In recent decade the continuously growth of demand for energy is being observed. Unfortunately, the usage of conventional energy source is related to air pollution, global warming and fossil fuels resource depletion. One of potential solution for above problem could be appliance of renewable energy sources power plants (such as solar, wind and water). However due to the intermittent character of electrical energy supply from these resources, these plants require additional large-scale energy storage systems (smart grids), with ability to balance energy's supply and demand. The reversible electrochemical batteries are one of the most promising technology for smart grids. They possess high Coulombic efficiency, are flexible in relation to varying operation conditions and their maintenance is relatively easy. The first Li-ion batteries were commercialized by Sony Corporation in 1991 and became the most popular energy storage devices. Due to their high energy density per mass unit and the long cycle life, the lithium-ion batteries are used in various applications such as automotive industry or in portable electronics. Moreover, in 2019 The Royal Swedish Academy of Sciences has awarded the Nobel Prize in Chemistry to 3 researches for development of lithium-ion batteries and contributing to significant development of the modern economy.

Unfortunately, continuously growing demand for lithium caused the shrinkage of its reserves and in the result, the drastic increase of its price. Owing to the abovementioned issue, the promising alternative for LIBs can be sodium-ion batteries (SIBs) because of the similar operation mechanism and abundance of world sodium resources. However, SIBs exhibit lower energy density comparing with LIBs, resulting from bigger and higher sodium ion, thus the application in large-scale energy storage system is being considered, where the cost is key factor. In order to commercialize Na-ion technology, it is necessary to develop stable and efficient materials that can work as an anode. Graphite, the most common anode in Li-ion batteries does not intercalate sodium ions in appropriate way. Promising candidate as anode materials could be elements from 14 and 15 group of periodic table which react electrochemically with Na and form various Na-Me (Me- metal, metalloid) alloys.

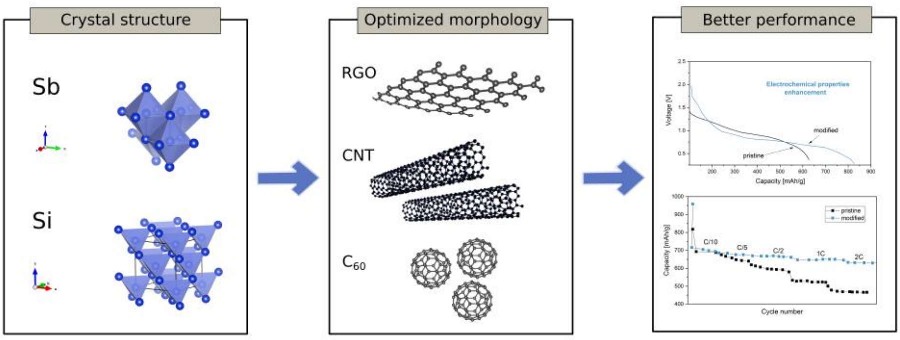

Figure 1. Schematic representation of project tasks.

This project concerns investigation of antimony (Sb), silicon (Si) and their intermetallic compounds (Sb-Si) as potential anodic materials for Na-ion cells. These materials have possibility to obtain electrodes with high endurance, nontoxicity, low costs and theoretical capacities of antimony and silicon are 660 $mAhg^{-1}$, 960 $mAhg^{-1}$, respectively. The project aims to elucidate the relationship between physicochemical properties of the compound's Sb/C, Si/C and Sb-Si/C composites and their chemical composition as well as different morphologies. Moreover, the project plans to identify correlation between composition, crystal structure, morphology, transport and electrochemical properties of synthesized materials. In order to avoid waste of time and costs, during measurements the verification of the samples will be performed. The ones with best characteristics will be subjected to the following research stage. The detailed examination of the Na alloying reaction mechanism for investigated materials will be performed and basing on the obtain results appropriate working conditions of the anode materials will be selected.

It is expected that the developed materials will be characterized by a high reversible capacity and high rate of electrode reactions. Moreover, within the project it is intended to synthesize materials with smaller volume changes than pure metalloids. Basing on knowledge acquired during the project, it will be possible to define general rules related with designing alloying anode materials based on Si and Sb and as a result develop a Na-ion battery with improved performance.