Energy security and the efficient use of energy is one of the key factors determining the proper functioning of the economy of the country. It can be achieved by diversification of the directions of energy carriers' supply, in Polish conditions it concerns the supply of gas and oil. Actually in the first case, it is possible to import of liquefied gas from any vendor in the world. Liquid Natural Gas (LNG) possesses a low temperature of -130 ° C, is transported by ships. Then, before the loading it into the pipeline system, the liquid gas must be compressed to a pressure of about thirty times higher than ambient pressure. Then, the gas is converted to gaseous form. Today, the process is implemented in atmospheric heaters, which means that the resources of "cold energy" are completely discharged to the environment in other words, it causes great loss.

In the project, the study of the installation, which allows to use this "cold energy" to produce "free" electricity, is proposed. The low temperature and relatively high pressure are factors that enable the use of LNG as a carriers for a cold engine. In contrast to conventional heat engines, this engine operates between the upper source, which is the surrounding environment, and the lower source, which may be liquefied gas. The use of occurred potential may influence the economic effects of the process. Moreover, it is desirable in terms of efficient energy management, leading to positive ecological effects such as natural resources savings and greenhouse gas emissions reduction. On the other hand, plans to launch LNG transhipment port will result in much potential for so-called driving force for the cold engine. Currently, this technology is not used in Poland.

The proposed engine should be characterized by a simplified structure such as a Stirling engine. It converts heat into work without fuel internal combustion process similarly as in the internal combustion engine. In fact, the heat is generated outside of the cylinder. As a result, it is possible to supply the engine with heat from any source, including liquefied petroleum gas (LNG). However at this state of art, the use of Stirling engines to generate electricity in gas liquefaction systems requires to carry out the basic theoretical research in two areas:

1. thermodynamic analysis using advanced mathematical modelling tools,
2. complex analysis confirming the thesis on potential energy and environmental benefits.

Parameters of proposed engine should be chosen to maximize the potential to perform work by liquefied natural gas. Firstly, the appropriate mathematical models to simulate the engine should be built since there are currently no systems of power plants with Stirling engine powered by LNG. For this purpose, the latest advanced tools of mathematical modelling including computational fluid dynamics and heat transfer will be developed.

Developed models will simulate the influence of operational parameters and design on the behaviour of this innovative plant. The obtained results will be the base to carry out advanced thermodynamic analysis based on the first, and the second law of thermodynamics. Such analysis will be used to maximize the performance potential of LNG to produce work in a Stirling engine. The obtained results from both numerical and thermodynamic modelling will be the basis for the second performance that is complex analysis.

Within the framework of these studies, the whole cycle of production from mining through transportation ending with the final gas and electricity generated in the proposed power plant will be included. This approach will evaluate the deployment of energy recovery from LNG at the stage of natural resources depletion, in particular, savings of those resources through the additional generation of electricity in the gas transport system. As a result, an objective comparison of the proposed transport technologies with the one which based on traditional compression and pipeline transmission will be possible.

Extraction and processing of primary fossil energy are strongly linked to the impact on greenhouse gas emissions. Algorithms that use complex analysis to assess these emissions in all leading chain from gas production to the final consumer will be investigated. In particular, the reduction of GHG emissions is possible due to the useful exploitation of the potential of LNG in the process of electricity generation. Such an approach is required for an objective comparison with other fossil fuels.

Thus, the planned theoretical studies include two major issues:

1. determination the optimal parameters of the power plant with a Stirling engine fed by LNG, and
2. justification of the proposed power plant in terms of resource efficiency of primary energy fuels and ecological effects.

Therefore, the implementation of the theoretical research, seems to be a necessary step before starting the research on the practical application of the engine.