Information System for Decision-Making in the Management of Renewable Energy Sources in the Microgrid System

Autors:

Nikolay Kiktev, Volodymyr Osypenko, Oleksii Kalivoshko and Alexey Kutyrev

National University of Life and Environmental Sciences of Ukraine
Taras Shevchenko National University of Kyiv
Kyiv National University of Technologies and Design
National Science Center "Institute of Agrarian Economics"
Kyiv, Ukraine
Federal Scientific Agroengineering Center "VIM"
Moscow, Russia

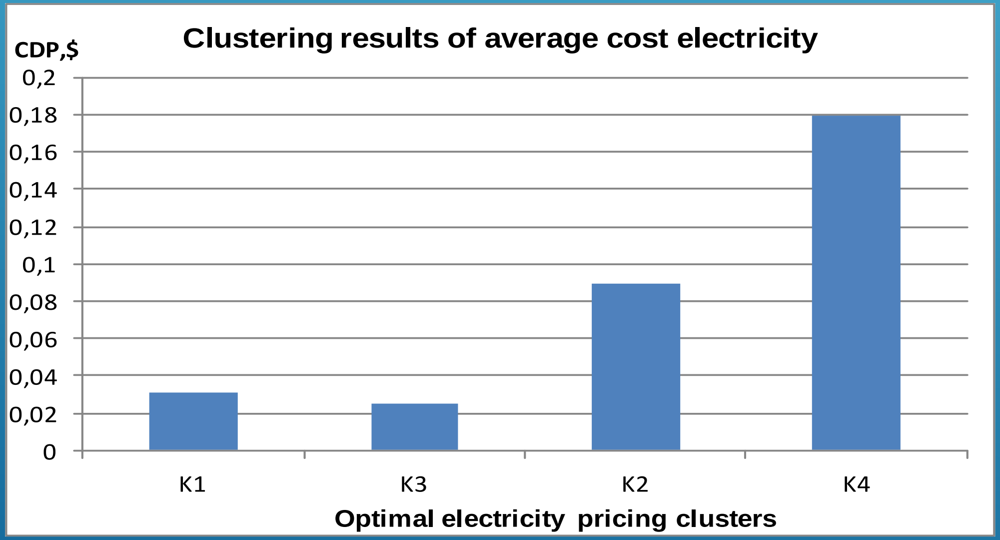
REVIEW AND ANALYSIS OF EXISTING SOLUTIONS

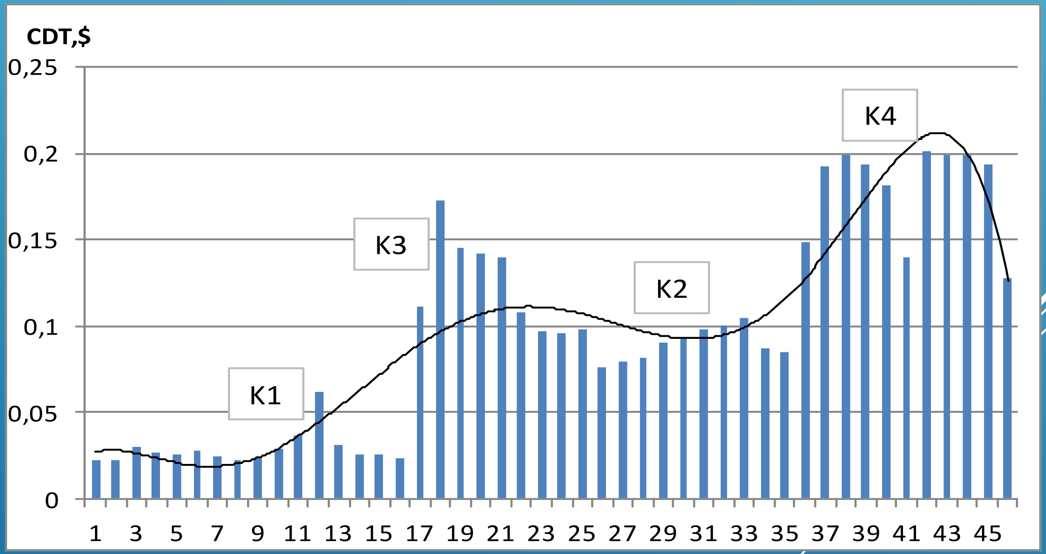
The works of Volodymyr Osypenko and Viktor Kaplun are devoted to solving this problem:

"Modeling of Dynamic Energy-Management Scenarios in Local Polygeneration Microgrids Using Inductive Bi-clustering Algorithm"

"About Using Electricity Pricing For Smart Grid Dynamic Management With Renewable Sources"

"On a Modeling -Based Elements of an Intelligent System for Cost-Effective Dispatching of Energy Islands with Photovoltaic Sources ».





