Lignocellulosic biomass is a raw material from so-called renewable energy source group. The lignocellulosic compound is a complicated structure, built mainly out of three connected compound groups: cellulose, hemicelluloses and lignin. High energy value of lignocellulosic biomass enable its use in a wide range of conversion processes. It can be used for direct burning, in the production of biogas or processed into liquid engine fuels (such as bioethanol or biobutanol). They are second-generation biofuels. The concept of second generation biofuel development is based on the idea that the raw material used for their production should be a biomass and any organic waste substance.

Biobutanol can be produced through fermentation route by a microorganism, usually Clostridium sp. The process is known as acetone-butanol-ethanol (ABE) fermentation since this microorganism produces acetone, butanol and ethanol as solvents in its metabolic pathway. Clostridium sp. is a Gram-positive bacillus. They are mesophilic with optimal temperatures of 10-65°C and requires anaerobic conditions in order to grow in its vegetative state. Traditionally, butanol was produced by ABE fermentation process in the ratio 3:6:1 using *Clostridium acetobutylicum* as the fermenting strain.

According to the research concept, the post-fermentation residue from ABE fermentation will be used in the anaerobic digestion process. Biogas production from residuals that are generated after biobutanol recovery is a solution for the economic use of biomass. Anaerobic digestion is a complex biochemical degradation process, in which organic substrates are decomposed by bacteria forming gaseous by products, mainly including methane (CH_4) and carbon dioxide (CO_2). Under optimal conditions, the biogas contains: methane 52-85%, carbon dioxide 14-48%, hydrogen sulfide 0.08-5.5%, hydrogen 0-5.5%, carbon monoxide 0-2.1%, nitrogen 0.6- 7.5%, oxygen 0-1%. The composition of the fermentation gas depends mainly on the type of substances that are decomposed in the fermentation chamber

The aim of this project is to investigate the possibility of obtaining biobutanol and biogas in sequentially combination of biochemical processes from waste biomass (corn straw and rye straw). The waste from the agricultural sector containing a lignocellulose structure will be used to obtain biobutanol. Whereas the post-fermentation residue obtained from ABE fermentation will be a raw material for the production of high-power biogas in the methane fermentation process. It is the only technology that allows to produce energy from wet biomass, without spending energy for drying.

In this project, **two basic research hypotheses** have been formulated. First, it is assumed that the use of sequentially combination of ABE and methane fermentations will allow for waste biomass management and obtaining two types of biofuels, i.e. biobutanol and biogas. Secondly, it is assumed that the use of multi-stage pre-treatment of lignocellulosic biomass (comminution, delignification, enzymatic hydrolysis and detoxification) will allow obtaining higher productivity and efficiency of both ABE and methane fermentations.

After the decomposition of lignocellulosic complex to monosaccharides, waste biomass will be able to used in fermentation processes. Both acetone-butanol-etahnol (ABE) and methane fermentation will be conducted in two different micro-technical installations. The concentration of biobutanol in the ABE mixture will be determined using a gas chromatograph. The methane content in the biogas will be determined using a biogas analyzer.

The research in the project will allow for a significant expand of knowledge in the range of the use of lignocellulosic waste from the agricultural industry. The innovative concept of waste biomass utilization in sequentially combination of two biochemical processes: acetone-butanol-ethanol fermentation and methane fermentation will be important in specific benefits relating for environmental protection - the reduction of organic pollution, utilization of excess waste from the agricultural sector, reduction of dust and gas emissions from conventional energy sources combustion.

The knowledge gained during the realization of this project will be important for further research related to the use of waste biomass in the process of obtaining second-generation biofuels.