# PROJECT

# Efficiency Enhancement for a Power System with Renewable Energy Sources through Energy Storage Application

### The Project Participants

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### The Project Background

Growing application of wind and solar power systems is the key direction in the up-to-date power engineering. These renewable energy sources function in a power system along with conventional thermal and nuclear power stations. Unlike conventional sources, however, renewable energy sources are significantly affected by seasonal or occasional variations of natural factors, such as cloudiness, wind force, diurnal luminance cycling and others, which makes the power system operation more complicated. Diurnal load variation resulted from irregular electricity consumption weakly correlates with irregularity of power generation by renewable sources which causes significant disbalance in the power system in different periods of the day and results in low efficiency and degraded stability of the system.

To increase efficiency of renewable sources application in a power system, utilization of energy storage capable of accumulating excess electric energy and compensate missing electricity production is suggested. There exist various-type energy storage systems such as electric (capacitive, superconducting, induction, electrodynamic, etc.), chemical (accumulating, fuel, hydrogen, etc.), and mechanical (superflywheel, potential-kinetic, elastic deformation) ones. In addition, indirect energy storage is feasible, for example, in the form of a cryogenic coolant (liquid nitrogen), high-pressure compressed gas, thermal energy, chemical conversion, etc.

The mentioned energy storage systems have different specific energy parameters, charge-discharge speeds, mass-dimensioning specifications, life time, efficiency indices, and utilized substances.

### The Project Objective

The objective of the project is validation of a package of technical and economical measures that enhance renewable energy sources efficiency in a power system via energy storage application.

### The Project Tasks

The main project tasks are

- development of mathematical models and structural layouts for basic energy storage systems;

- evaluation of a power system with renewable sources requirements for defined energy accumulation capacities;

- analysis of different-type energy storage systems performance and specification of the most expedient fields of their application in a power system;

- development of mathematical models of a power system with renewable sources functioning;

- substantiation of energy storage system types, parameters, and arrangement in the power system;

- analysis of the power system operation under different load and renewable sources application scenarios via soft-computing techniques on the basis of neural networks, fuzzy logic and genetic algorithms.

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