



नवीन और
नवीकरणीय ऊर्जा मंत्रालय
MINISTRY OF
NEW AND
RENEWABLE ENERGY

SARDAR SWARAN SINGH

NATIONAL INSTITUTE OF BIO-ENERGY

(An autonomous institute of Ministry of New and Renewable Energy, GoI)



Quarterly Newsletter

Bio-ऊर्जा

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Issue 11

Word from the Director General, SSS-NIBE



The Eleventh issue of SSS-NIBE's quarterly newsletter is scheduled for release as we complete the first quarter of the financial year 2025–26.

The last quarter was a period of consolidation of the R&D efforts in all the five R&D divisions at the institute. A major milestone being successful commissioning of 20m³ capacity biogas plant set up by Organic Recycling System Ltd. (ORSL) at Solapur on 28th May 2025. ORSL has signed an NDA/MoU for the Thermophilic biogas digester technology with the institute. This is the first scientific invention from the institute that has successfully transitioned from Lab to the Field. The pilot plant based on Napier grass, a perennial energy crop known for its high biomass yield is currently undergoing field validation, it is expected by the end of this financial year it will reach a Technology maturity i.e. TRL 6. This will soon provide pathway for the Technology Transfer and generate revenue to the institute. This project is also unique due to its integrated approach—combining large-scale Napier grass cultivation, scientific validation through pilot-scale biogas production, and institutional collaboration—positions the project as a model for sustainable bioenergy development.

Likewise, a MoU has been signed with an industry for Technology validation of 2G Ethanol technology. It is expected that the validation process would be complete before end of this financial year.

Last but not the least, the institute is gearing up for conducting the 5th International conference ICRABR 2025 during October 2025. The call for abstracts has been extended and we are hoping for a successful event with large contingency of international participation.

*Dr. G. Sridhar
(Director General)
SSS-NIBE*

Research and Innovation

Valorization of Renewable Biomass Carbohydrates into Fine Chemicals

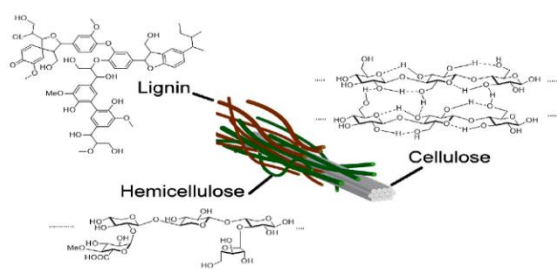
Ms. Komalpreet Kaur

Today's 90% of the energy supply comes from non-renewable sources (i.e., fossil resources), and replacing the raw materials used in the chemical industry with renewable sources while simultaneously mitigating carbon dioxide emissions is a major challenge for humanity. Sustainability, eco-friendliness, and cost-effectiveness are significant components of renewable energy. Renewable energy sources such as hydro, wind, bioenergy, geothermal, and hydrogen are increasingly being adopted to address the global demand for sustainable energy. Among these, biomass stands out as a versatile resource, offering both energy generation and renewable feedstocks for the production of chemicals and materials. Due to its wide availability and carbon-neutral nature, biomass has been identified as a promising alternative to fossil resources for the synthesis of fundamental platform chemicals. These biogenic building blocks have the potential to partially or entirely substitute fossil-derived counterparts in established chemical processes. In the conventional chemical

industry, the generation of energy and the synthesis of key platform chemicals such as propylene, methanol, and xylene heavily rely on fossil fuels, which significantly contribute to greenhouse gas (GHG) emissions. Transitioning to biomass-derived alternatives offers a viable pathway to mitigate these emissions while promoting a more sustainable chemical production framework.

Renewable biomass as a raw material (such as sugarcane bagasse, corn cobs, food waste, wheat straw, rice straw, etc.) can be used to produce platform chemicals and reduce dependence on non-renewable sources. Every year 170 billion metric tonnes of biomass is generated, which contains approximately 70-75% carbohydrates about which only 3-4% is used by humans for food and other uses. Lignocellulosic biomass is primarily composed of three major structural components: cellulose (35–50%), hemicellulose (20–35%), and lignin (10–25%). Cellulose is a linear homopoly-saccharide consisting of C6 glucose units linked by β -1,4-glycosidic bonds, forming tightly packed micro fibrils that provide mechanical strength to the plant cell

wall. In contrast, hemicellulose is a branched heteropoly saccharide composed of a mixture of C5 sugars such as xylose, arabinose, and ribose, C6 sugars including glucose, mannose, and galactose, and various uronic acids such as glucuronic acid, 4-O-methyl-D-glucuronic acid, and galacturonic acid. This diverse composition imparts amorphous and less crystalline characteristics to hemicellulose, making it more susceptible to hydrolysis than cellulose.

