

SYNPOL - Biopolymers from Syngas Fermentation



PROJECT DETAILS

PROJECT REFERENCE: 311815

PROGRAMME ACRONYM: FP7-KBBE

SUBPROGRAMME AREA: KBBE.2012.3.4-02

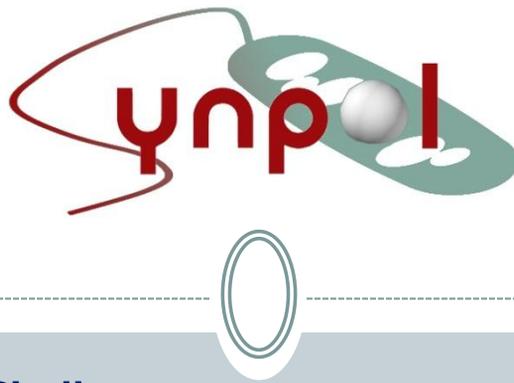
CONTRACT TYPE: COLLABORATIVE PROJECT

DURATION: 48 MONTHS **PROJECT STARTING DATE:** 1ST OF OCTOBER 2012



The SYNPOL project has received funding from the European Union Seventh Framework Programme (FP7; 2007-2013) under grant agreement no. 311815.





The Project & The Challenge

SYNPOL aims to propel the sustainable production of new biopolymers from feedstock.

SYNPOL will thereto establish a platform that integrates biopolymer production through modern processing technologies, with bacterial fermentation of syngas, and the pyrolysis of highly complex biowaste (e.g., municipal, commercial, sludge, agricultural).

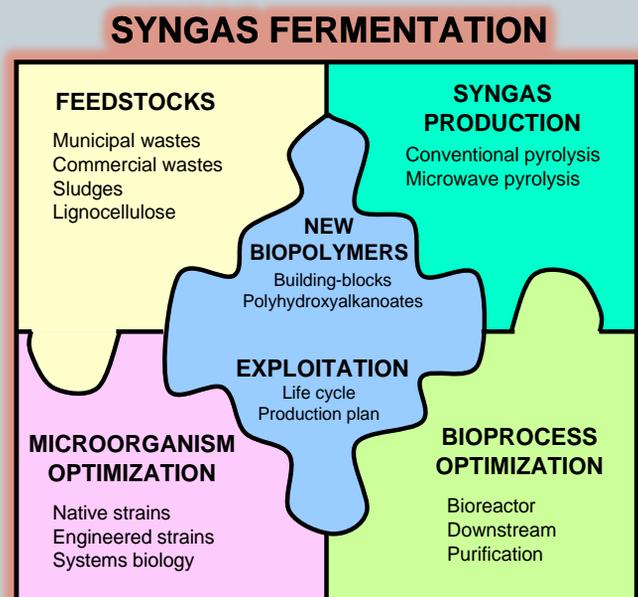
The R&D activities will focus on the integration of innovative physico-chemical, biochemical, downstream and synthetic technologies to produce a wide range of new biopolymers. The integration will engage novel and mutually synergistic production methods as well as the assessment of the environmental benefits and drawbacks. This integrative platform will be revolutionary in its implementation of novel microwave pyrolytic treatments together with systems-biology defined highly efficient and physiologically balanced recombinant bacteria. The latter will produce biopolymer building-blocks and polyhydroxyalkanoates (PHAs) that will serve to synthesize novel bio-based plastic prototypes by chemical and enzymatic catalysis.

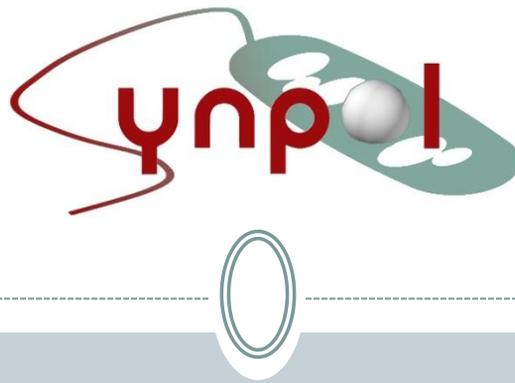
Thus, the **SYNPOL** platform will empower the treatment and recycling of complex biological and chemical wastes and raw materials in a single integrated process.

The knowledge generated through this innovative biotechnological approach will not only benefit the environmental management of terrestrial wastes, but also reduce the harmful environmental impact of petrochemical plastics.

Therefore, this project offers a timely strategic action that will enable the EU to lead worldwide the syngas fermentation technology for waste revalorisation and sustainable biopolymer production.

Figure 1: The SYNPOL concept
(Integration of syngas fermentation process for the production of new biopolymers)





Project Approach

The basic idea of the **SYNPOL** project is the establishment of an integrated processing technology for the efficient synthesis of cost-effective commercial new biopolymers using the products derived from fermentation of syngas generated from very complex waste feedstocks.

