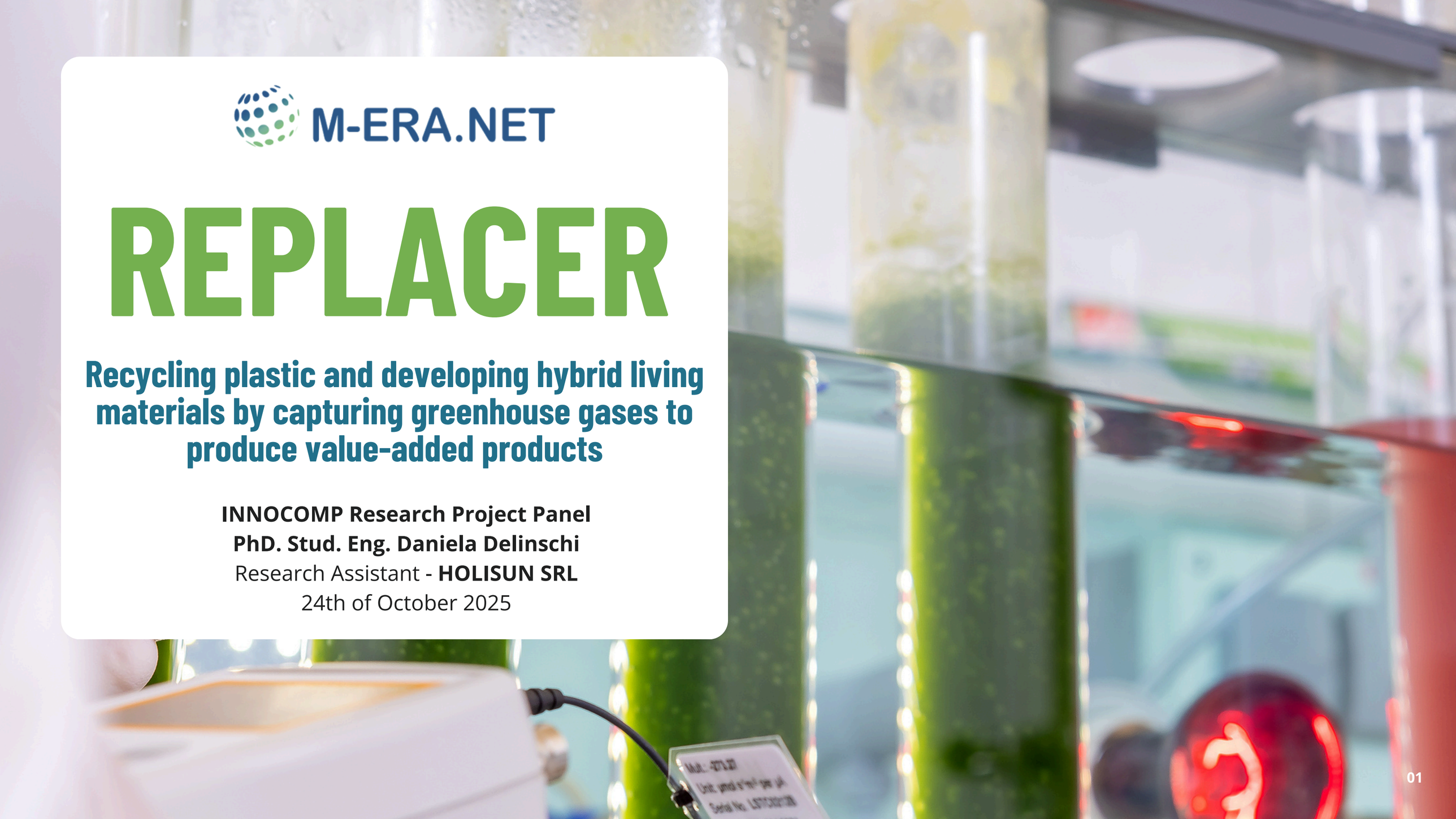

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Recycling plastic and developing hybrid living materials by capturing greenhouse gases to produce value-added products