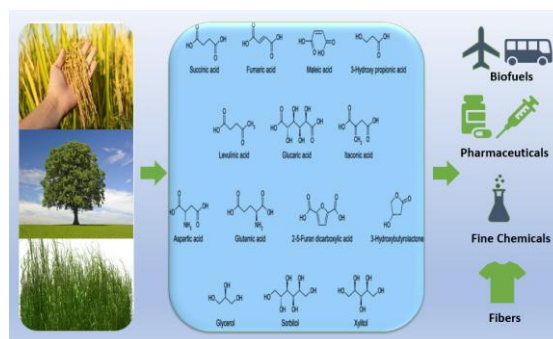


Typical composition of lignocellulosic biomass

The transformation of carbohydrates into fine chemicals can be achieved through various chemical, biological, and catalytic approaches. Chemical methods such as acid/base catalysis, dehydration, oxidation, and hydrogenation are commonly employed to convert monosaccharides and polysaccharides into platform molecules like furfural, hydroxy methyl furfural (HMF), and sugar alcohols.

Carbohydrate-derived platform chemicals represent a pivotal class of intermediates

enabling the transition toward a bio-based and sustainable chemical industry.



Possibility of fine chemicals from biomass and its applications

Compounds such as 5-hydroxymethyl furfural (HMF) and furfural serve as key precursors for the synthesis of advanced biofuels (e.g., 2,5-dimethylfuran), bioplastics (e.g., polyethylene furanoate via FDCA), and resin-based materials. Levulinic acid, another crucial platform molecule, finds application in the production of green solvents (γ -valerolactone), plasticizers, and pharmaceutical intermediates. Polyols such as sorbitol, xylitol, and arabitol are widely utilized in the food, cosmetic, and pharmaceutical sectors, not only as sweeteners but also as starting materials for surfactants and vitamin synthesis. Gluconic acid and its derivatives act as biodegradable complexing agents in detergents and water treatment. Moreover, succinic acid and itaconic acid are gaining industrial relevance in the production

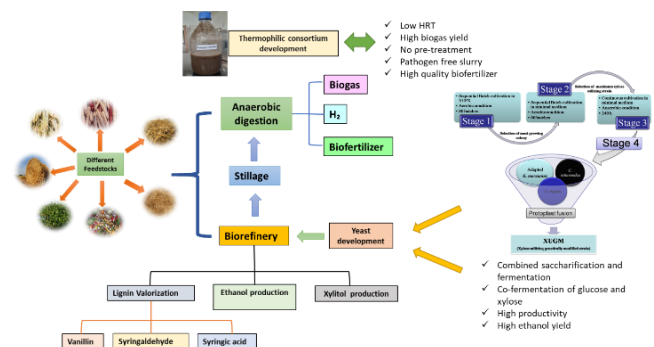
of bio-based polymers, coatings, and specialty chemicals. Despite their high potential, the commercial deployment of these platform chemicals is often limited by high production costs, catalyst stability issues, and the need for efficient separation and purification techniques. Therefore, ongoing research is focused on improving catalytic systems, integrating green solvents, and optimizing process intensification strategies to enhance yield, selectivity, and overall economic viability.

Biorefining of lignocellulosic biomass for bioenergy and biochemicals

Dr. Sachin Kumar

Integrated biorefinery is a sustainable approach for economic, environmental and socially favorable management of wastes along with the generation of renewable and cleaner fuels as well as chemicals/ food/ materials. The strategy is to develop a sustainable integrated biorefinery to achieve maximum yield, productivity and quality of the products; minimize the energy consumption and adverse effect on environment; and competent to broad range of types, seasonal availability and quality of the feedstock. Utility of the primary product of the biorefinery i.e., bioethanol is being the most demanding

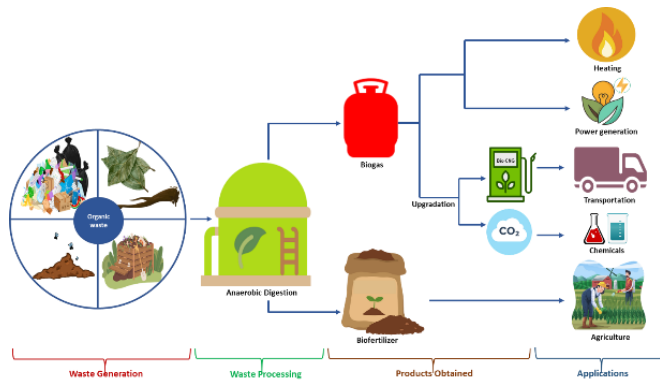
oxygenated additive of gasoline having high octane number causing reduced nitrogen oxides (NO_x) emissions, high heat of vaporization and efficiency of engine. In fact, it is one of the most efficient renewable fuels with potential of replacing gasoline in the coming era to fulfil the continuously rising global energy demands. Further, secondary product of the biorefinery i.e., biogas, is in energy sector as carbon neutral fuel for its application as bio-CNG, electricity, and heating. Further, spent slurry is usable as biofertilizer.



