacteria and the ammonia nitrogen concentration had little effect on it. These results demonstrate that upgrading biogas by increasing the concentration of ammonia nitrogen is feasible. ([Read more...](#))

(Li et al., 2020; International Journal of Hydrogen Energy; Published on 18th August 2020)

11. Removal of H₂S from biogas using gasified wood chars

Biomass gasification is a mature thermochemical process used to produce a gaseous fuel to run burners, engines, and gas turbines. One of the byproducts of biomass gasification is char, which is a residue with low value and sometimes this material is even considered waste. Therefore, options for using gasification chars are required. On the other hand, there is a necessity of making biogas production and use more attractive by employing cheap materials for the biogas cleaning process. One of the promising options for using gasification chars is for cleaning biogas produced via anaerobic digestion (AD). The objective of this work was to assess the use of residual gasification chars from fast growing wood species (Eucalyptus Grandis-EG and Pinus Patula-PP) to remove hydrogen sulfide (H₂S) from biogas produced via AD. Gasification chars were produced employing a laboratory scale downdraft gasifier. EG char (EG-C30) was produced by gasification of EG using a 30 L min⁻¹ airflow, whereas the PP chars (PP-C20 and PP-C40) were produced from PP using 20 and 40 L min⁻¹ airflow. Results show that these three chars offer potential for biogas cleaning, although PP-derived chars produced at higher airflow rates are more effective. The H₂S removal capacity of the chars is ascribed to their large apparent surface area (up to 517 m² g⁻¹) and the presence of minerals and metals (e.g., Ca, K, and Fe) in the chars' ash. ([Read more...](#))

(Pelaez-Samaniego et al., 2020; Biomass and Bioenergy; Published on 24th August 2020)

12. Profitability analysis of a novel configuration to synergize biogas upgrading and Power-to-Gas

This work presents a profitability analysis of a novel route to produce biomethane and synthetic natural gas through Power-to-Gas technology. Differently to traditional Power-to-Gas processes, the process configuration herein proposed allows to produce biomethane even if a source of hydrogen is not available. The novelties of this work are both the new process configuration and the comparison among results for several plant sizes (100, 250, 500, and 1000 m³/h) under two representative EU scenarios (Spain and Germany). The main finding of this work is that no profitable results can be obtained at the present natural gas prices, evidencing the need of incentives. Largest plant could reach profitability under reasonable subsidies (12–15 €/MWh). The forecasted cost reduction for H₂ production and CO₂ methanation are also analysed. The results show that subsidies are needed even in the most optimistic scenario. A corollary of this study is the current technological great challenge to develop low carbon routes which push forward the transition towards sustainable societies. ([Read more...](#))

(Baena-Moreno et al., 2020; Energy Conversion and Management; Published on 4th September 2020)

13. In situ Biogas Upgrading by CO₂-to-CH₄ Bioconversion

Biogas produced by anaerobic digestion is an important renewable energy carrier. Nevertheless, the high CO₂ content in biogas limits its utilization to mainly heat and electricity generation. Upgrading biogas into biomethane broadens its potential as a vehicle fuel or substitute for natural gas. CO₂-to-CH₄ bioconversion represents one cutting-edge solution for biogas upgrading. In situ bioconversion can capture endogenous CO₂ directly from the biogas reactor, is easy to operate, and provides an infrastructure for renewable electricity storage. Despite these advantages, several challenges need to be addressed to move in situ upgrading technologies closer to applications at scale. This opinion article reviews the state of the art of this technology and identifies some obstacles and opportunities of biological in-situ upgrading technologies for future development. ([Read more...](#))

(Fu et al., 2020; Trends in Biotechnology; Published on 8th September 2020)

14. Comprehending the contemporary state of art in biogas enrichment and CO₂ capture technologies via swing adsorption

Biogas is a bio-renewable energy resource that has the potential to serve as a possible replacement for fossil fuels, especially natural gas and as a hydrogen carrier. However, raw biogas produced via anaerobic digestion process contains a large number of impurities such as hydrogen sulfide and carbon dioxide. Thus, upgradation and purification of the raw biogas by capturing CO₂ before its application are necessary. In this regard, swing adsorption (pressure/vacuum/temperature/electrical) technologies have received considerable attention from the research community worldwide as compared to other techniques because of flexibility in operation, high auto-control degree, low energy consumption, and less capital investment. Thus, this review provides a detailed mechanistic insight into the effect of various factors such as type of adsorption technologies, different kinds of adsorbents, bed configuration, source and composition of the biogas, time cycle, and operating conditions on the efficiency of biogas purification process via pressure swing adsorption technologies. Moreover, an overview of the fundamentals of the pressure swing adsorption (PSA) process is provided by focusing on different innovative engineering approaches that contribute to the continuous improvement in process performance. ([Read more...](#))

(Shah et al., 2020; International Journal of Hydrogen Energy; Published on 3rd December 2020)

15. Techno-economic assessment of a synthetic fuel production facility by hydrogenation of CO₂ captured from biogas

In this study, a thermodynamic and economic analysis of a synthetic fuel production facility by utilizing the hydrogenation of CO₂ captured from biogas is carried out. It is aimed to produce methanol, a synthetic fuel by hydrogenation of carbon dioxide. A PEM electrolyzer driven by grid-tie solar PV modules is used to supply the hydrogen need of methanol. The CO₂ is captured from biogas produced in an actual wastewater treatment plant by a water washing unit which is a method of biogas purification. The required power which is generated by PV panels, in order to produce methanol, is found to be 2923 kW. Herein, the electricity consumption of 2875 kW, which is the main part of the total electricity generation, belongs to the PEM system. As a result of the study, the daily methanol

production is found to be as 1674 kg. The electricity, hydrogen and methanol production costs are found to be \$ 0.043 kWh⁻¹, \$ 3.156 kg⁻¹, and \$ 0.693 kg⁻¹, respectively. Solar availability, methanol yield from the reactor, and PEM overpotentials are significant factors effecting the product cost. The results of the study present feasible methanol production costs with reasonable investment requirements. Moreover, the efficiency of the cogeneration plant could be increased via enriching the biogas while emissions are reduced.