INNOCOMP Research Project Panel
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Research Assistant - **HOLISUN SRL**
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Global Challenges

- **Climate Change**: CO2 and CH4 emissions drive global warming
- **Plastic Pollution**: only ~10% of plastic waste is recycled globally
- **Food Insecurity**: Europe imports ~70% of its protein feed (mainly soy, which has high environmental impact)

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Specific Oportunities

- **Greenhouse Gas Utilisation (GGU)**: transform CO2 and CH4 into resources
- **Circular Economy**: Turn plastic waste into high-value products
- **Biotechnology Integration**: Use specific microorganisms to build *living materials* that convert gases and plastic into biomass

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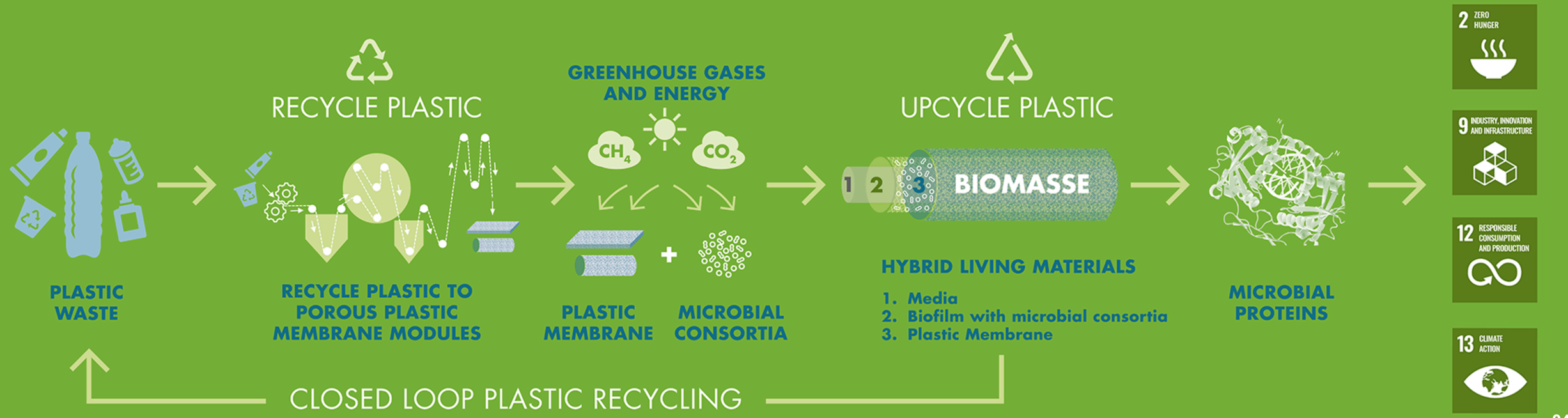
Project goal

Aims to develop **high-performance** biobased **hybrid living materials** that *capture CO_2 and methane* while producing microbial proteins as a value-added feed source.



Expected results

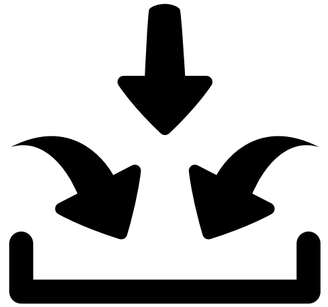
01 **Develop a new closed-loop research platform of design-build-test-learn (DBTL)** that combines material recycling and processing, synthetic microbial consortia by capturing GHGs, cross-cutting analytics, and using modelling and artificial intelligence strategies for building novel HLMs.

02 **Develop high-performance HLMs** as an **energy-efficient and cost-effective solution** for scrubbing GHGs and producing biomass as a feed (microbial proteins) using the iterative DBTL cycle.