R&D activities will be focused on the integration of innovative physico-chemical, biochemical, downstream and synthetic technologies to produce a wide range of new biopolymers, based on a number of novel and mutually synergistic production methods, and including an assessment on the environmental benefits and drawbacks related to the concept.

The **SYNPOL** platform allows the treatment and recycling of biological- and chemical-derived wastes and raw materials in a single integrated process.

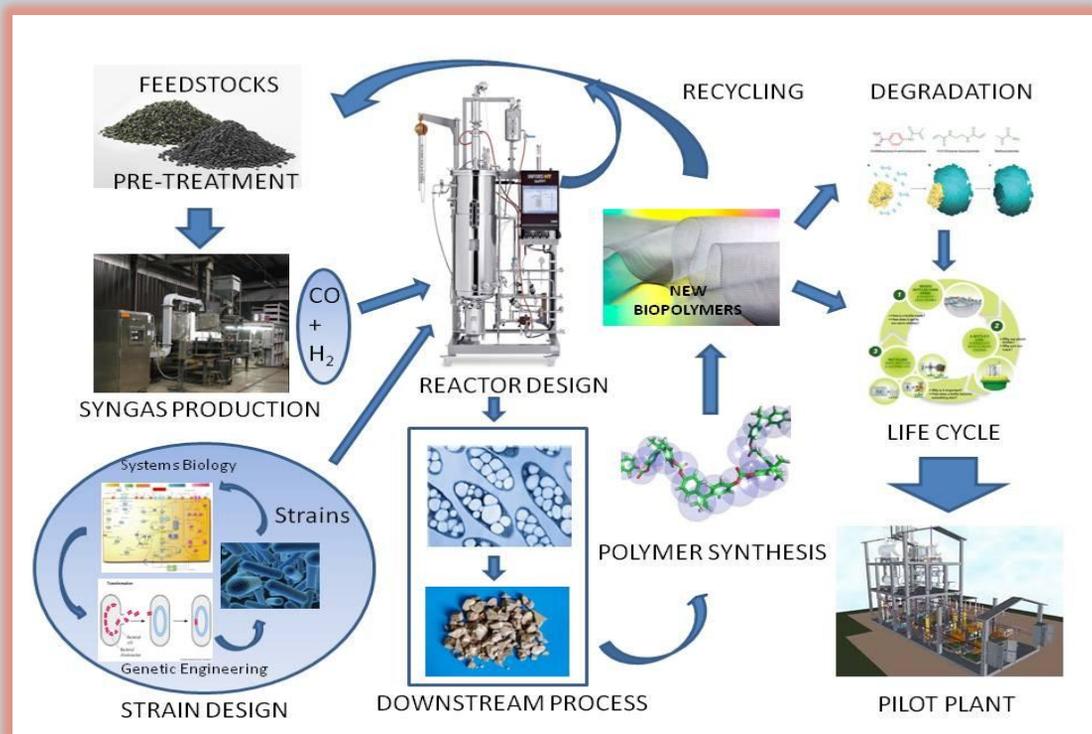
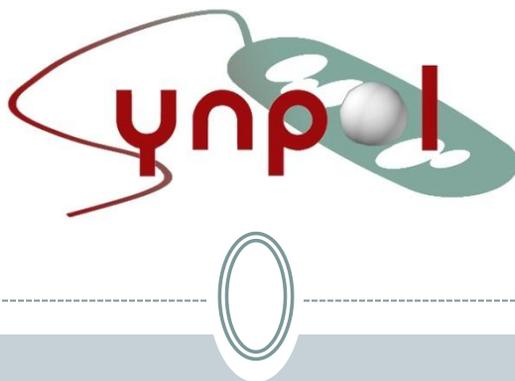


Figure 2: The **SYNPOL** platform.



