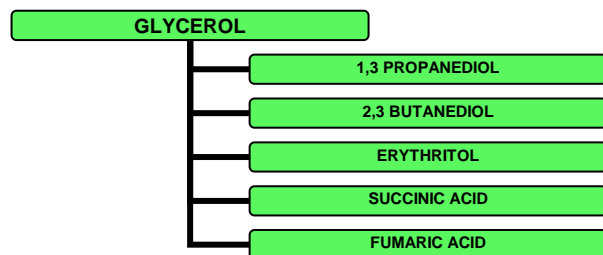


In the face of shortage of fossil fuel supplies and climate warming triggered by excessive carbon dioxide emission alternative resources for chemical industry have gained considerable attention. Renewable resources and their derivatives are of particular interest. Glycerol, which constitutes one of the by-products during biodiesel production, is one of such substrates.

### THE PROJECT'S OBJECTIVE

The ultimate aim of this project is development of modern technology of microbiological conversion of glycerol to products with high value-added. The ability to convert glycerol to polyols and dicarboxylic acids poses bacteria from genera *Clostridium*, *Citrobacter*, *Lactobacillus* and others. The other strategy is genetic engineering of safe for humans microorganisms in order to confer them with the trait of overproduction of these metabolites.



### RESEARCH TASKS

- Isolation of bacteria and construction of microorganisms with desired biosynthetic traits.
- Development and optimization of the process of biotechnological conversion of glycerol to metabolites with implementation of bioreactor techniques.
- Separation and purification of particular metabolites from fermentation broth.
- Application of purified metabolites in production of final industrial products: polyurethanes, unsaturated polyesters and ford components.

Developed here biotechnological processes are based on usage of renewable resource and waste product which is glycerol from biodiesel production plants. Therefore, plant biomass is converted not only into engines fuel but also into chemical products, including plastics. In this way the substrate is used in its entirety. Simultaneously, a real alternative to usage of petrochemical substrates is being developed.

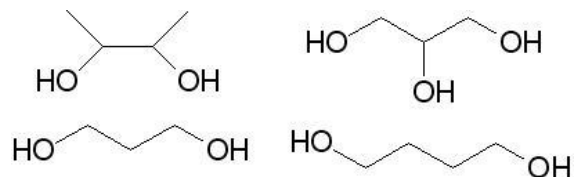
### THE PRODUCTS OF GLYCEROL BIOCONVESRION

The most promising products obtained from glycerol are polyols, including **1,3-propanediol**, which is an important substrate in production of synthetic materials, e.g. polyurethanes, unsaturated polyesters, and epoxy resins.

**Erythritol** is another attractive product of waste glycerol processing. This polyol, due to its sweet taste and low calorific value (20-times less than sucrose), can be used by food industry as a sweetener instead of unhealthy sucrose.

Further products offered in this project are **succinic and fumaric acids**. Fumaric acid is used by chemical industry for production of alkyl resins, paints and lacquers, and also as a copolymer. This substance is as well used by food industry as a natural acidifier and preservative. Succinic acid constitutes a substrate in synthetic materials production and in food and pharmaceutical industry.

Therefore, this Project opens a way to development of innovative "green chemistry" in Poland. Proposed research program constitutes a complete, holistic solution to the issue of development and implementation of several new technologies at a pilot scale.



Development of these technologies opens new perspectives to Polish chemical industry. Domestic renewable resources are proposed as an alternative to petroleum-derived ones, which need to be imported. Proposed in this project chemical compounds are going to be produced from waste glycerol – a substrate from renewable resources. It is particularly important in the face of large fluctuations of price and supply of petroleum-derived resources. It should be also stressed, that synthetic polymers are an important product for economy and building industry not only in Poland but also in whole European Union. Nearly all the branches of production use synthetic polymers. This means that the products will be launched on the global market.

Studies on production of 1,3-propanediol and dicarboxylic acids are connected to the National Programme for Research and Development, research area "Modern technologies for industry", where material technologies concerning synthetic materials are mentioned as priorities. The governmental document indicates the necessity for research on usage of renewable resources, specifically rapeseed oil. This substrate will be used not only in production of bio-fuels but also in production of polyols, which are used in synthesis of polyurethanes, polyesters and modified epoxy resins. As it was stressed in an application, the proposed project meets these requirements thoroughly.



Erythritol production is a priority technology as well. This subject is directly connected with a research area "Environment and Agriculture" and subject "Innovative food products with high nutritional and healing value". Erythritol due to its low calorific value can be recommended to people suffering from obesity. It needs to be stressed that obesity is one of the most common civilization diseases and one third of our society is afflicted with it.

Succinic acid and fumaric acid belong to most important products obtained through fermentation of renewable carbon and energy sources. Therefore, an interest in these acids increases, mainly as substrates in production of polyesters, cosmetics, food additives or in agriculture. Improvement and development of innovative biotechnologies of these acids based on most recent achievements of genetic engineering, process engineering and industrial microbiology should enable development of competitive to chemical technologies.

The ultimate result of the project will be development and verification at semi-industrial scale of new technologies of conversion of waste glycerol into polyols, i.e. 1,3-propanediol and erythritol, and the two dicarboxylic acids.



The developed technologies of these products synthesis are going to be proposed as patents, technological documentation, license, know-how and advisory on their implementation and production. An appropriate offer is going to be addressed directly to interested companies and presented in the Internet, on fairs, exhibitions, specially organized scientific conferences and at inquiry desks of OP IE.

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Project's value  
**27 585 604,93 PLN**  
European Union contribution  
**21 865 858,24 PLN**  
Accomplishment time  
**01.01.2010 – 31.12.2014**

The consortium of the „Green Chemistry” project



**Poznan University of Technology**



**Wroclaw University of Environmental and Life Sciences**



**University of Life Sciences in Lublin**



**West Pomeranian University of Technology,  
Szczecin**

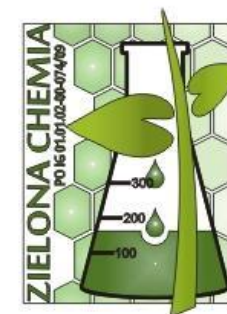


**Research project  
PO IG 01.01.02-00-074/09**

## **BIOTECHNOLOGICAL CONVERSION OF GLYCEROL TO POLYOLS AND DICARBOXYLIC ACIDS**

**OPERATIONAL PROGRAMME - INNOVATIVE  
ECONOMY**

Priority 1. Research and development of modern technologies  
Activity 1.1 Support for scientific research for establishment of a knowledge-based economy  
Subactivity 1.1.2 Strategic programmes of scientific research and development



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