03 **Design HLM-bioreactor prototypes** and demonstrate the **feasibility** of the developed microbial protein process using **environmental** and **economic assessments** and address social and ethical issues by applying responsible research and innovation **(RRI)** techniques**.**

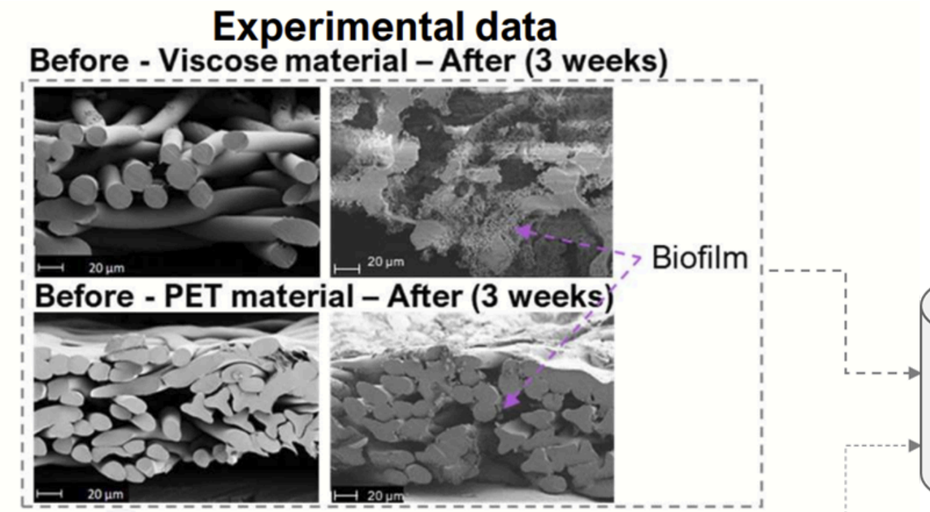
Inputs and Outputs of the System

- Plastic Sources
- Specific types of microorganisms
- (optionally) Methane



- Living cultures of microorganisms which can be used as a protein source

Growth Optimisation Architecture

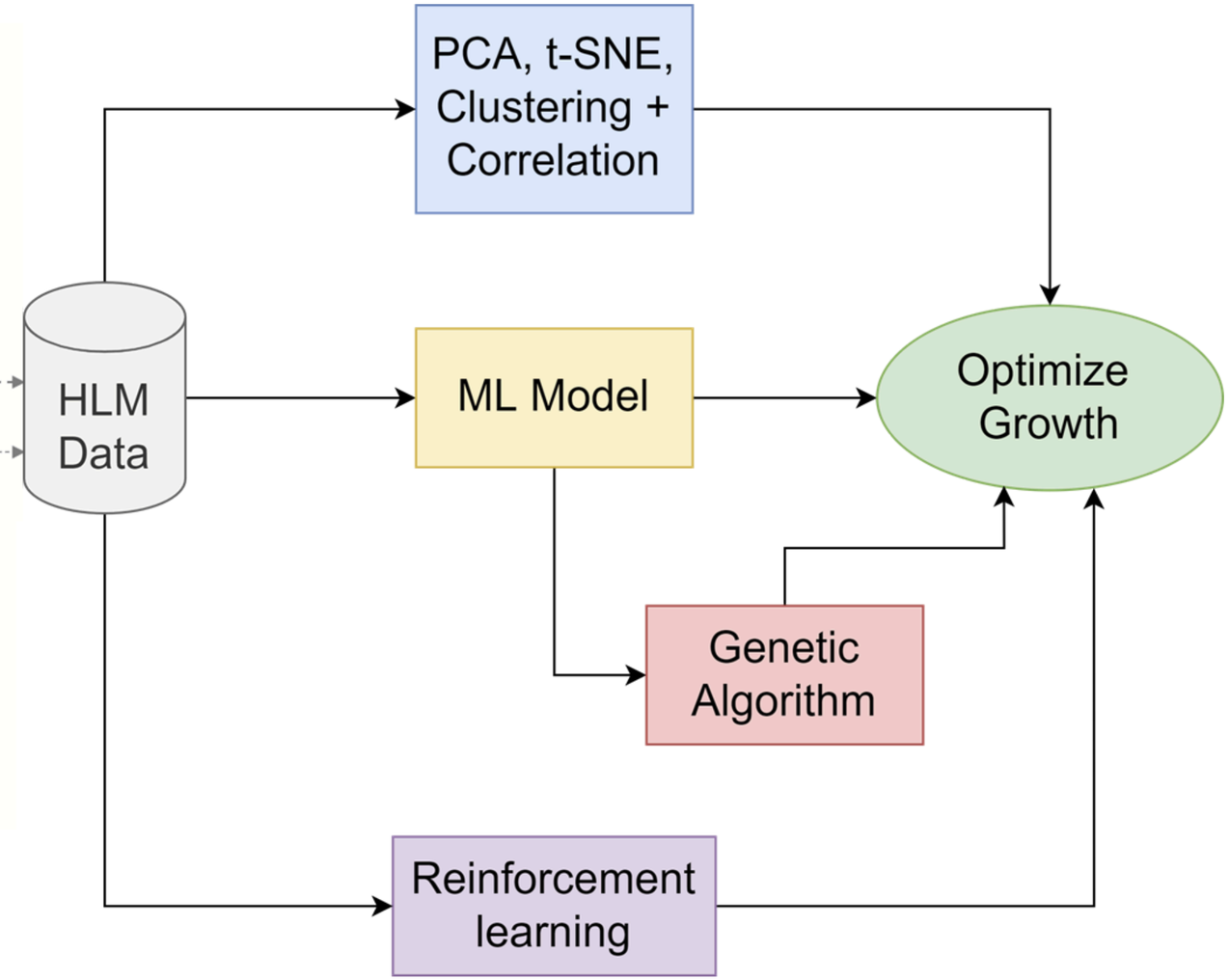


Mathematical model data

time-dependent displacement tensor:

$$F_i^{\ j}(x, t_0, t) = \frac{\partial x^j(x,t)}{\partial x^i(x,t_0)}$$