[\(Read more...\)](#)

(Tozlu, 2020; International Journal of Hydrogen Energy; Published on 30th December 2020)

NEWS HIGHLIGHTS- NATIONAL

1. Haryana gets its first grid connection biogas plant

Haryana's first grid-connected 1.2 MW biogas-based power plant has been commissioned at a cost of about Rs. 14 crores in Morkhi village of Jind district in Haryana. The plant has been set up by Mor Bio Energy Private Limited and entire power will be purchased by the Haryana Power Purchase Centre at the tariff to be decided by Haryana Electricity Regulatory Commission (HERC).

Ranjit Singh, minister of power and new and renewable energy, said a three-day trial run from March 11 to 15 was done at 80% capacity by the joint team of power and new and renewable energy department. The main feed material of this plant is poultry litter and cow dung. It consumes nearly 180 tonnes biodegradable waste per day and apart from electricity it produces nearly 15 tonne organic fertilizer per day, he added.

He said the waste slurry of this plant contains of nitrogen and other nutrients and can be used as organic fertilizer for crop. Additionally, these projects will avoid release of methane gas in environment and mitigate the problem of pollution created by the poultry farms in the state.

(22nd May 2020, Times of India)

2. India exploring global funds for compressed biogas projects: Oil minister

India is exploring global funds and prioritizing lending for compressed biogas (CBG) projects, oil minister Dharmendra Pradhan said on Tuesday, as the country looks to reduce its crude imports and increase its use of cleaner fuels. "We are also exploring global funds to fund CBG projects," Pradhan said at the inauguration of a biogas plant in Tamil Nadu. India plans to invest \$24 billion to produce 15 million tonnes of compressed biogas from 5000 plants by 2023, and wants bio-manure, a by-product, to contribute to the growth of the organic farming. "A new package for medium and small-scale enterprises shall also assist to fund CBG plants across India," Pradhan said on Tuesday.

(23rd June 2020; Source: Times of India)

3. Compressed bio-gas plant inaugurated in Namakkal

A compressed bio-gas (CBG) plant was inaugurated in Namakkal district by chief minister Edappadi K Palaniswami through video conference in the presence of Union minister for petroleum and natural gas Dharmendra Pradhan on Tuesday. The plant is said to cost INR 25 crore. “I have inaugurated retail sale stations in Namakkal, Puduchatram, Rasipuram and Salem areas along with this CBG plant,” he said.

Palaniswami said Indian Oil Corporation and Germany’s Oil Talking company jointly had set up a bio-gas plant in Namakkal at the cost of INR 34 crores. The plant is producing 2.4 MW of electricity. “Now, additionally, CBG unit has been set up,” he said. The new unit will produce 15 tons of CBG and 20 tons of bio-manure.

(24th June 2020; Source: Times of India)

4. India moves to include compressed biogas under priority sector lending

India plans to include compressed biogas (CBG) under Priority Sector Lending to provide expedited financial assistance to new projects. The Indian Ministry of Petroleum and Natural Gas & Steel has also announced financial packages for Micro, Small and Medium Enterprises to develop CBG plants across India.

The government has stated that it will include bio-manure in the 1985 Fertilizer Control Order that seeks to regulate the trade, price and quality control of fertilizers. Additionally, oil marketing companies have also agreed to launch long-term agreements on CBG. These measures form part of efforts taken by the government to achieve targets set under the 2018 Sustainable Alternative Towards Affordable Transportation (SATAT) scheme. SATAT aims to produce 15 million tonnes of CBG from 5,000 plants by 2023, along with generating 50 million tonnes of bio-manure.

Minister of Petroleum and Natural Gas & Steel, Shri Dharmendra Pradhan, said: “There is immense potential in India’s oil and gas sector and the projects that have been initiated in the recent past would go a long way in ensuring India’s energy security. Biogas production is growing steadily, as more people are setting up biogas plants to produce biogas. Biogas is a renewable, as well as a clean, source of energy. The gas generated through bio-digestion is non-polluting and it reduces greenhouse emissions.”

The Indian government is also encouraging the use of biofuels to increase the green energy mix, reduce imports, generate employment and reduce pollution. The efforts are in line with the 2015 Paris Climate Agreement and the 'Make in India' initiative.

(30th June 2020; Source: Energy Live News)

5. IOC plans more compressed biogas units in Tamil Nadu

Indian Oil Corporation (IOC) has planned to set up more number of compressed biogas (CBG) units in the country. In a video conference with reporters from Puduchatram in Namakkal district on Thursday, executive director and state head of Indian Oil Corporation (IOC) P Jayadevan said IOC would be responsible for the compressed biogas and this can be consumed as a green renewable energy for automotive and industrial applications.

“Through central government’s sustainable alternative towards affordable transportation (SATAT), IOC envisages a target production of 15 million metric tonnes of compressed biogas from 5,000 plants across the country by 2023,” he said.