The purpose of this study is to create an information and control system for the implementation of the algorithm for the most efficient use of all possible energy sources in the microgrid system.

Research objectives:

- determine the input and output information on the management of renewable energy sources;
- using previous research to develop an algorithm for determining the most efficient source of electricity;
- to create a dynamic database of electricity parameters for a certain period of the year;
- using forecasting methods to estimate the cost of using different types of electricity sources for the next period;
- issuing recommendations to the user to determine the source that should be used in a certain period of time.

FORMULATION OF THE PROBLEM

The formula for calculating wind energy

$$P = \frac{kRV^3S}{2}$$

Here k is the efficiency of the turbine, which takes into account the impossibility of installation at 100%; R - air density, kg / m^2; V - wind speed, m / s; S = πD^2 / 4 - wind flow area, m^2.

Formulas for calculating solar energy

$$E_1 = \frac{E_2 P_1 \eta}{P_2}$$

Here E_1 - energy production using solar panels; E_2 - insolation per square meter; P_1 - nominal power of the solar cell; η is the total efficiency of electric current transmission; P_2 - maximum solar power per square meter of the earth's surface.

- Decision-making on the use of this energy source is carried out in accordance with the formula:

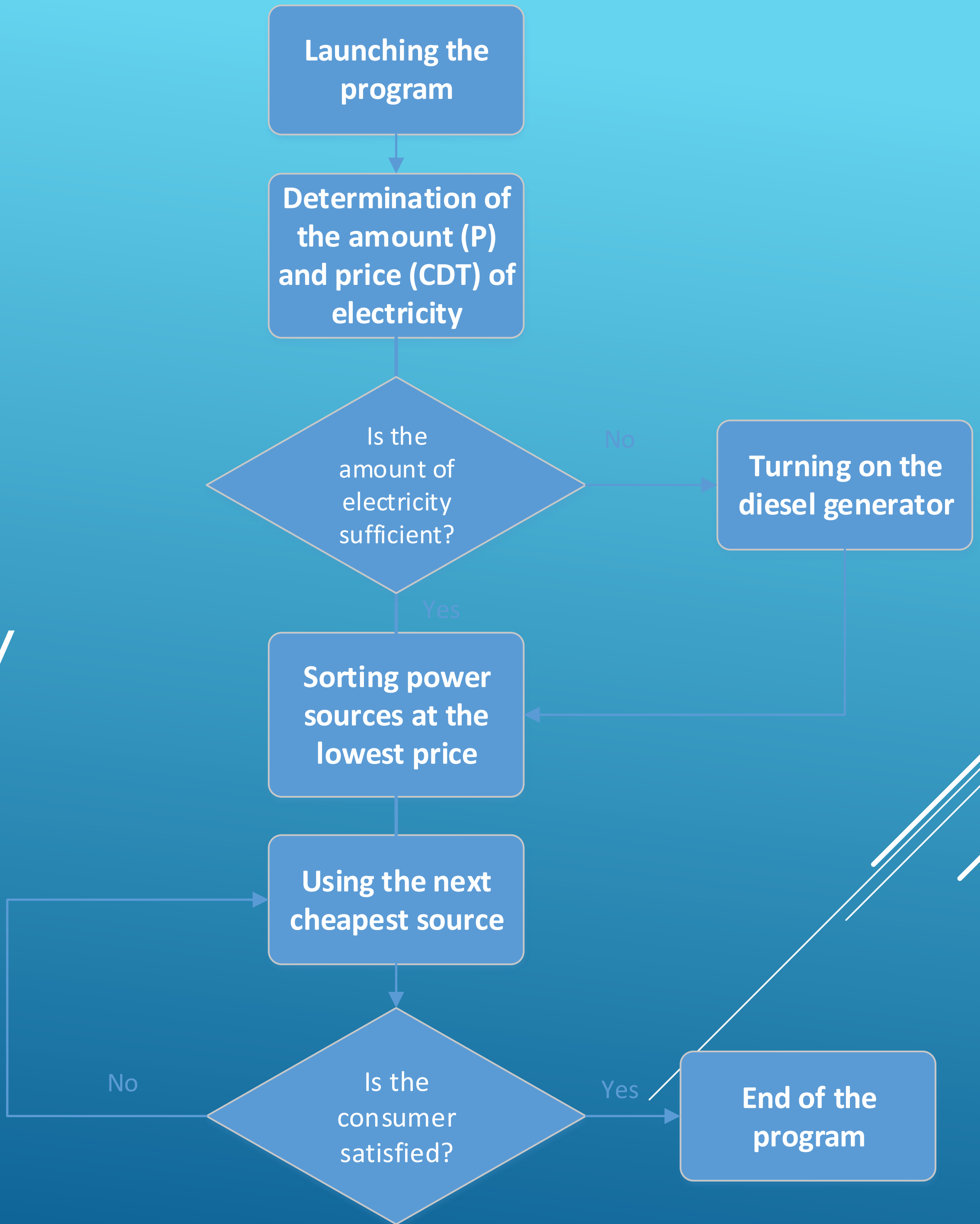
Dec = {R,C;CDT->min}

where R is the amount of energy produced;

C is the ability of the system to satisfy the consumer; CDT is the cost of electricity.

CALCULATION OF ELECTRICITY INDICATORS

Block diagram of energy use decision making

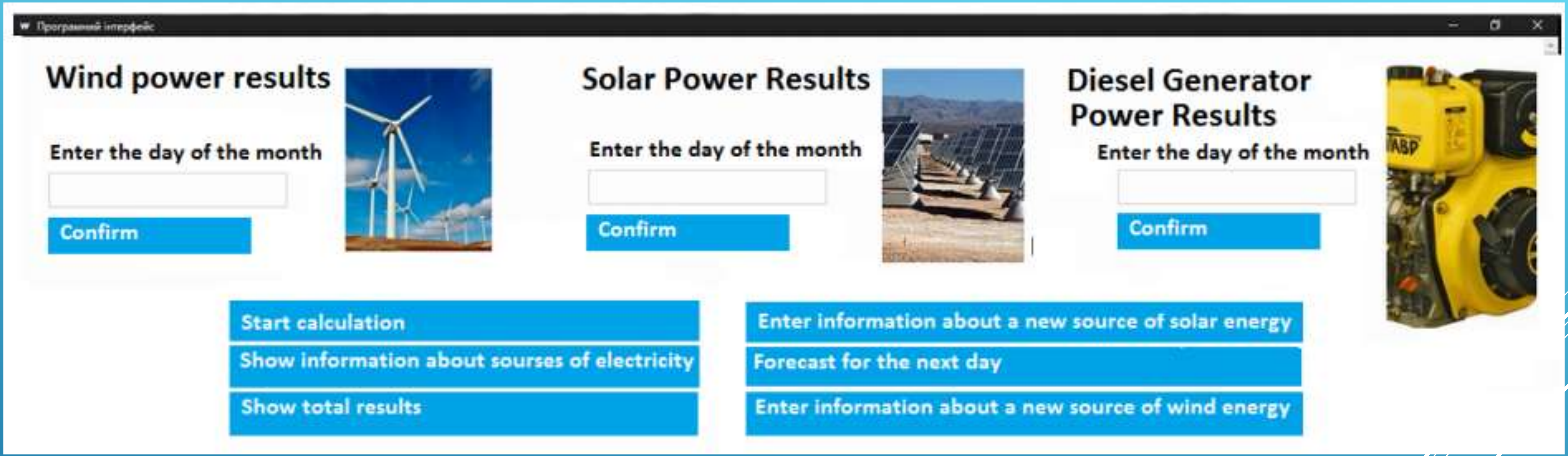


DATABASE ARCHITECTURE

Among the most typical databases (MySQL, PostgreSQL, MongoDB, Microsoft SQL Server, SQLite) implementations differ in the organization of data at different levels. Currently, SQLite is the most used database in the world, it will be used during the task. SQLite is a C-language library that implements a small, fast, stand-alone, highly reliable, fullfeatured SQL database engine.

