



Second Generation Biofuels



The **U.S.-India Consortium for Development of Sustainable Advanced Lignocellulosic Biofuel Systems** is a collaborative effort between Indian and U.S. institutions under the **Joint Clean Energy Research and Development Center (JCERDC)** initiated by the Governments of India and the United States to accelerate transition to a low-carbon, high-performance and energy-secure economy. The Biofuel Consortium addresses the second generation biofuels R&D priority area of the JCERDC, emphasizing sustainable feedstock cultivation and supply, biochemical conversion technologies for production of second generation biofuels with minimal environmental impact, and analysis of overall sustainability and supply chain of feedstocks as well as biofuel. The consortium is jointly led by the **Indian Institute of Chemical Technology (IICT)**, Hyderabad, India and the **University of Florida (UF)**, Gainesville, Florida, USA.



VISION

The major goal of this consortium is to develop and optimize selected non-food biomass (high-yielding varieties of sorghum, pearl millet, bamboo and switchgrass)-based advanced biofuel systems and bio-based products like biogas and lignin-based high-value polymers for the U.S. and India. The successful completion of the project is expected to benefit both nations by delivering a working model for feedstock production and supply, biochemical conversion approaches and technologies that have been validated on pre-commercial scale systems, and overall economics and sustainability of biofuel production and supply systems.





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ORGANIZATION

The research is grouped under three broad thrust areas or Work Programs (WP):

- WP1 – Feedstock development and supply
- WP2 – Biorefinery technologies
- WP3 – Sustainability, marketing and policy

OBJECTIVES

Feedstock development and supply (WP1)

This program focuses on breeding high-yielding switchgrass and sorghum in the USA and sorghum, pearl millet and bamboo cultivars in India that can be grown on marginal lands. These marginal lands have been identified as those lands that are flood and drought prone in the USA along the Mississippi and Missouri river flood plains and in the Midwestern states, and salinity and drought prone areas in Central, Western and Southern states of India. Specific objectives are to:

- 1 Improve production potential and feedstock quality using genomics and breeding tools, and identify locally adapted cultivars and their optimization for large-scale production.
- 2 Develop production logistics and identify soil and environmental criteria to ensure a commercially successful advanced feedstock production system.

Biorefinery technologies (WP2)

The overall goal of this work program is to improve lignocellulosic biomass processing technologies for fermentable sugar production and subsequently their conversion to biofuel. Biofuels targeted are ethanol in India and butanol in the USA. An additional emphasis of this program is on processing and utilization of waste streams for recovery of nutrients and bio-product production. It is envisioned that this approach would ensure that the biofuel is manufactured with minimal environmental impact and there are additional revenues for the biorefinery. This work program is also well positioned to accelerate deployment of commercial systems both in the USA and India due to the availability of a pre-commercial scale biorefinery at the University of Florida. Objectives of this work program are:

- 3 Develop biocatalysts for production of advanced biofuels, and optimize pretreatment and fermentation processes.
- 4 Develop co-products and applications from biorefinery waste streams that minimize environmental impacts and maximize revenues.