(17th July 2020; Source Times of India)

6. India's GAIL eyes compressed biogas in strategic push beyond natural gas

GAIL (India) Ltd. is looking to explore opportunities in the compressed biogas sector, as it steps up efforts to expand the business beyond natural gas, part of a push to embrace cleaner forms of energy. The move by GAIL, which commands a 75% market share in gas transmission and more than 50% share in gas trading in India, is seen as part of the government's vision to prepare for the energy transition process, under which New Delhi hopes to raise the share of gas in its energy mix from as low as 6% to 15% by 2030. The state-run company recently signed an agreement with Carbon Clean Solutions Ltd. to build a strategic partnership and explore project development opportunities in the CBG value chain in India.

GAIL and CCSL will explore opportunities in areas, such as feedstock arrangement, production technologies, gas offtake arrangements, as well as transportation, marketing and distribution of CBG. Through the memorandum of understanding, CCSL will initially build four CBG plants using their own funding, technology, and expertise. These plants will be based on 10-year CBG offtake agreements with GAIL or its associated companies.

"There is significant market potential for production of CBG in India," Santanu Roy, executive director for business development at GAIL, said in a recent statement. He added that this would help push the Sustainable Alternative Towards Affordable Transportation scheme of the petroleum ministry, which envisages targeting production of 15 million mt of CBG from 5,000 plants by 2023.

Upon completion of the initial plants, GAIL and CCSL will look to actively advance the partnership with the intention of developing up to 100 CBG plants in India, he added. "As energy demand increases and the country looks to reduce its crude imports it provides a great business opportunity," said Aniruddha Sharma, CEO of CCSL, in a statement. India, which imports 80% of its crude oil requirements, is stepping up efforts to explore new forms of energy to clean up the skies and reduce dependence on imported fuels.

The country's push toward embracing hydrogen is also gaining speed as some of the country's top energy companies, such as Indian Oil Corp., Reliance Industries and Adani Group, are increasingly highlighting the urgency to move toward the carbon-free fuel. GAIL is India's leading natural gas company with interests across the natural trading, transmission, LPG production and transmission, LNG re-gasification, petrochemicals, city gas and E&P. It owns and operates a network of around 12,200 km of high-pressure trunk pipelines. In addition, it is working on multiple pipeline projects, aggregating over 5400 km. The government is in the process of including CBG under priority sector lending in an effort to ease the process of financing CBG plants, according to the petroleum ministry.

(5th August 2020; Source: S & P Global Platts)

7. India looks to blend biogas with natural gas

The Indian government is considering blending biogas with natural gas to boost the domestic availability of biofuels and reduce reliance on imports. According to a report by the New Indian Express, Oil Secretary Shri Tarun Kapoor said the gas distribution sector is rapidly expanding and a portion must come from bio-sources. During a World Biofuel Day webinar, Kapoor said: "They cannot be completely (dependent) on liquefied natural gas or domestic gas, that scope is anyway limited."

The plan for biogas follows a move to blend ethanol extracted from sugarcane with petrol, and mixing diesel with biodiesel extracted from non-edible oil. Kapoor said India is largely an agricultural economy and there are lots of agricultural residues available, with potential

to produce biofuels. Discussing the three main biofuels-ethanol, biodiesel, and biogas - Kapoor said: “If we are able to exploit these three, we can reduce our dependence on import of crude to a large extent and import of gas also.”

To implement these plans, Kapoor called for including appropriate technologies, involving skilled and professional workers, and financial institutions to help get the ball rolling. Kapoor sought support from state governments, according to the report, as agricultural residues and other wastes may come from municipal solid waste or other forms of wastes that must be collected, separated, managed, and supplied to various plants.

(11th August 2020; Source: Biogas News)

8. Twenty PMPML buses to run on bio-CNG from mid-October

Twenty buses of the Pune Mahanagar Parivahan Mahamandal Limited (PMPML) will run on fuel made from food waste collected from different hotels from October 20. Called bio-CNG or CBG (compressed bio-gas), Indian Oil will supply it to the transport body, PMPML chairman-cum-managing director Rajendra Jagtap told TOI, adding that the trials have been completed.

There is a refueling station in Talegaon, and buses from the Bhosari depot of the PMPML moving towards Talegaon area will be running on this fuel. Another fueling station at Nigdi will be ready within three months. More than 50 buses in the PMPML fleet will run on bio-CNG. We are keen on use of alternative and eco-friendly fuel,” Jagtab said.

In 2014, the Pune Municipal Corporation and the Pimpri Chinchwad Municipal Corporation got into agreement with Noble Exchange Environment Solutions Private Limited to collect hotel food waste and convert it into bio-fuel.

(5th October 2020, Time of India)

9. Biogas plant will take care of stubble burning problem: Prakash Javadekar

Union Environment Minister Prakash Javadekar virtually inaugurated a compressed biogas demonstration plant in Pune for biomass production during a meeting held to discuss “steps taken for prevention of air pollution in Delhi-NCR with emphasis on finding a permanent solution” on Friday. “Government is taking all steps to combat air pollution in Delhi and North India and we will be using all possible technological interventions towards that. We

have launched a demonstration plant virtually at Pune which produces compressed biogas from biomass,” Javadekar tweeted.

Such technology (biogas plant) will take care of the issue of stubble burning especially in North India,” Prakash Javadekar said.

According to an official statement, top officials of the Union Environment and the Health Ministries and the governments of Delhi, Haryana, and Punjab attended the meeting. Dr MM Kutty, ex-secretary, Ministry of Petroleum and Natural Gas was appointed as the president and Arvind K. Nautiyal, Joint Secretary, Ministry of Environment as a full-time member of the panel.

