Wireless electricity transmission technologies are becoming an increasingly common way of powering devices, especially mobile ones. The main advantages of these technologies in comparison with wired connections are increased safety, reliability and the possibility to use them in conditions where wired power supply implementation is difficult. To implement wireless energy transmission acoustic waves, radio waves or light beams are used in special cases. Usually, however, for higher powers, e.g. for electric-vehicles, inductive coupling is used. The technologies of capacitive coupling and hybrid inductive-capacitive coupling are used less frequently.

Wireless power supply technologies have been developed for many years in many of the world's leading scientific laboratories, including ETH Zurich, University of Auckland, University of Toulouse - LAPLACE Laboratory, Oak Ridge National Laboratory. In Poland, wireless power supply is handled by small research groups, e.g. the group gathered around ABB Krakow Research Centre. And although wireless technology is generally mature, there are still many problems that have not been fully explored. Such problems include, for example, the questions of the use of multi-coil transmission systems to power moving objects, e.g. non-traction-less rail vehicles. In this case, the use of coils can eliminate mechanical contacts and develop their dynamic switching in order to achieve optimum energy transmission efficiency. In this way it is possible to eliminate the sparking of contacts and, moreover, to make the power supply of the object independent of external conditions (e.g. temperature, humidity, dust, icing), and to increase the safety of use.

Most of the work in the area of wireless energy transmission concentrates primarily on a static approach (i.e. it concerns a stationary transmitter and receiver) with the use of inductive coupling. In the case of moving objects, the static approach is multiplied accordingly, which requires the use of a much larger number of passive elements (capacitors and inductors) and active switching elements (power transistors). Therefore, the reliability of wireless power supply systems for moving objects is much lower than for static objects. Moreover, such systems take into account only misalignment of transmitting and receiving coils.

The main premise and motivation to undertake the project is the need to develop principles of dynamic adaptation of control algorithms for wireless power supply systems in cases of changes of transmitter and receiver positions, allowing to obtain maximum energy efficiency of the system with a minimum number of active switches, which increases reliability. This motivation is directly related to the project objective.

The main objective of the project is to develop and analyze new methods to improve the efficiency of dynamic wireless charging in conditions of dynamically changing the position of the receivers. These methods will use the properties of hybrid inductive-capacitance coupling, consisting of auto-tuning the circuits to the position of the receiver, eliminating the need to switch transmitting coils with active switches, which significantly reduces their number. This objective **will be pursued through**: a) the development and analytical testing of a mathematical model describing a hybrid wireless charging system in 2D and 3D coordinates, b) simulation studies of the developed model, c) experimental confirmation of established relationships based on the results of experimental testing of laboratory models. In addition to hybrid coupling circuits, topologies of inverters for powering hybrid circuits, which should have a minimum number of active elements and operate in soft switching mode, are also considered to be important subjects. Preliminary studies have also shown that hybrid couplings and the elimination of switched coils will also improve system efficiency and reduce EMC disturbances

The proposed tests fill a gap in the area of dynamic wireless charging. The new approach, which involves the simultaneous use of magnetic and capacitive coupling, has not yet been thoroughly tested. The results of the preliminary research allow us to expect that the proposed approach, apart from the purely scientific aspect (cognitive and stimulating new ideas of wireless charging), will also allow the development of relatively simple solutions for dynamic wireless charging circuits. At the same time, the new solutions will allow the elimination of currently used and highly developed systems characterized by a large number of sensors, and thus more complex and unreliable. The new topologies, together with new material technologies for the elements and control strategies used, will also allow fuller use to be made of the topologies of power electronic converters used.

An example of practical use of the approach proposed in the project, apart from the rail vehicles mentioned above, can also be the system of wireless power supply for Cartesian robots. In this case, the problems considered in the project boil down to taking into account the influence of linear motor movement along the arm on the efficiency of its power supply.