SUMMARY

The need to stop climate change affects and will undoubtedly have a significant impact on shaping national environmental and energy policies. The need to reduce CO2 emissions will apply to all branches of the economy, including urban infrastructure, and thus also water and wastewater management. This goal can be achieved in two ways: by increasing the share of non-carbon energy sources in the Polish energy mix (RES, nuclear energy), or by increasing energy efficiency. Most research and implementation work focuses on large treatment plants (over 100,000 RLM), while there are few works focusing on this problem in relation to small and medium-sized facilities The specificity here is the fact that these facilities have limited energy production capabilities, so the preferred model of operation for facilities in this category should be rationalization, and to a lesser extent optimization of electricity consumption. Much of the research to date has focused mainly on the generation potential of electricity and heat by the wastewater treatment plants. These studies however were focused on large facilities. Therefore, in the doctoral dissertation it was decided to conduct research determining the possibility of rationalization and the potential for further optimization of energy consumption by small and medium wastewater treatment plants. A modern facility was commissioned for use in 2014. The facility is representative of a large number of municipal wastewater treatment plants created as part of adapting the Polish water and sewage sector to the European Union standards.

The research was carried out in two ways, for the treatment plant treated as a whole, and also separately focused on the biological part of the facility - technological line No. 2 (CT2) consisting of two SBR reactors with associated devices. During the tests, the influence of individual factors (WWTP's daily flow, SBR's daily flow; the amount of removed pollutants: BOD_5, COD, total nitrogen in kg/portion or in kg/d; sewage and ambient temperature; reactor operation mode) on the energy consumption and the energy efficiency of the WWTP and the treatment processes were checked. Two periods were selected for the main research - summer and winter, during which research was undertaken to determine the impact of local climate conditions on energy consumption and energy efficiency by treatment plants, as well as CT2. Before starting the measurements, the unification of the operating mode of both reactors included in CT2 was agreed with the facility operator, so that CT2 could be treated as one device. The facility operator did not comply with the arrangements made, which forced changes in the research plan, but also made several discoveries possible. The tests confirmed the existence of a proportional relationship between the size of the portion, the amount of removed pollutants, the efficiency of wastewater treatment processes, and the energy consumption of SBR reactors and the energy efficiency of wastewater treatment processes.

The study confirmed the existence of significant potential for rationalization of electricity consumption by small and medium-sized wastewater treatment plants with the possibility of further optimization. A significant discrepancy was found between the amount of energy used for wastewater treatment and the total energy consumption of wastewater treatment plants. During the tests, no measurable impact of climatic conditions on the object's operation was found.