(7th November 2020, Hindustan Times)

NEWS HIGHLIGHTS – INTERNATIONAL

1. Sixty-four buses in Tartu, Estonia to run on biomethane

As of 1 January 2020, all buses in the Estonian city of Tartu will run on biomethane. Tartu is one of the few medium-sized cities in Europe where the city's entire public transport system has been converted to run on renewable fuel. Energy company Alexela supplies Tartu's urban buses with biomethane via the region's largest public gas filling station in the city of Tartu. The project was supported by the Environmental Investment Centre with €2.2 million from the European Union's Cohesion Fund. According to the city's deputy mayor Raimond Tamm, Tartu's big goal is to reduce the environmental impact resulting from transport. He said: "The adoption of biomethane allows us to take a major step forward in that direction.

"A clean, people-friendly and sustainable city environment has been Tartu's priority for decades, as it is today and will continue to be in the future." "In terms of the environment, there is no better alternative to biomethane in the transport sector today," said Aivo Adamson, chairman of the management board of AS Alexela. "Biomethane is also made unique by the fact that it is produced locally in Estonia. In this way, we are able to use the locally-produced renewable fuel to reduce the volume of imported liquid fuels, keep jobs in Estonia, and support rural areas." Biomethane production is planned for summer 2020 in Ilmatsalu, with the majority of the plant's output expected to be used by Tartu's urban buses.

(16th January 2020; Source: [Bioenergy News](#))

2. Biomethane demand increases by 800% in United Kingdom

Demand for renewable biomethane compressed natural gas (Bio-CNG) has increased by 800%, thanks to major companies adopting alternative fuels, according to CNG Fuels. The news follows the announcement that CNG Fuels is building two new re-fueling stations to deliver the low-carbon, low-cost alternative for heavy goods vehicles (HGVs), with support from fund manager, Ingenious. The new refueling stations in Warrington, UK (Europe's biggest station) and Northampton are capable of refueling more than 1,000 HGVs every day, more than doubling the 600 per-day capacity of CNG Fuels' existing stations at Leyland, Lancashire and Crewe, Cheshire. The firm is planning to open an additional six

to eight stations over the next 12 months as it expands its network of HGV refueling stations in line with soaring demand.

CNG Fuels has helped hauler's to save 55,000 tonnes of carbon dioxide since it began supplying Bio-CNG in 2017. This number is expected to rise to 90,000 tonnes by the end of 2020, as demand is set to soar thanks to major brands such as the John Lewis Partnership, parcel company Hermes and Home Bargains committing to moving away from diesel. "We're at a tipping point," said Philip Fjeld, CEO of CNG Fuels. "Fleet operators are waking up to the urgency and scale of de-carbonisation necessary for net-zero emissions by 2050 and we're seeing demand for our fuel increase rapidly as a result. Our customers ordered hundreds of new biomethane-fueled trucks in 2019 and that trend is only set to accelerate over the next decade.

The number of HGVs and buses running on natural gas is expected to increase six-fold to 60,000 by 2030, according to Element Energy. In response, CNG Fuels is opening new refueling stations across the UK, with gas network Cadent managing the gas pipelines through which the Bio-CNG is fed. David Jones, transport strategy manager at Cadent, said: "It's clear that big-name companies are now confident to switch from diesel to gas as a green answer to fueling their HGV fleets and supporting the UK's journey to net zero. Biomethane is a 'here now' solution to tackling climate change, a low-carbon alternative to diesel for HGVs, and a zero-carbon option, in the form of hydrogen, is coming within a few years."

The John Lewis Partnership has already committed to replacing its diesel HGV fleet with 500 state-of-the-art biomethane-powered vehicles by 2028. Hermes is also replacing its 200-strong fleet of diesel trucks. Other major companies including Home Bargains, ASDA, Argos, Royal Mail, DHL and Cadent are adopting biomethane. Mervyn McIntyre, head of network fleet & vehicle compliance at Hermes Parcelnet said: "We're proud of our move towards a more sustainable future as the first parcel carrier to invest in biofuels for our first-mile fleet. This will ultimately benefit people across the UK as we all look to reduce our carbon footprint. "We're delighted in the choice of Warrington as a location for a refueling station, which will improve the efficiency of our network and allow us to run additional routes using biomethane-fueled vehicles."

Home Bargains started operating its first 10 CNG tractor vehicles in December 2019, with the company reporting a "very positive" experience. Alan Beech, fleet and compliance

manager at Home Bargains/T.J. Morris, said: “We are looking to add more CNG vehicles to our fleet and expect the first 10 vehicles to reduce total greenhouse gas emissions by more than 1,200 tonnes a year, compared to running diesel vehicles.” The new CNG Fuels refueling station in Warrington is located at Omega South on the M62 and caters to multiple major hauler’s in the area. The Northampton station is located at the Red Lion Truckstop off the M1 and can refuel more than 350 HGVs per day. The site is also part of the UK’s first large-scale study of how biomethane can help to reduce road transport emissions, supported by the Office for Low Emissions Vehicles in partnership with Innovate UK.

(19th March 2020; Source: [Bioenergy News](#))

3. Longmont, Colorado welcomes biogas-fueled waste collection vehicles

Biogas-fueled waste collection vehicles have been introduced in the city of Longmont in Colorado, US. As part of a project prioritized in the city’s 2018 greenhouse gas (GHG) inventory, Longmont has become the first city along the Front Range mountains to implement a renewable vehicle fuel project. Biogas produced at the city’s wastewater treatment plant is transformed into renewable natural gas (RNG) that powers the city’s waste collection trucks. With 11 RNG-powered trucks already on the road, Longmont is offsetting over 100,000 gallons of diesel fuel annually, reducing GHG emissions by around 1,000 tonnes of carbon dioxide equivalent per year. Further reductions are expected when the site reaches full capacity.