Integrated biorefinery from lignocellulosic biomass

Integrated biorefinery can be employed by targeting products of choice to be generated in combination e.g., H₂, CH₄ and biofertilizer or ethanol, biogas/ H₂, xylitol/ vanillin, syringic acid; or many other combinations of biofuels/ chemicals. Biogas and H₂ are one of the most demanding biofuels due to their variety of applications. Recently, co-production of H₂ and CH₄ in form of "hythane" rather than their

individual production is being practiced for taking beneficial effects of both the fuels.



Sustainable processing of organic waste for its application in energy and biochemicals

The addition of small amount of H_2 could increase the heat efficiency of bio-CNG, makes the engine easy to ignite and reduces the energy requirements. Moreover, it is eco-friendly because it causes reduced GHG emissions into atmosphere as H_2 replaces and reduces the CO_2 content in a mixture of gaseous products. The digestate after the products generation could be further utilized as a biofertilizer for crop lands. Second generation bioethanol has already been proved as a great alternative to the gasoline and recommended to be blended with gasoline in transportation vehicles.

The process of dark fermentative hydrogen production has the disadvantage of low hydrogen (H_2) yield due to the accumulation of volatile fatty acids (VFAs) in the fermentation

medium. However, capability of purple non-sulphur (PNS) bacteria to ferment these VFAs provides a novel opportunity for the valorization of dark fermentative effluent (DFE) as substrate for photo fermentation. It would be beneficial to consider a sequential dark and photo fermentation for enhanced biohydrogen production from organic wastes.

Lignin valorization for generation of different industrial chemicals helps in the financial viability of the integrated biorefinery. The well-developed integrated biorefinery of biomass could lead to the cleaner production of multiple products such as sugars, biofuels, industrial chemicals, and sustainable management of largely produced wastes rather than uncontrolled burning or degradation. Lignin extracted from residual biomass is a precursor of variety of industrially significant chemicals for example, vanillin, which is widely used as a flavoring agent in food and beverages, pharmaceuticals, etc., syringic acid and syringaldehyde are used in pharmaceuticals, food, cosmetics, textiles, pulp and paper industries.

News and Events

Expert Talk on Sustainable Energy Standards

Dr. A. K. Sarma, Scientist-E, SSS-NIBE delivered an expert talk during the training program titled "Empowering Sustainable Energy: Training on Indian Standards for Solid Biofuels" held on April 15, 2025, in Chandigarh. The event was organized by the Bureau of Indian Standards (BIS) in collaboration with the National Mission on the Use of Biomass in Thermal Power Plants (SAMARTH), under the Ministry of Power.

Expert Talk on Earth Day:

Dr. Vandit Vijay, Scientist-C, SSS-NIBE delivered the Earth Day Talk organized by Science City on April 22, 2025, on the theme "Our Power, Our Planet", focusing on renewable energy and the transition away from fossil fuels. The session was specially conducted for school children from various parts of Punjab.

During his talk, Dr. Vandit Vijay highlighted the harmful impacts of conventional fossil fuels, emphasizing their major role in greenhouse gas (GHG) emissions, global warming, pollution, and the resulting effects of climate

change. He underscored the critical importance of adopting renewable energy sources in achieving India's climate goals and advocated for conscious consumption practices to ensure a healthy and sustainable future for our planet.

Biogas Plant Field Visit to Promote Organic Farming and Clean Energy

SETU Aayog (State Institute of Empowerment & Transformation), established by the Government of Uttarakhand and modeled on the lines of NITI Aayog, invited nominations from NIBE for a field visit aimed at promoting organic farming and reducing reliance on LPG and fossil fuels. The initiative focused on exploring the potential of customized, community-based biogas units to be operated by FPOs, PACS, and PRIs.

Dr. Vandit Vijay and Mr. Rakesh Godara represented NIBE during the field visit, assisting in evaluating the feasibility of the identified cluster along with other stakeholders. The visit took place on May 15, 2025, followed by a meeting on May 16, 2025, with the District Administration and Chief Development Officer, Ms. Akanksha Konde,

IAS, to discuss observations and the way forward.

Workshop at CSIR-NEERI: Energy Dialogues on Inclusive Clean Energy Transitions

Director General, NIBE, attended the workshop titled “Energy Dialogues: Clean. Viable. Inclusive” as a Guest of Honour on May 27, 2025, at CSIR-NEERI, Nagpur. Organized by CSIR, the workshop aimed to explore emerging innovations and opportunities in key areas such as biomass energy, green hydrogen, emission control, carbon finance, and strategic planning for inclusive energy transitions. The event served as a platform for dialogue among experts, policymakers, and stakeholders to advance clean, viable, and inclusive energy solutions for a sustainable future.

