Protection of primary resources on the earth, prevention of environmental pollution, sustainable development and a stable global economy are today's world main goals. One of the solutions that brings us closer to these goals is recycling of wastes produced in various industries and returning raw materials to the production cycle.

Climate change has become a decisive political and economic factor, which has an influence on current and future social, political and economic developments. In order to minimize the influence of the transport sector on global CO_2 emissions, electro-mobility is to be expanded in the future. The research and introduction of electric vehicles (EV) is significantly supported by politics. Recent increase in sales of electric vehicles generates a huge increase in production of lithium ion batteries (LIBs). It is well known that lithium is a non-abundant element, limited to only 20 ppm in earth's crust. Moreover, cobalt, commonly used in cathode materials of Li-ion cells, is a larger problem regarding availability (25 ppm in earth's crust) and geopolitical aspect. Seventy percent of the world's cobalt comes from the Democratic Republic of Congo and a significant portion of cobalt production in the Congo violates human rights and child labor laws, as a 2016 Amnesty International report, "This Is What We Die For" documented all too well. Moreover, 90% of the cobalt extracted in Africa is exported to China. These problems shows a tremendous need to fully close the waste loop of these critical raw materials. According to International Energy Agency (IEA) analysis and projections, by 2030 roughly 100-120 GWh of power batteries used in electric vehicles will be phased out globally each year. Such a huge amount of spent batteries (mainly LIBs) is considered as a reliable secondary source for recovering essential metals such as Li, Co, Ni, Al, Cu, Mn, and also natural graphite.

The presented project fits perfectly into these needs. The project aims to develop more sustainable recycling processes for recovery of all possible elements and components from spent lithium-ion batteries. Although various methods for recycling of LIBs have already reached the industrial stage, there is a vast need to improve these processes towards a greater sustainability. The recycling of spent LIBs is not as well-developed as the recycling of other types of batteries, due to different chemical composition of cathodic material. Commercial recycling of LIBs is currently focused mainly of on recovering precious metals, especially cobalt, copper and nickel, while recovery of other valuable elements and components such as lithium or graphite still maintains in the lab-scale. Therefore, basic studies are required in this field to achieve more sustainable, environmentally friendly and economic methods for recovery of all possible elements and components from LIBs.

The presented project focuses on several tasks that aim to develop economically profitable and environmentally friendly recycling strategies, which serve to separate and clean all possible battery components, namely anode active material (graphite), cathode active material (Co, Ni), current collectors (Cu, Al), and lithium from the electrolyte. Various methods will be developed and compared, with the main focus on minimization of harmful by-products. Proper design and optimization of hydrometallurgical processes, including bioleaching as the most environmentally friendly option, may create a unique process that will be a milestone for increasing a rate of sustainable battery recycling.

The project goal is to achieve a high quality recovered active materials that will be suitable for their reuse in new electrochemical cells. Evaluation of market viability of the recovered products will be possible through their detailed physicochemical and structural studies, combined with their insightful electrochemical characterization.