The city of Longmont plans to convert the rest of the fleet as the 10 remaining diesel trucks come up for replacement. A statement on the City of Longmont government website said: “Residents can breathe easier knowing this new fleet will significantly reduce nitric oxide and nitrogen oxide tailpipe emissions – leading contributors in ground-level ozone. “The fueling process is simpler for collection truck drivers, as well. Drivers simply connect their trucks to one of 16 fueling posts at the end of their shift to begin the overnight fueling process. In the morning, the trucks are fully fueled and ready to go.” The city worked with Carollo Engineers, a national design firm, to design and construct the biogas treatment system. CGRS, a Fort Collins-based environmental services and construction company, served as the project manager and construction contractor for the project, as well as designing the new fueling station.

(20th May 2020; Source: [Bioenergy News](#))

4. Gasum to open LBG filling station near Arlanda Airport, Stockholm

Gasum will open a liquefied natural gas (LNG) and liquefied biogas (LBG) filling station near Arlanda Airport in Stockholm at the end of the year. The station is Gasum's first in the Stockholm area. By opening a station offering LNG and LBG for heavy-duty vehicles, the company said it is responding to its customers' needs to extend the existing station network to another key transport hub. Following the opening of this latest station, Gasum's network in Sweden will include 16 filling stations in total.

The Arlanda filling station will be located at a central heavy transport hub in the vicinity of Arlanda Airport, Arlandastad Shopping Centre and the E4 motorway. Gasum is working with Arlandastad Holding, the company that manages Airport City Stockholm – a new city forming around the airport. Dieter Sand, CEO of Arlandastad Holding, said: “We are very pleased to have Gasum, a company that is actively working towards reaching the EU's climate goals, choose us as their partner in Arlandastad. The station encourages companies operating in the region to invest in cleaner transport, which goes hand in hand with our efforts.”

“The gas filling station near the Arlanda airport is a long-awaited addition to our existing network,” said Mikael Antonsson, director of traffic at Gasum, Sweden. “Many of our customers are now able to increase their investment in gas-powered vehicles, of which Lidl is a good example. “This interest in sustainable solutions for transport remains very strong. Liquefied gas is a fuel that offers both sustainability and competitiveness.” Carl Ceder, logistics manager at Lidl Sweden, commented: “Gasum and their expansion of new biogas filling stations is a very important part of our conversion to completely fossil-free transport. “Thanks to the fact that they are opening new gas stations for biogas, such as the future one in northern Stockholm, we have been able to start the process of switching biogas trucks and thereby reducing our climate impact.”

(19th June 2020; Source: [Bioenergy News](#))

5. Malaby Biogas LCA study confirms plant's 'significant carbon negativity'

Malaby Biogas, the UK-based operator of Bore Hill Farm Biodigester has confirmed the significant carbon negativity of its operations following a six-month lifecycle assessment

(LCA). The company said the findings “drive home” the vital role that small-scale anaerobic digestion (AD) plants could play as part of the UK Government’s legally binding commitment to reach net-zero emissions by 2050 and its commitment to delivering a post-COVID-19 green recovery.

The LCA study for Malaby’s Bore Hill Farm Biodigester was conducted by a final-year Masters student at the University of Bath and concluded it had an emissions intensity score of -102g of carbon dioxide (CO₂)/MJ electricity generated, indicating the “significantly negative” carbon impact of the operation. In a recently published report by the EU, it was estimated that food waste costs the EU economy around €143 billion per year and is responsible for 15% of all GHG emissions associated with the food supply chain.

Small and medium-sized (SME) biodigester plants such as Malaby are well-placed to help decarbonise food production. Their proximity to rural businesses and farms ensures all forms of food and organic waste are used within a closed-loop system while boosting regional economies. With an estimated 100 similar AD plants close to Malaby’s currently operational in the UK, the study findings suggest that small-scale AD plants are already helping to mitigate as much as 600,000 tonnes of GHG emissions annually, equivalent to removing 400,000 new cars off the road, or 770,000 round-trip seats to New York.

Thomas Minter, director of Malaby Biogas, said: “The key findings from this LCA study really drive home the role that the UK’s AD industry could play in reducing the GHG emissions associated with the food supply chain. “Decarbonisation – on both a local and national scale – is not an ambition but a legally binding obligation. We urge the government to put policies in place that support the potential of AD in the UK as part of the creation of a green recovery. Not only will this enable the government to address its net-zero ambitions, but it will also help provide vital jobs for young people.” Malaby’s Bore Hill Farm Biodigester has been operational for eight years and processes almost 30,000 tonnes of food and organic waste each year, converting it into more than 7,000 megawatt-hours of renewable electricity that is fed into the National Grid.

With local authorities expected to implement food waste collections for households over the next five years and policies being set to support decarbonisation of agriculture, the potential for more distributed renewable resource management will increase “significantly,” according to Malaby. “Building a closed-loop economy for organic wastes and residues - be it from commercial or residential sources, people, or animals - is vital if

we want to accelerate the transition to a net-zero economy as part of a COVID-19 recovery,” added Minter. “Malaby Biogas wholeheartedly supports all our local authorities in this transition which can boost local renewable energy production as well as providing significant economic and educational opportunities for communities.”

(24th July 2020; Source: [Bioenergy News](#))

6. EnviTec Biogas receives order for 1 MW plant in Greece

EnviTec Biogas has received a new order for a 1 MW biogas plant in Greece. The new plant in Agios Athanasios in the Thessaloniki regional area will use silage, food waste, and wet manure. The facility is the second project in Greece for the German biogas firm. EnviTec Biogas, along with the future plant owner - a logistics firm in the food industry – designed the thermophilic anaerobic post-digester, which will serve as an alternative to pasteurisation for the expired food waste that the customer is collecting on behalf of its clients.