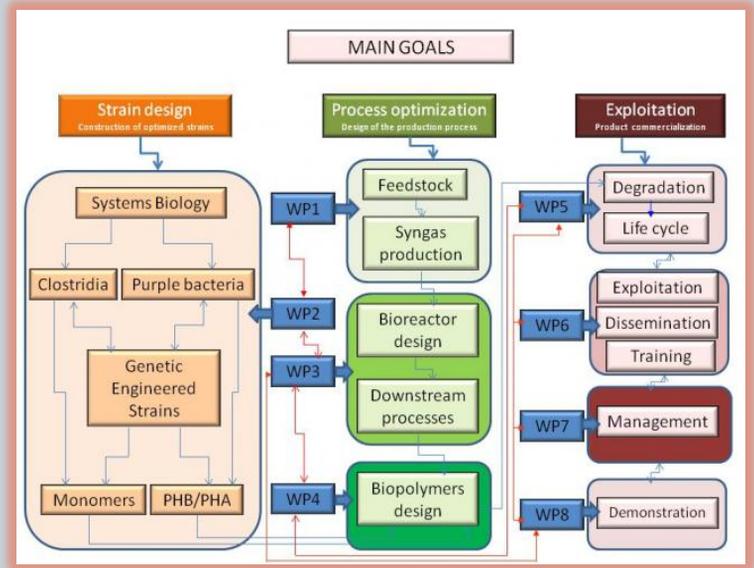
Project Objectives

1. Optimize syngas production from different feedstocks by using new gasification technologies.
2. Characterize syngas generated from feedstocks via a combination of state-of-the-art techniques.
3. Analyse energy costs required to generate syngas from different feedstocks.
4. Enhance naturally occurring pathways of acetogenic bacteria by metabolic engineering supported by systems biology tools with the aim of generating by syngas fermentation large amounts of intermediates that can be used as building blocks for the synthesis of new biopolymers.
5. Design new metabolic pathways by using systems biology tools to produce polyhydroxyalkanoates (PHAs) in acetogenic bacteria.
6. Enhance naturally occurring pathways of purple bacteria by metabolic engineering, again supported by systems biology to generate by syngas fermentation large amounts of PHAs.
7. Design transferable genetic systems to confer the ability to metabolize CO to other bacteria under aerobic conditions.
8. Design new recombinant bacteria endowed with programmed autolytic systems to facilitate the downstream processing of biopolymers.
9. Establish a cost-effective consolidated syngas fermentation technology using the natural and recombinant microorganisms by improving the operational conditions.
10. Integrate interdisciplinary knowledge to consolidate an efficient downstream processing, to decrease energy inputs, reduce environmental impacts, increase purification efficiency and diminish the final cost of the products.
11. Develop cost effective technologies for the chemical synthesis of new biopolymers based on the “green” building blocks and the PHAs produced by syngas fermentation, utilizing state-of-the-art chemical processes.
12. Develop blend, plasticizer, and composite formulations based on a PHA matrix using fermented and waste stream products.
13. Reduce the environmental impact of the integrated **SYNPOL** technology by recycling the residues.
14. Demonstrate the chemical and organic recyclability of the developed biopolymers.
15. Develop life cycle and environmental impact analyses as a valuable tool to provide technical and economic advances in the development of environmental friendly biopolymers.
16. Plant production design, scale-up and optimization of consolidated **SYNPOL** technology targeting on the increase of the products yield, improving the overall production economics as well as the up-scaling capabilities.
17. Establish portfolios for the exploitation of the process and the products derived from **SYNPOL** project.
18. Disseminate the scientific knowledge acquired during **SYNPOL** project to the society by developing multiple training and diffusion activities.



Project Strategy

The **SYNPOL** project aims at the establishment of a platform that will integrate syngas production and fermentation technologies for the cost-effective commercial production of high-added value biopolymers. The project will also demonstrate the efficient and techno-economic feasible production of “green” fine chemicals using an overall sustainability assessment perspective. The work plan (see Figure) comprises three main goals:



- i) **Strain design.** Studies that will allow obtaining the most efficient strains for syngas conversion into bio-based chemical building blocks and biopolymers.
- ii) **Process optimization.** Main step of the process, i.e., syngas production, syngas fermentation, downstream process and biopolymer synthesis will be optimized to increase the yield, reduce costs and decrease environmental impact.
- iii) **Exploitation.** Studies concerning degradation, life cycle and production plant design will be performed in order to demonstrate the commercial viability and sustainability of the SYNPOL technology. It will also include activities for dissemination of results, training and management.

These goals will be achieved through the implementation of the following WPs which are dealing with:

- (WP1) **Production of syngas.**
- (WP2) **Improvement of microorganisms.**
- (WP3) **Fermentation design.**
- (WP4) **Biopolymers design.**
- (WP5) **Biopolymer degradation and life cycle.**
- (WP6) **Exploitation, dissemination and training activities.**
- (WP7) **Management.**
- (WP8) **Demonstration.**



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Project Partners:

Consejo Superior de Investigaciones Científicas (Spain) – Coordinator

The University of Manchester (United Kingdom)

Universität Ulm (Germany)

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Haute Ecole Spécialisée de Suisse Occidentale (Switzerland)

Kungliga Tekniska Högskolan (Sweden)

Westfälische Wilhelms-Universität Münster (Germany)

Université de Strasbourg (France)

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Bioplastech Ltd. (Ireland)

Organic Waste Systems NV (Belgium)

Bionet Servicios Técnicos S. L. (Spain)

Infors AG (Switzerland)

Befesa Gestión de Residuos Industriales S. L. (Spain)