For more information, please visit: <http://biofuels.ifas.ufl.edu/>





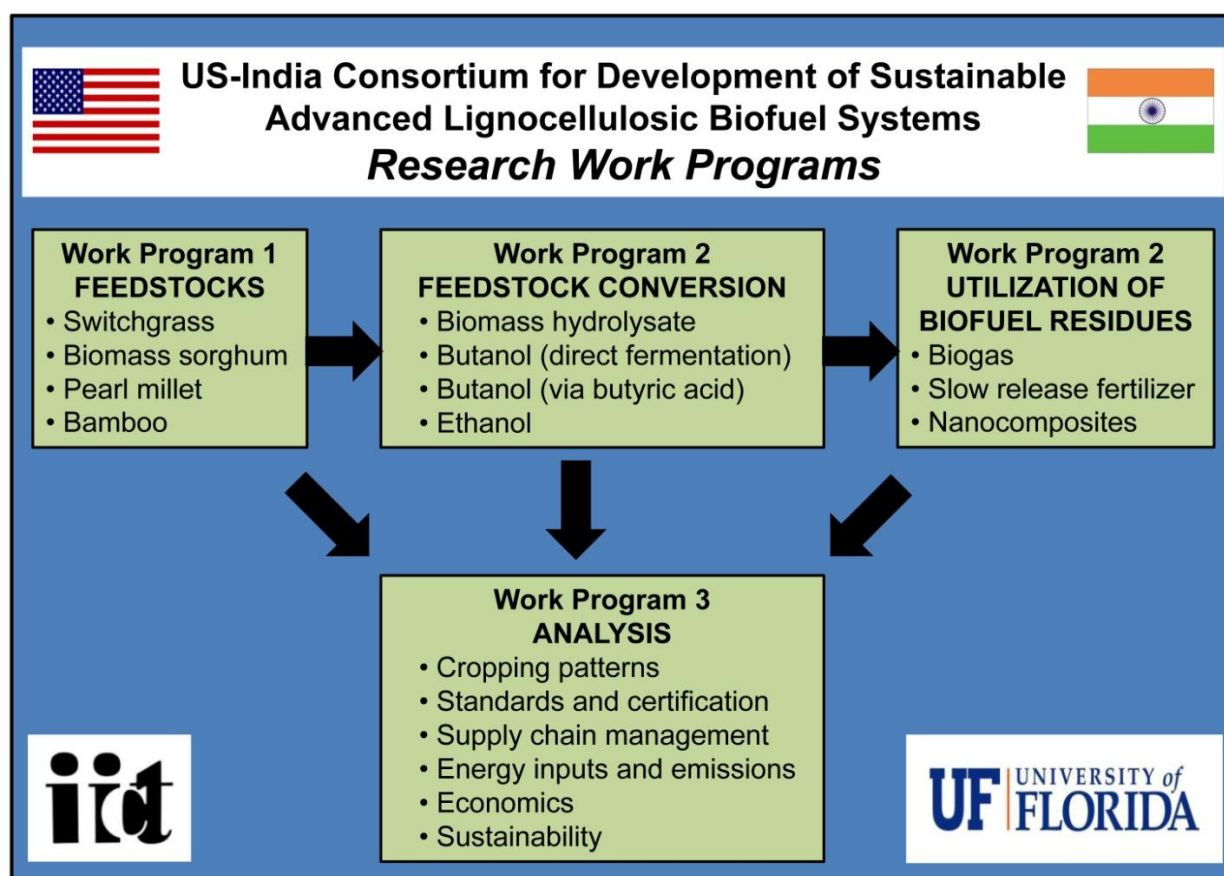
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Sustainability, marketing and policy (WP3)

Despite the significant potential for the expansion of advanced biofuels production in the USA and India, the environmental, economic, and social consequences of dramatically increased harvesting of advanced biofuels feedstocks have not been systematically analyzed. This lack of information limits our ability to ensure long-term sustainability of these feedstock practices and forecast sustainable feedstock supply and development of biofuel systems in both these countries. Understanding the sustainability of biofuels supply and demand systems is a critical component for private sector investments and government policy making. Objectives of this work program are:

- 5 Analyze and develop certification protocols and sustainability standards.
- 6 Assess energy requirements and emissions, and perform economic analysis.
- 7 Undertake supply-chain management analysis.



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CONSORTIUM PARTNERS

INDIA	UNITED STATES OF AMERICA
<i>Lead Institution:</i> Indian Institute of Chemical Technology (IICT), Hyderabad	<i>Lead Institution:</i> University of Florida (UF), Gainesville, Florida
<i>Other Partners:</i> International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad; Directorate of Sorghum Research (DSR), Hyderabad; Jawaharlal Nehru Technological University (JNTU), Hyderabad; Tamil Nadu Agricultural University (TNAU), Coimbatore; Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya (RVSKVV), Gwalior; Centre for Economic and Social Studies (CESS), Hyderabad; Indian Institute of Technology-Delhi (IITD); Indian Institute of Technology-Madras (IITM)	<i>Other Partners:</i> University of Missouri (UM), Columbia, Missouri; Virginia Tech, Blacksburg, Virginia; Montclair State University (MSU), New Jersey; Texas A&M University, College Station, Texas
<i>Industry Partners:</i> Abellon Clean Energy Ltd., Ahmedabad; Hindustan Petroleum Corporation Ltd. (HPCL), Bangalore	<i>Industry Partners:</i> Green Technologies LLC, Gainesville, Florida



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