“The fact that our plants are made to measure for our customers was a key selling point for our client,” said Dimitrios Pagidis, customer representative for EnviTec Biogas in Greece. Alongside a total of two digesters, a vertical mixer, two mixing tanks and a Kreis-Dissolver are also planned. Lars von Lehmden, managing director of EnviTec Anlagenbau, said: “Even after nearly 20 years in the industry, this new construction project will expand our market position in Europe and is, therefore, an important milestone, especially considering the current COVID-19 crisis and the resulting economic uncertainty.”

As part of the targets announced by the EU, Greece has committed to ensuring that around 20% of its gross final energy consumption is generated from renewable sources by the end of this year. Feed-in-tariffs have also been guaranteed for 20 years from the date when the biogas plant begins operations. The Agios Athanasios plant will be completed over the next eight months and will feed its energy into the existing electrical grid.

(3rd August 2020; Source: [Bioenergy News](#))

7. EPA approves second biogas facility at Melbourne Regional Landfill

The Environmental Protection Authority Victoria (EPA) in Australia has granted a works approval for a second biogas facility at Melbourne Regional Landfill. The facility will double the site’s capacity to destroy captured landfill gas generated by the decomposition

of waste in the landfill, by burning it to generate around 68,000 MWh of electricity every year.

It is estimated the proposed facility would reduce greenhouse gas emissions by the equivalent of 220,000 of carbon dioxide annually at full capacity and generate enough electricity to power 15,000 homes. In addition to standard environmental requirements, the works approval also specifies maximum exhaust stack heights and requires one of the eight new electricity generators to be fitted with a device that measures and records the destruction of the methane gas and the resulting emissions. The proposed facility will mirror the existing facility which has been operational since 2006.

(17th September 2020; Source: Bioenergy News)

8. UK Government launches consultation to scale-up biomethane production

The UK Government is planning to scale-up green gas (biomethane) production to heat around 230,000 homes, with more biomethane plants built as a result. Supported by the new Green Gas Levy, the UK Government is helping people across the UK to ‘go green’ on their energy supplies. With the potential to prevent as much as 21.6 million tonnes of carbon dioxide (CO₂) entering the atmosphere, the government’s Green Gas Levy will result in only minimal costs for consumers, starting at just 11p per month, yet will see climate gains equivalent to planting more than 71 million trees.

The Green Gas Levy was first announced in the 2020 Budget earlier this year and this announcement launches a consultation which invites views on how the final initiative will be designed and implemented. UK Energy Minister Kwasi Kwarteng said: “Reaching net-zero means reducing emissions across our entire energy system, including the way we heat our homes and businesses.

“This new funding will support an ambitious scheme to decarbonise the gas grid that will prevent millions of tonnes of CO₂ from entering the atmosphere – another step towards reaching net-zero by 2050 at minimal cost to UK bill payers.” “Fully deployed, the biomethane industry could deliver a 6% reduction in the UK’s greenhouse gas emissions by 2030 and provide heating for 6.4 million homes, creating tens of thousands of jobs and boosting energy and food production security,” said Charlotte Morton, chief executive of the Anaerobic Digestion and Bioresources Association. “As biomethane is already compatible with our current gas grid, it is also a particularly cost-effective way to

decarbonise the UK's heating infrastructure. "We welcome this consultation and the commitment shown by the Department for Business, Energy & Industrial Strategy, to integrate biomethane into the government's net-zero strategy. With the right policy support, there is much more this industry could contribute to the green economy and to achieving the UK's 5th Carbon Budget over the next decade, but this represents a significant step in the right direction." The consultation on 22 September is the latest measure designed to fight climate change and help the UK reach its net-zero target. In August, the UK Government announced the £2 billion (€2.17 billion) Green Homes Grant, which will fund up to two-thirds of the cost of upgrading the energy performance of UK homes, impacting more than 600,000 homes in England, and saving households up to £600 (€653) per year on their energy bills.

(22nd September 2020; Source: Bioenergy News)

9. BiON acquires two biogas plants from Megagreen Energy

Environmental engineering, wastewater treatment and renewable energy solutions firm BiON has acquired two biogas power plants from its associate firm Megagreen Energy (MGE). The acquisition of the two biogas plants, Nasarudin and Seberang Perak (both in Malaysia), increase BiON's installed capacity to 7 MW. The plants were acquired for MYR45.99m (€9.46 million). Commercial operations at the two plants are expected to commence by the end of the year, subject to the receipt of approvals from the relevant authorities. The plants are under the Malaysian Feed-in-Tariff (FiT) programme with 16-year power purchase agreements with Tenaga Nasional Berhad, the country's largest integrated electricity company. Once the two biogas plants are running at full capacity, they are expected to contribute around MYR9.0m (€1.85 million) in revenues per year over the 16-years.



Fig. Seberang Perak biogas plant. The plant sits on the site of the palm oil mill from which BiON will take the palm oil mill effluent (POME) to generate electricity to be fed into the national grid. (Source: Bioenergy Insight)

(22nd September 2020; Source: Bioenergy News)

10. Weltec Biopower builds biogas plant in South Korea

Weltec Biopower is building a 7 MW biogas plant in South Korea. The plant is being constructed in the province of Gyeonggi-do, 60 kilometers north of the capital, Seoul, and will convert biogas into heat via an integrated gas boiler. It is hoped the plant will go live in spring 2021 and digest up to 93,000 tons of food waste annually, some of which will come from local households.

