INFOGRAPHICS II

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TRANSFORMING FOOD WASTE INTO SUSTAINABLE BIOPOLYMERS

OUR MILESTONE PATH

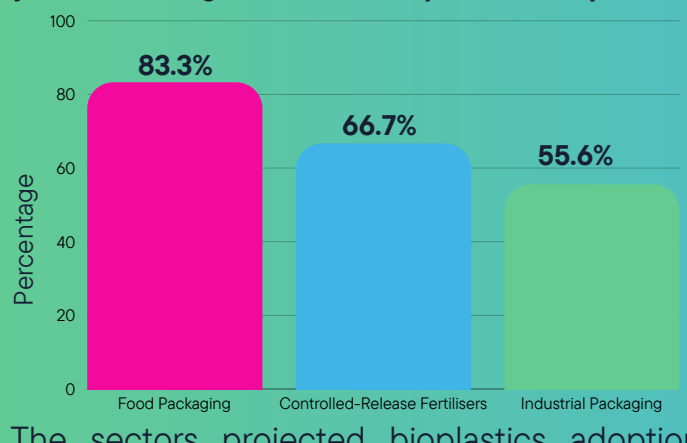
- **Sep 2023** — BSF larvae cultivation bioreactor was designed and constructed.
- **Jan 2024** — Pre-treatment of larvae biomass was developed.
- **May 2024** — Workshop conducted on barriers & potential solutions.
- **July 2024** — Primary process qualitative data shared for Life Cycle Inventory.
- **Sep 2024** — Demonstration of circular process.
- **Sep 2024** — Business model assessed.
- **Sep 2024** — Metabolic model for PHA production was developed.
- **May 2025** — Best PHA production process route was selected & optimized.
- **Aug 2025 Dec 2025** — Two IPR patent application filed successfully.
- **Mar 2026** — Workshop on best practices & policy recommendations.

EXPLOITABLE RESULTS

- Larvae Cultivation Prototype
- Chitin & Chitosan production
- Superabsorbent biopolymers
- Validated PHA process
- Physics Informed Neural Network bioprocess model

BIOPLASTICS ADOPTION

Projected Leading Sectors for Bioplastics Adoption



According to the BioLaMer policy document,[1] although several uncertainties are expected to pose significant challenges to bioplastics business strategy and decision-making over the next 5–10 years, respondents remained optimistic that supportive policy measures could transform current momentum into sustained sectoral growth.

The sectors projected bioplastics adoption are food packaging, controlled-release fertilisers, and industrial packaging.

PINN BASED BIOPROCESS MODELLING

BioLaMer's metabolic model development was published in an open-access journal. The article presents a specialized architecture designed to improve how biological processes can be modelled by combining artificial intelligence with physical laws.[2]

- **Dual-ANN Structure** — Allows the model to handle complex data more accurately than single standard network.
- **Physics-Informed Loss Function** — This model is trained using both physics loss and data loss.
- **Overcoming Data Dependencies** — Achieves high accuracy with limited experimental data
- **PINN vs Hybrid Semi-parametric Models** — PINN integrates physics laws with neural networks allowing flexibility for learning unknown kinetics.
- **Time-varying Control Inputs** — Optimized for dynamic batch and fed-batch fermentation, effectively manages time-varying control inputs for real-world industrial application

This improved predictive control enables more reliable industrial-scale sustainable bioplastics production and scale-up optimisation.

PROJECT IMPACT

ENVIRONMENTAL

- Reduction of Food Waste
- Carbon Storage
- Reduces reliance on Fossil-based plastics

ECONOMIC

- Bioinnovation Market Potential
- Waste Valorisation Opportunities
- Circular Value Chains

SOCIAL

- Green Jobs
- Support Circular Economy Awareness
- Sustainable Contributions

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