The problems of climate change, or more specifically global warming issues, still instigate heated debates in the scientific environment as well as in media and in private conversations. Unfortunately, these discussions are often based on emotions and popular opinions instead of concrete, measurable facts. Therefore, studies concerning e.g. assessment of greenhouse gas emissions caused by human activity are still needed.

Investigations of emissions are primarily focused on carbon dioxide (CO_2), methane (CH_4), and nitrogen oxide (N_2O). These gases are mainly responsible for absorption of heat, which is stored in the atmosphere instead of being emitted into space, thereby raising the temperature on the surface of the Earth.

Investigations of greenhouse gas emissions have been carried out for many years. They resulted in identification of the main sources of emission of these gases and many anthropogenic processes occurring in nature and contributing to these emissions. Wastewater treatment plants have been recognized as relatively significant emission sources. Processes taking place at the stage of anaerobic and aerobic treatment undoubtedly lead to an increase in the content of all the three gases (CO_2, CH_4, and N_2O) in the atmosphere.

The treatment technology of domestic (derived from areas inhabited by humans) and industrial (from various types of manufacturing and/or service facilities) wastewater has been well developed and thus it allows a systematic increase in the purity of river waters (in proximity
to wastewater treatment plants). In the case of large amounts of wastewater produced in a given area, flow treatment plants are the best solution developed so far. Their name is associated with the fact that wastewater flows through facilities representing successive stages
of purification. For instance, in a typical municipal wastewater treatment (domestic wastewater) these stages include mechanical treatment (gratings and sand beds, sometimes preceded by gravel beds) and biological treatment, which can be divided into aerobic (consisting
in aeration of wastewater so that aerobic microorganisms utilize carbon, nitrogen, and phosphorus contained in wastewater) and anaerobic (where anaerobic microorganisms reduce the impurity load in the methanogenesis process by utilising the aforementioned elements).

However, construction of flow treatment plants is not always desirable. For small residential areas and factories, SBR-type (Sequencing Batch Reactor) wastewater treatment plants are a better solution. In Polish, they can be referred to as portion wastewater treatment plants. In this type of facilities, the same processes of biological treatment that in flow treatment plants are carried out in different devices take place in a single reactor. This is possible by the use of successive stages: filling, stirring, aeration, sedimentation, decantation, and dead phase (removal of excess sludge attached during the purification process).

Since there are substantially greater numbers of flow treatment plants treating larger amounts of wastewater, it is not surprising that
a majority of investigations concerning greenhouse gas emissions have been conducted in these facilities. Due to the gap in available information, the proposed project focuses on analyses of gas emissions from a SBR-type wastewater treatment plant.

It has been well described and propagated in literature that the composition of the so-called activated sludge varies depending on the temperature in the different seasons. Activated sludge is a community of mainly microorganisms, which purify wastewater while feeding on organic pollutants. Being aware of these changes and based on my research carried out as part of the Diamond Grant (where
I investigated e.g. changes in eukaryotic organisms depending on the season of the year), **in this project, I have proposed analyses
of activated sludge typical for spring, summer, autumn and winter.** The sludge will be sampled from a wastewater treatment plant
in Lublin (central-eastern Poland).

However, not only **investigation of gas emission in different seasons of the year at normal work of the SBR-type wastewater treatment plants is the aim of the project.** Additionally, the author has planned a task of **assessment of gas emission during the different technological phases of wastewater treatment,** i.e. sludge adaptation (the first step of operation of the wastewater treatment plant), normal work (optimum work conditions and maximum wastewater treatment), malfunction (caused by lack of aeration and rapid reduction of the abundance of aerobic microorganisms), malfunction repair, and normal work after malfunction.

Obviously, analysis of malfunction is almost impossible in a wastewater treatment plant working normally, as no one would agree to cause malfunction and cessation of wastewater treatment for scientific reasons. **Therefore, the analyses will be performed in a laboratory model of an SBR wastewater treatment plant.** Such a model of a 2-chamber wastewater treatment plant has been developed and validated as part of the Diamond Grant.

Besides gas emission, the investigations will also comprise measurements of the quality of raw sewage (from the wastewater treatment plant in Lublin) and treated wastewater and, more specifically, analyses of suspension and turbidity and on-line analyses of oxygen, pH, and redox. Since in practice there is no possibility of interpretation of results without information about changes in activated sludge (seasonal and malfunction-induced variability), additional analyses will assess changes in the functional biodiversity of the microbial composition of activated sludge.

The prospective results will mainly supplement the knowledge about greenhouse gas emission in the context of development of

the greenhouse gas balance. However, it is also possible (this aspect is going to be checked by the author) that changes in gas emission may serve as an early-warning indicator of divergence of the treatment process from the optimum.