Weltec said since President Moon Jae-in assumed office, the government has been making “concerted efforts” to achieve autonomy in the power and heat sector and significantly increase the share of renewable energies. Recently, a Green New Deal was announced to deliver net-zero carbon emissions by 2050. South Korea will be the first country in East Asia to set a timeframe to end its contribution to climate change, according to Weltec.

Weltec has already planned and built two biogas plants in South Korea to process organic waste in 2012 and 2016. Both plants boast a high level of plant availability and profitability, said the firm, which highlighted its extensive experience in the waste sector as a key factor in building this modern facility in Gyeonggi-do. Vladimir Bogatov, sales manager for Asia, said: “For this purpose, we customized the two duplex steel digesters of the newest generation with a capacity of 6,200 cubic metre (m³) and 2,700 m³, respectively, to the conditions on-site.

“Due to the space limitations on-site and local requirements, the tanks are very slim and have a height of 8.8m.” Other components of the biogas plant are also custom-made. The raw materials will arrive in processed form and will be fed into the plant as a ready-to-use liquid mixture. “To ensure efficient pre-treatment, we will equip the upstream storage units with special mixing and pump technology,” said Bogatov. “Our custom-developed SPS-based LoMOS control system will make sure that the substrates are automatically pumped from the pre-storage unit into the digesters, thereby ensuring uninterrupted heat supply.”



Fig. Weltec Biopower Plant (Source: Weltec Biopower)

11. Warrens Group praises UK Government’s biomethane plans

Food waste recycler Warrens Group has welcomed the UK Government’s plans to increase biomethane production to heat around 230,000 homes. On 22 September, the government launched a consultation on a Green Gas Levy, as part of its plans to scale-up biomethane, reduce emissions from the gas grid and help the UK reach its net-zero target.

Kevin Quigley, commercial director at Warrens Group, welcomed the consultation as a “significant step in the right direction” to integrate biomethane in the government’s net-zero strategy. “At Warrens Group, our fundamental purpose is to collect food waste and convert it into energy,” said Quigley.

If fully deployed, the biomethane sector could deliver a 6% reduction in the UK’s greenhouse gas emissions by 2030 and provide heating for 6.4 million homes, creating tens of thousands of jobs and boosting energy and food production security. Quigley said the government must not lose sight of its food waste recycling strategy for this to be successful.

“It’s vital that the government continues with its food waste recycling strategy, as if we can’t source the feedstock, we won’t be able to generate the biomethane needed.” As part of the firm’s ongoing efforts to reduce emissions, it has installed a biomethane filling station capable of fueling 200 vehicles per day and it guarantees no losses in transmissions of gas from conversions to filling.

(28th September 2020; Source: Bioenergy News)

12. CalBioGas produces first RNG with Kern County dairy farms

CalBioGas, a joint venture between California Bioenergy, Chevron U.S.A., and local dairy farmers, successfully produced its first renewable natural gas (RNG) from dairy farms in Kern County. CalBioGas brings technology and operational experience to help build digesters and methane capture projects to convert methane into RNG. CalBioGas, dairy farmers, and Chevron are funding digester projects across three geographic clusters in Kern, Tulare, and Kings Counties. As they are completed, the projects will mitigate the dairy farms’ methane emissions and reduce greenhouse gas emissions from livestock.

N. Ross Buckenham, CalBioGas’ CEO, said: “The project is the result of efforts of a remarkable range of stakeholders, including the California Department of Food and Agriculture, the California Energy Commission and the California Public Utility Commission. “CalBioGas is also honoured to be supported by a group of California’s dairy farmers, Farm Credit West and Chevron, California’s largest energy company.

“These projects bring so many win-wins – they help create local jobs, improve local air quality by producing RNG for use in low-NOx emission fleets, and reduce dairy methane emissions”. The dairy biomethane projects are designed to send dairy biogas to a centralised processing facility where it will be upgraded to RNG and injected into local utility SoCalGas’ pipeline. The RNG is then marketed as an alternative fuel for heavy-duty trucks and buses.

(28th September 2020; Source: Bioenergy News)

13. Climate benefits of agricultural biogas greater than previously thought

A report by Aarhus University for the Danish Energy Agency has concluded that the climate effect of biogas in the agricultural sector is greater than previously assumed.

Previous analyses have shown that the production of biogas can provide several benefits to the environment and for the climate. The Aarhus University report examines the climatic and environmental effects of degassing different biomass compositions.

The report contains several updated results for the effects and provides a description and quantification of all relevant environmental and climate effects of biogas production, including energy production, greenhouse gas emissions, nitrogen leaching, ammonia evaporation, nutrient utilisation, and odour nuisance from application. The report looks at the effects of five biomass compositions.

Aarhus University's report concluded that overall, there is an environmental and climate benefit from degassing. With a residence time longer than 45 days, the gain from biogas increases 'only marginally'. The effect depends, in particular, on the amount of highly metabolisable organic material in the biomass composition, according to the study. The report also found that methane emissions from cow manure are higher than previously calculated, and the emission from pig manure is lower. This means there is potential for greater reduction in methane from allowing cattle manure to be degassed, in particular, and that the climate effect of biogas in the agricultural sector is greater than previously assumed.

(21st October 2020; Source: Bioenergy News)

14. BiON to accelerate biogas expansion in Malaysia with consortium

BiON is to establish a consortium to accelerate the expansion of biogas activities in Malaysia. The environmental engineering, wastewater treatment, and renewable energy solutions firm signed several non-binding memorandums of understanding (MoUs) with three parties with complementary expertise and resources in the biogas industry in Malaysia. The parties will now seek to enter formal partnerships to enable a 'significant' strengthening and expansion of BiON's biogas and broader waste-to-energy activities.