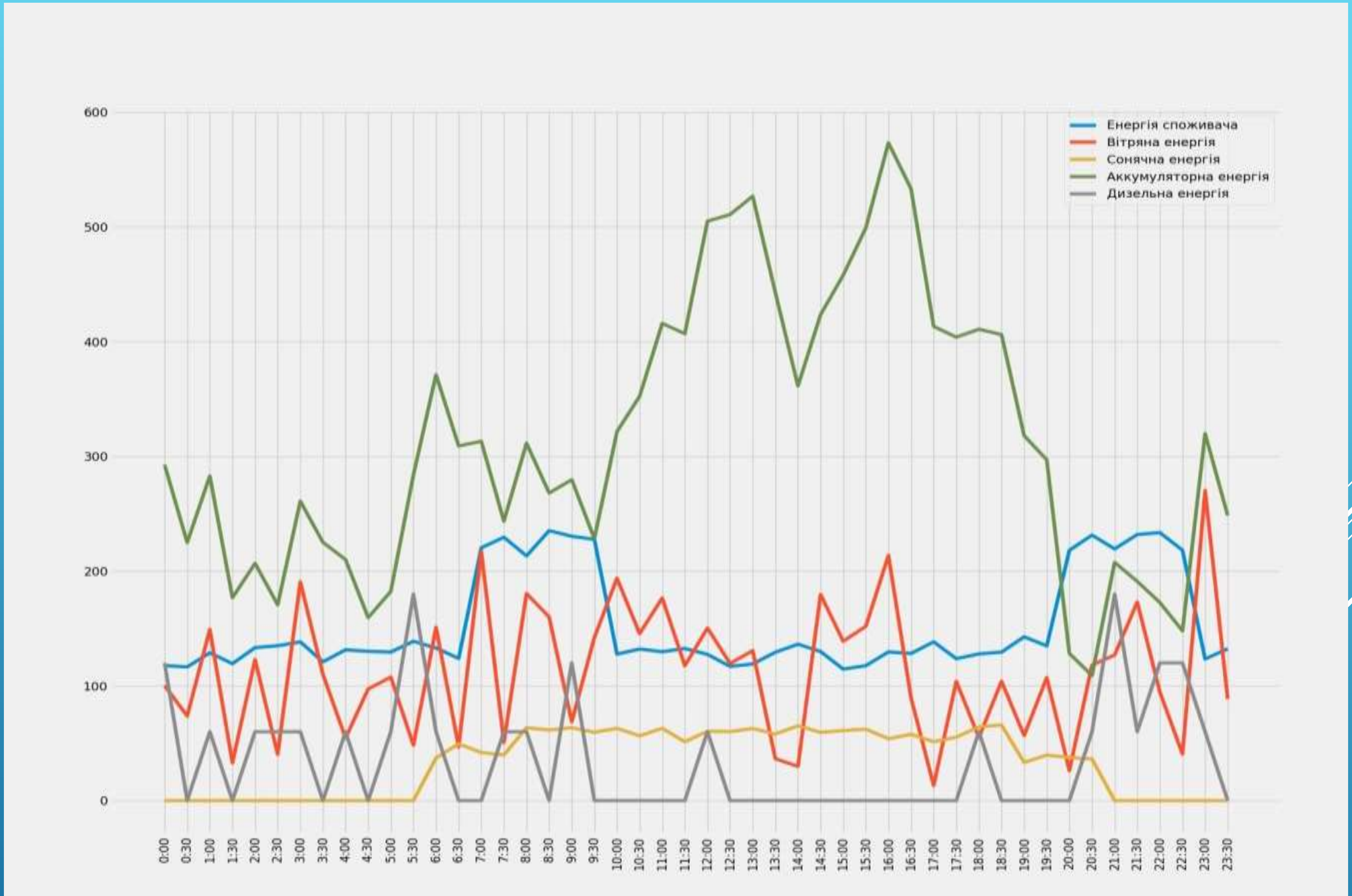
The structure of the database of the management system of renewable energy sources includes 9 tables:

1) Handbook of wind turbines;
2) reference solar panels;
3) handbook of diesel generators;
4) results of calculations of electricity and its cost for wind turbines,
5) results of calculations of electricity and its cost for solar panels
6) results of calculations of electricity and its cost for diesel generators;
7) initial conditions;
8) general dynamic database;
9) forecast for the next period.



THE FORM OF THE GRAPHICAL INTERFACE

- Blue - the required amount of energy to the consumer
- Green - the amount of energy on batteries
- Red - energy produced by wind farms
- Yellow - energy produced by solar power plants
- Gray - energy produced by a diesel generator



FORECAST OF ENERGY USE THE NEXT DAY BASED ON PRELIMINARY DATA

- The energy storage technology segment needs new solutions every day. Coming to the electric car market greatly contributes to such innovations. The aim of the article was to show that a dynamic approach to charge and discharge management at the energy storage system level provides good quality of service (energy efficient power reduction, power smoothing and uncertainty reduction) with reduced storage capacity.
- The results of this study allow further application of the initial data of the model (optimal clustering) to dynamically estimate the total cost of energy generated by its own components of the program, taking into account the cost of the network, in our case within one day.
- Further implementation of the research results will contribute to the improvement of mathematical and information support of decision support processes in the management of hybrid power grids. Further research can be aimed at improving the user-friendliness of the interface, the use of more efficient mathematical methods for grouping (clustering) data and forecasting technical and economic indicators.

CONCLUSION

THANK YOU FOR THE ATTENTION!