$$\mathrm{d}x^i(t) = F_\mu^{\ i}(x, t_0, t)\, \mathrm{d}x^\mu(t_0)$$



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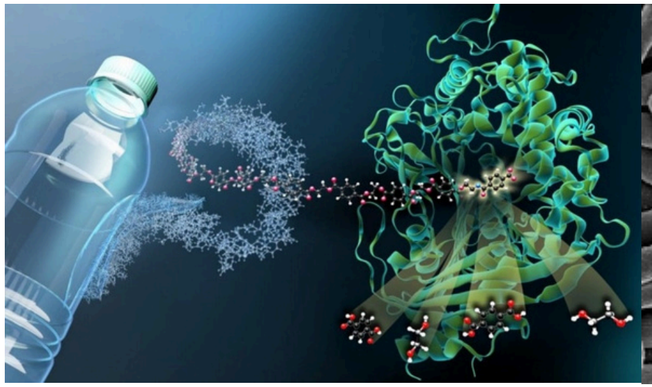
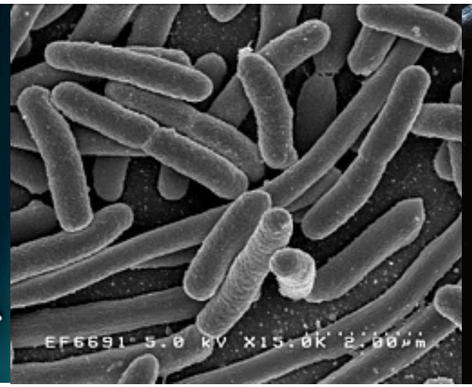
Why is it useful?



Organisms consume plastic, reducing their prevalence in the nature



Organisms are harmless, no risk of contamination, no bad impact.

A very good source of protein for various applications

Reduce the impact of microplastics on the environment, without adding more impact

Conclusion:
We replace or use a bad waste (*plastic*) to produce something very useful (*protein*).
Either on their own would be a good result.

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THANK YOU FOR YOUR ATTENTION!

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