

# Biorefinery and Chemicals UK-India Status

Professor Basu Saha

Associate Director of the Centre for  
Global Eco-Innovation,  
Lancaster University, UK

Dr Shyam Kumar Masakapalli

Associate Professor,  
School of Basic Science,  
Indian Institute of Technology Mandi, India

Dr Sanjay Nagarajan

Research Fellow,  
Sustainable Environment Research Centre,  
University of South Wales, UK

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# Existing project areas

- Fuels + anything else
- Biomass to valuable chemicals
  - Agri and forest waste based
  - Industrial waste based
    - Paper and pulp waste
    - Food and beverage industry waste (e.g. waste cooking oil/fats)
  - Municipal and domestic waste
    - Solid waste
    - Wastewater/sludge
- Non-fermentative biomass valorisation pathways
  - Fast pyrolysis,
  - New catalytic routes
  - Gasification
  - Torrefaction

## Products

1. Biofuels – gas, diesel, alcohols, biooil
2. VFAs
3. Food/beverage/pharma ingredients
4. Bioplastics
5. Nanocellulose
6. Ash as binders for concrete
7. Animal protein
8. Activated carbon/carbon based catalysts/supports

## Overlaps

1. Bioengineering of microbes and enzymes – AD and fermentation
2. CO<sub>2</sub> to Value – Algal biorefineries

## Feedstock

1. Sugarcane
2. Rice straw
3. Paper mill waste
4. Municipal solid waste
5. Flower waste
6. Coffee waste
7. Food waste
8. Oils/fats

## Industries

1. FibreRight
2. BioSep Ltd
3. Lixea
4. FibreLean
5. James Cropper
6. Inspro
7. Moolec
8. GFR
9. Nova Pangea Tech
10. ONGC
11. IOCL
12. BPCL
13. HPCL
14. Praj
15. Vivira

## Universities/Institutes

1. Imperial
2. Leeds
3. QUB
4. Aston
5. Manchester
6. York
7. Surrey
8. Bath
9. Southampton
10. Nottingham
11. John Innes
12. Cranfield
13. USW - SERC
14. Aberystwyth
15. IITs
16. IISc
17. ICT
18. IIP
19. NEERI
20. VSI
21. CSIR labs

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# Gaps in research field from funded projects

## Existing gaps needing more research

- Scalable pre-treatment
  - Waste segregation
  - Choice of pre-treatment
  - Moving up the TRL ladder
  - Advanced/innovative methodologies
    - Cavitation based – non-milled biomass use
- Process integration – chemical/biochemical/physical
- Pre-treatment – yet to scale (novel technologies)
  - Advanced microwaves
  - IL – scale up approaches
- Processing plants for biorefineries – reimagining the design and scale up
- Maximising biomass conversion
  - Lignin valorisation for complete biomass utilisation – e.g. vanillin, bioplastics
- AD based biorefineries for fuels, fertilisers and chemicals
- LCA and socio-economic impacts – feasibility and models

## Overlaps

1. Identifying regional biomass wastes as resources – Resources section

## New gaps identified

1. AI/Modelling – kinetic modelling, process modelling, etc
2. Development of efficient, scalable heterogeneous catalysts
3. Addressing feedstock heterogeneity
4. Aquatic biomass valorisation

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# Research needs

- Scalable pre-treatment for biorefineries – moving up the TRL ladder – tuneable bespoke methods
- Addressing feedstock heterogeneity for maximising biomass conversion – e.g., lignin valorisation
- Process integration for maximising biomass conversion – combining chemical/biochemical/physical processes
- Allied needs – bioengineering, catalyst development, modelling and LCA tools