Visit to ORSL: Inauguration of 20m³ Thermophilic Biogas Plant in Solapur

On May 28, 2025, the DG, SSS-NIBE, along with a team of scientists, visited Solapur to participate in the formal inauguration of a 20m³ capacity biogas plant (based on Napier grass) set up by Organic Recycling System Ltd. (ORSL). The plant employs advanced thermophilic biogas digester technology designed to enhance the efficiency and speed

of organic waste decomposition under high-temperature conditions.

This event marked a significant milestone in the ongoing collaboration between SSS-NIBE and ORSL, following the signing of a Non-Disclosure Agreement (NDA) and a Memorandum of Understanding (MoU) for the joint development and deployment of thermophilic biogas technologies. The partnership aims to scale up decentralized waste-to-energy solutions, supporting India’s broader goals of energy self-reliance, clean energy transition, and rural empowerment.



Inauguration of 20m³ Thermophilic Biogas Plant in Solapur

Participation in National Biomass Conference on Accelerating Biomass Co-firing (ABC) in Thermal Power Plants

Dr. Tapas Kumar Patra, along with two research fellows, represented SSS-NIBE as exhibitors at the National Biomass Conference on ABC

Accelerating Biomass Co-firing in Thermal Power Plants, held on June 10, 2025, at Eros Hotel, New Delhi. The conference was organized by the SAMARTH Mission in collaboration with the National Power Training Institute (NPTI).

The event brought together key stakeholders from the energy sector, including policymakers, researchers, industry leaders, and technology providers, to deliberate on strategies for enhancing biomass utilization in coal-based thermal power plants. The participation of SSS-NIBE highlighted the institute's ongoing research, technological developments, and policy advocacy in the field of biomass co-firing and sustainable energy transitions.



International Yoga Day Celebration

11th International Yoga Day Celebration at SSS-NIBE

In line with the directives of the Ministry of New and Renewable Energy (MNRE), Sardar

Swaran Singh National Institute of Bio-Energy (SSS-NIBE) organized a series of awareness activities to commemorate the 11th International Day of Yoga on June 21, 2025. The celebration aimed to promote physical, mental, and spiritual well-being through the integration of yogic practices into daily life.

As part of the program, an expert lecture on "Holistic Wellbeing through Yogic Practices" was conducted on June 6, 2025. The session emphasized the role of yoga in fostering a balanced lifestyle, stress management, and overall wellness, drawing participation from staff, researchers, and students.



International Yoga Day Celebration

This was followed by a week-long Yoga Shivar held from June 7 to 13, 2025, at the SSS-NIBE campus ground. The sessions were conducted by renowned yoga expert Shri T. P. Singh from RCF, who guided participants through various asanas, breathing techniques, and meditation practices. The initiative received enthusiastic

participation, reflecting the institute's commitment to promoting a culture of health, mindfulness, and inner harmony in alignment with national objectives.

National Hands-on-Training cum Workshop on Agro-biomass Sampling and Characterization Techniques:

SSS-NIBE conducted a two-day National Workshop on "Specialized Hands-on-Training cum Workshop on Agro-biomass Sampling and Characterization Techniques for Thermal Power Plants (TPP)" between June 12 -13, 2025.

The event, dedicated to empowering thermal power plant officials with practical knowledge and skills on biomass co-firing. The workshop was formally inaugurated by Chief Guest, Shri Satish Upadhyay, Mission Director of the SAMARTH Mission, in the presence of Dr. G. Sridhar, Director General, SSS-NIBE. In his welcome address, Dr. Kunwar Pal, Scientist-C, outlined the objectives of the workshop and shared an overview of the ongoing research initiatives at SSS-NIBE, especially in the domain of biomass co-firing.

ICRABR-2025: 5th International Conference on Recent Advances in Bio-energy Research

We're excited to announce the 5th International Conference on Recent Advances in Bio-energy Research (ICRABR-2025), organized by SSS-NIBE, taking place from 6th to 9th October, 2025. With a growing global focus on renewable energy, the conference will highlight cutting-edge research in biomass and bio-energy—including biohydrogen, biomethanation, bioethanol, biomass gasification, carbon materials, value added chemical and more. Building on the success of previous editions, ICRABR-2025 will bring together global experts to explore sustainable solutions for energy and environmental challenges. For more details please visit: www.icrabr.com

Important Dates

Abstract Submission Opens:	20/03/2025
Abstract Submission Closes:	15/08/2025
Early Bird Registration Deadline:	30/08/2025
Intimation of Abstract acceptance:	20/08/2025
Final Registration Deadline:	10/09/2025



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