The efficiency of using GIS as subsystem in information model of power generation

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Abstract – In the work were considered the benefits of using GIS in Distributed Energy Generation and tools for creating GIS with the aim to consider existing ways to combine information system with energy efficiency.

Key words – Renewable Energy Sources, Geographic Information System, Distributed Energy Generation.

I. Introduction

Today is the undisputed a fact that the world's energy resources are limited. Accordingly, the problem of economic and efficient spending is considered one of the most relevant, but not new. In Ukraine, as in the whole world, more than 40% of the primary energy consumed in non-industrial buildings (houses, schools, hospitals, etc.). Not surprising that one of the most obvious ways resource saving is considered to be input into the grid renewable energy sources (RES) and the construction of new types of grid, based on the principle of distributed energy.

Integration autonomous power systems in a power grid with distributed generation, will rapidly, in real-time to compensate stopping generation of energy with any energy installations due to insufficient illumination or no wind. Today in the arsenal of utility companies have a lot of asset management tools in different areas (both economic and engineering, etc.). Managing complicated because typically they are associated with different databases. The solution to this problem is to develop a common information model of power generation facilities and the creating Decision Support System (DSS). For disparate spatial databases as a key tool for managing information about the devices of the new energy grid are often used Geographic Information System (GIS).

At this stage we try to explore existing methods of using the GIS in energy conservation with the aim to understand obvious ways to control a huge amount of dynamical information about existing power grids and the potential of renewable energy sources.

II. Using GIS in Energy System Siting Decisions

Information obtained in the “near real” time, can be imported into GIS to conduct various types of spatial analysis. Information about the location of the equipment, users, potential of renewable sources can be transmitted to the system to provide a better understanding of the location.

According to the Federal Geographic Data Committee (FGDC) GIS is a computer system for the input, storage, maintenance, management, retrieval, analysis, synthesis, and output of geographic or location-based information [1].

Infrastructure energy complexes is characterized by a large spatial extension. Power grid elements, generation, distribution, and other objects related to each other, interact with their environment, change the state, added, replaced and repaired during the operation. All this can be modeled in a GIS (but very difficult in conventional databases and can not be entirely on conventional maps). Thus, we get a detailed, accurate and up-to-date model.

Some projects have built already relating to building DSS based on geographic information system for evaluation of renewable energy in the distributed electricity generation. The following are some of the existing ones.

In [2] methodology is developed for the definition of the better localities for using new energy systems but without to perform grid studies. In [3] GIS is used for hydro plants evaluation. In [4] DSS designed for wind energy. The decision support system in [5] using GIS assists to define a preferred installation location for the construction of RES, to search for potential sites for RES installations and then to analyze the behavior of the grid and distributed generation systems, but system doesn’t use idea of smart grid.

In additional to information about potential of RES, system must hold data about existing renewable energy station and electricity grid in region.

III. Tools for creating GIS

For building GIS there are several tools, which we try to consider, this tools have to have opportunity to combine with Smart Grid simulation tools.

PostGIS [6] is a spatial database add-on for the PostgreSQL relational database server. PostGIS makes it possible for the PostgreSQL server with spatial data, thus creating a repository for GIS. PostgreSQL supports self-spatial data types, so that in fact PostGIS provides a more convenient interface management, rather than just data storage. In this case, it becomes possible to maintain the whole of vector layers, rather than just points or polygons.

PostGIS / PostgreSQL includes the following features:

- Standards support OpenGIS Consortium (OGC).
- Support for text and binary representations of GIS objects.
- The rapid spatial indexing using GiST.
- Function analysis of the geo.
- PostgreSQL JDBC access to geodata.
- Support to access functions in accordance with the specification of OGC.

OpenMap [7] is a tool based on Java Beans, for building applications and applets needing geographic information. Using the components OpenMap, data can be used from other applications. Thus, OpenMap is part of the components of Swing, who understand the geographical coordinates. These components allow you to display the card and process the user to manipulate the data.

GeoServer [8] is a Java (J2EE) application that satisfies the specification of OpenGIS Consortium's Web Feature Server, including integration with WMS. This is a free product, a licensed according to GPL 2.0 license. Users who wish to gain access to view and change their geodata via the Internet, using easily customizable and meets industry-standard server can take advantage of GeoServer.

Quantum GIS (QGIS) [9] is cross-platform Geographic Information System (GIS). Supports vector and raster formats, including spatial tables stored in databases using PostgreSQL PostGIS, common GIS vector formats such as Shapefiles and raster images with geo-data (TIFF, PNG and GEOTIFF). Available set of plug-ins to extend the functionality of the dynamic. By means of a special plug-in provides the ability to view layers of GRASS (GRASS layers), both vector and raster. The layers can be edited in GRASS QGIS.

Key features of the system:

- Support for tables with PostGIS spatial data;
- Supported formats shapefiles (shapefiles), coatings ArcInfo, File Mapinfo, and other formats are available through the OG;
- Support for raster;
- The identification of objects;
- Displaying the attribute tables;
- The choice of objects;
- Export to map-file Mapserver.

GRASS includes various image processing programs for the monitor and the paper processing program vector graphics, raster graphics processing other graphics program for processing digital information for the files.

Key features of the system:

- Manage vector images. The new mechanism allows you to work with two-dimensional and three-dimensional topological data, and update spatial data indexing system speeds up access to vector data. You can import vector data from other GIS (provided topological correction).
- Management attributes. Processing of attribute information is fully compatible with the requirements of the major DBMS (supported by the open source database PostgreSQL, mySQL, and the technology DBF and ODBC), to manage the attributes used commands in SQL.
- User interface. The interface for each module is generated dynamically.
- The basic framework for localization. As the database used any SQL-enabled server interface odbc. From the open-source PostgreSQL is preferable to use special GIS-extension PostGIS.

MapGuide Open Source is a web-based map-making platform that allows to quickly developing web mapping applications.The process of installation of MapGuide server is more difficult, that may be challenging for beginners. MapGuide Open Source provides a powerful map engine and advanced client-side map browser tools and technologies (such as AJAX viewer and vector-based DWF viewer) [10].

gvSIG - sophisticated geographic information system for managing spatial data and perform complex research. gvSIG has a user-friendly interface, is able to access the most common formats, as vector, as raster. Has a wide range of tools for working with geographic-like information [11].

Conclusion

According to submitted analysis we defined tools and methods of using GIS as huge database for control data about existing power grids and the potential of RES. Also defined, that GIS useful for both definition preferred location for the construction of RES and analyze the behavior of the power grid. So in the next step we have to create such information model of power generation.

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