BiON, through its wholly-owned subsidiaries, BiON Ventures Sdn Bhd (BVSB) and BiON, has signed MOUs with: Green Lagoon Technology (GLT), a developer of biogas power plants for customers and those that are wholly-owned, with a specialisation in in-ground bioreactor systems. The firm currently has four grid-connected biogas plants generating a total of 6 MW. LIPP Engineering (LIPP), an engineering, procurement and construction firm focused on generating renewable energy from various biomass or waste sources utilising its German-developed technology. Further, through a subsidiary company, LIPP

has strong manufacturing capabilities enabling it to produce advanced equipment and machinery. SIRIM Tech Venture (SIRIM), a government organisation established to promote technological advancement and adoption to drive industrial efficiency and development in Malaysia.

“Each member of this consortium – with BiON at the centre – brings different, but complementary, resources and expertise, which, together, provide critical mass to enable us to drive forward not only our own business but the development of the biogas and broader waste-to-energy industry in Malaysia.

Under the terms of BiON’s agreement with GLT, the parties will seek to formalize a partnership that is expected to involve the establishment of a special purpose vehicle (SPV) (55% owned by BiON with a majority board control) that would own and operate the entire biogas assets of both firms, valued for the purposes of the transaction at RM53.9 million (€11.1 million) for BVSB and RM61.1 million (€12.5 million) for GLT. BVSB will be responsible for raising the funds to meet the requirements of SPV and GLT will be responsible for managing all biogas plant projects, including current pipeline and future biogas plant projects.

BiON will also work with LIPP and SIRIM to explore potential waste-to-energy opportunities, including biogas, that would be of mutual benefit and which can leverage the resources of both parties. The company’s partnership with SIRIM includes the joint establishment of a bioenergy hub for the commercialization of agricultural and industrial waste.

(19th November 2020; Source: Bioenergy News)

15. In Australia, 4,400 homes in Adelaide to be powered by biogas and solar

More than 4,400 homes in Southern Adelaide, Australia, will soon be powered by a new renewable energy hub that utilizes biogas and solar power. The hub includes the state’s first solar farm built on landfill that is sealed to prevent harmful emissions leaking into the atmosphere. The 1,780 solar panels at the Southern Region Waste Resource Authority’s (SRWRA) Seaford Heights site can generate up to 600 kW of electricity.

SRWRA is a regional subsidiary established by Marion, Onkaparinga, and Holdfast Bay councils, which operates waste management services on their behalf. When combined with

the biogas facility, this will generate 25,000 MW of electricity per year – enough to power more than 4,400 homes each day in the site’s surrounding suburbs. The power is fed into the SA Power Networks’ grid, reducing reliance on fossil fuels and cutting greenhouse gas emissions by up to 135,000 tons per year.

(21st December 2020; Source: Bioenergy News)

16. US RNG industry is ‘rapidly expanding’, new study shows

Renewable natural gas (RNG) capacity and production across the US is rapidly expanding, according to a new study. Sustainable energy firm Energy Vision released its most recent joint assessment of the US RNG industry, performed on behalf of the US Department of Energy’s Argonne National Laboratory.

The study found the total number of RNG production facilities in the US that are operational, under construction, or planned, increased by 42% from 219 in early 2019, to 312 by the end of 2020. The figure includes 157 RNG production facilities now operating, 76 projects under construction, and 79 in the planning stages. The 157 operational projects now producing RNG represent total production capacity of 59 million MMBtu, equivalent to over 459 million gallons of diesel – enough to refuel 50,000 refuse trucks (nearly 40% of refuse trucks in the US). With 155 new RNG projects under construction or in the planning stages, rapid capacity growth is expected in the years ahead.

Matt Tomich, Energy Vision’s president, said: “More greenhouse gases (GHGs) are captured in producing the fuel than are ever emitted by the vehicles burning it, meaning that making and using RNG can result in lower atmospheric GHGs than if it were never made or used in the first place.” As a transport fuel, switching vehicle fleets from diesel to RNG derived from a food waste digester exceeds international 2050 GJG emissions goals, cutting emissions by more than 80% below 2005 levels.

Potential domestic RNG production is estimated to be between 10 and 20 times greater than actual current production. “RNG is a powerful tool for decarbonising high-emissions, difficult-to-decarbonise sectors like transportation, manufacturing, and various thermal applications,” said Tomich,” and it can reduce the climate impacts of the natural gas industry itself. “It is also a strategy that directly addresses the significant fugitive methane emissions currently produced by the management of urban and agricultural waste streams. How much it can reduce climate impacts depends on how much we can produce, and how

fast. This new assessment shows RNG ramping up quickly, and growth is likely to keep accelerating.”

(22nd December 2020; Source: Bioenergy News)

UPCOMING EVENTS

National

1. WORLD FUTURE FUEL SUMMIT & EXPO

16–17 February, 2021

New Delhi, India

For more information, visit: <http://www.worldfuturefuelsummit.in/>

International

1. ADBA National Conference 2021 (Virtual)

16–17 February, 2021

United Kingdom

For more information, visit: <https://adbioresources.org/events/>

2. International Biogas Congress & Expo

23–24 March, 2021

Brussels, Belgium

For more information, visit: https://www.bioenergy-news.com/conference/biogas/biogas_index_2021.php

3. Bio360 expo

24–25 March, 2021

Nantes, France

For more information, visit: <https://www.bio-360.com/en/>

4. REGATEC 2020

14–15 April, 2021

Weimar, Germany

For more information, visit: <http://regatec.org/exhibitors/>

5. Value of Biogas Virtual Conferences

27–29 April, 2021

Canada

For more information, visit: <https://biogasassociation.ca/vob2021/>