The growing electricity demand, the requirements for its acquisition methods, and their environmental impact have contributed to the dynamic development of ***green" energy storage devices***. Among them, special attention should be paid to ***electrochemical capacitors***, commercially known as ***supercapacitors***, which, along with batteries, are used to store energy in the form of an electric charge. Electrochemical capacitors owe their popularity mainly to ***ultra-high power***, i.e. the dynamics of energy transfer over time, which significantly exceeds the performance of traditional batteries. It is because, in the simplest approach, the charge is stored by purely physical phenomena in the so-called ***electrical double layer***, which is formed at the electrode/electrolyte interface due to the mutual electrostatic interactions of positive and negative charges. In the era of energy transformation, a rapid increase in the significance of supercapacitors is expected due to the need to reduce the emission of exhaust gases, as well as to diversify energy sources, as included in climate packages. These devices could successfully function as supporting systems for renewable energy sources regarding stabilization of power grids, or traditional batteries, e.g. in electric vehicles under conditions of high peak power demand. A specific type of supercapacitor is the so-called ***hybrid capacitor*** which, due to the working mechanism, operates by means of a combination of the electrochemical signature of a battery and a classic supercapacitor. The result is much ***higher energy*** of the device while maintaining high dynamics of charge-discharge. In this respect, the systems in which the traditional electrolyte is enriched, or replaced, with ***a substance with redox properties*** dissolved in a suitable solvent (typically water) are of special importance. The electric charge is then accumulated as a result of the charging of the double electrical double layer, and additionally, through the redox reaction (oxidation and reduction) of the species present in the solution. A model example that fits into the trend of eco-friendly energy storage is an aqueous electrolyte based on ***iodine redox couple*** (I^-/I_3^-), however, the physicochemical and electrochemical properties of water determine a limited range of operating temperatures and a relatively low voltage of the capacitor. Therefore, this project aims at developing ***alternative "green" and anhydrous solvents*** for this group of devices to fill the gap in the concept proposed so far. Among media of potentially high significance, ***deep eutectic solvents, DES***, which have recently attracted great attention, should be mentioned. These mixtures are characterized by a substantially reduced melting point with respect to the pure components they obtained from, a high boiling point, as well as the only condition for their formation is the selection of the appropriate molar ratio of reactants and reaction temperature. The formation of the eutectic mixture is possible due to the existence of specific weak ***hydrogen bond (HB) interactions*** between the ***donor (HBD)*** and the ***acceptor (HBA),*** which, translating into the macroscopic scale, gives the mixture exhibiting unique properties. ***DES***, typically obtained from inexpensive and widely available components, are currently gaining dynamically growing interest, also in the technology of energy storage devices. The design, synthesis, and application of redox-active DES for hybrid capacitors, which is the main goal of this project are, however barely explored. As part of the planned research, DES composed ***of organic and inorganic iodine salts (as HBA)*** and ***polyhydroxy alcohols (as HBD)*** with different lengths of the aliphatic chain and the position of the hydroxyl group (C3−C6), will be subjected to synthesis and characterization, The main physicochemical parameters (conductivity, viscosity, phase transition temperatures) and capacitor operating parameters over a ***wide range of temperatures*** (0–100°C), will be assessed. Based on the obtained results, the electrolyte with the best characteristics will be selected, i.e. it should be ***competitive in terms of capacitance and energy*** with respect to conventional electric double-layer systems and exhibit a broader operating voltage window in comparison to aqueous iodide-based analogs. Among important research objectives, is also the development of strategies aiming at reducing the high ***self-discharge*** dynamics of the systems with redox electrolytes. The phenomenon, more precisely known as ***"redox shuttle effect",*** makes the accumulated charge spontaneously "escape" from the device as a result of the diffusion of “charged” redox individuals to the opposite electrode. For this purpose, a strategy of anchoring DES in properly selected polymer matrices will be proposed, i.e. so-called ***eutectogels*** will be designed to take advantage of both the benefits of the limited diffusion rate in the gel and the ability of iodine to form charge-transfer complexes with the electron-rich polymer networks. It is expected that the developed solvents may also be of interest to scientists in other related fields, including photovoltaics (dye-sensitized solar cells) or redox flow batteries.