DESCRIPTION FOR THE GENERAL PUBLIC

Current state-of-the-art technology is very efficient in terms of energy production either from fossil fuels or renewable sources. However, renewable energy sources such as wind or sun have one big disadvantage; they are not continuous. In the case of renewable energy sources, it is mandatory to store energy when it is possible so it can be used when necessary. For this reason, it is obligatory to develop and improve materials that can store more efficiently the generated electrical energy and could support the electrical grid by implementing of smart grid concept by for example so so-called shift of energy demand (**Figure no. 1**).

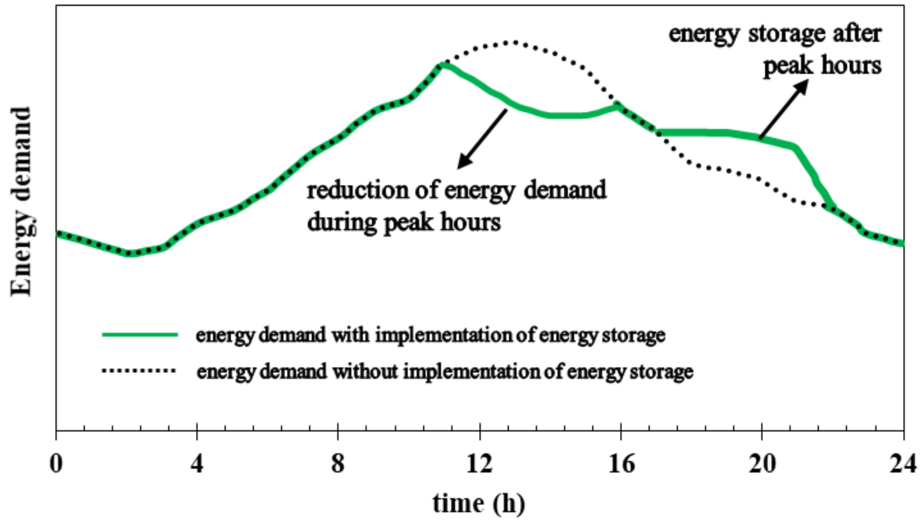

Figure no. 1. Example of energy demand with (green solid line) and without (black dotted line) implementation of energy storage devices and utilization of energy demand shift in the electrical grid.

The best-developed energy storage devices are electrochemical capacitors (ECs) and lithium-ion batteries (LIBs). EC stores energy in an electrical double layer at the electrode/electrolyte interphase which is a physical phenomenon occurring at the surface of electrode material. The electrode material for EC should have well-developed surface area to increase the capacitance according to the formula:

$$C = \frac{\varepsilon \cdot S}{d}$$

where ε is the electric permittivity (F m^{-1}), S is the accessible surface area [m^2], d is the thickness of the EDL (m), and the accessible surface area S is strictly related to the porosity of the electrode material. The ECs pose almost infinite cyclability and high power density (10 kW kg^{-1}) but the energy density is limited to (10 Wh kg^{-1}).On the other hand, we have LIB where the energy is stored in the bulk of the material through the electrochemical reaction of oxidation and reduction. Contrary to the ECs LIBs pose high energy density (250 Wh kg^{-1}) but the power density is usually not higher than 1 kW kg^{-1} and the cycalbility does not exceed 1000 cycles. Despite the differences between both of the devices it is possible to implement carbon-based electrodes in their construction. By adjusting the processing step (temperature, addition of chemical agents, flow rate, and type of protective gas) of the carbonaceous precursors (wood cuttings, fruit peels, fruit stones, nutshells, etc.) it is possible to obtain either highly porous or more ordered structure of carbon to design materials with reduced resistivity and increased capacity or capacitance. Because lithium sources are scarce and located in geopolitically unstable regions the subject of metal insertion into the carbon structure will be including also the sodium and potassium insertion into the carbon-based anode materials.

Most of the used carbonaceous precursors, graphite, soft carbons, hard carbons, and activated carbons come from the Asia Pacific region or the United States of America. In this study, we would like to focus on the wastes and by-products from processing plants characteristic to the Central European region and the production located in Poland. It would provide a possible way to recycle unused materials and obtain interesting materials for energy storage following the National Prevention Program of Waste Generation, EU directive 2008/98/WE from 19 November 2008, and EU Development Strategy – Europe 2020.